SAR Test Report

Project Number: 4081001

Report Number: 4081001EMC01 **Revision Level:** 0

Client: ClearOne, Inc.

Equipment Under Test: Dialog 20 Beltpack Transmitter

Model Name: 910-6104-001

FCC ID: FBI-DIALOG20BLT

IC ID: 1970-DIALOG20BLT

Applicable Standards: IEEE STD 1528: 2013

Report issued on: 28 December 2016

Test Result: Compliant

Equipment Class	Mode	Band	Frequency (MHz)	Measured Conducted Power (dBm)	SAR	
					1g Head W/kg	1g Body W/kg
DTS	WiFi	US	2403-2481	12.3	**n/a**	**0.642**

Tested by: ______________________
Fabian Nica, Senior Engineering Technician

Reviewed by: ______________________
David Schramm, EMC/RF/SAR/HAC Manager

Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

Table of Contents

1 GENERAL INFORMATION

1.1 Client Information

Name:	ClearOne, Inc.
Address:	5225 Wiley Post Way, Suite 500
City, State, Zip, Country:	Salt Lake City, UT 8416, USA

1.2 Test Laboratory

Name:	SGS Consumer and Retail
Address:	620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country:	Suwanee, GA 30024, USA
Accrediting Body:	A2LA
Type of lab:	Testing Laboratory
Certificate Number:	3212.01

1.3 General Information of EUT

Type of Product:	Wireless Microphone
Model Number:	910-6104-001
Serial Number:	1
Frequency Range:	2403-2481MHz (79 Channels)
Antenna:	External, Monopole: 1.5dBi
Rated Voltage:	2.4Vdc(2xAA Batteries)
Test Voltage:	2.4Vdc
Sample Received Date:	18 October 2016
Dates of testing:	15 and 16 December 2016
Sample type:	Pre-production

1.4 Operating Modes and Conditions

The EUT was configured with software to allow the EUT to be manually put into various modes of operation and operate continuously as indicated below:

The transmitter was programmed by setting the receiver to the desired channel and then syncing the transmitter to the receiver. Once connected, the device transmitted continuously at full power. The device was programmed to transmit at low, middle, and high channels.

Channel 03, 2403MHz

Channel 42, 2442MHz

Channel 81, 2481MHz

1.5 DUT Accessories

No accessories provided.

During testing the EUT was placed against the Oval Phantom in a Touch position with the back side

During testing 0cm distance was used. Distance was determined to be the minimum spacing from user when the EUT is worn.

2 TEST METHODOLOGY

Testing was performed in accordance with the IEEE STD 1528: 2013, IC RSS 102 Issue 5, as well as the following:

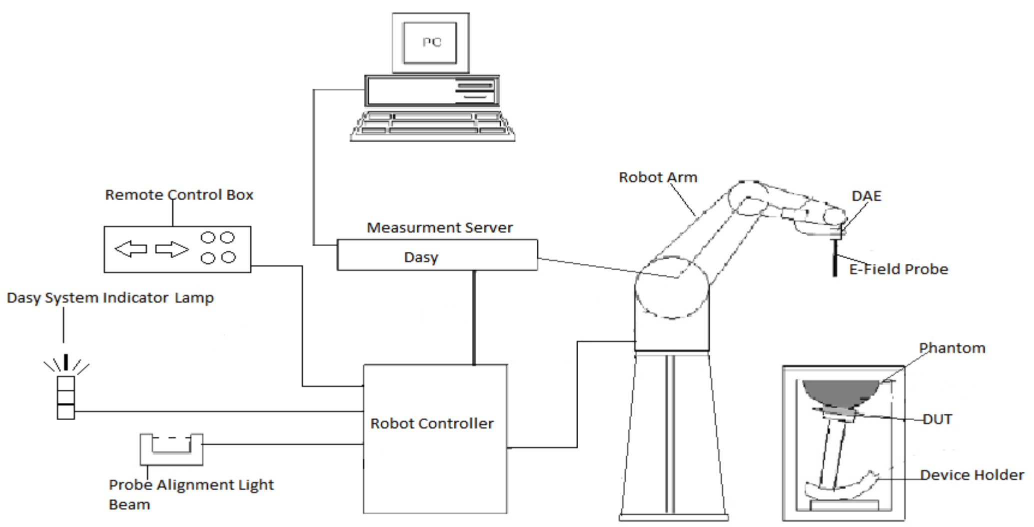
- IEC 62209-2
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 RF Exposure Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06

3 TEST EQUIPMENT

Equipment	Model	Manufacturer	Serial Number	Cal Date	Cal Int
Dasy5 Controller	SP1D	Stäubli	S-1188	NA	-
PC	Compaq 8000 Elite	HP	CZC1231RWS	NA	-
Probe Alignment Beam	LB5/80	Speag	SEUKS030AA	NA	-
Oval Phantom	ELI5	Speag	1146	NA	
Device Holder	SD 00 HO1 HA	Speag	NA	NA	-
Data Acquisition Electronics	DAE4	Speag	1287	1/19/2016	1yr
Dielectric Probe Kit	Dak-3.5	Speag	1109	NA	-
Body Simulating Liquid	BSL2450	SGS	NSN	Prior to testing	-
E-Field Probe	EX3DV4	Speag	3812	1/27/16	1yr
System Validation Dipole	D2450V2	Speag	890	1/21/2016	1yr
RF Cable	SF106	Huber & Suhner	247436006	8/3/16	1yr
RF Cable	SF106	Huber & Suhner	247435002	8/3/16	1yr
Network Analyzer	E5062A	Agilent	MY44102097	11/13/2016	1yr
Power Meter	E4419B	Agilent	G839511059	7/28/2017	1yr
Power Sensor	E9300B	Agilent	2702A61269	7/28/2017	1yr
Power Sensor	E9300B	Agilent	MY41094585	7/28/2016	1yr
Dual Directional Coupler	11692D	Hewlett Packard	1212A02572	8/6/14	3yr
Signal Generator	SMB100A	Rohde & Schwarz	104999	6/30/2014	3yr
Digital Thermometer	DTM3000	LKM Electronic	2952	11/30/2016	1yr

Note: The calibration period system validation dipoles is typically 1 year but may be 3 years. The dipoles with a 3yr calibration interval are validated annually according to FCC KDB 450824 D02 Dipole SAR Validation Verification v01r01.

3.1 TEST SYSTEM BLOCK DIAGRAM



The Dasy5 SAR test system consists of:

- 1 Stäubli Robot and system controller cabinet
- 1 Electro Optical Converter mounted on robots arm
- Robot stand
- Robot remote controller
- Light beam for E-field probe alignment
- DASY5 measurement server
- SAM Twin Phantom
- Hand-Held/ Laptop device holder
- HP PC with DASY5 software
- Data Acquisition Electronics(DAE)
- System validation dipole kit
- Head/Body simulating liquid
- E-field probe
- Warning lamps

4 LIQUID PARAMETERS CHECK

The tissue dielectric parameters shall be measured at the beginning of the test or within 24 hours of the first SAR test. All dielectric parameters should be within the tolerance values shown in Table 3-1. For frequencies in 300 MHz to just under 6 GHz, the measured conductivity and relative permittivity should be within ±5% of the target values in table 1. The measured permittivity tolerances can be relaxed to no more than the ±10%. All efforts should be made to obtain the target values as closely as possible.

The head tissue dielectric parameters recommended by the IEEE1528-2013 Standard have been incorporated in Table 3-1.

Table 3-1

Target dielectric properties of tissue equivalent material in the 300-2450 MHz frequency range

Frequency (MHz)	Head		Body	
	Relative permittivity (ε_r)	Conductivity(σ) (S/m)	Relative permittivity (ε_r)	Conductivity(σ) (S/m)
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55	1.05
1450	40.5	1.20	54	1.3
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95

Table 3-2

Tissue Simulating Liquid Formulations

	835 MHz		1900 MHz		2450 MHz		5200-5800 MHz	
	Head	Body	Head	Body	Head	Body	Head	Body
Bactericide	0.10	0.10					See Note 2	See Note 3
DGBE								
HEC	1.00	1.00						
NaCL	1.45	0.94	1.03	0.70	0.00	0.30		
Sucrose	57.00	44.90						
Polysorbate (Tween) 20			46.10	28.00	45.25	28.00		
Water	40.45	53.06	52.87	71.30	55.75	71.70		

Note 1: Speag proprietary - Water 50-65%; Mineral Oil 10-30%; Emulsifiers 8-25%; NaCL 0-1.5%; Hexylene Glycol 1.0-2.8%
Note 2: Speag proprietary - Water 60-80%; Esters, Emulsifiers, Inhibitors 20-40%; NaCL 0-1.5%; Oleic acid 10-28%

4.1 Table 3-2 Tissue Verification Measured

Tissue Verification									
Liquid Temp °C	Date	Tissue Type	Measured Frequency (MHz)	Measured Dielectric Constant, ε	Measured Condcutivity, σ S/m	Target Dielectric Constant, ε	Target Condcutivity, σ S/m	% deviation, ε	% deviation, σ
21.61	12/15/2016	2450B	2403	48.43	1.95	52.7	1.95	-8.1%	-0.2%
			2442	48.31	1.99	52.7	1.95	-8.3%	2.1%
			2450	48.28	1.99	52.7	1.95	-8.4%	2.1%
			2481	48.18	2.03	52.7	1.95	-8.6%	4.1%

5 SAR MEASUREMENT SYSTEM VERIFICATION

The system performance verification verifies the system operates within the ±10% limit. Each performance check is performed prior to any SAR testing to measure accuracy.

5.1 Performance check measurement conditions

- Measurements are performed in the flat section of the SAM phantom
- Phantom is filled with Head or Body simulating liquids
- DASY5 system parameters are tested using a Isotropic E-field probe
- The dipole is mounted on an extendable tripod that is positioned below the flat phantom center. The dipole is oriented parallel with the body's axis. The standard measuring distance is 10 mm above 1 GHz or 15 mm below 1 GHz from the dipole to the simulating liquids surface.
- A grid spacing of 15 mm is aligned with the dipole
- 7x7x7 cube is selected for a zoom scan
- A 4 mm distance is set between the probe and phantom surface
- Dipole input power(forward power) is set to 100 mW
- Results are normalized to 1 W input power

5.2 SAR Reference Values for Head and body calibration

Numerical reference SAR values (W/kg) for dipole and flat phantom
(IEEE1528-2013 Table 7)

Frequency (MHz)	1g SAR	10g SAR
300	3.0	2.0
450	4.9	3.3
835	9.5	6.2
900	10.8	6.9
1450	29.0	16.0
1800	38.1	19.8
1900	39.7	20.5
2000	41.1	21.1
2450	52.4	24.0

5.2.1 System Verification

System Check														
Scan	Date	Ambient Temp (°C)	Liquid Temp (°C)	Input Power (W)	Tissue Frequency (MHz)	Dipole SN	Tissue Type	Measured SAR_{1g} (W/kg)	1W Target SAR_{1g} (W/kg)	1W Normalized SAR_1 (W/kg)	Deviation (%)	Area Measured SAR_{1g} (W/kg)	Zoom vs Area %err	Validation Time
C1	12/15/2016	22.7	21.61	0.100	2450	890	Body	5.29	51.90	52.90	1.9%	5.350	1.1%	10:49am

6 SAR MEASUREMENT PROCEDURE

- Area Scan is used for a fast scan in two dimension to find the area of high field values before any finer measurement around the hotspot. The routines implemented in the DASY5 software can find the maximum locations.
- Zoom Scan is used to assess the peak spatial values within a cubic averaging volume containing 1g and 10g of simulated tissue. The scan measures a 7x7x7 area within the cube. Once measurement is done the values are displayed within the job's label.
- Power Drift will measure the field at the same location as the most recent power reference measurement within the same procedure and settings. The Power Drift Measurement gives the field difference in dB.
- Z- Scan measure points along a straight vertical line. The lines run along the z-axis of a one dimensial grid. To get a reasonable extrapolation the extrapolated distance should not be larger than the step size in z direction.

6.1 HEAD SAR CONFIGURATION

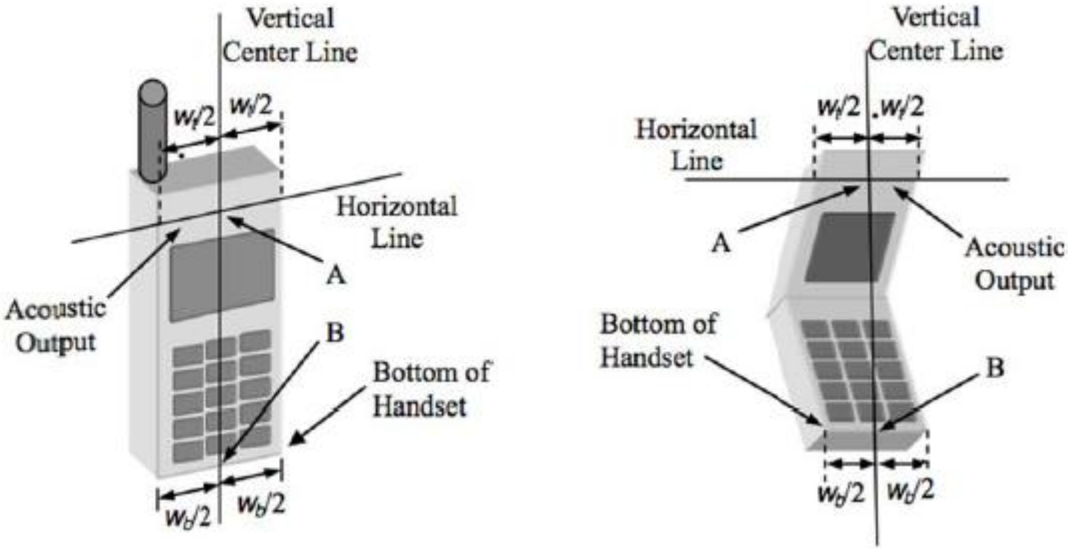
6.1.1 SAM SPECIFICATIONS

The Specific Anthropomorphic Mannequin (SAM) phantom corresponds to specifications defined in IEEE 1528 and IEC 62209-1. It allows dosimetric evaluation of the left, right, hand phone usage as well as body mounted usage at the flat region of the phantom

6.1.2 HANDSET REFERENCE POINTS

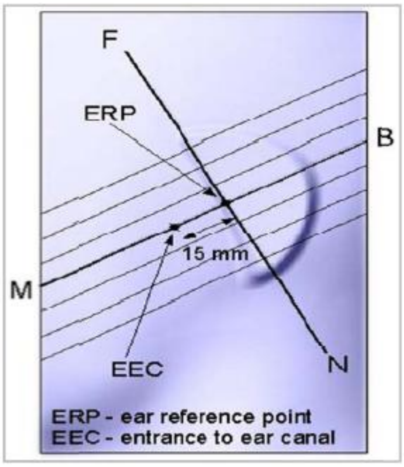
In order to identify reference points on the handset, define two imaginary lines on the handset

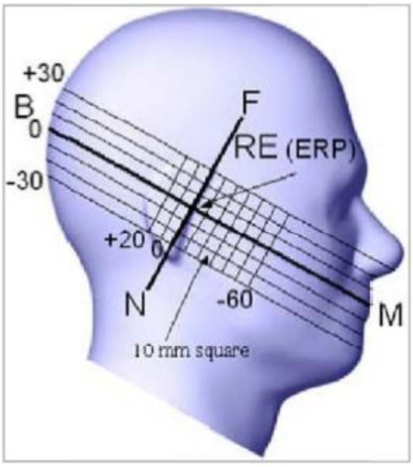
- The vertical centreline passes through two points on the front side of the handset. The midpoint of the width at the acoustic output and the midpoint of the width of the bottom of handset.
- The horizontal line is perpendicular to the vertical centreline and passes through the center of the acoustic output.
- The two lines intersect at point A.



6.1.3 EAR REFERENCE

This category includes most wireless handsets. The handset should have its earpieces located within the upper part of the device or along the centerline. The handset should be positioned with the earpiece region pressed against the ear spacer of the phantom.





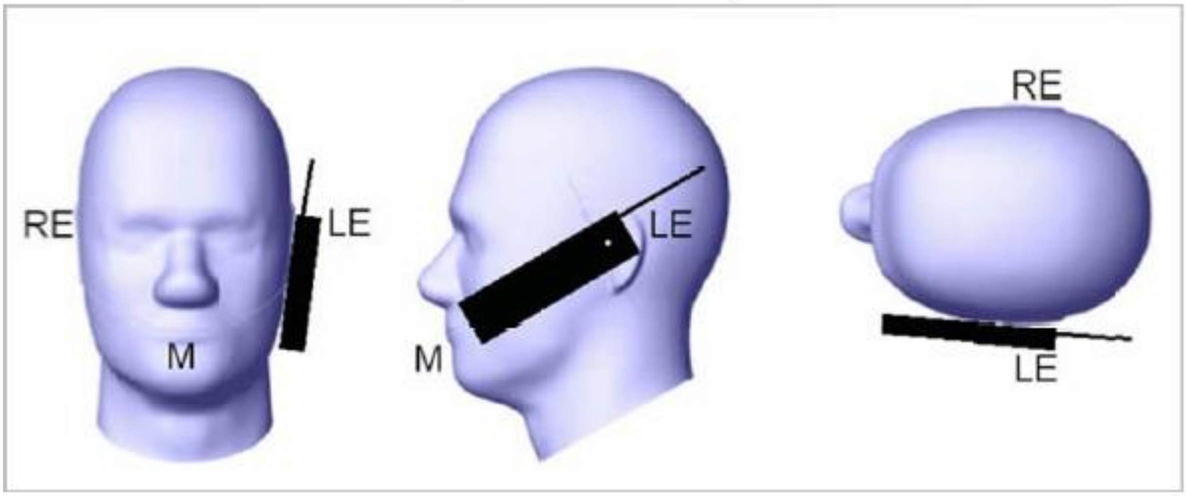
6.1.4 CHEEK POSITIONS

The device is attached toward the mouth part of the phantom by pivoting against the ear reference point

The test position is established when:

- Any point on the display, keypad or mouthpiece portion of the EUT is in contact with the phantom

Cheek / Touch Position

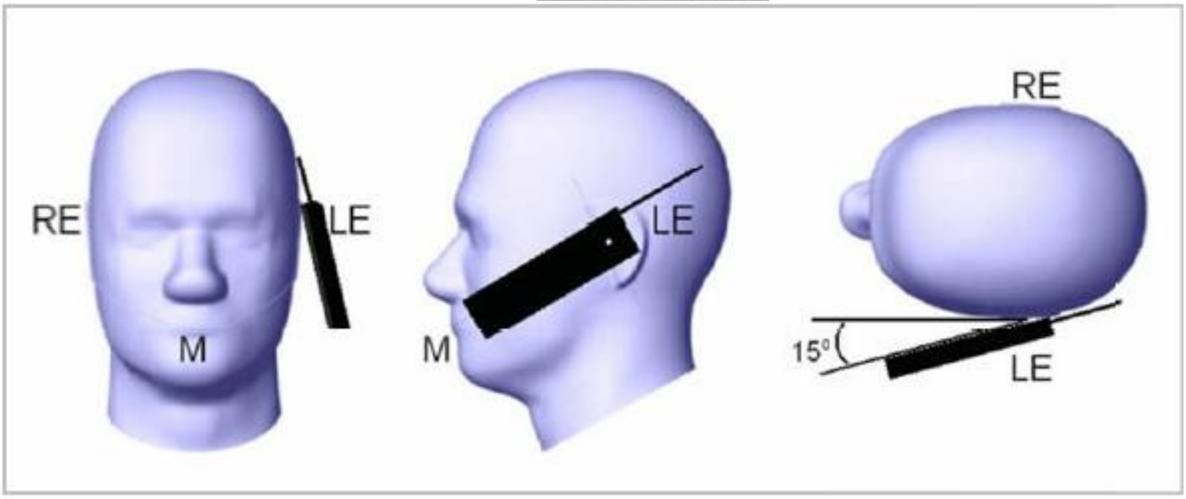


6.1.5 TILT POSITION

The test position is established when:

- Repeat the cheek touch position setup
- While maintaining the orientation of the handset move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
- Rotate the handset around the horizontal line by 15°
- While maintain the orientation of the handset move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear.
- The tilt position is obtained when the contact point is on the pinna and the antenna is at the back of the phantoms head.

Ear/Tilt 15° Position

- 

7 CONDUCTED OUTPUT POWER VERIFICATION

Frequency MHz	Measured Power dBm	Max Power dBm
2403	10.08	12.5
2442	12.32	12.5
2481	9.17	12.5

8 BODY SAR MEASUREMENT RESULTS

The results are compliant with FCC Part 2.1093. All values were measured to be less than 1.6 W/kg.

Date	Mode	CH	Frequency MHz	Max Pwr dBm	Meas Pwr dBm	Power Drift dB	1g SAR W/kg	Scaling factor	Scaled SAR 1g W/kg	Plot #
12/16/2016	2.4GHz	42	2442	12.50	12.32	0.03	0.169	1.042	0.176	-
		3	2403	12.50	10.08	0.18	0.116	1.746	0.203	-
		81	2481	12.50	9.17	0.29	0.298	2.153	0.642	1

9 UNCERTAINTY BUDGET 0.3 – 3 GHZ RANGE

Test Name:	SAR IEEE 1528/ 62209-1 (0.3 to 3 GHz range)
Instrument(s) Used:	SAR Measurement Sytem
Standard(s) Reference:	IEEE 1528:2013 and IEC 62209-1:2010

Symbol	Source of Uncertainty	Value	Probability Distribution	Divisor	ci (1g)	ci (10g)	Std. Unc. (1g)	Std. Unc. (10g)	vi or veff
	MEASUREMENT DESCRIPTION								
	Probe Calibration	5.5%	N1	1	1	1	5.5%	5.5%	inf
	Axial Isotropy	4.7%	R	1.732	0.7	0.7	1.9%	1.9%	inf
	Hemispherical Isotropy	9.6%	R	1.732	0.7	0.7	3.9%	3.9%	inf
	Boundary Effects	1.0%	R	1.732	1	1	0.6%	0.6%	inf
	Linearity	4.7%	R	1.732	1	1	2.7%	2.7%	inf
	System Detection Limits	1.0%	R	1.732	1	1	0.6%	0.6%	inf
	Modulation Response	2.4%	R	1.732	1	1	1.4%	1.4%	inf
	Readout Electronics	0.3%	N1	1	1	1	0.3%	0.3%	inf
	Response Time	0.8%	R	1.732	1	1	0.5%	0.5%	inf
	Integration Time	2.6%	R	1.732	1	1	1.5%	1.5%	inf
	RF Ambient Noise	3.0%	R	1.732	1	1	1.7%	1.7%	inf
	RF Ambient Reflections	3.0%	R	1.732	1	1	1.7%	1.7%	inf
	Probe Positioner	0.4%	R	1.732	1	1	0.2%	0.2%	inf
	Probe Positioning	2.9%	R	1.732	1	1	1.7%	1.7%	inf
	Max. SAR Eval.	1.0%	R	1.732	1	1	0.6%	0.6%	inf
	TEST SAMPLE RELATED								
	Device Positioning	2.9%	N1	1	1	1	2.9%	2.9%	inf
	Device Holder	3.6%	N1	1	1	1	3.6%	3.6%	inf
	Power Drift	5.0%	R	1.732	1	1	2.9%	2.9%	inf
	Power Scaling	0.0%	R	1.732	1	1	0.0%	0.0%	inf
	PHANTOM AND SETUP								
	Phantom Uncertainty	4.0%	R	1.732	1	1	2.3%	2.3%	inf
	SAR correction	1.9%	R	1.732	1	0.84	1.1%	0.9%	inf
	Liquid Conductivity(meas.)	2.5%	N1	1	0.78	0.71	2.0%	1.8%	inf
	Liquid Permittivity(meas.)	2.5%	N1	1	0.26	0.26	0.7%	0.7%	inf
	Temp. unc. - Conductivity	1.7%	R	1.732	0.78	0.71	0.8%	0.7%	inf
	Temp. unc. - Permittivity	0.3%	R	1.732	0.23	0.26	0.0%	0.0%	inf
			n1	1	1	1	0.0%	0.0%	inf
uc(Fs)	Combined Standard Uncertainty		N1	1			10.6%	10.5%	
U(Fs)	Expanded Uncertainty		Normal k=	2			**21.2%**	**21.1%**	

The Expanded Uncertainty is 21.2% for a Normal k factor equal to 2

10 SAR PLOT

Plot 1

DUT: ClearOne; Type: Beltpack; Serial: 1

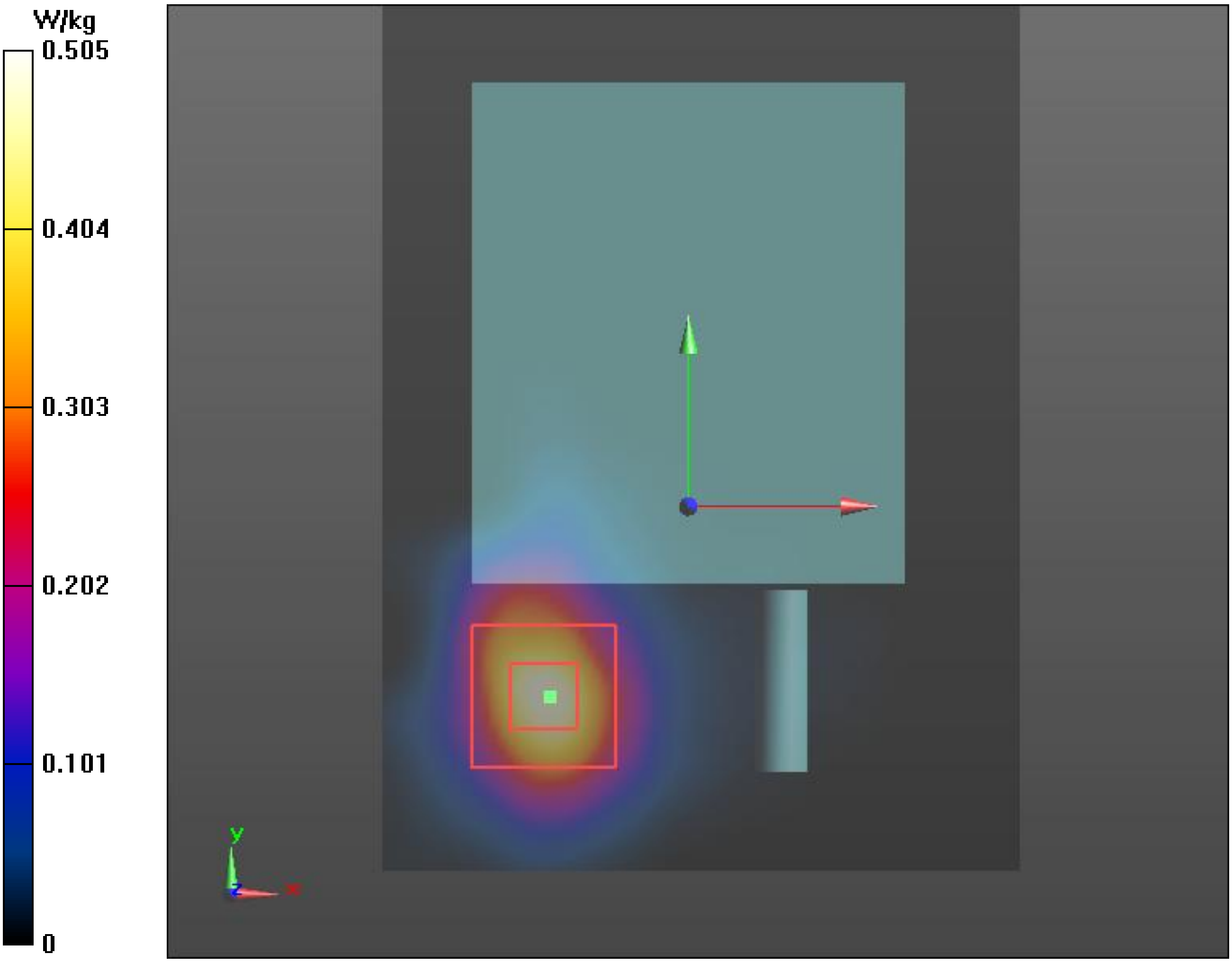
Communication System: UID 0, CW (0); Communication System Band: FullSpan (0.0 - 6000.0 MHz);
Frequency: 2481 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 2481 MHz; σ = 2.035 S/m; ε_r = 48.182; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5

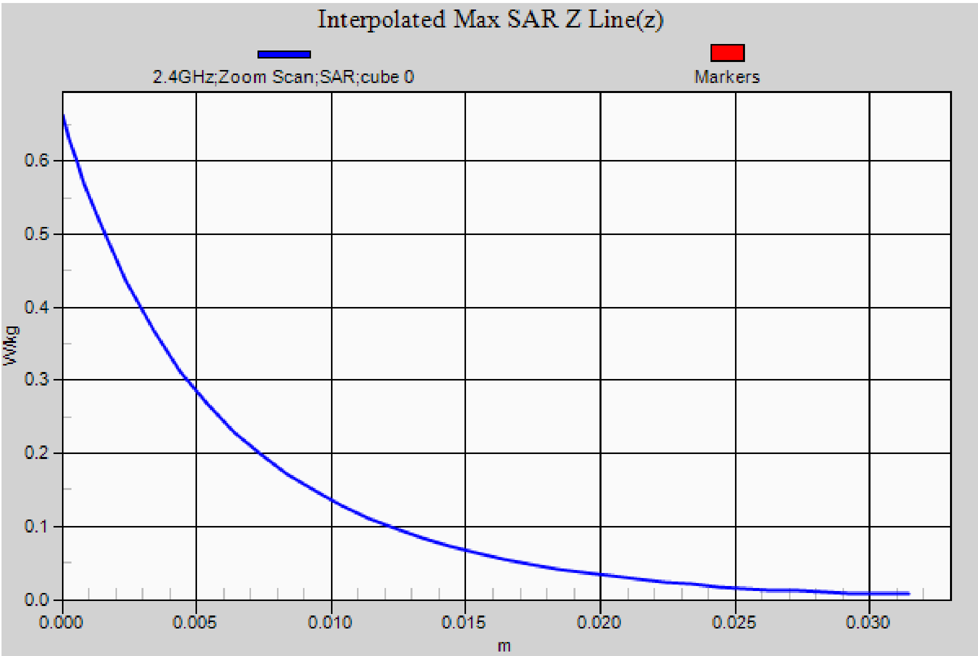
DASY Configuration:

- Probe: EX3DV4 - SN3812; ConvF(7.2, 7.2, 7.2); Calibrated: 1/27/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1287; Calibrated: 1/19/2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1146
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Configuration/2.4GHz/Area Scan (81x111x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.505 W/kg

Configuration/2.4GHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.330 V/m; Power Drift = 0.29 dB
Peak SAR (extrapolated) = 0.663 W/kg
SAR(1 g) = 0.298 W/kg; SAR(10 g) = 0.134 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.507 W/kg


W/kg
0.505
0.404
0.303
0.202
0.101
0
y
z
x


Interpolated Max SAR Z Line(z)
2.4GHz;Zoom Scan;SAR;cube 0
Markers
W/kg
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

11 SYSTEM CHECK PLOT

C1

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:890

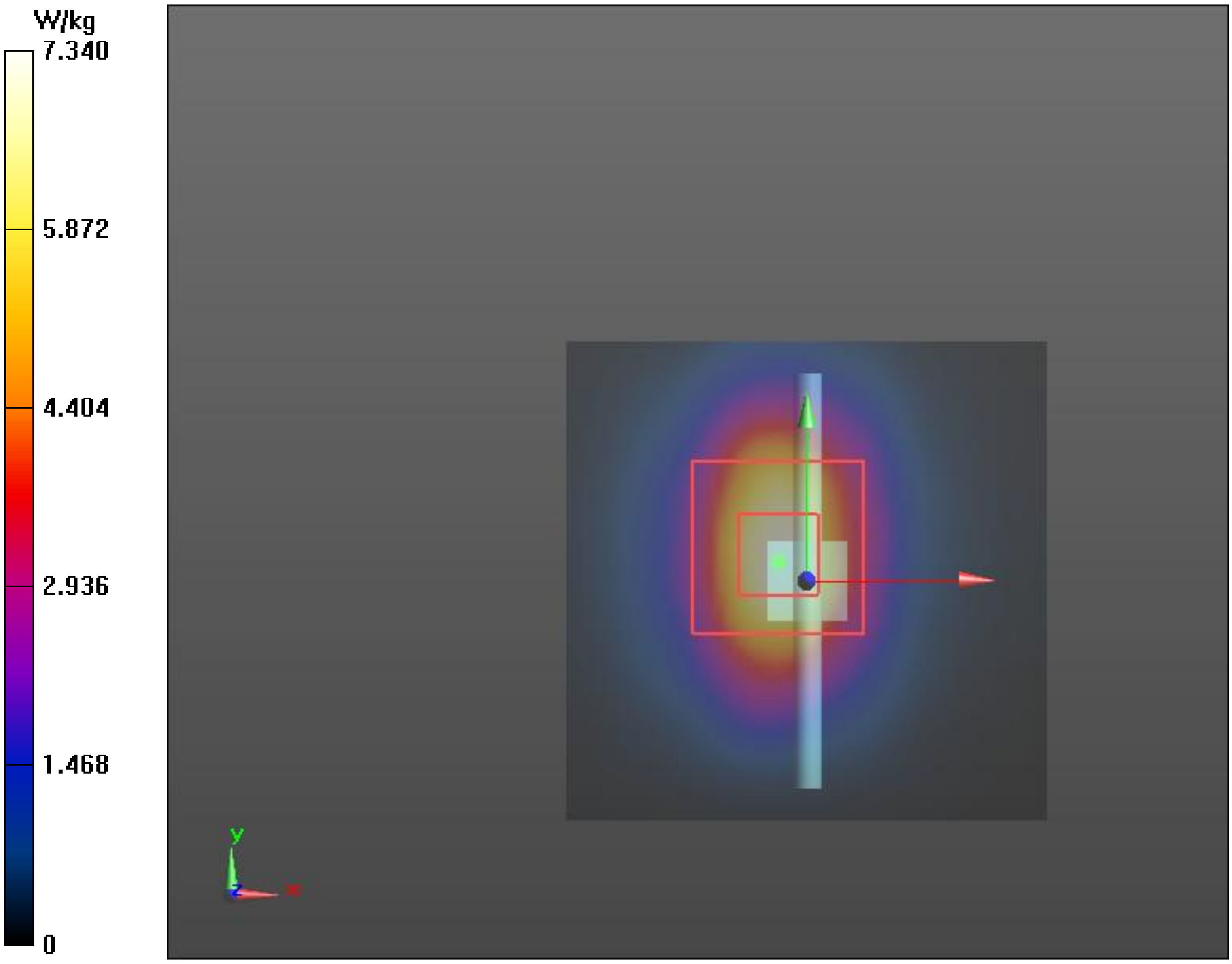
Communication System: UID 0, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 2450 MHz; σ = 1.998 S/m; ε_r = 48.279; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5

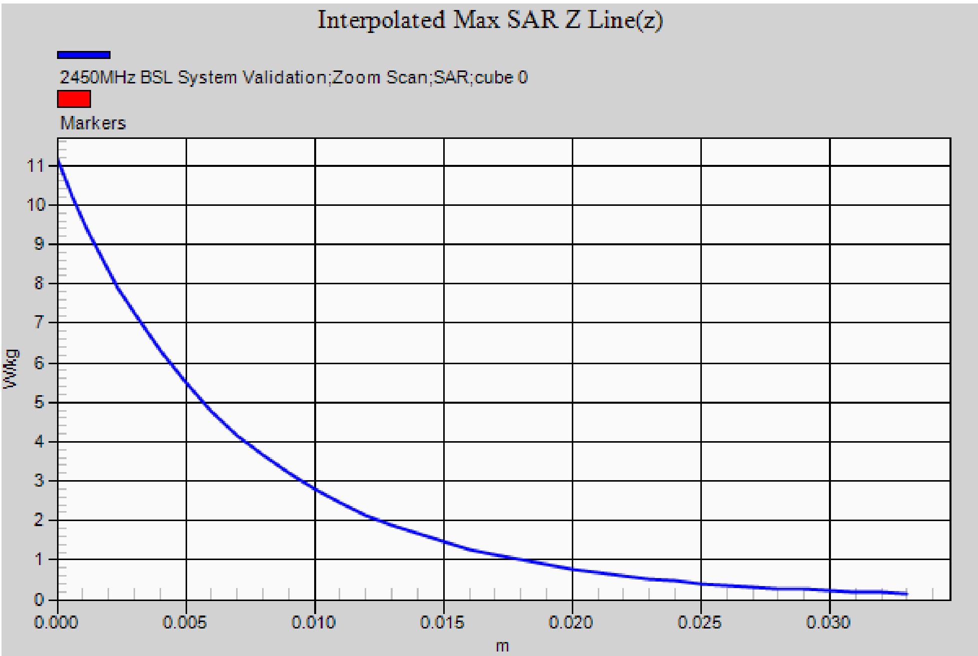
DASY Configuration:

- Probe: EX3DV4 - SN3812; ConvF(7.2, 7.2, 7.2); Calibrated: 1/27/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0, 16.0
- Electronics: DAE4 Sn1287; Calibrated: 1/19/2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1146
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

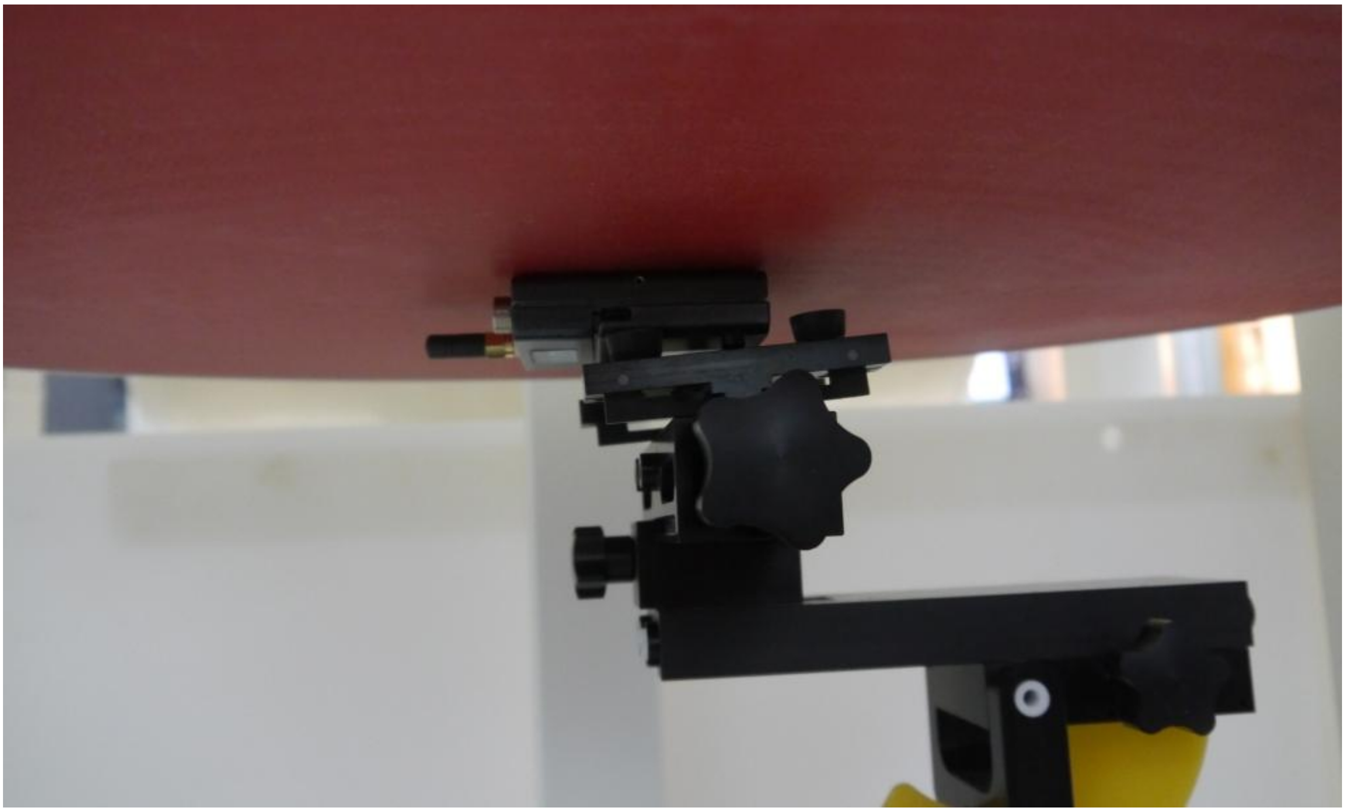
Configuration/2450MHz BSL System Validation/Area Scan (51x51x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 7.34 W/kg

Configuration/2450MHz BSL System Validation/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.84 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 11.2 W/kg
SAR(1 g) = 5.29 W/kg; SAR(10 g) = 2.48 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 7.22 W/kg


W/kg
7.340
5.872
4.404
2.936
1.468
0
y
x


Interpolated Max SAR Z Line(z)
2450MHz BSL System Validation;Zoom Scan;SAR;cube 0
Markers
W/kg
m
0.000
0.005
0.010
0.015
0.020
0.025
0.030

12 SETUP PHOTOGRAPHS



13 REVISION HISTORY

Revision Level	Description of changes	Revision Date
0	Initial release	28 December 2016