SAR Evaluation Report

DUT Information

Manufacturer	Datalogic
Model Name	TASKBOOK SH10
FCC ID	U4FTBII
IC Number	3862D-TBII
Type / Category	tablet PC ☒ portable ☐ mixed mobile/portable
Intended Use	☐ ☐ next to the ear ☐ body-worn ☐ limb-worn ☐ hand-held ☐ front-of-face ☒ body supported ☐ clothing-integrated

Prepared by

Testing Laboratory	IMST GmbH, Test Center Carl-Friedrich-Gauß-Str. 2 – 4 47475 Kamp-Lintfort Germany
Laboratory Accreditation	The Test Center facility 'Dosimetric Test Lab' within IMST GmbH is accredited by the German National 'Deutsche Akkreditierungsstelle GmbH (DAkkS)' for testing according to the scope as listed in the accreditation certificate: D-PL-12139-01-00. The German Bundesnetzagentur (BNetzA) recognizes IMST GmbH as CAB-EMC on the basis of the Council Decision of 22. June 1998 concerning the conclusion of the MRA between the European Community and the United States of America (1999/178/EC) in accordance with § 4 of the Recognition Ordinance of 11. January 2016. The recognition is valid until 20. July 2021 under the registration number: BNetzA-CAB-16/21-14. IMST GmbH is recognized as a wireless testing laboratory to perform equipment testing in Canada under the terms of Phase I of the Canada-EU Comprehensive Economic and Trade Agreement (CETA) under CAB identifier: DE0010.

Prepared for

Applicant / Manufacturer	7layers GmbH Borsigstraße 11 40880 Ratingen Germany	Datalogic S.r.l. Via San Vitalino, 13 40012 Lippo di Calderara di Reno – Bologna Italy

Test Specification

Applied Rules/Standards	IEEE 1528-2013, FCC CFR 47 § 2.1093, RSS-102 Issue 5	
Exposure Category	☒ general public / uncontrolled exposure	☐ occupational / controlled exposure
Test Result	☒ PASS	☐ FAIL

Report Information

Data Stored	60320_6190898
Issue Date	July 31, 2019
Revision Date	
Revision Number	(A new revision replaces all previous revisions and thus, become invalid herewith)
Remarks	This report relates only to the item(s) evaluated. This report shall not be reproduced, except in its entirety, without the prior written approval of IMST GmbH. The results and statements contained in this report reflect the evaluation for the certain model described above. The manufacturer is responsible for ensuring that all production devices meet the intent of the requirements described in this report.

Table of Contents

1 Subject of Investigation

The TASKBOOK SH10 is tablet PC operating in 2.4 GHz and 5 GHz frequency range. It has two integrated antennas which are able to transmit simultaneously.

1.1 Technical Data of DUT

Product Specifications	
Manufacturer	Datalogic
Model Name / Number	TASKBOOK SH10
Brand Name	TASKBOOK
Serial Number of DUT	#.12.18.D6.000155 (SAR testing) / T19B00978 (output power testing)
IMST DUT Number	01 (SAR testing) / 02 (output power testing)
Hardware Version	7L2A (SAR testing) / 7L2C(output power testing)
Integrated Transmitter	SparkLAN Instruments WINFQ-258ACN(BT)
Operation Mode	BT, BTLE, IEEE 802.11 b/g/a/ac
Operation Frequency Range	2.4 GHz, 5 GHz
TX Antenna Type	2x integrated (1x WLAN/BT, 1x WLAN)
Usage Configuration	body-supported conditions
Max. Output Power	refer to chapter 6.2
Power Supply	internal Li-Ion
DUT Stage	☐ production unit ☒ identical prototype
Notes: -	

1.2 Picture of the DUT and Antenna Location

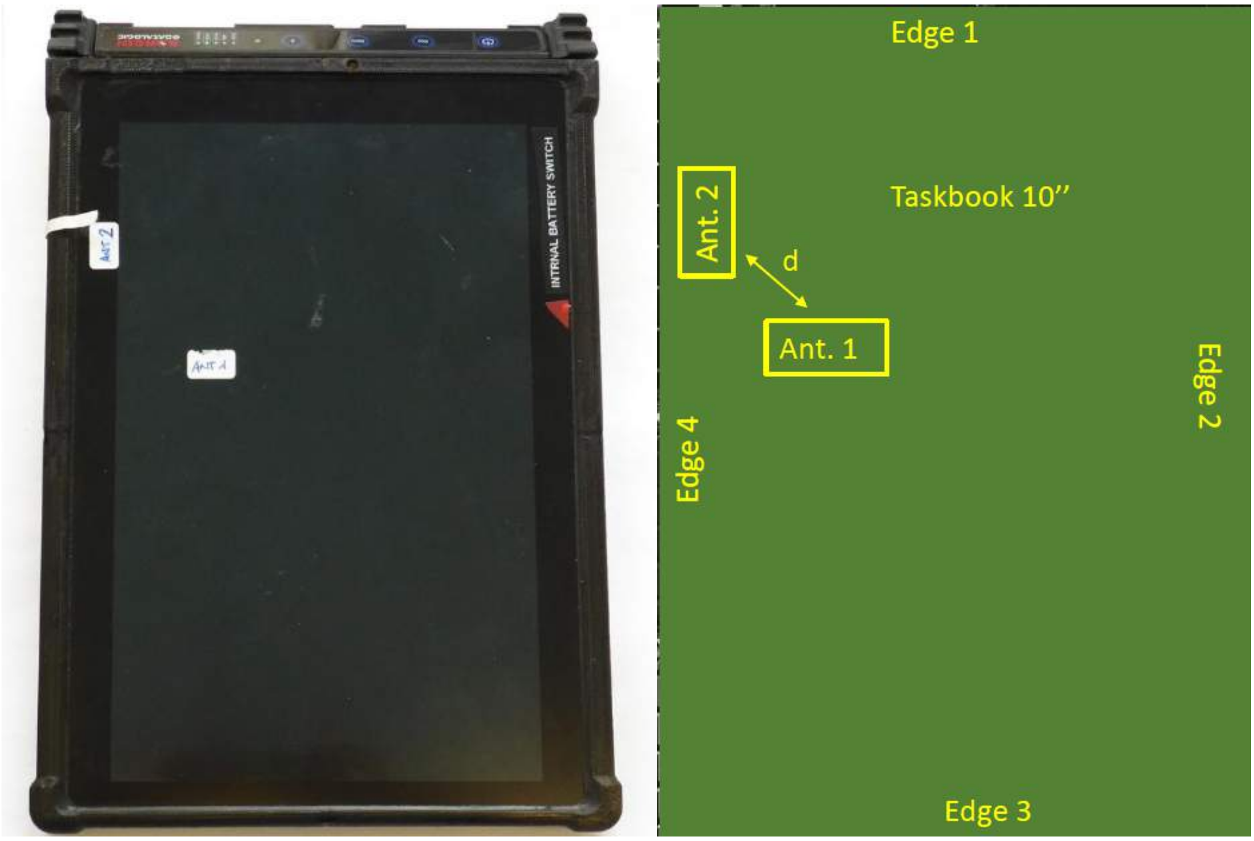

Fig. 1: Front view and antenna location of the DUT.

Antenna Type and Location		
Antenna	**BT/WLAN**	**WLAN**
Reference	Ant. 1	Ant. 2
Configuration Edge		
Distance to [mm]	**Ant. 1**	**Ant. 2**
Edge 1	105	82
Edge 2	103	172
Edge 3	145	161
Edge 4	40	7
Ant. 1 <> Ant. 2 (d)	51	

Table 1: Antenna location.

1.3 Test Specification / Normative References

The tests documented in this report were performed according to the standards and rules described below.

Test Specifications		
Test Standard / Rule	**Description**	**Issue Date**
☒ IEEE 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.	June 14, 2013
☐ FCC CFR 47 § 2.1091	Code of Federal Regulations; Title 47. Radiofrequency radiation exposure evaluation: **Mobile Devices.**	October 01, 2010
☒ FCC CFR 47 § 2.1093	Code of Federal Regulations; Title 47. Radiofrequency radiation exposure evaluation: **Portable Devices.**	October 01, 2010
☒ RSS-102, Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)	March, 2015
Measurement Methodology KDB		
☒ KDB 865664 D01 v01r04	SAR measurement 100 MHz to 6 GHz	August 07, 2015
☒ KDB 865664 D02 v01r01	Exposure Reporting	October 23, 2015
Product KDB		
☒ KDB 447498 D01 v06	General RF Exposure Guidance	October 23, 2015
☒ KDB 616217 D04 v01r02	SAR for Laptop and Tablets	October 23, 2015
Technology KDB		
☒ KDB 248227 D01 v02r02	802.11 Wi-Fi SAR	October 23, 2015

Table 2: Normative references.

1.4 Attestation of Test Results

Highest Reported SAR1g [W/kg]					
Exposure Conditions	**Equipment Class**			**SAR$_{1g}$ Limit [W/kg]**	
	DSS (Bluetooth)	**DTS (WLAN 2.4 GHz)**	**U-NII (WLAN 5 GHz)**		
Standalone Transmission	0.400*	0.484	1.316	1.6	PASS
Simultaneous Transmission	0.400*	0.491	1.745	1.6	PASS refer to chapter 8
Notes: Engineering test software has been used for WLAN measurements. All measured SAR results and considered configurations are shown in chapter 7. *Estimated SAR values according to Table 22.					

Table 3: Highest reported SAR results.

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Reviewed by: ....

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Quality Assurance

2 Exposure Criteria and Limits

2.1 SAR Limits

Human Exposure Limits				
Condition	**Uncontrolled Environment** (General Population)		**Controlled Environment** (Occupational)	
	SAR Limit [W/kg]	**Mass Avg.**	**SAR Limit [W/kg]**	**Mass Avg.**
SAR averaged over the whole body mass	0.08	whole body	0.4	whole body
Peak spatially-averaged SAR for the head, neck & trunk	1.6	1g of tissue*	8.0	1g of tissue*
Peak spatially-averaged SAR in the limbs	4.0	10g of tissue*	20.0	10g of tissue*
Note: *Defined as a tissue volume in the shape of a cube				

Table 4: SAR limits specified in IEEE Standard C95.1-2005 and Health Canada's Safety Code 6.

In this report the comparison between the exposure limits and the measured data is made using the spatial peak SAR; the power level of the device under test guarantees that the whole body averaged SAR is not exceeded.

2.2 Exposure Categories

General Public / Uncontrolled Exposure
General population comprises individuals of all ages and of varying health status, and may include particularly susceptible groups or individuals. In many cases, members of the public are unaware of their exposure to electromagnetic fields. Moreover, individual members of the public cannot reasonably be expected to take precautions to minimize or avoid exposure.
Occupational / Controlled Exposure
The occupationally exposed population consists of adults who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions.

Table 5: RF exposure categories.

2.3 Distinction between Maximum Permissible Exposure and SAR Limits

The biological relevant parameter describing the effects of electromagnetic fields in the frequency range of interest is the specific absorption rate SAR (dimension: power/mass). It is a measure of the power absorbed per unit mass. The SAR may be spatially averaged over the total mass of an exposed body or its parts. The SAR is calculated from the r.m.s. electric field strength *E* inside the human body, the conductivity σ and the mass density ρ of the biological tissue:

$$SAR = \sigma \frac{E^2}{\rho} = c \left. \frac{\partial T}{\partial t} \right|_{t \to 0+} \quad . \tag{1}$$

The specific absorption rate describes the initial rate of temperature rise $\partial T / \partial t$ as a function of the specific heat capacity *c* of the tissue. A limitation of the specific absorption rate prevents an excessive heating of the human body by electromagnetic energy.

As it is sometimes difficult to determine the SAR directly by measurement (e.g. whole body averaged SAR), the standard specifies more readily measurable maximum permissible exposures in terms of external electric *E* and magnetic field strength *H* and power density *S*, derived from the SAR limits. The limits for *E*, *H* and *S* have been fixed so that even under worst case conditions, the limits for the specific absorption rate SAR are not exceeded.

3 The Measurement System

DASY is an abbreviation of „Dosimetric Assessment System“ and describes a system that is able to determine the SAR distribution inside a phantom of a human being according to different standards. The DASY4 system consists of the following items as shown in Fig: 2. Additionally, Fig: 3 shows the equipment, similar to the installations in other laboratories.

- Fully compliant with all current measurement standards as stated in Fig. 4
- High precision robot with controller
- Measurement server (for surveillance of the robot operation and signal filtering)
- Data acquisition electronics DAE (for signal amplification and filtering)
- Field probes calibrated for use in liquids
- Electro-optical converter EOC (conversion from the optical into a digital signal)
- Light beam (improving of the absolute probe positioning accuracy)
- Two SAM phantoms filled with tissue simulating liquid
- DASY4 software
- SEMCAD

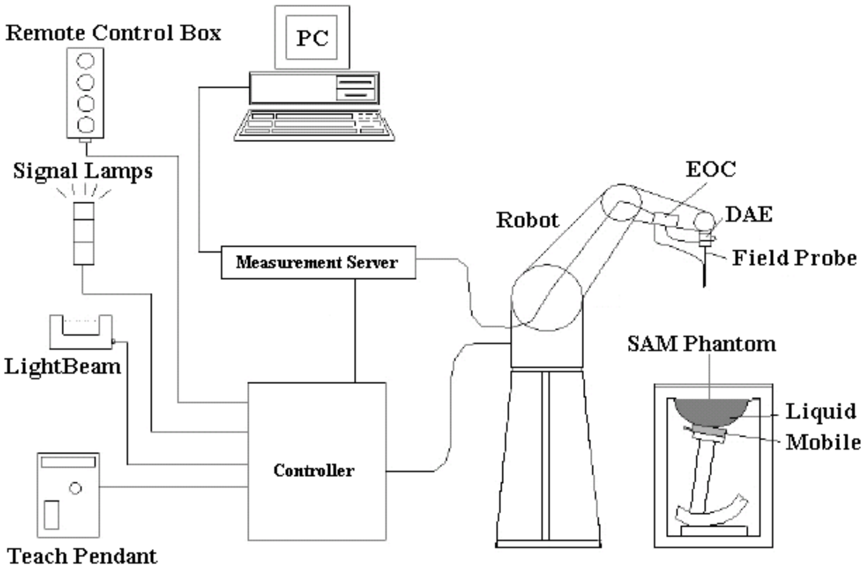


Fig. 2: The DASY4 measurement system.

Fig. 3: The measurement set-up with a DASY system and phantoms containing tissue simulating liquid.

The DUT operating at the maximum power level is placed by a non-metallic device holder (delivered from Schmid & Partner) in the above described positions at a shell phantom of a human being. The distribution of the electric field strength *E* is measured in the tissue simulating liquid within the shell phantom. For this miniaturised field probes with high sensitivity and low field disturbance are used. Afterwards the corresponding SAR values are calculated with the known electrical conductivity σ and the mass density ρ of the tissue in the SEMCAD FDTD software. The software is able to determine the averaged SAR values (averaging region 1 g or 10 g) for compliance testing.

The measurements are done by two scans: first a coarse scan determines the region of the maximum SAR afterwards the averaged SAR is measured in a second scan within the shape of a cube.

3.1 Phantoms

TWIN SAM PHANTOM V4.0	
	Specific Anthropomorphic Mannequin defined in IEEE 1528 and IEC 62209-1 and delivered by Schmid & Partner Engineering AG. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. The details and the Certificate of conformity can be found in Fig. 5.
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)
Dimensions	Length: 1000 mm; Width: 500 mm Height: adjustable feet
Filling Volume	approx. 25 liters

ELI PHANTOM V4.0	
	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. The details and the Certificate of conformity can be found in Fig. 8
Shell Thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	approx. 30 liters

3.2 E-Field-Probes

For the measurements the Dosimetric E-Field Probes ET3DV6R or EX3DV4 with following specifications are used. They are manufactured and calibrated in accordance with FCC and IEEE 1528-2013 recommendations annually by Schmid & Partner Engineering AG.

ET3DV6R	
Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system (ET3DV6 only) Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Dimensions	Overall length: 337 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm
Frequency	10 MHz to 2.3 GHz Linearity: ± 0.2 dB (30 MHz to 2.3 GHz)
Directivity	Axial isotropy: ± 0.2 dB in TSL (rotation around probe axis) Spherical isotropy: ± 0.4 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Calibration Range	450 MHz / 750 MHz / 835 MHz / 1750 MHz / 1900 MHz for head and body simulating liquid

EX3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	Axial isotropy: ± 0.3 dB in TSL (rotation around probe axis) Spherical isotropy: ± 0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Calibration Range	2450 MHz / 2600 MHz / 5250 MHz / 5600 MHz / 5800 MHz for head and body simulating liquid

4 Measurement Procedure

4.1 General Requirement

The test shall be performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature shall be in the range of 20°C to 26°C and 30-70% humidity. All tests have been conducted according the latest version of all relevant KDBs.

4.2 Measurement Procedure

The following steps are used for each test position:

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile phone and the base station simulator is established via air interface.
- Measurement of the local E-field value at a fixed location (P1). This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with resolution settings for area scan and zoom scan according KDB 865664 D01 as shown in Table *6*.
- The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard´s method [DASY4].
- Repetition of the E-field measurement at the fixed location (P1) and repetition of the whole procedure if the two results differ by more than ± 0.21dB.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>≥ 3 GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 - 3 GHz: ≤ 12 mm</td><td>3 - 4 GHz: ≤ 12 mm
4 - 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: ΔX_{Zoom}, ΔY_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 - 3 GHz: ≤ 5 mm*</td><td>3 - 4 GHz: ≤ 5 mm*
4 - 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">Uniform grid: $\Delta Z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 - 4 GHz: ≤ 4 mm
4 - 5 GHz: ≤ 3 mm
5 - 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta Z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 - 4 GHz: ≤ 3 mm
4 - 5 GHz: ≤ 2.5 mm
5 - 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta Z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta Z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 - 4 GHz: ≥ 28 mm
4 - 5 GHz: ≥ 25 mm
5 - 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium: see EEE 1528-2013 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz</td></tr>
</table>

Table 6: Parameters for SAR scan procedures.

4.3 Additional Information for IEEE 802.11 (WiFi) Transmitters

For both DSSS and OFDM wireless modes an Initial Test Position must be established for each applicable exposure configuration using either:

- Design implementation defined by the manufacturer, or
- Investigative results by the test lab based on:
  - Exclusions based on the distance from the antenna to the surface, or
  - Highest measured SAR from the area-scan-only measurements on all applicable test positions at the Initial Test Configuration, if found to require SAR tests.

Then, the initial test position procedure defines the required complete SAR scan measurements on each exposure configuration as following:

- When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurements is not required for the remaining test positions in that configuration as well as 802.11 transmission mode combinations within the frequency or aggregated band.
- When the reported SAR of the initial test position is > 0.4 W/kg, further SAR measurements is required in the initial test position or next closest/smallest test separation distance based on manufacturer justification, on the following highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions are tested.
- When the reported SAR for all initial and subsequent test positions is > 0.8 W/kg, further SAR measurements is required on these positions on the subsequent next highest measured output power channels, until the reported SAR is ≤ 1.2 W/kg or all required channels have been tested.

For OFDM transmission configurations in 2.4 GHz and 5 GHz bands, it is important to determine SAR Initial Test Configuration for each stand alone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units. The procedure is as following:

- Highest output power channel is chosen; if there are channels with same maximum output power then the closest to the mid-band frequency is preferred. If there are more than one channel with same maximum output power and same distance to the mid-band frequency, then the channel with the higher frequency is preferred.
- When SAR measurement is required for a subsequent test configuration and the channel bandwidth is smaller than that in the initial test configuration, all channels in the subsequent test configuration that overlap with the larger bandwidth channel tested in the initial test configuration should be used to determine the highest maximum output power channel in the subsequent test configuration.

Along with the initial test position reduction guidelines, the following procedures are also applied to SAR measurement requirements when multiple OFDM configurations are supported:

- When the reported SAR of the initial test configuration with the highest output power channel is > 0.8 W/kg, further SAR measurements is required for next highest output power channel in the initial test configuration, until the reported SAR is ≤ 1.2 W/kg or all required channels have been tested.

- When the reported SAR of the subsequent test configuration with the highest output power channel is > 1.2 W/kg, further SAR measurements is required for next highest output power channel in this test configuration, until the reported SAR is ≤ 1.2 W/kg or all required channels have been tested.
- When the reported SAR of the subsequent test configuration is > 1.2 W/kg, further SAR measurements for the following subsequent test configurations are required.

4.4 Measurement Variability

According KDB 865664 repeated measurements are required only when the measured SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with ≤ 20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required.

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

5 System Verification and Test Conditions

5.1 Date of Testing

Date of Testing			
Band	**Frequency [MHz]**	**Date of System Check**	**Date of SAR Measurement**
IEEE 802.11 b/g	2450	July 04, 2019	July 04 - 05, 2019
IEEE 802.11 a/ac	5250 / 5600 / 5800	July 23, 2019	July 23 - 24, 2019

Table 7: Date of testing.

5.2 Environment Conditions

Environment Conditions		
Ambient Temperature[°C]	**Liquid Temperature [°C]**	**Humidity [%]**
22.0 ± 2	22.0 ± 2	40.0 ± 10
Notes: To comply with the required noise level (less than 12 mW/kg) periodically measurements without a DUT were conducted.		

Table 8: Environment Conditions.

5.3 Tissue Simulating Liquid Recipes

Tissue Simulating Liquid								
Frequency Range		**Water**	**Tween 20**	**Tween 80**	**Salt**	**Preventol**	**DGME**	**Triton X/100**
[MHz]		**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
Head Tissue								
☐	300	50.4	47.3	-	2.2	0.1	-	-
☐	450	50.8	47.5	-	1.6	0.1	-	-
☐	700 - 1000	52.8	46.0	-	1.1	0.1	-	-
☐	1600 - 1800	55.4	44.1	-	0.4	0.1	-	-
☐	1850 - 1980	55.2	44.5	-	0.2	0.1	-	-
☐	2000 - 2700	55.7	45.2	-	-	0.1	-	-
☐	5000 - 6000	65.5	-	-	-	-	17.25	17.25
Body Tissue								
☐	300	70.3	28.6	-	1.0	0.1	-	-
☐	450	71.0	28.0	-	0.9	0.1	-	-
☐	700 - 1000	71.2	28.0	-	0.7	0.1	-	-
☐	1600 - 1800	71.4	28.0	-	0.5	0.1	-	-
☐	1850 - 1980	71.5	28.0	-	0.4	0.1	-	-
☒	2000 - 2700	71.6	28.0	-	0.3	0.1	-	-
☒	5000 - 6000	79.9	-	20.0	-	0.1	-	-
Notes: Used liquid for measurement is checked above.								

Table 9: Recipes of the tissue simulating liquid.

5.4 Tissue Simulating Liquid Parameters

For the measurement of the following parameters the Speag DAK-3.5 dielectric probe kit is used, representing the open-ended coaxial probe measurement procedure.

Recommended values for the dielectric parameters of the tissue simulating liquids are given in IEEE 1528 and FCC published RF Exposure KDB Procedures. All tests were carried out using liquids with dielectric parameters within +/- 5% of the recommended values. The dielectric properties of the tissue simulating liquid have been measured within 24 h before SAR testing. The depth of the tissue simulant was at least 15.0 cm for all system check and device tests, measured from the ear reference point in case of the SAM phantom and from the inner surface of the flat phantom.

Tissue Simulating Liquids								
Ambient / Liquid Temperature(C) : 22.0 ± 2						Humidity (%) : 40.0 ± 10		
Band	**Frequency**	**Channel**	**Permittivity**			**Conductivity**		
			Measured	**Target**	**Delta**	**Measured**	**Target**	**Delta**
	[MHz]		**ε'**	**ε'**	**+/- 5 [%]**	**σ [S/m]**	**σ [S/m]**	**+/- 5 [%]**
WLAN 2.4 GHz	*2450*	*System Check*	*52.2*	*52.7*	*-1.0*	*2.02*	*1.95*	*3.3*
	2412	1	52.3	52.8	-0.8	1.97	1.91	2.9
	2437	6	52.2	52.7	-0.9	2.00	1.94	3.1
	2462	11	52.1	52.7	-1.0	2.03	1.96	3.2
WLAN 5 GHz	*5250.0*	*System Check*	*48.5*	*48.9*	*-0.9*	*5.36*	*5.36*	*0.0*
	5180.0	36	48.7	49.0	-0.7	5.25	5.28	-0.6
	5240.0	48	48.5	49.0	-0.9	5.34	5.35	-0.2
	5260.0	52	48.5	48.9	-0.9	5.38	5.37	0.1
	5320.0	64	48.4	48.9	-1.0	5.46	5.44	0.3
	5600.0	System Check	47.7	48.5	-1.7	5.89	5.77	2.1
	5500.0	100	47.9	48.6	-1.5	5.74	5.65	1.5
	5520.0	104	47.9	48.6	-1.5	5.77	5.67	1.7
	5580.0	116	47.7	48.5	-1.6	5.85	5.74	1.8
	5600.0	120	47.7	48.5	-1.7	5.89	5.77	2.1
	5620.0	124	47.6	48.4	-1.7	5.92	5.79	2.3
	5680.0	136	47.5	48.4	-1.8	6.00	5.86	2.4
	5700.0	140	47.4	48.3	-1.9	6.03	5.88	2.6
	5800.0	*System Check*	*47.2*	*48.2*	*-2.0*	*6.20*	*6.00*	*3.3*
	5745.0	149	47.3	48.3	-2.1	6.13	5.94	3.2
	5765.0	153	47.3	48.2	-2.0	6.16	5.96	3.5
	5785.0	157	47.3	48.2	-2.0	6.18	5.98	3.3
	5805.0	161	47.2	48.2	-2.1	6.20	6.01	3.2
Notes:								

Table 10: Parameters of the tissue simulating liquid.

5.5 Simplified Performance Checking

The simplified performance check was realized using the dipole validation kit. The input power of the dipole antenna was 250 mW (CW) and it was placed under the flat part of the SAM phantom. The target and measured results are listed in the Table 11 and shown in Appendix C - System Verification Plots. The target values were adopted from the calibration certificates found also in the appendix.

System Check Results										
Frequency [MHz]	Dipole #SN	SAR Values with Body TSL [W/kg]								Date
		Measured				Target		Delta		
		with 250 mW		scaled to 1 W		normalized to 1 W		+/- 10 [%]		
		1g	10g	1g	10g	1g	10g	1g	10g	
2450	D2450V2 #709	13.90	6.47	55.60	25.88	51.20	24.00	8.59	7.83	July 04, 19
5250	D5GHzV2 #1028	18.10	5.08	72.40	20.32	74.90	21.10	-3.34	-3.70	July 23, 19
5600	D5GHzV2 #1028	19.10	5.34	76.40	21.36	79.10	22.20	-3.41	-3.78	July 23, 19
5800	D5GHzV2 #1028	17.60	4.89	70.40	19.56	76.40	21.30	-7.85	-8.17	July 23, 19

Table 11: Dipole target and measured results.

6 Measurement Conditions

6.1 SAR Test Conditions

Test Conditions			
Band	TX Range [MHz]	Crest Factor	Phantom
IEEE 802.11 b/g	2412 - 2462	1	SAM Twin Phantom V4.0
IEEE 802.11 a/ac	5180 - 5825	1	
Notes: Engineering test software has been used for WLAN measurements.			

Table 12: Used frequency range and crest factors during the test.

6.2 Tune-Up Information

6.2.1 Maximum Transmitting Output Power Values

Output Power Tune-Up Information for Bluetooth					
Band	Mode	Frequency Range [MHz]	Channel	Averaged Output Power (RMS) [dBm]	
				Nominal Target	Tune-Up Limit
Bluetooth	Classic + EDR	2402	0	5.0	6.0
		2441	39	5.0	6.0
		2480	78	5.0	6.0
	Low Energy	2402	0	0.0	1.0
		2440	19	0.0	1.0
		2480	39	0.0	1.0
Notes:					

Table 13: Maximum transmitting output power for Bluetooth declared by the manufacturer.

Output Power Tune-Up Information for WLAN 2.4 GHz					
Band / Mode		Frequency Range [MHz]	Channel	Averaged Output Power (RMS) [dBm]	
				Nominal Target	Tune-Up Limit
2.4 GHz DSSS	802.11b	2412	1	19.0	19.5
		2437	6	20.0	20.5
		2462	11	19.0	19.5
		2467	12	/	/
		2472	13	/	/
2.4 GHz OFDM	802.11g	2412	1	17.0	17.5
		2437	6	20.0	20.5
		2462	11	17.0	17.5
		2467	12	/	/
		2472	13	/	/
	802.11n HT20	2412	1	16.5	17.0
		2437	6	20.0	20.5
		2462	11	16.0	16.5
		2467	12	/	/
		2472	13	/	/
	802.11n HT40	2422	3	14.0	14.5
		2437	6	19.0	19.5
		2452	9	11.0	11.5
		2457	10	11.0	11.5
☒	Product hardware has the capability to operate on channel 12 and 13. However, these channels will be disabled via software and will not be accessible to user.				
Notes:					

Table 14: Maximum transmitting output power for 2.4 GHz WLAN declared by the manufacturer.

Output Power Tune-Up Information for WLAN 5.2 GHz					
Band / Mode		**Frequency Range [MHz]**	**Channel**	**Averaged Output Power (RMS) [dBm]**	
				Nominal Target	**Tune-Up Limit**
5.2 GHz Sub-1 / U-NII-1	**802.11a**	5180	36	13.5	14.0
		5200	40	15.5	16.0
		5220	44	15.5	16.0
		5240	48	15.0	15.5
	802.11ac VHT20	5180	36	14.0	14.5
		5200	40	15.5	16.0
		5220	44	15.5	16.0
		5240	48	15.0	15.5
	802.11ac VHT40	5190	38	10.5	11.0
		5230	46	15.5	16.0
	802.11ac VHT80	5210	42	10.5	11.0
5.3 GHz Sub-2 / U-NII-2A	**802.11a**	5260	52	15.0	15.5
		5280	56	13.5	14.0
		5300	60	15.5	16.0
		5320	64	15.0	15.5
	802.11ac VHT20	5260	52	15.0	15.5
		5280	56	13.5	14.0
		5300	60	15.5	16.0
		5320	64	15.0	15.5
	802.11ac VHT40	5270	54	15.0	15.5
		5310	62	13.0	13.5
	802.11ac VHT80	5290	58	12.5	13.0
Notes:					

Table 15: Maximum transmitting output power for 5.2 GHz WLAN declared by the manufacturer

Output Power Tune-Up Information for WLAN 5.5 GHz					
Band / Mode		Frequency Range [MHz]	Channel	Averaged Output Power (RMS) [dBm]	
				Nominal Target	Tune-Up Limit
5.5 GHz Sub-3 / U-NII-2C	**802.11a**	5500	100	13.5	14.0
		5520	104	12.0	12.5
		5540	108	12.5	13.0
		5560	112	12.5	13.0
		5580	116	13.5	14.0
		5600	120	15.5	16.0
		5620	124	14.5	14.5
		5640	128	14.5	14.5
		5660	132	15.0	15.5
		5680	136	15.0	15.5
		5700	140	13.5	14.5
		5720	144	9.5	10.0
	802.11ac VHT20	5500	100	14.0	14.5
		5520	104	12.0	12.5
		5540	108	12.5	13.0
		5560	112	12.5	13.0
		5580	116	14.5	15.0
		5600	120	15.5	16.0
		5620	124	14.5	14.5
		5640	128	14.5	14.5
		5660	132	14.5	14.5
		5680	136	14.5	14.5
		5700	140	13.5	14.0
		5720	144	9.5	10.0
	802.11ac VHT40	5510	102	10.5	11.0
		5550	110	11.5	12.0
		5590	118	14.5	15.0
		5630	126	14.5	15.0
		5670	134	13.5	14.0
		5710	142	10.0	10.5
	802.11ac VHT80	5530	106	12.5	13.0
		5610	122	14.0	14.5
		5690	138	11.0	11.5
Notes:					

Table 16: Maximum transmitting output power for 5.5 GHz WLAN declared by the manufacturer

Output Power Tune-Up Information for WLAN 5.8 GHz					
Band / Mode		Frequency Range [MHz]	Channel	Averaged Output Power (RMS) [dBm]	
				Nominal Target	Tune-Up Limit
5.8 GHz Sub-4 / U-NII-3	802.11a	5745	149	13.5	14.5
		5765	153	15.5	16.0
		5785	157	15.5	16.0
		5805	161	15.5	16.0
		5825	165	15	15.5
	802.11ac VHT20	5745	149	12.5	13.0
		5765	153	15.5	16.0
		5785	157	15.5	16.0
		5805	161	15	15.5
		5825	165	14.5	15.0
	802.11ac VHT40	5755	151	10.0	10.5
		5795	159	15.0	15.5
	802.11ac VHT80	5775	155	10.5	11.0
Notes:					

Table 17: Maximum transmitting output power for 5.8 GHz WLAN declared by the manufacturer.

6.3 Measured Output Power

6.3.1 Conducted Output Power for WLAN 2.4 GHz

Measured Avg. Output Power for 2.4 GHz [dBm]							
Band	Mode	Frequency	CH	ANT 1		ANT 2	
[GHz]	IEEE 802.11	[MHz]		Measured Avg. Power	Note	Measured Avg. Power	Note
2.4 DSSS	b	2412	1	18.80	1	18.20	1
		2437	6	19.70		20.00	
		2462	11	18.90		19.20	
2.4 OFDM	g/n				2		2
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.						
Note 2:	SAR test reduction according to KDB 248227, Sec. 5.2.2., when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or when KDB 447498 D01 SAR test exclusion applies to the OFDM configuration.						

Table 18: Conducted output power of DUT for WLAN 2.4 GHz.

Measured Avg. Output Power for 5.2 GHz [dBm]								
Band	Mode		Frequency	CH	ANT 1		ANT 2	
[GHz]	IEEE 802.11		[MHz]		Measured Avg. Power	Note	Measured Avg. Power	Note
5.2 U-NII-1	a		5180	36	13.10	1	13.50	1
			5200	40	15.20		15.40	
			5220	44	15.30		15.50	
			5240	48	15.00		14.80	
	ac	VHT20/40/80				2		2
5.3 U-NII-2A	a		5260	52	15.10	1	15.30	1
			5280	56	12.20		12.20	
			5300	60	15.30		14.40	
			5320	64	14.40		13.50	
	ac	VHT20/40/80				2		2
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.							
Note 2:	SAR test reduction according to KDB 248227, Sec. 5.2.2., when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or when KDB 447498 D01 SAR test exclusion applies to the OFDM configuration.							

Table 19: Conducted output power of DUT for WLAN 5.2 GHz.

Measured Avg. Output Power for 5.5 GHz [dBm]								
Band	Mode		Frequency	CH	ANT 1		ANT 2	
[GHz]	IEEE 802.11		[MHz]		Measured Avg. Power	Note	Measured Avg. Power	Note
5.5 U-NII-2C	a		5500	100	13.20	1	12.30	1
			5520	104	10.80		10.70	
			5540	108	12.30		11.40	
			5560	112	11.20		11.10	
			5580	116	12.10		12.00	
			5600	120	15.10		14.60	
			5620	124	13.40		13.70	
			5640	128	13.60		14.20	
			5660	132	15.50		15.30	
			5680	136	15.50		15.40	
			5700	140	13.00		13.20	
			5720	144	8.40		8.70	
	ac	VHT20/40/80	5580	116	13.20	2	12.7	2
			5600	120	14.90		14.20	
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.							
Note 2:	SAR test reduction according to KDB 248227, Sec. 5.2.2., when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or when KDB 447498 D01 SAR test exclusion applies to the OFDM configuration.							

Table 20: Conducted output power of DUT for WLAN 5.5 GHz.

Measured Avg. Output Power for 5.8 GHz[dBm]								
Band	**Mode**		**Frequency**	**CH**	**ANT 1**		**ANT 2**	
					Measured Avg. Power	**Note**	**Measured Avg. Power**	**Note**
[GHz]	**IEEE 802.11**		**[MHz]**					
5.8 U-NII-3	**a**		5745	149	14.00	1	13.90	1
			5765	153	16.00		15.80	
			5785	157	15.70		15.80	
			5805	161	14.90		15.30	
			5825	165	14.70		15.00	
	ac	**VHT20/40/80**				2		2
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.							
Note 2:	SAR test reduction according to KDB 248227, Sec. 5.2.2., when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg or when KDB 447498 D01 SAR test exclusion applies to the OFDM configuration.							

Table 21: Conducted output power of DUT for WLAN 5.8 GHz.

6.4 Standalone SAR Test Exclusion

SAR test exclusion is determined for the DUT according to KDB 447498 D01 with 1g SAR exclusion thresholds for 100 MHz to 6GHz at test separation distances ≤ 50 mm determined by:

*[(max power of channel. incl. tune-up tolerance. mW) / (min test separation distance. mm)] * [√f(GHz)]*

≤ 3.0 for 1g SAR and ≤ 7.5 for 10g extremity SAR, where

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

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

Transmission Scenario for FCC Test Exclusion Considerations							
Exposure Position	Antenna	ANT / CHAIN 1					
	Mode	BT	IEEE 802.11b/g/n	IEEE 802.11a/n/ac			
	Frequency [GHz]	2.440	2.437	5.200	5.300	5.600	5.785
	Frame Avg. Power [dBm]	6.0	20.5	16.0	16.0	16.0	16.0
	Frame Avg. Power [mW]	4.0	112.2	39.8	39.8	39.8	39.8
Back	Antenna to user [mm]	5.0	5.0	5.0	5.0	5.0	5.0
	SAR exclusion threshold	1.2	35.0	18.2	18.3	18.8	19.2
	SAR testing required?	**no**	**yes**	**yes**	**yes**	**yes**	**yes**
	Estimated SAR [W/kg]	0.17	measured	measured	measured	measured	measured
Edge 1	Antenna to user [mm]	105.0	105.0	105.0	105.0	105.0	105.0
	SAR exclusion threshold	646.0	646.1	615.8	615.2	613.4	612.4
	SAR testing required?	**no**	**no**	**no**	**no**	**no**	**no**
	Estimated SAR [W/kg]	0.40	0.40	0.40	0.40	0.40	0.40
Edge 2	Antenna to user [mm]	103.0	103.0	103.0	103.0	103.0	103.0
	SAR exclusion threshold	626.0	626.1	595.8	595.2	593.4	592.4
	SAR testing required?	**no**	**no**	**no**	**no**	**no**	**no**
	Estimated SAR [W/kg]	0.40	0.40	0.40	0.40	0.40	0.40
Edge 3	Antenna to user [mm]	145.0	145.0	145.0	145.0	145.0	145.0
	SAR exclusion threshold	1046.0	1046.1	1015.8	1015.2	1013.4	1012.4
	SAR testing required?	**no**	**no**	**no**	**no**	**no**	**no**
	Estimated SAR [W/kg]	0.40	0.40	0.40	0.40	0.40	0.40
Edge 4	Antenna to user [mm]	40.0	40.0	40.0	40.0	40.0	40.0
	SAR exclusion threshold	0.2	4.4	2.3	2.3	2.4	2.4
	SAR testing required?	**no**	**yes**	**no**	**no**	**no**	**no**
	Estimated SAR [W/kg]	0.02	measured	0.30	0.31	0.31	0.32

Table 22: Antenna 1: SAR test exclusion for body-supported exposure configuration against different device edges according to KDB 447498.

Transmission Scenario for FCC Test Exclusion Considerations						
Exposure Position	Antenna	ANT / CHAIN 2				
	Mode	IEEE 802.11b/g/n	IEEE 802.11a/n/ac			
	Frequency [GHz]	2.437	5.200	5.300	5.600	5.785
	Frame Avg. Power [dBm]	20.5	16.0	16.0	16.0	16.0
	Frame Avg. Power [mW]	112.2	39.8	39.8	39.8	39.8
Back	Antenna to user [mm]	5.0	5.0	5.0	5.0	5.0
	SAR exclusion threshold	35.0	18.2	18.3	18.8	19.2
	SAR testing required?	**yes**	**yes**	**yes**	**yes**	**yes**
	Estimated SAR [W/kg]	measured	measured	measured	measured	measured
Edge 1	Antenna to user [mm]	82.0	82.0	82.0	82.0	82.0
	SAR exclusion threshold	416.1	385.8	385.2	383.4	382.4
	SAR testing required?	**no**	**no**	**no**	**no**	**no**
	Estimated SAR [W/kg]	0.40	0.40	0.40	0.40	0.40
Edge 2	Antenna to user [mm]	172.0	172.0	172.0	172.0	172.0
	SAR exclusion threshold	1316.1	1285.8	1285.2	1283.4	1282.4
	SAR testing required?	**no**	**no**	**no**	**no**	**no**
	Estimated SAR [W/kg]	0.40	0.40	0.40	0.40	0.40
Edge 3	Antenna to user [mm]	161.0	161.0	161.0	161.0	161.0
	SAR exclusion threshold	1206.1	1175.8	1175.2	1173.4	1172.4
	SAR testing required?	**no**	**no**	**no**	**no**	**no**
	Estimated SAR [W/kg]	0.40	0.40	0.40	0.40	0.40
Edge 4	Antenna to user [mm]	7.0	7.0	7.0	7.0	7.0
	SAR exclusion threshold	25.0	13.0	13.1	13.5	13.7
	SAR testing required?	**yes**	**yes**	**yes**	**yes**	**yes**
	Estimated SAR [W/kg]	measured	measured	measured	measured	measured

Table 23: Antenna 2: SAR test exclusion for body-supported exposure configuration against different device edges according to KDB 447498.

When the standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas the standalone SAR must be estimated according to KDB 447498 in order to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel including tune-up tolerance. mW)/(min. test separation distance. mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm;*

  where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR

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

- *0.4 W/kg for 1g SAR and 1.0 W/kg for 10g SAR. when the test separation distance is > 50 mm*

6.5 SAR Test Exclusion Consideration according to RSS-102

Transmission Scenario for ISED Test Exclusion Considerations							
Exposure Position	Antenna	ANT / CHAIN 1					
	Mode	BT	IEEE 802.11b/g/n	IEEE 802.11a/n/ac			
	Frequency [GHz]	2.440	2.437	5.200	5.300	5.600	5.785
	Frame Avg. Power [dBm]	6.0	20.5	16.0	16.0	16.0	16.0
	Frame Avg. Power [mW]	4.0	112.2	39.8	39.8	39.8	39.8
Back	Antenna to user [mm]	5.0	5.0	5.0	5.0	5.0	5.0
	SAR exclusion threshold	4.0	4.0	2.1	2.0	1.5	1.0
	SAR testing required?	no	yes	yes	yes	yes	yes
Edge 1	Antenna to user [mm]	105.0	105.0	105.0	105.0	105.0	105.0
	SAR exclusion threshold	310.0	310.0	278.0	258.0	179.0	112.0
	SAR testing required?	no	no	no	no	no	no
Edge 2	Antenna to user [mm]	103.0	103.0	103.0	103.0	103.0	103.0
	SAR exclusion threshold	310.0	310.0	278.0	258.0	179.0	112.0
	SAR testing required?	no	no	no	no	no	no
Edge 3	Antenna to user [mm]	145.0	145.0	145.0	145.0	145.0	145.0
	SAR exclusion threshold	310.0	310.0	278.0	258.0	179.0	112.0
	SAR testing required?	no	no	no	no	no	no
Edge 4	Antenna to user [mm]	40.0	40.0	40.0	40.0	40.0	40.0
	SAR exclusion threshold	173.5	173.5	166.0	157.0	119.5	87.9
	SAR testing required?	no	no	no	no	no	no

Table 24: Antenna 1: SAR test exclusion for the applicable transmitter according to RSS-102, section 2.5.1.

Transmission Scenario for Test Exclusion Considerations						
Exposure Position	Antenna	ANT / CHAIN 2				
	Mode	IEEE 802.11b/g/n	IEEE 802.11a/n/ac			
	Frequency [GHz]	2.437	5.200	5.300	5.600	5.785
	Frame Avg. Power [dBm]	20.5	16.0	16.0	16.0	16.0
	Frame Avg. Power [mW]	112.2	39.8	39.8	39.8	39.8
Back	Antenna to user [mm]	5.0	5.0	5.0	5.0	5.0
	SAR exclusion threshold	4.0	2.1	2.0	1.5	1.0
	SAR testing required?	yes	yes	yes	yes	yes
Edge 1	Antenna to user [mm]	82.0	82.0	82.0	82.0	82.0
	SAR exclusion threshold	310.0	278.0	258.0	179.0	112.0
	SAR testing required?	no	no	no	no	no
Edge 2	Antenna to user [mm]	172.0	172.0	172.0	172.0	172.0
	SAR exclusion threshold	310.0	278.0	258.0	179.0	112.0
	SAR testing required?	no	no	no	no	no
Edge 3	Antenna to user [mm]	161.0	161.0	161.0	161.0	161.0
	SAR exclusion threshold	310.0	278.0	258.0	179.0	112.0
	SAR testing required?	no	no	no	no	no
Edge 4	Antenna to user [mm]	7.0	7.0	7.0	7.0	7.0
	SAR exclusion threshold	4.0	2.1	2.0	1.5	1.0
	SAR testing required?	yes	yes	yes	yes	yes

Table 25: Antenna 2: SAR test exclusion for the applicable transmitter according to RSS-102, section 2.5.1.

7 SAR Test Results

The tables below contain the measured SAR values averaged over a mass of 1g. SAR assessment was conducted in the worst case configuration with output power values according to Table 18 – Table 21. According to KDB 447498 D01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance limit shown in Table 14 – Table 17.

Reported SAR is calculated by the following formulas:

- Scaling factor tune up limit = tune-up limit power (mW) / RF power (mW)
- Scaling factor max. duty cycle = max. possible duty cycle / used duty cycle for SAR measurement
- Reported SAR = measured SAR * scaling factor tune up limit * scaling factor max. duty cycle

The plots with the highest measured SAR values are shown in

Appendix B - SAR Distribution Plots.

SAR Results for WLAN 2.4 GHz												
ANT 1												
Band [GHz]	**Mode 802.11**	**Frequency [MHz]**	**CH**	**DUT Test Position**	**Gap [mm]**	**Picture No.**	**Measured SAR_{1g} [W/kg]**	**Drift [dBm]**	**Tune-Up SF**	**Reported SAR_{1g} [W/kg]**	**Plot No.**	**Note**
2.4 DSSS	**b**	2437	6	back	0	3	0.261	-0.141	1.202	0.314	1	1
				edge 4	0	3	0.006	0.152	1.202	0.007		
		2412	1	back	0	3	0.207	0.116	1.175	0.243		
		2462	11	back	0	3	0.248	-0.020	1.148	0.285		
ANT 2												
Band [GHz]	**Mode 802.11**	**Frequency [MHz]**	**CH**	**DUT Test Position**	**Gap [mm]**	**Picture No.**	**Measured SAR_{1g} [W/kg]**	**Drift [dBm]**	**Tune-Up SF**	**Reported SAR_{1g} [W/kg]**	**Plot No.**	**Note**
2.4 DSSS	**b**	2437	6	back	0	3	0.176	0.098	1.122	0.197		1
				edge 4	0	3	0.431	-0.062	1.122	0.484	2	
		2412	1	edge 4	0	3	0.352	0.165	1.349	0.475		
		2462	11	edge 4	0	3	0.276	0.000	1.072	0.296		
Note*:	Channels 12 and 13 are disabled by manufacturer and will not be accessible to user.											
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.											

Table 26: SAR results for WLAN 2.4 GHz.

SAR Results for WLAN 5.2 GHz												
ANT 1												
Band [GHz]	Mode 802.11	Frequency [MHz]	CH	DUT Test Position	Gap [mm]	Picture No.	Measured SAR_{1g} [W/kg]	Drift [dBm]	Tune-Up SF	Reported SAR_{1g} [W/kg]	Plot No.	Note
5.3 U-NII-2A	a	5300	60	back	0	3	0.470	-0.117	1.175	0.552	3	1,2
ANT 2												
Band [GHz]	Mode 802.11	Frequency [MHz]	CH	DUT Test Position	Gap [mm]	Picture No.	Measured SAR_{1g} [W/kg]	Drift [dBm]	Tune-Up SF	Reported SAR_{1g} [W/kg]	Plot No.	Note
5.3 U-NII-2A	a	5300	60	back	0	3	0.618	-0.195	1.445	0.893	4	1,2,3
		5320	64	back	0	3	0.556	0.016	1.585	0.881		
		5300	60	edge 4	0	3	0.416	-0.182	1.445	0.601		
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.											
Note 2:	When the same max. output power is specified for both bands, begin SAR measurement in U-NII-2A by applying the OFDM SAR requirements. If the highest reported SAR is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.											
Note 3:	When the reported SAR is > 0.8 W/kg, SAR measurement is tested for the subsequent next highest output power channels until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.											

Table 27: SAR results for WLAN 5.2 GHz.

SAR Results for WLAN 5.5 GHz												
ANT 1												
Band [GHz]	Mode 802.11	Frequency [MHz]	CH	DUT Test Position	Gap [mm]	Picture No.	Measured SAR_{1g} [W/kg]	Drift [dBm]	Tune-Up SF	Reported SAR_{1g} [W/kg]	Plot No.	Note
5.5 U-NII-2C	a	5500	100	back	0	3	0.563	-0.036	1.202	0.677		1,2
		5600	120	back	0	3	1.070	-0.103	1.230	1.316	5	
		5660	132	back	0	3	0.841	-0.197	1.000	0.841		
		5700	140	back	0	3	0.390	-0.183	1.413	0.551		
	ac VHT20	5580	116	back	0	3	0.691	0.132	1.514	1.046		1,2,3
		5600	120	back	0	3	0.972	0.128	1.288	1.252		
ANT 2												
Band [GHz]	Mode 802.11	Frequency [MHz]	CH	DUT Test Position	Gap [mm]	Picture No.	Measured SAR_{1g} [W/kg]	Drift [dBm]	Tune-Up SF	Reported SAR_{1g} [W/kg]	Plot No.	Note
5.5 U-NII-2C	a	5600	120	back	0	3	0.311	0.191	1.380	0.429	6	1
		5600	120	edge 4	0	3	0.186	-0.001	1.380	0.257		
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.											
Note 2:	When the reported SAR is > 0.8 W/kg, SAR measurement is tested for the subsequent next highest output power channels until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.											
Note 3:	When the highest reported SAR for the initial test configuration is > 1.2 W/kg, SAR measurement is tested for the subsequent test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.											

Table 28: SAR results for WLAN 5.5 GHz.

SAR Results for WLAN 5.8 GHz												
ANT 1												
Band [GHz]	Mode 802.11	Frequency [MHz]	CH	DUT Test Position	Gap [mm]	Picture No.	Measured SAR_{1g} [W/kg]	Drift [dBm]	Tune-Up SF	Reported SAR_{1g} [W/kg]	Plot No.	Note
5.8 U-NII-3	a	5785	157	back	0	3	0.489	0.017	1.072	0.524	7	1,2
ANT 2												
Band [GHz]	Mode 802.11	Frequency [MHz]	CH	DUT Test Position	Gap [mm]	Picture No.	Measured SAR_{1g} [W/kg]	Drift [dBm]	Tune-Up SF	Reported SAR_{1g} [W/kg]	Plot No.	Note
5.8 U-NII-3	a	5785	157	back	0	3	0.313	0.197	1.047	0.328	8	1,2
		5785	157	edge 4	0	3	0.173	0.184	1.047	0.181		
Note 1:	SAR Test reduction according to KDB 248227, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11 a/g/n/ac mode is used for SAR measurement.											
Note 2:	When the reported SAR is > 0.8 W/kg, SAR measurement is tested for the subsequent next highest output power channels until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.											

Table 29: SAR results for WLAN 5.8 GHz.

Results for SAR Measurement Variability									
ANT 1									
Frequency Band	Mode	DUT Test Position	Highest Measured	1st Repeated Measurement		2nd Repeated Measurement		3rd Repeated Measurement	
			SAR_{1g} [W/kg]	SAR_{1g} [W/kg]	SAR Ratio	SAR_{1g} [W/kg]	SAR Ratio	SAR_{1g} [W/kg]	SAR Ratio
2450	b	back	0.261	NR	/				
5300	a	back	0.470	NR	/				
5600	a	back	1.070	1.080	1.01	NR			
5800	a	back	0.489	NR	/				
ANT 2									
Frequency Band	Mode	DUT Test Position	Highest Measured	1st Repeated Measurement		2nd Repeated Measurement		3rd Repeated Measurement	
			SAR_{1g} [W/kg]	SAR_{1g} [W/kg]	SAR Ratio	SAR_{1g} [W/kg]	SAR Ratio	SAR_{1g} [W/kg]	SAR Ratio
2450	b	edge 4	0.431	NR	/				
5300	a	back	0.618	NR	/				
5600	a	back	0.311	NR	/				
5800	a	back	0.313	NR	/				
Note:	SAR measurement variability according to chapter 4.4. 2nd and 3rd repeated measurement are not required since the ratio of the largest to smallest SAR for the original and 1st repeated measurement is < 1.20.								

Table 30: Results for SAR measurement variability.

8 Simultaneous Transmission Consideration

Simultaneous Transmission Capabilities of DUT		
ANT1 WLAN	**ANT1 Bluetooth**	**ANT2 WLAN**
V	X	V
X	V	V
Notes: Only WLAN of Ant1 + Ant 2, or BT of Ant1 + Ant 2 are able to transmit simultaneously.		

Table 31: Simultaneous transmission capabilities.

For the following simultaneous transmission analysis the worst case SAR results shown in Table 26 – Table 29 have been used.

According to KDB 447498, the following table gives an overview about the ∑SAR for simultaneous transmitting modes. When ∑SAR > 1.6 W/kg. a SAR test exclusion is determined by the SAR to peak location separation ratio. The ratio is determined by $(SAR1 + SAR2)^{1.5}/Ri$ rounded to two decimal digits and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. Where Ri is the separation distance between the peak SAR locations for the antenna pair in mm. When SAR is measured for both antennas in a pair the peak location separation distance is computed by the square root of $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$ where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the area scans or extrapolated peak SAR locations in the zoom scans as appropriate.

SAR for Standalone Transmission					
Exposure Position of DUT	**ANT 1 Highest reported SAR [W/kg]**			**ANT 2 Highest reported SAR [W/kg]**	
	DSS [T1]	**DTS [T2]**	**U-NII [T3]**	**DTS [T4]**	**U-NII [T5]**
back	0.400*	0.314	1.316	0.197	0.429
edge 1	0.400*	0.400*	0.400*	0.400*	0.400*
edge 2	0.400*	0.400*	0.400*	0.400*	0.400*
edge 3	0.400*	0.400*	0.400*	0.400*	0.400*
edge 4	0.400*	0.007	0.320*	0.484	0.601
Notes: *Estimated SAR values according to Table 22.					

Table 32: Highest reported SAR for standalone transmission.

Simultaneous Transmission Analysis							
Exposure Position of DUT	**ANT 1 Highest reported SAR [W/kg]**			**ANT 2 Highest reported SAR [W/kg]**		**Σ SAR1g [W/kg]**	**SPLSR Analysis**
	DSS [T1]	**DTS [T2]**	**U-NII [T3]**	**DTS [T4]**	**U-NII [T5]**		
back	0.400*			0.197		0.597	NO
	0.400*				0.429	0.829	NO
		0.314		0.197		0.511	NO
		0.314			0.429	0.743	NO
			1.316	0.197		1.513	NO
			1.316		0.429	**1.745**	**YES**
edge 1	0.400*			0.400*		0.800	NO
	0.400*				0.400*	0.800	NO
		0.400*		0.400*		0.800	NO
		0.400*			0.400*	0.800	NO
			0.400*	0.400*		0.800	NO
			0.400*		0.400*	0.800	NO
edge 2	0.400*			0.400*		0.800	NO
	0.400*				0.400*	0.800	NO
		0.400*		0.400*		0.800	NO
		0.400*			0.400*	0.800	NO
			0.400*	0.400*		0.800	NO
			0.400*		0.400*	0.800	NO
edge 3	0.400*			0.400*		0.800	NO
	0.400*				0.400*	0.800	NO
		0.400*		0.400*		0.800	NO
		0.400*			0.400*	0.800	NO
			0.400*	0.400*		0.800	NO
			0.400*		0.400*	0.800	NO
edge 4	0.400*			0.484		0.884	NO
	0.400*				0.601	1.001	NO
		0.007		0.484		0.491	NO
		0.007			0.601	0.608	NO
			0.320*	0.484		0.804	NO
			0.320*		0.601	0.921	NO

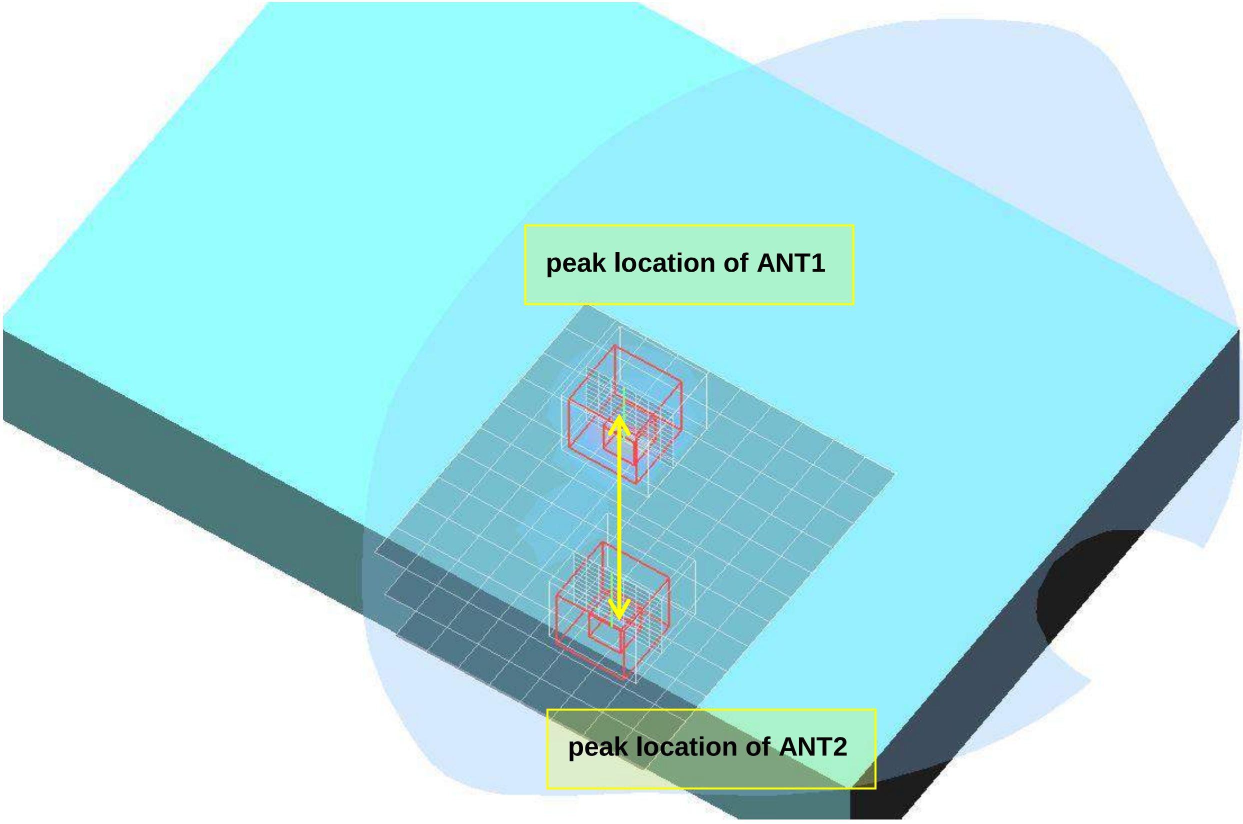
Notes: Analysis taken into consideration of the simultaneous transmission capabilities is shown in Table 31.
*Estimated SAR values according to Table 22.

Table 33: SAR for simultaneous transmission scenario.

8.1 SPLSR Evaluation Analysis

SPLSR Analysis								
Exposure Position of DUT	**TX ANT**	**Highest Reported SAR**	**Coordinates of Peak Location**			**Pair of TX ANT**	**Calculated Ri (mm)**	**SPLSR**
			X	**Y**	**Z**			
back	1	1.316	209.037	663.107	-746.432	1 + 2	61.9	**0.037**
back	2	0.429	261.944	695.288	-745.497			
Notes: Volume SAR scan for simultaneous transmission is not required because SPLSR is < 0.04.								

Table 34: Results of SPLSR analysis.



9 Administrative Measurement Data

9.1 Calibration of Test Equipment

Test Equipment Overview						
	Test Equipment	**Manufacturer**	**Model**	**Serial Number**	**Last Calibration**	**Next Calibration**
DASY System Components						
☒	Software Versions DASY4	SPEAG	V4.7	N/A	N/A	N/A
☒	Software Versions SEMCAD	SPEAG	V1.8	N/A	N/A	N/A
☐	Dosimetric E-Field Probe	SPEAG	ET3DV6R	1579	02/2018	02/2019
☐	Dosimetric E-Field Probe	SPEAG	ET3DV6R	1669	02/2019	02/2020
☒	Dosimetric E-Field Probe	SPEAG	EX3DV4	3536	09/2018	09/2019
☐	Dosimetric E-Field Probe	SPEAG	EX3DV4	3860	09/2017	09/2018
☐	Data Acquisition Electronics	SPEAG	DAE 3	335	02/2019	02/2020
☒	Data Acquisition Electronics	SPEAG	DAE 4	631	09/2018	09/2019
☒	Phantom	SPEAG	SAM	1059	N/A	N/A
☒	Phantom	SPEAG	SAM	1176	N/A	N/A
☐	Phantom	SPEAG	SAM	1340	N/A	N/A
☐	Phantom	SPEAG	SAM	1341	N/A	N/A
☐	Phantom	SPEAG	ELI4	1004	N/A	N/A
Dipoles						
☐	System Validation Dipole	SPEAG	D450V2	1014	03/2018	03/2021
☐	System Validation Dipole	SPEAG	D835V2	470	03/2018	03/2021
☐	System Validation Dipole	SPEAG	D1640V2	311	09/2018	09/2021
☐	System Validation Dipole	SPEAG	D1750V2	1005	03/2018	03/2021
☐	System Validation Dipole	SPEAG	D1900V2	535	03/2018	03/2021
☒	System Validation Dipole	SPEAG	D2450V2	709	11/2018	11/2021
☐	System Validation Dipole	SPEAG	D2600V2	1019	11/2018	11/2021
☒	System Validation Dipole	SPEAG	D5GHzV2	1028	05/2017	05/2020
Material Measurement						
☒	Network Analyzer	Agilent	E5071C	MY46103220	08/2017	08/2019
☒	Dielectric Probe Kit	SPEAG	DAK-3.5	1234	02/2018	02/2020
☒	Thermometer	LKMelectronic	DTM3000	3511	02/2018	02/2020
Power Meters and Sensors						
☒	Power Meter	Anritsu	ML2487A	6K00002319	06/2018	06/2020
☒	Power Sensor	Anritsu	MA2472A	990365	06/2018	06/2020
☒	Power Meter	Anritsu	ML2488A	6K00002078	06/2018	06/2020
☒	Power Sensor	Anritsu	MA2472A	002122	06/2018	06/2020
☒	Spectrum Analyzer	Rohde & Schwarz	FSP7	100433	04/2018	04/2020
RF Sources						
☒	Network Analyzer	Agilent	E5071C	MY46103220	08/2017	08/2019
☐	RF Generator	Rohde & Schwarz	SM300	100142	N/A	N/A
Amplifiers						
☐	Amplifier 10 MHz – 4200 MHz	Mini Circuits	ZHL-42-42W	D080504-1	N/A	N/A
☒	Amplifier 2 GHz – 6 GHz	Ciao Wireless	CA26-451	37452	N/A	N/A
Radio Tester						
☐	Radio Communication Tester	Anritsu	MT8815B	6200576536	04/2018	04/2020
☐	Radio Communication Tester	Anritsu	MT8820C	6200918336	04/2018	04/2020
Notes: Used test equipment for measurement is checked above.						

Table 35: Calibration of test equipment.

9.2 Uncertainty Assessment

Uncertainty Budget for SAR Measurements according to IEEE 1528-2013 (300 MHz - 6 GHz)								
Error Sources	**Uncertainty Value [± %]**	**Probability Distribution**	**Divisor**	**ci**	**ci**	**Standard Uncertainty [± %]**		**vi² or veff**
Measurement System				1g	10g	1g	10g	
Probe calibration	6.7	Normal	1	1	1	6.7	6.7	∞
Axial isotropy	0.3	Rectangular	√3	√0.5	√0.5	0.1	0.1	∞
Hemispherical isotropy	1.3	Rectangular	√3	√0.5	√0.5	0.5	0.5	∞
Boundary effects	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Linearity	0.3	Rectangular	√3	1	1	0.2	0.2	∞
System detection limit	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Modulation response	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Readout electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.5	0.5	∞
Integration time	1.4	Rectangular	√3	1	1	0.8	0.8	∞
RF ambient conditions - noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF ambient conditions - refl.	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe positioner mech. tol.	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe positioning	2.9	Rectangular	√3	1	1	1.7	1.7	∞
Algorithms for max SAR eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Test sample positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device holder uncertainty	3.6	Normal	1	1	1	3.6	3.6	5
SAR drift measurement (< 0.2 dB)	4.7	Rectangular	√3	1	1	2.7	2.7	∞
SAR scaling	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Phantom and Set-up								
Phantom uncertainty	4.0	Rectangular	√3	1	1	2.3	2.3	∞
SAR correction for perm./cond.	1.9	Normal	1	1	0.84	1.9	1.6	∞
Liquid conductivity (meas.)	5.0	Normal	1	0.78	0.71	3.9	3.6	∞
Liquid permittivity (meas.)	5.0	Normal	1	0.23	0.26	1.2	1.3	∞
Liquid conductivity temp. unc.	2.9	Rectangular	√3	0.78	0.71	1.3	1.2	∞
Liquid permittivity temp. unc.	1.8	Rectangular	√3	0.23	0.26	0.2	0.3	∞
Combined Standard Uncertainty						11.1	11.0	
Coverage Factor for 95%						kp=2		
Expanded Standard Uncertainty						**22.2**	**21.9**	
Notes: *Worst case probe calibration uncertainty has been applied for all available probes and frequencies.*								

Table 36: Uncertainty budget for SAR measurements.

Uncertainty Budget for SAR System Validation according to IEEE 1528-2013 (300 MHz - 6 GHz)								
Error Sources	**Uncertainty Value [± %]**	**Probability Distribution**	**Divisor**	**ci**	**ci**	**Standard Uncertainty [± %]**		**vi² or veff**
Measurement System				1g	10g	1g	10g	
Probe calibration	6.7	Normal	1	1	1	6.7	6.7	∞
Axial isotropy	0.3	Rectangular	√3	1	1	0.1	0.1	∞
Hemispherical isotropy	1.3	Rectangular	√3	0	0	0.0	0.0	∞
Boundary effects	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Linearity	0.3	Rectangular	√3	1	1	0.2	0.2	∞
System detection limit	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Modulation response	0.0	Rectangular	√3	0	0	0.0	0.0	∞
Readout electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.0	Rectangular	√3	0	0	0.0	0.0	∞
Integration time	0.0	Rectangular	√3	0	0	0.0	0.0	∞
RF ambient conditions - noise	1.0	Rectangular	√3	1	1	0.6	0.6	∞
RF ambient conditions - refl.	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Probe positioner mech. tol.	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe positioning	2.9	Rectangular	√3	1	1	1.7	1.7	∞
Algorithms for max SAR eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Validation Dipole								
Dev. of exp. dipole from num.	5.0	Normal	1	1	1	5.0	5.0	∞
Input power and SAR drift (< 0.2 dB)	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Dipole axis to liquid distance (< 2deg)	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Phantom and Set-up								
Phantom uncertainty	4.0	Rectangular	√3	1	1	2.3	2.3	∞
SAR correction for perm./cond.	1.9	Normal	1	1	0.84	1.9	1.6	∞
Liquid conductivity (meas.)	5.0	Normal	1	0.78	0.71	3.9	3.6	∞
Liquid permittivity (meas.)	5.0	Normal	1	0.23	0.26	1.2	1.3	∞
Liquid conductivity temp. unc.	2.9	Rectangular	√3	0.78	0.71	1.3	1.2	∞
Liquid permittivity temp. unc.	1.8	Rectangular	√3	0.23	0.26	0.2	0.3	∞
Combined Standard Uncertainty						10.7	10.6	
Coverage Factor for 95%						kp=2		
Expanded Standard Uncertainty						**21.5**	**21.2**	
Notes: *Worst case probe calibration uncertainty has been applied for all available probes and frequencies.*								

Table 37: Uncertainty budget for SAR system validation.

10 Report History

Revision History				
Revision	**Description of Revision**	**Date**	**Revised Page**	**Revised By**
/	Initial Release	July 31, 2019	-	-

END OF THE SAR REPORT

Please refer to separated appendix file for the following data:

- Appendix A - Pictures
- Appendix B - SAR Distribution Plots
- Appendix C - System Verification Plots
- Appendix D – Certificates of Conformity
- Appendix E – Calibration Certificates for DAEs
- Appendix F – Calibration Certificates for E-Field Probes
- Appendix G – Calibration Certificates for Dipoles

Appendixes for SAR_Report_FCC_ISED_60320_6190898_SH10

DUT Information

Manufacturer	Datalogic			
Model Name	TASKBOOK SH10			
FCC ID	U4FTBII			
IC Number	3862D-TBII			
Type / Category	tablet PC		☒ portable	☐ mixed mobile/portable
Intended Use	☐	☐ next to the ear	☐ body-worn	☐ limb-worn
	☐ hand-held	☐ front-of-face	☒ body supported	☐ clothing-integrated

Prepared by

Testing Laboratory	IMST GmbH, Test Center Carl-Friedrich-Gauß-Str. 2 – 4 47475 Kamp-Lintfort Germany

Prepared for

Applicant / Manufacturer	7layers GmbH Borsigstraße 11 40880 Ratingen Germany	Datalogic S.r.l. Via San Vitalino, 13 40012 Lippo di Calderara di Reno – Bologna Italy

Test Specification

Applied Rules/Standards	IEEE 1528-2013, FCC CFR 47 § 2.1093, RSS-102 Issue 5	
Exposure Category	☒ general public / uncontrolled exposure	☐ occupational / controlled exposure
Test Result	☒ PASS	☐ FAIL

Report Information

Data Stored	60320_6190898
Issue Date	July 31, 2019
Revision Date	
Revision Number	(A new revision replaces all previous revisions and thus, become invalid herewith)
Appendixes	Appendix A - Pictures Appendix B - SAR Distribution Plots Appendix C - System Verification Plots Appendix D – Certificates of Conformity Appendix E – Calibration Certificates for DAEs Appendix F – Calibration Certificates for E-Field Probes Appendix G – Calibration Certificates for Dipoles

Appendix A - Pictures

Pictures of the DUT

Pic.1: Front viewsof DUT.

Pic. 2: Back view of DUT.

Pictures of Test Positions of the DUT

Pic. 3: Test position, back of DUT towards the phantom, 0 mm distance.

Pic. 4: Test position, edge 4 of DUT towards the phantom, 0 mm distance.

Appendix B - SAR Distribution Plots

Worst Case Plots for SAR Measurement per Technology

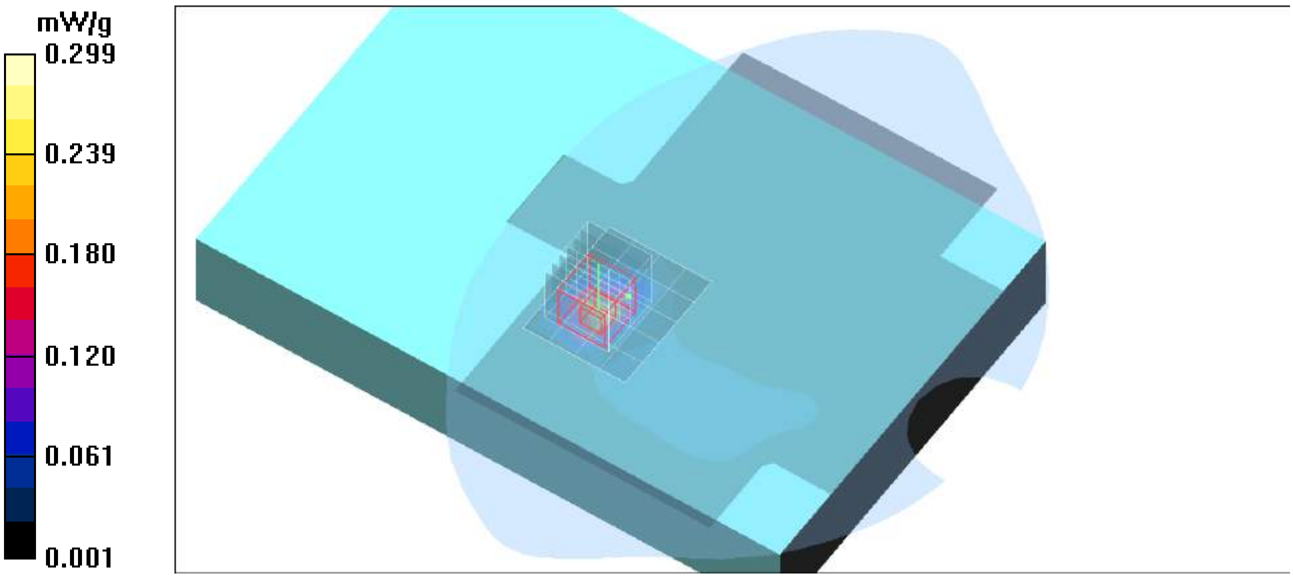
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx20_CH6b_back_chain1.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 b

Communication System: WLAN 2450; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.66, 7.66, 7.66); Calibrated: 9/14/2018
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Pre-Scan (61x51x1): Measurement grid: dx=30mm, dy=40mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.088 mW/g
Flat/Area Scan (5x6x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.261 mW/g
Flat/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.15 V/m; Power Drift = -0.141 dB
Peak SAR (extrapolated) = 0.579 W/kg
SAR(1 g) = 0.261 mW/g; SAR(10 g) = 0.113 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.299 mW/g



Plot. 1: SAR distribution plot for WLAN 2.4 GHz, ANT 1, channel 6, back, 0 mm to phantom.

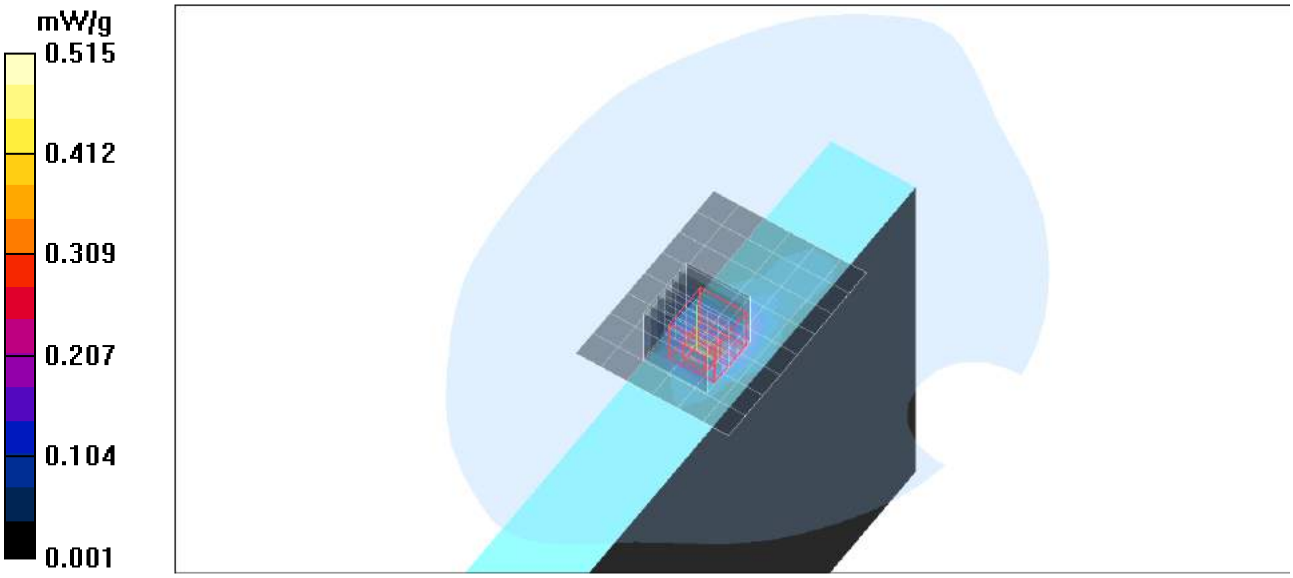
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx20_CH6b_edge4_chain2.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 b

Communication System: WLAN 2450; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.66, 7.66, 7.66); Calibrated: 9/14/2018
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Area Scan (7x9x1): Measurement grid: dx=12mm, dy=12mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.377 mW/g
Flat/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.8 V/m; Power Drift = -0.062 dB
Peak SAR (extrapolated) = 1.18 W/kg
SAR(1 g) = 0.431 mW/g; SAR(10 g) = 0.177 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.515 mW/g



Plot. 2: SAR distribution plot for WLAN 2.4 GHz, ANT 2, channel 6, edge 4, 0 mm to phantom.

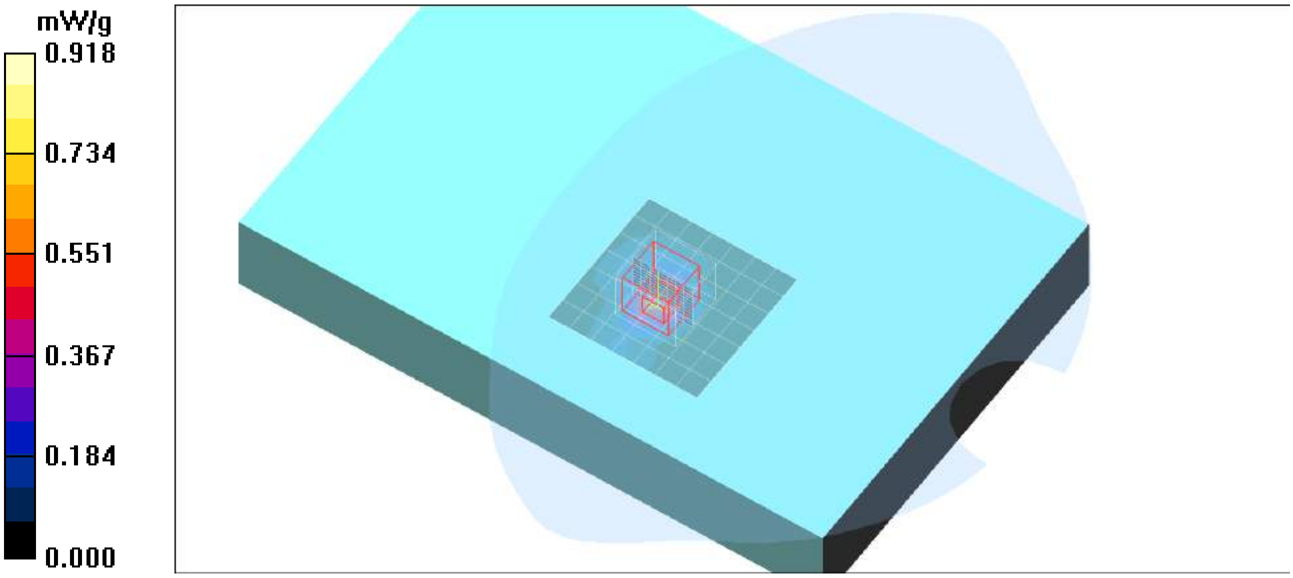
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx16_CH60a_back_chain1.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 a

Communication System: 5 GHz ; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5300 MHz; σ = 5.43 mho/m; ε_r = 48.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.92, 4.92, 4.92); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Area Scan (8x8x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.719 mW/g
Flat/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 7.59 V/m; Power Drift = -0.117 dB
Peak SAR (extrapolated) = 2.12 W/kg
SAR(1 g) = 0.470 mW/g; SAR(10 g) = 0.146 mW/g
Maximum value of SAR (measured) = 0.918 mW/g



Plot. 3: SAR distribution plot for WLAN 5.2 GHz, ANT 1, channel 60, back, 0 mm to phantom.

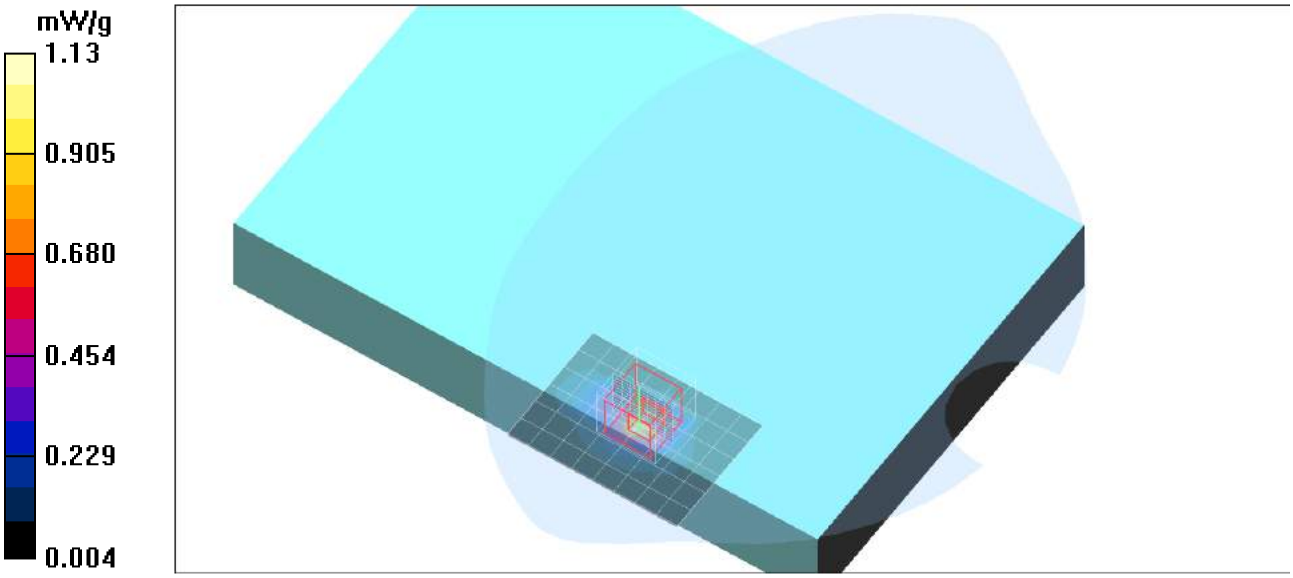
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx16_CH60a_back_chain2.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 a

Communication System: 5 GHz ; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5300 MHz; σ = 5.43 mho/m; ε_r = 48.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.92, 4.92, 4.92); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Area Scan (9x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.857 mW/g
Flat/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 13.3 V/m; Power Drift = -0.195 dB
Peak SAR (extrapolated) = 2.25 W/kg
SAR(1 g) = 0.618 mW/g; SAR(10 g) = 0.207 mW/g
Maximum value of SAR (measured) = 1.13 mW/g



Plot. 4: SAR distribution plot for WLAN 5.2 GHz, ANT 2, channel 60, back, 0 mm to phantom.

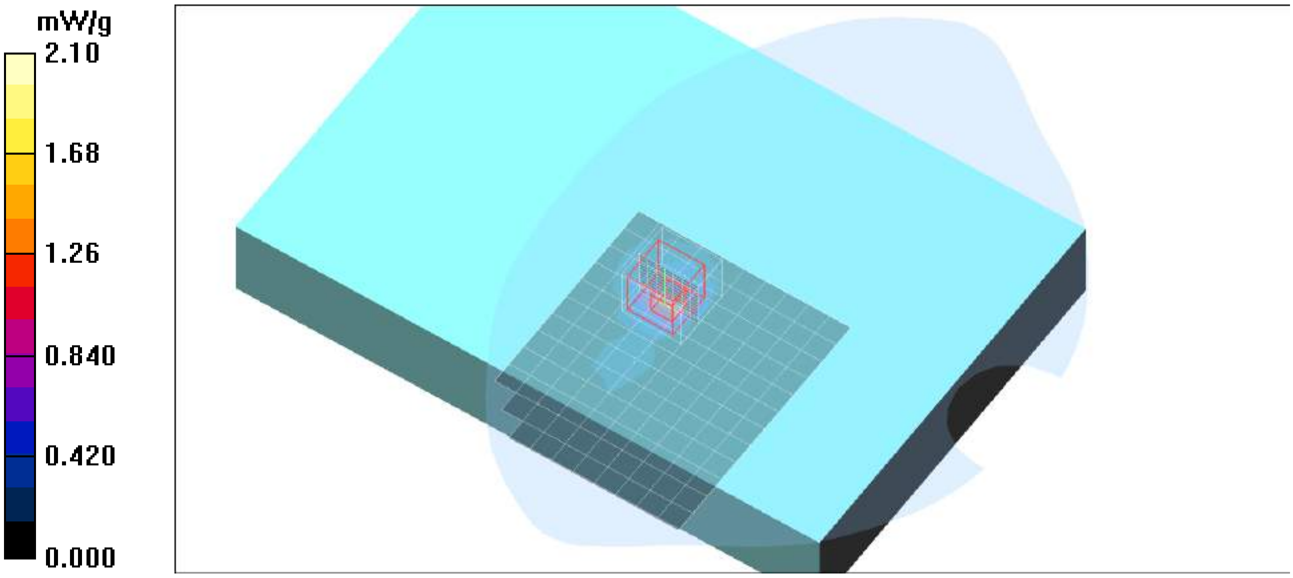
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx16_CH120a_back_chain1.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 a

Communication System: 5 GHz ; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.89 mho/m; ε_r = 47.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.37, 4.37, 4.37); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Area Scan (11x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.46 mW/g
Flat/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 8.42 V/m; Power Drift = -0.103 dB
Peak SAR (extrapolated) = 4.75 W/kg
SAR(1 g) = 1.07 mW/g; SAR(10 g) = 0.301 mW/g
Maximum value of SAR (measured) = 2.10 mW/g



Plot. 5: SAR distribution plot for WLAN 5.5 GHz, ANT 1, channel 120, back, 0 mm to phantom.

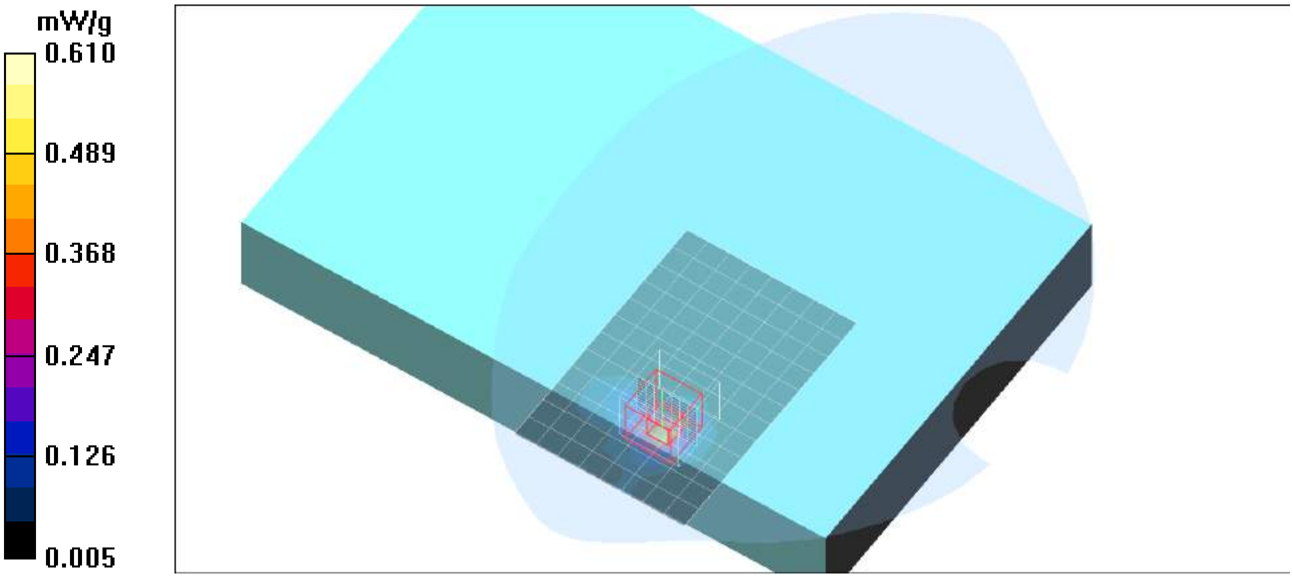
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx16_CH120a_back_chain2.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 a

Communication System: 5 GHz ; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.89 mho/m; ε_r = 47.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.37, 4.37, 4.37); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Area Scan (9x13x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.445 mW/g
Flat/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 7.75 V/m; Power Drift = 0.191 dB
Peak SAR (extrapolated) = 1.02 W/kg
SAR(1 g) = 0.311 mW/g; SAR(10 g) = 0.109 mW/g
Maximum value of SAR (measured) = 0.610 mW/g



Plot. 6: SAR distribution plot for WLAN 5.5 GHz, ANT 2, channel 120, back, 0 mm to phantom.

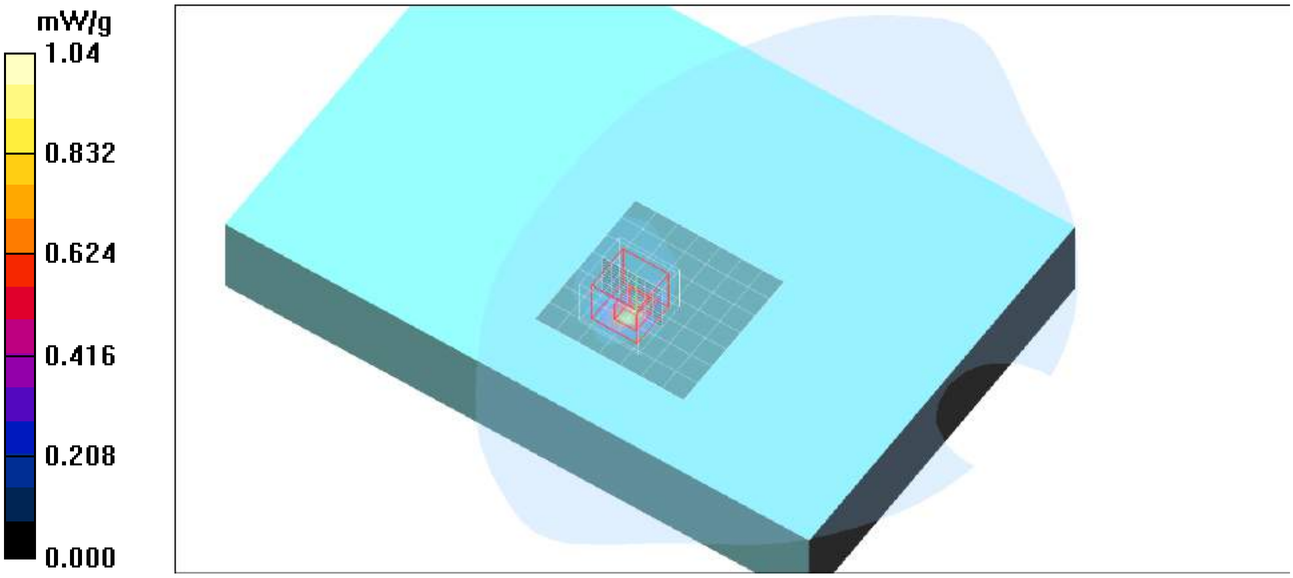
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx16_CH157a_back_chain1.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 a

Communication System: 5 GHz ; Frequency: 5785 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5785 MHz; σ = 6.18 mho/m; ε_r = 47.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.55, 4.55, 4.55); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Area Scan (8x8x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.871 mW/g
Flat/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 4.55 V/m; Power Drift = 0.017 dB
Peak SAR (extrapolated) = 2.27 W/kg
SAR(1 g) = 0.489 mW/g; SAR(10 g) = 0.133 mW/g
Maximum value of SAR (measured) = 1.04 mW/g



Plot. 7: SAR distribution plot for WLAN 5.8 GHz, ANT 1, channel 120, back, 0 mm to phantom.

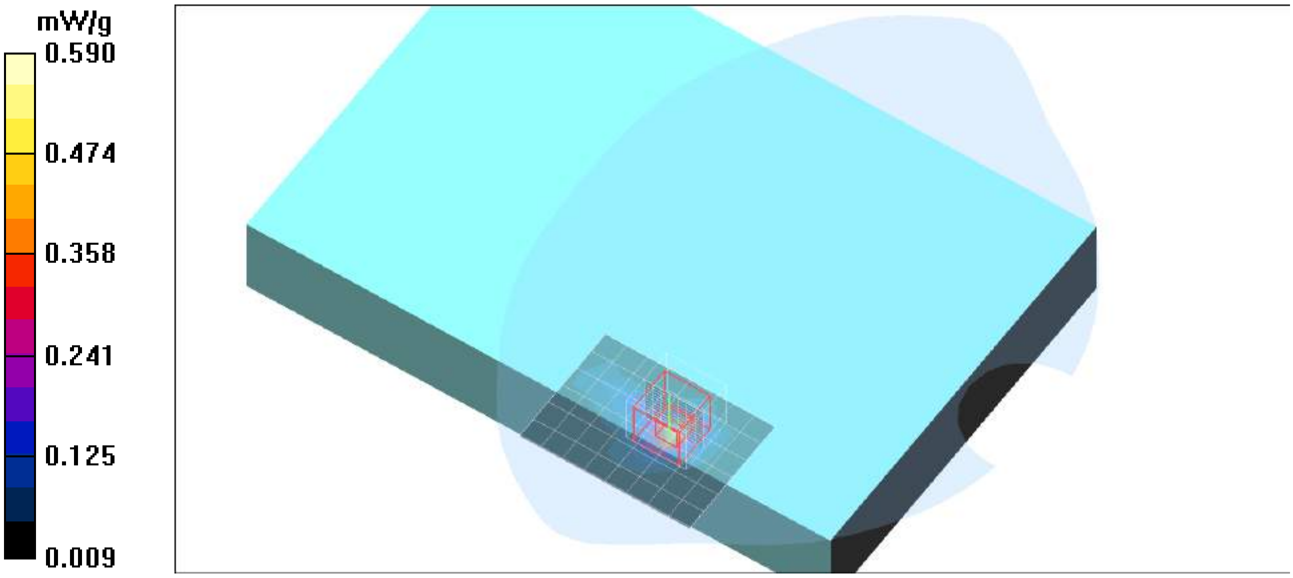
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: SH10_7L2A_tx16_CH157a_back_chain2.da4

DUT: Datalogic; Type: SH 10 TaskBook; Serial: #.12.18.D6.000155
Program Name: IEEE 802.11 a

Communication System: 5 GHz ; Frequency: 5785 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5785 MHz; σ = 6.18 mho/m; ε_r = 47.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.55, 4.55, 4.55); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Flat/Area Scan (9x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.535 mW/g
Flat/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 4.47 V/m; Power Drift = 0.197 dB
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.313 mW/g; SAR(10 g) = 0.112 mW/g
Maximum value of SAR (measured) = 0.590 mW/g



Plot. 8: SAR distribution plot for WLAN 5.8 GHz, ANT 2, channel 120, back, 0 mm to phantom.

Appendix C - System Verification Plots

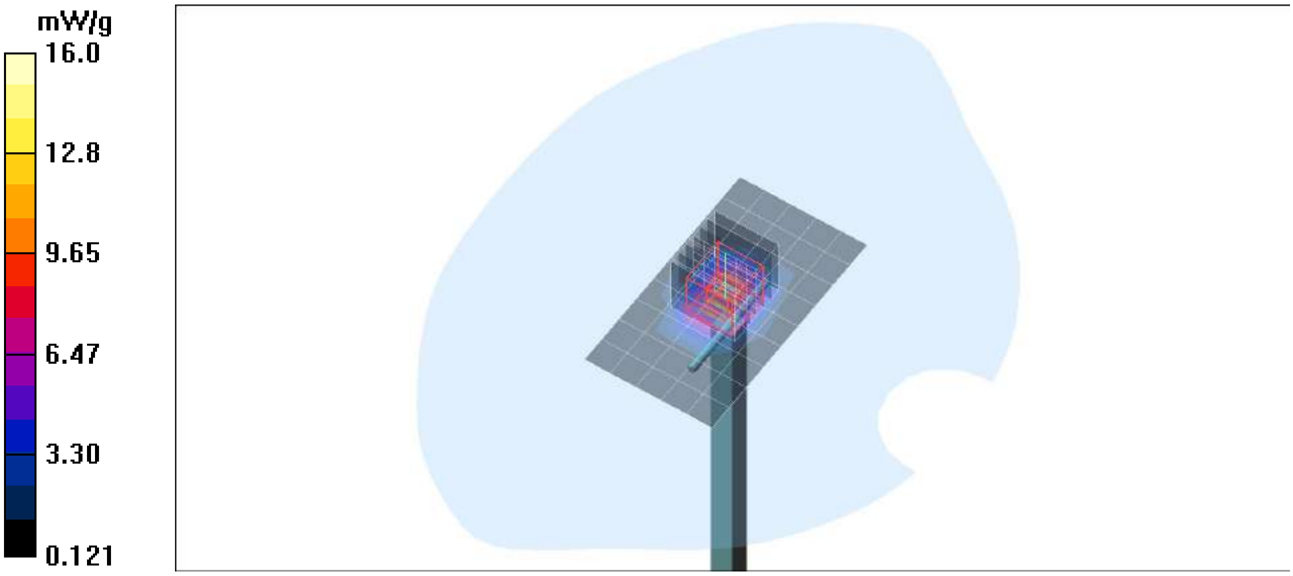
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 04072019_1Db_2450b_3536_631.da4

DUT: Dipole 2450 MHz SN: 709; Type: D2450V2; Serial: D2450V2 - SN:709
Program Name: System Performance Check at 2450 MHz

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 2.02 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.66, 7.66, 7.66); Calibrated: 9/14/2018
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (6x10x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 14.0 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.3 V/m; Power Drift = -0.095 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.47 mW/g
Maximum value of SAR (measured) = 16.0 mW/g



Plot. 1: System verification measurement 2450 MHz, body (July 04, 2019).

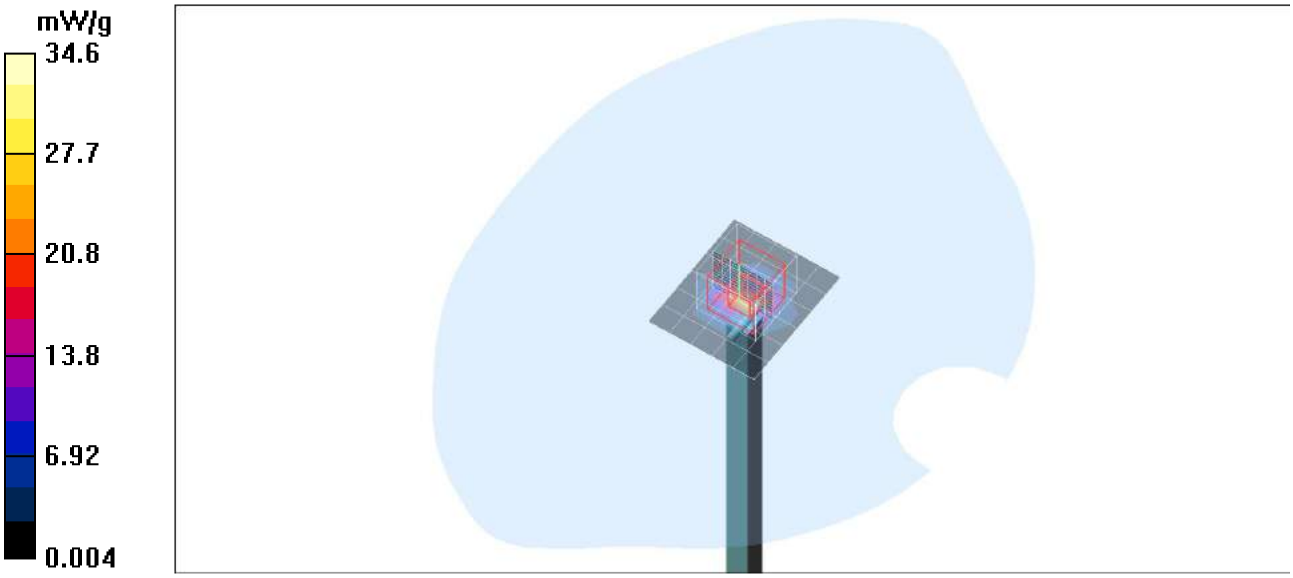
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 23072019_1Db_5250b_3536_631.da4

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028
Program Name: System Performance Check at 5250 MHz

Communication System: CW; Frequency: 5250 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5250 MHz; σ = 5.36 mho/m; ε_r = 48.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.92, 4.92, 4.92); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (6x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 29.6 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 92.1 V/m; Power Drift = -0.023 dB
Peak SAR (extrapolated) = 70.7 W/kg
SAR(1 g) = 18.1 mW/g; SAR(10 g) = 5.08 mW/g
Maximum value of SAR (measured) = 34.6 mW/g



Plot. 2: System verification measurement 5250 MHz, body (July 23, 2019).

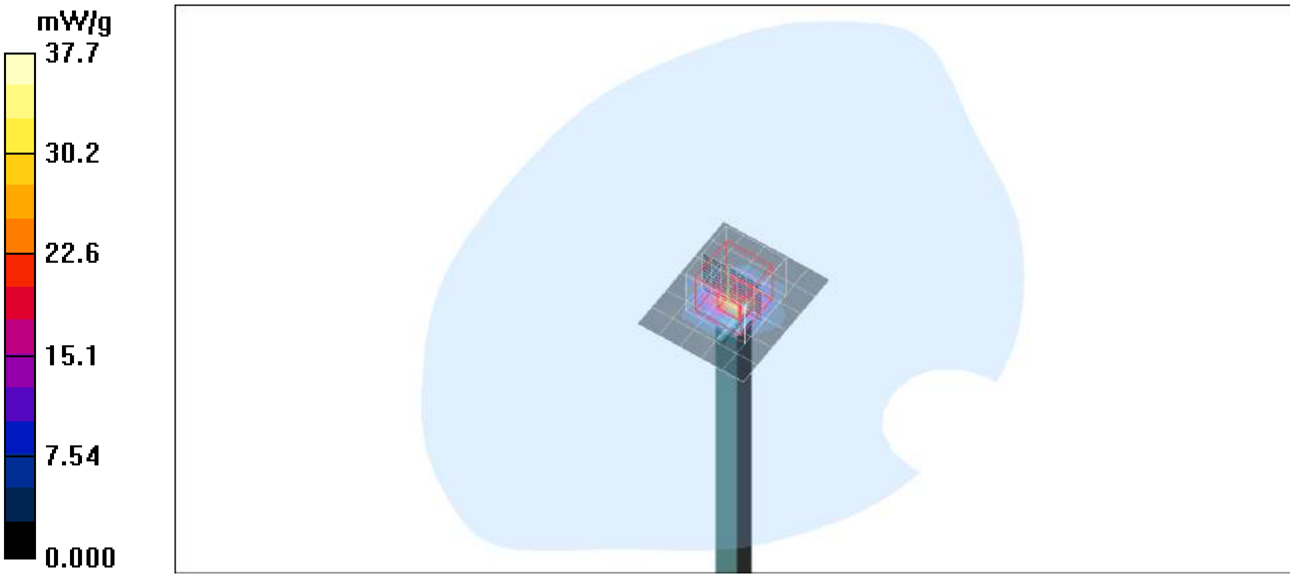
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 23072019_1Db_5600b_3536_631.da4

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028
Program Name: System Performance Check at 5600 MHz

Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.89 mho/m; ε_r = 47.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.37, 4.37, 4.37); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (6x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 32.1 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 91.3 V/m; Power Drift = -0.060 dB
Peak SAR (extrapolated) = 79.6 W/kg
SAR(1 g) = 19.1 mW/g; SAR(10 g) = 5.34 mW/g
Maximum value of SAR (measured) = 37.7 mW/g



Plot. 3: System verification measurement 5600 MHz, body (July 23, 2019).

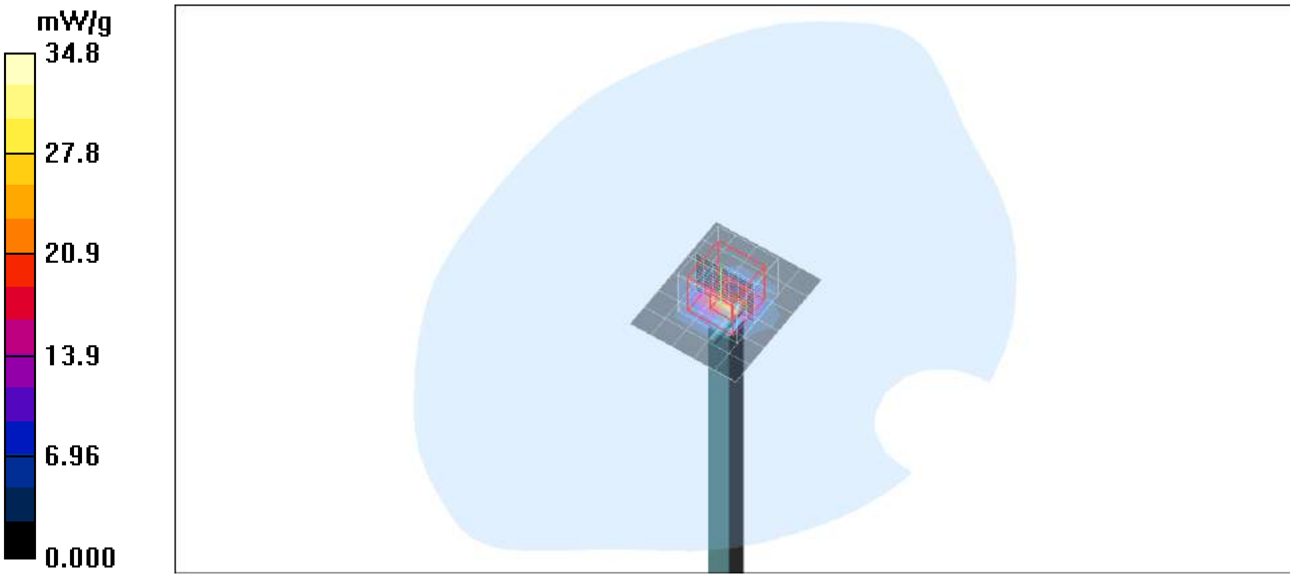
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 23072019_1Db_5800b_3536_631.da4

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028
Program Name: System Performance Check at 5800 MHz

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5800 MHz; σ = 6.2 mho/m; ε_r = 47.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(4.55, 4.55, 4.55); Calibrated: 9/14/2018
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 9/13/2018
- Phantom: SAM 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (6x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 30.2 mW/g
d=10mm, Pin=250mW/Zoom Scan (8x8x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 85.4 V/m; Power Drift = -0.024 dB
Peak SAR (extrapolated) = 77.6 W/kg
SAR(1 g) = 17.6 mW/g; SAR(10 g) = 4.89 mW/g
Maximum value of SAR (measured) = 34.8 mW/g



Plot. 4: System verification measurement 5800 MHz, body (July 23, 2019).

Appendix D – Certificates of Conformity

Schmid & Partner Engineering AG **s p e a g**

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity

Item	Dosimetric Assessment System DASY4
Type No	SD 000 401A, SD 000 402A
Software Version No	DASY 4.7
Manufacturer / Origin	Schmid & Partner Engineering AG Zeughausstrasse 43, CH-8004 Zürich, Switzerland

References

[1] IEEE 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
[2] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
[3] IEC 62209 – 2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures, Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", March 2010
[4] KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
[5] ANSI-C63.19-2011, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", May 2011

Conformity

We certify that this **system is designed to be fully compliant** with the standards [1 – 5] for RF emission tests of wireless devices.

Uncertainty

The uncertainty of the measurements with this system was evaluated according to the above standards and is documented in the applicable chapters of the DASY4 system handbook and in Chapter 27 of the DASY5 system handbook.

The uncertainty values represent current state of methodology and are subject to changes. They are applicable to all laboratories using DASY4 provided the following requirements are met (responsibility of the system end user):

1) the system is used by an experienced engineer who follows the manual and the guidelines taught during the training provided by SPEAG,
2) the probe and validation dipoles have been calibrated for the relevant frequency bands and media within the requested period,
3) the DAE has been calibrated within the requested period,
4) the "minimum distance" between probe sensor and inner phantom shell and the radiation source is selected properly,
5) the system performance check has been successful,
6) the operational mode of the DUT is CW, CDMA, FDMA or TDMA (GSM, DCS, PCS, IS136, PDC) and the measurement/integration time per point is ≥ 500 ms,
7) if applicable, the probe modulation factor is evaluated and applied according to field level, modulation and frequency,
8) the dielectric parameters of the liquid are conform with the standard requirement,
9) the DUT has been positioned as described in the manual.
10) the uncertainty values from the calibration certificates, and the laboratory and measurement equipment dependent uncertainties, are updated by end user accordingly.

s p e a g
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Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Date 19.09.2016 **Signature / Stamp**

Doc No 880 – SD00040XA-Standards_1609 – G KP/FB Page 1 (1)

Fig. 4: Certificate of conformity for the used DASY4 system:

Schmid & Partner Engineering AG **speag**

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Certificate of Conformity / First Article Inspection

Item	SAM Twin Phantom V4.0 and V5.0
Type No	QD 000 P40 C
Series No	TP-1150 and higher
Manufacturer	Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland

Tests

Complete tests were made on the pre-series QD 000 P40 A, # TP-1001, on the series first article QD 000 P40 B # TP-1006. Certain parameters are retested on series items.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the geometry according to the CAD model.	IT'IS CAD File *	First article, Samples
Material thickness of shell	2mm +/- 0.2mm in flat section, other locations: +/- 0.2mm with respect to CAD file	in flat section, in the cheek area	First article, Samples, TP-1314 ff.
Material thickness at ERP	6mm +/- 0.2mm at ERP		First article, All items
Material parameters	rel. permittivity 2 – 5, loss tangent ≤ 0.05, at f ≤ 6 GHz	rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05	Material samples
Material resistivity	Compatibility with tissue simulating liquids .	Compatible with SPEAG liquids. **	Phantoms, Material sample
Sagging	Sagging of the flat section in tolerance when filled with tissue simulating liquid.	< 1% for filling height up to 155 mm	Prototypes, Sample testing

* The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

** Note: Compatibility restrictions apply certain liquid components mentioned in the standard, containing e.g. DGBE, DGMHE or Triton X-100. Observe technical note on material compatibility.

Standards

[1] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01

[2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003

[3] IEC 62209–1 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", 2005-02-18

[4] IEC 62209–2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 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)", 2010-03-30

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of **hand-held** SAR measurements and system performance checks as specified in [1 – 4] and further standards.

Date 25.07.2011

Signature / Stamp speag Schmid & Partner Engineering AG, Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 44 245 9700, Fax +41 44 245 9779, www.speag.com

Doc No 881 – QD 000 P40 C – H Page 1 (1)

Fig. 5: Certificate of conformity for the used SAM phantom.

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Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 4.0
Type No	QD OVA 001 B
Series No	1003 and higher
Manufacturer	SPEAG Zeughausstrasse 43 CH-8004 Zürich Switzerland

Tests
Complete tests were made on the prototype units QD OVA 001 AA 1001, QD OVA 001 AB 1002, pre-series units QD OVA 001 BA 1003-1005 as well as on the series units QD OVA 001 BB, 1006 ff.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the standard IEC 62209 – 2 [1] requirements	Dimensions of bottom for 300 MHz – 6 GHz: longitudinal = 600 mm (max. dimension) width= 400 mm (min dimension) depth= 190 mm Shape: ellipse	Prototypes, Samples
Material thickness	Compliant with the standard IEC 62209 – 2 [1] requirements	Bottom plate: 2.0mm +/- 0.2mm	Prototypes, All items
Material parameters	Dielectric parameters for required frequencies	300 MHz – 6 GHz Rel. permittivity = 4 +/-1, Loss tangent ≤ 0.05	Material sample
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe Technical Note for material compatibility.	DEGMBE based simulating liquids	Equivalent phantoms, Material sample
Sagging	Compliant with the requirements according to the standard. Sagging of the flat section when filled with tissue simulating liquid	< 1% typical < 0.8% if filled with 155mm of HSL900 and without DUT below	Prototypes, Sample testing

Standards

[1] IEC 62209 – 2, Draft Version 0.9, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures
Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", December 2004

Conformity
Based on the sample tests above, we certify that this item is in compliance with the standard [1].

Date 07.07.2005

Signature / Stamp

s p e a g
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Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Doc No 881 – QD OVA 001 B - C Page 1 (1)

Fig. 8: Certificate of conformity for the ELI phantom.

Appendix E – Calibration Certificates for DAEs

DAE 4 – SN: 631

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

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

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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 **IMST**

Certificate No: **DAE4-631_Sep18**

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BM - SN: 631

Calibration procedure(s): QA CAL-06.v29
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: September 13, 2018

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Sep-18 (No:23488)	Sep-19
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	04-Jan-18 (in house check)	In house check: Jan-19
Calibrator Box V2.1	SE UMS 006 AA 1002	04-Jan-18 (in house check)	In house check: Jan-19

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	i.V.

Issued: September 13, 2018

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

Certificate No: DAE4-631_Sep18 Page 1 of 5

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Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Glossary

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 following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

Certificate No: DAE4-631_Sep18 Page 2 of 5

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	404.319 ± 0.02% (k=2)	404.282 ± 0.02% (k=2)	406.220 ± 0.02% (k=2)
Low Range	3.94611 ± 1.50% (k=2)	3.92898 ± 1.50% (k=2)	3.95869 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	33.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	199997.59	0.38	0.00
Channel X	+ Input	20005.07	3.55	0.02
Channel X	- Input	-19995.84	5.96	-0.03
Channel Y	+ Input	199997.06	0.12	0.00
Channel Y	+ Input	20001.74	0.32	0.00
Channel Y	- Input	-20001.02	0.91	-0.00
Channel Z	+ Input	199997.23	0.28	0.00
Channel Z	+ Input	19998.21	-3.18	-0.02
Channel Z	- Input	-20003.93	-2.00	0.01

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2001.06	0.03	0.00
Channel X	+ Input	201.98	0.65	0.32
Channel X	- Input	-198.32	0.21	-0.11
Channel Y	+ Input	2001.63	0.70	0.04
Channel Y	+ Input	200.62	-0.54	-0.27
Channel Y	- Input	-199.28	-0.50	0.25
Channel Z	+ Input	2001.32	0.49	0.02
Channel Z	+ Input	199.08	-2.00	-0.99
Channel Z	- Input	-199.15	-0.39	0.19

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	1.76	0.23
	- 200	1.72	-0.01
Channel Y	200	18.14	18.32
	- 200	-19.97	-20.58
Channel Z	200	3.87	3.91
	- 200	-5.80	-5.82

3. Channel separation

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

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	-0.33	-3.25
Channel Y	200	9.44	-	0.60
Channel Z	200	6.77	6.86	-

4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15991	15875
Channel Y	15459	16158
Channel Z	16650	17058

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.76	-0.32	2.12	0.47
Channel Y	-0.55	-1.79	0.70	0.50
Channel Z	-0.76	-2.09	0.72	0.55

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	−0.01	-8	-9

Appendix F – Calibration Certificates for E-Field Probes

Probe EX3DV4 – SN3536

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

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

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Accreditation No.: **SCS 0108**

Client **IMST** Certificate No: **EX3-3536_Sep18**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3536

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: September 14, 2018

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18

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

Issued: September 18, 2018

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

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3536

Manufactured: April 30, 2004
Calibrated: September 14, 2018

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

EX3DV4– SN:3536 September 14, 2018

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.43	0.41	0.35	± 10.1 %
DCP (mV)[B]	99.7	103.1	99.6	

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	188.6	±3.5 %
		Y	0.0	0.0	1.0		175.9	
		Z	0.0	0.0	1.0		192.0	

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

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
2450	39.2	1.80	7.56	7.56	7.56	0.26	1.02	± 12.0 %
2600	39.0	1.96	7.41	7.41	7.41	0.40	0.85	± 12.0 %
5250	35.9	4.71	5.24	5.24	5.24	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.78	4.78	4.78	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.85	4.85	4.85	0.40	1.80	± 13.1 %

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

EX3DV4– SN:3536 September 14, 2018

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
2450	52.7	1.95	7.66	7.66	7.66	0.38	0.85	± 12.0 %
2600	52.5	2.16	7.57	7.57	7.57	0.34	0.90	± 12.0 %
5250	48.9	5.36	4.92	4.92	4.92	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.37	4.37	4.37	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.55	4.55	4.55	0.50	1.90	± 13.1 %

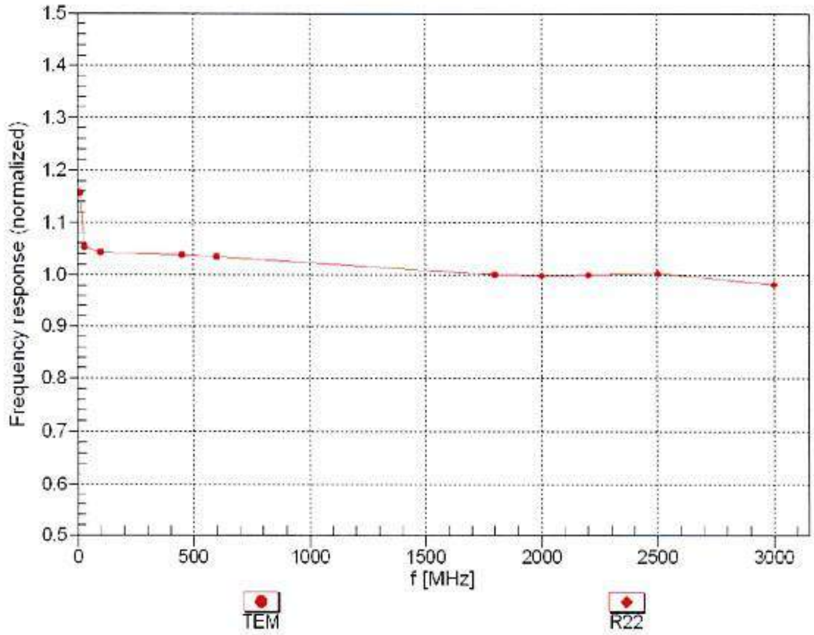
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz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

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4– SN:3536 September 14, 2018

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

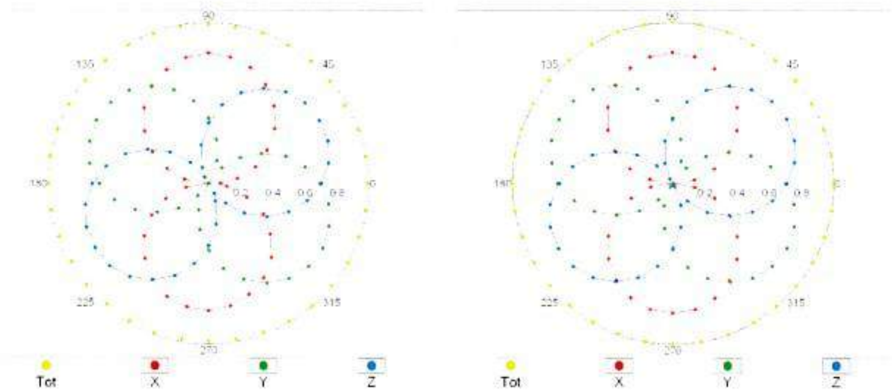


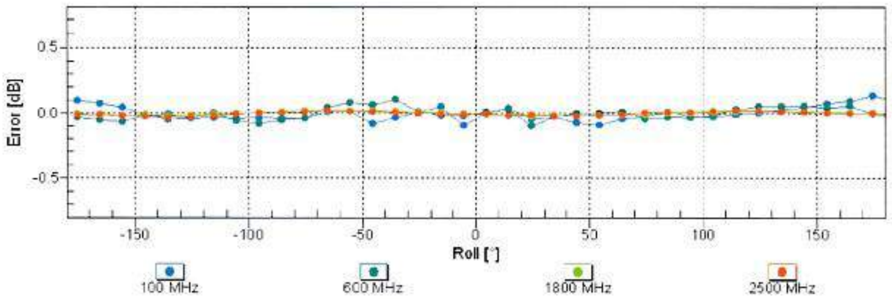
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4– SN:3536 September 14, 2018

Receiving Pattern (ϕ), ϑ = 0°

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



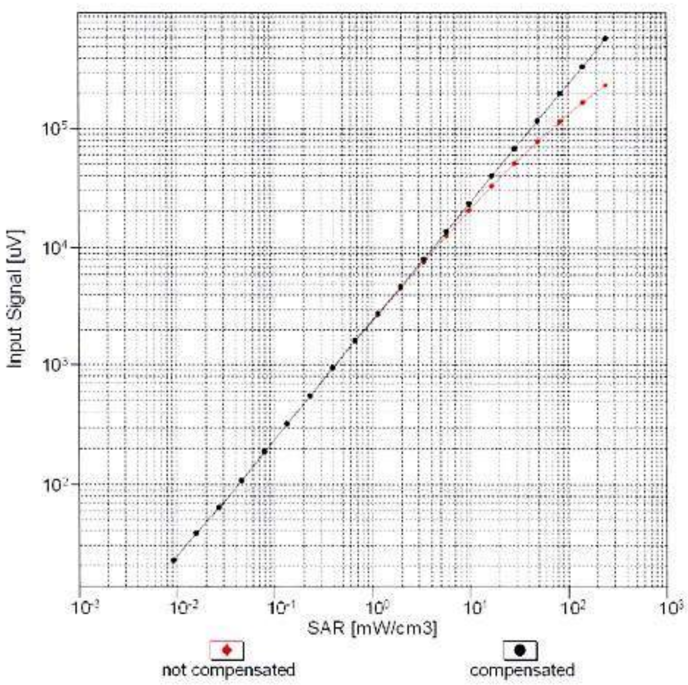


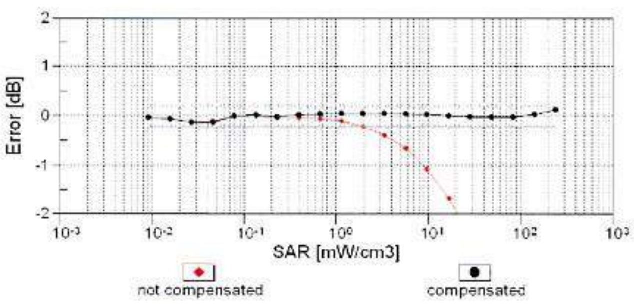
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: EX3-3536_Sep18 Page 8 of 11

EX3DV4– SN:3536 September 14, 2018

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





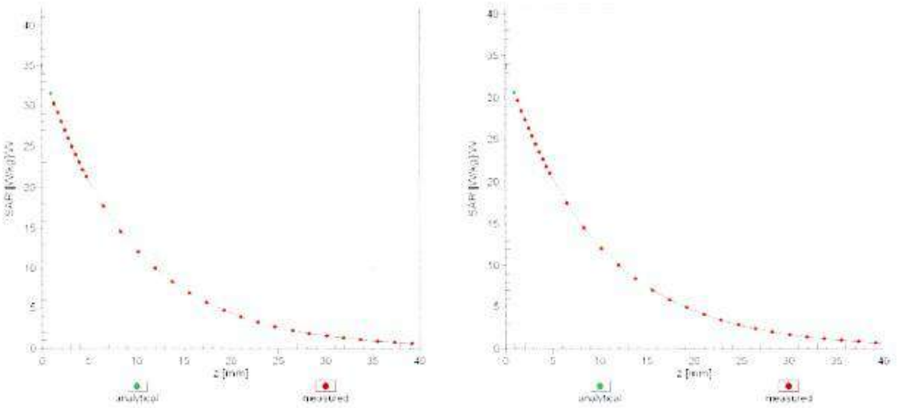
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: EX3-3536_Sep18 Page 9 of 11

EX3DV4– SN:3536 September 14, 2018

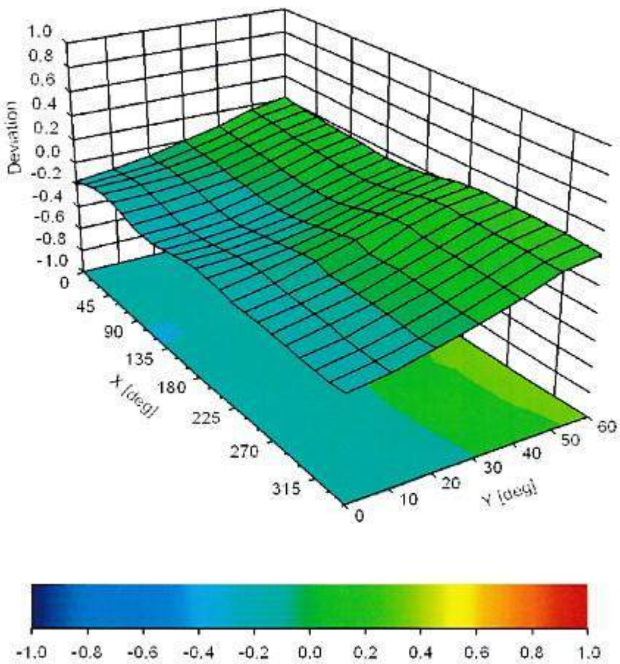
Conversion Factor Assessment

f = 2450 MHz,WGLS R22 (H_convF) f = 2450 MHz,WGLS R22 (M_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3536_Sep18 Page 10 of 11

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-5.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Appendix G – Calibration Certificates for Dipoles

10.1.1 Dipole 2450 MHz – SN709

Calibration Laboratory of
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Engineering AG
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Accreditation No.: **SCS 0108**

Client **IMST**

Certificate No: **D2450V2-709_Nov18**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN:709

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

Calibration date: November 12, 2018

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 12, 2018

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Certificate No: D2450V2-709_Nov18 Page 1 of 8

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
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 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.4 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.5 Ω + 0.9 jΩ
Return Loss	- 29.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω + 2.5 jΩ
Return Loss	- 32.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 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	July 05, 2002

DASY5 Validation Report for Head TSL

Date: 12.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

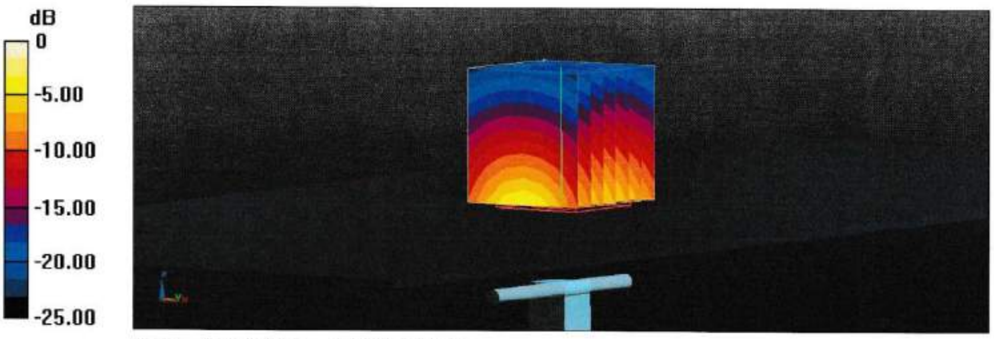
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:709

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

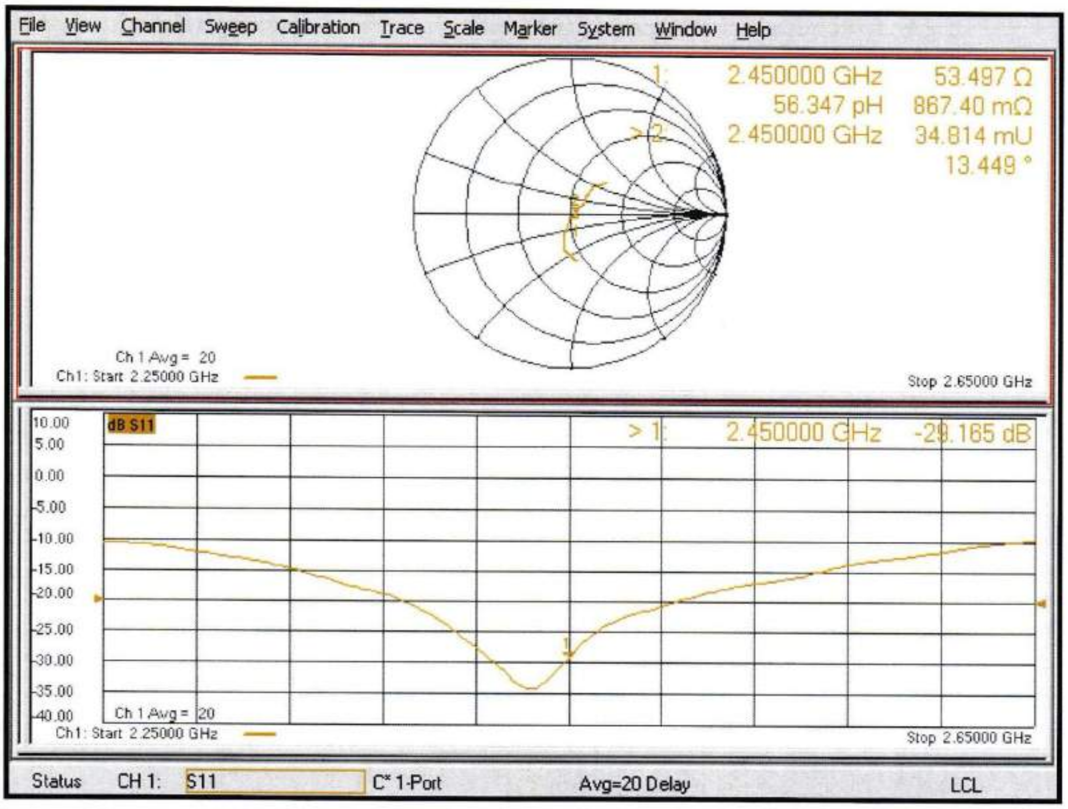
- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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 = 118.6 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.34 W/kg
Maximum value of SAR (measured) = 22.9 W/kg



0 dB = 22.9 W/kg = 13.60 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

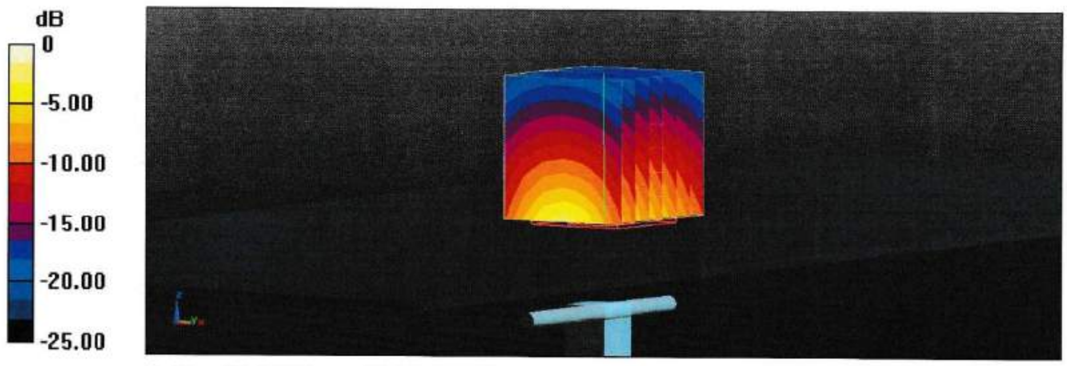
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:709

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

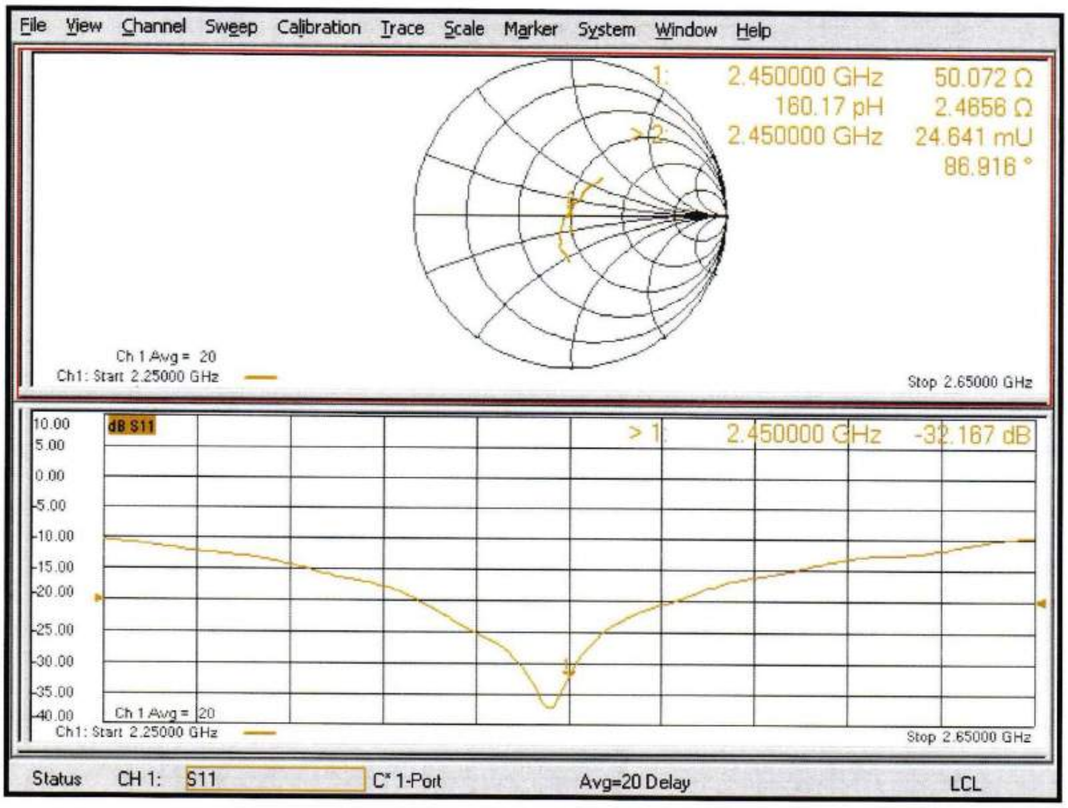
- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

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 = 109.7 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.07 W/kg
Maximum value of SAR (measured) = 21.8 W/kg



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

Impedance Measurement Plot for Body TSL



10.1.2 Dipole 5 GHz – SN1028

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Accreditation No.: SCS 0108

Client **IMST**

Certificate No: D5GHzV2-1028_May17

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN:1028
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	May 17, 2017

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3503	31-Dec-16 (No. EX3-3503_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

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

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

Issued: May 18, 2017

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Certificate No: D5GHzV2-1028_May17 Page 1 of 13

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-2, "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	V52.10.0
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 5600 MHz ± 1 MHz 5800 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	34.8 ± 6 %	4.59 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	8.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.6 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	**23.0 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	34.2 ± 6 %	4.95 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**82.5 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.7 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	5.16 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.6 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	47.5 ± 6 %	5.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.53 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 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	46.9 ± 6 %	5.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.95 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	6.26 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.68 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.4 W/kg ± 19.9 % (k=2)**

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

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.0 Ω - 9.0 jΩ
Return Loss	- 21.0 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.0 Ω - 2.8 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.7 Ω - 5.8 jΩ
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	50.6 Ω - 6.9 jΩ
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.5 Ω - 1.6 jΩ
Return Loss	- 22.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	58.4 Ω - 4.7 jΩ
Return Loss	- 21.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 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	July 09, 2004

DASY5 Validation Report for Head TSL

Date: 17.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5250 MHz; σ = 4.59 S/m; ε_r = 34.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.95 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.16 S/m; ε_r = 34; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

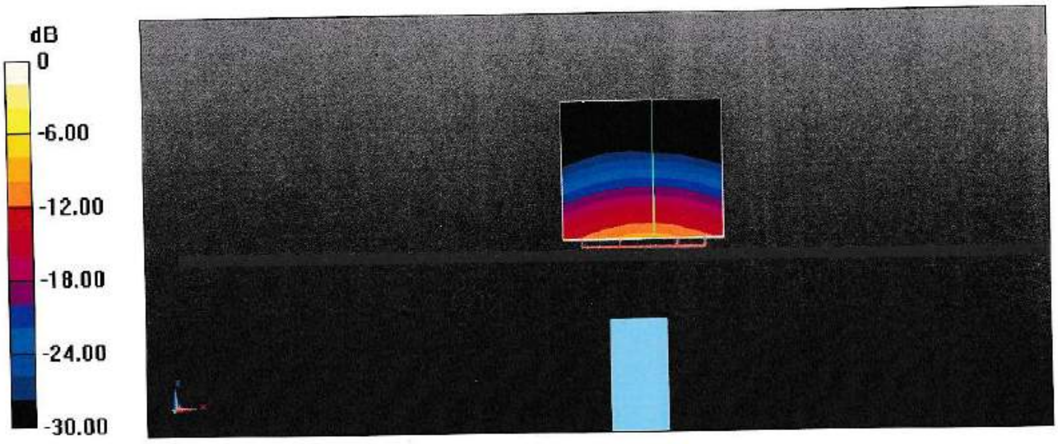
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.58, 5.58, 5.58); Calibrated: 31.12.2016, ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016, ConvF(5.01, 5.01, 5.01); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.0(1444); SEMCAD X 14.6.10(7416)

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 = 69.19 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 29.2 W/kg
SAR(1 g) = 8.02 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 18.4 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 = 69.58 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.4 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.06 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 31.6 W/kg
SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

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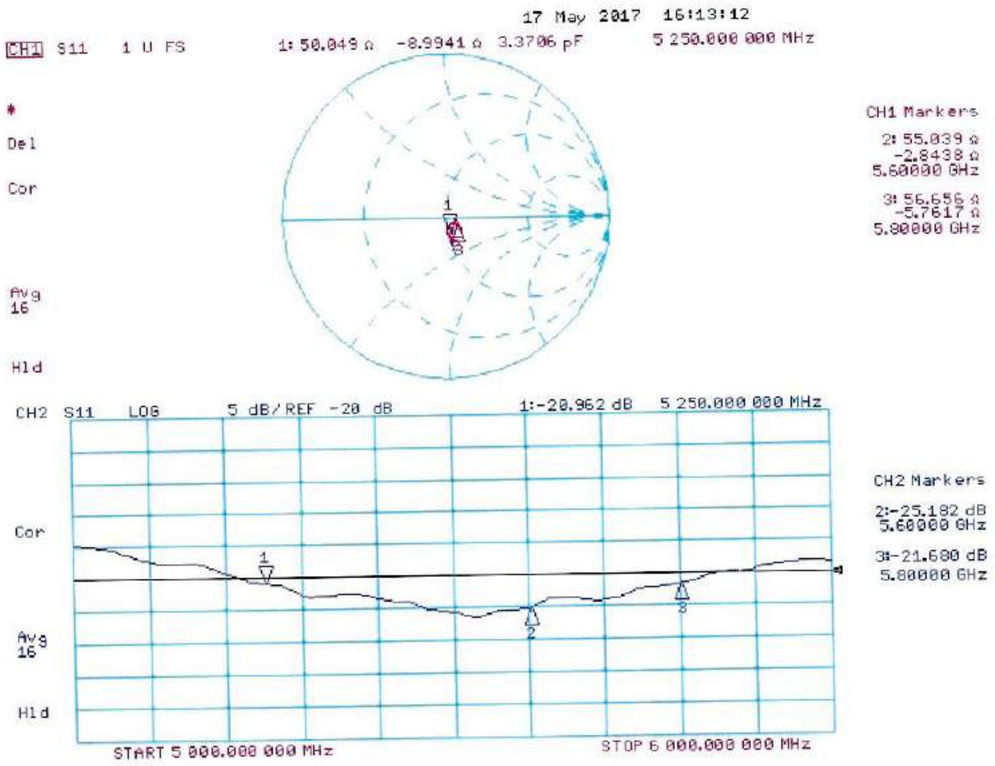
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 16.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5250 MHz; σ = 5.5 S/m; ε_r = 47.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.98 S/m; ε_r = 46.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.26 S/m; ε_r = 46.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

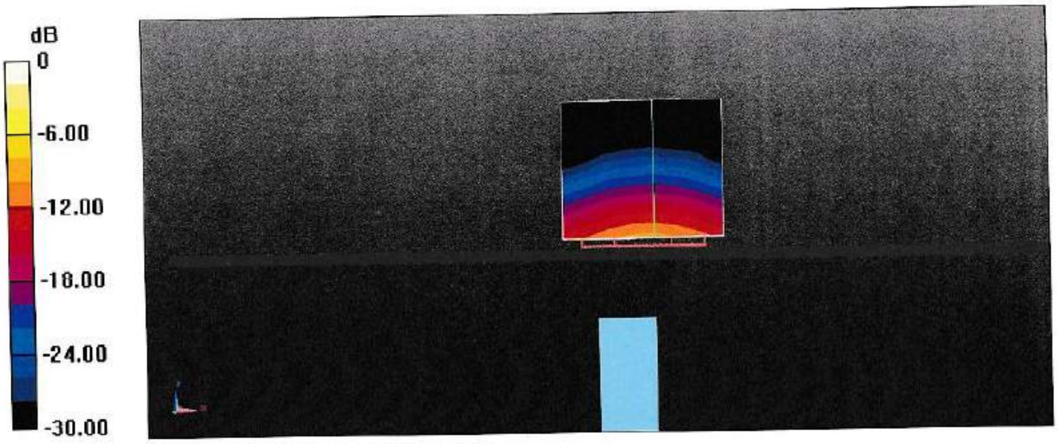
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.48, 4.48, 4.48); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1444); SEMCAD X 14.6.10(7416)

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 = 62.60 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 7.53 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 17.2 W/kg

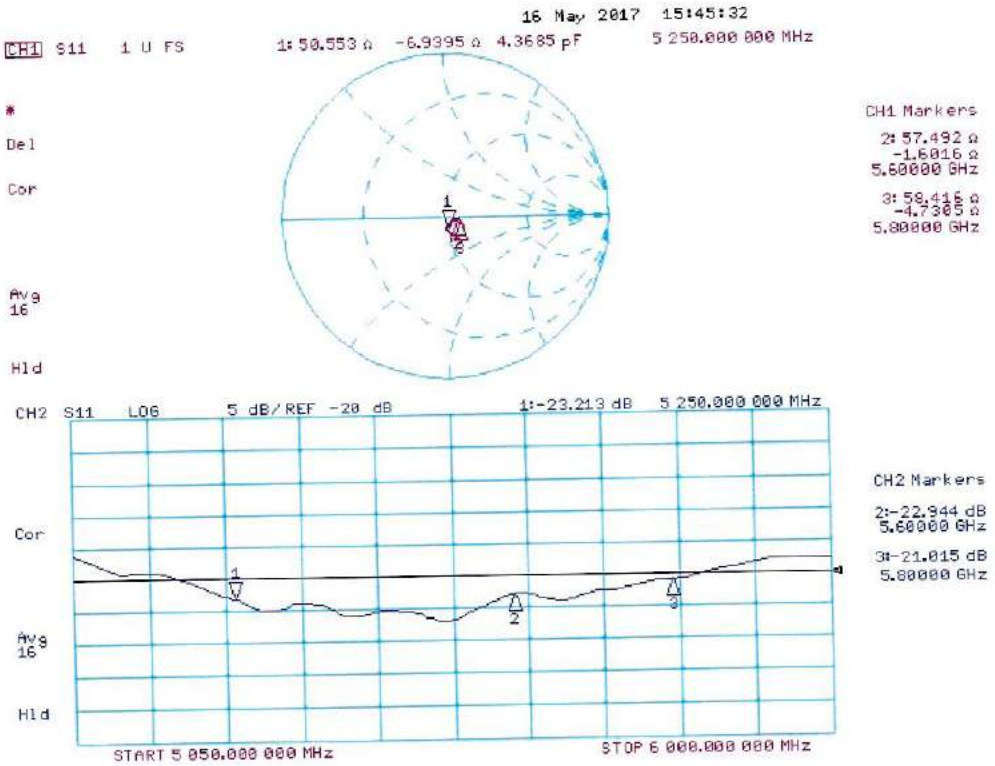
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.57 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 18.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.73 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 33.7 W/kg
SAR(1 g) = 7.68 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

Impedance Measurement Plot for Body TSL



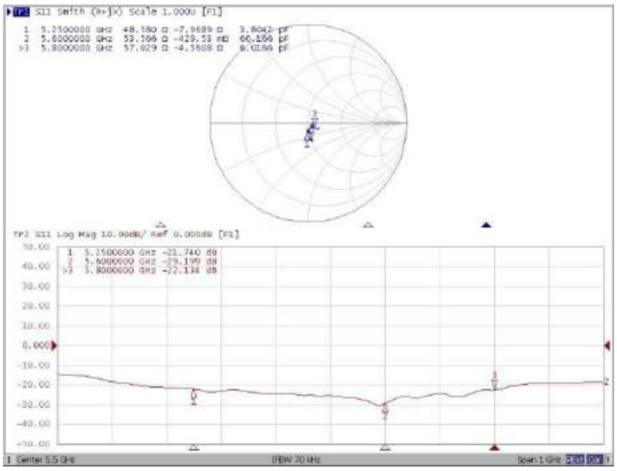
Extended Dipole Calibration Verification for the D5GHzV2, SN: 1028

Referring to section 3.2.2 of KDB 865664 D01, the tables below contain the measurement results for the impedance and return loss of the dipole.

Justification of the Extended Calibration						
5250 HEAD TSL	**Calibration**		**Verification**			
	May 17, 2017		May 2, 2019			
Impedance transformed to feed point	Target		Measured		Delta	
	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]
	50.0	-9.0	48.58	-7.97	**-1.4**	**1.0**
Return Loss	Target [dB]		Measured [dB]		Delta [%]	
	-21.0		-21.7		**3.3**	
5600 HEAD TSL	**Calibration**		**Verification**			
	May 17, 2017		May 2, 2019			
Impedance transformed to feed point	Target		Measured		Delta	
	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]
	55.0	-2.8	53.57	-0.43	**-1.4**	**+2.4**
Return Loss	Target [dB]		Measured [dB]		Delta [%]	
	-25.2		-29.2		**15.9**	
5800 HEAD TSL	**Calibration**		**Verification**			
	May 17, 2017		May 2, 2019			
Impedance transformed to feed point	Target		Measured		Delta	
	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]
	56.7	-5.8	57.03	-4.56	**+0.3**	**+1.2**
Return Loss	Target [dB]		Measured [dB]		Delta [%]	
	-21.7		-22.1		**2.0**	
5250 BODY TSL	**Calibration**		**Verification**			
	May 17, 2017		May 28, 2019			
Impedance transformed to feed point	Target		Measured		Delta	
	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]
	50.6	-6.9	47.98	-6.98	**-2.6**	**-0.1**
Return Loss	Target [dB]		Measured [dB]		Delta [%]	
	-23.2		-22.6		**-2.6**	
5600 BODY TSL	**Calibration**		**Verification**			
	May 17, 2017		May 28, 2019			
Impedance transformed to feed point	Target		Measured		Delta	
	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]
	57.5	-1.6	54.87	0.24	**-2.6**	**+1.8**
Return Loss	Target [dB]		Measured [dB]		Delta [%]	
	-22.9		-26.6		**16.2**	
5800 BODY TSL	**Calibration**		**Verification**			
	May 17, 2017		May 28, 2019			
Impedance transformed to feed point	Target		Measured		Delta	
	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]	R [Ω]	X [jΩ]
	58.4	-4.7	57.35	-4.72	**-1.1**	**-0.0**
Return Loss	Target [dB]		Measured [dB]		Delta [%]	
	-21.0		-21.8		**3.8**	

The impedance is within 5 ohm of prior calibration.
The return loss is <-20 dB and within 20% of prior calibration.

Therefore the verification result supports extended dipole calibration.

<table>
<tr><th colspan="2">5250 / 5600 / 5800 MHz</th></tr>
<tr><th>Measurement Plot for Head TSL</th><th>Measurement Plot for Body TSL</th></tr>
<tr><td>
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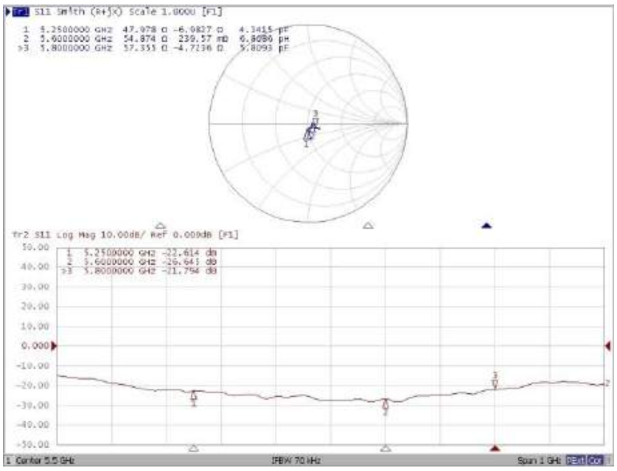
<td>
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