FCC SAR Test Report

APPLICANT	:	**Cardo Systems, Ltd.**
EQUIPMENT	:	**SC EDGE**
BRAND NAME	:	**Cardo Systems, Ltd.**
MODEL NAME	:	**SC EDGE**
FCC ID	:	**Q95ER32**
STANDARD	:	**FCC 47 CFR Part 2 (2.1093)**

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Si Zhang

Approved by: Si Zhang

ilac-MRA

ACCREDITED
Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA4D2601	Rev. 01	Initial issue of report	Feb. 25, 2025

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Cardo Systems, Ltd., SC EDGE, SC EDGE,** are as follows.

Highest 1g SAR Summary				
Equipment Class	Frequency Band		Head (Separation 22mm) 1g SAR (W/kg)	Highest Simultaneous Transmission 1g SAR (W/kg)
DSS	Bluetooth	2.4GHz Bluetooth	**0.40**	0.40
DTS	Zigbee	Zigbee	<0.10	
Highest 10g SAR Summary				
Equipment Class	Frequency Band		Extremity (W/kg) (Separation 0mm)	Highest Simultaneous Transmission 10g SAR (W/kg)
DSS	Bluetooth	2.4GHz Bluetooth	**2.69**	2.69
DTS	Zigbee	Zigbee	<0.10	
Date of Testing:			2025/2/18	

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Extremity SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

<table>
<tr><th colspan="4">Testing Laboratory</th></tr>
<tr><td>Test Firm</td><td colspan="3">Sporton International Inc. (Kunshan)</td></tr>
<tr><td>Test Site Location</td><td colspan="3">No. 1098, Pengxi North Road, Kunshan Economic Development Zone
Jiangsu Province 215300 People's Republic of China
TEL : +86-512-57900158</td></tr>
<tr><td rowspan="2">Test Site No.</td><td>Sporton Site No.</td><td>FCC Designation No.</td><td>FCC Test Firm Registration No.</td></tr>
<tr><td>SAR01-KS</td><td>CN1257</td><td>314309</td></tr>
</table>

Applicant	
Company Name	Cardo Systems, Ltd.
Address	101 E. Park Blvd, Suite 600, Plano TX, 75074 USA

Manufacturer	
Company Name	Cardo Systems, Ltd.
Address	101 E. Park Blvd, Suite 600, Plano TX, 75074 USA

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	SC EDGE
Brand Name	Cardo Systems, Ltd.
Model Name	SC EDGE
FCC ID	Q95ER32
S/N	Bluetooth:SP4389A140 Zigbee:SP4499A319
Wireless Technology and Frequency Range	Bluetooth: 2402 MHz ~ 2480 MHz Zigbee: 2405 MHz ~ 2475 MHz
Mode	Bluetooth BR/EDR/LE Zigbee: O-QPSK
HW Version	1
SW Version	1
EUT Stage	Identical Prototype

Remark:
1. This device does not support voice function.
2. This device has Bluetooth operations. The Bluetooth has two Antennas (Chip Antenna and Printed Antenna).
3. For Bluetooth Chip Antenna supported BR/EDR/LE, Bluetooth Printed Antenna supported BR/EDR Only.
4. SAR testing for ZigBee was performed using FTM (Factory Test Mode).

5. RF Exposure Limits

5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

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). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

6. Specific Absorption Rate (SAR)

6.1 Introduction

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

6.2 SAR Definition

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

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

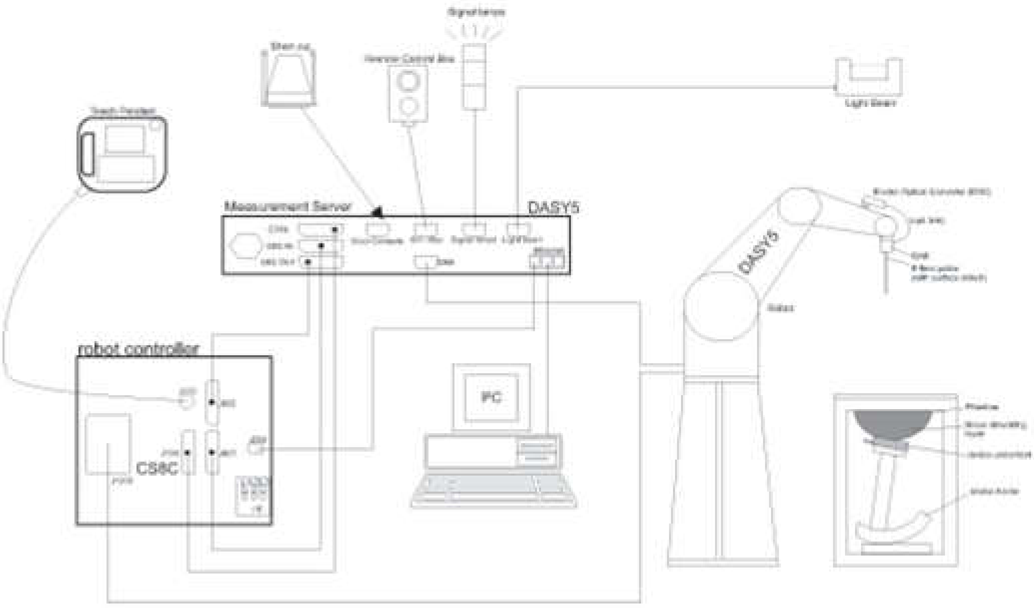
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. System Description and Setup

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



- A standard high precision 6-axis robot 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 WinXP or Win7 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.

7.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<EX3DV4 Probe>

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

7.2 Data Acquisition Electronics (DAE)

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

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

Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom

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. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm

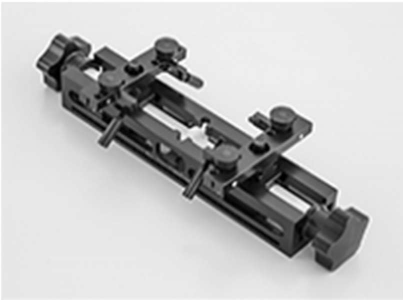
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices or for evaluating transmitters operating at low frequencies. ELI is fully compatible with standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN power measurement, use engineering software to configure EUT WLAN continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

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

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

8.1 Spatial Peak SAR Evaluation

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

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

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

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

8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements 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. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

8.3 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 fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 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.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

8.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. 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.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

8.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.6 Power Drift Monitoring

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

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	1095	2024/2/8	2025/2/7
SPEAG	Data Acquisition Electronics	DAE4	1279	2024/8/20	2025/8/19
SPEAG	Dosimetric E-Field Probe	EX3DV4	7764	2024/9/2	2025/9/1
SPEAG	SAM Twin Phantom	SAM Twin	TP-1842	NCR	NCR
CHIGO	Thermo-Hygrometer	HTC-1	1929537	2024/5/15	2025/5/14
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46112129	2024/7/4	2025/7/3
SPEAG	Dielectric Probe Kit	DAK-3.5	1144	2024/8/20	2025/8/19
Anritsu	Vector Signal Generator	MG3710A	6201682672	2025/1/3	2026/1/2
Rohde & Schwarz	Power Meter	NRVD	102081	2024/7/4	2025/7/3
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2024/7/4	2025/7/3
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2024/7/4	2025/7/3
R&S	BLUETOOTH TESTER	CBT	101246	2024/7/4	2025/7/3
Rohde & Schwarz	Spectrum Analyzer	FSV7	101631	2024/10/11	2025/10/10
TES	DIGITAC THERMOMETER	TYPE-K	200505600	2024/7/8	2025/7/7
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	N/A	Note 1	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
Agilent	Dual Directional Coupler	778D	20500	Note 1	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note 1	

Note:

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

10. System Verification

10.1 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. 10.1. 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 in Fig. 10.2.

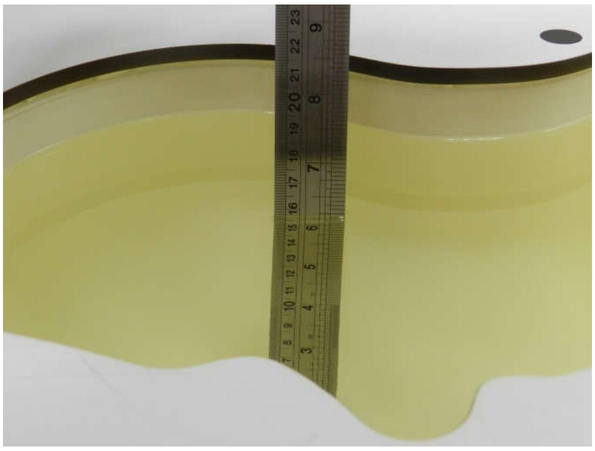


Fig 10.1Photo of Liquid Height for Head SAR

Fig 10.2 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Head								
2450	55.0	0	0	0	0	45.0	1.80	39.2

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	22.8	1.744	39.267	1.80	39.20	-3.11	0.17	±5	2025/2/18

10.3 System Performance Check Results

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

<1g SAR>

Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2025/2/18	2450	50	1095	7764	1279	2.670	52.60	53.4	1.52

<10g SAR>

Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2025/2/18	2450	50	1095	7764	1279	1.260	24.70	25.2	2.02

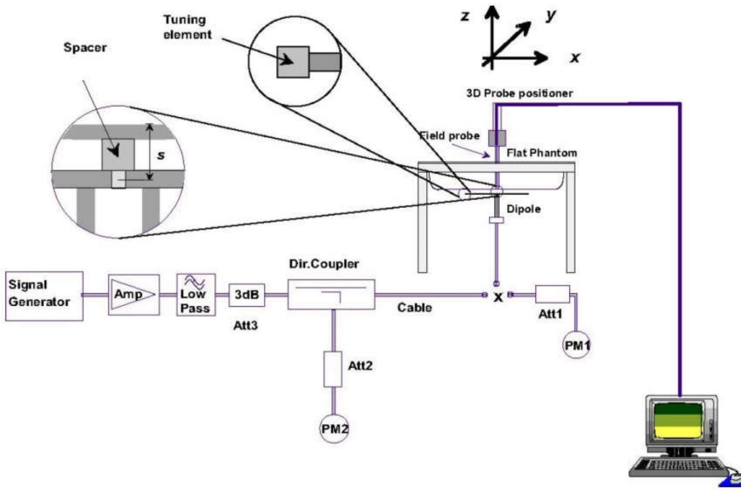


Fig 10.3.1 System Performance Check Setup

Fig 10.3.2 Setup Photo

11. RF Exposure Positions

11.1 Head SAR Testing for SC EDGE

(a) To position the device parallel to the phantom surface with in back of face surfaces of the device.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 22 mm.

11.2 Extremity SAR Testing for SC EDGE

(a) To position the device parallel to the phantom surface with all surfaces of the device.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 0 mm.

<EUT Setup Photos>

Please refer to Appendix D for the test setup photos.

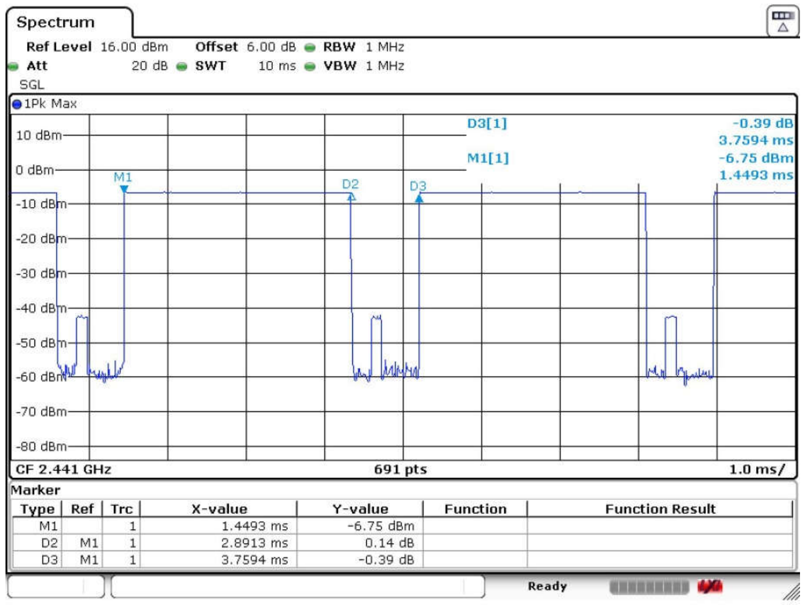
12. Conducted RF Output Power (Unit: dBm)

<2.4GHz Bluetooth>

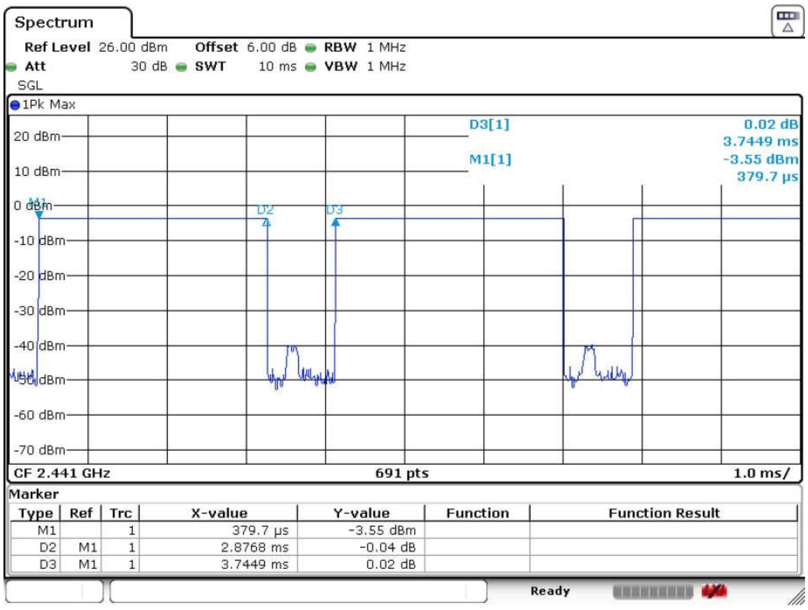
General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
2. The Bluetooth duty cycle are 76.91% for Printed Antenna, 76.82% for Chip Antenna as following figure, according to Oct. 2016 TCB workshop for Bluetooth SAR scaling need further consideration and the maximum duty cycle is 100%, therefore the actual duty cycle will be scaled up to100% for Bluetooth reported SAR calculation.

Bluetooth time-domain plot for Printed Antenna



Bluetooth time-domain plot for Chip Antenna



<Printed Antenna>

Mode	Channel	Frequency (MHz)	Average power (dBm)			Tune-up Limit
			1Mbps	2Mbps	3Mbps	
BR / EDR	CH 00	2402	18.75	18.46	18.84	20.50
	CH 39	2441	19.27	19.25	19.39	20.50
	CH 78	2480	19.16	19.31	19.16	20.50

<Chip Antenna>

Mode	Channel	Frequency (MHz)	Average power (dBm)			Tune-up Limit
			1Mbps	2Mbps	3Mbps	
BR / EDR	CH 00	2402	-2.82	-2.86	-2.80	-1.00
	CH 39	2441	-2.62	-2.40	-2.51	-1.00
	CH 78	2480	-3.01	-3.25	-2.45	-1.50

Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Limit
LE_1M	CH 00	2402	-17.17	-15.50
	CH 19	2440	-16.87	-15.50
	CH 39	2480	-17.27	-15.50

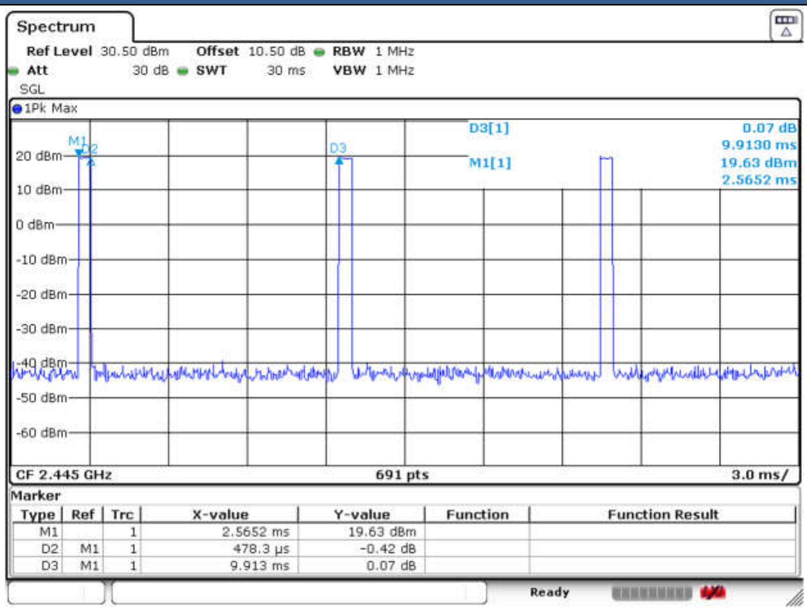
Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Limit
LE_2M	CH 00	2402	-16.54	-15.00
	CH 19	2440	-16.34	-15.00
	CH 39	2480	-16.61	-15.00

<Zigbee Conducted Power>

General Note:

1. For the requirement of manufacturer, Max device Transmission Duty Cycle is 4.82%.

Zigbee time-domain plot for Printed Antenna



<Printed Antenna>

Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Limit
Zigbee	CH 11	2405	15.55	17.00
	CH 19	2445	15.54	17.00
	CH 21	2455	15.51	17.00
	CH 23	2465	15.57	17.00
	CH 25	2475	10.51	12.00

13. Bluetooth Exclusions Applied

<Chip Antenna>

Mode Band	Max Average power(dBm)	
	BR/EDR	LE
2.4GHz Bluetooth	-1.00	-15.00

Note:

1. Per KDB 447498 D01v06, 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
   - 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

Bluetooth Max Power (dBm)	Separation Distance (mm)	Frequency (GHz)	exclusion thresholds
-1.00	22	2.48	0.1

Note:

Per KDB 447498 D01v06, a distance of 22 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.1 which is <= 3, SAR testing is not required.

14. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos.

15. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of Bluetooth signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor.
   d. For Zigbee: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor* Transmission duty cycle factor.
   e. For the requirement of manufacturer, the actual Max Transmission Duty Cycle is 5.04%.
2. Per KDB 447498 D01v06, for each exposure position, 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
   - ≤ 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
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
4. When Extremity SAR is considered, SAR thresholds is specified in the procedures for SAR test reduction and exclusion should be multiplied by 2.5.
5. Head SAR is evaluated with the back of device and positioned at 22mm from the flat phantom filled with head tissue-equivalent medium for the SAR test, the distance of 22 mm of more detail please refer to Operation Description. Extremity SAR is performed against flat section of SAM Twin phantom.
6. The printed antenna is a PCB board installed in the helmet. the PCB board was directly chosen to perform SAR Testing due to Phantom limitation, which is more conservative.

15.1 Head SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	Bluetooth	1Mbps	Back	22mm	ANT-Printed	39	2441	19.27	20.50	1.327	76.91	1.300	0.14	0.233	**0.402**
	Bluetooth	1Mbps	Back	22mm	ANT-Printed	0	2402	18.75	20.50	1.496	76.91	1.300	0	0.168	0.327
	Bluetooth	1Mbps	Back	22mm	ANT-Printed	78	2480	19.16	20.50	1.361	76.91	1.300	0.11	0.224	0.396
	Zigbee	-	Back	22mm	ANT-Printed	23	2465	15.57	17.00	1.390	4.82	1.046	0.08	0.000	0.000
	Zigbee	-	Back	22mm	ANT-Printed	11	2405	15.55	17.00	1.396	4.82	1.046	0.01	0.000	0.000
	Zigbee	-	Back	22mm	ANT-Printed	19	2445	15.54	17.00	1.400	4.82	1.046	-0.07	0.002	0.003
02	Zigbee	-	Back	22mm	ANT-Printed	21	2455	15.51	17.00	1.409	4.82	1.046	0.04	0.002	**0.003**
	Zigbee	-	Back	22mm	ANT-Printed	25	2475	10.51	12.00	1.409	4.82	1.046	-0.01	0.000	0.000

15.2 Extremity SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	Bluetooth	1Mbps	Front	0mm	ANT-Printed	39	2441	19.27	20.50	1.327	76.91	1.300	0.08	0.995	1.717
	Bluetooth	1Mbps	Back	0mm	ANT-Printed	39	2441	19.27	20.50	1.327	76.91	1.300	0.01	0.904	1.560
	Bluetooth	1Mbps	Left side	0mm	ANT-Printed	39	2441	19.27	20.50	1.327	76.91	1.300	0.03	0.211	0.364
	Bluetooth	1Mbps	Right side	0mm	ANT-Printed	39	2441	19.27	20.50	1.327	76.91	1.300	-0.08	0.034	0.059
	Bluetooth	1Mbps	Top side	0mm	ANT-Printed	39	2441	19.27	20.50	1.327	76.91	1.300	-0.08	0.827	1.427
	Bluetooth	1Mbps	Bottom side	0mm	ANT-Printed	39	2441	19.27	20.50	1.327	76.91	1.300	0.1	0.517	0.892
	Bluetooth	1Mbps	Front	0mm	ANT-Printed	0	2402	18.75	20.50	1.496	76.91	1.300	-0.18	0.908	1.766
03	Bluetooth	1Mbps	Front	0mm	ANT-Printed	78	2480	19.16	20.50	1.361	76.91	1.300	-0.02	1.520	**2.690**
	Bluetooth	1Mbps	Front	0mm	ANT-Chip	39	2441	-2.62	-1.00	1.453	76.82	1.302	0.03	0.001	0.002
	Bluetooth	1Mbps	Back	0mm	ANT-Chip	39	2441	-2.62	-1.00	1.453	76.82	1.302	-0.04	0.000	0.001
	Bluetooth	1Mbps	Left side	0mm	ANT-Chip	39	2441	-2.62	-1.00	1.453	76.82	1.302	-0.08	0.000	0.000
	Bluetooth	1Mbps	Right side	0mm	ANT-Chip	39	2441	-2.62	-1.00	1.453	76.82	1.302	0.17	0.000	0.000
	Bluetooth	1Mbps	Top side	0mm	ANT-Chip	39	2441	-2.62	-1.00	1.453	76.82	1.302	0.18	0.004	0.008
	Bluetooth	1Mbps	Bottom side	0mm	ANT-Chip	39	2441	-2.62	-1.00	1.453	76.82	1.302	0.05	0.001	0.002
	Bluetooth	1Mbps	Top side	0mm	ANT-Chip	0	2402	-2.82	-1.00	1.521	76.82	1.302	-0.08	0.000	0.000
	Bluetooth	1Mbps	Top side	0mm	ANT-Chip	78	2480	-3.01	-1.50	1.417	76.82	1.302	-0.13	0.000	0.000
	Zigbee	-	Front	0mm	ANT-Printed	23	2465	15.57	17.00	1.390	4.82	1.046	-0.13	0.000	0.000
	Zigbee	-	Back	0mm	ANT-Printed	23	2465	15.57	17.00	1.390	4.82	1.046	0.06	0.001	0.001
	Zigbee	-	Left side	0mm	ANT-Printed	23	2465	15.57	17.00	1.390	4.82	1.046	-0.03	0.000	0.000
	Zigbee	-	Right side	0mm	ANT-Printed	23	2465	15.57	17.00	1.390	4.82	1.046	0.09	0.000	0.000
	Zigbee	-	Top side	0mm	ANT-Printed	23	2465	15.57	17.00	1.390	4.82	1.046	0.08	0.000	0.000
	Zigbee	-	Bottom side	0mm	ANT-Printed	23	2465	15.57	17.00	1.390	4.82	1.046	-0.07	0.000	0.000
	Zigbee	-	Back	0mm	ANT-Printed	11	2405	15.55	17.00	1.396	4.82	1.046	0.05	0.003	0.004
04	Zigbee	-	Back	0mm	ANT-Printed	19	2445	15.54	17.00	1.400	4.82	1.046	0.06	0.009	**0.013**
	Zigbee	-	Back	0mm	ANT-Printed	21	2455	15.51	17.00	1.409	4.82	1.046	-0.12	0.006	0.009
	Zigbee	-	Back	0mm	ANT-Printed	25	2475	10.51	12.00	1.409	4.82	1.046	0.03	0.000	0.000

16. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	SC EDGE	
		Head	Limbs
1.	Bluetooth Chip Antenna + Zigbee Printed Antenna	Yes	Yes

General Note:

Note:

1. Bluetooth and Zigbee share the same antenna, and they cannot transmit simultaneously. Zigbee Printed ant and Bluetooth Chip ant are located on different antennas, they can transmit simultaneously.
2. According to the EUT characteristic, two Bluetooth antennas cannot transmit simultaneously.
3. When stand-alone SAR is not required for a transmitter or antenna, its SAR is considered zero in the SAR summing process to assess Multi-band transmission SAR compliance.
4. The reported SAR summation is calculated based on the same configuration and test position
5. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) 1g Scalar SAR summation < 1.6W/kg and 10g Scalar SAR summation < 4.0W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04 for 1g SAR and SPLSR≤ 0.10 for 10g SAR , simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band 1g SAR < 1.6W/kg and 10g SAR < 4.0W/kg.
6. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 based on the formula below.
   i) (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.
   ii) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   iii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.
   iv) Bluetooth estimated SAR on Chip Antenna is conservatively determined by 22 mm separation, for all applicable exposure positions.

Bluetooth Max Power	Exposure Position	Head
	Test separation	22 mm
-1.00 dBm	Estimated SAR (W/kg)	0.008 W/kg

16.1 Head Exposure Conditions

Exposure Position	1	2	1+2
	Bluetooth ANT-Chip	Zigbee ANT-Printed	Summed
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
Back	0.008	0.003	0.01

16.2 Extremity SAR Exposure Conditions

Exposure Position	1	2	1+2
	Bluetooth ANT-Chip	Zigbee ANT-Printed	Summed
	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)
Front	0.002		0.00
Back	0.001	0.013	0.01
Left side			0.00
Right side			0.00
Top side	0.008		0.01
Bottom side	0.002		0.00

Test Engineer : Martin Li, Varus Wang, Light Wang

17. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

18. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[6] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[7] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

Appendixes

Please refer to separated files for the following appendixes

Appendix A. Plots of System Performance Check

Appendix B. Plots of High SAR Measurement

Appendix C. DASY Calibration Certificate

Appendix D. Test Setup Photos

------THE END------