

TEST REPORT

Report Number: 100810573LEX-001

Project Number: G100810573

Evaluation of Model Number: 8GB

FCCID: CKD-00053

ICID: 10240A-00053

**Tested to the SAR Criteria in
FCC OET Bulletin 65, Supplement C (Edition 01-01)
Industry Canada RSS-102 Issue 4**

For

Livescribe, Inc.

Test Performed by:

Intertek
731 Enterprise Drive
Lexington, KY 40510

Test Authorized by:

Livescribe, Inc.
7677 Oakport St. 12th Floor
Oakland, CA 94621

Prepared By: Jason Centers **Date:** 10/20/12

Jason Centers, Senior Project Engineer

Approved By: James T. Sudduth **Date:** 10/20/12

James Sudduth, Senior Staff Engineer

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TABLE OF CONTENTS

1.0 DOCUMENT HISTORY 3

2.0 INTRODUCTION..... 4

 MODIFICATIONS MADE TO TEST SAMPLE 4

3.0 TEST SITE DESCRIPTION..... 5

 MEASUREMENT EQUIPMENT 6

 MEASUREMENT TRACEABILITY 6

 MEASUREMENT UNCERTAINTY 7

4.0 JOB DESCRIPTION 9

5.0 SYSTEM VERIFICATION 10

 SYSTEM VALIDATION..... 10

 TISSUE SIMULATING LIQUID DESCRIPTION AND VALIDATION 11

6.0 EVALUATION PROCEDURES 12

 TEST POSITIONS: 12

 REFERENCE POWER MEASUREMENT: 12

 AREA SCAN: 12

 ZOOM SCAN: 12

 INTERPOLATION, EXTRAPOLATION AND DETECTION OF MAXIMA: 13

 POWER DRIFT MEASUREMENT: 14

 RF AMBIENT ACTIVITY:..... 14

7.0 TEST CONFIGURATION..... 15

8.0 CRITERIA..... 19

9.0 TABULAR TEST RESULTS..... 20

 CONDUCTED POWER MEASUREMENTS 20

 BODY MODE SAR TEST RESULTS..... 21

10.0 REFERENCES 22

11.0 APPENDIX A – SAR PLOTS 23

12.0 APPENDIX B – SYSTEM VERIFICATION PLOTS 31

1.0 DOCUMENT HISTORY

Revision/ Project Number	Writer Initials	Date	Change
1.0 /G100810573	JC	10/20/12	Original document

2.0 INTRODUCTION

At the request of Livescribe, Inc., the SKY WiFi Smartpen 8GB was evaluated for SAR in accordance with the requirements of RF Exposure compliance testing defined in FCC OET Bulletin 65, Supplement C (Edition 01-01). 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 $\pm 21.4\%$.

The SKY WiFi Smartpen 8GB was tested at the maximum output power measured by Intertek. Maximum output power measurements are tabulated under Section 9.0 Tabular 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)	Average Conducted Output Power (dBm)	SAR _{1g} – Body Mode (W/kg)	Limit (W/kg)
2412-2463	802.11b/1Mbps	6	2437.0	17.68	0.57	1.6

Table 1: Maximum Measured SAR

Based on the worst-case data presented above, the SKY WiFi Smartpen 8GB was found to be **compliant** with the 1.6 mW/g requirement defined in OET Bulletin 65, Supplement C (Edition 01-01) 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 $22.0 \pm 2^{\circ}\text{C}$. 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.

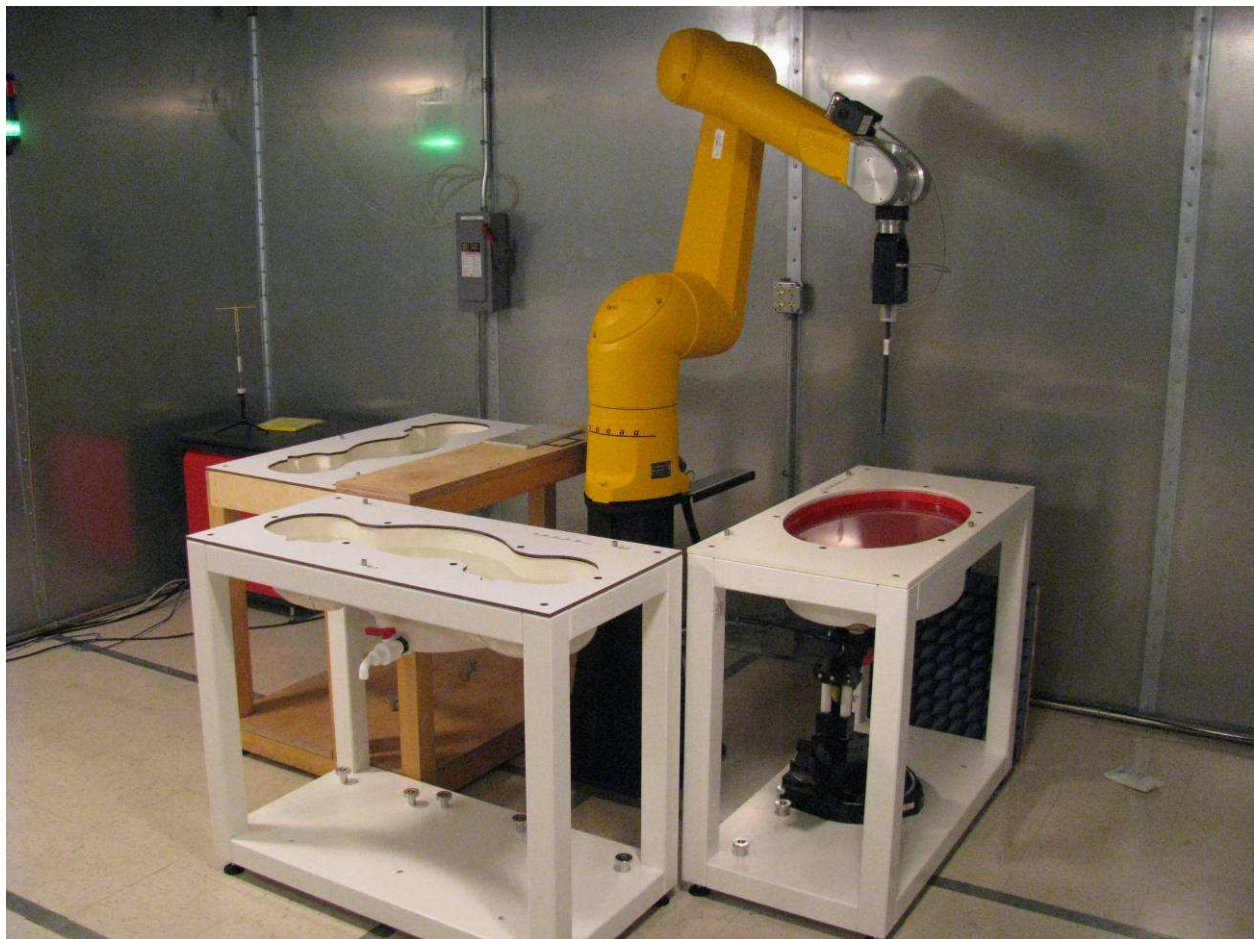


Figure 1: Intertek SAR Test Site

Measurement Equipment

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

Description	Serial Number	Manufacture	Model	Cal. Date	Cal. Due
SAR Probe	3516	Speag	EXDV3	12/14/11	12/14/12
System Verification Dipole	1042	Speag	D750V3	9/12/11	9/12/12
System Verification Dipole	4d122	Speag	D835V2	9/20/11	9/20/12
System Verification Dipole	13	Speag	D900V2	12/7/11	12/7/12
System Verification Dipole	224	Speag	D1800V2	12/9/11	12/9/12
System Verification Dipole	718	Speag	D2450V2	12/9/11	12/9/12
System Verification Dipole	1025	Speag	D5GHzV2	12/14/11	12/14/12
DAE	358	Speag	DAE4	9/15/11	9/15/12
Signal Generator	US37040988	Hewlett Packard	ESG-D3000A	11/29/11	11/29/12
Network Analyzer	US39173983	Agilent	8753ES	11/22/11	11/22/12
Power Meter	1838538	Gigatronics	8542C	9/23/11	9/23/12
Power Sensor	1830320	Gigatronics	80601A	9/23/11	9/23/12
USB Power Sensor	100705	Rohde & Schwarz	NRP-Z51	9/9/11	9/9/12
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/23/11	9/23/12
Dielectric Probe Kit	3080	Agilent	85070D	NCR	NCR
ELI5 Phantom	1144	Speag	QDOVA002AA	NCR	NCR
Twin SAM Phantom	1663	Speag	QD000P40CD	NCR	NCR
Twin SAM Phantom	1243	Speag	QD000P40CA	NCR	NCR
6-axis robot	F11/5H1YA/A/01	Staubli	RX-90	NCR	NCR

NCR – No Calibration Required

Table 2: Test Equipment Used for SAR Evaluation

Measurement Traceability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

Measurement Uncertainty

The Table below includes the uncertainty budget suggested by the IEEE Std 1528-2003 and determined by SPEAG for the DASY522 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 DASY52 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 DASY522 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 Livescribe, Inc., the SKY WiFi Smartpen 8GB was evaluated to the requirements defined in OET Bulletin 65, Supplement C (Edition 01-01).

The SKY WiFi Smartpen, models: 2GB, 4GB and 8GB, have identical radio sections, cables and housing. The only difference between the models is a minor change in the non-radio section. The only difference between the three models is memory size. All radio tests were performed on the model: 8GB only; however, the test results are also applicable to the 2GB and 4GB models

Test sample	
Manufacturer	Livescribe, Inc.
Model Number	8GB
Serial Number	MPK1206011617-001
Receive Date	8/31/2012
Test Start Date	8/31/2012
Test End Date	9/1/2012
Device Received Condition	Good
Device Category	Portable
RF Exposure Category	General Population/Uncontrolled Environment
Antenna Type	Integral
Contact Information	
Contact Name	Thomas Davenport
Phone Number	(510) 553-4925
Email Address	tdavenport@livescribe.com

Table 3: Product Information

Operating Bands	Frequency Range (MHz)	Modulation	Maximum Output Power (dBm)	Duty Cycle
2.4GHz ISM	2412-2462	802.11 b/g/n	17.76	1:1

Table 4: Operating Bands

5.0 SYSTEM VERIFICATION

System Validation

Prior to the assessment, the system was verified to be within $\pm 10\%$ 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 a reference dipole. The results from the daily system verifications with a dipole are shown in Table 5.



Figure 2: System Verification Setup

Reference Dipole Validation									
Ambient Temp (°C)	Fluid Temp (°C)	Frequency (MHz)	Dipole	Fluid Type	Dipole Power Input	Cal. Lab SAR (1g)	Measured SAR (1g)	% Error SAR (1g)	Date
23.4	22.9	2450	D2450V2	MSL2450	1W	53.9	51.2	5.01	8/31/12
23.1	23.2	2450	D2450V2	MSL2450	1W	53.9	51.6	4.27	9/1/12

Table 5: Dipole Validation

Tissue Simulating Liquid Description and Validation

The dielectric parameters were verified to be within 5% of the target values each day prior to assessment. The dielectric parameters (ϵ_r , σ) are shown in Table 6. A recipe for the tissue simulating fluid used is shown in Table 7.

Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Dielectric Constant Target	Conductivity Target	Dielectric Constant Measure	Imaginary Part	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
2450MSL	2400	52.77	1.95	51.69	14.03	1.87	2.05	4.00	8/31/12
	2450	52.7	1.95	51.53	14.25	1.9410	2.22	0.46	8/31/12
	2480	52.66	1.95	51.41	14.37	1.9813	2.37	1.60	8/31/12

Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Dielectric Constant Target	Conductivity Target	Dielectric Constant Measure	Imaginary Part	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
2450MSL	2400	52.77	1.95	51.49	14.07	1.88	2.43	3.73	9/1/12
	2450	52.7	1.95	51.28	14.26	1.9423	2.69	0.39	9/1/12
	2480	52.66	1.95	51.09	14.4	1.9854	2.98	1.82	9/1/12

Table 6: Dielectric Parameter Validation

TYPICAL COMPOSITION OF INGREDIENTS FOR LIQUID TISSUE PHANTOMS, Supplement C Edition 01-01 to OET Bulletin 65 Edition 97-01, Page 36. (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		

Table 7: Tissue Simulating Fluid Recipe

6.0 EVALUATION PROCEDURES

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm \pm 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 Supplement C Edition 01 – 01 of Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C. 20554, 1997.

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 be used for assessing the power drift later in the test procedure.

Area Scan:

A coarse area scan with a horizontal grid spacing of 15 x 15 mm 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.

Zoom Scan:

A zoom scan was performed around the approximate location of the peak SAR as determined from the area scan. The zoom scan was comprised of a measurement volume of 30 x 30 x 30 mm based on 7 x 7 x 7 points with a step size of 5mm. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

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 DASY52, 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 DASY52 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 postprocessing 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:

The SAR evaluation was performed in an ambient free RF shielded enclosure.

7.0 TEST CONFIGURATION

For the purpose of this evaluation, the 8GB was considered to be a device that could be operated when held against the body. All SAR scans were performed with a freshly charged battery installed.

The test channels and operating modes were selected using software based test commands for the evaluation of the WLAN radio. The device was positioned against the bottom of the phantom with zero clearance during the evaluation. A photograph of the 8GB, as positioned for testing, is shown in Figure 3 through Figure 6.

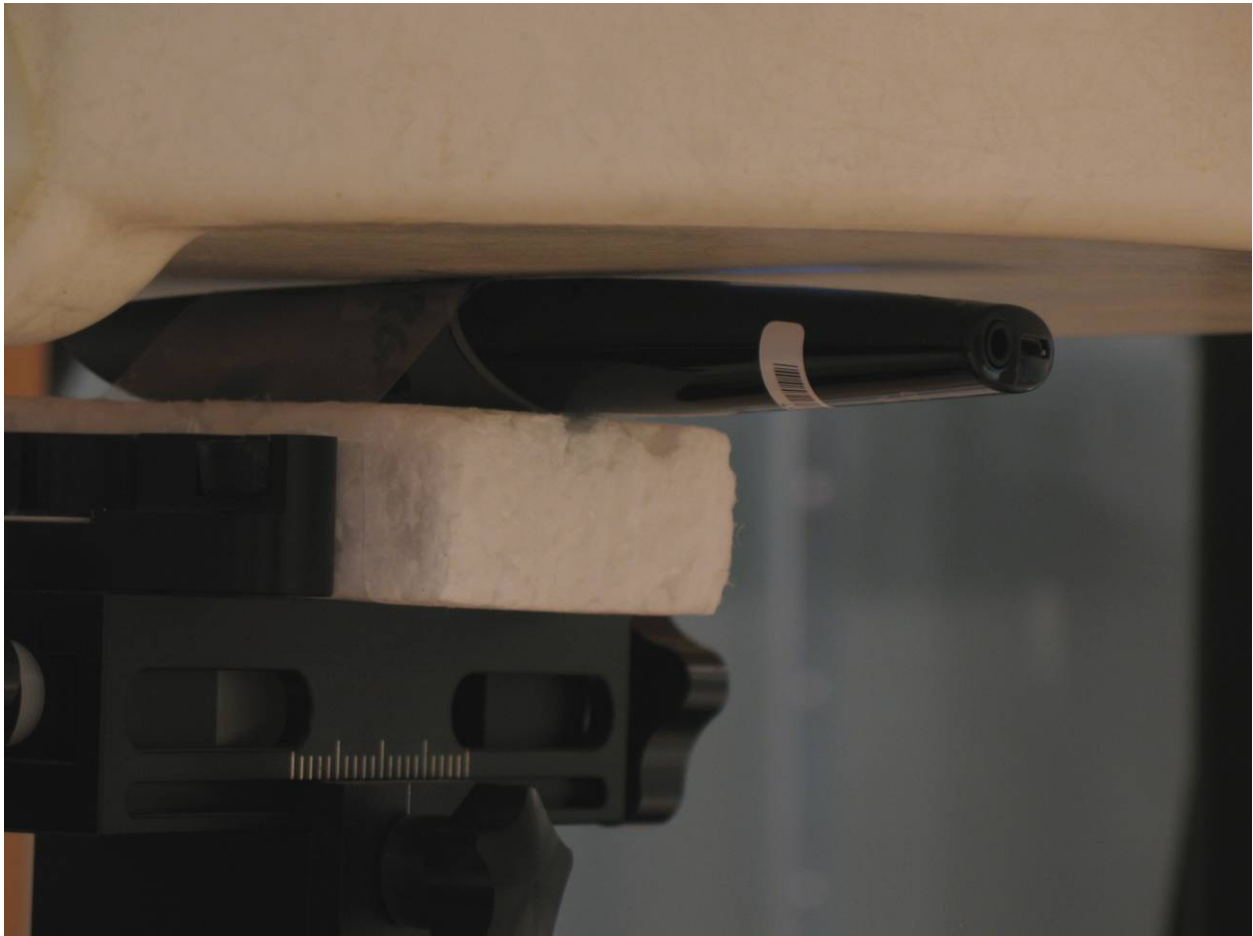


Figure 3: Front of Test Sample – Front



Figure 4: Back of Test Sample – Right Side



Figure 5: Front of Test Sample – Left Side



Figure 6: Back of Test Sample – Back Side

8.0 CRITERIA

The following FCC limits for SAR apply to 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

9.0 TABULAR 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 under APPENDIX A – SAR Plots.

Conducted Power Measurements

The conducted power measurements for the 802.11 module in the 8GB were performed in using the channel integration method for power in accordance with KDB 558074 section 8.2.2.

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)			
			Data Rate (Mbps)			
			1	2	5.5	11
802.11b	2412	1	17.55	17.49	17.41	17.44
	2437	6	17.68	17.59	17.54	17.51
	2462	11	17.68	17.69	17.56	17.52

Table 8: Conducted Output Power – 802.11b – Average Power

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	17.36	17.36	17.15	17.17	17.08	16.92	16.08	14.72
	2437	6	17.72	17.46	17.46	17.43	17.48	17.3	16.3	15.4
	2462	11	17.76	17.74	17.72	17.72	17.61	17.5	16.76	15.8

Table 9: Conducted Output Power – 802.11g – Average Power

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
802.11n	2412	1	15.36	15.32	15.37	15.77	15.71	15.8	15.73	14.74
	2437	6	16.22	16.03	16.16	15.56	15.43	15.27	15.32	14.5
	2462	11	16.21	16.08	16.41	16.36	16.24	16.3	15.8	15.01

Table 10: Conducted Output Power – 802.11n HT20 – Average Power

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
802.11n	2422	3	12.18	11.65	11.65	12.14	12.1	12.04	12.03	11.9
	2437	6	12.54	12.37	12.31	11.79	11.68	11.58	11.55	11.48
	2452	9	12.11	11.91	11.83	11.73	11.64	11.56	11.63	11.52

Table 11: Conducted Output Power – 802.11HT40 – Average Power

Body Mode SAR Test Results

The device is a pen that can be used when held against the body. The device was evaluated according to the specific requirements found in FCC KDB 447498[9]. The worse case 1-g SAR value was less than the 1.6mW/g limit. In accordance with KDB 248227, the lowest data rate in b mode was evaluated at the channel with the highest output power. Other datarates and modes were not tested since the conducted output power was less than 0.25dB higher then the power measured at 1Mbps.

SAR Measurement Results at the Body - WWAN Module								
Band	Channel	Frequency (MHz)	Mode	Battery	Test Position	Seperation Distance (mm)	Power Drift (dB)	SAR 1g (W/kg)
2.4GHz	6.00	2437.00	802.11b - 1Mbps	Standard	Back Touching Phantom	0.00	0.13	0.41
2.4GHz	6.00	2437.00	802.11b - 1Mbps	Standard	Front Touching Phantom	0.00	0.02	0.32
2.4GHz	6.00	2437.00	802.11b - 1Mbps	Standard	Right Side Touching Phantom	0.00	-0.11	0.57
2.4GHz	6.00	2437.00	802.11b - 1Mbps	Standard	Left Side Touching Phantom	0.00	0.12	0.20

Table 12: Body Mode SAR Results

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, "Dosimetric 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. Taylor 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 A – SAR PLOTS

Date/Time: 8/31/2012 10:43:29 AM

Test Laboratory: Intertek

File Name: [802.11b Scan.da52:4](#)

802.11b Scan - Front

Procedure Notes:

DUT: Livescribe Pen 8GB; Serial: MPK1206011617-001

Communication System: Generic 802.11b/g/n; Communication System Band: 2.4 GHz Band; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437 \text{ MHz}$; $\sigma = 1.923 \text{ mho/m}$; $\epsilon_r = 51.555$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

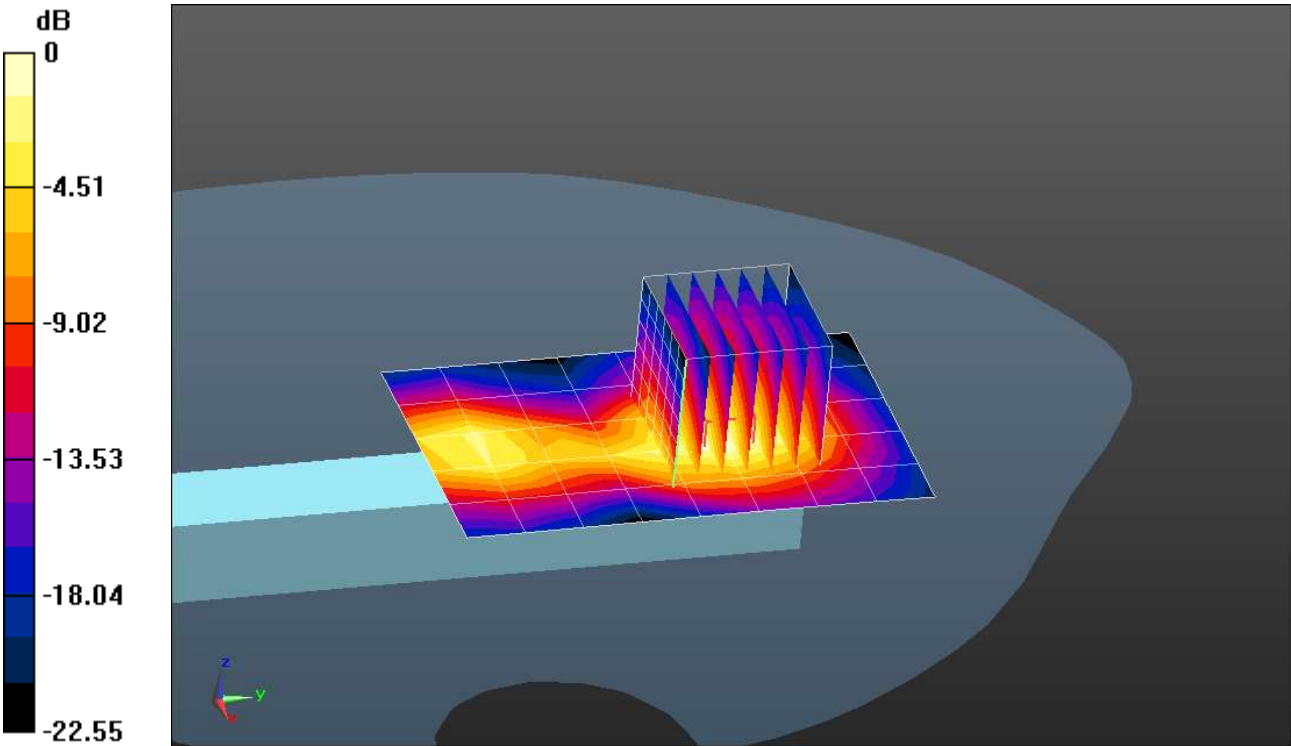
DASYS Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.21, 8.21, 8.21); Calibrated: 12/14/2011;
- Sensor-Surface: 4mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/15/2011
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASYS 52.8.1(838); SEMCAD X 14.6.5(6469)

Wifi Flat-Section MSL Testing on 8_31_2012/Front of Device Against Phantom, Data Rate =1mbps/Area Scan 2 (6x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$
Maximum value of SAR (measured) = 0.405 mW/g

Wifi Flat-Section MSL Testing on 8_31_2012/Front of Device Against Phantom, Data Rate =1mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
Reference Value = 7.989 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.851 mW/g
Maximum value of SAR (measured) = 0.632 mW/g

SAR(1 g) = 0.414 mW/g



0 dB = 0.405 mW/g = -7.85 dB mW/g

Test Laboratory: Intertek

File Name: [802.11b Scan.da52:4](#)**802.11b Scan – Back Side**

Procedure Notes:

DUT: Livescribe Pen 8GB; Serial: MPK1206011617-001

Communication System: Generic 802.11b/g/n; Communication System Band: 2.4 GHz Band; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437 \text{ MHz}$; $\sigma = 1.923 \text{ mho/m}$; $\epsilon_r = 51.555$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.21, 8.21, 8.21); Calibrated: 12/14/2011;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/15/2011
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Wifi Flat-Section MSL Testing on 8_31_2012/Back of Device Against Phantom, Data Rate =1mbps/Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 0.447 mW/g

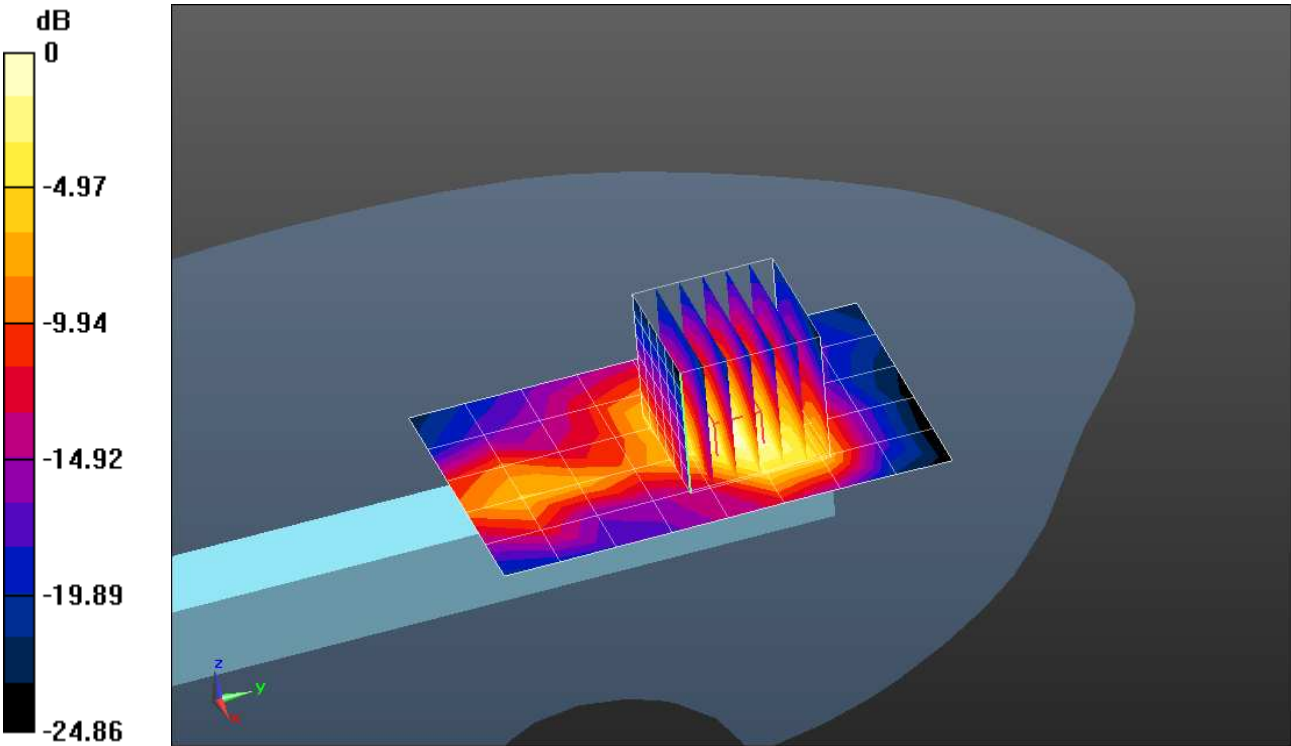
Wifi Flat-Section MSL Testing on 8_31_2012/Back of Device Against Phantom, Data Rate =1mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.898 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.718 mW/g

Maximum value of SAR (measured) = 0.485 mW/g

SAR(1 g) = 0.316 mW/g



0 dB = 0.447 mW/g = -6.99 dB mW/g

Test Laboratory: Intertek

File Name: [802.11b Scan.da52:4](#)**802.11b Scan – Right Side**

Procedure Notes:

DUT: Livescribe Pen 8GB; Serial: MPK1206011617-001

Communication System: Generic 802.11b/g/n; Communication System Band: 2.4 GHz Band; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437 \text{ MHz}$; $\sigma = 1.923 \text{ mho/m}$; $\epsilon_r = 51.555$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.21, 8.21, 8.21); Calibrated: 12/14/2011;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/15/2011
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

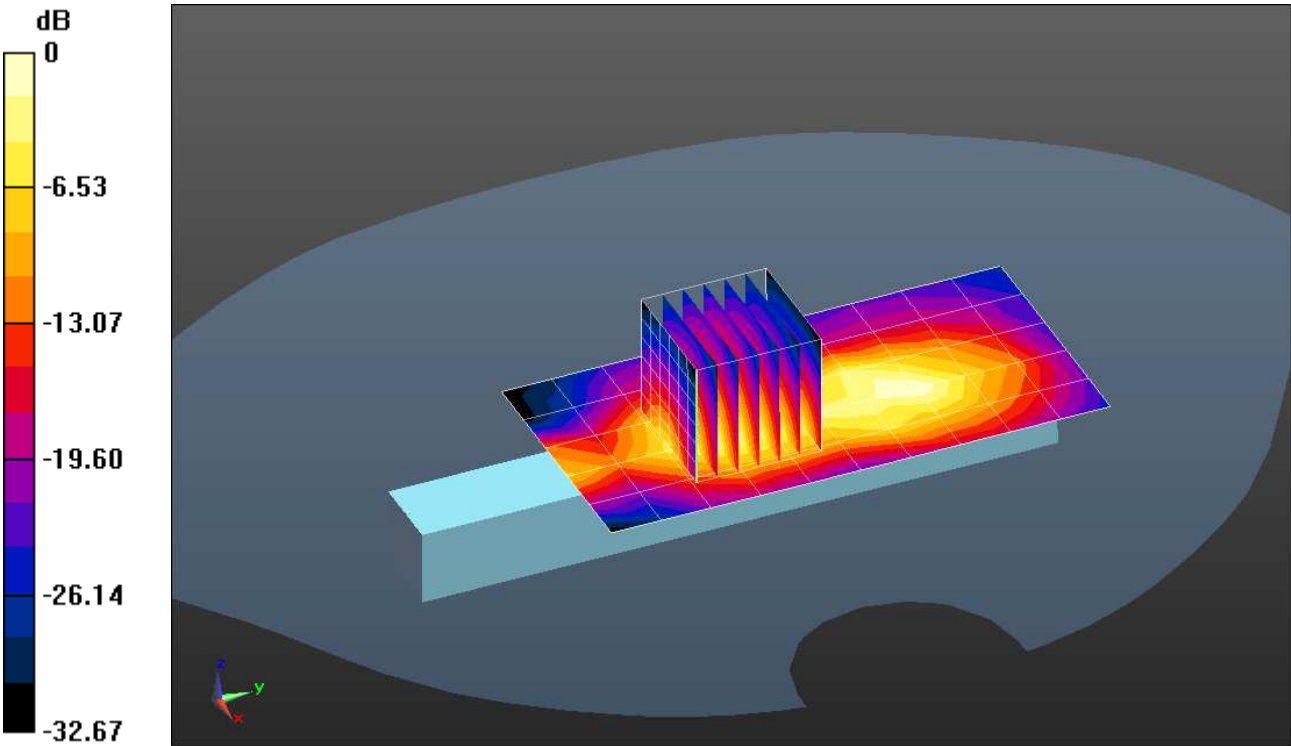
Wifi Flat-Section MSL Testing on 8_31_2012/Right Side of Device Against Phantom, Data Rate =1mbps 2/Area Scan 2 (6x11x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.963 mW/g**Wifi Flat-Section MSL Testing on 8_31_2012/Right Side of Device Against Phantom, Data Rate =1mbps 2/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 13.842 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 1.147 mW/g

Maximum value of SAR (measured) = 0.856 mW/g

SAR(1 g) = 0.565 mW/g



0 dB = 0.963 mW/g = -0.33 dB mW/g

Test Laboratory: Intertek

File Name: [802.11b Scan_9_1_2012.da52:4](#)**802.11b Scan_9_1_2012 – Left Side**

Procedure Notes:

DUT: Livescribe Pen 8GB; Serial: MPK1206011617-001

Communication System: Generic 802.11b/g/n; Communication System Band: 2.4 GHz Band; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2437 \text{ MHz}$; $\sigma = 1.928 \text{ mho/m}$; $\epsilon_r = 51.337$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.21, 8.21, 8.21); Calibrated: 12/14/2011;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/15/2011
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Wifi Flat-Section MSL Testing on 8_31_2012/Left Side of Device Against Phantom, Data Rate =1mbps/Area Scan 2 (6x11x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 0.258 mW/g

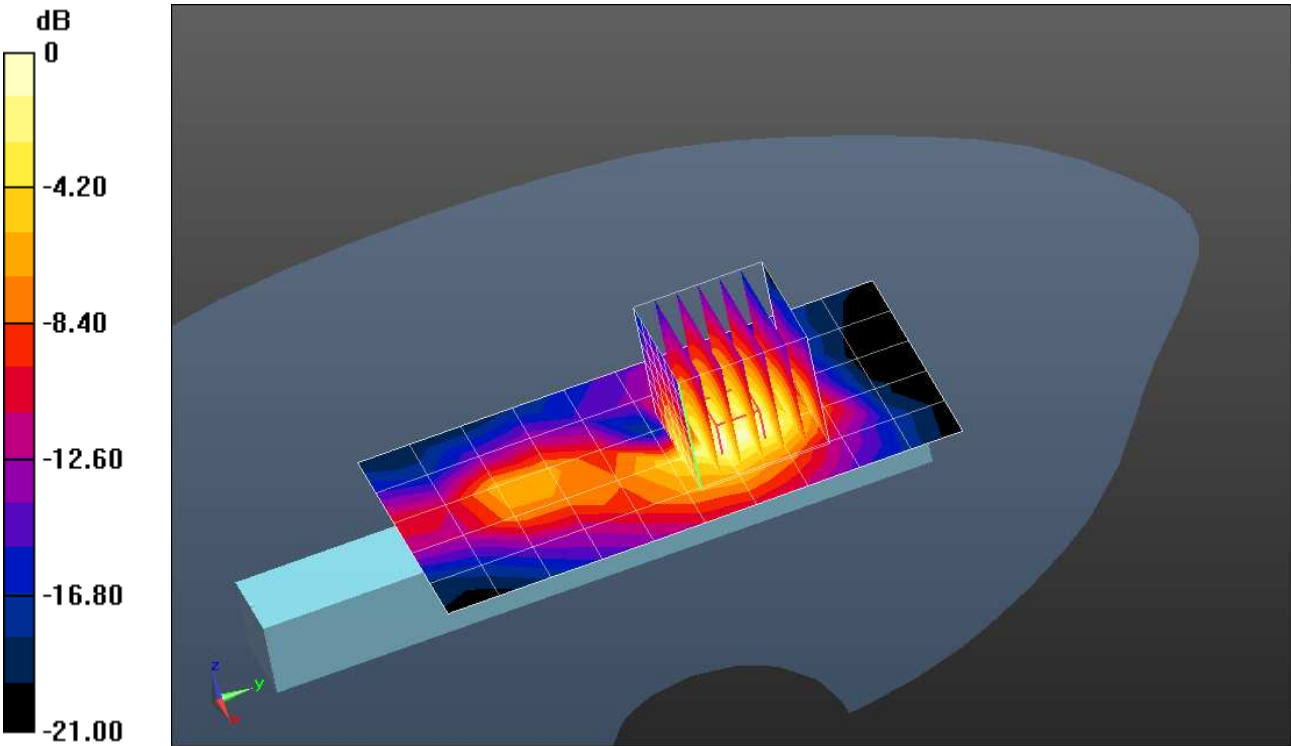
Wifi Flat-Section MSL Testing on 8_31_2012/Left Side of Device Against Phantom, Data Rate =1mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 8.526 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.433 mW/g

Maximum value of SAR (measured) = 0.316 mW/g

SAR(1 g) = 0.196 mW/g



0 dB = 0.258 mW/g = -11.77 dB mW/g

12.0 APPENDIX B – SYSTEM VERIFICATION PLOTS

Date/Time: 8/31/2012 9:39:00 AM

Test Laboratory: Intertek

File Name: [Dipole Validation 8_31_2012.da52:1](#)**Dipole Validation 8-31-2012**

Procedure Notes:

DUT: Dipole 2450 MHz D2450V2; Serial: D2450V2 - SN: 718

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.942$ mho/m; $\epsilon_r = 51.528$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.21, 8.21, 8.21); Calibrated: 12/14/2011;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/15/2011
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

Maximum value of SAR (measured) = 0.737 mW/g

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=10 mW with 10db attenuator at dipole, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

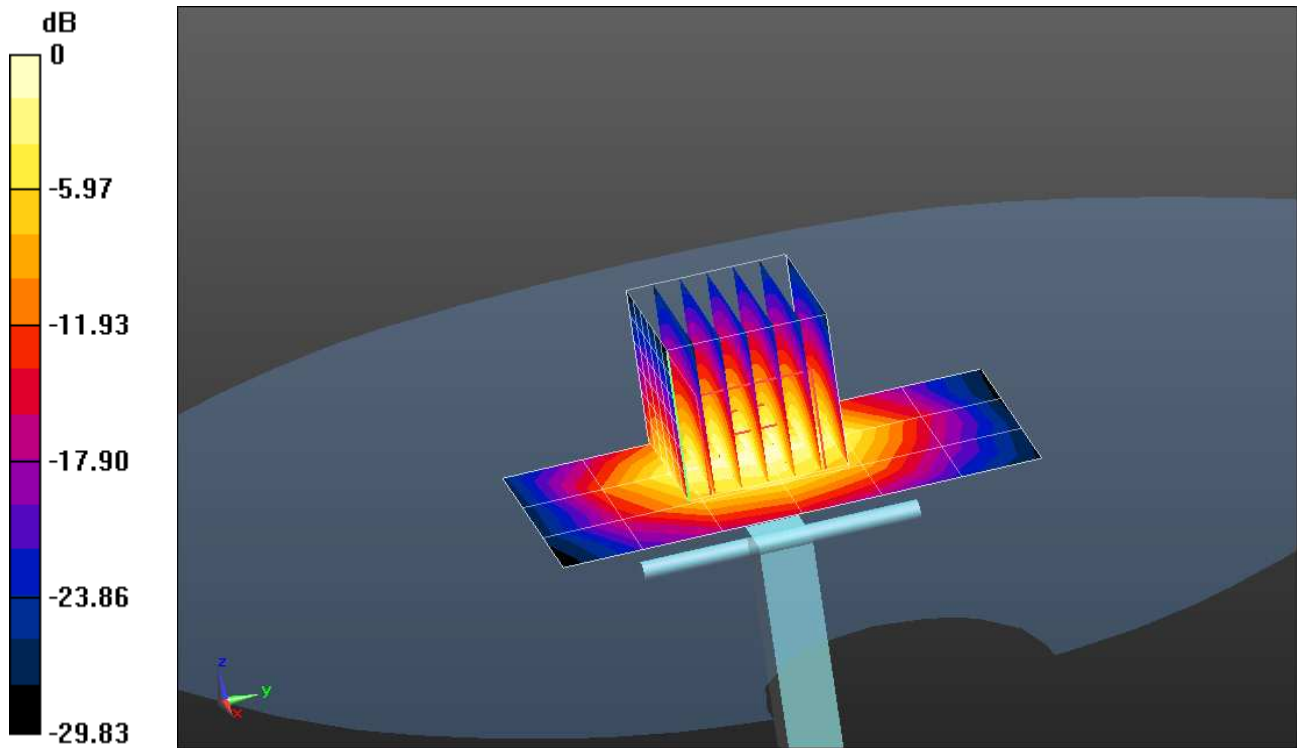
Reference Value = 19.632 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 104.0 mW/g

SAR(1 g) = 51.2 mW/g; SAR(10 g) = 23.8 mW/g (SAR corrected for target medium)

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 58.6 mW/g



0 dB = 0.737 mW/g = -2.65 dB mW/g

Date/Time: 9/1/2012 12:13:17 PM

Test Laboratory: Intertek

File Name: [Dipole Validation 9_1_2012.da52:1](#)**Dipole Validation 9-1-2012**

Procedure Notes:

DUT: Dipole 2450 MHz D2450V2; Serial: D2450V2 - SN:718

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.944$ mho/m; $\epsilon_r = 51.285$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV3 - SN3516; ConvF(8.21, 8.21, 8.21); Calibrated: 12/14/2011;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn358; Calibrated: 9/15/2011
- Phantom: SAM 1 with CRP v5.0; Type: QD000P40CD; Serial: TP: 1243
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

Maximum value of SAR (measured) = 0.784 mW/g

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=10 mW with 10db attenuator at dipole, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

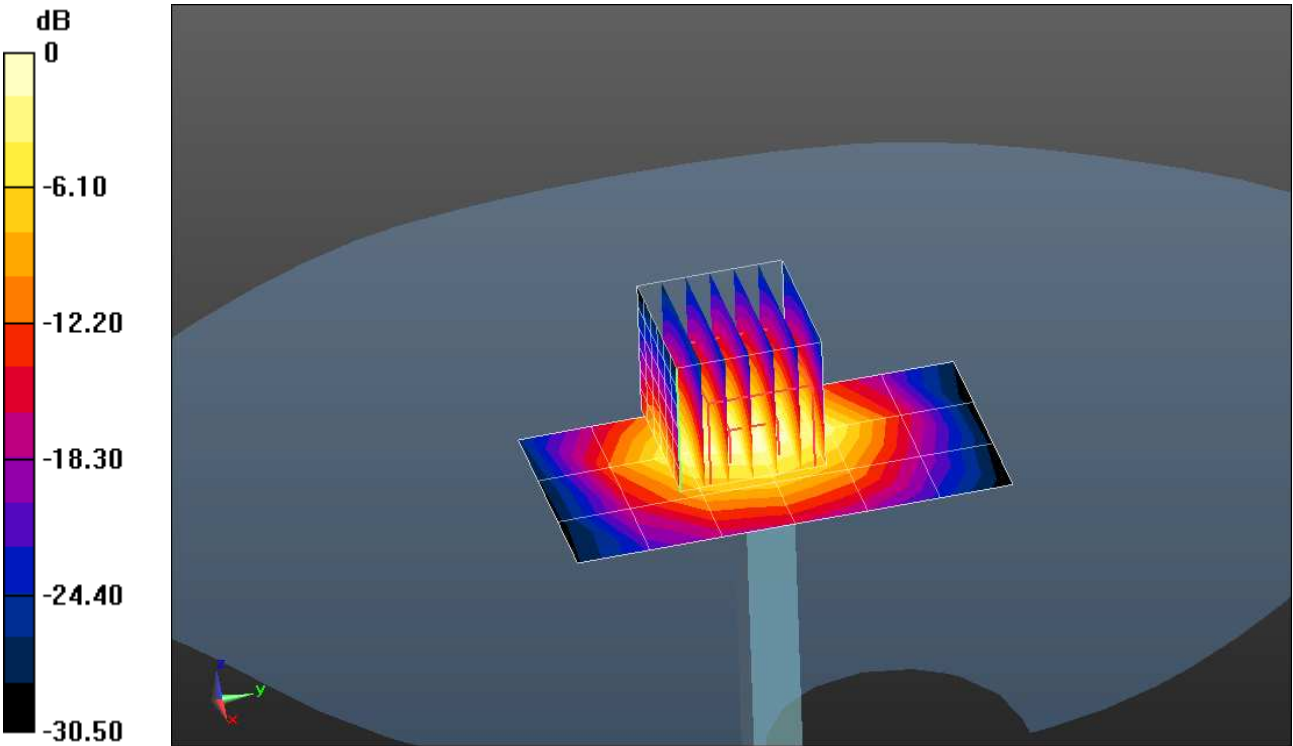
Reference Value = 18.688 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 104.5 mW/g

SAR(1 g) = 51.6 mW/g; SAR(10 g) = 24.2 mW/g

Normalized to target power = 1 W and actual power = 0.01 W

Maximum value of SAR (measured) = 58.6 mW/g



0 dB = 0.784 mW/g = -2.11 dB mW/g