

TEST REPORT

Report Number: 102570592LEX-003

Project Number: G102570592

**Evaluation of the: Verifier Sentry (Model: SENTRY1)
With the following Modules Installed:**

FCCID: Q9YSENTRY2 (WiFi/Bluetooth Module)

FCCID: Q9YSENTRY4 (CDMA Cell/PCS Module)

**Tested to the SAR Criteria in
FCC Part 2.1093. Rss-102 Issue 5, per KDB447498 D01 v06**

For

Cross Match Technologies

Test Performed by:

Intertek
731 Enterprise Drive
Lexington, KY 40510

Test Authorized by:

Cross Match Technologies
3960 RCA Blvd Suite 6001
Palm Beach Gardens, FL 33410

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DOCUMENT HISTORY

Revision/ Project Number	Writer Initials	Date	Change
1.0 /G102570592	BCT	6/10/2016	Original document

1.0 INTRODUCTION

At the request of Cross Match Technologies, Inc., the Verifier Sentry was evaluated for SAR in accordance with the requirements for FCC Part 2.1093 and RSS-102 Issue 5. Testing was performed in accordance with IEEE Std 1528:2013, IEC62209-2:2010, 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 $\pm 22.3\%$.

The SENTRY1 was tested at the maximum output power measured by Intertek. Maximum output power measurements are tabulated under Section 8.0 Test Results. The maximum spatial peak SAR value for the sample device averaged over 1g (for body worn mode) and 10g (for hand held mode) was found to be:

Transmit Band (MHz)	Transmit Mode	Operating Mode	Channel	Frequency (MHz)	Conducted Output Power (dBm)	Reported SAR _{1g} – Body Mode, SAR _{10g} – Handheld Mode (W/kg)	Limit (W/kg)
1850-1910	CDMA PCS	Body	1175	1908.75MHz	23.47dBm	1.2587	1.6W/kg
824-849	CDMA Cell	Body	384	836.52MHz	24.18dBm	0.5275	1.6W/kg
2390 – 2483.5	WiFi	Body	11	2462MHz	21.0dBm	0.0571	1.6W/kg
1850-1910	CDMA PCS	Handheld	1175	1908.75MHz	23.35dBm	3.9025	4W/kg
824-849	CDMA Cell	Handheld	384	836.52MHz	24.18dBm	0.8138	4W/kg
2390 – 2483.5	WiFi	Handheld	6	2437MHz	23.27dBm	0.1109	4W/kg

Table 1: Maximum Measured SAR

Based on the worst-case data presented above, the Verifier Sentry was found to be **compliant** with the 1.6 W/kg and 4W/kg requirements for general population / uncontrolled exposure.

2.0 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.

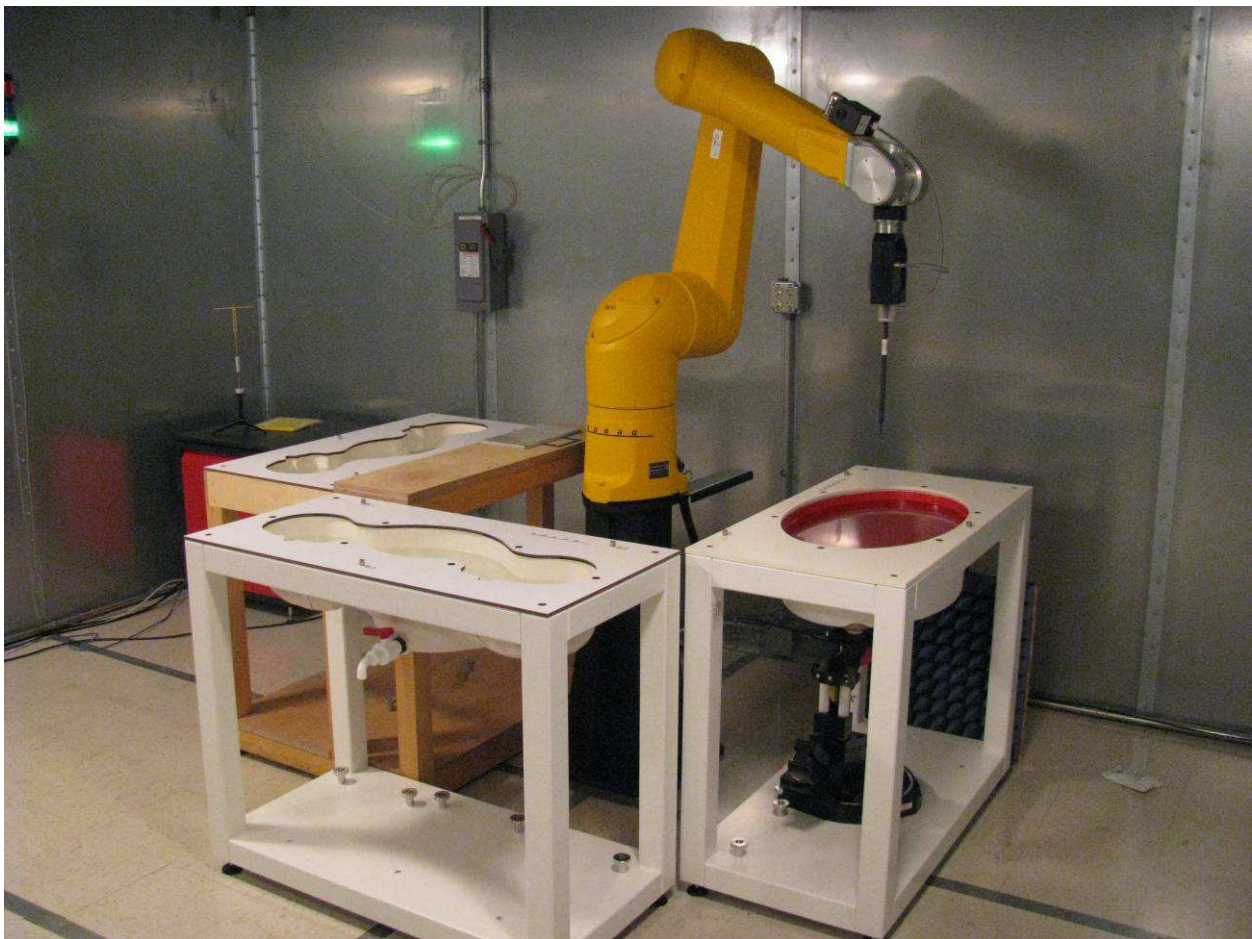


Figure 1: Intertek SAR Test Site

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	12/16/15	12/16/16
System Verification Dipole	4d122	Speag	D835V2	9/17/15	9/17/16
System Verification Dipole	5d154	Speag	D1900V2	9/21/15	9/21/16
System Verification Dipole	718	Speag	D2450V2	12/10/15	12/10/16
DAE	358	Speag	DAE4	9/16/15	9/16/16
Vector Signal Generator	257708	Rohde & Schwarz	SMBV100A	9/18/15	9/18/16
Network Analyzer	US391739 83	Agilent	8753ES	3/18/15	3/18/16
USB Power Sensor	100155	Rohde & Schwarz	NRP-Z81	9/20/15	9/20/16
USB Power Sensor	100705	Rohde & Schwarz	NRP-Z51	12/17/15	12/17/16
Dielectric Probe Kit	1111	Speag	DAK-3.5	NCR	NCR
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/18/15	9/18/16
Base Station Simulator	119981	Rohde & Schwarz	CMU200	9/22/15	9/22/16
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	F11/5H1Y A/A/01	Staubli	RX-90	NCR	NCR

NCR – No Calibration Required

Table 2: Test Equipment Used for SAR Evaluation

Measurement Uncertainty

The Table below includes the uncertainty budget suggested by the IEEE Std 1528-2013 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	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
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%	∞
Modulation Response	±2.4%	R	√3	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±2.0%	R	√3	1	1	±1.2%	±1.2%	∞
Test sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	√3	1	1	±0%	±0%	∞
Phantom and Setup								
Phantom Uncertainty	±6.1%	R	√3	1	1	±3.5%	±3.5%	∞
SAR Correction	±1.9%	R	√3	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	R	√3	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity (mea.)	±2.5%	R	√3	0.26	0.26	±0.3%	±0.4%	∞
Temp unc. - Conductivity	±3.4%	R	√3	0.78	0.71	±1.5%	±1.4%	∞
Temp unc. - Permittivity	±0.4%	R	√3	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±11.2%	±11.1%	361
Expanded STD Uncertainty						±22.3%	±22.2%	

Notes.

1. Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2013. 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%	∞
Modulation Response	±2.4%	R	√3	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Probe Positioning	±6.7%	R	√3	1	1	±3.9%	±3.9%	∞
Max. SAR Eval.	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Test sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Power Scaling	±0.0%	R	√3	1	1	±0%	±0%	∞
Phantom and Setup								
Phantom Uncertainty	±6.6%	R	√3	1	1	±3.8%	±3.8%	∞
SAR Correction	±1.9%	R	√3	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)	±2.5%	R	√3	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity (mea.)	±2.5%	R	√3	0.26	0.26	±0.3%	±0.4%	∞
Temp unc. - Conductivity	±3.4%	R	√3	0.78	0.71	±1.5%	±1.4%	∞
Temp unc. - Permittivity	±0.4%	R	√3	0.23	0.26	±0.1%	±0.1%	∞
Combined Standard Uncertainty						±12.3%	±12.2%	748
Expanded STD Uncertainty						±24.6%	±24.5%	

Notes.

Worst Case uncertainty budget for DASY5 assessed according to IEEE 1528-2013. 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.

3.0 JOB DESCRIPTION

At the request of Cross Match Technologies, SAR testing was performed on the SENTRY1.

Test sample	
Manufacturer	Cross Match Technologies
Product Name	Verifier Sentry SENTRY1
Serial Number	Not Labeled
Receive Date	5/12/2016
Device Received Condition	Good
Device Category	Portable
RF Exposure Category	General Population/Uncontrolled Environment
Antenna Type	Internal
Test sample Accessories	
Accessory	Holster

Table 3: Product Information

Operating Bands	Frequency Range (MHz)	Maximum Output Power (declared by Manufacturer)	Duty Cycle
CDMA Cell	824.2 – 848.31MHz	24.5dBm	1:1
CDMA PCS	1851.25 – 1908.75MHz	23.5dBm	1:1
WiFi	2390 – 2483.5MHz	21dBm	1:1
Bluetooth	2402 – 2480MHz	7.73dBm	1:1

Table 4: Operating Bands

4.0 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 reference dipole. The results from the system verifications with a dipole are shown in *Table 5*.

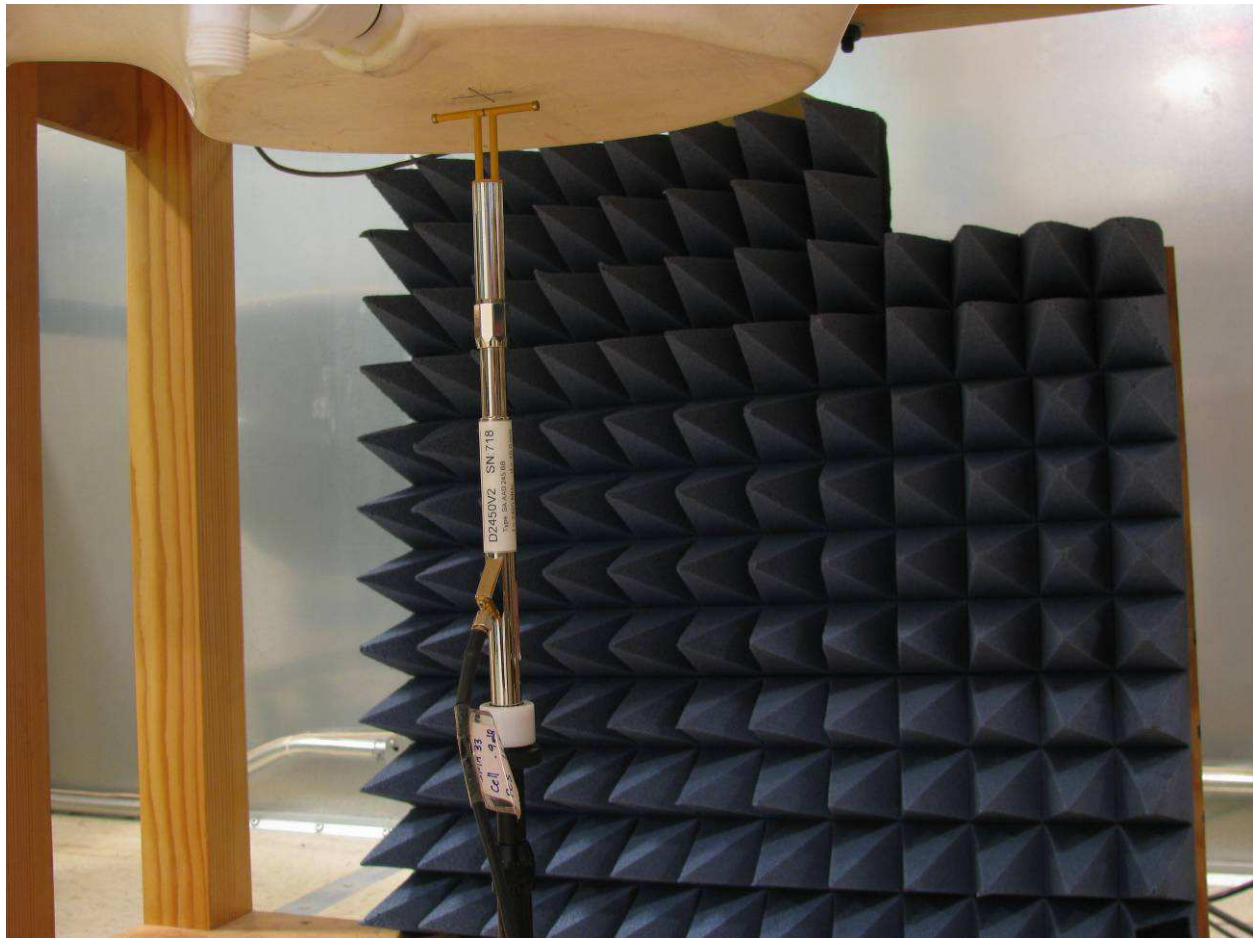


Figure 2: System Verification Setup

Evaluation For: Cross Match Technologies

Product Name: Verifier Sentry SENTRY1

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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
23.1	22.1	2450	D2450V2	MSL2450	1W	52.5	53.1	1.14	5/26/2016
23.1	22.1	835	D835V2	MSL900	1W	9.49	10.1	6.43	5/17/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	39.9	41.4	3.76	5/18/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	39.9	41	2.76	6/6/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	39.9	40.9	2.51	6/28/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	39.9	42.1	5.51	7/6/2016
23.1	22.1	2450	D2450V2	MSL2450	1W	52.5	56.7	8.00	7/1/2016

Table 5: Dipole Validations (1g measurements)

Reference Dipole Validation									
Ambient Temp (°C)	Fluid Temp (°C)	Frequency (MHz)	Dipole	Fluid Type	Dipole Power Input	Cal. Lab SAR (10g)	Measured SAR (10g)	% Error SAR (10g)	Date
23.1	22.1	2450	D2450V2	MSL2450	1W	24.6	24.2	1.63	5/26/2016
23.1	22.1	835	D835V2	MSL900	1W	6.22	6.68	7.40	5/17/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	21.1	21.4	1.42	5/18/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	21.1	21.2	0.47	6/6/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	21.1	21.4	1.42	6/28/2016
23.1	22.1	1900	D1900V2	MSL1900	1W	21.1	21.9	3.79	7/6/2016
23.1	22.1	2450	D2450V2	MSL2450	1W	24.6	26.2	6.50	7/1/2016

Table 6: Dipole Validations (10g measurements)

Measurement Uncertainty for System Validation

Source of Uncertainty	Value(dB)	Probability Distribution	Divisor	c_i	$u_i(y)$	$(u_i(y))^2$
Measurement System						
Probe Calibration	5.50	n1	1	1	5.50	30.250
Axial Isotropy	4.70	r	1.732	0.7	2.71	7.364
Hemispherical Isotropy	9.60	r	1.732	0.7	5.54	30.722
Boundary Effect	1.00	r	1.732	1	0.58	0.333
Linearity	4.70	r	1.732	1	2.71	7.364
System Detection Limits	1.00	r	1.732	1	0.58	0.333
Readout Electronics	0.30	n1	1	1	0.30	0.090
Response Time	0.80	r	1.732	1	0.46	0.213
Integration Time	2.60	r	1.732	1	1.50	2.253
RF Ambient Noise	3.00	r	1.732	1	1.73	3.000
RF Ambient Reflections	3.00	r	1.732	1	1.73	3.000
Probe Positioner	0.40	r	1.732	1	0.23	0.053
Probe Positioning	2.90	r	1.732	1	1.67	2.803
Max. SAR Eval.	1.00	r	1.732	1	0.58	0.333
Dipole / Generator / Power Meter Related						
Dipole positioning	2.90	n1	1	1	2.90	8.410
Dipole Calibration Uncertainty	0.68	r	1.732	1	0.39	0.154
Power Meter 1 Uncertainty (+20C to +25C)	0.13	n1	1	2	0.13	0.017
Power Meter 2 Uncertainty (+20C to +25C)	0.04	n1	1	3	0.04	0.002
Sig Gen VSWR Mismatch Error	1.80	n1	1	5	1.80	3.240
Sig Gen Resolution Error	0.01	n1	1	6	0.01	0.000
Sig Gen Level Error	0.90	n1	1	1	0.90	0.810
Phantom and Setup						
Phantom Uncertainty	4.00	r	1.732	1	2.31	5.334
Liquid Conductivity (target)	5.00	r	1.732	0.43	2.89	8.334
Liquid Conductivity (meas.)	2.50	n1	1	0.43	2.50	6.250
Liquid Permittivity (target)	5.00	r	1.732	0.49	2.89	8.334
Liquid Permittivity (meas.)	2.50	n1	1	0.49	2.50	6.250
Combined Standard Uncertainty		N1	1	1	11.63	135.247
Expanded Uncertainty		Normal k=	2		23.26	

Expanded Uncertainty is 23.3 for Normal k= 2

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 9.

Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Imaginary Part	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
2.4GHZ MSL	2400	52.77	1.95	51.59	14.79	1.97	2.24	1.20	5/25/16
	2450	52.7	1.95	51.39	14.8	2.02	2.49	3.38	
	2462	52.66	1.95	51.33	14.92	2.04	2.53	4.73	
Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Imaginary Part	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
2.4GHZ MSL	2400	52.77	1.95	51.87	14.86	1.98	1.71	1.68	6/28/2016
	2450	52.7	1.95	51.64	14.88	2.03	2.01	3.94	
	2462	52.66	1.95	51.45	14.91	2.04	2.30	4.66	
Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
MSL1900	1850	53.3	1.52	53.2	14.91	1.53	0.19	0.89	5/17/16
	1880	53.3	1.52	52.92	14.96	1.56	0.71	2.87	
	1910	53.3	1.52	51.89	14.98	1.59	2.65	4.65	
Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
MSL835	824	55.2	0.97	53.02	21.31	0.98	3.95	0.64	5/17/16
	836	55.2	0.97	52.64	21.24	0.99	4.64	1.77	
	850	55.2	0.98	52.53	21.18	1.00	4.84	2.13	
Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
MSL1900	1850	53.3	1.52	52.89	14.86	1.53	0.77	0.55	6/6/16
	1880	53.3	1.52	52.81	14.92	1.56	0.92	2.59	
	1910	53.3	1.52	52.76	14.95	1.59	1.01	4.44	
Measured Tissue Properties									
Tissue Type	Frequency Measure (MHz)	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
MSL1900	1850	53.3	1.52	52.79	14.91	1.53	0.96	0.89	6/28/16
	1880	53.3	1.52	52.73	14.96	1.56	1.07	2.87	
	1910	53.3	1.52	52.7	14.98	1.59	1.13	4.65	

Table 7: Dielectric Parameter Validations

Evaluation For: Cross Match Technologies

Product Name: Verifier Sentry SENTRY1

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Measured Tissue Properties									
Tissue Type	Frequency Measure	Permittivity Target	Conductivity Target	Permittivity Measure	Complex Permittivity Measure	Conductivity Measure	Dielectric % Deviation	Conductivity % Deviation	Date
MSL1900	1850	53.3	1.52	52.81	14.89	1.53	0.92	0.75	7/6/2016
	1880	53.3	1.52	52.76	14.92	1.56	1.01	2.59	
	1910	53.3	1.52	52.71	14.96	1.59	1.11	4.51	

Table 8: Dielectric Parameter Validations (continued)

TYPICAL COMPOSITION OF INGREDIENTS FOR LIQUID TISSUE PHANTOMS. (450MHz to 2450 MHz data only)												
Ingredient weight) (% by	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 9: Tissue Simulating Fluid Recipe

Tissue Simulating Liquid for 5GHz, MBL3500-5800V5 Manufactured by SPEAG (proprietary mixture)

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

5.0 EVALUATION PROCEDURES

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm ± 0.2 cm. 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 1528:2013, IEC62209-2:2010, 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 be used for 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 10.

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 10.

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			$30^{\circ} \pm 1^{\circ}$	$20^{\circ} \pm 1^{\circ}$
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 $\leq$ 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 1 st 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	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
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 <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> 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 10: 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.

6.0 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

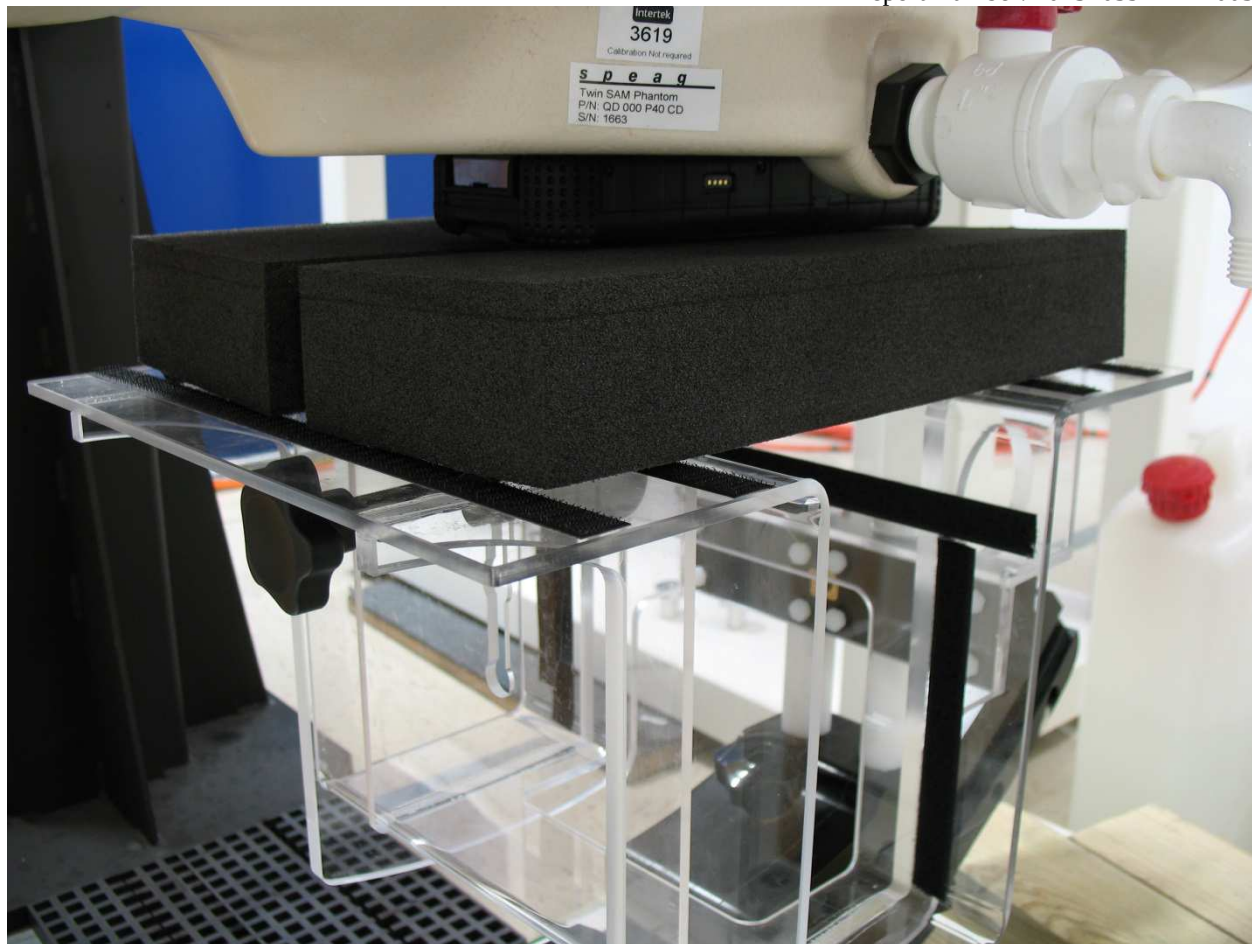
7.0 TEST CONFIGURATION

The Verifier Sentry can be operated and worn on the body using a pouch. The pouch is non-metallic and provides 14mm of separation between the device and the person. The pouch is formed such that the device can be positioned in one of two ways; with the screen facing toward the body or with the screen facing away from the body. Testing was performed with the sample installed in the pouch in both orientations. The test position is shown in the photographs below.

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 Verifier Sentry can also be operated in handheld mode outside of the pouch. Therefore testing was also performed with the device in direct contact with the phantom on each of the four sides using the spatial limit for hands, feet, wrists and ankles over a 10g cube.

Testing was performed on the middle channel of each operating band first. When the 10g SAR exceeded 2W/kg on the middle channel, the low and high channels were also scanned.



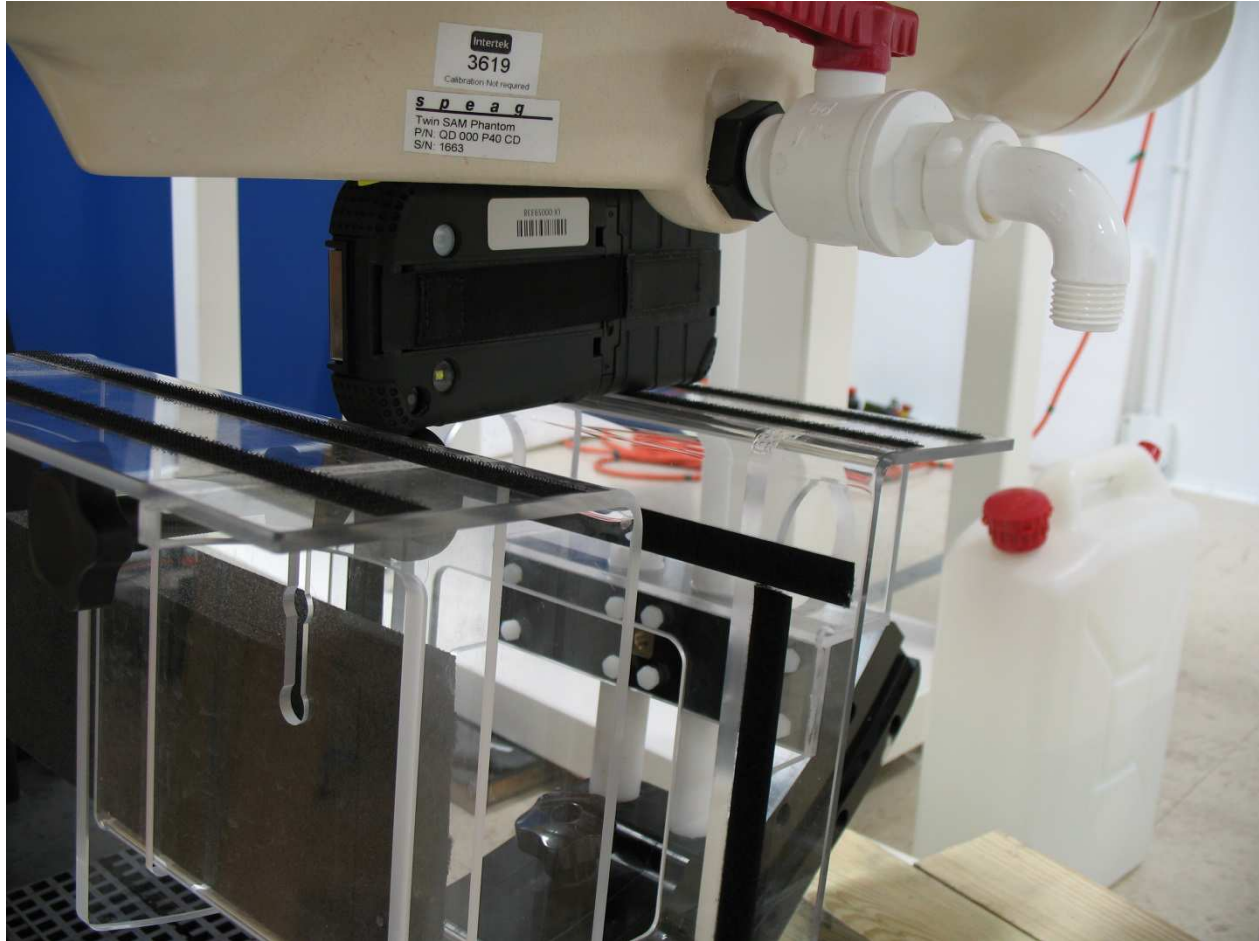
Front Side



Back Side



Right Side



Left Side



Front Side, In pouch



Back Side, In Pouch

8.0 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 and 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 was less than the 1.6W/kg limit. Also the worst case 10-g SAR value was less than the 4W/kg limit for extremity use conditions.

Standalone SAR Measurements (Body Worn Mode in Pouch):

	Body Mode SAR Results Using 900MHz MSL							
							Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
Date	TX Mode		Position	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)		
5/17/2016	CDMA Cell Band, Low Channel (1013)	Pouch	Back	0.18	0.3880	0.4611	23.75	24.50
			Front			0.0000	23.75	24.50
5/17/2016	CDMA Cell Band, Mid Channel (384)	Pouch	Back	-0.08	0.4900	0.5275	24.18	24.50
			Front	-0.08	0.4650	0.5006	24.18	24.50
5/17/2016	CDMA Cell Band, High Channel (777)	Pouch	Back	-0.20	0.3010	0.3816	23.47	24.50
			Front			0.0000	23.47	24.50
1g SAR Limit (Head & Body) = 1.6W/kg								

Table 11: CDMA Cell SAR Results

	Body Mode SAR Results Using 1900MHz MSL							
							Measured Conducted Output Power	Maximum Conducted Output Power
Date	TX Mode		Position	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	(dBm)	(dBm)
5/18/2016	CDMA PCS Band, Low Channel (25)	Pouch	Back	0.30	1.1300	1.0668	23.75	23.50
			Front			0.0000	23.75	23.50
5/18/2016	CDMA PCS Band, Mid Channel (600)	Pouch	Back	-0.21	0.8680	0.7422	24.18	23.50
			Front	-0.18	0.2040	0.1744	24.18	23.50
5/18/2016	CDMA PCS Band, High Channel (1175)	Pouch	Back	-0.02	1.2500	1.2587	23.47	23.50
			Front			0.0000	23.47	23.50
1g SAR Limit (Head & Body) = 1.6W/kg								

Table 12: CDMA PCS SAR Results

	Body Mode SAR Results Using 1900MHz MSL							
Date	TX Mode		Position	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
6/28/2016	CDMA PCS Band, High Channel (1175) (Repeatability Measurement)	Pouch	Back	0.23	1.1100	1.1177	23.47	23.50
			Front					
1g SAR Limit (Head & Body) = 1.6W/kg								

Table 13: CDMA PCS SAR Results (Repeatability Measurement)

Evaluation For: Cross Match Technologies

Product Name: Verifier Sentry SENTRY1

Report Number: 102570592LEX-003

	Body Mode SAR Results Using 2450MHz MSL							
				Power Drift	Measured SAR	Reported SAR	Measured Conducted	Maximum Conducted
Date	TX Mode	Spacing	Position	(dB)	1g (W/kg)	1g (W/kg)	Output Power (dBm)	Output Power (dBm)
5/26/2016	802.11b (Low)	Pouch	Back	-0.23	0.0760	0.0570	22.25	21.00
			Front					
5/26/2016	802.11b (Mid)	Pouch	Back	-0.23	0.0570	0.0338	23.27	21.00
			Front	-0.21	0.0560	0.0332	23.27	21.00
5/26/2016	802.11b (High)	Pouch	Back	-0.24	0.0930	0.0571	23.12	21.00
			Front					
5/26/2016	802.11g (Low)	Pouch	Back	-0.18	0.0570	0.0343	22.21	20.00
			Front					
5/26/2016	802.11g (Mid)	Pouch	Back	-0.26	0.0960	0.0535	22.54	20.00
			Front	-0.21	0.0250	0.0139	22.54	20.00
5/26/2016	802.11g (High)	Pouch	Back	-0.15	0.1040	0.0568	22.63	20.00
			Front					
5/26/2016	802.11n (Low)	Pouch	Back					
			Front					
5/26/2016	802.11n (Mid)	Pouch	Back					
			Front					
5/26/2016	802.11n (High)	Pouch	Back					
			Front					
1g SAR Limit (Head & Body) = 1.6W/kg								

Table 14: WiFi SAR Results

	Body Mode SAR Results Using 2450MHz MSL							
							Measured Conducted Output Power	Maximum Conducted Output Power
Date	TX Mode		Position	Power Drift (dB)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	(dBm)	(dBm)
	Bluetooth Low Channel	Pouch	Back					
			Front					
7/1/2016	Bluetooth Mid Channel	Pouch	Back	0.10	0.0198	0.0220	7.28	7.73
			Front	-0.19	0.0196	0.0217	7.28	7.73
	Bluetooth High Channel	Pouch	Back					
			Front					
1g SAR Limit (Head & Body) = 1.6W/kg								

Table 15: Bluetooth SAR Results

Standalone SAR Measurements (Hand Held Mode):

	Extremity SAR Results Using 900MHz MSL							
Date	TX Mode		Position	Power Drift (dB)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
5/17/2016	CDMA Cell Band, Low Channel (1013)	Pouch	Back	0.06	0.5220	0.6204	23.75	24.50
			Front					
			Left					
			Right					
5/17/2016	CDMA Cell Band, Mid Channel (384)	Pouch	Back	0.13	0.7560	0.8138	24.18	24.50
			Front	-0.03	0.4890	0.5264	24.18	24.50
			Left	0.14	0.1120	0.1206	24.18	24.50
			Right	0.25	0.5020	0.5404	24.18	24.50
5/17/2016	CDMA Cell Band, High Channel (777)	Pouch	Back	0.34	0.4600	0.5831	23.47	24.50
			Front					
			Left					
			Right					
10g SAR Limit (Extremities) = 4.0								

Table 16: CDMA Cell SAR Results

	Extremity SAR Results Using 1900MHz MSL							
Date	TX Mode		Position	Power Drift (dB)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
5/18/2016	CDMA PCS Band, Low Channel	Direct Contact with Phantom	Back	0.07	2.5500	2.7198	23.22	23.50
			Front					
			Left	0.02	3.1600	3.3704	23.22	23.50
			Right					
5/18/2016	CDMA PCS Band, Mid Channel	Direct Contact with Phantom	Back	-0.16	1.7000	1.8300	23.18	23.50
			Front	0.21	0.2930	0.3154	23.18	23.50
			Left	-0.29	3.0000	3.2294	23.18	23.50
			Right	-0.04	0.0110	0.0118	23.18	23.50
6/6/2016	CDMA PCS Band, High Channel	Direct Contact with Phantom	Back	0.09	2.7500	2.8466	23.35	23.50
			Front					
			Left	0.10	3.7700	3.9025	23.35	23.50
			Right					
10g SAR Limit (Extremities) = 4.0								

Table 17: CDMA PCS SAR Results

	Extremity SAR Results Using 1900MHz MSL							
							Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
Date	TX Mode	Spacing	Position	Power Drift (dB)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)		
6/28/2016, 7/6/2016	CDMA PCS Band, High Channel (Repeatability Measurements)	Direct Contact with Phantom	Left	-0.20	3.4000	3.5195	23.35	23.50
			Left	-0.15	3.4200	3.5402	23.35	23.50
10g SAR Limit (Extremities) = 4.0								

Table 18: CDMA PCS SAR Results (Repeatability Measurements)

Evaluation For: Cross Match Technologies

Product Name: Verifier Sentry SENTRY1

Report Number: 102570592LEX-003

	Extremity SAR Results Using 2450MHz MSL							
Date	TX Mode	Spacing	Position	Power Drift (dB)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)	Measured Conducted Output Power (dBm)	Maximum Conducted Output Power (dBm)
5/26/2016	802.11b (Mid)	Direct Contact with Phantom	Back	-0.29	0.0920	0.0545	23.27	21.00
			Right	0.01	0.1870	0.1109	23.27	21.00
			Left	0.10	0.0083	0.0049	23.27	21.00
			Front	-0.24	0.0830	0.0492	23.27	21.00
5/26/2016	802.11g (Mid)	Direct Contact with Phantom	Back	-0.27	0.0780	0.0435	22.54	20.00
			Right	-0.04	0.1880	0.1048	22.54	20.00
			Left	-0.10	0.0059	0.0033	22.54	20.00
			Front	-0.14	0.0980	0.0546	22.54	20.00
5/26/2016	802.11n (Mid)	Direct Contact with Phantom	Back					
			Right					
			Left					
			Front					
10g SAR Limit (Extremities) = 4.0								

Table 19: WiFi SAR Results

Conducted Output Power Measurements:

Mode	Frequency (MHz)	Channel Number	Type	Conducted Power (dBm)			
				Data Rate (Mbps)			
				1	2	5.5	11
802.11b	2412	1	Peak	22.25	22.23	22.22	22.21
	2437	6	Peak	23.27	23.18	22.92	22.92
	2462	11	Peak	23.12	23.09	23.06	22.94

Table 20: Conducted Power Measurements (802.11b)

Mode	Frequency (MHz)	Channel Number	Type	Conducted Power (dBm)							
				Data Rate (Mbps)							
				6	9	12	18	24	36	48	54
802.11g	2412	1	Peak	22.21	22.18	20.42	19.85	19.91	19.92	18.42	18.42
	2437	6	Peak	22.54	22.32	20.36	19.92	19.76	19.72	18.89	18.54
	2462	11	Peak	22.63	22.55	21.89	20.97	20.01	19.78	18.99	18.61

Table 21: Conducted Power Measurements (802.11g)

Mode	Frequency (MHz)	Channel Number	Type	Conducted Power (dBm)							
				MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
802.11n	2412	1	Peak	22.19	20.21	19.91	19.89	19.75	18.11	18.13	15.45
	2437	6	Peak	22.54	21.86	20.73	19.91	19.64	18.43	17.65	16.06
	2462	11	Peak	22.62	22.06	21.56	20.87	20.01	18.98	18.02	16.21

Table 22: Conducted Power Measurements (802.11n)

			Power Readings in dBm			
Band	Channel	Frequency (MHz)	RC1/SO55	RC3/SO55	RC3/SO32 (+F-SCH)	RC3/SO32 (+SCH)
Cellular	1013	824.7	23.79	23.75	23.71	23.72
	384	836.52	24.18	24.12	23.16	23.14
	777	848.31	23.49	23.87	23.53	23.47
PCS	25	1851.25	23.22	23.21	22.99	22.99
	600	1880	23.18	23.09	22.98	23.02
	1175	1908.75	23.35	23.32	23.07	22.98

Table 23: Conducted Power Measurements (CDMA)

Mode	Channel	Frequency (MHz)	Output Power (Average, dBm)	Output Power (Peak, dBm)
GFSK	0	2402	6.76	7.28
	39	2440	7.28	7.78
	78	2480	7.27	7.73
EDR2	0	2402	4.46	5.38
	39	2440	4.5	5.46
	78	2480	4.51	5.43
EDR3	0	2402	4.37	7.01
	39	2440	4.53	7.43
	78	2480	4.52	7.43
BLE	0	2402	6.75	7.26
	39	2440	7.26	7.73
	78	2480	7.25	7.71

*Note that the Bluetooth radio is exempt from SAR testing due to the low output power

Table 24: Conducted Power Measurements (Bluetooth)

Simultaneous Transmission Calculations:

The device does not support simultaneous transmission with any of the radios that are onboard.

SAR Test Exclusions:

The Bluetooth radio was excluded from standalone SAR due to the low output power.

The Near Field Communication radio was excluded from standalone SAR since it operates under 15.225 and has a low output power.

9.0 REFERENCES

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- [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”.
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APPENDIX – SYSTEM VALIDATION SUMMARY

Per FCC KDB 865664, a tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters have been included in the summary table below. The validation was performed with reference dipoles using the required tissue equivalent media for system validation according to KDB 865664. Each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point. All measurements were performed using probes calibrated for CW signals. Modulations in the table above represent test configurations for which the SAR system has been validated. The SAR system was also validated with modulated signals per KDB 865664.

Frequency (MHz)	Date	Probe (SN#)	Probe (Model #)	Probe Calibration Point		Dielectric Properties		CW Validation			Modulation Validation		
				Frequency (MHz)	Fluid Type	σ	ϵ_r	Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	PAR
835	12/20/2015	3516	EX3DV3	835	Body	54.2	0.98	Pass	Pass	Pass	GMSK	Pass	N/A
900	12/20/2015	3516	EX3DV3	900	Body	54	1.02	Pass	Pass	Pass	GMSK	Pass	N/A
1750	12/20/2015	3516	EX3DV3	1800	Body	52.9	1.41	Pass	Pass	Pass	GMSK	Pass	N/A
1900	12/20/2015	3516	EX3DV3	1900	Body	52.7	1.48	Pass	Pass	Pass	GMSK	Pass	N/A

Frequency (MHz)	Date	Probe (SN#)	Probe (Model #)	Probe Calibration Point		Dielectric Properties		CW Validation			Modulation Validation		
				Frequency (MHz)	Fluid Type	σ	ϵ_r	Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	PAR
2450	12/22/2015	3516	EX3DV3	2450	Body	50.65	2.02	Pass	Pass	Pass	OFDM	N/A	Pass
5200	12/21/2015	3516	EX3DV3	5200	Body	48.71	5.54	Pass	Pass	Pass	OFDM	N/A	Pass
5500	12/21/2015	3516	EX3DV3	5500	Body	47.68	6.29	Pass	Pass	Pass	OFDM	N/A	Pass
5800	12/21/2015	3516	EX3DV3	5800	Body	48.71	5.54	Pass	Pass	Pass	OFDM	N/A	Pass

Table 25: SAR System Validation Summary