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TEST REPORT

KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR19-SPF0010 Page (1) of (83)	KCTL

1. Client

- Name : Intel Mobile Communications
- Address : 100 Center Point Circle, Suite 200 Columbia, South Carolina 29210 USA
- Date of Receipt : 2019-04-26

2. Use of Report : -

3. Product Name : WLAN and BT, 2x2 PCIe M.2 SD 1216 adapter card

- Model Number : 9560D2W
- Manufacturer and Country of Origin : Intel Mobile Communications / USA

4. Host Product Name : NoteBook PC

- Host Model Number : XE350XBA
- Manufacturer : Samsung Electronics Co., Ltd.

5. FCC ID : PD99560D2

6. Date of Test : 2019-05-09 to 2019-05-18

7. Test Standards : IEEE 1528-2013, ANSI/IEEE C95.1, KDB Publication

8. Test Results : Refer to the test result in the test report

Affirmation	Tested by Name : Kyounghoo Min (Signature)	Technical Manager Name : Jongwon Ma (Signature)

2019-05-23

KCTL Inc.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc.

Report revision history

Date	Revision	Page No
2019-05-23	Initial report	-

This test report is a general report that does not use the KOLAS accreditation mark and is not related to KOLAS accreditation.

CONTENTS

1. General information

Client	:	Intel Mobile Communications
Address	:	100 Center Point Circle, Suite 200 Columbia, South Carolina 29210 USA
Manufacturer	:	Intel Mobile Communications
Address	:	100 Center Point Circle, Suite 200 Columbia, South Carolina 29210 USA
Contact Person		Steven Hackett / steven.c.hackett@intel.com
Laboratory	:	KCTL Inc.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132
		VCCI Registration No. : R-3327, G-198, C-3706, T-1849
		Industry Canada Registration No. : 8035A
		KOLAS No.: KT231

2. Device information

2.1 Basic description

Product Name	WLAN and BT, 2x2 PCIe M.2 SD 1216 adapter card
Product Model Number	9560D2W
Product Manufacturer	Intel Mobile Communications
Host Product Name	NoteBook PC
Host Model Number	XE350XBA
Host Manufacturer	Samsung Electronics Co., Ltd.
Host Serial Number	0ZGT91ZM400004V
Mode of Operation	WLAN 2.4 GHz / 5 GHz, Bluetooth
Tx Freq. Range	WLAN 2.4 GHz : 2 412 MHz ~ 2 472 MHz WLAN 5.2 GHz : 5 180 MHz ~ 5 240 MHz WLAN 5.3 GHz : 5 260 MHz ~ 5 320 MHz WLAN 5.6 GHz : 5 500 MHz ~ 5 720 MHz WLAN 5.8 GHz : 5 745 MHz ~ 5 825 MHz Bluetooth : 2 402 MHz ~ 2 480 MHz
TDWR Information	5.60 GHz ~ 5.65 GHz band (TDWR) is supported by the device

2.2 Summary of SAR Test Results

Band	Equipment Class	Highest Reported
		1g Body (W/kg
802.11b	DTS	1.16
U-II-1	NII	N/A
U-NII-2A	NII	0.86
U-NII-2C	NII	0.94
U-NII-3	NII	0.85
Bluetooth	DSS	0.40
Simultaneous SAR per KDB 690783 D01v01r03		1.56

3. Report Overview

This report details the results of testing carried out on the samples listed in section 2, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this test report is used in any configuration other than that detailed in the test report, the manufacturer must ensure the new configuration complies with all relevant standards and certification requirements. Any mention of KCTL Inc. Wireless lab or testing done by KCTL Inc. Wireless lab made in connection with the distribution or use of the tested product must be approved in writing by KCTL Inc. Wireless lab.

4. Test Lab Declaration or Comments

None

5. Applicant Declaration or Comments

None

6. SAR Test Methods and Procedures

The tests documented in this report were performed in accordance with IEEE Standard 1528-2003 & IEEE 1528a-2005 and the following published KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 616217 D04 SAR for laptop and tablets v01r02
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)
- April 2019 TCB Workshop Notes (Tissue Simulating Liquids)

7. Measurement Uncertainty

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Standard 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

8. Specific Absorption Rate

8.1 Introduction

The SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational / controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

8.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength. However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

8.3 SAR Standards and Limits

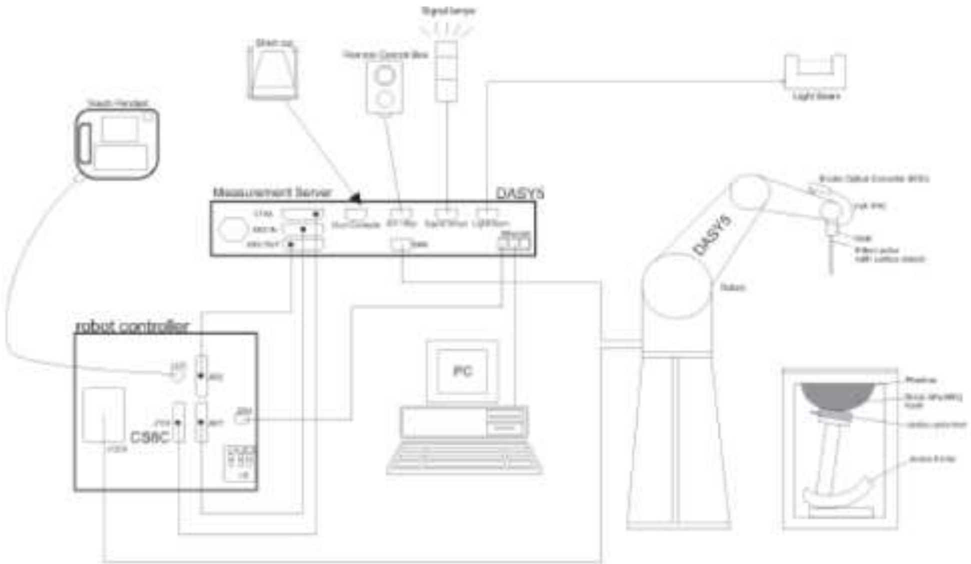
According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (''SAR'') in Section 4.2 of ''IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,'' ANSI/IEEE C95.3–2003, Copyright 2003 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements

(NCRP) in ‘‘Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields,’’ NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.
(1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube). Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.
(2) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.

Human Exposure	**Uncontrolled Environment General Population**	**Controlled Environment Occupational**
Partial Peak SAR 1) (Partial)	1.60 m W/g	8.00 m W/g
Partial Average SAR 2) (Whole Body)	0.08 m W/g	0.40 m W/g
Partial Peak SAR 3) (Hands/Feet/Ankle/Wrist)	4.00 m W/g	20.00 m W/g

1) The spatial Peak value of the SAR averaged over any 1g gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2) The spatial Average value of the SAR averaged over the whole body.
3) The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

9. The SAR Measurement System



<SAR System Configuration>

- A standard high precision 6-axis robot 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.
- 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. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Windows XP or Windows 7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

9.1 Data Acquisition Electronics

Type	DAE3, DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
Calibration	ISO/IEC 17025 calibration (Annual)	
Measurement Mange	−100 – +300 mV (16 bit resolution and two range settings: 4 mV, 400 mV)	
Input Offset Voltage	< 5 μV (with auto zero)	
Input Resistance	200 Mohm	
Input Bias Current	< 50 fA	

9.2 Isotropic E-field Probe

Type	EX3DV4	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material(resistant to organic solvents)	
Calibration	ISO/IEC 17025 calibration (Annual)	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 Mhz to 6 GHz)	
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μW/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

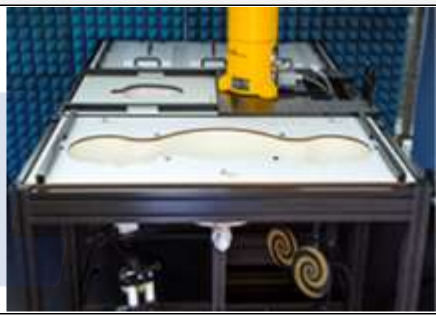
Type	ES3DV3	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material(resistant to organic solvents)	
Calibration	ISO/IEC 17025 calibration (Annual)	
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB (30 Mhz to 4 GHz)	
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μW/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 2 mm	

9.3 System Validation Dipoles

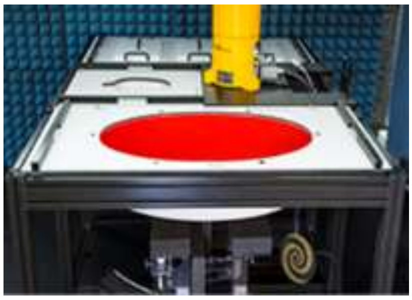
Type	Dipole Antenna
Construction	Symmetrical dipole with λ/4 balun. Enables measurement of feed point impedance with network analyzers (NWA) Matched for use near flat phantoms filled with tissue simulating liquids
Calibration	ISO/IEC 17025 calibration (Biennial)
Frequency	300 MHz to 6 GHz
Return Loss	> 20 dB at specified validation position
Power Capability	>100 W (*f* <1 GHz); >40 W (*f* >1 GHz)

9.4 Phantom

Type	Twin SAM
Construction	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.
Material	Vinyl ester, fiberglass reinforced (VE-GF)
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



Type	ELI
Construction	The ELI phantom is used 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 with the robet.
Material	Vinyl ester, fiberglass reinforced (VE-GF)
Shell Thickness	2 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm / Minor axis: 400 mm
Filling Volume	approx. 300 liters



9.5 Device Holder for Transmitters

Construction	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 Standard or other specifications. The device holder can be locked for positioning at different phantom sections	
Type	MD4HHTV5	MD4LAPV5
Photo		
Material	Polyoxymethylene(POM)	Polyoxymethylene(POM), PET-G, Foam

10. Test Equipment Information

Test Platform	SPEAG DASY5 System			
Version	DASY5 : Version 52.10.2.1495 SEMCAD : Version 14.6.12 (7450)			
Location	KCTL Inc.			
Manufacture	SPEAG			
Hardware Reference				
Equipment	Model	Serial Number	Date of Calibration	Due date of next Calibration
Shield Room	Shield Room	8F - #1	N/A	N/A
DASY5 Robot	TX90XL Speag	F07/554JA1/A/01	N/A	N/A
DASY5 Controller	TX90XL Speag	F07/554JA1/C/01	N/A	N/A
Phantom	2mm Oval Phantom ELI5	1173	N/A	N/A
Phantom	2mm Oval Phantom ELI5	1220	N/A	N/A
Mounting Device	Laptop Holder	None	N/A	N/A
DAE	DAE4	1567	2019-02-05	2020-02-05
Probe	EX3DV4	3928	2019-01-31	2020-01-31
Signal Generator	E4438C	MY42080486	2019-01-04	2020-01-04
Signal Generator	E4438C	MY42080486	2019-05-13	2020-05-13
Dual Power Meter	E4419B	GB43312301	2018-05-15	2019-05-15
Dual Power Meter	E4419B	GB43312301	2019-05-13	2020-05-13
Power Sensor	8481H	3318A19377	2018-05-15	2019-05-15
Power Sensor	8481H	3318A19377	2019-05-13	2020-05-13
Power Sensor	8481H	3318A19379	2018-05-15	2019-05-15
Power Sensor	8481H	3318A19379	2019-05-13	2020-05-13
Attenuator	8491B 3dB	17387	2018-05-14	2019-05-14
Attenuator	8491B 3dB	17387	2019-05-13	2020-05-13
Attenuator	8491B-6dB	MY39270294	2018-05-14	2019-05-14
Attenuator	8491B-6dB	MY39270294	2019-05-13	2020-05-13
Attenuator	8491B 10dB	29425	2018-05-14	2019-05-14
Attenuator	8491B 10dB	29425	2019-05-13	2020-05-13
Power Amplifier	2055-BBS3Q7E9I	1005D/C0521	2019-03-08	2020-03-08
Power Amplifier	5190FE	1012	2018-05-15	2019-05-15
Power Amplifier	5190FE	1012	2019-05-14	2020-05-14
Dual Directional Coupler	772D	2839A00719	2018-05-15	2019-05-15
Dual Directional Coupler	772D	2839A00719	2019-05-13	2020-05-13
Low Pass Filter	LA-30N	40058	2018-05-14	2019-05-14
Low Pass Filter	LA-30N	40058	2019-05-13	2020-05-13
Low Pass Filter	LA-60N	40059	2018-05-14	2019-05-14
Low Pass Filter	LA-60N	40059	2019-05-13	2020-05-13
Dipole Validation Kits	D2450V2	895	2018-07-24	2020-07-24
Dipole Validation Kits	D5GHzV2	1130	2018-05-25	2020-05-25
Network Analyzer	E5071B	MY42403524	2019-01-04	2020-01-04
Dielectric Assessment kit	DAK-3.5	1078	2018-08-22	2019-08-22
Humidity/Temp. Data Recorder	MHB-382SD	23107	2018-06-14	2019-06-14
Humidity/Temp. Data Recorder	MHB-382SD	46307	2019-04-10	2020-04-10

11. System Verification

11.1 Tissue Verification

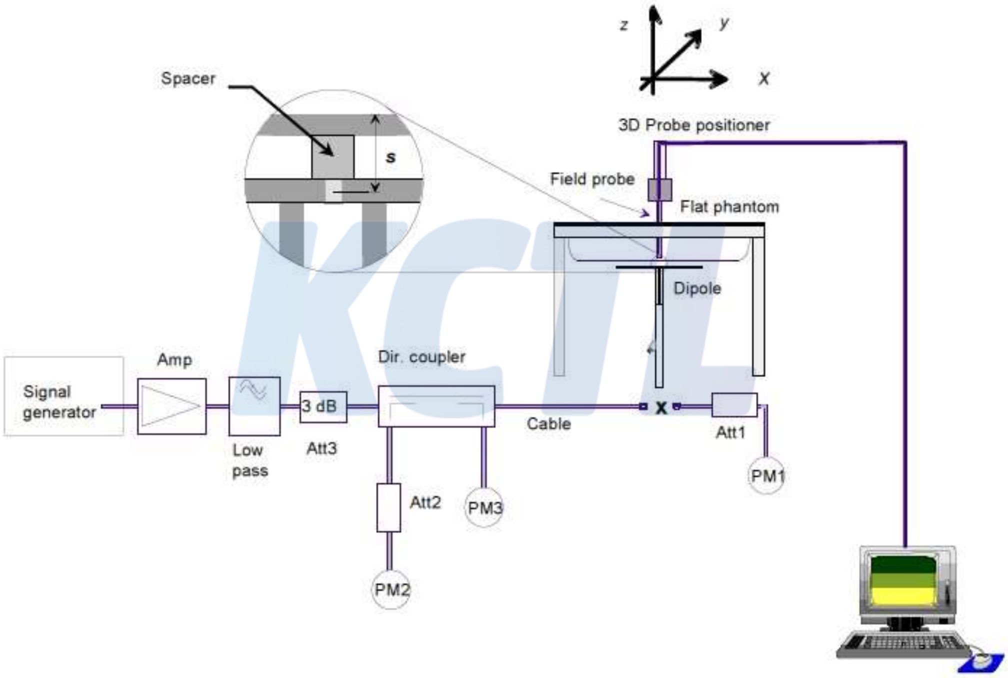
The dielectric properties for this Tissue Simulant Liquids were measured by using the SPEAG Model DAK3.5 Dielectric Probe in conjunction with Agilent E5071B Network Analyzer (300 kHz – 8 500 MHz). The Conductivity (σ) and Permittivity (ρ) are listed in Table 1.For the SAR measurement given in this report. The temperature variation of the Tissue Simulant Liquids was (22 ± 2) °C.

Freq. (MHz)	Tissue Type	Limit/Measured	Permittivity (ρ)	Conductivity (σ)	Temp (℃)
2 450	HSL	Recommended Limit	39.20 ± 5 % (37.24 ~ 41.16)	1.80 ± 5 % (1.71 ~ 1.89)	22 ± 2
		Measured, 2019-05-10	39.03	1.85	20.92
2 450	HSL	Recommended Limit	39.20 ± 5 % (37.24 ~ 41.16)	1.80 ± 5 % (1.71 ~ 1.89)	22 ± 2
		Measured, 2019-05-18	38.25	1.86	20.66
5 300	HSL	Recommended Limit	35.90 ± 5 % (34.11 ~ 37.70)	4.76 ± 5 % (4.52 ~ 5.00)	22 ± 2
		Measured, 2019-05-09	35.97	4.80	20.84
5 600	HSL	Recommended Limit	35.50 ± 5 % (33.73 ~ 37.28)	5.07 ± 5 % (4.82 ~ 5.32)	22 ± 2
		Measured, 2019-05-09	35.23	5.10	20.62
5 800	HSL	Recommended Limit	35.30 ± 5 % (33.54 ~ 37.07)	5.27 ± 5 % (5.01 ~ 5.53)	22 ± 2
		Measured, 2019-05-10	35.92	5.07	20.81

<Table 1.Measurement result of Tissue electric parameters>

11.2 Test System Verification

The microwave circuit arrangement for system verification is sketched below picture. The daily system accuracy verification occurs within the flat section of the SAM phant om. A SAR measurement was performed to see if the measured SAR was within ± 1 0% from the target SAR values. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the Table 2. During the tests, the ambient temperature of the laboratory was in the range (22 ± 2) ℃, the relative humidity was in the range(50 ± 20)% and the liquid depth Above the ear/grid reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the re sults are within acceptable tolerance of the reference values.



Validation Kit	Dipole Ant. S/N	Frequency (MHz)	Tissue Type	Limit/Measurement (Normalized to 1 W) 1 g	
D2450V2	895	2 450	HSL	Recommended Limit (Normalized)	51.30 ± 10 % (46.17 ~ 56.43)
				Measured, 2019-05-10	48.80
D2450V2	895	2 450	HSL	Recommended Limit (Normalized)	51.30 ± 10 % (46.17 ~ 56.43)
				Measured, 2019-05-18	48.80
D5GHzV2	1130	5 300	HSL	Recommended Limit (Normalized)	82.50 ± 10 % (74.25 ~ 90.75)
				Measured, 2019-05-09	84.20
D5GHzV2	1130	5 600	HSL	Recommended Limit (Normalized)	84.40 ± 10 % (75.96 ~ 92.84)
				Measured, 2019-05-09	83.10
D5GHzV2	1130	5 800	HSL	Recommended Limit (Normalized)	80.40 ± 10 % (72.36 ~ 88.44)
				Measured, 2019-05-10	80.10

<Table 2.Test System Verification Result>

12. SAR Measurement Procedures

12.1 SAR Scan Procedures

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 1.4 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan & Zoom Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot and Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing1 g and 10 g of simulated tissue. If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly. Area Scan & Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04.

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 mm ± 1 mm	½·δ·ln(2) mm 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: ΔxArea, ΔyArea			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: ΔzZoom(n)		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	ΔzZoom(1): between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		ΔzZoom(n>1): between subsequent points	≤ 1.5·ΔzZoom(n-1) mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 3: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

13. WLAN Measured Procedures

13.1 General Device Setup

The normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable.
Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.
A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 – 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

13.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

13.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements.
When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.
Unless band gap channels are permanently disabled, SAR must be considered for these channels. When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency point requirements.

13.4 2.4 GHz SAR Test Requirement

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following.

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel; i.e., all channels require testing.

2.4 GHz 802.11g/n OFDM are additionally evaluated for SAR if highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

13.5 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz band, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel band width, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

13.6 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.
When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements.

13.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required.

14. RF Average Conducted Output Power

14.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. Test highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

14.1.1 Maximum Tune-up power

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

Band	Ant	Mode	Channel	Output Power (dBm)		
				Target	Max. Allowed	SAR Test
WLAN 2.4 GHz	Ant 0	802.11b	All Channel	14.00	**14.50**	**Yes**
		802.11g	All Channel	14.00	**14.50**	No
		802.11n(HT20)	All Channel	14.00	**14.50**	No
		802.11n(HT40)	4, 5, 6, 7, 8	14.00	**14.50**	No
			3	13.50	**14.00**	
			9	13.25	**13.75**	
	Ant 1	802.11b	All Channel	14.00	**14.50**	**Yes**
		802.11g	All Channel	14.00	**14.50**	No
		802.11n(HT20)	All Channel	14.00	**14.50**	No
		802.11n(HT40)	4, 5, 6,	14.00	**14.50**	No
			3, 7, 8	13.50	**14.00**	
			9	13.25	**13.75**	
	MIMO	802.11n(HT20)	All Channel	14.00	**14.50**	No
		802.11n(HT-40)	3,8	12.50	**13.00**	**Yes**
			7	13.75	**14.25**	
			9	12.25	**12.75**	
			4, 5, 6	14.00	**14.50**	

Band	Ant	Mode	Channel	Output Power (dBm)		
				Target	Max. Allowed	SAR Test
WLAN 5 GHz	Ant 0	802.11a	All Channel	11.50	**12.00**	No
		802.11n(HT20)	All Channel	11.50	**12.00**	No
		802.11n(HT40)	All Channel	11.50	**12.00**	No
		802.11ac(VHT20)	All Channel	11.50	**12.00**	No
		802.11ac(VHT40)	All Channel	11.50	**12.00**	No
		802.11ac(VHT80)	All Channel	11.50	**12.00**	**Yes**
		802.11ac(VHT160)	All Channel	11.50	**12.00**	No
	Ant 1	802.11a	All Channel	11.50	**12.00**	No
		802.11n(HT20)	All Channel	11.50	**12.00**	No
		802.11n(HT40)	All Channel	11.50	**12.00**	No
		802.11ac(VHT20)	All Channel	11.50	**12.00**	No
		802.11ac(VHT40)	All Channel	11.50	**12.00**	No
		802.11ac(VHT80)	All Channel	11.50	**12.00**	**Yes**
		802.11ac(VHT160)	All Channel	11.50	**12.00**	No
	MIMO	802.11n(HT20)	All Channel	9.00	**9.50**	No
		802.11n(HT40)	All Channel	9.00	**9.50**	No
		802.11ac(VHT20)	All Channel	9.00	**9.50**	No
		802.11ac(VHT40)	All Channel	9.00	**9.50**	No
		802.11ac(VHT80)	42	8.50	**9.00**	No
			58 ~ 155	9.00	**9.50**	**Yes**
		802.11ac(VHT160)	All Channel	9.00	**9.50**	No
Bluetooth	Ant 1	BDR(GFSK)	All Channel	9.20	**10.70**	**Yes**
		EDR (π/4DQPSK)	All Channel	5.20	**6.70**	No
		EDR(8DPSK)	All Channel	5.20	**6.70**	No
		LE(GFSK)	All Channel	5.00	**6.50**	No

14.1.2 WLAN Average Conducted Output Power

Band	Ant	Mode	Conducted Powers (dBm)		
			Low	Mid.	High
WLAN 2.4 GHz	Ant 0	802.11b	14.34	14.34	14.44
	Ant 1	802.11b	14.24	14.44	14.34
	Ant 0 MIMO	802.11n(HT-40)	12.82	14.32	12.52
	Ant 1 MIMO	802.11n(HT-40)	12.82	14.32	12.62
WLAN 5.3 GHz	Ant 0	802.11ac(VHT-80)	-	11.88	-
	Ant 1	802.11ac(VHT-80)	-	11.98	-
	Ant 0 MIMO	802.11ac(VHT-80)	-	8.91	-
	Ant 1 MIMO	802.11ac(VHT-80)	-	8.91	-
WLAN 5.6 GHz	Ant 0	802.11ac(VHT-80)	11.78	11.88	11.88
	Ant 1	802.11ac(VHT-80)	11.78	11.88	11.78
	Ant 0 MIMO	802.11ac(VHT-80)	8.81	8.81	8.91
	Ant 1 MIMO	802.11ac(VHT-80)	8.91	8.81	8.81
WLAN 5.8 GHz	Ant 0	802.11ac(VHT-80)	-	11.78	-
	Ant 1	802.11ac(VHT-80)	-	11.88	-
	Ant 0 MIMO	802.11ac(VHT-80)	-	8.92	-
	Ant 1 MIMO	802.11ac(VHT-80)	-	8.92	-

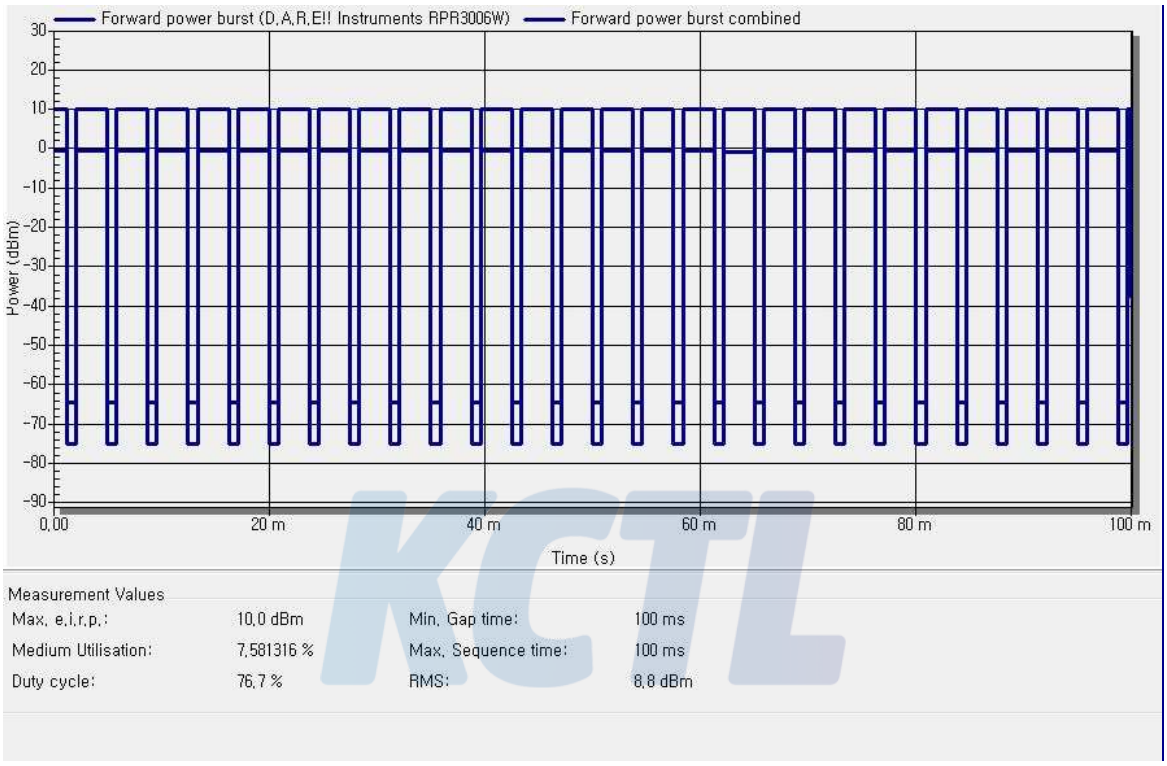
14.1.3 Bluetooth Average Conducted Output Power

Mode	Ant	Conducted Powers (dBm)		
		Low	Mid.	High
BDR(GFSK)	Ant 1	8.95	9.75	9.95

14.1.4 Bluetooth Duty Cycle

Bluetooth Duty Cycle, Power Measurement Setup, Transmission Plot

Mode			Duty Cycle [%]	Duty Cycle Compensate Factor
Bluetooth	BDR	DH5	76.7	1.30



15. SAR Test Results

15.1 WLAN 2.4 GHz Body SAR Test Results

802.11b Ant 0

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	2 412	14.34	14.50	1.04	1.01	1.030	1.079	
Rear	0	2 437	14.34	14.50	1.04	1.01	1.100	1.153	
Rear	0	2 462	14.44	14.50	1.01	1.01	1.130	**1.157**	#1
Repeated (See Section 16)									
Rear	0	2 462	14.44	14.50	1.01	1.01	1.130	1.157	

802.11b Ant 1

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	2 412	14.24	14.50	1.06	1.01	0.991	**1.063**	#2
Rear	0	2 437	14.44	14.50	1.01	1.01	0.974	0.998	
Rear	0	2 462	14.34	14.50	1.04	1.01	0.937	0.982	
Repeated (See Section 16)									
Rear	0	2 412	14.24	14.50	1.06	1.01	0.956	1.025	

802.11n(HT-40) MIMO

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)		Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
			Ant 0	Ant 1	Ant 0 & Ant 1					
Rear	0	2 422	12.82	12.82	13.00	1.04	1.10	0.626	0.719	
Rear	0	2 437	14.32	14.32	14.50	1.04	1.10	0.778	**0.893**	#3
Rear	0	2 452	12.52	12.62	12.75	1.05	1.10	0.589	0.684	

15.2 WLAN 5.3 GHz Body SAR Test Results

802.11ac(VHT-80) Ant 0

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	5 290	11.88	12.00	1.03	1.09	0.767	**0.861**	#4

802.11ac(VHT-80) Ant 1

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	5 290	11.98	12.00	1.00	1.09	0.782	**0.858**	#5

802.11ac(VHT-80) MIMO

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)		Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
			Ant 0	Ant 1	Ant 0 & Ant 1					
Rear	0	5 290	8.91	8.91	9.50	1.15	1.20	0.394	**0.544**	#6

15.3 WLAN 5.6 GHz Body SAR Test Results

802.11ac(VHT-80) Ant 0

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	5 530	11.78	12.00	1.05	1.09	0.754	0.866	
Rear	0	5 610	11.88	12.00	1.03	1.09	0.671	0.753	
Rear	0	5 690	11.88	12.00	1.03	1.09	0.825	**0.926**	#7
Repeated (See Section 16)									
Rear	0	5 690	11.88	12.00	1.03	1.09	0.807	0.906	

802.11ac(VHT-80) Ant 1

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	5 530	11.78	12.00	1.05	1.09	0.728	0.836	
Rear	0	5 610	11.88	12.00	1.03	1.09	0.791	0.888	
Rear	0	5 690	11.78	12.00	1.05	1.09	0.817	**0.938**	#8
Repeated (See Section 16)									
Rear	0	5 690	11.78	12.00	1.05	1.09	0.774	0.889	

802.11ac(VHT-80) MIMO

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)		Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
			Ant 0	Ant 1	Ant 0 & Ant 1					
Rear	0	5 530	8.81	8.91	9.50	1.17	1.20	0.341	0.482	
Rear	0	5 610	8.81	8.81	9.50	1.17	1.20	0.404	**0.571**	#9
Rear	0	5 690	8.91	8.81	9.50	1.17	1.20	0.346	0.489	

15.4 WLAN 5.8 GHz Body SAR Test Results

802.11ac(VHT-80) Ant 0

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	5 775	11.78	12.00	1.05	1.09	0.679	**0.780**	#10

802.11ac(VHT-80) Ant 1

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	5 775	11.88	12.00	1.03	1.09	0.757	**0.850**	#11

802.11ac(VHT-80) MIMO

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)		Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
			Ant 0	Ant 1	Ant 0 & Ant 1					
Rear	0	5 775	8.92	8.92	9.50	1.14	1.21	0.266	**0.368**	#12

15.5 Bluetooth Body SAR Test Results

BDR_DH5

EUT Position	Distance (mm)	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Power Scaling Factor	Duty Cycle Compensate Factor	Measured 1 g SAR (W/kg)	Scaled 1 g SAR (W/kg)	Plot No.
Rear	0	2 480	9.95	10.70	1.19	1.30	0.258	**0.400**	#13

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 447498 D01v06.
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings and the standard batteries are the only options.
4. Liquid tissue depth was at least 15 cm.
5. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
6. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
7. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.

WLAN & Bluetooth Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5GHz WIFI operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2W/kg.
3. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance.
5. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
6. When the specified maximum output power is the same for both UNII Band1 and UNII Band 2A, begins SAR measurement in UNII band 2A; and if the highest reported SAR for UNII band 2A is ≤ 1.2W/kg, SAR is not required for UNII band1 > 1.2W/kg, both bands should be tested independently for SAR.
7. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), according to the initial test position or fixed exposure requirements, is adjusted by the ratio of the subsequent test configuration to the initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/Kg, SAR is not required for that subsequent test configuration.
8. WLAN & Bluetooth transmission was verified using a spectrum analyzer.

16. SAR Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg.
2) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
3) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Band	Frequency (MHz)	EUT Position	Separation Distance (mm)	Measured 1 g SAR (W/kg)	Repeated 1g SAR (W/kg)	Ratio
WLAN 2.4 GHz_Ant.0	2 462	Rear	0	1.130	1.130	1.00
WLAN 2.4 GHz_Ant.1	2 412	Rear	0	0.991	0.956	0.96
WLAN 5.6 GHz_Ant.0	5 690	Rear	0	0.825	0.807	0.98
WLAN 5.6 GHz_Ant.1	5 690	Rear	0	0.817	0.774	0.95

17. Simultaneous Transmission

17.1 Simultaneous Transmission Configurations

No	Scenario	Operation
1	WLAN 2.4 GHz Main + Bluetooth Aux	Yes
2	WLAN 5 GHz Main + Bluetooth Aux	Yes
3	WLAN 5 GHz MIMO + Bluetooth Aux	Yes

Notes

- Bluetooth and WLAN Aux(Ant.1) share the same antenna path.
- Bluetooth can transmit with WLAN 2.4 GHz Main(Ant.0) simultaneously.

17.1 Simultaneous Transmission Analysis

Notebook Body SAR Simultaneous Transmission

Band	EUT Position	Scaled 1 g SAR Ant.0 (W/kg)	Scaled 1 g SAR Ant.1 (W/kg)	Σ 1 g SAR (W/kg)	SPLSR
WLAN 2.4 GHz Main + Bluetooth Aux	Rear	1.157	0.400	**1.557**	ΣSAR<1.6, Not required
WLAN 5 GHz Main + Bluetooth Aux	Rear	0.926	0.400	1.326	ΣSAR<1.6, Not required
WLAN 5 GHz MIMO + Bluetooth Aux	Rear	0.569	0.400	0.969	ΣSAR<1.6, Not required

Notes

- Simultaneous transmission SAR test exclusion considerations
  Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration. Per KDB Publication 447498 D01v06.
- When the sum of SAR1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR1g 1.6 W/kg), the SPLSR procedures is not required. When the sum of SAR1g is greater than the SAR limit (SAR1g 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

18. Test System Verification Results

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: Head_D2450(190510).da5:0

DUT: Dipole 2450 MHz D2450V2, Type: D2450V2, Serial: D2450V2 - SN:895

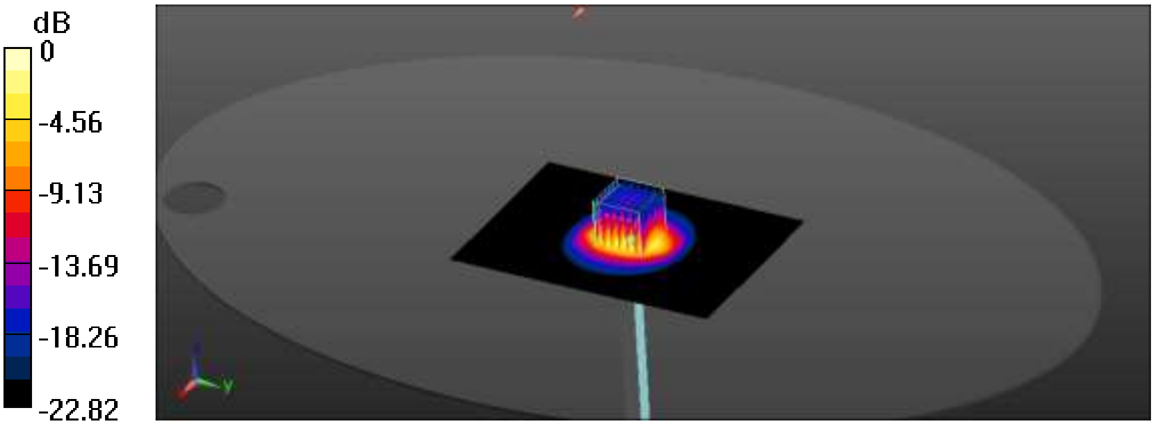
Communication System: UID 0, CW (0); Communication System Channel Number: 11; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.852 S/m; ε_r = 39.034; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(7.21, 7.21, 7.21) @ 2450 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_3_20180808; Type: QD OVA 002 AA; Serial: 1173
- Measurement SW: DASY52, Version 52.10 (1);

Configuration/d=10 mm, Pin=250 mW, dist=1.4 mm (EX-Probe)/Area Scan (101x141x1):
Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 20.7 W/kg

Configuration/d=10 mm, Pin=250 mW, dist=1.4 mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 107.0 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 26.7 W/kg
SAR(1 g) = 12.2 W/kg; SAR(10 g) = 5.57 W/kg
Maximum value of SAR (measured) = 21.1 W/kg



0 dB = 21.1 W/kg = 13.24 dBW/kg

Date: 2019-05-18

Test Laboratory: KCTL Inc.
File Name: Head_D2450(190518).da5:0

DUT: Dipole 2450 MHz D2450V2, Type: D2450V2, Serial: D2450V2 - SN:895

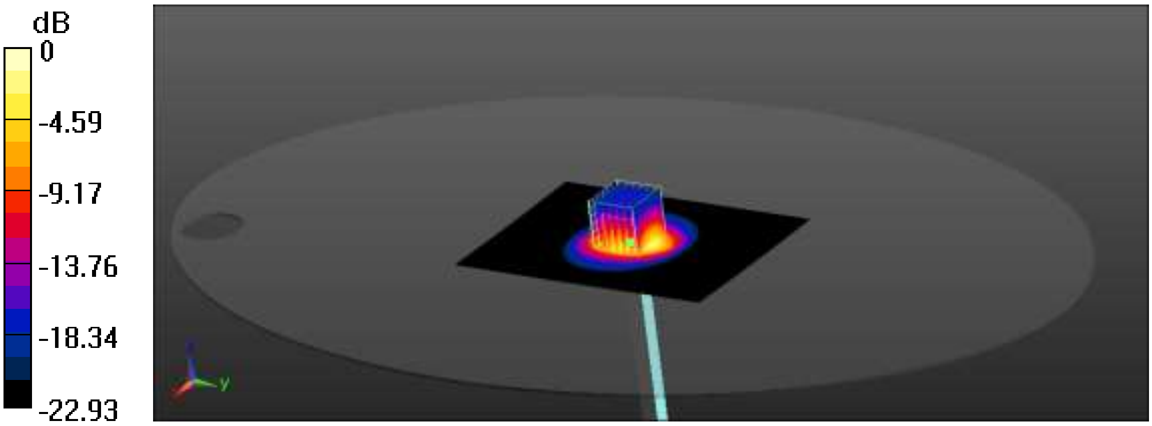
Communication System: UID 0, CW (0); Communication System Channel Number: 11; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.863 S/m; ε_r = 38.25; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(7.21, 7.21, 7.21) @ 2450 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_3_20180808; Type: QD OVA 002 AA; Serial: 1173
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/d=10 mm, Pin=250 mW, dist=1.4 mm (EX-Probe)/Area Scan (101x141x1):
Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 21.1 W/kg

Configuration/d=10 mm, Pin=250 mW, dist=1.4 mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.0 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 26.3 W/kg
SAR(1 g) = 12.2 W/kg; SAR(10 g) = 5.58 W/kg
Maximum value of SAR (measured) = 20.8 W/kg



0 dB = 20.8 W/kg = 13.18 dBW/kg

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: Head_D5.3GHz(190509).da52:0

DUT: Dipole D5GHzV2, Type: D5GHzV2, Serial: D5GHzV2 - SN:1130

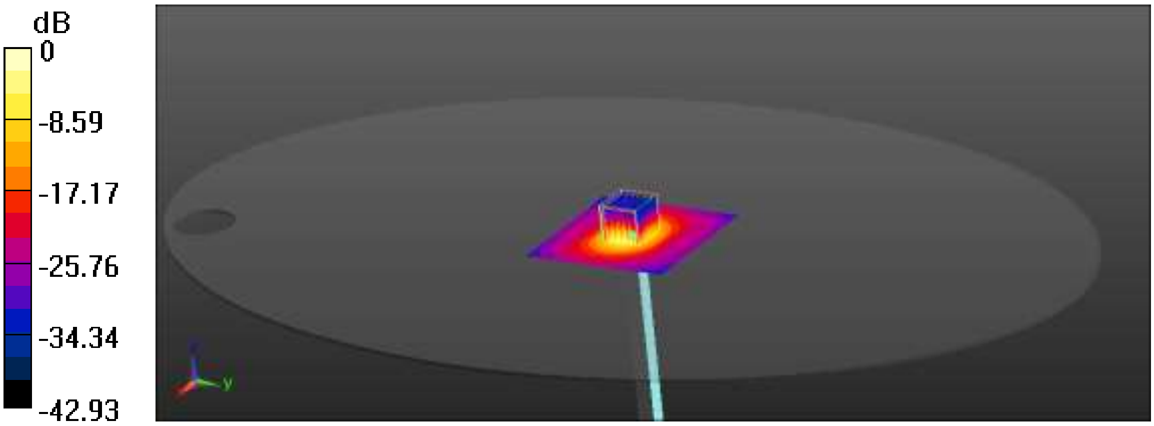
Communication System: UID 0, CW (0); Communication System Channel Number: 1; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium parameters used (extrapolated): f = 5300 MHz; σ = 4.797 S/m; ε_r = 35.967; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.95, 4.95, 4.95) @ 5300 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/d=10mm, Pin=100mW, f=5300MHz/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.7 W/kg

Configuration/d=10mm, Pin=100mW, f=5300MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 76.27 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 39.6 W/kg
SAR(1 g) = 8.42 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 22.5 W/kg



0 dB = 22.5 W/kg = 13.52 dBW/kg

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: Head_D5.6GHz(190509).da52:0

DUT: Dipole D5GHzV2, Type: D5GHzV2, Serial: D5GHzV2 - SN:1130

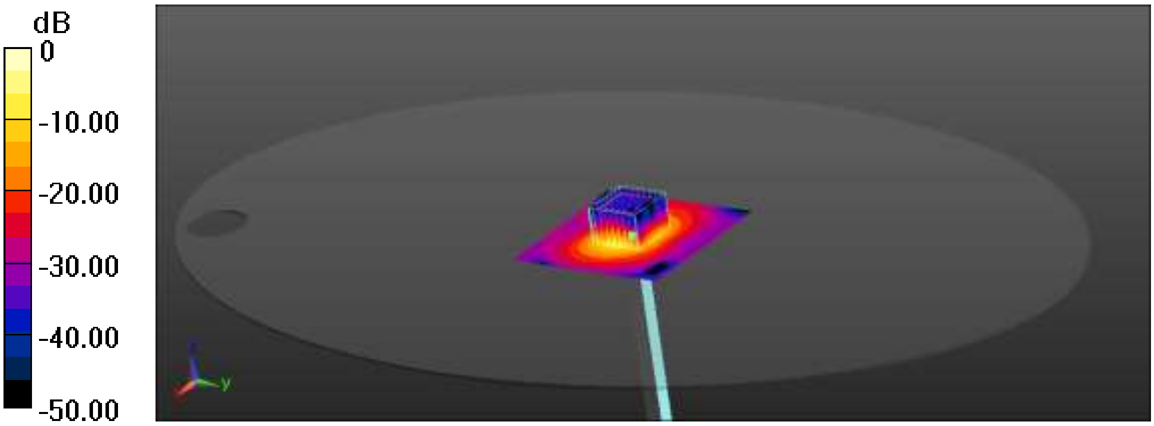
Communication System: UID 0, CW (0); Communication System Channel Number: 3; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.1 S/m; ε_r = 35.225; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.78, 4.78, 4.78) @ 5600 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/d=10mm, Pin=100mW, f=5600MHz/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 22.2 W/kg

Configuration/d=10mm, Pin=100mW, f=5600MHz/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.09 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 41.8 W/kg
SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.36 W/kg
Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 dBW/kg

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: Head_D5.8GHz(190510).da52:0

DUT: Dipole D5GHzV2, Type: D5GHzV2, Serial: D5GHzV2 - SN:1130

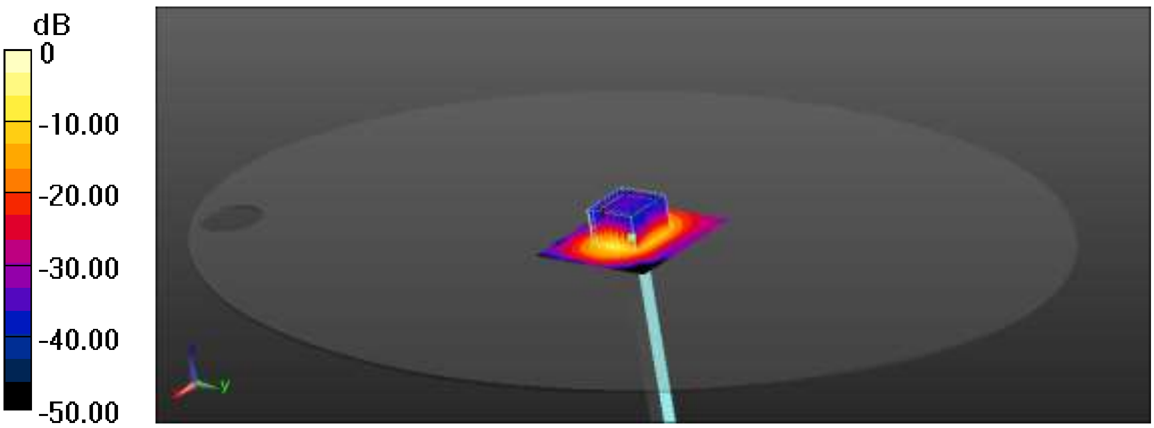
Communication System: UID 0, CW (0); Communication System Channel Number: 4; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium parameters used: f = 5800 MHz; σ = 5.073 S/m; ε_r = 35.921; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.7, 4.7, 4.7) @ 5800 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/d=10mm, Pin=100mW, f=5800MHz/Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.6 W/kg

Configuration/d=10mm, Pin=100mW, f=5800MHz/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.26 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 40.5 W/kg
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 21.3 W/kg



0 dB = 21.3 W/kg = 13.28 dBW/kg

19. Test Results

#1

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: 3.802.11b_f.2 462_Rear_0 mm_Ant.0.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

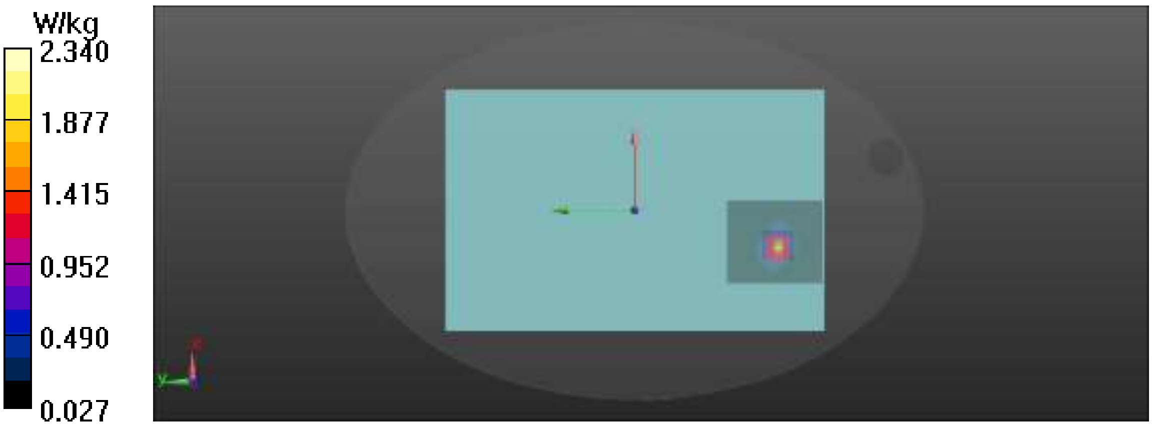
Communication System: UID 0, 2.4GWLAN (0); Communication System Channel Number: 11;
Frequency: 2462 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2462 MHz; σ = 1.861 S/m; ε_r = 39.002; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(7.21, 7.21, 7.21) @ 2462 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_3_20180808; Type: QD OVA 002 AA; Serial: 1173
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11b_f.2 462_Rear_0 mm_Ant.0/Area Scan (71x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.69 W/kg

Configuration/802.11b_f.2 462_Rear_0 mm_Ant.0/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 33.08 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 3.61 W/kg
SAR(1 g) = 1.13 W/kg; SAR(10 g) = 0.451 W/kg
Maximum value of SAR (measured) = 2.34 W/kg



#2

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: 4.802.11b_f.2 412_Rear_0 mm_Ant.1.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

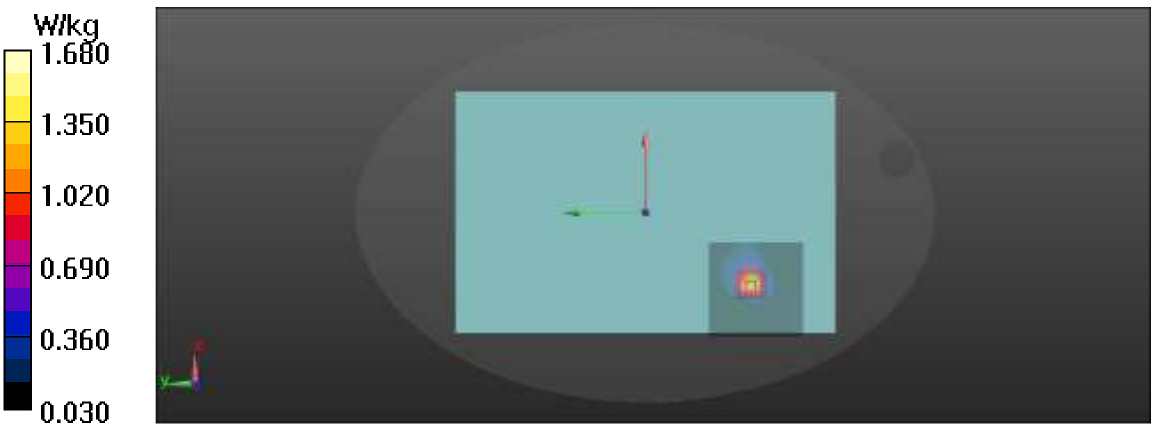
Communication System: UID 0, 2.4GWLAN (0); Communication System Channel Number: 1;
Frequency: 2412 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.814 S/m; ε_r = 39.132; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(7.21, 7.21, 7.21) @ 2412 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_3_20180808; Type: QD OVA 002 AA; Serial: 1173
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11b_f.2 412_Rear_0 mm_Ant.1/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 2.21 W/kg

Configuration/802.11b_f.2 412_Rear_0 mm_Ant.1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.737 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 2.30 W/kg
SAR(1 g) = 0.991 W/kg; SAR(10 g) = 0.481 W/kg
Maximum value of SAR (measured) = 1.68 W/kg



#3

Date: 2019-05-18

Test Laboratory: KCTL Inc.
File Name: 2.802.11n40_f.2 437_Rear_0 mm_MIMO.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

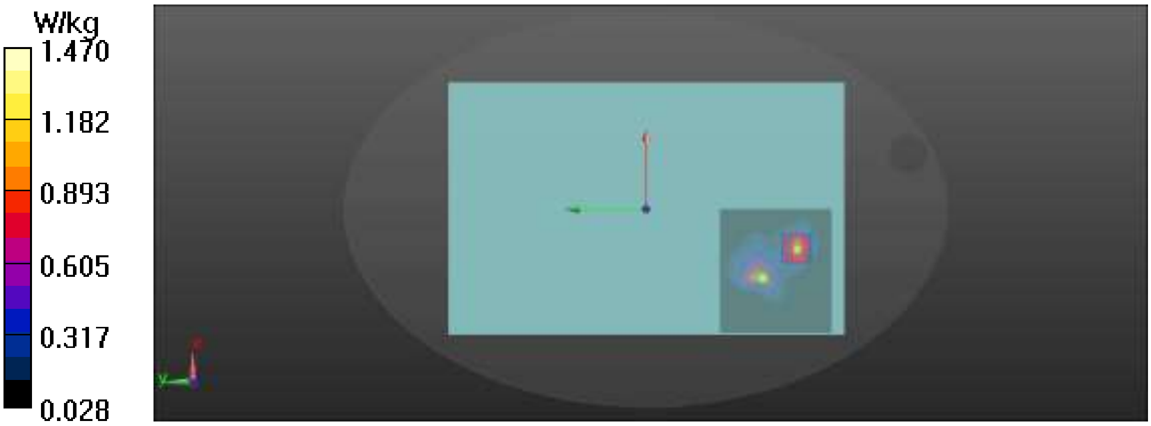
Communication System: UID 0, 2.4GWLAN (0); Communication System Channel Number: 6;
Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.838 S/m; ε_r = 39.07; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(7.21, 7.21, 7.21) @ 2437 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_3_20180808; Type: QD OVA 002 AA; Serial: 1173
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11n40_f.2 437_Rear_0 mm_MIMO/Area Scan (101x91x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.18 W/kg

Configuration/802.11n40_f.2 437_Rear_0 mm_MIMO/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.06 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 2.34 W/kg
SAR(1 g) = 0.778 W/kg; SAR(10 g) = 0.318 W/kg
Maximum value of SAR (measured) = 1.47 W/kg



#4

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: 2.802.11ac80_f.5 290_Rear_0 mm_Ant.0.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

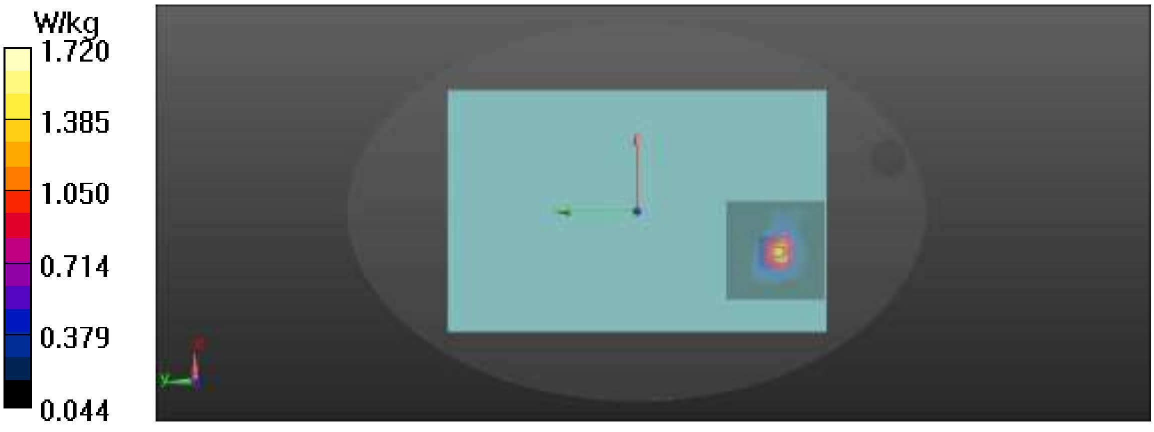
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 58;
Frequency: 5290 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5290 MHz; σ = 4.807 S/m; ε_r = 35.934; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.95, 4.95, 4.95) @ 5290 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 290_Rear_0 mm_Ant.0/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.69 W/kg

Configuration/802.11ac80_f.5 290_Rear_0 mm_Ant.0/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 20.08 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 5.50 W/kg
SAR(1 g) = 0.767 W/kg; SAR(10 g) = 0.340 W/kg
Maximum value of SAR (measured) = 1.72 W/kg



#5

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: 4.802.11ac80_f.5 290_Rear_0 mm_Ant.1.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

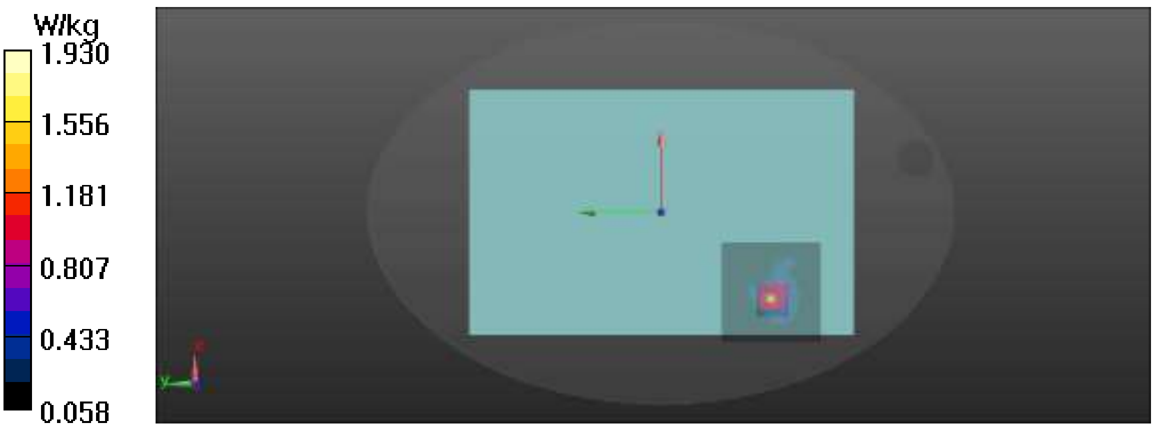
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 58;
Frequency: 5290 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5290 MHz; σ = 4.807 S/m; ε_r = 35.934; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.95, 4.95, 4.95) @ 5290 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 290_Rear_0 mm_Ant.1/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.50 W/kg

Configuration/802.11ac80_f.5 290_Rear_0 mm_Ant.1/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 22.27 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 4.29 W/kg
SAR(1 g) = 0.782 W/kg; SAR(10 g) = 0.276 W/kg
Maximum value of SAR (measured) = 1.93 W/kg



#6

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: 3.802.11ac80_f.5 290_Rear_0 mm_MIMO.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

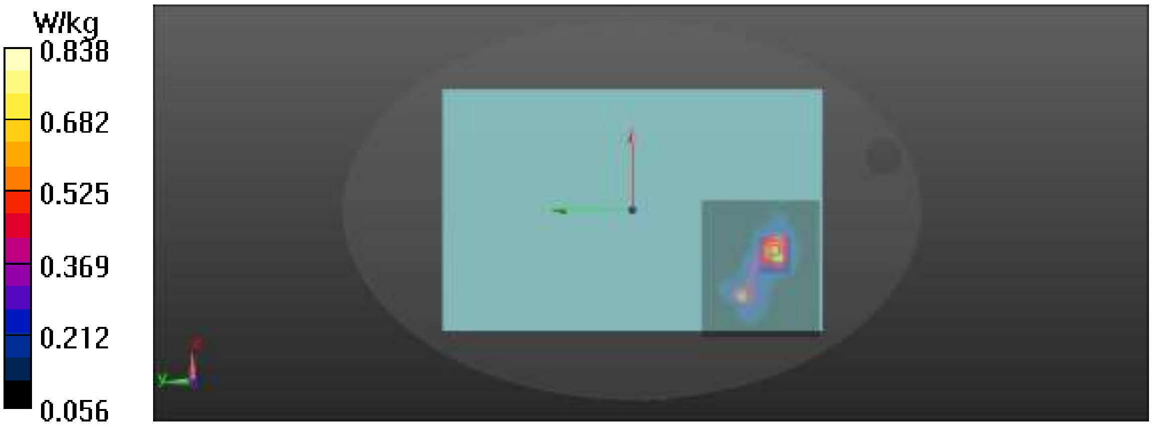
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 58;
Frequency: 5290 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5290 MHz; σ = 4.807 S/m; ε_r = 35.934; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.95, 4.95, 4.95) @ 5290 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (1);

Configuration/802.11ac80_f.5 290_Rear_0 mm_MIMO/Area Scan (141x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.833 W/kg

Configuration/802.11ac80_f.5 290_Rear_0 mm_MIMO/Zoom Scan (10x9x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 14.49 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 2.88 W/kg
SAR(1 g) = 0.394 W/kg; SAR(10 g) = 0.200 W/kg
Maximum value of SAR (measured) = 0.838 W/kg



#7

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: 2.802.11ac80_f.5 690_Rear_0 mm_Ant.0.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

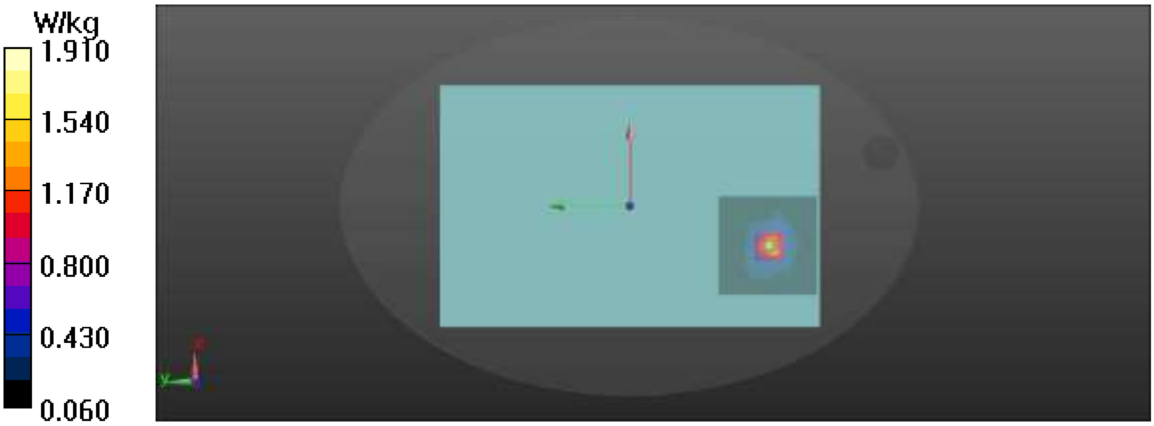
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 138;
Frequency: 5690 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5690 MHz; σ = 5.216 S/m; ε_r = 34.937; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.78, 4.78, 4.78) @ 5690 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 690_Rear_0 mm_Ant.0/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.92 W/kg

Configuration/802.11ac80_f.5 690_Rear_0 mm_Ant.0/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 21.14 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 6.79 W/kg
SAR(1 g) = 0.825 W/kg; SAR(10 g) = 0.353 W/kg
Maximum value of SAR (measured) = 1.91 W/kg



#8

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: 4.802.11ac80_f.5 690_Rear_0 mm_Ant.1.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

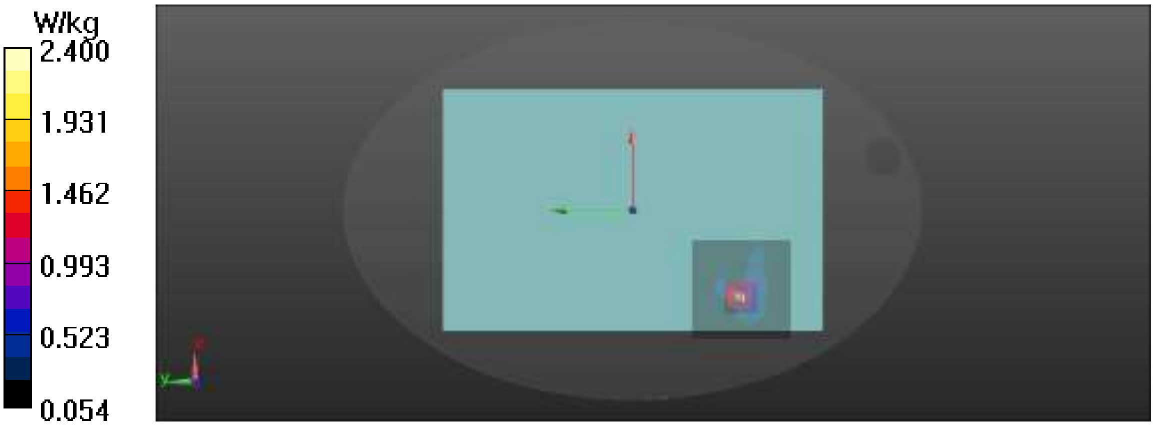
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 138;
Frequency: 5690 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5690 MHz; σ = 5.216 S/m; ε_r = 34.937; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.78, 4.78, 4.78) @ 5690 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 690_Rear_0 mm_Ant.1/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.40 W/kg

Configuration/802.11ac80_f.5 690_Rear_0 mm_Ant.1/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 4.878 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 6.02 W/kg
SAR(1 g) = 0.817 W/kg; SAR(10 g) = 0.267 W/kg
Maximum value of SAR (measured) = 2.40 W/kg



#9

Date: 2019-05-09

Test Laboratory: KCTL Inc.
File Name: 8.802.11ac80_f.5 610_Rear_0 mm_MIMO.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

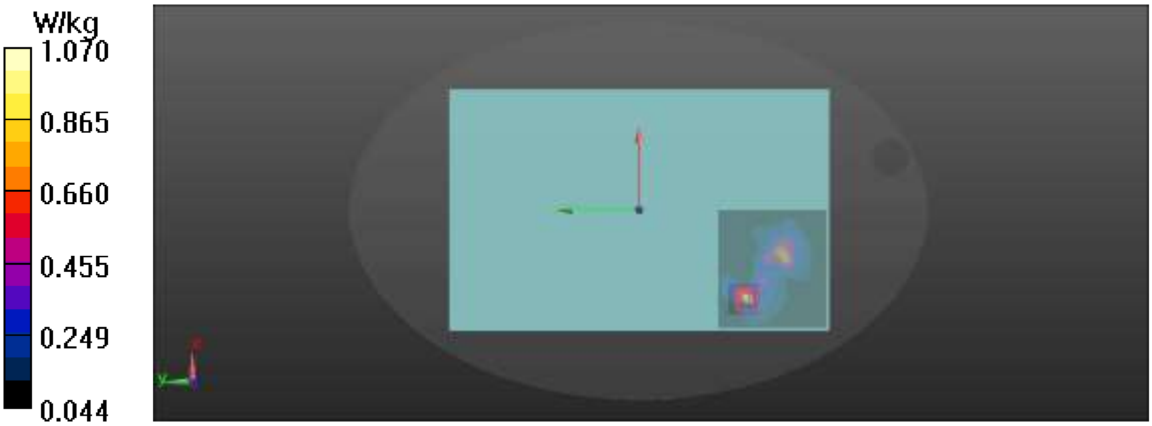
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 122;
Frequency: 5610 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5610 MHz; σ = 5.115 S/m; ε_r = 35.184; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.78, 4.78, 4.78) @ 5610 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 610_Rear_0 mm_MIMO/Area Scan (121x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.834 W/kg

Configuration/802.11ac80_f.5 610_Rear_0 mm_MIMO/Zoom Scan (9x9x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 12.56 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 2.25 W/kg
SAR(1 g) = 0.404 W/kg; SAR(10 g) = 0.156 W/kg
Maximum value of SAR (measured) = 1.07 W/kg



#10

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: 1.802.11ac80_f.5 775_Rear_0 mm_Ant.0.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

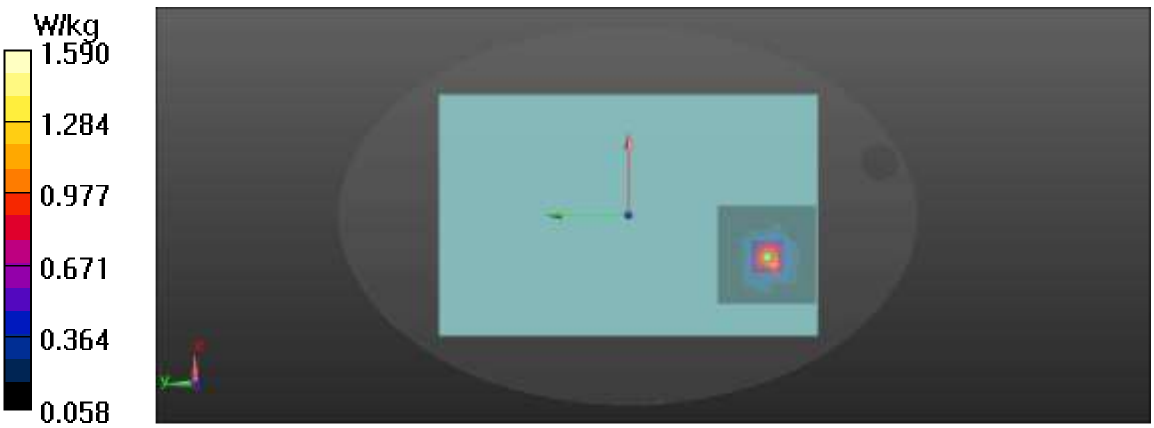
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 155;
Frequency: 5775 MHz; Duty Cycle: 1:1
Medium parameters used: f = 5775 MHz; σ = 5.045 S/m; ε_r = 35.981; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.7, 4.7, 4.7) @ 5775 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 775_Rear_0 mm_Ant.0/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.56 W/kg

Configuration/802.11ac80_f.5 775_Rear_0 mm_Ant.0/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 19.45 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 3.32 W/kg
SAR(1 g) = 0.679 W/kg; SAR(10 g) = 0.304 W/kg
Maximum value of SAR (measured) = 1.59 W/kg



#11

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: 2.802.11ac80_f.5 775_Rear_0 mm_Ant.1.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

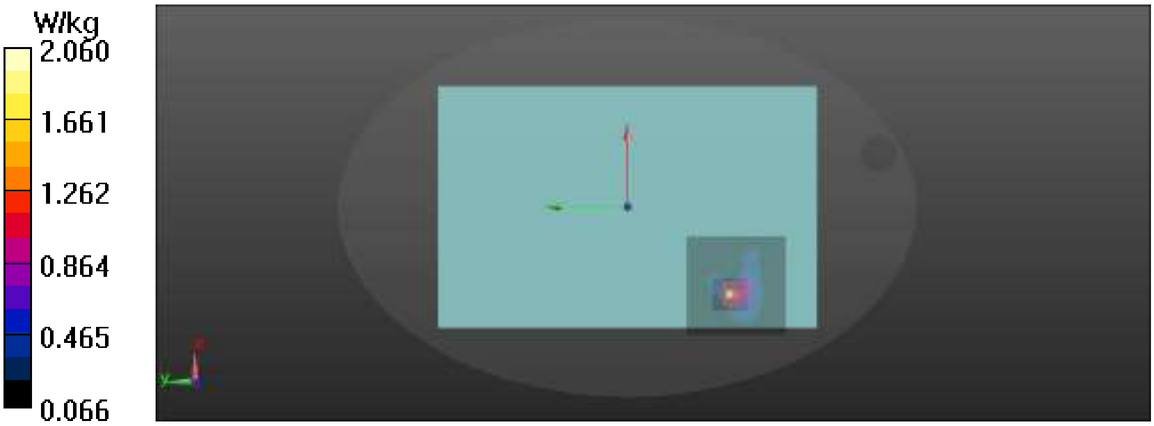
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 155;
Frequency: 5775 MHz; Duty Cycle: 1:1
Medium parameters used: f = 5775 MHz; σ = 5.045 S/m; ε_r = 35.981; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.7, 4.7, 4.7) @ 5775 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 775_Rear_0 mm_Ant.1/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.51 W/kg

Configuration/802.11ac80_f.5 775_Rear_0 mm_Ant.1/Zoom Scan (9x10x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 18.86 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 5.37 W/kg
SAR(1 g) = 0.757 W/kg; SAR(10 g) = 0.251 W/kg
Maximum value of SAR (measured) = 2.06 W/kg



#12

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: 3.802.11ac80_f.5 775_Rear_0 mm_MIMO.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

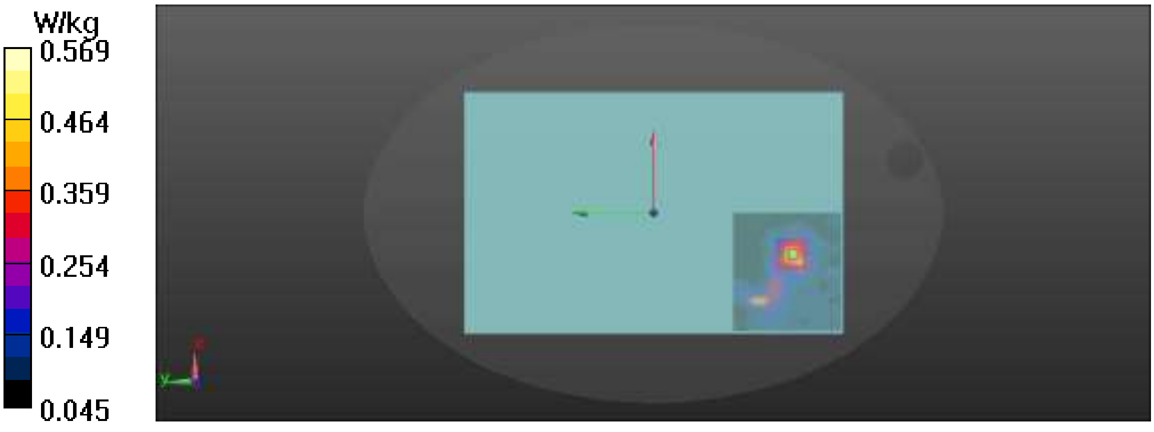
Communication System: UID 0, 5GWLAN (0); Communication System Channel Number: 155;
Frequency: 5775 MHz; Duty Cycle: 1:1
Medium parameters used: f = 5775 MHz; σ = 5.045 S/m; ε_r = 35.981; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(4.7, 4.7, 4.7) @ 5775 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_2_20180808; Type: QD OVA 002 BB; Serial: 1220
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/802.11ac80_f.5 775_Rear_0 mm_MIMO/Area Scan (121x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.565 W/kg

Configuration/802.11ac80_f.5 775_Rear_0 mm_MIMO/Zoom Scan (9x9x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 10.67 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.24 W/kg
SAR(1 g) = 0.266 W/kg; SAR(10 g) = 0.150 W/kg
Maximum value of SAR (measured) = 0.569 W/kg



#13

Date: 2019-05-10

Test Laboratory: KCTL Inc.
File Name: 1.Bluetooth_BDR_DH5_f.2 480_Rear_0 mm_Ant.1.da53:0

DUT: XE350XBA, Type: Notebook, Serial: 0ZGT91ZM400004V

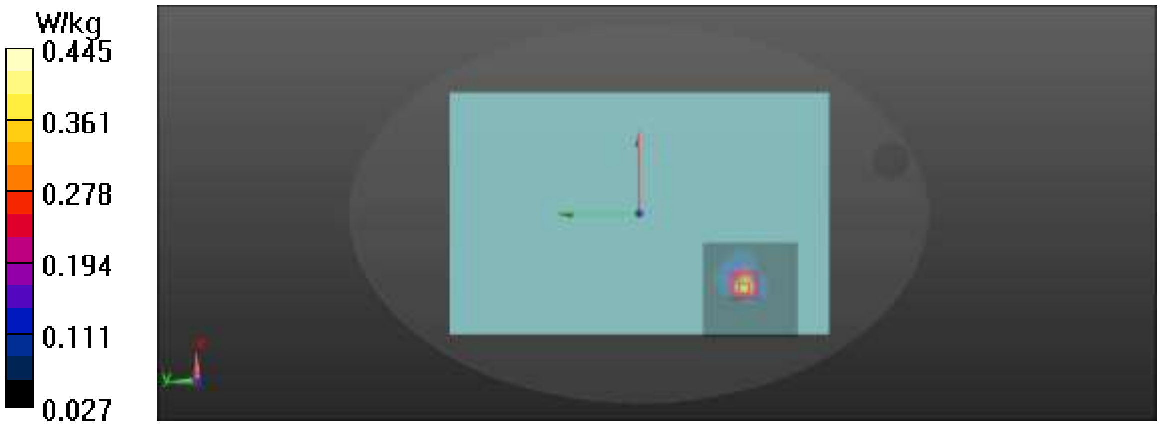
Communication System: UID 0, Bluetooth (0); Communication System Channel Number: 78;
Frequency: 2480 MHz;   Duty Cycle: 1:1
Medium parameters used: f = 2480 MHz; σ = 1.88 S/m; ε_r = 38.972; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3928; ConvF(7.21, 7.21, 7.21) @ 2480 MHz;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1567; Calibrated: 2019-02-05
- Phantom: ELI V5.0 (20deg probe tilt)_3_20180808; Type: QD OVA 002 AA; Serial: 1173
- Measurement SW: DASY52, Version 52.10 (2);

Configuration/1.Bluetooth_BDR_DH5_f.2 480_Rear_0 mm_Ant.1/Area Scan (81x81x1):
Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.542 W/kg

Configuration/1.Bluetooth_BDR_DH5_f.2 480_Rear_0 mm_Ant.1/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.21 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.592 W/kg
SAR(1 g) = 0.258 W/kg; SAR(10 g) = 0.134 W/kg
Maximum value of SAR (measured) = 0.445 W/kg



Appendix A. Calibration certificate

Appendix A.1 Probe Calibration certificate

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 KCTL (Dymstec)

Certificate No: EX3-3928_Jan19

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3928

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7
Calibration procedure for dosimetric E-field probes

Calibration date: January 31, 2019

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
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 2, 2019

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: EX3-3928_Jan19 Page 1 of 10

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).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.48	0.22	0.55	± 10.1 %
DCP (mV)[B]	94.9	94.8	96.3	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	135.8	±3.0 %	± 4.7 %
		Y	0.0	0.0	1.0		135.4		
		Y	0.0	0.0	1.0		143.6		

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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	70.7
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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928

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	9.34	9.34	9.34	0.55	0.90	± 12.0 %
850	41.5	0.92	9.27	9.27	9.27	0.60	0.85	± 12.0 %
900	41.5	0.97	9.02	9.02	9.02	0.47	0.89	± 12.0 %
1750	40.1	1.37	7.97	7.97	7.97	0.38	0.84	± 12.0 %
1900	40.0	1.40	7.79	7.79	7.79	0.25	0.85	± 12.0 %
2300	39.5	1.67	7.51	7.51	7.51	0.28	0.84	± 12.0 %
2450	39.2	1.80	7.21	7.21	7.21	0.31	0.85	± 12.0 %
2600	39.0	1.96	6.92	6.92	6.92	0.35	0.89	± 12.0 %
3500	37.9	2.91	6.86	6.86	6.86	0.25	1.20	± 13.1 %
3700	37.7	3.12	6.70	6.70	6.70	0.25	1.20	± 13.1 %
5200	36.0	4.66	5.16	5.16	5.16	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.95	4.95	4.95	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.86	4.86	4.86	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.78	4.78	4.78	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.70	4.70	4.70	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are 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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3928

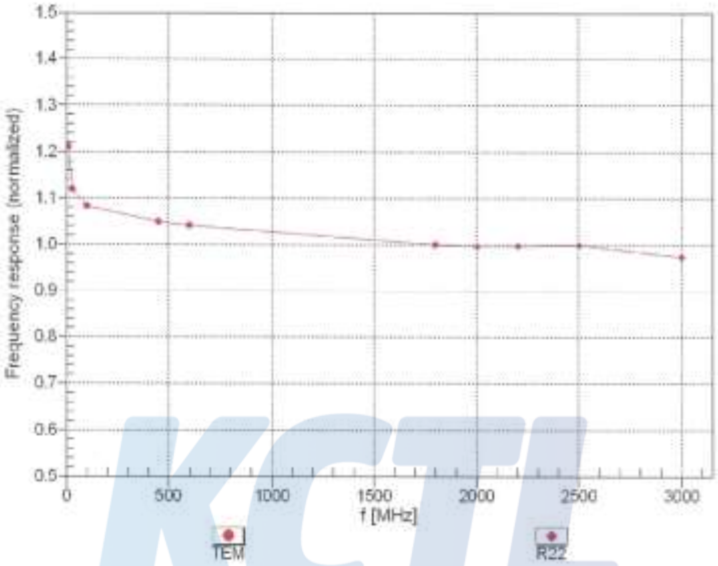
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	9.55	9.55	9.55	0.51	0.80	± 12.0 %
850	55.2	0.99	9.32	9.32	9.32	0.39	0.84	± 12.0 %
900	55.0	1.05	9.28	9.28	9.28	0.46	0.86	± 12.0 %
1750	53.4	1.49	7.70	7.70	7.70	0.37	0.84	± 12.0 %
1900	53.3	1.52	7.46	7.46	7.46	0.37	0.84	± 12.0 %
2300	52.9	1.81	7.25	7.25	7.25	0.38	0.86	± 12.0 %
2450	52.7	1.95	7.22	7.22	7.22	0.24	0.93	± 12.0 %
2600	52.5	2.16	6.95	6.95	6.95	0.25	0.94	± 12.0 %
3500	51.3	3.31	6.66	6.66	6.66	0.25	1.20	± 13.1 %
3700	51.0	3.55	6.64	6.64	6.64	0.25	1.25	± 13.1 %
5200	49.0	5.30	4.43	4.43	4.43	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.30	4.30	4.30	0.50	1.90	± 13.1 %
5500	48.6	5.65	4.03	4.03	4.03	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.91	3.91	3.91	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

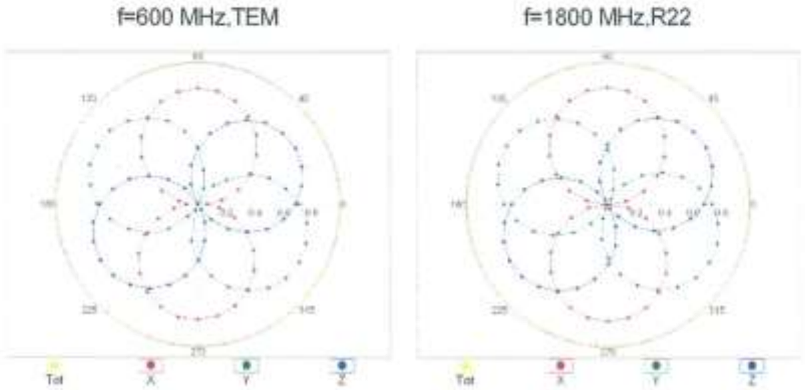
Frequency Response of E-Field

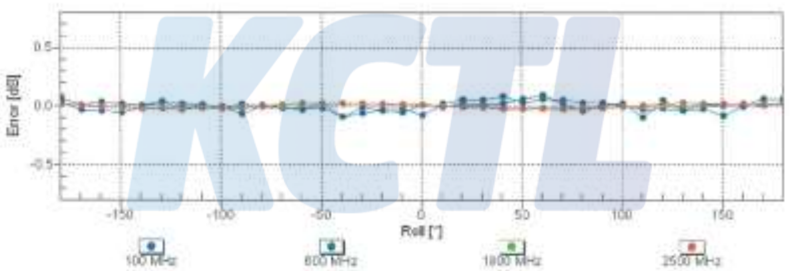
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

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

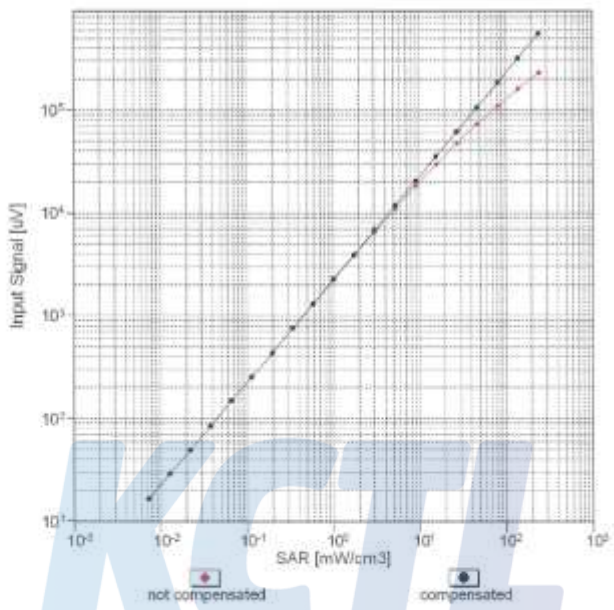


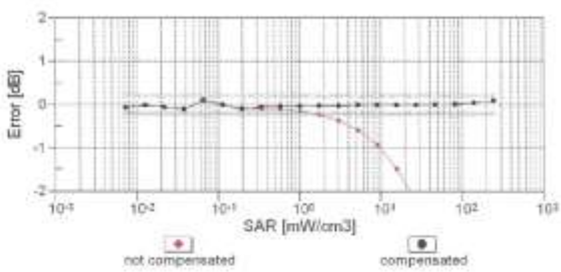


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

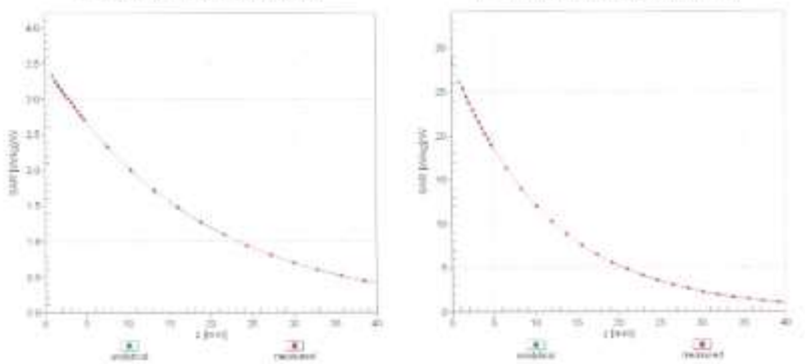
(TEM cell , f_{eval}= 1900 MHz)





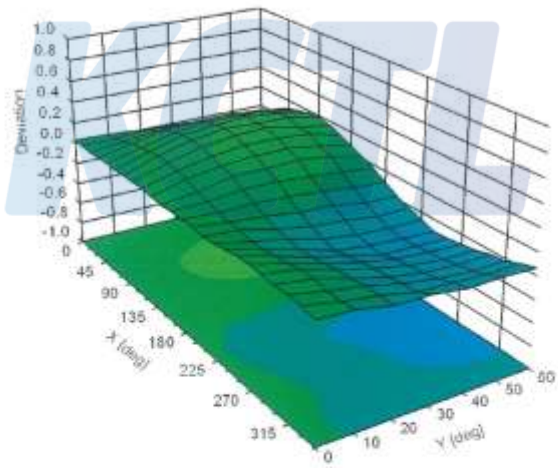
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (φ, ϑ), f = 900 MHz



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

Appendix A.2 Dipole Calibration certificate

D2450V2

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

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

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

Accreditation No.: **SCS 0108**

Client **KCTL (Dymstec)**

Certificate No: **D2450V2-895_Jul18**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN:895

Calibration procedure(s): QA CAL-05.v10
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 24, 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 Agilent E8358A	SN: US41080477	31-Mar-14 (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: July 24, 2018

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Certificate No: D2450V2-895_Jul18 Page 1 of 8

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

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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	37.8 ± 6 %	1.85 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	13.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 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	51.9 ± 6 %	2.02 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	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.8 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 1.8 jΩ
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.2 Ω + 5.0 jΩ
Return Loss	- 25.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 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	June 19, 2012

DASY5 Validation Report for Head TSL

Date: 24.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

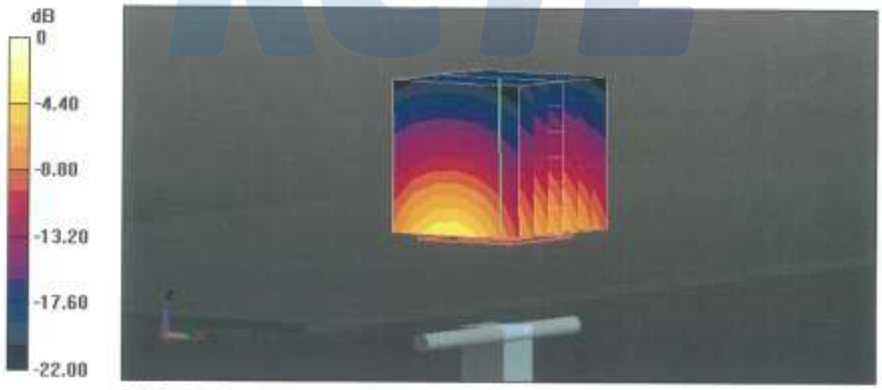
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:895

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

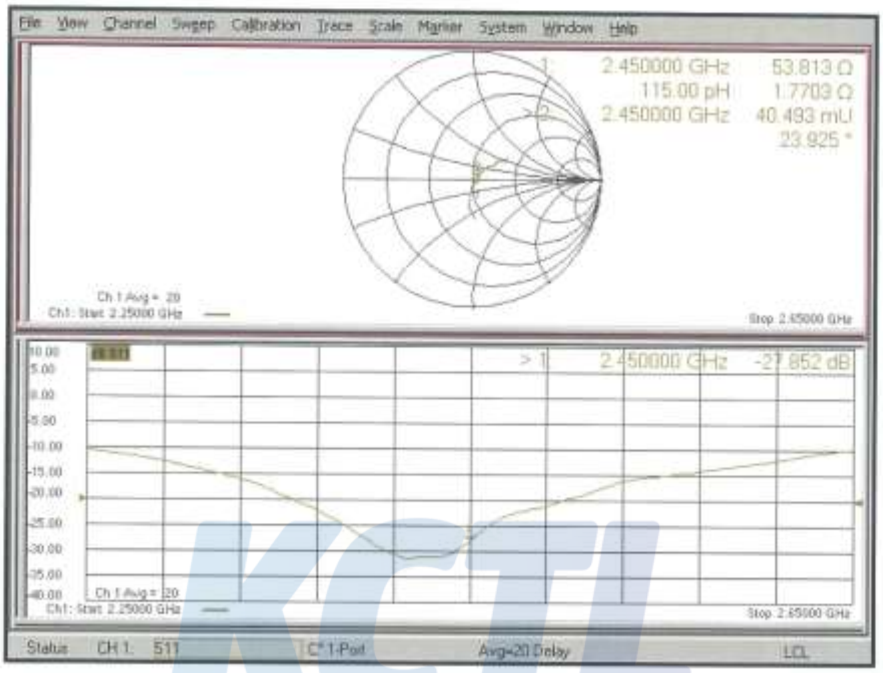
- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 115.0 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (measured) = 21.4 W/kg



0 dB = 21.4 W/kg = 13.30 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-895_Jul18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 24.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

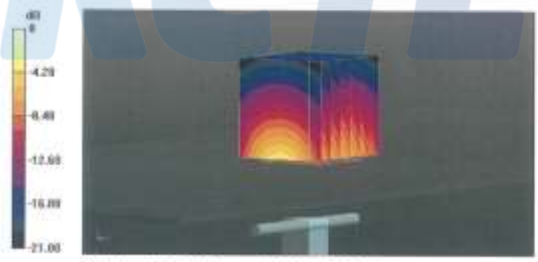
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:895

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

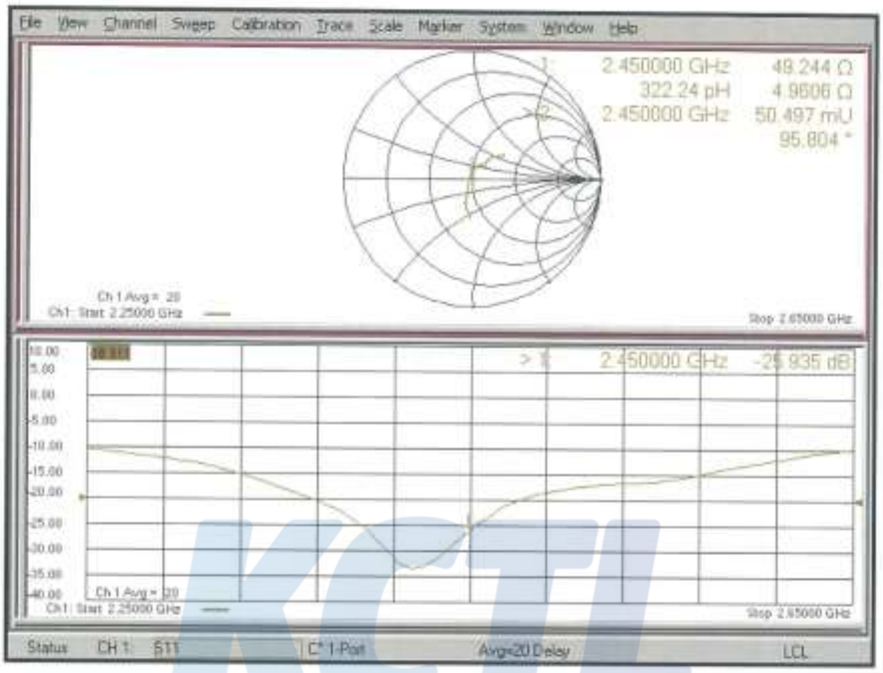
- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 108.0 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 25.1 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.03 W/kg
Maximum value of SAR (measured) = 20.9 W/kg



0 dB = 20.9 W/kg = 13.20 dBW/kg

Impedance Measurement Plot for Body TSL



D5GHzV2

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Accreditation No.: **SCS 0108**

Client **SGS Korea (Dymstec)**

Certificate No: **D5GHzV2-1130_May18**

CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN:1130

Calibration procedure(s): QA CAL-22.v3
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: May 25, 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: 3503	30-Dec-17 (No. EX3-3503_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:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 25, 2018

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Certificate No: D5GHzV2-1130_May18 Page 1 of 14

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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 V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.2 ± 6 %	4.52 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**77.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.3 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.1 ± 6 %	4.63 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.1 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.8 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.7 ± 6 %	4.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**85.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	5.15 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.6 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.41 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**73.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.54 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.95 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.4 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	45.9 ± 6 %	6.22 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.63 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	53.4 Ω - 9.7 jΩ
Return Loss	- 20.0 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	52.1 Ω - 4.3 jΩ
Return Loss	- 26.6 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.5 Ω - 2.9 jΩ
Return Loss	- 21.6 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.8 Ω - 0.8 jΩ
Return Loss	- 23.9 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.6 Ω - 8.6 jΩ
Return Loss	- 21.3 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	51.0 Ω - 4.0 jΩ
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.9 Ω - 3.2 jΩ
Return Loss	- 22.0 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	55.9 Ω - 2.5 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 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	September 08, 2011

Certificate No: D5GHzV2-1130_May18 Page 8 of 14

DASY5 Validation Report for Head TSL

Date: 25.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1130

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.52 S/m; ε_r = 36.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5300 MHz; σ = 4.63 S/m; ε_r = 36.1; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.94 S/m; ε_r = 35.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 5.15 S/m; ε_r = 35.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

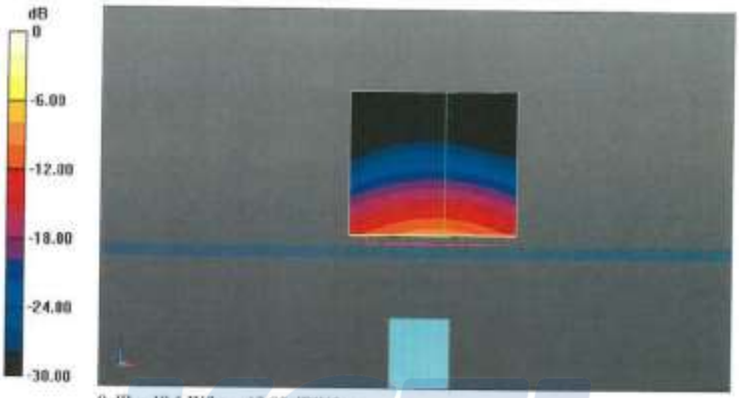
- Probe: EX3DV4 - SN3503; ConvF(5.75, 5.75, 5.75) @ 5200 MHz, ConvF(5.5, 5.5, 5.5) @ 5300 MHz, ConvF(5.05, 5.05, 5.05) @ 5600 MHz, ConvF(4.96, 4.96, 4.96) @ 5800 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: 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=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.29 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 74.92 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 30.2 W/kg
SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 18.9 W/kg

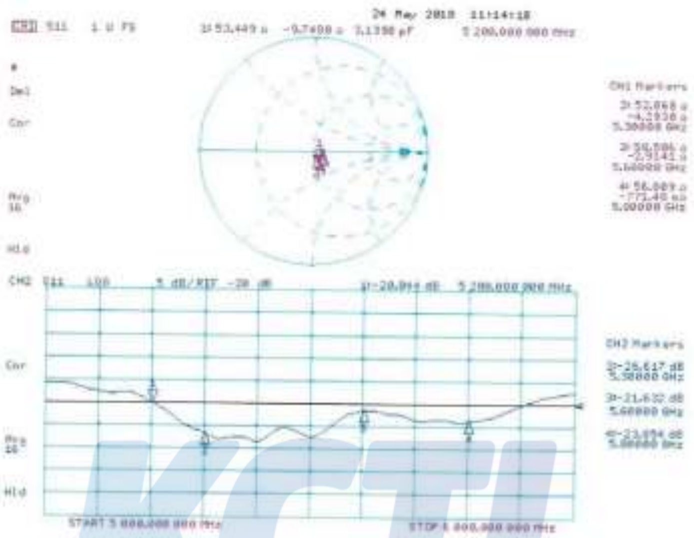
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 75.83 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 8.53 W/kg; SAR(10 g) = 2.45 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.55 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 32.8 W/kg
SAR(1 g) = 8.3 W/kg; SAR(10 g) = 2.36 W/kg
Maximum value of SAR (measured) = 19.6 W/kg



0 dB = 19.6 W/kg = 12.92 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1130

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.41 S/m; ε_r = 47; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5300 MHz; σ = 5.54 S/m; ε_r = 46.8; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.95 S/m; ε_r = 46.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 6.22 S/m; ε_r = 45.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

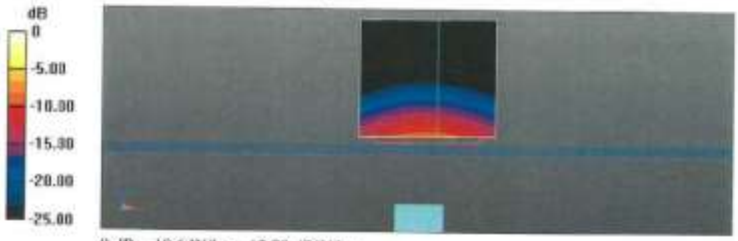
- Probe: EX3DV4 - SN3503; ConvF(5.35, 5.35, 5.35) @ 5200 MHz, ConvF(5.15, 5.15, 5.15) @ 5300 MHz, ConvF(4.65, 4.65, 4.65) @ 5600 MHz, ConvF(4.53, 4.53, 4.53) @ 5800 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: 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=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.61 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 7.45 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 17.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.51 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 17.9 W/kg

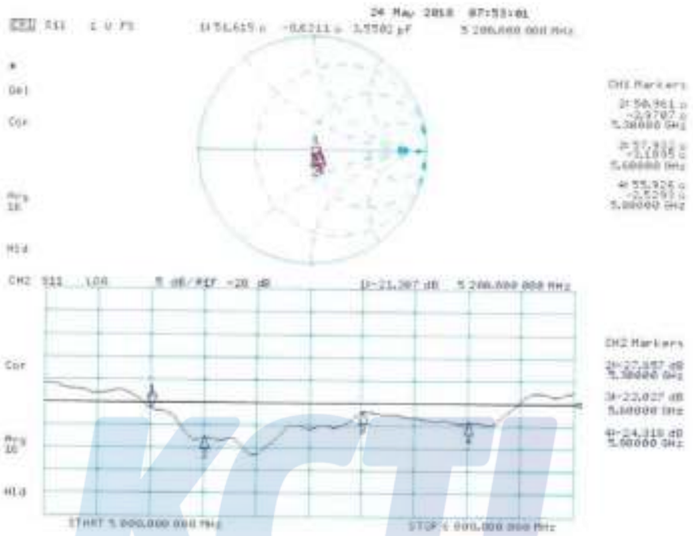
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.63 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 33.8 W/kg
SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 19.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.70 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 18.6 W/kg = 12.70 dBW/kg

Impedance Measurement Plot for Body TSL



Appendix B. EUT Photo

Front

Rear

Left

Right

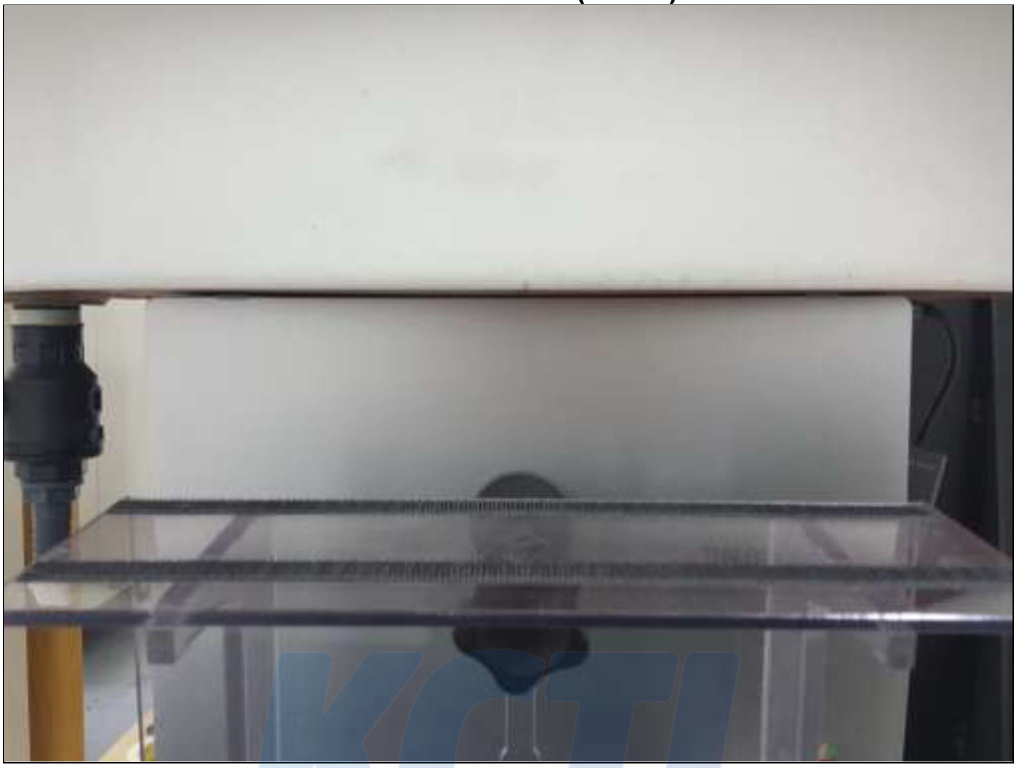
Top

Bottom

Notebook Front View

Appendix C. Test Photo

Notebook Rear (0 mm)



End of test report