# PART 2 Test Under Dynamic Transmission Condition

## No. 24T04Z103003-002

**For**

**Realme Chongqing Mobile Telecommunications Corp., Ltd.**

**Mobile Phone**

**Model Name: RMX5061**

**with**

**Hardware Version: 11**

**Software Version: realme UI 6.0**

**FCC ID: 2AUYFRMX5061**

**Issued Date: 2025-05-02**

**Note:**

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of CTTL.

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## REPORT HISTORY

| Report Number | Revision | Issue Date | Description |
|---|---|---|---|
| 24T04Z103003-002 | Rev.0 | 2025-05-02 | Initial creation of test report |

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# 1 Test Laboratory

## 1.1. Introduction & Accreditation

**Telecommunication Technology Labs, CAICT** is an ISO/IEC 17025:2017 accredited test laboratory under American Association for Laboratory Accreditation (A2LA) with lab code 7049.01, and is also an FCC accredited test laboratory (CN1349), and ISED accredited test laboratory (CAB identifier:CN0066). The detail accreditation scope can be found on A2LA website.

## 1.2. Testing Location

Location 1: CTTL(huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China 100191

## 1.3. Testing Environment

| | |
|---|---|
| Normal Temperature: | 18-25℃ |
| Relative Humidity: | 30-70% |

## 1.4. Project data

| | |
|---|---|
| Testing Start Date: | 2025-04-10 |
| Testing End Date: | 2025-04-26 |

## 1.5. Signature

**Wang Meng**

**(Prepared this test report)**

**Lin Jun**

**(Reviewed this test report)**

**Qi Dianyuan**

**Deputy Director of the laboratory**

**(Approved this test report)**

# 2 Test Methodology

## 2.1 Applicable Limit Regulations

**ANSI C95.1–1992:**IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

It specifies the maximum exposure limit of **4.0** W/kg as averaged over any 10 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

## 2.2 Applicable Measurement Standards

**IEEE Std 1528–2013:** Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

**EN IEC/IEEE 62209-1528:2021** Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from head-held and body-mounted wireless communication devices (Frequency range of 4 MHz to 10 GHz)

### 2.3 KDB and Workshop Procedures

**KDB447498 D01: General RF Exposure Guidance v06:** Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

**KDB648474 D04 Handset SAR v01r03:** SAR Evaluation Considerations for Wireless Handsets.

**KDB941225 D01 SAR test for 3G devices v03r01:** SAR Measurement Procedures for 3G Devices

**KDB941225 D05 SAR for LTE Devices v02r05:** SAR Evaluation Considerations for LTE Devices

**KDB941225 D06 Hotspot Mode SAR v02r01:** SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

**KDB248227 D01 802.11 Wi-Fi SAR v02r02:** SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

**KDB865664 D01 SAR measurement 100 MHz to 6 GHz v01r04:** SAR Measurement Requirements for 100 MHz to 6 GHz.

**KDB865664 D02 RF Exposure Reporting v01r02:** RF Exposure Compliance Reporting and Documentation Considerations

## 3 Introduction

FCC regulation allows time averaged RF power to demonstrate compliance to RF exposure safety limits. Because RF exposure is correlated to transmission power (TX power), e.g., lower RF exposure is correlated to lower TX power, the TX power can be controlled to meet FCC RF exposure limits defined specific absorption rate (SAR) limit for transmit frequencies < 6GHz.

For SAR limit, the proposed Time-Averaged Specific Absorption Rate (TA-SAR) algorithm manages TX power to ensure that at all times the time-averaged RF exposure is compliant with the FCC SAR requirement. In the FCC regulation, the averaging window of SAR is 100 seconds for transmit frequencies less than 3GHz, 60 seconds for transmit frequencies between 3GHz and 6GHz.

This document describes the test plan, test procedures, measurement setup, and measurement results for the verification of the proposed TA-SAR algorithm being able to make RF exposure meet FCC requirement.

This purpose of the Part 2 report is to demonstrate the EUT complies with FCC exposure requirement under TX varying transmission scenarios, thereby validity of MediaTek TAS feature for FCC equipment authorization.

# 4 Operating Parameters for Algorithm Validation

Mediatek developed the TA-SAR algorithm to control instantaneous TX power for transmit frequencies less than 6GHz, respectively, so that the total time-averaged RF exposures are less than FCC requirement.

TA-SAR algorithm validation has been performed for 2G,3G,LTE,5G NR according to cases with different combinations of operating parameters listed in Table 4-1.

**Table 4-1 TA-SAR operating parameters**

| Operating parameters | Description |
|---|---|
| $P_{sub6\_limit}$ | The time-averaged maximum power level limit for different band in sub6. |
| $P_{lowThresh\_offset}$ | To calculate $P_{lowthresh}$.<br>($P_{lowThresh} = P_{sub6\_limit} - P_{lowThresh\_offset}$ ) |
| $P_{ue\_backoff\_offset}$ | To calculate $P_{ue\_backoff}$.<br>($P_{ue\_backoff} = P_{sub6\_limit} - P_{l\ ue\_backoff\_offset}$ ) |
| $P_{ue\_max\_cust\_offset}$ | To calculate $P_{ue\_max\_cust}$.<br>$P_{ue\_max}$ is maximum TX power at which a UE can possibly transmit in sub6.<br>($P_{ue\_max\_cust}$ = mim ($P_{ue\_max}$ ,$P_{sub6\_limit} + P_{ue\_max\_cust\_offset}$) |

## 5 Overview of TA-SAR

For the completeness of verifying that the proposed TA-SAR algorithm can realize FCC compliance regarding RF exposure, several test scenarios are constructed as below:

**Scenario 1**: test under different TA-SAR parameters to verify that the TA-SAR algorithm meets compliance requirements with different combinations of operating parameters.

**Scenario 2**: test under time-varying TX power to verify that the TA-SAR algorithm ensures SAR compliance through dynamic TX power.

**Scenario 3**: test under call drop and re-establishment conditions to ensure the TA-SAR algorithm control continuity and SAR compliance.

**Scenario 4**: test under RAT/band handover to ensure the TA-SAR algorithm control continuity and correctness.

**Scenario 5**: test under different ECIs (Exposure Condition Index) to ensure the TA-SAR algorithm control behaves as expected during ECI switching from one ECI to another. (e.g., head→ body worn)

**Scenario 6**: test under different transmission antennae to ensure the TA-SAR algorithm control works correctly during antenna switching from one antenna to another.

**Scenario 7**: test under SAR exposure switching between two active radios (radio#1 dominant, radio#1+radio#2, and radio#2 dominant) to ensure the TA-SAR algorithm control continuity and SAR compliance.

## 6 TA-SAR Test Scenarios and Test Procedures

In order to demonstrate that TA-SAR algorithm performs as expected under various operating scenarios, Table 6-1 lists the test scenarios and expected test sequences to validate TA-SAR algorithm in these scenarios. The test sequences 0,1,2 are defined in section 6.1. The details of each test procedures via conducted power and SAR measurements are described in section 6.2~6.9 and section 6.10, respectively.

**Table 6-1 Test scenario list of TA-SAR validation**

| Test scenario | | Test sequence # | Description |
|---|---|---|---|
| 1 | Range of TA-SAR parameters | 0 | Adjust parameters |
| 2 | Time-varying TX power | 1 and 2 | Test under time-varying TX power |
| 3 | Call disconnection and re-establishment | 0 | Test call drop and re-establishment |
| 4 | Band/RAT handover | 0 | Test band/RAT change |
| 5 | ECI (Exposure Condition Index) change | 0 | Test under ECI transition (e.g., head→ body worn) |
| 6 | Antenna switching | 0 | Change antenna |
| 7 | SAR exposure switching | 0 | Switch RATs when testing (e.g., LTE→NR) |

### 6.1 Test Sequences for All Scenarios

Two test sequences having possibly time-varying TX power are predefined for TA-SAR validation:

- **Test sequence 0**: EUT's TX power is requested to be maximum.
- **Test sequence 1**: EUT's TX power is requested to be at power less than $P_{LowThresh}$ for 300s, then at maximum power for 200s, and finally at $P_{LowThresh}$ -2dB for the remaining time.
- **Test sequence 2**: EUT's TX power to vary with time. This sequence is generated relative to measured $P_{UE\_max}$, measured $P_{sub6\_limit}$ and calculated $P_{UE\_backoff}$ (= measured $P_{sub6\_limit}$ in dBm - $P_{UE\_backoff\_offset}$ in dB) of EUT based on measured $P_{sub6\_limit}$.
- Test sequence is generated based on below parameters of the EUT:

  A. Measured maximum power ($P_{UE\_max}$)

  B. Measured Tx power at SAR_design_limit ($P_{sub6\_limit}$)

  C. Threshold of dynamic power reduction status determination: reserve hysteresis margin for instantaneous power ($P_{LowThresh}$)

  D. SAR_time_window (FCC: 100s for f<3GHz, 60s for 3GHz<f<6GHz)

The test sequence 0,1, and 2 are illustrated in Figure 6-1, Figure 6-2, and Figure 6-3, respectively. The waveforms of the three test sequences are listed in Table 6-2,Table 6-3, and Table 6-4.

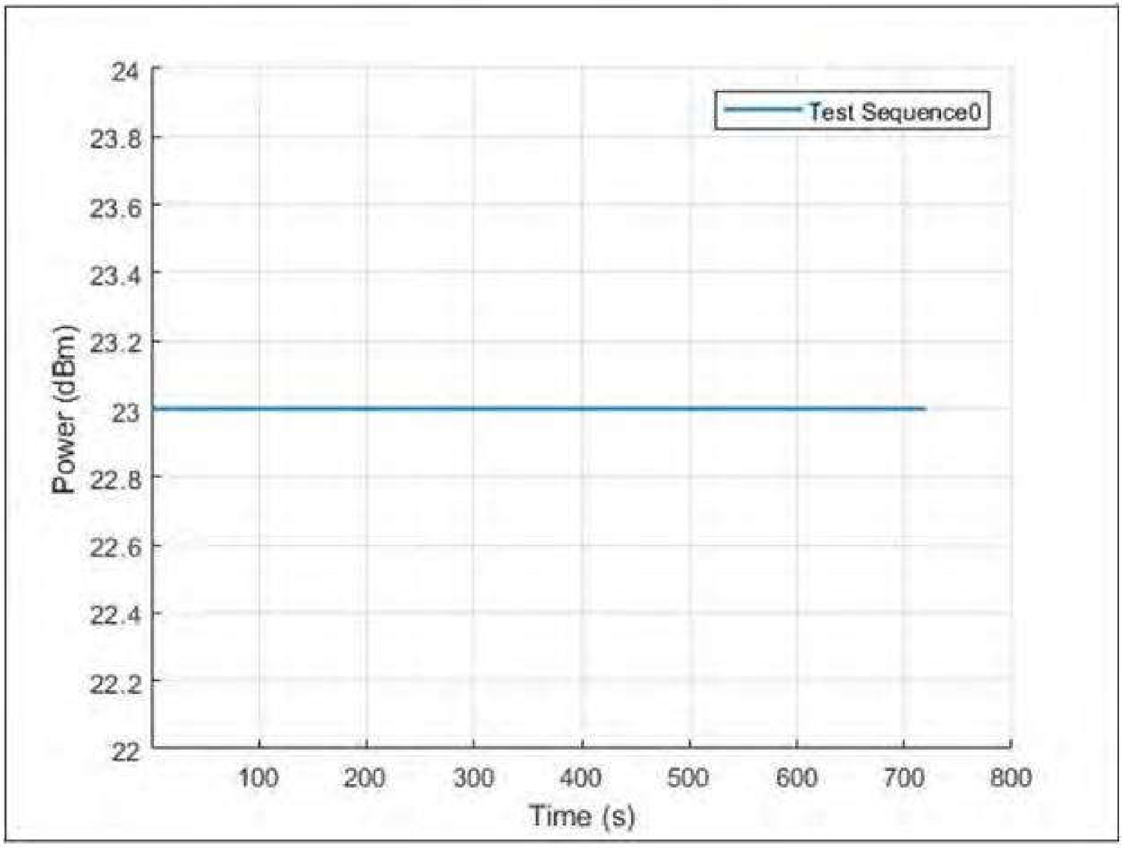



Figure 6-1 Test sequence 0

**Table 6-2 Test sequence 1**

| Time | Duration | Power (dBm) | Note |
|---|---|---|---|
| 720 | 720 | 23 | $P_{UE\_max}$ |

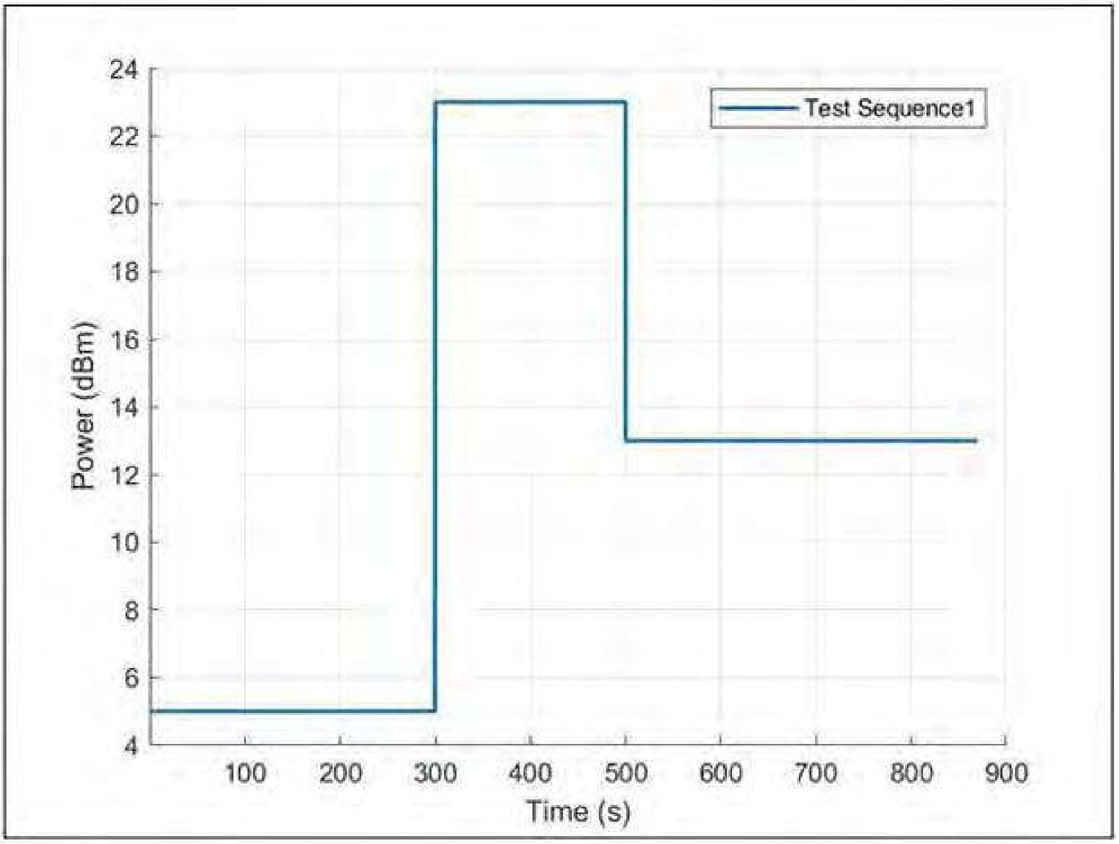



Figure 6-2 Test sequence 1

**Table 6-3 Test sequence 1**

| Time | Duration | Power (dBm) | Note |
|---|---|---|---|
| 300 | 300 | 5 | $< P_{Lowthresh}$ |
| 500 | 200 | 23 | $P_{UE\_max}$ |
| 870 | 370 | 13 | $P_{Lowthresh} - 2dB$ |

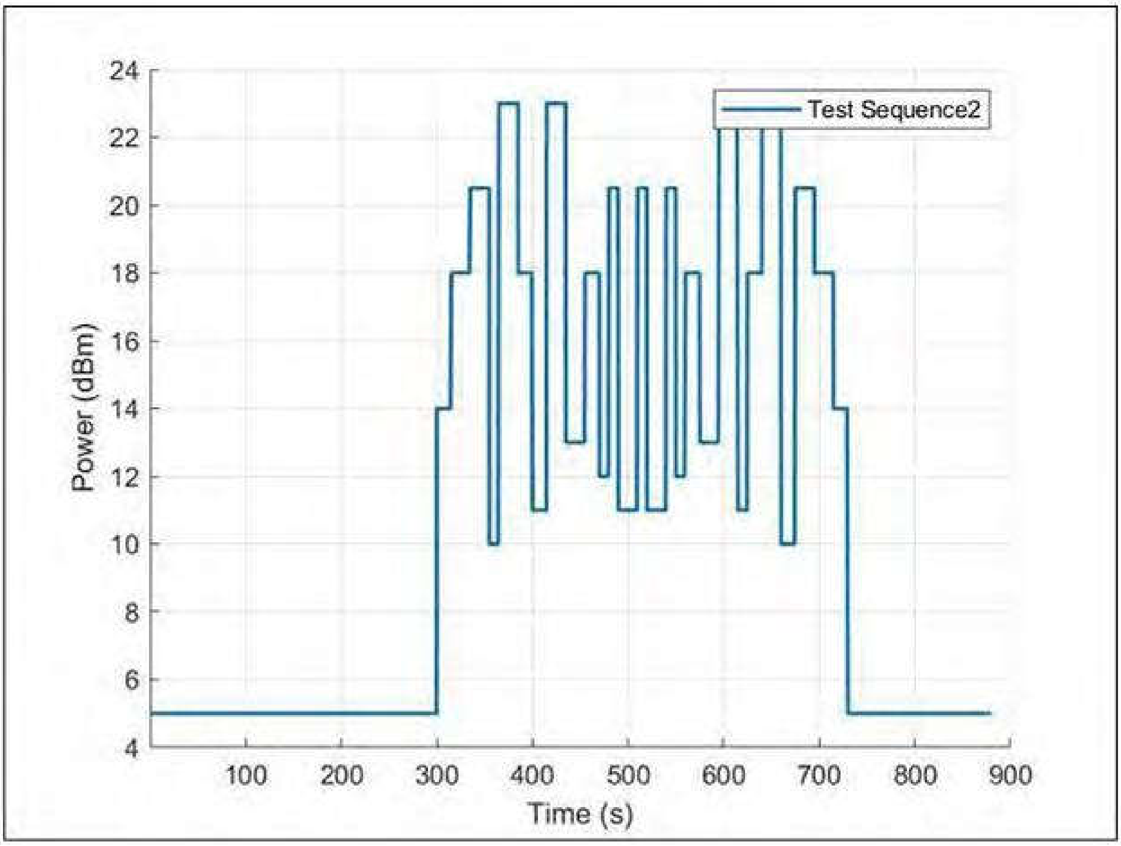



Figure 6-3 Test sequence 2

**Table 6-4 Test sequence 2**

| Time | Duration | Power (dBm) | Note |
|---|---|---|---|
| 300 | 300 | 5 | < $P_{Lowthresh}$ |
| 315 | 15 | 14 | $P_{sub6\_limit}$ – 4dB |
| 335 | 20 | 18 | $P_{sub6\_limit}$ |
| 355 | 20 | 20.5 | ($P_{sub6\_limit}$ + $P_{UE\_max}$)/2 |
| 365 | 10 | 10 | $P_{sub6\_limit}$ – 8dB |
| 385 | 20 | 23 | $P_{UE\_max}$ |
| 400 | 15 | 18 | $P_{sub6\_limit}$ |

| | | | |
|---|---|---|---|
| 415 | 15 | 11 | $P_{sub6\_limit}$ – 7dB |
| 435 | 20 | 23 | $P_{UE\_max}$ |
| 455 | 20 | 13 | $P_{sub6\_limit}$ – 5dB |
| 470 | 15 | 18 | $P_{sub6\_limit}$ |
| 480 | 10 | 12 | $P_{sub6\_limit}$ – 6dB |
| 490 | 10 | 20.5 | $(P_{sub6\_limit} + P_{UE\_max})/2$ |
| 510 | 20 | 11 | $P_{sub6\_limit}$ – 7dB |
| 520 | 10 | 20.5 | $(P_{sub6\_limit} + P_{UE\_max})/2$ |
| 540 | 20 | 11 | $P_{sub6\_limit}$ – 7dB |
| 550 | 10 | 20.5 | $(P_{sub6\_limit} + P_{UE\_max})/2$ |
| 560 | 10 | 12 | $P_{sub6\_limit}$ – 6dB |
| 575 | 15 | 18 | $P_{sub6\_limit}$ |
| 595 | 20 | 13 | $P_{sub6\_limit}$ – 5dB |
| 615 | 20 | 23 | $P_{UE\_max}$ |
| 625 | 10 | 11 | $P_{sub6\_limit}$ – 7dB |
| 640 | 15 | 18 | $P_{sub6\_limit}$ |
| 660 | 20 | 23 | $P_{UE\_max}$ |
| 675 | 15 | 10 | $P_{sub6\_limit}$ – 8dB |
| 695 | 20 | 20.5 | $(P_{sub6\_limit} + P_{UE\_max})/2$ |
| 715 | 20 | 18 | $P_{sub6\_limit}$ |
| 730 | 15 | 14 | $P_{sub6\_limit}$ – 4dB |
| 870 | 140 | 5 | $< P_{Lowthresh}$ |

## 6.2 Test Configuration and Procedure for Scenario 1: Range of TA-SAR Parameters via Conducted Power Measurements

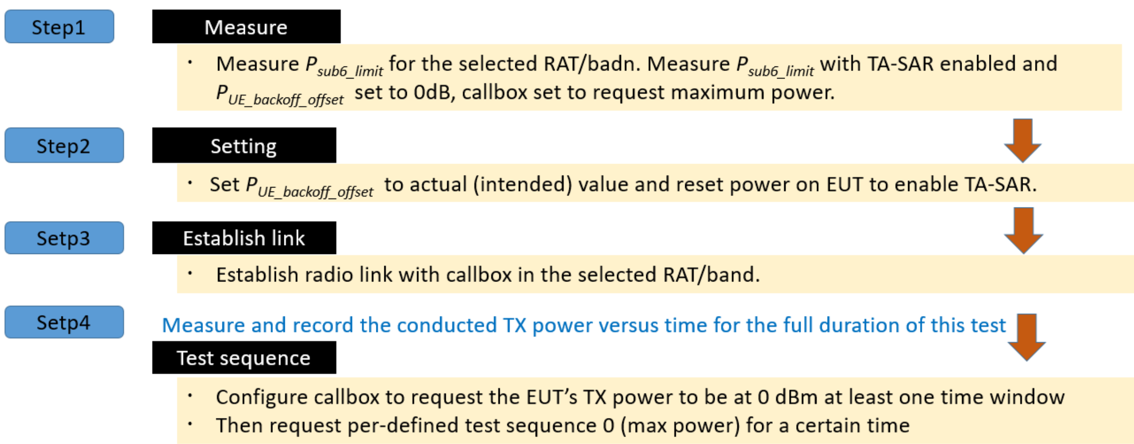
### 5.2.1 Configuration

This test is performed by changing the parameters ($P_{LowThresh\_offset}$, $P_{UE\_backoff\_offset}$, $P_{UE\_max\_cust\_offset}$) for the selected RAT (Radio Access Technologies) and band. Since Meditek's TA algorithm operation is independent of RATs/bands/channels, any one RAT can be selected for this test and the selected band of the RAT has the least $P_{sub6\_limit}$. In principle, two sets of the parameters are determined for this test (if applicable). If the parameters of the EUT are fixed (without a support of dynamic change), only the set of the default parameters needs to be tested.

### 5.2.2 Procedure

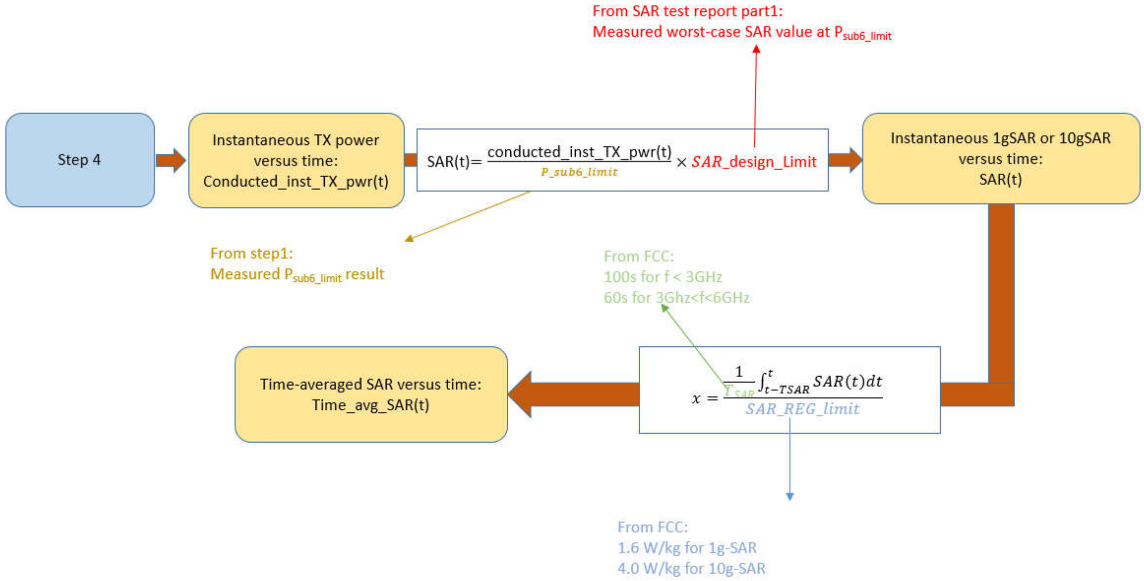
TX power is measured, recorded, and processed by the following steps:

- Step 1~4: measure and record TX power versus time for test scenario 1




- Step 5: convert the measured conducted TX power into SAR

Convert the measured conducted TX power from step 4 into 1gSAR or 10gSAR value using the following equation. Perform the running time average to power and 1gSAR or 10gSAR to determine time-averaged value versus time as follows,




- Step 6: plot results

A. Make one power perspective plot containing

1. Instantaneous TX power
2. Requested power
3. Calculated time-averaged power
4. Calculated time-averaged power limits

B. Make one SAR perspective plot containing

5. Calculated time-averaged 1gSAR or 10gSAR
6. FCC limit of 1.6 W/kg (1gSAR) or 4.0 W/kg (10gSAR)

## 6.3 Test Configuration and Procedure for Scenario 2: Time-varying TX Power via Conducted Power Measurements

### 6.3.1 Configuration

Since Mediatek's TA-SAR feature operation is independent of bands and channels for a given RAT, selecting one band per RAT is sufficient to validate this feature. One band per RAT are proposed for this test. The criteria for band selection for each RAT is based on the $P_{sub6\_limit}$ values (corresponding to SAR_design_limit) and is described as below:

- Select two bands, among the ones whose $P_{sub6\_limit}$ values are below $P_{UE\_max}$ , which correspond to least and highest $P_{sub6\_limit}$ values respectively.
  - Only one band needs to be tested if all the bands have same $P_{sub6\_limit.}$
  - Only one band needs to be tested if only the band has $P_{sub6\_limit}$ below $P_{UE\_max.}$
  - If the same least $P_{sub6\_limit}$ applies to multiple bands, select the band with the highest measured 1gSAR at $P_{sub6\_limit.}$
  - If $P_{sub6\_limit}$ values of all bands are all over $P_{UE\_max}$ (i.e., TA-SAR feature is not enabled), there is no need to test this RAT.

### 6.3.2 Procedure

TX power is measured, recorded, and processed by the following steps:

- Step 1~4: measure and record TX power versus time for test scenario 2

**Step1** — **Measure**

- Measure $P_{UE\_max,}$ measure $P_{sub6\_limit}$ and calculate $P_{UE\_backoff}$ (= measured $P_{sub6\_limit}$ in dBm - $P_{UE\_backoff\_offset}$ in dB) and generate the test sequences for all the RATs and selected bands.
- Both test sequence 1 and test sequence 2 are generated according to measured $P_{UE\_max}$ and measure $P_{sub6\_limit}$ of the EUT.

- Measure $P_{UE\_max}$ with TA-SAR disabled and callbox set to request maximum power.
- Measure $P_{sub6\_limit}$ with TA-SAR enabled and $P_{UE\_backoff\_offset}$ set to 0dB, callbox set to request maximum power.

**Step2** — **Setting**

- Apply actual (intended) value to $P_{UE\_backoff\_offset}$ and reset power on EUT to enable TA-SAR

**Setp3** — **Establish link**

- Establish radio link in selected radio configuration

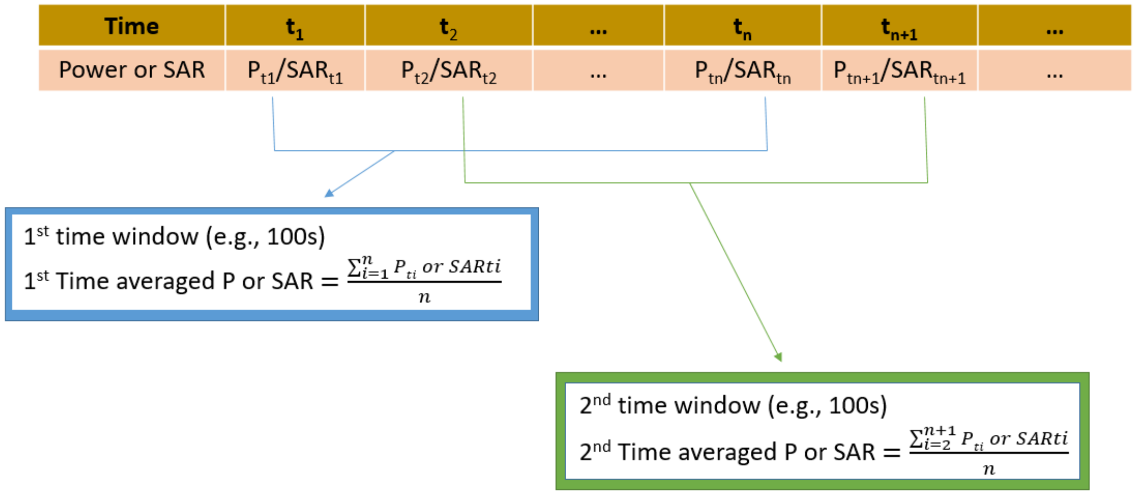
**Setp4** — Measure and record the conducted TX power versus time for the full duration of this test

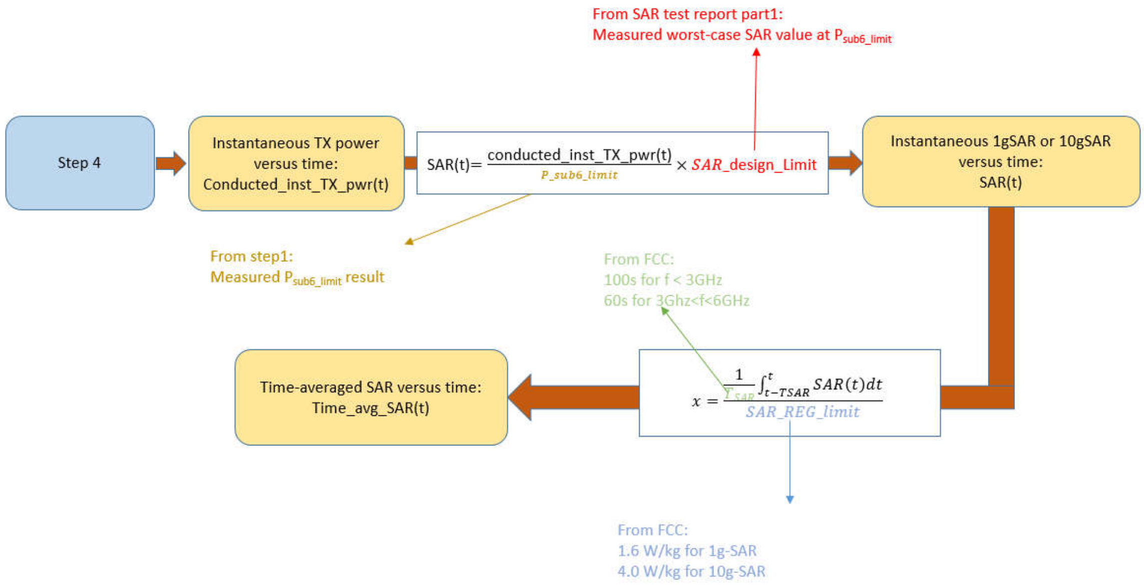
**Test sequence**

- Configure callbox to request the EUT's TX power pre-defined test sequence 1

- Step 5: convert the measured conducted TX power into SAR

Convert the measured conducted TX power from step 4 into 1gSAR or 10gSAR value using the following equation. Perform the running time average to power and 1gSAR or 10gSAR to determine time-averaged value versus time as below:



- Step 6: plot results

  A. Make one power perspective plot containing

     1. Instantaneous TX power
     2. Requested power (test sequence1)
     3. Calculated time-averaged power
     4. Calculated time-averaged power limits

  B. Make one SAR perspective plot containing

     1. Calculated time-averaged 1gSAR or 10gSAR
     2. FCC limit of 1.6 W/kg (1gSAR) or 4.0 W/kg (10gSAR)

- Step 7: repeat steps 2~6 for test sequence 2

Repeat steps 2 ~ 6 for pre-defined test sequence 2 and replace test sequence 1 in step 4 with test sequence 2.

- Step 8: repeat steps 2~7 for different bands

### 6.4 Test Configuration and Procedure for Scenario 3: Call Disconnection and Re-establishment via Conducted Power Measurements

#### 6.4.1 Configuration

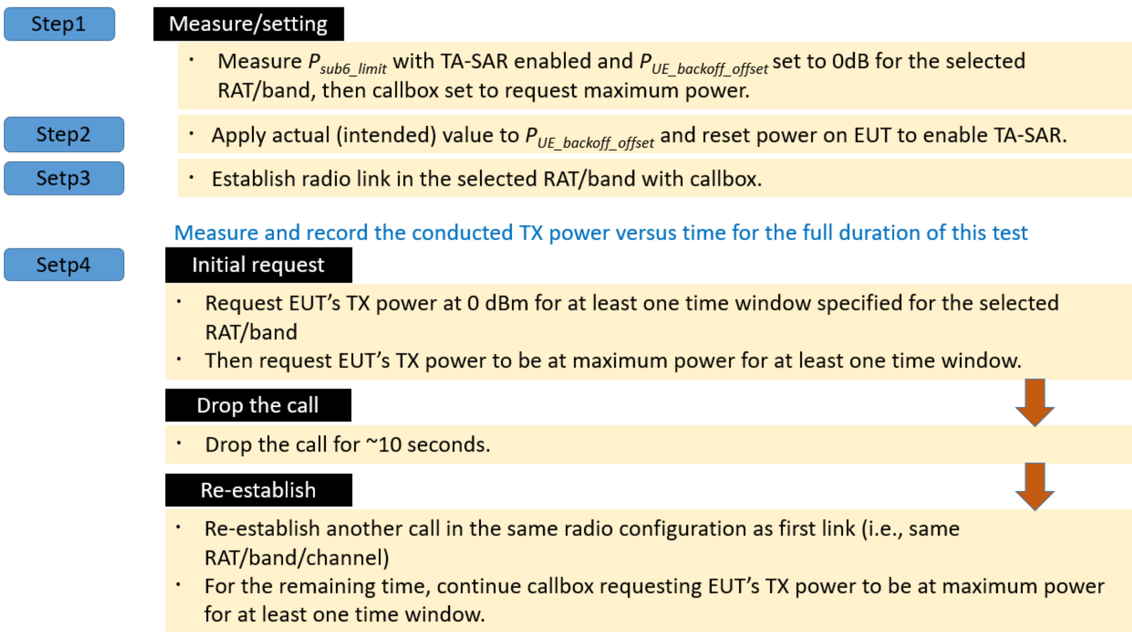
For call disconnection measurement, the criteria of selecting the test configuration is:

- Select the RAT/band with least $P_{sub6\_limit}$ among all supported RATs/bands.
- Select the RAT/band having the highest measured 1gSAR at $P_{sub6\_limit}$ if multiple RATs/bands having same least $P_{sub6\_limit}$.
- Select the radio configuration in this RAT/band that corresponds to the highest measured 1gSAR at $P_{sub6\_limit}$.

#### 6.4.2 Procedure

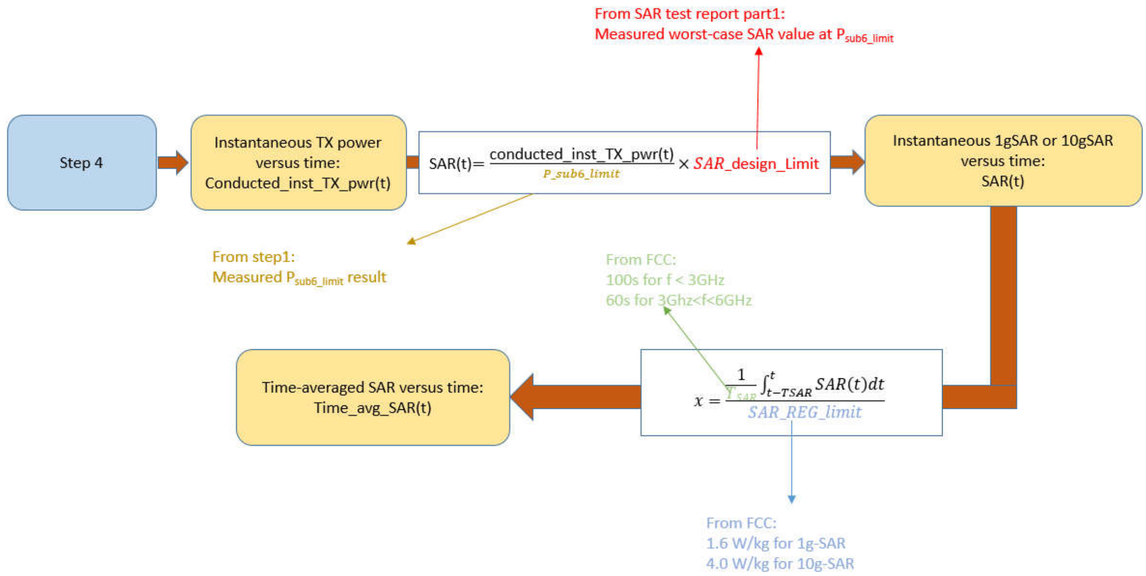
TX power is measured, recorded, and processed by the following steps:

- Step 1~4: measure and record TX power versus time for test scenario 3



- Step 5: convert the measured conducted TX power into SAR

Convert the measured conducted TX power from step 4 into 1gSAR or 10gSAR value using the following equation. Perform the running time average to power and 1gSAR or 10gSAR to determine time-averaged value versus time as follows:




- Step 6: plot results

  A. Make one power perspective plot containing

     1. Instantaneous TX power

     2. Requested power

     3. Calculated time-averaged power

     4. Calculated time-averaged power limits

  B. Make one SAR perspective plot containing

     1. Calculated time-averaged 1gSAR or 10gSAR

     2. FCC limit of 1.6 W/kg (1gSAR) or 4.0 W/kg (10gSAR)

## 6.5 Test Configuration and Procedure for Scenario 4: Band Handover via Conducted Power Measurements

### 6.5.1 Configuration

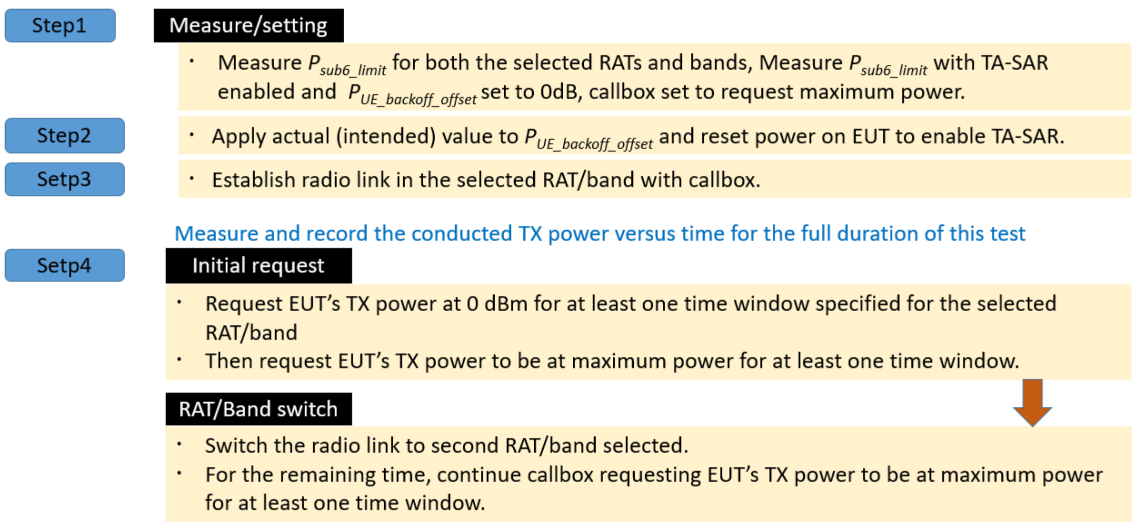
For a given TX antenna, select a RAT/ band with the lowest $P_{sub6\_limit}$ and the other RAT/band with the highest $P_{sub6\_limit}$. Both of them have $P_{sub6\_limit}$ values less than $P_{UE\_max}$ if possible.

- Select the RAT/band having the highest measured 1gSAR at $P_{sub6\_limit}$ if multiple RATs/bands have the same lowest $P_{sub6\_limit}$.
- Select the RAT/band having the lowest measured 1gSAR at $P_{sub6\_limit}$ if multiple RATs/bands have the same highest $P_{sub6\_limit}$.

### 6.5.2 Procedure

TX power is measured, recorded, and processed by the following steps:

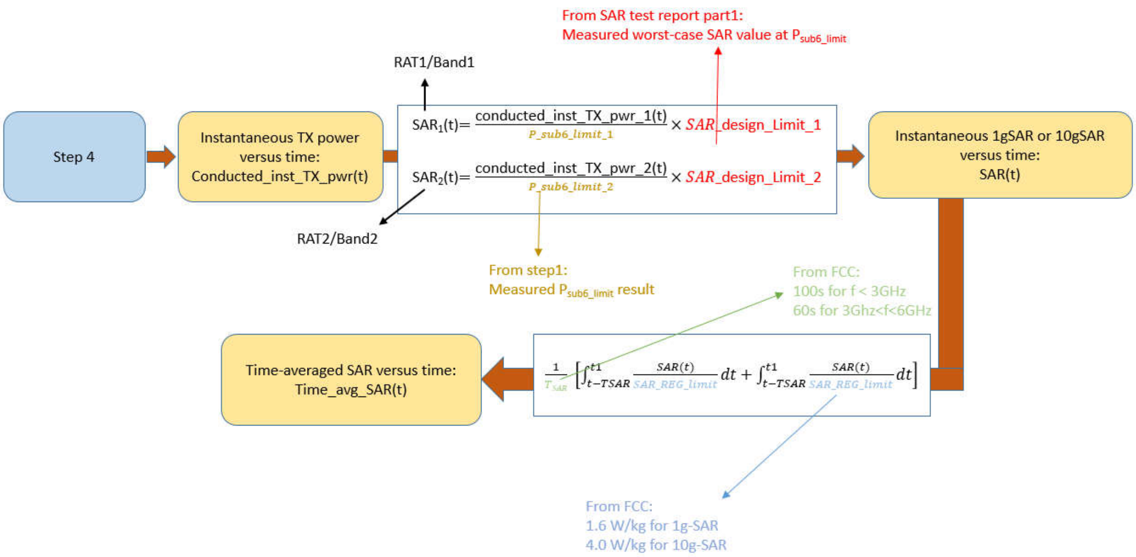
- Step 1~4: measure and record TX power versus time for test scenario 4



- Step 5: convert the measured conducted TX power into SAR

Convert the measured conducted TX power from step 4 into 1gSAR or 10gSAR value using the following equation. Perform the running time average to power and 1gSAR or 10gSAR to determine time-averaged value versus time as follows,




- Step 6: plot results

A. Make one power perspective plot containing

   1. Instantaneous TX power
   2. Requested power
   3. Calculated time-averaged power
   4. Calculated time-averaged power limits

B. Make one SAR perspective plot containing

   1. Calculated time-averaged 1gSAR or 10gSAR
   2. FCC limit of 1.6 W/kg (1gSAR) or 4.0 W/kg (10gSAR)
   3. Normalized time-averaged 1gSAR/1.6 or 10gSAR /4.0

## 6.6 Test Configuration and Procedure for Scenario 5: Exposure Condition Index (ECI) Change via Conducted Power Measurements

### 6.6.1 Configuration

Select any one RAT/band, which has at least two ECIs whose $P_{sub6\_limit}$ values are different and are below $P_{UE\_max}$.

### 6.6.2 Procedure

The test procedure is identical to section 6.5.2 except the following 2 changes:

1. Replace band switch operation with ECI switch.
2. In step 4, the second ECI switching is arranged after the first one lasts for at least one time window, i.e., switch the second ECI back to the first ECI, and then continue with callbox requesting EUT's TX power to be at maximum power for at least one time window.

It is noted that the following operations are done as well for this scenario:

- The correct power control is controlled by TA_SAR during ECI switches from one ECI to another.
- The validation criteria are, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed FCC limit of 1.6W/kg for 1gSAR or 4W/kg for 10gSAR.

## 6.7 Test Configuration and Procedure for Scenario 6: Antenna Switching via Conducted Power Measurements

### 6.7.1 Configuration

Among RATs/bands supporting TX antenna switches, select the RAT/band with the highest $P_{sub6\_limit}$ difference between a pair of supported TX antennas.

- Select the RAT/band having the highest measured 1gSAR at $P_{sub6\_limit}$ if multiple RATs/bands having the same $P_{sub6\_limit}$ difference between the supported TX antennas.
- Antenna selection order
  - Select the configuration with two antennas having $P_{sub6\_limit}$ values less than $P_{UE\_max}$.
  - If the previous configuration does not exist, select the configuration with one antenna having $P_{sub6\_limit}$ value less than $P_{UE\_max}$.
  - If the above two cannot be found, select one configuration with the two antennas having the least difference between their $P_{sub6\_limit}$ and $P_{UE\_max}$ (i.e., $P_{sub6\_limit}$ can be greater than $P_{UE\_max}$).

### 6.7.2 Procedure

The test procedure is identical to section 6.5.2 except the following 2 changes:

1. Replace band switch operation with antenna switch.
2. In step 4, the second antenna switching is arranged after the first one lasts for at least one time window, i.e., switch the second antenna back to the first antenna, and then continue with callbox requesting EUT's TX power to be at maximum power for at least one time window.

It is noted that the following operations are done as well for this scenario:

- The correct power control is controlled by TA_SAR during antenna switches from one antenna to another.
- The validation criteria are, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed FCC limit of 1.6W/kg for 1gSAR or 4.0W/kg for 10gSAR.

## 6.8 Test Configuration and Procedure for Scenario 8: SAR Exposure Switching via Conducted Power Measurements

### 6.8.1 Configuration

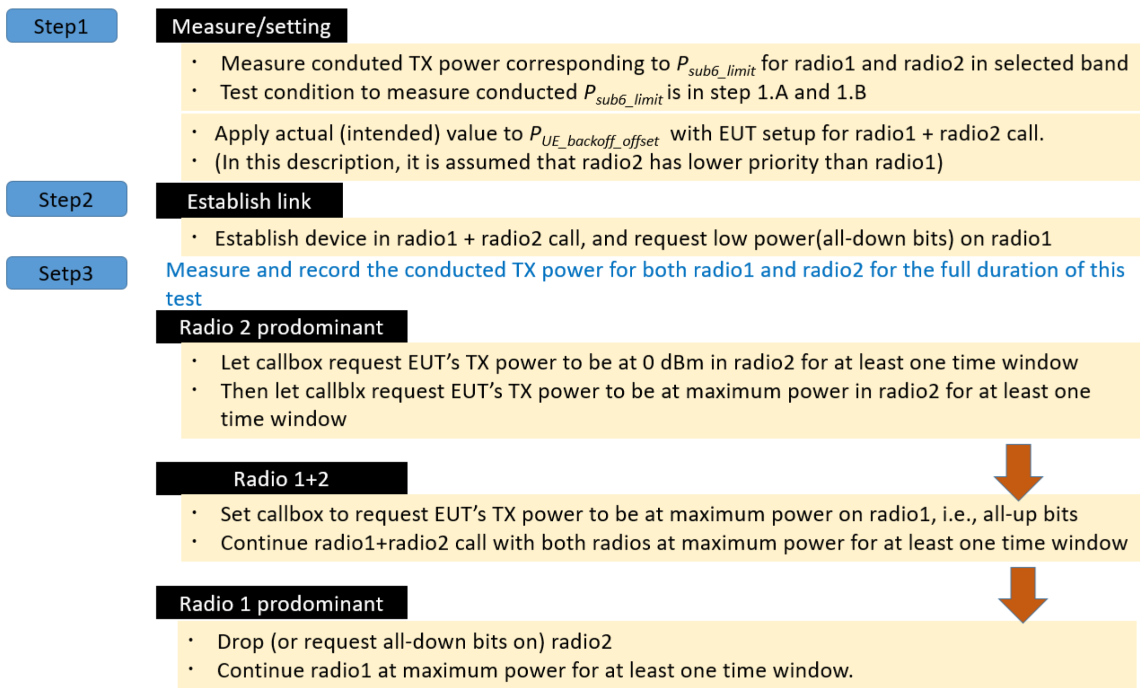
If supported, SAR exposure switch with two active radios having the same and different time averaging windows should be covered in this test. Mediatek's TA algorithm operation is independent of the source of SAR exposure (e.g., LTE vs. NR FR1) and ensures total time-averaged RF exposure compliance for SAR exposure among the scenarios of radio 1 only, radio 1 + radio 2, and radio 2 only.

- Select any two <6GHz RATs/bands that the EUT supports for simultaneous transmission (e.g., LTE + NR FR1).
- The selection order among all supported simultaneous transmission configurations is
  - Select one configuration with $P_{sub6\_limit}$ values of radio1 and radio2 less than their corresponding $P_{UE\_max}$, and their $P_{sub6\_limit}$ values are different if possible.
  - If the previous configuration does not exist, at least one radio has its $P_{sub6\_limit}$ less than $P_{UE\_max}$.
  - If above two cannot be found, select one configuration that has $P_{sub6\_limit}$ of radio 1 and radio 2 with the least difference between $P_{sub6\_limit}$ and $P_{UE\_max}$ (i.e., $P_{sub6\_limit}$ can be greater than $P_{UE\_max}$)
- One test with two active radios in any two different time windows is sufficient to cover this scenario.
- One SAR switching is sufficient because the TA algorithm operation is the same.

### 6.8.2 Procedure

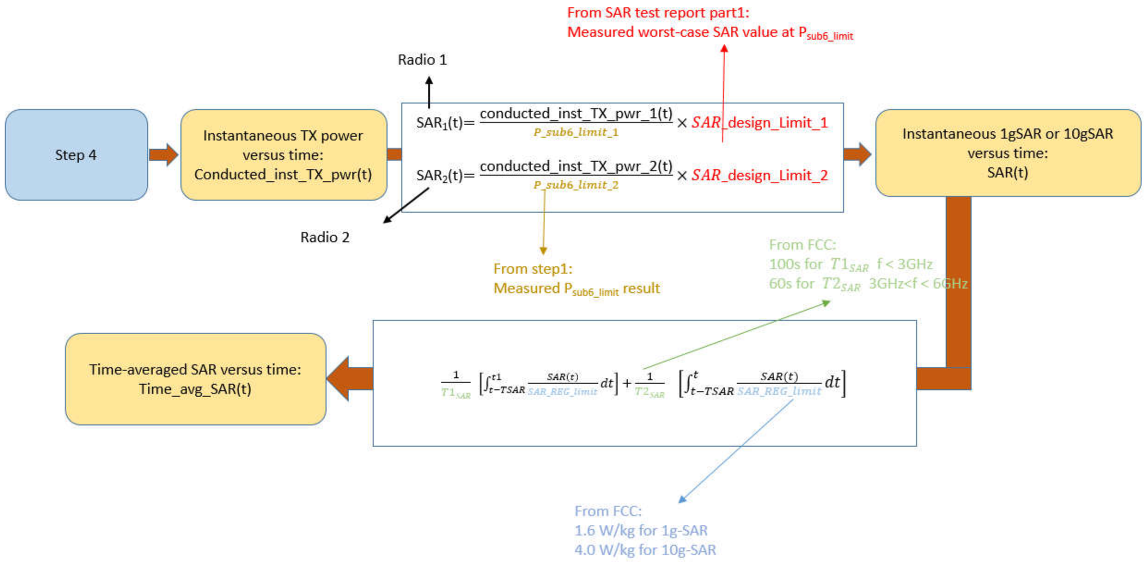
- Step 1~3: measure and record TX power versus time for test scenario 8

1. Measure conducted TX power corresponding to radio1 $P_{sub6\_limit}$
   - Establish device in call with the callbox for radio1 band.
   - Measure conducted TX power corresponding to radio1 $P_{sub6\_limit}$ with TA-SAR enabled and $P_{UE\_backoff\_offset}$ set to 0dB, callbox set to request maximum power.
2. Measure conducted TX power corresponding to radio2 $P_{sub6\_limit}$
   - Repeat above step to measure conducted TX power corresponding to radio2 $P_{sub6\_limit}$.
   - If radio2 is dependent on radio1 (for example, non-standalone mode of NR FR1 requiring radio1 LTE as anchor), then establish radio1 + radio2 call with callbox, and request all down bits for radio1 LTE.
   - In this scenario, with callbox requesting maximum power from radio2 NR FR1, measured conducted TX power corresponds to radio2 Psub6_limit (as radio1 LTE is at all-down bits).



- Step 4: convert the measured conducted TX power into SAR

Convert the measured conducted TX power from step 3 into 1gSAR or 10gSAR value using the following equation. Perform the running time averaged to power and 1gSAR or 10gSAR to determine time-averaged value versus time as follows,




- Step 5: plot results

A. Make one power perspective plot containing

   1. Instantaneous TX power
   2. Requested power
   3. Calculated time-averaged power
   4. Calculated time-averaged power limits

B. Make one SAR perspective plot containing

   1. Calculated time-averaged 10gSAR
   2. FCC limit of 1.6 W/kg (1gSAR) or 4.0 W/kg (10gSAR)
   3. Normalized time-averaged 1gSAR/1.6 or 10gSAR /4.0

## 6.9 Test Configuration and Procedure for Scenario 2: Time-varying TX Power via SAR Measurements

### 6.9.1 Configuration

Section 6.2 to 6.9 focus on Mediatek's TA feature compliance validation via conducted TX power measurements. This section further provides a SAR measurement procedure for time-varying TX power scenario described in section 6.3. Hence, this section follows the test configuration of section 6.3, and uses test sequences 1 and 2 defined in section 6.1.

### 6.9.2 Procedure

SAR is measured and recorded by the following steps:

- Step 1~4: measure and record SAR time

**Step1** — **Measure**

- Perform area scan with TA-SAR enabled and $P_{UE\_backoff\_offset}$ set to 0dB, and callbox set to request maximum power for all the RATs and selected bands.
- Measure meas_SAR at location of the area scan. This meas_SAR value, meas_sar_ $P_{sub6\_limit}$, corresponds to meas_SAR at the measured $P_{sub6\_limit}$

**Step2** — **Setting**

- Apply actual (intended) value to $P_{UE\_backoff\_offset}$ and reset power on EUT to enable TA-SAR

**Setp3** — **Establish link**

- Establish radio link in selected radio configuration

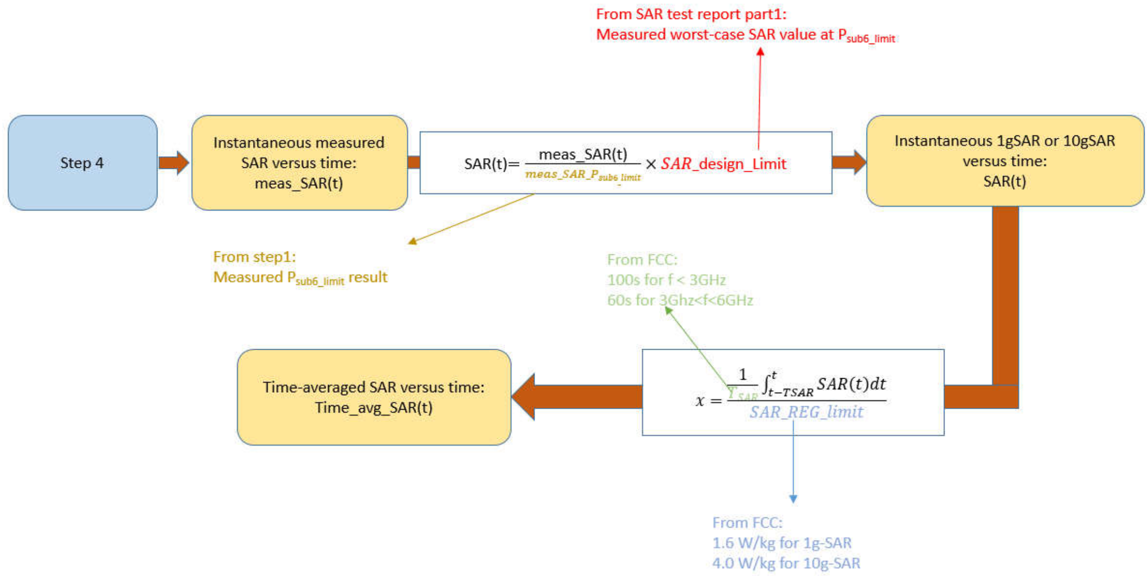
**Setp4** — Measure and record meas_SAR versus time at peak location of the area scan.

**Test sequence**

- Configure callbox to request the EUT's TX power pre-defined test sequence 1

- Step 5: convert the measured SAR into time-averaged SAR

Convert the instantaneous measured SAR from step 4 into 1gSAR or 10gSAR value. Perform the running time average to 1gSAR or 10gSAR to determine time-averaged value versus time as follows,




where, meas_SAR_$P_{sub6_limit}$ is the value determined in step 1, and meas_SAR(t) is the instantaneous measured SAR measured in step 4.

- Step 6: plot results

  A. Calculated time-averaged 1gSAR or 10gSAR

  B. FCC limit of 1.6 W/kg (1gSAR) or 4.0 W/kg (10gSAR)

- Step 7: repeat steps 2~6 for pre-defined test sequence 2

Repeat steps 2 ~ 6 for pre-defined test sequence 2 and replace test sequence 1 in step 4 with test sequence 2.

- Step 8: repeat steps 2~7 for selected bands

The time-averaged SAR versus time shall not exceed FCC limit at all times.

# 7 TA-SAR Validation via Conducted Power Measurements

## 7.1 Measurement Setup

### 7.1.1 Test Bench Introduction

All of the test cases defined in this chapter are conducted by using the phone device, whose antenna placement for each RAT is illustrated in Figure 7-1.

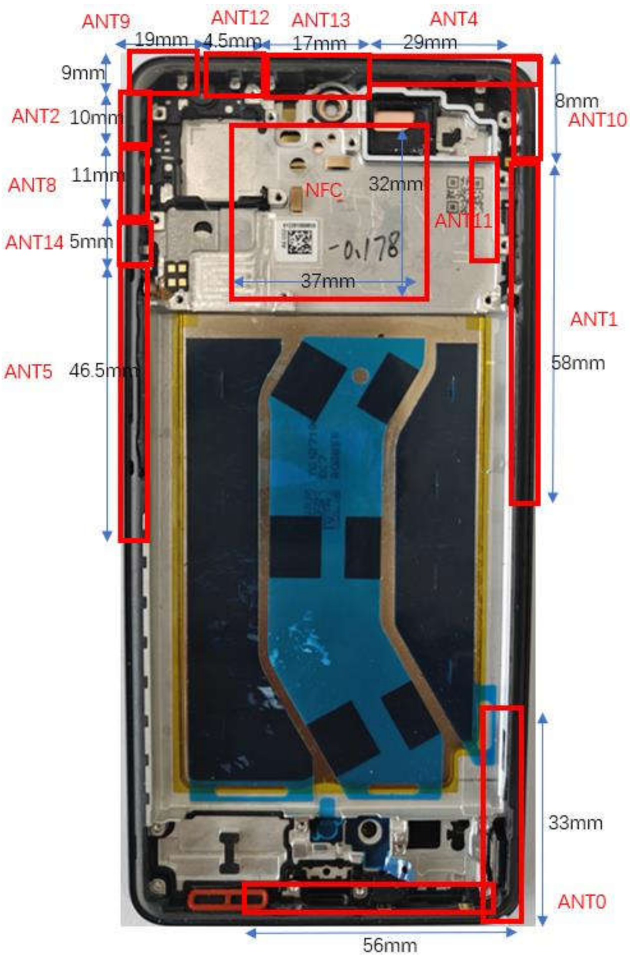



Figure 7-1 Antenna placement of the phone

The call boxes Keysight UXM (supporting sub6 NR and LTE) and Rohde & Schwarz CMW500 (supporting LTE, WCDMA and 2G) are used to validate the proposed TA-SAR mechanism. Figure 7-2 shows the block diagram of the measurement bench, which supports the following test scenarios.

- Test scenario 1: range of TA-SAR parameters
- Test scenario 2: time-varying TX power
- Test scenario 3: call disconnection and re-establishment
- Test scenario 5: ECI change

For these measurements, RF ports of the call box is connected to the EUT's antenna port, and the call box establishes a connection link through the test script console tool and the power meter measures the conducted output power of the EUT. The pictures of Figure 7-2 are relegated in Figures A-1 and A-2 in Appendix A.

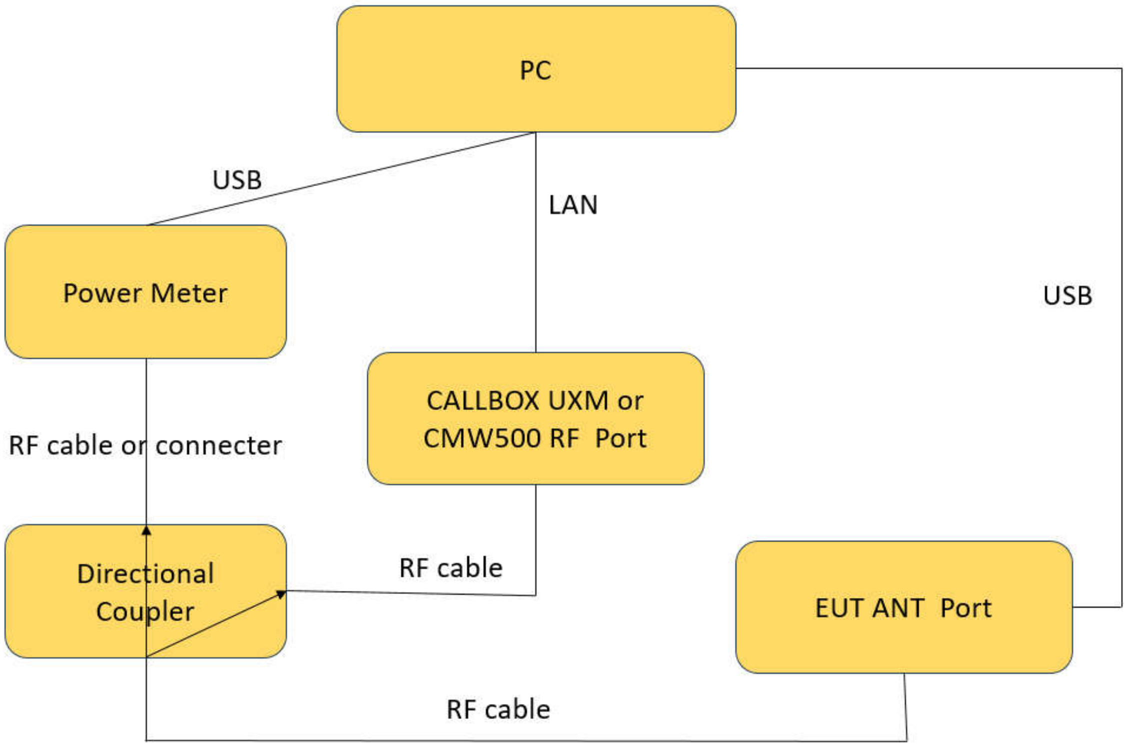



Figure 7-2 TA-SAR conductive power test setup block diagram for scenarios 1/2/3/5

Figure 7-3 shows the block diagram of the measurement bench, which support test scenario 4(band handover) and scenario 7 (time window switching). For these measurements, the RF port of the call box is connected with a 1-to-2 power divider, which allows the call box to transmit/receive signals from the two different system configurations set in these two test scenarios. Figure 7-4 shows the setup, which is highly similar to Figure 7-3, to support test scenario 6 (antenna switching); as seen in the figure, two EUT's antenna ports are individually connected with a RF cable. The pictures for these two setups are shown in Figures A-3 and A-4 in Appendix A.

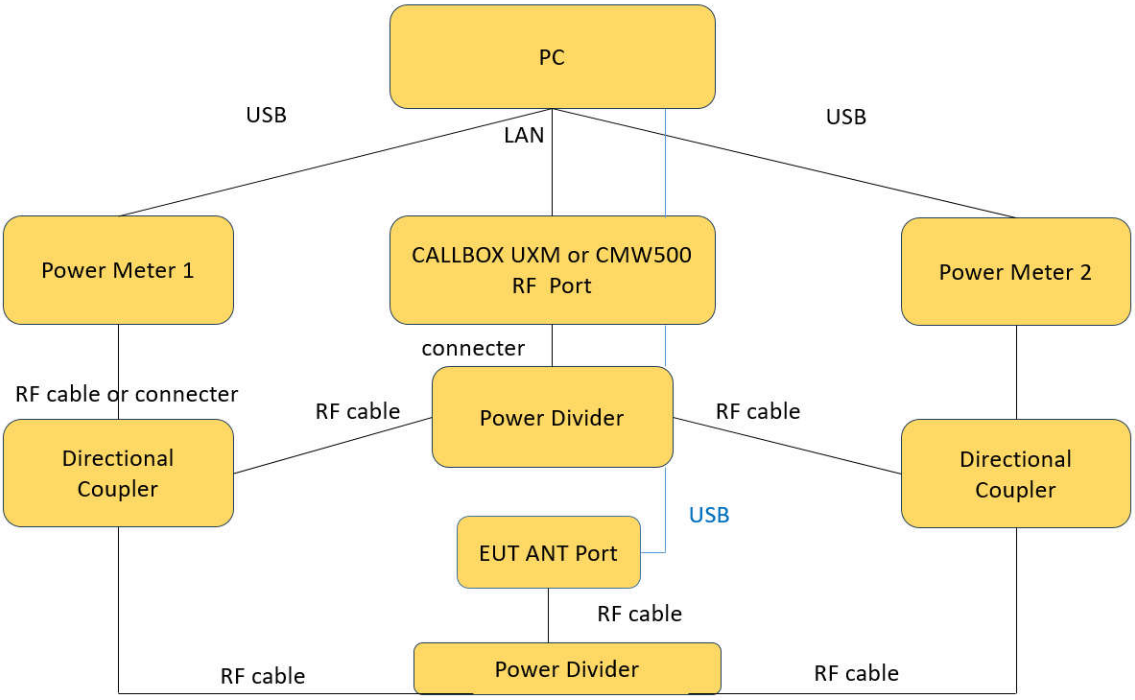



Figure 7-3 TA-SAR conductive power test setup block diagram for scenarios 4 and 7

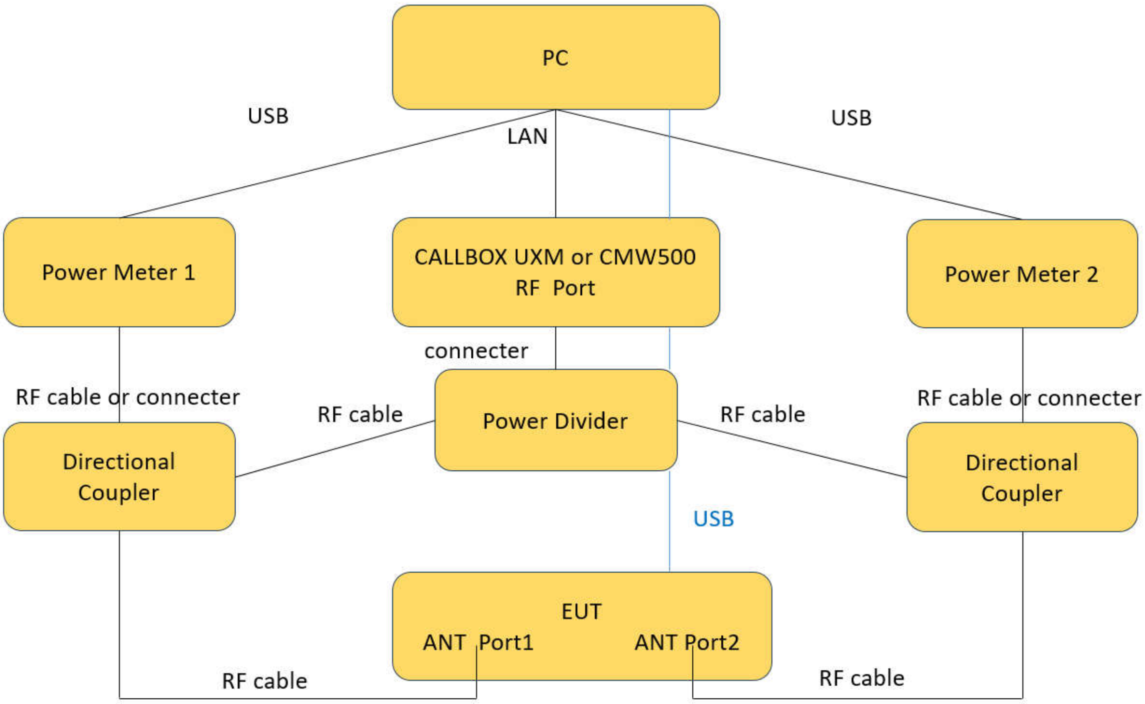



Figure 7-4 TA-SAR conductive power test setup block diagram for scenarios 6

Figure 7-5 shows the setup for test scenario 4 (RAT handover) and scenario 8 (SAR exposure switching). Since two RATs need to be controlled in these two scenarios, RF port of RAT #1 and RF port of RAT #2 of the call box are individually connected to an antenna port of the EUT through a directional coupler. It is noted that each of the two RATs individually transmit signals though one antenna port. The antenna port assignment of each RAT for these two scenarios is described in Figure 7-1. The pictures of Figure 6-5 are shown in Figures A-5 and A-6 in Appendix A.

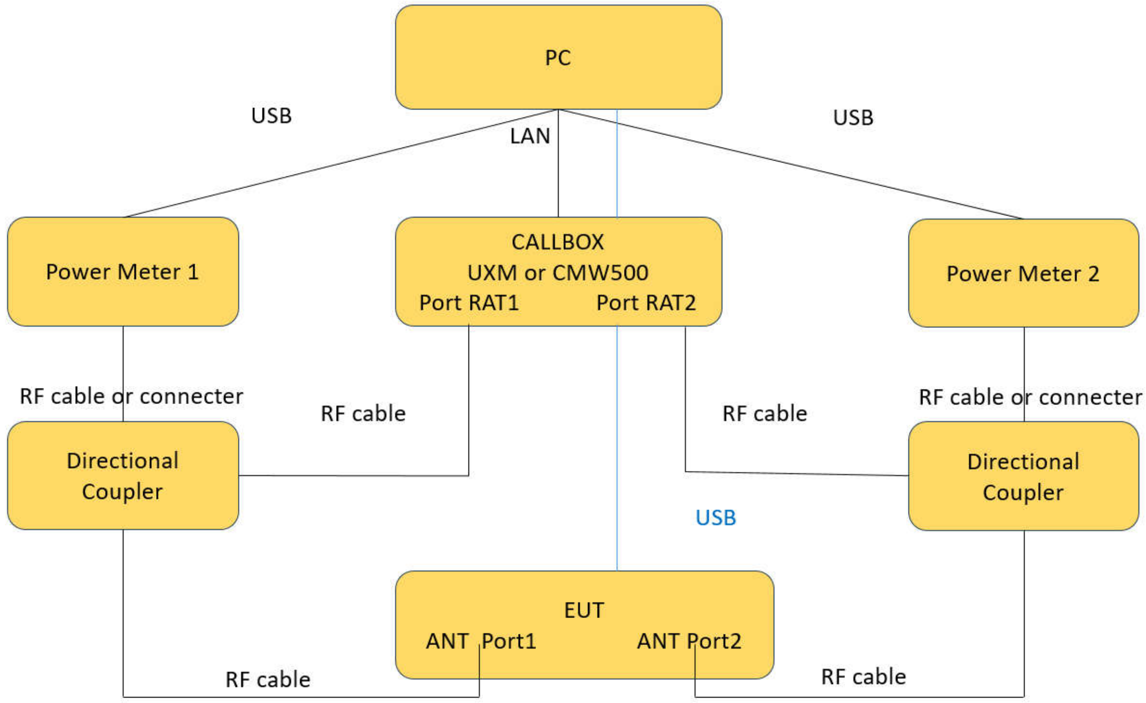



Figure 7-5 TA-SAR conductive power test setup block diagram for scenarios 4/8

### 7.1.2 Sub NR/LTE/3G/2G Power Limit Table and Test Configurations

For the supported bands/channels/antennas of each technology, the measured power limit ($P_{sub6\_limit}$), corresponding to SAR_design_limit, is listed in the Table 7-1. The SAR_design_limit is determined by taking device uncertainty into consideration. Please note that for TDD bands with TX duty cycles less than or equal to 100%, the measured power limit corresponds to the burst averaged power level which does not account for TX duty cycle.

**Table 7-1 Summary table of power limit (Psub6_limit) for all supported RAT**

| Band | Antenna | Standalone Body | Standalone Head | Simultaneous transmission Body | Simultaneous transmission Head | Pmax* |
|---|---|---|---|---|---|---|
| | | DSI 1 | DSI 2 | DSI 3 | DSI 4 | |
| GSM 850 | 0 | 33.00 | 33.00 | 33.00 | 33.00 | 33.00 |
| GSM 1900 | 0 | 29.25 | 30.00 | 29.25 | 30.00 | 30.00 |
| WCDMA Band 2 | 0 | 21.00 | 23.00 | 21.00 | 23.00 | 23.00 |
| WCDMA Band 2 | 4 | 20.50 | 18.00 | 20.50 | 16.00 | 23.00 |
| WCDMA Band 4 | 0 | 22.00 | 24.00 | 22.00 | 24.00 | 24.00 |
| WCDMA Band 4 | 4 | 20.00 | 18.50 | 20.00 | 16.50 | 24.00 |
| WCDMA Band 5 | 0 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 |
| WCDMA Band 5 | 1 | 24.00 | 20.50 | 24.00 | 19.00 | 24.00 |
| LTE Band 2 | 0 | 19.50 | 23.00 | 19.50 | 23.00 | 23.00 |
| LTE Band 2 | 4 | 20.00 | 17.50 | 20.00 | 15.50 | 22.50 |
| LTE Band 4 | 0 | 21.45 | 24.20 | 21.45 | 24.20 | 24.20 |
| LTE Band 4 | 4 | 20.30 | 14.30 | 20.30 | 14.30 | 23.80 |
| LTE Band 4 | 5 | 21.95 | 22.70 | 21.95 | 17.20 | 24.20 |
| LTE Band 4 | 1 | 22.00 | 18.00 | 22.00 | 18.00 | 23.00 |
| LTE Band 5 | 0 | 24.20 | 24.20 | 24.20 | 24.20 | 24.20 |
| LTE Band 5 | 1 | 23.20 | 20.45 | 23.20 | 19.20 | 24.20 |
| LTE Band 7 | 0 | 22.00 | 23.00 | 22.00 | 23.00 | 23.00 |
| LTE Band 7 | 4 | 20.75 | 18.50 | 20.75 | 17.00 | 22.50 |
| LTE Band 7 | 5 | 19.00 | 20.00 | 19.00 | 18.50 | 23.00 |
| LTE Band 7 | 1 | 19.70 | 20.70 | 19.70 | 19.20 | 21.70 |
| LTE Band 12 | 0 | 24.20 | 24.20 | 24.20 | 24.20 | 24.20 |
| LTE Band 12 | 1 | 24.20 | 22.95 | 24.20 | 21.45 | 24.20 |
| LTE Band 13 | 0 | 23.00 | 23.00 | 23.00 | 23.00 | 23.00 |
| LTE Band 13 | 1 | 23.00 | 21.75 | 23.00 | 20.25 | 23.00 |
| LTE Band 17 | 0 | 24.20 | 24.20 | 24.20 | 24.20 | 24.20 |
| LTE Band 17 | 1 | 24.20 | 22.95 | 24.20 | 21.45 | 24.20 |
| LTE Band 26 | 0 | 24.20 | 24.20 | 24.20 | 24.20 | 24.20 |
| LTE Band 26 | 1 | 24.20 | 20.45 | 24.20 | 20.45 | 24.20 |
| LTE Band 66 | 0 | 21.45 | 24.20 | 21.45 | 24.20 | 24.20 |
| LTE Band 66 | 4 | 20.30 | 14.30 | 20.30 | 14.30 | 23.80 |
| LTE Band 66 | 5 | 21.95 | 22.70 | 21.95 | 17.20 | 24.20 |
| LTE Band 66 | 1 | 22.00 | 18.00 | 22.00 | 18.00 | 23.00 |
| LTE Band 38 | 0 | 24.20 | 24.20 | 24.20 | 24.20 | 24.20 |
| LTE Band 38 | 4 | 23.25 | 20.00 | 23.25 | 18.50 | 24.00 |
| LTE Band 38 | 5 | 21.20 | 21.20 | 21.20 | 19.70 | 24.20 |
| LTE Band 38 | 1 | 22.80 | 22.80 | 22.80 | 18.30 | 23.80 |
| LTE Band 41 PC3 | 0 | 23.00 | 23.00 | 23.00 | 23.00 | 23.00 |
| LTE Band 41 PC3 | 4 | 20.50 | 18.00 | 20.50 | 16.50 | 23.00 |
| LTE Band 41 PC3 | 5 | 20.00 | 20.50 | 20.00 | 20.50 | 23.50 |
| LTE Band 41 PC3 | 1 | 22.60 | 20.80 | 22.60 | 19.80 | 22.60 |
| LTE Band 41 PC2 | 0 | 26.00 | 26.00 | 26.00 | 26.00 | 26.00 |
| LTE Band 41 PC2 | 4 | 22.30 | 19.80 | 22.30 | 18.30 | 25.40 |
| LTE Band 41 PC2 | 5 | 20.25 | 21.75 | 20.25 | 21.75 | 26.00 |
| LTE Band 41 PC2 | 1 | 24.80 | 22.30 | 24.80 | 20.80 | 24.80 |
| NR n2 | 0 | 19.50 | 23.00 | 19.50 | 23.00 | 23.00 |
| NR n2 | 4 | 20.50 | 15.50 | 20.50 | 14.50 | 22.50 |
| NR n5 | 0 | 24.20 | 24.20 | 24.20 | 24.20 | 24.20 |
| NR n5 | 1 | 22.50 | 20.20 | 22.50 | 18.70 | 24.20 |
| NR n7 | 0 | 23.00 | 23.00 | 23.00 | 23.00 | 23.00 |
| NR n7 | 4 | 21.80 | 17.50 | 21.80 | 16.00 | 23.00 |
| NR n7 | 5 | 19.50 | 20.50 | 19.50 | 19.00 | 23.00 |
| NR n7 | 1 | 21.70 | 20.70 | 21.70 | 16.70 | 21.70 |
| NR n66 | 0 | 21.20 | 24.20 | 21.20 | 24.20 | 24.20 |
| NR n66 | 4 | 21.00 | 17.50 | 21.00 | 15.50 | 24.00 |
| NR n66 | 5 | 22.20 | 23.20 | 22.20 | 19.70 | 24.20 |
| NR n66 | 1 | 22.80 | 21.80 | 22.80 | 19.80 | 23.80 |
| NR n38 | 0 | 24.20 | 24.20 | 24.20 | 24.20 | 24.20 |
| NR n38 | 4 | 22.00 | 16.70 | 22.00 | 15.20 | 24.20 |
| NR n38 | 5 | 19.70 | 19.70 | 19.70 | 18.20 | 24.20 |
| NR n38 | 1 | 21.80 | 19.80 | 21.80 | 16.80 | 23.80 |
| NR n41 PC2 | 0 | 24.50 | 27.00 | 24.50 | 27.00 | 27.00 |
| NR n41 PC2 | 4 | 22.20 | 16.90 | 21.20 | 13.90 | 26.40 |
| NR n41 PC2 | 5 | 20.30 | 21.00 | 20.30 | 19.50 | 27.00 |
| NR n41 PC2 | 1 | 19.70 | 18.50 | 19.70 | 15.50 | 25.70 |

Table 7-2 summarizes the test configurations of all RATs, and the corresponding worst-case measured SAR for each RAT under the power limit.

**Table 7-2 Test configurations of radio technologies and worst-case measured SAR0**

| Test case | Test Scenario | Tech | Band | ANT | ECI | Channel | Frequency | Modulation | RB | BW (MHz) | SAR Exposure Scenario | Position | Worst-case Measured SAR at P_sub6_limit W/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Range of TA-SAR parameters | WCDMA | 1900 | 4 | 4 | 9538 | 1907.6 | RMC | \ | \ | Head | Right Cheek | 0.506 |
| 2.1 ~ 2.2 | Time-varying TX power | Sub6 NR | N41 | 0 | 3 | 518598 | 2592.99 | DFT-OFDM QPSK | 135_67 | 100M | Hotspot | Rear | 0.504 |
| 2.3 ~ 2.4 | | Sub6 NR | N41 | 4 | 4 | 518598 | 2592.99 | DFT-OFDM QPSK | 135_67 | 100M | Head | Right Cheek | 0.451 |
| 2.5 ~ 2.6 | | LTE | B38 | 4 | 3 | 38150 | 2610 | QPSK | 1_99 | 20M | Hotspot | Rear | 0.649 |
| 2.7 ~ 2.8 | | LTE | B66 | 4 | 4 | 132572 | 1770 | QPSK | 50_25 | 20M | Head | Right Cheek | 0.475 |
| 2.9 ~ 2.10 | | WCMDA | 1900 | 4 | 4 | 9538 | 1907.6 | RMC | / | / | Head | Right Cheek | 0.506 |
| 2.11 ~ 2.12 | | WCMDA | 1700 | 0 | 3 | 1413 | 1732.6 | RMC | / | / | Hotspot | Rear | 0.31 |
| 2.13 ~ 2.14 | | GSM | 1900 | 0 | 3 | 512 | 1850.2 | 1TX | / | / | Hotspot | Rear | 0.193 |
| 3.1 | Call disconnection and re-establishment | WCMDA | 1900 | 4 | 4 | 9538 | 1907.6 | RMC | / | / | Head | Right Cheek | 0.506 |
| 4.1 | Band handover | WCMDA | 1700 | 0 | 3 | 1413 | 1732.6 | RMC | / | / | Hotspot | Rear | 0.31 |
| | | LTE | B7 | 5 | 3 | 21350 | 2560 | QPSK | 1_99 | 20M | Hotspot | Right | 0.534 |
| 5.1 | ECI change | LTE | B66 | 4 | 4 | 132572 | 1770 | QPSK | 50_25 | 20M | Head | Right Cheek | 0.475 |
| | | LTE | B66 | 4 | 3 | 132572 | 1770 | QPSK | 50_25 | 20M | Hotspot | Top | 0.553 |
| 6.1 | Antenna switching | WCMDA | 1700 | 0 | 3 | 1413 | 1732.6 | RMC | / | / | Hotspot | Rear | 0.31 |
| | | WCDMA | 1700 | 4 | 3 | 1312 | 1712.4 | RMC | / | / | Hotspot | Top | 0.341 |
| 8.1 | SAR exposure switching | LTE | B7 | 5 | 4 | 21350 | 2560 | QPSK | 1_99 | 20M | Head | Right Cheek | 0.511 |
| | | Sub6 NR | N66 | 4 | 4 | 349000 | 1745 | DFT-OFDM QPSK | 108_54 | 40M | Head | Right Cheek | 0.604 |

## 7.2 Conducted Power Measurement Results for Scenario 1: Range of TA-SAR Parameters

In this scenario, two TA-SAR parameters are swept to validate Mediatek's TA-SAR algorithm. The parameter sets are summarized in Table 7-2, and the test procedure follows section 6.2.2. The measurement setup is shown in Figure 7-3. The high-level summary of the final validation results are also listed in the last column of the table, which concludes that Mediatek's TA-SAR algorithm can maintain the time-averaged SAR is always below the FCC requirement for all test case. The following section will demonstrate case-by-case to show how Mediatek's TA-SAR algorithm behaves for different parameters.

**Table 7-3 TA-SAR parameters setting for scenario 1**

| Test case | RAT | Test band | Test seq. | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WCDMA | 1900 | 0 | 4 | 23 | 16 | 15.5 | 13 | 19 | Pass |

These test cases are for 3G WCDMA and are conducted under WCDMA 1900 with ECI = 4. The corresponding detailed test procedure is described in 6.2.2. For the figure set of each case, the first figure demonstrates the ETU's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time, and the power limit (P_reg_sub6_limit = $P_{sub6\_limit}$ + device uncertainty). The second figure illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 6.2.2. For all test cases, the time-averaged SAR does not exceed the FCC limit.

Case 0 in table 7-3

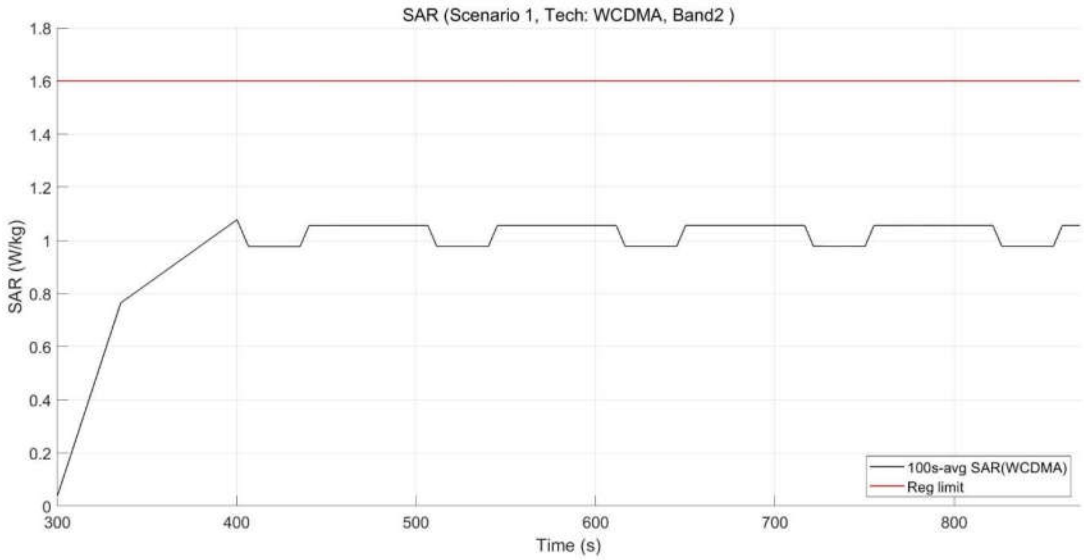



Figure 7-6 Time-averaged SAR for case 0

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.077 W/kg |
| Validation result: Pass | |

## 7.3 Conducted Power Measurement Results for Scenario 2: Time-Varying TX Power

In this scenario, Mediatek's TA-SAR algorithm is tested under more dynamic power test sequences. The test sequence #1 is shown in section 6.1 and test sequence #2 is tabulated in Table 6-4. All of the test cases for this scenario are relegated in Table 6-2, and the test procedure follows section 6.3.2. The measurement setup is shown in Figure 7-4. The high-level summary of the final validation results are also listed in the last column of the table, which concludes that Mediatek's TA-SAR algorithm can maintain the time-averaged SAR is always below the FCC requirement for all test cases. The following sections will demonstrate case-by-case to show how Mediatek's TA-SAR algorithm behaves for each RAT.

**Table 7-4 TA-SAR parameters setting for scenario 2**

| Test case | RAT | Test band | Test seq. | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sub6 NR | N41 | 1 | 3 | 27 | 24.5 | 24 | 21.5 | 27 | Pass |
| 2 | Sub6 NR | N41 | 2 | 3 | 27 | 24.5 | 24 | 21.5 | 27 | Pass |
| 3 | Sub6 NR | N41 | 1 | 4 | 26.4 | 13.9 | 13.4 | 10.9 | 16.9 | Pass |
| 4 | Sub6 NR | N41 | 2 | 4 | 26.4 | 13.9 | 13.4 | 10.9 | 16.9 | Pass |
| 5 | LTE | B38 | 1 | 3 | 24 | 23.25 | 22.75 | 20.25 | 24 | Pass |
| 6 | LTE | B38 | 2 | 3 | 24 | 23.25 | 22.75 | 20.25 | 24 | Pass |
| 7 | LTE | B66 | 1 | 4 | 23.8 | 14.3 | 13.8 | 11.3 | 17.3 | Pass |
| 8 | LTE | B66 | 2 | 4 | 23.8 | 14.3 | 13.8 | 11.3 | 17.3 | Pass |
| 9 | WCMDA | 1900 | 1 | 4 | 23 | 16 | 15.5 | 13 | 19 | Pass |
| 10 | WCMDA | 1900 | 2 | 4 | 23 | 16 | 15.5 | 13 | 19 | Pass |
| 11 | WCMDA | 1700 | 1 | 3 | 24 | 22 | 21.5 | 19 | 24 | Pass |
| 12 | WCMDA | 1700 | 2 | 3 | 24 | 22 | 21.5 | 19 | 24 | Pass |
| 13 | GSM | 1900 | 1 | 3 | 30 | 29.25 | 28.75 | 26.25 | 30 | Pass |
| 14 | GSM | 1900 | 2 | 3 | 30 | 29.25 | 28.75 | 26.25 | 30 | Pass |

### 7.3.1 Measurement results for NR

These test cases are for sub6 NR and is conducted under NR bands n41 with ECI=3/4. The corresponding detailed test procedure is described in 6.3.2. The figure illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 6.3.2. For all test cases, the time-averaged SAR does not exceed the FCC limit.

- **Case 2.1 in table 7-4: NR n41 result for test sequence 1**

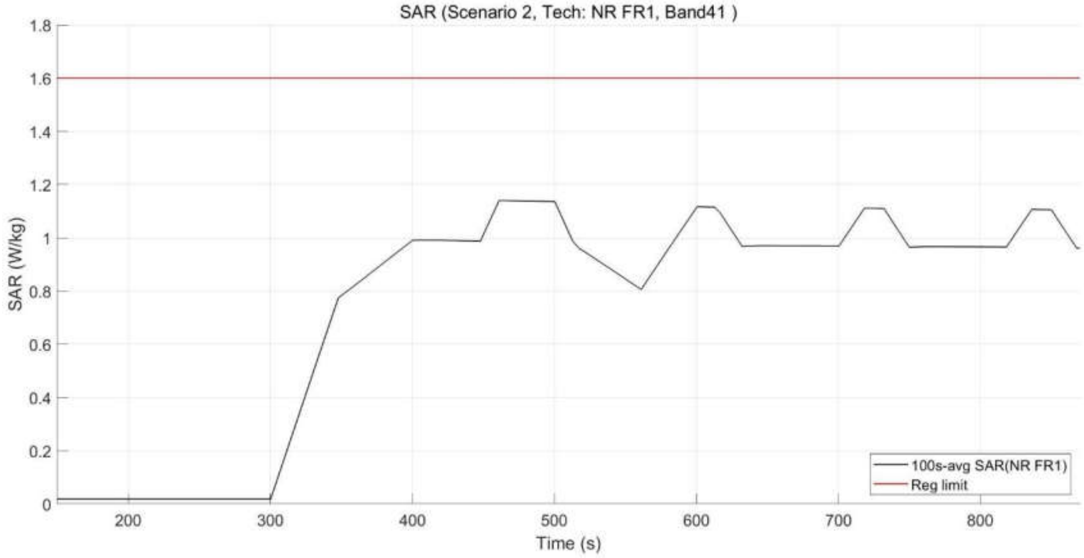



Figure 7-7 Time-averaged SAR for case 2.1(sub6 NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.140 W/kg |
| Validation result: Pass | |

- **Case 2.2 in table 7-4: NR n41 result for test sequence 2**

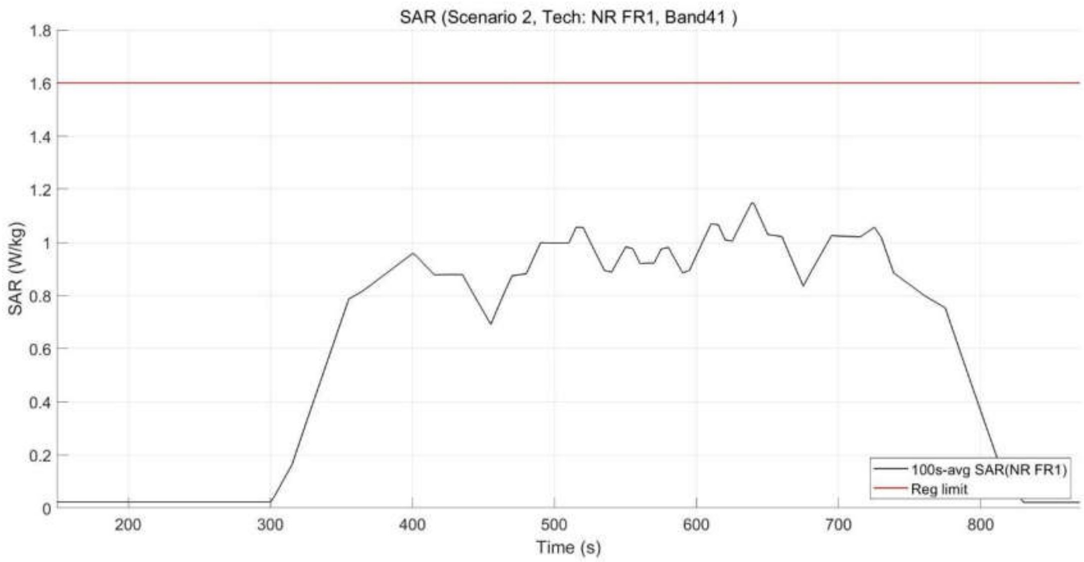



Figure 7-8 Time-averaged SAR for case 2.2(sub6 NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.148 W/kg |
| Validation result: Pass | |

- **Case 2.3 in table 7-4: NR n41 result for test sequence 1**

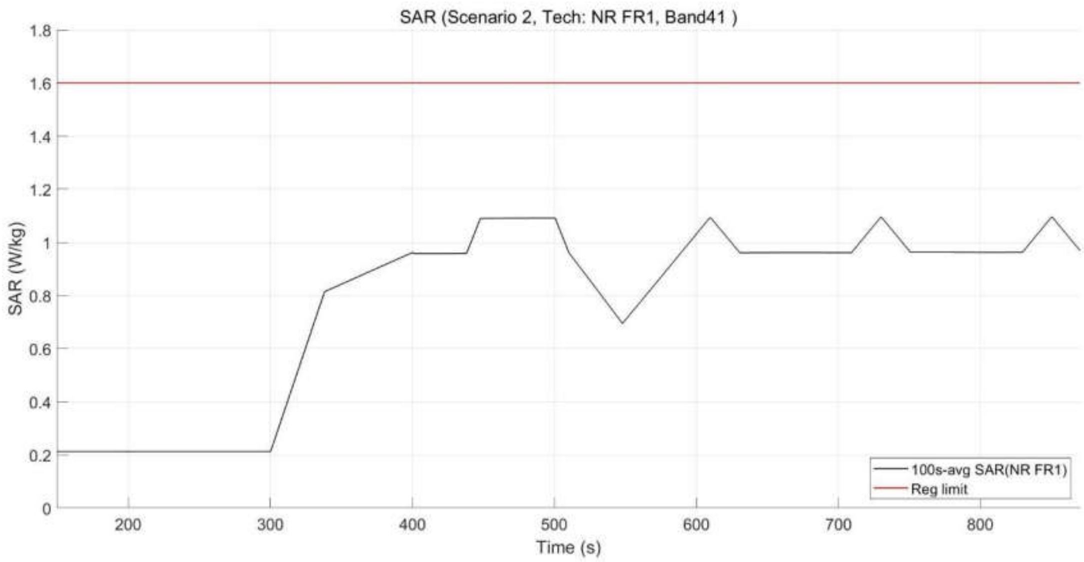



Figure 7-9 Time-averaged SAR for case 2.3(sub6 NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.093 W/kg |
| Validation result: Pass | |

- **Case 2.4 in table 7-4: NR n41 result for test sequence 2**

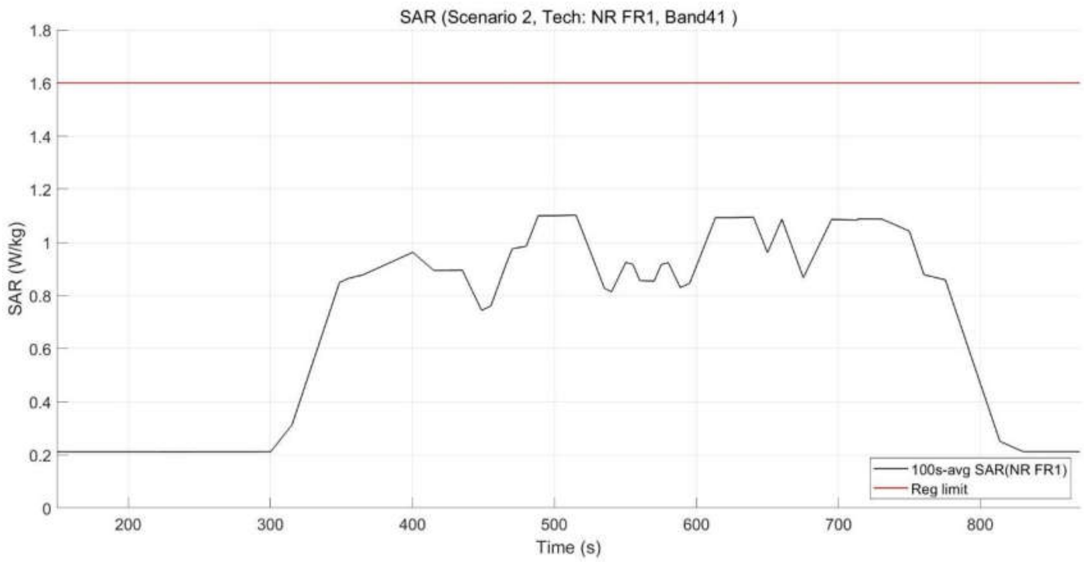



Figure 7-10 Time-averaged SAR for case 2.4(sub6 NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.102 W/kg |
| Validation result: Pass | |

### 7.3.1 Measurement results for LTE

These test cases are for 4G LTE and are conducted under LTE bands B38 and B66 with ECI=3/4. The corresponding detailed test procedure is described in 6.3.2. The figure illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 6.3.2. For all test cases, the time-averaged SAR does not exceed the FCC limit.

- **Case 2.5 in table 7-4: LTE B38 result for test sequence 1**

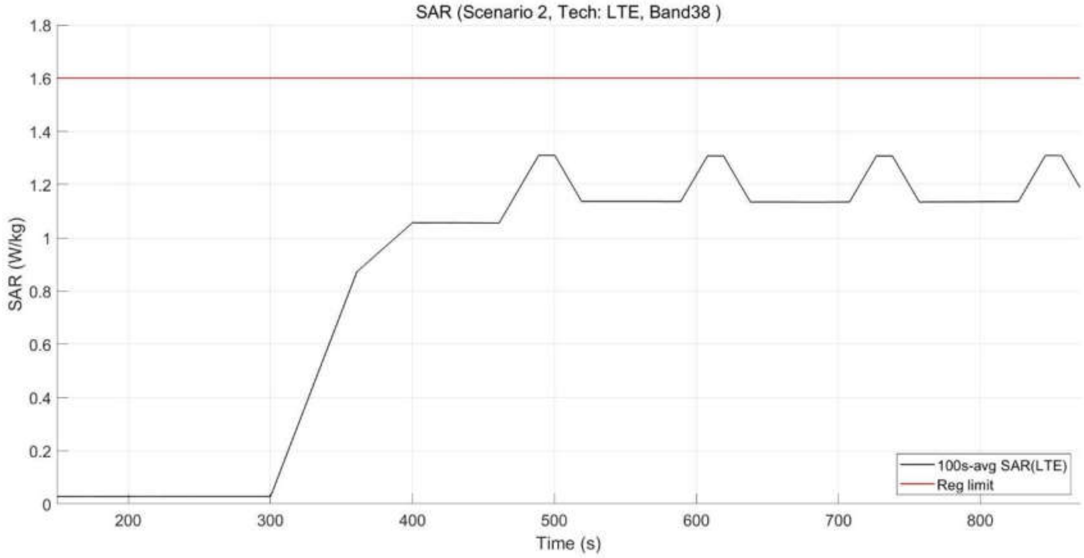



Figure 7-11 Time-averaged SAR for case 2.5(LTE B38)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.310 W/kg |
| Validation result: Pass | |

- **Case 2.6 in table 7-4: LTE B38 result for test sequence 2**

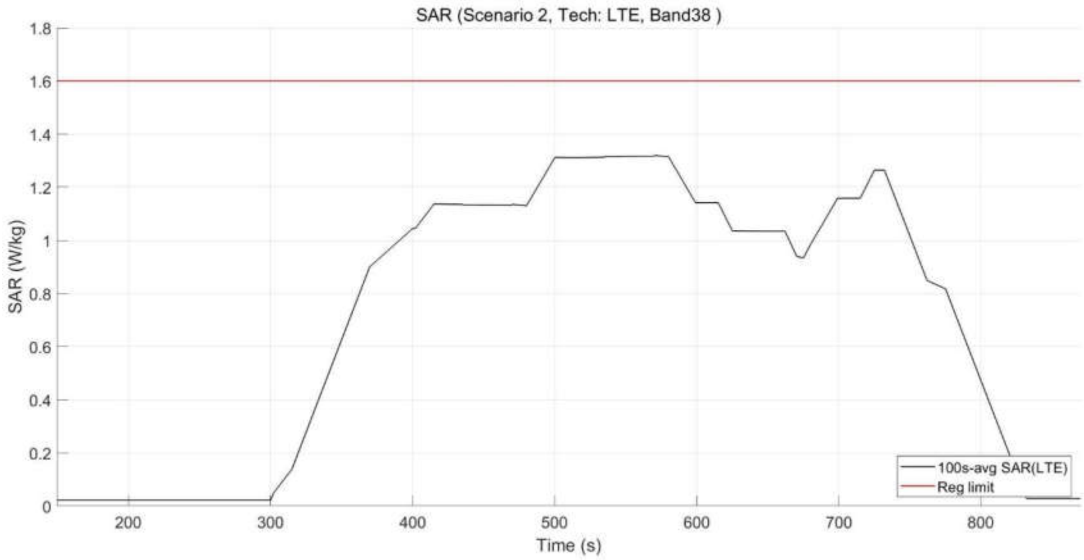



Figure 7-12 Time-averaged SAR for case 2.6(LTE B38)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.319 W/kg |
| Validation result: Pass | |

- **Case 2.7 in table 7-4: LTE B66 result for test sequence 1**

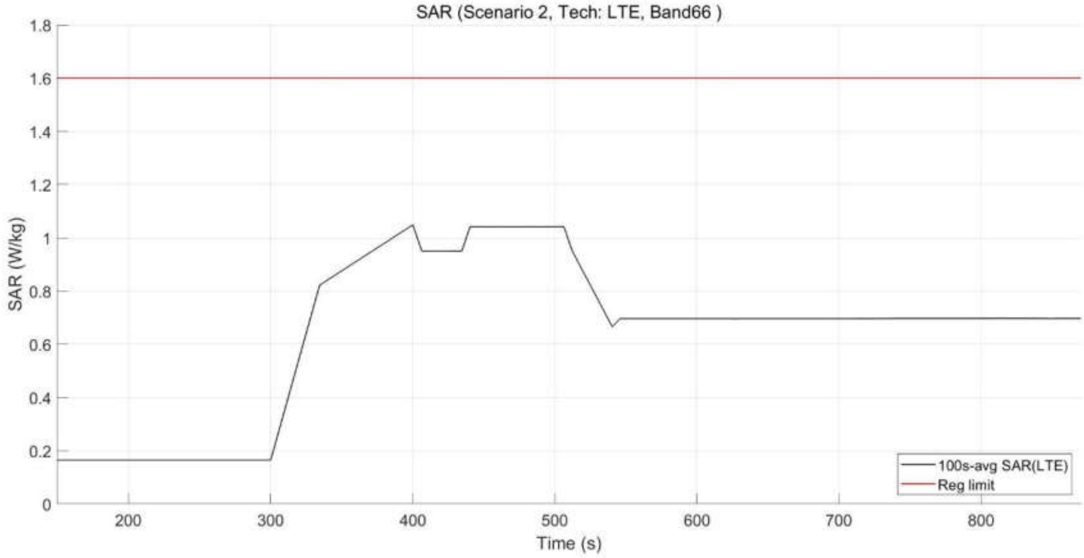



Figure 7-13 Time-averaged SAR for case 2.7(LTE B66)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.048 W/kg |
| Validation result: Pass | |

- **Case 2.8 in table 7-4: LTE B66 result for test sequence 2**

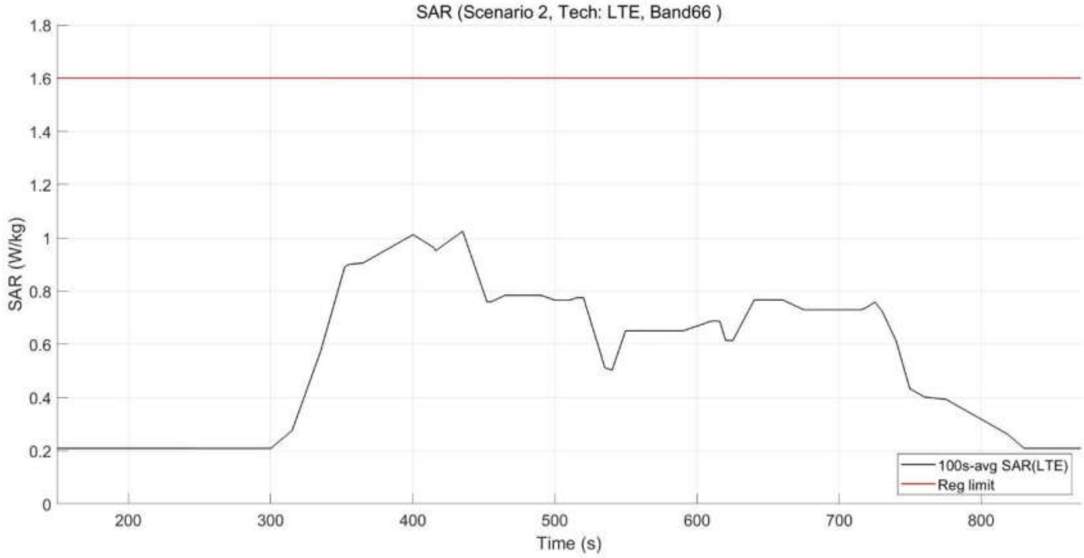



Figure 7-14 Time-averaged SAR for case 2.8(LTE B66)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.024 W/kg |
| Validation result: Pass | |

### 7.3.2 Measurement results for 3G WCDMA

These test cases are for 3G WCDMA and are conducted under WCDMA B2 and B4 with ECI=4/3. The corresponding detailed test procedure is described in 6.3.2. The figure illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 6.3.2. For all test cases, the time-averaged SAR does not exceed the FCC limit.

- **Case 2.9 in table 7-4: WCDMA B2 result for test sequence 1**

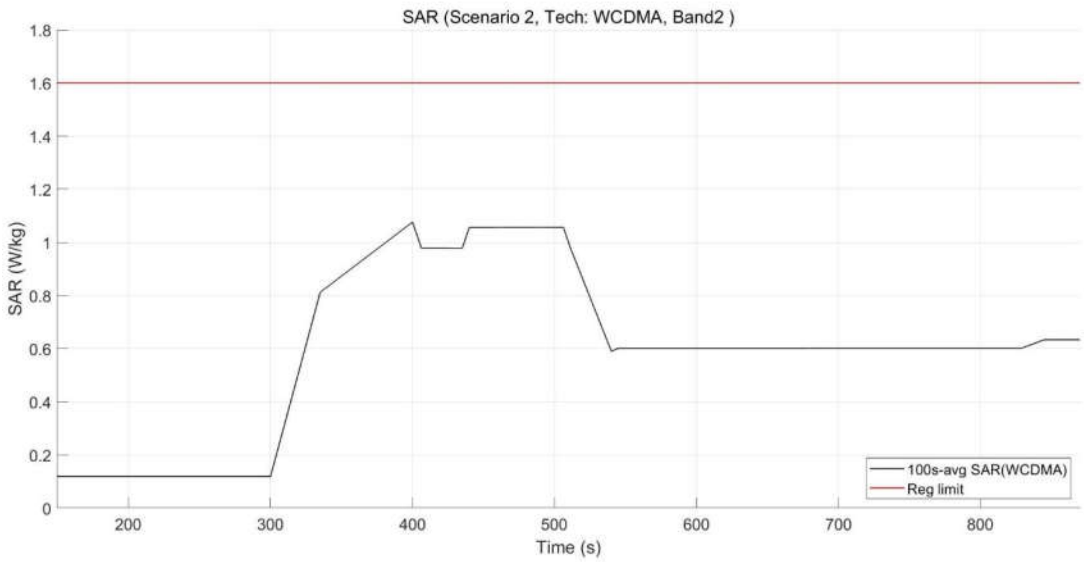



Figure 7-15 Time-averaged SAR for case 2.9(WCDMA B2)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.076 W/kg |
| Validation result: Pass | |

- **Case 2.10 in table 7-4: WCDMA B2 result for test sequence 2**

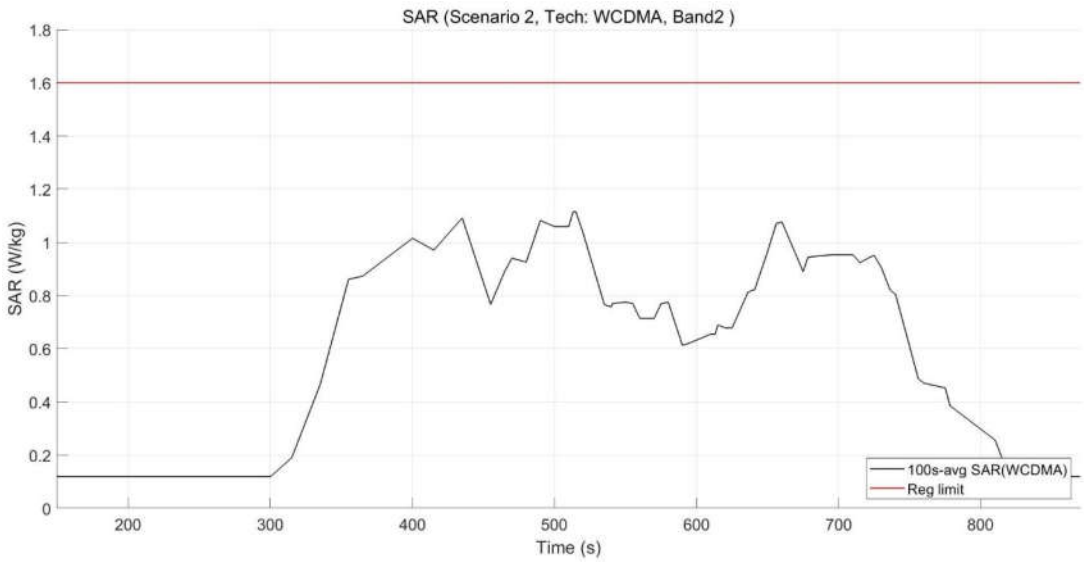



Figure 7-16 Time-averaged SAR for case 2.10(WCDMA B2)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.115 W/kg |
| Validation result: Pass | |

- **Case 2.11 in table 7-4: WCDMA B4 result for test sequence 1**

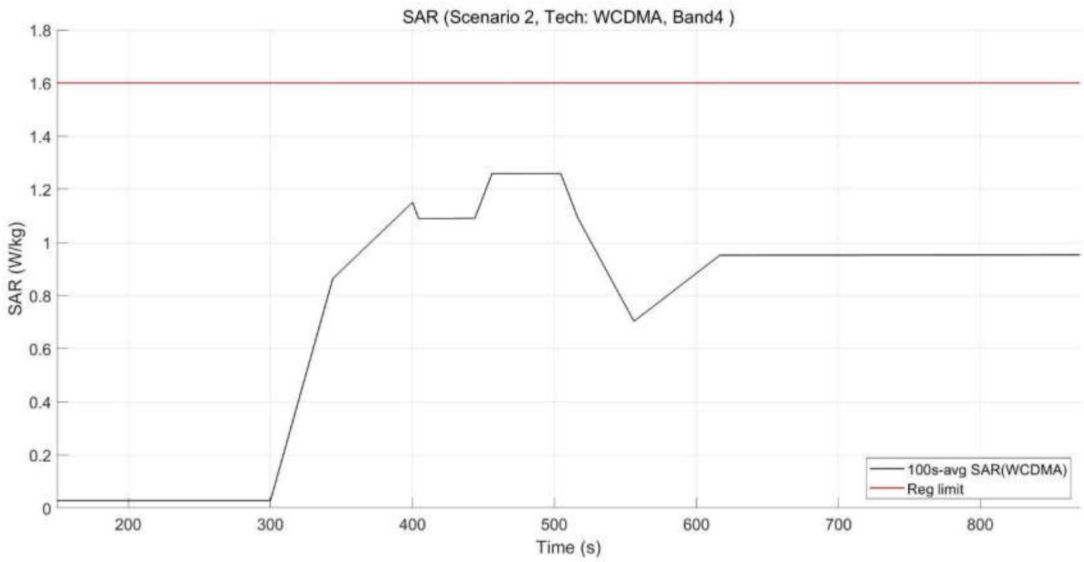



Figure 7-17 Time-averaged SAR for ase 2.11(WCDMA B4)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.259 W/kg |
| Validation result: Pass | |

- **Case 2.12 in table 7-4: WCDMA B4 result for test sequence 2**

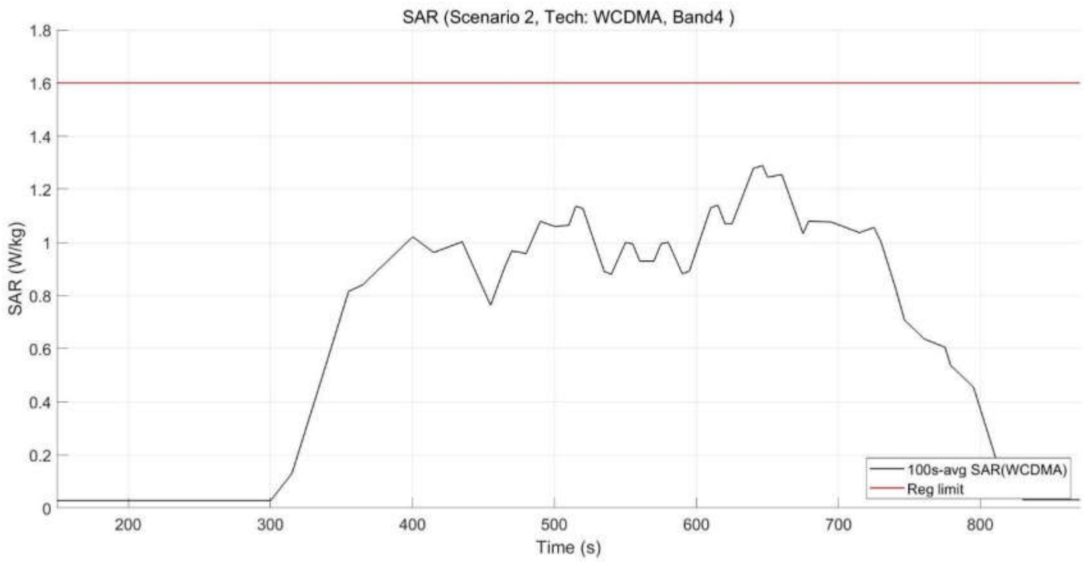



Figure 7-18 Time-averaged SAR for case case 2.12(WCDMA B4)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.289 W/kg |
| Validation result: Pass | |

### 7.3.2 Measurement results for 2G

These test cases are for 2G and are conducted under 2G band PCS1900 with ECI=3. The corresponding detailed test procedure is described in 6.3.2. The figure illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 6.3.2. For all test cases, the time-averaged SAR does not exceed the FCC limit.

- **Case 2.13 in table 7-4: 2G PCS 1900 result for test sequence 1**

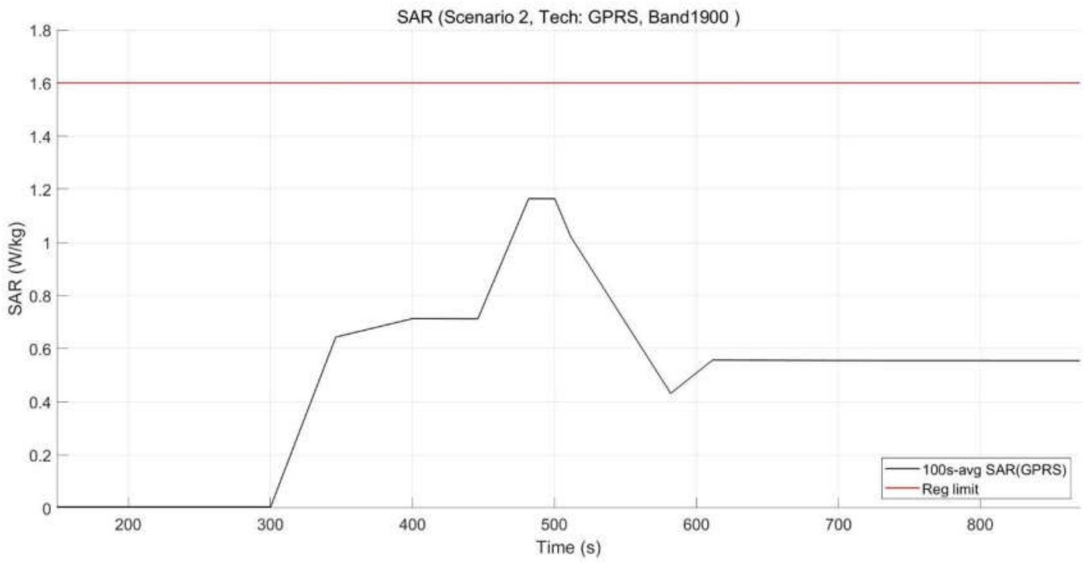



Figure 7-19 Time-averaged SAR for case 2.13(2G PCS 1900)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.164 W/kg |
| Validation result: Pass | |

- **Case 2.14 in table 7-4: 2G PCS 1900 result for test sequence 2**

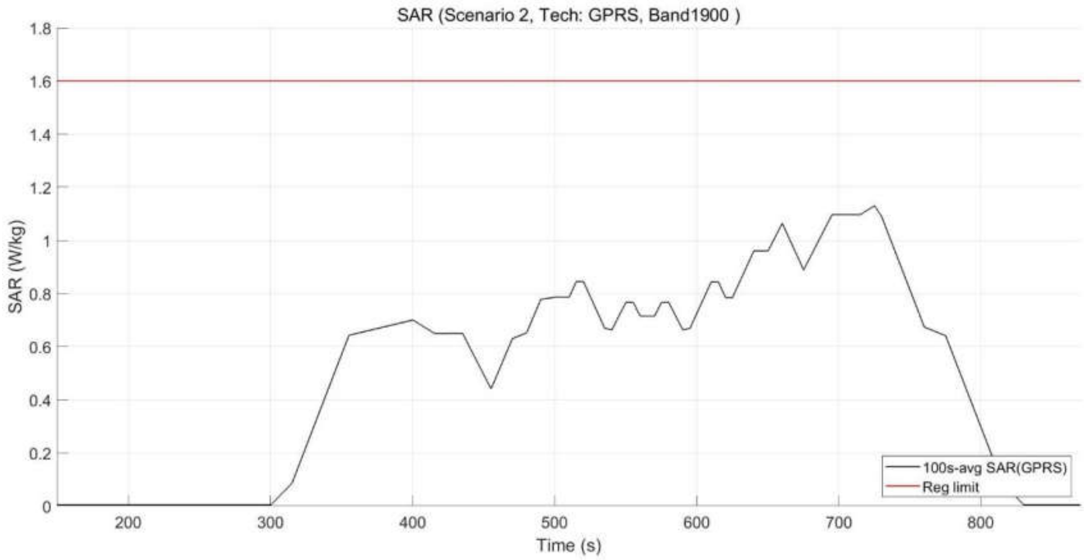



Figure 7-20 Time-averaged SAR for case 2.14(2G PCS 1900)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.130 W/kg |
| Validation result: Pass | |

## 7.4 Conducted Power Measurement Results for Scenario 3: Call Disconnection and Re-establishment

In this scenario, the test power sequence #0 (i.e., maximum TX power is requested by a call box for each RAT) is used, and the call drop is manually configured for a pre-defined period and then the call is re-established to continue data transmission. The test case for this scenario is relegated in Table 7-5, and the test procedure follows section 6.4.2. The measurement setup is Figure 7-2. The high-level summary of the final validation results is also listed in the last column of the table, which concludes that Mediatek's TA-SAR algorithm can maintain the time-averaged SAR is always below the FCC requirement. The following section will demonstrate how Mediatek's TA-SAR algorithm behaves.

**Table 7-5 TA-SAR parameters setting for scenario 3**

| Test case | RAT | Test band | Test seq. | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 | WCDMA | 1900 | 0 | 4 | 23 | 16 | 15.5 | 13 | 19 | Pass |

This test is for 3G WCDMA and is conducted under WCDMA B2 with ECI = 4. The corresponding detailed test procedure is described in 6.4.2. Figure 7-21 illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 6.4.2. As seen in this figure, the time-averaged SAR does not exceed the FCC limit.

- **Case 3.1 in table 7-5: call drop happens at the time instance of 500 seconds**

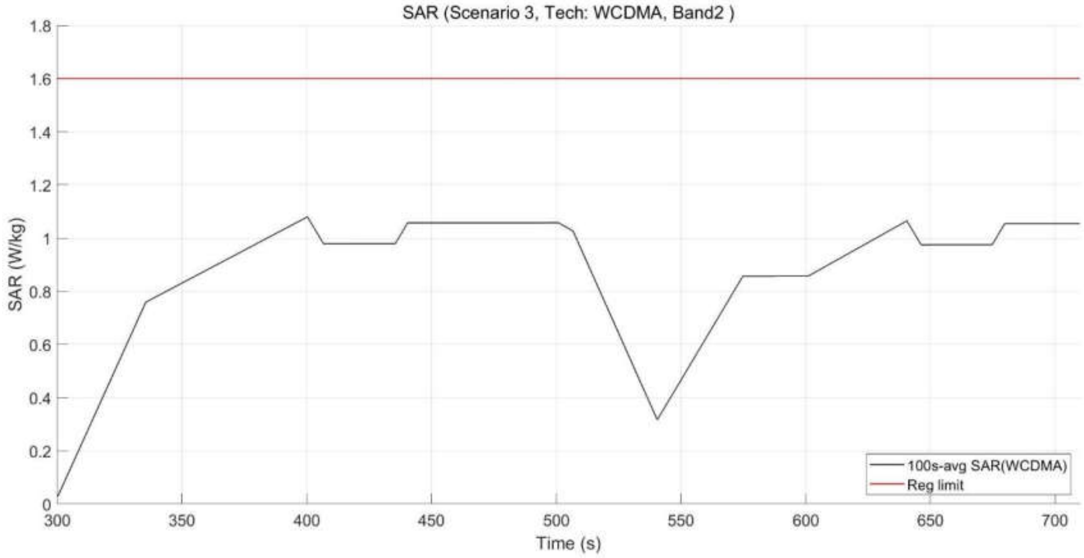



Figure 7-21 Time-averaged SAR for case 3.1(WCDMA B2)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.079 W/kg |
| Validation result: Pass | |

## 7.5 Conducted Power Measurement Results for Scenario 4: Band Handover

In this scenario, the test power sequence #0 (i.e., maximum TX power is requested by a call box for each RAT) is used, and band (and RAT) handover is manually configured at a specific time instance. The test case widely cover handover scenarios between two RATs. The test case for this scenario is relegated in Table 7-6, and the test procedure follows section 6.5.2. The measurement setup is shown in Figure 7-3 (band handover) and Figure 7-5 (RAT handover). The high-level summary of the final validation results are also listed in the last column of the table, which concludes that Mediatek's TA-SAR algorithm can maintain the time-averaged SAR is always below the FCC requirement. The following sections will demonstrate how Mediatek's TA-SAR algorithm behaves.

**Table 7-6 TA-SAR parameters setting for scenario 4**

| Test case | RAT | Test band | Test seq. | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.1 | WCDMA | 1700 | 0 | 3 | 24 | 22 | 21.5 | 19 | 24 | Pass |
| | LTE | B7 | 0 | 3 | 23 | 19 | 18.5 | 16 | 22 | Pass |

This test aims to validate the TA-SAR algorithm with a handover from WCDMA band B4 to LTE band B7 and ECI = 3. The corresponding detailed test procedure is described in 6.5.2. The figure illustrates the corresponding time-averaged normalized SAR over time converted from the TX time-averaged power by using the equation listed in section 6.5.2. The figure shows that the time-averaged normalized SAR does not exceed the normalized FCC limit of 1.

- **Case 4.1 in table 7-6: band handover happens at the time instance of 500 seconds**

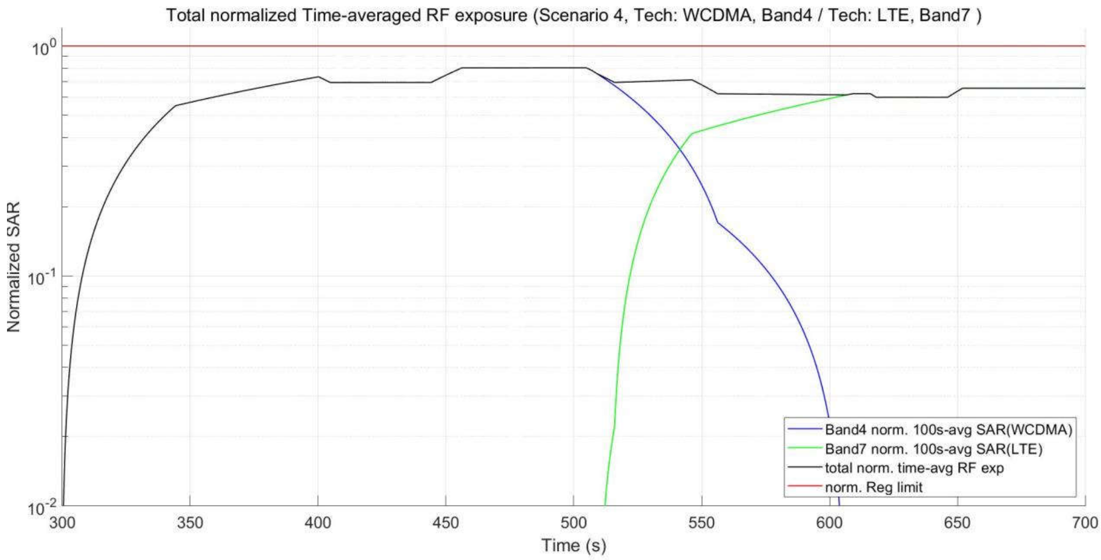



Figure 7-22 Time-averaged SAR for case 4.1(LTE B7, WCDMA B4)

| | |
|---|---|
| FCC limit of total RF exposure (normalized) | 1.0 |
| Max total normalized time-averaged RF exposure | 0.803 |
| Validation result: Pass | |

### 7.6 Conducted Power Measurement Results for Scenario 5: ECI Change

In this scenario, the test power sequence #0 (i.e., maximum TX power is requested by a call box for each RAT) is used, and ECI change at the EUT side is manually configured at a specific time instance. The test case cover ECI switching scenarios between two ECIs. The test case for this scenario is relegated in Table 7-7, and the test procedure follows section 6.6.2. The measurement setup is shown in Figure 7-2. The high-level summary of the final validation results are also listed in the last column of the table, which concludes that Mediatek's TA-SAR algorithm can maintain the time-averaged SAR is always below the FCC requirement. The following sections will demonstrate how Mediatek's TA-SAR algorithm behaves.

**Table 7-7 TA-SAR parameters setting for scenario 5**

| Test case | RAT | Test band | Test seq. | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|
| 5.1 | LTE | B66 | 0 | 4 | 23.8 | 14.3 | 13.8 | 11.3 | 17.3 | Pass |
| | LTE | B66 | 0 | 3 | 23.8 | 20.3 | 19.8 | 17.3 | 23.3 | Pass |

This test aims to validate the TA-SAR algorithm with ECI change from 4G LTE B66 with ECI = 4 to ECI = 3. The corresponding detailed test procedure is described in 6.6.2. The figure illustrates the corresponding time-averaged normalized SAR over time converted from the TX time-averaged power by using the equation listed in section 6.6.2. The figure shows that the time-averaged normalized SAR does not exceed the normalized FCC limit of 1.

- **Case 5.1 in table 7-7: two ECI changes happens at the time instance of 500 seconds and 700 seconds,respectivly**

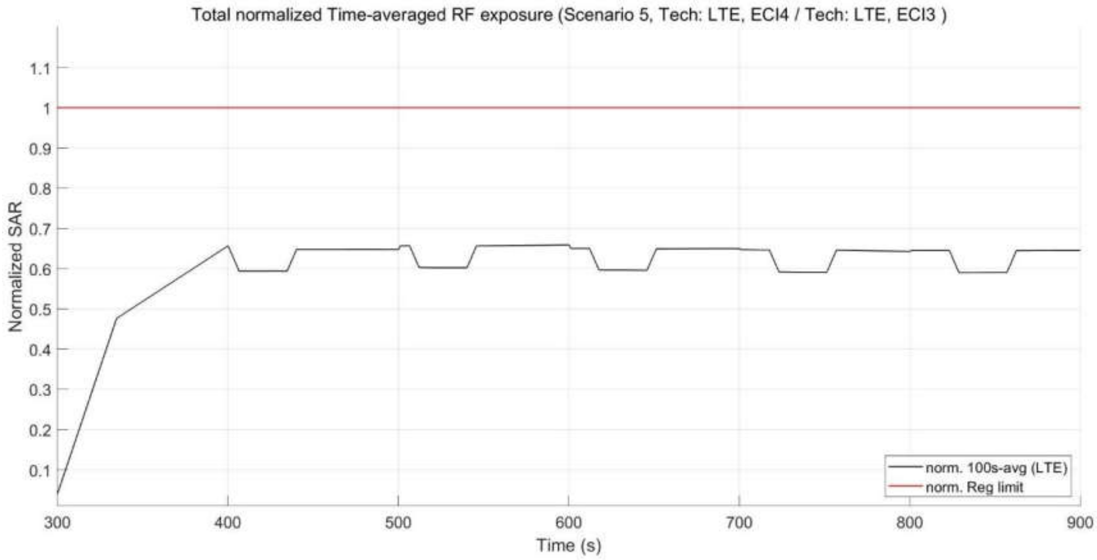



Figure 7-23 Time-averaged SAR for case 5.1(LTE B66)

| | |
|---|---|
| FCC limit of total RF exposure (normalized) | 1.0 |
| Max total normalized time-averaged RF exposure | 0.659 |
| Validation result: Pass | |

### 7.7 Conducted Power Measurement Results for Scenario 6: Antenna Handover

In this scenario, the test power sequence #0 (i.e., maximum TX power is requested by a call box for each RAT) is used, and antenna change at the EUT side is manually configured at a specific time instance. The test case for this scenario is relegated in Table 7-8, and the test procedure follows section 6.7.2. The measurement setup is shown in Figure 7-4. The high-level summary of the final validation results are also listed in the last column of the table, which concludes that Mediatek's TA-SAR algorithm can maintain the time-averaged SAR is always below the FCC requirement. The following sections will demonstrate how Mediatek's TA-SAR algorithm behaves.

**Table 7-8 TA-SAR parameters setting for scenario 6**

| Test case | RAT | Test band | Test seq. | ANT | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.1 | WCMDA | 1700 | 0 | 0 | 3 | 24 | 22 | 21.5 | 19 | 24 | Pass |
| | WCDMA | 1700 | 0 | 4 | 3 | 24 | 20 | 19.5 | 17 | 23 | Pass |

This test aims to validate the TA-SAR algorithm with antenna change during the test period for WCMDA 1700 with ECI = 3. The corresponding detailed test procedure is described in 6.7.2. The figure illustrates the corresponding time-averaged normalized SAR over time converted from the TX time-averaged power by using the equation listed in section 6.7.2. The figure shows that the time-averaged normalized SAR does not exceed the normalized FCC limit of 1.

- **Case 6.1 in table 7-6: antenna handover happens at the time instance of 500 seconds**

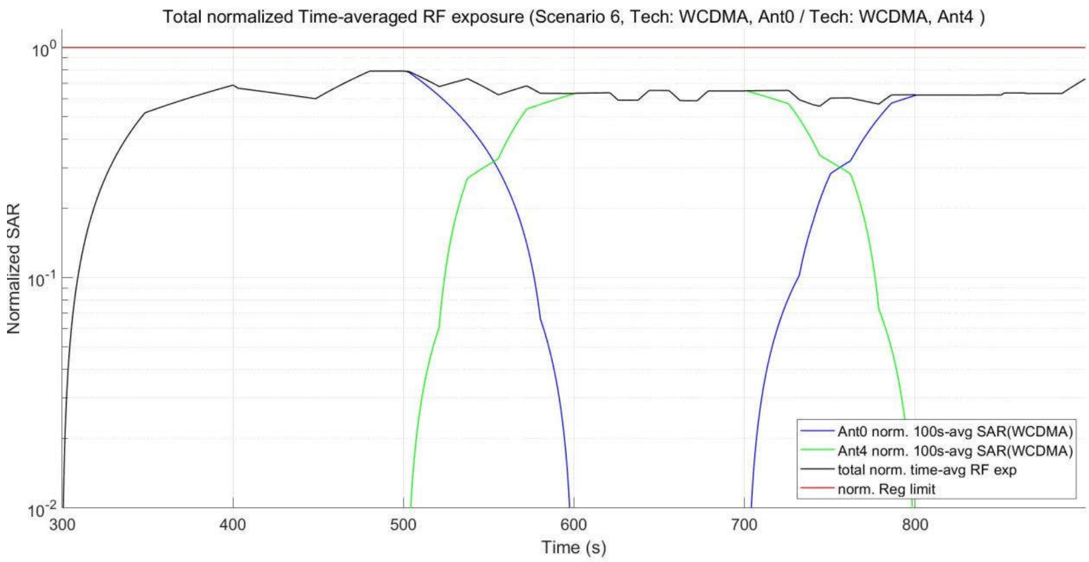



Figure 7-24 Time-averaged SAR for case 6.1(WCDMA B4)

| | |
|---|---|
| FCC limit of total RF exposure (normalized) | 1.0 |
| Max total normalized time-averaged RF exposure | 0.790 |
| Validation result: Pass | |

## 7.8 Conducted Power Measurement Results for Scenario 7: SAR Exposure Switching

In this scenario, the test power sequence #0 (i.e., maximum TX power is requested by a call box for each RAT) is used, and LTE and NR FR1 are turned on at the same time for a pre-defined period during the test. This scenario aims to validate whether the TA-SAR algorithm is able to maintain TER below the FCC limit when the two radios change TX power dynamically. The experiment parameters are summarized in Table 7-9, and the test procedure follows section 6.9.2. The measurement setup is shown in Figure 7-5.

**Table 7-9 TA-SAR parameters setting for scenario 7**

| Test case | RAT | Test band | Test seq. | ANT | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.1 | LTE | B7 | 0 | 5 | 4 | 23 | 18.5 | 18 | 15.5 | 21.5 | Pass |
| | Sub6 NR | N66 | 0 | 4 | 4 | 24 | 15.5 | 15 | 12.5 | 18.5 | Pass |

During the test period,

- Time = 300s~500s: NR FR1-dominant scenario.
- Time = 500s~7000s: LTE + NR FR1 scenario.
- Time = 700s~900s: LTE-dominant scenario.

The figure illustrates the corresponding time-averaged normalized SAR over time converted from the TX time-averaged power by using the equation listed in section 6.9.2. The figure shows that the time averaged normalized SAR does not exceed the normalized FCC limit of 1.

- **Case 7.1 in table 7-9**

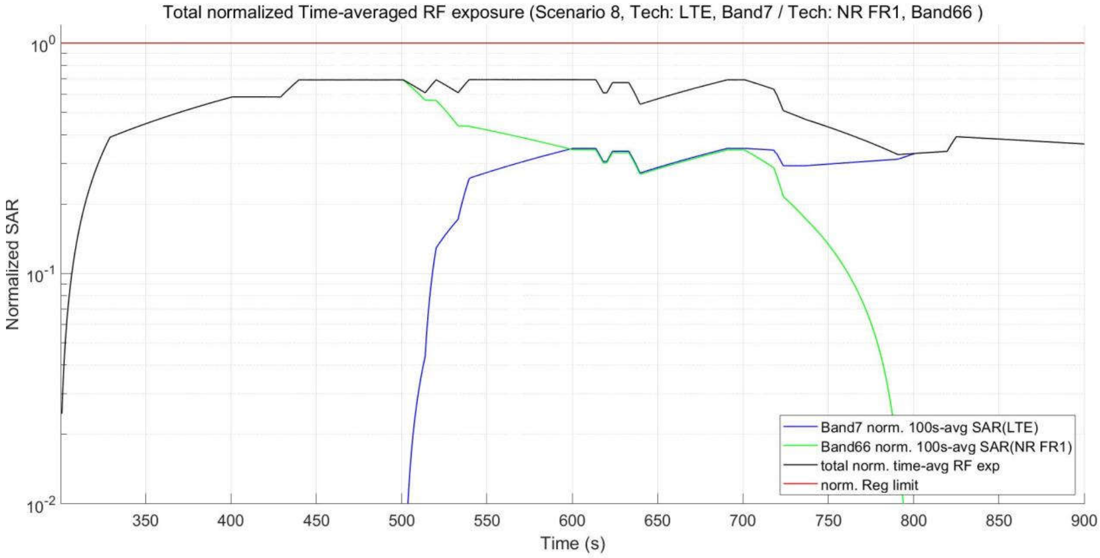



Figure 7-25 Normalized Time-averaged SAR

| | |
|---|---|
| FCC limit of total RF exposure (normalized) | 1.0 |
| Max total normalized time-averaged RF exposure | 0.694 |
| Validation result: Pass | |

# 8 TA-SAR Validation via SAR Measurements

## 8.1 Measurement Setup

The measurement setup is similar to normal fixed power SAR measurement. The difference in SAR measurement setup for time averaging feature validation is that the call box operates under the close loop power control mode and is connected to the PC, so that the PC can control the call box based on the test sequence to configure EUT's TX target power. The same test procedure used in conducted power setup for time-varying TX power measurement is also used in this section for time-averaging SAR measurements. Since the SAR chamber is an uncontrolled environment, the path loss between call box antenna and the EUT are well calibrated. The test setup is illustrated in Figure 8-1.

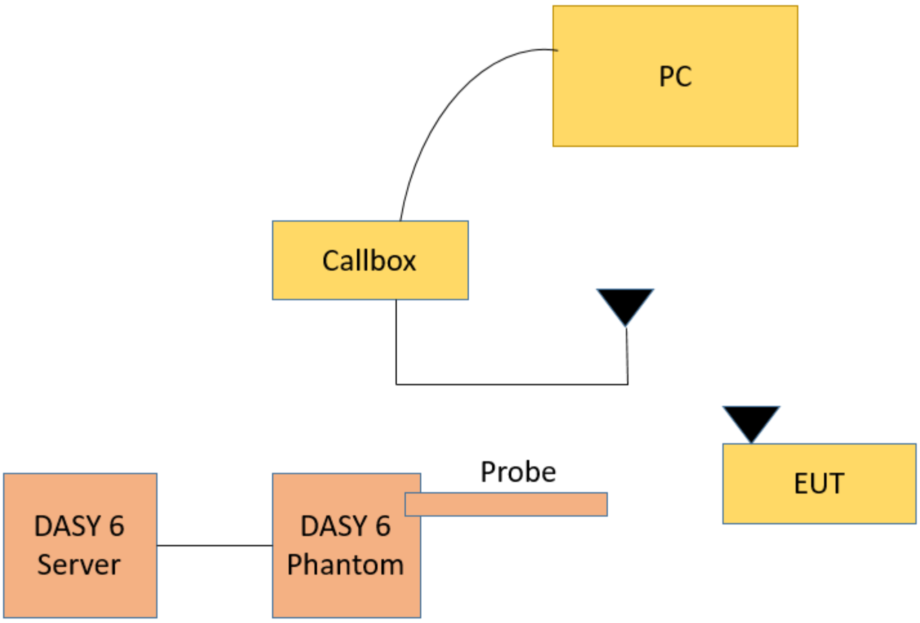



Figure 8-1 TA-SAR wireless test environment

## 8.2 SAR Measurement Results for Scenario 2: Time-Varying TX power

In this scenario, Mediatek's TA-SAR algorithm is tested under more dynamic power test sequences. The test sequence #1 is shown in section 6.1 and test sequence #2 is tabulated in table 6.4. All of the test cases for this scenario are relegated in Table 8-1, and the test procedure follows section 6.9.2. The measurement setup is shown in Figure 8-1. All of the measurements are conduct by using DASY6. The high-level summary of the final validation results is given in the last column of the table, which concludes that Mediatek's TA-SAR algorithm can maintain the time-averaged SAR is always below the FCC requirement for all test cases. The following sections will demonstrate case-by-case to show how Mediatek's TA-SAR algorithm behaves for each RAT.

**Table 8-1 Operating parameters for TA-SAR parameters setting**

| Test case | RAT | Test band | Test seq. | ECI | Max power (dBm) | $P_{sub6\_limit}$ (dBm) | $P_{LowThresh}$ (dBm) | $P_{UE\_backoff}$ (dBm) | $P_{UE\_max\_cust}$ (dBm) | Pass /Fail SAR limit |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Sub6 NR | N41 | 1 | 3 | 27 | 24.5 | 24 | 21.5 | 27 | Pass |
| 2 | Sub6 NR | N41 | 2 | 3 | 27 | 24.5 | 24 | 21.5 | 27 | Pass |
| 3 | Sub6 NR | N41 | 1 | 4 | 26.4 | 13.9 | 13.4 | 10.9 | 16.9 | Pass |
| 4 | Sub6 NR | N41 | 2 | 4 | 26.4 | 13.9 | 13.4 | 10.9 | 16.9 | Pass |
| 5 | LTE | B38 | 1 | 3 | 24 | 23.25 | 22.75 | 20.25 | 24 | Pass |
| 6 | LTE | B38 | 2 | 3 | 24 | 23.25 | 22.75 | 20.25 | 24 | Pass |
| 7 | LTE | B66 | 1 | 4 | 23.8 | 14.3 | 13.8 | 11.3 | 17.3 | Pass |
| 8 | LTE | B66 | 2 | 4 | 23.8 | 14.3 | 13.8 | 11.3 | 17.3 | Pass |
| 9 | WCMDA | 1900 | 1 | 4 | 23 | 16 | 15.5 | 13 | 19 | Pass |
| 10 | WCMDA | 1900 | 2 | 4 | 23 | 16 | 15.5 | 13 | 19 | Pass |
| 11 | WCMDA | 1700 | 1 | 3 | 24 | 22 | 21.5 | 19 | 24 | Pass |
| 12 | WCMDA | 1700 | 2 | 3 | 24 | 22 | 21.5 | 19 | 24 | Pass |
| 13 | GSM | 1900 | 1 | 3 | 30 | 29.25 | 28.75 | 26.25 | 30 | Pass |
| 14 | GSM | 1900 | 2 | 3 | 30 | 29.25 | 28.75 | 26.25 | 30 | Pass |

### 8.2.1 SAR Measurement results for NR

- **Case 1 in table 8-1: NR n41 result for test sequence 1**

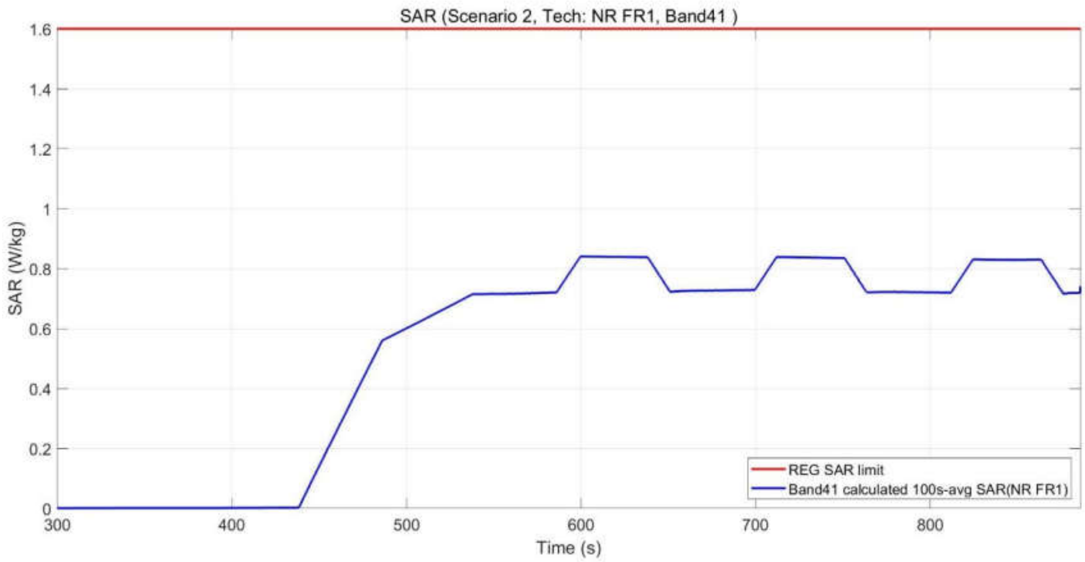



Figure 8-2 Time-averaged SAR for case 1 in table 8-1 (sub NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 0.841 W/kg |
| Validation result: Pass | |

- **Case 2 in table 8-1: NR n41 result for test sequence 2**

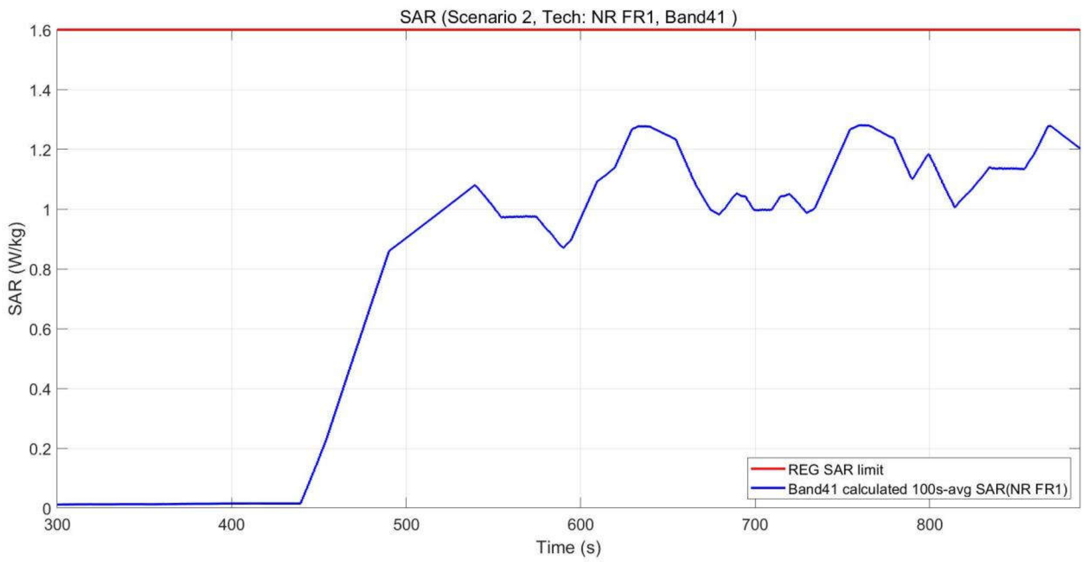



Figure 8-3 Time-averaged SAR for case 2 in table 8-1 (sub NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.280 W/kg |
| Validation result: Pass | |

- **Case 3 in table 8-1: NR n41 result for test sequence 1**

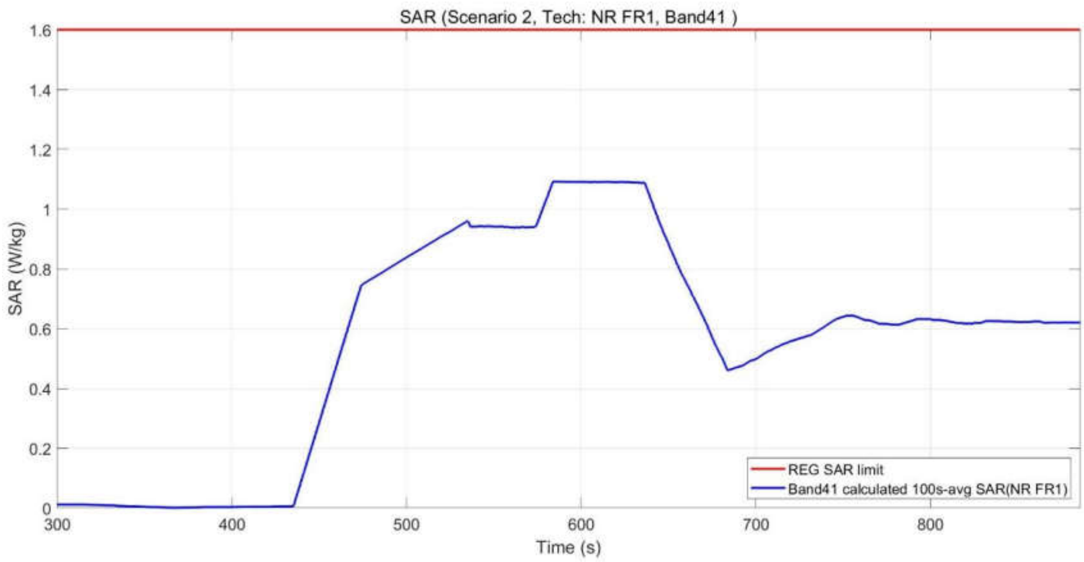



Figure 8-4 Time-averaged SAR for case 3 in table 8-1 (sub NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.092 W/kg |
| Validation result: Pass | |

- **Case 4 in table 8-1: NR n41 result for test sequence 2**

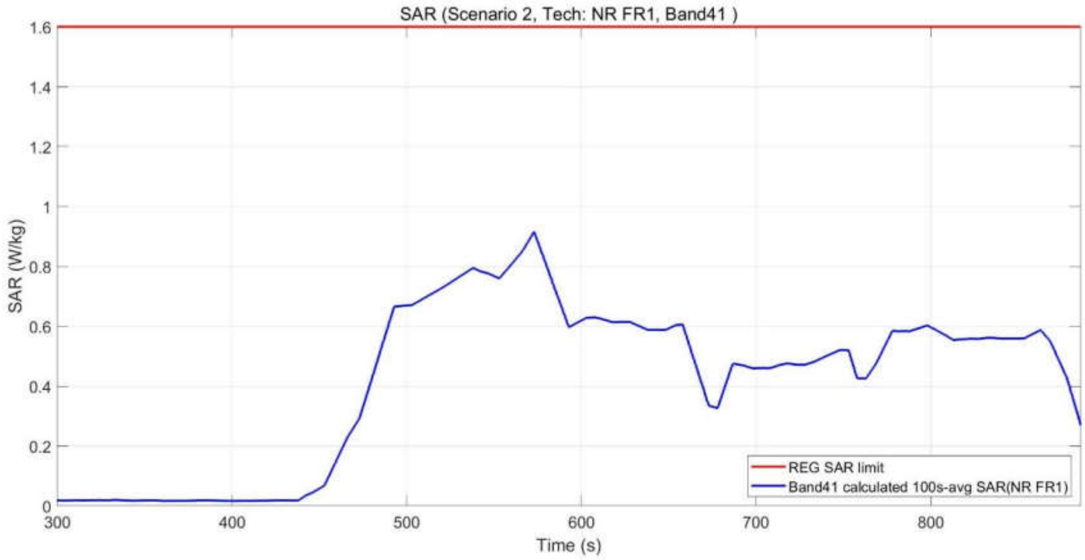



Figure 8-5 Time-averaged SAR for case 4 in table 8-1 (sub NR n41)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 0.913 W/kg |
| Validation result: Pass | |

### 8.2.2 SAR Measurement results for 4G LTE

- **Case 5 in table 8-1: 4G LTE B38 result for test sequence 1**

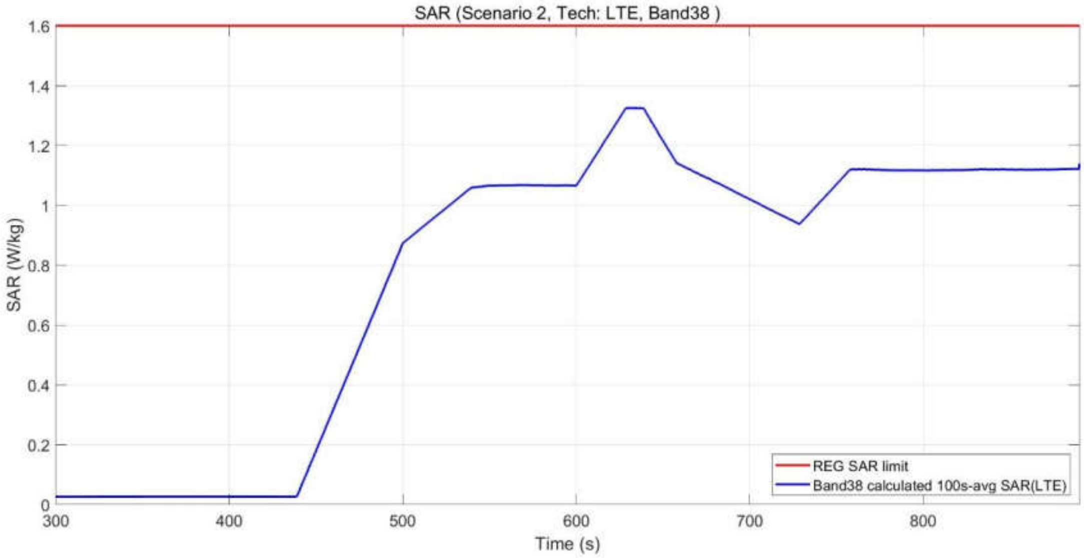



Figure 8-6 Time-averaged SAR for case 5 in table 8-1 (4G LTE B38)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.325 W/kg |
| Validation result: Pass | |

- **Case 6 in table 8-1: 4G LTE B38 result for test sequence 2**

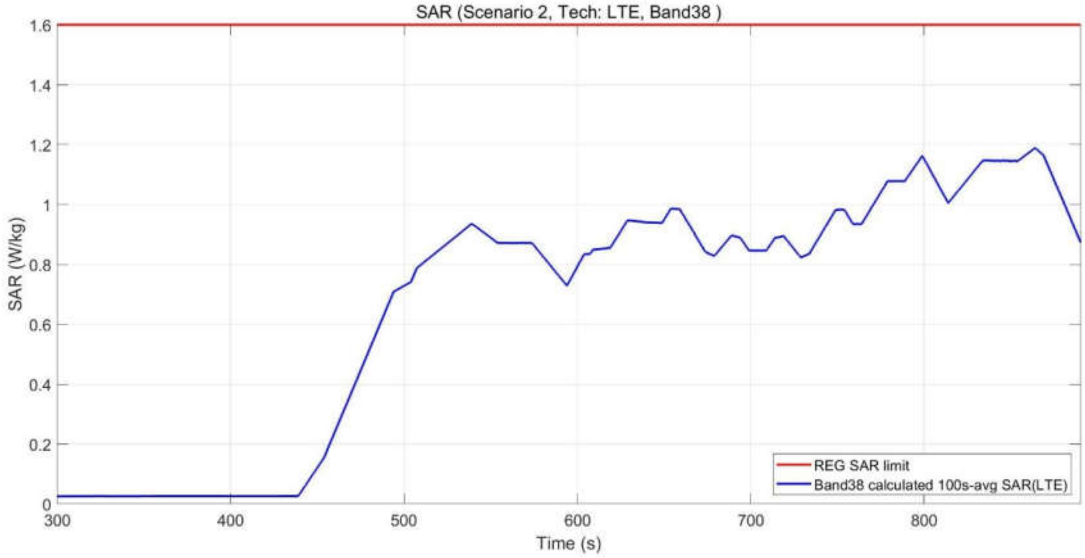



Figure 8-7 Time-averaged SAR for case 6 in table 8-1 (4G LTE B38)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.188 W/kg |
| Validation result: Pass | |

- **Case 7 in table 8-1: 4G LTE B66 result for test sequence 1**

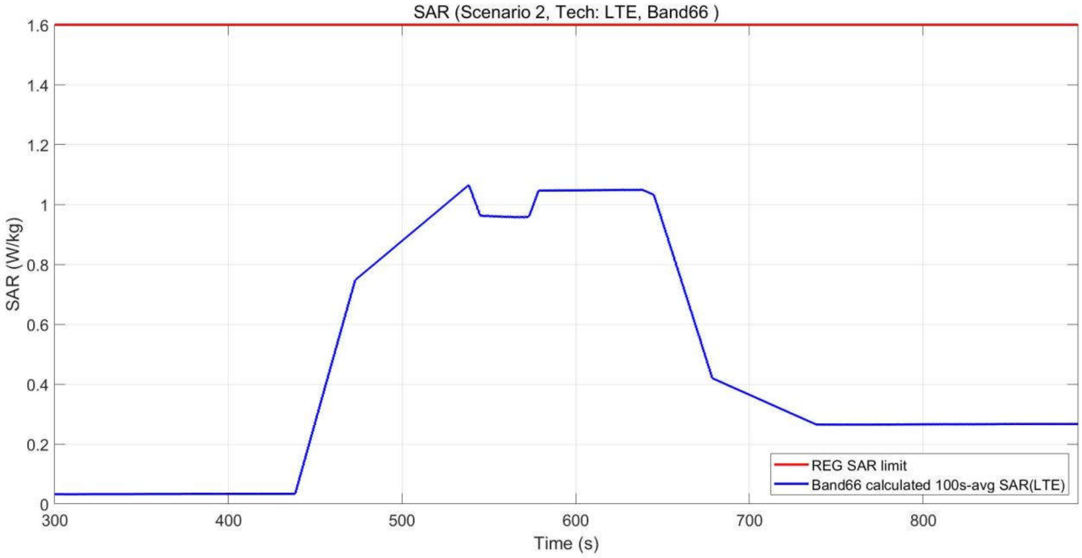



Figure 8-8 Time-averaged SAR for case 7 in table 8-1 (4G LTE B66)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.063 W/kg |
| Validation result: Pass | |

- **Case 8 in table 8-1: 4G LTE B66 result for test sequence 2**

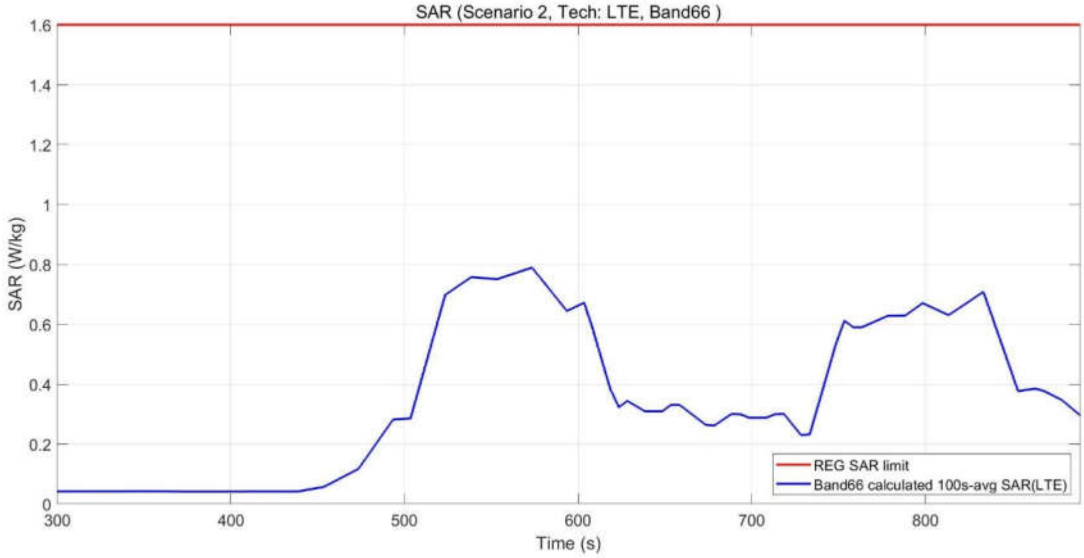



Figure 8-9 Time-averaged SAR for case 8 in table 8-1 (4G LTE B66)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 0.789 W/kg |
| Validation result: Pass | |

### 8.2.3 SAR Measurement results for 3G WCDMA

- **Case 9 in table 8-1: 3G WCDMA B2 result for test sequence 1**

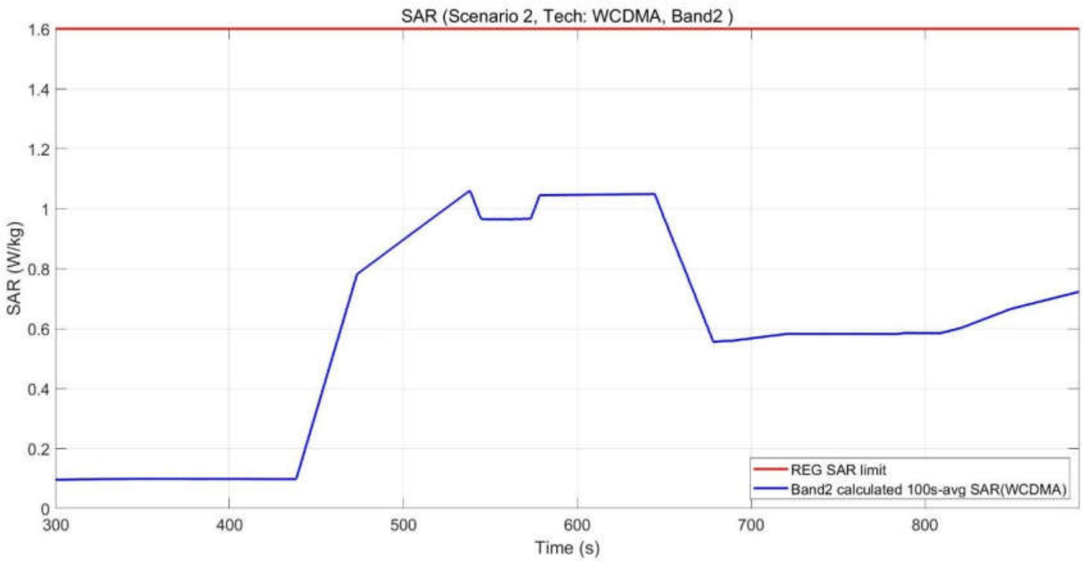



Figure 8-10 Time-averaged SAR for case 9 in table 8-1 (3G WCDMA B2)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.059 W/kg |
| Validation result: Pass | |

- **Case 10 in table 8-1: 3G WCDMA B2 result for test sequence 2**

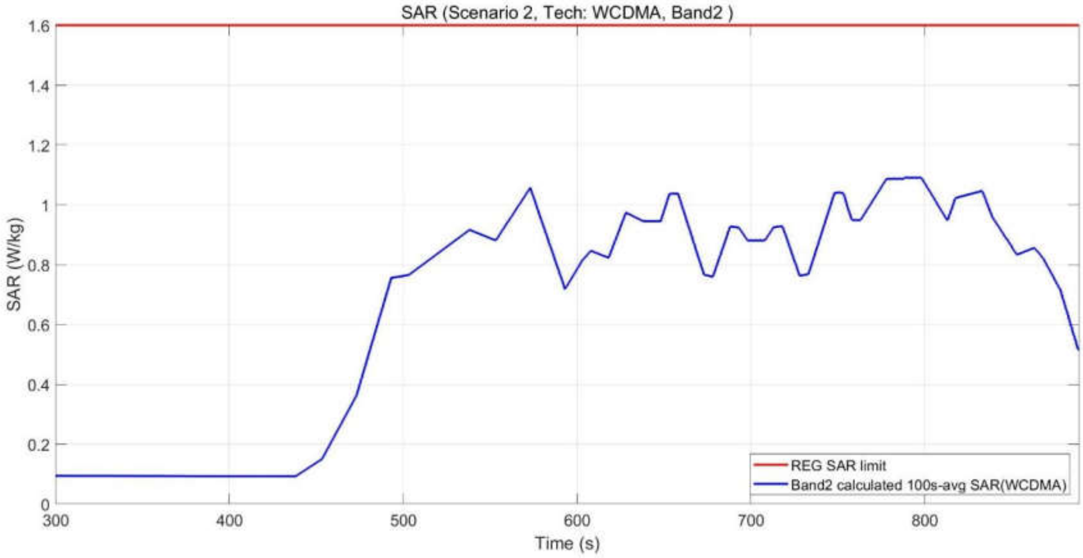



Figure 8-11 Time-averaged SAR for case 10 in table 8-1 (3G WCDMA B2)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.091 W/kg |
| Validation result: Pass | |

- **Case 11 in table 8-1: 3G WCDMA B4 result for test sequence 1**

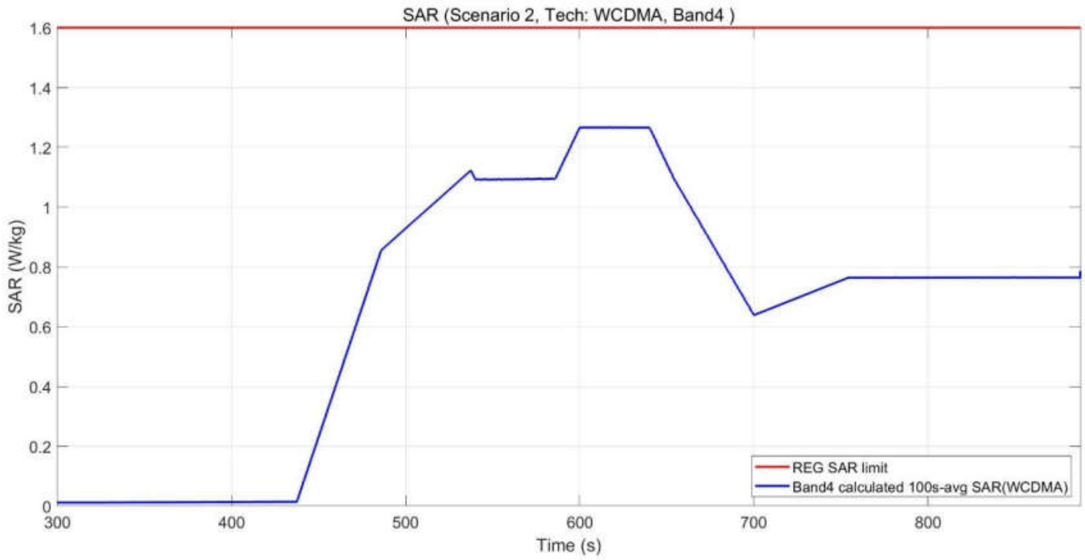



Figure 8-12 Time-averaged SAR for case 11 in table 8-1 (3G WCDMA B4)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.267 W/kg |
| Validation result: Pass | |

- **Case 12 in table 8-1: 3G WCDMA B4 result for test sequence 2**

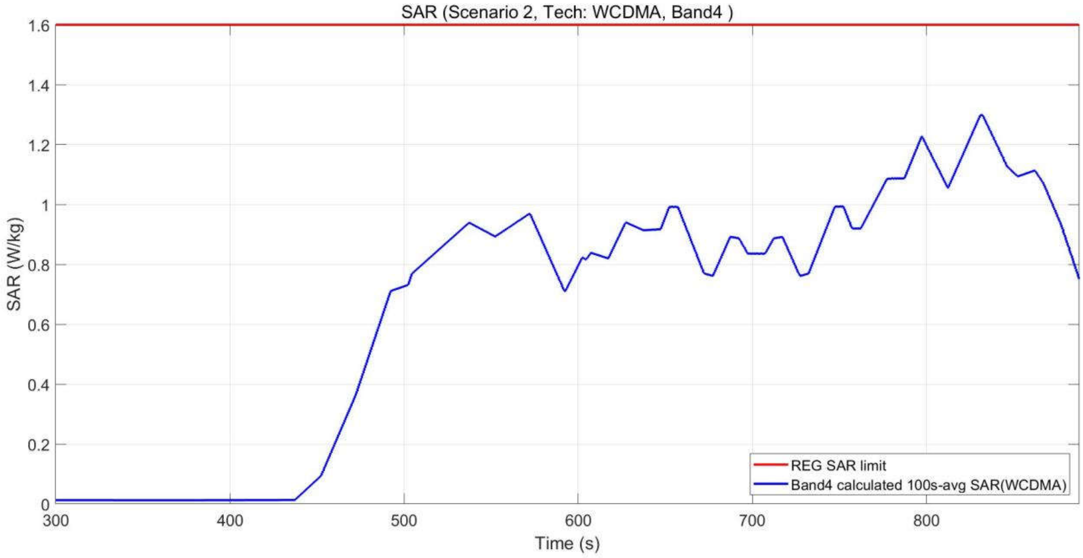



Figure 8-13 Time-averaged SAR for case 12 in table 8-1 (3G WCDMA B4)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.299 W/kg |
| Validation result: Pass | |

### 8.2.4 SAR Measurement results for 2G GSM

- **Case 13 in table 8-1: 2G GSM 1900 result for test sequence 1**

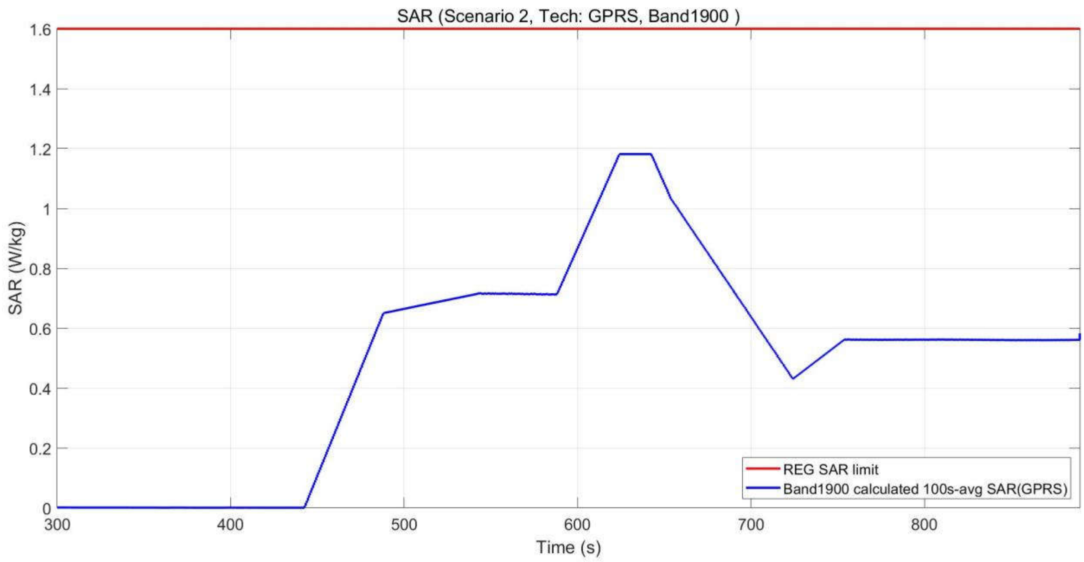



Figure 8-14 Time-averaged SAR for case 13 in table 8-1 (2G GSM 1900)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.182 W/kg |
| Validation result: Pass | |

- **Case 14 in table 8-1: 2G GSM 1900 result for test sequence 2**

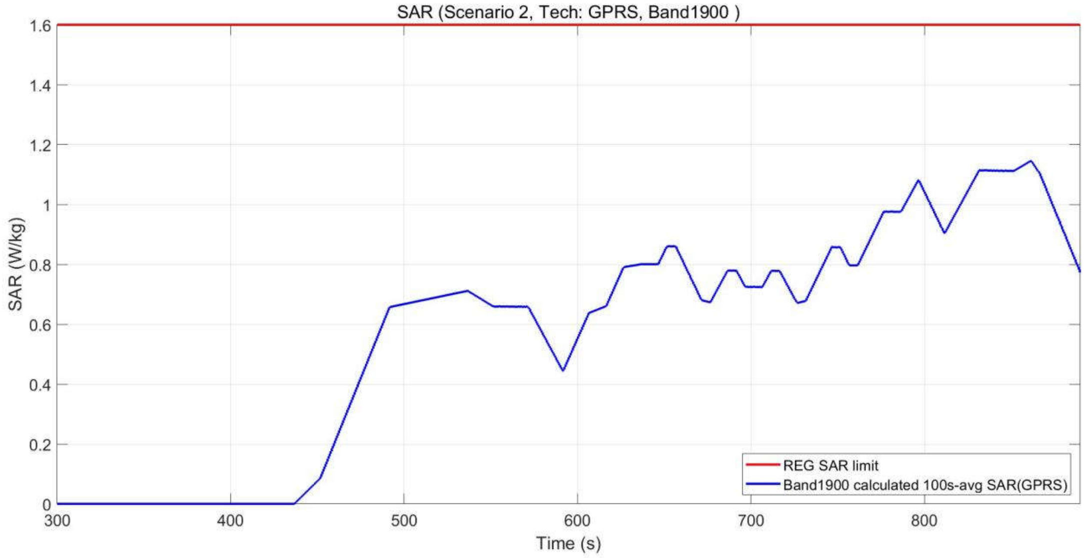



Figure 8-15 Time-averaged SAR for case 14 in table 8-1 (2G GSM 1900)

| | |
|---|---|
| FCC 1gSAR limit | 1.6 W/kg |
| Max 100s-time averaged 1gSAR | 1.144 W/kg |
| Validation result: Pass | |

# 9 Conclusions

This document proposes TA-SAR test scenarios and procedures, and further proves Mediatek's TA-SAR algorithms can meet the FCC SAR regulations with the proposed test scenarios and procedures. As shown in Chapters 7, Mediatek's TA-SAR algorithms are able to maintain SAR over time below the FCC regulatory limits (based on the agreed TX-power-to-SAR translation). Furthermore, the near-field measurements are also done in an FCC certified lab to further validate the proposed test methodologies, and the results shown in Chapters 7 demonstrate that Mediatek's TA-SAR algorithms really can maintain SAR over time below the FCC regulatory limits under the proposed test procedures. Based on the provided measurement evidences, it is concluded that Mediatek's TA-SAR algorithms can be tested by using the proposed test methodology for FCC compliance.

# Appendix A Main Test Instruments

**Table A-1 List of Main Instruments**

| | Name | Type | Serial Number | Calibration Date | Valid Period |
|---|---|---|---|---|---|
| 01 | Network analyzer | N5239A | MY55491241 | May 21, 2024 | One year |
| 02 | Power sensor | NRP50S | 101488 | June 5, 2024 | One year |
| 03 | Power sensor | NRP50S | 101489 | | |
| 04 | Signal Generator | MG3700A | 6201052605 | June 12 2024 | One Year |
| 05 | Amplifier | 60S1G4 | 0331848 | No Calibration Requested | |
| 06 | Directional Coupler | 4216-10 | 02858 | No Calibration Requested | |
| 07 | Directional Coupler | 4216-10 | 02860 | No Calibration Requested | |
| 08 | BTS | CMW500 | 159890 | January 21, 2025 | One year |
| 09 | 5G Wireless Test Platform | E7515B | MY60192696 | August 23,2024 | One year |
| 10 | E-field Probe | SPEAG EX3DV4 | 7548 | January 06,2025 | One year |
| 11 | DAE | SPEAG DAE4 | 1588 | September 13,2024 | One year |
| 12 | Dipole Validation Kit | SPEAG D1750V2 | 1003 | July 11,2024 | One year |
| 13 | Dipole Validation Kit | SPEAG D1900V2 | 5d101 | July 8,2024 | One year |
| 14 | Dipole Validation Kit | SPEAG D2600V2 | 1012 | July 10,2024 | One year |

## Appendix B Tissue Simulating Liquids

| Measurement Date (yyyy-mm-dd) | Type | Frequency | Permittivity ε | Drift (%) | Conductivity σ (S/m) | Drift (%) |
|---|---|---|---|---|---|---|
| 2025/4/15 | Head | 1750 MHz | 40.53 | 1.12 | 1.387 | 1.24 |
| 2025/4/16 | Head | 1900 MHz | 38.96 | -2.60 | 1.411 | 0.79 |
| 2025/4/26 | Head | 2600 MHz | 40.10 | 2.79 | 1.947 | -0.66 |

## Appendix C System Validation

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) | | Measured value(W/kg) | | Deviation | |
|---|---|---|---|---|---|---|---|
| | | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average |
| 2025/4/15 | 1750 MHz | 19.8 | 37.2 | 20.7 | 38.8 | 4.65% | 4.19% |
| 2025/4/16 | 1900 MHz | 20.6 | 39.1 | 20.9 | 40.8 | 1.55% | 4.35% |
| 2025/4/26 | 2600 MHz | 24.8 | 54.9 | 24.4 | 54.8 | -1.45% | -0.18% |

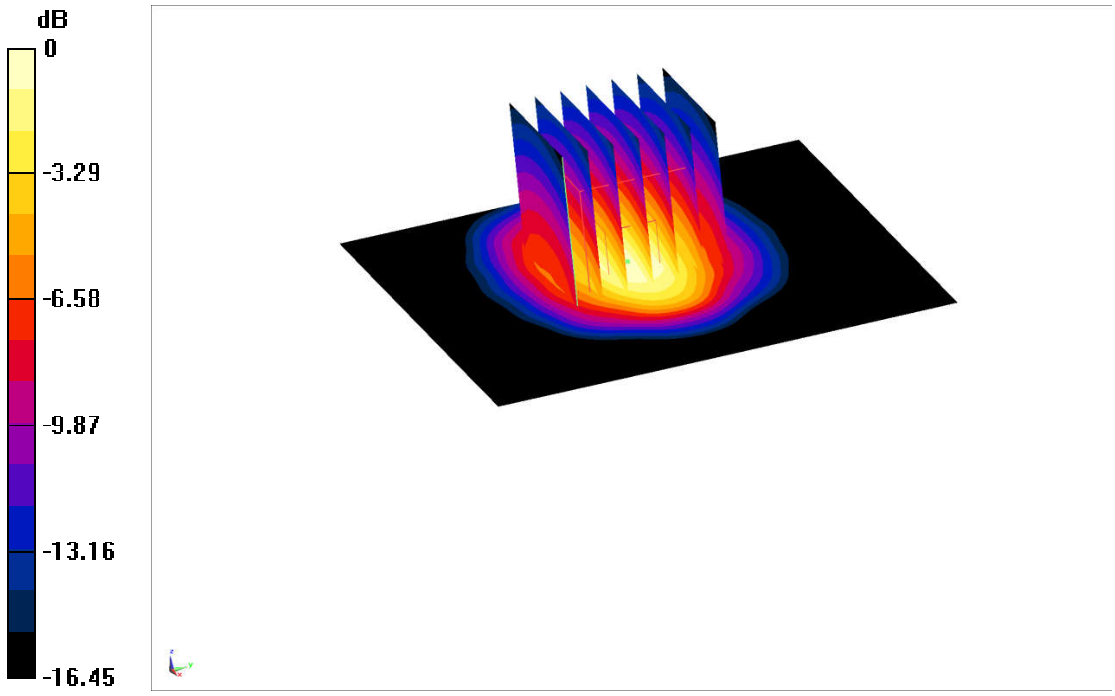
# Appendix D System Validation Results

## 1750MHz

Date: 4/15/2025
Electronics: DAE4 Sn1588
Medium: H700-6000M
Medium parameters used: f = 1750 MHz; σ = 1.387 S/m; εr = 40.53; ρ = 1000 kg/m3
Ambient Temperature:23.3°C Liquid Temperature: 22.5°C
Communication System: UID 0, CW (0) Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 –SN7548 ConvF(8.66,8.66,8.66)

Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.8 W/kg

Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.2 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 17.1 W/kg
SAR(1 g) = 9.69 W/kg; SAR(10 g) = 5.18 W/kg
Maximum value of SAR (measured) = 14.5 W/kg




0 dB = 14.5 W/kg = 11.61 dBW/kg

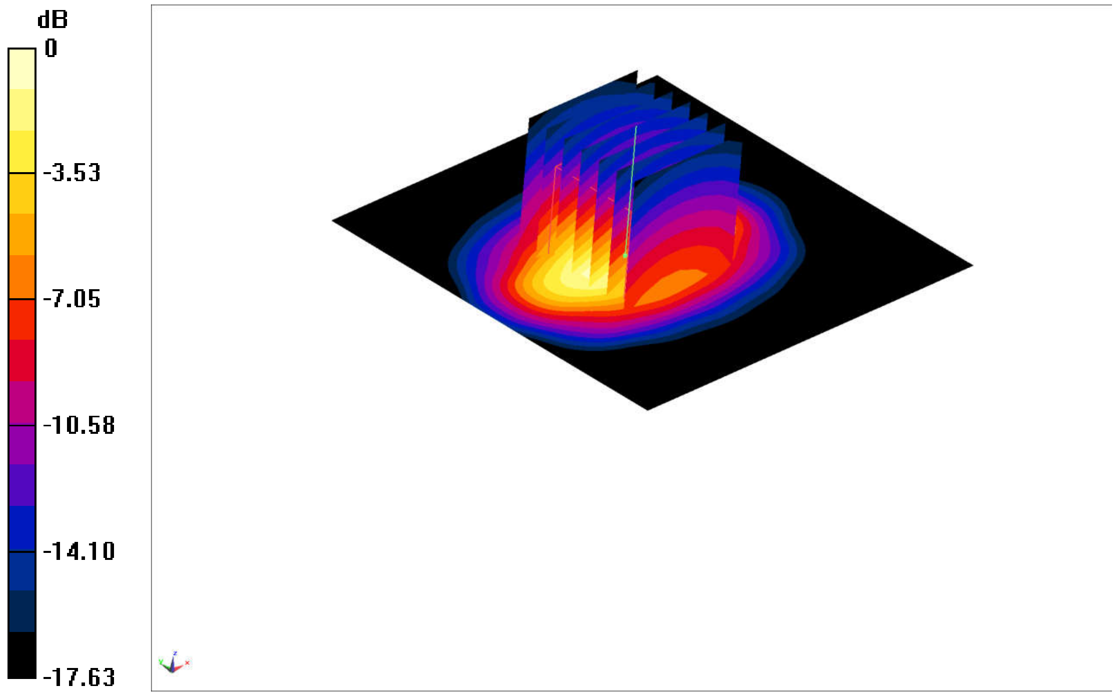
 

## 1900MHz

Date: 4/16/2025
Electronics: DAE4 Sn1588
Medium: H700-6000M
Medium parameters used: f = 1900 MHz; σ = 1.411 S/m; εr = 38.96; ρ = 1000 kg/m3
Ambient Temperature:23.3°C     Liquid Temperature: 22.5°C
Communication System: UID 0, CW (0) Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 –SN7548 ConvF(8.32,8.32,8.32)

Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 16.1 W/kg

Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.5 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 18.7 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.23 W/kg
Maximum value of SAR (measured) = 15.8 W/kg



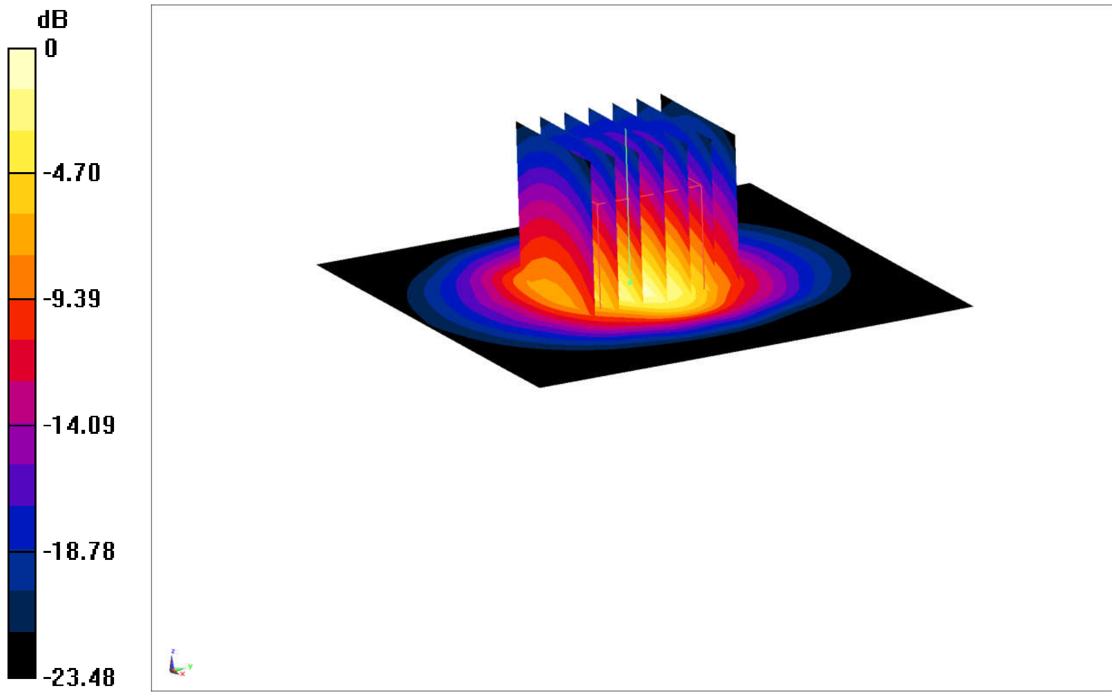

0 dB = 15.8 W/kg = 11.99 dBW/kg

## 2600MHz

Date: 4/26/2025
Electronics: DAE4 Sn1588
Medium: H700-6000M
Medium parameters used: f = 2600 MHz; σ = 1.947 S/m; εr = 40.1; ρ = 1000 kg/m3
Ambient Temperature:23.3°C Liquid Temperature: 22.5°C
Communication System: UID 0, CW (0) Frequency: 2600 MHz Duty Cycle: 1:1
Probe: EX3DV4 –SN7548 ConvF(7.6,7.6,7.6)

Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 23.1 W/kg

Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.2 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 30.1 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.11 W/kg
Maximum value of SAR (measured) = 23.8 W/kg




0 dB = 23.8 W/kg = 13.77 dBW/kg

## ANNEX E Probe Calibration Certificate

## Probe 7548 Calibration Certificate

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中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client CTTL Certificate No: 24J02Z000968

### CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN : 7548 |
| Calibration Procedure(s) | FF-Z11-004-02<br>Calibration Procedures for Dosimetric E-field Probes |
| Calibration date: | January 06, 2025 |

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power Meter NRP2 | 106277 | 18-Oct-24(CTTL, No.24J02X101459) | Oct-25 |
| Power sensor NRP8S | 104291 | 18-Oct-24(CTTL, No.24J02X101459) | Oct-25 |
| Power sensor NRP8S | 104292 | 18-Oct-24(CTTL, No.24J02X101459) | Oct-25 |
| Reference 10dBAttenuator | 18N50W-10dB | 19-Jan-23(CTTL, No.J23X00212) | Jan-25 |
| Reference 20dBAttenuator | 18N50W-20dB | 19-Jan-23(CTTL, No.J23X00211) | Jan-25 |
| Reference Probe EX3DV4 | SN 7307 | 28-May-24(SPEAG, No.EX-7307_May24) | May-25 |
| DAE4 | SN 771 | 19-Jan-24(SPEAG, No.DAE4-771_Jan24) | Jan-25 |
| DAE4 | SN 1555 | 16-Aug-24(SPEAG, No. DAE4-1555_Aug24) | Aug-25 |
| **Secondary Standards** | **ID #** | **Cal Date(Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| SignalGenerator MG3700A | 6201052605 | 12-Jun-24(CTTL, No.24J02X005419) | Jun-25 |
| SignalGenerator APSIN26G | 181-33A6D0700-1959 | 26-Mar-24(CTTL, No.24J02X002468) | Mar-25 |
| Network Analyzer E5071C | MY46110673 | 18-Dec-24(CTTL, No.24J02X103932) | Dec-25 |
| Reference 10dBAttenuator | BT0520 | 11-May-23(CTTL, No.J23X04061) | May-25 |
| Reference 20dBAttenuator | BT0267 | 11-May-23(CTTL, No.J23X04062) | May-25 |
| OCP DAKS | SN 0015 | 09-Oct-24(SPEAG, No. OCP-DAKS-0015_Oct24) | Oct-25 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Yu Zongying | SAR Test Engineer | |
| Reviewed by: | Lin Jun | SAR Test Engineer | |
| Approved by: | Qi Dianyuan | SAR Project Leader | |

Issued: January 09, 2025



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**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A,B,C,D | modulation dependent linearization parameters |
| Polarization Φ | Φ rotation around probe axis |
| Polarization θ | θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Methods Applied and Interpretation of Parameters:**

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the $E^2$-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7548

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (*k*=2) |
|---|---|---|---|---|
| Norm(μV/(V/m)$^2$)[A] | 0.63 | 0.67 | 0.63 | ±10.0% |
| DCP(mV)[B] | 109.2 | 112.4 | 112.1 | |

## Calibration Results for Modulation Response

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Max Dev. | Max Unc[E] (*k*=2) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 214.6 | ±2.1% | ±4.7% |
| | | Y | 0.0 | 0.0 | 1.0 | | 221.8 | | |
| | | Z | 0.0 | 0.0 | 1.0 | | 211.2 | | |
| 10352-AAA | Pulse Waveform (200Hz, 10%) | X | 2.10 | 63.39 | 7.82 | 10.00 | 60 | ±4.6% | ±9.6% |
| | | Y | 2.22 | 63.84 | 8.05 | | 60 | | |
| | | Z | 2.20 | 63.95 | 8.51 | | 60 | | |
| 10353-AAA | Pulse Waveform (200Hz, 20%) | X | 0.91 | 60.29 | 5.12 | 6.99 | 80 | ±3.4% | ±9.6% |
| | | Y | 0.99 | 60.71 | 5.39 | | 80 | | |
| | | Z | 1.08 | 60.95 | 6.05 | | 80 | | |
| 10354-AAA | Pulse Waveform (200Hz, 40%) | X | 20.00 | 76.00 | 9.00 | 3.98 | 95 | ±2.6% | ±9.6% |
| | | Y | 20.00 | 76.00 | 9.00 | | 95 | | |
| | | Z | 28.00 | 80.00 | 11.00 | | 95 | | |
| 10355-AAA | Pulse Waveform (200Hz, 60%) | X | 0.27 | 60.00 | 3.26 | 2.22 | 120 | ±2.1% | ±9.6% |
| | | Y | 0.29 | 60.00 | 3.34 | | 120 | | |
| | | Z | 0.36 | 60.00 | 4.18 | | 120 | | |
| 10387-AAA | QPSK Waveform, 1 MHz | X | 0.74 | 60.70 | 8.20 | 1.00 | 150 | ±4.1% | ±9.6% |
| | | Y | 0.62 | 60.53 | 8.07 | | 150 | | |
| | | Z | 0.82 | 60.79 | 8.01 | | 150 | | |
| 10388-AAA | QPSK Waveform, 10 MHz | X | 1.36 | 62.01 | 10.29 | 0.00 | 150 | ±1.3% | ±9.6% |
| | | Y | 1.27 | 62.09 | 10.17 | | 150 | | |
| | | Z | 1.41 | 61.83 | 9.77 | | 150 | | |
| 10396-AAA | 64-QAM Waveform, 100 kHz | X | 1.81 | 63.08 | 14.22 | 3.01 | 150 | ±0.9% | ±9.6% |
| | | Y | 1.78 | 63.15 | 14.36 | | 150 | | |
| | | Z | 1.82 | 62.01 | 12.96 | | 150 | | |
| 10414-AAA | WLAN CCDF, 64-QAM, 40MHz | X | 3.92 | 64.10 | 13.49 | 0.00 | 150 | ±4.7% | ±9.6% |
| | | Y | 3.76 | 64.29 | 13.50 | | 150 | | |
| | | Z | 3.80 | 63.26 | 12.65 | | 150 | | |

**Note: For details on UID parameters see Appendix**

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor *k*=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X, Y, Z do not affect the E$^2$-field uncertainty inside TSL (see Page 5).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7548

## Sensor Model Parameters

| | C1 fF | C2 fF | α $V^{-1}$ | T1 $ms.V^{-2}$ | T2 $ms.V^{-1}$ | T3 ms | T4 $V^{-2}$ | T5 $V^{-1}$ | T6 |
|---|---|---|---|---|---|---|---|---|---|
| X | 16.35 | 105.87 | 33.96 | 3.59 | 0.00 | 4.90 | 0.39 | 0.00 | 1.02 |
| Y | 12.67 | 80.99 | 33.29 | 3.87 | 0.00 | 4.90 | 0.26 | 0.00 | 1.02 |
| Z | 16.13 | 103.15 | 32.73 | 6.23 | 0.00 | 4.90 | 0.46 | 0.00 | 1.02 |

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 6.7 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disable |
| Probe Overall Length | 337mm |
| Probe Body Diameter | 10mm |
| Tip Length | 9mm |
| Tip Diameter | 2.5mm |
| Probe Tip to Sensor X Calibration Point | 1mm |
| Probe Tip to Sensor Y Calibration Point | 1mm |
| Probe Tip to Sensor Z Calibration Point | 1mm |
| Recommended Measurement Distance from Surface | 1.4mm |

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN:7548

## Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz][C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha[G] | Depth[G] (mm) | Unct. ($k$=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 41.9 | 0.89 | 10.73 | 10.73 | 10.73 | 0.10 | 1.45 | ±12.7% |
| 900 | 41.5 | 0.97 | 10.24 | 10.24 | 10.24 | 0.12 | 1.35 | ±12.7% |
| 1450 | 40.5 | 1.20 | 8.93 | 8.93 | 8.93 | 0.18 | 1.05 | ±12.7% |
| 1750 | 40.1 | 1.37 | 8.66 | 8.66 | 8.66 | 0.21 | 1.01 | ±12.7% |
| 1900 | 40.0 | 1.40 | 8.32 | 8.32 | 8.32 | 0.21 | 1.05 | ±12.7% |
| 2100 | 39.8 | 1.49 | 8.37 | 8.37 | 8.37 | 0.17 | 1.18 | ±12.7% |
| 2300 | 39.5 | 1.67 | 8.07 | 8.07 | 8.07 | 0.47 | 0.70 | ±12.7% |
| 2450 | 39.2 | 1.80 | 7.77 | 7.77 | 7.77 | 0.47 | 0.76 | ±12.7% |
| 2600 | 39.0 | 1.96 | 7.60 | 7.60 | 7.60 | 0.51 | 0.71 | ±12.7% |
| 3300 | 38.2 | 2.71 | 7.15 | 7.15 | 7.15 | 0.42 | 0.95 | ±13.9% |
| 3500 | 37.9 | 2.91 | 6.95 | 6.95 | 6.95 | 0.35 | 1.15 | ±13.9% |
| 3700 | 37.7 | 3.12 | 6.65 | 6.65 | 6.65 | 0.35 | 1.30 | ±13.9% |
| 3900 | 37.5 | 3.32 | 6.71 | 6.71 | 6.71 | 0.40 | 1.25 | ±13.9% |
| 4100 | 37.2 | 3.53 | 6.68 | 6.68 | 6.68 | 0.35 | 1.26 | ±13.9% |
| 4200 | 37.1 | 3.63 | 6.58 | 6.58 | 6.58 | 0.35 | 1.35 | ±13.9% |
| 4400 | 36.9 | 3.84 | 6.48 | 6.48 | 6.48 | 0.35 | 1.35 | ±13.9% |
| 4600 | 36.7 | 4.04 | 6.40 | 6.40 | 6.40 | 0.50 | 1.15 | ±13.9% |
| 4800 | 36.4 | 4.25 | 6.35 | 6.35 | 6.35 | 0.50 | 1.15 | ±13.9% |
| 4950 | 36.3 | 4.40 | 6.10 | 6.10 | 6.10 | 0.50 | 1.18 | ±13.9% |
| 5250 | 35.9 | 4.71 | 5.51 | 5.51 | 5.51 | 0.55 | 1.22 | ±13.9% |
| 5600 | 35.5 | 5.07 | 4.92 | 4.92 | 4.92 | 0.50 | 1.30 | ±13.9% |
| 5750 | 35.4 | 5.22 | 5.05 | 5.05 | 5.05 | 0.50 | 1.30 | ±13.9% |

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency up to 6 GHz, the validity of tissue parameters ($\varepsilon$ and $\sigma$) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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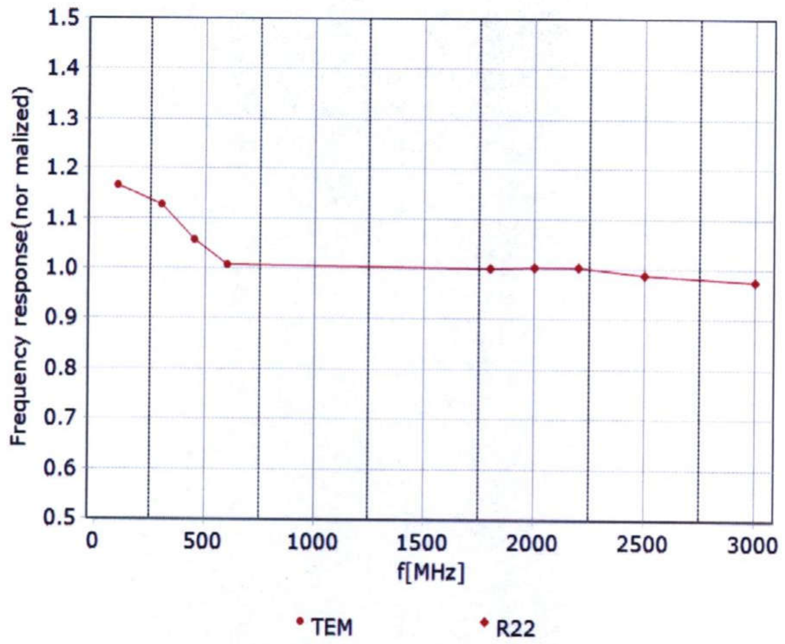
# Frequency Response of E-Field
## (TEM-Cell: ifi110 EXX, Waveguide: R22)




**Uncertainty of Frequency Response of E-field: ±7.4% (*k*=2)**

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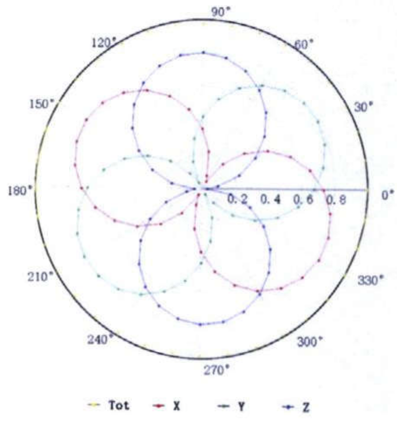
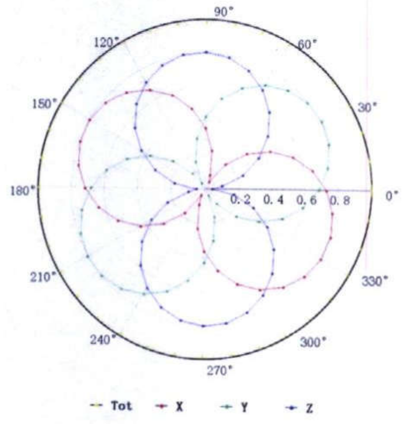
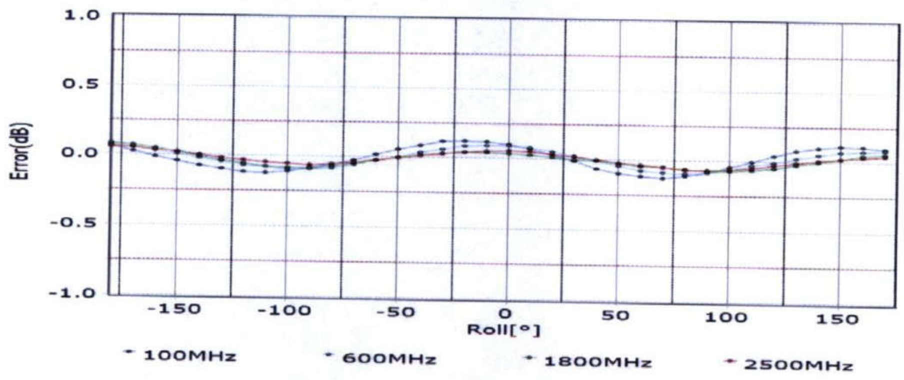
# Receiving Pattern (Φ), θ=0°

## f=600 MHz, TEM




## f=1800 MHz, R22




Uncertainty of Axial Isotropy Assessment: ±1.2% ($k$=2)



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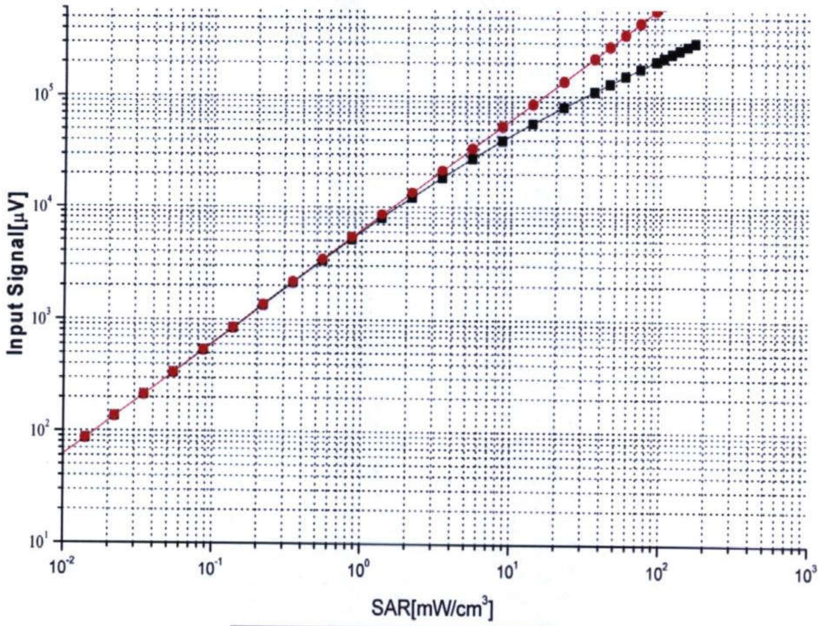
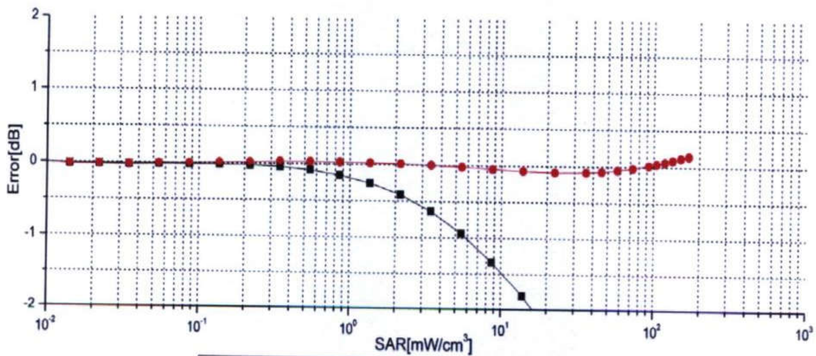
## Dynamic Range f($SAR_{head}$)
## (TEM cell, f = 900 MHz)




**Uncertainty of Linearity Assessment: ±0.9% (*k*=2)**

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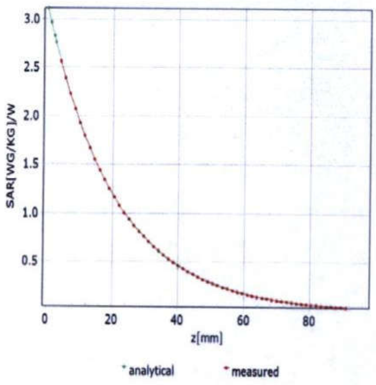
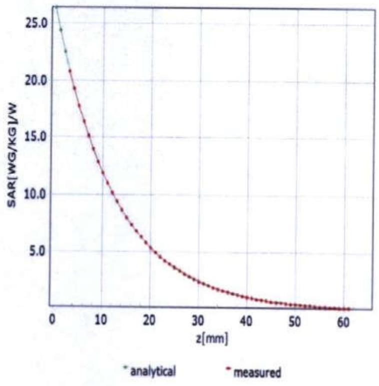
## Conversion Factor Assessment

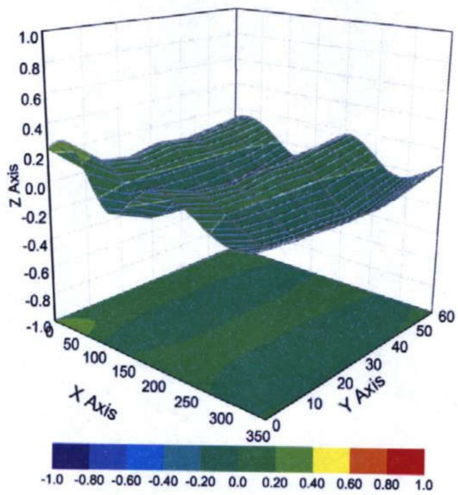
**f=750 MHz,WGLS R9(H_convF)**




**f=1750 MHz,WGLS R22(H_convF)**




## Deviation from Isotropy in Liquid




**Uncertainty of Spherical Isotropy Assessment: ±3.2% (*k*=2)**

