CERTIFICATE #3478.01

TEST REPORT

EUT Description	**Radio Control Module 2.4GHz inside the IWBS**
Brand Name	**Intel®**
Model Name	**RCM24G**
FCC / ISED ID	**FCC ID: 2A12A-RCM24G/ISED ID: 1000B-RCM24G**
Date of Test Start/End	**2017-11-21 / 2017-11-22**
Features	**Proprietary 2.4GHz RF Transceiver (Hopping Mode)** (see section 5)

Applicant	**Intel Corporation**
Address	**2200 Mission College Boulevard, Santa Clara, CA 95051 / USA**
Contact Person	**Dr. Andreas Gaede-Tsangas**
Telephone/Fax/ Email	**andreas.gaede-tsangas@intel.com**

Reference Standards	**FCC 47 CFR Part §2.1093** **RSS-102, Issue 5** (see section 1)	
RF Exposure Environment	**Portable devices - General population/uncontrolled exposure**	
	SAR Result	SAR Limit
Maximum SAR Result & Limit	**0.44 W/kg (1g)**	**1.6 W/kg (1g)**
Min. test separation distance	**20mm**	

Test Report identification	**171010-01.TR01**
Revision Control	**Rev. 00** **This test report revision replaces any previous test report revision** (see section 8)

The test results relate only to the samples tested.
The test report shall not be reproduced in full, without written approval of the laboratory.

Issued by	Reviewed by
Digitally signed by Rafael QUIROZ MORENO Date: 2017.11.22 18:05:45 +01'00'	Digitally signed by Jose M. FORTES DN: cn=Jose M. FORTES, o=Intel Mobile Communications, ou=WRF Lab, email=jose.m.fortes.lopez@intel.com, c=FR Date: 2017.11.22 18:29:57 +01'00'
Rafael QUIROZ (Test Engineer Lead)	José M. FORTES (Technical Officer)

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1. Standards, reference documents and applicable test methods

1. FCC 47 CFR Part §2.1093 – Radiofrequency radiation exposure evaluation: portable devices.
2. FCC OET KDB 447498 D01 –RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices.
3. FCC OET KDB 865664 D01 – SAR Measurement Requirements for 100 MHz to 6 GHz.
4. FCC OET KDB 865664 D02 – RF Exposure Compliance Reporting and Documentation Considerations.
5. ISED RSS 102, Issue 5 – Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands).
6. ISED Notice 2016-DRS001 – Applicability of latest FCC RF Exposure KDB Procedures and Other Procedures.
7. ISED Notice 2012-DRS0529 – SAR correction for measured conductivity and relative permittivity based on IEC 62209-2 standard.
8. IEEE Std 1528-2013 – IEEE Recommended Practice Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques.

2. General conditions, competences and guarantees

- ✓ Intel Mobile Communications France SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2005 testing laboratory accredited by the American Association for Laboratory Accreditation (A2LA) with the certificate number 3478.01.
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3. Environmental Conditions

✓ At the site where the measurements were performed the following limits were not exceeded during the tests:

Temperature	21ºC ± 2ºC
Humidity	45% ± 10%
Liquid Temperature	20ºC ± 2ºC

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#01	171010-01.S01	Radio Control Module 2.4GHz inside the IWBS	RCM24G	W1DVT1KY7380031	2017-10-17	NA

5. EUT Features

Brand Name	Intel®
Model Name	RCM24G
FCC / ISED ID	FCC ID: 2A12A-RCM24G/ISED ID: 1000B-RCM24G
Firmware Version	RCM24G_12017USCA
Driver Version	N/A
Prototype / Production	Production
Host Identification	IWBS (Intel Wireless Base Station) for Intel UAS
Exposure Conditions	Body worn
Supported Radios	Proprietary 2.4GHz (FHSS) 2.4GHz (2402.5 – 2471.5 MHz)
Antenna Information	**Antenna 1:** Dipole **Antenna 2:** Dipole See Annex *F* for more details on antennas location.
Simultaneous Transmission Configurations	FHSS 2.4GHz Antenna 1 + FHSS 2.4GHz Antenna 2
Additional Information	NA

Supported Radios

Mode	Duty Cycle	Modulation	Band	UL Freq Range (MHz)	Measured Max. Conducted Power (dBm)
FHSS Proprietary	100%	MSK	2.4GHz	2402.5-2471.5	19.35

Maximum Output power specification + Tune up tolerance limit			SISO mode	
Equipment Class	Mode	BW (MHz)	Antenna 1 (dBm)	Antenna 2 (dBm)
DSS	FHSS Proprietary	1MHz	20.93	20.93

6. Remarks and comments

1. Only the plots for the test positions with the highest measured SAR per band/mode are included in Annex C as required per FCC OET KDB 865664 D02, paragraph 2.3.8.

7. Test Verdicts summary

Standard	Band	Highest Reported SAR (1g) (W/kg)	Verdict
Proprietary FHSS	2.4GHz	0.44	P

P: Pass
F: Fail
NM: Not Measured
NA: Not Applicable

According to the FCC OET KDB 690783 D01, this is the summary of the values for the Grant Listing:

Highest Reported SAR (1g) (W/kg)	
Exposure Condition	Equipment Class
	DSS
Body Worn	0.44
Simultaneous Tx	Sum-SAR: 0.80

Considering the results of the performed test according to FCC 47CFR Part 2.1093 and ISED RSS 102, Issue 5 the item under test is IN COMPLIANCE with the requested specifications specified in Section 1. Standards, reference documents and applicable test methods.

8. Document Revision History

Revision #	Date	Modified by	Revision Details
Rev. 00	2017-11-22	V. Kaculini	First Issue

Annex A. Test & System Description

A.1 SAR Definition

Specific Absorption rate is defined as the time derivative of the incremental energy (dW) absorbed by (dissipated in) and incremental mass (dm) contained in a volume element (dV) of a given density (ρ).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

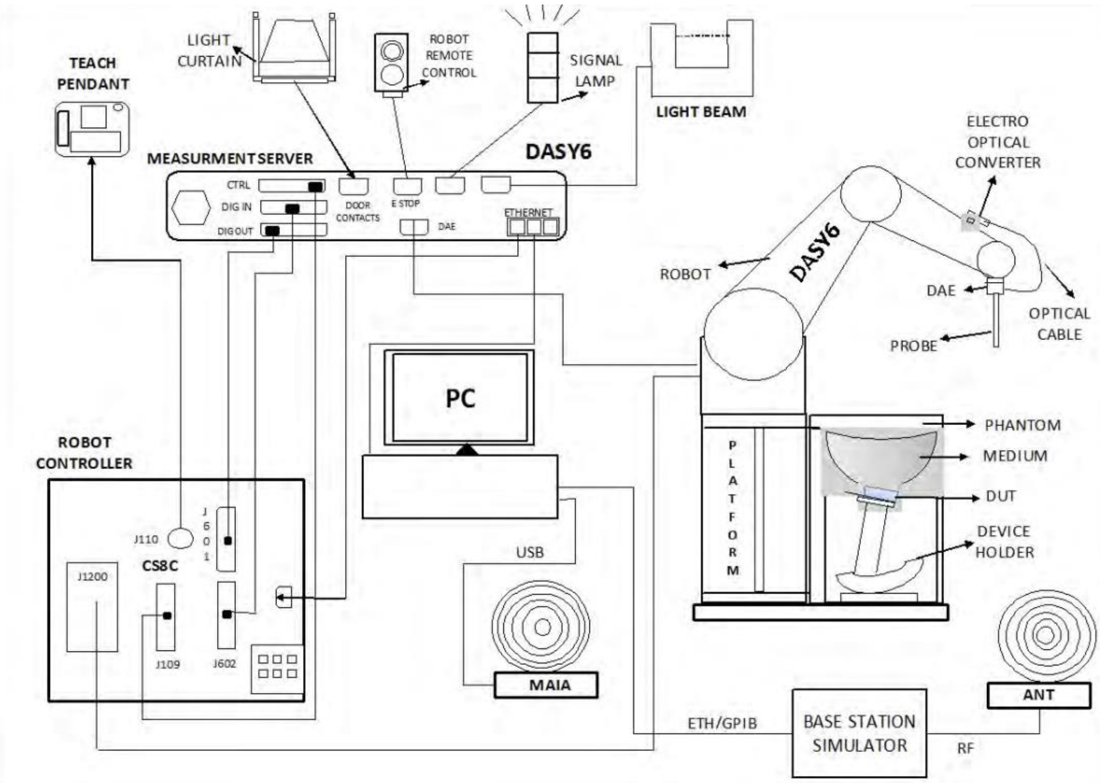
Where:

σ = Conductivity of the tissue (S/m)
ρ = Mass density of the tissue (kg/m3)
E = RMS electric field strength (V/m)

A.2 SPEAG SAR Measurement System

A.2.1 SAR Measurement Setup

The DASY6 system for performing compliance tests consists of the following items:



- ✓ A standard high precision 6-axis robot (Staübli TX/RX family) with controller, teach pendant and software. It includes an arm extension for accommodating the data acquisition electronics (DAE).
- ✓ An isotropic field probe optimized and calibrated for the targeted measurements.
- ✓ A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- ✓ The Electro-optical Converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. The EOC signal is transmitted to the measurement server.
- ✓ The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movements interrupts.
- ✓ The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- ✓ A computer running Win7 professional operating system and the DASY6 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.
- ✓ MAIA is a hardware interface (Antenna) used to evaluate the modulation and audio interference characteristics of RF signals.
- ✓ ANT is an ultra-wideband antenna for use with the base station simulators over 698 MHz to 6GHz.
- ✓ The base station simulator is an equipment used for SAR cellular tests in order to emulate the cellular signals characteristics and behavior between a regular base station and the equipment under test.
- ✓ Tissue simulating liquid.
- ✓ System Validation dipoles.
- ✓ Network emulator or RF test tool.

A.2.2 E-Field Measurement Probe

The probe is constructed using three orthogonal dipole sensors arranged on an interlocking, triangular prism core. The probe has built-in shielding against static charges and is contained within a PEEK cylindrical enclosure material at the tip.

The probe's characteristics are:

Frequency Range	30MHz – 6GHz
Length	337 mm
Probe tip external diameter	2.5 mm
Typical distance between dipoles and the probe tip	1 mm
Axial Isotropy (in human-equivalent liquids)	±0.3 dB
Hemispherical Isotropy (in human-equivalent liquids)	±0.5 dB
Linearity	±0.2 dB
Maximum operating SAR	100 W/kg
Lower SAR detection threshold	0.001 W/kg

A.2.3 SAM Phantom

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

The phantom's characteristics are:

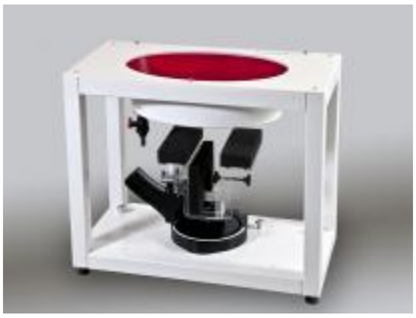
Material	Vinylester, glass fiber reinforced (VE-GF)
Shell thickness	2 mm ± 0.2 mm
Shell thickness at ERP	6 ± 0.2 mm
Filling volume	25 Liters
Dimensions	Length: 1000mm / Width: 500mm

A.2.4 Flat Phantom

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

The phantom's characteristics are:

Material	Vinylester, glass fiber reinforced (VE-GF)
Shell thickness	2 mm ± 0.2 mm
Filling volume	30 Liters approx.
Dimensions	Major axis: 600mm / Minor axis: 400mm



A.2.5 Device Positioner

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of 0.5 mm would produce a SAR uncertainty of 20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

A simple but effective and easy-to-use extension for the Mounting Device; facilitates testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.); lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin SAM, ELI and other Flat Phantoms.

A.3 Data Evaluation

- **Power Reference measurement**

The robot measures the E field in a specified reference position that can be either the selected section's grid reference point or a user point in this section at 4mm of the inner surface of the phantom, 2mm for frequencies above 3GHz.

- **Area Scan**

Measurement procedures for evaluating SAR from wireless handsets typically start with a coarse measurement grid to determine the approximate location of the local peak SAR values. This is known as the area-scan procedure. The SAR distribution is scanned along the inside surface of one side of the phantom head, at least for an area larger than the projection of the handset and antenna. The distance between the measured points and phantom surface should be less than 8 mm, and should remain constant (with variation less than ± 1 mm) during the entire scan in order to determine the locations of the local peak SAR with sufficient accuracy. The angle between the probe axis and the surface normal line is recommended but not required to be less than 30°. If this angle is larger than 30° and the closest point on the probe-tip housing to the phantom surface is closer than a probe diameter, the boundary effect may become larger and polarization dependent. This additional uncertainty needs to be analyzed and accounted for. To achieve this, modified test procedures and additional uncertainty analyses not described in this recommended practice may be required. The measurement and interpolation point spacing should be chosen such as to allow identification of the local peak locations to within one-half of the linear dimension of a side of the zoom-scan volume. Because a local peak having specific amplitude and steep gradients may produce a lower peak spatial-average SAR compared to peaks with slightly lower amplitude and less steep gradients, it is necessary to evaluate these other peaks as well. However, since the spatial gradients of local SAR peaks are a function of the wavelength inside the tissue-equivalent liquid and the incident magnetic field strength, it is not necessary to evaluate local peaks that are less than 2 dB or more below the global maximum peak. Two-dimensional spline algorithms (Brishoual et al. 2001; Press et al., 1996) are typically used to determine the peaks and gradients within the scanned area. If a peak is found at a distance from the scan border of less than one-half the edge dimension of the desired 1 g or 10 g cube, the measurement area should be enlarged if possible.

- **Zoom Scan**

To evaluate the peak spatial-average SAR values for 1 g or 10 g cubes, fine resolution volume scans, called zoom scans, are performed at the peak SAR locations identified during the area scan. The minimum zoom scan volume size should extend at least 1.5 times the edge dimension of a 1 g cube in all directions from the center of the scan volume, for both 1 g and 10 g peak spatial-average SAR evaluations. Along the phantom curved surfaces, the front face of the volume facing the tissue/liquid interface conforms to the curved boundary, to ensure that all SAR peaks are captured. The back face should be equally distorted to maintain the correct averaging mass. The flatness and orientation of the four side faces are unchanged from that of a cube whose orientation is within ± 30° of the line normal to the phantom at the center of the cube face next to the phantom surface. The peak local SAR locations that were determined in the area scan (interpolated values) should be used for the centers of the zoom scans. If a scan volume cannot be centered due to proximity of a phantom shape feature, the probe should be tilted to allow scan volume enlargement. If probe tilt is not feasible, the zoom-scan origin may be shifted, but not by more than half of the 1 g or 10 g cube edge dimension.

After the zoom-scan measurement, extrapolations from the closest measured points to the surface, for example along lines parallel to the zoom-scan centerline, and interpolations to a finer resolution between all measured and extrapolated points are performed. Extrapolation algorithm considerations are described in 6.5.3, and 3-D spline methods (Brishoual et al., 2001; Kreyszig, 1983; Press et al., 1996) can be used for interpolation. The peak spatial-average SAR is finally determined by a numerical averaging of the local SAR values in the interpolation grid, using for example a trapezoidal algorithm for the integration (averaging).

In some areas of the phantom, such as the jaw and upper head regions, the angle of the probe with respect to the line normal to the surface may be relatively large, e.g., greater than ± 30º, which could increase the boundary effect error to a larger level. In these cases, during the zoom scan a change in the orientation of the probe, the phantom, or both is recommended but not required for the duration of the zoom scan, so that the angle between the probe axis and the line normal to the surface is within 30º for all measurement points.

- **Power Drift measurement**

The robot re-measures the E-Field in the same reference location measured at the Power Reference. The drift measurement gives the field difference in dB from the first to the last reference reading. This allows a user to monitor the power drift of the device under test that must remain within a maximum variation of ±5%.

- **Post-processing**

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1528 and IEC 62209-1/2 standards. It can be conducted for 1g and 10g.

The software allows evaluations that combine measured data and robot positions, such as:

- ✓ Maximum search
- ✓ Extrapolation
- ✓ Boundary correction
- ✓ Peak search for averaged SAR

Interpolation between the measured points is performed when the resolution of the grid is not fine enough to compute the average SAR over a given mass.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation.

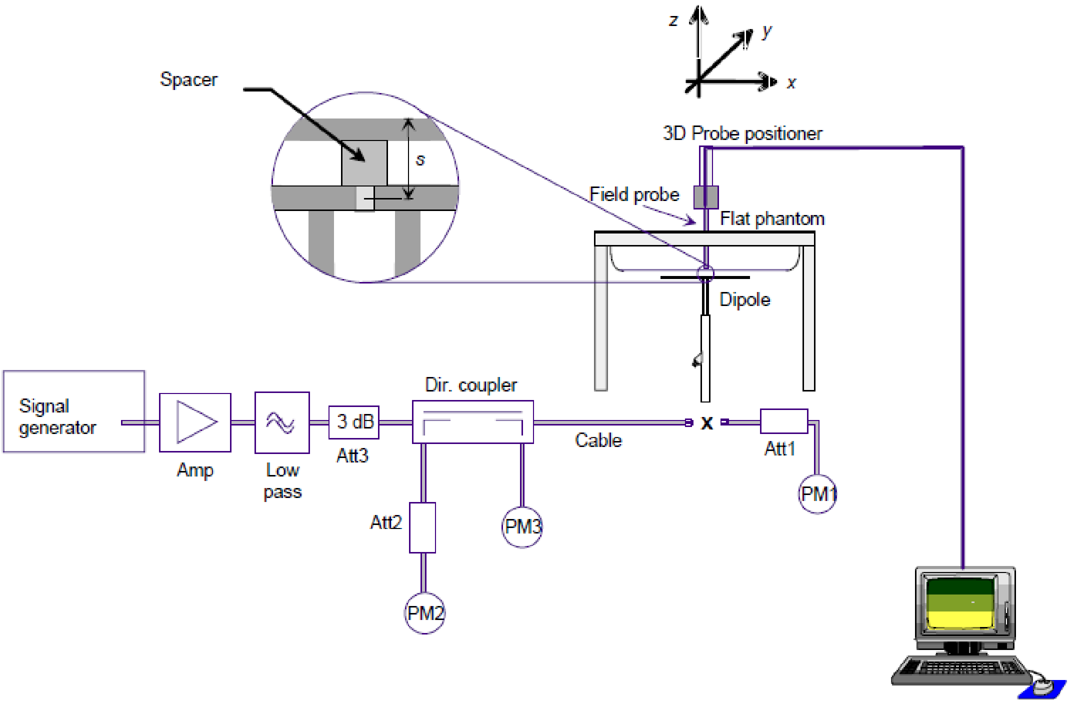
A.4 System and Liquid Check

A.4.1 System Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results.

The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

In the simplified setup for system check, the EUT is replaced by a calibrated dipole and the power source is replaced by a controlled continuous wave generated by a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the phantom at the correct distance.



The equipment setup is shown below:

- ✓ Signal Generator
- ✓ Amplifier
- ✓ Directional coupler
- ✓ Power meter
- ✓ Calibrated dipole

First, the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the connector (x) to the system check source. The signal generator is adjusted for the desired forward power at the connector as read by power meter PM1 after attenuation Att1 and also as coupled through Att2 to PM2. After connecting the cable to the source, the signal generator is readjusted for the same reading at power meter PM2.

SAR results are normalized to a forward power of 1W to compare the values with the calibration reports results as described at IEEE 1528 and IEC 62209 standards.

A.4.2 Liquid Check

The dielectric parameters check is done prior to the use of the tissue simulating liquid. The verification is made by comparing the relative permittivity and conductivity to the values recommended by the applicable standards.

The liquid verification was performed using the following test setup:

- ✓ VNA (Vector Network Analyzer)
- ✓ Open-Short-Load calibration kit
- ✓ RF Cable
- ✓ Open-Ended Coaxial probe
- ✓ DAK software tool
- ✓ SAR Liquid
- ✓ De-ionized water
- ✓ Thermometer

These are the target dielectric properties of the tissue-equivalent liquid material as defined in FCC OET KDB 865664 D01.

Frequency	Body SAR	
(MHz)	ε_r (F/m)	σ (S/m)
150	61.9	0.80
300	58.2	0.92
450	56.7	0.94
835	55.2	0.97
900	55.0	1.05
1450	54.0	1.30
1800-2000	53.3	1.52
2450	52.7	1.95
3000	52.0	2.73
5800	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m3)

The measurement system implement a SAR error compensation algorithm as documented in IEEE Std 1528-2013 (equivalent to draft standard IEEE P1528-2011) to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters (applied to only scale up the measured SAR, and not downward) so, according to FCC OET KDB 865664 D01, the tolerance for ε_r and σ may be relaxed to ± 10%.

A.5 Test Equipment List

A.5.1 SAR System #2

ID #	Device	Type/Model	Serial Number	Manufacturer	Cal. Date	Cal. Due Date
0236	Dosimetric E-field Probe	EX3DV4	3978	SPEAG	2017-05-19	2018-05-19
0242	Data Acquisition Electronics	DAE4	1429	SPEAG	2017-07-13	2018-07-13
0451	6-axis Robot	TX60 L	F16/55FXA1/A/01	STAÜBLI	NA	NA
0453	Robot Controller	CS8C	F16/55FXA1/C/01	STAÜBLI	NA	NA
0455	Measurement Server	DASY6 P/N: SE UMS 028 BB	1489	SPEAG	NA	NA
0456	Electro-Optical Converter	EOC60	1098	SPEAG	NA	NA
0459	Light Beam Unit	SE UKS 030 AA	-	Di-soric	NA	NA
0460	Oval Flat Phantom	ELI v8.0	2048	SPEAG	NA	NA
0461	Measurement SW	DASY6 6.4.0.12171	9-5DEE27C2	SPEAG	NA	NA
0466	Laptop Holder	P/N SM LH1 001 CD	-	SPEAG	NA	NA

A.5.2 Shared Instrumentation

ID #	Device	Type/Model	Serial Number	Manufacturer	Cal. Date	Cal. Due Date
0098	USB Power Sensor	NRP-Z81	102278	R&S	2017-09-18	2019-09-18
0099	USB Power Sensor	NRP-Z81	102279	R&S	2017-09-19	2019-09-19
0114	Vector Signal Generator	ESG E4438C	MY45092885	Agilent	NA	NA
0170	Power Amplifier	SAM-01	151922	ETS-Lindgren	NA	NA
0224	Liquid measurement SW	DAK-3.5	V2.4.0.761	SPEAG	NA	NA
0237	Dielectric Probe Kit	DAK-3.5	1037	SPEAG	2016-06-14	2018-06-14
0239	2450MHz System Validation Dipole	D2450V2	937	SPEAG	2016-06-20	2018-06-20
0398	Temperature & Humidity Logger	TR-72NW-H + HHA-3151	Logger: 62180216 Sensor: 0202622A	TandD	2016-02-01	2018-02-01
0408	Thermometer	TESTO 922	33622932	Testo	2016-05-19	2018-05-19
0412	Coupler	CD0.5-8-20-30	1251-002	Amd-group	NA	NA
0655	Vector Reflectometer	PLANAR R140	0190616	Copper Mountain Technologies	2017-09-19	2019-09-19

A.5.3 Tissue Simulant Liquid

TSL	Manufacturer / Model	Freq Range (MHz)	Main Ingredients
Body WideBand	SPEAG MBBL600-6000V6 Batch 160603-01	600-6000	Ethanediol, Sodium petroleum sulfonate, Hexylene Glycol / 2-Methyl-pentane-2.4-diol, Alkoxylated alcohol

A.6 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the below table:

SAR System #2

SPEAG DASY6 Uncertainty Budget According to IEEE 1528-2013 and IEC 62209-1/2016 (0.3 - 6 GHz range)								
Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(vi) veff
Measurement System								
Probe Calibration	±6.55 %	N	1	1	1	±6.55 %	±6.55 %	∞
Axial Isotropy	±4.7 %	R	√3	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	√3	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±2.0 %	R	√3	1	1	±1.2 %	±1.2 %	∞
Linearity	±4.7 %	R	√3	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	√3	1	1	±0.6 %	±0.6 %	∞
Modulation Response	±2.4 %	R	√3	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	√3	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	√3	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	√3	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	√3	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.04 %	R	√3	1	1	±0.0 %	±0.0 %	∞
Probe Positioning	±0.8 %	R	√3	1	1	±0.5 %	±0.5 %	∞
Max. SAR Eval.	±4.0 %	R	√3	1	1	±2.3 %	±2.3 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	√3	1	1	±2.9 %	±2.9 %	∞
Power Scaling	±0.0 %	R	√3	1	1	±0.0 %	±0.0 %	∞
Phantom and Setup								
Phantom Uncertainty	±6.6 %	R	√3	1	1	±3.8 %	±3.8 %	∞
SAR correction	±1.9 %	R	√3	1	0.84	±1.9 %	±1.6 %	∞
Liquid Conductivity (mea.)DAK	±2.5 %	R	√3	0.78	0.71	±2.0 %	±1.8 %	∞
Liquid Permittivity (mea.) DAK	±2.5 %	R	√3	0.23	0.26	±0.6 %	±0.7 %	∞
Temp. unc. - Conductivity BB	±3.4 %	R	√3	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity BB	±0.4 %	R	√3	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±11.9 %	±11.8 %	569
Expanded STD Uncertainty						**±23.8 %**	**±23.6 %**	

SPEAG DASY6 Uncertainty Budget According to IEC 62209-2/2010 (30 MHz - 6 GHz range)								
Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(vi) veff
Measurement System								
Probe Calibration	±6.55 %	N	1	1	1	±6.55 %	±6.55 %	∞
Axial Isotropy	±4.7 %	R	√3	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	√3	0.7	0.7	±3.9 %	±3.9 %	∞
Linearity	±4.7 %	R	√3	1	1	±2.7 %	±2.7 %	∞
Modulation Response	±2.4 %	R	√3	1	1	±1.4 %	±1.4 %	∞
System Detection Limits	±1.0 %	R	√3	1	1	±0.6 %	±0.6 %	∞
Boundary Effects	±2.0 %	R	√3	1	1	±1.2 %	±1.2 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	√3	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	√3	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	√3	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	√3	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.04 %	R	√3	1	1	±0.0 %	±0.0 %	∞
Probe Positioning	±0.8 %	R	√3	1	1	±0.5 %	±0.5 %	∞
Post-processing	±4.0 %	R	√3	1	1	±2.3 %	±2.3 %	∞
Test Sample Related								
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Test sample Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Power Scaling	±0.0 %	R	√3	1	1	±0.0 %	±0.0 %	∞
Power Drift	±5.0 %	R	√3	1	1	±2.9 %	±2.9 %	∞
Phantom and Setup								
Phantom Uncertainty	±7.6 %	R	√3	1	1	±4.4 %	±4.4 %	∞
SAR correction	±1.9 %	R	√3	1	0.84	±1.9 %	±1.6 %	∞
Liquid Conductivity (mea.)DAK	±2.5 %	R	√3	0.78	0.71	±2.0 %	±1.8 %	∞
Liquid Permittivity (mea.) DAK	±2.5 %	R	√3	0.23	0.26	±0.6 %	±0.7 %	∞
Temp. unc. - Conductivity BB	±3.4 %	R	√3	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity BB	±0.4 %	R	√3	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±12.1 %	±12.0 %	605
Expanded STD Uncertainty						**±24.1 %**	**±24.0 %**	

A.7 RF Exposure Limits

SAR assessments have been made in line with the requirements of FCC 47 CFR Part §2.1093 and RSS 102, Issue 5 on the limitation of exposure of the general population / uncontrolled exposure for portable devices.

Exposure Type	General Population / Uncontrolled Environment
Peak spatial-average SAR (averaged over any 1 gram of tissue)	**1.6 W/kg**
Whole body average SAR	**0.08 W/kg**
Peak spatial-average SAR (extremities) (averaged over any 10 grams of tissue)	**4.0 W/kg**

Annex B. Test Results

B.1 Test Conditions

B.1.1 Test SAR Test positions relative to the phantom

The device under test was the Intel® RCM24G card inside the IWBS (Intel Wireless Base Station) for Intel UAS. The EUT was placed at a 20mm distance from the flat phantom as requested by the applicant. This distance was measured with respect to the front/back plastic cover of the device. Refer to the *F.2* for more information

The dipoles can be positioned in straight or folded mode at different angles, refer to in *F.1* for more details. After an initial investigation it was confirmed that the straight configuration was the worst case position. All the results presented in this report were obtained using this straight configuration.

Considering the configuration of the EUT in *F.2*, the surfaces/edges to be measured for each antenna are:

Distance		Antenna	
		Antenna 1	Antenna 2
20mm	Position	• Back face • Front face	• Back face • Front face

See *B.1.3.1* for a more detailed list of the applied reductions.

See *F.2* section for more information on the tested positions

B.1.2 Test signal, Output power and Test Frequencies

The EUT was set by the applicant to transmit automatically at maximum power and 100% duty cycle.

B.1.3 Evaluation Exclusion and Test Reductions

B.1.3.1 SAR evaluation exclusion

The SAR Test Exclusion Threshold in FCC OET KDB 447498 D01 v06 can be applied to determine SAR test exclusion for adjacent edge configurations. For 100MHz to 6GHz and test separation distances ≤50mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following formula:

$$[(\text{max. power of channel, including tune} - \text{up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot \left[\sqrt{f_{(GHz)}}\right] \leq 3.0\ for\ 1g\ SAR, and \leq 7.5\ for\ 10g\ extremity\ SAR \quad (1)$$

Where:

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

For test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined using the following formulas:

$$\langle(Power\ allowed\ at\ numeric\ threshold\ for\ 50\ mm\ in\ (1)) + (test\ separation\ distance - 50\ mm) \cdot (f_{MHz}/150)\rangle mW,\ for\ 100MHz\ to\ 1500MHz \quad (2)$$

$$\langle(Power\ allowed\ at\ numeric\ threshold\ for\ 50\ mm\ in\ (1)) + (test\ separation\ distance - 50\ mm) \cdot 10)\rangle mW,\ for\ 1500MHz\ and\ \leq 6GHz \quad (3)$$

Antenna	Band Name	Output power		Front Face	Back Face
		dBm	mW		
Antenna 1	FHSS	20.93	123.9	**<50**	**<50**
Antenna 2	FHSS	20.93	123.9	**<50**	**<50**

Front Face	Back Face
T	T
T	T

T: Tested position
R: Reduced

See Annex *F* for a more detailed explanation of the separation distance related to the platform.

B.1.3.2 General SAR test reduction

According to FCC OET KDB 447498 D01, 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.

B.2 Conducted Power Measurements

					Antenna 1		Antenna 2		SAR Test?
Band	Mode	Data Rate	Ch #	Freq (MHz)	Avg Pwr (dBm)	Tune-up Pwr (dBm)	Avg Pwr (dBm)	Tune-up Pwr (dBm)	
2.4GHz	FHSS Proprietary MSK Modulation	500kbps	0	2402.5	9.40	12.19	9.20	12.19	No[2]
			34	2436.5	**19.35**	20.93	**19.00**	20.93	Yes
			69	2471.5	8.45	11.32	8.40	11.32	No[2]

Initial test configuration

1. NR: Not Required
2. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for subsequent next highest measured output power channel(s) in the initial test configuration until reported SAR is ≤ 1.2 W/kg or all required channels are tested.

B.3 Tissue Parameters Measurement

Body TSL

Freq. (MHz)	Target Parameters		Measured TSL Parameters		Deviation (%)		Date
	ε' (F/m)	σ (S/m)	ε' (F/m)	σ (S/m)	ε'	σ	
2450	52.70	1.95	50.46	2.10	-4.26	7.65	2017-11-21

See *Annex D* for more details.

B.4 System Check Measurements

Body Measurements

Frequency (MHz)	Average	Target SAR (W/Kg)	Measured SAR (W/Kg)	Deviation to target (%)	Limit (%)	Date
2450	1g	49.40	50.80	2.83	±10	2017-11-21
	10g	23.40	23.40	0.00		

See *Annex C* for more details.

B.5 SAR Test Results

B.5.1 FHSS – 2.4GHz – MSK Modulation

Ant.	Mode Data rate	Ch #	Freq (MHz)	Position	Correct. Factor (dB)	SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Plot #
Antenna 1	FHSS Proprietary 500kbps	34	2436.5	Front Face	1.58	0.31	0.44	**1**
				Back Face	1.58	0.21	0.30	
Antenna 2				Front Face	1.93	0.23	0.36	**2**
				Back Face	1.93	0.22	0.34	

B.5.2 SAR Measurement Variability

According to FCC OET KDB 865664, SAR Measurement variability is assessed when the maximum initial measured SAR is >0.8 W/kg for a certain band/mode.

As all measured SAR results are below 0.8W/kg, therefore SAR variability is not required.

B.5.3 Simultaneous Transmission SAR Evaluation

According to FCC OET KDB 447498 D01, when the sum of 1g SAR for all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

All the values stated in the table below are the worst case found for standalone measurement with disregard of the transmission mode or channel where the worst case was found.

Position	Simultaneous Tx Antenna Combination		Σ SAR 1g (W/kg)	Limit (W/kg)
	Antenna 1	Antenna 2		
Front Face	0.44	0.36	0.80	1.6
Back Face	0.30	0.34	0.64	

Considering the results described above and according to the simultaneous transmission evaluation exclusions described in FCC OET KDB 447498 D01, no SAR to peak location measurement is required.

Annex C. Test System Plots

1. FHSS Proprietary – MSK Modulation, CH34, Antenna 1 – Front Face

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	S/N	DUT Type
RCM24G, Intel	-	W1DVT1KY7380031	Radio Control Module 2.4GHz inside the IWBS

Exposure Conditions

Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat, Muscle Simulating Liquid	FRONT(SCREEN), 20	2.4 GHz	Unknown, Manual	2436.5, 34	7.45	2.08	50.5

Hardware Setup

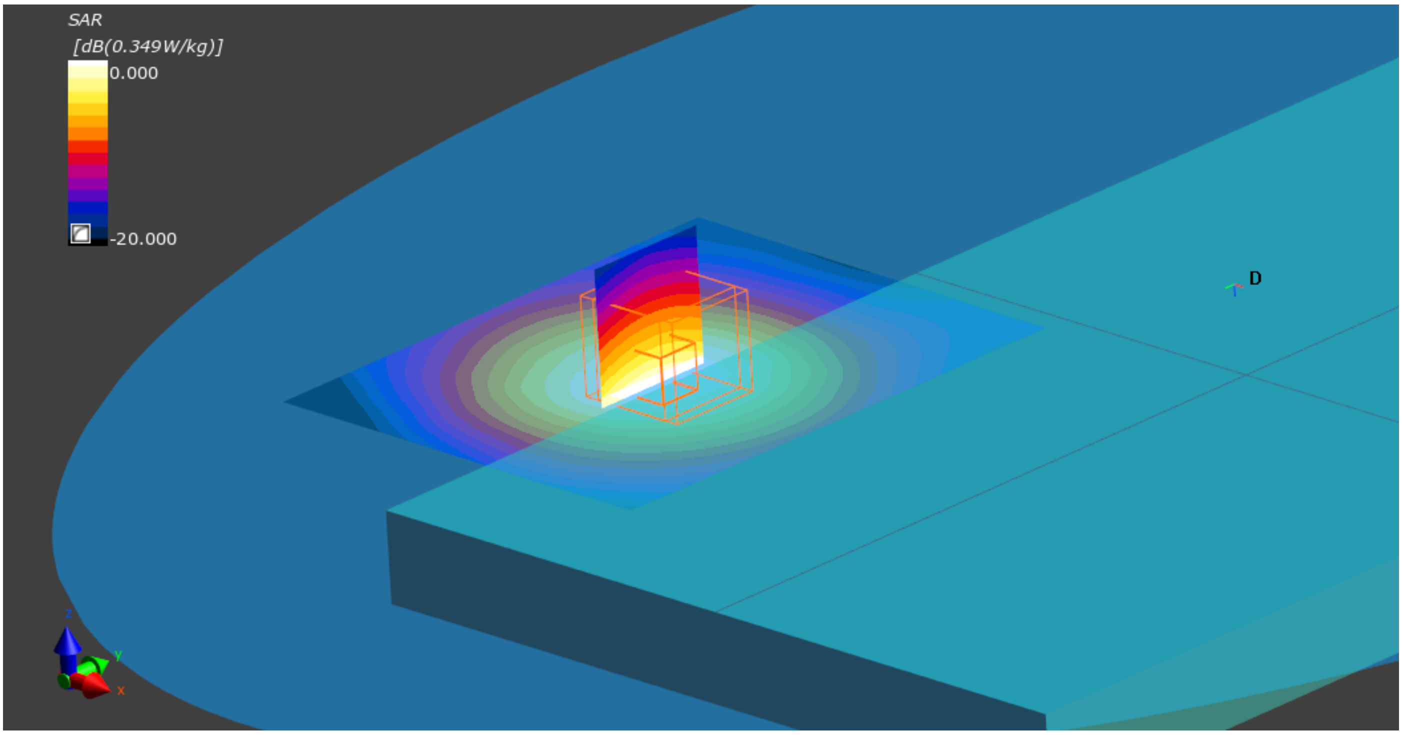
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
ELI V8.0 (20deg probe tilt) - 2048	MBBL-600-6000v5, 2017-Nov-21	EX3DV4 - SN3978, 2017-05-19	DAE4 Sn1429, 2017-07-13

Scan Setup

	Area Scan	Zoom Scan
Grid Extents [mm]	96.0 x 120.0	30.0 x 30.0 x 30.0
Grid Steps [mm]	12.0 x 12.0	5.0 x 5.0 x 5.0
Sensor Surface [mm]	3.0	1.4
Graded Grid	No	No
Grading Ratio	n/a	n/a
MAIA	MAIA not used	MAIA not used
Surface Detection	Yes	Yes
Scan Method	Measured	Measured

Measurement Results

	Area Scan	Zoom Scan
Date	2017-11-21, 14:37	2017-11-21, 14:47
SAR 1g [W/Kg]	**0.282**	**0.306**
SAR 10g [W/Kg]	**0.156**	**0.161**
Power Drift [dB]	-0.30	0.03
Power Scaling	Disabled	Disabled
Scaling Factor [dB]		
TSL Correction	No correction	No correction



2. FHSS Proprietary – MSK Modulation, CH34, Antenna 2 – Front Face

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	S/N	DUT Type
RCM24G, Intel	-	W1DVT1KY7380031	Radio Control Module 2.4GHz inside the IWBS

Exposure Conditions

Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat, Muscle Simulating Liquid	FRONT(SCREEN), 20	2.4 GHz	Unknown, Manual	2436.5, 34	7.45	2.08	50.5

Hardware Setup

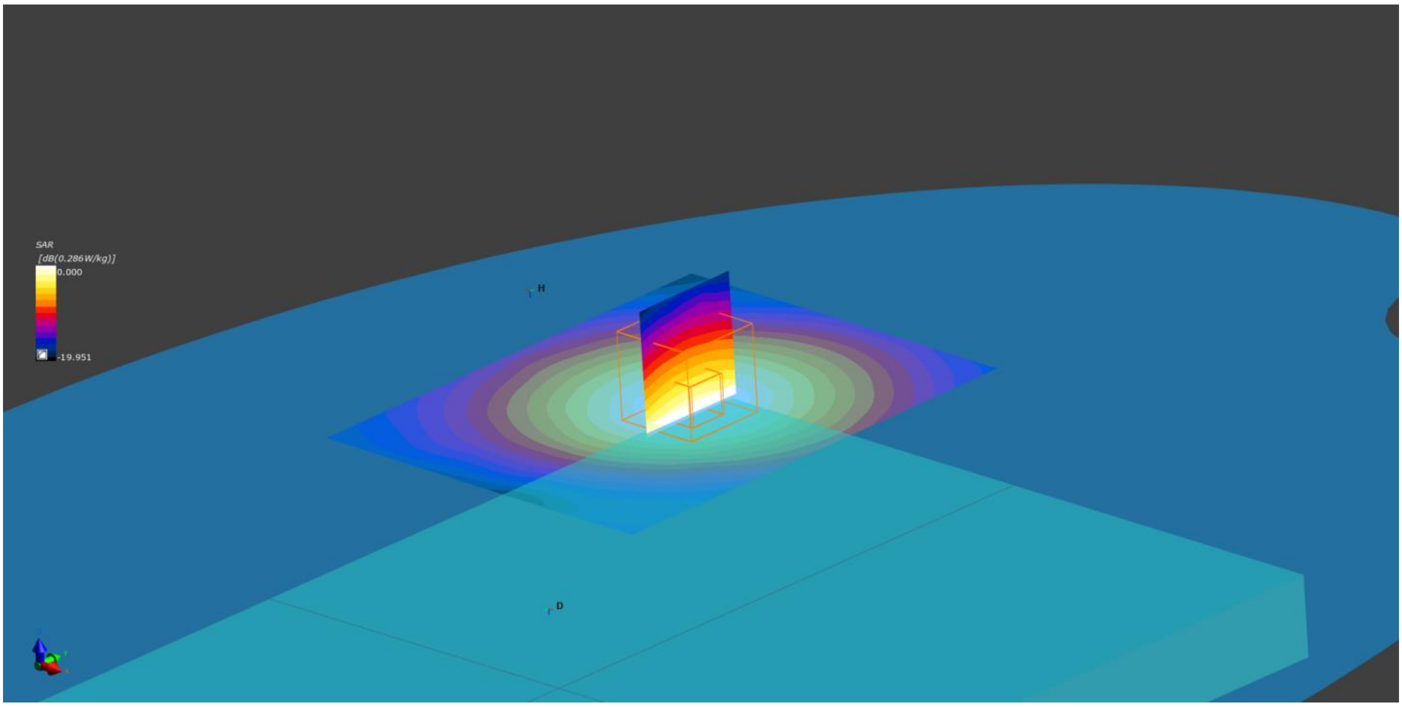
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
ELI V8.0 (20deg probe tilt) - 2048	MBBL-600-6000v5, 2017-Nov-21	EX3DV4 - SN3978, 2017-05-19	DAE4 Sn1429, 2017-07-13

Scan Setup

	Area Scan	Zoom Scan
Grid Extents [mm]	96.0 x 120.0	30.0 x 30.0 x 30.0
Grid Steps [mm]	12.0 x 12.0	5.0 x 5.0 x 5.0
Sensor Surface [mm]	3.0	1.4
Graded Grid	No	No
Grading Ratio	n/a	n/a
MAIA	MAIA not used	MAIA not used
Surface Detection	Yes	Yes
Scan Method	Measured	Measured

Measurement Results

	Area Scan	Zoom Scan
Date	2017-11-21, 15:18	2017-11-21, 15:24
SAR 1g [W/Kg]	**0.231**	**0.230**
SAR 10g [W/Kg]	**0.129**	**0.129**
Power Drift [dB]	-0.20	-0.10
Power Scaling	Disabled	Disabled
Scaling Factor [dB]		
TSL Correction	No correction	No correction



3. System Check Body Liquid 2450MHz

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	S/N	DUT Type
Dipole 2.45GHz, Speag	50.0 x 10.0 x 1.0	937	Dipole

Exposure Conditions

Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat, MuscleSimulating Liquid			, 0--	2450.0, 0	7.45	2.10	50.5

Hardware Setup

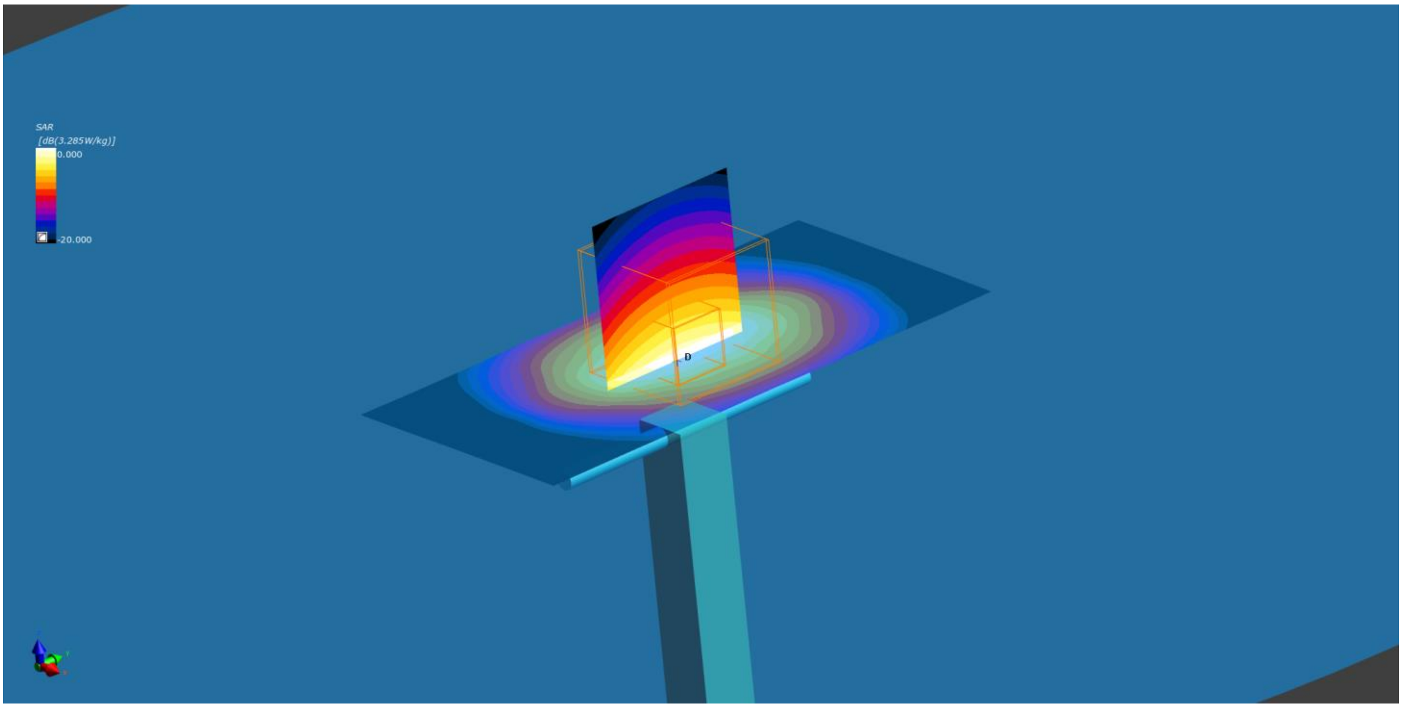
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
ELI V8.0 (20deg probe tilt) - 2048	MBBL-600-6000v5, 2017-Nov-21	EX3DV4 - SN3978, 2017-05-19	DAE4 Sn1429, 2017-07-13

Scan Setup

	Area Scan	Zoom Scan
Grid Extents [mm]	48.0 x 96.0	30.0 x 30.0 x 30.0
Grid Steps [mm]	12.0 x 12.0	5.0 x 5.0 x 5.0
Sensor Surface [mm]	3.0	1.4
Graded Grid	No	No
Grading Ratio	n/a	n/a
MAIA	MAIA not used	MAIA not used
Surface Detection	Yes	Yes
Scan Method	Measured	Measured

Measurement Results

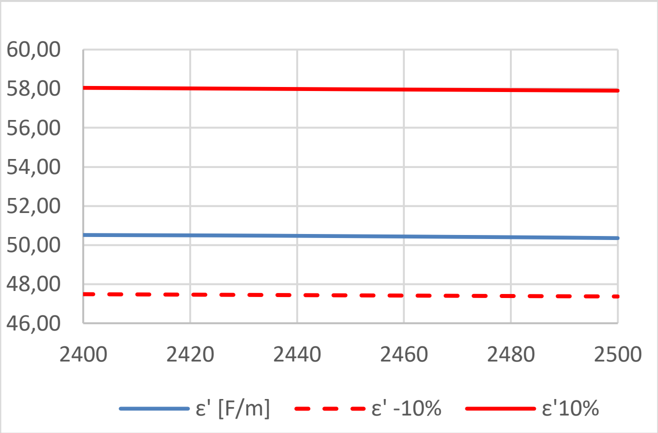
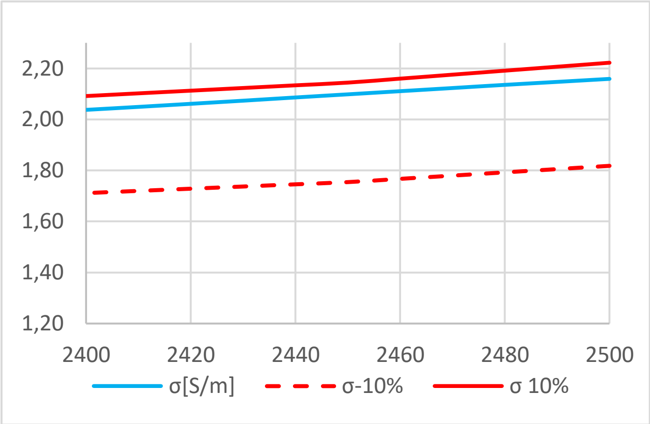
	Area Scan	Zoom Scan
Date	2017-11-21, 10:56	2017-11-21, 11:02
SAR 1g [W/Kg]	**2.35**	**2.54**
SAR 10g [W/Kg]	**1.03**	**1.17**
Power Drift [dB]	n/a	0.02
Power Scaling	Disabled	Disabled
Scaling Factor [dB]		
TSL Correction	No correction	No correction



Annex D. TSL Dielectric Parameters

D.1 Body DTS 2450MHz

Freq. (MHz)	Target		2017-11-21 Measured	
	ε' (F/m)	σ (S/m)	ε' (F/m)	σ (S/m)
2400	52.77	1.90	50.52	2.04
2410	52.75	1.91	50.51	2.05
2420	52.74	1.92	50.50	2.06
2430	52.73	1.93	50.49	2.07
2440	52.71	1.94	50.47	2.09
2450	**52.70**	**1.95**	**50.46**	**2.10**
2460	52.69	1.96	50.44	2.11
2470	52.67	1.98	50.42	2.12
2480	52.66	1.99	50.40	2.14
2490	52.65	2.01	50.38	2.15
2500	52.64	2.02	50.36	2.16

Permittivity	Conductivity
	

Annex E. Calibration Certificates

ID	Device	Type/Model	Serial Number	Manufacturer	Calibration Certificate
0236	Dosimetric E-field Probe	EX3DV4	3978	SPEAG	
0239	2450MHz System Validation Dipole	D2450V2	937	SPEAG	

Dipole calibration

According to the KDB 865664 D01, a dipole must be calibrated using a fully validated SAR system according to the tissue dielectric parameters and SAR probe calibration frequency required for device testing. However, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements.

1. When the most recent return-loss result, measured at least annually, deviates by more than 20% from the previous measurement (i.e. value in dB × 0.2) or not meeting the required 20 dB minimum return-loss requirement.

2. When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 Ω from the previous measurement

The below results show the latest return loss and impedance measurements for each dipole performed by the lab:

Dipole 2450MHz Body TSL			
	Return Loss [dB]	Impedance [Ω]	Date
Previous	-26.30	51.1 + 4.8 j	2016-06-20
Last	-28.82	47.5 – 2.5 j	2017-03-17