SAR TEST REPORT

Test Report No. 14121389S-A-R1

Customer	**Canon Inc.**
Description of EUT	**Wireless LAN/Bluetooth Combo Module**
Model Number of EUT	**ES204**
FCC ID	**AZD241**
Test Regulation	**FCC 47CFR Part 2 (2.1093)**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**August 23, 2022**
Remarks	This SAR tested report is evaluation for 4th host platform of ES204. The past host platforms SAR results refer to section 3.1 in this report.

Representative Test Engineer	**Approved By**
Hiroshi Naka Engineer	Toyokazu Imamura Leader

CERTIFICATE 1266.03

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☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 14121389S-A

This report is a revised version of 14121389S-A. 14121389S-A is replaced with this report.

<table>
<tr><th>Revision</th><th>Test Report No.</th><th>Date</th><th>Page Revised Contents</th></tr>
<tr><td>- (Original)</td><td>14121389S-A</td><td>March 22, 2022</td><td>-</td></tr>
<tr><td>-R1</td><td>14121389S-A-R1</td><td>August 23, 2022</td><td>(p5, 2.1) Updated of "Rating" of host platform as "DC 7.2 V (Battery), DC 8.0 V (AC adaptor), DC 9.0 V (USB)."
(p5, 2.2) Corrected the mistake in table. (U-NII-2A (5.3 GHz band))
(p5, 2.2) The antenna gain when built into the host platform was added for reference. "*. (Reference purpose only) Antenna gain with the host platform: DS126861 enclosure: -2.9 dBi (@2480 MHz), -1.5 dBi (@5350 MHz)."
(p8, 3.6) Added comment for Step 4 Zoom Scan (3dB check of Δx, Δy).
"For 5 GHz band, SEMCAD Plot shows 4 mm, but the 3 dB point was tested at a distance greater than 4 mm in horizontally (which is step size of Δx, Δy)."
"For 2.4 GHz band, SEMCAD Plot shows 5 mm, but the 3 dB point was tested at a distance greater than 5 mm in horizontally (which is step size of Δx, Δy)."
(p10, 4.2) Replaced the antenna separation distance of bottom to aprox. 90mm from approx..98 mm.
(p10, 4.2) Corrected the mistake in table of exemption limit. (separation distance, setup name)
<table><tr><td>>50 mm
(55 mm)</td><td>>50 mm
(98 mm)</td></tr><tr><td>Rear</td><td>Right, Bottom</td></tr><tr><td>SAR1g</td><td>SAR1g</td></tr><tr><td>Exempt, >100mW</td><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td><td>Exempt, >100mW</td></tr></table>-><table><tr><td>>50 mm</td></tr><tr><td>Rear, Right, Bottom</td></tr><tr><td>SAR1g</td></tr><tr><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td></tr><tr><td>Exempt, >100mW</td></tr></table>(new)
(p10) Corrected ERP calculation formula and calculated results in table. (was: "-2.54"->new: "-2.15")
(p10) Add asterisk comment of "Module-based antenna gains with maximum values were used conservatively."
(p11) Corrected the mistake of CH. (5700 MHz, 140CH (11a, 11n20-SiSO, 11ac20-SISO))
(p14, 6.2) Corrected the mistake of tested frequency of 2.4 GHz band. (2412 MHz, setup of top-front, top, rear)
(p14, 6.2) Corrected the mistake of CH.(116CH, 5580 MHz)
(p19) Corrected the mistake of setup name. (Front-front->Top-front)</td></tr>
</table>

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Reference : Abbreviations (Including words undescribed in this report) (radio_r0v09s02_211221)

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
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
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
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
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)
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
NS	No signal detect.
NSA	Normalized Site Attenuation
OBW	Occupied Band Width
OFDM	Orthogonal Frequency Division Multiplexing
P/M	Power meter
PCB	Printed Circuit Board
PER	Packet Error Rate
PHY	Physical Layer
PK	Peak
PN	Pseudo random Noise
PRBS	Pseudo-Random Bit Sequence
PSD	Power Spectral Density
QAM	Quadrature Amplitude Modulation
QP	Quasi-Peak
QPSK	Quadrature Phase Shift Keying
RBW	Resolution Band Width
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
RSS	Radio Standards Specifications
Rx	Receiving
SA, S/A	Spectrum Analyzer
SAR	Specific Absorption Rate
SISO	Single Input Single Output (Radio)
SG	Signal Generator
SPLSR	SAR to Peak Location Separation Ratio
SVSWR	Site-Voltage Standing Wave Ratio
T/R	Test Receiver
Tx	Transmitting
U-NII	Unlicensed National Information Infrastructure (Radio)
VBW	Video BandWidth
Vert.	Vertical
WLAN	Wireless LAN
Wi-Fi, WiFi	Wireless LAN, trademarked by Wi-Fi Alliance

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<u>Contents of appendixes</u>

SECTION 1: Customer information

Company Name	Canon Inc.
Address	30-2, Shimomaruko 3-chome, Ohta-ku, Tokyo 146-8501 Japan
Telephone Number	+81-3-5482-7283
Contact Person	Tomohiro Suzuki

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

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2, SECTION 4 and Appendix 1.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT and host platform

	EUT	Host platform
Type	Wireless LAN/Bluetooth Combo Module	Digital Camera
Model Number	ES204	DS126861
Serial Number	AT220107-B24	001019000134
Rating	DC 3.3 V supplied form the host platform.	DC 7.2 V (Battery), DC 8.0 V (AC adaptor), DC 9.0 V (USB)
Condition of sample	Engineering prototype (*1)	Engineering prototype (*1)
Receipt Date of sample	January 7, 2022 (for power measurement) (*. No modification by the Lab.) March 2, 2022 (for SAR test) (*. No modification by the Lab.)	
Test Date (SAR)	March 2 and 3, 2022	

*1. Not for sale: The sample is equivalent to mass-produced items.

2.2 Product Description

General

Feature of EUT	Model: ES204 (referred to as the EUT in this report) is a Wireless LAN/Bluetooth Combo Module which installs into the specified host platforms.
SAR Category Identified	Portable device (*. Since EUT may contact to a human body during Wi-Fi / Bluetooth operation, the partial-body SAR (1g) shall be observed.)
SAR Accessory	None (*. for the host platform)

Radio specification

Equipment type		Transceiver			
Frequency of operation		*. The operation frequency in each operation band refer to remarks in below.			
Channel spacing	Bluetooth	1 MHz (BR, EDR), 2 MHz (BT LE) (*.This platform only supports BT LE limited by the firmware.)			
	WLAN	5 MHz (2.4GHz band), 20 MHz (5GHz band)			
Bandwidth	Bluetooth	79 MHz			
	WLAN	20 MHz (11b, 11g, 11a, 11n20, 11ac20), 40 MHz (11n40, 11ac40), 80 MHz (11ac80)			
Type of modulation	Bluetooth	GFSK/FHSS (BR, BT LE), π/4-DQPSK / FHSS, 8DPSK / FHSS (EDR) (*.This platform only supports BT LE limited by the firmware.)			
	WLAN	DSSS: DBPSK, DQPSK, CCK (11b); OFDM: BPSK, QPSK, 16QAM, 64QAM, 256QAM (*.256QAM is only for ac80) (11g, 11a, 11 n20, 11ac20, 11n40, 11ac40, 11ac80)			
Typical and maximum transmit power		*. The specification of typical and maximum tune-up tolerance limit power (which may occur) refer to remarks in below table. *. The measured output power (conducted) as SAR reference power refers to section 5 in this report.			
Quantity of antenna		1 piece	Antenna type	Printed PCB	Antenna connector type	Antenna side: Soldered / Module side: MHF4
Antenna gain (peak)		2.98 dBi (2.4 GHz band), 4.94 dBi (5 GHz band) (*.module alone base, including cable loss) *. (Reference purpose only) Antenna gain with the host platform: DS126861 enclosure: -2.9 dBi (@2480 MHz), -1.5 dBi (@5350 MHz).			

*. Typical power and tune-up limit power (as "maximum power")

Tx Mode	Data rate, MCS Index	**Output power (Typical and maximum) [dBm]** (*. The measured output power (conducted) refers to section 5 in this report.)														
		2.4 GHz band			**U-NII-1** (5.2 GHz band)			**U-NII-2A** (5.3 GHz band)			**U-NII-2C** (5.6 GHz band)			**U-NII-3** (5.8 GHz band)		
		F [MHz]	Typical	Max.	F [MHz]	Typical	Max.	F [MHz]	Typical	Max.	F [MHz]	Typical	Max.	F [MHz]	Typical	Max.
BR	1Mbps	2402~2480	**N/A (*2)**		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EDR	(2~3) Mbps	2402~2480	**N/A (*2)**		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BT LE	PHY1, PHY2	2402~2480	3.0	**6.0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11b	(1~11) Mbps	2412~2462	8.0	**10.0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11g	(6~54) Mbps	2412~2462	8.0	**10.0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11a	(6~54)Mbps	N/A	N/A	N/A	5180~5240	8.0	**10.0**	5260~5320	8.0	**10.0**	5500~5580, 5660~5700	8.0	**10.0**	5745~5825	8.0	**10.0**
11n20	MCS0~7	2412~2462	7.0	**9.0**	5180~5240	7.0	**9.0**	5260~5320	7.0	**9.0**	5500~5580, 5660~5700	7.0	**9.0**	5745~5825	7.0	**9.0**
11ac20	MCS0~8	N/A	N/A	N/A	5180~5240	7.0	**9.0**	5260~5320	7.0	**9.0**	5500~5580, 5660~5700	7.0	**9.0**	5745~5825	7.0	**9.0**
11n40	MCS0~7	2422~2452	7.0	**9.0**	5190, 5230	7.0	**9.0**	5270, 5310	7.0	**9.0**	5510, 5550, 5670	7.0	**9.0**	5755, 5795	7.0	**9.0**
11ac40	MCS0~9	N/A	N/A	N/A	5190, 5230	7.0	**9.0**	5270, 5310	7.0	**9.0**	5510, 5550, 5670	7.0	**9.0**	5755, 5795	7.0	**9.0**
11ac80	MCS0~9	N/A	N/A	N/A	5210	7.0	**9.0**	5290	7.0	**9.0**	5530	7.0	**9.0**	5775	7.0	**9.0**

*. (mode) 11b: IEEE 802.11b, 11g: IEEE 802.11g, 11a: IEEE 802.11a, 11n20: IEEE 802.11n(20HT)-SISO, 11n40: IEEE 802.11n(40HT)-SISO, 11ac20: IEEE 802.11ac(20VHT)-SISO, 11ac40: IEEE 802.11n (40VHT)-SISO, 11ac80: IEEE 802.11ac(80VHT)-SISO.

*. F: Frequency; incl.: including; Max.: maximum; N/A: Not applicable.

*. The EUT do not use the special transmitting technique such as "beam-forming" and "time-space code diversity."

*. Maximum tune-up tolerance limit is conducted burst average power and is defined by a customer as Duty cycle 100% (continuous transmitting).

*. Wi-Fi and Bluetooth use same antenna. Therefore, simultaneously transmitted SAR was not considered for the WLAN 2.4 GHz band and Bluetooth. Simultaneously transmitted SAR was only considered for the WLAN 5 GHz band and Bluetooth.

*2. This host device only supports BT LE limited by the firmware.

SECTION 3: Maximum SAR value, test specification and procedures

3.1 Summary of Maximum SAR Value

Band	Max. power [dBm]	Summary of Highest Reported SAR [W/kg]	
		Partial-body (Separation 0 mm, Flat phantom)	Head (Separation 0 mm, SAM phantom)
		SAR (1g)	SAR (1g)
DTS, WLAN 2.4 GHz	10.0	**0.14**	**N/A**
U-NII-1, WLAN 5.2 GHz	10.0	**0.26**	**N/A**
U-NII-2A, WLAN 5.3 GHz	10.0	**0.35**	**N/A**
U-NII-2C, WLAN 5.6 GHz	10.0	**0.68 (0.677)**	**N/A**
U-NII-3, WLAN 5.8 GHz	10.0	**0.68 (0.676)**	**N/A**
DTS, Bluetooth	6.0	**< 0.10**	**N/A**
Simultaneous SAR (5 GHz WLAN + BT LE)		**0.72** (*1)	**N/A**
Criteria	Partial body (body): 1.6 W/kg (SAR (1g)) for general population/uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093).		
Test Procedure	SAR measurement: KDB 447498 D04, KDB 248227 D01, KDB 865664 D01, IEC Std. 1528, UL Japan's SAR Work Procedures No.13-EM-W0429 and 13-EM-W0430.		
Category	FCC 47CFR §2.1093 (Portable device)		
SAR type	Partial-Body (including "Front-of-face")		

*1. WLAN and Bluetooth use same antenna. Therefore, simultaneously transmitted SAR was not considered for the WLAN 2.4 GHz band and Bluetooth. Simultaneously transmitted SAR was only considered for the WLAN 5 GHz band and Bluetooth.
*. "yellow marker" in the table; the highest Reported SAR (1g) and SAR (10g) of each band (2.4 GHz, 5 GHz) are shaded with yellow marker.

Test outline: Where the EUT is built into this new platform, it was verified whether multi-platform conditions can be suited in according with clause 4.2.4 in KDB 447498 D04 (v01).

Consideration of the test results:	**The highest reported SAR of this host platform was kept; ≤ 0.8 W/kg (SAR(1g))** Since highest reported SAR (1g) on this EUT platforms obtained in accordance with KDB 447498 D04 (v01) was kept under 0.8 W/kg, this EUT was approved to operate "Specific set of Host Platforms."

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for partial body) specified in FCC 47 CFR part 2 (2.1093) and had been tested in accordance with the measurement methods and procedures specified in FCC KDB publications and IEEE 1528-2013.

3.1.1 History of maximum SAR value in different platforms - Informative (Reference purpose only)

*. The following information indicates a highest SAR number of the different host platforms in the past test. The SAR test results are not described in this report.
*. In the past, this module had installed into the following host platforms and tested with measured highest reported SAR (1g) with < 0.8 W/kg. (per KDB 447498 D01 (v06); multi-platform operation requirement).

		Highest Reported SAR [W/kg]		
Host platform # :		1	2	3
Host platform type :		Digital Camera	Digital Camera	Digital Cinema Camera
Host platform model number :		DS126836	DS126855	ID0156
Reference SAR test report :		13024973S-A (*2)	13651875S-A (*2)	13863703S-A (*2)
SAR test procedure :		KDB 248227 D01(v02r02), KDB 447498 D01(v06, KDB 865664 D01 (v01r04)	KDB 248227 D01(v02r02), KDB 447498 D01(v06, KDB 865664 D01 (v01r04)	KDB 248227 D01(v02r02), KDB 447498 D01(v06, KDB 865664 D01 (v01r04)
Band	Max.Power [dBm]	Body-worn (Separation 0 mm)	Body-worn (Separation 0 mm)	Body-worn (Separation 0 mm)
		SAR (1g)	SAR (1g)	SAR (1g)
WLAN 2.4 GHz	10.0	**0.25**	**0.17**	**0.17**
WLAN 5.2 GHz	10.0	**0.42**	**0.11**	**0.43**
WLAN 5.3 GHz	10.0	**0.33**	**0.15**	**0.25**
WLAN 5.6 GHz	10.0	**0.32**	**0.22**	**N/A** (*3)
WLAN 5.8 GHz	10.0	**0.25**	**0.12**	**N/A** (*3)
Bluetooth	6.0	**0.08**	**0.06**	**0.06** (*3)
Simultaneous SAR (SUM SAR)		**0.50** (*4)	**0.28** (*4)	**0.49** (*3, *4)
Criteria	Partial body (head & body): 1.6 W/kg (SAR (1g)) for general population/uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093).			

*2. SAR evaluation and report publishing was done by Shonan EMC Lab. UL Japan.
*3. This host platform (model: ID0156) is only supported WLAN 5.2 GHz/5.3 GHz band and BT LE(PHY1) which are limited by firmware.
*4. WLAN and Bluetooth use same antenna. Therefore, simultaneously transmitted SAR was not considered for the WLAN 2.4 GHz band and Bluetooth. Simultaneously transmitted SAR was only considered for the WLAN 5 GHz band and Bluetooth.

3.2 Test specification

The tests documented in this report were performed in accordance with the following standard: FCC 47 CFR Parts 2 (2.1093), IEEE Std.1528-2013, and the following FCC Published RF exposure KDB procedures:

FCC 47 CFR part 2 (2.1093)	Radiofrequency radiation exposure evaluation: portable devices
ANSI/IEEE C95.1-1992	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz
IEEE Std. 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
KDB 248227 D01	SAR Guidance for IEEE 802.11 (Wi-Fi) transmitters v02r02
KDB 447498 D04	Interim General RF Exposure Guidance v01
KDB 447498 D03	OET Bulletin 65, Supplement C Cross-Reference v01
KDB 865664 D01	SAR measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02	RF exposure compliance reporting and documentation considerations v01r02

In addition to the above, the following information was used:

TCB workshop, October 2016	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, April 2019	RF Exposure Procedure, 802.11ax SAR Testing
TCB workshop, October 2019	RF Exposure Procedure, Tissue Simulating Liquids (TSL) -Effective February 19, 2019, FCC has permitted the use of single head tissue simulating liquid specified in IEC 62209 for all SAR tests. -Mix and Match of traditional FCC SAR TSLs and IEC 62209 TSL in a single application is not permitted. -TSL can be changed in a Permissive Change. If SAR increases and original SAR > 1.2 W/kg, additional SAR tests will be required. -If FCC parameters are used, 5 % tolerance. If IEC parameters, 10 %.

3.3 Exposure limit

Environments of exposure limit	Whole-Body (averaged over the entire body)	Partial-Body (averaged over any 1g of tissue)	Hands, Wrists, Feet and Ankles (averaged over any 10g of tissue)
(A) Limits for Occupational /Controlled Exposure (W/kg)	0.4	8.0	20.0
(B) Limits for General population /Uncontrolled Exposure (W/kg)	0.08	1.6	4.0

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

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

General population / uncontrolled exposure, Partial-Body (averaged over any 1g of tissue) limit: 1.6 W/kg

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

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1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
Telephone number: +81 463 50 6400 / Facsimile number: +81 463 50 6401

*. 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 Normal SAR measurement procedure

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. The SAR test reference power measurement and the SAR test were proceeded with the lowest data rate (which has the higher time-based average power typically) on each operation mode. Therefore, the average output power was measured on the lower, middle (or near middle), upper and specified channels with the lowest data rate of each operation mode. The power of other data rate was also measured to confirm the time-base average power and when if it's required. The power measurement result is shown in Section 5.

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

Step 2: Power reference measurement

Measurement of the E-field at a fixed location above the central position of flat phantom (or/and furthermore an interpolated peak SAR location of area scan in step 2) was used as a reference value for assessing the power drop.

Step 3: Area Scan (Area scan parameters: KDB 865664 D01 (v01r04).)

The SAR distribution at the exposed side of head or body position was measured at a distance of each device from the inner surface of the shell. The area covered the entire dimension of the antenna of EUT and suitable horizontal grid spacing of EUT. Based on these data, the area of the maximum absorption was determined by splines interpolation.

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

Step 4: Zoom Scan and post-processing (Zoom scan parameters: KDB 865664 D01 (v01r04).)

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 volume of 30 mm (X) × 30 mm (Y) × 30 mm (Z) (or more) was assessed by measuring 7×7×7 points (or more), ≤ 3 GHz.

A volume of 28 mm (X) × 28 mm (Y) × 24mm (Z) (or more) was assessed by measuring 8×8×7 points (or more) (by "Ratio step" method (*1)), > 3 GHz.

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.
For 5 GHz band, SEMCAD Plot shows 4 mm, but the 3 dB point was tested at a distance greater than 4 mm in horizontally (which is step size of Δx, Δy).
For 2.4 GHz band, SEMCAD Plot shows 5 mm, but the 3 dB point was tested at a distance greater than 5 mm in horizontally (which is step size of Δx, Δy).

*. 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 ≤ 3 GHz	3 GHz < f ≤ 6 GHz
1	Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
2	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
3		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
4			$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5 ·$\Delta z_{Zoom}(n-1)$ mm	
5	Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
	* The asterisk table-footnote is per KDB Pub. 865664 D01 v01r04. NOTE For uniformity purposes the integer frequency increments of rows 1 to 3 and 5 apply, rather than the corresponding variable and fixed parameters given in IEC 62209-1:2016 and IEC 62209-2:2010/AMD1:2019.				

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 procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 2. It was checked that the power drift is within ±5% in the evaluation procedure of SAR testing. The verification of power drift during the SAR test is that DASY system calculates the power drift by measuring the e-filed at the same location at beginning and the end of the scan measurement for each test position. The result is shown in SAR plot data of APPENDIX 2.

*. DASY system calculation Power drift value[dB] =20log(Ea)/(Eb) (where, Before SAR testing: Eb[V/m] / After SAR testing: Ea[V/m])
Limit of power drift[W] = ±5%; Power drift limit (X) [dB] = 10log(P_drift)=10log(1.05/1) = 10log(1.05)-10log(1) = <u>0.21dB</u>
from E-filed relations with power; S=E×H=E^2/η=P/(4×π×r^2) (η: Space impedance) → P=(E^2×4×π×r^2)/η
Therefore, The correlation of power and the E-filed
Power drift limit (X) dB=10log(P_drift) = 10log(E_drift)^2=20log(E_drift)
From the above mentioned, **<u>the calculated power drift of DASY system must be the less than (±) 0.21 dB.</u>**

Step 6: Z-Scan

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

*. The all SAR tests were conservatively performed with test separation distance 0 mm. The phantom bottom thickness is approx. 2mm. Typical distance from probe tip to dipole centers is 1mm. The distance between the SAR probe tip to the surface of test device which is touched the bottom surface of the phantom is approx. 3 mm for 2.4GHz band and 2.4 mm for 5GHz band.

*1. "Ratio step" method parameters used; the first measurement point: "1.4mm" from the phantom surface, the initial z grid separation: "1.4mm", subsequent graded grid ratio: "1.4". These parameters comply with the requirement of KDB 865664 D01and recommended by Schmid & Partner Engineering AG (DASY5 manual).

SECTION 4: Operation of EUT during testing

4.1 Operating modes for SAR testing

The EUT has Bluetooth (BR, EDR, Low energy) and IEEE 802.11b/11g/11a/11n20-SISO/11n40-SISO/11ac20-SISO/11ac40-SISO/11ac80-SISO continuous transmitting modes. The frequency and the modulation used in the SAR testing are shown as a following.

Operation mode	**BR**	**EDR**	**BT LE**		**11b**	**11g**	**11n20**	**11n40**	**11a**	**11n20**	**11ac20**	**11n40**	**11ac40**	**11ac80**	**11a**	**11n20**	**11ac20**	**11n40**	**11ac40**	**11ac80**
band	Bluetooth				2.4GHz band				U-NII-1						U-NII-2A					
Tx band [MHz]	2402~2480				2412~2462			2422~2452	5180~5240			5190, 5230		5210	5260~5320			5270, 5310		5290
Bandwidth [MHz]	1	1	1		20	20	20	40	20	20	20	40	40	80	20	20	20	40	40	80
Max.power [dBm]	6	3	6		**10**	**10**	9	9	**10**	9	9	9	9	9	10	9	9	9	9	9
Modulation	FHSS	FHSS	FHSS		DSSS	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM
D/R [Mbps]	1	2~3	1	2	1	6	MCS0	MCS0	6	MCS0	MCS0	MCS0	MCS0	MCS0	6	MCS0	MCS0	MCS0	MCS0	MCS0
Frequency tested [MHz]	Not supported.		2402 (*1)	n/a (*1)	2412, 2437, 2462	2412 (*2)	n/a (*2)	n/a (*2)	5180, 5220, 5240 (*3)	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)	5260, 5300, 5320	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)

Operation mode	**11a**	**11n20**	**11ac20**	**11n40**	**11ac40**	**11ac80**	**11a**	**11n20**	**11ac20**	**11n40**	**11ac40**	**11ac80**
band	U-NII-2C						U-NII-3					
Tx band [MHz]	5500~5580, 5660~5700			5510,5550,5670		5530	5745~5825			5755, 5795		5775
Bandwidth [MHz]	20	20	20	40	40	80	20	20	20	40	40	80
Max.power [dBm]	**10**	9	9	9	9	9	**10**	9	9	9	9	9
Modulation	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM	OFDM
D/R [Mbps]	6	MCS0	MCS0	MCS0	MCS0	MCS0	6	MCS0	MCS0	MCS0	MCS0	MCS0
Frequency tested [MHz]	5500, 5580, 5700	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)	5745, 5785, 5825	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)	n/a (*4)

	Test name	**Software name**	**Version**	**Date**	**Storage location / Remarks**
Controlled software	Power measurement	RF Test Command for 11ac1×1 WLAN/BTC/BLE module	Version 1.0	2022/01/07	*. Memory of test jig, operated by Tera-Term
	SAR	RF TEST	Version 1.0	2022/03/02	Memory of digital camera (firmware)

*. Max.power: Maximum power (tune-up limit power), D/R: Data rate, n/a: SAR test was not applied.
*. (mode) 11b: IEEE 802.11b, 11g: IEEE 802.11g, 11a: IEEE 802.11a, 11n20: IEEE 802.11n(20HT)-SISO, 11n40: IEEE 802.11n(40HT)-SISO, 11ac20: IEEE 802.11ac(20VHT)-SISO, 11ac40: IEEE 802.11n(40VHT)-SISO, 11ac80: IEEE 802.11ac(80VHT)-SISO.
*1. SAR test was applied to a maximum output power channel of BT-LE (PHY1) mode in representatively.
*2. (KDB 248227 D01) Since reported SAR 1g of DSSS mode which had highest output power was enough small (< 1.2 W/kg), SAR test of OFDM mode (lower power than 11b) was reduced.
*3. SAR test of U-NII-1 band was also applied for the reference purpose, even though the reported SAR(1g) of U-NII-2A band was enough lower than 1.2 W/kg.
*4. Since the maximum output power was lower than 11a mode, the SAR test was reduced.
*5. WLAN and Bluetooth use same antenna. Therefore, simultaneously transmitted SAR was not considered for the WLAN 2.4 GHz band and Bluetooth. Simultaneously transmitted SAR was only considered for the WLAN 5 GHz band and Bluetooth.

***. 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.

For 5GHz band, the initial test configuration was selected accordance to the transmission mode with the highest maximum output power. When the reported SAR is > 0.8 W/kg, SAR is required for the subsequent highest measured output power channel until the reported SAR result is ≤ 1.2 W/kg or all required channels are measured. For other transmission modes, SAR is not required when the highest reported SAR for initial test configuration is adjusted by the ratio of subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

4.2 RF exposure conditions

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

Setup plan	Explanation of SAR test setup plan (*. Refer to Appendix 1 for test setup photographs which had been tested.)	Wi-Fi: D [mm]	Wi-Fi: SAR Tested /Reduced (*1)	Bluetooth: D [mm]	Bluetooth: SAR Tested /Reduced (*1)
Front-upper	An upper portion of front surface of camera is touched to the Flat phantom.	**1.72**	Tested	**1.72**	Tested
Front-left-upper	A left upper portion of front surface of camera is touched to the Flat phantom.	**≈ 7**	Tested	**≈ 7**	*Reduced*
Top-front-edge	A front edge of convex surface (view finder) of a camera is touched to the Flat phantom.	**≈ 8**	Tested	**≈ 8**	*Reduced*
Top-front	A front portion of convex surface (view finder) of a camera is touched to the Flat phantom.	**≈ 8**	Tested	**≈ 8**	*Reduced*
Top	A top of convex surface (view finder) of a camera is touched to the Flat phantom.	**≈ 8**	Tested	**≈ 8**	*Reduced*
Front	A front surface of camera (lens mounting area) is touched to the Flat phantom.	**< 27**	*Reduced*	**< 27**	*Reduced*
Left	A left surface of camera is touched to the Flat phantom.	**≈ 40**	*Reduced*	**≈ 40**	*Reduced*
Rear (LCD)	A rear surface of camera is touched to the Flat phantom.	**≈ 55**	*Reduced*	**≈ 55**	*Reduced*
Right	A right surface of camera is touched to the Flat phantom.	**≈ 77**	*Reduced*	**≈ 77**	*Reduced*
Bottom	A bottom surface of camera is touched to the Flat phantom.	**≈ 90**	*Reduced*	**≈ 90**	*Reduced*

*. **D:** Antenna separation distance. It is the distance from the antenna inside platform the outer surface of platform which user may touch.
*. Size of host platform: Refer to Appendix 1-1.
***1. [SAR test exemption consideration by KDB 447498 D04 (v01)]**

Tx mode		Higher frequency [MHz]	Conducted Max. ave. power [dBm]	Conducted Max. ave. power [mW]	Antenna Gain [dBi]	Antenna ERP [dBm]	Antenna ERP [mW]	≤ 5mm (1.72 mm) Front-upper SAR1g	≈ 7 mm Front-left-upper SAR1g	≈ 8 mm Top-front-edge, Top-front SAR1g	≈ 8 mm Top SAR1g	< 27 mm Front SAR1g	40 mm Left SAR1g	> 50 mm Rear, Right, Bottom SAR1g
								Judge of SAR test exemption ("Test "or "Exempt") / SAR based Threshold power — Antenna separation distance						
BT LE		2480	6	4	2.98	6.83	**5**	**Test**, 3 mW	**Test**, 5 mW	**Test**, 7 mW	**Test**, 7 mW	Exempt, 67 mW	Exempt, > 100 mW	Exempt, > 100 mW
WLAN	2.4 GHz	2462	10	10	2.98	10.83	**12**	**Test**, 3 mW	**Test**, 5 mW	**Test**, 7 mW	**Test**, 7 mW	Exempt, 68 mW	Exempt, > 100 mW	Exempt, > 100 mW
WLAN	5.2 GHz	5240	10	10	4.94	12.79	**19**	**Test**, 1 mW	**Test**, 3 mW	**Test**, 4 mW	**Test**, 4 mW	Exempt, 49 mW	Exempt, > 100 mW	Exempt, > 100 mW
WLAN	5.3 GHz	5320	10	10	4.94	12.79	**19**	**Test**, 1 mW	**Test**, 3 mW	**Test**, 4 mW	**Test**, 4 mW	Exempt, 49 mW	Exempt, > 100 mW	Exempt, > 100 mW
WLAN	5.6 GHz	5700	10	10	4.94	12.79	**19**	**Test**, 1 mW	**Test**, 3 mW	**Test**, 4 mW	**Test**, 4 mW	Exempt, 47 mW	Exempt, > 100 mW	Exempt, > 100 mW
WLAN	5.8 GHz	5825	10	10	4.94	12.79	**19**	**Test**, 1 mW	**Test**, 3 mW	**Test**, 4 mW	**Test**, 4 mW	Exempt, 47 mW	Exempt, > 100 mW	Exempt, > 100 mW

*. Module-based antenna gains with maximum values were used conservatively.
*. Antenna separation distance is rounded to the nearest integer numbers (in mm) before calculation.
*. (Calculating formula) ERP (dBm) = (max. conducted output power, dBm) + (antenna gain, dBi) – 2.15

<Conclusion for consideration for SAR test reduction>

1) **The all SAR tests were conservatively performed with test separation distance 0 mm.**
2) **For WLAN operation; "Front-upper" and "Top (Top-front-edge, Top-front, Top)" setup are applied the SAR test because near antenna section (higher than calculated threshold power). The SAR test of other SAR test setup are reduced, because there have enough antenna separation distance and the SAR test exclusion judge was "test can be reduced".**
3) **For Bluetooth operation, the SAR test was applied with the worst SAR condition of WLAN mode to evaluate "simultaneous transmission".**

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).

Table: Example Power Thresholds [mW] (SAR(1g), KDB 447498 D01 (v07))

Frequency [MHz] \ Distance [mm]	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	35	40	45	50
2402	3	4	5	7	9	10	12	15	17	20	22	25	28	32	35	39	42	46	50	55	59	64	68	73	78	84	112	144	180	220
2412	3	4	5	7	8	10	12	15	17	20	22	25	28	32	35	39	42	46	50	55	59	64	68	73	78	83	112	144	180	220
2450	3	4	5	7	8	10	12	15	17	19	22	25	28	31	35	38	42	46	50	54	59	63	68	73	78	83	111	143	179	219
2462	3	4	5	7	8	10	12	14	17	19	22	25	28	31	35	38	42	46	50	54	58	63	68	73	78	83	111	143	179	219
2480	3	4	5	7	8	10	12	14	17	19	22	25	28	31	35	38	42	46	50	54	58	63	67	72	77	82	111	143	179	218
3600	2	3	4	5	6	8	10	11	13	16	18	20	23	26	29	32	35	38	42	45	49	53	57	62	66	71	96	125	158	195
5180	2	2	3	4	5	6	8	9	11	13	15	17	19	21	24	26	29	32	35	38	42	45	49	53	57	61	84	110	141	175
5240	1	2	3	4	5	6	8	9	11	13	14	17	19	21	24	26	29	32	35	38	42	45	49	53	57	61	83	110	140	174
5260	1	2	3	4	5	6	8	9	11	13	14	16	19	21	24	26	29	32	35	38	42	45	49	52	56	61	83	110	140	174
5320	1	2	3	4	5	6	8	9	11	12	14	16	19	21	23	26	29	32	35	38	41	45	48	52	56	60	83	109	139	173
5500	1	2	3	4	5	6	7	9	10	12	14	16	18	21	23	26	28	31	34	37	41	44	48	51	55	59	82	108	138	172
5700	1	2	3	4	5	6	7	9	10	12	14	16	18	20	23	25	28	31	34	37	40	43	47	51	55	59	81	107	136	170
5745	1	2	3	4	5	6	7	9	10	12	14	16	18	20	22	25	28	31	34	37	40	43	47	51	54	58	80	106	136	169
5800	1	2	3	4	5	6	7	9	10	12	14	16	18	20	22	25	28	30	33	36	40	43	47	50	54	58	80	106	136	169
5825	1	2	3	4	5	6	7	9	10	12	14	16	18	20	22	25	28	30	33	36	40	43	47	50	54	58	80	106	135	169

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	1,920 R^2
1.34	-	30	35.6 m	-	1.6 m	3,450 R^2/f^2
30	-	300	1.6 m	-	159 mm	3.83 R^2
300	-	1,500	159 mm	-	31.8 mm	0.0128 $R^2 f$
1,500	-	100,000	31.8 mm	-	0.5 mm	19.2R^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
Threshold ERP [W] = 19.2 × R^2 (~formula (A.1))
(*. where "R" is: > 0.4 m)

Calculating formula:

$$P_{th}\ (\mathrm{mW}) = ERP_{20\ cm}\ (\mathrm{mW}) = \begin{cases} 2040f & 0.3\ \mathrm{GHz} \le f < 1.5\ \mathrm{GHz} \\ 3060 & 1.5\ \mathrm{GHz} \le f \le 6\ \mathrm{GHz} \end{cases} \quad \text{(B.1)}$$

$$P_{th}\ (\mathrm{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \mathrm{cm})^x & d \le 20\ \mathrm{cm} \\ ERP_{20\ cm} & 20\ \mathrm{cm} < d \le 40\ \mathrm{cm} \end{cases} \quad \text{(B.2)} \qquad x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right)$$

and f is in GHz, d is the separation distance (cm), and ERP_{20cm} is per Formula (B.1).

SECTION 5: Confirmation before testing

5.1 SAR reference power measurement (antenna terminal conducted average power of EUT)

*. Antenna gain (peak): 2.98 dBi (2.4GHz band), 4.94 dBi 5GHz band)

Mode	Frequency		Data rate	Power Setting (software)	Duty cycle	Duty factor	Duty scaled factor	Measurement Result				Power correction				Power tuning applied?	Remarks
								Time average power		Burst power		Power		Δ from max.	Tune-up factor		
												Typical	Max.				
	[MHz]	CH	[Mbps]	[-]	[%]	[dB]	[-]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[dBm]	[dB]	[-]		
BT-LE (PHY1)	2402	0	1	5	64.1	1.93	1.56	3.24	2.11	**5.17**	3.29	3.0	6.0	-0.83	1.21	tuned-up	-
	2440	19	1	5	64.1	1.93	1.56	3.20	2.09	**5.13**	3.26	3.0	6.0	-0.87	1.22	tuned-up	-
	2480	39	1	5	64.1	1.93	1.56	3.23	2.10	**5.16**	3.28	3.0	6.0	-0.84	1.21	tuned-up	-
BT-LE (PHY2)	2402	0	1	5	34.5	4.62	2.90	0.49	1.12	**5.11**	3.24	3.0	6.0	-0.89	1.23	tuned-up	-
	2440	19	1	5	34.5	4.62	2.90	0.45	1.11	**5.07**	3.21	3.0	6.0	-0.93	1.24	tuned-up	-
	2480	39	1	5	34.5	4.62	2.90	0.48	1.12	**5.10**	3.24	3.0	6.0	-0.90	1.23	tuned-up	-
11b	2412	1	1	8	100	0.00	1.00	8.36	6.85	**8.36**	6.85	8.0	**10.0**	-1.64	1.46	n/a (default)	*.Initial CH-WLAN 2.4GHz.
	2437	6	1	8	100	0.00	1.00	8.19	6.59	**8.19**	6.59	8.0	**10.0**	-1.81	1.52	n/a (default)	-
	2462	11	1	8	100	0.00	1.00	8.08	6.43	**8.08**	6.43	8.0	**10.0**	-1.92	1.56	n/a (default)	-
11g	2412	1	6	8	100	0.00	1.00	8.26	6.70	**8.26**	6.70	8.0	**10.0**	-1.74	1.49	n/a (default)	-
	2437	6	6	8	100	0.00	1.00	8.12	6.49	**8.12**	6.49	8.0	**10.0**	-1.88	1.54	n/a (default)	-
	2462	11	6	8	100	0.00	1.00	8.01	6.32	**8.01**	6.32	8.0	**10.0**	-1.99	1.58	n/a (default)	-
11n20 -SISO	2412	1	MCS0	7	100	0.00	1.00	7.46	5.57	**7.46**	5.57	7.0	9.0	-1.54	1.43	n/a (default)	-
	2437	6	MCS0	7	100	0.00	1.00	7.30	5.37	**7.30**	5.37	7.0	9.0	-1.70	1.48	n/a (default)	-
	2462	11	MCS0	7	100	0.00	1.00	7.19	5.24	**7.19**	5.24	7.0	9.0	-1.81	1.52	n/a (default)	-
11n40 -SISO	2422	3	MCS0	7	100	0.00	1.00	7.40	5.50	**7.40**	5.50	7.0	9.0	-1.60	1.45	n/a (default)	-
	2437	6	MCS0	7	100	0.00	1.00	7.31	5.38	**7.31**	5.38	7.0	9.0	-1.69	1.48	n/a (default)	-
	2452	9	MCS0	7	100	0.00	1.00	7.23	5.28	**7.23**	5.28	7.0	9.0	-1.77	1.50	n/a (default)	-
11a	5180	36	6	9	100	0.00	1.00	8.94	7.83	**8.94**	7.83	8.0	**10.0**	-1.06	1.28	tuned-up	-
	5200	40	6	9	100	0.00	1.00	8.98	7.91	**8.98**	7.91	8.0	**10.0**	-1.02	1.26	tuned-up	-
	5220	44	6	9	100	0.00	1.00	8.98	7.91	**8.98**	7.91	8.0	**10.0**	-1.02	1.26	tuned-up	*.Initial CH-WLAN 5.2GHz.
	5240	48	6	9	100	0.00	1.00	8.88	7.73	**8.88**	7.73	8.0	**10.0**	-1.12	1.29	tuned-up	-
	5260	52	6	9	100	0.00	1.00	8.80	7.59	**8.80**	7.59	8.0	**10.0**	-1.20	1.32	tuned-up	*.Initial CH-WLAN 5.3GHz.
	5280	56	6	9	100	0.00	1.00	8.71	7.43	**8.71**	7.43	8.0	**10.0**	-1.29	1.35	tuned-up	-
	5300	60	6	9	100	0.00	1.00	8.75	7.50	**8.75**	7.50	8.0	**10.0**	-1.25	1.33	tuned-up	-
	5320	64	6	9	100	0.00	1.00	8.65	7.33	**8.65**	7.33	8.0	**10.0**	-1.35	1.36	tuned-up	-
	5500	100	6	10	100	0.00	1.00	8.62	7.28	**8.62**	7.28	8.0	**10.0**	-1.38	1.37	tuned-up	-
	5580	116	6	10	100	0.00	1.00	8.64	7.31	**8.64**	7.31	8.0	**10.0**	-1.36	1.37	tuned-up	-
	5700	140	6	10	100	0.00	1.00	8.74	7.48	**8.74**	7.48	8.0	**10.0**	-1.26	1.34	tuned-up	*.Initial CH-WLAN 5.6GHz.
	5745	149	6	9	100	0.00	1.00	8.61	7.26	**8.61**	7.26	8.0	**10.0**	-1.39	1.38	tuned-up	-
	5785	157	6	9	100	0.00	1.00	8.72	7.45	**8.72**	7.45	8.0	**10.0**	-1.28	1.34	tuned-up	-
	5825	165	6	9	100	0.00	1.00	8.77	7.53	**8.77**	7.53	8.0	**10.0**	-1.23	1.33	tuned-up	*.Initial CH-WLAN 5.8GHz.
11n20 -SISO	5180	36	MCS0	8	100	0.00	1.00	8.12	6.49	**8.12**	6.49	7.0	9.0	-0.88	1.22	tuned-up	-
	5200	40	MCS0	8	100	0.00	1.00	8.17	6.56	**8.17**	6.56	7.0	9.0	-0.83	1.21	tuned-up	-
	5220	44	MCS0	8	100	0.00	1.00	8.17	6.56	**8.17**	6.56	7.0	9.0	-0.83	1.21	tuned-up	-
	5240	48	MCS0	8	100	0.00	1.00	8.07	6.41	**8.07**	6.41	7.0	9.0	-0.93	1.24	tuned-up	-
	5260	52	MCS0	8	100	0.00	1.00	7.99	6.30	**7.99**	6.30	7.0	9.0	-1.01	1.26	tuned-up	-
	5280	56	MCS0	8	100	0.00	1.00	7.90	6.17	**7.90**	6.17	7.0	9.0	-1.10	1.29	tuned-up	-
	5300	60	MCS0	8	100	0.00	1.00	7.94	6.22	**7.94**	6.22	7.0	9.0	-1.06	1.28	tuned-up	-
	5320	64	MCS0	8	100	0.00	1.00	7.85	6.10	**7.85**	6.10	7.0	9.0	-1.15	1.30	tuned-up	-
	5500	100	MCS0	9	100	0.00	1.00	7.81	6.04	**7.81**	6.04	7.0	9.0	-1.19	1.32	tuned-up	-
	5580	116	MCS0	9	100	0.00	1.00	7.83	6.07	**7.83**	6.07	7.0	9.0	-1.17	1.31	tuned-up	-
	5700	140	MCS0	9	100	0.00	1.00	7.94	6.22	**7.94**	6.22	7.0	9.0	-1.06	1.28	tuned-up	-
	5745	149	MCS0	8	100	0.00	1.00	7.80	6.03	**7.80**	6.03	7.0	9.0	-1.20	1.32	tuned-up	-
	5785	157	MCS0	8	100	0.00	1.00	7.91	6.18	**7.91**	6.18	7.0	9.0	-1.09	1.29	tuned-up	-
	5825	165	MCS0	8	100	0.00	1.00	7.97	6.27	**7.97**	6.27	7.0	9.0	-1.03	1.27	tuned-up	-
11ac20 -SISO	5180	36	MCS0	8	100	0.00	1.00	8.13	6.50	**8.13**	6.50	7.0	9.0	-0.87	1.22	tuned-up	-
	5200	40	MCS0	8	100	0.00	1.00	8.15	6.53	**8.15**	6.53	7.0	9.0	-0.85	1.22	tuned-up	-
	5220	44	MCS0	8	100	0.00	1.00	8.15	6.53	**8.15**	6.53	7.0	9.0	-0.85	1.22	tuned-up	-
	5240	48	MCS0	8	100	0.00	1.00	8.06	6.40	**8.06**	6.40	7.0	9.0	-0.94	1.24	tuned-up	-
	5260	52	MCS0	8	100	0.00	1.00	7.98	6.28	**7.98**	6.28	7.0	9.0	-1.02	1.26	tuned-up	-
	5280	56	MCS0	8	100	0.00	1.00	7.89	6.15	**7.89**	6.15	7.0	9.0	-1.11	1.29	tuned-up	-
	5300	60	MCS0	8	100	0.00	1.00	7.95	6.24	**7.95**	6.24	7.0	9.0	-1.05	1.27	tuned-up	-
	5320	64	MCS0	8	100	0.00	1.00	7.87	6.12	**7.87**	6.12	7.0	9.0	-1.13	1.30	tuned-up	-
	5500	100	MCS0	9	100	0.00	1.00	7.81	6.04	**7.81**	6.04	7.0	9.0	-1.19	1.32	tuned-up	-
	5580	116	MCS0	9	100	0.00	1.00	7.82	6.05	**7.82**	6.05	7.0	9.0	-1.18	1.31	tuned-up	-
	5700	140	MCS0	9	100	0.00	1.00	7.94	6.22	**7.94**	6.22	7.0	9.0	-1.06	1.28	tuned-up	-
	5745	149	MCS0	8	100	0.00	1.00	7.81	6.04	**7.81**	6.04	7.0	9.0	-1.19	1.32	tuned-up	-
	5785	157	MCS0	8	100	0.00	1.00	7.92	6.19	**7.92**	6.19	7.0	9.0	-1.08	1.28	tuned-up	-
	5825	165	MCS0	8	100	0.00	1.00	7.97	6.27	**7.97**	6.27	7.0	9.0	-1.03	1.27	tuned-up	-

(cont'd)

(cont'd)

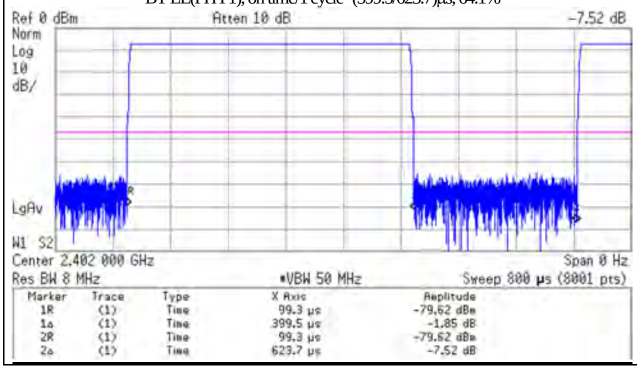
Mode	Frequency		Data rate	Power Setting (software)	Duty cycle	Duty factor	Duty scaled factor	Measurement Result: Time average power		Measurement Result: Burst power		Power correction: Power Typical	Power correction: Power Max.	Power correction: Δ from max.	Power correction: Tune-up factor	Power tuning applied?	Remarks
	[MHz]	CH	[Mbps]	[-]	[%]	[dB]	[-]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[dBm]	[dB]	[-]		
1n40 -SISO	5190	38	MCS0	8	100	0.00	1.00	8.07	6.41	**8.07**	6.41	7.0	9.0	-0.93	1.24	tuned-up	-
	5230	46	MCS0	8	100	0.00	1.00	8.12	6.49	**8.12**	6.49	7.0	9.0	-0.88	1.22	tuned-up	-
	5270	54	MCS0	8	100	0.00	1.00	7.95	6.24	**7.95**	6.24	7.0	9.0	-1.05	1.27	tuned-up	-
	5310	62	MCS0	8	100	0.00	1.00	7.90	6.17	**7.90**	6.17	7.0	9.0	-1.10	1.29	tuned-up	-
	5510	102	MCS0	9	100	0.00	1.00	7.82	6.05	**7.82**	6.05	7.0	9.0	-1.18	1.31	tuned-up	-
	5550	110	MCS0	9	100	0.00	1.00	7.81	6.04	**7.81**	6.04	7.0	9.0	-1.19	1.32	tuned-up	-
	5670	134	MCS0	9	100	0.00	1.00	7.83	6.07	**7.83**	6.07	7.0	9.0	-1.17	1.31	tuned-up	-
	5755	151	MCS0	8	100	0.00	1.00	7.85	6.10	**7.85**	6.10	7.0	9.0	-1.15	1.30	tuned-up	-
	5795	159	MCS0	8	100	0.00	1.00	7.95	6.24	**7.95**	6.24	7.0	9.0	-1.05	1.27	tuned-up	-
11ac40 -SISO	5190	38	MCS0	8	100	0.00	1.00	8.09	6.44	**8.09**	6.44	7.0	9.0	-0.91	1.23	tuned-up	-
	5230	46	MCS0	8	100	0.00	1.00	8.11	6.47	**8.11**	6.47	7.0	9.0	-0.89	1.23	tuned-up	-
	5270	54	MCS0	8	100	0.00	1.00	7.94	6.22	**7.94**	6.22	7.0	9.0	-1.06	1.28	tuned-up	-
	5310	62	MCS0	8	100	0.00	1.00	7.91	6.18	**7.91**	6.18	7.0	9.0	-1.09	1.29	tuned-up	-
	5510	102	MCS0	9	100	0.00	1.00	7.82	6.05	**7.82**	6.05	7.0	9.0	-1.18	1.31	tuned-up	-
	5550	110	MCS0	9	100	0.00	1.00	7.82	6.05	**7.82**	6.05	7.0	9.0	-1.18	1.31	tuned-up	-
	5670	134	MCS0	9	100	0.00	1.00	7.83	6.07	**7.83**	6.07	7.0	9.0	-1.17	1.31	tuned-up	-
	5755	151	MCS0	8	100	0.00	1.00	7.85	6.10	**7.85**	6.10	7.0	9.0	-1.15	1.30	tuned-up	-
	5795	159	MCS0	8	100	0.00	1.00	7.95	6.24	**7.95**	6.24	7.0	9.0	-1.05	1.27	tuned-up	-
11ac80 -SISO	5210	42	MCS0	7	100	0.00	1.00	7.47	5.58	**7.47**	5.58	7.0	9.0	-1.53	1.42	n/a (default)	-
	5290	58	MCS0	7	100	0.00	1.00	7.33	5.41	**7.33**	5.41	7.0	9.0	-1.67	1.47	n/a (default)	-
	5530	106	MCS0	7	100	0.00	1.00	7.32	5.40	**7.32**	5.40	7.0	9.0	-1.68	1.47	n/a (default)	-
	5775	155	MCS0	7	100	0.00	1.00	7.39	5.48	**7.39**	5.48	7.0	9.0	-1.61	1.45	n/a (default)	-

*. [ ] : SAR test was applied.
*. The SAR test powers by setting power were not more than 2dB lower than maximum tune-up power (KDB 447498 D04 (v01) requirement).
*. CH: Channel; Max: Maximum; n/a: not applied.

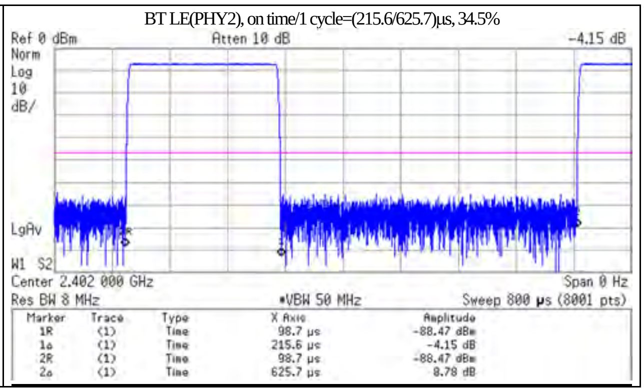
*. Calculating formula: Time average power (dBm) = (P/M Reading, dBm)+(Cable loss, dB)+(Attenuator, dB)
Burst power (dBm) = (P/M Reading, dBm)+(Cable loss, dB)+(Attenuator, dB)+(duty factor, dB)
Duty cycle: (duty cycle, %) = (Tx on time) / (1 cycle time) × 100, Duty factor (dBm) = 10 × log (100/(duty cycle, %))
Duty cycle scaled factor: Duty cycle correction factor for obtained SAR value, Duty scaled factor [-] = 100(%) / (duty cycle, %)
Δ from max. (Deviation form maximum power, dB) = (Burst power measured (average, dBm)) - (Max.tune-up limit power (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: January 7, 2022 / Measured by: H. Naka / Place: Preparation room of No. 7 shield room. (21 deg.C./ 40 %RH)
*. Uncertainty of antenna port conducted test; (±) 1.3 dB (Average power), (±) 2.7 % (duty cycle).
*. Chart of the worst duty cycle for each operation mode in right and in follows.

BT LE(PHY1), on time/1 cycle=(399.5/623.7)μs, 64.1%



BT LE(PHY2), on time/1 cycle=(215.6/625.7)μs, 34.5%



SECTION 6: SAR Measurement results

6.1 Tissue simulating liquid measurement

6.1.1 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

6.1.2 Liquid measurement (Liquid verification)

Frequency [MHz]	Liquid type	Liquid parameters (*a)														ΔSAR Coefficients(*b)			Date measured
		Liquid Temp. [deg.C.]	Liquid depth of phantom [mm]	Permittivity (εr) [-]						Conductivity [S/m]						ΔSAR		Correction required? (*c)	
				Target value	Measured				Δend, >48hrs [%] (*1)	Target value	Measured				Δend, >48hrs [%] (*1)	(1g) [%]	(10g) [%]		
					Value	Δεr [%]	Interpolated	Limit [%]			Value	Δσ [%]	Interpolated	Limit [%]					
2402	Head	22.5	150	***39.29***	40.04	1.9	☑	10	begin	***1.757***	1.794	2.1	☑	10	begin	0.6	0.3	not required.	
2412				***39.27***	40.03	1.9	☑	10	begin	***1.766***	1.802	2.0	☑	10	begin	0.6	0.2	not required.	
2437				***39.22***	40.00	2.0	☑	10	begin	***1.788***	1.823	2.0	☑	10	begin	0.5	0.2	not required.	
2462				***39.18***	39.98	2.1	☑	10	begin	***1.813***	1.842	1.6	☑	10	begin	0.3	0.1	not required.	
5180				***36.01***	35.64	-1.0	☐	10	begin	***4.635***	4.435	-4.3	☐	10	begin	0.3	0.5	not required.	
5220				***35.96***	35.58	-1.1	☐	10	begin	***4.676***	4.475	-4.3	☐	10	begin	0.3	0.5	not required.	
5240				***35.94***	35.51	-1.2	☐	10	begin	***4.696***	4.500	-4.2	☐	10	begin	0.4	0.5	not required.	
5260				***35.92***	35.46	-1.3	☐	10	begin	***4.717***	4.523	-4.1	☐	10	begin	0.4	0.5	not required.	March 2,. 2022
5300				***35.87***	35.42	-1.3	☐	10	begin	***4.758***	4.566	-4.0	☐	10	begin	0.4	0.5	not required.	(Used until March 3)
5320				***35.85***	35.37	-1.3	☐	10	begin	***4.778***	4.582	-4.1	☐	10	begin	0.4	0.6	not required.	
5500				**35.64**	35.10	-1.5	☐	10	< 48hrs	**4.963**	4.770	-3.9	☐	10	< 48hrs	0.5	0.6	not required.	
5580				**35.55**	34.97	-1.6	☐	10	< 48hrs	**5.045**	4.871	-3.4	☐	10	< 48hrs	0.5	0.6	not required.	
5700				**35.41**	34.79	-1.8	☐	10	< 48hrs	**5.168**	4.999	-3.3	☐	10	< 48hrs	0.5	0.6	not required.	
5745				**35.36**	34.69	-1.9	☑	10	< 48hrs	**5.214**	5.043	-3.3	☑	10	< 48hrs	0.5	0.6	not required.	
5785				**35.32**	34.62	-2.0	☑	10	< 48hrs	**5.255**	5.095	-3.0	☑	10	< 48hrs	0.5	0.6	not required.	
5825				**35.27**	34.58	-2.0	☑	10	< 48hrs	**5.296**	5.150	-2.8	☑	10	< 48hrs	0.5	0.6	not required.	

*1. "begin": SAR test has ended within 24 hours from the liquid parameter measurement, "< 48 hrs.": Since SAR test has ended within 48 hours (2 days) from the liquid parameter measurement and a change in the liquid temperature was within 1 degree, liquid parameters measured on first day were used on next day continuously, "value (%)": 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(>48 hrs.) (%)"" = {(dielectric properties, end of test series) / (dielectric properties, beginning of test series) -1} × 100

*a. The target values of (2000, 2450, 3000, 5800) MHz are parameters defined in Appendix A of KDB 865664 D01. For other frequencies, the target nominal dielectric values shall be obtained by linear interpolation between the higher and lower tabulated figures. Above 5800MHz were obtained using linear extrapolation.

*b. The coefficients in below are parameters defined in IEEE Std.1528-2013.
Calculating formula: $\Delta SAR(1g) = C\varepsilon r \times \Delta\varepsilon r + C\sigma \times \Delta\sigma$, $C\varepsilon r = -7.854E\text{-}4 \times f^3 + 9.402E\text{-}3 \times f^2 - 2.742E\text{-}2 \times f - 0.2026$ / $C\sigma = 9.804E\text{-}3 \times f^3 - 8.661E\text{-}2 \times f^2 + 2.981E\text{-}2 \times f + 0.7829$
Calculating formula: $\Delta SAR(10g) = C\varepsilon r \times \Delta\varepsilon r + C\sigma \times \Delta\sigma$, $C\varepsilon r = 3.456 \times 10^{-3} \times f^3 - 3.531 \times 10^{-2} \times f^2 + 7.675 \times 10^{-2} \times f - 0.1860$ / $C\sigma = 4.479 \times 10^{-3} \times f^3 - 1.586 \times 10^{-2} \times f^2 - 0.1972 \times f + 0.7717$
<u>Since the calculated ΔSAR values of the tested liquid had shown positive correction, the measured SAR was not converted by ΔSAR correction.</u>
Calculating formula: ΔSAR corrected SAR (W/kg) = (Measured SAR (W/kg)) × (100 - (ΔSAR(%)) / 100

*. Calibration frequency of the SAR measurement probe (and used conversion factors for each frequency.)
The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Liquid	SAR test frequency	Probe calibration frequency	Validity	Conversion factor	Uncertainty
Head	(2412, 2437, 2462) MHz	2450 MHz	within ± 5 0MHz of calibration frequency	7.35	± 12.0 %
Head	(5180, 5220, 5240, 5260, 5300, 5320) MHz	5250 MHz	within ± 110 MHz of calibration frequency	5.14	± 13.1 %
Head	(5500, 5580, 5700) MHz	5600 MHz	within ± 110 MHz of calibration frequency	4.56	± 13.1 %
Head	(5745, 5785, 5825) MHz	5800 MHz	within ± 110 MHz of calibration frequency	4.60	± 13.1 %

6.2 SAR results

Test setup					Mode and Frequency			Duty cycle		Power correction			SAR results [W/kg] (Max.value of multi-peak)				SAR type	SAR Limit [W/kg]	SAR plot # in Appx. 2	Setup photo# in Appx. 1-3	Remarks
Ant. #	Test position	Gap [mm]	Source power	LCD position	Mode (D/R) Mark with "*" is the initial mode & frequency.	[MHz]	CH	Duty [%]	Duty scaled factor	Max. tune-up limit [dBm]	Measured conducted [dBm]	Power scaled factor	Measured	ΔSAR [%]	ΔSAR corrected	**Scaled** (*b)					
Step 1) 2.4 GHz Band (*1)																					
-	Front-upper	0	Battery	Op.180N	11b (1Mbps)*	2412*	1	100	1.00	10	8.36	1.46	0.094	+ sign	n/a (*a)	**0.138**	1g	1.6	1-1	P1	-
-	Front-upper	0	Battery	Op.180N	11b (1Mbps)*	2437	6	100	1.00	10	8.19	1.52	0.081	+ sign	n/a (*a)	**0.123**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11b (1Mbps)*	2462	11	100	1.00	10	8.08	1.56	0.072	+ sign	n/a (*a)	**0.112**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11g (6Mbps)	2412	1	100	1.00	10	8.26	1.49	0.091	+ sign	n/a (*a)	**0.136**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	BT LE (1Mbps)	2402	1	64.1	1.56	6	5.17	1.21	0.025	+ sign	n/a (*a)	**0.047**	1g	1.6	-	P1	-
-	Front-left-upper	0	Battery	Op.180N	11b (1Mbps)*	2412*	1	100	1.00	10	8.36	1.46	0.061	+ sign	n/a (*a)	**0.089**	1g	1.6	-	P2	-
-	Top-front-edge	0	Battery	Op.180N	11b (1Mbps)*	2412*	1	100	1.00	10	8.36	1.46	0.065	+ sign	n/a (*a)	**0.095**	1g	1.6	-	P3	-
-	Top-front	0	Battery	Op.180N	11b (1Mbps)*	2412*	1	100	1.00	10	8.36	1.46	0.068	+ sign	n/a (*a)	**0.099**	1g	1.6	-	P4	-
-	Top	0	Battery	Cl.R	11b (1Mbps)*	2412*	1	100	1.00	10	8.36	1.46	0.031	+ sign	n/a (*a)	**0.045**	1g	1.6	-	P5	Wide area scan
-	Front	0	Battery	Cl.R	11b (1Mbps)*	2412*	1	100	1.00	10	8.36	1.46	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P6	Wide area scan
-	Left	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Rear	0	Battery	Op.180R	11b (1Mbps)*	2412*	1	100	1.00	10	8.36	1.46	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P7	Wide area scan
-	Right	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Bottom	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
Step 2) U-NII-2A (5.3 GHz) (and U-NII-1 (5.2 GHz)) Band																					
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5260*	52	100	1.00	10	8.80	1.32	0.216	+ sign	n/a (*a)	**0.285**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5300	60	100	1.00	10	8.75	1.33	0.245	+ sign	n/a (*a)	**0.326**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5320	64	100	1.00	10	8.65	1.36	0.259	+ sign	n/a (*a)	**0.352**	1g	1.6	2a-1	P1	-
-	Front-left-upper	0	Battery	Op.180N	11a (6Mbps)*	5260*	52	100	1.00	10	8.80	1.32	0.151	+ sign	n/a (*a)	**0.199**	1g	1.6	-	P2	-
-	Top-front-edge	0	Battery	Op.180N	11a (6Mbps)*	5260*	52	100	1.00	10	8.80	1.32	0.110	+ sign	n/a (*a)	**0.145**	1g	1.6	-	P3	-
-	Top-front	0	Battery	Op.180N	11a (6Mbps)*	5260*	52	100	1.00	10	8.80	1.32	0.059	+ sign	n/a (*a)	**0.078**	1g	1.6	-	P4	-
-	Top	0	Battery	Cl.R	11a (6Mbps)*	5260*	52	100	1.00	10	8.80	1.32	0.030	+ sign	n/a (*a)	**0.040**	1g	1.6	-	P5	Wide area scan
-	Front	0	Battery	Cl.R	11a (6Mbps)*	5260*	52	100	1.00	10	8.80	1.32	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P6	Wide area scan
-	Left	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Rear	0	Battery	Op.180R	11a (6Mbps)*	5260*	52	100	1.00	10	8.80	1.32	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P7	Wide area scan
-	Right	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Bottom	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5180	36	100	1.00	10	8.94	1.28	0.185	+ sign	n/a (*a)	**0.237**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5220*	44	100	1.00	10	8.98	1.26	0.196	+ sign	n/a (*a)	**0.247**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5240	48	100	1.00	10	8.88	1.29	0.201	+ sign	n/a (*a)	**0.259**	1g	1.6	2b-1	P1	-
Step 3) U-NII-2C (5.6 GHz) Band																					
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5500	100	100	1.00	10	8.62	1.37	0.467	+ sign	n/a (*a)	**0.640**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5580	116	100	1.00	10	8.64	1.37	0.489	+ sign	n/a (*a)	**0.670**	1g	1.6		P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5700*	140	100	1.00	10	8.74	1.34	0.505	+ sign	n/a (*a)	**0.677**	1g	1.6	3-1	P1	-
-	Front-left-upper	0	Battery	Op.180N	11a (6Mbps)*	5700*	140	100	1.00	10	8.74	1.34	0.235	+ sign	n/a (*a)	**0.315**	1g	1.6	-	P2	-
-	Top-front-edge	0	Battery	Op.180N	11a (6Mbps)*	5700*	140	100	1.00	10	8.74	1.34	0.354	+ sign	n/a (*a)	**0.474**	1g	1.6	-	P3	-
-	Top-front	0	Battery	Op.180N	11a (6Mbps)*	5700*	140	100	1.00	10	8.74	1.34	0.197	+ sign	n/a (*a)	**0.264**	1g	1.6	-	P4	-
-	Top	0	Battery	Cl.R	11a (6Mbps)*	5700*	140	100	1.00	10	8.74	1.34	0.061	+ sign	n/a (*a)	**0.082**	1g	1.6	-	P5	Wide area scan
-	Front	0	Battery	Cl.R	11a (6Mbps)*	5700*	140	100	1.00	10	8.74	1.34	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P6	Wide area scan
-	Left	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Rear	0	Battery	Op.180R	11a (6Mbps)*	5700*	140	100	1.00	10	8.74	1.34	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P7	Wide area scan
-	Right	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Bottom	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
Step 4) U-NII-3 (5.8 GHz) Band																					
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5745	149	100	1.00	10	8.61	1.38	0.454	+ sign	n/a (*a)	**0.627**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5785	157	100	1.00	10	8.72	1.34	0.478	+ sign	n/a (*a)	**0.641**	1g	1.6	-	P1	-
-	Front-upper	0	Battery	Op.180N	11a (6Mbps)*	5825*	165	100	1.00	10	8.77	1.33	0.508	+ sign	n/a (*a)	**0.676**	1g	1.6	4-1	P1	-
-	Front-left-upper	0	Battery	Op.180N	11a (6Mbps)*	5825*	165	100	1.00	10	8.77	1.33	0.327	+ sign	n/a (*a)	**0.435**	1g	1.6	-	P2	-
-	Top-front-edge	0	Battery	Op.180N	11a (6Mbps)*	5825*	165	100	1.00	10	8.77	1.33	0.371	+ sign	n/a (*a)	**0.493**	1g	1.6	-	P3	-
-	Top-front	0	Battery	Op.180N	11a (6Mbps)*	5825*	165	100	1.00	10	8.77	1.33	0.219	+ sign	n/a (*a)	**0.291**	1g	1.6	-	P4	-
-	Top	0	Battery	Cl.R	11a (6Mbps)*	5825*	165	100	1.00	10	8.77	1.33	0.070	+ sign	n/a (*a)	**0.093**	1g	1.6	-	P5	Wide area scan
-	Front	0	Battery	Cl.R	11a (6Mbps)*	5825*	165	100	1.00	10	8.77	1.33	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P6	Wide area scan
-	Left	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Rear	0	Battery	Op.180R	11a (6Mbps)*	5825*	165	100	1.00	10	8.77	1.33	N/A (*1)	+ sign	n/a (*a)	**N/A**	1g	1.6	-	P7	Wide area scan
-	Right	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt
-	Bottom	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1g	1.6	-	-	SAR test: Exempt

Notes:
- *. The higher scaled (reported) SAR in each operation band is marked (shaded yellow marker).
- *. Appx. Appendix, Ant: antenna; (LCD position) Op.180N: Open 180 degree-normal, Op.180R: Open 180 degree-reverse, Cl.R: Close-reverse; Max.: maximum.; n/a: not applied. Gap: It is the separation distance between the platform surface and the bottom outer surface of phantom.
- *. During SAR test, the radiated power is always monitored by Spectrum Analyzer.

*a. Since the calculated ΔSAR values of the tested liquid had shown positive correction, the measured SAR was not converted by ΔSAR correction.

*b. Calculating formula: Scaled SAR (W/kg) = (Measured SAR (W/kg)) × (Duty scaled factor) × (Power scaled factor)
where, Duty scaled factor [-] = 100(%) / (duty cycle, %), Power scaled factor [-] = 10 ^ (((Max.tune-up limit, dBm) - (Measured conducted, dBm)) / 10)

*1. (KDB 248227 D01) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test of OFDM mode was reduced.

OFDM mode	Maximum tune-up tolerance limit				OFDM scaled factor [-]	DSSS worst reported SAR value				Estimated SAR value: OFDM [W/kg]	Exclusion limit [W/kg]	Standalone SAR test of OFDM mode require?
	DSSS		OFDM									
	[dBm]	[mW] (a)	[dBm]	[mW] (b)	(b)/(a)×100	SAR type	Setup	Antenna	[W/kg]			
11g	10.0	10	10.0	10	1.00	1g	Front-upper	-	0.138	**0.14**	**≤ 1.2**	**No**
11n20	10.0	10	9.0	8	0.80	1g	Front-upper	-	0.138	**0.11**	**≤ 1.2**	**No**
11n40	10.0	10	9.0	8	0.80	1g	Front-upper	-	0.138	**0.11**	**≤ 1.2**	**No**

*2. (KDB 248227 D01) For 5GHz band, for other transmission modes, SAR is not required when the highest reported SAR for initial test configuration is adjusted by the ratio of subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Band	OFDM mode	Maximum tune-up tolerance limit				Power scaled factor [-]	Initial mode's worst reported SAR(1g) value			Estimated SAR value: other mode [W/kg]	Exclusion limit [W/kg]	Standalone SAR test of other mode require?
		Initial mode (11a)		other mode								
		[dBm]	[mW] (a)	[dBm]	[mW] (b)	(b)/(a)×100	Setup	Antenna	[W/kg]			
5.2 GHz WLAN	11n20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.259	**0.21**	**≤ 1.2**	**No**
5.2 GHz WLAN	11ac20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.259	**0.21**	**≤ 1.2**	**No**
5.2 GHz WLAN	11n40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.259	**0.21**	**≤ 1.2**	**No**
5.2 GHz WLAN	11ac40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.259	**0.21**	**≤ 1.2**	**No**
5.2 GHz WLAN	11ac80-SISO	10	10	9	8	0.80	Front-upper	(single)	0.259	**0.21**	**≤ 1.2**	**No**
5.3 GHz WLAN	11n20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.352	**0.28**	**≤ 1.2**	**No**
5.3 GHz WLAN	11ac20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.352	**0.28**	**≤ 1.2**	**No**
5.3 GHz WLAN	11n40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.352	**0.28**	**≤ 1.2**	**No**
5.3 GHz WLAN	11ac40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.352	**0.28**	**≤ 1.2**	**No**
5.3 GHz WLAN	11ac80-SISO	10	10	9	8	0.80	Front-upper	(single)	0.352	**0.28**	**≤ 1.2**	**No**
5.6 GHz WLAN	11n20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.677	**0.54**	**≤ 1.2**	**No**
5.6 GHz WLAN	11ac20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.677	**0.54**	**≤ 1.2**	**No**
5.6 GHz WLAN	11n40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.677	**0.54**	**≤ 1.2**	**No**
5.6 GHz WLAN	11ac40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.677	**0.54**	**≤ 1.2**	**No**
5.6 GHz WLAN	11ac80-SISO	10	10	9	8	0.80	Front-upper	(single)	0.677	**0.54**	**≤ 1.2**	**No**
5.8 GHz WLAN	11n20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.676	**0.54**	**≤ 1.2**	**No**
5.8 GHz WLAN	11ac20-SISO	10	10	9	8	0.80	Front-upper	(single)	0.676	**0.54**	**≤ 1.2**	**No**
5.8 GHz WLAN	11n40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.676	**0.54**	**≤ 1.2**	**No**
5.8 GHz WLAN	11ac40-SISO	10	10	9	8	0.80	Front-upper	(single)	0.676	**0.54**	**≤ 1.2**	**No**
5.8 GHz WLAN	11ac80-SISO	10	10	9	8	0.80	Front-upper	(single)	0.676	**0.54**	**≤ 1.2**	**No**

6.3 Simultaneous transmission evaluation

***. Simultaneous transmission SAR measurement (Volume Scan) was not required because SUM SAR(1g) was < 1.6 W/kg.**

Simultaneous transmission scenario					**Σ SAR 1g (Limit: ≤1.6 W/kg)**	**SPLSR Check? (Yes/ No)**	Antenna separation distance-design base [mm]	**SPLSR (≤ 0.04)**	**Volume Scan? (Yes/No)**
Test position	**WLAN**		**Highest Reported SAR (*1)**						
	mode	**band**	**WLAN**	**Bluetooth**					
Front-upper	11b, 11g	2.4GHz	0.138 W/kg	0.047 W/kg	*. not supported	n/a	n/a	n/a	n/a
	11a	U-NII-1	0.259 W/kg	0.047 W/kg	0.306 W/kg	< 1.6 W/kg (ΣSAR 1g), No	0 (*. same antenna)	n/a	No
	11a	U-NII-2A	0.352 W/kg	0.047 W/kg	0.399 W/kg	< 1.6 W/kg (ΣSAR 1g), No	0 (*. same antenna)	n/a	No
	11a	U-NII-2C	0.677 W/kg	0.047 W/kg	0.724 W/kg	< 1.6 W/kg (ΣSAR 1g), No	0 (*. same antenna)	n/a	No
	11a	U-NII-3	0.676 W/kg	0.047 W/kg	0.723 W/kg	< 1.6 W/kg (ΣSAR 1g), No	0 (*. same antenna)	n/a	No

Note: *1. These values are measured higher reported SAR (1g) of each operation band. Refer to section 6.2.
*. This wireless module supports both WLAN and Bluetooth on a same antenna.
*. WLAN (5GHz) and Bluetooth can transmit simultaneously.
*. WLAN (2.4GHz) and Bluetooth cannot transmit simultaneously.

<SAR Summation Analysis>
Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR of all simultaneous transmitting antennas in an operating mode and exposure condition is within the SAR limit (SAR(1g): 1.6 W/kg,), the simultaneous transmission SAR is not required. When the sum of SAR is greater than the SAR limit (SAR(1g): 1.6 W/kg), SAR test exclusion is determined by the SPLSR.
(Calculating formula) Per KDB447498 D04(v01), SPLSR = (SAR1 + SAR2)^1.5 / (minimum antenna separation distance, mm)
where; the minimum antenna separation distance is determined by the closest physical separation of the antennas, according to geometric center of the antennas.

6.4 SAR Measurement Variability (Repeated measurement requirement)

In accordance with published RF Exposure KDB procedure 865664 D01 (v01r04) SAR measurement 100 MHz to 6 GHz. 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(1g) 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.

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

6.5 Device holder perturbation verification

When the highest reported SAR of an antenna is > 1.2 W/kg, holder perturbation verification (by Urethane form alone) is required by using the highest SAR configuration among all applicable frequency bands.

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

APPENDIX 2: SAR Measurement data

Appendix 2-1: Worst Reported (Scaled) SAR Plot

Plot 1-1: 2.4 GHz band, Front-upper & touch / 11b (1Mbps) / 2412 MHz

EUT: WLAN/BT Combo Module (Digital Camera); Type: ES204 (DS126861); Serial: AT220107-B24 (001019000134)

Mode: 11b(1Mbps, DSSS) (UID: 0, Wi-fi_2.4Hz (0), Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2412 MHz; Crest Factor: 1.0**

Medium: HSL5GHz(v6.2203); Medium parameters used (interpolated): f = 2412 MHz; σ = 1.802 S/m; ε_r = 40.03; ρ = 1000 kg/m^3

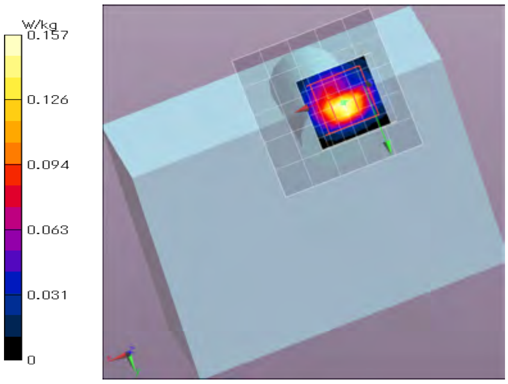
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

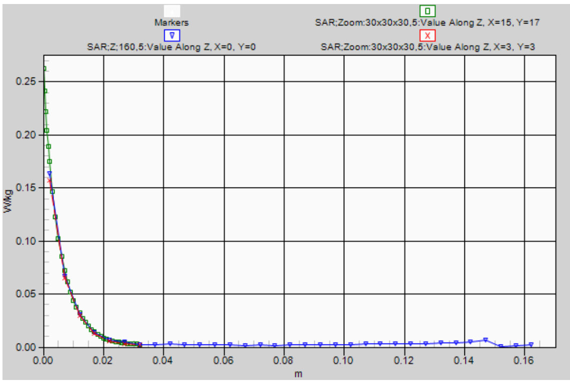
DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(7.35, 7.35, 7.35) @ 2412 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0, 161.0

touch1/24h3,2412,frt-top,b(1m)/
Area:60x60,12 (6x6x1): Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.173 W/kg
Area:60x60,12 (51x51x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.211 W/kg
Z;160,5 (1x1x33): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 0.164 W/kg

Zoom:30x30x30,5 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 9.675 V/m; Power Drift = -0.01 dB; Maximum value of SAR (measured) = 0.157 W/kg; Peak SAR (extrapolated) = 0.263 W/kg

SAR(1 g) = 0.094 W/kg; SAR(10 g) = 0.034 W/kg (*. Smallest distance from peaks to all points 3 dB below = 5 mm; Ratio of SAR at M2 to SAR at M1 = 41.5%)





Remarks: *. Date tested: 2022/3/2; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: (23~24) deg.C. / (50~70) %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

Plot 2a-1: U-NII-2A (5.3 GHz) band, Front-upper & touch / 11a (6Mbps) / 5320 MHz

EUT: WLAN/BT Combo Module (Digital Camera); Type: ES204 (DS126861); Serial: AT220107-B24 (001019000134)

Mode: 11a (6Mbps, OFDM) (UID: 0, Wi-fi_5GHz (0), Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 5320 MHz; Crest Factor: 1.0**

Medium: HSL5GHz(v6.2203); Medium parameters used: f = 5320 MHz; σ = 4.582 S/m; ε_r = 35.37; ρ = 1000 kg/m^3

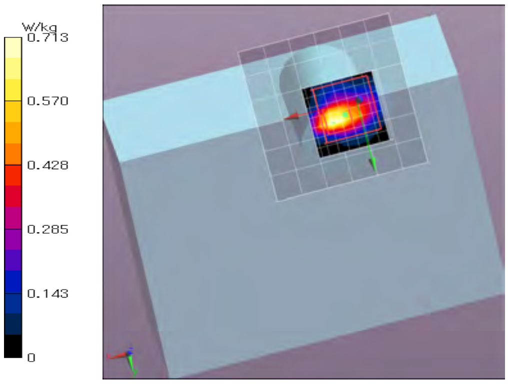
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

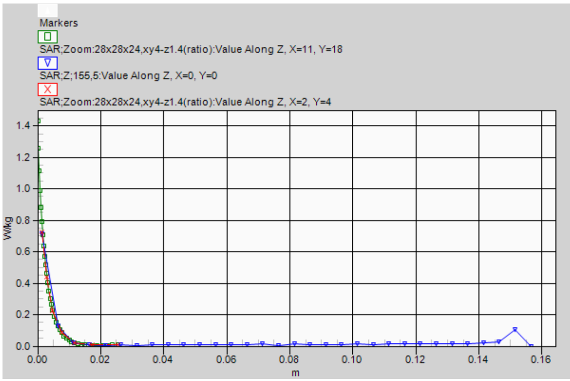
DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(5.14, 5.14, 5.14) @ 5320 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0, 156.0

touch2/5h3,53.3.5320,frt-top,a(6m)/
Area:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.382 W/kg
Area:60x60,10 (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 0.578 W/kg
Z;155,5 (1x1x32): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 0.713 W/kg

Zoom:28x28x24,xy4-z1.4(ratio) (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Reference Value = 12.88 V/m; Power Drift = -0.07 dB; Maximum value of SAR (measured) = 0.724 W/kg; Peak SAR (extrapolated) = 1.43 W/kg

SAR(1 g) = 0.259 W/kg; SAR(10 g) = 0.076 W/kg (*. Smallest distance from peaks to all points 3 dB below = 4 mm; Ratio of SAR at M2 to SAR at M1 = 60.5%)





Remarks: *. Date tested: 2022/3/2; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: (23~24) deg.C. / (50~70) %RH,
*. liquid temperature: 22.6(start)/22.6(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

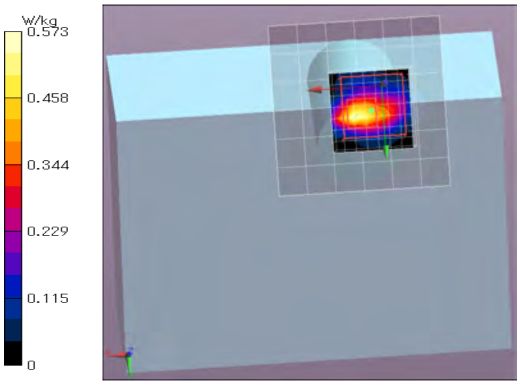
APPENDIX 2: SAR Measurement data / Appendix 2-1: Worst Reported (Scaled) SAR Plot (cont'd)

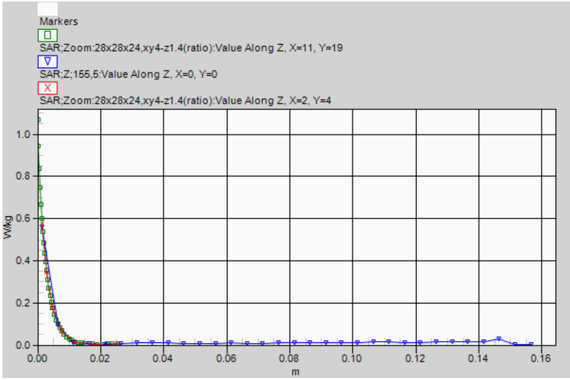
Plot 2b-1: U-NII-1 (5.2 GHz) band, Front-upper & touch / 11a (6Mbps) / 5240 MHz
EUT: WLAN/BT Combo Module (Digital Camera); Type: ES204 (DS126861); Serial: AT220107-B24 (001019000134)
Mode: 11a (6Mbps, OFDM) (UID: 0, Wi-fi_5GHz (0), Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 5240 MHz; Crest Factor: 1.0**
Medium: HSL5GHz(v6.2203); Medium parameters used: f = 5240 MHz; σ = 4.5 S/m; ε_r = 35.51; ρ = 1000 kg/m^3
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(5.14, 5.14, 5.14) @ 5240 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0, 156.0

touch3/5h13,52.3.5240,frt-top,a(6m)/
Area:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.400 W/kg
Area:60x60,10 (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 0.454 W/kg
Z;155,5 (1x1x32): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 0.559 W/kg

Zoom:28x28x24,xy4-z1.4(ratio) (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Reference Value = 11.15 V/m; Power Drift = -0.10 dB; Maximum value of SAR (measured) = 0.573 W/kg; Peak SAR (extrapolated) = 1.07 W/kg
SAR(1 g) = 0.201 W/kg; SAR(10 g) = 0.060 W/kg (*. Smallest distance from peaks to all points 3 dB below = 4.3 mm; Ratio of SAR at M2 to SAR at M1 = 60.4%)





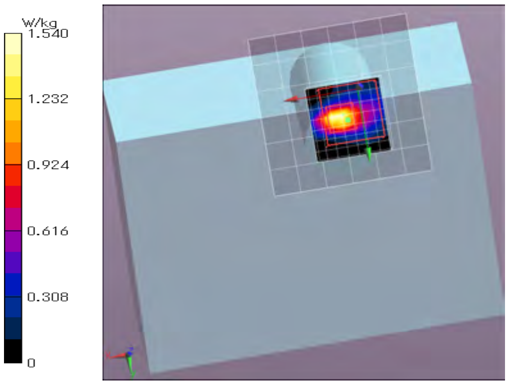
Remarks: *. Date tested: 2022/3/2; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: (23~24) deg.C. / (50~70) %RH,
*. liquid temperature: 22.6(start)/22.6(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

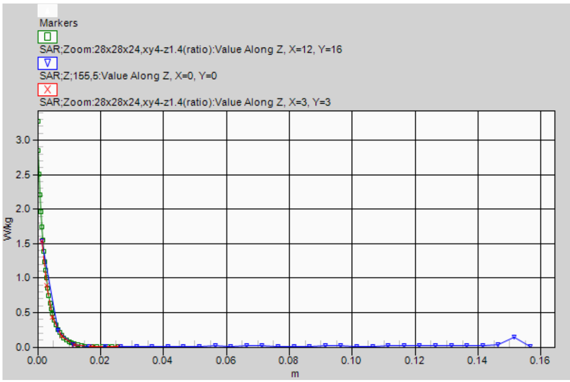
Plot 3-1: U-NII-2C (5.6 GHz) band, Front-upper & touch / 11a (6Mbps) / 5700 MHz
EUT: WLAN/BT Combo Module (Digital Camera); Type: ES204 (DS126861); Serial: AT220107-B24 (001019000134)
Mode: 11a (6Mbps, OFDM) (UID: 0, Wi-fi_5GHz (0), Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 5700 MHz; Crest Factor: 1.0**
Medium: HSL5GHz(v6.2203); Medium parameters used: f = 5700 MHz; σ = 4.999 S/m; ε_r = 34.79; ρ = 1000 kg/m^3
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(4.56, 4.56, 4.56) @ 5700 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0, 156.0

touch2/5h4,56.1.5700,frt-top,a(6m)/
Area:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.670 W/kg
Area:60x60,10 (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 0.962 W/kg
Z;155,5 (1x1x32): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 1.54 W/kg

Zoom:28x28x24,xy4-z1.4(ratio) (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Reference Value = 18.28 V/m; Power Drift = -0.12 dB; Maximum value of SAR (measured) = 1.54 W/kg; Peak SAR (extrapolated) = 3.27 W/kg
SAR(1 g) = 0.505 W/kg; SAR(10 g) = 0.123 W/kg (*. Smallest distance from peaks to all points 3 dB below = 4 mm; Ratio of SAR at M2 to SAR at M1 = 58.2%)





Remarks: *. Date tested: 2022/3/3; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: (23~24) deg.C. / (50~70) %RH,
*. liquid temperature: 22.6(start)/22.6(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

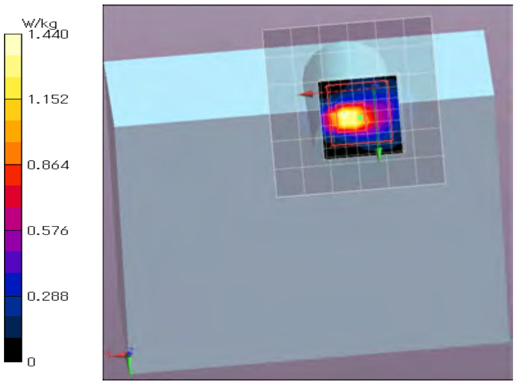
APPENDIX 2: SAR Measurement data / Appendix 2-1: Worst Reported (Scaled) SAR Plot (cont'd)

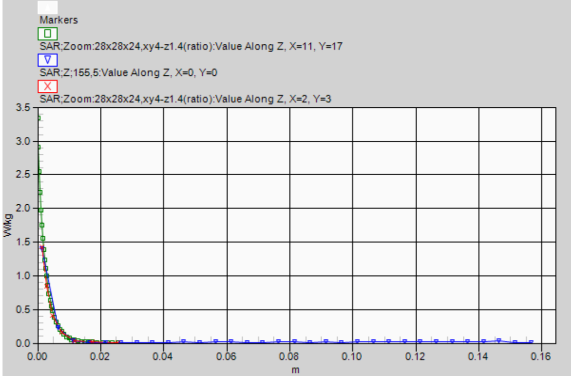
Plot 4-1: U-NII-3 (5.8 GHz) band, Front-upper & touch / 11a (6Mbps) / 5825 MHz
EUT: WLAN/BT Combo Module (Digital Camera); Type: ES204 (DS126861); Serial: AT220107-B24 (001019000134)
Mode: 11a (6Mbps, OFDM) (UID: 0, Wi-fi_5GHz (0), Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 5825 MHz; Crest Factor: 1.0**
Medium: HSL5GHz(v6.2203); Medium parameters used (interpolated): f = 5825 MHz; σ = 5.15 S/m; ε_r = 34.58; ρ = 1000 kg/m^3
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(4.6, 4.6, 4.6) @ 5825 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0, 156.0

touch3/5h8,58.1.5825,frt-top,a(6m)/
Area:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.802 W/kg
Area:60x60,10 (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 0.976 W/kg
Z;155,5 (1x1x32): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 1.41 W/kg

Zoom:28x28x24,xy4-z1.4(ratio) (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Reference Value = 17.51 V/m; Power Drift = -0.11 dB; Maximum value of SAR (measured) = 1.44 W/kg; Peak SAR (extrapolated) = 3.34 W/kg
SAR(1 g) = 0.508 W/kg; SAR(10 g) = 0.127 W/kg (*. Smallest distance from peaks to all points 3 dB below = 4 mm; Ratio of SAR at M2 to SAR at M1 = 59.1%)





Remarks: *. Date tested: 2022/3/3; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: (23~24) deg.C. / (50~70) %RH,
*. liquid temperature: 22.6(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

APPENDIX 3: Test instruments

Appendix 3-1: Equipment used

Test Name	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Calibration Last Date	Interval (Month)
AT	SAT10-SARP1	160520	Attenuator	Weinschel - API Technologies Corp	4M-10	-	2021/12/01	12
AT	SDPS-06	188161	Power Supply(DC)	GW Instek	PW16-5ADP	18026330	-	-
AT	SOS-26	191844	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
AT	SPM-13	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2021/01/25	12
AT	SPSS-06	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2021/01/25	12

*. AT (antenna terminal conducted power measurement) was measured January 7, 2022. (Refer to Section 5 in this report.)

Test Name	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Calibration Last Date	Interval (Month)
SAR	COTS-SSAR-02	144885	DASY52 software	Schmid&Partner Engineering AG	DASY5 PRO	Ver.52.10.3.1513	-	-
SAR	COTS-SSEP-02	144886	Dielectric assessment software	Schmid&Partner Engineering AG	DAK	Ver.DAK1.10.317.11	-	-
SAR	KAT10-P1	144882	Attenuator	Weinschel - API Technologies Corp	24-10-34	BY5927	2021/12/01	12
SAR	KCPL-07	146100	Directional Coupler	Pulsar Microwave Corp.	CCS30-B26	621	-	-
SAR	KDAE-01	144944	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	626	2021/12/08	12
SAR	KIU-08	145059	Power sensor	Rohde & Schwarz	NRV-Z4	100372	2021/09/18	12
SAR	KIU-09	145099	Power sensor	Rohde & Schwarz	NRV-Z4	100371	2021/09/18	12
SAR	KOS-14	144986	Thermo-Hygrometer data logger	SATO KEIRYOKI	SK-L200THIIα/SK-LTHIIα-2	015246/08169	2021/10/13	12
SAR	KPA-12	145359	RF Power Amplifier	Milmega	AS2560-50	1018582	-	-
SAR	KPFL-01	145560	Flat Phantom	Schmid&Partner Engineering AG	Oval flat phantom ELI 4.0	1059	2021/08/18	12
SAR	KPM-05	144988	Power meter	Keysight Technologies Inc	E4417A	GB41290718	2021/04/09	12
SAR	KPM-06	144989	Power Meter	Rohde & Schwarz	NRVD	101599	2021/09/18	12
SAR	KPSS-01	144990	Power sensor	Keysight Technologies Inc	E9327A	US40440544	2021/04/09	12
SAR	KRU-04	145086	Ruler(300mm)	SHINWA	13134	-	2022/02/16	12
SAR	KRU-05	145087	Ruler(100x50mm,L)	SHINWA	12101	-	2022/02/16	12
SAR	KSDA-01	145090	Dipole Antenna	Schmid&Partner Engineering AG	D2450V2	822	2021/12/09	12
SAR	KSDA-02	145091	Dipole Antenna	Schmid&Partner Engineering AG	D5GHzV2	1070	2021/04/20	12
SAR	KSDH-01	145596	Device holder	Schmid&Partner Engineering AG	Mounting device for transmitter	-	2021/09/14	12
SAR	KSG-08	145109	Signal Generator	Rohde & Schwarz	SMT06	100763	2021/09/19	12
SAR	SALC-01	146112	Primepure Ethanol	Kanto Chemical Co., Inc.	14032-79	-	-	-
SAR	SAT20-SARP1	160521	Attenuator	Weinschel - API Technologies Corp	4M-20	-	2021/12/01	12
SAR	SAT6-SAR1	145160	Attenuator	Huber+Suhner	6806.17.A	766429-1	2021/12/01	12
SAR	SCC-SAR2	145405	Coaxial Cable	Huber+Suhner	SF104A/11PC3542/11N451/4M	MY699/4A	2021/12/01	12
SAR	SEPP-02	145500	Dielectric probe	Schmid&Partner Engineering AG	DAK3.5	1129	2021/04/14	12
SAR	SOS-26	191844	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
SAR	SOS-SAR2	201967	Digital thermomoter	HANNA	Checktemp-4	A01440226111	2021/10/13	12
SAR	SOS-SAR3	201968	Digital thermomoter	HANNA	Checktemp-4	A01310946111	2021/10/13	12
SAR	SPB-02	146235	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV4	3907	2021/04/21	12
SAR	SRU-06	150560	Measuring Tool, Ruler	SHINWA	14001	--	2022/02/16	12
SAR	SSA-04	146176	Spectrum Analyzer	ADVANTEST	R3272	101100994	-	-
SAR	SSAR-02	146177	SAR measurement system	Schmid&Partner Engineering AG	DASY5	1324	-	-
SAR	SSLHV6-01	207714	Head Tissue Simulating Liquid	Schmid&Partner Engineering AG	HBBL600-10000V6	SL AAH U16 BC	-	-
SAR	SSNA-01	146258	Network Analyzer	Keysight Technologies Inc	8753ES	US39171777	2021/11/09	12
SAR	SSRBT-02	145621	SAR robot	Schmid&Partner Engineering AG	TX60 Lspeag	F12/5L2QA1/A/01	2021/09/14	12
SAR	SWTR-03	146185	DI water	MonotaRo	34557433	-	-	-

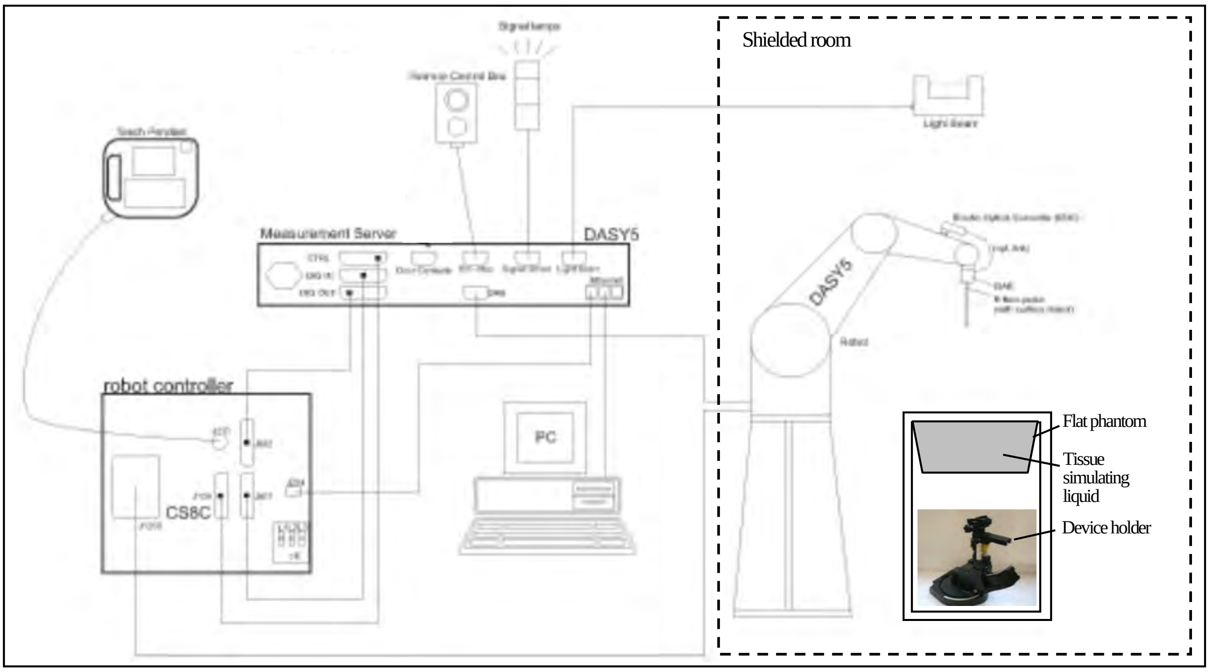
*. Local ID: SALC-01, the parameters of primepure Ethanol (as reference liquid) used for the simulated tissue parameter confirmation was defined the NPL Report MAT23 (http://www.npl.co.uk/content/conpublication/4295)

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

Appendix 3-2: Configuration and peripherals

These measurements were performed with the automated near-field scanning system DASY5 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 ± 0.02 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.



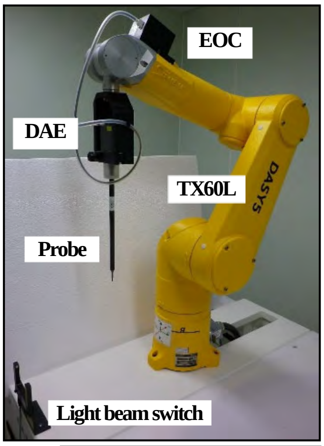
The DASY5 system for performing compliance tests consist of the following items:

1	A standard high precision 6-axis robot (Stäubli TX/RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
2	An isotropic field probe optimized and calibrated for the targeted measurement.
3	A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4	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.
5	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.
6	The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
7	A computer running Win7 professional operating system and the DASY5 software.
8	R Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
9	The phantom.
10	The device holder for EUT. (low-loss dielectric palette) (*. when it was used.)
11	Tissue simulating liquid mixed according to the given recipes.
12	Validation dipole kits allowing to validate the proper functioning of the system.

Appendix 3-3: Test system specification

TX60 Lsepag robot/CS8Csepag-TX60 robot controller

- Number of Axes : 6 •Repeatability : ±0.02 mm
- Manufacture : Stäubli Unimation Corp.



DASY5 Measurement server

- Features : The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV Celeron, 128MB chip-disk and 128MB RAM. The necessary circuits for communication with the DAE4 electronics box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY5 I/O board, which is directly connected to the PC/104 bus of the CPU board.
- Calibration : No calibration required.
- Manufacture : Schmid & Partner Engineering AG

Data Acquisition Electronic (DAE)

- Features : Signal amplifier, multiplexer, A/D converter and control logic.
  Serial optical link for communication with DASY5 embedded system (fully remote controlled).
  2 step probe touch detector for mechanical surface detection and emergency robot stop (not in -R version)
- Measurement Range : 1 μV to > 200 mV (16bit resolution and 2 range settings: 4 mV, 400 mV)
- Input Offset voltage : < 1 μV (with auto zero)
- Input Resistance : 200 MΩ
- Battery Power : > 10 hrs. of operation (with two 9 V battery)
- Manufacture : Schmid & Partner Engineering AG

Electro-Optical Converter (EOC61)

- Manufacture : Schmid & Partner Engineering AG

Light Beam Switch (LB5/80)

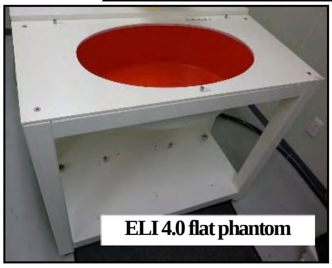
- Manufacture : Schmid & Partner Engineering AG

SAR measurement software

- Item : Dosimetric Assessment System DASY5
- Software version : Refer to Appendix 3-1 (Equipment used)
- Manufacture : Schmid & Partner Engineering AG

E-Field Probe

- Model : EX3DV4 (serial number: 3907)
- Construction : Symmetrical design with triangular core.
  Built-in shielding against static charges.
  PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
- Frequency : 10MHz to 6GHz, Linearity: ±0.2 dB (30MHz to 6GHz)
- Conversion Factors (CF) : Head: (2.45, 5.25, 5.6, 5.8) GHz
  : Body: (2.45, 5.25, 5.6, 5.75) GHz
- Directivity : ±0.3 dB in HSL (rotation around probe axis)
  ±0.5 dB in tissue material (rotation normal to probe axis)
- Dynamic Range : 10μW/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 6GHz with precision of better 30%.
- Manufacture : Schmid & Partner Engineering AG



Phantom

- Model Number : <u>**ELI 4.0 oval flat phantom**</u>
- Shell Material : Fiberglass •Shell Thickness : Bottom plate: 2 ±0.2 mm
- Dimensions : Bottom elliptical: 600×400 mm, Depth: 190 mm (Volume: Approx. 30 liters)
- Manufacture : Schmid & Partner Engineering AG

Device Holder

☒ Urethane foam

☒ Device holder: In combination with the ELI4, 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 62209-2.
•Material : Polyoxymethylene (POM), PET-G, Foam
•Manufacture : Schmid & Partner Engineering AG

Data storage and evaluation (postprocessing)

The DASY5 software stores the measured voltage acquired by the Data Acquisition Electronics (DAE) as raw data together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and communication system parameters) in measurement files with the extension ".da5x". The postprocessing software evaluates the data every time the data is visualized or exported.
The fields and SAR are calculated from the measured voltage (probe voltage acquired by the DAE) and the following parameters:

Probe parameters:	- Sensitivity	*normi, ai0, ai1, ai2*
	- Conversion Factor	*convFi*
	- Diode Compression Point	*dcpi*
	- Probe Modulation Response Factors	*ai, bi, ci, d*
Device parameters:	- Frequency	*f*
	- Crest factor	*cf*
Media parameters:	- Conductivity	σ
	- Relative Permittivity	ρ

This parameters are stored in the DASY5 V52 measurement file.
These parameters must be correctly set in the DASY5 V52 software setup. They are available as configuration file and can be imported into the measurement file. The values displayed in the multimeter window are assessed using the parameters of the actual system setup. In the scan visualization and export modes, the parameters stored in the measurement file are used.
The measured voltage is not proportional to the exciting. It must be first linearized.

Approximated Probe Response Linearization using Crest Factor;
This linearization method is enabled when a custom defined communication system is measured. The compensation applied is a function of the measured voltage, the detector diode compression point and the crest factor of the measured signal.

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

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

The resulting linearized voltage is only approximated because the probe is not calibrated to this specific signal.

Field and SAR Calculation
The primary field data for each channel are calculated using the linearized voltage:

$$\text{E} - \text{fieldprobes}: \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

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

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

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

Appendix 3-4: Simulated tissue composition and parameter confirmation

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) (*1)				
Manufacture	Schmid & Partner Engineering AG	Note: *1. speag_920-SLAAxyy-E_1.12.15CL (Maintenance of tissue simulating liquid)			

*. The dielectric parameters were checked prior to assessment using the DAK3.5 dielectric probe kit.

Date measured	Frequency [MHz]	Liquid type	Ambient/		Liquid temp.	Liquid depth of phantom	Liquid parameters (*a)										ΔSAR (*b)	
							Permittivity (εr) [-]					Conductivity [S/m]					1g [%]	10g [%]
			[deg.C.]	[%RH]	[deg.C.]	[mm]	Target	Meas.	Δεr[%]	Limit	Δend, >48hrs	Target	Meas.	Δσ[%]	Limit	Δend, >48hrs		
March 2, 2022 (Used until March 3)	2450	Head	23	40~50	22.5	150	***39.2***	39.99	2.0	10%	-	***1.80***	1.833	1.8	10%	-	0.4	0.2
	5250	Head					***35.93***	35.51	-1.2	10%	-	***4.706***	4.510	-4.2	10%	-	0.4	0.5
	5600	Head					***35.53***	34.93	-1.7	10%	< 48 hrs.	***5.065***	4.890	-3.5	10%	< 48 hrs.	0.5	0.6
	5800	Head					***35.3***	34.58	-2.0	10%	< 48 hrs.	***5.27***	5.113	-3.0	10%	< 48 hrs.	0.5	0.6

*. Calculating formula: Δend(>48 hrs.) (%) = {(dielectric properties, end of test series) / (dielectric properties, beginning of test series) -1} × 100

*a. The target values of (2000, 2450, 3000 and 5800) MHz are parameters defined in Appendix A of KDB 865664 D01. For other frequencies, the target nominal dielectric values shall be obtained by linear interpolation between the higher and lower tabulated figures.

Standard										*Interpolated & Extrapolated*									
f (MHz)	Head Tissue		Body Tissue		f (MHz)	Head Tissue		Body Tissue		f (MHz)	Head Tissue		Body Tissue		f (MHz)	Head Tissue		Body Tissue	
	εr	σ [S/m]	εr	σ [S/m]		εr	σ [S/m]	εr	σ [S/m]		εr	σ [S/m]	εr	σ [S/m]		εr	σ [S/m]	εr	σ [S/m]
(1800-)2000	**40.0**	**1.40**	**53.3**	**1.52**	3000	**38.5**	**2.40**	**52.0**	**2.73**	*5250*	*35.93*	*4.706*	*48.95*	*5.358*	*5750*	*35.36*	*5.219*	*48.27*	*5.942*
2450	**39.2**	**1.80**	**52.7**	**1.95**	5800	**35.3**	**5.27**	**48.2**	**6.00**	*5600*	*35.53*	*5.065*	*48.47*	*5.766*					

*b. The coefficients are parameters defined in IEEE Std. 1528-2013.

$\Delta SAR(1g) = C\varepsilon r \times \Delta\varepsilon r + C\sigma \times \Delta\sigma$, $C\varepsilon r = -7.854E\text{-}4 \times f^3 + 9.402E\text{-}3 \times f^2 - 2.742E\text{-}2 \times f - 0.2026$ / $C\sigma = 9.804E\text{-}3 \times f^3 - 8.661E\text{-}2 \times f^2 + 2.981E\text{-}2 \times f + 0.7829$

$\Delta SAR(10g) = C\varepsilon r \times \Delta\varepsilon r + C\sigma \times \Delta\sigma$, $C\varepsilon r = 3.456 \times 10^{-3} \times f^3 - 3.531 \times 10^{-2} \times f^2 + 7.675 \times 10^{-2} \times f - 0.1860$ / $C\sigma = 4.479 \times 10^{-3} \times f^3 - 1.586 \times 10^{-2} \times f^2 - 0.1972 \times f + 0.7717$

Appendix 3-5: Daily 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.

Date	Frequency [MHz]	ΔSAR			Daily check results (*. Meas.: Measured, Cal.: Calibration value, STD: Standard value)																	
					SAR (1g) [W/kg] (*d)									SAR (10g) [W/kg] (*d)								
		Liquid Type	1g [%]	10g [%]	Meas. (*c)	ΔSAR-correct	1W scaled	Target Cal. (*e)	Target STD (*f)	Deviation Cal. [%]	Deviation STD [%]	Limit [%]	Pass ?	Meas. (*c)	ΔSAR-correct	1W scaled	Target Cal. (*e)	Target STD (*f)	Deviation Cal. [%]	Deviation STD [%]	Limit [%]	Pass ?
March 2, 2022	2450	Head	0.4	0.2	13.2	13.15	52.6	52	52.4	1.2	0.4	±10	Pass	6.13	6.12	24.48	24.4	24	0.3	2.0	±10	Pass
March 2, 2022	5250	Head	0.4	0.5	7.72	7.69	76.9	78.8	n/a	-2.4	-	±10	Pass	2.22	2.21	22.1	22.6	n/a	-2.2	-	±10	Pass
March 3, 2022	5600	Head	0.5	0.6	8.26	8.22	82.2	82.4	n/a	-0.2	-	±10	Pass	2.34	2.33	23.3	23.4	n/a	-0.4	-	±10	Pass
March 3, 2022	5800	Head	0.5	0.6	8.06	8.02	80.2	80.1	78	0.1	2.8	±10	Pass	2.29	2.28	22.8	22.5	21.9	1.3	4.1	±10	Pass

*. Calculating formula:
ΔSAR corrected SAR (1g,10g) (W/kg) = (Measured SAR(1g,10g) (W/kg)) × (100 - (ΔSAR(%)) / 100

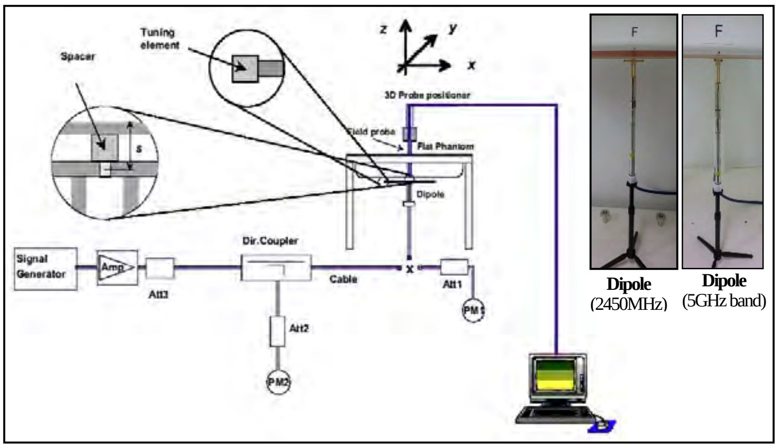
*c. The "Meas. (Measured)" SAR value is obtained at 250 mW for 2450MHz, 100 mW for (5250, 5600, 5800) MHz

*d. 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 manufacturer's calibration target value which was normalized.

*e. The target value is a parameter defined in the calibration data sheet of D2450V2 (sn:822) and D5GHZV2 (sn:1070) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D2450V2-822_Dec21 and D5GHzV2-1070_Apr21, the data sheet was filed in this report).

*f. The target value (normalized to 1W) is defined in IEEE Std.1528.

Test setup for the system performance check->



Dipole (2450MHz)
Dipole (5GHz band)

Appendix 3-6: Daily check measurement data

Photographs of Liquid depth
150 mm (Liquid type: Head, March 2, 2021)

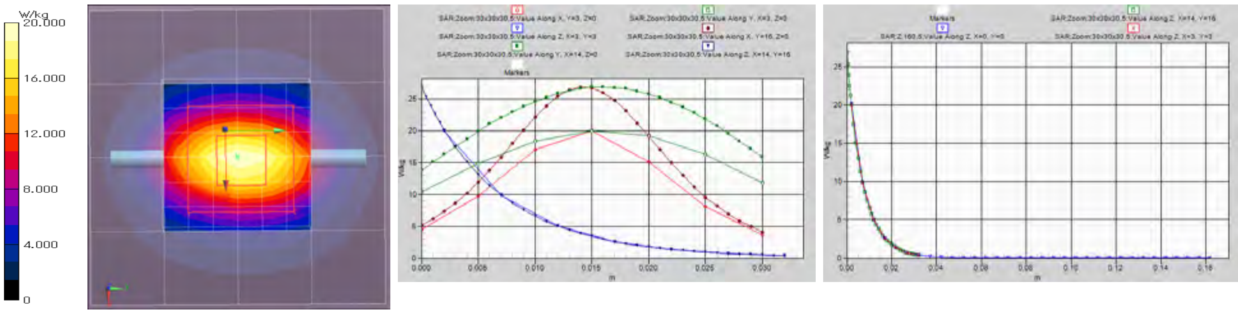
EUT: Diploe(2.4GHz)-822; Type: D2450V2; Serial: 822; Power: 250 mW

Communication System: CW (0) (*.UID: 0, Frame Length in ms: 0; Communication System PAR: 0; PMF: 1) **; Frequency: 2450 MHz; Crest Factor: 1.0**
Medium: HSL5GHz(v6.2203); Medium parameters used: f = 2450 MHz; σ = 1.833 S/m; $ε_r$ = 39.99; ρ = 1000 kg/m³
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(7.35, 7.35, 7.35) @ 2450 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0, 161.0

Area:60x60,15 (5x5x1): Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (measured) = 19.7 W/kg
Area:60x60,15 (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm; Maximum value of SAR (interpolated) = 19.7 W/kg
Z;160,5 (1x1x33): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 20.2 W/kg

Zoom:30x30x30,5 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 105.4 V/m; Power Drift = 0.07 dB; Maximum value of SAR (measured) = 20.0 W/kg; Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.13 W/kg (*. Smallest distance from peaks to all points 3 dB below = 9 mm; Ratio of SAR at M2 to SAR at M1 = 49.4%)



Remarks: *. Date tested: 2022/3/2; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of dipole to phantom: 8mm (10mm to liquid); ambient: (24) deg.C. / (45~55) %RH,
*. liquid temperature: 22.3(start)/22.3(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

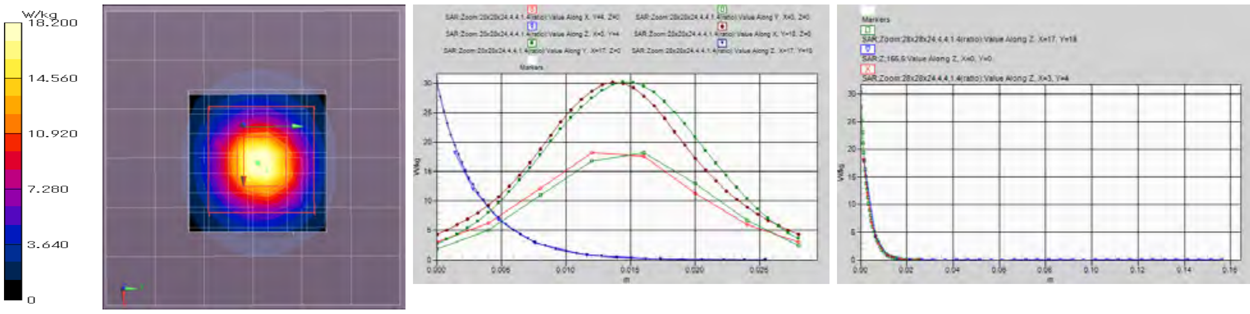
EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070; Power: 100mW

Communication System: CW (0) (*.UID: 0, Frame Length in ms: 0; Communication System PAR: 0; PMF: 1) **; Frequency: 5250 MHz; Crest Factor: 1.0**
Medium: HSL5GHz(v6.2203); Medium parameters used: f = 5250 MHz; σ = 4.51 S/m; $ε_r$ = 35.51; ρ = 1000 kg/m³
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(5.14, 5.14, 5.14) @ 5250 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0, 156.0

Area:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 18.1 W/kg
Area:60x60,10 (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 18.7 W/kg
Z;155,5 (1x1x32): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 18.0 W/kg

Zoom:28x28x24,4,4,1.4(ratio) (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Reference Value = 69.62 V/m; Power Drift = 0.10 dB; Maximum value of SAR (measured) = 18.2 W/kg; Peak SAR (extrapolated) = 30.2 W/kg
SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.22 W/kg (*. Smallest distance from peaks to all points 3 dB below = 7.2 mm; Ratio of SAR at M2 to SAR at M1 = 66.1%)



Remarks: *. Date tested: 2022/3/2; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of dipole to phantom: 8mm (10mm to liquid); ambient: (24) deg.C. / (45~55) %RH,
*. liquid temperature: 22.3(start)/22.3(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

Appendix 3-6: Daily check measurement data (cont'd)

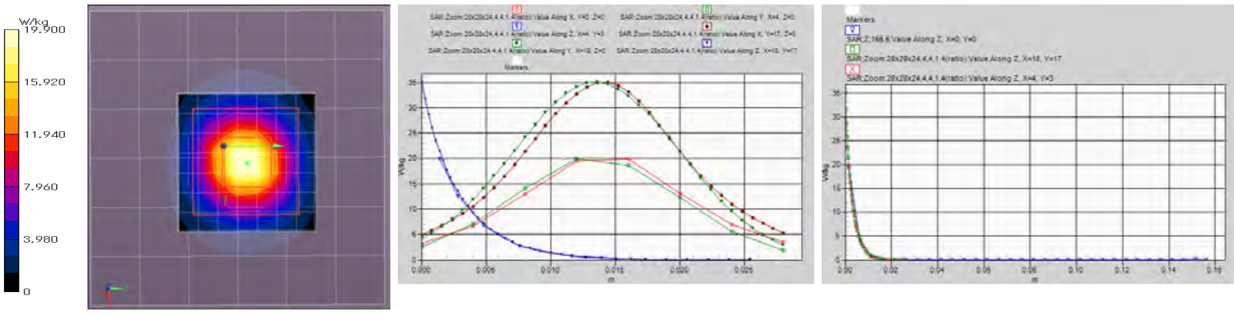
Photographs of Liquid depth
150 mm (Liquid type: Head, March 3, 2021)

EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070; Power: 100mW
Communication System: CW (0) (*.UID: 0, Frame Length in ms: 0; Communication System PAR: 0; PMF: 1) **; Frequency: 5600 MHz; Crest Factor: 1.0**
Medium: HSL5GHz(v6.2203); Medium parameters used: f = 5600 MHz; σ = 4.89 S/m; $ε_r$ = 34.93; ρ = 1000 kg/m^3
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(4.56, 4.56, 4.56) @ 5600 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0, 156.0

Area:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 20.6 W/kg
Area:60x60,10 (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 21.4 W/kg
Z;155,5 (1x1x32): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 19.8 W/kg

Zoom:28x28x24,4,4,1.4(ratio) (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Reference Value = 71.36 V/m; Power Drift = 0.03 dB; Maximum value of SAR (measured) = 19.9 W/kg; Peak SAR (extrapolated) = 35.1 W/kg
SAR(1 g) = 8.26 W/kg; SAR(10 g) = 2.34 W/kg (*. Smallest distance from peaks to all points 3 dB below = 7.2 mm; Ratio of SAR at M2 to SAR at M1 = 63.4%)



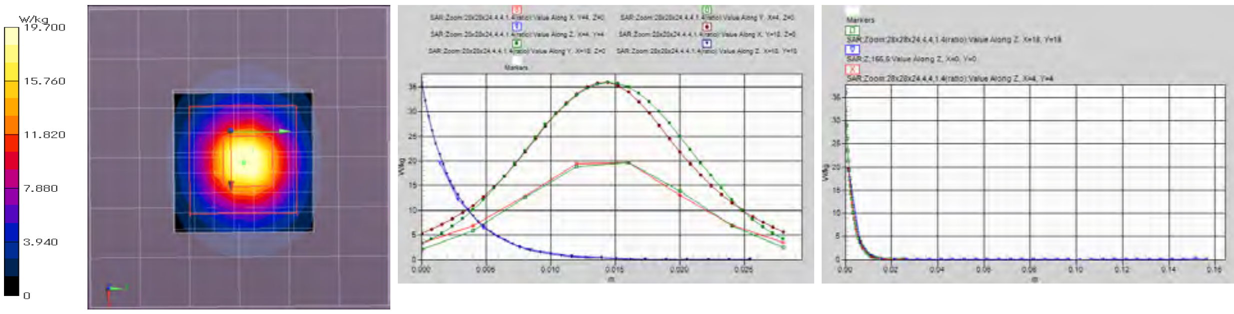
Remarks: *. Date tested: 2022/3/3; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of dipole to phantom: 8mm (10mm to liquid); ambient: (24) deg.C. / (45~60) %RH,
*. liquid temperature: 22.3(start)/22.3(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070; Power: 100mW
Communication System: CW (0) (*.UID: 0, Frame Length in ms: 0; Communication System PAR: 0; PMF: 1) **; Frequency: 5800 MHz; Crest Factor: 1.0**
Medium: HSL5GHz(v6.2203); Medium parameters used: f = 5800 MHz; σ = 5.113 S/m; $ε_r$ = 34.58; ρ = 1000 kg/m^3
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Electronics: DAE4 Sn626; Calibrated: 2021/12/08 / -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474) / -Probe: EX3DV4 - SN3907; ConvF(4.6, 4.6, 4.6) @ 5800 MHz; Calibrated: 2021/04/21
-Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0, 156.0

Area:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 20.3 W/kg
Area:60x60,10 (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 20.9 W/kg
Z;155,5 (1x1x32): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 19.6 W/kg

Zoom:28x28x24,4,4,1.4(ratio) (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Reference Value = 69.24 V/m; Power Drift = 0.03 dB; Maximum value of SAR (measured) = 19.7 W/kg; Peak SAR (extrapolated) = 36.0 W/kg
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.29 W/kg (*. Smallest distance from peaks to all points 3 dB below = 7.2 mm; Ratio of SAR at M2 to SAR at M1 = 62%)



Remarks: *. Date tested: 2022/3/3; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 150 mm; Position: distance of dipole to phantom: 8mm (10mm to liquid); ambient: (24) deg.C. / (45~60) %RH,
*. liquid temperature: 22.3(start)/22.3(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

Appendix 3-7: Uncertainty Assessment (SAR measurement/Daily check)

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

Uncertainty of SAR measurement (2.4GHz~6GHz) (*.v6h,ε&σ: 10%, DAK3.5, Tx: ≈100% duty cycle) (v09r02)	1g SAR	10g SAR
Combined measurement uncertainty of the measurement system (k=1)	± 13.2 %	± 13.1 %
Expanded uncertainty (k=2)	± 26.4 %	± 26.2 %

	Error Description (2.4-6GHz)	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g)	ui (10g)	Vi, veff
A	**Measurement System** (DASY5)						(std. uncertainty)	(std. uncertainty)	
1	Probe Calibration Error	±7.0 %	Normal	1	1	1	±7.0 %	±7.0 %	∞
2	Axial isotropy Error	±4.7 %	Rectangular	√3	0.71	0.71	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy Error	±9.6 %	Rectangular	√3	0.71	0.71	±3.9 %	±3.9 %	∞
4	Linearity Error	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
5	Probe modulation response (v09)	±5.5 %	Rectangular	√3	1	1	±3.2 %	±3.2 %	∞
6	Sensitivity Error (detection limit)	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	Boundary effects Error	±4.3%	Rectangular	√3	1	1	±2.5 %	±2.5 %	∞
8	Readout Electronics Error(DAE)	±0.3 %	Rectangular	√3	1	1	±0.3 %	±0.3 %	∞
9	Response Time Error	±0.8 %	Normal	1	1	1	±0.5 %	±0.5 %	∞
10	Integration Time Error (≈100% duty cycle)	±0 %	Rectangular	√3	1	1	0 %	0 %	∞
11	RF ambient conditions-noise (v09)	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
12	RF ambient conditions-reflections	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
13	Probe positioner mechanical tolerance	±3.3 %	Rectangular	√3	1	1	±1.9 %	±1.9 %	∞
14	Probe Positioning with respect to phantom shell	±6.7 %	Rectangular	√3	1	1	±3.9 %	±3.9 %	∞
15	Max. SAR evaluation (Post-processing)	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
B	**Test Sample Related**								
16	Device Holder or Positioner Tolerance (v09)	±3.2 %	Normal	1	1	1	±3.2 %	±3.2 %	5
17	Test Sample Positioning Error (v09)	±2.1 %	Normal	1	1	1	±2.1 %	±2.1 %	10
18	Power scaling	±0 %	Rectangular	√3	1	1	±0 %	±0 %	∞
19	Drift of output power (measured, <0.2dB)	±5.0 %	Rectangular	√3	1	1	±2.9 %	±2.9 %	∞
C	**Phantom and Setup**								
20	Phantom uncertainty (shape, thickness tolerances)	±7.5 %	Rectangular	√3	1	1	±4.3 %	±4.3 %	∞
21	Algorithm for correcting SAR (e',σ: 10%)	±1.9 %	Normal	1	1	0.84	±1.9 %	±1.6 %	∞
22	Measurement Liquid Conductivity Error (DAK3.5)	±3.0 %	Normal	1	0.78	0.71	±2.3 %	±2.1 %	7
23	Measurement Liquid Permittivity Error (DAK3.5)	±3.1 %	Normal	1	0.23	0.26	±0.7 %	±0.8 %	7
24	Liquid Conductivity-temp.uncertainty (≤2deg.C.v6h)	±3.0 %	Rectangular	√3	0.78	0.71	±1.4 %	±1.2 %	∞
25	Liquid Permittivity-temp.uncertainty (≤2deg.C.v6h)	±1.0 %	Rectangular	√3	0.23	0.26	±0.1 %	±0.2 %	∞
	Combined Standard Uncertainty (v09r02)						**± 13.2 %**	**± 13.1 %**	945
	Expanded Uncertainty (k=2) (v09r02)						**± 26.4 %**	**± 26.2 %**	

*. This measurement uncertainty budget is suggested by IEEE Std.1528(2013) and determined by Schmid & Partner Engineering AG (DASY5 Uncertainty Budget). Per KDB 865664 D01 (v01r04) SAR Measurement 100 MHz to 6 GHz, Section 2.8.1., when the highest measured SAR(1g) within a frequency band is < 1.5W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std.1528 (2013) is not required in SAR reports submitted for equipment approval.

Uncertainty of daily check (2.4~6GHz) (*.v6h,ε&σ tolerance: 10%, DAK3.5, CW) (v09r02)	1g SAR	10g SAR
Combined measurement uncertainty of the measurement system (k=1)	± 10.8 %	± 10.7 %
Expanded uncertainty (k=2)	± 21.6 %	± 21.4 %

	Error Description (2.4-6GHz)	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g)	ui (10g)	Vi, veff
A	**Measurement System** (DASY5)						(std. uncertainty)	(std. uncertainty)	
1	Probe Calibration Error	±7.0 %	Normal	1	1	1	±7.0 %	±7.0 %	∞
2	Axial isotropy error	±4.7 %	Rectangular	√3	0.71	0.71	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy error	±9.6 %	Rectangular	√3	0	0	0 %	0 %	∞
4	Probe linearity	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
5	Probe modulation response (CW)	±0.0 %	Rectangular	√3	1	1	0 %	0 %	∞
6	System detection limit	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	Boundary effects	±4.3 %	Rectangular	√3	1	1	±2.5 %	±2.5 %	∞
8	System readout electronics (DAE)	±0.3 %	Normal	1	1	1	±0.3 %	±0.3 %	∞
9	Response Time Error (<5ms/100ms wait)	±0.0 %	Rectangular	√3	1	1	0 %	0 %	∞
10	Integration Time Error (CW)	±0.0 %	Rectangular	√3	1	1	0 %	0 %	∞
11	RF ambient conditions-noise	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
12	RF ambient conditions-reflections	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
13	Probe positioner mechanical tolerance	±3.3 %	Rectangular	√3	1	1	±1.9 %	±1.9 %	∞
14	Probe positioning with respect to phantom shell	±6.7 %	Rectangular	√3	1	1	±3.9 %	±3.9 %	∞
15	Max. SAR evaluation (Post-processing)	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
B	**Test Sample Related**								
16	Deviation of the experimental source	±1.9 %	Normal	1	1	1	±1.9 %	±1.9 %	∞
17	Dipole to liquid distance (10mm±0.2mm,<2deg.)	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2 %	∞
18	Drift of output power (measured, <0.1dB)	±2.3 %	Rectangular	√3	1	1	±1.3 %	±1.3 %	∞
C	**Phantom and Setup**								
19	Phantom uncertainty	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2%	∞
20	Algorithm for correcting SAR (e',σ: 10%)	±1.9 %	Normal	1	1	0.84	±1.9 %	±1.6 %	∞
21	Liquid conductivity (meas.) (DAK3.5)	±3.0 %	Normal	1	0.78	0.71	±2.3 %	±2.1 %	∞
22	Liquid permittivity (meas.) (DAK3.5)	±3.1 %	Normal	1	0.23	0.26	±0.7 %	±0.8 %	∞
23	Liquid Conductivity-temp.uncertainty (≤2deg.C.v6h)	±3.0 %	Rectangular	√3	0.78	0.71	±1.4 %	±1.2 %	∞
24	Liquid Permittivity-temp.uncertainty (≤2deg.C.v6h)	±1.0 %	Rectangular	√3	0.23	0.26	±0.1 %	±0.2 %	∞
	Combined Standard Uncertainty (v09r02)						**±10.8 %**	**±10.7 %**	
	Expanded Uncertainty (k=2) (v09r02)						**±21.6 %**	**±21.4 %**	

*. This measurement uncertainty budget is suggested by IEEE Std. 1528(2013) and determined by Schmid & Partner Engineering AG (DASY5 Uncertainty Budget).

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

Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4)

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **UL Japan (RCC)**

Certificate No: **EX3-3907_Apr21**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3907
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes
Calibration date:	April 21, 2021

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)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
DAE4	SN: 660	23-Dec-20 (No. DAE4-660_Dec20)	Dec-21
Reference Probe ES3DV2	SN: 3013	30-Dec-20 (No. ES3-3013_Dec20)	Dec-21
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: April 24, 2021

Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

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.e., 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 ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect 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 with CW signal (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; Dx,y,z; VRx,y,z*: *A, B, C, D* 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 ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values 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 ± 50 MHz to ± 100 MHz.
- *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).

Certificate No: EX3-3907_Apr21 Page 2 of 10

Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.45	0.58	0.54	± 10.1 %
DCP (mV)[B]	102.7	97.5	99.0	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.6	± 3.5 %	± 4.7 %
		Y	0.0	0.0	1.0		129.4		
		Z	0.0	0.0	1.0		129.5		

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 Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-143.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

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)	Unc (k=2)
2450	39.2	1.80	7.35	7.35	7.35	0.41	0.90	± 12.0 %
5250	35.9	4.71	5.14	5.14	5.14	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.56	4.56	4.56	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.60	4.60	4.60	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies 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 cetermined 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
2450	52.7	1.95	7.44	7.44	7.44	0.36	0.95	± 12.0 %
5250	48.9	5.36	4.49	4.49	4.49	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.96	3.96	3.96	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.07	4.07	4.07	0.50	1.90	± 13.1 %

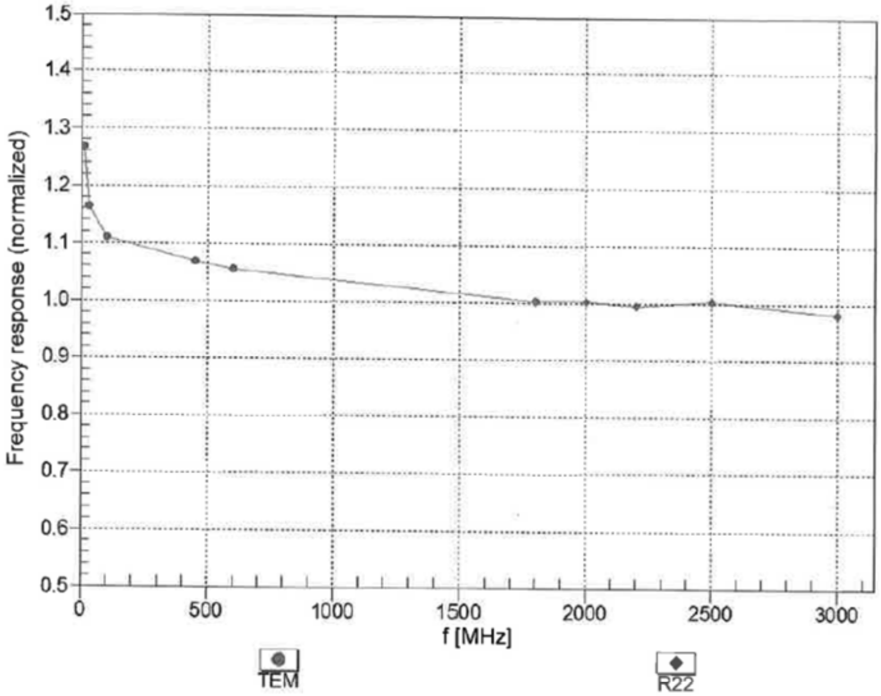
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

EX3DV4– SN:3907

April 21, 2021

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



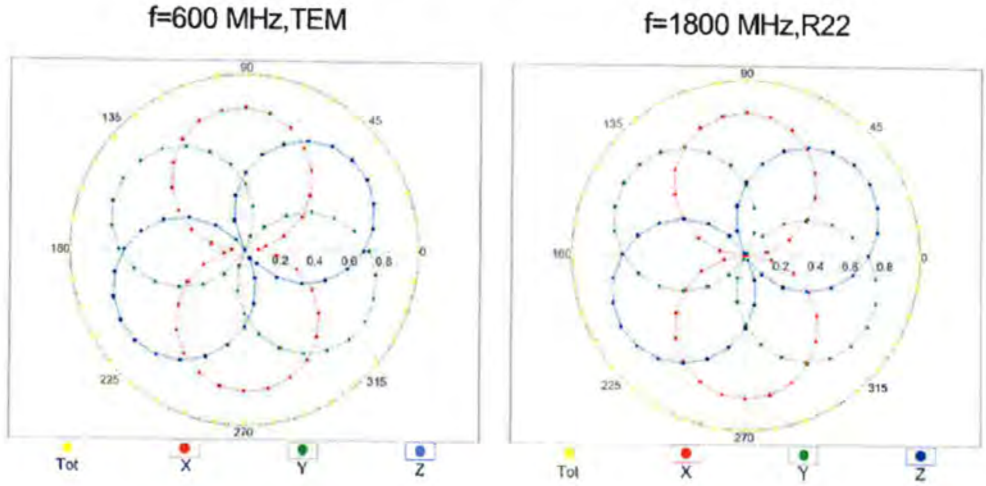
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

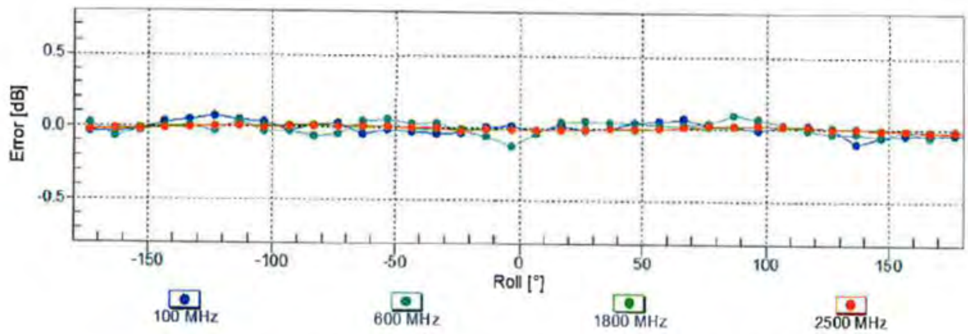
Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

EX3DV4– SN:3907

April 21, 2021

Receiving Pattern (ϕ), $\vartheta = 0°$





Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: EX3-3907_Apr21

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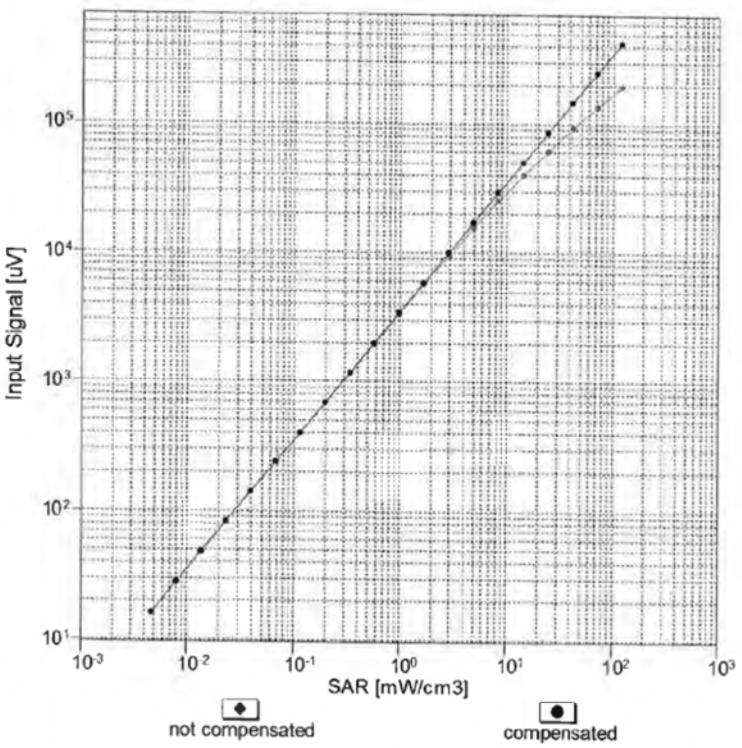
Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

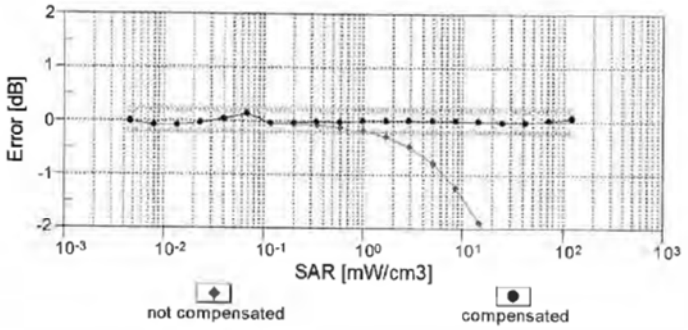
EX3DV4– SN:3907

April 21, 2021

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)

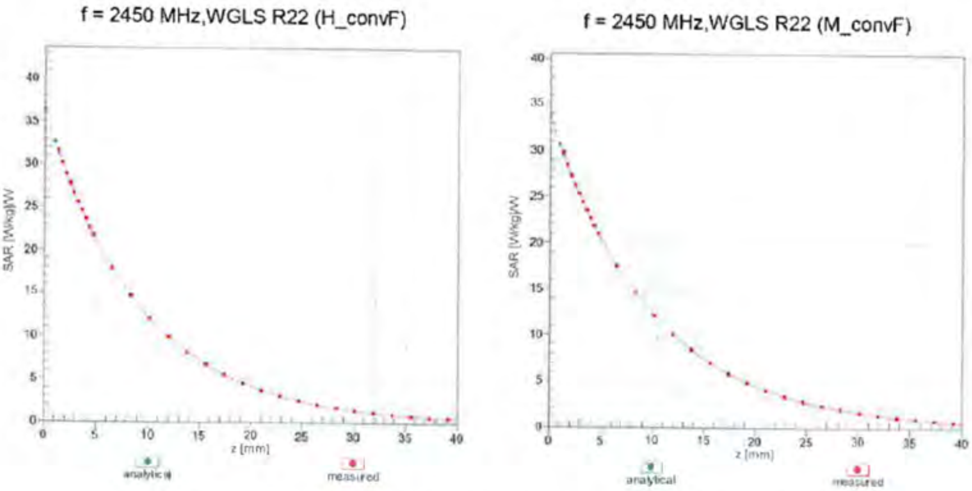




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

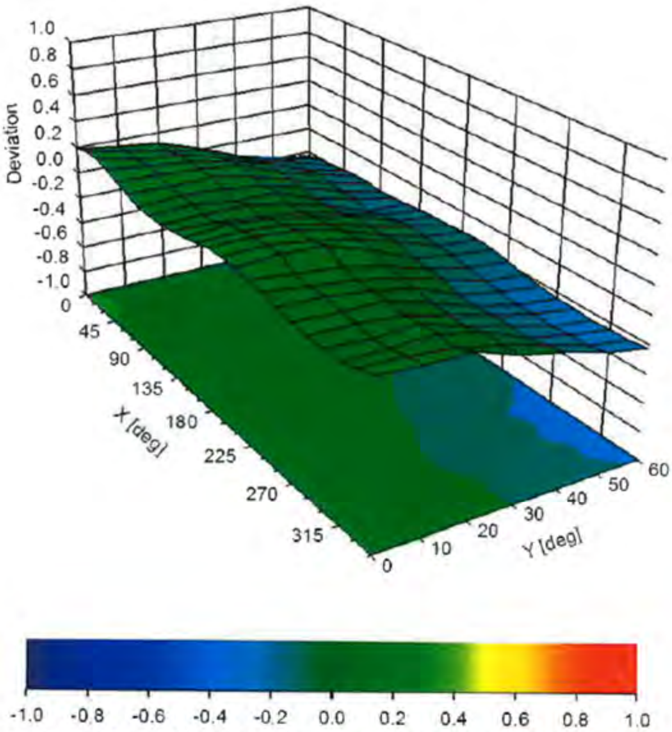
Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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