FCC WiFi/BT TAS validation Report

FCC ID	**:**	**B94-MT7925B22ME**
Equipment	**:**	**2TX 11be(WiFi7) BW160+BT/BLE Combo Card**
Brand Name	**:**	**MediaTek**
Model Name	**:**	**MT7925B22M**
Applicant	**:**	**HP Inc. 3390 East Hormony Road, Fort Collins Colorado, USA 80528**
Standard	**:**	**FCC 47 CFR Part 2 (2.1093)**

The product was received on Nov. 06, 2024 and testing was started from Jan. 10, 2025 and completed on Jan. 15, 2025. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures and has been pass the FCC requirement.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Laboratory, the test report shall not be reproduced except in full.

Approved by: Cona Huang / Deputy Manager

SPORTON INTERNATIONAL INC. Wensan Laboratory
No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FA4N0665B	01	Initial issue of report	Jan. 16, 2025

1. Overview

Mediatek developed the Wi-Fi/BT TA-SAR/TA-PD Test Proposal v1.3.1.2 to control instantaneous Tx power for transmit frequency.
FCC regulation allows time-averaged RF exposure to demonstrate compliance to safety limits. Because RF exposure is correlated to transmission power (TX power), the TX power can be controlled to meet FCC RF exposure limits defined as the specific absorption rate (SAR) limit for transmit frequencies < 6GHz and power density (PD) limit for transmit frequencies > 6 GHz. 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 regulation. For PD limit, the proposed Time-Averaged Power Density (TA-PD) algorithm controls TX power to ensure that at all times the time-averaged RF exposure is compliant with the FCC PD requirement. For Wi-Fi 6GHz band, the proposed TA-SAR algorithm and the proposed TA-PD algorithm ensure that at all times the time-averaged RF exposure is compliant with the FCC SAR requirement, PD requirement, and total exposure ratio (TER) limit. In the FCC regulation, the averaging window of SAR is 100 seconds for transmit frequencies less than 3 GHz and 60 seconds for transmit frequencies between 3GHz and 6GHz. As a result, for Wi-Fi and BT 2.4GHz band, the time window is 100 seconds and for Wi-Fi 5/6GHz band, the time window is 60 seconds. For Wi-Fi 6GHz band, the averaging window of PD is 30 seconds

This document proposes the test plan, test procedures, and measurement setup for the validation of the proposed

- Wi-Fi TA-SAR (time-averaged specific absorption rate) and TA-PD (time-averaged absorbed power density) algorithm,
- BT TA-SAR algorithm.

The operations of Wi-Fi TA-SAR/TA-PD and BT TA-SAR algorithms are independent. Each of these algorithms operates under a fixed budget of TER from the very beginning to guarantee compliance. The measurement results are also provided to show that the requirements defined by FCC can be all met. The scope of the test proposal is for Wi-Fi TA-SAR/TA-PD and BT TAR-SAR only, while the cellular TA-SAR/TA-PD is not within the scope of this test proposal. The cellular TA-SAR/TA-PD algorithms may require different test scenarios, test procedures, etc. for validation. For the validation of our WiFi/BT TA-SAR/TA-PD algorithms, OEMs should follow the test scenarios, test procedures, etc. in this inquiry document.

OEMs using our Wi-Fi/BT chipsets and third-party cellular chipsets can use proper fixed TER budgeting scheme for the simultaneous cellular TA-SAR/TA-PD operation and our Wi-Fi/BT TA-SAR/TA-PD operation. One example of this fixed TER budgeting scheme is shown below. Please note that the third-party cellular TA-SAR/TA-PD operation is out of our control. It is up to OEMs to decide how to operate cellular TA-SAR/TAPD and Wi-Fi/BT TA-SAR/TA-PD simultaneously

A proper fixed TER budgeting scheme can be as follows,

- cellular TA-SAR/TA-PD is allocated a TER budget of 0.5,
- Wi-Fi TA-SAR/TA-PD is allocated a TER budget of 0.4, and
- BT TA-SAR is allocated a TER budget of 0.1

The above TER budgeting scheme is fixed at the very beginning, does not change over time, and the sum of these TER budget values is less than or equal to 1. Due to this fixed TER budgeting, at any time instant, cellular TA-SAR/TA-PD algorithm under its own dynamic power control for a given set of algorithm parameters should maintain its TER to be less than 0.5, Wi-Fi TA-SAR/TA-PD algorithm under its own dynamic power control for a given set of algorithm parameters should maintain its TER to be less than 0.4, and BT TA-SAR algorithm under its own dynamic power control for a given set of algorithm parameters should maintain its TER to be less than 0.1. Therefore, at any time instant, the overall TER is less than 1. In summary, the fixed TER budgeting scheme allows that

- cellular, WiFi, BT radios can be active at the same time,
- each radio runs its own power control algorithm independently from the other control algorithms,
- all control algorithms need not be in sync, and
- overall TER meets regulatory compliance

Please note that the above fixed TER budgeting scheme is conservative and not optimal. For example, even if the cellular radio is not active, it is still allocated a TER budget of 0.5. To take full advantage of time averaging dynamic power control for all radios, a joint and dynamic TER budgeting scheme such that the TER budgets for cellular TA-SAR/TA-PD, Wi-Fi TA-SAR/TA-PD, BT TA-SAR can be determined jointly and dynamically may be much better, however such a joint and dynamic TER budgeting scheme does require that all Tx power controls need to be in sync. This joint and dynamic TER budgeting scheme is much more complicated than fixed TER budgeting scheme and is not within the scope of our inquiry document. Joint TA-SAR/TA-PD algorithms for all radios will be our next version TA-SAR/TA-PD algorithms

Mediatek's Wi-Fi/BT TA-SAR/TA-PD algorithms were implemented in Matlab for validation by simulation, they were also implemented in firmware in a phone and a notebook for validation by conducted power measurements and SAR/PD measurements. Mediatek's customers cannot change the algorithms. However, they are allowed to set the values of certain parameters according to the need for their products. This is necessary because the characteristics of the customers' products can be quite different, for example, a specific frame chosen by a customer for a cell phone, a specific antenna module chosen by a customer for a notebook, etc. Mediatek's Wi-Fi/BT TA-SAR/TA-PD algorithms will function with the parameters set by our customers and guarantee RF regulatory compliance

2. Wi-Fi and BT TA-SAR/TA-PD Algorithm Concept

Mediatek developed the TA-SAR and TA-PD algorithms to control instantaneous TX power for transmit frequencies less and larger than 6GHz respectively, so that the total time-averaged RF exposures (i.e., SAR, PD, and SAR+PD exposure) are less than FCC requirement.

2.1 Algorithm Description

The proposed TA-SAR and TA-PD algorithms use TX power control to accomplish RF exposure compliance for Wi-Fi and BT system. The basic concept of both algorithms is the same, if time-averaged TX power approaches a predefined TX power limit which is mapped from SAR or PD limit, the instantaneous TX power will be constrained to ensure that the time-averaged TX power is less than the predefined TX limit at all times. The parameters of the Wi-Fi TA-SAR algorithm are listed in Table 2-1. The parameters of the Wi-Fi TAPD algorithm are listed in Table 2-2. The parameters of the BT TA-SAR algorithm are listed in Table 2-3

- The current time-averaged TX power is guaranteed to be lower than the predefined TX power limit PSAR_limit or PPD_limit, which is mapped from SAR or PD limit. As in traditional SAR testing, we measure the power PSAR_limit (mW) and its corresponding maximum 1g or 10g peak spatial-averaged SAR (SAR_REG_limit), similarly, PPD_limit (mW) and its corresponding maximum 4cm2 averaged PD (PD_REG_limit). For example, PSAR_limit = 70.79mW = 18.5dBm maps to SAR_REG_limit = 1.6W/kg. If device total uncertainty is considered for more conservative assessment, WF_SAR_design_limit (or BT_SAR_design_limit) which is SAR_REG_limit minus the device total uncertainties is used for TX power mapping, similarly, WF_PD_design_limit which is PD_REG_limit minus the device total uncertainties is used for TX power mapping. The TX power limit PWF_SAR_limit (or PBT_SAR_limit is the power mapped from WF_SAR_design_limit (or BT_SAR_design_limit), similarly, the TX power limit PWF_PD_limit is the power mapped from WF_PD_design_limit. For example, if the device total uncertainty is 0.5dB, PWF_SAR_limit = 63.09mW = 18dBm maps to WF_SAR_design_limit = 1.43W/kg.
- If the predicted time-averaged TX power tends to be larger than PSAR_limit or P_{PD_limit}, TA-SAR/TA-PD algorithm enables TX constraint to limit instantaneous TX power. The constraint power is dynamically adjusted based on predicted power and duty of the next time period
- At any time period, TA-SAR algorithm satisfies the following equation:

$$\frac{1}{T_{SAR}}\int_{t-T_{SAR}}^{t} inst\_TX\_power(\tau)d\tau \le P_{SAR\_limit}$$

Where inst_TX_power(τ) denotes the instantaneous TX power at time τ and T_{SAR} is the time averaging window defined by FCC for assessing time-averaged SAR.P_{SAR_limit} is the predefined TX power limit which is mapped from SAR exposure limit.

- At any time period, TA-PD algorithm satisfies the following equation:

$$\frac{1}{T_{PD}}\int_{t-T_{PD}}^{t} inst\_TX\_power(\tau)d\tau \le P_{PD\_limit}$$

where inst_TX_power(τ) denotes the instantaneous TX power at time τ and T_{PD} is the time averaging window defined by FCC for assessing time-averaged PD. P_{PD_limit}, is the predefined TX power limit which is mapped from PD exposure limit

To meet total exposure ratio (TER) requirement when 2.4G/5GHz band and 6GHz band or more bands are in simultaneous transmissions, TA-SAR and TA-PD algorithms satisfy the following:

The normalized TA-SAR of each 2.4GHz, 5GHz or 6GHz band is calculated by the following equation,

$$SAR_{n,normalized} = \frac{SAR_{n,avg}}{SAR_{n,limit}} = \frac{\frac{1}{T_{SAR_n}}\int_{t-T_{SAR_n}}^{t} SAR_n(\tau)d\tau}{SAR\_REG\_limit_n}$$

and the normalized TA-PD of each 6GHz band is calculated by the following equation

$$PD_{m,normalized} = \frac{PD_{m,avg}}{PD_{m,limit}} = \frac{\frac{1}{T_{PD_m}}\int_{t-T_{PD_m}}^{t} PD_m(\tau)d\tau}{PD\_REG\_limit_m}$$

where $SAR_{n,limit}$ is the SAR regulatory limit $SAR\_REG\_limit_n$ that is applicable to the n-th transmitter/test frequency and $PD_{m,limit}$ is the PD regulatory limit $PD\_REG\_limit_m$ that is applicable to the m-th transmitter/test frequency.

In particular, for Wi-Fi SAR

$$\frac{1}{T_{SAR}}\int_{t-T_{SAR}}^{t} SAR(\tau)d\tau = \frac{\frac{1}{T_{SAR}}\int_{t-T_{SAR}}^{t} inst\_SAR\_TX\_power(\tau)d\tau}{P_{WF\_SAR\_limit}} \times WF\_SAR\_design\_limit$$

for Wi-Fi PD,

$$\frac{1}{T_{PD}}\int_{t-T_{PD}}^{t} PD(\tau)d\tau = \frac{\frac{1}{T_{PD}}\int_{t-T_{PD}}^{t} inst\_PD\_TX\_power(\tau)d\tau}{P_{WF\_PD\_limit}} \times WF\_PD\_design\_limit$$

and for BT SAR

$$\frac{1}{T_{SAR}}\int_{t-T_{SAR}}^{t} SAR(\tau)d\tau = \frac{\frac{1}{T_{SAR}}\int_{t-T_{SAR}}^{t} inst\_SAR\_TX\_power(\tau)d\tau}{P_{BT\_SAR\_limit}} \times BT\_SAR\_design\_limit$$

Where inst_SAR_Tx_power(τ) and inst_PD_Tx_power(τ)denote the instantaneous TX power at time τ for SAR and PD respectively. T_{SAR} and T_{PD} are the time averaging windows defined by FCC for assessing time averaged SAR and PD. The meanings of PWF_SAR_limit, WF_SAR_design_limit, and SAR_REG_limit are described in Table 2-1, the meanings of $P_{WF\_PD\_limit}$, WF_PD_design_limit, and PD_REG_limit are described in Table 2-2, and the meanings of $P_{BT\_SAR\_limit}$, BT_SAR_design_limit, and SAR_REG_limit are described in Table 2-3.

Since Wi-Fi 6GHz band needs to obey both SAR and PD exposure limits, the maximum of normalized TA-SAR and normalized TA-PD in 6GHz band should be used in TER calculation. For simultaneous transmission, the sum of the normalized TA-SAR values in 2.4GHz and 5GHz bands together with the sum of the values of the maximum of normalized TA-SAR and normalized TA-PD in 6GHz band should meet TER requirement, as shown below.

$$TER = \sum_{n=1}^{M}\frac{SAR_{n,avg}}{SAR_{n,limit}}\ (2GHz/5GHz) + \sum_{m=M+1}^{N}\max\left[\frac{SAR_{m,avg}}{SAR_{m,limit}}, \frac{PD_{m,avg}}{PD_{m,limit}}\right](6GHz) \le 1$$

2.2 Operating Parameters for Algorithm Validation

Table 2-1 WiFi TA-SAR algorithm parameters

Algorithm parameters	Description
P_WF_SAR_limit ($P_{WF\_SAR\_limit}$)	The time-averaged maximum power level limit corresponding to WF_SAR_design_limit. • For FCC, SAR_REG_limit: 1.6 W/kg (1g-SAR), 4 W/kg (10g-SAR). • WF_SAR_design_limit is SAR_REG_limit with device total uncertainty for more conservative assessment. • P_WF_SAR_limit has the unique value for each Wi-Fi band/antenna/exposure condition index
P_WF_SAR_MAX_limit ($P_{WF\_SAR\_MAX\_limit}$)	Wi-Fi TA-SAR maximum instantaneous TX power limit, which is less than or equal to maximum TX power P_WF_SAR_MAX that can be possibly transmitted in Wi-Fi. The power limit is dynamically adjusted based on Wi-Fi TA-SAR algorithm

Table 2-2 WiFi TA-PD algorithm parameters

Algorithm parameters	Description
P_WF_PD_limit ($P_{WF\_PD\_limit}$)	The time-averaged maximum power level limit corresponding to WF_PD_design_limit. • For FCC, PD_REG_limit: 10 W/m2 (4cm2 PD) • WF_PD_design_limit is PD_REG_limit with device total uncertainty for more conservative assessment. • P_WF_PD_limit has the unique value for each Wi-Fi band/antenna/exposure condition index
P_WF_PD_MAX_limit ($P_{WF\_PD\_MAX\_limit}$)	Wi-Fi TA-PD maximum instantaneous PD TX power limit, which is less than or equal to maximum TX power P_WF_PD_MAX that can be possibly transmitted in Wi-Fi. The power limit is dynamically adjusted based on Wi-Fi TA-PD algorithm.

Table 2-3 BT TA-SAR algorithm parameters

Algorithm parameters	Description
P_BT_SAR_limit ($P_{BT\_SAR\_limit}$)	The time-averaged maximum power level limit corresponding to BT_SAR_design_limit. • For FCC, SAR_REG_limit: 1.6 W/kg (1g-SAR), 4 W/kg (10g-SAR). • BT_SAR_design_limit is SAR_REG_limit with device total uncertainty for more conservative assessment. • P_BT_SAR_limit has the unique value for each BT antenna/exposure condition index
P_BT_SAR_MAX_limit ($P_{BT\_SAR\_MAX\_limit}$)	BT TA-SAR maximum instantaneous TX power limit, which is less than or equal to maximum TX power P_BT_SAR_MAX that can be possibly transmitted in BT. The power limit is dynamically adjusted based on BT TA-SAR algorithm

3. Overview of Wi-Fi and BT TA-SAR/TA-PD Test Proposal

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 TX mode change between normal mode and sleep mode to verify algorithm and SAR compliance.
- **Scenario 2:** Test band handover to ensure algorithm control continuity and correctness.
- **Scenario 3:** Test different transmission antennas to ensure algorithm control works correctly during antenna switch from one antenna to another.
- **Scenario 4:** Test different ECI (Exposure Condition Index) to ensure algorithm control behaves as expected during ECI switch from one ECI to another. (ex., head→ body worn)
- **Scenario 5:** Test TER under 2.4GHz band and 6GHz band simultaneous transmission. Since both SAR and PD are required in Wi-Fi 6GHz band, the maximum of normalized TA-SAR and normalized TA-PD in 6GHz band should be used in TER calculation. The proposed algorithm can ensure TA-SAR/TA-PD control correctness and prove the normalized total RF exposure is less than or equal to 1 (FCC requirement)

Table 3-1 shows the test scenario list for Wi-Fi TA-SAR/TA-PD validation. For Wi-Fi TA-SAR 2.4GHz and 5GHz bands validation, scenarios 1 to 4 are proposed to demonstrate FCC compliance. For Wi-Fi 7 MLO SAR and PD switch, scenario 5 is proposed. For Wi-Fi TA-PD 6GHz band validation, scenario 1 is proposed

Table 3-1 Test scenario list for Wi-Fi TA-SAR/TA-PD validation

Test Scenario		Description	WiFi TA-SAR 2.4G/5GHz	WiFi TA-SAR 6GHz	WiFi TA-PD 6GHz
1	TX mode change between normal mode and sleep mode	Test normal mode and sleep mode switch	v	v	v
2	Band handover	Test 2.4G/5GHz band change	v	NA	NA
3	Antenna switching	Change antenna index	v	NA	NA
4	ECI (Exposure condition index change)	Test under ECI transition (e.g., hand to body worn)	v	NA	NA
5	Simultaneous SAR and PD	TER 2.4GHz TA-SAR and 6GHz TA-SAR/TA-PD	NA	NA	v

Table 3-2 shows the test scenario list for BT TA-SAR validation. For BT TA-SAR 2.4GHz band validation, scenario 1 is proposed to demonstrate FCC compliance

Table 3-2 Test scenario list for BT TA-SAR validation

Test Scenario		Description	BT TA-SAR 2.4GHz
1	BT Tx with varying duty	BT Tx transmit maximum power with varying duty	NA

The applicable operational conditions depend on the hardware and software capabilities of Mediatek's chips that have Wi-Fi/BT TA-SAR/TA-PD features. For the chip that will be used by Mediatek's customers, there are two(2) antennas. For ease of discussion, a definition of operational bands is as follows,

- G-Band: 2.4GHz band
- A-Band: one of the 5GHz band or 6GHz Band

The maximum supported features are dual band dual concurrent (DBDC) G-band + A-band, in which case, there can be two spatial streams in G-band (out of two antennas) and A-band (out of two antennas) simultaneously

Since RF regulatory compliance is related to RF radiation and exposure, it is important to list all the available operational (radiation) conditions out of the two(2) antennas in the chip in order to examine if the proposed five(5) test scenarios are sufficient to cover all the applicable operational conditions. The table below summarizes all the applicable operational conditions, where representative antenna states are shown. For example, in G-band SISO, the table shows that Ant0 is active in G-band and Ant1 is off, while it can also be true that Ant0 is off and Ant1 is active in G-band. The last column of the table shows which proposed test scenarios can cover the corresponding operational condition

Operational conditions	Ant0	Ant1	Proposed test scenarios
G-band SISO [1]	G-band	off	(1,3,4)
G-band MIMO [2]	G-band	G-band	(1,4)
A-band SISO	A-band	off	(1,3,4)
A-band MIMO	A-band	A-band	(1,4)
G-band SISO + A-band MIMO	G+A Band	A-band	(1,2,3,4,5)
G-band MIMO + A-band SISO	G+A Band	G-band	(1,2,3,4,5)
G-band MIMO + A-band MIMO	G+A Band	G+A Band	(1,2,3,4,5)

[1] SISO: single-input single-output
[2] MIMO: multiple-input multiple-output

For each applicable operation condition, the algorithm parameters, such as PSItime averaging window size, etc., can be adjusted accordingly to guarantee RF regulatory compliance. Therefore, all the applicable operation conditions are considered in algorithm design and proposed test scenarios

4. Wi-Fi TA-SAR Test Scenarios and Test Procedures

In order to demonstrate that Wi-Fi TA-SAR algorithm performs as expected under various operating scenarios, Table 4-1 lists the test scenarios and test sequences to validate TA-SAR algorithm. The test sequences are defined in section 4.1. The details of each test procedures via conducted power and SAR measurements are described in sections 4.2~4.6 and section 4.7, respectively

Table 4-1 Test scenario and test sequence list for Wi-Fi TA-SAR validation

Test Scenario		Test Sequence	Description	Device Requirement
1	TX mode change between normal mode and sleep mode	Defined in section 4.1	Test normal mode and sleep mode switch	
2	Band handover	Defined in section 4.1	Test 2.4G/5GHz band change	Supports DBDC
3	Antenna switching	Defined in section 4.1	Change antenna index	
4	ECI (Exposure condition index change)	Defined in section 4.1	Test under ECI transition (e.g., hand to body worn)	
5	Simultaneous SAR and PD	Defined in section 4.1	TER 2.4GHz TA-SAR and 6GHz TA-SAR/TA-PD	Supports WiFI DBDC or MLO

4.1 Test Sequences for All Scenarios

The test sequence is predefined for TA-SAR:

- Test sequence: Wi-Fi is requested to transmit static and maximum power with high duty

4.2 Test Configuration and Procedure for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode via Conducted Power Measurements

4.2.1 Configuration

The scenario tests Wi-Fi TX mode switching from normal throughput mode to sleep mode. Since Mediatek's TA-SAR feature operation is independent of bands and channels, selecting one band is sufficient to validate this feature. The criteria for band selection are based on the P_WF_SAR_limit values (corresponding to WF_SAR_design_limit) and are described as below

Select one band/channel with least P_WF_SAR_limit among all supported bands and the P_WF_SAR_limit value is below P_WF_SAR_MAX.

- Only one band/channel needs to be tested if all the bands have the same P_WF_SAR_limit.
- Only one band/channel needs to be tested if only one band has P_WF_SAR_limit below P_WF_SAR_MAX.
- If the same least P_WF_SAR_limit applies to multiple bands, select the band with the highest
- measured 1gSAR at P_WF_SAR_limit.
- If P_WF_SAR_limit values of all bands are over P_WF_SAR_MAX, there is no need to test these bands.

4.2.2 Procedure

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

Steps 1~4: Measure and record TX power versus time for test scenario 1

- Step 1: Start $P_{WF\_SAR\_limit}$ calibration mode and measure $P_{WF\_SAR\_limit}$ for the selected band.
- Step 2: Establish radio link with AP in the selected band and enable TA-SAR.
- Step 3: Configure pre-defined TX power sequence to DUT and measure TX power versus time.
- Step 4: Wi-Fi TX switches modes

Initial Wi-Fi normal mode: Configure pre-defined TX power sequence to DUT for selected band and then DUT transmits packets after 400s
Switch to Wi-Fi sleep mode: Wi-Fi switches to sleep mode about 10s and no packets are transmitted.
Wi-Fi wakes up to normal mode: Wi-Fi wakes up from sleep mode and DUT re-transmits packets for at least the specified time duration

- 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 10g SAR to determine time-averaged value versus time as follows

Instantaneous 1gSAR or 10gSAR versus time: SAR(τ)

$$SAR(\tau) = \frac{conducted\_inst\_SAR\_TX\_power(\tau)}{P_{WF\_SAR\_limit}} \times WF\_SAR\_design\_limit$$

Where $P_{WF\_SAR\_limit}$ is measured from step 1 and WF_SAR_design_limit is measured worst case SAR value at $P_{WF\_SAR\_limit}$

Time average SAR versus time: Time_avg_SAR(t)

$$Time\_avg\_SAR(t) = \frac{1}{T_{SAR}} \int_{t-T_{SAR}}^{t} SAR(\tau)d\tau$$

- Step 6: Plot results

a. Make one power perspective plot containing
   1. Instantaneous TX power
   2. Requested power (test sequence)
   3. Calculated time-averaged power
   4. Calculated time-averaged power limits

4.3 Test Configuration and Procedure for Scenario 2: Band Handover via Conducted Power Measurements

4.3.1 Configuration

The scenario tests Wi-Fi 2.4GHz and 5GHz band handover and DBDC mode. The test configuration switches from Wi-Fi 2.4GHz band to Wi-Fi 5GHz band and then switches to 2.4GHz/5GHz DBDC mode.

- For Wi-Fi 2.4GHz band, select the channel with least P_WF_SAR_limit value and below P_WF_SAR_MAX. If the same least P_WF_SAR_limit applies to multiple bands, select the channel with the highest measured 1gSAR at P_WF_SAR_limit.
- For Wi-Fi 5GHz band, select the channel with least P_WF_SAR_limit value and below P_WF_SAR_MAX. If the same least P_WF_SAR_limit applies to multiple bands, select the channel with the highest measured 1gSAR at P_WF_SAR_limit

4.3.2 Procedure

TX power is measured, recorded, and processed by the following steps:
Steps 1~4: Measure and record TX power versus time for test scenario 2.

- Step 1: Start $P_{WF\_SAR\_limit}$ calibration mode and measure $P_{WF\_SAR\_limit}$ for both the selected bands/channels. (2.4GHz and 5GHz)
- Step 2: Establish radio link with AP in the selected band and enable TA-SAR.
- Step 3: Configure pre-defined TX power sequence to DUT and measure TX power versus time
- Step 4: Wi-Fi TX switches bands.
  Initial 2.4GHz band connection: Configure pre-defined TX power sequence to DUT for 2.4GHz band and then DUT transmits packets for 400s.
  Band switch to 5GHz band connection: Wi-Fi switches to the 5GHz band for 400s.
  Dual band mode (DBDC) connection: Wi-Fi connects to 2.4GHz and 5GHz bands simultaneously for 400s

- 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 10g SAR to determine time-averaged value versus time as follows

Instantaneous 1gSAR or 10gSAR versus time: SAR_1(τ) (band1), SAR_2(τ) (band2)

$$SAR\_1(\tau) = \frac{conducted\_inst\_SAR\_TX\_power\_1(\tau)}{P_{WF\_SAR\_limit\_1}} \times WF\_SAR\_design\_limit\_1$$

$$SAR\_2(\tau) = \frac{conducted\_inst\_SAR\_TX\_power\_2(\tau)}{P_{WF\_SAR\_limit\_2}} \times WF\_SAR\_design\_limit\_2$$

Where $P_{WF\_SAR\_limit\_1}$ and $P_{WF\_SAR\_limit\_2}$ are measure from step 1,
WF_SAR_design_limit_1 and WF_SAR_design_limit_2 are measure worst case SAR values at $P_{WF\_SAR\_limit\_1}$ and $P_{WF\_SAR\_limit\_2}$, respectively

Time average SAR versus time: Time_avg_SAR(t)

$$Time\_avg\_SAR(t) = \frac{1}{T_{SAR}}\left[\frac{\int_{t-T_{SAR}}^{t} SAR\_1(\tau)d\tau}{WF\_SAR\_REG\_limit\_1} + \frac{\int_{t-T_{SAR}}^{t} SAR\_2(\tau)d\tau}{WF\_SAR\_REG\_limit\_2}\right]$$

- 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 normalized time-averaged Total Exposure Ratio (TER)
  2. Calculated maximum of normalized time-averaged RF Exposure

4.4 Test Test Configuration and Procedure for Scenario 3: Antenna Switching via Conducted Power Measurements

4.4.1 Configuration

Wi-Fi first selects an antenna to transmit packets then switches to another antenna within the same band. Note that $P_{WF\_SAR\_limit}$ may have a unique value for each Wi-Fi “band/antenna/exposure condition index” and time averaging window size also depends on frequencies. For any band supporting multiple TX antennas, select the one with the highest difference in PWF_SAR_limit among all supported antennas.

- Select the band having the highest measured 1gSAR at P_WF_SAR_limit if multiple bands have the same P_WF_SAR_limit among supported antennas.
- Antenna selection order
  a. Select the configuration with two antennas having P_WF_SAR_limit values less than P_WF_SAR_MAX.
  b. If the previous configuration does not exist, select the configuration with one antenna having P_WF_SAR_limit value less than P_WF_SAR_MAX.
  c. If the above two cannot be found, select one configuration with the two antennas having the least difference between their P_WF_SAR_limit and P_WF_SAR_MAX

4.4.2 Procedure

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

Steps 1~4: Measure and record TX power versus time for test scenario 3

- Step 1: Start $P_{WF\_SAR\_limit}$ calibration mode and measure $P_{WF\_SAR\_limit}$ for both the selected antennas.
- Step 2: Establish radio link with AP in the selected band and enable TA-SAR.
- Step 3: Configure pre-defined TX power sequence to DUT and measure TX power versus time.
- Step 4: Wi-Fi TX switches antennas

Connect to one selected antenna: Configure pre-defined TX power sequence to DUT for selected band and selected antenna and then DUT transmits packets for 400s.
Switch to another antenna: Wi-Fi TX switches to another selected antenna and DUT transmits packets for 400s

- Step 5: Convert the measured conducted TX power into SAR based on the formulas for scenario 1

- 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 normalized time-averaged Total Exposure Ratio (TER)
   2. Calculated maximum of normalized time-averaged RF Exposure

It is noted that the following operations are done as well for this scenario:
- The correct power control is realized by TA-SAR algorithm when antenna switches from one to another.
- The validation criteria are, at all times, the time-averaged 1gSAR or 10gSAR versus time shall not exceed FCC limit of 1.6 W/kg for 1gSAR or 4.0 W/kg for 10gSAR

4.5 Test Configuration and Procedure for Scenario 4: Exposure Condition Index (ECI) Change via Conducted Power Measurements

4.5.1 Configuration

The scenario tests the time-averaged TX power is less than the predefined TX limit at all times when exposure condition index changes which means P_WF_SAR_limit changes in the test. This scenario selects any one band having two different P_WF_SAR_limit values less than P_WF_SAR_MAX in the two ECI group. One test is sufficient as the feature operation is independent of technology and band.

4.5.2 Procedure

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

Steps 1~4: Measure and record TX power versus time for test scenario 4

- Step 1: Start $P_{WF\_SAR\_limit}$ calibration mode and measure $P_{WF\_SAR\_limit}$ for both the selected band/channel.
- Step 2: Establish radio link with AP in the selected band and enable TA-SAR.
- Step 3: Configure pre-defined TX power sequence to DUT and measure TX power versus time.
- Step 4: Wi-Fi TX ECI change

Connect to selected band with initial $P_{WF\_SAR\_limit}$ in only ECI group index: Configure pre-defined TX power sequence to DUT for selected band and then DUT transmits packets for 400s.
Change $P_{WF\_SAR\_limit}$ value to another ECI group index: Set the command to change $P_{WF\_SAR\_limit}$ for 400s

- Step 5: Convert the measured conducted TX power into SAR based on the formulas for scenario 1

- 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 normalized time-averaged Total Exposure Ratio (TER)
   2. Calculated maximum of normalized time-averaged RF Exposure

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

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

4.6 Test Configuration and Procedure for Scenario 5: Simultaneous SAR and PD via Conducted Power Measurements

4.6.1 Configuration

The scenario is to test TER (total exposure ratio) under 2.4GHz band and 6GHz band simultaneous transmission. Since Wi-Fi 6GHz band needs to obey both SAR and PD exposure limits, the maximum of normalized TA-SAR and normalized TA-PD in 6GHz band should be used in TER calculation. The proposed algorithms can ensure TA-SAR/TA-PD control correctness by demonstrating that TER is less than or equal to 1 (FCC requirement).

- Select one channel of Wi-Fi 2.4GHz band with measured P_WF_SAR_limit less than P_WF_SAR_MAX and select one channel of Wi-Fi 6GHz band with measured P_WF_SAR_limit less than P_WF_SAR_MAX and with measured P_WF_PD_limit less than P_WF_PD_MAX.

4.6.2 Procedure

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

Steps 1~4: Measure and record TX power versus time for test scenario 4

- Step 1: Start P $P_{WF\_SAR\_limit}$ and $P_{WF\_PD\_limit}$ calibration mode, measure $P_{WF\_SAR\_limit}$ for the selected 2.4GHz band, and measure $P_{WF\_SAR\_limit}$ and $P_{WF\_PD\_limit}$ for the selected 6GHz band channel.
- Step 2: Establish radio link with AP in the selected band and enable TA-SAR and TA-PD
- Step 3: Configure pre-defined TX power sequence to DUT and measure TX power versus time.
- Step 4: Wi-Fi transmits packets at 2.4GHz band and 6GHz band
- Step 5: Convert the measured conducted TX power into SAR, PD and calculate TER

For TA-SAR of each 2.4GHz, 5GHz, or 6GHz band

$$SAR_{n,normalized} = \frac{SAR_{n,avg}}{SAR_{n,limit}} = \frac{\frac{1}{T_{SAR_n}}\int_{t-T_{SAR_n}}^{t} SAR_n(\tau)d\tau}{SAR\_REG\_limit_n}$$

For TA-PD of each band at 6GHz band

$$PD_{m,normalized} = \frac{PD_{m,avg}}{PD_{m,limit}} = \frac{\frac{1}{T_{APD_m}}\int_{t-T_{APD_m}}^{t} PD_m(\tau)d\tau}{PD\_REG\_limit_m}$$

Instantaneous 1gSAR or 10gSAR versus time: SAR(τ), PD(τ)

$$SAR(\tau) = \frac{conducted\_inst\_SAR\_TX\_power(\tau)}{P_{WF\_SAR\_limit}} \times WF\ SAR\ design\_limit$$

$$PD(\tau) = \frac{conducted\_inst\_PD\_TX\_power(\tau)}{P_{WF\_PD\_limit}} \times WF\_PD\_design\_limit$$

Where $P_{WF\_SAR\_limit}$ is measured from step 1 and WF_SAR_design_limit is measured worst case SAR value at $P_{WF\_SAR\_limit}$, $P_{WF\_PD\_limit}$ is measured from step 1 and WF_PD_design_limit is measured worst case PD value at $P_{WF\_PD\_limit}$.

For simultaneous transmission, the sum of the normalized TA-SAR values in 2.4GHz and 5GHz bands together with the sum of the values of the maximum of normalized TA-SAR and normalized TA-PD in 6GHz band should meet TER requirement, as shown below

$$TER = \sum_{n=1}^{M} \frac{SAR_{n,avg}}{SAR_{n,limit}} (2GHz/5GHz) + \sum_{m=M+1}^{N} \max\left[\frac{SAR_{m,avg}}{SAR_{m,limit}}, \frac{PD_{m,avg}}{PD_{m,limit}}\right] (6GHz) \leq 1$$

- 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/PD perspective plot containing
   1. Calculated normalized time-averaged 1gSAR or 10gSAR for 2.4GHz band
   2. Calculated maximum of normalized time-averaged SAR (1gSAR or 10gSAR) and normalized time-averaged PD for 6GHz band
   3. Total Exposure Ratio (TER)
   4. FCC TER limit of 1

4.7 Test Configuration and Procedure for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode via SAR Measurements

4.7.1 Configuration

The test procedures in the previous sections (sections 4.2 ~ 4.6) mainly focus on measuring conducted TX power, in this section test via SAR measurement is performed. The validation can be provided by performing one test scenario from the previous section.
In this test via SAR measurement, the test configuration of test scenario 1 in section 4.2.1 is used

4.7.2 Procedure

SAR is measured and recorded by the following steps

Steps 1~3: Measure and record TA-SAR versus time for test scenario 1

- Step 1: Start meas_SAR_ $P_{WF\_SAR\_limit}$ calibration mode for the selected band/channel. Measure meas_SAR at peak location of the area scan where meas_SAR_ $P_{WF\_SAR\_limit}$ corresponds to this meas_SAR value at $P_{WF\_SAR\_limit}$
- Step 2: Establish radio link with AP in the selected band and enable TA-SAR.
- Step 3: Configure pre-defined TX power sequence to DUT and measure TX power versus time.
- Step 4: Convert the measured SAR into time-averaged SAR

Convert the instantaneous measured SAR from step 3 into 1gSAR or 10gSAR value. Perform the running time average to 1gSAR or 10g SAR to determine the time-averaged value versus time by the following equations

Instantaneous 1gSAR or 10gSAR versus time: SAR(τ)

$$SAR(\tau) = \frac{meas\_SAR(\tau)}{\mathrm{meas\_SAR\_P_{WF\_SAR\_limit}}} \times WF\_SAR\_design\_limit$$

Where meas_SAR_$P_{WF_SAR_limit}$ is measured from step 1, meas_SAR(t) is the instantaneous SAR measured in step 3, and WF_SAR_design_limit is the measured worse-case SAR value at $P_{WF\_SAR\_limit}$

$$Time\_avg\_SAR(t) = \frac{1}{T_{SAR}} \int_{t-T_{SAR}}^{t} SAR(\tau)d\tau$$

- Step 5: Plot results
  a. Calculated normalized time-averaged Total Exposure Ratio (TER)
  b. Calculated maximum of normalized time-averaged RF Exposure

5. Wi-Fi TA-PD Test Scenarios and Test Procedures

In order to demonstrate that TA-PD algorithm performs as expected under various operating scenarios, Table 5-1 lists the test scenarios and test sequences to validate TA-PD algorithm. The details of test procedures via conducted power and PD measurements are described in section 5.2 and 5.3

Table 5-1 Test scenario and test sequence list for Wi-Fi TA-PD validation

Test scenario	Test sequence	Description	Device requirement
TX mode change between normal mode and sleep mode	Defined in section 5.1	Test normal mode and sleep mode switch	Support 6GHz band

5.1 Test Sequences for All Scenarios

The test sequence is predefined for TA-PD:

- Test sequence: Wi-Fi is requested to transmit static and maximum power with high duty

5.2 Test Configuration and Procedure for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode via Conducted Power Measurements

5.2.1 Configuration

The scenario tests Wi-Fi TX mode switching from normal throughput mode to sleep mode. Since Mediatek's TA-PD feature operation is independent of bands and channels, selecting one band is sufficient to validate this feature. The criteria for band selection are based on the P_WF_PD_limit values (corresponding to WF_PD_design_limit) and are described as below

Select one band with least P_WF_PD_limit among the ones whose P_WF_PD_limit values are below P_WF_PD_MAX .

- Only one band needs to be tested if all the bands have same P_WF_PD_limit
- Only one band needs to be tested if only one band has P_WF_PD_limit below P_WF_PD_MAX
- If the same least P_WF_PD_limit applies to multiple bands, select the band with the highest measured PD at P_WF_PD_limit
- If P_WF_PD_limit values of all bands are over P_WF_PD_MAX, there is no need to test these bands.

5.2.2 Procedure

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

Steps 1~4: Measure and record TX power versus time for test scenario 1

- Step 1: Start $P_{WF\_PO\_limit}$ calibration mode and measure $P_{WF\_PD\_limit}$ for the selected band.
- Step 2: Establish radio link with AP in the selected band and enable TA-PD.
- Step 3: Configure pre-defined TX power sequence to DUT and measure TX power versus time.
- Step 4: Wi-Fi TX switches modes

Initial Wi-Fi normal mode: Configure pre-defined TX power sequence to DUT for selected band and then DUT transmits packets after 400s
Switch to Wi-Fi sleep mode: Wi-Fi switches to sleep mode about 10s and no packets are transmitted.
Wi-Fi wakes up to normal mode: Wi-Fi wakes up from sleep mode and DUT re-transmits packets for at least the specified time duration

- Step 5: Convert the measured conducted TX power into PD

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 10g SAR to determine time-averaged value versus time as follows

Convert the measured conducted TX power from Step 4 into spatial-averaged PD value using the following equation. Perform the running time average to power and spatial-averaged PD value to determine time averaged value versus time as follows.

Instantaneous PD versus time: PD(t)

$$PD(\tau) = \frac{conducted\_inst\_PD\_TX\_power(\tau)}{P_{WF\_PD\_limit}} \times WF\_PD\_design\_limit$$

Where $P_{WF\_PD\_limit}$ is measured from step 1 and WF_PD_design_limit is measured worst case PD value at $P_{WF\_PD\_limit}$

Time average SAR versus time: Time_avg_PD(t)

$$Time\_avg\_PD(t) = \frac{1}{T_{PD}} \int_{t-T_{PD}}^{t} PD(\tau)d\tau$$

Step 6: Plot results

a. Make one power perspective plot containing
   1. Instantaneous TX power
   2. Requested power (test sequence)
   3. Calculated time-averaged power
   4. Calculated time-averaged power limits

b. Make one SAR perspective plot containing
   1. Calculated time-averaged PD
   2. FCC limit of 10W/m2 (PD)

5.3 Test Configuration and Procedure for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode via PD Measurements

5.3.1 Configuration

The test procedure in the previous section (section 5.2) mainly focuses on measuring conducted TX power, in this section test via PD measurement is performed. The validation can be provided by performing test scenario 1

5.3.2 Procedure

PD is measured and recorded by the following steps:

Steps 1~3: measure and record TA-PD versus time for test scenario 1

- Step 1: Start meas_PD_PWF_PD_limit calibration mode for the selected band/channel. Measure meas_PD at peak location of the area scan and the meas_PD_PWF_PD_limit corresponds to thismeas_PD value at $P_{WF\_PD\_limit}$
- Step 2: Establish radio link with AP in the selected band and enable TA-PD.
- Step 3: Configure pre-defined TX power sequence to DUT and measure instantaneous PD versus time.
- Step 4: Convert the measured PD into time-averaged PD

Convert the instantaneous measured PD from step 4 into spatial-averaged PD value. Perform the running time average to spatial-averaged PD value to determine time-averaged value versus time by following equations.

Instantaneous PD versus time: PD(t)

$$PD(\tau) = \frac{meas\_PD(\tau)}{\text{meas\_PD\_P}_{\text{WF\_PD\_limit}}} \times WF\_PD\_design\_limit$$

where meas_SAR_PWF_PD_limit is measured from step 1, meas_PD(t) is the instantaneous measured PD measured in step 3, and WF_PD_design_limit is the measured worse-case PD value at $P_{WF\_PD\_limit}$

$$Time\_avg\_PD(\tau) = \frac{1}{T_{PD}} \int_{t-T_{PD}}^{t} PD(\tau)d\tau$$

Step 5: Plot results
1. Calculated time-averaged PD
2. FCC limit of 10W/m2 (PD)

6. Wi-Fi TA-SAR Validation via Conducted Power Measurements

6.1 Test Sequences for All Scenarios

For conducted power measurements, TA-SAR algorithm is implemented in firmware in a phone and a notebook. The exact setup diagrams for Android DUT and Windows DUT are shown in Section 6

The general measurement setup for Android DUT is shown in Figure 6-1. There is a control PC which controls DUT and peer devices that act as soft-AP or STA. The WLAN traffic is established between peer devices and DUT, e.g., an engineering model of smart phone. The traffic from DUT TX is UDP and controlled by control PC. For Windows DUT, the general measurement setup is shown in Figure 6-2. Different from Android DUT, the TA-SAR control program is executed in Windows DUT

The test sequence and scenarios are controlled by PC command. The transmitter power is measured with spectrum analyzers. There are two peer devices and two spectrum analyzers to support test scenarios with multiple operation frequencies. Furthermore, the moving average of each measured power is calculated to ensure the conductive time-averaging power is always below the power limit threshold.

The test measurement setup for test scenarios 1 and 4 is illustrated in Figure 6-3 and Figure 6-4. The test measurement setup for test scenarios 2 and 5 is illustrated in Figure 6-5 and Figure 6-6. The test measurement setup for test scenario 3 is illustrated in Figure 6-7 and Figure 6-8. Note that for test scenario 3, an RF attenuator is added to the conductive path to provide proper attenuation from DUT to AP and DUT to spectrum analyzer

Figure 6-1 General setup for TA-SAR conducted power measurement for Android DUT

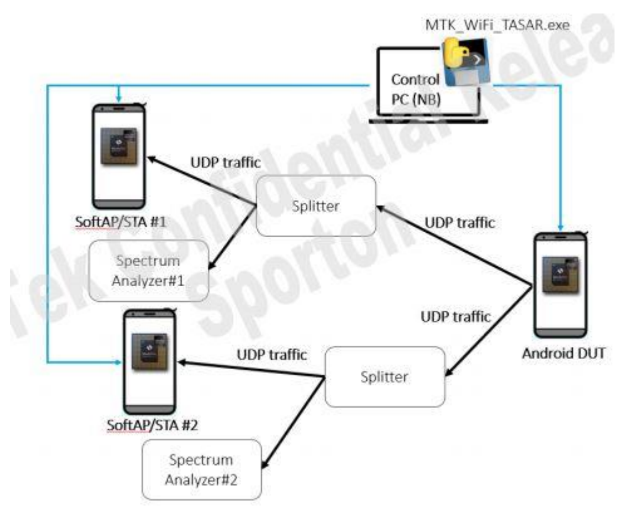


Figure 6-2 General setup for TA-SAR conducted power measurement for Windows DUT

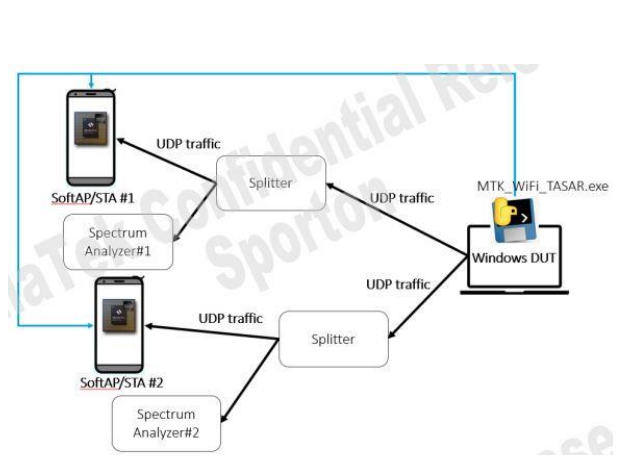


Figure 6-3 TA-SAR conducted power test setup for test scenarios 1 and 4 with Android DUT

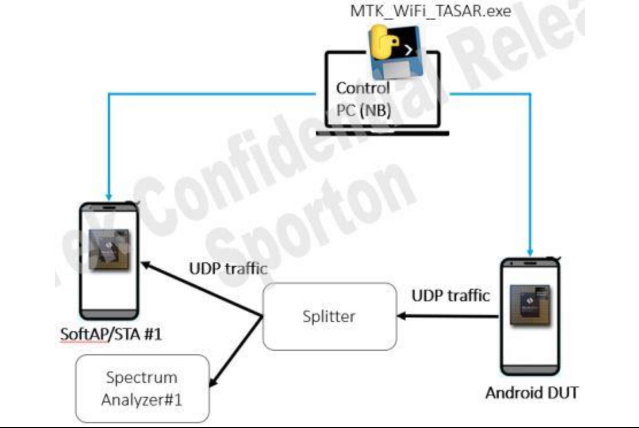


Figure 6-4 TA-SAR conducted power test setup for test scenarios 1 and 4 with Windows DUT

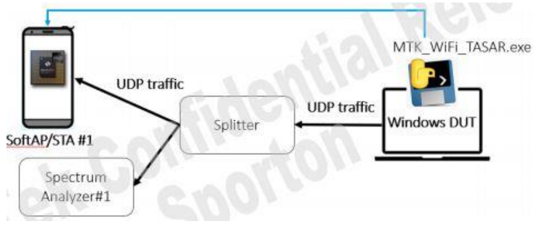


Figure 6-5 TA-SAR conducted power test setup for test scenarios 2 and 5 with Android DUT

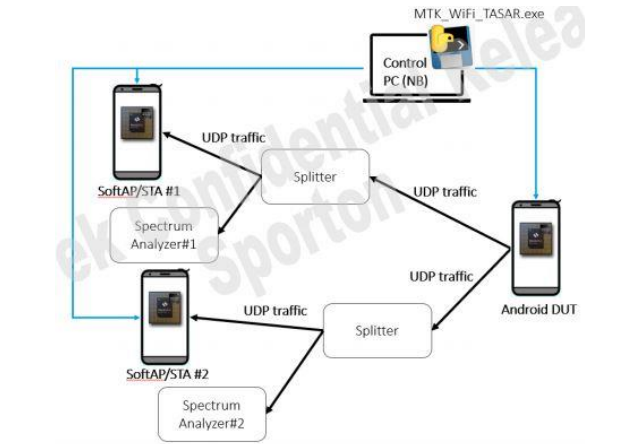


Figure 6-6 TA-SAR conducted power test setup for test scenarios 2 and 5 with Windows DUT

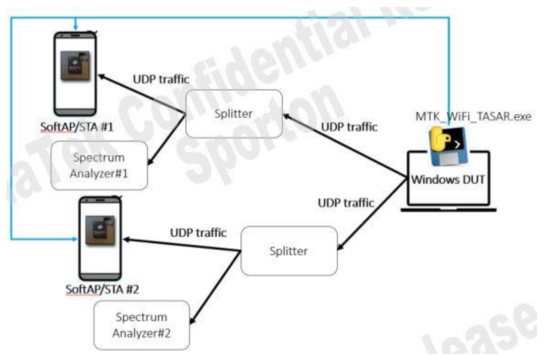


Figure 6-7 TA-SAR conducted power test setup for test scenario 3 with Android DUT

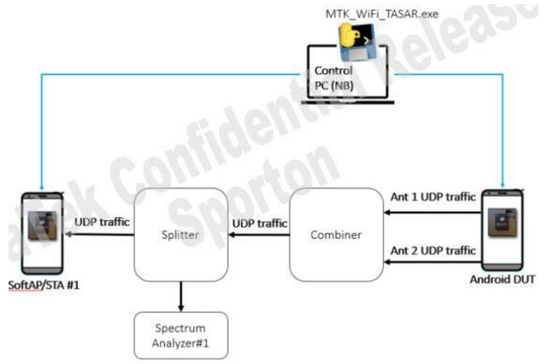
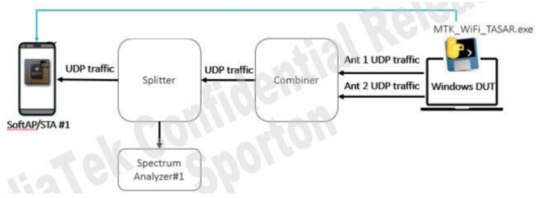


Figure 6-8TA-SAR conducted power test setup for test scenario 3 with Windows DUT



Spectral analyzer utilizing zero-span mode is used for monitoring the time-domain conductive power of the DUT. This spectral analyzer may be replaced by a power probe or other time-domain power logging instrument as well. The detailed setup of the spectral analyzer is shown as follow:

Center frequency: = WLAN channel frequency
Span:

Center Frequency:	=WLAN Channel fequency
Span	Zero span
RBW	Spectral analyzer's maximum capability (8MHz for Keysight PXA N9030A
VBW	=RBW
Sweep Time	1400s
Sweep Point	=10 time of sweep time + 1 = 14001
Detector Mode:	RMS
Trace Mode:	Single hold (clear write)

Since the WLAN data bandwidth (ex. 20MHz) is larger than the max resolution bandwidth of spectralanalyzer, a power correlation method is essential to determine the actual conductive channel power (per data bandwidth occupied) from the readout of the spectral analyzer (in terms of power density dBm/RBW)

The correlation term that accounts for the conductive power to spectral analyzer readout and RF cable loss is obtained with the following steps:

1. Setup the TA-SAR conductive measurement as shown in Figure 6-1 to Figure 6-4
2. Configure DUT to MTK engineering mode and set DUT to continuous packet TX mode (duty cycle ≥ 98%) with TX information such as WLAN channel, rate, and TX power
3. Determine the power correlation term as

Corr. = DUT Tx power – measured power of the spectral analyzer

The readout of the spectral analyzer is thus correlated to the actual conductive channel power at the DUT output port by arithmetically adding Corr. to the raw data in mW domain

In control PC, an executable file named MTK_WiFi_TASAR.exe controls the test of TA-SAR/TA-PD according to different test scenarios. It controls the connections between DUT and peer devices, controls test sequence according to the selected test scenario, starts the UDP traffic from DUT, and pulls the logs from DUT

Table 6-1 Test configurations for all TA-SAR parameters setting and scenario

Test Case	Test Scenario	Test Sequence	Test band	Mode	Test Position	Gap (mm)	ANT	Channel	Part 1, SAR @Plimit 1-g SAR (W/kg)	SAR Limit.	Plimit Setting	Pmax Setting	Unc.
1	2G SAR TX Mode Change between Normal Mode and Sleep Mode	1-1	WLAN2.4GHz	802.11b 5.5Mbps	Top Edge	0mm	2	7	0.441	1.6	18	22	0.5
2	6G PD TX Mode Change between Normal Mode and Sleep Mode	1-2-1	WLAN6GHz	802.11a 6Mbps	Top Edge	2mm	2	37	2.95	1.6	16	21	0.5
3	6G SAR TX Mode Change between Normal Mode and Sleep Mode	1-2-2	WLAN6GHz	802.11a 6Mbps	Top Edge	0mm	2	37	0.31	1.6	16	21	0.5
4	Band Handover (Dual-Band Dual-Concurrent)	2	WLAN2.4GHz	802.11b 5.5Mbps	Top Edge	0mm	1	7	0.771	1.6	18	22	0.5
			WLAN5GHz	802.11a 6Mbps	Top Edge	0mm	2	165	0.308	1.6	16	22	0.5
5	Antenna Switching	3	WLAN2.4GHz	802.11b 5.5Mbps	Top Edge	0mm	2	7	0.441	1.6	18	22	0.5
			WLAN2.4GHz	802.11b 5.5Mbps	Top Edge	0mm	1	7	0.771	1.6	18	22	0.5
6	ECI change	4	WLAN2.4GHz	802.11b 5.5Mbps	Top Edge	0mm	2	7	0.441	1.6	18	22	0.5
7	Simultaneous SAR and PD	5	WLAN2.4GHz	802.11b 5.5Mbps	Top Edge	0mm	1	7	0.771	1.6	18	22	0.5
			WLAN6GHz	802.11a 6Mbps	Top Edge	0mm	2	37	0.31	1.6	16	21	0.5

6.2 Conducted Power Measurement Results for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode

This test is the conducted power measurement for Wi-Fi 2.4GHz / 6GHz band TX mode change. The detailed setting is listed in Table 6-1. Figure 6-10-1 and 6-10-2 demonstrates the DUT's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time, and the power limit for scenario 1-1.

Figure 6-10-1 Time-averaged 2.4G conducted TX power over time for test scenario 1

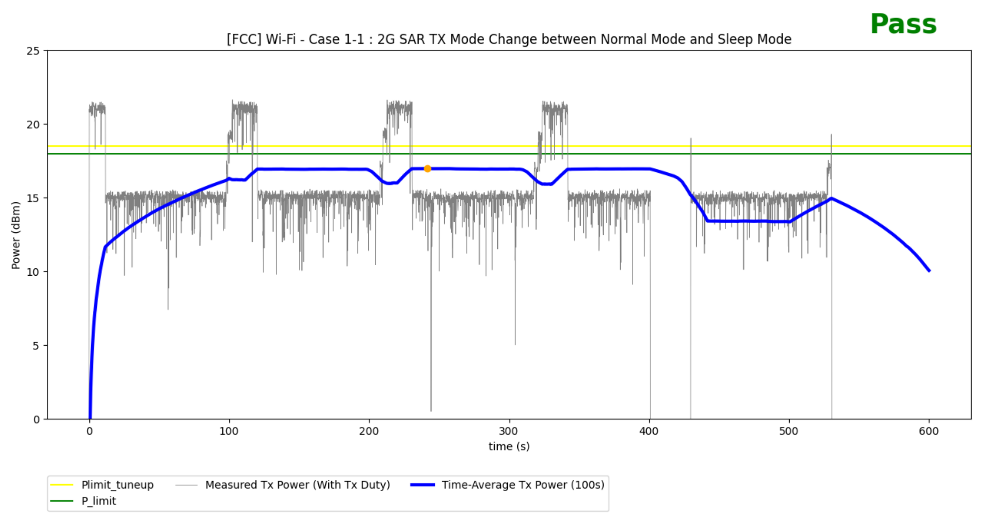
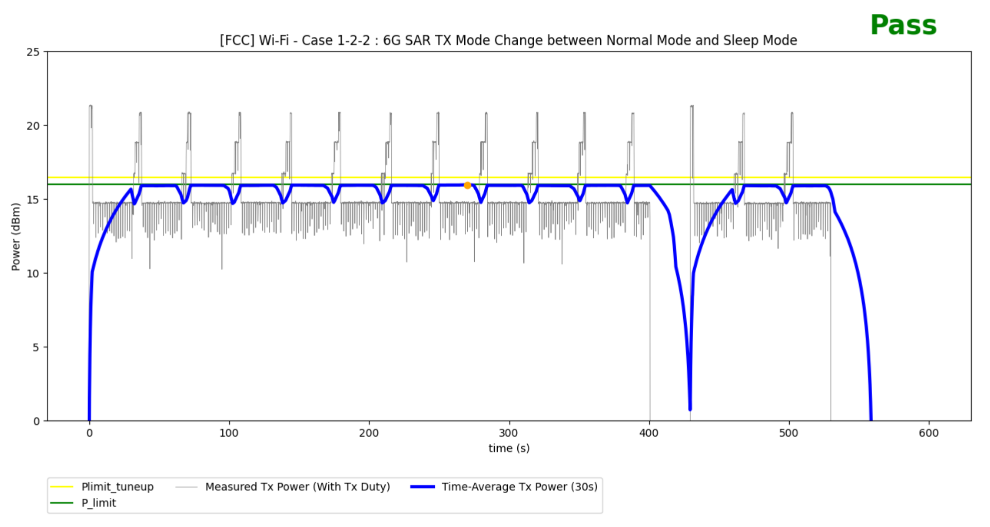
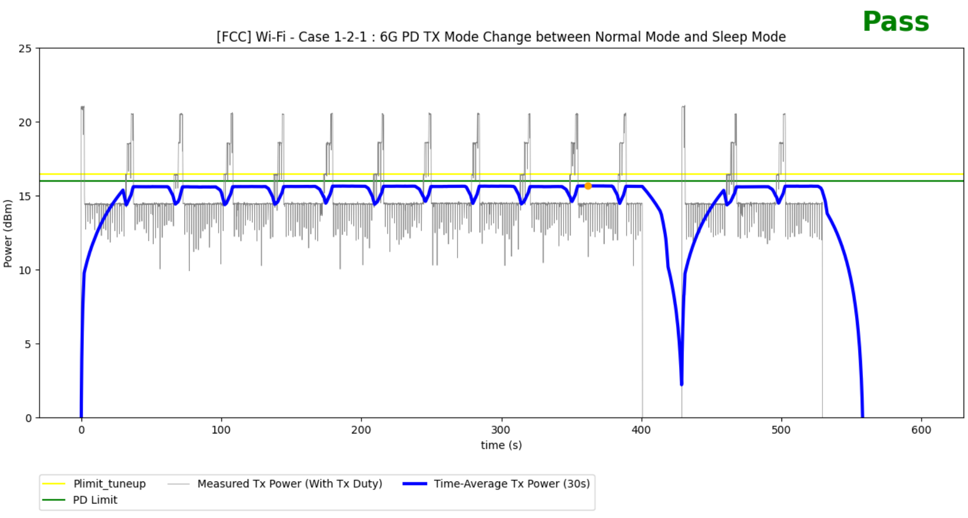


Figure 6-10-2 Time-averaged 6G conducted TX power over time for test scenario 1



This test is the conducted power measurement for Wi-Fi PD 6GHz band TX mode change. The detailed setting is listed in Table 6-1. Figure 6-10-3 demonstrates the DUT's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time.

Figure 6-10-3 Time-averaged conducted TX power over time for test scenario 1



6.3 Conducted Power Measurement Results for Scenario 2: Band Handover

This test is the conducted power measurement for Wi-Fi 2.4GHz/5GHz band handover. The detailed setting is listed in Table 6-1. Figure 6-11 demonstrates the DUT's instantaneous conducted TX power, the time averaged conducted TX power behavior over time, and the power limit. Figure 6-12 illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 4.3.2. As seen in this figure, the normalized time-averaged SAR does not exceed the FCC limit

Figure 6-11 Time-averaged conducted TX power over time for test scenario 2

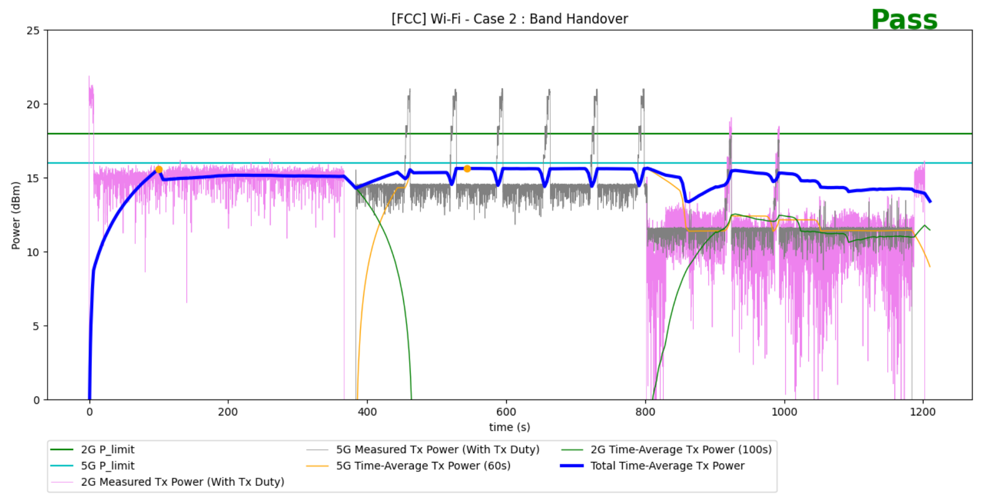
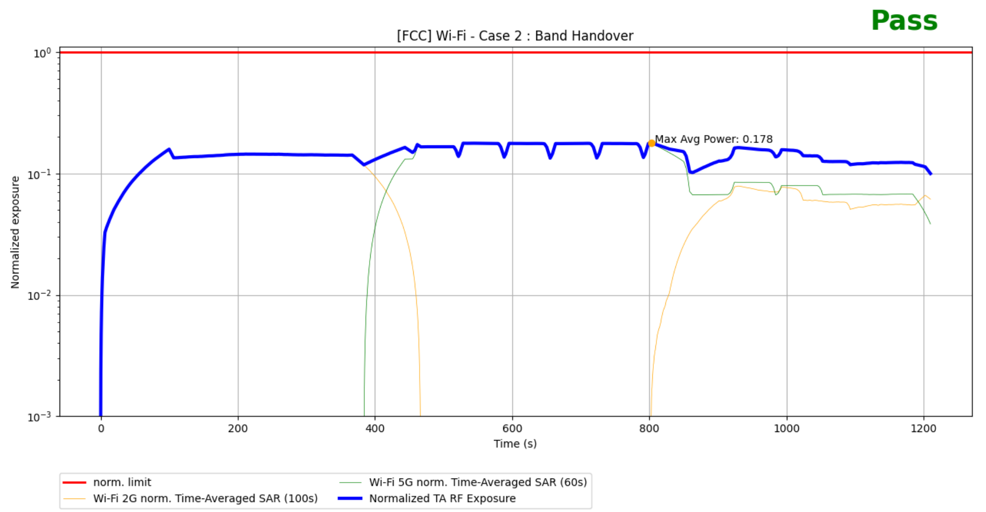


Figure 6-12 Calculated normalized time-averaged Total Exposure Ratio (TER) for test scenario 2



6.4 Conducted Power Measurement Results for Scenario 3: Antenna Switching

This test is the conducted power measurement for Wi-Fi antenna switching. The detailed setting is listed in Table 6-1. Figure 6-13 demonstrates the DUT's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time, and the power limit. Figure 6-14 illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 4.4.2. As seen in this figure, the normalized time-averaged SAR does not exceed the FCC limit

Figure 6-13 Time-averaged conducted TX power over time for test scenario 3

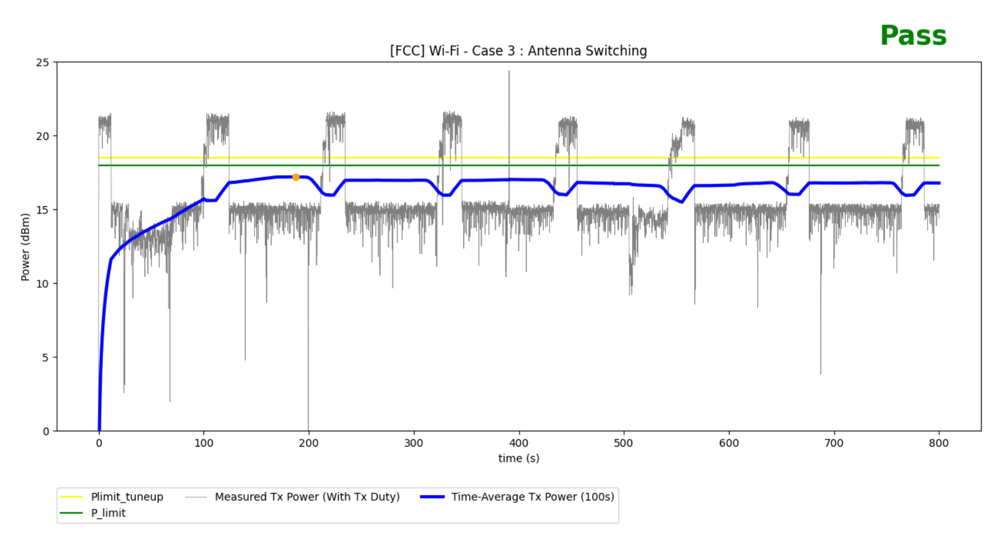
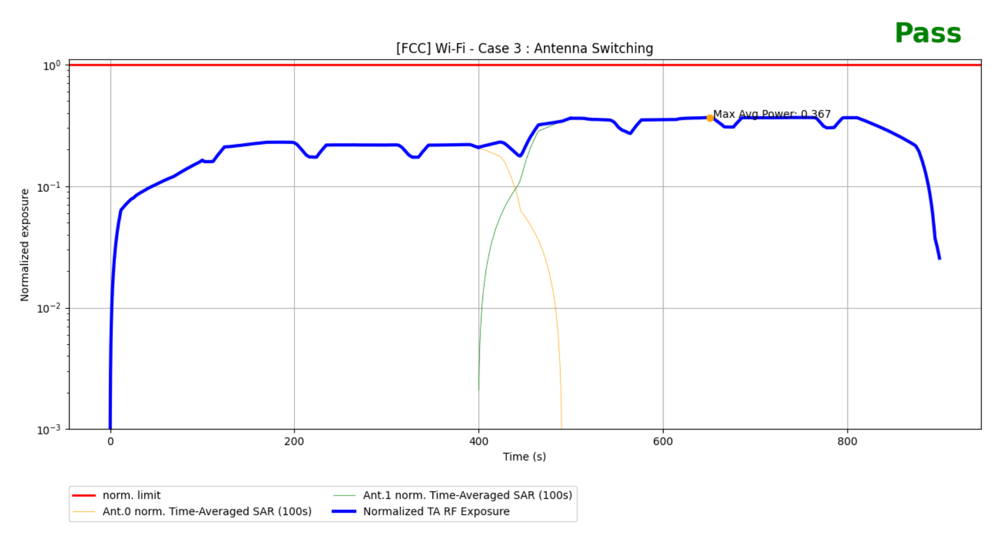


Figure 6-14 Calculated normalized time-averaged Total Exposure Ratio (TER) for test scenario 3



6.5 Conducted Power Measurement Results for Scenario 4: ECI Change

This test is the conducted power measurement for Wi-Fi ECI change. The detailed setting is listed in Table 6-1. Figure 6-15 demonstrates the DUT's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time, and the power limit. Figure 6-16 illustrates the corresponding time-averaged SAR over time converted from the TX time-averaged power by using the equation listed in section 4.5.2. As seen in this figure, the normalized time-averaged SAR does not exceed the FCC limit

Figure 6-15 Time-averaged conducted TX power over time for test scenario 4

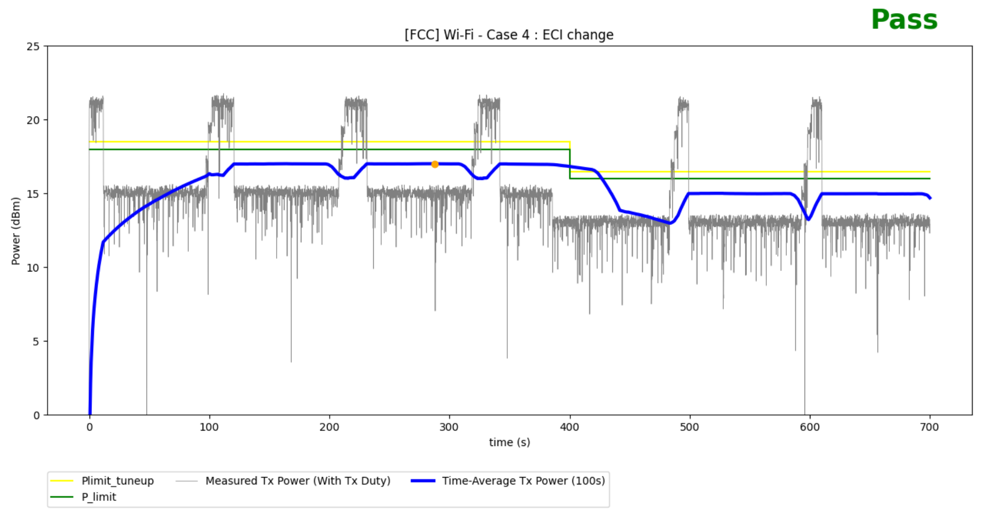
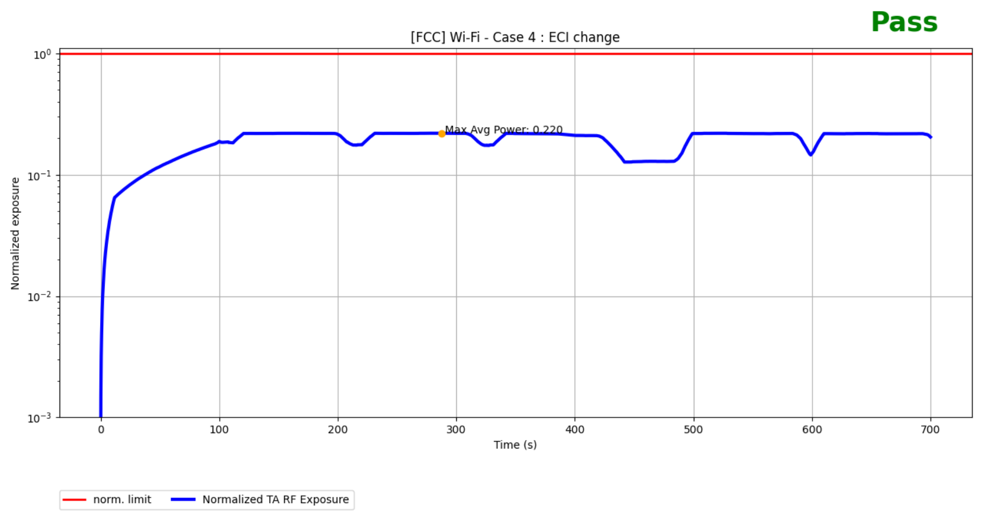


Figure 6-16 Calculated normalized time-averaged Total Exposure Ratio (TER) for test scenario 4



6.6 Conducted Power Measurement Results for Scenario 5: Simultaneous SAR and PD

This test is the conducted power measurement for Wi-Fi SAR and PD TER. The detailed setting is listed in Table 6-1. As mentioned in Section 4.6, Wi-Fi 6GHz band needs to obey both SAR and PD exposure limits, therefore the maximum of normalized TA-SAR and normalized TA-PD in 6GHz band should be used in TER calculation. For our simulation in 6GHz band, normalized TA-PD is larger than normalized TA-SAR, therefore normalized TA-PD is used in TER calculation. Figure 6-17-1 shows the conducted power measurement result for 2.4GHz TA-SAR and 6GHz TA-PD. The conducted power result of SAR/PD exposure is converted into normalized time-averaged SAR/PD. Figure 6-17-2 shows the total normalized time-averaged RF exposure is always below the normalized FCC requirement of 1.

Figure 6-17-1 Time-averaged conducted TX power over time for test scenario 5

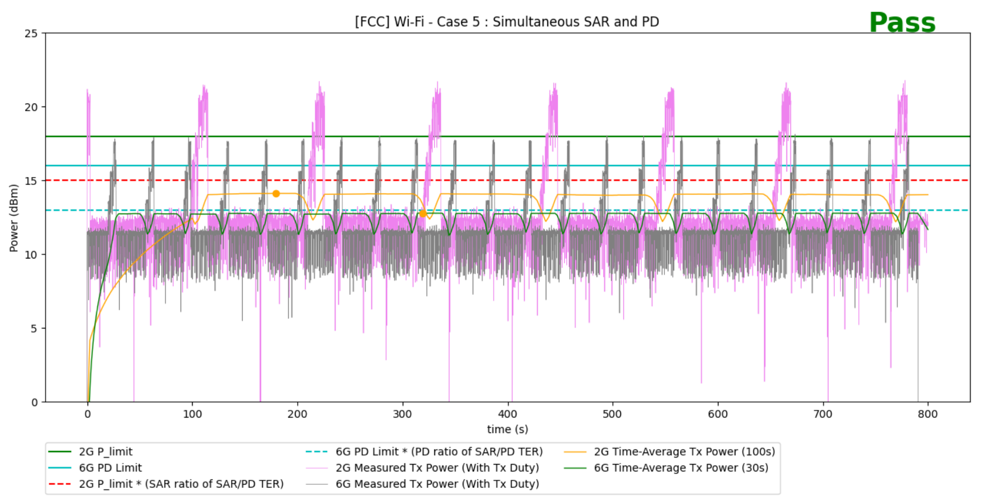
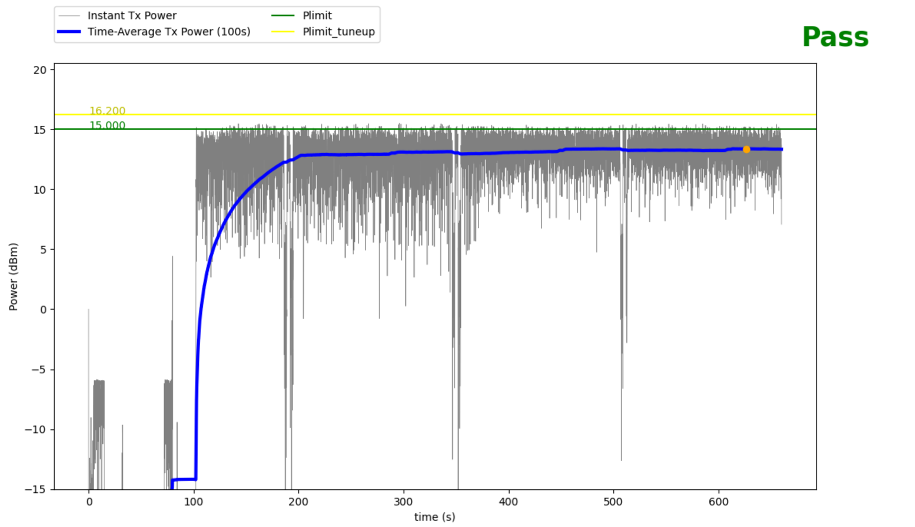


Figure 6-17-2 Normalized time-averaged SAR over time for test scenario 5



7. TA-SAR Validation via SAR Measurements

7.1 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 7-1.

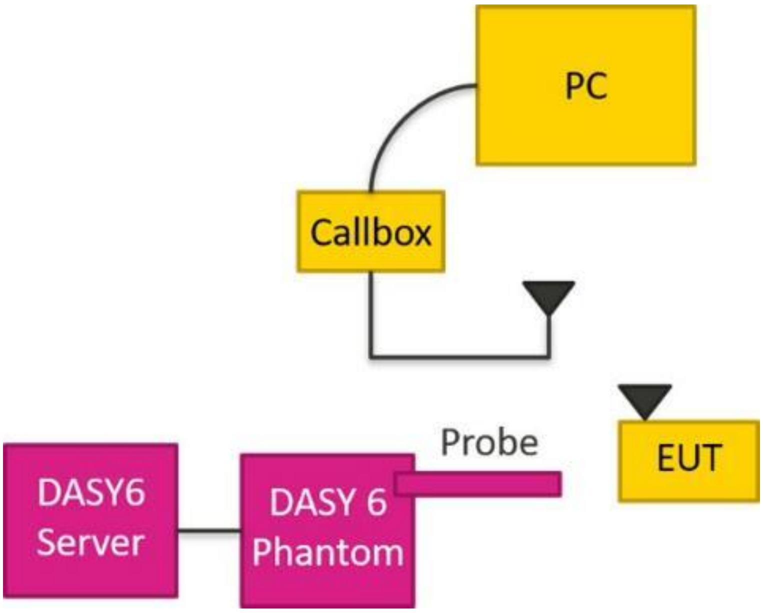
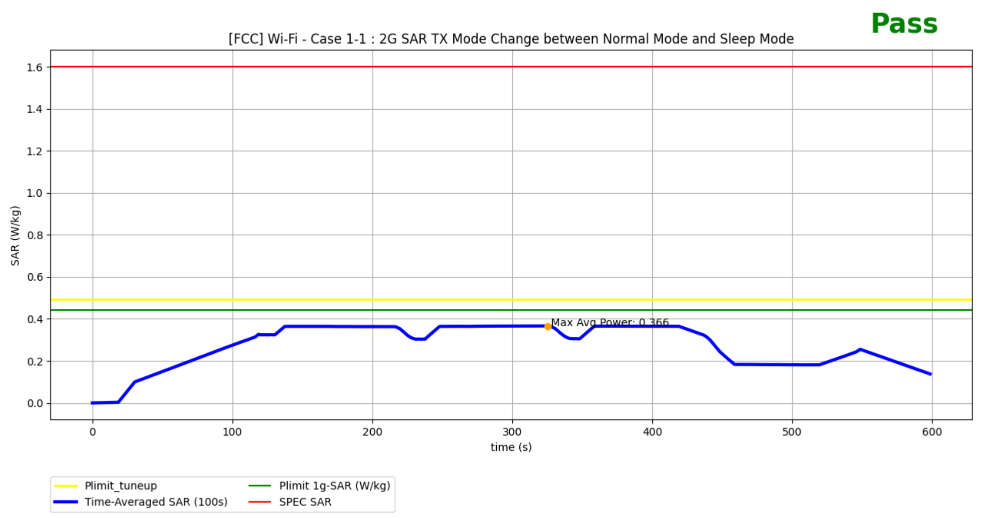


Figure 7-1 TA-SAR wireless test environment

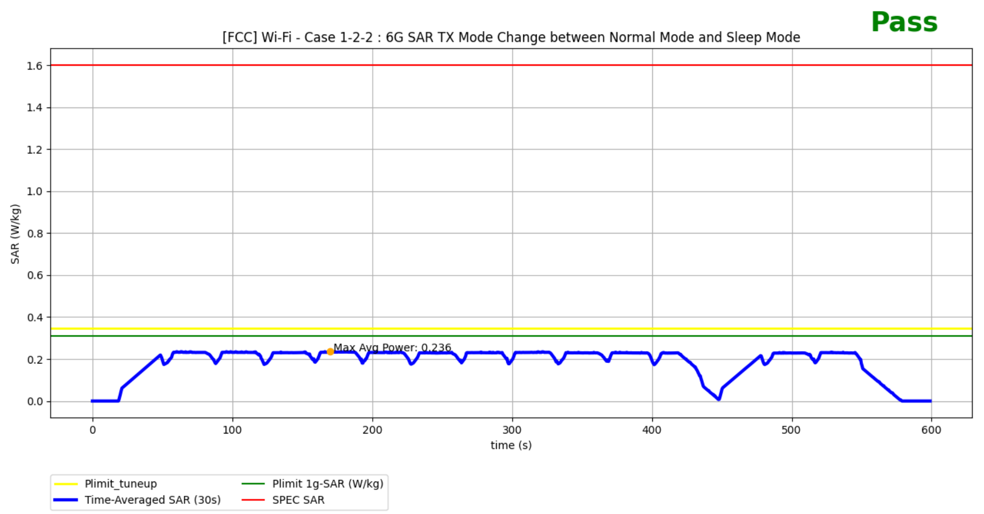
Test Case	Test Scenario	Test Sequence	Test band	Mode	Test Position	Gap (mm)	ANT	Channel	Part 1, SAR @Plimit 1-g SAR (W/kg)	SAR Limit.	Plimit Setting	Pmax Setting	Uncertainty
1	2G SAR TX Mode Change between Normal Mode and Sleep Mode	1-1	WLAN2.4GHz	802.11b 5.5Mbps	Top Edge	0mm	2	7	0.441	1.6	18	22	0.5
2	6G PD TX Mode Change between Normal Mode and Sleep Mode	1-2-1	WLAN6GHz	802.11a 6Mbps	Top Edge	2mm	2	37	2.95	1.6	16	21	0.5
3	6G SAR TX Mode Change between Normal Mode and Sleep Mode	1-2-2	WLAN6GHz	802.11a 6Mbps	Top Edge	0mm	2	37	0.31	1.6	16	21	0.5

7.1.1 SAR Measurement Results for Wi-Fi TA-SAR Test Scenario 1: TX Mode Change between Normal Mode and Sleep Mode

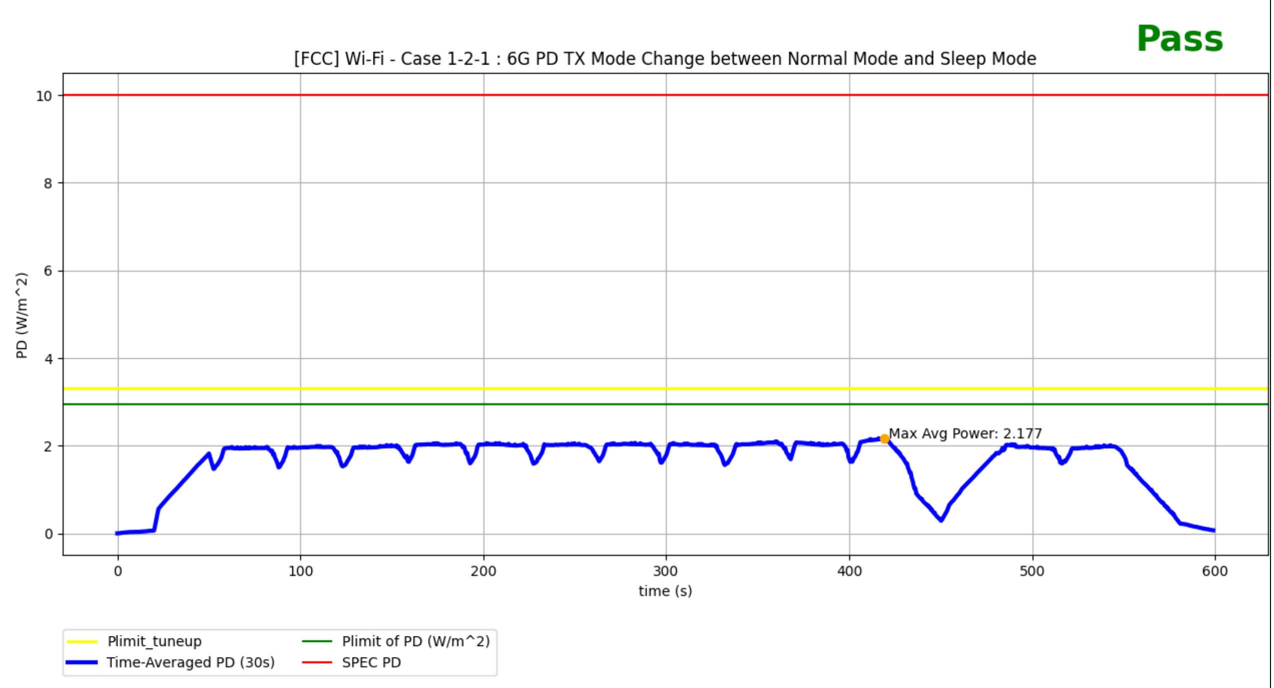
Figure 6-18-1 Time-averaged 2.4G SAR measurement for Wi-Fi TA-SAR test scenario 1-1



FCC 1g SAR limit	1.6 W/kg
Max time averaged 1g SAR	0.366 W/kg
Validation result: Pass	

Figure 6-18-2 Time-averaged 6G SAR measurement for Wi-Fi TA-SAR test scenario 1-1	
	
FCC 1g SAR limit	1.6 W/kg
Max time averaged 1g SAR	0.236 W/kg
Validation result: Pass	

7.1.2 TA-PD Measurement Results for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode

Figure 6-19 Time-averaged PD measurement result for test scenario 1	
	
FCC PD limit	10 W/m^2
Max time averaged PD	2.177 W/m^2
Validation result: Pass	

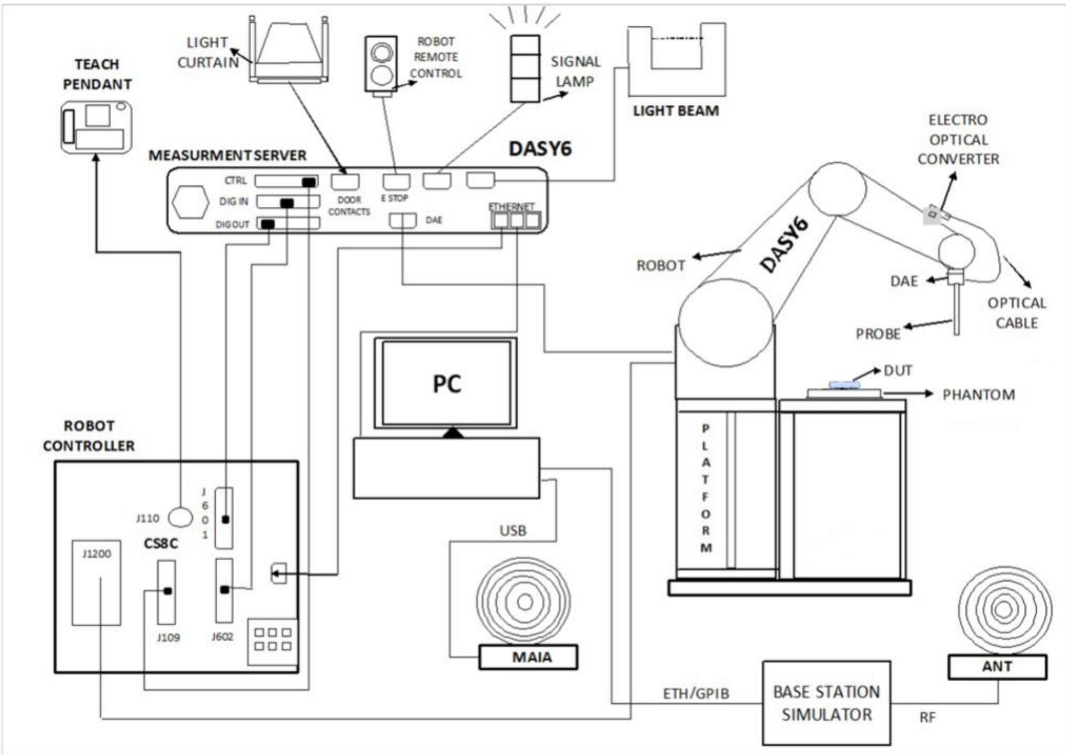
8. Conclusions

This document proposes Wi-Fi/BT TA-SAR and TA-PD test scenarios and procedures, and proves Mediatek's TASAR and TA-PD algorithms can meet the FCC SAR and PD regulations with the proposed test scenarios and procedures. Mediatek's TA-SAR and TA-PD algorithms are able to maintain SAR and PD over time below the FCC regulatory limits. 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 the reprot that Mediatek's TA-SAR and TA-PD algorithms can maintain SAR and PD over time below the FCC regulatory limits with the proposed test procedures. Based on the provided measurement results, it is concluded that Mediatek's TA-SAR and TA-PD algorithms can be tested by using the proposed test methodology for FCC compliance.

9. DASY System Verification

9.1 The system to be used for the near field power density measurement

- SPEAG DASY system
- SPEAG DASY 5G module software
- EUmmWVx probe
- 5G Phantom cover



9.2 Test Side Location

Sporton Lab and below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190). The ISED Assigned Code is 4086B and 4086H

Test Site	SPORTON INTERNATIONAL INC. Wensan Laboratory
Test Site Location	4086H No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan
Test Site No.	SAR15-HY

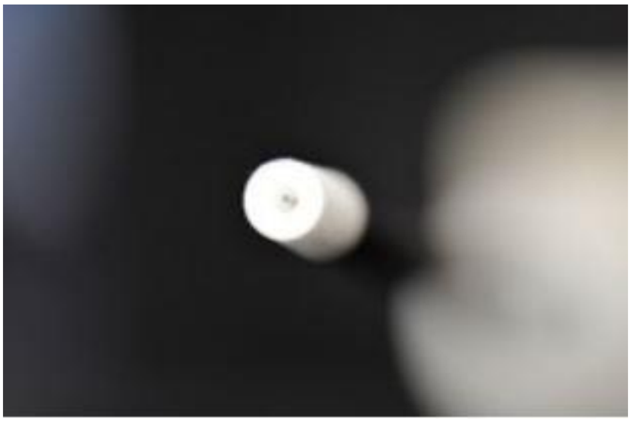
9.3 SAR E-Field Probe

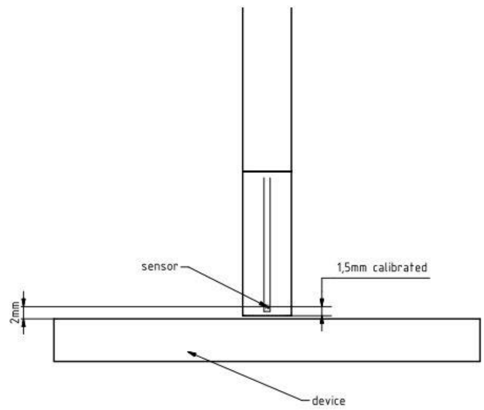
Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	4 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)	
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 μW/g)	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

9.4 EUmmWave Probe / E-Field 5G Probe

The probe design allows measurements at distances as small as 2 mm from the sensors to the surface of the device under test (DUT). The typical sensor to probe tip distance is 1.5 mm.

Frequency	750 MHz – 110 GHz
Probe Overall Length	320 mm
Probe Body Diameter	8.0 mm
Tip Length	23.0 mm
Tip Diameter	8.0 mm
Probe's two dipoles length	0.9 mm – Diode loaded
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 (min < 50 V/m - 3000 V/m)
Position Precision	< 0.2 mm
Distance between diode sensors and probe's tip	1.5 mm
Minimum Mechanical separation between probe tip and a Surface	0.5 mm
Applications	E-field measurements of 5G devices and other mm-wave transmitters operating above 10GHz in < 2 mm distance from device (free-space) Power density, H-field and far-field analysis using total field reconstruction.
Compatibility	cDASY6 + 5G-Module SW1.0 and higher

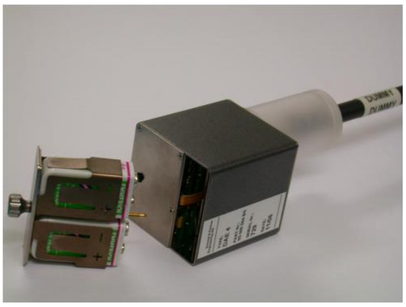




9.5 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



10. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	736	Aug. 15, 2024	Aug. 14, 2025
SPEAG	6500MHz System Validation Kit	D6.5GHzV2	1003	Mar. 15, 2024	Mar. 14, 2025
SPEAG	5G Verification Source	10GHz	1052	Oct. 16, 2024	Oct. 15, 2025
SPEAG	Data Acquisition Electronics	DAE4ip	1800	Jun. 18, 2024	Jun. 17, 2025
SPEAG	Data Acquisition Electronics	DAE4	1805	May. 22, 2024	May. 21, 2025
SPEAG	Dosimetric E-Field Probe	EX3DV4	7814	Jun. 20, 2024	Jun. 19, 2025
SPEAG	EUmmWV Probe Tip Protection	EUmmWV4	9461	Oct. 16, 2024	Oct. 15, 2025
Anritsu	Signal Generator	MG3710A	6201502524	Sep. 24, 2024	Sep. 23, 2025
Anritsu	Power Sensor	MA2411B	1911334	Jul. 15, 2024	Jul. 14, 2025
Anritsu	Power Meter	ML2496A	2119003	Jul. 16, 2024	Jul. 15, 2025
Anritsu	Power Sensor	MA2411B	1911333	Jul. 15, 2024	Jul. 14, 2025
Anritsu	Power Meter	ML2495A	1804003	Oct. 16, 2024	Oct. 15, 2025
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 23, 2024	Oct. 22, 2025
Mini-Circuits	Power Amplifier	ZHL-42W+	715701915	May. 17, 2024	May. 16, 2025
R&S	Signal Analyzer	FSV3044	101103	Jan. 31, 2024	Jan. 30, 2025
R&S	Signal Analyzer	FSV3044	101048	Apr. 23, 2024	Apr. 22, 2025
TESTO	Hygro meter	608-H1	45196600	Oct. 28, 2024	Oct. 27, 2025

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

11. SAR System verification and validation

11.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18℃ to 25℃, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18℃ to 25℃ and within ± 2℃ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.

The liquid tissue depth was at least 15cm in the phantom for all SAR testing

<Tissue Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	22.6	1.840	38.800	1.80	39.20	2.22	-1.02	±5	2025/1/14
6500	22.9	6.160	34.700	6.07	34.50	1.48	0.58	±5	2025/1/14

11.2 System Verification

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A.

<System Verification Results>

Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2025/1/14	2450	50	D2450V2-736	EX3DV4 - SN7814	DAE4ip Sn1800	2.660	51.400	53.2	3.50
2025/1/14	6500	100	D6.5GHzV2-1003	EX3DV4 - SN7814	DAE4ip Sn1800	29.900	293.000	299	2.05

12. Power Density System Verification

The system performance check verifies that the system operates within its specifications.
The EUT is replaced by a calibrated source, the same spatial resolution, measurement region and the test separation used in the calibration was applied to system check. Through visual inspection into the measured power density distribution, both spatially (shape) and numerically (level) have no noticeable difference. The measured results should be within 0.66dB of the calibrated targets.

Date	Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N	Distance (mm)	Measured 4 cm^2 (W/m^2)	Targeted 4 cm^2 (W/m^2)	Deviation (dB)
2025/1/14	10G	10GHz_1052	9461	1805	2	55.8	57.2	-0.11

13. Uncertainty Assessment

Declaration of Conformity:
The test results with all measurement uncertainty excluded is presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the ufacturer takes all the responsibilities for the accuracy of product specification.
The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.
A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.
A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	1/k[(b)]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity
(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.
The judgment of conformity in the report is based on the measurement results excluding the measurement uncertainty.

Applies for SAR system

Uncertainty Budget for frequency range 30 MHz to 6 GHz							
Error Description	**Uncertainty Value (±%)**	**Probability**	**Divisor**	**(Ci) 1g**	**(Ci) 10g**	**Standard Uncertainty (1g) (±%)**	**Standard Uncertainty (10g) (±%)**
Measurement System							
Probe Calibration	7.0	N	1	1	1	7.0	7.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Linearity	4.7	R	1.732	1	1	2.7	2.7
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Boundary Effects	2.0	R	1.732	1	1	1.2	1.2
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	6.7	R	1.732	1	1	3.9	3.9
Post-processing	4.0	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Holder	3.6	N	1	1	1	3.6	3.6
Test sample Positioning	3.0	N	1	1	1	3.0	3.0
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Phantom and Setup							
Phantom Uncertainty	7.6	R	1.732	1	1	4.4	4.4
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						**12.9%**	**12.8%**
Coverage Factor for 95 %						**K=2**	**K=2**
Expanded STD Uncertainty						**25.9%**	**25.5%**

Applies for PD system

mmWave Uncertainty Budget Evaluation Distances to the Antennas > λ/2π					
Error Description	Uncertainty Value (±dB)	Probability	Divisor	(Ci)	Standard Uncertainty (±dB)
Uncertainty terms dependent on the measurement system					
Probe Calibration	0.49	N	1	1	0.49
Probe correction	0.00	R	1.732	1	0.00
Frequency response (BW ≤ 1 GHz)	0.20	R	1.732	1	0.12
Sensor cross coupling	0.00	R	1.732	1	0.00
Isotropy	0.50	R	1.732	1	0.29
Linearity	0.20	R	1.732	1	0.12
Probe scattering	0.00	R	1.732	1	0.00
Probe positioning offset	0.30	R	1.732	1	0.17
Probe positioning repeatability	0.04	R	1.732	1	0.02
Sensor mechanical offset	0.00	R	1.732	1	0.00
Probe spatial resolution	0.00	R	1.732	1	0.00
Field impedance dependence	0.00	R	1.732	1	0.00
Amplitude and phase drift	0.00	R	1.732	1	0.00
Amplitude and phase noise	0.04	R	1.732	1	0.02
Measurement area truncation	0.00	R	1.732	1	0.00
Data acquisition	0.03	N	1	1	0.03
Sampling	0.00	R	1.732	1	0.00
Field reconstruction	0.60	R	1.732	1	0.35
Forward transformation	0.00	R	1.732	1	0.00
Power density scaling	0.00	R	1.732	1	0.00
Spatial averaging	0.10	R	1.732	1	0.06
System detection limit	0.04	R	1.732	1	0.02
Uncertainty terms dependent on the DUT and environmental factors					
Probe coupling with DUT	0.00	R	1.732	1	0.0
Modulation response	0.40	R	1.732	1	0.2
Integration time	0.00	R	1.732	1	0.0
Response time	0.00	R	1.732	1	0.0
Device holder influence	0.10	R	1.732	1	0.1
DUT alignment	0.00	R	1.732	1	0.0
RF ambient conditions	0.04	R	1.732	1	0.0
Ambient reflections	0.04	R	1.732	1	0.0
Immunity / secondary reception	0.00	R	1.732	1	0.0
Drift of the DUT		R	1.732	1	
Combined Std. Uncertainty					0.76 dB
Expanded STD Uncertainty (95%)					1.52 dB

Appendix A. Plots of System Performance Check

Appendix B. DASY Calibration Certificate

Appendix C. Test Setup Photos