Part 0: SAR Characterization Evaluation Report for FCC

Applicant Name	:	ASUSTeK COMPUTER INC.
Applicant Address	:	1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan
Product Name	:	2TX 11be (WiFi7)BW160 + BT/BLE Combo Card
Brand Name	:	MediaTek
Model Number	:	MT7925B22M
FCC ID	:	MSQ-MT7925B22M

Report Number	:	USSC244183001
Compliant Standards	:	FCC 47 CFR §2.1093
Sample Received Date	:	Apr. 15, 2024
Date of Testing	:	Apr. 26, 2024 ~ Apr. 29, 2024
Report Issue Date	:	Jun. 13, 2024

The above equipment have been tested by **Eurofins E&E Wireless Taiwan Co., Ltd.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Device Under Test (DUT) configurations represented herein are true and accurate accounts of the measurements of the sample's characteristics under the conditions specified in this report.

Note:
1. The test results are valid only for samples provided by customers and under the test conditions described in this report.
2. This report shall not be reproduced except in full, without the written approval of Eurofins E&E Wireless Taiwan Co., Ltd.
3. The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Approved By：

Roy Wu / Technical Director

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Revision History

Rev.	Issue Date	Description	Revised by
00	Jun. 13, 2024	Initial release	Rowan Hsieh

1. Information of Testing Laboratory

Test Facilities

Company Name: Eurofins E&E Wireless Taiwan Co., Ltd.
Address No.: 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan
Website: https://www.atl.com.tw
Telephone: +886-3-271-0188
Fax: +886-3-271-0190
E-mail: infoEETW@eurofins.com

Test Site Location

☐ No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan
☑ No. 2, Wuquan 5th Rd. Wugu Dist., New Taipei City, Taiwan

Laboratory Accreditation

Location	TAF	FCC	ISED
No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan	Accreditation No.: 1330	Designation No.: TW0010	Company No.: 7381A CAB ID: TW1330
No. 2, Wuquan 5th Rd. Wugu Dist., New Taipei City, Taiwan	Accreditation No.: 1330	Designation No.: TW0034	Company No.: 28922 CAB ID: TW1330

2. Device Under Test Information

Product Name	2TX 11be (WiFi7)BW160 + BT/BLE Combo Card	
Brand Name	MediaTek	
Model Name	MT7925B22M	
FCC ID	MSQ-MT7925B22M	
Host Information	Product Name: Notebook PC Trade Name: ASUS Model Name: GA605W, GA605WI, GA605WV, GA605WU, GA665W, GA665WI, GA665WV, GA665WU All models are electrically identical, different model names are for marketing purpose.	
Supported Wireless Technologies	***Tx Frequency (MHz)***	***Operating Mode***
	WLAN 2.4G : 2412 ~ 2472 5G : 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5720, 5745 ~ 5825, 5815 ~ 5885 6G : 5955 ~ 7115	2.4G : 802.11b/g/n/ac/ax/be 5G : 802.11a/n/ac/ax/be 6G : 802.11a/ax/be
	Bluetooth 2402 ~ 2480	BR, EDR, LE

Note:

The above DUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

Time-Averaging for SAR and Power Density

This device is enabled with *MediaTek*'s TA-SAR and TA-PD algorithms to control and manage instantaneous transmitting power in real time for transmit frequencies less and larger than 6 GHz respectively and to ensure that the time-averaged RF exposure from WLAN is in compliance with FCC requirements.

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 < 6 GHz 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 6 GHz 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.

This *Part 0* report shows *SAR Characterization* of WLAN radios. The characterization is achieved by determining power limit (*P_WF_SAR_limit)* for 2.4G / 5G / 6G bands that corresponds to the exposure design targets after accounting for all device design related uncertainties. The SAR characterization is denoted as SAR Char in this report.

The compliance test under the *Static Transmission Scenario* and *Simultaneous Transmission* analysis are reported in the *Part 1* report (*SAR, APD and IPD Evaluation Report)*. The validation of the TA-SAR and TA-PD feature and compliance under the *Dynamic (Time-Varying) Transmission Scenario* for WLAN technologies are reported in the *Part 2* report (*TAS Algorithm Validation report*).

In addition, this device supports WLAN and Bluetooth technology, but the output power of ***Bluetooth*** modem is not controlled by the Wi-Fi TA-SAR algorithm and has no TAS function.

Operating Parameters for Wi-Fi TA-SAR and TA-PD Algorithm

Term	*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), 4.0 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.
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/m^2 (4 cm^2 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. SAR Measurement System

3.1. Definition of Specific Absorption Rate (SAR)

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ).The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\boldsymbol{\rho}\mathbf{dv}}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be related to the electrical field in the tissue by

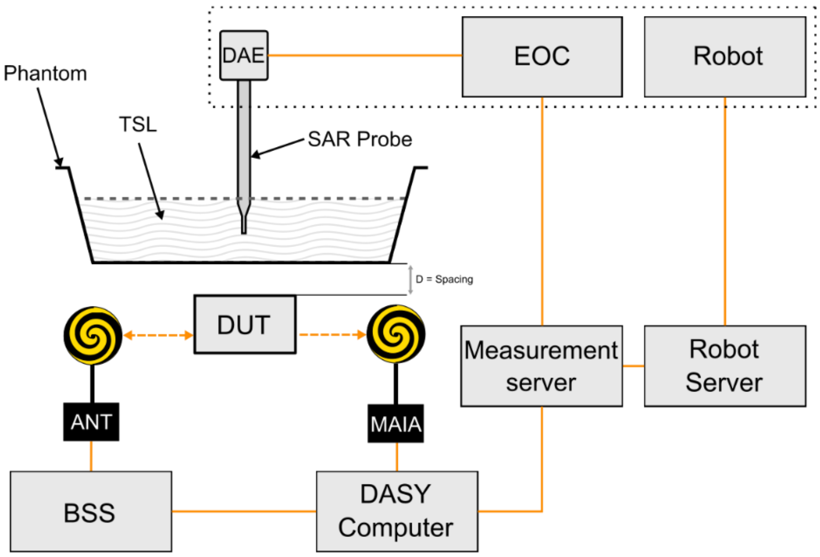
$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

3.2. SPEAG DASY8 System

The DASY8 system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY8 software defined. The DASY8 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

Figure 3-1: SPEAG DASY8 System Setup



3.3. SAR Measurement Procedure

According to the SAR test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

The SAR measurement procedures for each of test conditions are as follows:

(a) Make DUT to transmit maximum output power
(b) Measure conducted output power through RF cable
(c) Place the DUT in the specific position of phantom
(d) Perform SAR testing steps on the DASY system
(e) Record the SAR value

3.3.1. Area Scan and Zoom Scan Procedure

First area scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an area scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, zoom scan is required. The zoom scan is performed around the highest E-field value to determine the averaged SAR-distribution.

Measure the local SAR at a test point at 1.4 mm of the inner surface of the phantom recommended by SEPAG. The area scan (two-dimensional SAR distribution) is performed cover at least an area larger than the projection of the DUT or antenna. The measurement resolution and spatial resolution for interpolation shall be chosen to allow identification of the local peak locations to within one-half of the linear dimension of the corresponding side of the zoom scan volume. Following table provides the measurement parameters required for the area scan.

Parameter	$f \leqq$ 3 GHz	3 GHz < $f \leqq$ 6 GHz
Maximum distance from closest measurement point to phantom surface	5 ± 1	δ ln(2)/2 ±0.5
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ±1°	20° ±1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≦2 GHz: ≦15 mm 2 – 3 GHz: ≦12 mm	3 – 4 GHz: ≦12 mm 4 – 6 GHz: ≦10 mm

From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks. Additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit (e.g. 1 W/kg for SAR_{1g} limit of 1.6 W/kg; or 1.26 W/kg for SAR_{10g} limit of 2 W/kg).

The zoom scan (three-dimensional SAR distribution) is performed at the local maxima locations identified in previous area scan procedure. The zoom scan volume must be larger than the required minimum dimensions. When graded grids are used, which only applies in the direction normal to the phantom surface, the initial grid separation closest to the phantom surface and subsequent graded grid increment ratios must satisfy the required protocols. The 1-g SAR averaging volume must be fully contained within the zoom scan measurement volume boundaries; otherwise, the measurement must be repeated by shifting or expanding the zoom scan volume. The similar requirements also apply to 10-g SAR measurements. Following table provides the measurement parameters required for the zoom scan.

Parameter		$f \leq$ 3 GHz	3 GHz < $f \leq$ 6 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}		≦2 GHz: ≦8 mm 2 – 3 GHz: ≦5 mm	3 – 4 GHz: ≦5 mm 4 – 6 GHz: ≦4 mm
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≦5 mm	3 – 4 GHz: ≦4 mm 4 – 5 GHz: ≦3 mm 5 – 6 GHz: ≦2 mm
	graded grids: $\Delta z_{Zoom}(1)$	≦4 mm	3 – 4 GHz: ≦3.0 mm 4 – 5 GHz: ≦2.5 mm 5 – 6 GHz: ≦2.0 mm
	$\Delta z_{Zoom}(n>1)$	≦$1.5 \cdot \Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume (x, y, z)		≥30 mm	3 – 4 GHz: ≥28 mm 4 – 5 GHz: ≥25 mm 5 – 6 GHz: ≥22 mm

3.3.2. Power Drift Monitoring

All SAR testing is under the DUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of DUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.

3.3.3. Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

3.3.4. SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

4. SAR Characterization

4.1. ECI (Exposure Condition Index) and SAR Determination

This device uses different Exposure Condition Index (ECI) to configure different time averaged power levels based on certain exposure scenarios. Depending on the detection scheme implemented in the DUT, the worst-case SAR was determined by measurements for the relevant exposure conditions for that ECI. Detailed descriptions of the detection mechanisms are included in the operational description document.

When SAR_{1g} and SAR_{10g} exposure comparison is needed, the worst-case was determined from SAR normalized to 1g or 10g SAR limit.

The exposure condition index (ECI) conditions used in below represent different exposure scenarios.

Exposure Scenario	Description	SAR Test Cases
Body (ECI = 0)	Device positioned against to body	Body SAR tested with DUT at 0 mm

4.2. SAR Design Target

The SAR design target (*WF_SAR_design_limit*) is determined by ensuring that it is less than SAR limit after accounting for total device designed related uncertainties specified by the manufacturer. The total uncertainties for this device is 1.0 dB. To account for total uncertainty, SAR design target (*WF_SAR_design_limit*) is determined as below:

$$WF\_SAR\_design\_limit \leq SAR\_REG\_limit - Total\ Uncertainties$$

For SAR_{1g}, the SAR regulatory limit (*SAR_REG_limit*) is 1.6 W/kg, and the SAR design target (*WF_SAR_design_limit*) is 0.95 W/kg.

4.3. SAR Characterization

The power limit (*P_WF_SAR_limit*) is calculated by linearly scaling with the measured SAR at the maximum tune-up output power (*P_WF_SAR_MAX_limit*) to correspond to the SAR design target (*WF_SAR_design_limit*). The power limit (*P_WF_SAR_limit*) determination for each exposure scenario corresponding to SAR design target (*WF_SAR_design_limit*) are show in below.

Exposure Condition Index (ECI)	P_WF_SAR_limit Determination Scenarios
ECI = 0	The worst-case SAR exposure is determined as maximum SAR normalized to the limit among: 1. Body-worn SAR

SAR Characterizations

ECI		*0*	*P_WF_SAR_MAX_limit (Maximum Tune-up Power, dBm)*
Averaging Volume		*1g*	
Test Distance (mm)		*0*	
WLAN Bands	*Tx Antenna*	*P_WF_SAR_limit (dBm)*	
2.4G	Ant 0	14.5	21.5
	Ant 1	14.5	21.5
5.3G (U-NII 2a)	Ant 0	13.0	21.5
	Ant 1	13.0	21.5
5.6G (U-NII 2c)	Ant 0	13.0	21.5
	Ant 1	13.0	21.5
5.8G (U-NII 3)	Ant 0	13.0	21.5
	Ant 1	13.0	21.5
6.2G (U-NII 5)	Ant 0	17.0	20.5
	Ant 1	17.0	20.5
6.5G (U-NII 6)	Ant 0	14.5	20.5
	Ant 1	14.5	20.5
6.7G (U-NII 7)	Ant 0	17.0	20.5
	Ant 1	17.0	20.5
7G (U-NII 8)	Ant 0	14.5	20.5
	Ant 1	14.5	20.5

Note：

1. When maximum tune-up output power (*P_WF_SAR_MAX_limit*) < power limit (*P_WF_SAR_limit*), the DUT will operate at a power level up to power maximum (*P_WF_SAR_MAX_limit*) level.
2. All power limit (*P_WF_SAR_limit*) and maximum tune-up output power (*P_WF_SAR_MAX_limit*) levels entered in above table correspond to average power levels after accounting for duty cycle.
3. The maximum tune-up output power (*P_WF_SAR_MAX_limit*) is used to configure DUT during RF tune-up procedure. The maximum allowed output power is equal to maximum tune-up output power +1.0 dB device design uncertainty.
4. For some bands / modes, a lower power limit (*P_WF_SAR_limit*) was selected as a more conservative evaluation.

************************************ End of Report ************************************