FCC 47 CFR § 2.1093
RF EXPOSURE EVALUATION REPORT
(Part 2: Test Under Dynamic Transmission Condition)

FOR

GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax and NFC

MODEL NUMBER: SM-A366U, SM-A366U1, SM-S366V

FCC ID: A3LSMA366U

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Revision History

Rev.	Date	Revisions	Revised By
V1	2024-12-30	Initial Issue	--
V2	2025-01-08	Revised Table 4-1 in Sec.4.1. Revised scenarios 3 &12 of Table 4-2 in Sec.4.1. Revised scenarios 3 &12 of Table 5-1 in Sec.5.2. Revised Sec.5.3.3 & Sec 5.7 & Sec 6.3.3 Added liquid and system check in Sec 6.1. Revised Equipment table in Sec.7. Revised Appendix B	Juyeon Choi

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Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO.,LTD.
FCC ID	A3LSMA366U
Model Number	SM-A366U, SM-A366U1, SM-S366V
Applicable Standards	FCC 47 CFR § 2.1093
Date Tested	2024-11-26 to 2025-01-08
Test Results	Pass

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

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1. Introduction

The equipment under test (EUT) is SM-A366U, SM-A366U1, SM-S366V (FCC ID : A3LSMA366U), it contains the Qualcomm modems supporting 2G/3G/4G and 5G NR bands(Sub-6). But WLAN/BT/NFC technologies are not support Qualcomm Smart Transmit. These modems are enabled with Qualcomm Smart Transmit feature to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is in compliance with the FCC requirement.

DUT contains embedded file system (EFS) version 20 configured for the 2nd Generation phase IV (GEN2.4+).

EFS v20 Verification

Per Qualcomm's 80-w2112-5 document, embeded file system (EFS) version 20 products are required to be verified for Smart Tx generation for relevant MCC setting. It was confirmed that this DUT contains embedded file system (EFS) version 20 configured for Smart Tx Second generation phase IV (GEN2.4+) for Sub6 with MCC settings for the US market.

EFS v20 Generation	MCC
GEN2_SUB6	310

This purpose of the Part 2 report is to demonstrate the EUT complies with FCC RF exposure requirement under Tx varying transmission scenarios, thereby validity of Qualcomm Smart Transmit feature for FCC equipment authorization of A3LSMA366U.

2. 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-varing Tx power transmission: To prove that the Smart Transmit feature accounts for Tx power variations in time accurately.

2. During a call disconnected 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 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).

5. During change in device state: To prove that the Smart Transmit feature functions correctly during transitions in device state, say, from body-worn state to hotspot, or say, from extremity mode to body-worn state, etc. Devices state here refers to all the device configurations required to be tested by FCC, for example, head position, body-worn position, hotspot mode, and extremity.

6. During time window switch: To prove that the Smart Transmit feature correctly handles the transition from one time window to another specified by FCC, and maintains the normalized time-averaged RF exposure to be less than normalized FCC limit of 1.0 at all times.

7. SAR exposure switching between sub6 radios favor modes: 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.

8. Exposure Category Switch : To prove that the Smart Transmit Feature correctly during transitions from head to body-worn or vice versa. The exposure continuity is handled in two categories : Head exposure and non-head exposure.

As described in Part 0 report (QRD SAR Char and PD Char for Qualcomm Smart Transmit, Using Combination of Simulation and Measurement (80-W2112-2), the RF exposure is proportional to the Tx power for a SAR characterized wireless device. Thus, time-averaging algorithm validation can be effectively performed through conducted power measurement. To have high confidence in this validation, but also be practical, the strategy for the validation including both power measurement and RF exposure measurement is outlined as follows:

Conducted power:

- Measure conducted Tx power for f < 6GHz
- Convert it into RF exposure and divide by respective FCC limits to get normalized exposure
- Perform time-averaging over predefined time windows
- Demonstrate that the total normalized time-averaged RF exposure is less than 1.0 for all transmission scenarios (i.e., previous scenarios 1 to 8);

  - For sub-6 transmission only:

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

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

Where, *conducted_Tx_power (t)*, *conducted_Tx_power_*P_{limit}, and *1g_or_10gSAR_*P_{limit} correspond to the measured instantaneous conducted Tx power, measured conducted Tx power at P_{limit}, and measured *1gSAR or 10gSAR* values at P_{limit} for the worst-case radio configuration within the tested technology/band/Antenna/DSI.

3. SAR Time Averaging Validation Test Procedures

This chapter provides the test plan and test procedures 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. The same test plan and test procedures described in this chapter apply to 60 seconds time window for 3 GHz =< *f* > 6 GHz.

3.1. Test sequence determination for validation

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

- Test sequence 1 : request EUT's Tx power to be at maximum power, measured P_{max}, for 80s, then requesting for half of the maximum power, i.e., measured $P_{max}/2$, 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 P_{max}, measured P_{limit} and Calcuated $P_{reserve}$ (= measured P_{limit} in dBm – *Reserve_power_margin* in dB) of EUT based on measured P_{limit}.

The details for generating these Sub-6's two test sequence's test sequence are described and listed in Section A.

Note: For test sequence generation, "measured P_{limit}" and "measured P_{max}" are used instead of the "P_{limit}" specified in EFS entry and "P_{max}" specified for the devise, because Smart Transmit feature operates against the actual power level of the "P_{limit}" that was calibrated for the EUT. The "measured P_{limit}" 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 P_{limit}.

3.2. Test configuration selection criteria for validation 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 provide.

3.2.1 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 on one band/mode/channel per technology is sufficient. Two bands per technology are proposed and selected for this testing to provide high confidence in this validation.

The criteria for the selection are based on the P_{limit} values determined in Part 0 report. Select two bands* in each supported technology that correspond to least** and highest*** P_{limit} values that are less than P_{max} for validating Smart Transmit.

***** If one P_{limit} level applies to all the bands within a technology, then only one band needs to be tested. In this case, within the bands having the same P_{limit}, the radio configuration (e.g., # of RBs, channel#) and devise position that correspond to the highest *measured 1g or 10gSAR* at P_{limit} shown in Part 1 report is selected.

****** In case of multiple bands having the same least P_{limit} within the technology, then select the band having the highest *measured 1g or 10gSAR* at P_{limit}.

******* The band having a higher P_{limit} needs to be properly selected so that the power limiting enforced by Smart Transmit can be validated using the pre-defined test sequences. If the highest P_{limit} in a technology is too high where the power limiting enforcement is not needed when testing with the pre-defined test sequences, then the next highest level is checked. This process is continued within the technology until second band for validation test is determined.

3.2.2 Test configuration selection for change in call

The criteria to select a test configuration for call-drop measurement is:

- Select technology/band with least P_{limit} 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 1g or 10gSAR* at P_{limit} listed in Part 1 report.
- In case of multiple bands having same least P_{limit}, then select the band having the highest *measured 1g or 10gSAR* at P_{limit} in Part 1 report.
- Test for change in call is not required if all $P_{limit} > P_{max}$

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., during the time when EUT is forced to have Tx power at $P_{reserve}$) for longest duration in one FCC defined 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 $P_{reserve}$). One test is sufficient as the feature operation is independent of technology and band.

3.2.3 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 P_{limit} within the technology group (in case of multiple bands having the same P_{limit}, then select the band with highest *measured 1g or 10gSAR* at P_{limit}) to a technology/band with highest P_{limit} within the technology group, in case of multiple bands having the same P_{limit}, then select the band with lowest *measured 1g or 10gSAR* at P_{limit} 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 $P_{reserve}$).

3.2.4 Test configuration selection for change in antenna

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

- Whenever possible and supported by the EUT, first antenna switch configuration within the same technology/band (i.e., same technology and band combination).
- Then, select any technology/band that supports multiple Tx antennas, and has the highest difference in P_{limit} among all supported antennas.
- In case of multiple bands having same difference in P_{limit} among supported antennas, then select the band having the highest *measured 1g or 10gSAR* at P_{limit} in Part 1 report.

This test is performed with the EUT's Tx power requested to be at maximum power in selected technology/band, and antenna change is conducted during Tx power enforcement duration (i.e., during the time when EUT is forced to have Tx power at $P_{reserve}$).

3.2.5 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 $P_{limit} < P_{max}$ within any technology and DSI group, and for same technology/band having a different P_{limit} 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 $P_{reserve}$).

Note(s):

Selected DSIs should be under the same exposure category(i.e., both selected DSIs are either under head exposure category or under non-head exposure category) if DUT is enabled with Smart Transmit version 18 or higher.

3.2.6 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 a different time window defined by FCC (such as 100-seconds time window), and its corresponding P_{limit} is less than P_{max} 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 P_{limit} is less than P_{max} if possible.
- Note it is preferred both P_{limit} values of two selected technology/band less than corresponding P_{max}, but if not possible, at least one of technologies/bands has its P_{limit} 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.

3.2.7 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 SAR_{radio1} only, SAR_{radio1} + SAR_{radio2}, and SAR_{radio2} 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 + Sub NR)
- Among all supported simultaneous transmission configurations, the selection order is
  1. Select one configuration where both P_{limit} of radio1 and radio2 is less than their corresponding P_{max}, preferably, with different P_{limits}. If this configuration is not available, then,
  2. Select one configuration that has P_{limit} less than its P_{max} for at least one radio. If this cannot be found, then.
  3. Select one configuration that has P_{limit} of radio1 and radio2 greater than P_{max} but with least (P_{limit} – P_{max}) delta.

Test for one simultaneous transmission scenario is sufficient as the feature operation is the same. Additional details for testing for LTE+Sub6 NR non-standalone is provided in Section.B.

3.2.8 Test configuration selection for Exposure Category Switch

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 switch back to head exposure,
(b) Start with non-head exposure and switch to head exposure and switch back to non-head exposure.

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

1. If the device's intended exposure mode is configured for time averaged exposure mode operation then:
   - If Plimit < Pmax for at least one radio 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 non-head 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.

   The validation criteria are, at all times, the combined time-averaged 1gSAR or 10gSAR versus time determined in Step 6c shall not exceed the regulatory *1g or 10gSAR*$_{limit}$ limit.

3.3. 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.

3.3.1 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 P_{max}, measure P_{limit} and calculate Preserve (= measured P_{limit} 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 P_{max} and measured P_{limit} of the EUT. Test condition to measure P_{max} and P_{limit} is:

   - Measure P_{max} with Smart Transmit disable and callbox set to request maximum power.
   - Measure P_{limit} with Smart Transmit enable and *Reserve_power_margin* set to 0 dB (Peak exposure mode); callbox set to request maximum power.

2. Set *Rerve_power_margin* to actual (intended) value and reset power on EUT to enable Smart Transmit, establish radio link in desired radio configuration, with 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 P_{limit} from above Step 1. Perform running time average to determine time-averaged power and 1gSAR or 10gSAR versus time as illustrated in Figure A-1 where using 100-secnods 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 P_{limit} 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 0 dBm 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.

Time	Power/SAR
t_1	P_{t1} or SAR_{t1}
t_2	P_{t2} or SAR_{t2}
:	:
:	:
t_n (t_1+100s)	P_{tn} or SAR_{tn}
t_{n+1} (t_2+100s)	P_{tn+1} or SAR_{tn+1}
:	:

1st 100s time window

$$time\ averaged\ P1\ or\ SAR1 = \frac{\sum_{i=1}^{n} P_{ti}\ or\ SAR_{ti}}{n}$$

2nd 100s time window

$$time\ averaged\ P2\ or\ SAR2 = \frac{\sum_{i=2}^{n+1} P_{ti}\ or\ SAR_{ti}}{n}$$

Figure A-1 100s running average illustration

3. Make one plot containing:
   a. Computed time-averaged 1gSAR or 10gSAR versus time determined in Step 2
   b. Corresponding regulatory *1g or 10gSAR$_{limit}$* limit.

4. Repeated 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 1gSAR or 10gSAR versus time shown in Step 2 (and plotted in Step 4) shall not exceed regulatory *1g or 10gSAR$_{limit}$* limit.

3.3.2 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 disconnects and re-establishment needs to be performed during power limit enforcement, i.e., when the EUT's Tx power is at $P_{reserve}$ 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 regulatory *1g or 10gSAR*$_{limit}$ limit.

Test procedure:

1. Measure P_{limit} for the technology/band selected in Section 3.2.2. measure P_{limit} with Smart Transmit enable and *Reserve_power_margin* set to 0 dB (Peak exposure mode); 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.
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 one time window specified running average to determine time-averaged 1g or 10gSAR value versus time.
6. Make one plot containing: (a) computed time-averaged 1g or 10gSAR versus time determine in Step 4 for the first call, (b) computed time-averaged 1g or 10gSAR versus time determine in Step 4 for the second call, (c) computed time-averaged 1g or 10gSAR of the first call and second call versus time and (d) corresponding regulatory *1g or 10gSAR*$_{limit}$ limit.

The validation criteria are, at all times, the combined time-averaged 1gSAR or 10gSAR versus time determined in Step 6c shall not exceed the regulatory *1g or 10gSAR*$_{limit}$ limit.

3.3.3 Change in technology and band

This test is to demonstrate the correct power control by Smart Transmit during technology 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 $P_{reserve}$ level (i.e., during Tx power enforcement) to make sure that the EUT's Tx power from previous $P_{reserve}$ level to the new $P_{reserve}$ level (corresponding to new technology/band). Since the P_{limit} 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:

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

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

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

where, *conducted_Tx_power_1(t)*, *conducted _Tx_power_*P_{limit_1}, and *1g_or_1gSAR_*P_{limit_1} correspond to the measured instantaneous conducted Tx power, measured conducted Tx power at P_{limit}, and measured *1g SAR* or *10gSAR* value at technology1/band1; *conducted_Tx_power_2(t)*, *conducted _Tx_power_*P_{limit_2}, and *1g_or_10gSAR_*P_{limit_2} correspond to the measured instantaneous conducted Tx power, measured conducted Tx power at P_{limit}, and measured *1gSAR* or *10gSAR* value at P_{limit} of technology2/band2. Transition from 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 in Section 3.2.3. Measure P_{limit} with Smart Transmit enabled and *Reserve_power_margin* set to 0 dB (Peak exposure mode); 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 second, 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 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 P_{limit} 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 the measured worst-case 1gSAR or 10gSAR value at P_{limit} for the corresponding technology/band reported in Part 1 report.
6. Make one plot containing: (a) computed time-averaged 1gSAR or 10gSAR of the first technology/band versus time determined in Step 5, (b) computed time-averaged 1gSAR or 10gSAR of the second technology/band versus time determined in Step 5, (c) combined time-averaged 1g or 10gSAR of the first technology/band and second technology/band versus time determined in Step 5 and (d) corresponding regulatory *1g or 10gSAR*$_{limit}$ limit.

The validation criteria are, at all times, the combined time-averaged 1gSAR or 10gSAR versus time determined in Step 6c shall not exceed the regulatory *1g or 10gSAR*$_{limit}$ limit.

3.3.4 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 to Section 3.3.3, with switching antenna instead of technology/band. The validation criteria are, at all times, the time-average 1gSAR or 10gSAR versus time shall not exceed the regulatory *1g or 10gSAR*$_{limit}$ limit.

Note: If the EUT does not support multiple transmitting WWAN antennas, the compliance plot for change in antenna should be similar to the plot for change in technology/band.

3.3.5 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, with changing device state instead of technology/band. The validation criteria is, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed the regulatory *1g or 10gSAR*$_{limit}$ limit.

Note: If the EUT does not support multiple device states, the compliance plot for change in device state should be similar to the plot for change in technology/band.

3.3.6 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 window 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:

$$1gSAR_1(t) = \frac{conducted\_Tx\_power\_1(t)}{conducted\_Tx\_power\_P_{limit\_1}} * 1g\_or\ 10g\_SAR\_P_{limit\_1} \qquad \text{2a}$$

$$1gSAR_2(t) = \frac{conducted\_Tx\_power\_2(t)}{conducted\_Tx\_power\_P_{limit\_2}} * 1g\_or\ 10g\_SAR\_P_{limit\_2} \qquad \text{2b}$$

$$\frac{1}{T1_{SAR}}\left[\int_{t-T1_{SAR}}^{t_1} \frac{1g\_or\ 10g\_SAR_1(t)}{FCC\ SAR\ limit}dt\right] + \frac{1}{T2_{SAR}}\left[\int_{t-T2_{SAR}}^{t} \frac{1g_{or}10g\_SAR_2(t)}{FCC\ SAR\ limit}dt\right] \le 1 \qquad \text{2c}$$

Where, *conducted_Tx_power_1(t)*, *conducted_Tx_power_P*$_{limit\_1}$*(t)*, and *1g_ or 10g_SAR_P*$_{limit\_1}$ correspond to the instantaneous Tx power, conducted Tx power at Plimit, and compliance *1g_ or 10g_SAR* values at P_{limit_1} of band1 with time-averaging window '$T1_{SAR}$'; *conducted_Tx_power_2(t)*, Conducted Tx power at P_{limit} , and compliance *1g_ or 10g_SAR* values at P_{limit_2} of Band2 with time-averaging window '$T2_{SAR}$'. One of the two bands is less than 3GHz, another is greater than 3GHz. Transition from first band with time-averaging window '$T1_{SAR}$' to the second band with time-averaging window '$T2_{SAR}$' happens at time-instant 't_1'.

Test procedure:

1. Measure P_{limit} for both the technologies and bands selected in Section 3.2.6 Measure P_{limit} with Smart Transmit enabled and *Reserve_power_margin* set to 0 dB(Peak exposure mode), 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

3. Establish radio link with callbox in the technology/band having 100s time window selected in Section 3.2.6.
4. 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 at least another 100s. 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 1gSAR or 10gSAR value (see Eq.(7a) and (7b)) using corresponding technology/band Step 1 result, and then perform 100s 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 P_{limit}.
6. Make one plot containing: (a) computed time-averaged 1g or 10gSAR of the first technology/band (having 100s time window) versus time determined in Step 5, (c) computed time-averaged 1g or 10gSAR of the second technology/band (having 60s time window) versus time determined in Step 5, (c) combined time-averaged 1g or 10gSAR of (a) and (b), and (d) corresponding regulatory *1g* or $10gSAR_{limit}$ limit.

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

7. Establish radio link with callbox in the technology/band having 60s time window selected in Section 3.2.6.
8. 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 transmit at maximum power for about 100s in this second 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 time-averaged 1gSAR or 10gSAR versus time shall not exceed the regulatory *1g* or $10gSAR_{limit}$ limit.

3.3.7 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. The detailed test procedure for SAR exposure switching in the case of LTE + Sub6 NR non-standalone mode transmission scenarios is provided in Section.B.

Test procedure:

1. Measure conducted Tx power corresponding to P_{limit} for radio 1 and radio 2 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 radio 1 P_{limit} with Smart Transmit <u>enable</u> and *Reserve_Power_margin* set to 0 dB(Peak exposure mode), 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 *Reserve_power_margin* to actual (intended) value, 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 theses radios into 1gSAR or 10gSAR value (see Eq.(6a) and (6b)) using corresponding technology/band P_{limit} 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) computed time-averaged 1g or 10gSAR versus time determined in Step 3, and combined time-averaged 1g or 10gSAR versus time, and (b) corresponding regulatory *1g* or $10gSAR_{limit}$ limit.

The validation criteria is, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed the regulatory *1g* or $10gSAR_{limit}$ limit.

Note: If multi_Tx_factor is set to > 1.0 with EFS version 19 (or higher), then in single Tx transmission scenarios, Smart Transmit ensures time-averaged RF exposure is ≤ (*SAR_design_target* * $10^{(+\text{sub6 device uncertainty} / 10)}$) < regulatory RF exposure limit for sub6 radio managed by Smart Transmit.
In simultaneous Tx transmission scenarios, Smart Transmit ensures time-averaged RF exposure is ≤ (*SAR_design_target* * *multi_Tx_factor* * $10^{(+\text{sub6 device uncertainty} / 10)}$) < regulatory RF exposure limit for sub6 radios managed by Smart Transmit. These simultaneous transmission scenarios are listed below:

- 2-or-more radio scenarios within WWAN like EN-DC, LTE ULCA, etc.
- 2-or-more-radio across technologies such as WWAN+WLAN, WWAN+BT, WLAN+BT and WWAN+WLAN+BT transmission scenarios (if WLAN/BT radios are also managed by Smart Transmit).

This device's multi_Tx_factor is 1.0.

3.3.8 Exposure Category Switch

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 switch back to head exposure, and (b) start with non-head exposure and switch back to head exposure and switch back to non-head exposure.

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 preferably 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:

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. (6a) and (6b)) using the corresponding Plimit measured in Step 1 and 1g_or_10gSAR value measured in 80-W2112-4 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.(6a) & (6b), 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).

3.4. Test procedures 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 7.1.
2. Time averaging feature validation:
   i. For a given radio configuration (technology/band) selected in Section 3.2.1, enable Smart Transmit and set *Reserve_power_margin* to 0 dB, with callbox to request maximum power, perform area scan, conduct point SAR measurement at peak location of the area scan. This point SAR value, *pointSAR_*P_{limit}, corresponds to point SAR at the measured P_{limit} (i.e., measured P_{limit} 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 enanble 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, conducted point SAR measurement versus time at peak location 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:

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

   Where, *pointSAR_*P_{limit} is the value determined in Step 2.i, and *pointSAR(t)* is the instantaneous point SAR measured in Step 2.ii, *1g_or 10g_SAR* P_{limit} 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-average 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)).

4. Test Configurations

4.1. WWAN (sub-6) transmission

This P_{limit} values, corresponding to 1.0 or 2.5 W/kg (1-g or 10-g respectively) of *SAR_design_target*, for technologies and bands supported by EUT are derived in Sec.6.4 of Part 0/1 report and summarized in Table 5-1. Note all P_{limit} power levels entered in Table 5-1 correspond to average power levels plus tolerance after accounting for duty cycle in the case of TDD modulation schemes (for e.g., GSM, LTE TDD).

Table 4-1 : P_{limit} for supported technologies and bands (P_{limit} in EFS file)

Exposure condition			Head (RCV)	Body-worn & Near Body	Hotspot	Pmax (Maximum tune-up Power) (dBm)
Spatial-average			1g	1g	1g	
Test distance (mm)			0	5	5	
DSI :			3	0 & 5	4	
RF Air Interface	Antenna	Antenna Group	P_{limit} corresponding to 1.0 W/kg (SAR_design_target) (1g) / 2.5 W/kg (SAR_design_target) (10g)			
GSM 850	Main1	AG 0	27.8	20.8	20.8	25.3
GSM 1900	Main2	AG 0	30.0	18.8	18.8	21.6
WCDMA 2	Main2	AG 0	20.5	19.0	19.0	23.0
WCDMA 4	Main2	AG 0	21.0	21.0	21.0	23.0
WCDMA 5	Main1	AG 0	25.1	23.5	23.5	23.5
LTE Band 71	Main1	AG 0	28.9	28.3	28.3	24.5
LTE Band 12	Main1	AG 0	27.2	22.5	22.5	24.5
LTE Band 13	Main1	AG 0	26.6	22.5	22.5	24.5
LTE Band 14	Main1	AG 0	26.6	26.1	26.1	24.5
LTE Band 26(5)	Main1	AG 0	30.3	23.0	23.0	24.5
LTE Band 66(4)	Main2	AG 0	29.2	18.0	18.0	24.0
LTE Band 66(4)	Sub.2	AG 1	17.5	17.0	17.0	24.0
LTE Band 25(2)	Main2	AG 0	30.8	19.0	19.0	24.0
LTE Band 25(2)	Sub.2	AG 1	18.5	18.5	18.5	23.5
LTE Band 30	Main2	AG 0	28.0	18.5	18.5	23.0
LTE Band 7	Main2	AG 0	28.7	17.0	17.0	24.0
LTE Band 7	Sub.2	AG 1	18.5	18.0	18.0	24.0
LTE Band 41(38) PC3	Main2	AG 0	29.1	16.5	16.5	22.0 (21.0)
LTE Band 41(38) PC3	Sub.2	AG 1	17 (16)	16.0	16.0	22.0 (21.0)
LTE Band 48	Sub.3	AG 1	16.0	14.5	14.5	20.0
NR Band n71	Main1	AG 0	27.0	26.5	26.5	24.5
NR Band n5	Main1	AG 0	26.5	23.0	23.0	24.5
NR Band n70	Main2	AG 0	32.6	19.0	19.0	24.0
NR Band n70	Sub.2	AG 1	19.0	18.0	18.0	24.0
NR Band n66	Main2	AG 0	31.5	19.0	19.0	24.0
NR Band n66	Sub.2	AG 1	18.5	17.5	17.5	24.0
NR Band n25(2)	Main2	AG 0	29.3	19.0	19.0	24.0
NR Band n25(2)	Sub.2	AG 1	18.5	19.0	19.0	24.0
NR Band n30	Main2	AG 0	28.8	19.0	19.0	23.0
NR Band n41 PC3	Main2	AG 0	22.5	16.5	16.5	23.5
NR Band n41 PC3	Sub.2	AG 1	17.5	17.0	17.0	23.5
NR Band n41 PC2	Main2	AG 0	22.5	16.5	16.5	25.5
NR Band n41 PC2	Sub.2	AG 1	17.5	17.0	17.0	26.0
NR Band n48 -Main-	Sub.3	AG 1	15.5	14.5	14.5	22.5
NR Band n48 -SRS2-	Main2	AG 0	40.2	20.4	20.4	18.5
NR Band n48 -SRS3-	Sub.7	AG 1	15.5	13.5	13.5	20.0
NR Band n48 -SRS4-	Sub.8	AG 1	28.2	23.1	23.1	18.0
NR Band n77(78) PC3 -Main-	Sub.3	AG 1	16.0	13.5	13.5	24.0 (23.5)
NR Band n77(78) PC3 -SRS2-	Main2	AG 0	30.3	19.7	19.7	19.0
NR Band n77(78) PC3 -SRS3-	Sub.7	AG 1	14.5	14.5	14.5	20.5 (20.0)
NR Band n77(78) PC3 -SRS4-	Sub.8	AG 1	22.6	23.6	23.6	18.5
NR Band n77(78) PC2 -Main-	Sub.3	AG 1	16.0	13.5	13.5	26.5
NR Band n77(78) PC2 -SRS2-	Main2	AG 0	19.0	19.0	19.0	22.0 (21.5)
NR Band n77(78) PC2 -SRS3-	Sub.7	AG 1	14.5	14.5	14.5	23.5 (23.0)
NR Band n77(78) PC2 -SRS4-	Sub.8	AG 1	18.5	18.5	18.5	21.5 (21.0)

* Maximum Tune-up Target Power, P_{max} is configured in NV settings in DUT to limit maximum average transmitting power. The DUT maximum allowed output power is equal to P_{max} + 1.0 dB device uncertainty.

Based on selection criteria described in Section 3.2.1, the selected technologies/bands for testing time-varying test sequences are highlighted in Table 4-1. During Part 2 testing, the *Reserve_power_margin* (dB) is set in EFS according to the manufacturer guide.

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 1g SAR or 10g SAR values for selected technology/band/DSI are extracted from Part 1 report and are listed in the last column of Table 4-2.

Based on equations (1a) and (2a), 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 (2a), the accuracy in compliance demonstrate remains the same.

If DSI's Plimit is higher than Pmax, then Plimit is operate as Pmax power.

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

Test Case	Test Scenario	Tech	Band	Antenna	DSI	Channel	Freq. (MHz)	RB/RB Offset /Bandwidth (MHz)	Mode	SAR Exposure Scenario	Worst configurations	Part 1 Worst Case Measured SAR at Plimit (W/kg)
1	Test Sequence 1 Test Sequence 2	GSM	850	Main.1	4	190	836.6	-	1 slot GPRS	Bodyworn & Hotspot	Rear - 5mm	0.446
2	Test Sequence 1 Test Sequence 2	GSM	1900	Main.2	4	661	1880.0	-	4 slots GPRS	Bodyworn & Hotspot	Rear - 5mm	0.415
3	Test Sequence 1 Test Sequence 2	WCDMA	2	Main.2	4	9538	1907.6	-	Rel 99	Bodyworn & Hotspot	Rear - 5mm	0.762
4	Test Sequence 1 Test Sequence 2	WCDMA	4	Main.2	4	1312	1712.4	-	Rel 99	Bodyworn & Hotspot	Rear - 5mm	0.757
5	Test Sequence 1 Test Sequence 2	LTE	B26	Main.1	4	26865	831.5	1/0/15 MHz	QPSK	Hotspot	Bottom - 5mm	0.883
6	Test Sequence 1 Test Sequence 2	LTE	B48	Sub.3	4	55340	3560.0	1/99/20 MHz	QPSK	Hotspot	Left - 5mm	0.453
7	Test Sequence 1 Test Sequence 2	NR	Bn5	Main.1	4	167300	836.5	1/52/20 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.900
8	Test Sequence 1 Test Sequence 2	NR	Bn77	Sub.3	4	633334	3500.0	1/136/100 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.376
9	Change in Call	NR	Bn77	Sub.3	4	633334	3500.0	1/136/100 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.376
10	Tech/Band Switch	LTE	B25	Main.2	4	26140	1860.0	1/99/20 MHz	QPSK	Bodyworn & Hotspot	Rear - 5mm	0.409
10	Tech/Band Switch	WCDMA	4	Main.2	4	1312	1712.4	-	Rel 99	Bodyworn & Hotspot	Rear - 5mm	0.757
11	Time Window Switch Antenna Switch	LTE	B41	Sub.2	3	40185	2549.5	1/99/20 MHz	QPSK	Head	Right Tilt - 0mm	0.267
11	Time Window Switch Antenna Switch	LTE	B48	Sub.3	3	55340	3560.0	1/99/20 MHz	QPSK	Head	Right Touch - 0mm	0.554
12	SAR1 vs SAR2 (EN-DC)	LTE	B12	Main.1	4	23095	707.5	1/0/10 MHz	QPSK	Hotspot	Bottom - 5mm	0.352
12	SAR1 vs SAR2 (EN-DC)	NR	Bn41	Main.2	4	518598	2593.0	1/271/100 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.661
13	Exposure Category Switch	LTE	B48	Sub.3	3	55340	3560.0	1/99/20 MHz	QPSK	Head	Right Touch - 0mm	0.554
13	Exposure Category Switch	LTE	B48	Sub.3	4	55340	3560.0	1/99/20 MHz	QPSK	Hotspot	Left - 5mm	0.453

Reported SAR values in Part 1 SAR report are tested at P_{limit} + tolerance. Therefore, 100s(or 60s) average SAR is shown to be ± 1.0 dB from SAR design target of WWAN bands.

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: Following the guideline in Section 3.2.1, The test case 1 ~ 8 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. Technology and band for change in call test: Following the guideline Section 3.2.2, NR Band n77 having the lowest P_{limit} among all technologies and bands (test case 9 in Table 4-2) is selected for performing the call drop test in conducted power setup.
3. Technologies and bands for change in technology/band test: Following the guidelines in Section 3.2.3 and 3.2.4, test case 10 in Table 4-2 is selected for handover test from a technology/band/Antenna in Within one technology group (LTE Band 25, DSI=4, Main.2), to a technology/band the same DSI within another technology group (WCDMA Band 4 DSI=4, Main.2) in conducted power setup.
4. Technologies and bands for change in time-window/Antenna test: Based on selection criteria in Section 3.2.4 and Section 3.2.6 for a given in DSI = 3 test case 11 in Table 4-2 is selected for time window switch between 100s window (LTE Band 41, DSI=3, Sub.2) and 60s window (LTE Band 48, DSI=3, Sub.3) in conducted power setup.
5. Technologies and bands for switch in SAR exposure (EN-DC): Based on selection criteria in Section 3.2.7 Scenario 1, test case 12 in Table 4-2 is selected for SAR exposure switching test in one of the supported simultaneous WWAN transmission scenario, i.e., LTE + Sub6 NR active in the same 100s time window, in conducted power setup.
6. Technologies and bands for change in Exposure category: Based on selection criteria in Section 3.2.8, for a given technology and band, test case 13 in Table 4-2 is selected for exposure category switch from Head DSI(LTE Band 48, DSI=3, Sub.3) to non-Head DSI(LTE Band 48, DSI=4, Sub.3) and vice versa, in conducted power setup.

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

5.1. Measurement setup

WWAN Bands Measurement setup

GSM / WCDMA / LTE test setup using The Rohde & Schwarz CMW500 callbox

The Rohde & Schwarz CMW500 callbox is used in this test.

Test setup Schematic	Test item(s)	Description(s)	Test setup photo
Figure B-1(a)	Time-varying Tx power transmission test (Section 3.3.1)	Single antenna measurement, one port (RF1 COM) of callbox	**A.1**
	Change in technology and band test (Section 3.3.3)		
	Exposure category switch test (Section 3.3.8)		
Figure B-1(b)	Change in time-window (Section 3.3.6)	two antenna measurement, one port (RF1 COM) of callbox	**A.2**
	Change in antenna (Section 3.3.4)		

LTE + Sub6 NR(NSA mode) and Sub6 NR(SA mode) test setup using The UXM callbox

The UXM callbox is used in this test.

Test setup Schematic	Test item(s)	Description(s)	Test setup photo
Figure B-1(a)	Time-varying Tx power transmission test (Section 3.3.1)	Single antenna measurement, one port (RF1 COM) of callbox	**A.3**
	Change in Call test (Section 3.3.2)		
Figure B-1(c)	SAR exposure switch test (EN-DC) (Section 3.3.7)	two different techs measurement, two ports (RF1 & RF8 COM) of callbox	**A.4**

All the path losses from RF port of DUT 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.

Setup photos of Test setup Schematic are list in Appendix A.

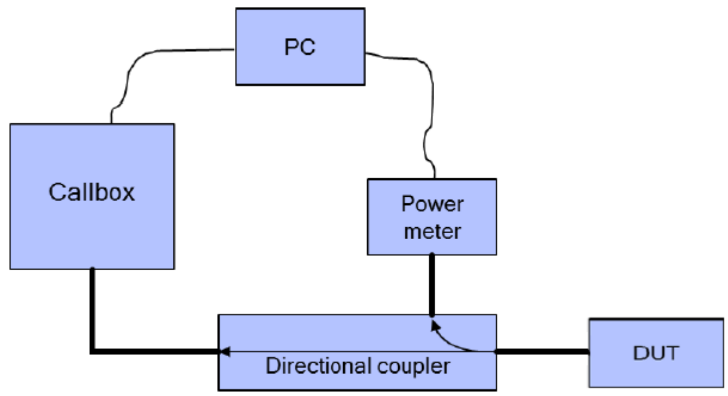


Figure B-1 (a)

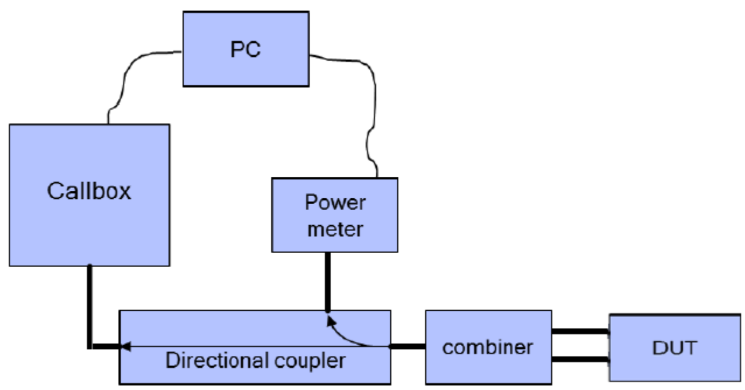


Figure B-1 (b)

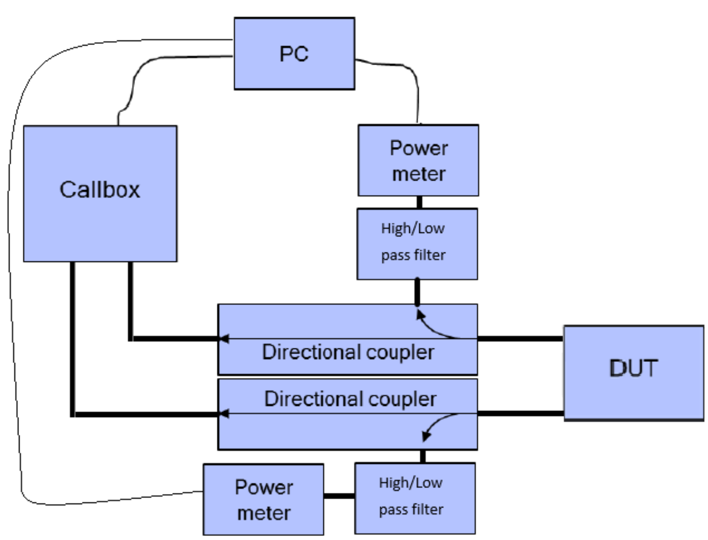


Figure B-1 (c)

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:

- 0 dBm 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 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 $P_{reserve}$ level. See Section 3.3 for detailed test procedure of call drop test, technology/band/antenna switch test and DSI switch test.

5.2. *P*$_{limit}$ and *P*$_{max}$ measurement results

This 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.

Table 5-1 : Measured *P*$_{limit}$ and *P*$_{max}$ of selected WWAN radio configurations

Note: the device uncertainty of *P*$_{max}$ is +1.0dB/-1.5dB as provided by manufacturer.

Test Case	Test Scenario	Tech	Band	Antenna	DSI	Channel	Freq. (MHz)	RB/RB Offset /Bandwidth (MHz)	Mode	SAR Exposure Scenario	Worst configurations	Part 1 Worst Case Measured SAR at Plimit (W/kg)	Plimit (dBm)	measured Plimit (dBm)	Tune-up Pmax (dBm)	Measured Pmax (dBm)
1	Test Sequence 1	GSM	850	Main.1	4	190	836.6	-	1 slot GPRS	Bodyworn & Hotspot	Rear - 5mm	0.446	20.80	20.57	23.30	23.06
	Test Sequence 2															
2	Test Sequence 1		1900	Main.2	4	661	1880.0	-	4 slots GPRS	Bodyworn & Hotspot	Rear - 5mm	0.415	18.80	18.59	20.80	21.11
	Test Sequence 2															
3	Test Sequence 1	WCDMA	2	Main.2	4	9538	1907.6	-	Rel 99	Bodyworn & Hotspot	Rear - 5mm	0.762	19.00	18.53	23.00	22.17
	Test Sequence 2															
4	Test Sequence 1		4	Main.2	4	1312	1712.4	-	Rel 99	Bodyworn & Hotspot	Rear - 5mm	0.757	21.00	20.83	23.00	22.98
	Test Sequence 2															
5	Test Sequence 1	LTE	B26	Main.1	4	26865	831.5	1/0/15 MHz	QPSK	Hotspot	Bottom - 5mm	0.883	23.00	22.76	24.50	24.39
	Test Sequence 2															
6	Test Sequence 1		B48	Sub.3	4	55340	3560.0	1/99/20 MHz	QPSK	Hotspot	Left - 5mm	0.453	14.50	14.89	20.00	18.70
	Test Sequence 2															
7	Test Sequence 1	NR	Bn5	Main.1	4	167300	836.5	1/52/20 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.900	23.00	22.83	24.50	24.44
	Test Sequence 2															
8	Test Sequence 1		Bn77	Sub.3	4	633334	3500.0	1/136/100 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.376	13.50	13.91	24.00	23.54
	Test Sequence 2															
9	Change in Call	NR	Bn77	Sub.3	4	633334	3500.0	1/136/100 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.376	13.50	13.91	24.00	23.54
10	Tech/Band Switch	LTE	B25	Main.2	4	26140	1860.0	1/99/20 MHz	QPSK	Bodyworn & Hotspot	Rear - 5mm	0.409	19.00	18.13	24.00	23.26
		WCDMA	4	Main.2	4	1312	1712.4	-	Rel 99	Bodyworn & Hotspot	Rear - 5mm	0.757	21.00	20.83	23.00	22.98
11	Time Window Switch Antenna Switch	LTE	B41	Sub.2	3	40185	2549.5	1/99/20 MHz	QPSK	Head	Right Tilt - 0mm	0.267	17.00	16.86	22.00	22.55
		LTE	B48	Sub.3	3	55340	3560.0	1/99/20 MHz	QPSK	Head	Right Touch - 0mm	0.554	16.00	15.91	20.00	18.70
12	SAR1 vs SAR2 (EN-DC)	LTE	B12	Main.1	4	23095	707.5	1/0/10 MHz	QPSK	Hotspot	Bottom - 5mm	0.352	22.50	22.53	24.50	24.08
		NR	Bn41	Main.2	4	518598	2593.0	1/271/100 MHz	DFT-s OFDM QPSK	Bodyworn & Hotspot	Rear - 5mm	0.661	16.50	16.53	23.50	23.70
13	Exposure Category Switch	LTE	B48	Sub.3	3	55340	3560.0	1/99/20 MHz	QPSK	Head	Right Touch - 0mm	0.554	16.00	15.91	20.00	18.70
					4	55340	3560.0	1/99/20 MHz	QPSK	Hotspot	Left - 5mm	0.453	14.50	14.89	20.00	18.70

Notes:

1. For GSM, LTE TDD Bands, Tests including duty-cycle transmit are normalized to frame average.
2. NR TDD Pmax and Plimit are measured according to Sec.B.3 in Report and scaled by duty cycle.

5.3. Time-varying Tx power measurement results (test case 1–8 in Table 5-1)

The measured P_{max} and measured P_{limit} of each selected radio configuration are used for generation of test sequences following the test plan in Section 3.3.1. The purpose of the time varying transmit power measurement is to demonstrate the effectiveness of power limiting enforcement and that the time averaged transmit power when converted into 1gSAR values does not exceed the regulatory limit.

The conducted Tx power measurement results after following the test procedure in Section 3.3.1 for all technologies and bands listed in Table 5-1 are reported in this section. In all the 1gSAR Plots, the green curve represents the 100s/60s-time averaged 1g/10g SAR value calculated based on conducted Tx power measurement; and the red line limit represents the regulatory limit of 1.6W/kg/4.0W/kg.

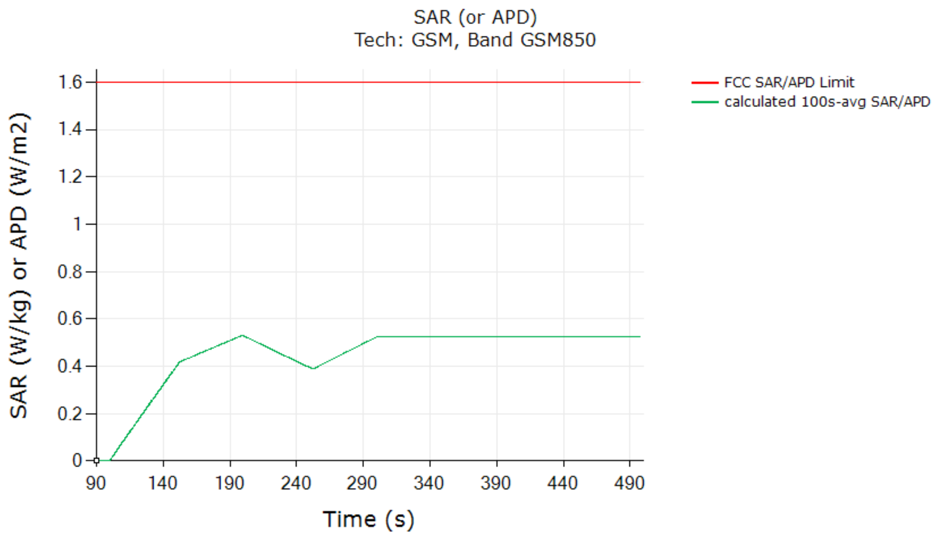
As can be seen, the power limiting enforcement is effective in all the tests, and the time-averaged 1g/10g SAR does not exceed the regulatory limit of 1.6W/kg/4.0W/kg for all the tested technologies/bands. Therefore, Smart Transmit time averaging feature is validated.

5.3.1. GSM Band 850

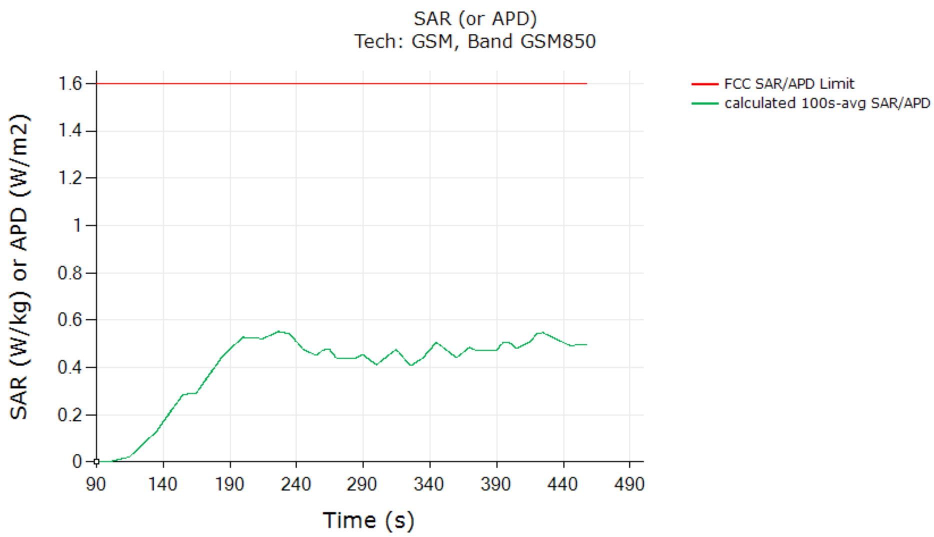
Test parameters

Parameters	Values
Tech/band/antenna/DSI	GSM 850/Main.1/DSI4
meas. P_{max}	23.06 dBm
meas. P_{limit}	20.57 dBm
meas. 1g SAR at P_{limit}	0.446 W/kg
Time window	100 s
Test setup schematic	Figure B-1(a)

Test result for test sequence 1:



Test result for test sequence 2:



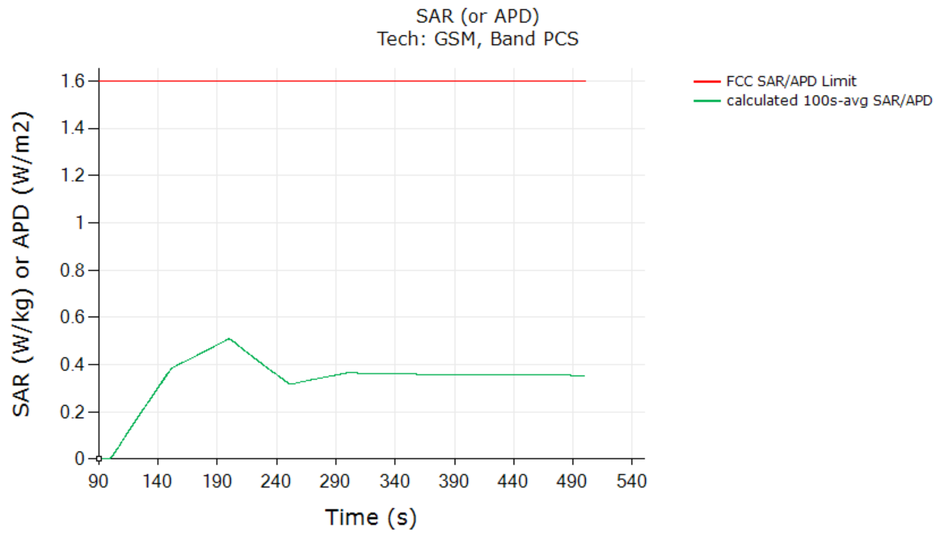
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.532	0.551	
Validated.			

5.3.2. GSM Band 1900

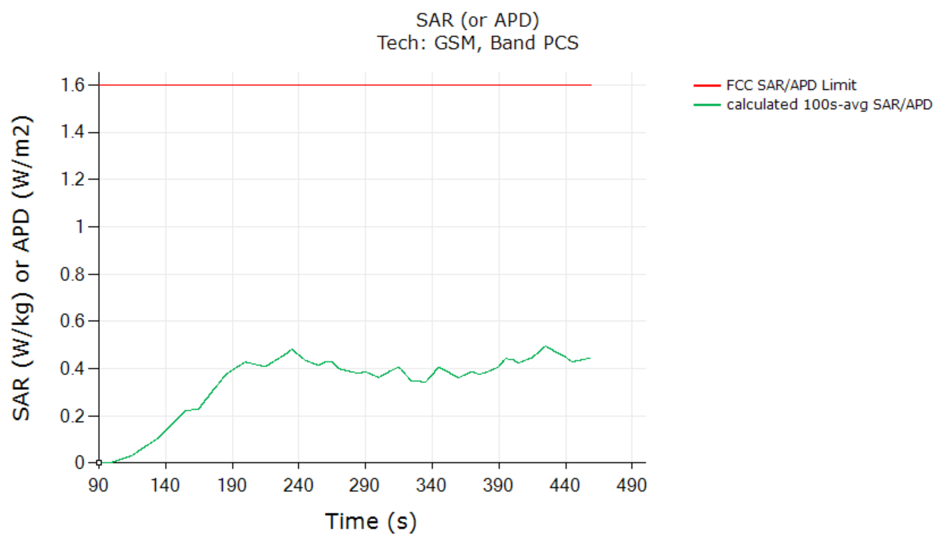
Test parameters

Parameters	Values
Tech/band/antenna/DSI	GSM 1900/Main.2/DSI4
meas. P_{max}	21.11 dBm
meas. P_{limit}	18.59 dBm
meas. 1g SAR at P_{limit}	0.415 W/kg
Time window	100 s
Test setup schematic	Figure B-1(a)

Test result for test sequence 1:



Test result for test sequence 2:



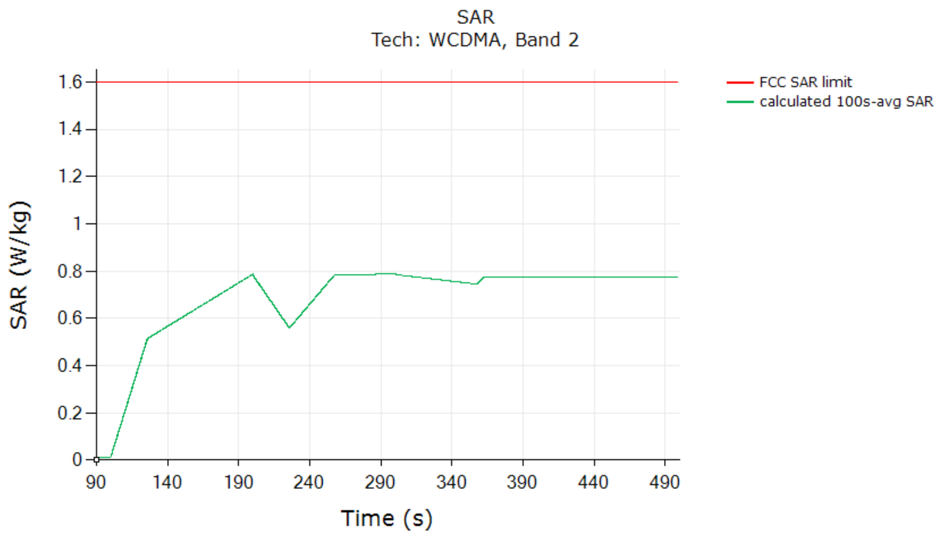
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.509	0.496	
Validated.			

5.3.3. WCDMA Band II

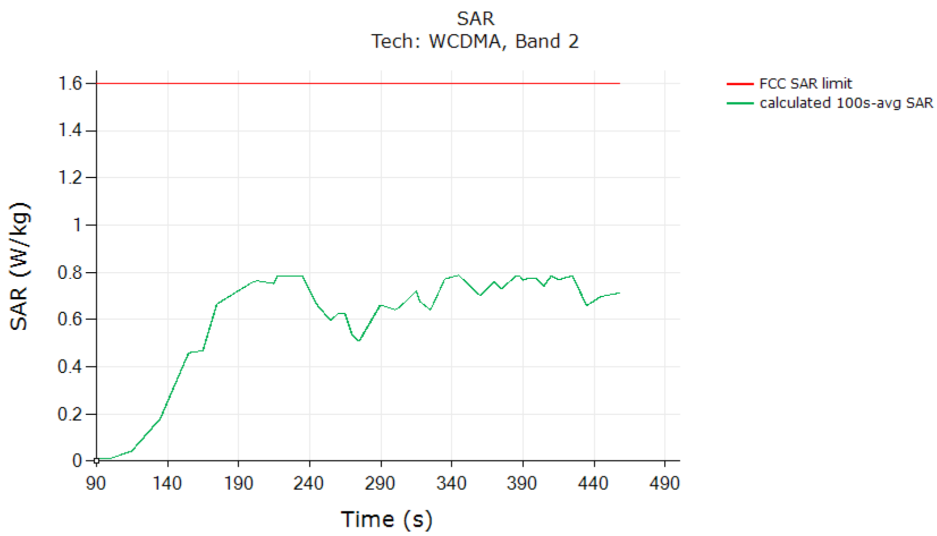
<u>Test parameters</u>

Parameters	Values
Tech/band/antenna/DSI	WCDMA/Main.2/DSI4
meas. P_{max}	22.17 dBm
meas. P_{limit}	18.53 dBm
meas. 1g SAR at P_{limit}	0.762 W/kg
Time window	100 s
Test setup schematic	Figure B-1(a)

<u>Test result for test sequence 1:</u>



<u>Test result for test sequence 2:</u>



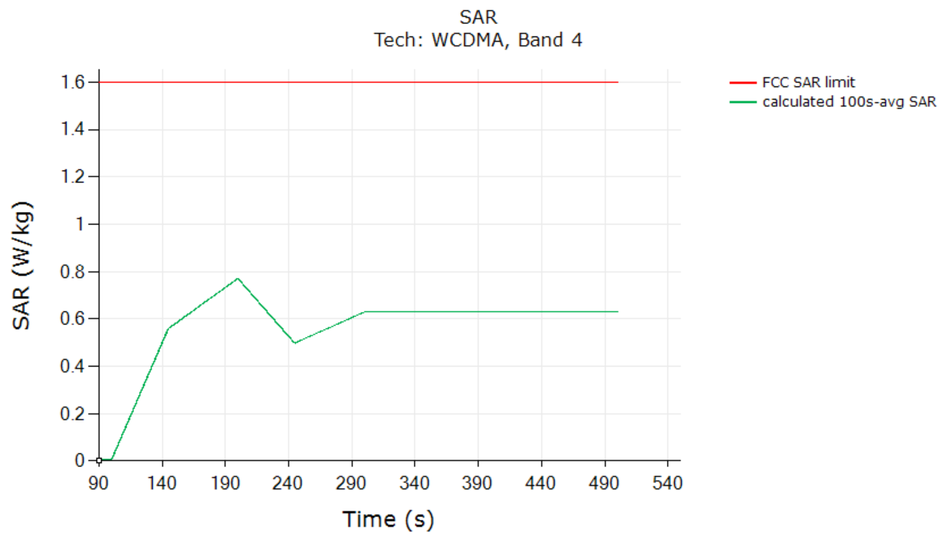
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.787	0.787	
Validated.			

5.3.4. WCDMA Band IV

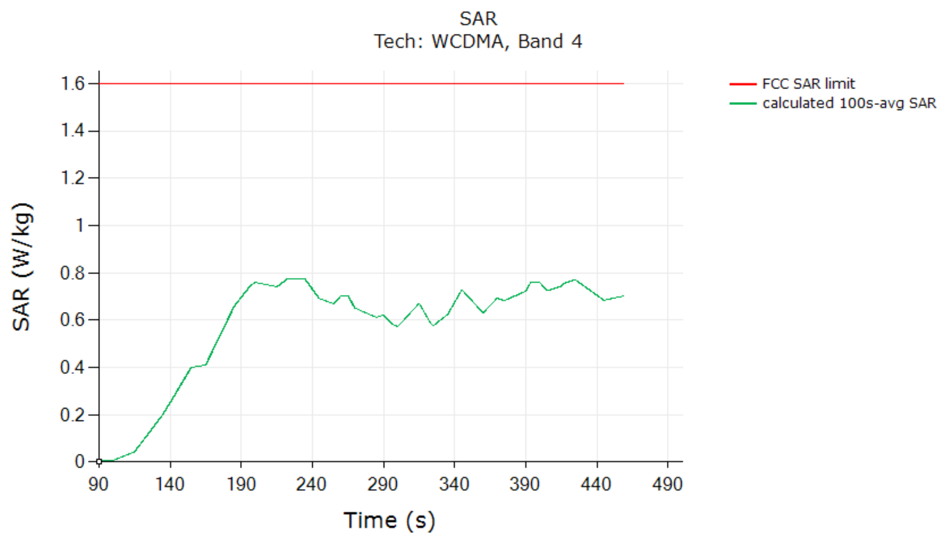
Test parameters

Parameters	Values
Tech/band/antenna/DSI	WCDMA4/Main.2/DSI4
meas. P_{max}	22.98 dBm
meas. P_{limit}	20.83 dBm
meas. 1g SAR at P_{limit}	0.757 W/kg
Time window	100 s
Test setup schematic	Figure B-1(a)

Test result for test sequence 1:



Test result for test sequence 2:



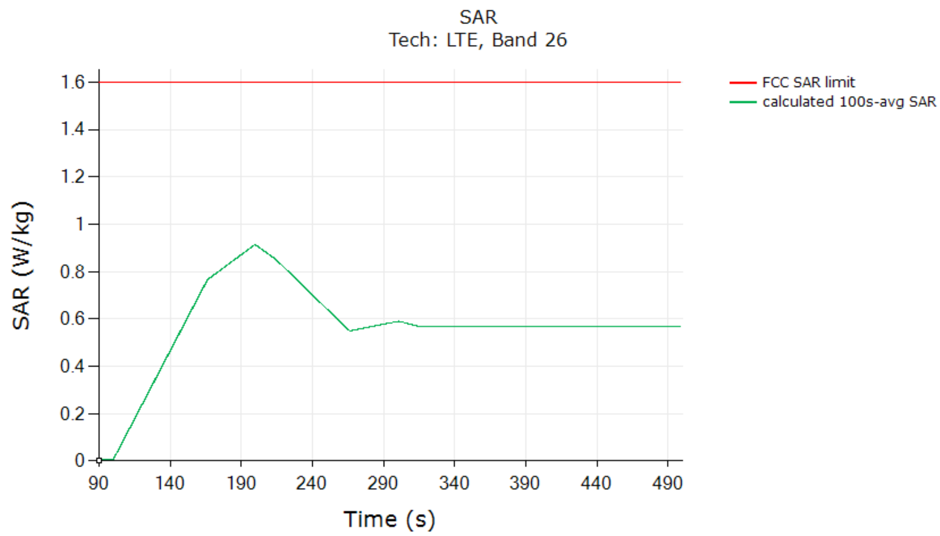
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.771	0.775	
Validated.			

5.3.5. LTE Band 26

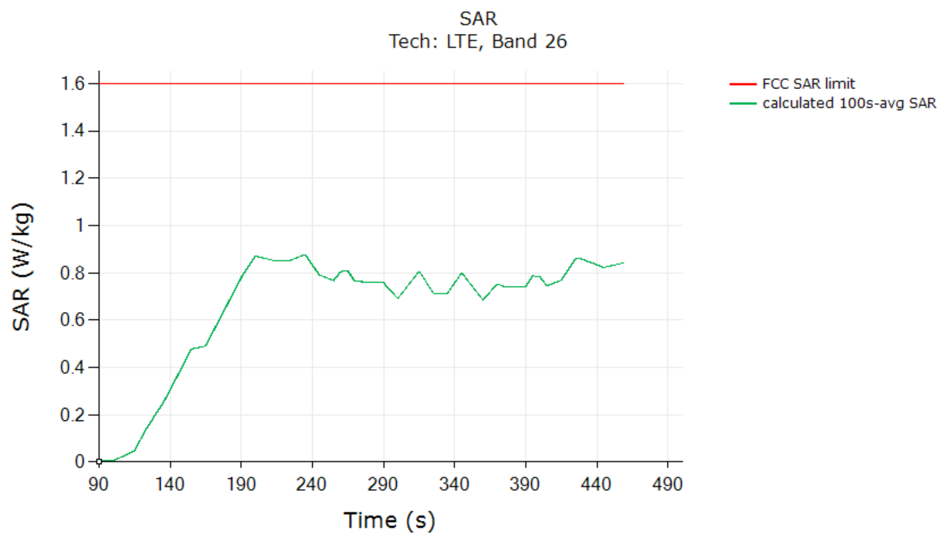
Test parameters

Parameters	Values
Tech/band/antenna/DSI	LTE Band 26/Main.1/DSI4
meas. P_{max}	24.39 dBm
meas. P_{limit}	22.76 dBm
meas. 1g SAR at P_{limit}	0.883 W/kg
Time window	100 s
Test setup schematic	Figure B-1(a)

Test result for test sequence 1:



Test result for test sequence 2:



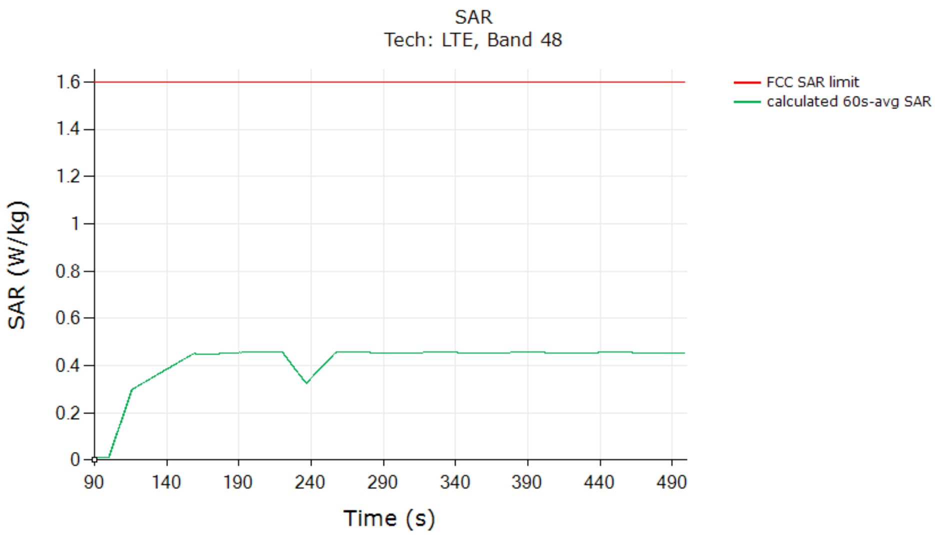
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.915	0.877	
Validated.			

5.3.6. LTE Band 48

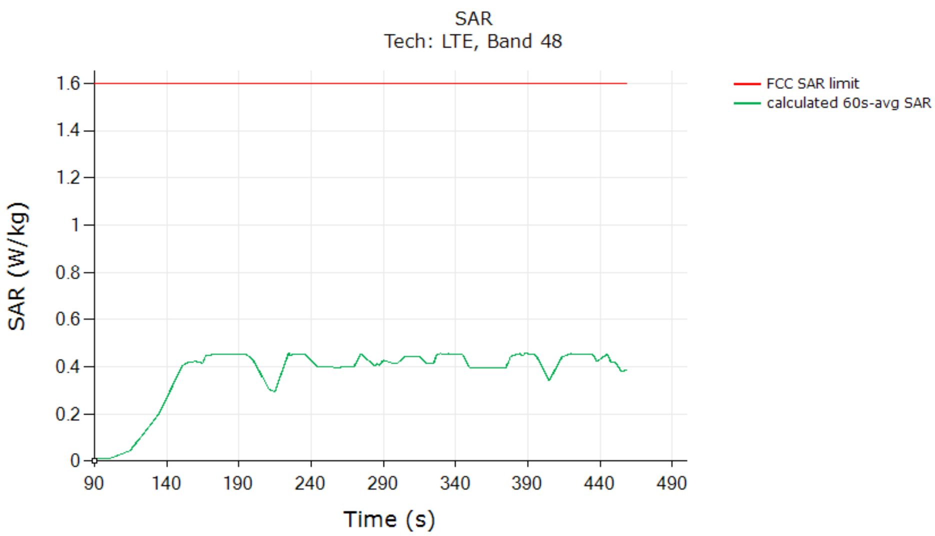
Test parameters

Parameters	Values
Tech/band/antenna/DSI	LTE Band 48/Sub.3/DSI4
meas. P_{max}	18.70 dBm
meas. P_{limit}	14.89 dBm
meas. 1g SAR at P_{limit}	0.453 W/kg
Time window	60 s
Test setup schematic	Figure B-1(a)

Test result for test sequence 1:



Test result for test sequence 2:



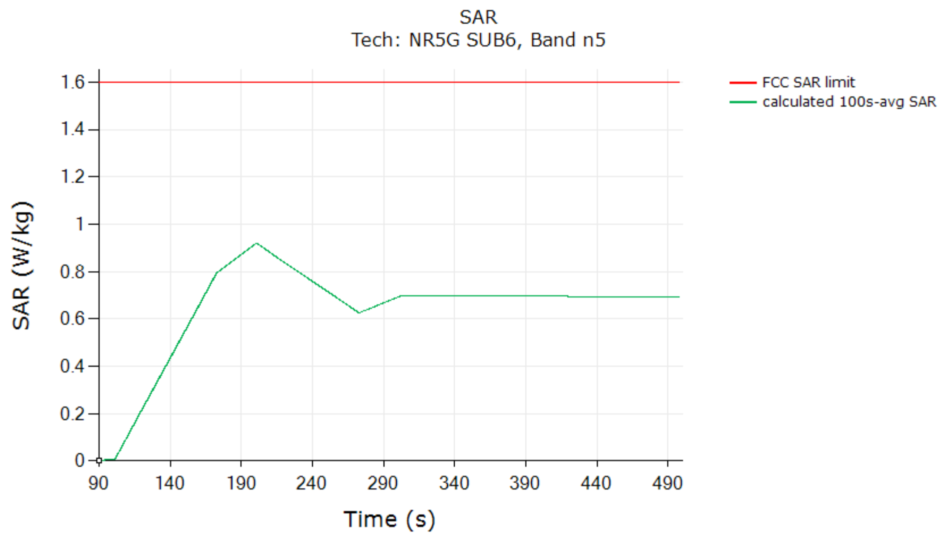
	Test Seq 1	Test Seq 2	(W/kg)
Max 60s-time averaged 1gSAR (green curve)	0.456	0.457	
Validated.			

5.3.7. NR Band n5

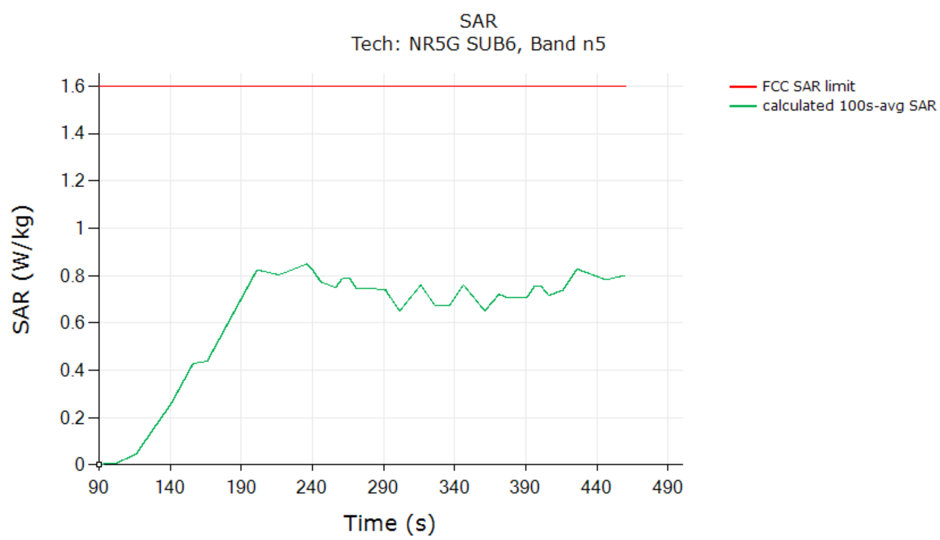
Test parameters

Parameters	Values
Tech/band/antenna/DSI	NR Band n5/Main.1/DSI4
meas. P_{max}	24.44 dBm
meas. P_{limit}	22.83 dBm
meas. 1g SAR at P_{limit}	0.900 W/kg
Time window	100 s
Test setup schematic	Figure B-1(a)

Test result for test sequence 1:



Test result for test sequence 2:



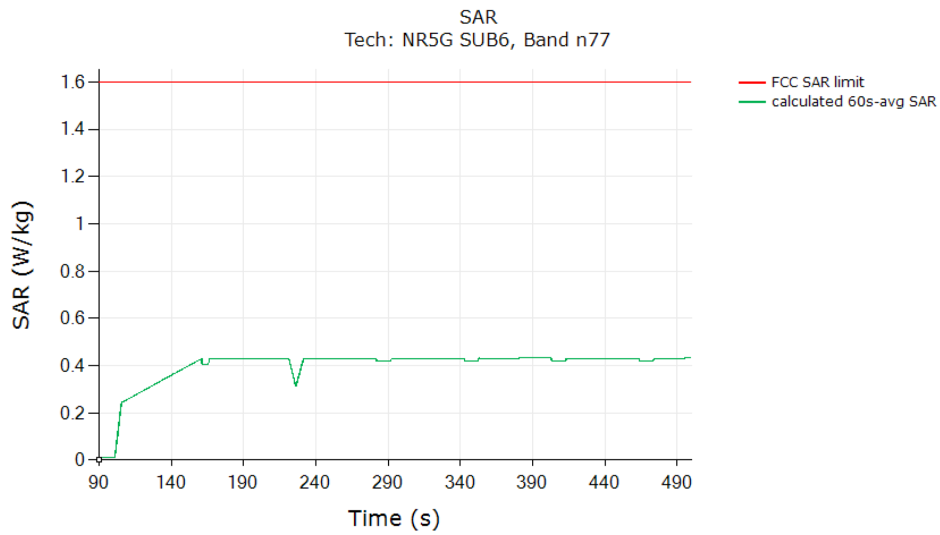
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.920	0.849	
Validated.			

5.3.8. NR Band n77

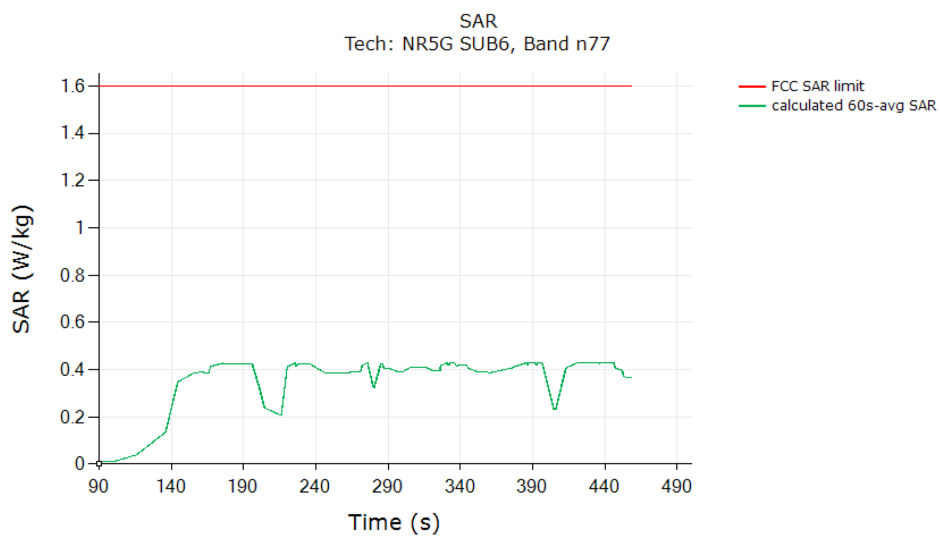
Test parameters

Parameters	Values
Tech/band/antenna/DSI	NR Band n77/Sub.3/DSI4
meas. P_{max}	23.54 dBm
meas. P_{limit}	13.91 dBm
meas. 1g SAR at P_{limit}	0.376 W/kg
Time window	60 s
Test setup schematic	Figure B-1(a)

Test result for test sequence 1:



Test result for test sequence 2:



	Test Seq 1	Test Seq 2	(W/kg)
Max 60s-time averaged 1gSAR (green curve)	0.431	0.429	
Validated.			

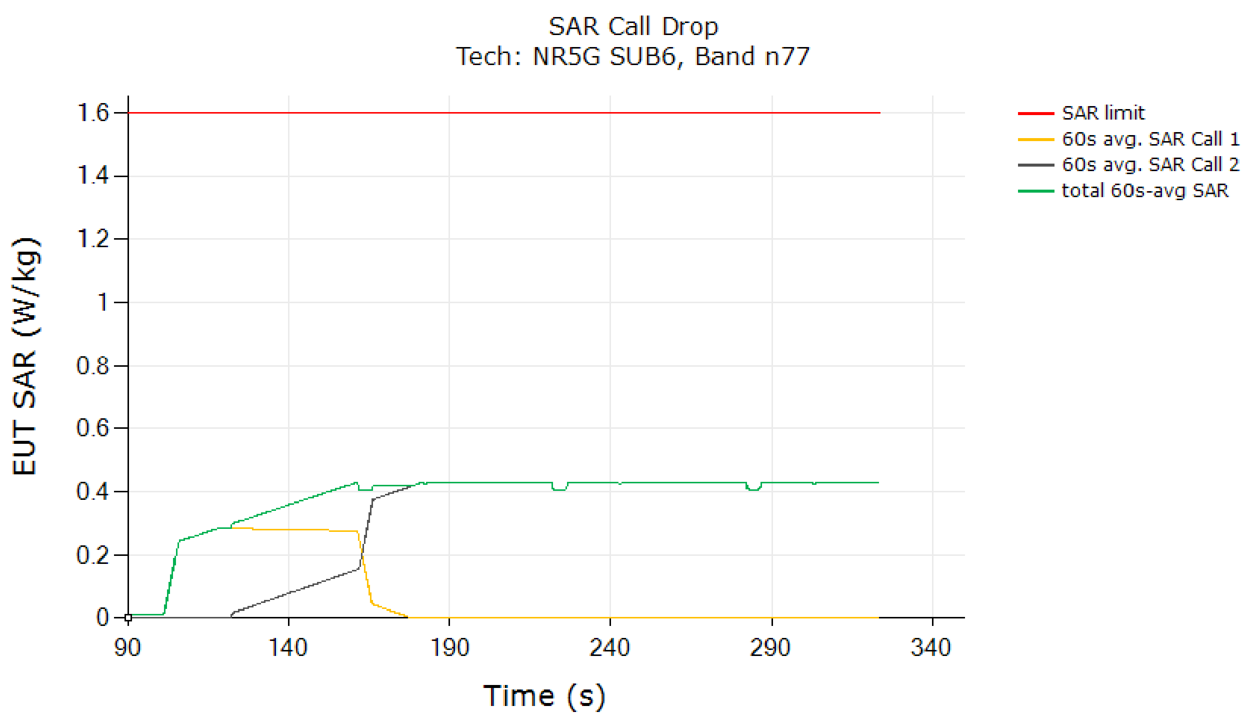
5.4. Change in Call Test Results (test case 9 in Table 5-1)

The detailed test procedures is described in Section 3.3.2.

Test parameters

Parameters	Values
Tech/band/antenna/DSI	NR Band n77/Sub.3/DSI4
meas. P_{max}	23.54 dBm
meas. P_{limit}	13.91 dBm
meas. 1g SAR at P_{limit}	0.376 W/kg
Time window	60 s
Call drop time instant	121 s
Test setup schematic	Figure B-1(a)

Call drop test result:



	(W/kg)
Max 60s-time averaged 1gSAR (green curve)	0.431
Validated.	

The test result validated the continuity of power limiting in call change scenario.

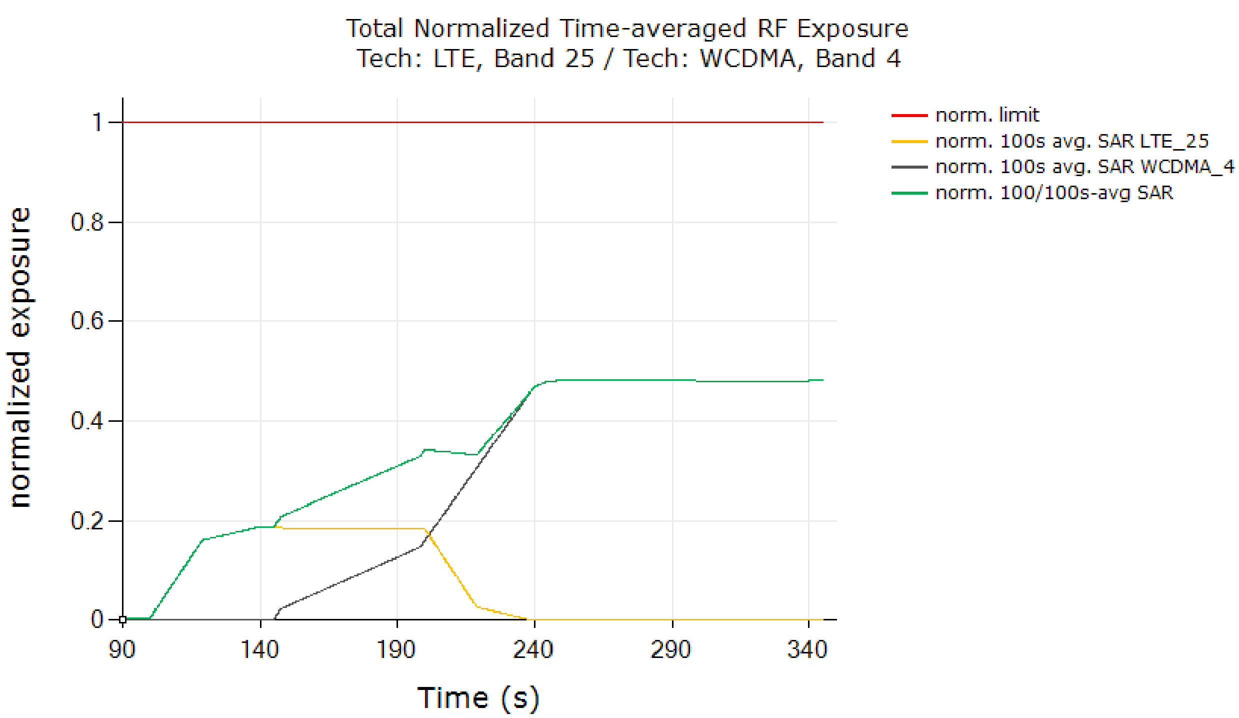
5.5. Change in Tech/Band test results (test case 10 in Table 5-1)

The detailed test procedures is described in Section 3.3.3

Test parameters

Tech/band/antenna/DSI	Parameters	Values
LTE Band 25/Main.2/DSI4	meas. P_{max}	23.26 dBm
	meas. P_{limit}	18.13 dBm
	meas. 1g SAR at P_{limit}	0.409 W/kg
	Time window	100 s
	Switch time instant	142 s
WCDMA B4/Main.2/DSI4	meas. P_{max}	22.98 dBm
	meas. P_{limit}	20.83 dBm
	meas. 1g SAR at P_{limit}	0.757 W/kg
	Time window	100 s
Test setup schematic		Figure B-1(a)

Test result for change in Tech/Band/Antenna:



Normalized SAR limit	1.0
Max Norm. Total time-avg SAR (green curve)	0.483
Validated.	

The test result validated the continuity of power limiting in Tech/Band switch scenario.

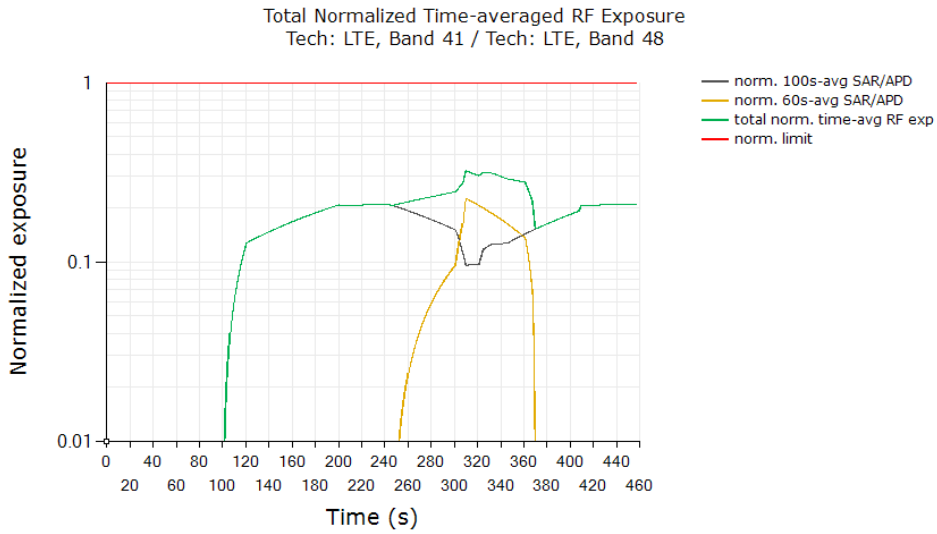
5.6. Change in Window/Antenna test results (test case 11 in Table 5-1)

The detailed test procedures is described in Section 3.3.4 and Section 3.3.6.

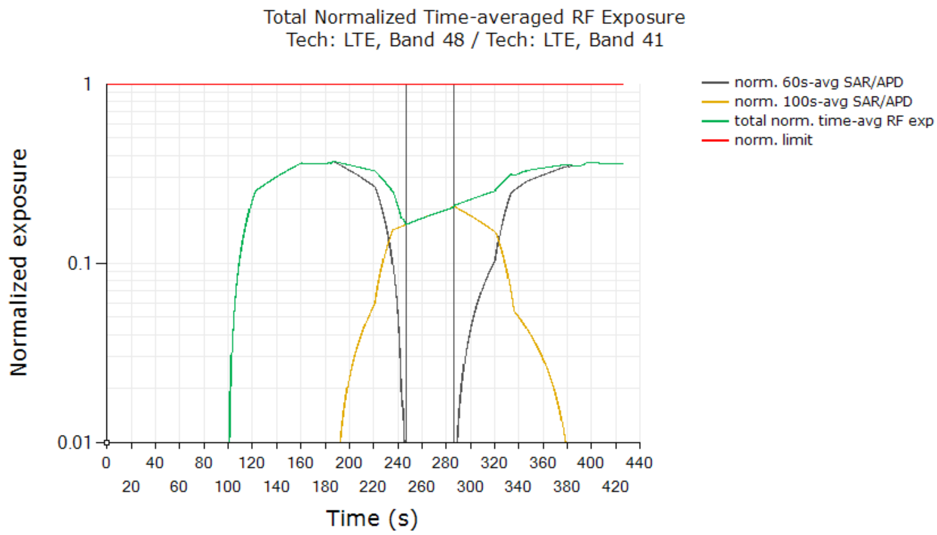
Test parameters

Tech/band/antenna/DSI	Parameters	Values	Tech/band/antenna/DSI	Parameters	Values
LTE Band 41/Sub.2/DSI3	meas. P_{max}	22.55 dBm	LTE Band 48/Sub.3/DSI3	meas. P_{max}	18.70 dBm
	meas. P_{limit}	16.86 dBm		meas. P_{limit}	15.91 dBm
	meas. 1g SAR at P_{limit}	0.267 W/kg		meas. 1g SAR at P_{limit}	0.554 W/kg
	Time window	100 s		Time window	60 s
Test setup schematic		Figure B-1(b)			

Test case.1 result for change in time-window [Band1(100s) to Band2(60s), then back to Band1(100s)):



Test case.2 result for change in time-window [Band2(60s) to Band1(100s), then back to Band2(60s)):



	Test case.1	Test case.2
Normalized SAR limit	1.0	1.0
Max Norm. Total time-avg SAR (green curve)	0.323	0.371
Validated.		

The test result validated the continuity of power limiting in time-window/Antenna switch scenario.

5.7. Switch in SAR exposure test result

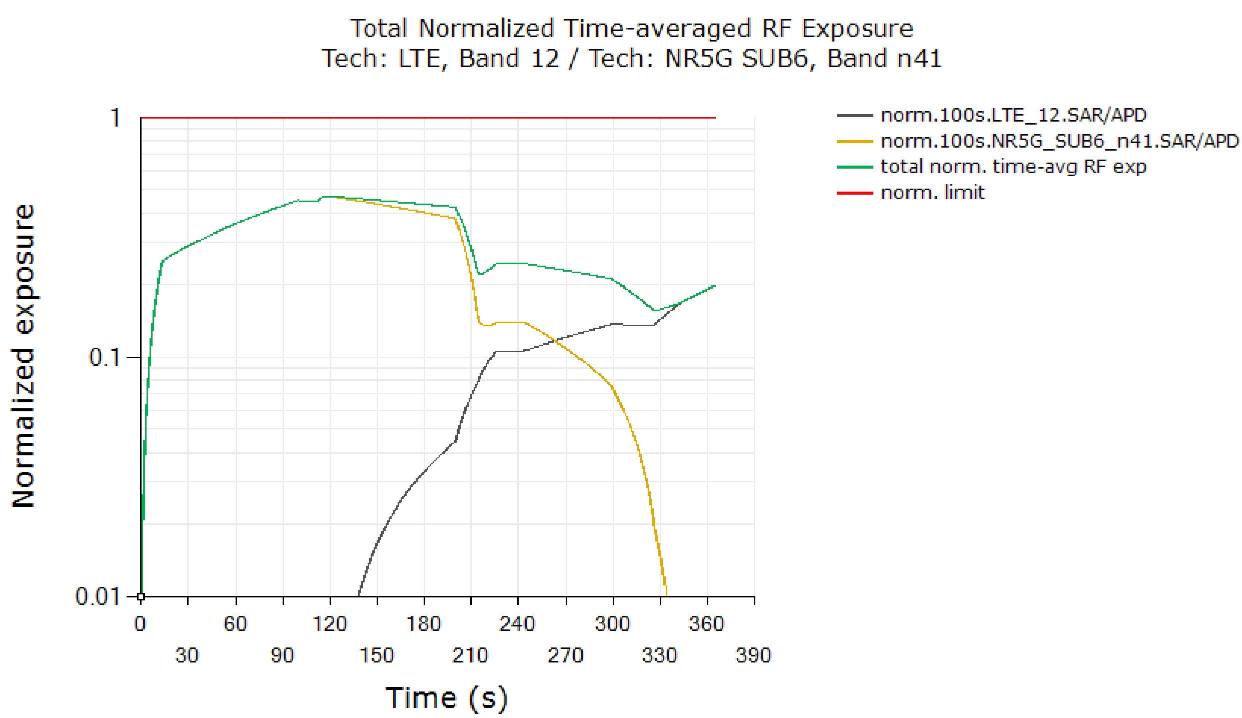
The detailed test procedures is described in Section 3.3.7.

5.7.1. WWAN (EN-DC : LTE+NR) (test case 12 in Table 5-1)

Test parameters

Tech/band/antenna/DSI	Parameters	Values
LTE Band 12/Main.1/DSI4	meas. P_{max}	24.08 dBm
	meas. P_{limit}	22.53 dBm
	meas. 1g SAR at P_{limit}	0.352 W/kg
	Time window	100 s
NR Band n41/Main.2/DSI4	meas. P_{max}	23.7 dBm
	meas. P_{limit}	16.53 dBm
	meas. 1g SAR at P_{limit}	0.661 W/kg
	Time window	100 s
Test setup schematic		Figure B-1 (c)

Test result for switch in SAR exposure (EN-DC):



Normalized SAR limit	1.0
Max Norm. Total time-avg SAR (green curve)	0.469
Validated.	

In this test, the total time-averaged normalized RF exposure (green curve) did not exceed normalized limit of 1.0 at all times, the above test result validated the continuity of power limiting in SAR exposure switch scenario.

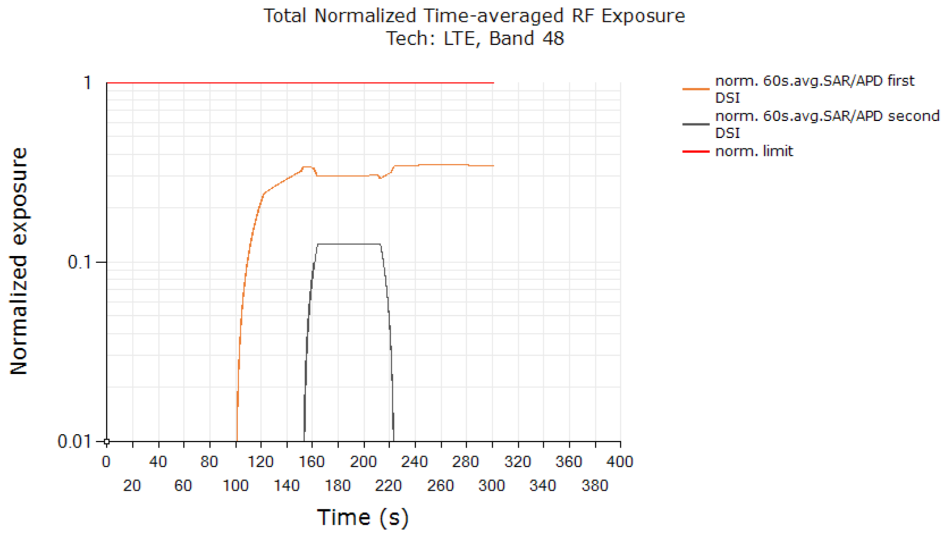
5.8. Exposure Category Switch test results (test case 13 in Table 5-1)

The detailed test procedures is described in Section 3.3.8.

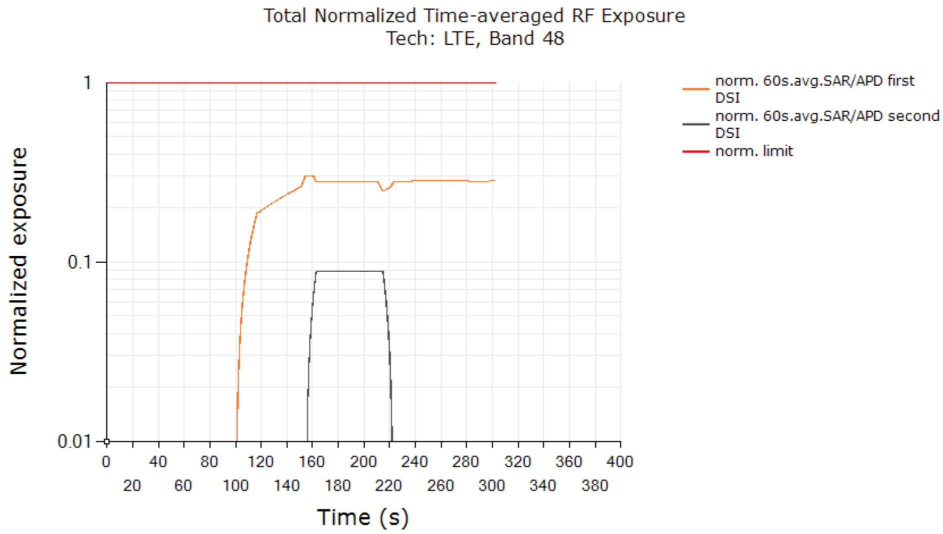
Test parameters

Tech/band/antenna/DSI	Parameters	Values	Tech/band/antenna/DSI	Parameters	Values
LTE Band 48/Sub.3/DSI3	meas. P_{max}	18.70 dBm	LTE Band 48/Sub.3/DSI4	meas. P_{max}	18.70 dBm
	meas. P_{limit}	15.91 dBm		meas. P_{limit}	14.89 dBm
	meas. 1g SAR at P_{limit}	0.554 W/kg		meas. 1g SAR at P_{limit}	0.453 W/kg
	Time window	60 s		Time window	60 s
Test setup schematic		Figure B-1(a)			

Test case.1 result for Exposure Category Switch (head to non-head, then back to head):



Test case.2 result for Exposure Category Switch (non-head to head, then back to non-head):



	Test case.1	Test case.2
Normalized SAR limit	1.0	1.0
Max Norm. Total time-avg SAR (orange curve)	0.348	0.304
Validated.		

In this test, the time-averaged normalized RF exposure in each exposure DSIs (orange curve) did not exceed normalized limit of 1.0 at all times.

6. SAR Test Results for Sub-6 Smart Transmit Feature Validation

6.1. Dielectric Property Measurement & System Check

Please detail of explain refer to Sec.8 in SAR Part.0/1 report

6.1.1. Dielectric Property Measurement

Dielectric Property Measurement Results :

SAR 6 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2025-01-07	Head 1900	e'	39.1754	Relative Permittivity (ϵ_r):	39.18	40.00	-2.06	5
		e''	13.6400	Conductivity (σ):	1.44	1.40	2.93	5
	Head 1850	e'	39.2264	Relative Permittivity (ϵ_r):	39.23	40.00	-1.93	5
		e''	13.7193	Conductivity (σ):	1.41	1.40	0.80	5
	Head 1915	e'	39.1569	Relative Permittivity (ϵ_r):	39.16	40.00	-2.11	5
		e''	13.6306	Conductivity (σ):	1.45	1.40	3.67	5

SAR 7 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2024-12-12	Head 835	e'	40.7300	Relative Permittivity (ϵ_r):	40.73	41.50	-1.86	5
		e''	19.2200	Conductivity (σ):	0.89	0.90	-0.85	5
	Head 810	e'	40.8100	Relative Permittivity (ϵ_r):	40.81	41.65	-2.03	5
		e''	19.5600	Conductivity (σ):	0.88	0.90	-1.86	5
	Head 850	e'	40.6800	Relative Permittivity (ϵ_r):	40.68	41.50	-1.98	5
		e''	19.0200	Conductivity (σ):	0.90	0.92	-1.76	5
2024-12-13	Head 1750	e'	40.0900	Relative Permittivity (ϵ_r):	40.09	40.08	0.01	5
		e''	13.6200	Conductivity (σ):	1.33	1.37	-3.19	5
	Head 1710	e'	40.2200	Relative Permittivity (ϵ_r):	40.22	40.15	0.18	5
		e''	13.7700	Conductivity (σ):	1.31	1.35	-2.76	5
	Head 1780	e'	40.0400	Relative Permittivity (ϵ_r):	40.04	40.04	0.00	5
		e''	13.5300	Conductivity (σ):	1.34	1.39	-3.38	5
2024-12-13	Head 1900	e'	39.9700	Relative Permittivity (ϵ_r):	39.97	40.00	-0.08	5
		e''	13.4400	Conductivity (σ):	1.42	1.40	1.42	5
	Head 1850	e'	39.9700	Relative Permittivity (ϵ_r):	39.97	40.00	-0.08	5
		e''	13.3900	Conductivity (σ):	1.38	1.40	-1.62	5
	Head 1915	e'	39.9900	Relative Permittivity (ϵ_r):	39.99	40.00	-0.02	5
		e''	13.4400	Conductivity (σ):	1.43	1.40	2.22	5
2024-12-20	Head 835	e'	41.6300	Relative Permittivity (ϵ_r):	41.63	41.50	0.31	5
		e''	18.9100	Conductivity (σ):	0.88	0.90	-2.45	5
	Head 810	e'	41.8400	Relative Permittivity (ϵ_r):	41.84	41.65	0.45	5
		e''	19.4100	Conductivity (σ):	0.87	0.90	-2.62	5
	Head 850	e'	41.5500	Relative Permittivity (ϵ_r):	41.55	41.50	0.12	5
		e''	18.6900	Conductivity (σ):	0.88	0.92	-3.46	5
2024-12-20	Head 1900	e'	40.9600	Relative Permittivity (ϵ_r):	40.96	40.00	2.40	5
		e''	13.1700	Conductivity (σ):	1.39	1.40	-0.62	5
	Head 1850	e'	41.0600	Relative Permittivity (ϵ_r):	41.06	40.00	2.65	5
		e''	13.3000	Conductivity (σ):	1.37	1.40	-2.28	5
	Head 1915	e'	40.9700	Relative Permittivity (ϵ_r):	40.97	40.00	2.43	5
		e''	13.1700	Conductivity (σ):	1.40	1.40	0.17	5
2024-12-20	Head 3400	e'	37.8236	Relative Permittivity (ϵ_r):	37.82	38.04	-0.58	5
		e''	15.4050	Conductivity (σ):	2.91	2.81	3.67	5
	Head 3500	e'	37.6897	Relative Permittivity (ϵ_r):	37.69	37.93	-0.63	5
		e''	15.4404	Conductivity (σ):	3.00	2.91	3.20	5
	Head 3600	e'	37.5297	Relative Permittivity (ϵ_r):	37.53	37.82	-0.76	5
		e''	15.5311	Conductivity (σ):	3.11	3.01	3.15	5
	Head 3700	e'	37.3759	Relative Permittivity (ϵ_r):	37.38	37.70	-0.86	5
		e''	15.6087	Conductivity (σ):	3.21	3.12	3.05	5
	Head 3800	e'	37.2312	Relative Permittivity (ϵ_r):	37.23	37.59	-0.95	5
		e''	15.6600	Conductivity (σ):	3.31	3.22	2.81	5
	Head 3900	e'	37.0867	Relative Permittivity (ϵ_r):	37.09	37.47	-1.03	5
		e''	15.7018	Conductivity (σ):	3.40	3.32	2.53	5
	Head 3980	e'	36.9786	Relative Permittivity (ϵ_r):	36.98	37.38	-1.08	5
		e''	15.7561	Conductivity (σ):	3.49	3.40	2.47	5

6.1.2. SAR System Check

Reference Target SAR Values

The reference SAR values can be obtained from the calibration certificate of system validation dipoles.

System Dipole	Serial No.	Cal. Date	Cal. Due.Date	Freq. (MHz)	Target SAR Values (W/kg)	
					1g/10g	Head
D835V2	4d174	2024-09-16	2025-09-16	835	1g	9.44
					10g	6.09
D1750V2	1125	2024-11-18	2025-11-18	1750	1g	36.60
					10g	19.50
D1900V2	5d190	2024-11-18	2025-11-18	1900	1g	38.90
					10g	20.50
D3500V2	1075	2023-05-19	2025-05-19	3500	1g	65.50
					10g	24.70
D3700V2	1036	2023-05-19	2025-05-19	3700	1g	67.80
					10g	24.50

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

SAR 6 Room

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
2025-01-07	D1900V2	5d190	Head	1g	3.89	38.9	38.90	0.00	1
				10g	2.01	20.1	20.50	-1.95	

SAR 7 Room

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
2024-12-12	D835V2	4d174	Head	1g	0.99	9.9	9.44	5.08	2
				10g	0.67	6.7	6.09	9.69	
2024-12-13	D1750V2	1125	Head	1g	3.74	37.4	36.60	2.19	3
				10g	2.04	20.4	19.50	4.62	
2024-12-13	D1900V2	5d190	Head	1g	4.19	41.9	38.90	7.71	
				10g	2.23	22.3	20.50	8.78	
2024-12-20	D835V2	4d174	Head	1g	0.91	9.1	9.44	-3.18	
				10g	0.62	6.2	6.09	2.13	
2024-12-20	D1900V2	5d190	Head	1g	4.11	41.1	38.90	5.66	
				10g	2.23	22.3	20.50	8.78	
2024-12-20	D3500V2	1075	Head	1g	6.46	64.6	65.50	-1.37	4
				10g	2.60	26.0	24.70	5.26	
2024-12-20	D3700V2	1036	Head	1g	6.70	67.0	67.80	-1.18	5
				10g	2.63	26.3	24.50	7.35	

6.2. Measurement setup

This measurement setup is similar to normal SAR measurements. The difference in SAR measurement setup for time averaging feature validation is that the callbox is signaling in close loop power control mode (instead of requesting maximum power in open loop control mode) and callbox is connected to the PC using GPIB(or Ethernet) so that the test script executed on PC can send GPIB(or Ethernet) commands to control the callbox's requested power over time (test sequence). The same test script used in conducted setup for time-varying Tx power measurements is also used in this section for running the test sequences during SAR measurements, and the recorded values from the disconnected power meter by the test script were discarded.

As mentioned in Section 3.4, for EUT to follow TPC command sent from the callbox wirelessly, the "path loss" between callbox antenna and the EUT needs to be very well calibrated. Since the SAR chamber is in uncontrolled environment, precautions must be taken to minimize the environmental influences on "path loss". Similarly, in the case of time-varying SAR measurements in Sub6 NR (with LTE as anchor), "path loss" between callbox antenna and the EUT needs to be carefully calibrated for both LTE link as well as for Sub6 NR link.

The EUT is placed in Worst-case position against flat section of SAM Twin phantom as shown in Appendix A.

6.3. SAR measurement results for time-varying Tx power transmission scenario

Following Section 3.4 procedure, time-averaged SAR measurements are conducted using EX3DV4 probe at peak location of area scan over 500 seconds. cDASY6 system validation for SAR measurement is provided in Section 7.1, and the associated SPEAG certificates are attached in Appendix E(Probes) & F(Dipoles) in SAR part 1 report. SAR probe integration times depend on the communication signal being tested. Integration times used by SPEAG for their probe calibrations can be downloaded from here (integration time is listed on the bottom of the first page for each tech):

http://www.speag.com/assets/downloads/servces/cs/UIDSummary 171205.pdf

Since the sampling rate used by cDASY6 for pointSAR measurements is not in user control, the number of points in 100s or 60s interval is determined from the scan duration setting in cDASY6 time-average pointSAR measurement by (100s or 60s / cDASY6_scan_duration * total number of pointSAR values recorded). Running average is performed over these number of points in excel spreadsheet to obtain 100s-/60s-averaged pointSAR.

Following Section 3.4, for each of selected technology/band (listed in Table 5-2):

1. With *Reserve_power_margin* set to 0 dB, area scan is performed at P_{limit} and time-averaged pointSAR measurements are conducted to determine the pointSAR at P_{limit} at peak location, denoted as *point*SAR$_{Plimit}$.

2. With *Reserve_power_margin* set to actual (intended) value, two more time-averaged pointSAR measurements are performed at the same peak location for test sequences 1 and 2.
   To demonstrate compliance, all the pointSAR measurement results were converted into 1gSAR or 10gSAR values by using Equation (3a), rewritten below:

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

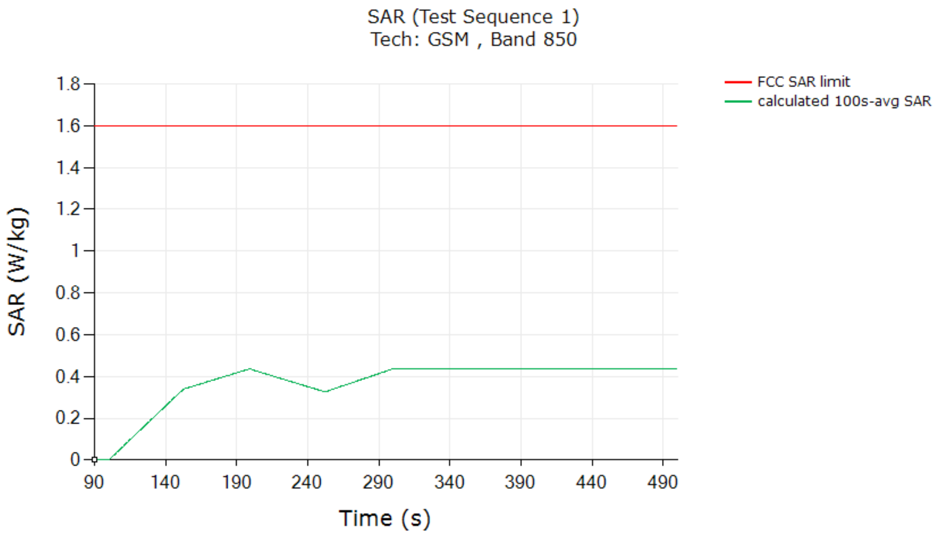
   Where, *pointSAR(t)*, *pointSAR_*P_{limit}, and *1g_or_10g SAR_*P_{limit} correspond to the measured instantaneous point SAR, measured point SAR at P_{limit} from above step 1 and 2, and measured *1gSAR or 10gSAR* values at P_{limit} obtained from Part 1 report and listed in Table 5-2 in Section 5.1 of this report.

6.3.1. GSM 850

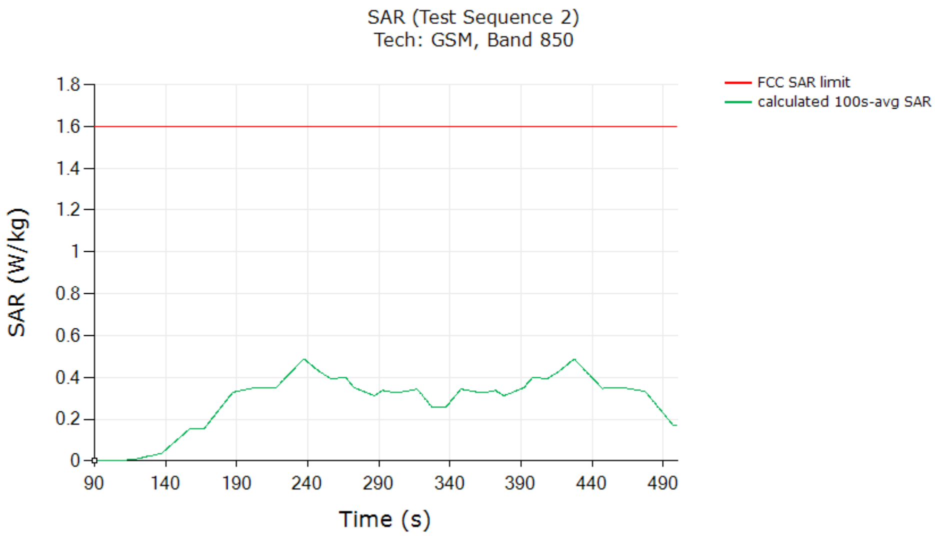
Test parameters

Parameters	Values
Tech/band/antenna/DSI	GSM 850/Main.1/DSI4
Test position	Rear, 5mm
meas. 1g SAR at P_{limit}	0.446 W/kg
Time window	100 s

Test result for test sequence 1:



Test result for test sequence 2:



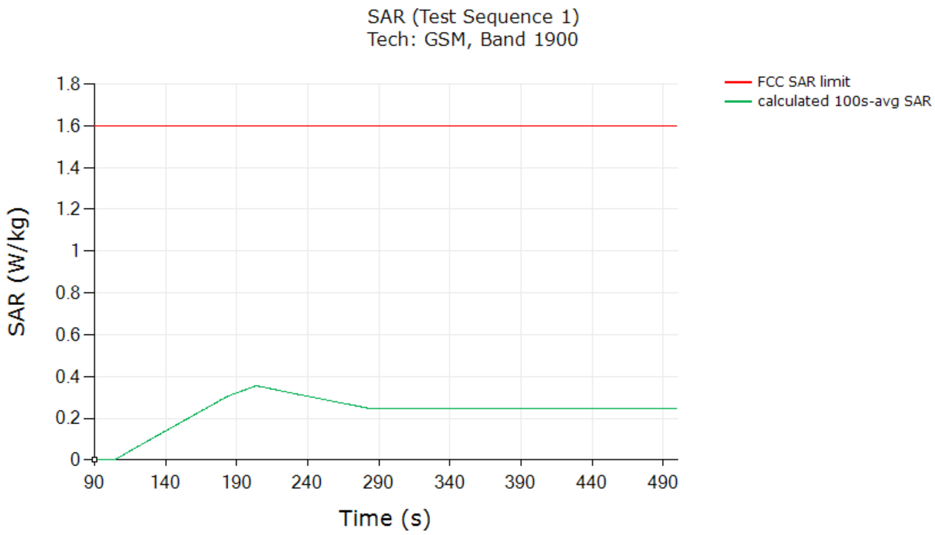
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.438	0.487	
Validated.			

6.3.2. GSM 1900

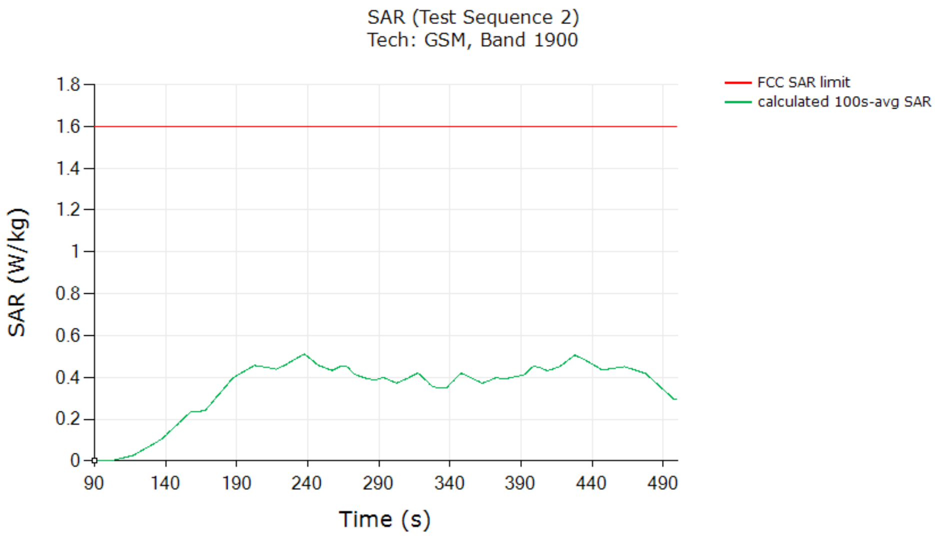
Test parameters

Parameters	Values
Tech/band/antenna/DSI	GSM 1900/Main.2/DSI4
Test position	Rear, 5mm
meas. 1g SAR at Plimit	0.415 W/kg
Time window	100 s

Test result for test sequence 1:



Test result for test sequence 2:



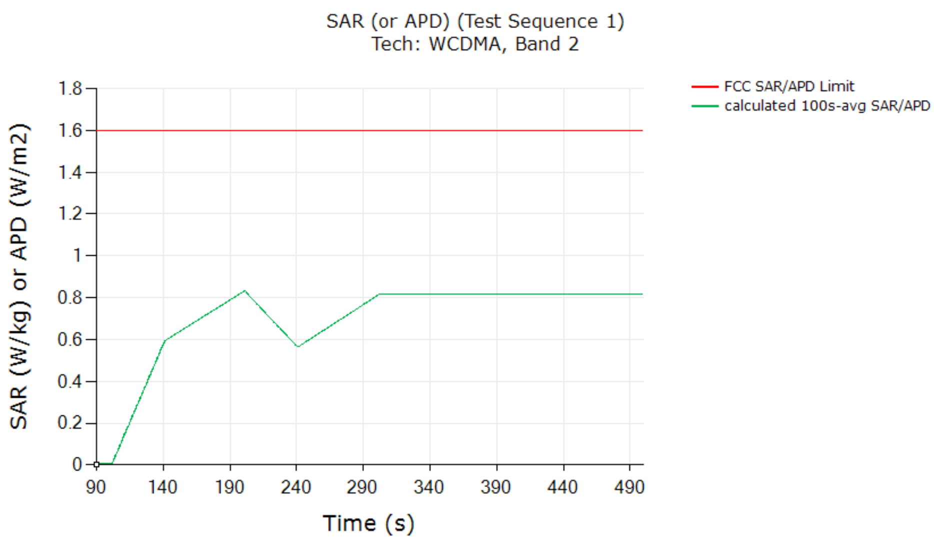
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.354	0.510	
Validated.			

6.3.3. WCDMA Band II

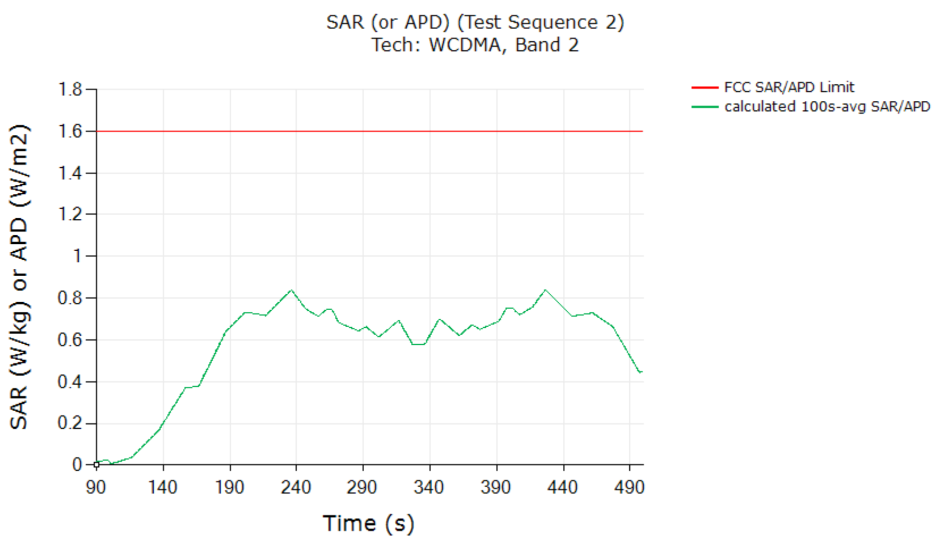
Test parameters

Parameters	Values
Tech/band/antenna/DSI	WCDMA B2/Main.2/DSI4
Test position	Rear, 5mm
meas. 1g SAR at P_{limit}	0.762 W/kg
Time window	100 s

Test result for test sequence 1:



Test result for test sequence 2:



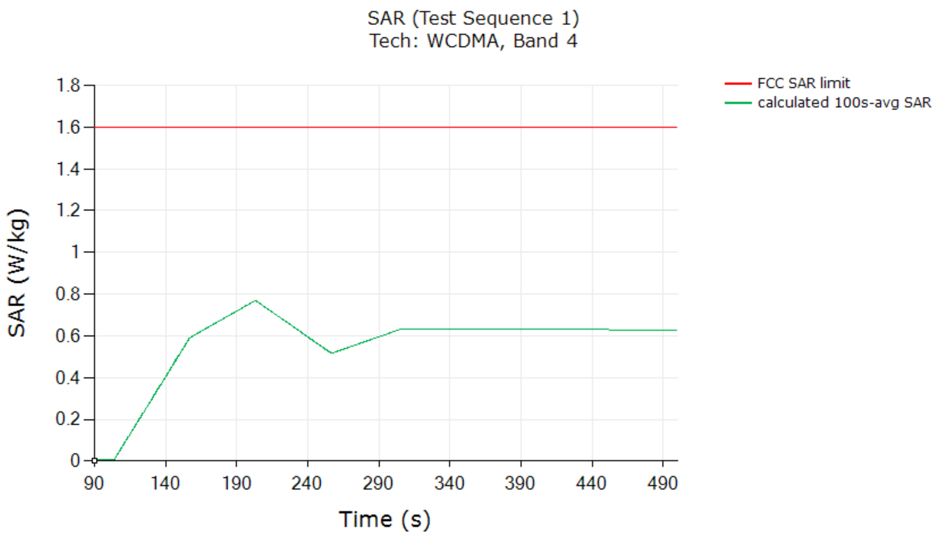
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.833	0.839	
Validated.			

6.3.4. WCDMA Band IV

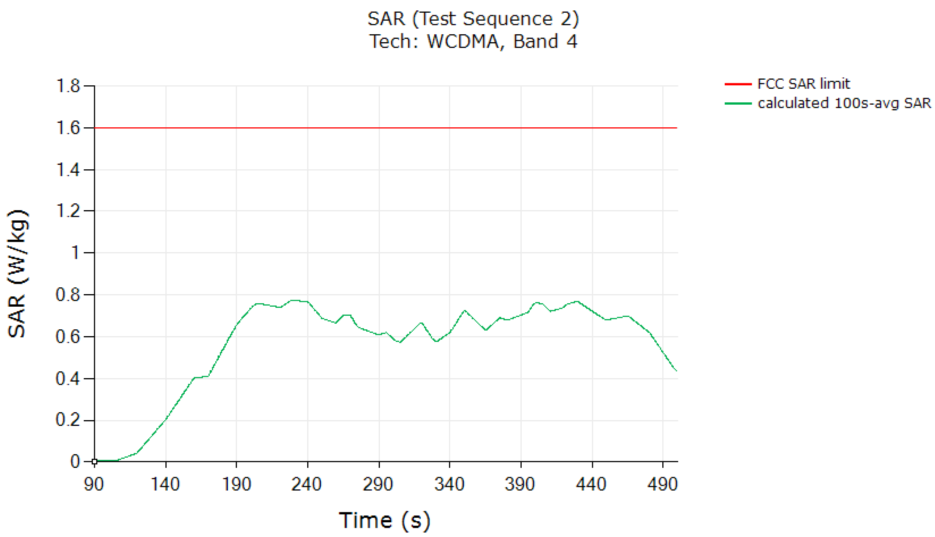
Test parameters

Parameters	Values
Tech/band/antenna/DSI	WCDMA B4/Main.2/DSI4
Test position	Rear, 5mm
meas. 1g SAR at P_{limit}	0.757 W/kg
Time window	100 s

Test result for test sequence 1:



Test result for test sequence 2:



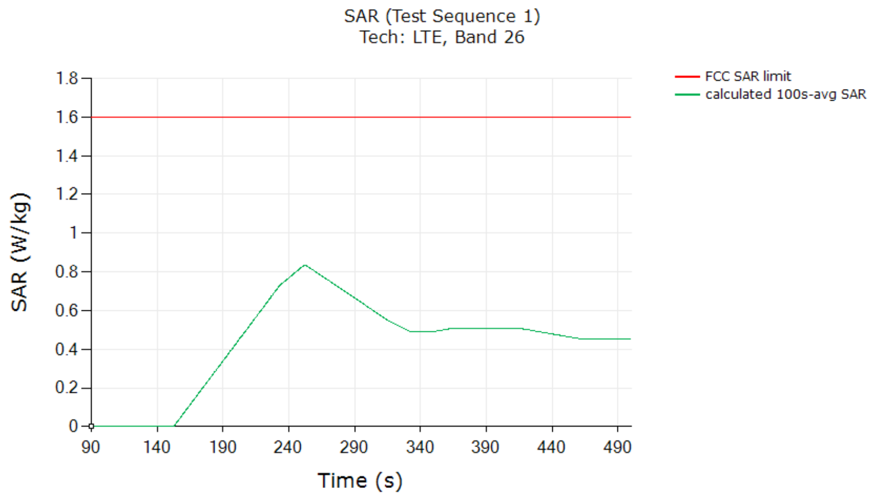
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.770	0.772	
Validated.			

6.3.5. LTE Band 26

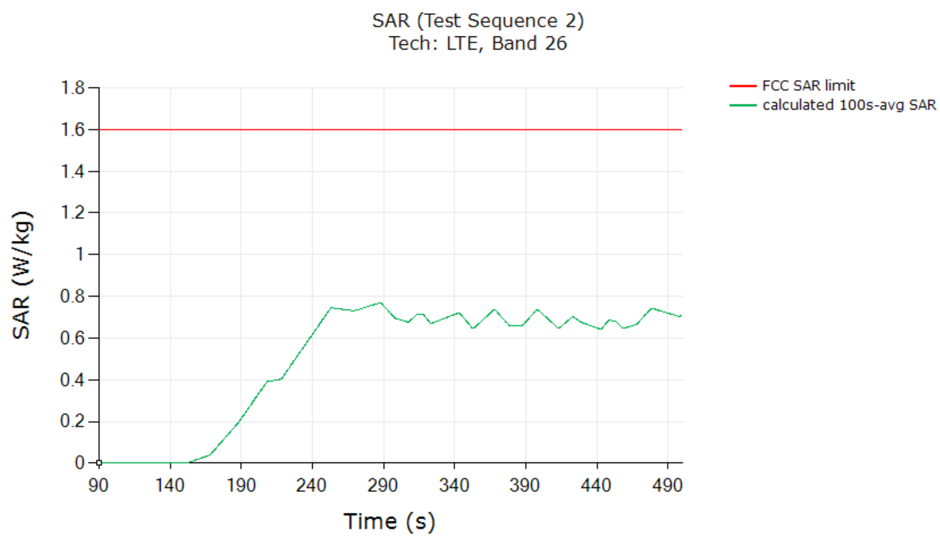
Test parameters

Parameters	Values
Tech/band/antenna/DSI	LTE B26/Main.1/DSI4
Test position	Bottom, 5mm
meas. 1g SAR at P_{limit}	0.883 W/kg
Time window	100 s

Test result for test sequence 1:



Test result for test sequence 2:



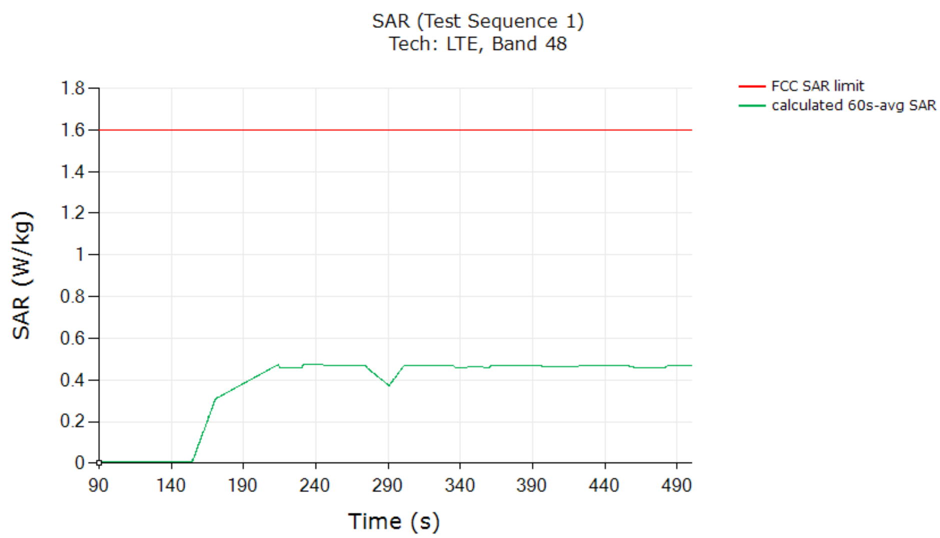
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.835	0.769	
Validated.			

6.3.6. LTE Band 48

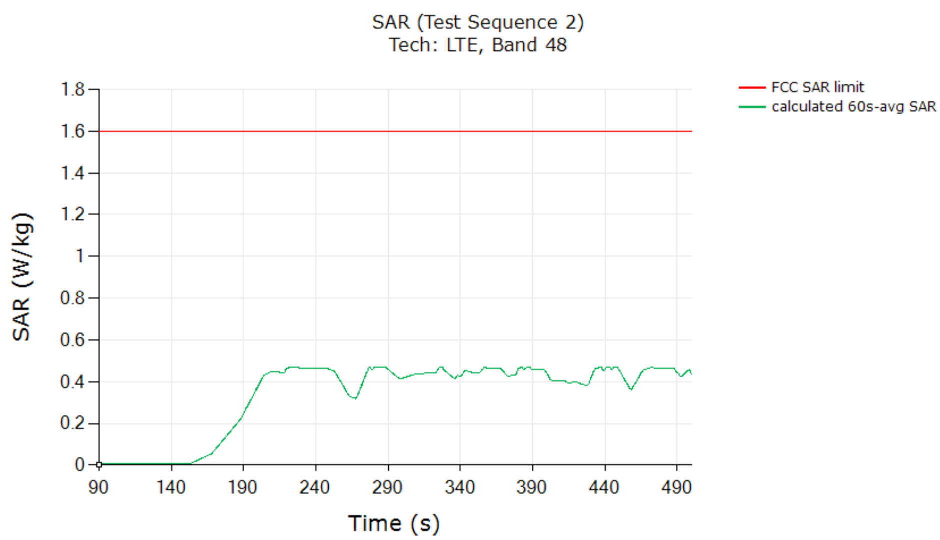
Test parameters

Parameters	Values
Tech/band/antenna/DSI	LTE B48/Sub.3/DSI4
Test position	Left, 5mm
meas. 1g SAR at Plimit	0.453 W/kg
Time window	60 s

Test result for test sequence 1:



Test result for test sequence 2:



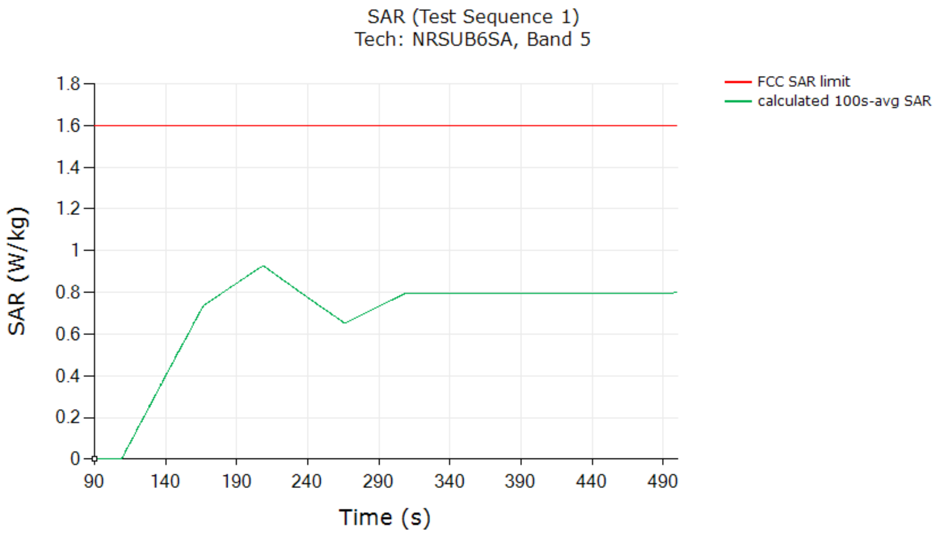
	Test Seq 1	Test Seq 2	(W/kg)
Max 60s-time averaged 1gSAR (green curve)	0.472	0.470	
Validated.			

6.3.7. NR Band n5

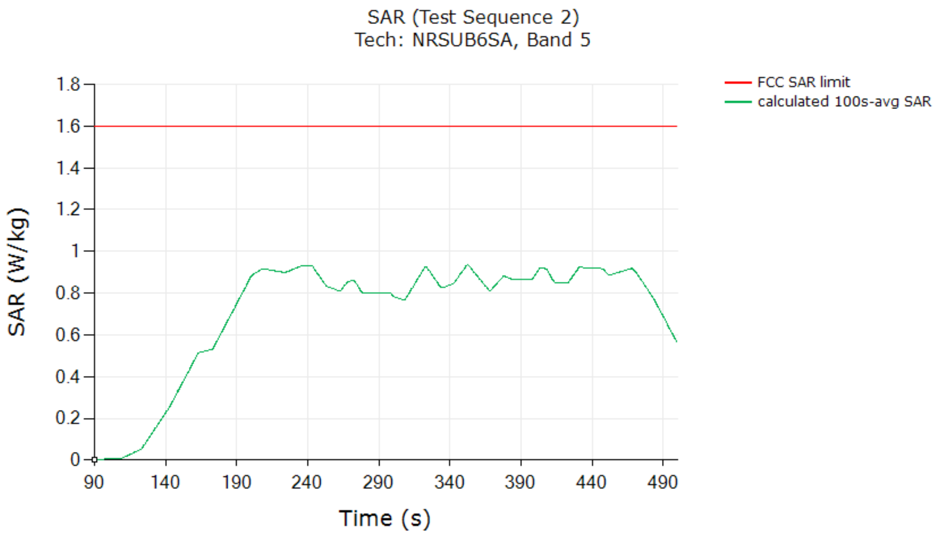
Test parameters

Parameters	Values
Tech/band/antenna/DSI	NR Bn5/Main.1/DSI4
Test position	Rear, 5mm
meas. 1g SAR at P_{limit}	0.900 W/kg
Time window	100 s

Test result for test sequence 1:



Test result for test sequence 2:



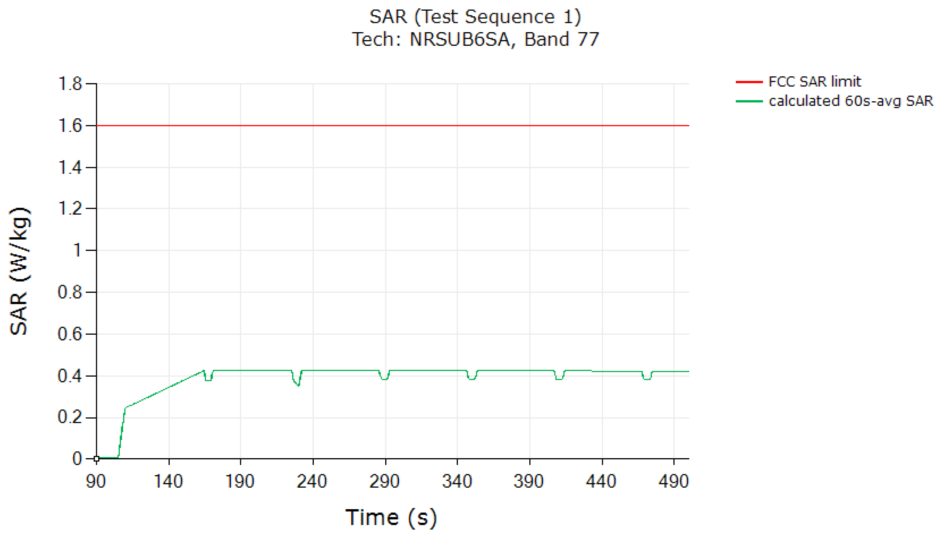
	Test Seq 1	Test Seq 2	(W/kg)
Max 100s-time averaged 1gSAR (green curve)	0.928	0.934	
Validated.			

6.3.8. NR Band n77

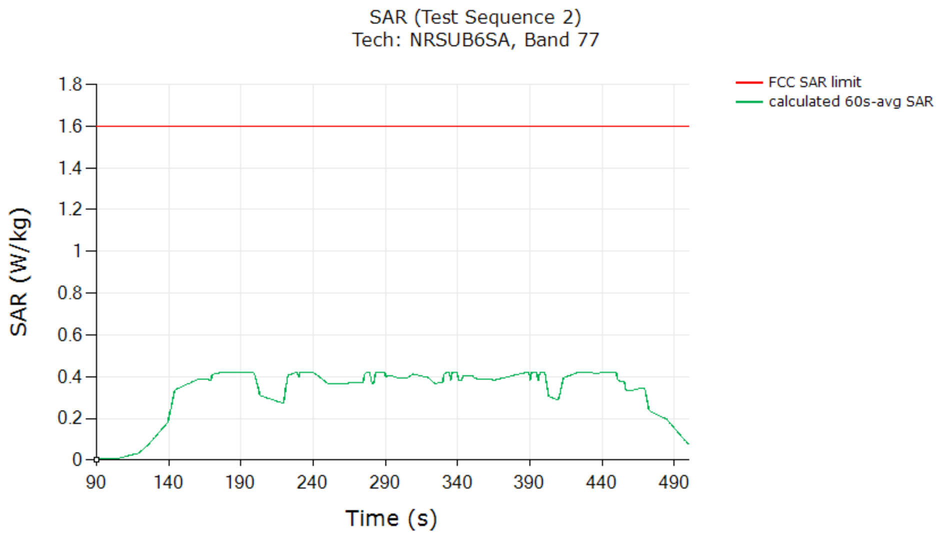
Test parameters

Parameters	Values
Tech/band/antenna/DSI	NR Bn77/Sub.3/DSI4
Test position	Rear, 5mm
meas. 1g SAR at P_{limit}	0.376 W/kg
Time window	60 s

Test result for test sequence 1:



Test result for test sequence 2:



	Test Seq 1	Test Seq 2	(W/kg)
Max 60s-time averaged 1gSAR (green curve)	0.426	0.422	
Validated.			

7. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Conducted test

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW500	169800	2025-07-24
Base Station Simulator	R & S	CMW500	169801	2025-01-03
				2026-01-02
UXM 5G Wireless Test Platform	KEYSIGHT	E7515B	MY58120110	2025-01-03
				2026-01-02
Power Sensor	R & S	NRP8S	104520	2025-07-25
Power Sensor	R & S	NRP8S	104521	2025-07-25
Power Sensor	R & S	NRP8S	113937	2025-09-23
Directional Coupler	MINI-CIRCUITS	ZUDC20-183+	N/A	2025-07-24
Directional Coupler	MINI-CIRCUITS	ZUDC20-183+	N/A	2025-07-24

SAR Test

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	E5071C	MY46522054	2025-07-24
Dielectric Assessment Kit	SPEAG	DAK-3.5	1196	2025-06-10
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	LKM	DTM3000	3851	2025-07-23

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Keysight	N5181B	MY59100587	2025-07-25
Power Sensor	KEYSIGHT	U2004A USB Sensor	MY61200006	2025-01-03
				2026-01-03
Power Sensor	KEYSIGHT	U2004A USB Sensor	MY61280010	2025-01-03
				2026-01-03
Broadband Power Amplifier	L2 MICROWAVE	BA00T60W2D	S3010-0001	2025-02-21
Directional Coupler	KRYTAR	100318010	215541	2025-01-04
				2026-01-02
Directional Coupler	KRYTAR	100318010	215542	2025-01-04
				2026-01-02
Low Pass Filter	MINI-CIRCUITS	VLF-1500+	32241	2025-03-01
Low Pass Filter	MINI-CIRCUITS	VLF-3000+	32226	2025-03-01
Low Pass Filter	MINI-CIRCUITS	VLF-6000+	S0142	2025-07-23
Attenuator	MINI-CIRCUITS	BW-S3W10+	N/A	2025-01-04
Attenuator	Keysight	849B010	MY39272293	2025-07-23
Attenuator	MINI-CIRCUITS	BW-N20W5+	N/A	2025-07-23
Attenuator	MINI-CIRCUITS	BW-N10W5+	N/A	2025-07-23
E-Field Probe	SPEAG	EX3DV4	7651	2025-03-18
E-Field Probe	SPEAG	EX3DV4	3871	2025-09-04
Data Acquisition Electronics	SPEAG	DAE4	1494	2025-07-15
System Validation Dipole	SPEAG	D835V2	4d174	2025-09-16
System Validation Dipole	SPEAG	D1750V2	1125	2025-11-18
System Validation Dipole	SPEAG	D1900V2	5d190	2025-11-18
System Validation Dipole	SPEAG	D3500V2	1075	2025-05-19
System Validation Dipole	SPEAG	D3900V2	1036	2025-05-19
Thermometer	Lutron	MHB-382SD	AK.18789	2025-07-26

Notes:
1. For SAR probe used in the test, please refer to Appendix E in SAR Part.1 for the calibration report.
2. For System Validation Dipole, Calibration interval applied every 2 years according to referencing KDB 865664 guidance.
3. All equipments were used until Cal.Due data.

8. Measurement Uncertainty

8.1. SAR

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

9. Conclusions

Qualcomm Smart Transmit feature employed in Samsung device (FCC ID: A3LSMA366U) has been validated through the conducted power / SAR measurement (as demonstrated in Section 5 & 6).

As demonstrated in this report, the power limiting enforcement is effective and the total normalized time-averaged RF exposure does not exceed 1.0 for all the transmission scenarios described in Section 2. Therefore, the EUT complies with FCC RF exposure requirement.

Section A. Test Sequences

Sub.6 radio.

1. Test sequence is generated based on below parameters of the EUT:
   a. Measured maximum power (P_{max})
   b. Measured Tx_power_at_SAR_design_target (P_{limit})
   c. Reserve_power_margin (dB)
      - $P_{reserve}$ (dBm) = measured P_{limit} (dBm) – *Reserve_power_margin* (dB)
   d. SAR_time_window (100s for FCC)

2. **Sub.6 radio_Test Sequence 1** Waveform:

   Based on the parameter above, the Test Sequence 1 is generated with one transmission between high and low Tx powers. Here, high power = P_{max}; low power = P_{max}/2, and the transition occurs after 80 seconds at high power P_{max}. As long as the power enforcement is taking into effective during one 100s/60s time window, the validation test with this defined test sequence 1 is valid, otherwise, select other radio configuration (band/DSI within the same technology group) having lower P_{limit} for this test. The test sequence 1 waveform is shown below:

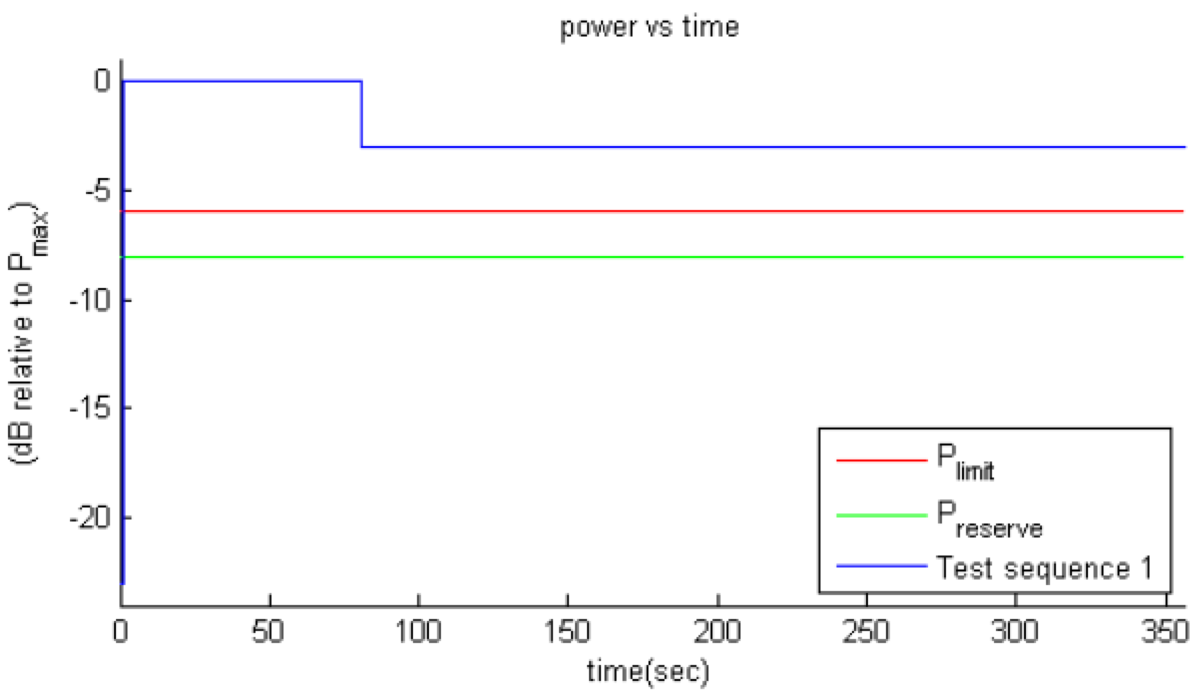


Figure A-1: Test sequence 1 waveform

3. **Sub.6 radio_Test Sequence 2** Waveform:

   Based on the parameters in Figure A-1, the Test Sequence 2 is generated as described in Table A-1, which contains two 170 second-long sequences (yellow and green highlighted rows) that are mirrored around the center row of 20s, resulting in a total duration of 360 seconds:

Table A-1: Test sequence 2

Time duration (seconds)	dB relative to P_{limit} or $P_{reserve}$
15	$P_{reserve} - 2$
20	P_{limit}
20	$(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step
10	$P_{reserve} - 6$
20	P_{max}
15	P_{limit}
15	$P_{reserve} - 5$
20	P_{max}
10	$P_{reserve} - 3$
15	P_{limit}
10	$P_{reserve} - 4$
20	$(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step
10	$P_{reserve} - 4$
15	P_{limit}
10	$P_{reserve} - 3$
20	P_{max}
15	$P_{reserve} - 5$
15	P_{limit}
20	P_{max}
10	$P_{reserve} - 6$
20	$(P_{limit} + P_{max})/2$ averaged in mW and rounded to nearest 0.1 dB step
20	P_{limit}
15	$P_{reserve} - 2$

The test Sequence 2 waveform is shown in Figure A-2.

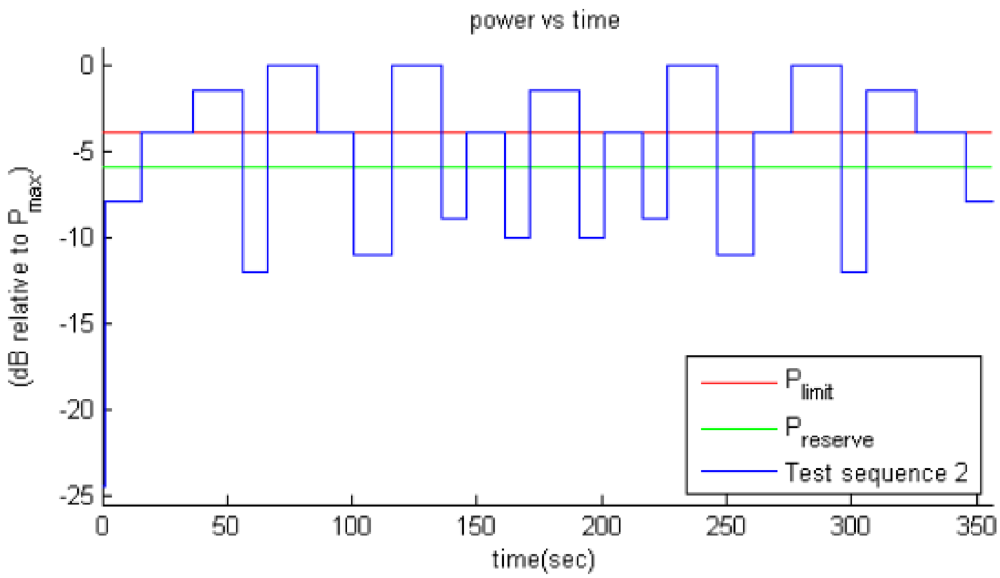


Figure A-2: Test sequence 2 waveform

Section B. Test Procedures for LTE + Sub6 NR

Section B provides the test procedures for validating Qualcomm Smart Transmit feature for LTE + Sub6 NR non-standalone (NSA) mode transmission scenario, where sub-6GHz LTE link acts as an anchor, and Sub6 NR standalone mode (SA) transmission scenario.

B.1 Time-varying Tx power test for sub6 NR in NSA mode and SA mode

Follows Section 3.2.1 to select test configurations for time-varying test. This test in performed with two pre-defined test sequences (described in Section 3.1) applied to Sub6 NR (with LTE on all-down bits or low power for the entire test after establishing the LTE + Sub6 NR call with the callbox). Follow the test procedures described in Section 3.3.1 to demonstrate the effectiveness of power limiting enforcement and that the time averaged Tx power of Sub6 NR when converted into 1g or 10gSAR values does not exceed the regulatory limit at all times (See Eq. (1a) and (1b)). Sub6 NR response to test sequence 1 and test sequence 2 will be similar to other technologies (say, LTE), and are shown in Sections 6.3.7 and 6.3.8.

B.2 Switch in SAR exposure between LTE vs. Sub6 NR during transmission

This test is to demonstrate that Smart Transmit feature accurately accounts for switching in exposures among SAR for LTE radio only, SAR from both LTE radio and sub6 NR, and SAR from sub6 NR only scenarios, and ensures total time-averaged RF exposure compliance with FCC limit.

Test procedure:

1. Measure conducted Tx power corresponding to P_{limit} for LTE and sub6 NR in selected band. Test condition to measure conducted P_{limit} is:

    - Establish device in call with the callbox for LTE in desired band. Measure conducted Tx power corresponding to LTE P_{limit} with Smart Transmit enable and *Reserve_power_margin* set to 0 dB, callbox set to request maximum power.
    - Repeat above step to measure conducted Tx power corresponding to Sub6 NR P_{limit}. If testing LTE + Sub6 NR in non-standalone mode, then establish LTE + Sub6 NR call with callbox and request all down bits for radio1 LTE. In this scenario, with callbox requesting maximum power from Sub6 NR, measured conducted Tx power corresponds to radio2 P_{limit} (as radio1 LTE is at all-down bits).

2. Set *Reserve_power_margin* to actual (intended) value with EUT setup for LTE _Sub6 NR call. First, establish LTE connection in all-up bits with the callbox, and then Sub6 NR connection is added with callbox requesting UE to transmit at maximum power in Sub6 NR. As soon as the Sub6 NR connection is established, request all-down bits on LTE link (otherwise, Sub6 NR will not have sufficient RF exposure margin to sustain the call with LTE in all-up bits). Continue LTE(all-down bits) + Sub6 NR transmission for more than one time-window duration to test predominantly Sub6 NR SAR exposure scenario (as SAR exposure is negligible from all-down bits in LTE). After at least one time-window, request LTE to go all-up bits to test LTE SAR and Sub6 NR SAR exposure scenario. After as least one more time-window, drop (or request all-down bits) Sub6 NR transmission to test predominantly LTE SAR exposure scenario. Continue the test for at least one more time-window. Record the conducted Tx powers for both LTE and Sub6 NR for the entire duration of this test.

3. Once the measurement is done, extract instantaneous Tx power versus time for both LTE and Sub6 NR links. Similar to technology/band switch test in Section 3.3.3, convert the conducted Tx power for both these radios into 1g or 10gSAR value (see Eq. (6a) and (6b)) using corresponding technology/band P_{limit} measured in Step 1, and then perform 100s running average to determine time-averaged 1g or 10gSAR versus time as illustrated in Figure A-1. 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) instantaneous 1g or 10gSAR versus time determined in Step 3, (b) computed time-averaged 1g or 10gSAR versus time determined in Step 3, and (c) corresponding regulatory *1g or 10gSAR*$_{limit}$ of 1.6 W/kg or 4.0 W/kg, and (d) corresponding normalized regulatory *1g or 10gSAR*$_{limit}$ 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 10gSAR*$_{limit}$ limit.

B.3 Test procedures for Pmax & Plimit conducted power measurement of NR TDD test

For Sub6 NR TDD test cases, a modified procedure was used due to a limitation of the available test equipment.

Test procedure for Conducted Test Sequences:

1. Measure P_{max}, measure P_{limit} and calculate $P_{reserve}$ (= measured P_{limit} 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 generated Pmax_sequences of the DUT as described below. Test condition to measure P_{max} and P_{limit} is:

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

   b. Measure Plimit_online_avg_dBm with Smart Transmit enabled and *Reserve_power_margin* set to 0 dB, callbox set to request maximum power.

   c. Measure Plimit_ftm_dbm in FTM Mode at 25% Duty Cycle.

   d. Calculate the DutyCycle_dB = Plimit_ftm_dBm – Plimit_online_avg_dBm + 6 dB

   e. Calculate Pmax_sequence = Pmax_online_avg_dBm + DutyCycle_dB

   f. Calculate Plimit_sequence = Plimit_online_avg_dBm + DutyCycle_dB

2. Follow remaining steps in Section 3.3.1 to complete time-varying Tx test cases

For the SAR test cases, the procedure in Section 3.4 applies however the initial area scan as described in section 3.4 step 2) i) is performed with the device in FTM mode.

Appendixes

Refer to separated files for the following appendixes.

S-4791547056-S1 FCC SAR Part2 App A Photos

S-4791547056-S1 FCC SAR Part2 App B System Plots

S-4791547056-S1 FCC SAR Part2 App C Dipole Certi

End OF REPORT