FCC SAR TEST REPORT

FCC ID	:	QXO-AP510I
Equipment	:	802.11ax Access Point
Brand Name	:	Extreme Networks
Model Name	:	AP560i
Applicant	:	Extreme Networks, Inc. 6480 Via Del Oro, San Jose, CA 95119
Manufacturer	:	Extreme Networks, Inc. 6480 Via Del Oro, San Jose, CA 95119
Standard	:	FCC 47 CFR Part 2 (2.1093) ANSI/IEEE C95.1-1992 IEEE 1528-2013

The product was received on Mar. 14, 2019 and testing was started from Jul. 19, 2019 and completed on Aug. 18, 2019. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Cona Huang / Deputy Manager

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History of this test report

Report No.	Version	Description	Issued Date
FA8O1739-16	01	Initial issue of report	Sep. 09, 2019

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Extreme Networks, Inc., 802.11ax Access Point, AP560i, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary Body (Separation 25mm) 1g SAR (W/kg)	Highest Simultaneous Transmission 1g SAR (W/kg)
DTS	2.4GHz WLAN	0.42	1.17
NII	5GHz WLAN	1.12	1.17
DSS	Bluetooth	< 0.01	1.17
DSS	Thread	< 0.01	1.17
Date of Testing:		2019/7/19 ~ 2019/8/18	

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications

Reviewed by: Jason Wang
Report Producer: Wan Liu

2. Guidance Applied

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

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02

3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	802.11ax Access Point
Brand Name	Extreme Networks
Model Name	AP560i
FCC ID	QXO-AP510I
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz Thread: 2405 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz : 802.11b/g/ax HEW20/HEW40 WLAN 5GHz : 802.11a/n/ax HEW20/HEW40/HEW80 Bluetooth LE Thread: O-QPSK
EUT Stage	Identical Prototype
Remark: 1. The EUT has three radios, the information as following table.	

Radio	Function		
	WLAN 2.4GHz	WLAN 5GHz	Bluetooth / Thread
1	V	V	-
2	-	V	-
3	-	-	V

4. RF Exposure Limits

4.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

4.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

5. Specific Absorption Rate (SAR)

5.1 Introduction

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

5.2 SAR Definition

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

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

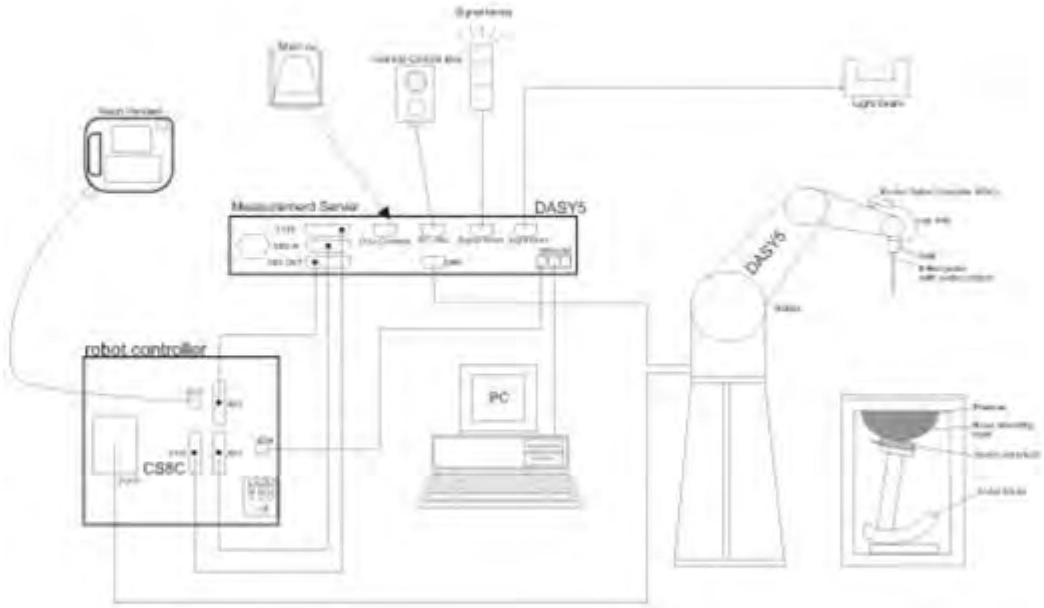
SAR is expressed in units of Watts per kilogram (W/kg)

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

6. System Description and Setup

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

6.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 μW/g – >100 mW/g; Linearity: ±0.2 dB
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm

<EX3DV4 Probe>

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

6.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

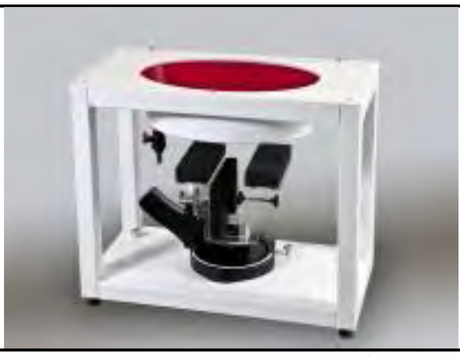
6.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)	
Filling Volume	Approx. 30 liters	
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm	

The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

6.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

7. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

7.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

7.2 Power Reference Measurement

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

7.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

7.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 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>

7.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

7.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	929	Mar. 06, 2019	Mar. 05, 2020
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Sep. 27, 2018	Sep. 26, 2019
SPEAG	Data Acquisition Electronics	DAE4	699	Jan. 03, 2019	Jan. 02, 2020
SPEAG	Data Acquisition Electronics	DAE4	778	May. 21, 2019	May. 20, 2020
SPEAG	Data Acquisition Electronics	DAE4	853	Jul. 18, 2019	Jul. 17, 2020
SPEAG	Dosimetric E-Field Probe	EX3DV4	3728	Jan. 15, 2019	Jan. 14, 2020
SPEAG	Dosimetric E-Field Probe	EX3DV4	7515	Oct. 03, 2018	Oct. 02, 2019
RCPTWN	Thermometer	HTC-1	TM685-1	Nov. 12, 2018	Nov. 11, 2019
RCPTWN	Thermometer	HTC-1	TM560-2	Nov. 12, 2018	Nov. 11, 2019
R&S	BT Base Station	CBT32	100522	Mar. 18, 2019	Mar. 17, 2020
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Dec. 11, 2018	Dec. 10, 2019
Agilent	ENA Network Analyzer	E5071C	MY46104758	Sep. 19, 2018	Sep. 18, 2019
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 19, 2018	Sep. 18, 2019
LINE SEIKI	Digital Thermometer	DTM3000-spezial	3169	Sep. 11, 2018	Sep. 10, 2019
Anritsu	Power Meter	ML2495A	1240001	Sep. 13, 2018	Sep. 12, 2019
Anritsu	Power Sensor	MA2411B	1207349	Sep. 13, 2018	Sep. 12, 2019
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 28, 2018	Aug. 27, 2019
Mini-Circuits	Power Amplifier	ZVE-8G+	070501814	Oct. 08, 2018	Oct. 07, 2019
Mini-Circuits	Power Amplifier	ZHL-42W+	715701915	May. 10, 2019	May. 09, 2020
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

9. System Verification

9.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.2.

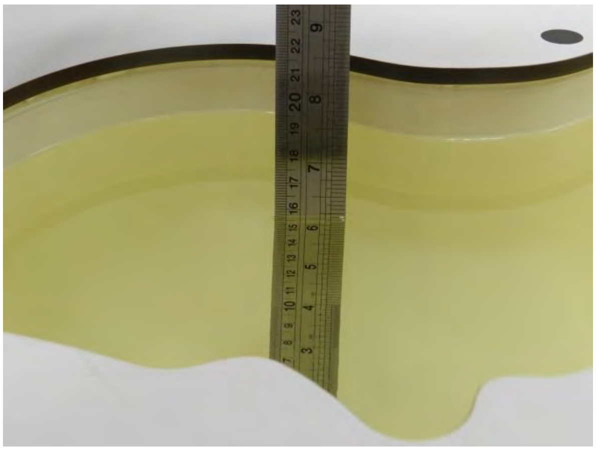


Fig 10.1Photo of Liquid Height for Head SAR

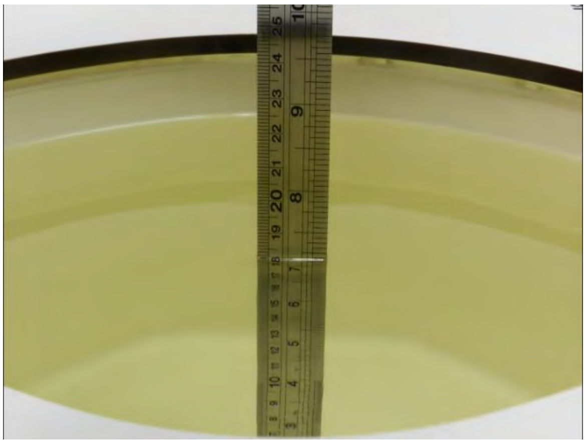


Fig 10.2 Photo of Liquid Height for Body SAR

9.2 Tissue Verification

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

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	22.3	1.835	40.164	1.80	39.20	1.94	2.46	±5	2019/8/18
5250	22.5	4.694	35.923	4.71	35.95	-0.34	-0.08	±5	2019/8/16
5600	22.3	5.019	36.838	5.07	35.50	-1.01	3.77	±5	2019/8/13
5750	22.6	5.012	35.710	5.22	35.35	-3.98	1.02	±5	2019/7/19
5750	22.3	5.177	36.661	5.22	35.35	-0.82	3.71	±5	2019/8/13

9.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2019/8/18	2450	250	D2450V2-929	EX3DV4 - SN3728	DAE4 Sn778	13.50	52.10	54	3.65
2019/8/16	5250	100	D5GHzV2-1006-5250	EX3DV4 - SN7515	DAE4 Sn853	8.19	80.70	81.9	1.49
2019/8/13	5600	100	D5GHzV2-1006-5600	EX3DV4 - SN7515	DAE4 Sn853	8.61	83.30	86.1	3.36
2019/7/19	5750	100	D5GHzV2-1006-5750	EX3DV4 - SN7515	DAE4 Sn699	7.88	80.40	78.8	-1.99
2019/8/13	5750	100	D5GHzV2-1006-5750	EX3DV4 - SN7515	DAE4 Sn853	8.35	80.40	83.5	3.86

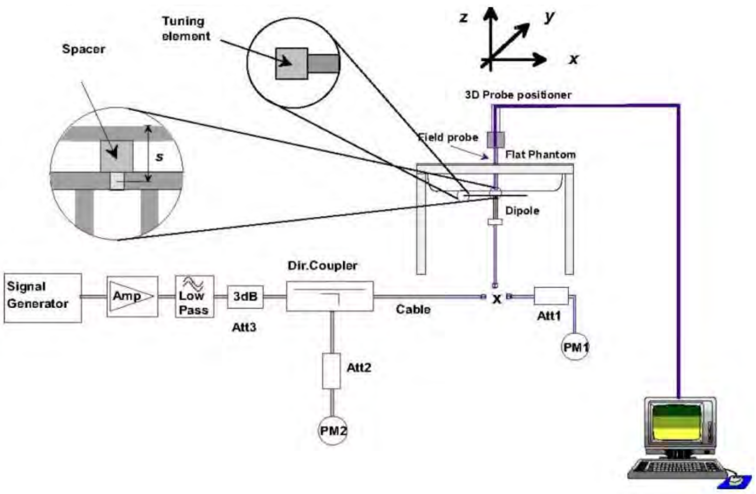


Fig 8.3.1 System Performance Check Setup

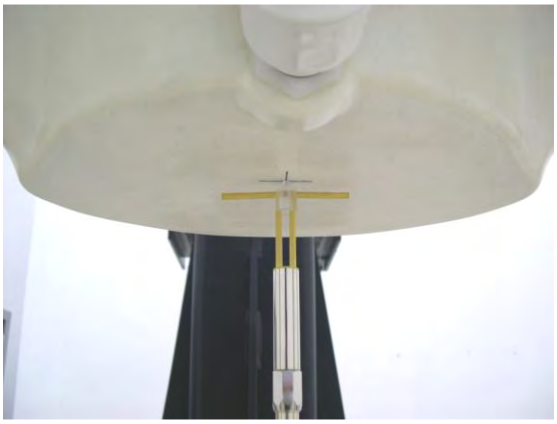


Fig 8.3.2 Setup Photo

10. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

1. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
2. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
3. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, 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 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
4. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
   a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
   b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
   c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
5. Per 201904 TCBC workshops, General principles of FCC KDB Publication 248227 D01 can be applied to determine the SAR Initial Test Configurations and test reduction for 802.11ax SAR testing. For the table below the 802.11ax maximum power is SU (non-OFDMA), and the device does not supports RU (OFDMA)
6. In applying the test guidance, the IEEE 802.11 mode with the maximum output power (out of all modes) should be considered for testing
7. For modes with the same maximum output power, the guidance from section 5.3.2 a) of FCC KDB Publication 248227 D01 should be applied, with 802.11ax being considered as the highest 802.11 mode for the appropriate frequency bands
8. When SAR testing for 802.11ax is required
   a. If the maximum output power is highest for OFDMA scenarios, choose the tone size with the maximum number of tones and the highest maximum output power
   b. Otherwise, consider the fully allocated channel for SAR testing
   c. When SAR testing is required on RU sizes less than the fully allocated channel, use the RU number closest to the middle of the channel, choosing the higher RU number when two RUs are equidistant to the middle of the channel

<Non-beamforming mode>

<Radio 1>

<2.4GHz WLAN ANT1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	22.04	22.50	94.60
		6	2437	22.93	23.00	
		11	2462	21.46	21.50	
	802.11g 6Mbps	1	2412	17.45	17.50	95.20
		6	2437	20.91	21.00	
		11	2462	16.33	16.50	
	802.11ax HEW20 Nss1	1	2412	16.94	17.00	98.60
		6	2437	21.03	21.50	
		11	2462	14.58	15.00	
	802.11ax HEW40 Nss1	3	2422	16.31	16.50	97.00
		6	2437	17.03	17.50	
		9	2452	15.93	16.00	

<2.4GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11ax HEW20 Nss2	1	2412	18.75	19.00	97.20
		6	2437	23.17	23.50	
		11	2462	18.85	19.00	
	802.11ax HEW40 Nss2	3	2422	18.06	18.50	94.80
		6	2437	19.54	20.00	
		9	2452	18.12	18.50	

<2.4GHz WLAN ANT1+2+3+4>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	26.99	27.00	94.90
		6	2437	28.09	28.50	
		11	2462	26.40	26.50	
	802.11g 6Mbps	1	2412	21.05	21.50	95.50
		6	2437	24.60	25.00	
		11	2462	20.99	21.00	
	802.11ax HEW20 Nss4	1	2412	20.69	21.00	95.30
		6	2437	25.11	25.50	
		11	2462	20.74	21.00	
	802.11ax HEW40 Nss1	3	2422	20.10	20.50	97.30
		6	2437	21.31	21.50	
		9	2452	19.79	20.00	

<5GHz WLAN ANT1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	18.54	19.00	95.50
		40	5200	20.12	20.50	
		44	5220	20.08	20.50	
		48	5240	18.37	18.50	
	802.11ax HEW20 Nss1	36	5180	18.15	18.50	98.40
		40	5200	20.19	20.50	
		44	5220	20.14	20.50	
		48	5240	18.75	19.00	
	802.11ax HEW40 Nss1	38	5190	16.32	16.50	96.30
		46	5230	18.32	18.50	
	802.11ax HEW80 Nss1	42	5210	15.90	16.00	94.40

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	19.02	19.50	95.50
		56	5280	18.93	19.00	
		60	5300	18.32	19.00	
		64	5320	18.85	19.00	
	802.11ax HEW20 Nss1	52	5260	20.10	20.50	98.40
		56	5280	20.29	20.50	
		60	5300	20.39	20.50	
		64	5320	18.44	18.50	
	802.11ax HEW40 Nss1	54	5270	20.10	20.50	96.30
		62	5310	15.67	16.00	
	802.11ax HEW80 Nss1	58	5290	14.84	15.00	94.40
	802.11ax HEW160 Nss1	50	5250	10.79	11.00	92.60

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	17.88	18.00	95.50
		116	5580	15.40	15.50	
		124	5620	15.23	15.50	
		132	5660	15.25	15.50	
		144	5720	13.59	14.00	
	802.11ax HEW20 Nss1	100	5500	18.02	18.50	98.40
		116	5580	15.30	15.50	
		124	5620	15.27	15.50	
		132	5660	15.20	15.50	
		144	5720	11.24	11.50	
	802.11ax HEW40 Nss1	102	5510	15.95	16.00	96.30
		110	5550	17.14	17.50	
		126	5630	17.06	17.50	
		134	5670	16.58	17.00	
		142	5710	15.03	15.50	
	802.11ax HEW80 Nss1	106	5530	15.78	16.00	94.40
		122	5610	17.99	18.00	
		138	5690	17.44	17.50	
	802.11ax HEW160 Nss1	114	5570	14.07	14.50	92.60

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	18.60	19.00	95.50
		157	5785	18.02	18.50	
		165	5825	19.39	19.50	
	802.11ax HEW20 Nss1	149	5745	19.55	20.00	98.40
		157	5785	19.22	19.50	
		165	5825	21.47	21.50	
	802.11ax HEW40 Nss1	151	5755	20.33	20.50	96.30
		159	5795	20.95	21.00	
	802.11ax HEW80 Nss1	155	5775	20.73	21.00	94.40

<5GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11ax HEW20 Nss2	36	5180	20.19	20.50	97.20
		40	5200	23.37	23.50	
		44	5220	23.23	23.50	
		48	5240	21.42	21.50	
	802.11ax HEW40 Nss2	38	5190	19.15	19.50	94.80
		46	5230	21.29	21.50	
	802.11ax HEW80 Nss2	42	5210	17.96	18.00	91.50

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11ax HEW20 Nss2	52	5260	23.46	23.50	97.20
		56	5280	23.41	23.50	
		60	5300	23.55	24.00	
		64	5320	19.83	20.00	
	802.11ax HEW40 Nss2	54	5270	22.87	23.00	94.80
		62	5310	18.79	19.00	
	802.11ax HEW80 Nss2	58	5290	18.74	19.00	91.50
	802.11ax HEW160 Nss2	50	5250	13.27	13.50	90.10

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11ax HEW20 Nss2	100	5500	19.48	19.50	97.20
		116	5580	18.08	18.50	
		124	5620	17.86	18.50	
		132	5660	18.06	18.50	
		144	5720	14.11	14.50	
	802.11ax HEW40 Nss2	102	5510	18.93	19.00	94.80
		110	5550	19.96	20.00	
		126	5630	19.84	20.00	
		134	5670	19.04	19.50	
		142	5710	17.68	18.00	
	802.11ax HEW80 Nss2	106	5530	18.49	18.50	91.50
		122	5610	20.89	21.00	
		138	5690	20.14	20.50	
	802.11ax HEW160 Nss2	114	5570	16.74	17.00	90.10

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11ax HEW20 Nss2	149	5745	22.52	23.00	97.20
		157	5785	22.30	23.00	
		165	5825	24.48	24.50	
	802.11ax HEW40 Nss2	151	5755	23.86	24.00	94.80
		159	5795	24.36	24.50	
	802.11ax HEW80 Nss2	155	5775	22.14	22.50	91.50

<5GHz WLAN ANT1+2+3+4>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	23.38	24.00	95.60
		40	5200	24.38	24.50	
		44	5220	24.28	24.50	
		48	5240	23.86	24.00	
	802.11ax HEW20 Nss4	36	5180	22.60	23.00	95.30
		40	5200	25.88	26.00	
		44	5220	25.77	26.00	
		48	5240	24.10	24.50	
	802.11ax HEW40 Nss4	38	5190	19.95	20.50	92.30
		46	5230	24.14	24.50	
	802.11ax HEW80 Nss4	42	5210	19.95	20.00	89.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	18.23	18.50	95.60
		56	5280	18.40	18.50	
		60	5300	18.42	18.50	
		64	5320	18.50	18.50	
	802.11ax HEW20 Nss4	52	5260	23.80	24.00	95.30
		56	5280	23.79	24.00	
		60	5300	23.87	24.00	
		64	5320	22.11	22.50	
	802.11ax HEW40 Nss4	54	5270	23.90	24.00	92.30
		62	5310	19.25	20.00	
	802.11ax HEW80 Nss4	58	5290	19.81	20.00	89.00
	802.11ax HEW160 Nss4	50	5250	15.39	15.50	88.30

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	18.27	18.50	95.60
		116	5580	18.36	18.50	
		124	5620	18.28	18.50	
		132	5660	18.26	18.50	
		144	5720	17.43	17.50	
	802.11ax HEW20 Nss4	100	5500	22.23	22.50	95.30
		116	5580	21.78	22.00	
		124	5620	21.65	22.00	
		132	5660	21.76	22.00	
		144	5720	17.53	18.00	
	802.11ax HEW40 Nss4	102	5510	19.89	20.00	92.30
		110	5550	23.34	23.50	
		126	5630	23.23	23.50	
		134	5670	20.66	21.00	
		142	5710	20.85	21.00	
	802.11ax HEW80 Nss1	106	5530	19.76	20.00	94.50
		122	5610	22.21	22.50	
		138	5690	23.43	23.50	
	802.11ax HEW160 Nss1	114	5570	19.36	19.50	88.30

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	24.90	25.00	95.60
		157	5785	24.39	25.00	
		165	5825	24.76	25.00	
	802.11ax HEW20 Nss1	149	5745	25.83	26.00	98.60
		157	5785	25.85	26.00	
		165	5825	27.59	28.00	
	802.11ax HEW40 Nss1	151	5755	27.04	28.00	97.00
		159	5795	27.46	28.00	
	802.11ax HEW80 Nss4	155	5775	24.29	24.50	89.00

<Radio 2>

<5GHz WLAN ANT1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	19.16	19.50	94.40
		40	5200	20.06	20.50	
		44	5220	20.03	20.50	
		48	5240	18.69	19.00	
	802.11ax HEW20 Nss1 MCS0	36	5180	17.36	17.50	98.60
		40	5200	20.20	20.50	
		44	5220	20.17	20.50	
		48	5240	19.23	19.50	
	802.11ax HEW40 Nss1 MCS0	38	5190	15.44	15.50	97.30
		46	5230	19.91	20.00	
	802.11ax HEW80 Nss1 MCS0	42	5210	15.52	16.00	94.50

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	18.55	19.00	94.40
		56	5280	20.51	21.00	
		60	5300	20.67	21.00	
		64	5320	19.60	20.00	
	802.11ax HEW20 Nss1 MCS0	52	5260	18.91	19.00	98.60
		56	5280	19.42	19.50	
		60	5300	19.60	20.00	
		64	5320	18.08	18.50	
	802.11ax HEW40 Nss1 MCS0	54	5270	18.12	18.50	97.30
		62	5310	16.88	17.00	
	802.11ax HEW80 Nss1 MCS0	58	5290	15.87	16.00	94.50
	802.11ax HEW160 Nss1 MCS0	50	5250	11.56	12.00	91.20

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	18.75	19.00	94.40
		116	5580	20.52	21.00	
		124	5620	20.44	20.50	
		132	5660	20.48	20.50	
		144	5720	18.14	18.50	
	802.11ax HEW20 Nss1	100	5500	18.37	18.50	98.60
		116	5580	21.08	21.50	
		124	5620	21.06	21.50	
		132	5660	21.04	21.50	
		144	5720	17.91	18.00	
	802.11ax HEW40 Nss1	102	5510	16.86	17.00	97.30
		110	5550	20.78	21.00	
		126	5630	20.58	21.00	
		134	5670	17.27	17.50	
		142	5710	19.50	20.00	
	802.11ax HEW80 Nss1	106	5530	16.47	16.50	94.50
		122	5610	18.92	19.00	
		138	5690	19.11	19.50	
	802.11ax HEW160 Nss1	114	5570	15.52	16.00	91.20

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	19.44	19.50	94.40
		157	5785	21.55	22.00	
		165	5825	20.59	21.00	
	802.11ax HEW20 Nss1	149	5745	22.50	22.50	98.60
		157	5785	21.96	22.00	
		165	5825	20.88	21.00	
	802.11ax HEW40 Nss1	151	5755	22.53	23.00	97.30
		159	5795	22.84	23.00	
	802.11ax HEW80 Nss1	155	5775	20.51	21.00	94.50

<5GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11ax HEW20 Nss2	36	5180	19.22	19.50	97.00
		40	5200	23.25	23.50	
		44	5220	23.21	23.50	
		48	5240	22.26	22.50	
	802.11ax HEW40 Nss2	38	5190	17.78	18.00	94.80
		46	5230	22.54	23.00	
	802.11ax HEW80 Nss2	42	5210	17.17	17.50	91.20

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11ax HEW20 Nss2	52	5260	21.89	22.00	97.00
		56	5280	22.45	22.50	
		60	5300	22.66	23.00	
		64	5320	20.36	20.50	
	802.11ax HEW40 Nss2	54	5270	21.27	21.50	94.80
		62	5310	18.94	19.00	
	802.11ax HEW80 Nss2	58	5290	18.10	18.50	91.20
	802.11ax HEW160 Nss2	50	5250	13.73	14.00	90.10

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11ax HEW20 Nss2	100	5500	20.11	20.50	97.00
		116	5580	23.76	24.00	
		124	5620	23.68	24.00	
		132	5660	23.61	24.00	
		144	5720	21.26	21.50	
	802.11ax HEW40 Nss2	102	5510	19.20	19.50	94.80
		110	5550	23.28	23.50	
		126	5630	23.10	23.50	
		134	5670	19.62	20.00	
		142	5710	22.36	22.50	
	802.11ax HEW80 Nss2	106	5530	18.31	18.50	91.20
		122	5610	21.21	21.50	
		138	5690	22.06	22.50	
	802.11ax HEW160 Nss2	114	5570	16.59	17.00	90.10

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11ax HEW20 Nss2	149	5745	25.50	25.50	97.00
		157	5785	24.69	25.00	
		165	5825	23.95	24.00	
	802.11ax HEW40 Nss2	151	5755	25.07	25.50	94.80
		159	5795	25.94	26.00	
	802.11ax HEW80 Nss2	155	5775	22.85	23.00	90.10

<5GHz WLAN ANT1+2+3+4>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	22.94	23.00	95.10
		40	5200	25.14	25.50	
		44	5220	25.11	25.50	
		48	5240	24.07	24.50	
	802.11ax HEW20 Nss4	36	5180	21.84	22.00	95.30
		40	5200	25.79	26.00	
		44	5220	25.70	26.00	
		48	5240	25.05	25.50	
	802.11ax HEW40 Nss1	38	5190	20.09	20.50	97.00
		46	5230	24.28	24.50	
	802.11ax HEW80 Nss1	42	5210	19.98	20.00	94.50

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	19.14	19.50	95.10
		56	5280	19.21	19.50	
		60	5300	19.34	19.50	
		64	5320	19.35	19.50	
	802.11ax HEW20 Nss4	52	5260	23.81	24.00	95.30
		56	5280	23.92	24.00	
		60	5300	23.96	24.00	
		64	5320	22.35	22.50	
	802.11ax HEW40 Nss4	54	5270	23.83	24.00	92.30
		62	5310	20.55	21.00	
	802.11ax HEW80 Nss4	58	5290	20.33	20.50	89.00
	802.11ax HEW160 Nss1	50	5250	15.72	16.00	88.10

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	19.17	19.50	95.10
		116	5580	19.27	19.50	
		124	5620	19.31	19.50	
		132	5660	19.35	19.50	
		144	5720	18.12	18.50	
	802.11ax HEW20 Nss4	100	5500	22.70	23.00	95.30
		116	5580	23.96	24.00	
		124	5620	23.93	24.00	
		132	5660	23.78	24.00	
		144	5720	23.28	23.50	
	802.11ax HEW40 Nss4	102	5510	20.36	20.50	92.30
		110	5550	23.81	24.00	
		126	5630	23.73	24.00	
		134	5670	21.48	21.50	
		142	5710	23.77	24.00	
	802.11ax HEW80 Nss4	106	5530	20.61	21.00	89.00
		122	5610	23.44	23.50	
		138	5690	23.88	24.00	
	802.11ax HEW160 Nss1	114	5570	19.43	19.50	88.10

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	25.48	25.50	95.10
		157	5785	27.63	28.00	
		165	5825	26.12	26.50	
	802.11ax HEW20 Nss1	149	5745	28.52	29.00	97.00
		157	5785	27.93	28.00	
		165	5825	27.05	27.50	
	802.11ax HEW40 Nss1	151	5755	26.63	27.00	94.50
		159	5795	27.98	28.00	
	802.11ax HEW80 Nss4	155	5775	24.18	24.50	89.00

<Beamforming mode>

<Radio 1>

<2.4GHz WLAN ANT1+2+3+4>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11ax HEW20 Nss1	1	2412	15.95	16.00	90.50
		6	2437	19.27	19.50	
		11	2462	15.21	15.50	
	802.11ax HEW40 Nss1	3	2422	16.05	16.50	90.30
		6	2437	17.03	17.50	
		9	2452	15.39	15.50	

<5GHz WLAN ANT1+2+3+4>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11ax HEW20 Nss1	36	5180	18.24	18.50	88.60
		40	5200	22.19	22.50	
		44	5220	22.08	22.50	
		48	5240	23.94	24.00	
	802.11ax HEW40 Nss1	38	5190	17.42	17.50	88.50
		46	5230	23.50	24.00	
	802.11ax HEW80 Nss1	42	5210	18.94	19.00	92.50

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11ax HEW20 Nss1	52	5260	18.29	18.50	88.60
		56	5280	18.02	18.50	
		60	5300	18.17	18.50	
		64	5320	18.16	18.50	
	802.11ax HEW40 Nss1	54	5270	18.37	18.50	88.50
		62	5310	18.17	18.50	
	802.11ax HEW80 Nss1	58	5290	18.27	18.50	92.50
	802.11ax HEW160 Nss1	50	5250	9.35	10.00	90.30

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11ax HEW20 Nss1	100	5500	18.16	18.50	88.60
		116	5580	18.23	18.50	
		124	5620	18.06	18.50	
		132	5660	18.02	18.50	
		144	5720	17.51	18.00	
	802.11ax HEW40 Nss1	102	5510	17.09	17.50	88.50
		110	5550	18.24	18.50	
		126	5630	18.09	18.50	
		134	5670	18.19	18.50	
		142	5710	18.38	18.50	
	802.11ax HEW80 Nss1	106	5530	18.26	18.50	92.50
		122	5610	18.16	18.50	
		138	5690	18.21	18.50	
	802.11ax HEW160 Nss1	114	5570	18.19	18.50	90.30

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11ax HEW20 Nss1	149	5745	24.27	24.50	88.60
		157	5785	24.39	24.50	
		165	5825	24.38	24.50	
	802.11ax HEW40 Nss1	151	5755	24.40	24.50	88.50
		159	5795	24.22	24.50	
	802.11ax HEW80 Nss1	155	5775	23.10	23.50	92.50

<Radio 2>

<5GHz WLAN ANT1+2+3+4>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11ax HEW20 Nss1	36	5180	16.92	17.00	88.30
		40	5200	20.89	21.00	
		44	5220	20.55	21.00	
		48	5240	25.17	25.50	
	802.11ax HEW40 Nss1	38	5190	16.47	16.50	88.10
		46	5230	21.40	21.50	
	802.11ax HEW80 Nss1	42	5210	18.57	19.00	93.80

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11ax HEW20 Nss1	52	5260	19.15	19.50	88.30
		56	5280	19.01	19.50	
		60	5300	19.13	19.50	
		64	5320	19.87	20.00	
	802.11ax HEW40 Nss1	54	5270	18.96	19.00	88.10
		62	5310	19.07	19.50	
	802.11ax HEW80 Nss1	58	5290	19.14	19.50	93.80
	802.11ax HEW160 Nss1	50	5250	10.08	10.50	91.20

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11ax HEW20 Nss1	100	5500	19.02	19.50	88.30
		116	5580	19.12	19.50	
		124	5620	19.00	19.50	
		132	5660	19.02	19.50	
		144	5720	18.04	18.50	
	802.11ax HEW40 Nss1	102	5510	18.34	18.50	88.10
		110	5550	19.09	19.50	
		126	5630	19.02	19.50	
		134	5670	19.11	19.50	
		142	5710	18.96	19.00	
	802.11ax HEW80 Nss1	106	5530	19.08	19.50	93.80
		122	5610	19.05	19.50	
		138	5690	18.95	19.00	
	802.11ax HEW160 Nss1	114	5570	18.93	19.00	92.10

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11ax HEW20 Nss1	149	5745	25.14	25.50	88.30
		157	5785	25.03	25.50	
		165	5825	25.16	25.50	
	802.11ax HEW40 Nss1	151	5755	25.12	25.50	88.10
		159	5795	25.10	25.50	
	802.11ax HEW80 Nss1	155	5775	23.77	24.00	93.80

<2.4GHz Bluetooth>

Mode	Channel	Frequency (MHz)	Average power (dBm)
			1Mbps
LE	CH 00	2402	1.38
	CH 13	2440	1.67
	CH 27	2480	1.65
Tune-up Limit			2.00

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps.

<2.4GHz Thread>

Mode	Channel	Frequency (MHz)	Average power (dBm)
Thread	CH11	2405	1.57
	CH18	2440	1.92
	CH26	2480	-3.15
Tune-up Limit			2.00

General Note:

1. For 2.4GHz Thread SAR testing was selected 1Mbps.

11. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For Bluetooth/Thread: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
   d. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.

WLAN Note:

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required 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.
2. Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for Radio1 ANT 1+2.
3. Per KDB 248227 D01v02r02, U-NII-2A SAR testing is not required when the U-NII-1 band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-2A band for Radio2 ANT 1+2.
4. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
5. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
6. Per 201904 TCBC workshops, General principles of FCC KDB Publication 248227 D01 can be applied to determine the SAR Initial Test Configurations and test reduction for 802.11ax SAR testing. For the table below the 802.11ax maximum power is SU (non-OFDMA), and this device does not supports RU (OFDMA)
7. In applying the test guidance, the IEEE 802.11 mode with the maximum output power (out of all modes) should be considered for testing
8. For modes with the same maximum output power, the guidance from section 5.3.2 a) of FCC KDB Publication 248227 D01 should be applied, with 802.11ax being considered as the highest 802.11 mode for the appropriate frequency bands
9. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

11.1 Body SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Radio	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front Face	25mm	Ant 1	Radio 1	6	2437	22.93	23.00	1.016	94.60	1.057	-0.09	0.176	0.189
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	25mm	Ant 1	Radio 1	6	2437	22.93	23.00	1.016	94.60	1.057	0	0.001	0.001
	WLAN2.4GHz	802.11b 1Mbps	Edge 1	25mm	Ant 1	Radio 1	6	2437	22.93	23.00	1.016	94.60	1.057	-0.09	0.089	0.096
	WLAN2.4GHz	802.11b 1Mbps	Edge 2	25mm	Ant 1	Radio 1	6	2437	22.93	23.00	1.016	94.60	1.057	0	0.018	0.019
	WLAN2.4GHz	802.11b 1Mbps	Edge 4	25mm	Ant 1	Radio 1	6	2437	22.93	23.00	1.016	94.60	1.057	-0.04	0.123	0.132
	WLAN2.4GHz	802.11ax HEW20 Nss2	Front Face	25mm	Ant 1+2	Radio 1	6	2437	23.17	23.50	1.079	97.20	1.029	-0.06	0.113	0.125
	WLAN2.4GHz	802.11ax HEW20 Nss2	Bottom Face	25mm	Ant 1+2	Radio 1	6	2437	23.17	23.50	1.079	97.20	1.029	0	0.001	0.001
	WLAN2.4GHz	802.11ax HEW20 Nss2	Edge 1	25mm	Ant 1+2	Radio 1	6	2437	23.17	23.50	1.079	97.20	1.029	0.11	0.061	0.068
	WLAN2.4GHz	802.11ax HEW20 Nss2	Edge 2	25mm	Ant 1+2	Radio 1	6	2437	23.17	23.50	1.079	97.20	1.029	0.09	0.014	0.016
	WLAN2.4GHz	802.11ax HEW20 Nss2	Edge 4	25mm	Ant 1+2	Radio 1	6	2437	23.17	23.50	1.079	97.20	1.029	0.07	0.077	0.085
01	WLAN2.4GHz	802.11b 1Mbps	Front Face	25mm	Ant 1+2+3+4	Radio 1	6	2437	28.09	28.50	1.099	94.90	1.054	-0.06	0.365	0.423
	WLAN2.4GHz	802.11b 1Mbps	Front Face	25mm	Ant 1+2+3+4	Radio 1	1	2412	26.99	27.00	1.002	94.90	1.054	0.11	0.250	0.264
	WLAN2.4GHz	802.11b 1Mbps	Front Face	25mm	Ant 1+2+3+4	Radio 1	11	2462	26.40	26.50	1.023	94.90	1.054	-0.06	0.217	0.234
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	25mm	Ant 1+2+3+4	Radio 1	6	2437	28.09	28.50	1.099	94.90	1.054	0	0.001	0.001
	WLAN2.4GHz	802.11b 1Mbps	Edge 1	25mm	Ant 1+2+3+4	Radio 1	6	2437	28.09	28.50	1.099	94.90	1.054	0.04	0.168	0.195
	WLAN2.4GHz	802.11b 1Mbps	Edge 2	25mm	Ant 1+2+3+4	Radio 1	6	2437	28.09	28.50	1.099	94.90	1.054	-0.14	0.170	0.197
	WLAN2.4GHz	802.11b 1Mbps	Edge 4	25mm	Ant 1+2+3+4	Radio 1	6	2437	28.09	28.50	1.099	94.90	1.054	-0.08	0.159	0.184
	WLAN5GHz	802.11ax HEW20 Nss2	Front Face	25mm	Ant 1+2	Radio 2	40	5200	23.25	23.50	1.059	97.00	1.031	-0.04	0.175	0.191
	WLAN5GHz	802.11ax HEW20 Nss2	Bottom Face	25mm	Ant 1+2	Radio 2	40	5200	23.25	23.50	1.059	97.00	1.031	0	0.001	0.001
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 1	25mm	Ant 1+2	Radio 2	40	5200	23.25	23.50	1.059	97.00	1.031	-0.04	0.152	0.166
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 2	25mm	Ant 1+2	Radio 2	40	5200	23.25	23.50	1.059	97.00	1.031	-0.06	0.235	0.257
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 4	25mm	Ant 1+2	Radio 2	40	5200	23.25	23.50	1.059	97.00	1.031	-0.19	0.073	0.080
	WLAN5GHz	802.11ax HEW20 Nss4	Front Face	25mm	Ant 1+2+3+4	Radio 1	40	5200	25.88	26.00	1.028	95.30	1.049	-0.06	0.398	0.429
	WLAN5GHz	802.11ax HEW20 Nss4	Front Face	25mm	Ant 1+2+3+4	Radio 1	36	5180	22.60	23.00	1.096	95.30	1.049	-0.07	0.169	0.194
02	WLAN5GHz	802.11ax HEW20 Nss4	Front Face	25mm	Ant 1+2+3+4	Radio 1	44	5220	25.77	26.00	1.054	95.30	1.049	-0.17	0.415	0.459
	WLAN5GHz	802.11ax HEW20 Nss4	Front Face	25mm	Ant 1+2+3+4	Radio 1	48	5240	24.10	24.50	1.096	95.30	1.049	0.07	0.273	0.314
	WLAN5GHz	802.11ax HEW20 Nss4	Bottom Face	25mm	Ant 1+2+3+4	Radio 1	40	5200	25.88	26.00	1.028	95.30	1.049	0	0.001	0.001
	WLAN5GHz	802.11ax HEW20 Nss4	Edge 1	25mm	Ant 1+2+3+4	Radio 1	40	5200	25.88	26.00	1.028	95.30	1.049	-0.08	0.141	0.152
	WLAN5GHz	802.11ax HEW20 Nss4	Edge 2	25mm	Ant 1+2+3+4	Radio 1	40	5200	25.88	26.00	1.028	95.30	1.049	-0.01	0.124	0.134
	WLAN5GHz	802.11ax HEW20 Nss4	Edge 4	25mm	Ant 1+2+3+4	Radio 1	40	5200	25.88	26.00	1.028	95.30	1.049	0.02	0.141	0.152
	WLAN5GHz	802.11ax HEW20 Nss4	Front Face	25mm	Ant 1+2+3+4	Radio 2	40	5200	25.79	26.00	1.050	95.30	1.049	-0.14	0.278	0.306
	WLAN5GHz	802.11ax HEW20 Nss4	Bottom Face	25mm	Ant 1+2+3+4	Radio 2	40	5200	25.79	26.00	1.050	95.30	1.049	0	0.001	0.001
	WLAN5GHz	802.11ax HEW20 Nss4	Edge 1	25mm	Ant 1+2+3+4	Radio 2	40	5200	25.79	26.00	1.050	95.30	1.049	-0.1	0.221	0.243
	WLAN5GHz	802.11ax HEW20 Nss4	Edge 2	25mm	Ant 1+2.+3+4	Radio 2	40	5200	25.79	26.00	1.050	95.30	1.049	-0.04	0.268	0.295
	WLAN5GHz	802.11ax HEW20 Nss4	Edge 4	25mm	Ant 1+2.+3+4	Radio 2	40	5200	25.79	26.00	1.050	95.30	1.049	-0.14	0.165	0.182

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Radio	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN5GHz	802.11ax HEW40 Nss1	Front Face	25mm	Ant 1	Radio 1	54	5270	20.10	20.50	1.096	96.30	1.038	-0.14	0.181	0.206
	WLAN5GHz	802.11ax HEW40 Nss1	Bottom Face	25mm	Ant 1	Radio 1	54	5270	20.10	20.50	1.096	96.30	1.038	0	0.001	0.001
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 1	25mm	Ant 1	Radio 1	54	5270	20.10	20.50	1.096	96.30	1.038	-0.02	0.061	0.069
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 2	25mm	Ant 1	Radio 1	54	5270	20.10	20.50	1.096	96.30	1.038	0.07	0.010	0.011
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 4	25mm	Ant 1	Radio 1	54	5270	20.10	20.50	1.096	96.30	1.038	0.06	0.062	0.071
	WLAN5GHz	802.11a 6Mbps	Front Face	25mm	Ant 1	Radio 2	60	5300	20.67	21.00	1.079	94.40	1.059	-0.02	0.179	0.205
	WLAN5GHz	802.11a 6Mbps	Bottom Face	25mm	Ant 1	Radio 2	60	5300	20.67	21.00	1.079	94.40	1.059	0	0.001	0.001
	WLAN5GHz	802.11a 6Mbps	Edge 1	25mm	Ant 1	Radio 2	60	5300	20.67	21.00	1.079	94.40	1.059	-0.01	0.202	0.231
	WLAN5GHz	802.11a 6Mbps	Edge 2	25mm	Ant 1	Radio 2	60	5300	20.67	21.00	1.079	94.40	1.059	-0.06	0.214	0.245
	WLAN5GHz	802.11a 6Mbps	Edge 4	25mm	Ant 1	Radio 2	60	5300	20.67	21.00	1.079	94.40	1.059	0.12	0.018	0.021
03	WLAN5GHz	802.11ax HEW20 Nss2	Front Face	25mm	Ant 1+2	Radio 1	60	5300	23.55	24.00	1.109	97.20	1.029	-0.12	0.328	0.374
	WLAN5GHz	802.11ax HEW20 Nss2	Front Face	25mm	Ant 1+2	Radio 1	52	5260	23.46	23.50	1.009	97.20	1.029	0.05	0.325	0.338
	WLAN5GHz	802.11ax HEW20 Nss2	Front Face	25mm	Ant 1+2	Radio 1	56	5280	23.41	23.50	1.021	97.20	1.029	-0.05	0.335	0.352
	WLAN5GHz	802.11ax HEW20 Nss2	Front Face	25mm	Ant 1+2	Radio 1	64	5320	19.83	20.00	1.040	97.20	1.029	0.09	0.119	0.127
	WLAN5GHz	802.11ax HEW20 Nss2	Bottom Face	25mm	Ant 1+2	Radio 1	60	5300	23.55	24.00	1.109	97.20	1.029	0	0.001	0.001
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 1	25mm	Ant 1+2	Radio 1	60	5300	23.55	24.00	1.109	97.20	1.029	0.02	0.135	0.154
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 2	25mm	Ant 1+2	Radio 1	60	5300	23.55	24.00	1.109	97.20	1.029	0.06	0.059	0.067
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 4	25mm	Ant 1+2	Radio 1	60	5300	23.55	24.00	1.109	97.20	1.029	-0.09	0.093	0.106
	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1	Radio 1	100	5500	18.02	18.50	1.117	98.40	1.016	0	0.073	0.083
	WLAN5GHz	802.11ax HEW20 Nss1	Bottom Face	25mm	Ant 1	Radio 1	100	5500	18.02	18.50	1.117	98.40	1.016	0.07	0.001	0.001
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 1	25mm	Ant 1	Radio 1	100	5500	18.02	18.50	1.117	98.40	1.016	0.12	0.021	0.024
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 2	25mm	Ant 1	Radio 1	100	5500	18.02	18.50	1.117	98.40	1.016	0	0.001	0.001
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 4	25mm	Ant 1	Radio 1	100	5500	18.02	18.50	1.117	98.40	1.016	0.06	0.041	0.047
04	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1	Radio 2	116	5580	21.08	21.50	1.102	98.60	1.014	0	0.506	0.565
	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1	Radio 2	100	5500	18.37	18.50	1.030	98.60	1.014	0.18	0.157	0.164
	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1	Radio 2	124	5620	21.06	21.50	1.107	98.60	1.014	-0.05	0.492	0.552
	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1	Radio 2	132	5660	21.04	21.50	1.112	98.60	1.014	0.09	0.424	0.478
	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1	Radio 2	144	5720	17.91	18.00	1.021	98.60	1.014	0.03	0.364	0.377
	WLAN5GHz	802.11ax HEW20 Nss1	Bottom Face	25mm	Ant 1	Radio 2	116	5580	21.08	21.50	1.102	98.60	1.014	0.18	0.010	0.011
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 1	25mm	Ant 1	Radio 2	116	5580	21.08	21.50	1.102	98.60	1.014	-0.17	0.296	0.331
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 2	25mm	Ant 1	Radio 2	116	5580	21.08	21.50	1.102	98.60	1.014	-0.11	0.410	0.458
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 4	25mm	Ant 1	Radio 2	116	5580	21.08	21.50	1.102	98.60	1.014	-0.15	0.097	0.108
	WLAN5GHz	802.11ax HEW80 Nss2	Front Face	25mm	Ant 1+2	Radio 1	122	5610	20.89	21.00	1.026	91.50	1.093	-0.04	0.350	0.392
	WLAN5GHz	802.11ax HEW80 Nss2	Bottom Face	25mm	Ant 1+2	Radio 1	122	5610	20.89	21.00	1.026	91.50	1.093	-0.18	0.001	0.001
	WLAN5GHz	802.11ax HEW80 Nss2	Edge 1	25mm	Ant 1+2	Radio 1	122	5610	20.89	21.00	1.026	91.50	1.093	0.1	0.072	0.081
	WLAN5GHz	802.11ax HEW80 Nss2	Edge 2	25mm	Ant 1+2	Radio 1	122	5610	20.89	21.00	1.026	91.50	1.093	0.03	0.055	0.062
	WLAN5GHz	802.11ax HEW80 Nss2	Edge 4	25mm	Ant 1+2	Radio 1	122	5610	20.89	21.00	1.026	91.50	1.093	0.03	0.099	0.111
	WLAN5GHz	802.11ax HEW20 Nss2	Front Face	25mm	Ant 1+2	Radio 2	116	5580	23.76	24.00	1.057	97.00	1.031	0.06	0.467	0.509
	WLAN5GHz	802.11ax HEW20 Nss2	Bottom Face	25mm	Ant 1+2	Radio 2	116	5580	23.76	24.00	1.057	97.00	1.031	0.05	0.010	0.011
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 1	25mm	Ant 1+2	Radio 2	116	5580	23.76	24.00	1.057	97.00	1.031	-0.1	0.257	0.280
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 2	25mm	Ant 1+2	Radio 2	116	5580	23.76	24.00	1.057	97.00	1.031	-0.09	0.492	0.536
	WLAN5GHz	802.11ax HEW20 Nss2	Edge 4	25mm	Ant 1+2	Radio 2	116	5580	23.76	24.00	1.057	97.00	1.031	-0.18	0.155	0.169
	WLAN5GHz	802.11ax HEW80 Nss1	Front Face	25mm	Ant 1+2+3+4	Radio 1	138	5690	23.43	23.50	1.016	94.50	1.058	-0.06	0.468	0.503
	WLAN5GHz	802.11ax HEW80 Nss1	Bottom Face	25mm	Ant 1+2+3+4	Radio 1	138	5690	23.43	23.50	1.016	94.50	1.058	-0.09	0.001	0.001
	WLAN5GHz	802.11ax HEW80 Nss1	Edge 1	25mm	Ant 1+2+3+4	Radio 1	138	5690	23.43	23.50	1.016	94.50	1.058	-0.12	0.078	0.084
	WLAN5GHz	802.11ax HEW80 Nss1	Edge 2	25mm	Ant 1+2+3+4	Radio 1	138	5690	23.43	23.50	1.016	94.50	1.058	-0.06	0.088	0.095
	WLAN5GHz	802.11ax HEW80 Nss1	Edge 4	25mm	Ant 1+2+3+4	Radio 1	138	5690	23.43	23.50	1.016	94.50	1.058	-0.14	0.107	0.115
	WLAN5GHz	802.11ax HEW80 Nss4	Front Face	25mm	Ant 1+2+3+4	Radio 2	138	5690	23.88	24.00	1.028	89.00	1.124	0	0.255	0.295
	WLAN5GHz	802.11ax HEW80 Nss4	Bottom Face	25mm	Ant 1+2+3+4	Radio 2	138	5690	23.88	24.00	1.028	89.00	1.124	0.11	0.001	0.001
	WLAN5GHz	802.11ax HEW80 Nss4	Edge 1	25mm	Ant 1+2+3+4	Radio 2	138	5690	23.88	24.00	1.028	89.00	1.124	-0.11	0.235	0.272
	WLAN5GHz	802.11ax HEW80 Nss4	Edge 2	25mm	Ant 1+2+3+4	Radio 2	138	5690	23.88	24.00	1.028	89.00	1.124	-0.1	0.233	0.269
	WLAN5GHz	802.11ax HEW80 Nss4	Edge 4	25mm	Ant 1+2+3+4	Radio 2	138	5690	23.88	24.00	1.028	89.00	1.124	-0.03	0.238	0.275

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Radio	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1	Radio 1	165	5825	21.47	21.50	1.007	98.40	1.016	-0.03	0.387	0.396
	WLAN5GHz	802.11ax HEW20 Nss1	Bottom Face	25mm	Ant 1	Radio 1	165	5825	21.47	21.50	1.007	98.40	1.016	0.05	0.001	0.001
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 1	25mm	Ant 1	Radio 1	165	5825	21.47	21.50	1.007	98.40	1.016	-0.06	0.164	0.168
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 2	25mm	Ant 1	Radio 1	165	5825	21.47	21.50	1.007	98.40	1.016	-0.13	0.018	0.018
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 4	25mm	Ant 1	Radio 1	165	5825	21.47	21.50	1.007	98.40	1.016	-0.01	0.102	0.104
	WLAN5GHz	802.11ax HEW40 Nss1	Front Face	25mm	Ant 1	Radio 2	159	5795	22.84	23.00	1.038	97.30	1.028	-0.13	0.360	0.384
	WLAN5GHz	802.11ax HEW40 Nss1	Bottom Face	25mm	Ant 1	Radio 2	159	5795	22.84	23.00	1.038	97.30	1.028	-0.08	0.001	0.001
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 1	25mm	Ant 1	Radio 2	159	5795	22.84	23.00	1.038	97.30	1.028	0.03	0.255	0.272
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 2	25mm	Ant 1	Radio 2	159	5795	22.84	23.00	1.038	97.30	1.028	0	0.238	0.254
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 4	25mm	Ant 1	Radio 2	159	5795	22.84	23.00	1.038	97.30	1.028	-0.01	0.081	0.086
	WLAN5GHz	802.11ax HEW40 Nss2	Front Face	25mm	Ant 1+2	Radio 1	159	5795	24.36	24.50	1.033	94.80	1.055	-0.11	0.555	0.605
	WLAN5GHz	802.11ax HEW40 Nss2	Bottom Face	25mm	Ant 1+2	Radio 1	159	5795	24.36	24.50	1.033	94.80	1.055	-0.02	0.001	0.001
	WLAN5GHz	802.11ax HEW40 Nss2	Edge 1	25mm	Ant 1+2	Radio 1	159	5795	24.36	24.50	1.033	94.80	1.055	0.03	0.179	0.195
	WLAN5GHz	802.11ax HEW40 Nss2	Edge 2	25mm	Ant 1+2	Radio 1	159	5795	24.36	24.50	1.033	94.80	1.055	0.09	0.087	0.095
	WLAN5GHz	802.11ax HEW40 Nss2	Edge 4	25mm	Ant 1+2	Radio 1	159	5795	24.36	24.50	1.033	94.80	1.055	-0.08	0.153	0.167
	WLAN5GHz	802.11ax HEW40 Nss2	Front Face	25mm	Ant 1+2	Radio 2	159	5795	25.94	26.00	1.014	94.80	1.055	-0.04	0.439	0.470
	WLAN5GHz	802.11ax HEW40 Nss2	Bottom Face	25mm	Ant 1+2	Radio 2	159	5795	25.94	26.00	1.014	94.80	1.055	0.05	0.008	0.009
	WLAN5GHz	802.11ax HEW40 Nss2	Edge 1	25mm	Ant 1+2	Radio 2	159	5795	25.94	26.00	1.014	94.80	1.055	-0.03	0.310	0.332
	WLAN5GHz	802.11ax HEW40 Nss2	Edge 2	25mm	Ant 1+2	Radio 2	159	5795	25.94	26.00	1.014	94.80	1.055	-0.13	0.446	0.477
	WLAN5GHz	802.11ax HEW40 Nss2	Edge 4	25mm	Ant 1+2	Radio 2	159	5795	25.94	26.00	1.014	94.80	1.055	0.02	0.132	0.141
	WLAN5GHz	802.11ax HEW40 Nss1	Front Face	25mm	Ant 1+2+3+4	Radio 1	159	5795	27.46	28.00	1.132	97.00	1.031	-0.04	0.815	0.952
05	WLAN5GHz	802.11ax HEW40 Nss1	Front Face	25mm	Ant 1+2+3+4	Radio 1	151	5755	27.04	28.00	1.247	97.00	1.031	-0.16	0.874	1.124
	WLAN5GHz	802.11ax HEW40 Nss1	Bottom Face	25mm	Ant 1+2+3+4	Radio 1	159	5795	27.46	28.00	1.132	97.00	1.031	0.02	0.001	0.001
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 1	25mm	Ant 1+2+3+4	Radio 1	159	5795	27.46	28.00	1.132	97.00	1.031	-0.16	0.246	0.287
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 2	25mm	Ant 1+2+3+4	Radio 1	159	5795	27.46	28.00	1.132	97.00	1.031	-0.09	0.195	0.228
	WLAN5GHz	802.11ax HEW40 Nss1	Edge 4	25mm	Ant 1+2+3+4	Radio 1	159	5795	27.46	28.00	1.132	97.00	1.031	-0.05	0.242	0.283
	WLAN5GHz	802.11ax HEW20 Nss1	Front Face	25mm	Ant 1+2+3+4	Radio 2	149	5745	28.52	29.00	1.117	97.00	1.031	0.03	0.643	0.740
	WLAN5GHz	802.11ax HEW20 Nss1	Bottom Face	25mm	Ant 1+2+3+4	Radio 2	149	5745	28.52	29.00	1.117	97.00	1.031	-0.13	0.011	0.013
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 1	25mm	Ant 1+2+3+4	Radio 2	149	5745	28.52	29.00	1.117	97.00	1.031	-0.07	0.532	0.613
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 2	25mm	Ant 1+2+3+4	Radio 2	149	5745	28.52	29.00	1.117	97.00	1.031	-0.18	0.667	0.768
	WLAN5GHz	802.11ax HEW20 Nss1	Edge 4	25mm	Ant 1+2+3+4	Radio 2	149	5745	28.52	29.00	1.117	97.00	1.031	-0.11	0.554	0.638

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Radio	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
06	Bluetooth	1Mbps	Front Face	25mm	Radio 3	13	2440	1.67	2.00	1.079	-0.19	0.002	0.002
	Bluetooth	1Mbps	Front Face	25mm	Radio 3	0	2402	1.38	2.00	1.153	0.09	0.002	0.002
	Bluetooth	1Mbps	Front Face	25mm	Radio 3	27	2480	1.65	2.00	1.084	0.14	0.001	0.001
	Bluetooth	1Mbps	Bottom Face	25mm	Radio 3	13	2440	1.67	2.00	1.079	0	0.001	0.001
	Bluetooth	1Mbps	Edge 1	25mm	Radio 3	13	2440	1.67	2.00	1.079	0	0.001	0.001
	Bluetooth	1Mbps	Edge 2	25mm	Radio 3	13	2440	1.67	2.00	1.079	0	0.001	0.001
	Bluetooth	1Mbps	Edge 4	25mm	Radio 3	13	2440	1.67	2.00	1.079	0	0.001	0.001

<Thread SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Radio	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Thread	1Mbps	Front Face	25mm	Radio 3	18	2440	1.92	2.00	1.019	0.19	0.002	0.002
07	Thread	1Mbps	Front Face	25mm	Radio 3	11	2405	1.57	2.00	1.104	0.12	0.002	0.003
	Thread	1Mbps	Front Face	25mm	Radio 3	26	2480	-3.15	-1.50	1.462	0	0.001	0.001
	Thread	1Mbps	Bottom Face	25mm	Radio 3	18	2440	1.92	2.00	1.019	0	0.001	0.001
	Thread	1Mbps	Edge 1	25mm	Radio 3	18	2440	1.92	2.00	1.019	0	0.001	0.001
	Thread	1Mbps	Edge 2	25mm	Radio 3	18	2440	1.92	2.00	1.019	0	0.001	0.001
	Thread	1Mbps	Edge 4	25mm	Radio 3	18	2440	1.92	2.00	1.019	0	0.001	0.001

11.2 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (mm)	Antenna	Radio	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	WLAN5GHz	802.11ax HEW40 Nss1	Front Face	25mm	Ant 1+2+3+4	Radio 1	151	5755	27.04	28.00	1.247	97.00	1.031	-0.16	0.874	-	1.124
2nd	WLAN5GHz	802.11ax HEW40 Nss1	Front Face	25mm	Ant 1+2+3+4	Radio 1	151	5755	27.04	28.00	1.247	97.00	1.031	-0.02	0.791	1.11	1.017

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
4. The ratio is the difference in percentage between original and repeated *measured SAR*.
5. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

12. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	WLAN2.4GHz (Radio 1) + WLAN 5GHz (Radio 2) + Bluetooth (Radio3)	Yes
2.	WLAN 5GHz (Radio 1) + WLAN 5GHz (Radio 2) + Bluetooth (Radio3)	Yes
3.	WLAN2.4GHz (Radio 1) + WLAN 5GHz (Radio 2) + Thread (Radio3)	Yes
4.	WLAN 5GHz (Radio 1) + WLAN 5GHz (Radio 2) + Thread (Radio3)	Yes

General Note:

1. The Scaled SAR summation is calculated based on the same configuration and test position.
2. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
   v) The SPLSR calculated results please refer to section 12.2.

12.1 Body Exposure Conditions

Exposure Position	1 Radio 1 5GHz WLAN Ant 1 1g SAR (W/kg)	2 Radio 1 2.4GHz WLAN Ant 1 1g SAR (W/kg)	3 Radio 2 5GHz WLAN Ant 1 1g SAR (W/kg)	4 Radio 3 Thread 1g SAR (W/kg)	5 Radio 3 Bluetooth BT 4.2 1g SAR (W/kg)	1+3+4 Summed 1g SAR (W/kg)	2+3+4 Summed 1g SAR (W/kg)	1+3+5 Summed 1g SAR (W/kg)	2+3+5 Summed 1g SAR (W/kg)
Front Face at 25mm	0.396	0.189	0.565	0.003	0.002	**0.964**	**0.757**	**0.963**	**0.756**
Bottom Face at 25mm	0.001	0.001	0.011	0.001	0.001	**0.013**	**0.013**	**0.013**	**0.013**
Edge 1 at 25mm	0.168	0.096	0.331	0.001	0.001	**0.500**	**0.428**	**0.500**	**0.428**
Edge 2 at 25mm	0.018	0.019	0.458	0.001	0.001	**0.477**	**0.478**	**0.477**	**0.478**
Edge 4 at 15mm	0.104	0.132	0.108	0.001	0.001	**0.213**	**0.241**	**0.213**	**0.241**

Exposure Position	1 Radio 1 5GHz WLAN Ant 1+2 1g SAR (W/kg)	2 Radio 1 2.4GHz WLAN Ant 1+2 1g SAR (W/kg)	3 Radio 2 5GHz WLAN Ant 1+2 1g SAR (W/kg)	4 Radio 3 Thread 1g SAR (W/kg)	5 Radio 3 Bluetooth BT 4.2 1g SAR (W/kg)	1+3+4 Summed 1g SAR (W/kg)	2+3+4 Summed 1g SAR (W/kg)	1+3+5 Summed 1g SAR (W/kg)	2+3+5 Summed 1g SAR (W/kg)
Front Face at 25mm	0.605	0.125	0.509	0.003	0.002	**1.117**	**0.637**	**1.116**	**0.636**
Bottom Face at 25mm	0.001	0.001	0.010	0.001	0.001	**0.012**	**0.012**	**0.012**	**0.012**
Edge 1 at 25mm	0.195	0.068	0.310	0.001	0.001	**0.506**	**0.379**	**0.506**	**0.379**
Edge 2 at 25mm	0.095	0.016	0.492	0.001	0.001	**0.588**	**0.509**	**0.588**	**0.509**
Edge 4 at 25mm	0.167	0.085	0.155	0.001	0.001	**0.323**	**0.241**	**0.323**	**0.241**

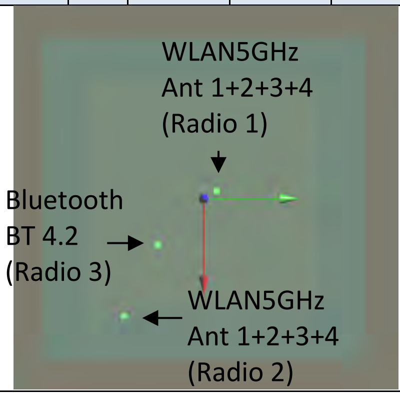
Exposure Position	1 Radio 1 5GHz WLAN Ant 1+2+3+4 1g SAR (W/kg)	2 Radio 1 2.4GHz WLAN Ant 1+2+3+4 1g SAR (W/kg)	3 Radio 2 5GHz WLAN Ant 1+2+3+4 1g SAR (W/kg)	4 Radio 3 Thread 1g SAR (W/kg)	5 Radio 3 Bluetooth BT 4.2 1g SAR (W/kg)	1+3+4 Summed 1g SAR (W/kg)	2+3+4 Summed 1g SAR (W/kg)	1+3+5 Summed 1g SAR (W/kg)	2+3+5 Summed 1g SAR (W/kg)	1+3+4 SPLSR	1+3+4 Case No	1+3+5 SPLSR	1+3+5 Case No
Front Face at 25mm	1.124	0.423	0.740	0.003	0.002	**1.867**	**1.166**	**1.866**	**1.165**	**0.03**	**Case 2**	**0.02**	**Case 1**
Bottom Face at 25mm	0.001	0.001	0.013	0.001	0.001	**0.015**	**0.015**	**0.015**	**0.015**				
Edge 1 at 25mm	0.287	0.195	0.613	0.001	0.001	**0.901**	**0.809**	**0.901**	**0.809**				
Edge 2 at 25mm	0.228	0.197	0.768	0.001	0.001	**0.997**	**0.966**	**0.997**	**0.966**				
Edge 4 at 25mm	0.283	0.184	0.638	0.001	0.001	**0.922**	**0.823**	**0.922**	**0.823**				

12.2 SPLSR Evaluation and Analysis

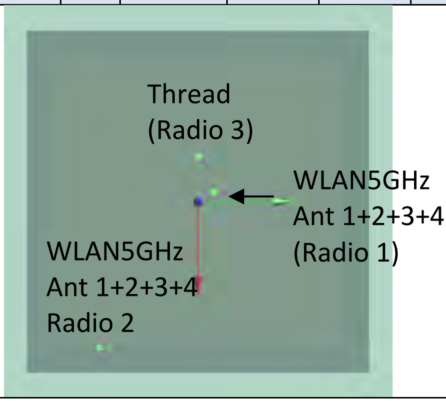
General Note:

1. SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (*min. separation distance, mm*). If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary

	Band	Position	SAR (W/kg)	Gap	SAR peak location (mm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case 1	WLAN5GHz Ant 1+2+3+4 Radio 1	Bottom Face	1.124	25mm	-5.2	18	-2.87	125.4	1.86	0.02	Not required
	WLAN5GHz Ant 1+2+3+4 Radio 2		0.74	25mm	92	-61.2	-0.83				
	WLAN5GHz Ant 1+2+3+4 Radio 1	Bottom Face	1.124	25mm	-5.2	18	-2.87	68.7	1.14	0.02	Not required
	Bluetooth BT 4.2		0.02	25mm	36	-37	-3.83				
	WLAN5GHz Ant 1+2+3+4 Radio 2	Bottom Face	0.74	25mm	92	-61.2	-0.83	61.1	0.76	0.01	Not required
	Bluetooth BT 4.2		0.02	25mm	36	-37	-3.83				



	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case 2	WLAN5GHz Ant 1+2+3+4 Radio 1	Bottom Face	1.124	25mm	-5.2	18	-2.87	125.4	1.86	0.02	Not required
	WLAN5GHz Ant 1+2+3+4 Radio 2		0.74	25mm	92	-61.2	-0.83				
	WLAN5GHz Ant 1+2+3+4 Radio 1	Bottom Face	1.124	25mm	-5.2	18	-2.87	36.6	1.15	0.03	Not required
	Thread		0.03	25mm	-28.8	-10	-4.1				
	WLAN5GHz Ant 1+2+3+4 Radio 2	Bottom Face	0.74	25mm	92	-61.2	-0.83	131.2	0.77	0.01	Not required
	Thread		0.03	25mm	-28.8	-10	-4.1				



Test Engineer： Carter Jhuang Randy Lin Neil Hsiang Willy Yu Jay Jian and White Huang

13. Uncertainty Assessment

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

14. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[6] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[7] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[8] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

System Check_Head_2450MHz

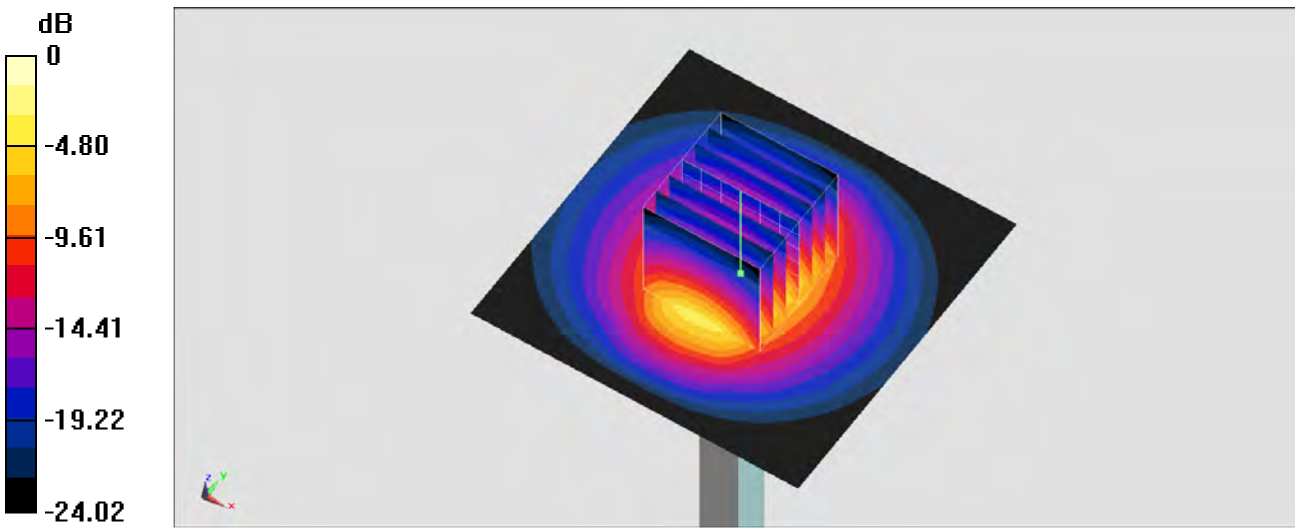
DUT: D2450V2-929

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL_2450_190818 Medium parameters used: f = 2450 MHz; σ = 1.835 S/m; ε_r = 40.164; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3728; ConvF(7.11, 7.11, 7.11) @ 2450 MHz; Calibrated: 2019/1/15
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2019/5/21
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Pin=250mW/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 23.7 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.0 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 5.96 W/kg
Maximum value of SAR (measured) = 23.7 W/kg



0 dB = 23.7 W/kg = 13.75 dBW/kg

System Check_Head_5250MHz

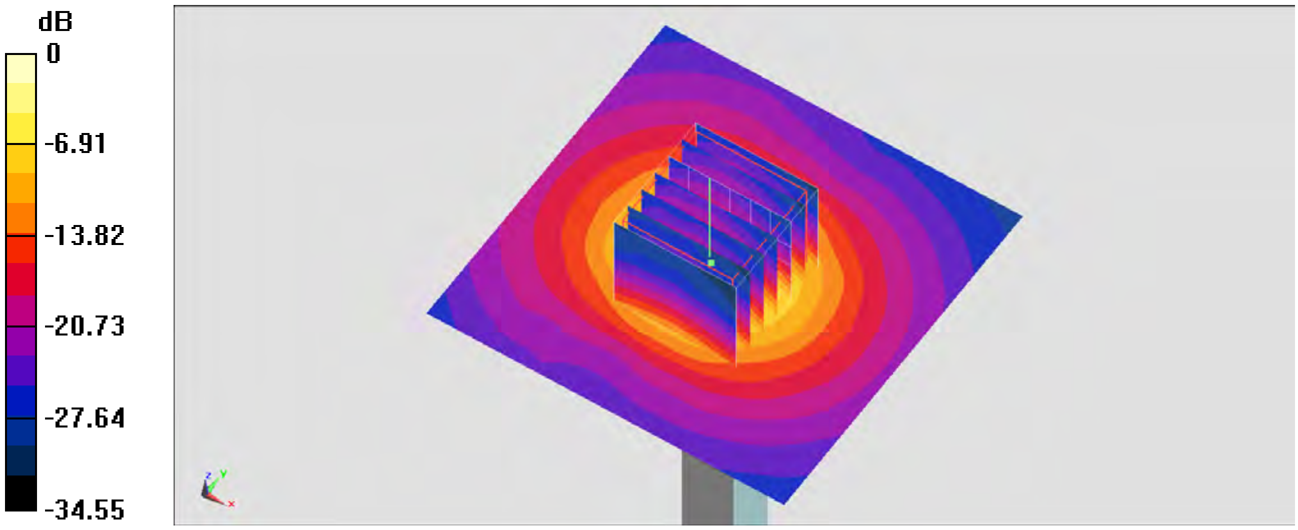
DUT: D5GHzV2-1006

Communication System: CW; Frequency: 5250 MHz;Duty Cycle: 1:1
Medium: HSL_5G_190816 Medium parameters used : f = 5250 MHz; σ = 4.694 S/m; ε_r = 35.923; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(5.45, 5.45, 5.45) @ 5250 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn853; Calibrated: 2019/7/18
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.9 W/kg

Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.46 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 34.8 W/kg
SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 20.2 W/kg



0 dB = 20.2 W/kg = 13.05 dBW/kg

System Check_Head_5600MHz

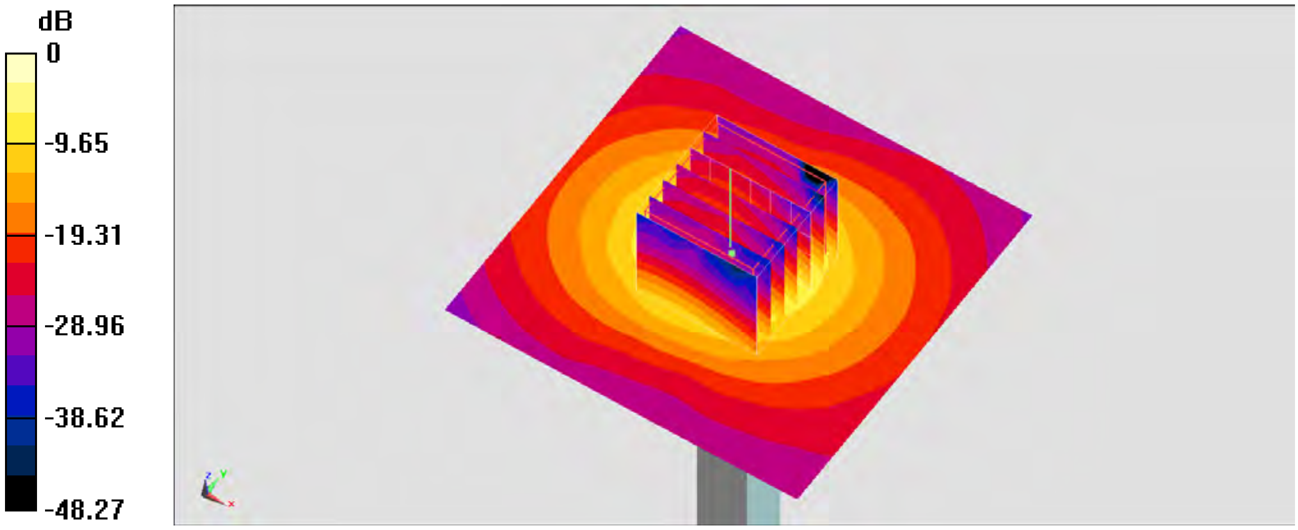
DUT: D5GHzV2-1006

Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: HSL_5G_190813 Medium parameters used: f = 5600 MHz; σ = 5.019 S/m; ε_r = 36.838; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(4.83, 4.83, 4.83) @ 5600 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn853; Calibrated: 2019/7/18
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.9 W/kg

Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.16 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 36.8 W/kg
SAR(1 g) = 8.61 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 21.7 W/kg



0 dB = 21.7 W/kg = 13.36 dBW/kg

System Check_Head_5750MHz

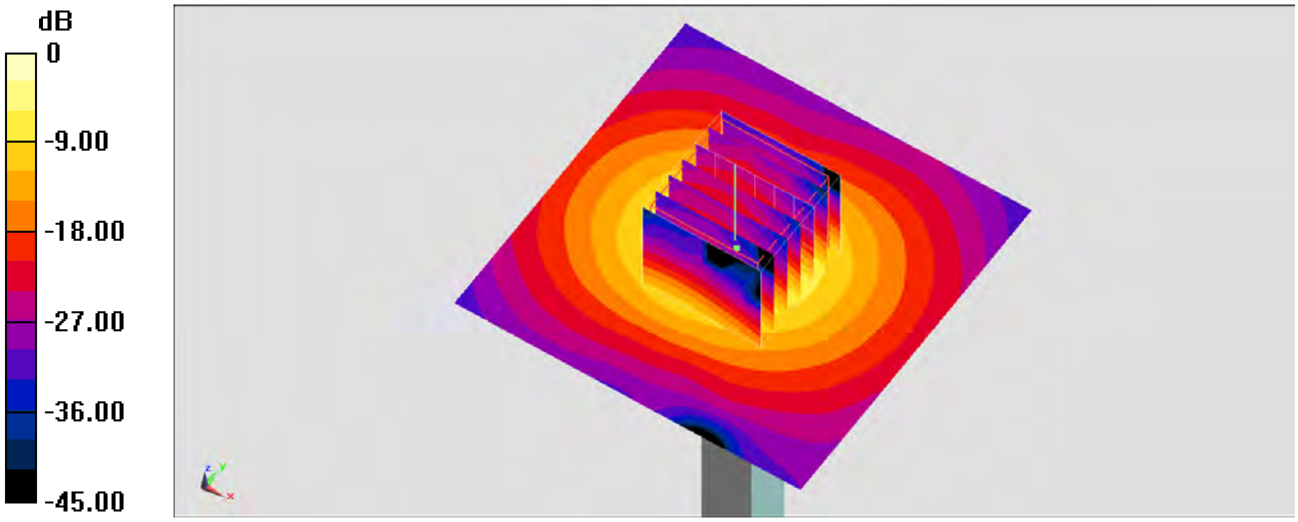
DUT: D5GHzV2-1006

Communication System: CW; Frequency: 5750 MHz;Duty Cycle: 1:1
Medium: HSL_5G_190719 Medium parameters used: f = 5750 MHz; σ = 5.012 S/m; ε_r = 35.71; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(4.95, 4.95, 4.95) @ 5750 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn699; Calibrated: 2019/1/3
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.3 W/kg

Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.99 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 34.9 W/kg
SAR(1 g) = 7.88 W/kg; SAR(10 g) = 2.19 W/kg
Maximum value of SAR (measured) = 20.0 W/kg



0 dB = 20.0 W/kg = 13.01 dBW/kg

System Check_Head_5750MHz

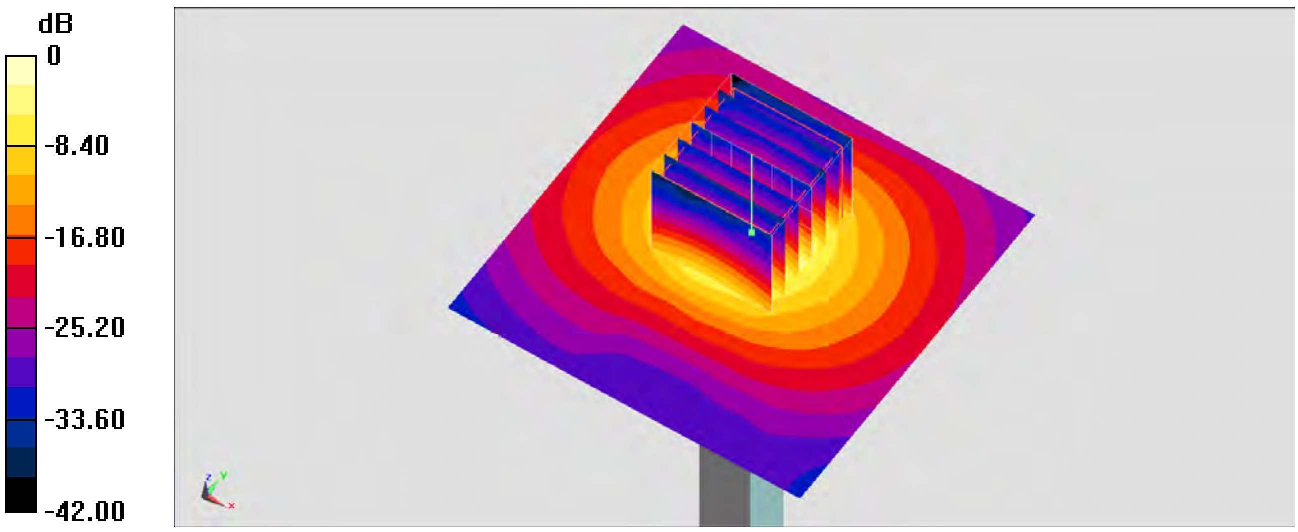
DUT: D5GHzV2-1006

Communication System: CW; Frequency: 5750 MHz;Duty Cycle: 1:1
Medium: HSL_5G_190813 Medium parameters used: f = 5750 MHz; σ = 5.177 S/m; ε_r = 36.661; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(4.95, 4.95, 4.95) @ 5750 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn853; Calibrated: 2019/7/18
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.7 W/kg

Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 57.53 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 38.7 W/kg
SAR(1 g) = 8.35 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 22.3 W/kg



0 dB = 22.3 W/kg = 13.48 dBW/kg

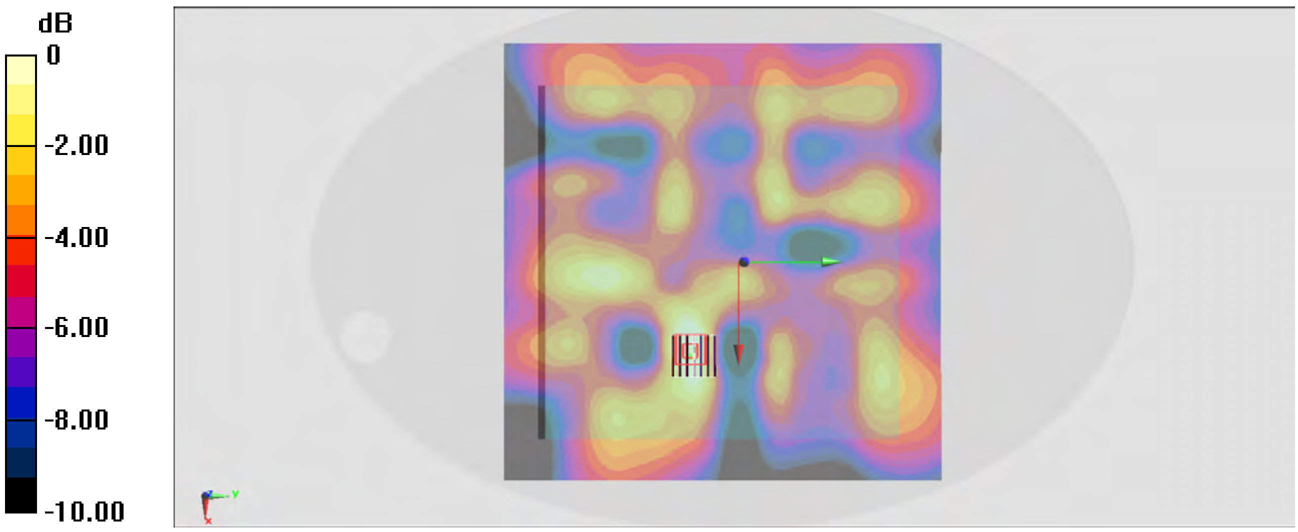
#01_WLAN2.4GHz_802.11b 1Mbps_Front Face_25mm_Ch6;Ant 1+2+3+4

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1.054
Medium: HSL_2450_190818 Medium parameters used: f = 2437 MHz; σ = 1.824 S/m; ε_r = 40.232; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3728; ConvF(7.11, 7.11, 7.11) @ 2437 MHz; Calibrated: 2019/1/15
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2019/5/21
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Area Scan (261x261x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.664 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.75 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.631 W/kg
SAR(1 g) = 0.365 W/kg; SAR(10 g) = 0.215 W/kg
Maximum value of SAR (measured) = 0.531 W/kg



0 dB = 0.531 W/kg = -2.75 dBW/kg

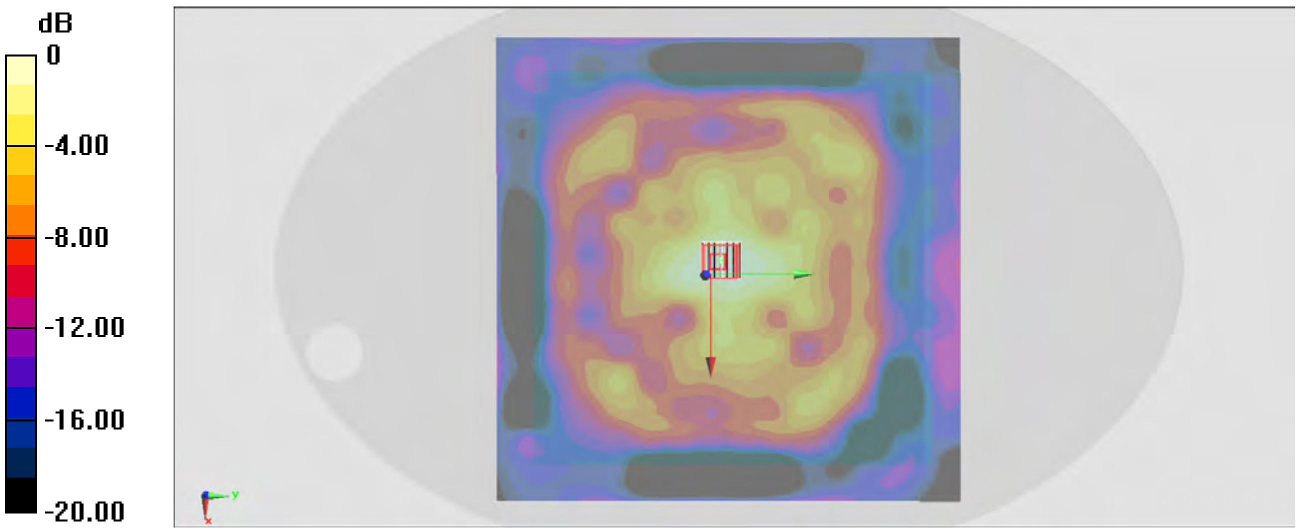
#02_WLAN5GHz_802.11ax HEW20 Nss4_Front Face_25mm_Ch44;Ant 1+2+3+4

Communication System: 802.11ax; Frequency: 5220 MHz;Duty Cycle: 1:1.049
Medium: HSL_5G_190816 Medium parameters used: f = 5220 MHz; σ = 4.664 S/m; ε_r = 35.954; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(5.45, 5.45, 5.45) @ 5220 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn853; Calibrated: 2019/7/18
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Area Scan (301x301x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.857 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 14.82 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.415 W/kg; SAR(10 g) = 0.194 W/kg
Maximum value of SAR (measured) = 0.834 W/kg



0 dB = 0.834 W/kg = -0.79 dBW/kg

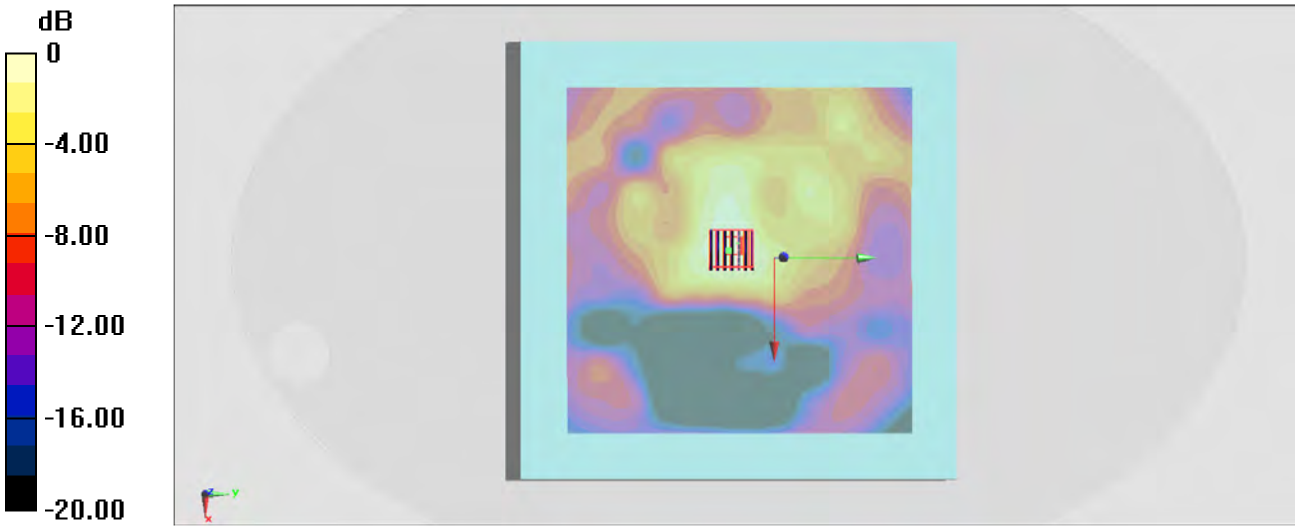
#03_WLAN5GHz_802.11ax HEW20 Nss2_Front Face_25mm_Ch60;Ant 1+2

Communication System: 802.11ax; Frequency: 5300 MHz;Duty Cycle: 1:1.029
Medium: HSL_5G_190816 Medium parameters used : f = 5300 MHz; σ = 4.743 S/m; ε_r = 35.876; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(5.45, 5.45, 5.45) @ 5300 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn853; Calibrated: 2019/7/18
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Area Scan (201x201x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.706 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 12.20 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 1.06 W/kg
SAR(1 g) = 0.328 W/kg; SAR(10 g) = 0.150 W/kg
Maximum value of SAR (measured) = 0.674 W/kg



0 dB = 0.674 W/kg = -1.71 dBW/kg

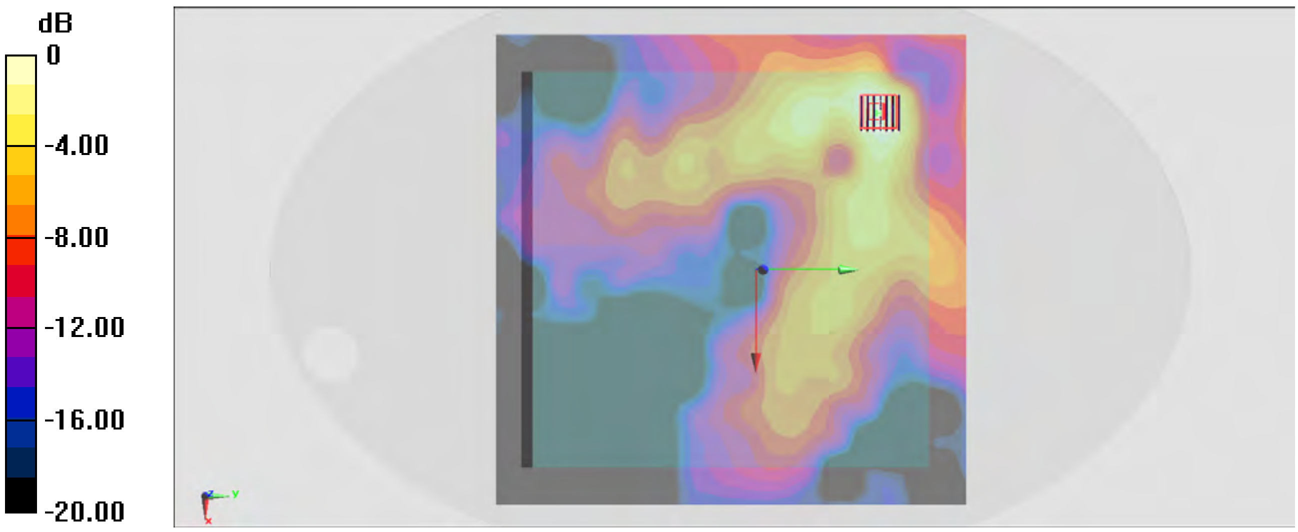
#04_WLAN5GHz_802.11ax HEW20 Nss1_Front Face_25mm_Ch116;Ant 1

Communication System: 802.11ax; Frequency: 5580 MHz;Duty Cycle: 1:1.014
Medium: HSL_5G_190813 Medium parameters used: f = 5580 MHz; σ = 4.99 S/m; ε_r = 36.87; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(4.83, 4.83, 4.83) @ 5580 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn853; Calibrated: 2019/7/18
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Area Scan (301x301x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.13 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 13.70 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.53 W/kg
SAR(1 g) = 0.506 W/kg; SAR(10 g) = 0.225 W/kg
Maximum value of SAR (measured) = 1.02 W/kg



0 dB = 1.02 W/kg = 0.09 dBW/kg

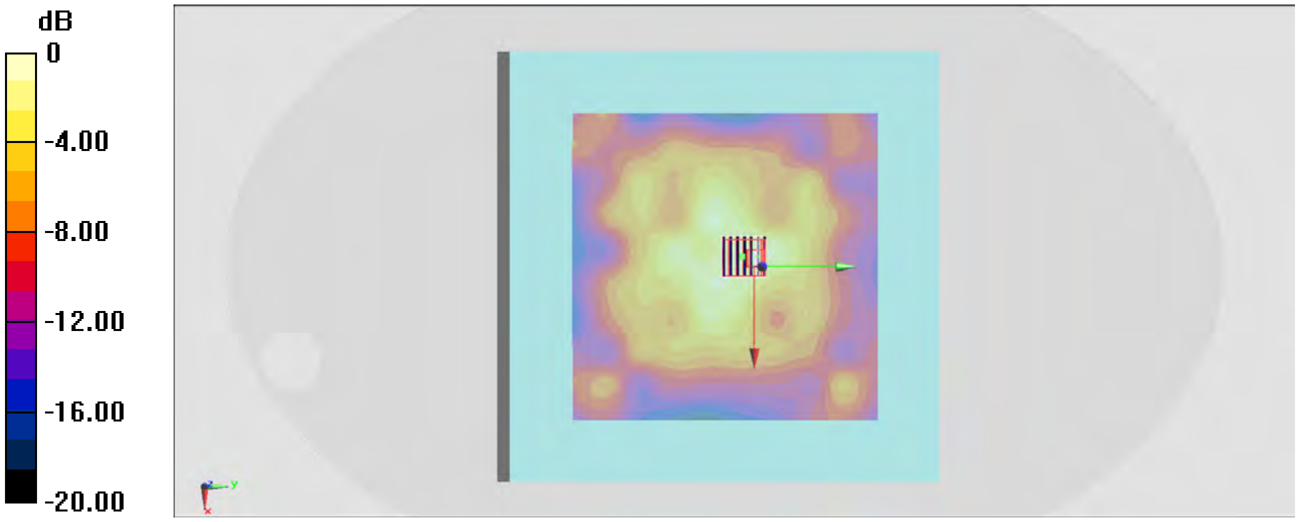
#05_WLAN5GHz_802.11ax HEW40 Nss1_Front Face_25mm_Ch151

Communication System: 802.11ax; Frequency: 5755 MHz;Duty Cycle: 1:1.031
Medium: HSL_5G_190719 Medium parameters used : f = 5755 MHz; σ = 5.018 S/m; ε_r = 35.695; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7515; ConvF(4.95, 4.95, 4.95) @ 5755 MHz; Calibrated: 2018/10/3
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn699; Calibrated: 2019/1/3
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Area Scan (181x181x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.50 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 18.25 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 2.95 W/kg
SAR(1 g) = 0.874 W/kg; SAR(10 g) = 0.342 W/kg
Maximum value of SAR (measured) = 1.87 W/kg



0 dB = 1.87 W/kg = 2.72 dBW/kg

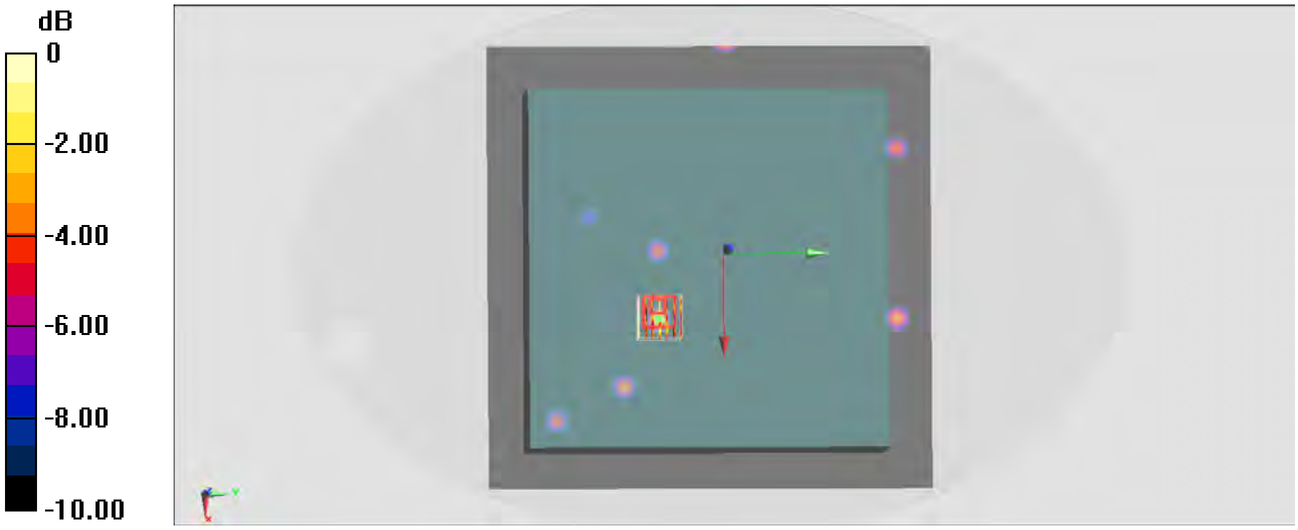
#06_Bluetooth_1Mbps_Front Face_25mm_Ch13

Communication System: Bluetooth; Frequency: 2440 MHz;Duty Cycle: 1:1
Medium: HSL_2450_190818 Medium parameters used: f = 2440 MHz; σ = 1.827 S/m; ε_r = 40.219; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3728; ConvF(7.11, 7.11, 7.11) @ 2440 MHz; Calibrated: 2019/1/15
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2019/5/21
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Area Scan (261x261x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.00343 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.175 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 0.00755 W/kg
SAR(1 g) = 0.00216 W/kg; SAR(10 g) = 0.00114 W/kg
Maximum value of SAR (measured) = 0.00467 W/kg



0 dB = 0.00467 W/kg = -23.31 dBW/kg

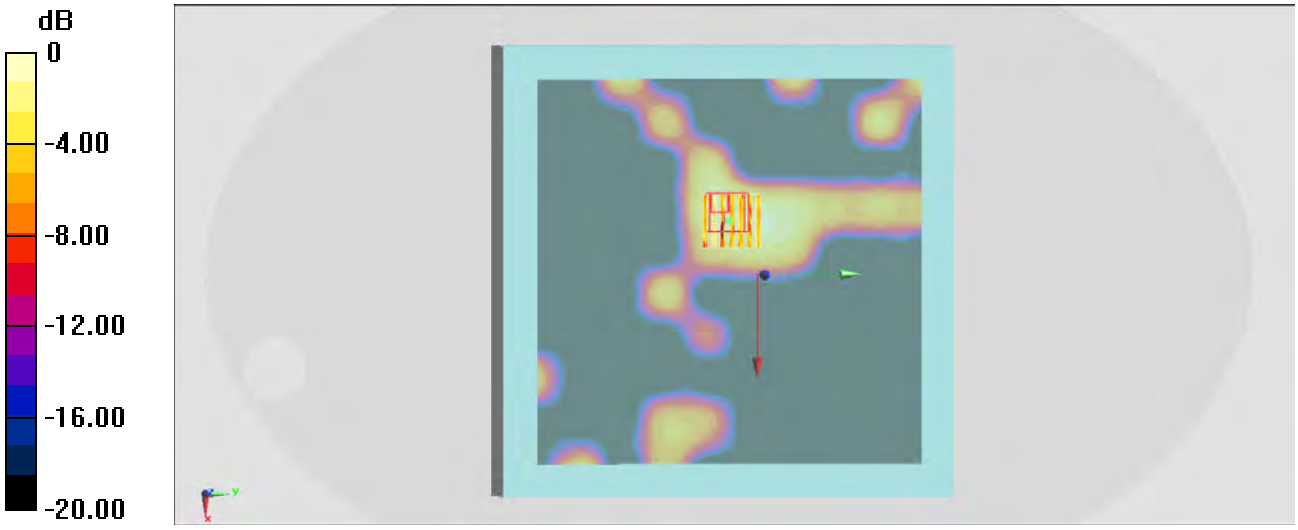
#07_Thread_1Mbps_Front Face_25mm_Ch11

Communication System: Bluetooth; Frequency: 2405 MHz;Duty Cycle: 1:1
Medium: HSL_2450_190818 Medium parameters used: f = 2405 MHz; σ = 1.782 S/m; ε_r = 40.342; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3728; ConvF(7.11, 7.11, 7.11) @ 2405 MHz; Calibrated: 2019/1/15
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2019/5/21
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1164
- Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Area Scan (181x181x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.00501 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.219 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.0100 W/kg
SAR(1 g) = 0.00244 W/kg; SAR(10 g) = 0.00138 W/kg
Maximum value of SAR (measured) = 0.00624 W/kg



0 dB = 0.00624 W/kg = -22.05 dBW/kg

In Collaboration with
speag
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client **Sporton** **Certificate No: Z19-60059**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 929

Calibration Procedure(s): FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: March 6, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: March 8, 2019

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
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E-mail: cttl@chinattl.com http://www.chinattl.cn

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, 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%.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

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E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
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	39.1 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.1 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 W/kg ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.2 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.9 W/kg ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0Ω+ 4.44 jΩ
Return Loss	- 26.5dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.5Ω+ 6.70 jΩ
Return Loss	- 23.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.025 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

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DASY5 Validation Report for Head TSL Date: 03.05.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 929

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.852 S/m; ε_r = 39.14; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.62, 7.62, 7.62) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

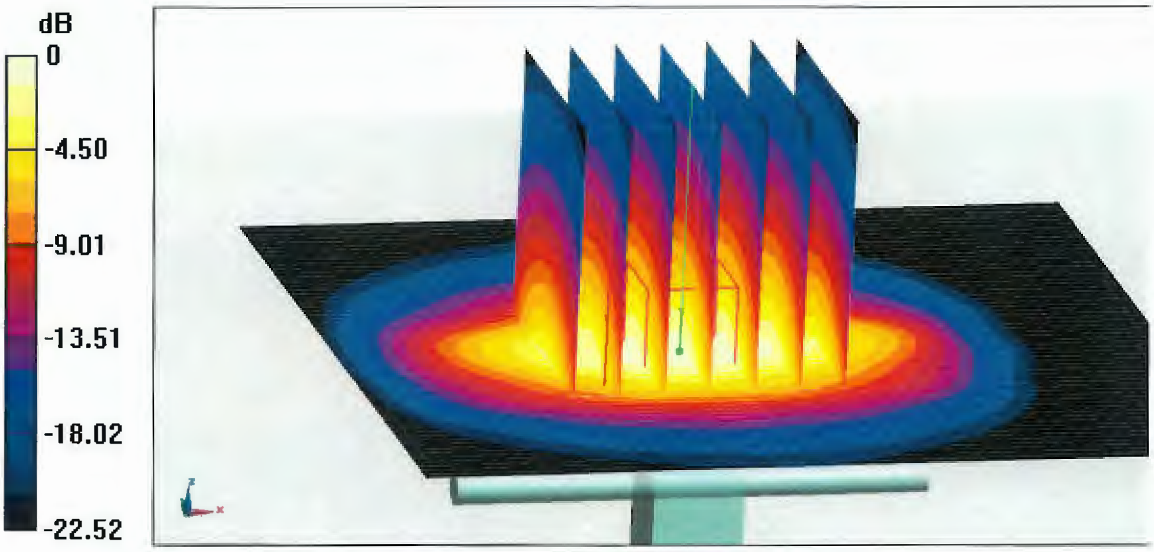
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.8 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 28.1 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.08 W/kg

Maximum value of SAR (measured) = 22.4 W/kg



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

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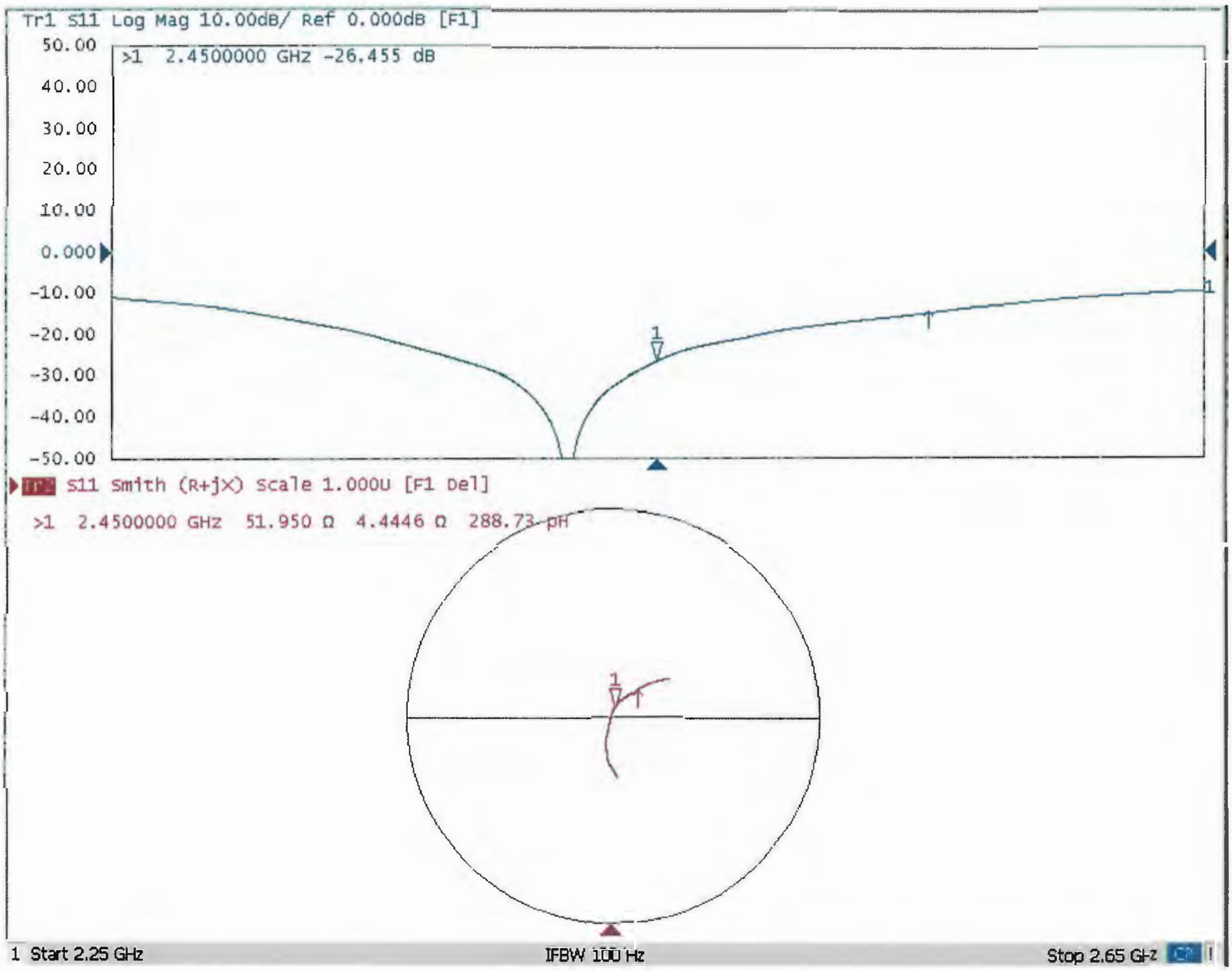
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 03.06.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 929

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 2.004 S/m; ε_r = 52.22; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.79, 7.79, 7.79) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

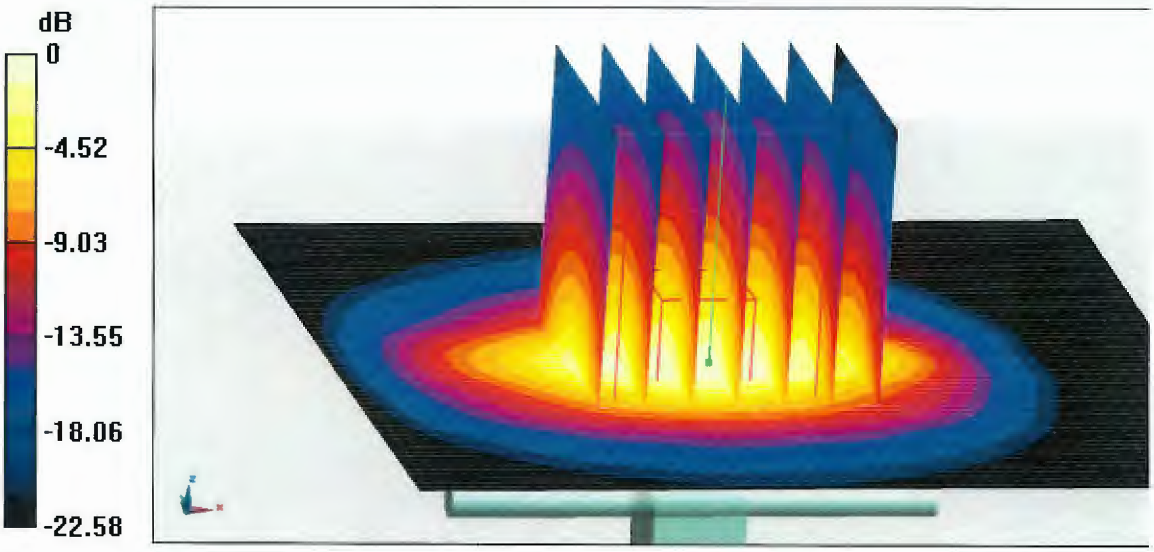
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.11 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.03 W/kg

Maximum value of SAR (measured) = 21.5 W/kg



0 dB = 21.5 W/kg = 13.32 dBW/kg

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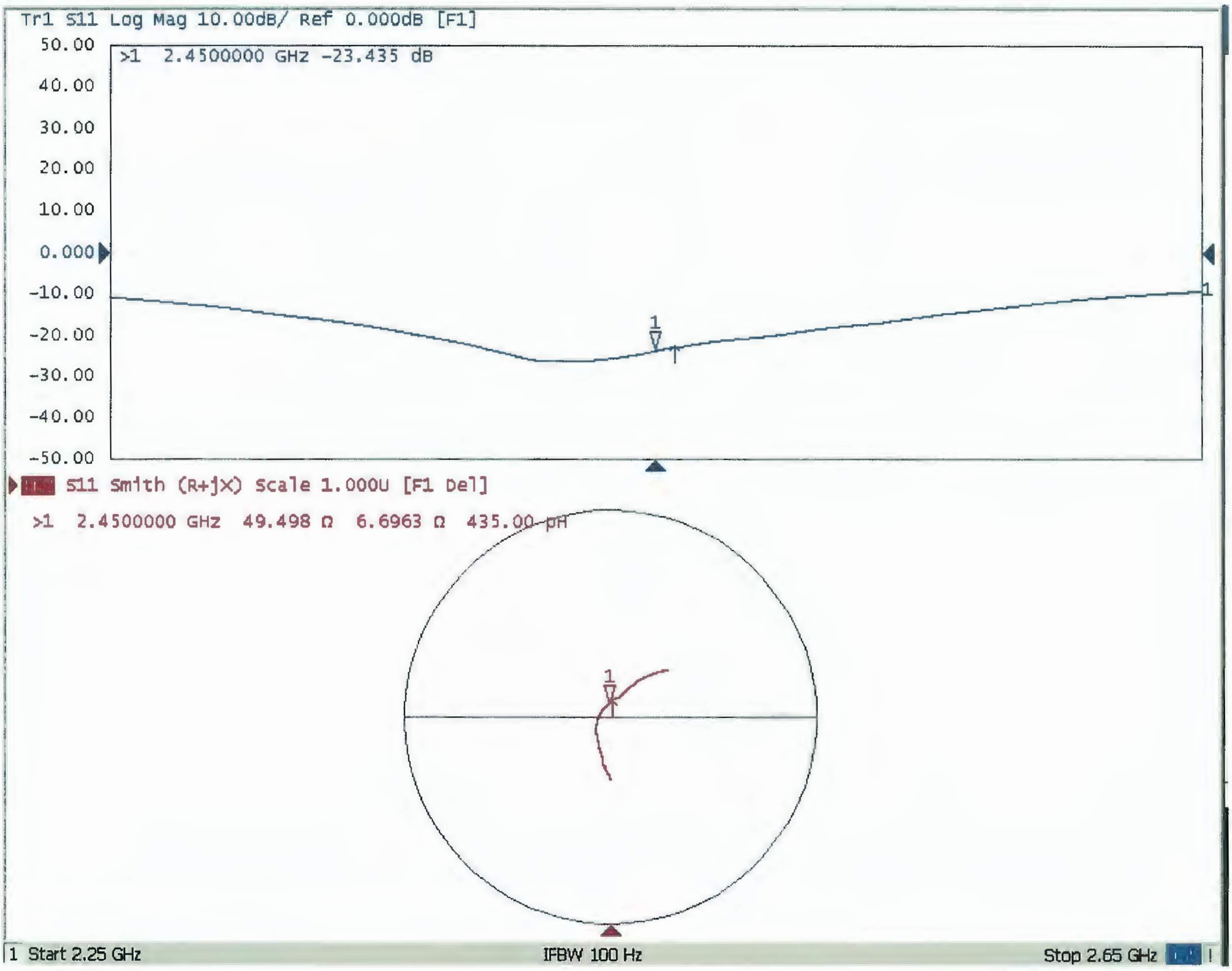
Impedance Measurement Plot for Body TSL



Calibration Laboratory of
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Engineering AG
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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 **Sporton**

Certificate No: D5GHzV2-1006_Sep18

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN:1006
Calibration procedure(s)	QA CAL-22.v3 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	September 27, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 3503	30-Dec-17 (No. EX3-3503_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18

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

Issued: September 28, 2018

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.0 ± 6 %	4.61 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	4.98 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	8.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.3 W / kg ± 19.9 % (k=2)**

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

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 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	46.9 ± 6 %	5.46 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	7.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**78.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.93 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	8.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**81.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.0 ± 6 %	6.14 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.81 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.4 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	54.6 Ω - 7.6 jΩ
Return Loss	- 21.5 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.2 Ω - 6.3 jΩ
Return Loss	- 21.0 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	60.0 Ω + 4.5 jΩ
Return Loss	- 20.1 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	54.2 Ω - 5.6 jΩ
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.2 Ω - 5.3 jΩ
Return Loss	- 20.9 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	59.6 Ω + 5.6 jΩ
Return Loss	- 19.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 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	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 27.09.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1006

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; $\sigma = 4.61$ S/m; $\varepsilon_r = 36$; $\rho = 1000$ kg/m^3 ,
Medium parameters used: f = 5600 MHz; $\sigma = 4.98$ S/m; $\varepsilon_r = 35.4$; $\rho = 1000$ kg/m^3 ,
Medium parameters used: f = 5750 MHz; $\sigma = 5.14$ S/m; $\varepsilon_r = 35.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

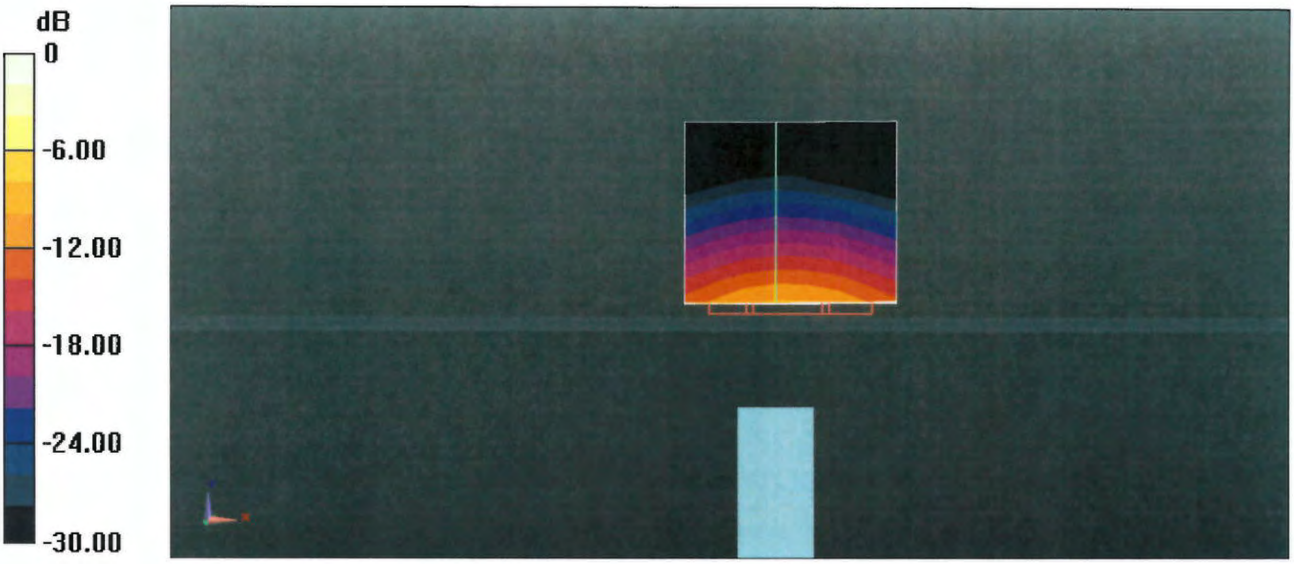
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.51, 5.51, 5.51) @ 5250 MHz, ConvF(5.05, 5.05, 5.05) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 79.28 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 26.7 W/kg
SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 18.1 W/kg

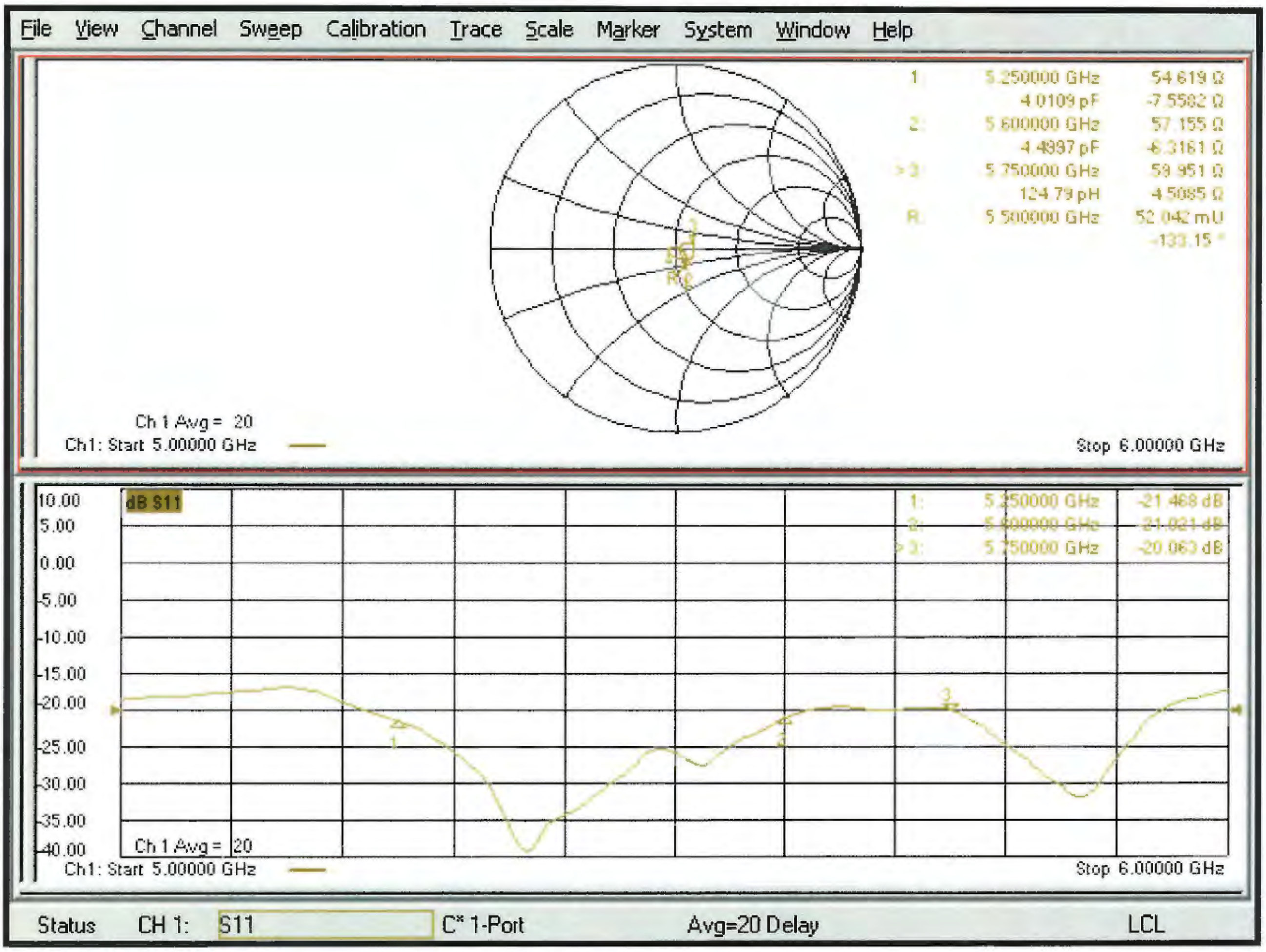
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 76.15 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 30.2 W/kg
SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 19.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 74.61 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 29.8 W/kg
SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.1 W/kg = 12.58 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.09.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1006

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.46 S/m; ε_r = 46.9; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.93 S/m; ε_r = 46.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 6.14 S/m; ε_r = 46; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

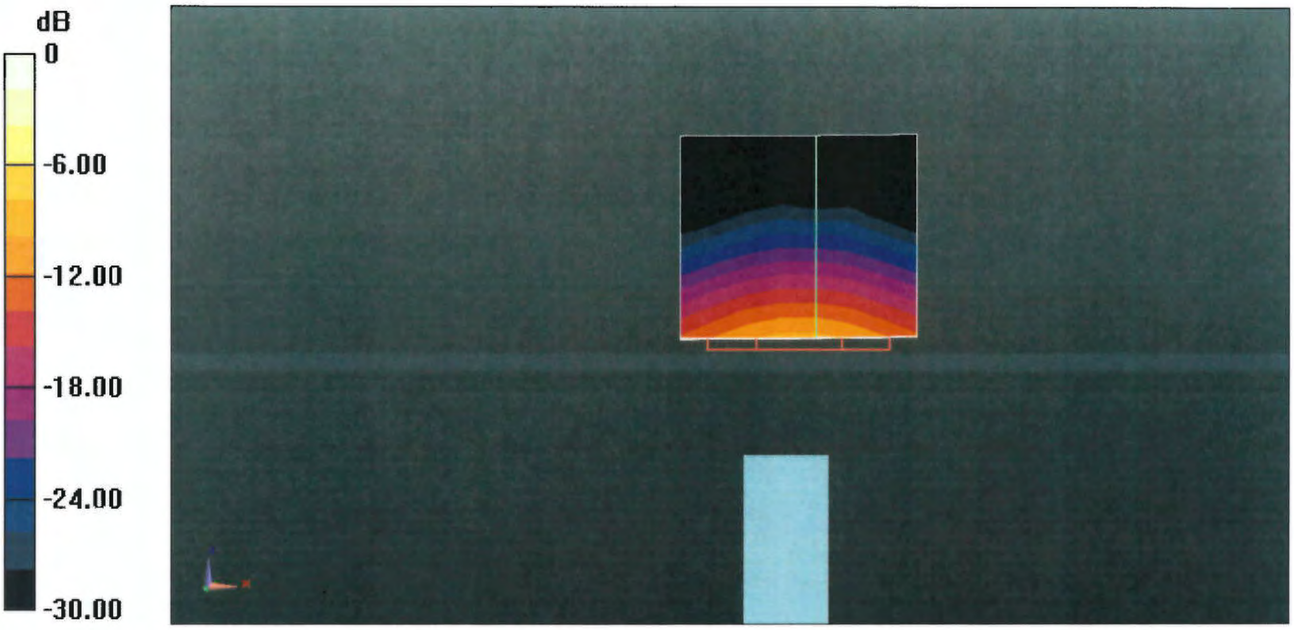
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.65, 4.65, 4.65) @ 5600 MHz, ConvF(4.57, 4.57, 4.57) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.77 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.19 W/kg
Maximum value of SAR (measured) = 18.6 W/kg

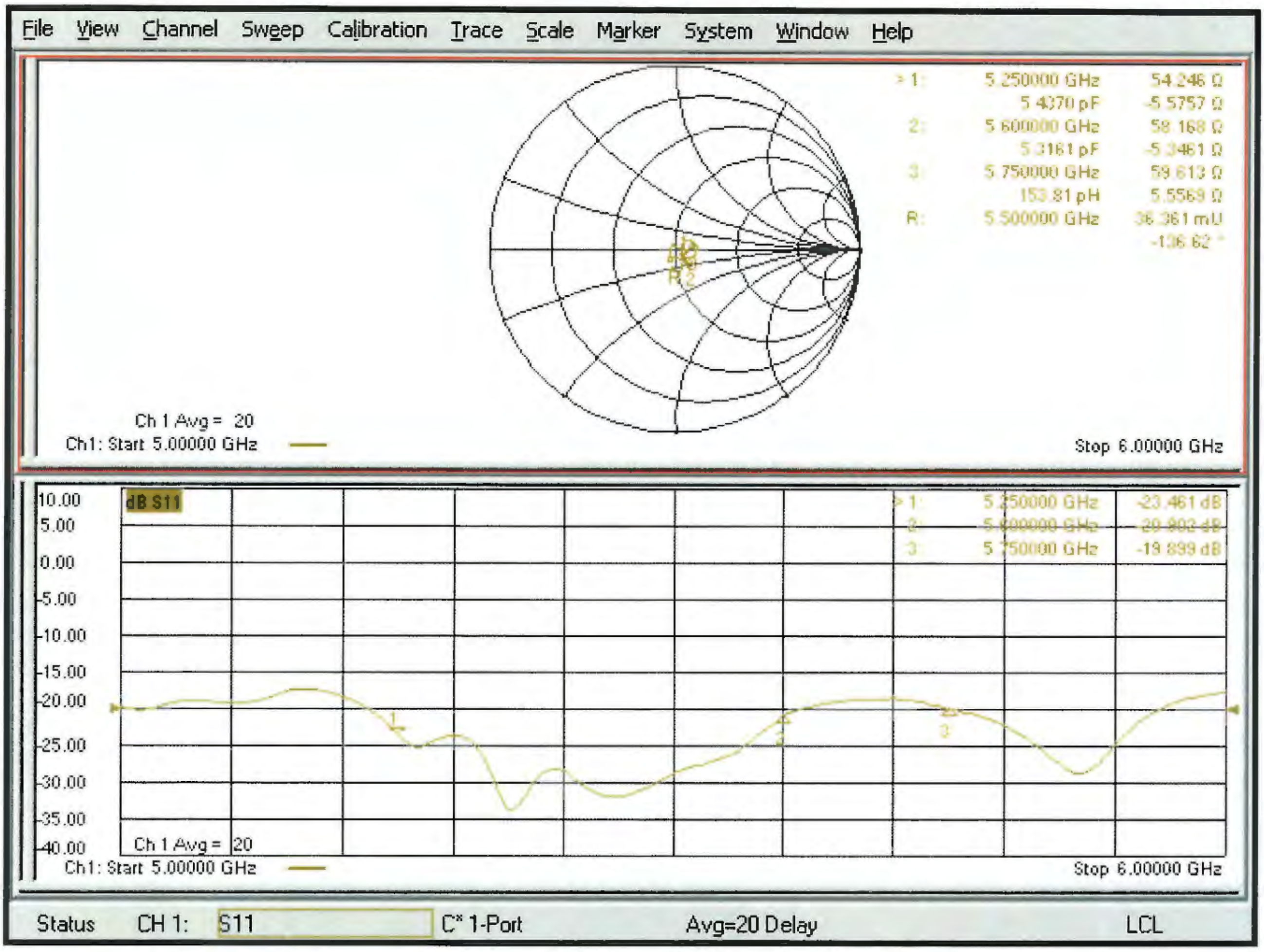
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.30 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 34.2 W/kg
SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.65 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 34.0 W/kg
SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 19.3 W/kg



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

Impedance Measurement Plot for Body TSL



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Client : **Sporton** **Certificate No: Z18-60556**

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 699
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	January 03, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: January 05, 2019

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Glossary:

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

Methods Applied and Interpretation of Parameters:

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

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DC Voltage Measurement

A/D - Converter Resolution nominal

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

Low Range: 1LSB = 61nV , full range = -1.......+3mV

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

Calibration Factors	X	Y	Z
High Range	404.660 ± 0.15% (k=2)	403.289 ± 0.15% (k=2)	404.463 ± 0.15% (k=2)
Low Range	3.97227 ± 0.7% (k=2)	3.95835 ± 0.7% (k=2)	3.98905 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	322° ± 1 °

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

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

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

Accreditation No.: SCS 0108

Client **Sporton**

Certificate No: DAE4-778_May19

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 778
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	May 21, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
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	07-Jan-19 (in house check)	In house check: Jan-20
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-19 (in house check)	In house check: Jan-20

	Name	Function	Signature
Calibrated by:	Adrian Gehring	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: May 21, 2019

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.

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	404.724 ± 0.02% (k=2)	403.523 ± 0.02% (k=2)	405.080 ± 0.02% (k=2)
Low Range	3.98714 ± 1.50% (k=2)	3.96425 ± 1.50% (k=2)	4.00091 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	269.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199997.18	3.13	0.00
Channel X	+ Input	20003.93	2.54	0.01
Channel X	- Input	-20000.18	1.44	-0.01
Channel Y	+ Input	199995.82	1.88	0.00
Channel Y	+ Input	20003.10	1.74	0.01
Channel Y	- Input	-19999.94	1.75	-0.01
Channel Z	+ Input	199997.86	3.59	0.00
Channel Z	+ Input	20000.46	-0.95	-0.00
Channel Z	- Input	-20005.38	-3.70	0.02

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.87	0.06	0.00
Channel X	+ Input	201.00	-0.20	-0.10
Channel X	- Input	-198.59	0.11	-0.05
Channel Y	+ Input	2000.10	-0.63	-0.03
Channel Y	+ Input	202.04	0.88	0.44
Channel Y	- Input	-199.00	-0.21	0.10
Channel Z	+ Input	2001.05	0.38	0.02
Channel Z	+ Input	198.96	-2.14	-1.07
Channel Z	- Input	-199.86	-0.97	0.49

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	-4.60	-5.60
	- 200	5.42	4.64
Channel Y	200	-0.35	-1.21
	- 200	-0.14	0.05
Channel Z	200	-12.41	-12.20
	- 200	9.83	10.24

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	-	-0.41	-2.24
Channel Y	200	8.92	-	0.13
Channel Z	200	4.06	7.55	-

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	16054	16756
Channel Y	16192	17734
Channel Z	16436	15674

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	-0.17	-1.48	0.79	0.43
Channel Y	0.39	-1.44	2.48	0.63
Channel Z	-0.48	-1.80	0.97	0.51

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

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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 **Sporton**

Certificate No: DAE4-853_Jul19

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 853
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	July 18, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
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	07-Jan-19 (in house check)	In house check: Jan-20
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-19 (in house check)	In house check: Jan-20

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

Issued: July 18, 2019

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.

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	402.636 ± 0.02% (k=2)	403.297 ± 0.02% (k=2)	403.459 ± 0.02% (k=2)
Low Range	3.95584 ± 1.50% (k=2)	3.96622 ± 1.50% (k=2)	3.96807 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	134.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200042.65	4.84	0.00
Channel X	+ Input	20006.48	0.46	0.00
Channel X	- Input	-20004.66	1.31	-0.01
Channel Y	+ Input	200039.01	1.51	0.00
Channel Y	+ Input	20006.29	0.53	0.00
Channel Y	- Input	-20007.74	-1.68	0.01
Channel Z	+ Input	200041.36	3.13	0.00
Channel Z	+ Input	20004.58	-1.11	-0.01
Channel Z	- Input	-20007.54	-1.47	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.38	-0.13	-0.01
Channel X	+ Input	201.93	0.66	0.33
Channel X	- Input	-197.86	0.69	-0.35
Channel Y	+ Input	2001.20	-0.19	-0.01
Channel Y	+ Input	199.34	-1.82	-0.91
Channel Y	- Input	-199.56	-0.94	0.47
Channel Z	+ Input	2001.44	0.12	0.01
Channel Z	+ Input	200.21	-0.93	-0.46
Channel Z	- Input	-200.23	-1.56	0.79

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	-5.99	-7.95
	- 200	10.58	8.82
Channel Y	200	4.92	4.61
	- 200	-6.14	-6.13
Channel Z	200	0.74	0.71
	- 200	-3.12	-3.28

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	-	5.13	0.42
Channel Y	200	10.58	-	6.17
Channel Z	200	14.06	7.88	-

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	16249	17230
Channel Y	16089	16493
Channel Z	16236	15987

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	0.46	-0.33	1.57	0.37
Channel Y	1.39	0.30	2.84	0.47
Channel Z	0.85	-0.17	2.74	0.67

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

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IMPORTANT NOTICE

USAGE OF THE DAE4

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

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

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

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

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

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

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

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

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

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Client **Sporton** **Certificate No: Z18-60555**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3728
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	January 15, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101547	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG, No.DAE4-1555_Aug18)	Aug -19
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
Network Analyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan -19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: January 17, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

b) IEC 62209-1, "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≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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

Probe EX3DV4

SN: 3728

Calibrated: January 15, 2019

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3728

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	0.34	0.36	0.37	±10.0%
DCP(mV)[B]	100.4	102.2	115.7	

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	136.6	±2.2%
		Y	0.0	0.0	1.0		142.0	
		Z	0.0	0.0	1.0		149.3	

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

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3728

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	9.67	9.67	9.67	0.07	1.69	±12.1%
835	41.5	0.90	9.36	9.36	9.36	0.09	1.52	±12.1%
900	41.5	0.97	9.44	9.44	9.44	0.10	1.49	±12.1%
1750	40.1	1.37	8.13	8.13	8.13	0.14	1.36	±12.1%
1900	40.0	1.40	7.70	7.70	7.70	0.17	1.25	±12.1%
2450	39.2	1.80	7.11	7.11	7.11	0.34	0.87	±12.1%
2600	39.0	1.96	6.94	6.94	6.94	0.40	0.80	±12.1%
5250	35.9	4.71	4.77	4.77	4.77	0.35	1.55	±13.3%
5600	35.5	5.07	4.20	4.20	4.20	0.35	1.60	±13.3%
5750	35.4	5.22	4.26	4.26	4.26	0.35	1.55	±13.3%

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3728

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	55.5	0.96	9.84	9.84	9.84	0.40	0.80	±12.1%
835	55.2	0.97	9.54	9.54	9.54	0.13	1.46	±12.1%
900	55.0	1.05	9.55	9.55	9.55	0.16	1.35	±12.1%
1750	53.4	1.49	7.83	7.83	7.83	0.15	1.32	±12.1%
1900	53.3	1.52	7.54	7.54	7.54	0.14	1.39	±12.1%
2450	52.7	1.95	7.08	7.08	7.08	0.27	1.33	±12.1%
2600	52.5	2.16	6.96	6.96	6.96	0.25	1.35	±12.1%
5250	48.9	5.36	4.37	4.37	4.37	0.40	1.95	±13.3%
5600	48.5	5.77	3.79	3.79	3.79	0.45	1.75	±13.3%
5750	48.3	5.94	3.82	3.82	3.82	0.42	1.62	±13.3%

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

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

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

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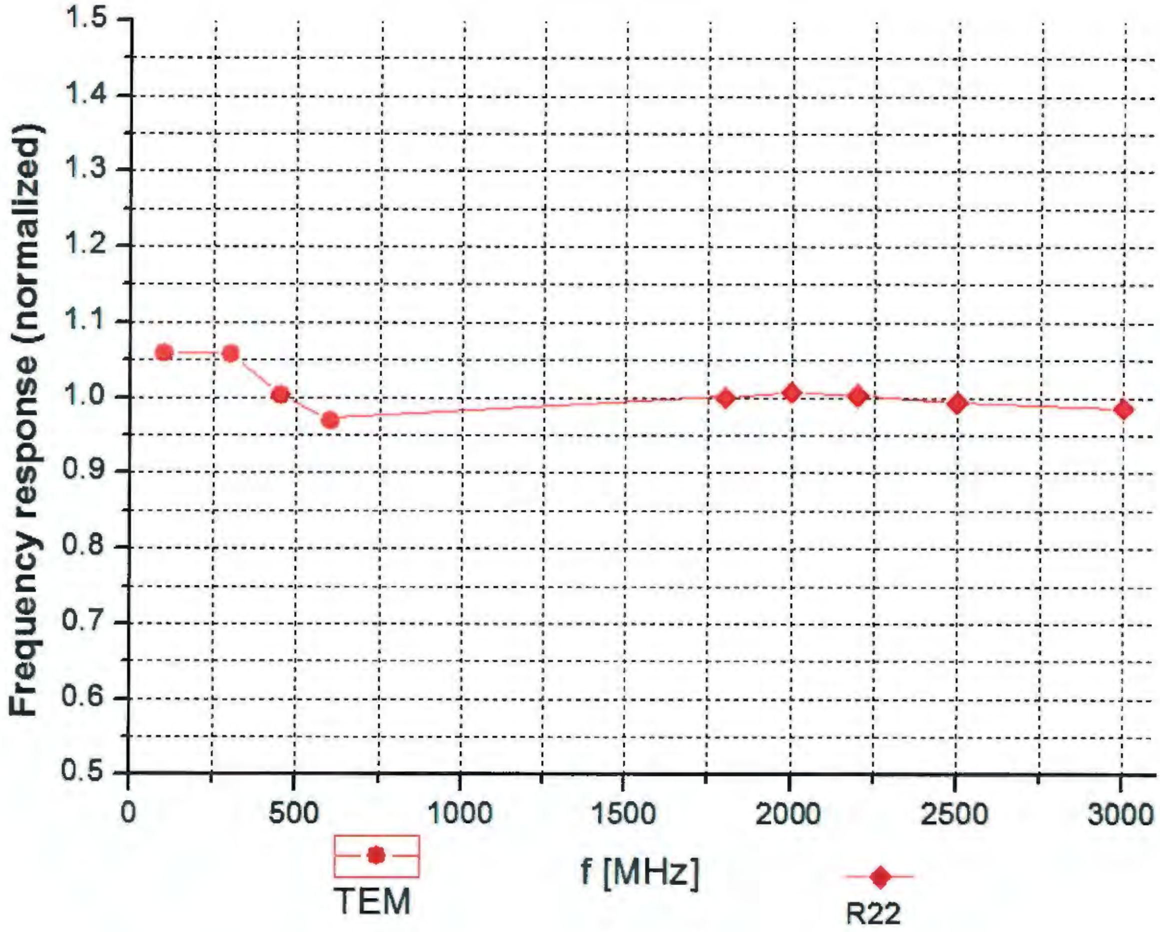
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

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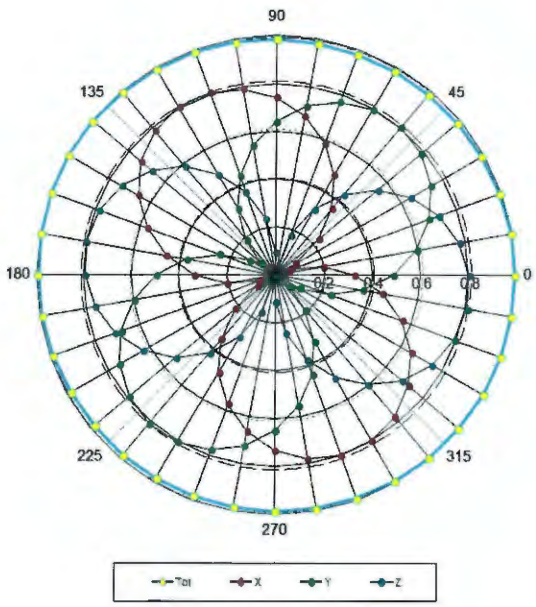
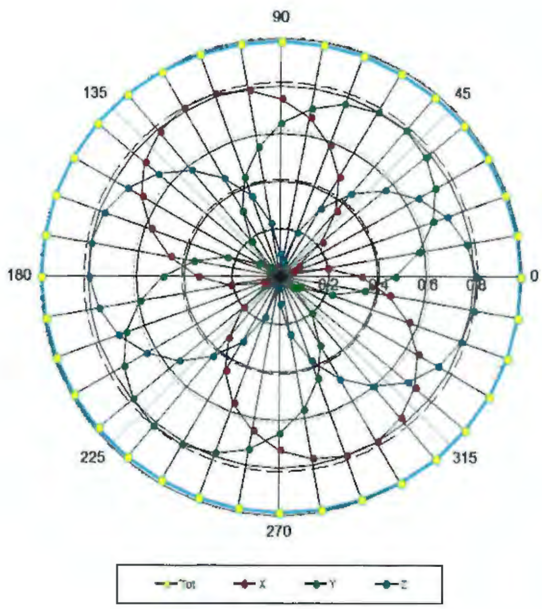
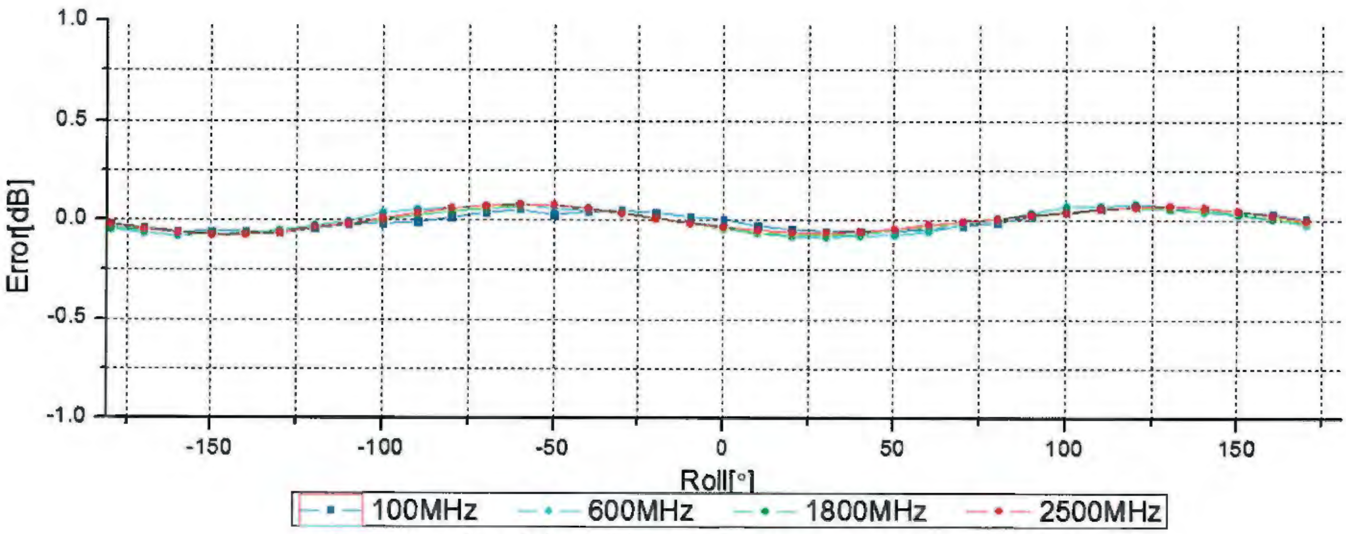
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

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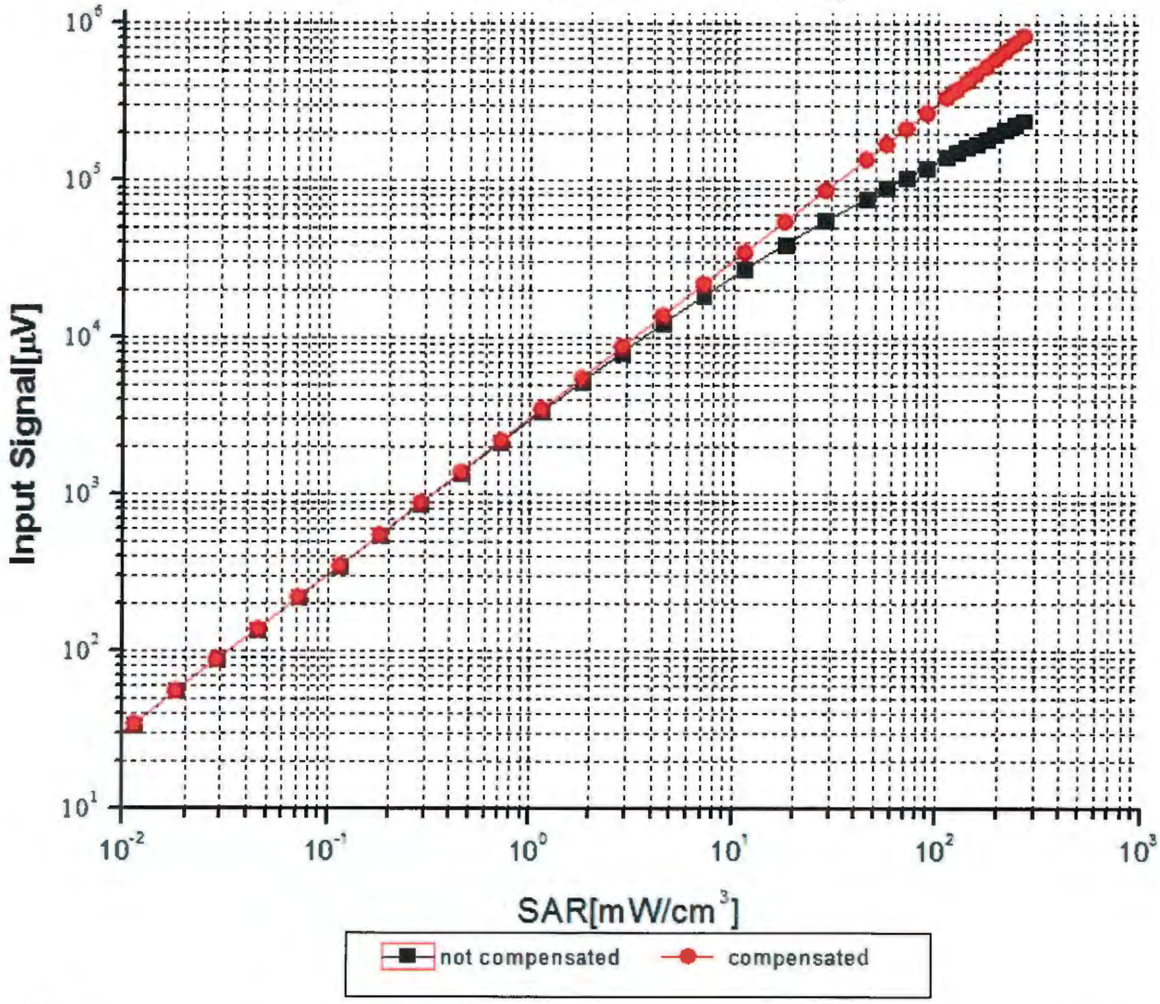
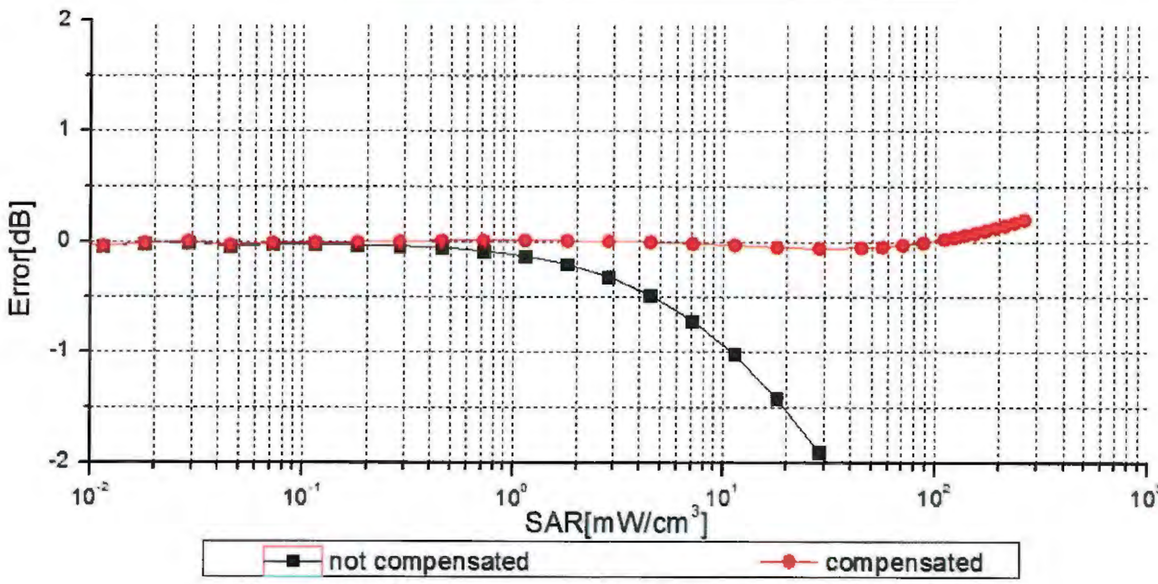
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





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

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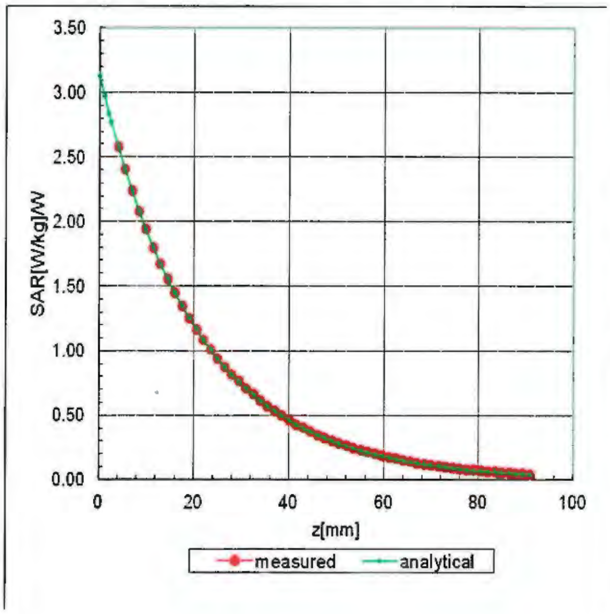
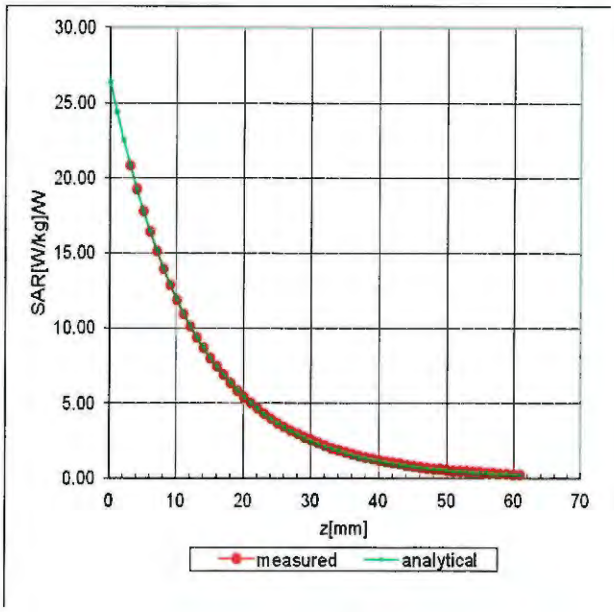
Conversion Factor Assessment

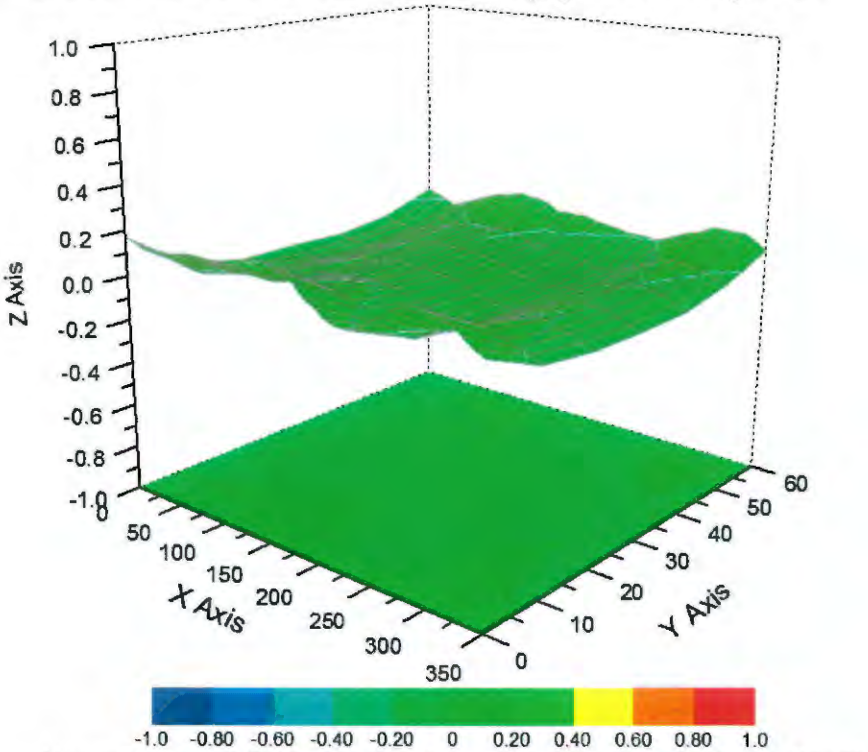
f=750 MHz, WGLS R9(H_convF)



f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (K=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3728

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	11.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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

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

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

Accreditation No.: **SCS 0108**

Client **Auden**

Certificate No: EX3-7515_Oct18

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7515
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	October 3, 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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 3, 2018

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:7515

Manufactured: March 28, 2018
Calibrated: October 3, 2018

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7515

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	0.42	0.50	0.46	± 10.1 %
DCP (mV)[B]	97.1	97.7	95.7	

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	169.5	±2.2 %
		Y	0.0	0.0	1.0		156.2	
		Z	0.0	0.0	1.0		176.6	

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7515

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	10.11	10.11	10.11	0.54	0.80	± 12.0 %
835	41.5	0.90	9.75	9.75	9.75	0.41	0.88	± 12.0 %
900	41.5	0.97	9.68	9.68	9.68	0.55	0.85	± 12.0 %
1750	40.1	1.37	8.65	8.65	8.65	0.34	0.88	± 12.0 %
1900	40.0	1.40	8.33	8.33	8.33	0.25	0.90	± 12.0 %
2000	40.0	1.40	8.28	8.28	8.28	0.29	0.88	± 12.0 %
2300	39.5	1.67	7.86	7.86	7.86	0.35	0.87	± 12.0 %
2450	39.2	1.80	7.42	7.42	7.42	0.36	0.88	± 12.0 %
2600	39.0	1.96	7.37	7.37	7.37	0.33	0.97	± 12.0 %
5250	35.9	4.71	5.45	5.45	5.45	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.83	4.83	4.83	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.95	4.95	4.95	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.

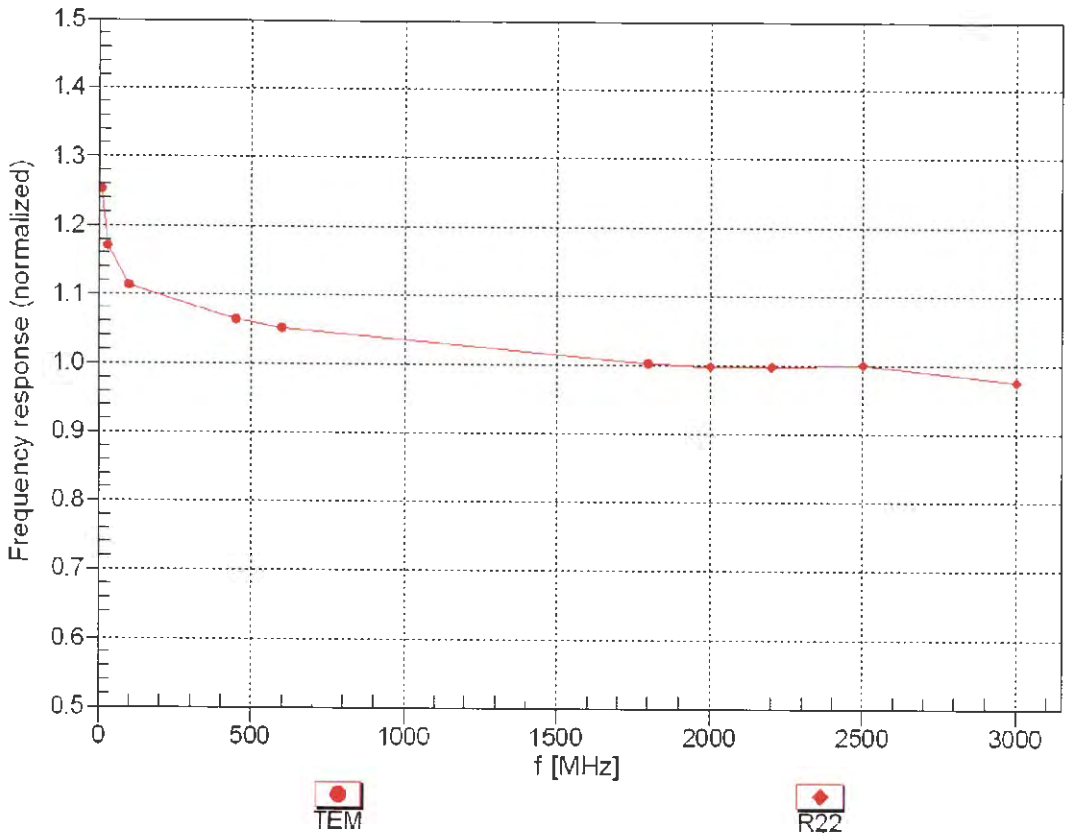
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7515

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	10.15	10.15	10.15	0.46	0.84	± 12.0 %
835	55.2	0.97	9.99	9.99	9.99	0.38	1.01	± 12.0 %
900	55.0	1.05	9.69	9.69	9.69	0.52	0.80	± 12.0 %
1750	53.4	1.49	8.20	8.20	8.20	0.36	0.93	± 12.0 %
1900	53.3	1.52	7.93	7.93	7.93	0.31	0.96	± 12.0 %
2000	53.3	1.52	7.89	7.89	7.89	0.38	0.87	± 12.0 %
2300	52.9	1.81	7.75	7.75	7.75	0.36	0.90	± 12.0 %
2450	52.7	1.95	7.53	7.53	7.53	0.36	0.94	± 12.0 %
2600	52.5	2.16	7.48	7.48	7.48	0.28	0.97	± 12.0 %
5250	48.9	5.36	4.96	4.96	4.96	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.39	4.39	4.39	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.42	4.42	4.42	0.50	1.90	± 13.1 %

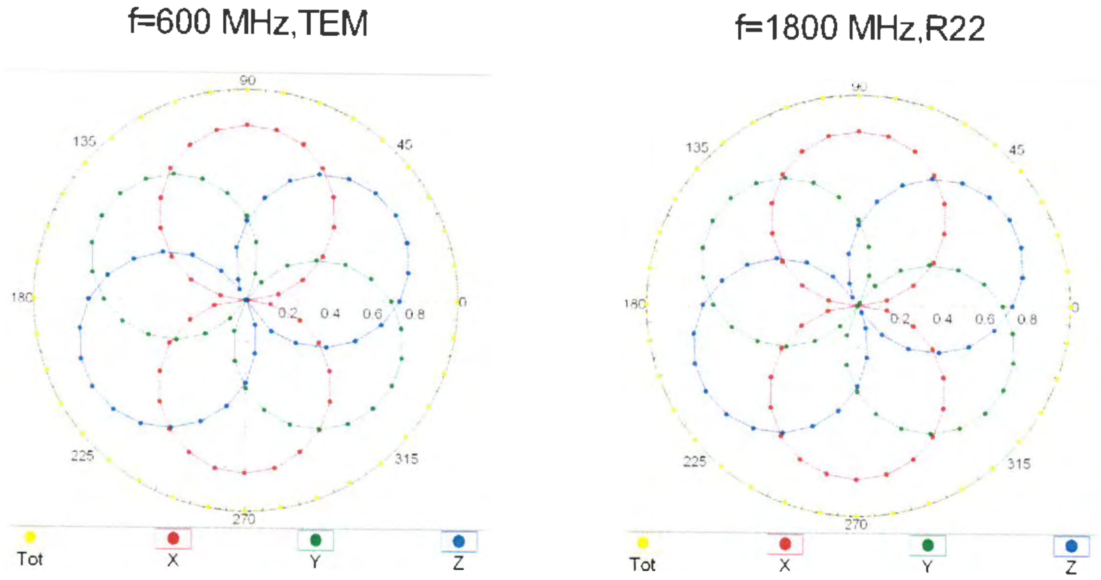
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz 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.

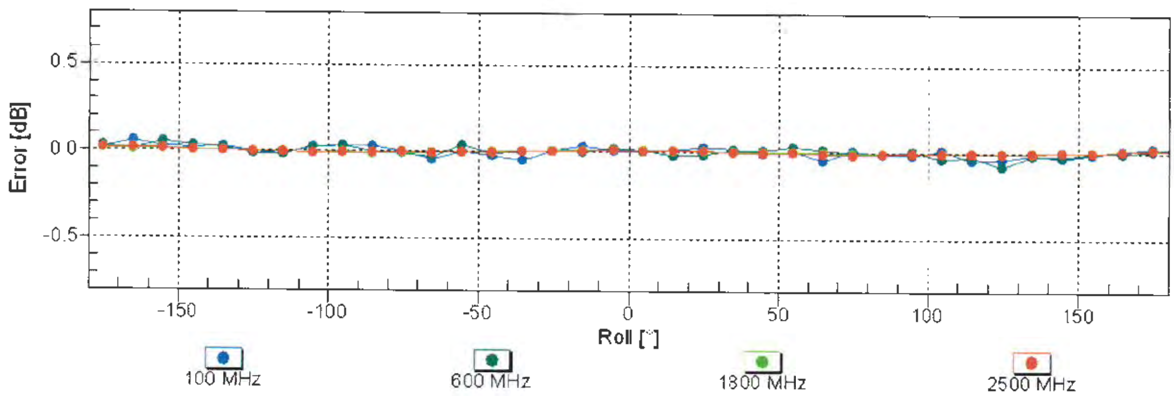
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

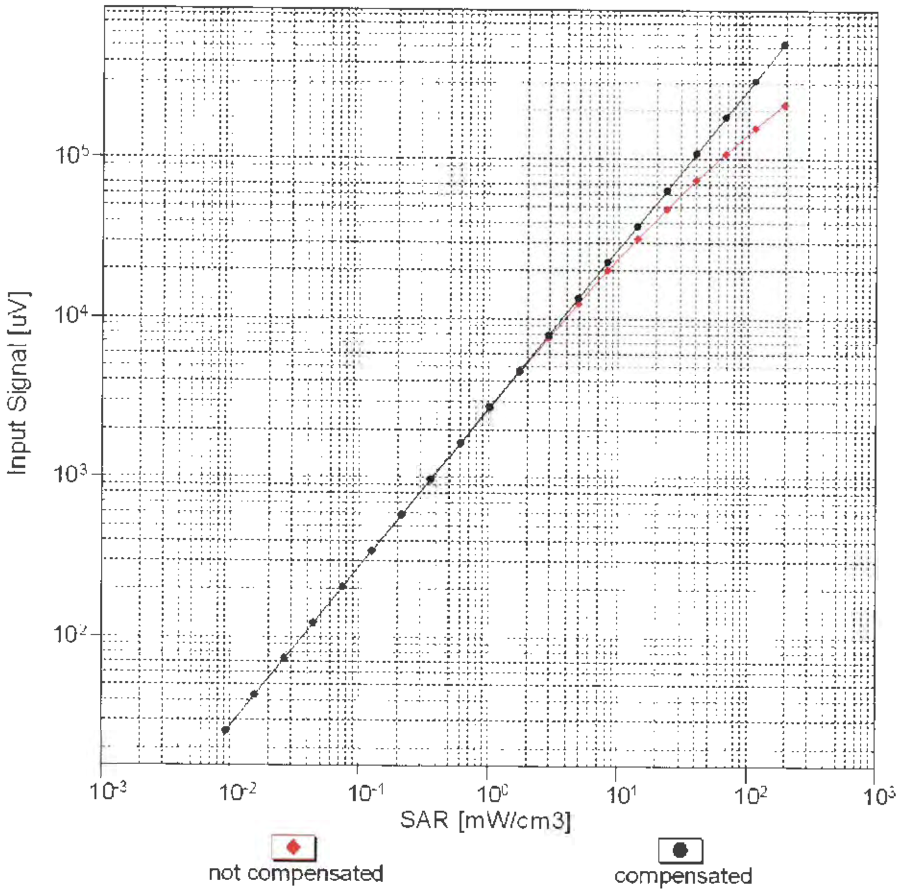
Receiving Pattern (ϕ), ϑ = 0°

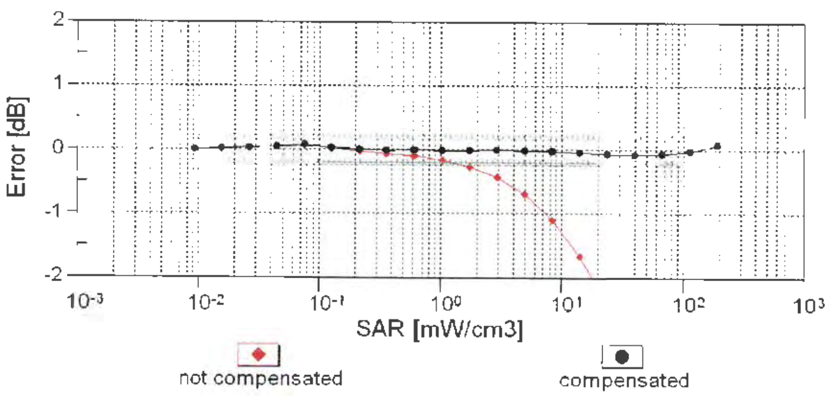




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

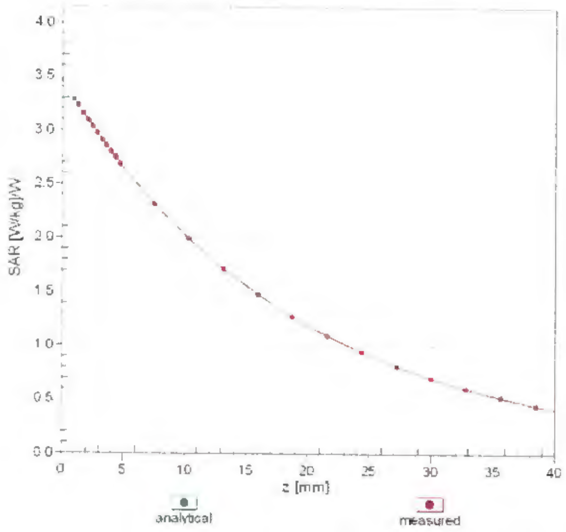




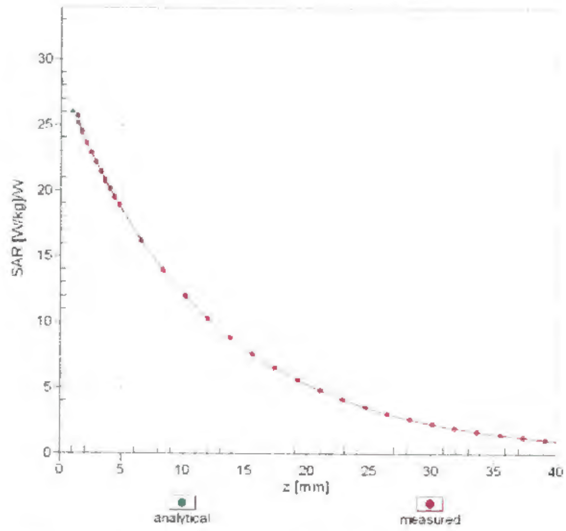
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

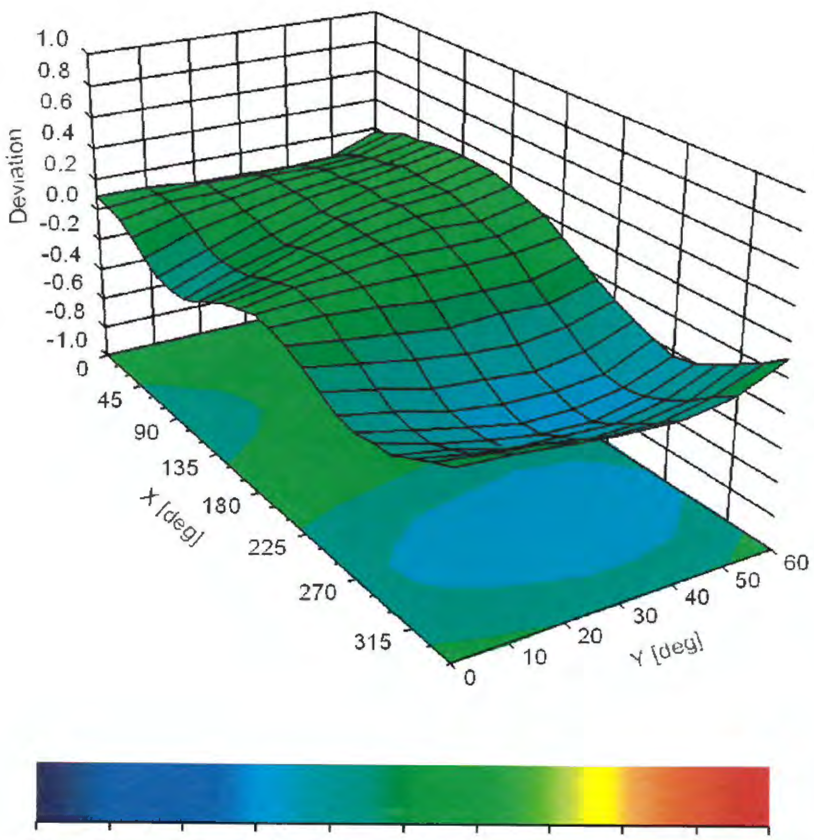


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7515

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-5.4
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