Certificate #5055.02

TEST REPORT FOR TAS

Report No.: SRTC2024-9004(F)-24050701(X)

Product Name: Mobile computer

Product Model: PM95

Applicant: POINTMOBILE CO., LTD

Manufacturer: POINTMOBILE CO., LTD

Specification: FCC 47 CFR PART 2 (2.1093)

FCC ID: V2X-PM95

The State Radio_monitoring_center Testing Center (SRTC)

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1. GENERAL INFORMATION

1.1 Notes of the test report

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1.4Manufacturer’s details

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1.5DUT information

Band Information	Support TAS or not
GSM_850	support
GSM_1900	support
WCDMA_B2	support
WCDMA_B4	support
LTE_B2	support
LTE_B4	support
LTE_B7	support
LTE_B30	support
LTE_B42	support
LTE_B43	support
LTE_B48	support
LTE_B66	support
NR5G_N2	support
NR5G_N7	support
NR5G_N30	support
NR5G_N38	support
NR5G_N41	support
NR5G_N48	support
NR5G_N66	support
NR5G_N77	support
NR5G_N78	support
DC_13A_n66A	support
DC_5A_n2A	support
DC_14A_n2A	support
DC_2A_n66A	support
DC_5A_n66A	support
DC_12A_n66A	support
DC_14A_n66A	support
DC_30A_n66A	support
DC_12A_n2A	support
DC_66A_n2A	support
DC_71A_n2A	support
DC_2A_n41A	support
DC_71A_n66A	support
DC_66A_n41A	support
DC_25A_n41A	support
DC_1A_n7A	support
DC_3A_n7A	support
DC_8A_n7A	support
DC_28A_n7A	support
DC_3A_n38A	support

DC_3A_n78A	support
DC_7A_n78A	support
DC_38A_n78A	support
DC_1A_n77A	support
DC_3A_n77A	support
DC_8A_n77A	support
DC_18A_n77A	support
DC_18A_n78A	support
DC_19A_n78A	support
DC_28A_n77A	support
DC_5A_n78A	support
DC_3A_n41A	support
DC_8A_n41A	support
DC_66A_n78A	support
DC_2A_n78A	support
DC_12A_n78A	support
DC_5A_n7A	support
DC_12A_n7A	support
DC_66A_n7A	support
DC_13A_n2A	support
DC_48A_n66A	support
DC_7A_n66A	support
DC_1A_n41A	support
DC_13A_n78A	support
DC_66A_n38A	support
DC_2A_n38A	support
DC_12A_n38A	support
DC_5A_n38A	support
DC_20A_n77A	support
DC_7A_n77A	support
DC_71A_n78A	support
DC_71A_n38A	support
DC_13A_n7A	support
DC_28A_n41A	support
DC_12A_n41A	support
DC_2A_n77A	support
DC_5A_n77A	support
DC_13A_n77A	support
DC_66A_n77A	support
DC_8A_n38A	support
DC_12A_n77A	support
DC_14A_n77A	support
DC_8A_n78A	support
DC_1A_n78A	support

DC_2A-13A_n66A	support
DC_13A-66A_n66A	support
DC_2A-5A_n2A	support
DC_5A-30A_n2A	support
DC_5A-66A_n2A	support
DC_12A-30A_n2A	support
DC_14A-66A_n2A	support
DC_29A-30A_n2A	support
DC_2A-5A_n66A	support
DC_2A-12A_n66A	support
DC_2A-66A_n66A	support
DC_5A-30A_n66A	support
DC_5A-66A_n66A	support
DC_12A-30A_n66A	support
DC_2A-2A_n66A	support
DC_2A-14A_n66A	support
DC_2A-29A_n66A	support
DC_14A-30A_n66A	support
DC_2C_n41A	support
DC_2A-12A_n2A	support
DC_2A-66A_n2A	support
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DC_2A-2A_n41A	support
DC_2A-2A_n78A	support
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DC_5B_n66A	support
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DC_5A-5A_n2A	support
DC_5B_n2A	support
DC_2A-14A_n2A	support
DC_29A-30A_n66A	support
DC_66A-66A_n77A	support
DC_2A-2A_n77A	support
DC_2A-12A_n7A	support
DC_13A-46A_n2A	support
DC_66A-66A_n2A	support

DC_66B_n2A	support
DC_66C_n2A	support
DC_13A_n66A	support
DC_5A_n2A	support
DC_14A_n2A	support
DC_2A_n66A	support
DC_5A_n66A	support
DC_12A_n66A	support
DC_14A_n66A	support
DC_30A_n66A	support
DC_12A_n2A	support
DC_66A_n2A	support
DC_71A_n2A	support
DC_2A_n41A	support
DC_71A_n66A	support
DC_66A_n41A	support
DC_25A_n41A	support
DC_1A_n7A	support
DC_3A_n7A	support
DC_8A_n7A	support
DC_28A_n7A	support

2.RESULT SUMMARY

Case	Verdict
TAS	Pass

This Test Report Is Approved by: Mr. Peng Zhen	Review by: Mr. Li Bin
Tested and issued by: Mr. Huang Yubin	Approved date: 20240710

3.Tx Varying Transmission Test Cases and Test Proposal

To validate time averaging feature and demonstrate the compliance in Tx varying transmission conditions, the following transmission scenarios are covered in Part 2 test:

1. During a time-varying Tx power transmission: To prove that the Smart Transmit feature accounts for Tx power variations in time accurately.

2. During a call disconnect and re-establish scenario: To prove that the Smart Transmit feature accounts for history of past Tx power transmissions accurately.

3. During technology/band handover: To prove that the Smart Transmit feature functions correctly during transitions in technology/band.

4. During DSI (Device State Index) change: To prove that the Smart Transmit feature functions correctly during transition from one device state (DSI) to another.

5. During antenna (or beam) switch: To prove that the Smart Transmit feature functions correctly during transitions in antenna (such as AsDiv scenario) or beams (different antenna array configurations).

6. SAR exposure switching between two active radios (radio1 and radio2): To prove that the Smart Transmit feature functions correctly and ensures total RF exposure compliance when exposure varies among SAR_radio1 only, SAR_radio1 + SAR_radio2, and SAR_radio2 only scenarios.

As described in Part 1 report, the RF exposure is proportional to the Tx power for a SAR -characterized wireless device. Thus, feature validation in Part 2 can be effectively performed through conducted and radiated power measurement. Therefore, the compliance demonstration under dynamic transmission conditions and feature validation are done in conducted/radiated power measurement setup for transmission scenario 1 through 8. To add confidence in the feature validation, the time-averaged SAR measurements are also performed but only performed for transmission scenario 1 to avoid the complexity in SAR measurement (such as, for scenario 3 requiring change in SAR probe calibration file to accommodate different bands and/or tissue simulating liquid).

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

Demonstrate the total RF exposure averaged over FCC defined time windows does not exceed FCC’s SAR limits, through time-averaged power measurements

Measure conducted Tx power (for f < 6GHz) versus time, and radiated Tx power (EIRP for f > 10GHz) versus time.

Convert it into RF exposure and divide by respective FCC limits to get normalized exposure versus time.

Perform running time-averaging over FCC defined time windows.

Demonstrate that the total normalized time-averaged RF exposure is less than 1 for all transmission scenarios at all times.

Mathematical expression:

For sub-6 transmission only:

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

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

where, conducted_Tx_power(t), conducted_Tx_power_plimit , and 1g_or_10gsAR_plimit correspond to the measured instantaneous conducted Tx power, measured conducted Tx power at Plimit, and measured 1gSAR or 10gSAR values at Plimit corresponding to sub-6 transmission.

Demonstrate the total RF exposure averaged over FCC defined time windows does not exceed FCC's SAR limits, through time-averaged SAR measurements. Note as mentioned earlier, this measurement is performed for transmission scenario 1 only.

For sub-6 transmission only, measure instantaneous SAR versus time; for LTE+ sub6 NR transmission, request low power (or all-down bits) on LTE so that measured SAR predominantly corresponds to sub6 NR.

Convert it into RF exposure and divide by respective FCC limits to obtain normalized exposure versus time.

Perform time averaging over FCC defined time window.

Demonstrate that the total normalized time-averaged RF exposure is less than 1 for transmission scenario 1 at all times. Mathematical expression:

- For sub-6 transmission only:

$$1g\_or\_10gSAR(t) = \frac{pointSAR(t)}{pointSAR\_P_{limit}} * 1g\_or\_10gSAR(t)\_P_{limit} \quad (3a)$$

$$\frac{\frac{1}{T_{SAR}}\int_{t-T_{SAR}}^{t} 1g\_or\_10gSAR(t)dt}{FCC\ SAR\ limit} \leq 1 \quad (3b)$$

where, pointsAR(t), pointsAR_plimit , and 1g_or_10gsAR_plimit,correspond to the measured instantaneous point SAR, measured point SAR at Plimit, and measured 1gSAR or 10gSAR values at Plimit corresponding to sub-6 transmission.

NOTE: cDASY6 measurement system by Schmid & Partner Engineering AG (SPEAG) of Zurich,Switzerland measures relative E-field, and provides ratio of $\frac{[\text{pointE(t)}]^2}{[\text{pointE\_input power.limit}]^2}$ **versus time.**

4.SAR Time Averaging Validation Test Procedures

This chapter provides the test plan and test procedure for validating Qualcomm Smart Transmit feature for sub-6 transmission. The 100 seconds time window for operating f < 3GHz is used as an example to detail the test procedures in this chapter.

4.1 Test sequence determination for validation

Following the FCC recommendation, two test sequences having time-variation in Tx power are predefined for sub-6 (f < 6 GHz) validation:

. Test sequence 1: request EUT's Tx power to be at maximum power, measured Pmaxt, for 80s, then requesting for half of the maximum power, i.e., measured Pmax/2, for the rest of the time.

. Test sequence 2: request EUT's Tx power to vary with time. This sequence is generated relative to measured Pmax, measured Plimit and calculated Preserve (= measured Plimit in dBm - Reserve_power_margin in dB) of EUT based on measured Plimit.

The details for generating these two test sequences is described and listed in Appendix A.

NOTE: For test sequence generation, "measured Plimit" and "measured Pmax" are used instead of the " Plimit" specified in EFS entry and " Pmax" specified for the device, because Smart Transmit feature operates against the actual power level of the " Plimit" that was calibrated for the EUT. The "measured Plimit" accurately reflects what the feature is referencing to, therefore, it should be used during feature validation testing. The RF tune up and device-to-device variation are already considered in Part 0 report prior to determining Plimit.

4.2 Test configuration selection criteria for validating Smart Transmit feature

For validating Smart Transmit feature, this section provides a general guidance to select test cases. In practice, an adjustment can be made in test case selection. The justification/clarification may be provided.

4.2.1 Test configuration selection for time-varying Tx power transmission

The Smart Transmit time averaging feature operation is independent of bands, modes, and channels for a given technology. Hence, validation of Smart Transmit in one band/mode/channel per technology is sufficient.

The criteria for the selection are based on the Plimit values determined in Part 1 report. Select the band in each supported technology that corresponds to the Plimit value that is less than Pmax for validating Smart Transmit.

Note this test is designed for single radio transmission scenario. If UE supports sub6 NR in both non-standalone (NSA) and standalone (SA) modes, then validation in time-varying Tx power transmission scenario described in this section needs to be performed in SA mode. Otherwise, it needs to be performed in NSA mode with LTE anchor set to low power. The

choice between SA and NSA mode needs to also take into account the selection criteria described below. In general, one mode out of the two modes (NSA or SA) is sufficient for this test.

4.2.2 Test configuration selection for change in call

The criteria to select a test configuration for call-drop measurement is:
. Select technology/band with least Plimit among all supported technologies/bands, and select the radio configuration (e.g., # of RBs, channel#) in this technology/band that corresponds to the highest measured 1gSAR at Plimit listed in Part 1 report.
. In case of multiple bands having same least Plimit, then select the band having the highest measured 1gSAR at Plimit in Part 1 report.
This test is performed with the EUT's Tx power requested to be at maximum power, the above band selection will result in Tx power enforcement (i.e., EUT forced to have Tx power at Preserve) for longest duration in one FCC defined time window. The call change (call drop/reestablish) is performed during the Tx power enforcement duration (i.e., during the time when EUT is forced to have Tx power at Preserve). One test is sufficient as the feature operation is independent of technology and band.

4.2.3 Test configuration selection for change in technology/band

The selection criteria for this measurement is, for a given antenna, to have EUT switch from a technology/band with lowest Plimit within the technology group (in case of multiple bands having the same Plimit, then select the band with highest measured 1gSAR at Plimit) to a technology/band with highest Plimit within the technology group, in case of multiple bands having the same Plimit, then select the band with lowest measured 1gSAR at Plimit in Part 1 report, or vice versa.
This test is performed with the EUT's Tx power requested to be at maximum power, the technology/band switch is performed during Tx power enforcement duration (i.e., during the time when EUT is forced to have Tx power at Preserve).

4.2.4 Test configuration selection for change in DSI

The criteria to select a test configuration for DSI change test is
. Select a technology/band having the Plimit < Pmax within any technology and DSI group, and for the same technology/band having a different Plimit in any other DSI group. Note that the selected DSI transition need to be supported by the device.
This test is performed with the EUT's Tx power requested to be at maximum power in selected technology/band, and DSI change is conducted during Tx power enforcement duration (i.e., during the time when EUT is forced to have Tx power at Preserve).

4.2.5 Test configuration selection for SAR exposure switching

If supported, the test configuration for SAR exposure switching should cover

1. SAR exposure switch when two active radios are in the same time window
2. SAR exposure switch when two active radios are in different time windows. One test with two active radios in any two different time windows is sufficient as Smart Transmit operation is the same for RF exposure switch in any combination of two different time windows.

The Smart Transmit time averaging operation is independent of the source of SAR exposure (for example, LTE vs. Sub6 NR) and ensures total time-averaged RF exposure compliance. Hence, validation of Smart Transmit in any one simultaneous SAR transmission scenario (i.e., one combination for LTE + Sub6 NR transmission) is sufficient, where the SAR exposure varies among SARradio1 only, SARradio1 + SARradio2 , and SARradio2 only scenarios.

The criteria to select a test configuration for validating Smart Transmit feature during SAR exposure switching scenarios is

. Select any two < 6GHz technologies/bands that the EUT supports simultaneous transmission (for example, LTE+ Sub6 NR).

. Among all supported simultaneous transmission configurations, the selection order is

1. Select one configuration where both Plimit of radio1 and radio2 is less than their corresponding Pmax, preferably, with different Plimits . If this configuration is not available, then,
2. Select one configuration that has Plimit less than its Pmax for at least one radio. If this cannot be found, then,
3. Select one configuration that has Plimit of radio1 and radio2 greater than Pmax but with least (Plimit – Pmax) delta.

SAR exposure switch validation with one simultaneous transmission scenario (i.e., either FR1 NSA or LTE inter-band ULCA) is sufficient as Smart Transmit operation is the same.

4.2.6 Test configuration selection for change in time window

FCC specifies different time window for time averaging based on operation frequency. The criteria to select a test configuration for validating Smart Transmit feature and demonstrating the compliance during the change in time window is

.Select any technology/band that has operation frequency classified in one time window defined by FCC (such as 100-seconds time window), and its corresponding Plimit is less than Pmax if possible.

.Select the 2nd technology/band that has operation frequency classified in a different time window defined by FCC (such as 60-seconds time window), and its corresponding Plimit is less than Pmax if possible.

.It is preferred both Plimit values of two selected technology/band less than corresponding Pmax, but if not possible, at least one of technologies/bands has its Plimit less than Pmax .

This test is performed with the EUT's Tx power requested to be at maximum power in selected technology/band. Test for one pair of time windows selected is sufficient as the feature operation is the same.

4.2.7 Test configuration selection for Exposure Category Switch

When exposure DSI changes from head to body-worn or vice versa, it is obvious that the exposure from an active radio does not expose the same tissues. Therefore, with

Qualcomm Smart Transmit EFS version 18 (or higher), the exposure continuity is handled in two categories: Head exposure and non-head exposure.

. Head exposure category includes all 4 positions of left cheek, left tilted, right cheek and right titled

. Non-head exposure category includes all other exposure scenarios (except head), i.e., body-worn, hotspot, extremity, etc.

The purpose of this test is to demonstrate that Smart Transmit ensures time-averaged RF exposure compliance when the EUT exposure category changes. For this purpose, there are two tests performed: (a) start with head exposure and switch to non-head exposure and switchback to head exposure, and (b) start with non-head exposure and switch to head exposure and switchback to non-head exposure.

The criteria to select a test configuration for exposure category switch measurement is:

If Plimit < Pmax for at least one radio out of all supported technology/band/antenna /DSI, then:

(a) Out of all head exposure DSIs, select a technology/band/antenna/DSI having the least Plimit (< Pmax), furthermore, having the largest difference between Pmax and Plimit (Plimit < Pmax) should be considered in the selection. Then, select a second DSI in the nonhead exposure category DSI that has the least Plimit among all the non-head DSIs for the same technology/band/antenna. This technology/band /antenna and selected

DSIs are used for head to non-head to head exposure switch test. If the Plimit > Pmax for all supported technology/band/antenna/DSI in head exposure category, then this test is not required.

(b) Similarly, out of all non-head exposure DSIs, select a technology/band/antenna/DSI having the least Plimit (< Pmax), furthermore, having the largest difference between Pmax and Plimit (Plimit < Pmax) should be considered in the selection. Then, select a second DSI in the head exposure category DSI that has the least Plimit among all the head DSIs for the same technology/band/antenna. This technology/band/antenna and selected DSIs are used for non-head to head to non-head exposure switch test. If the Plimit > Pmax for all supported technology/band/antenna/DSI in non-head exposure category, then this test is not required.

If Plimit > Pmax for all supported technology/band/antenna/DSIs for both head and nonhead DSI categories, then:

(c) select a supported sub6 simultaneous transmission scenario (like LTE + FR1 NSA, or LTE inter-band ULCA, or FR1 inter-band NR-DC, etc.) in head DSI that has Plimit < Pmax +10*log(N) for all radios of selected technology(s)/band(s)/antenna(s), where N is the number of active radios in selected sub6 simultaneous transmission scenario. Note that the antennas determined for the selected radios of simultaneous transmission scenario

should be in the same antenna group if EUT is configured with GEN2_SUB6. Then, select a second DSI in the non-head exposure category that has the lowest Plimit among all the non-head DSIs for all the radios of the selected technology(s)/band(s)/antenna(s) simultaneous transmission scenario. This selected technology(s)/band(s)/antenna(s) and selected DSIs are used for head to non-head to head exposure switch test. If the head DSI has Plimit > Pmax +10*log(N) for all radios supported in sub6 simultaneous transmission scenarios, then this test is not required.

(d) select a supported sub6 simultaneous transmission scenario (like LTE + FR1 NSA, or LTE inter-band ULCA, or FR1 inter-band NR-DC, etc.) in non-head DSI that has Plimit< Pmax +10*log(N) for all radios of the selected technology(s)/band(s) /antenna(s), where N is the number of active radios in selected sub6 simultaneous transmission scenario. Note that the antennas determined for the selected radios of simultaneous transmission scenario should be in the same antenna group if EUT is configured with GEN2_SUB6. Then, select a second DSI in the head exposure category that has the lowest Plimit among all the head DSIs for all the radios of the selected technology(s)/band(s) /antenna(s) simultaneous transmission scenario. This selected technology(s)/band(s) /antenna(s) and selected DSIs are used for non-head to head to non-head exposure switch test. If the non-head DSI has Plimit > Pmax +10*log(N) for all radios supported in sub6 simultaneous transmission scenarios, then this test is not required.

Use the highest measured 1g or 10g SAR at Plimit (Plimit < Pmax) shown in Part 1 report for the selected tech/band/antenna/DSI out of all radio configurations and device positions in Equation (1a) and (3a) to calculate time-varying SAR. However, in the case of Plimit > Pmax, the SAR measured in Part 1 report for the corresponding radio configuration selected and tested in Part 2 should be applied in Equation (1a) and (3a).

4.3 Test procedures for conducted power measurements

This section provides general conducted power measurement procedures to perform compliance test under dynamic transmission scenarios described in Section 2. In practice, an adjustment can be made in these procedures. The justification/clarification may be provided.

4.3.1 Time-varying Tx power transmission scenario

This test is performed with the two pre-defined test sequences described in Section 3.1 for all the technologies and bands selected in Section 3.2.1. The purpose of the test is to demonstrate the effectiveness of power limiting enforcement and that the time-averaged SAR (corresponding time-averaged Tx power) does not exceed the FCC limit at all times (see Eq. (1a) and (1b)).

Test procedure

1. Measure Pmax, measure Plimit and calculate Preserve (= measured Plimit in dBm –

Reserve_power_margin in dB) and follow Section 3.1 to generate the test sequences for all the technologies and bands selected in Section 3.2.1. Both test sequence 1 and test sequence 2 are created based on measured Pmax and measured Plimit of the EUT. Test condition to measure Pmax and Plimit is:

Measure Pmax with Smart Transmit disabled and callbox set to request maximum power.

Measure Plimit with Smart Transmit Peak exposure mode enabled, callbox set to request maximum power.

Measure Preserve via test sequence 1 measurement.

2. Set the EUT to the intended Smart Transmit exposure mode, and then set callbox requesting the EUT's Tx power to be at pre-defined test sequence 1, measure and record Tx power versus time, and then convert the conducted Tx power into 1gSAR or 10gSAR value (see Eq. (1a)) using measured Plimit from above Step 1. Perform running time average to determine time-averaged power and 1gSAR or 10gSAR versus time as illustrated in Figure 3-1 where using 100-seconds time window as an example.

NOTE: In Eq. (1a), instantaneous Tx power is converted into instantaneous 1gSAR or 10gSAR value by applying the measured worst-case 1gSAR or 10gSAR value at Plimit for the corresponding technology/band/antenna/DSI reported in Part 1 report.
NOTE: For an easier computation of the running time average, 0 dBm can be added at the beginning of the test sequences the length of the responding time window, for example, add 0dBm for 100-seconds so the running time average can be directly performed starting with the first 100-seconds data using excel spreadsheet. This technique applies to all tests performed in this Part 2 report for easier time-averaged computation using excel spreadsheet.

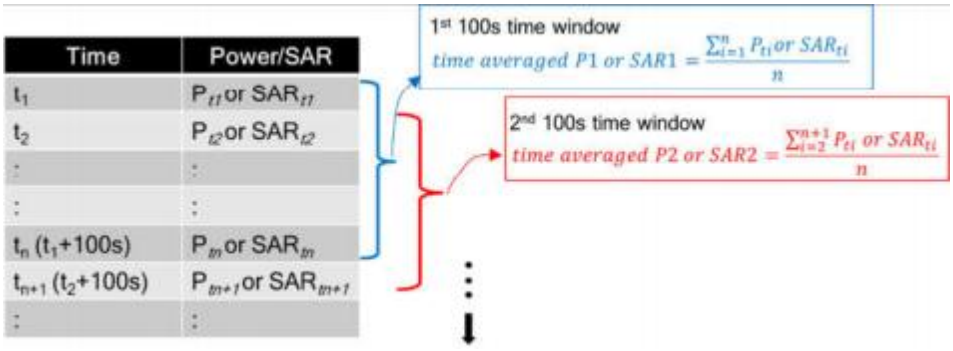


Figure 3-1 100s running average illustration

3. Make one plot containing:

a. Instantaneous Tx power versus time measured in Step 2,

b. Requested Tx power used in Step 2 (test sequence 1),

c. Computed time-averaged power versus time determined in Step 2,

d. Time-averaged power limit (corresponding to FCC SAR limit of 1.6 W/kg for 1gSAR or 4.0W/kg for 10gSAR) given by

Time avearged power limit = meas. plimit + 10 × log($\frac{FCC\ SAR\ limit}{meas.SAR\_Plimit}$) (5a)

Where meas. plimit and meas. SAR_plimit correspond to measured power at Plimit and measured SAR at Plimit.

4. Make another plot containing:

a.Computed time-averaged 1gSAR or 10gSAR versus time determined in Step 2

b. FCC 1gSARlimit of 1.6W/kg or FCC 10gSARlimit of 4.0W/kg.

5.Repeat Steps 2 ~ 4 for pre-defined test sequence 2 and replace the requested Tx power (test sequence 1) in Step 2 with test sequence 2.

6. Repeat Steps 2 ~ 5 for all the selected technologies and bands.

The validation criteria are, at all times, the time-averaged power versus time shown in Step 3 plotshall not exceed the time-averaged power limit (defined in Eq. (5a)), in turn, the time-averaged 1gSAR or 10gSAR versus time shown in Step 4 plot shall not exceed the FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR (i.e., Eq. (1b)).

4.3.2 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 disconnect and re-establishment needs to be performed during power limit enforcement, i.e., when the EUT's Tx power is at Preserve level, to demonstrate the continuity of RF exposure management and limiting in call change scenario. In other words, the RF exposure averaged over any FCC defined time window (including the time windows containing the call change) doesn't exceed FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.

Test procedure

1. Measure Plimit for the technology/band selected in Section 3.2.2. Measure Plimit with Smart Transmit Peak exposure mode enabled, callbox set to request maximum power.

2. Set Reserve_power_margin to actual (intended) value and reset power on EUT to enable Smart Transmit.

3. Establish radio link with callbox in the selected technology/band.

4. Request EUT's Tx power at 0 dBm for at least one time window specified for the selected technology/band, followed by requesting EUT's Tx power to be 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's Tx power to be 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. Once the measurement is done, extract instantaneous Tx power versus time, convert the measured conducted Tx power into 1gSAR or 10gSAR value using Eq. (1a), and then perform the running time average to determine time-averaged power and 1gSAR or 10gSAR versus time.

NOTE: In Eq.(1a), instantaneous Tx power is converted into instantaneous 1gSAR or 10gSAR value by applying the measured worst-case 1gSAR or 10gSAR value at Plimit for the corresponding technology/band/antenna/DSI reported in Part 1 report.

5. Make one plot containing: (a) instantaneous Tx power versus time, (b) requested power, (c) computed time-averaged power, (d) time-averaged power limit calculated using Eq.(5a).

6. Make another plot containing: (a) computed time-averaged 1gSAR or 10gSAR versus time, and (b) FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.

The validation criteria are, at all times, the time-averaged power versus time shall not exceed the time-averaged power limit (defined in Eq.(5a)), in turn, the time-averaged 1gSAR or 10gSAR versus time shall not exceed the FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR (i.e., Eq. (1b)).

4.3.3 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 in Section 3.3.2, to validate the continuity of RF exposure limiting during the transition, the technology and band handover needs to be performed when EUT's Tx power is at Preserve level (i.e., during Tx power enforcement) to make sure that the EUT's Tx power from previous Preserve level to the new Preserve level (corresponding to new technology/band). Since the Plimit could vary with technology and band, Eq. (1a) can be written as follows to convert the instantaneous Tx power in 1gSAR or

10gSAR exposure for the two given radios, respectively:

$$1g\_or\_10gSAR_1(t) = \frac{conducted\_Tx\_power\_1(t)}{conducted\_Tx\_power\_P_{limit\_1}} * 1g\_or\_10gSAR\_P_{limit-1} \quad (6a)$$

$$1g\_or\_10gSAR_2(t) = \frac{conducted\_Tx\_power\_2(t)}{conducted\_Tx\_power\_P_{limit\_2}} * 1g\_or\_10gSAR\_P_{limit-2} \quad (6b)$$

$$\frac{1}{T_{SAR}}\left[\int_{t-T_{SAR}}^{t_1} \frac{1g\_or\_10gSAR_1(t)}{FCC\ SAR\ limit} dt + \int_{t-T_{SAR}}^{t} \frac{1g\_or\_10gSAR_2(t)}{FCC\ SAR\ limit} dt\right] \leq 1 \quad (6c)$$

Where, conducted_Tx_power_ 1(t), conducted_Tx_power_Plimit_ 1, and 1g or 10gSAR_Plimit_ 1 correspond to the measured instantaneous conducted Tx power, measured conducted Tx power at Plimit, and measured 1gSAR or 10gSAR value at Plimit of technology1/band1; conducted_Tx_power_2(t), conducted_Tx_power_Plimit_2 (t), and 1g or 10gSAR_Plimit_2 correspond to the measured instantaneous conducted Tx power, measured conducted Tx power at Plimit, and measured 1gSAR or 10gSAR value at Plimit of technology2/band2. Transition from technology1/band1 to the technology2/band2 happens at time-instant 't1'.

Test procedure

1. Measure Plimit for both the technologies and bands selected in Section 3.2.3. Measure Plimit with Smart Transmit Peak exposure mode enabled, callbox set to request maximum power.

2. Set Reserve_power_margin to actual (intended) value and reset power on EUT to enable Smart Transmit

3. Establish radio link with callbox in first technology/band selected.

4. Request EUT's Tx power at 0 dBm for at least one time window specified for the selected technology/band, followed by requesting EUT's Tx power to be at maximum power for about ~60 seconds, and then switch to second technology/band selected.Continue with callbox requesting EUT's Tx power to be 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 1gSAR or 10gSAR value using Eq. (6a) and (6b) and corresponding measured Plimit values from Step 1 of this section. Perform the running time average to determine time-averaged power and 1gSAR or 10gSAR versus time.

NOTE: In Eq. (6a) & (6b), instantaneous Tx power is converted into instantaneous 1gSAR or 10gSAR value by applying the measured worst-case 1gSAR or 10gSAR value at Plimit for the corresponding technology/band/antenna/DSI reported in Part 1 report.

6. Make one plot containing: (a) instantaneous Tx power versus time, (b) requested power, (c) computed time-averaged power, (d) time-averaged power limit calculated using Eq. (5a).

7. Make another plot containing: (a) computed time-averaged 1gSAR or 10gSAR versus time, and (b) FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.

The validation criteria are, at all times, the time-averaged 1gSAR or 10gSAR versus time

shall not exceed the FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR (i.e., Eq. (6c)).

4.3.4 Change in antenna

This test is to demonstrate the correct power control by Smart Transmit during antenna switches from one antenna to another. The test procedure is identical to Section 3.3.3, by replacing technology/band switch operation with antenna switch. The validation criteria are, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.
NOTE: If the EUT does not support antenna switch within the same technology/band, but has multiple antennas to support different frequency bands, then the antenna switch test is included as part of change in technology and band (Section 3.3.3) test.

4.3.5 Change in DSI

This test is to demonstrate the correct power control by Smart Transmit during DSI switches from one DSI to another. The test procedure is identical to Section 3.3.3, by replacing technology/band switch operation with DSI switch. The validation criteria are, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.

4.3.6 Change in time window

This test is to demonstrate the correct power control by Smart Transmit during the change in averaging time window when a specific band handover occurs. FCC specifies time-averaging windows of 100s for Tx frequency < 3GHz, and 60s for Tx frequency between 3GHz and 6GHz.
To validate the continuity of RF exposure limiting during the transition, the band handover test needs to be performed when EUT handovers from operation band less than 3GHz to greater than 3GHz and vice versa. The equations (3a) and (3b) in Section 2 can be written as follows for transmission scenario having change in time window,

$$1gSAR_1(t) = \frac{conducted\_Tx\_power\_1(t)}{conducted\_Tx\_power\_P_{limit\_1}} * 1g\_or\ 10g\_SAR\_P_{limit\_1} \qquad (7a)$$

$$1gSAR_2(t) = \frac{conducted\_Tx\_power\_2(t)}{conducted\_Tx\_power\_P_{limit\_2}} * 1g\_or\ 10g\_SAR\_P_{limit\_2} \qquad (7b)$$

$$\frac{1}{T1_{SAR}}\left[\int_{t-T1_{SAR}}^{t_1} \frac{1g\_or\ 10g\_SAR_1(t)}{FCC\ SAR\ limit} dt\right] + \frac{1}{T2_{SAR}}\left[\int_{t-T2_{SAR}}^{t} \frac{1g_{or}10g\_SAR_2(t)}{FCC\ SAR\ limit} dt\right] \leqslant 1 \qquad (7c)$$

Where, conducted_Tx_power_ 1(t), conducted_Tx_power_Plimit_ 1 (t), and 1g_ or 10g_SAR_Plimit_ 1 correspond to the instantaneous Tx power, conducted Tx power at

Plimit, and compliance 1g_ or 10g_SAR values at Plimit_ 1 of band1 with time-averaging window T1SAR'; conducted_Tx_power_2(t), conducted_Tx_power_Plimit_2 (t), and 1g_ or 10g_SAR_Plimit_2 correspond to the instantaneous Tx power, conducted Tx power at Plimit, and compliance 1g_ or 10g_SAR values at Plimit_2 of band2 with time-averaging window ' T2SAR'. One of the two bands is less than 3GHz, another is greater than 3GHz.

Transition from first band with time-averaging window 'T1SAR' to the second band with time-averaging window 'T2SAR' happens at time-instant 't1'.

Test procedure

1. Measure Plimit for both the technologies and bands selected in Section 3.2.6. Measure Plimit with Smart Transmit Peak exposure mode enabled, callbox set to request maximum power.

2. Set Reserve_power_margin to actual (intended) value and enable Smart Transmit

Transition from 100s time window to 60s time window, and vice versa

1. Establish radio link with callbox in the technology/band having 100s time window selected in Section 3.2.6.

2. Request EUT's Tx power to be at 0 dBm for at least 100 seconds, followed by requesting EUT's Tx power to be at maximum power for about ~140 seconds, and then switch to second technology/band (having 60s time window) selected in Section 3.2.6. Continue with callbox requesting EUT's Tx power to be at maximum power for about ~60s in this second technology/band, and then switchback to the first technology/band. Continue with callbox requesting EUT's Tx power to be at maximum power for at least another 100s. Measure and record Tx power versus time for the entire duration of the test.

3. Once the measurement is done, extract instantaneous Tx power versus time, and convert the conducted Tx power into 1gSAR or 10gSAR value (see Eq. (7a) and (7b)) using corresponding technology/band Step 1 result, and then perform 100s running average to determine time-averaged 1gSAR or 10gSAR versus time. Note that in Eq.(7a) & (7b), instantaneous Tx power is converted into instantaneous 1gSAR or 10gSAR value by applying the worst-case 1gSAR or 10gSAR value tested in Part 1 for the selected technologies/bands at Plimit.

4. Make one plot containing: (a) instantaneous Tx power versus time measured in Step 4.

5. Make another plot containing: (a) instantaneous 1gSAR versus time determined in Step 5, (b) computed time-averaged 1gSAR versus time determined in Step 5, and (c) corresponding regulatory 1gSARlimit of 1.6W/kg or 10gSARlimit of 4.0W/kg.

Transition from 60s time window to 100s time window, and vice versa

1. Establish radio link with callbox in the technology/band having 60s time window selected in Section 3.2.6.

2. Request EUT's Tx power to be at 0 dBm for at least 60 seconds, followed by requesting EUT's Tx power to be at maximum power for about ~80 seconds, and then switch to second technology/band (having 100s time window) selected in

Section 3.2.6. Continue with callbox requesting EUT's Tx power to be at maximum power for about ~100s in this second technology/band,and then switchback to the first

technology/band. Continue with callbox requesting EUT's Tx power to be atmaximum power for the remaining time for a total test time of 500 seconds. Measure and record Tx power versus time for the entire duration of the test.

3. Repeat above Step 5~7 to generate the plots

The validation criteria is, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed the regulatory 1gSARlimit of 1.6W/kg or 10gSARlimit of 4.0W/kg

4.3.7 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 FCC limit. Here, radio1 represents primary radio (for example, LTE anchor in a NR non-standalone mode call) and radio2 represents secondary radio (for example, sub6 NR). The detailed test procedure for SAR exposure switching in the case of LTE+ sub6 NR non-standalone mode transmission scenario is provided in Appendix B.2.

Test procedure:

1. Measure conducted Tx power corresponding to Plimit for radio1 and radio2 in selected band. Test condition to measure conducted Plimit is:

Establish device in call with the callbox for radio1 technology/band. Measure conducted Tx power corresponding to radio1 Plimit with Smart Transmit Peak exposure mode enabled, callbox set to request maximum power.

Repeat above step to measure conducted Tx power corresponding to radio2 Plimit. 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 Plimit (as radio1 LTE is at all-down bits)

2. Set EUT to intended Smart Transmit exposure mode, with EUT setup for radio1 + radio2 call. In this description, it is assumed that radio2 has lower priority than radio1. Establish device in radio1+radio2 call, and request all-down bits or low power on

radio1, with callbox requesting EUT's Tx power to be at maximum power in radio2 for at least one time window. After one time window, set callbox to request EUT's Tx power to be 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 on) 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. Convert the conducted Tx power for both these radios into

1gSAR or 10gSAR value (see Eq. (6a) and (6b)) using corresponding technology/band Plimit measured in Step 1, and then perform the running time average to determine time-averaged 1gSAR or 10gSAR versus time.

4. Make one plot containing: (a) instantaneous Tx power versus time measured in Step

2.

5. Make another plot containing: (a) instantaneous 1gSAR versus time determined in Step 3, (b) computed time-averaged 1gSAR versus time determined in Step 3, and (c) corresponding regulatory 1gSARlimit of 1.6W/kg or 10gSARlimit of 4.0W/kg.

The validation criteria is, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed the regulatory 1gSARlimit of 1.6W/kg or 10gSARlimit of 4.0W/kg.

4.3.8 Test procedure for Exposure Category Switch

This test is performed with the EUT being requested to transmit at maximum power in selected technology/band/antenna/DSI. The change in exposure category is preferrably performed during Tx power enforcement (i.e., EUT forced to transmit at a sustainable level). One test is sufficient as this feature operation is independent of technology, band and antenna. Test procedure are:

In case of head to non-head to head exposure switch test, ‘first DSI’ in below test procedure refers to head DSI and ‘second DSI’ refers to non-head DSI. Similarly, in case of non-head to head to non-head exposure switch test, ‘first DSI’ in below test procedure refers to non-head DSI and ‘second DSI’ refers to head DSI.

1. Measure Plimit for all the technology(s)/band(s)/antenna(s)/DSI(s) selected following the above selection criteria. 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.

3. Establish radio link with first DSI and with callbox in the selected technology(s)/band(s)/antenna(s).

4.Request EUT to transmit at 0 dBm for at least 100 seconds, followed by requesting EUT to transmit at maximum Tx power for the active radio(s) for half of the regulatory time window, and then switch to the second DSI for ~10s, and switch back to the first DSI for at least one time window. Throughout this test, when switching between DSIs (i.e., switching between exposure categories), continue with callbox requesting EUT to transmit at maximum Tx power for the active radio(s). 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 (see Eq. (7a) and (7b)) using the corresponding Plimit measured in Step 1 and 1g or 10gSAR value measured in Part 1 report, and then perform 100s running average to determine time-averaged 1g or 10gSAR versus time as illustrated in Figure 5-1. Note that in

Eq. (7a) & (7b), instantaneous Tx power is converted into instantaneous 1g or 10gSAR value by applying the worst-case 1gSAR value for the selected technologies/bands at Plimit as reported in Part 1 report.

6. Make one plot containing: (a) computed time-averaged normalized 1g or 10gSAR of the selected technology(s)/band(s)/antenna(s) versus time determined in Step 5 for exposure under first DSI, (b) total time-averaged normalized exposure for exposure under first DSI if simultaneous transmission scenario was tested, and (c) normalized regulatory

limit of 1.0.

7. Make another plot containing: (a) computed time-averaged 1g or 10gSAR of the selected technology(s)/band(s)/antenna(s) versus time determined in Step 5 for exposure under second DSI,(b) total time-averaged normalized exposure for exposure under second DSI if simultaneous transmission scenario was tested, and (c) normalized regulatory limit of 1.0.

The validation criteria is, at all times, the time-averaged normalized exposure versus time shall not exceed the normalized limit of 1.0 for both first & second DSIs (i.e., both head exposure category and non-head exposure category).

4.4 Test procedure for time-varying SAR measurements

This section provides general time-varying SAR measurement procedures to perform compliance test under dynamic transmission scenarios described in Section 2. In practice, an adjustment can be made in these procedures. The justification/clarification may be provided.

To perform the validation through SAR measurement for transmission scenario 1 described in Section 2, the “path loss” between callbox antenna and EUT needs to be calibrated to ensure that the EUT Tx power reacts to the requested power from callbox in a radiated call. It should be noted that when signaling in closed loop mode, protocol- level power control is in play, resulting in EUT not solely following callbox TPC (Tx power control) commands. In other words, EUT response has many dependencies (RSSI, quality of signal, path loss variation, fading, etc.,) other than just TPC commands. These dependencies have less impact in conducted setup (as it is a controlled environment and the path loss can be very well calibrated) but have significant impact on radiated testing in an uncontrolled environment, such as SAR test setup. Therefore, the deviation in EUT Tx power from callbox requested power is expected, however the time-averaged SAR should not exceed FCC SAR requirement at all times as Smart Transmit controls Tx power at EUT.

The following steps are for time averaging feature validation through SAR measurement:

1. “Path Loss” calibration: Place the EUT against the phantom in the worst-case position determined based on Section 3.2.1. For each band selected, prior to SAR measurement, perform “path loss” calibration between callbox antenna and EUT. Since the SAR test environment is not controlled and well calibrated for OTA (Over the Air) test, extreme care needs to be taken to avoid the influence from reflections. The test setup is described in Section 6.1.

2. Time averaging feature validation:

   i For a given radio configuration (technology/band) selected in Section 3.2.1, enable Smart Transmit Peak exposure mode, with callbox to request maximum power, perform area scan, conduct pointSAR measurement at peak location of the area scan. This point SAR value, pointSAR_Plimit, corresponds to point SAR at the measured Plimit (i.e., measured Plimit from the EUT in Step 1 of Section 3.3.1).

ii Set Reserve_power_margin to actual (intended) value and reset power on EUT to enable Smart Transmit. Note, if Reserve_power_margin cannot be set wirelessly, care must be taken to re-position the EUT in the exact same position relative to the SAM phantom as in above Step 2.i. Establish radio link in desired radio configuration, with callbox requesting the EUT's Tx power at power levels described by test sequence 1 generated in Step 1 of Section 3.3.1, conduct point SAR measurement versus time at peak location of the area scan determined in Step 2.i of this section. Once the measurement is done, extract instantaneous point SAR vs time data, pointSAR(t), and convert it into instantaneous 1gSAR or 10gSAR vs. time using Eq. (3a), re-written below:

$$1g\_or\_10gsAR(t) = \frac{pointSAR(t)}{pointSAR\_P_{limit}} * 1g\_or\_10gsAR\_plimit$$

where, pointSAR_Plimit is the value determined in Step 2.i, and pointSAR(t) is the instantaneous point SAR measured in Step 2.ii, 1g_or_10gsAR_plimit is the measured 1gSAR or 10gSAR value listed in Part 1 report.

Iii Perform 100s running average to determine time-averaged 1gSAR or 10gSAR versus time.

Iv Make one plot containing: (a) time-averaged 1gSAR or 10gSAR versus time determined in Step 2.iii of this section, (b) FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.

v Repeat 2.ii ~ 2.iv for test sequence 2 generated in Step 1 of Section 3.3.1.

vi Repeat 2.i ~ 2.v for all the technologies and bands selected in Section 3.2.1.

The time-averaging validation criteria for SAR measurement is that, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR (i.e., Eq. (3b)).

5.Test Configurations

5.1 WWAN (sub-6) transmission

The Plimit values, corresponding to SAR_design_target, for technologies and bands supported by EUT are derived in Part 0 report and summarized in Table 4-1. Note all Plimit power levels
entered in Table 4-1 correspond to average power levels after accounting for duty cycle in the case of TDD modulation schemes (for e.g., GSM, LTE TDD & 5G NR TDD).
Per Qualcomm's document, embedded file system (EFS) version 19 products are required to be verified for Smart Tx generation for relevant MCC settings. It was confirmed that this DUT
contains embedded file system (EFS) version 19 configured for Smart Tx 2nd generation (GEN2) for Sub6 with MCC settings for the US market and WLAN/BT are the radios outside of Smart Transmit control.

Table 4-1: Plimit for supported technologies and bands (Plimit in EFS file)

Band	Antenna	Head DSI 1	Head DSI 2	Non_Head DSI 3	Non_Head DSI 4	Omm_Extremity DSI 5	Pmax*
LTE_B30	10	23	21	23	23	23	23
LTE_B4	0	23	23	21	23	23	23
LTE_B42	11	21	18	14	20	18	21
LTE_B43	11	21	21	21	20	18.5	21
LTE_B48	11	21	18	14.5	20	18.5	21
LTE_B66	0	23	23	21	23	23	23
LTE_B7	6	23	23	20.5	23	23	23
NR5G_N2	0	23	23	23	23	23	23
NR5G_N30	10	23	21.5	23	23	23	23
NR5G_N66	0	23	23	21.5	23	23	23
NR5G_N7	6	23	23	20.5	23	23	23
NR5G_N2	2	23	20.5	23	23	23	23
NR5G_N7	10	23	21	20.5	23	23	23
NR5G_N38	10	23	21	23	23	23	23
NR5G_N66	2	21	18	21.5	23	23	23

*Pmax is used for RF tune up procedure. The maximum allowed output power is equal to Pmax.
Maximum target power, Pmax, is configured in NV settings in EUT to “limit maximum transmitting power”. This power is converted into “peak power in NV settings for TDD schemes”. The EUT maximum allowed output power is equal to Pmax. EFS file Plimit level will compare to Pmax, when Plimit is high than Pmax, the power will be limited to Pmax power level.
**All Plimit power levels entered in the Table correspond to average power levels after accounting for duty cycle in the case TDD modulation schemes.
Based on selection criteria described in Section 3.2.1, the selected technologies/bands for testing time-varying test sequences are listed in Table 4-1.
The radio configurations used in Part 2 test for selected technologies, bands, DSIs and antennas are listed in Table 4-2. The corresponding worst-case radio configuration 1gSAR or 10gSAR values for selected technology/band/DSI are extracted from Part 1 report and are listed in the last column of Table 4-1.
Based on equations (1a) and (3a), it is clear that Part 2 testing outcome is normalized quantity, which implies that it can be applied to any radio configuration within a selected technology/band/DSI. Thus, as long as applying the worst-case SAR obtained from the worst radio configuration in Part 1 testing to calculate time-varying SAR exposure in equations (1a) and (3a), the accuracy in compliance demonstration remains the same.

Table 4-2: Radio configurations selected for Part 2 test

Test case #	Test scenario	Tech	Band	Ant	DSI	Channel	Freq (MHz)	BW	RB size	RB offset	mode	position	Position details	Part 1, SAR@ Plimit 1g SAR (W/kg)
1	Time-Varying	LTE	4	0	0	20175	1732.5	20	1	0	QPSK	Right Cheek	0	0.63
2		LTE	42	11	0	42590	3500	20	1	0	QPSK	Left Cheek	0	1.12
3	Call Drop	LTE	42	11	2	42590	3500	20	1	0	QPSK	Left Cheek	0	0.51
4	DSI Switch	LTE	42	11	2	42590	3500	20	1	0	QPSK	Left Cheek	0	0.51
		LTE	42	11	3	42590	3500	20	1	0	QPSK	Rear Face	5	0.37

Based on the selection criteria described in Section 3.2, the radio configurations for the Tx varying transmission test cases listed in Section 2 are:

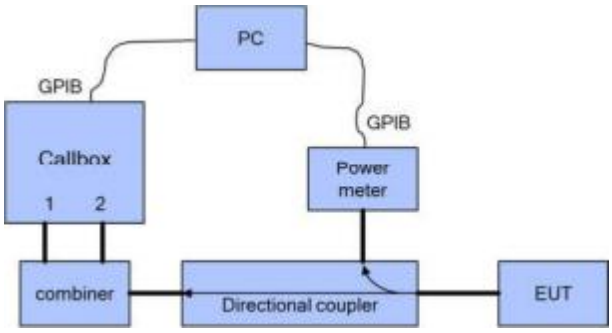
1. Technologies and bands for time-varying Tx power transmission: The test case 1~4 listed in Table 4-2 are selected to test with the test sequences defined in Section 3.1 in both time-varying conducted power measurement and time-varying SAR measurement.

2. Technologies and bands for change in DSI: The test case 8 listed in Table 4-2 is selected for DSI switch test by establishing a call in LTE Band 42 in DSI=2, and then handing over to DSI = 3 exposure scenario in conducted power setup.

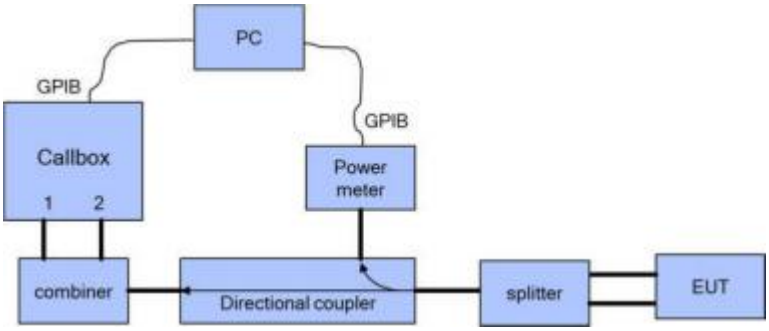
6. Conducted Power Test Results for Sub-6 Smart Transmit Feature Validation

6.1 Measurement setup

The Rohde & Schwarz CMW500 callbox is used in this test. The test setup schematic are shown in Figures 5-1. For single antenna measurement, one port (RF1 COM) of the callbox is connected to the RF port of the EUT using a directional coupler. For antenna & technology switch measurement, two ports (RF1 COM and RF3 COM) of the callbox used for signaling two different technologies are connected to a combiner, which is in turn connected to a directional coupler. The other end of the directional coupler is connected to a splitter to connect to two RF ports of the EUT corresponding to the two antennas of interest. In both the setups, power meter is used to tap the directional coupler for measuring the conducted output power of the EUT. For time averaging validation test (Section 3.3.1), call drop test (Section 3.3.2), and DSI switch test (Section 3.3.4), only RF1 COM port of the callbox is used to communicate with the EUT. For
technology/band switch measurement (Section. 3.3.3),both RF1 COM and RF3 COM port of callbox are used to switch from one technology communicating on RF1 COM port to another technology communicating on RF3 COM port. All the path losses from RF port of EUT to the callbox RF COM port and to the power meter are calibrated and automatically entered as offsets in the callbox and the power meter via test scripts on the PC used to control callbox and power meter.
Sub6 NR test setup:
The Keysight UXM E7515B callbox is used in this test. The test setup schematic are shown in Figures 5-1. For single antenna measurement, one port (RF1 COM) of the callbox is connected to the RF port of the EUT using a directional coupler.



(a)



(b)

Figure 5-1 Conducted power measurement setup

Both the callbox and power meter are connected to the PC using GPIB cables. Two test scripts are custom made for automation, and the test duration set in the test scripts is 500 seconds.

For time-varying Tx power measurement, the PC runs the 1st test script to send GPIB commands to control the callbox's requested power versus time, while at the same time to record the conducted power measured at EUT RF port using the power meter. The commands sent to the callbox to request power are:

. 0dBm for 100 seconds
. Test sequence 1 or test sequence 2 (defined in Section 3.1 and generated in Section 3.2.1), for 360 seconds
. Stay at the last power level of test sequence 1 or test sequence 2 for the remaining time.

Power meter readings are periodically recorded every 100ms. A running average of this measured Tx power over 100 seconds is performed in the post-data processing to determine the 100s-time averaged power.

For call drop, technology/band/antenna switch, and DSI switch tests, after the call is established, the callbox is set to request the EUT's Tx power at 0dBm for 100 seconds while simultaneously starting the 2nd test script runs at the same time to start recording the Tx power measured at EUT RF port using the power meter. After the initial 100 seconds since starting the Tx power recording, the callbox is set to request maximum power from the EUT for the rest of the test. Note that the call drop/re-establish, or technology/band/antenna switch or DSI switch is manually performed when the Tx power of EUT is at Preserve level. See Section 3.3 for detailed test procedure of call drop test, technology/band/antenna switch test and DSI switch test.

6.2 Plimit and Pmax measurement results

The measured Plimit for all the selected radio configurations given in Table 4-2 are listed in below Table 5-1. Pmax was also measured for radio configurations selected for testing time-varying Tx power transmission scenarios in order to generate test sequences following the test procedures in Section 3.1.

Test case #	Test scenario	Tech	Band	Ant	DSI	Channel	Freq (MHz)	BW	RB size	RB offset	mode	position	Position details	Plinit EFS setting (dBm)	target Pmax (dBm)	Measured Plimit (dBm)	Measured Pmax (dBm)
1	Time-Varying	LTE	4	0	3	20175	1732.5	20	1	0	QPSK	Right Cheek	0	21	23	21.211	23.281
2		LTE	42	11	3	42590	3500	20	1	0	QPSK	Left Cheek	0	21	21	14.690	19.696
3	Call Drop	LTE	42	11	2	42590	3500	20	1	0	QPSK	Left Cheek	0	18	21	17.9	19.696
4	DSI Switch	LTE	42	11	2	42590	3500	20	1	0	QPSK	Left Cheek	0	18	21	17.9	19.696
		LTE	42	11	3	42590	3500	20	1	0	QPSK	Rear Face	5	21	21	14.690	19.696

6.3 Time-varying Tx power measurement results

The measurement setup is shown in Figures 5-1(a) and 5-1(c). The purpose of the time-varying Tx power measurement is to demonstrate the effectiveness of power limiting enforcement and that the time-averaged Tx power when represented in time-averaged 1gSAR or 10gSAR values does not exceed FCC limit as shown in Eq. (1a) and (1b), where, conducted_Tx_power(t), conducted_Tx_power_plimit , and 1g_or_10gsAR_plimit correspond to the measured instantaneous conducted Tx power, measured conducted Tx power at Plimit, and measured 1gSAR and 10gSAR values at Plimit reported in Part 1 test (listed in Table 4-2 of this report as well).

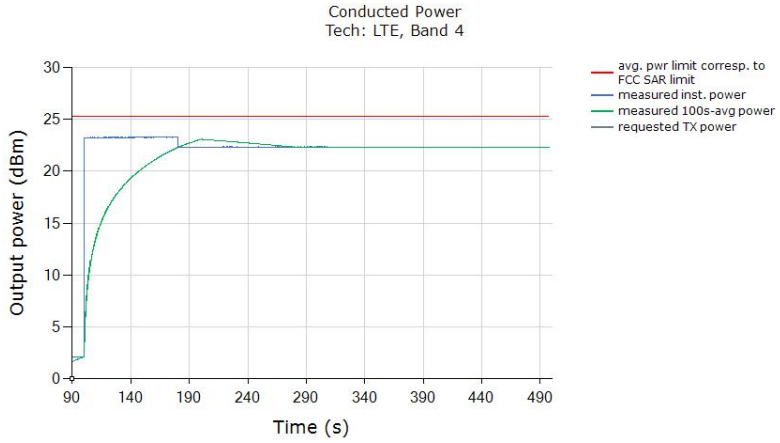
Following the test procedure in Section 3.3, the conducted Tx power measurement for all selected configurations are reported in this section. In all the conducted Tx power plots, the dotted line represents the requested power by callbox (test sequence 1 or test sequence 2), the blue curve represents the instantaneous conducted Tx power measured using power meter, the green curve represents time-averaged power and red line represents the conducted power limit that corresponds to FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.

Similarly, in all the 1g or 10gSAR plots (when converted using Eq. (1a)), the green curve represents the 100s/60s-time averaged 1gSAR or 10gSAR value calculated based on instantaneous 1gSAR or 10gSAR; and the red line limit represents the FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR.

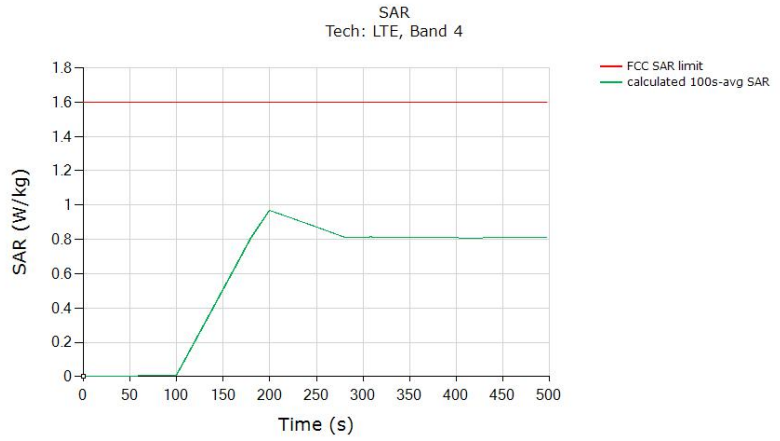
The power limiting enforcement is effective in all the tests, and the time-averaged 1gSAR does not exceed the SAR design target + device uncertainty for all the tested technologies/bands. Therefore, Qualcomm Smart Transmit time averaging feature is validated.

6.3.1 LTE Band 4

Test result for test sequence 1:

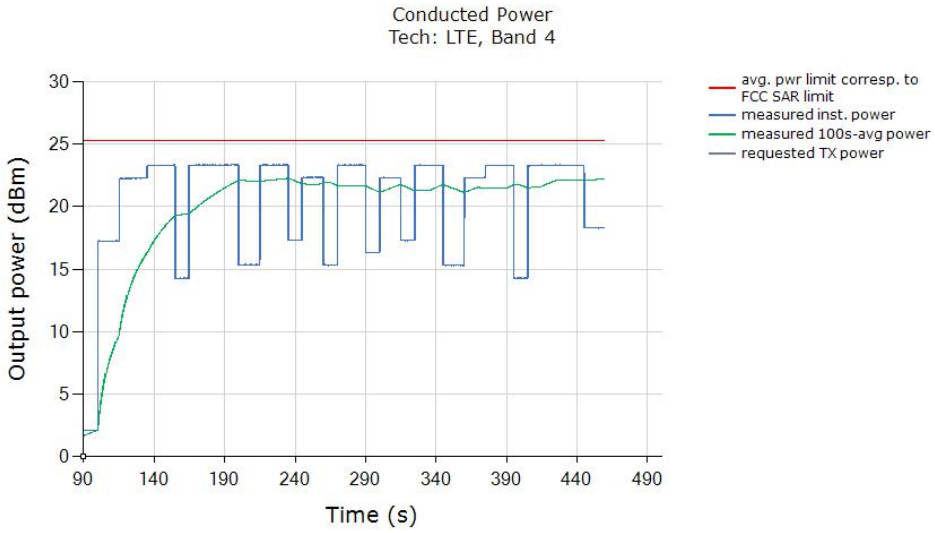


Above time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR using Equation (1a) and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:

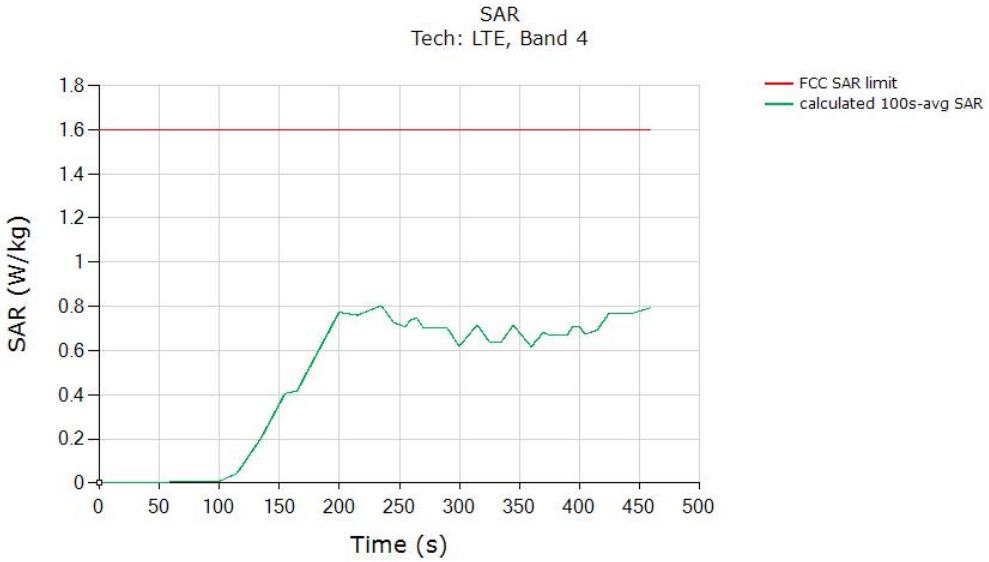


	(W/kg)
FCC 1gSAR limit	1.6
Max 100s-time averaged 1gSAR (green curve)	0.968
Validated: Max time averaged SAR (green curve) does not exceed measured SAR at Plimit	

Test result for test sequence 2:



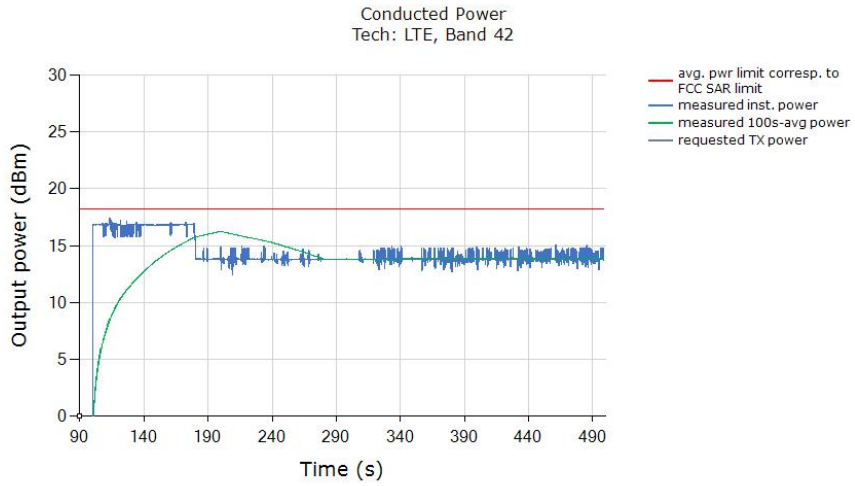
Above time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR using Equation (1a) and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



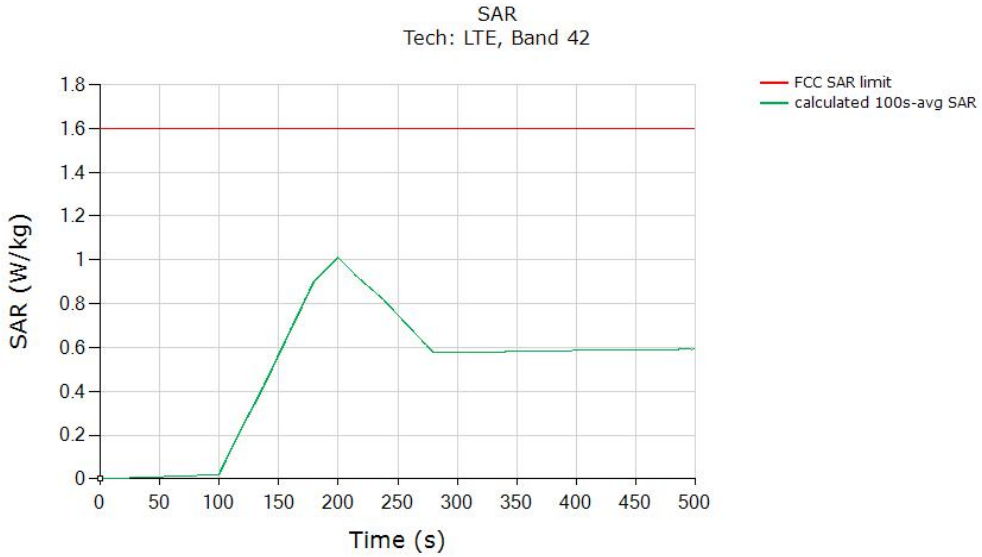
	(W/kg)
FCC 1gSAR limit	1.6
Max 100s-time averaged 1gSAR (green curve)	0.803
Validated: Max time averaged SAR (green curve) does not exceed measured SAR at Plimit	

6.3.2 LTE Band 42

Test result for test sequence 1:

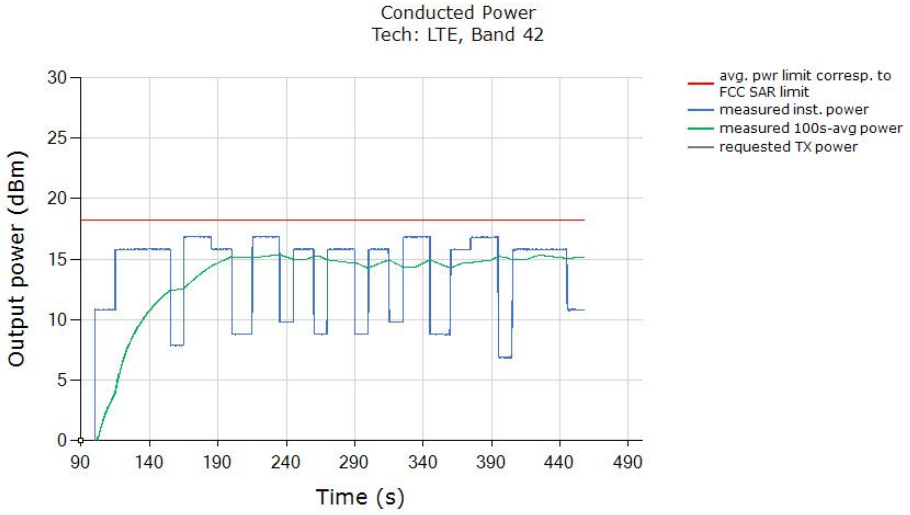


Above time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR using Equation (1a) and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:

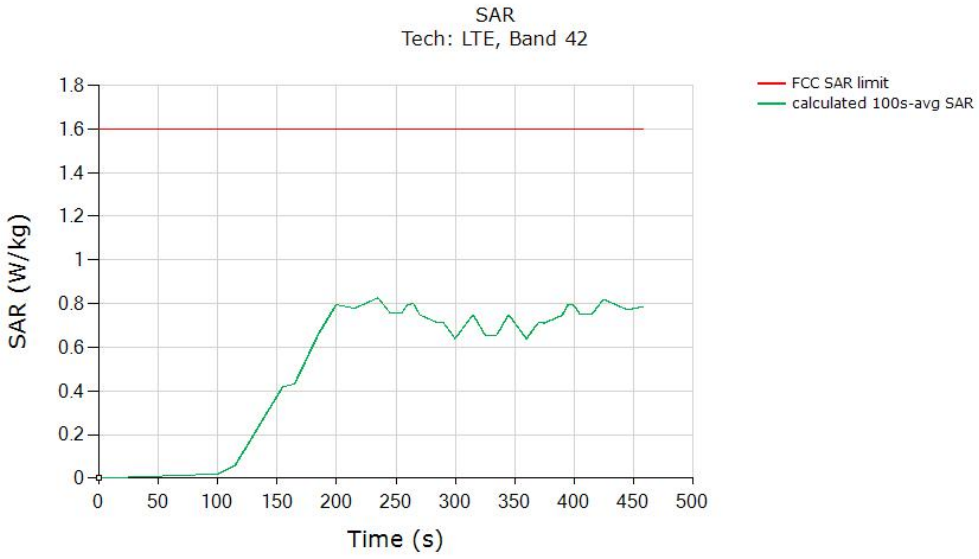


	(W/kg)
FCC 1gSAR limit	1.6
Max 100s-time averaged 1gSAR (green curve)	1.012
Validated: Max time averaged SAR (green curve) does not exceed measured SAR at Plimit	

Test result for test sequence 2:



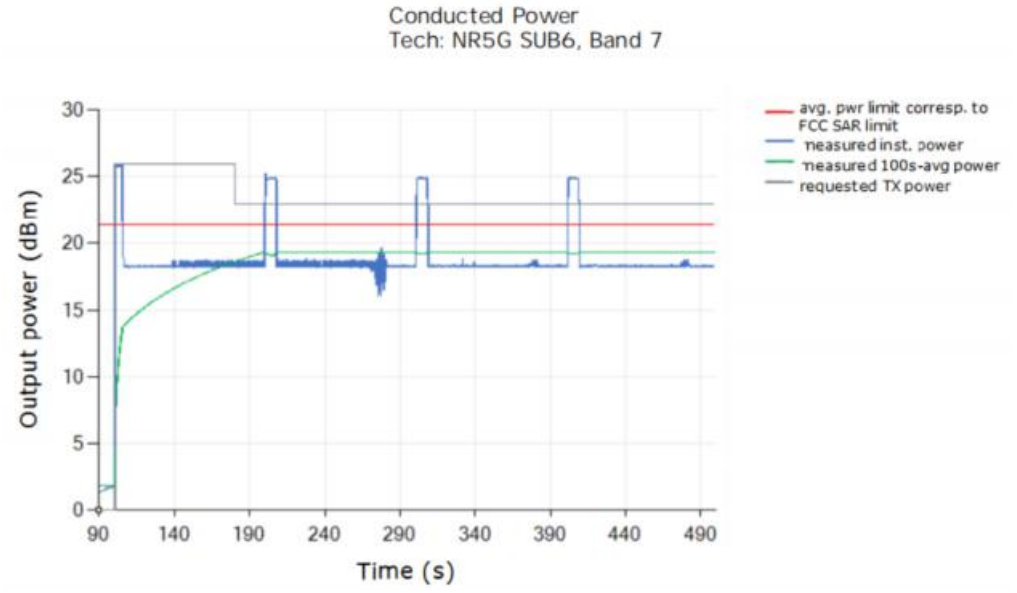
Above time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR using Equation (1a) and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:

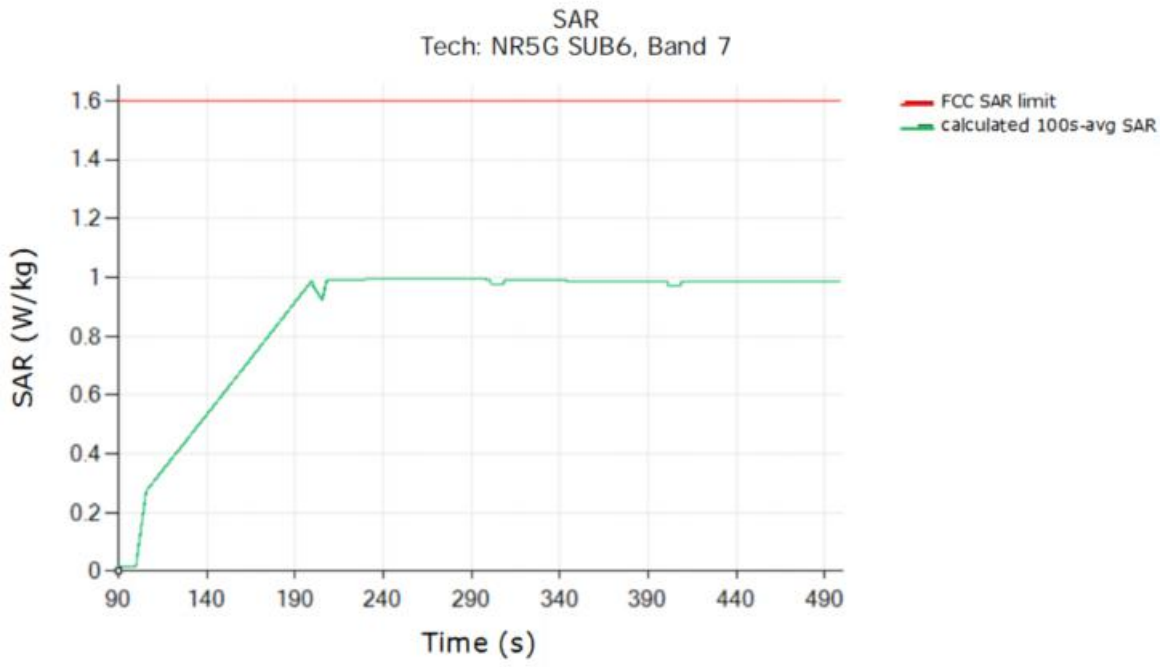


	(W/kg)
FCC 1gSAR limit	1.6
Max 100s-time averaged 1gSAR (green curve)	0.826
Validated: Max time averaged SAR (green curve) does not exceed measured SAR at Plimit	

6.3.3 5GNR n7 SAR test results

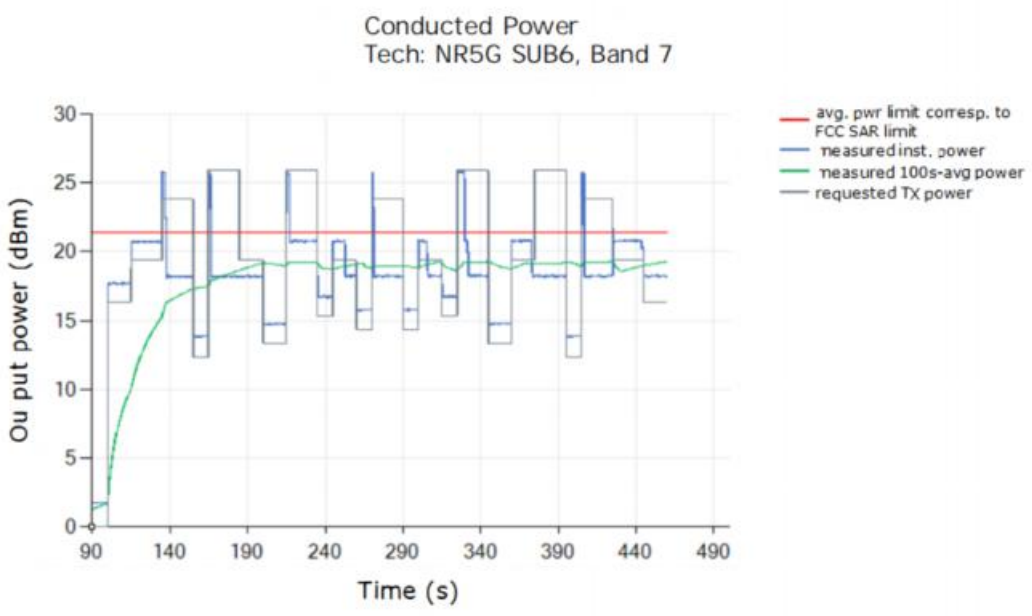
Test result for test sequence 1:

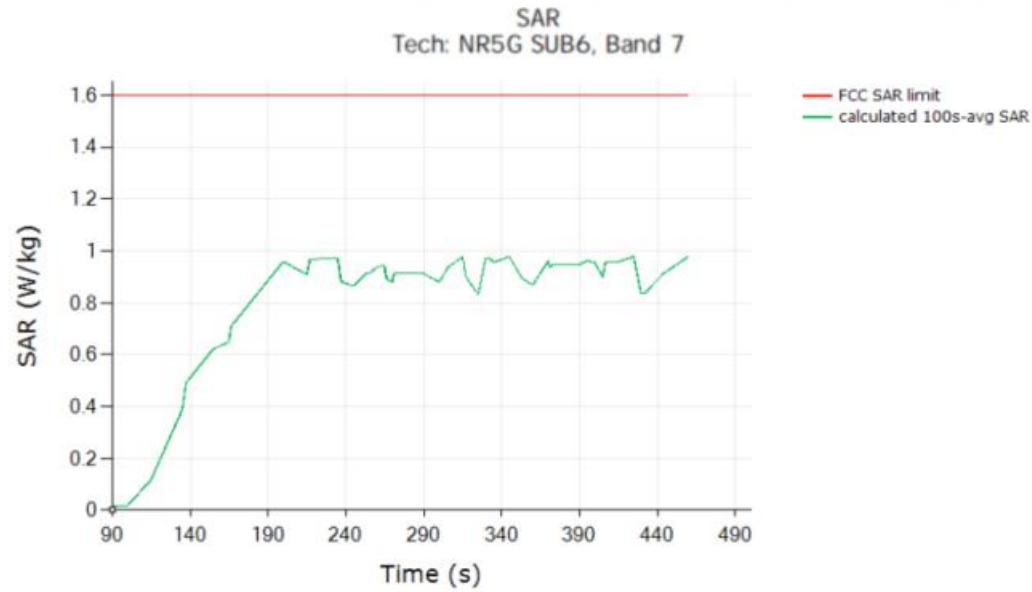




	(W/kg)
FCC 1gSAR limit	1.6
Max 100s-time averaged 1gSAR (green curve)	0.996
Validated: Max time averaged SAR (green curve) does not exceed measured SAR at Plimit	

Test result for test sequence 2:



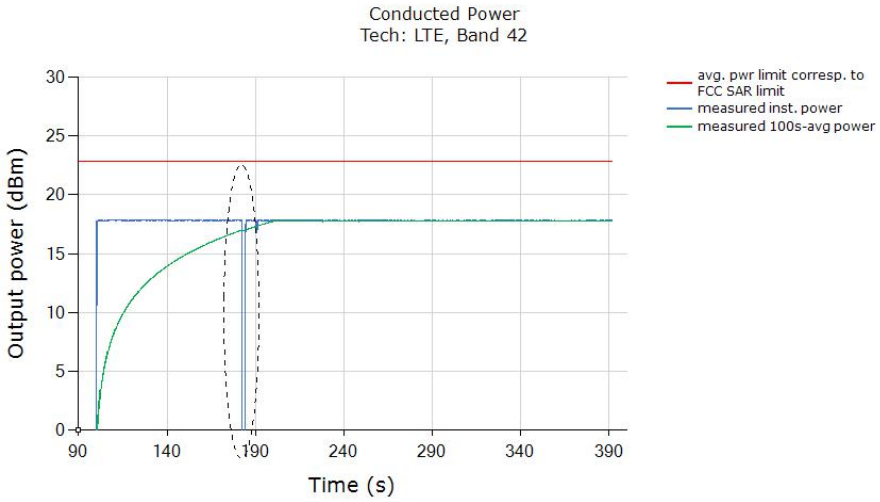


	(W/kg)
FCC 1gSAR limit	1.6
Max 100s-time averaged 1gSAR (green curve)	0.973
Validated: Max time averaged SAR (green curve) does not exceed measured SAR at Plimit	

Note: NR and LTE test separately in the case of ENDC, and the device can switch to the power of the specified DSI.

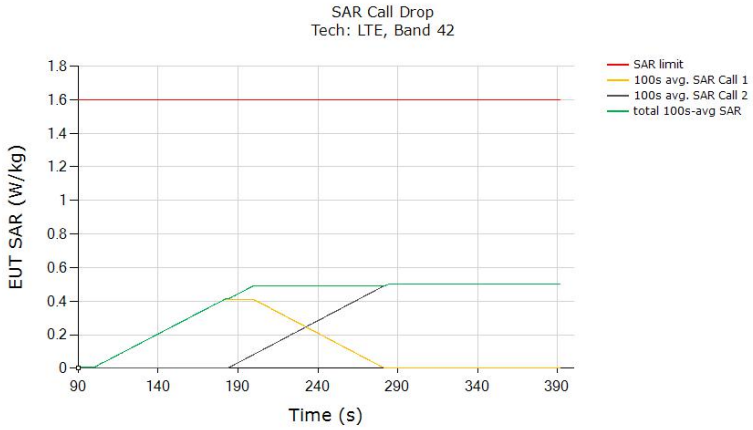
6.4 Change in Call Test Results

Call drop test result:



Plot Notes: … The conducted power plot shows expected Tx transition.

Plot 2: Above time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR using Equation (1a) and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



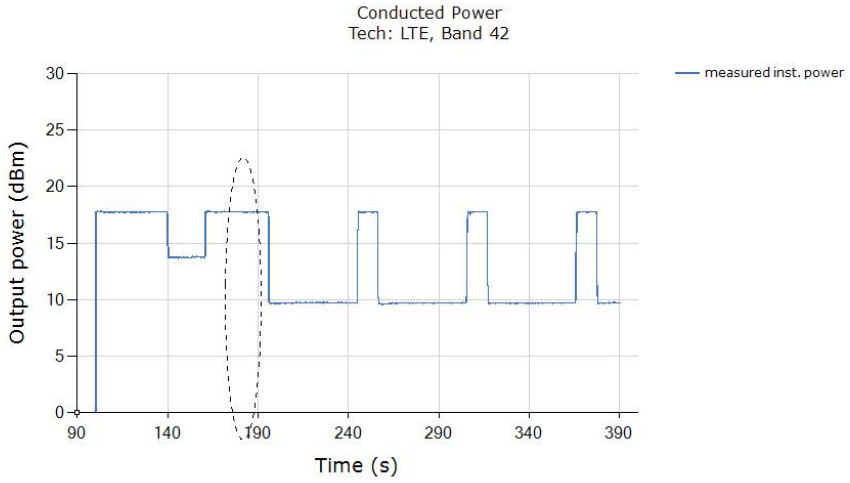
	(W/kg)
FCC 1gSAR limit	1.6
Max 100s-time averaged 1gSAR (green curve)	0.500
Validated: The test result validated the continuity of power limiting in Change in Call scenario.	

Note:In the case of a dropped call, the power of the corresponding DSI can be switched.

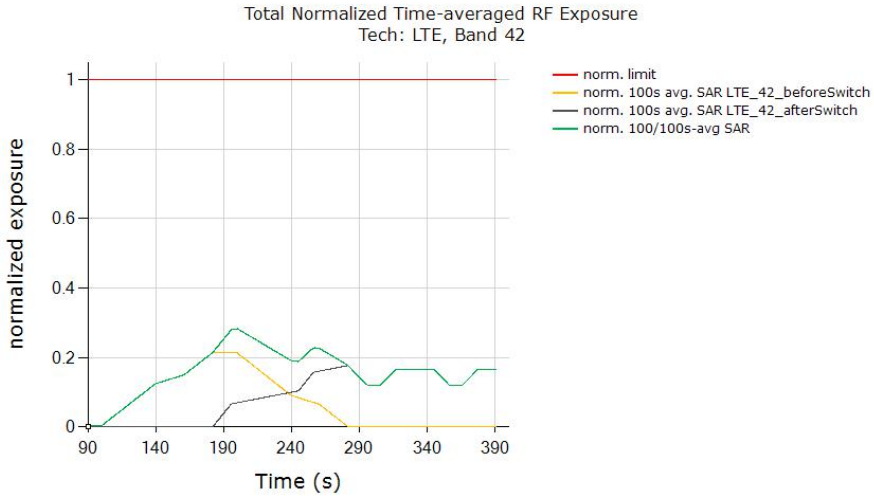
6.5 Change in DSI test results

Test result for change in DSI:

Plot 1: Measured Tx power (dBm) versus time shows that the transmitting power changed when DSI=5 switches to DSI = 4.



Plot 2: All the time-averaged conducted Tx power measurement results were converted into time-averaged normalized SAR values using Equation (6a), (6b) and (6c), and plotted below to demonstrate that the normalized time-averaged RF exposure does not exceed the FCC limit of 1.0:



	(W/kg)
FCC normalized Exposure Ratio limit	1.0
Max 100s-time averaged normalized Exposure Ratio (green curve)	0.283
Validated:The test result validated the continuity of power limiting in DSI switch scenario.	

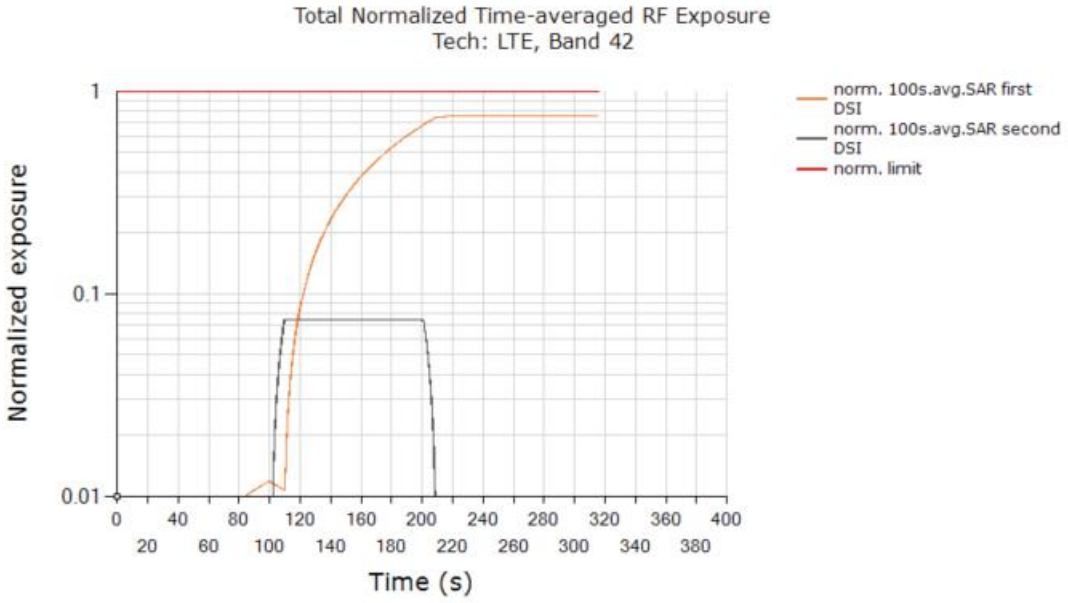
Note:In the case of a Changed in DSI, the power of the corresponding DSI can be switched.

6.6 Change in Exposure Category test results

The validation criteria is, at all times, the time-averaged normalized exposure versus time shall not exceed the normalized limit of 1.0 for both first & second DSIs (i.e., both head exposure

category and non-head exposure category).

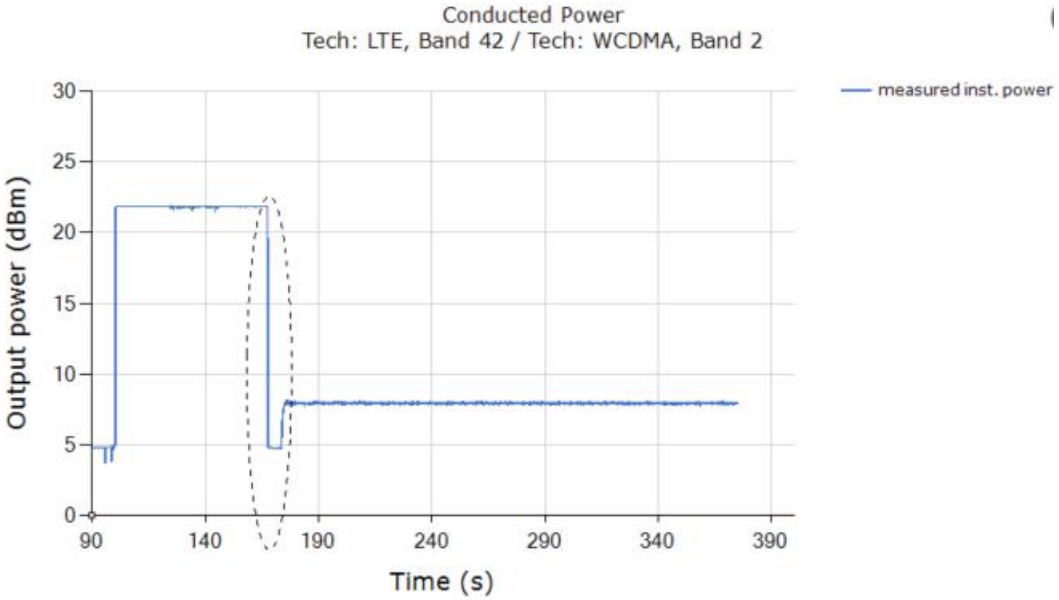
Test case 1: For head to non-head to head exposure switch test, the time-averaged normalized RF exposure in head exposure DSI (orange curve) did not exceed normalized limit of 1.0 at all times.

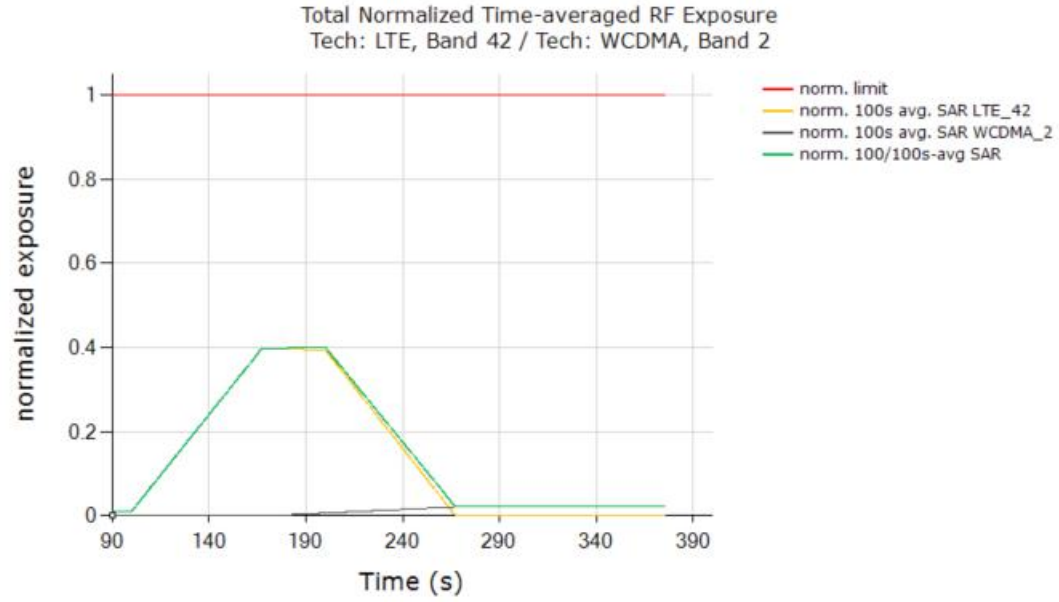


	(W/kg)
FCC normalized Exposure Ratio limit	1.0
Max 100s-time averaged normalized Exposure Ratio (green curve)	0.075
Validated:The test result validated the continuity of power limiting in Exposure Category scenario.	

Note:In the case of a Changed in Exposure CategoryI, the power of the corresponding DSI can be switched.

6.7 Teach Band Switch





	(W/kg)
FCC 10gSAR limit	1.6
Max 100s-time averaged 10gSAR (green curve)	0.401
Validated:The test result validated the continuity of power limiting in Change in Teach Band Switch scenario.	

Note:In the case of a Changed in Band, the power of the corresponding DSI can be switched.

Appendix. Test Equipment List

Test Equipment	Model	Serial Number	Calibration within 1year
Signal Generator	E8257dD	MY46522016	Comply
Power meter	E4417A	MY45101004	Comply
Power Sensor	E9300B	MY41496001	Comply
Power Sensor	E9300B	MY41496003	Comply
Vector Network Analyzer	VNA R140	0011213	Comply
Dielectric Parameter Probe	DAKS-3.5	1042	Comply
Communication Tester	E5515C	MY48367401	Comply
Communication Tester	CMW500	161702	Comply
Communication Tester	MT8820C	6201300660	Comply
Communication Tester	SP9500	20334	Comply

---End Report---