FCC SAR Test Report

Product	:	Grid Pad 16
Trade mark	:	Smartbox
Model/Type reference	:	GP16A
Serial Number	:	N/A
Report Number	:	EED32Q82023105
FCC ID	:	2APXM-GP16A
Date of Issue:	:	Mar. 20, 2025
Test Standards	:	Refer to Section 1.5
Test result	:	PASS

Prepared for:
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1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report.

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1.2 Application details

Date of receipt of test item:	2025-01-10
Start of test:	2025-01-15
End of test:	2025-01-25

1.3 EUT Information

Device Information:			
Product:	Grid Pad 16		
Model:	GP16A		
Trade mark:	Smartbox		
SN:	N/A		
Product Type:	☐ Mobile ☒ Portable ☐ Fix Location		
Exposure Category:	uncontrolled environment / general population		
Antenna Type :	PCB antenna		
Antenna gain:	Bluetooth LE & Bluetooth Classic: -4.58dBi, 2.4G WiFi: ANT1(main): -4.58dBi, ANT2(AUX): 0.42dBi; 5G WiFi: ANT1(Main): Band1: 3.81dBi, Band4: 0.26dBi ANT2(AUX): Band1: 3.81dBi, Band4: 0.26dBi		
Others Accessories:	N/A		
Device Operating Configurations:			
Supporting Mode(s) :	BT Dual mode: 2402MHz to 2480MHz; 2.4GHz Wi-Fi: 802.11b/g/n(HT20 and HT40)/ax(HE20 and HE40): 2412MHz ~2462 MHz. 5G WIFI: U-NII-1:5.15-5.25GHz; U-NII-3:5.725-5.850GHz.		
Modulation:	BT: GFSK,π/4DQPSK,8DPSK WIFI: DSSS/OFDM/OFDMA		
Operating Frequency Range(s)	Band	TX(MHz)	RX(MHz)
	WIFI 2.4G	2412~2462	
	WIFI 5G	5150-5250; 5725-5850	
	BT	2402~2480	
Test Channels (low-mid-high):	1/3-6-9/11 (2.4G Wi-Fi) 0-39-78 (BT) 0-19-39 (BLE 2450) WIFI 5G 802.11a/n/ac/ax(20M): 36-40-44-48-149-153-157-161-165 WIFI 5G 802.11 n/ac/ax (40M): 38-46-151-159 WIFI 5G 802.11ac/ax(80M): 42-155		
Power Source:	AC/DC ADAPTER:	MODEL:MANGO60S-19AB-ES INPUT:100-240V~50/60Hz,1.5A MAX OUTPUT:19V,3.15A,60W MAX	

	Rechargeable Li-ion Battery 1:	Model:875583-3S Nominal Voltage:11.4V Rated Capacity:5820mAh/66.348Wh Charging Limited Voltage:13.05V
	Rechargeable Li-ion Battery 2:	Model:875583-3S Nominal Voltage:11.4V Rated Capacity:5820mAh/66.348Wh Charging Limited Voltage:13.05V

1.4 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing are as below:

Band	MAX Reported SAR (W/kg)		SAR Test Limit (W/kg)
	1-g Head	1-g Body (0mm)	
WiFi 2.4G	N/A	0.006	**1.60**
WiFi 5.2G	N/A	0.693	**1.60**
WiFi 5.8G	N/A	0.739	**1.60**
Highest Simultaneous Transmission	N/A	1.534	**1.60**

Remark: N/A: This devices doesn't support voice mode, the head mode is not applicable.

Note:

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits(1.6W/kg) according to the FCC rule §2.1093, the ANSI/IEEE C95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and Procedures specified in IEEE Std 1528-2013.

1.5 Test standard/s

ANSI Std C95.1-1992	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
IEEE Std 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 5 of February 2021)
KDB 248227 D01	SAR guidance for IEEE 802.11(Wi-Fi) transmitters v02r02
KDB 616217 D04	SAR for laptop and tablets v01r02
KDB 447498 D04	Interim General RF Exposure Guidance v01
KDB 690783 D01	SAR Listings on Grants v01r03
KDB 865664 D01	SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02	RF Exposure Reporting v01r02

1.6 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain/Body/Arms/Legs)	**1.60 mW/g**	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

The limit applied in this test report is shown in bold letters

Notes:

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the apPropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the apPropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation.

1.7 SAR Definition

Specific Absorption Rate is defined as 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).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

where:

σ = conductivity of the tissue (S/m)
ρ = mass density of the tissue (kg/m^3)
E = rms electric field strength (V/m)

1.8 Testing laboratory

Test Site	Centre Testing International Group Co., Ltd.
Test Location	Hongwei Industrial Zone, Bao'an 70 District, Shenzhen, Guangdong, China
Telephone	+86 (0) 755 3368 3668
Fax	+86 (0) 755 3368 3385

1.9 Test Environment

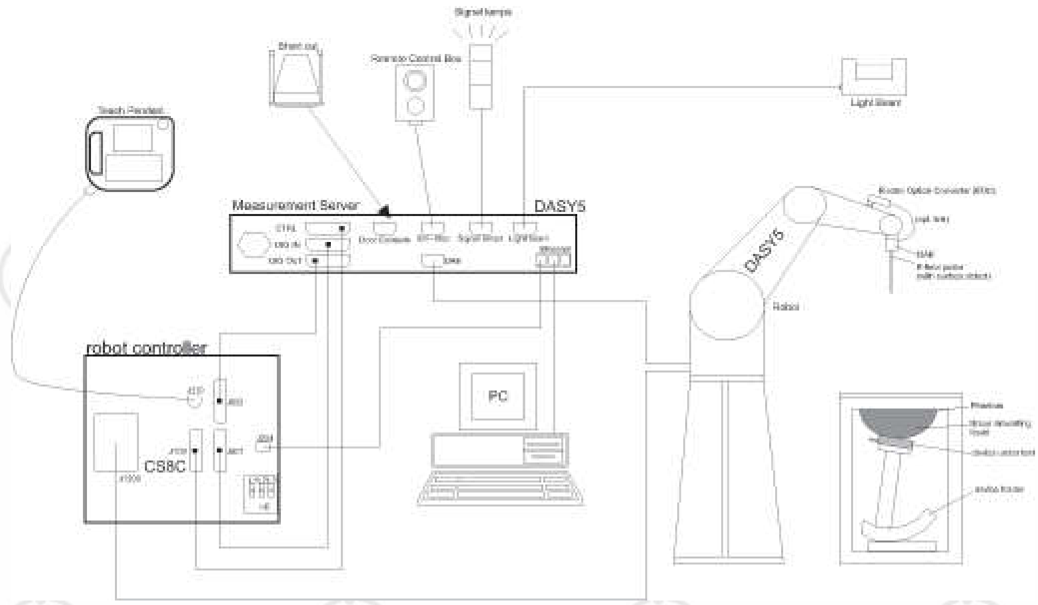
	Required	Actual
Ambient temperature:	18 – 25 °C	21.5 ± 2.0 °C
Tissue Simulating liquid:	18 – 25 °C	21.5 ± 2.0 °C
Relative humidity content:	30 – 70 %	30 – 70 %

1.10 Applicant and Manufacturer

Applicant/Client Name:	Smartbox Assistive Technology Limited
Applicant Address:	Ysobel House, Enigma Commercial Centre, Sandys Road, Malvern, Worcestershire, UK WR14 1JJ
Manufacturer Name:	Smartbox Assistive Technology Limited
Manufacturer Address:	Ysobel House, Enigma Commercial Centre, Sandys Road, Malvern, Worcestershire, UK WR14 1JJ
Factory Name:	Estone Technology LTD
Factory Address:	2F,Building No.1, Jia'an Industrial Park,No.2 Long Chang Road, Bao'an, Shenzhen 518101, China.

2 SAR Measurement System Description and Setup

2.1 The Measurement System Description



The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli TX/RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field Probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for Probe alignment. This imProves the (absolute) accuracy of the Probe positioning.
- A computer running Win7 Profesional operating system and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

2.2 Probe description

Dosimetric Probes: These Probes are specially designed and calibrated for use in liquids with high permittivities. They should not be used in air, since the spherical isotropy in air is poor(±2 dB). The dosimetric Probes have special calibrations in various liquids at different frequencies.

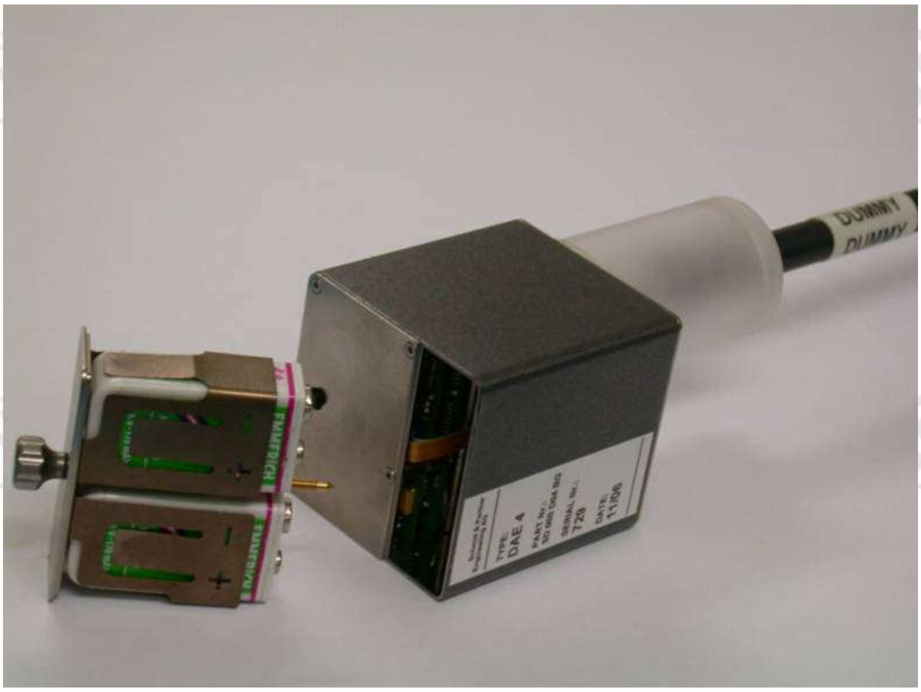
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Dynamic range	5 μW/g to 100 mW/g; Linearity: ± 0.2 dB

2.3 Data Acquisition Electronics description

The data acquisition electronics (DAE4) consist 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 with a 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 mechanical Probe mounting device includes two different sensor systems for frontal and sideways Probe contacts. They are used for mechanical surface detection and Probe collision detection. The input impedance of the DAE4 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

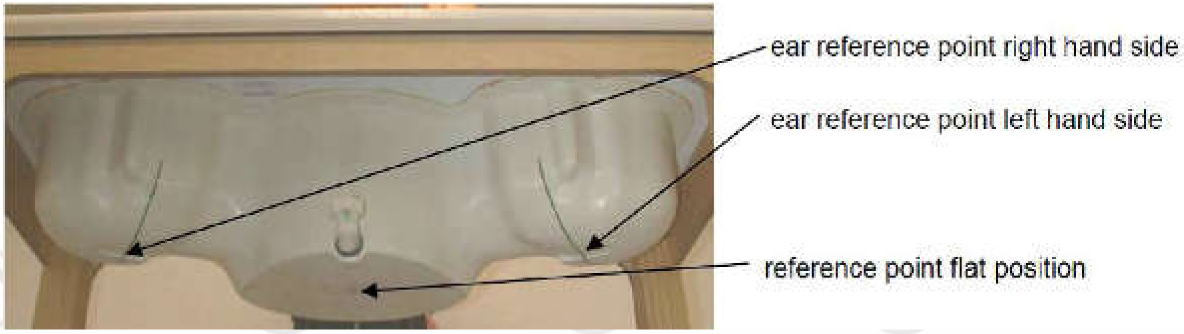
Batteries: The DAE works with either two standard 9V batteries or two 9V (actually 8.4V or 9.6 V) rechargeable batteries. Because the electronics automatically power-down unused components during braking or between measurements, the battery lifetime depends on system usage. Typical lifetimes are >20 hours for batteries and >10 hours for accus. Remove the batteries if you do not plan to use the DAE for a long period of time.



2.4 SAM Twin Phantom description

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6 mm). The phantom has three measurement areas:

- ♦ Left hand
- ♦ Right hand
- ♦ Flat phantom



The phantom table for the DASY systems have the size of 100 x 50 x 85 cm (L xWx H). these tables are reinforced for mounting of the robot onto the table. For easy dislocation these tables have fork lift cut outs at the bottom.

The bottom plate contains three pairs of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.

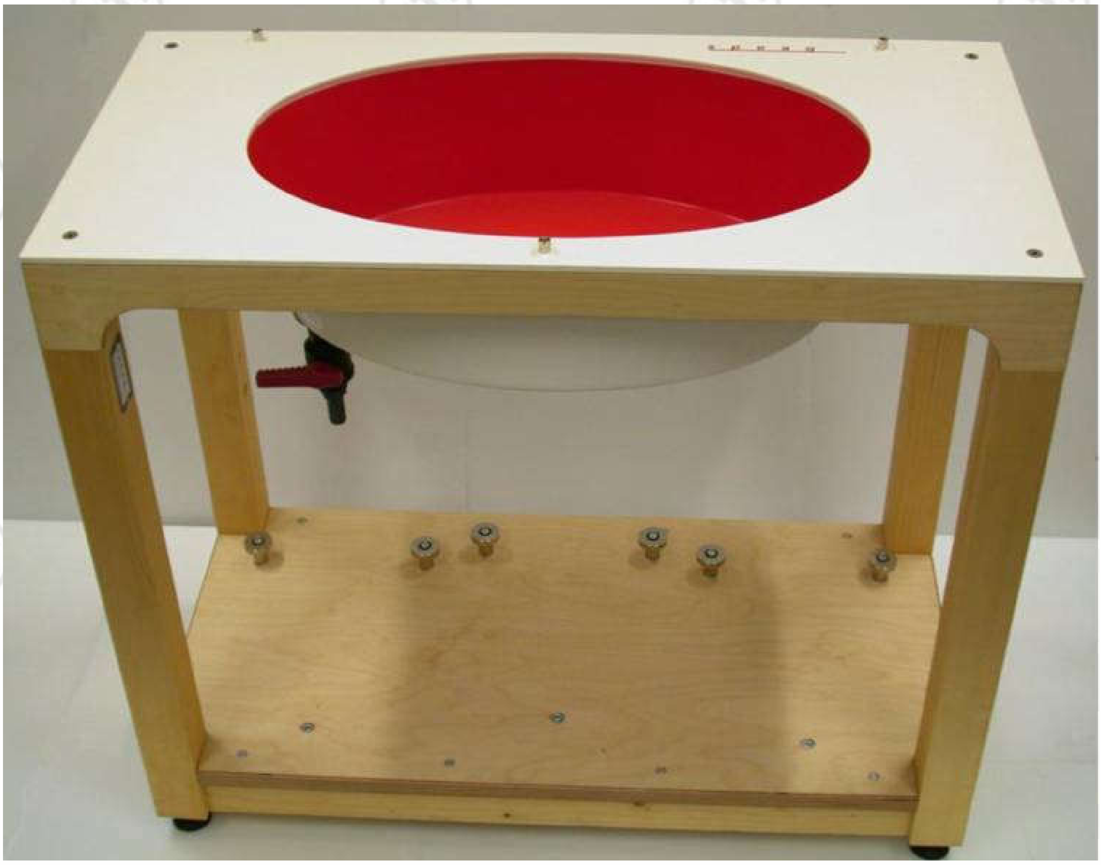
A white cover is Provided to cover the phantom during off-periods to prevent water evaporation and changes in the liquid parameters.

Three reference marks are Provided on the phantom counter. These reference marks are used to teach the absolute phantom position relative to the robot.

2.5 ELI4 Phantom description

The ELI4 phantom is intended for compliance testing of handheld and body mounted wireless devices in the frequency range of 30MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209-2 and all known tissue simulating liquids.

ELI4 has been optimized regarding its performance and can be integrated into a SPEAG standard phantom table. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points



2.6 Device Holder description

The SAR in the phantom is apProximately inversely Proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would Produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP).Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

3 SAR Test Equipment List

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

	Manufacturer	Device Type	Type(Model)	Serial number	Date of last calibration	Valid period
☒	SPEAG	E-Field Probe	EX3DV4	7328	2024-04-18	One year
☐	SPEAG	835 MHz Dipole	D835V2	4d193	2024-01-17	Three years
☐	SPEAG	1750 MHz Dipole	D1750V2	1134	2024-01-17	Three years
☐	SPEAG	1900 MHz Dipole	D1900V2	5d198	2024-01-18	Three years
☐	SPEAG	2000 MHz Dipole	D2000V2	1078	2024-01-22	Three years
☐	SPEAG	2300 MHz Dipole	D2300V2	1082	2023-01-11	Three years
☒	SPEAG	2450 MHz Dipole	D2450V2	959	2024-01-17	Three years
☐	SPEAG	2600 MHz Dipole	D2600V2	1101	2024-01-22	Three years
☒	SPEAG	5 GHz Dipole	D5GHzV2	1208	2024-01-16	Three years
☒	SPEAG	DAKS Probe	DAKS-3.5	1052	2024-04-22	Three years
☒	SPEAG	Planar R140 Vector Reflectometer	DAKS-VNA R140	0200514	2024-04-22	Three years
☒	SPEAG	Data acquisition electronics	DAE4	1458	2025-01-20	One year
☒	SPEAG	Software	DASY 5	NA	NCR	NCR
☐	SPEAG	Twin Phantom	SAM V5.0	1875	NCR	NCR
☒	SPEAG	Flat Phantom	ELI V6.0	2024	NCR	NCR
☒	Liquid	Head Liquid	2450 Head	2450	/	/
☒	Liquid	Head Liquid	5200 Head	5250	/	/
☒	Liquid	Head Liquid	5800 Head	5750	/	/
☐	R & S	Universal Radio Communication Tester	CMW500	102898	2024-12-05	One year
☒	Agilent	Signal Generator	N5181A	MY50142334	2024-12-05	One year
☒	BONN	Power Amplifier and directional coupler	SU319W	BL-SZ1550140	2024-12-05	One year
☒	KEITHLEY	RF Power Meter	3500	1128079	2024-06-12	One year
☒	KEITHLEY	RF Power Meter	3500	1128081	2024-06-12	One year
☒	JINGCHUAN G	Temperature/ Humidity Indicator	GSP-8	EMK197F0009 5	2024-06-05	One year

Note:

1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three-year extended calibration interval. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.

a) There is no physical damage on the dipole;

b) System check with specific dipole is within 10% of calibrated value;

c) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.

d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.

4 SAR Measurement Procedures

4.1 Spatial Peak SAR Evaluation

The DASY5 software includes all numerical Procedures necessary to evaluate the spatial peak SAR values.The base for the evaluation is a "cube" measurement in a volume of 30mm^3 (7x7x7 points). The measured volume must include the 1 g and 10 g 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. If the 10g cube or both cubes are not entirely inside the measured volumes,the system issues a warning regarding the evaluated spatial peak values within the PostProcessing engine (SEMCAD X). This means that if the measured volume is shifted, higher values might be possible. To get the correct values you can use a finer measurement grid for the area scan. In complicated field distributions, a large grid spacing for the area scan might miss some details and give an incorrectly interpolated peak location. The entire evaluation of the spatial peak values is performed within the PostProcessing engine (SEMCAD X). The system always gives the maximum values for the 1 g and 10 g cubes.

The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. extraction of the measured data (grid and values) from the Zoom Scan
2. calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. generation of a high-resolution mesh within the measured volume
4. interpolation of all measured values from the measurement grid to the high-resolution grid
5. extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. calculation of the averaged SAR within masses of 1 g and 10 g

4.2 Data Storage and Evaluation

Data Storage

The DASY5 software stores the measured voltage acquired by the Data Acquisition Electronics (DAE) as raw data together with all the necessary software parameters for the data evaluation (Probe calibration data, liquid parameters and communication system parameters) in measurement files with the extension .da5x. The postProcessing software evaluates the data every time the data is visualized or exported. This allows the verification and modification of the setup after completion of the measurement. For example, if a measurement has been performed with an incorrect crest factor, the parameter can be corrected afterwards and the data can be reevaluated.

To avoid unintentional parameter changes or data manipulations, the parameters in measured files are locked. In the administrator access mode of the software, the parameters can be unlocked. After changing the parameters, the measured scans can be reevaluated in the postProcessing engine.

The measured data can be visualized or exported in different units or formats, depending on the selected Probe type (e.g., E-field, H-field, SAR). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

The fields and SAR are calculated from the measured voltage (Probe voltage acquired by the DAE) and the following parameters:

Probe parameters:	- Sensitivity	$norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion Factor	$convF_i$
	- Diode Compression Point	dcp_i
	- Probe Modulation Response Factors	a_i, b_i, c_i, d
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Relative Permittivity	ρ

This parameters are stored in the DASY5 V52 measurement file.

These parameters must be correctly set in the DASY5 V52 software setup. They are available as configuration file and can be imported into the measurement file. The values displayed in the multimeter window are assessed using the parameters of the actual system setup. In the scan visualization and export modes, the parameters stored in the measurement file are used.

The measured voltage is not Proportional to the exciting. It must be first linearized.

ApProximated Probe Response Linearization using Crest Factor.

This linearization method is enabled when a custom defined communication system is measured. The compensation applied is a function of the measured voltage, the detector diode compression point and the crest factor of the measured signal.

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with	V_i	=	linearized voltage of channel i (uV)	(i = x,y,z)
	U_i	=	measured voltage of channel i (uV)	(i = x,y,z)
	cf	=	crest factor of exciting field	(DASY parameter)
	dcp_i	=	diode compression point of channel i (uV)	(Probe parameter, i = x,y,z)

Field and SAR Calculation

The primary field data for each channel are calculated using the linearized voltage:

E - fieldProbes : $$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

H - fieldProbes : $$H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

with	V_i	=	linearized voltage of channel i	(i = x,y,z)
	$Norm_i$	=	sensor sensitivity of channel i	(i = x,y,z)
			$uV/(V/m)^2$ for E-field Probes	
	ConvF	=	sensitivity enhancement in solution	
	a_{ij}	=	sensor sensitivity factors for H-field Probes	
	f	=	carrier frequency [GHz]	
	E_i	=	electric field strength of channel i in V/m	
	H_i	=	magnetic field strength of channel i in A/m	

The RMS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with	SAR	=	local specific absorption rate in mW/g
	E_{tot}	=	total field strength in V/m
	σ	=	conductivity in [mho/m] or [Siemens/m]
	ρ	=	equivalent tissue density in g/cm^3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

Spatial Peak SAR for 1 g and 10 g

The DASY5 software includes all numerical Procedures necessary to evaluate the spatial peak SAR values.The base for the evaluation is a "cube" measurement at the points of the fine cube grid consisting of 5 x 5 x 7 points(with 8mm horizontal resolution) or 7 x 7 x 7 points(with 5mm horizontal resolution) or 8 x 8 x 7 points(with 4mm horizontal resolution)..The entire evaluation of the spatial peak values is performed within the PostProcessing engine (SEMCAD X).The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. extraction of the measured data (grid and values) from the Zoom Scan.
2. calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters).
3. generation of a high-resolution mesh within the measured volume.
4. interpolation of all measured values from the measurement grid to the high-resolution grid
5. extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface.
6. calculation of the averaged SAR within masses of 1 g and 10 g.

4.3 Data Storage and Evaluation

The DASY5 installation includes predefined files with recommended Procedures for measurements and validation. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

Step 1: Power reference measurement

The Power Reference Measurement and Power Drift Measurement are for monitoring the power drift of the device under test in the batch Process. The Minimum distance of Probe sensors to surface determines the closest measurement point to phantom surface. By default, the Minimum distance of Probe sensors to surface is 4 mm. This distance can be modified by the user, but cannot be smaller than the Distance of sensor calibration points to Probe tip as defined in the Probe Properties. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hotspot. The sophisticated interpolation routines implemented in DASY5 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2003 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan

The Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The default Zoom Scan is defined in the following table. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Area scan and Zoom scan resolutions per FCC KDB Publication 865664 D01:

Frequency	Maximun Area Scan resolution (Δx_{Area},Δy_{Area})	Maximun Zoom Scan spatial resolution (Δx_{Zoom},Δy_{Zoom})	Maximun Zoom Scan spatial resolution			Minimum zoom scan volume (x,y,z)
			Uniform Grid	Graded Grad		
			$\Delta z_{Zoom}(n)$	$\Delta z_{Zoom}(1)$*	$\Delta z_{Zoom}(n>1)$*	
≤ 2GHz	≤ 15mm	≤ 8mm	≤ 5mm	≤ 4mm	≤1.5*$\Delta z_{Zoom}(n-1)$	≥ 30mm
2-3GHz	≤ 12mm	≤ 5mm	≤ 5mm	≤ 4mm	≤1.5*$\Delta z_{Zoom}(n-1)$	≥ 30mm
3-4GHz	≤ 12mm	≤ 5mm	≤ 4mm	≤ 3mm	≤1.5*$\Delta z_{Zoom}(n-1)$	≥ 28mm
4-5GHz	≤ 10mm	≤ 4mm	≤ 3mm	≤ 2.5mm	≤1.5*$\Delta z_{Zoom}(n-1)$	≥ 25mm
5-6GHz	≤ 10mm	≤ 4mm	≤ 2mm	≤ 2mm	≤1.5*$\Delta z_{Zoom}(n-1)$	≥ 22mm

Step 4: Power Drift Monitoring

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement job within the same Procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. If the value changed by more than 5%, the evaluation should be retested.

5 SAR Verification Procedure

5.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 5.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown as followed:

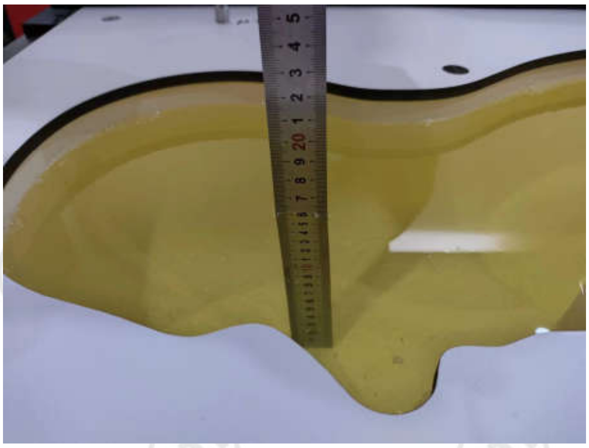


Photo of Liquid Height for Head SAR

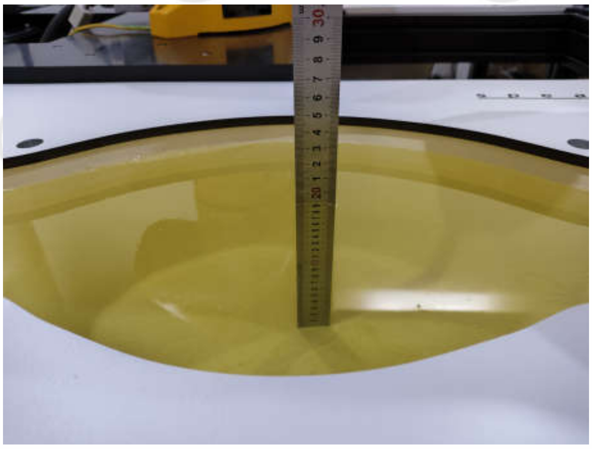


Photo of Liquid Height for Body SAR

5.2 Tissue Verification

The following materials are used for Producing the tissue-equivalent materials.
(Liquids used for tests are marked with☒):

Ingredients (% of weight)	Frequency (MHz)						
Tissue Type	Head Tissue						
frequency band	☐ 835	☐ 1800	☐ 2000	☐ 2300	☒ 2450	☐ 2600	☒ 5200-5800
Water	41.45	52.64	54.9	62.82	62.7	55.242	65.52
Salt (NaCl)	1.45	0.36	0.18	0.51	0.5	0.306	0.0
Sugar	56.0	0.0	0.0	0.0	0.0	0.0	0.0
HEC	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Bactericide	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	36.8	0.0	17.24
DGBE	0.0	47.0	44.92	36.67	0.0	44.452	0.0
Diethylenglycol monohexylether	0.0	0.0	0.0	0.0	0.0	0.0	17.24

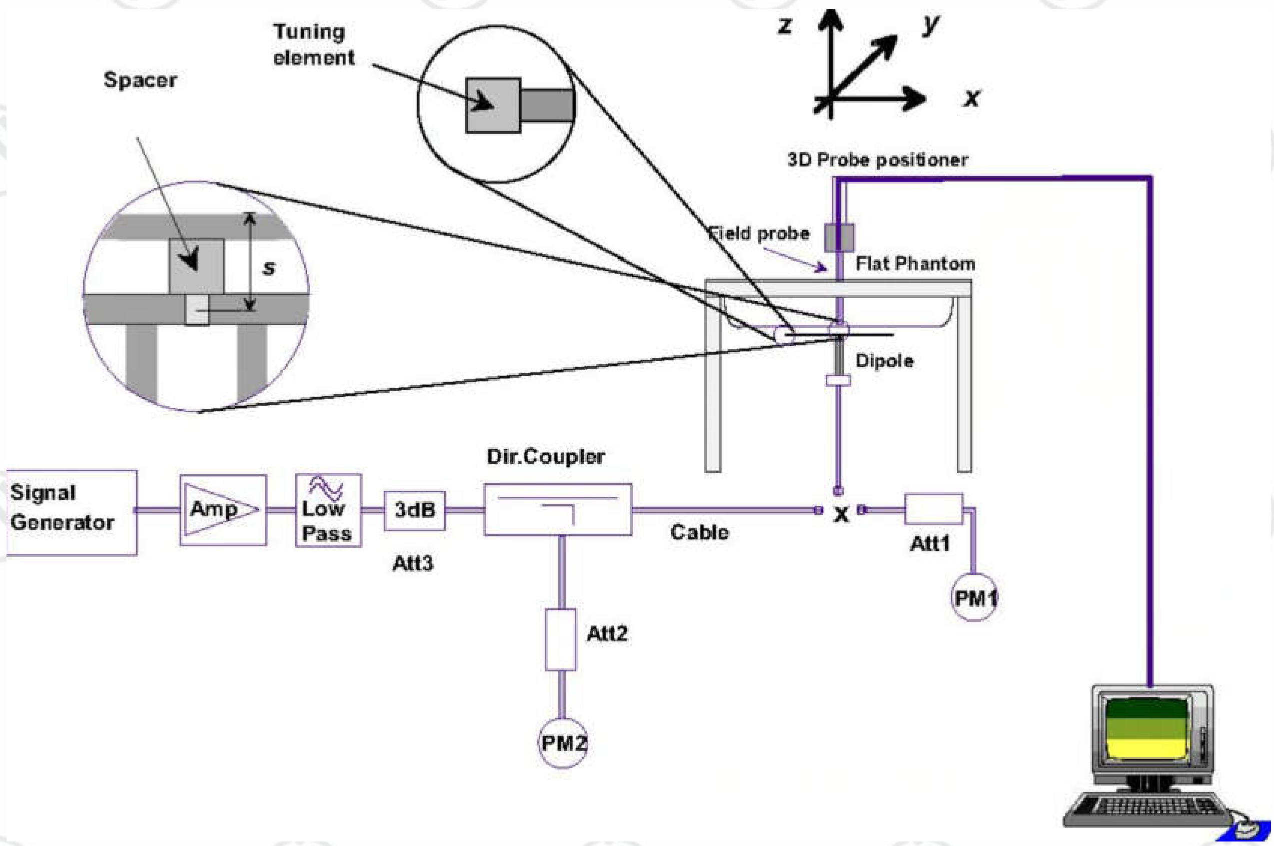
Salt: 99+% Pure Sodium Chloride
Sugar: 98+% Pure Sucrose
Water: De-ionized, 16MΩ+ resistivity
HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

Tissue simulating liquids: parameters:

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Deviation (Within ±5%)		Liquid Temp.	Test Date
		εr (+/-5%)	σ (S/m) (+/-5%)	εr	σ (S/m)	Δεr %	Δσ %		
2450H	**2450**	39.20 (37.24~41.16)	1.80 (1.71~1.89)	39.86	1.822	1.68	1.22	20.75°C	1/18/2025
	2412	39.27 (37.31~41.23)	1.77 (1.68~1.86)	39.89	1.770	1.58	0.00	20.75°C	1/18/2025
	2437	39.22 (37.26~41.18)	1.79 (1.70~1.88)	39.98	1.817	1.94	1.51	20.75°C	1/18/2025
	2462	39.18 (37.22~41.14)	1.81 (1.72~1.90)	39.79	1.839	1.56	1.60	20.75°C	1/18/2025
5000H	**5250**	35.90 (34.11~37.70)	4.66 (4.47~4.95)	34.98	4.672	-2.56	0.26	20.21°C	1/20/2025
	5200	35.82 (34.20~37.61)	4.80 (4.56~5.04)	34.94	4.582	-2.46	-4.54	20.21°C	1/20/2025
	5180	36.02 (34.22~37.82)	4.64 (4.41~4.87)	35.26	4.531	-2.11	-2.35	20.21°C	1/20/2025
	5240	35.96 (34.16~37.76)	4.70 (4.47~4.94)	35.02	4.505	-2.61	-4.15	20.21°C	1/20/2025
5000H	**5750**	35.30 (33.54~37.07)	5.27 (5.01~5.53)	34.13	5.082	-3.31	-3.57	20.21°C	1/20/2025
	5745	35.36 (33.59~37.13)	5.22 (4.96~5.48)	34.11	5.169	-3.54	-0.98	20.21°C	1/20/2025
	5785	35.32 (33.55~37.09)	5.26 (5.00~5.52)	34.24	5.252	-3.06	-0.15	20.21°C	1/20/2025
	5825	35.28 (33.52~37.04)	5.30 (5.04~5.57)	33.89	5.234	-3.94	-1.25	20.21°C	1/20/2025
εr= Relative permittivity, σ= Conductivity									

5.3 System check Procedure

The System check is performed by using a System check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 250mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the System check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).
System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



5.4 System check results

The system Check is performed for verifying the accuracy of the complete measurement system and performance of the software. The following table shows System check results for all frequency bands and tissue liquids used during the tests (plot(s) see annex A).

System Check (MHz)	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Measured SAR (Tolerances)		Liquid Temp.	Test Date
	1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)	1-g(%)	10-g(%)		
D2450 Head	53.60 (48.24~58.96)	24.70 (22.23~27.17)	53.50	24.50	-0.19	-0.81	20.75°C	1/18/2025
D5250 Head	78.20 (70.38~86.02)	22.10 (19.89~24.31)	73.30	22.00	-6.27	-0.45	20.21°C	1/20/2025
D5750 Head	77.60 (69.84~85.36)	21.50 (19.35~23.65)	74.10	21.90	-4.51	1.86	20.21°C	1/20/2025
Note: All SAR values are normalized to 1W forward power.								

6 SAR Measurement variability and uncertainty

6.1 SAR measurement variability

In accordance with published RF Exposure KDB Procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.The same Procedures should be adapted for measurements according to extremity exposure limits by applying a factor of 2.5 for extremity exposure.

1) Repeated measurement is not required when the original highest measured SAR is < 2.0 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 2.0 W/kg, repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 3.0 or when the original or repeated measurement is ≥ 3.6 W/kg (~ 10% from the 10-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥3.75 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

6.2 SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04,when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment apProval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

7 SAR Test Configuration

7.1 WIFI 5G Test Configurations

1) U-NII-1 and U-NII-2A Bands

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR Procedures for OFDM configurations are applied. For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following：

1.1) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, both bands are tested independently for SAR.

1.2) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, both bands are tested independently for SAR.

1.3) The two U-NII bands may be aggregated to support a 160 MHz channel on channel number 50. Without additional testing, the maximum output power for this is limited to the lower of the maximum output power certified for the two bands. When SAR measurement is required for at least one of the bands and the highest reported SAR adjusted by the ratio of specified maximum output power of aggregated to standalone band is > 1.2 W/kg, SAR is required for the 160 MHz channel. This Procedure does not apply to an aggregated band with maximum output higher than the standalone band(s); the aggregated band must be tested independently for SAR. SAR is not required when the 160 MHz channel is operating at a reduced maximum power and also qualifies for SAR test exclusion.

2) U-NII-2C and U-NII-3 Bands

The frequency range covered by these bands is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR Probe calibration frequency points to support SAR measurements. when Terminal Doppler Weather Radar (TDWR) restriction applies, all channels that operate at 5.60 – 5.65 GHz must be included to apply the SAR test reduction and measurement Procedures.

When the same transmitter and antenna(s) are used for U-NII-2C band and U-NII-3 band or 5.8 GHz band of §15.247, the bands may be aggregated to enable additional channels with 20, 40 or 80 MHz bandwidth to span across the band gap, as illustrated in Appendix B. The maximum output power for the additional band gap channels is limited to the lower of those certified for the bands. Unless band gap channels are permanently disabled, they must be considered for SAR testing. The frequency range covered by these bands is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR Probe calibration frequency points to support SAR measurements. To maintain SAR measurement accuracy and to facilitate test reduction, the channels in U-NII-2C band above 5.65 GHz may be grouped with the 5.8 GHz channels in U-NII-3 or §15.247 band to enable two SAR Probe calibration frequency points to cover the bands, including the band gap channels. When band gap channels are supported and the bands are not aggregated for SAR testing, band gap channels must be considered independently in each band according to the normally required OFDM SAR measurement and Probe calibration frequency points requirements.

3) OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements

The initial test configuration for 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for Production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement Procedures. When multiple configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined according to the following steps applied sequentially.

3.1) The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.

3.2) If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.

3.3) If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.

3.4) When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection Procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement Procedures or additional power measurements required for further SAR test reduction. The same Procedures also apply to subsequent highest output power channel(s) selection.

3.4.1) The channel closest to mid-band frequency is selected for SAR measurement.

3.4.2) For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

4) SAR Test Requirements for OFDM configurations

When SAR measurement is required for 802.11 a/n/ac OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies. When band gap channels between U-NII-2C band and 5.8 GHz U-NII-3 or §15.247 band are supported, the highest maximum output power transmission mode configuration and maximum output power channel across the bands must be used to determine SAR test reduction, according to the initial test configuration and subsequent test configuration requirements. In applying the initial test configuration and subsequent test configuration Procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the Procedures.

7.2 WIFI 2.4G Test Configurations

For WiFi SAR testing, a communication link is set up with the testing software for WiFi mode test. During the test,at the each test frequency channel, the EUT is operated at the RF continuous emission mode. The RF signal utilized in SAR measurement has 100% duty cycle and its crest factor is 1. The test Procedures in KDB 248227D01 v02r02 are applied.

Per KDB 248227 D01 802.11 Wi-Fi SAR v02r02,SAR Test Reduction criteria are as follows:

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS Procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement Procedures in the required wireless mode test configuration(s). The relative SAR levels of multiple exposure test positions can be established by area scan measurements on the highest measured output power channel to determine the initial test position. The area scans must be measured using the same SAR measurement configurations, including test channel, maximum output power, Probe tip to phantom distance, scan resolution etc.

When the *reported* SAR for the *initial test position* is:

1) ≤0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR Procedures.
2) > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions are tested.
3) For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required test channels are considered.

SAR is not required for the following 2.4 GHz OFDM conditions.

1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
2) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

8 SAR Test Results

8.1 Conducted Power Measurements

8.1.1 Conducted power of Wi-Fi 5G

Antenna		ANT1				
Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Tune-up	Average Power (dBm)
U-NII-1	802.11a	36	5180	6	10.50	9.73
		40	5200		10.50	**10.15**
		48	5240		10.50	9.82
	802.11n HT20	36	5180	6.5	9.50	8.70
		40	5200		9.50	8.79
		48	5240		9.50	9.04
	802.11n HT40	38	5190	13.5	9.00	8.56
		46	5230		9.00	8.91
	802.11ac VHT20	36	5180	6.5	9.50	8.65
		40	5200		9.50	8.80
		48	5240		9.50	9.02
	802.11ac VHT40	38	5190	13.5	9.00	8.58
		46	5230		9.00	8.88
	802.11ac VHT80	42	5210	29.3	7.50	7.05
	802.11ax HEW20	36	5180	8	9.50	8.74
		40	5200		9.50	8.80
		48	5240		9.50	9.13
	802.11ax HEW40	38	5190	16	9.00	8.90
		46	5230		9.00	8.46
	802.11ax HEW80	42	5210	34	7.00	6.83
U-NII-3	802.11a	149	5745	6	9.00	**8.65**
		157	5785		9.00	8.58
		165	5825		9.00	8.34
	802.11n HT20	149	5745	6.5	7.50	7.48
		157	5785		7.50	7.30
		165	5825		7.50	7.14
	802.11n HT40	151	5755	13.5	8.00	7.96
		159	5795		8.00	7.50

	802.11ac VHT20	149	5745	6.5	7.50	7.48
		157	5785		7.50	7.30
		165	5825		7.50	7.08
	802.11ac VHT40	151	5755	13.5	8.00	7.96
		159	5795		8.00	7.49
	802.11ac VHT80	155	5775	29.3	8.00	7.54
	802.11ax HEW20	149	5745	8	8.00	7.54
		157	5785		8.00	7.42
		165	5825		8.00	7.19
	802.11ax HEW40	151	5755	16	8.00	7.73
		159	5795		8.00	7.28
	802.11ax HEW80	155	5775	34	7.50	7.22

Antenna		**ANT2**				
Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Tune-up	Average Power (dBm)
U-NII-1	802.11a	36	5180	6	10.50	9.45
		40	5200		10.50	9.64
		48	5240		10.50	**10.16**
	802.11n HT20	36	5180	6.5	9.00	8.32
		40	5200		9.00	8.43
		48	5240		9.00	8.97
	802.11n HT40	38	5190	13.5	9.50	8.72
		46	5230		9.50	9.24
	802.11ac VHT20	36	5180	6.5	9.00	8.33
		40	5200		9.00	8.43
		48	5240		9.00	8.96
	802.11ac VHT40	38	5190	13.5	9.00	8.62
		46	5230		9.00	8.41
	802.11ac VHT80	42	5210	29.3	9.00	8.95
	802.11ax HEW20	36	5180	8	9.00	8.36
		40	5200		9.00	8.52
		48	5240		9.00	8.98
	802.11ax HEW40	38	5190	16	9.00	8.39
		46	5230		9.00	8.88

	802.11ax HEW80	42	5210	34	9.00	8.56
U-NII-3	802.11a	149	5745	6	9.00	8.34
		157	5785		9.00	8.28
		165	5825		9.00	**8.62**
	802.11n HT20	149	5745	6.5	8.00	7.32
		157	5785		8.00	7.00
		165	5825		8.00	7.53
	802.11n HT40	151	5755	13.5	8.00	7.56
		159	5795		8.00	7.58
	802.11ac VHT20	149	5745	6.5	8.00	7.29
		157	5785		8.00	7.32
		165	5825		8.00	7.88
	802.11ac VHT40	151	5755	13.5	8.00	7.47
		159	5795		8.00	7.52
	802.11ac VHT80	155	5775	29.3	7.50	7.37
	802.11ax HEW20	149	5745	8	8.00	7.44
		157	5785		8.00	7.04
		165	5825		8.00	7.63
	802.11ax HEW40	151	5755	16	7.50	7.17
		159	5795		7.50	7.21
	802.11ax HEW80	155	5775	34	7.50	7.05

MIMO

Band				U-NII-1		
Antenna				ANT1+ANT2	ANT1	ANT2
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power(dBm)	Average Power(dBm)	Average Power(dBm)
802.11n (HT20)	36	5180	6.5	8.39	4.85	5.85
	40	5200		8.46	4.92	5.93
	48	5240		8.95	5.20	6.57
802.11n (HT40)	38	5190	13.5	8.86	5.29	6.35
	46	5230		8.62	5.02	6.12
802.11ac (VHT20)	36	5180	6.5	8.39	4.78	5.90
	40	5200		8.49	4.92	5.98
	48	5240		8.96	5.19	6.60
802.11ac (VHT40)	38	5190	13.5	8.90	5.36	6.37
	46	5230		8.89	5.27	6.42
802.11ac (VHT80)	42	5210	29.3	8.58	5.05	6.04
802.11ax (HEW20)	36	5180	8	8.49	4.92	5.97
	40	5200		8.63	5.03	6.13
	48	5240		9.09	5.34	6.72
802.11ax (HEW40)	38	5190	16	8.55	4.95	6.06
	46	5230		9.01	5.26	6.64
802.11ax (HEW80)	42	5210	34	8.79	5.23	6.27

Band				U-NII-3		
Antenna				ANT1+ANT2	ANT1	ANT2
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power(dBm)	Average Power(dBm)	Average Power(dBm)
802.11n (HT20)	149	5745	6.5	7.50	3.83	5.06
	157	5785		7.27	3.67	4.78
	165	5825		7.49	3.48	5.30
802.11n (HT40)	151	5755	13.5	7.94	4.44	5.37
	159	5795		7.87	4.06	5.54
802.11ac (VHT20)	149	5745	6.5	7.53	3.88	5.08
	157	5785		7.25	3.69	4.72
	165	5825		7.57	3.59	5.35
802.11ac (VHT40)	151	5755	13.5	7.90	4.41	5.32
	159	5795		7.75	3.92	5.43
802.11ac (VHT80)	155	5775	29.3	7.83	4.35	5.24
802.11ax (HEW20)	149	5745	8	7.70	3.97	5.31
	157	5785		7.36	3.83	4.82
	165	5825		7.69	3.71	5.47
802.11ax (HEW40)	151	5755	16	7.63	4.12	5.07
	159	5795		7.48	3.68	5.13
802.11ax (HEW80)	155	5775	34	7.54	4.06	4.95

8.1.2 Conducted Power of Wi-Fi 2.4G

The output power of Wi-Fi 2.4G is as following:

Antenna		ANT1			
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Tune-up	Average Power(dBm)
802.11b	1	2412	1	13.50	13.09
	6	2437		13.50	**13.15**
	11	2462		13.50	13.15
802.11g	1	2412	6	12.80	12.67
	6	2437		12.80	12.63
	11	2462		12.80	12.57
802.11n (HT20)	1	2412	6.5	12.80	12.58
	6	2437		12.80	12.52
	11	2462		12.80	12.47
802.11n (HT40)	3	2422	13	12.95	12.06
	6	2437		12.95	12.90
	9	2452		12.95	12.86
802.11ax (HEW20)	1	2412	8	12.80	12.03
	6	2437		12.80	12.67
	11	2462		12.80	12.65
802.11ax (HEW40)	3	2422	16	12.95	12.89
	6	2437		12.95	12.83
	9	2452		12.95	12.76

Antenna		ANT2			
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Tune-up	Average Power(dBm)
802.11b	1	2412	1	13.50	13.01
	6	2437		13.50	13.24
	11	2462		13.50	**13.27**
802.11g	1	2412	6	13.00	12.41
	6	2437		13.00	12.80
	11	2462		13.00	12.75
802.11n (HT20)	1	2412	6.5	13.00	12.37
	6	2437		13.00	12.70
	11	2462		13.00	12.71
802.11n (HT40)	3	2422	13	13.00	12.78
	6	2437		13.00	12.99
	9	2452		13.00	12.68
802.11ax (HEW20)	1	2412	8	13.00	12.40
	6	2437		13.00	12.84
	11	2462		13.00	12.79
802.11ax (HEW40)	3	2422	16	13.00	12.55
	6	2437		13.00	12.76
	9	2452		13.00	12.92

MIMO

Antenna				ANT1+ANT2	ANT1	ANT2
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power(dBm)	Average Power(dBm)	Average Power(dBm)
802.11n (HT20)	1	2412	6.5	12.27	9.1	9.41
	6	2437		12.45	9.05	9.8
	11	2462		12.44	9.06	9.77
802.11n (HT40)	3	2422	13	12.76	9.57	9.92
	6	2437		12.81	9.56	10.03
	9	2452		12.94	9.54	10.29
802.11ax (HEW20)	1	2412	8	12.33	9.17	9.46
	6	2437		12.57	9.17	9.92
	11	2462		12.56	9.19	9.88
802.11ax (HEW40)	3	2422	16	12.52	9.36	9.66
	6	2437		12.64	9.39	9.86
	9	2452		12.72	9.32	10.06

8.1.3 Conducted Power of BT

The output power of BT is as following:

For BT 3.0:

Average Conducted Power(dBm)				Tune-up Power(dBm)
Channel	0CH	39CH	78CH	
GFSK	1.93	1.60	1.58	2.50
π/4DQPSK	1.94	1.59	1.58	
8DPSK	**2.11**	1.78	1.75	

Note: channel /Frequency: 0/2402, 39/2441, 78/2480.

For BT (BLE)

Average Conducted Power(dBm)				Tune-up Power(dBm)
Channel	0CH	19CH	39CH	
BLE_1M	**3.12**	2.83	2.82	3.50
BLE_2M	3.11	2.83	2.84	

Note: channel /Frequency: 0/2402, 19/2440, 39/2480.

8.2 SAR test results

Notes:

1) Per KDB447498 D01v06, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.

2) Per KDB447498 D01v06, All measurement SAR result is scaled-up to account for tune-up tolerance is compliant.

3) Per KDB865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/Kg; if the deviation among the repeated measurement is ≤ 20%, and the measured SAR <1.45W/Kg, only one repeated measurement is required.

4) Per KDB865664 D02v01r02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The same Procedures should be adapted for measurements according to extremity exposure limits by applying a factor of 2.5 for extremity exposure. The published RF exposure KDB Procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-Processing (Refer to appendix B for details).

8.2.1 Results overview of WiFi 5G

ANT1

Test Position With 0mm	Test channel /Freq. (MHz)	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Tune-up power (dBm)	Scaled SAR_{1-g} (W/kg)	Actual Duty Cycle	Reported SAR_{1-g} (W/kg)
			1-g	10-g						
5.2G WiFi (U-NII-1 Band)										
Front Side	40/5200	802.11a	0.420	0.158	0.000	10.15	10.50	0.455	86.67%	0.525
Back Side	40/5200	802.11a	0.012	0.005	0.000	10.15	10.50	0.013	86.67%	0.015
Left Side	40/5200	802.11a	0.195	0.072	0.000	10.15	10.50	0.211	86.67%	0.244
Front Side	36/5180	802.11a	0.405	0.152	0.000	9.73	10.50	0.484	83.33%	0.580
Front Side	48/5240	802.11a	0.494	0.182	0.000	9.82	10.50	0.578	83.33%	**0.693**

Test Position With 0mm	Test channel /Freq. (MHz)	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Tune-up power (dBm)	Scaled SAR_{1-g} (W/kg)	Actual Duty Cycle	Reported SAR_{1-g} (W/kg)
			1-g	10-g						
5.8G WiFi (U-NII-3 Band)										
Front Side	149/5745	802.11a	0.617	0.211	0.000	8.98	9.00	0.620	83.87%	**0.739**
Back Side	149/5745	802.11a	0.025	0.009	0.000	8.98	9.00	0.025	83.87%	0.029
Left Side	149/5745	802.11a	0.192	0.069	0.000	8.98	9.00	0.193	83.87%	0.230
Front Side	157/5785	802.11a	0.451	0.158	0.000	8.58	9.00	0.497	86.21%	0.576
Front Side	165/5825	802.11a	0.607	0.200	0.000	8.95	9.00	0.614	83.33%	0.737

ANT2

Test Position With 0mm	Test channel /Freq. (MHz)	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Tune-up power (dBm)	Scaled SAR_{1-g} (W/kg)	Actual Duty Cycle	Reported SAR_{1-g} (W/kg)
			1-g	10-g						
5.2G WiFi (U-NII-1 Band)										
Front Side	48/5240	802.11a	0.380	0.120	0.000	10.16	10.50	0.411	83.33%	**0.493**
Back Side	48/5240	802.11a	0.001	0.001	0.000	10.16	10.50	0.001	83.33%	0.001
Top Side	48/5240	802.11a	0.191	0.058	0.000	10.16	10.50	0.207	83.33%	0.248
Front Side	36/5180	802.11a	0.314	0.099	0.000	9.45	10.50	0.400	83.33%	0.480
Front Side	40/5200	802.11a	0.286	0.089	0.000	9.64	10.50	0.349	83.87%	0.416

Test Position With 0mm	Test channel /Freq. (MHz)	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Tune-up power (dBm)	Scaled SAR_{1-g} (W/kg)	Actual Duty Cycle	Reported SAR_{1-g} (W/kg)
			1-g	10-g						
5.8G WiFi (U-NII-3 Band)										
Front Side	165/5825	802.11a	0.399	0.123	0.000	8.62	9.00	0.435	83.33%	0.523
Back Side	165/5825	802.11a	0.015	0.005	0.000	8.62	9.00	0.016	83.33%	0.020
Top Side	165/5825	802.11a	0.315	0.096	0.000	8.62	9.00	0.344	83.33%	0.413
Front Side	149/5745	802.11a	0.484	0.137	0.000	8.34	9.00	0.563	83.33%	0.676
Front Side	157/5785	802.11a	0.499	0.142	0.000	8.28	9.00	0.589	83.87%	**0.702**

Note:

1) Scaled SAR = SAR Value * 10(0.1*(Tune up Power-Conducted Power))

Reported SAR = SAR Value * 10(0.1*(Tune up Power-Conducted Power))/ Duty factor * 100

8.2.2 Results overview of WiFi 2.4G

Test Position With 0mm	Test channel /Freq. (MHz)	Test Mode	SAR Value (W/kg)		Power Drift (dBm)	Conducted Power (dBm)	Tune-up power (dBm)	Scaled SAR_{1-g} (W/kg)	Actual Duty Cycle	Reported SAR_{1-g} (W/kg)
			1-g	10-g						
ANT1										
Front Side	6/2437	802.11b	0.004	0.001	0.000	13.15	13.50	0.004	98.82%	0.004
Back Side	6/2437	802.11b	0.001	0.001	0.000	13.15	13.50	0.001	98.82%	0.001
Left Side	6/2437	802.11b	0.001	0.001	0.000	13.15	13.50	0.001	98.82%	0.001
Front Side	1/2412	802.11b	0.004	0.001	0.000	13.09	13.50	0.005	98.82%	0.005
Front Side	11/2462	802.11b	0.006	0.002	0.000	13.15	13.50	0.006	99.05%	**0.006**
ANT2										
Front Side	11/2462	802.11b	0.006	0.002	0.000	13.27	13.50	0.006	99.52%	**0.006**
Back Side	11/2462	802.11b	0.001	0.001	0.000	13.27	13.50	0.001	99.52%	0.001
Top Side	11/2462	802.11b	0.004	0.001	0.000	13.27	13.50	0.004	99.52%	0.004
Front Side	1/2412	802.11b	0.003	0.001	0.000	13.01	13.50	0.004	99.52%	0.004
Front Side	6/2437	802.11b	0.005	0.002	0.000	13.24	13.50	0.005	99.29%	0.005

Note: Per KDB248227D01:

1) SAR is measured for 2.4 GHz 802.11b DSSS using initial test position Procedure.

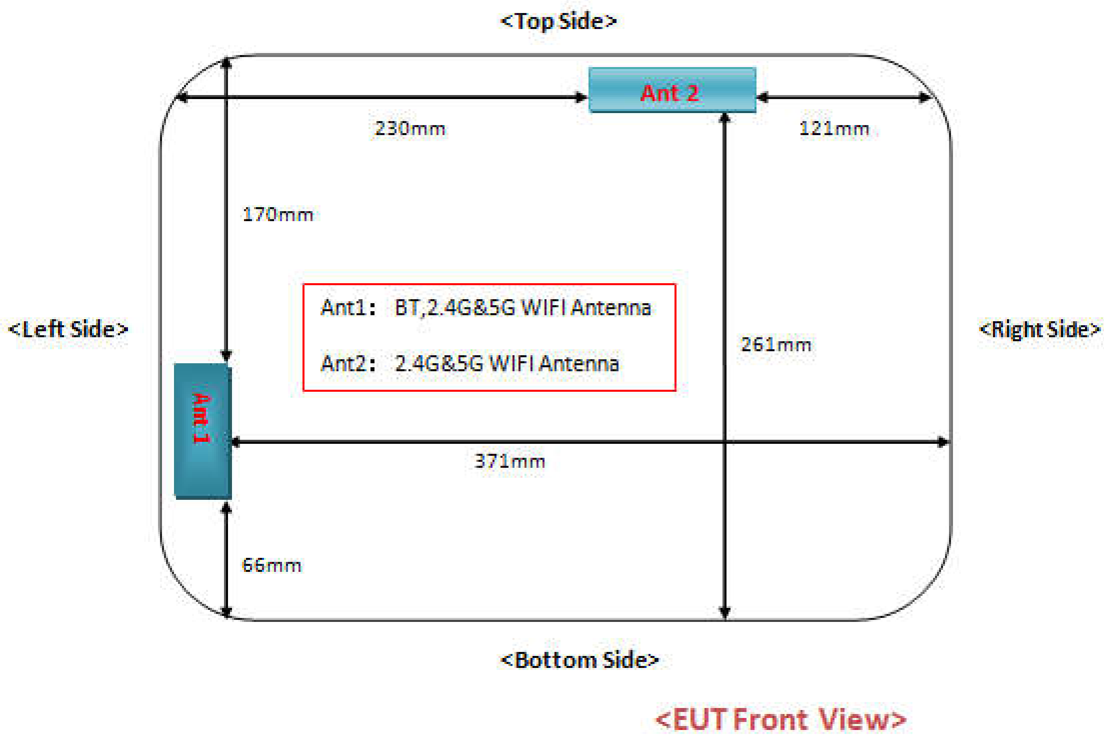
2) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤1.2 W/kg, 802.11g/n/ax OFDM SAR Test is not required.

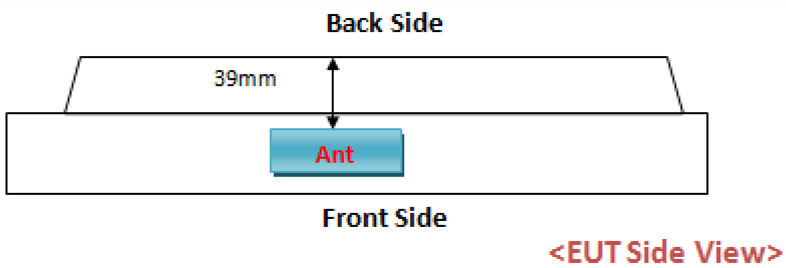
3) Scaled SAR = SAR Value * 10(0.1*(Tune up Power-Conducted Power))

Reported SAR = SAR Value * 10(0.1*(Tune up Power-Conducted Power))/ Duty factor * 100

8.3 Multiple Transmitter Information

The location of the antennas inside this device is shown as below picture:





Note:1)Per KDB 616217, because the diagonal Length is ＞200mm, it is considered a " tablet" device and need to test 0mm 1g Body SAR.
2) The device doesn't support telephone receiver, so additional Head SAR testing is not considered per KDB616217D04 and KDB648474D04.

8.4 Stand-alone SAR

Per FCC KDB 447498D01:

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following:

a) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·(f(MHz)/150)]} mW, at 100 MHz to 1500 MHz

b) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW at > 1500 MHz and ≤ 6 GHz

WiFi Antenna:

ANT1

(Antennas <50mm to adjacent sides)

Band	Exposure Condition	f(GHz)	Pmax	Pmax	Seperation Distance(mm)						SAR Test (Yes or No)					
			dBm	mW	Front side	Back side	Left side	Right side	Top side	Bottom side	Front side	Back side	Left side	Right side	Top side	Bottom side
WiFi 2.4G	Body 0mm	2.45	13.50	22.39	5.00	39.00	5.00	371.00	170.00	66.00	Yes	Yes	Yes	>50mm	>50mm	>50mm
WiFi 5.2G	Body 0mm	5.20	10.50	11.22	5.00	39.00	5.00	371.00	170.00	66.00	Yes	Yes	Yes	>50mm	>50mm	>50mm
WiFi 5.8G	Body 0mm	5.80	9.00	7.94	5.00	39.00	5.00	371.00	170.00	66.00	Yes	Yes	Yes	>50mm	>50mm	>50mm

(Antennas >50mm to adjacent sides)

Band	Exposure Condition	f(GHz)	Pmax	Pmax	Seperation Distance(mm)						SAR Test (Yes or No)					
			dBm	mW	Front side	Back side	Left side	Right side	Top side	Bottom side	Front side	Back side	Left side	Right side	Top side	Bottom side
WiFi 2.4G	Body 0mm	2.45	13.50	22.39	5.00	39.00	5.00	371.00	170.00	66.00	<50mm	<50mm	<50mm	No	No	No
WiFi 5.2G	Body 0mm	5.20	10.50	11.22	5.00	39.00	5.00	371.00	170.00	66.00	<50mm	<50mm	<50mm	No	No	No
WiFi 5.8G	Body 0mm	5.80	9.00	7.94	5.00	39.00	5.00	371.00	170.00	66.00	<50mm	<50mm	<50mm	No	No	No

ANT2

(Antennas <50mm to adjacent sides)

Band	Exposure Condition	f(GHz)	Pmax	Pmax	Seperation Distance(mm)						SAR Test (Yes or No)					
			dBm	mW	Front side	Back side	Left side	Right side	Top side	Bottom side	Front side	Back side	Left side	Right side	Top side	Bottom side
WiFi 2.4G	Body 0mm	2.45	13.50	22.39	5.00	39.00	230.00	121.00	5.00	261.00	Yes	Yes	>50mm	>50mm	Yes	>50mm
WiFi 5.2G	Body 0mm	5.20	10.50	11.22	5.00	39.00	230.00	121.00	5.00	261.00	Yes	Yes	>50mm	>50mm	Yes	>50mm
WiFi 5.8G	Body 0mm	5.80	9.00	7.94	5.00	39.00	230.00	121.00	5.00	261.00	Yes	Yes	>50mm	>50mm	Yes	>50mm

(Antennas >50mm to adjacent sides)

Band	Exposure Condition	f(GHz)	Pmax	Pmax	Seperation Distance(mm)						SAR Test (Yes or No)					
			dBm	mW	Front side	Back side	Left side	Right side	Top side	Bottom side	Front side	Back side	Left side	Right side	Top side	Bottom side
WiFi 2.4G	Body 0mm	2.45	13.50	22.39	5.00	39.00	230.00	121.00	5.00	261.00	<50mm	<50mm	No	No	<50mm	No
WiFi 5.2G	Body 0mm	5.20	10.50	11.22	5.00	39.00	230.00	121.00	5.00	261.00	<50mm	<50mm	No	No	<50mm	No
WiFi 5.8G	Body 0mm	5.80	9.00	7.94	5.00	39.00	230.00	121.00	5.00	261.00	<50mm	<50mm	No	No	<50mm	No

ANT1：BT Antenna

(Antennas <50mm to adjacent sides)

Band	Exposure Condition	f(GHz)	Pmax	Pmax	Seperation Distance(mm)						SAR Test (Yes or No)					
			dBm	mW	Front side	Back side	Left side	Right side	Top side	Bottom side	Front side	Back side	Left side	Right side	Top side	Bottom side
BT	Body 0mm	2.45	3.50	2.24	5.00	39.00	5.00	371.00	170.00	66.00	No	No	No	>50mm	>50mm	>50mm

(Antennas >50mm to adjacent sides)

Band	Exposure Condition	f(GHz)	Pmax	Pmax	Seperation Distance(mm)						SAR Test (Yes or No)					
			dBm	mW	Front side	Back side	Left side	Right side	Top side	Bottom side	Front side	Back side	Left side	Right side	Top side	Bottom side
BT	Body 0mm	2.45	3.50	2.24	5.00	39.00	5.00	371.00	170.00	66.00	<50mm	<50mm	<50mm	No	No	No

3) When the minimum test separation distance is > 50 mm, the estimated SAR value is 0.4 W/kg.

For conditions where the estimated SAR is overly conservative for certain conditions, the test lab may choose to perform standalone SAR measurements and use the measured SAR to determine simultaneous transmission SAR test exclusion.

Per FCC KDB 447498D01:

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5mm is applied to determine SAR test exclusion.

Mode	Position	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	F (GHz)	Calculation Result	SAR test exclusion Threshold	SAR test exclusion
BT	Body-Worn	3.50	2.24	5.00	2.450	0.70	3.00	Yes

1) When the standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion:

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm, where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR.

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Mode	Position	Pmax(dBm)	Pmax(mW)	Distance(mm)	f(GHz)	X	Estimated SAR(W/Kg)
BT	Body-Worn	3.50	2.24	5.00	2.45	7.50	0.093

Note: 1) maximum possible output power (including tune-up tolerance) declared by manufacturer
2) Held to ear configurations are not applicable to Bluetooth for this device

8.5 Simultaneous transmission analysis

No.	Simultaneous Transmission Consideration	Required
1	2.4GHz WLAN Ant1 + 2.4GHz WLAN Ant2	Yes
2	5.2GHz WLAN Ant1 +5.2GHz WLAN Ant2	Yes
3	5.8GHz WLAN Ant1 +5.8GHz WLAN Ant2	Yes
4	2.4GHz WLAN(Ant1+Ant2) + Bluetooth	Yes
5	5.2GHz WLAN(Ant1+Ant2) + Bluetooth	Yes
6	5.8GHz WLAN(Ant1+Ant2) + Bluetooth	Yes

Estimate SAR:

Mode	Max. tune-up Power (dBm)	Frequency (GHz)	Estimate 1-g SAR(W/kg)
BT	3.50	2.450	0.093

Simultaneous Transmission Max SAR:

Mode	Ant1 Position	Ant1 1g SAR (W/kg)	Ant2 1g SAR (W/kg)	Summed(Ant1+Ant2) 1-g SAR(W/kg)
2.4GHz WLAN	Front Side	0.006	0.006	**0.012**
2.4GHz WLAN	Back Side	0.001	0.001	0.002
2.4GHz WLAN	Left Side	0.001	-	0.001
2.4GHz WLAN	Top Side	-	0.004	0.004
5.2GHz				
5.2GHz WLAN	Front Side	0.693	0.493	**1.186**
5.2GHz WLAN	Back Side	0.015	0.001	0.016
5.2GHz WLAN	Left Side	0.244	-	0.244
5.2GHz WLAN	Top Side	-	0.248	0.248
5.8GHz				
5.8GHz WLAN	Front Side	0.739	0.702	**1.441**

5.8GHz WLAN	Back Side	0.029	0.020	0.049
5.8GHz WLAN	Left Side	0.230	-	0.230
5.8GHz WLAN	Top Side	-	0.413	0.413

Mode	Position	Ant1+Ant2 1g SAR (W/kg)	BT Estimate 1g SAR (W/kg)	Summed 1-g SAR(W/kg)
2.4GHz WLAN	Front Side	0.012	0.093	0.105
5.2GHz WLAN	Front Side	1.186	0.093	1.279
5.8GHz WLAN	Front Side	1.441	0.093	**1.534**

Note:

1) Per KDB 447498D01v06, Simultaneous Transmission SAR Evaluation procedures is as followed:

Step 1: If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.

Step 2: If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

Step 3: If the ratio of SAR to peak separation distance is ≤ 0.04, Simultaneous SAR measurement is not required.

2) Simultaneous Transmission SAR Evaluation is not required for 2.4GHz WLAN and 5GHz WLAN , because the software mechanism have been incorporated to guarantee that the 2.4GHz WLAN and 5GHz WLAN transmitters would not simultaneously operate.

8.6 Simultaneous Transmission Possibilitiesand Conlcusion

The above SAR results are sufficient to determine that the simultaneous transmission case does not exceed the SAR limit, so simultaneous transmission of SAR and Volume Scans is not required according to KDB 447498 D04v01, so the tested resultis complywiththe FCC limit.

Annex A: Appendix A: SAR System performance Check Plots

(Please See Appendix A)

Annex B: Appendix B: SAR Measurement results Plots

(Please See Appendix B)

Annex C: Appendix C: Calibration reports

(Please See Appendix C)

Annex D: Appendix D: Photo documentation

(Please See Appendix D)

Statement

1. This report is considered invalid without approved signature, special seal and the seal on the perforation;

2. The Company Name shown on Report and Address, the sample(s) and sample information was/were provided by the applicant who should be responsible for the authenticity which CTI hasn't verified;

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