



# A Test Lab Techno Corp.

Changan Lab : No. 140 -1, Changan Street, Bade City, Taoyuan County, Taiwan R.O.C.

Tel : 886-3-271-0188 / Fax : 886-3-271-0190

## SAR EVALUATION REPORT



Test Report No.	:	1110FS20-01
Applicant	:	Microlink Communications Inc.
Product Type	:	MTP1121 PCI Express Mini Card
Trade Name	:	Microlink
Model Number	:	MTP1121
Dates of Received	:	Aug. 18, 2011
Dates of Test	:	Oct. 12 ~ Oct. 13, 2011
Date of Issued	:	Nov. 21, 2011
Test Environment	:	Ambient Temperature : $22 \pm 2^{\circ}\text{C}$ Relative Humidity : 40 - 70 %
Standard	:	ANSI/IEEE C95.1-1999 IEEE Std. 1528-2003 47 CFR Part §2.1093; FCC/OET Bulletin 65 Supplement C [July 2001] KDB 447498 RF Exposure Procedures and Equipment Authorization Policies KDB 941225 D01 SAR Test for 3G Devices 3G-SAR
Max. SAR	:	1.380 W/kg Body SAR
Test Lab Location	:	Chang-an Lab



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Approved By

(Sam Chuang)

Tested By

(Alex Wu)



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# 1. Description of Equipment under Test (EUT)

Applicant	Microlink Communications Inc.		
Applicant Address	No. 23, Xinghua Rd., Taoyuan City, Taoyuan County 330, Taiwan		
Manufacture	Option NV		
Manufacture Address	Gaston Geenslaan 14 Leuven, 3001 Belgium		
Product Type	MTP1121 PCI Express Mini Card		
Trade Name	Microlink		
Model Number	MTP1121		
FCC ID	ZUJ-MTP1121		
RF Function	1xRTT / 1xEVDO Rev.0 / 1xEVDO Rev.A Cellular Band 1xRTT / 1xEVDO Rev.0 / 1xEVDO Rev.A PCS Band		
Tx Frequency	Band		Operate Frequency (MHz)
	1xRTT / 1xEVDO Rev.0 / 1xEVDO Rev.A	Cellular Band	824.0 - 849.0
		PCS Band	1850.0 - 1910.0
RF Conducted Power (Avg.)	Band		Power (W / dBm)
	Cellular Band		0.245 / 23.89
	PCS Band		0.252 / 24.02
Max. SAR Measurement	1.380 W/kg Body SAR		
Antenna Type	Printed Antenna		
Device Category	Portable Device		
RF Exposure Environment	General Population / Uncontrolled		
Battery Option	Standard		
Application Type	Certification		

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general population exposure limits specified in Standard C95.1-1999 and had been tested in accordance with the measurement procedures specified in IEEE Std. 1528-2003.

## 2. Introduction

The A Test Lab Techno Corp. has performed measurements of the maximum potential exposure to the user of **Microlink Communications Inc.** Trade Name : **Microlink** Model(s) : **MTP1121**. The test procedures, as described in American National Standards, Institute C95.1-1999 [ 1 ] , FCC/OET Bulletin 65 Supplement C [July 2001] were employed and they specify the maximum exposure limit of 1.6mW/g as averaged over any 1 gram of tissue for portable devices being used within 20cm between user and EUT in the uncontrolled environment. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment used are included within this test report.

### 2.1 SAR Definition

Specific Absorption Rate (SAR) 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 ( $\rho$ ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Figure 2).

$$SAR = \frac{d}{dt} \left( \frac{dw}{dm} \right) = \frac{d}{dt} \left( \frac{dw}{\rho dv} \right)$$

Figure 2. SAR Mathematical Equation

SAR is expressed in units of Watts per kilogram (W/kg)

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

Where :

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

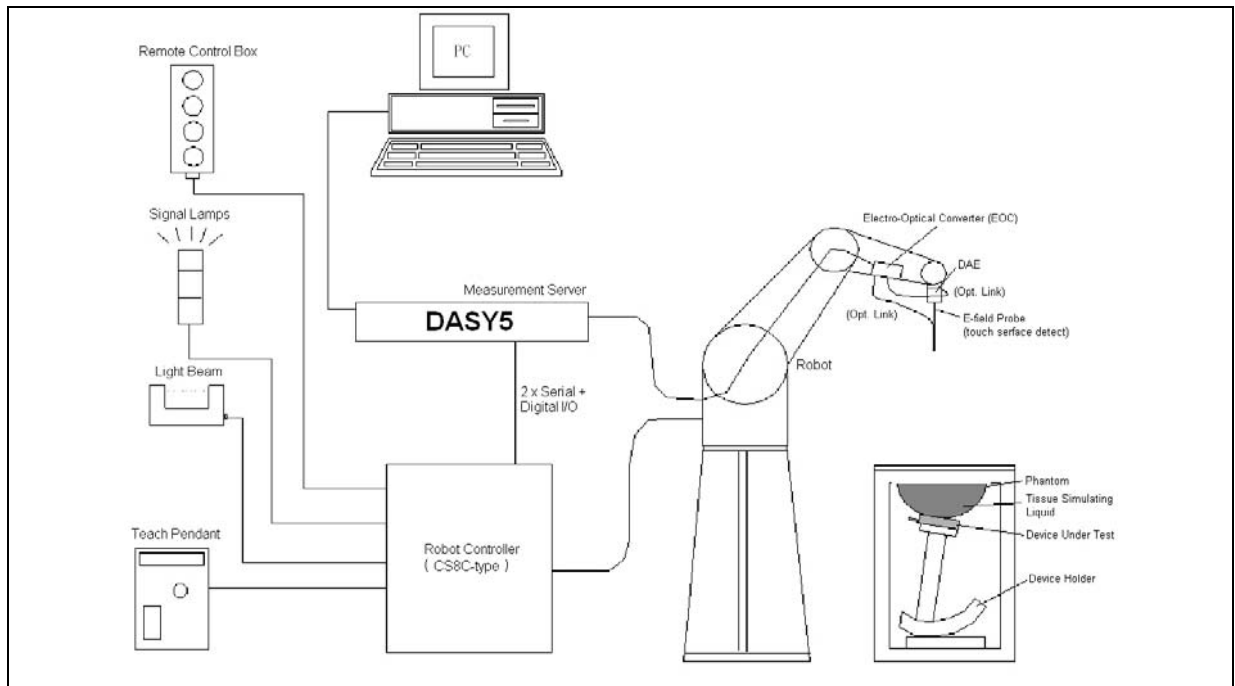
$\rho$  = mass density of the tissue (kg/m<sup>3</sup>)

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

\* Note :

The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane [ 2 ]

### 3. SAR Measurement Setup



The DASY5 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Stäubli TX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
5. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
6. A computer operating Windows 2000 or Windows XP.
7. DASY5 software.
8. Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The SAM twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. Validation dipole kits allowing validating the proper functioning of the system.



### 3.1 DASY5 E-Field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 or EX3DV3 (manufactured by SPEAG), designed in the classical triangular configuration [3] and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY5 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped when reaching the maximum.

### 3.1.1 E-Field Probe Specification

Construction	<p>Symmetrical design with triangular core</p> <p>Built-in optical fiber for surface detection System</p> <p>Built-in shielding against static charges</p> <p>PEEK enclosure material (resistant to organic solvents, e.q., glycol)</p>
Calibration	<p>In air from 10 MHz to 6 GHz</p> <p>In brain and muscle simulating tissue at frequencies of 2450MHz (accuracy <math>\pm 8\%</math>)</p> <p>Calibration for other liquids and frequencies upon request</p>
Frequency	<p><math>\pm 0.2</math> dB (30 MHz to 6 GHz) for EX3DV3</p> <p><math>\pm 0.2</math> dB (30 MHz to 4 GHz) for ES3DV3</p> <p><math>\pm 0.2</math> dB (30 MHz to 6 GHz) for EX3DV4</p>
Directivity	<p><math>\pm 0.3</math> dB in brain tissue (rotation around probe axis)</p> <p><math>\pm 0.5</math> dB in brain tissue (rotation normal probe axis)</p>
Dynamic Range	10 $\mu$ W/g to > 100mW/g; Linearity: $\pm 0.2$ dB
Dimensions	<p>Overall length: 337mm</p> <p>Tip length: 20mm</p> <p>Body diameter: 12mm</p> <p>Tip diameter: 2.5mm for EX3DV3 and EX3DV4, 3.9mm for ES3DV3</p> <p>Distance from probe tip to dipole centers: 1.0mm for EX3DV3 and EX3DV4, 2.0mm for ES3DV3</p>
Application	<p>General dosimetry up to 6GHz</p> <p>Compliance tests of mobile phones</p> <p>Fast automatic scanning in arbitrary phantoms</p>



**Figure 3. E-field Probe**



**Figure 4. Probe setup on robot**



### 3.1.2 E-Field Probe Calibration process

#### Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm<sup>2</sup>) using an RF Signal generator, TEM cell, and RF Power Meter.

#### Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm<sup>2</sup>.

#### Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C \frac{\Delta T}{\Delta t}$$

Where :

$\Delta t$  = Exposure time (30 seconds),

$C$  = Heat capacity of tissue (head or body),

$\Delta T$  = Temperature increase due to RF exposure.

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

Where :

$\sigma$  = Simulated tissue conductivity,

$\rho$  = Tissue density (kg/m<sup>3</sup>).





### 3.2 Data Acquisition Electronic (DAE) System

#### Cell Controller

Processor : Intel Core(TM)2 CPU  
Clock Speed : @ 1.86GHz  
Operating System : Windows XP Professional

#### Data Converter

Features : Signal Amplifier, multiplexer, A/D converter, and control logic  
Software : DASY5 v5.0 (Build 125) & SEMCAD X Version 13.4 Build 125  
Connecting Lines : Optical downlink for data and status info  
Optical uplink for commands and clock

### 3.3 Robot

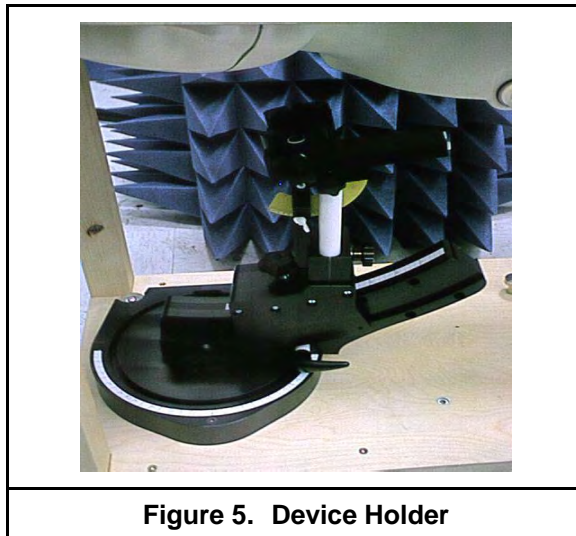
Positioner : Stäubli Unimation Corp. Robot Model: TX90XL  
Repeatability :  $\pm 0.02$  mm  
No. of Axis : 6

### 3.4 Measurement Server

Processor : PC/104 with a 400MHz intel ULV Celeron  
I/O-board : Link to DAE4 (or DAE3)  
16-bit A/D converter for surface detection system  
Digital I/O interface  
Serial link to robot  
Direct emergency stop output for robot

### 3.5 Device Holder

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity  $\epsilon=3$  and loss tangent  $\delta=0.02$ . The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



### 3.6 Phantom - SAM v4.0

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness	$2 \pm 0.2$ mm
Filling Volume	Approx. 25 liters
Dimensions	1000x500 mm (LxW)
<b>Table 1. Specification of SAM v4.0</b>	



**Figure 6. SAM Twin Phantom**

### 3.7 Oval Flat Phantom - ELI 4.0

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (Oval Flat) phantom defined in IEEE 1528-2003, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of wireless portable device usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

<b>Shell Thickness</b>	2 $\pm$ 0.2 mm
<b>Filling Volume</b>	Approx. 30 liters
<b>Dimensions</b>	190x600x400 mm (HxLxW)
<b>Table 2. Specification of ELI 4.0</b>	

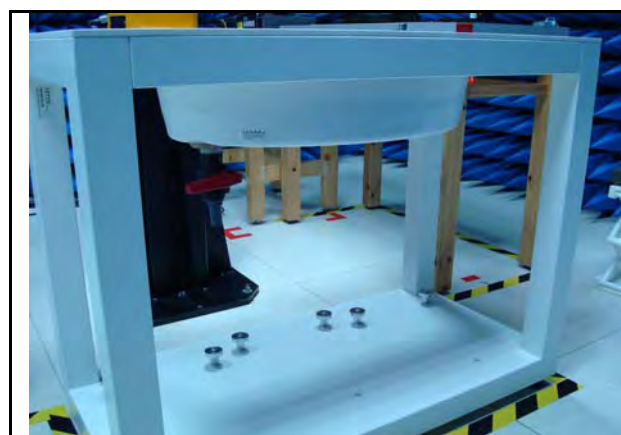


Figure 7. Oval Flat Phantom

### 3.8 Data Storage and Evaluation

#### 3.8.1 Data Storage

The DASY5 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension DA55. The post processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

### 3.8.2 Data Evaluation

The DASY5 post processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software :

<b>Probe parameters :</b>	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	dcpi
<b>Device parameters :</b>	- Frequency	f
	- Crest factor	cf
<b>Media parameters :</b>	- Conductivity	$\sigma$
	- Density	$\rho$

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as :

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with  $V_i$  = compensated signal of channel  $i$  ( $i = x, y, z$ )

$U_i$  = input signal of channel  $i$  ( $i = x, y, z$ )

$cf$  = crest factor of exciting field (DASY parameter)

$dcp_i$  = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated :

**E-field probes :**

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

**H-field probes :**

with  $V_i$  = compensated signal of channel  $i$  ( $i = x, y, z$ )

$Norm_i$  = sensor sensitivity of channel  $i$  ( $i = x, y, z$ )

$\mu V/(V/m)^2$  for E-field Probes

$ConvF$  = sensitivity enhancement in solution

$a_{ij}$  = sensor sensitivity factors for H-field probes

$f$  = carrier frequency [GHz]

$E_i$  = electric field strength of channel  $i$  in V/m

$Hi$  = magnetic field strength of channel  $i$  in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude) :

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with  $SAR$  = local specific absorption rate in mW/g

$E_{tot}$  = total field strength in V/m

$\sigma$  = conductivity in [mho/m] or [Siemens/m]

$\rho$  = equivalent tissue density in  $g/cm^3$

**\*Note :** That the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = \frac{H_{tot}^2}{37.7}$$

with  $P_{pwe}$  = equivalent power density of a plane wave in  $mW/cm^2$

$E_{tot}$  = total electric field strength in V/m

$H_{tot}$  = total magnetic field strength in A/m

#### 4. Tissue Simulating Liquids

The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue. The dielectric parameters of the liquids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an E5071B Network Analyzer.

##### IEEE SCC-34/SC-2 in 1528 recommended Tissue Dielectric Parameters

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in human head. Other head and body tissue parameters that have not been specified in 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equation and extrapolated according to the head parameter specified in 1528.

Target Frequency	Head		Body	
(MHz)	$\epsilon_r$	$\sigma$ (S/m)	$\epsilon_r$	$\sigma$ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 - 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00
( $\epsilon_r$ = relative permittivity, $\sigma$ = conductivity and $\rho$ = 1000 kg/m <sup>3</sup> )				

Table 3. Tissue dielectric parameters for head and body phantoms



## 4.1 Ingredients

The following ingredients are used:

- Water: deionized water (pure H<sub>2</sub>O), resistivity  $\geq 16 \text{ M } \Omega$  -as basis for the liquid
- Sugar: refined white sugar (typically 99.7 % sucrose, available as crystal sugar in food shops)  
-to reduce relative permittivity
- Salt: pure NaCl -to increase conductivity
- Cellulose: Hydroxyethyl-cellulose, medium viscosity (75-125 mPa.s, 2% in water, 20 °C), CAS # 54290 -to increase viscosity and to keep sugar in solution.
- Preservative: Preventol D-7 Bayer AG, D-51368 Leverkusen, CAS # 55965-84-9 -to prevent the spread of bacteria and molds
- DGBE: Diethylenglycol-monobutyl ether (DGBE), Fluka Chemie GmbH, CAS # 112-34-5 -to reduce relative permittivity

## 4.2 Recipes

The following tables give the recipes for tissue simulating liquids to be used in different frequency bands.

Note: The goal dielectric parameters (at 22 °C) must be achieved within a tolerance of  $\pm 5\%$  for  $\epsilon$  and  $\pm 5\%$  for  $\sigma$ .

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride      Sugar: 98+% Pure Sucrose

Water: De-ionized,  $16 \text{ M } \Omega$  resistivity      HEC: Hydroxyethyl Cellulose

DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

### 4.3 Liquid Confirmation

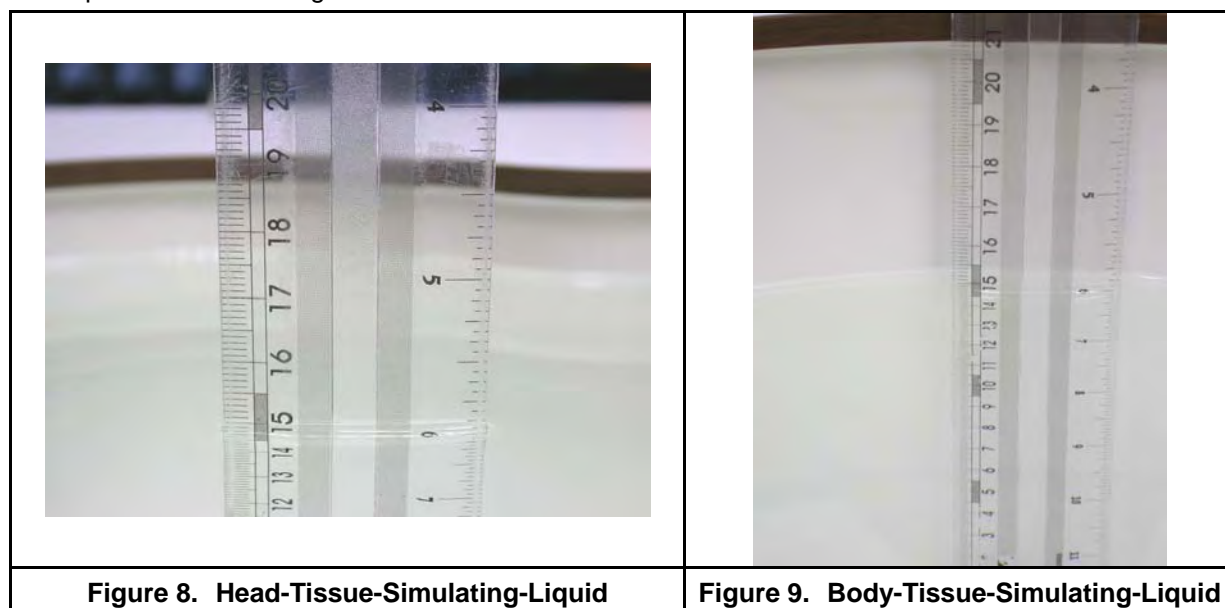
#### 4.3.1 Parameters

Liquid Verify								
Ambient Temperature : 22 $\pm$ 2 $^{\circ}$ C ; Relative Humidity : 40 -70%								
Liquid Type	Frequency	Temp ( $^{\circ}$ C)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)	Measured Date
835MHz Body	820MHz	22.0	$\epsilon_r$	55.20	53.62	-2.86	$\pm$ 5	10/12/2011
			$\sigma$	0.97	0.94	-3.09	$\pm$ 5	
	835MHz	22.0	$\epsilon_r$	55.20	53.50	-3.08	$\pm$ 5	
			$\sigma$	0.97	0.96	-1.03	$\pm$ 5	
	850MHz	22.0	$\epsilon_r$	55.20	53.37	-3.32	$\pm$ 5	
			$\sigma$	0.97	0.97	0.00	$\pm$ 5	
1900MHz Body	1850MHz	22.0	$\epsilon_r$	53.30	52.13	-2.20	$\pm$ 5	10/12/2011
			$\sigma$	1.52	1.46	-3.95	$\pm$ 5	
	1900MHz	22.0	$\epsilon_r$	53.30	52.05	-2.35	$\pm$ 5	
			$\sigma$	1.52	1.50	-1.32	$\pm$ 5	
	1930MHz	22.0	$\epsilon_r$	53.30	51.95	-2.53	$\pm$ 5	
			$\sigma$	1.52	1.53	0.66	$\pm$ 5	

Table 4. Measured Tissue dielectric parameters for body phantoms

#### 4.3.2 Liquid Depth

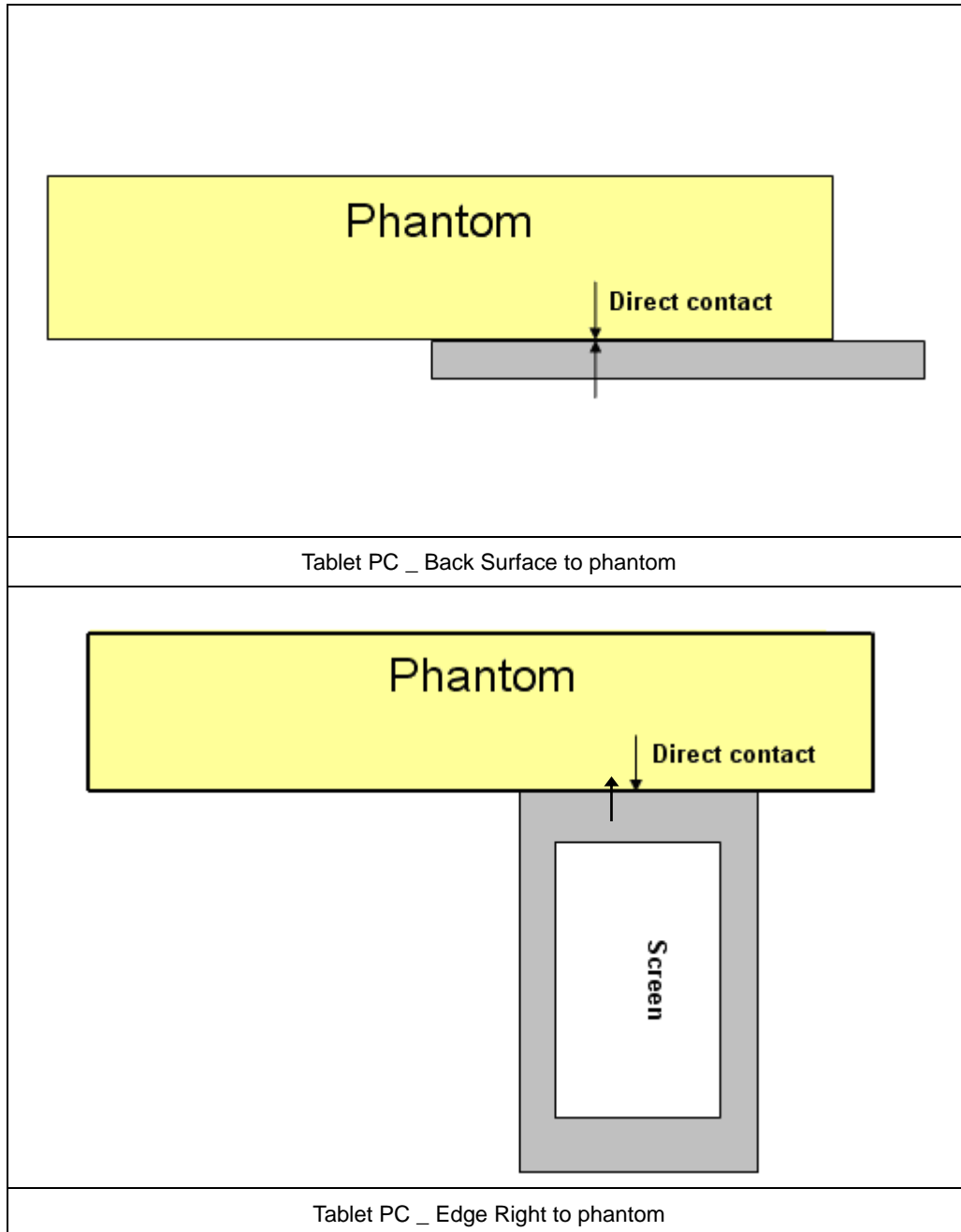
The liquid level was during measurement 15cm  $\pm$ 0.5cm.

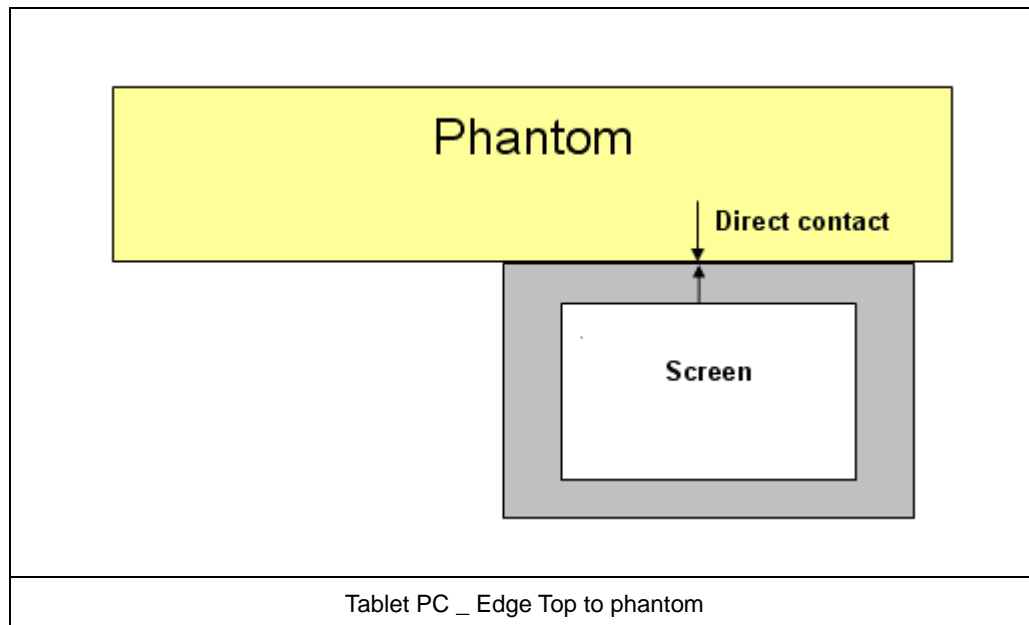




## 5. Test Configuration Position

This DUT was tested in two positions. It is tablet PC back and top touching with 0 cm air gap. Please refer to “SAR Test Setup Photographs” file for the test setup photos.







## 6. SAR Testing with RF Transmitters

### 6.1 SAR Testing with CDMA2000 Transmitters

The following procedures were performed according to FCC “SAR Measurement Procedures for 3G Devices” v02, October 2007.

#### 6.1.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by “SAR Measurement Procedures for 3G Devices” v02, October 2007. Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. SO55 tests were measured with power control bits in the “All Up” condition.

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 6. parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH0 and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 7 was applied.
5. FCHs were configured at full rate for maximum SAR with “All Up” power control bits.

Table 5. Parameters for Max. Power for RC1		
Parameter	Units	Value
$I_{or}$	dBm/1.23MHz	-104
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 6. Parameters for Max. Power for RC3		
Parameter	Units	Value
$I_{or}$	dBm/1.23MHz	-86
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

#### 6.1.2 Head SAR Measurements

SAR for head exposure configurations is measured in RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55. SAR for RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3.



### 6.1.3 Body SAR Measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + SCHn) is not required when the maximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + SCHn) with FCH at full rate and SCH0 enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts. Body SAR was measured using TDSO / SO32 with power control bits in the “All Up” Body SAR in RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR for that channel in RC3.

### 6.1.4 Handsets with EVDO

For handsets with Ev-Do capabilities, when the maximum average output of each channel in Rev. 0 is less than ¼ dB higher than that measured in RC3 (1x RTT), body SAR for EV-DO is not required. Otherwise, SAR for Rev. 0 is measured on the maximum output channel at 153.6 kbps using the body exposure configuration that results in the highest SAR for that channel in RC3. SAR for Rev. A is not required when the maximum average output of each channel is less than that measured in Rev. 0 or less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel for Rev. A using a Reverse Data Channel payload size of 4096 bits and a Termination Target of 16 slots defined for Subtype 2 Physical Layer configurations. A Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots would be configured in the downlink for both Rev. 0 and Rev. A.



## **6.2 SAR Testing with 802.11 Transmitters**

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable.

### **6.2.1 General Device Setup**

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

### **6.2.2 Frequency Channel Configurations**

802.11 a/b/g and 4.9 GHz operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g modes are tested on channels 1, 6 and 11. 802.11a is tested for UNII operations on channels 36 and 48 in the 5.15-5.25 GHz band; channels 52 and 64 in the 5.25-5.35 GHz band; channels 104, 116, 124 and 136 in the 5.470-5.725 GHz band; and channels 149 and 161 in the 5.8 GHz band. When 5.8 GHz §15.247 is also available, channels 149, 157 and 165 should be tested instead of the UNII channels. 4.9 GHz is tested on channels 1, 10 and 5 or 6, whichever has the higher output power, for 5 MHz channels; channels 11, 15 and 19 for 10 MHz channels; and channels 21 and 25 for 20 MHz channels. These are referred to as the “default test channels”. 802.11g mode was evaluated only if the output power was 0.25 dB higher than the 802.11b mode.



## 802.11 Test Channels per FCC Requirement

Mode		GHz	Channel	Turbo Channel	Default Test "Channels"			
					§15.247		UNII	
					802.11b	802.11g		
802.11 b/g		2412	1		✓	▽		
		2437	6	6	✓	▽		
		2462	11		✓	▽		
802.11a	UNII	5.18	36				✓	
		5.20	40	42 (5.21 GHz)				*
		5.22	44					*
		5.24	48	50 (5.25 GHz)				
		5.26	52				✓	
		5.28	56	58 (5.29 GHz)				*
		5.30	60					*
		5.32	64				✓	
		5.500	100	Unknown				*
		5.520	104				✓	
		5.540	108					*
		5.560	112					*
		5.580	116				✓	
		5.600	120					*
		5.620	124				✓	
		5.640	128					*
		5.660	132					*
		5.680	136				✓	
		5.700	140					*
	UNII or §15.247	5.745	149		✓		✓	
		5.765	153	152 (5.76 GHz)		*		*
		5.785	157		✓			*
		5.805	161	160 (5.80 GHz)		*	✓	
	§15.247	5.825	165		✓			



### 6.3 Conducted Power

Band	RC/TAP (REV)	CH	Frequency (MHz)	RF Conducted Output Power (dBm)
				Average
1xRTT Cellular Band	RC3/SO32	Lowest	824.70	<b>23.89</b>
		Middle	836.52	23.86
		Highest	848.31	23.79

Band	RTAP (kbps)	CH	Frequency (MHz)	RF Conducted Output Power (dBm)
				Average
1xEVDO Rev.0 Cellular Band	153.6	Lowest	824.70	23.73
		Middle	836.52	23.69
		Highest	848.31	<b>23.82</b>

Band	RETAP Payload size	CH	Frequency (MHz)	RF Conducted Output Power (dBm)
				Average
1xEVDO Rev.A Cellular Band	4096 Bits	Lowest	824.70	23.59
		Middle	836.52	23.56
		Highest	848.31	<b>23.78</b>

Band	RC/TAP (REV)	CH	Frequency (MHz)	RF Conducted Output Power (dBm)
				Average
1xRTT PCS Band	RC3/SO32	Lowest	1851.25	<b>24.02</b>
		Middle	1880.00	23.77
		Highest	1908.75	23.69

Band	RTAP (kbps)	CH	Frequency (MHz)	RF Conducted Output Power (dBm)
				Average
1xEVDO Rev.0 PCS Band	153.6	Lowest	1851.25	<b>23.85</b>
		Middle	1880.00	23.56
		Highest	1908.75	23.47

Band	RETAP Payload size	CH	Frequency (MHz)	RF Conducted Output Power (dBm)
				Average
1xEVDO Rev.A PCS Band	4096 Bits	Lowest	1851.25	<b>23.86</b>
		Middle	1880.00	23.57
		Highest	1908.75	23.40

## 7. System Performance Check

### 7.1 Symmetric Dipoles for System Validation

Construction	Symmetrical dipole with 1/4 balun enables measurement of feed point impedance with NWA matched for use near flat phantoms filled with head simulating solutions Includes distance holder and tripod adaptor Calibration Calibrated SAR value for specified position and input power at the flat phantom in head simulating solutions.
Frequency	835, 1900 MHz
Return Loss	> 20 dB at specified validation position
Power Capability	> 100 W ( $f < 1\text{GHz}$ ); > 40 W ( $f > 1\text{GHz}$ )
Options	Dipoles for other frequencies or solutions and other calibration conditions are available upon request
Dimensions	D835V2 : dipole length 150 mm; overall height 330 mm D1900V2 : dipole length 62 mm; overall height 300 mm

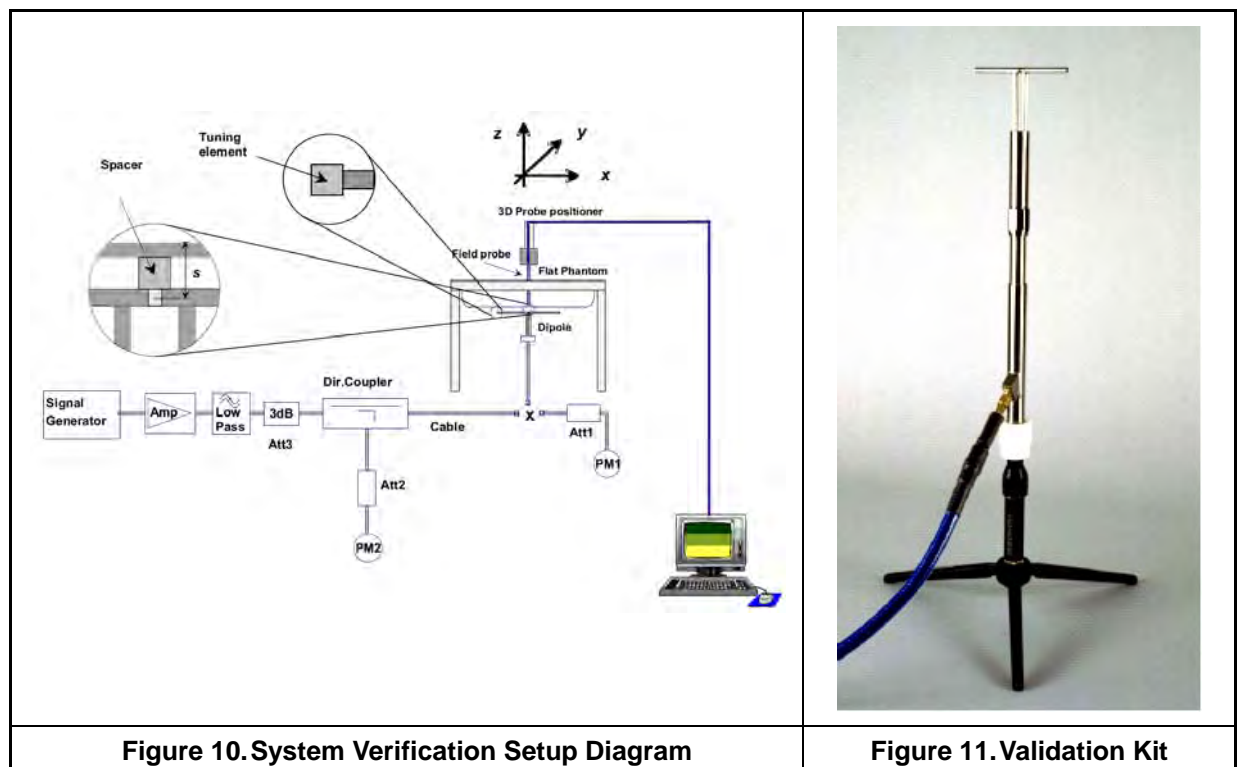


Figure 10. System Verification Setup Diagram

Figure 11. Validation Kit



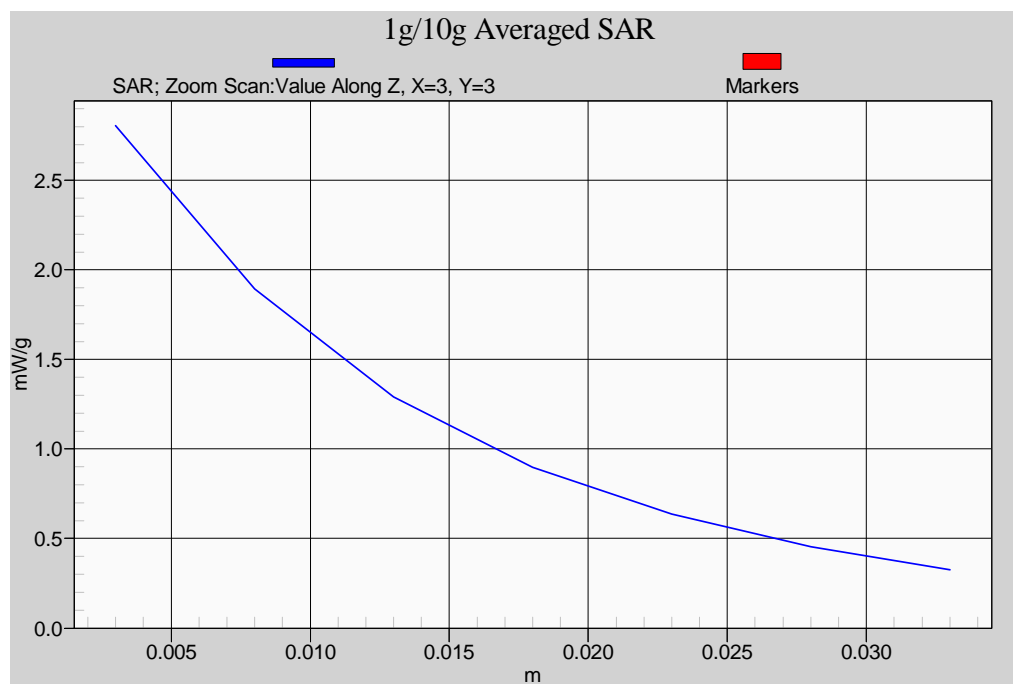


## 7.2 Validation

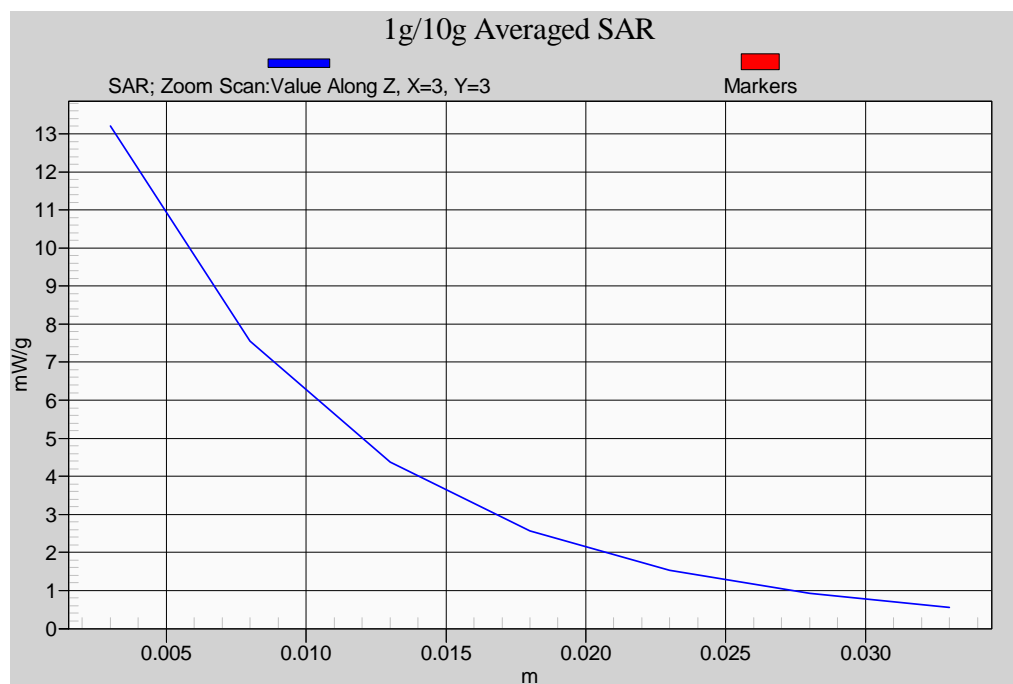
Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of  $\pm 7\%$ . The validation was performed at 835 and 1900MHz.

Validation kit		Mixture Type	SAR <sub>1g</sub> [mW/g]		SAR <sub>10g</sub> [mW/g]		Date of Calibration
D835V2-SN4d082		Body	9.43		6.22		07/19/2011
D1900V2-SN5d111		Body	40.9		21.5		07/22/2011
Frequency (MHz)	Power (dBm)	SAR <sub>1g</sub> (mW/g)	SAR <sub>10g</sub> (mW/g)	Drift (dB)	Difference percentage		Date
					1g	10g	
835 (Body)	250mW	2.4	1.57	0.028	1.8 %	1.0 %	10/12/2011
	Normalize to 1 Watt	9.6	6.28				
1900 (Body)	250mW	10.4	5.44	0.122	1.7 %	1.2 %	10/12/2011
	Normalize to 1 Watt	41.6	21.76				

### Z-axis Plot of System Performance Check



Body-Tissue-Simulating-Liquid 835MHz



Body-Tissue-Simulating-Liquid 1900MHz



## 8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Dosimetric E-Field Probe	ES3DV3	3150	04/14/2011	04/14/2012
SPEAG	835MHz System Validation Kit	D835V2	4d082	07/18/2011	07/18/2012
SPEAG	1900MHz System Validation Kit	D1900V2	5d111	07/22/2011	07/22/2012
SPEAG	Data Acquisition Electronics	DAE4	779	01/31/2011	01/31/2012
SPEAG	Measurement Server	SE UMS 011 AA	1025	NCR	
SPEAG	Device Holder	N/A	N/A	NCR	
SPEAG	Phantom	SAM V4.0	TP-1150	NCR	
SPEAG	Robot	Staubli TX90XL	F07/564ZA1/C/01	NCR	
SPEAG	Software	DASY5 V5.0 Build 125	N/A	NCR	
SPEAG	Software	SEMCAD V13.4 Build 125	N/A	NCR	
Agilent	Dielectric Probe Kit	85070C	US99360094	NCR	
Agilent	ENA Series Network Analyzer	E5071B	MY42404655	04/14/2010	04/14/2012
R&S	Power Sensor	NRP-Z22	100179	05/27/2011	05/27/2012
Agilent	MXG Vector Signal Generator	N5182A	MY47420962	05/16/2011	05/16/2012
Agilent	Dual Directional Coupler	778D	50334	NCR	
Mini-Circuits	Power Amplifier	ZHL-42W-SMA	D111103#5	NCR	
Mini-Circuits	Power Amplifier	ZVE-8G-SMA	D042005 671800514	NCR	

**Table 7. Test Equipment List**



## 9. **Measurement Uncertainty**

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environmental. However, we estimate the measurement uncertainties in SAR to be less than  $\pm 20.10\%$  [ 8 ] .

According to Std. C95.3 [ 9 ], the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of  $\pm 1$  to 3 dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least  $\pm 2$  dB can be expected.

According to CENELEC [ 10 ] , typical worst-case uncertainty of field measurements is  $\pm 5$  dB. For well-defined modulation characteristics the uncertainty can be reduced to  $\pm 3$  dB.

Item	Uncertainty Component	Uncertainty Value	Prob. Dist	Div.	$c_i$ (1g)	$c_i$ (10g)	Std. Unc. (1-g)	Std. Unc. (10-g)	$v_i$ or $v_{eff}$
<b>Measurement System</b>									
u1	Probe Calibration ( $k=1$ )	$\pm 5.5\%$	Normal	1	1	1	$\pm 5.5\%$	$\pm 5.5\%$	$\infty$
u2	Probe Isotropy	$\pm 7.6\%$	Rectangular	$\sqrt{3}$	0.7	0.7	$\pm 3.1\%$	$\pm 3.1\%$	$\infty$
u3	Boundary Effect	$\pm 1.0\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$	$\infty$
u4	Linearity	$\pm 4.7\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 2.7\%$	$\pm 2.7\%$	$\infty$
u5	System Detection Limit	$\pm 1.0\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 0.58\%$	$\pm 0.58\%$	$\infty$
u6	Readout Electronics	$\pm 0.3\%$	Normal	1	1	1	$\pm 0.3\%$	$\pm 0.3\%$	$\infty$
u7	Response Time	$\pm 0.8\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 0.5\%$	$\pm 0.5\%$	$\infty$
u8	Integration Time	$\pm 2.6\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 1.5\%$	$\pm 1.5\%$	$\infty$
u9	RF Ambient Conditions	$\pm 0\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 0\%$	$\pm 0\%$	$\infty$
u10	RF Ambient Reflections	$\pm 0\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 0\%$	$\pm 0\%$	$\infty$
u11	Probe Positioner Mechanical Tolerance	$\pm 0.4\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 0.2\%$	$\pm 0.2\%$	$\infty$
u12	Probe Positioning with respect to Phantom Shell	$\pm 2.9\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 1.7\%$	$\pm 1.7\%$	$\infty$
u13	Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	$\pm 1.0\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$	$\infty$
<b>Test sample Related</b>									
u14	Test sample Positioning	$\pm 3.6\%$	Normal	1	1	1	$\pm 3.6\%$	$\pm 3.6\%$	89
u15	Device Holder Uncertainty	$\pm 3.5\%$	Normal	1	1	1	$\pm 3.5\%$	$\pm 3.5\%$	5
u16	Output Power Variation - SAR drift measurement	$\pm 5.0\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 2.9\%$	$\pm 2.9\%$	$\infty$
<b>Phantom and Tissue Parameters</b>									
u17	Phantom Uncertainty ( shape and thickness tolerances)	$\pm 4.0\%$	Rectangular	$\sqrt{3}$	1	1	$\pm 2.3\%$	$\pm 2.3\%$	$\infty$
u18	Liquid Conductivity - deviation from target values	$\pm 5.0\%$	Rectangular	$\sqrt{3}$	0.64	0.43	$\pm 1.8\%$	$\pm 1.2\%$	$\infty$
u19	Liquid Conductivity - measurement uncertainty	$\pm 1.93\%$	Normal	1	0.64	0.43	$\pm 1.24\%$	$\pm 0.83\%$	69
u20	Liquid Permittivity - deviation from target values	$\pm 5.0\%$	Rectangular	$\sqrt{3}$	0.6	0.49	$\pm 1.7\%$	$\pm 1.4\%$	$\infty$
u21	Liquid Permittivity - measurement uncertainty	$\pm 1.4\%$	Normal	1	0.6	0.49	$\pm 0.84\%$	$\pm 1.69\%$	69
<b>Combined standard uncertainty</b>			RSS				$\pm 10.05\%$	$\pm 9.98\%$	313
<b>Expanded uncertainty (95% CONFIDENCE LEVEL )</b>			$k=2$				$\pm 20.10\%$	$\pm 19.96\%$	

**Table 8. Uncertainty Budget of DASY**

## 10. **Measurement Procedure**

The measurement procedures are as follows:

1. For WLAN function, engineering testing software installed on Notebook can provide continuous transmitting signal.
2. Measure output power through RF cable and power meter
3. Set scan area, grid size and other setting on the DASY software
4. Find out the largest SAR result on these testing positions of each band
5. Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

1. Power reference measurement
2. Area scan
3. Zoom scan
4. Power drift measurement

### 10.1 **Spatial Peak SAR Evaluation**

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages

1. Extraction of the measured data (grid and values) from the Zoom Scan
2. Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. Generation of a high-resolution mesh within the measured volume
4. Interpolation of all measured values from the measurement grid to the high-resolution grid
5. Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. Calculation of the averaged SAR within masses of 1g and 10g



## **10.2 Area & Zoom Scan Procedures**

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 7x7x9 points with step size 5, 5 and 3 mm for 300 MHz to 3 GHz, and 7x7x9 points with step size 5, 5 and 3 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

## **10.3 Volume Scan Procedures**

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the DUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## **10.4 SAR Averaged Methods**

In DASYS, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

## **10.5 Power Drift Monitoring**

All SAR testing is under the DUT install full charged battery and transmit maximum output power. In DASYS measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of DUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.



## 11. SAR Test Results Summary

### 11.1 Body SAR

Measurement Results									
Band	Frequency		Power (dBm)	Phantom Position	Spacing (mm)	Accessory	SAR <sub>1g</sub> [mW/g]	Power Drift (dB)	Remark
	CH	MHz							
1xEVDO Rev.0 Cellular Band	1013	824.70	23.73	Flat	0	N/A	1.260	0.158	Back Surface to Phantom
	384	836.52	23.69	Flat	0	N/A	1.210	0.050	Back Surface to Phantom
	777	848.31	23.82	Flat	0	N/A	<b>1.380</b>	0.129	Back Surface to Phantom
	1013	824.70	23.73	Flat	0	N/A	1.090	-0.073	Edge Right to Phantom
	384	836.52	23.69	Flat	0	N/A	1.040	-0.181	Edge Right to Phantom
	777	848.31	23.82	Flat	0	N/A	1.260	-0.158	Edge Right to Phantom
	777	848.31	23.69	Flat	0	N/A	0.180	-0.001	Edge Top to Phantom
1xEVDO Rev.0 PCS Band	25	1851.25	23.86	Flat	0	N/A	0.422	-0.042	Back Surface to Phantom
	25	1851.25	23.86	Flat	0	N/A	0.698	0.177	Edge Right to Phantom
	25	1851.25	23.86	Flat	0	N/A	0.023	0.160	Edge Top to Phantom
1xEVDO Rev.A PCS Band	25	1851.25	23.85	Flat	0	N/A	0.435	-0.074	Back Surface to Phantom
	25	1851.25	23.85	Flat	0	N/A	0.696	0.123	Edge Right to Phantom
	25	1851.25	23.85	Flat	0	N/A	0.031	-0.145	Edge Top to Phantom
Std. C95.1-1999 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population						1.6 W/kg (mW/g) Averaged over 1 gram			

#### Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001], IEEE1528-2003 and RSS-102.
2. All modes of operation were investigated, and worst-case results are reported.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Batteries are fully charged for all readings.
5. If the Channel's SAR 1g of maximum conducted power is > 0.8 mW/g, low, middle and high channel are supposed to be tested.
6. For WWAN, the antenna location to edge <5 cm, therefore should be test three mode (Edge Right and Edge Top and Back surface).



## 11.2 Std. C95.1-1999 RF Exposure Limit

Human Exposure	Population Uncontrolled Exposure ( W/kg ) or (mW/g)	Occupational Controlled Exposure ( W/kg ) or (mW/g)
Spatial Peak SAR* (head)	1.60	8.00
Spatial Peak SAR** (Whole Body)	0.08	0.40
Spatial Peak SAR*** (Partial-Body)	1.60	8.00
Spatial Peak SAR**** (Hands / Feet / Ankle / Wrist )	4.00	20.00

**Table 9. Safety Limits for Partial Body Exposure**

### Notes :

- \* 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.
- \*\* The Spatial Average value of the SAR averaged over the whole – body.
- \*\*\* The Spatial Average value of the SAR averaged over the partial – body.
- \*\*\*\* 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.

**Population / Uncontrolled Environments :** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

**Occupational / 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).



## 12. Conclusion

The SAR test values found for the portable mobile phone **Microlink Communications Inc. Trade Name: Microlink Model(s): MTP1121** is below the maximum recommended level of 1.6 W/kg (mW/g).

## 13. References

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- [13] KDB 941225 D01 SAR Test for 3G Devices 3G-SAR
- [14] KDB 941225 D03 SAR Test Reduction GSM GPRS EDGE
- [15] KDB 941225 D04 SAR for GSM E GPRS Dual Xfer Mode v01
- [16] KDB 941225 D06 Hot Spot SAR v01



## Appendix A - System Performance Check

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 10/12/2011 7:09:32 PM

### System Performance Check at 835MHz\_20111012\_Body

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d082**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.958 \text{ mho/m}$ ;  $\epsilon_r = 53.5$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

### System Performance Check at 835MHz/Area Scan (61x111x1):

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 2.8 mW/g

### System Performance Check at 835MHz/Zoom Scan (7x7x7)/Cube 0:

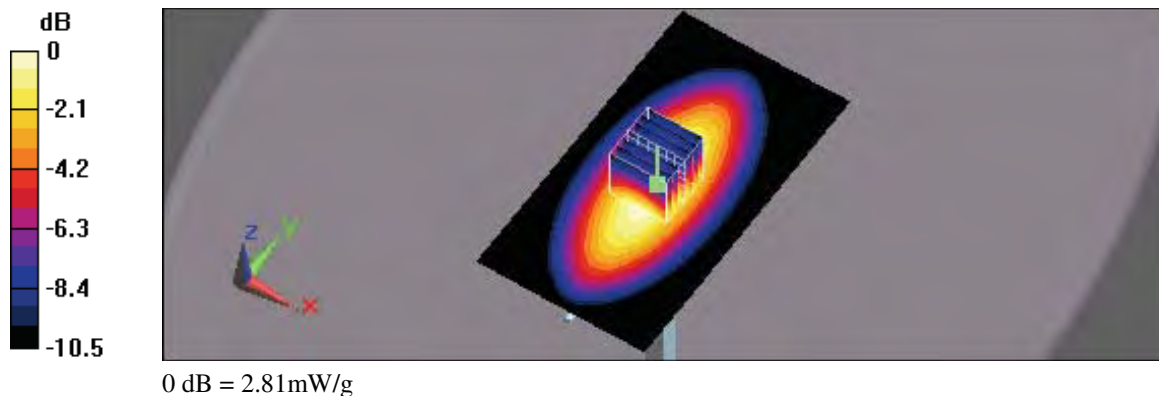
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 52.7 V/m; Power Drift = 0.028 dB

Peak SAR (extrapolated) = 3.55 W/kg

**SAR(1 g) = 2.4 mW/g; SAR(10 g) = 1.57 mW/g**

Maximum value of SAR (measured) = 2.81 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 10:25:17 AM

#### System Performance Check at 1900MHz\_20111012\_Body

**DUT: Dipole D1900V2\_SN5d111; Type: D1900V2; Serial: D1900V2 - SN:5d111**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.5$  mho/m;  $\epsilon_r = 52.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

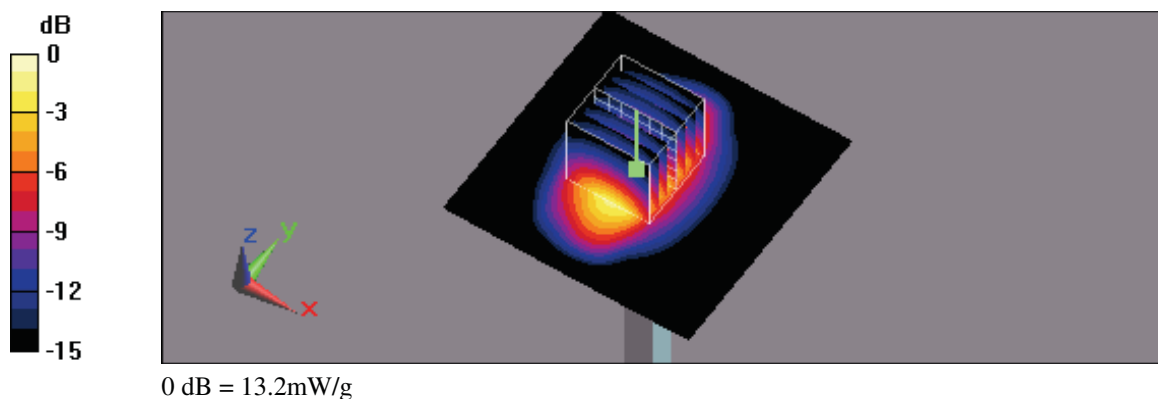
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(4.71, 4.71, 4.71); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

#### System Performance Check at 1900MHz/Area Scan (61x61x1):

Measurement grid:  $dx=15$ mm,  $dy=15$ mm  
Maximum value of SAR (interpolated) = 13.1 mW/g

#### System Performance Check at 1900MHz/Zoom Scan (7x7x7)/Cube 0:

Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
Reference Value = 91.3 V/m; Power Drift = 0.122 dB  
Peak SAR (extrapolated) = 18.5 W/kg  
**SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.44 mW/g**  
Maximum value of SAR (measured) = 13.2 mW/g





## Appendix B - SAR Measurement Data

Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/13/2011 12:28:37 AM

**Flat\_1xEVDO Cell Rev0 CH1013\_Back Surface to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO Cellular; Frequency: 824.7 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 825$  MHz;  $\sigma = 0.949$  mho/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

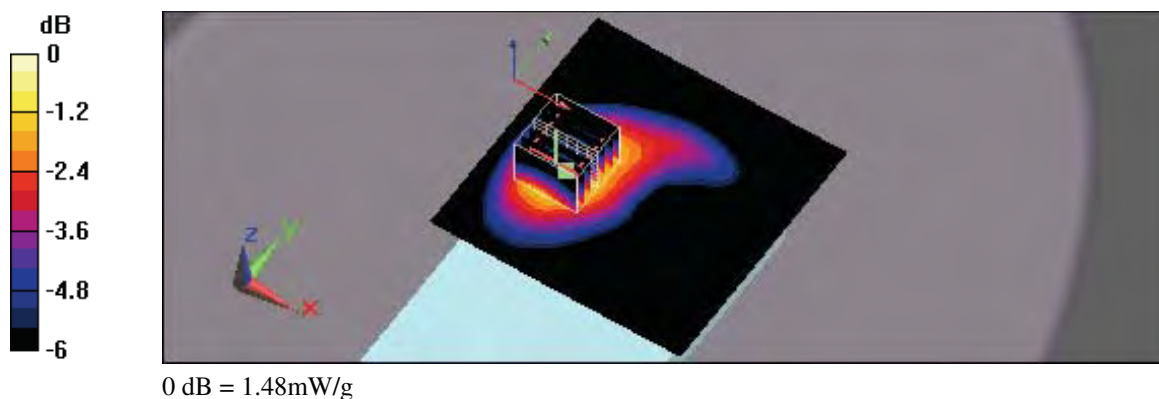
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

### Flat/Area Scan (81x81x1):

Measurement grid:  $dx=15$ mm,  $dy=15$ mm  
Maximum value of SAR (interpolated) = 1.42 mW/g

### Flat/Zoom Scan (7x7x9)/Cube 0:

Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=3$ mm  
Reference Value = 9.38 V/m; Power Drift = 0.158 dB  
Peak SAR (extrapolated) = 1.93 W/kg  
**SAR(1 g) = 1.26 mW/g; SAR(10 g) = 0.828 mW/g**  
Maximum value of SAR (measured) = 1.48 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/13/2011 12:55:28 AM

# **Flat\_1xEVDO Cell Rev0 CH384\_Back Surface to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO Cellular; Frequency: 836.52 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 837 \text{ MHz}$ ;  $\sigma = 0.96 \text{ mho/m}$ ;  $\epsilon_r = 53.5$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

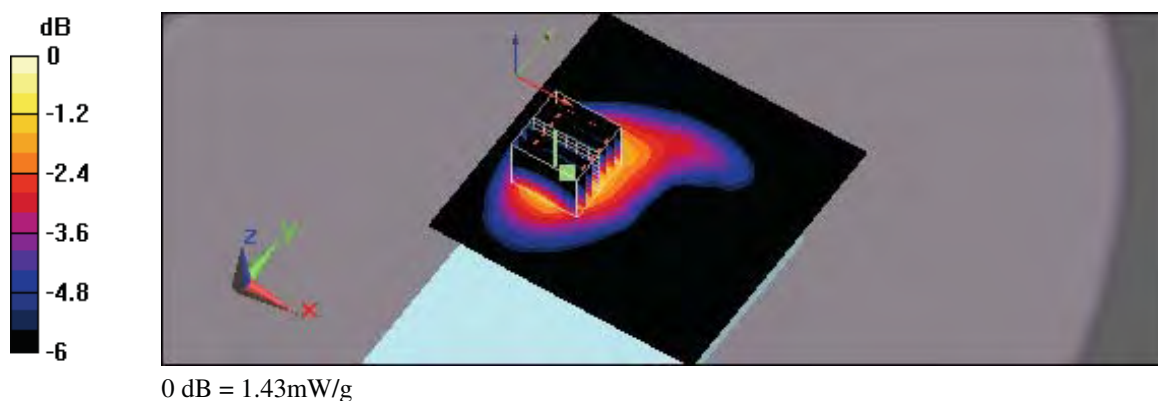
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

## **Flat/Area Scan (81x81x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 1.35 mW/g

## **Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 9.04 V/m; Power Drift = 0.050 dB  
Peak SAR (extrapolated) = 1.89 W/kg  
**SAR(1 g) = 1.21 mW/g; SAR(10 g) = 0.784 mW/g**  
Maximum value of SAR (measured) = 1.43 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/13/2011 12:00:17 AM

**Flat\_1xEVDO Cell Rev0 CH777\_Back Surface to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO Cellular; Frequency: 848.31 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 848.31$  MHz;  $\sigma = 0.973$  mho/m;  $\epsilon_r = 53.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASYS (IEEE/IEC)

DASY5 Configuration:

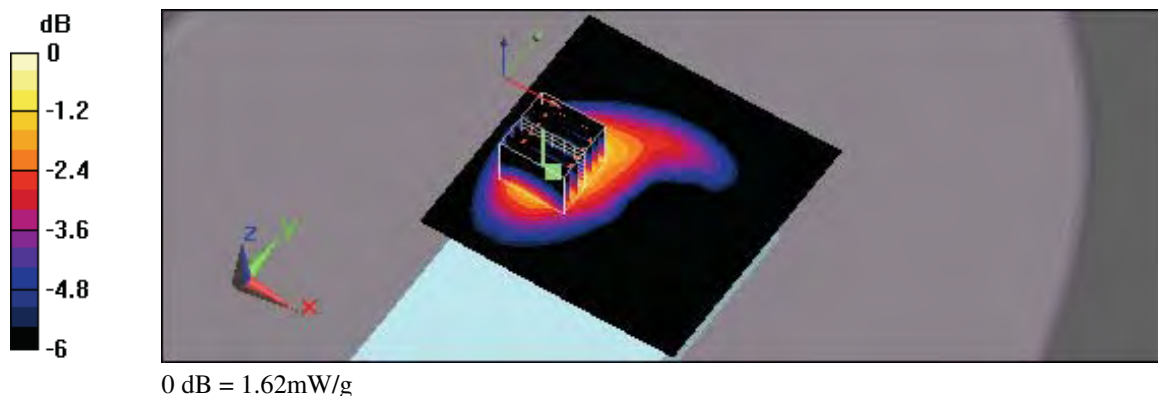
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASYS, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

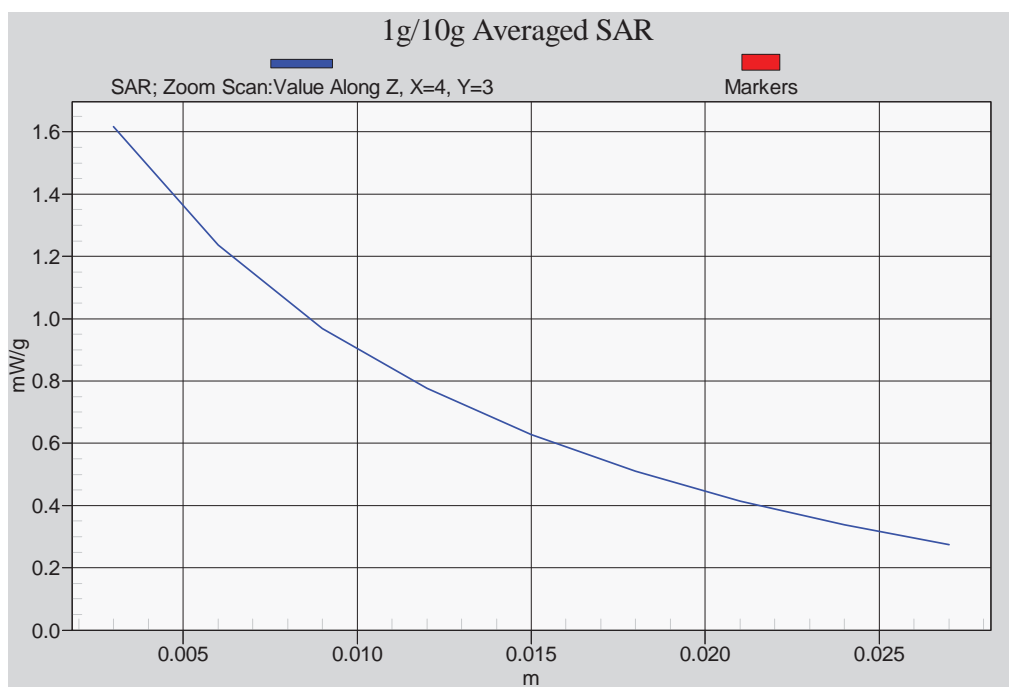
**Flat/Area Scan (81x81x1):**

Measurement grid:  $dx=15$ mm,  $dy=15$ mm  
Maximum value of SAR (interpolated) = 1.52 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=3$ mm  
Reference Value = 9.25 V/m; Power Drift = 0.129 dB  
Peak SAR (extrapolated) = 3.01 W/kg  
**SAR(1 g) = 1.38 mW/g; SAR(10 g) = 0.891 mW/g**  
Maximum value of SAR (measured) = 1.62 mW/g







Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 8:49:46 PM

**Flat\_1xEVDO Cell Rev0 CH1013\_Edge Right to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO Cellular; Frequency: 824.7 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 825$  MHz;  $\sigma = 0.949$  mho/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

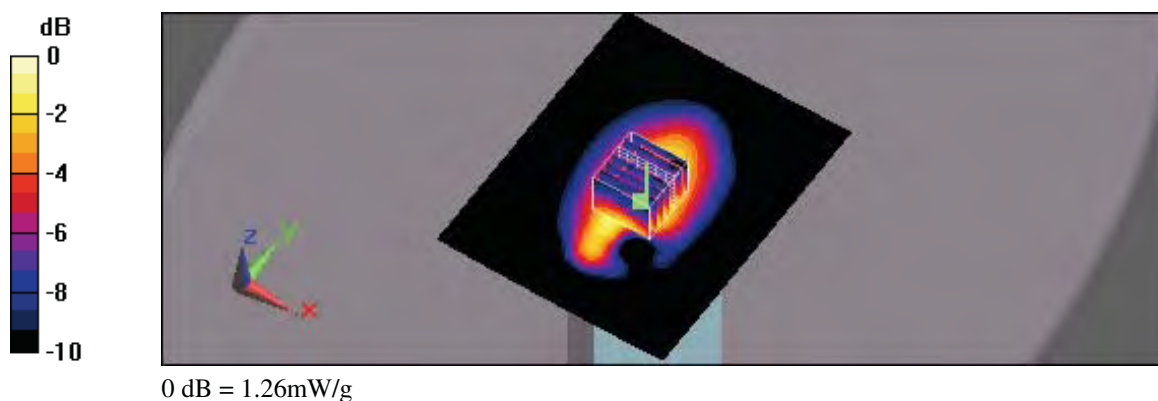
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

**Flat/Area Scan (81x101x1):**

Measurement grid:  $dx=15$ mm,  $dy=15$ mm  
Maximum value of SAR (interpolated) = 1.35 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=3$ mm  
Reference Value = 35.9 V/m; Power Drift = -0.073 dB  
Peak SAR (extrapolated) = 2.54 W/kg  
**SAR(1 g) = 1.09 mW/g; SAR(10 g) = 0.636 mW/g**  
Maximum value of SAR (measured) = 1.26 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 11:09:42 PM

**Flat\_1xEVDO Cell Rev0 CH384\_Edge Right to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO Cellular; Frequency: 836.52 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 837 \text{ MHz}$ ;  $\sigma = 0.96 \text{ mho/m}$ ;  $\epsilon_r = 53.5$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

**Flat/Area Scan (81x101x1):**

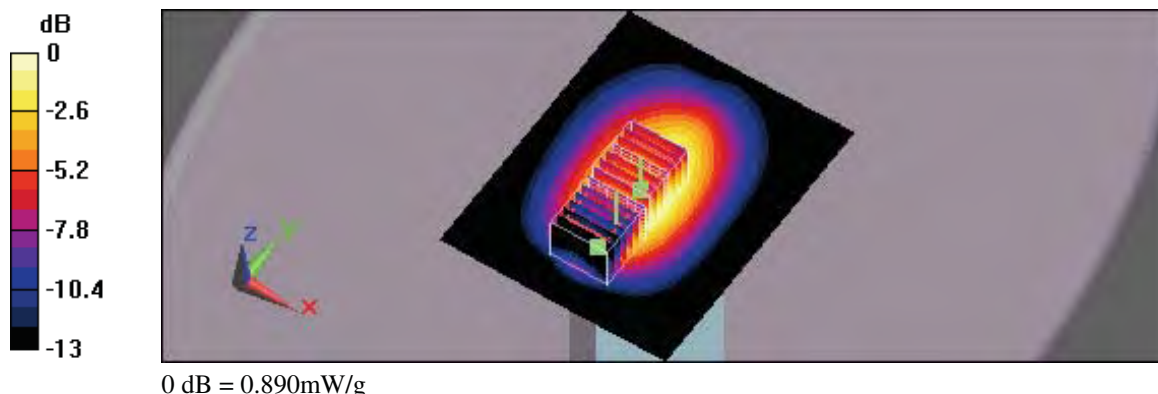
Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 1.28 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 37.1 V/m; Power Drift = -0.181 dB  
Peak SAR (extrapolated) = 1.68 W/kg  
**SAR(1 g) = 1.04 mW/g; SAR(10 g) = 0.645 mW/g**  
Maximum value of SAR (measured) = 1.25 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 1:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 37.1 V/m; Power Drift = -0.181 dB  
Peak SAR (extrapolated) = 1.54 W/kg  
**SAR(1 g) = 0.709 mW/g; SAR(10 g) = 0.369 mW/g**  
Maximum value of SAR (measured) = 0.890 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 9:37:35 PM

**Flat\_1xEVDO Cell Rev0 CH777\_Edge Right to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO Cellular; Frequency: 848.31 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 848.31$  MHz;  $\sigma = 0.973$  mho/m;  $\epsilon_r = 53.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

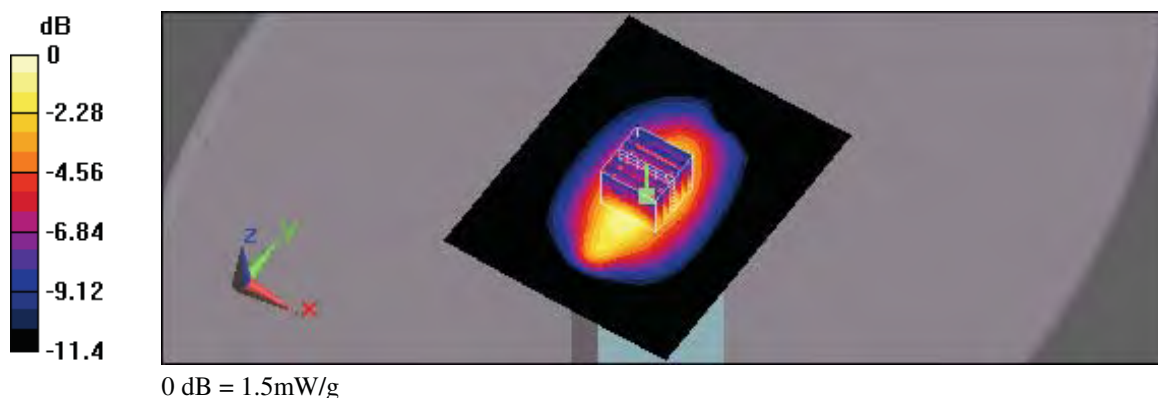
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

**Flat/Area Scan (81x101x1):**

Measurement grid:  $dx=15$ mm,  $dy=15$ mm  
Maximum value of SAR (interpolated) = 1.52 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=3$ mm  
Reference Value = 39.9 V/m; Power Drift = -0.158 dB  
Peak SAR (extrapolated) = 2.64 W/kg  
**SAR(1 g) = 1.26 mW/g; SAR(10 g) = 0.772 mW/g**  
Maximum value of SAR (measured) = 1.5 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/13/2011 3:10:32 AM

# **Flat\_1xEVDO Cell Rev0 CH777\_Edge Top to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO Cellular; Frequency: 848.31 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 848.31 \text{ MHz}$ ;  $\sigma = 0.973 \text{ mho/m}$ ;  $\epsilon_r = 53.4$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

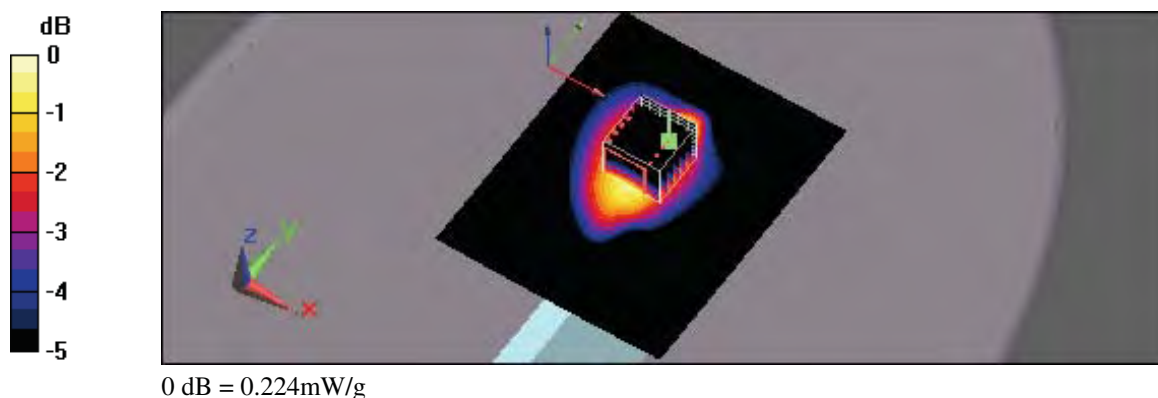
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(6.16, 6.16, 6.16); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

## **Flat/Area Scan (81x101x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 0.254 mW/g

## **Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 6.86 V/m; Power Drift = -0.00135 dB  
Peak SAR (extrapolated) = 0.319 W/kg  
**SAR(1 g) = 0.180 mW/g; SAR(10 g) = 0.123 mW/g**  
Maximum value of SAR (measured) = 0.224 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 3:06:13 PM

**Flat\_1xEVDO PCS Rev0 CH25\_Back Surface to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO PCS ; Frequency: 1851.25 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 1851.25 \text{ MHz}$ ;  $\sigma = 1.46 \text{ mho/m}$ ;  $\epsilon_r = 52.1$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

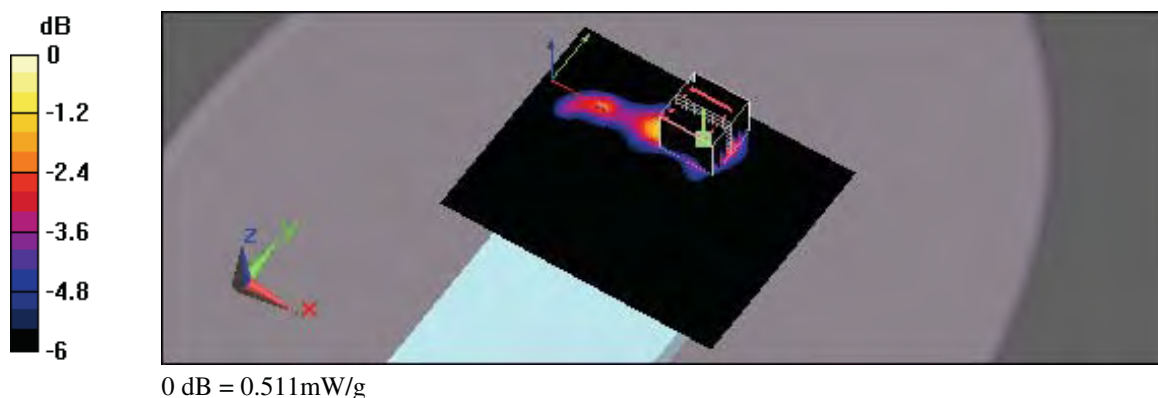
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(4.71, 4.71, 4.71); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

**Flat/Area Scan (101x81x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 0.490 mW/g

**Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 1.45 V/m; Power Drift = -0.042 dB  
Peak SAR (extrapolated) = 0.712 W/kg  
**SAR(1 g) = 0.422 mW/g; SAR(10 g) = 0.232 mW/g**  
Maximum value of SAR (measured) = 0.511 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 1:24:45 PM

# **Flat\_1xEVDO PCS Rev0 CH25\_Edge Right to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO PCS ; Frequency: 1851.25 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 1851.25 \text{ MHz}$ ;  $\sigma = 1.46 \text{ mho/m}$ ;  $\epsilon_r = 52.1$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

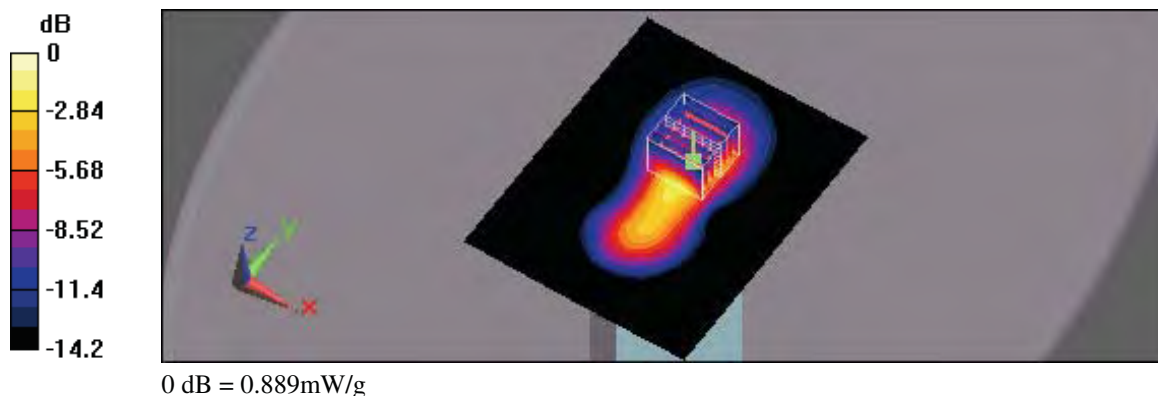
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(4.71, 4.71, 4.71); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

## **Flat/Area Scan (81x101x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 0.810 mW/g

## **Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 20.7 V/m; Power Drift = 0.177 dB  
Peak SAR (extrapolated) = 2.59 W/kg  
**SAR(1 g) = 0.698 mW/g; SAR(10 g) = 0.368 mW/g**  
Maximum value of SAR (measured) = 0.889 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 2:20:29 PM

# **Flat\_1xEVDO PCS Rev0 CH25\_Edge Top to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO PCS ; Frequency: 1851.25 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 1851.25 \text{ MHz}$ ;  $\sigma = 1.46 \text{ mho/m}$ ;  $\epsilon_r = 52.1$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

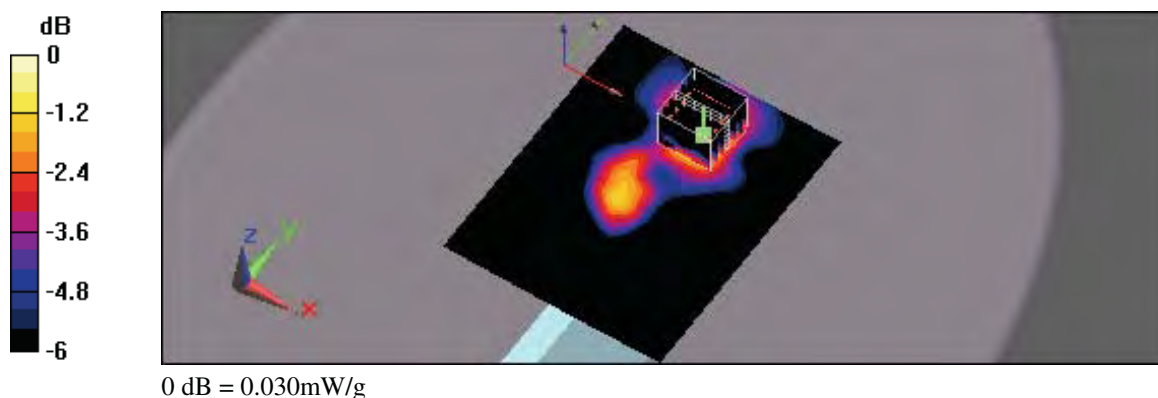
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(4.71, 4.71, 4.71); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

## **Flat/Area Scan (81x101x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 0.029 mW/g

## **Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 0.109 V/m; Power Drift = 0.16 dB  
Peak SAR (extrapolated) = 0.041 W/kg  
**SAR(1 g) = 0.023 mW/g; SAR(10 g) = 0.013 mW/g**  
Maximum value of SAR (measured) = 0.030 mW/g





Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 4:30:24 PM

# **Flat\_1xEVDO PCS RevA CH25\_Back Surface to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO PCS ; Frequency: 1851.25 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 1851.25 \text{ MHz}$ ;  $\sigma = 1.46 \text{ mho/m}$ ;  $\epsilon_r = 52.1$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

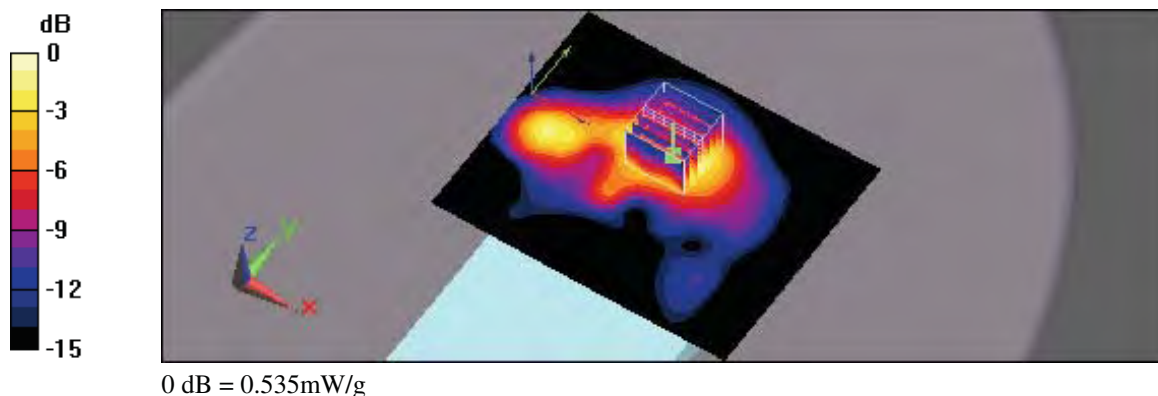
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(4.71, 4.71, 4.71); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

## **Flat/Area Scan (101x81x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 0.547 mW/g

## **Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 1.5 V/m; Power Drift = -0.074 dB  
Peak SAR (extrapolated) = 0.686 W/kg  
**SAR(1 g) = 0.435 mW/g; SAR(10 g) = 0.240 mW/g**  
Maximum value of SAR (measured) = 0.535 mW/g





Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 12:23:22 PM

# **Flat\_1xEVDO PCS RevA CH25\_Edge Right to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO PCS ; Frequency: 1851.25 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 1851.25 \text{ MHz}$ ;  $\sigma = 1.46 \text{ mho/m}$ ;  $\epsilon_r = 52.1$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

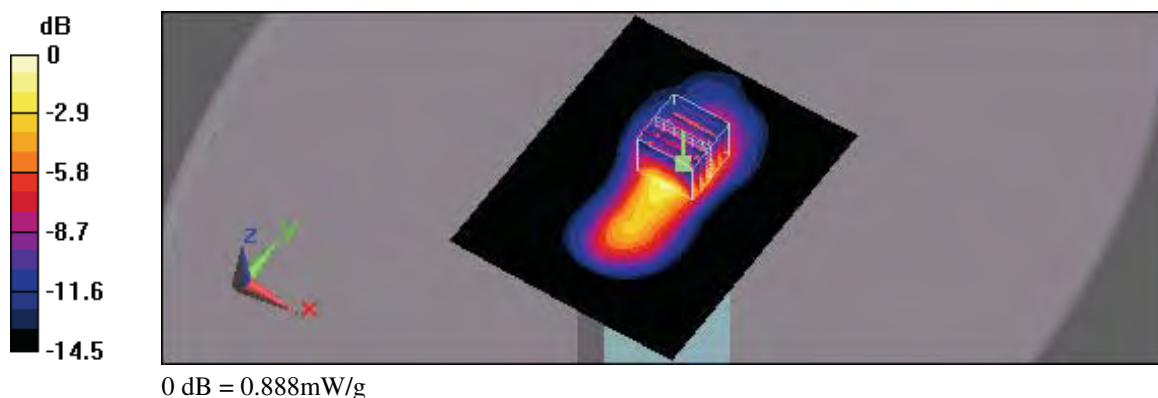
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(4.71, 4.71, 4.71); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

## **Flat/Area Scan (81x101x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 0.847 mW/g

## **Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 20.4 V/m; Power Drift = 0.123 dB  
Peak SAR (extrapolated) = 1.18 W/kg  
**SAR(1 g) = 0.696 mW/g; SAR(10 g) = 0.373 mW/g**  
Maximum value of SAR (measured) = 0.888 mW/g



Test Laboratory: A Test Lab Techno Corp.  
Date/Time: 10/12/2011 5:48:36 PM

# **Flat\_1xEVDO PCS RevA CH25\_Edge Top to phantom 0mm**

**DUT: MTP1121; Type: MTP1121 PCI Express Mini Card; FCC ID: ZUJ-MTP1121**

Communication System: 1xEVDO PCS ; Frequency: 1851.25 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 1851.25 \text{ MHz}$ ;  $\sigma = 1.46 \text{ mho/m}$ ;  $\epsilon_r = 52.1$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

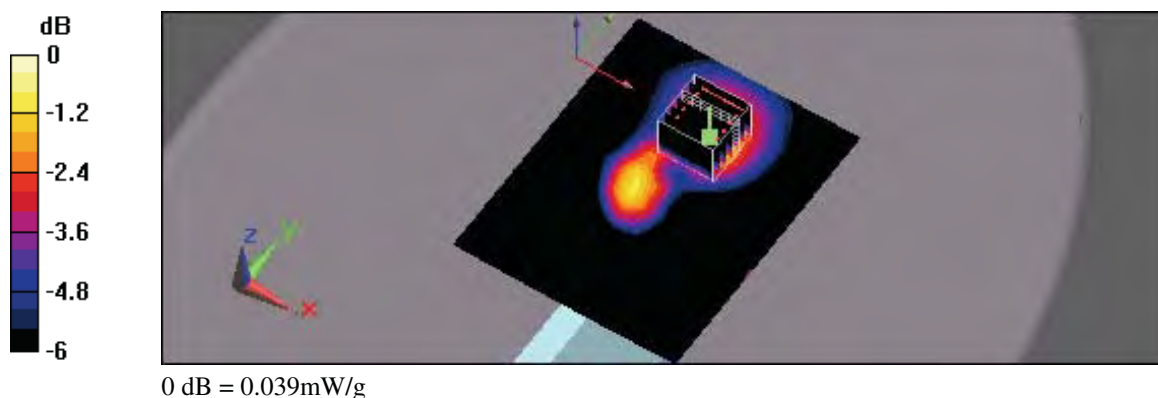
- Area Scan setting - Find Secondary Maximum Within: 2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: ES3DV3 - SN3150; ConvF(4.71, 4.71, 4.71); Calibrated: 4/14/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 1/31/2011
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

## **Flat/Area Scan (81x101x1):**

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
Maximum value of SAR (interpolated) = 0.036 mW/g

## **Flat/Zoom Scan (7x7x9)/Cube 0:**

Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$   
Reference Value = 0.935 V/m; Power Drift = -0.145 dB  
Peak SAR (extrapolated) = 0.056 W/kg  
**SAR(1 g) = 0.031 mW/g; SAR(10 g) = 0.018 mW/g**  
Maximum value of SAR (measured) = 0.039 mW/g





## ***Appendix C - Calibration***

All of the instruments Calibration information are listed below.

- Dipole \_ D835V2 SN:4d082 Calibration No.D835V2-4d082\_Jul11
- Dipole \_ D1900V2 SN:5d111 Calibration No.D1900V2-5d111\_Jul11
- Probe \_ ES3DV3 SN:3150 Calibration No.ES3-3150\_Apr11
- DAE \_ DAE4 SN:779 Calibration No.DAE4-779\_Jan11

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Accreditation No.: **SCS 108**

Client **ATL (Auden)**

Certificate No: **D835V2-4d082\_Jul11**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d082**

Calibration procedure(s) **QA CAL-05.v8**  
 Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **July 19, 2011**



This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 19, 2011

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D835V2-4d082\_Jul11

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Accreditation No.: **SCS 108**

#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

#### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.



## Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.0 $\pm$ 6 %	0.88 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.28 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.25 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.50 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.07 mW / g $\pm$ 16.5 % (k=2)

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.8 $\pm$ 6 %	0.98 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.39 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.43 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.22 mW / g $\pm$ 16.5 % (k=2)

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.4 $\Omega$ - 7.0 j $\Omega$
Return Loss	- 23.1 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.1 $\Omega$ - 8.8 j $\Omega$
Return Loss	- 20.0 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 17, 2008

## DASY5 Validation Report for Head TSL

Date: 18.07.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d082**

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.88 \text{ mho/m}$ ;  $\epsilon_r = 41$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.745 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.357 W/kg

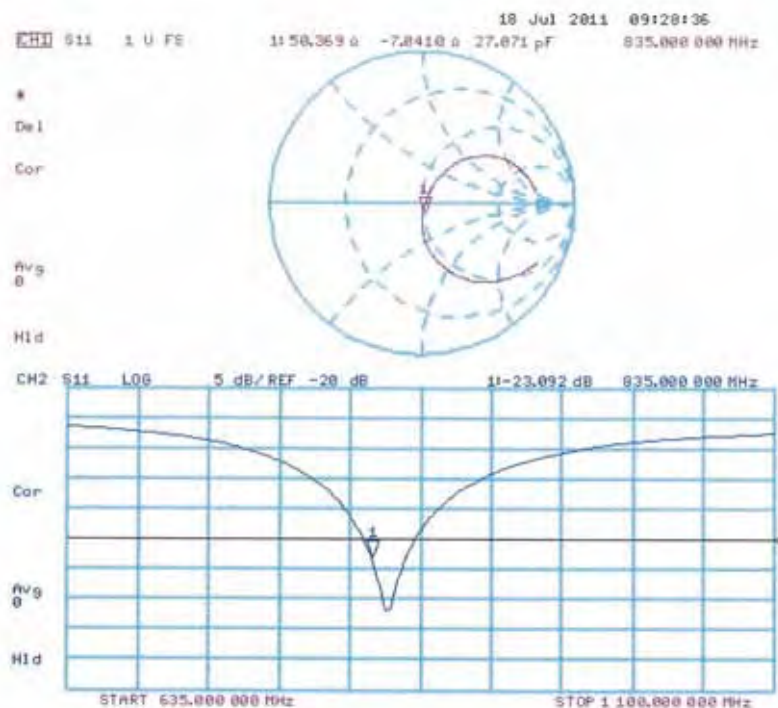
**SAR(1 g) = 2.28 mW/g; SAR(10 g) = 1.5 mW/g**

Maximum value of SAR (measured) = 2.657 mW/g





# Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 19.07.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d082**

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.98$  mho/m;  $\epsilon_r = 53.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

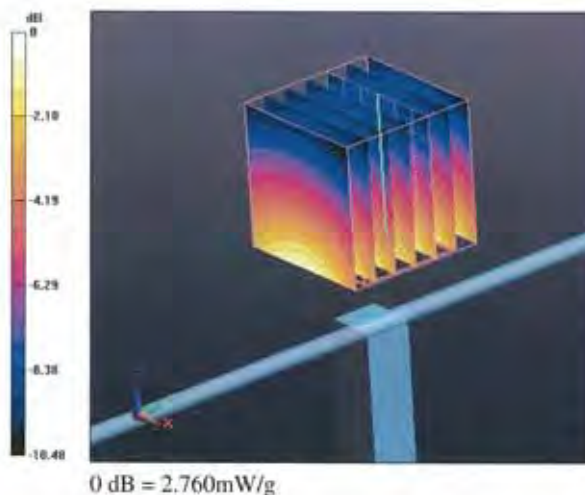
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.883 V/m; Power Drift = 0.06 dB

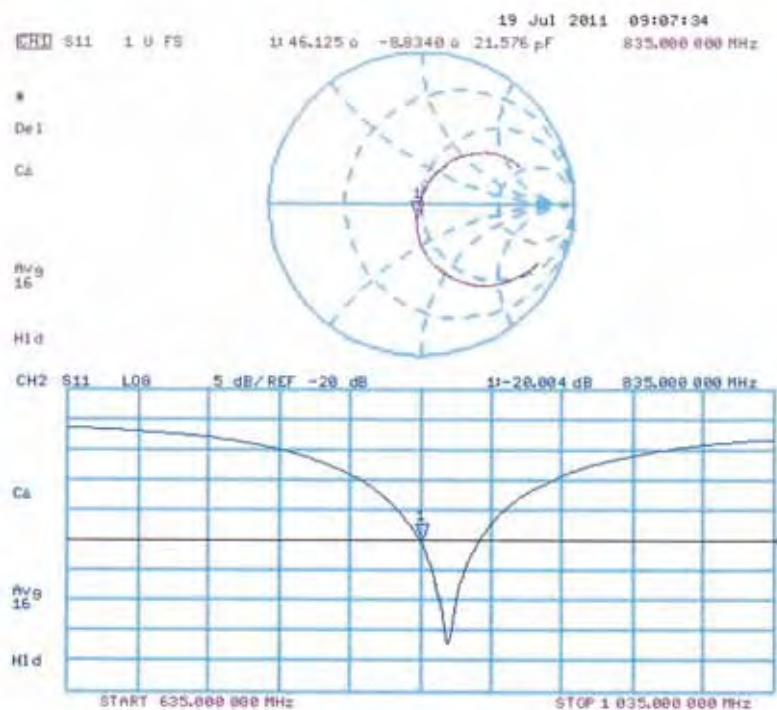
Peak SAR (extrapolated) = 3.464 W/kg

**SAR(1 g) = 2.39 mW/g; SAR(10 g) = 1.57 mW/g**

Maximum value of SAR (measured) = 2.762 mW/g



# Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 108**

Client **ATL (Auden)**

Certificate No: **D1900V2-5d111\_Jul11**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d111**

Calibration procedure(s) **QA CAL-05.v8**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **July 22, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by:	Name Dimce Iliev	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 22, 2011

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Certificate No: D1900V2-5d111\_Jul11

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Accreditation No.: **SCS 108**

#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

#### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

#### Additional Documentation:

- DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.



## Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.42 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.9 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.25 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.8 mW / g $\pm$ 16.5 % (k=2)

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.3 $\pm$ 6 %	1.53 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.9 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.39 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.5 mW / g $\pm$ 16.5 % (k=2)



## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.3 \Omega + 6.7 j\Omega$
Return Loss	- 23.5 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$45.9 \Omega + 6.6 j\Omega$
Return Loss	- 21.8 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 28, 2008



## DASY5 Validation Report for Head TSL

Date: 20.07.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d111**

Communication System: CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.42$  mho/m;  $\epsilon_r = 39.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

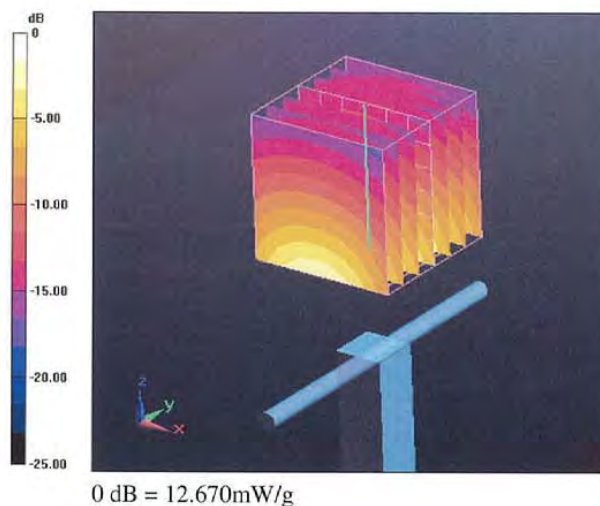
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.068 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.391 W/kg

**SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.25 mW/g**

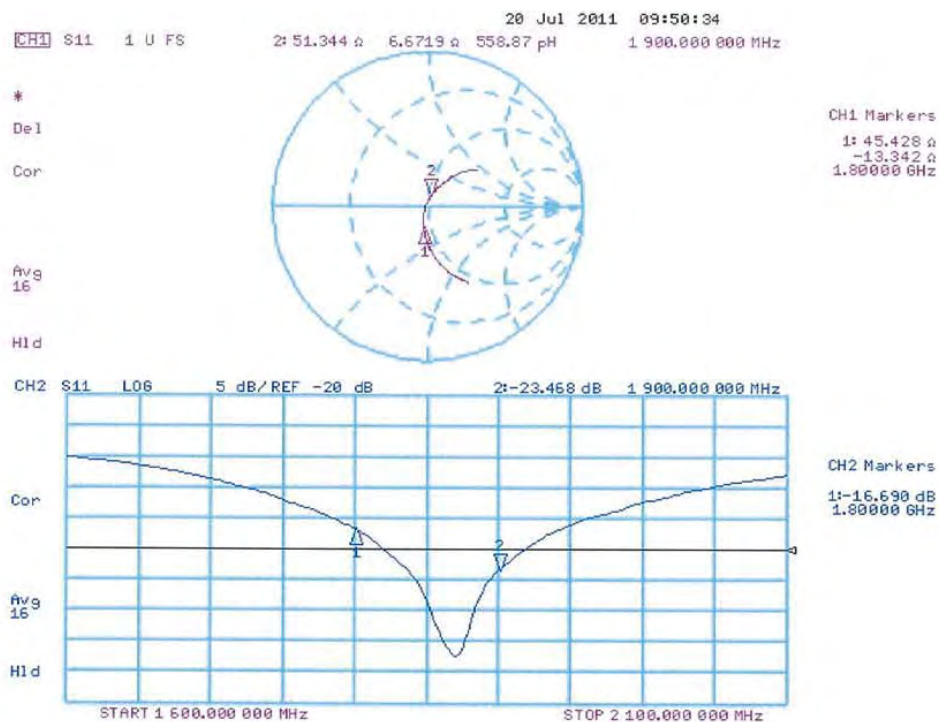
Maximum value of SAR (measured) = 12.667 mW/g







## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 22.07.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d111**

Communication System: CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.53$  mho/m;  $\epsilon_r = 52.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

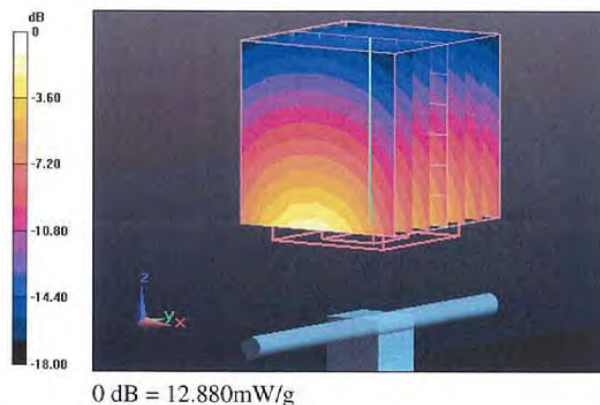
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.720 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.122 W/kg

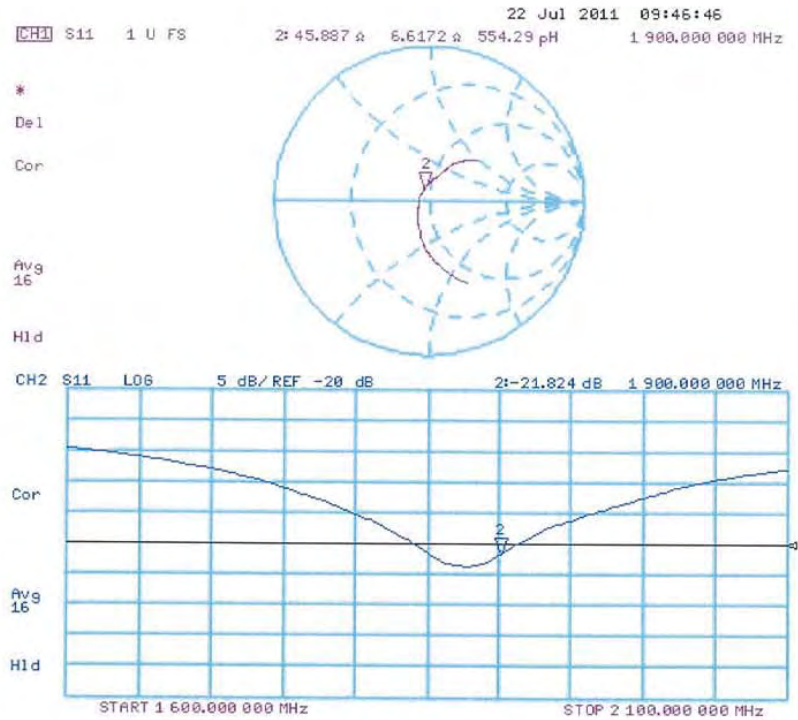
**SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.39 mW/g**

Maximum value of SAR (measured) = 12.882 mW/g





## Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **ATL (Auden)**

Certificate No: **ES3-3150\_Apr11**

## CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3150**

Calibration procedure(s) **QA CAL-01.v7, QA CAL-23.v4, QA CAL-25.v3  
Calibration procedure for dosimetric E-field probes**

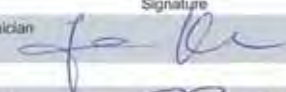

Calibration date: **April 14, 2011 (Additional Conversion Factors)**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41495277	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013, Dec10)	Dec-11
DAE4	SN: 654	23-Apr-10 (No. DAE4-654, Apr10)	Apr-11
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			
Issued: April 18, 2011			

Certificate No: ES3-3150\_Apr11

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#### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\theta$	$\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis

#### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>** are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.
- VR**: VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.



ES3DV3 – SN:3150

April 14, 2011

# Probe ES3DV3

## SN:3150

### Additional Conversion Factors

Manufactured: June 12, 2007  
Calibrated: April 14, 2011

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3150

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V/m})^2$ ) <sup>A</sup>	1.25	1.24	1.23	$\pm 10.1 \%$
DCP (mV) <sup>B</sup>	102.3	100.4	101.1	

### Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc <sup>E</sup> (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	149.9	$\pm 2.4 \%$
			Y	0.00	0.00	1.00	149.5	
			Z	0.00	0.00	1.00	149.1	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



ES3DV3- SN:3150

April 14, 2011

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3150

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>f</sup>	Conductivity (S/m) <sup>f</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
900	41.5	0.97	6.16	6.16	6.16	0.70	1.18	± 12.0 %

<sup>c</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



## DASY/EASY - Parameters of Probe: ES3DV3- SN:3150

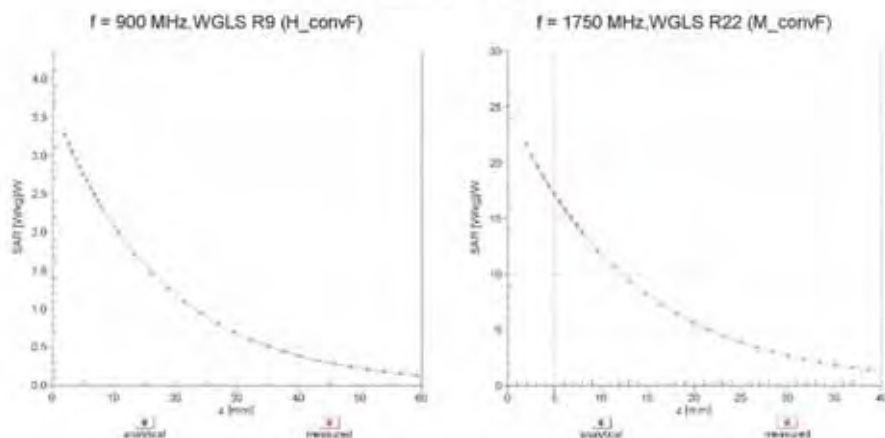
### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>f</sup>	Conductivity (S/m) <sup>f</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	6.16	6.16	6.16	0.60	1.32	± 12.0 %
900	55.0	1.05	6.09	6.09	6.09	0.60	1.33	± 12.0 %
1750	53.4	1.49	5.00	5.00	5.00	0.45	1.79	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.31	2.29	± 12.0 %

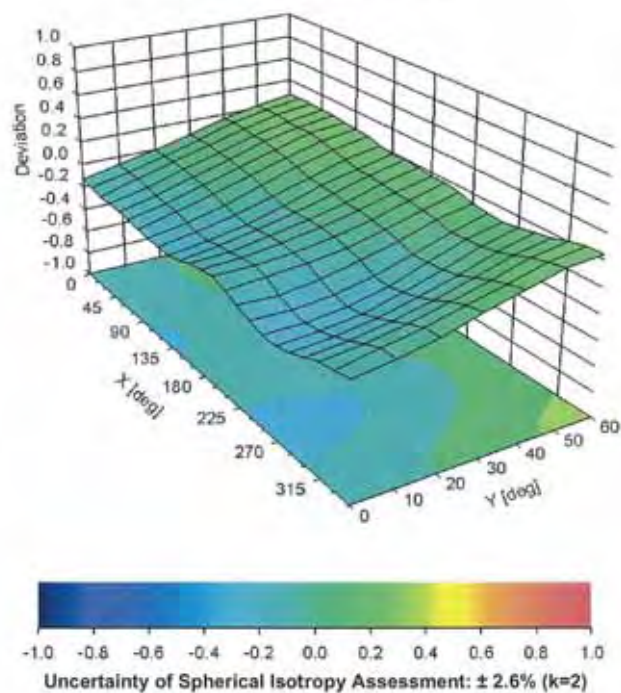
<sup>c</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

## Conversion Factor Assessment



## Deviation from Isotropy in Liquid Error ( $\phi, \theta$ ), f = 900 MHz





ES3DV3- SN:3150

April 14, 2011

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3150

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	2 mm

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Accreditation No.: **SCS 108**

Client **ATL (Auden)**

Certificate No: **DAE4-779\_Jan11**

## CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 779**

Calibration procedure(s) **QA CAL-08.v22  
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **January 31, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-10 (No:10376)	Sep-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	07-Jun-10 (in house check)	In house check: Jun-11

Calibrated by:	Name <b>Andrea Guntli</b>	Function <b>Technician</b>	Signature 
Approved by:	Name <b>Fin Bomholt</b>	Function <b>R&amp;D Director</b>	Signature 

Issued: January 31, 2011

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## Glossary

**DAE** data acquisition electronics  
**Connector angle** information used in DASY system to align probe sensor X to the robot coordinate system.

## Methods Applied and Interpretation of Parameters

- **DC Voltage Measurement:** Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- **Connector angle:** The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - **DC Voltage Measurement Linearity:** Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - **Common mode sensitivity:** Influence of a positive or negative common mode voltage on the differential measurement.
  - **Channel separation:** Influence of a voltage on the neighbor channels not subject to an input voltage.
  - **AD Converter Values with inputs shorted:** Values on the internal AD converter corresponding to zero input voltage
  - **Input Offset Measurement:** Output voltage and statistical results over a large number of zero voltage measurements.
  - **Input Offset Current:** Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - **Input resistance:** Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - **Low Battery Alarm Voltage:** Typical value for information. Below this voltage, a battery alarm signal is generated.
  - **Power consumption:** Typical value for information. Supply currents in various operating modes.





### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1  $\mu$ V , full range = -100...+300 mV  
Low Range: 1LSB = 61 nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.517 $\pm$ 0.1% (k=2)	403.748 $\pm$ 0.1% (k=2)	403.972 $\pm$ 0.1% (k=2)
Low Range	3.96927 $\pm$ 0.7% (k=2)	3.98585 $\pm$ 0.7% (k=2)	3.99915 $\pm$ 0.7% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	155.5 $^{\circ}$ $\pm$ 1 $^{\circ}$
---	-------------------------------------

## Appendix

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	200001.8	6.19	0.00
Channel X + Input	20003.75	4.25	0.02
Channel X - Input	-19996.56	3.04	-0.02
Channel Y + Input	200005.0	0.90	0.00
Channel Y + Input	20000.78	1.38	0.01
Channel Y - Input	-19996.43	2.97	-0.01
Channel Z + Input	200002.2	-1.15	-0.00
Channel Z + Input	19999.59	0.19	0.00
Channel Z - Input	-19995.05	4.35	-0.02

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2000.4	0.25	0.01
Channel X + Input	200.27	0.37	0.18
Channel X - Input	-199.08	1.12	-0.56
Channel Y + Input	2000.1	0.19	0.01
Channel Y + Input	199.01	-0.89	-0.45
Channel Y - Input	-199.30	0.50	-0.25
Channel Z + Input	1999.6	-0.40	-0.02
Channel Z + Input	199.22	-0.88	-0.44
Channel Z - Input	-200.27	-0.37	0.19

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	-3.66	-5.39
	-200	5.82	4.90
Channel Y	200	13.39	13.58
	-200	-14.98	-15.16
Channel Z	200	2.20	2.53
	-200	-4.84	-4.61

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	1.33	-0.57
Channel Y	200	1.97	-	3.29
Channel Z	200	1.19	-0.28	-

#### 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15613	15134
Channel Y	15831	16218
Channel Z	16150	17743

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	-0.26	-1.03	0.79	0.42
Channel Y	0.52	-1.04	2.07	0.58
Channel Z	-2.22	-3.25	-0.85	0.44

#### 6. Input Offset Current

Nominal input circuitry offset current on all channels: <25fA

#### 7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

#### 8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

#### 9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9