



Chunghwa Telecom CO., Ltd
Telecommunication Laboratories
Testing & Certification Center

TEL : +886 3 4244445
FAX : +886 3 4202444
ADDR. : 12, Lane 551, Min-Tsu Road Sec. 5
Yang-Mei, Taoyuan, Taiwan, R.O.C.
E-mail: tsd@cht.com.tw <http://www.chttl.com.tw>

Report No : TSC-98-10-AP-15-FCC (SAR)

Date of Issue : Nov. 30, 2009



SAR Test Report

Device Under Test : Bluetooth EDGE Wireless Modem

Model No. : Energy

Applicant : Getac Technology Corporation

This Test report applied to the tested sample only.

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Report No : TSC-98-10-AP-15-FCC (SAR)

Applicant : Getac Technology Corporation
TEL. : 886-227857888
Addr. : 4F,No.1,R&D Road 2,Hsinchu Science-Based Industrial Park, Hsinchu, Taiwan, R.O.C.

Device Under Test : Bluetooth EDGE Wireless Modem
Trade name : Getac Technology Corporation.
Model No. : Energy
Manufacturer : Getac Technology (Kunshan) Co.,Ltd.

Applied Date : Oct. 30, 2009

Date of Sample Arrived : Oct. 30, 2009

Date of Finished : Nov. 27, 2009

Applied standard : IEEE 1528 2003, 47 CFR §2.1093, OET 65 Supplement C 01-01

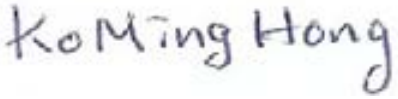


Cited Document : KDB 447498, 450824, 648474, FCC DA02-1438

Test Equipment : Refer to page 22

Test Environment : 23-24°C, 45-51 % R.H.

Test results : IEEE 1528 2003 Complied

SAR 1g = **1.198** W/kg (Maximum), Refer to page 24

Approved by	Reviewed by	Test Engineer
 Ko Ming-Hong	 Chia-cheng Chang	 Shin-yen Du



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1. General Information

1.1 EUT Description

Product Name	Bluetooth EDGE Wireless Modem
Trade Name	Getac Technology Corporation
Model No.	Energy
IMEI	353227020113280
Operation Frequency	GSM850: TX 824.0-849.0 MHz; RX 869.0-894.0 MHz GSM1900: TX 1850-1910 MHz; RX 1930-1990MHz
FCC ID	QYLEENERGY
Antenna Type	INTERNAL
Device Category	Portable
Battery	MITAC Technology Corp. 3.7V 2400mAh 9Wh LI-Ion Rechargeable Battery
WWAN Module	CINTERION MC75I
RF Exposure Environment	Uncontrolled
Output Power (Conducted dBm)	GSM850: GPRS 32.09(max), 32.04(av) EDGE 29.45(max), 26.19(av) GSM1900: GPRS 28.89(max), 28.80(av) EDGE 27.78(max), 24.28(av)
Bluetooth Module	nFore NF2303, Operation Freq. 2402-2480MHz, (max. Power 3.52dBm)
Notes	<ol style="list-style-type: none"> The DUT's Bluetooth output power is 3.52dBm (2.25mW) which less than P_{REF} 12mW thresholds limit and 1-g SAR value is less than 1.6W/kg therefore it doesn't need for simultaneous SAR test. The DUT use external antenna with a 3M long cable usually (refer to page 28). This SAR test configuration use internal antenna for the purpose of worst case testing.

1.2 Test Environment

Ambient conditions in the laboratory:

Items	Required	Actual
Temperature (°C)	24	See first page
Humidity (%RH)	50	See first page

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2. SAR Measurement System

2.1 ALSAS-10U System Description

ALSAS-10-U is fully compliant with the technical and scientific requirements of IEEE 1528, IEC 62209, EN50361, CENELEC, ARIB, ACA, and the Federal Communications Commission. The system comprises of a six axes articulated robot which utilizes a dedicated controller. ALSAS-10U uses the latest methodologies and FDTD modeling to provide a platform which is repeatable with minimum uncertainty.

2.1.1 Applications

Predefined measurement procedures compliant with the guidelines of CENELEC, IEEE, IEC, FCC, etc are utilized during the assessment for the device. Automatic detection for all SAR maximum are embedded within the core architecture for the system, ensuring that peak locations used for centering the zoom scan are within a 1mm resolution and a 0.05mm repeatable position. System operation range currently available up-to 6 GHz in simulated tissue.

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 10mm² step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

Where the system identifies multiple SAR peaks (which are within 25% of peak value) the system will provide the user with the option of assessing each peak location individually for zoom scan averaging.



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2.1.3 Zoom Scan (Cube Scan Averaging)

The averaging zoom scan volume utilized in the ALSAS-10U software is in the shape of a cube and the side dimension of a 1 g or 10 g mass is dependent on the density of the liquid representing the simulated tissue. A density of 1000 kg/m³ 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.

When the cube intersects with the surface of the phantom, it is oriented so that 3 vertices touch the surface of the shell or the center of a face is tangent to the surface. The face of the cube closest to the surface is modified in order to conform to the tangent surface.

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 7x7x7 (5mmx5mmx5mm) providing a volume of 30mm in the X & Y axis, and 30mm in the Z axis.

2.1.4 ALSAS-10U Interpolation and Extrapolation Uncertainty

The overall uncertainty for the methodology and algorithms the used during the SAR calculation was evaluated using the data from IEEE 1528 based on the example f3 algorithm:

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

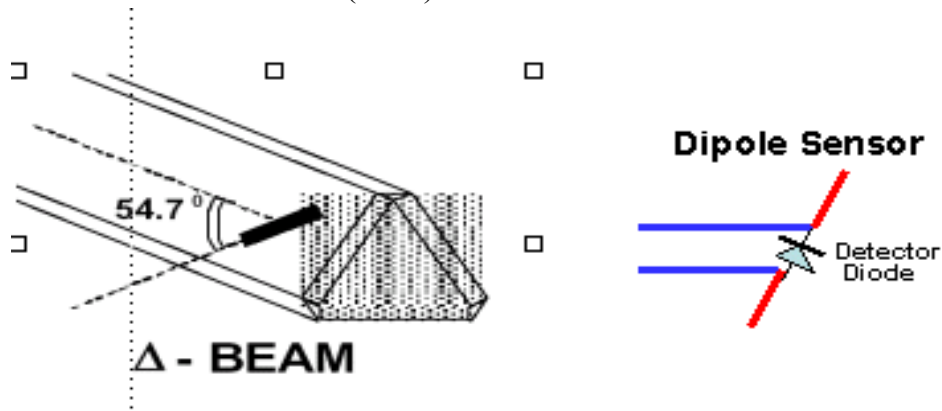
2.2 Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change. A number of methods is used for calibrating probes, and these are outlined in the table below:

Calibration Frequency	Air Calibration	Tissue Calibration
2450MHz	TEM Cell	Temperature

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:

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SAR is assessed with a calibrated probe which moves at a default height of 5mm from the center of the diode, which is mounted to the sensor, to the phantom surface (in the Z Axis). The 5mm offset height has been selected so as to minimize any resultant boundary effect due to the probe being in close proximity to the phantom surface.

The following algorithm is an example of the function used by the system for linearization of the output from the probe when measuring complex modulation schemes.

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

2.2.1 Isotropic E-Field Probe Specification

Calibration in Air	Frequency Dependent Below 2GHz Calibration in air performed in a TEM Cell Above 2GHz Calibration in air performed in waveguide
Sensitivity	0.70 $\mu\text{V}/(\text{V}/\text{m})^2$ to 0.85 $\mu\text{V}/(\text{V}/\text{m})^2$
Dynamic Range	0.0005 W/kg to 100W/kg
Isotropic Response	Better than 0.2dB
Diode Compression point (DCP)	Calibration for Specific Frequency
Probe Tip Radius	< 5mm
Sensor Offset	1.56 (+/- 0.02mm)
Probe Length	290mm
Video Bandwidth	@ 500 Hz: 1dB @1.02 KHz: 3dB
Boundary Effect	Less than 2% for distance greater than 2.4mm
Spatial Resolution	Diameter less than 5mm Compliant with Standards

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2.3 Boundary Detection Unit and Probe Mounting Device

ALSAS-10U incorporates a boundary detection unit with a sensitivity of 0.05mm for detecting all types of surfaces. The robust design allows for detection during probe tilt (probe normalize) exercises, and utilizes a second stage emergency stop. The signal electronics are fed directly into the robot controller for high accuracy surface detection in lateral and axial detection modes (X, Y, & Z).

The probe is mounted directly onto the Boundary Detection unit for accurate tooling and displacement calculations controlled by the robot kinematics. The probe is connect to an isolated probe interconnect where the output stage of the probe is fed directly into the amplifier stage of the Daq-Paq

2.4 Daq-Paq (Analog to Digital Electronics)

ALSAS-10U incorporates a fully calibrated Daq-Paq (analog to digital conversion system) which has a 4 channel input stage, sent via a 2 stage auto-set amplifier module. The input signal is amplified accordingly so as to offer a dynamic range from 5 μ V to 800mV. Integration of the fields measured is carried out at board level utilizing a Co-Processor which then sends the measured fields down into the main computational module in digitized form via an RS232 communications port. Probe linearity and duty cycle compensation is carried out within the main Daq-Paq module.

ADC	12 Bit
Amplifier Range	20mV to 200mV and 150mV to 800mV
Field Integration	Local Co-Processor utilizing proprietary integration algorithms
Number of Input Channels	4 in total 3 dedicated and 1 spare
Communication	Packet data via RS232

2.5 Axis Articulated Robot



ALSAS-10U utilizes a six axis articulated robot, which is controlled using a Pentium based real-time movement controller. The movement kinematics engine utilizes proprietary (Thermo CRS) interpolation and extrapolation algorithms, which allow full freedom of movement for each of the six joints within the working envelope. Utilization of joint 6 allows for full probe rotation with a tolerance better than 0.05mm around the central axis.

Robot/Controller Manufacturer	Thermo CRS
Number of Axis	Six independently controlled axis
Positioning Repeatability	0.05mm
Controller Type	Single phase Pentium based C500C
Robot Reach	710mm
Communication	RS232 and LAN compatible

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2.6 ALSAS Universal Workstation

ALSAS Universal workstation allows for repeatability and fast adaptability. It allows users to do calibration, testing and measurements using different types of phantoms with one set up, which significantly speeds up the measurement process.

2.7 Phantom Types

The ALSAS-10U allows the integration of multiple phantom types. SAM Phantoms fully compliant with IEEE 1528, EN50361 Universal Phantom, and Universal Flat.

2.7.1 APREL Laboratories Universal Phantom

The Universal Phantom is used on the ALSAS-10U as a system validation phantom. The Universal Phantom has been fully validated both experimentally from 800MHz to 6GHz and numerically using XFDTD numerical software. The shell thickness is 2mm overall, with a 4mm spacer located at the NF/MB intersection providing an overall thickness of 6mm in line with the requirements of IEEE-1528.

The design allows for fast and accurate measurements, of handsets, by allowing the conservative SAR to be evaluated at on frequency for both left and right head experiments in one measurement.



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3. Tissue Simulating Liquid

3.1 The composition of the tissue simulating liquid

INGREDIENT (% Weight)	835MHz Head	1900MHz Head
Water	40.45%	54.90%
Salt	1.45%	0.18%
Sugar	57.0%	0%
HEC	1.00%	0%
Preventol	0.10%	0%
DGBE	0%	44.92%

(Body Tissue was supplied by QuieTek Corp.)

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/Body Tissue Simulant Measurement				Nov. 02 and Nov. 26 2009	
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp.	
		ϵ_r	σ [s/m]	[°C]	
		42.1/55.0-55.5	0.92/0.98	23-24.0	
835 MHz	Reference result \pm 5% window	41.5/55.2	0.90/0.97	N/A	
		39.5-43.5/ 52.5-57.9	0.86-0.94/0.92- 1.01		
		42.1/55.0-55.5	0.92/0.98	23-24.0	

Head/Body Tissue Simulant Measurement				Nov.02 and Nov. 27 2009	
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp.	
		ϵ_r	σ [s/m]	[°C]	
		40.5/52.9-53.5	1.41/1.52-1.54	23-24.0	
1900 MHz	Reference result \pm 5% window	40.0/53.3	1.40/1.52	N/A	
		38.0-42.0/50.7- 55.9	1.33-1.47/1.46- 1.61		
		40.5/52.9-53.5	1.41/1.52-1.54	23-24.0	

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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 (MHz)	Head		Body	
	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

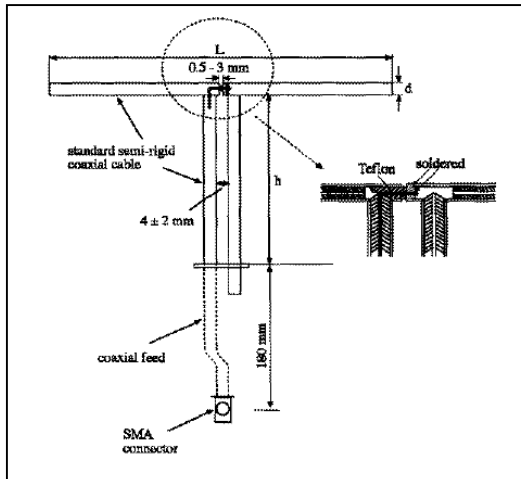
(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000 \text{ kg/m}^3$)

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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)
835MHz	161	89.8
1900 MHz	68	39.5

4.1.2 Validation Result

Validation Kid	Tissue Type	SAR1g(W/Kg)	Date of Cal.
ALS-D-835-S-2	Head	9.49	02 Feb. 2009
ALS-D-1900-S-2	Head	40.3	16 Mar. 2009

Frequency (MHz)	Power (mW)	SAR1g (W/Kg)	Power Drift (%)	Date of Validation
835 Head	1000	9.199	-0.274	02 Nov. 2009
1900 Head	250	9.158	-3.858	02 Nov. 2009
	Normalized to 1W	36.632		



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SAR Test Report (835M)

Report Date : 02-Nov-2009
 By Operator : 123
 Measurement Date : 02-Nov-2009
 Starting Time : 02-Nov-2009 09:57:24 AM
 End Time : 02-Nov-2009 10:18:38 AM
 Scanning Time : 1274 secs

Product Data

Device Name : dipole
 Serial No. : 835
 Type : Dipole
 Model :
 Frequency : 835.00 MHz
 Max. Transmit Pwr : 1.0 W
 Drift Time : 0 min(s)
 Length : 161 mm
 Width : 3.6 mm
 Depth : 89.8 mm
 Antenna Type : Internal
 Orientation : 15mm Space
 Power Drift-Start : 9.104 W/kg
 Power Drift-Finish: 9.079 W/kg
 Power Drift (%) : -0.274
 Picture :

Phantom Data

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

Tissue Data

Type : HEAD
 Serial No. : 835
 Frequency : 835.00 MHz
 Last Calib. Date : 02-Nov-2009
 Temperature : 24.00 °C
 Ambient Temp. : 24.00 °C
 Humidity : 50.00 RH%
 Epsilon : 42.10 F/m
 Sigma : 0.92 S/m
 Density : 1000.00 kg/cu. m

Probe Data

Name : Probe 257 - CHTL
 Model : E020
 Type : E-Field Triangle
 Serial No. : 257
 Last Calib. Date : 12-Dec-2008
 Frequency : 835.00 MHz
 Duty Cycle Factor: 1
 Conversion Factor: 6.5
 Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
 Compression Point: 95.00 mV
 Offset : 1.56 mm

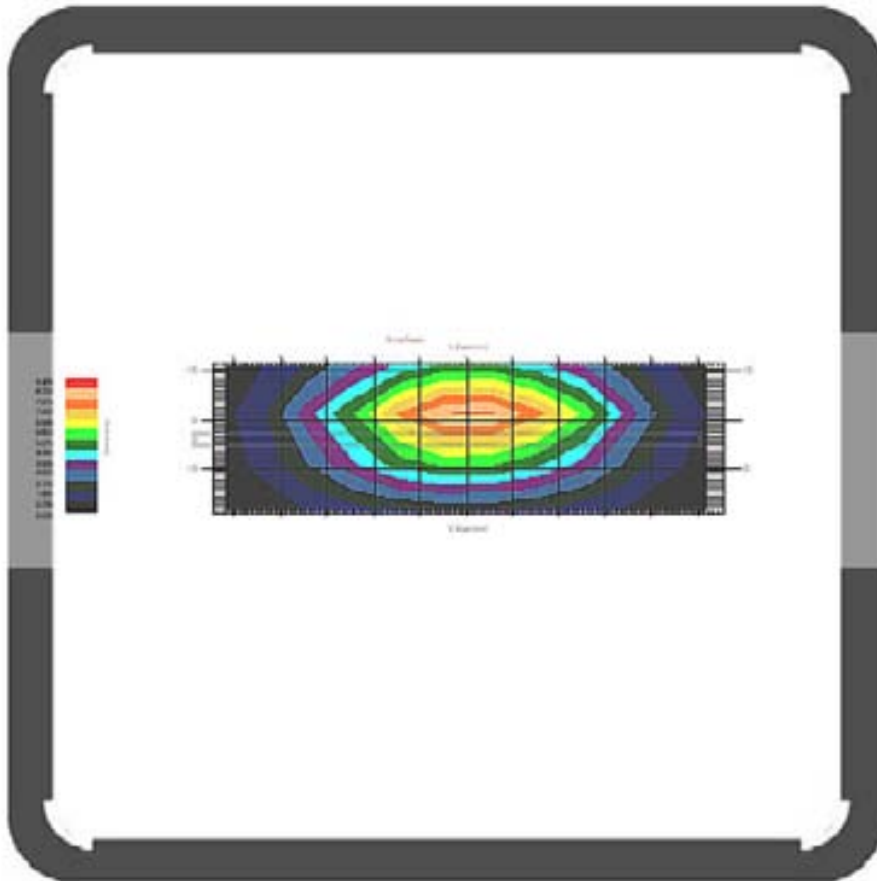
Measurement Data

Crest Factor : 1

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Scan Type : Complete
Tissue Temp. : 24.00 °C
Ambient Temp. : 24.00 °C
Set-up Date : 02-Nov-2009
Set-up Time : 9:00:44 AM
Area Scan : 4x12x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data
DUT Position : 15mm Space
Separation : 0
Channel : Mid - 835



1 gram SAR value : 9.199 W/kg
10 gram SAR value : 6.109 W/kg
Area Scan Peak SAR : 8.770 W/kg
Zoom Scan Peak SAR : 12.911 W/kg

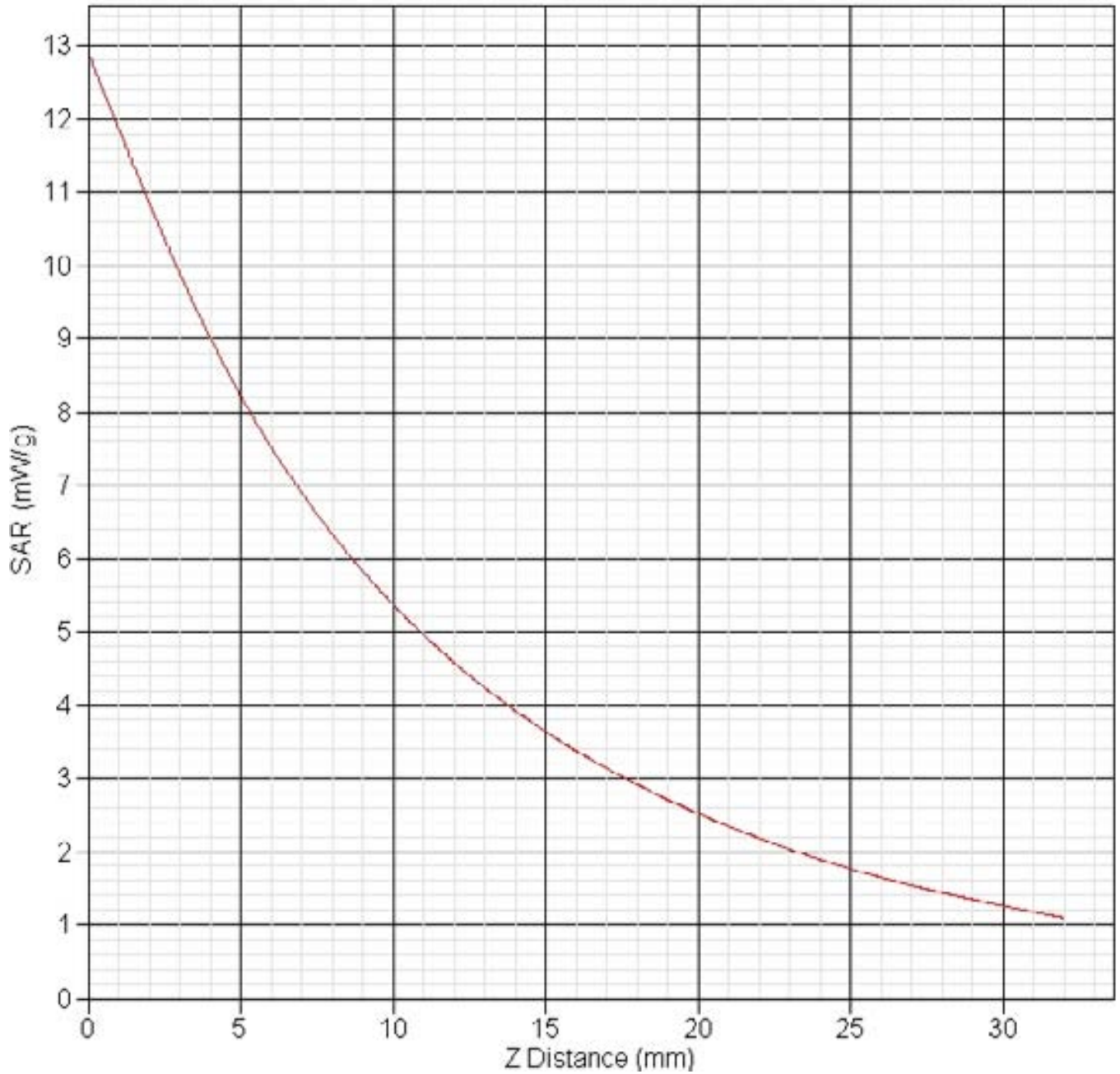
Report No : TSC-98-10-AP-15-FCC (SAR)

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	0.3	rectangular	$\sqrt{3}$	1	0.2
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	2.2	normal	1	0.7	1.6
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	1.4	normal	1	0.6	0.9
Combined Uncertainty		RSS			9.4
Combined Uncertainty (coverage factor=2)		Normal (k=2)			18.8

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SAR-Z Axis
at Hotspot x:-1.80 y:-2.40





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SAR Test Report (1900M)

Report Date : 02-Nov-2009
 By Operator : 123
 Measurement Date : 02-Nov-2009
 Starting Time : 02-Nov-2009 10:33:49 AM
 End Time : 02-Nov-2009 10:49:26 AM
 Scanning Time : 937 secs

Product Data
 Device Name : dipole
 Serial No. : 1900
 Type : Dipole
 Model :
 Frequency : 1900.00 MHz
 Max. Transmit Pwr : 0.25 W
 Drift Time : 0 min(s)
 Length : 3.6 mm
 Width : 68 mm
 Depth : 1 mm
 Antenna Type : Internal
 Orientation : 10mm Space
 Power Drift-Start : 9.823 W/kg
 Power Drift-Finish: 9.444 W/kg
 Power Drift (%) : -3.858
 Picture :

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

Tissue Data
 Type : HEAD
 Serial No. : 1900
 Frequency : 1900.00 MHz
 Last Calib. Date : 02-Nov-2009
 Temperature : 23.00 °C
 Ambient Temp. : 24.00 °C
 Humidity : 45.00 RH%
 Epsilon : 40.50 F/m
 Sigma : 1.41 S/m
 Density : 1000.00 kg/cu. m

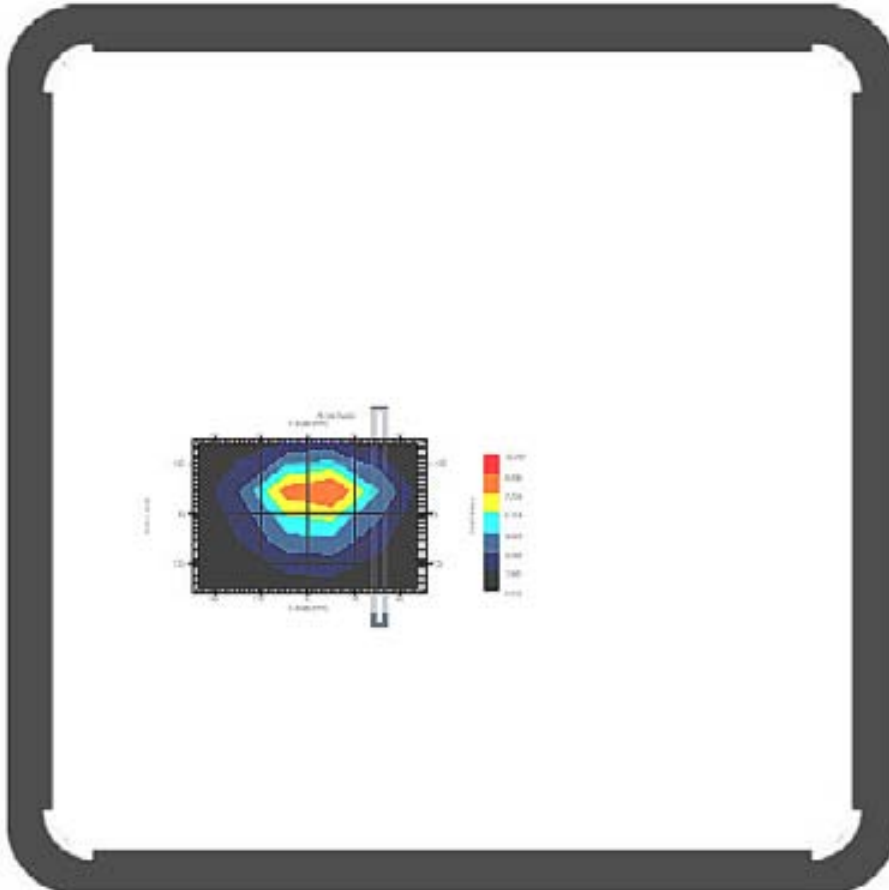
Probe Data
 Name : Probe 257 - CHTL
 Model : E020
 Type : E-Field Triangle
 Serial No. : 257
 Last Calib. Date : 12-Dec-2008
 Frequency : 1900.00 MHz
 Duty Cycle Factor: 1
 Conversion Factor: 5.5
 Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
 Compression Point: 95.00 mV
 Offset : 1.56 mm

Measurement Data
 Crest Factor : 1

Report No : TSC-98-10-AP-15-FCC (SAR)

Scan Type : Complete
Tissue Temp. : 23.00 °C
Ambient Temp. : 24.00 °C
Set-up Date : 02-Nov-2009
Set-up Time : 10:28:35 AM
Area Scan : 4x6x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data
DUT Position : 10mm Space
Separation : 0
Channel : Mid - 1900



1 gram SAR value : 9.158 W/kg
10 gram SAR value : 4.879 W/kg
Area Scan Peak SAR : 9.299 W/kg
Zoom Scan Peak SAR : 16.414 W/kg

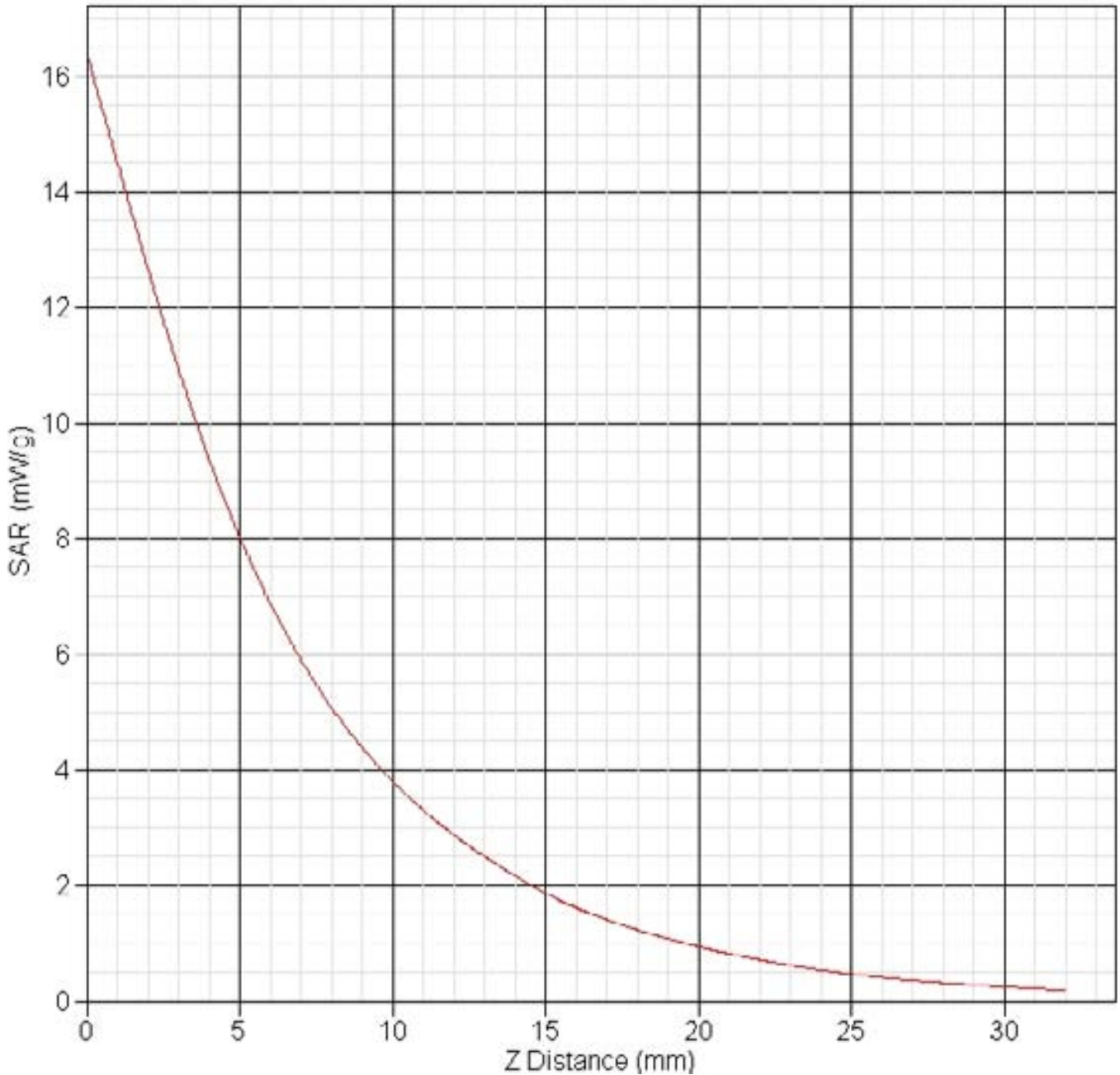
Report No : TSC-98-10-AP-15-FCC (SAR)

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	3.9	rectangular	$\sqrt{3}$	1	2.2
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	0.7	normal	1	0.7	0.5
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	1.3	normal	1	0.6	0.8
Combined Uncertainty		RSS			9.5
Combined Uncertainty (coverage factor=2)		Normal (k=2)			19.1

Report No : TSC-98-10-AP-15-FCC (SAR)

SAR-Z Axis
at Hotspot x:-6.70 y:-2.40



4.2 Arrangement Assessment Setup

4.2.1 Test Positions for body-worn

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR



Report No : TSC-98-10-AP-15-FCC (SAR)
compliance under such circumstances. Other
separation distance may be use, but not exceed 2.5 cm.

4.3 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 1mm²) 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 1mm³).



Report No : TSC-98-10-AP-15-FCC (SAR)

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

Report No : TSC-98-10-AP-15-FCC (SAR)

6. Test Equipment List

Instrument	Manufacturer	Model No.	Calibration Due	Calibration Cycle(year)
Data Acquisition Package	Aprel	ALS-DAQ-PAQ-2	NCR	NCR
Aprel Laboratories Probe	Aprel	ALS-E020	10-Dec-2010	1
Aprel Laboratories Dipole	Aprel	ALS-D-835-S-2	01-Feb-2010	1
Aprel Laboratories Dipole	Aprel	ALS-D-1900-S-2	15-Mar-2010	1
Boundary Detection Sensor System	Aprel	ALS-PMDPS-2	NCR	NCR
Dielectric Probe Kit	Aprel	ALS-PR-DIEL	NCR	NCR
Universal Work Station	Aprel	ALS-UWS	NCR	NCR
Device Holder 2.0	Aprel	ALS-H-E-SET-2	NCR	NCR
Left Ear SAM Phantom	Aprel	ALS-P-SAM-L	NCR	NCR
Right Ear SAM Phantom	Aprel	ALS-P-SAM-R	NCR	NCR
Flat Phantom	Aprel	ALS-P-UP-1	NCR	NCR
Aprel Dipole Spacer	Aprel	ALS-DS-U	NCR	NCR
SAR Software	Aprel	ALSAS-10	NCR	NCR
CRS C500C Controller	Thermo	ALS-C500	NCR	NCR
CRF F3 Robot	Thermo	ALS-F3	NCR	NCR
Power Amplifier	Mini-Circuit	ZHL-42	NCR	NCR
Directional Coupler	Agilent	778D-012	NCR	NCR
Universal Radio Communication Tester	JRC	NZ-917BJ	NCR	NCR
Power meter	HP	437B	June 15 2010	1
Vector S/G	R&S	SMU200A	June 04 2010	1
Wireless Communications Test Set	Agilent	8960	May 14 2010	1
Vector Network	Anritsu	MS4623B	May 12 2010	1

Report No : TSC-98-10-AP-15-FCC (SAR)

7. Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	0.9	rectangular	$\sqrt{3}$	1	0.5
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	1.0	normal	1	0.7	0.7
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	0.4	normal	1	0.6	0.2
Combined Uncertainty		RSS			9.3
Combined Uncertainty (coverage factor=2)		Normal (k=2)			18.5

Report No : TSC-98-10-AP-15-FCC (SAR)

8 SAR Test Results

Output Power test

Band	CH	Frequency (MHz)	Output Power (dBm) PK	Output Power (dBm) AV
GSM850 (GSM)	128	824.2	32.09	32.04
	189	836.4	31.84	31.79
	251	848.8	31.67	31.61
GSM850 (EDGE)	128	824.2	29.41	25.83
	189	836.4	29.45	26.19
	251	848.8	29.09	25.63
GSM 1900 (GSM)	512	1850.2	28.37	28.27
	661	1880	28.89	28.8
	810	1909.8	28.36	28.26
GSM 1900 (EDGE)	512	1850.2	27.22	23.69
	661	1880	27.78	24.28
	810	1909.8	27.23	23.65

SAR GSM 850MHz (Lo CH 128, Mid CH 190, Hi CH 251)

N o.	Test Position (Body)	Antenna Type	Frequency		SAR 1g (W/kg)	Power Drift %	Limit (W/kg)
			CH	MHz			
1	GPRS_Top_Touch	INTERNAL	190	836.6	0.455	-0.927	1.6
2	GPRS_Bottom_Touch	INTERNAL	190	836.6	0.584	1.840	1.6
3	GPRS_Left_Touch	INTERNAL	190	836.6	0.118	3.144	1.6
4	GPRS_Right_Touch	INTERNAL	190	836.6	0.766	4.286	1.6
5	GPRS_Front_Touch	INTERNAL	190	836.6	0.805	0.315	1.6
6	GPRS_Rear_Touch	INTERNAL	190	836.6	0.265	-4.019	1.6
7	GPRS_Front_Touch	INTERNAL	128	824.2	0.708	1.706	1.6
8	GPRS_Front_Touch	INTERNAL	251	848.8	1.198	-4.556	1.6
9	EDGE_Front_Touch	INTERNAL	128	824.2	0.650	-1.325	1.6
10	EDGE_Front_Touch	INTERNAL	190	836.6	0.456	-0.562	1.6
11	EDGE_Front_Touch	INTERNAL	251	848.8	0.636	-2.224	1.6

Report No : TSC-98-10-AP-15-FCC (SAR)

SAR GSM 1900MHz (Lo CH 512, Mid CH 661, Hi CH 810)

No.	Test Position (Body)	Antenna Type	Frequency		SAR 1g (W/kg)	Power Drift %	Limit (W/kg)
			CH	MHz			
1	GPRS_Top_Touch	INTERNAL	661	1880	0.084	-4.563	1.6
2	GPRS_Bottom_Touch	INTERNAL	661	1880	0.435	-2.415	1.6
3	GPRS_Left_Touch	INTERNAL	661	1880	0.043	4.354	1.6
4	GPRS_Right_Touch	INTERNAL	661	1880	0.033	-0.845	1.6
5	GPRS_Front_Touch	INTERNAL	661	1880	1.192	4.830	1.6
6	GPRS_Rear_Touch	INTERNAL	661	1880	0.910	4.740	1.6
7	GPRS_Front_Touch	INTERNAL	512	1850.2	0.529	0.549	1.6
8	GPRS_Front_Touch	INTERNAL	810	1909.8	0.532	-0.181	1.6
9	EDGE_Front_Touch	INTERNAL	512	1850.2	0.376	-4.650	1.6
10	EDGE_Front_Touch	INTERNAL	661	1880	0.381	-3.449	1.6
11	EDGE_Front_Touch	INTERNAL	810	1909.8	0.328	-4.866	1.6

(The SAR test results above are mark in red and blue when the SAR test result is the max. in that mode.
 The detail test data please refer to paragraph A.4. TEST DATA)

Report No : TSC-98-10-AP-15-FCC (SAR)

9.EUT Photographs



Front View



Rear View

Report No : TSC-98-10-AP-15-FCC (SAR)

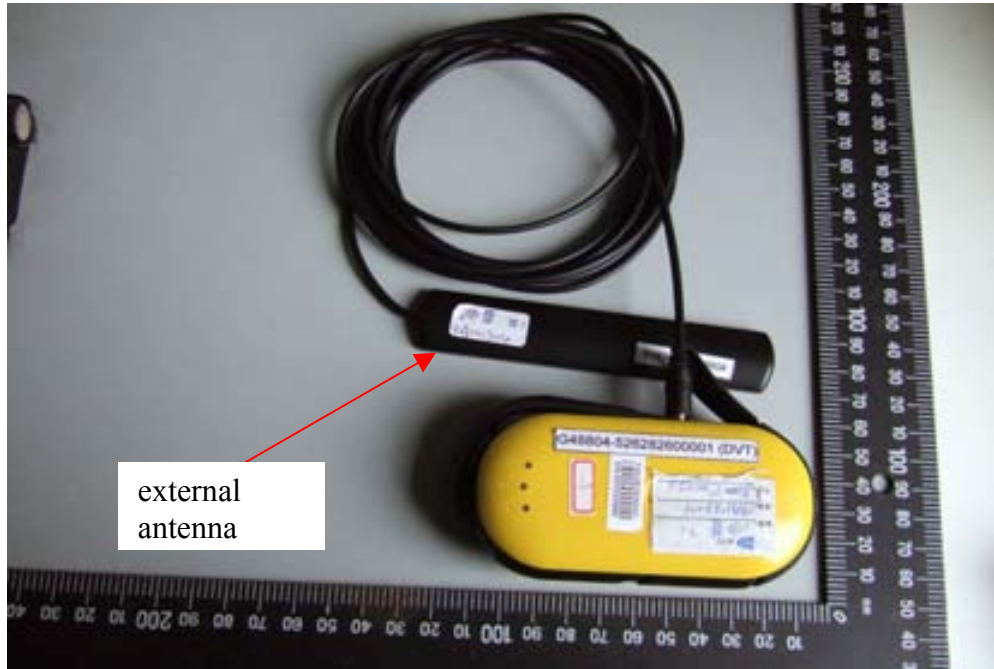


Left Side View 2

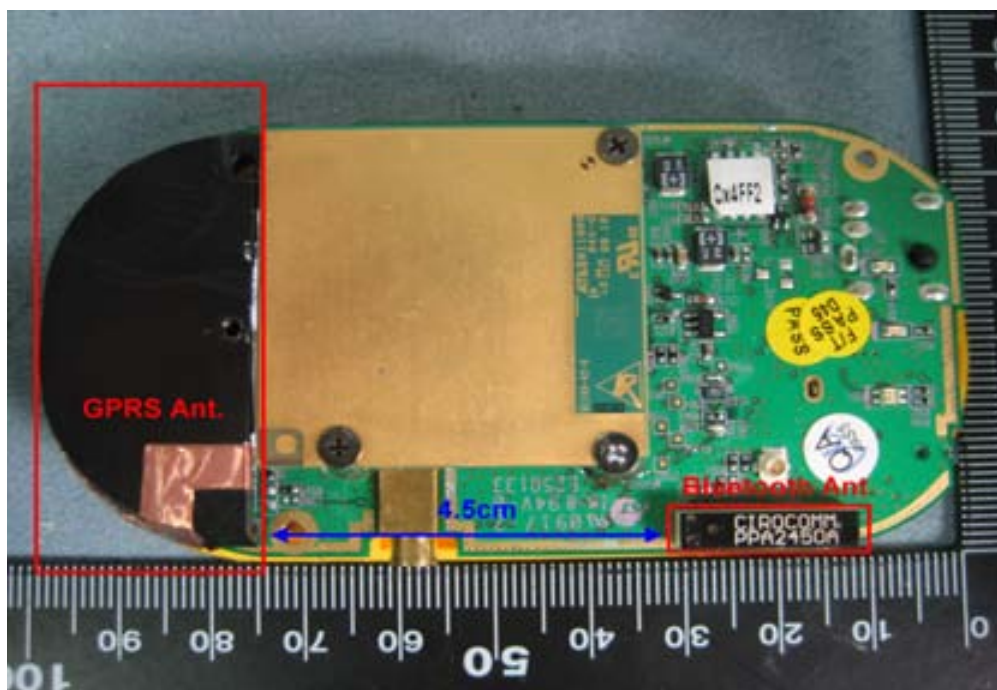


Bottom View

Report No : TSC-98-10-AP-15-FCC (SAR)

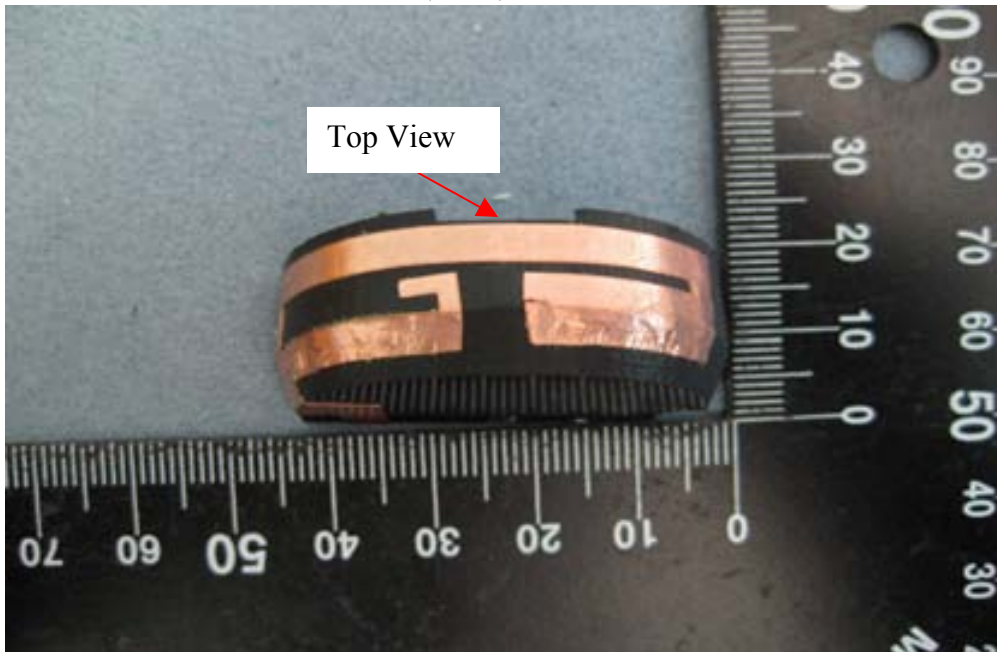


Front View with external antenna

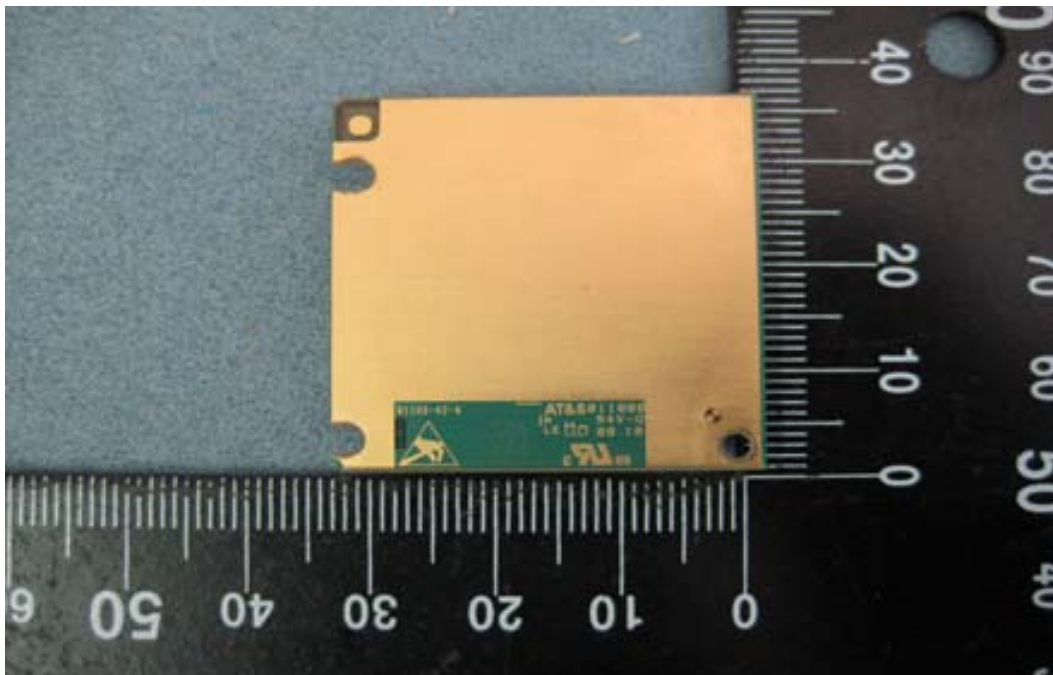


WWAN and Bluetooth Antenna Location
(Antenna separation = 4.5cm)

Report No : TSC-98-10-AP-15-FCC (SAR)



WWAN Antenna Location2(Inside of Top)

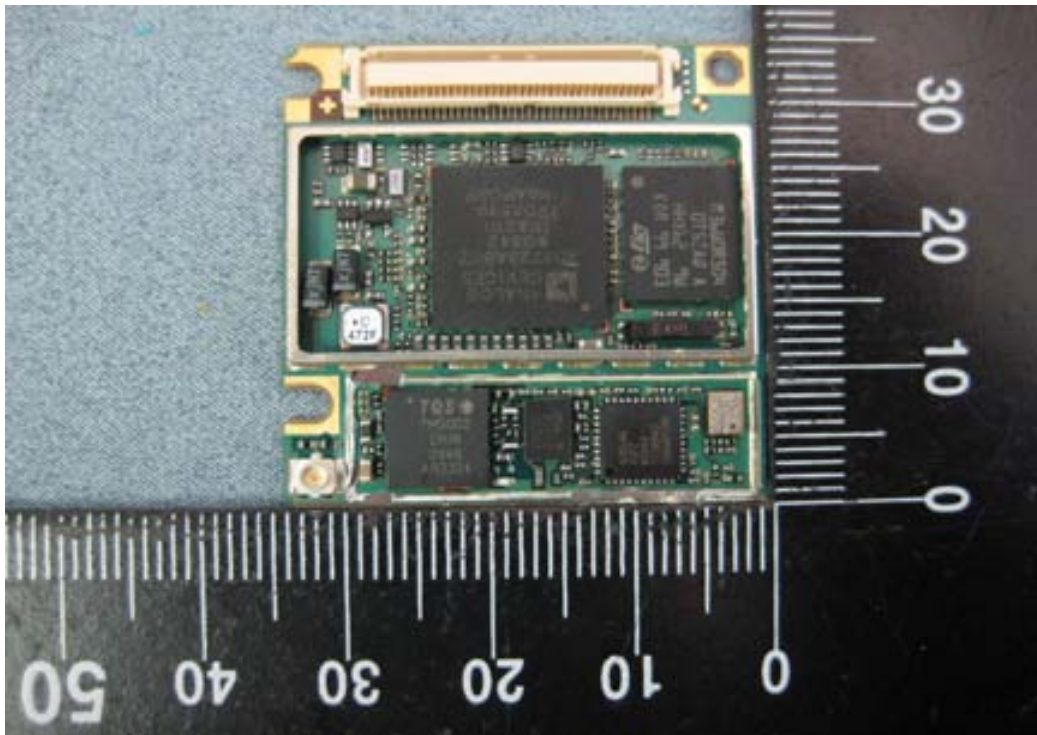


Front View of WWAN Module

Report No : TSC-98-10-AP-15-FCC (SAR)



Rear View of WWAN Module-1

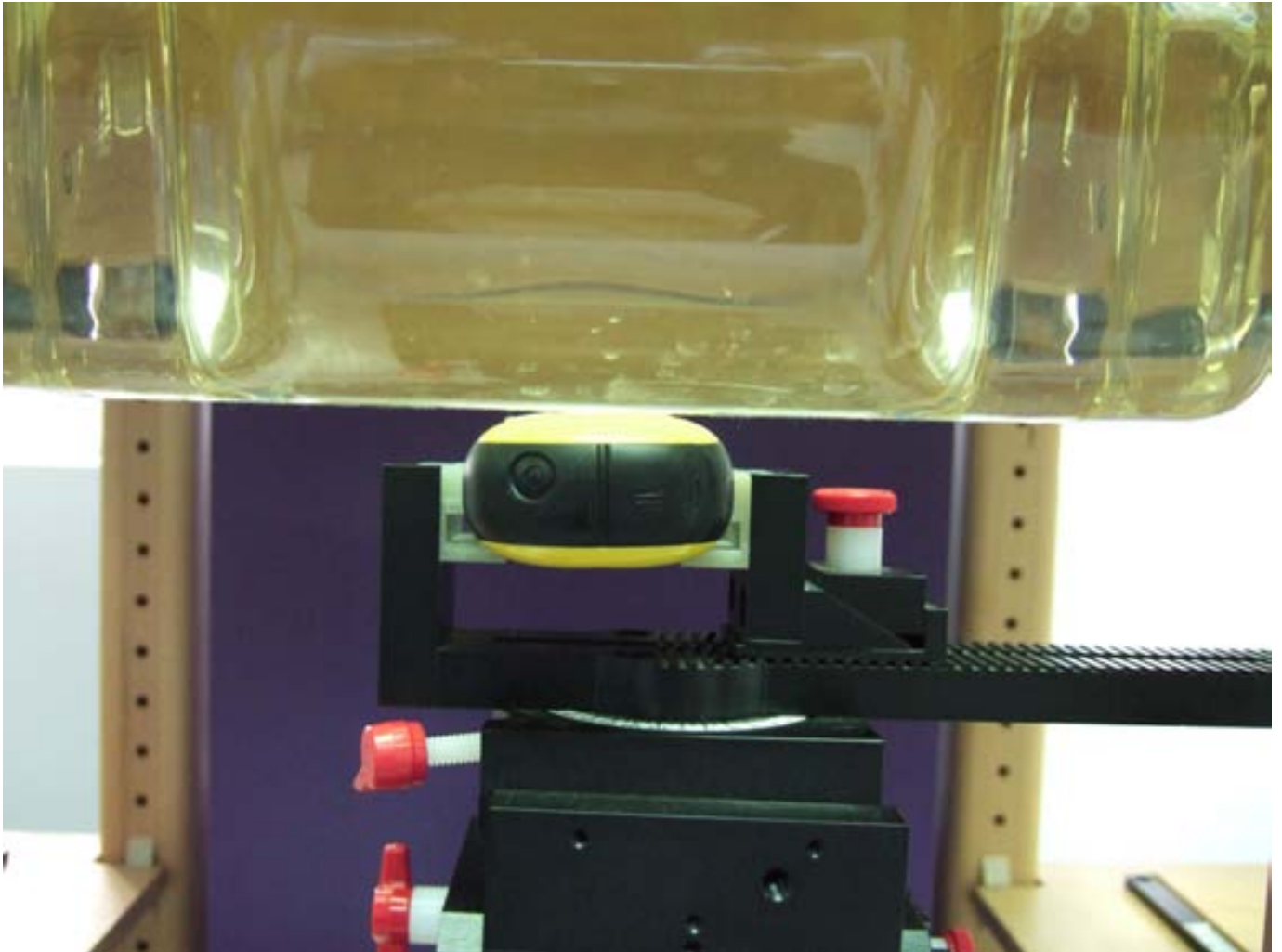


Rear View of WWAN Module-2

Report No : TSC-98-10-AP-15-FCC (SAR)

A. TEST CONFIGURATIONS AND TEST DATA

A.1 TEST CONFIGURATION



GPRS/EDGE Front Side Touch Position

Report No : TSC-98-10-AP-15-FCC (SAR)



GPRS/EDGE Bottom Side Touch Position

Report No : TSC-98-10-AP-15-FCC (SAR)



GPRS/EDGE Left Side Touch Position

Report No : TSC-98-10-AP-15-FCC (SAR)

A.2 Liquid Level Photo

Liquid Level in Flat Phantom > 15cm





Chunghwa Telecom CO., Ltd
Telecommunication Laboratories
Testing & Certification Center

TEL : +886 3 4244445
FAX : +886 3 4202444
ADDR. : 12, Lane 551, Min-Tsu Road Sec. 5
Yang-Mei, Taoyuan, Taiwan , R.O.C.
E-mail: tsd@cht.com.tw <http://www.chttl.com.tw>

Report No : TSC-98-10-AP-15-FCC (SAR)

A.3 TISSUE LIQUIDS Dielectric Parameter

A.3.1 835 MHz Body TISSUE LIQUIDS Dielectric measurement data

Tissue Data
Epsilon : 55.0-55.5 F/m
Sigma : 0.98 S/m
Density : 1000.00 kg/cu. m

A.3.2 1900 MHz Body TISSUE LIQUIDS Dielectric measurement data

Tissue Data
Epsilon : 52.9-53.5 F/m
Sigma : 1.52-1.54 S/m
Density : 1000.00 kg/cu. m



Report No : TSC-98-10-AP-15-FCC (SAR)

A.4. TEST DATA

A.4.1 GSM850M Mode (GPRS Mid. CH Front side Touch)

SAR Test Report

Report Date : 27-Nov-2009
 By Operator : 123
 Measurement Date : 27-Nov-2009
 Starting Time : 27-Nov-2009 08:18:48 AM
 End Time : 27-Nov-2009 08:42:45 AM
 Scanning Time : 1437 secs

Product Data
 Device Name : Energy
 Serial No. : R95XXS0004
 Type : Other
 Model :
 Frequency : 850.00 MHz
 Max. Transmit Pwr : 2 W
 Drift Time : 0 min(s)
 Length : 102.2 mm
 Width : 54.2 mm
 Depth : 32 mm
 Antenna Type : Internal
 Orientation : Touch
 Power Drift-Start : 0.692 W/kg
 Power Drift-Finish: 0.694 W/kg
 Power Drift (%) : 0.315
 Picture :

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

Tissue Data
 Type : BODY
 Serial No. : 835
 Frequency : 835.00 MHz
 Last Calib. Date : 26-Nov-2009
 Temperature : 23.00 °C
 Ambient Temp. : 23.00 °C
 Humidity : 50.00 RH%
 Epsilon : 55.50 F/m
 Sigma : 0.98 S/m
 Density : 1000.00 kg/cu. m

Probe Data
 Name : Probe 257 - CHTL
 Model : E020
 Type : E-Field Triangle
 Serial No. : 257
 Last Calib. Date : 12-Dec-2008
 Frequency : 835.00 MHz



Chunghwa Telecom CO., Ltd
Telecommunication Laboratories
Testing & Certification Center

TEL : +886 3 4244445
FAX : +886 3 4202444
ADDR. : 12, Lane 551, Min-Tsu Road Sec. 5
Yang-Mei, Taoyuan, Taiwan , R.O.C.
E-mail: tsd@cht.com.tw <http://www.chttl.com.tw>

Report No : TSC-98-10-AP-15-FCC (SAR)

Duty Cycle Factor: 4
Conversion Factor: 6.9
Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

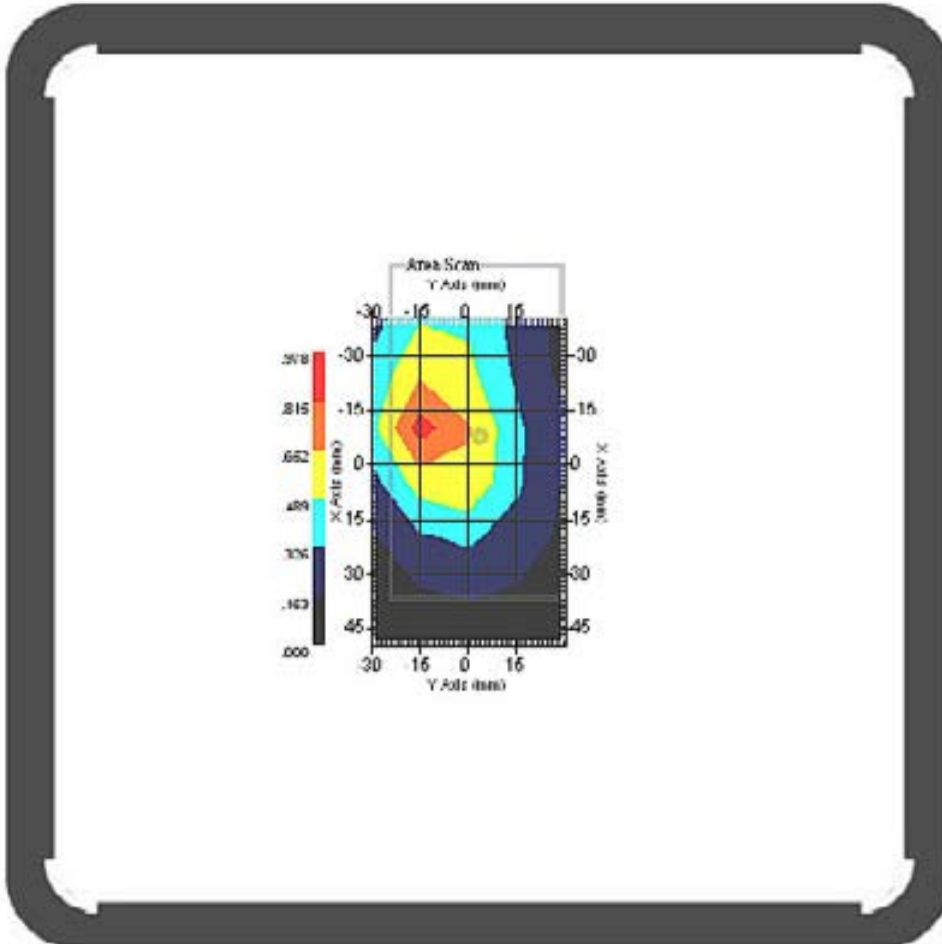
Measurement Data

Crest Factor : 4
Scan Type : Complete
Tissue Temp. : 23.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 26-Nov-2009
Set-up Time : 1:32:10 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Touch
Separation : 0
Channel : Mid - 190

Report No : TSC-98-10-AP-15-FCC (SAR)



1 gram SAR value : 0.805 W/kg
10 gram SAR value : 0.478 W/kg
Area Scan Peak SAR : 0.885 W/kg
Zoom Scan Peak SAR : 1.421 W/kg



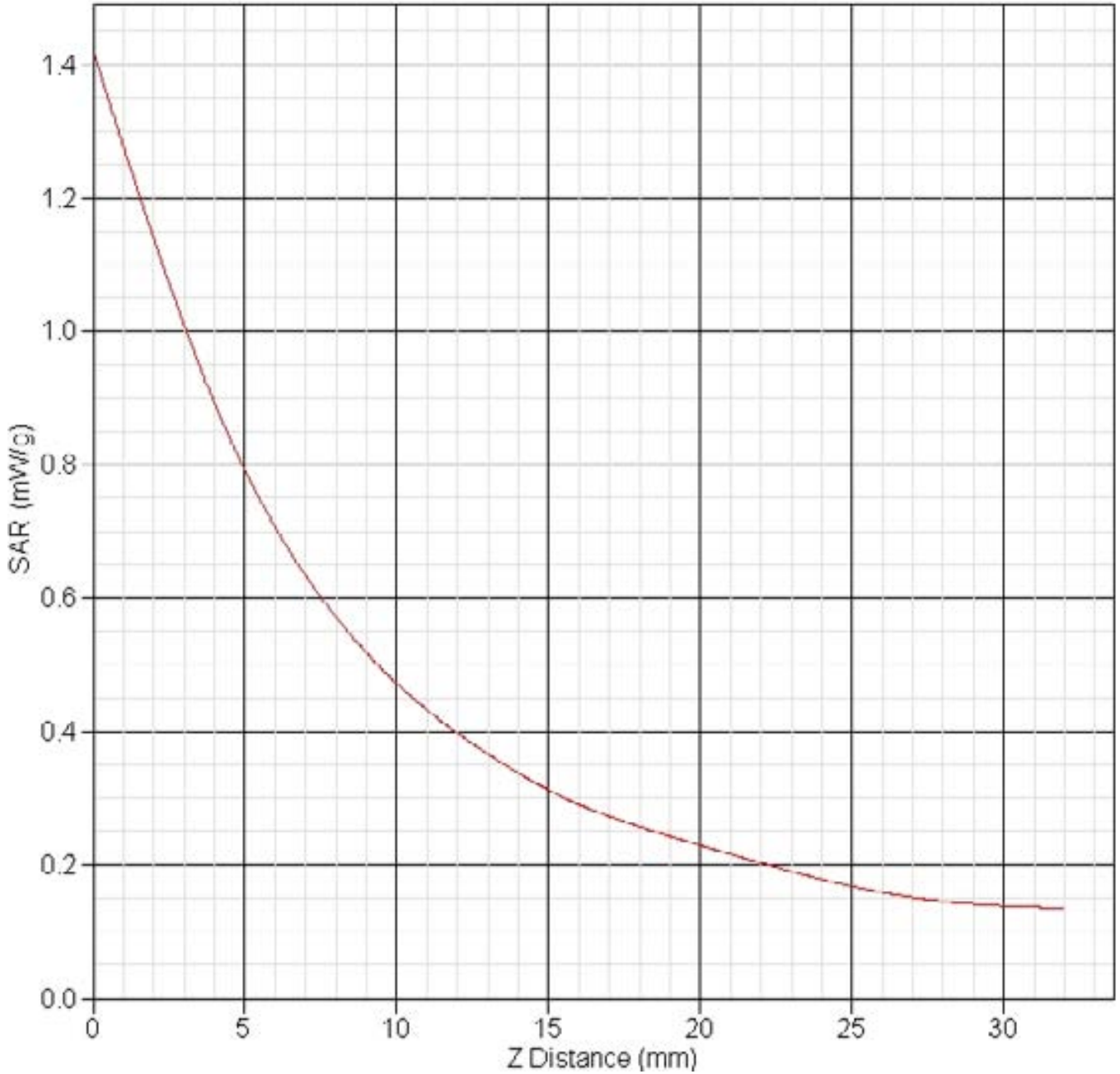
Report No : TSC-98-10-AP-15-FCC (SAR)

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	0.3	rectangular	$\sqrt{3}$	1	0.2
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	1.0	normal	1	0.7	0.7
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	0.5	normal	1	0.6	0.3
Combined Uncertainty		RSS			9.3
Combined Uncertainty (coverage factor=2)		Normal (k=2)			18.5

Report No : TSC-98-10-AP-15-FCC (SAR)

SAR-Z Axis
at Hotspot x:-9.80 y:-15.20





Report No : TSC-98-10-AP-15-FCC (SAR)

GSM850M Mode (GPRS Hi. CH Front side Touch)

SAR Test Report

Report Date : 04-Nov-2009
 By Operator : 123
 Measurement Date : 04-Nov-2009
 Starting Time : 04-Nov-2009 12:25:14 PM
 End Time : 04-Nov-2009 12:47:59 PM
 Scanning Time : 1365 secs

Product Data

Device Name : Energy
 Serial No. : R95XXS0004
 Type : Other
 Model :
 Frequency : 850.00 MHz
 Max. Transmit Pwr : 2 W
 Drift Time : 0 min(s)
 Length : 102.2 mm
 Width : 54.2 mm
 Depth : 32 mm
 Antenna Type : Internal
 Orientation : Touch
 Power Drift-Start : 1.136 W/kg
 Power Drift-Finish: 1.084 W/kg
 Power Drift (%) : -4.556
 Picture :

Phantom Data

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

Tissue Data

Type : BODY
 Serial No. : 835
 Frequency : 835.00 MHz
 Last Calib. Date : 03-Nov-2009
 Temperature : 24.00 °C
 Ambient Temp. : 24.00 °C
 Humidity : 51.00 RH%
 Epsilon : 55.00 F/m
 Sigma : 0.98 S/m
 Density : 1000.00 kg/cu. m

Probe Data

Name : Probe 257 - CHTL
 Model : E020
 Type : E-Field Triangle
 Serial No. : 257
 Last Calib. Date : 12-Dec-2008
 Frequency : 835.00 MHz
 Duty Cycle Factor: 4
 Conversion Factor: 6.9
 Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
 Compression Point: 95.00 mV
 Offset : 1.56 mm

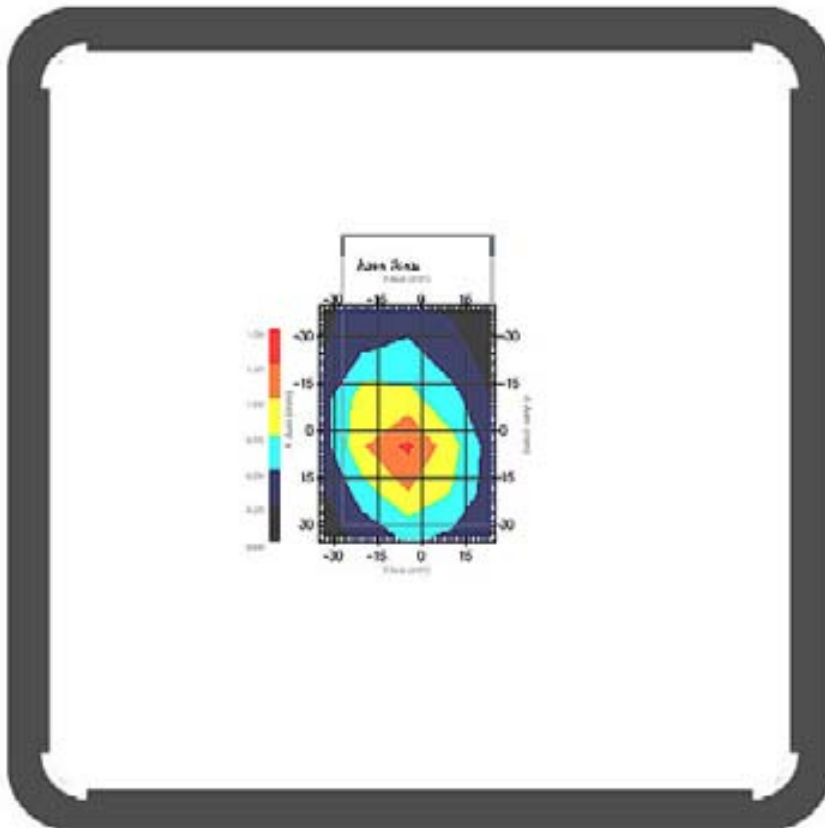
Report No : TSC-98-10-AP-15-FCC (SAR)

Measurement Data

Crest Factor : 4
Scan Type : Complete
Tissue Temp. : 24.00 °C
Ambient Temp. : 24.00 °C
Set-up Date : 03-Nov-2009
Set-up Time : 3:32:10 PM
Area Scan : 6x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Touch
Separation : 0
Channel : High - 251



1 gram SAR value : 1.198 W/kg
10 gram SAR value : 0.689 W/kg
Area Scan Peak SAR : 1.306 W/kg
Zoom Scan Peak SAR : 2.782 W/kg

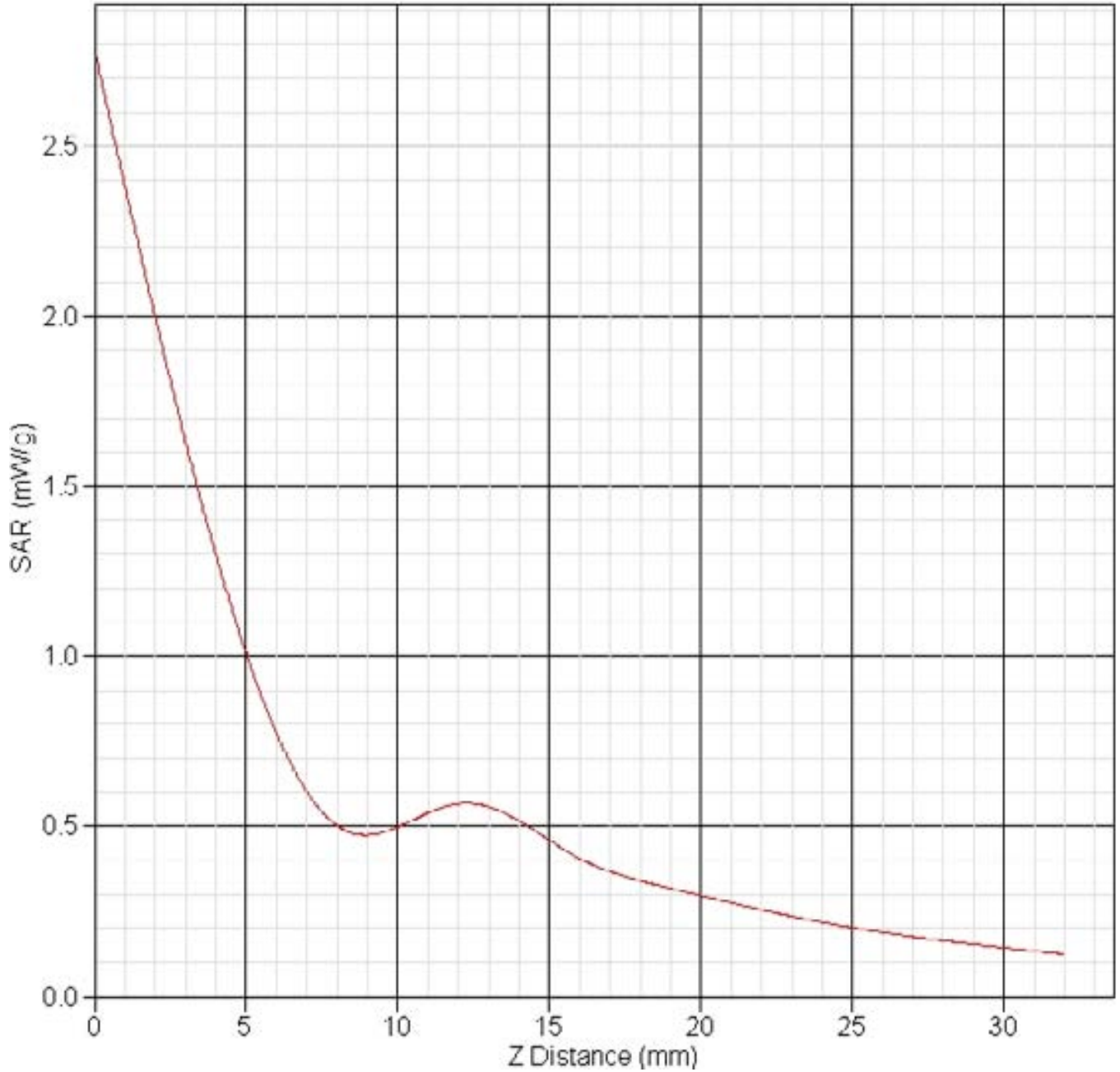
Report No : TSC-98-10-AP-15-FCC (SAR)

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	4.6	rectangular	$\sqrt{3}$	1	2.6
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	1.0	normal	1	0.7	0.7
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	0.4	normal	1	0.6	0.2
Combined Uncertainty		RSS			9.6
Combined Uncertainty (coverage factor=2)		Normal (k=2)			19.2

Report No : TSC-98-10-AP-15-FCC (SAR)

SAR-Z Axis
at Hotspot x:-2.80 y:-13.20





Report No : TSC-98-10-AP-15-FCC (SAR)

(EDGE Lo. CH Front side Touch)

SAR Test Report

Report Date : 26-Nov-2009
 By Operator : 123
 Measurement Date : 26-Nov-2009
 Starting Time : 26-Nov-2009 03:04:42 PM
 End Time : 26-Nov-2009 03:29:31 PM
 Scanning Time : 1489 secs

Product Data

Device Name : Energy
 Serial No. : R95XXS0004
 Type : Other
 Model :
 Frequency : 850.00 MHz
 Max. Transmit Pwr : 2 W
 Drift Time : 0 min(s)
 Length : 102.2 mm
 Width : 54.2 mm
 Depth : 32 mm
 Antenna Type : Internal
 Orientation : Touch
 Power Drift-Start : 0.585 W/kg
 Power Drift-Finish: 0.577 W/kg
 Power Drift (%) : -1.325
 Picture :

Phantom Data

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

Tissue Data

Type : BODY
 Serial No. : 835
 Frequency : 835.00 MHz
 Last Calib. Date : 26-Nov-2009
 Temperature : 23.00 °C
 Ambient Temp. : 23.00 °C
 Humidity : 50.00 RH%
 Epsilon : 55.50 F/m
 Sigma : 0.98 S/m
 Density : 1000.00 kg/cu. m

Probe Data

Name : Probe 257 - CHTL
 Model : E020
 Type : E-Field Triangle
 Serial No. : 257
 Last Calib. Date : 12-Dec-2008
 Frequency : 835.00 MHz
 Duty Cycle Factor: 4
 Conversion Factor: 6.9
 Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
 Compression Point: 95.00 mV
 Offset : 1.56 mm

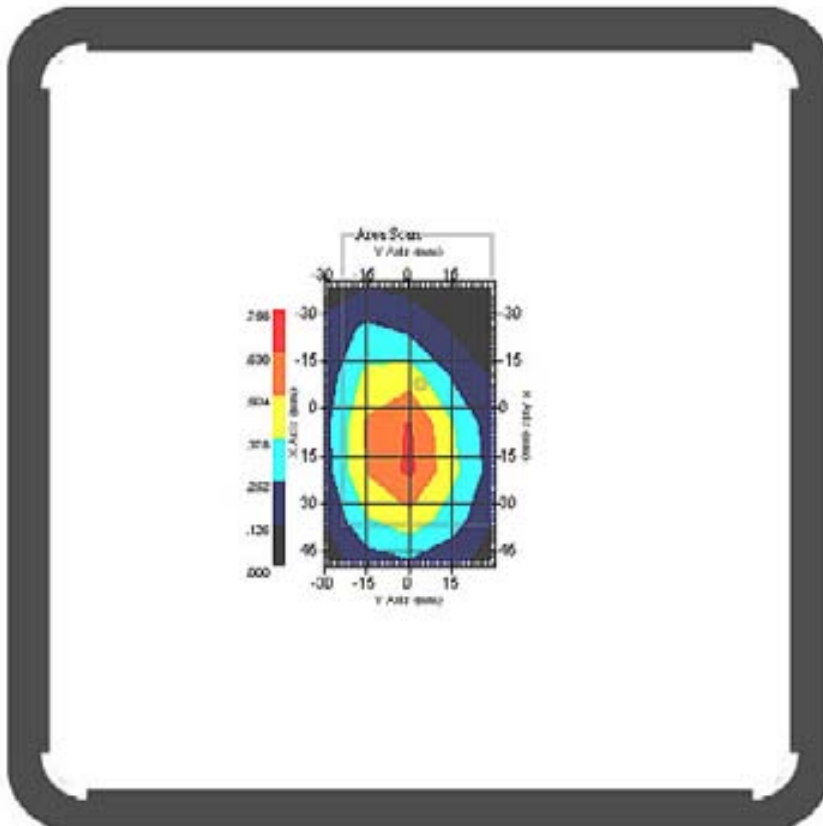
Report No : TSC-98-10-AP-15-FCC (SAR)

Measurement Data

Crest Factor : 4
Scan Type : Complete
Tissue Temp. : 23.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 26-Nov-2009
Set-up Time : 1:32:10 PM
Area Scan : 7x5x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Touch
Separation : 0
Channel : Low - 128



1 gram SAR value : 0.650 W/kg
10 gram SAR value : 0.429 W/kg
Area Scan Peak SAR : 0.658 W/kg
Zoom Scan Peak SAR : 0.950 W/kg

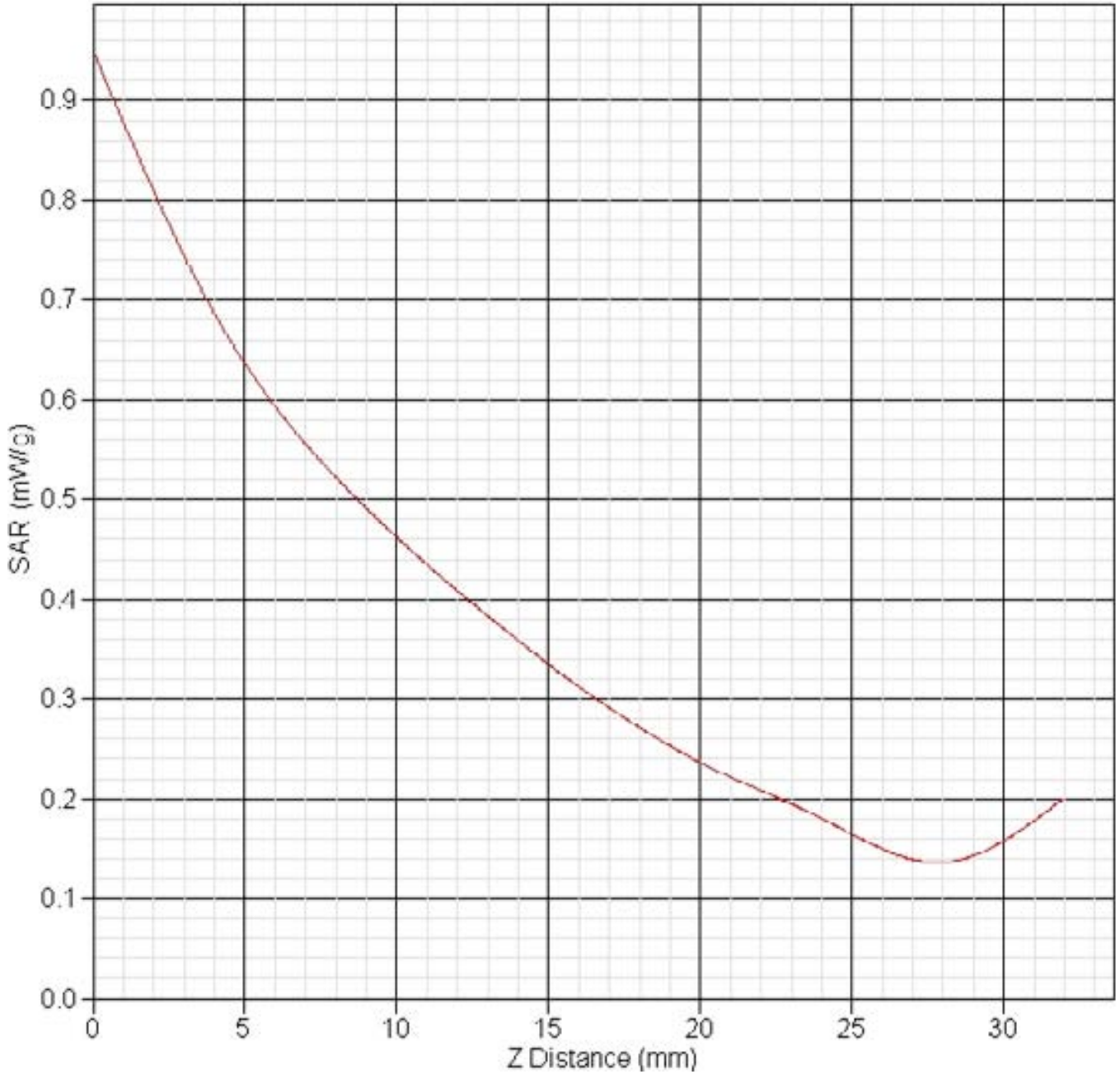
Report No : TSC-98-10-AP-15-FCC (SAR)

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	1.3	rectangular	$\sqrt{3}$	1	0.8
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	1.0	normal	1	0.7	0.7
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	0.5	normal	1	0.6	0.3
Combined Uncertainty		RSS			9.3
Combined Uncertainty (coverage factor=2)		Normal (k=2)			18.6

Report No : TSC-98-10-AP-15-FCC (SAR)

SAR-Z Axis
at Hotspot x:12.20 y:-0.40





Report No : TSC-98-10-AP-15-FCC (SAR)

A.4.2 GSM1900M Mode (GPRS Mid. CH Front side Touch)

SAR Test Report

Report Date : 03-Nov-2009
 By Operator : 123
 Measurement Date : 03-Nov-2009
 Starting Time : 02-Nov-2009 05:56:51 PM
 End Time : 02-Nov-2009 06:26:08 PM
 Scanning Time : 1757 secs

Product Data
 Device Name : Energy
 Serial No. : R95XXS0004
 Type : Other
 Model :
 Frequency : 1900.00 MHz
 Max. Transmit Pwr : 1 W
 Drift Time : 0 min(s)
 Length : 102.2 mm
 Width : 54.2 mm
 Depth : 32 mm
 Antenna Type : Internal
 Orientation : Touch
 Power Drift-Start : 0.269 W/kg
 Power Drift-Finish: 0.282 W/kg
 Power Drift (%) : 4.830
 Picture :

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

Tissue Data
 Type : BODY
 Serial No. : 1900
 Frequency : 1900.00 MHz
 Last Calib. Date : 02-Nov-2009
 Temperature : 23.00 °C
 Ambient Temp. : 24.00 °C
 Humidity : 45.00 RH%
 Epsilon : 53.50 F/m
 Sigma : 1.54 S/m
 Density : 1000.00 kg/cu. m

Probe Data
 Name : Probe 257 - CHTL
 Model : E020
 Type : E-Field Triangle
 Serial No. : 257
 Last Calib. Date : 12-Dec-2008
 Frequency : 1900.00 MHz
 Duty Cycle Factor: 4
 Conversion Factor: 5.9
 Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
 Compression Point: 95.00 mV

Report No : TSC-98-10-AP-15-FCC (SAR)

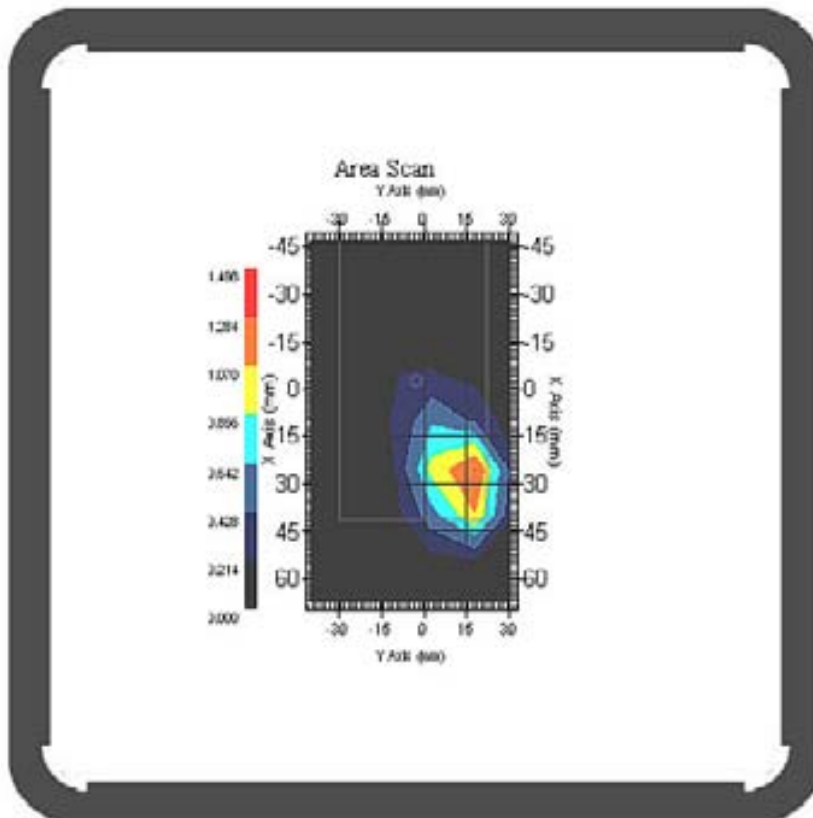
Offset : 1.56 mm

Measurement Data

Crest Factor : 4
Scan Type : Complete
Tissue Temp. : 23.00 °C
Ambient Temp. : 24.00 °C
Set-up Date : 02-Nov-2009
Set-up Time : 11:36:30 AM
Area Scan : 9x6x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Touch
Separation : 0
Channel : Mid - 661



1 gram SAR value : 1.192 W/kg
10 gram SAR value : 0.605 W/kg
Area Scan Peak SAR : 1.293 W/kg
Zoom Scan Peak SAR : 2.502 W/kg

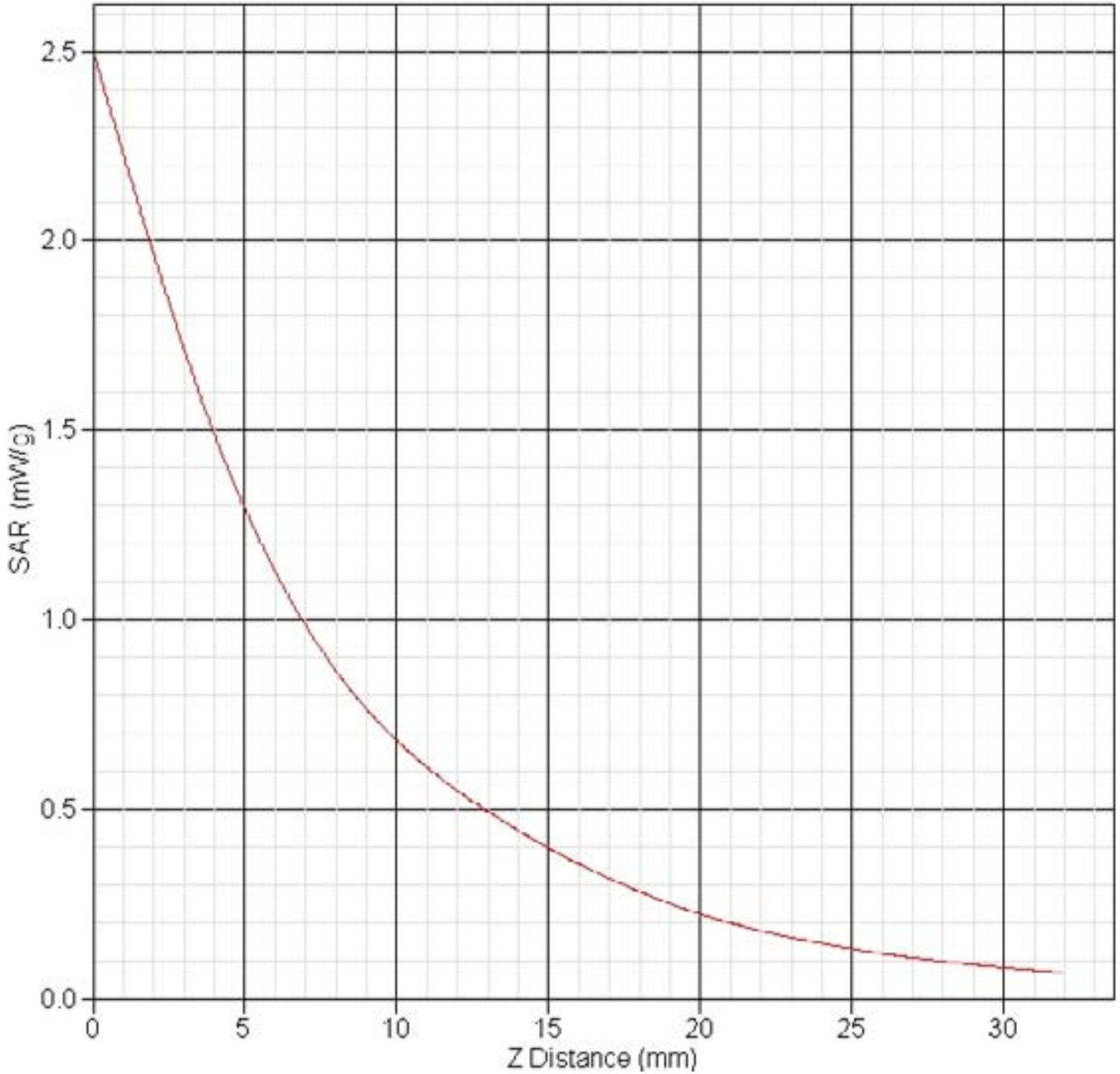
Report No : TSC-98-10-AP-15-FCC (SAR)

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	4.8	rectangular	$\sqrt{3}$	1	2.8
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	1.3	normal	1	0.7	0.9
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	0.4	normal	1	0.6	0.2
Combined Uncertainty		RSS			10.7
Combined Uncertainty (coverage factor=2)		Normal (k=2)			21.4

Report No : TSC-98-10-AP-15-FCC (SAR)

SAR-Z Axis
at Hotspot x:33.40 y:17.60





Report No : TSC-98-10-AP-15-FCC (SAR)

(EGPRS Mid. CH Front side Touch)

SAR Test Report

Report Date : 27-Nov-2009
 By Operator : 123
 Measurement Date : 27-Nov-2009
 Starting Time : 27-Nov-2009 01:22:28 PM
 End Time : 27-Nov-2009 01:41:43 PM
 Scanning Time : 1155 secs

Product Data

Device Name : Energy
 Serial No. : R95XXS0004
 Type : Other
 Model :
 Frequency : 1900.00 MHz
 Max. Transmit Pwr : 1 W
 Drift Time : 0 min(s)
 Length : 102.2 mm
 Width : 54.2 mm
 Depth : 32 mm
 Antenna Type : Internal
 Orientation : Touch
 Power Drift-Start : 0.323 W/kg
 Power Drift-Finish: 0.312 W/kg
 Power Drift (%) : -3.449
 Picture :

Phantom Data

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

Tissue Data

Type : BODY
 Serial No. : 1900
 Frequency : 1900.00 MHz
 Last Calib. Date : 27-Nov-2009
 Temperature : 23.00 °C
 Ambient Temp. : 23.00 °C
 Humidity : 50.00 RH%
 Epsilon : 52.90 F/m
 Sigma : 1.52 S/m
 Density : 1000.00 kg/cu. m

Probe Data

Name : Probe 257 - CHTL
 Model : E020
 Type : E-Field Triangle
 Serial No. : 257
 Last Calib. Date : 12-Dec-2008
 Frequency : 1900.00 MHz
 Duty Cycle Factor: 4
 Conversion Factor: 5.9
 Probe Sensitivity: 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
 Compression Point: 95.00 mV
 Offset : 1.56 mm

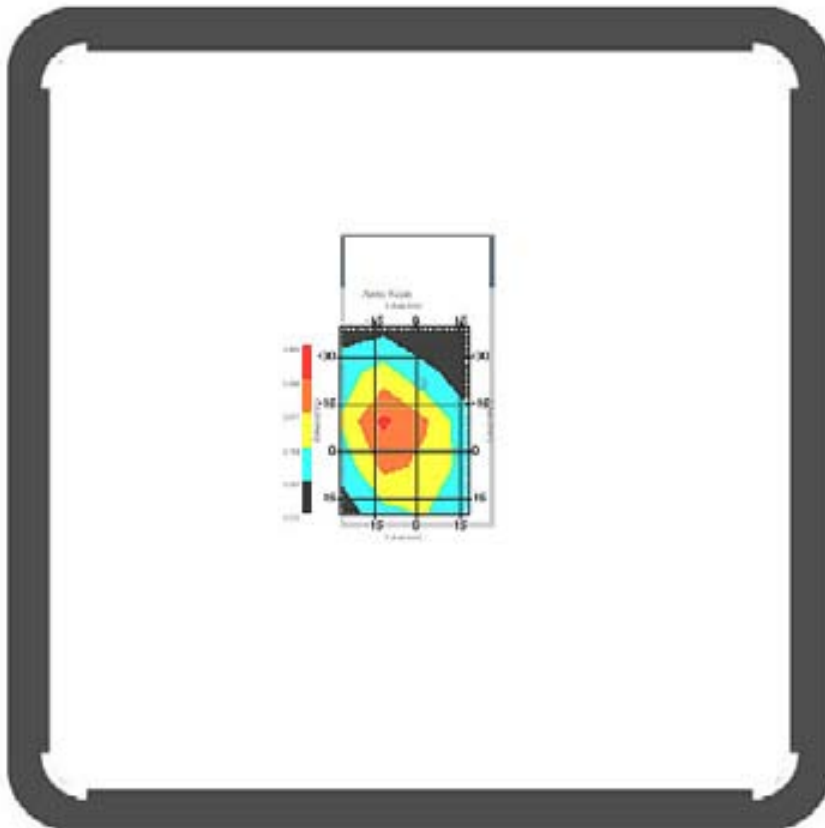
Report No : TSC-98-10-AP-15-FCC (SAR)

Measurement Data

Crest Factor : 4
Scan Type : Complete
Tissue Temp. : 23.00 °C
Ambient Temp. : 23.00 °C
Set-up Date : 27-Nov-2009
Set-up Time : 9:36:30 AM
Area Scan : 5x4x1 : Measurement x=15mm, y=15mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm

Other Data

DUT Position : Touch
Separation : 0
Channel : Mid - 661



1 gram SAR value : 0.381 W/kg
10 gram SAR value : 0.202 W/kg
Area Scan Peak SAR : 0.410 W/kg
Zoom Scan Peak SAR : 0.680 W/kg

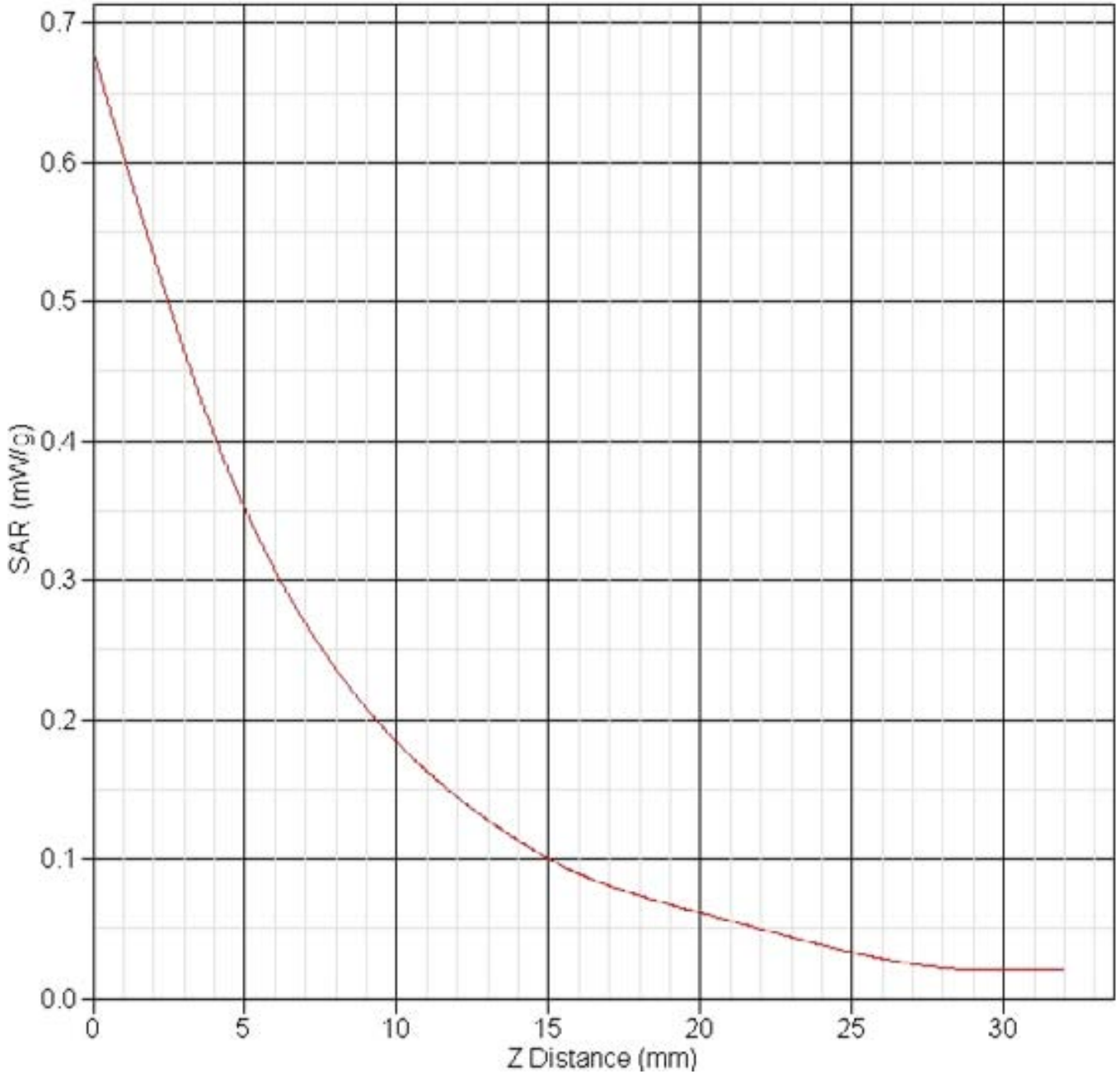
Report No : TSC-98-10-AP-15-FCC (SAR)

Exposure Assessment Measurement Uncertainty

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^{-1} (1-g)	Standard Uncertainty (1-g) %
Measurement System					
Probe Calibration	3.5	normal	1	1	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	0.6
Readout Electronics	1.0	normal	1	1	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1.0
RF Ambient Condition	3.0	rectangular	$\sqrt{3}$	1	1.7
Probe Positioner Mech.	0.4	rectangular	$\sqrt{3}$	1	0.2
Restriction					
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	2.1
Test Sample Positioning	4.0	normal	1	1	4.0
Device Holder Uncertainty	2.0	normal	1	1	2.0
Drift of Output Power	3.4	rectangular	$\sqrt{3}$	1	1.9
Phantom and Setup					
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	2.0
Liquid Conductivity(meas.)	0.0	normal	1	0.7	0.0
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	1.7
Liquid Permittivity(meas.)	0.8	normal	1	0.6	0.5
Combined Uncertainty		RSS			9.9
Combined Uncertainty (coverage factor=2)		Normal (k=2)			19.8


Report No : TSC-98-10-AP-15-FCC (SAR)

SAR-Z Axis
at Hotspot x:-9.70 y:-12.20



Report No : TSC-98-10-AP-15-FCC (SAR)

A.4.3 Dipole Calibration Data

<p>NCL CALIBRATION LABORATORIES</p> <p>Calibration File No: DC-956 Project Number: ISLB-D-835S2-5414</p> <p>CERTIFICATE OF CALIBRATION</p> <p>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.</p> <p>WISB Validation Dipole</p> <p>Manufacturer: APREL Laboratories Part number: ALS-D-835-6-2 Frequency: 835 MHz Serial No: 835-180-00553</p> <p>Customer: WISB</p> <p>Calibrated: 2nd February 2009 Released on: 5th February 2009</p> <p>This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary</p> <p>Released By: </p> <p style="text-align: center;"><u>NCL CALIBRATION LABORATORIES</u> 51 SPECTRUM WAY NEPEAN, ONTARIO CANADA, K2R 1E8 Division of APREL Labs TEL: (913) 620-4868 FAX: (913) 625-4162</p>



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

Dipole 835-180-00553 was a re-calibration.

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

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

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

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

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
 Division of APREL Laboratories.

Calibration Results Summary

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

Mechanical Dimensions

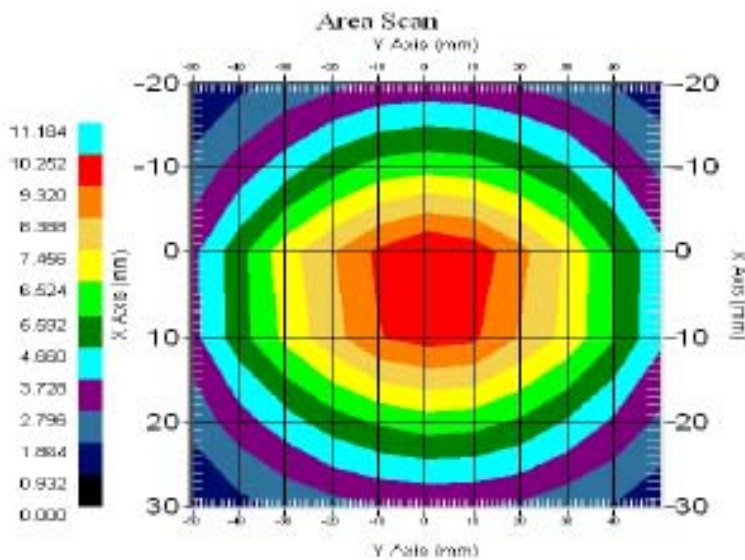
Length: 161.0 mm
 Height: 89.8 mm

Electrical Specification

SWR: 1.02 U
 Return Loss: -39.8 dB
 Impedance: 49.8 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
835 MHz	9.49	8.1	14.21



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



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 835-180-00553. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

References

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

Conditions

Dipole 835-180-00553 was a re-calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

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

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Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
 Division of APREL Laboratories.

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
161.0 mm	89.8 mm	162.1 mm	89.8 mm

Tissue Validation

Head Tissue 835MHz	Measured
Dielectric constant, ϵ_r	42.54
Conductivity, σ [S/m]	0.91

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

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Report No : TSC-98-10-AP-15-FCC (SAR)

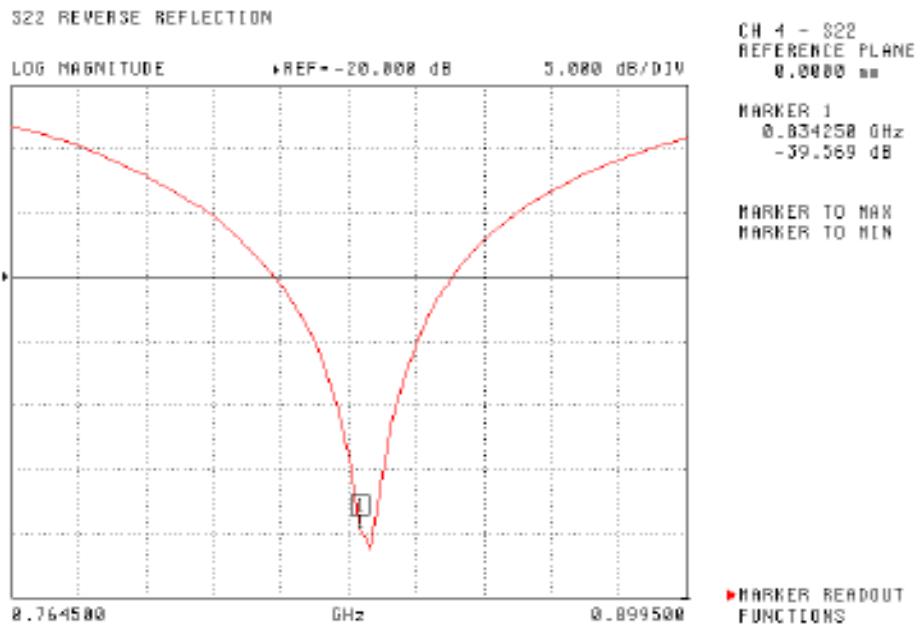
NCL Calibration Laboratories
 Division of APREL Laboratories.

Electrical Calibration

Test	Result
S11 RL	-39.6 dB
SWR	1.02 U
Impedance	49.6 Ω

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

S11 Parameter Return Loss



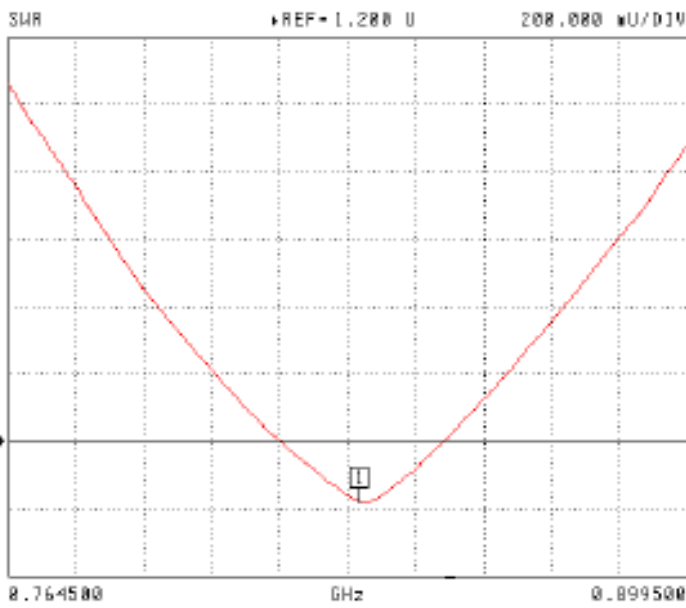
This page has been reviewed for content and attested to by signature within this document.

Report No : TSC-98-10-AP-15-FCC (SAR)

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SWR

322 REVERSE REFLECTION



CH 4 - 322
 REFERENCE PLANE
 0.0000 mm

MARKER 1
 0.834250 GHz
 1.028 U

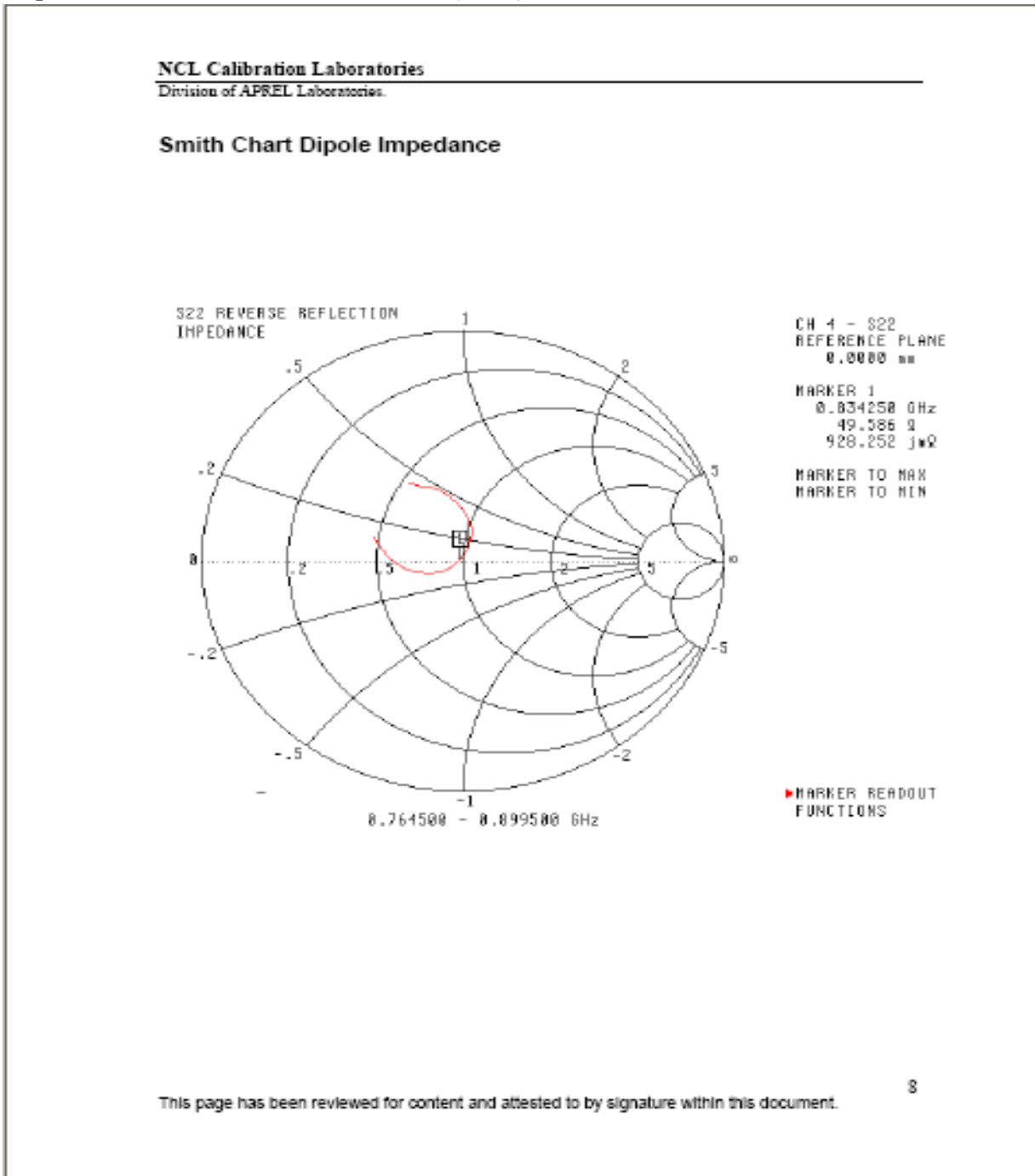
MARKER TO MAX
 MARKER TO MIN

▶ MARKER READOUT
 FUNCTIONS

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

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Report No : TSC-98-10-AP-15-FCC (SAR)

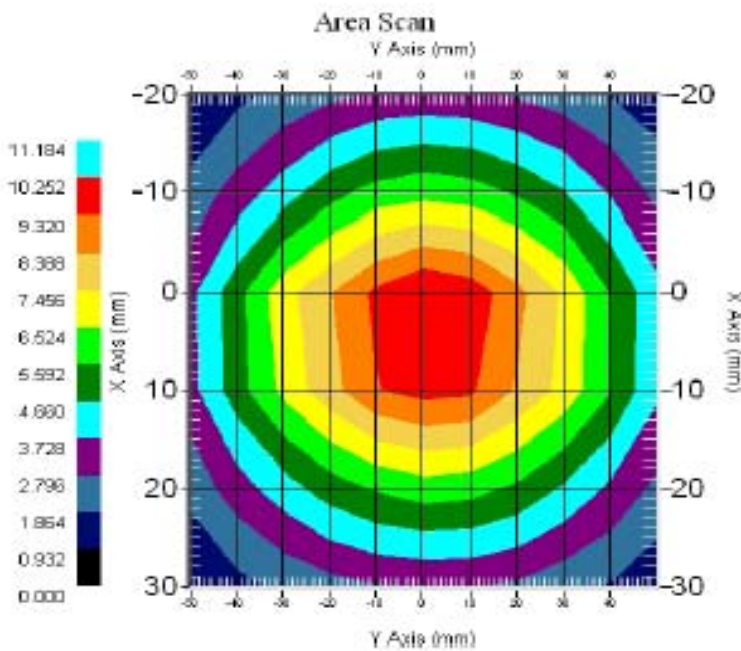


Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
 Division of APREL Laboratories.

System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
835 MHz	9.49	6.1	14.21



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

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Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

Test Equipment

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

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

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Chunghwa Telecom CO., Ltd
Telecommunication Laboratories
Testing & Certification Center

TEL : +886 3 4244445
FAX : +886 3 4202444
ADDR. : 12, Lane 551, Min-Tsu Road Sec. 5
Yang-Mei, Taoyuan, Taiwan , R.O.C.
E-mail: tsd@cht.com.tw <http://www.chttl.com.tw>

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL CALIBRATION LABORATORIES

Calibration File No: DC-962
Project Number: ISLB-1900 Dipole Replacement-5430

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.

ISL Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-1900-S-2
Frequency: 1900 MHz
Serial No: 1900-210-00703-Re-issue

Customer: ISL

Calibrated: 16th March 2009
Released on: 23rd March 2009

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

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA, K2R 1E5

Division of APREL Lab.
TEL: (613) 620-4566
FAX: (613) 620-4162



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

Conditions

Dipole 1900-210-00703 was new (and reissued under the initial dipole serial number) taken from stock prior to calibration.

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

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

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

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

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
 Division of APREL Laboratories.

Calibration Results Summary

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

Mechanical Dimensions

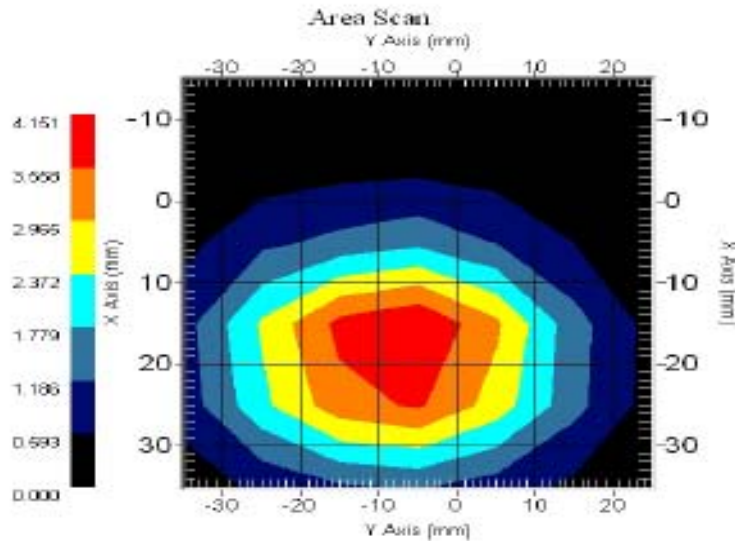
Length: 68.0 mm
 Height: 39.5 mm

Electrical Specification

SWR: 1.015 U
 Return Loss: -43.654 dB
 Impedance: 50.076 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1900 MHz	40.3	20.14	71.7



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



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole 1900-210-00703. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

References

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

Conditions

Dipole 1900-210-00703 was new taken from stock.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

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

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Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
 Division of APREL Laboratories.

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
68.0 mm	39.5 mm	68.7mm	40.0 mm

Tissue Validation

Head Tissue 1900 MHz	Measured
Dielectric constant, ϵ_r	40.2
Conductivity, σ [S/m]	1.43

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

Report No : TSC-98-10-AP-15-FCC (SAR)

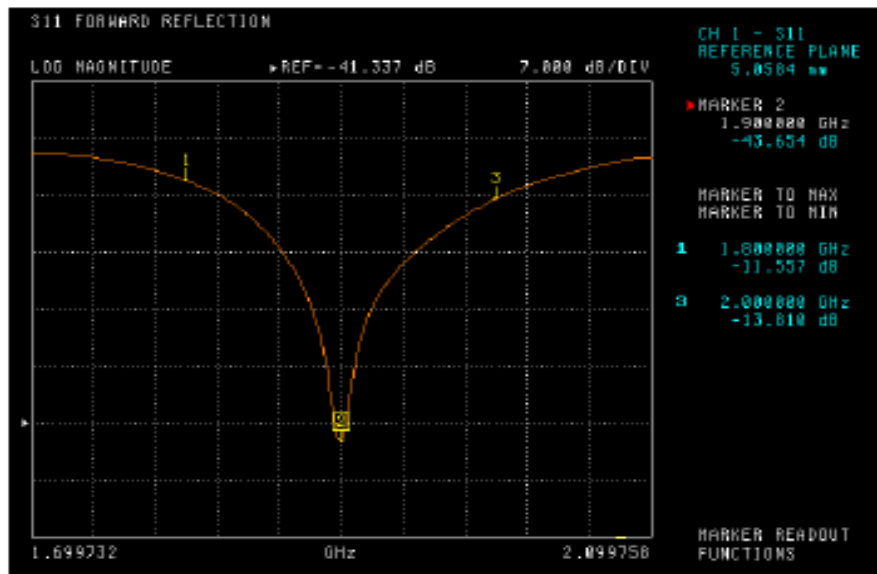
NCL Calibration Laboratories
 Division of APREL Laboratories.

Electrical Calibration

Test	Result
S11 R/L	-43.654 dB
SWR	1.015 U
Impedance	50.076 Ω

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

S11 Parameter Return Loss

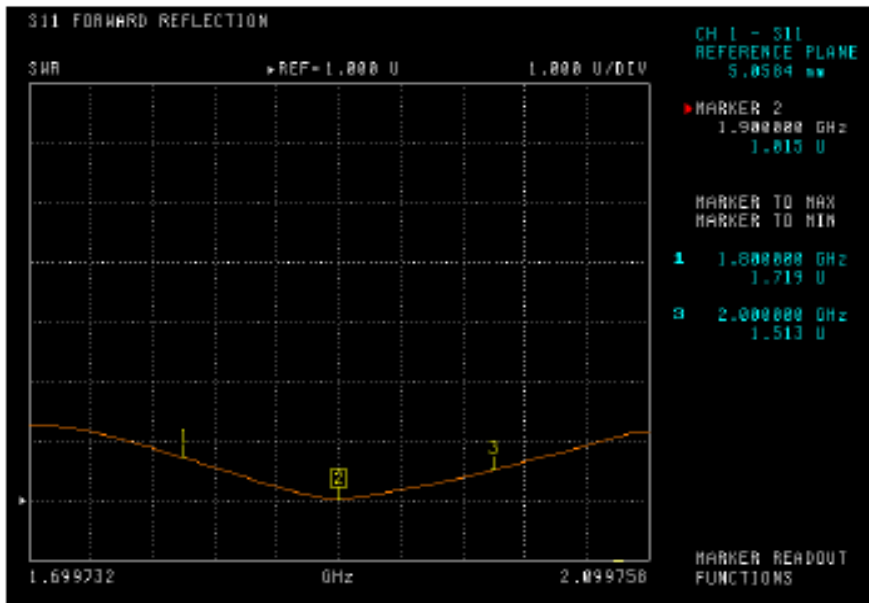


This page has been reviewed for content and attested to by signature within this document.

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

SWR



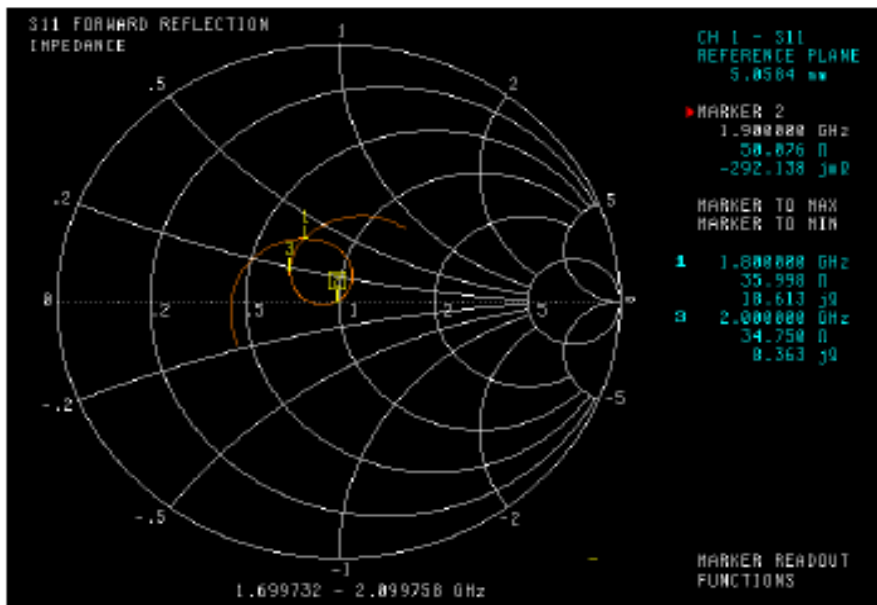
This page has been reviewed for content and attested to by signature within this document.

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Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
 Division of APREL Laboratories.

Smith Chart Dipole Impedance



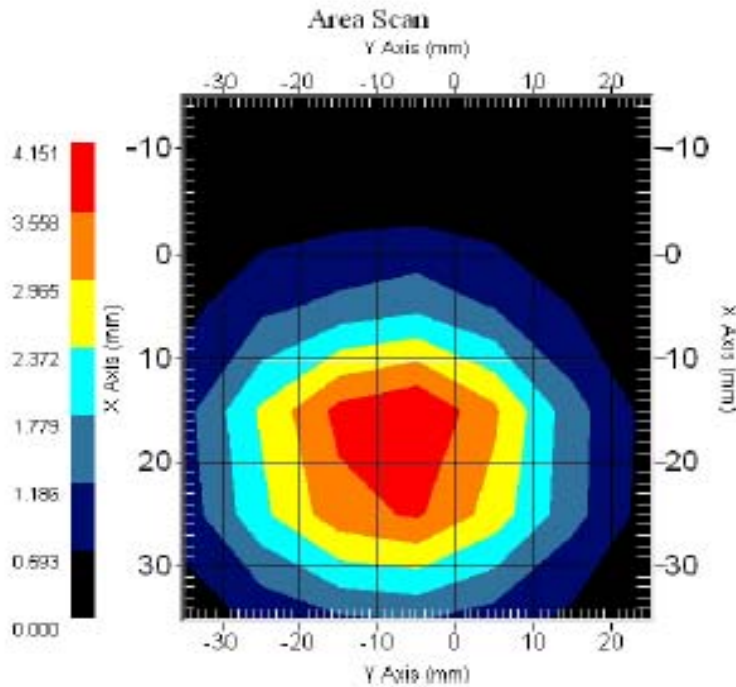
This page has been reviewed for content and attested to by signature within this document.

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
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System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
1900 MHz	40.3	20.14	71.7



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



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Test Equipment

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

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

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Chunghwa Telecom CO., Ltd
Telecommunication Laboratories
Testing & Certification Center

TEL : +886 3 4244445
FAX : +886 3 4202444
ADDR. : 12, Lane 551, Min-Tsu Road Sec. 5
Yang-Mei, Taoyuan, Taiwan, R.O.C.
E-mail: tsd@cht.com.tw <http://www.chttl.com.tw>

Report No : TSC-98-10-AP-15-FCC (SAR)

A.4.4 Probe Calibration Data

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-042

Client: CHTL

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.

Equipment: Miniature Isotropic RF Probe 900 MHz


Manufacturer: APREL Laboratories
Model No.: ALS-E-020
Serial No.: 257

HEAD Calibration

Calibration Procedure: SSI/DRB-TP-001-032-E020-V2
Project No: SGL-ALS-E020-CAL-5395

Calibrated: 12th December 2008
Released on: 12th December 2008

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

Released By: 

NCL CALIBRATION LABORATORIES

<small>51 SPECTRUM WAY NEPEAN, ONTARIO CANADA K2R 1E5</small>	<small>Division of APREL Lab. TEL: (613) 620-4566 FAX: (613) 625-4191</small>
---	---



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 257.

References

- SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
- IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Experimental Techniques"
- SSI-TP-011 Tissue Calibration Procedure
- IEC 62209 "Human exposure to radio frequency fields from hand-held and Head-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

Conditions

Probe 257 is a re-calibration.

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

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



Stuart Nicol



Jesse Hones



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	257
Frequency:	900 MHz
Sensor Offset:	1.58 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Sensitivity in Head Tissue

Frequency: 900 MHz
Epsilon: 41.5 (+/-5%) Sigma: 0.97 S/m (+/-5%)

ConvF

Channel X: 6.4

Channel Y: 6.4

Channel Z: 6.4

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq.

Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.44mm.

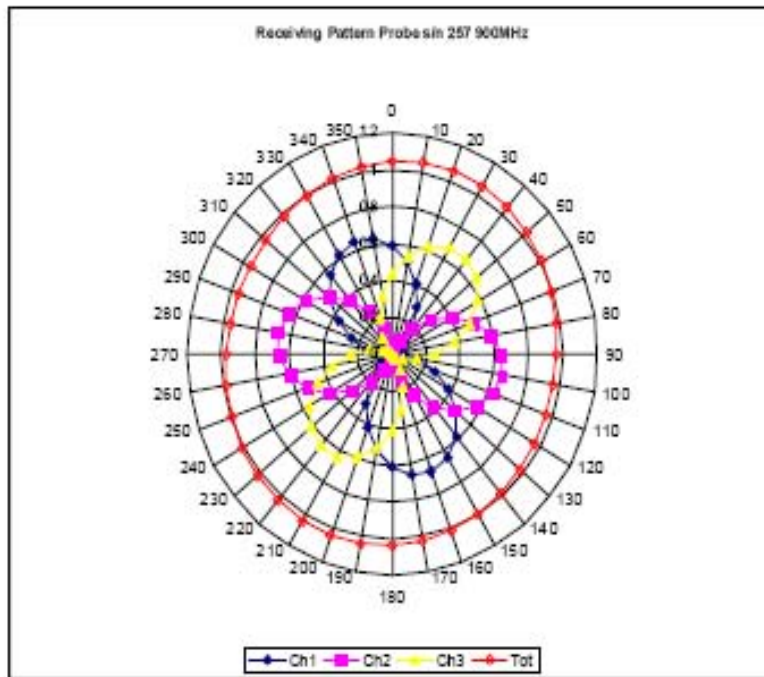
Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

Receiving Pattern 900 MHz (Air)

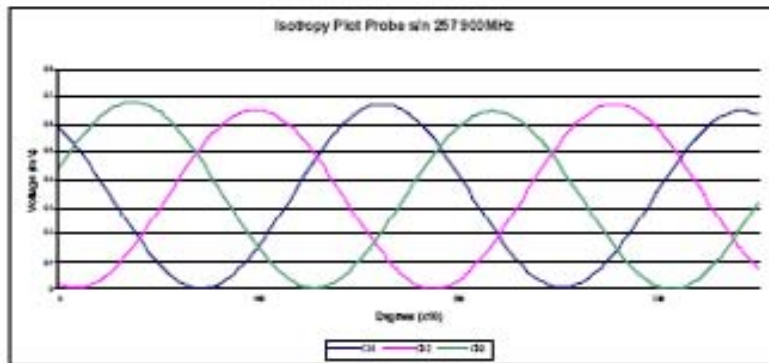
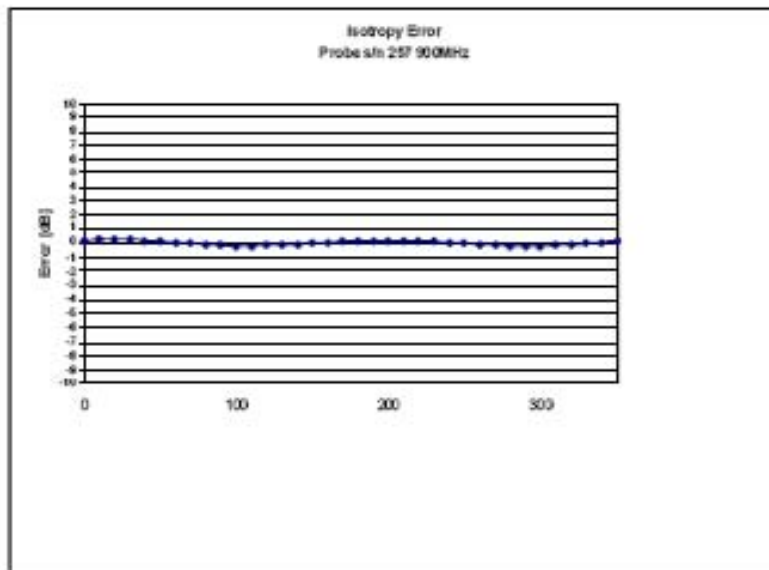


Page 5 of 10
This page has been reviewed for content and attested to on Page 2 of this document.

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

Isotropy Error 900 MHz (Air)



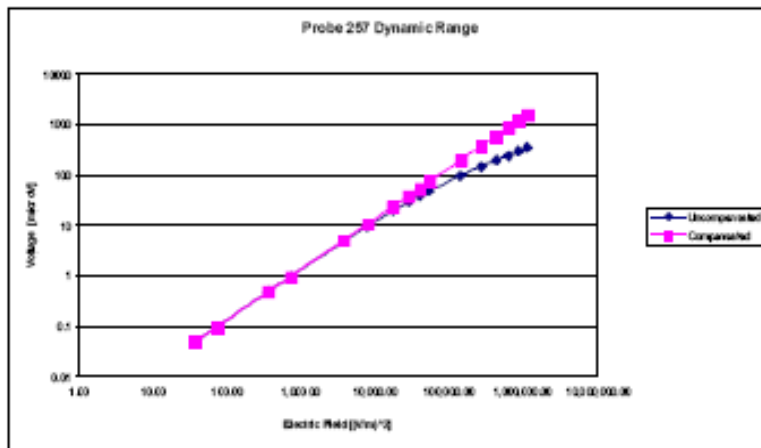
Isotropy in Tissue: 0.10 dB

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This page has been reviewed for content and attested to on Page 2 of this document.

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

Dynamic Range



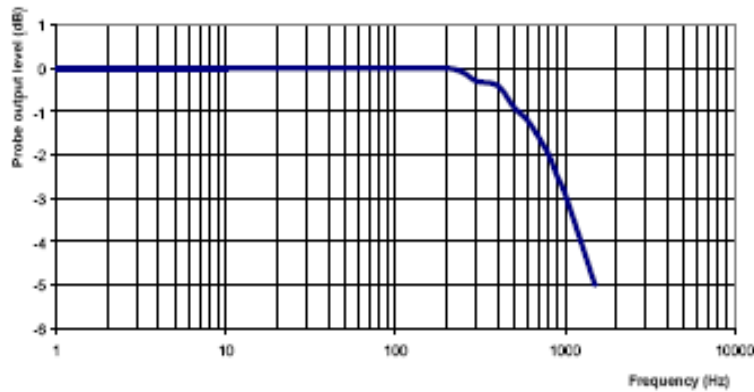


Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories
Division of APREL Laboratories.

Video Bandwidth

Probe Frequency Characteristics



Video Bandwidth at 500 Hz 1 dB
Video Bandwidth at 1000 Hz 3 dB



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Conversion Factor Uncertainty Assessment

Frequency:	900MHz
Epsilon: 41.5 (+/-5%)	Sigma: 0.97 S/m (+/-5%)
ConvF	
Channel X: 6.4	7%(K=2)
Channel Y: 6.4	7%(K=2)
Channel Z: 6.4	7%(K=2)

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 M Ω .

Boundary Effect:

For a distance of 2.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Test Equipment

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



Chunghwa Telecom CO., Ltd
Telecommunication Laboratories
Testing & Certification Center

TEL : +886 3 4244445
FAX : +886 3 4202444
ADDR. : 12, Lane 551, Min-Tsu Road Sec. 5
Yang-Mei, Taoyuan, Taiwan, R.O.C.
E-mail: tsd@cht.com.tw <http://www.chttl.com.tw>

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-943

Client: CHTTL

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.

Equipment: Miniature Isotropic RF Probe 1800 MHz

Manufacturer: APREL Laboratories

Model No.: ALS-E-020

Serial No.: 257

HEAD Calibration

Calibration Procedure: SSVDDB-TP-D01-032-E020-V2

Project No: SCL-ALS-E020-CAL-5305

Calibrated: 11th December 2008

Released on: 12th December 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 1G6

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



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 257.

References

- SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
- IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Experimental Techniques"
- SSI-TP-011 Tissue Calibration Procedure
- IEC 62209 "Human exposure to radio frequency fields from hand-held and Head-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

Conditions

Probe 257 is a re-calibration.

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

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



Stuart Nicol



Jesse Hones



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories

Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	257
Frequency:	1800 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories

Sensitivity in Head Tissue

Frequency:	1800 MHz
Epsilon: 40.0 (+/-5%)	Sigma: 1.40 S/m (+/-5%)

ConvF

Channel X: 5.5
Channel Y: 5.5
Channel Z: 5.5

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq.

Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.44mm.

Spatial Resolution:

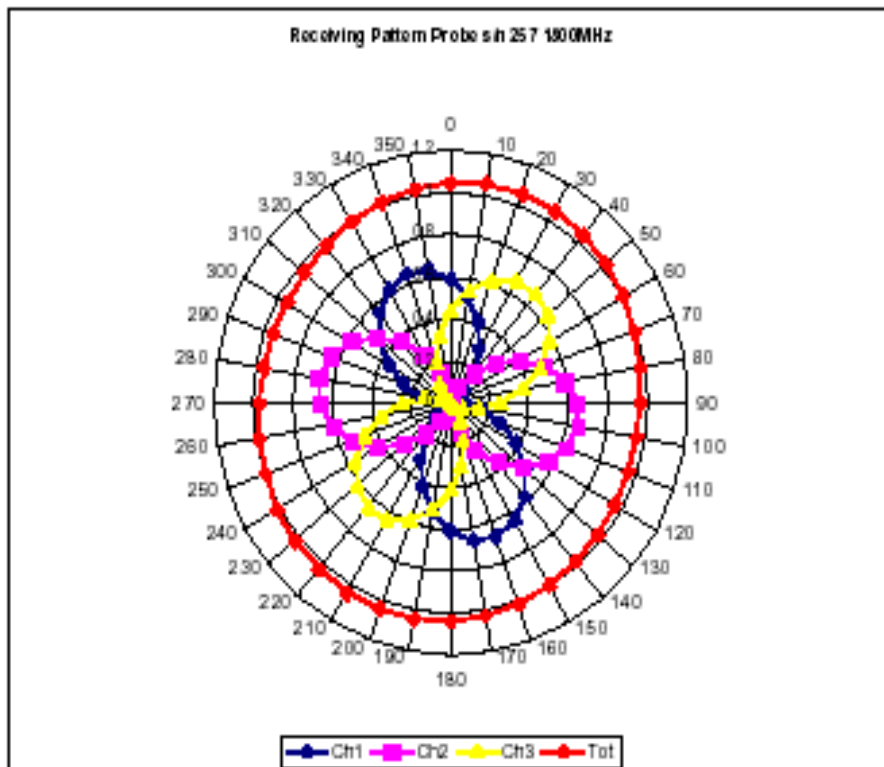
The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories

Receiving Pattern 1800 MHz (Air)

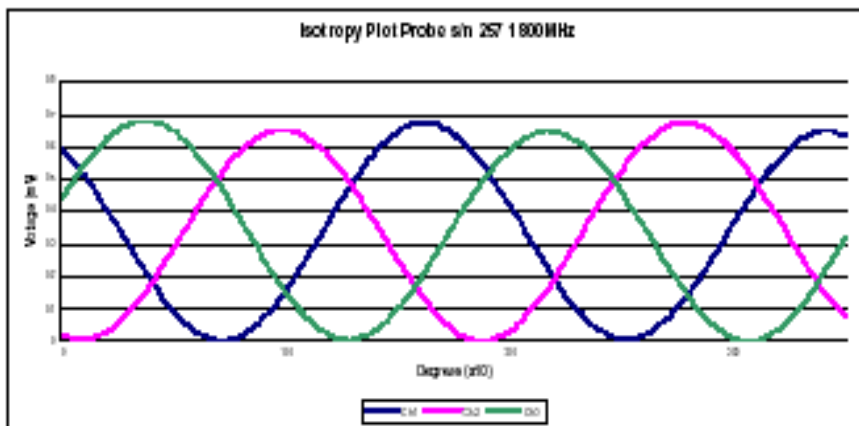
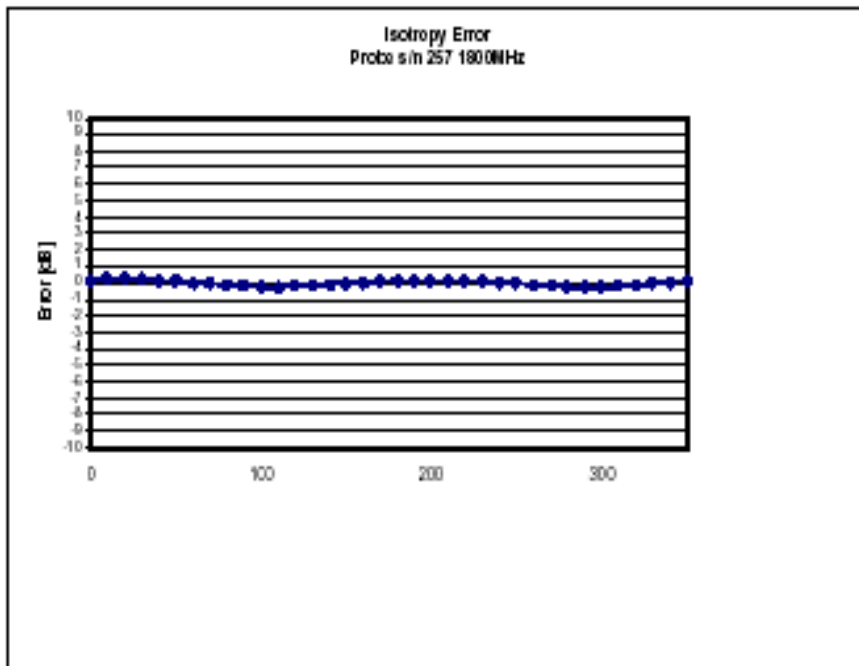


Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories

Isotropy Error 1800 MHz (Air)



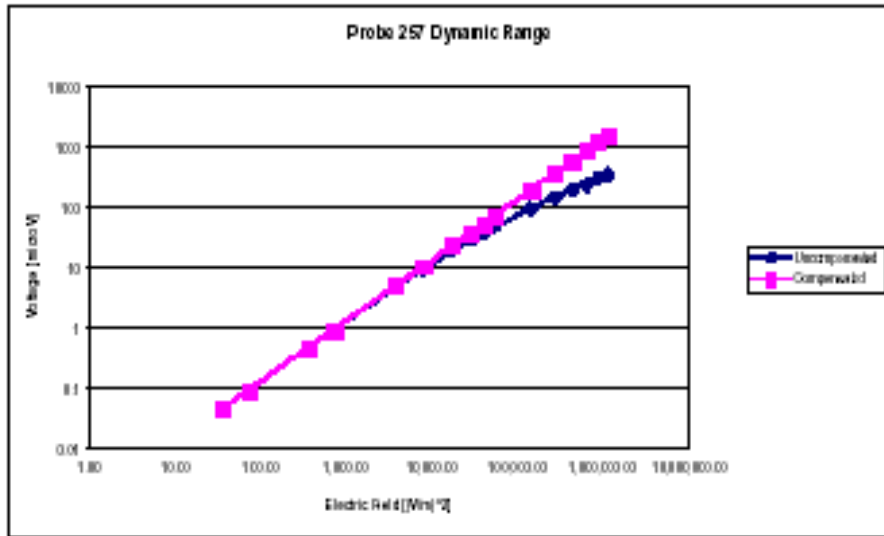
Isotropy in Tissue: 0.10 dB

Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories

Dynamic Range





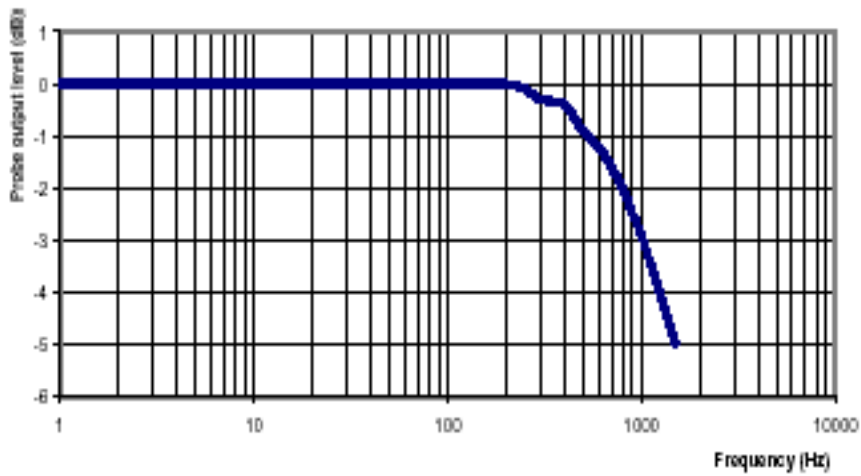
Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories

Video Bandwidth

Probe Frequency Characteristics



Video Bandwidth at 500 Hz 1 dB
Video Bandwidth at 1000 Hz 3 dB



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories

Conversion Factor Uncertainty Assessment

Frequency:	1800MHz
Epsilon: 40.0 (+/-5%)	Sigma: 1.40 S/m (+/-5%)
ConvF	
Channel X: 5.5	7%(K=2)
Channel Y: 5.5	7%(K=2)
Channel Z: 5.5	7%(K=2)

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 MΩ.

Boundary Effect:

For a distance of 2.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.



Report No : TSC-98-10-AP-15-FCC (SAR)

NCL Calibration Laboratories

Division of APREL Laboratories.

Test Equipment

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