

**RF EXPOSURE PART 2 TEST REPORT****Applicant Name:**

Samsung Electronics Co., Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:

01/21/2026 – 02/04/2025

Test Site/Location:

Element, Columbia, MD, USA

Document Serial No.:

1M2512010100-03.A3L

FCC ID:

A3LSMA576JPN

APPLICANT:

SAMSUNG ELECTRONICS CO., LTD.

DUT Type:

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SC-54G

Device Serial Numbers:

Pre-Production Samples [1341M, 1253, 1901M]

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



Rj Ortanez

Executive Vice President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 26	Voice/Data	814.7 - 848.3 MHz
LTE Band 5	Voice/Data	824.7 - 848.3 MHz
LTE Band 66	Voice/Data	1710.7 - 1779.3 MHz
LTE Band 2	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
NR Band n5	Voice/Data	826.5 - 846.5 MHz
NR Band n41	Voice/Data	2501.01 - 2685 MHz
2.4 GHz WIFI	Voice/Data	2412 - 2462 MHz
5 GHz WIFI	Voice/Data	U-NII-1: 5180 - 5240 MHz U-NII-2A: 5260 - 5320 MHz U-NII-2C: 5500 - 5720 MHz U-NII-3: 5745 - 5825 MHz U-NII-4: 5845 - 5885 MHz
6 GHz WIFI	Voice/Data	U-NII-5: 5945 - 6415 MHz U-NII-6: 6435 - 6515 MHz U-NII-7: 6535 - 6875 MHz U-NII-8: 6895 - 7115 MHz
2.4 GHz Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz

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1.2 Time-Averaging Algorithm for RF Exposure Compliance

The Samsung S.LSI proprietary TAS algorithm accounts for cellular technologies 2G, 3G, 4G, 5G NR FR1, as well as connectivity technologies such as Wi-Fi and Bluetooth (BT), to ensure that the Device Under Test (DUT) maintains total RF exposure below the applicable regulatory limits. To achieve this, the modem dynamically controls transmitter power in real time to ensure compliance with these regulatory limits over the required averaging intervals, while enabling dynamic transmit power control to maintain system performance.

FCC RF exposure limits consist of Specific Absorption Rate (SAR), which apply based on the operating frequency range. SAR limits are defined over specified measurement durations, allowing time-averaged evaluation of RF exposure. RF exposure limits are defined based on time-averaged exposure over a specified averaging window. In the current TAS algorithm implementation, the averaging window duration is configurable. Specifically, a 60s and 30s averaging window are used for WWAN and WLAN/BT respectively, consistent with FCC requirements.

The Samsung S.LSI proprietary TAS algorithm operates as follows:

- The minimum duration for SAR calculation is defined as the SAR averaging window, which consists of N time slots. Any FCC-specified measurement or time-averaging duration for a given RAT is composed of M such averaging windows. The SAR budget for the measurement duration is defined as the product of the FCC SAR limit (or the corresponding transmit power level used by the algorithm) and M.
- For each averaging window, the algorithm calculates the average SAR consumption by computing the average of the instantaneous transmit power across all slots within the window. Since SAR values are not directly available in real time, the transmit (Tx) power is used as a proxy to estimate the consumed SAR.
- The algorithm estimates the total SAR consumed over the FCC-defined measurement duration by summing the SAR consumption across all averaging windows within that duration, including the current window.
- The remaining SAR budget is continuously monitored on a per-window basis, and the maximum allowable Tx power for the subsequent window is dynamically controlled to ensure continued compliance with SAR regulatory limits.

The figure below illustrates the detailed operation of the TAS algorithm. The unit used for TAS/SAR and PD evaluation is average transmitted power (units: watts) over the applicable measurement duration. Accordingly, the total SAR budget is defined as the product of the required average SAR limit and the measurement duration, consistent with FCC requirements. Thus, the SAR budget represents the integrated SAR value over the specified measurement duration.

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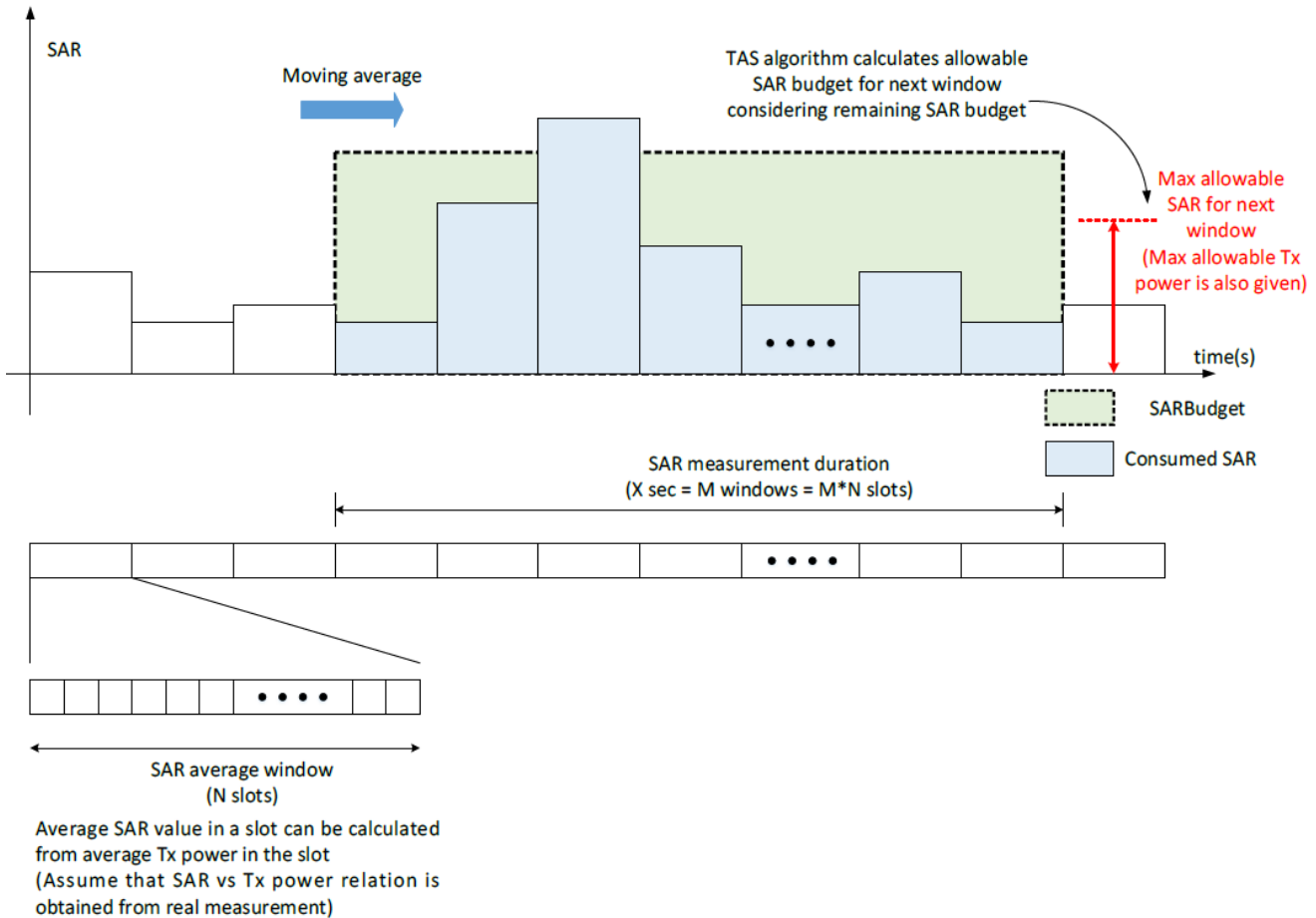


Figure 1.2-1 SAR measurement from Tx power using block-wise processing

To monitor compliance margin with fine granularity, the measurement duration is divided into smaller time segments referred to as averaging windows, and a maximum transmit power limit is applied to each window. The TAS algorithm continuously updates the SAR consumption for the current window and the remaining SAR budget using a moving-average window approach. Since SAR values are not directly available in real time, transmit (Tx) power is used as a proxy for SAR calculation.

After N slots have elapsed, the TAS algorithm discards the oldest window and adds a new window to update the SAR consumption status. Based on the updated remaining SAR budget, the algorithm calculates the permissible maximum transmitting power (Tx MaxPower) for the next window to ensure compliance with SAR limits. By enforcing this Tx MaxPower constraint, the DUT is guaranteed not to exceed the SAR budget over any FCC-defined measurement duration.

Because the slot duration (TTI) is a very short time interval, this fine time resolution enables the DUT to respond promptly to dynamic events and operating conditions. Parameter N is configurable to provide implementation flexibility. For example, when N = 1, the SAR budget is updated on a per-slot basis, allowing rapid response to

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transmit power changes; however, excessively frequent updates may increase CPU and software processing load when the TAS algorithm is implemented within the modem.

In this implementation, the window length is selected to be sufficiently short to enable timely response to various operational events, such as changes in allowed SAR consumption. Accordingly, an appropriate window size is defined for each RAT to meet these requirements. Based on the remaining SAR budget, the maximum allowable SAR (or equivalently, transmit power) for the next window is determined and may be higher or lower than the nominal SAR design target. For any case, total exposure ratio (TER) calculated at any instance is defined as follows:

- For Sub-6 transmission without Wi-Fi/BT:

$$TER(t) = \frac{\sum_{l_{SAR}=0}^{L_{SAR}-1} SAR_{avg,l_{SAR}}(t)}{SAR_{limit,FCC}} \leq 1 \quad (1)$$

where $SAR_{avg,l_{SAR}}(t)$ is the average SAR over a period of $T_{SAR,l_{SAR}}$ (for example 60s) for the $l_{SAR} - th$ RF source operating as:

$$SAR_{avg,l_{SAR}}(t) = \frac{1}{T_{SAR,l_{SAR}}} \int_{u=t-T_{SAR,l_{SAR}}}^t SAR_{l_{SAR}}(u) du \quad (2)$$

- For Sub-6 transmission with Wi-Fi/BT:

$$TER(t) = \frac{\sum_{l_{SAR}=0}^{L_{SAR}-1} SAR_{avg,l_{SAR}}(t)}{SAR_{limit,FCC}} \leq 1 - SAR_{WiFi,norm} - SAR_{BT,norm} \quad (3)$$

where $SAR_{WiFi,norm}$ represents the normalized SAR contribution of Wi-Fi, and $SAR_{BT,norm}$ represents the normalized SAR contribution of Bluetooth (BT). When the corresponding transmitters are disabled, these normalized SAR values are set to zero. Using this approach, a simplified Total Exposure Ratio (TER) criterion can be applied that accounts for all RF components within the platform.

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1.3 Combined TAS (C-TAS) for Cellular-Connectivity Coexistence

In the DC-TAS architecture, the TAS manager, which determines the target SAR levels for both the cellular and connectivity chipsets, is implemented within the cellular and connectivity subsystems rather than in the application processor (AP). DC-TAS operation requires the presence of both the cellular and connectivity chipsets, and neither chipset may be replaced with a third-party component.

To address scenarios in which the cellular subsystem is not operational, an auxiliary TAS manager is implemented on the connectivity side. This auxiliary TAS manager is enabled only when the cellular subsystem is inactive. Figure 1.3-1 illustrates the high-level DC-TAS architecture.

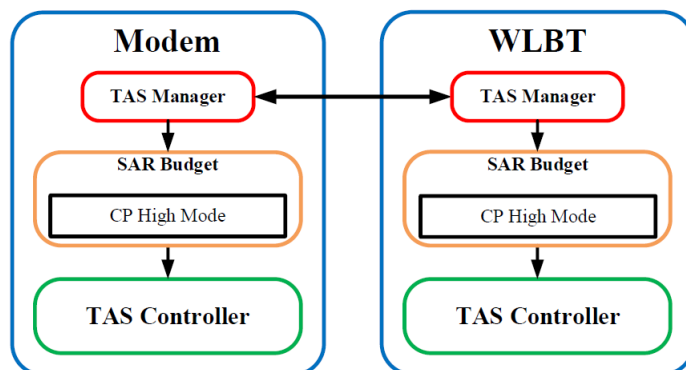


Figure 1.3-1 DC-TAS architecture

1.4 Bibliography

Report Type	Report Serial Number
RF Exposure Part 1 Test Report	1M2512010100-01.A3L
RF Exposure Part 0 Test Report	1M2512010100-02.A3L
RF Exposure Compliance Summary	1M2512010100-04.A3L

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2 RF EXPOSURE LIMITS

2.1 Uncontrolled Environment

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

2.2 Controlled Environment

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

2.3 RF Exposure Limits for Frequencies Below 6 GHz

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

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

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

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2.4 RF Exposure Limits for Frequencies Above 6 GHz

Per §1.1310 (d)(3), the MPE limits are applied for frequencies above 6 GHz. Power Density is expressed in units of W/m² or mW/cm².

Peak Spatially Averaged Power Density was evaluated over a circular area of 4 cm² per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes.

Table 2-2
Human Exposure Limits Specified in FCC 47 CFR §1.1310

Human Exposure to Radiofrequency (RF) Radiation Limits		
Frequency Range [MHz]	Power Density [mW/cm ²]	Averaging Time [Minutes]
(A) Limits for Occupational / Controlled Environments		
1,500 – 100,000	5.0	6
(B) Limits for General Population / Uncontrolled Environments		
1,500 – 100,000	1.0	30

Note: 1.0 mW/cm² is 10 W/m²

2.5 Time Averaging Windows for FCC Compliance

Per October 2018 TCB Workshop Notes, the below time-averaging windows can be used for assessing time-averaged exposures for devices that are capable of actively monitoring and adjusting power output over time to comply with exposure limits.

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

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3 TAS VALIDATION TEST CASES

The RF exposure is proportional to transmit (Tx) power for SAR characterization. Accordingly, TAS feature validation can be effectively performed using conducted measurements, since SAR can be derived from transmit power levels. As a result, compliance demonstration under dynamic transmission conditions and TAS feature validation are conducted using a conducted power measurement setup for the defined transmission scenarios.

To provide additional confidence in this approach, the linear relationship between measured SAR and Tx power is demonstrated in the SAR Part 1 report.

1. Measurement of Transmit Power:

- Measure the conducted transmit power over time, denoted as $TxPower(t)$.
- All measurements are referenced to the UE antenna planes.
- Convert the measured powers to RF exposure values using a linear relationship:

$$SAR_{inst}(t) = \frac{TxPower(t)}{P_{limit}} \times SAR_{design_target} \quad (4)$$

Here, P_{limit} and are the *measured powers* at which the corresponding technology meets the SAR_design_target.

2. Calculate the Total RF Exposure:

- Calculate the total RF exposure over the most recent measurement durations for each RAT:
- The total exposure within a measurement duration is obtained by summing the instantaneous SAR values across all relevant RATs and bands for all time instances u within the respective intervals: $[t - T_{SAR}, t]$.

3. Calculate Total Exposure Ratio (TER):

- Divide the total RF exposure by the corresponding FCC limits.
- The sum, denoted as $TER(t)$, must remain below 1 for all time instances t .

3.1 Cellular Validation Test Scenario

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

1. Time-varying transmit power: Verification that the TAS feature accurately accounts for transmit (Tx) power variations over time.
2. Call disconnected and re-establishment: Verification that the TAS feature correctly accounts for historical Tx power following call termination and subsequent re-establishment.
3. Technology and band handover: Verification that the TAS feature correctly maintains and applies Tx power history across band and RAT transitions.
4. RSI (Radio SAR Index) change: Verification that the TAS feature operates correctly and maintains compliance limits across RSI changes.

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5. SAR exposure switching: Verification that the TAS feature supports multi-RAT transmission with transitions in operating modes.
6. Uplink Carrier Aggregation (UL CA): Verification that the TAS feature correctly handles component carrier (CC) addition and removal, supporting both single-CC and CA operation.
7. Uplink MIMO (UL MIMO): Verification that the TAS feature accurately manages Tx power variations during Rank-2 transmission.
8. Spatial TAS operation: Verification of TAS operation with uncoupled antennas under dual-transmitter scenarios. Note that, for scenarios involving two simultaneous transmitters, coupling cases shall be evaluated to demonstrate compliance with SAR regulatory requirements, while uncoupling cases may be evaluated on an optional basis.

3.2 Wi-Fi and Bluetooth (WLBT) Validation Test Scenario

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

1. WLAN only: WLAN connected case to the AP (access point)
2. WLAN with BT: WLAN is connected to AP and BT enabled (not paired)
3. Dominant power switching WLBT: WLBT with various BT scenarios such as BT Off, BT Normal on, BT audio mode, and BT Max

3.3 C-TAS Validation Test Scenario

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

1. WLAN and Cellular Coexistence Modified: Validation of WLAN and cellular simultaneous operation under multiple scenarios, including ALL UP and ALL DOWN conditions.

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4 CELLULAR TAS VALIDATION TEST PROCEDURES

This chapter provides the test plan and test procedure for validating S.LSI Cellular TAS, WLBT Connectivity TAS, and DC-TAS transmission. The 60 seconds time window is used for cellular technologies, and 30 seconds time window is used for all WLAN/BT bands (e.g. 2.4GHz, 5GHz, and 6GHz).

4.1 Test Configuration Selection Criteria for Cellular Validation

For validating the S.LSI Cellular TAS feature, this section provides the general guidance to select test cases.

4.1.1 Time-Varying Tx Power Transmission

Two predefined time-varying transmit (Tx) power sequences are applied for all RAT cases, as described below:

1. **Test Sequence A:** This sequence consists of two power levels. One level is the maximum transmit power, $P_{\max}$, which is applied for at least 150 seconds. The other level is set to the target power level plus 2 dB ($P_{\text{limit}}(\text{dBm}) + 2 \text{ dB}$) and is applied for at least 200 seconds.
2. **Test Sequence B:** This sequence consists of multiple transmit power levels. The specific power levels are defined in the Appendix B as functions of $P_{\max}$ and P_{limit} .

The Samsung S.LSI TAS algorithm operates independently of band, mode, or channel for a given technology. Accordingly, validation can be performed using one or two representative band/mode/channel combinations per technology. The selection of these combinations is based on the relative values of P_{limit} and $P_{\max}$.

Specifically, the selected combination must satisfy $P_{\text{limit}} < P_{\max}$ so that the TAS algorithm actively enforces transmit power restrictions. In principle, two bands may be selected with different P_{limit} values, one corresponding to the lowest P_{limit} and another corresponding to the highest P_{limit} that remains below $P_{\max}$.

For the purpose of demonstrating TAS algorithm performance in this report, only the low P_{limit} case is considered.

4.1.2 Change In Call

The criterion for selecting the technology and band for call setup and call drop transition testing is to choose the band with the lowest P_{limit} among all supported bands. The test is performed with the DUT requesting transmission at $P_{\max}$ so that the Samsung S.LSI TAS feature enforces transmit power restriction for the longest possible duration. The call transition is initiated while the DUT is operating under power-restricted conditions.

A single test is sufficient, as the TAS behavior is independent of band or technology. For the purpose of demonstrating TAS algorithm performance in this report, only the low P_{limit} case is considered.

4.1.3 Change In Technology/Band/Antenna

FCC specifies different measurement durations for time averaging based on the operating frequency. The criterion for selecting test cases to demonstrate compliance is to choose a technology, band, and antenna group for which $P_{\text{limit}} < P_{\max}$, ensuring that the TAS algorithm actively enforces transmit power restrictions.

For the purpose of demonstrating TAS algorithm performance in this report, only the low P_{limit} case is considered.

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4.1.4 SAR Exposure Switching

The criterion for selecting this test case is to choose one LTE band and one NR band for which $P_{\text{limit}} < P_{\text{max}}$ in each case. The test is performed with both RATs operating simultaneously in an EN-DC scenario.

4.2 Test Procedures for Conducted Power Measurements for Cellular Validation

This section provides general conducted power measurement procedures to perform compliance test under dynamic transmission scenarios described in Section 3. In practice, an adjustment can be made in these procedures. The justification/clarification may be provided.

The TAS algorithm is independent of the transmit power level and can operate with any two set power levels (one higher and one lower than P_{limit}). The choice of the upper level is therefore arbitrary and is typically set to the average P_{max} , which accounts for any known duty cycle and maximum power reduction (MPR) applied during the test.

All tests reported herein use fixed-amplitude modulation (QPSK for NR and LTE). For SAR characterization, the correct P_{limit} is set to achieve the SAR design target. The TAS algorithm ensures that the long-term average transmit power remains below P_{limit} , regardless of P_{max} .

Throughout the test procedures described in this section, the term “ALL UP” is used to indicate the power control “up” command. In this context, the test equipment requests the UE to transmit at the maximum power level of its assigned power class. In addition, throughout the test procedures described in this section, the term “ALL DOWN” is used to indicate the power control “down” command. In this context, the test equipment requests the UE to transmit at the minimum power level.

4.2.1 Time-Varying Tx Power Transmission

This test is performed using the two predefined test sequences for all sub-6 GHz technologies, including GSM, WCDMA, LTE, and NR FR1. The purpose of the test is to demonstrate enforcement of maximum transmit power limits and to verify that the time-averaged SAR always remains below the FCC limit.

Test procedure

1. Using P_{max} and P_{limit} , generate the power level test sequences for each selected technology and band. Both Test Sequences A and B are generated. Maximum power may be adjusted based on DUT test results.
2. Connect the DUT to the call box in the selected RAT. Configure the call box to request DUT transmit power according to the sequences generated in Step 1. Set an initial transmit power of 0 dBm for 60 seconds prior to starting the test sequence to facilitate post-processing of the time-averaged values with the first sequence value.
3. After completion of the sequence, release the connection.
4. Plot Instantaneous and Averaged Power
 - Instantaneous transmit power versus time (measured in Step 2)
 - Requested transmit power versus time (from Step 2)
 - Time-averaged power over 60 seconds using instantaneous values from Step 2
 - P_{limit} determined to meet the SAR design target

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5. Plot Time-Averaged SAR

- Computed time-averaged 1 g SAR versus time (from Step 2)
- FCC 1 g SAR limit of 1.6 W/kg

Pass Criteria: Time-averaged 1 g SAR (Step 5) must not exceed the FCC limit of 1.6 W/kg at any time during the test. Time-averaged transmit power (Step 4) must not exceed P_{limit} at any point in the test sequence.

4.2.2 Change in Call

This test is designed to demonstrate that the Samsung S.LSI TAS feature correctly accounts for historical transmit power values during time averaging when a new call is established. The call transition is performed while the DUT is operating under active power-limit enforcement.

Test procedure

1. Connect the DUT to the call box.
2. Configure the call box to set DUT transmit power to a low value below 0 dBm for 60 seconds.
3. Configure the call box to send “**ALL UP**” power control commands.
4. Continue transmission from the DUT to achieve the maximum power P_{max} .
5. After 150 seconds of transmission at P_{max} , release the call from the call box.
6. After 10 seconds, re-establish the LTE connection from the call box to the DUT.
7. Repeat sending “**ALL UP**” power control commands to bring transmit power to P_{max} and continue transmission for 140 seconds.
8. Release the LTE connection at the end of the sequence.
9. Plot Instantaneous and Averaged Power
 - Instantaneous transmit power versus time (measured in Step 2)
 - Requested transmit power versus time (from Step 2)
 - Time-averaged power over 60 seconds using instantaneous values from Step 2
 - P_{limit} determined to meet the SAR design target
10. Plot Time-Averaged SAR
 - Computed time-averaged 1 g SAR versus time (from Step 2)
 - FCC 1 g SAR limit of 1.6 W/kg

Pass Criteria: Time-averaged 1 g SAR must not exceed the FCC limit of 1.6 W/kg at any time during the test. Time-averaged transmit power must not exceed P_{limit} at any point in the test sequence. The current TAS algorithm software enables the UE to accurately estimate transmit power and time-averaged SAR, even during call drop and call re-establishment events. The UE records the time when it enters sleep mode and uses this information upon wake-up to calculate the durations of transmit power on and off periods

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4.2.3 Change In Technology/Band/Antenna

This test is designed to demonstrate that the Samsung S.LSI TAS feature can correctly handle changes in technology, band, and antenna when a new event occurs. Since both P_{limit} and the antenna can vary across bands, separate equations are used to convert transmit power to SAR, and combined SAR exposure criteria are applied as follows:

$$\text{SAR}_1(t) = \frac{\text{TxPower}_1(t)}{P_{\text{limit},1,\text{FR1}}} \times \text{SAR}_{\text{design target1}} \quad (6.3-1)$$

$$\text{SAR}_2(t) = \frac{\text{TxPower}_2(t)}{P_{\text{limit},2,\text{FR1}}} \times \text{SAR}_{\text{design target2}} \quad (6.3-2)$$

Here:

- $P_{\text{limit},1,\text{FR1}}$ corresponds to the measured power at which the first technology/band meets the measured SAR level of $\text{SAR}_{\text{design target1}}$, with a time-averaging duration of $T_{1,\text{SAR}}$.
- $P_{\text{limit},2,\text{FR1}}$, $\text{SAR}_{\text{design target2}}$, and $T_{2,\text{SAR}}$ are similarly defined for the second technology/band/antenna combination.
- In this report, a 60-second time-averaging duration is applied for all sub-6 GHz bands, including those below 3 GHz.

Test procedure

1. Establish radio connection of DUT with call box.
1. Configure call box to set DUT Tx power to a low value below 0 dBm for 60s.
2. Configure call box to send "ALL UP" power control commands and continue transmission from DUT so that maximum power of Pmax is achieved Continue the transmission for 150s.
3. Change the technology/band/antenna to 2nd technology/band/antenna and continue the transmission for another 150s.
4. Release the connection.
5. Plot Instantaneous and Averaged Power
 - Instantaneous transmit power versus time (measured in Step 2)
 - Requested transmit power versus time (from Step 2)
 - Time-averaged power over 60 seconds using instantaneous values from Step 2
 - P_{limit} determined to meet the SAR design target
6. Plot Time-Averaged SAR
 - Computed time-averaged 1 g SAR versus time (from Step 2)
 - FCC 1 g SAR limit of 1.6 W/kg

Pass Criteria: Time-averaged 1 g SAR must not exceed the FCC limit of 1.6 W/kg at any time during the test. Time-averaged transmit power must not exceed P_{limit} at any point in the test sequence. 1.6 W/kg throughout the test duration. It is required to check if power limiting enforcement is operated as expected when tech/band/antenna change occurs in between.

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4.2.4 SAR Exposure Switching

These tests are designed to demonstrate that the Samsung S.LSI TAS feature can correctly handle changes in the dominant SAR-contributing radio when two RATs are active simultaneously. The test involves adjusting the required transmit power of both radios so that either one or both RATs become the dominant contributor to the total exposure ratio at different times during the test.

Test procedure:

1. Test procedure Connect the DUT to both LTE and NR call boxes in an NSA.
2. Configure both LTE and NR call boxes to set DUT transmit power to a low value of 0 dBm for 60 seconds.
3. Configure the NR call box to send “**ALL UP**” power control commands.
4. Continue DUT transmission until NR reaches maximum power $P_{\max}$ and maintain for 150 seconds.
5. Configure the LTE call box to send “**ALL UP**” power control commands, resulting in both LTE and NR requesting maximum power from the DUT.
6. Continue transmission for 150 seconds.
7. Configure the NR call box to send “**ALL DOWN**” power control commands so that LTE becomes the dominant SAR-contributing radio.
8. Continue transmission for 150 seconds.
9. Release both LTE and NR connections.
10. Plot Instantaneous and Averaged Power
 - Instantaneous transmit power versus time (measured in Step 2)
 - Requested transmit power versus time (from Step 2)
 - Time-averaged power over 60 seconds using instantaneous values from Step 2
 - P_{limit} determined to meet the SAR design target
11. Plot Time-Averaged SAR
 - Computed time-averaged 1 g SAR versus time (from Step 2)
 - FCC 1 g SAR limit of 1.6 W/kg

Pass Criteria: Time-averaged 1 g SAR must not exceed the FCC limit of 1.6 W/kg at any time during the test. Time-averaged transmit power must not exceed P_{limit} at any point in the test sequence. 1.6 W/kg throughout the test duration. of 1.6 W/kg throughout the test duration. It is required to check if power limiting enforcement is operated as expected when dominant power is changed in ENDC.

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5 CONNECTIVITY (WLBT) TEST PROCEDURS

This chapter provides the test plan and test procedure for validating S.LSI Cellular TAS, WLBT Connectivity TAS, and DC-TAS transmission. The 60 seconds time window is used for cellular technologies, and 30 seconds time window is used for all WLAN/BT bands (e.g. 2.4GHz, 5GHz, and 6GHz).

5.1 Test Configuration Selection Criteria for WLAN and Bluetooth Validation

For validating the S.LSI WLBT TAS feature, this section provides the general guidance to select test cases.

Three different test scenarios were defined to verify that the time-averaged transmit power is properly controlled in response to changes in the Plimit value. During each test, Plimit was modified mid-test to evaluate whether the time-averaged power correctly tracks the updated Plimit setting via RSI state. The total test duration was 720 seconds:

1. **WLAN only:** WLAN connected case to the AP (access point)
2. **WLAN with BT:** WLAN and Bluetooth coexistence with dominant power switching, evaluated under multiple Bluetooth operating scenarios, including BT Off, BT Normal On, BT Audio Mode, and BT Maximum Power.

The Samsung S.LSI TAS algorithm operates independently of band, mode, or channel for a given technology. Specifically, the selected combination must satisfy $P_{\text{limit}} < P_{\text{max}}$ so that the TAS algorithm actively enforces transmit power restrictions.

5.2 Test Procedures for WLAN and Bluetooth Validation

1. **WLAN only (AP connected):**
 - Establish WLAN connections between the DUT and the call boxes on the selected WLAN bands.
 - Plimit is configured according to the initial RSI state and maintained for the first 360 s.
 - The RSI state is then changed, and Plimit is updated accordingly and maintained for the subsequent 360 s.
2. **Dominant power switching WLBT**
 - Establish WLAN and Bluetooth (BT) connections between the DUT and the call boxes on the selected BT bands and WLAN 5G bands.
 - Set both WLAN and BT to ALL DOWN for 140 s.
 - Set WLAN to ALL UP while keeping BT at ALL DOWN (BT remains in the OFF state) for 140 s.
 - Change BT to Normal-On mode and maintain WLAN at ALL UP for 140 s.
 - Change BT to Normal-Audio mode while maintaining WLAN at ALL UP for 140 s.
 - Set WLAN to ALL DOWN and keep BT transmitting (BT in Max mode) for 140 s.

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6 CELLULAR-CONNECTIVITY (C-TAS) TEST PROCEDURES

6.1 Test Configuration Selection Criteria for C-TAS Validation

For validating the S.LSI C-TAS feature, this section provides the general guidance to select test cases.

Test scenarios were defined to verify that the time-averaged transmit power is properly controlled in response to changes in the WLAN and cellular simultaneous operation under multiple scenarios, including ALL UP and ALL DOWN conditions:

1. WLAN and Cellular Coexistence 1
2. WLAN and Cellular Coexistence 2
3. WLAN and Cellular Coexistence 3

The Samsung S.LSI TAS algorithm operates independently of band, mode, or channel for a given technology. Specifically, the selected combination must satisfy $P_{\text{limit}} < P_{\text{max}}$ so that the TAS algorithm actively enforces transmit power restrictions.

6.2 Test Procedures for C-TAS Validation

1. WLAN and Cellular Coexistence 1

- Establish NR/LTE and WLAN connections between the DUT and the call boxes on the selected LTE/NR bands and the WLAN band.
- Set both NR/LTE and WLAN to ALL DOWN for 100 s.
- Set NR/LTE to ALL UP while keeping WLAN at ALL DOWN for 150 s.
- Maintain NR/LTE at ALL UP and set WLAN to ALL UP for 150 s.
- Set NR/LTE to ALL DOWN while keeping WLAN at ALL UP for 150 s.
- Release all connections.

2. WLAN and Cellular Coexistence 2

- Establish NR/LTE and WLAN connections between the DUT and the call boxes on the selected LTE/NR bands and the WLAN band.
- Set both NR/LTE and WLAN to ALL DOWN for 100 s.
- Set NR/LTE to ALL UP while keeping WLAN at ALL DOWN for 150 s.
- Set NR/LTE to ALL DOWN and set WLAN to ALL UP for 150 s.
- Release all connections.

3. WLAN and Cellular Coexistence 3

- Establish NR/LTE and WLAN connections between the DUT and the call boxes on the selected LTE/NR bands and the WLAN band.
- Set both NR/LTE and WLAN to ALL DOWN for 100 s.
- Keep NR/LTE at ALL DOWN and set WLAN to ALL UP for 150 s.
- Set NR/LTE to ALL UP while keeping WLAN at ALL UP for 150 s.
- Keep NR/LTE at ALL UP and set WLAN to ALL DOWN for 150 s.
- Release all connections.

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7 TEST CONFIGURATIONS AND MEASUREMENT SETUP

7.1 Test Configuration

The P_{limit} values corresponding to a SAR_{design_target} of 1.0 W/kg (1g SAR) for both cellular and connectivity technologies, across all technologies and bands supported by the DUT, are derived in the RF Exposure Part 0 Report and summarized in Table 7-1. All P_{limit} power levels listed in Table 7-1 represent time-averaged transmit power, with duty cycle effects properly accounted for in the case of TDD modulation schemes.

Table 7-1
 P_{limit} for supported technologies and bands

Exposure Scenario			Maximum Tune-Up Output Power*	Body-Worn, Hotspot, or Phablet	Head
Averaging Volume				1g/10g	1g
Spacing				10mm, 5mm, 0mm	0mm
RSI				0	1
Technology/Band	Antenna	Antenna Group	P _{max}	P _{limit}	P _{limit}
GSM 850	A	AG0	24.6	20.8	42.4
GSM 850	E	AG1	24.8	18.8	18.8
GSM 1900	A	AG0	21.3	17.6	33.7
UMTS 850	A	AG0	24.0	22.0	32.9
UMTS 850	E	AG1	23.5	21.0	21.0
LTE Band 12	A	AG0	24.5	22.0	32.9
LTE Band 12	E	AG1	24.0	19.0	19.0
LTE Band 26/5	A	AG0	24.0	21.5	31.3
LTE Band 26/5	E	AG1	23.5	19.5	19.5
LTE Band 66	A	AG0	23.5	17.0	32.1
LTE Band 66	F	AG1	23.0	17.0	17.0
LTE Band 2	A	AG0	23.5	17.0	32.1
LTE Band 2	F	AG1	23.0	18.0	18.0
LTE Band 41	B	AG0	21.0	16.0	31.9
LTE Band 41	F	AG1	21.0	15.0	15.0
NR Band n5	A	AG0	24.0	22.0	34.1
NR Band n5	E	AG1	23.5	19.0	19.0
NR Band n41 PC3	B	AG0	23.5	32.8	19.0
2.4 GHz WIFI	H	AG1	18.0	16.0	14.0
2.4 GHz WIFI MIMO	H	AG1	18.0	20.8	18.0
2.4 GHz WIFI MIMO	J	AG1	16.0	19.1	16.0
5 GHz WIFI	G	AG1	16.0	16.9	13.0
5 GHz WIFI MIMO	E	AG1	14.0	18.4	13.9
5 GHz WIFI MIMO	G	AG1	16.0	21.7	15.9
6 GHz WIFI	G	AG1	9.0	20.6	15.2
6 GHz WIFI MIMO	E	AG1	6.0	19.5	14.8
6 GHz WIFI MIMO	G	AG1	9.0	23.4	17.3
2.4 GHz Bluetooth	H	AG1	0.0	22.0	19.9

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* Maximum tune up target power, P_{max} , is configured in NV settings in DUT to limit maximum transmitting power. This power is converted into peak power in NV settings for TDD schemes. The DUT maximum allowed output power is equal to $P_{max} + 1$ dB device uncertainty.

The measured P_{limit} for all the selected radio configurations is listed below Table 7-2, 7-3, and 7-4. P_{max} was also measured for radio configurations selected for testing time-varying Tx power transmission scenarios to generate test sequences following the test procedures in Section 4.2.

Table 7-2
Cellular Radio configurations selected for Part 2 test

Test Case #	Test Scenario	Tech	Band	Antenna	Antenna Group	RSI	Channel	Frequency [MHz]	Test Configurations	Tune-up P _{limit} [dBm]	Tune-up P _{max} [dBm]	Measured P _{limit} [dBm]	Measured P _{max} [dBm]	SAR Design Target [W/kg]
1	Time Varying Tx Power	GSM	850	A	0	0	190	836.5	GPRS 4 Tx Slots	20.8	24.3	20.12	24.67	1.000
2			1900	A	0	0	661	1880	GPRS 4 Tx Slots	16.3	20.8	16.82	20.83	1.000
3		WCDMA	5	E	1	0	4183	836.5	RMC	21.0	23.5	20.07	23.68	1.000
4		LTE	12	A	0	0	23095	707.5	QPSK 1/25/10 MHz BW	22.0	24.5	21.84	24.02	1.000
5			41	F	1	0	40620	2593	QPSK 1/50/20 MHz BW	15.0	21.0	14.67	21.02	1.000
6		NR	n5 NSA	A	0	0	167300	836.5	DFT-S-OFDM, QPSK 1/1/20 MHz BW	22.0	24.0	22.09	24.67	1.000
7			n41 SA	B	0	0	518598	2593	DFT-S-OFDM, QPSK 1/1/100 MHz BW	17.5	25.5	17.40	24.94	1.000
8	Dropped Connection	LTE	41	F	1	0	40620	2593	QPSK 1/50/20 MHz BW	15.0	21.0	14.67	21.02	1.000
9	Technology / Band Hand-off / Antenna (two TAS RATs)	LTE	41	B	1	0	40620	2593	QPSK 1/50/20 MHz BW	16.0	21.0	16.53	21.76	1.000
		WCDMA	5	A	1	0	4183	836.5	RMC	22.0	24.0	22.17	24.75	1.000
10	SAR Exposure Switching EN-DC	LTE	66	A	0	0	132322	1745	QPSK 1/50/20 MHz BW	17.0	23.5	17.37	22.98	1.000
		Sub6 NR NSA	n5 NSA	A	0	0	167300	836.5	DFT-S-OFDM, QPSK 1/1/20 MHz BW	22.0	24.0	21.72	24.32	1.000

- The device's uncertainty is +/- 1 dB as provided by manufacturer
- The above P_{max} value for GPRS850 and GPRS1900 are for 4 Tx Slots
- All powers are time-averaged powers.

This device does not support uplink carrier aggregation (ULCA) or uplink MIMO (UL-MIMO); therefore, the corresponding test cases were not performed. For scenarios involving two simultaneous transmitters, coupled antenna configurations were evaluated to demonstrate compliance with applicable SAR regulatory requirements. Uncoupled antenna configurations were evaluated on an optional basis.

Table 7-3
Connectivity (WLBT) configurations selected for Part 2 test

Test Case #	Test Scenario	Tech	Band	Antenna	Antenna Group	RSI	Channel	Frequency [MHz]	Test Configurations	Tune-up P _{limit} [dBm]	Tune-up P _{max} [dBm]	Measured P _{limit} [dBm]	Measured P _{max} [dBm]	SAR Design Target [W/kg]
1	WLAN 2.4 GHz only connected case to the AP (access point)	WLAN	2.4	H	1	0	6	2437	802.11b 20MHz DSSS	16.0	18.0	15.92	17.32	1.000
						1				14.0		13.95		
2	WLAN 5 GHz only connected case to the AP	WLAN	5	G	1	0	153	5765	802.11ac 20MHz DSSS	16.0	16.0	15.35	15.35	1.000
						1				13.0		13.27		
3	WLBT with BT Normal on and audio mode	WLAN	5	G	1	1	153	5765	802.11ac 20MHz DSSS	13.0	16.0	13.27	15.35	1.000
		BT	2.4	H	1	1	39	2441	DSSS	16.8	16.8	17.29	17.29	1.000

- The device's uncertainty is +/- 1 dB as provided by manufacturer
- All powers are time-averaged powers.

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This device does not support simultaneous WLAN 2.4 GHz and Bluetooth 2.4 GHz transmission; therefore, the corresponding test cases were not performed. For WLAN 6 GHz, Plimit is greater than or equal to Pmax; as a result, the corresponding WLAN 6 GHz test case was excluded from this report.

Table 7-4
C-TAS configurations selected for Part 2 test

Test Case #	Test Scenario	Tech	Band	Antenna	Antenna Group	RSI	Channel	Frequency [MHz]	Test Configurations	Tune-up Plimit [dBm]	Tune-up Pmax [dBm]	Measured Plimit [dBm]	Measured Pmax [dBm]	SAR Design Target [W/kg]
1	WLAN and Cellular Coexistence Modified 1	LTE	66	F	1	1	132322	1745	QPSK 1/50/20 MHz BW	17.0	23.0	17.61	23.22	1.000
		WLAN	2.4	H	1	1	6	2437	802.11b 20MHz DSSS	14.0	18.0	13.95	17.32	1.000
2	WLAN and Cellular Coexistence Modified 2	LTE	66	F	1	1	132322	1745	QPSK 1/50/20 MHz BW	17.0	23.0	17.61	23.22	1.000
		WLAN	2.4	H	1	1	6	2437	802.11b 20MHz DSSS	14.0	18.0	13.95	17.32	1.000
3	WLAN and Cellular Coexistence Modified 3	LTE	66	F	1	1	132322	1745	QPSK 1/50/20 MHz BW	17.0	23.0	17.61	23.22	1.000
		WLAN	2.4	H	1	1	6	2437	802.11b 20MHz DSSS	14.0	18.0	13.95	17.32	1.000

- The device's uncertainty is +/- 1 dB as provided by manufacturer
- All powers are time-averaged powers.

Table 7-5
RSI and Corresponding Exposure Scenarios

Scenario	Description	SAR Test Cases
Head (RSI = 1)	▪ Device positioned next to head ▪ Receiver Active	<i>Head SAR per KDB Publication 648474 D04</i>
Body-worn (RSI = 0)	▪ Device being used with a body-worn accessory	<i>Body-worn SAR per KDB Publication 648474 D04</i>
Hotspot mode (RSI = 0)	▪ Device transmits in hotspot mode near body ▪ Hotspot Mode Active	<i>Hotspot SAR per KDB Publication 941225 D06</i>
Phablet (RSI = 0)	▪ Device is held with hand	<i>Phablet SAR per KDB Publication 648474 D04 & KDB Publication 616217 D04</i>

7.2 Conducted Power Measurement Setup

Legacy test setup

The Rohde & Schwarz CMW500 callbox was used in this test. The test setup schematic is shown in Figure 7.2-1a (Appendix A – Test Setup Photo 1, 3, 4, 7, 8) for measurements with a single antenna of DUT and in Figure 7.2-1b (Appendix A – Test Setup Photo 5) for measurements involving antenna switch. For single antenna measurement, one port (RF1 COM) of the callbox is connected to the RF port of the DUT using a directional coupler. For technology/band switch measurement, one port (RF1 COM) of the callbox used for signaling two different technologies is connected to a combiner, which is in turn connected to a directional coupler. The other end of the directional coupler is connected to a splitter to connect to two RF ports of the DUT corresponding to the two antennas of interest. In the setups, power meter is used to tap the directional coupler for measuring the conducted output power of the DUT. For all legacy conducted tests, only RF1 COM port of the callbox is used to communicate with the DUT.

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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.

Sub6 NR test setup:

The Anritsu MT8000A callbox was used in this test. The test setup schematic is the same as the Legacy Test Setup shown in Figure 7.2-1a (Appendix A – Test Setup Photo 1 and 2). One port of the callbox is connected to the RF port of the DUT using a directional coupler. In the setup, the power meter is used to tap the directional coupler for measuring the conducted output power of the DUT.

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.

LTE+Sub6 NR test setup:

The LTE conducted port and Sub-6 GHz NR conducted port are separate by filters on this EUT. Therefore, LTE and Sub-6 GHz NR signals for power meter measurements were conducted using independent measurement paths, as illustrated in in Figure 7.2-1c (Appendix A – Test Setup Photo 6) for the SAR Exposure Switching EN-DC test case.

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.

WLAN SISO test setup:

The Rohde & Schwarz CMW500 callbox was used in this test. The test setup schematic is the same as the Legacy Test Setup shown in Figure 7.2-1a (Appendix A – Test Setup Photo 7,8).

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.

WLAN and Bluetooth test setup:

The Rohde & Schwarz CMW500 callbox was used in this test. WLAN 5GHz port and Bluetooth 2.4GHz conducted ports are different on this EUT, therefore, the WLAN and Bluetooth signals for power meter measurement are performed on separate paths as shown below in Figure 7.2-1d (Appendix A – Test Setup Photo 9).

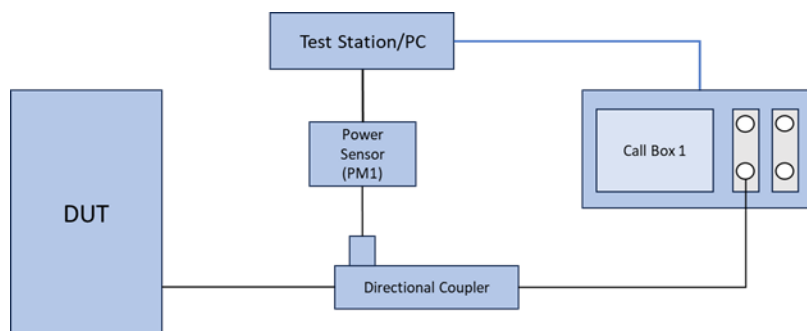
All the path losses from RF port of DUT to the callbox RF COM port and to the power meter are calibrated and automatically entered as offsets in the callbox and the power meter via test scripts on the PC used to control callbox and power meter.

WLAN and LTE test setup:

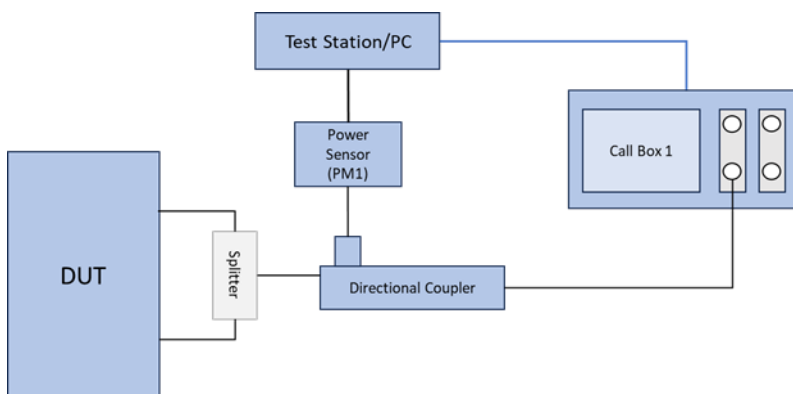
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The Rohde & Schwarz CMW500 callbox was used in this test. WLAN 2.4GHz port and LTE conducted ports are different on this EUT, therefore, the WLAN and LTE signals for power meter measurement are performed on separate paths as shown below in Figure 7.2-1e (Appendix A – Test Setup Photo 10).

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.

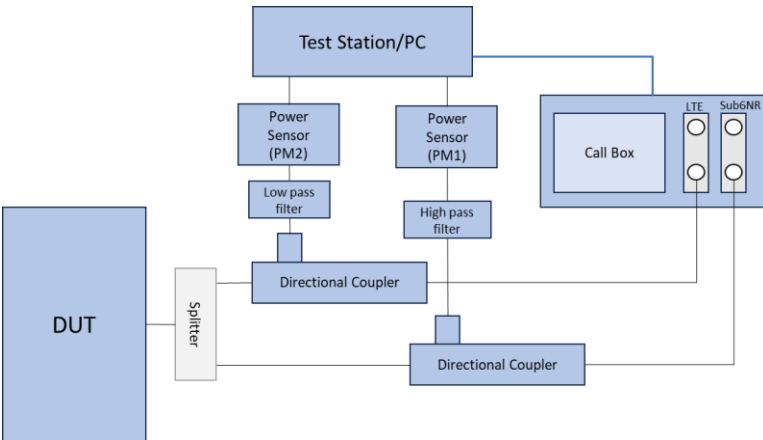


(a) Appendix A – Test Setup Photo 1, 2, 3, 4, 7, 8

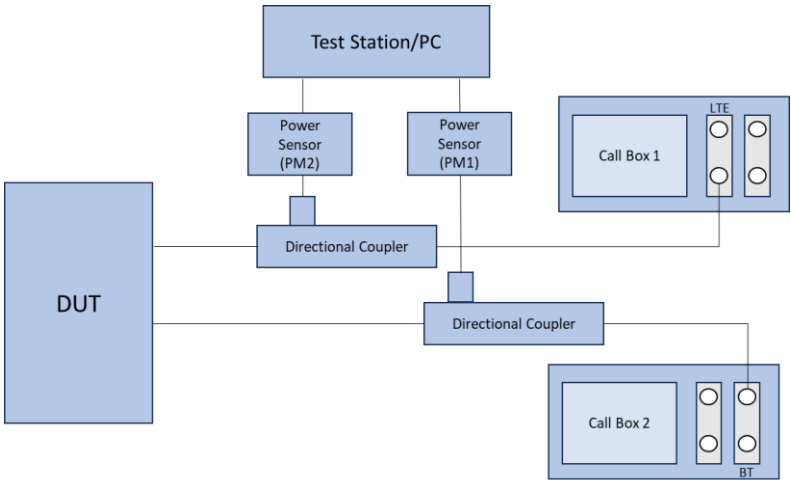


(b) Appendix A – Test Setup Photo 5

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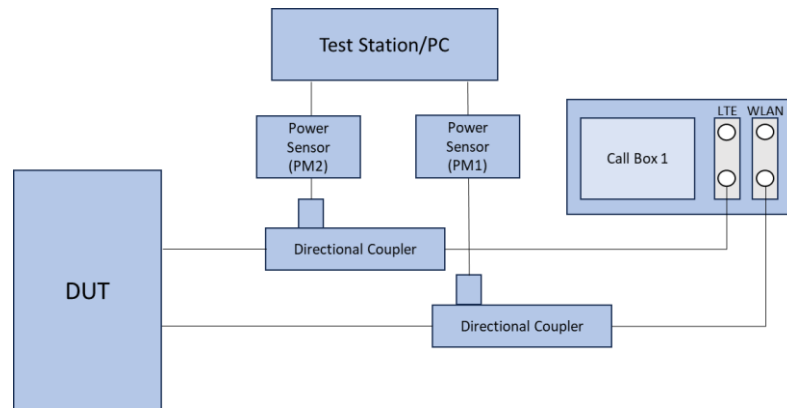


(c) Appendix A – Test Setup Photo 6



(d) Appendix A – Test Setup Photo 9

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(e) Appendix A – Test Setup Photo 10

Figure 7.2-1 Conducted power measurement setup

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 DUT RF port using the power meter. The commands sent to the callbox to request power are:

- 0dBm for 100 seconds
- test sequence A or test sequence B (defined in Section 4.1 and generated in Section 4.2.1).
- stay at the last power level of test sequence A or test sequence B 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 RSI switch tests, after the call is established, the callbox is set to request the DUT'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 DUT 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 DUT for the rest of the test. Note that the call drop/re-establish, or technology/band/antenna switch or RSI switch is manually performed. See Section 4.2 for detailed test procedure of call drop test, technology/band/antenna switch test and RSI switch test.

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8 CONDUCTED POWER MEASUREMENT FOR CELLULAR TAS

8.1 Time-varying Tx Power

The time-varying Tx power test case can be skipped if the measured SAR at $P_{\max}$ is less than 90% of the SAR design target. In this scenario, even continuous transmission at $P_{\max}$ would not reach the target SAR limit.

Following the test procedure described in Section 4.2.1, conducted transmit power measurement results for all selected test cases are presented in this section. Time-varying transmit power measurements were performed using Test Sequence A or B, as defined in Appendix B.

In all conducted transmit power plots:

- The blue line represents the measured instantaneous power using the power meter.
- The dotted blue line represents the time-averaged transmit power.
- The dotted orange line represents the measured P_{limit} , where tune-up P_{limit} corresponding to the SAR design target.
- The dotted red line represents the measured P_{limit} with 1dB TAS uncertainty.

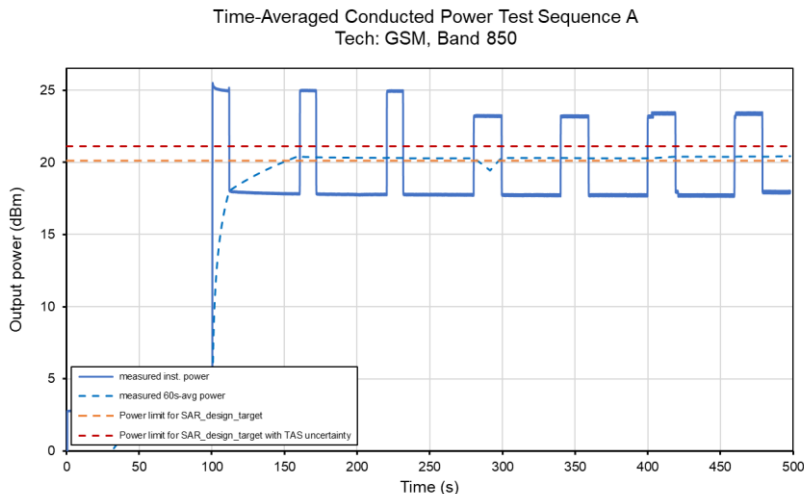
In all SAR plots:

- The blue line represents the time-averaged 1g SAR.
- The dotted orange line represents the SAR design target
- The dotted red line represents the SAR design target
- The red line represents the FCC 1 g SAR limit of 1.6 W/kg.

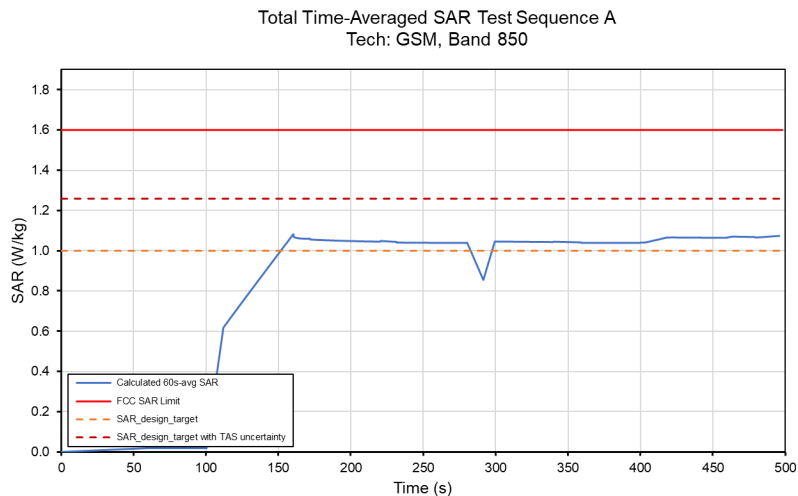
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8.1.1 GSM/GPRS 850, Antenna A

Test result for test sequence A:



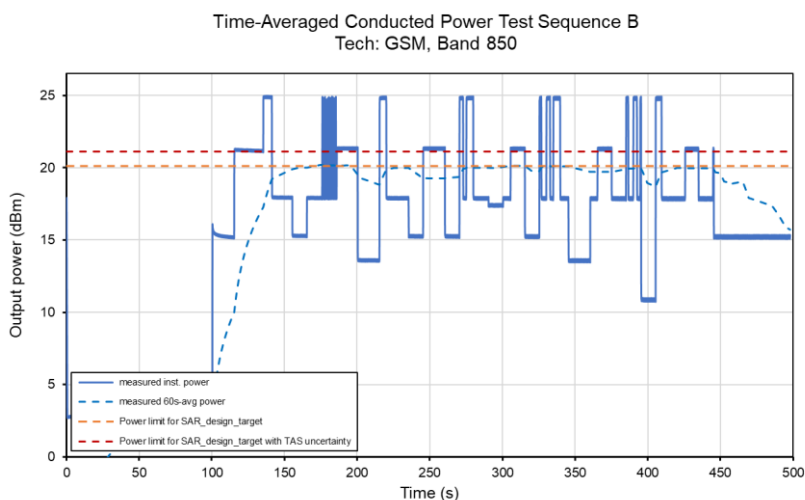
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



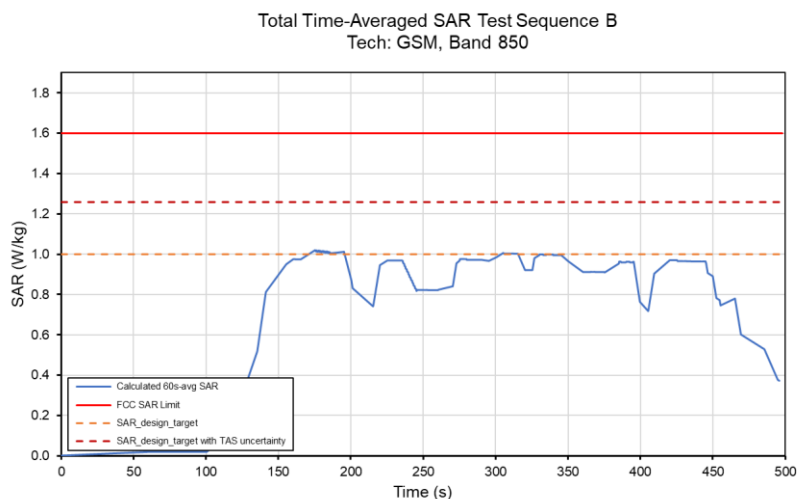
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.083
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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Test result for test sequence B:



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

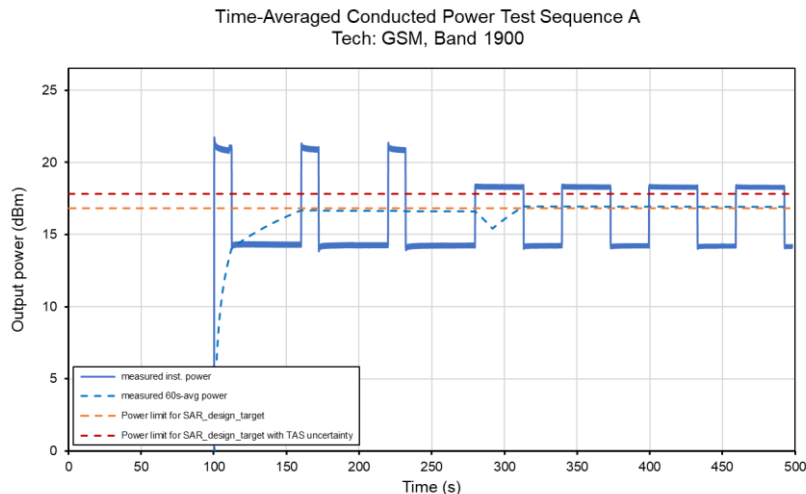


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.020
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

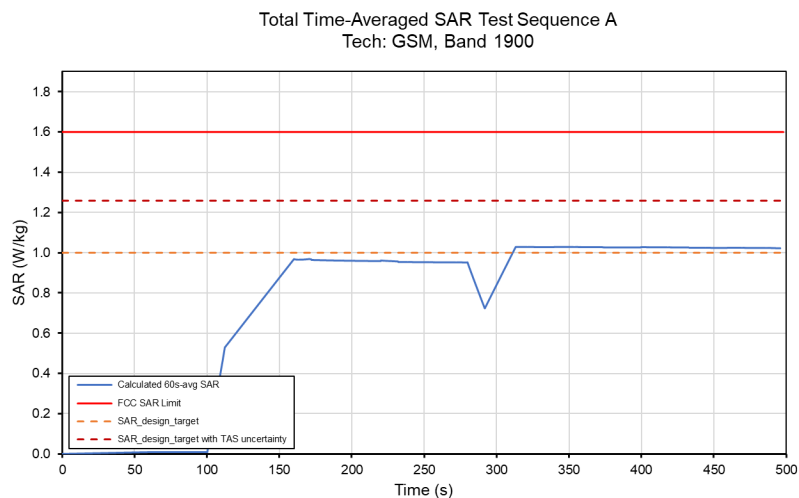
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.1.2 GSM/GPRS 1900, Antenna A

Test result for test sequence A:



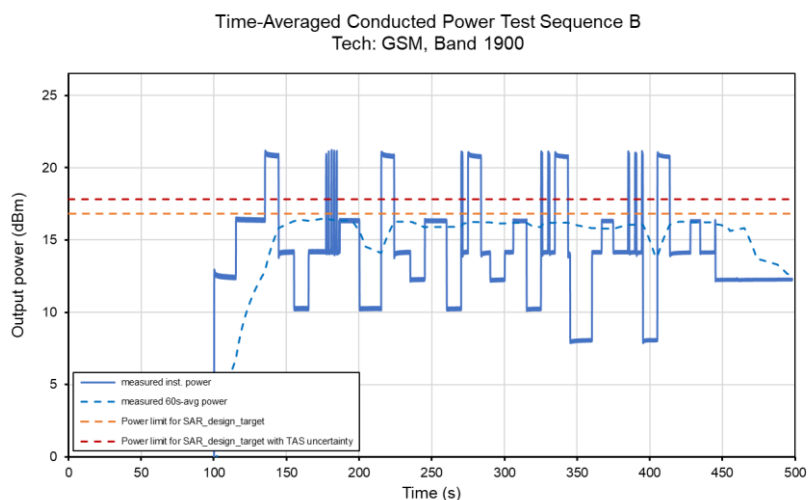
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



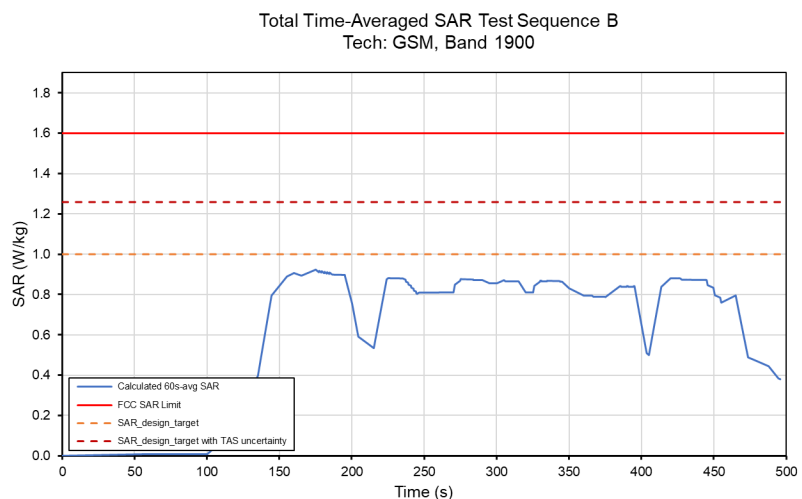
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.029
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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Test result for test sequence B:



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

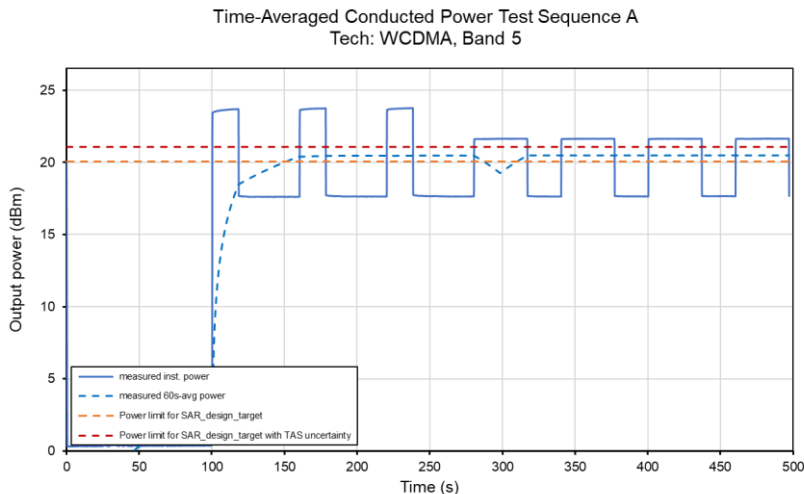


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.924
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

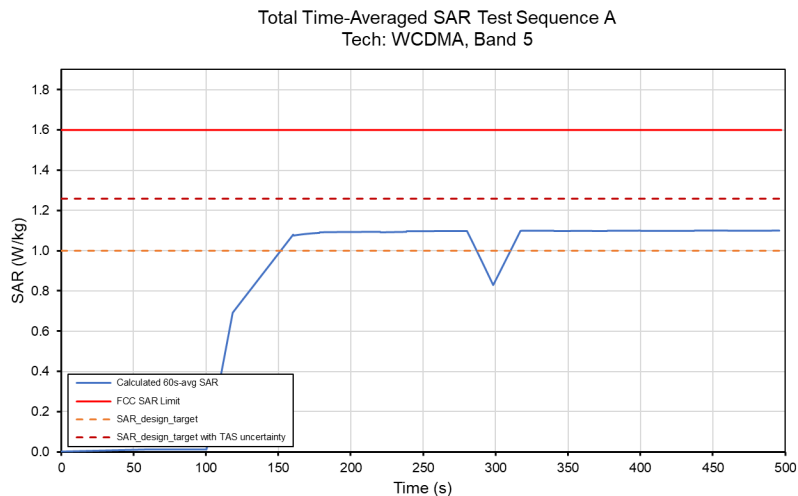
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.1.3 WCDMA Band 5, Antenna E

Test result for test sequence A:



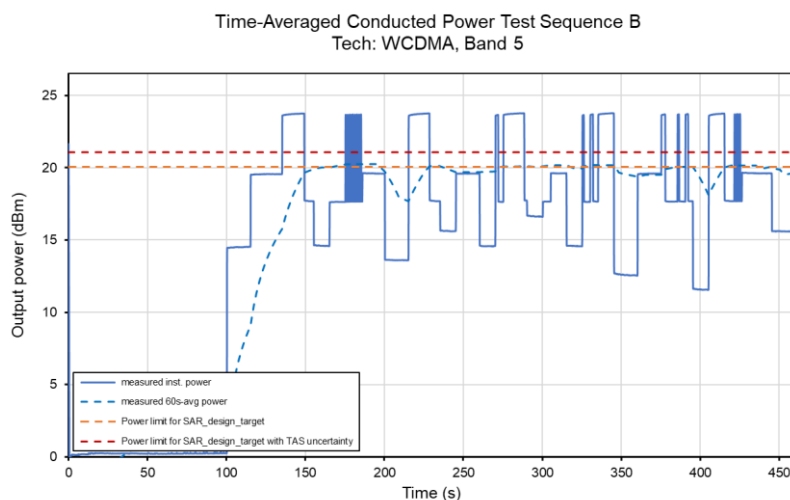
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



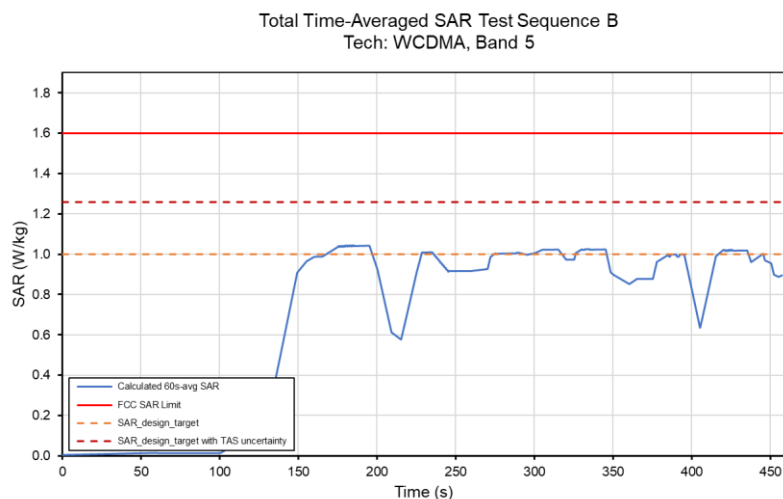
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.102
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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Test result for test sequence B:



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

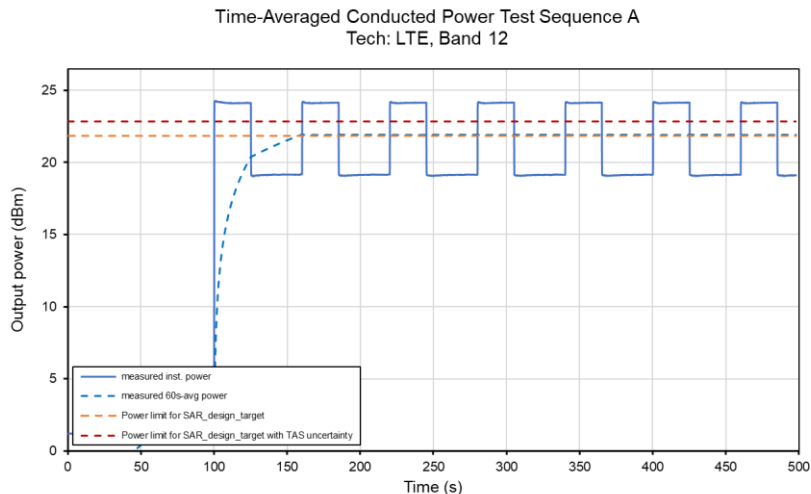


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.044
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

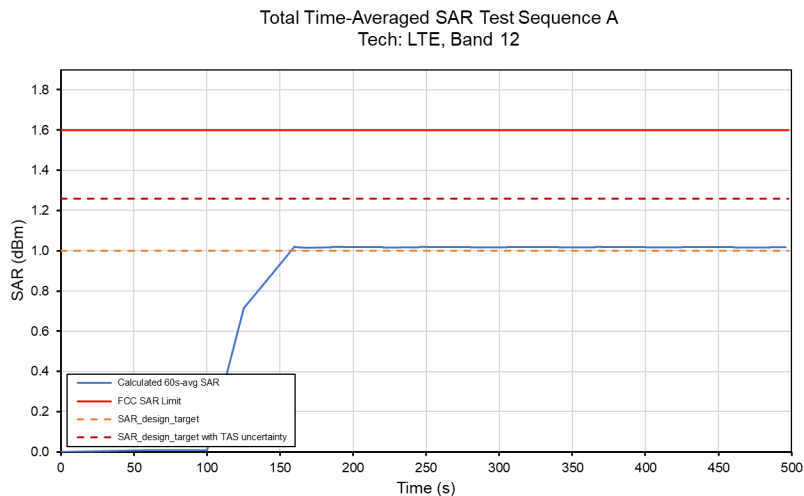
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.1.4 LTE Band 12, Antenna A

Test result for test sequence A:



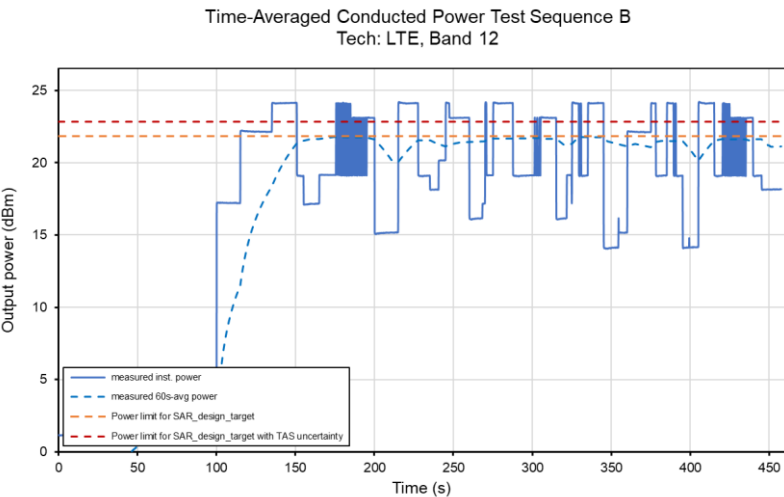
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



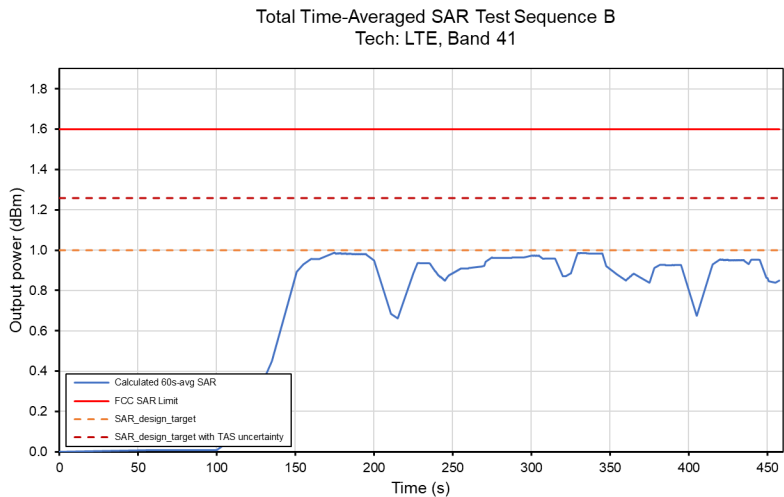
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.021
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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Test result for test sequence B:



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

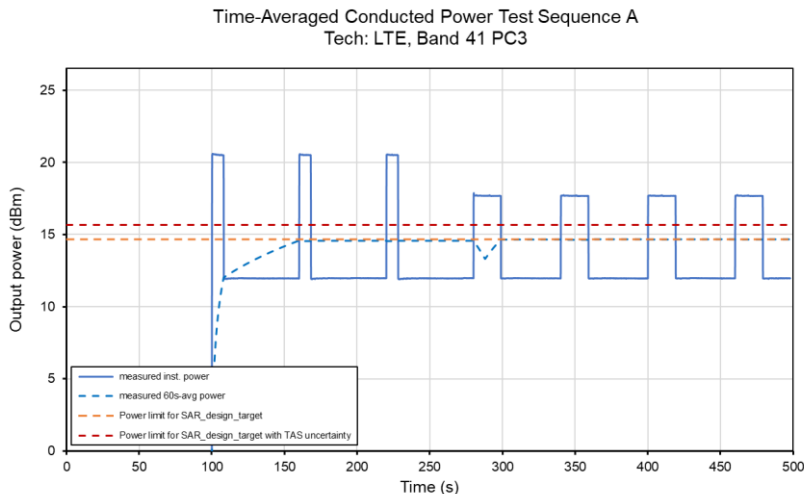


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.988
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

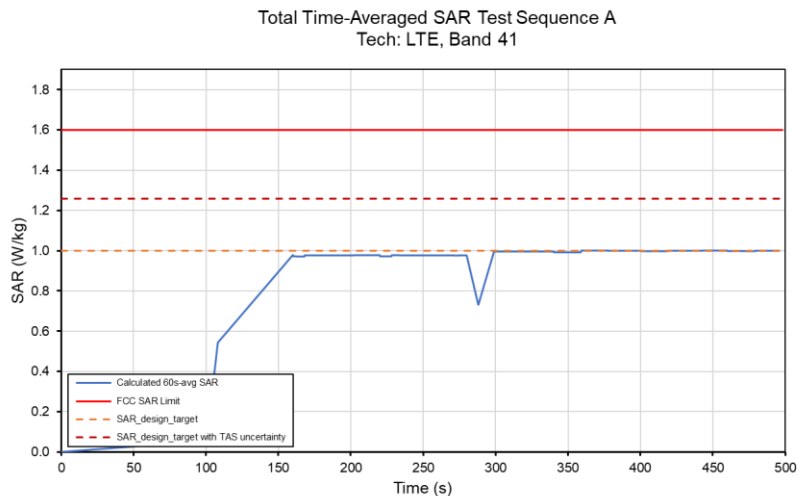
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.1.5 LTE Band 41, Antenna F

Test result for test sequence A:



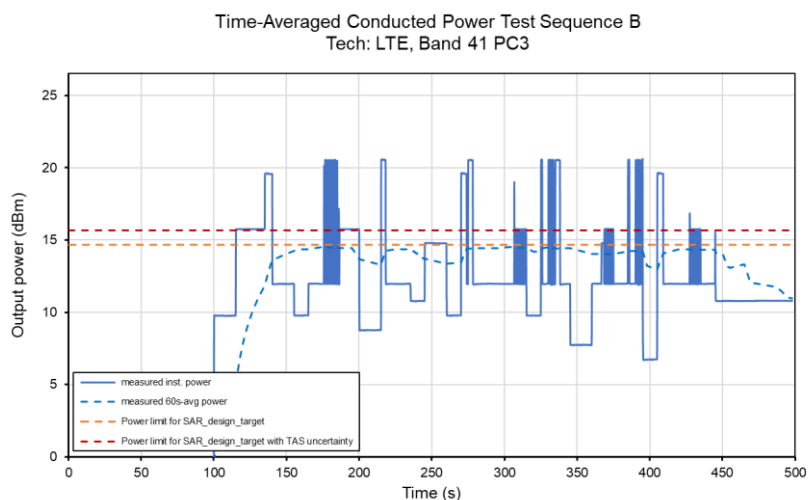
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



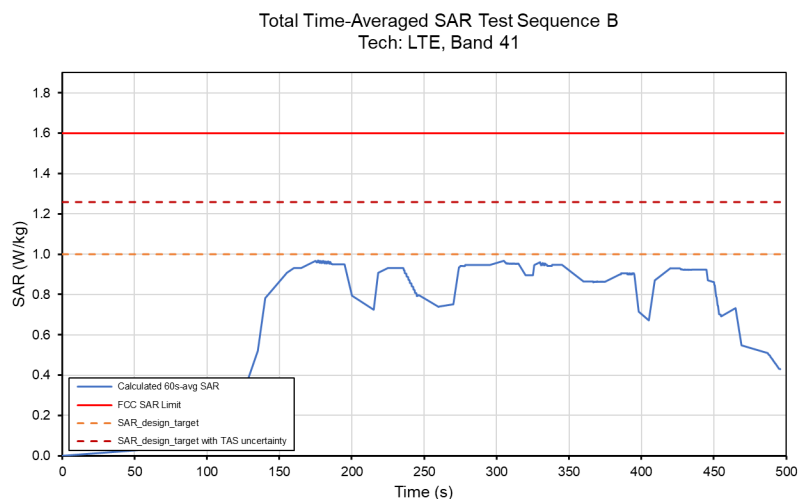
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.001
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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Test result for test sequence B:



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

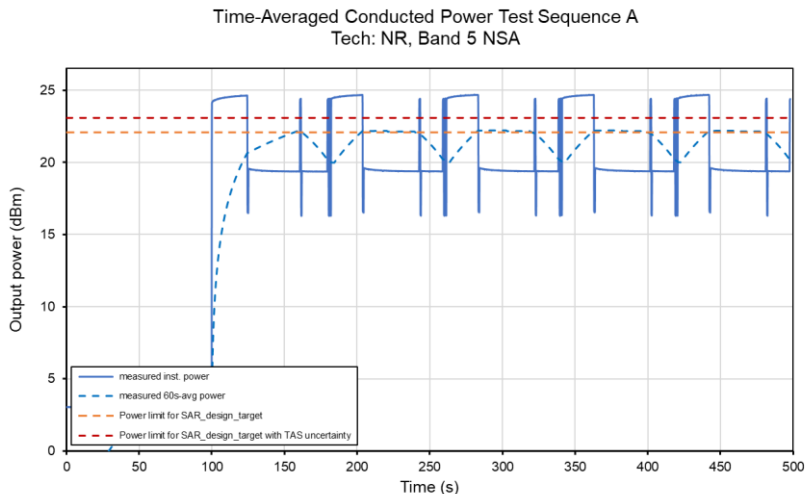


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.969
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

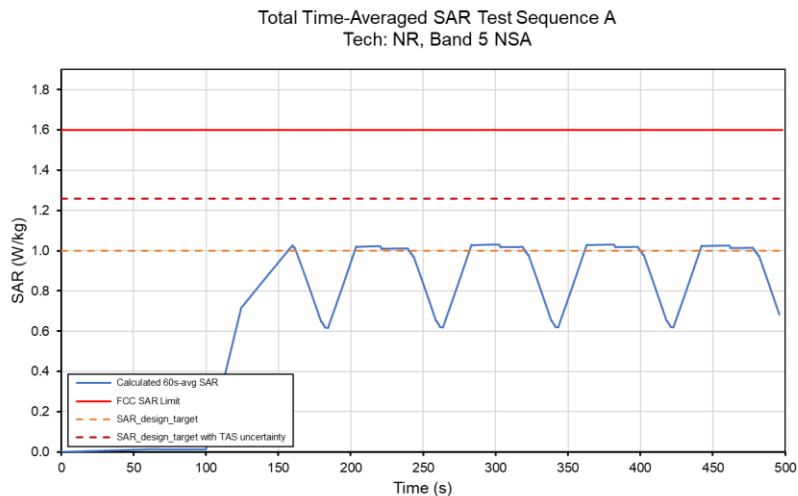
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.1.6 NR Band n5 NSA, Antenna A

Test result for test sequence A:



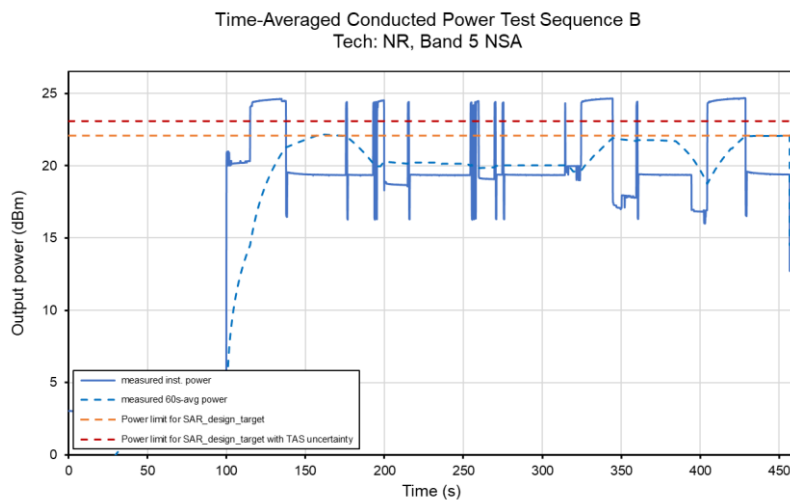
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



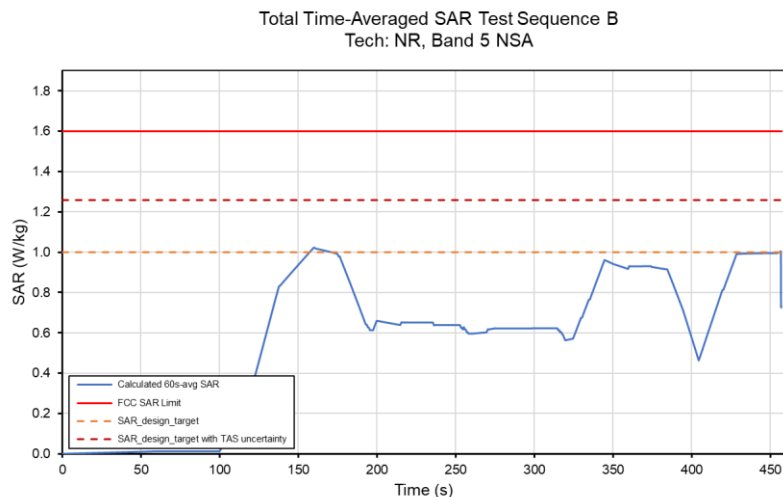
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.031
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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Test result for test sequence B:



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

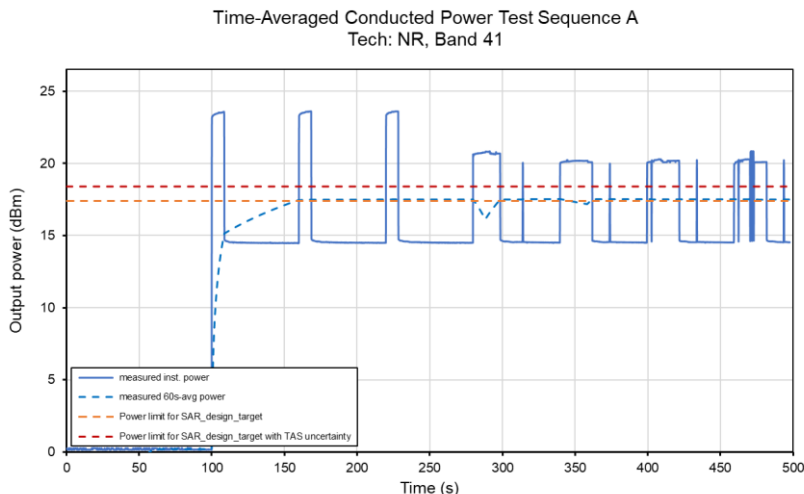


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.023
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

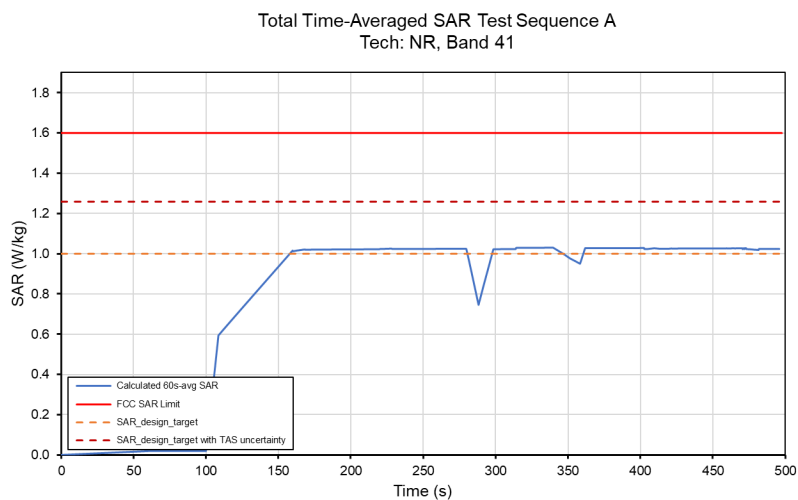
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.1.7 NR Band n41 SA, Antenna B

Test result for test sequence A:



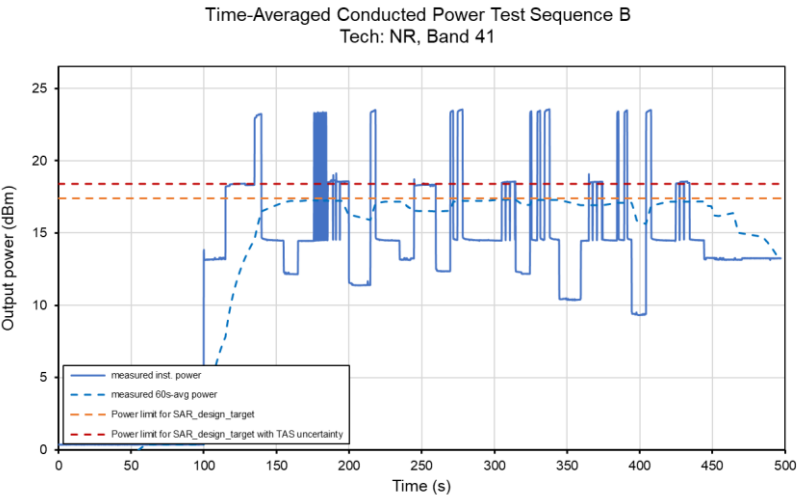
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



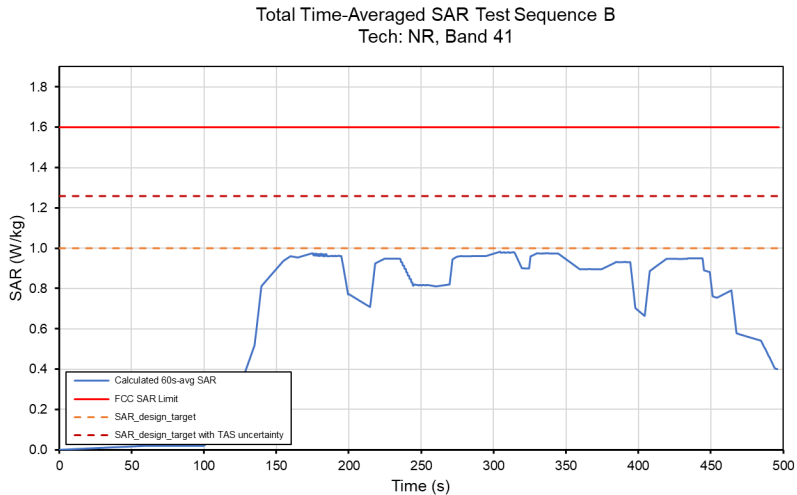
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.031
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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Test result for test sequence B:



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

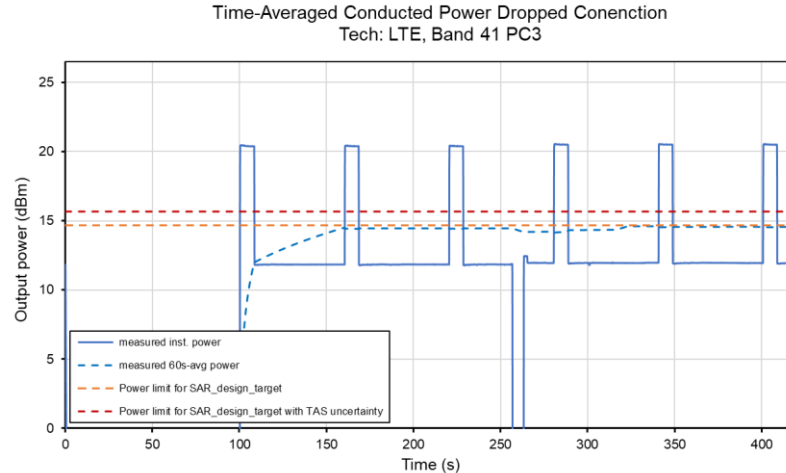


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.983
Validated: Max time averaged SAR (green curve) is within 1 dB device uncertainty of measured SAR at P_{limit} .	

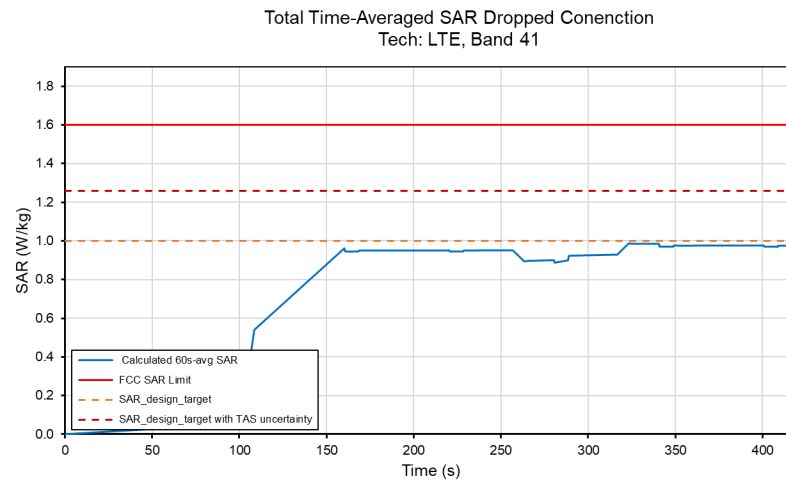
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.1 Change in Call

This test was measured with LTE Band n41, Antenna F, RSI = 0, and with callbox requesting maximum power. The measurement setup is shown in Figure 7.2-1a. The detailed test procedure is described in Section 4.2.2.



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



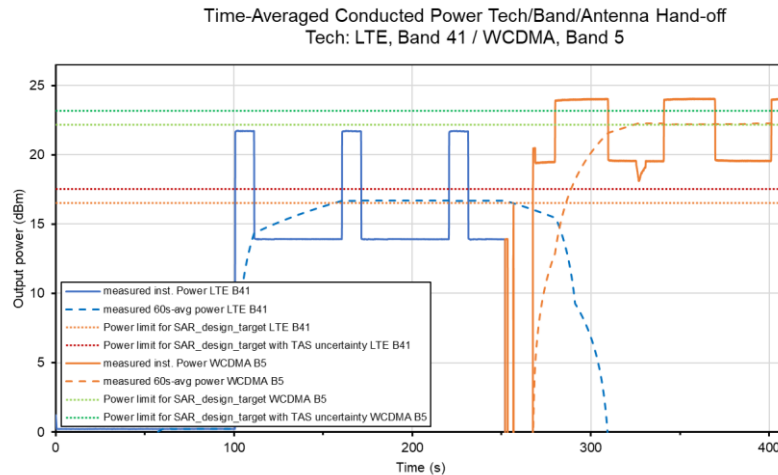
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.987
Validated	

In this test, the SAR_design_target is 1.0 W/kg. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.0 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting in call change scenario.

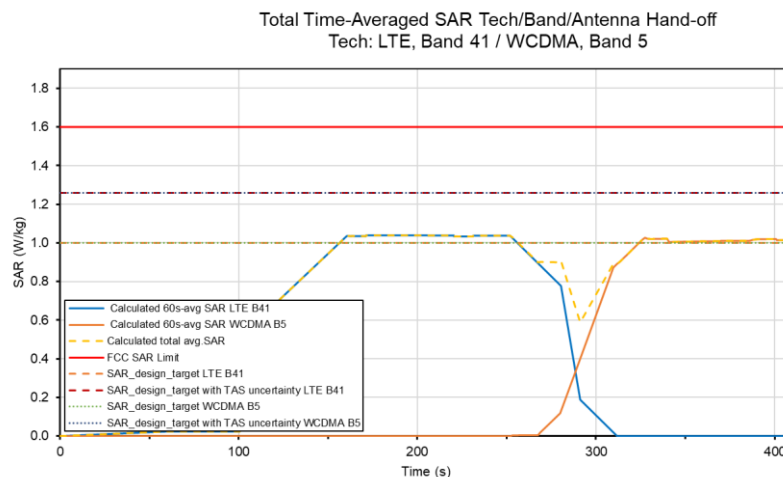
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.2 Change in Technology/Band/Antenna

This test was conducted with callbox requesting maximum power, and with a technology switch from LTE Band 66, Antenna F, RSI = 0 to WCDMA Band 5, Antenna E, RSI = 0. Following procedure detailed in Section 4.2.4, and measurement setup shown in Figure 7.2-1b, the switch was performed as shown in the plot below.



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



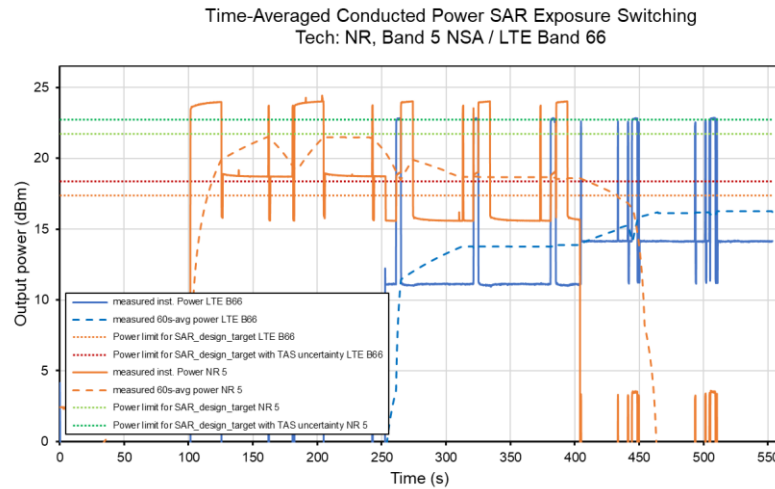
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.039
Validated	

In this test, the SAR_design_target is 1.0 W/kg. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.0 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting in tech/band/antenna change scenario.

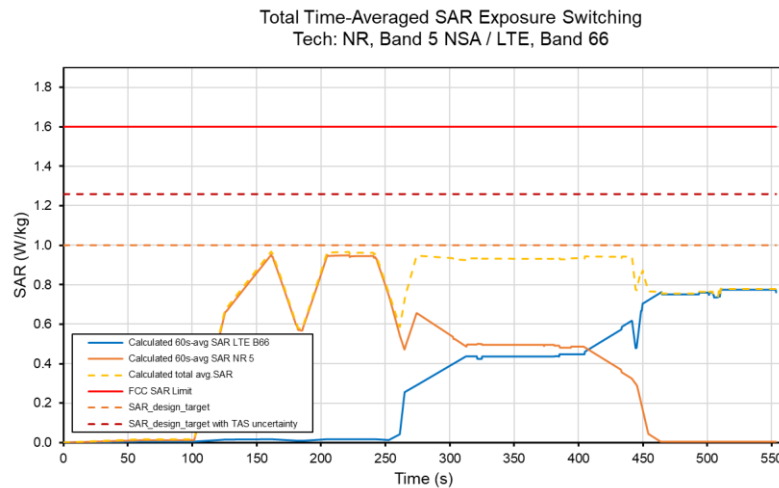
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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8.3 SAR Exposure Switching EN-DC

This test was conducted with callbox requesting maximum power, and with the EUT in LTE Band 66 + Sub6 NR Band n5 call. Following procedure detailed in Section 4.2.7, and using the measurement setup shown in Figure 7.2-1c since LTE and Sub6 NR are on different antenna ports, the SAR exposure switch measurement is performed with the EUT in various SAR exposure scenarios, i.e., in SAR_{sub6NR} only scenario (t = 100s ~ 250s), SAR_{sub6NR} + SAR_{LTE} scenario (t = 250s ~ 400s) and SAR_{LTE} only scenario (t > 400s).



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



	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.968
Validated	

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In this test, the SAR_design_target is 1.0 W/kg for both LTE and NR. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.0 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting in SAR Exposure Switching EN-DC scenario.

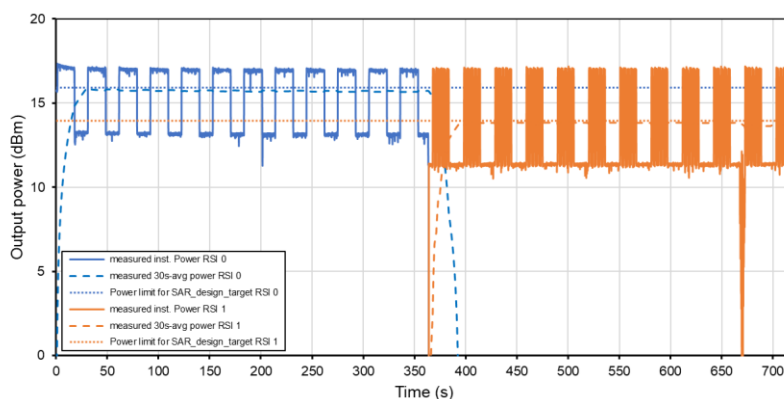
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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9 CONDUCTED POWER MEASUREMENT FOR WLBT TAS

9.1 WLAN 2.4GHz Only

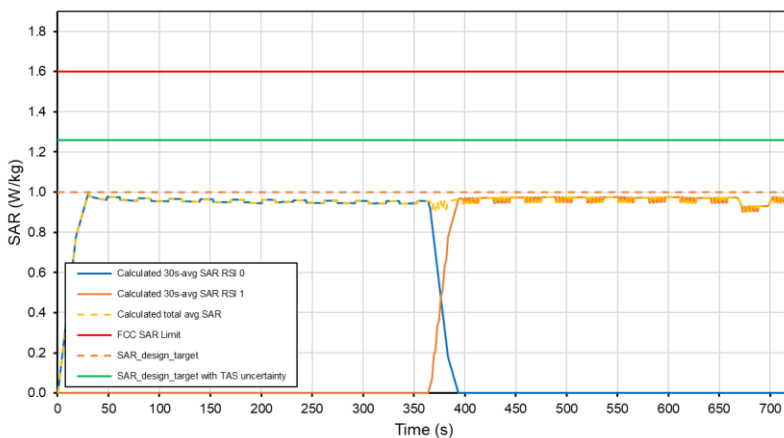
This test was measured with WLAN 2.4GHz, Antenna H, RSI = 0&1, and with callbox requesting maximum power. The measurement setup is shown in Figure 7.2-1a. The detailed test procedure is described in Section 5.2.

Time-Averaged Conducted Power WLAN 2.4GHz



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

Total Time-Averaged SAR WLAN 2.4GHz



	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.993
Validated	

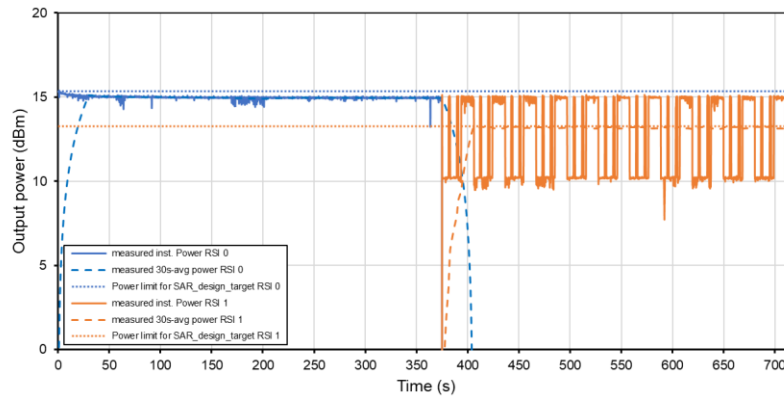
FCC ID: A3LSMA576JPN	RF EXPOSURE PART 2 TEST REPORT	Approved by: Technical Manager
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In this test, the SAR_design_target is 1.0 W/kg. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.0 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting WLAN 2.4GHz.

9.2 WLAN 5GHz Only

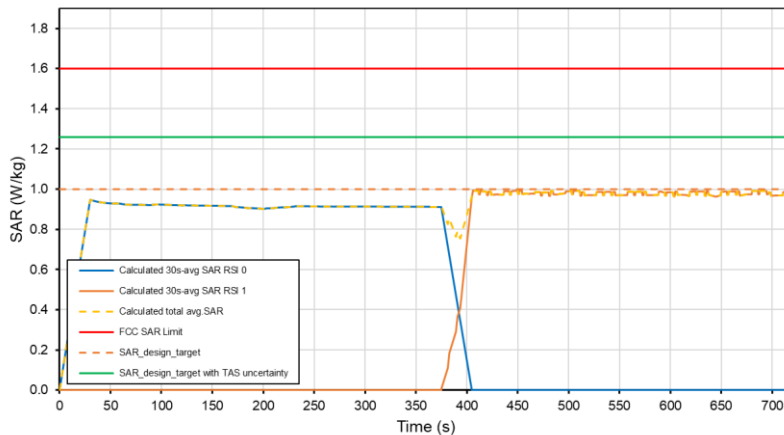
This test was measured with WLAN 5GHz, Antenna G, RSI = 0&1, and with callbox requesting maximum power. The measurement setup is shown in Figure 7.2-1a. The detailed test procedure is described in Section 5.2.

Time-Averaged Conducted Power WLAN 2.4GHz



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

Total Time-Averaged SAR WLAN 2.4GHz



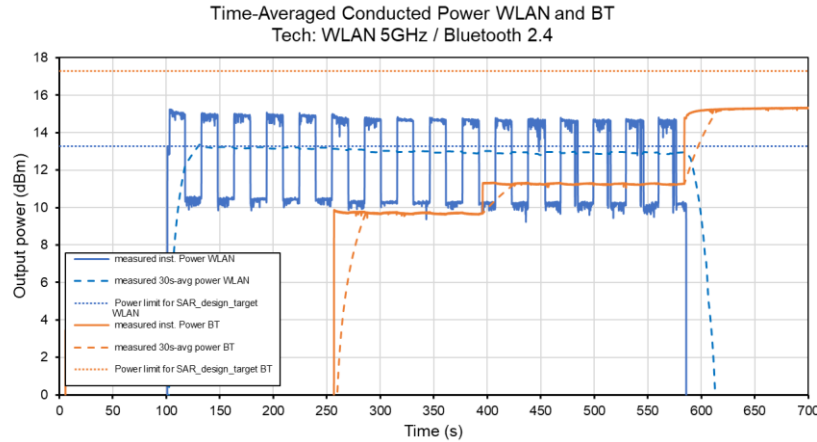
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	0.994
Validated	

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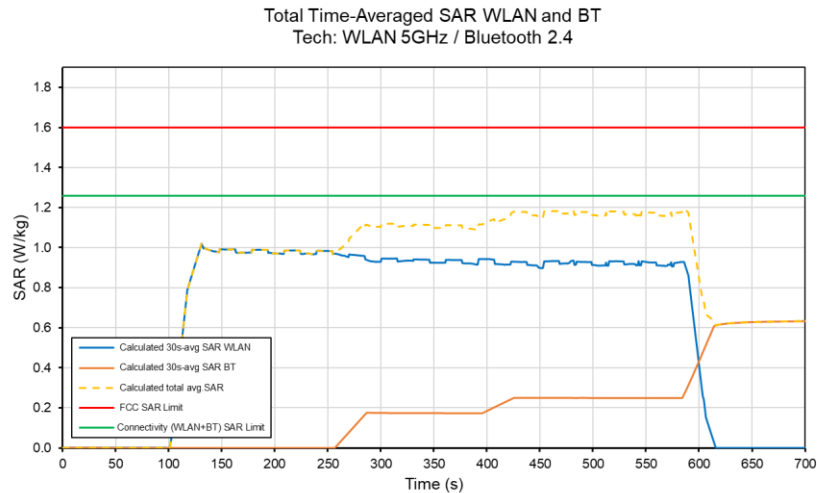
In this test, the SAR_design_target is 1.0 W/kg. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.0 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting WLAN 5GHz.

9.3 WLBT with BT Normal-on and Audio mode

This test was measured with WLAN 5GHz, Antenna G, RSI = 1 (Head) and BT 2.4GHz, Antenna H, RSI = 1 (Head), and with callbox requesting maximum power. The measurement setup is shown in Figure 7.2-1e. The detailed test procedure is described in Section 5.2.



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



	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.196
Validated	

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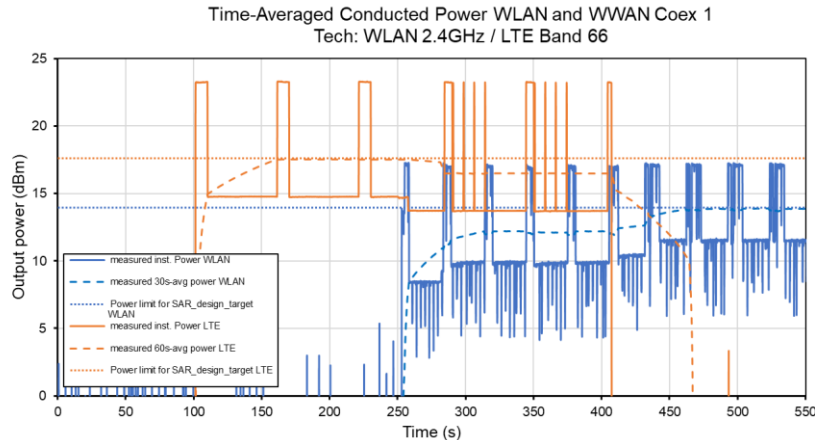
In this test, the SAR_design_target is 1.0 W/kg. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.2 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting WLAN 5GHz + BT.

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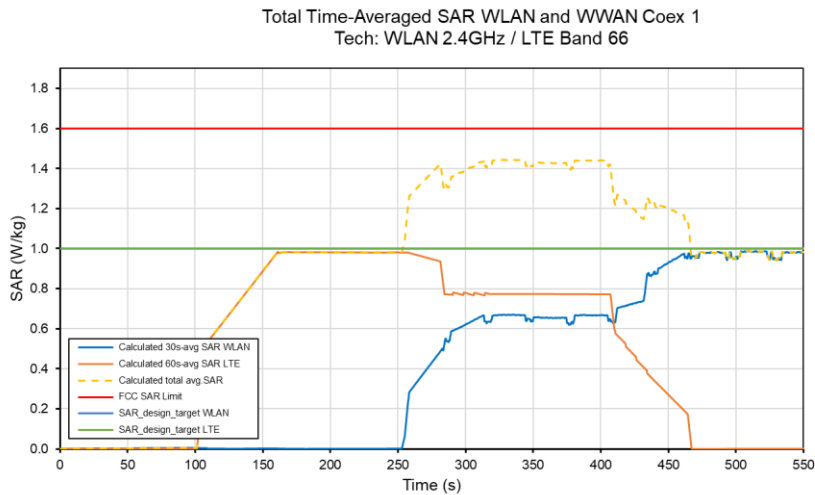
10 CONDUCTED POWER MEASUREMENT FOR DIRECT C-TAS

10.1 WLAN and Cellular Coexistence 1

This test was measured with LTE Band 66, Antenna F, RSI = 1 (Head) and WLAN 2.4, Antenna H, RSI = 1 (Head), and with callbox requesting maximum power. The measurement setup is shown in Figure 7.2-1e. The detailed test procedure is described in Section 6.2.



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



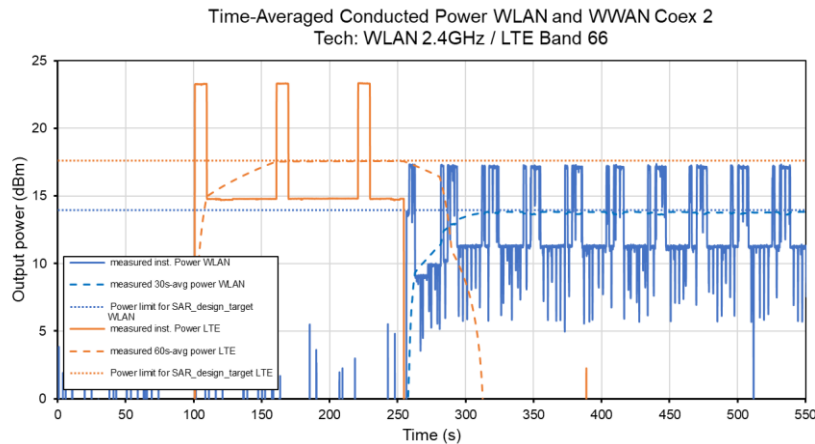
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.444
Validated	

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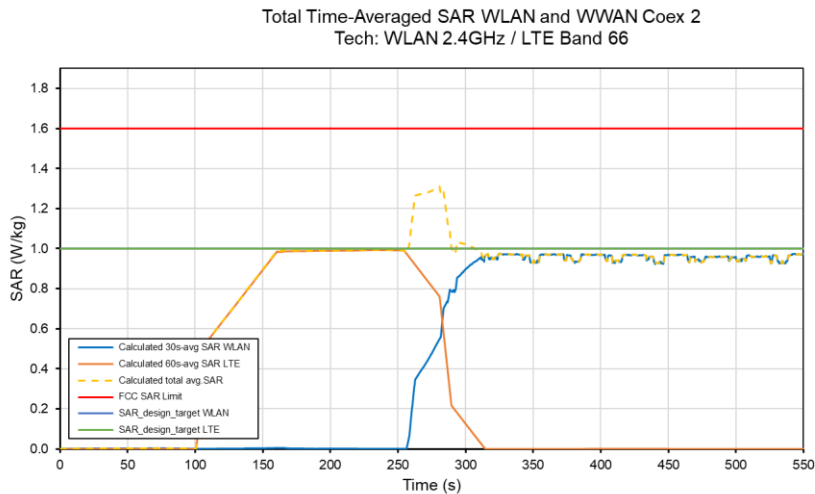
In this test, the SAR_design_target is 1.0 W/kg for both Cellular (LTE) and Connectivity (WLAN). As shown above, the total time-averaged SAR does not exceed the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting WLAN and Cellular coexistence.

10.2 WLAN and Cellular Coexistence 2

This test was measured with LTE Band 66, Antenna F, RSI = 1 (Head) and WLAN 2.4, Antenna H, RSI = 1 (Head), and with callbox requesting maximum power. The measurement setup is shown in Figure 7.2-1e. The detailed test procedure is described in Section 6.2.



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



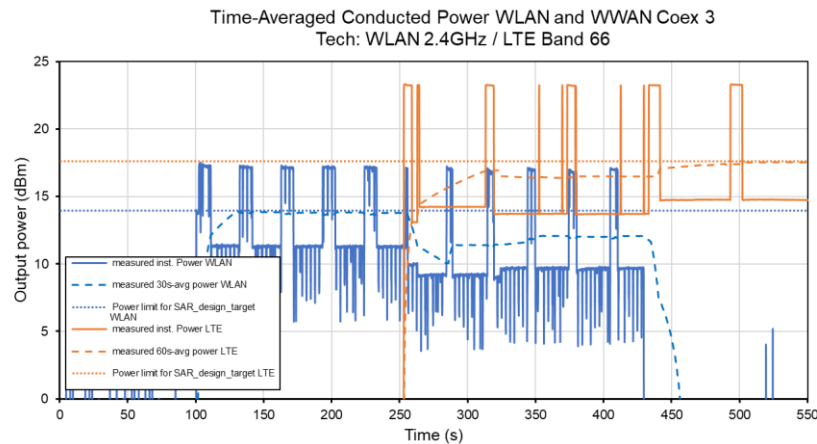
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.311
Validated	

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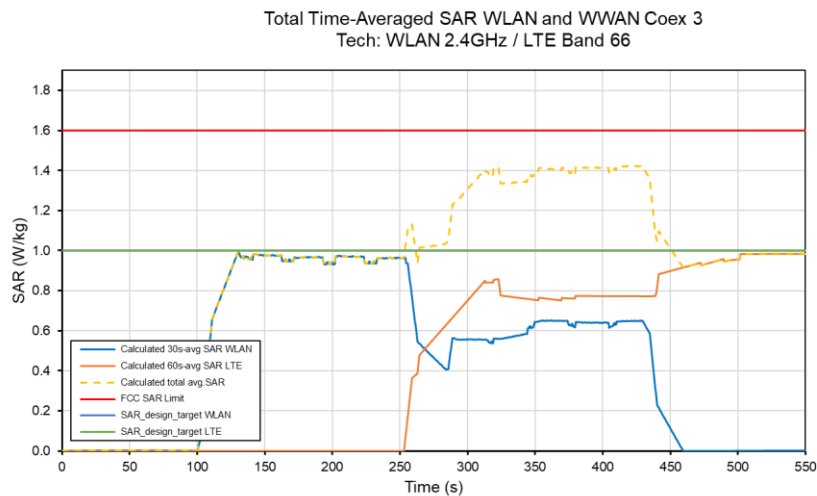
In this test, the SAR_design_target is 1.0 W/kg for both Cellular (LTE) and Connectivity (WLAN). As shown above, the total time-averaged SAR does not exceed the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting WLAN and Cellular coexistence.

10.3 WLAN and Cellular Coexistence 3

This test was measured with LTE Band 66, Antenna F, RSI = 1 (Head) and WLAN 2.4, Antenna H, RSI = 1 (Head), and with callbox requesting maximum power. The measurement setup is shown in Figure 7.2-1e. The detailed test procedure is described in Section 6.2.



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



	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (green curve)	1.423
Validated	

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In this test, the SAR_design_target is 1.0 W/kg for both Cellular (LTE) and Connectivity (WLAN). As shown above, the total time-averaged SAR does not exceed the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting WLAN and Cellular coexistence.

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11 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E4404B	Spectrum Analyzer	N/A	N/A	N/A	MY45113242
Agilent	N5182A	MXG Vector Signal Generator	5/30/2025	Annual	5/30/2026	MY48180366
Agilent	N5182A	MXG Vector Signal Generator	8/1/2025	Annual	8/1/2026	MY47420651
Anritsu	ML2496A	Power Meter	8/21/2025	Annual	8/21/2026	1138001
Anritsu	ML2496A	Power Meter	6/27/2025	Annual	6/27/2026	1840005
Anritsu	MA2411B	Pulse Power Sensor	7/3/2025	Annual	7/3/2026	1726261
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	3/14/2025	Annual	3/14/2026	6262044715
Anritsu	MT8000A	Radio Communication Test Station	4/11/2025	Annual	4/11/2026	6261987983
Anritsu	MA24106A	USB Power Sensor	8/4/2025	Annual	8/4/2026	1827530
Anritsu	MA24106A	USB Power Sensor	4/28/2025	Annual	4/28/2026	1520501
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433973
Control Company	4052	Long Stem Thermometer	2/27/2024	Biennial	2/27/2026	240174346
Control Company	4040	Therm./ Clock/ Humidity Monitor	4/15/2024	Biennial	4/15/2026	240310280
Keysight Technologies	N9020A	MXA Signal Analyzer	7/7/2025	Annual	7/7/2026	MY48010233
Keysight Technologies	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	E7515B	UXM 5G Wireless Test Platform	CBT	N/A	CBT	MY59150289
Keysight Technologies	E7770A	Common Interface Unit	CBT	N/A	CBT	MY58290483
K & L	11SH10-1300/U4000	High Pass Filter	CBT	N/A	CBT	11SH10-1300/U4000 - 2
Krytar	110067006	Directional Coupler, 10 - 67 GHz	CBT	N/A	CBT	200391
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTECH	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Newmark System	NSC-G2	Motion Controller	CBT	N/A	CBT	1007-D
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini Circuits	ZA2PD2-63-S+	Power Splitter	CBT	N/A	CBT	SUU64901930
Mini Circuits	ZAPD-2-272-S+	Power Splitter	CBT	N/A	CBT	SF702001405
MiniCircuits	NLP-1200+	Low Pass Filter	CBT	N/A	CBT	VUU78201318
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter DC to 6000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2050
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2051
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Narda	4216-10	Directional Coupler, 0.5 to 8.0 GHz, 10 dB	CBT	N/A	CBT	1492
Narda	4216-10	Directional Coupler, 0.5 to 8.0 GHz, 10 dB	CBT	N/A	CBT	1493
Narda	4772-3	Attenuator	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator	CBT	N/A	CBT	120
Narda	BW-S10W2+	Attenuator	CBT	N/A	CBT	831
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	4/2/2024	Biennial	4/2/2026	1262
Seekonk	NC-100	Torque Wrench	4/2/2024	Biennial	4/2/2026	1262
Rohde & Schwarz	CMW500	Radio Communication Tester	9/1/2025	Annual	9/1/2026	162125
Rohde & Schwarz	CMW500	Radio Communication Tester	8/14/2025	Annual	8/14/2026	164948
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	2/19/2025	Annual	2/19/2026	109322
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	2/19/2025	Annual	2/19/2026	109960
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	2/24/2025	Annual	2/24/2026	109961
Rohde & Schwarz	NRP50S	3-Path Dipole Power Sensor	2/19/2025	Annual	2/19/2026	101339

Notes:

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

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12 CONCLUSION

12.1 Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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