

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

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APPLICANT:

SAMSUNG ELECTRONICS CO., LTD.

DUT Type:

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SM-F776B

Device Serial Numbers:

Pre-Production Samples [1494M, 4195M, 1493M]

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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APPENDIX A: TEST SETUP PHOTOGRAPHS

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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
UMTS 1750	Voice/Data	1712.4 - 1752.6 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 17	Voice/Data	706.5 - 713.5 MHz
LTE Band 13	Voice/Data	779.5 - 784.5 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 4	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 25	Voice/Data	1850.7 - 1914.3 MHz
LTE Band 2	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
NR Band n71	Voice/Data	665.5 - 695.5 MHz
NR Band n5	Voice/Data	826.5 - 846.5 MHz
NR Band n66	Voice/Data	1712.5 - 1777.5 MHz
NR Band n25	Voice/Data	1852.5 - 1912.5 MHz
NR Band n2	Voice/Data	1852.5 - 1907.5 MHz
NR Band n41	Voice/Data	2501.01 - 2685 MHz
NR Band n77	Voice/Data	3455.01 - 3544.98 MHz; 3705 - 3975 MHz
2.4 GHz WIFI	Voice/Data	2412 - 2472 MHz
5 GHz WIFI	Voice/Data	U-NII-1: 5180 - 5240 MHz U-NII-2A: 5260 - 5320 MHz U-NII-2C: 5500 - 5720 MHz U-NII-3: 5745 - 5825 MHz U-NII-4: 5845 - 5885 MHz
6 GHz WIFI	Voice/Data	U-NII-5: 5935 - 6415 MHz U-NII-6: 6435 - 6515 MHz U-NII-7: 6535 - 6875 MHz U-NII-8: 6895 - 7115 MHz
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

1.2.1 Combined-Time Averaged SAR (C-TAS)

This device is enabled with **Samsung S.LSI TAS** and **Qualcomm FastConnect TAS**. The Samsung S.LSI proprietary TAS algorithm accounts for 2G, 3G, 4G, and 5G NR FR1 operations to ensure that the Device Under Test (DUT) maintains total RF exposure below the applicable regulatory limits. For WLAN operations, the Qualcomm® FastConnect™ TAS functionality dynamically controls and manages WLAN transmit power in real time to ensure that the time-averaged RF exposure remains compliant with regulatory requirements.

The **TAS Manager**, which determines the target SAR levels for both the cellular and connectivity chipsets, is implemented within the cellular and connectivity subsystems. In the C-TAS architecture, the TAS manager is implemented in the application processor (AP), where all TAS-related decisions are coordinated and managed. Acting as the bridge for C-TAS operation between different CP and connectivity chipsets, the TAS Manager regulates and adjusts the average power limits (Plimit) of each CP and Wi-Fi/BT chipset while ensuring continued compliance with the TER constraint.

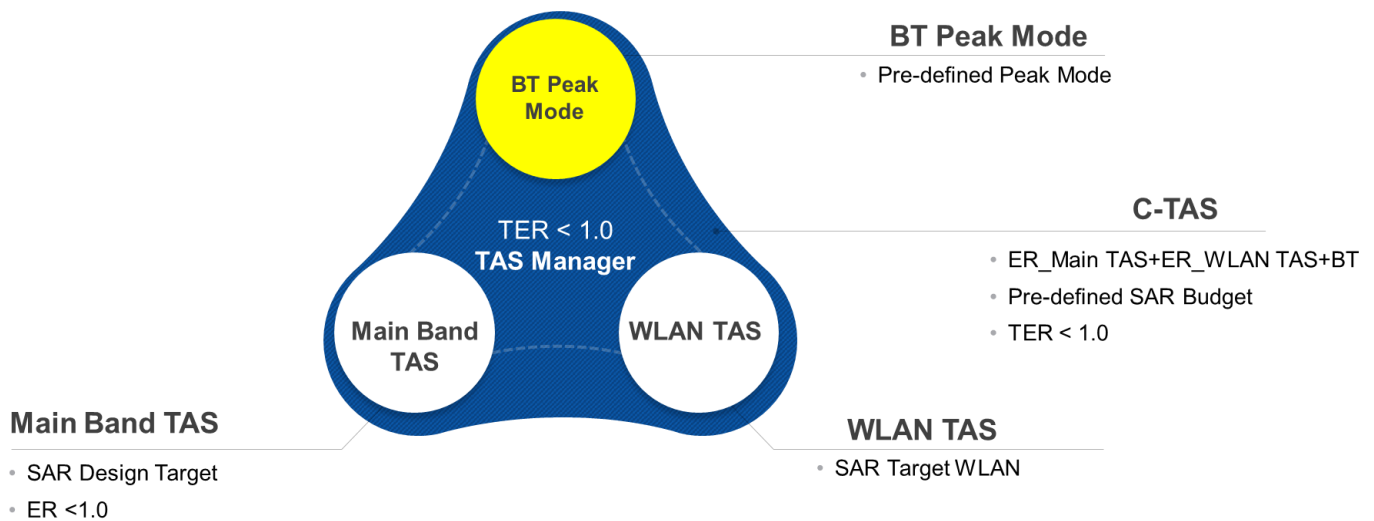


Figure 1.2-1 C-TAS architecture

1.2.2 S.LSI Cellular TAS

The Samsung S.LSI proprietary TAS algorithm accounts for 2G, 3G, 4G, and 5G NR FR1, 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 averaging window is used, consistent with FCC requirements.

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

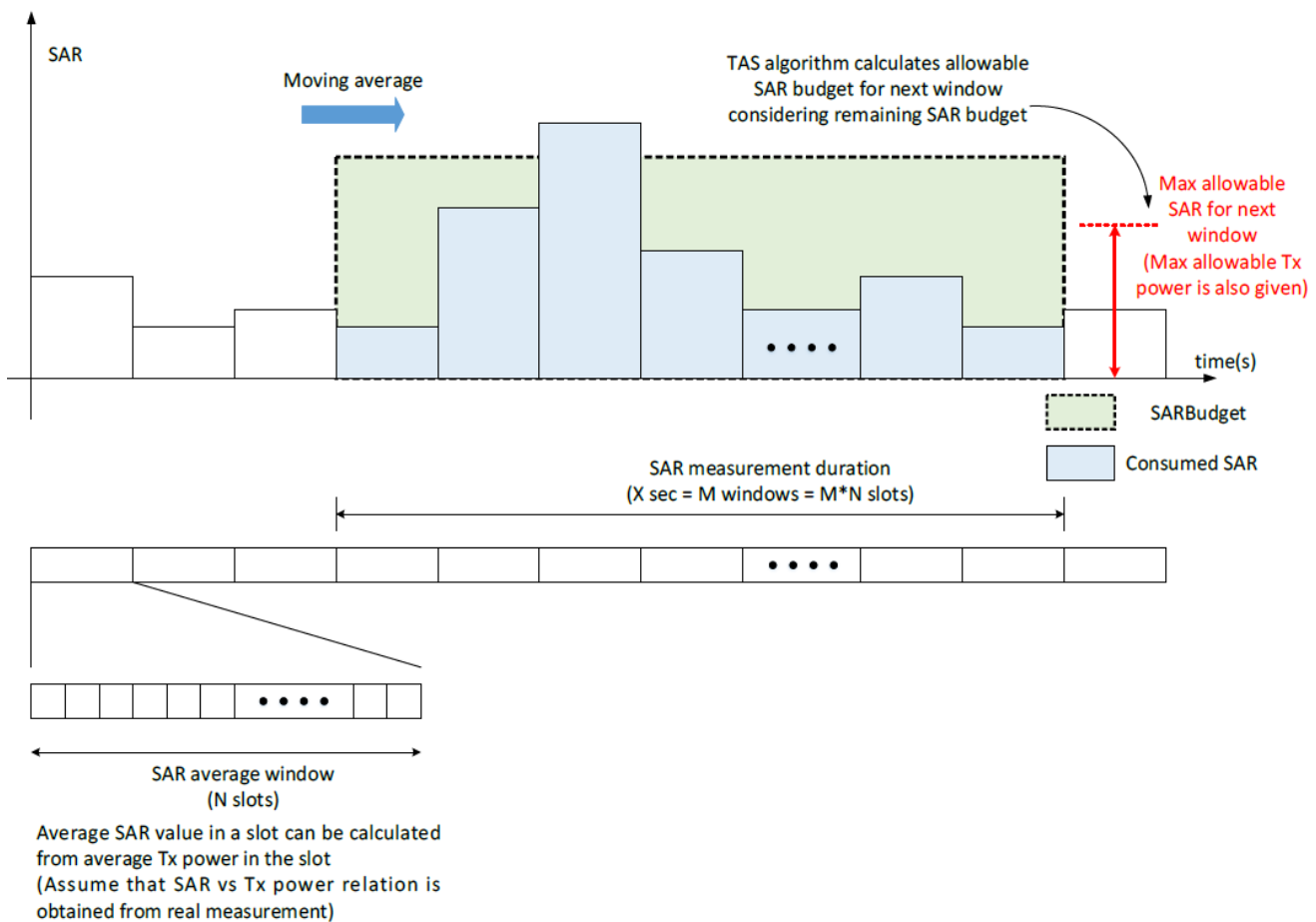
- The minimum duration for SAR calculation is defined as the SAR averaging window, which consists of N time slots. Any FCC-specified measurement or time-averaging duration for a given RAT is composed of M

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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 evaluation is average transmit 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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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 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.

1.2.3 FastConnect WiFi TAS

This device is enabled with Qualcomm FastConnect features, which dynamically control and manage WLAN transmit power in real time to ensure that time-averaged RF exposure remains compliant with regulatory requirements. The RF Exposure Part 2 WLAN Test Report includes validation of the FastConnect features and provides reference test results and plots using parameters determined from static SAR testing and configured in the FastConnect TAS BDF for validation of the FastConnect TAS functionality.

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1.3 Bibliography

Report Type	Report Serial Number
RF Exposure Part 1 Test Report	1M2603110020-01.A3L
RF Exposure Part 0 Test Report	1M2603110020-02.A3L
RF Exposure Part 2 WLAN Test Report	1M2603110020-26.A3L
RF Exposure Compliance Summary	1M2603110020-04.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. RSI (Radio SAR Index) change: Verification that the TAS feature operates correctly and maintains compliance limits across RSI changes.
4. Technology/band/antenna handover: Verification that the TAS feature correctly maintains and applies Tx power history across band and RAT transitions.
5. 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.

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6. SAR exposure switching: Verification that the TAS feature supports multi-RAT transmission with transitions in operating modes.
7. NSA with antenna switching: Verification that the TAS feature correctly handle the change of NSA antenna switching with both active RATs operating simultaneously.
8. Foldable Status/Event: Verification that the TAS feature correctly handle the change of the foldable device status with both active RATs operating simultaneously.
9. 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 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. WWAN + WLAN + BT + External Radio: To demonstrate the time averaged RF exposure compliance continuity during technology transition in both single-radio and multi-radio transmission scenarios and under both modes (i.e., ON and airplane).

$$TER(t) = \frac{\sum_{l_{WWAN}=0}^{L_{WWAN}-1} SAR_{avg,l_{WWAN}}(t)}{SAR_{limit,FCC}} + \frac{\sum_{l_{WLAN}=0}^{L_{WLAN}-1} SAR_{avg,l_{WLAN}}(t)}{SAR_{limit,FCC}} + \frac{\sum_{l_{BT}=0}^{L_{BT}-1} SAR_{avg,l_{BT}}(t)}{SAR_{limit,FCC}} + \frac{SAR_{External\ Radio}}{SAR_{limit,FCC}} \leq 1$$

NOTE: RF Exposure of External Radio represents the worst-case measured SAR of non-TAS radios reported in the RF Exposure Part 1 Report (e.g., WPT, NFC, etc.) is 0.021 W/kg.

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4 TAS VALIDATION TEST PROCEDURES

This chapter provides the test plan and test procedure for validating S.LSI Cellular TAS and C-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 S.SLI 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 RSI

The criterion for selecting a test case to demonstrate compliance across an RSI change within a radio is to choose a technology and band for which $P_{\text{limit}} < P_{\max}$ in both RSI states. This ensures that the TAS algorithm actively enforces transmit power restrictions in each state.

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

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4.1.4 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 $P_{\text{limit}} < P_{\text{max}}$, 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.

4.1.5 Uplink CA

The criterion for selecting this test case is to demonstrate TAS algorithm compliance during LTE/NR transmission with multiple component carriers (CCs). This test verifies that TAS algorithm compliance is independent of the transmission scenario, whether operating with a single CC or with carrier aggregation (CA).

4.1.6 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.

4.1.7 NSA Antenna 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 tests are performed with both RATs operating simultaneously, either in an EN-DC scenario or in a dual-SIM scenario with various power-sharing (pre-saving) configurations).

4.1.8 Foldable Status/Event

The criterion for selecting this test configuration is to demonstrate that the Samsung S.LSI algorithm supports foldable device status operation. The test is performed in an EN-DC FR1 scenario with both RATs connected, where LTE and NR operate under different antenna groups when the device is unfolded.

4.2 Test Procedures for Conducted Power Measurements for S.LSI 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.

Pass Criteria: Time-averaged transmit power must not exceed measured P_{limit} (with 1dB device uncertainty) at any point in the test. Time-averaged 1 g SAR must not exceed the FCC limit of 1.6 W/kg at any time during the test. Normalized time-averaged SAR must not exceed the FCC limit of 1.0 at any time during the test.

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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
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

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.

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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

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

4.2.3 Change In RSI

This test is designed to demonstrate that the Samsung S.LSI TAS feature can correctly handle changes in the RSI resulting from different SAR index states detected by the host platform software. The test involves modifying

Test procedure

1. Establish radio connection of DUT with call box.
2. Configure call box to set DUT Tx power to a low value below 0 dBm for 60s and set the RSI index for 1st RSI.
3. 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.
4. Change the RSI index to 2nd RSI and continue the transmission for another 150s.
5. Release the connection.
6. 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
7. 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

It is required to check if power limiting enforcement is operated as expected when RSI index is changed during the test.

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4.2.4 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:

$$\text{SAR}_1(t) = \frac{\text{TxPower}_1(t)}{P_{\text{limit},1,\text{FR1}}} \times \text{SAR}_{\text{design target1}} \quad (4.2.4-1)$$

$$\text{SAR}_2(t) = \frac{\text{TxPower}_2(t)}{P_{\text{limit},2,\text{FR1}}} \times \text{SAR}_{\text{design target2}} \quad (4.2.4-2)$$

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.
2. Configure call box to set DUT Tx power to a low value below 0 dBm for 60s.
3. 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.
4. Change the technology/band/antenna to 2nd technology/band/antenna and continue the transmission for another 150s.
5. Release the connection.
6. 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
7. 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

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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4.2.5 Uplink CA

This test is designed to demonstrate that the Samsung S.LSI TAS feature can correctly manage SAR exposure during LTE/NR transmission when additional intra-band or inter-band LTE/NR component carriers (CCs) are added or removed.

Test procedure

1. Establish radio connection of DUT with call box over cell 1.
2. Configure call box to set DUT Tx power to a low value below 0 dBm for 60s.
3. Configure call box to send “ALL UP” power control commands and continue transmission from DUT so that maximum power of P_{max} is achieved Continue the transmission for 150s.
4. Establish connection of DUT with call box over Cell 2, other cell of the band Combo CA and continue the transmission for another 150s.
5. Release the connection.
6. 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
7. 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

It is required to check if power limiting enforcement is operated as expected when intra-band or inter-band change occurs.

4.2.6 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.

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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

It is required to check if power limiting enforcement is operated as expected when dominant power is changed in ENDC.

4.2.7 NSA Antenna Switching

This test is designed to demonstrate that the Samsung S.LSI TAS feature can correctly handle antenna switching in an NSA configuration with two simultaneous active RATs. The test involves changing the transmit antennas 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. Connect the DUT to both LTE and NR call boxes in an NSA configuration.
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 LTE call box to send “**ALL UP**” power control commands. Continue DUT transmission until LTE reaches maximum power P_{max} and maintain for 150 seconds.
4. Configure the NR call box to send “**ALL UP**” power control commands, resulting in maximum power requests from the DUT for both LTE and NR. Continue transmission for 150 seconds.
5. Change NR from 1st antenna to 2nd antenna. Configure the NR call box to send “**ALL UP**” power control commands and continue transmission for 150 seconds.
6. Release both LTE and NR connections.
7. 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
8. Plot Time-Averaged SAR
 - Computed time-averaged 1 g SAR versus time (from Step 2)

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- FCC 1 g SAR limit of 1.6 W/kg

It is required to check if power limiting enforcement is operated as expected when Tx antenna is changed in ENDC.

4.2.8 Foldable Status/Event

This test is to demonstrate that Samsung S.LSI TAS feature can properly handle the change of the foldable device status in the case of two simultaneous active RATs.

Test procedure:

1. Connect the DUT to both LTE and NR call boxes in an NSA configuration.
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 LTE and NR call box to send “**ALL UP**” power control commands. Continue DUT transmission until LTE reaches maximum power P_{max} and maintain for 150 seconds.
4. Switching the device setting to the folded status. Continue transmission for 150 seconds.
5. Switching the device setting to the unfolded status. continue transmission for 150 seconds.
6. Release both LTE and NR connections.
7. 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
8. 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

It is required to check if power limiting enforcement is operated as expected when Tx antenna is changed in ENDC.

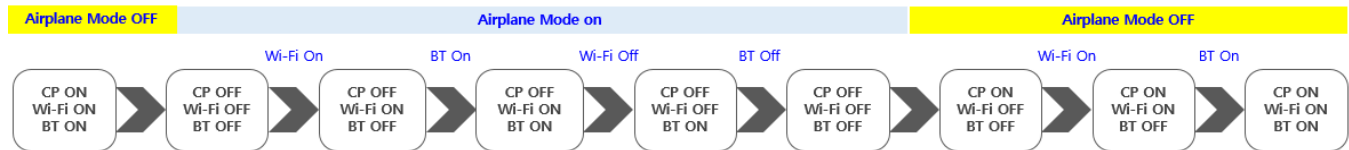
4.3 Test Configuration Selection Criteria for C-TAS

The selection criteria for radios to be tested is to select a radio which has the $P_{limit} < P_{max}$ ratio among all configurations supported (including SISO, MIMO, DBS, SISO+MIMO or DBS+MIMO whichever appropriate) within each technology and within the same antenna group. For a given RSI/DSI and antenna group, select band/antenna configurations for WWAN, WLAN and BT technologies that have $P_{limit} < P_{max}$.

4.4 Test Procedures for Conducted Power Measurements for C-TAS

Below is the test flow outline of the C-TAS. The test contains 9 sections and 8 transitions:

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1. Airplane Mode OFF : CP ON ,WLAN ON ,BT ON
2. Airplane Mode ON : CP OFF, WLAN OFF, BT : OFF
3. Airplane Mode ON : WLAN ON , CP OFF, BT,OFF
4. Airplane Mode ON : WLAN ON , BT ON , CP OFF
5. Airplane Mode ON : WLAN OFF , BT ON , CP OFF
6. Airplane Mode ON : WLAN OFF , BT OFF, CP OFF
7. Airplane Mode OFF : CP ON, BT OFF, WLAN OFF
8. Airplane Mode OFF : CP ON , WLAN ON , BT OFF
9. Airplane Mode OFF : CP ON ,WLAN ON ,BT ON
10. Plot Time-Averaged SAR
 - RF Exposure of External Radio represents the worst-case measured SAR of non-TAS radios reported in the RF Exposure Part 1 Report (e.g., WPT, NFC, etc.) is 0.021 W/kg.
 - Computed time-averaged 1g SAR versus time, FCC 1 g SAR limit of 1.6 W/kg.
 - Computed normalized time-averaged 1g SAR versus time, FCC normalized SAR limit of 1.0.

Pass Criteria: Time-averaged transmit power must not exceed P_{limit} at any point in the test sequence. Time-averaged 1 g SAR must not exceed the FCC limit of 1.6 W/kg at any time during the test. Normalized time-averaged SAR must not exceed the FCC limit of 1.0 at any time during the test.

Note: WWAN Mode = CP

Through this technology switching compliance test, the CP (WWAN Mode), WLAN, and BT modes were evaluated under simultaneous transmission conditions with each technology actively transmitting together. During the simultaneous transmission state of each technology mode on the DUT, the output power is monitored and controlled by the C-TAS algorithm. The results confirm that the DUT complies with the applicable FCC regulatory exposure limits.

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5 TEST CONFIGURATIONS AND MEASUREMENT SETUP

5.1 Test Configurations

The P_{limit} values corresponding to a SAR_{design_target} of 1.0 W/kg (1g SAR), across all technologies and bands supported by the DUT, are derived in the RF Exposure Part 0 Report and summarized in Table 5-1 correspond to average power levels after accounting for duty cycle in the case of TDD modulation schemes.

Table 5-1
 P_{limit} for supported technologies and bands

Exposure Scenario			Maximum Tune-Up Output Power*	Open – Free/Hotspot	Open – Head	Closed – Free/Hotspot
Averaging Volume				1g/10g	1g	1g
Spacing				5mm, 0mm	0mm	5mm
RSI				0/2	1	3/4
Technology/Band	Antenna	Antenna Group	P _{max}	P _{limit}	P _{limit}	P _{limit}
GSM 850	A	AG0	23.0	21.0	33.8	22.0
GSM 850	E	AG1	23.0	25.0	21.0	27.1
GSM 1900	B	AG0	22.0	19.0	21.0	19.0
UMTS 850	A	AG0	25.0	22.0	22.9	22.5
UMTS 850	E	AG1	24.0	22.0	21.5	22.5
UMTS 1750	B	AG0	24.5	19.0	22.9	19.5
UMTS 1750	H	AG1	24.0	21.0	19.0	20.0
UMTS 1900	B	AG0	25.0	18.0	22.9	18.5
UMTS 1900	H	AG1	24.0	20.0	19.0	20.0
LTE Band 12/17	A	AG0	24.0	23.0	31.6	24.0
LTE Band 12/17	E	AG1	24.0	22.0	21.0	22.5
LTE Band 13	A	AG0	23.5	22.5	30.9	23.0
LTE Band 13	E	AG1	24.0	20.5	20.0	21.0
LTE Band 26	A	AG0	24.5	21.5	30.9	22.5
LTE Band 26	E	AG1	25.0	23.0	21.5	23.5
LTE Band 5	A	AG0	23.5	21.0	30.9	22.5
LTE Band 5	E	AG1	24.5	23.0	21.0	23.5
LTE Band 66/4	B	AG0	24.0	19.0	35.5	20.0
LTE Band 66/4	H	AG1	25.0	21.0	18.0	21.5
LTE Band 25/2	B	AG0	24.0	18.0	35.2	19.5
LTE Band 25/2	H	AG1	24.5	21.0	19.5	21.0
LTE Band 41 PC3	B	AG0	23.5	17.5	39.2	19.5
LTE Band 41 PC3	H	AG1	24.0	19.0	18.5	19.0
LTE Band 41 PC2	B	AG0	25.1	17.5	39.2	19.5
LTE Band 41 PC2	H	AG1	25.6	19.0	18.5	19.0
NR Band n71	A	AG0	24.0	26.2	32.6	26.5
NR Band n71	E	AG1	25.0	23.0	22.0	23.0
NR Band n5	A	AG0	24.5	20.5	24.0	21.5
NR Band n5	E	AG1	25.0	23.0	22.0	23.5
NR Band n66	B	AG0	24.0	19.0	33.7	20.0
NR Band n66	H	AG1	25.0	21.5	19.5	22.0
NR Band n25/n2	B	AG0	24.0	18.0	34.6	19.5
NR Band n25/n2	H	AG1	24.5	21.0	19.5	21.0
NR Band n41 PC3 (Path 1)	B	AG0	24.5	18.5	44.1	20.5
NR Band n41 PC3 (Path 1)	H	AG1	23.0	19.0	16.5	19.0
NR Band n41 PC3 (Path 1)	C	AG0	23.0	19.0	31.4	21.0
NR Band n41 PC3 (Path 1)	G	AG1	21.5	18.0	18.0	18.0
NR Band n41 PC3 (Path 2)	H	AG1	25.0	19.0	16.5	19.0
NR Band n41 PC3 (Path 2)	B	AG0	24.0	17.0	23.0	19.0
NR Band n41 PC3 (Path 2)	G	AG1	24.0	18.0	16.0	18.0
NR Band n41 PC3 (Path 2)	C	AG0	23.5	18.0	16.0	18.0
NR Band n77 PC2	F	AG1	26.0	17.0	14.0	17.0
NR Band n77 PC2	H	AG1	25.0	17.0	15.0	17.0
NR Band n77 PC2	K	AG1	25.0	17.0	14.0	17.0
NR Band n77 PC2	C	AG0	25.0	17.0	14.0	17.0

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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 5-2. 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 5-2
Radio configurations selected for WWAN S.LSI Part 2 test

Test Scenario	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	3	190	836.5	GPRS 4 Tx Slots	22.0	23.0	21.10	23.56	1.000
2			1900	B	0	2	661	1880.0	GPRS 4 Tx Slots	19.0	22.0	19.54	21.53	1.000
3		WCDMA	5	A	0	1	4183	836.5	RMC	22.9	25.0	23.71	25.44	1.000
4			2	B	1	2	9400	1880.0	RMC	18.0	25.0	18.45	24.87	1.000
5		LTE	12	A	0	2	23095	707.5	QPSK 1/25/10 MHz BW	23.0	24.0	23.10	24.64	1.000
6			41	H	1	1	40620	2593.0	QPSK 1/50/20 MHz BW	16.5	22.0	16.97	22.42	1.000
7		NR	n5	E	1	2	167300	836.5	DFT-S-OFDM, QPSK 1/1/20 MHz BW	23.0	25.0	22.57	25.46	1.000
8			n77	F	1	1	650000	3750.0	DFT-S-OFDM, QPSK 1/137/100 MHz BW	14.0	24.9	13.20	24.24	1.000
9	Dropped Connection	NR	n77	F	1	1	650000	3750	DFT-S-OFDM, QPSK 1/137/100 MHz BW	14.0	24.9	13.20	24.24	1.000
10	Change in Operating State (RSI)	LTE	66	H	1	3	132322	1745.0	QPSK 1/50/20 MHz BW	21.5	25.0	21.47	24.81	1.000
			66	H	1	1	132322	1745.0	QPSK 1/50/20 MHz BW	18.0	25.0	18.93	24.81	1.000
11	Tech/Band/Antenna Switching	LTE	66	B	1	2	132322	1745.0	QPSK 1/50/20 MHz BW	19.0	24.0	19.14	24.43	1.000
		WCDMA	5	A	0	2	4183	837	RMC	22.0	25.0	22.82	25.44	1.000
12	Inter-band ULCA	LTE SCC	12	A	0	2	23095	708	QPSK 1/25/10 MHz BW	23.0	24.0	23.10	24.64	1.000
		LTE PCC	66	B	1	2	132322	1745	QPSK 1/50/20 MHz BW	19.0	24.0	19.14	24.43	1.000
13	Switching in SAR Exposure EN-DC	LTE	12	E	1	3	23095	707.5	QPSK 1/25/10 MHz BW	22.5	24.0	22.75	23.71	1.000
		Sub6 NR NSA	n25	H	1	3	376500	1882.5	DFT-S-OFDM, QPSK 1/1/40 MHz BW	21.0	24.5	20.48	24.34	1.000
14	NSA Antenna Switching EN-DC	LTE	12	E	1	3	23095	707.5	QPSK 1/25/10 MHz BW	22.5	24.0	22.75	23.71	1.000
		Sub6 NR NSA	n66	B	1	3	349000	1745.0	DFT-S-OFDM, QPSK 1/1/40 MHz BW	20.0	24.0	19.57	24.50	1.000
		Sub6 NR NSA	n25	H	1	3	376500	1882.5	DFT-S-OFDM, QPSK 1/1/40 MHz BW	21.0	24.5	20.48	24.34	1.000
15	Foldable Status/Event	LTE	12	E	1	3	23095	708	QPSK 1/25/10 MHz BW	22.5	24.0	22.75	23.71	1.000
		LTE	12	E	1	2	23095	708	QPSK 1/25/10 MHz BW	22.0	24.0	21.99	23.71	1.000
		Sub6 NR NSA	n66	B	1	3	349000	1745	DFT-S-OFDM, QPSK 1/1/40 MHz BW	20.0	24.0	19.57	24.50	1.000
		Sub6 NR NSA	n66	B	1	2	349000	1745	DFT-S-OFDM, QPSK 1/1/40 MHz BW	19.0	24.0	19.17	24.50	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.
- There are no Antenna Grouping for Closed configurations.
- This device does not support intra-band 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.

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Table 5-3
Radio configurations selected for C-TAS

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 Desgin Target [W/kg]	External Radios (non-TAS) [W/kg]
C-TAS	WWAN	66	H	1	Head	132322	1745	QPSK 1/50/20 MHz BW	18.0	25.0	18.69	24.81	1.000	0.021
	WLAN	5 GHz	F	1	Head	153	5765	802.11ac 20MHz DSSS	15.0	17.0	15.62	17.13	1.000	
	BT	2.4	G	1	Head	0	2402	FHSS 1Mbps	18.0	18.0	17.75	17.75	1.000	

- External Radio represents the worst-case measured SAR of non-TAS radios reported in the RF Exposure Part 1 Report (e.g., WPT, NFC, etc.) is 0.021 W/kg.

Table 5-4
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>
Free – Folder Open (RSI = 0)	- Device being used with a body-worn accessory - Folder Open - Device is held in hand	<i>Body-worn SAR per KDB Publication 648474 D04</i> <i>Phablet SAR per KDB Publication 648474 D04 & KDB Publication 616217 D04</i>
Hotspot – Folder Open (RSI = 2)	- Device transmits in hotspot mode near body - Hotspot Mode Active - Folder Open	<i>Hotspot SAR per KDB Publication 941225 D06</i>
Free – Folder Closed (RSI = 3)	- Device being used with a body-worn accessory - Folder Closed	<i>Body-worn SAR per KDB Publication 648474 D04</i>
Hotspot– Folder Closed (RSI = 4)	- Device transmits in hotspot mode near body - Hotspot Mode Active - Folder Closed	<i>Hotspot SAR per KDB Publication 941225 D06</i>

5.2 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 5.2-1a (Appendix A – Test Setup Photo 1, 2, 3, 4, and 5) for measurements with a single antenna of DUT and in Figure 5.2-1b (Appendix A – Test Setup Photo 6) for measurements involving antenna switch and Figure 5.2-1c (Appendix A – Test Setup Photo 7) for inter-band ULCA measurements. 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.

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.

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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 5.2-1a (Appendix A – Test Setup Photo 1 and 5). 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:

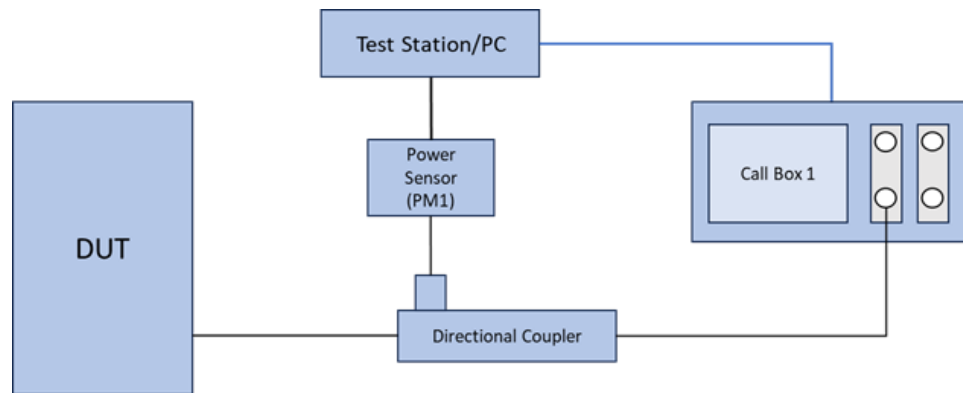
The LTE conducted port and Sub-6 GHz NR conducted port are separate by filters on this EUT. Therefore, LTE and Sub-6 GHz NR signals for power meter measurements were conducted using independent measurement paths, as illustrated in in Figure 5.2-1d (Appendix A – Test Setup Photo 8 and 10) for the SAR Exposure Switching EN-DC test case, and in Figure 5.2-1e (Appendix A – Test Setup Photo 9) for the NSA Antenna 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.

C-TAS test setup:

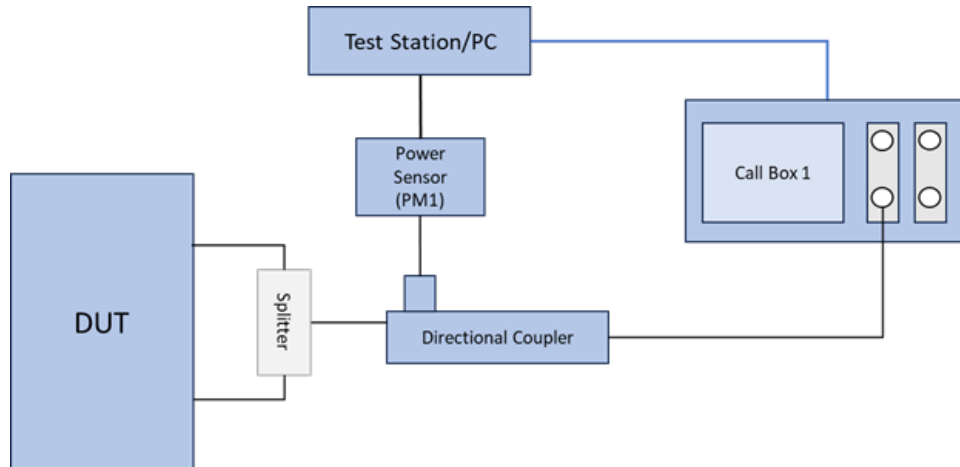
The Rohde & Schwarz CMW500 callbox was used in this test. WWAN, WLAN, and BT conducted port are different on this EUT. Therefore, the WWAN, WLAN, and BT signals for power meter measurement are performed on paths shown below in Figure 5-1f (Appendix D – Test Setup Photo 11).

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.

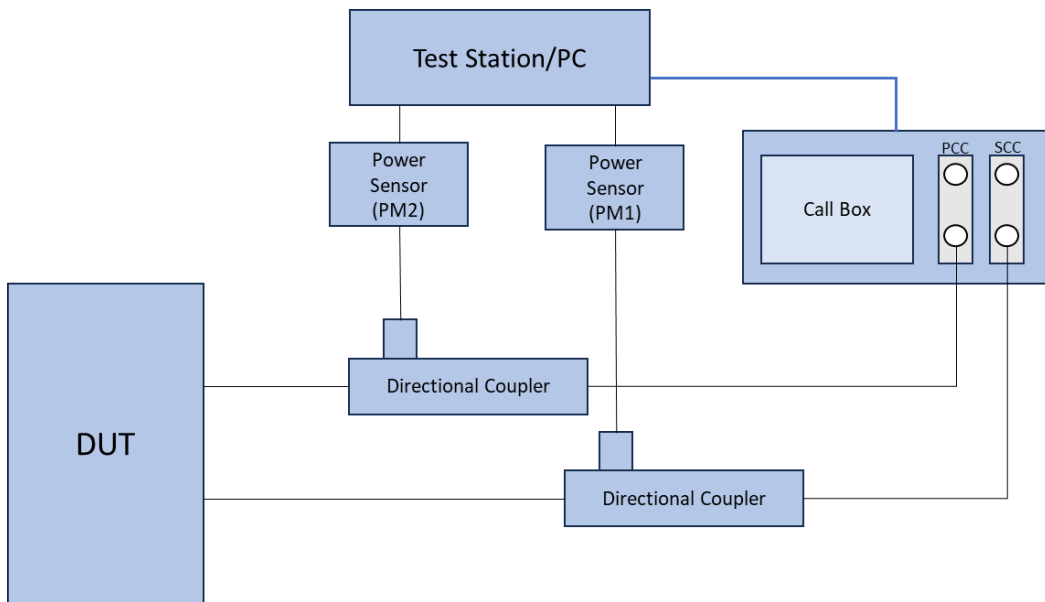


(a) Appendix A – Test Setup Photo 1, 2, 3, 4, and 5

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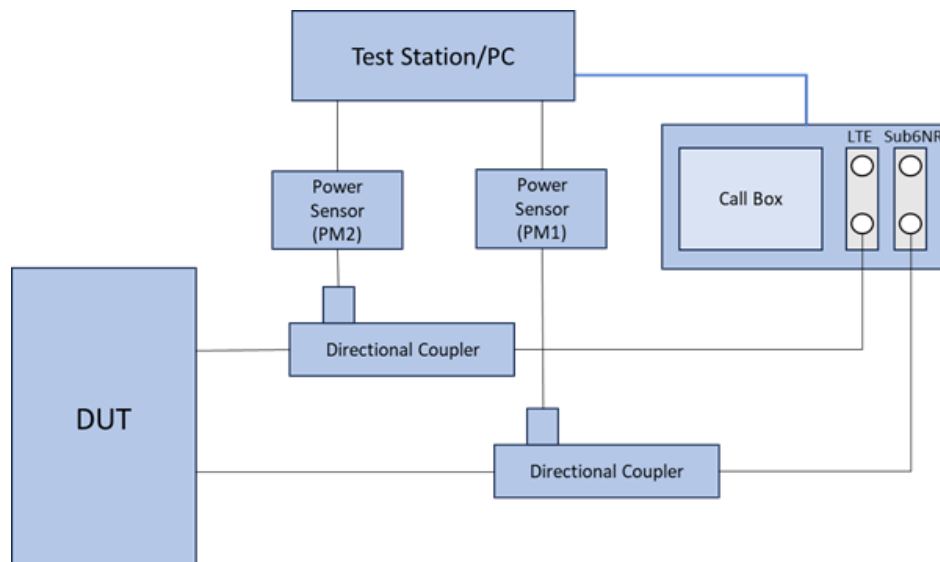


(b) Appendix A – Test Setup Photo 6

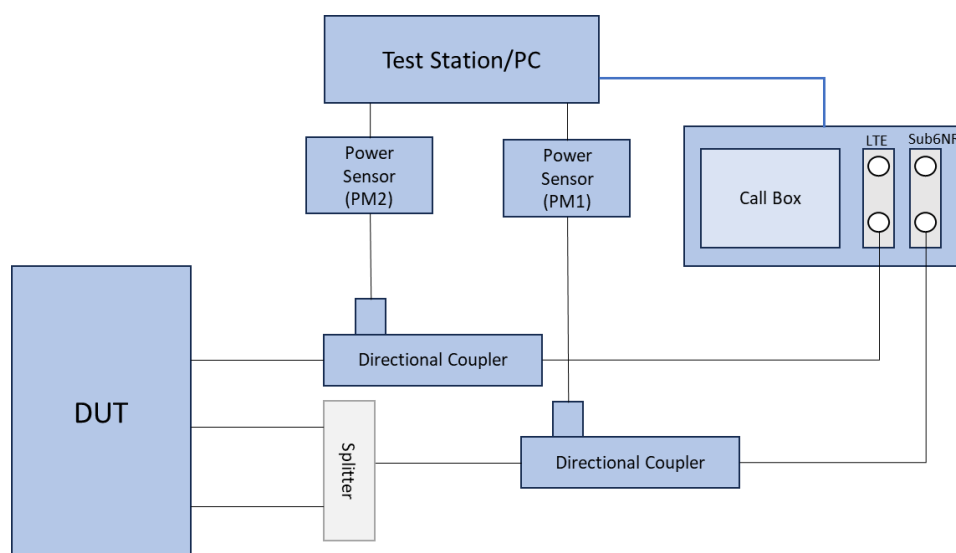


(c) Appendix A – Test Setup Photo 7

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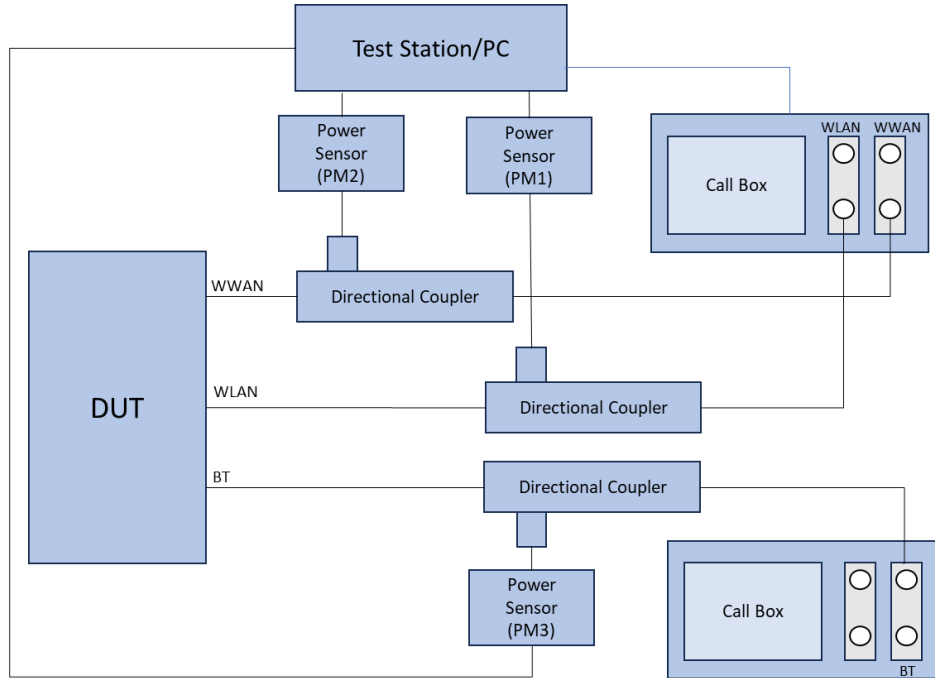


(d) Appendix A – Test Setup Photo 8, 10



(e) Appendix A – Test Setup Photo 9

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(f) Appendix A – Test Setup Photo 11

Figure 5.2-1
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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6 CONDUCTED POWER MEASUREMENT FOR CELLULAR TAS

6.1 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.

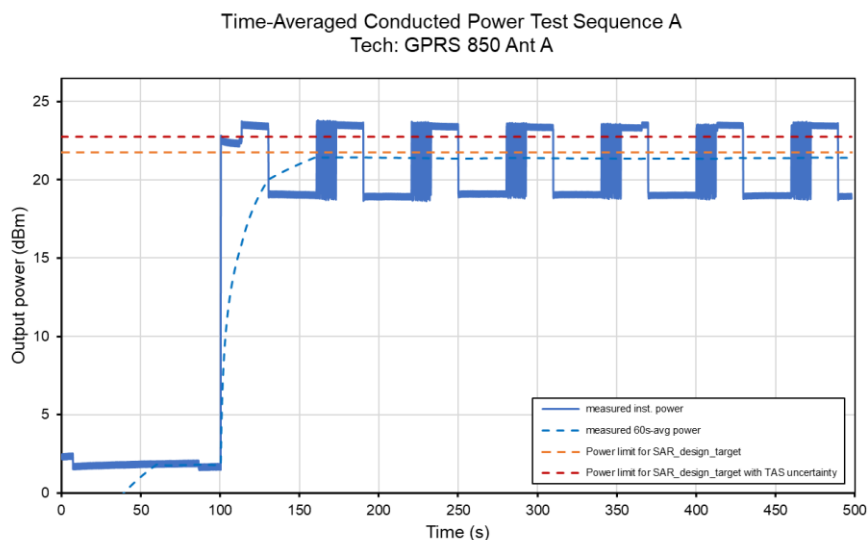
In all SAR plots:

- 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.

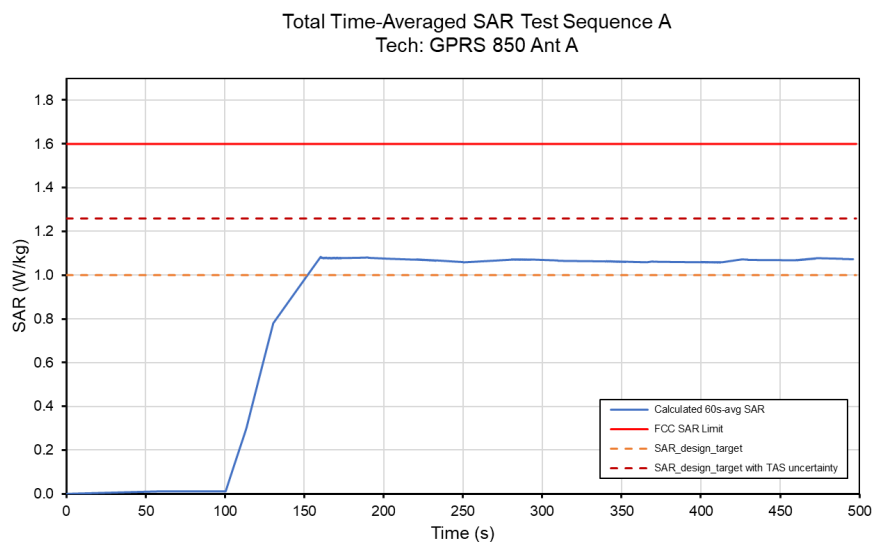
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6.1.1 GSM/GPRS 850, Antenna A

Test result for test sequence A:



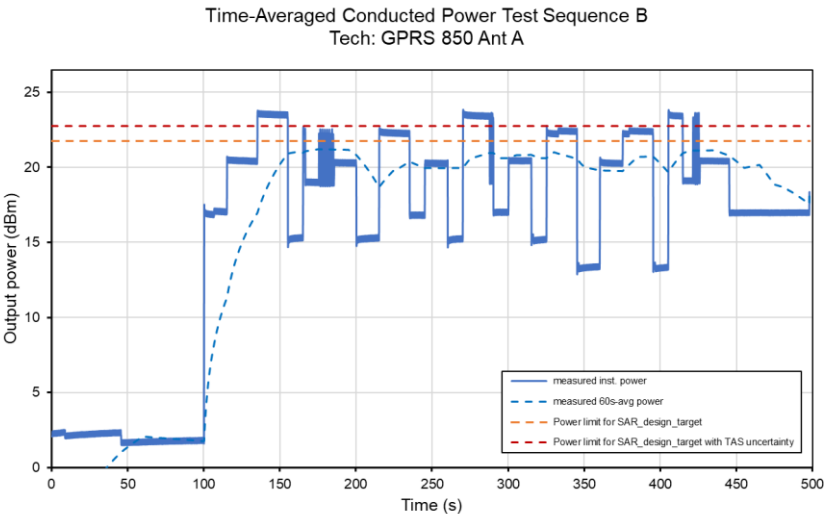
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



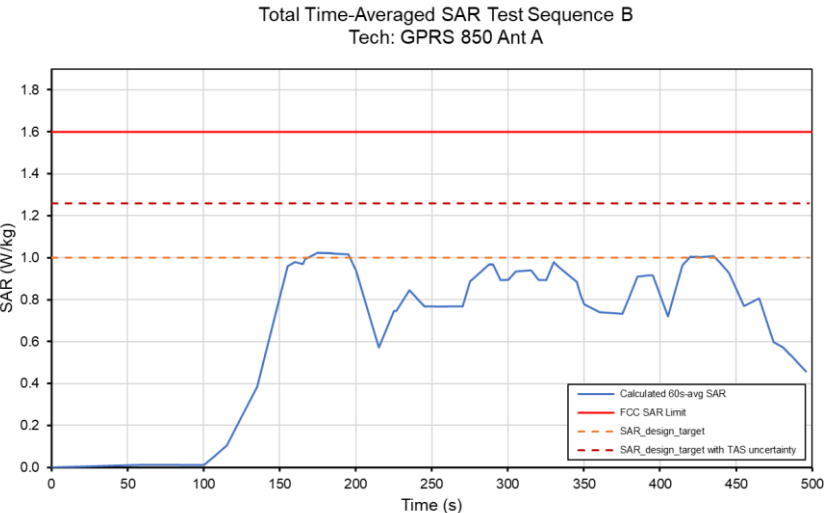
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.084
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

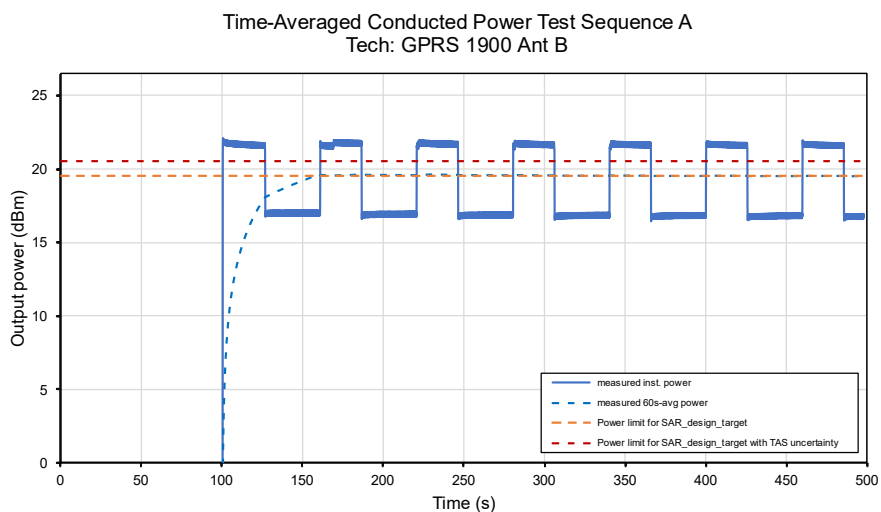


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.024
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

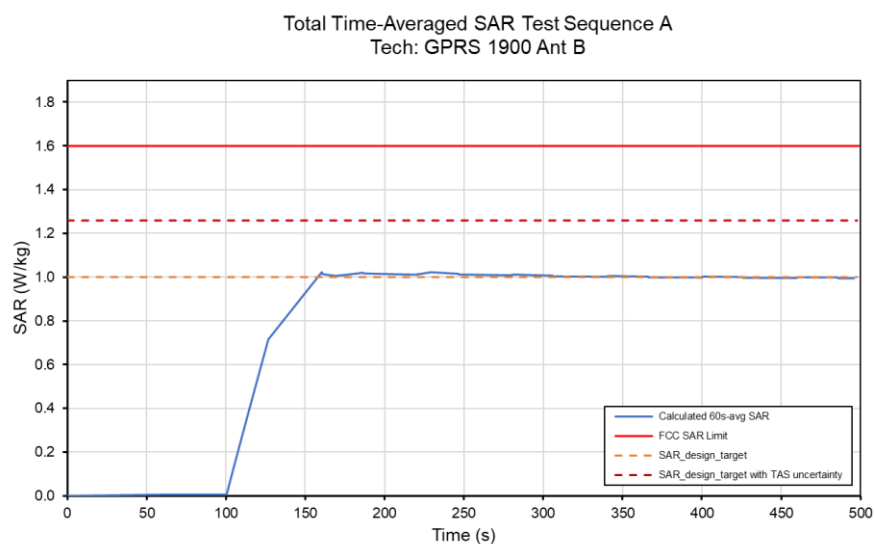
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6.1.2 GSM/GPRS 1900, Antenna B

Test result for test sequence A:



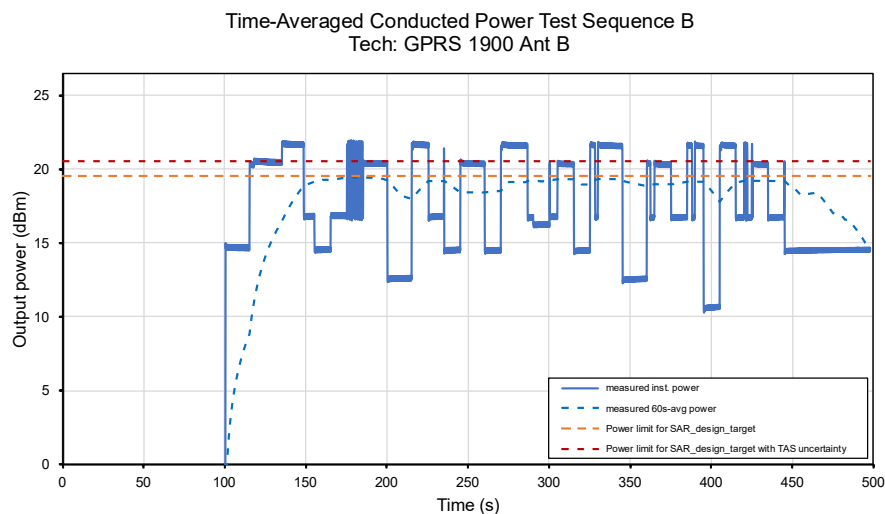
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



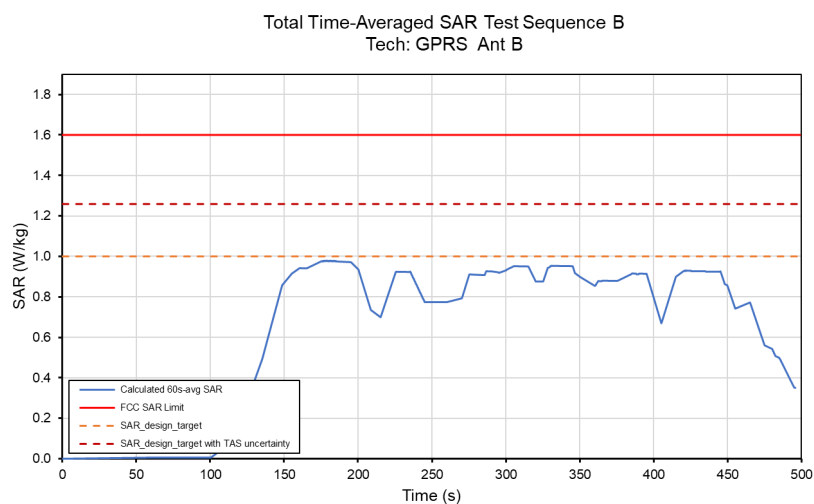
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.023
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

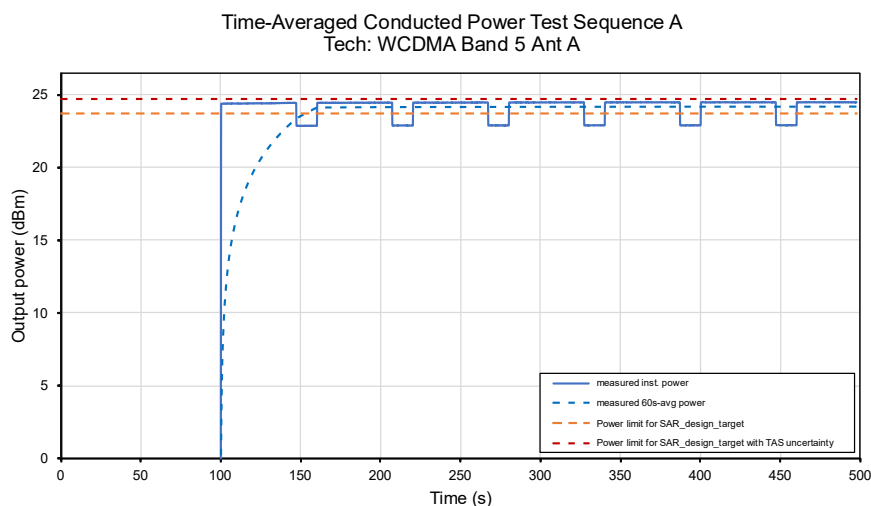


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	0.980
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

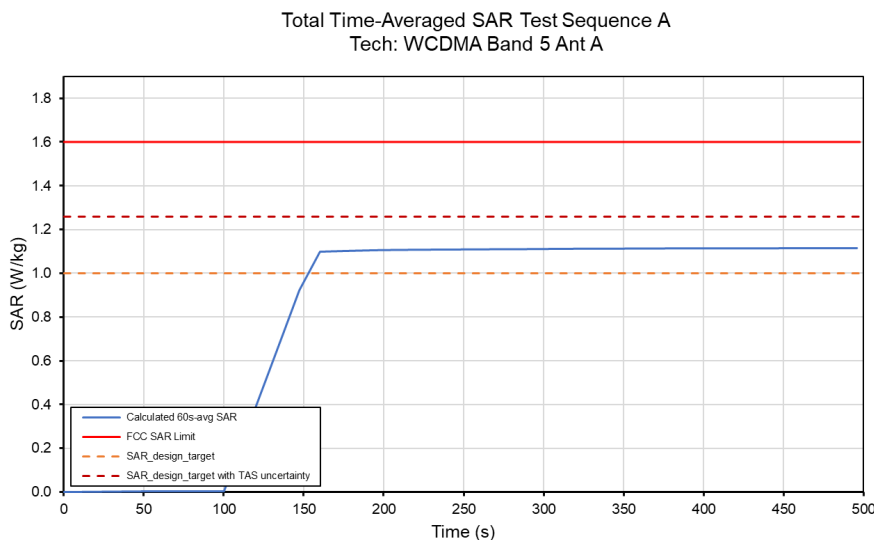
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6.1.3 WCDMA Band 5, Antenna A

Test result for test sequence A:



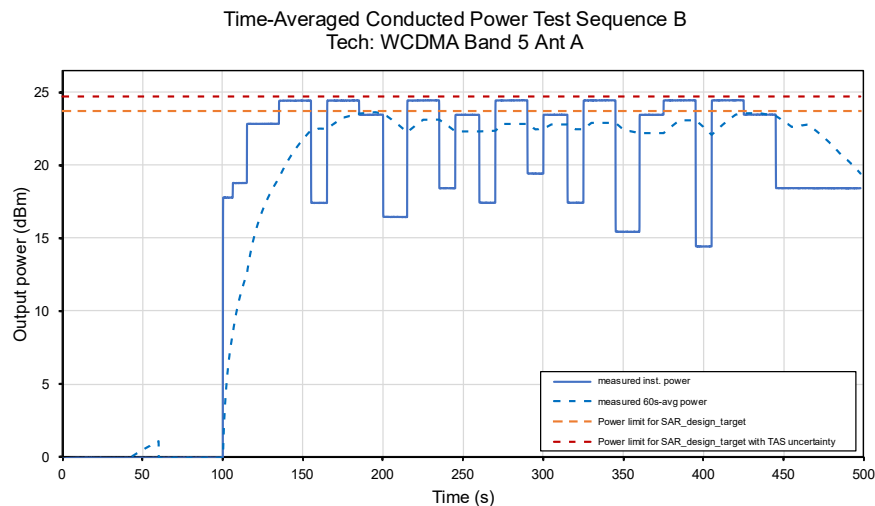
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



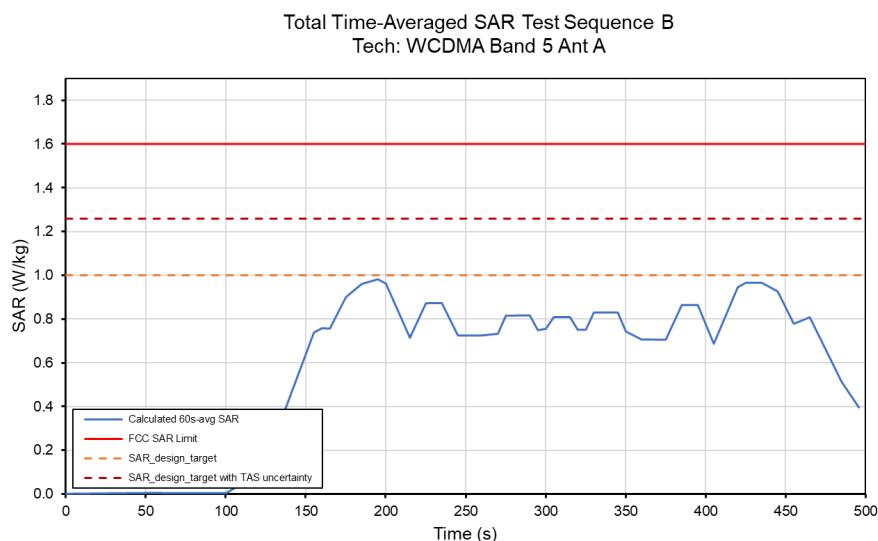
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.115
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

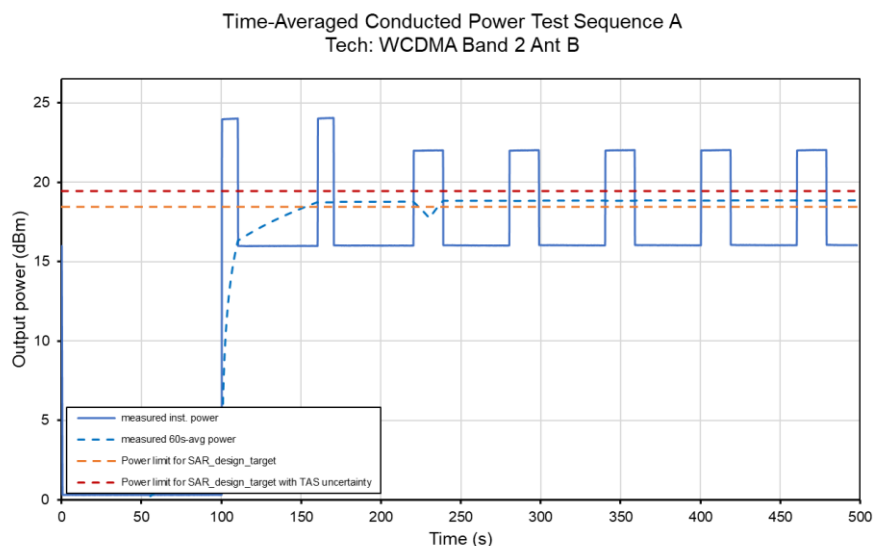


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	0.982
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

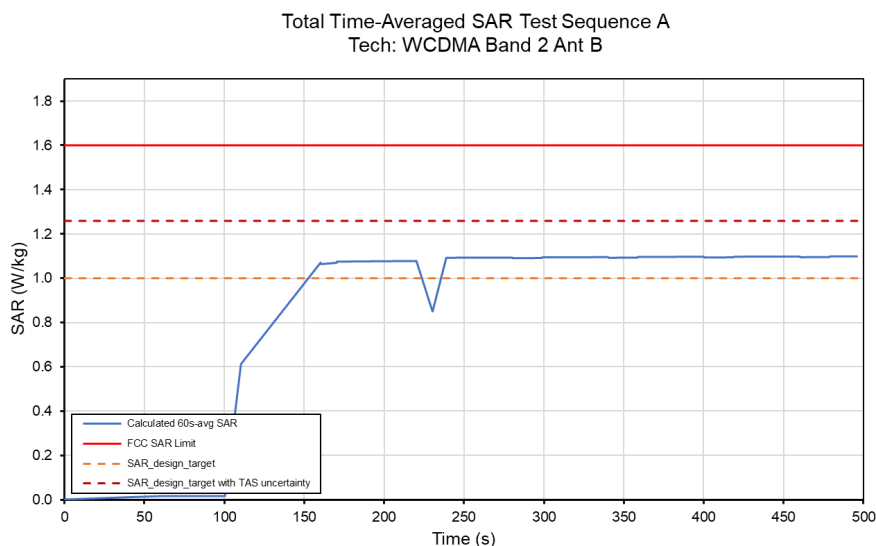
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6.1.4 WCDMA Band 2, Antenna B

Test result for test sequence A:



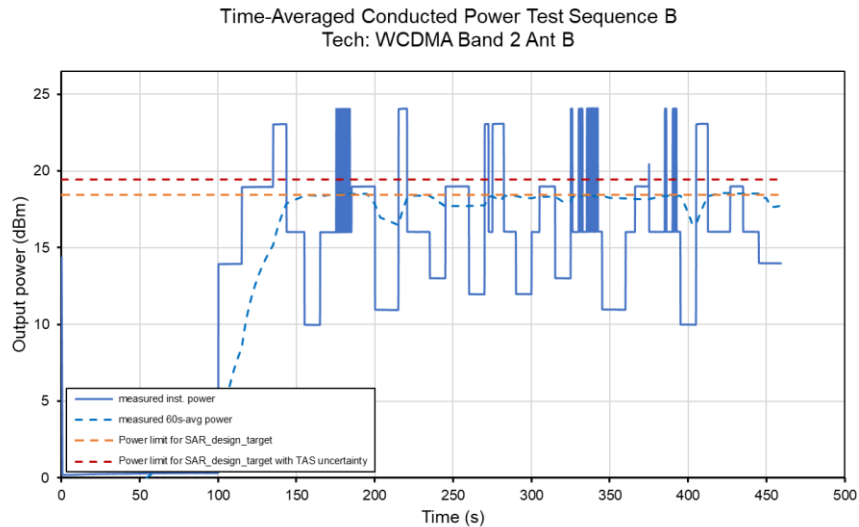
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



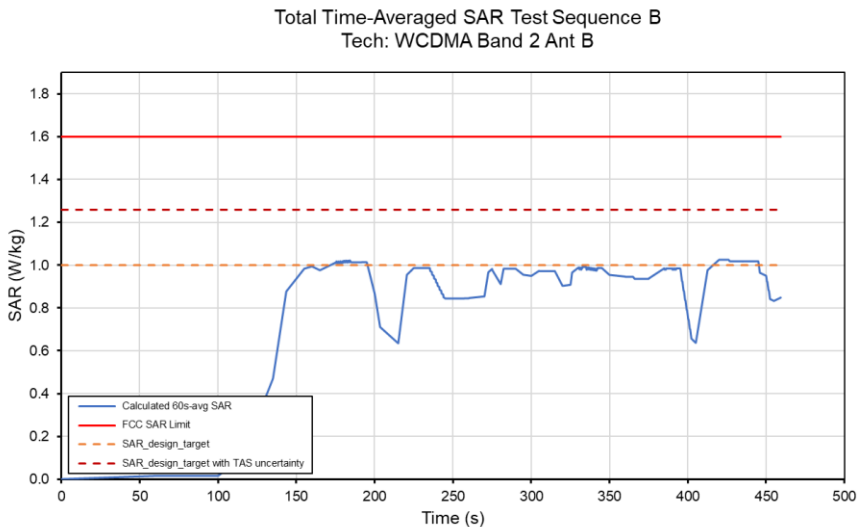
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.099
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

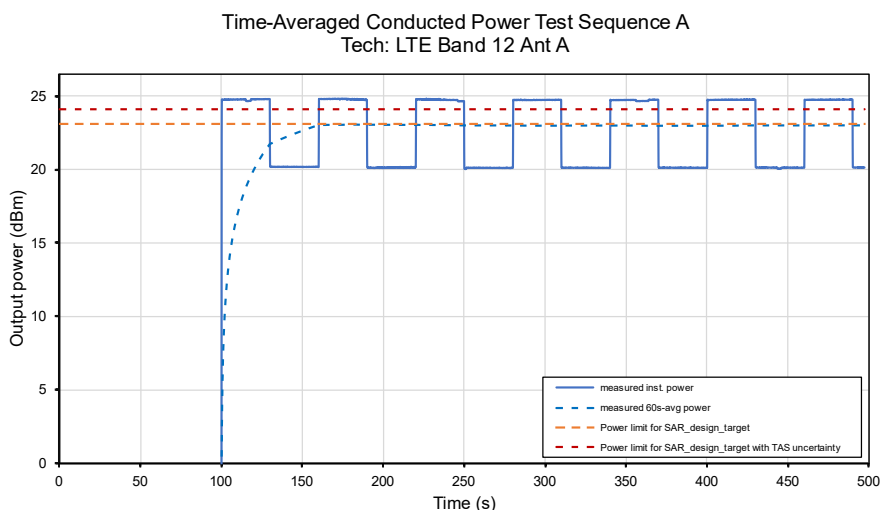


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.026
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

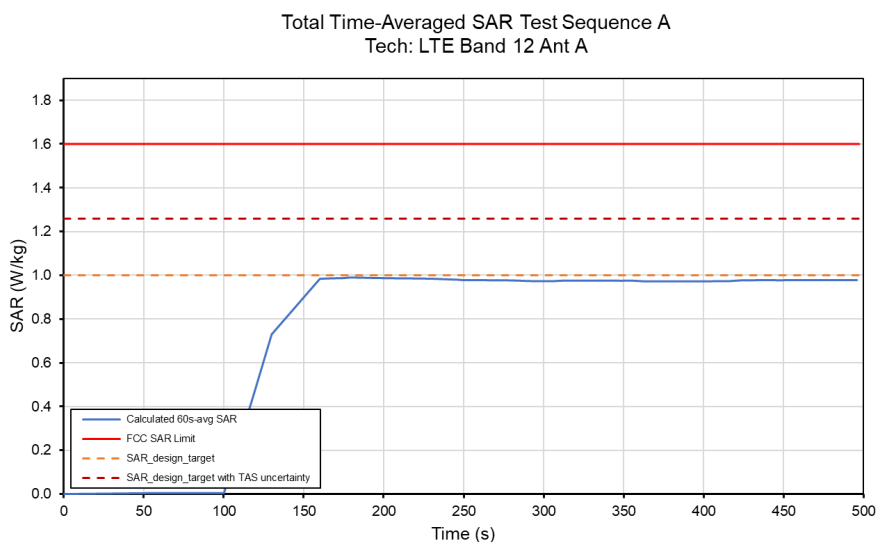
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6.1.5 LTE Band 12, Antenna A

Test result for test sequence A:



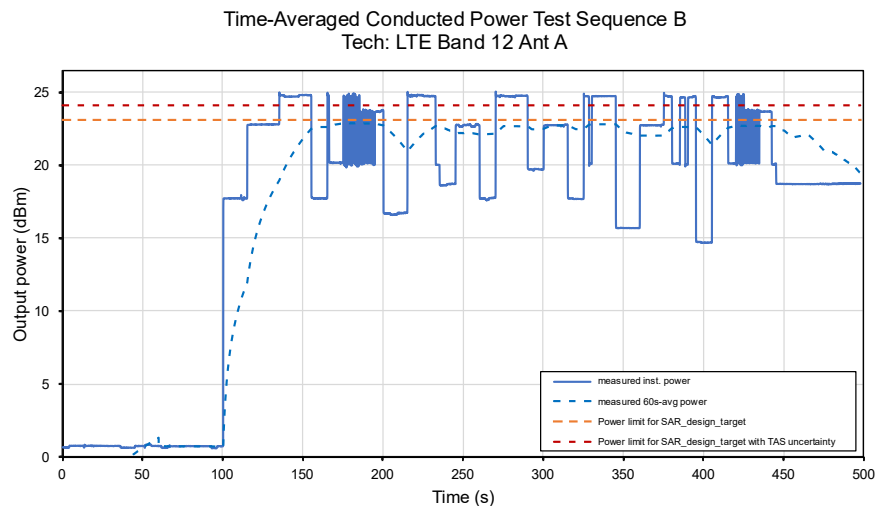
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



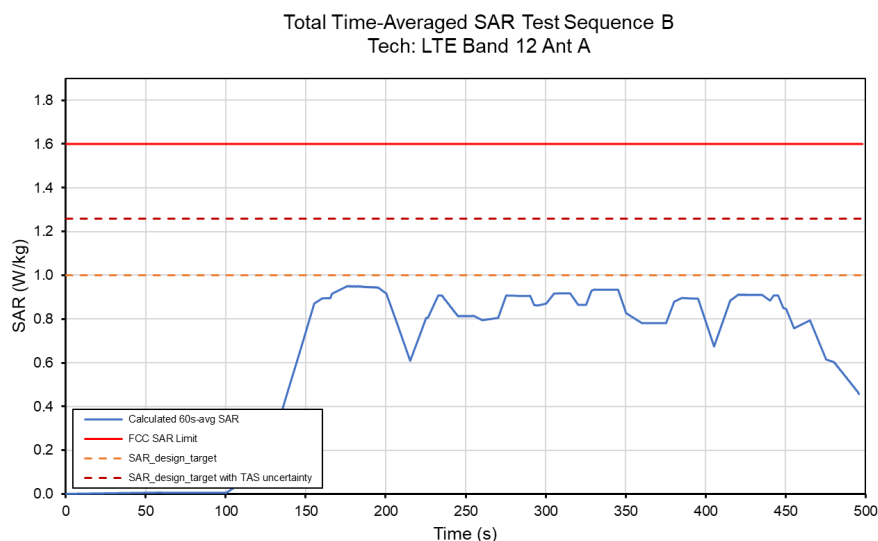
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	0.989
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

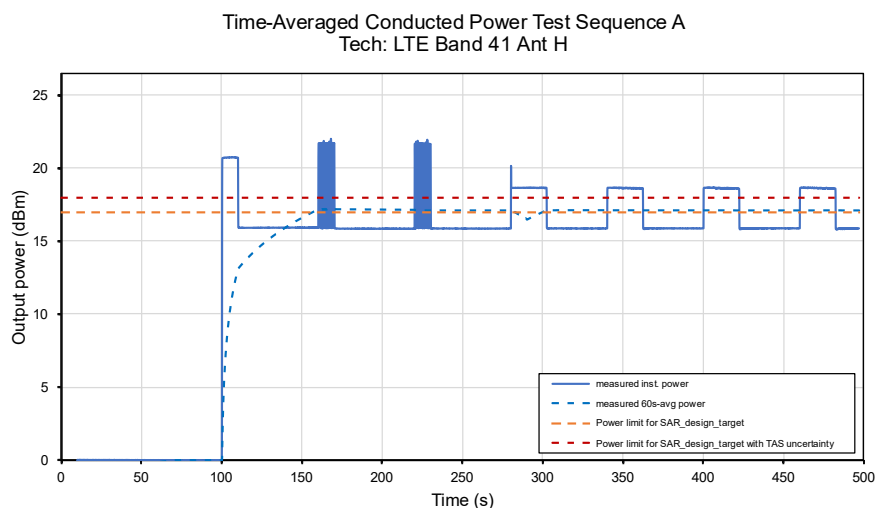


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	0.952
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

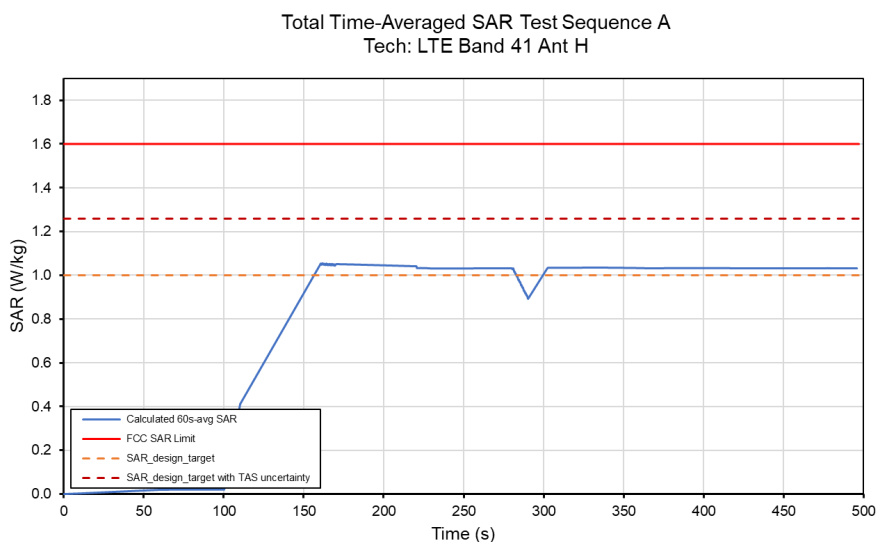
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6.1.6 LTE Band 41, Antenna H

Test result for test sequence A:



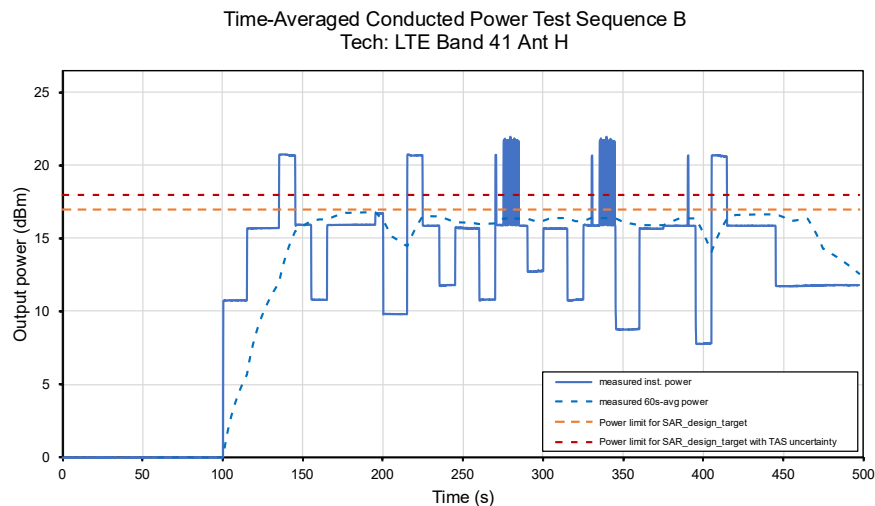
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



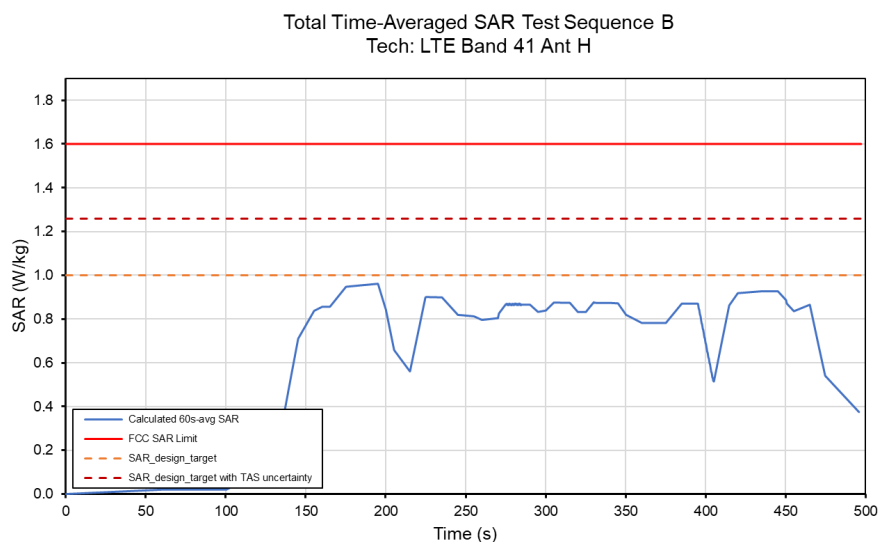
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.055
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

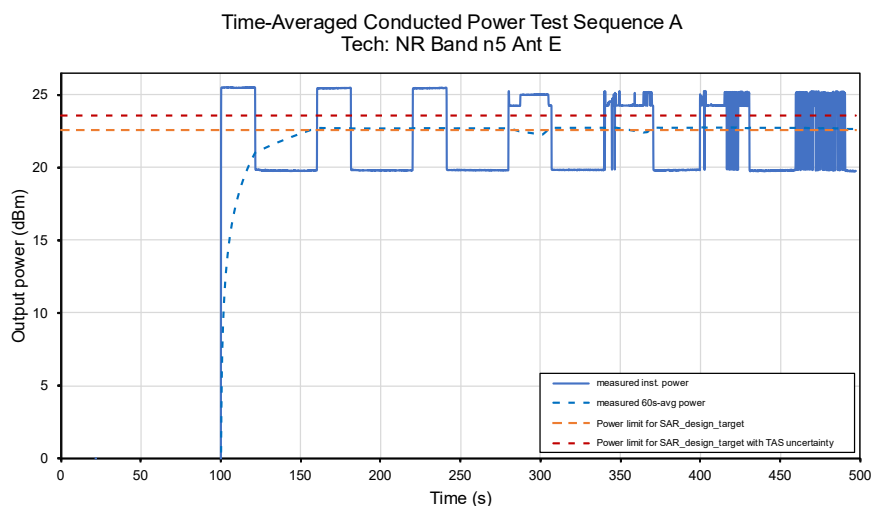


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	0.961
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

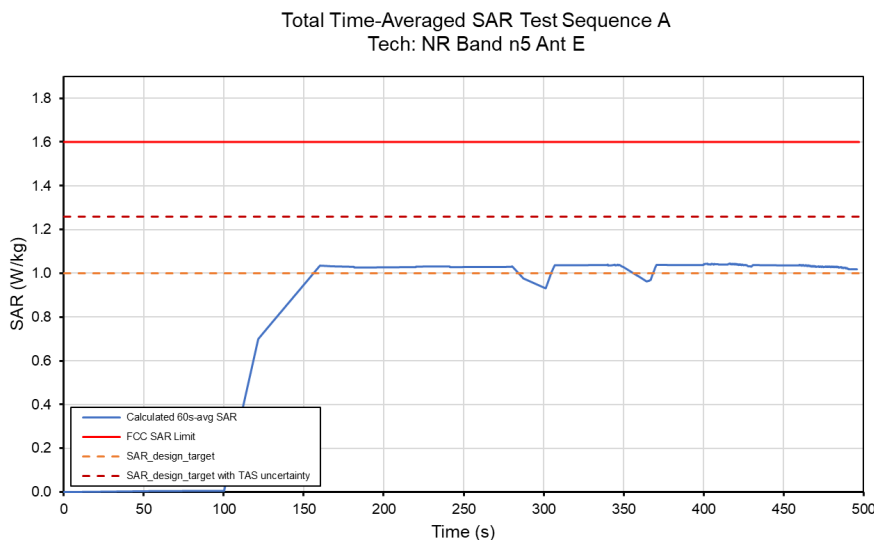
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6.1.7 NR Band n5 SA, Antenna E

Test result for test sequence A:



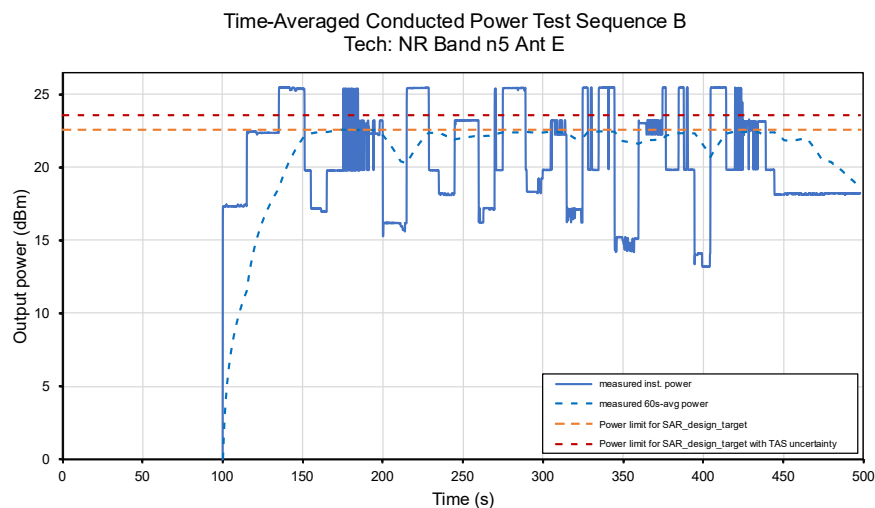
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



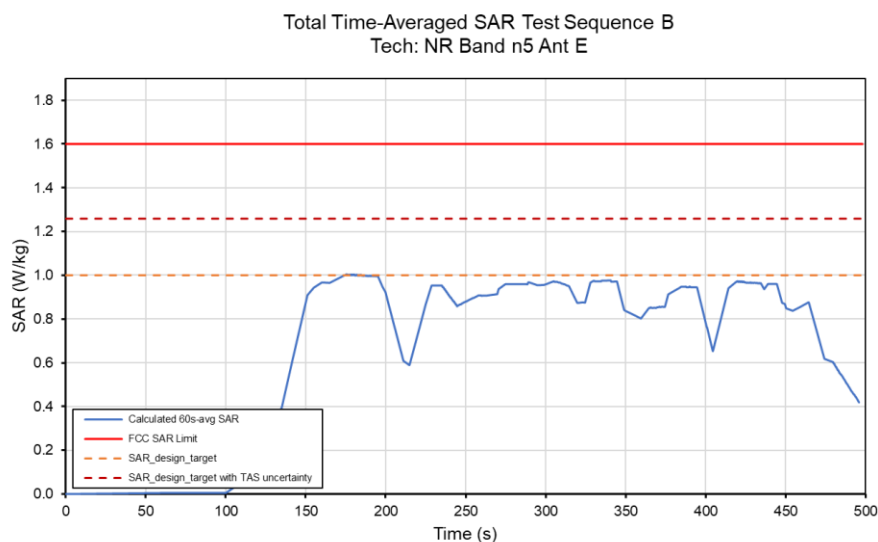
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.045
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

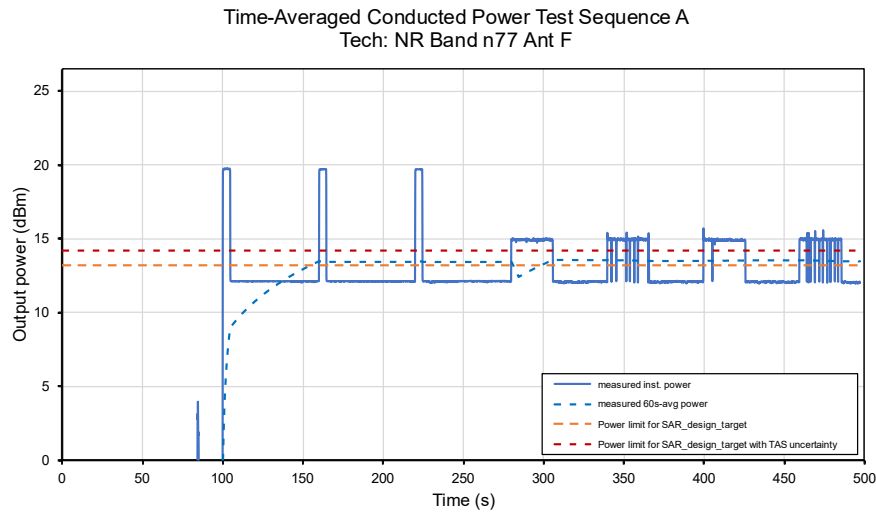


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.005
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

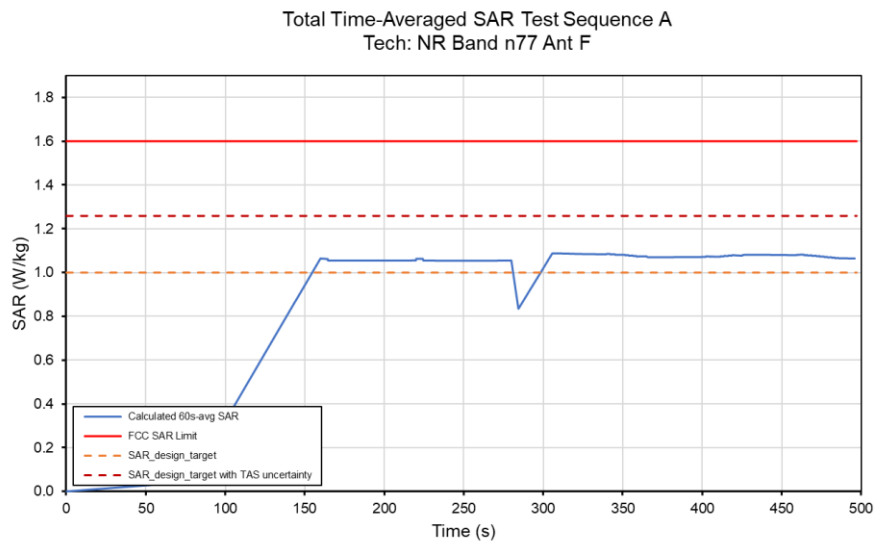
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6.1.8 NR Band n77 SA, Antenna F

Test result for test sequence A:



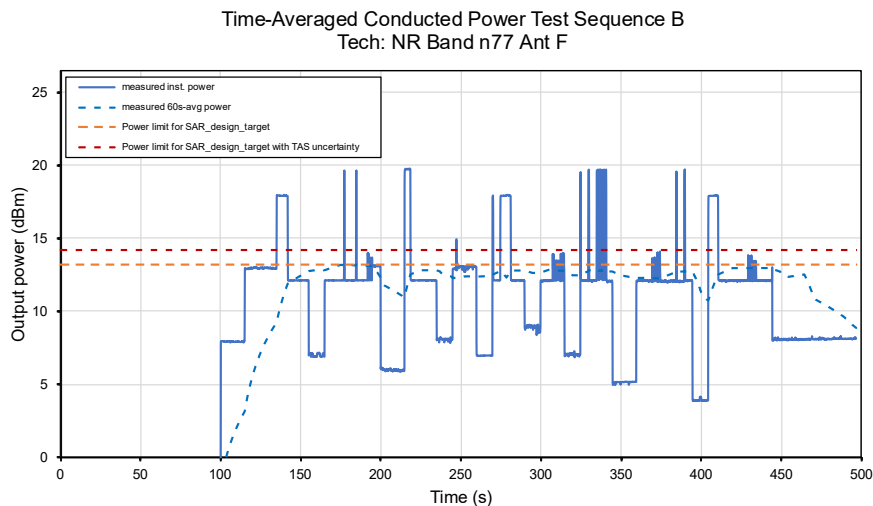
Time-averaged conducted Tx power is converted/calculated into time-averaged 1gSAR and plotted below to demonstrate that the time-averaged 1gSAR versus time does not exceed the FCC limit of 1.6 W/kg for 1gSAR:



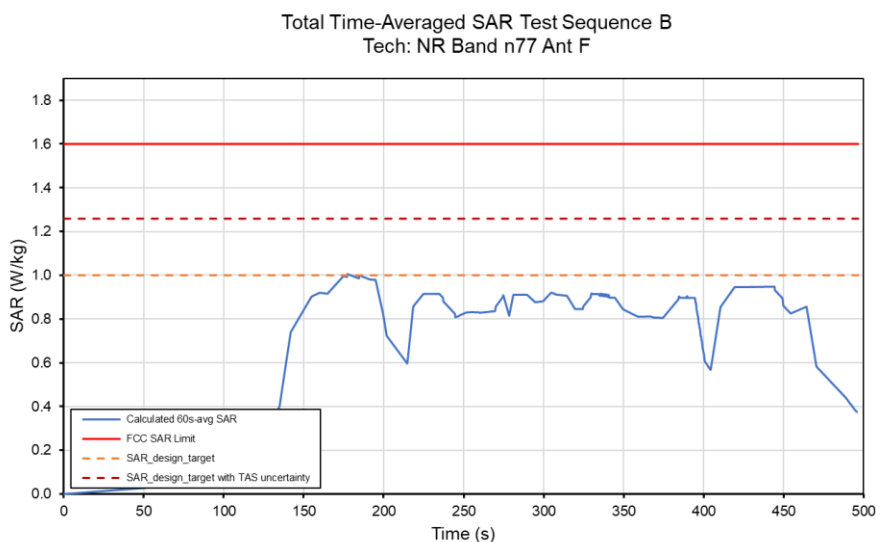
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.088
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

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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:

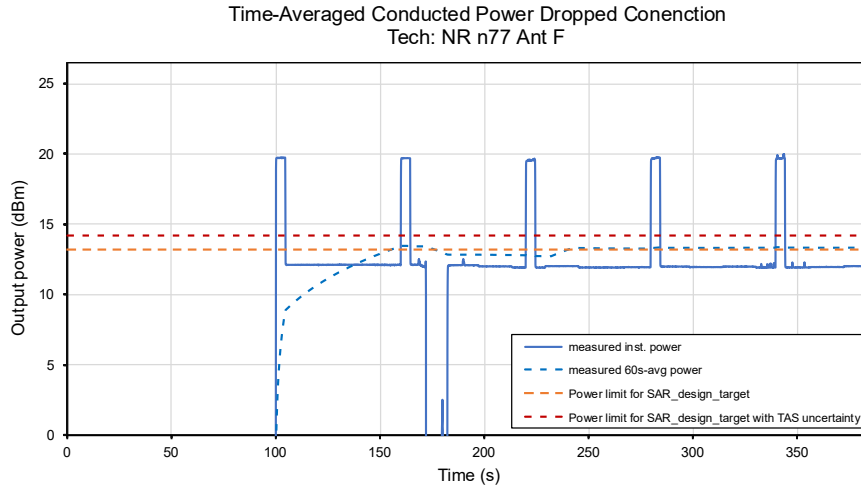


	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.006
Validated: Max time averaged SAR is within 1 dB device uncertainty of measured SAR at P_{limit} .	

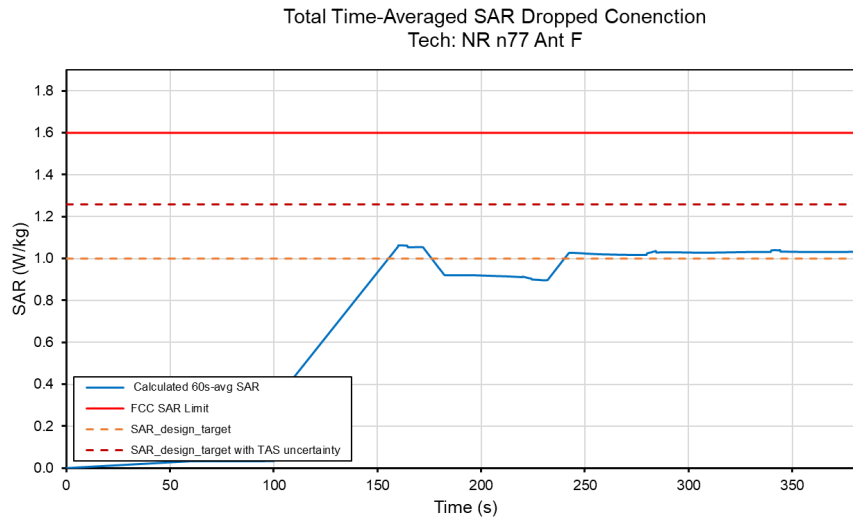
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6.2 Change in Call

This test was measured with NR Band n77, Antenna F, RSI = 1, and with callbox requesting maximum power. The measurement setup is shown in Figure 5.2-1a. 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:



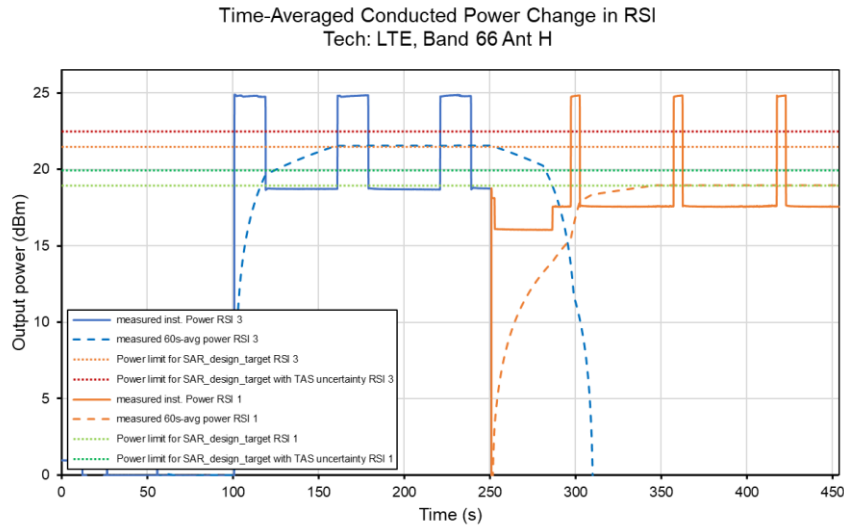
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (blue curve)	1.063
Validated	

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

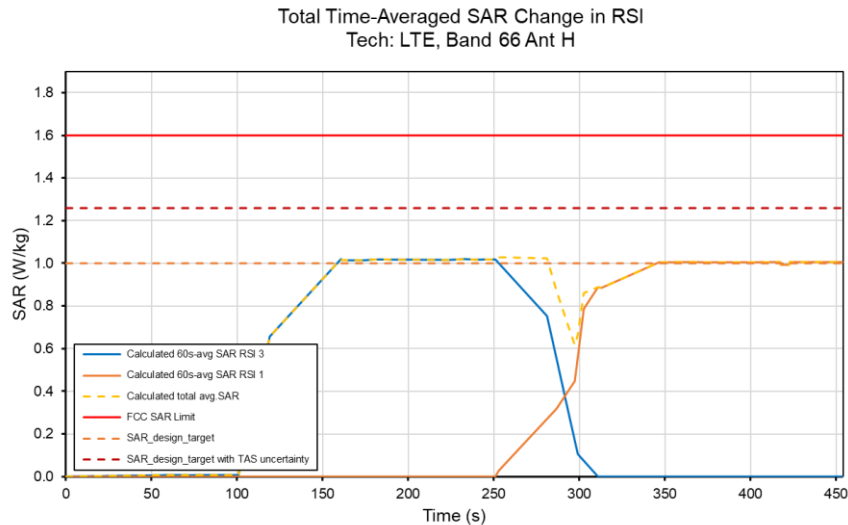
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6.3 Change in RSI

This test was conducted with callbox requesting maximum power, and with a technology switch from LTE Band 66, Antenna F, RSI = 3 to RSI = 1. Following procedure detailed in Section 4.2.3, and using the measurement setup shown in Figure 5.2-1a, the technology/band 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:



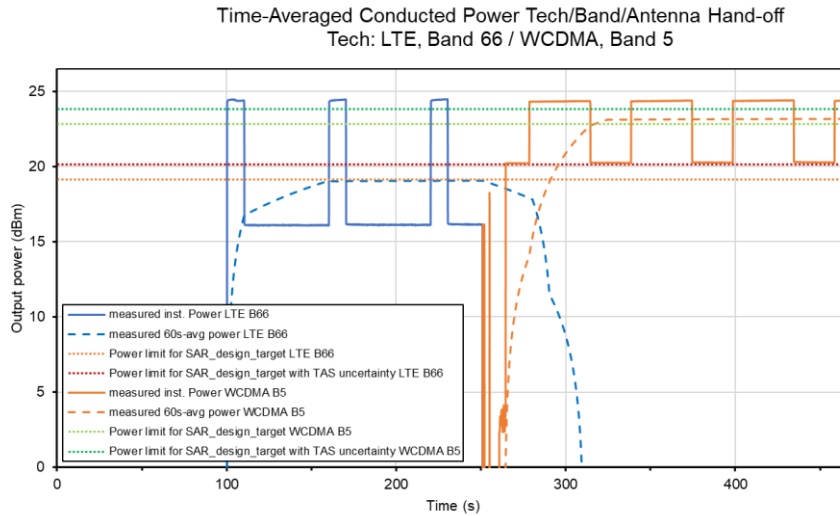
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (yellow curve)	1.028
Validated	

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 RSI change scenario.

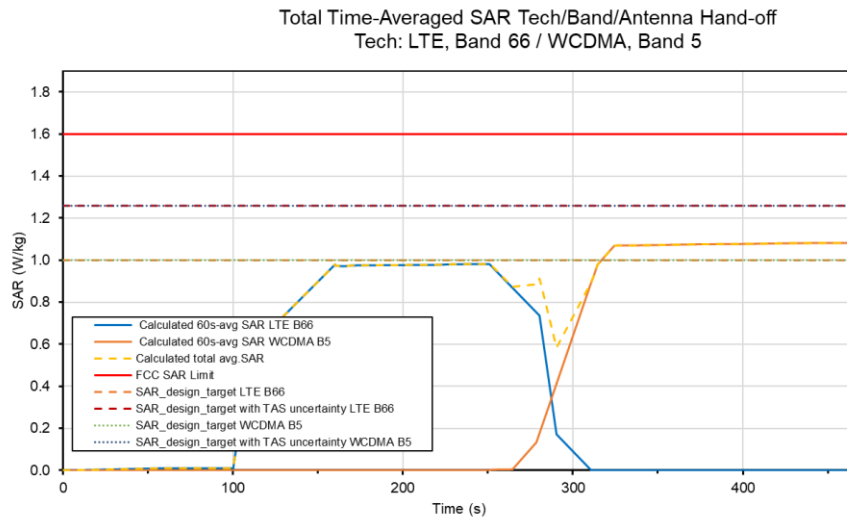
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6.4 Change in Technology/Band/Antenna

This test was conducted with callbox requesting maximum power, and with a technology switch from LTE Band 66, Antenna B, RSI = 2 to WCDMA Band 5, Antenna A, RSI = 2. Following procedure detailed in Section 4.2.4, and measurement setup shown in Figure 5.2-1b, 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:



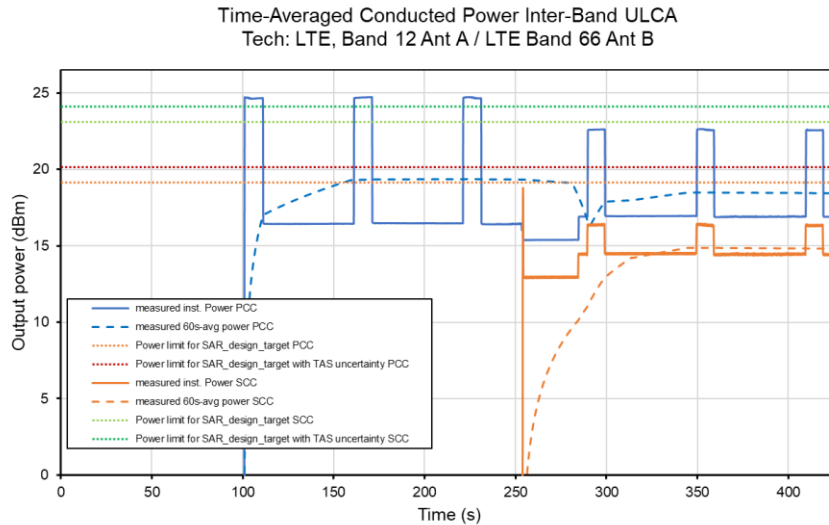
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (yellow curve)	1.082
Validated	

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.

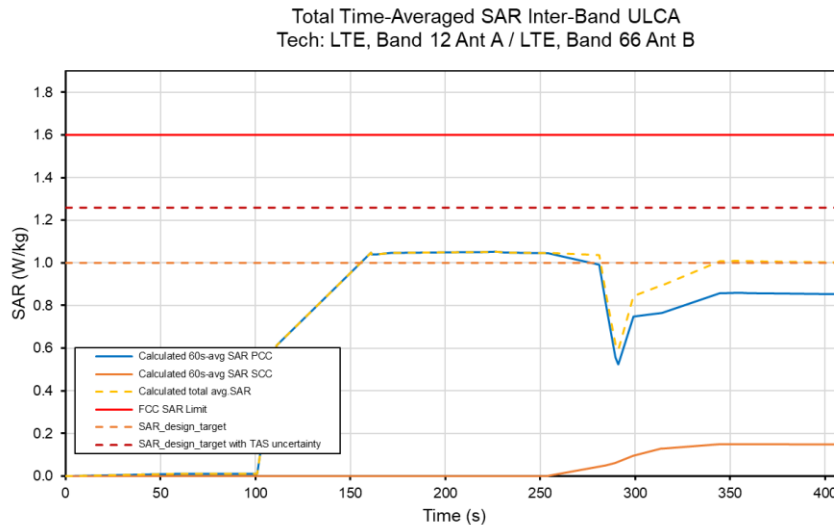
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6.5 Inter-Band ULCA

This test was conducted with callbox requesting maximum power, and with an inter-band ULCA connection between LTE Band 66 (PCC) and LTE Band 12 (SCC). Following procedure detailed in Section 4.2.5, and measurement setup shown in Figure 5.2-1d, 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:



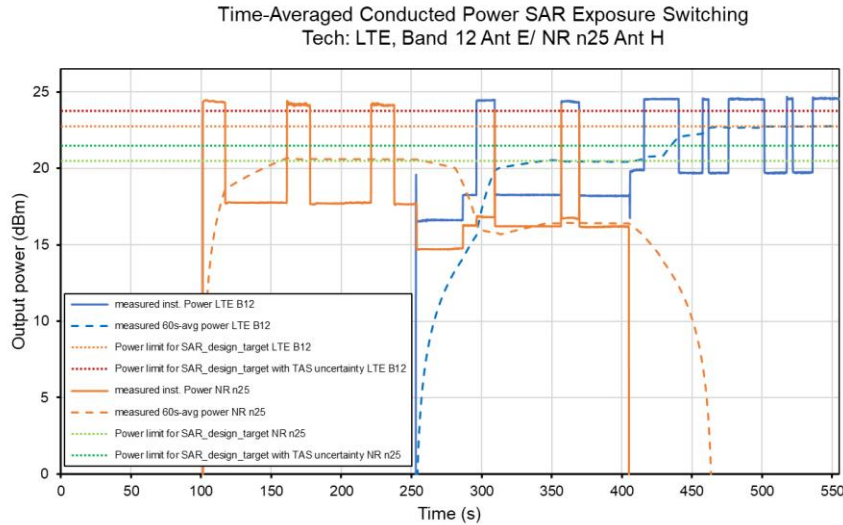
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (yellow curve)	1.052
Validated	

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 Inter-band ULCA scenario.

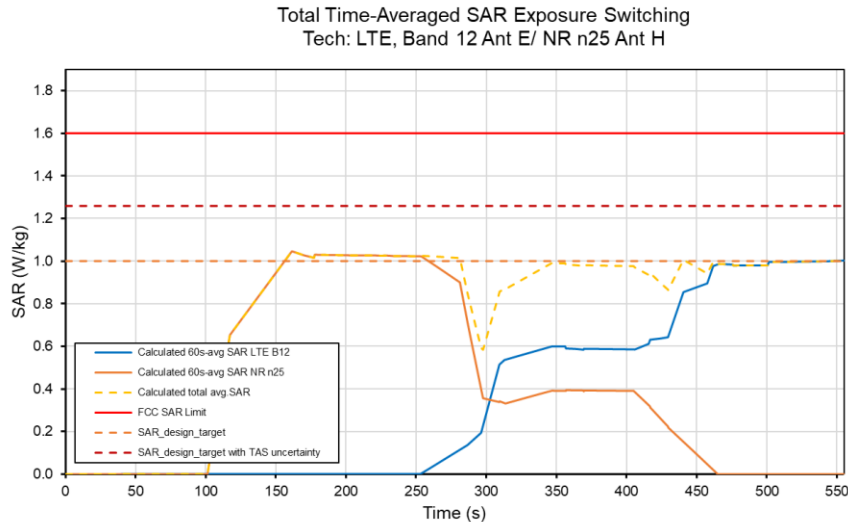
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6.6 SAR Exposure Switching EN-DC

This test was conducted with callbox requesting maximum power, and with the EUT in LTE Band 12 + Sub6 NR Band n25 call. Following procedure detailed in Section 4.2.7, and using the measurement setup shown in Figure 5.2-1d 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:



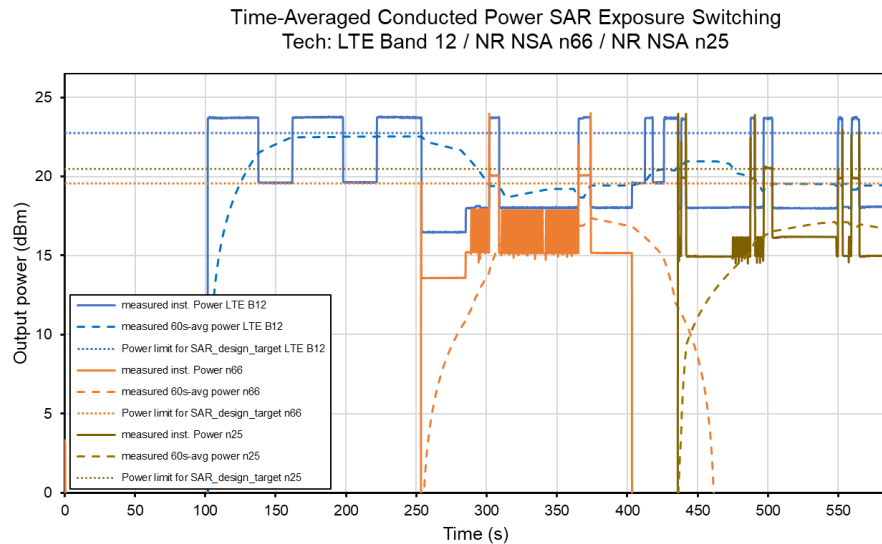
	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (yellow curve)	1.046
Validated	

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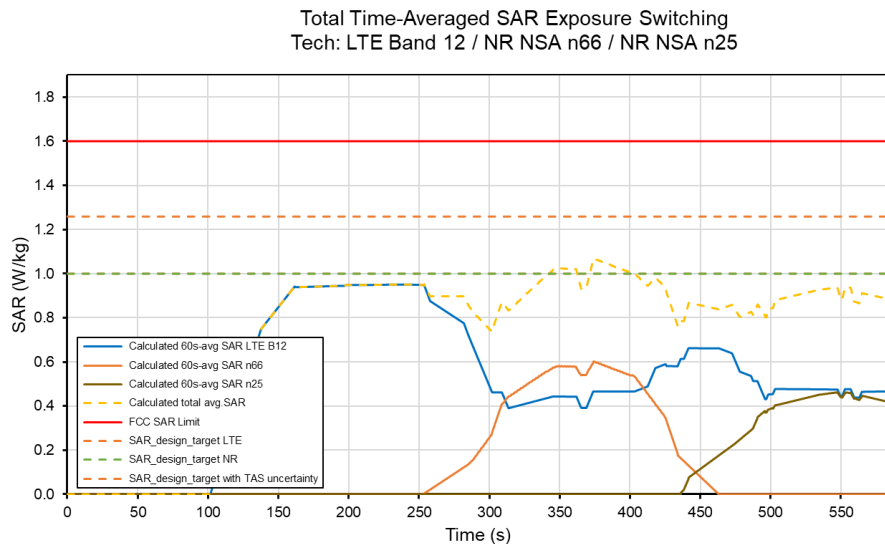
In this test, the SAR_design_target is 1.0 W/kg for both LTE and NR. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.0 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting in SAR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

6.7 NSA Antenna Switching EN-DC

This test was conducted with callbox requesting maximum power, and with the EUT in LTE Band 12 + Sub6 NR Band n66 and Band n25 call. Following procedure detailed in Section 4.2.8, and using the measurement setup shown in Figure 5.2-1e 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_{LTE} only scenario (t = 100s ~ 250s), SAR_{su6NR, Band n66} + SAR_{LTE} scenario (t = 250s ~ 400s) and switching antenna SAR_{su6NR, Band n25} + SAR_{LTE} 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:



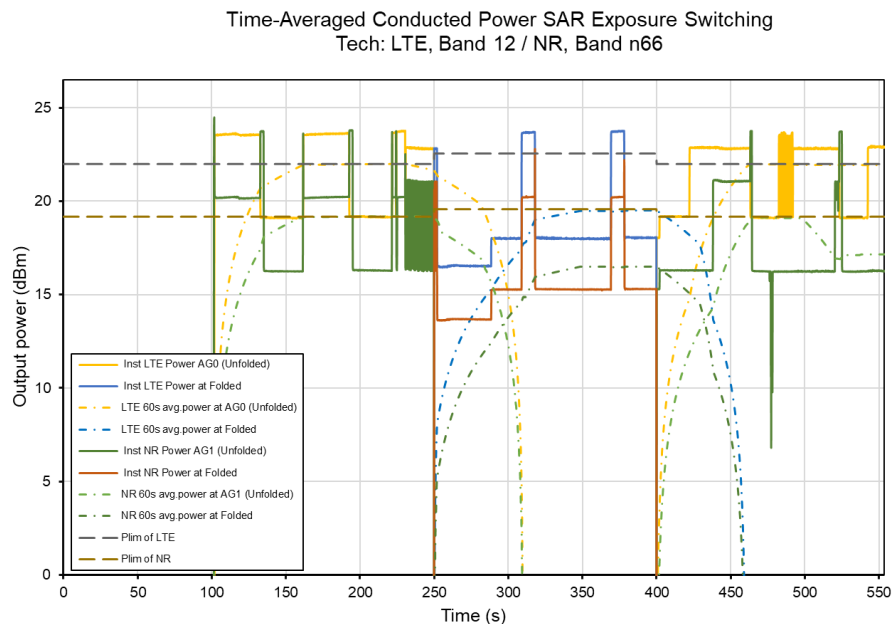
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	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR (yellow curve)	1.067
Validated	

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 NSA Antenna Switching EN-DC scenario.

6.8 Foldable Status/Event

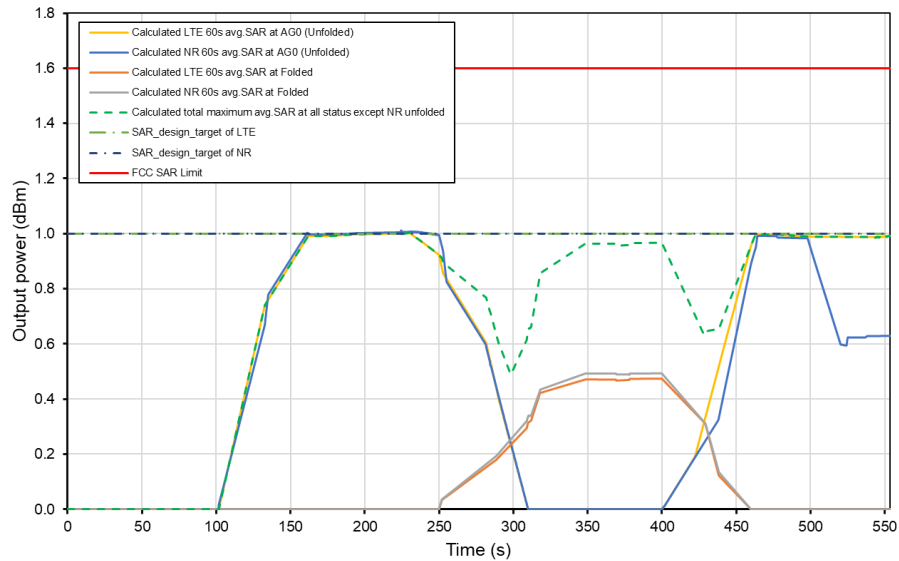
This test was conducted with callbox requesting maximum power, and with the EUT in LTE Band 12 + Sub6 NR Band n66 call. Following procedure detailed in Section 4.2.9, and using the measurement setup shown in Figure 5.2-1d since LTE and Sub6 NR are on different antenna ports, the foldable device switch measurement is performed with the EUT in various SAR exposure scenarios, i.e., in SAR_{su6NR} + SAR_{LTE} in 'open' DSI scenario (t = 100s ~ 250s), SAR_{su6NR} + SAR_{LTE} in 'close' DSI scenario (t = 250s ~ 400s) and back to SAR_{su6NR} + SAR_{LTE} in 'open' DSI 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:

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Total Time-Averaged SAR Exposure Switching
Tech: LTE, Band 12 / NR, Band n66



	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged 1gSAR of All states except NR unfolded (green curve)	1.003
Max 60s-time averaged 1g SAR of NR in unfolded state (blue curve)	1.012
Validated	

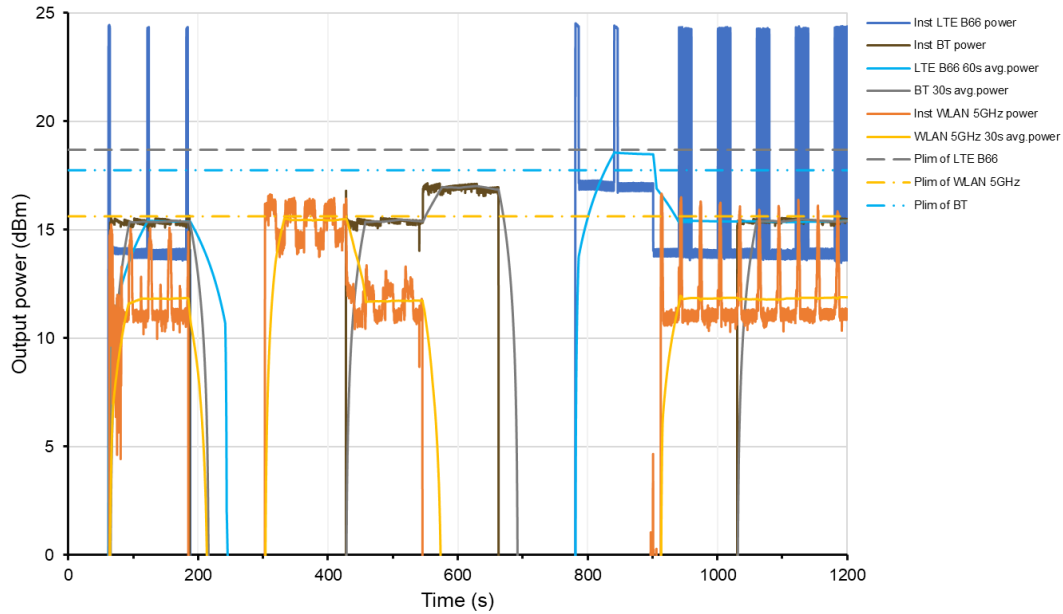
In this test, the SAR_design_target is 1.0 W/kg for both LTE and NR. As shown above, the total time-averaged SAR does not exceed the target SAR level of 1.0 W/kg + uncertainty (1dB) and therefore remains below the FCC limit of 1.6 W/kg. The test result validated the continuity of power limiting for foldable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

6.9 C-TAS (WWAN + WLAN + BT)

This test was conducted with callbox requesting maximum power, and with the EUT in LTE Band 66 + WLAN 5GHz + Bluetooth call. Following procedure detailed in Section 4.4, and using the measurement setup shown in Figure 5-1f since WWAN, WLAN, Bluetooth are in different antenna ports, the SAR exposure switch measurement is performed with the EUT in various SAR exposure scenarios, WWAN radio transmission, WLAN transmission, simultaneous transmission of WWAN + WLAN + BT, simultaneous transmission of WLAN + BT in airplane mode, BT in airplane mode, WLAN in airplane mode, and finally simultaneous transmission of WWAN + WLAN + BT.

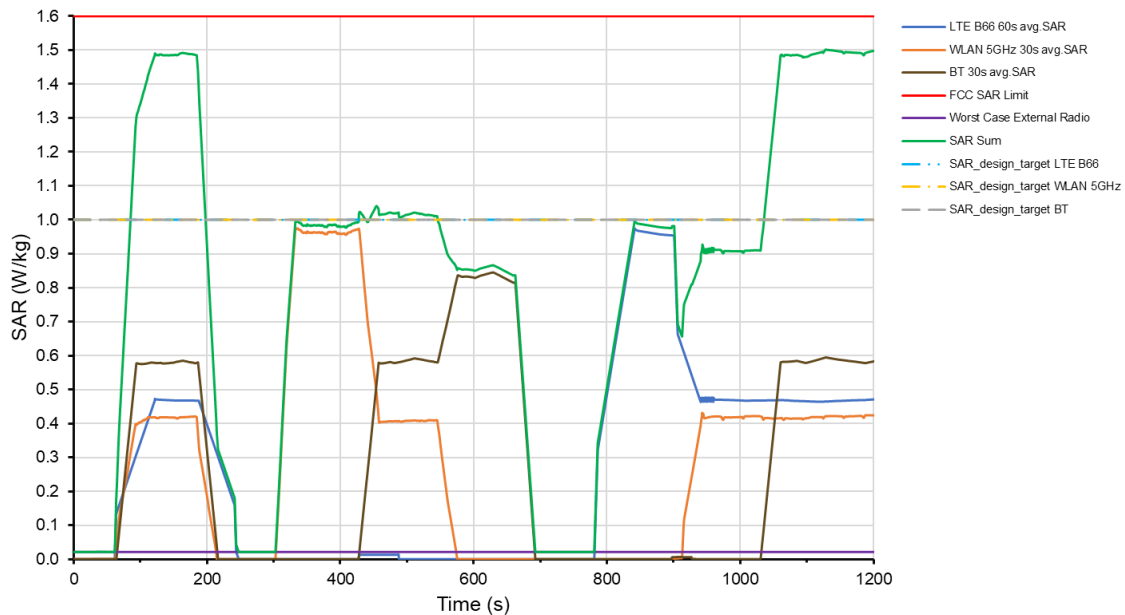
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WWAN + WLAN + BT Instantaneous and Time-Averaged Tx Power Tech: LTE, Band 66 / WLAN, 5GHz / Bluetooth



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:

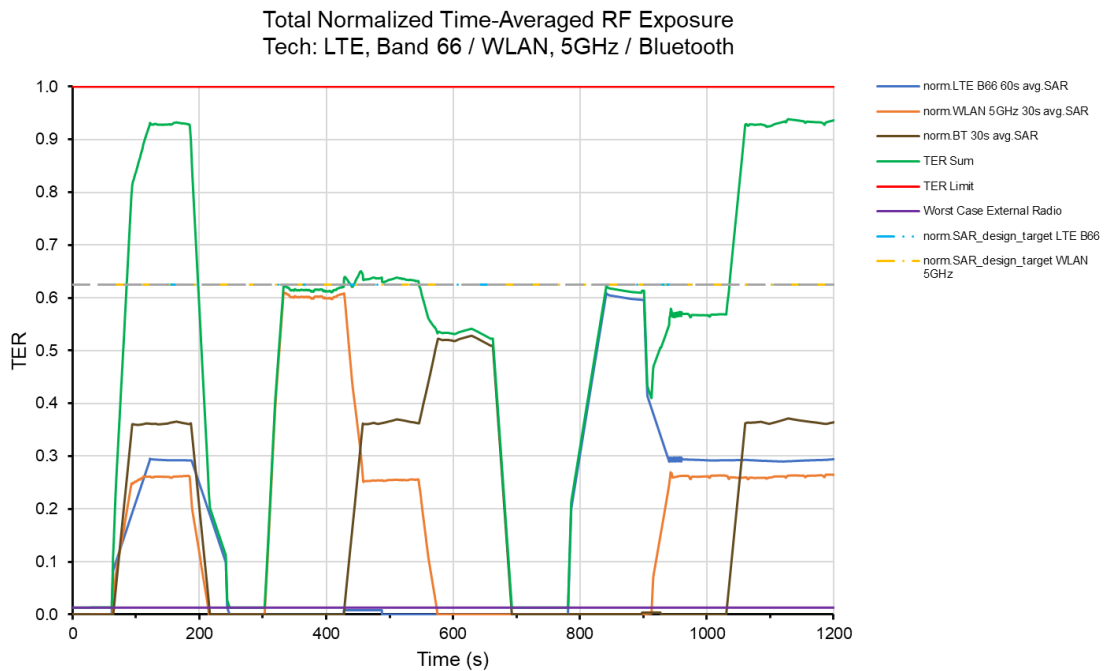
Total Time-Averaged RF Exposure Tech: LTE, Band 66 / WLAN, 5GHz / Bluetooth



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	(W/kg)
FCC 1gSAR limit	1.6
Max 60s-time averaged WWAN (blue curve)	0.609
Max 30s-time averaged WLAN (orange curve)	0.611
Max 30s-time averaged BT (grey curve)	0.528
External Radio (purple curve)	0.021
Max time averaged SAR (green curve)	1.504
Validated	

Time-averaged conducted Tx power is converted/calculated into normalized time-averaged nSAR and plotted below to demonstrate that the TER versus time does not exceed the FCC limit of 1.0.



FCC normalized total exposure limit	1.0
Max Norm 60s-time averaged WWAN (blue curve)	0.609
Max Norm 30s-time averaged WLAN (orange curve)	0.611
Max Norm 30s-time averaged BT (grey curve)	0.528
External Radio (purple curve)	0.013
Max time averaged normalized SAR (green curve)	0.940
Validated	

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7 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E4404B	Spectrum Analyzer	N/A	N/A	N/A	MY45113242
Anritsu	MT8821C	Radio Communication Analyzer MT8821C	3/11/2026	Annual	3/11/2027	6262044715
Anritsu	MT8000A	Radio Communication Test Station	6/5/2025	Annual	6/5/2026	6261987986
Control Company	4352	Long Stem Thermometer	12/22/2025	Biennial	12/22/2027	250770096
Control Company	4040	Therm./ Clock/ Humidity Monitor	12/29/2025	Biennial	12/29/2027	250778127
K & L	11SH10-1300/U4000	High Pass Filter	CBT	N/A	CBT	11SH10-1300/U4000 - 2
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	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	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2050
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2051
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	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Mini-Circuits	TRQ-516-08	Torque Wrench	12/3/2025	Biennial	12/3/2026	MC-1907
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	4/1/2026	Annual	4/1/2027	109322
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	4/1/2026	Annual	4/1/2027	109960
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	4/1/2026	Annual	4/1/2027	109961
Rohde & Schwarz	NRP8S	3-Path Dipole Power Sensor	10/1/2025	Annual	10/1/2026	108168
Rohde & Schwarz	NRP50S	3-Path Dipole Power Sensor	2/23/2026	Annual	2/23/2027	109956

Notes:

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

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8 CONCLUSION

8.1 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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