RF EXPOSURE TEST REPORT

Test Report No. 15407883S-A-R1

Customer	Nintendo Co., Ltd.
Description of EUT	Game Controller
Model Number of EUT	BEE-021
FCC ID	BKEBEE021
Test Regulation	FCC 47CFR 2.1093
Test Result	Complied
Issue Date	January 16, 2025
Remarks	-

Representative Test Engineer	Approved By
A. O	T. Imamura
Akihiro Oda Engineer	Toyokazu Imamura Engineer

CERTIFICATE 1266.03

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
☒ There is no testing item of "Non-accreditation".

Report Cover Page -Form-ULID-003532 (DCS:13-EM-F0429) Issue# 24.0 (SAR Revision- v23.13sar240920)

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REVISION HISTORY

Original Test Report No.: 15407883S-A

This report is a revised version of 15407883S-A. 15407883S-A is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15407883S-A	November 7, 2024	-
R1	15407883S-A-R1	January 16, 2025	Section 3.1_DSS -> DTS Section 4.2_

							Antenna Separation distance [mm]							
							3.99	8.84	32.72	36.14	40.04	45.46	52.56	76.5
		Antenna					Bottom1	Front	Bottom2	Top	Back	Left	Bottom3	Right
Tx mode	Higher Freq. [MHz]	Max. ATP		Gain	EIRP		SAR1g test exempt threshold power [mW] (upper row)							
		[dBm]	[mW]	[dBi]	[dBm]	[mW]	Judge of SAR test exemption (lower row)							
EDR	2480	3.5	2	1.52	5.02	3.18	3.0	3.0	3.0	7.0	206.9	242.5	>242.5	>242.5
							Test	Test	Test	Exempt	Exempt	Exempt	Exempt	Exempt
BR, BT LE	2480	6.5	4.47	1.52	8.02	6.34	3.0	3.0	3.0	7.0	206.9	242.5	>242.5	>242.5
							Test	Test	Test	Exempt	Exempt	Exempt	Exempt	Exempt

->

							Antenna Separation distance [mm]							
							3.99	8.84	32.72	37.36	40.04	45.46	52.56	76.5
		Antenna					Bottom1	Front	Bottom2	Top	Back	Left	Bottom3	Right
Tx mode	Higher Freq. [MHz]	Max. ATP		Gain	ERP		SAR1g test exempt threshold power [mW] (upper row)							
		[dBm]	[mW]	[dBi]	[dBm]	[mW]	Judge of SAR test exemption (lower row)							
EDR	2480	3.5	2	1.52	2.87	1.94	6.8	8.05	97.31	125.27	142.94	182.04	240.01	490.59
							Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt
BR, BT LE	2480	6.5	4.47	1.52	5.87	3.86	6.8	8.05	97.31	125.27	142.94	182.04	240.01	490.59
							Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt

Reference : Abbreviations (Including words undescribed in this report) (R16v240731S10v240806)

A2LA	The American Association for Laboratory Accreditation
AC	Alternating Current
AFH	Adaptive Frequency Hopping
AM	Amplitude Modulation
Amp, AMP	Amplifier
ANSI	American National Standards Institute
Ant, ANT	Antenna
AP	Access Point
APD	Absorbed Power Density
ASK	Amplitude Shift Keying
Atten., ATT	Attenuator
AV	Average
BPSK	Binary Phase-Shift Keying
BR	Bluetooth Basic Rate
BT	Bluetooth
BT LE	Bluetooth Low Energy
BW	BandWidth
Cal Int	Calibration Interval
CCK	Complementary Code Keying
CDD	Cyclic Delay Diversity
CFR	Code of Federal Regulations
Ch., CH	Channel
CISPR	Comite International Special des Perturbations Radioelectriques
CW	Continuous Wave
DBPSK	Differential BPSK
DC	Direct Current
D-factor	Distance factor
DFS	Dynamic Frequency Selection
DQPSK	Differential QPSK
DSSS	Direct Sequence Spread Spectrum
DUT	Device Under Test
EDR	Enhanced Data Rate
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EN	European Norm
ERP, e.r.p.	Effective Radiated Power
ETSI	European Telecommunications Standards Institute
EU	European Union
EUT	Equipment Under Test
Fac.	Factor
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
FM	Frequency Modulation
Freq.	Frequency
FSK	Frequency Shift Keying
GFSK	Gaussian Frequency-Shift Keying
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HE	High Efficiency (e.g. IEEE 802.11ax20HE)
HT	High Throughput (e.g. IEEE 802.11n20HT)
Hori.	Horizontal
ICES	Interference-Causing Equipment Standard
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
ILAC	International Laboratory Accreditation Conference
IPD	Incident Power Density
ISED	Innovation, Science and Economic Development Canada
ISO	International Organization for Standardization
JAB	Japan Accreditation Board
LAN	Local Area Network
LIMS	Laboratory Information Management System
MCS	Modulation and Coding Scheme
MIMO	Multiple Input Multiple Output (Radio)
MPE	Maximum Permissible Exposure
MRA	Mutual Recognition Arrangement
MU-MIMO	Multi-User Multiple Input Multiple Output (Radio)
N/A	Not Applicable, Not Applied
NII	National Information Infrastructure (Radio)
NIST	National Institute of Standards and Technology
NR	New Radio
NS	Nerve Stimulation
NSA	Normalized Site Attenuation
NVLAP	National Voluntary Laboratory Accreditation Program
OBW	Occupied Band Width
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PD	Power Density
psPD	Peak spatial-average power density
psPDn+	Surface-normal propagation-direction peak spatial-average power density
psPDtot+	Total propagating spatial-average peak power density
psPDmod+	Total peak spatial-average power density considering reactive near-field effects
P/M	Power meter
PCB	Printed Circuit Board
PER	Packet Error Rate
PHY	Physical Layer
PK	Peak
PN	Pseudo random Noise
PP	Preamble Puncturing
PRBS	Pseudo-Random Bit Sequence
PSD	Power Spectral Density
QAM	Quadrature Amplitude Modulation
QP	Quasi-Peak
QPSK	Quadrature Phase Shift Keying
RAT	Radio Access Technology
RBW	Resolution Band Width
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
RSS	Radio Standards Specifications
RU	Resource Unit
Rx	Receiving
SA, S/A	Spectrum Analyzer
SAR	Specific Absorption Rate
SDM	Space Division Multiplexing
SISO	Single Input Single Output (Radio)
SG	Signal Generator
sPD	Spatial-average power density
sPDn+	Surface-normal propagation-direction spatial-average power density
sPDtot+	Total propagating spatial-average power density
sPDmod+	Total spatial-average power density considering reactive near-field effects
SPLSR	SAR to Peak Location Separation Ratio
SVSWR	Site-Voltage Standing Wave Ratio
TER	Total Exposure Ratio
TSL	Tissue Simulation Liquid
T/R	Test Receiver
Tx	Transmitting
U-NII	Unlicensed National Information Infrastructure (Radio)
URS	Unintentional Radiator(s)
VBW	Video BandWidth
Vert.	Vertical
VHT	Very High Throughput (e.g. IEEE 802.11ac20VHT)
WLAN	Wireless LAN
Wi-Fi, WiFi	Wireless LAN, trademarked by Wi-Fi Alliance
WPT	Wireless Power Transmit

CONTENTS PAGE

Contents of appendixes

SECTION 1: Customer information

Company Name	Nintendo Co., Ltd.
Address	11-1 Hokotate-cho, Kamitoba, Minami-ku, Kyoto 601-8501, Japan
Telephone Number	+81-75-662-9600
Contact Person	Yosuke Ishikawa

The information provided from the customer is as follows;
- Customer name, Company name, Type of Equipment, Model No., FCC ID on the cover and other relevant pages.
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT)
- SECTION 4: Operation of EUT during testing
- Appendix 1: The part of Antenna location information, Description of EUT and Support Equipment

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type	Game Controller
Model Number	BEE-021
Serial Number	HHL04000006178
Rating	DC 5 V (*.Supply voltage from connector) (*. DC 3.89 V from Re-chargeable Li-ion battery for the internal circuit)
Condition of sample	Engineering prototype (Not for sale: The sample is equivalent to mass-produced items.)
Receipt Date of sample	October 9, 2024 (for power measurement) (*. No modification by the Lab.) October 23, 2024(for SAR test) (*. No modification by the Lab.)
Test Date (SAR)	October 24, 2024

2.2 Product Description

This report contains data provided by the customer which can impact the validity of results. UL Japan, Inc. is only responsible for the validity of results after the integration of the data provided by the customer. The data provided by the customer is marked "a)" in the table below.

General

Feature of EUT	Model: BEE-021 (referred to as the EUT in this report) is a Game Controller.
SAR Category Identified	Portable device (*. Since EUT may contact to a localized human body during wireless operation, the partial-body SAR (1g) shall be observed.)
SAR Accessory	None, there are no accessories that would affect SAR test.

Radio specification

Equipment type	Transceiver
Frequency of operation	Bluetooth: 2402 MHz ~ 2480 MHz
Supported modulations	Bluetooth: BR/EDR/BT LE (FHSS, GFSK (*. EDR: GFSK+ π/4-DQPSK, GFSK+ 8DPSK))
Typical and maximum transmit power	*. The specification of typical and maximum transmit power (which may occur) refer to remarks in below "Table of Typical power and Maximum tune-up tolerance limit power". The measured output power (conducted) as SAR reference power refers to section 5 in this report.

Antenna quantity	1 pc.	Antenna type	PCB antenna	Antenna connector type	PCB integrated
Antenna gain a)	1.52 dBi (max. gain)				

. Table of Typical power and Maximum tune-up tolerance limit power (. Indicate only the lowest data rate which has maximum power.)
Maximum tune-up tolerance limit is conducted burst average power and is defined by a customer as Duty cycle 100% (continuous transmitting).

Type	Band	Channel	Frequency [MHz]	Mode	D/R [Mbps]	Typ. [dBm]	Max. [dBm]
BT	BR	0 to 78	2402 to 2480	DH5	1	-	6.5
BT	EDR	0 to 78	2402 to 2480	2DH5	2	-	3.5
BT	EDR	0 to 78	2402 to 2480	3DH5	3	-	3.5
BT	BTLE	0 to 39	2402 to 2480	PHY1	1	-	6.5
BT	BTLE	0 to 39	2402 to 2480	PHY2	2	-	6.5

*. : The transmission mode with the highest power in each band is marked with a yellow marker.
D/R: data rate, Ant.: antenna, Max. Maximum tune-up limit power, N/A: Not applicable

SECTION 3: Maximum SAR value, test specification and procedures

3.1 Summary of Maximum SAR Value

Mode / Band	Highest Reported SAR [W/kg]					
	SAR type	Partial-body (Flat phantom , Separation 0 mm)	SAR type	Head (SAM phantom)	SAR type	Limbs (Flat phantom)
FHSS) Bluetooth	1g	< 0.10	1g	N/A	10g	N/A
DTS) Bluetooth	1g	< 0.10	1g	N/A	10g	N/A
Simultaneous SAR	1g	N/A	1g	N/A	10g	N/A
Limit applied	Partial bod y: 1.6 W/kg (SAR1g) for general population/uncontrolled exposure is specified in FCC 47 CFR 2.1093.					
Test Procedure	Refer to Section 3.2 in this report. In addition; UL Japan's SAR measurement work procedures No. ULID-003599 (13-EM-W0430). UL Japan's SAR measurement equipment calibration and inspection work procedures No. ULID-003598 (13-EM-W0429).					

Conclusion
The SAR test values found for the device are separately below the maximum limit of 1.6 W/kg.

3.2 RF Exposure limit

SAR Exposure Limit (100 kHz ~ 6 GHz)		
	General Population / Uncontrolled Exposure (*1)	Occupational / Controlled Exposure (*2)
Spatial Peak SAR (*3) (Whole Body)	0.08 W/kg	0.4 W/kg
Spatial Peak SAR (*4) (Partial-Body, Head or Body)	1.6 W/kg	8 W/kg
Spatial Peak SAR (*5) (Hands / Feet / Ankle / Wrist)	4 W/kg	20 W/kg

*. For the purpose of this Regulation, FCC has adopted the SAR and RF exposure limits established in FCC 47 CFR 1.1310: Radiofrequency radiation exposure limits.
*1. General Population / Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.
*2. Occupational / 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).
*3. The Spatial Average value of the SAR averaged over the whole body.
*4. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time
*5. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

The limit applied to this device which tested in this report is;

Limit of Spatial Peak SAR (Partial-Body)	**1.6 W/kg**	**General population / uncontrolled exposure**

3.3 Test specification

Standard	Description	Version
47 CFR 2.1093	(Limit) Radiofrequency radiation exposure evaluation: portable devices	-
ANSI/IEEE C95.1	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz	1992
IEEE Std. 1528	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.	2013
KDB 248227 D01	SAR Guidance for IEEE 802.11 (Wi-Fi) transmitters v02r02	v02r02
KDB 447498 D04	Interim General RF Exposure Guidance v01	v01
KDB 447498 D03	OET Bulletin 65, Supplement C Cross-Reference v01	v01
KDB 865664 D01	SAR measurement 100 MHz to 6 GHz v01r04	v01r04
KDB 865664 D02	RF exposure compliance reporting and documentation considerations v01r02	v01r02
IEC/IEEE 62209-1528 (*1)	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). - Secs. 6.1, 7.4.2, 7.7 - *f* above 4 MHz SAR provisions (TCB workshop, 2022-10)	2020

*1. The measurement uncertainty budget is suggested by IEC/IEEE 62209-1528:2020. Refer to Appendix3-3 for more details.
In addition to the above, the following information was used:

TCB workshop 2016-10	(RF Exposure Procedure) Bluetooth Duty Factor.
TCB workshop 2016-10	(RF Exposure Procedure) DUT Holder Perturbations; When the highest reported SAR of an antenna is > 1.2 W/kg, holder perturbation verification is required for each antenna, using the highest SAR configuration among all applicable frequency bands.
TCB workshop 2017-05	(RF Exposure Procedure) Broadband liquid above 3 GHz. Allow application of 10% tissue dielectric tolerance correction in KDB 865664 D01.
TCB workshop 2018-04	(RF Exposure Procedure) Allow Expedited Area Scans. (including mother scans)
TCB workshop 2019-04	(RF Exposure Procedure) 802.11ax SAR Testing
TCB workshop 2019-04	(RF Exposure Procedure) Tissue Simulating Liquids (TSL) FCC has permitted the use of single head tissue simulating liquid specified in IEC 62209 for all SAR tests. If FCC parameters are used, 5 % tolerance. If IEC parameters, 10 %.
TCB workshop 2019-04	(RF Exposure Policy) SAR Zoom-Scan Update.
TCB workshop 2021-04	(RF Exposure Procedure) Application of specific phantoms. (case by case, PAG)

3.4 Addition, deviation and exclusion to the test procedure

No addition, exclusion nor deviation has been made from the test procedure.

3.5 Test Location

UL Japan, Inc., Shonan EMC Lab.
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
Telephone number: +81 463 50 6400

*. A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D / CAB identifier: JP0001)

Place	Width × Depth × Height (m)	Size of reference ground plane (m) / horizontal conducting plane
No.7 Shielded room	2.76 × 3.76 × 2.4	2.76 × 3.76

3.6 SAR measurement procedure

3.6.1 SAR Definition

SAR is defined as the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). The equation description is shown in right.	SAR = $\frac{d}{dt}(\frac{dW}{dm}) = \frac{d}{dt}(\frac{dW}{\rho * dV})$
SAR measurement can be related to the electrical field in the tissue by the equation in right. SAR is expressed in units of Watts per kilogram (W/kg). Where : σ = conductivity of the tissue (S/m), ρ = mass density of the tissue (kg/m^3), E = RMS electric field strength in tissue (V/m)	SAR = $\frac{\sigma \lvert E \rvert^2}{\rho}$

3.6.2 Full SAR measurement procedure

The SAR measurement procedures are as follows: (1) The EUT is installed engineering testing software that provides continuous transmitting signal; (2) Measure output power through RF cable and power meter; (3) Set scan area, grid size and other setting on the DASY software; (4) Find out the largest SAR result on these testing positions of each band; (5) Measure SAR results for other channels in worst SAR testing position if the 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:
Step 1) Power measurement -.> SAR: Step 2) Power reference measurement -> Step 3) Area scan -> Step 4) Zoom scan -> Step 5) Power drift measurement

Step 1: Confirmation before SAR testing

Before SAR test, the RF wiring for the sample had been switched to the antenna conducted power measurement line from the antenna line and the average power was measured. This SAR reference power measurement was proceeded with the lowest data rate (which may have the higher time-based average power typically) on each operation mode and on the lower, middle (or near middle), upper and specified channels. The power measurement result is shown in Section 5.

*. The EUT transmission power used SAR test was verified that it was not more than 2 dB lower than the maximum tune-up tolerance limit. (KDB447498 D04 (v01))

Step 2: Power reference measurement

Measured psSAR value at a peak location of Fast Area Scan was used as a reference value for assessing the power drop.

Step 3: Area Scan

(Scan parameters: KDB 865664 D01, IEC/IEEE 62209-1528 (> 6GHz))

Area Scans are used to determine the peak location of the measured field before doing a finer measurement around the hotspot. Peak location can be found accurately even on coarse grids using the advanced interpolation routines implemented in DASY8. Area Scans measure a two dimensional volume covering the full device under test area. DASY8 uses Fast Averaged SAR algorithm to compute the 1 g and 10 g of simulated tissue from the Area Scan. DASY8 can either manually or automatically generates Area Scan grid settings based on device dimensions. In automatically case, the scan extent is defined by the device dimensions plus additional 15mm on each side. In manually, the scan covered the entire dimension of the antenna of EUT.

Step 4: Zoom Scan and post-processing

(Scan parameters: KDB 865664 D01, IEC/IEEE 62209-1528 (> 6GHz))

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

*. A minimum volume of 30 mm (x) × 30 mm (y) × 30 mm (z) was assessed by "Ratio step" method (*1), for 2.4 GHz band. (Step XY: 5 mm)
*. A minimum volume of 24 mm (x) × 24 mm (y) × 24 mm (z) was assessed by "Ratio step" method (*1), for 5 GHz band (Step XY: 4 mm).
*. A minimum volume of 24 mm (x) × 24 mm (y) × 24 mm (z) was assessed by "Ratio step" method (*1), for 6 GHz band (Step XY: 3.4 mm).

When the SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are proceeded for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR. If the zoom scan measured as defined above complies with both of the following criteria. or if the peak spatial-average SAR is below 0.1 W/kg, no additional measurements are needed.

*. The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x and y directions and recorded.
*. The ratio of the SAR at the second measured point to the SAR at the closest measured point at the x-y location of the measured maximum SAR value shall be at least 30 % and recorded.

			$f \leq$ 3 GHz	3 GHz < $f \leq$ 10 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 mm ± 1 mm	1/2 × δ × ln(2) mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			5 ° ± 1 °(flat phantom only) 30 ° ± 1 °(other phantom)	5 ° ± 1 °(flat phantom only) 30 ° ± 1 °(other phantom)
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 > 6 GHz : ≤ 60/f mm, or half of the corresponding zoom scan length, whichever is smaller.
			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.	
Maximum zoom scan spatial resolution: Δx_{Area}, Δy_{Area}			≤ 2 GHz : ≤ 8 mm, 2~3 GHz : ≤ 5 mm (*1)	3~4 GHz : ≤ 5 mm (*1), 4~6 GHz : ≤ 4 mm (*1) > 6 GHz : ≤ 24/f mm
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3~4 GHz : ≤ 4 mm, 4~5 GHz : ≤ 3 mm, 5~6 GHz : ≤ 2 mm > 6 GHz : ≤ 10/(f-1) mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3~4 GHz : ≤ 3 mm, 4~5 GHz : ≤ 2.5 mm, 5~6 GHz : ≤ 2 mm > 6 GHz : ≤ 12/f mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5 × Δz_{zoom} (n-1) mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3~4 GHz : ≥ 28 mm, 4~ 5 GHz : ≥ 25 mm, 5~6 GHz : ≥ 22 mm > 6 GHz : ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 (≤ 6 GHz) and IEC/IEEE 62209-1528 (≤ 10 GHz) for details.
*1. When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 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. (KDB 865664 D01)
*. The scan parameters of > 6GHz is defined IEC/IEEE 62209-1528.

Step 5: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same project. The Power Drift Measurement gives the SAR difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. It was checked that the power drift was within ± 5% (0.21 dB) in single SAR project run. The verification of power drift during the SAR test shown in SAR plot data of APPENDIX 2.

*. The most of SAR tests were conservatively performed with test separation distance 0 mm. The phantom bottom thickness is approx. 2mm. Therefore, the distance between the SAR probe tip to the surface of test device which is touched the bottom surface of the phantom is approx. 2.4 mm. Typical distance from probe tip to probe's dipole centers is 1mm.
*1. "Ratio step" method parameters used; the first measurement point: "1.4 mm" from the phantom surface, the initial z grid separation: "1.5 mm", subsequent graded grid ratio: "1.5" for 2.4 GHz band and the initial z grid separation: "1.4 mm", subsequent graded grid ratio: "1.4" for above 5 GHz. These parameters comply with the requirement of KDB 865664 D01and recommended by Schmid & Partner Engineering AG (DASY8 manual).

SECTION 4: Operation of EUT during testing

4.1 Operating modes for testing

The EUT has Bluetooth continuous transmitting modes.
The test modes and frequencies used in the SAR test are shown in the table of power measurement results in Section 5 with markings.
The control software in the power measurement and SAR test are shown in the following.

	Test name	Software name	Version	Date	Storage location / Remarks
Controlled software	Power measurement	InspectionFwPackage	V1.0.14	2024-09-18	*. Memory of EUT (firmware), set by host PC.
	SAR test	InspectionFwPackage	V1.0.14	2024-09-18	*. Memory of EUT (firmware), set by host PC.

4.2 RF exposure conditions (Test exemption)

Antenna separation distances in each test setup plan are shown as follows.

SAR test exemption consideration by KDB 447498 D04 (v01)

							Antenna Separation distance [mm]							
							3.99	8.84	32.72	37.36	40.04	45.46	52.56	76.5
		Antenna					Bottom1	Front	Bottom2	Top	Back	Left	Bottom3	Right
Tx mode	Higher Freq. [MHz]	Max. ATP		Gain	ERP		SAR1g test exempt threshold power [mW] (upper row)							
		[dBm]	[mW]	[dBi]	[dBm]	[mW]	Judge of SAR test exemption (lower row)							
EDR	2480	3.5	2	1.52	2.87	1.94	6.8	8.05	97.31	125.27	142.94	182.04	240.01	490.59
							Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt
BR, BT LE	2480	6.5	4.47	1.52	5.87	3.86	6.8	8.05	97.31	125.27	142.94	182.04	240.01	490.59
							Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt

*. Freq.: Frequency, ATP: Antenna terminal conducted power.
*** Bottom1 was judged SAR test exempt with a SAR of 10g because the gap was small and only a finger could fit through.**
*. Antenna separation distance. It is the distance from the antenna inside EUT to the outer surface of EUT which user may touch. Details of "antenna separation distance" and "Size of EUT" are shown in Appendix 1-1.
*. The table shows the upper frequency which has the maximum power (as "Tune-up limit") in each operation band, in mode and on the single antenna transmission.
*. Since this method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive), when the minimum test separation distance is < 5 mm, a distance of 5 mm was applied to determine SAR test exclusion for the calculation.
***. The actual test setup tested depends on the measurement results. See Section 7 for the actual tested test setup.**

Calculating formula:

1) ERP
ERP (dBm) = (Max. ATP, dBm) + (antenna gain, dBi) – 2.15

2) SAR test exempt threshold power
$P_{th}(mW)$=

$$ERP_{20cm}(mW) = \begin{cases} 2040f & 0.3\ GHz \le f < 1.5\ GHz \\ 3060 & 1.5\ GHz \le f \le 6.0\ GHz \end{cases} \quad (B.1)$$

$$P_{th}(mW) = \begin{cases} ERP_{20cm}(d/20)^x & d \le 20cm \\ ERP_{20cm} & 20cm < d \le 40cm \end{cases} \quad (B.2)$$

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

and f is in GHz, d is the separation distance (cm), and ERP20cm is per Formula (B.1).

TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L/2\pi$		$\lambda_H/2\pi$	W
0.3	-	1.34	159 m	-	35.6 m	$1920\ R^2$
1.34	-	30	35.6 m	-	1.6 m	$1920\ R^2/f^2$
30	-	300	1.6 m	-	159 m	$3.83\ R^2$
300	-	1500	159 mm	-	31.8 mm	$0.0128\ R^2 f$
1500	-	100000	31.8 mm	-	0.5 mm	$19.2\ R^2$

Subscripts L and H are low and high; λ is wavelength.
From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns. R is in meter, f is in MHz.
Upper 2.4GHz; Threshold ERP [W] = 19.2 × R^2, at distance: over 40 cm

SAR-based thresholds (Pth (mW) shown below table of "Example Power Thresholds [mW]" are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged effective radiated power (ERP), whichever is greater. The SAR-based exemption is calculated by Formula (B.2) in below, applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold Pth (mW).
When 10-g extremity SAR applies, SAR test exemption may be considered by applying a factor of 2.5 to the SAR-based exemption thresholds.
*. This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive).

Below is the test reduction procedure for KDB.

***. OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements**

(KDB 248227 D01, SAR Guidance for Wi-Fi Transmitters) The initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures.
When multiple channel bandwidth configurations in a frequency band have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected.

***. SAR test reduction considerations**

(KDB 447498 D04(v01), General RF Exposure Guidance) Testing of other required channels within the operating mode of a frequency band is not required when the reported 1g or 10g SAR for the mid-band or highest output power channel is:
(1) ≤ 0.8 W/kg for 1g , or 2.0 W/kg for 10g respectively, when the transmission band is ≤ 100 MHz
(2) ≤ 0.6 W/kg for 1g, or 1.5 W/kg for 10g respectively, when the transmission band is between 100 MHz and 200 MHz
(3) ≤ 0.4 W/kg for 1g, or 1.0 W/kg for 10g respectively, when the transmission band is ≥ 200 MHz
The SAR has been measured with highest transmission duty factor supported by the test mode tool for WLAN and/or Bluetooth. When the transmission duty factor could not be 100%, the reported SAR will be scaled to 100% transmission duty factor to determine compliance. When SAR is not measured at the maximum power level allowed for production unit, the measured SAR will be scaled to the maximum tune-up tolerance limit to determine compliance.

(KDB 248227 D01, SAR Guidance for Wi-Fi Transmitters) When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for subsequent next highest measured output power channel(s) in the initial test configuration until reported SAR is ≤ 1.2 W/kg or all required channels are tested.

For 2.4GHz band, the highest measured maximum output power channel of DSSS was selected for SAR measurement, When the reported SAR is ≤ 0.8 W/kg, no further SAR test is required in this exposure configuration. Otherwise, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel. For OFDM modes (802.11g/n), SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

SECTION 5: Confirmation before testing

5.1 Test reference power measurement

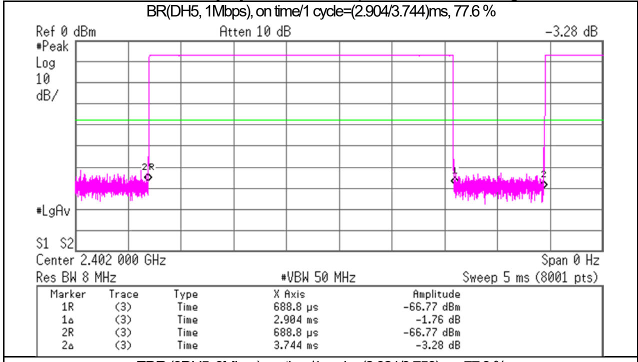
CH	Freq.	Tx mode		Power			Duty cycle	Duty factor	Duty scaled factor	Power				Adjusted power setting? (*1)
		Mode	D/R	Typ.	Max.	Set				Burst Ave.	Δmax	Scaled Factor	Time. Ave	
	[MHz]		[Mbps]	[dBm]	[dBm]		[%]	[dB]	[-]	[dBm]	[dB]		[dBm]	
0	2402	BR	1	-	6.5	fix	77.6	1.10	1.29	5.10	1.40	1.38	4.00	No
39	2441	BR	1	-	6.5	fix	77.6	1.10	1.29	5.13	1.37	1.37	4.03	No
78	2480	BR	1	-	6.5	fix	77.6	1.10	1.29	5.25	1.25	1.33	4.15	No
0	2402	EDR(2M)	2	-	3.5	fix	77.4	1.11	1.29	1.92	1.58	1.44	0.81	No
39	2441	EDR(2M)	2	-	3.5	fix	77.4	1.11	1.29	1.97	1.53	1.42	0.86	No
78	2480	EDR(2M)	2	-	3.5	fix	77.4	1.11	1.29	2.15	1.35	1.36	1.04	No
0	2402	EDR(3M)	3	-	3.5	fix	77.8	1.09	1.29	1.90	1.60	1.45	0.81	No
39	2441	EDR(3M)	3	-	3.5	fix	77.8	1.09	1.29	1.95	1.55	1.43	0.86	No
78	2480	EDR(3M)	3	-	3.5	fix	77.8	1.09	1.29	2.11	1.39	1.38	1.02	No
0	2402	BT LE(1M)	1	-	6.5	fix	86.3	0.64	1.16	5.07	1.43	1.39	4.43	No
19	2440	BT LE(1M)	1	-	6.5	fix	86.3	0.64	1.16	4.92	1.58	1.44	4.28	No
39	2480	BT LE(1M)	1	-	6.5	fix	86.3	0.64	1.16	5.20	1.30	1.35	4.56	No
0	2402	BT LE(2M)	2	-	6.5	fix	58.7	2.31	1.70	5.00	1.50	1.41	2.69	No
19	2440	BT LE(2M)	2	-	6.5	fix	58.7	2.31	1.70	4.85	1.65	1.46	2.54	No
39	2480	BT LE(2M)	2	-	6.5	fix	58.7	2.31	1.70	5.14	1.36	1.37	2.83	No

*. ▭ : SAR test was applied.
*1. "Yes": The power setting was adjusted so that measured average power was not more than 2 dB lower than the maximum tune-up tolerance limit.
*. CH: Channel; Power: Power specification; Max.: Maximum; Set: Set power by test software; Burst Ave.: Measured burst average power; Time Ave.: Measured time-based average power; N/A: Not applied,/Not applicable

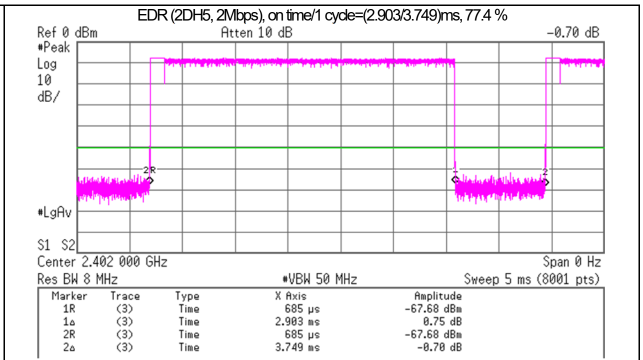
*. Calculating formula: Time average power (dBm) = (P/M Reading, dBm)+(Cable loss, dB)+(Attenuator, dB)
Burst power (dBm) = (P/M Reading, dBm)+(Cable loss, dB)+(Attenuator, dB)+(duty factor, dB)
Duty cycle: (duty cycle, %) = (Tx on time) / (1 cycle time) × 100, Duty factor (dBm) = 10 × log (100/(duty cycle, %))
Duty cycle scaled factor: Duty cycle correction factor for obtained SAR value, Duty scaled factor [-] = 100(%) / (duty cycle, %)
ΔMax. (Deviation form max.power, dB) = (Max.tune-up limit power (average, dBm)) - (Burst power measured (average, dBm))
Tune-up factor: Power tune-up factor for obtained SAR value, Tune-up factor [-] = 1 / (10 ^ ("Deviation from max., dB" / 10))

*. Date measured: 2024-10-09 / Measured by: A.Oda / Place: Preparation room of No. 7 shield room. (24 deg.C./ 53 %RH)
*. Uncertainty of antenna port conducted test; (±) 0.81 dB (Average power), (±) 0.27 % (duty cycle).
*. Chart of the worst duty cycle for each operation mode in right and in follows.

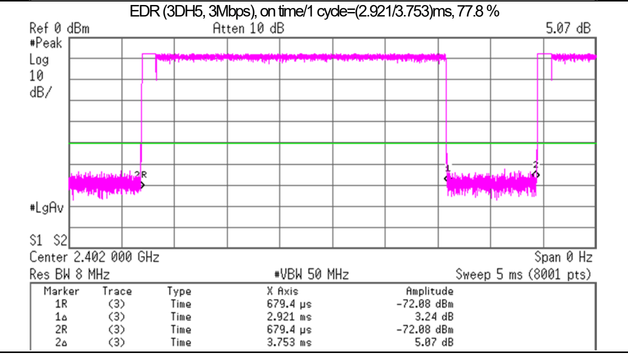
BR(DH5, 1Mbps), on time/1 cycle=(2.904/3.744)ms, 77.6 %



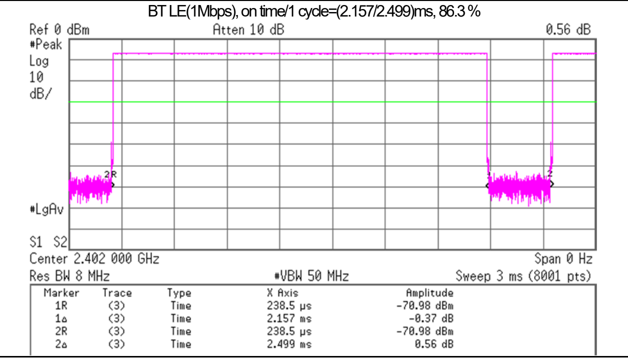
EDR (2DH5, 2Mbps), on time/1 cycle=(2.903/3.749)ms, 77.4 %



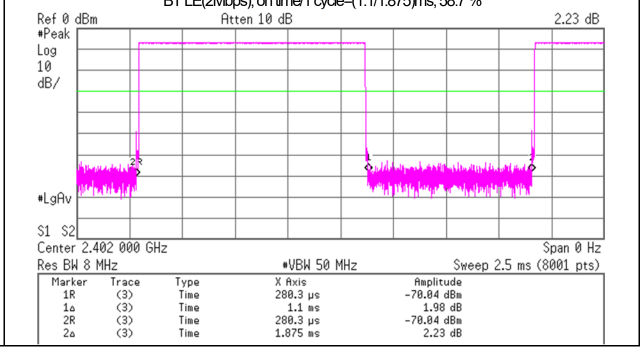
EDR (3DH5, 3Mbps), on time/1 cycle=(2.921/3.753)ms, 77.8 %



BT LE(1Mbps), on time/1 cycle=(2.157/2.499)ms, 86.3 %



BT LE(2Mbps), on time/1 cycle=(1.1/1.875)ms, 58.7 %



SECTION 6: Tissue simulating liquid

6.1 Liquid measurement

<SPC: System performance check>

Date	Freq.	Liq.	Target	Permittivity (*.measured)					Target	Conductivity (*.measured)				ΔSAR		ΔSAR	e',e''	Liq.	Liq.	Liquid usage
measured		type	e'	**e'**	Δe'	Limit	**e''**	Δend	σ_tgt	σ	Δσ	Limit	Δend	1g	10g	correct required ?	Lerp	Temp.	depth	conditions
(YYYY-MM-DD)	[MHz]		[-]	**[-]**	[%]	[%](*2)	**[-]**	[%](*1)	[S/m]	[S/m]	[%]	[%](*2)	[%](*1)	[%]	[%]		?	[deg.C.]	[mm]	
2024-10-23	2450	Head	39.20	39.68	1.2	±10	13.6656	<48 hrs	1.800	1.863	3.5	±10	<48 hrs	1.4	0.7	No	No	22.2	150	<48 hrs

<SAR test>

Date	Freq.	Liq.	Target	Permittivity (*.measured)					Target	Conductivity (*.calculated)(*4)				ΔSAR		ΔSAR	e',e''	Liq.	Liq.	Liquid usage
measured		type	e'	**e'**	Δe'	Limit	**e''**	Δend	σ_tgt	σ	Δσ	Limit	Δend	1g	10g	correct required ?	Lerp	Temp.	depth	conditions
(YYYY-MM-DD)	[MHz]		[-]	**[-]**	[%]	[%](*2)	**[-]**	[%](*1)	[S/m]	[S/m]	[%]	[%](*2)	[%](*1)	[%]	[%]		?	[deg.C.]	[mm]	(*1)
2024-10-23	2402	Head	39.29	39.77	1.2	±10	13.6465	<48hrs.	1.757	1.824	3.8	±10	<48hrs.	1.6	0.8	No	No	22.2	150	Measured before SAR test. There were used until 2024-10-24 (< 48 hrs.).
2024-10-23	2440	Head	39.22	39.70	1.2	±10	13.6586	<48hrs.	1.791	1.854	3.5	±10	<48hrs.	1.4	0.7	No	No	22.2	150	
2024-10-23	2441	Head	39.22	39.69	1.2	±10	13.6593	<48hrs.	1.792	1.855	3.5	±10	<48hrs.	1.4	0.7	No	No	22.2	150	
2024-10-23	2480	Head	39.16	39.63	1.2	±10	13.6889	<48hrs.	1.833	1.889	3.1	±10	<48hrs.	1.2	0.6	No	No	22.2	150	

*. Lerp: Linear interpolation, Ref.: reference

*1. Definition of Δend.) "begin": there are measured before SAR test; "< 24 hrs.": SAR test has ended within 24 hours from the liquid parameter measured; "< 48 hrs.": Since SAR test has ended within 48 hours from the liquid parameter measured and a change in the liquid temperature was within 1 degree, liquid parameters measured on first day were used on next day continuously; "> 48 hrs.": Since the SAR test series took longer than 48 hours, the liquid parameters were measured on every 48 hours period and on the date which was end of test series. Since the difference of liquid parameters between the beginning and next measurement was smaller than 5%, the liquid parameters measured in beginning were used until end of each test series.
Calculating formula: "Δend (when, >48 hrs.) (%)"" = {(dielectric properties, end of test series) / (dielectric properties, beginning of test series) -1} × 100

*2. The electrical properties of the liquid at <6 GHz were controlled to within 5% even with a limit of 10%.

*. The electrical characteristics of the SAR test frequencies were measured using DAK software, DAK-3.5 and a network analyzer with the 2.4 GHz band swept at 1 MHz and the 5 GHz and 6 GHz bands swept at 5 MHz. In this way, the electrical characteristics of all test frequencies were measured directly at the individual frequencies without interpolation.

*. The target values refers to clause 6.2 of this report.

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*. The coefficients in below are parameters defined in IEEE Std.1528.
(Calculating formula,4 MHz~6 GHz): $\Delta SAR(1g) = C\varepsilon r \times \Delta\varepsilon r + C\sigma \times \Delta\sigma$, $C\varepsilon r = -7.854E{-}4 \times f^3 + 9.402E{-}3 \times f^2 - 2.742E{-}2 \times f - 0.2026$ / $C\sigma = 9.804E{-}3 \times f^3 - 8.661E{-}2 \times f^2 + 2.981E{-}2 \times f + 0.7829$
$\Delta SAR(10g) = C\varepsilon r \times \Delta\varepsilon r + C\sigma \times \Delta\sigma$, $C\varepsilon r = 3.456 \times 10^{-3} \times f^3 - 3.531 \times 10^{-2} \times f^2 + 7.675 \times 10^{-2} \times f - 0.1860$ / $C\sigma = 4.479 \times 10^{-3} \times f^3 - 1.586 \times 10^{-2} \times f^2 - 0.1972 \times f + 0.7717$
<u>Since the ΔSAR values of the tested liquid had shown positive, the measured SAR was not ΔSAR corrected by the conservative reason.</u>
(Calculating formula): ΔSAR corrected SAR (W/kg) = (Measured SAR (W/kg)) × (100 - (ΔSAR(%)) / 100

6.2 Target of tissue simulating liquid

Nominal dielectric values of the tissue simulating liquids in the phantom are listed in the following table. (Appendix A, KDB 865664 v01r04)

Target Frequency	Head		Body	
(MHz)	ε_r	σ(S/m)	ε_r	σ(S/m)
1800~2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95

Target Frequency	Head		Body	
(MHz)	ε_r	σ(S/m)	ε_r	σ(S/m)
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

*. For other frequencies, the target nominal dielectric values were obtained by linear interpolation between the higher and lower tabulated figures. Above 5800MHz were obtained using linear extrapolation.

6.3 Simulated tissue composition

Liquid type	Head	Control No.	SSLHV6-01	Model No. / Product No.	HBBL600-10000V6 / SL AAH U16 BC
Ingredient: Mixture [%]	Water: >77, Ethanediol: <5.2, Sodium petroleum sulfonate:<2.9, Hexylene Glycol: <2.9, alkoxylated alcohol (>C_{16}):<2.0				
Tolerance specification	± 10%				
Temperature gradients [% / deg.C]	permittivity: -0.19 / conductivity: -0.57 (at 2.6 GHz), permittivity: +0.31 / conductivity: -1.43 (at 5.5 GHz) (*)				
Manufacture	Schmid & Partner Engineering AG	Note: *. speag_920-SLAAxyy-E_1.12.15CL (Maintenance of tissue simulating liquid)			

SECTION 7: Measurement results

7.1 Measurement results

7.1.1 SAR measurement results

RF Exposure	Setup	Gap	Source	Tx mode				Freq.		Duty	Duty S/F	Pmax	Pset	Pmeas	Pwr. S/F	SAR1g [W/kg] (*b)			Limit	SAR10g [W/kg] (*b)			Limit	Data plot#,	Setup photo#,
conditon	position	[mm]	power	mode	Tx	Stream	D/R [Mbps]	[MHz]	CH	[%]	[-]	[dBm]	[-]	[dBm]	[-]	Meas.	Δsar(*a)	Report	[W/kg]	Meas.	Δsar(*a)	Report	[W/kg]	Appx.2	Appx.1-3
Body	Front	0	Battery	BR	1Tx	-	1	2402	0	77.6	1.29	6.5	fix	5.1	1.38	0.013	N/A	**0.023**	1.6	0.007	N/A	**0.012**	N/A	-	S1
Body	Front	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	0.013	N/A	**0.023**	1.6	0.007	N/A	**0.012**	N/A	-	S1
Body	Front	0	Battery	BR	1Tx	-	1	2480	78	77.6	1.29	6.5	fix	5.25	1.33	0.015	N/A	**0.026**	1.6	0.008	N/A	**0.014**	N/A	D2	S1
Body	Front	0	Battery	BT LE(1M)	1Tx	-	1	2402	0	86.3	1.16	6.5	fix	5.07	1.39	0.013	N/A	**0.021**	1.6	0.007	N/A	**0.011**	N/A	-	S1
Body	Front	0	Battery	BT LE(1M)	1Tx	-	1	2440	19	86.3	1.16	6.5	fix	4.92	1.44	0.014	N/A	**0.023**	1.6	0.008	N/A	**0.013**	N/A	-	S1
Body	Front	0	Battery	BT LE(1M)	1Tx	-	1	2480	39	86.3	1.16	6.5	fix	5.2	1.35	0.018	N/A	**0.028**	1.6	0.01	N/A	**0.016**	N/A	D1	S1
Body	Front	0	Battery	BT LE(2M)	1Tx	-	2	2402	0	58.7	1.7	6.5	fix	5	1.41	0.008	N/A	**0.019**	1.6	0.004	N/A	**0.01**	N/A	-	S1
Body	Front	0	Battery	BT LE(2M)	1Tx	-	2	2440	19	58.7	1.7	6.5	fix	4.85	1.46	0.009	N/A	**0.022**	1.6	0.005	N/A	**0.012**	N/A	-	S1
Body	Front	0	Battery	BT LE(2M)	1Tx	-	2	2480	39	58.7	1.7	6.5	fix	5.14	1.37	0.011	N/A	**0.026**	1.6	0.005	N/A	**0.012**	N/A	-	S1
Body	Back	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	0.006	N/A	**0.011**	1.6	0.003	N/A	**0.005**	N/A	-	S2
Body	Top	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	0.005	N/A	**0.009**	1.6	0.003	N/A	**0.005**	N/A	-	S3
Body	Bottom3	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	0.009	N/A	**0.016**	1.6	0.005	N/A	**0.009**	N/A	-	S4
Body	Left	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	0.004	N/A	**0.007**	1.6	0.002	N/A	**0.004**	N/A	-	S5
Body	Right	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	0.003	N/A	**0.005**	1.6	0.001	N/A	**0.002**	N/A	-	S6
Body	Bottom2	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	exempt	N/A	**N/A**	1.6	exempt	N/A	**N/A**	N/A	-	-
Hand	Bottom1	0	Battery	BR	1Tx	-	1	2441	39	77.6	1.29	6.5	fix	5.13	1.37	exempt	N/A	**N/A**	N/A	exempt	N/A	**N/A**	4	-	-

*. Exempt: SAR test is exempted by evaluated SAR test exclusion threshold power. See section 4.
*. Ant.: Antenna; D/R: Data rate; Freq.: Frequency; Duty: Duty cycle; D.S/F: Duty Scaling Factor; Pmax: Max power (Tune-up tolerance power); Pmeas.: Measurement conducted power; P.S/F Power Scaling Factor; Meas.: Measurement; Appx: Appendix; Gap: It is separation distance between the device surface and the bottom outer surface of phantom.
*. All SAR tests were conservatively performed with test separation distance 0 mm.
*. Before test, the battery was full charged. During SAR test, the radiated power is always monitored by Spectrum Analyzer or/and MAIA.

*a. Since the calculated ΔSAR values of the tested liquid had shown positive correction even when error was more than 5%, the measured SAR was not converted by ΔSAR correction.
Calculating formula: ΔSAR corrected SAR (W/kg) = (Measured SAR (W/kg)) × (100 - (ΔSAR(%)) / 100, when ΔSAR shows negative sign.
*b. Calculating formula: Reported (Scaled) SAR (W/kg) = (Measured SAR (W/kg)) × (Duty scaled factor) × (Power scaled factor)
where, Duty scaled factor (D.S/F) [-] = 100(%) / (measured duty cycle, %), Power scaled factor (P.S/F) [-] = 10 ^ (((Max.power, dBm) - (Measured power, dBm)) / 10)

7.2 Simultaneous transmission (including Co-location) evaluation

Result: Simultaneous transmission is not existed.

7.3 SAR Measurement Variability (Repeated measurement requirement)

Result: Since all the measured SAR are less than 0.8 W/kg (SAR(1g)), the repeated measurement is not required.

7.4 Device holder (D/H) perturbation verification (SAR)

Result: Since all the reported (scaled) SAR are less than 1.2 W/kg (SAR(1g)), the additional "device holder perturbation verification" measurement is not considered.

7.5 Requirements on the Uncertainty Evaluation

Decision Rule

☑ Uncertainty is not included.

☐ Uncertainty is included.

*. The highest measured SAR(1g) is less than 1.5 W/kg and the highest measured SAR(10g) is less than 3.75 W/kg. Thus, per KDB Publication 865664 D01, the extended measurement uncertainty analysis described in IEEE 1528-2013 is not required.

APPENDIX 2: Measurement data

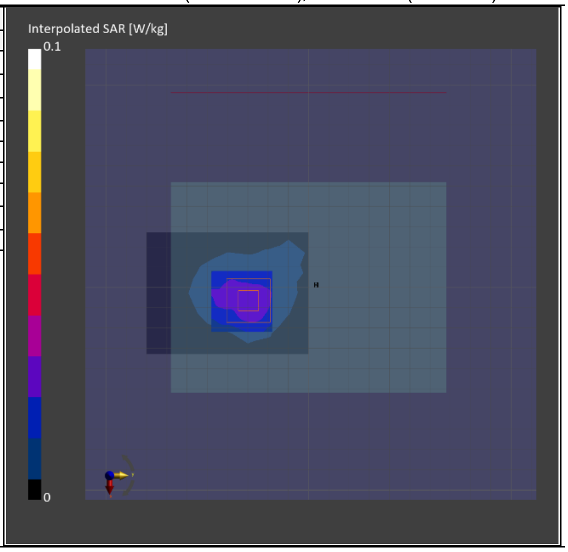
Appendix 2-1: Plot(s) of Worst Reported Exposure Value

Plot D1: Front & touch, BT LE(1 Mbps), 2480 MHz

EUT: Game Controller ; Model: BEE-021; Serial:HHL04000006178
Mode: BT LE (1 Mbps) (UID: 0 (CW)) ; Frequency: 2480 MHz ; Test Distance: 0.00 mm
TSL parameters used: Head(v6) ; f= 2480 MHz; Conductivity: 1.889 S/m; Permittivity: 39.63

DASY8 Configuration: - Electronics: DAE4 - SN626 (Calibrated: 2024-01-09) / - Phantom: ELI V8.0 (20deg probe tilt) ; Serial: 2161 ; Phantom section: Flat
- Probe: EX3DV4 - SN3907(Calibrated: 2024-01-15); ConvF: (6.83, 7.07, 6.68) @ 2480 MHz/ - Software: 16.4.0.5005 (Measurement); 16.4.0.5005 (Evaluation)

Scan Setup				Measurement Results		
Setup items	Fast	Area	Zoom	Meas. Items	Area	**Zoom**
Grid Extents [mm]	180.0x140.0	80.0×60.0	30.0×30.0×30.0	psSAR 1g [W/kg]	0.017	**0.018**
Grid Steps [mm]	10.0x10.0	10.0×10.0	5.0×5.0×1.5	psSAR 10g [W/kg]	0.009	**0.01**
Sensor Distance [mm]	4.0	3.0	1.4	Power Drift [dB]	0.11	0.19
Graded Grid	N/A	N/A	Yes	pSAR (extrapolated) [W/kg]	N/A	0.032
Grading Ratio	N/A	N/A	1.5	Power Scaling	Disabled	Disabled
MAIA monitored	N/A	Y	Y	TSL Correction	No correction	No correction
Surface Detection	VMS + 6p	VMS + 6p	VMS + 6p	M2/M1 [%]	N/A	81.7
Scan Method	Measured	Measured	Measured	Dist 3dB Peak [mm]	N/A	14.4
Grid Effective [mm]	N/A	80.0×60.0	30.0×30.0×31.2	SAR1g Position (x,y,z)	N/A	6.5,-29.7,-172.0



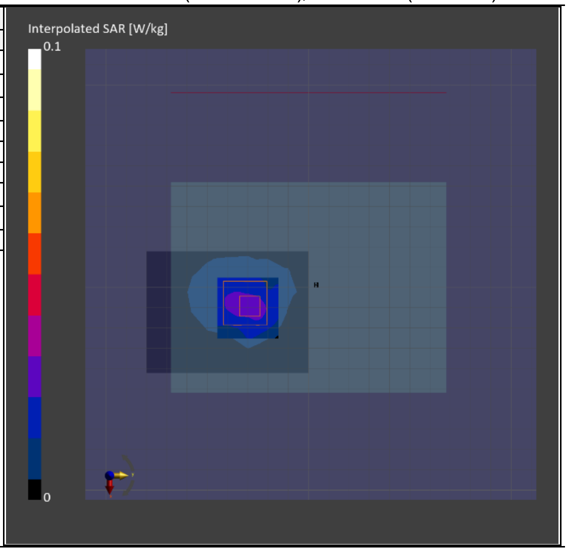
Remarks: *. Order No.: 15407883; Date tested:2024-10-24 ; Tested by: A. Oda; Tested location: UL Japan, Shonan EMC Lab. No.7 shielded room
*. Liquid temperature: 22.5 deg.C. ± 0.5 deg.C. (22.5 deg.C., in check); Ambient: 23 deg.C. / 76 %RH; *. Red cubic: big=SAR(10g) / small=SAR(1g)
*. Project file name-Measurement Group: 241024_15407883_bee-021_hac.d8sar- 241024-6,ble,2480m,front

Plot D2: Front & touch, BR(DH5), 2480 MHz

EUT: Game Controller ; Model: BEE-021; Serial:HHL04000006178
Mode: BR (DH5) CW (UID: 0 (CW)) ; Frequency: 2480 MHz ; Test Distance: 0.00 mm
TSL parameters used: Head(v6) ; f= 2480 MHz; Conductivity: 1.889 S/m; Permittivity: 39.63

DASY8 Configuration: - Electronics: DAE4 - SN626 (Calibrated: 2024-01-09) / - Phantom: ELI V8.0 (20deg probe tilt) ; Serial: 2161 ; Phantom section: Flat
- Probe: EX3DV4 - SN3907(Calibrated: 2024-01-15); ConvF: (6.83, 7.07, 6.68) @ 2480 MHz/ - Software: 16.4.0.5005 (Measurement); 16.4.0.5005 (Evaluation)

Scan Setup				Measurement Results		
Setup items	Fast	Area	Zoom	Meas. Items	Area	**Zoom**
Grid Extents [mm]	180.0x140.0	80.0×60.0	30.0×30.0×30.0	psSAR 1g [W/kg]	0.016	**0.015**
Grid Steps [mm]	10.0x10.0	10.0×10.0	5.0×5.0×1.5	psSAR 10g [W/kg]	0.009	**0.008**
Sensor Distance [mm]	4.0	3.0	1.4	Power Drift [dB]	0.01	-0.18
Graded Grid	N/A	N/A	Yes	pSAR (extrapolated) [W/kg]	N/A	0.063
Grading Ratio	N/A	N/A	1.5	Power Scaling	Disabled	Disabled
MAIA monitored	N/A	Y	Y	TSL Correction	No correction	No correction
Surface Detection	VMS + 6p	VMS + 6p	All points	M2/M1 [%]	N/A	79.5
Scan Method	Measured	Measured	Measured	Dist 3dB Peak [mm]	N/A	13.5
Grid Effective [mm]	N/A	80.0×60.0	30.0×30.0×31.2	SAR1g Position (x,y,z)	N/A	9.3,-29.1,-171.8



Remarks: *. Order No.: 15407883; Date tested:2024-10-24 ; Tested by: A. Oda; Tested location: UL Japan, Shonan EMC Lab. No.7 shielded room
*. Liquid temperature: 22.5 deg.C. ± 0.5 deg.C. (22.5 deg.C., in check); Ambient: 23 deg.C. / 63 %RH; *. Red cubic: big=SAR(10g) / small=SAR(1g)
*. Project file name-Measurement Group: 241024_15407883_bee-021_hac.d8sar- 241024-3,br,2480m,front

APPENDIX 3: Test instruments

Appendix 3-1: Equipment used

Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Interval (Month)
AT	191844	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2024/08/10	12
AT	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2024/09/11	12
AT	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2024/09/11	12
AT	236500	Attenuator	To-Conne Co., Ltd.	SA-PJ-10	-	2023/12/04	12
AT	245174	Coaxial Cable	Hayashi-Repic co., Ltd.	KMS020B-GL140sE-KMS020B-2.0m	49334-01-01	2024/02/14	12
AT	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2024/03/25	12

*. AT was measured 2024-10-09. (Refer to Section 5 in this report.)

Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Interval (Month)
SAR	224031	DASY8 Module SAR/APD soft	Schmid & Partner Engineering AG	ver.16.4.5005	9-2506F07D	-	-
SAR	144886	Dielectric assessment kit soft	Schmid & Partner Engineering AG	DAK ver.3.0.6.14	9-0EE103A4	-	-
SAR	224020	DASY8 PC	Hewlett Packard	HP Z4 G4 Workstation	CZC1198G21	-	-
SAR	225155	Mounting Platform	Schmid & Partner Engineering AG	MP8E-TX2-60L Basic	-	-	-
SAR	224032	6-axis Robot	Schmid & Partner Engineering AG	TX2-60L spe	F/22/0033789/A/001	2024/08/05	12
SAR	224023	Robot Controller	Schmid & Partner Engineering AG	CS9spe-TX2-60	F/22/0033789/C/001	-	-
SAR	224025	Measurement Server	Schmid & Partner Engineering AG	DASY8 Measurement Server	10042	2024/06/04	12
SAR	224026	Electro-Optical Converter	Schmid & Partner Engineering AG	EOC8-60	1027	-	-
SAR	224027	Light Beam Unit	Schmid & Partner Engineering AG	LIGHTBEAM-85	2069	-	-
SAR	227155	SP2 Manual Control Pendant	Schmid & Partner Engineering AG	D21144507 C	22066839	-	-
SAR	144944	Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE4	626	2024/01/09	12
SAR	146235	Dosimetric E-Field Probe	Schmid & Partner Engineering AG	EX3DV4	3907	2024/01/15	12
SAR	224034	Flat Phantom	Schmid & Partner Engineering AG	ELI V8.0	2161	2024/08/05	12
SAR	145596	Device holder	Schmid & Partner Engineering AG	Mounting device for transmitter	-	2024/08/05	12
SAR	224028	Modulation & Audio Interference Analyzer	Schmid & Partner Engineering AG	MAIA	1582	-	-
SAR	145090	Dipole Antenna (2.45 GHz)	Schmid & Partner Engineering AG	D2450V2	822	2024/01/05	12
SAR	230872	RF Power Source	Schmid & Partner Engineering AG	POWERSOURCE1	4300	2024/01/03	12
SAR	145500	Dielectric probe	Schmid & Partner Engineering AG	DAK3.5	1129	2024/01/16	12
SAR	146258	Network Analyzer	Keysight Technologies Inc	8753ES	US39171777	2024/10/10	12
SAR	145106	Ruler(150mm,L)	SHINWA	12103	-	2024/02/26	12
SAR	145086	Ruler(300mm)	SHINWA	13134	-	2024/02/26	12
SAR	145087	Ruler(100x50mm,L)	SHINWA	12101	-	2024/02/26	12
SAR	150560	Ruler(150mm)	SHINWA	14001	-	2024/02/26	12
SAR	144986	Thermo-Hygrometer data logger	SATO KEIRYOKI	SK-L200THIIα/SK-LTHIIα-2	015246/08169	2024/08/10	12
SAR	201967	Digital thermometer	HANNA	Checktemp-4	A01440226111	2024/08/10	12
SAR	201968	Digital thermometer	HANNA	Checktemp-4	A01310946111	2024/08/10	12
SAR	191844	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2024/08/10	12
SAR	146176	Spectrum Analyzer	ADVANTEST	R3272	101100994	-	-
SAR	146185	DI water	MonotaRo	34557433	-	-	-
SAR	146112	Primepure Ethanol	Kanto Chemical Co., Inc.	14032-79	-	-	-
SAR	207714	Head Tissue Simulating Liquid	Schmid & Partner Engineering AG	HBBL600-10000V6	SL AAH U16 BC	-	-

*. SAR test was performed 2024-10-24.

The expiration date of calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chain of calibrations.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.
*. Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

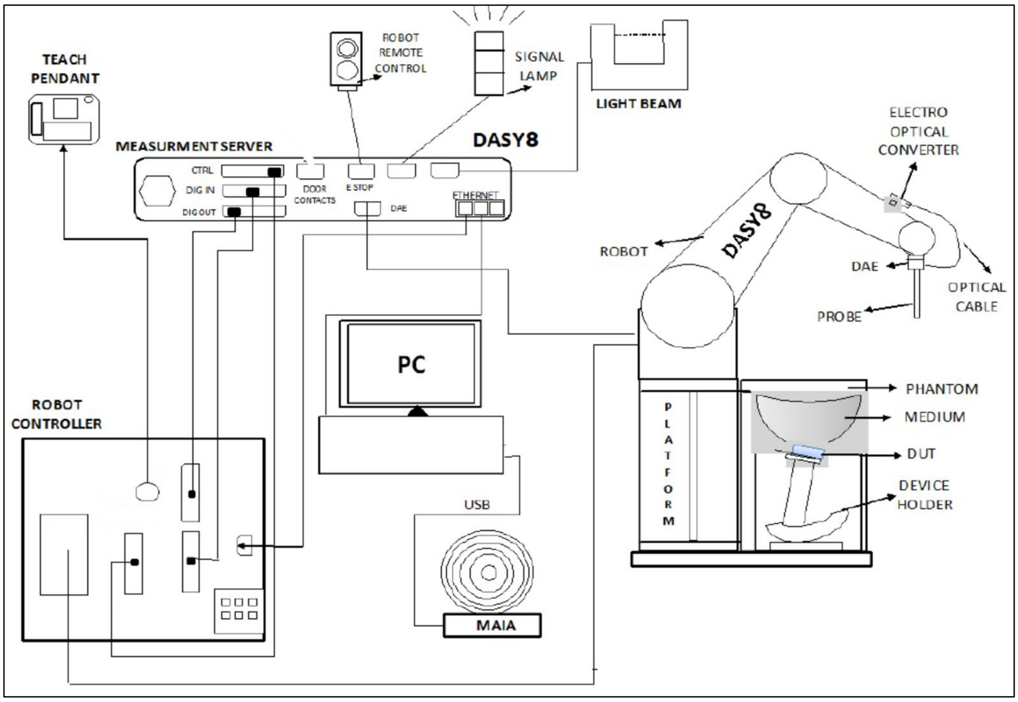
[Test Item] AT: Antenna terminal conducted power, SAR: Specific Absorption Rate

*. LIMS ID: 146112, the parameters of primepure Ethanol (as reference liquid) used for the simulated tissue parameter confirmation was defined the NPL Report MAT23 (http://www.npl.co.uk/content/conpublication/4295)

Appendix 3-2: Measurement System

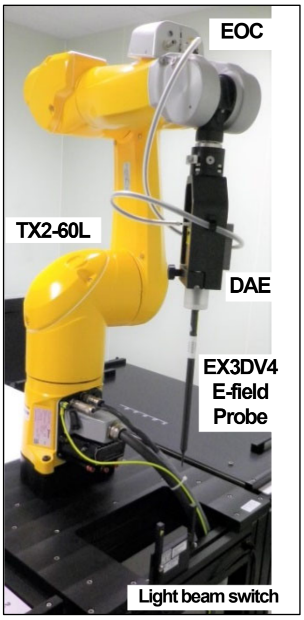
Appendix 3-2-1: SAR Measurement System

These measurements were performed with the automated near-field scanning system DASY8 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot), which positions the probes with a positional repeatability of better than ± 0.03 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetry probes EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.



The DASY8 SAR/APD system for performing compliance tests consist of the following items:

- 6-axis robotic arm (Stäubli TX2-60L) for positioning the probe
- Mounting Platform for keeping the phantoms at a fixed location relative to the robot
- Measurement Server for handling all time-critical tasks, such as measurement data acquisition and supervision of safety features
- EOC (Electrical to Optical Converter) for converting the optical signal from the DAE to electrical before being transmitted to the measurement server
- LB (Light-Beam unit) for probe alignment (measurement of the exact probe length and eccentricity)
- SAR probe (EX3DV4 probes) for measuring the E-field distribution in the phantom. The SAR distribution and the psSAR (peak spatial averaged SAR) are derived from the E-field measurement.
- SAR phantom that represents a physical model with an equivalent human anatomy. A Specific Anthropomorphic Mannequin (SAM) head is usually used for handheld devices, and a Flat phantom is used for body-worn devices.
- TSL (Tissue Simulating Liquid) representing the dielectric properties of used tissue, e.g. Head Simulating Liquid, HSL.
- DAE (Data Acquisition Electronics) for reading the probe voltages and transmitting it to the DASY8 PC.
- Device Holder for positioning the DUT beneath the phantom.
- MAIA (Modulation and Interference Analyzer) for confirming the accuracy of the probe linearization parameters
- Operator PC for running the DASY8 software to define/execute the measurements
- System validation kits for system check/validation purposes.



Platforms

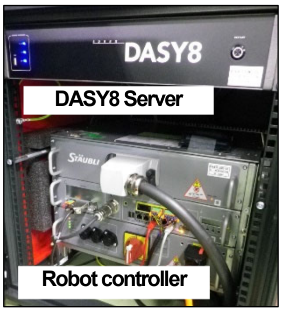
The platform is a multi-phantom support structure made of a wood and epoxy composite (ε = 3.3 and loss tangent δ < 0.07). It is a strong and rigid structure transparent to electric and magnetic fields (nonmetallic components).

TX2-60L robot, CS9 robot controller

•Number of Axes : 6 •Repeatability : ± 0.03 mm •Manufacture : Stäubli

DASY8 Measurement server

The DASY8 Measurement Server handles all time critical tasks such as acquisition of measurement data, detection of phantom surface, control of robot movements, supervision of safety features.
•Manufacture : Schmid & Partner Engineering AG



Data Acquisition Electronic (DAE)

The DAE is used to acquire the probe sensor voltages and transfer them to the DASY8 Measurement Server, and to report mechanical surface detection and probe collisions. The 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 with a control logic unit. Transmission to the DASY8 Measurement Server is accomplished through an optical downlink for data and status information and an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts used for mechanical surface detection and probe collision detection.
•Measurement Range : 1 µV to > 200 mV (2 range settings: 4 mV (low), 400 mV (high))
•Input Offset voltage : < 1 µV (with auto zero) •Input Resistance : 200 MΩ
•Battery operation : > 10 hrs. (with two rechargeable 9 V battery)
•Manufacture : Schmid & Partner Engineering AG

Electro-Optical Converter (EOC8-TX2-60L)

The Electrical to Optical Converter (EOC8) supports as data exchange between the DAE and the measurement server (optical connector) and data acquisition based on Ethernet protocol.
•Manufacture : Schmid & Partner Engineering AG

Light Beam Switch

The light beam unit allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm, as well as the probe length and the horizontal probe offset, are measured. The software then corrects all movements within the measurement jobs, such that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.
•Manufacture : Schmid & Partner Engineering AG

SAR measurement software

•Software version : Refer to Appendix 3-1 (Equipment used) •Manufacture : Schmid & Partner Engineering AG

E-Field Probe

•Model : EX3DV4 •Frequency : 4 MHz to 10 GHz, Linearity: ±0.2 dB (30 MHz to 10 GHz)
•Construction : Symmetrical design with triangular core, Built-in shielding against static charges, PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
•CF : Refer to calibration data of Appendix. (CF: Conversion Factors)
•Directivity : ± 0.1 dB in TSL (rotation around probe axis) / ± 0.3 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)
•Dimension : Overall length: 330 mm (Tip: 20 mm) / Tip diameter: 2.5 mm (Body: 12 mm)
Typical distance from probe tip to dipole centers: 1mm
•Application : High precision dosimetric measurement in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.
•Manufacture : Schmid & Partner Engineering AG

ELI Phantom

The ELI phantom is used for compliance testing of handheld and body-mounted wireless devices in the frequency range of 4 MHz to 10 GHz. ELI is fully compatible with the IEC/IEEE 62209-1528 standard and all known tissue simulating liquids.
ELI V8.0 phantom shell has optimized pretension in the bottom surface during production, such that the phantom is more robust and with reduced sagging.
•Model Number : ELI V8.0 flat phantom •Shell Material : Vinyl ester, fiberglass reinforced (VE-GF)
•Shell Thickness : 2.0 ± 0.2 mm (bottom plate) •Dimensions : 600 mm × 400 mm (oval) (volume: Approx. 30 liters)
•Manufacture : Schmid & Partner Engineering AG

Device Holder, Laptop holder, support material

Accurate device positioning is crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards. The device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

☒ Device holder: In combination with the ELI phantom, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Transmitter devices can be easily and accurately positioned. The low-loss dielectric urethane foam was used for the mounting section of device holder.
•Material : Polyoxymethylene (POM) •Manufacture: Schmid & Partner Engineering AG
☐ Laptop holder: A simple but effective and easy-to-use extension for the Mounting Device; facilitates testing of larger devices (e.g., laptops, cameras, etc.) according to IEC/IEEE 62209-1528.
•Material : Polyoxymethylene (POM), PET-G, Foam •Manufacture: Schmid & Partner Engineering AG
☒ Support form: Urethane foam

Data storage and evaluation (post processing)

The uplink signal transmitted by the DUT is measured inside the TSL by the probe, which is accurately positioned at a precisely known distance and with a normal orientation with respect to the phantom surface. The dipole / loop sensors at the probe tips pick up the signal and generate a voltage, which is measured by the voltmeter inside the DAE. The DAE returns digital values, which are converted to an optical signal and transmitted via the EOC to the measurement server. The data is finally transferred to the DASY8 software for further post processing. In addition, the DASY8 software periodically requests a measurement with short-circuited inputs from the DAE to compensate the amplifier offset and drift. This procedure is called DAE zeroing.
The operator has access to the following low level measurement settings:
• the integration time is the voltage acquisition time at each measurement point. It is typically 0.5 s.
• the zeroing period indicates how often the DAE zeroing is performed.
In parallel, the MAIA measures the characteristics of the uplink signal via the air interface and sends this information to the DASY8 software, which compares them to the communication system defined by the operator. A warning is issued if any difference is detected.

The measurement data is now acquired and can be post processed to compute the psSAR1g /8g /10g.
The measured voltages are not directly proportional to SAR and must be linearized. The formulas below are based on [1] (*1).
The measured voltage is first linearized using the (a, b, c, d) set of parameters specific to the communication system and sensor:

$$V_{compi} = U_i + U_i^2 \cdot \frac{10^{\frac{d}{10}}}{d_{cp_i}}$$

with	V_{compi}	= compensated voltage of channel i (μV)	(i = x,y,z)
	U_i	= input voltage of channel i (μV)	(i = x,y,z)
	d	= PMR factor d (dB)	(Probe parameter)
	dcp_i	= diode compression point of channel i (μV)	(Probe parameter, i = x,y,z)

$$V_{compi_{dB\sqrt{\mu V}}} = 10 \cdot \log_{10}(V_{compi})$$

$$corr_i = a_i \cdot e^{-\left(\frac{b_i - 10\log_{10}(V_{compi})}{c_i}\right)^2}$$

with	$corr_i$	= correction factor of channel i (dB)	(i = x,y,z)
	$Vcompi_{dB\sqrt{\mu V}}$	= compensated voltage of channel i (dB$\sqrt{\mu V}$)	(i = x,y,z)
	a_i	= PMR factor a of channel *i* (dB)	(Probe parameter, i = x,y,z)
	b_i	= PMR factor b of channel *i* (dB$\sqrt{\mu V}$)	(Probe parameter, i = x,y,z)
	c_i	= PMR factor c of channel *i* (-)	(Probe parameter, i = x,y,z)

The voltage $V_{i\,dB\sqrt{\mu V}}$ is the linearized voltage in dB$\sqrt{\mu V}$):

$$V_{i_{dB\sqrt{\mu V}}} = V_{compi_{dB\sqrt{\mu V}}} - corr_i$$

with	$V_{i\,dB\sqrt{\mu V}}$	= linearized voltage of channel i (dB$\sqrt{\mu V}$)	(i = x,y,z)
	$Vcompi_{dB\sqrt{\mu V}}$	= compensated voltage of channel i (dB$\sqrt{\mu V}$)	(i = x,y,z)
	$Corr_i$	= PMR factor a of channel *i* (dB)	(i = x,y,z)

Finally, the linearized voltage is converted in μV :

$$V_i = 10^{\frac{V_{i_{dB\sqrt{\mu V}}}}{10}}$$

with	V_i	= linearized voltage of channel i (μV)	(i = x,y,z)
	$Vcompi_{dB\sqrt{\mu V}}$	= linearized voltage of channel i (dB$\sqrt{\mu V}$)	(i = x,y,z)

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

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

with	V_i	= linearized voltage of channel i in μV	(i = x,y,z)
	$Norm_i$	= sensor sensitivity of channel i in μV/(V/m)2 for E-field Probes	(i = x,y,z)
	$ConvF$	= sensitivity enhancement in solution	
	E_i	= electric field strength of channel i in V/m	(i = x,y,z)

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

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

The E-field data value is used to calculate SAR :

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with	SAR	= local specific absorption rate in mW/g
	Etot	= total field strength in V/m
	σ	= conductivity in [Ω/m] or [S/m]
	ρ	= equivalent tissue density in g/cm3

Note: The resulting linearized voltage is only approximated because the probe UID is used 0 (CW) for the test signal in this test report.

(*1) [1] Jagadish Nadakuduti, Sven Kuehn, Marcel Fehr, Mark Douglas Katja Pokovic and Niels Kuster, “The Effect of Diode Response of electromagnetic Field Probes for the Measurements of Complex Signals.” IEEE Transactions on Electromagnetic Compatibility, vol. 54, pp. 1195–1204, Dec. 2012.

Appendix 3-2-2: SAR system check results

*. Prior to the SAR assessment of EUT, the Daily check was performed to test whether the SAR system was operating within its target of ±10%. The Daily check results are in the table below.

Liquid type:	Head	ΔSAR		P.in	SAR (1g) [W/kg] (*b)							SAR (10g) [W/kg] (*b)							Dev.
Date	Freq.	1g	10g		Meas.	1W	Target (*c)		Dev.[%]		Pass	Meas.	1W	Target (*c)		Dev.[%]		Pass	limit
	[MHz]	[%]	[%]	[dBm]	(*a)	scaled	CAL.	STD	CAL.	STD	?	(*a)	scaled	CAL.	STD	Cal.	STD	?	[%]
2024-10-24	2450	1.4	0.7	17.01	2.69	52.8	53.4	52.4	-1.1	0.8	Pass	1.26	24.9	25	24	-0.4	3.7	Pass	±10

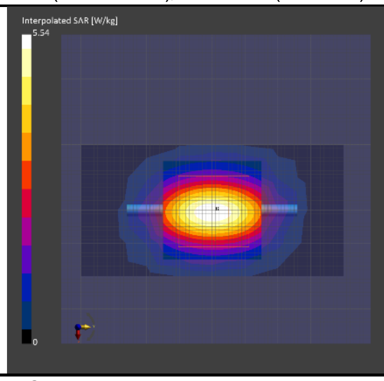
*. Freq.: Frequency, Meas.: Measurement, CAL.: Value of Calibration, STD: Value of Standard, Dev. Deviation.
*a. (2.45 GHz) The Measured SAR/ value is obtained at 17 dBm (50 mW) setting of POWERSOURCE1 (LIMS ID#230872, S/N: 4300) calibrated by Schmid & Partner Engineering AG, the data sheet was filed in this report.
*b. The measured SAR value of Daily check was compensated for tissue dielectric deviations (ΔSAR) and scaled to 1W of output power in order to compare with the manufacture's calibration target value which was normalized.
ΔSAR corrected SAR (1g) (W/kg) = (Measured SAR(1g) (W/kg)) × (100 - (ΔSAR1g(%)) / 100
ΔSAR corrected SAR (10g) (W/kg) = (Measured SAR(10g) (W/kg)) × (100 - (ΔSAR10g(%)) / 100
*c. The target value is a parameter defined in the calibration data sheet of D2450V2 (sn:822) dipole, calibrated by Schmid & Partner Engineering AG, the data sheet was filed in this report.
*d. The target value (normalized to 1W) is defined in IEEE Std.1528.

Appendix 3-2-3: SAR system check measurement data

Photographs of Liquid depth
150 mm (Head, 2024-10-24)

Dipole: D2450V2-822_2401 ; Mode: CW(0) ; Frequency: 2450 MHz ; Test Distance: 10 mm (dipole to liquid); Power setting: 17.0 dBm
TSL parameters used: Head(v6) ; f= 2450 MHz; Conductivity: 1.863 S/m; Permittivity: 39.68
DASY8 Configuration: - Electronics: DAE4 - SN626(Calibrated:2024-01-09)/ - Phantom: ELI V8.0 (20deg probe tilt) ; Serial: 2161 ; Phantom section: Flat
- Probe: EX3DV4 - SN3907(Calibrated: 2024-01-15); ConvF: (6.83, 7.07, 6.68) @2450 MHz/ - Software: 16.4.0.5005 (Measurement); 16.4.0.5005 (Evaluation)

Scan Setup				Measurement Results		
Setup Items	Fast	Area	Zoom	Meas. Items	Area	Zoom
Grid Extents [mm]	40.0x80.0	40.0×80.0	30.0×30.0×30.0	psSAR1g [W/kg]	2.69	**2.69**
Grid Steps [mm]	10.0x10.0	10.0×10.0	5.0×5.0×1.5	psSAR10g [W/kg]	1.25	**1.26**
Sensor Distance [mm]	4.0	3.0	1.4	Power Drift [dB]	-0.00	0.01
Graded Grid	N/A	N/A	Yes	pSAR (extrapolated) [W/kg]	N/A	5.54
Grading Ratio	N/A	N/A	1.5	Power Scaling	Disabled	Disabled
MAIA monitored	N/A	Y	Y	TSL Correction	No correction	No correction
Surface Detection	VMS + 6p	All points	All points	M2/M1 [%]	N/A	80.1
Scan Method	Measured	Measured	Measured	Dist 3dB Peak [mm]	N/A	9.1
Grid Effective [mm]	N/A	40.0×80.0	30.0×30.0×31.2	psSAR8g [W/kg]	1.38	1.39
				PD 1 cm^2-sq. [W/m^2]	N/A	N/A
				PD 4 cm^2-sq. [W/m^2]	N/A	N/A



Remarks: *. Order No.: ;*. Date tested:2024-10-24 ; Tested by: A. Oda; Tested location: UL Japan, Shonan EMC Lab. No.7 shielded room
*. Liquid temperature: 22.2 deg.C. ± 0.5 deg.C. (22.2 deg.C., in check); Ambient: 22 deg.C. / 71 %RH; *. Red cubic: big=SAR(10g) / small=SAR(1g)
*. Project file name-Measurement Group: 241024_15407883_bee-021_hac.d8sar- SPC Measurement Group

Appendix 3-3: Measurement Uncertainty

Uncertainty of SAR measurement (2.4GHz~6GHz) (*. liquid: head(v6), DAK, WLAN)							SAR 1g	SAR 10g
Symbol	Error Description	Unc. [%]	Probablity distribution	Divisor	ci 1g	ci 10g	ui 1g [%]	ui 10g [%]
-	**Measurement system (DASY8)**							
CF	Probe Calibration (EX3DV4) (*.HSL:10%)	± 14.0	Normal	2	1	1	± 7.0	± 7.0
CFdfift	Probe Calibration Drift	± 1.7	Rectangular	√3	1	1	± 1.0	± 1.0
LIN	Probe Linearity	± 4.7	Rectangular	√3	1	1	± 2.7	± 2.7
BBS	Broadband Signal	± 2.6	Rectangular	√3	1	1	± 1.5	± 1.5
ISO	Probe Isotropy	± 7.6	Rectangular	√3	1	1	± 4.4	± 4.4
DAE	Data Acquisition	± 1.2	Normal	1	1	1	± 1.2	± 1.2
AMB	RF Ambient (noise&refrection) (< 12 W/g)	± 1.0	Normal	1	1	1	± 1.0	± 1.0
Δsys	Probe Positioning	± 0.5	Normal	1	0.29	0.29	± 0.2	± 0.2
DAT	Data Processing	± 4.0	Rectangular	√3	1	1	± 2.3	± 2.3
-	**Phantom and Device Error**							
LIQ(σ)	Conductivity (measured) (DAK)	± 5.0	Normal	2	0.78	0.71	± 2.0	± 1.8
LIQ(Tσ)	Conductivit (temp.)(1℃,v6-head)	± 2.4	Rectangular	√3	0.78	0.71	± 1.1	± 1.0
EPS	Phantom Permittivity	± 14.0	Rectangular	√3	0.25	0.25	± 2.0	± 2.0
DIS	Distance EUT-TSL (liq.-ant:5mm)	± 2.7	Normal	1	2	2	± 5.4	± 5.4
Dxyz	Test Sample positioning	± 1.8	Normal	1	1	1	± 1.8	± 1.8
H	Device holder uncertainty	± 3.6	Normal	1	1	1	± 3.6	± 3.6
MOD	EUT Modulation	± 2.4	Normal	√3	1	1	± 1.4	± 1.4
TAS	Time-average SAR	± 0.0	Rectangular	√3	1	1	± 0.0	± 0.0
RFdfift	Drift of output power (measured, <0.2 dB)	± 4.7	Normal	2	1	1	± 2.4	± 2.4
-	**Correction to the SAR results**							
C(e,σ)	Deviation to Target (e',σ:10 %, IEC head)	± 1.9	Normal	1	1	0.84	± 1.9	± 1.6
C(R)	SAR Scaling	± 0.0	Rectangular	√3	1	1	± 0.0	± 0.0
u(ΔSAR)	**Combined standard uncertainty**					RSS	**± 12.3**	**± 12.3**
U	**Expand uncertainty (95% confidence interval)** (v11r06)					k=2	**± 24.6**	**± 24.6**

*. This uncertainty budget is suggested by IEC/IEEE 62209-1528 and determined by SPEAG, DASY8 Module SAR Manual, 2024-05 (Chapter 6.3, DASY8 Uncertainty Budget for Hand-held/Body-worn Devices, Frequency band: 300 MHz - 3 GHz range and 3 GHz - 6 GHz range). All listed error components have veff equal to ∞.

Uncertainty of SAR daily check (2.4GHz~6GHz) (*. liquid: head(v6), DAK, CW)							SAR 1g	SAR 10g
Symbol	Error Description	Unc. [%]	Probablity distribution	Divisor	ci 1g	ci 10g	ui 1g [%]	ui 10g [%]
-	**Measurement system (DASY8)**							
CF	Probe Calibration (EX3DV4) (*.HSL:10%)	± 14.0	Normal	2	1	1	± 7.00	± 7.00
CFdfift	Probe Calibrationr Drift	± 1.7	Rectangular	√3	1	1	± 1.0	± 1.0
LIN	Probe Linearity	± 4.7	Rectangular	√3	1	1	± 2.7	± 2.7
ISO	Probe Isotropy	± 4.7	Rectangular	√3	1	1	± 2.7	± 2.7
DAE	Data Acquisition	± 1.2	Normal	1	1	1	± 1.2	± 1.2
AMB	RF Ambient (noise&refrection) (< 12 W/g)	± 1.0	Normal	1	1	1	± 1.0	± 1.0
Δsys	Probe Positioning	± 0.5	Normal	1	0.29	0.29	± 0.2	± 0.2
DAT	Data Processing	± 4.0	Rectangular	√3	1	1	± 2.3	± 2.3
-	**Phantom and Device Error**							
LIQ(σ)	Conductivity (measured) (DAK)	± 5.0	Normal	2	0.78	0.71	± 2.0	± 1.8
LIQ(Tσ)	Conductivit (temp.)(1℃,v6-head)	± 2.4	Rectangular	√3	0.78	0.71	± 1.1	± 1.0
EPS	Phantom Permittivity	± 14.0	Rectangular	√3	0.25	0.25	± 2.0	± 2.0
VAL	Validation antenna uncertainty	± 5.5	Rectangular	√3	1	1	± 3.2	± 3.2
Pin	Uncertainty in accpted power	± 2.5	Normal	2	1	1	± 1.3	± 1.3
DIS	Distance EUT-TSL (VAL) (liq.-ant:10mm)	± 2.0	Normal	1	2	2	± 4.0	± 4.0
Dxyz	Test Sample (dipole) positioning	± 1.0	Normal	1	1	1	± 1.0	± 1.0
RFdfift	Drift of output power (measured, <0.1dB)	± 2.3	Rectangular	√3	1	1	± 1.3	± 1.3
-	**Correction to the SAR results**							
C(e,σ)	Deviation to Target (e',σ:10 %, IEC head)	± 1.9	Normal	1	1	0.84	± 1.9	± 1.6
u(ΔSAR)	**Combined standard uncertainty**					RSS	**± 10.8**	**± 10.7**
U	**Expand uncertainty (95% confidence interval)** (v11r06)					k=2	**± 21.6**	**± 21.4**

*. This uncertainty budget is suggested by IEC/IEEE 62209-1528 and determined by SPEAG, DASY8 Module SAR Manual, 2024-05 (Chapter 6.2, DASY8 Uncertainty Budget for System Verification, Frequency band: 300 MHz - 6 GHz range). All listed error components have veff equal to ∞.

*. Table of uncertainties are listed for ISO/IEC 17025.

*. Although this standard determines only the limit value of uncertainty, there is no applicable rule of uncertainty in this. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

Appendix 3-4: Calibration certificates

LIMS ID	Description	Type/Model	Serial Number	Manufacture	Calibration Certificate	Note
146235	Dosimetric E-Field Probe	EX3DV4	3907	SPEAG		-
145090	Dipole Antenna (2.45 GHz)	D2450V2	822	SPEAG		*1
230872	RF Power Source	POWERSORCE1	4300	SPEAG		-

*1: As stated on page 2 of the certificate, the calibration was performed in accordance with the latest standard IEC/IEEE 62209-1528. Therefore, the reported SAR values are valid for any system that complies with IEC/IEEE 62209-1528 including all new versions of DASY such as DASY6 and DASY8.

-End of report-