TEST REPORT

Applicant Name :	Meizhou Guo Wei Electronics Co., Ltd
Address :	AD1 Section, Economic Development Area, Dongsheng Industrial District, Meizhou, Guangdong, China.
Report Number :	SZNS221020-48207E-SA
FCC ID:	2ARRB-MB600
IC:	20353-MB600

Test Standard (s)

FCC Part 2.1093; RSS-102

Sample Description

Product Type:	TRUE WIRELESS EARBUDS
Model No.:	MOTO BUDS 600 ANC
Multiple Model(s) No.:	N/A
Trade Mark:	Motorola
Date Received:	2022/10/26
Test Date:	2022/11/08
Report Date:	2022/11/09

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

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Approved By:

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<table>
<tr><th colspan="4">Attestation of Test Results</th></tr>
<tr><th colspan="2">MODE</th><th>Max. SAR Level(s) Reported(W/kg)</th><th>Limit (W/kg)</th></tr>
<tr><td rowspan="2">Bluetooth</td><td>1g Head SAR</td><td>0.05</td><td rowspan="2">1.6</td></tr>
<tr><td>1g Body SAR</td><td>0.25</td></tr>
<tr><td rowspan="6">Applicable Standards</td><td colspan="3">FCC 47 CFR part 2.1093
Radiofrequency radiation exposure evaluation: portable devices</td></tr>
<tr><td colspan="3">RSS-102 Issue 5 Amendment 1 (February 2, 2021)
Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands).</td></tr>
<tr><td colspan="3">Safety Code 6 Health Canada’s Radiofrequency Exposure Guidelines
Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz</td></tr>
<tr><td colspan="3">RF Exposure Procedures: TCB Workshop October 2016(Bluetooth Duty Factor)</td></tr>
<tr><td colspan="3">IEC/IEEE 62209-1528:2020
Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)</td></tr>
<tr><td colspan="3">KDB procedures
KDB 447498 D04 Interim General RF Exposure Guidance v01
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02 RF Exposure Reporting v01r02</td></tr>
<tr><td colspan="4">Note: This wireless device has been shown to be capable of compliance for localized specific absorption rate (SAR) for General Population/Uncontrolled Exposure limits specified in FCC 47 CFR part 2.1093 and has been tested in accordance with the measurement procedures specified in IEEE 62209-1528:2020 and RF exposure KDB procedures.
The results and statements contained in this report pertain only to the device(s) evaluated.</td></tr>
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	SZNS221020-48207E-SA	Original Report	2022/11/09

EUT DESCRIPTION

This report has been prepared on behalf of ***Meizhou Guo Wei Electronics Co., Ltd*** and their product ***TRUE WIRELESS EARBUDS***, Model: ***MOTO BUDS 600 ANC***, FCC ID: ***2ARRB-MB600*** ; IC: ***20353-MB600*** or the EUT (Equipment under Test) as referred to in the rest of this report.

Technical Specification

HVIN:	MOTO BUDS 600 ANC
Device Type:	Portable
Exposure Category:	Population / Uncontrolled
Antenna Type(s):	Internal Antenna
Power Sensor	None
Operation Mode :	Bluetooth: GFSK, π/4-DQPSK, 8DPSK BLE: GFSK
Frequency Band:	2402 -2480 MHz(TX&RX)
Power Source:	DC 3.7V from battery
Normal Operation:	Headset

REFERENCE, STANDARDS, AND GUIDELINES

FCC:

The Report and Order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ANSI/IEEE standard C95.1-1992 [6] for an uncontrolled environment (Paragraph 65). According to the Supplement C of OET Bulletin 65 “Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under “worst-case” conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g average over 1 gram of tissue mass.

IC:

The Report and Order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ISS-102 for an uncontrolled environment. According to the Safety Code 6 Health Canada’s Radiofrequency Exposure Guidelines, the device should be evaluated at maximum output power (radiated from the antenna) under “worst-case” conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g average over 1 gram of tissue mass.

SAR Limits

FCC Limit(1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	**1.60**	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

IC Limit(1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	**1.60**	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

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

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

General Population/Uncontrolled environments Spatial Peak limit 1.6W/kg (IC) applied to the EUT.

FACILITIES

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358,the FCC Designation No.: CN1189.
Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 4297.01 .

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A.

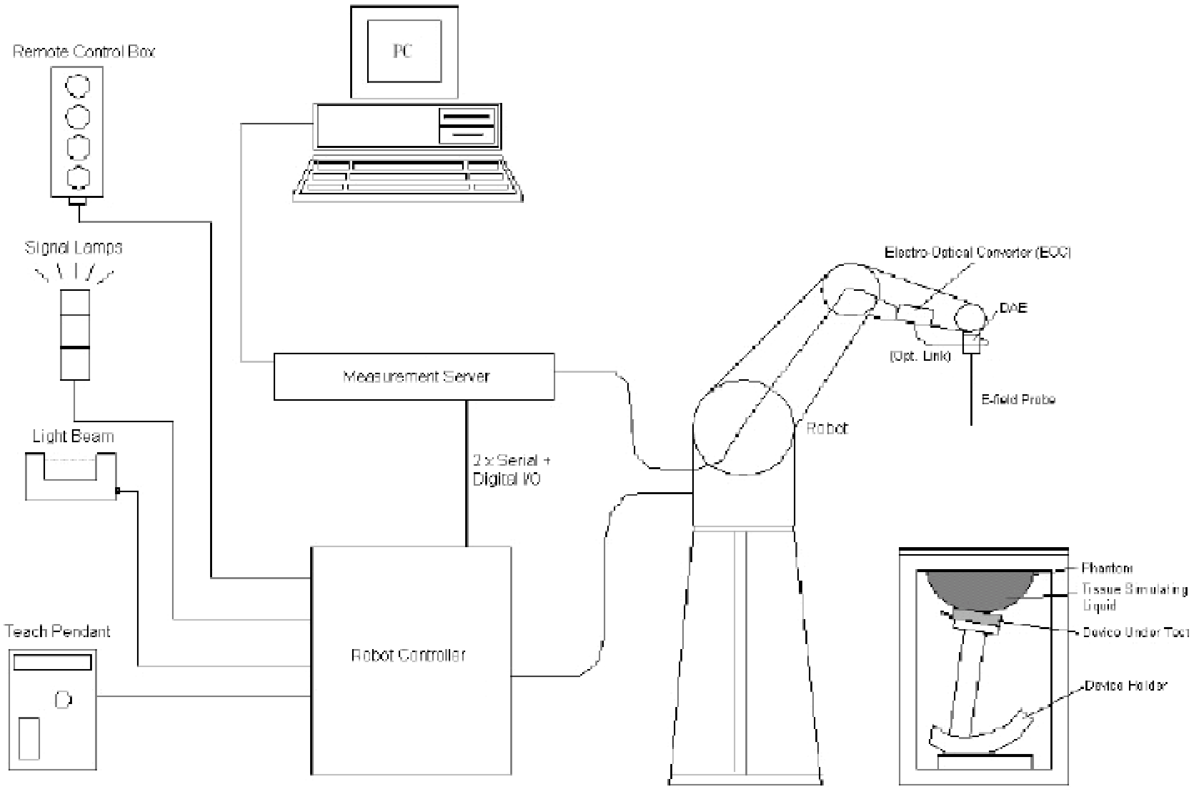
The test site has been registered with ISED Canada under ISED Canada Registration Number CN0016.

DESCRIPTION OF TEST SYSTEM

These measurements were performed with the automated near-field scanning system DASY5 from Schmid & Partner Engineering AG (SPEAG) which is the Fifth generation of the system shown in the figure hereinafter:

DASY5 System Description

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



- A standard high precision 6-axis robot (Staubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal application, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7 professional operating system and the DASY52 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.

DASY5 Measurement Server

The DASY5 measurement server is based on a PC/104 CPU board with a 400 MHz Intel ULV Celeron, 128 MB chip-disk and 128 MB RAM. The necessary circuits for communication with the DAE4 (or DAE3) electronics box, as well as the 16-bit AD converter system for optical detection and digital I/O interface are contained on the DASY6 I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all real-time data evaluations of field measurements and surface detection, controls robot movements, and handles safety operations. The PC operating system cannot interfere with these time-critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program- controlled robot movements. Furthermore, the measurement server is equipped with an expansion port, which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Connection of devices from any other supplier could seriously damage the measurement server.

Data Acquisition Electronics

The data acquisition electronics (DAE4) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of both the DAE4 as well as of the DAE3 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

EX3DV4 E-Field Probes

Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 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 to > 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
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

SAM Twin Phantom

The SAM Twin Phantom (shown in front of DASY5) is a fiberglass shell phantom with shell thickness 2 mm, except in the ear region where the thickness is increased to 6 mm..

When the phantom is mounted inside allocated slot of the DASY5 platform, phantom reference points can be taught directly in the DASY5 V5.2 software. When the DASY5 platform is used to mount the

Phantom, some of the phantom teaching points cannot be reached by the robot in DASY5 V5.2. A special tool called P1a-P2aX-Former is provided to transform two of the three points, P1 and P2, to reachable locations. To use these new teaching points, a revised phantom configuration file is required.
In addition to our standard broadband liquids, the phantom can be used with the following tissue simulating liquids:

Sugar-water-based liquids can be left permanently in the phantom. Always cover the liquid when the system is not in use to prevent changes in liquid parameters due to water evaporation.
DGBE-based liquids should be used with care. As DGBE is a softener for most plastics, the liquid should be taken out of the phantom, and the phantom should be dried when the system is not in use (desirable at least once a week).

Do not use other organic solvents without previously testing the solvent resistivity of the phantom.
Approximately 25 liters of liquid is required to fill the SAM Twin phantom.

Calibration Frequency Points for EX3DV4 E-Field Probes SN: 7441 Calibrated: 2022/05/16

Calibration Frequency Point(MHz)	Frequency Range(MHz)		Conversion Factor		
	From	To	X	Y	Z
750 Head	650	850	10.04	10.04	10.04
900 Head	850	1000	9.61	9.61	9.61
1450 Head	1350	1550	8.52	8.52	8.52
1750 Head	1650	1850	8.32	8.32	8.32
1900 Head	1850	1950	7.94	7.94	7.94
2000 Head	1950	2100	7.99	7.99	7.99
2300 Head	2200	2400	7.78	7.78	7.78
2450 Head	2400	2550	7.54	7.54	7.54
2600 Head	2550	2700	7.30	7.30	7.30
3300 Head	3200	3400	7.09	7.09	7.09
3500 Head	3400	3600	6.89	6.89	6.89
3700 Head	3600	3800	6.55	6.55	6.55
3900 Head	3800	4000	6.60	6.60	6.60
4400 Head	4300	4500	6.34	6.34	6.34
4600 Head	4500	4700	6.26	6.26	6.26
4800 Head	4700	4900	6.16	6.16	6.16
4950 Head	4900	5050	5.85	5.85	5.85
5250 Head	5140	5360	5.35	5.35	5.35
5600 Head	5490	5700	4.85	4.85	4.85
5750 Head	5700	5860	4.83	4.83	4.83

Area Scans

Parameter	DUT transmit frequency being tested	
	$f \leq 3$ GHz	3 GHz < $f \leq 10$ GHz
Maximum distance between the measured points (geometric centre of the sensors) and the inner phantom surface (z_{M1} in Figure 20 in mm)	5 ± 1	δ ln(2)/2 ± 0,5 [a]
Maximum spacing between adjacent measured points in mm (see O.8.3.1)[b]	20, or half of the corresponding zoom scan length, whichever is smaller	60/f, or half of the corresponding zoom scan length, whichever is smaller
Maximum angle between the probe axis and the phantom surface normal (α in Figure 20)[c]	5° (flat phantom only) 30° (other phantoms)	5° (flat phantom only) 20° (other phantoms)
Tolerance in the probe angle	1°	1°

[a] δ is the penetration depth for a plane-wave incident normally on a planar half-space.

[b] See Clause O.8 on how Δx and Δy may be selected for individual area scan requirements.

[c] The probe angle relative to the phantom surface normal is restricted due to the degradation in the measurement accuracy in fields with steep spatial gradients. The measurement accuracy decreases with increasing probe angle and increasing frequency. This is the reason for the tighter probe angle restriction at frequencies above 3 GHz.

Zoom Scan (Cube Scan Averaging)

Parameter	DUT transmit frequency being tested	
	$f \le 3$ GHz	3 GHz $< f \le 10$ GHz
Maximum distance between the closest measured points and the phantom surface (z_{M1} in Figure 20 and Table 3, in mm)	5	δ ln(2)/2 [a]
Maximum angle between the probe axis and the phantom surface normal (α in Figure 20)	5° (flat phantom only) 30° (other phantoms)	5° (flat phantom only) 20° (other phantoms)
Maximum spacing between measured points in the x- and y-directions (Δx and Δy, in mm)	8	$24 / f$ [b]
For uniform grids: Maximum spacing between measured points in the direction normal to the phantom shell (Δz_1 in Figure 20, in mm)	5	$10 / (f - 1)$
For graded grids: Maximum spacing between the two closest measured points in the direction normal to the phantom shell (Δz_1 in Figure 20, in mm)	4	$12 / f$
For graded grids: Maximum incremental increase in the spacing between measured points in the direction normal to the phantom shell ($R_z = \Delta z_2 / \Delta z_1$ in Figure 20)	1,5	1,5
Minimum edge length of the zoom scan volume in the x- and y-directions (L_z in O.8.3.2, in mm)	30	22
Minimum edge length of the zoom scan volume in the direction normal to the phantom shell (L_h in O.8.3.2 in mm)	30	22
Tolerance in the probe angle	1°	1°

[a] δ is the penetration depth for a plane-wave incident normally on a planar half-space.

[b] This is the maximum spacing allowed, which might not work for all circumstances.

Tissue Dielectric Parameters for Head

The head tissue dielectric parameters recommended by the IEC 62209-1528-2020

Recommended Tissue Dielectric Parameters for Head

Table 2 – Dielectric properties of the tissue-equivalent medium

Frequency MHz	Real part of the complex relative permittivity, ε_r'	Conductivity, σ S/m	Penetration depth (E-field), δ mm
4	*55,0*	*0,75*	293,0
13	*55,0*	*0,75*	165,5
30	55,0	0,75	112,8
150	52,3	0,76	62,0
300	45,3	0,87	46,1
450	43,5	0,87	43,0
750	*41,9*	*0,89*	39,8
835	41,5	0,90	39,0
900	41,5	0,97	36,2
1 450	40,5	1,20	28,6
1 800	40,0	1,40	24,3
1 900	40,0	1,40	24,3
1 950	40,0	1,40	24,3
2 000	40,0	1,40	24,3
2 100	*39,8*	*1,49*	22,8
2 450	39,2	1,80	18,7
2 600	*39,0*	*1,96*	17,2
3 000	38,5	2,40	14,0
3 500	*37,9*	*2,91*	11,4
4 000	*37,4*	*3,43*	10,0
4 500	*36,8*	*3,94*	9,7

Frequency MHz	**Real part of the complex relative permittivity,** ε_r'	**Conductivity,** σ S/m	**Penetration depth (E-field),** δ mm
5 000	*36,2*	*4,45*	1,5
5 200	*36,0*	*4,66*	8,4
5 400	*35,8*	*4,86*	8,1
5 600	*35,5*	*5,07*	7,5
5 800	35,3	5,27	7,3
6 000	*35,1*	*5,48*	7,0
6 500	*34,5*	*6,07*	6,7
7 000	*33,9*	*6,65*	6,4
7 500	*33,3*	*7,24*	6,1
8 000	*32,7*	*7,84*	5,9
8 500	*32,1*	*8,46*	5,3
9 000	*31,6*	*9,08*	4,8
9 500	*31,0*	*9,71*	4,4
10 000	*30,4*	*10,40*	4,0

NOTE For convenience, permittivity and conductivity values are linearly interpolated for frequencies that are not a part of the original data from Drossos et al. [2]. They are shown in italics in Table 2. The italicized values are linearly interpolated (below 5800 MHz) or extrapolated (above 5800 MHz) from the non-italicized values that are immediately above and below these values.

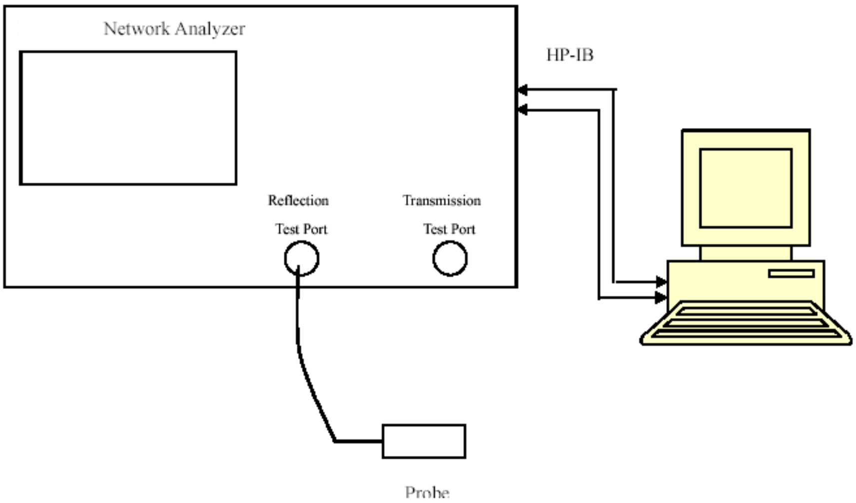
EQUIPMENT LIST AND CALIBRATION

Equipments List & Calibration Information

Equipment	Model	S/N	Calibration Date	Calibration Due Date
DASY5 Test Software	DASY52 52.10.4	N/A	NCR	NCR
DASY5 Measurement Server	DASY5 6.0.31	N/A	NCR	NCR
Data Acquisition Electronics	DAE4	1211	2022/03/01	2023/02/28
E-Field Probe	EX3DV4	7441	2022/05/16	2023/05/15
Mounting Device	MD4HHTV5	SD 000 H01 KA	NCR	NCR
SAM Twin Phantom	SAM-Twin V5.0	1744	NCR	NCR
Dipole,2450MHz	D2450V2	751	2020/10/13	2023/10/12
Simulated Tissue Liquid Head	HBBL600-10000V6	SL AAH U16 BC	Each Time	
Network Analyzer	8753D	3410A08288	2022/7/05	2023/7/04
Dielectric Assessment Kit	DAK-3.5	1320	NCR	NCR
Signal Generator	SMB100A	108362	2021/12/23	2022/12/22
USB wideband power sensor	U2021XA	MY52350001	2021/12/23	2022/12/22
Power Amplifier	CBA 1G-070	T44328	2021/12/23	2022/12/22
Linear Power Amplifier	AS0860-40/45	1060913	2021/12/23	2022/12/22
Directional Coupler	4223-20	3.113.277	2021/12/23	2022/12/22
6dB Attenuator	8493B 6dB Attenuator	2708A 04769	2021/12/23	2022/12/22
Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12

SAR MEASUREMENT SYSTEM VERIFICATION

Liquid Verification



Liquid Verification Setup Block Diagram

Liquid Verification Results

Frequency (MHz)	Liquid Type	Liquid Parameter		Target Value		Delta (%)		Tolerance (%)
		ε_r	Ơ (S/m)	ε_r	Ơ (S/m)	$\Delta\varepsilon_r$	ΔƠ	
2402	Simulated Tissue Liquid Head	40.938	1.801	39.28	1.77	4.22	1.75	±5
2440	Simulated Tissue Liquid Head	40.766	1.809	39.23	1.79	3.92	1.06	±5
2450	Simulated Tissue Liquid Head	40.927	1.809	39.20	1.80	4.41	0.5	±5
2480	Simulated Tissue Liquid Head	40.647	1.803	39.18	1.81	3.74	-0.39	±5

**Liquid Verification above was performed on 2022/11/08.*

System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

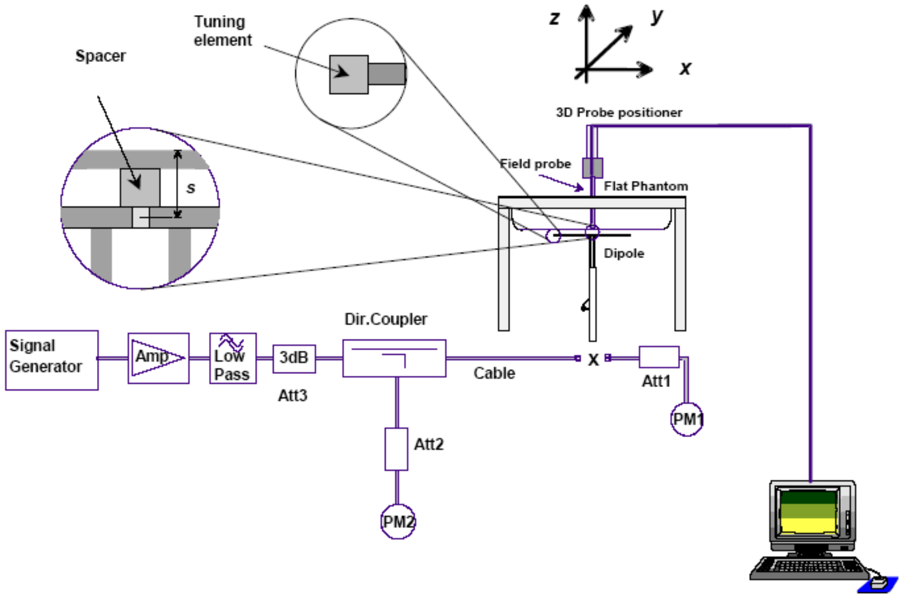
The spacing distance*s* in the **System Verification Setup Block Diagram** is given by the following:

a) s = 15 mm ± 0.2 mm for 300 MHz ≤ f ≤ 1 000 MHz;

b) s = 10 mm ± 0.2 mm for 1 000 MHz < f ≤ 6 000 MHz;

c) s = 10 mm ± 0.1 mm for 6 000 MHz < f ≤ 10 000 MHz.

System Verification Setup Block Diagram



System Accuracy Check Results

Date	Frequency Band	Liquid Type	Input Power (mW)	Measured SAR (W/kg)		Normalized to 1W (W/kg)	Target Value (W/kg)	Delta (%)	Tolerance (%)
2022/11/08	2450 MHz	Head	100	1g	5.06	50.6	53.0	-4.528	±10

*The SAR values above are normalized to 1 Watt forward power.

SAR SYSTEM VALIDATION DATA

System Performance 2450MHz

DUT: D2450V2; Type: 2450 MHz; Serial: 751

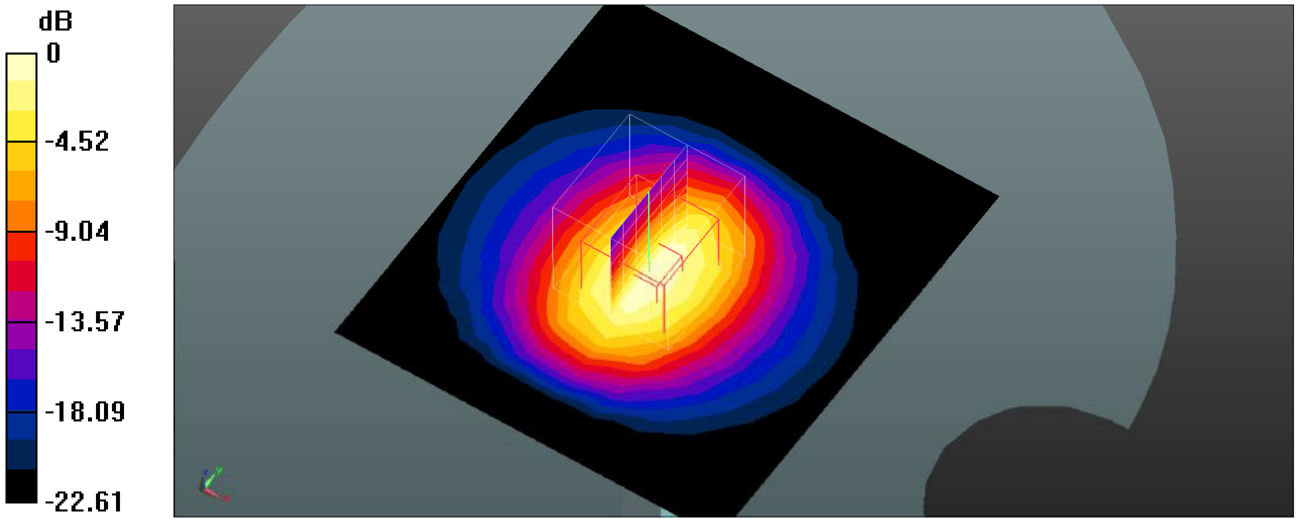
Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.809 S/m; ε_r = 40.927; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7441; ConvF(7.54, 7.54, 7.54) @2450; Calibrated: 2022/05/16
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1211; Calibrated: 2022/03/01
- Phantom: Twin SAM; Type: QD000P40CD; Serial: 1744
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

Pin=100mw/Area Scan (101x111x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 6.65 W/kg

Pin=100mw/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.77 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 12.7 W/kg
SAR(1 g) = 5.06 W/kg; SAR(10 g) = 2.44 W/kg
Maximum value of SAR (measured) = 6.53 W/kg



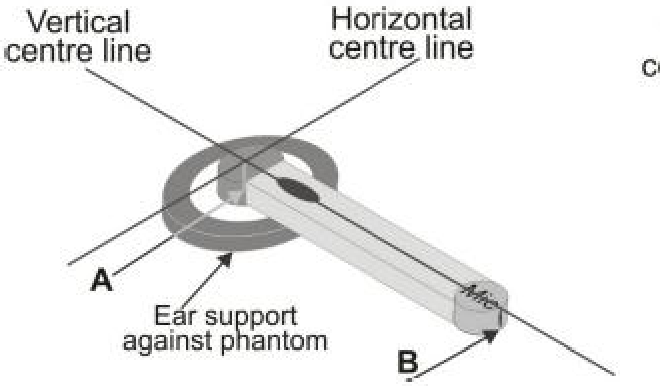
0 dB = 6.53 W/kg = 8.15 dBW/kg

EUT TEST STRATEGY AND METHODOLOGY

Test positions for head mounted device

Device operated next to the side of the head consisting of an acoustic output or earphone and a microphone and containing a radio transmitter and receiver held in position on or around the ear by mechanical support, e.g. around the head. A head mounted device (headset) is designed to be used at the ear but does not protrude into the pinna or the auditory canal. For all practical purposes of this Standard, it is considered as a handset as it contains the same basic components and performs the same basic functions

When SAR measurement is necessary for hand-held devices that do not transmit while at the head or torso, a flat phantom may be used. To assess this type of device, the device shall be placed directly against the flat phantom as shown in the picture below for the sides of the device that are in contact with the hand for the intended use.



Test Distance for SAR Evaluation

For this case the EUT(Equipment Under Test) is set 0mm away from the phantom, the test distance is 0mm.

CONDUCTED OUTPUT POWER MEASUREMENT

Maximum Target Output Power

Max Target Power(dBm)			
Mode/Band	Channel		
	Low	Middle	High
BDR(GFSK)	2.0	2.5	2.0
EDR(π/4-DQPSK)	1.0	1.5	0.5
EDR(8DPSK)	1.5	2.0	1.0
BLE(1M)	7.5	7.5	7.5
BLE(2M)	7.5	7.5	7.5

Test Results:

Bluetooth:

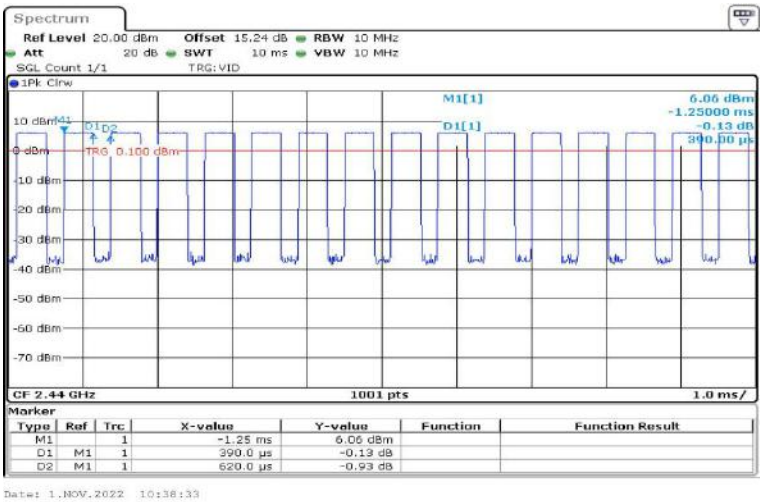
Mode	Channel frequency (MHz)	Conducted Peak Power[dBm]
BDR(GFSK)	2402	1.88
	2441	2.45
	2480	1.48
EDR(π/4-DQPSK)	2402	0.78
	2441	1.19
	2480	0.01
EDR(8DPSK)	2402	1.17
	2441	1.69
	2480	0.80
BLE(1M)	2402	7.10
	2440	6.91
	2480	6.79
BLE(2M)	2402	7.07
	2440	6.95
	2480	6.69

Duty Cycle:

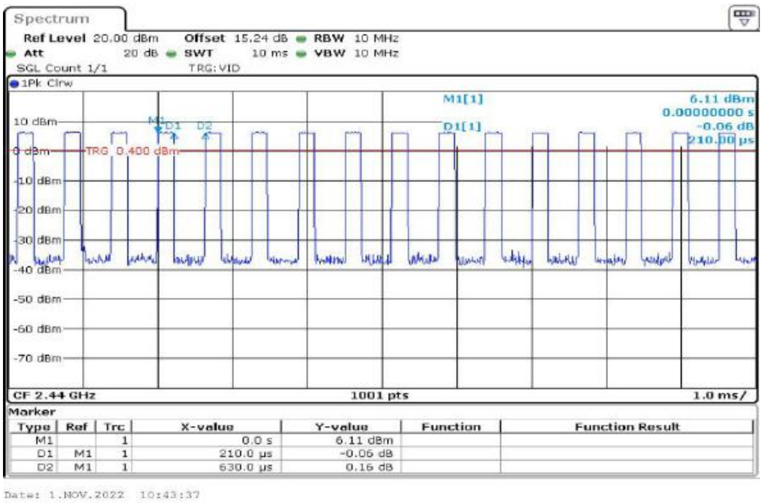
Test Mode	Duty Cycle [%]
BLE_1M	62.90
BLE_2M	33.33

Test Graphs:

BLE_1M_Ant1_2440



BLE_2M_Ant1_2440



Standalone SAR test exclusion considerations

External Photos:

Flat View

Touch View

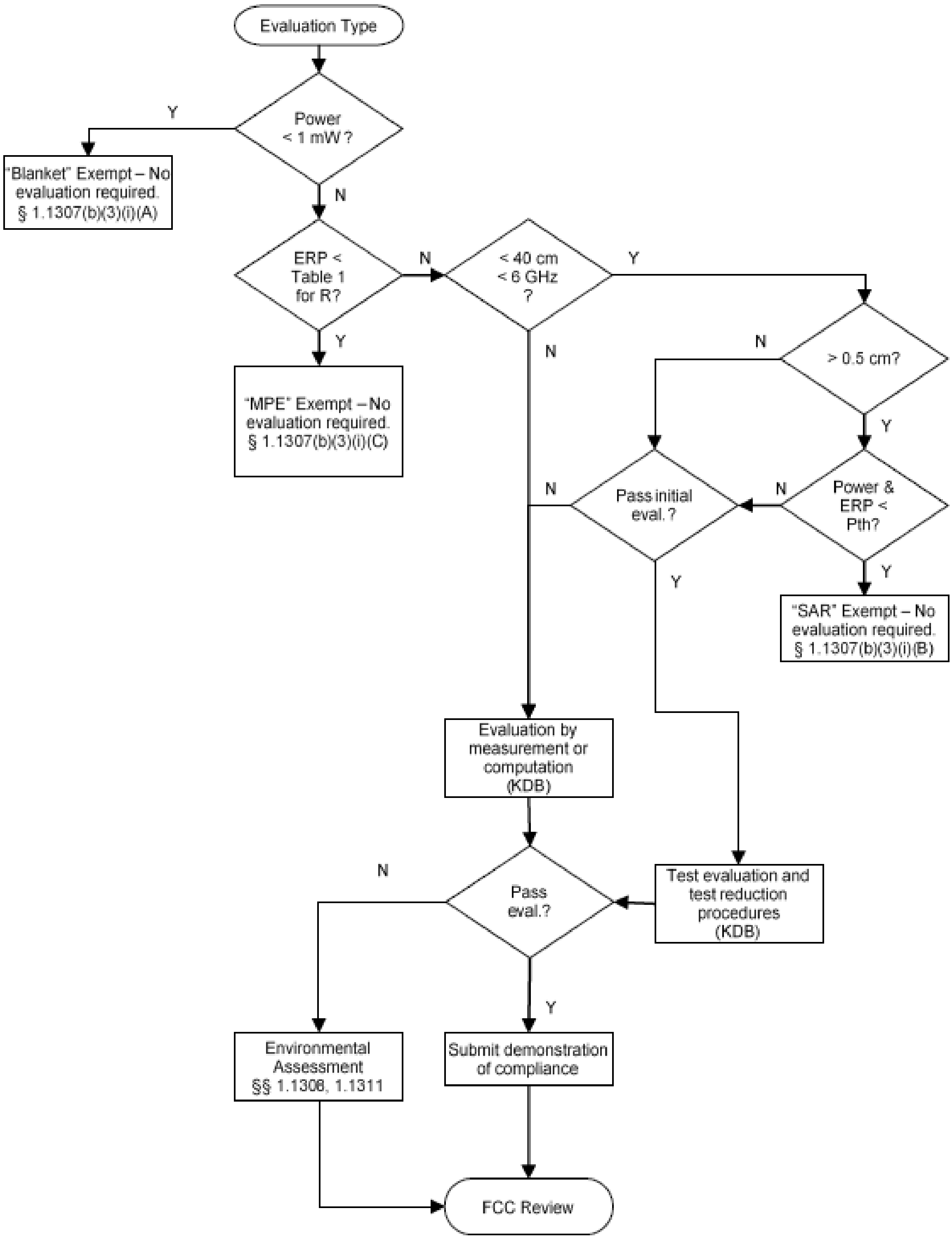
Antenna

Antenna Distance To Edge

Antenna Distance To Edge(mm)		
Antenna	**Touch**	**Flat**
Bluetooth	< 5	< 5

Standalone SAR test exclusion considerations(KDB)

General Sequence for Determination of Procedure (exemption or evaluation) to Establish Compliance with Exposure Limits for a Single RF Source:



Mode	Frequency (GHz)	Max Target Power (dBm)	Antenna gain (dBi)	P_{Max} (dBm)	P_{Max} (mW)	Separation Distance (cm)	P_{th} (Body) (mW)	SAR Test Exclusion
Bluetooth(BDR/EDR)	2.441	2.5	-1.98	2.5	1.78	< 0.5	2.75	Yes
BLE	2.48	7.5	-1.98	7.5	5.62	< 0.5	2.72	No

Note:
1. ERP= Max Target Power+ Antenna gain-2.15
2. P_{Max} refers to the greater value in the conducted average power and ERP.
3. The formula for calculating P_{th} is given below, with distances ranging from 20cm to 40cm.

$$P_{th}\ (\text{mW}) = ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

4. The formula for calculating P_{th} is given below, with distances ranging from 0.5cm to 40cm.

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right)$$

and f is in GHz, d is the separation distance (cm), and ERP_{20cm} is per Formula (Note 3).
5. When the separation distance is less than 0.5cm, 0.5cm is used as the calculation distance

Standalone SAR test exclusion considerations(RSS-102)

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance[4,5]

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Antenna	Frequency (MHz)	Max Target Power (dBm)	Antenna gain (dBi)	P_{Max} (dBm)	P_{Max} (mW)	Distance (mm)	P_{th} (mW)	SAR Test Exclusion?
Bluetooth(BDR/EDR)	2441	2.5	-1.98	2.5	1.78	< 5	4	Yes
BLE	2480	7.5	-1.98	7.5	5.62	< 5	4	No

Note:
1. EIRP= Max Target Power+ Antenna gain.
2. P_{Max} refers to the greater value in the Max Target Power and EIRP.

SAR test for the EUT edge considerations Result

Antenna Distance To Edge(mm)		
Mode	Touch	Flat
Left	**Required**	**Required**
Right	**Required**	**Required**

SAR MEASUREMENT RESULTS

This page summarizes the results of the performed dosimetric evaluation.

SAR Test Data

Environmental Conditions

Temperature:	23.2-24.1℃
Relative Humidity:	45-58 %
ATM Pressure:	101.3 kPa
Test Date:	2022/11/08

Testing was performed by Jacky Yang, Ryse Chai.

BLE:

EUT Position	Frequency (MHz)	Test Mode	Max. Meas. Power (dBm)	Max. Rated Power (dBm)	Scaled Factor	Duty Cycle (%)	Duty Factor	1g SAR (W/kg)		
								Meas. SAR	Scaled SAR	Plot
Left Touch (0mm)	2402	GFSK	/	/	/	/	/	/	/	/
	2440	GFSK	6.91	7.5	1.146	62.90	1.002	0.040	0.05	1#
	2480	GFSK	/	/	/	/	/	/	/	/
Left Flat (0mm)	2402	GFSK	7.10	7.5	1.096	62.90	1.002	0.156	0.17	2#
	2440	GFSK	6.91	7.5	1.146	62.90	1.002	0.215	0.25	**3#**
	2480	GFSK	6.79	7.5	1.178	62.90	1.002	0.143	0.17	4#
Right Touch (0mm)	2402	GFSK	/	/	/	/	/	/	/	/
	2440	GFSK	6.91	7.5	1.146	62.90	1.002	0.023	0.03	5#
	2480	GFSK	/	/	/	/	/	/	/	/
Right Flat (0mm)	2402	GFSK	/	/	/	/	/	/	/	/
	2440	GFSK	6.91	7.5	1.146	62.90	1.002	0.177	0.20	6#
	2480	GFSK	/	/	/	/	/	/	/	/

Note:
1. Based on the Notice 2016-DRS001 requirements, the low, mid and high frequency channels for the configuration with the highest SAR value must be tested regardless of the SAR value measured.
2. When SAR or MPE is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance.
3. For SAR testing of BLE signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle 63.0% provided by the manufacturer scaling factor which is equal to "63.0%/(duty cycle)".
4. Scaled SAR= Meas. SAR*Scaled Factor*Duty Factor
5. According to KDB 447498 D04 Section 3.3.1, we need to choose the flat Phantom instead of the phantom ear test.
6. For the mode with the same tune up power, we chose the lowest modulation and lowest rate mode for testing, so we chose BLE_1M for testing.

SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results

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 Highest Measured SAR Configuration in Each Frequency Band

SAR probe calibration point	Frequency Band	Freq.(MHz)	EUT Position	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
				Original	Repeated	
/	/	/	/	/	/	/

Note:

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20.
2. The measured SAR results **do not** have to be scaled to the maximum tune-up tolerance to determine if repeated measurements are required.
3. 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..

SAR SIMULTANEOUS TRANSMISSION DESCRIPTION

Simultaneous Transmission:

Note:
This portable device has no Simultaneous Transmission

SAR Plots

Plots 1#:

DUT: TRUE WIRELESS EARBUDS; Type: MOTO BUDS 600 ANC; Serial: SZNS221020-48207E-SA-S1

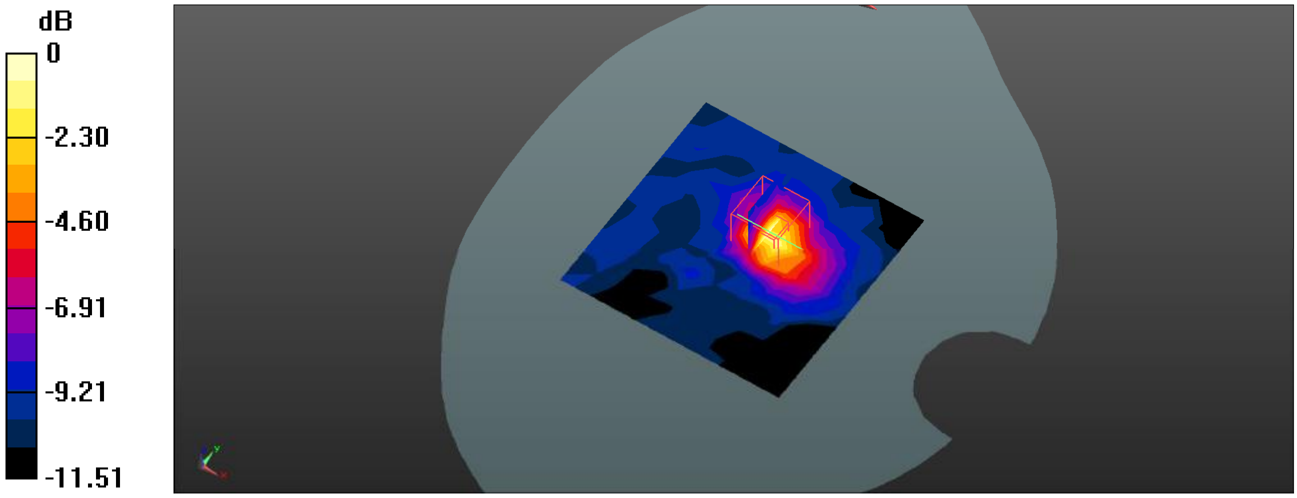
Communication System: UID 0, Bluetooth(GFSK) (0); Frequency: 2440 MHz;Duty Cycle: 1:1.58983
Medium parameters used (interpolated): f = 2440 MHz; σ = 1.809 S/m; ε_r = 40.766; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7441; ConvF(7.54, 7.54, 7.54) @ 2440 MHz; Calibrated: 2022/05/16
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1211; Calibrated: 2022/03/01
- Phantom: Twin SAM; Type: QD000P40CD; Serial: 1744
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

Left Touch/Bluetooth BLE_1M Mid/Area Scan (11x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0399 W/kg

Left Touch/Bluetooth BLE_1M Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.986 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.0790 W/kg
SAR(1 g) = 0.040 W/kg; SAR(10 g) = 0.018 W/kg
Maximum value of SAR (measured) = 0.0505 W/kg



0 dB = 0.0505 W/kg = -12.97 dBW/kg

Plots 2#:

DUT: TRUE WIRELESS EARBUDS; Type: MOTO BUDS 600 ANC; Serial: SZNS221020-48207E-SA-S1

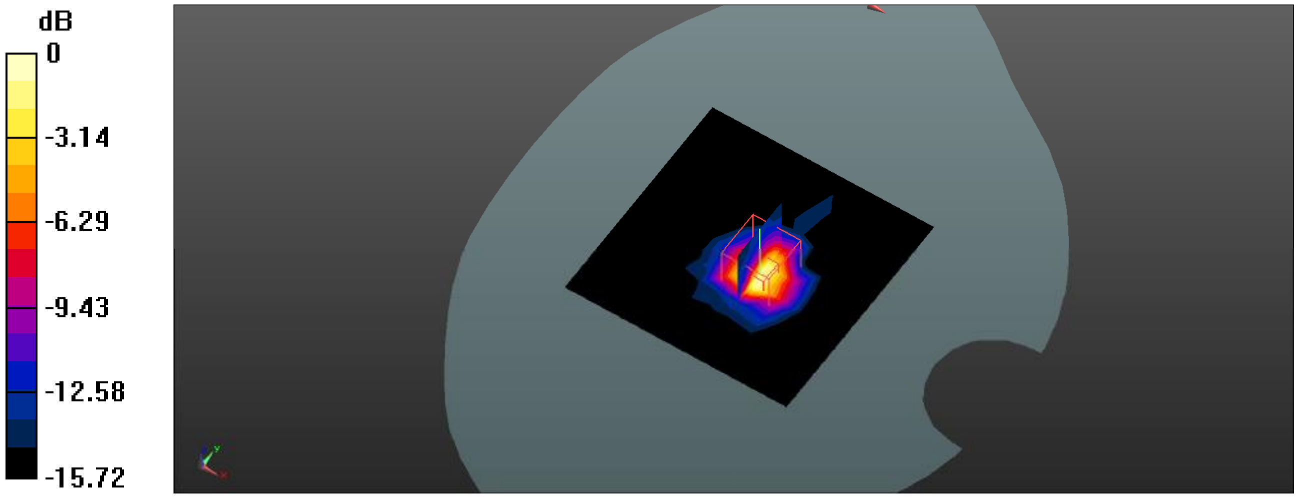
Communication System: UID 0, Bluetooth(GFSK) (0); Frequency: 2402 MHz;Duty Cycle: 1:1.58983
Medium parameters used (interpolated): f = 2402 MHz; σ = 1.801 S/m; ε_r = 40.938; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7441; ConvF(7.54, 7.54, 7.54) @ 2402 MHz; Calibrated: 2022/05/16
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1211; Calibrated: 2022/03/01
- Phantom: Twin SAM; Type: QD000P40CD; Serial: 1744
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

Left Flat/Bluetooth BLE_1M Low/Area Scan (11x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.152 W/kg

Left Flat/Bluetooth BLE_1M Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.868 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.502 W/kg
SAR(1 g) = 0.156 W/kg; SAR(10 g) = 0.055 W/kg
Maximum value of SAR (measured) = 0.183 W/kg



0 dB = 0.183 W/kg = -7.38 dBW/kg

Plots 3#:

DUT: TRUE WIRELESS EARBUDS; Type: MOTO BUDS 600 ANC; Serial: SZNS221020-48207E-SA-S1

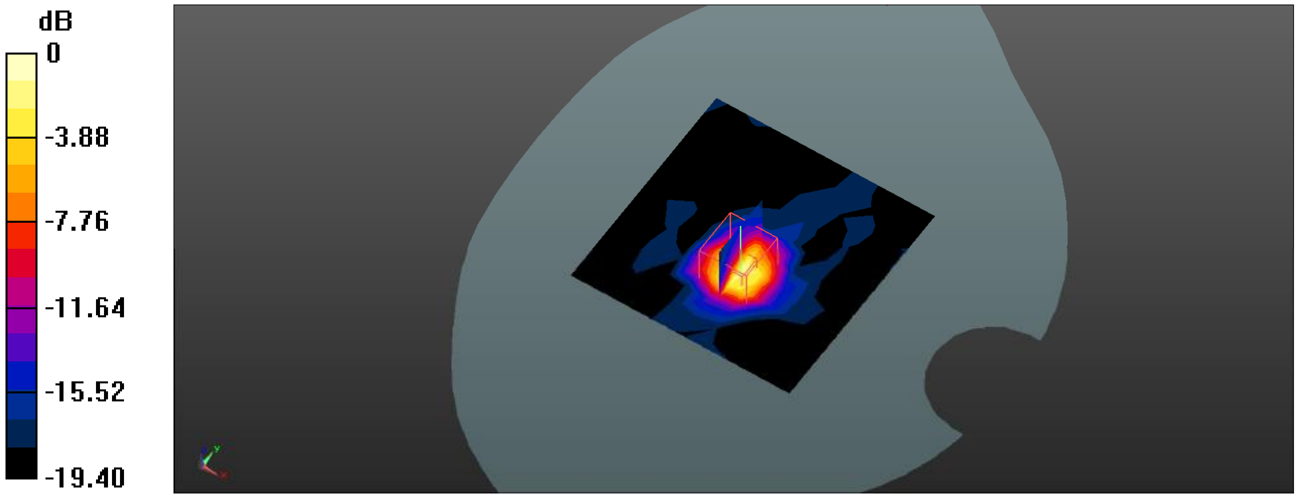
Communication System: UID 0, Bluetooth(GFSK) (0); Frequency: 2440 MHz;Duty Cycle: 1:1.58983
Medium parameters used (interpolated): f = 2440 MHz; σ = 1.809 S/m; ε_r = 40.766; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7441; ConvF(7.54, 7.54, 7.54) @ 2440 MHz; Calibrated: 2022/05/16
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1211; Calibrated: 2022/03/01
- Phantom: Twin SAM; Type: QD000P40CD; Serial: 1744
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

Left Flat/Bluetooth BLE_1M Mid/Area Scan (11x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.243 W/kg

Left Flat/Bluetooth BLE_1M Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.150 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 0.647 W/kg
SAR(1 g) = 0.215 W/kg; SAR(10 g) = 0.074 W/kg
Maximum value of SAR (measured) = 0.252 W/kg



0 dB = 0.252 W/kg = -5.99 dBW/kg

Plots 4#:

DUT: TRUE WIRELESS EARBUDS; Type: MOTO BUDS 600 ANC; Serial: SZNS221020-48207E-SA-S1

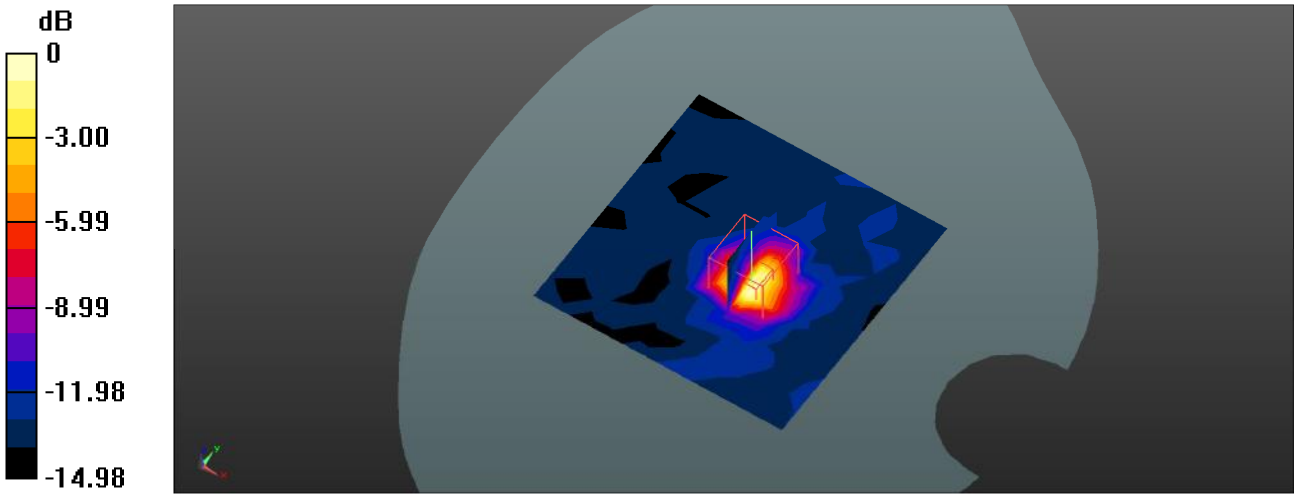
Communication System: UID 0, Bluetooth(GFSK) (0); Frequency: 2480 MHz;Duty Cycle: 1:1.58983
Medium parameters used (interpolated): f = 2480 MHz; σ = 1.803 S/m; ε_r = 40.647; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7441; ConvF(7.54, 7.54, 7.54) @ 2480 MHz; Calibrated: 2022/05/16
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1211; Calibrated: 2022/03/01
- Phantom: Twin SAM; Type: QD000P40CD; Serial: 1744
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

Left Flat/Bluetooth BLE_1M High/Area Scan (11x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.150 W/kg

Left Flat/Bluetooth BLE_1M High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.442 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.458 W/kg
SAR(1 g) = 0.143 W/kg; SAR(10 g) = 0.050 W/kg
Maximum value of SAR (measured) = 0.166 W/kg



0 dB = 0.166 W/kg = -7.80 dBW/kg

Plots 5#:

DUT: TRUE WIRELESS EARBUDS; Type: MOTO BUDS 600 ANC; Serial: SZNS221020-48207E-SA-S1

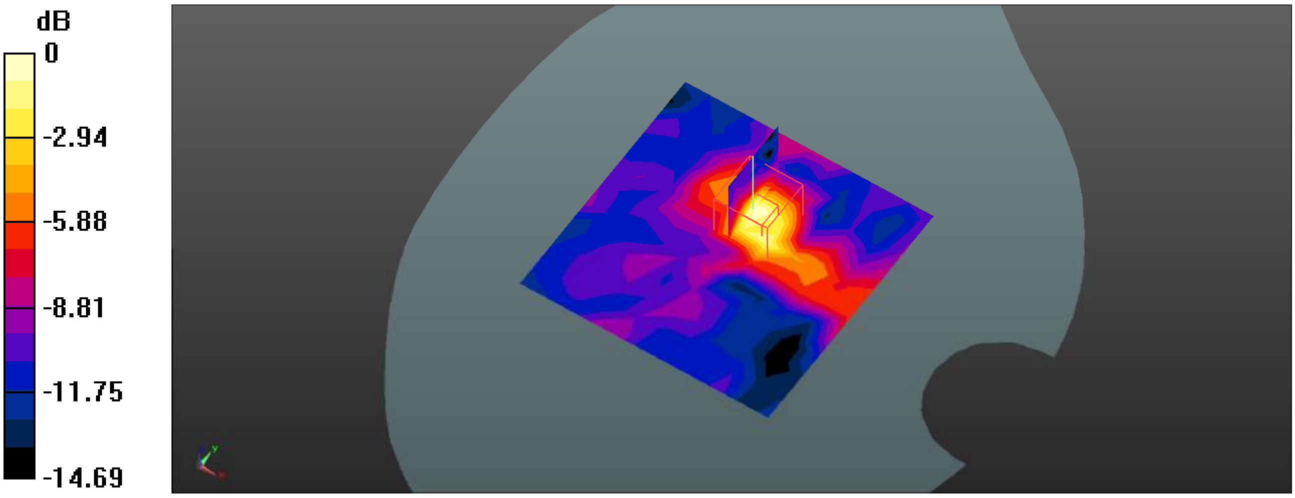
Communication System: UID 0, Bluetooth(GFSK) (0); Frequency: 2440 MHz;Duty Cycle: 1:1.58983
Medium parameters used (interpolated): f = 2440 MHz; σ = 1.809 S/m; ε_r = 40.766; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7441; ConvF(7.54, 7.54, 7.54) @ 2440 MHz; Calibrated: 2022/05/16
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1211; Calibrated: 2022/03/01
- Phantom: Twin SAM; Type: QD000P40CD; Serial: 1744
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

Right Touch/Bluetooth BLE_1M Mid/Area Scan (11x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0279 W/kg

Right Touch/Bluetooth BLE_1M Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.225 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.0510 W/kg
SAR(1 g) = 0.023 W/kg; SAR(10 g) = 0.00902 W/kg
Maximum value of SAR (measured) = 0.0273 W/kg



0 dB = 0.0273 W/kg = -15.64 dBW/kg

Plots 6#:

DUT: TRUE WIRELESS EARBUDS; Type: MOTO BUDS 600 ANC; Serial: SZNS221020-48207E-SA-S1

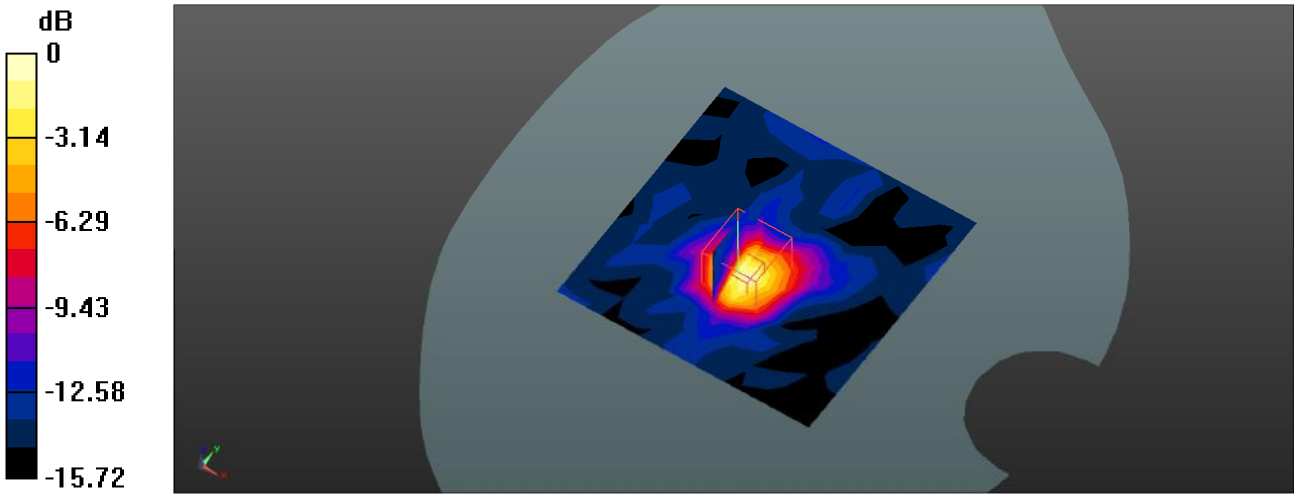
Communication System: UID 0, Bluetooth(GFSK) (0); Frequency: 2440 MHz;Duty Cycle: 1:1.58983
Medium parameters used (interpolated): f = 2440 MHz; σ = 1.809 S/m; ε_r = 40.766; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7441; ConvF(7.54, 7.54, 7.54) @ 2440 MHz; Calibrated: 2022/05/16
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1211; Calibrated: 2022/03/01
- Phantom: Twin SAM; Type: QD000P40CD; Serial: 1744
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

Right Flat/Bluetooth BLE_1M Mid/Area Scan (11x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.204 W/kg

Right Flat/Bluetooth BLE_1M Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.17 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.397 W/kg
SAR(1 g) = 0.177 W/kg; SAR(10 g) = 0.052 W/kg
Maximum value of SAR (measured) = 0.192 W/kg



0 dB = 0.192 W/kg = -7.17 dBW/kg

APPENDIX A MEASUREMENT UNCERTAINTY

The uncertainty budget has been determined for the measurement system and is given in the following Table.

Measurement uncertainty evaluation for IEC/IEEE 62209-1528:2020 SAR test

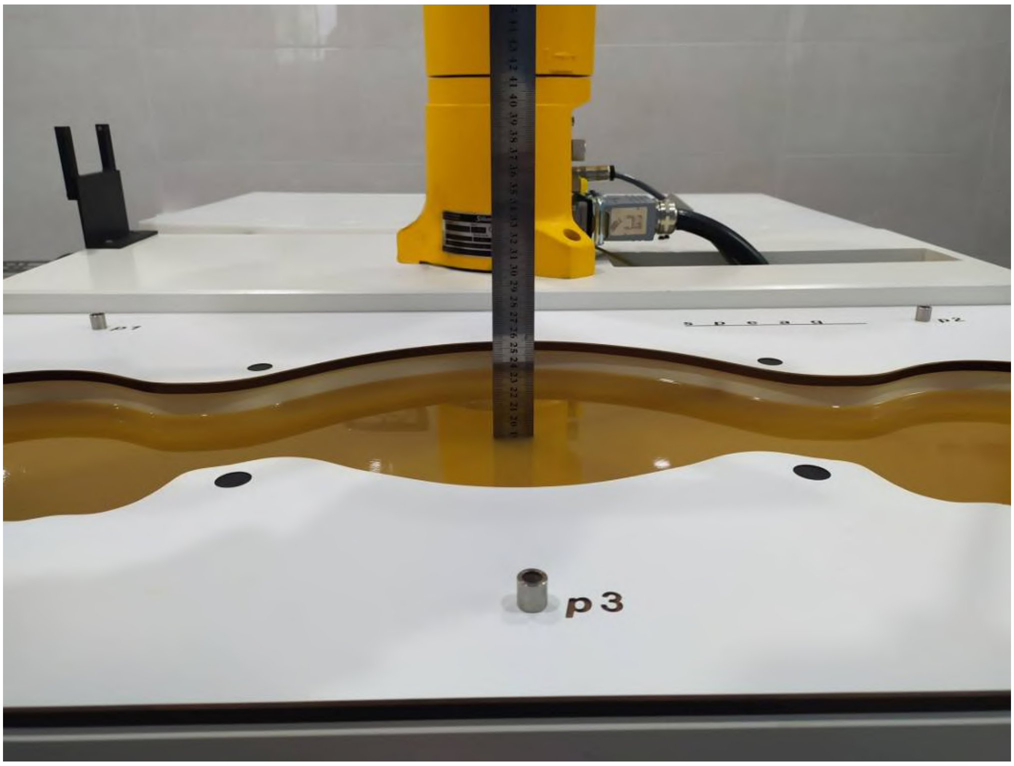
$$\Delta SAR = LIN + ISO + DAE + AMB + \frac{2}{\delta}\Delta_{xyz} + DAT + 2DIS + H + D_{xyz} + MOD + RF_{\text{drift}}$$

Symbol	Input quantity X_i (source of uncertainty)	Prob Dist.[a] PDF_i	Unc. $a(x_i)$	Div.[a] q_i	$u(x_i)= a(x_i)/q_i$	c_i	$u(y)= c_i \cdot u(x_i)$	v_i
		Measurement system errors						
CF	Probe calibration	N (k=2)	6.55	2	3.3	1	3.3	∞
CF_{drift}	Probe calibration drift	R	1.0	√3	0.6	1	0.6	∞
LIN	Probe linearity and detection limit	R	4.7	√3	3.3	1	3.3	∞
BBS	Boundary signal	R	1.0	√3	0.6	1	0.6	∞
ISO	Probe isotropy	R	9.6	√3	5.5	1	5.5	∞
DAE	Other probe and data acquistion errors	N	1.0	1	1.0	1	1.0	∞
AMB	RF ambient and noise	N	1.0	1	1.0	1	1.0	∞
Δ_{xyz}	Probe positioning errors	N	0.8	1	0.8	2/δ	0.9	∞
DAT	Data processing errors	N	2.0	1	2.0	1	2.0	∞
		Phantom and device(DUT or validation antenna)errors						
$LIQ(\sigma)$	Measurement of phantom conductivity(σ)	N	2.5	1	2.5	1	2.5	∞
$LIQ(T\text{c})$	Temperature effects(medium)	R	0.1	√3	0.05	1	0.05	∞
EPS	Shell permittivity	R	4.0	√3	2.3	$c_i = \begin{cases} 0 & f \le 3\text{ GHz} \\ 0,25 & 3\text{ GHz} < f \le 6\text{ GHz} \\ 0,5 & 6\text{ GHz} < f \le 10\text{ GHz} \end{cases}$	0	∞
DIS	Distance between the radiating element of the DUT and the phantom medium	N	5.0	1	5.0	2	10.0	∞
D_{xyz}	Repeatability of positioning the DUT or source against the phantom	N	2.8	1	2.8	1	2.8	5
H	Device holder effects	N	6.3	1	6.3	1	6.3	∞
MOD	Effect of operating mode on	R	9.0	√3	5.2	1	5.2	∞
TAS	Time-average SAR	R	2.0	√3	1.1	1	1.1	∞
RF_{drift}	Variation in SAR due to drift in output of DUT	N	1.0	1	1.0	1	1.0	∞
VAL	Validation antenna uncertainty(validation measurement only)	N	5.0	1	5.0	1	5.0	∞
P_{in}	Uncertainty in accepted power(validation measurement only)	N	5.0	1	5.0	1	5.0	∞
		Corrections to the SAR result(if applied)						
$C(\varepsilon',\sigma)$	Phantom deviation from target(ε',σ)	N	1.9	1	1.9	1	1.9	∞
$C(R)$	SAR scaling	R	4.0	√3	2.3	1	2.3	∞
$u(\Delta SAR)$	Combined uncertainty	RSS	7.4	1	7.4	1	7.4	∞
U	Expanded uncertainty and effective degrees of freedom	K=2	7.4	1	7.4	U =K	14.8	$v$eff

APPENDIX B EUT TEST POSITION PHOTOS

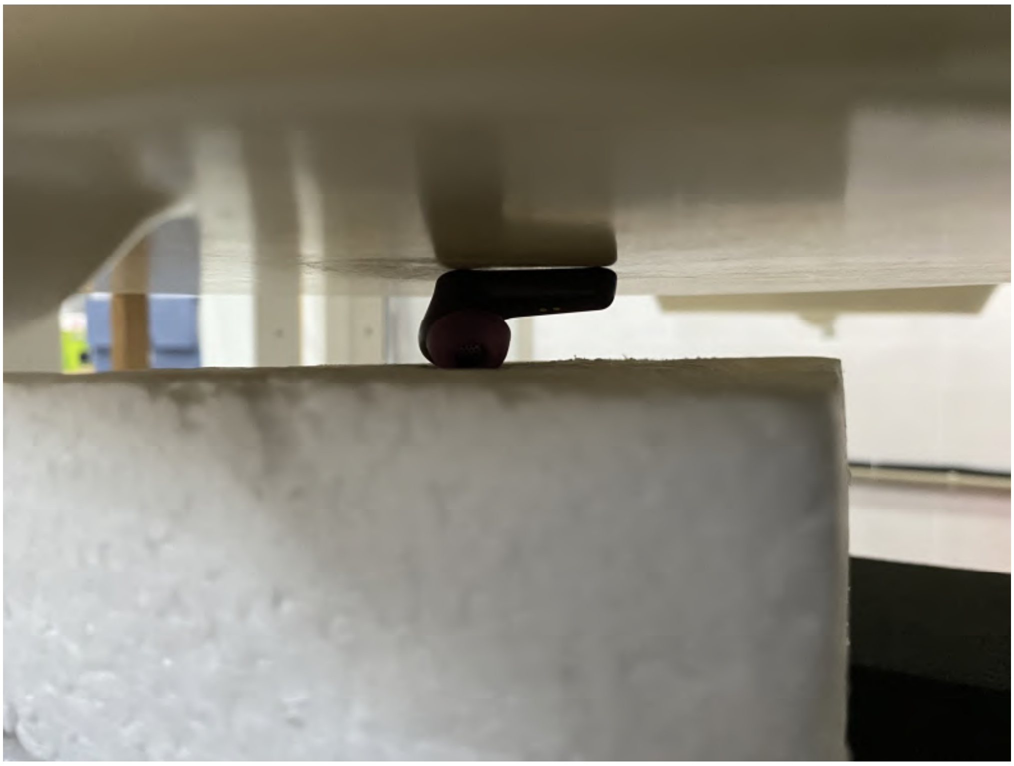
Liquid depth ≥ 15cm

Phantom Type: Twin SAM Phantom ; Type: QD000 P40 CD; Serial: 1744



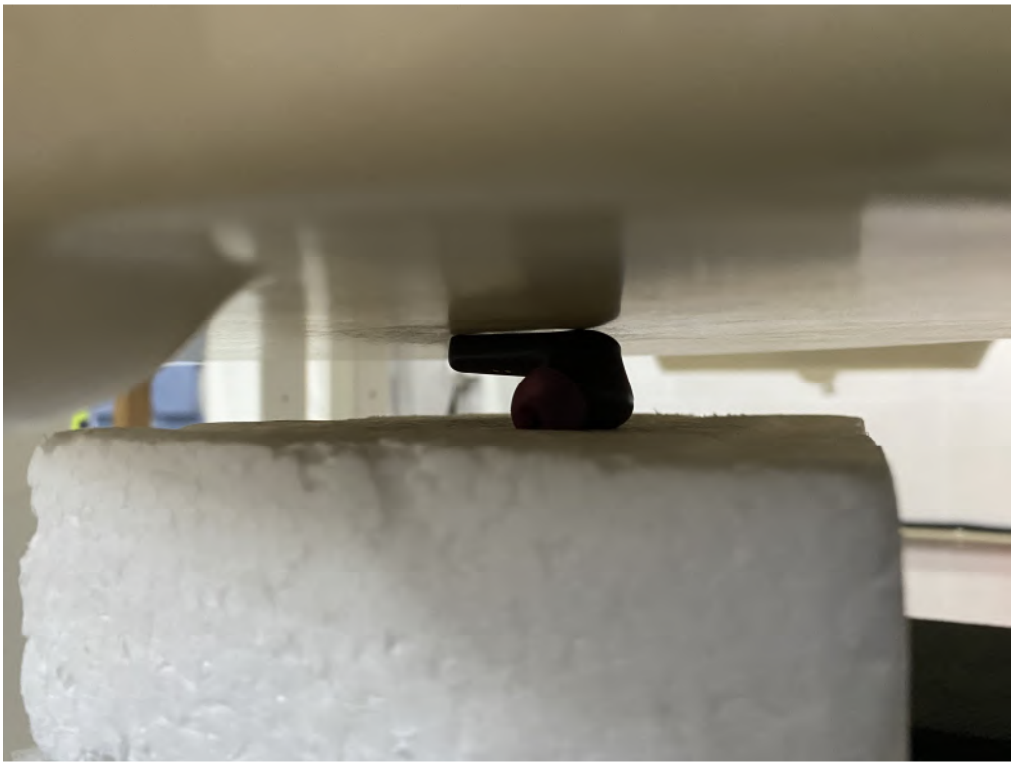
Left Touch(0mm)

Left Flat(0mm)



Right Touch(0mm)

Right Flat(0mm)



APPENDIX C PROBE CALIBRATION CERTIFICATES

In Collaboration with speag CALIBRATION LABORATORY

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中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client BACL Certificate No: Z22-60101

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN : 7441

Calibration Procedure(s): FF-Z11-004-02
Calibration Procedures for Dosimetric E-field Probes

Calibration date: May 16, 2022

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Power sensor NRP-Z91	101547	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Power sensor NRP-Z91	101548	15-Jun-21(CTTL, No.J21X04466)	Jun-22
Reference 10dBAttenuator	18N50W-10dB	20-Jan-21(CTTL, No.J21X00486)	Jan-23
Reference 20dBAttenuator	18N50W-20dB	20-Jan-21(CTTL, No.J21X00485)	Jan-23
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG, No.EX3-7464_Jan22)	Jan-23
DAE4	SN 1555	20-Aug-21(SPEAG, No.DAE4-1555_Aug21/2)	Aug-22

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGenerator MG3700A	6201052605	16-Jun-21(CTTL, No.J21X04467)	Jun-22
Network Analyzer E5071C	MY46110673	14-Jan-22(CTTL, No.J22X00406)	Jan-23

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: May 23, 2022

Certificate No: Z22-60101 Page 1 of 9

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7441

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (*k*=2)
Norm(μV/(V/m)²)[A]	0.40	0.47	0.39	±10.0%
DCP(mV)[B]	90.9	102.2	105.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (*k*=2)
0	CW	X	0.0	0.0	1.0	0.00	147.5	±2.7%
		Y	0.0	0.0	1.0		169.7	
		Z	0.0	0.0	1.0		155.0	

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor *k*=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 4).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7441

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	10.04	10.04	10.04	0.12	1.39	±12.1%
900	41.5	0.97	9.61	9.61	9.61	0.16	1.41	±12.1%
1450	40.5	1.20	8.52	8.52	8.52	0.28	0.95	±12.1%
1750	40.1	1.37	8.32	8.32	8.32	0.29	0.88	±12.1%
1900	40.0	1.40	7.94	7.94	7.94	0.27	1.03	±12.1%
2000	40.0	1.40	7.99	7.99	7.99	0.25	1.15	±12.1%
2300	39.5	1.67	7.78	7.78	7.78	0.65	0.65	±12.1%
2450	39.2	1.80	7.54	7.54	7.54	0.65	0.67	±12.1%
2600	39.0	1.96	7.30	7.30	7.30	0.64	0.67	±12.1%
3300	38.2	2.71	7.09	7.09	7.09	0.47	0.89	±13.3%
3500	37.9	2.91	6.89	6.89	6.89	0.42	0.95	±13.3%
3700	37.7	3.12	6.55	6.55	6.55	0.42	1.01	±13.3%
3900	37.5	3.32	6.60	6.60	6.60	0.35	1.35	±13.3%
4400	36.9	3.84	6.34	6.34	6.34	0.35	1.35	±13.3%
4600	36.7	4.04	6.26	6.26	6.26	0.45	1.20	±13.3%
4800	36.4	4.25	6.16	6.16	6.16	0.45	1.25	±13.3%
4950	36.3	4.40	5.85	5.85	5.85	0.50	1.15	±13.3%
5250	35.9	4.71	5.35	5.35	5.35	0.55	1.15	±13.3%
5600	35.5	5.07	4.85	4.85	4.85	0.55	1.20	±13.3%
5750	35.4	5.22	4.83	4.83	4.83	0.55	1.20	±13.3%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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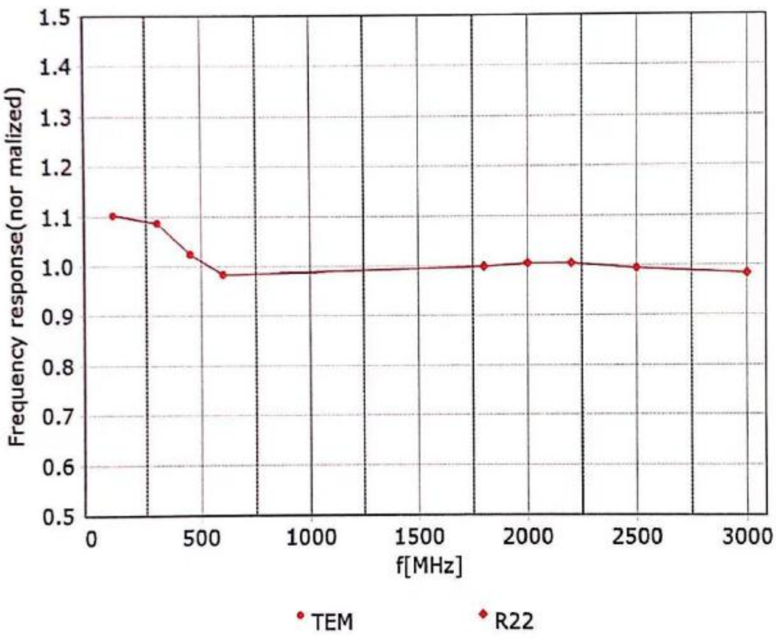
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (*k*=2)

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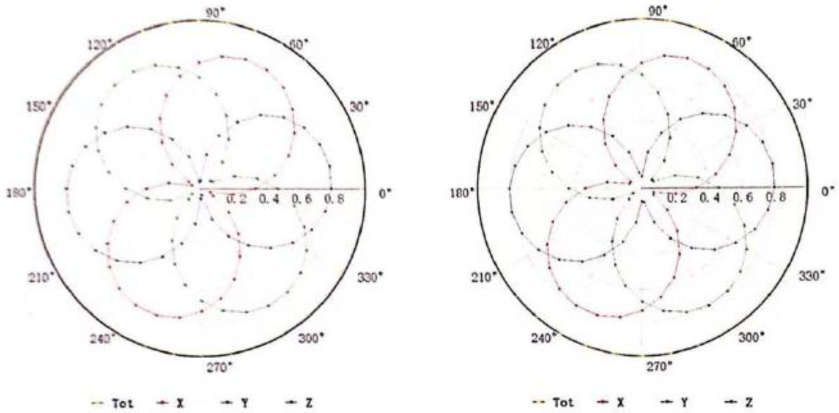
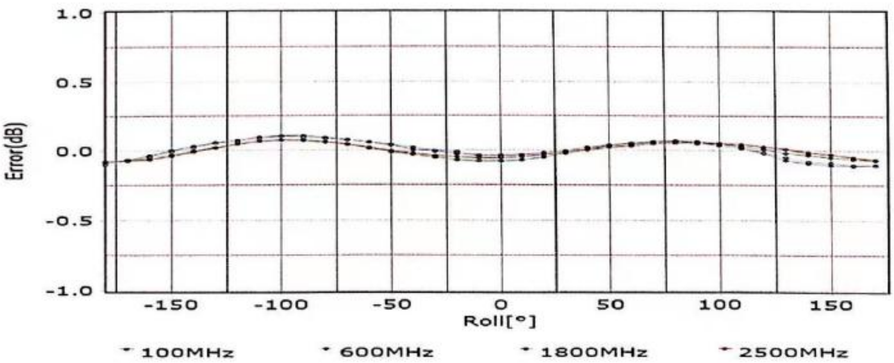
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM **f=1800 MHz, R22**





Uncertainty of Axial Isotropy Assessment: ±1.2% (*k*=2)

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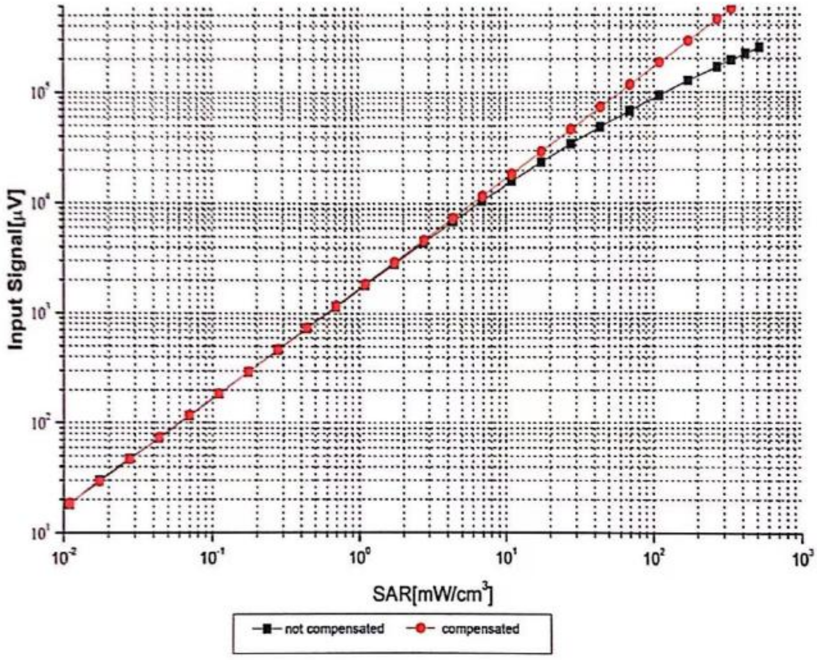
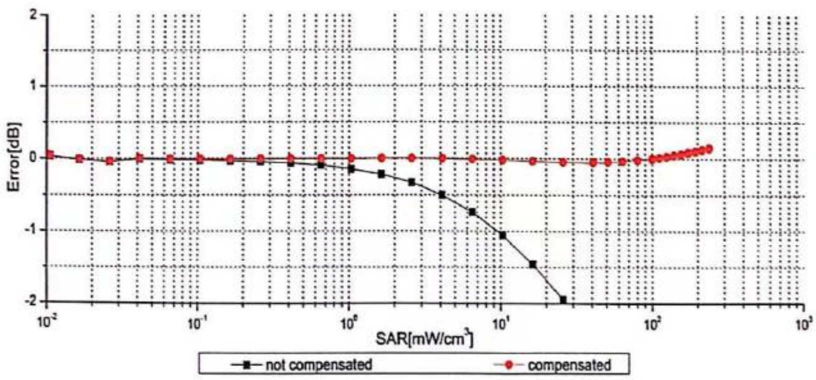
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (*k*=2)

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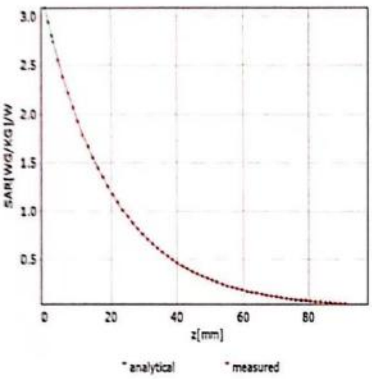
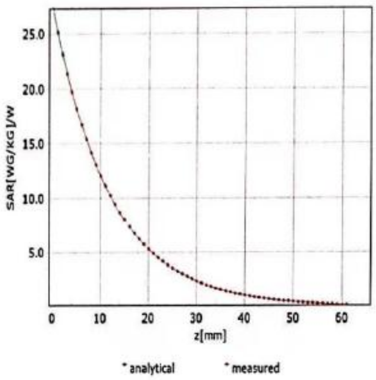
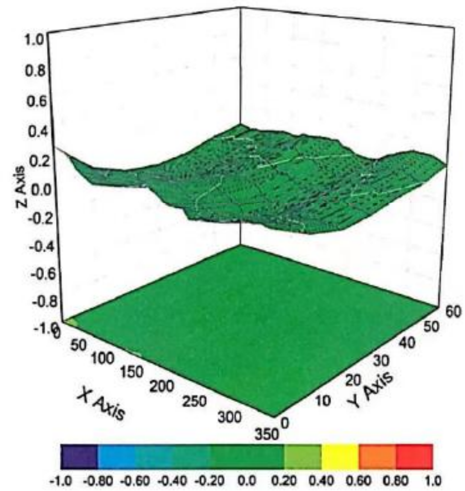
Conversion Factor Assessment

f=750 MHz,WGLS R9(H_convF) **f=1750 MHz,WGLS R22(H_convF)**





Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (*k*=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7441

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	100.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

APPENDIX D DIPOLE CALIBRATION CERTIFICATES

In Collaboration with s p e a g CALIBRATION LABORATORY

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Client BACL Certificate No: Z20-60412

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 751

Calibration Procedure(s): FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: October 13, 2020

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	12-May-20 (CTTL, No.J20X02965)	May-21
Power sensor NRP6A	101369	12-May-20 (CTTL, No.J20X02965)	May-21
ReferenceProbe EX3DV4	SN 3617	30-Jan-20(SPEAG,No.EX3-3617_Jan20)	Jan-21
DAE4	SN 771	10-Feb-20(CTTL-SPEAG,No.Z20-60017)	Feb-21
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	25-Feb-20 (CTTL, No.J20X00516)	Feb-21
NetworkAnalyzer E5071C	MY46110673	10-Feb-20 (CTTL, No.J20X00515)	Feb-21

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: October 22, 2020

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

Certificate No: Z20-60412 Page 2 of 6

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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 6 %	1.81 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.0 W/kg ± 18.8 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 W/kg ± 18.7 % (*k*=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.6Ω+ 4.03 jΩ
Return Loss	- 25.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.022 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 10.13.2020

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 751

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.809 S/m; ε_r = 39.02; ρ = 1000 kg/m^3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.65, 7.65, 7.65) @ 2450 MHz; Calibrated: 2020-01-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2020-02-10
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.1 V/m; Power Drift = -0.04 dB

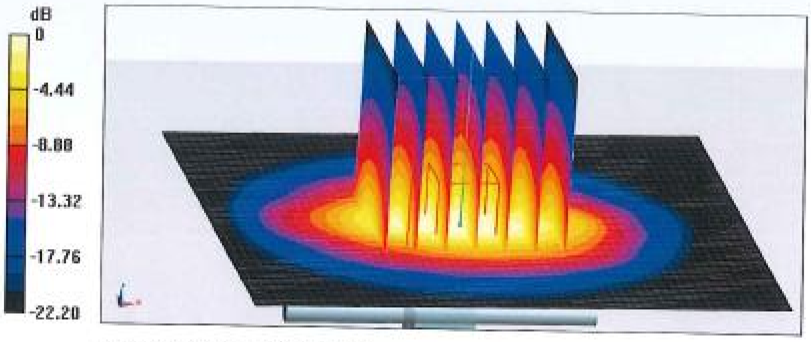
Peak SAR (extrapolated) = 28.1 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.12 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 47.6%

Maximum value of SAR (measured) = 22.7 W/kg



0 dB = 22.7 W/kg = 13.56 dBW/kg

Certificate No: Z20-60412 Page 5 of 6

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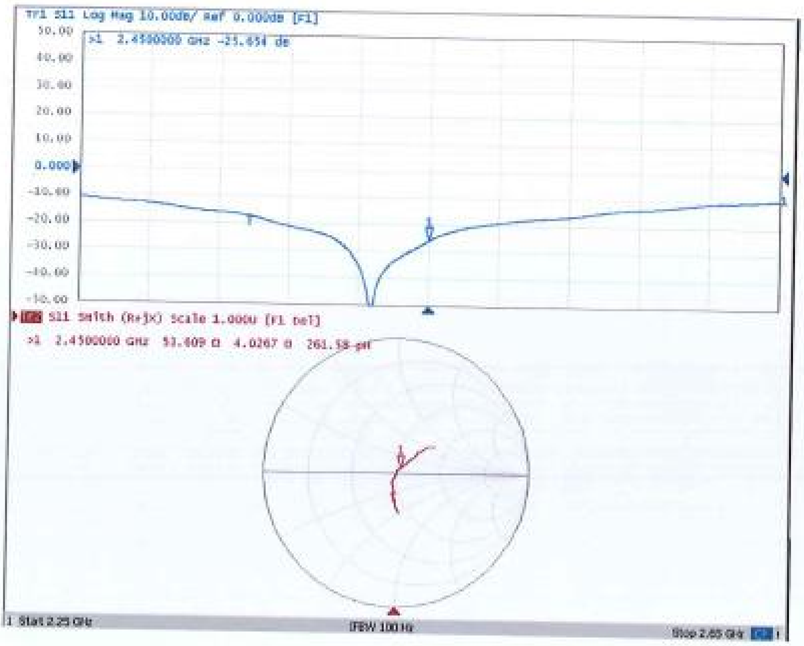
Impedance Measurement Plot for Head TSL



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