

# RF Exposure Lab

802 N. Twin Oaks Valley Road, Suite 105 • San Marcos, CA 92069 • U.S.A.  
TEL (760) 471-2100 • FAX (760) 471-2121  
<http://www.rfexposurelab.com>

## CERTIFICATE OF COMPLIANCE SAR EVALUATION

Teligy  
40 Concourse Way  
Greer, SC 29650

Dates of Test: May 16 & June 1, 2012  
Test Report Number: SAR.20110609  
Revision B

FCC ID:	Z5E-IPWPEM1-BG1
Model(s):	WBG
Test Sample:	Engineering Unit Same as Production
Serial Number:	WBG00112
Equipment Type:	Wireless Locator
Classification:	Portable Transmitter Next to Body
TX Frequency Range:	2498.8 – 2687.2 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	2600 MHz – 23.83 dB Conducted
Signal Modulation:	QPSK
Antenna Type:	Internal; Ant 1 – Antenova P/N 3030A6250-01; Ant 2 – Antenova P/N 3030A6150-01
Application Type:	Certification
FCC Rule Parts:	Part 2, 27
KDB Test Methodology:	KDB 447498, KDB 615223
Maximum SAR Value:	1.244 W/kg
Separation Distance:	0 mm

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE 1528-2003, OET Bulletin 65 Supp. C, RSS-102 and Safety Code 6 (See test report).

I attest to the accuracy of the data. All measurements were performed by myself or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RF Exposure Lab, LLC certifies that no party to this application are subject to denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 863(a).



Jay M. Moulton  
Vice President



Certificate # 2387.01

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## 1. Introduction

This measurement report shows compliance of the Teligy Model WBG FCC ID: Z5E-IPWPEM1-BG1 with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices. The FCC have adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on August 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC regulated portable devices. [1], [6]

The test results recorded herein are based on a single type test of Teligy Model WBG and therefore apply only to the tested sample.

The test procedures, as described in ANSI C95.1 – 1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [2], ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields [3], FCC OET Bulletin 65 Supp. C – 2001 [4], IEEE Std.1528 – 2003 Recommended Practice [5], and Health Canada Safety Code 6 Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz were employed.

### SAR Definition [5]

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

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

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

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

where:

$\sigma$  = conductivity of the tissue (S/m)

$\rho$  = mass density of the tissue (kg/m<sup>3</sup>)

$E$  = rms electric field strength (V/m)

## 2. SAR Measurement Setup

### Robotic System

The measurements are conducted utilizing the ALSAS-10-U automated dosimetric assessment system. The ALSAS-10-U is designed and manufactured by Aprel Laboratories in Nepean, Ontario, Canada. The system utilizes a Robcomm 3 robot manufactured by ThermoCRS located in Michigan USA.

### System Hardware

The system consists of a six axis articulated arm, controller for precise probe positioning (0.05 mm repeatability), a power supply, a teach pendent for teaching area scans, near field probe, an IBM Pentium 4™ 2.66 GHz PC with Windows XP Pro™, and custom software developed to enable communications between the robot controller software and the host operating system.

An amplifier is located on the articulated arm, which is isolated from the custom designed end effector and robot arm. The end effector provides the mechanical touch detection functionality and probe connection interface. The amplifier is functionally validated within the manufacturer's site and calibrated at NCL Calibration Laboratories. A Data Acquisition Card (DAC) is used to collect the signal as detected by the isotropic e-field probe. The DAC manufacturer calibrates the DAC to NIST standards. A formal validation is executed using all mechanical and electronic components to prove conformity of the measurement platform as a whole.

### System Description

The ALSAS-10-U has been designed to measure devices within the compliance environment to meet all recognized standards. The system also conforms to standards, which are currently being developed by the scientific and manufacturing community.

The course scan resolution is defined by the operator and reflects the requirements of the standard to which the device is being tested. Precise measurements are made within the predefined course scan area and the values are logged.

The user predefines the sample rate for which the measurements are made so as to ensure that the full duty-cycle of a pulse modulation device is covered during the sample. The following algorithm is an example of the function used by the system for linearization of the output for the probe.

$$V_i = U_i + U_i^2 \bullet \frac{cf}{dcpi}$$



The Aprel E-Field probe is evaluated to establish the diode compression point.

A complex algorithm is then used to calculate the values within the measured points down to a resolution of 1mm. The data from this process is then used to provide the co-ordinates from which the cube scan is created for the determination of the 1 g and 10 g averages.

Cube scan averaging consists of a number of complex algorithms, which are used to calculate the one, and ten gram averages. The basis for the cube scan process is centered on the location where the maximum measured SAR value was found. When a secondary peak value is found which is within 60% of the initial peak value, the system will report this back to the operator who can then assess the need for further analysis of both the peak values prior to the one and ten-gram cube scan averaging process. The algorithm consists of 3D cubic Spline, and Lagrange extrapolation to the surface, which form the matrix for calculating the measurement output for the one and ten gram average values. The resolution for the physical scan integral is user defined with a final calculated resolution down to 1mm.

In-depth analysis for the differential of the physical scanning resolution for the cube scan analysis has been carried out, to identify the optimum setting for the probe positioning steps, and this has been determined at 8mm increments on the X, & Y planes. The reduction of the physical step increment increased the time taken for analysis but did not provide a better uncertainty or return on measured values.

The final output from the system provides data for the area scan measurements, physical and splined (1mm resolution) cube scan with physical and calculated values (1mm resolution).

The overall uncertainty for the methodology and algorithms the ALSAS-10-U used during the SAR calculation was evaluated using the data from IEEE 1528 f3 algorithm:

$$f_3(x, y, z) = A \frac{a^2}{\frac{a^2}{4} + x'^2 + y'^2} \left( e^{-\frac{2z}{a}} + \frac{a^2}{2(a + 2z)^2} \right)$$

The probe used during the measurement process has been assessed to provide values for diode compression. These values are calculated during the probe calibration exercise and are used in the mathematical calculations for the assessment of SAR.

## E-Field Probe

The E-field probe used by RF Exposure Lab, LLC, has been fully calibrated and assessed for isotropic, and boundary effect. The probe utilizes a triangular sensor arrangement as detailed in the diagram below right.



The SAR is assessed with the probe which moves at a default height of 4 mm from the center of the diode, which is mounted to the sensor, to the phantom surface (Z height). The diagram above right shows how the center of the sensor is defined with the location of the diode placed at the center of the dipole. The 4 mm default in the Z axis is the optimum height for assessing SAR where the boundary effect is at its least, with the probe located closest to the phantom surface (boundary).

The manufacturer specified precision of the robot is  $\pm 0.05$  mm and the precision of the APREL bottom detection device is  $\pm 0.1$  mm. These precisions are calibrated and tested in the manufacturing process of the bottom detection device. A constant distance is maintained because the surface of the phantom is dynamically detected for each point. The surface detection algorithm corrects the position of the robot so that the probe rests on the surface of the phantom. The probe is then moved to the measurement location 2.44 mm above the phantom surface resulting in the probe center location to be at 4.0 mm above the phantom surface. Therefore, the probe sensor will be at 4.0 mm above the phantom surface  $\pm 0.1$  mm for each SAR location for frequencies below 3 GHz. The probe is moved to the measurement location 1.44 mm above the phantom surface resulting in the probe center location to be at 2.0 mm above the phantom surface. Therefore, the probe sensor will be at 2.0 mm above the phantom surface  $\pm 0.1$  mm for each SAR location for frequencies above 3 GHz.

The probe boundary effect compensation cannot be disabled in the ALSAS-10U testing system. The probe tip will always be at least half a probe tip diameter from the phantom surface. For frequencies up to 3 GHz, the probe diameter is 5 mm. With the sensor offset set at 1.54 mm (default setting), the sensor to phantom gap will be 4.0 mm which is greater than half the probe tip diameter. For frequencies greater than 3 GHz, the probe diameter is 3 mm. With the sensor offset set at 0.56 mm (default setting), the sensor to phantom gap will be 3.0 mm which is greater than half the probe tip diameter.

The separation of the first 2 measurement points in the zoom scan is specified in the test setup software. For frequencies below 3 GHz, the user must specify a zoom scan resolution of less than 6 mm in the z-axis to have the first two measurements within 1 cm of the surface. The z-axis is set to 4 mm as shown on each of the data sheets in Appendix B. For frequencies above 3 GHz, the user must specify a zoom scan resolution of less than 3 mm in the z-axis to have the first two measurements within 5 mm of the surface. The z-axis is set to 2 mm as shown on each of the data sheets in Appendix B.

The zoom scan volume for devices  $\leq 3$  GHz with a cube scan of 5x5x8 yields a volume of  $32 \times 32 \times 28$  mm<sup>3</sup>. For devices  $> 3$  GHz and  $< 4.5$  GHz, the cube scan of 9x9x9 yields a volume of  $32 \times 32 \times 24$  mm<sup>3</sup>. For devices  $\geq 4.5$  GHz, the cube scan of 7x7x12 yields a volume of  $24 \times 24 \times 22$  mm<sup>3</sup>.

### 3. Robot Specifications

#### Specifications

Positioner:	ThermoCRS, Robot Model: Robocomm 3
Repeatability:	0.05 mm
No. of axis:	6

#### Data Acquisition Card (DAC) System

#### Cell Controller

Processor:	Pentium 4™
Clock Speed:	2.66 GHz
Operating System:	Windows XP Pro™

#### Data Converter

Features:	Signal Amplifier, End Effector, DAC
Software:	ALSAS 10-U Software

#### E-Field Probe

Model:	Various See Probe Calibration Sheet
Serial Number:	Various See Probe Calibration Sheet
Construction:	Triangular Core Touch Detection System
Frequency:	10MHz to 6GHz

#### Phantom

Phantom:	Uniphantom, Right Phantom, Left Phantom
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## 4. Probe and Dipole Calibration

See Appendix D and E.

## 5. Phantom & Simulating Tissue Specifications

### SAM Phantom



The Aprel system utilizes three separate phantoms. Each phantom for SAR assessment testing is a low loss dielectric shell, with shape and dimensions derived from the anthropomorphic data of the 90<sup>th</sup> percentile adult male head dimensions as tabulated by the US Army. The SAM phantom shell is bisected along the mid sagittal plane into right and left halves. The perimeter sidewalls of each phantom half is extended to allow filling with liquid to a depth of 15 cm that is sufficient to minimize reflections from the upper surface [5]. The Uni-Phantom is used to conduct body measurements and head to face measurements. The depth of the phantom allows for 15 cm of tissue material to be filled within the phantom. See photos in Appendix C.

### Head & Body Simulating Mixture Characterization

The head and body mixtures consist of the material based on the table listed below. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. Body tissue parameters that have not been specified in P1528 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations.

**Table 5.1 Typical Composition of Ingredients for Tissue**

Ingredients	Simulating Tissue	
	2600 MHz Body	
Mixing Percentage		
Water		69.83
Sugar		0.00
Salt		0.00
HEC		0.00
Bactericide		0.00
DGBE		30.17
Dielectric Constant	Target	52.51
Conductivity (S/m)	Target	2.16

### Device Holder



In combination with the SAM phantom, the mounting device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, and uni-phantom).

## 6. ANSI/IEEE C95.1 – 1992 RF Exposure Limits [2]

### Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 6.1 Human Exposure Limits**

	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Professional Population (W/kg) or (mW/g)
SPATIAL PEAK SAR <sup>1</sup> Head	1.60	8.00
SPATIAL AVERAGE SAR <sup>2</sup> Whole Body	0.08	0.40
SPATIAL PEAK SAR <sup>3</sup> Hands, Feet, Ankles, Wrists	4.00	20.00

<sup>1</sup> The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

<sup>2</sup> The Spatial Average value of the SAR averaged over the whole body.

<sup>3</sup> The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

## 7. Measurement Uncertainty

### Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	$c_i^1 (1-g)$	$c_i^1 (10-g)$	Standard Uncertainty (1-g) %	Standard Uncertainty (10-g) %	$v_i$
Measurement System								
Probe Calibration	3.5	normal	1	1	1	3.5	3.5	$\infty$
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	0.7	0.7	1.5	1.5	$\infty$
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	0.7	0.7	4.4	4.4	$\infty$
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
Linearity	4.7	rectangular	$\sqrt{3}$	1	1	2.7	2.7	$\infty$
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
Readout Electronics	1.0	normal	1	1	1	1.0	1.0	$\infty$
Response Time	0.8	rectangular	$\sqrt{3}$	1	1	0.5	0.5	$\infty$
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1	1.0	1.0	$\infty$
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1	1.7	1.7	$\infty$
Probe Positioner Mech. Restriction	0.4	rectangular	$\sqrt{3}$	1	1	0.2	0.2	$\infty$
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1	1.7	1.7	$\infty$
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	1	2.1	2.1	$\infty$
Test Sample Positioning	4.0	normal	1	1	1	4.0	4.0	7
Device Holder Uncertainty	2.0	normal	1	1	1	2.0	2.0	2
Drift of Output Power	4.2	rectangular	$\sqrt{3}$	1	1	2.4	2.4	$\infty$
Phantom and Setup								
Phantom Uncertainty (shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	1	2.0	2.0	$\infty$
Liquid Conductivity (target)	5.0	rectangular	$\sqrt{3}$	0.7	0.5	2.0	1.4	$\infty$
Liquid Conductivity (meas.)	0.5	normal	1	0.7	0.5	0.4	0.3	5
Liquid Permittivity (target)	5.0	rectangular	$\sqrt{3}$	0.6	0.5	1.7	1.4	$\infty$
Liquid Permittivity (meas.)	1.0	normal	1	0.6	0.5	0.6	0.5	5
Combined Uncertainty		RSS				9.6	9.4	>500
Combined Uncertainty (coverage factor=2)		Normal (k=2)				19.1	18.8	>500

## 8. System Validation

### Tissue Verification

**Table 8.1 Measured Tissue Parameters**

		2590 MHz Body		2590 MHz Body	
Date(s)		May 16, 2012		Jun. 1, 2012	
Liquid Temperature (°C)	20.0	Target	Measured	Target	Measured
Dielectric Constant: $\epsilon$	52.52	52.28	52.52	52.48	
Conductivity: $\sigma$	2.15	2.18	2.15	2.16	

See Appendix A for data printout.

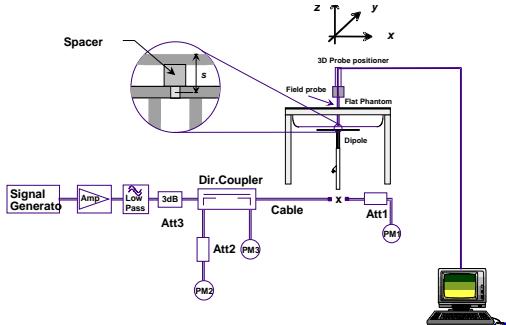
### Test System Verification

Prior to assessment, the system is verified to the  $\pm 10\%$  of the specifications at the test frequency by using the system kit. Power is normalized to 1 watt. Body Tissue used for all validation test setups. The probe is valid to  $\pm 100$  MHz for 835 and 1900 MHz, and  $\pm 5\%$  for 2600 MHz. The dipole is valid over the same frequency range. (Graphic Plots Attached)

**Table 8.2 System Dipole Validation Target & Measured**

	Test Frequency	Target 1W SAR <sub>1g</sub> (W/kg) per Certificate	Tissue Used for Calibration	Tissue Used for Verification	Measure SAR <sub>1g</sub> (W/kg)	Deviation (%)
16-May-2012	2600 MHz	56.42	Body	Body	55.40	- 1.81
01-Jun-2012	2600 MHz	56.42	Body	Body	54.01	- 4.27

See Appendix A for data plots.



**Figure 8.1 Dipole Validation Test Setup**

## 9. SAR Test Data Summary

### See Measurement Result Data Pages

See Appendix B for SAR Test Data Plots.

See Appendix C for SAR Test Setup Photos.

### Procedures Used To Establish Test Signal

The actual transmission is activated through a base station simulator or similar equipment. The DUT did not contain any test software to facilitate any of the required signaling for the tests. See data pages for actual procedure used in measurement.

### Device Test Condition

In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power unless otherwise noted. If a conducted power deviation of more than 5% occurred, the test was repeated. The power drift of each test is measured at the start of the test and again at the end of the test. The drift percentage is calculated by the formula  $((\text{end/start})-1)*100$  and rounded to three decimal places. The drift percentage is calculated into the resultant SAR value on the data sheet for each test.

The device was tested on front and back sides. The power was set to maximum power for each test in each bandwidth and modulation. All testing was conducted per KDB 447498 and KDB 615223.

Bluetooth operation was not evaluated as the power level of the BT transmitter was less than  $60/f_{\text{GHz}}$ .

## 10. WiMax System Description

The device is a 2.5 GHz WiMax transceiver in a host configuration using IPWireless chipset which supports 1xTx and 2xRx for this device. Both antennas were tested for transmitting to insure that any cross wiring of the antennas would be evaluated. The IPWireless module utilizes a proprietary WiMax signal. The maximum duty cycle given by the manufacturer of the module is 40%. Therefore, the conversion factor for testing was determined to be  $1/0.4 = 2.5$ .

In the test mode, the UL operates in PUSC with all data sub-channels occupied with data. During normal operation, the MS will transmit on all sub-channels when the maximum UL throughput is required. It is possible for the MS to transmit with fewer sub-channels. The sub-channels consist of tones that are distributed over the entire signal BW and a jump every three symbols so that the spectral density and hence SAR for the fractional sub-channel case will be similar to the full sub-channel case that is tested. (Note: In the WiMax standard, a sub-channel consists of tones that are spread across the occupied bandwidth. After every three symbols, the tones that make up the sub-channel switch to a new set of frequencies spread across the band. This "jumping" is called sub-channel rotation and helps to give the sub-channel frequency diversity.)

The testing was done using a common 29:18 ratio as this is the maximum achievable ratio for the product. The 29 indicates the number of downlink (from the base station) symbols, and the 18 indicates the number of uplink (transmitted from the MS) symbols. Inside the uplink, 15 symbols are used for data, and three of the symbols are used for sending control information to the network. During the testing, the control symbols contained no information, so did not contribute to the total energy transmitted. To compensate for the maximum energy which may be present in the 3 control symbols, the following scheme is used for the scaling factor:

Maximum output power of 5 MHz is 23.83 dBm = 241.55 mW

The maximum power in 5 MHz control traffic is 71.04 mW (5/17 of 241.55 mW)

**Scaled factor for 5 MHz Bandwidth = see table below**

Maximum output power of 10 MHz is 23.96 dBm = 248.89 mW

The maximum power in 10 MHz control traffic is 35.56 mW (5/35 of 248.89 mW)

**Scaled factor for 10 MHz Bandwidth = see table below**

## 10.1.1 WiMax Conducted Power Measurements

Zone Type	Modulation	Frequency	Chain A - Main		
			Peak Power	Average Power	PAPR
PUSC	QPSK (5 MHz)	2498.5	33.02	23.81	9.21
		2593.0	32.50	23.83	8.67
		2687.5	32.49	23.77	8.72
	16QAM (5 MHz)	2498.5	33.11	23.76	9.35
		2593.0	32.46	23.79	8.67
		2687.5	32.72	23.75	8.97
	64QAM (5 MHz)	2498.5	33.18	23.72	9.46
		2593.0	32.52	23.77	8.75
		2687.5	32.40	23.73	8.67
	QPSK (10 MHz)	2501.0	33.53	23.92	9.61
		2593.0	32.90	23.96	8.94
		2685.0	32.88	23.89	8.99
	16QAM (10 MHz)	2501.0	33.58	23.88	9.70
		2593.0	32.63	23.91	8.72
		2685.0	32.75	23.84	8.91
	64QAM (10 MHz)	2501.0	33.31	23.86	9.45
		2593.0	32.72	23.89	8.83
		2685.0	32.81	23.87	8.94

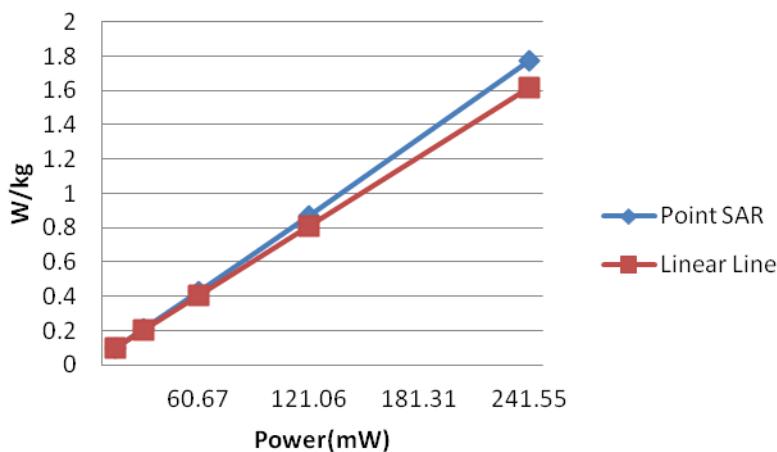
Note: An Agilent wideband power meter was used for measuring the conducted power.

The SAR probe used in the measurements is calibrated with a sinusoidal CW signal. Since the DL:UL symbol ratio configuration used in the SAR tests provides a periodic uplink burst, the duty factor can be compensated by selecting the correct conversion factor (cf) for the SAR measurements. The high PAPR of OFDM/OFDMA is expected to introduce additional SAR measurement errors because the SAR probe is not calibrated for this type of random noise-like signals with large amplitude and phase variations within the bursts. The SAR error is also expected to vary with the average power and average PAPR at each measurement point, both temporally and spatially. In order to estimate the measurement error due to PAPR issues, the configuration with the highest SAR in each channel bandwidth and frequency band is measured at various power levels, from 16.60 mW for 5 MHz BW and 14.45 mW for 10 MHz BW, in 3 dB steps, until the maximum power level is reached with the device positioned 0 mm from the phantom surface. As shown by the results and plot below, SAR is linear to power only when the probe sensors are operating within the square-law region. As power continues to increase, the measured SAR error becomes increasingly larger. Since these are single point peak SAR values measured with the probe positioned at the peak SAR location, at 2 mm from the phantom surface, the values are substantially higher than the 1-g SAR required to determine compliance. Based on the linearity plots, SAR is not being underestimated.

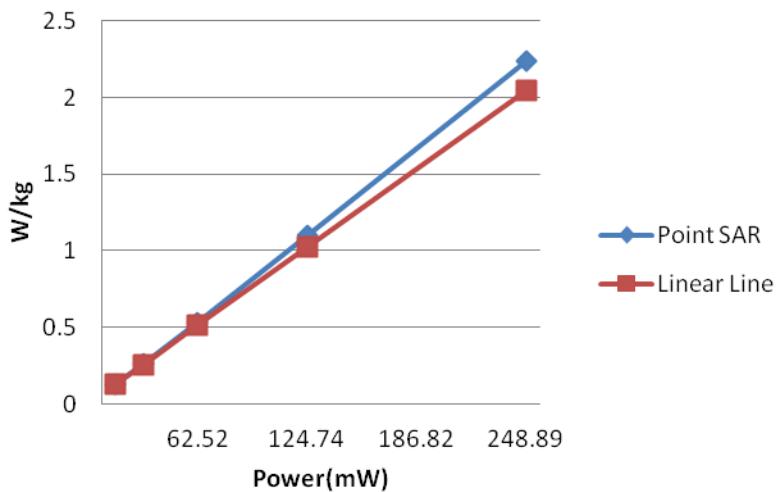
## Linearity Response Check QPSK

Output Power	dBm	11.83	14.83	17.83	20.83	23.83
	mW	15.24	30.41	60.67	121.06	241.55
<b>5 MHz Single Point SAR (W/kg)</b>		0.101	0.209	0.424	0.865	1.771
<b>5 MHz Linear Line</b>		0.101	0.202	0.404	0.808	1.616
<b>Percent Deviation</b>		0.00	3.47	4.95	7.05	9.59
Output Power	dBm	11.96	14.96	17.96	20.96	23.96
	mW	15.70	31.33	62.52	124.74	248.89
<b>10 MHz Single Point SAR (W/kg)</b>		0.128	0.264	0.535	1.102	2.241
<b>10 MHz Linear Line</b>		0.128	0.256	0.512	1.024	2.048
<b>Percent Deviation</b>		0.00	3.13	4.49	7.62	9.42

## 5 MHz QPSK



## 10 MHz QPSK



PUSC				
	High	Middle	Low	Max. Rated Power
	QPSK	QPSK	QPSK	QPSK
<b>5 MHz</b>	238	242	240	282
<b>Scaling Factor</b>	1.255	1.234	1.244	
<b>10 MHz</b>	245	249	247	282
<b>Scaling Factor</b>	1.184	1.165	1.174	

**5 MHz calculation of Scaling Factor formula used is as follows:**

$$[(\text{Rated Power}^*5/17)^*3 + (\text{Rated Power}^*15)]/[\text{Measured Power}^*15]$$

**10 MHz calculation of Scaling Factor formula used is as follows:**

$$[(\text{Rated Power}^*5/35)^*3 + (\text{Rated Power}^*15)]/[\text{Measured Power}^*15]$$

Sample of Scaling Factor Calculation:

Using High Channel 5 MHz QPSK the measured average power was 238 mW. The maximum rated power of the device is 282 mW.

$$[(282 \text{ mW}^*5/17)^*3 + (282 \text{ mW}^*15)]/[238 \text{ mW}^*15] = 1.255$$

Using High Channel 10 MHz QPSK the measured average power was 245 mW. The maximum rated power of the device is 282 mW.

$$[(282 \text{ mW}^*5/35)^*3 + (282 \text{ mW}^*15)]/[245 \text{ mW}^*15] = 1.184$$

**10.2.1 Spectrum Analyzer Plots (See Appendix G for Plots)**

SAR Test Configurations for WiMax						
		QPSK				
		Side	Low	Mid	High	
Antenna 1	PUSC	5 MHz	Back	Note 1	Tested	Note 1
		5 MHz	Front	Tested	Tested	Tested
		10 MHz	Back	Note 1	Tested	Note 1
		10 MHz	Front	Tested	Tested	Tested
		5 MHz	Back	Note 1	Tested	Note 1
		5 MHz	Front	Note 1	Tested	Note 1
Antenna 2		10 MHz	Back	Note 1	Tested	Note 1
		10 MHz	Front	Tested	Tested	Tested

Note 1 - Reduced Per KDB 447498 1) e).

SAR Test Configurations for WiMax									
		16QAM					64QAM		
		Side	Low	Mid	High	Low	Mid	High	
Antenna 1	PUSC	5 MHz	Back	Note 2					
		5 MHz	Front	Note 2	Note 2	Tested	Note 2	Note 2	Tested
		10 MHz	Back	Note 2					
		10 MHz	Front	Note 2	Tested	Note 2	Note 2	Tested	Note 2
		5 MHz	Back	Note 2					
		5 MHz	Front	Note 2					
Antenna 2		10 MHz	Back	Note 2					
		10 MHz	Front	Note 2					

Note 1 - Reduced Per KDB 447498 1) e).

Note 2 – Reduced per October 2010 TCB Workshop Note page 33.

## SAR Data Summary – 2600 MHz Body – WiMax 5 MHz PUSC

## MEASUREMENT RESULTS

Gap	Antenna	Side	Frequency		Modulation	End Power (dBm)	SAR (W/kg)	Scaling Factor	Calculated SAR
			MHz	Ch.					
0 mm	Antenna 1	Back	2593.0	Mid	QPSK	23.83	0.320	1.234	0.395
			2498.8	Low	QPSK	23.81	0.648	1.255	0.813
		Front	2593.0	Mid	QPSK	23.83	0.886	1.234	1.093
			2687.2	High	QPSK	23.77	0.976	1.244	1.214
		Front	2687.2	High	16QAM	23.75	0.702	1.244	0.873
			2687.2	High	64QAM	23.73	0.602	1.244	0.749
	Antenna 2	Back	2593.0	Mid	QPSK	23.83	0.225	1.234	0.317
		Front	2593.0	Mid	QPSK	23.83	0.319	1.234	0.397

**Body**  
**1.6 W/kg (mW/g)**  
averaged over 1 gram

1. Power Measured  Conducted  ERP  EIRP

2. SAR Measurement

    Phantom Configuration  Left Head  Uniphantom  Right Head

    SAR Configuration  Head  Body

3. Test Signal Call Mode  Test Code  Base Station Simulator

4. Test Configuration  With Belt Clip  Without Belt Clip  N/A

5. All Testing conducted using KDB 447498 Section 2 and KDB 615223.



Jay M. Moulton  
Vice President

Note: When the highest SAR channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 447498 section 1) e). Test reduction was based on TCB workshop slides from April and October of 2010.

## SAR Data Summary – 2600 MHz Body – WiMax 10 MHz PUSC

## MEASUREMENT RESULTS

Gap	Antenna	Side	Frequency		Modulation	End Power (dBm)	SAR (W/kg)	Scaling Factor	Calculated SAR
			MHz	Ch.					
0 mm	Antenna 1	Back	2593.0	Mid	QPSK	23.96	0.341	1.165	0.397
		Front	2498.8	Low	QPSK	23.92	0.690	1.174	0.810
			2593.0	Mid	QPSK	23.96	1.068	1.165	1.244
			2687.2	High	QPSK	23.89	0.947	1.184	1.121
		Back	2593.0	Mid	16QAM	23.91	0.882	1.165	1.028
		Front	2593.0	Mid	64QAM	23.89	0.877	1.165	1.022
	Antenna 2	Back	2593.0	Mid	QPSK	23.96	0.226	1.165	0.263
		Front	2498.8	Low	QPSK	23.92	0.321	1.174	0.377
			2593.0	Mid	QPSK	23.96	0.654	1.165	0.762
		Front	2687.2	High	QPSK	23.89	0.455	1.184	0.539

**Body**  
1.6 W/kg (mW/g)  
averaged over 1 gram

1. Power Measured	<input checked="" type="checkbox"/> Conducted	<input type="checkbox"/> ERP	<input type="checkbox"/> EIRP
2. SAR Measurement			
Phantom Configuration	<input type="checkbox"/> Left Head	<input checked="" type="checkbox"/> Uniphantom	<input type="checkbox"/> Right Head
SAR Configuration	<input type="checkbox"/> Head	<input checked="" type="checkbox"/> Body	
3. Test Signal Call Mode	<input checked="" type="checkbox"/> Test Code	<input type="checkbox"/> Base Station Simulator	
4. Test Configuration	<input type="checkbox"/> With Belt Clip	<input type="checkbox"/> Without Belt Clip	<input checked="" type="checkbox"/> N/A
5. All Testing conducted using KDB 447498 Section 2 and KDB 615223.			



Jay M. Moulton  
Vice President

Note: When the highest SAR channel is 3 dB or more below the limit the remaining channels are not required to be tested per KDB 447498 section 1) e). Test reduction was based on TCB workshop slides from April and October of 2010.

## 11. Test Equipment List

Table 11.1 Equipment Specifications

Type	Calibration Due Date	Calibration Done Date	Serial Number
ThermoCRS Robot	N/A	N/A	RAF0338198
ThermoCRS Controller	N/A	N/A	RCF0338224
ThermoCRS Teach Pendant (Joystick)	N/A	N/A	STP0334405
IBM Computer, 2.66 MHz P4	N/A	N/A	8189D8U KCPR08N
Aprel E-Field Probe ALS-E020	09/07/2012	09/07/2011	RFE-217
Aprel E-Field Probe ALS-E030	07/15/2012	07/15/2011	E030-001
Aprel Dummy Probe	N/A	N/A	023
Aprel Left Phantom	N/A	N/A	RFE-267
Aprel Right Phantom	N/A	N/A	RFE-268
Aprel UniPhantom	N/A	N/A	RFE-273
Aprel Validation Dipole ALS-D-450-S-2 Head	01/12/2013	01/12/2010	RFE-362
Aprel Validation Dipole ALS-D-450-S-2 Body	01/19/2013	01/19/2011	RFE-362
Aprel Validation Dipole ALS-D-750-S-2 Head	01/14/2013	01/14/2010	177-00501
Aprel Validation Dipole ALS-D-750-S-2 Body	11/15/2012	11/15/2010	177-00501
Aprel Validation Dipole ALS-D-835-S-2 Head	01/14/2013	01/14/2010	180-00561
Aprel Validation Dipole ALS-D-835-S-2 Body	11/16/2012	11/16/2010	180-00561
Aprel Validation Dipole ALS-D-900-S-2 Head	01/12/2013	01/12/2010	RFE-275
Aprel Validation Dipole ALS-D-900-S-2 Body	11/19/2012	11/19/2010	RFE-275
Aprel Validation Dipole ALS-D-1900-S-2 Head	01/15/2013	01/15/2010	210-00713
Aprel Validation Dipole ALS-D-1900-S-2 Body	11/16/2012	11/16/2010	210-00713
Aprel Validation Dipole ALS-D-2450-S-2 Head	01/12/2013	01/12/2010	RFE-278
Aprel Validation Dipole ALS-D-2450-S-2 Body	11/18/2012	11/18/2010	RFE-278
Aprel Validation Dipole RFE-D-2600-S-2 Body	01/18/2013	01/18/2010	RFE-121
Aprel Validation Dipole RFE-D-BB-S-2 Head	01/12/2013	01/12/2010	235-00801
Aprel Validation Dipole RFE-D-BB-S-2 Body	02/09/2013	02/09/2011	235-00801
Agilent N1911A Power Meter	03/29/2013	03/29/2012	GB45100254
Agilent N1922A Power Sensor	03/29/2013	03/29/2012	MY45240464
Advantest R3261A Spectrum Analyzer	03/29/2013	03/29/2012	31720068
Agilent (HP) 8350B Signal Generator	03/29/2013	03/29/2012	2749A10226
Agilent (HP) 83525A RF Plug-In	03/29/2013	03/29/2012	2647A01172
Agilent (HP) 8753C Vector Network Analyzer	03/29/2013	03/29/2012	3135A01724
Agilent (HP) 85047A S-Parameter Test Set	04/03/2013	04/03/2012	2904A00595
Agilent (HP) 8960 Base Station Sim.	04/05/2014	04/05/2012	MY48360364
Aprel Dielectric Probe Assembly	N/A	N/A	0011
Head Equivalent Matter (450 MHz)	N/A	N/A	N/A
Head Equivalent Matter (835/900 MHz)	N/A	N/A	N/A
Head Equivalent Matter (1900 MHz)	N/A	N/A	N/A
Head Equivalent Matter (2450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (750 MHz)	N/A	N/A	N/A
Body Equivalent Matter (835/900 MHz)	N/A	N/A	N/A
Body Equivalent Matter (1900 MHz)	N/A	N/A	N/A
Body Equivalent Matter (2450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (2600 MHz)	N/A	N/A	N/A
Body Equivalent Matter (5200 MHz)	N/A	N/A	N/A
Body Equivalent Matter (5800 MHz)	N/A	N/A	N/A

## 12. Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body is a very complex phenomena that depends on the mass, shape, and size of the body; the orientation of the body with respect to the field vectors; and, the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

## 13. References

- [1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation, August 1996
- [2] ANSI/IEEE C95.1 – 1992, American National Standard Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300kHz to 100GHz, New York: IEEE, 1992.
- [3] ANSI/IEEE C95.3 – 1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 1992.
- [4] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, June 2001.
- [5] IEEE Standard 1528 – 2003, IEEE Recommended Practice for Determining the Peak-Spatial Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, October 2003.
- [6] Industry Canada, RSS – 102e, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), March 2010.
- [7] Health Canada, Safety Code 6, Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz, 2009.

## Appendix A – System Validation Plots and Data

*****				
Test Result for UIM Dielectric Parameter				
Wed 16/May/2012 07:12:51				
Freq Frequency (GHz)				
FCC_eH	FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon			
FCC_sH	FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma			
FCC_eB	FCC Limits for Body Epsilon			
FCC_sB	FCC Limits for Body Sigma			
Test_e	Epsilon of UIM			
Test_s	Sigma of UIM			
*****				
Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.4900	52.65	2.01	52.46	2.03
2.4988	52.64	2.02	52.45	2.04*
2.5000	52.64	2.02	52.45	2.04
2.5100	52.62	2.04	52.43	2.06
2.5200	52.61	2.05	52.41	2.08
2.5300	52.60	2.06	52.40	2.09
2.5400	52.59	2.08	52.39	2.10
2.5500	52.57	2.09	52.36	2.11
2.5600	52.56	2.11	52.35	2.13
2.5700	52.55	2.12	52.33	2.15
2.5800	52.53	2.13	52.31	2.16
2.5900	52.52	2.15	52.28	2.18
2.5930	52.52	2.15	52.28	2.18*
2.6000	52.51	2.16	52.26	2.19
2.6100	52.50	2.18	52.24	2.21
2.6200	52.48	2.19	52.21	2.23
2.6300	52.47	2.21	52.20	2.25
2.6400	52.46	2.22	52.19	2.26
2.6500	52.45	2.23	52.17	2.27
2.6600	52.43	2.25	52.15	2.29
2.6700	52.42	2.26	52.14	2.30
2.6800	52.41	2.28	52.13	2.32
2.6872	52.39	2.29	52.11	2.33*
2.6900	52.39	2.29	52.11	2.33

\* values interpolated

\*\*\*\*\*

## Test Result for UIM Dielectric Parameter

Fri 01/Jun/2012 07:29:48

Freq Frequency (GHz)

FCC_eH	FCC Bulletin 65 Supplement C ( June 2001) Limits for Head Epsilon
FCC_sH	FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
FCC_eB	FCC Limits for Body Epsilon
FCC_sB	FCC Limits for Body Sigma
Test_e	Epsilon of UIM
Test_s	Sigma of UIM

\*\*\*\*\*

Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.4900	52.65	2.01	52.65	2.01
<b>2.4988</b>	<b>52.64</b>	<b>2.02</b>	<b>52.63</b>	<b>2.03*</b>
2.5000	52.64	2.02	52.63	2.03
2.5100	52.62	2.04	52.62	2.04
2.5200	52.61	2.05	52.61	2.05
2.5300	52.60	2.06	52.60	2.07
2.5400	52.59	2.08	52.58	2.08
2.5500	52.57	2.09	52.56	2.09
2.5600	52.56	2.11	52.55	2.11
2.5700	52.55	2.12	52.53	2.13
2.5800	52.53	2.13	52.51	2.14
<b>2.5900</b>	<b>52.52</b>	<b>2.15</b>	<b>52.48</b>	<b>2.16</b>
<b>2.5930</b>	<b>52.52</b>	<b>2.15</b>	<b>52.48</b>	<b>2.16*</b>
2.6000	52.51	2.16	52.46	2.17
2.6100	52.50	2.18	52.44	2.19
2.6200	52.48	2.19	52.41	2.21
2.6300	52.47	2.21	52.40	2.22
2.6400	52.46	2.22	52.38	2.24
2.6500	52.45	2.23	52.37	2.25
2.6600	52.43	2.25	52.36	2.26
2.6700	52.42	2.26	52.34	2.28
2.6800	52.41	2.28	52.33	2.27
<b>2.6872</b>	<b>52.39</b>	<b>2.29</b>	<b>52.31</b>	<b>2.29*</b>
2.6900	52.39	2.29	52.31	2.29

\* values interpolated

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 07:22:56 AM  
End Time : 16-May-2012 07:36:02 AM  
Scanning Time : 786 secs

## Product Data

Device Name : Validation  
Serial No. : 2600  
Type : Dipole  
Model : RFE-D-2600-S-2  
Frequency : 2600.00 MHz  
Max. Transmit Pwr : 0.1 W  
Drift Time : 0 min(s)  
Length : 49.5 mm  
Width : 3.6 mm  
Depth : 30.0 mm  
Antenna Type : Internal  
Orientation : Touch  
Power Drift-Start : 6.381 W/kg  
Power Drift-Finish: 6.404 W/kg  
Power Drift (%) : 0.355

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2600  
Frequency : 2600.00 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.26 F/m  
Sigma : 2.19 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

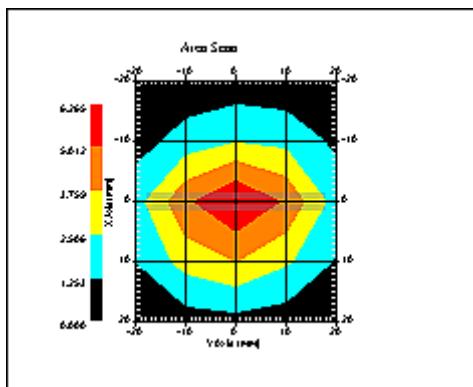
Name : Probe 217 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 4.0  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

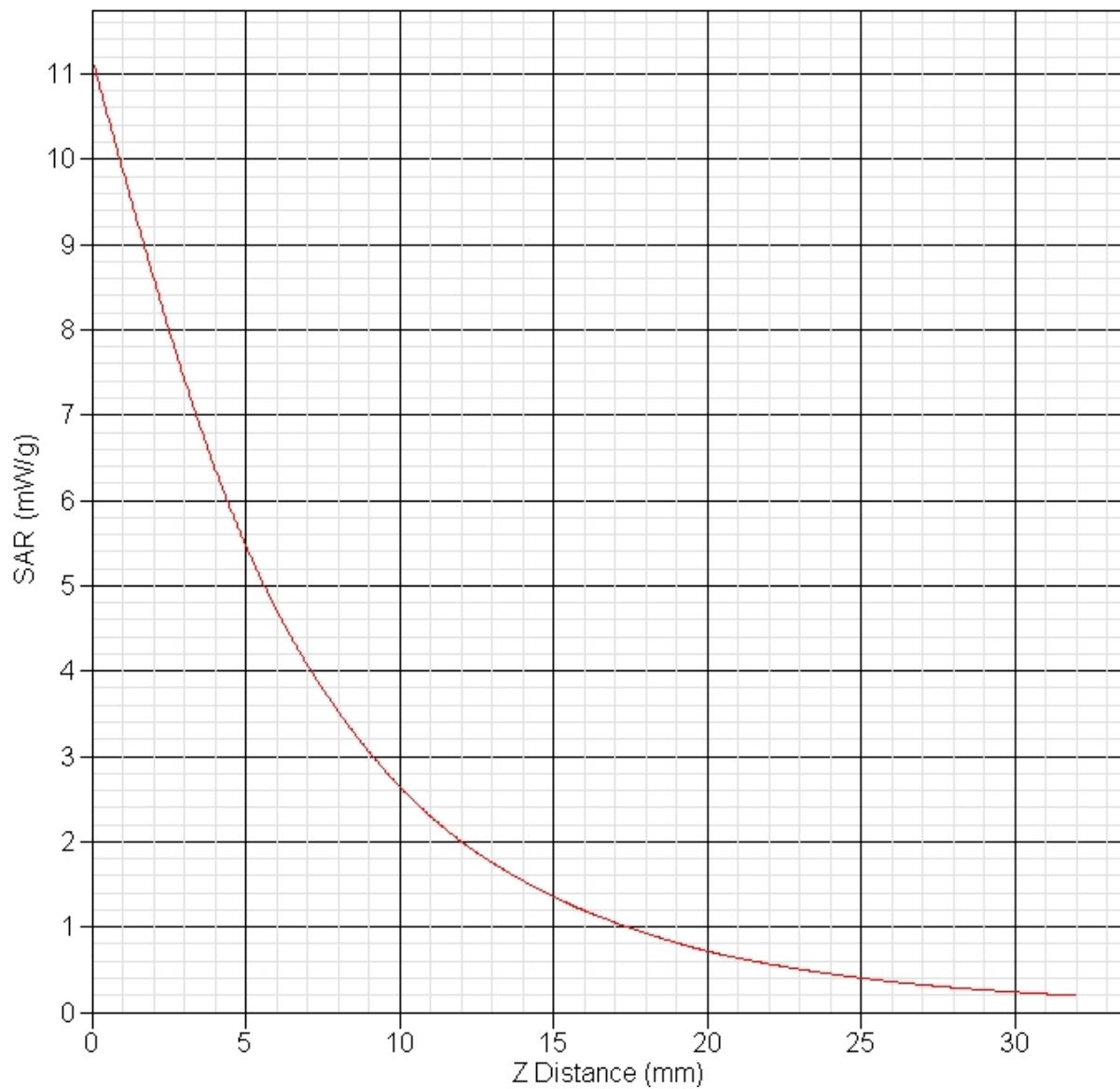
Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 7:40:13 AM  
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Touch  
Separation : 10 mm  
Channel : Mid



1 gram SAR value : 5.540 W/kg  
10 gram SAR value : 2.516 W/kg  
Area Scan Peak SAR : 6.265 W/kg  
Zoom Scan Peak SAR : 11.190 W/kg

**SAR-Z Axis**  
at Hotspot x:0.24 y:-0.18

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 07:37:55 AM  
End Time : 01-Jun-2012 07:52:56 AM  
Scanning Time : 778 secs

## Product Data

Device Name : Validation  
Serial No. : 2600  
Type : Dipole  
Model : ALS-D-2600-S-2  
Frequency : 2600.00 MHz  
Max. Transmit Pwr : 0.1 W  
Drift Time : 0 min(s)  
Length : 48.8 mm  
Width : 3.6 mm  
Depth : 32.8 mm  
Antenna Type : Internal  
Orientation : Touch  
Power Drift-Start : 5.955 W/kg  
Power Drift-Finish: 6.185 W/kg  
Power Drift (%) : 3.865

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2590  
Frequency : 2590.00 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.48 F/m  
Sigma : 2.13 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

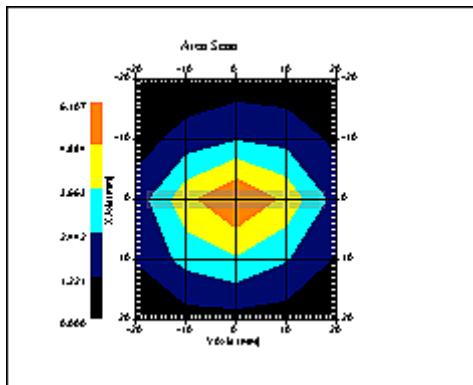
Name : Probe 217 - RFEL  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 1  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

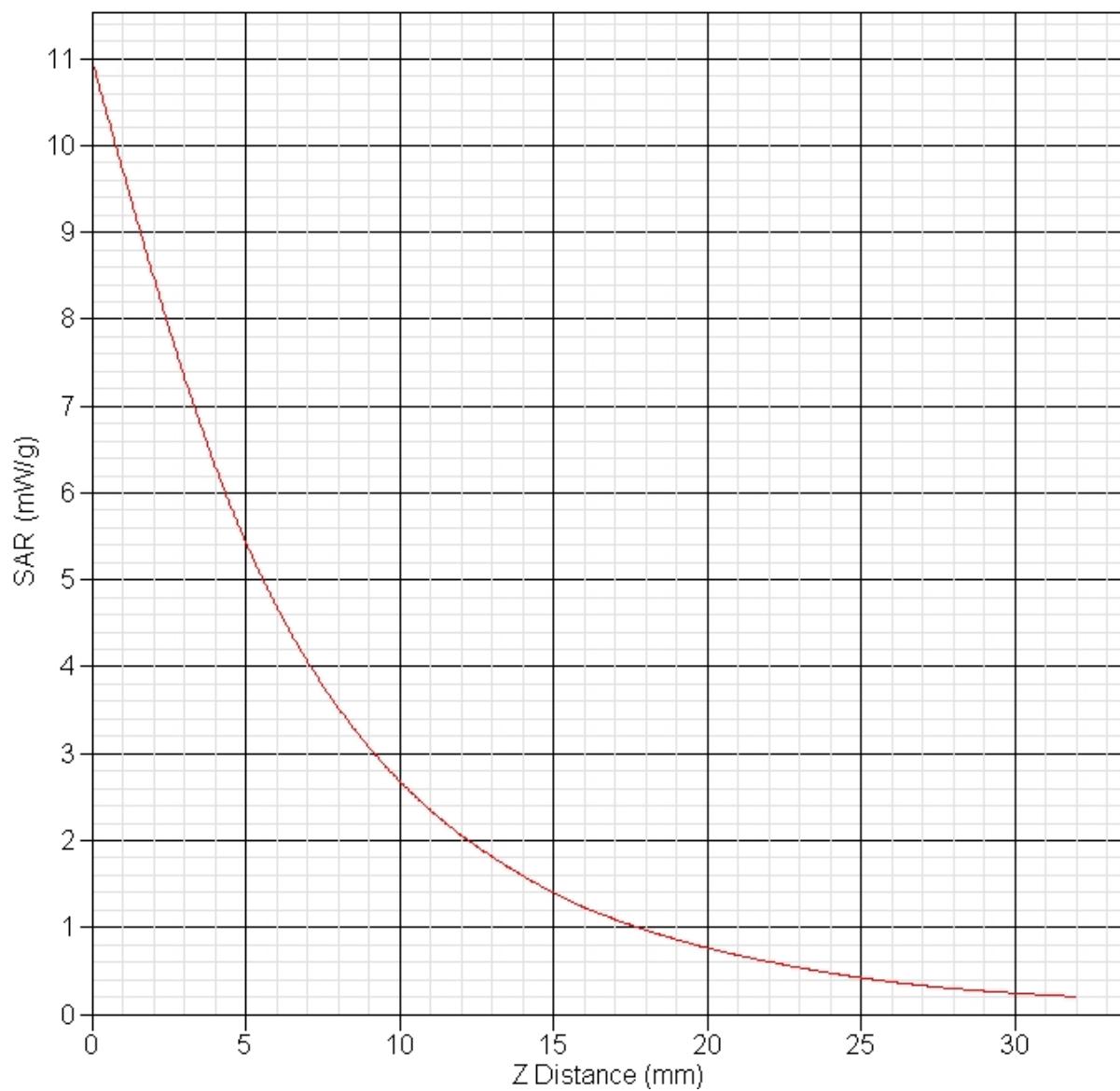
Crest Factor : 1  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 7:40:13 AM  
Area Scan : 5x5x1 : Measurement x=10mm, y=10mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Touch  
Separation : 10 mm  
Channel : Mid



1 gram SAR value : 5.401 W/kg  
10 gram SAR value : 2.484 W/kg  
Area Scan Peak SAR : 6.107 W/kg  
Zoom Scan Peak SAR : 10.990 W/kg

**SAR-Z Axis**  
at Hotspot x:0.30 y:-0.18

## Appendix B – SAR Test Data Plots

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 07:57:59 AM  
End Time : 01-Jun-2012 08:31:16 AM  
Scanning Time : 1697 secs

Product Data  
Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 5 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.242 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Back  
Power Drift-Start : 0.174 W/kg  
Power Drift-Finish: 0.173 W/kg  
Power Drift (%) : -0.576

Phantom Data  
Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

Tissue Data  
Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.48 F/m  
Sigma : 2.16 S/m  
Density : 1000.00 kg/cu. m

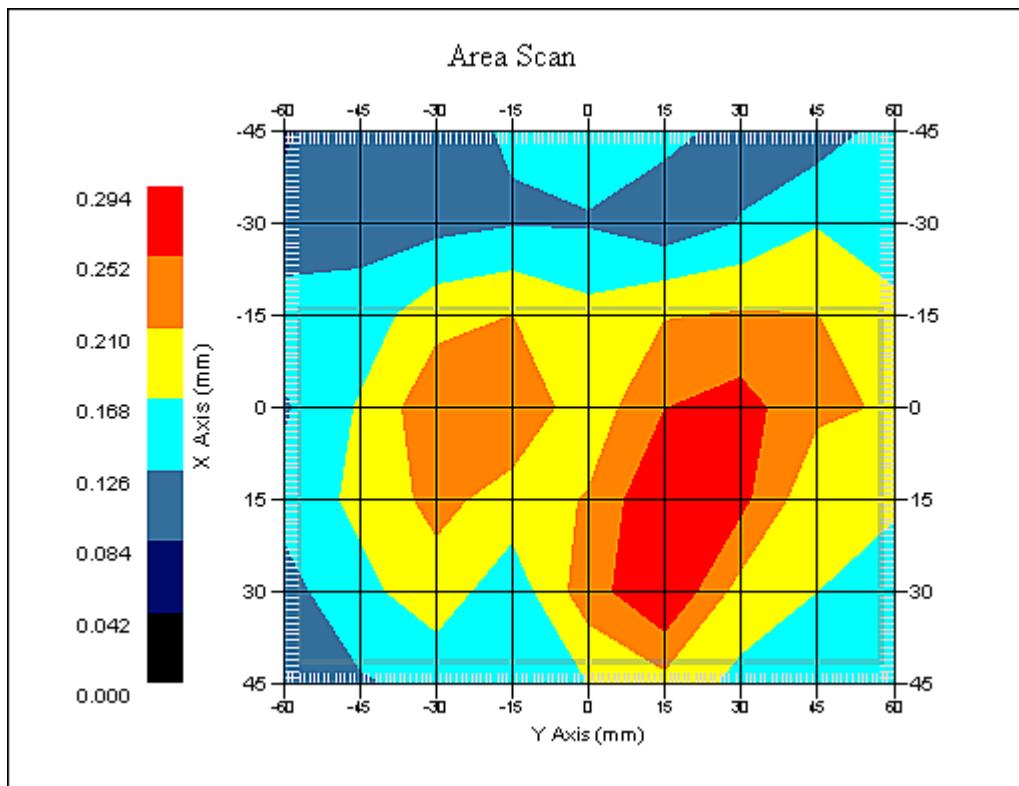
Probe Data  
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 8:23:08 AM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Back  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.320 W/kg  
10 gram SAR value : 0.249 W/kg  
Area Scan Peak SAR : 0.294 W/kg  
Zoom Scan Peak SAR : 0.490 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 08:37:43 AM  
End Time : 01-Jun-2012 09:10:13 AM  
Scanning Time : 1950 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 5 MHz  
Model : WBG  
Frequency : 2498.80 MHz  
Max. Transmit Pwr : 0.24 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.490 W/kg  
Power Drift-Finish: 0.500 W/kg  
Power Drift (%) : 1.937

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2498  
Frequency : 2498.80 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.63 F/m  
Sigma : 2.03 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

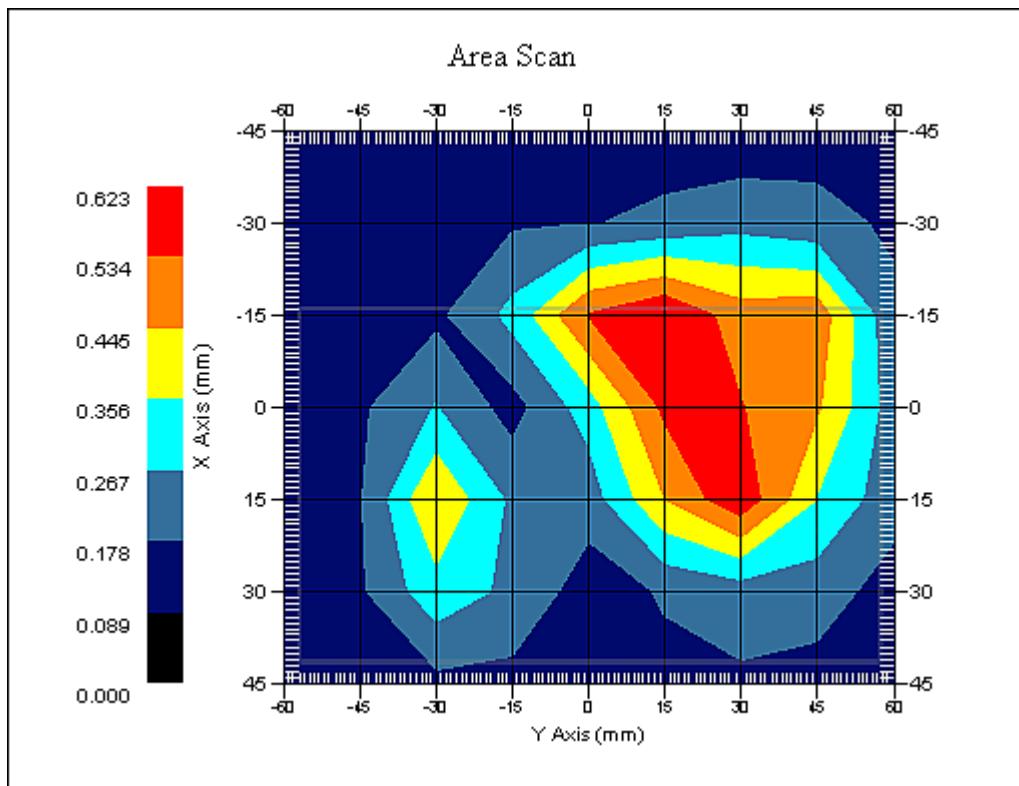
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Low



1 gram SAR value : 0.648 W/kg  
10 gram SAR value : 0.410 W/kg  
Area Scan Peak SAR : 0.621 W/kg  
Zoom Scan Peak SAR : 1.020 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 09:12:31 AM  
End Time : 01-Jun-2012 09:34:46 AM  
Scanning Time : 1335 secs

Product Data  
Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 5 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.242 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.676 W/kg  
Power Drift-Finish: 0.663 W/kg  
Power Drift (%) : -1.928

Phantom Data  
Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

Tissue Data  
Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.48 F/m  
Sigma : 2.16 S/m  
Density : 1000.00 kg/cu. m

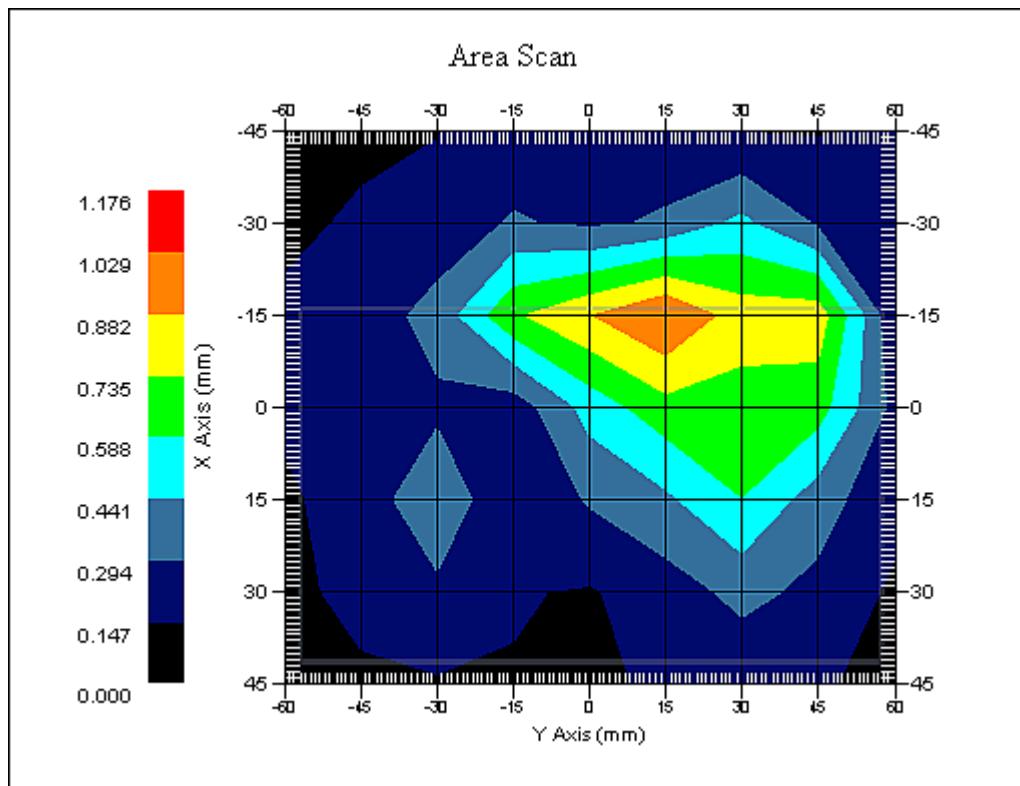
Probe Data  
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.886 W/kg  
10 gram SAR value : 0.522 W/kg  
Area Scan Peak SAR : 1.031 W/kg  
Zoom Scan Peak SAR : 1.521 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 09:39:16 AM  
End Time : 01-Jun-2012 10:01:52 AM  
Scanning Time : 1356 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 5 MHz  
Model : WBG  
Frequency : 2687.20 MHz  
Max. Transmit Pwr : 0.238 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.597 W/kg  
Power Drift-Finish: 0.589 W/kg  
Power Drift (%) : -1.329

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2687  
Frequency : 2687.20 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.31 F/m  
Sigma : 2.29 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

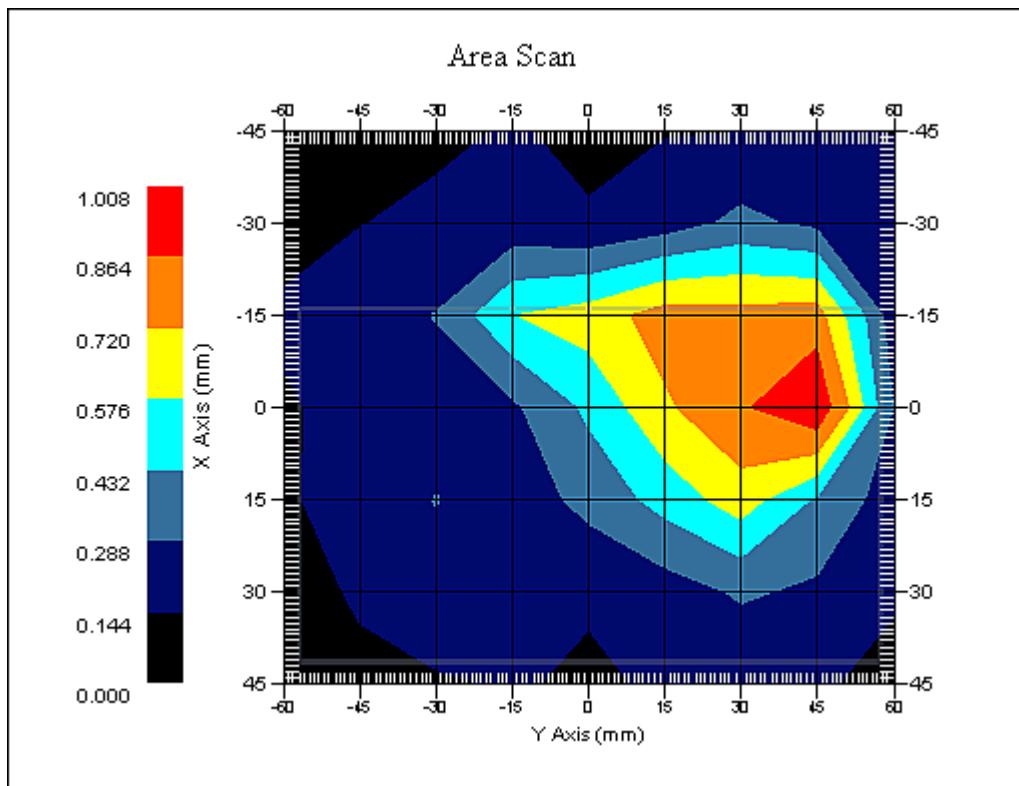
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

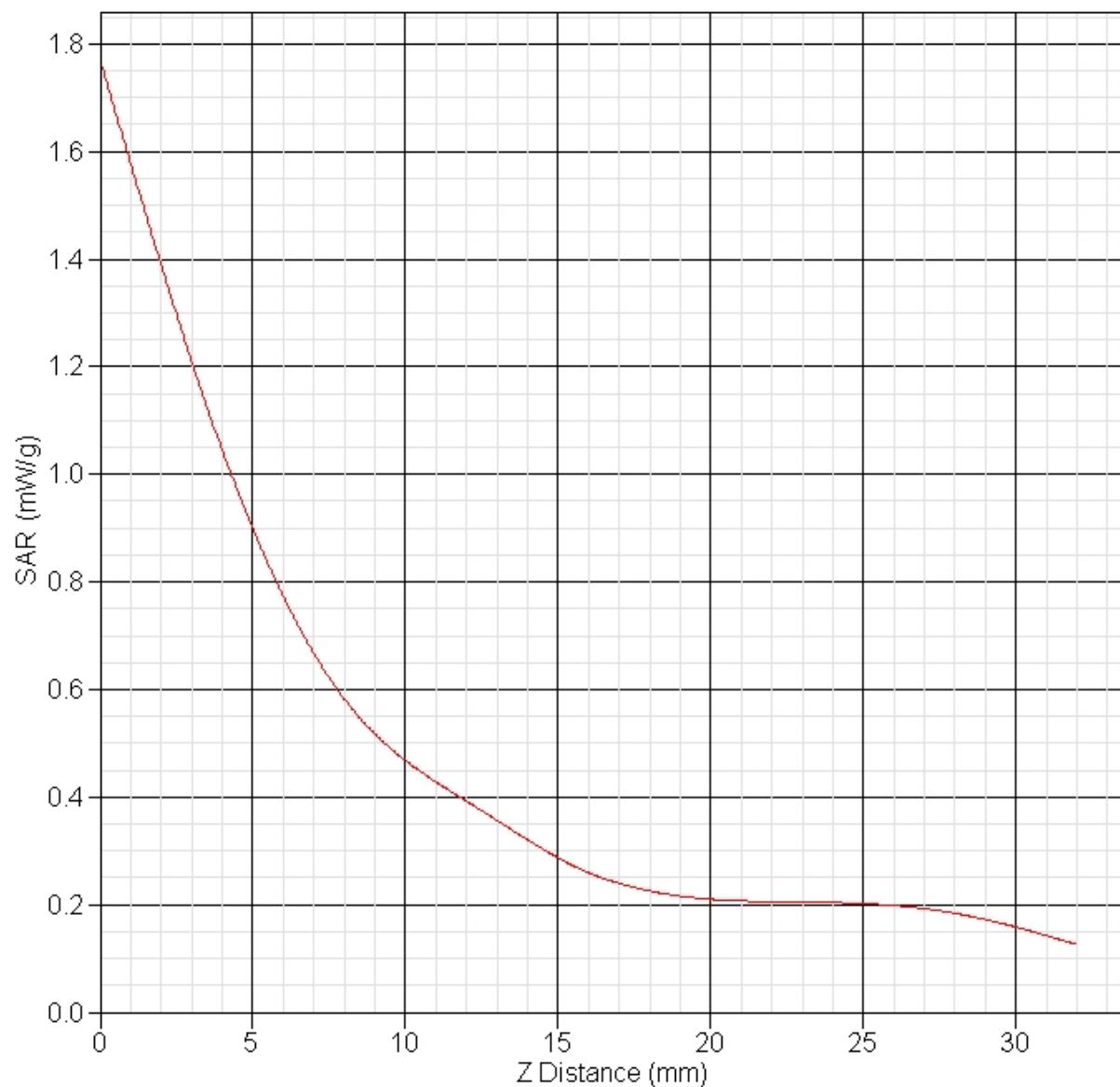
Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : High



1 gram SAR value : 0.976 W/kg  
10 gram SAR value : 0.557 W/kg  
Area Scan Peak SAR : 1.005 W/kg  
Zoom Scan Peak SAR : 1.771 W/kg

**SAR-Z Axis**  
at Hotspot x:7.16 y:37.06

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 11:16:53 AM  
End Time : 01-Jun-2012 11:39:38 AM  
Scanning Time : 1365 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - 16QAM 5 MHz  
Model : WBG  
Frequency : 2687.20 MHz  
Max. Transmit Pwr : 0.237 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenn 1  
Orientation : Front  
Power Drift-Start : 0.471 W/kg  
Power Drift-Finish: 0.462 W/kg  
Power Drift (%) : -1.758

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2687  
Frequency : 2687.20 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.31 F/m  
Sigma : 2.29 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

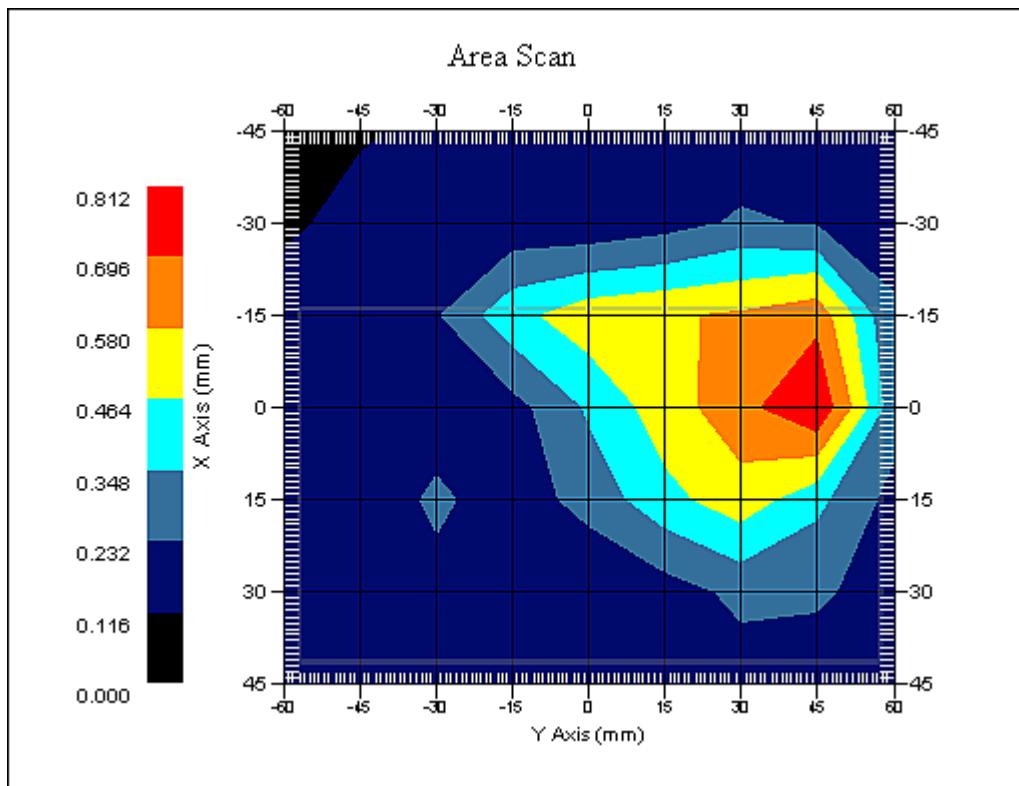
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : High



1 gram SAR value : 0.702 W/kg  
10 gram SAR value : 0.407 W/kg  
Area Scan Peak SAR : 0.812 W/kg  
Zoom Scan Peak SAR : 1.281 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 11:37:28 AM  
End Time : 01-Jun-2012 12:00:05 PM  
Scanning Time : 1357 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - 64QAM 5 MHz  
Model : WBG  
Frequency : 2687.20 MHz  
Max. Transmit Pwr : 0.236 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.450 W/kg  
Power Drift-Finish: 0.439 W/kg  
Power Drift (%) : -2.342

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2687  
Frequency : 2687.20 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.31 F/m  
Sigma : 2.29 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

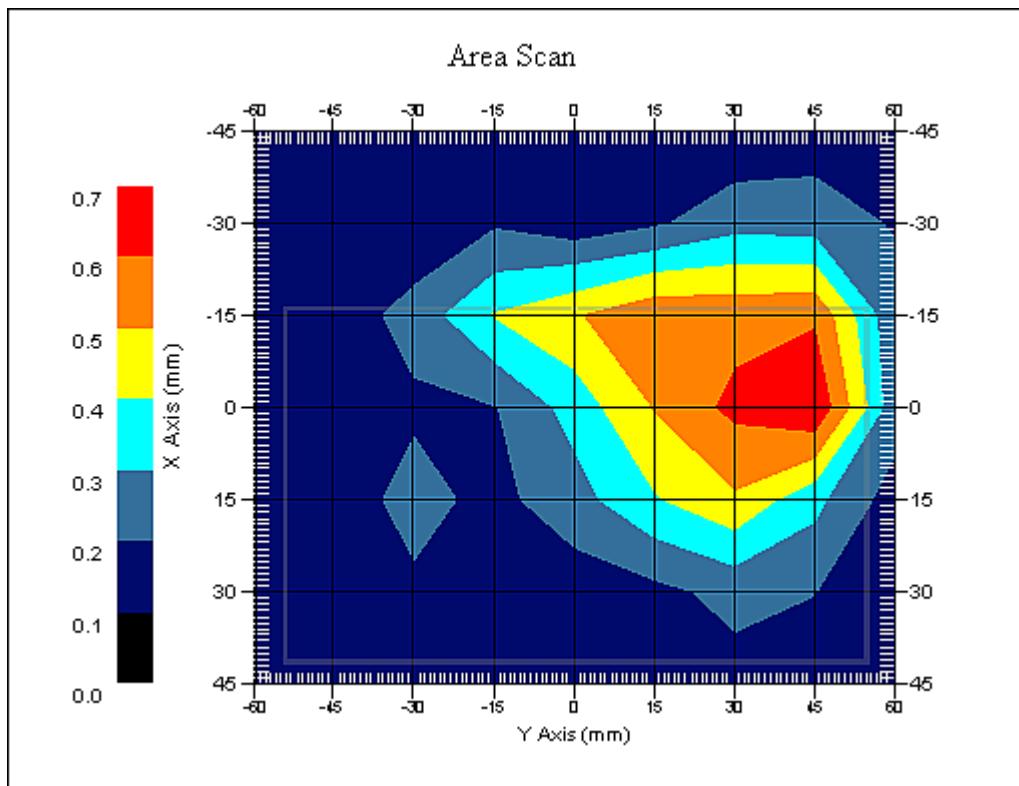
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu\text{V}/(\text{V}/\text{m})^2$   
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : High



1 gram SAR value : 0.602 W/kg  
10 gram SAR value : 0.395 W/kg  
Area Scan Peak SAR : 0.698 W/kg  
Zoom Scan Peak SAR : 1.101 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 10:41:12 AM  
End Time : 01-Jun-2012 11:13:00 AM  
Scanning Time : 1908 secs

Product Data  
Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 5 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.242 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 2  
Orientation : Back  
Power Drift-Start : 0.144 W/kg  
Power Drift-Finish: 0.144 W/kg  
Power Drift (%) : 0.445

Phantom Data  
Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

Tissue Data  
Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.48 F/m  
Sigma : 2.16 S/m  
Density : 1000.00 kg/cu. m

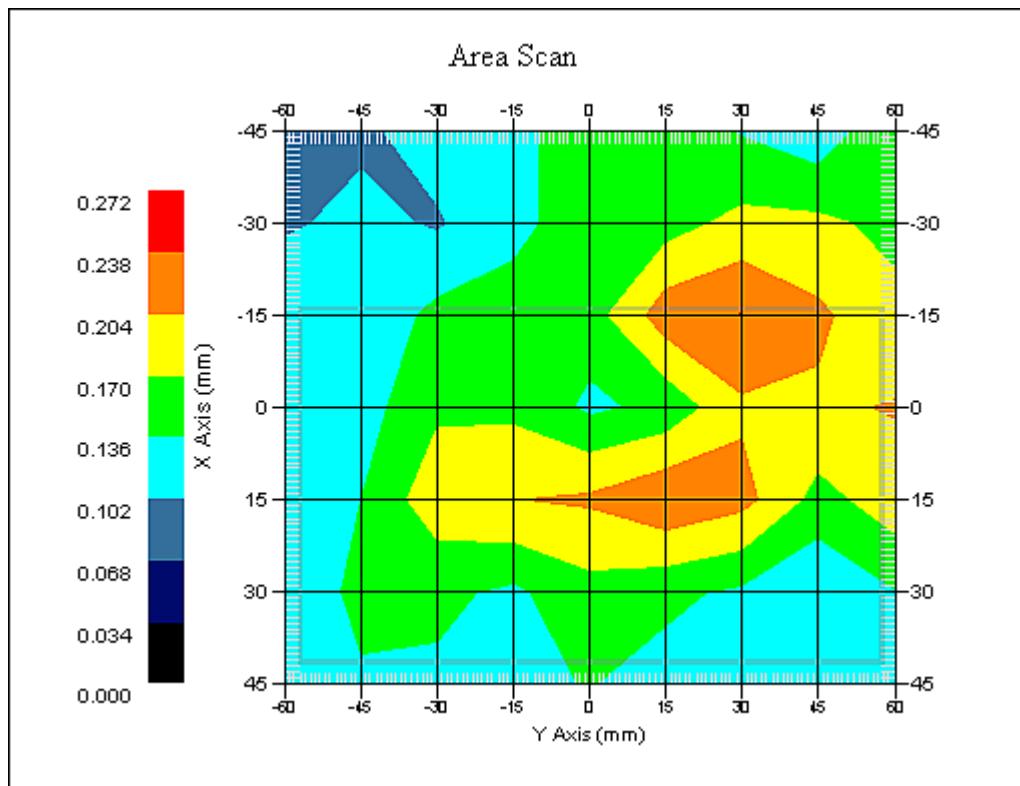
Probe Data  
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Back  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.225 W/kg  
10 gram SAR value : 0.171 W/kg  
Area Scan Peak SAR : 0.239 W/kg  
Zoom Scan Peak SAR : 0.280 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 10:04:38 AM  
End Time : 01-Jun-2012 10:38:10 AM  
Scanning Time : 2012 secs

Product Data  
Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 5 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.25 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 2  
Orientation : Front  
Power Drift-Start : 0.145 W/kg  
Power Drift-Finish: 0.143 W/kg  
Power Drift (%) : -1.346

Phantom Data  
Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

Tissue Data  
Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.48 F/m  
Sigma : 2.16 S/m  
Density : 1000.00 kg/cu. m

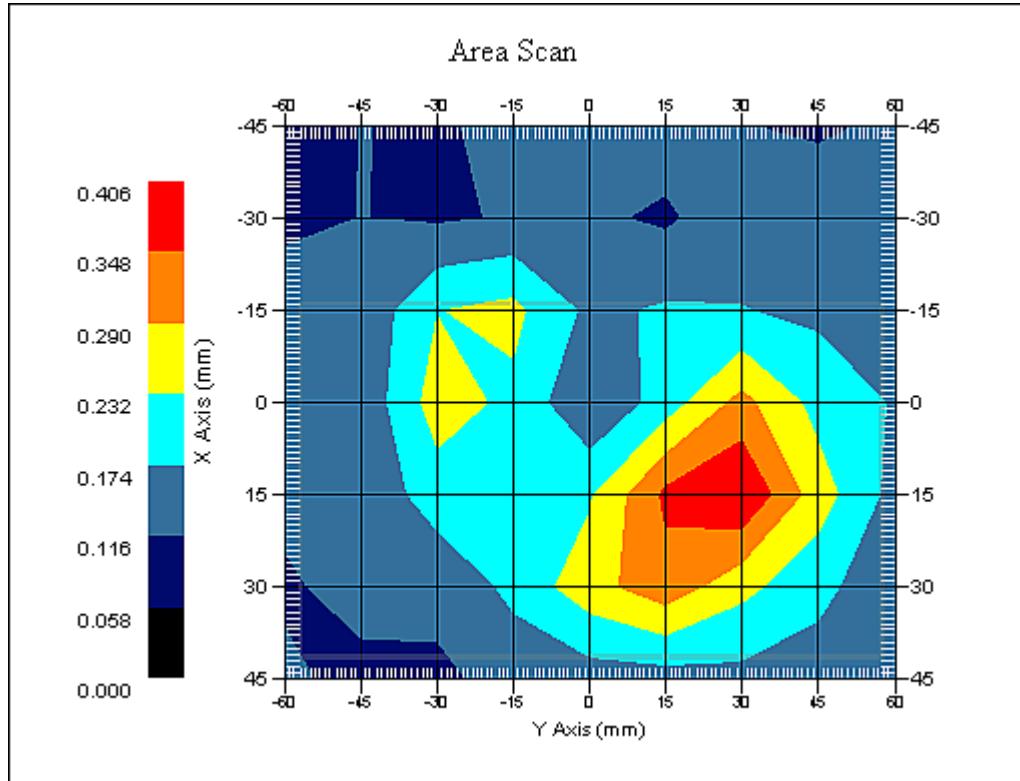
Probe Data  
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 8:23:08 AM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.319 W/kg  
10 gram SAR value : 0.265 W/kg  
Area Scan Peak SAR : 0.405 W/kg  
Zoom Scan Peak SAR : 0.620 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 09:58:00 AM  
End Time : 16-May-2012 10:41:29 AM  
Scanning Time : 2609 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.249 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Back  
Power Drift-Start : 0.137 W/kg  
Power Drift-Finish: 0.135 W/kg  
Power Drift (%) : -1.454

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.28 F/m  
Sigma : 2.18 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

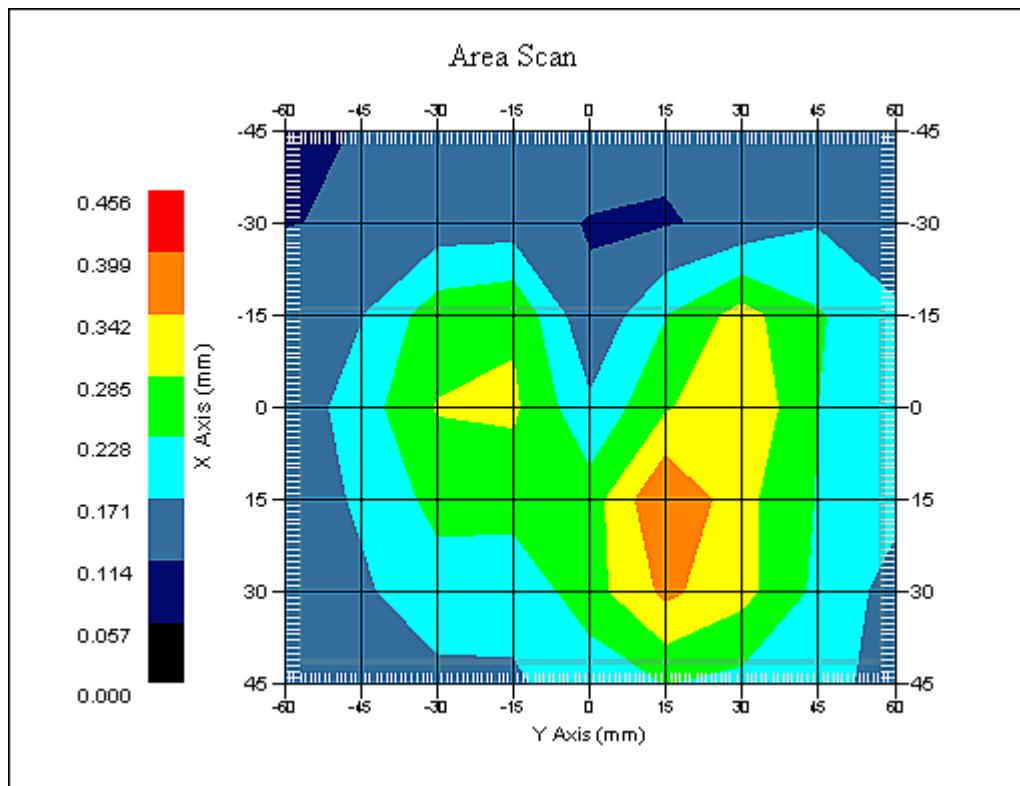
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 8:23:08 AM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Back  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.341 W/kg  
10 gram SAR value : 0.255 W/kg  
Area Scan Peak SAR : 0.401 W/kg  
Zoom Scan Peak SAR : 0.620 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 08:50:03 AM  
End Time : 16-May-2012 09:13:22 AM  
Scanning Time : 1399 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2498.80 MHz  
Max. Transmit Pwr : 0.247 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.520 W/kg  
Power Drift-Finish: 0.516 W/kg  
Power Drift (%) : -0.763

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2498  
Frequency : 2498.80 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.45 F/m  
Sigma : 2.04 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

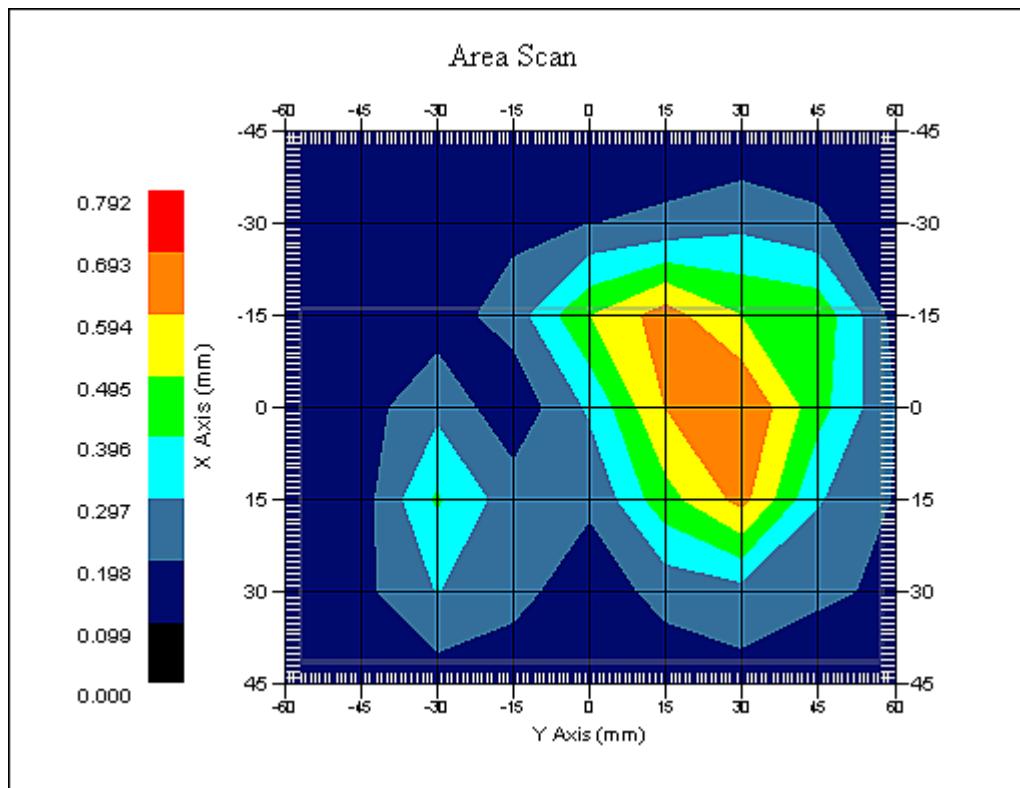
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 8:23:08 AM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Low



1 gram SAR value : 0.690 W/kg  
10 gram SAR value : 0.441 W/kg  
Area Scan Peak SAR : 0.695 W/kg  
Zoom Scan Peak SAR : 1.020 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 08:23:05 AM  
End Time : 16-May-2012 08:46:05 AM  
Scanning Time : 1380 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.249 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.838 W/kg  
Power Drift-Finish: 0.838 W/kg  
Power Drift (%) : 0.091

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.28 F/m  
Sigma : 2.18 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

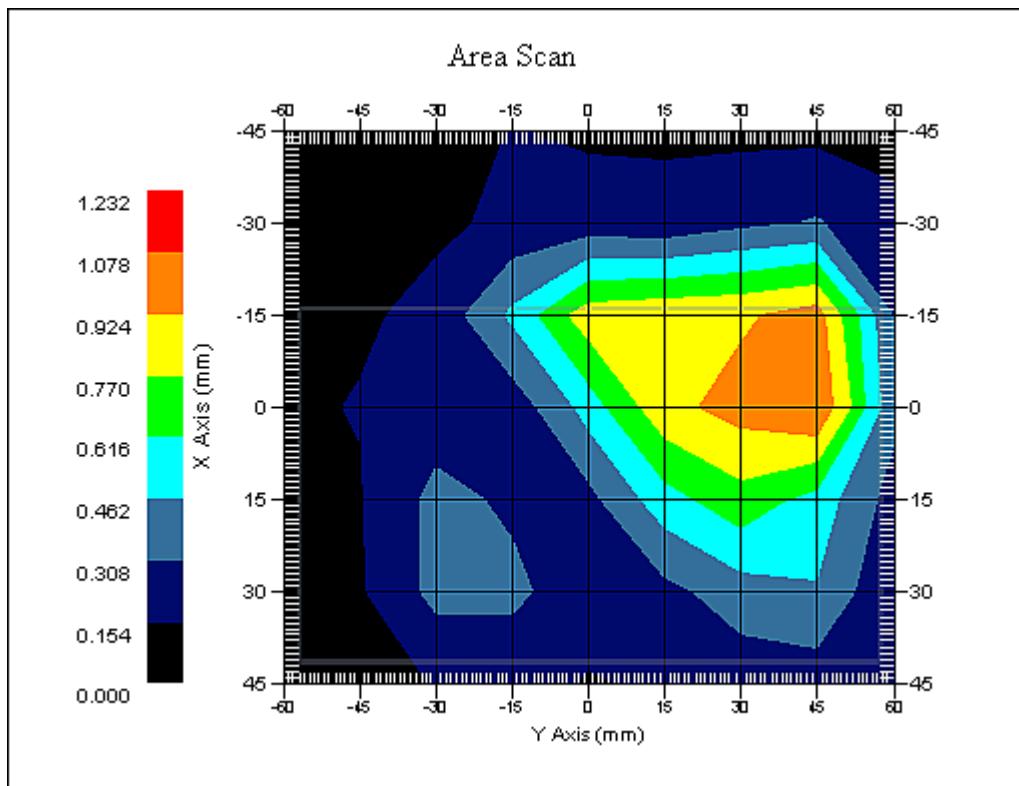
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

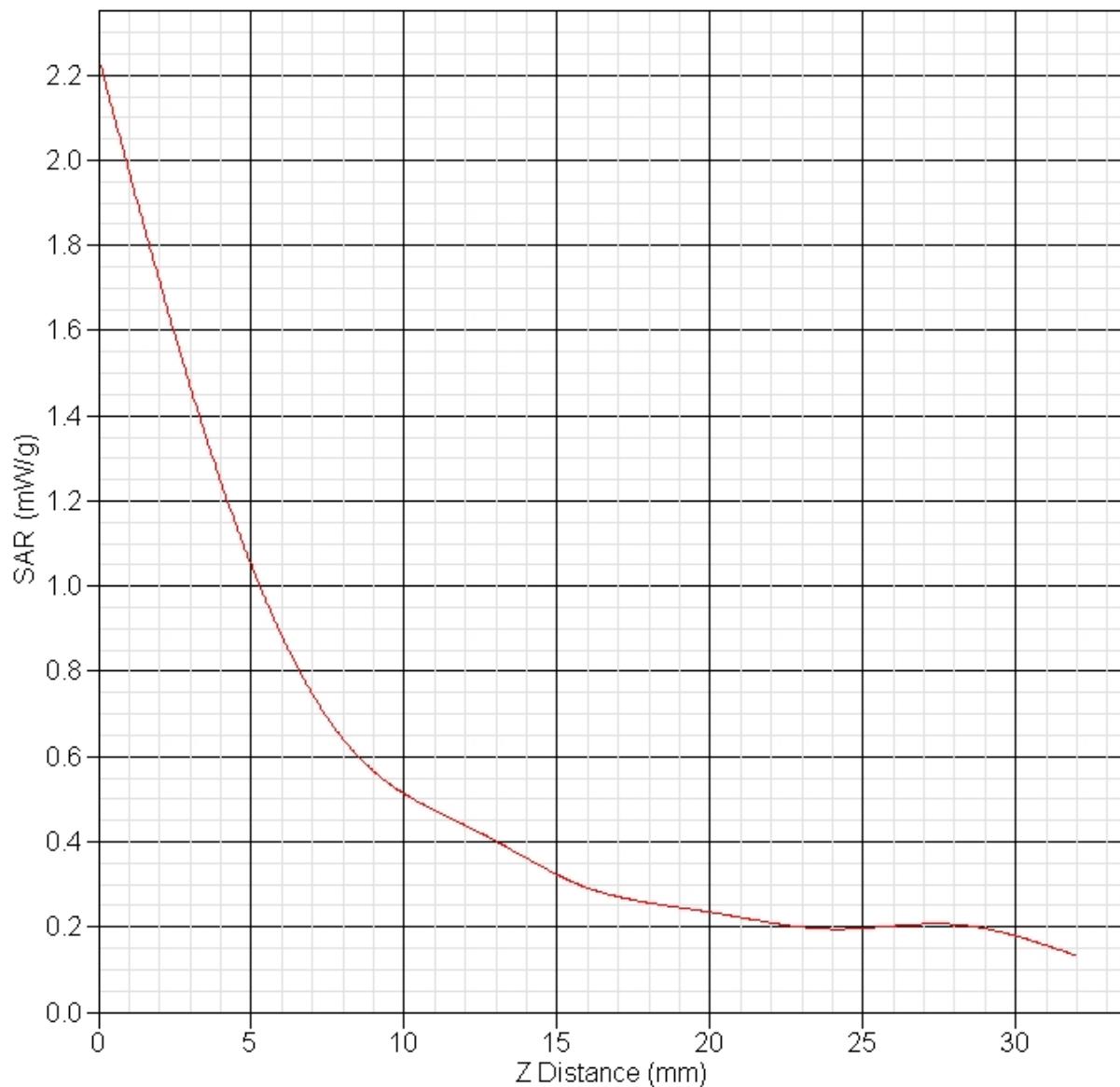
Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 8:23:08 AM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 1.068 W/kg  
10 gram SAR value : 0.569 W/kg  
Area Scan Peak SAR : 1.079 W/kg  
Zoom Scan Peak SAR : 2.241 W/kg

**SAR-Z Axis**  
at Hotspot x:7.14 y:45.06

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 09:17:14 AM  
End Time : 16-May-2012 09:50:09 AM  
Scanning Time : 1975 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2687.20 MHz  
Max. Transmit Pwr : 0.245 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.727 W/kg  
Power Drift-Finish: 0.733 W/kg  
Power Drift (%) : 0.785

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2687  
Frequency : 2687.20 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.11 F/m  
Sigma : 2.33 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

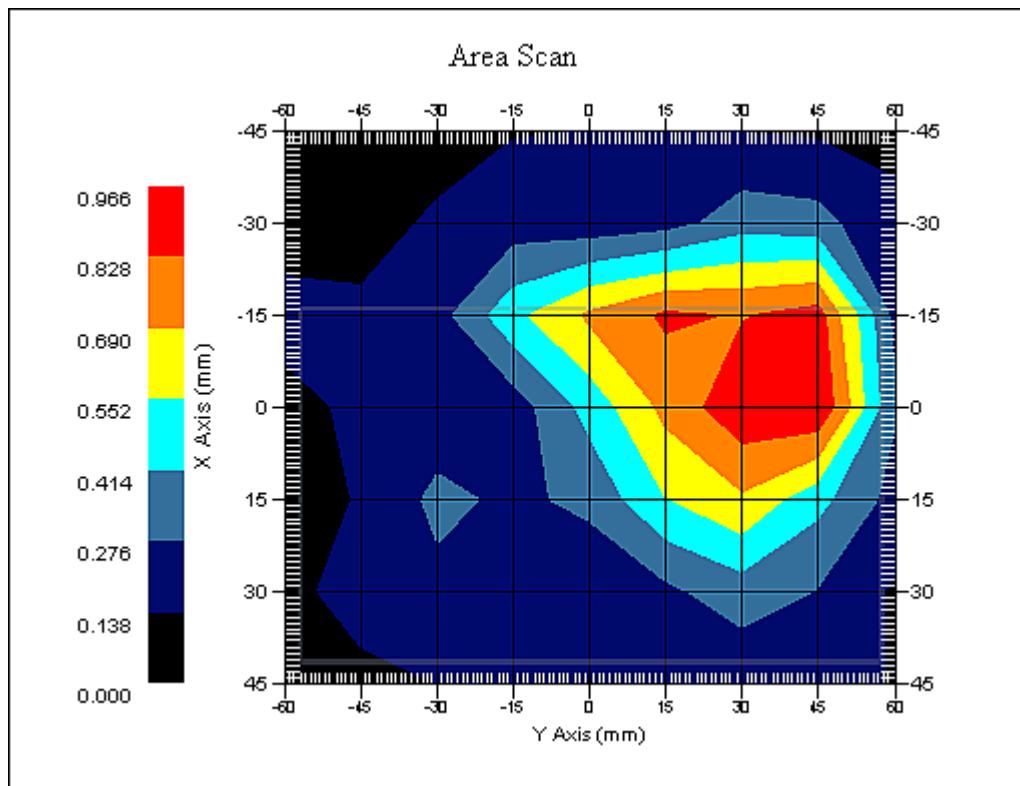
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 8:23:08 AM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : High



1 gram SAR value : 0.947 W/kg  
10 gram SAR value : 0.519 W/kg  
Area Scan Peak SAR : 0.965 W/kg  
Zoom Scan Peak SAR : 1.841 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 12:16:30 PM  
End Time : 01-Jun-2012 12:39:00 PM  
Scanning Time : 1350 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - 16QAM 10 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.246 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.689 W/kg  
Power Drift-Finish: 0.680 W/kg  
Power Drift (%) : -1.348

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.48 F/m  
Sigma : 2.16 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

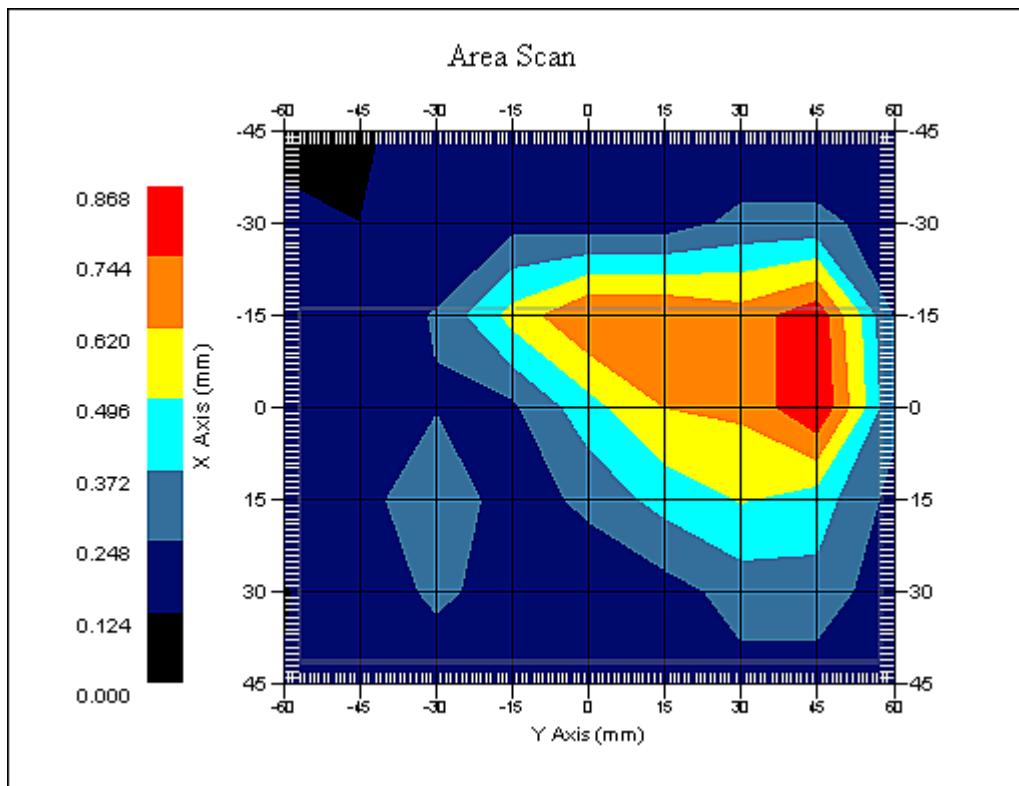
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.882 W/kg  
10 gram SAR value : 0.477 W/kg  
Area Scan Peak SAR : 0.867 W/kg  
Zoom Scan Peak SAR : 1.701 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 01-Jun-2012  
Starting Time : 01-Jun-2012 12:45:02 PM  
End Time : 01-Jun-2012 01:17:32 PM  
Scanning Time : 1950 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - 64QAM 10 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.245 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 1  
Orientation : Front  
Power Drift-Start : 0.705 W/kg  
Power Drift-Finish: 0.722 W/kg  
Power Drift (%) : 2.512

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 01-Jun-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.48 F/m  
Sigma : 2.16 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

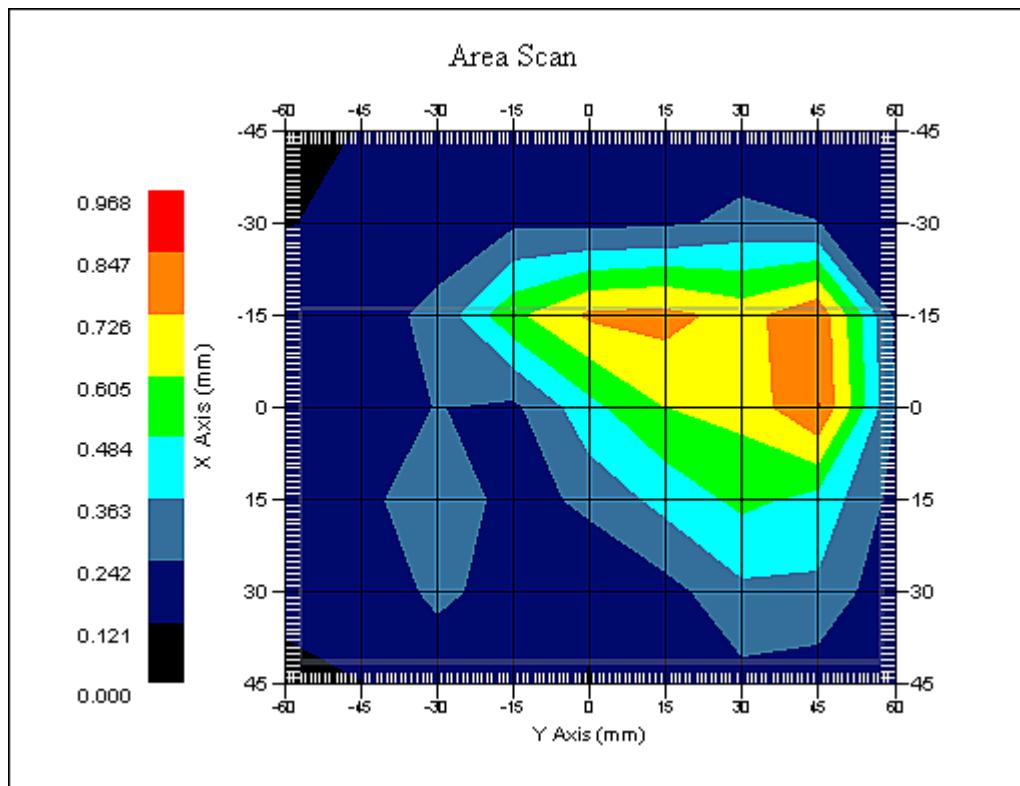
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 01-Jun-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.877 W/kg  
10 gram SAR value : 0.481 W/kg  
Area Scan Peak SAR : 0.850 W/kg  
Zoom Scan Peak SAR : 1.641 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 01:08:08 PM  
End Time : 16-May-2012 01:39:59 PM  
Scanning Time : 1911 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.249 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 2  
Orientation : Back  
Power Drift-Start : 0.161 W/kg  
Power Drift-Finish: 0.168 W/kg  
Power Drift (%) : 4.390

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.28 F/m  
Sigma : 2.18 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

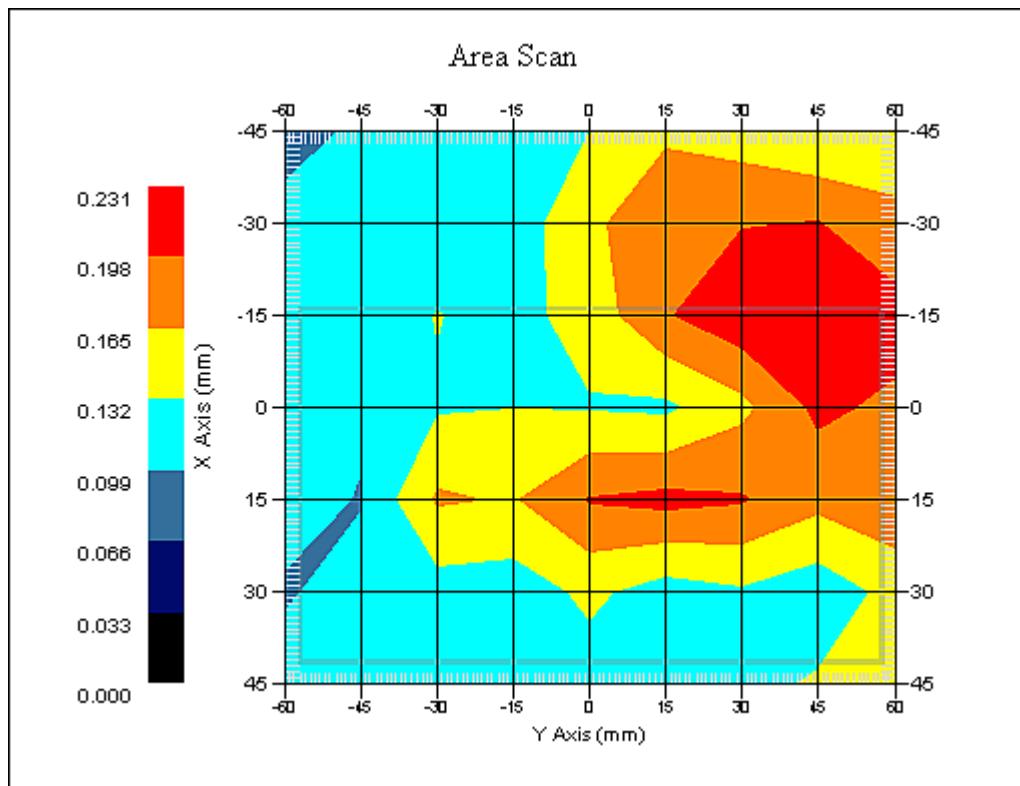
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Back  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.226 W/kg  
10 gram SAR value : 0.192 W/kg  
Area Scan Peak SAR : 0.231 W/kg  
Zoom Scan Peak SAR : 0.310 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 11:36:15 AM  
End Time : 16-May-2012 12:09:45 PM  
Scanning Time : 2010 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2498.80 MHz  
Max. Transmit Pwr : 0.247 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 2  
Orientation : Front  
Power Drift-Start : 0.144 W/kg  
Power Drift-Finish: 0.140 W/kg  
Power Drift (%) : -2.771

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2498  
Frequency : 2498.80 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.45 F/m  
Sigma : 2.04 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

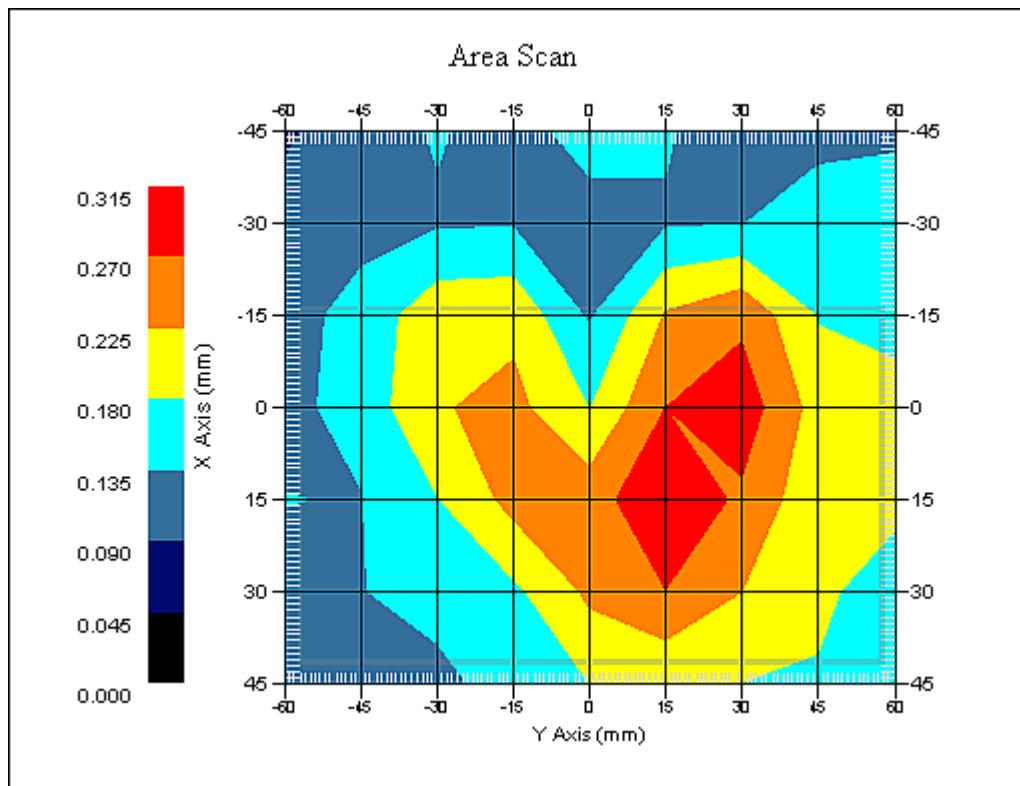
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 8:23:08 AM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Low



1 gram SAR value : 0.321 W/kg  
10 gram SAR value : 0.233 W/kg  
Area Scan Peak SAR : 0.312 W/kg  
Zoom Scan Peak SAR : 0.490 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 10:48:30 AM  
End Time : 16-May-2012 11:30:35 AM  
Scanning Time : 2525 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2593.00 MHz  
Max. Transmit Pwr : 0.249 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 2  
Orientation : Front  
Power Drift-Start : 0.207 W/kg  
Power Drift-Finish: 0.216 W/kg  
Power Drift (%) : 4.179

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2593  
Frequency : 2593.00 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.28 F/m  
Sigma : 2.18 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

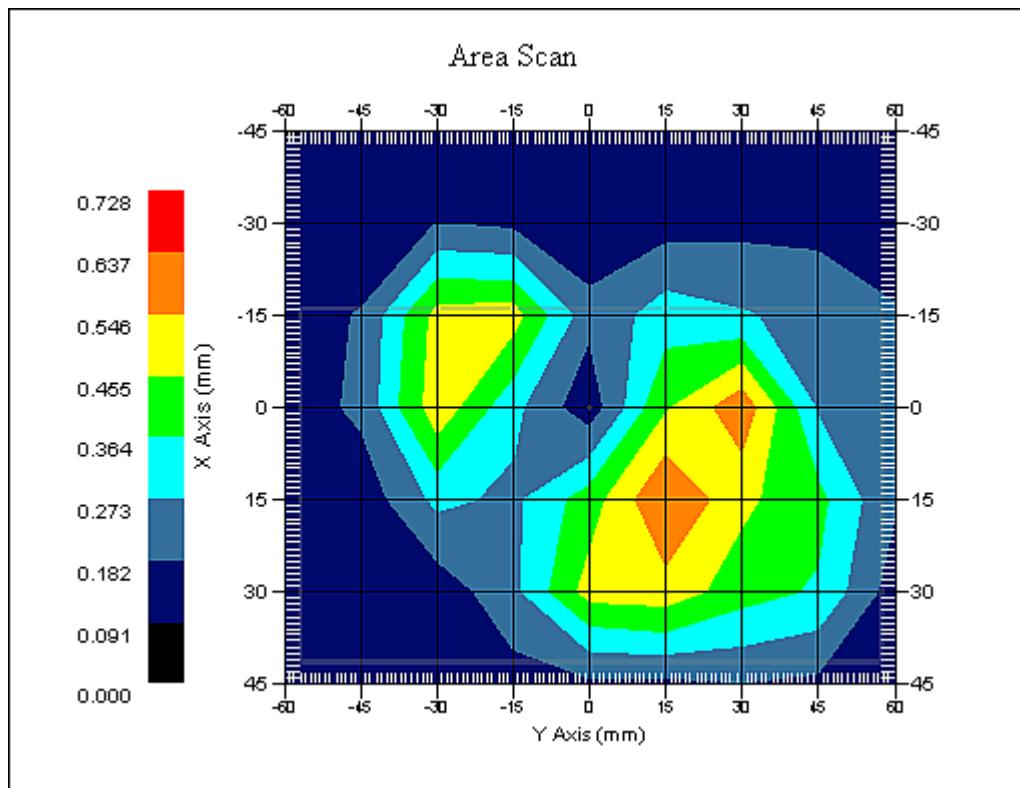
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : Mid



1 gram SAR value : 0.654 W/kg  
10 gram SAR value : 0.463 W/kg  
Area Scan Peak SAR : 0.640 W/kg  
Zoom Scan Peak SAR : 1.120 W/kg

**SAR Test Report**

By Operator : Jay  
Measurement Date : 16-May-2012  
Starting Time : 16-May-2012 12:14:37 PM  
End Time : 16-May-2012 12:56:32 PM  
Scanning Time : 2515 secs

## Product Data

Device Name : Teligy  
Serial No. : WBG00112  
Mode : Proprietary WiMax - QPSK 10 MHz  
Model : WBG  
Frequency : 2687.20 MHz  
Max. Transmit Pwr : 0.245 W  
Drift Time : 0 min(s)  
Length : 70 mm  
Width : 114 mm  
Depth : 36 mm  
Antenna Type : Antenna 2  
Orientation : Front  
Power Drift-Start : 0.169 W/kg  
Power Drift-Finish: 0.171 W/kg  
Power Drift (%) : 1.392

## Phantom Data

Name : APREL-Uni  
Type : Uni-Phantom  
Size (mm) : 280 x 280 x 200  
Serial No. : System Default  
Location : Center  
Description : Uni-Phantom

## Tissue Data

Type : BODY  
Serial No. : 2687  
Frequency : 2687.20 MHz  
Last Calib. Date : 16-May-2012  
Temperature : 20.00 °C  
Ambient Temp. : 23.00 °C  
Humidity : 45.00 RH%  
Epsilon : 52.11 F/m  
Sigma : 2.33 S/m  
Density : 1000.00 kg/cu. m

## Probe Data

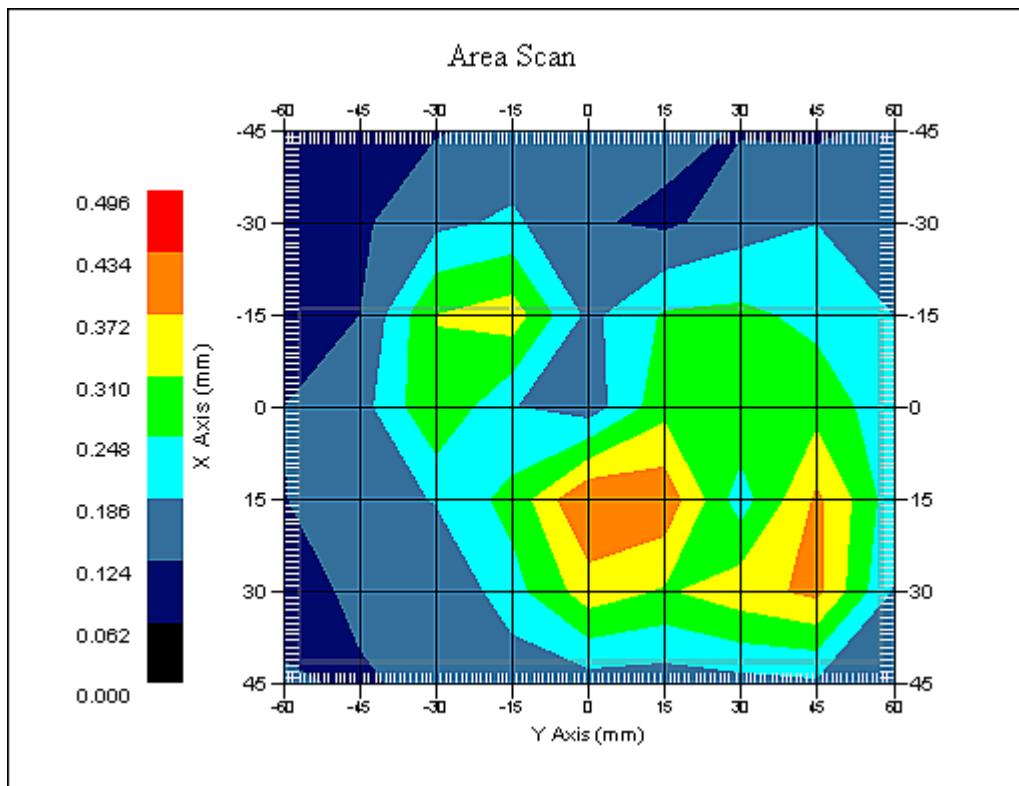
Name : RFEL 217  
Model : E020  
Type : E-Field Triangle  
Serial No. : 217  
Last Calib. Date : 07-Sep-2011  
Frequency : 2600.00 MHz  
Duty Cycle Factor: 2.5  
Conversion Factor: 4  
Probe Sensitivity: 1.20 1.20 1.20  $\mu$ V/ (V/m)<sup>2</sup>  
Compression Point: 95.00 mV  
Offset : 1.56 mm

## Measurement Data

Crest Factor : 2.5  
Scan Type : Complete  
Tissue Temp. : 20.00 °C  
Ambient Temp. : 23.00 °C  
Set-up Date : 16-May-2012  
Set-up Time : 12:13:22 PM  
Area Scan : 7x9x1 : Measurement x=15mm, y=15mm, z=4mm  
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

## Other Data

DUT Position : Front  
Separation : 0 mm  
Channel : High

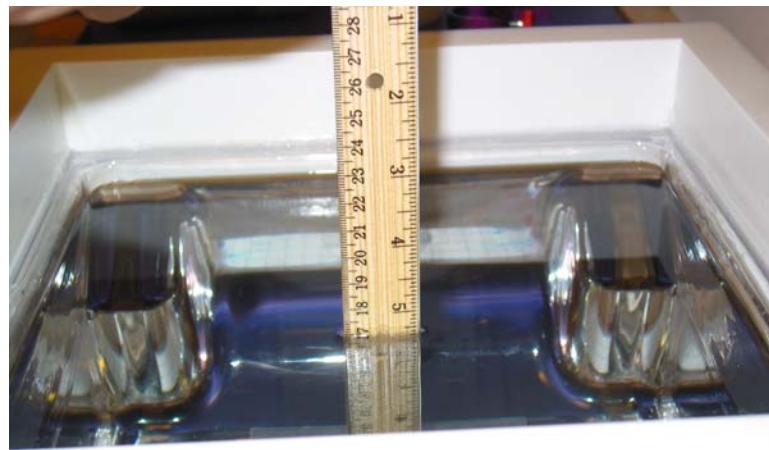


1 gram SAR value : 0.455 W/kg  
10 gram SAR value : 0.263 W/kg  
Area Scan Peak SAR : 0.435 W/kg  
Zoom Scan Peak SAR : 0.820 W/kg

## Appendix C – SAR Test Setup Photos



## System Body Configuration



## Body Tissue Depth



**Test Position Back 0 mm Gap**



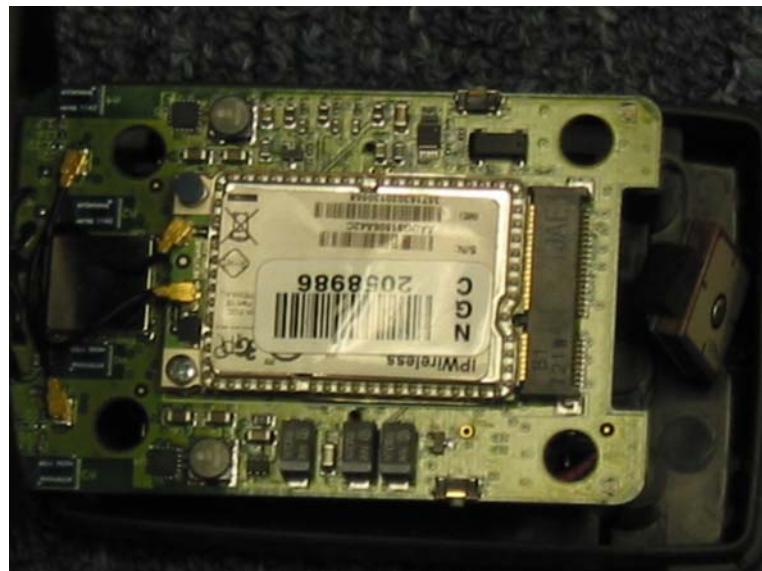
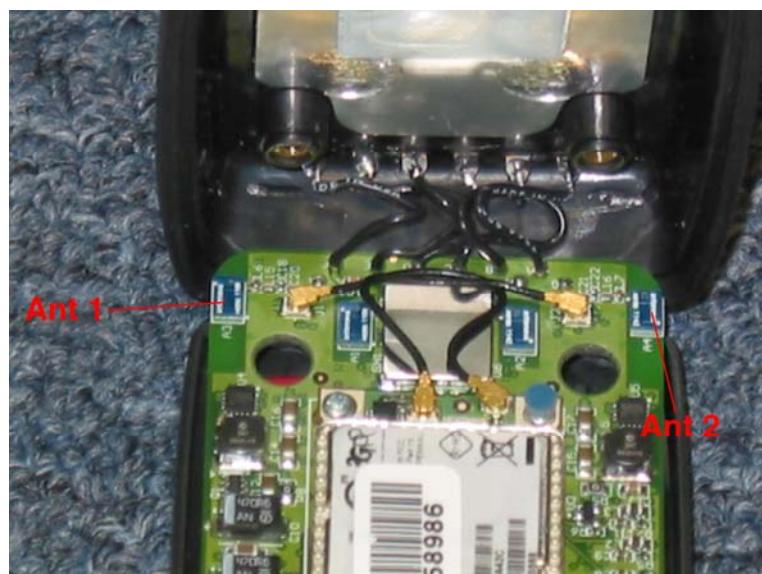
**Test Position Front 0 mm Gap**



## Front of Device



## Back of Device

**RF Module****Antenna Locations**

## Appendix D – Probe Calibration Data Sheets

# NCL CALIBRATION LABORATORIES

Calibration File No.: PC1333-1350

Client.: RFEL

## C E R T I F I C A T E   O F   C A L I B R A T I O N

It is certified that the equipment identified below has been calibrated in the  
**NCL CALIBRATION LABORATORIES** by qualified personnel following recognized  
procedures and using transfer standards traceable to NRC/NIST.

Equipment: Miniature Isotropic RF Probe

Record of Calibration

Head and Body

Manufacturer: APREL Laboratories

**Model No.:** E-020

**Serial No.:** 217

**Calibration Procedure:** D01-032-E020-V2, D22-012-Tissue, D28-002-Dipole  
**Project No:** RFEL-PC-5620

**Calibrated:** 7<sup>th</sup> September 2011  
**Released on:** 7<sup>th</sup> September 2011

**Approved By:** Stuart Nicol

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: \_\_\_\_\_

**NCL CALIBRATION LABORATORIES**

303 Terry Fox Drive, Suite 102  
Kanata, Ontario  
CANADA K2K 3J1

Division of APREL  
TEL: (613) 435-8300  
FAX: (613) 435-8306

# **NCL Calibration Laboratories**

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Division of APREL Inc.

## **Introduction**

This Calibration Report reproduces the results of the calibration performed in line with the references listed below. Calibration is performed using accepted methodologies as per the references listed below. Probes are calibrated for air, and tissue and the values reported are the results from the physical quantification of the probe through metrological practices.

## **Calibration Method**

Probes are calibrated using the following methods.

<1000MHz

TEM Cell for sensitivity in air

Standard phantom using temperature transfer method for sensitivity in tissue

>1000MHz

Waveguide\* method to determine sensitivity in air and tissue

\*Waveguide is numerically (simulation) assessed to determine the field distribution and power

The boundary effect for the probe is assessed using a standard flat phantom where the probe output is compared against a numerically simulated series of data points

## **References**

- IEEE Standard 1528 (2003) including Amendment 1  
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- EN 62209-1 (2006)  
Human Exposure to RF Fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures-Part 1: Procedure to measure the Specific Absorption Rate (SAR) for hand-held mobile wireless devices
- IEC 62209-2 Ed. 1.0 (2010-03)  
Human exposure to RF fields from hand-held and body-mounted wireless devices - Human models, instrumentation, and procedures - Part 2: specific absorption rate (SAR) for wireless communication devices (30 MHz - 6 GHz)
- TP-D01-032-E020-V2 E-Field probe calibration procedure
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

# **NCL Calibration Laboratories**

Division of APREL Inc.

## **Conditions**

Probe 217 was a re-calibration.

**Ambient Temperature of the Laboratory:** 22 °C +/- 1.5°C  
**Temperature of the Tissue:** 21 °C +/- 1.5°C  
**Relative Humidity:** < 60%

## **Primary Measurement Standards**

<b>Instrument</b>	<b>Serial Number</b>	<b>Cal date</b>
Power meter Anritsu MA2408A	90025437	Nov.4, 2010
Power Sensor Anritsu MA2481D	103555	Nov 4, 2010
Attenuator HP 8495A (70dB)	1944A10711	Sept. 14, 2010
Network Analyzer Anritsu MT8801C	MB11855	Feb. 8, 2011

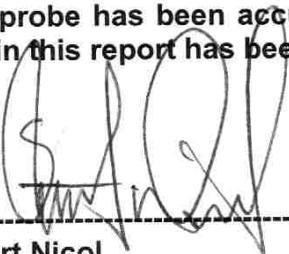
## **Secondary Measurement Standards**

Signal Generator Agilent E4438C -506 MY55182336 June 7, 2011

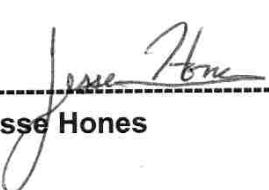
## **Attestation**

The below named signatories have conducted the calibration and review of the data which is presented in this calibration report.

**We the undersigned attest that to the best of our knowledge the calibration of this probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.**



-----  
**Stuart Nicol**



-----  
**Jesse Hones**

# **NCL Calibration Laboratories**

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Division of APREL Inc.

## **Probe Summary**

**Probe Type:** E-Field Probe E020  
**Serial Number:** 217  
**Frequency:** 750MHz  
**Sensor Offset:** 1.56  
**Sensor Length:** 2.5  
**Tip Enclosure:** Composite\*  
**Tip Diameter:** < 2.9 mm  
**Tip Length:** 55 mm  
**Total Length:** 289 mm

\*Resistive to recommended tissue recipes per IEEE-1528

## **Sensitivity in Air**

**Channel X:**  $1.2 \mu\text{V}/(\text{V}/\text{m})^2$   
**Channel Y:**  $1.2 \mu\text{V}/(\text{V}/\text{m})^2$   
**Channel Z:**  $1.2 \mu\text{V}/(\text{V}/\text{m})^2$   
**Diode Compression Point:** 95 mV

# NCL Calibration Laboratories

Division of APREL Inc.

## Calibration for Tissue (Head H, Body B)

Frequency	Tissue Type	Measured Epsilon	Measured Sigma	Calibration Uncertainty	Tolerance Uncertainty for 5%*	Conversion Factor
450 H	Head	45.31	0.91	4.1	3.6	5.8
450 B	Body	56.77	0.99	4.1	3.6	6.0
650 B	Body	57.42	0.91	3.96	3.5	6.2
750 H	Head	42.16	0.87	3.94	3.5	6.2
750 B	Body	55.54	0.94	3.94	3.4	6.3
835 H	Head	42.5	0.93	3.5	3.4	6.4
835 B	Body	56.37	0.954	3.5	3.4	6.4
900 H	Head	41.89	1.0	3.5	3.4	6.1
900 B	Body	53.68	1.05	3.5	3.4	6.1
1450 H	Head	X	X	X	X	X
1450 B	Body	X	X	X	X	X
1500 H	Head	X	X	X	X	X
1500 B	Body	X	X	X	X	X
1640 H	Head	39.0	1.25	3.5	2.7	5.2
1640 B	Body	52.03	1.39	3.5	2.7	5.0
1735 H	Head	X	X	X	X	X
1735 B	Body	51.68	1.5	3.5	2.7	5.2
1800 H	Head	38.38	1.39	3.5	2.7	4.9
1800 B	Body	51.54	1.56	3.5	2.7	5.1
1900 H	Head	38.4	1.43	3.5	2.7	4.9
1900 B	Body	52.08	1.59	3.5	2.7	4.8
2000 H	Head	X	X	X	X	X
2000 B	Body	X	X	X	X	X
2100 H	Head	X	X	X	X	X
2100 B	Body	X	X	X	X	X
2300 H	Head	X	X	X	X	X
2300 B	Body	X	X	X	X	X
2450 H	Head	38.2	1.82	3.5	3.5	3.91
2450 B	Body	51.74	1.96	3.5	3.5	3.94
2600 H	Head	X	X	X	X	X
2600 B	Body	51.18	2.16	3.5	3.5	4.0
3000 H	Head	X	X	X	X	X
3000 B	Body	X	X	X	X	X
3600 H	Head	X	X	X	X	X
3600 B	Body	X	X	X	X	X
5200 H	Head	X	X	X	X	X
5200 B	Body	X	X	X	X	X
5600 H	Head	X	X	X	X	X
5600 B	Body	X	X	X	X	X
5800 H	Head	X	X	X	X	X
5800 B	Body	X	X	X	X	X

## **NCL Calibration Laboratories**

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Division of APREL Inc.

### **Boundary Effect:**

Uncertainty resulting from the boundary effect is less than 2.1% for the distance between the tip of the probe and the tissue boundary, when less than 0.58mm.

### **Spatial Resolution:**

The spatial resolution uncertainty is less than 1.5% for 4.9mm diameter probe.  
The spatial resolution uncertainty is less than 1.0% for 2.5mm diameter probe.

### **DAQ-PAQ Contribution**

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of  $5\text{ M}\Omega$ .

### **Boundary Effect:**

For a distance of 0.58mm the worst case evaluated uncertainty (increase in the probe sensitivity) is less than 2.1%.

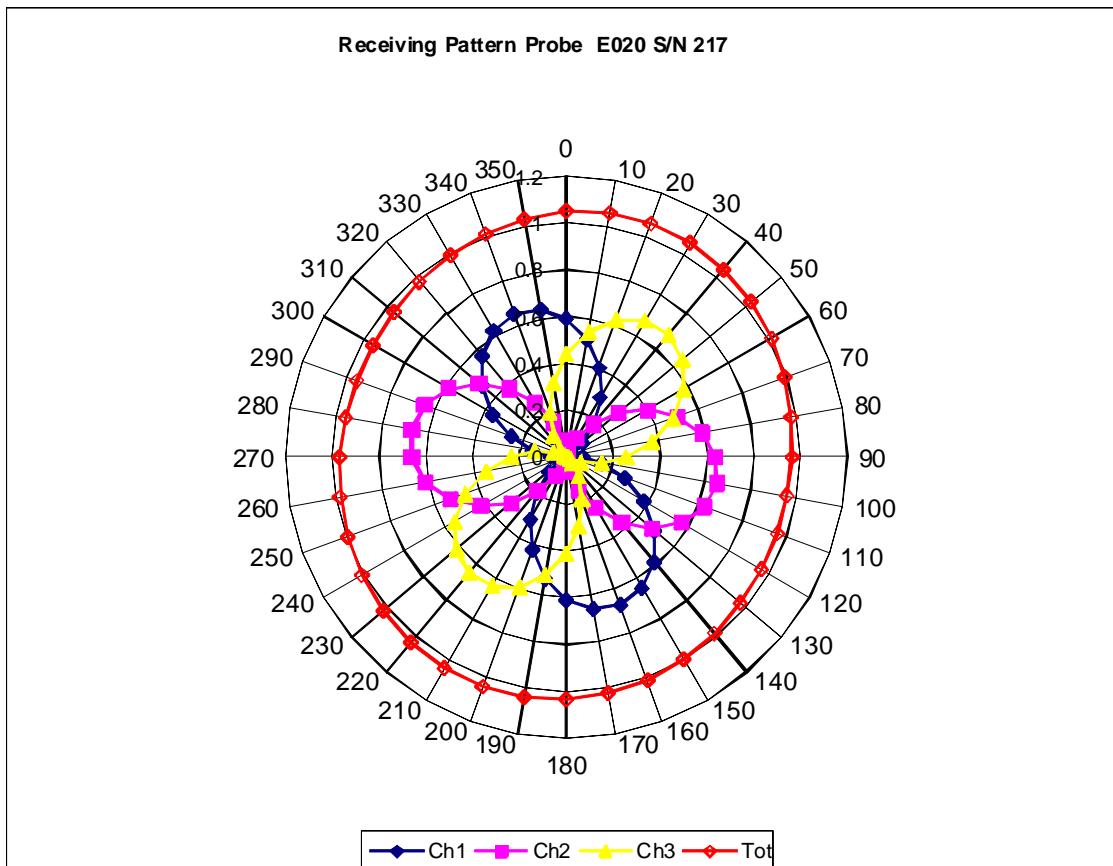
### **NOTES:**

\*The maximum deviation from the centre frequency when comparing the lower to upper range is listed.

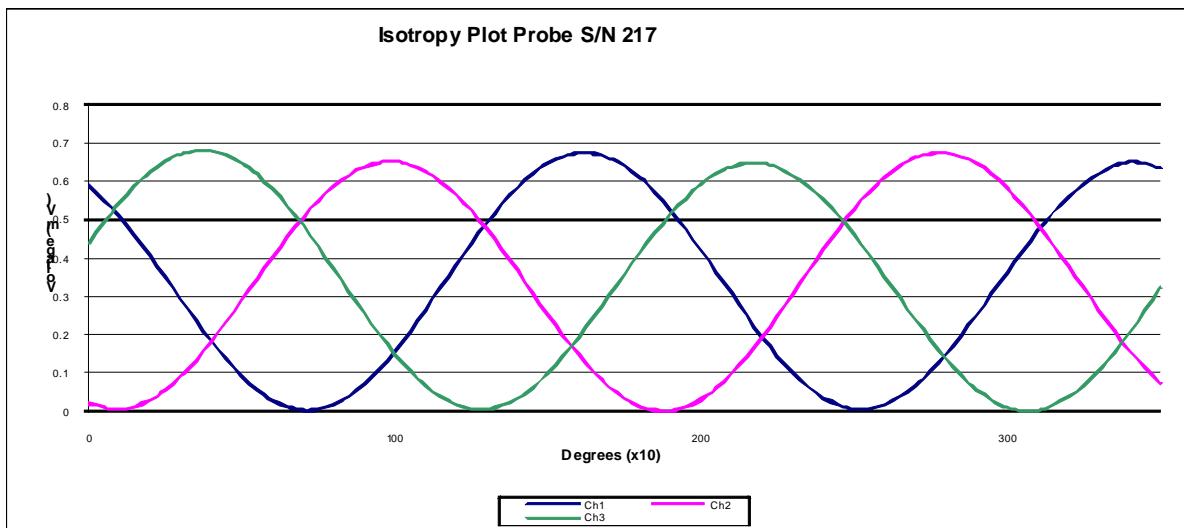
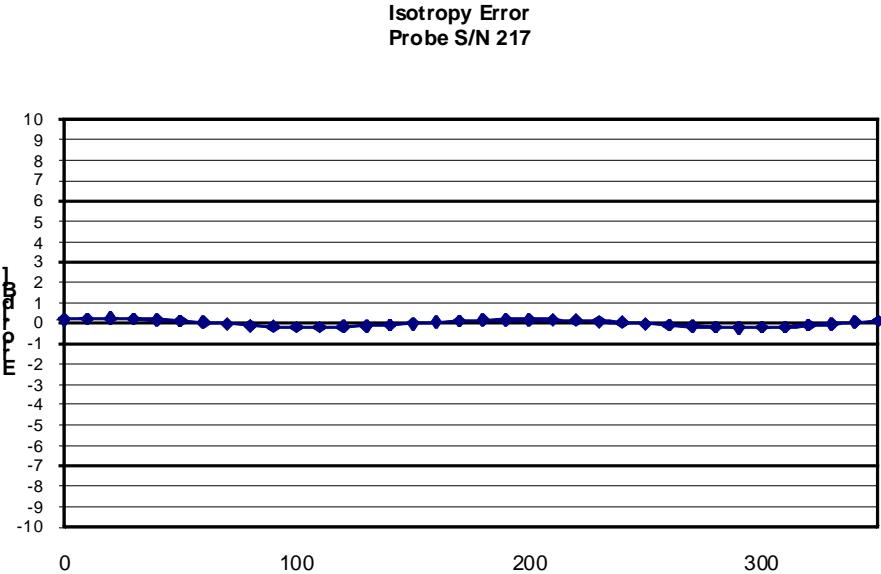
The probe was received in good condition.

Probe was calibrated on new DAC-PAQ.

## Receiving Pattern Air



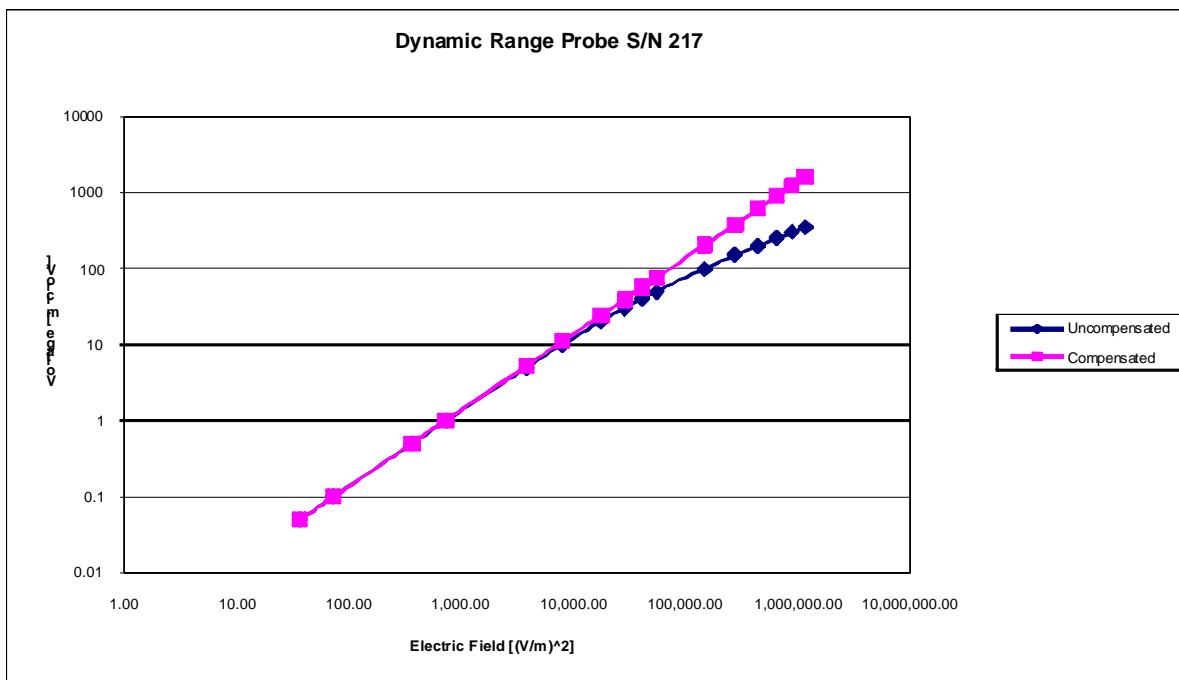
## Isotropy Error



Isotropicity Tissue:

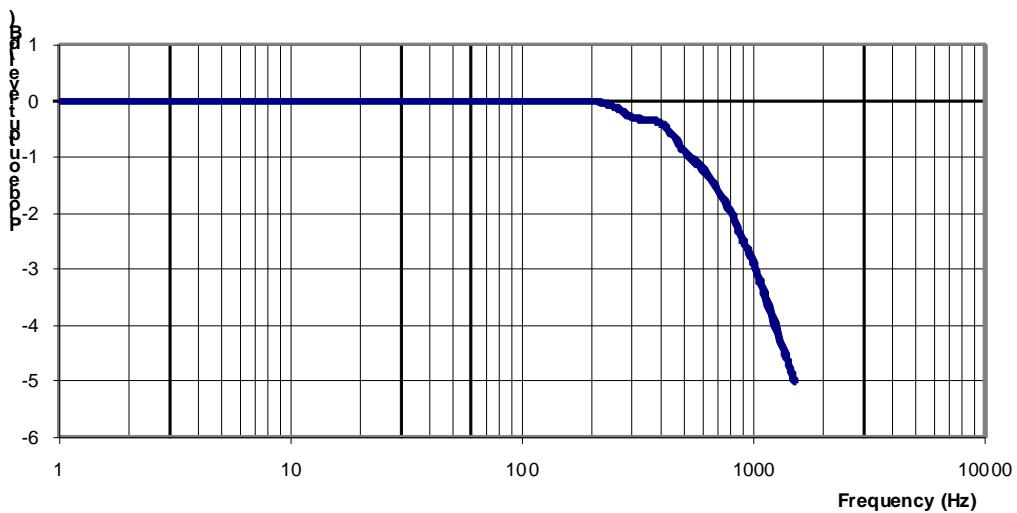
0.12 dB

## Dynamic Range



## Video Bandwidth

**Probe Frequency Characteristics**



**Video Bandwidth at 500 Hz**

1 dB

**Video Bandwidth at 1.02 KHz:**

3 dB

## Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2011.

## Appendix E – Dipole Calibration Data Sheets

## NCL CALIBRATION LABORATORIES

Calibration File No: DC-1116  
Project Number: RFEL-2600-Dipole-5482

## C E R T I F I C A T E   O F   C A L I B R A T I O N

It is certified that the equipment identified below has been calibrated in the  
**NCL CALIBRATION LABORATORIES** by qualified personnel following recognized  
procedures and using transfer standards traceable to NRC/NIST.

APREL Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-2600-S-2

Frequency: 2600 MHz Body

Serial No: 225-00903

Customer: RFEL

BODY Calibration

Calibrated: 18<sup>th</sup> January 2010  
Released on: 19<sup>th</sup> January 2010

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: \_\_\_\_\_

**NCL** CALIBRATION LABORATORIES

17 Bentley Avenue  
NEPEAN, ONTARIO  
CANADA K2E 6T7

Division of APREL Lab.  
TEL: (613) 820-2730  
FAX: (613) 820-4161

## **NCL Calibration Laboratories**

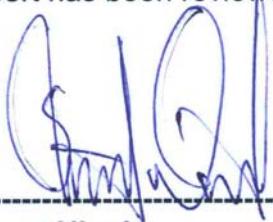
Division of APREL Laboratories.

### **Conditions**

Dipole 225-00903 was new and taken from stock prior to calibration.

**Ambient Temperature of the Laboratory:** 22 °C +/- 0.5°C  
**Temperature of the Tissue:** 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



**Stuart Nicol**



**C. Teodorian**

## Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

### Mechanical Dimensions

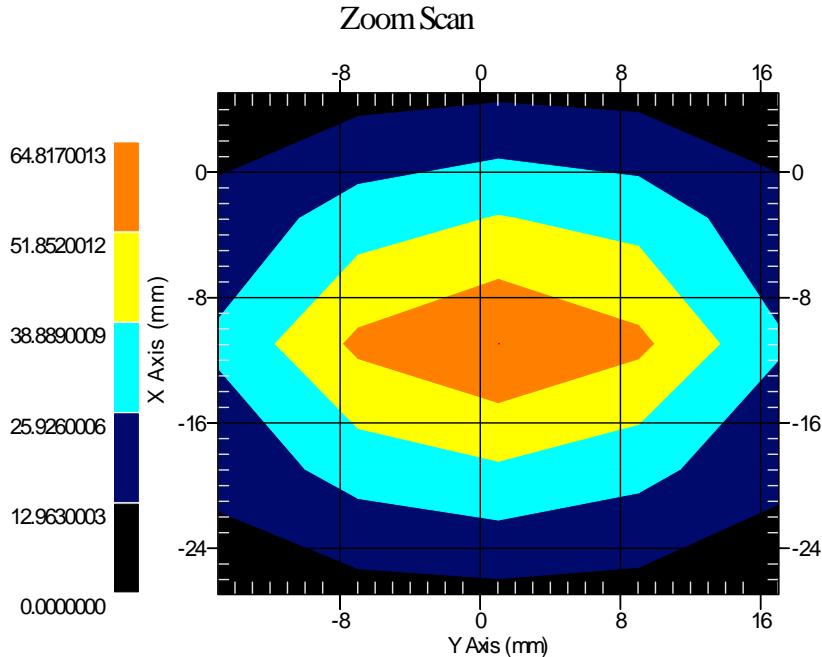
**Length:** 48.8 mm  
**Height:** 32.8 mm

### Electrical Specification

**SWR:** 1.013U  
**Return Loss:** -43.521dB  
**Impedance:** 49.355 ohm

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
2600 MHz	56.42	24.68	119



## Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 225-00903. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 225.

## References

SSI-TP-018-ALSAS Dipole Calibration Procedure

SSI-TP-016 Tissue Calibration Procedure

IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

## Conditions

Dipole 225-00903 was new taken from stock.

**Ambient Temperature of the Laboratory:** 22 °C +/- 0.5°C

**Temperature of the Tissue:** 20 °C +/- 0.5°C

## Dipole Calibration uncertainty

The calibration uncertainty for the dipole is made up of various parameters presented below.

<b>Mechanical</b>	1%
<b>Positioning Error</b>	1.22%
<b>Electrical</b>	1.7%
<b>Tissue</b>	2.2%
<b>Dipole Validation</b>	2.2%
<b>TOTAL</b>	<b>8.32% (16.64% K=2)</b>

# **NCL Calibration Laboratories**

Division of APREL Laboratories.

## **Dipole Calibration Results**

### **Mechanical Verification**

<b>Measured Length</b>	<b>Measured Height</b>
48.8 mm	32.8 mm

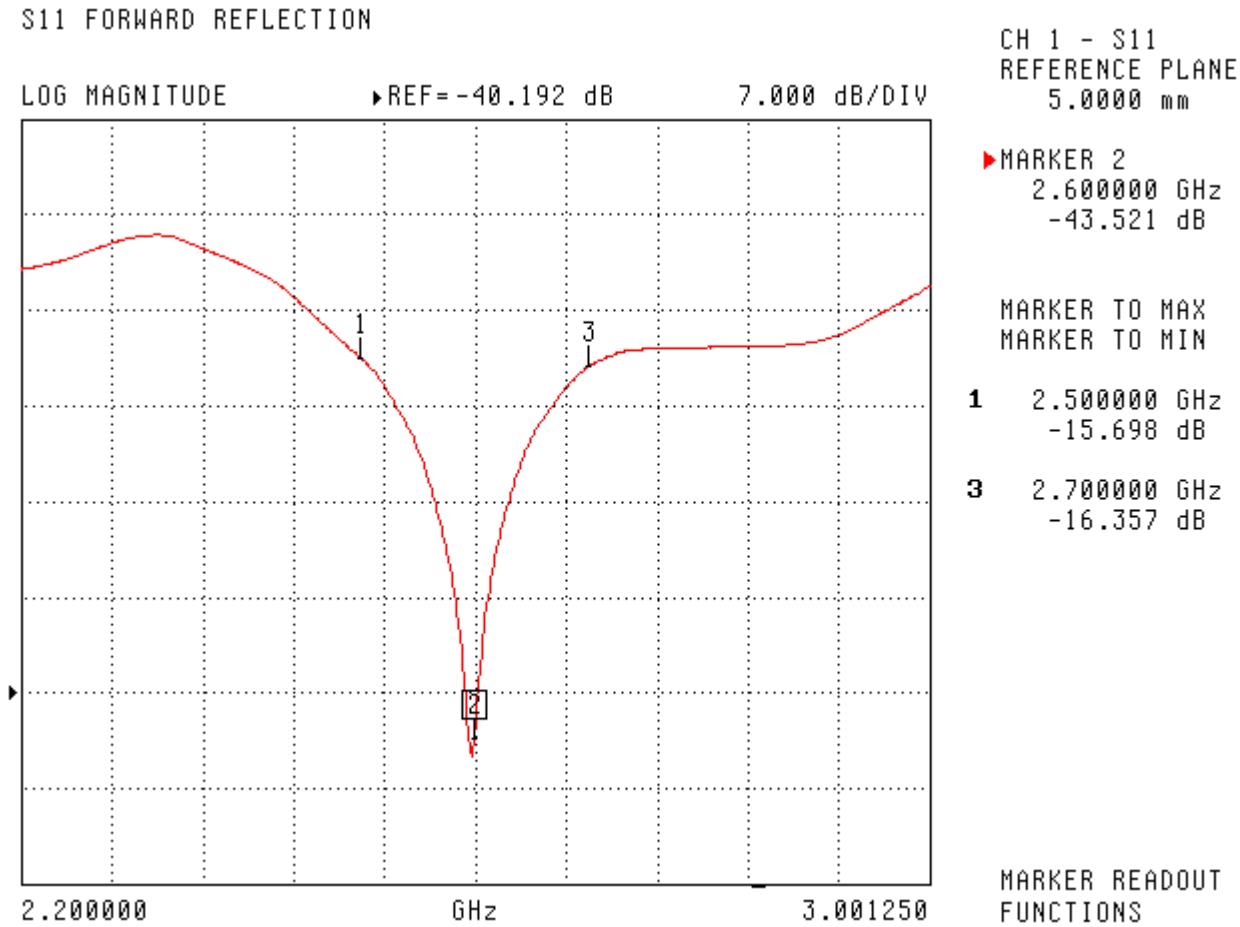
### **Tissue Validation**

<b>Body Tissue 2600 MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	51.15
<b>Conductivity, <math>\sigma</math> [S/m]</b>	2.13

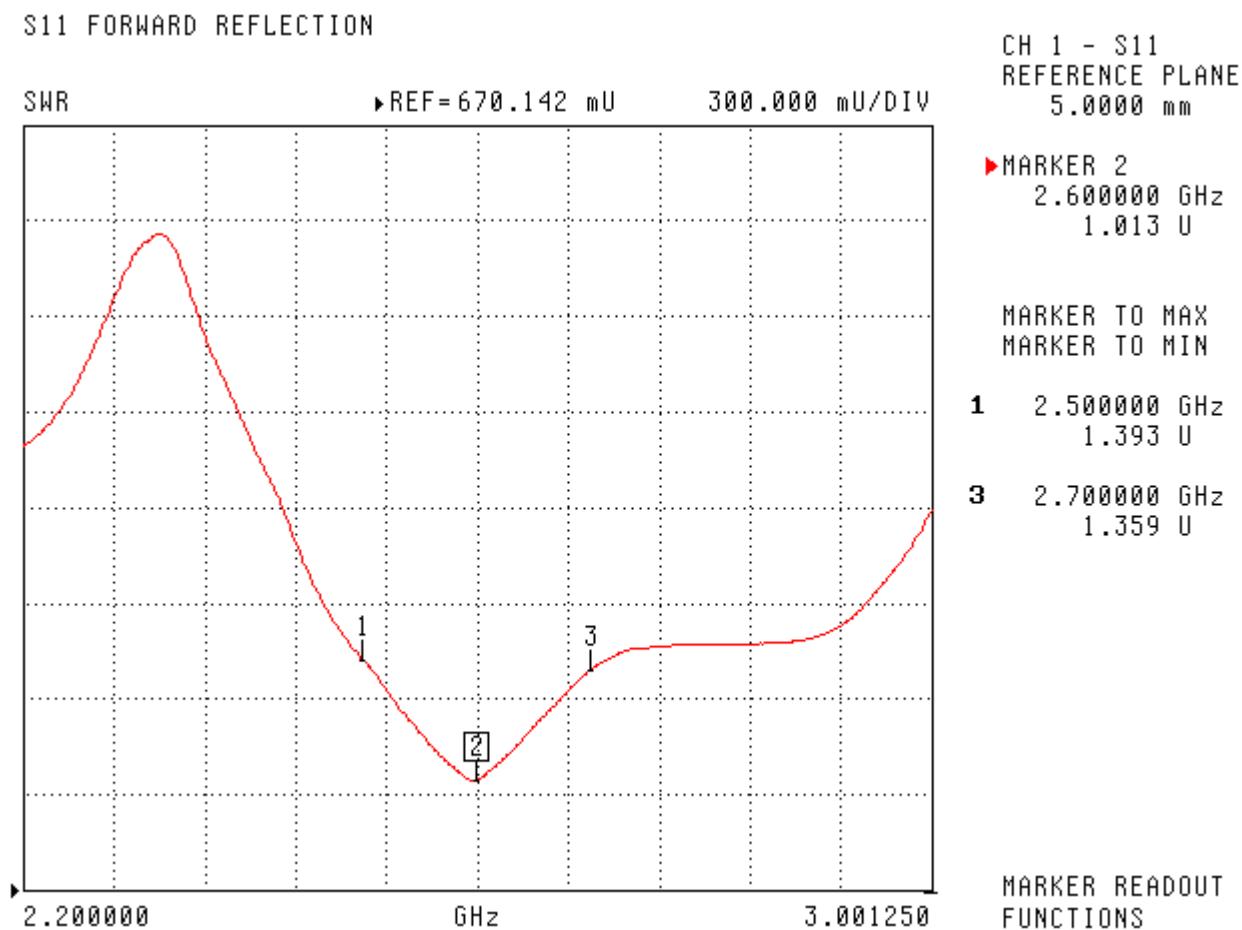
**Electrical Calibration**

Test	Result
S11 R/L	-43.521
SWR	1.013U
Impedance	49.355Ω

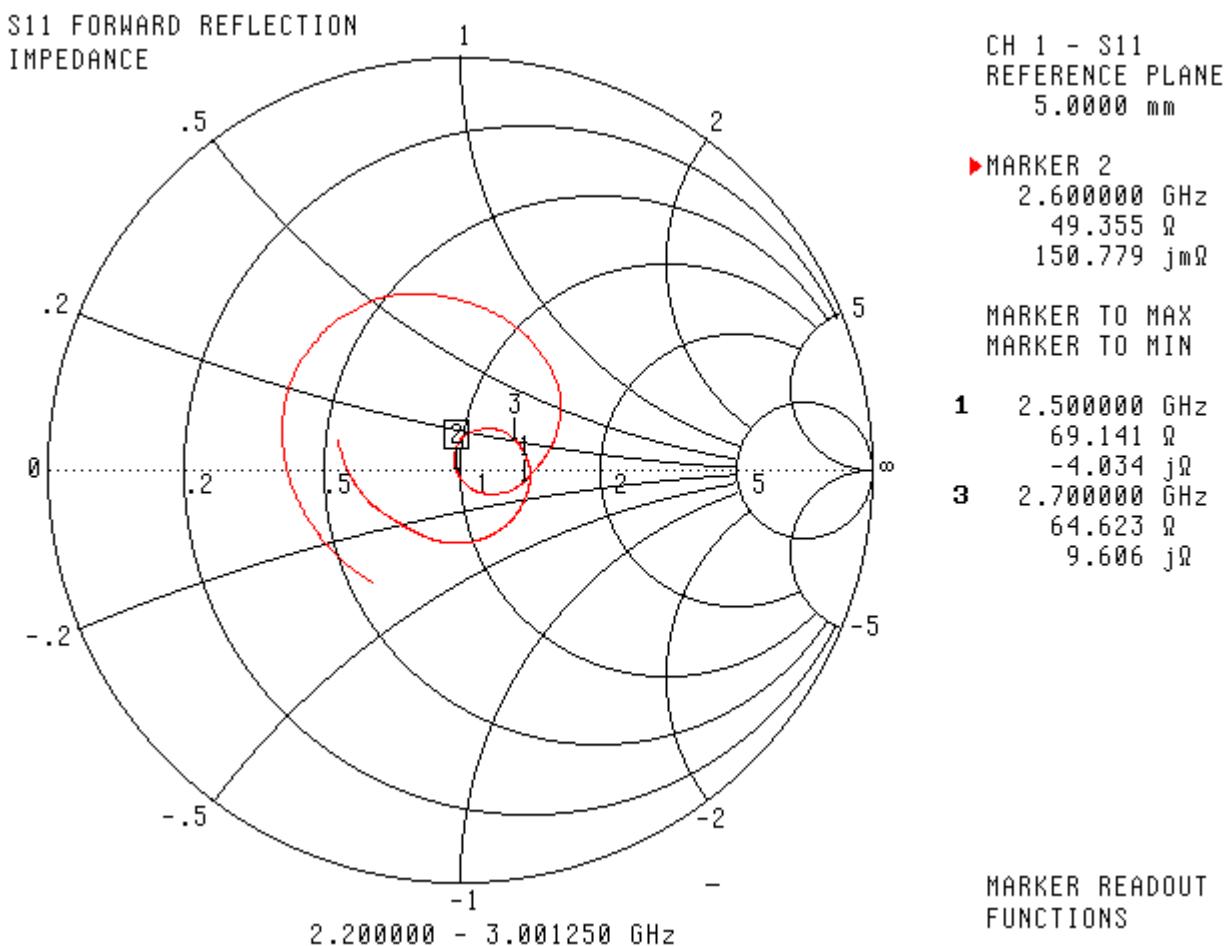
The Following Graphs are the results as displayed on the Vector Network Analyzer.

**S11 Parameter Return Loss**

## SWR

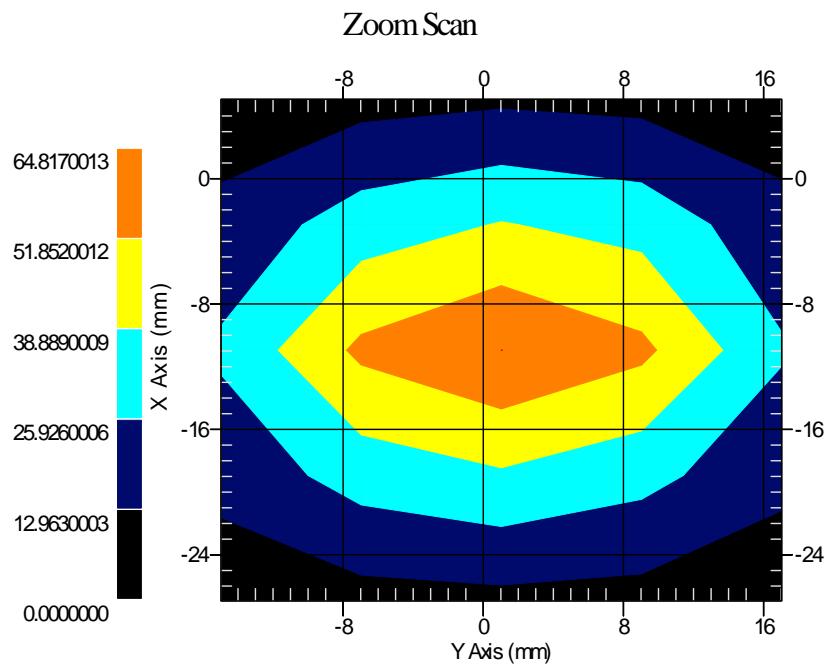


## Smith Chart Dipole Impedance



**System Validation Results Using the Electrically Calibrated Dipole**

Body Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
2600 MHz	56.42	24.68	119



## **NCL Calibration Laboratories**

Division of APREL Laboratories.

### **Test Equipment**

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2009.

### **Extended Calibration**

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 450824:

<b>ALS-D-2600-S-2 SN: 225-00903</b>				
<b>Date of Measurement</b>	<b>Return Loss (dB)</b>	<b>Δ%</b>	<b>Impedance (Ω)</b>	<b>Δ%</b>
1/18/2010	-43.521		49.355	
1/12/2011	-42.183	-3.1	48.371	-2
1/12/2012	-42.365	-2.7	48.975	-0.8

## Appendix F – Phantom Calibration Data Sheets

## NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-273

### CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the  
**NCL CALIBRATION LABORATORIES** by qualified personnel following recognized  
procedures and using transfer standards traceable to National Standards.

Thickness of the UniPhantom is 2 mm  $\pm$  10%  
Pinna thickness is 6 mm  $\pm$  10%

Resolution: 0.01 mm      Calibrated to: 0.0 mm  
Stability: OK      Accuracy: < 0.1 mm

Calibrated By:

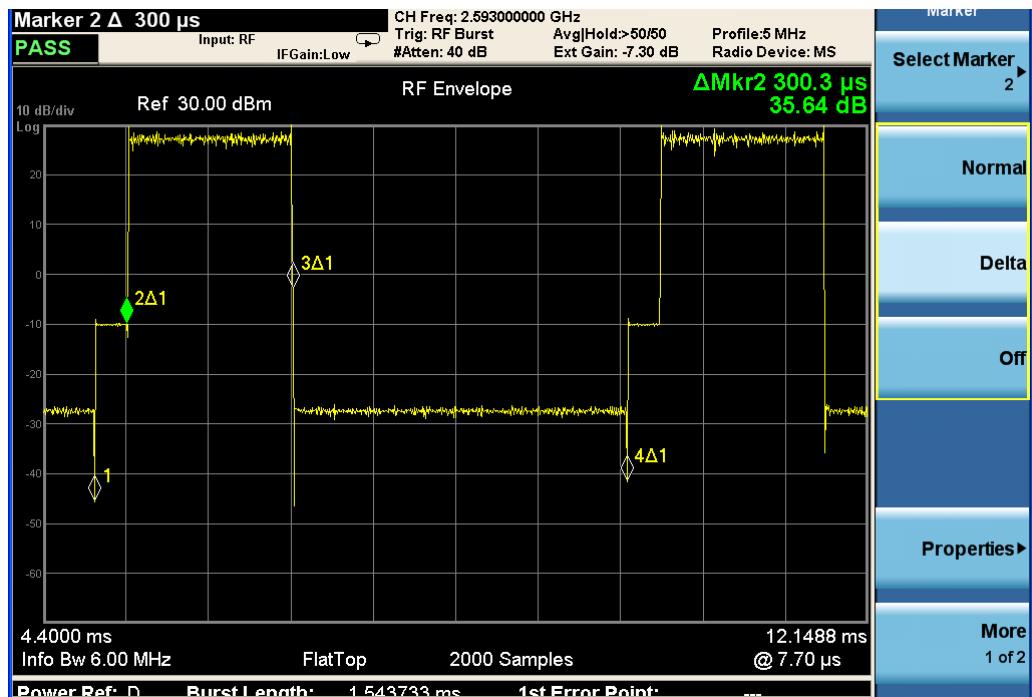
Karen K.      Feb 17/04

### **NCL CALIBRATION LABORATORIES**

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

Division of APREL Lab.  
TEL: (613) 820-4988  
FAX: (613) 820-4161

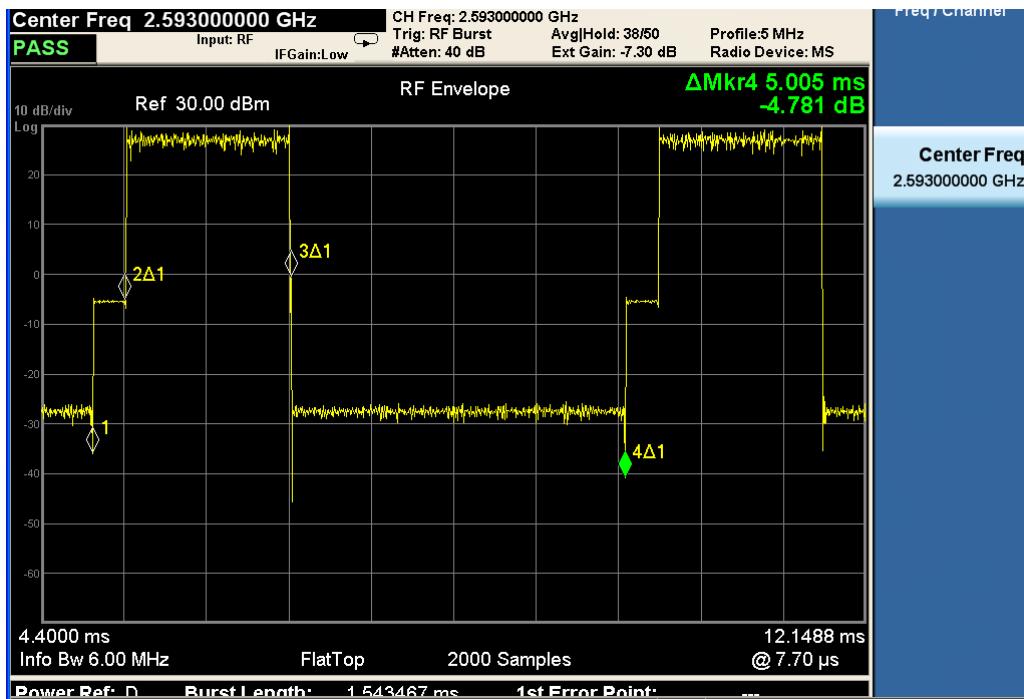
## Appendix G – Additional Plots



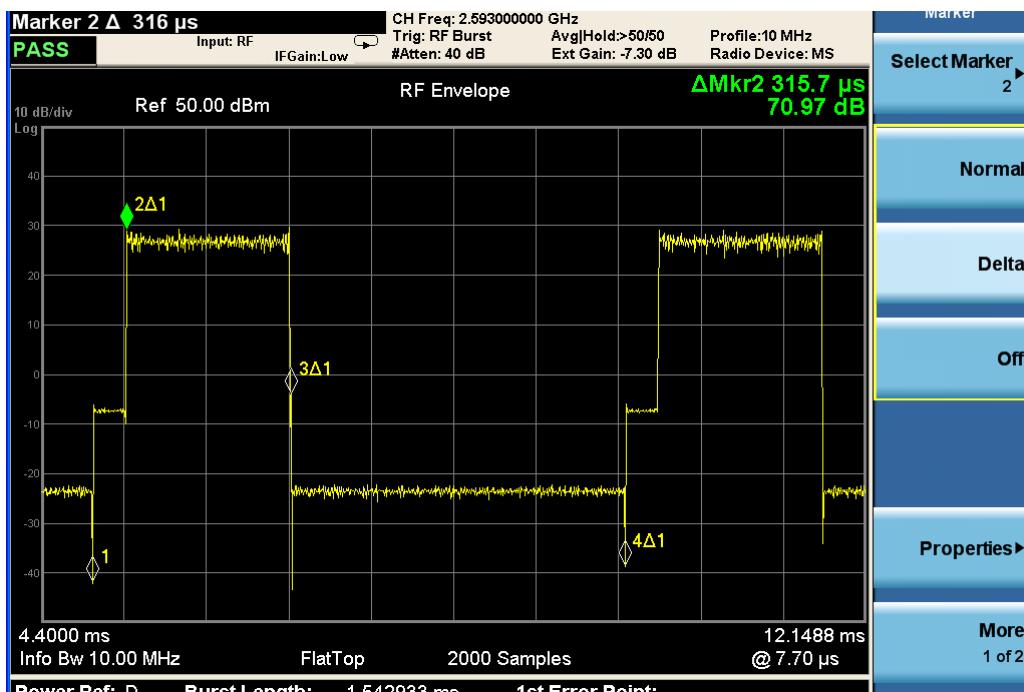
## 5MHz QPSK PUSC 2.593GHz DL: 29, UL: 18



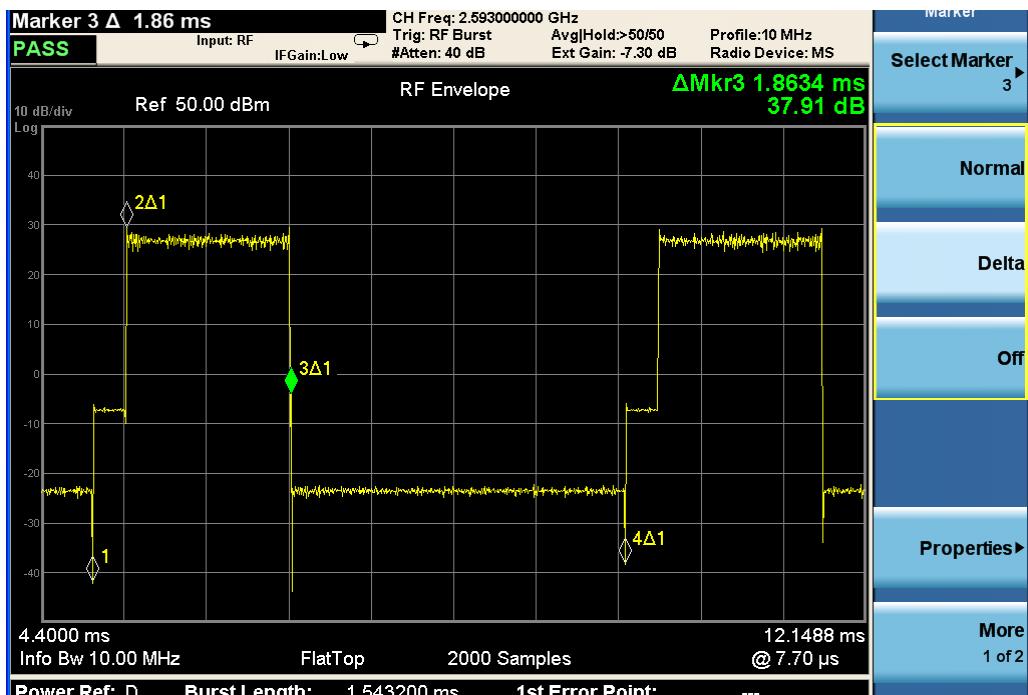
## 5MHz QPSK PUSC 2.593GHz DL: 29, UL: 18



## 5MHz QPSK PUSC 2.593GHz DL: 29, UL: 18



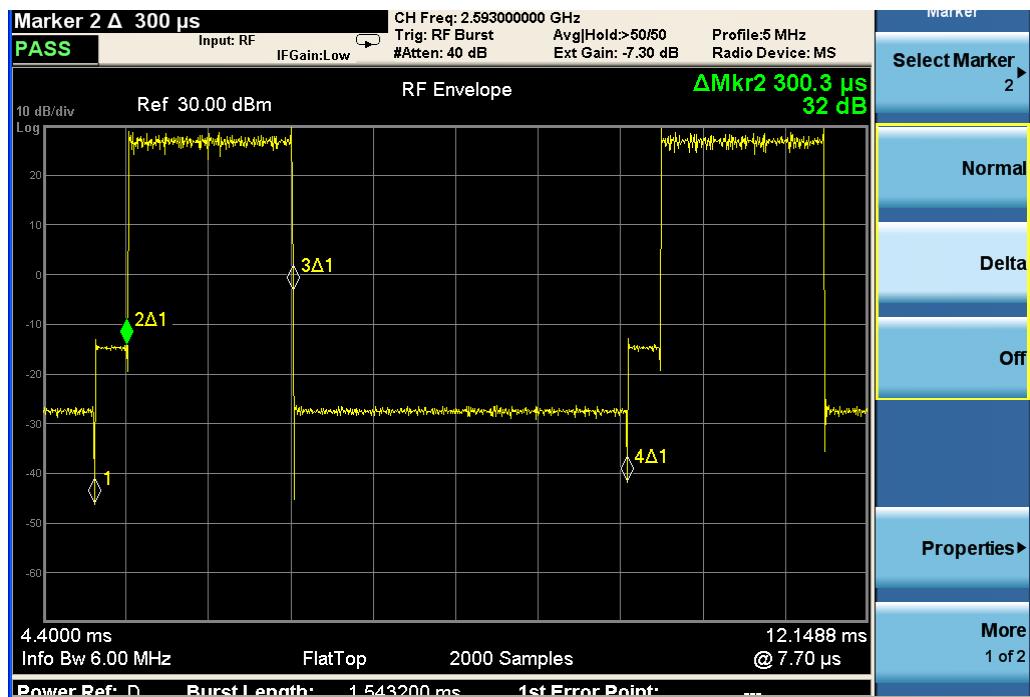
## 10MHz QPSK PUSC 2.593GHz DL: 29, UL: 18



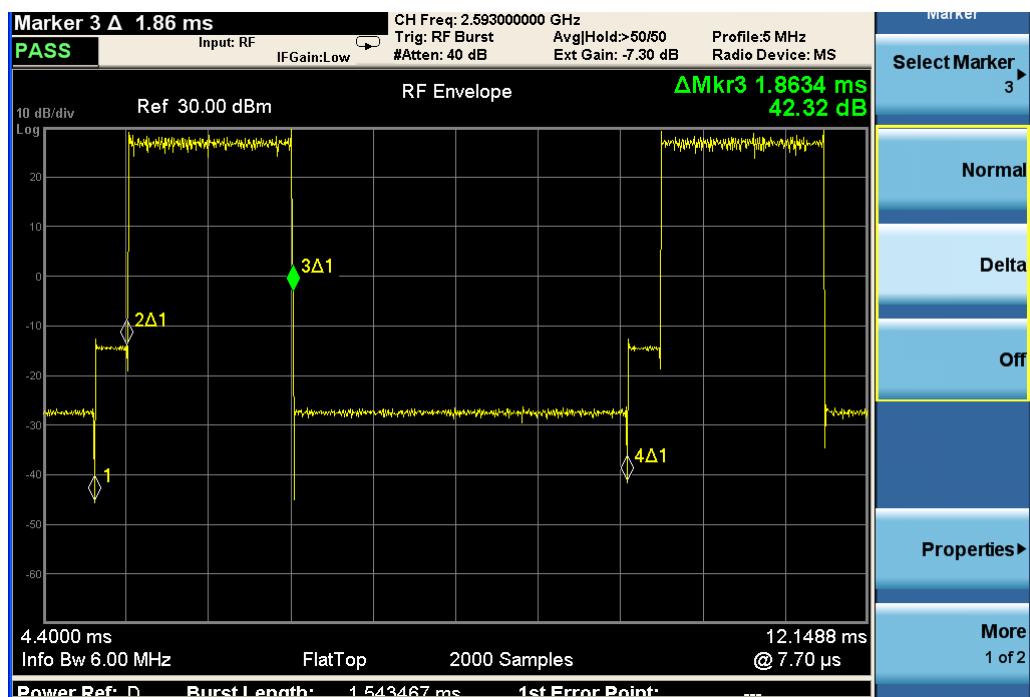
### 10MHz QPSK PUSC 2.593GHz DL: 29, UL: 18



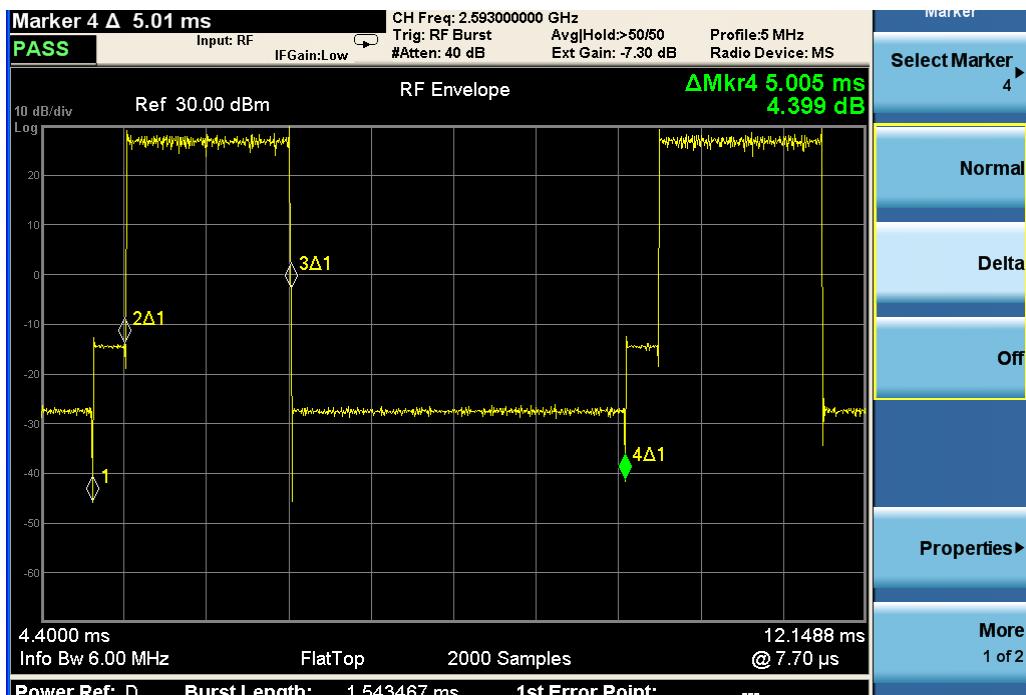
### 10MHz QPSK PUSC 2.593GHz DL: 29, UL: 18



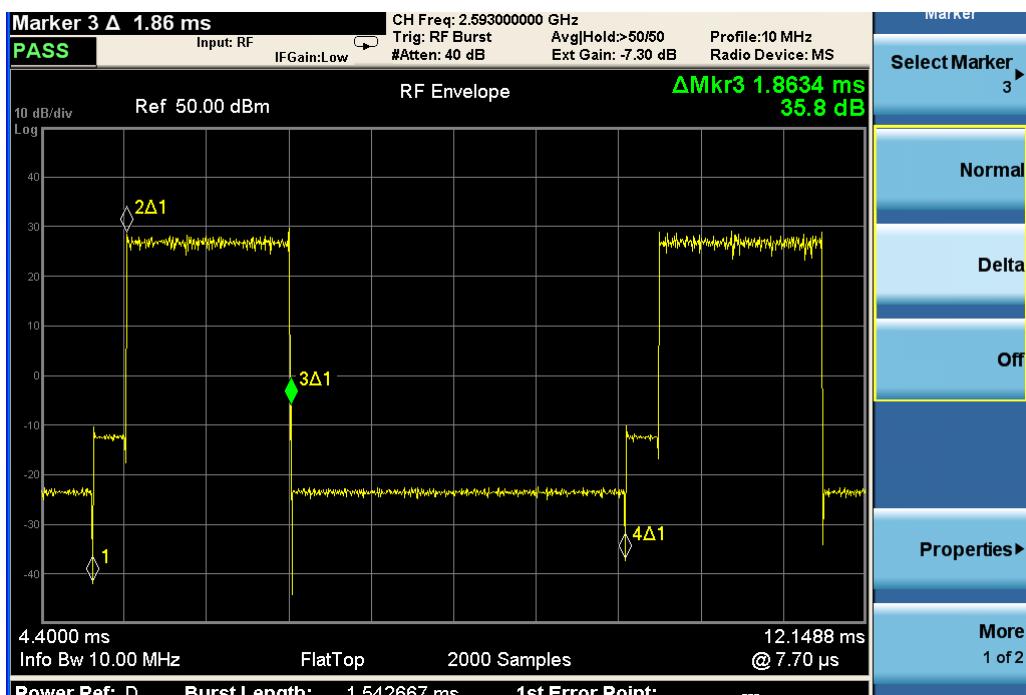
5MHz 16QAM PUSC 2.593GHz DL: 29, UL: 18



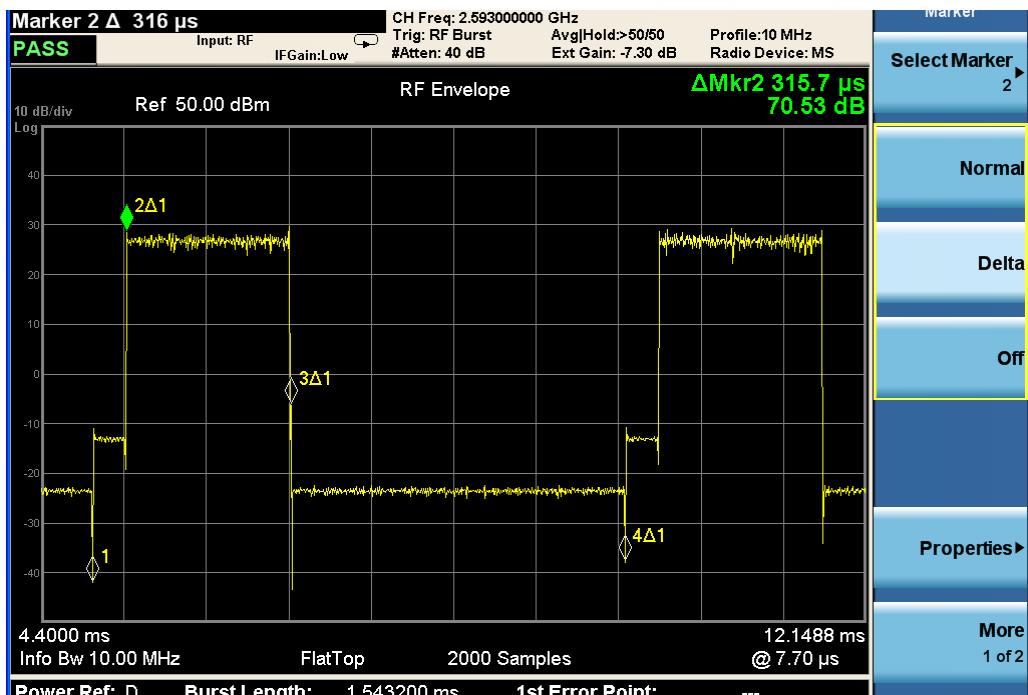
5MHz 16QAM PUSC 2.593GHz DL: 29, UL: 18



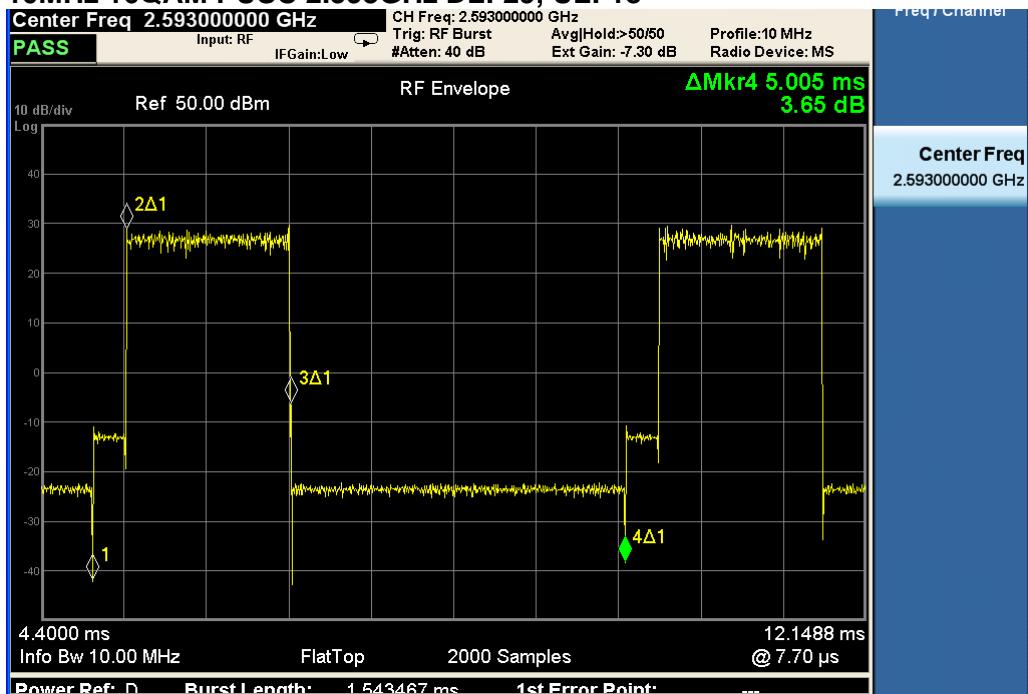
## 5MHz 16QAM PUSC 2.593GHz DL: 29, UL: 18



## 10MHz 16QAM PUSC 2.593GHz DL: 29, UL: 18



### 10MHz 16QAM PUSC 2.593GHz DL: 29, UL: 18



### 10MHz 16QAM PUSC 2.593GHz DL: 29, UL: 18