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FCC SAR Compliance Test Report

Product Name:	Smart Watch
Model:	MIL-B19
Report No.:	SYBH(Z-SAR)20210831004001-1
FCC ID:	2ATEYMIL-B19

Date	Name	Signature
Prepared by: (Test Engineer) **2021-09-13**	**Liang Zifeng**	Liang Zifeng
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2. The laboratory has passed the accreditation by The American Association for Laboratory Accreditation (A2LA). The accreditation number is 2174.01 & 2174.02 & 2174.03.
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※※ Modified History ※※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	2021-09-13	Liang Zifeng

1 General Information

1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during test are as below Table 1.

Band	Max Reported SAR(W/kg)	
	1-g Next to mouth(10mm)	10-g Extremity SAR (0mm)*
2.4G Wi-Fi	**0.11**	**0.24**
BT**	0.03	/
The highest reported SAR for Next-to-mouth and 10-g Extremity SAR exposure conditions are 0.11W/kg and 0.24W/kg per KDB690783 D01.		

Table 1: Summary of test result

Note:

1)* For 10-g Extremity Exposure Condition operation, this device has been tested and meets the 10-g SAR limits of 4.0 W/kg for general population/ uncontrolled exposure according to IEEE C95.1:1991.

2)** Stand-alone 10-g Extremity SAR evaluation is not required for BT, because the Max output power is below SAR test exclusion thresholds.

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits according to the IEEE C95.1:1991, the NCRP Report Number 86 for uncontrolled environment, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.

1.2 RF exposure limits

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

Table 2: RF exposure limits

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

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1.3 EUT Description

<table>
<tr><td>Device type :</td><td colspan="3">Portable device</td></tr>
<tr><td>Product Name:</td><td colspan="3">Smart Watch</td></tr>
<tr><td>Models:</td><td colspan="3">MIL-B19</td></tr>
<tr><td>SN :</td><td colspan="3">F82F65BA4295; F82F65BA4086</td></tr>
<tr><td>Exposure category:</td><td colspan="3">Uncontrolled environment / general population</td></tr>
<tr><td>Hardware version :</td><td colspan="3">R3</td></tr>
<tr><td>Software version :</td><td colspan="3">2.0.1.137</td></tr>
<tr><td>Antenna type :</td><td colspan="3">Internal antenna</td></tr>
<tr><td>Test device production information</td><td colspan="3">Identical Prototype</td></tr>
<tr><td>Test modulation</td><td colspan="3">Wi-Fi(DSSS/OFDM), BT(GFSK/π/4-DQPSK/8DPSK)</td></tr>
<tr><td rowspan="4">Supporting mode(s) and Operating frequency range(s)</td><td>Band</td><td>Tx (MHz)</td><td>Rx (MHz)</td></tr>
<tr><td>2.4G Wi-Fi</td><td colspan="2">2400-2483.5</td></tr>
<tr><td>BT</td><td colspan="2">2400-2483.5</td></tr>
<tr><td>NFC</td><td colspan="2">13.56</td></tr>
<tr><td rowspan="2">Test channels (low-mid-high) :</td><td colspan="3">11b:1-6-11
11g/n(20M):1-6-11</td></tr>
<tr><td colspan="3">0-19-39-78(BT)</td></tr>
</table>

Table 3: Device information and operating configuration

1.3.1 General Description

MIL-B19 is a smart watch; it can be communicated with mobile phone via Bluetooth. Watch also support alarm clock, intelligent user can judge the state of motion, scientific sleep monitoring,information assistance,heart rate monitoring,GPS functionalities and supports music playback and bluetooth calling. The BT/WIFI frequency is 2.4GHz.

Battery information:

Name	Manufacturer/trademark	Description
Li-polymer Battery	Huawei Device Co., Ltd. (Manufacturer: SUNWODA)	Battery Model: HB522025EFW Rated capacity: 292mAh Nominal Voltage: 3.87V Charging Voltage: 4.45V
	Huawei Device Co., Ltd. (Manufacturer: NVT)	

1.4 Test specification(s)

ANSI C95.1-1992 /IEEE C95.1-1991	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 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
KDB 447498 D01	General RF Exposure Guidance v06
KDB 248227 D01	SAR Guidance for IEEE 802 11 Wi-Fi SAR v02r02
KDB 865664 D01	SAR measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02	RF Exposure Reporting v01r02
KDB 690783 D01	SAR Listings on Grants v01r03

1.5 Testing laboratory

Test Site	Reliability Laboratory of Huawei Technologies Co., Ltd.
Test Location	NO.2 New City Avenue Songshan Lake Sci. & Tech. Industry Park, Dongguan, Guangdong, P.R.C
Telephone	+86 769 23830808
Fax	+86 769 23837628
State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025.

1.6 Applicant and Manufacturer

Company Name	Huawei Device Co., Ltd.
Address	No.2 of Xincheng Road, Songshan Lake Zone, Dongguan, Guangdong 523808, People's Republic of China

1.7 Application details

Start Date of test	2021-09-07
End Date of test	2021-09-07

1.8 Ambient Condition

Ambient temperature	18°C – 25°C
Relative Humidity	30% – 70%

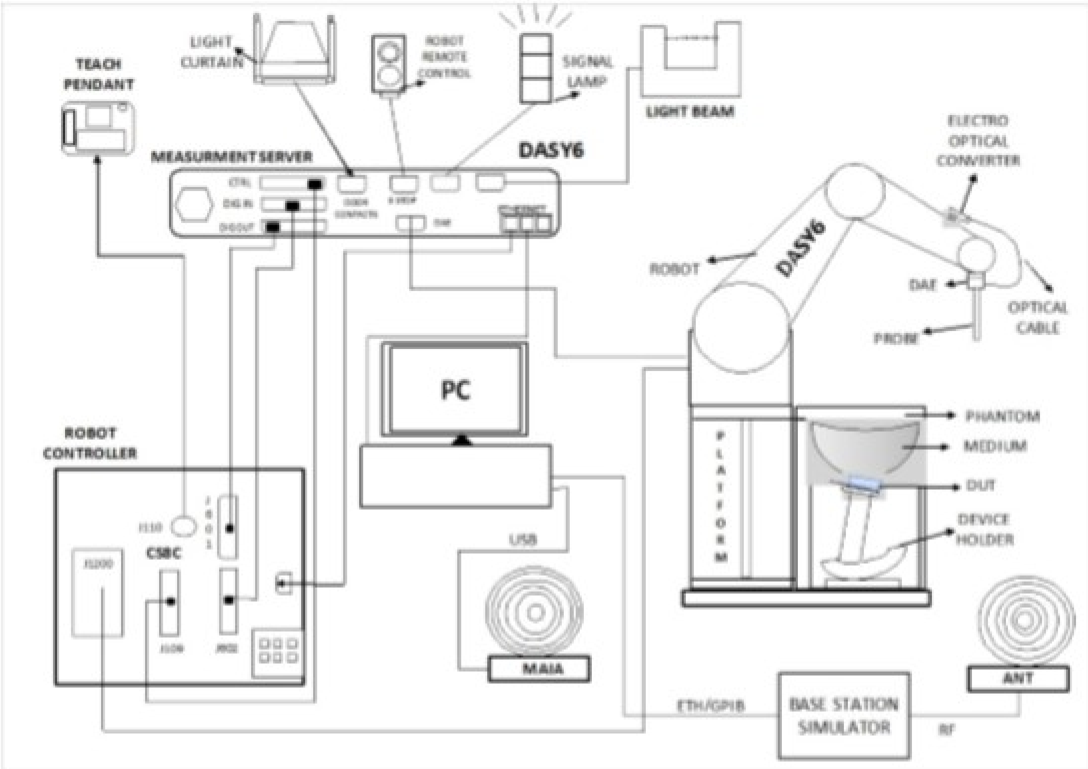
2 SAR Measurement System

2.1 SAR Measurement Set-up

cDASY V6.0 Complaince Dosimetric Assessment System

The DASY6 system combines a sophisticated measurement system with a variety of probes (E-field, H-field, temperature, etc.) and a high-precision 6-axis robot positioner. The combination allows for completely automated measurement scans and evaluations with both field and position information, e.g., volume averages, peak search, and extrapolations. The main purpose is the measurement in the nearfield of radiators of highly non-isotropic fields for which the exact measurement location is critical. Each of the numerous parameters of the many components of the dosimetric measurement system (phantom, medium, positioner, probe, electronics, measurement server, evaluation procedures) influences the measurement result.

The DASY6 system in cDASY6/DASY5 V5.2 SAR Configuration is shown below:



The cDASY6 system for performing compliance tests consist of the following items:

- Robot (6 Axis) & Parts
  - -Controller
  - -Teach Pendant
  - -Signal Lamps
  - -Remote Control
- Phantoms
- Platforms
- Tissue/Head Sim. Liquids
- Dielectric Measurement Kit
- DUT Holder
- Probes & Dipole Kit
- Data Acquisition Electronics (DAE)
- Measurement Server

• Light Beam Unit
• Computer & Software
• MAIA / ANT

2.2 Test environment

The DASY measurement system is placed at the head end of a room with dimensions: 5 x 2.5 x 3 m³, the SAM phantom is placed in a distance of 75 cm from the side walls and 1.1m from the rear wall.
Picture 1 of the photo documentation shows a complete view of the test environment.
The system allows the measurement of SAR values larger than 0.005 mW/g.

2.3 DASY6 Measurement Chain

The DASY6 dosimetric measurement system signal chain is shown in the figure below:

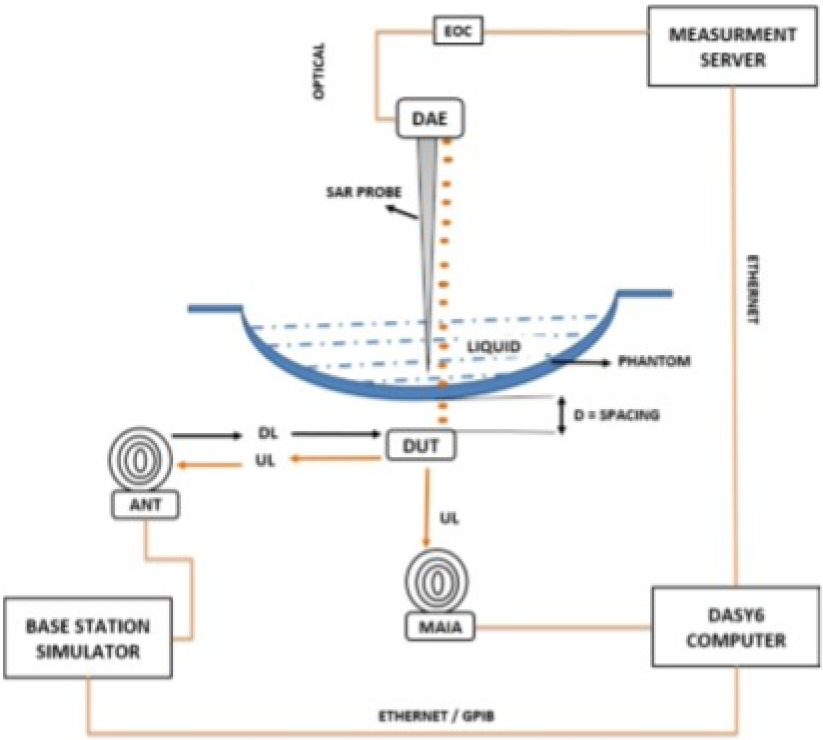


Figure: cDASY6 Dosimetric Measurement System Signal Chain

The base-station simulator is controlled by the computer, to setup a specific test mode call with the device under test (DUT). The test mode call parameters (Freq. Band, Channel, Modulation, etc.) are set within the cDASY6 software.
The DUT is placed in the Device Holder and held at a fixed spacing / orientation with respect to the phantom. The phantom has a fixed geometry and thickness defined by the compliance standards.
The phantom is filled with liquid medium of known permittivity and conductivity.
The uplink signal transmitted by the DUT is measured inside the medium by the probe, which is accurately positioned at a precisely known distance and defined orientation with respect to the phantom surface, normal at the point by the 6-axis robot positioner.
The dipole / loop sensors at the probe tips pick up the signal and generate a voltage, which is measured by the voltmeter inside the data acquisition electronics (DAE). The DAE returns digital values, which are converted to an optical signal and transmitted via the electro-optic converter (EOC) to the measurement server (MS). The data is finally recorded in the DASY6 software.
The Modulation and Interference Analyzer (MAIA) measures the uplink signal and the cDASY6 software calculated signal characteristics such as bandwidth, modulation frequency, etc. and matches these with the known characteristics of the test mode call parameters set up via the base-station simulator. This is important, as the probe has different calibration factors for different types of uplink signals – to obtain an accurate reading, the uplink signal must match the probe calibration factors applied.

In case of a new or unknown signal, the MAIA is used to ascertain the best match of probe calibration factors depending on the characteristics of measured signal.
The free-space E-field / H-field measurement setup is also similar. The SAR probe is replaced by the E-an/or H-field probe, while the DUT is typically placed on a plane surface. The data acquisition and signalling processing via the DAE, EOC, and MS by the DASY6 software remains the same.

2.4 Data Acquisition Electronics description

The data acquisition electronics (DAE) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converte 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.

Input Impedance	200MOhm	
The Inputs	symmetrical and floating	
Common mode rejection	above 80 dB	

2.5 Probe description

These probes are specially designed and calibrated for use in liquids with high permittivity. 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.

Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements

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 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)	
Dynamic range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones	

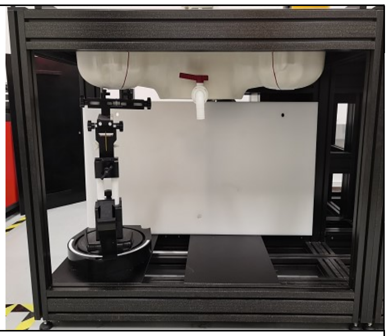
Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

Construction	Symmetrical design with triangular core 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 (30 MHz to 6 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic range	10 µW/g to > 100 mW/g; Linearity: ± 0.2 dB(noise: typically<1µW/g)	
Dimensions	Overall length: 337 mm (Tip:20 mm) Tip diameter:2.5 mm (Body:12 mm) Typical distance from probe tip to dipole centers: 1mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%	

2.6 Phantom description

SAM Twin Phantom

Shell Thickness	2mm±0.2mm;The ear region:6.0±0.2mm
Filling Volume	Approximately 25 liters
Dimensions	Length:1000mm; Width:500mm; Height: adjustable feet
Measurement Areas	Left hand Right hand Flat phantom

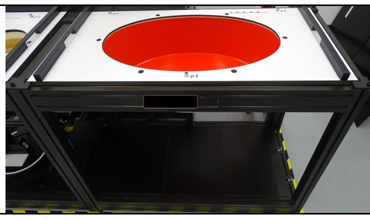


The bottom plate contains three pairs of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.
A white cover is provided to cover the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on top of this phantom cover are possible. Three reference marks are provided on the phantom counter. These reference marks are used to teach the absolute phantom position relative to the robot.

The following figure shows the definition of reference point:

ELI4 Phantom

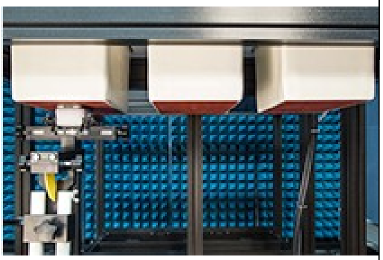
Shell Thickness	2mm±0.2mm
Filling Volume	Approximately 30 liters
Dimensions	Major axis:600mm; Minor axis:400mm;
Measurement Areas	Flat phantom



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

The phantom shell material is resistant to all ingredients used in the tissue-equivalent liquid recipes. The shell of the phantom including ear spacers is constructed from low permittivity and low loss material, with a relative permittivity 2≤εr≤5 at ≤3 GHz,3≤ εr≤4 at >3 GHz and a loss tangent ≤0.05.

Modular Triple Flat Phantom

Shell Thickness (bottom plate)	2mm±0.2mm	
Filling Volume (Module)	approx. 8.1 liters (filling height: 155 mm)	
Dimensions	Length: 292 mm Width: 178 mm Height: 178 mm Useable area: 280 × 175 mm	
Measurement Areas	Flat phantom	
The Modular Flat Phantom consists of three identical modules that can be installed and removed separately without emptying the liquid. It is used for compliance testing of small wireless devices in body-worn configurations according to IEC 62209-2, etc.		

2.7 Device holder description

The DASY device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. This device holder is used for standard mobile phones or PDA's only. If necessary an additional support of polystyrene material is used.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε =3 and loss tangent σ =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.
The device holder permits the device to be positioned with a tolerance of ±1° in the tilt angle.

Larger DUT's (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values.
Therefore those devices are normally only tested at the flat part of the SAM.

2.8 Robot System

The DASY6 system uses the high precision industrial robots TX60L, TX90XL, and the RX160L from St¨aubli SA (France). The basic specifications of the three robots are as follows:

Specifications	TX60L	TX90XL	RX160L
Number of Axes	6	6	6
Nominal Load	2 kg	5 kg	14 kg
Maximum Load	5 kg	12 kg	28 kg
Reach	920 mm	1450 mm	2010 mm
Repeatability	0.03 mm	0.035 mm	0.05 mm
Control Unit	CS8c	CS8c	CS8c
Programming Language	VAL3	VAL3	VAL3
Weight	52.2 kg	116 kg	250 kg

The DASY6 system uses the high-precision industrial robots TX60L, TX90XL, and RX160L from St¨aubli SA (France). The TX robot family – the successor of the well-known RX robot family – continues to offer the features important for DASY6 applications:

• High precision (repeatability 0.02mm)
• High reliability (industrial design)
• Low maintenance costs (virtually maintenance-free as all gears are direct drive, no belt drives)
• Jerk-free straight movements (brushless synchron motors, no stepper motors)
• Low extremely low frequency (ELF) interference (motor control fields are shielded by the closed metallic construction)

The robots are controlled by the St¨aubli CS8c robot controllers. All information regarding the use and maintenance of the robot arm and the robot controller is provided on CDs delivered with the robot. Paper manuals are available directly from St¨aubli upon request.

2.9 Test Equipment List

This table gives a complete overview of the SAR measurement equipment.
Devices used during the test described are marked ☒

	Manufacturer	Device	Type	Serial number	Date of last calibration	Valid period*
☒	SPEAG	Dosimetric E-Field Probe	EX3DV4	3736	2021-03-03	One year
☒	SPEAG	Data acquisition electronics	DAE4	852	2021-04-26	One year
☒	SPEAG	2450 MHz Dipole	D2450V2	860	2018-11-17	Three years
☒	SPEAG	Software	DASY52	N/A	NCR	NCR
☒	SPEAG	Twin Phantom	SAM	1892	NCR	NCR
☒	R & S	Universal Radio Communication Tester	CMW 500	116265	2021-07-02	One year
☒	Anritsu	Signal Analyzer	MS2690A	6261767335	2021-03-14	One year
☒	SPEAG	Dielectric Probe Kit	DAK3.5	1143	NCR	NCR
☒	Agilent	Network Analyser	E5071C	MY46629448	2021-07-02	One year
☒	Keysight	Signal Generator	N5181A	MY50145341	2020-11-09	One year
☒	MINI-CIRCUITS	Amplifier	ZHL-42W	QA1402001	NCR	NCR
☒	AR	Directional Coupler	DC7144M1	0423264	2021-07-03	One year
☒	R & S	Power Meter	NRP2	105880	2021-03-13	One year
☒	R & S	Power Meter Sensor	NRP8S	103084	2021-03-13	One year
☒	R & S	Power Meter	NRP2	105879	2021-03-13	One year
☒	R & S	Power Meter Sensor	NRP8S	103083	2021-03-13	One year

Note:
1) Per KDB865664 D01 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.
2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.
3) *All the equipment are within the valid period when the tests are performed.

3 SAR Measurement Procedure

3.1 Scanning procedure

The DASY installation includes predefined files with recommended procedures for measurements and system check. They are read-only document files and destined as fully defined but unmeasured masks. 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.

- The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. +/- 5 %.

- For power drift measurement, DASY software supports that the reference position can be either the selected section's grid reference point or a user point. If the E-field of power reference measurement in the default grid reference point is very small, the test lab may set the reference position to the user point near the hotspot location to avoid large measurement uncertainty.

- The “surface check” measurement tests the optical surface detection system of the DASY system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

- The “area scan” measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension (≤2GHz), 12 mm in x- and y- dimension (2-4 GHz) and 10mm in x- and y- dimension (4-6GHz). If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.
  Results of this coarse scan are shown in Appendix B.

- A “zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous “coarse” scan. This is a fine grid with maximum scan spatial resolution: Δx_{zoom}, Δy_{zoom}≤2GHz - ≤8mm, 2-4GHz - ≤5 mm and 4-6 GHz-≤4mm; Δz_{zoom} ≤3GHz - ≤5 mm, 3-4 GHz- ≤4mm and 4-6GHz-≤2mm where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in Appendix B. Test results relevant for the specified standard (see chapter 1.4.)are shown in table form in chapter 7.2.

- A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2 mm steps. This measurement shows the continuity of the liquid and can - depending in the field strength – also show the liquid depth. A z-axis scan of the measurement with maximum SAR value is shown in Appendix B.

The following table summarizes the area scan and zoom scan resolutions per KDB865664 D01:

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

3.2 Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured 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 algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.
- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.
- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.

Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

Advanced Extrapolation

DASY uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

3.3 Data Storage and Evaluation

Data Storage

The DASY software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension "DAE". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show 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 by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf/dcp_i$$

with
V_i = compensated signal of channel i (i = x, y, z)
U_i = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes: $E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$

H-field probes: $H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2)/f$

with V_i = compensated signal of channel i (i = x, y, z)

$Norm_i$ = sensor sensitivity of channel i (i = x, y, z) [mV/ (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 RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

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

$$SAR = (E_{tot}^2 \cdot \sigma) / (\rho \cdot 1000)$$

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 normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$P_{pwe} = E_{tot}^2 / 3770$ or $P_{pwe} = H_{tot}^2 \cdot 37.7$

with P_{pwe} = equivalent power density of a plane wave in mW/cm^2

E_{tot} = total electric field strength in V/m

H_{tot} = total magnetic field strength in A/m

4 System Verification Procedure

4.1 Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectic parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ± 5% of the target values.

The following materials are used for producing the tissue-equivalent materials.

Ingredients (% of weight)	Head Tissue					
Frequency Band (MHz)	750	835	1750	1900	2450	2600
Water	39.2	41.45	52.64	55.242	62.7	55.242
Salt (NaCl)	2.7	1.45	0.36	0.306	0.5	0.306
Sugar	57.0	56.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	47.0	44.542	36.8	44.452
Ingredients (% of weight)	Body Tissue					
Frequency Band (MHz)	750	835	1750	1900	2450	2600
Water	50.3	52.4	69.91	69.91	73.2	64.493
Salt (NaCl)	1.60	1.40	0.13	0.13	0.04	0.024
Sugar	47.0	45.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	29.96	29.96	26.7	32.252

Table 4: Tissue Dielectric Properties

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

☒**Simulating Head Liquid (HBBL600-6000MHz),Manufactured by SPEAG:**

Ingredients	(% by weight)
Water	50-65%
Esters,Emulsifiers,Inhibitors	10-30%
Sodium salt	8-25%

☐**Simulating Body Liquid (MBBL600-6000MHz),Manufactured by SPEAG:**

Ingredients	(% by weight)
Water	60-80%
Esters,Emulsifiers,Inhibitors	20-40%
Sodium salt	0-1.5%

Note: According to 201904 TCB workshop slides for RF Exposure Procedures, Procedures has permitted the use of single head tissue simulating liquid specified in IEC 62209-1 for all SAR tests. So the single head tissue simulating liquid is used for all SAR tests in this test report. The conservative ±5% tolerance is used in tissue dielectric parameters measurments.

Tissue Type	Target Frequency	Target Tissue		Measured Tissue		Deviation (Within +/-5%)		Liquid Temp.	Test Date
		εr	σ (S/m)	εr	σ (S/m)	$\Delta\varepsilon_r$	Δσ		
2450MHz Head	2410	39.3	1.76	41.03	1.732	4.40%	-1.59%	22.8°C	2021-09-07
	2435	39.2	1.79	41.01	1.748	4.62%	-2.35%		
	2450	39.2	1.80	41.00	1.758	4.59%	-2.33%		
	2460	39.2	1.81	40.99	1.766	4.57%	-2.43%		

Table 5: Measured Tissue Parameter

Note:

1) The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.
2) KDB865664 was ensured to be applied for probe calibration frequencies greater than or equal to 50MHz of the EUT frequencies.
3) The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies. The SAR test plots may slightly differ from the table above since the DASY rounds to three significant digits.

4.2 System Check

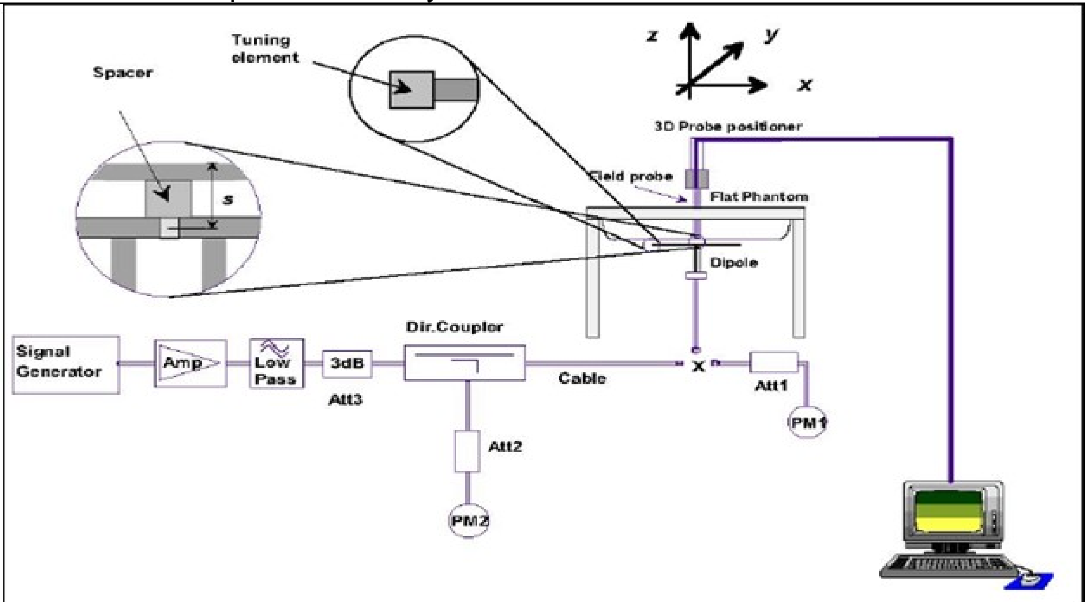
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE 1528 (described above). The following table shows system check results for all frequency bands and tissue liquids used during the tests (Graphic Plot(s) see Appendix A).

Dipole Information	System Check	Target SAR (Normalized to 1W)		Measured SAR (Normalized to 1W)		Deviation (Within +/-10%)		Test Date
SN		1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)	Δ1-g	Δ10-g	
860	2450MHz Head	53.10	24.70	50.80	24.04	-4.33%	-2.67%	2021-09-07

Table 6: System Check Results

4.3 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 plexiglass 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 SAM. It is fed with a power of 250 mW (below 3GHz) or 100mW (3-6GHz). 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 system check 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 SAR measurement variability and uncertainty

5.1 SAR measurement variability

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The 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.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 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 > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

The detailed repeated measurement results are shown in the following section.

5.2 SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz, 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.

6 SAR Test Configuration

6.1 Test Positions Configuration

Per KDB 447498 D01, transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. Next to the mouth exposure requires 1-g SAR, and the wrist-worn condition requires 10-g extremity SAR. The 10-g extremity and 1-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. The wrist bands should be strapped together to represent normal use conditions. SAR for wrist exposure is evaluated with the back of the devices positioned in direct contact against a flat phantom fill with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must be representative of actual use conditions.

6.1.1 10-g Extremity Exposure Condition

The wrist watch requires extremity 10 gram SAR testing for the wrist (4.0 W/kg limit) with the back of the device in direct contact with the flat phantom. As the back side of this device can be well positioned in direct contact against a flat phantom, flat phantom testing is possible per KDB447498 D01.

6.1.2 Next-to-mouth Exposure Condition

The device also has a speaker mode, so head SAR testing (1.6 W/kg limit) of the front face of the device at a distance of 10mm from the flat phantom is appropriate per section 6.2 of KDB Publication 447498 D01.

6.2 Wi-Fi Test Configuration

For Wi-Fi SAR testing, a communication link is set up with the testing software for Wi-Fi mode test. During the test,at the each test frequency channel, the EUT is operated at the RF continuous emission mode. Per KDB248227 D01, a minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

6.2.1 Initial Test Position Procedure

For exposure condition with multiple test position, such as handsets operating next to the ear, devices with hotspot mode or UMPC mini-tablet , procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all position in an exposure condition. The test position with the highest extrapolated(peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4W/kg, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8W/kg or all test position are measured. For all positions/configurations tested using the initial test position and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required channels are tested.

6.2.2 Initial Test Configuration Procedure

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2 of KDB248227 D01). SAR test reduction of subsequent highest output test channels is based on the *reported* SAR of the initial test configuration.
For next to the ear, hotspot mode and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR measurement using the initial test configuration transmission mode. For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration.
When the *reported* SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the *reported* SAR is ≤ 1.2 W/kg or all required channels are tested.

6.2.3 Sub Test Configuration Procedure

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units.
When the highest reported SAR for the initial test configuration, according to the initial test position or

fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.

6.2.4 2.4G Wi-Fi SAR Test Procedures

Separate SAR procedures are applied to DSSS and OFDM configurations in the 2.4 GHz band to simplify DSSS test requirements. For 802.11b DSSS SAR measurements, DSSS SAR procedure applies to fixed exposure test position and initial test position procedure applies to multiple exposure test positions.

A) 802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the *reported* SAR of the highest measured maximum output power channel (section 3.1 of of KDB248227 D01) for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the *reported* SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any *reported* SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

B) 2.4GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3 of of KDB248227 D01). 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.

7 SAR Measurement Results

7.1 Conducted power measurements

7.1.1 Conducted power of 2.4G Wi-Fi

Mode	Duty cycle	Channel	Frequency (MHz)	Data Rate (Mbps)	Tune-up Max.	Average Power (dBm)	SAR Test (Yes/No)
802.11b	99%	1	2412	1Mbps	16	15.16	No
		6	2437		16	**15.45**	Yes
		11	2462		16	14.91	No
802.11g	98%	1	2412	6Mbps	14	13.91	No
		6	2437		14	13.75	No
		11	2462		14	13.84	No
802.11n 20M	98%	1	2412	MCS0	14	13.85	No
		6	2437		14	13.24	No
		11	2462		14	13.61	No

Table 7: Test results conducted power measurement 2.4G Wi-Fi

Note: The conducted power of WIFI is measured with RMS detector.

7.1.2 Conducted power of BT

The output power of BT antenna is as the following:

BT	Tune-up	Average Conducted Power (dBm)		
		0CH	39CH	78CH
DH5	13.00	11.69	**11.74**	11.32
2DH5	12.00	8.91	9.11	8.69
3DH5	12.00	8.92	9.10	8.68

BT	Tune-up	Average Conducted Power (dBm)		
		0CH	19CH	39CH
BT 4.0	13.00	11.75	11.58	11.39
BT 5.0	13.00	11.70	11.54	11.40

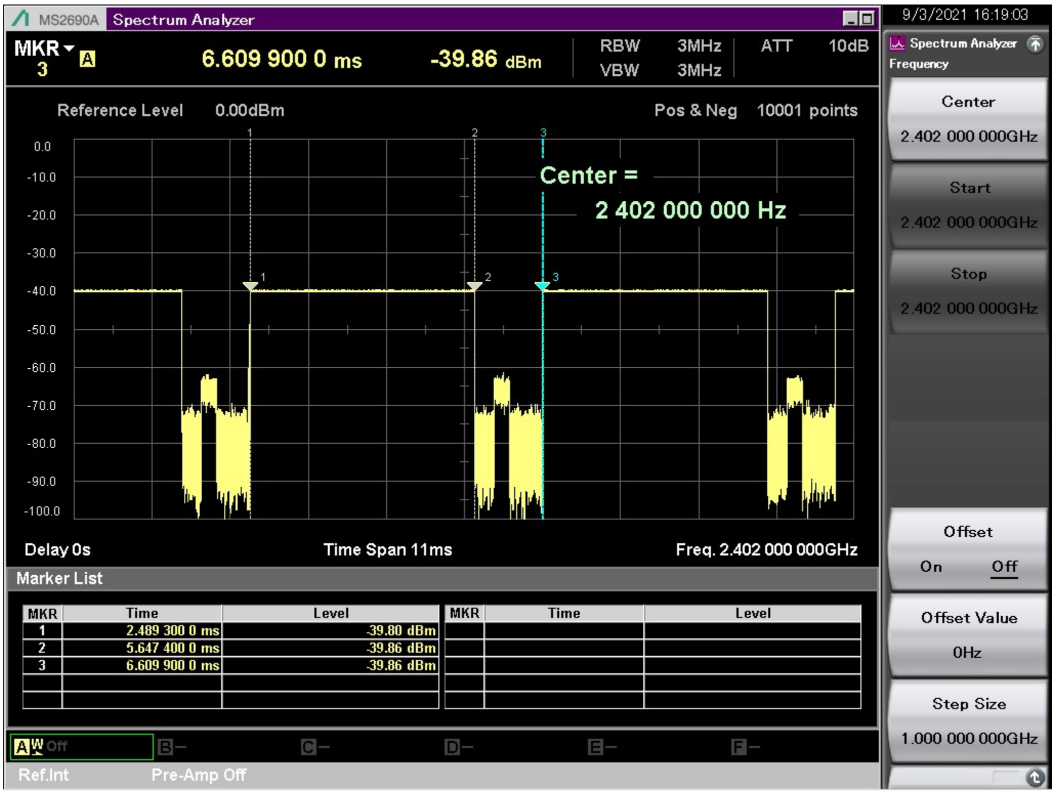
Table 8: Conducted power measurement results of BT.

Note:

1) The conducted power of BT is measured with RMS detector.

2) The bolded mode was selected for SAR testing.

BT duty factor measured results:



The duty cycle plot is shown above, so the duty cycle of bluetooth is calculated as below:

$$Duty\ cycle = pules\ \frac{width}{period} * 100\% = \frac{3.1581ms}{4.1206ms} * 100\% = 76.64\%$$

7.2 SAR measurement Results

General Notes:

1) Per KDB 447498 D01, all SAR measurement results are scaled to the maximum tune-up tolerance limit to demonstrate SAR compliance.

2) Per KDB 447498 D01, 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:

● ≤ 0.8W/kg for 1-g or 2.0W/kg for 10-g respectively, when the transmission band is ≤ 100MHz.

● ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz.

● ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 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.

3) Per KDB 865664 D01,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 KDB 865664 D02, 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 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).

5) Devices with built-in NFC or similar functions that do not require separate SAR testing for these specific capabilities can generally be tested according to the SAR measurement procedures normally required for the device.

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Wi-Fi Notes:

Per KDB 248227D01:

1) When reported SAR for the initial test position is ≤ 0.4W/kg, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8W/kg or all test position are measured. For all positions/configurations tested using the initial test position and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required channels are tested..

2) When the DSSS *reported* SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

3) 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, SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations

4) The highest SAR measured for the initial test position or initial test configuration should be used to determine SAR test exclusion according to the sum of 1-g SAR and SAR peak to location ratio provisions in KDB 447498. In addition, a test lab may also choose to perform standalone SAR measurements for test positions and 802.11 configurations that are not required by the initial test position or initial test configuration procedures and apply the results to determine simultaneous transmission SAR test exclusion, according to sum of 1-g and SAR peak to location ratio requirements to reduce the number of simultaneous transmission SAR measurements.

BT Notes:

BT was configured to transimit manximum averaged power level and max duty cycle for each operation mode to be tested. If the actual duty cycle is <100%, the SAR test results should be scaled to 100% duty cycle to ensure SAR compliance.

7.2.1 SAR measurement Results of 2.4G Wi-Fi

Test Position	Dist.	Test Channel /Freq.(MHz)	Test Mode	Measured 1-g SAR (W/kg)	Measured 10-g SAR (W/kg)	Duty Cycle	Conducted Power (dBm)	Tune-up Power (dBm)	Reported 1-g SAR (W/kg)	Accessory Information	Note
Front side	10mm	6/2437	802.11b	0.074	0.037	99%	15.45	16.00	0.085	Battery 1#	/
Front side	10mm	6/2437	802.11b	0.070	0.033	99%	15.45	16.00	0.080	Battery 2#	/
Front side	10mm	6/2437	802.11b	**0.096**	0.049	99%	15.45	16.00	**0.110**	Battery 1#with silica gel strap	Plot

Table 9: Next to mouth SAR test results of 2.4G Wi-Fi

Test Position	Dist.	Test Channel /Freq.(MHz)	Test Mode	Measured 1-g SAR (W/kg)	Measured 10-g SAR (W/kg)	Duty Cycle	Conducted Power (dBm)	Tune-up Power (dBm)	Reported 10-g SAR (W/kg)	Accessory Information	Note
Back side	0mm	6/2437	802.11b	0.391	0.183	99%	15.45	16.00	0.210	Battery 1#	/
Back side	0mm	6/2437	802.11b	0.383	0.176	99%	15.45	16.00	0.202	Battery 2#	/
Back side	0mm	6/2437	802.11b	0.428	**0.210**	99%	15.45	16.00	**0.241**	Battery 1#with silica gel strap	Plot

Table 10: 10-g Extremity SAR test results of 2.4G Wi-Fi

Note: Per KDB248227D01, for SAR test of WiFi 2.4G, SAR is measured for 2.4 GHz 802.11b DSSS using the initial test configuration procedure. The highest reported SAR for DSSS is adjusted by the ratio of OFDM 802.11g/n to DSSS specified maximum output power and the adjusted SAR is < 1.2 W/kg, so SAR for 802.11g/n is not required.

7.2.2 SAR measurement Results of BT

Test Position	Dist.	Test Channel /Freq.(MHz)	Test Mode	Measured 1-g SAR (W/kg)	Measured 10-g SAR (W/kg)	Duty Cycle	Conducted Power (dBm)	Tune-up Power (dBm)	Reported 1-g SAR (W/kg)	Accessory Information	Note
Front side	10mm	39/2441	DH5	**0.017**	0.007	76.64%	11.74	13.00	**0.029**	Battery 1#	Plot
Front side	10mm	39/2441	DH5	0.011	0.004	76.64%	11.74	13.00	0.020	Battery 2#	/
Front side	10mm	39/2441	DH5	0.011	0.004	76.64%	11.74	13.00	0.019	Battery 1#with silica gel strap	/

Table 11: Next to mouth SAR test results of BT

7.3 Multiple Transmitter Evaluation

The detailed location of the Tx antennas inside the device refers to Appendix E.

7.3.1 Stand-alone SAR test exclusion

Per FCC KDB 447498 D01, the 1-g SAR 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 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.

Mode	Position	P_{max} (dBm) *	P_{max} (mW)	Distance (mm)	f (GHz)	Calculation Result	SAR Exclusion threshold	SAR test exclusion
BT	Next to mouth	13.00	19.95	10	2.480	3.14	3.00	No
BT	10-g Extremity	13.00	19.95	5	2.480	6.28	7.50	Yes

Table 12: Standalone SAR test exclusion for BT

Note:

1)* - maximum possible output power declared by manufacturer

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to 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.

Per KDB 447498 D01, the approximate SAR values were estimated at selected frequencies, test separation distances and power levels for determining simultaneous transmission SAR test exclusion when standalone SAR is not required.

Mode	Position	P_{max} (dBm)*	P_{max} (mW)	Distance (mm)	f (GHz)	X	Estimated SAR (W/kg)*
BT	10-g Extremity	13.00	19.95	5	2.480	18.75	0.335

Table 13: Estimated SAR calculation for BT

Note:

1) * - maximum possible output power declared by manufacturer

7.3.2 Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities of this device are as below:

NO.	Simultaneous Tx Combination	Next to mouth	10-g Extremity
1	Wi-Fi/ BT + NFC	Yes	Yes

Table 14: Simultaneous Transmission Possibilities

7.3.3 SAR Summation Scenario

Band	1g Next to mouth SAR_{Max}	10-g Extremity SAR_{Max}
2.4G Wi-Fi	0.110	0.241
BT	0.029	0.335
Simultaneous Transmission SAR (W/kg)	**0.110**	**0.335**

Table 15: SAR Simultaneous Tx Combination

Note:

1) Wi-Fi 2.4G and Bluetooth share the same Tx antenna and can't transmit simultaneously.

2) Devices with built-in NFC or similar functions that do not require separate SAR testing for these specific capabilities can generally be tested according to the SAR measurement procedures normally required for the device. So the total exposure ratio (TER) is < 1, which can also meet the RF exposure requirements of simultaneous Transmission scenarios

Simultaneous Transmission Conclusion

The above numeral summed SAR results is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore simultaneous transmission SAR with Volume Scans is not required per KDB 447498 D01.

Appendix A. System Check Plots

(Please See Appendix No.: SYBH(Z-SAR)20210831004001-1A, total: 5 pages)

Appendix B. SAR Measurement Plots

(Please See Appendix No.: SYBH(Z-SAR)20210831004001-1B, total: 4 pages)

Appendix C. Calibration Certificate

(Please See Appendix No.: SYBH(Z-SAR)20210831004001-1C, total: 38 pages)

Appendix D. Photo documentation

(Please See Appendix No.: SYBH(Z-SAR)20210831004001-1D, total: 5 pages)

Appendix E. Antenna Location

(Please See Appendix No.: SYBH(Z-SAR)20210831004001-1E, total: 1 page)

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