SAR TEST REPORT

Project No.	:	JB-Z0528-B
Client	:	Murata Manufacturing Co., Ltd.
Address	:	10-1 Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555 Japan
Type of Equipment	:	Communication Module
Model No.	:	Type1DR (* installed in Digital Camera 1DR026)
FCC-ID	:	VPYLB1DR
Regulation Applied	:	FCC 47 CFR 2.1093

SAR Limits :

Exposure Characteristics	Spatial Peak SAR (Head and Trunk) averaged over any 1 g of tissue
General Public Exposure	1.6 W/kg

The Highest Reported SAR :

RF Exposure Conditions	Equipment Class			Note(s)
	DTS	DTS	U-NII	
	Wi-Fi 2.4 GHz	Bluetooth Low Energy	Wi-Fi 5 GHz	
Body-Worn	N/A	0.117 W/kg	0.293 W/kg	
Simultaneous Tx	0.410 W/kg			

Test Result : **Complied**

Sample Receipt	:	October 19, 2018	
Testing	:	December 4, 2018 - December 22, 2018	(for conducted power measurements)
		April 12, 2019 - April 16, 2019	(for SAR measurement)
Reported	:	June 11, 2019	

Reported by :

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- *This report replaces and supersedes all previous versions. Refer to Revision History on the following page.*

TESTING CERT #3203.01

Format No.: NV1-1-01 Version 5.0

REVISION HISTORY

Project No.	Revision	Page	Description	Issued date
JB-Z0528	Original	-	-	May 30, 2019
JB-Z0528-A	1	4, 89	Updated the descriptions of DUT and Host platform.	June 5, 2019
JB-Z0528-B	2	1	Corrected the Testing date.	June 11, 2019

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1. General Information

1.1. Description of Device Under Test (DUT)

DUT Descriptions

	DUT
Type of Equipment	Communication Module
Model No.	Type1DR
FCC-ID	VPYLB1DR
Test Sample Condition	☐ Prototype ☐ Pre-production ☒ Mass-production
	* Not for sale: The sample is equivalent to mass-production items. * No modification by the test lab.
Serial No.	407
Rating	DC 3.2 V (VBAT) DC 1.8 V (VDDXO) DC 1.8 or 3.3 V (VIO) * Supplied from the host.
Head/Body-Worn Accessories (supplied with the device)	n/a
Device Dimension (W x H x D)	7.7 mm x 7.9 mm x 1.1 mm
Device Category	Portable
Exposure Category	General population/ Uncontrolled environment
Note(s): * Please refer to Appendix D for Host Platform Descriptions.	

Wireless Technologies

Wireless Technologies	Frequency Bands	Operating Mode	Power Setting Mode
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	Low Power Mode
	5 GHz	802.11a 802.11n (HT20/HT40) 802.11ac (VHT20/VHT40/VHT80)	High Power Mode
Bluetooth	2.4 GHz	Version 4.1(LE)	n/a
Note(s): * The DUT installed in this host does not support the Wi-Fi 2.4 GHz High Power Mode, Wi-Fi 5 GHz Low power Mode, and Bluetooth Classic (BR/EDR) operations.			

Radio Specification

	Original Approval	Class II Permissive Change *The DUT is installed in this host.
Antenna Type	Monopole antenna	Monopole antenna
Antenna Gain	+ 0.91 dBi (2.4 GHz) + 1.0 dBi (5 GHz)	-2.38 dBi (2.4 GHz) -1.37 dBi (5 GHz)
Note(s): * The antenna is of the same type and lower gain than in the original approval.		

1.2. Antenna Placement

Antenna	Minimum Distance from Edges or Sides of Host Platform (mm)						
	Front	Back	Left	Right	Top	Top-Tilt	Bottom
Wi-Fi/Bluetooth	*1	*1	*1	*1	*1	*1	*1

*1 Please refer to Appendix D.

1.3. Simultaneous Transmission Conditions

Wi-Fi 2.4 GHz cannot transmit simultaneously with Bluetooth and/or Wi-Fi 5GHz.
Wi-Fi 5 GHz can transmit simultaneously with Bluetooth at the same antenna.

1.4. Nominal and Maximum Possible Power (Maximum Tune-up Tolerance Limit)

Wireless Technologies	Mode	Band	Frequency Band (MHz)		Channel	Data Rate /MCS	Full Power (Burst Averaged)			
			Lower	Higher			Nominal (dBm)	Tolerance (dB)		Max. Tune-up Limit (dBm)
Wi-Fi	802.11b	2.4 GHz	2412	2462	All	All	7.0	-2.0	+2.0	9.0
	802.11g		2412	2462	All	All	7.0	-2.0	+2.0	9.0
	802.11n (HT20)		2412	2462	All	All	7.0	-2.0	+2.0	9.0
	802.11a	W52	5180	5240	All	All	13.0	-2.0	+2.0	15.0
		W53	5260	5340	All	All	13.0	-2.0	+2.0	15.0
		W56	5500	5700	All	All	13.0	-2.0	+2.0	15.0
		W58	5745	5825	All	All	11.0	-2.0	+2.0	13.0
	802.11n (HT20)	W52	5180	5240	All	All	13.0	-2.0	+2.0	15.0
		W53	5260	5340	All	All	13.0	-2.0	+2.0	15.0
		W56	5500	5700	All	All	13.0	-2.0	+2.0	15.0
		W58	5745	5825	All	All	11.0	-2.0	+2.0	13.0
	802.11n (HT40)	W52	5190	5230	All	All	13.0	-2.0	+2.0	15.0
		W53	5270	5310	All	All	13.0	-2.0	+2.0	15.0
		W56	5510	5670	All	All	13.0	-2.0	+2.0	15.0
		W58	5755	5795	All	All	11.0	-2.0	+2.0	13.0
	802.11ac (VHT20)	W52	5180	5240	All	MCS 0-7	13.0	-2.0	+2.0	15.0
						MCS 8	12.0	-2.0	+2.0	14.0
		W53	5260	5240	All	MCS 0-7	13.0	-2.0	+2.0	15.0
						MCS 8	12.0	-2.0	+2.0	14.0
		W56	5500	5700	All	MCS 0-7	13.0	-2.0	+2.0	15.0
						MCS 8	12.0	-2.0	+2.0	14.0
		W58	5745	5825	All	All	11.0	-2.0	+2.0	13.0

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Wireless Technologies	Mode	Band	Frequency Band (MHz)		Channel	Data Rate /MCS	Full Power (Burst Averaged)			
			Lower	Higher			Nominal (dBm)	Tolerance (dB)		Max. Tune-up Limit (dBm)
Wi-Fi	802.11ac (VHT40)	W52	5190	5230	38	MCS 0-7	12.0	-2.0	+2.0	14.0
					46	MCS 0-7	13.0	-2.0	+2.0	15.0
					All	MCS 8-9	12.0	-2.0	+2.0	14.0
		W53	5270	5310	All	MCS 0-7	13.0	-2.0	+2.0	15.0
					All	MCS 8-9	12.0	-2.0	+2.0	14.0
		W56	5510	5670	All	MCS 0-7	13.0	-2.0	+2.0	15.0
					All	MCS 8-9	12.0	-2.0	+2.0	14.0
		W58	5755	5795	All	All	11.0	-2.0	+2.0	13.0
	802.11ac (VHT80)	W52	5210		All	All	11.5	-2.0	+2.0	13.5
		W53	5290		All	All	11.5	-2.0	+2.0	13.5
		W56	5530	5690	All	All	12.0	-2.0	+2.0	14.0
		W58	5775		All	All	11.0	-2.0	+2.0	13.0
Bluetooth	LE		2402	2480	All	-	7.0	-2.8	+2.5	9.5

1.5. RF Exposure Conditions

Wireless Technologies	RF Exposure Conditions	User-to-Host Distance (mm)	Test Position	Host-to-Ant. Distance (mm)	SAR Required	Note(s)
Wi-Fi	Body-Worn	0	Front	Refer to Appendix D	Yes	
			Back	Refer to Appendix D	Yes	
			Left	Refer to Appendix D	Yes	
			Right	Refer to Appendix D	Yes	
			Top	Refer to Appendix D	N/A	1
			Top-Tilt	Refer to Appendix D	Yes	1
			Bottom	Refer to Appendix D	Yes	
Bluetooth	Body-Worn	0	Front	Refer to Appendix D	Yes	2
			Back	Refer to Appendix D	Yes	2
			Left	Refer to Appendix D	Yes	2
			Right	Refer to Appendix D	Yes	2
			Top	Refer to Appendix D	N/A	1
			Top-Tilt	Refer to Appendix D	Yes	1, 2
			Bottom	Refer to Appendix D	Yes	2

Note(s):

1. Due to the shape of the protruding portion of the top surface of the host platform, SAR was evaluated with the "Top-Tilt" test position, instead of the "Top" test position. Please refer to Appendix D for more details.
2. Although Bluetooth meets the exclusion threshold (see 1.7), SAR testing has been conducted, because Bluetooth can transmit simultaneously with Wi-Fi 5 GHz at the same antenna.

1.6. RF Exposure Limits

Human Exposure	General Population/ Uncontrolled Exposure	Occupational/ Controlled Exposure
Spatial Peak SAR (Head and Trunk) averaged over any 1 g of tissue	**1.6 W/kg***	8 W/kg
Spatial Average SAR (Whole Body) averaged over the whole body	0.08 W/kg	0.4 W/kg
Spatial Peak SAR (Extremities: Hands/Wrists/Feet/Ankles) averaged over any 10 g of tissue	4 W/kg	20 W/kg

* The limit(s) applied in this report.

1.7. SAR Test Exclusion

SAR test exclusion is applied according to KDB 447498 D01.

The 1-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:

* f(GHz) is the RF channel transmit frequency in GHz

* Power and distance are rounded to the nearest mW and mm before calculation

* The result is rounded to one decimal place for comparison

* When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

Body-Worn SAR (1-g SAR) Test Exclusion as per KDB 447498 D01

Freq. Band	Freq. (MHz)	Test Position	User-to-Host Distance (mm)	Host-to-Ant Distance (mm)	User-to-Ant Distance (mm)	Min. Test Sep. Distance (mm)	Max. Possible Power			Exclusion Threshold	SAR Required (> 3.0)
							(dBm)	(mW)	rounded (mW)		
Wi-Fi 2.4 GHz	2450	Front	0	*1	*1	*1	9.0	7.9	8	*1	No
	2450	Back	0	*1	*1	*1	9.0	7.9	8	*1	No
	2450	Left	0	*1	*1	*1	9.0	7.9	8	*1	No
	2450	Right	0	*1	*1	*1	9.0	7.9	8	*1	No
	2450	Top-Tilt	0	*1	*1	*1	9.0	7.9	8	*1	No
	2450	Bottom	0	*1	*1	*1	9.0	7.9	8	*1	No
Wi-Fi 5 GHz	5800	Front	0	*1	*1	*1	15.0	31.6	32	*1	Yes
	5800	Back	0	*1	*1	*1	15.0	31.6	32	*1	Yes
	5800	Left	0	*1	*1	*1	15.0	31.6	32	*1	No
	5800	Right	0	*1	*1	*1	15.0	31.6	32	*1	No
	5800	Top-Tilt	0	*1	*1	*1	15.0	31.6	32	*1	Yes
	5800	Bottom	0	*1	*1	*1	15.0	31.6	32	*1	No
Bluetooth	2450	Front	0	*1	*1	*1	9.5	8.9	9	*1	No
	2450	Back	0	*1	*1	*1	9.5	8.9	9	*1	No
	2450	Left	0	*1	*1	*1	9.5	8.9	9	*1	No
	2450	Right	0	*1	*1	*1	9.5	8.9	9	*1	No
	2450	Top-Tilt	0	*1	*1	*1	9.5	8.9	9	*1	No
	2450	Bottom	0	*1	*1	*1	9.5	8.9	9	*1	No

*1 Please refer to Appendix D.

1.8. Test Specification, Methods and Procedures

Test Specification

☒	FCC 47 CFR 2.1093	Radiofrequency radiation exposure evaluation: portable devices

Test Methods

☒	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	v02r02	SAR Guidance for IEEE 802.11 (Wi-Fi) Transmitters
☒	KDB 447498 D01	v06	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
☐	KDB 447498 D02	v02r01	SAR Measurement Procedures for USB Dongle Transmitters
☐	KDB 615223 D01	v01r01	802.16e/WiMax SAR Measurement Guidance
☐	KDB 616217 D04	v01r02	SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers
☐	KDB 643646 D01	v01r03	SAR Test Reduction Considerations for Occupational PTT Radios
☐	KDB 648474 D03	v01r04	Evaluation and Approval Considerations for Handsets with Specific Wireless Charging Battery Covers
☐	KDB 648474 D04	v01r03	SAR Evaluation Considerations for Wireless Handsets
☒	KDB 865664 D01	v01r04	SAR Measurement Requirements for 100 MHz to 6 GHz
☐	KDB 941225 D01	v03r01	3G SAR Measurement Procedures
☐	KDB 941225 D05	v02r05	SAR Evaluation Considerations for LTE Devices
☐	KDB 941225 D06	v02r01	SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
☐	KDB 941225 D07	v01r02	SAR Evaluation Procedures for UMPC Mini-Tablet Devices

Test Procedures

The SAR tests were performed according to the procedures of
Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory,
the Document No. NV3-2 and NV3-16, available upon request.

☒ No deviation from the procedures
☐ Deviation from the procedures
☐ ______________________________

References

[1] ICNIRP. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics 74(4): 494-522, 1998.

[2] American National Standards Institute (ANSI), "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1-1992.

[3] Health Canada, "Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz," Safety Code 6 (2009).

[4] European Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 199 of 30 July 1999).

[5] REDCA Technical Guidance Note 20 (TGN 20), SAR Testing and Assessment Guidance, Version 5.0, July 2017.

[6] Australian Communications and Media Authority (ACMA),Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 2014.

[7] TCB Workshop April 2019; RF Exposure Procedures (Tissue Simulating Liquids)

[8] Schmid & Partner Engineering AG (SPEAG), DASY52 System Handbook, April 2014.

[9] Schmid & Partner Engineering AG (SPEAG), Safety Data Sheet, Doc No 772-SLAAx0yy-J, June 14, 2013.

[10] Schmid & Partner Engineering AG (SPEAG), Safety Data Sheet, Doc No 772-SLAAx1yy-I, October 18, 2013.

[11] Schmid & Partner Engineering AG (SPEAG), Safety Data Sheet, Doc No 772-SLAAx6yy-H, September 26, 2013.

[12] Schmid & Partner Engineering AG (SPEAG), Material Safety Data Sheet, Doc No 772-SLAAH502A-D, August 9, 2013.

[13] Schmid & Partner Engineering AG (SPEAG), Material Safety Data Sheet, Doc No 772-SLAAx4yy-J, August 9, 2013.

[14] Schmid & Partner Engineering AG (SPEAG), Material Safety Data Sheet, Doc No 772-SLAAHxU16B-C, June 9, 2015.

1.9. Test Facilities and Accreditation

Test Facilities

Test Facility Name	:	Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
Address	:	8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
Shielded Room Used	:	☒ 4th Site Shielded Room 2 ☐ 4th Site Shielded Room 3

A2LA Accreditation

Certificate No.	:	3203.01
Expiration	:	October 31, 2019

2. Test Set-up

2.1. Test Equipment and Measurement Software Lists

Table 2-1 Test Equipment List

Used	Control No.	Equipment Description	Model No.	Serial No.	Manufacturer	Cal. Int.	Last Cal.	Note(s)
☒	W0128	Robot	TX60 L	F14/5VR2B1/A/01	Staubli	N/A	N/A *1	
☐	W0124	Robot	RX60B L	F04/5Z71A1/A/03	Staubli	N/A	N/A *1	
☒	WA0002	E-Field Probe	EX3DV4	3921	SPEAG	1Y	18.10.22	
☐	WA0052	E-Field Probe	EX3DV4	7452	SPEAG	1Y	19.03.15	
☒	W0095	Data Acquisition Electronics	DAE4	482	SPEAG	1Y	18.09.21	
☐	W0096	Data Acquisition Electronics	DAE4	610	SPEAG	1Y	19.01.09	
☐	W0081	Twin SAM Phantom	Twin SAM	TP-1441	SPEAG	N/A	N/A *1	
☐	W0082	Twin SAM Phantom	Twin SAM	TP-1325	SPEAG	N/A	N/A *1	
☐	W0126	Twin SAM Phantom	Twin SAM	TP-1851	SPEAG	N/A	N/A *1	
☒	W0127	Twin SAM Phantom	Twin SAM	TP-1852	SPEAG	N/A	N/A *1	
☐	W0119	ELI Phantom	ELI V5.0	1259	SPEAG	N/A	N/A *1	
☒	WA0026	System Validation Dipole	D2450V2	936	SPEAG	1Y	18.06.19	
☒	WA0028	System Validation Dipole	D5GHzV2	1183	SPEAG	1Y	18.06.27	
☒	W0121	Vector Reflectometer	DAKS_VNA R140	0111013	Copper Mountain Technologies	1Y	18.06.25	
☒	WA0029	Dielectric Probe	DAKS-3.5	1034	SPEAG	1Y	18.06.19	
☒	W0009	Signal Generator	E4438C	US41461247	Agilent	1Y	18.10.06	
☒	W0122	Power Amp	CGA020M60 2-2633R	B40550	R&K	N/A	N/A *1	
☒	W0104	Power Sensor	U2021XA	MY54040006	Agilent	1Y	18.10.06	
☒	W0105	Power Sensor	U2021XA	MY54080005	Agilent	1Y	18.10.06	
☒	W0120	Directional Coupler	4226-20	-	narda	1Y	18.10.06	
☒	W0117	Attenuator	8493B 3 dB	MY39260857	Agilent	1Y	18.10.06	
☒	W0118	Attenuator	AT-110 10 dB	932968	Hirose	1Y	18.10.06	
☒	W0148	Attenuator	AT-103 3 dB	980711	Hirose	1Y	18.10.06	
☐	WC0022	RF Cable	SUCOFLEX 106	503094/6	HUBER+SUHN ER	1Y	18.10.06	
☒	WC0023	RF Cable	SUCOFLEX 104	MY36443/4	HUBER+SUHN ER	1Y	18.10.06	
☒	WC0024	RF Cable	SUCOFLEX 126E	MY1150/26E	HUBER+SUHN ER	1Y	18.10.06	
☒	WC0025	RF Cable	SUCOFLEX 104	MY37246/4	HUBER+SUHN ER	1Y	18.10.06	
☒	WC0026	RF Cable	SUCOFLEX 126E	MY1558/26E	HUBER+SUHN ER	1Y	18.10.06	
☒	M1048	Thermometer	0560 6220	39512479/703	testo	1Y	18.07.10	
☐	M1049	Thermometer	0560 6220	39512571/703	testo	1Y	18.06.01	
☐	W0112	Water Thermometer	735-1	02736130	testo	1Y	18.08.06	
☐	W0113	Water Thermometer	735-1	02788580	testo	1Y	18.05.30	
☒	W0116	Water Thermometer	735-1	02788596	testo	1Y	18.07.06	

Note(s):
*1 In-house verification is conducted periodically.

Table 2-2 Measurement Software List

Used	Control No.	Software Description	Model No.	Ver.	Manufacturer
☐	SW-0401	SAR measurement software	DASY52	52.8.8.1222	SPEAG
☐	SW-0402	SAR post-processing software	SEMCAD X	14.6.10 (7331)	SPEAG
☒	SW-0403	Dielectric measurement software	DAK	2.4.0.638	SPEAG
☒	SW-0404	SAR measurement software	DASY52	52.8.8.1222	SPEAG
☒	SW-0405	SAR post-processing software	SEMCAD X	14.6.10 (7331)	SPEAG
☐	SW-0406	SAR measurement spreadsheet	-	1.00	Main Lab.
☒	SW-0314	Power measurement software	N1918A	R03.09.00	Agilent

2.2. Measurement System Description

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

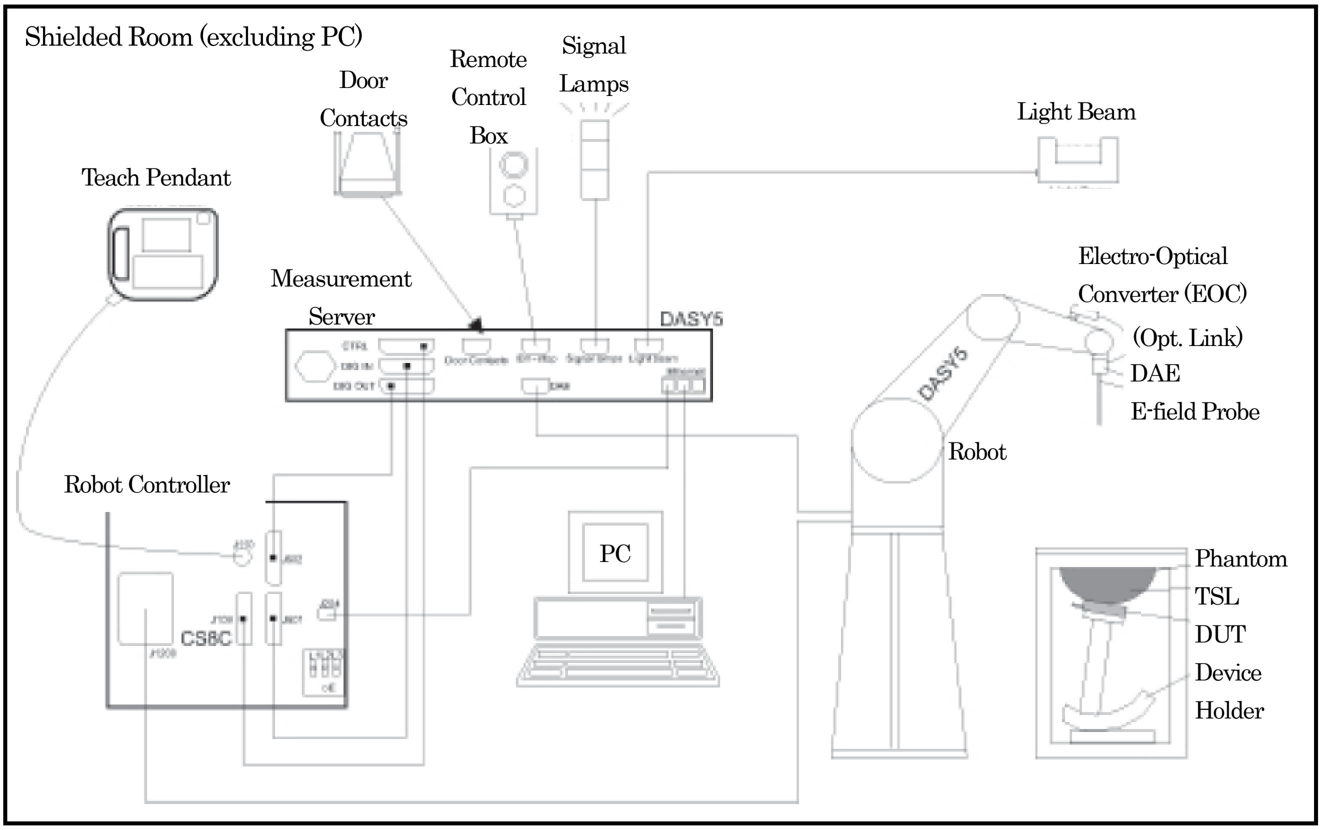


Figure 2-1 Measurement System Description

- A standard high precision 6-axis robot (Staubli TX/RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7 professional operating system and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantoms (the Twin SAM and/or ELI phantoms) enabling the testing of handheld (left-hand and right-hand) and/or body-mounted usage.
- The device holders for handheld mobile phones and/or larger devices (e.g., laptops, cameras, etc.).
- Tissue simulating liquid (TSL) mixed according to the given recipes.
- System Validation Dipole Kits allowing to validate the proper functioning of the system.

2.3. Measurement System Main Components

Robot (Positioner)

	Shielded Room 2	Shielded Room 3
Manufacturer	Staubli SA	
Model No.	TX60L	RX60BL
Number of Axis	6	
Reach at Wrist	920 mm	865 mm
Repeatability	+/- 0.03 mm	+/- 0.033 mm
Nominal Load Capacity	2 kg	1.5 kg
Maximum Load Capacity	5 kg	2.5 kg
Control Unit	CS8c	CS7m
Weight	52.2 kg	45 kg

E-Field Probe

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	EX3DV4
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 μW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μW/g)
Dimensions	Overall length: 337 mm (Tip length: 20 mm) Tip diameter: 2.5 mm (Body diameter: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

Data Acquisition Electronics (DAE)

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	DAE4
Construction	Signal amplifier, multiplexer, A/D converter, and control logic Serial optical link for communication with DASY4/5 embedded system (fully remote controlled) Two-step probe touch detector for mechanical surface detection and emergency robot stop
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4 mV, 400 mV)
Input Offset Voltage	< 5 μV (with auto zero)
Input Resistance	200 MΩ
Input Bias Current	< 50 fA
Battery Power	> 10 hours of operation (with two 9.6 V NiMH accus)
Dimensions (L x W x H)	60 x 60 x 68 mm

DASY5 Measurement Server

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	DASY5 Measurement Server
CPU	Intel ULV Celeron 400 MHz
Chip-Disk	128 MB
RAM	128 MB
Construction	16 Bit A/D converter for surface detection system Vacuum Fluorescent Display
I/O Interface	Robot Interface / Serial link to DAE (with watchdog supervision) / Door contact port / Emergency stop port (to connect the remote control) / Signal lamps port / Light beam port / Three Ethernet connection ports (for PC, Control Unit, and future applications) / Two USB 2.0 ports (for installation and advanced troubleshooting by SPEAG) / Two serial links (for future applications) / Expansion port (for future applications)
Dimensions (L x W x H)	440 x 241 x 89 mm

Phantoms (Twin SAM Phantom)

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	Twin SAM
Description	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.
Material	Vinylester, glass fiber reinforced (VE-GF)
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet
Filling Volume	Approx. 25 liters
Wooden Support	SPEAG standard phantom table

Phantoms (ELI Phantom)

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	ELI V5.0
Description	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles. ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4, but has reinforced top structure.
Material	Vinylester, glass fiber reinforced (VE-GF)
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)
Shell Thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	Approx. 30 liters
Wooden Support	SPEAG standard phantom table

Device Holder (Mounting Device for Hand-Held Transmitters)

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	MD4HHTV5
Description	In combination with the Twin SAM or ELI Phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).
Material	Polyoxymethylene (POM)

Device Holder (Mounting Device Adaptor for Ultra Wide Transmitters)

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	MDA4WTV5
Description	An upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140mm.
Material	Polyoxymethylene (POM)

Device Holder (Mounting Device Adaptor for Laptops)

Manufacturer	Schmid & Partner Engineering AG (SPEAG)
Model No.	MDA4LAP
Description	A simple but effective and easy-to-use extension for the Mounting Device; facilitates testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.); lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin SAM, ELI Phantoms.
Material	Polyoxymethylene (POM), PET-G, Foam

System Validation Dipole Kits

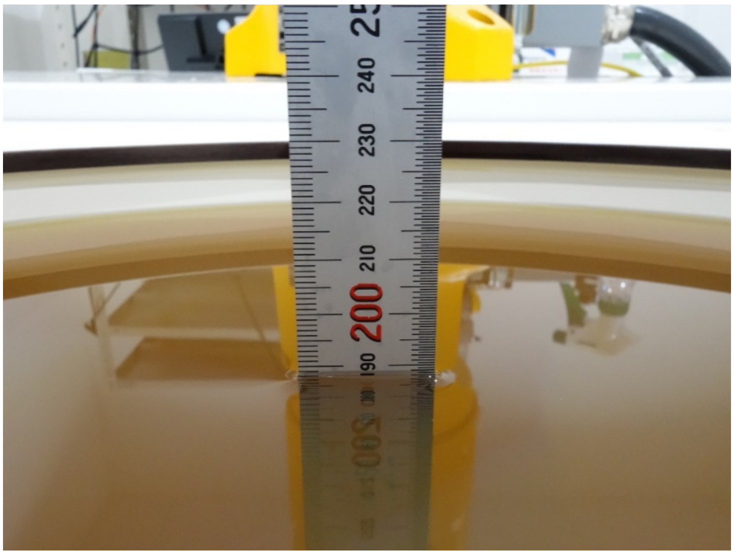
Manufacturer	Schmid & Partner Engineering AG (SPEAG)		
Model No.	D-Series		
Construction	Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with tissue simulating solutions		
Frequency	2450, 5100 to 5800 MHz		
Return Loss	> 20 dB at specified validation position		
Power Capability	> 100 W (f < 1 GHz); > 40 W (f > 1 GHz)		
Accessories	Distance holder, tripod adaptor, tripod		
Dimensions	Product	Dipole length	Overall height
	D2450V2	52.0 mm	290.0 mm
	D5GHzV2	20.6 mm	300.0 mm

2.4. Tissue Simulating Liquids

Recipes for tissue simulating liquids manufactured by SPEAG

Ingredients (% by weight)	Frequency (MHz)					
	1900 to 3800		3500 to 5800		600 to 6000	
Used	☐	☐	☐	☐	☒	☐
Tissue Simulating Liquids	HBBL 1900-3800 V3	MBBL 1900-3800 V3	HBBL 3500-5800 V5	MBBL 3500-5800 V5	HBBL 600-6000 V6	MBBL 600-6000 V6
Tissue Type	Head	Body	Head	Body	Head	Body
H_2O	50 – 73 %		50 – 65 %	60 – 80 %	–	
Non-ionic detergents	25 – 50 %		–	–	–	
NaCl	0 – 2 %		0 – 1.5 %	0 – 1.5 %	–	
Preventol-D7	0.05 – 0.1 %		–	–	–	
Ethanediol	–		–	–	1.0 – 4.9 %	
Sodium Petroleum Sulfonate	–		–	–	< 2.9 %	
Hexylene Glycol	–		–	–	< 2.9 %	
Alkoxylated Alcohol	–		–	–	< 2.0 %	
Mineral Oil	–		10 – 30 %	–	< 20 %	
Emulsifiers	–		8 – 25 %	20 – 40 %	–	

For the SAR measurement, the phantom must be filled with tissue simulating liquid to a depth of at least 15 cm.



HBBL 600-6000 V6

Figure 2-2 Photos: Liquid Depth (at the center of the flat phantom)

2.5. SAR Measurement

<u>Step 1: Power Reference Measurement</u>
Before an area scan and after the zoom scan, single point SAR measurements are performed at defined locations to estimate the SAR measurement drift due to device output power variations.

<u>Step 2: Area Scan</u>
An area scan is performed according to the requirements in Table 2-3.

<u>Step 3: Zoom Scan</u>
A zoom scan is performed according to the requirements in Table 2-3.

<u>Step 4: Power Drift Measurement</u>
Before an area scan and after the zoom scan, single point SAR measurements are performed at defined locations to estimate the SAR measurement drift due to device output power variations.

Table 2-3 Area Scan and Zoom Scan Parameters

<table>
<tr><th colspan="3" rowspan="2"></th><th colspan="2">DUT Transmit Frequency being Tested</th></tr>
<tr><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½ δ ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm</td><td>3 – 4 GHz: ≤ 5 mm
4 – 6 GHz: ≤ 4 mm</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5 $\cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium.</td></tr>
</table>

2.6. Measurement Uncertainty

☒ Table 2-4 DASY5 Uncertainty Budget for SAR Tests

According to IEEE Std 1528-2013 (0.3GHz to 3GHz range)								
Input quantity	Uncertainty of Xi			Ci		Ciu(Xi)		Vi Veff
	Xi	Prob. Dist.	Div.	1g [-]	10g [-]	1g	10g	
Measurement System								
Probe Calibration (k=1)	±6.0%	N	1.00	1.00	1.00	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	1.73	0.70	0.70	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.7%	R	1.73	0.70	0.70	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	1.73	1.00	1.00	±0.6%	±0.6%	∞
Linearity	±4.7%	R	1.73	1.00	1.00	±2.7%	±2.7%	∞
System Detection Limits	±0.3%	R	1.73	1.00	1.00	±0.1%	±0.1%	∞
Modulation Response	±2.4%	R	1.73	1.00	1.00	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1.00	1.00	1.00	±0.3%	±0.3%	∞
Response Time	±0.8%	R	1.73	1.00	1.00	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	1.73	1.00	1.00	±1.5%	±1.5%	∞
RF Ambient Noise	±0.1%	R	1.73	1.00	1.00	±0.1%	±0.1%	∞
RF Ambient Reflections	±0.8%	R	1.73	1.00	1.00	±0.4%	±0.4%	∞
Probe Positioner	±0.4%	R	1.73	1.00	1.00	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	1.73	1.00	1.00	±1.7%	±1.7%	∞
Max. SAR Eval.	±2.0%	R	1.73	1.00	1.00	±1.2%	±1.2%	∞
Test Sample Related								
Device Positioning	±1.8%	N	1.00	1.00	1.00	±1.8%	±1.8%	14
Device Holder	±3.6%	N	1.00	1.00	1.00	±3.6%	±3.6%	5
Power Drift	±5.0%	R	1.73	1.00	1.00	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	1.73	1.00	1.00	±0.0%	±0.0%	∞
Phantom and Setup								
Phantom Uncertainty	±7.2%	R	1.73	1.00	1.00	±4.2%	±4.2%	∞
SAR Correction	±1.9%	R	1.73	1.00	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	R	1.73	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity (mea.)	±2.5%	R	1.73	0.23	0.26	±0.3%	±0.4%	∞
Temp. Unc. - Conductivity	±3.4%	R	1.73	0.78	0.71	±1.5%	±1.4%	∞
Temp. Unc. - Permittivity	±0.4%	R	1.73	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±10.9%	±10.8%	407
Expanded Uncertainty (95% conf. interval)			k=2			±21.7%	±21.7%	

☐ Table 2-5 DASY5 Uncertainty Budget for SAR Tests

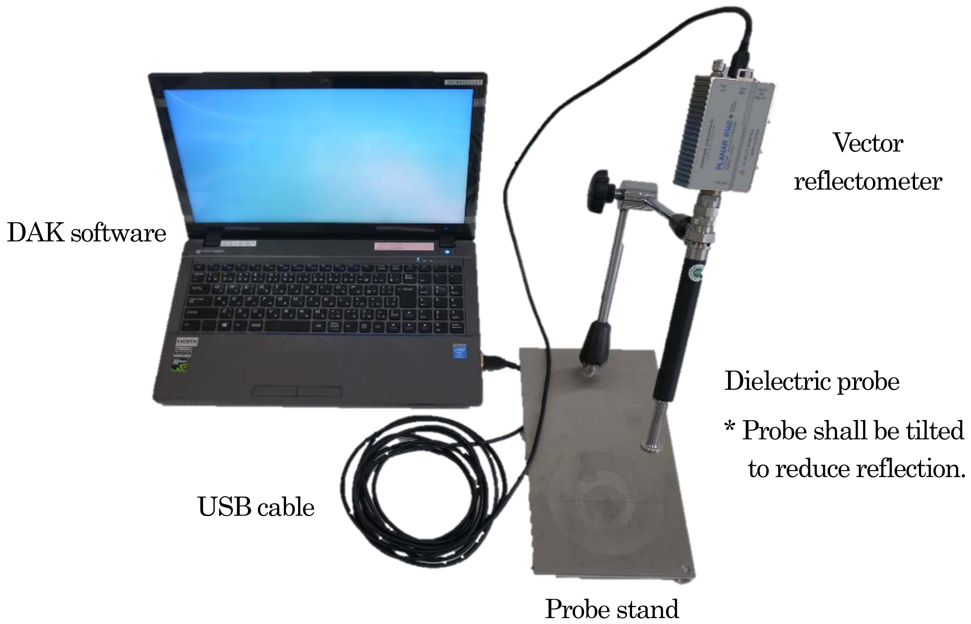
According to IEEE Std 1528-2013 (3GHz to 6GHz range)								
Input quantity	Uncertainty of Xi			Ci		Ciu(Xi)		Vi Veff
	Xi	Prob. Dist.	Div.	1g [-]	10g [-]	1g	10g	
Measurement System								
Probe Calibration (k=1)	±6.55%	N	1.00	1.00	1.00	±6.6%	±6.6%	∞
Axial Isotropy	±4.7%	R	1.73	0.70	0.70	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.7%	R	1.73	0.70	0.70	±3.9%	±3.9%	∞
Boundary Effects	±2.0%	R	1.73	1.00	1.00	±1.2%	±1.2%	∞
Linearity	±4.7%	R	1.73	1.00	1.00	±2.7%	±2.7%	∞
System Detection Limits	±0.3%	R	1.73	1.00	1.00	±0.1%	±0.1%	∞
Modulation Response	±2.4%	R	1.73	1.00	1.00	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1.00	1.00	1.00	±0.3%	±0.3%	∞
Response Time	±0.8%	R	1.73	1.00	1.00	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	1.73	1.00	1.00	±1.5%	±1.5%	∞
RF Ambient Noise	±0.1%	R	1.73	1.00	1.00	±0.1%	±0.1%	∞
RF Ambient Reflections	±0.8%	R	1.73	1.00	1.00	±0.4%	±0.4%	∞
Probe Positioner	±0.8%	R	1.73	1.00	1.00	±0.5%	±0.5%	∞
Probe Positioning	±6.7%	R	1.73	1.00	1.00	±3.9%	±3.9%	∞
Max. SAR Eval.	±4.0%	R	1.73	1.00	1.00	±2.3%	±2.3%	∞
Test Sample Related								
Device Positioning	±1.8%	N	1.00	1.00	1.00	±1.8%	±1.8%	14
Device Holder	±3.6%	N	1.00	1.00	1.00	±3.6%	±3.6%	5
Power Drift	±5.0%	R	1.73	1.00	1.00	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	1.73	1.00	1.00	±0.0%	±0.0%	∞
Phantom and Setup								
Phantom Uncertainty	±7.6%	R	1.73	1.00	1.00	±4.4%	±4.4%	∞
SAR Correction	±1.9%	R	1.73	1.00	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	R	1.73	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity (mea.)	±2.5%	R	1.73	0.23	0.26	±0.3%	±0.4%	∞
Temp. Unc. - Conductivity	±3.4%	R	1.73	0.78	0.71	±1.5%	±1.4%	∞
Temp. Unc. - Permittivity	±0.4%	R	1.73	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±12.0%	±12.0%	607
Expanded Uncertainty (95% conf. interval)			k=2			±24.0%	±24.0%	

☒ Table 2-6 DASY5 Uncertainty Budget for SAR System Check

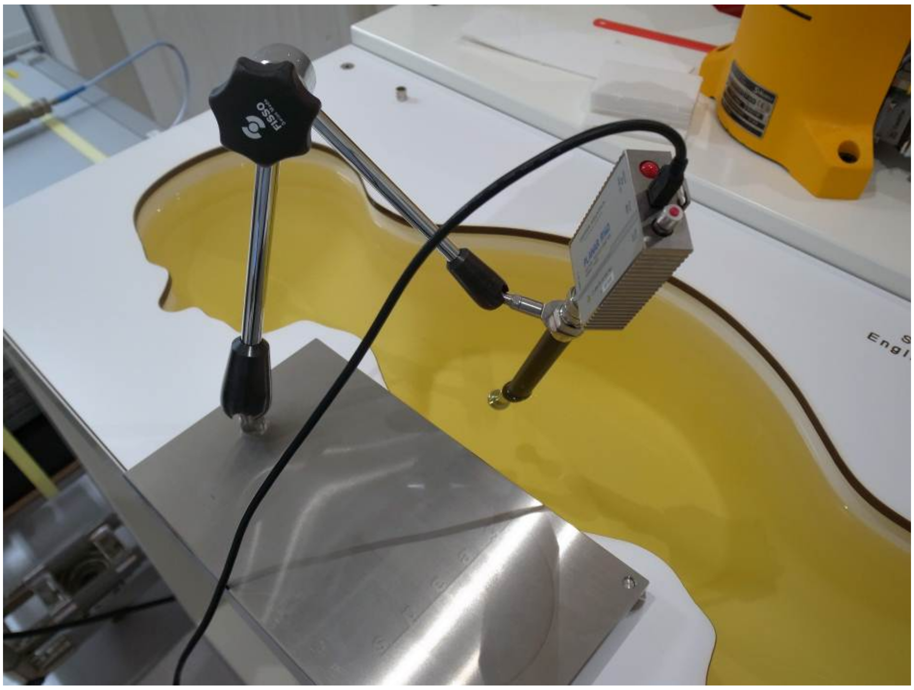
According to IEEE Std 1528-2013 (0.3GHz to 6GHz range)								
Input quantity	Uncertainty of Xi			Ci		Ciu(Xi)		Vi Veff
	Xi	Prob. Dist.	Div.	1g [-]	10g [-]	1g	10g	
Measurement System								
Probe Calibration (k=1)	±6.55%	N	1.00	1.00	1.00	±6.6%	±6.6%	∞
Axial Isotropy	±4.7%	R	1.73	0.70	0.70	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.7%	R	1.73	0.70	0.70	±3.9%	±3.9%	∞
Boundary Effects	±2.0%	R	1.73	1.00	1.00	±1.2%	±1.2%	∞
Linearity	±4.7%	R	1.73	1.00	1.00	±2.7%	±2.7%	∞
System Detection Limits	±0.3%	R	1.73	1.00	1.00	±0.1%	±0.1%	∞
Modulation Response	±0.0%	R	1.73	1.00	1.00	±0.0%	±0.0%	∞
Readout Electronics	±0.3%	N	1.00	1.00	1.00	±0.3%	±0.3%	∞
Response Time	±0.0%	R	1.73	1.00	1.00	±0.0%	±0.0%	∞
Integration Time	±0.0%	R	1.73	1.00	1.00	±0.0%	±0.0%	∞
RF Ambient Noise	±1.0%	R	1.73	1.00	1.00	±0.6%	±0.6%	∞
RF Ambient Reflections	±1.0%	R	1.73	1.00	1.00	±0.6%	±0.6%	∞
Probe Positioner	±0.8%	R	1.73	1.00	1.00	±0.5%	±0.5%	∞
Probe Positioning	±6.7%	R	1.73	1.00	1.00	±3.9%	±3.9%	∞
Max. SAR Eval.	±4.0%	R	1.73	1.00	1.00	±2.3%	±2.3%	∞
Dipole Related								
Deviation of exp. Dipole	±5.5%	R	1.73	1.00	1.00	±3.2%	±3.2%	∞
Dipole Axis to Liquid Dist.	±2.0%	R	1.73	1.00	1.00	±1.2%	±1.2%	∞
Inoput Power & SAR Drift	±3.4%	R	1.73	1.00	1.00	±2.0%	±2.0%	∞
Phantom and Setup								
Phantom Uncertainty	±7.6%	R	1.73	1.00	1.00	±4.4%	±4.4%	∞
SAR Correction	±1.9%	R	1.73	1.00	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	N	1.00	0.78	0.71	±2.0%	±1.8%	∞
Liquid Permittivity (mea.)	±2.5%	N	1.00	0.23	0.26	±0.6%	±0.7%	∞
Temp. Unc. - Conductivity	±3.4%	R	1.73	0.78	0.71	±1.5%	±1.4%	∞
Temp. Unc. - Permittivity	±0.4%	R	1.73	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±11.6%	±11.5%	
Expanded Uncertainty (95% conf. interval)			k=2			±23.1%	±23.0%	

2.7. Dielectric Parameter Measurement of Tissue Simulating Liquids

The dielectric properties of the tissue simulating liquids used were verified within 24 hours before the SAR measurement.



(a) Dielectric Parameter Measurement System



(b) Example Photo: Dielectric Parameter Measurement

Figure 2-3 Dielectric Parameter Measurement Set-up

*1 Target values are linearly interpolated between the values defined in KDB 865664 D01, when necessary.

*2 The deviation of measured values from target values must be within +/-5 %.

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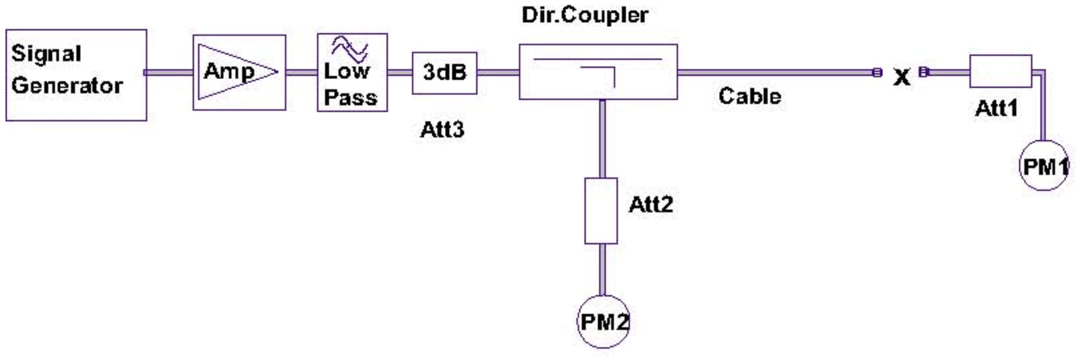
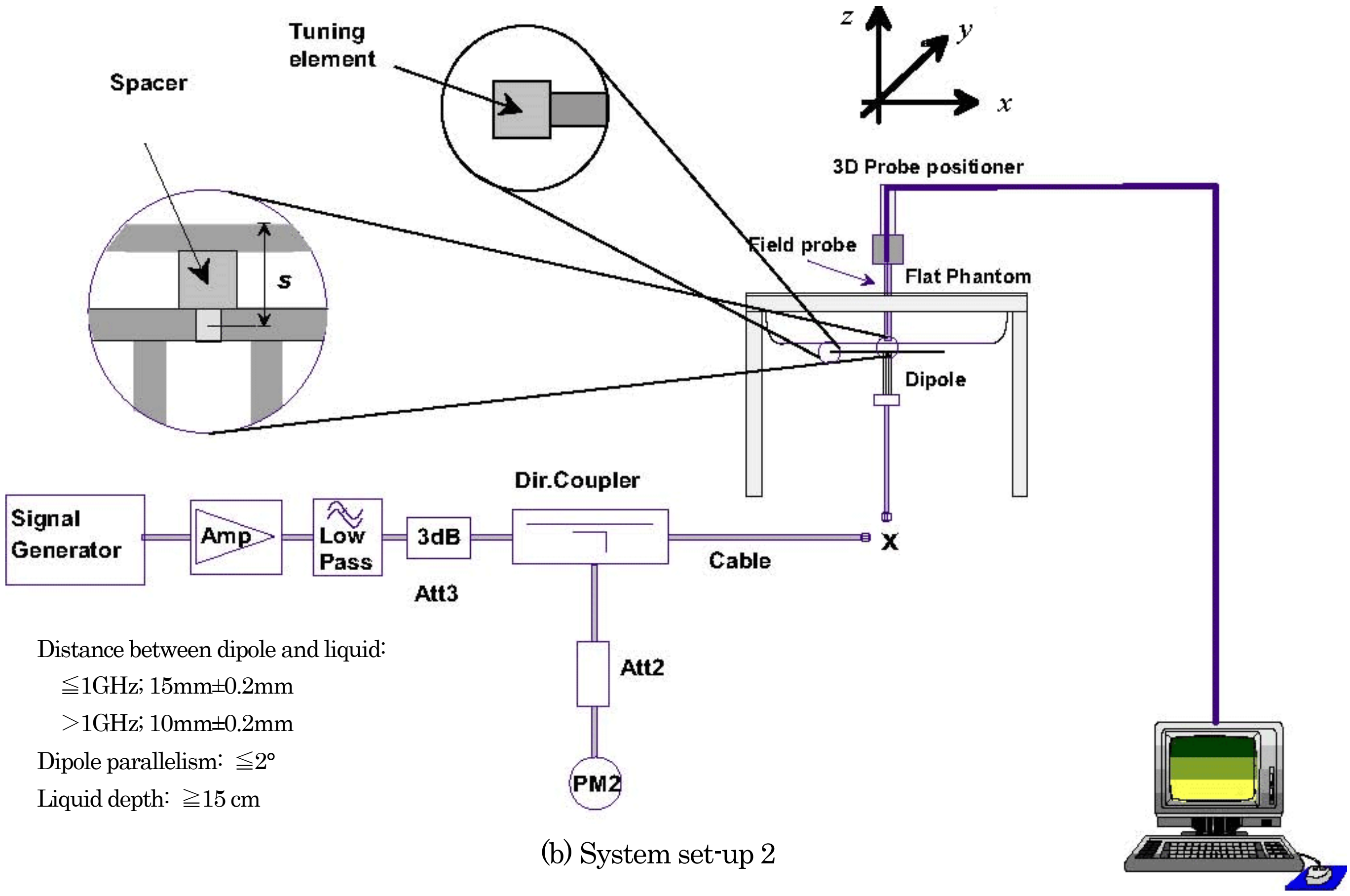
TSL	Freq. (MHz)	Param.	Target *1	Meas.	Dev. (%) *2	Date	Amb. Temp. (deg. C)	Rel. Hum. (%RH)	Liquid Temp. (deg. C)	Note(s)
HBBL 600-6000V6	2402	ε_r	39.29	40.04	1.91	2019/04/12	23.5	43.0	21.4	
		σ (S/m)	1.76	1.81	2.84					
	2440	ε_r	39.22	39.98	1.94					
		σ (S/m)	1.79	1.83	2.23					
	2480	ε_r	39.16	39.93	1.97					
		σ (S/m)	1.83	1.87	2.19					
	5270	ε_r	35.91	35.68	-0.64	2019/04/13	20.6	45.2	20.6	
		σ (S/m)	4.73	4.70	-0.63					
	5310	ε_r	35.86	35.63	-0.64					
		σ (S/m)	4.77	4.75	-0.42					
	5510	ε_r	35.63	35.25	-1.07	2019/04/16	22.1	48.3	21.0	
		σ (S/m)	4.97	4.90	-1.41					
	5590	ε_r	35.54	35.12	-1.18					
		σ (S/m)	5.05	4.98	-1.39					
	5670	ε_r	35.45	35.00	-1.27					
		σ (S/m)	5.14	5.07	-1.36					
	5775	ε_r	35.33	34.45	-2.49	2019/04/13	20.4	44.3	20.6	
		σ (S/m)	5.24	5.24	0.00					

2.8. System Check Measurement

The system check was performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium.



(a) System set-up 1



(b) System set-up 2

Figure 2-4 System Check Measurement Set-up

D2450V2

D5GHzV2

(c) Photo: System Validation Dipole Placement

Figure 2-4 System Check Measurement Set-up (continued)

*1 The normalized values (1 W) were calculated by normalizing the measured values to 1-W forward input power.
*2 The target values (1 W) are defined in IEEE Std 1528 and/or the calibration certificate of system validation dipoles used.
*3 The deviation of normalized values from target values must be within +/-10 %.

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System Validation Dipole	Freq. (MHz)	Param.	250 mW-Meas. (W/kg)	1 W-Norm. (W/kg) *1	1 W-Target (W/kg) *2	Dev. (%) *3	Date	Amb. Temp. (deg. C)	Rel. Hum. (%RH)	Liquid Temp. (deg. C)	Note(s)
D2450V2	2450	1-g SAR	13.90	55.60	51.50	7.96	2019/04/12	23.4	42.2	21.4	
		10-g SAR	6.44	25.76	24.30	6.01					
System Validation Dipole	Freq. (MHz)	Param.	100 mW-Meas. (W/kg)	1 W-Norm. (W/kg) *1	1 W-Target (W/kg) *2	Dev. (%) *3	Date	Amb. Temp. (deg. C)	Rel. Hum. (%RH)	Liquid Temp. (deg. C)	Note(s)
D5GHzV2	5300	1-g SAR	7.79	77.90	81.20	-4.06	2019/04/13	20.5	43.9	20.4	
		10-g SAR	2.21	22.10	23.50	-5.96					
D5GHzV2	5600	1-g SAR	8.19	81.90	85.30	-3.99	2019/04/16	22.2	48.5	21.0	
		10-g SAR	2.29	22.90	24.40	-6.15					
D5GHzV2	5800	1-g SAR	7.52	75.20	80.50	-6.58	2019/04/13	20.5	43.9	20.4	
		10-g SAR	2.12	21.20	23.00	-7.83					

3. Conducted Power Measurements

☒<The Initial Test Configuration Procedures for Wi-Fi>

According to KDB 248227 D01,

the initial test configuration 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.

When multiple channel bandwidth configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined by applying the following steps sequentially.

1) The largest channel bandwidth configuration is selected among the multiple configurations in a frequency band with the same specified maximum output power.
2) If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
3) If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.
4) When multiple transmission modes (802.11a/g/n/ac) 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; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

3.1. Conducted Power Measurement Results

Wi-Fi 5 GHz (W52: U-NII-1 and W53: U-NII-2A Bands)

Date	:	2018/12/21	Measured by	:	M. Kouga
Amb. Temp.	:	22.0 deg. C	Rel. hum.	:	40.6 %RH

The Initial Test Configuration (ITC) : IEEE 802.11n (HT40) in W53 (*2)(*3)

Mode	Freq. Band	Ch.	Freq. (MHz)	Power Setting	Data Rate /MCS	Meas. Frame Averaged Power (dBm)	Meas. Burst Averaged Power (dBm) *1	Max. Poss. Power (dBm)	Within 2 dB of Max. Poss. Power	SAR Tested	Note(s)
802.11a	W52	36	5180	Tune-up	6.0 Mbps	14.16	14.23	15.0	Yes	-	
		40	5200		6.0 Mbps	14.05	14.11	15.0	Yes	-	
		44	5220		6.0 Mbps	13.97	14.03	15.0	Yes	-	
		48	5240		6.0 Mbps	14.00	14.06	15.0	Yes	-	
	W53	52	5260	Tune-up	6.0 Mbps	14.29	14.36	15.0	Yes	-	
		56	5280		6.0 Mbps	14.12	14.18	15.0	Yes	-	
		60	5300		6.0 Mbps	**14.49**	14.55	15.0	Yes	-	
		64	5320		6.0 Mbps	14.09	14.15	15.0	Yes	-	
802.11n (HT20)	W52	36	5180	Tune-up	MCS-0	14.17	14.24	15.0	Yes	-	
		40	5200		MCS-0	14.29	14.36	15.0	Yes	-	
		44	5220		MCS-0	13.99	14.06	15.0	Yes	-	
		48	5240		MCS-0	14.04	14.11	15.0	Yes	-	
	W53	52	5260	Tune-up	MCS-0	14.10	14.17	15.0	Yes	-	
		56	5280		MCS-0	**14.37**	14.44	15.0	Yes	-	
		60	5300		MCS-0	14.11	14.18	15.0	Yes	-	
		64	5320		MCS-0	14.20	14.26	15.0	Yes	-	
802.11n (HT40)	W52	38	5190	Tune-up	MCS-0	13.28	13.42	14.0	Yes	-	
		46	5230		MCS-0	**14.27**	14.40	15.0	Yes	-	
	W53	54	5270	Tune-up	MCS-0	14.21	14.35	15.0	Yes	Yes	ITC
		62	5310		MCS-0	14.16	14.30	15.0	Yes	Yes	
802.11ac (VHT20)	W52	36	5180	Tune-up	MCS-0	14.01	14.08	15.0	Yes	-	
		40	5200		MCS-0	14.35	14.41	15.0	Yes	-	
		44	5220		MCS-0	14.06	14.13	15.0	Yes	-	
		48	5240		MCS-0	14.08	14.15	15.0	Yes	-	
	W53	52	5260	Tune-up	MCS-0	14.11	14.18	15.0	Yes	-	
		56	5280		MCS-0	**14.38**	14.45	15.0	Yes	-	
		60	5300		MCS-0	14.14	14.21	15.0	Yes	-	
		64	5320		MCS-0	14.16	14.23	15.0	Yes	-	
802.11ac (VHT40)	W52	38	5190	Tune-up	MCS-0	13.41	13.55	14.0	Yes	-	
		46	5230		MCS-0	13.98	14.11	15.0	Yes	-	
	W53	54	5270	Tune-up	MCS-0	**14.24**	14.38	15.0	Yes	-	
		62	5310		MCS-0	14.19	14.32	15.0	Yes	-	
802.11ac (VHT80)	W52	42	5210	Tune-up	MCS-0	12.51	12.79	13.5	Yes	-	
	W53	58	5290	Tune-up	MCS-0	**12.54**	12.81	13.5	Yes	-	

*1 Used for confirmation that the DUT's output power is within +0/-2 dB of the maximum tune-up tolerance limits (max. poss. power), since the maximum tune-up tolerance limits are defined as burst averaged values.

*2 When the same maximum output power is specified for U-NII-1 and U-NII-2A bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg or 3 W/kg (1-g or 10-g respectively), SAR is not required for U-NII-1 band for that configuration.

*3 SAR is not required for the remaining 802.11 transmission configurations (802.11a/n-HT20/ac-VHT20/ac-VHT40/ac-VHT80) when the highest reported SAR for the initial test configuration (802.11 n-HT40) is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or 3 W/kg (1-g or 10-g respectively), according to KDB 248227 D01.

Wi-Fi 5 GHz (W56: U-NII-2C Band)

Date	:	2018/12/21	Measured by	:	M. Kouga
Amb. Temp.	:	22.2 deg. C	Rel. hum.	:	41.0 %RH

The Initial Test Configuration (ITC) : IEEE 802.11n (HT40) (*3)

Mode	Freq. Band	Ch.	Freq. (MHz)	Power Setting	Data Rate /MCS	Meas. Frame Averaged Power (dBm)	Meas. Burst Averaged Power (dBm) *1	Max. Poss. Power (dBm)	Within 2 dB of Max. Poss. Power	SAR Tested	Note(s)
802.11a	W56	100	5500	Tune-up	6.0 Mbps	13.99	14.06	15.0	Yes	-	
		120	5600		6.0 Mbps	14.17	14.24	15.0	Yes	-	
		140	5700		6.0 Mbps	**14.36**	14.42	15.0	Yes	-	
802.11n (HT20)	W56	100	5500	Tune-up	MCS-0	14.16	14.23	15.0	Yes	-	
		116	5600		MCS-0	14.12	14.19	15.0	Yes	-	
		140	5700		MCS-0	**14.20**	14.26	15.0	Yes	-	
802.11n (HT40)	W56	102	5510	Tune-up	MCS-0	**14.18**	14.32	15.0	Yes	Yes	ITC
		118	5590		MCS-0	14.16	14.29	15.0	Yes	Yes	
		134	5670		MCS-0	14.17	14.31	15.0	Yes	Yes	
802.11ac (VHT20)	W56	100	5500	Tune-up	MCS-0	14.15	14.22	15.0	Yes	-	
		116	5600		MCS-0	14.01	14.08	15.0	Yes	-	
		140	5700		MCS-0	**14.22**	14.29	15.0	Yes	-	
802.11ac (VHT40)	W56	102	5510	Tune-up	MCS-0	14.11	14.25	15.0	Yes	-	
		118	5590		MCS-0	14.15	14.29	15.0	Yes	-	
		134	5630		MCS-0	**14.22**	14.36	15.0	Yes	-	
802.11ac (VHT80)	W56	106	5530	Tune-up	MCS-0	13.02	13.29	14.0	Yes	-	
		122	5610	Tune-up	MCS-0	**13.12**	13.39	14.0	Yes	-	

*1 Used for confirmation that the DUT's output power is within +0/-2 dB of the maximum tune-up tolerance limits (max. poss. power), since the maximum tune-up tolerance limits are defined as burst averaged values.

*3 SAR is not required for the remaining 802.11 transmission configurations (802.11 a/n-HT20/ac-VHT20/ac-VHT40/ac-VHT80) when the highest reported SAR for the initial test configuration (802.11 n-HT40) is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or 3 W/kg (1-g or 10-g respectively), according to KDB 248227 D01.

Wi-Fi 5 GHz (W58: U-NII-3 Band)
Date : 2018/12/22 Measured by : M. Kouga
Amb. Temp. : 22.2 deg. C Rel. hum. : 41.0 %RH

The Initial Test Configuration (ITC) : IEEE 802.11ac (VHT80) (*3)

Mode	Freq. Band	Ch.	Freq. (MHz)	Data Rate /MCS	Meas. Frame Averaged Power (dBm)	Meas. Burst Averaged Power (dBm) *1	Max. Poss. Power (dBm)	Within 2 dB of Max. Poss. Power	SAR Tested	Note(s)
802.11a	W58	149	5745	6.0 Mbps	12.37	12.43	13.0	Yes	-	
		157	5785	6.0 Mbps	12.44	12.50	13.0	Yes	-	
		165	5825	6.0 Mbps	**12.51**	12.58	13.0	Yes	-	
802.11n (HT20)	W58	149	5745	MCS-0	12.26	12.33	13.0	Yes	-	
		157	5785	MCS-0	**12.44**	12.51	13.0	Yes	-	
		165	5825	MCS-0	12.37	12.44	13.0	Yes	-	
802.11n (HT40)	W58	151	5755	MCS-0	12.35	12.48	13.0	Yes	-	
		159	5795	MCS-0	**12.68**	12.82	13.0	Yes	-	
802.11ac (VHT20)	W58	149	5745	MCS-0	12.63	12.70	13.0	Yes	-	
		157	5785	MCS-0	12.42	12.49	13.0	Yes	-	
		165	5825	MCS-0	**12.68**	12.75	13.0	Yes	-	
802.11ac (VHT40)	W58	151	5755	MCS-0	12.47	12.61	13.0	Yes	-	
		159	5795	MCS-0	**12.56**	12.70	13.0	Yes	-	
802.11ac (VHT80)	W58	155	5775	MCS-0	**12.49**	12.76	13.0	Yes	Yes	ITC

*1 Used for confirmation that the DUT's output power is within +0/-2 dB of the maximum tune-up tolerance limits (max. poss. power), since the maximum tune-up tolerance limits are defined as burst averaged values.

*3 SAR is not required for the remaining 802.11 transmission configurations (802.11 a/n-HT20/n-HT40/ac-VHT20/ac-VHT40) when the highest reported SAR for the initial test configuration (802.11 ac-VHT80) is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or 3 W/kg (1-g or 10-g respectively), according to KDB 248227 D01.

Bluetooth
Date : 2018/12/04 Measured by : M. Kouga
Amb. Temp. : 22.4 deg. C Rel. hum. : 66.2 %RH

Bluetooth LE

Ch.	Freq. (MHz)	Packet Type	Meas. Frame Averaged Power (dBm)	Meas. Burst Averaged Power (dBm) *1	Max. Poss. Power (dBm)	Within 2 dB of Max. Poss. Power	SAR Tested	Note(s)
0	2402	-	6.68	8.74	9.5	Yes	Yes	
19	2440	-	**7.28**	9.34	9.5	Yes	Yes	Worst Ch
39	2480	-	6.98	9.04	9.5	Yes	Yes	

*1 Used for confirmation that the DUT's output power is within +0/-2 dB of the maximum tune-up tolerance limits (max. poss. power), since the maximum tune-up tolerance limits are defined as burst averaged values.

4. SAR Measurements

☒<SAR Correction/Scaling>
According to KDB 447498 D01, KDB 248227 D01, and/or KDB 865664 D01,
the maximum SAR values are determined by taking account of the following correction or scaling factors.

The maximum 1-g SAR and/or 10-g SAR values (reported SAR) are calculated by applying the ΔSAR positive correction for deviations of the tissue-equivalent liquid and the power scaling for the maximum duty factor and maximum possible power levels (maximum tune-up tolerance limit) to each measured 1-g SAR and/or 10-g SAR value:

Reported SAR (W/kg) = Measured SAR (W/kg) * ΔSAR positive correction factor * Duty cycle scaling factor * Tune-up scaling factor

where;

ΔSAR positive correction factor = (100 - ΔSAR*1) / 100
Duty cycle scaling factor = Max. possible duty cycle / Measured duty cycle used for the SAR measurement
Tune-up scaling factor = Max. possible power (mW) / Measured power used for the SAR measurement (mW)

*1 $\Delta SAR\ (\%) = c_\varepsilon * \Delta\varepsilon_r + c_\sigma * \Delta\sigma$

<For 1-g SAR>

$c_\varepsilon = -7.854 * 10^{-4} f^3 + 9.402 * 10^{-3} f^2 - 2.742 * 10^{-2} f - 0.2026$

$c_\sigma = 9.804 * 10^{-3} f^3 - 8.661 * 10^{-2} f^2 + 2.981 * 10^{-2} f + 0.7829$

<For 10-g SAR>

$c_\varepsilon = 3.456 * 10^{-3} f^3 - 3.531 * 10^{-2} f^2 + 7.675 * 10^{-2} f - 0.1860$

$c_\sigma = 4.479 * 10^{-3} f^3 - 1.586 * 10^{-2} f^2 - 0.1972 f + 0.7717$

where;

- c_ε coefficient representing the sensitivity of SAR to permittivity
- $\Delta\varepsilon_r$ percent change in permittivity
- c_σ coefficient representing the sensitivity of SAR to conductivity
- $\Delta\sigma$ percent change in conductivity
- f frequency in GHz

A negative ΔSAR would translate to a lower measured SAR value than what would be measured if using dielectric properties equal to the target values.
A positive ΔSAR would translate to a higher measured SAR value than what would be measured if using dielectric properties equal to the target values.
SAR correction shall not be made when the ΔSAR has a positive sign to provide a conservative SAR value.
The SAR is only corrected when ΔSAR has a negative sign.

☒<SAR Test Reduction for Wi-Fi>

SAR test reduction for Wi-Fi is applied according to KDB 248227 D01.

For 2.4 GHz 802.11g/n OFDM configurations

SAR is not required for the following 2.4 GHz OFDM conditions.

1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
2) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or 3 W/kg (1-g or 10-g respectively).

For U-NII-1 (W52) and U-NII-2A (W53) Bands

When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies.

1) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg or 3 W/kg (1-g or 10-g respectively), SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
2) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg or 3 W/kg (1-g or 10-g respectively), SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

4.1. SAR Measurement Results

<Body-Worn SAR>

Wi-Fi 5 GHz (W53: U-NII-2A Band)

Date : 2019/04/13 Measured by : S. Fukushima

Amb. Temp. : 22.6 deg. C Rel. hum. : 36.2 %RH

Mode	Ch.	Freq. (MHz)	Position	Dis. (mm)	Max. Poss. Power (dBm)	Meas. Power (dBm)	Max. Duty Cycle (%)	Meas. Duty Cycle (%)	Meas. 1-g SAR (W/kg)	Reported 1-g SAR (W/kg)	Liquid Temp. (deg. C)	Plot No.
Step 1: Worst Position Check												
802.11n (HT40)	54	5270	Front	0	15.00	14.35	100.00	96.89	0.001	0.001	20.3	
			Back		15.00	14.35	100.00	96.89	0.007	0.008	20.4	
			Top-Tilt		15.00	14.35	100.00	96.89	0.240	0.288	20.7	
Step 2: Worst Channel Check (for Step 1)												
802.11n (HT40)	62	5310	Top-Tilt	0	15.00	14.30	100.00	96.89	0.242	**0.293**	20.6	1

*1 The burst averaged power values are used for power scaling since the maximum tune-up tolerance limits are defined as burst averaged values.

*2 Reported SAR (W/kg) = Measured SAR (W/kg) * Duty cycle scaling factor * Tune-up scaling factor

where;

Duty cycle scaling factor = Max. possible duty cycle (%) / Measured duty cycle used for the SAR measurement (%)

Tune-up scaling factor = Max. possible power (mW) (* equal to 100% duty cycle) / Measured power used for the SAR measurement (mW)

Wi-Fi 5 GHz (W56: U-NII-2C Band)

Date : 2019/04/16 Measured by : S. Fukushima

Amb. Temp. : 22.6 deg. C Rel. hum. : 36.2 %RH

Mode	Ch.	Freq. (MHz)	Position	Dis. (mm)	Max. Poss. Power (dBm)	Meas. Power (dBm)	Max. Duty Cycle (%)	Meas. Duty Cycle (%)	Meas. 1-g SAR (W/kg)	Reported 1-g SAR (W/kg)	Liquid Temp. (deg. C)	Plot No.
Step 1: Worst Position Check												
802.11n (HT40)	102	5510	Front	0	15.00	14.32	100.00	96.87	N/D	N/D	21.1	
			Back		15.00	14.32	100.00	96.87	0.014	0.017	21.1	
			Top-Tilt		15.00	14.32	100.00	96.87	0.203	0.245	21.2	
Step 2: Worst Channel Check (for Step 1)												
802.11n (HT40)	118	5590	Top-Tilt	0	15.00	14.29	100.00	96.87	0.210	**0.255**	21.1	2
	134	5670		0	15.00	14.31	100.00	96.87	0.188	0.227	21.0	

N/D: Not Detected

*1 The burst averaged power values are used for power scaling since the maximum tune-up tolerance limits are defined as burst averaged values.

*2 Reported SAR (W/kg) = Measured SAR (W/kg) * Duty cycle scaling factor * Tune-up scaling factor

where;

Duty cycle scaling factor = Max. possible duty cycle (%) / Measured duty cycle used for the SAR measurement (%)

Tune-up scaling factor = Max. possible power (mW) (* equal to 100% duty cycle) / Measured power used for the SAR measurement (mW)

Wi-Fi 5 GHz (W58: U-NII-3 Band)

Date : 2019/04/13 Measured by : S. Fukushima
Amb. Temp. : 22.0 deg. C Rel. hum. : 36.4 %RH

Mode	Ch.	Freq. (MHz)	Position	Dis. (mm)	Max. Poss. Power (dBm)	Meas. Power (dBm)	Max. Duty Cycle (%)	Meas. Duty Cycle (%)	Meas. 1-g SAR (W/kg)	Reported 1-g SAR (W/kg)	Liquid Temp. (deg. C)	Plot No.
Worst Position Check												
802.11ac (VHT80)	155	5775	Front	0	13.00	12.49	100.00	93.96	N/D	N/D	20.2	
			Back		13.00	12.49	100.00	93.96	0.005	0.006	20.3	
			Top-Tilt		13.00	12.49	100.00	93.96	0.087	**0.104**	20.7	3

N/D: Not Detected

*1 The burst averaged power values are used for power scaling since the maximum tune-up tolerance limits are defined as burst averaged values.

*2 Reported SAR (W/kg) = Measured SAR (W/kg) * Duty cycle scaling factor * Tune-up scaling factor

where;

Duty cycle scaling factor = Max. possible duty cycle (%) / Measured duty cycle used for the SAR measurement (%)

Tune-up scaling factor = Max. possible power (mW) (* equal to 100% duty cycle) / Measured power used for the SAR measurement (mW)

Bluetooth

Date : 2019/04/12 Measured by : S. Fukushima
Amb. Temp. : 23.1 deg. C Rel. hum. : 51.3 %RH

Mode	Ch.	Freq. (MHz)	Position	Dis. (mm)	Max. Poss. Power (dBm)	Meas. Power (dBm)	Max. Duty Cycle (%)	Meas. Duty Cycle (%)	Meas. 1-g SAR (W/kg)	Reported 1-g SAR (W/kg)	Liquid Temp. (deg. C)	Plot No.
Step 1: Worst Position Check												
LE	19	2440	Front	0	9.50	9.34	100.00	62.24	0.002	0.003	21.3	
			Back		9.50	9.34	100.00	62.24	0.004	0.007	21.2	
			Top-Tilt		9.50	9.34	100.00	62.24	0.070	**0.117**	21.4	4
Step 2: Worst Channel Check (for Step 1)												
LE	0	2402	Top-Tilt	0	9.50	8.74	100.00	62.24	0.052	0.100	21.4	
	39	2480	Top-Tilt		9.50	9.04	100.00	62.24	0.058	0.104	21.4	

*1 The burst averaged power values are used for power scaling since the maximum tune-up tolerance limits are defined as burst averaged values.

*2 Reported SAR (W/kg) = Measured SAR (W/kg) * Duty cycle scaling factor * Tune-up scaling factor

where;

Duty cycle scaling factor = Max. possible duty cycle (%) / Measured duty cycle used for the SAR measurement (%)

Tune-up scaling factor = Max. possible power (mW) (* equal to 100% duty cycle) / Measured power used for the SAR measurement (mW)

4.2. SAR Measurement Variability

According to KDB 865664 D01, additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), 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 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Freq. Band (MHz)	RF Exposure Conditions	Position	Highest Meas. SAR (W/kg)		Repeat SAR	Repeated Meas. SAR (W/kg)	Ratio of Largest to Smallest SAR
Wi-Fi 5 GHz (W53:U-NII-2A)	Body-Worn	Top-Tilt	1-g SAR	0.242	No	N/A	N/A
Wi-Fi 5 GHz (W56:U-NII-2C)	Body-Worn	Top-Tilt	1-g SAR	0.210	No	N/A	N/A
Wi-Fi 5 GHz (W58:U-NII-3)	Body-Worn	Top-Tilt	1-g SAR	0.087	No	N/A	N/A
Bluetooth	Body-Worn	Top-Tilt	1-g SAR	0.070	No	N/A	N/A

5. Simultaneous Transmission SAR evaluation

Simultaneous transmission SAR evaluation is determined according to KDB 447498 D01, Evaluation by summation of Reported SAR values, as the reference method.

1) If Reported SAR summation > 1.6W/kg, SAR test exclusion is determined by the SPLSR.
2) SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (minimum separation distance), and the peak separation distance is determined form the square root of $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$ where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR location in the zoom scan.
3) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
4) Simultaneously transmission SAR, and the reported multi-band SAR < 1.6 W/kg

RF Exposure Conditions	Test Position	Highest Reported 1g-SAR (W/kg)		Σ 1-g SAR (W/kg)	SPLSR Required
		Wi-Fi 5 GHz (Measured)	Bluetooth (Measured)		
Body-Worn	Top-Tilt	0.293	0.117	**0.410**	N/A

6. Test Verifications and Procedure

Due to the shape of the protruding portion of the top surface of the host platform, there is a gap of approximately 3 mm between the flat phantom and the antenna of the host platform. Therefore, the following verification was performed to confirm whether the DUT will still be complied with the SAR limit even when the flat phantom and the antenna of the host platform are in direct contact (i.e. with the gap of 0 mm).

6.1. Verification of vertical linearity

Verification of vertical linearity was performed to extrapolate roughly the SAR level at direct contact 0 mm. This data is used for reference only because it is a "Roughly extrapolated SAR value" based on "Distance scaling factor".
Please refer to Appendix D for more details.

1) At the top-tilt position, measure the Single point SAR value while changing the distance of the host platform in the vertical direction from 0 mm to 5 mm in 1 mm steps, and confirm that the Single point SAR value decreases linearly in proportion to the distance.
2) Calculate the "Distance scaling factor" equivalent to 3 mm, which is the gap between the flat phantom and the host platform, from a decrease in Single point SAR value.
3) Multiply the Reported-SAR value in section 4.1 by the "Distance scaling factor". The result is referred to as "Roughly extrapolated SAR value" at direct contact 0 mm.

Single point SAR Measurement Result

Freq. Bands	Mode	Ch.	Freq. (MHz)	Position	Dis. (mm)	Gap (mm)	Single point SAR (W/kg)
Wi-Fi 5GHz (UNII-2A)	802.11n (HT40)	62	5310	Top-Tilt	0	3	0.610
					1	4	0.451
					2	5	0.359
					3	6	0.271
					4	7	0.203
					5	8	0.164
Bluetooth	LE	19	2440	Top-Tilt	0	3	0.074
					1	4	0.065
					2	5	0.056
					3	6	0.050
					4	7	0.042
					5	8	0.036

Roughly extrapolated SAR value at the direct contact 0 mm

Freq. Bands	Dis. (mm)	Gap (mm)	Single point SAR (W/kg)	Distance scaling factor	Reported 1-g SAR (W/kg)	Roughly extrapolated SAR (W/kg)	Σ 1-g SAR (W/kg)
Wi-Fi 5GHz (UNII-2A)	0	3	0.610	×2.25	0.293	0.659	0.837
	3	6	0.271				
Bluetooth	0	3	0.074	×1.48	0.117	0.178	
	3	6	0.050				

*1 Roughly extrapolated SAR (W/kg) is an estimated value when gap assumes 0 mm.

*2 Roughly extrapolated SAR (W/kg) = Reported SAR (W/kg) * Distance scaling factor

where;

Distance scaling factor = Single point SAR (* at distance 0.0 mm) / Single point SAR (* at distance 3.0 mm)

Appendix A. Plots of SAR Measurement

Please see the following page(s).

Plot No. 1

Date: 2019/04/13

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Wi-Fi 5GHz (62ch)_Body-Worn_Top-Tilt_0mm

DUT: Type1DR (installed in Digital Camera 1DR026)

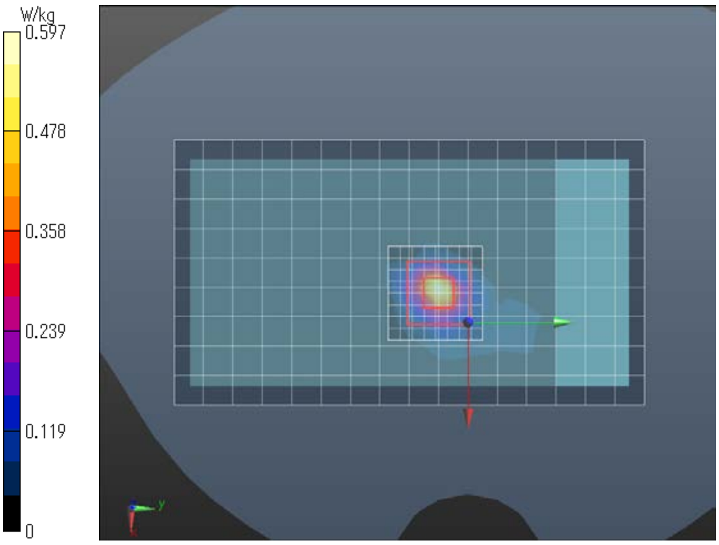
Communication System: UID 0, Wi-Fi_802.11n_HT40_MCS0 (0);
Communication System Band: 5GHz; Frequency: 5310 MHz;
Medium parameters used: f = 5310 MHz; σ = 4.748 S/m; ε_r = 35.627; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(5.3, 5.3, 5.3); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Wi-Fi 5GHz (62ch)_Body-Worn_Top-Tilt_0mm/
Area Scan (10x17x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.597 W/kg

Configuration/Wi-Fi 5GHz (62ch)_Body-Worn_Top-Tilt_0mm/
Zoom Scan (9x9x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 12.40 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 0.970 W/kg
SAR(1 g) = 0.242 W/kg; SAR(10 g) = 0.062 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.596 W/kg



Plot No. 2

Date: 2019/04/16

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Wi-Fi 5GHz (118ch)_Body-Worn_Top-Tilt_0mm

DUT: Type1DR (installed in Digital Camera 1DR026)

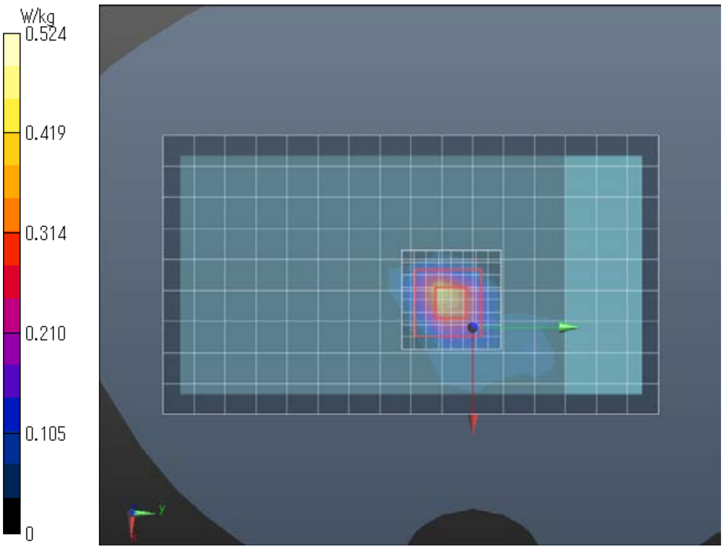
Communication System: UID 0, Wi-Fi_802.11n_HT40_MCS0 (0);
Communication System Band: 5GHz; Frequency: 5590 MHz;
Medium parameters used: f = 5590 MHz; σ = 4.982 S/m; ε_r = 35.123; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(4.72, 4.72, 4.72); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Wi-Fi 5GHz (118ch)_Body-Worn_Top-Tilt_0mm/
Area Scan (10x17x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.425 W/kg

Configuration/Wi-Fi 5GHz (118ch)_Body-Worn_Top-Tilt_0mm/
Zoom Scan (9x9x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 10.27 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.870 W/kg
SAR(1 g) = 0.210 W/kg; SAR(10 g) = 0.055 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.524 W/kg



Plot No. 3

Date: 2019/04/13

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Wi-Fi 5GHz (155ch)_Body-Worn_Top-Tilt_0mm

DUT: Type1DR (installed in Digital Camera 1DR026)

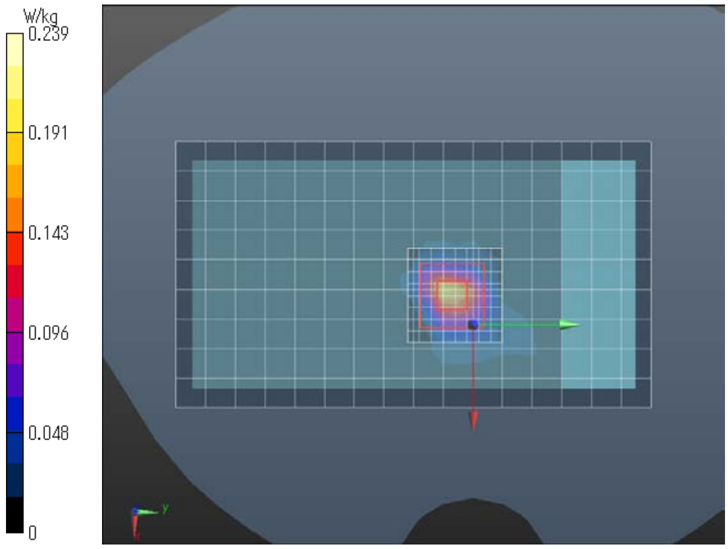
Communication System: UID 0, Wi-Fi_802.11ac_VHT80_MCS0;
Communication System Band: 5GHz; Frequency: 5775 MHz;
Medium parameters used: f = 5775 MHz; σ = 5.244 S/m; ε_r = 34.453; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(4.96, 4.96, 4.96); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Wi-Fi 5GHz (155ch)_Body-Worn_Top-Tilt_0mm/
Area Scan (10x17x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.197 W/kg

Configuration/Wi-Fi 5GHz (155ch)_Body-Worn_Top-Tilt_0mm/
Zoom Scan (9x9x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 6.828 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.536 W/kg
SAR(1 g) = 0.087 W/kg; SAR(10 g) = 0.023 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.239 W/kg



Plot No. 4

Date: 2019/04/12

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Bluetooth LE (19ch)_Body-Worn_Top-Tilt_0mm

DUT: Type1DR (installed in Digital Camera 1DR026)

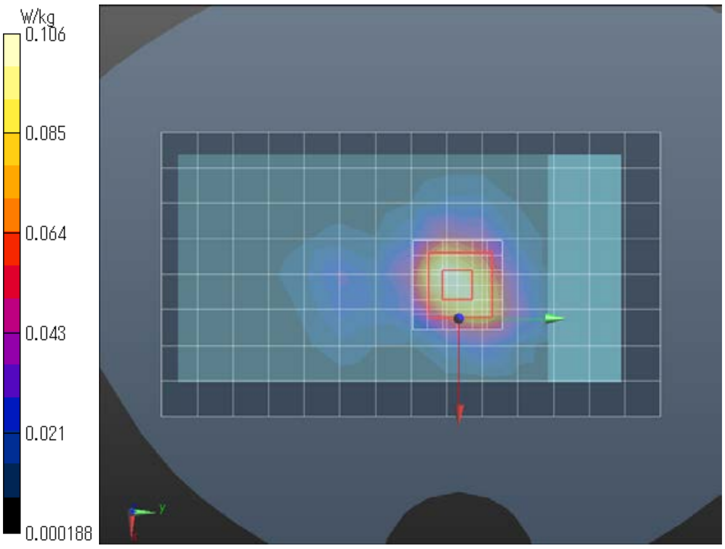
Communication System: UID 0, Bluetooth LE (0);
Communication System Band: Bluetooth; Frequency: 2440 MHz;
Medium parameters used: f = 2440 MHz; σ = 1.834 S/m; ε_r = 39.984; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(7.34, 7.34, 7.34); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Bluetooth LE (19ch)_Body-Worn_Top-Tilt_0mm/
Area Scan (9x15x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.106 W/kg

Configuration/Bluetooth LE (19ch)_Body-Worn_Top-Tilt_0mm/
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.932 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.135 W/kg
SAR(1 g) = 0.070 W/kg; SAR(10 g) = 0.038 W/kg (SAR corrected for target medium)



Appendix B. Plots of System Check

Please see the following page(s).

Date: 2019/04/12

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/ RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Validation_D2450_HSL

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 936

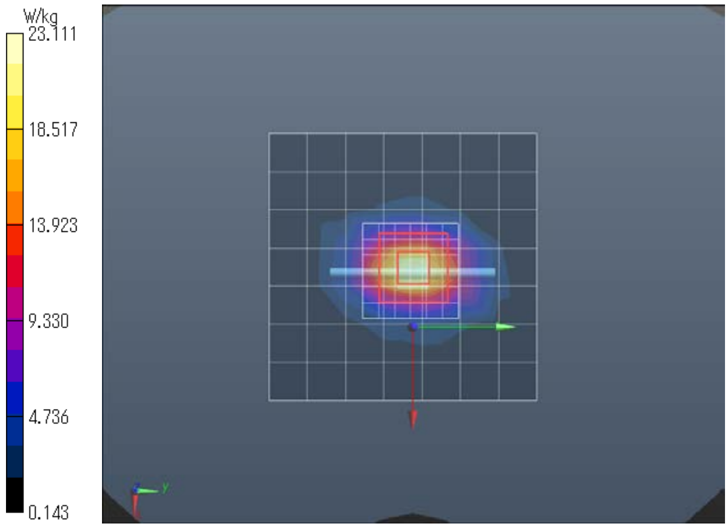
Communication System: UID 0, CW (0);
Communication System Band: 2.4 GHz; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.842 S/m; ε_r = 39.97; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(7.34, 7.34, 7.34); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies above 2 GHz/Validation D2450 HSL/
Area Scan (8x8x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 18.6 W/kg

System Performance Check at Frequencies above 2 GHz/Validation D2450 HSL/
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 118.7 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 28.7 W/kg
SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.44 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 23.1 W/kg



Date: 2019/04/13

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Validation_D5300_HSL

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1183

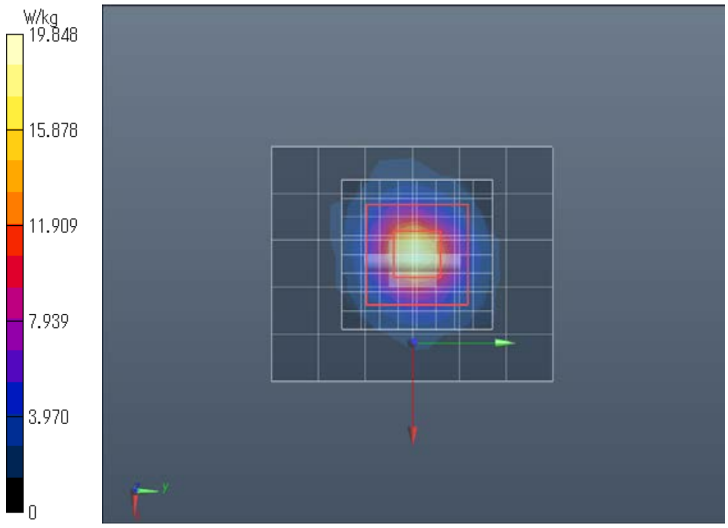
Communication System: UID 0, CW (0);
Communication System Band: 5 GHz; Frequency: 5300 MHz;
Medium parameters used: f = 5300 MHz; σ = 4.738 S/m; ε_r = 35.641; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(5.3, 5.3, 5.3); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies above 5 GHz/Validation D5300 HSL/
Area Scan (6x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 17.6 W/kg

System Performance Check at Frequencies above 5 GHz/Validation D5300 HSL/
Zoom Scan (9x9x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 69.04 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.21 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 19.8 W/kg



Date: 2019/04/16

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Validation_D5600_HSL

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1183

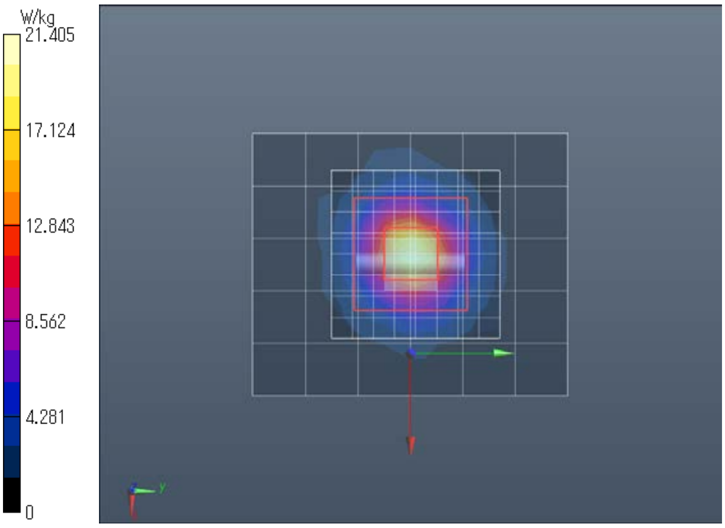
Communication System: UID 0, CW (0);
Communication System Band: 5 GHz; Frequency: 5600 MHz
Medium parameters used: f = 5600 MHz; σ = 4.993 S/m; ε_r = 35.109; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(4.72, 4.72, 4.72); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies above 5 GHz/Validation D5600 HSL/
Area Scan (6x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 18.8 W/kg

System Performance Check at Frequencies above 5 GHz/Validation D5600 HSL/
Zoom Scan (9x9x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 69.43 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 36.9 W/kg
SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.29 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 21.4 W/kg



Date: 2019/04/13

Test Laboratory: Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory Main Lab. 4th Site Shielded Room 2

Validation_D5800_HSL

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1183

Communication System: UID 0, CW (0);
Communication System Band: 5 GHz; Frequency: 5800 MHz
Medium parameters used: f = 5800 MHz; σ = 5.273 S/m; ε_r = 34.408; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(4.96, 4.96, 4.96); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 25.0
- Electronics: DAE4 Sn482; Calibrated: 2018/09/21
- Phantom: SAM (20deg probe tilt) with CRP v5.0 FRONT; Type: QD000P40CD; Serial: TP:1852
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies above 5 GHz/Validation D5800 HSL/
Area Scan (6x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 17.8 W/kg

System Performance Check at Frequencies above 5 GHz/Validation D5800 HSL/
Zoom Scan (9x9x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 65.31 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 35.7 W/kg
SAR(1 g) = 7.52 W/kg; SAR(10 g) = 2.12 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 19.9 W/kg