Test report No.: 2550151R-SAUSV05S-A

TAS Validation Report

Product Name	2TX 11be (WiFi7) BW160 + BT/BLE Combo Card
Trademark	MediaTek
Model and /or type reference	MT7925B22M
Applicant´s name / address	ASUSTeK COMPUTER INC. 1F, No. 15, Lide Rd, Beitou, Taipei, 112 Taiwan
Manufacturer´s name	MediaTek Inc.
FCC ID	MSQ-MT7925B22M
Applicable Standard	IEEE 1528-2013
Verdict Summary	IN COMPLIANCE
Documented By (Senior Project Specialist / Ida Tung)	Ida Tung
Tested By (Senior Engineer / Luke Cheng)	Luke Cheng
Approved By (Assistant Manager / San Lin)	San Lin
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Revision History

Report No.	Version	Description	Issued Date
2550151R-SAUSV05S-A	V1.0	Initial issue of report.	2025/08/28

1. General Information

1.1 EUT Description

Product Name	2TX 11be (WiFi7) BW160 + BT/BLE Combo Card
Trademark	MediaTek
Model and /or type reference	MT7925B22M
FCC ID	MSQ-MT7925B22M
Frequency Range	WLAN 2.4GHz: 2412-2472MHz WLAN 5GHz: 5180-5240MHz, 5260-5320MHz, 5500-5720MHz, 5745-5825MHz, 5845-5885MHz WLAN 6GHz: 5955-7115MHz BT: 2402-2480MHz
Type of Modulation	802.11b: DSSS 802.11a/g/n/ac/ax/be: OFDM, OFDMA GFSK(1Mbps) / π /4DQPSK(2Mbps) / 8DPSK(3Mbps)
Antenna Type	PIFA
Device Category	Portable
RF Exposure Environment	Uncontrolled

Host information		
Brand	Product Name	Model No.
ASUS	Notebook PC	PM3606CKA

2. Wi-Fi and 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** 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 TA-PD algorithm are listed in Table 2-2.

- The current time-averaged TX power is guaranteed to be lower than the predefined TX power limit P_{SAR_limit} or P_{PD_limit}, which is mapped from SAR or PD limit. As in traditional SAR testing, we measure the power P_{SAR_limit} (mW) and its corresponding maximum 1g or 10g peak spatial-averaged SAR (SAR_REG_limit), similarly, P_{PD_limit} (mW) and its corresponding maximum 4cm2 averaged PD (PD_REG_limit).
- If the predicted time-averaged TX power tends to be larger than P_{SAR_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:

$$\frac{1}{T_{\mathrm{SAR}}} = \int_{t-T_{\mathrm{SAR}}}^{t} inst\_TX\_Power(\tau)d\tau \leq P_{SAR\_limit}$$

where $inst\_TX\_power(\tau)$ 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:

$$\frac{1}{T_{\text{PD}}} = \int_{t-T_{\text{PD}}}^{t} inst\_TX\_Power(\tau)d\tau \leq PD_{PD\_limit}$$

where $inst\_TX\_power(\tau)$ 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,

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

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

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

where $SARn,limit$ is the SAR regulatory limit SAR_REG_limitn that is applicable to the n-th transmitter/test frequency and $PDm,limit$ is the PD regulatory limit PD_REG_limitm that is applicable to the m-th transmitter/test frequency.

In particular, for Wi-Fi SAR,

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

for Wi-Fi PD,

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

where $inst\_SAR\_TX\_power(\tau)$ and $inst\_PD\_TX\_power(\tau)$ denote the instantaneous TX power at time τ for SAR and PD respectively. $TSAR$ and TPD are the time averaging windows defined by FCC for assessing time-averaged SAR and PD. The meanings of $P_{WF\_SAR\_limit}$, 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.

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.

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

2.2 Operating Parameters for Algorithm Validation

Table 2-1 Wi-Fi 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 Wi-Fi 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.

3. Overview of Wi-Fi 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.
- **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	Wi-Fi TA-SAR 2.4/5GHz	Wi-Fi TA-SAR 6GHz	Wi-Fi TA-PD 6GHz
1. TX mode change between normal mode and sleep mode	Test normal mode and sleep mode switch	✓	✓	✓
2. Band handover	Test 2.4G/5GHz band change	✓		
3. Antenna switching	Change antenna index	✓		
4.ECI (Exposure Condition Index) change	Test under ECI transition	✓		
5. Simultaneous SAR and PD	TER of 2.4GHz TA-SAR and 6GHz TA-SAR/TA-PD	✓	✓	✓

The applicable operational conditions depend on the hardware and software capabilities of MediaTek's chips that have Wi-Fi 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-band + A-band	A-band	(1, 2, 3, 4, 5)
G-band MIMO + A-band SISO	G-band + A-band	G-band	(1, 2, 3, 4, 5)
G-band MIMO + A-band MIMO	G-band + A-band	G-band + 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 $P_{WF\_SAR\_limit}$, time 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.

For Wi-Fi TA-SAR validation, description of the conducted power measurement test procedures is included in sections 4.2~4.6, and description of the SAR measurement test procedures is included in section 4.7. For Wi-Fi TA-PD validation, description of the conducted power measurement test procedures is included in section 5.2, and description of the PD measurement test procedures is included in section 5.3.

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	Body-only configuration
5. Simultaneous SAR and PD	Defined in section 4.1	TER of 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.

The test sequence is illustrated in Figure 4-1. The waveform of the test sequence is listed in Table 4-2.

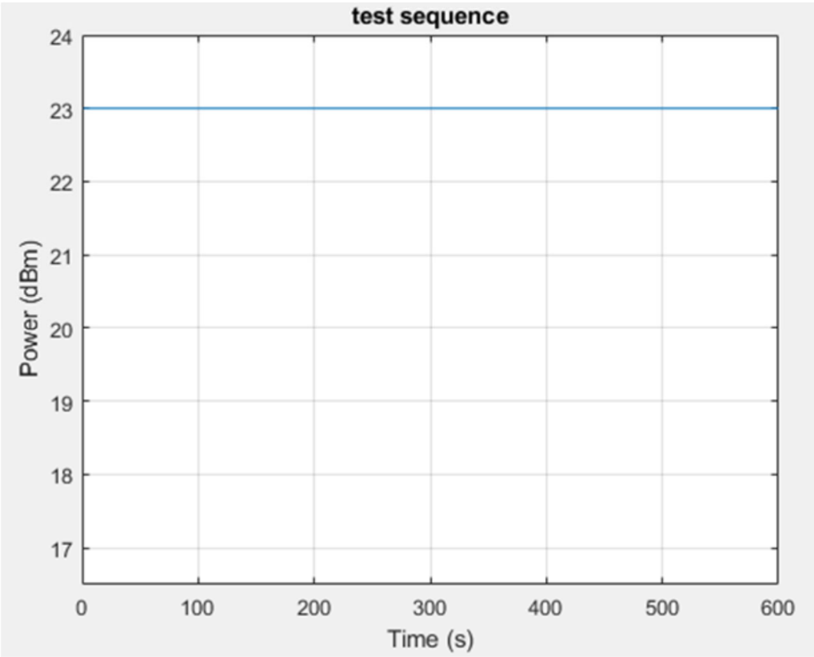


Figure 4-1 Test sequence

Table 4-2 Test sequence

Time (s)	Duration (s)	Power (dBm)	Note
600	600	23	Wi-Fi TX maximum power (P_WF_SAR_MAX)

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*.

o Only one band/channel needs to be tested if all the bands have the same *P_WF_SAR_limit*.

o Only one band/channel needs to be tested if only one band has *P_WF_SAR_limit* below *P_WF_SAR_MAX*.

o If the same least *P_WF_SAR_limit* applies to multiple bands, select the band with the highest

o measured 1gSAR at *P_WF_SAR_limit*.

o 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: $SAR(\tau)$

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

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

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)

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: $SAR\_1(\tau)$ (band1), $SAR\_2(\tau)$ (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 measured from step 1, $WF\_SAR\_design\_limit\_1$ and $WF\_SAR\_design\_limit\_2$ are measured 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 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

4.4 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. 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 having the same P_WF_SAR_limit among supported antennas.
- Antenna selection order o Select the configuration with two antennas having *P_WF_SAR_limit* values less than *P_WF_SAR_MAX.*

o If the previous configuration does not exist, selec the configuration with one antenna having *P_WF_SAR_limit* value less than *P_WF_SAR_MAX*.

o 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 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

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 groups. 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 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 changes.

Connect to selected band with initial $P_{WF\_SAR\_limit}$ in one 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 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

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

- Steps 1~4: Measure and record TX power versus time for test scenario 5.

■ Step 1: Start $P_{WF\_SAR\_limit}$ 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 link with AP for 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

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

For TA-PD of each band at 6GHz band

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

Instantaneous 1gSAR or 10gSAR versus time: $SAR(\tau)$, $PD(\tau)$

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

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

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 PWF_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 instantaneous SAR 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: $SAR(\tau)$

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

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 PWF_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 time-averaged 1gSAR or 10gSAR

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

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
1. TX mode change between normal mode and sleep mode	Defined in section 5.1	Test normal mode and sleep mode switch	Supports 6GHz band

5.1 Test Sequences for All Scenarios

The test sequence is predefined for TA-PD:

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

The test sequence is illustrated in Figure 5-1. The waveform of the test sequence is listed in Table 5-2.

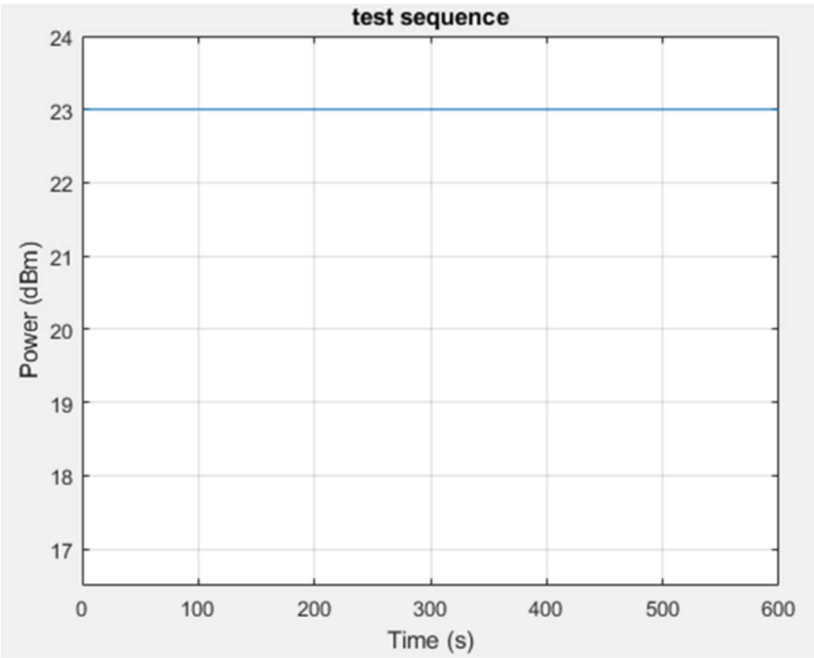


Figure 5-1 Test sequence

Time (s)	Duration (s)	Power (dBm)	Note
600	600	23	Wi-Fi TX maximum power (P_WF_PD_MAX)

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* .

o Only one band needs to be tested if all the bands have same *P_WF_PD_limit*.
o Only one band needs to be tested if only one band has *P_WF_PD_limit* below *P_WF_PD_MAX*.
o 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*.
o 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 $P_{WF\_PD\_limit}$ 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 for 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 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: $PD(\tau)$

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

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-averaged PD versus time: $Time\_avg\_PD(\tau)$

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

- Step 6: Plot results

A. Make one power perspective plot containing

1. Instantaneous Tx power
2. Requested power
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

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_$P_{WF_PD_limit}$ calibration mode for the selected band/channel. Measure meas_PD at peak location of the area scan and the meas_PD_$P_{WF_PD_limit}$ corresponds to this meas_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: $PD(\tau)$

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

where meas_SAR_$P_{WF_PD_limit}$ 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 $P_{WF\_PD\_limit}$.

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

- Step 5: Plot results

A. Calculated time-averaged PD

B. FCC limit of 10W/m2 (PD)

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

For conducted power measurements, TA-SAR algorithm is implemented in firmware in a notebook. The exact setup diagrams for Windows DUT are shown in Section 6.1.

6.1 Measurement Setup

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. 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 6-2.
- The test measurement setup for test scenarios 2 and 5 is illustrated in Figure 6-3.
- The test measurement setup for test scenario 3 is illustrated in Figure 6-4.

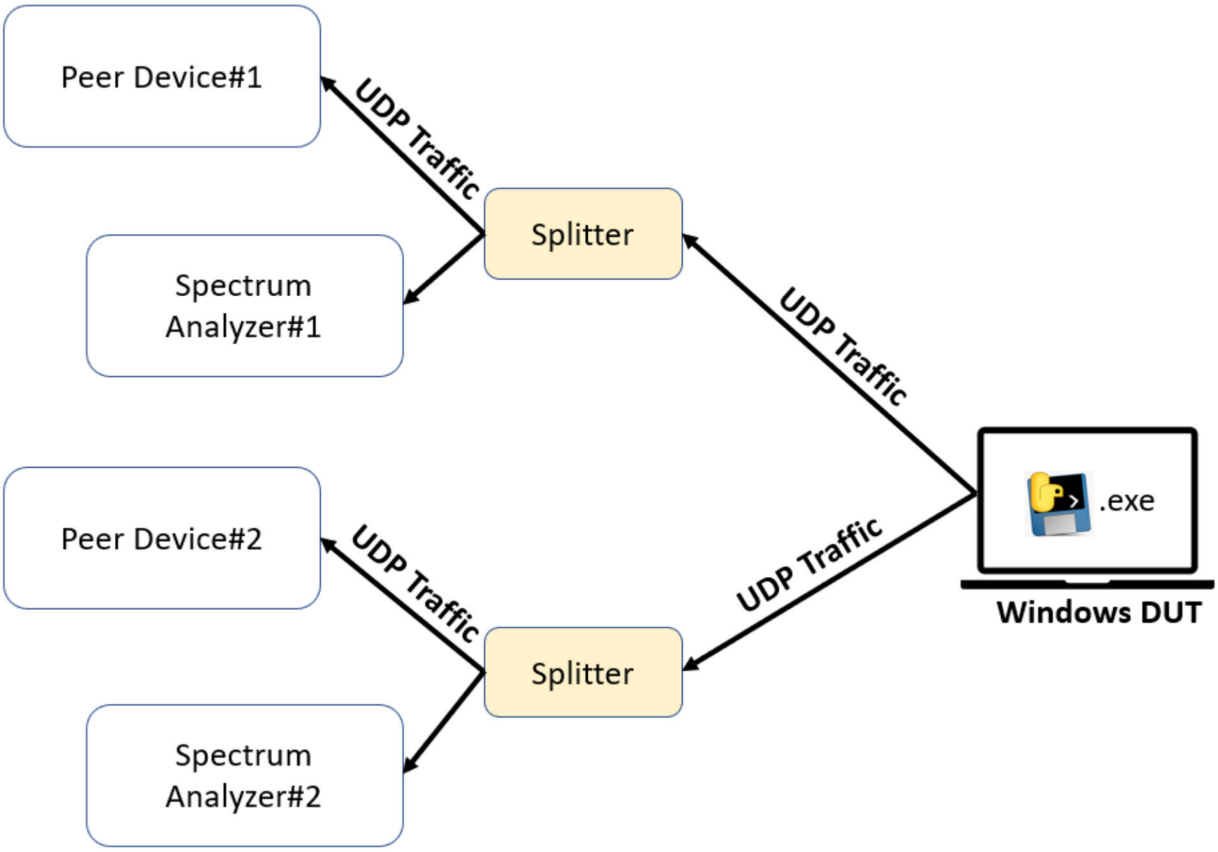


Figure 6-1. General setup for TA-SAR conducted power measurement for Windows DUT

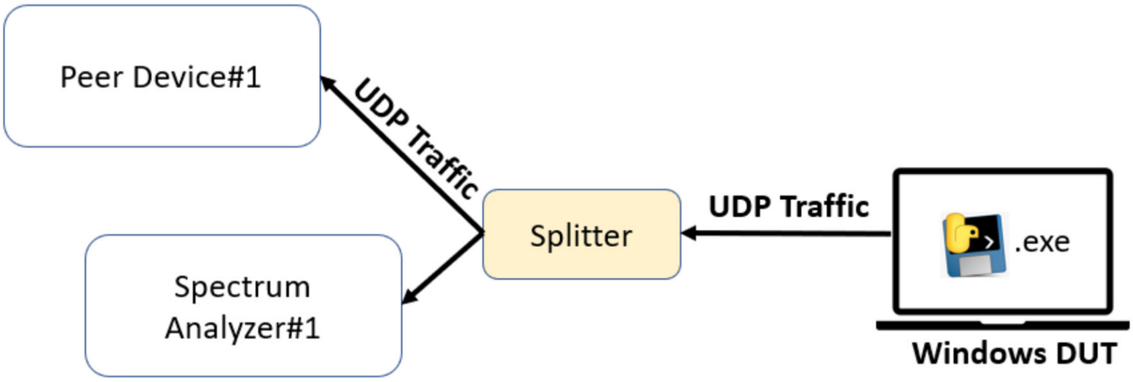


Figure 6-2. TA-SAR conducted power test setup for test scenarios 1 and 4 with Windows DUT

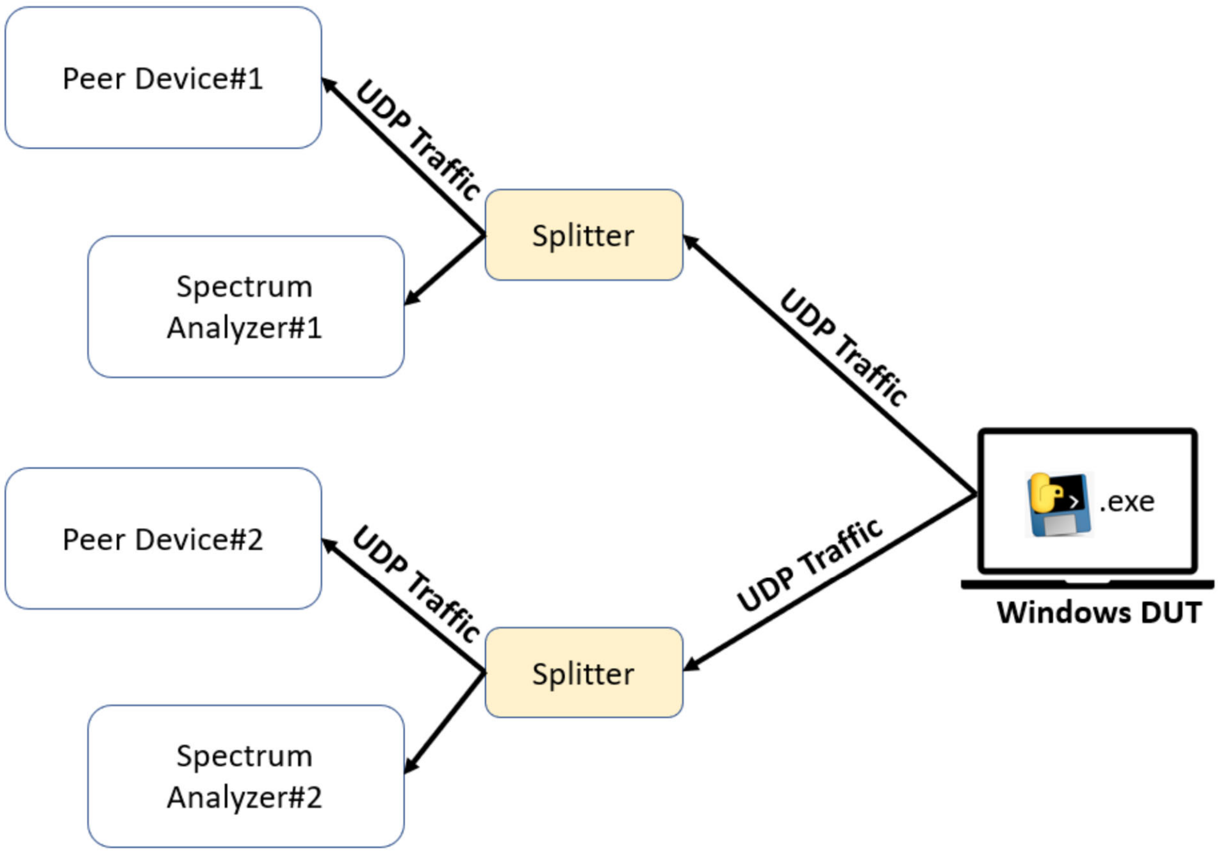


Figure 6-3. TA-SAR conducted power test setup for test scenarios 2 and 5 with Windows DUT

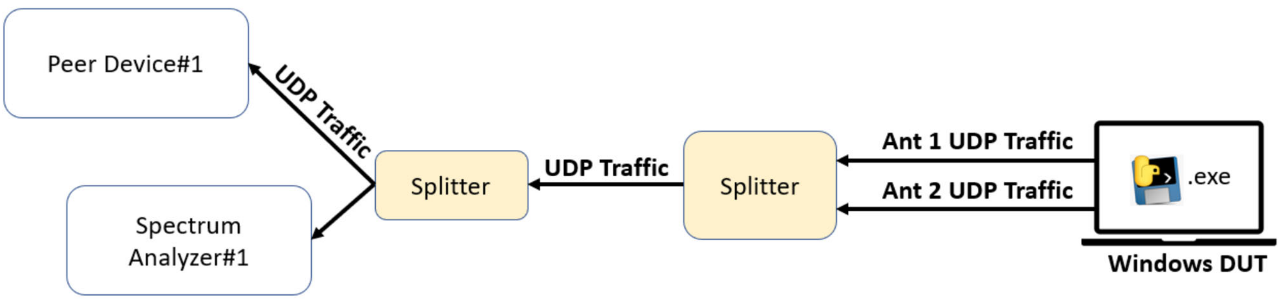


Figure 6-4. TA-SAR conducted power test setup for test scenario 3 with Windows DUT

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 follows:

Center frequency: = WLAN channel frequency

Span: Zero span

RBW: Spectral analyzer's maximum capability (8MHz for Keysight PXA N9030A)

VBW: =RBW

Sweep Time: 1400s

Sweep Point: =10 times 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 spectral analyzer, 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 sequences according to the selected test scenario, starts the UDP traffic from DUT, and pulls the logs from DUT.

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 and 6GHz band TX mode change. The detailed setting is listed in Table 6-1 and Table 6-2. Figure 6-1 and 6-2 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 and 1-2. As seen in this figure, the time-averaged SAR does not exceed the FCC limit.

Table 6-1 TA-SAR parameters setting for test scenario 1-1

Test band	Max power	$P_{WF\_SAR\_limit}$
2.4 GHz	22 dBm	17 dBm

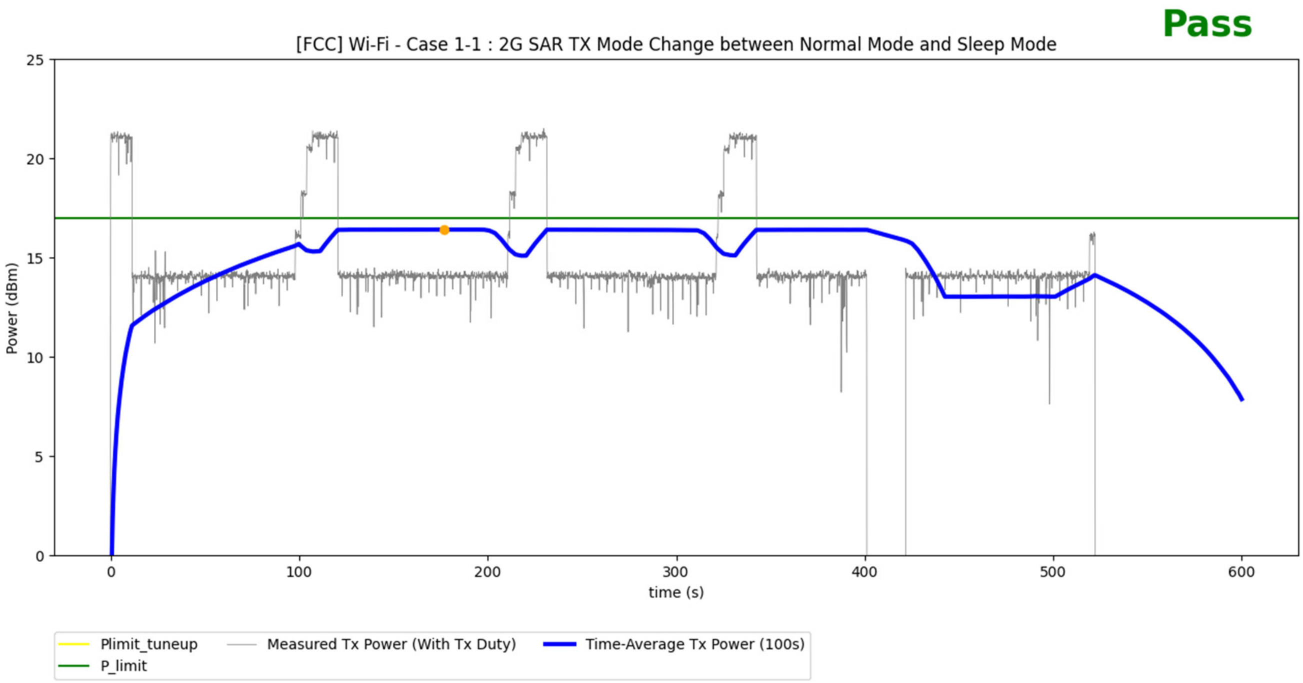


Figure 6-1 Time-averaged conducted TX power over time for test scenario 1-1

Table 6-2 TA-SAR parameters setting for test scenario 1-2

Test band	Max power	$P_{WF\_SAR\_limit}$
6 GHz	21 dBm	14.5 dBm

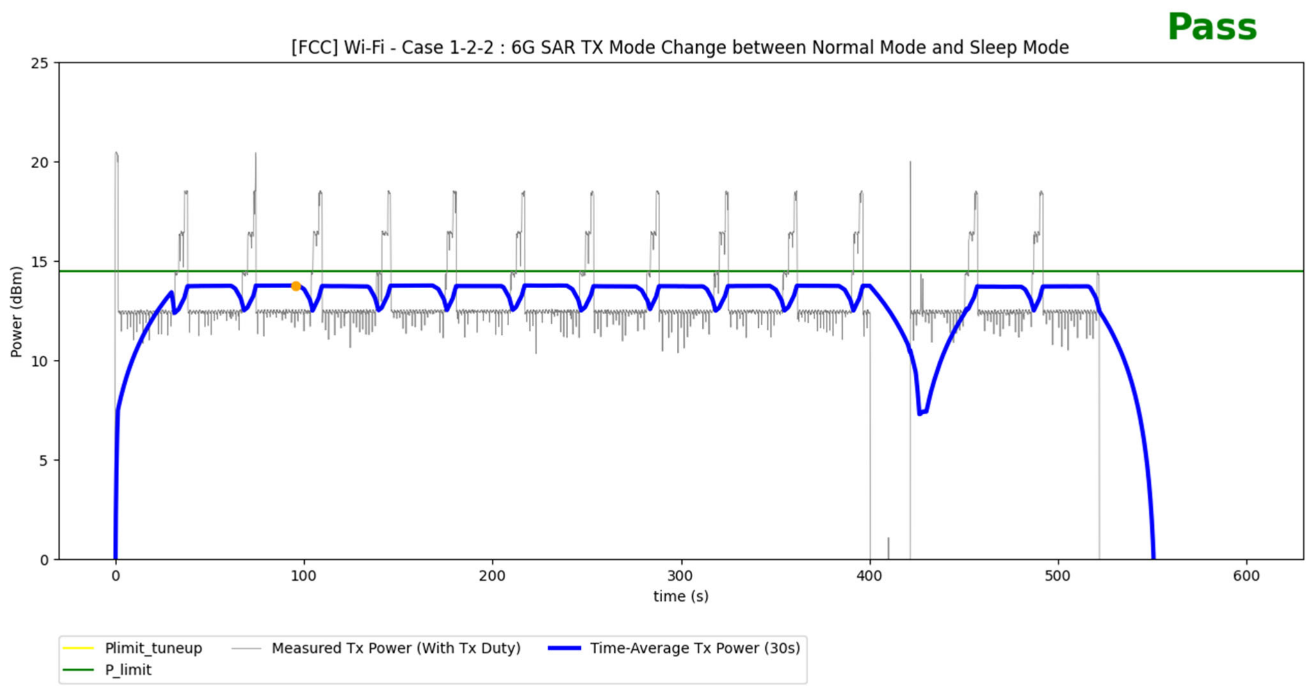


Figure 6-2 Time-averaged conducted TX power over time for test scenario 1-2

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 6-3. Figure 6-3 demonstrates DUT's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time, and the power limit. Figure 6-3-2 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.

Table 6-3 TA-SAR parameters setting for scenario 2

Test band	Switch time	Max power	$P_{WF\_SAR\_limit}$
2.4 GHz	0~400s	22 dBm	17 dBm
5 GHz	400s~800s	22 dBm	15.5 dBm
2.4 GHz+5 GHz	800s~1200s	22/22 dBm	17/15.5 dBm

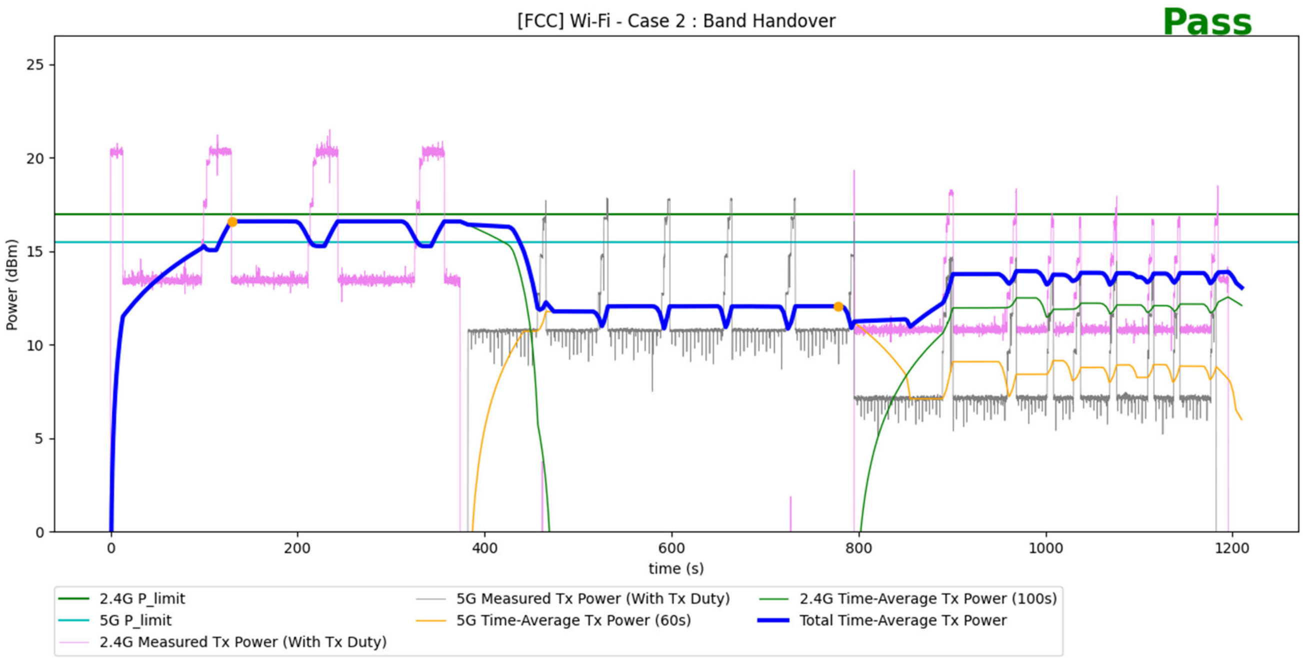


Figure 6-3 Time-averaged conducted TX power over time for test scenario 2

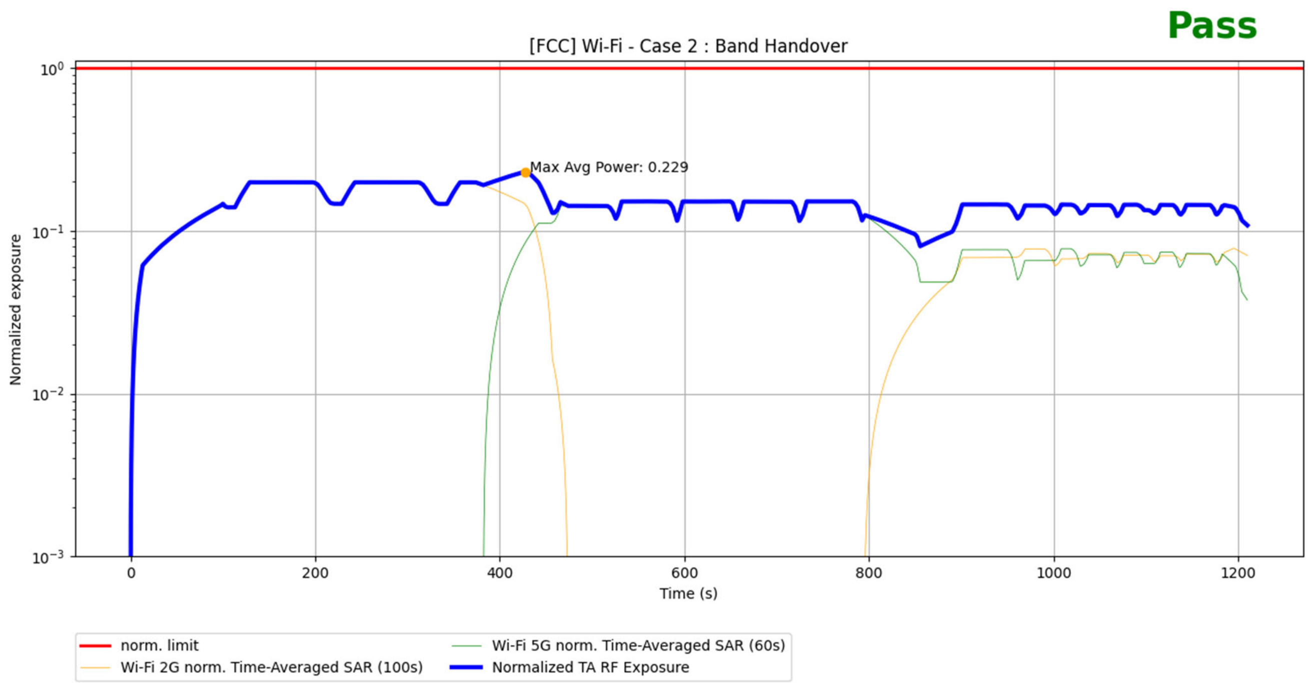


Figure 6-3-2 Normalized time-averaged SAR over time for test scenario 2

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 6-4. Figure 6-4 demonstrates the DUT's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time, and the power limit. Figure 6-4-2 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.

Table 6-4 TA-SAR parameters setting for test scenario 3

Test band	Antenna	Switch time	Max power	$P_{WF\_SAR\_limit}$
2.4 GHz	0	0~400s	22 dBm	17 dBm
2.4 GHz	1	400s~800s	22 dBm	17 dBm

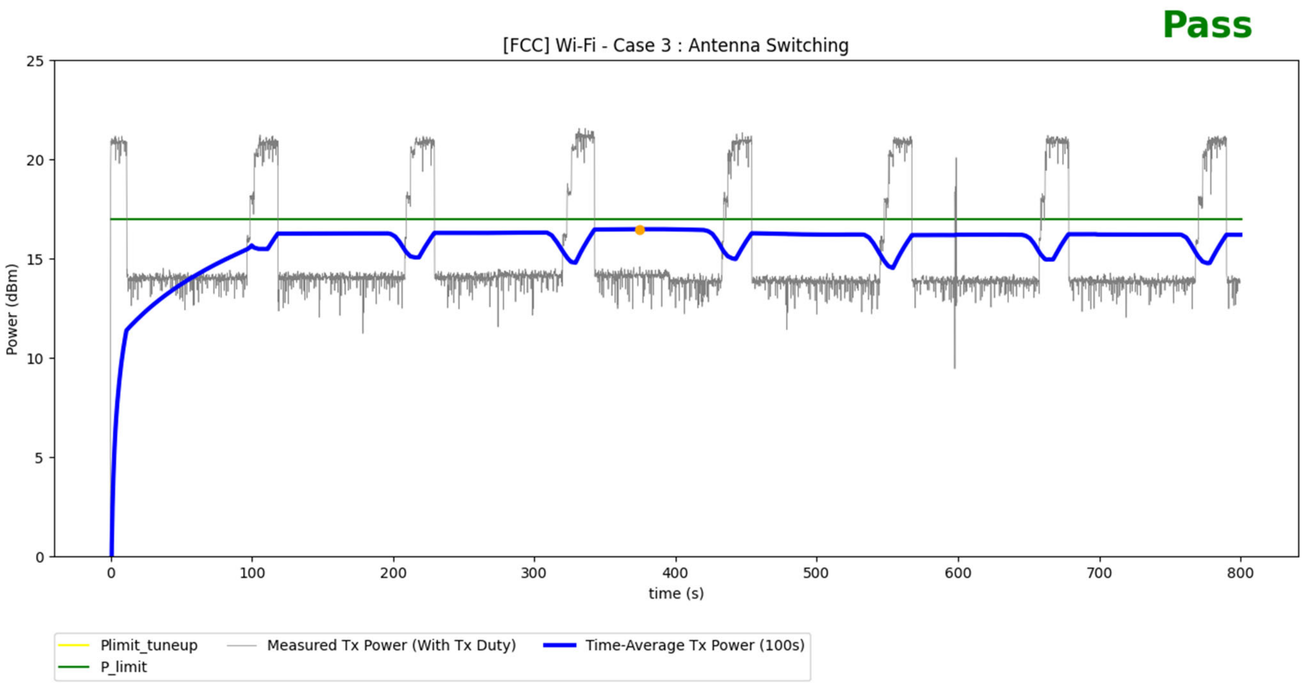


Figure 6-4 Time-averaged conducted TX power over time for test scenario 3

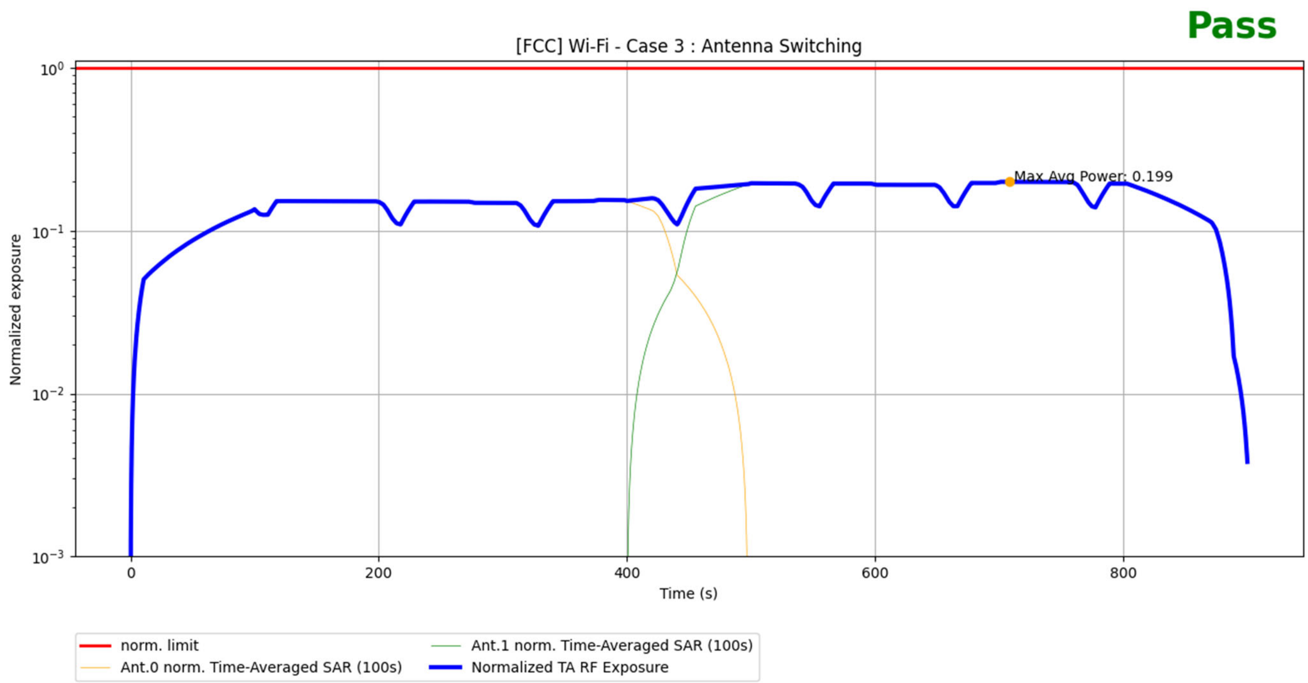


Figure 6-4-2 Normalized time-averaged SAR over time for test scenario 3

6.5 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 6-6. 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 6-6 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 6-6-2 shows the total normalized time-averaged RF exposure is always below the normalized FCC requirement of 1.

Table 6-6 TA-SAR/TA-PD parameters setting for test scenario 5

TER	Test band	Switch time	Max power	P_{SAR_limit} or P_{PD_limit}
SAR	2.4 GHz	0~800s	22	17
SAR	6 GHz	0~800s	21	14.5
PD	6 GHz	0~800s	21	14.5

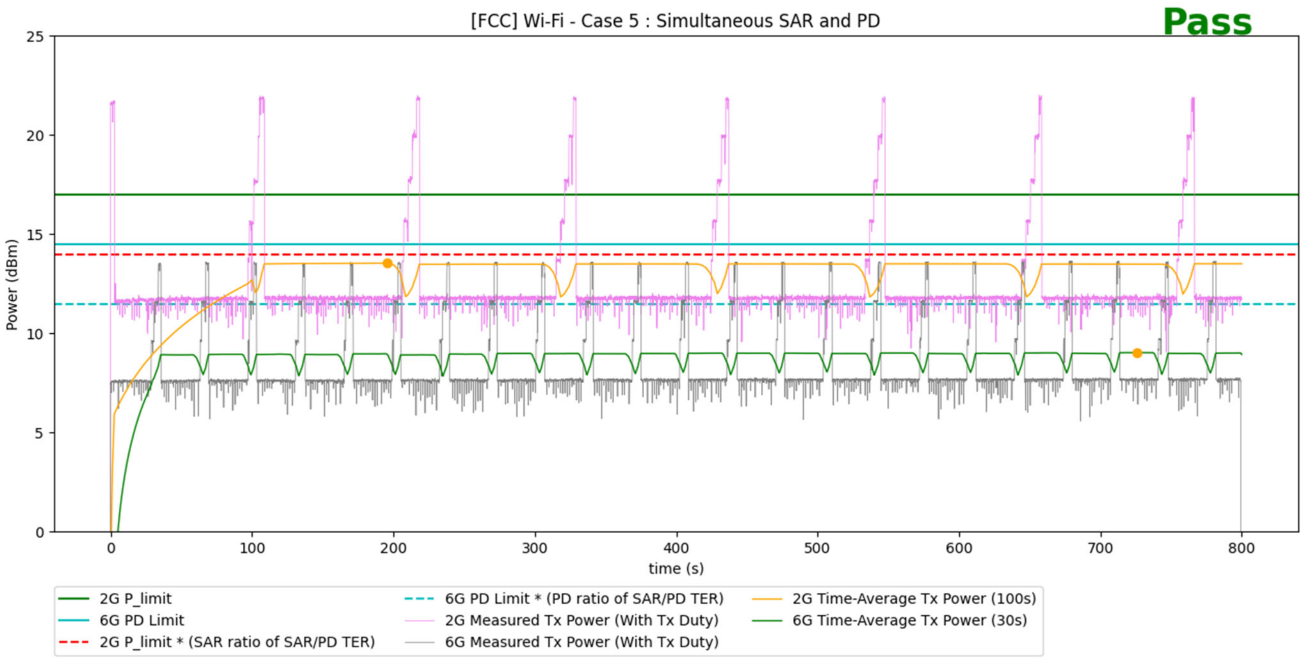


Figure 6-6 Time-averaged conducted TX power over time for test scenario 5

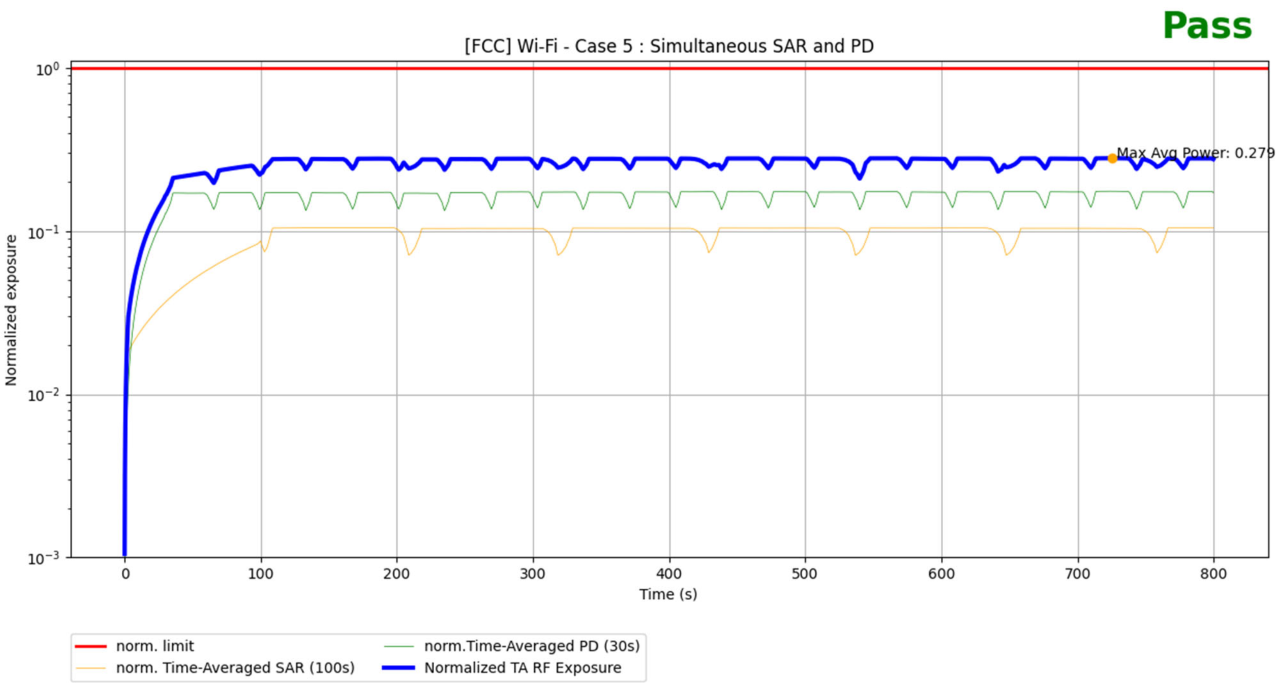


Figure 6-6-2 Normalized time-averaged SAR over time for test scenario 5

7. Wi-Fi TA-SAR Validation via SAR Measurements

7.1 Measurement Setup

Refer to Appendix C. Test Setup Photographs

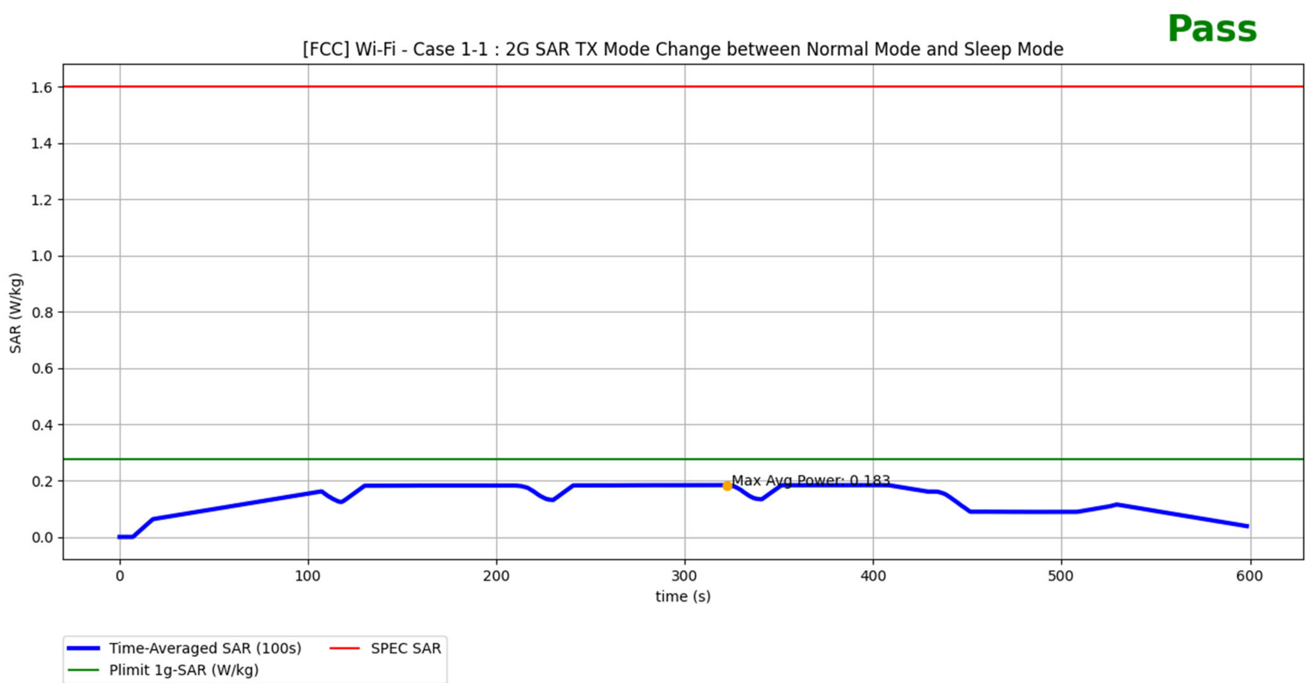
7.2 TA-SAR Measurement Results for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode

MediaTek's TA-SAR algorithm was tested using DASY6. The detailed settings are listed in Table 7-1 and Table 7-2. Figure 7-1 demonstrates scenario 1-1 of 2.4GHz band TA-SAR measurement result and Figure 7-2 demonstrates scenario 1-2 of 6GHz band TA-SAR measurement result.

Table 7-1 TA-SAR parameters setting for test scenario 1-1

Test band	Max power	$P_{WF\_SAR\_limit}$
2.4GHz	22 dBm	17 dBm

Figure 7-1 Time-averaged SAR measurement for scenario 1-1

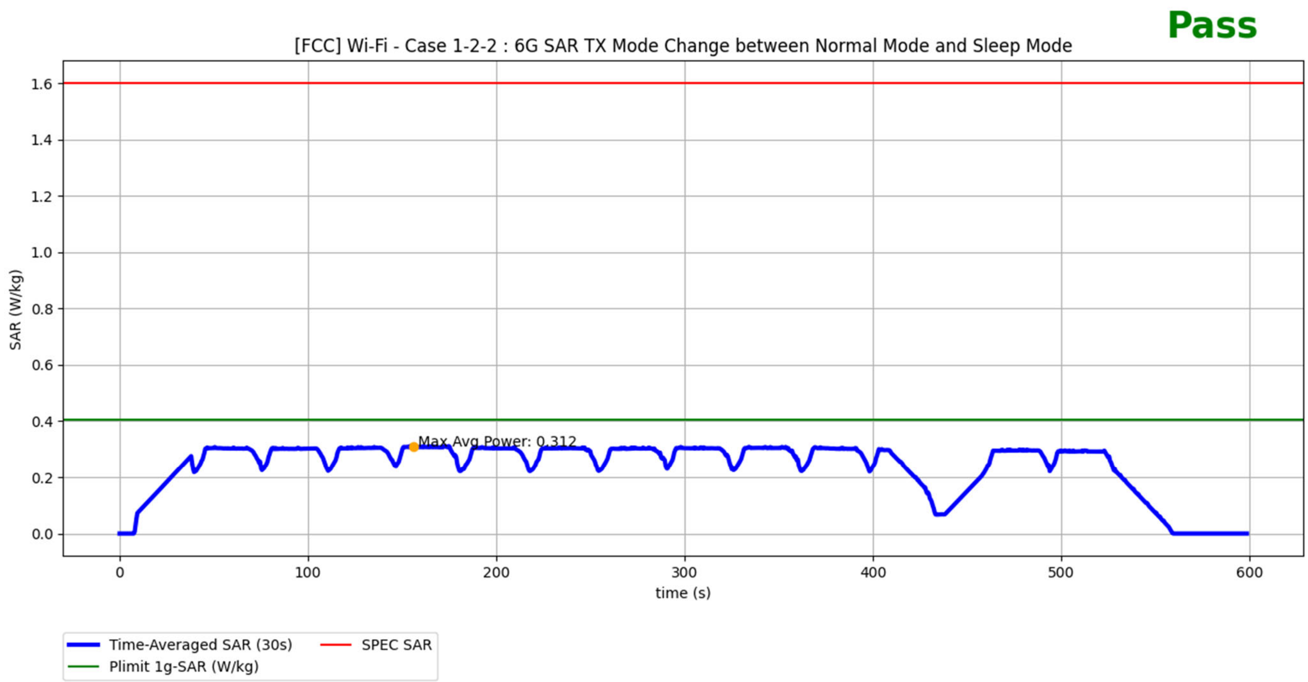


FCC 1gSAR limit	1.6 W/kg
Max 100s-time averaged 1gSAR	0.183 W/kg
Validation result: pass	

Table 7-2 TA-SAR parameters setting for test scenario 1-2

Test band	Max power	$P_{WF\_SAR\_limit}$
6GHz	21 dBm	14.5 dBm

Figure 7-2 Time-averaged SAR measurement for scenario 1-2



FCC 1gSAR limit	1.6 W/kg
Max 100s-time averaged 1gSAR	0.312 W/kg
Validation result: pass	

8. Wi-Fi TA-PD Validation via Conducted Power Measurements

8.1 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 PD 6GHz band TX mode change. The test measurement setup is illustrated in Section 8. The detailed setting is listed in Table 8-1. Figure 8-1 demonstrates DUT's instantaneous conducted TX power, the time-averaged conducted TX power behavior over time, and the power limit. As seen in this figure, the time-averaged PD does not exceed the FCC limit.

Table 8-1 TA-PD parameters setting for test scenario 1

Test band	Max power	$P_{WF\_PD\_limit}$
6GHz	21 dBm	14.5 dBm

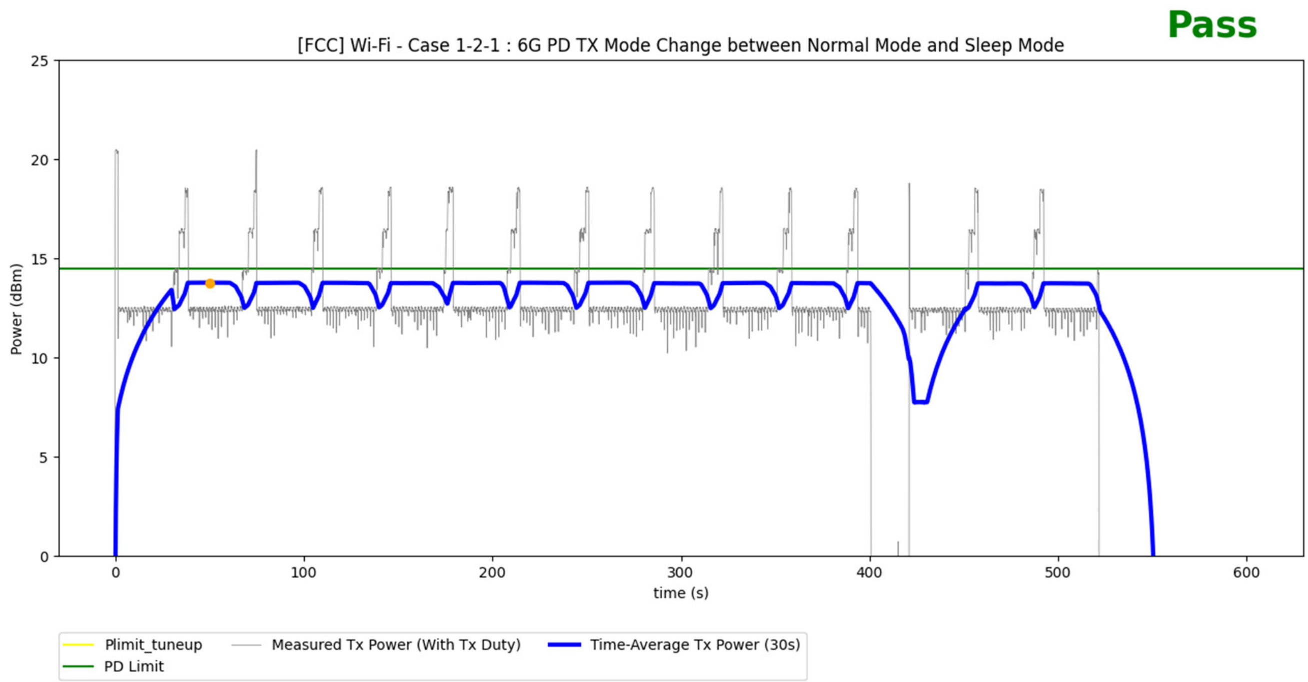


Figure 8-1 Time-averaged conducted TX power over time for scenario 1

9. Wi-Fi TA-PD Validation via PD Measurements

9.1 Measurement Setup

Refer to Appendix C. Test Setup Photographs

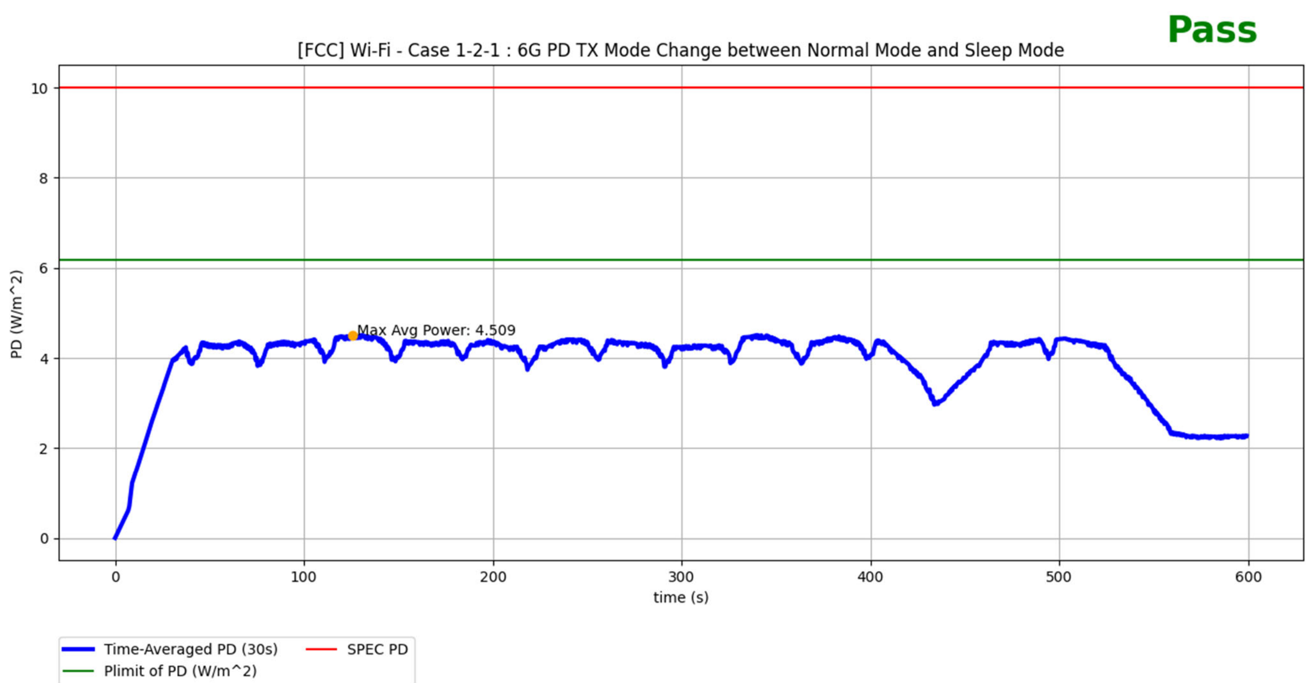
9.2 TA-PD Measurement Results for Scenario 1: TX Mode Change between Normal Mode and Sleep Mode

MediaTek's TA-SAR algorithm was tested using DASY6. The detailed setting is listed in Table 9-1. Figure 9-1 demonstrates scenario 1 of 6GHz band TA-PD measurement result.

Table 9-1 TA-PD parameters setting for test scenario 1

Test band	Max power	$P_{WF\_PD\_limit}$
6GHz	21 dBm	14.5 dBm

Figure 9-1 Time-averaged PD measurement result for test scenario 1



FCC PD limit	10 W/m^2
Max 30s-time averaged PD	4.509 W/m^2
Validation result: pass	

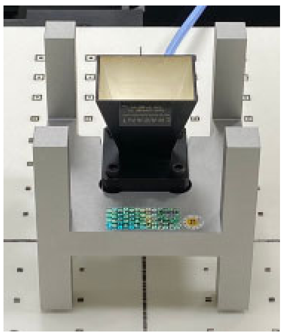
10. Measurement Procedure

10.1 SAR System Check

10.1.1 Dipoles

The SAR dipoles are optimized symmetrical dipole with $\lambda/4$ balun matched to a Flat phantom section filled with tissue simulating liquids. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC signals. They are available for the variety of frequencies between 300MHz and 10 GHz. The provided tripod is used to hold the dipole below the phantom. As the distance between the dipole center and the TSL is critical, a spacer is placed between the dipole and the phantom. The spacing distance is frequency dependent.

10.1.2 Verification Source



The verification sources apply to system check or verification at specific mmWave frequencies. The sources comprisehorn-antennas and very stable signal generators.

10.1.3 SAR System Check Result

1. Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %.
2. 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 of this report.

Date	Frequency (MHz)	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Delta 1g ±10 (%)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Delta 10g ±10 (%)	Tissue Temp. (°C)
2025/7/24	2450	250	12.40	51.80	49.6	-4.25	6.04	24.20	24.16	-0.17	22.1
2025/7/25	6500	100	30.30	294.00	303	3.06	5.80	53.90	58	7.61	22.1

Date	Frequency (MHz)	Input Power (mW)	Measured APD 4 cm^2 (W/m^2)	Targeted APD 4 cm^2 (W/m^2)	Normalized APD 4 cm^2 (W/m^2)	Delta 4 cm^2 ±10 (%)	Tissue Temp. (°C)
2025/7/25	6500	100	140.00	1320.00	1400	6.06	22.1

10.1.4 Power Density System Check Result

The system performance check verifies that the system operates within its specifications.

The system check is successful if the difference between the normalized measured local power density and the numerically validated target value is within the reported expanded uncertainty of the measurement system.

The recommended settings for measurement of verification sources are listed in the following:

Frequency (GHz)	Grid step	Grid extent X/Y (mm)	Measurement points
10	0.125 (λ/8)	60 / 60	18 x 18

According to the DASY specification in the user's manual and SPEAG's recommendation, the deviation threshold of ±0.66 dB represents the expanded standard uncertainty for system performance check. The system check is successful if the measured results are within ±0.66 dB tolerances to the target value shown in the calibration certificate of the verification source.

Date	Frequency (GHz)	Distance (mm)	Input Power (mW)	Measured Avg 4 cm^2 (W/m^2)	Targeted Avg 4 cm^2 (W/m^2)	Deviation (dB)
2025/7/25	10	10	138	182.7	177.00	0.14

Note: The Measured Avg PD was the average of psPDn+, psPDtot+ and psPDmod+, which refers to the demonstration from calibration certificate.

10.2 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using Dielectric Probe Kit and Vector Network Analyzer.

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)			Tissue Temp. (°C)
			Measured	Target	Delta (%)	Measured	Target	Delta (%)	
2025/7/24	Head	2450	39.70	39.20	1.28	1.81	1.80	0.56	22.1
2025/7/25	Head	6500	34.30	34.50	-0.58	6.05	6.07	-0.33	

10.3Test Equipment List

Instrument	Manufacturer	Model No.	Serial No.	Last Calibration	Next Calibration
Reference Dipole 2450MHz	Speag	D2450V2	1054	2024/11/18	2027/11/17
Reference Dipole 6.5GHz	Speag	D6.5GHzV2	1021	2024/02/12	2027/02/11
Verification Source Antenna 10GHz	Speag	5G Verification Source 10GHz	2006	2025/04/14	2026/04/13
Data Acquisition Electronic	Speag	DAE4	1651	2025/02/12	2026/02/11
E-Field Probe	Speag	EX3DV4	7631	2025/02/26	2026/02/25
mmWave E-field Probe	Speag	EUmmWV4	9546	2025/04/16	2026/04/15
SAR Software	Speag	cDASY6	V16.4.0.5005	N/A	N/A
Power Amplifier	Mini-Circuit	ZVE-8G+	447202211	N/A	N/A
Directional Coupler	Agilent	87300C	MY44300353	N/A	N/A[1]
Attenuator	Woken	WATT-218FS-10	N/A	N/A	N/A[1]
Attenuator	Mini-Circuit	BW-S20W2+	N/A	N/A	N/A[1]
Vector Network Analyzer	Agilent	E5071C	MY46108013	2025/03/28	2026/03/27
Signal Generator	Anritsu	MG3694A	041902	2024/08/20	2025/08/19
Power Meter	Anritsu	ML2487A	6K00001447	2024/10/19	2025/10/18
Power Sensor	Anritsu	MA2411B	1339194	2024/10/19	2025/10/18
EXA Spectrum Analyzer	Agilent	N9010A	MY48030495	2025/01/02	2026/01/01
EXA Spectrum Analyzer	Agilent	N9010A	MY53470892	2024/10/30	2025/10/29

Note: 1. System Check, the path loss measured by the network analyzer, includes the signal generator, amplifier, cable, attenuator and directional coupler.

Note:

Per requirements for dipole calibration, the following are recommended procedures for SAR dipole calibration.

1. After a dipole is damaged and properly repaired to meet required specifications.

2. When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions.

3. When the most recent return-loss, measured at least annually, deviates by more than 20% from the previous measurement (i.e. 0.2 of the dB value) or not meeting the required -20 dB return-loss specification.

D6.5GHzV2-1021

	Frequency	Tissue	Return loss	Limit	Date
Calibration	6500 MHz	Head	-27.6	Within 20%	2024/2/12
Measurement	6500 MHz	Head	-27.70		2025/2/10

4. When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 Ω from the previous measurement.

D6.5GHzV2-1021

	Frequency	Tissue	Impedance	Limit	Date
Calibration	6500 MHz	Head	53.5	Within 5Ω	2024/2/12
Measurement	6500 MHz	Head	53.26		2025/2/10

11. Conclusions

This document proposes Wi-Fi TA-SAR and TA-PD test scenarios and procedures and demonstrates that MediaTek's TA-SAR and TA-PD algorithms are able to meet FCC SAR and PD regulatory requirements under the proposed test conditions. As shown in Chapters 6 and 8, MediaTek's TA-SAR and TA-PD algorithms can maintain SAR and PD levels below the FCC regulatory limits over time.

In addition, near-field measurements were conducted to further validate the proposed test methodology. The results, presented in Chapters 7 and 9, confirm that MediaTek's TA-SAR and TA-PD algorithms can consistently maintain SAR and PD levels below the FCC limits under the proposed procedures.

Based on the measurement data provided, it is concluded that the algorithms can be evaluated for FCC compliance using the proposed test approach.

Appendix

Appendix A. System Check Data

Appendix C. Test Setup Photographs

Appendix D. Probe Calibration Data

Appendix E. Dipole Calibration Data