SAR Test Report

(Class II Permissive Change)

Product Name ： 802.11b/g/n RTL8191SE miniCard

Model No. ： RTL8191SE

Applicant ： Realtek Semiconductor Corp.

Address ： No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

Date of Receipt ： 2010/01/11

Issued Date ： 2010/01/20

Report No. ： 101187R-HPUSP09V01

Report Version ： V1.0

Test Report Certification

Issued Date: 2010/01/20
Report No.:101187R-HPUSP09V01

QuieTek

Product Name	:	802.11b/g/n RTL8191SE miniCard
Applicant	:	Realtek Semiconductor Corp.
Address	:	No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan
Manufacturer	:	Realtek Semiconductor Corp.
Model No.	:	RTL8191SE
Trade Name	:	Realtek
FCC ID	:	TX2-RTL8191SE
Applicable Standard	:	FCC Oet65 Supplement C June 2001 IEEE Std. 1528-2003 47CFR § 2.1093
Test Result	:	Max. SAR Measurement (1g) **0.419** W/kg
Application Type	:	Certification

The test results relate only to the samples tested.
The test report shall not be reproduced except in full without the written approval of QuieTek Corporation.

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Tested By : Jung Chang
(Engineer / Jung Chang)

Approved By :
(Manager / Vincent Lin)

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1. General Information

1.1 EUT Description

Product Name	802.11b/g/n RTL8191SE miniCard
Trade Name	Realtek
Model No.	RTL8191SE
FCC ID	TX2-RTL8191SE
TX Frequency	2412MHz ~ 2462MHz
Number of Channel	11
Type of Modulation	DSSS/OFDM
Antenna Type	PIFA
Antenna Kit	Refer to Antenna List
Device Category	Portable
RF Exposure Environment	Uncontrolled
Max. Output Power (Conducted)	802.11b: 18.45 dBm 802.11g: 16.81 dBm

Antenna List

No.	Manufacturer	Part No.	Peak Gain
1	WANSHIN	WPB139(Main) WPB140(Aux)	3.30 dBi for 2.4 GHz

Note:

1. This is to request a Class II permissive change for **FCC ID: TX2-RTL8191SE,** originally granted on **01/22/2009.**
   The major change filed under this application is:
   Change #1: Additional Chassis added
   Model Name : JooJoo
   Product Name: Tablet PC
   Change #2: Addition new antenna, antenna gain:3.30
   The device have co-located with FCCID:QISEM770W HSPA module card, but non-simultaneously transmit.
2. The Host contain FCCID:TLZ-BT253 Bluetooth module, the output power of Bluetooth module transmitting antenna is ≤ 60/f(GHz) mW and it is ≥ 5 cm from all other simultaneous transmitting antennas.
3. The test method are refer to FCC KDB 447498, KDB 616217 and KDB 248227.

4. In compliance with Section 2.1093 submit a statement confirming compliance with the limits SAR. Submit a report if the maximum SAR value increases under this FCC ID: **TX2-RTL8191SE**”.

1.2 Test Environment

Ambient conditions in the laboratory:

Items	Required	Actual
Temperature (°C)	18-25	22.6
Humidity (%RH)	30-70	51

Site Description:

Accredited by TAF
Accredited Number: 0914
Effective through: December 12, 2011

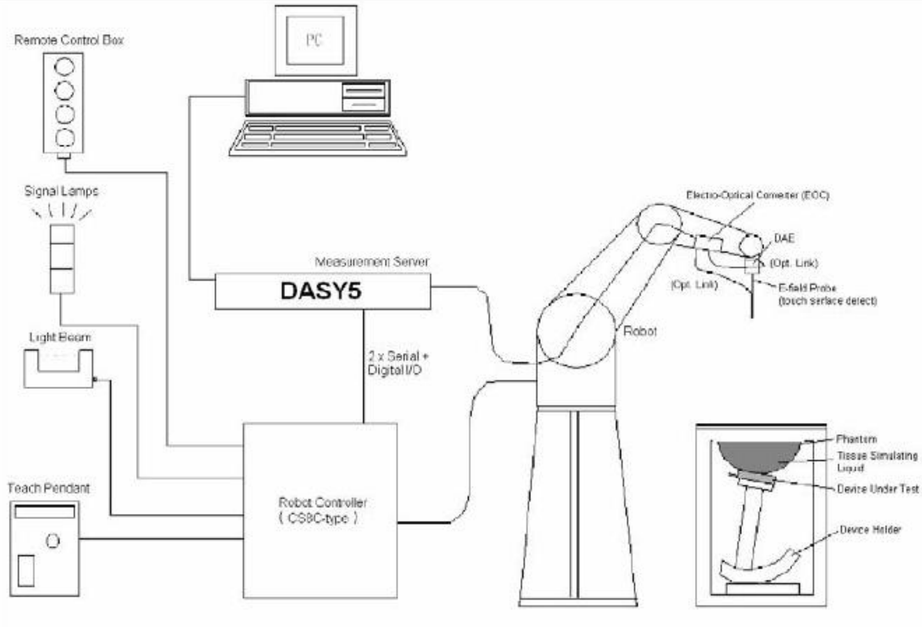
Testing Laboratory
0914

Site Name: Quietek Corporation

Site Address: No. 5-22, Ruei-Shu Valley, Ruei-Ping Tsuen,
Lin-Kou Shiang, Taipei,
Taiwan, R.O.C.
TEL : 886-2-8601-3788 / FAX : 886-2-8601-3789
E-Mail : service@quietek.com

2. SAR Measurement System

2.1 DASY5 System Description



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

- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- 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.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

2.1.1 Applications

Predefined procedures and evaluations for automated compliance testing with all worldwide standards, e.g., IEEE 1528, OET 65, IEC 62209-1, IEC 62209-2, EN 50360, EN 50383 and others.

2.1.2 Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a $10mm^2$ step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2003, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).

2.1.3 Zoom Scan (Cube Scan Averaging)

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. A density of 1000 kg/m^3 is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications (including FCC) utilize a physical step of 5x5x7 (8mmx8mmx5mm) providing a volume of 32mm in the X & Y axis, and 30mm in the Z axis.

2.1.4 Uncertainty of Inter-/Extrapolation and Averaging

In order to evaluate the uncertainty of the interpolation, extrapolation and averaged SAR calculation algorithms of the Postprocessor, DASY5 allows the generation of measurement grids which are artificially predefined by analytically based test functions. Therefore, the grids of area scans and zoom scans can be filled with uncertainty test data, according to the SAR benchmark functions of IEEE 1528.The three analytical functions shown in equations as below are used to describe the possible range of the expected SAR distributions for the tested handsets. The field gradients are covered by the spatially flat distribution f1, the spatially steep distribution f3 and f2 accounts for H-field cancellation on the phantom/tissue surface.

$$f_1(x,y,z) = Ae^{-\frac{z}{2a}} \cos^2\left(\frac{\pi}{2}\frac{\sqrt{x'^2+y'^2}}{5a}\right)$$

$$f_2(x,y,z) = Ae^{-\frac{z}{a}} \frac{a^2}{a^2+x'^2}\left(3-e^{-\frac{2z}{a}}\right)\cos^2\left(\frac{\pi}{2}\frac{y'}{3a}\right)$$

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

2.2 DASY5 E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN 62209-1, IEC 62209, etc.) under ISO 17025. The calibration data are in Appendix D.

2.2.1 Isotropic E-Field Probe Specification

Model	Ex3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

2.3 Boundary Detection Unit and Probe Mounting Device

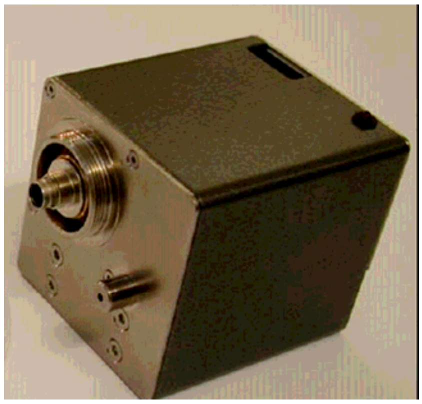
The DASY probes use a precise connector and an additional holder for the probe, consisting of a plastic tube and a flexible silicon ring to center the probe. The connector at the DAE is flexibly mounted and held in the default position with magnets and springs. Two switching systems in the connector mount detect frontal and lateral probe collisions and trigger the necessary software response.

2.4 DATA Acquisition Electronics (DAE) and Measurement Server

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit.

Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.



The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV Celeron, 128MB chipdisk and 128MB RAM. The necessary circuits for communication with the DAE electronics box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY5 I/O board, which is directly connected to the PC/104 bus of the CPU board.

2.5 Robot

The DASY5 system uses the high precision robots TX90 XL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY5 system, the CS8C robot controller version from Stäubli is used.

The XL robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

2.6 Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.

The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

2.7 Device Holder

The DASY5 device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR).
Thus the device needs no repositioning when changing the angles.
The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity εr =3 and loss tangent δ = 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.

2.8 SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- Left head
- Right head
- Flat phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

3. Tissue Simulating Liquid

3.1 The composition of the tissue simulating liquid

INGREDIENT (% Weight)	900MHz Head	1800MHz Head	2450MHz Head	2450MHz Body
Water	--	--	46.7	73.2
Salt	--	--	0.00	0.04
Sugar	--	--	0.00	0.00
HEC	--	--	0.00	0.00
Preventol	--	--	0.00	0.00
DGBE	--	--	53.3	26.7

3.2 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using APREL Dielectric Probe Kit and Anritsu MS4623B Vector Network Analyzer.

Head Tissue Simulant Measurement

Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε_r	σ [s/m]	
2450MHz	Reference result ± 5% window	40.1 38.095 to 42.105	1.78 1.691 to 1.869	N/A
	13-Jan-10	39.62	1.81	21.4

Body Tissue Simulant Measurement

Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε_r	σ [s/m]	
2450MHz	Reference result ± 5% window	52.7 50.065 to 55.335	1.95 1.8525 to 2.0475	N/A
	13-Jan-10	51.96	1.97	21.4
2412 MHz	Low channel	52.76	1.90	21.4
2437 MHz	Mid channel	52.29	1.93	21.4
2462 MHz	High channel	51.54	1.98	21.4

3.3 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 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 a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

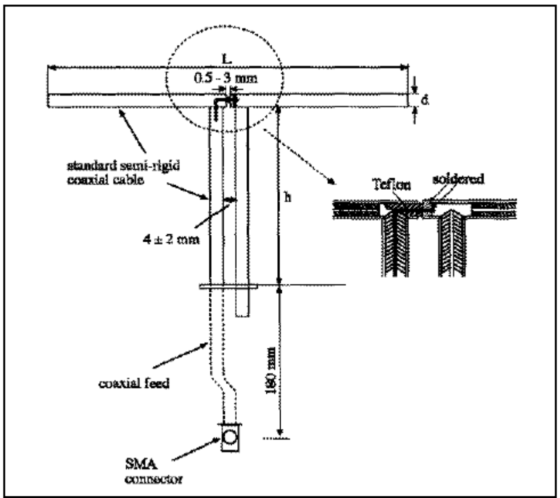
Target Frequency	Head		Body	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

4. SAR Measurement Procedure

4.1 SAR System Validation

4.1.1 Validation Dipoles



The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. the table below provides details for the mechanical and electrical specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
2450MHz	53.5	30.4	3.6

4.1.2 Validation Result

System Performance Check at 2450MHz

Validation Kit: ASL-D-2450-S-2

Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
2450 MHz	Reference result ± 10% window	48.07 43.263 to 52.877	25.65 23.085 to 28.215	N/A
	13-Jan-10	50	23.88	21.4

Note: 1. The power level is used 250mW
2. All SAR values are normalized to 1W forward power.

4.2 SAR Measurement Procedure

The ALSAS-10U calculates SAR using the following equation,

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

σ: represents the simulated tissue conductivity

ρ: represents the tissue density

The EUT is set to transmit at the required power in line with product specification, at each frequency relating to the LOW, MID, and HIGH channel settings.

Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the Universal Phantom where the maximum area scan dimensions are larger than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR location (interpolated resolution set at $1mm^2$)which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at $1mm^3$).

5. SAR Exposure Limits

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 "Uncontrolled Environments" limits. These limits apply to a location which is deemed as "Uncontrolled Environment" which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for brain or body)	**1.60 W/kg**
Spatial Average SAR (whole body)	**0.08 W/kg**
Spatial Peak SAR (10g for hands, feet, ankles and wrist)	**4.00 W/kg**

6. Test Equipment List

Instrument	Manufacturer	Model No.	Serial No.	Last Calibration	Next Calibration
Stäubli Robot TX60L	Stäubli	TX60L	F09/5BL1A1/ A06	May. 2009	only once
Controller	Speag	CS8c	N/A	May. 2009	only once
Aprel Reference Dipole 2450Mhz	Aprel	ALS-D-2450-S-2	QTK-319	May. 2008	May. 2010
SAM Twin Phantom	Speag	QD000 P40 CA	Tp 1515	N/A	N/A
Device Holder	Speag	N/A	N/A	N/A	N/A
Data Acquisition Electronic	Speag	DAE4	1204	Apr. 2009	Apr. 2010
E-Field Probe	Speag	EX3DV4	3602	May. 2009	May. 2010
SAR Software	Speag	DASY5	V5.0 Build 125	N/A	N/A
Aprel Dipole Spaccer	Aprel	ALS-DS-U	QTK-295	N/A	N/A
Power Amplifier	Mini-Circuit	ZHL-42	D051404-20	N/A	N/A
Directional Coupler	Agilent	778D-012	50550	N/A	N/A
Universal RadioCommunication Tester	R&S	CMU 200	104846	May. 2009	May. 2010
Vector Network	Anritsu	MS4623B	992801	Aug. 2009	Aug. 2010
Signal Generator	Anritsu	MG3692A	042319	Jun. 2009	Jun. 2010
Power Meter	Anritsu	ML2487A	6K00001447	Apr. 2009	Apr. 2010
Wide Bandwidth Sensor	Anritsu	MA2491	030677	Apr. 2009	Apr. 2010

7. Measurement Uncertainty

Uncertainty								
Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±5.9 %	N	1	1	1	±5.9 %	±5.9 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Setup								
Phantom Uncertainty	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Liquid Conductivity (target)	±5.0 %	R	$\sqrt{3}$	0.64	0.43	±1.8 %	±1.2 %	∞
Liquid Conductivity (meas.)	±2.5 %	N	1	0.64	0.43	±1.6 %	±1.1 %	∞
Liquid Permittivity (target)	±5.0 %	R	$\sqrt{3}$	0.6	0.49	±1.7 %	±1.4 %	∞
Liquid Permittivity (meas.)	±2.5 %	N	1	0.6	0.49	±1.5 %	±1.2 %	∞
Combined Std. Uncertainty						±10.9 %	±10.7 %	387
Expanded STD Uncertainty						**±21.9 %**	**±21.4 %**	

8. Peak Conducted Power Measurement

802.11 b

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
2412	17.95	0.5	18.45	69.98
2437	17.43	0.5	17.93	62.09
2462	17.41	0.5	17.91	61.80

802.11 g

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
2412	16.21	0.5	16.71	46.88
2437	16.31	0.5	16.81	47.97
2462	14.78	0.5	15.28	33.73

802.11 n-20M

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
2412	16.31	0.5	16.81	47.97
2437	16.19	0.5	16.69	46.67
2462	14.71	0.5	15.21	33.19

802.11 n-40M

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
2422	16.27	0.5	16.77	47.53
2437	16.22	0.5	16.72	46.99
2452	14.16	0.5	14.66	29.24

9. Test Results

9.1 SAR Test Results Summary

SAR MEASUREMENT						
Ambient Temperature (°C) : 22.6 ±2				Relative Humidity (%): 51		
Liquid Temperature (°C) : 21.4 ±2				Depth of Liquid (cm):>15		
Product: 802.11b/g/n RTL8191SE miniCard						
Test Mode: 802.11g						
Test Position Body	Antenna Position	Frequency		Conducted Power (dBm)	**SAR** 1g (W/kg)	Limit (W/kg)
		Channel	MHz			
Top	Fixed	6	2437	16.81	0.078	1.6
Test Mode: 802.11b						
Top	Fixed	1	2412	18.45	0.419	1.6
Top	Fixed	6	2437	17.93	0.291	1.6
Top	Fixed	11	2462	17.91	0.230	1.6
Back	Fixed	6	2437	17.93	0.188	1.6
Test Mode: 802.11n (20M)						
Top	Fixed	1	2412	16.81	0.050	1.6
Test Mode: 802.11n (40M)						
Top	Fixed	3	2422	16.77	0.040	1.6

Appendix

Appendix A. SAR System Validation Data

Appendix B. SAR measurement Data

Appendix C. Test Setup Photographs & EUT Photographs

Appendix D. Probe Calibration Data

Appendix E. Dipole Calibration Data

Appendix A. SAR System Validation Data

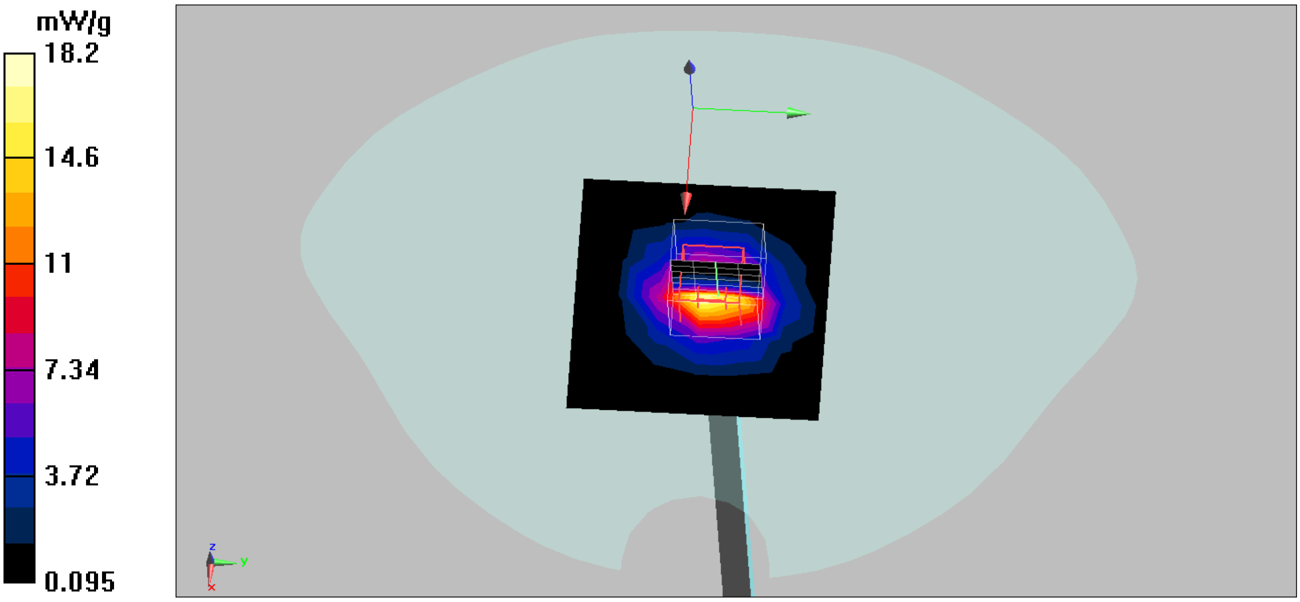
Date/Time: 1/13/2010

Test Laboratory: Quietek
System Performance Check_2450MHz-Head-
DUT: Dipole 2450 MHz; Type: ALS-D-2450-S-2; Serial: QTK-319
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.81 mho/m; ε_r = 39.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(7.1, 7.1, 7.1); Calibrated: 5/20/2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

2450MHz_Head/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 17.4 mW/g

2450MHz_Head/Zoom Scan (7x7x7) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 100.5 V/m; Power Drift = 0.142 dB
Peak SAR (extrapolated) = 25.5 W/kg
SAR(1 g) = 12.5 mW/g; SAR(10 g) = 5.97 mW/g
Maximum value of SAR (measured) = 18.3 mW/g



Appendix B. SAR measurement Data

Date/Time: 1/13/2010

Test Laboratory: Quietek

802.11g_6 Top

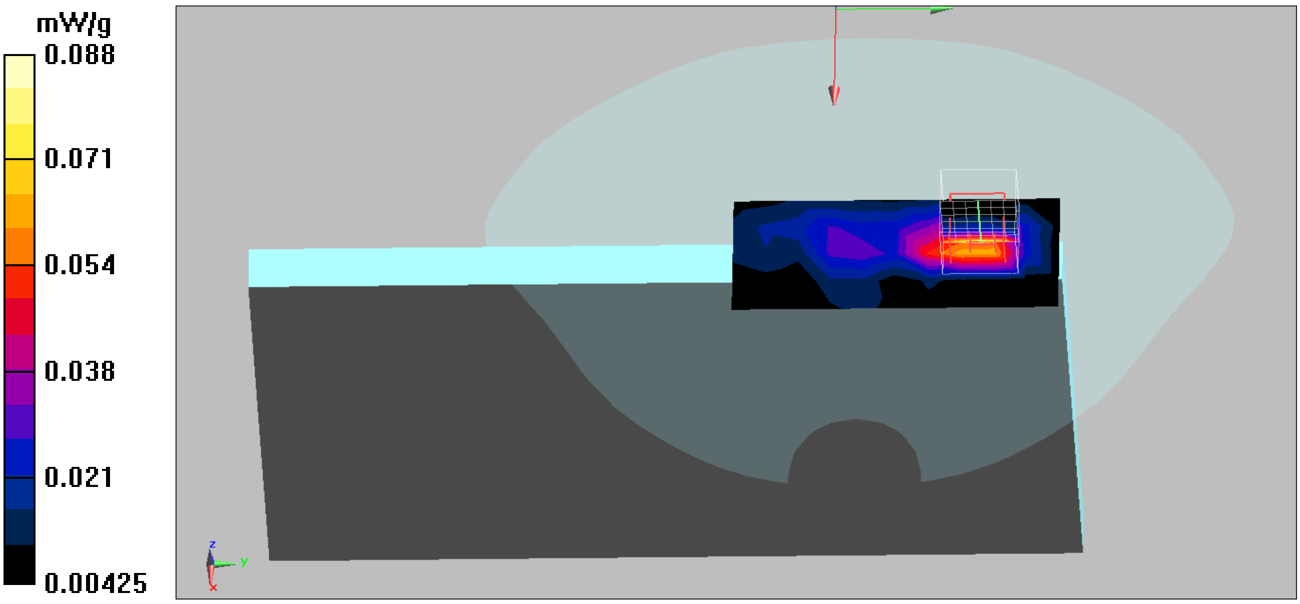
DUT: 802.11b/g/n RTL8191SE miniCard ; Type: RTL8191SE

Communication System: 802.11g; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.93 mho/m; εr = 52.3; ρ = 1000 kg/m3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(6.9, 6.9, 6.9); Calibrated: 5/20/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM;
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

Body/Area Scan (5x11x1): Measurement grid: dx=13mm, dy=13mm
Maximum value of SAR (measured) = 0.064 mW/g

Body/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.05 V/m; Power Drift = 0.078 dB
Peak SAR (extrapolated) = 0.206 W/kg
SAR(1 g) = 0.078 mW/g; SAR(10 g) = 0.035 mW/g
Maximum value of SAR (measured) = 0.088 mW/g



Date/Time: 1/13/2010

Test Laboratory: Quietek

802.11b_1 Top

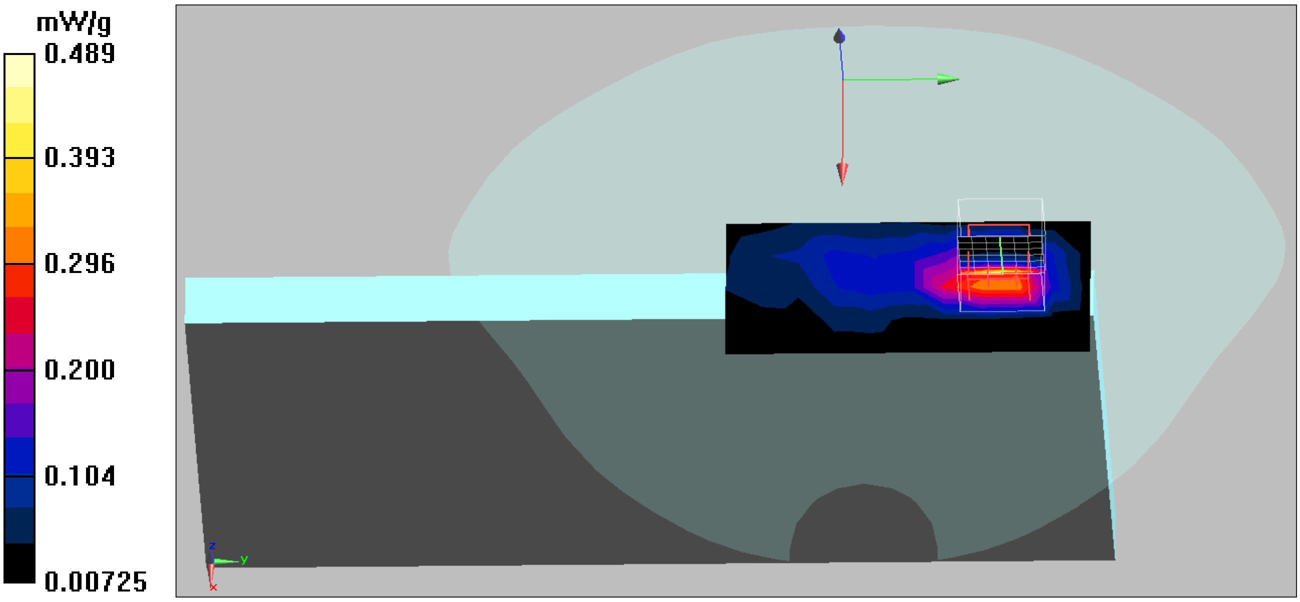
DUT: 802.11b/g/n RTL8191SE miniCard ; Type: RTL8191SE

Communication System: 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.9 mho/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(6.9, 6.9, 6.9); Calibrated: 5/20/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM;
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

Body/Area Scan (5x11x1): Measurement grid: dx=13mm, dy=13mm
Maximum value of SAR (measured) = 0.326 mW/g

Body/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.98 V/m; Power Drift = 0.175 dB
Peak SAR (extrapolated) = 1.03 W/kg
SAR(1 g) = 0.419 mW/g; SAR(10 g) = 0.174 mW/g
Maximum value of SAR (measured) = 0.489 mW/g



Date/Time: 1/13/2010

Test Laboratory: Quietek

802.11b_6 Top

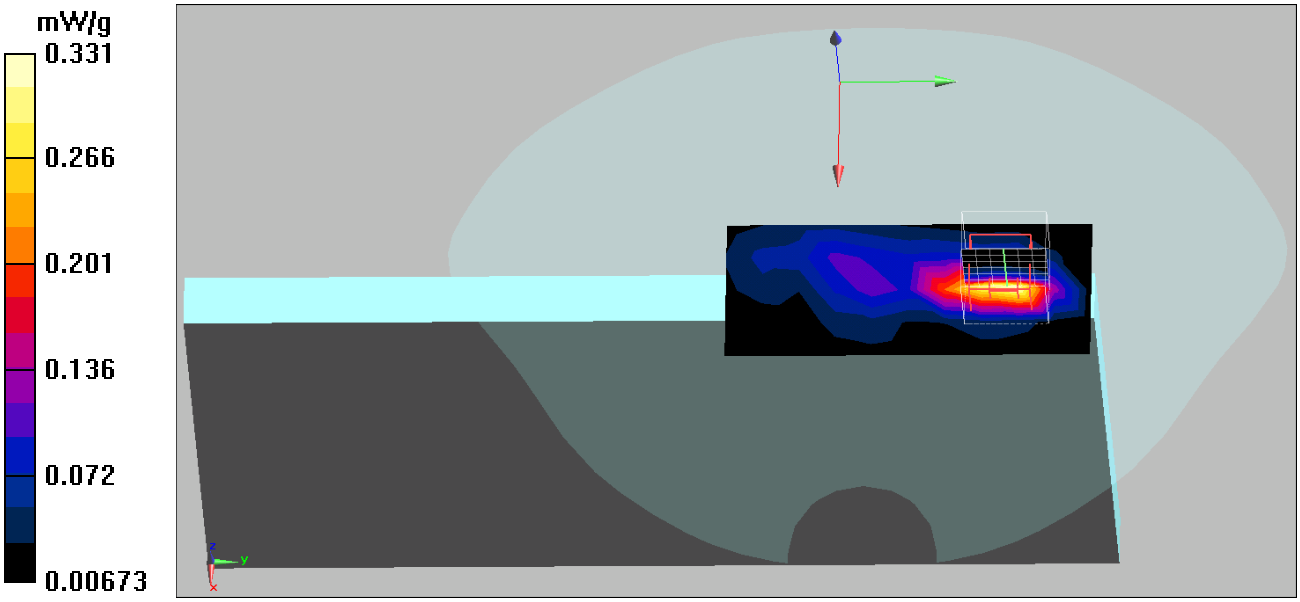
DUT: 802.11b/g/n RTL8191SE miniCard ; Type: RTL8191SE

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.93 mho/m; ε_r = 52.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(6.9, 6.9, 6.9); Calibrated: 5/20/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM;
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

Body/Area Scan (5x11x1): Measurement grid: dx=13mm, dy=13mm
Maximum value of SAR (measured) = 0.322 mW/g

Body/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.43 V/m; Power Drift = 0.091 dB
Peak SAR (extrapolated) = 0.738 W/kg
SAR(1 g) = 0.291 mW/g; SAR(10 g) = 0.119 mW/g
Maximum value of SAR (measured) = 0.331 mW/g



Date/Time: 1/13/2010

Test Laboratory: Quietek

802.11b_11 Top

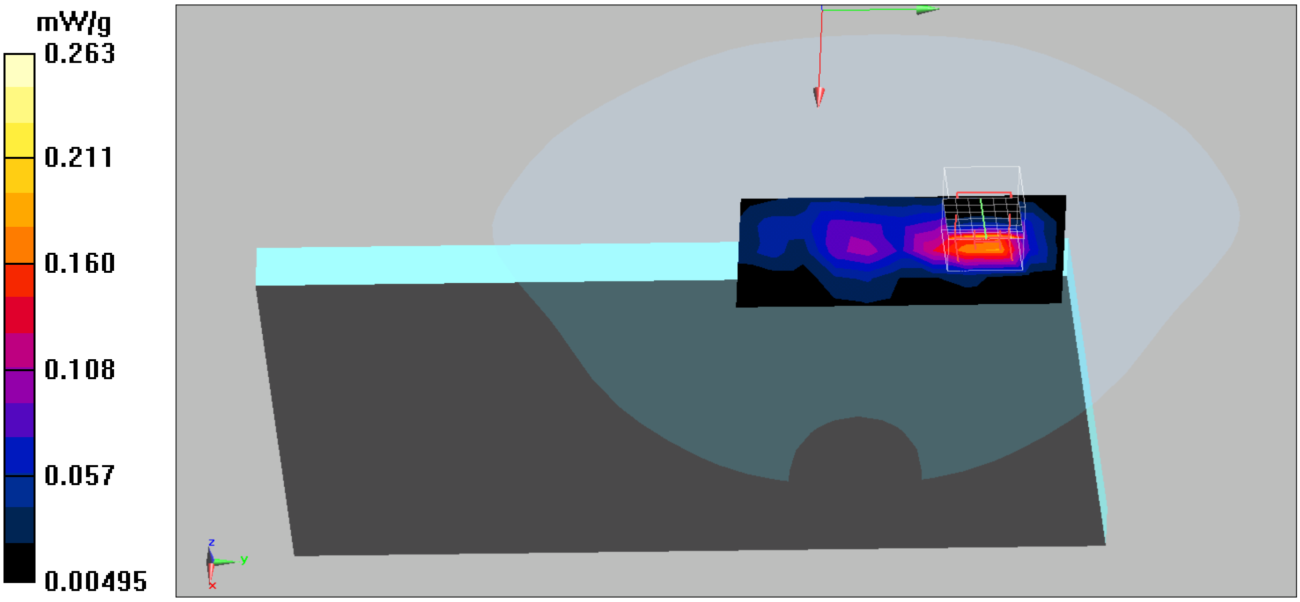
DUT: 802.11b/g/n RTL8191SE miniCard ; Type: RTL8191SE

Communication System: 802.11b; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2462 MHz; σ = 1.98 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(6.9, 6.9, 6.9); Calibrated: 5/20/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM;
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

Body/Area Scan (5x11x1): Measurement grid: dx=13mm, dy=13mm
Maximum value of SAR (measured) = 0.180 mW/g

Body/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.27 V/m; Power Drift = -0.083 dB
Peak SAR (extrapolated) = 0.585 W/kg
SAR(1 g) = 0.230 mW/g; SAR(10 g) = 0.095 mW/g
Maximum value of SAR (measured) = 0.263 mW/g



Date/Time: 1/13/2010

Test Laboratory: Quietek

802.11b_6 Back

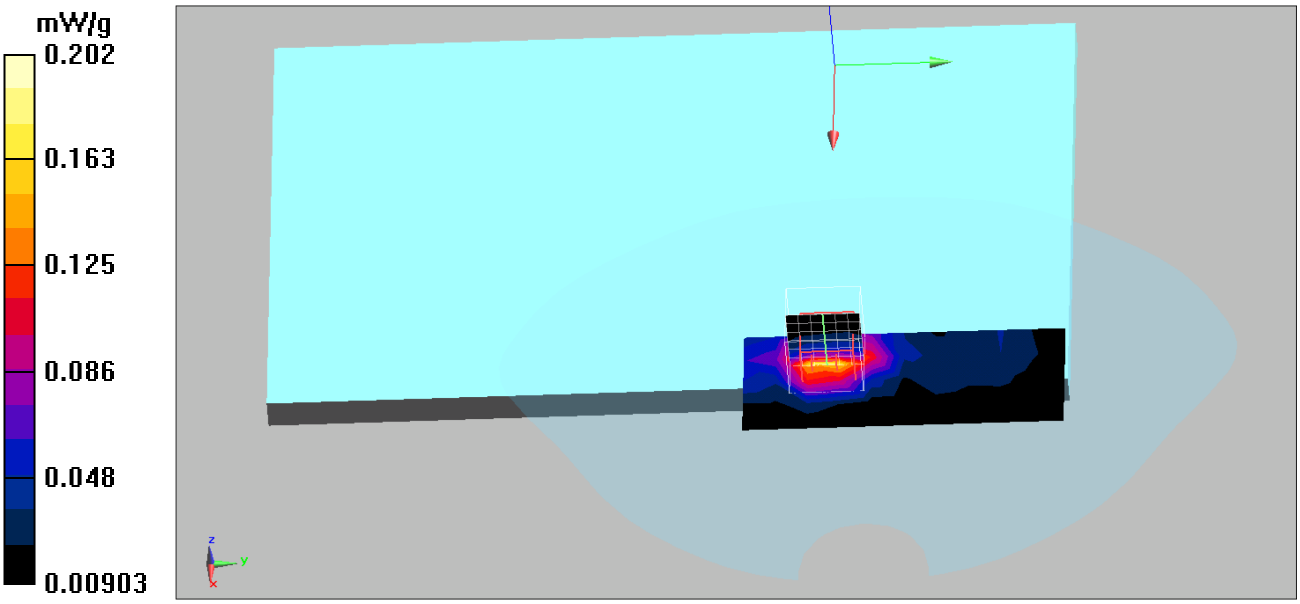
DUT: 802.11b/g/n RTL8191SE miniCard ; Type: RTL8191SE

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2437 MHz; σ = 1.93 mho/m; ε_r = 52.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(6.9, 6.9, 6.9); Calibrated: 5/20/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM;
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

Body/Area Scan (5x11x1): Measurement grid: dx=13mm, dy=13mm
Maximum value of SAR (measured) = 0.173 mW/g

Body/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.41 V/m; Power Drift = -0.129 dB
Peak SAR (extrapolated) = 0.435 W/kg
SAR(1 g) = 0.188 mW/g; SAR(10 g) = 0.091 mW/g
Maximum value of SAR (measured) = 0.202 mW/g



Date/Time: 1/13/2010

Test Laboratory: Quietek

802.11n_1 20M Top

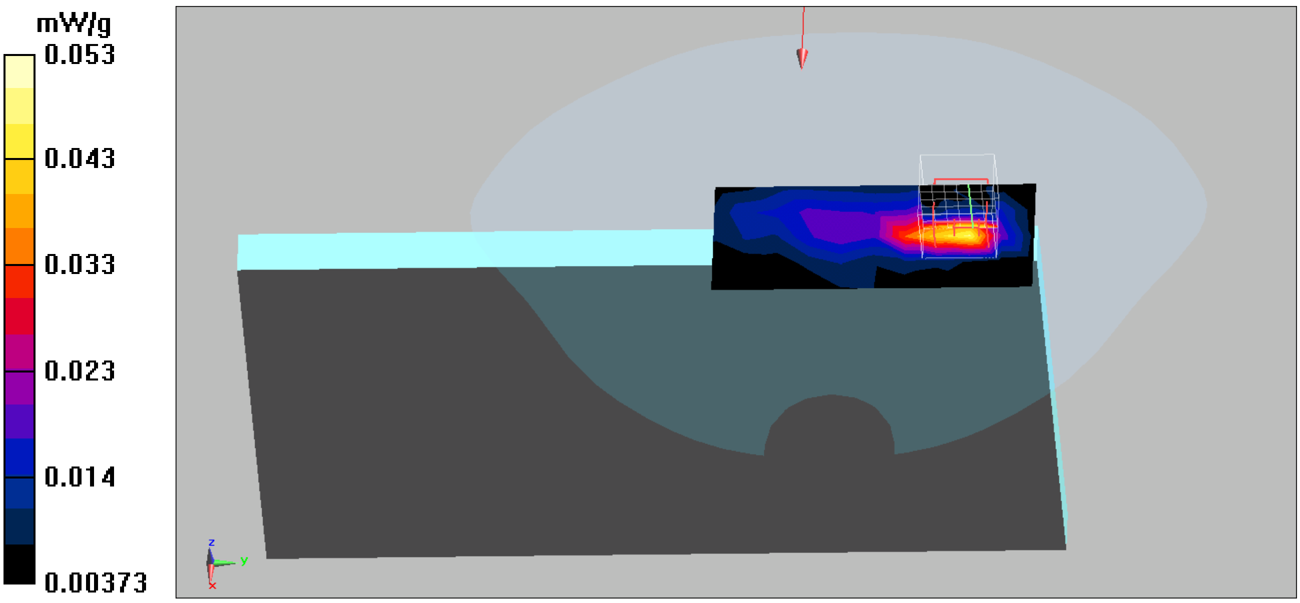
DUT: 802.11b/g/n RTL8191SE miniCard ; Type: RTL8191SE

Communication System: 802.11n; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.9 mho/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(6.9, 6.9, 6.9); Calibrated: 5/20/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM;
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

Body/Area Scan (5x11x1): Measurement grid: dx=13mm, dy=13mm
Maximum value of SAR (measured) = 0.047 mW/g

Body/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.11 V/m; Power Drift = 0.112 dB
Peak SAR (extrapolated) = 0.135 W/kg
SAR(1 g) = 0.050 mW/g; SAR(10 g) = 0.023 mW/g
Maximum value of SAR (measured) = 0.053 mW/g



Date/Time: 1/13/2010

Test Laboratory: Quietek

802.11n_3 40M Top

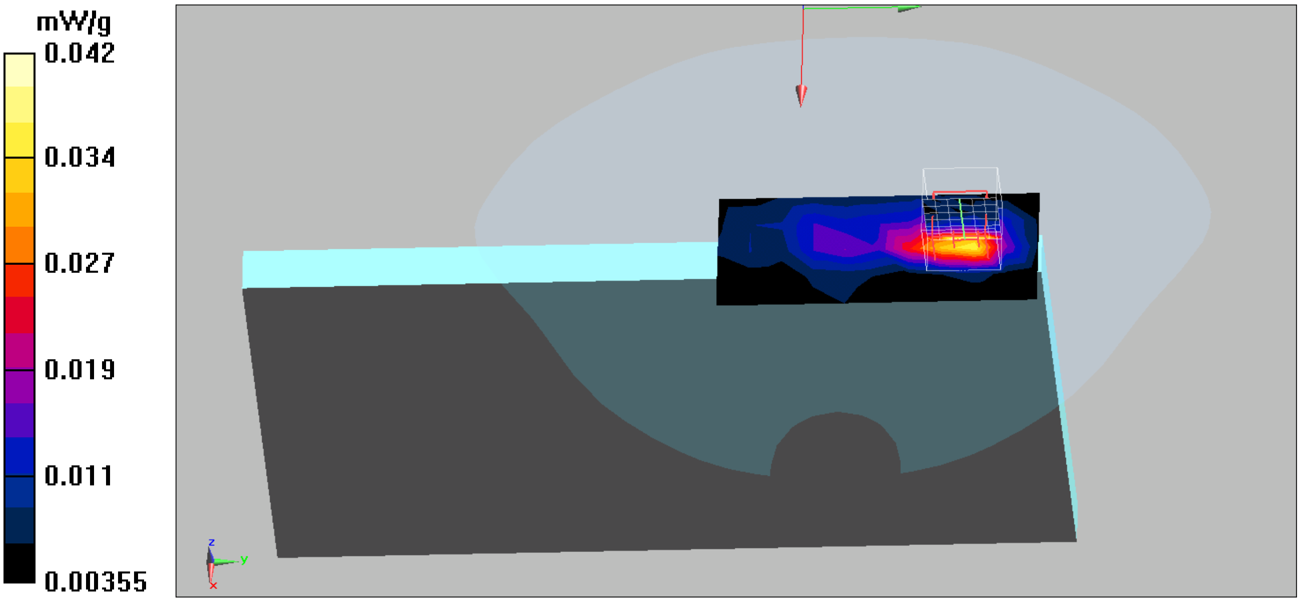
DUT: 802.11b/g/n RTL8191SE miniCard ; Type: RTL8191SE

Communication System: 802.11n; Frequency: 2422 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2422 MHz; σ = 1.92 mho/m; ε_r = 52.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Ambient Temperature (°C) : 22.6, Liquid Temperature (°C) : 21.4
DASY4 Configuration:

- Probe: EX3DV4 - SN3602; ConvF(6.9, 6.9, 6.9); Calibrated: 5/20/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1207; Calibrated: 4/7/2009
- Phantom: SAM Right Table; Type: SAM;
- Measurement SW: DASY5, V5.0 Build 125; SEMCAD X Version 13.4 Build 125

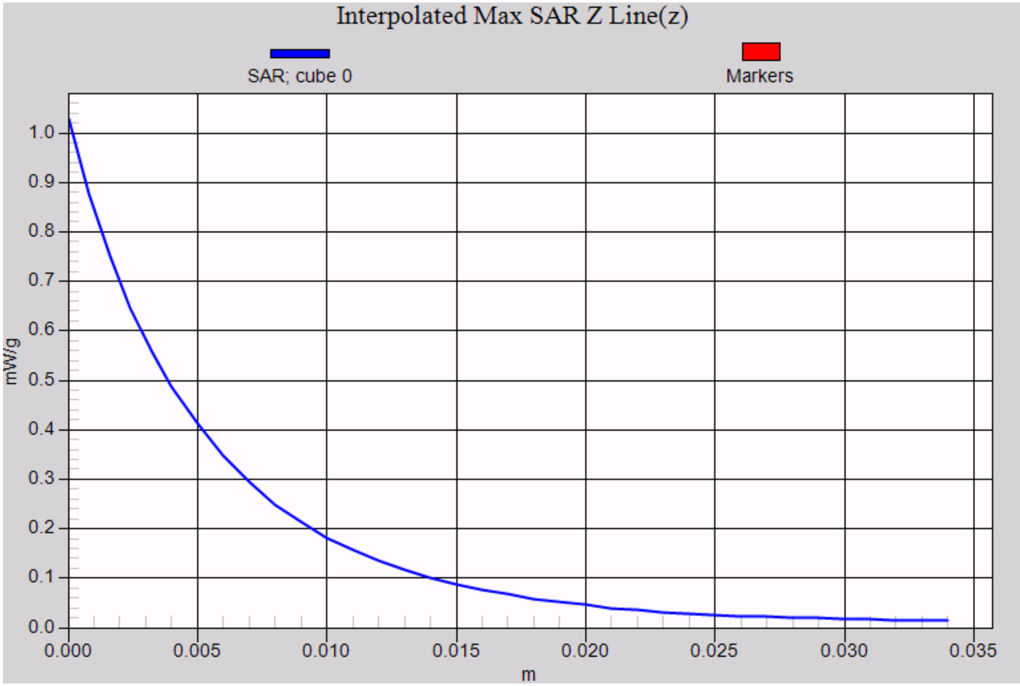
Body/Area Scan (5x11x1): Measurement grid: dx=13mm, dy=13mm
Maximum value of SAR (measured) = 0.037 mW/g

Body/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.77 V/m; Power Drift = 0.148 dB
Peak SAR (extrapolated) = 0.096 W/kg
SAR(1 g) = 0.040 mW/g; SAR(10 g) = 0.019 mW/g
Maximum value of SAR (measured) = 0.042 mW/g



802.11b EUT Top Z-Axis plot

Channel: 1



Appendix D. Probe Calibration Data

Miniature Isotropic RF Probe
S/N: 3602

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Quietek (Auden)**

Certificate No: **EX3-3602_May09**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3602
Calibration procedure(s)	QA CAL-01.v6, QA CAL-14.v3 and QA CAL-23.v3 Calibration procedure for dosimetric E-field probes
Calibration date:	May 20, 2009
Condition of the calibrated item	In Tolerance

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 ± 3)°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	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: May 20, 2009

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) 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
b) 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:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * 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*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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 *NORMx,y,z * 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 ± 50 MHz to ± 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.

Probe EX3DV4

SN:3602

Manufactured: March 23, 2009
Calibrated: May 20, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: EX3DV4 SN:3602

Sensitivity in Free Space[A]

NormX	**0.41** ± 10.1%	$\mu V/(V/m)^2$	DCP X	**87** mV
NormY	**0.40** ± 10.1%	$\mu V/(V/m)^2$	DCP Y	**89** mV
NormZ	**0.52** ± 10.1%	$\mu V/(V/m)^2$	DCP Z	**89** mV

Diode Compression[B]

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		**2.0 mm**	**3.0 mm**
SAR_{be} [%]	Without Correction Algorithm	10.2	6.1
SAR_{be} [%]	With Correction Algorithm	0.9	0.6

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**2.0 mm**	**3.0 mm**
SAR_{be} [%]	Without Correction Algorithm	6.7	2.9
SAR_{be} [%]	With Correction Algorithm	0.5	0.3

Sensor Offset

Probe Tip to Sensor Center **1.0** mm

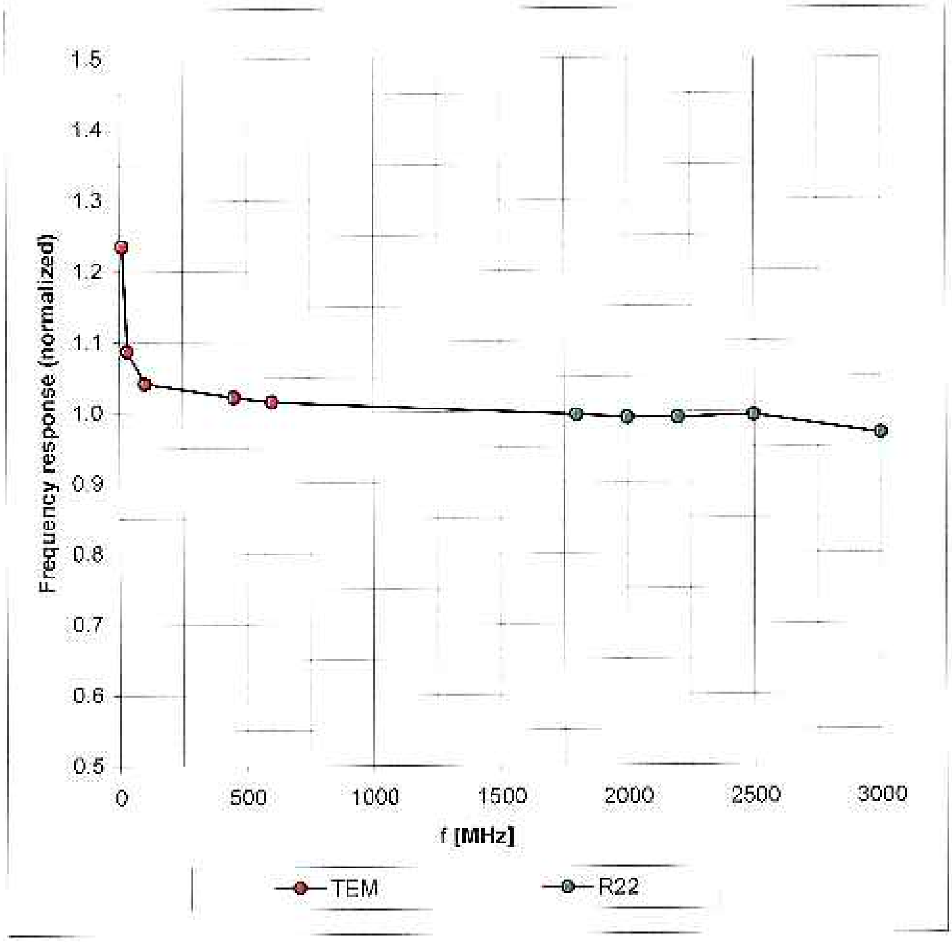
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.

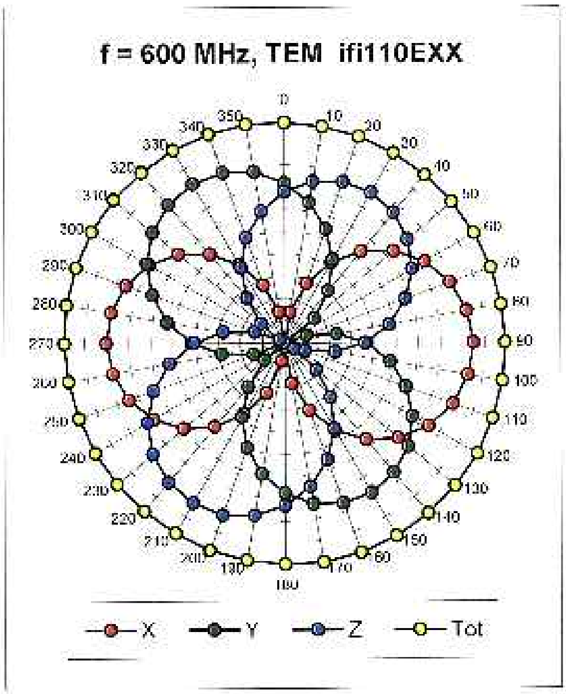
Frequency Response of E-Field

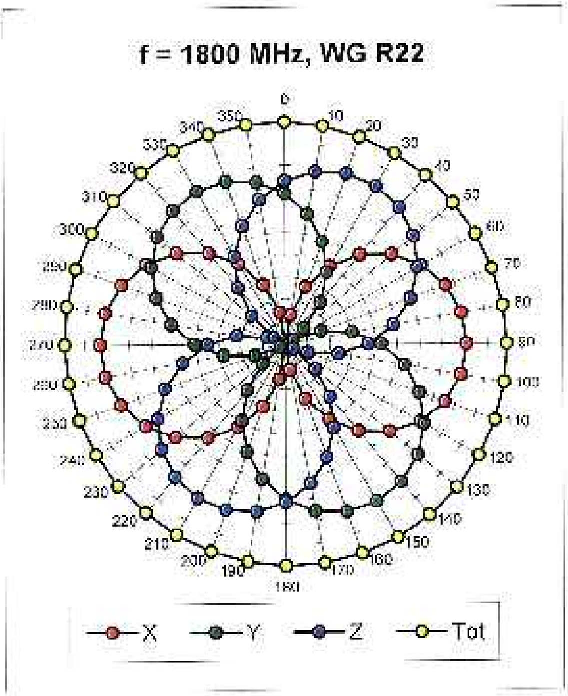
(TEM-Cell:ifi110 EXX, Waveguide: R22)

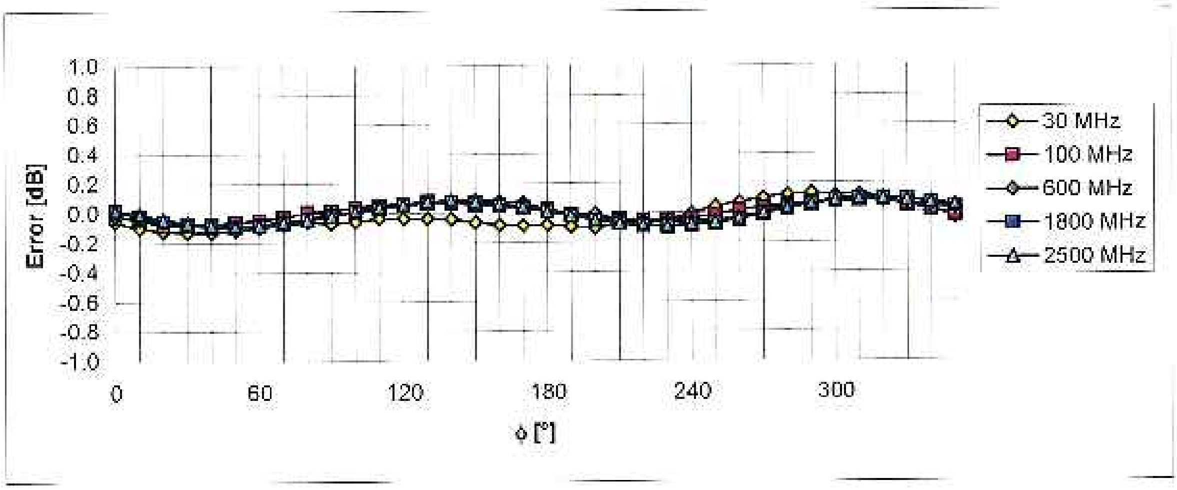


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°



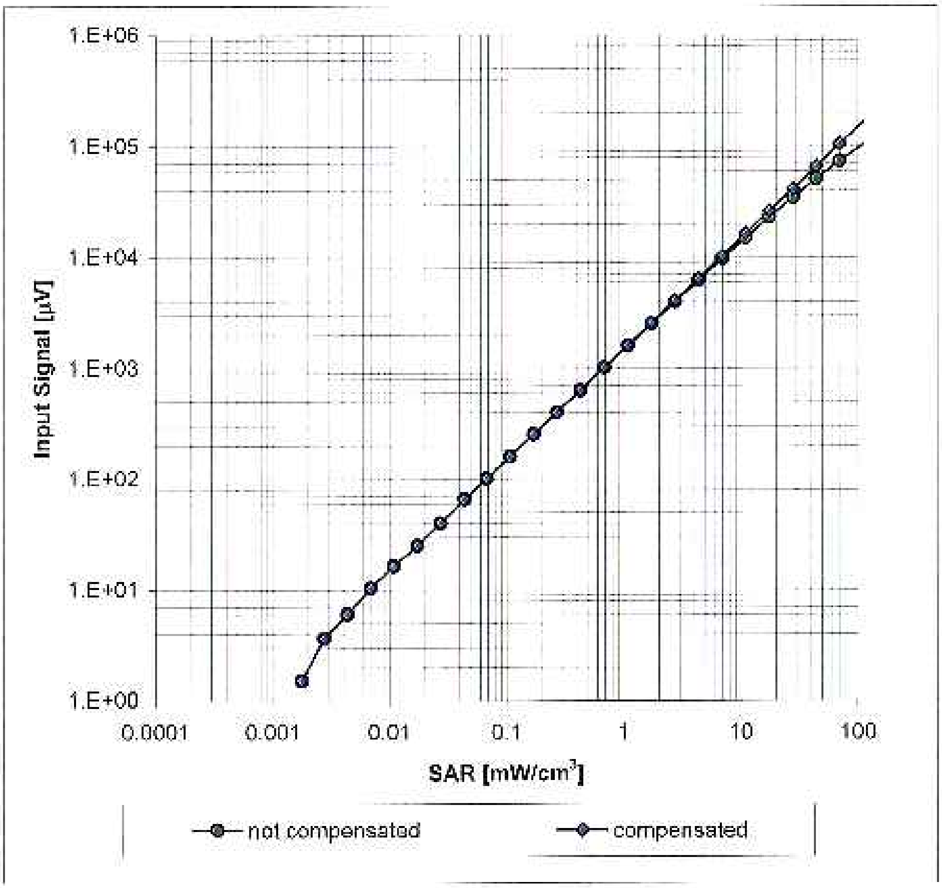


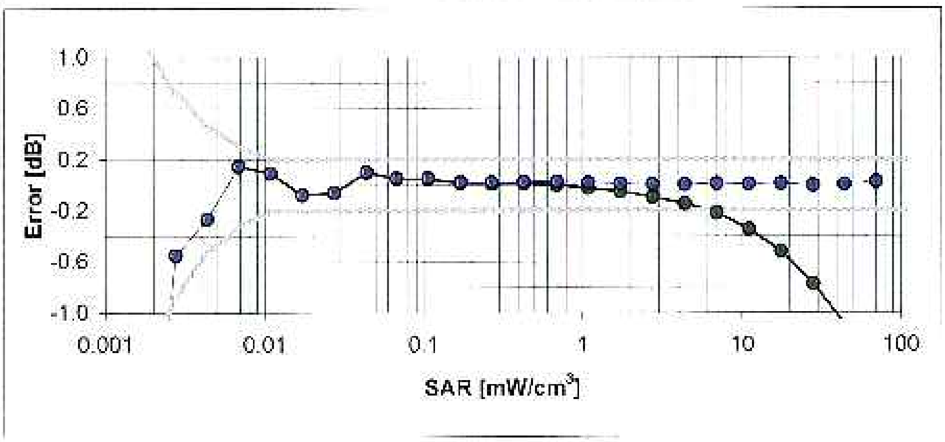


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(Waveguide R22, f = 1800 MHz)





Uncertainty of Linearity Assessment: ± 0.6% (k=2)

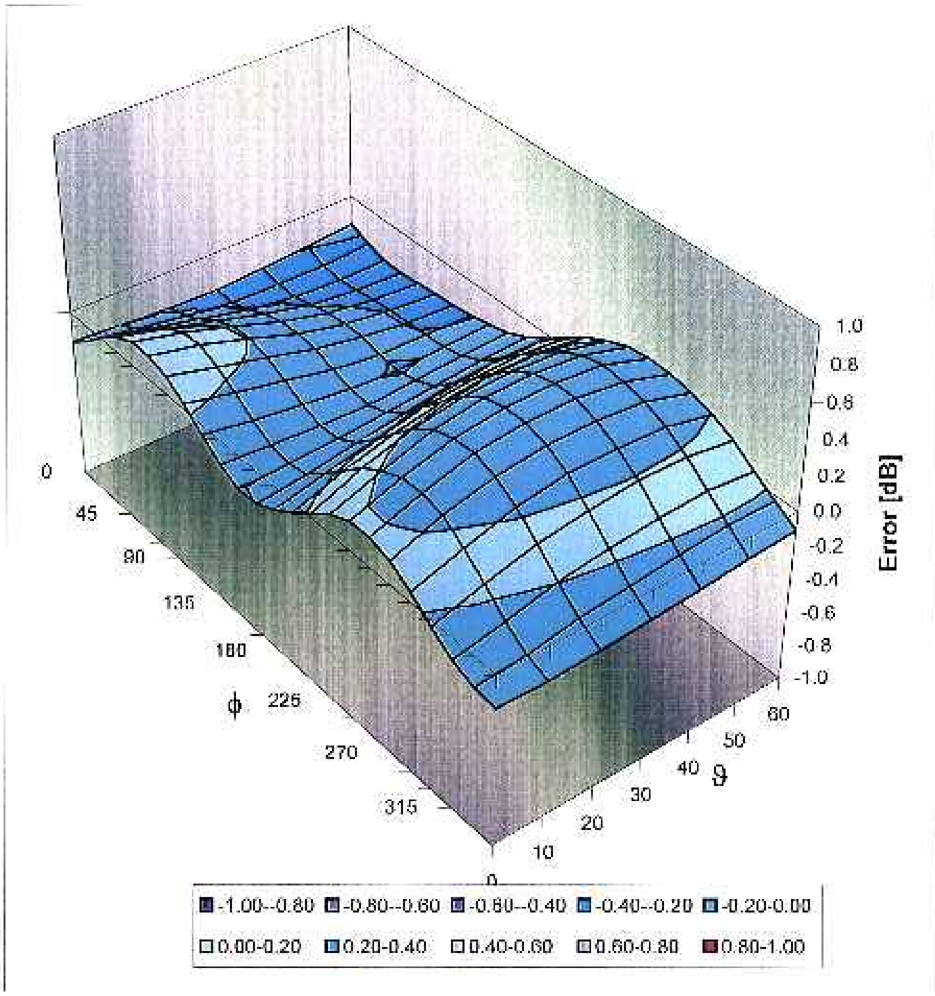
Conversion Factor Assessment

f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty	
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.56	0.71	9.14	± 11.0% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.65	0.65	8.86	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.84	0.55	7.81	± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.84	0.56	7.55	± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.46	0.70	7.10	± 11.0% (k=2)
2600	± 50 / ± 100	Head	39.0 ± 5%	1.96 ± 5%	0.41	0.77	7.10	± 11.0% (k=2)
3500	± 50 / ± 100	Head	37.9 ± 5%	2.91 ± 5%	0.42	1.00	6.26	± 13.1% (k=2)
5200	± 50 / ± 100	Head	36.0 ± 5%	4.66 ± 5%	0.43	1.75	4.79	± 13.1% (k=2)
5300	± 50 / ± 100	Head	35.9 ± 5%	4.76 ± 5%	0.43	1.75	4.43	± 13.1% (k=2)
5500	± 50 / ± 100	Head	35.6 ± 5%	4.96 ± 5%	0.50	1.75	4.44	± 13.1% (k=2)
5600	± 50 / ± 100	Head	35.5 ± 5%	5.07 ± 5%	0.50	1.75	4.42	± 13.1% (k=2)
5800	± 50 / ± 100	Head	35.3 ± 5%	5.27 ± 5%	0.52	1.75	4.21	± 13.1% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.72	0.65	9.32	± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.55	0.74	8.97	± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.70	0.65	7.97	± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.48	0.78	7.68	± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.42	0.79	6.90	± 11.0% (k=2)
2600	± 50 / ± 100	Body	52.5 ± 5%	2.16 ± 5%	0.28	1.23	6.81	± 11.0% (k=2)
3500	± 50 / ± 100	Body	51.3 ± 5%	3.31 ± 5%	0.35	1.22	5.76	± 13.1% (k=2)
5200	± 50 / ± 100	Body	49.0 ± 5%	5.30 ± 5%	0.50	1.80	4.43	± 13.1% (k=2)
5300	± 50 / ± 100	Body	48.5 ± 5%	5.42 ± 5%	0.52	1.80	4.23	± 13.1% (k=2)
5500	± 50 / ± 100	Body	48.6 ± 5%	5.65 ± 5%	0.55	1.80	4.08	± 13.1% (k=2)
5600	± 50 / ± 100	Body	48.5 ± 5%	5.77 ± 5%	0.55	1.80	3.95	± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	6.00 ± 5%	0.61	1.80	4.00	± 13.1% (k=2)

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

QuieTek

Appendix E. Dipole Calibration

Validation Dipole 2450 MHz
M/N: ALS-D-2450-S-2
S/N: QTK-319

NCL CALIBRATION LABORATORIES

Calibration File No: DC-891

CERTIFICATE OF CALIBRATION

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

Quietek Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-2450-S-2
Frequency: 2.45 GHz
Serial No: QTK-319

Customer: Quietek

Project Number: QTKB-Dipole-CAL-5336

Calibrated: 9th May 2008
Released on: 9th May 2008

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

Released By: ______________________

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

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

Calibration Results Summary

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

Mechanical Dimensions

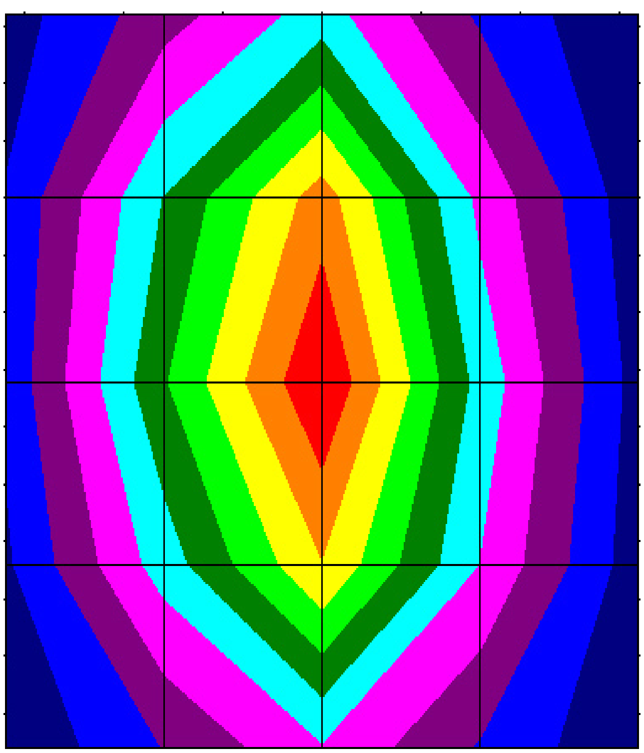
Length: 53.5 mm
Height: 30.4 mm

Electrical Specification

SWR: 1.19 U
Return Loss: -20.8 dB
Impedance: 49.4 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
2.45 GHz	48.07	25.65	95.6



Conditions

Dipole 319 is a recalibration.

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

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

IEC 62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & Part 2: Procedure to determine the specific absorption rate (SAR) for mobile wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)

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

Stuart Nicol

C. Teodorian

Dipole Calibration Results

Mechanical Verification

IEEE Length	IEEE Height	Measured Length	Measured Height
51.5 mm	30.4 mm	53.5 mm	30.4 mm

Tissue Validation

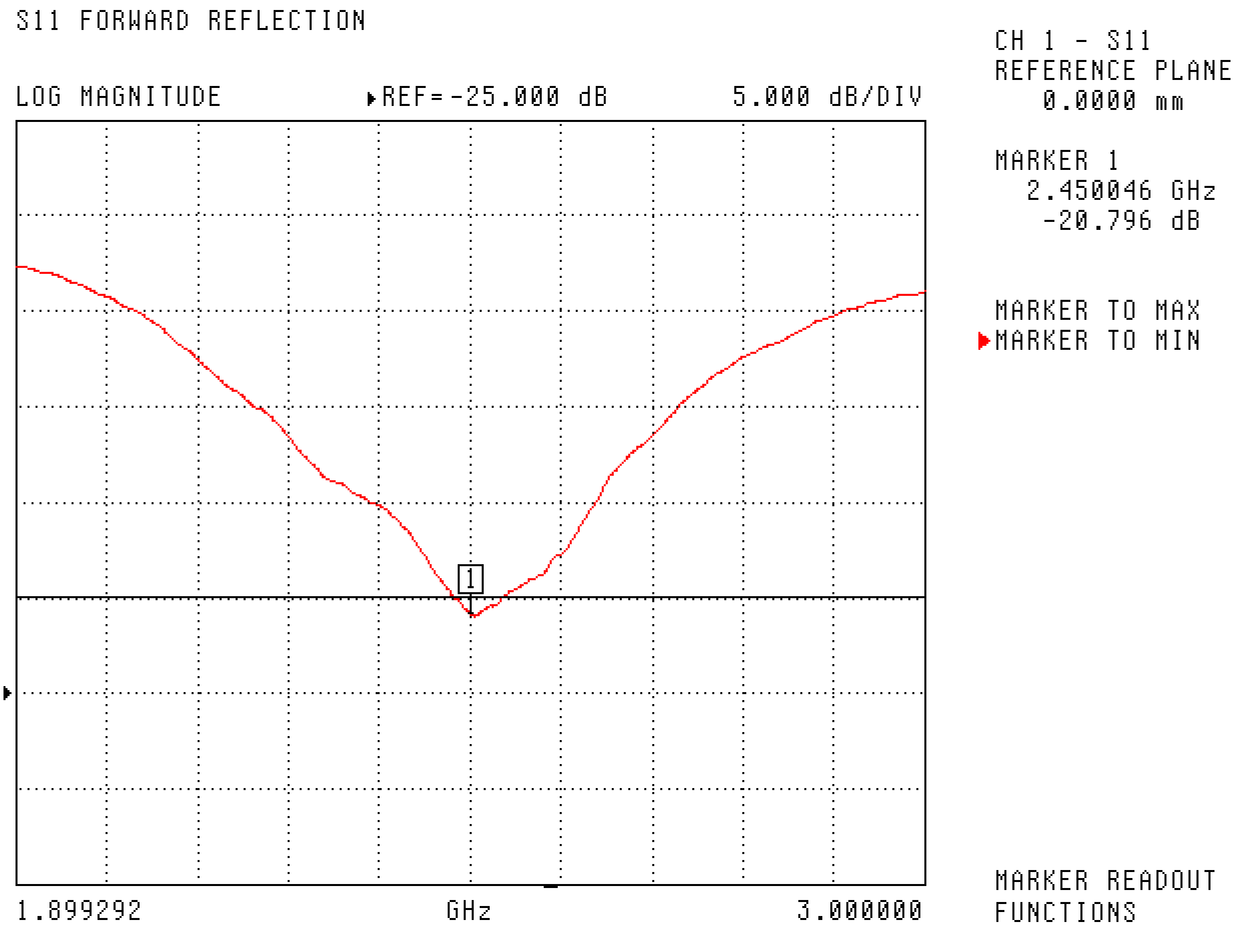
Head Tissue 2450 MHz	Measured
Dielectric constant, ε_r	40.1
Conductivity, σ [S/m]	1.78

Electrical Calibration

Test	Result
S11 R/L	-20.8 dB
SWR	1.2 U
Impedance	49.4 Ω

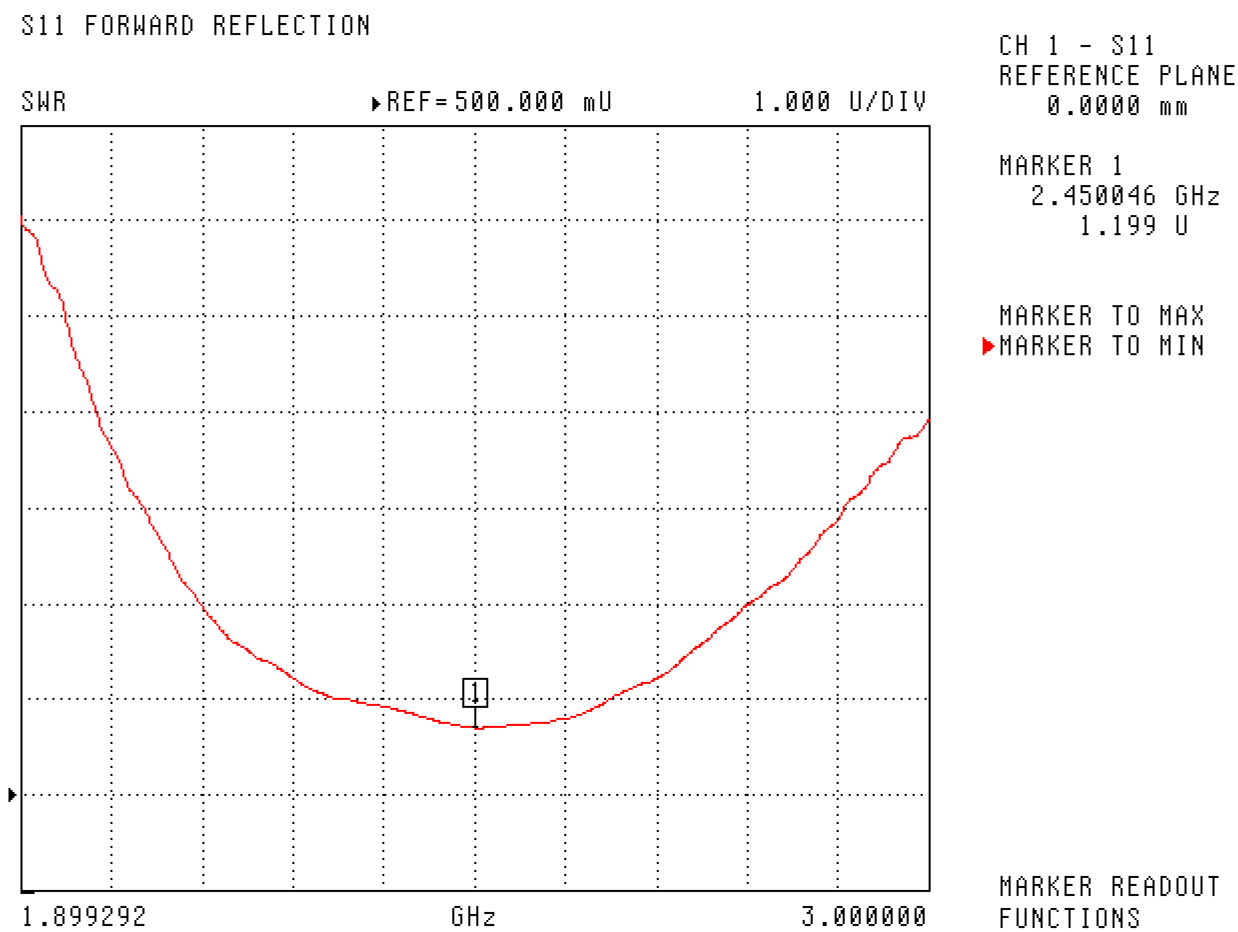
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss

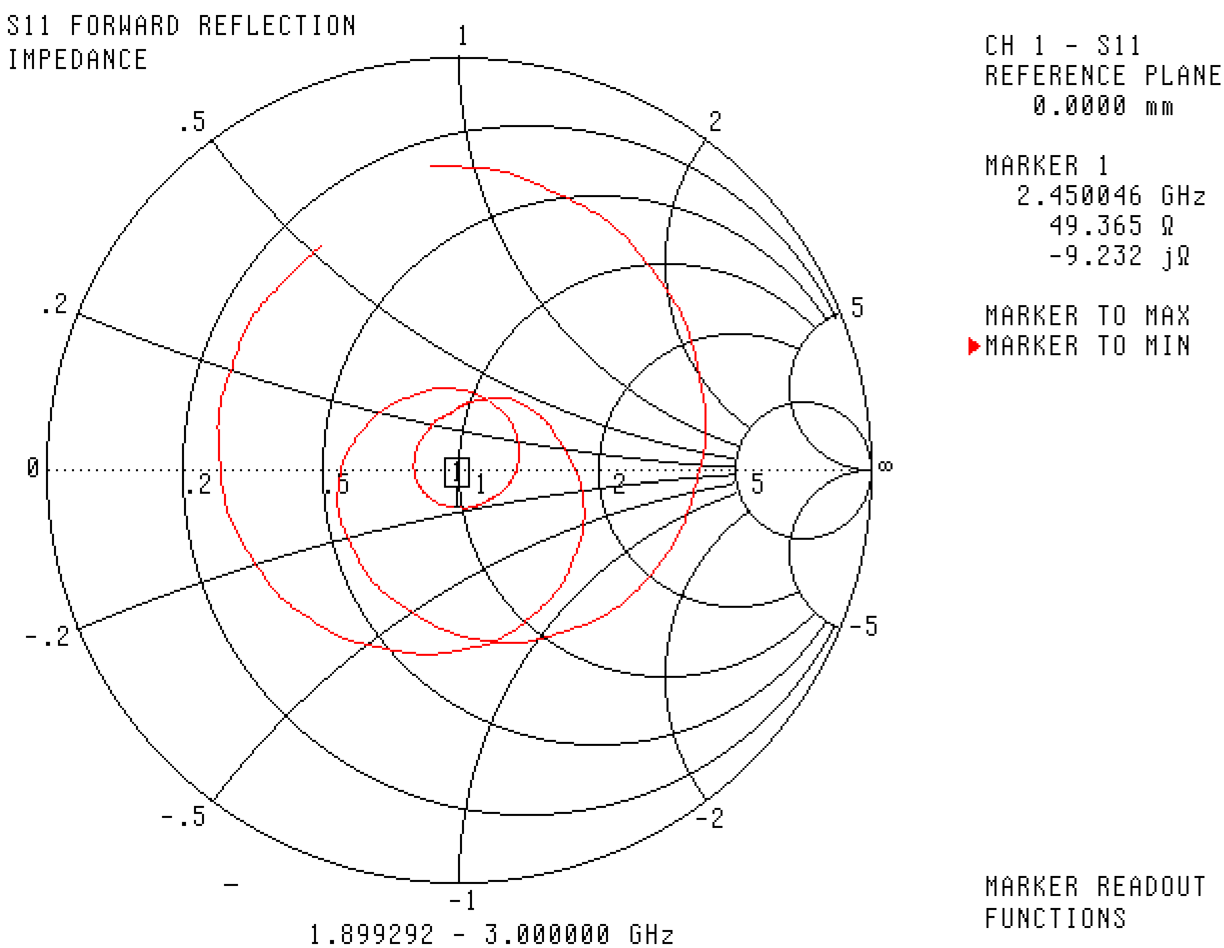


This page has been reviewed for content and attested to by signature within this document.

SWR

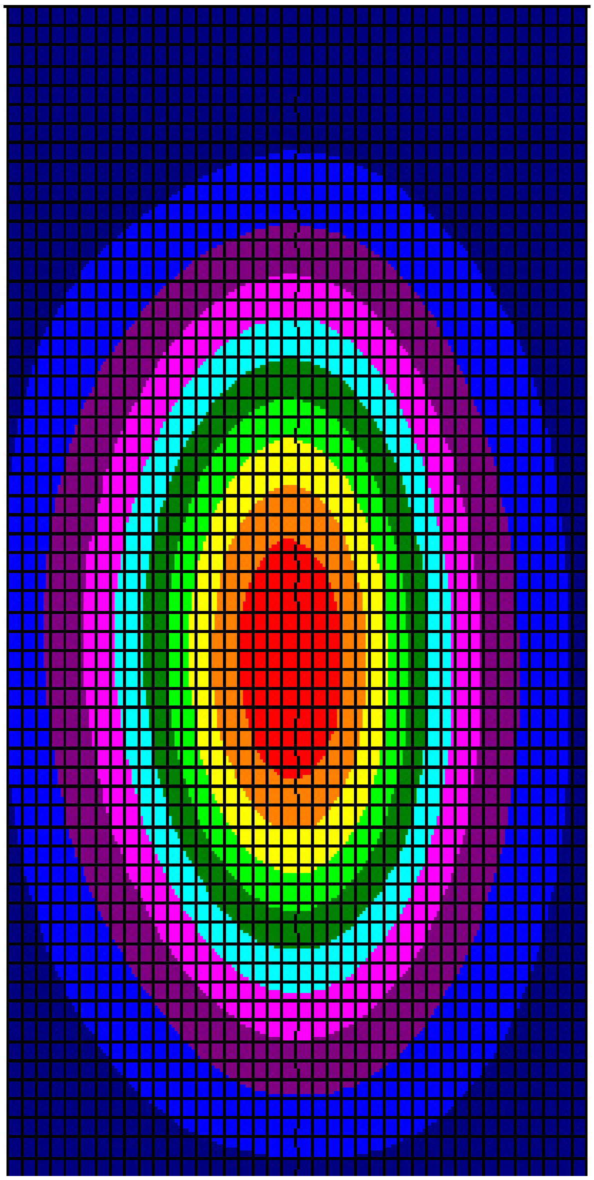

S11 FORWARD REFLECTION
SWR
REF=500.000 mU
1.000 U/DIV
1
1.899292
GHz
3.000000
CH 1 - S11
REFERENCE PLANE
0.0000 mm
MARKER 1
2.450046 GHz
1.199 U
MARKER TO MAX
MARKER TO MIN
MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance



System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak Above Feed Point
2.45 GHz	48.07	25.65	95.6



Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2008.