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TEST REPORT

Report Number: 101941214LEX-003
Project Number: G101941214

Evaluation of Model Number: Qollector2

Tested to the SAR Criteria in
FCC Part 2.1093 per KDB 447498
IC RSS-102 Issue 4

For

SRAM

Test Performed by:	Test Authorized by:
Intertek 731 Enterprise Drive Lexington, KY 40510	SRAM 1333 North Kingsbury 4th Floor Chicago, IL 60622

Prepared By: _____ **Date:** 3/10/15

Jason Centers, Staff Engineer

Approved By: _____ **Date:** 3/10/15

Bryan Taylor, Team Leader

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1.0 DOCUMENT HISTORY

Revision/ Project Number	Writer Initials	Date	Change
1.0 /G101941214	JC	3/10/15	Original document

2.0 INTRODUCTION

At the request of SRAM, the Qollector Activity Monitor was evaluated for SAR in accordance with the requirements for FCC Part 2.1093 and RSS-102. Testing was performed in accordance with IEEE Std 1528, IEC62209-2, and the Office of Engineering and Technology KDB 447498. Testing was performed at the Intertek facility in Lexington, Kentucky.

For the evaluation, the dosimetric assessment system DASY52 was used. The total uncertainty for the evaluation of the spatial peak SAR values averaged over a cube of 1g tissue mass had been assessed for this system to be ±21.4%.

The Qollector2 was tested at the maximum output power measured by Intertek. Maximum output power measurements are tabulated under Section 9.0 Test Results.

The maximum spatial peak SAR value for the sample device averaged over 1g was found to be:

Transmit Band (MHz)	Mode	Channel	Frequency (MHz)	Conducted Output Power (dBm)	Reported SAR_{1g} – Body Mode (W/kg)	Limit (W/kg)
1850-1910	CDMA PCS Band BC1	1175	1908.75	23.48	0.13	1.6W/kg
824-849	CDMA Cell Band BC0	384	836.52	24.39	0.12	1.6W/kg
2402-2480	ANT+	40	2440	3.7	0.04	1.6W/kg

Table 1: Maximum Measured SAR

Mode	Reported Simultaneous SAR_{1g} – Body Mode (W/kg)	Limit (W/kg)
CDMA BC1 & ANT+	0.17	1.6W/kg

Table 2: Maximum Simultaneous SAR

Based on the worst-case data presented above, the Qollector Activity Monitor was found to be **compliant** with the 1.6 W/kg requirement for general population / uncontrolled exposure.

Modifications made to test sample

Intertek implemented no modifications.

3.0 TEST SITE DESCRIPTION

The SAR test site located at 731 Enterprise Drive, Lexington KY 40510 is comprised of the SPEAG model DASY 5.2 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3]. This system is installed in an ambient-free shielded chamber. The ambient temperature is controlled to 22.0 $\pm 2^{O}$C. During the SAR evaluations, the RF ambient conditions are monitored continuously for signals that might interfere with the test results. The tissue simulating liquid is also stored in this area in order to keep it at the same constant ambient temperature as the room.

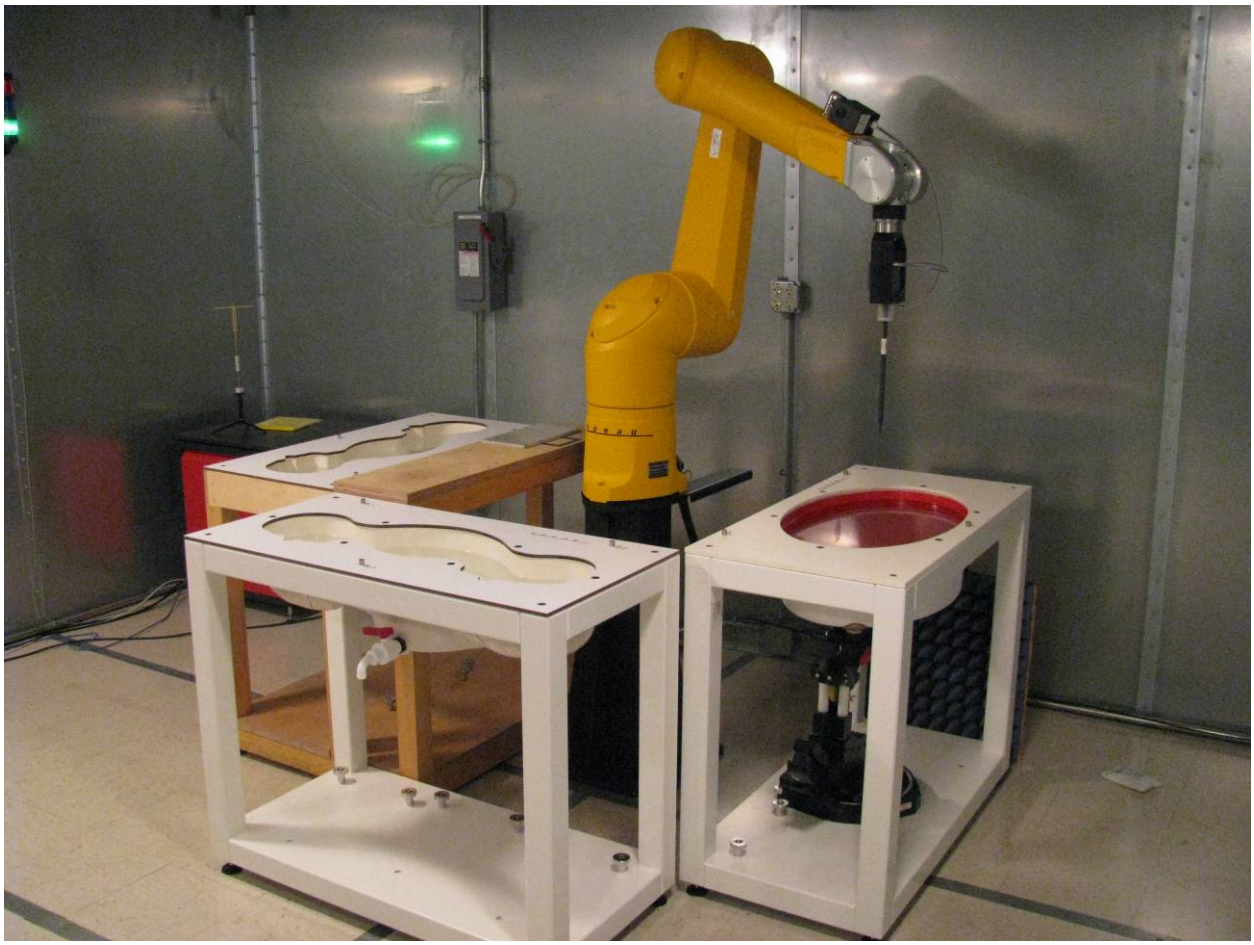

Figure 1: Intertek SAR Test Site

Measurement Equipment

The following major equipment/components were used for the SAR evaluation:

Description	Serial Number	Manufacture	Model	Cal. Date	Cal. Due	Eq. Used
SAR Probe	3516	Speag	EXDV3	12/12/14	12/12/15	☒
System Verification Dipole	4d122	Speag	D835V2	9/9/14	9/9/15	☒
System Verification Dipole	5d154	Speag	D1900V2	9/11/14	9/11/15	☒
System Verification Dipole	718	Speag	D2450V2	12/8/14	12/8/15	☒
DAE	358	Speag	DAE4	9/16/14	9/16/15	☒
Vector Signal Generator	257708	Rohde & Schwarz	SMBV100A	9/20/14	9/20/15	☒
Network Analyzer	US39173983	Agilent	8753ES	3/17/14	3/17/15	☒
USB Power Sensor	100155	Rohde & Schwarz	NRP-Z81	9/16/14	9/16/14	☒
USB Power Sensor	100705	Rohde & Schwarz	NRP-Z51	9/16/14	9/16/14	☒
Dielectric Probe Kit	1111	Speag	DAK-3.5	8/12/14	8/12/15	☒
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/15/14	9/15/15	☒
Base Station Simulator	119981	Rohde & Schwarz	CMU200	1/8/14	1/8/15	☒
SAM Twin Phantom	1663	Speag	QD 000 P40 C	NCR	NCR	☒
Oval Flat Phantom ELI 5.0	1108	Speag	QD OVA 002 A	NCR	NCR	☒
6-axis robot	F11/5H1YA/A/01	Staubli	RX-90	NCR	NCR	☒

NCR – No Calibration Required

Table 3: Test Equipment Used for SAR Evaluation

Measurement Uncertainty

The Table below includes the uncertainty budget suggested by the IEEE Std 1528-2003 and determined by SPEAG for the DASY5 measurement System.

Error Description	Uncertainty Value	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std.Unc. (1g)	Std.Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±5.5%	N	1	1	1	±5.5%	±5.5%	∞
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 Effect	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
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	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
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%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Standard Uncertainty						±10.7%	±10.5%	387
Expanded STD Uncertainty						**±21.4%**	**±21.0%**	

Notes.

1. Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2003. The budget is valid for the frequency range 300 MHz – 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.

Error Description	Uncertainty Value	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std.Unc. (1g)	Std.Unc. (10g)	(v_i) v_{eff}
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 Effect	±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%	∞
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	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Probe Positioning	±9.9%	R	√3	1	1	±5.7%	±5.7%	∞
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%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Standard Uncertainty						±12.8%	±12.8%	330
Expanded STD Uncertainty						**±25.6%**	**±25.2%**	

Notes.

Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2003. The budget is valid for the frequency range 3 GHz – 6 GHz and represents a worst-case analysis. Probe calibration error reflects uncertainty of the EX3D probe. For specific tests and configurations, the uncertainty could be considerably smaller.

4.0 JOB DESCRIPTION

At the request of SRAM, SAR testing was performed on the Qollector2.

Test sample	
Manufacturer	SRAM
Model Number	Qollector2
Serial Number	Not Labeled
Receive Date	12/17/14
Device Received Condition	Good
Device Category	Portable
RF Exposure Category	General Population/Uncontrolled Environment
Antenna Type	Internal
Test sample Accessories	
Accessory	None Provided

Table 4: Product Information

Operating Bands	Frequency Range (MHz)	Nominal Output Power (± Tolerance)	Duty Cycle
CDMA Cell	824.2 – 848.31MHz	24dBm (+1/-0.5dB)	1:1
CDMA PCS	1851.25 – 1908.75MHz	24dBm (+1/-0.5dB)	1:1

Table 5: Operating Bands

5.0 SYSTEM VERIFICATION

System Validation

Prior to the assessment, the system was verified to be within ±10% of the specifications by using the system validation kit. The system validation procedure tests the system against reference SAR values and the performance of probe, readout electronics and software. The test setup utilizes a phantom and reference dipole. The results from the system verifications with a dipole are shown in *Table 6.*

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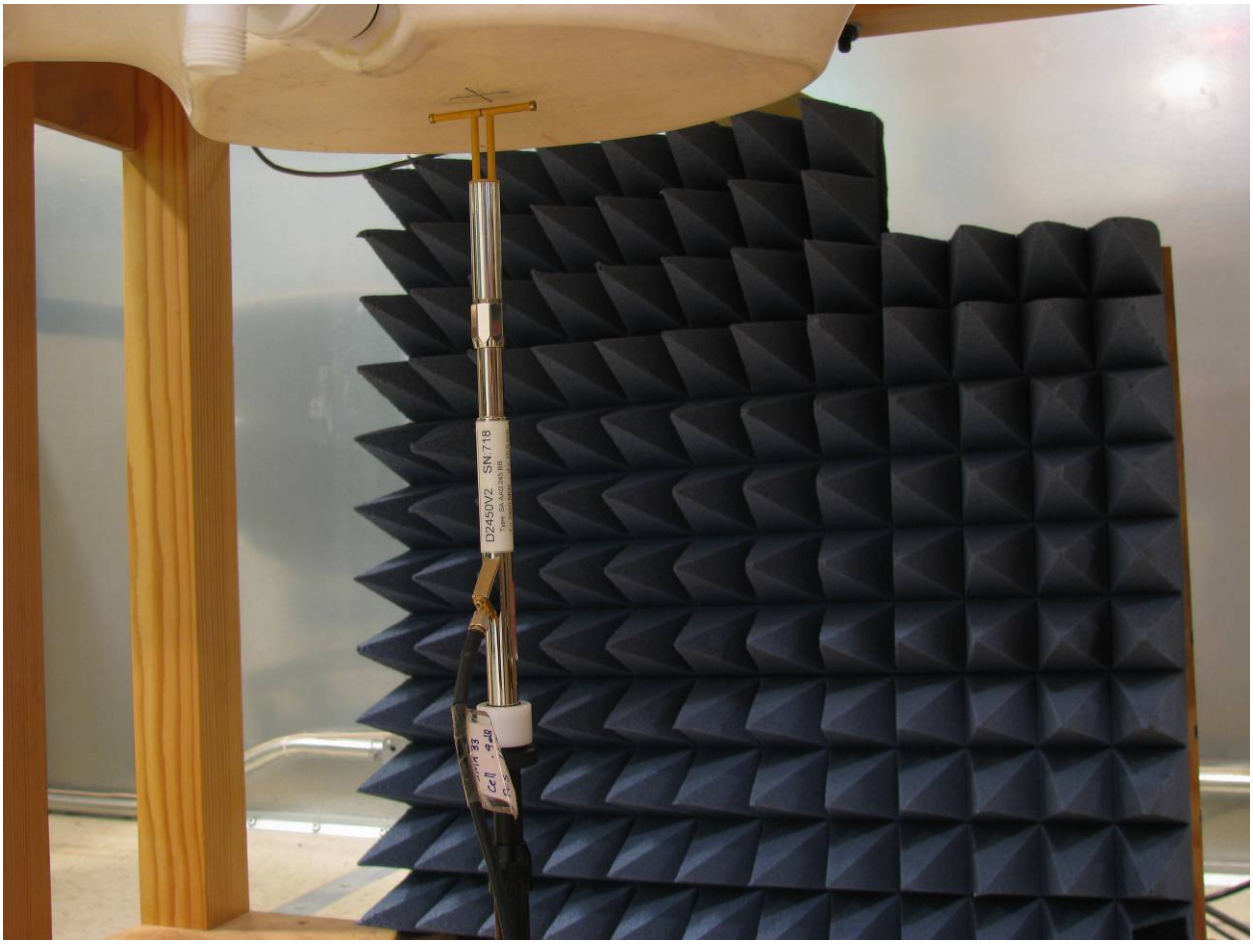


Figure 2: System Verification Setup

Reference Dipole Validation												
Ambient Temp (ºC)	Fluid Temp (ºC)	Frequency (MHz)	Dipole	Fluid Type	Dipole Power Input	Cal. Lab SAR (1g)	Cal. Lab SAR (10g)	Measured SAR (1g)	Measured SAR (10g)	% Error SAR (1g)	% Error SAR (10g)	Date
23.1	22.8	1900	D1900V2	MSL1900	1W	40.6	21.5	42.5	22.1	4.68	2.79	1/19/2015
22.7	22.9	835	D835V2	MSL 835	1W	9.41	6.16	9.73	6.47	3.40	5.03	1/19/2015
22.6	21.8	2450	D2450V2	MSL 2450	1W	50.6	23.6	54.5	24.9	7.71	5.51	1/16/2015

Table 6: Dipole Validations

Tissue Simulating Liquid Description and Validation

The dielectric parameters were verified to be within 5% of the target values prior to assessment. The dielectric parameters (ε_r, σ) are shown in Table 7. A recipe for the tissue simulating fluid used is shown in Table 8.

Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
	2405	52.77	1.95	50.53	15.12	2.02	4.24	3.67	1/16/15
	2450	52.7	1.95	50.38	15.01	2.04	4.40	4.85	1/16/15
MSL2400	2480	52.66	2	50.25	15.19	2.09	4.58	4.72	1/16/15

Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
	1850	53.3	1.52	50.97	15.01	1.53	4.37	0.66	1/19/15
	1880	53.3	1.52	50.87	15.1	1.55	4.56	1.97	1/19/15
MSL1900	1910	53.3	1.52	50.77	15.1	1.58	4.75	3.95	1/19/15

Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
	824	55.2	0.97	52.74	21.29	0.98	4.46	0.55	1/20/15
	836	55.2	0.97	52.52	21.28	0.99	4.86	1.96	1/20/15
MSL835	850	55.2	0.98	52.5	21.21	1.00	4.89	2.28	1/20/15

Table 7: Dielectric Parameter Validations

Table 8: Tissue Simulating Fluid Recipe

TYPICAL COMPOSITION OF INGREDIENTS FOR LIQUID TISSUE PHANTOMS. (450MHz to 2450 MHz data only)												
Ingredient (% by weight)	f (MHz)											
	450		835		915		1900		2450		5500	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56	54.9	70.45	62.7	68.64	65.53	78.67
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.36	0.5	0	0	0
Sugar	56.32	46.78	56	45	56.5	41.76	0	0	0	0	0	0
HEC	0.98	0.52	1	1	1	1.21	0	0	0	0	0	0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0	0	0	0	0	0
Triton X-100	0	0	0	0	0	0	0	0	36.8	0	17.235	10.665
DGBE	0	0	0	0	0	0	44.92	29.18	0	31.37	0	0
DGHE	0	0	0	0	0	0	0	0	0	0	17.235	10.665
Dielectric Constant	43.42	58	42.54	56.1	42	56.8	39.9	53.3	39.8	52.7		
Conductivity (S/m)	0.85	0.83	0.91	0.95	1	1.07	1.42	1.52	1.88	1.95		

Tissue Simulating Liquid for 5GHz, MBBL3500-5800V5 Manufactured by SPEAG (proprietary mixture)

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

6.0 EVALUATION PROCEDURES

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm ±0.2cm. The fluid parameters were verified and the dipole validation was performed as described in the previous sections.

Test Positions:

The Device was positioned against the SAM and flat phantom using the exact procedure described in IEEE Std 1528, IEC62209-2, and the Office of Engineering and Technology KDB 447498.

Reference Power Measurement:

The measurement probe was positioned at a fixed location above the reference point. A power measurement was made with the probe above this reference position so it could used for the assessing the power drift later in the test procedure.

Area Scan:

A coarse area scan was performed in order to find the approximate location of the peak SAR value. This scan was performed with the measurement probe at a constant height in the simulating fluid. A two dimensional spline interpolation algorithm was then used to determine the peaks and gradients within the scanned area. The area scan resolution conformed to the requirements of KDB 865664 as shown in Table 9.

Zoom Scan:

A zoom scan was performed around the approximate location of the peak SAR as determined from the area scan. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure. The zoom scan resolution conformed to the requirements of KDB 865664 as shown in Table 9.

			≤ 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.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Table 9: SAR Area and Zoom Scan Resolutions

Interpolation, Extrapolation and Detection of Maxima:

The probe is calibrated at the center of the dipole sensors which is located 1 to 2.7 mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated.

In DASY5, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and extrapolation routines. The interpolation, extrapolation and maximum search routines are all based on the modified Quadratic Shepard's method.

Thereby, the interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The DASY5 routines construct a once-continuously differentiable function that interpolates the measurement values as follows:

- For each measurement point a trivariate (3-D) / bivariate (2-D) quadratic is computed. It interpolates the measurement values at the data point and forms a least-square fit to neighboring measurement values.
- The spatial location of the quadratic with respect to the measurement values is attenuated by an inverse distance weighting. This is performed since the calculated quadratic will fit measurement values at nearby points more accurate than at points located further away.
- After the quadratics are calculated for at all measurement points, the interpolating function is calculated as a weighted average of the quadratics.

There are two control parameters that govern the behavior of the interpolation method. One specifies the number of measurement points to be used in computing the least-square fits for the local quadratics. These measurement points are the ones nearest the input point for which the quadratic is being computed. The second parameter specifies the number of measurement points that will be used in calculating the weights for the quadratics to produce the final function. The input data points used there are the ones nearest the point at which the interpolation is desired. Appropriate defaults are chosen for each of the control parameters.

The trivariate quadratics that have been previously computed for the 3-D interpolation and whose input data are at the closest distance from the phantom surface, are used in order to extrapolate the fields to the surface of the phantom.

In order to determine all the field maxima in 2-D (Area Scan) and 3-D (Zoom Scan), the measurement grid is refined by a default factor of 10 and the interpolation function is used to evaluate all field values between corresponding measurement points. Subsequently, a linear search is applied to find all the candidate maxima. In a last step, non-physical maxima are removed and only those maxima which are within 2 dB of the global maximum value are retained.

Averaging and Determination of Spatial Peak SAR

The interpolated data is used to average the SAR over the 1g and 10g cubes by spatially discretizing the entire measured volume. The resolution of this spatial grid used to calculate the averaged SAR is 1mm or about 42875 interpolated points. The resulting volumes are defined as cubical volumes containing the appropriate tissue parameters that are centered at the location. The location is defined as the center of the incremental volume.

The spatial-peak SAR must be evaluated in cubical volumes containing a mass that is within 5% of the required mass. The cubical volume centered at each location, as defined above, should be expanded in all directions until the desired value for the mass is reached, with no surface boundaries of the averaging volume extending beyond the outermost surface of the considered region. In addition, the cubical volume should not consist of more than 10% of air. If these conditions are not satisfied then the center of the averaging volume is moved to the next location. Otherwise, the exact size of the final sampling cube is found using an inverse polynomial approximation algorithm, leading to results with improved accuracy. If one boundary of the averaging volume reaches the boundary of the measured volume during its expansion, it will not be evaluated at all. Reference is kept of all locations used and those not used for averaging the SAR. All average SAR values are finally assigned to the centered location in each valid averaging volume.

All locations included in an averaging volume are marked to indicate that they have been used at least once. If a location has been marked as used, but has never been assigned to the center of a cube, the highest averaged SAR value of all other cubical volumes which have used this location for averaging is assigned to this location. Only those locations that are not part of any valid averaging volume should be marked as unused. For the case of an unused location, a new averaging volume must be constructed which will have the unused location centered at one surface of the cube. The remaining five surfaces are expanded evenly in all directions until the required mass is enclosed, regardless of the amount of included air. Of the six possible cubes with one surface centered on the unused location, the smallest cube is used, which still contains the required mass.

If the final cube containing the highest averaged SAR touches the surface of the measured volume, an appropriate warning is issued within the post processing engine.

Power Drift Measurement:

The probe was positioned at precisely the same reference point and the reference power measurement was repeated. The difference between the initial reference power and the final one is referred to as the power drift. The power drift measurement was used to assess the output power stability of the test sample throughout the SAR scan.

RF Ambient Activity:

During the entire SAR evaluation, the RF ambient activity was monitored using a spectrum analyzer with an antenna connected to it. The spectrum analyzer was tuned to the frequency of measurement and with one trace set to max hold mode. In this way, it was possible to determine if at any point during the SAR measurement there was an interfering ambient signal. If an ambient signal was detected, then the SAR measurement was repeated.

7.0 CRITERIA

The following FCC limits for SAR apply to portable devices operating in the General Population/Uncontrolled Exposure environment:

Exposure (General Population/Uncontrolled Exposure environment)	SAR (W/kg)
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

8.0 TEST CONFIGURATION

The Qollector2 can be operated and worn on the body using a necklace. Therefore SAR scans were performed on both the device positioned against the phantom with zero spacing. The test position is shown in Figure 3.

Testing was performed on the middle channel of each operating band first. When the 1g SAR exceeded 0.8W/kg on the middle channel, the low and high channels were also scanned.

The calculation for simultaneous transmission exclusion from KDB447498 was used to show that the measured 1g SAR from the cellular radio and ANT+ radio summed was less than the 1.6W/kg limit. See the test result section for this calculation.

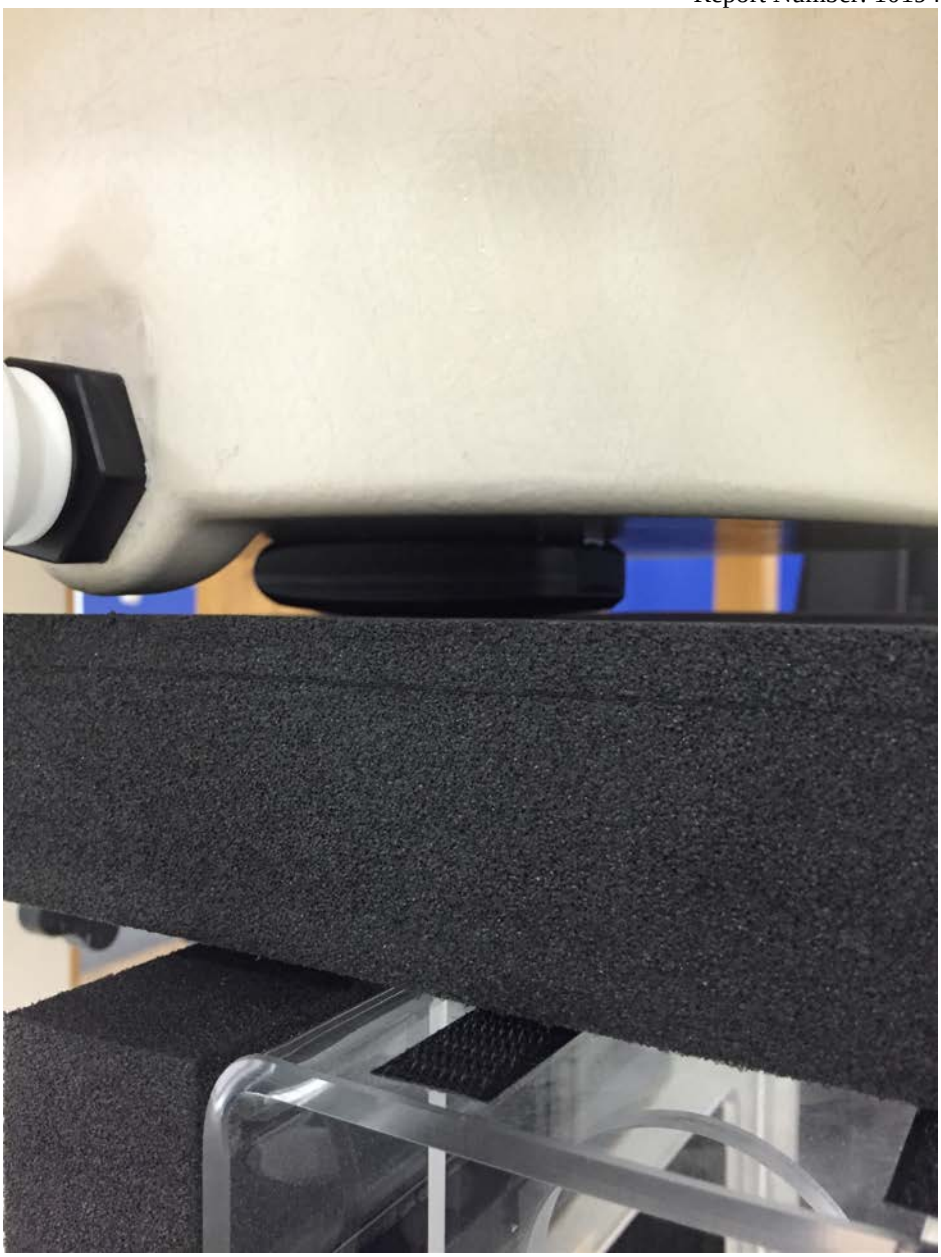


Figure 3: Front Test Position

9.0 TEST RESULTS

The results on the following page(s) were obtained when the device was transmitting at maximum output power. Detailed measurement data and plots, which reveal information about the location of the maximum SAR with respect to the device, are referenced are shown in separate exhibits presented with this application. The measured conducted output power was compared to the power declared by the manufacturer and used for scaling the measured SAR values.

The device was evaluated according to the specific requirements found in FCC KDB 447498[9]. The worst case 1-g SAR value for the cellular transmitter and ANT+ radio was less than the 1.6mW/g limit.

Repeatability measurements were not required since the scaled SAR values were less than 0.8W/kg.

The device is designed to use the cellular radio with a low duty factor. The worst case transmission duty factor is 5% with the device transmitting a maximum of 3 seconds and a worst case interval of 60 seconds. This duty factor is controlled by firmware and cannot be changed by the user.

Conducted Output Power Measurements:

Band	Channel	Frequency (MHz)	RC3/SO32 (+F-SCH)	RC3/SO32 (+SCH)
Cellular	1013	824.7	24.31	23.84
	384	836.52	24.39	23.9
	777	848.31	24.31	23.94
PCS	25	1851.25	23.75	23.31
	600	1880	23.75	23.22
	1175	1908.75	23.48	22.87

Table 10: Conducted Power Measurements

Standalone SAR Measurements:

Body Mode SAR Results Using 835MHz MSL											
Band	Channel	Frequency (MHz)	Mode	Position	Separation Distance (mm)	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Duty Factor Scaled Reported SAR 1g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
CDMA BC0	1013	824.70	1xRTT	Back	0	-0.09	2.12	2.49	**0.12**	24.31	25.00
CDMA BC0	384	836.52	1xRTT	Back	0	0.09	2.12	2.44	**0.12**	24.39	25.00
CDMA BC0	777	848.31	1xRTT	Back	0	0.00	2.10	2.46	**0.12**	24.31	25.00
1g SAR Limit = 1.6W/kg											

Table 11: CDMA Cell BCO SAR Results

Body Mode SAR Results Using 1900MHz MSL											
Band	Channel	Frequency (MHz)	Mode	Position	Separation Distance (mm)	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Duty Factor Scaled Reported SAR 1g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
CDMA BC1	25	1851.25	1xRTT	Back	0	-0.20	1.85	2.47	**0.12**	23.75	25.00
CDMA BC1	600	1880.00	1xRTT	Back	0	0.03	1.85	2.47	**0.12**	23.75	25.00
CDMA BC1	1175	1908.75	1xRTT	Back	0	-0.10	1.86	2.64	**0.13**	23.48	25.00
1g SAR Limit = 1.6W/kg											

Table 12: CDMA PCS BC1 SAR Results

Body Mode SAR Results Using 2450MHz MSL										
Band	Channel	Frequency (MHz)	Mode	Position	Separation Distance (mm)	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
2.4GHz	2	2402.00	ANT+	Back	0	-0.07	0.01	**0.02**	3.81	5.00
2.4GHz	40	2440.00	ANT+	Back	0	0.16	0.03	**0.04**	3.70	5.00
2.4GHz	80	2480.00	ANT+	Back	0	0.04	0.03	**0.04**	3.61	5.00
1g SAR Limit = 1.6W/kg										

Table 13: ANT+ SAR Results

Simultaneous Transmission Calculations (ANT+ and Cellular Radio):

Highest Reported SAR for ANT+ transmitter = 0.04W/kg

Highest Reported SAR for Cellular Radio = 0.13W/kg

Worst case simultaneous transmission 1-g SAR = 0.04W/kg + 0.13W/kg = 0.17W/kg

SAR Test Exclusions:

No standalone exclusions were used for this device. The SAR level for each transmitter was measured.

The sum of reported SAR levels for each transmitter that could operate simultaneously was << 1.6W/kg, therefore, simultaneous SAR measurements are not required.

10.0 REFERENCES

[1] ANSI, *ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz*, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992

[2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), FCC, Washington, D.C. 20554, 1997

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.

[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

[5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.

[6] Barry N. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

[7] Federal Communications Commission, KDG 248227 - "SAR Measurement Procedures for 802.11 a/b/g Transmitters"

[8] Federal Communications Commission, KDB 648474 – "SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas".

[9] Federal Communications Commission, KDB 447498 – "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies".

[10] Federal Communications Commission, KDB 616217 – "SAR Evaluation Considerations for Laptop Computers with Antennas Built-in on Display Screens".

[11] Federal Communications Commission, KDB 450824 – "SAR Probe Calibration and System Verification Considerations for Measurements at 150MHz – 3GHz".

[12] Federal Communications Commission, KDB 865664 – "SAR Measurement Requirements for 3-6GHz".

[13] Federal Communications Commission, KDB 941225 – "SAR Measurement Procedures for 3G Devices".

[14] ANSI, ANSI/IEEE C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices.

11.0 APPENDIX – WORST CASE SAR PLOTS

Date/Time: 1/19/2015 3:55:14 PM

Test Laboratory: Intertek
File Name: CDMA Cell Band.da52:4

CDMA Cell Band

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, Generic CDMA (0); Communication System Band: CDMA Cell Band; Frequency: 836.52 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 836.52 MHz; σ = 0.99 S/m; ε_r = 52.519; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

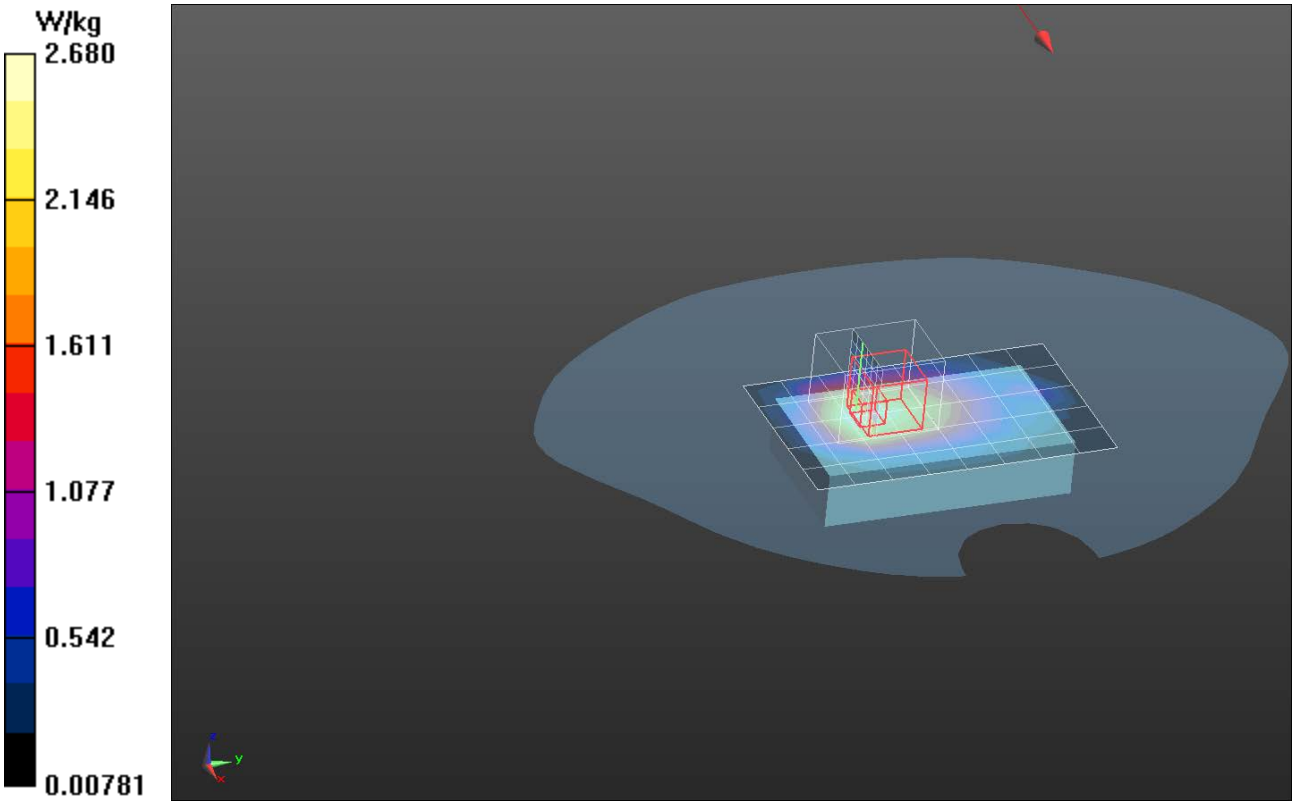
- Probe: EX3DV3 - SN3516; ConvF(10.51, 10.51, 10.51); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Mid Channel/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.68 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Mid Channel/Zoom Scan (7x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.16 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 3.41 W/kg
SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.43 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.92 W/kg


W/kg
2.680
2.146
1.611
1.077
0.542
0.00781

Date/Time: 1/19/2015 4:55:45 PM

Test Laboratory: Intertek
File Name: CDMA Cell Band.da52:4

CDMA Cell Band

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, Generic CDMA (0); Communication System Band: CDMA Cell Band; Frequency: 824.7 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 824.7 MHz; σ = 0.981 S/m; ε_r = 52.727; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

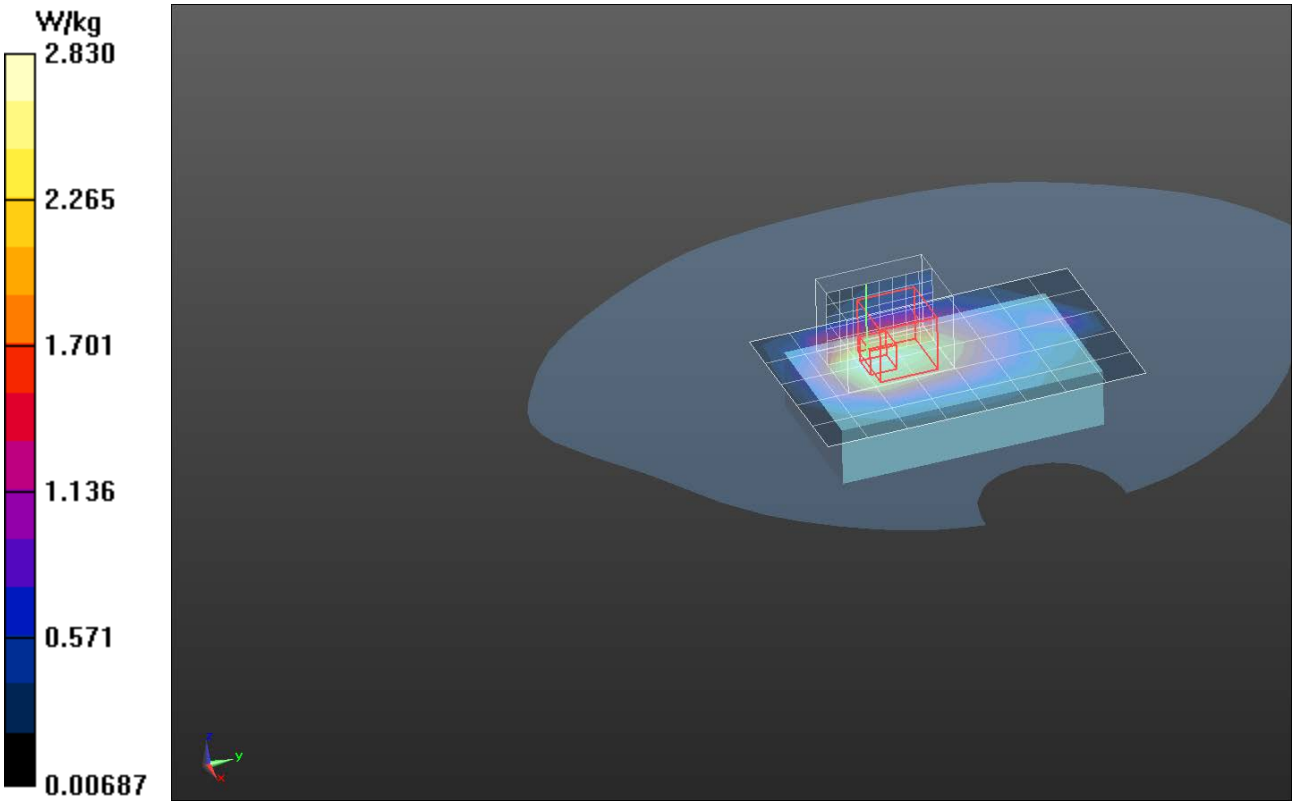
- Probe: EX3DV3 - SN3516; ConvF(10.51, 10.51, 10.51); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Low Channel/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.83 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Low Channel/Zoom Scan (7x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.61 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 3.33 W/kg
SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.45 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.86 W/kg


W/kg
2.830
2.265
1.701
1.136
0.571
0.00687

Date/Time: 1/19/2015 3:19:37 PM

Test Laboratory: Intertek
File Name: CDMA Cell Band.da52:4

CDMA Cell Band

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, Generic CDMA (0); Communication System Band: CDMA Cell Band; Frequency: 848.31 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 848.31 MHz; σ = 0.999 S/m; ε_r = 52.502; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

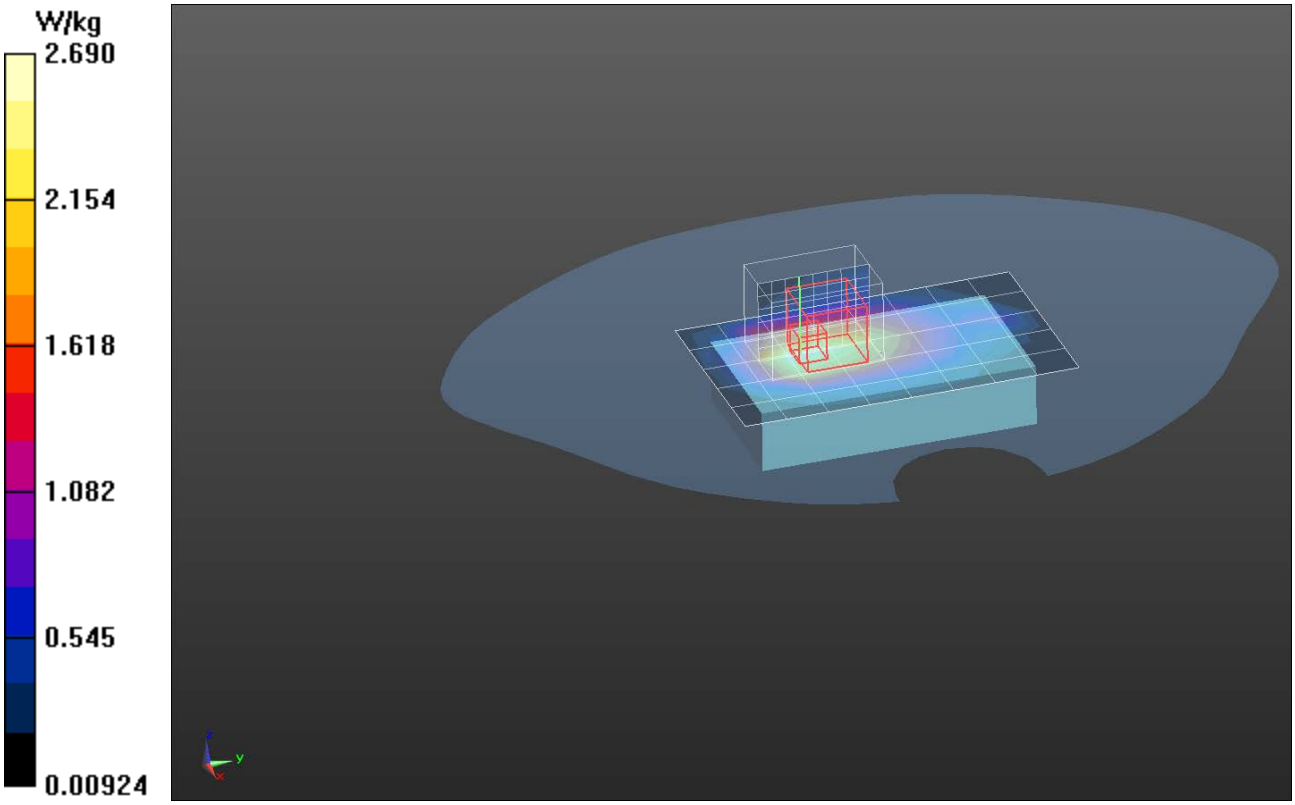
- Probe: EX3DV3 - SN3516; ConvF(10.51, 10.51, 10.51); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom High Channel/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.69 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom High Channel/Zoom Scan (7x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 45.23 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.37 W/kg
SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.42 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.88 W/kg


W/kg
2.690
2.154
1.618
1.082
0.545
0.00924

Date/Time: 1/19/2015 9:28:35 PM

Test Laboratory: Intertek
File Name: CDMA PCS.da52:4

CDMA PCS

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, Generic CDMA (0); Communication System Band: CDMA PCS Band; Frequency: 1880 MHz;Duty Cycle: 1:1

Medium parameters used: f = 1880 MHz; σ = 1.55 S/m; ε_r = 50.87; ρ = 1000 kg/m^3

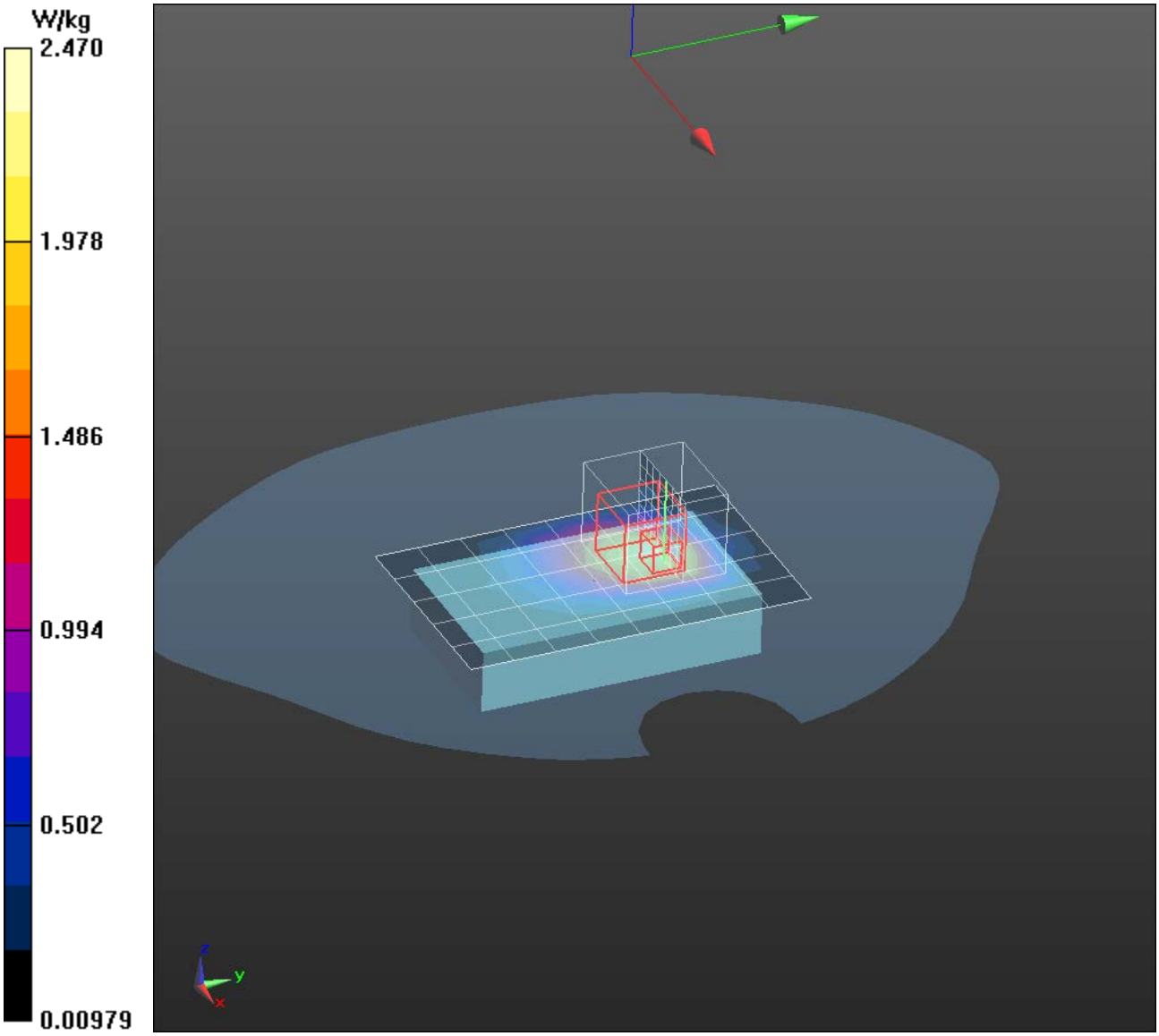
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.48, 8.48, 8.48); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Mid Channel 2/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.47 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Mid Channel 2/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 29.54 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.51 W/kg
SAR(1 g) = 1.85 W/kg; SAR(10 g) = 1.05 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 2.89 W/kg


W/kg
2.470
1.978
1.486
0.994
0.502
0.00979

Date/Time: 1/19/2015 10:34:32 PM

Test Laboratory: Intertek
File Name: CDMA PCS.da52:4

CDMA PCS

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, Generic CDMA (0); Communication System Band: CDMA PCS Band; Frequency: 1851.25 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 1851.25 MHz; σ = 1.531 S/m; ε_r = 50.966; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

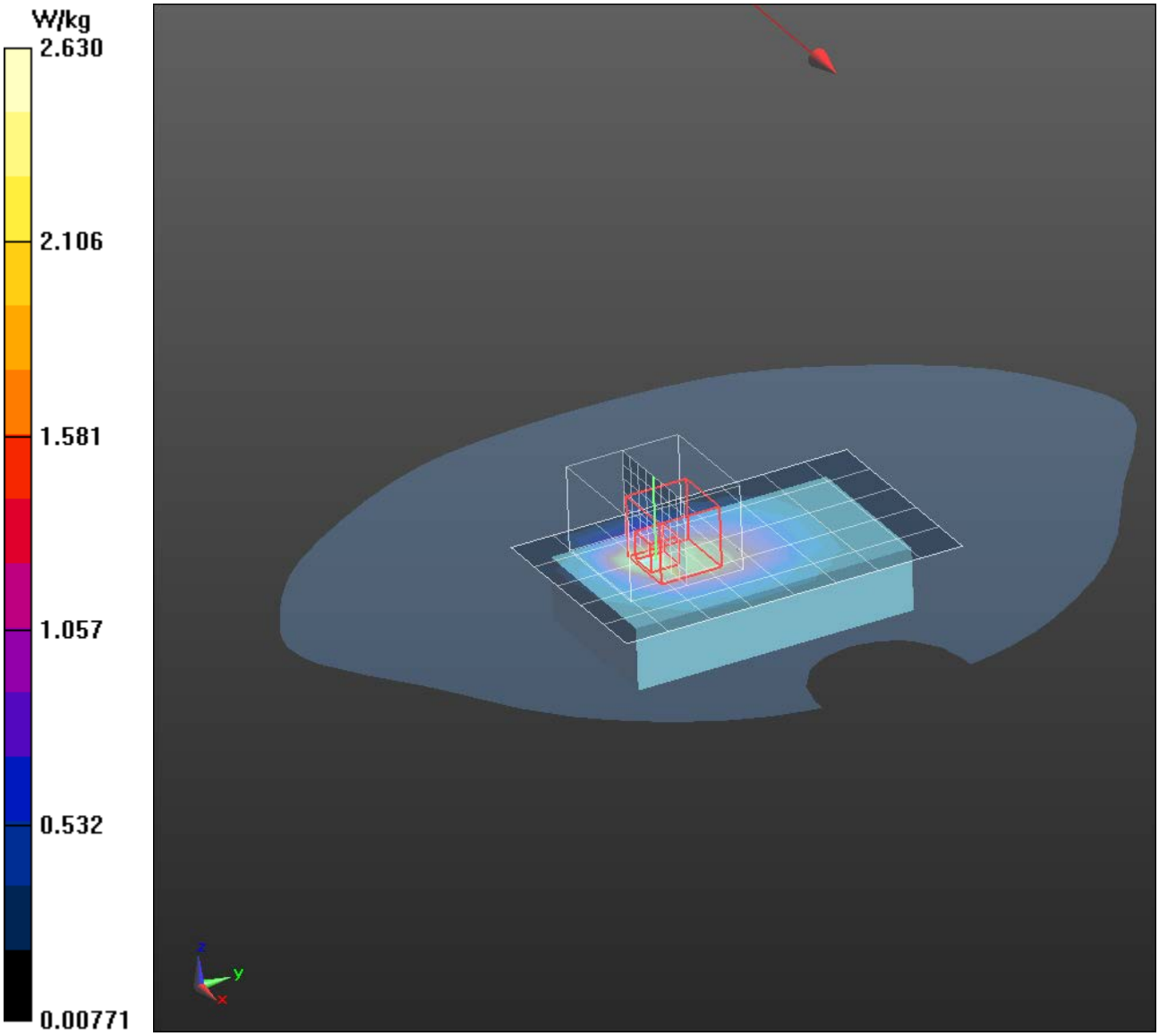
- Probe: EX3DV3 - SN3516; ConvF(8.48, 8.48, 8.48); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Low Channel 2/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.63 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Low Channel 2/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 30.35 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 3.55 W/kg
SAR(1 g) = 1.85 W/kg; SAR(10 g) = 1.04 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.93 W/kg


W/kg
2.630
2.106
1.581
1.057
0.532
0.00771

Date/Time: 1/20/2015 11:33:13 AM

Test Laboratory: Intertek
File Name: CDMA PCS.da52:4

CDMA PCS

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, Generic CDMA (0); Communication System Band: CDMA PCS Band; Frequency: 1908.75 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 1908.75 MHz; σ = 1.579 S/m; ε_r = 50.774; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

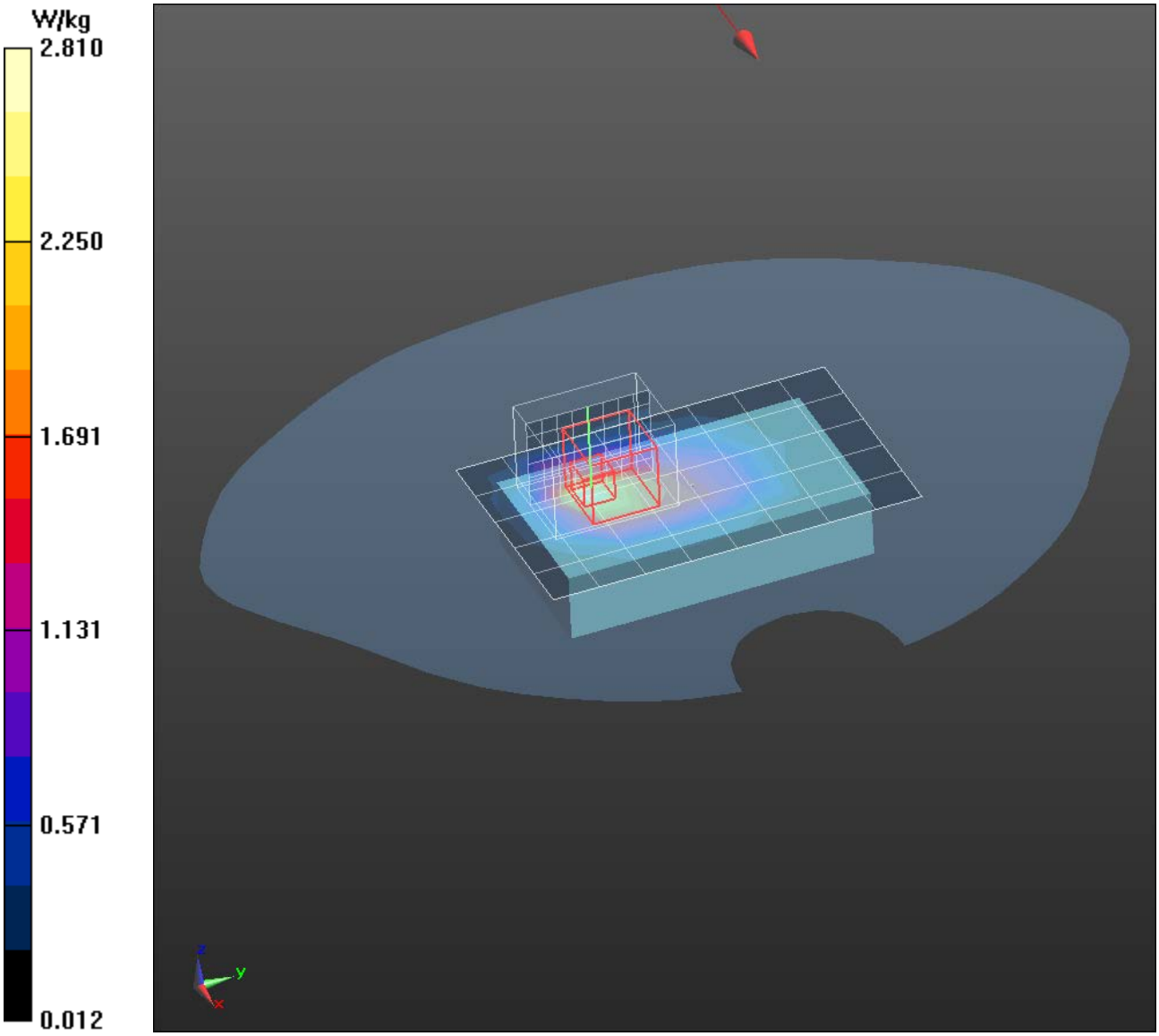
- Probe: EX3DV3 - SN3516; ConvF(8.48, 8.48, 8.48); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom High Channel 2/Area Scan (6x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.81 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom High Channel 2/Zoom Scan (7x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 30.43 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 3.57 W/kg
SAR(1 g) = 1.86 W/kg; SAR(10 g) = 1.03 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.91 W/kg


W/kg
2.810
2.250
1.691
1.131
0.571
0.012

Date/Time: 1/16/2015 7:35:32 PM

Test Laboratory: Intertek
File Name: ANT Radio.da52 run2.da52:4

ANT Radio.da52 run2

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, ANT+ (0); Communication System Band: 2.4GHz; Frequency: 2402 MHz;Duty Cycle: 1:1

Medium parameters used (extrapolated): f = 2402 MHz; σ = 2.019 S/m; ε_r = 50.518; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

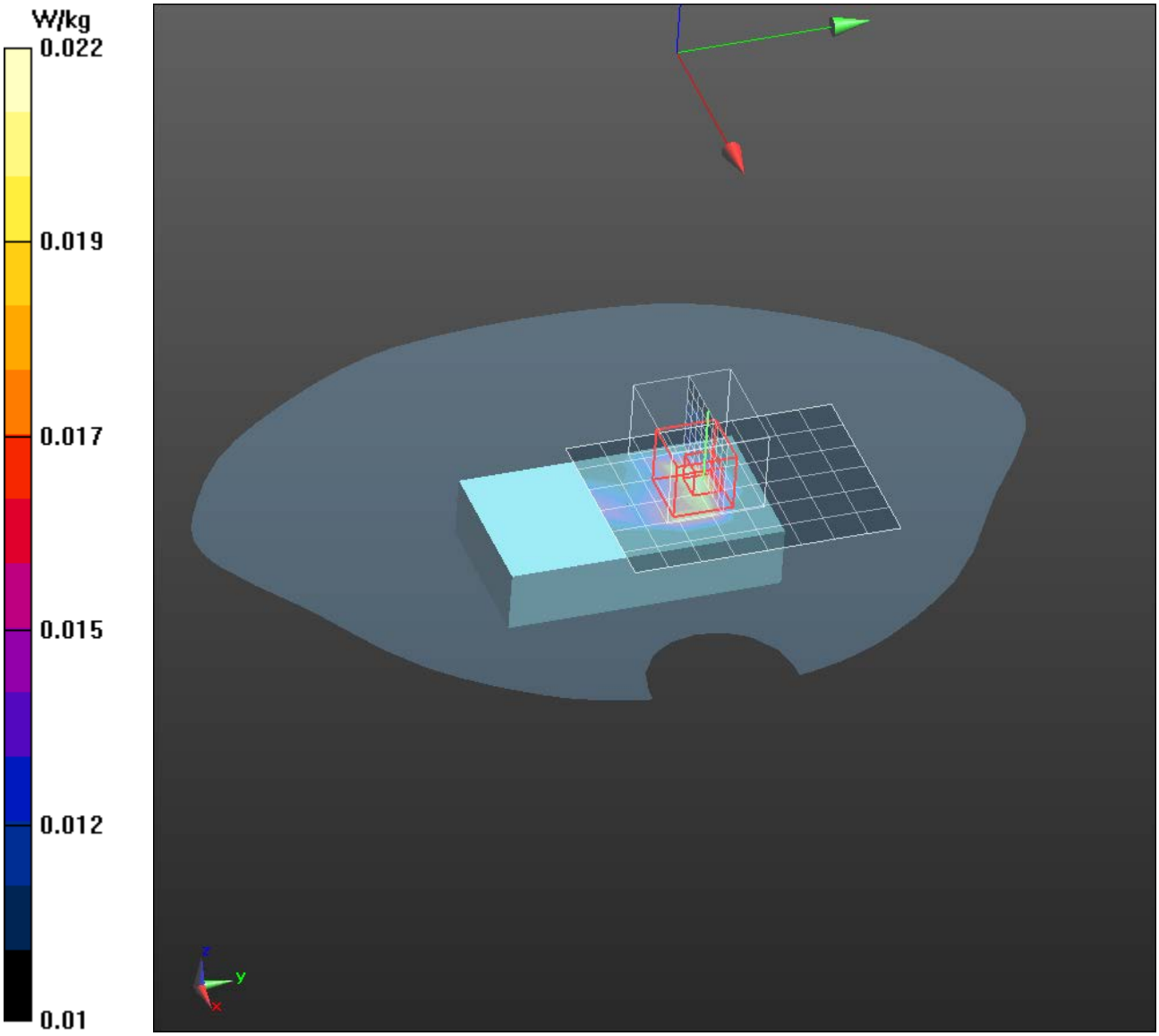
- Probe: EX3DV3 - SN3516; ConvF(7.98, 7.98, 7.98); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Low Channel/Area Scan (7x9x1): Measurement grid: dx=12mm, dy=12mm

Info: Extrapolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0215 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Low Channel/Zoom Scan (9x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.936 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.0340 W/kg
SAR(1 g) = 0.015 W/kg; SAR(10 g) = 0.0077 W/kg (SAR corrected for target medium)

Info: Extrapolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0250 W/kg


W/kg
0.022
0.019
0.017
0.015
0.012
0.01

Date/Time: 1/16/2015 9:35:44 PM

Test Laboratory: Intertek
File Name: ANT Radio.da52 run2.da52:4

ANT Radio.da52 run2

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, ANT+ (0); Communication System Band: 2.4GHz; Frequency: 2440 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 2440 MHz; σ = 2.036 S/m; ε_r = 50.67; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

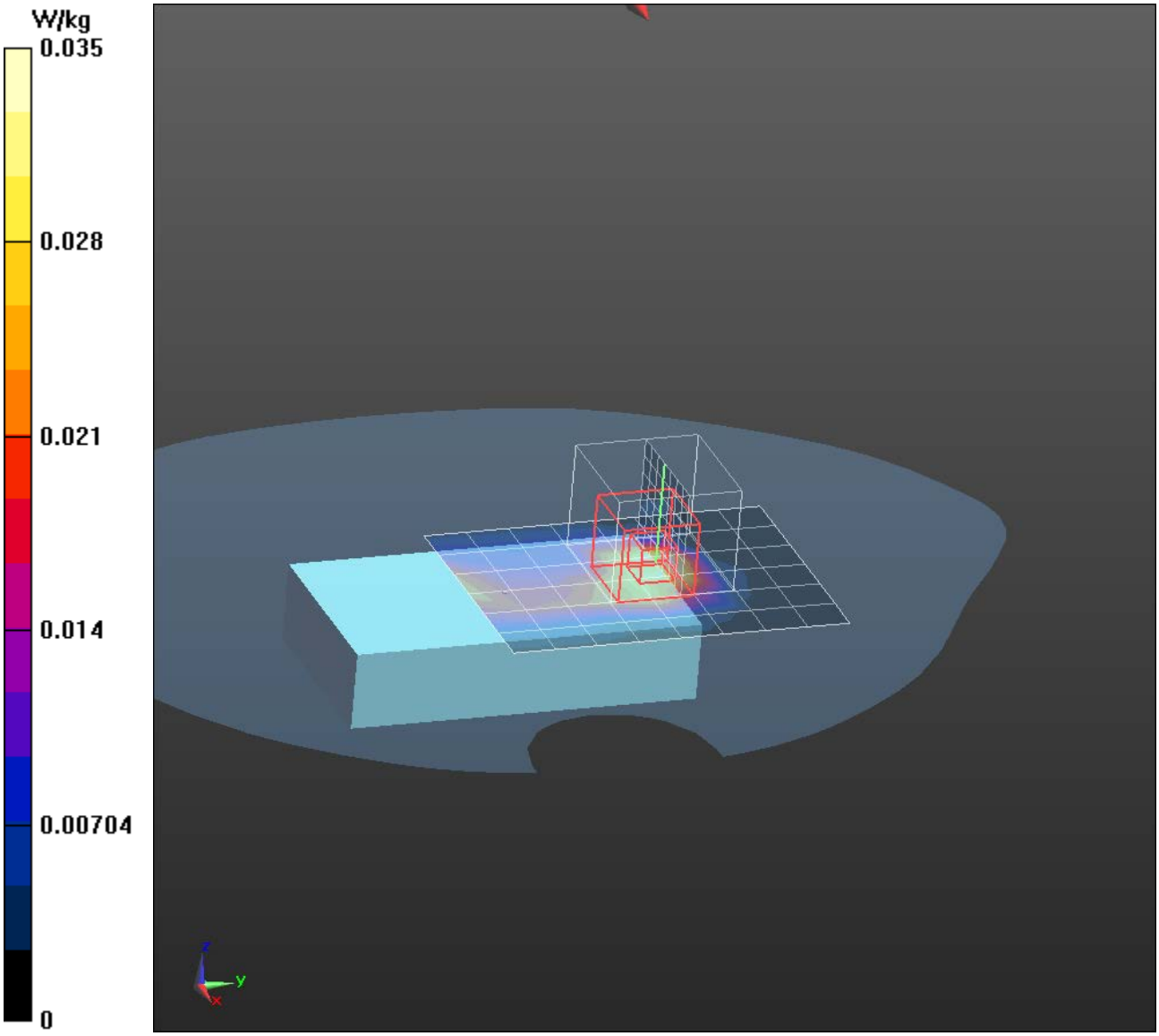
- Probe: EX3DV3 - SN3516; ConvF(7.98, 7.98, 7.98); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Mid Channel/Area Scan (7x9x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0352 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom Mid Channel/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.178 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 0.0650 W/kg
SAR(1 g) = 0.028 W/kg; SAR(10 g) = 0.013 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0473 W/kg


W/kg
0.035
0.028
0.021
0.014
0.00704
0

Date/Time: 1/16/2015 10:02:35 PM

Test Laboratory: Intertek
File Name: ANT Radio.da52 run2.da52:4

ANT Radio.da52 run2

Procedure Notes:

DUT: LogicPD; Serial: Not Specified

Communication System: UID 0, ANT+ (0); Communication System Band: 2.4GHz; Frequency: 2480 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2480 MHz; σ = 2.09 S/m; ε_r = 50.25; ρ = 1000 kg/m^3

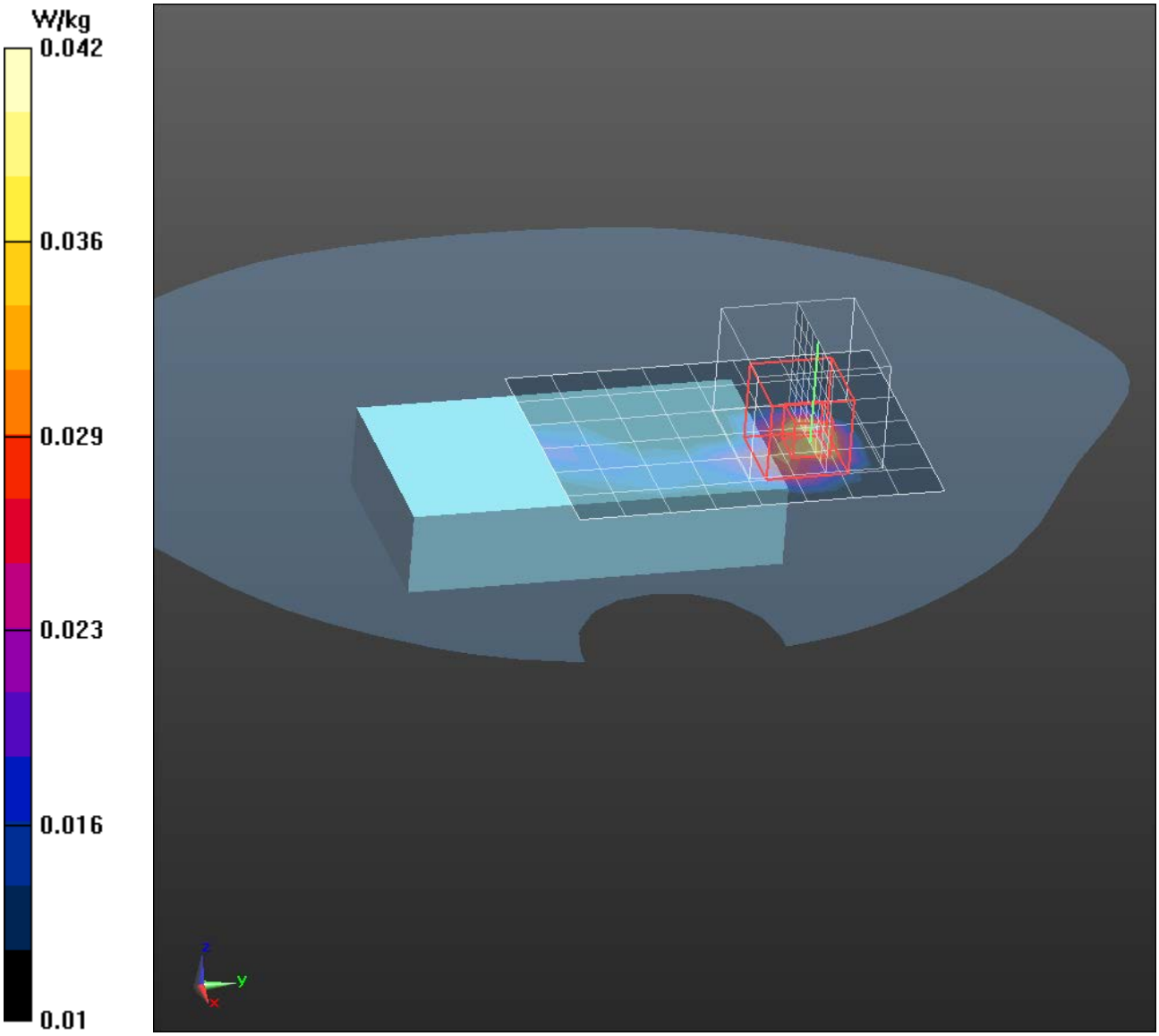
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(7.98, 7.98, 7.98); Calibrated: 12/12/2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom High Channel/Area Scan (7x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0420 W/kg

WWAN Flat-Section MSL Testing/Back Side of Device 0mm Away From Phantom High Channel/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.722 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.0660 W/kg
SAR(1 g) = 0.028 W/kg; SAR(10 g) = 0.014 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.0489 W/kg


W/kg
0.042
0.036
0.029
0.023
0.016
0.01

12.0 APPENDIX – DIPOLE VALIDATION PLOTS

Date/Time: 1/16/2015 10:52:11 AM

Test Laboratory: Intertek
File Name: 2450 MHz Dipole Validation.da52:2

2450 MHz Dipole Validation

Procedure Notes:

DUT: Dipole 2450 MHz D2450V2; Serial: D2450V2 - SN:xxx

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 2.04 S/m; ε_r = 50.71; ρ = 1000 kg/m^3

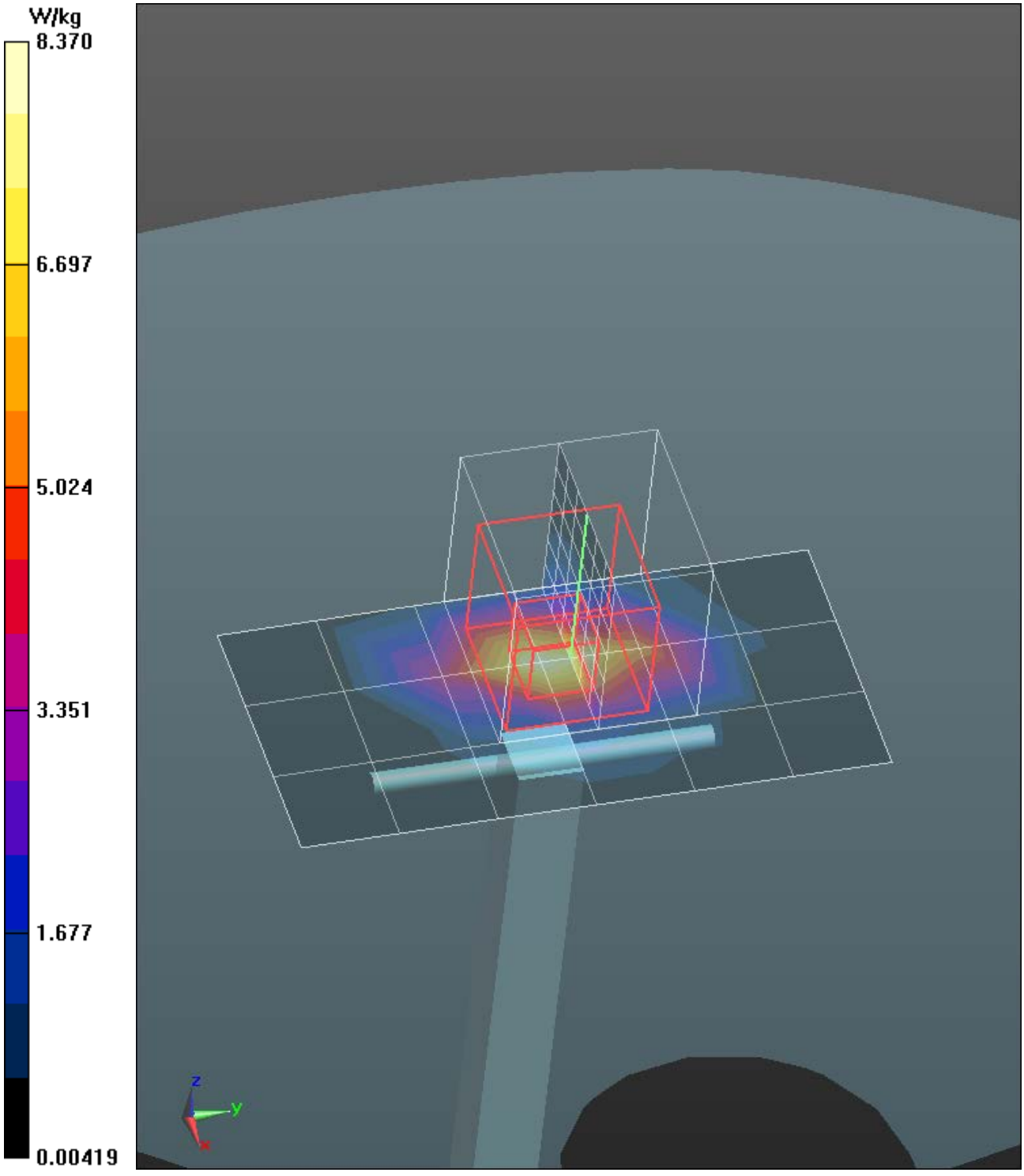
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(7.98, 7.98, 7.98); Calibrated: 12/12/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Area Scan (4x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 8.37 W/kg

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.18 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 115 W/kg
SAR(1 g) = 54.5 W/kg; SAR(10 g) = 24.9 W/kg (SAR corrected for target medium)
Normalized to target power = 1 W and actual power = 0.1 W
Maximum value of SAR (measured) = 83.3 W/kg


W/kg
8.370
6.697
5.024
3.351
1.677
0.00419
z
y
x

Date/Time: 1/19/2015 10:04:23 AM

Test Laboratory: Intertek
File Name: 835MHz Dipole Validation.da52:0

835MHz Dipole Validation

Procedure Notes: Ambient Temp: 22.8C, Fluid Temp: 22.2C

DUT: Dipole 835 MHz D835V2; Serial: D835V2 - SN:4d122

Communication System: UID 10000, CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 835 MHz; σ = 0.989 S/m; ε_r = 52.538; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

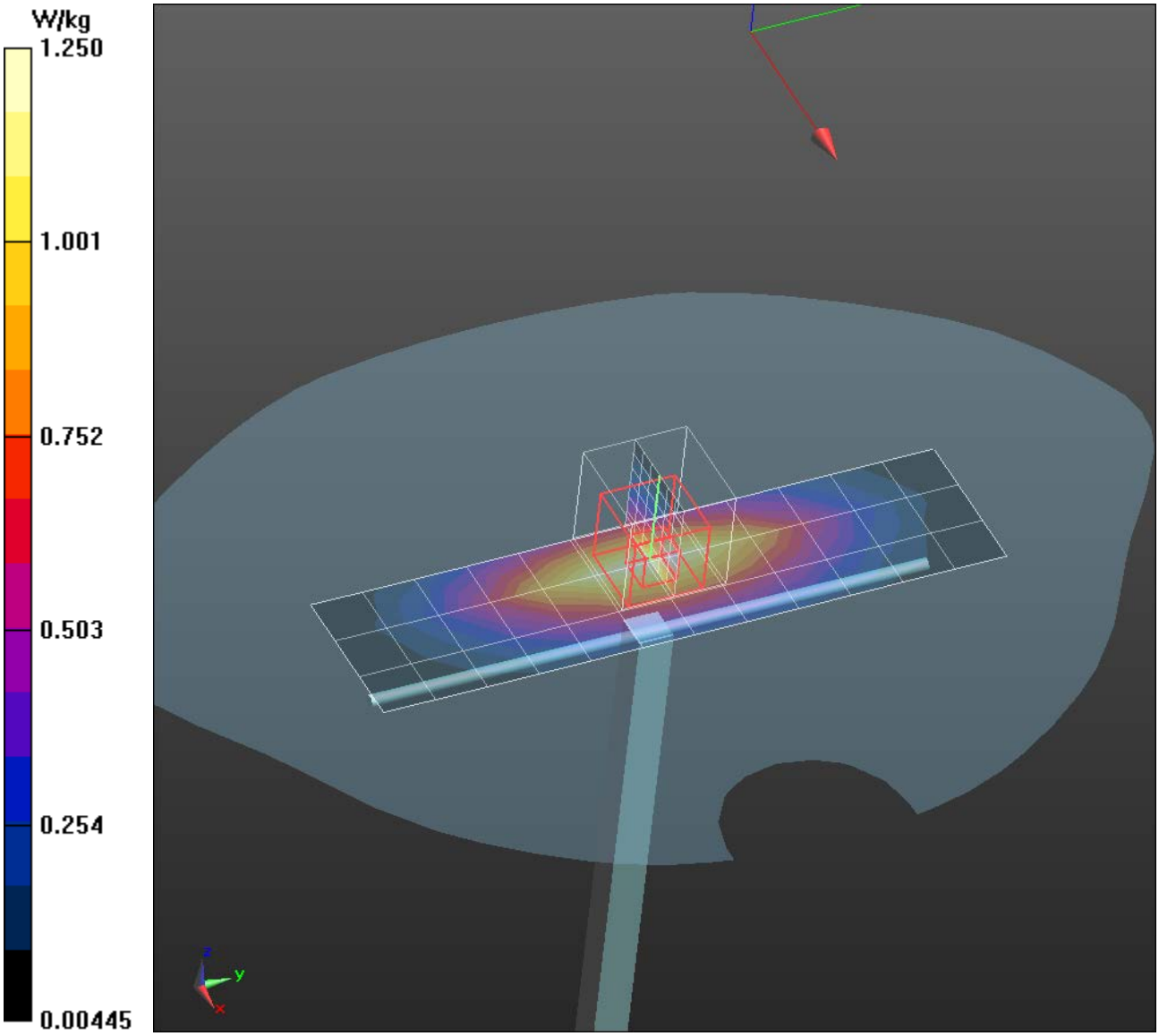
- Probe: EX3DV3 - SN3516; ConvF(10.51, 10.51, 10.51); Calibrated: 12/12/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=100 mW, dist=2.0mm (EX-Probe)/Area Scan (4x13x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.25 W/kg

System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=100 mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 35.69 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 14.7 W/kg
SAR(1 g) = 9.73 W/kg; SAR(10 g) = 6.47 W/kg (SAR corrected for target medium)
Normalized to target power = 1 W and actual power = 0.1 W

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 10.8 W/kg


W/kg
1.250
1.001
0.752
0.503
0.254
0.00445

Date/Time: 1/19/2015 5:49:21 PM

Test Laboratory: Intertek
File Name: 1900 MHz Dipole Validation.da52:2

1900 MHz Dipole Validation

Procedure Notes:

DUT: Dipole 1900 MHz D1900V2; Serial: D1900V2 - SN:xxx

Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 1900 MHz; σ = 1.57 S/m; ε_r = 50.803; ρ = 1000 kg/m^3

Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

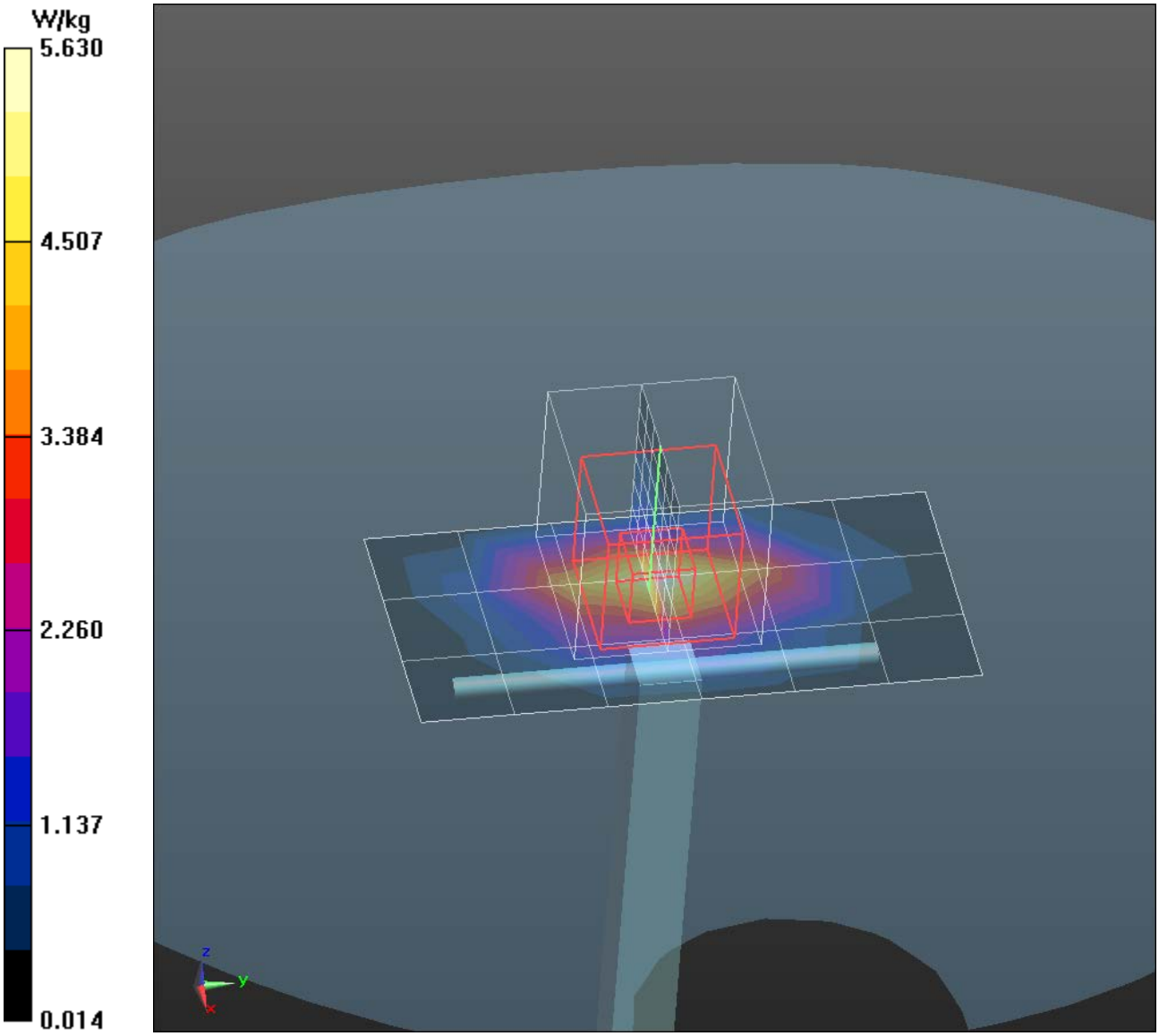
- Probe: EX3DV3 - SN3516; ConvF(8.48, 8.48, 8.48); Calibrated: 12/12/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/16/2014
- Phantom: SAM 2 with CRP v5.0; Type: QD000P40CD; Serial: TP:1663
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Area Scan (4x7x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 5.63 W/kg

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 62.65 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 77.0 W/kg
SAR(1 g) = 42.5 W/kg; SAR(10 g) = 22.1 W/kg (SAR corrected for target medium)
Normalized to target power = 1 W and actual power = 0.1 W

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 60.8 W/kg


W/kg
5.630
4.507
3.384
2.260
1.137
0.014

13.0 APPENDIX – DESCRIPTION OF THE PHANTOMS USED FOR TESTING

Schmid & Partner Engineering AG
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info@speag.com, http://www.speag.com

Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 5.0
Type No	QD OVA 002 A
Series No	1108 and higher
Manufacturer	Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland

Tests
Complete tests were made on the prototype units QD OVA 001 A, pre-series units QD OVA 001 B as well as on some series units QD OVA 001 B. Some tests are made on all series units QD OVA 002 A.

Test	Requirement	Details	Units tested
Shape	Internal dimensions, depth and sagging are compatible with standards	Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for f > 375 MHz	Prototypes
Material thickness	Bottom: 2.0mm +/- 0.2mm	dimension compliant with [3] for f > 800 MHz	all
Material parameters	rel. permittivity 2 – 5, loss tangent ≤ 0.05, at f ≤ 6 GHz	rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05	Material samples
Material resistivity	Compatibility with tissue simulating liquids .	Compatible with SPEAG liquids. **	Phantoms, Material sample
Sagging	Sagging of the flat section in tolerance when filled with tissue simulating liquid.	within tolerance for filling height up to 155 mm	Prototypes, samples

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

Standards
[1] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
[2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
[3] IEC 62209–1 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", 2005-02-18
[4] IEC 62209–2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", 2010-03-30

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

Date 25.7.2011

Signature / Stamp

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Certificate of Conformity / First Article Inspection

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

Tests

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

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

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

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

Standards

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

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

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

[4] IEC 62209–2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", 2010-03-30

Conformity

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

Date 25.07.2011

Signature / Stamp

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