SAR TEST REPORT

Project No.	:	JB-Z0479-A
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 1DR024)
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	
	Wi-Fi 2.4 GHz	Bluetooth Low Energy	
Body-Worn	0.987 W/kg	N/A	

Test Result : Complied

Sample Receipt	:	February 6, 2018	
Testing	:	February 23, 2018 - April 23, 2018	(for conducted power measurements)
		December 12, 2018	(for SAR measurement)
Reported	:	December 26, 2018	

Reported by :

Shinichi Suzuki
Test Engineer
EMC/ RF Test Laboratory Main Lab.
Design Technology Division
Sony Global Manufacturing & Operations Corporation

Approved Signatory :

Teruki Kurihara
Technical Manager
EMC/ RF Test Laboratory Main Lab.
Design Technology Division
Sony Global Manufacturing & Operations Corporation

Notice

- *These test results relate only to the items (combination equipment, test configuration, operation condition etc.) tested.*
- *This report shall not be reproduced except in full, without written approval of the laboratory.*
- *This report must not be used by the client to claim product endorsement by A2LA or any agency of the U.S. Government.*
- *All test results are traceable to the national and / or international standards.*
- *The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in Sony Global Manufacturing & Operations Corporation EMC/ RF Test Laboratory.*

TESTING CERT #3203.01

Format No.: NV1-1-01 Version 5.0

REVISION HISTORY

Project No.	Revision	Page	Description	Issued date
JB-Z0479	Original	-	-	December 21, 2018
JB-Z0479-A	1	30	Revised the table of SAR Measurement Results.	December 26, 2018

TABLE OF CONTENTS

A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

1. General Information

1.1. Description of Device Under Test (DUT)

DUT and Host Platform Descriptions

	DUT	Host Platform *The DUT is installed in this host.
Type of Equipment	Communication Module	Digital Camera
Model No.	Type1DR	1DR024
FCC-ID	VPYLB1DR	
Test Sample Condition	☐ Prototype ☐ Pre-production ☒ Mass-production	☒ Prototype ☐ Pre-production ☐ Mass-production
	* Not for sale: The sample is equivalent to mass-production items. * No modification by the test lab.	
Serial No.	448	31
Rating	DC 3.2 V (VBAT) DC 1.8 V (VDDXO) DC 1.8 or 3.3 V (VIO) * Supplied from the host.	Li-ion Battery DC 3.7 V/ 700 mAh ☐ Not user accessible.
Head/Body-Worn Accessories (supplied with the device)	n/a	n/a
Device Dimension (W x H x D)	7.7 mm x 7.9 mm x 1.1 mm	See Appendix D
Device Category	Portable	
Exposure Category	General population/ Uncontrolled environment	

Wireless Technologies

Wireless Technologies	Frequency Bands	Operating Mode	Power Setting Mode
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	High Power Mode
Bluetooth	2.4GHz	Version 4.1(LE)	n/a

Note(s):
* The DUT installed in this host does not support the Wi-Fi 2.4 GHz Low Power Mode, Wi-Fi 5 GHz, and/or 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	-10.01 dBi

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	Back-Tilt	Left	Right	Top	Bottom
Wi-Fi/Bluetooth	3.9	25.6	≈ 25.6	9.55	43.45	12.0	16.5

* Please refer to Appendix D for more details.

1.3. Simultaneous Transmission Conditions

Wi-Fi 2.4 GHz cannot transmit simultaneously with Bluetooth.

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

Wireless Technologies	Mode	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	2412	2462	All	All	17.0	+2.0	-2.0	19.0
	802.11g	2412	2462	1	All	13.5	+2.0	-2.0	15.5
				2 to 10	6 to 48 Mbps	17.0	+2.0	-2.0	19.0
					54 Mbps	16.0	+2.0	-2.0	18.0
				11	All	13.5	+2.0	-2.0	15.5
	802.11n (HT20)	2412	2462	1	All	13.5	+2.0	-2.0	15.5
				2 to 10	MCS 0 to 2	17.0	+2.0	-2.0	19.0
					MCS 3 to 6	16.0	+2.0	-2.0	18.0
					MCS 7	15.0	+2.0	-2.0	17.0
				11	All	13.5	+2.0	-2.0	15.5
Bluetooth	BLE	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 /Bluetooth	Body-Worn	0	Front	3.9	Yes	
			Back	25.6	N/A	1
			Back-Tilt	≈ 25.6	Yes	1
			Left	9.55	Yes	
			Right	43.45	Yes	
			Top	12.0	Yes	
			Bottom	16.5	Yes	

Note(s):
1. Due to the shape of the LCD panel of the back surface of the host platform, SAR was evaluated with the bottom corner of the back surface positioned in direct contact against the flat phantom, the "Back-Tilt" test position, instead of the "Back" test position. Please refer to Appendix D for more details.

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)] ·
[$\sqrt{f(GHz)}$] ≤ 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 2.4GHz	2450	Front	0	3.9	3.9	5	19.0	79.4	79	24.7	Yes
	2450	Back-Tilt	0	25.6	25.6	26	19.0	79.4	79	4.8	Yes
	2450	Left	0	9.55	9.55	10	19.0	79.4	79	12.4	Yes
	2450	Right	0	43.45	43.45	43	19.0	79.4	79	2.9	No
	2450	Top	0	12.0	12.00	12	19.0	79.4	79	10.3	Yes
	2450	Bottom	0	16.5	16.50	17	19.0	79.4	79	7.3	Yes
Bluetooth	2450	Front	0	3.9	3.9	5	9.5	8.9	9	2.8	No
	2450	Back-Tilt	0	25.6	25.6	26	9.5	8.9	9	0.5	No
	2450	Left	0	9.55	9.55	10	9.5	8.9	9	1.4	No
	2450	Right	0	43.45	43.45	43	9.5	8.9	9	0.3	No
	2450	Top	0	12.0	12.00	12	9.5	8.9	9	1.2	No
	2450	Bottom	0	16.5	16.50	17	9.5	8.9	9	0.8	No

A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

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

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

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

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

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

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

[13] 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	18.03.12	
☐	W0095	Data Acquisition Electronics	DAE4	482	SPEAG	1Y	18.09.21	
☒	W0096	Data Acquisition Electronics	DAE4	610	SPEAG	1Y	18.01.10	
☐	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+SUHNER	1Y	18.10.06	
☒	WC0023	RF Cable	SUCOFLEX 104	MY36443/4	HUBER+SUHNER	1Y	18.10.06	
☒	WC0024	RF Cable	SUCOFLEX 126E	MY1150/26E	HUBER+SUHNER	1Y	18.10.06	
☒	WC0025	RF Cable	SUCOFLEX 104	MY37246/4	HUBER+SUHNER	1Y	18.10.06	
☒	WC0026	RF Cable	SUCOFLEX 126E	MY1558/26E	HUBER+SUHNER	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:

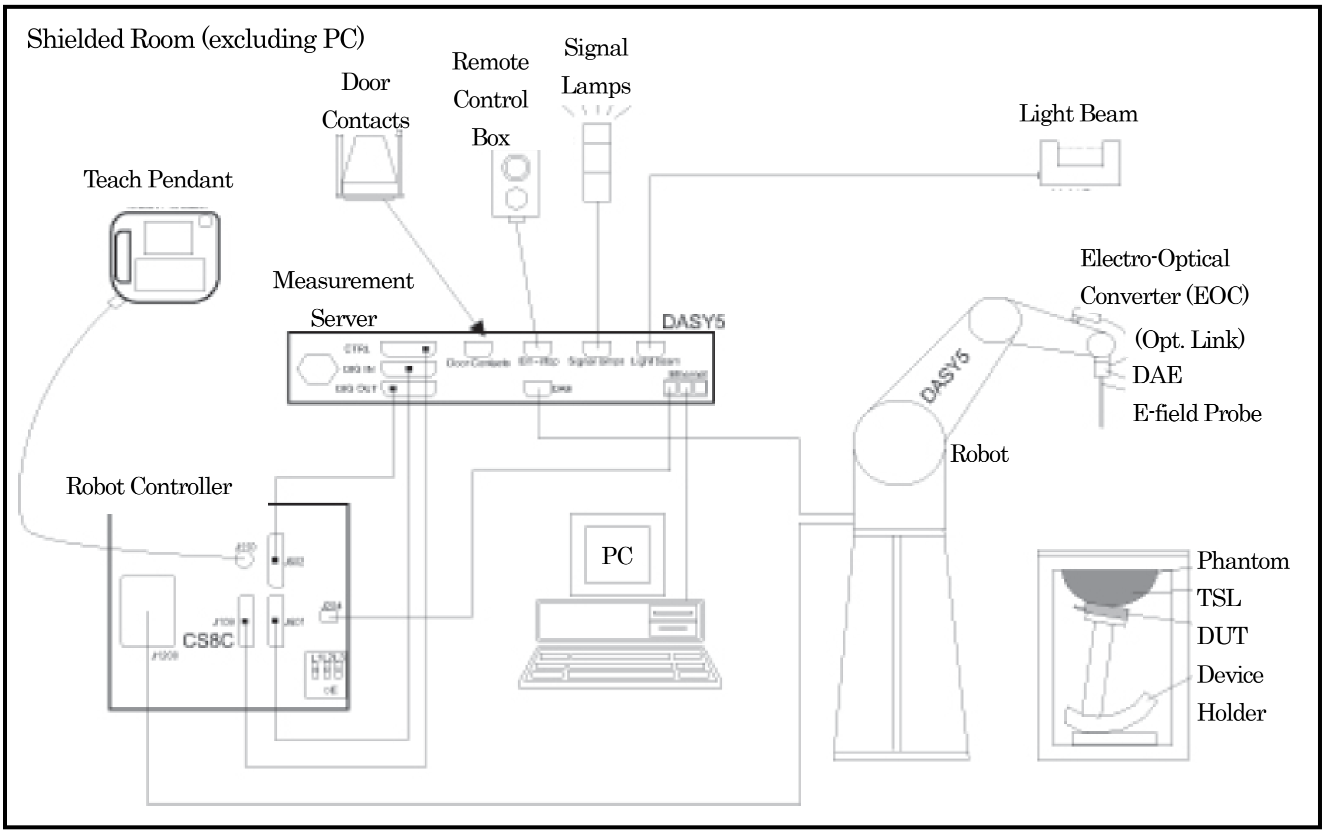


Figure 2-1 Measurement System Description

- 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

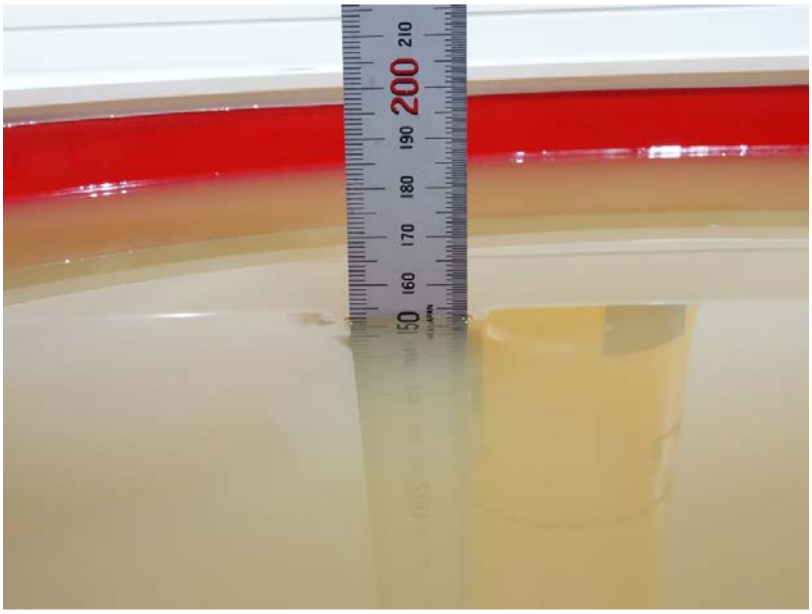
Manufacturer	Schmid & Partner Engineering AG (SPEAG)		
Model No.	D-Series		
Construction	Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with tissue simulating solutions		
Frequency	2450, 5100 to 5800 MHz		
Return Loss	> 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.



MBBL 600-6000 V6

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

2.5. SAR Measurement

Step 1: Power Reference Measurement
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.

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

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

Step 4: Power Drift Measurement
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><td colspan="3" rowspan="2"></td><td colspan="2">DUT Transmit Frequency being Tested</td></tr>
<tr><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></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>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 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 $\leq$ 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>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 5 mm
4 – 6 GHz: $\leq$ 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>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 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>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 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

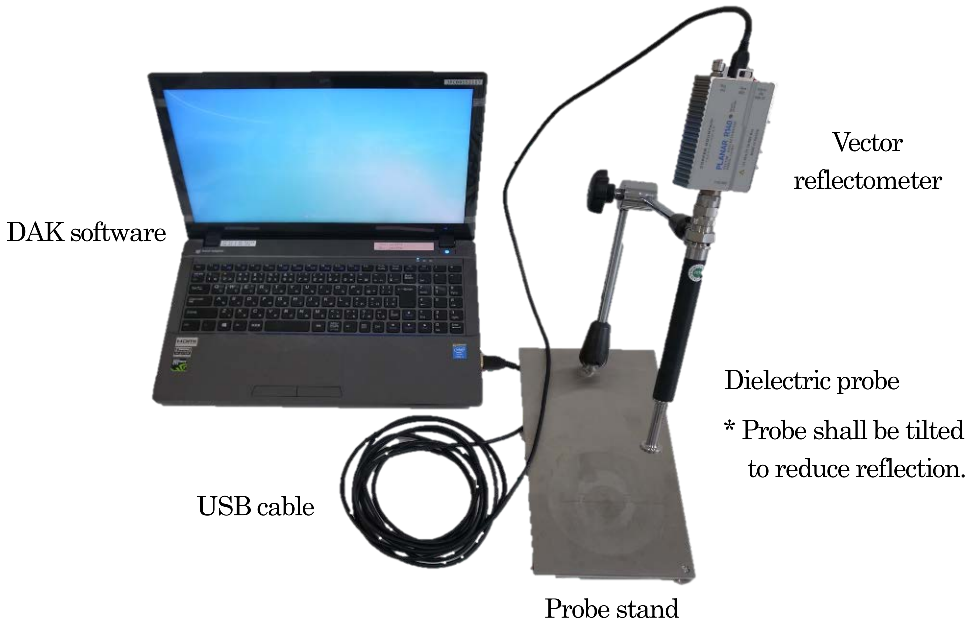
According to IEEE Std 1528-2013 (3GHz to 6GHz range)								
Input quantity	Uncertainty of Xi			Ci		Ciu(Xi)		Vi Veff
	Xi	Prob. Dist.	Div.	1g [-]	10g [-]	1g	10g	
Measurement System								
Probe Calibration (k=1)	±6.55%	N	1.00	1.00	1.00	±6.6%	±6.6%	∞
Axial Isotropy	±4.7%	R	1.73	0.70	0.70	±1.9%	±1.9%	∞
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

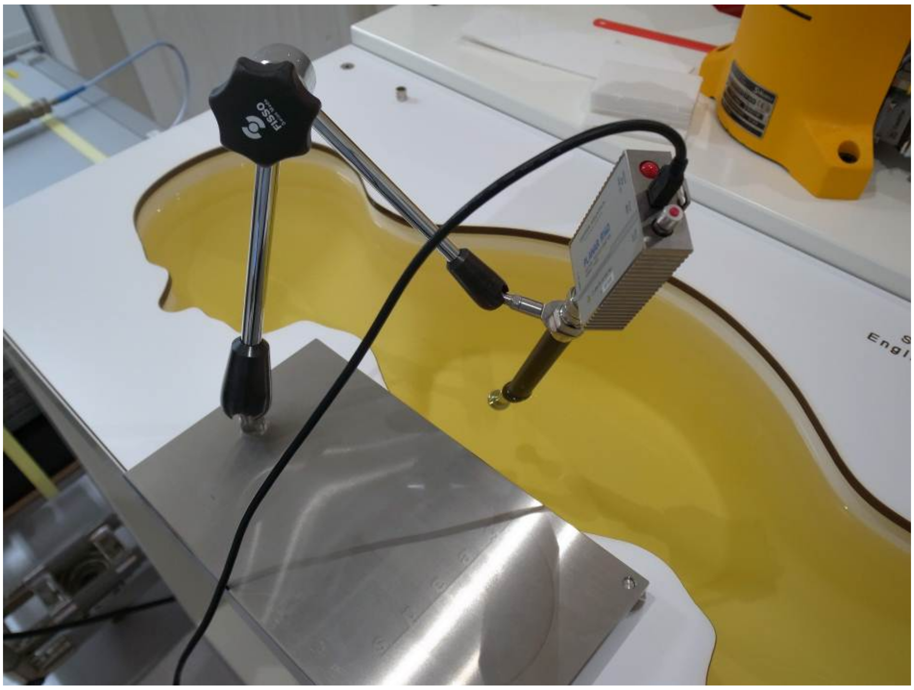
According to IEEE Std 1528-2013 (0.3GHz to 6GHz range)								
Input quantity	Uncertainty of Xi			Ci		Ciu(Xi)		Vi Veff
	Xi	Prob. Dist.	Div.	1g [-]	10g [-]	1g	10g	
Measurement System								
Probe Calibration (k=1)	±6.55%	N	1.00	1.00	1.00	±6.6%	±6.6%	∞
Axial Isotropy	±4.7%	R	1.73	0.70	0.70	±1.9%	±1.9%	∞
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 %.

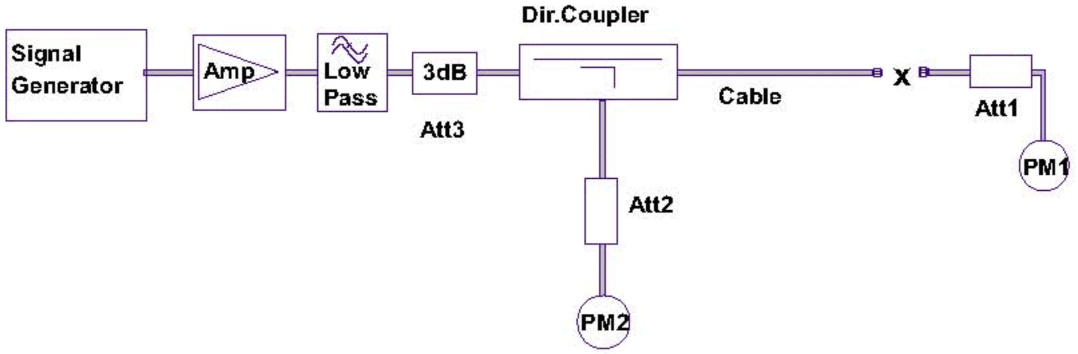
4th Site Shielded Room 2

TSL	Freq. (MHz)	Param.	Target *1	Meas.	Dev. (%) *2	Date	Amb. Temp. (deg. C)	Rel. Hum. (%RH)	Liquid Temp. (deg. C)	Note(s)
MBBL 600-6000V6	2402	ε_r	52.76	52.95	0.36	2018/12/12	23.6	49.6	21.8	
		σ (S/m)	1.90	1.97	3.68					
	2412	ε_r	52.75	52.94	0.36					
		σ (S/m)	1.91	1.98	3.66					
	2437	ε_r	52.72	52.90	0.34					
		σ (S/m)	1.94	2.00	3.09					
	2440	ε_r	52.71	52.90	0.36					
		σ (S/m)	1.94	2.00	3.09					
	2462	ε_r	52.68	52.86	0.34					
		σ (S/m)	1.97	2.02	2.54					
	2480	ε_r	52.66	52.83	0.32					
		σ (S/m)	1.99	2.04	2.51					

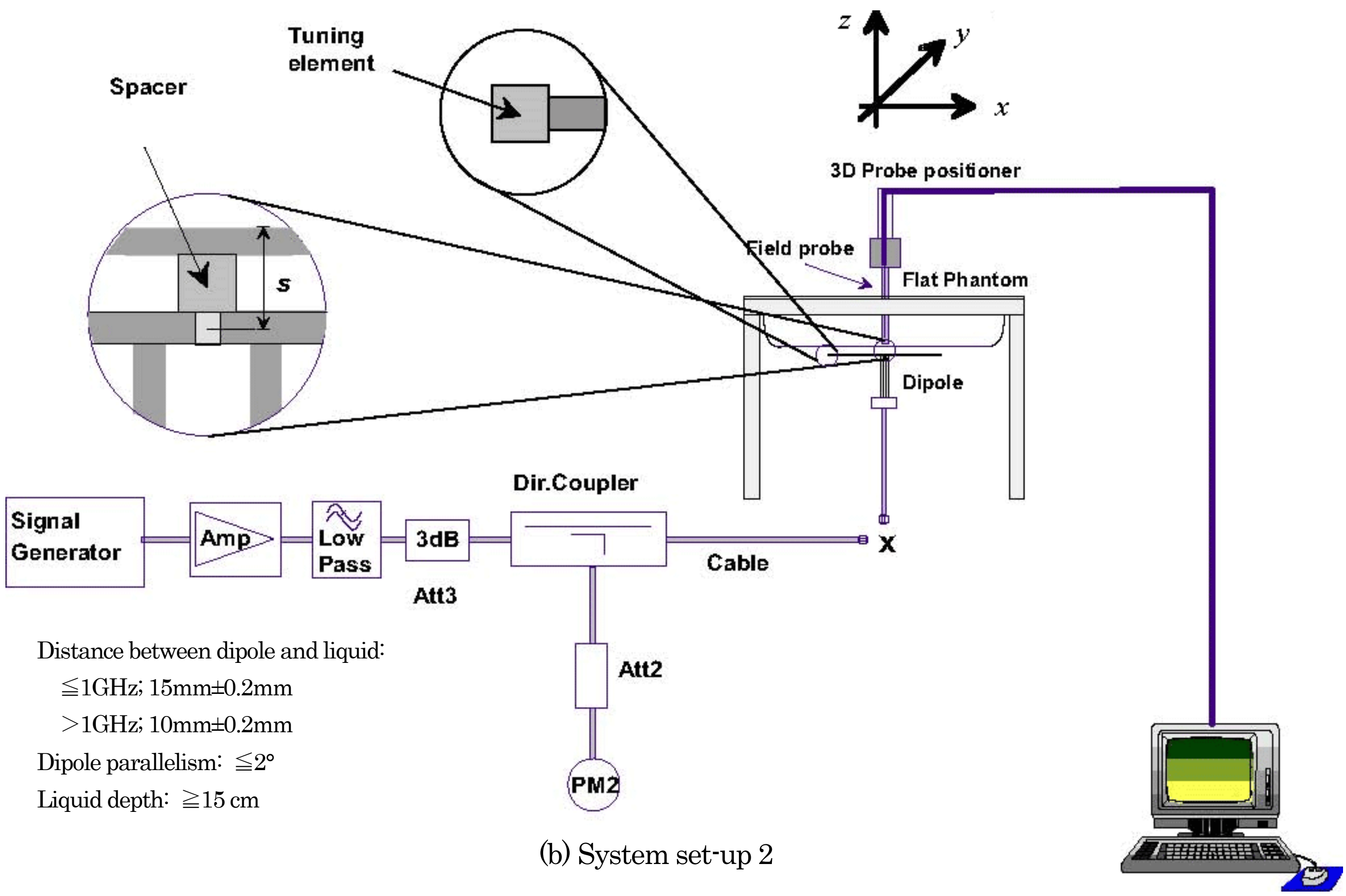
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

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

Body TSL

(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 %.

4th Site Shielded Room 2 (Body TSL)

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	13.10	52.40	50.10	4.59	2018/12/12	22.0	42.1	21.3	
		10-g SAR	6.07	24.28	23.70	2.45					

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 2.4 GHz

Date : 2018/02/23 Measured by : M. Kouga
Amb. Temp. : 22.3 deg. C Rel. hum. : 36.7 %RH

IEEE 802.11b

Ch.	Freq. (MHz)	Power Setting	Data Rate (Mbps)	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)
Step 1: Worst Date Rate Check									
1	2412	Default	1.0	16.38	16.39	19.0	-	-	
			2.0	16.45	16.47	19.0	-	-	
			5.5	**16.47**	16.51	19.0	-	-	Worst D/R
			11.0	16.39	16.47	19.0	-	-	
Step 2: Worst Channel Check									
1	2412	Tune-up	5.5	18.18	18.22	19.0	Yes	Yes	
6	2437		5.5	18.26	18.30	19.0	Yes	Yes	
11	2462		5.5	**18.35**	18.40	19.0	Yes	Yes	Worst Ch

IEEE 802.11g (*2)(*3)

Ch.	Freq. (MHz)	Power Setting	Data Rate (Mbps)	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)
2	2417	Tune-up	6.0	17.90	17.97	19.0	Yes	-	
6	2437		6.0	17.93	18.00	19.0	Yes	-	
10	2457		6.0	**17.98**	18.05	19.0	Yes	-	Worst Ch

IEEE 802.11n (*2)(*3)

Ch.	Freq. (MHz)	Power Setting	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)
2	2417	Tune-up	0	17.76	17.84	19.0	Yes	-	
6	2437		0	17.78	17.86	19.0	Yes	-	
10	2457		0	**17.80**	17.87	19.0	Yes	-	Worst Ch

*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 SAR is not required for 802.11g/n channels when the highest reported SAR for DSSS (802.11b) 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), according to KDB 248227 D01.

*3 Channels 2, 6, and 10 are measured since channels 1 and 11 require reduced output power, according to KDB 248227 D01.

Bluetooth

Date	:	2018/04/23	Measured by	:	M. Kouga
Amb. Temp.	:	24.5 deg. C	Rel. hum.	:	48.0 %RH

Bluetooth LE (*4)

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	-	5.84	7.90	9.5	Yes	-	
19	2440	-	**6.54**	8.60	9.5	Yes	-	Worst Ch
39	2480	-	6.29	8.36	9.5	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.

*4 SAR is not required for Bluetooth when SAR test exclusion is applied according to KDB 447498 D01.

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 2.4 GHz

Date : 2018/12/12 Measured by : S. Fukushima and S. Kinoshita

Amb. Temp. : 22.6 deg. C Rel. hum. : 42.6 %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												
802.11b	11	2462	Front	0	19.00	18.40	100.00	98.98	0.851	**0.987**	21.5	1
			Back-Tilt		19.00	18.40	100.00	98.98	0.006	0.007	20.6	
			Left		19.00	18.40	100.00	98.98	0.076	0.088	20.8	
			Top		19.00	18.40	100.00	98.98	0.121	0.140	20.5	
			Bottom		19.00	18.40	100.00	98.98	0.079	0.092	20.5	
Step 2: Worst Channel Check (for Step 1)												
802.11b	1	2412	Front	0	19.00	18.22	100.00	98.98	0.686	0.829	21.6	
	6	2437			19.00	18.30	100.00	98.98	0.760	0.902	21.3	
Step 3: Variability Check												
802.11b	11	2462	Front	0	19.00	18.40	100.0	98.98	0.828	0.961	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 2.4 GHz	Body-Worn	Front	1-g SAR	0.851	Yes	0.828	1.03

Appendix A. Plots of SAR Measurement

Please see the following page(s).

Plot No. 1

Date: 2018/12/12

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

Wi-Fi 2.4GHz (11ch)_Body-Worn_Front_0mm

DUT: Type1DR (installed in Digital Camera 1DR024)

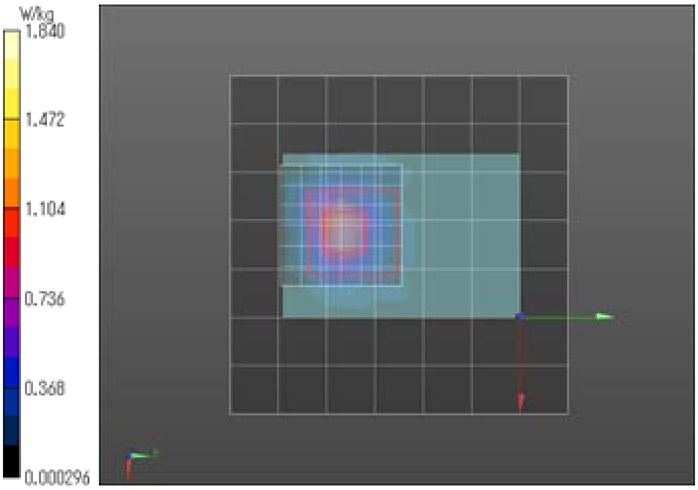
Communication System: UID 0, Wi-Fi_802.11b_5.5Mbps (0);
Communication System Band: Wi-Fi 2.4GHz; Frequency: 2462 MHz;
Medium parameters used: f = 2462 MHz; σ = 2.024 S/m; ε_r = 52.861; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(7.6, 7.6, 7.6); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn610; Calibrated: 2018/01/10
- Phantom: ELI v5.0 (20deg probe tilt); Type: QDOVA002AA; Serial: TP:1259
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/Wi-Fi 2.4GHz (11ch)_Body-Worn_Front_0mm/
Area Scan (8x8x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 1.01 W/kg

Configuration/Wi-Fi 2.4GHz (11ch)_Body-Worn_Front_0mm/
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.13 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 2.48 W/kg
SAR(1 g) = 0.851 W/kg; SAR(10 g) = 0.278 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 1.84 W/kg



Appendix B. Plots of System Check

Please see the following page(s).

Date: 2018/12/12

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

Validation_D2450_MSL

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

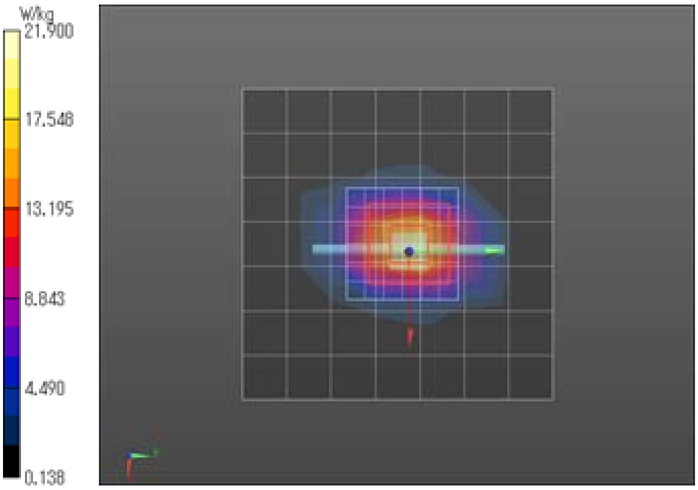
Communication System: UID 0, CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.013 S/m; ε_r = 52.88; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3921; ConvF(7.6, 7.6, 7.6); Calibrated: 2018/10/22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn610; Calibrated: 2018/01/10
- Phantom: ELI v5.0 (20deg probe tilt); Type: QDOVA002AA; Serial: TP:1259
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies above 2 GHz/Validation D2450 MSL/
Area Scan (8x8x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 15.1 W/kg

System Performance Check at Frequencies above 2 GHz/Validation D2450 MSL/
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.3 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.7 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.07 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 21.9 W/kg



Appendix C. Calibration Certificate

C.1. E-Field Probe EX3DV4 (Serial No. 3921 / Control No. WA0002)

Please see the following pages.

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**

Client **SONY Global M&O (Vitec)**

Certificate No: **EX3-3921_Oct18**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3921
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	October 22, 2018

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	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 25, 2018

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).

Probe EX3DV4

SN:3921

Manufactured: December 18, 2012
Calibrated: October 22, 2018

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

EX3DV4– SN:3921

October 22, 2018

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3921

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.48	0.42	0.47	± 10.1 %
DCP (mV)[B]	101.6	103.5	99.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	157.2	±3.0 %
		Y	0.0	0.0	1.0		171.3	
		Z	0.0	0.0	1.0		155.2	

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.

Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

EX3DV4– SN:3921

October 22, 2018

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3921

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)
750	41.9	0.89	10.59	10.59	10.59	0.34	1.10	± 12.0 %
835	41.5	0.90	10.07	10.07	10.07	0.50	0.80	± 12.0 %
900	41.5	0.97	9.61	9.61	9.61	0.43	0.85	± 12.0 %
1450	40.5	1.20	8.75	8.75	8.75	0.34	0.86	± 12.0 %
1750	40.1	1.37	8.55	8.55	8.55	0.41	0.80	± 12.0 %
1900	40.0	1.40	8.16	8.16	8.16	0.38	0.85	± 12.0 %
1950	40.0	1.40	7.90	7.90	7.90	0.31	0.80	± 12.0 %
2300	39.5	1.67	7.74	7.74	7.74	0.37	0.87	± 12.0 %
2450	39.2	1.80	7.34	7.34	7.34	0.41	0.85	± 12.0 %
2600	39.0	1.96	7.18	7.18	7.18	0.45	0.85	± 12.0 %
3500	37.9	2.91	7.29	7.29	7.29	0.25	1.20	± 13.1 %
3900	37.5	3.32	6.84	6.84	6.84	0.25	1.30	± 13.1 %
4600	36.7	4.04	6.76	6.76	6.76	0.25	1.30	± 13.1 %
5200	36.0	4.66	5.46	5.46	5.46	0.40	1.80	± 13.1 %
5300	35.9	4.76	5.30	5.30	5.30	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.94	4.94	4.94	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.72	4.72	4.72	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.96	4.96	4.96	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. 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.

Certificate No: EX3-3921_Oct18 Page 5 of 11

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3921

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	7.60	7.60	7.60	0.31	0.95	± 12.0 %
5200	49.0	5.30	4.86	4.86	4.86	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.69	4.69	4.69	0.50	1.90	± 13.1 %
5500	48.6	5.65	4.15	4.15	4.15	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.00	4.00	4.00	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.31	4.31	4.31	0.50	1.90	± 13.1 %

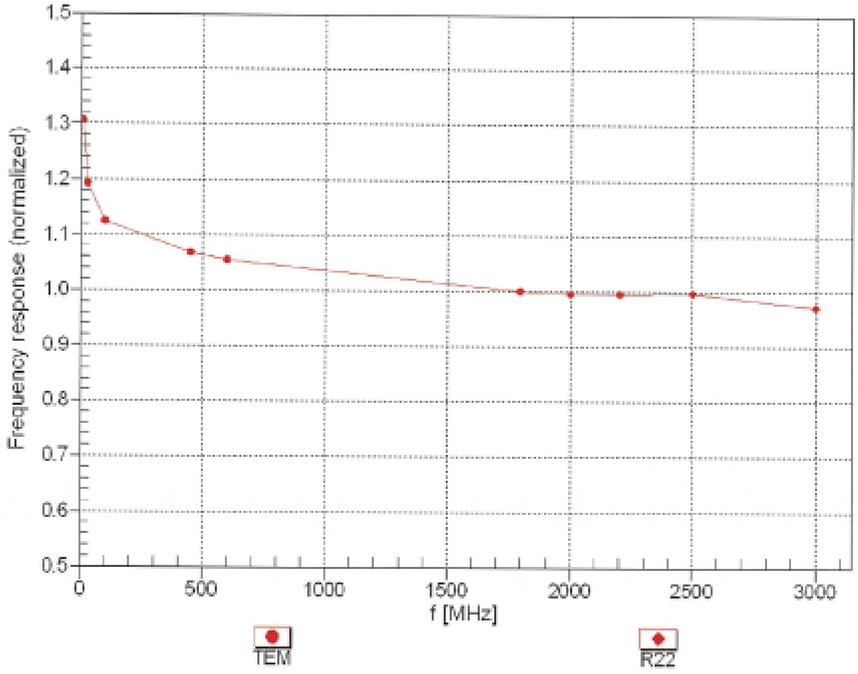
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz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

EX3DV4– SN:3921

October 22, 2018

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

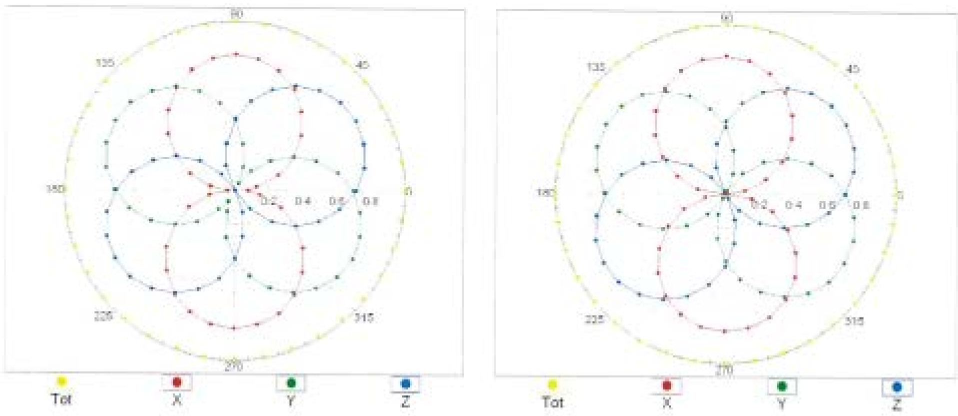
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

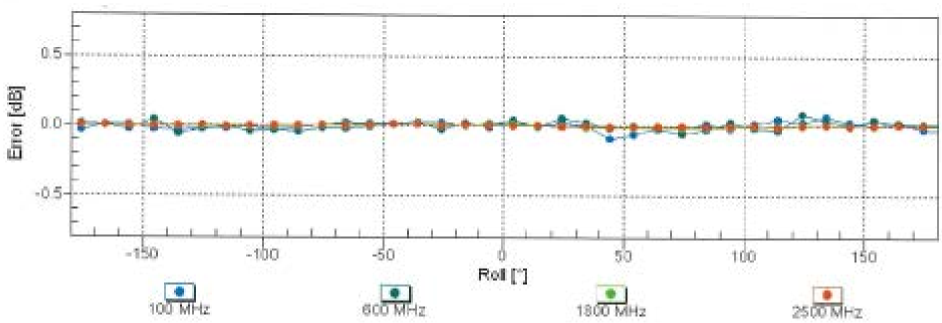
EX3DV4– SN:3921

October 22, 2018

Receiving Pattern (ϕ), ϑ = 0°

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



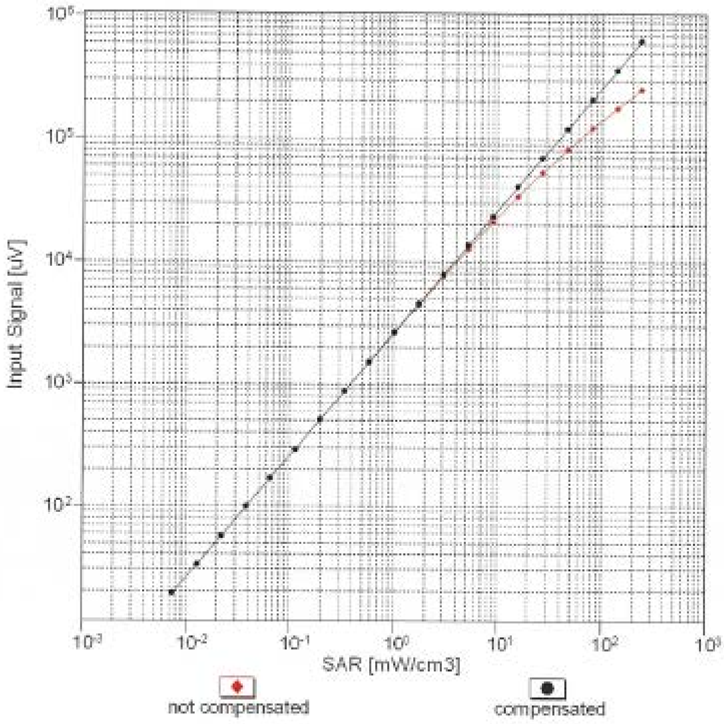


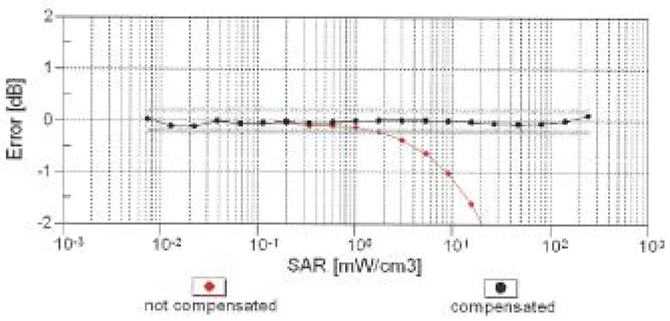
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750   FAX +81 438 37 1021

EX3DV4– SN:3921 October 22, 2018

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)





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

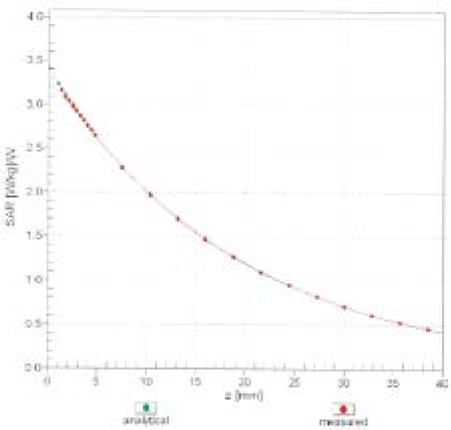
Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

EX3DV4– SN:3921

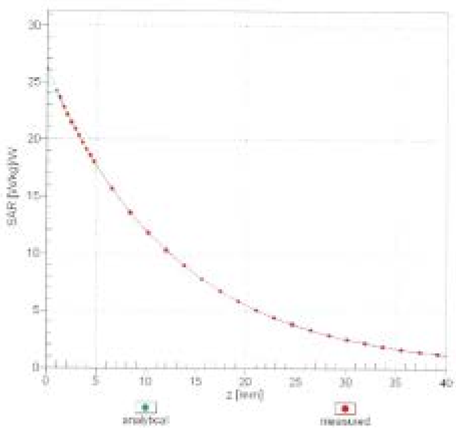
October 22, 2018

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

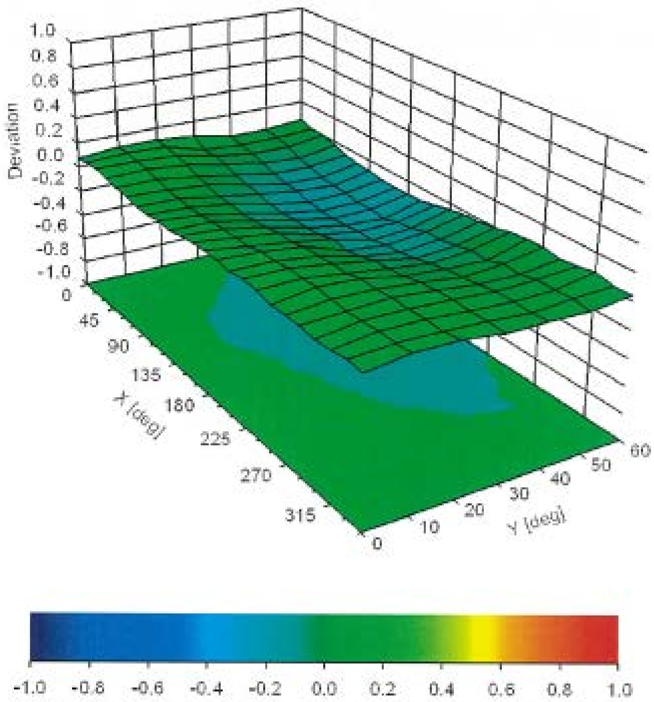


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

EX3DV4– SN:3921

October 22, 2018

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3921

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	124.2
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

Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

C.2. System Validation Dipole D2450V2 (Serial No. 936 / Control No. WA0026)

Please see the following pages.

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
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: **SONY Global M&O (Vitec)**

Certificate No: **D2450V2-936_Jun18**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:936
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	June 19, 2018

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	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 21, 2018

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**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for 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"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.0 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.99 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.7 W/kg ± 16.5 % (k=2)**

Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.0 Ω + 3.0 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.1 Ω + 4.3 jΩ
Return Loss	- 27.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 13, 2014

DASY5 Validation Report for Head TSL

Date: 19.06.2018

Test Laboratory: SPEAG, Zurich, Switzerland

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

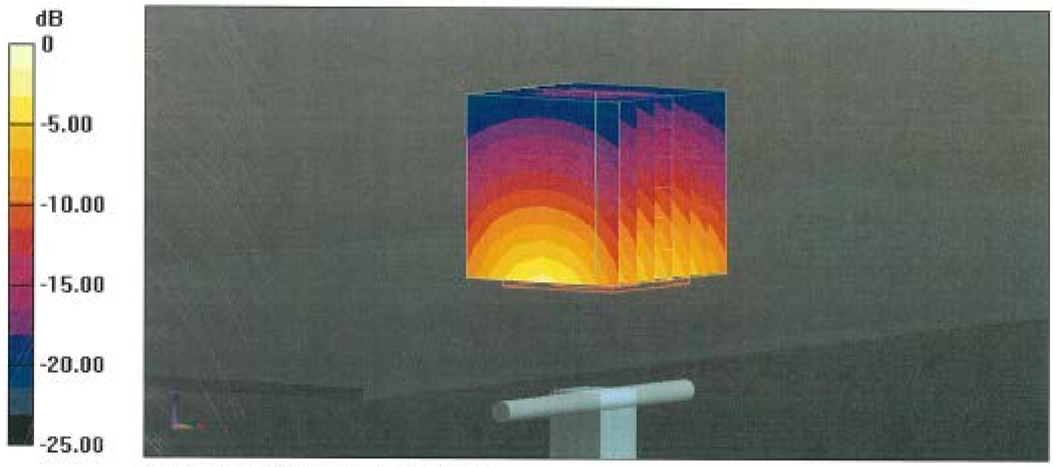
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ε_r = 38; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

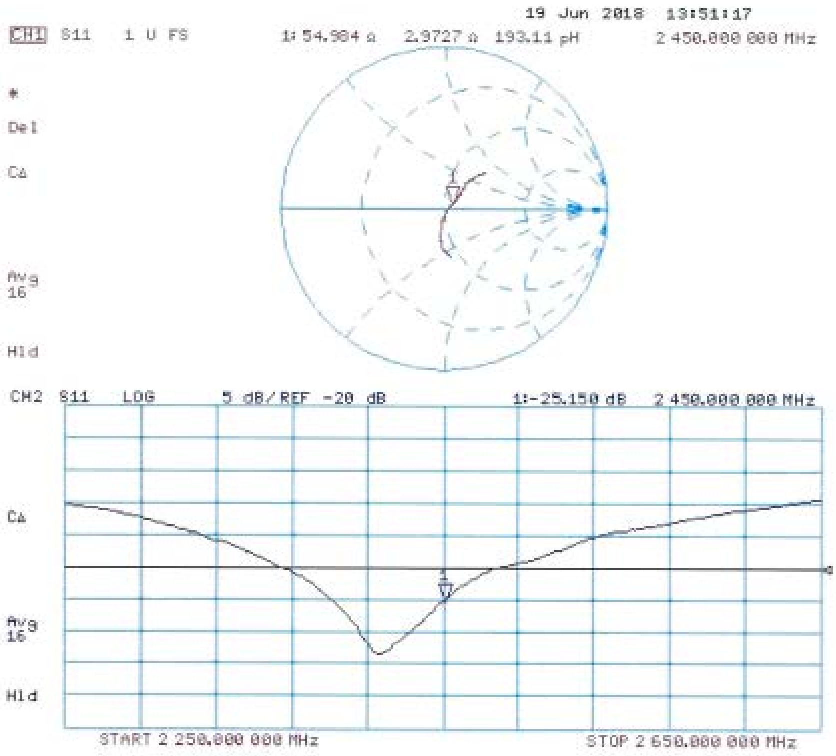
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.9 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 26.2 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.16 W/kg
Maximum value of SAR (measured) = 21.8 W/kg



0 dB = 21.8 W/kg = 13.38 dBW/kg

Impedance Measurement Plot for Head TSL



Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

DASY5 Validation Report for Body TSL

Date: 19.06.2018

Test Laboratory: SPEAG, Zurich, Switzerland

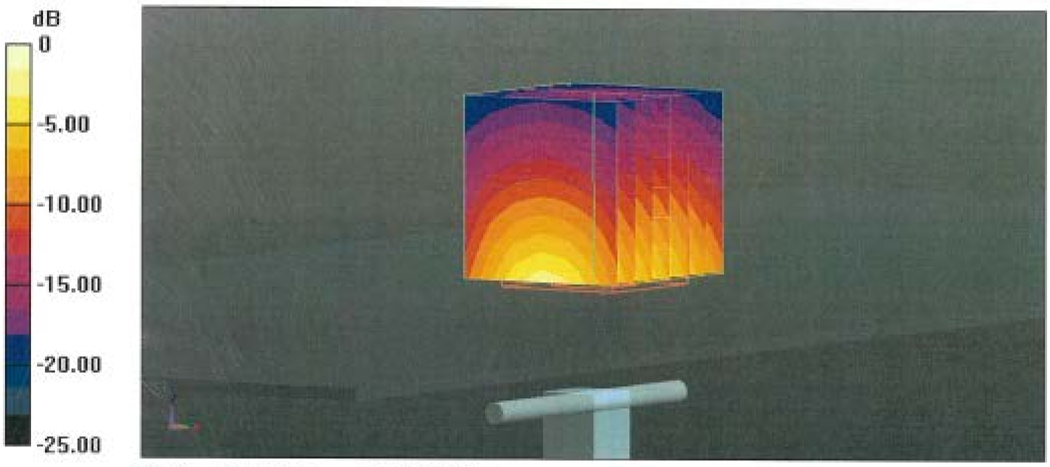
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:936

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ε_r = 52.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

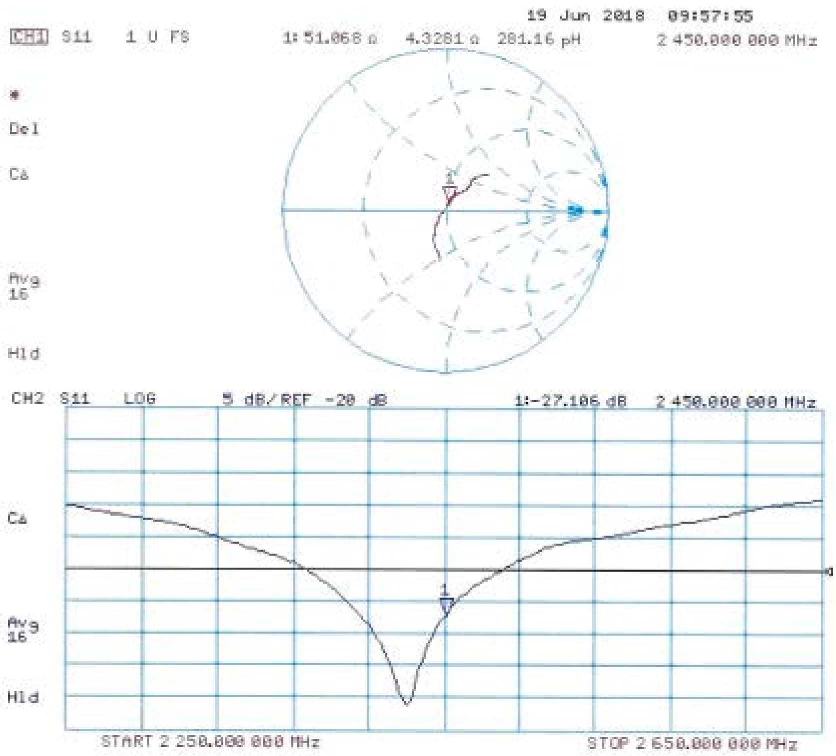
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.4 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 25.1 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.99 W/kg
Maximum value of SAR (measured) = 20.5 W/kg



0 dB = 20.5 W/kg = 13.12 dBW/kg

Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021

Impedance Measurement Plot for Body TSL



Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory, Main Lab.
A2LA Cert. #3203.01
8-4 Shiomi Kisarazu-shi Chiba-ken, 292-0834, Japan
PHONE +81 438 37 2750 FAX +81 438 37 1021