# SAR TEST REPORT

for

Razer Inc.

Notebook PC

Model No.: RZ09-0239

FCC ID: RWO-RZ090239

| The MAX SAR(1g) | |
|---|---|
| Body SAR | 0.797W/Kg |

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# SAR TEST REPORT

Applicant : Razer Inc.

Manufacturer : Razer Inc.

Product : Notebook PC

(A) Model No. : RZ09-0239

(B) Serial No. : N/A

(C) Test Voltage : AC 120V/60Hz

Measurement Standard Used:

· FCC 47 CFR Part 2 (2.1093)
· IEEE C95.1-1999
· IEEE 1528-2013
· FCC OET Bulletin 65 Supplement C (Edition 01-01)
· FCC KDB 447498 D01 v06
· FCC KDB 248227 D01 v02r02
· FCC KDB 616217 D04 v01r02
· FCC KDB 865664 D01/D02

This report applies to above tested sample only. This report shall not be reproduced in part without written approval of UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch.

Date of Test : Sep.08, 2017 Report of date: Sep.21, 2017

Prepared by : James Qin / Engineer Reviewed by : Shawn Wen/ Laboratory Leader

Approved & Authorized Signer : Stephen Guo / Laboratory Manager

# 1. GENERAL INFORMATION

## 1.1. Description of Device (EUT)

| | | |
|---|---|---|
| Product Name | : | Notebook PC |
| Model No. | : | RZ09-0239 |
| Radio | : | IEEE802.11 a/b/g/n/ac; Bluetooth V3.0+EDR; Bluetooth V4.1 |
| Operation Frequency | : | IEEE 802.11a:<br>5180MHz—5240MHz; 5260MHz—5320MHz<br>5500MHz—5700MHz; 5745MHz—5825MHz<br>IEEE 802.11ac VHT20:<br>5180MHz—5240MHz; 5260MHz—5320MHz<br>5500MHz—5700MHz; 5745MHz—5825MHz<br>IEEE 802.11ac VHT40:<br>5190MHz—5230MHz; 5270MHz—5310MHz<br>5510MHz—5670MHz; 5755MHz—5795MHz<br>IEEE 802.11ac VHT80: 5210MHz, 5290MHz; 5530MHz—5690MHz; 5775MHz<br>IEEE 802.11b: 2412MHz—2462MHz<br>IEEE 802.11g: 2412MHz—2462MHz<br>IEEE802.11nHT20: 2412MHz—2462MHz;<br>5180MHz—5240MHz; 5260MHz—5320MHz<br>5500MHz—5700MHz; 5745MHz—5825MHz<br>IEEE802.11nHT40: 2422MHz—2452MHz;<br>5190MHz—5230MHz; 5270MHz—5310MHz<br>5510MHz—5670MHz; 5755MHz—5795MHz<br>Bluetooth : 2402-2480MHz |
| Modulation Technology | : | IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK)<br>IEEE 802.11a/g: OFDM(64QAM, 16QAM, QPSK, BPSK)<br>IEEE 802.11ac VHT20, VHT40, VHT80: OFDM(16QAM, 64QAM, 256QAM, QPSK, BPSK)<br>IEEE 802.11n HT20, HT40: OFDM (64QAM, 16QAM,QPSK,BPSK)<br>Bluetooth V3.0+EDR: GFSK, π/4DQPSK,8-DPSK<br>Bluetooth V4.1:GFSK |

| | | |
|---|---|---|
| Antenna Gain | Assembly | : Antenna Type: PIFA<br>Bluetooth: 1.89dBi<br>WIFI 2.4GHz:ANT 0: 1.89dBi; ANT 1: 3.08dBi<br>WIFI 5GHz:<br>Band 1: ANT 0: 2.91dBi; ANT 1: 2.96dBi<br>Band 2: ANT 0: 3.08dBi; ANT 1: 2.96dBi<br>Band 3: ANT 0: 1.61dBi; ANT 1: 2.99dBi<br>Band 4: ANT 0: 3.16dBi; ANT 1: 2.88dBi |
| Applicant | | : Razer Inc.<br>201 3rd Street, Suite 900, San Francisco, CA 94103 |
| Manufacturer | | : Razer Inc.<br>201 3rd Street, Suite 900, San Francisco, CA 94103 |
| Factory | | : BYD Precision Manufacture Co., Ltd<br>No.3001, Bao He Road, Baolong Industrial, Longgang Street, Longgang Zone, Shenzhen, 518116, P.R., China |
| Power Adaptor | | : Manufacturer: Razer Inc. M/N: RC30-0239<br>Input: 100-240Vac; 50/60Hz, 2.0A<br>Output: 20V; 3.25A<br>DC Cable: Shielded, Undetachable, 2.0m |
| Power Cable | | : Unshielded, Detachable, 1.0m |
| Date of Test | | : Sep.08, 2017 |
| Date of Receipt | | : Aug.28, 2017 |

# 2. GENERAL DESCRIPTION

## 2.1. Product Description For EUT

**[None]**

## 2.2. Applied Standards

The Specific Absorption Rate (SAR) testing specification, method and procedure for this device is in accordance with the following standards:

· FCC 47 CFR Part 2 (2.1093)
· IEEE C95.1-1999
· IEEE 1528-2013
· FCC OET Bulletin 65 Supplement C (Edition 01-01)
· FCC KDB 447498 D01 v06
· FCC KDB 248227 D01 v02r02
· FCC KDB 616217 D04 v01r02
· FCC KDB 865664 D01/D02

## 2.3. Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

## 2.4. Test Conditions

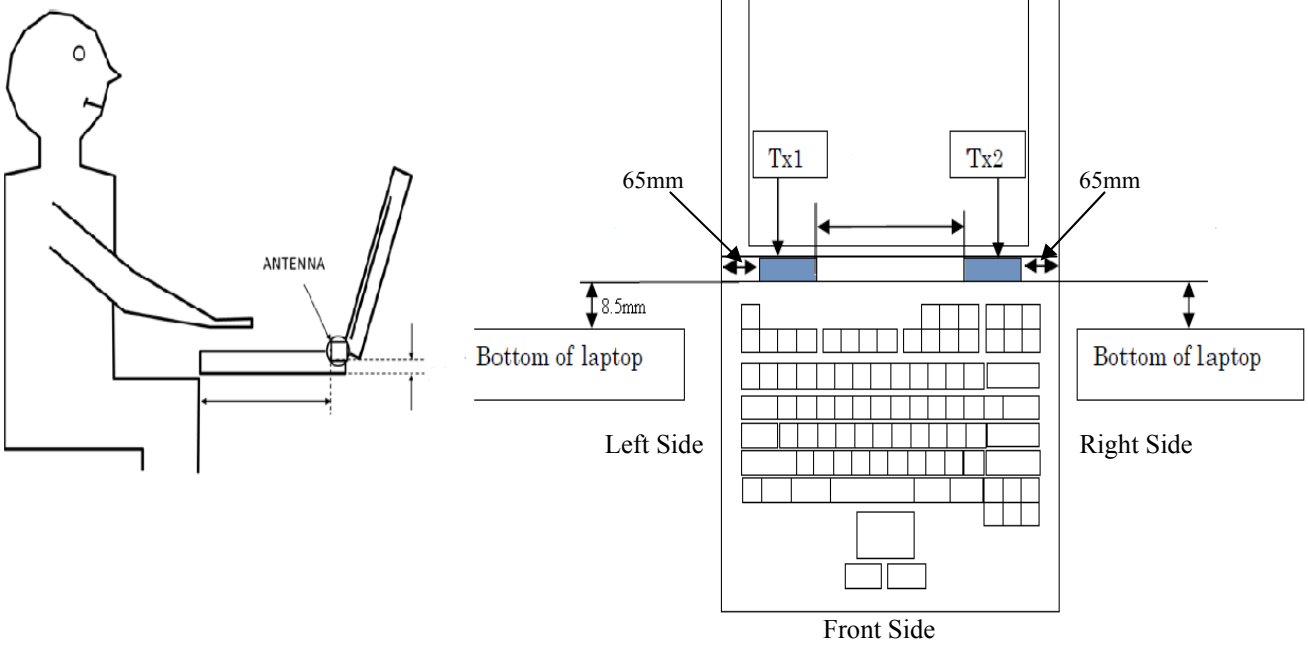
### 2.4.1. **Ambient Condition**

| | |
|---|---|
| **Ambient Temperature** | 20 to 24 ℃ |
| **Humidity** | < 60 % |

### 2.4.2. **Test Configuration**

The distance between the EUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30dB smaller than the output power of EUT. The EUT was set from the emulator to radiate maximum output power during all tests.

## 2.5. Exposure Positions Consideration




| | |
|---|---|
| WiFi Antenna | 802.11 a/b/g/nHT20/nHT40/acVHT20/ acVHT40/acVHT80 |

**Note:**

1. The distance from the WLAN antenna to the top surface is 4.7mm.
2. The diagonal of the screen is larger than 20cm.

| Sides for Body SAR tests<br>Test distance: 0 mm | | | | | | |
|---|---|---|---|---|---|---|
| Band | Screen Back | Front | Top | Bottom | Right | Left |
| WLAN 2.4GHz | ✓ | X | X | ✓ | X | X |
| WLAN 5GHz | ✓ | X | X | ✓ | X | X |

**Note:**

1. Per KDB447498 Appendix B, The side which has a distance to the WLAN antenna is more than 60mm can be exclude from SAR evaluation.

At test separation distance 60mm:

| Frequency (MHz) | SAR test exclusion threshold | Max Output power(dBm) | Sides more than 60mm distance from Antenna can be Excused ? |
|---|---|---|---|
| 2450 | 196mW(22.9dBm) | 15.91 | Yes |
| 5200 | 166mW(22.2dBm) | 15.38 | Yes |
| 5400 | 165mW(22.17dBm) | 15.21 | Yes |
| 5800 | 162mW(22.10dBm) | 15.10 | Yes |

## 2.6. Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied. The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] ·[ √ f(GHz)] ≤ 3.0 for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

According to the KDB447498 appendix A, the SAR test exclusion threshold for 2450MHz at 5mm test separation distances is 10 mW,5.2GHz is 7 mW, 5.4GHz and 5.8GHz is 6mW

**Appendix A**

**SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm**

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

| MHz | 5 | 10 | 15 | 20 | 25 | mm |
|---|---|---|---|---|---|---|
| 150 | 39 | 77 | 116 | 155 | 194 | SAR Test Exclusion Threshold (mW) |
| 300 | 27 | 55 | 82 | 110 | 137 | |
| 450 | 22 | 45 | 67 | 89 | 112 | |
| 835 | 16 | 33 | 49 | 66 | 82 | |
| 900 | 16 | 32 | 47 | 63 | 79 | |
| 1500 | 12 | 24 | 37 | 49 | 61 | |
| 1900 | 11 | 22 | 33 | 44 | 54 | |
| 2450 | 10 | 19 | 29 | 38 | 48 | |
| 3600 | 8 | 16 | 24 | 32 | 40 | |
| 5200 | 7 | 13 | 20 | 26 | 33 | |
| 5400 | 6 | 13 | 19 | 26 | 32 | |
| 5800 | 6 | 12 | 19 | 25 | 31 | |

Standalone SAR test exclusion considerations

| Band/Mode | F(GHz) | SAR test exclusion threshold (mW) | RF output power | | SAR test exclusion |
|---|---|---|---|---|---|
| | | | dBm | mW | |
| Bluetooth | 2.441 | 10 | 2.71 | 1.87 | YES |
| 2.4GHz WLAN | 2.45 | 10 | 15.91 | 38.99 | NO |
| 5.2GHz WLAN | 5.2&5.3 | 7 | 15.38 | 34.51 | NO |
| 5.5GHz WLAN | 5.5 | 6 | 15.21 | 33.19 | NO |
| 5.8GHz WLAN | 5.8 | 6 | 15.10 | 32.36 | NO |

## 2.7. EUT Configuration and operation conditions for test.


***( EUT: Notebook PC)***

## 2.8. Test Equipments

| Name of equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| ENA Network Analyzer | Keysight | E5080A | MY55100583 | February 12, 2018 |
| Dielectric Probe kit | SPEAG | SM DAK 040 SA | 1155 | NCR |
| DC power supply | Keysight | E36103A | MY55350020 | February 9, 2018 |
| Signal Generator | Rohde & Schwarz | SME06 | 837633\001 | May 16, 2018 |
| BI-Directional Coupler | WERLATONE | C8060-102 | 3423 | February 12, 2018 |
| Peak and Average Power Sensor | Keysight | E9323A | MY55440013 | February 12, 2018 |
| Peak and Average Power Sensor | Keysight | E9323A | MY55420006 | February 12, 2018 |
| Dual Channel PK Power Meter | Keysight | N1912A | MY55416024 | February 12, 2018 |
| Amplifier | CORAD TECHNOLOGY LTD | AMF-4D-00400 600-50-30P | 1983561 | NCR |
| Dosimetric E-Field Probe | SPEAG | EX3DV4 | 7383 | December 26, 2018 |
| Data Acquisition Electronic | SPEAG | DAE3 | 427 | December 08, 2018 |
| Dipole Kit 2.45 GHz | SPEAG | D2450V2 | 977 | January 13, 2018 |
| Dipole Kit 5 GHz | SPEAG | D5GHzV2 | 1231 | January 12, 2018 |
| Software | SPEAG | DASY52 | N/A | NCR |
| Thermometer | Control Company | 4242 | 150709653 | February 12, 2018 |
| Thermometer | VICTOR | VC230 | / | February 12, 2018 |
| Note:NCR means no calibration required(calibrated with system). | | | | |

Note: Dipole antenna calibration interval is 3 year, annual check result to be follow (Refer to KDB 865664, Dipole calibration)

## 2.9. Laboratory Environment

| | |
|---|---|
| Temperature | Min:20℃,Max.25℃ |
| Relative humidity | Min. = 30%, Max. = 70% |
| Note: Ambient noise is checked and found very low and in compliance with requirement of standards. | |

## 2.10. Measurement Uncertainty

| Test Item | Uncertainty |
|---|---|
| Uncertainty for SAR test | 1g: 21.14 |
| | 10g: 20.64 |
| Uncertainty for test site temperature and humidity | 0.6℃ |

| Source | Type | Uncertainly Value (%) | Probability Distribution | K | C1(1g) | C1(10g) | Standard uncertainty ui(%)1g | Standard uncertainty ui(%)10g | Degree of freedom Veff or Vi |
|---|---|---|---|---|---|---|---|---|---|
| **Measurement system repetivity** | A | 0.5 | N | 1 | | 1 | 0.5 | 0.5 | 9 |
| Probe calibration | B | 5.9 | N | 1 | 1 | 1 | 5.9 | 5.9 | ∞ |
| Isotropy | B | 4.7 | R | √3 | 1 | 1 | 2.7 | 2.7 | ∞ |
| Linearity | B | 4.7 | R | √3 | 1 | 1 | 2.7 | 2.7 | ∞ |
| Probe modulation response | B | 0 | R | √3 | 1 | 1 | 0 | 0 | ∞ |
| Detection limits | B | 1.0 | R | √3 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Boundary effect | B | 1.9 | R | √3 | 1 | 1 | 1.1 | 1.1 | ∞ |
| Readout electronics | B | 1.0 | N | 1 | 1 | 1 | 1.0 | 1.0 | ∞ |
| Response time | B | 0 | R | √3 | 1 | 1 | 0 | 0 | ∞ |
| Integration time | B | 4.32 | R | √3 | 1 | 1 | 2.5 | 2.5 | ∞ |
| RF ambient conditions – noise | B | 0 | R | √3 | 1 | 1 | 0 | 0 | ∞ |
| RF ambient conditions – reflections | B | 3 | R | √3 | 1 | 1 | 1.73 | 1.73 | ∞ |
| Probe positioner mech. restrictions | B | 0.4 | R | √3 | 1 | 1 | 0.2 | 0.2 | ∞ |
| Probe positioning with respect to phantom shell | B | 2.9 | R | √3 | 1 | 1 | 1.7 | 1.7 | ∞ |
| Post-processing | B | 0 | R | √3 | 1 | 1 | 0 | 0 | ∞ |
| **Test sample related** | | | | | | | | | |
| Device holder uncertainty | A | 2.94 | N | 1 | 1 | 1 | 2.94 | 2.94 | M-1 |
| Test sample positioning | A | 4.1 | N | 1 | 1 | 1 | 4.1 | 4.1 | M-1 |
| Power scaling | B | 5.0 | R | √3 | 1 | 1 | 2.9 | 2.9 | ∞ |
| Drift of output power (measured SAR drift) | B | 5.0 | R | √3 | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | |
| Phantom uncertainty (shape and thickness tolerances) | B | 4.0 | R | √3 | 1 | 1 | 2.3 | 2.1 | ∞ |
| Algorithm for correcting SAR for deviations in permittivity and conductivity | B | 1.9 | N | 1 | 1 | 0,84 | 1,9 | 1,6 | ∞ |
| Liquid conductivity (meas.) | A | 0.55 | N | 1 | 0.78 | 0.71 | 0.24 | 0.21 | M-1 |
| Liquid permittivity (meas.) | A | 0.19 | N | 1 | 0.23 | 0.26 | 0.09 | 0.06 | M |
| Liquid permittivity – temperature uncertainty | A | 5.0 | R | √3 | 0,78 | 0,71 | 1.4 | 1.1 | ∞ |
| Liquid conductivity – temperature uncertainty | A | 5.0 | R | √3 | 0.23 | 0,26 | 1.2 | 0.8 | ∞ |
| **Combined standard uncertainty** | $u_c' = \sqrt{\sum_{i=1}^{25} c_i^2 u_i^2}$ | | | | | | **10.57** | **10.32** | |
| **Expanded uncertainty (95 % conf. interval)** | $u_e = 2u_c$ | | N | | K=2 | | **21.14** | **20.64** | |

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

| Ingredients (% by weight) | Frequency (MHz) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 450 | | 835 | | 915 | | 1900 | | 2450 | |
| Tissue Type | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 38.56 | 51.16 | 41.45 | 52.4 | 41.05 | 56.0 | 54.9 | 40.4 | 62.7 | 73.2 |
| Salt (NaCl) | 3.95 | 1.49 | 1.45 | 1.4 | 1.35 | 0.76 | 0.18 | 0.5 | 0.5 | 0.04 |
| Sugar | 56.32 | 46.78 | 56.0 | 45.0 | 56.5 | 41.76 | 0.0 | 58.0 | 0.0 | 0.0 |
| HEC | 0.98 | 0.52 | 1.0 | 1.0 | 1.0 | 1.21 | 0.0 | 1.0 | 0.0 | 0.0 |
| Bactericide | 0.19 | 0.05 | 0.1 | 0.1 | 0.1 | 0.27 | 0.0 | 0.1 | 0.0 | 0.0 |
| Triton X-100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 36.8 | 0.0 |
| DGBE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 44.92 | 0.0 | 0.0 | 26.7 |
| Dielectric Constant | 43.42 | 58.0 | 42.54 | 56.1 | 42.0 | 56.8 | 39.9 | 54.0 | 39.8 | 52.5 |
| Conductivity (S/m) | 0.85 | 0.83 | 0.91 | 0.95 | 1.0 | 1.07 | 1.42 | 1.45 | 1.88 | 1.78 |

Salt: 99+% Pure Sodium Chloride  Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity  HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

**Simulating Liquids for 5 GHz, Manufactured by SPEAG**

| Ingredients | (% by weight) |
|---|---|
| Water | 78 |
| Mineral oil | 11 |
| Emulsifiers | 9 |
| Additives and Salt | 2 |

# 3. MEASURE PROCEDURES

## 3.1. General description of test procedures

For the 802.11a/b/g SAR body tests, a communication link is set up with the test mode software for WIFI mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate. Testing at higher data rates is not required when the maximum average output power is less than 0.25dB higher than those measured at the lowest data rate.

802.11b/g operating modes are tested independently according to the service requirements in each frequency band.802.11b/g modes are tested on channels1,6,11;however,if output power reduction is necessary for channels 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels must be tested instead.

SAR is not required for 802.11g channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels. When the maximum average output channel in each frequency band is not included in the “default test channels”, the maximum channel should be tested instead of an adjacent “default test channels”, these are referred to as the “required test channels” and are illustrated in table 1.

Please apply the following guidance for SAR testing:

1. Please use a 0 mm (touching) test separation distance on the flat phantom during SAR testing of this device. This separation distance is based on the guidance found in FCC KDB Publication 447498 D01, Section 5.2.3 3)
2. Please utilize a body tissue simulating liquid (TSL) of the appropriate frequency during SAR testing.
3. Please use the guidance found in FCC KDB Publication 447498 D01 to determine which sides of the device need to be tested for SAR.
4. FCC KDB Publication 248227 D01 should be used for selection of the WiFi channels, data rates, etc.

# 4. SAR MEASUREMENTS SYSTEM

## 4.1. SAR Measurement Set-up

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

(1) A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
(2) A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage It issue simulating liquid. The probe is equipped with an optical surface detector system.
(3) A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
(4) A unit to operate the optical surface detector which is connected to the EOC.
(5) The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
(6) The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.
(7) DASY5 software and SEMCAD data evaluation software.
(8) Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
(9) The generic twin phantom enabling the testing of left-hand and right-hand usage.
(10) The device holder for handheld mobile phones.
(11) Tissue simulating liquid mixed according to the given recipes.
(12) System validation dipoles allowing to validate the proper functioning of the system.

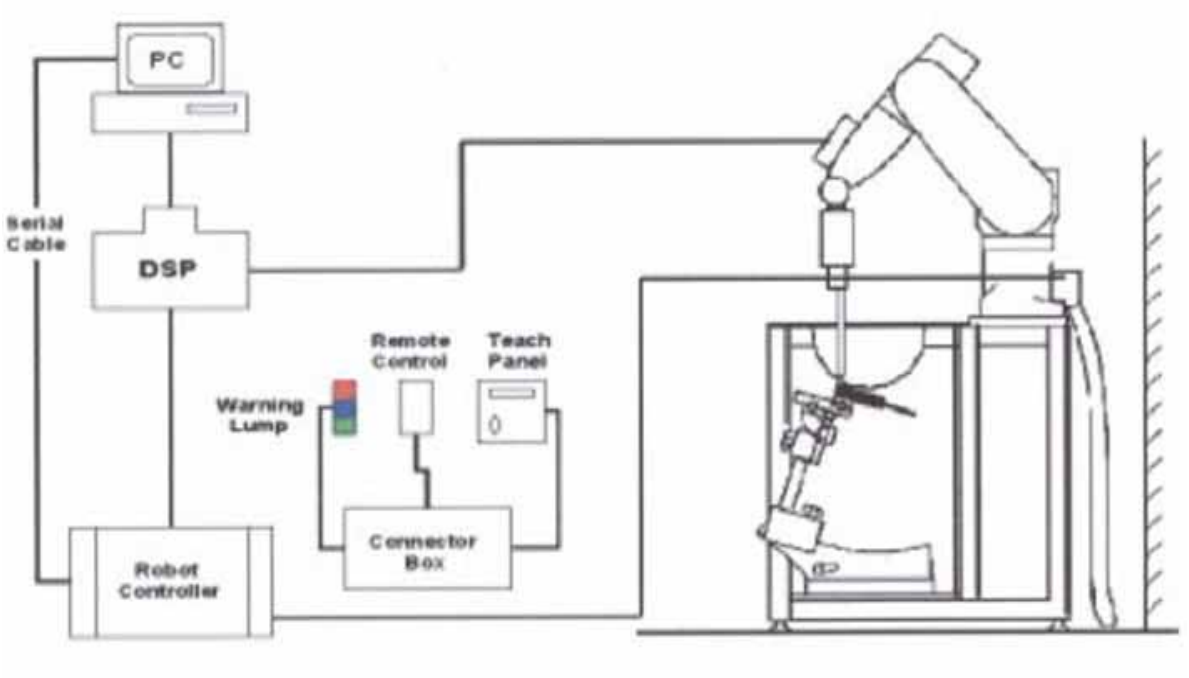



**Figure 4.1 SAR Lab Test Measurement Set-up**

## 4.2. ELI Phantom

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

| | |
|---|---|
| Material | Vinylester, glass fiber reinforced (VE-GF) |
| Liquid Compatibility | Compatible with all SPEAG tissue simulating liquids (incl. DGBE type) |
| Shell Thickness | 2.0 ± 0.2 mm (bottom plate) |
| Dimensions | Major axis: 600 mm<br>Minor axis: 400 mm |
| Filling Volume | approx. 30 liters |
| Wooden Support | SPEAG standard phantom table |

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.

**Figure 6.2 Top View of Twin Phantom**

A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters.

On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

The phantom can be used with the following tissue simulating liquids:

*Water-sugar based liquid
*Glycol based liquids

## 4.3. Device Holder for SAM Twin Phantom

The SAR in the Phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source in 5 mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ± 20%. An accurate device position is therefore crucial for accurate and repeatable measurement. The position in which the devices must be measured, are defined by the standards.
The DASY5 device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (EPR).
Thus the device needs no repositioning when changing the angles.

The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permitti $\varepsilon_r$ =3 and loss tange $\delta$ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

**Figure 4.3 Device Holder**

## 4.4. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangul -ar configuration and optimized for dosimetric evaluation.

**Figure 4.4 EX3DV4 E-field Probe**

### 4.4.1. EX3DV4 Probe Specification

| | |
|---|---|
| Construction | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | ISO/IEC 17025 calibration service available |
| Frequency | 10 MHz to > 6 GHz<br>Linearity: ± 0.2 dB<br>(30 MHz to 6 GHz) |
| Directivity | ± 0.3 dB in HSL (rotation around probe axis)<br>± 0.5 dB in tissue material (rotation normal to probe axis) |
| Dynamic Range | 10 µW/g to > 100 mW/g Linearity:<br>± 0.2dB (noise: typically < 1 µW/g) |
| Dimensions | Overall length: PRS-T2 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers:<br>1 mm |
| Application | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%. |

## 4.5. E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than ±10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$\mathbf{SAR} = \mathbf{C}\frac{\Delta T}{\Delta t}$$

Where: $\Delta t$ = Exposure time (30 seconds),
C = Heat capacity of tissue (brain or muscle),
$\Delta T$ = Temperature increase due to RF exposure.
Or

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

Where:
$\sigma$ = Simulated tissue conductivity,
$\rho$ = Tissue density (kg/m3).

## 4.6. Scanning procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The ”reference“ and ”drift“ measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure.The indicated drift is mainly the variation of the EUT’s output power and should vary max. ± 5 %.

The ”surface check“ measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles.

The difference between the optical surface detection and the actual surface depends on the Probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

**Area Scan**

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged.

After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

**Zoom Scan**

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

**Spatial Peak Detection**

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

- · maximum search
- · extrapolation
- · boundary correction
- · peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space.They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

# 5. DATA STORAGE AND EVALUATION

## 5.1. Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for thedata evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

## 5.2. Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

| | | |
|---|---|---|
| Probe parameters: | - Sensitivity | Normi, ai0, ai1, ai2 |
| | - Conversion factor | ConvFi |
| | - Diode compression point | Dcpi |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | |
| | - Density | |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$Vi = Ui + Ui2 \cdot c\,f / d\,c\,pi$$

With ***Vi*** = compensated signal of channel i ( i = x, y, z )

***Ui*** = input signal of channel i ( i = x, y, z )

***cf*** = crest factor of exciting field (DASY parameter)

***dcp*i** = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes: ***Ei = ( Vi / Normi · ConvF )1/2***

H-field probes: ***Hi = ( Vi )1/2 · ( ai0 + ai1 f + ai2f2 ) / f***

With ***Vi*** = compensated signal of channel i (i = x, y, z)

***Normi*** = sensor sensitivity of channel i (i = x, y, z)

***ConvF*** = sensitivity enhancement in solution

***aij*** = sensor sensitivity factors for H-field probes

***f*** = carrier frequency [GHz]

***Ei*** = electric field strength of channel i in V/m

***Hi*** = magnetic field strength of channel i in A/m

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

***Etot = (Ex2+ EY2+ Ez2)1/2***

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

***SAR = ( Etot2· ) / ( · 1000)*** with

***SAR*** = local specific absorption rate in mW/g

***Etot*** = total field strength in V/m

= conductivity in [mho/m] or [Siemens/m]

= equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

***Ppwe*** = *Etot2 / 3770* or ***Ppwe = Htot2 · 37.7***

with ***Ppwe*** = equivalent power density of a plane wave in mW/cm2

***Etot*** = total electric field strength in V/m

***Htot*** = total magnetic field strength in A/m

# 6. SYSTEM CHECK

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates were measured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulates, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system check results (dielectric parameters and SAR values) are given in the ANNEX A.

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.

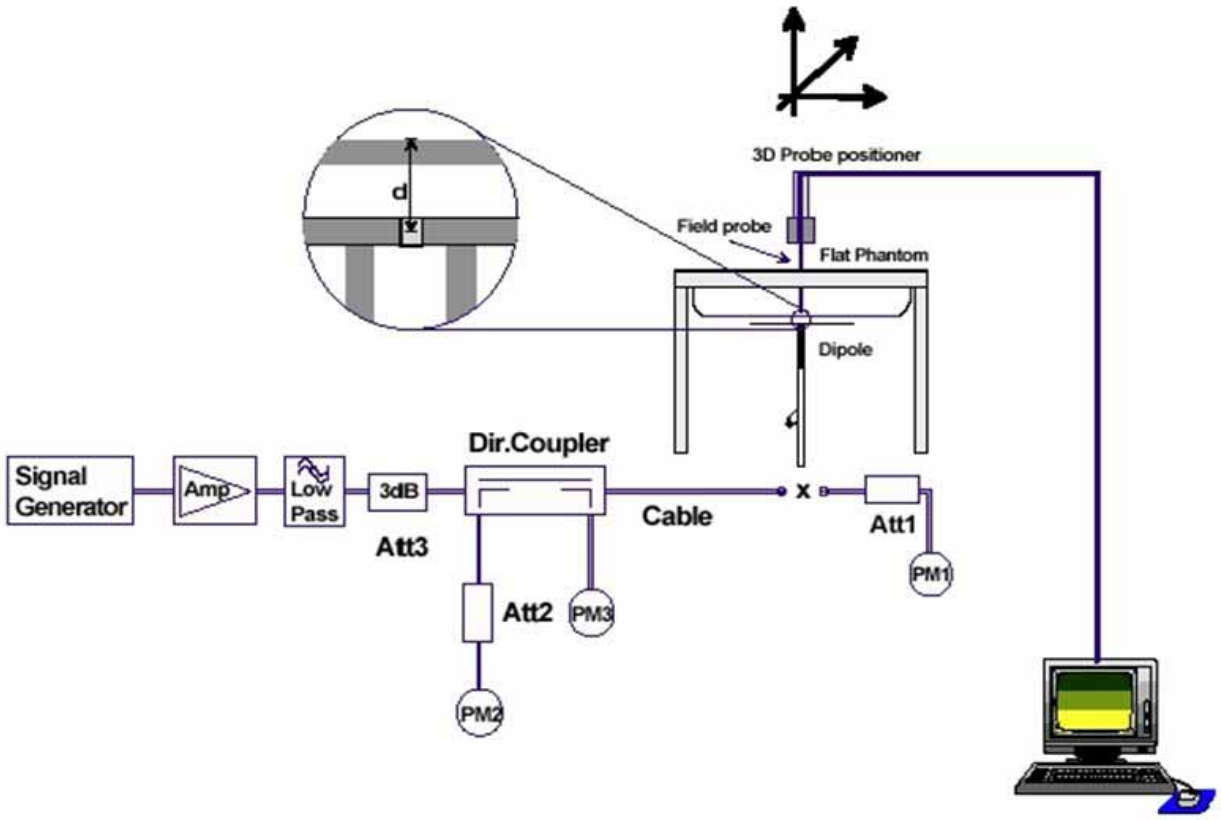



**Figure 6.1: System Check Set-up**

# 7. TEST RESULTS

## 7.1. Duty Cycle

| Duty Cycle | |
|---|---|
| 2.4GHz | 99.36% |
| 5GHz Band 1 | 96.41% |
| 5GHz Band 2 | 96.09% |
| 5GHz Band 3 | 96.97% |
| 5GHz Band 4 | 96.00% |

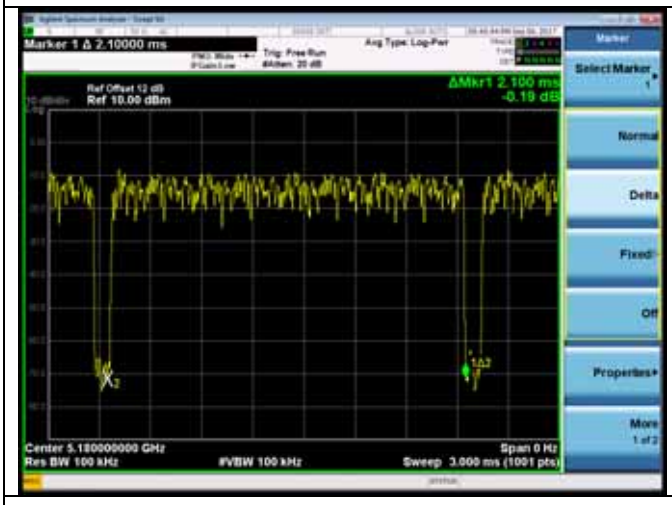
Note: Please see the duty cycle test plot in next page.

**2.4GHz:**



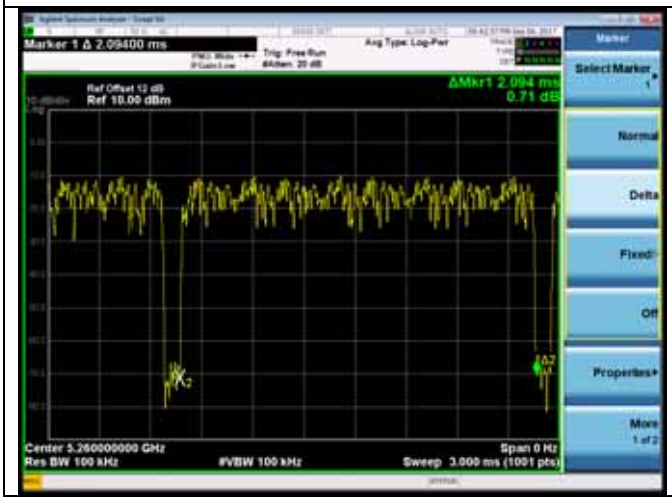
**5GHz:**

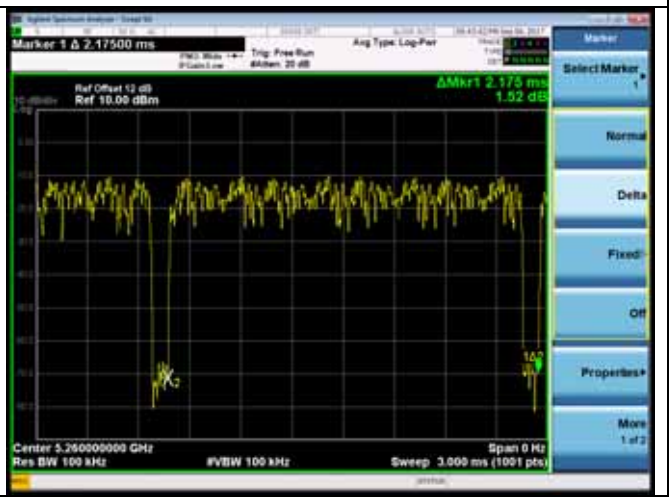
Band 1



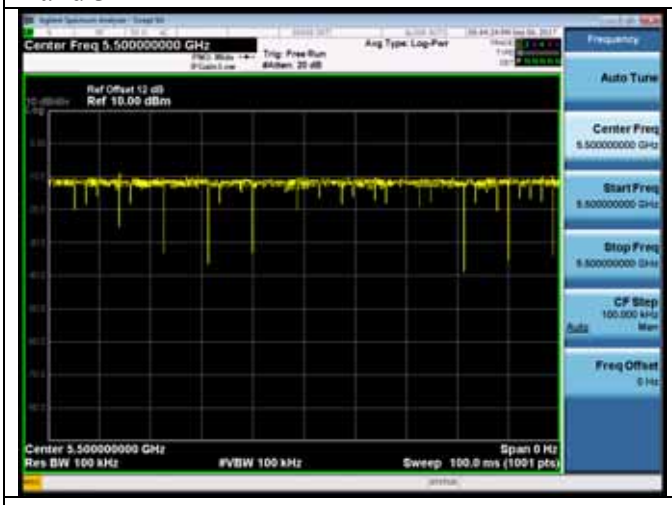


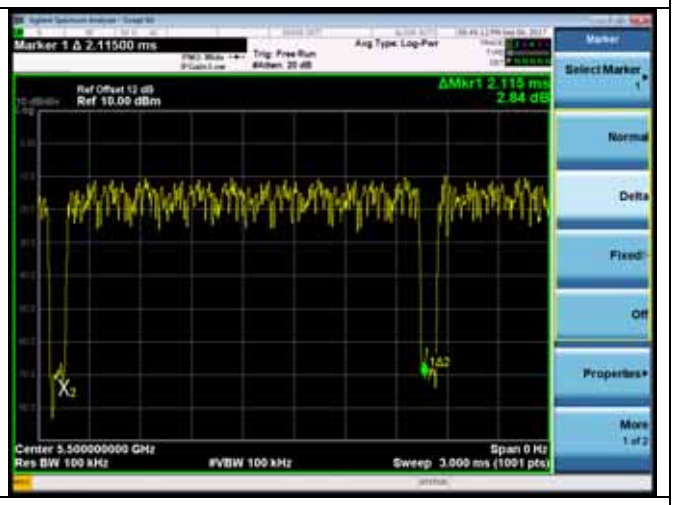
Band 2



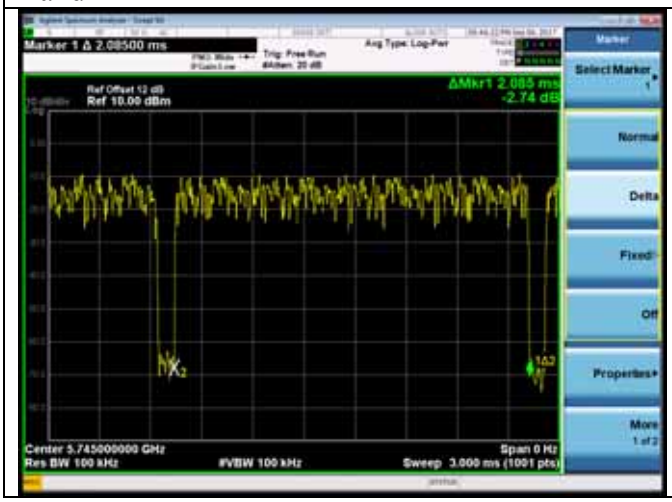



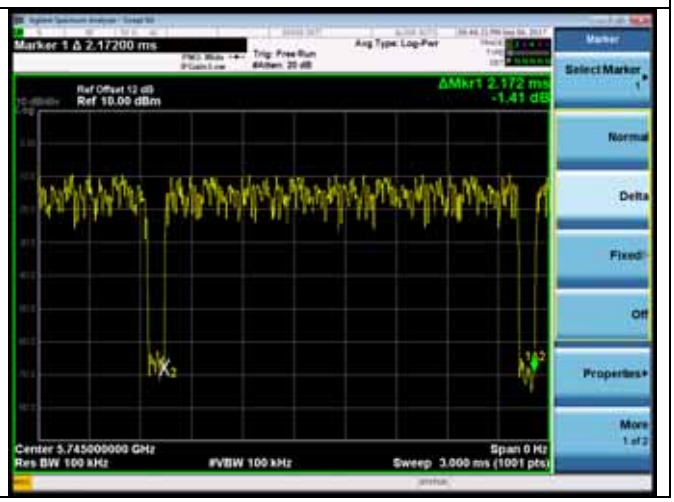
Band 3




Band 4



## 7.2. Output power

(BT 3.0)

| Test Mode | Frequency (MHz) | Output Power ( dBm ) |
|---|---|---|
| GFSK | 2402 | 2.10 |
| | 2441 | 2.14 |
| | 2480 | 2.09 |
| 8-DPSK | 2402 | 2.71 |
| | 2441 | 2.34 |
| | 2480 | 2.42 |

(BT 4.1)

| Test Mode | Frequency (MHz) | Output Power ( dBm ) |
|---|---|---|
| GFSK | 2402 | -1.274 |
| | 2440 | -0.659 |
| | 2480 | -0.567 |

(WIFI 2.4G)

| Test Mode | CH | Output Power ( dBm ) | |
|---|---|---|---|
| | | ANT 0 | ANT 1 |
| 11b | CH1 | 15.91 | 14.96 |
| | CH6 | 15.45 | 15.48 |
| | CH11 | 15.64 | 15.83 |
| 11g | CH1 | 14.87 | 14.27 |
| | CH6 | 14.45 | 14.56 |
| | CH11 | 14.75 | 15.04 |
| 11n HT20 | CH1 | 10.75 | 11.17 |
| | CH6 | 10.13 | 11.76 |
| | CH11 | 10.64 | 12.26 |
| 11n HT40 | CH3 | 10.53 | 11.32 |
| | CH6 | 10.02 | 11.48 |
| | CH9 | 10.22 | 11.82 |

**Notes:**

1. Use the data rate with the maximum output level for the SAR test.
2. BT and WIFI can't transmit at same time.

(WIFI 5GHz)
Band 1

| Test Mode | Frequency ( MHz ) | Output Power ( dBm ) | |
|---|---|---|---|
| | | ANT 0 | ANT 1 |
| 11a | 5180 | 14.81 | 15.38 |
| | 5200 | 14.51 | 15.06 |
| | 5240 | 14.34 | 14.36 |
| 11n HT20 | 5180 | 10.80 | 11.24 |
| | 5200 | 10.53 | 10.89 |
| | 5240 | 10.19 | 10.40 |
| 11n HT40 | 5190 | 10.65 | 10.92 |
| | 5230 | 10.62 | 10.28 |
| 11ac VHT20 | 5180 | 8.55 | 8.98 |
| | 5200 | 8.18 | 8.74 |
| | 5240 | 8.26 | 8.25 |
| 11ac VHT40 | 5190 | 8.66 | 8.98 |
| | 5230 | 8.47 | 8.34 |
| 11ac VHT80 | 5210 | 8.47 | 9.05 |

Band 2

| Test Mode | Frequency ( MHz ) | Output Power ( dBm ) | |
|---|---|---|---|
| | | ANT 0 | ANT 1 |
| 11a | 5260 | 15.00 | 14.89 |
| | 5300 | 14.19 | 14.08 |
| | 5320 | 14.24 | 14.06 |
| 11n HT20 | 5260 | 10.89 | 11.01 |
| | 5300 | 10.38 | 10.38 |
| | 5320 | 10.44 | 10.37 |
| 11n HT40 | 5270 | 10.69 | 11.20 |
| | 5310 | 10.32 | 10.76 |
| 11ac VHT20 | 5260 | 8.52 | 8.95 |
| | 5300 | 8.40 | 8.31 |
| | 5320 | 8.45 | 8.44 |
| 11ac VHT40 | 5270 | 8.85 | 9.19 |
| | 5310 | 8.42 | 8.71 |
| 11ac VHT80 | 5290 | 8.58 | 8.95 |

Band 3

| Test Mode | Frequency ( MHz ) | Output Power ( dBm ) | |
|---|---|---|---|
| | | ANT 0 | ANT 1 |
| 11a | 5500 | 15.12 | 14.27 |
| | 5600 | 15.21 | 14.98 |
| | 5700 | 14.47 | 14.61 |
| 11n HT20 | 5500 | 10.54 | 10.30 |
| | 5600 | 10.87 | 10.91 |
| | 5700 | 10.86 | 10.81 |
| 11n HT40 | 5510 | 10.42 | 10.51 |
| | 5590 | 10.85 | 11.24 |
| | 5670 | 10.45 | 11.39 |
| 11ac VHT20 | 5500 | 8.57 | 8.40 |
| | 5600 | 8.92 | 8.99 |
| | 5700 | 8.57 | 8.90 |
| 11ac VHT40 | 5510 | 8.49 | 8.72 |
| | 5590 | 8.96 | 9.31 |
| | 5670 | 8.57 | 9.59 |
| 11ac VHT80 | 5530 | 8.69 | 8.85 |
| | 5610 | 8.90 | 9.47 |

Band 4

| Test Mode | Frequency ( MHz ) | Output Power ( dBm ) | |
|---|---|---|---|
| | | ANT 0 | ANT 1 |
| 11a | 5745 | 15.03 | 15.10 |
| | 5785 | 14.79 | 14.75 |
| | 5825 | 14.22 | 14.02 |
| 11n HT20 | 5745 | 10.49 | 11.15 |
| | 5785 | 10.17 | 10.59 |
| | 5825 | 9.56 | 9.91 |
| 11n HT40 | 5755 | 10.23 | 10.95 |
| | 5795 | 10.40 | 10.22 |
| 11ac VHT20 | 5745 | 8.56 | 8.74 |
| | 5785 | 8.26 | 8.15 |
| | 5825 | 7.63 | 7.48 |
| 11ac VHT40 | 5755 | 8.34 | 8.81 |
| | 5795 | 8.01 | 8.24 |
| 11ac VHT80 | 5775 | 8.27 | 8.78 |

**Notes:**

1. Use the data rate with the maximum output level for the SAR test.
2. BT and WIFI can't transmit at same time.

## 7.3. System Check for Body Tissue simulating liquid

| Frequency | Description | SAR(W/kg) (±18.8% for 2450 MHz window) (±24.4% for 5250/5600/5750 MHz window) | | Dielectric Parameters (±5% window) | | Temp |
|---|---|---|---|---|---|---|
| | | 1g | 10g | εr | σ(s/m) | ℃ |
| 2450MH | Recommended value | 12.9<br>10.47 — 15.33 | 5.94<br>4.83 — 6.45 | 52.7 | 1.95 | / |
| | Measurement value 2017-09-08 | 12.5 | 5.84 | 52.327 | 1.99 | 22.01 |
| 5250MHz | Recommended value | 7.62<br>5.76— 9.49 | 2.15<br>1.63 — 2.67 | 47.88 | 5.446 | / |
| | Measurement value 2017-09-08 | 8.66 | 2.65 | 48.79 | 5.33 | 22.11 |
| 5600MHz | Recommended value | 7.97<br>6.03 — 9.14 | 2.23<br>1.69— 2.77 | 47.31 | 5.798 | / |
| | Measurement value 2017-09-08 | 8.25 | 2.49 | 48.71 | 5.68 | 22.07 |
| 5750MHz | Recommended value | 7.48<br>5.65 — 9.31 | 2.11<br>1.60— 2.62 | 47.23 | 5.879 | / |
| | Measurement value 2017-09-08 | 7 | 2.13 | 48.12 | 5.83 | 22.13 |

**Note:** Recommended Values used derive from the calibration certificate and 250 mW is used as feeding power to the calibrated dipole.

## 7.4. Test Results

**WIFI 2.4G:**
**ANT 0:**

| Mode | Channel | Test Position | Output Power | | Measured Results | | Scaled-1 | | Scaled-Final | | Power Drift (dBm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max. Scaled AV Power (dBm) | Measured AV Power (dBm) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg) | SAR10g (W/kg ) | |
| 11b | CH1 | Screen Back | 16.00 | 15.91 | 0.579 | 0.307 | 0.591 | 0.313 | 0.595 | 0.315 | -0.06 |
| | | Bottom | | | 0.711 | 0.490 | 0.726 | 0.500 | 0.731 | 0.503 | 0.13 |
| Conclusion: PASS | | | | | | | | | | | |
| Note :<br>Factor= Max. Scaled AV Power(W)/Measured Power(W)<br>Scaled SAR-1= Measured SAR*Factor<br>Scaled-Final= Scaled SAR-1*(1/Duty Cycle)<br>The Max.Reported SAR : 0.731**W/kg for 1g SAR** | | | | | | | | | | | |

**ANT 1:**

| Mode | Channel | Test Position | Output Power | | Measured Results | | Scaled-1 | | Scaled-Final | | Power Drift (dBm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max. Scaled AV Power (dBm) | Measured AV Power (dBm) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg) | SAR10g (W/kg ) | |
| 11b | CH11 | Screen Back | 16.00 | 15.83 | 0.737 | 0.392 | 0.766 | 0.408 | 0.771 | 0.410 | -0.20 |
| | | Bottom | | | 0.669 | 0.443 | 0.696 | 0.461 | 0.700 | 0.464 | 0.19 |
| Conclusion: PASS | | | | | | | | | | | |
| Note :<br>Factor= Max. Scaled AV Power(W)/Measured Power(W)<br>Scaled SAR-1= Measured SAR*Factor<br>Scaled-Final= Scaled SAR-1*(1/Duty Cycle)<br>The Max.Reported SAR : 0.771**W/kg for 1g SAR** | | | | | | | | | | | |

**Notes:**
1. The Max. Scaled AV power get from measured AV power base on the duty cycle.
2. For 11b, 11g, 11n HT20 mode, choose the channel which has the max output level for test, because the test result is less then 0.8W/kg and Max. Scaled SAR<1.2W/kg, so other channel can be excluded from SAR test.

**WIFI 5G:**
**ANT 0:**

| Mode | Channel | Test Position | Output Power | | Measured Results | | Scaled-1 | | Scaled-Final | | Power Drift (dBm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max. Scaled AV Power (dBm) | Measured AV Power (dBm) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg) | SAR10g (W/kg ) | |
| 11a | CH36 | Screen Back | 15.00 | 14.81 | 0.662 | 0.386 | 0.692 | 0.403 | 0.717 | 0.418 | -0.09 |
| | | Bottom | | | 0.632 | 0.359 | 0.660 | 0.375 | 0.685 | 0.389 | 0.12 |
| | CH52 | Screen Back | 15.00 | 15.00 | 0.200 | 0.075 | 0.200 | 0.075 | 0.208 | 0.075 | 0.03 |
| | | Bottom | | | 0.686 | 0.344 | 0.686 | 0.344 | 0.714 | 0.358 | 0.11 |
| | CH60 | Screen Back | 14.50 | 14.19 | 0.576 | 0.222 | 0.619 | 0.238 | 0.644 | 0.248 | 0.17 |
| | | Bottom | | | 0.657 | 0.390 | 0.706 | 0.419 | 0.734 | 0.436 | 0.14 |
| | CH112 | Screen Back | 14.50 | 14.07 | 0.363 | 0.149 | 0.401 | 0.365 | 0.413 | 0.170 | 0.02 |
| | | Bottom | | | 0.684 | 0.347 | 0.731 | 0.371 | 0.754 | 0.395 | 0.11 |
| | CH120 | Screen Back | 15.50 | 15.21 | 0.345 | 0.137 | 0.369 | 0.146 | 0.380 | 0.151 | 0.13 |
| | | Bottom | | | 0.708 | 0.260 | 0.757 | 0.278 | 0.781 | 0.287 | 0.04 |
| | CH149 | Screen Back | 15.50 | 15.03 | 0.387 | 0.158 | 0.431 | 0.176 | 0.449 | 0.183 | 0.17 |
| | | Bottom | | | 0.679 | 0.323 | 0.757 | 0.360 | 0.788 | 0.375 | -0.17 |
| | CH165 | Screen Back | 14.50 | 14.22 | 0.387 | 0.159 | 0.413 | 0.170 | 0.430 | 0.177 | 0.03 |
| | | Bottom | | | 0.685 | 0.331 | 0.731 | 0.353 | 0.761 | 0.368 | 0.10 |
| Conclusion: PASS | | | | | | | | | | | |
| Note :<br>Factor= Max. Scaled AV Power(W)/Measured Power(W)<br>Scaled SAR-1= Measured SAR*Factor<br>Scaled-Final= Scaled SAR-1*(1/Duty Cycle)<br>The Max.Reported SAR : 0.788**W/kg for 1g SAR** | | | | | | | | | | | |

**ANT 1:**

| Mode | Channel | Test Position | Output Power | | Measured Results | | Scaled-1 | | Scaled-Final | | Power Drift (dBm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max. Scaled AV Power (dBm) | Measured AV Power (dBm) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg ) | SAR10g (W/kg ) | SAR1g (W/kg) | SAR10g (W/kg ) | |
| 11a | CH36 | Screen Back | 15.50 | 15.38 | 0.747 | 0.316 | 0.768 | 0.325 | 0.797 | 0.337 | 0.11 |
| | | Bottom | | | 0.701 | 0.351 | 0.721 | 0.361 | 0.747 | 0.374 | -0.07 |
| | CH52 | Screen Back | 15.00 | 14.89 | 0.183 | 0.077 | 0.188 | 0.079 | 0.195 | 0.082 | -0.13 |
| | | Bottom | | | 0.460 | 0.147 | 0.472 | 0.151 | 0.491 | 0.157 | 0.05 |
| | CH60 | Screen Back | 14.50 | 14.08 | 0.184 | 0.080 | 0.203 | 0.088 | 0.211 | 0.092 | 0.20 |
| | | Bottom | | | 0.426 | 0.143 | 0.469 | 0.158 | 0.488 | 0.164 | 0.12 |
| | CH112 | Screen Back | 14.50 | 14.05 | 0.308 | 0.152 | 0.342 | 0.169 | 0.352 | 0174 | 0.10 |
| | | Bottom | | | 0.114 | 0.063 | 0.126 | 0.070 | 0.130 | 0.072 | 0.18 |
| | CH120 | Screen Back | 15.00 | 14.98 | 0.289 | 0.128 | 0.290 | 0.129 | 0.299 | 0.133 | 0.13 |
| | | Bottom | | | 0.361 | 0.212 | 0.363 | 0.213 | 0.374 | 0.220 | 0.17 |
| | CH149 | Screen Back | 15.50 | 15.10 | 0.253 | 0.121 | 0.277 | 0.133 | 0.289 | 0.138 | 0.15 |
| | | Bottom | | | 0.390 | 0.267 | 0.428 | 0.293 | 0.445 | 0.305 | 0.11 |
| | CH165 | Screen Back | 14.50 | 14.02 | 0.248 | 0.122 | 0.277 | 0.136 | 0.289 | 0.142 | 0.14 |
| | | Bottom | | | 0.417 | 0.280 | 0.466 | 0.313 | 0.485 | 0.326 | -0.19 |
| Conclusion: PASS | | | | | | | | | | | |
| Note :<br>Factor= Max. Scaled AV Power(W)/Measured Power(W)<br>Scaled SAR-1= Measured SAR*Factor<br>Scaled-Final= Scaled SAR-1*(1/Duty Cycle)<br>The Max.Reported SAR : 0.797**W/kg for 1g SAR** | | | | | | | | | | | |

**Notes:**

1. The Max. Scaled AV power get from measured AV power base on the duty cycle.
2. 11a mode has the Max. output power can pare with other mode.
3. For 11a mode, choose the channel which has the max output level for test, because the test result is less then 0.8W/kg, so other channel can be excluded from SAR test.
4. The SAR Evaluation for simultaneously can be excluded since ANT0 Max. SAR+ ANT1 Max. SAR less than 1.6W/kg.

## 7.5. Dielectric Performance for Body Tissue simulating liquid

| Frequency | Description | Dielectric Parameters (±5% window) | | Temp |
|---|---|---|---|---|
| | | εr | σ(s/m) | ℃ |
| 2450MH | Recommended value | 52.7 | 1.95 | / |
| | Measurement value 2017-09-08 | 52.327 | 1.99 | 22.01 |
| 5250MHz | Recommended value | 47.88 | 5.446 | / |
| | Measurement value 2017-09-08 | 48.79 | 5.33 | 22.11 |
| 5600MHz | Recommended value | 47.31 | 5.798 | / |
| | Measurement value 2017-09-08 | 48.71 | 5.68 | 22.07 |
| 5750MHz | Recommended value | 47.23 | 5.879 | / |
| | Measurement value 2017-09-08 | 48.12 | 5.83 | 22.13 |

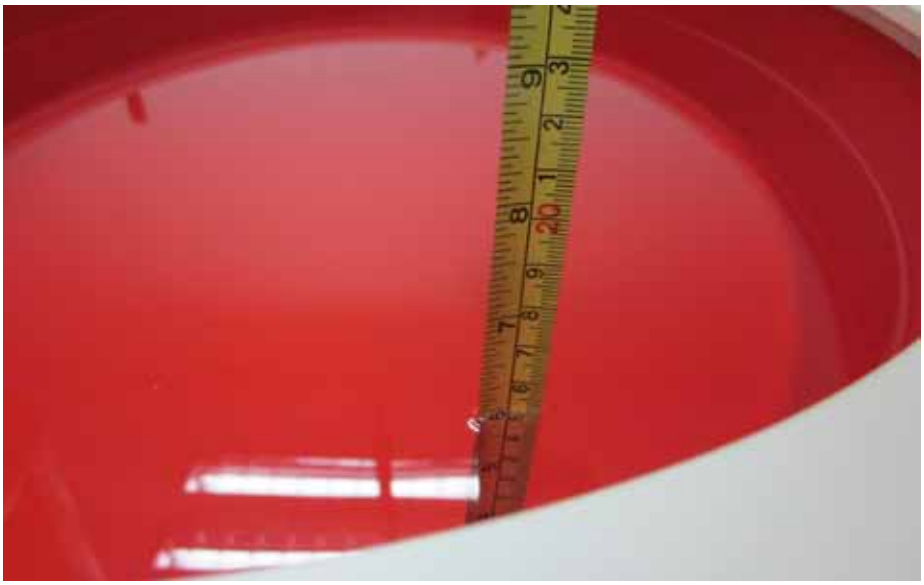


**Figure 4.4: Liquid depth in the Flat Phantom**

# 8. ANNEX A: SYSTEM CHECK RESULTS

Date/Time: 08/09/2017 15:40:17

**CW 2450**

**DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:977**

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 2450 MHz; $\sigma$ = 1.99 S/m; $\varepsilon_r$ = 52.327; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(7.35, 7.35, 7.35);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CW 2450MHz/Area Scan (61x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 16.6 W/kg

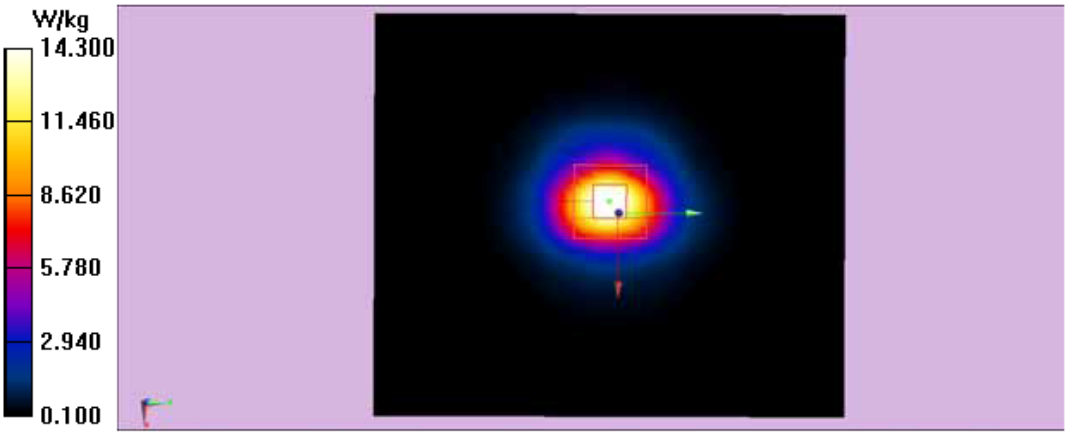
**Configuration/CW 2450MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 79.77 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 25.7 W/kg

**SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.84 W/kg**

Maximum value of SAR (measured) = 14.3 W/kg



Date/Time: 08/09/2017 11:34:36

**CW 5250**

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1231**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5250 MHz;Communication System PAR: 0 dB

Medium parameters used (interpolated): f = 5250 MHz; $\sigma$ = 5.33 S/m; $\varepsilon_r$ = 48.79; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.44, 5.44, 5.44);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CW 5250MHz/Area Scan (61x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 7.37 W/kg

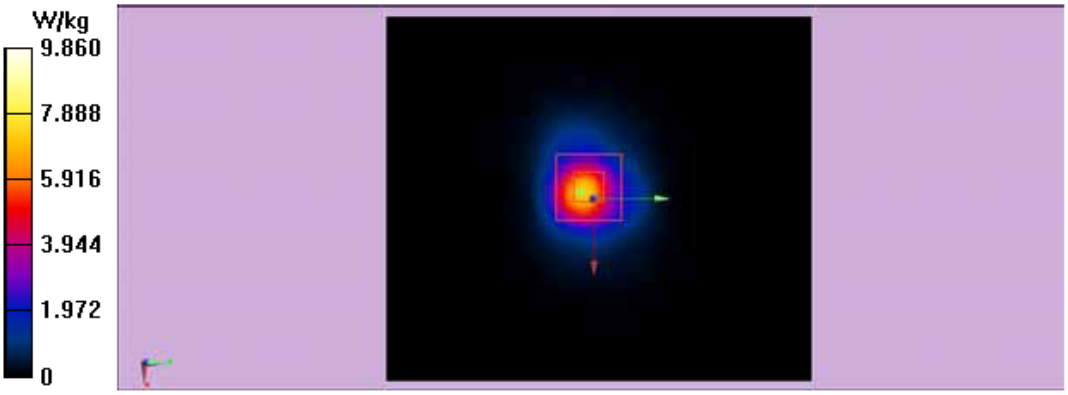
**Configuration/CW 5250MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 42.21 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.9 W/kg

**SAR(1 g) = 8.66 W/kg; SAR(10 g) = 2.65 W/kg**

Maximum value of SAR (measured) = 9.86 W/kg



Date/Time: 08/09/2017 13:19:01

**CW 5600**

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1231**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5600 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5600 MHz; $\sigma$ = 5.68 S/m; $\varepsilon_r$ = 48.71; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CW 5600MHz/Area Scan (61x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 6.99 W/kg

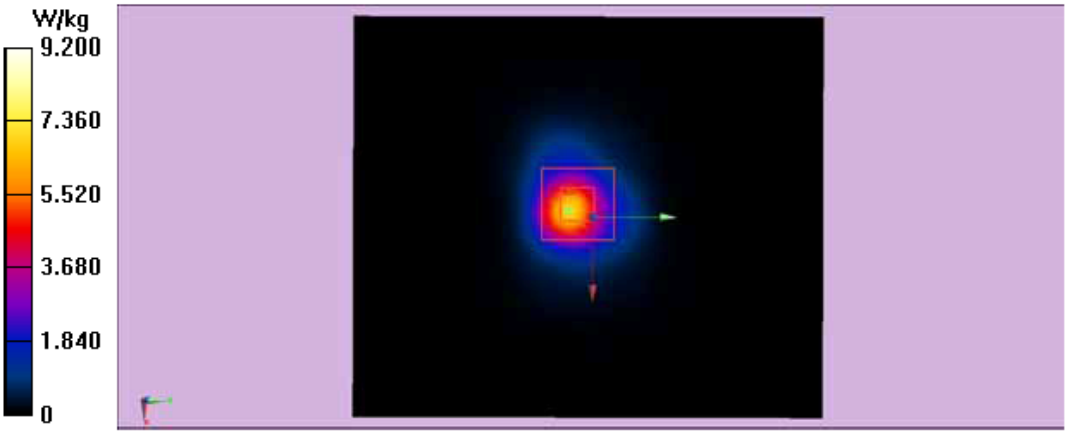
**Configuration/CW 5600MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 37.57 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.7 W/kg

**SAR(1 g) = 8.25 W/kg; SAR(10 g) = 2.49 W/kg**

Maximum value of SAR (measured) = 9.20 W/kg



Date/Time: 08/09/2017 13:43:22

**CW 5750**

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1231**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5750 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5750 MHz; $\sigma$ = 5.83 S/m; $\varepsilon_r$ = 48.12; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CW 5750MHz/Area Scan (61x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 5.92 W/kg

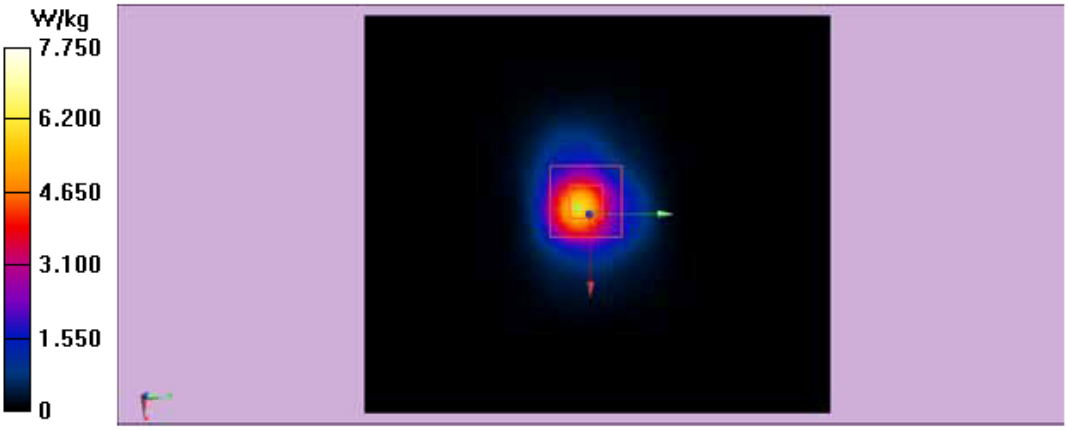
**Configuration/CW 5750MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 33.99 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 23.9 W/kg

**SAR(1 g) = 7 W/kg; SAR(10 g) = 2.13 W/kg**

Maximum value of SAR (measured) = 7.75 W/kg



# 9. ANNEX B: GRAPH RESULTS WITH BANDS OF WATCH

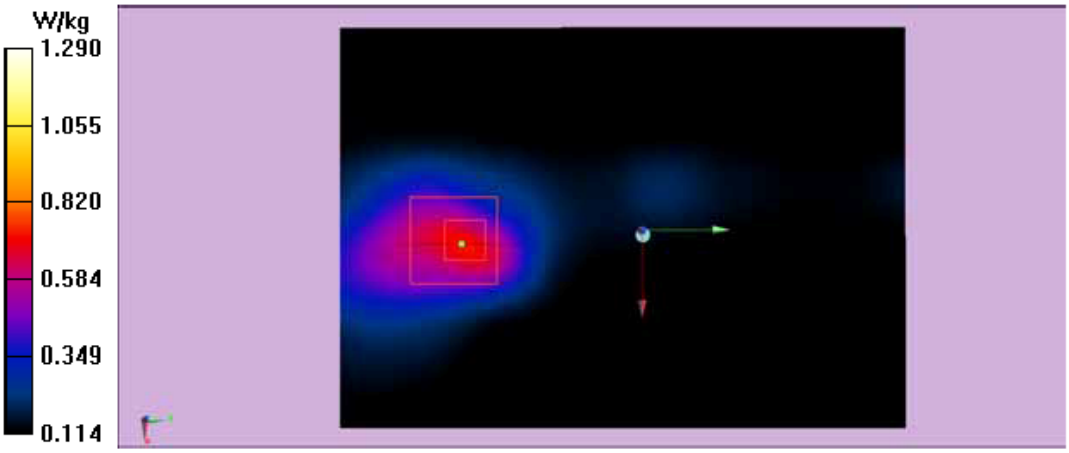
**WIFI 2.4G**
**ANT 0:**

Date: 07/09/2017

**11b CH1(2412MHz Bottom)**
**EUT: Notebook M/N: RZ09-0239**
Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) (0);
Communication System Band: ISM 2.4GHz Band (2400.0-2483.5MHz); Frequency: 2412 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 2412 MHz; $\sigma$ = 1.931 S/m; $\varepsilon_r$ = 56.485; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(7.35, 7.35, 7.35); Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH1(2412MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 0.729 W/kg
**Configuration/CH1(2412MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.39 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 3.21 W/kg
**SAR(1 g) = 0.711 W/kg; SAR(10 g) = 0.490 W/kg**
Maximum value of SAR (measured) = 1.29 W/kg



Date: 07/09/2017

**11b CH1(2412MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) (0); Communication System Band: ISM 2.4GHz Band (2400.0-2483.5MHz); Frequency: 2412 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 2412 MHz; $\sigma$ = 1.931 S/m; $\varepsilon_r$ = 56.485; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(7.35, 7.35, 7.35); Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH1(2412MHz Screen Back)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.574 W/kg

**Configuration/CH1(2412MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

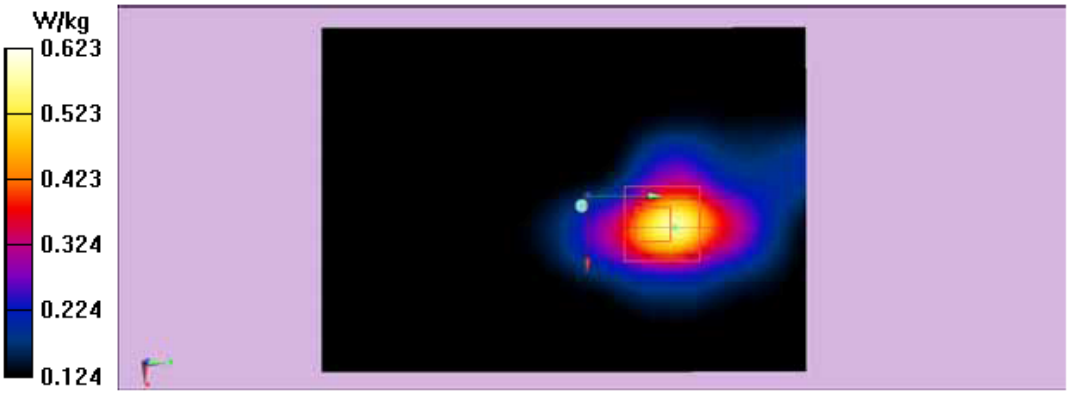
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.062 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 1.49 W/kg

**SAR(1 g) = 0.579 W/kg; SAR(10 g) = 0.307 W/kg**

Maximum value of SAR (measured) = 0.623 W/kg



**WIFI 2.4G**
**ANT 1:**

Date: 07/09/2017

**11b CH11(2462MHz Bottom)**

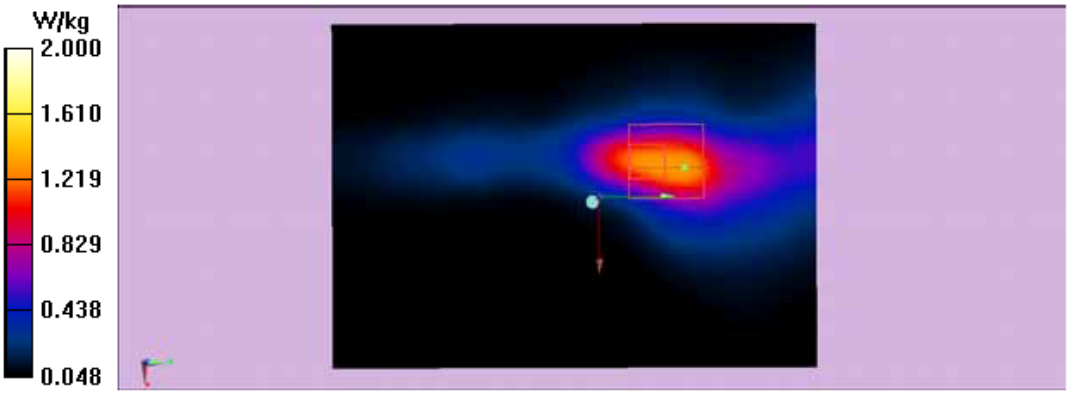
**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) (0);
Communication System Band: ISM 2.4GHz Band (2400.0-2483.5MHz); Frequency: 2462 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 2462 MHz; $\sigma$ = 2.01 S/m; $\varepsilon_r$ = 56.306; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(7.35, 7.35, 7.35); Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH11(2462MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 1.33 W/kg

**Configuration/CH11(2462MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.15 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 4.51 W/kg
**SAR(1 g) = 0.669 W/kg; SAR(10 g) = 0.443 W/kg**
Maximum value of SAR (measured) = 2.00 W/kg



Date: 07/09/2017

**11b CH11(2462MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) (0); Communication System Band: ISM 2.4GHz Band (2400.0-2483.5MHz); Frequency: 2462 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 2462 MHz; $\sigma$ = 2.01 S/m; $\varepsilon_r$ = 56.306; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(7.35, 7.35, 7.35); Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH11(2462MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.755 W/kg

**Configuration/CH11(2462MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

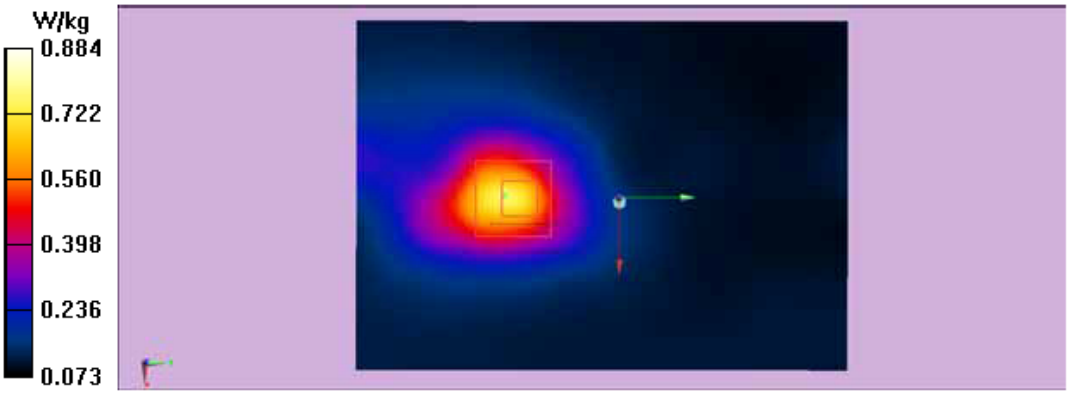
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.572 V/m; Power Drift = -0.20 dB

Peak SAR (extrapolated) = 2.24 W/kg

**SAR(1 g) = 0.837 W/kg; SAR(10 g) = 0.392 W/kg**

Maximum value of SAR (measured) = 0.884 W/kg



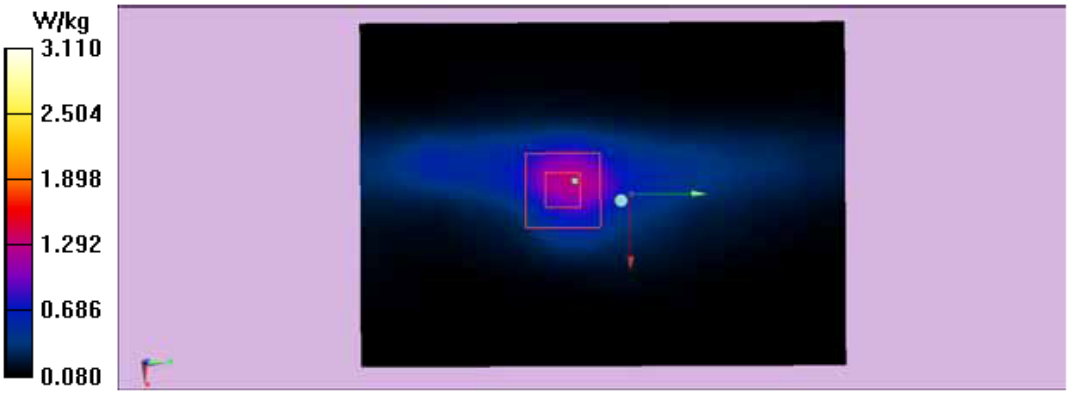
**WIFI 5G**
**ANT 0:**

Date: 08/09/2017

**11a CH36(5180MHz Bottom)**
**EUT: Notebook M/N: RZ09-0239**
Communication System: UID 0, IEEE 802.11a WiFi 5.2GHz (0); Communication System Band: IEEE 802.11a WiFi 5.2GHz; Frequency: 5180 MHz;Communication System PAR: 0 dB
Medium parameters used: f = 5180 MHz; $\sigma = 4.896$ S/m; $\varepsilon_r = 47.26$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section
DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.44, 5.44, 5.44); Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH36(5180MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm
Maximum value of SAR (interpolated) = 1.29 W/kg
**Configuration/CH36(5180MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.21 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 7.71 W/kg
**SAR(1 g) = 0.632 W/kg; SAR(10 g) = 0.359 W/kg**
Maximum value of SAR (measured) = 3.11 W/kg



Date: 08/09/2017

**11a CH36(5180MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.2GHz (0); Communication System Band: IEEE 802.11a WiFi 5.2GHz; Frequency: 5180 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5180 MHz; $\sigma = 4.896$ S/m; $\varepsilon_r = 47.26$; $\rho = 1000$ kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.44, 5.44, 5.44); Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH36(5180MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 1.13 W/kg

**Configuration/CH36(5180MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

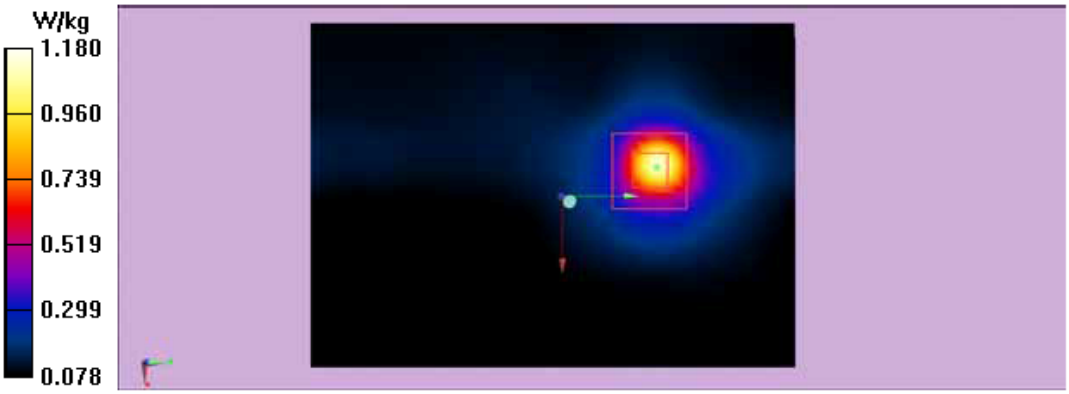
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.224 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 2.77 W/kg

**SAR(1 g) = 0.662 W/kg; SAR(10 g) = 0.386 W/kg**

Maximum value of SAR (measured) = 1.18 W/kg



Date: 08/09/2017

**11a CH52(5260MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5260 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5260 MHz; $\sigma$ = 5.235 S/m; $\varepsilon_r$ = 49.85; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH52(5260MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 1.42 W/kg

**Configuration/CH52(5260MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

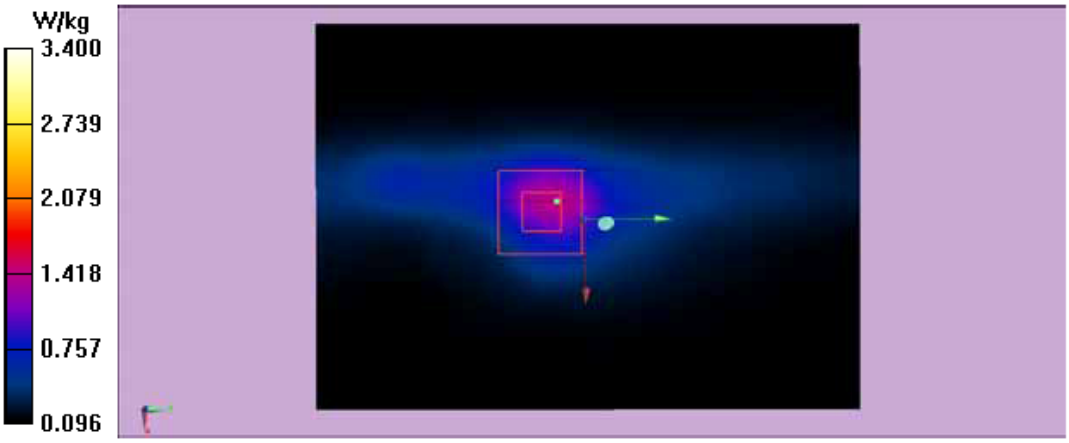
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.57 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 8.43 W/kg

**SAR(1 g) = 0.686 W/kg; SAR(10 g) = 0.344 W/kg**

Maximum value of SAR (measured) = 3.40 W/kg



Date: 08/09/2017

**11a CH52(5260MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5260 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5260 MHz; $\sigma$ = 5.235 S/m; $\varepsilon_r$ = 49.85; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH52(5260MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.196 W/kg

**Configuration/CH52(5260MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

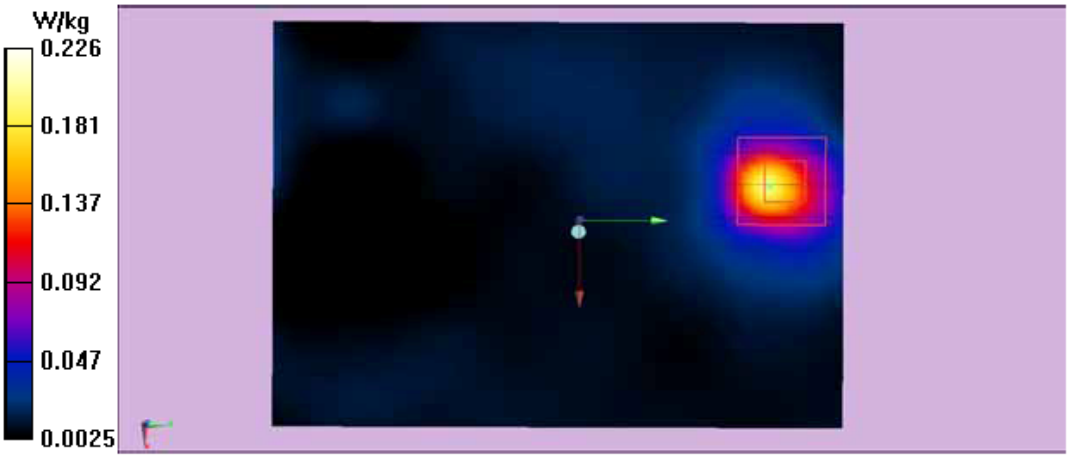
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.171 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.596 W/kg

**SAR(1 g) = 0.200 W/kg; SAR(10 g) = 0.075 W/kg**

Maximum value of SAR (measured) = 0.226 W/kg



Date: 08/09/2017

**11a CH60(5300MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5300 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5300 MHz; $\sigma$ = 5.221 S/m; $\varepsilon_r$ = 49.90; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH60(5300MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.663 W/kg

**Configuration/CH60(5300MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

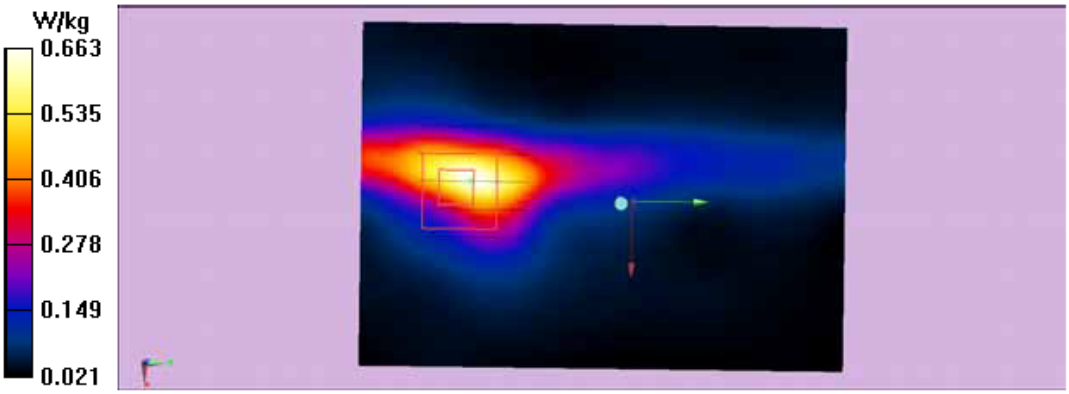
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.805 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 4.61 W/kg

**SAR(1 g) = 0.657 W/kg; SAR(10 g) = 0.390 W/kg**

Maximum value of SAR (measured) = 1.92 W/kg



Date: 08/09/2017

**11a CH60(5300MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5300 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5300 MHz; $\sigma$ = 5.221 S/m; $\varepsilon_r$ = 49.90; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH60(5300MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.513 W/kg

**Configuration/CH60(5300MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

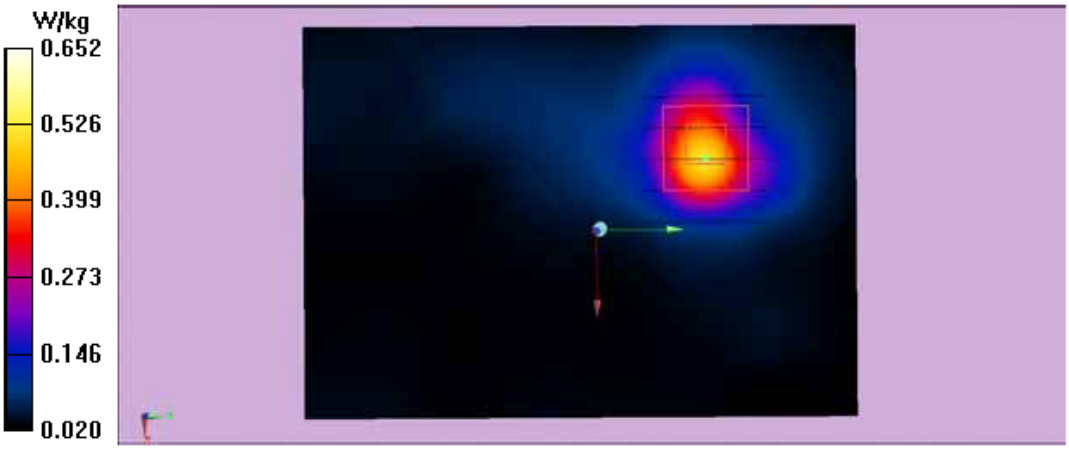
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.847 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 1.66 W/kg

**SAR(1 g) = 0.576 W/kg; SAR(10 g) = 0.222 W/kg**

Maximum value of SAR (measured) = 0.652 W/kg



Date: 15/09/2017

**11a CH112(5560MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5560 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5560 MHz; $\sigma$ = 5.301 S/m; $\varepsilon_r$ = 49.71; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH112(5560MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 1.01 W/kg

**Configuration/CH112(5560MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

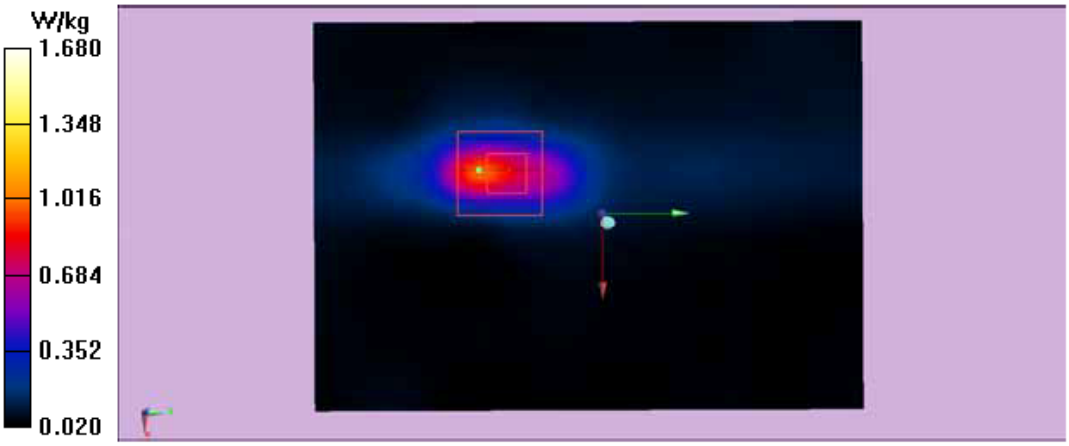
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.858 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 3.33 W/kg

**SAR(1 g) = 0.714 W/kg; SAR(10 g) = 0.347 W/kg**

Maximum value of SAR (measured) = 1.68 W/kg



Date: 15/09/2017

**11a CH112(5560MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5560 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5560 MHz; $\sigma$ = 5.301 S/m; $\varepsilon_r$ = 49.71; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH112(5560MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.441 W/kg

**Configuration/CH112(5560MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

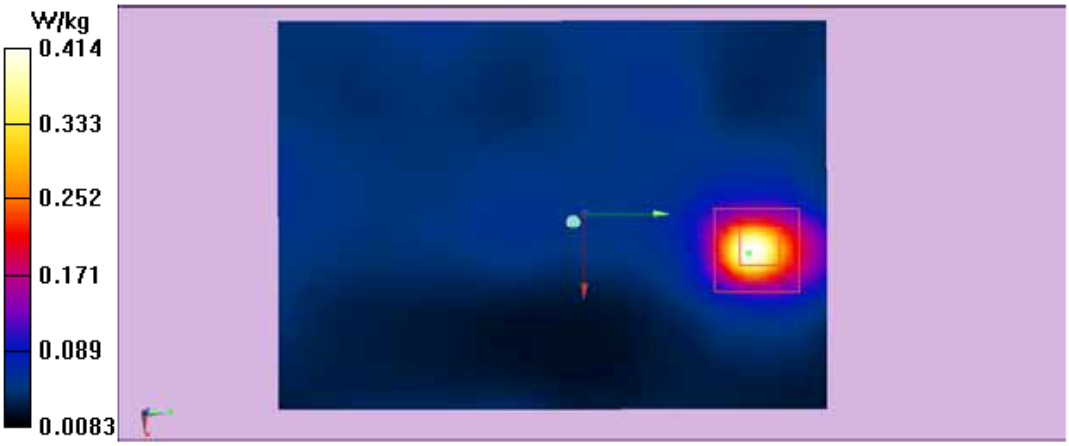
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.327 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.01 W/kg

**SAR(1 g) = 0.363 W/kg; SAR(10 g) = 0.149 W/kg**

Maximum value of SAR (measured) = 0.414 W/kg



Date: 15/09/2017

**11a CH120(5600MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5600 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5600 MHz; $\sigma$ = 5.350 S/m; $\varepsilon_r$ = 49.65; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH120(5600MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.337 W/kg

**Configuration/CH120(5600MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

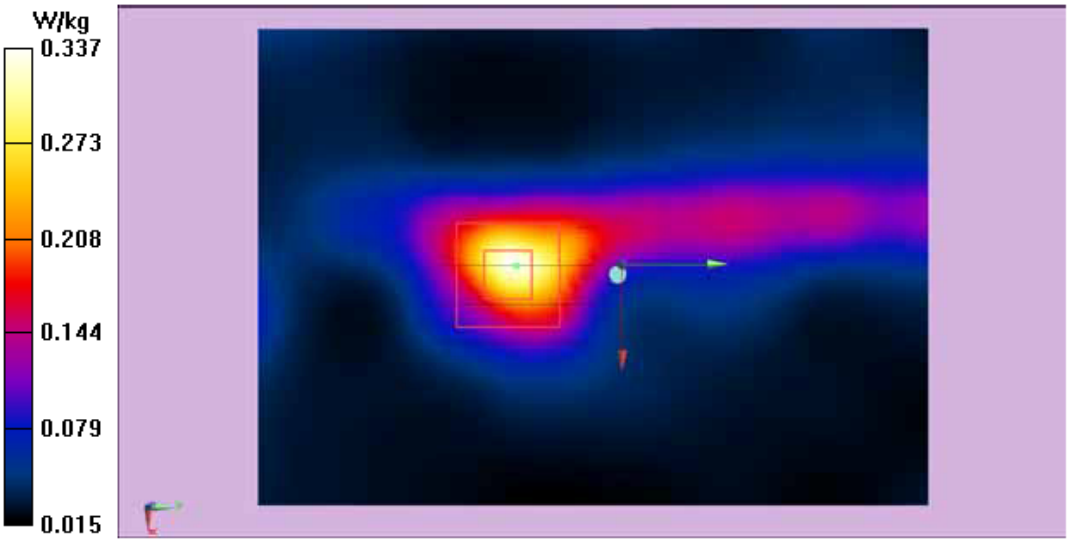
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.467 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.51 W/kg

**SAR(1 g) = 0.728 W/kg; SAR(10 g) = 0.260 W/kg**

Maximum value of SAR (measured) = 1.14 W/kg



Date: 15/09/2017

**11a CH120(5600MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5600 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5600 MHz; $\sigma$ = 5.350 S/m; $\varepsilon_r$ = 49.65; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH120(5600MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.365 W/kg

**Configuration/CH120(5600MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

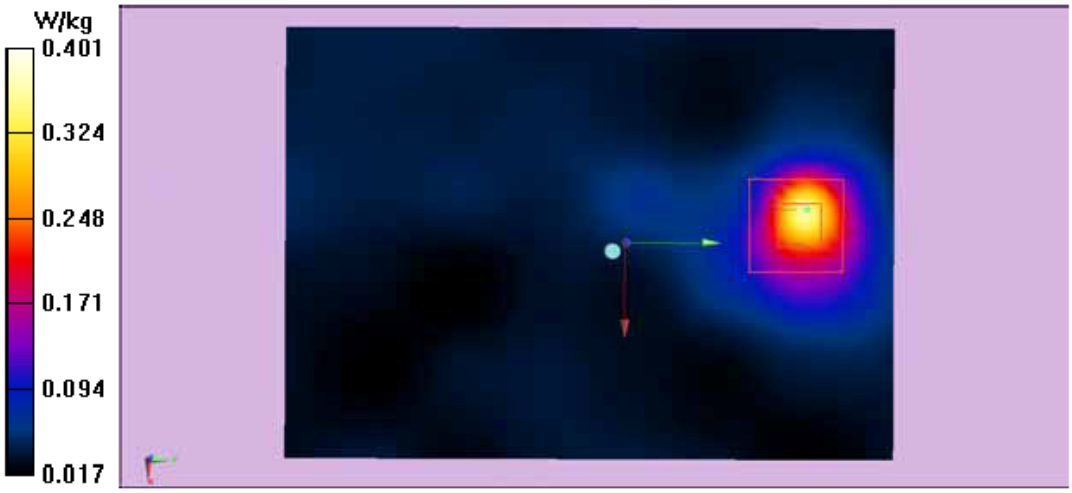
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.142 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.981 W/kg

**SAR(1 g) = 0.345 W/kg; SAR(10 g) = 0.137 W/kg**

Maximum value of SAR (measured) = 0.401 W/kg



Date: 16/09/2017

**11a CH149(5745MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5745 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5745 MHz; $\sigma$ = 5.713 S/m; $\varepsilon_r$ = 48.21; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH149(5745MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.419 W/kg

**Configuration/CH149(5745MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

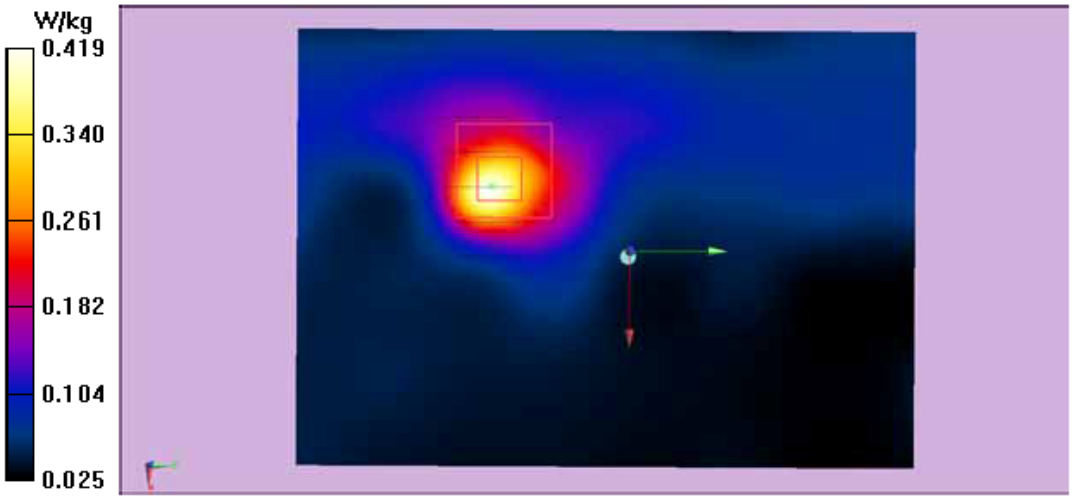
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.547 V/m; Power Drift = -0.17 dB

Peak SAR (extrapolated) = 3.11 W/kg

**SAR(1 g) = 0.703 W/kg; SAR(10 g) = 0.323 W/kg**

Maximum value of SAR (measured) = 1.49 W/kg



Date: 16/09/2017

**11a CH149(5745MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5745 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5745 MHz; $\sigma$ = 5.713 S/m; $\varepsilon_r$ = 48.21; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH149(5745MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.457 W/kg

**Configuration/CH149(5745MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

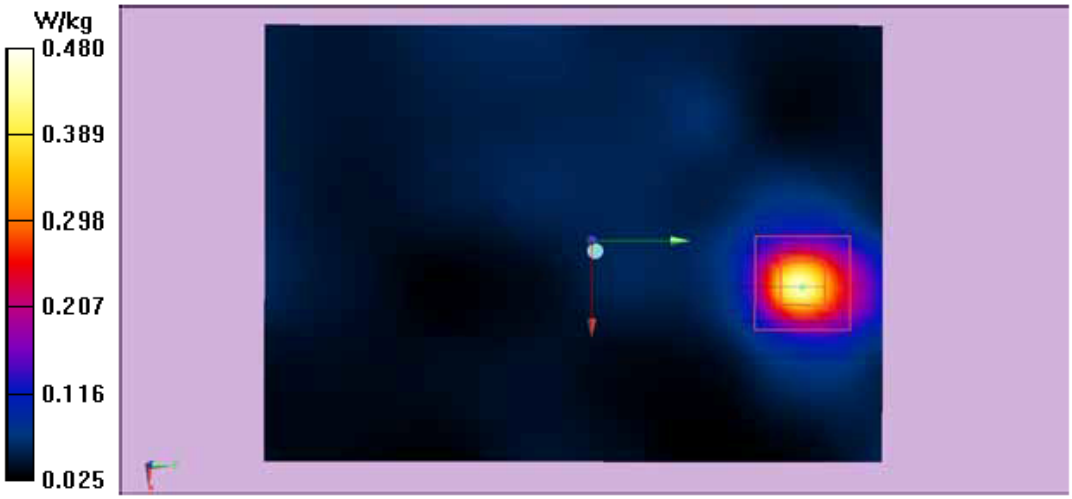
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.214 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 1.09 W/kg

**SAR(1 g) = 0.387 W/kg; SAR(10 g) = 0.158 W/kg**

Maximum value of SAR (measured) = 0.480 W/kg



Date: 16/09/2017

**11a CH165(5825MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5825 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5825 MHz; $\sigma$ = 6.102 S/m; $\varepsilon_r$ = 47.81; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH165(5825MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.465 W/kg

**Configuration/CH165(5825MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

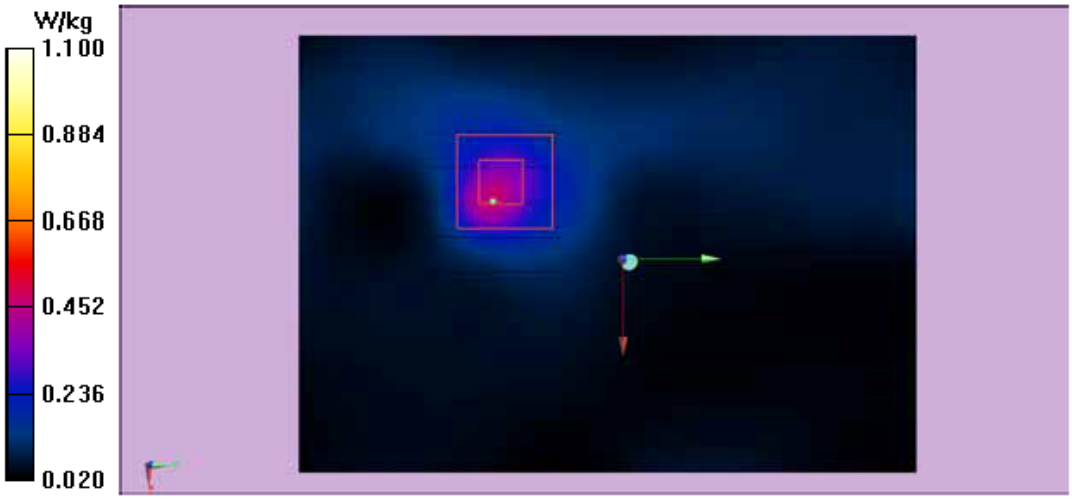
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.192 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 2.89 W/kg

**SAR(1 g) = 0.685 W/kg; SAR(10 g) = 0.331 W/kg**

Maximum value of SAR (measured) = 1.10 W/kg



Date: 16/09/2017

**11a CH165(5825MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5825 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5825 MHz; $\sigma$ = 6.102 S/m; $\varepsilon_r$ = 47.81; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH165(5825MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.394 W/kg

**Configuration/CH165(5825MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

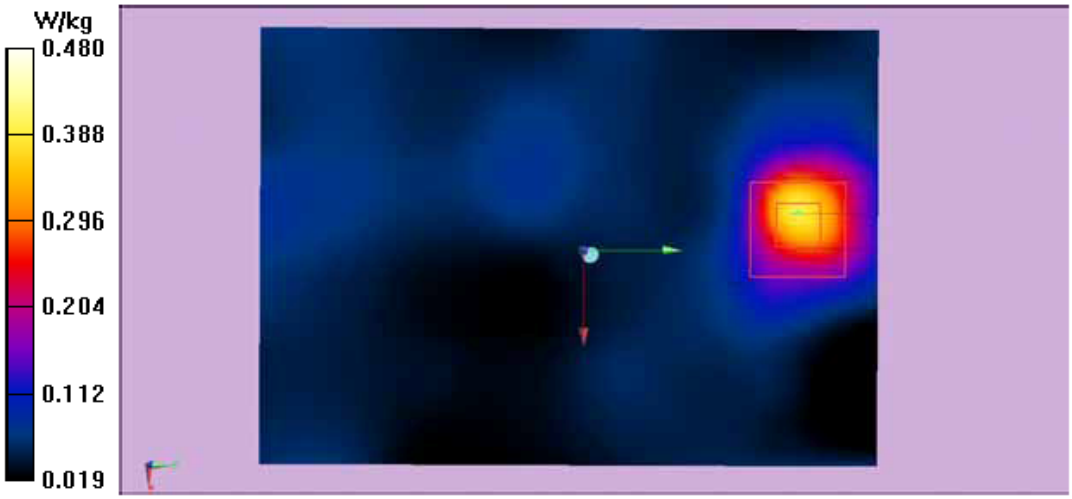
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.170 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.04 W/kg

**SAR(1 g) = 0.387 W/kg; SAR(10 g) = 0.159 W/kg**

Maximum value of SAR (measured) = 0.480 W/kg



**WIFI 5G**
**ANT 1:**

Date: 08/09/2017

**11a CH36(5180MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.2GHz (0); Communication System Band: IEEE 802.11a WiFi 5.2GHz; Frequency: 5180 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5180 MHz; $\sigma = 4.896$ S/m; $\varepsilon_r = 47.26$; $\rho = 1000$ kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.44, 5.44, 5.44);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Configuration/CH36(5180MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 1.06 W/kg

**Configuration/CH36(5180MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

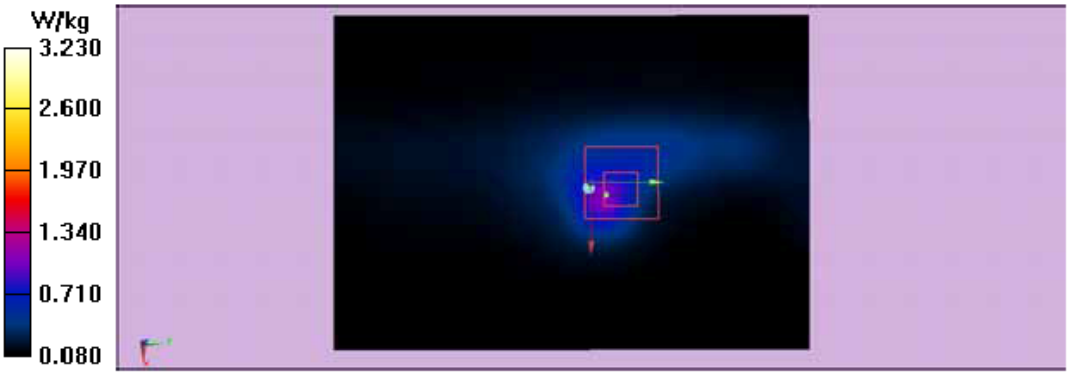
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 18.12 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 7.03 W/kg

**SAR(1 g) = 0.701 W/kg; SAR(10 g) = 0.351 W/kg**

Maximum value of SAR (measured) = 3.23 W/kg



Date: 08/09/2017

**11a CH36(5180MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.2GHz (0); Communication System Band: IEEE 802.11a WiFi 5.2GHz; Frequency: 5180 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5180 MHz; $\sigma = 4.896$ S/m; $\varepsilon_r = 47.26$; $\rho = 1000$ kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.44, 5.44, 5.44);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH36(5180MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.812 W/kg

**Configuration/CH36(5180MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

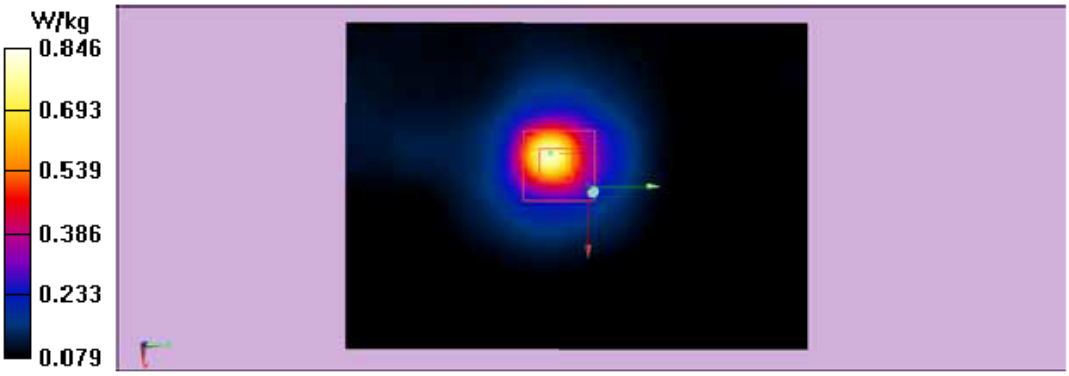
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.228 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 2.10 W/kg

**SAR(1 g) = 0.747 W/kg; SAR(10 g) = 0.316 W/kg**

Maximum value of SAR (measured) = 0.846 W/kg



Date: 08/09/2017

**11a CH52(5260MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5260 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5260 MHz; $\sigma$ = 5.235 S/m; $\varepsilon_r$ = 49.85; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH52(5260MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.142 W/kg

**Configuration/CH52(5260MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

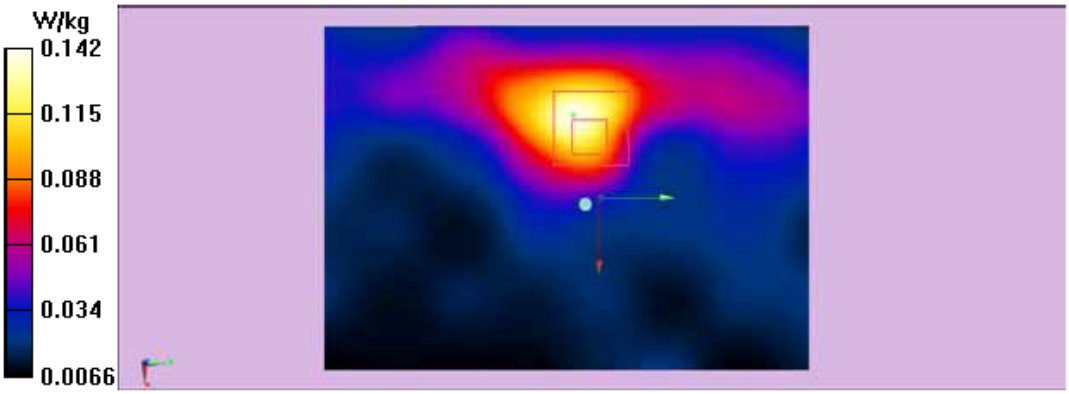
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.388 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 1.36 W/kg

**SAR(1 g) = 0.460 W/kg; SAR(10 g) = 0.147 W/kg**

Maximum value of SAR (measured) = 0.586 W/kg



Date: 08/09/2017

**11a CH52(5260MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5260 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5260 MHz; $\sigma$ = 5.235 S/m; $\varepsilon_r$ = 49.85; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH52(5260MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.136 W/kg

**Configuration/CH52(5260MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

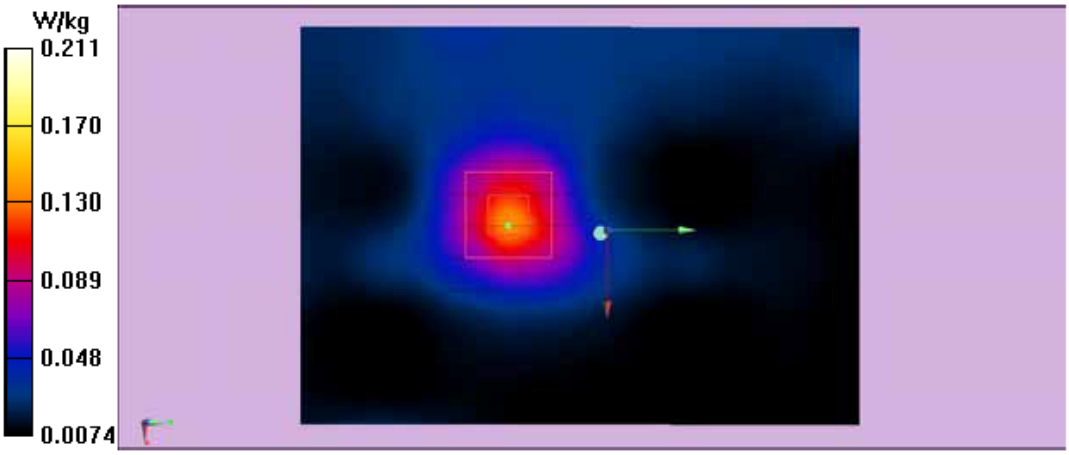
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.620 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.503 W/kg

**SAR(1 g) = 0.183 W/kg; SAR(10 g) = 0.077 W/kg**

Maximum value of SAR (measured) = 0.211 W/kg



Date: 08/09/2017

**11a CH60(5300MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5300 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5300 MHz; $\sigma$ = 5.221 S/m; $\varepsilon_r$ = 49.90; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH60(5300MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.154 W/kg

**Configuration/CH60(5300MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

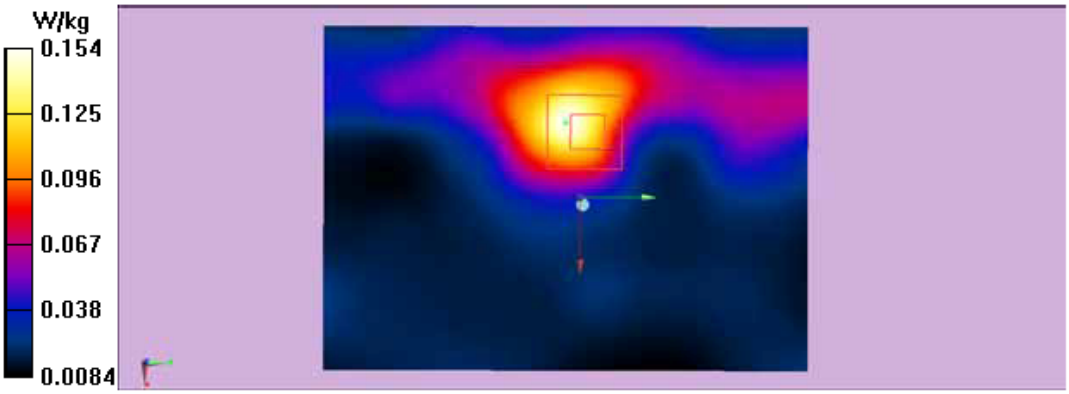
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.316 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 1.23 W/kg

**SAR(1 g) = 0.426 W/kg; SAR(10 g) = 0.143 W/kg**

Maximum value of SAR (measured) = 0.517 W/kg



Date: 08/09/2017

**11a CH60(5300MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.3GHz (0); Communication System Band: IEEE 802.11a WiFi 5.3GHz ; Frequency: 5300 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5300 MHz; $\sigma$ = 5.221 S/m; $\varepsilon_r$ = 49.90; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(5.09, 5.09, 5.09);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH60(5300MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.165 W/kg

**Configuration/CH60(5300MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

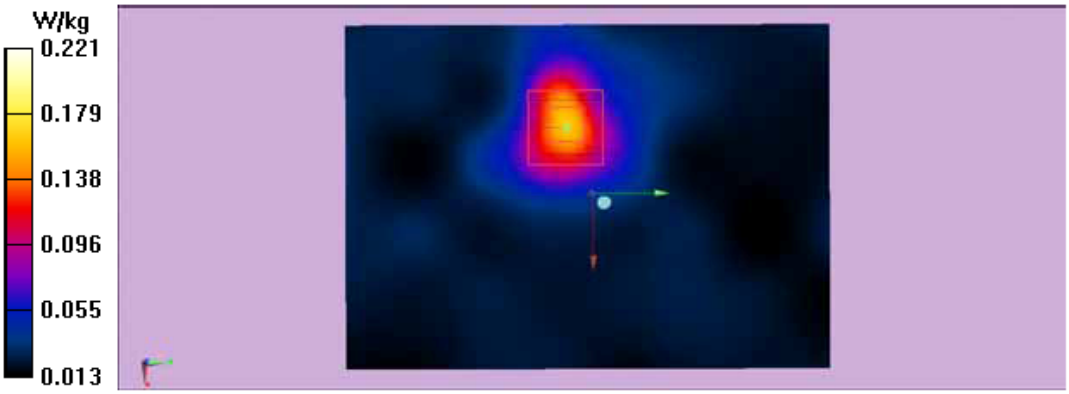
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.100 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 0.502 W/kg

**SAR(1 g) = 0.184 W/kg; SAR(10 g) = 0.080 W/kg**

Maximum value of SAR (measured) = 0.221 W/kg



Date: 15/09/2017

**11a CH112(5560MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5560 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5560 MHz; $\sigma$ = 5.301 S/m; $\varepsilon_r$ = 49.71; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH112(5560MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.128 W/kg

**Configuration/CH112(5560MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

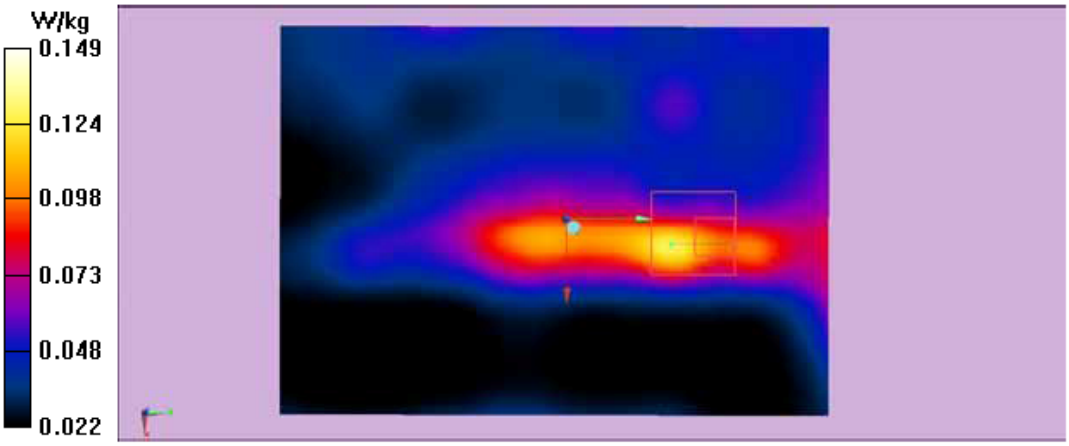
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.494 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 0.275 W/kg

**SAR(1 g) = 0.114 W/kg; SAR(10 g) = 0.063 W/kg**

Maximum value of SAR (measured) = 0.149 W/kg



Date: 15/09/2017

**11a CH112(5560MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5560 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5560 MHz; $\sigma$ = 5.301 S/m; $\varepsilon_r$ = 49.71; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH112(5560MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.320 W/kg

**Configuration/CH112(5560MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

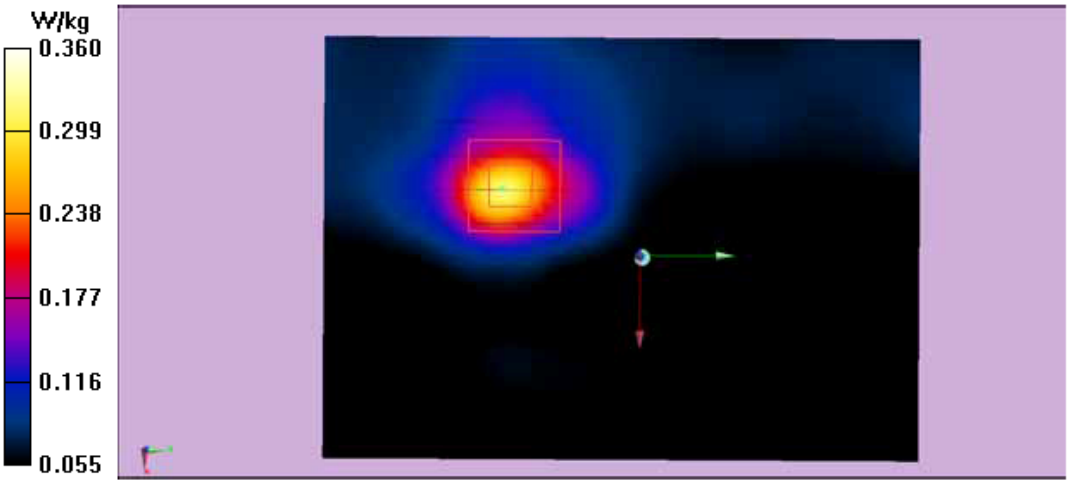
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.467 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.789 W/kg

**SAR(1 g) = 0.308 W/kg; SAR(10 g) = 0.152 W/kg**

Maximum value of SAR (measured) = 0.360 W/kg



Date: 15/09/2017

**11a CH120(5600MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5600 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5600 MHz; $\sigma$ = 5.350 S/m; $\varepsilon_r$ = 49.65; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH120(5600MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.592 W/kg

**Configuration/CH120(5600MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

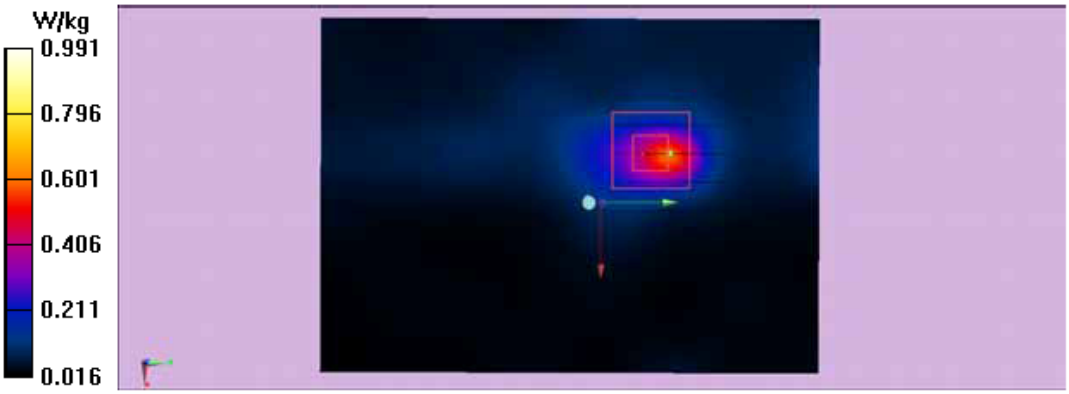
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.427 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 1.91 W/kg

**SAR(1 g) = 0.361 W/kg; SAR(10 g) = 0.212 W/kg**

Maximum value of SAR (measured) = 0.991 W/kg



Date: 15/09/2017

**11a CH120(5600MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.5GHz (0); Communication System Band: IEEE 802.11a WiFi 5.5GHz; Frequency: 5600 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5600 MHz; $\sigma$ = 5.350 S/m; $\varepsilon_r$ = 49.65; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.25, 4.25, 4.25);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH120(5600MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.291 W/kg

**Configuration/CH120(5600MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

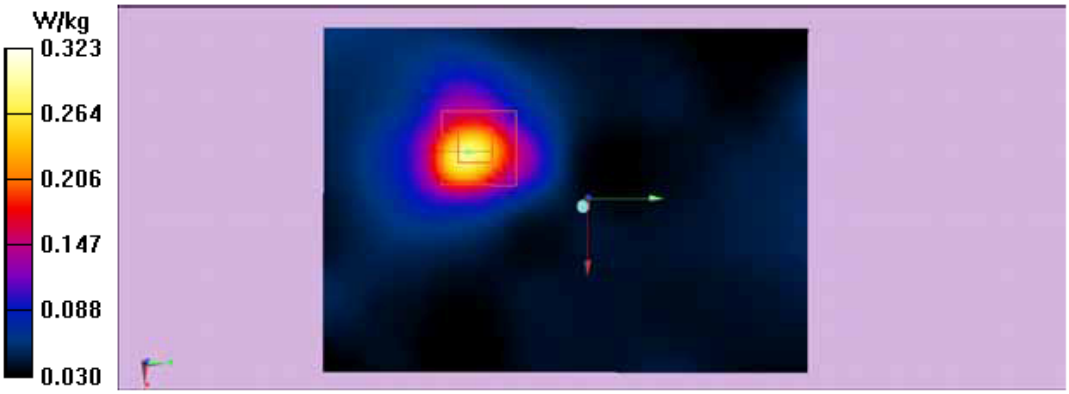
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.356 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.788 W/kg

**SAR(1 g) = 0.287 W/kg; SAR(10 g) = 0.128 W/kg**

Maximum value of SAR (measured) = 0.323 W/kg



Date: 16/09/2017

**11a CH149(5745MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5745 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5745 MHz; $\sigma$ = 5.713 S/m; $\varepsilon_r$ = 48.21; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH149(5745MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.400 W/kg

**Configuration/CH149(5745MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

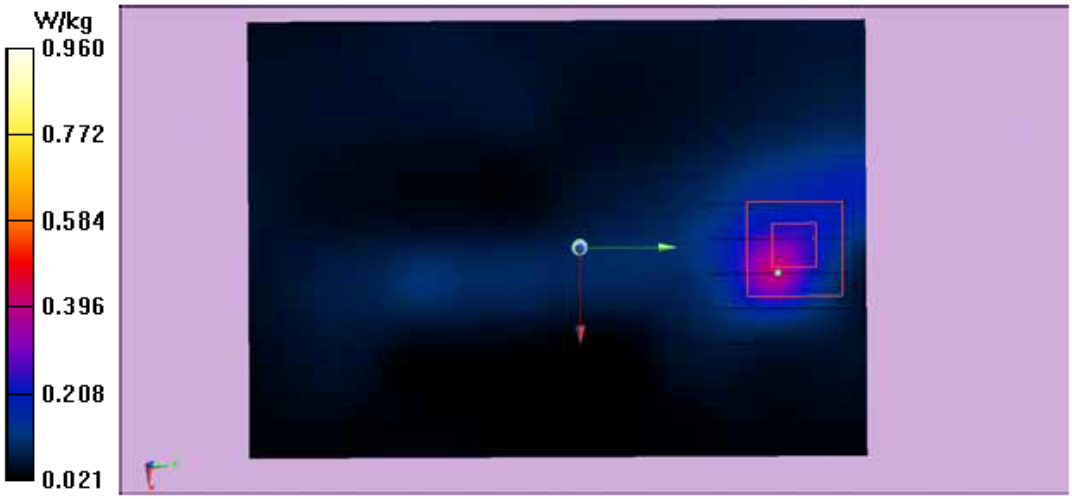
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.203 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 2.26 W/kg

**SAR(1 g) = 0.390 W/kg; SAR(10 g) = 0.267 W/kg**

Maximum value of SAR (measured) = 0.960 W/kg



Date: 16/09/2017

**11a CH149(5745MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5745 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5745 MHz; $\sigma$ = 5.713 S/m; $\varepsilon_r$ = 48.21; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH149(5745MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.257 W/kg

**Configuration/CH149(5745MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

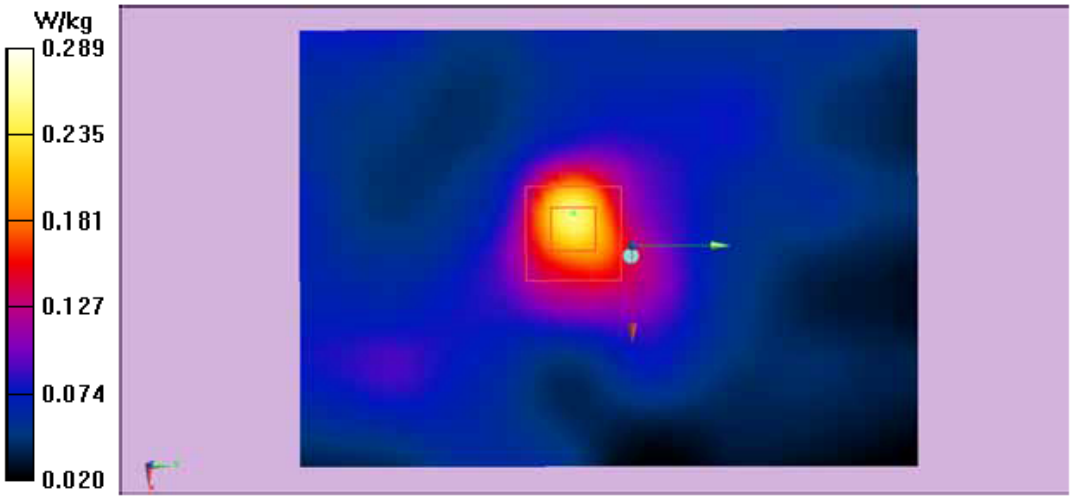
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.166 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 0.664 W/kg

**SAR(1 g) = 0.253 W/kg; SAR(10 g) = 0.121 W/kg**

Maximum value of SAR (measured) = 0.289 W/kg



Date: 16/09/2017

**11a CH165(5825MHz Bottom)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5825 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5825 MHz; $\sigma$ = 6.102 S/m; $\varepsilon_r$ = 47.81; $\rho$ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH165(5825MHz Bottom)/Area Scan (51x71x1):** Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.400 W/kg

**Configuration/CH165(5825MHz Bottom)/Zoom Scan (5x5x7)/Cube 0:**

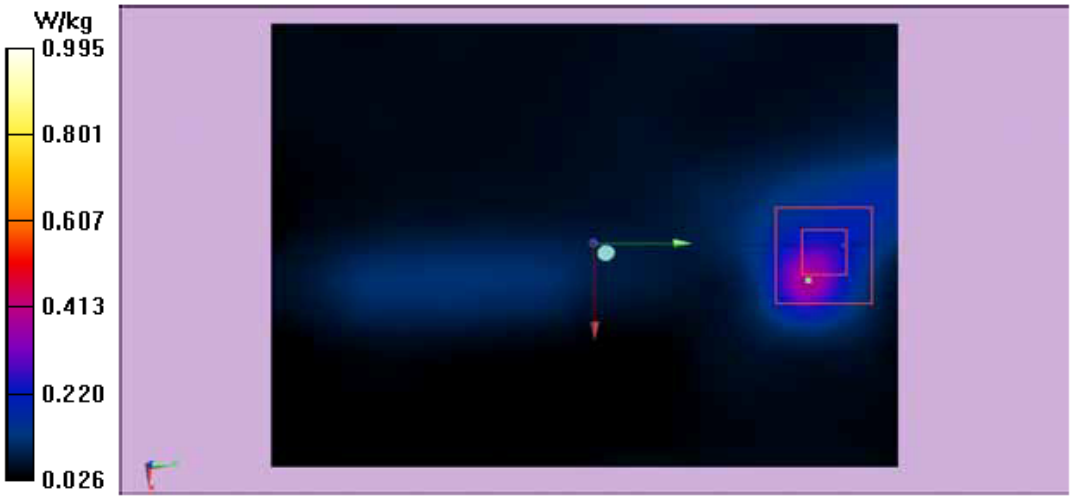
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.539 V/m; Power Drift = -0.19 dB

Peak SAR (extrapolated) = 2.36 W/kg

**SAR(1 g) = 0.417 W/kg; SAR(10 g) = 0.280 W/kg**

Maximum value of SAR (measured) = 0.995 W/kg



Date: 16/09/2017

**11a CH165(5825MHz Screen Back)**

**EUT: Notebook M/N: RZ09-0239**

Communication System: UID 0, IEEE 802.11a WiFi 5.8GHz (0); Communication System Band: IEEE 802.11a WiFi 5.8GHz ; Frequency: 5825 MHz;Communication System PAR: 0 dB

Medium parameters used: f = 5825 MHz; $\sigma$ = 6.102 S/m; $\varepsilon_r$ = 47.81; $\rho$ = 1000 kg/$m^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN7383; ConvF(4.33, 4.33, 4.33);Calibrated: 2016/12/27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 2016/12/9
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1235
- DASY52 52.10.0(1442); SEMCAD X Version 14.6.10 (7313)

**Configuration/CH165(5825MHz Screen Back)/Area Scan (51x71x1):**

Interpolated grid: dx=2.000 mm, dy=2.000 mm

Maximum value of SAR (interpolated) = 0.269 W/kg

**Configuration/CH165(5825MHz Screen Back)/Zoom Scan (5x5x7)/Cube 0:**

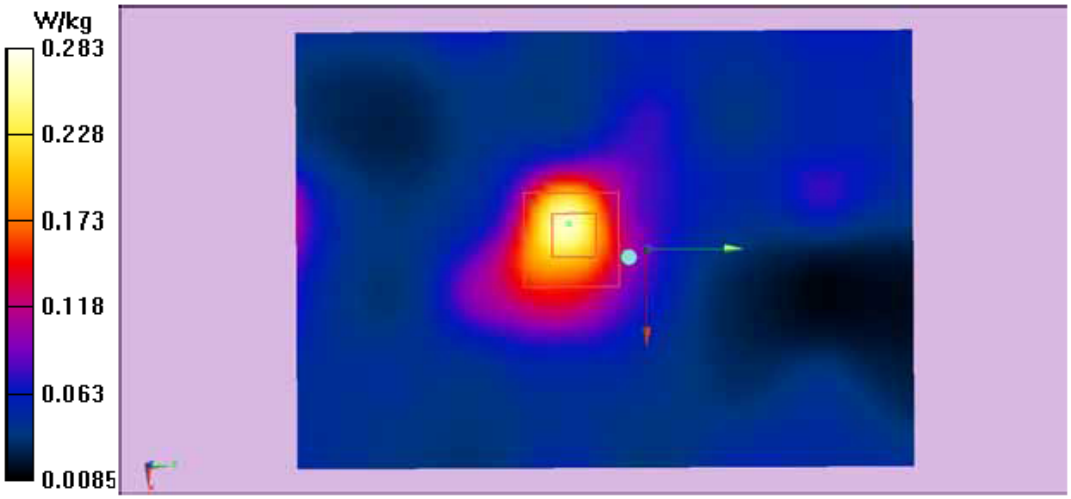
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.972 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.720 W/kg

**SAR(1 g) = 0.248 W/kg; SAR(10 g) = 0.122 W/kg**

Maximum value of SAR (measured) = 0.283 W/kg



# 10. ANNEX C: DASY CABLIBRATION CERTIFICATE

Schmid & Partner Engineering AG

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info@speag.com, http://www.speag.com

s p e a g

## IMPORTANT NOTICE

### USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

**Battery Exchange**: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

**Shipping of the DAE**: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

**E-Stop Failures**: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

**Repair**: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

**DASY Configuration Files:** Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

**Important Note:**
**Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.**

**Important Note:**
**Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.**

**Important Note:**
**To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.**

In Collaboration with
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E-mail: cttl@chinattl.com Http://www.chinattl.cn

中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client UL Certificate No: Z16-97247

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:7383 |
| Calibration Procedure(s) | FD-Z11-004-01<br>Calibration Procedures for Dosimetric E-field Probes |
| Calibration date: | December 27, 2016 |

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power Meter NRP2 | 101919 | 27-Jun-16 (CTTL, No.J16X04777) | Jun-17 |
| Power sensor NRP-Z91 | 101547 | 27-Jun-16 (CTTL, No.J16X04777) | Jun-17 |
| Power sensor NRP-Z91 | 101548 | 27-Jun-16 (CTTL, No.J16X04777) | Jun-17 |
| Reference10dBAttenuator | 18N50W-10dB | 13-Mar-16(CTTL,No.J16X01547) | Mar-18 |
| Reference20dBAttenuator | 18N50W-20dB | 13-Mar-16(CTTL, No.J16X01548) | Mar-18 |
| Reference Probe EX3DV4 | SN 7433 | 26-Sep-16(SPEAG,No.EX3-7433_Sep16) | Sep-17 |
| DAE4 | SN 1331 | 21-Jan-16(SPEAG, No.DAE4-1331_Jan16) | Jan -17 |
| **Secondary Standards** | **ID #** | **Cal Date(Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| SignalGeneratorMG3700A | 6201052605 | 27-Jun-16 (CTTL, No.J16X04776) | Jun-17 |
| Network Analyzer E5071C | MY46110673 | 26-Jan-16 (CTTL, No.J16X00894) | Jan -17 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Zhao Jing | SAR Test Engineer | |
| Reviewed by: | Qi Dianyuan | SAR Project Leader | |
| Approved by: | Lu Bingsong | Deputy Director of the laboratory | |

Issued: December 31, 2016

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**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 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, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005

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

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# Probe EX3DV4

# SN: 7383

Calibrated: December 27, 2016

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7383

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm(μV/(V/m)$^2$)$^A$ | 0.39 | 0.48 | 0.51 | ±10.8% |
| DCP(mV)$^B$ | 97.7 | 97.3 | 101.0 | |

## Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Unc$^E$ (k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 168.0 | ±2.5% |
| | | Y | 0.0 | 0.0 | 1.0 | | 189.9 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 196.8 | |

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

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7383

## 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) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 41.9 | 0.89 | 10.08 | 10.08 | 10.08 | 0.30 | 0.70 | ±12% |
| 835 | 41.5 | 0.90 | 9.69 | 9.69 | 9.69 | 0.13 | 1.45 | ±12% |
| 900 | 41.5 | 0.97 | 9.81 | 9.81 | 9.81 | 0.13 | 1.41 | ±12% |
| 1450 | 40.5 | 1.20 | 8.90 | 8.90 | 8.90 | 0.17 | 1.05 | ±12% |
| 1810 | 40.0 | 1.40 | 8.17 | 8.17 | 8.17 | 0.25 | 1.02 | ±12% |
| 1900 | 40.0 | 1.40 | 8.26 | 8.26 | 8.26 | 0.21 | 1.21 | ±12% |
| 2100 | 39.8 | 1.49 | 8.34 | 8.34 | 8.34 | 0.16 | 1.36 | ±12% |
| 2300 | 39.5 | 1.67 | 7.78 | 7.78 | 7.78 | 0.45 | 0.77 | ±12% |
| 2450 | 39.2 | 1.80 | 7.45 | 7.45 | 7.45 | 0.28 | 1.27 | ±12% |
| 2600 | 39.0 | 1.96 | 7.35 | 7.35 | 7.35 | 0.33 | 1.09 | ±12% |
| 3500 | 37.9 | 2.91 | 6.92 | 6.92 | 6.92 | 0.32 | 1.64 | ±13% |
| 3700 | 37.7 | 3.12 | 6.58 | 6.58 | 6.58 | 0.38 | 1.25 | ±13% |
| 5250 | 35.9 | 4.71 | 5.20 | 5.20 | 5.20 | 0.35 | 1.50 | ±13% |
| 5600 | 35.5 | 5.07 | 4.69 | 4.69 | 4.69 | 0.40 | 1.50 | ±13% |
| 5750 | 35.4 | 5.22 | 4.90 | 4.90 | 4.90 | 0.40 | 1.50 | ±13% |

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7383

## 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) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 55.5 | 0.96 | 10.40 | 10.40 | 10.40 | 0.40 | 0.82 | ±12% |
| 835 | 55.2 | 0.97 | 10.13 | 10.13 | 10.13 | 0.15 | 1.58 | ±12% |
| 900 | 55.0 | 1.05 | 10.14 | 10.14 | 10.14 | 0.19 | 1.35 | ±12% |
| 1450 | 54.0 | 1.30 | 8.71 | 8.71 | 8.71 | 0.12 | 1.49 | ±12% |
| 1810 | 53.3 | 1.52 | 8.10 | 8.10 | 8.10 | 0.15 | 1.58 | ±12% |
| 1900 | 53.3 | 1.52 | 8.01 | 8.01 | 8.01 | 0.17 | 1.41 | ±12% |
| 2100 | 53.2 | 1.62 | 8.32 | 8.32 | 8.32 | 0.16 | 1.63 | ±12% |
| 2300 | 52.9 | 1.81 | 7.83 | 7.83 | 7.83 | 0.33 | 1.21 | ±12% |
| 2450 | 52.7 | 1.95 | 7.63 | 7.63 | 7.63 | 0.38 | 1.05 | ±12% |
| 2600 | 52.5 | 2.16 | 7.55 | 7.55 | 7.55 | 0.38 | 1.03 | ±12% |
| 3500 | 51.3 | 3.31 | 6.57 | 6.57 | 6.57 | 0.41 | 1.53 | ±13% |
| 3700 | 51.0 | 3.55 | 6.58 | 6.58 | 6.58 | 0.40 | 1.85 | ±13% |
| 5250 | 48.9 | 5.36 | 4.63 | 4.63 | 4.63 | 0.46 | 1.90 | ±13% |
| 5600 | 48.5 | 5.77 | 3.99 | 3.99 | 3.99 | 0.50 | 1.95 | ±13% |
| 5750 | 48.3 | 5.94 | 4.33 | 4.33 | 4.33 | 0.52 | 2.00 | ±13% |

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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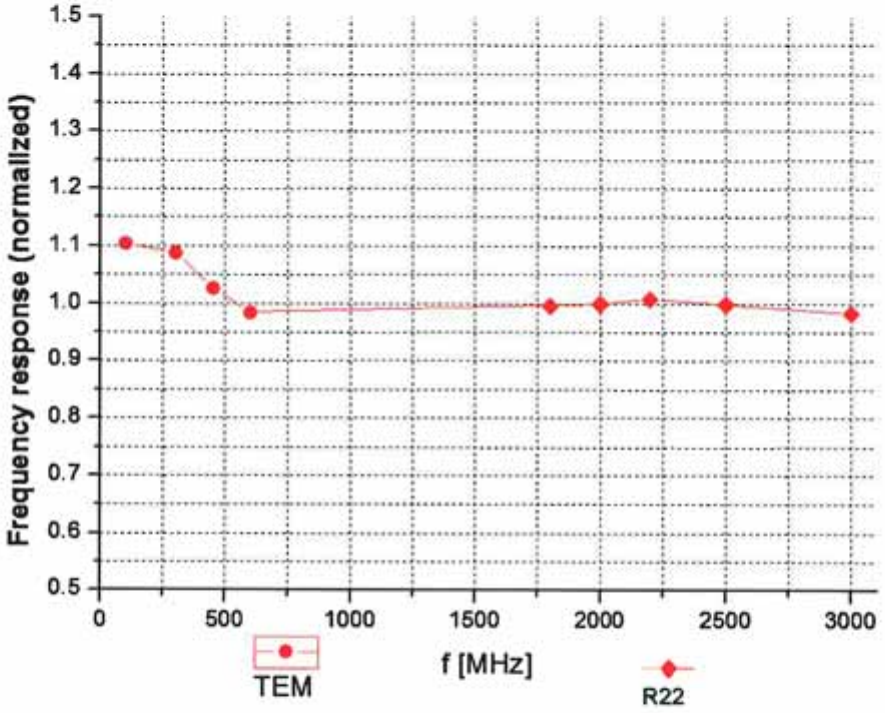
# Frequency Response of E-Field
## (TEM-Cell: ifi110 EXX, Waveguide: R22)




**Uncertainty of Frequency Response of E-field: ±7.5% (k=2)**

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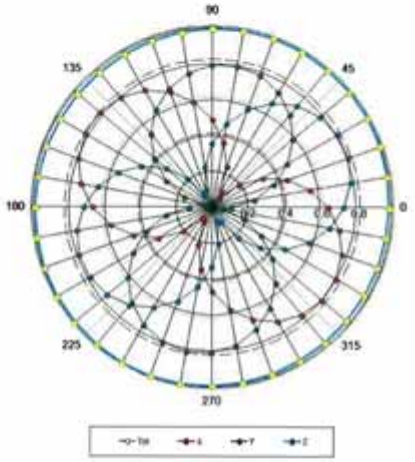
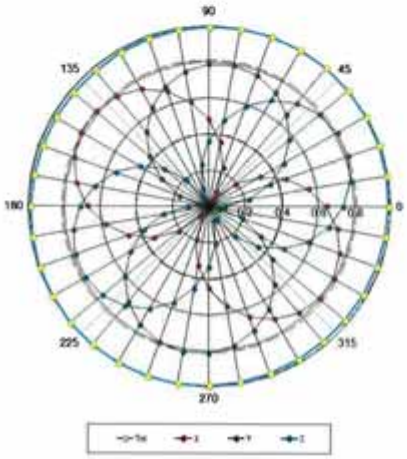
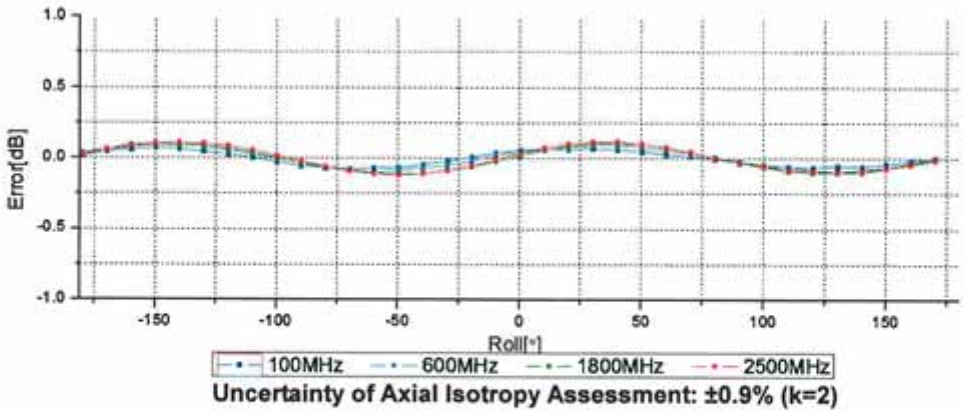
# Receiving Pattern (Φ), θ=0°

## f=600 MHz, TEM




## f=1800 MHz, R22




**Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)**

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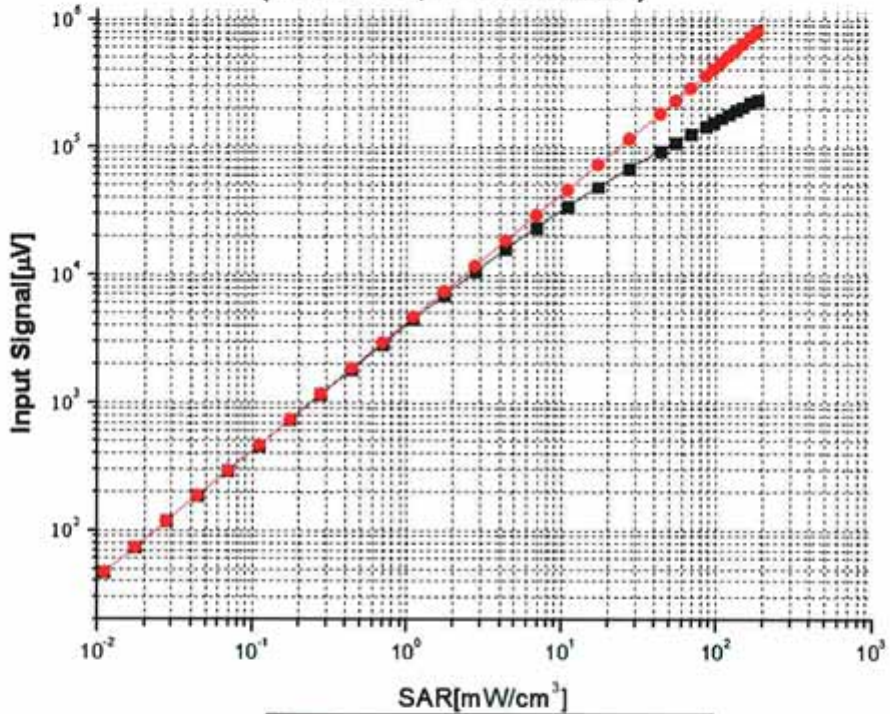
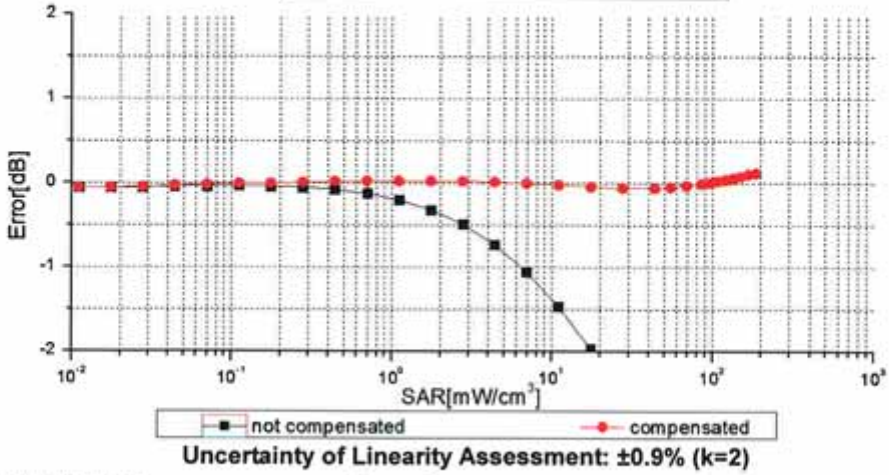
## Dynamic Range f($SAR_{head}$)
## (TEM cell, f = 900 MHz)




**Uncertainty of Linearity Assessment: ±0.9% (k=2)**

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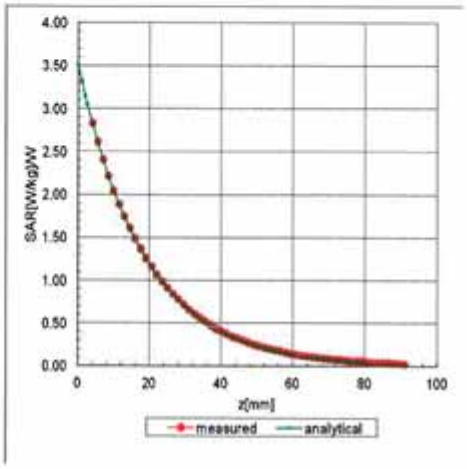
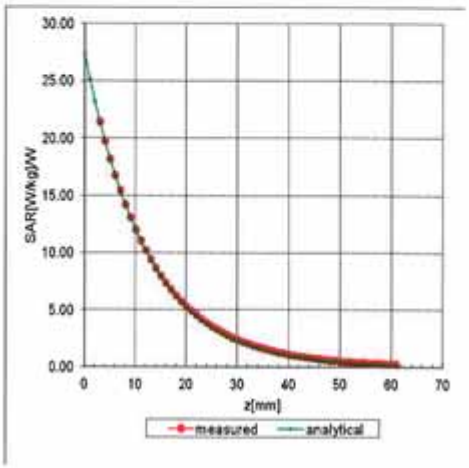
# Conversion Factor Assessment

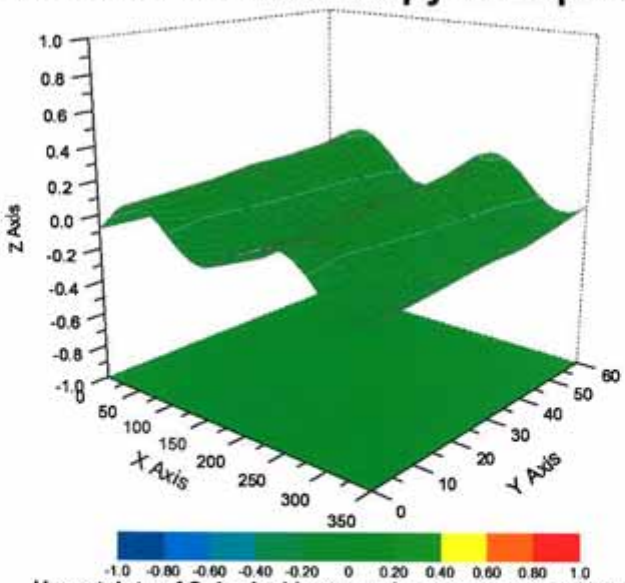
**f=900 MHz, WGLS R9(H_convF)**




**f=1810 MHz, WGLS R22(H_convF)**




## Deviation from Isotropy in Liquid




**Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)**

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7383

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 127.9 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disable |
| Probe Overall Length | 337mm |
| Probe Body Diameter | 10mm |
| Tip Length | 9mm |
| Tip Diameter | 2.5mm |
| Probe Tip to Sensor X Calibration Point | 1mm |
| Probe Tip to Sensor Y Calibration Point | 1mm |
| Probe Tip to Sensor Z Calibration Point | 1mm |
| Recommended Measurement Distance from Surface | 1.4mm |

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CNAS L0570

Client : UL Certificate No: Z16-97246

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE3 - SN: 427 |
| Calibration Procedure(s) | FD-Z11-002-01<br>Calibration Procedure for the Data Acquisition Electronics (DAEx) |
| Calibration date: | December 09, 2016 |

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Process Calibrator 753 | 1971018 | 27-June-16 (CTTL, No:J16X04778) | June-17 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Yu Zongying | SAR Test Engineer | |
| Reviewed by: | Qi Dianyuan | SAR Project Leader | |
| Approved by: | Lu Bingsong | Deputy Director of the laboratory | |

Issued: December 10, 2016

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**Glossary:**

| | |
|---|---|
| DAE | data acquisition electronics |
| Connector angle | information used in DASY system to align probe sensor X to the robot coordinate system. |

**Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

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## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV
Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| High Range | 404.093 ± 0.15% (k=2) | 403.247 ± 0.15% (k=2) | 404.055 ± 0.15% (k=2) |
| Low Range | 3.95614 ± 0.7% (k=2) | 3.99327 ± 0.7% (k=2) | 4.00212 ± 0.7% (k=2) |

## Connector Angle

| Connector Angle to be used in DASY system | 183° ± 1 ° |
|---|---|

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

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S Swiss Calibration Service

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

**Accreditation No.: SCS 0108**

**Client** UL (Song Shan Lake) Branch

**Certificate No: D2450V2-977_Jan16/2**

# CALIBRATION CERTIFICATE (Replacement of No:D2450V2-977_Jan16)

| | |
|---|---|
| Object | D2450V2 - SN: 977 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | January 14, 2016 |

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 EPM-442A | GB37480704 | 07-Oct-15 (No. 217-02222) | Oct-16 |
| Power sensor HP 8481A | US37292783 | 07-Oct-15 (No. 217-02222) | Oct-16 |
| Power sensor HP 8481A | MY41092317 | 07-Oct-15 (No. 217-02223) | Oct-16 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 01-Apr-15 (No. 217-02131) | Mar-16 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 01-Apr-15 (No. 217-02134) | Mar-16 |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-15 (No. EX3-7349_Dec15) | Dec-16 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Jun-18 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Michael Weber | Laboratory Technician | M.Weber |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: March 14, 2016

**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, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
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 | V52.8.8 |
| **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 | 37.9 ± 6 % | 1.88 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 cm³ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.5 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **52.5 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.23 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.5 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 52.7 | 1.95 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 52.2 ± 6 % | 2.03 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 cm³ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.7 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.14 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **24.3 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 | 55.3 Ω + 5.3 jΩ |
| Return Loss | - 23.0 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 52.1 Ω + 7.0 jΩ |
| Return Loss | - 22.9 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.157 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 | December 30, 2014 |

## DASY5 Validation Report for Head TSL

Date: 14.01.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz ; Type: D2450V2; Serial: D2450V2 - SN: 977**

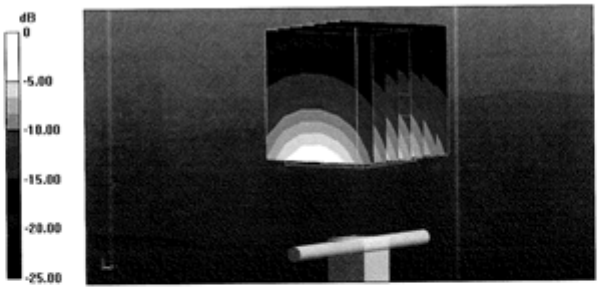
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.88 S/m; $\varepsilon_r$ = 37.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.76, 7.76, 7.76); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

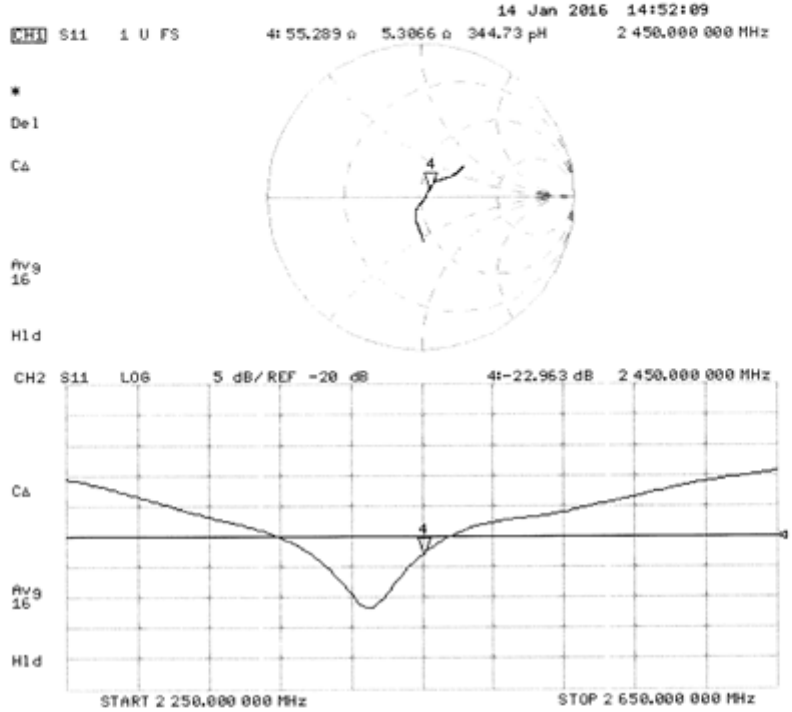
### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 113.8 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.7 W/kg
**SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.23 W/kg**
Maximum value of SAR (measured) = 22.1 W/kg




0 dB = 22.1 W/kg = 13.44 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 14.01.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz ; Type: D2450V2; Serial: D2450V2 - SN: 977**

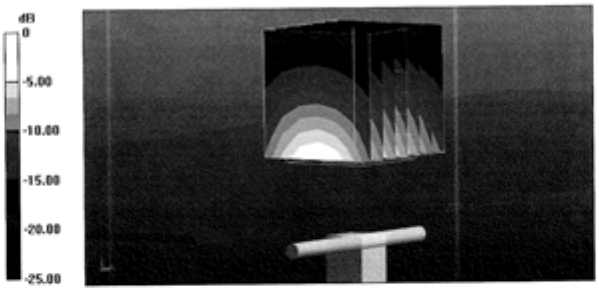
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.03 S/m; $\varepsilon_r$ = 52.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

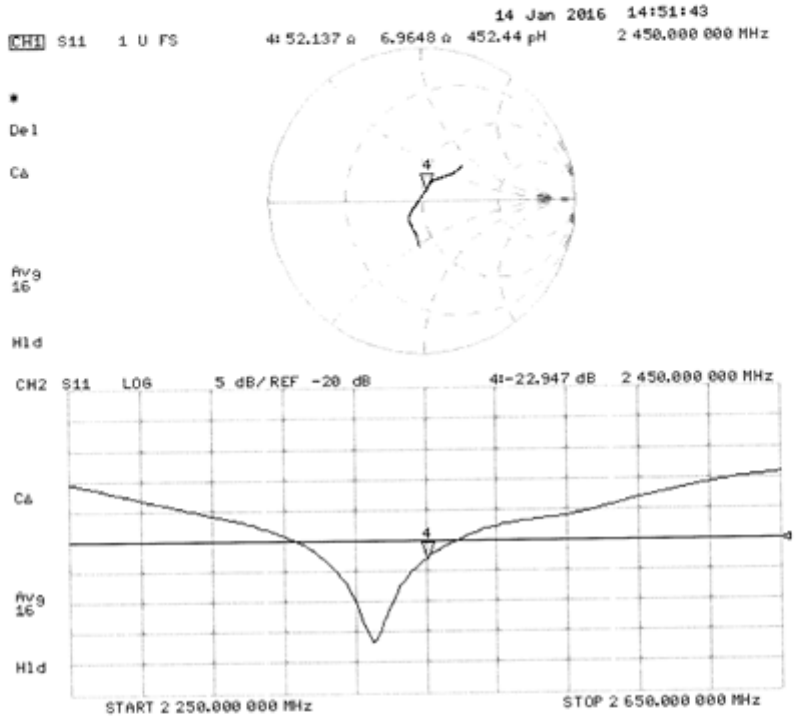
### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 107.4 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.5 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.14 W/kg**
Maximum value of SAR (measured) = 21.6 W/kg

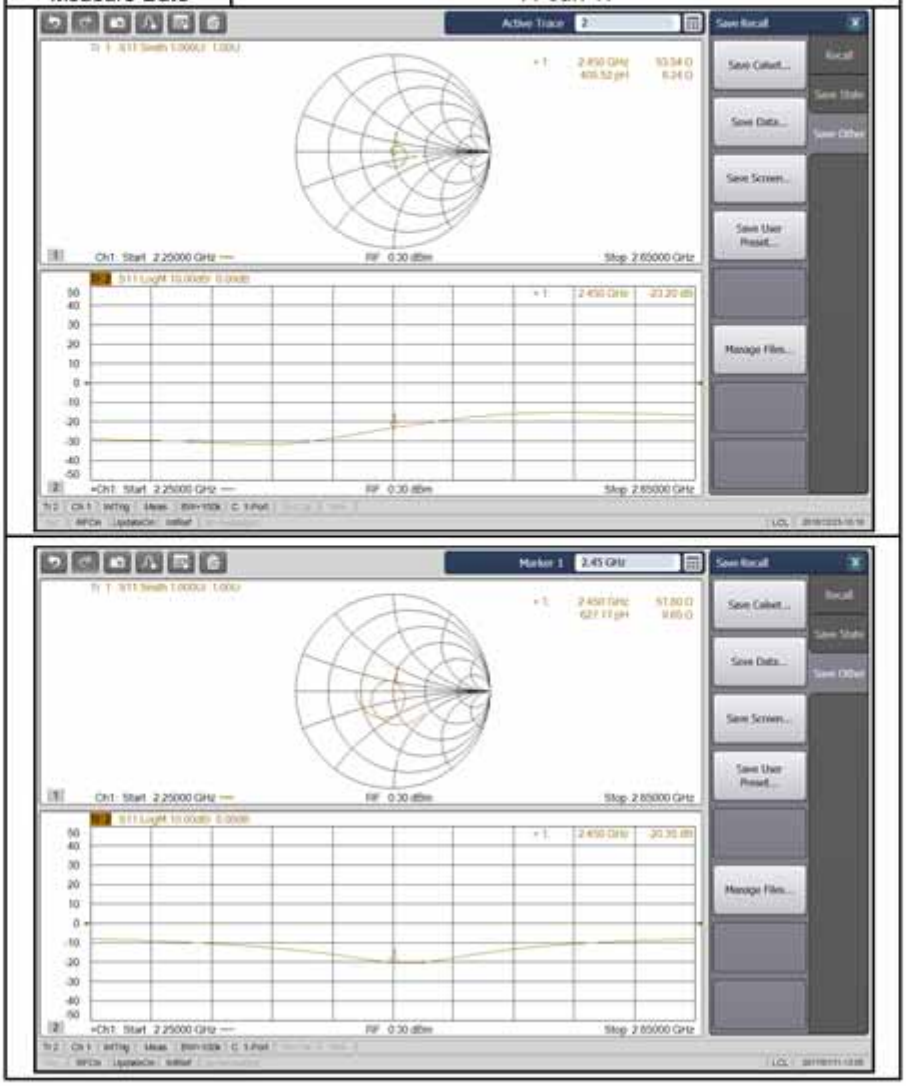



0 dB = 21.6 W/kg = 13.34 dBW/kg

## Impedance Measurement Plot for Body TSL



| Dipole2450 Head TSL | Target Value | | Measure Value | | Difference | |
|---|---|---|---|---|---|---|
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 55.3 | 5.3 | 53.5 | 6.2 | -1.8 | 0.9 |
| Return loss(dB) | -23.0 | | -23.2 | | 0.9% | |
| Measure Date | 23-Dec-16 | | | | | |
| Dipole2450 Body TSL | Target Value | | Measure Value | | Difference | |
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 52.1 | 7.0 | 51.8 | 9.7 | -0.3 | 2.7 |
| Return loss(dB) | -22.9 | | -20.4 | | -11.1% | |
| Measure Date | 11-Jan-17 | | | | | |



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

S Schweizerischer Kalibrierdienst
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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** UL (Song Shan Lake) Branch

**Certificate No: D5GHzV2-1231_Jan16/2**

# CALIBRATION CERTIFICATE (Replacement of No:D5GHzV2-1231_Jan16)

| | |
|---|---|
| Object | D5GHzV2 - SN: 1231 |
| Calibration procedure(s) | QA CAL-22.v2<br>Calibration procedure for dipole validation kits between 3-6 GHz |
| Calibration date: | January 13, 2016 |

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 EPM-442A | GB37480704 | 07-Oct-15 (No. 217-02222) | Oct-16 |
| Power sensor HP 8481A | US37292783 | 07-Oct-15 (No. 217-02222) | Oct-16 |
| Power sensor HP 8481A | MY41092317 | 07-Oct-15 (No. 217-02223) | Oct-16 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 01-Apr-15 (No. 217-02131) | Mar-16 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 01-Apr-15 (No. 217-02134) | Mar-16 |
| Reference Probe EX3DV4 | SN: 3503 | 31-Dec-15 (No. EX3-3503_Dec15) | Dec-16 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Jun-18 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Jeton Kastrati | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: March 14, 2016

**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 62209-2, "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
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

d) 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 | V52.8.8 |
| **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** | 5250 MHz ± 1 MHz<br>5600 MHz ± 1 MHz<br>5750 MHz ± 1 MHz | |

## Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 35.9 | 4.71 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 35.3 ± 6 % | 4.61 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL at 5250 MHz

| **SAR averaged over 1 cm$^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.08 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **80.5 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.32 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.1 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 | 34.8 ± 6 % | 4.97 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 | 8.42 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **83.8 W / kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.41 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.0 W/kg ± 19.5 % (k=2)** |

## Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 35.4 | 5.22 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 34.6 ± 6 % | 5.13 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL at 5750 MHz

| **SAR averaged over 1 cm³ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.21 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **81.7 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.33 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.1 W/kg ± 19.5 % (k=2)** |

## Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.9 | 5.36 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 47.2 ± 6 % | 5.40 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL at 5250 MHz

| **SAR averaged over 1 cm³ (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 | **76.1 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.16 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.4 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 | 46.6 ± 6 % | 5.87 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 | 8.10 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **80.4 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.27 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **22.5 W/kg ± 19.5 % (k=2)** |

## Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.3 | 5.94 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 46.3 ± 6 % | 6.09 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL at 5750 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 7.76 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **77.0 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.17 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.5 W/kg ± 19.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL at 5250 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 49.3 Ω - 5.8 jΩ |
| Return Loss | - 24.6 dB |

### Antenna Parameters with Head TSL at 5600 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 50.5 Ω - 0.8 jΩ |
| Return Loss | - 40.8 dB |

### Antenna Parameters with Head TSL at 5750 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 56.6 Ω + 0.9 jΩ |
| Return Loss | - 24.1 dB |

### Antenna Parameters with Body TSL at 5250 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 48.6 Ω - 4.0 jΩ |
| Return Loss | - 27.3 dB |

### Antenna Parameters with Body TSL at 5600 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 50.8 Ω + 1.4 jΩ |
| Return Loss | - 35.7 dB |

### Antenna Parameters with Body TSL at 5750 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 56.9 Ω + 3.0 jΩ |
| Return Loss | - 23.1 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.195 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 | May 04, 2015 |

## DASY5 Validation Report for Head TSL

Date: 12.01.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1231**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; $\sigma$ = 4.61 S/m; $\varepsilon_r$ = 35.3; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5600 MHz; $\sigma$ = 4.97 S/m; $\varepsilon_r$ = 34.8; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5750 MHz; $\sigma$ = 5.13 S/m; $\varepsilon_r$ = 34.6; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

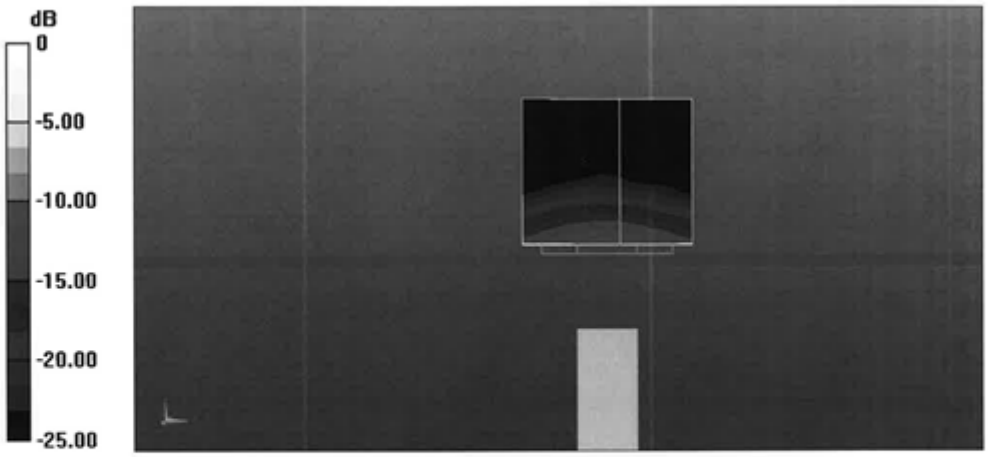
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.53, 5.53, 5.53); Calibrated: 31.12.2015, ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.95, 4.95, 4.95); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 74.26 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 29.6 W/kg
**SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.32 W/kg**
Maximum value of SAR (measured) = 18.6 W/kg

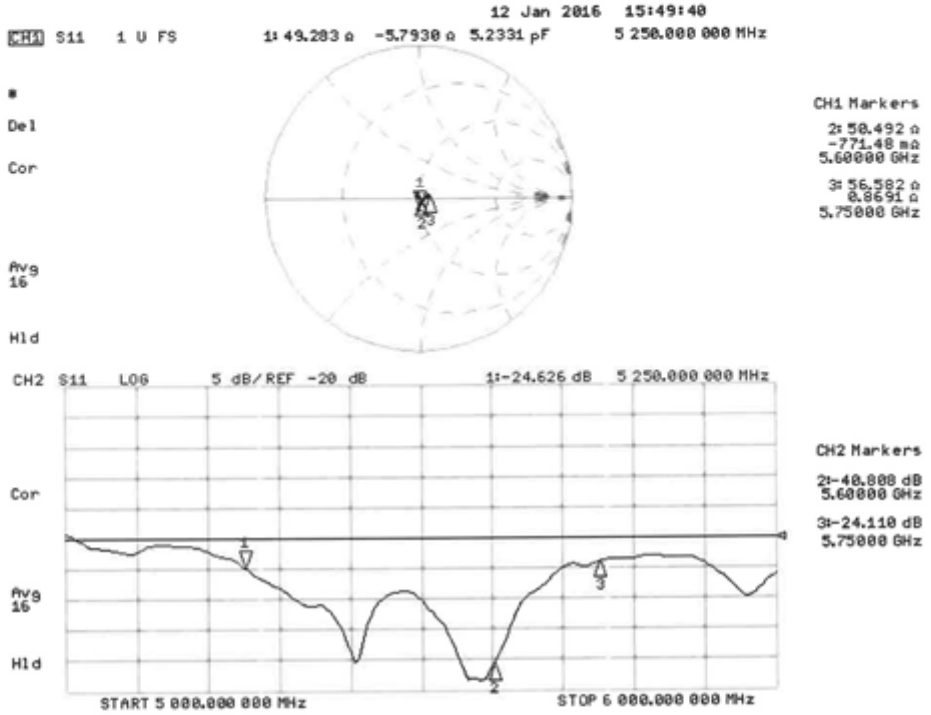
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 74.04 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 33.3 W/kg
**SAR(1 g) = 8.42 W/kg; SAR(10 g) = 2.41 W/kg**
Maximum value of SAR (measured) = 19.9 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.59 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 33.9 W/kg
**SAR(1 g) = 8.21 W/kg; SAR(10 g) = 2.33 W/kg**
Maximum value of SAR (measured) = 19.8 W/kg




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

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.01.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1231**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; $\sigma$ = 5.4 S/m; $\varepsilon_r$ = 47.2; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5600 MHz; $\sigma$ = 5.87 S/m; $\varepsilon_r$ = 46.6; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5750 MHz; $\sigma$ = 6.09 S/m; $\varepsilon_r$ = 46.3; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

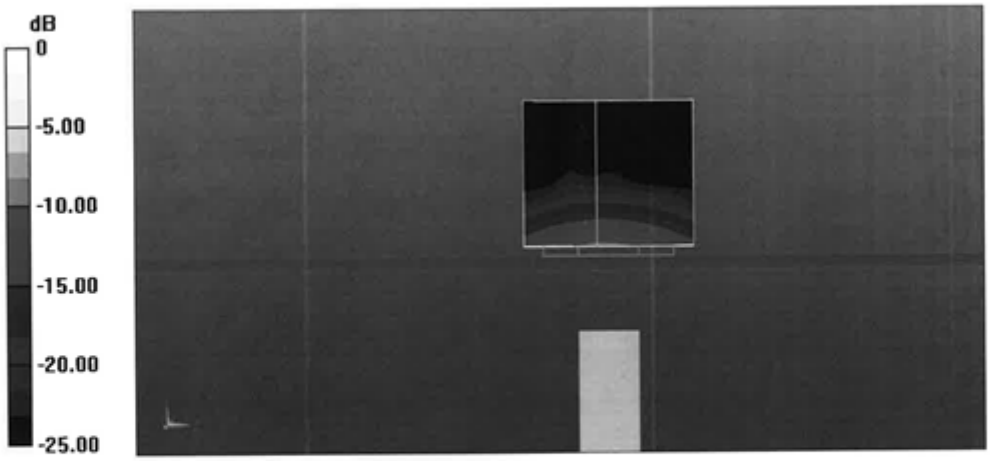
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.85, 4.85, 4.85); Calibrated: 31.12.2015, ConvF(4.35, 4.35, 4.35); Calibrated: 31.12.2015, ConvF(4.3, 4.3, 4.3); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.92 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 29.1 W/kg
**SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.16 W/kg**
Maximum value of SAR (measured) = 17.4 W/kg

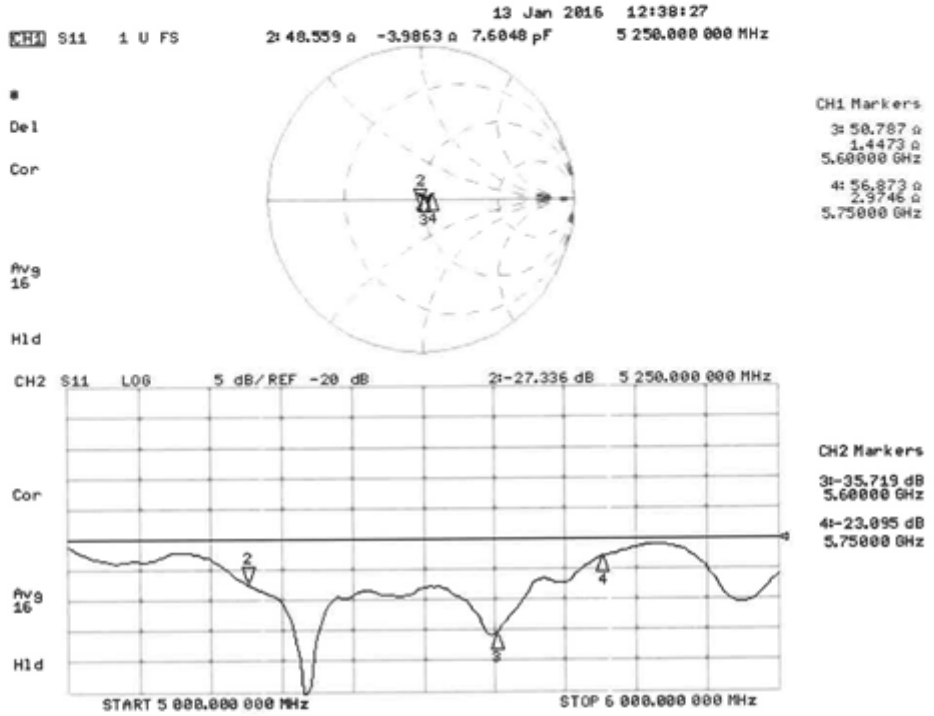
**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.32 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 33.8 W/kg
**SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.27 W/kg**
Maximum value of SAR (measured) = 19.3 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.32 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 33.5 W/kg
**SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.17 W/kg**
Maximum value of SAR (measured) = 18.7 W/kg

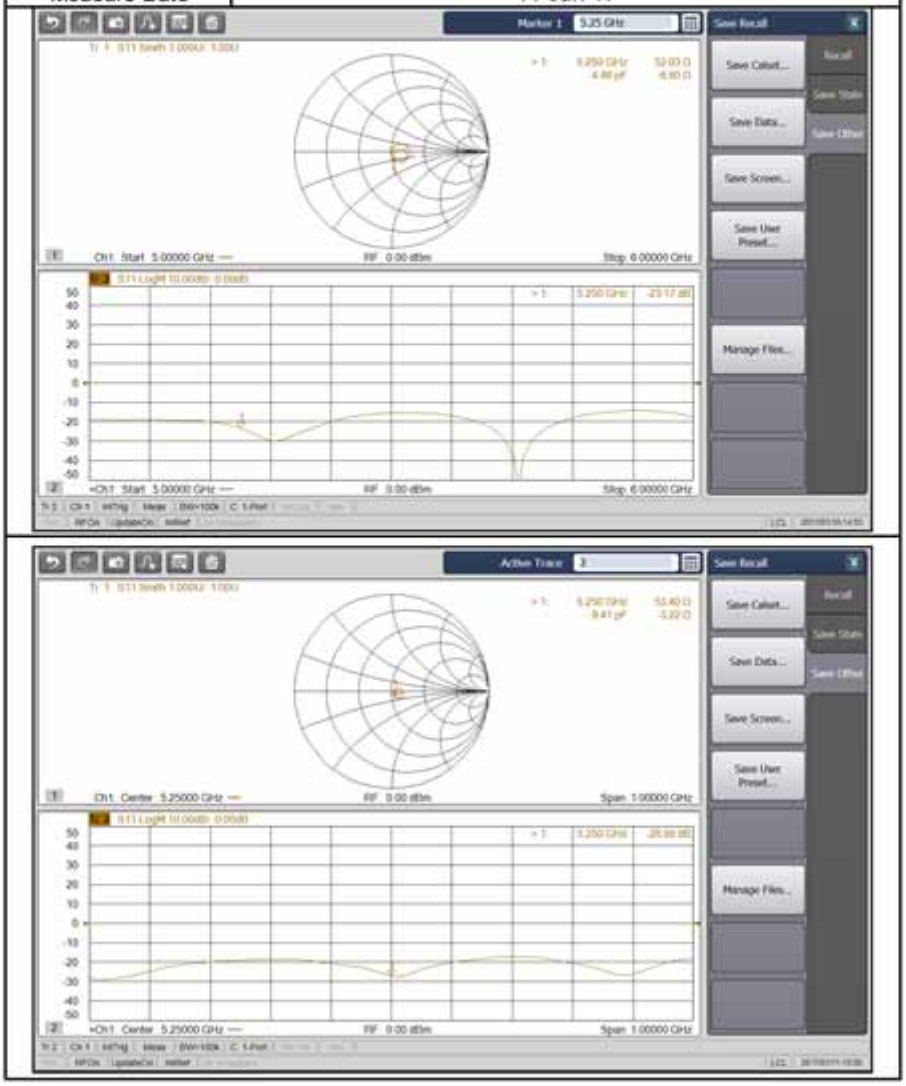



0 dB = 17.4 W/kg = 12.41 dBW/kg

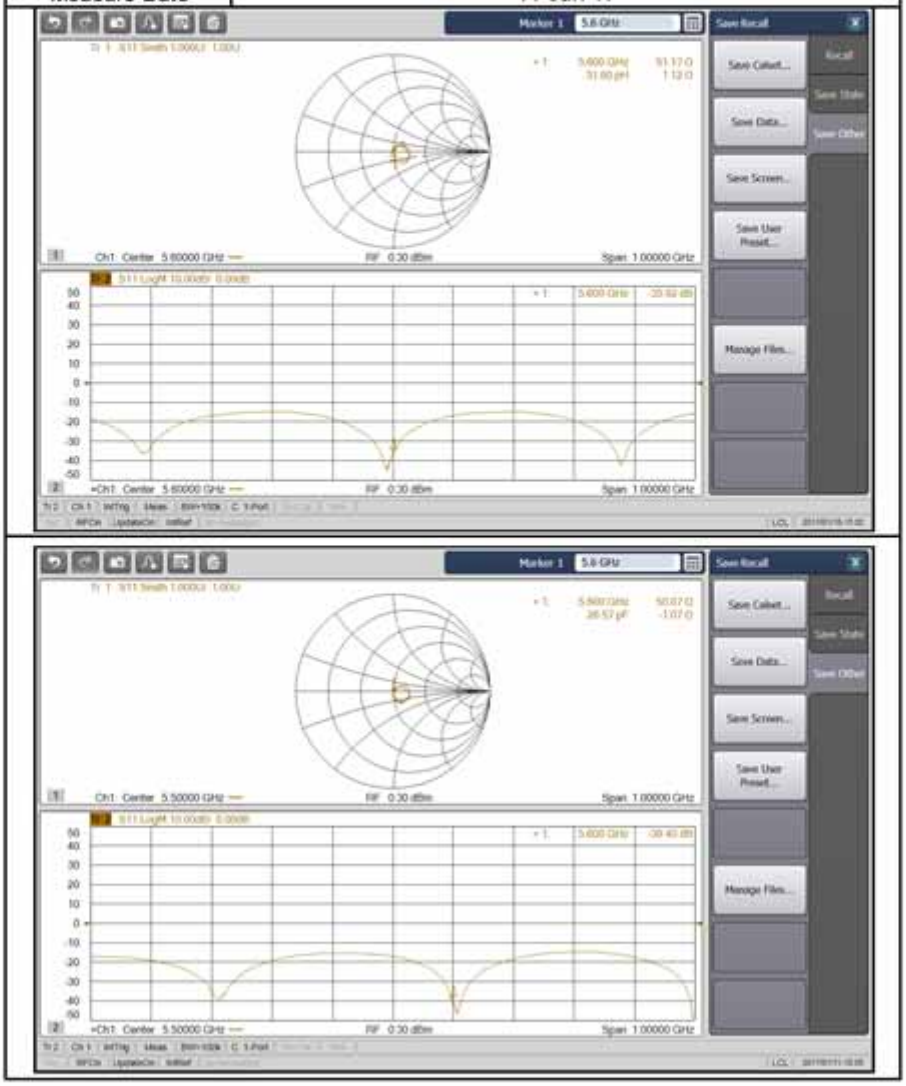
## Impedance Measurement Plot for Body TSL



| Dipole5250 Head TSL | Target Value | | Measure Value | | Difference | |
|---|---|---|---|---|---|---|
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 49.3 | -5.8 | 52.0 | -6.8 | 2.7 | -1.0 |
| Return loss(dB) | -24.6 | | -23.2 | | -5.8% | |
| Measure Date | 10-Jan-17 | | | | | |
| Dipole5250 Body TSL | Target Value | | Measure Value | | Difference | |
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 48.6 | -4.0 | 53.4 | -3.2 | 4.8 | 0.8 |
| Return loss(dB) | -27.3 | | -26.9 | | -1.5% | |
| Measure Date | 11-Jan-17 | | | | | |



| Dipole5600 Head TSL | Target Value | | Measure Value | | Difference | |
|---|---|---|---|---|---|---|
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 50.5 | -0.8 | 51.2 | 1.1 | 0.7 | 1.9 |
| Return loss(dB) | -40.8 | | -35.9 | | -12.0% | |
| Measure Date | 10-Jan-17 | | | | | |
| Dipole5600 Body TSL | Target Value | | Measure Value | | Difference | |
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 50.8 | 1.4 | 50.1 | -1.1 | -0.7 | -2.5 |
| Return loss(dB) | -35.7 | | -39.4 | | 10.4% | |
| Measure Date | 11-Jan-17 | | | | | |



| Dipole5750 Head TSL | Target Value | | Measure Value | | Difference | |
|---|---|---|---|---|---|---|
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 56.6 | 0.9 | 56.2 | 1.2 | -0.4 | 0.3 |
| Return loss(dB) | -24.1 | | -24.6 | | 2.0% | |
| Measure Date | 10-Jan-17 | | | | | |
| Dipole5750 Body TSL | Target Value | | Measure Value | | Difference | |
| | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) | R(Ω) | X(jΩ) |
| Impedance | 56.9 | 3.0 | 56.1 | 5.1 | -0.8 | 2.1 |
| Return loss(dB) | -23.1 | | -22.6 | | -2.4% | |
| Measure Date | 11-Jan-17 | | | | | |