

SAR EVALUATION REPORT

For

AMGOO TELECOM (Shenzhen) CO.,LTD

3/F,Block R2-A(North),Gaoxin S. Ave. 4th,Hi-Tech Industrial Park,
Nanshan District,Shenzhen,China

FCC ID: UOSAM241F

Report Type: Original Report	Product Type: Feature Phone
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Report Number: RSZ141201005-20	
Report Date: 2014-12-11	
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Attestation of Test Results		
EUT Information	Company Name	AMGOO TELECOM (Shenzhen) CO.,LTD
	EUT Description	Feature Phone
	FCC ID	UOSAM241F
	Model Number	AM241F
	Test Date	2014-12-02
Frequency	Max. SAR Level(s) Reported	Limit(W/Kg)
GSM 850	0.540 W/kg 1g Head SAR 0.772 W/kg 1g Body SAR	1.6
PCS 1900	0.166 W/kg 1g Head SAR 0.560 W/kg 1g Body SAR	
Simultaneous	0.764 W/kg 1g Head SAR 0.845 W/kg 1g Body SAR	
Applicable Standards	ANSI / IEEE C95.1 : 2005 IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields,3 kHz to 300 GHz.	
	ANSI / IEEE C95.3 : 2002 IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields,100 kHz—300 GHz.	
	IEEE1528:2013 IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques	
	KDB procedures KDB 447498 D01 Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies. KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets KDB 865664 D01 SAR Measurement Requirements for 100 MHz to 6 GHz	
<p>Note: This wireless device has been shown to be capable of compliance for localized specific absorption rate (SAR) for General Population/Uncontrolled Exposure limits specified in ANSI/IEEE Standards and has been tested in accordance with the measurement procedures specified in IEEE 1528-2013 and RF exposure KDB procedures.</p> <p>The results and statements contained in this report pertain only to the device(s) evaluated.</p>		

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY	5
EUT DESCRIPTION	6
TECHNICAL SPECIFICATION	6
REFERENCE, STANDARDS, AND GUIDELINES	7
SAR LIMITS	8
FACILITIES.....	9
DESCRIPTION OF TEST SYSTEM	10
EQUIPMENT LIST AND CALIBRATION	17
EQUIPMENTS LIST & CALIBRATION INFORMATION	17
SAR MEASUREMENT SYSTEM VERIFICATION	18
LIQUID VERIFICATION	18
SYSTEM ACCURACY VERIFICATION	21
SAR SYSTEM VALIDATION DATA	22
EUT TEST STRATEGY AND METHODOLOGY	30
TEST POSITIONS FOR DEVICE OPERATING NEXT TO A PERSON’S EAR.....	30
CHEEK/TOUCH POSITION	31
EAR/TILT POSITION	31
TEST POSITIONS FOR BODY-WORN AND OTHER CONFIGURATIONS	32
SAR EVALUATION PROCEDURE.....	33
TEST METHODOLOGY	33
CONDUCTED OUTPUT POWER MEASUREMENT	34
PROVISION APPLICABLE	34
TEST PROCEDURE	34
MAXIMUM OUTPUT POWER AMONG PRODUCTION UNITS	34
TEST RESULTS:	35
SAR MEASUREMENT RESULTS.....	37
SAR TEST DATA.....	37
SAR SIMULTANEOUS TRANSMISSION DESCRIPTION	39
SAR PLOTS (SUMMARY OF THE HIGHEST SAR VALUES)	41
APPENDIX A MEASUREMENT UNCERTAINTY	45
APPENDIX B – PROBE CALIBRATION CERTIFICATES.....	46
APPENDIX C DIPOLE CALIBRATION CERTIFICATES	56
APPENDIX D EUT TEST POSITION PHOTOS	74
LIQUID DEPTH 15CM.....	74
BODY-WORN BACK SETUP PHOTO (15MM).....	74
LEFT HEAD TOUCH SETUP PHOTO	75
LEFT HEAD TILT SETUP PHOTO	75
RIGHT HEAD TOUCH SETUP PHOTO	76
RIGHT HEAD TILT SETUP PHOTO	76
APPENDIX E EUT PHOTOS.....	77
EUT – FRONT VIEW.....	77
EUT – BACK VIEW	77
EUT –LEFT SIDE VIEW	78
EUT – RIGHT SIDE VIEW	78

EUT – TOP VIEW 79
EUT – BOTTOM VIEW..... 79
EUT – UNCOVER VIEW..... 80
APPENDIX F INFORMATIVE REFERENCES 81

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RSZ141201005-20	Original Report	2014-12-11

EUT DESCRIPTION

This report has been prepared on behalf of AMGOO TELECOM (Shenzhen) CO.,LTD and their product, FCC ID: UOSAM241, Model: AM241F or the EUT (Equipment under Test) as referred to in the rest of this report.

Technical Specification

Product Type	Portable
Exposure Category:	Population / Uncontrolled
Antenna Type(s):	Internal Antenna
Body-Worn Accessories:	Headset
Face-Head Accessories:	None
Multi-slot Class:	Class 12
Operation Mode :	GSM Voice, GPRS Data and Bluetooth
Frequency Band:	GSM 850 : 824-849 MHz(TX) ; 869-894 MHz(RX) PCS 1900: 1850-1910 MHz(TX) ; 1930-1990 MHz(RX) Bluetooth : 2402MHz-2480MHz
Conducted RF Power:	GSM 850 : 31.71 dBm PCS 1900: 28.52 dBm Bluetooth: 7.21dBm
Dimensions (L*W*H):	106 mm (L) × 53 mm (W) × 17 mm (H)
Power Source:	3.7 V _{DC} Rechargeable Battery
Normal Operation:	Head and Body-worn

REFERENCE, STANDARDS, AND GUIDELINES

FCC:

The Report and Order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ANSI/IEEE standard C95.1-1992 [6] for an uncontrolled environment (Paragraph 65). According to the Supplement C of OET Bulletin 65 "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g average over 1 gram of tissue mass.

CE:

The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 2 mW/g as recommended by EN62209-1 for an uncontrolled environment. According to the Standard, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in Europe is 2 mW/g average over 10 gram of tissue mass.

The test configurations were laid out on a specially designed test fixture to ensure the reproducibility of measurements. Each configuration was scanned for SAR. Analysis of each scan was carried out to characterize the above effects in the device.

SAR Limits

FCC Limit (1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

CE Limit (10g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 10 g of tissue)	2.0	10
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

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

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

General Population/Uncontrolled environments Spatial Peak limit 1.6W/kg (FCC) & 2 W/kg (CE) applied to the EUT.

FACILITIES

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect data is located at 6/F, the 3rd Phase of WanLi Industrial Building, Shi Hua Road, Fu Tian Free Trade Zone, Shenzhen, Guangdong, P.R. of China

DESCRIPTION OF TEST SYSTEM

These measurements were performed with ALSAS 10 Universal Integrated SAR Measurement system from APREL Laboratories.

ALSAS-10U System Description

ALSAS-10-U is fully compliant with the technical and scientific requirements of IEEE 1528, IEC 62209, 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.

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 maxima 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.

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.

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 5x5x8 (8mmx8mmx5mm) providing a volume of 32mm³ in the X & Y axis, and 35mm in the Z axis.



ALSAS-10U Interpolation and Extrapolation Uncertainty

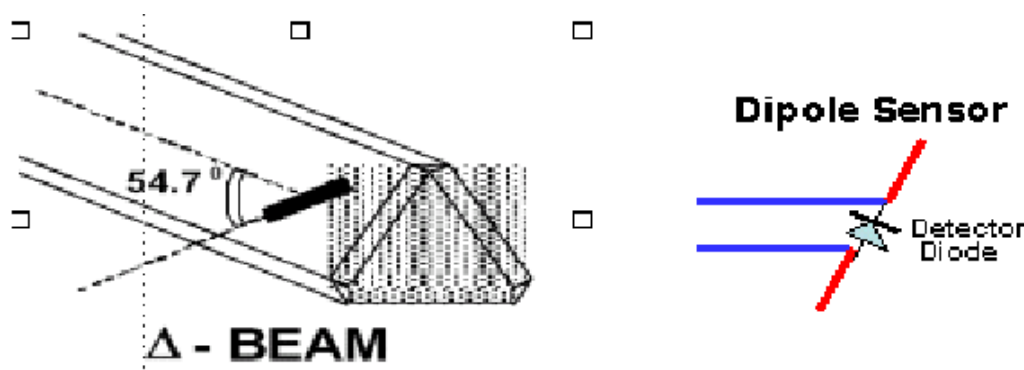
The overall uncertainty for the methodology and algorithms the used during the SAR calculation was evaluated using the data from IEEE 1528 based on the example f3 algorithm:

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

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.

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



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.

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

Isotropic E-Field Probe Specification

Calibration Method	Frequency Dependent Below 1 GHz Calibration in air performed in a TEM Cell Above 1 GHz 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 100 W/kg
Isotropic Response	Better than 0.1 dB
Diode Compression Point (DCP)	Calibration for Specific Frequency
Probe Tip Diameter	< 2.9 mm
Sensor Offset	1.56 (+/- 0.02 mm)
Probe Length	289 mm
Video Bandwidth	@ 500 Hz: 1 dB @ 1.02 kHz: 3 dB
Boundary Effect	Less than 2.1% for distance greater than 0.58 mm
Spatial Resolution	The spatial resolution uncertainty is less than 1.5% for 4.9mm diameter probe. The spatial resolution uncertainty is less than 1.0% for 2.5mm diameter probe

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.

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 μV 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	20 mV to 200 mV and 150 mV to 800 mV
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

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	0.05 mm
Controller Type	Single phase Pentium based C500C
Robot Reach	710 mm
Communication	RS232 and LAN compatible

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.

Universal Device Positioner

The universal device positioner allows complete freedom of movement of the EUT. Developed to hold a EUT in a free-space scenario any additional loading attributable to the material used in the construction of the positioner has been eliminated. Repeatability has been enhanced through the linear scales which form the design used to indicate positioning for any given test scenario in all major axes. A 15° tilt indicator is included for the of aid cheek to tilt movements for head SAR analysis. Overall uncertainty for measurements have been reduced due to the design of the Universal device positioner, which allows positioning of a device in as near to a free-space scenario as possible, and by providing the means for complete repeatability.

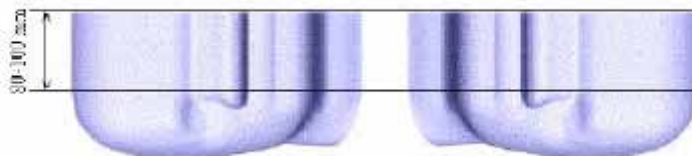


Phantom Types

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

APREL SAM Phantoms

The SAM phantoms developed using the IEEE SAM CAD file. They are fully compliant with the requirements for both IEEE 1528 and FCC Supplement C. Both the left and right SAM phantoms are interchangeable, transparent and include the IEEE 1528 grid with visible NF and MB lines.



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.



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.

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

Recommended Tissue Dielectric Parameters for Head and Body

Frequency (MHz)	Head Tissue		Body Tissue	
	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

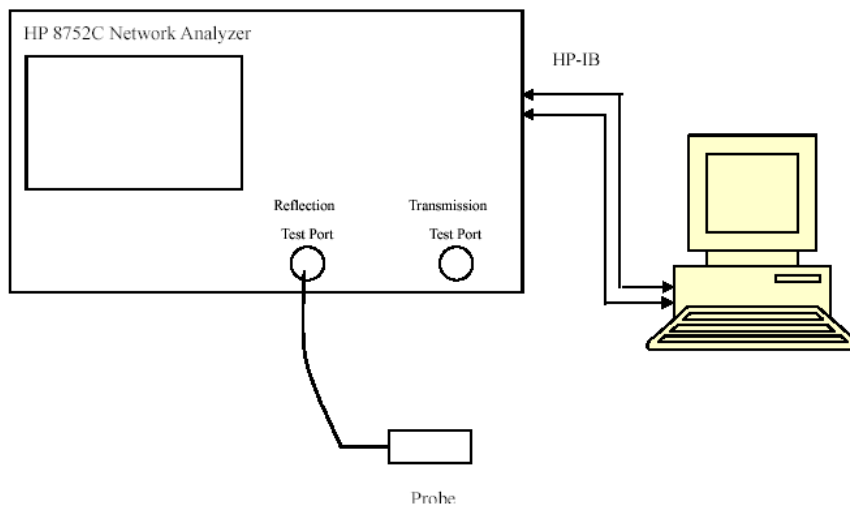
EQUIPMENT LIST AND CALIBRATION

Equipments List & Calibration Information

Equipment	Model	Calibration Date	S/N
CRS F3 robot	ALS-F3	N/A	RAF0805352
CRS F3 Software	ALS-F3-SW	N/A	N/A
CRS C500C controller	ALS-C500	N/A	RCF0805379
Probe mounting device & Boundary Detection Sensor System	ALS-PMDPS-3	N/A	120-00270
Universal Work Station	ALS-UWS	N/A	100-00157
Data Acquisition Package	ALS-DAQ-PAQ-3	2014-10-14	110-00212
Miniature E-Field Probe	ALS-E-020	2014-10-14	500-00283
Dipole, 835MHz	ALS-D-835-S-2	2014-10-08	180-00558
Dipole, 1900MHz	ALS-D-1900-S-2	2014-10-09	210-00710
Dipole Spacer	ALS-DS-U	N/A	250-00907
Device holder/Positioner	ALS-H-E-SET-2	N/A	170-00510
Left ear SAM phantom	ALS-P-SAM-L	N/A	130-00311
Right ear SAM phantom	ALS-P-SAM-R	N/A	140-00359
UniPhantom	ALS-P-UP-1	N/A	150-00413
Simulated Tissue 835 MHz Head	ALS-TS-835-H	Each Time	270-01002
Simulated Tissue 835 MHz Body	ALS-TS-835-B	Each Time	270-02101
Simulated Tissue 1900 MHz Head	ALS-TS-1900-H	Each Time	295-01103
Simulated Tissue 1900 MHz Body	ALS-TS-1900-B	Each Time	295-02102
Directional couple	DC6180A	N/A	0325849
Power Amplifier	5S1G4	N/A	71377
Dielectric probe kit	HP85070B	2014-06-13	N/A
Attenuator	3dB	2014-05-08	5402
Network analyzer	8752C	2014-06-03	3410A02356
Synthesized Sweeper	HP 8341B	2014-06-03	2624A00116
UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	2013-11-23	106891
EMI Test Receiver	ESCI	2014-06-13	101746

SAR MEASUREMENT SYSTEM VERIFICATION

Liquid Verification



Liquid Verification Setup Block Diagram

Liquid Verification Results

Frequency	Liquid Type	Liquid Parameter		Target Value		Delta (%)		Tolerance (%)
		ϵ_r	σ (S/m)	ϵ_r	σ (S/m)	$\Delta\epsilon_r$	$\Delta\sigma$ (S/m)	
824.2	Head	41.15	0.90	41.50	0.90	-0.843	0.000	±5
	Body	53.94	0.94	55.20	0.97	-2.283	-3.093	±5
836.6	Head	41.21	0.91	41.50	0.90	-0.699	1.111	±5
	Body	53.93	0.95	55.20	0.97	-2.301	-2.062	±5
848.8	Head	41.12	0.91	41.50	0.90	-0.916	1.111	±5
	Body	53.85	0.97	55.20	0.97	-2.446	0.000	±5
1850.2	Head	39.80	1.37	40.00	1.40	-0.500	-2.143	±5
	Body	52.20	1.46	53.30	1.52	-2.064	-3.947	±5
1880.0	Head	39.77	1.38	40.00	1.40	-0.575	-1.429	±5
	Body	52.02	1.48	53.30	1.52	-2.402	-2.632	±5
1909.8	Head	39.68	1.41	40.00	1.40	-0.800	0.714	±5
	Body	51.94	1.51	53.30	1.52	-2.552	-0.658	±5

*Liquid Verification was performed on 2014-12-02.

Please refer to the following tables.

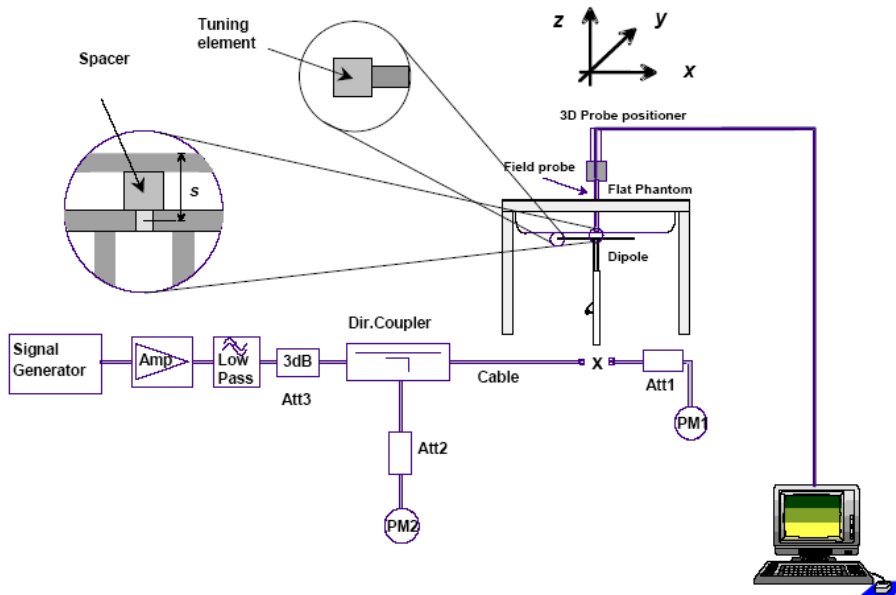
835 MHz Head			835 MHz Body		
Frequency (MHz)	e'	e''	Frequency (MHz)	e'	e''
824.0	41.1497	19.5801	824.0	53.9401	20.4077
824.5	41.2415	19.5588	824.5	54.0012	20.3249
825.0	41.1210	19.5711	825.0	53.8726	20.4277
825.5	41.1364	19.6490	825.5	54.0090	20.4194
826.0	41.0514	19.6170	826.0	53.9107	20.4520
826.5	41.2040	19.6076	826.5	53.9197	20.4305
827.0	41.1046	19.6044	827.0	54.0261	20.3380
827.5	41.1095	19.5870	827.5	54.0591	20.4237
828.0	41.1712	19.6587	828.0	53.8808	20.4073
828.5	41.1463	19.6249	828.5	54.0000	20.3136
829.0	41.2045	19.6050	829.0	53.9168	20.3872
829.5	41.1371	19.6573	829.5	53.9418	20.3921
830.0	41.1709	19.5516	830.0	53.9314	20.4417
830.5	41.1614	19.5810	830.5	53.9094	20.4607
831.0	41.1250	19.5635	831.0	53.9249	20.4163
831.5	41.0439	19.5948	831.5	54.0142	20.4358
832.0	41.1324	19.6829	832.0	54.0056	20.4609
832.5	41.1773	19.6001	832.5	54.0171	20.3966
833.0	41.1362	19.5524	833.0	53.8936	20.4440
833.5	41.1619	19.6091	833.5	54.0045	20.4005
834.0	41.1790	19.5809	834.0	53.9253	20.4225
834.5	41.1616	19.5674	834.5	53.9812	20.3807
835.0	41.1470	19.6477	835.0	53.9995	20.3261
835.5	41.1281	19.6209	835.5	53.9776	20.4235
836.0	41.1791	19.6363	836.0	53.9021	20.3592
836.5	41.2107	19.5950	836.5	53.9252	20.3770
837.0	41.1853	19.5834	837.0	53.9474	20.4330
837.5	41.1466	19.5372	837.5	53.9597	20.3763
838.0	41.1899	19.5644	838.0	53.9507	20.4419
838.5	41.1122	19.6056	838.5	53.9524	20.4086
839.0	41.1634	19.5541	839.0	53.9530	20.4294
839.5	41.1486	19.4933	839.5	54.0063	20.4566
840.0	41.1286	19.3516	840.0	53.9636	20.4405
840.5	41.2340	19.3512	840.5	53.9136	20.4574
841.0	41.1942	19.3524	841.0	53.9559	20.3303
841.5	41.1483	19.2919	841.5	53.9673	20.4473
842.0	41.1545	19.2967	842.0	53.9898	20.3388
842.5	41.2064	19.3874	842.5	53.9279	20.3879
843.0	41.1817	19.3702	843.0	53.9403	20.3438
843.5	41.1456	19.2404	843.5	53.8654	20.3716
844.0	41.1362	19.2777	844.0	53.9499	20.4178
844.5	41.0893	19.2825	844.5	54.0506	20.4263
845.0	41.1785	19.3423	845.0	53.9658	20.3639
845.5	41.2365	19.3373	845.5	53.9141	20.3458
846.0	41.1161	19.3353	846.0	53.9227	20.3403
846.5	41.2060	19.3512	846.5	53.9163	20.4851
847.0	41.1683	19.2637	847.0	53.9109	20.4444
847.5	41.1559	19.3289	847.5	53.9524	20.4460
848.0	41.1798	19.3117	848.0	53.9675	20.4330
848.5	41.1173	19.2725	848.5	53.9261	20.4433
849.0	41.1235	19.2439	849.0	53.8521	20.5067

1900 MHz Head				1900 MHz Body		
Frequency (MHz)	e'	e''		Frequency (MHz)	e'	e''
1850.0	39.8049	13.2815		1850.0	52.1972	14.1821
1851.2	39.7730	13.2061		1851.2	52.1181	14.0546
1852.4	39.7183	13.2090		1852.4	51.9759	14.1678
1853.6	39.7839	13.2610		1853.6	51.9369	14.1286
1854.8	39.7105	13.2166		1854.8	51.9340	14.2302
1856.0	39.7632	13.2860		1856.0	52.1586	14.0965
1857.2	39.7968	13.1888		1857.2	51.9813	14.2141
1858.4	39.8377	13.1521		1858.4	52.1173	14.0762
1859.6	39.6995	13.2471		1859.6	51.9412	14.1333
1860.8	39.8031	13.1692		1860.8	51.9638	14.2013
1862.0	39.7662	13.2728		1862.0	52.1227	14.1773
1863.2	39.7308	13.2948		1863.2	52.2325	14.2111
1864.4	39.6850	13.2049		1864.4	52.0643	14.0944
1865.6	39.6386	13.1418		1865.6	52.1278	14.1831
1866.8	39.7275	13.2895		1866.8	52.2307	14.1715
1868.0	39.7616	13.2554		1868.0	51.9666	14.1444
1869.2	39.8173	13.2302		1869.2	51.8443	14.1150
1870.4	39.6501	13.1853		1870.4	51.9460	14.1529
1871.6	39.7368	13.2011		1871.6	52.1115	14.2550
1872.8	39.7741	13.2714		1872.8	52.1959	14.1362
1874.0	39.7911	13.2963		1874.0	52.2685	14.0906
1875.2	39.7973	13.3536		1875.2	52.0621	14.1275
1876.4	39.6455	13.3460		1876.4	52.1107	14.1605
1877.6	39.6790	13.1897		1877.6	52.1728	14.1569
1878.8	39.6981	13.2941		1878.8	52.1359	14.1526
1880.0	39.7657	13.2164		1880.0	52.0170	14.1746
1881.2	39.8027	13.2598		1881.2	51.8544	14.1596
1882.4	39.7448	13.2170		1882.4	52.0872	14.1591
1883.6	39.7399	13.1453		1883.6	52.0184	14.0818
1884.8	39.8852	13.1002		1884.8	52.0610	14.1902
1886.0	39.6907	13.1718		1886.0	52.1804	14.0939
1887.2	39.6509	13.2549		1887.2	52.1027	14.1852
1888.4	39.7847	13.3238		1888.4	52.0082	14.1869
1889.6	39.8036	13.2769		1889.6	52.1068	14.1219
1890.8	39.8399	13.3096		1890.8	51.9571	14.0881
1892.0	39.6564	13.3057		1892.0	51.9142	14.2711
1893.2	39.7375	13.2095		1893.2	51.9174	14.2463
1894.4	39.6706	13.1056		1894.4	52.0511	14.1869
1895.6	39.8584	13.3094		1895.6	52.1014	14.1971
1896.8	39.8400	13.1466		1896.8	52.0660	14.0638
1898.0	39.6488	13.1465		1898.0	52.1803	14.1712
1899.2	39.7651	13.2511		1899.2	52.2318	14.1049
1900.4	39.7812	13.3460		1900.4	52.2695	14.1897
1901.6	39.8481	13.1827		1901.6	52.1569	14.1237
1902.8	39.7706	13.2246		1902.8	52.1343	14.2778
1904.0	39.6859	13.1766		1904.0	52.0310	14.0881
1905.2	39.6796	13.2727		1905.2	52.1527	14.0715
1906.4	39.8227	13.1804		1906.4	52.1484	14.2814
1907.6	39.6757	13.2701		1907.6	51.9378	14.0922
1908.8	39.8449	13.1649		1908.8	52.2344	14.1217
1910.0	39.6754	13.2889		1910.0	51.9368	14.2142

System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of $\pm 10\%$. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

System Verification Setup Block Diagram



Probe and dipole antenna List and Detail

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
APREL	Probe	ALS-E-020	500-00283	2014-10-14	2015-10-13
APREL	Dipole antenna(835MHz)	ALS-D-835-S-2	180-00558	2014-10-08	2017-10-07
APREL	Dipole antenna(1900MHz)	ALS-D-1900-S-2	210-00710	2014-10-09	2017-10-08

System Accuracy Check Results

Date	Frequency Band	Liquid Type	Measured SAR (W/Kg)		Target Value (W/Kg)	Delta (%)	Tolerance (%)
2014-12-02	835	Head	1g	10.337	9.773	5.771	± 10
		Body	1g	9.932	9.736	2.013	± 10
	1900	Head	1g	40.039	39.481	1.413	± 10
		Body	1g	40.527	39.715	2.045	± 10

*All SAR values are normalized to 1 Watt forward power.

SAR SYSTEM VALIDATION DATA**Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)****System Performance Check 835 MHz Head Liquid****Dipole 835 MHz; Type: ALS-D-835-S-2; S/N: 180-00558**

Product Data

Device Name : Dipole 835 MHz
Serial No. : 180-00558
Type : Dipole
Model : ALS-D-835-S-2
Frequency Band : 835
Max. Transmit Pwr : 1 W
Drift Time : 3 min(s)
Power Drift-Start : 9.725 W/kg
Power Drift-Finish : 9.765 W/kg
Power Drift (%) : 0.411

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Serial No. : System Default
Location : Center
Description : Default
Phantom Data

Tissue Data

Type : Head
Serial No. : 270-01002
Frequency : 835.0 MHz
Last Calib. Date : 02-Dec-2014
Temperature : 20.00 °C
Ambient Temp. : 21.00 °C
Humidity : 56.00 RH%
Epsilon : 41.08 F/m
Sigma : 0.92 S/m
Density : 1000.00 kg/cu. m

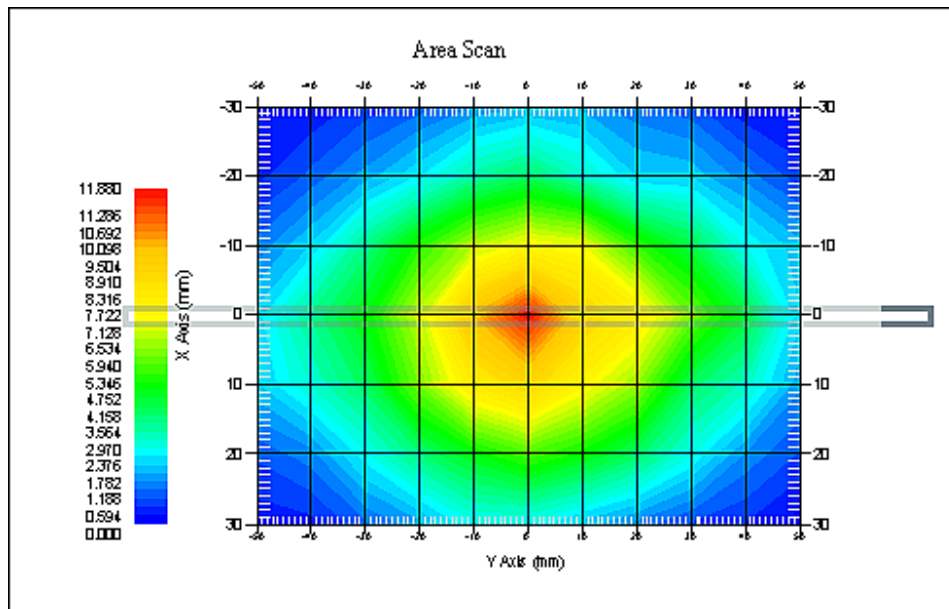
Probe Data

Name : E-Field
Model : E-020
Type : E-Field Triangle
Serial No. : 500-00283
Last Calib. Date : 14-Oct-2014
Frequency Band : 835
Duty Cycle Factor : 1
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

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 21.00 °C
Ambient Temp. : 21.00 °C
Area Scan : 7x9x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm

1 gram SAR value : 10.337 W/kg
10 gram SAR value : 6.955 W/kg
Area Scan Peak SAR : 11.585 W/kg
Zoom Scan Peak SAR : 16.327 W/kg



835 MHz System Validation with Head Tissue

Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)**System Performance Check 835 MHz Body Liquid****Dipole 835 MHz; Type: ALS-D-835-S-2; S/N: 180-00558**

Product Data

Device Name : Dipole 835 MHz
Serial No. : 180-00558
Type : Dipole
Model : ALS-D-835-S-2
Frequency Band : 835
Max. Transmit Pwr : 1 W
Drift Time : 3 min(s)
Power Drift-Start : 10.557 W/kg
Power Drift-Finish : 10.422 W/kg
Power Drift (%) : -1.279

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Serial No. : System Default
Location : Center
Description : Default
Phantom Data

Tissue Data

Type : Body
Serial No. : 270-02101
Frequency : 835.0 MHz
Last Calib. Date : 02-Dec-2014
Temperature : 20.00 °C
Ambient Temp. : 21.00 °C
Humidity : 56.00 RH%
Epsilon : 53.91 F/m
Sigma : 0.96 S/m
Density : 1000.00 kg/cu. m

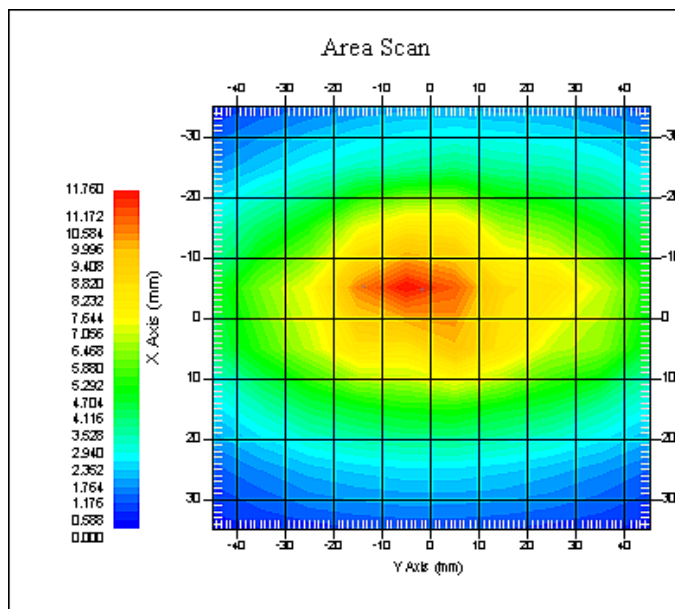
Probe Data

Name : E-Field
Model : E-020
Type : E-Field Triangle
Serial No. : 500-00283
Last Calib. Date : 14-Oct-2014
Frequency Band : 835
Duty Cycle Factor : 1
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

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 21.00 °C
Ambient Temp. : 21.00 °C
Area Scan : 7x9x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm

1 gram SAR value : 9.932 W/kg
10 gram SAR value : 6.592 W/kg
Area Scan Peak SAR : 11.751 W/kg
Zoom Scan Peak SAR : 15.858 W/kg



835 MHz System Validation with Body Tissue

Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)**System Performance Check 1900 MHz Head Liquid****Dipole 1900 MHz; Type: ALS-D-1900-S-2; S/N: 210-00710**

Product Data

Device Name : Dipole 1900MHz
Serial No. : 210-00710
Type : Dipole
Model : ALS-D-1900-S-2
Frequency Band : 1900
Max. Transmit Pwr : 1 W
Drift Time : 3 min(s)
Power Drift-Start : 39.862 W/kg
Power Drift-Finish : 39.631 W/kg
Power Drift (%) : -0.579

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Serial No. : System Default
Location : Center
Description : Default

Tissue Data

Type : Head
Serial No. : 295-01103
Frequency : 1900.00 MHz
Last Calib. Date : 02-Dec-2014
Temperature : 20.00 °C
Ambient Temp. : 21.00 °C
Humidity : 56.00 RH%
Epsilon : 39.68 F/m
Sigma : 1.42 S/m
Density : 1000.00 kg/cu. M

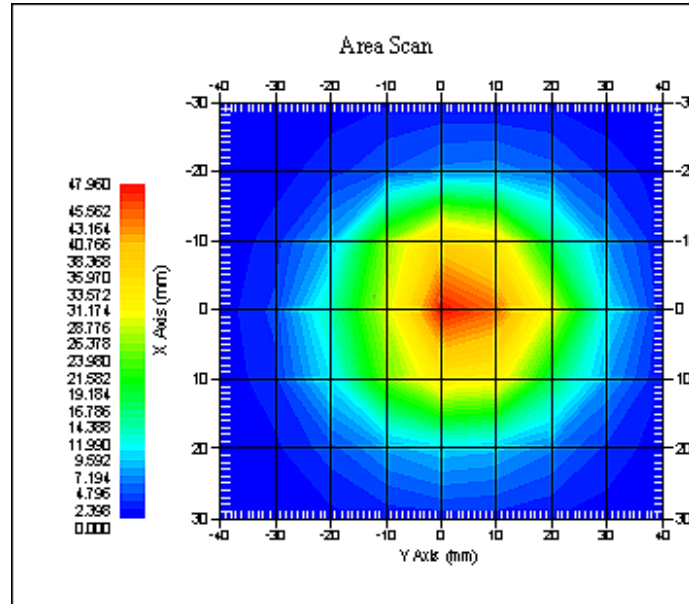
Probe Data

Name : E-Field
Model : E-020
Type : E-Field Triangle
Serial No. : 500-00283
Last Calib. Date : 14-Oct-2014
Frequency Band : 1900
Duty Cycle Factor : 1
Conversion Factor : 4.8
Probe Sensitivity : 1.20 1.20 1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
Compression Point : 95.00 mV
Offset : 1.56 mm

Measurement Data

Crest Factor : 1
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 20.00 °C
Area Scan : 7x9x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm

1 gram SAR value : 40.039 W/kg
 10 gram SAR value : 21.531 W/kg
 Area Scan Peak SAR : 46.957 W/kg
 Zoom Scan Peak SAR : 79.857 W/kg



1900 MHz System Validation with Head Tissue

Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)**System Performance Check 1900 MHz Body Liquid****Dipole 1900 MHz; Type: ALS-D-1900-S-2; S/N: 210-00710**

Product Data

Device Name : Dipole 1900MHz
Serial No. : 210-00710
Type : Dipole
Model : ALS-D-1900-S-2
Frequency Band : 1900
Max. Transmit Pwr : 1 W
Drift Time : 3 min(s)
Power Drift-Start : 40.119 W/kg
Power Drift-Finish : 40.825 W/kg
Power Drift (%) : 1.760

Phantom Data

Name : APREL-Uni
Type : Uni-Phantom
Serial No. : System Default
Location : Center
Description : Default

Tissue Data

Type : Body
Serial No. : 295-02102
Frequency : 1900.00 MHz
Last Calib. Date : 02-Dec-2014
Temperature : 20.00 °C
Ambient Temp. : 21.00 °C
Humidity : 56.00 RH%
Epsilon : 52.13 F/m
Sigma : 1.51 S/m
Density : 1000.00 kg/cu. m

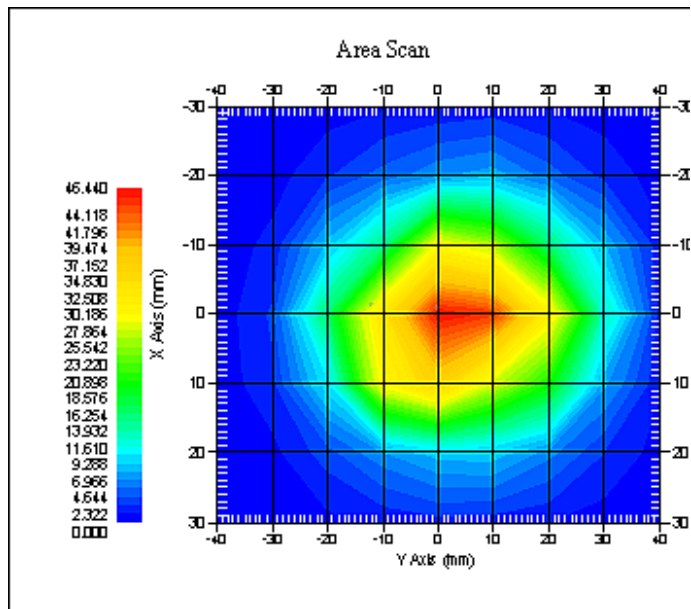
Probe Data

Name : E-Field
Model : E-020
Type : E-Field Triangle
Serial No. : 500-00283
Last Calib. Date : 14-Oct-2014
Frequency Band : 1900
Duty Cycle Factor : 1
Conversion Factor : 4.5
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
Scan Type : Complete
Tissue Temp. : 20.00 °C
Ambient Temp. : 21.00 °C
Area Scan : 7x9x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm

1 gram SAR value : 40.527 W/kg
10 gram SAR value : 21.315 W/kg
Area Scan Peak SAR : 45.837 W/kg
Zoom Scan Peak SAR : 79.852 W/kg



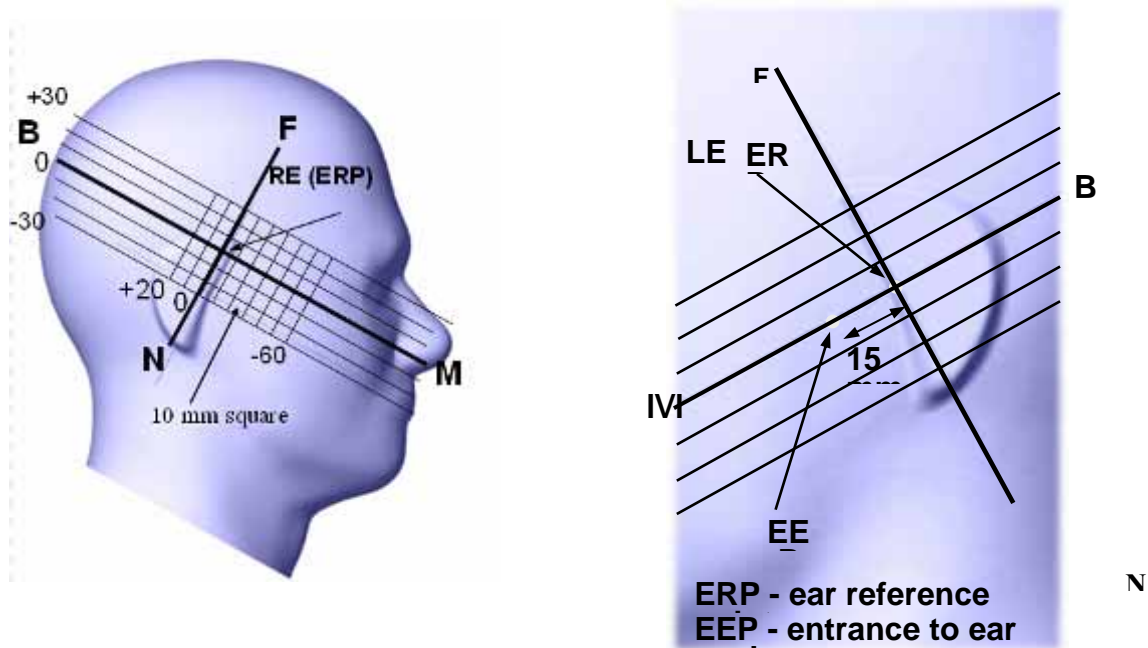
1900 MHz System Validation with Body Tissue

EUT TEST STRATEGY AND METHODOLOGY

Test Positions for Device Operating Next to a Person’s Ear

This category includes most wireless handsets with fixed, retractable or internal antennas located toward the top half of the device, with or without a foldout, sliding or similar keypad cover. The handset should have its earpiece located within the upper ¼ of the device, either along the centerline or off-centered, as perceived by its users. This type of handset should be positioned in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point”. The “test device reference point” should be located at the same level as the center of the earpiece region. The “vertical centerline” should bisect the front surface of the handset at its top and bottom edges. A “ear reference point” is located on the outer surface of the head phantom on each ear spacer. It is located 1.5 cm above the center of the ear canal entrance in the “phantom reference plane” defined by the three lines joining the center of each “ear reference point” (left and right) and the tip of the mouth.

A handset should be initially positioned with the earpiece region pressed against the ear spacer of a head phantom. For the SCC-34/SC-2 head phantom, the device should be positioned parallel to the “N-F” line defined along the base of the ear spacer that contains the “ear reference point”. For interim head phantoms, the device should be positioned parallel to the cheek for maximum RF energy coupling. The “test device reference point” is aligned to the “ear reference point” on the head phantom and the “vertical centerline” is aligned to the “phantom reference plane”. This is called the “initial ear position”. While maintaining these three alignments, the body of the handset is gradually adjusted to each of the following positions for evaluating SAR:



Cheek/Touch Position

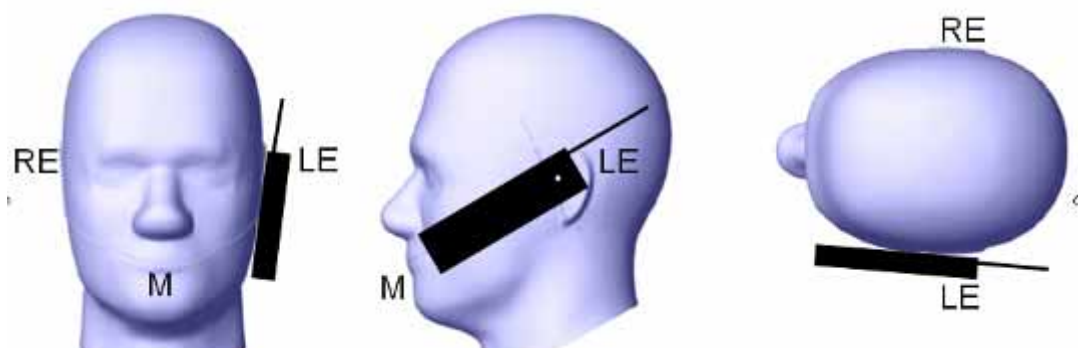
The device is brought toward the mouth of the head phantom by pivoting against the “ear reference point” or along the “N-F” line for the SCC-34/SC-2 head phantom.

This test position is established:

- When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.
- (or) When any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

For existing head phantoms – when the handset loses contact with the phantom at the pivoting point, rotation should continue until the device touches the cheek of the phantom or breaks its last contact from the ear spacer.

Cheek /Touch Position



Ear/Tilt Position

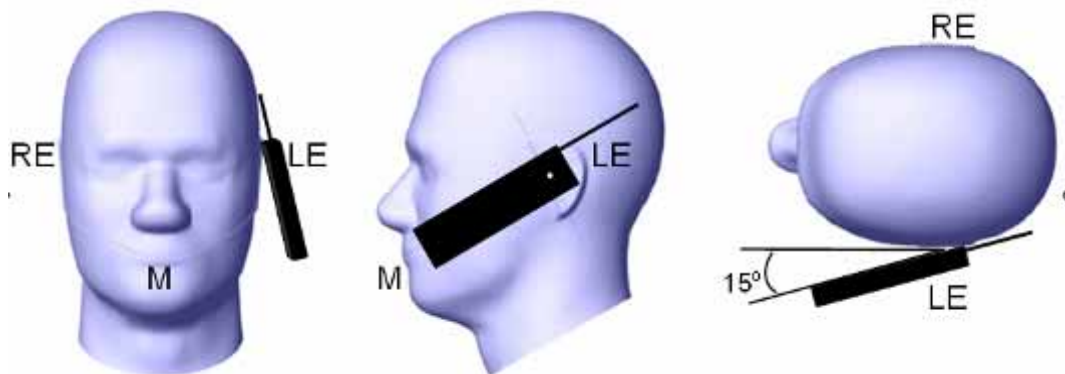
With the handset aligned in the “Cheek/Touch Position”:

1) If the earpiece of the handset is not in full contact with the phantom’s ear spacer (in the “Cheek/Touch position”) and the peak SAR location for the “Cheek/Touch” position is located at the ear spacer region or corresponds to the earpiece region of the handset, the device should be returned to the “initial ear position” by rotating it away from the mouth until the earpiece is in full contact with the ear spacer.

2) (otherwise) The handset should be moved (translated) away from the cheek perpendicular to the line passes through both “ear reference points” (note: one of these ear reference points may not physically exist on a split head model) for approximate 2-3 cm. While it is in this position, the device handset is tilted away from the mouth with respect to the “test device reference point” until the inside angle between the vertical centerline on the front surface of the phone and the horizontal line passing through the ear reference point is by 15 80°. After the tilt, it is then moved (translated) back toward the head perpendicular to the line passes through both “ear reference points” until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process should be repeated with a tilt angle less than 15° so that the device and its antenna would touch the phantom simultaneously. This test position may require a device holder or positioner to achieve the translation and tilting with acceptable positioning repeatability.

If a device is also designed to transmit with its keypad cover closed for operating in the head position, such positions should also be considered in the SAR evaluation. The device should be tested on the left and right side of the head phantom in the “Cheek/Touch” and “Ear/Tilt” positions. When applicable, each configuration should be tested with the antenna in its fully extended and fully retracted positions. These test configurations should be tested at the high, middle and low frequency channels of each operating mode; for example, AMPS, CDMA, and TDMA. If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tile/Ear, extended and retracted) is at least 2.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s). If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

Ear /Tilt 15° Position



Test positions for body-worn and other configurations

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. Devices with a headset output should be tested with a headset connected to the device. When multiple accessories that do not contain metallic components are supplied with the device, the device may be tested with only the accessory that dictates the closest spacing to the body. When multiple accessories that contain metallic components are supplied with the device, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (e.g., the same metallic belt-clip used with different holsters with no other metallic components), only the accessory that dictates the closest spacing to the body must be tested.

Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances. Other separation distances may be used, but they should not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

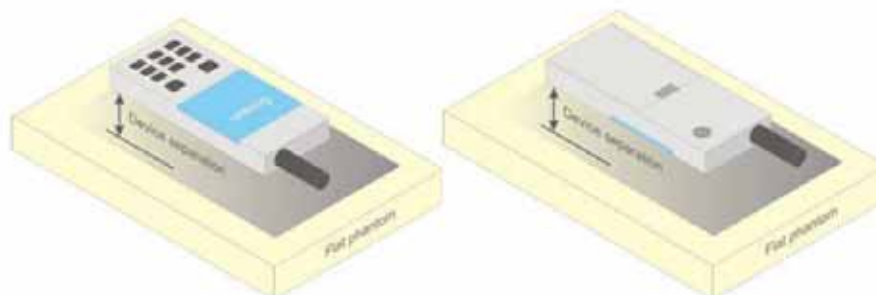


Figure 5 – Test positions for body-worn devices

SAR Evaluation Procedure

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location above the ear point or central position was used as a reference value for assessing the power drop. The SAR at this point is measured at the start of the test and then again at the end of the testing.

Step 2: The SAR distribution at the exposed side of the head was measured at a distance of 4 mm from the inner surface of the shell. The area covered the entire dimension of the head or EUT and the horizontal grid spacing was 10 mm x 10 mm. Based on these data, the area of the maximum absorption was determined by spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.

Step 3: Around this point, a volume of 35 mm x 35 mm x 35 mm was assessed by measuring 7x 7 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

- 1) The data at the surface were extrapolated, since the center of the dipoles is 1.2 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
- 2) The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one dimensional splines with the "Not a knot"-condition (in x, y and z-directions). The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the averages.

All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement of the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation was repeated.

Test methodology

KDB 447498 D01.
KDB 648474 D04
KDB 865664 D01

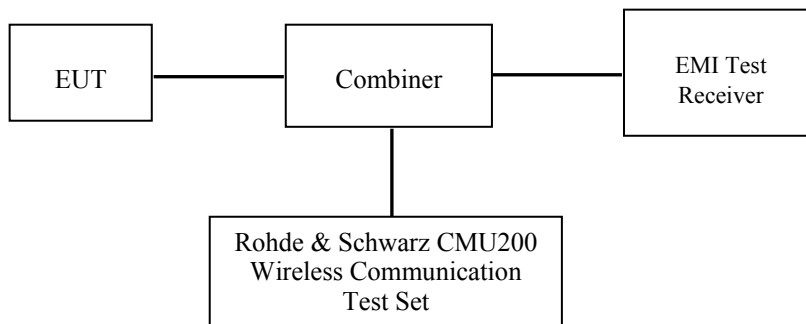
CONDUCTED OUTPUT POWER MEASUREMENT

Provision Applicable

The measured peak output power should be greater and within 5% than EMI measurement.

Test Procedure

The RF output of the transmitter was connected to the input of the EMI Test Receiver through sufficient attenuation.



GSM

Maximum Output Power among production units

Max Target Power for Production Unit (dBm)			
Mode/Band	Channel		
	Low	Middle	High
GSM 835	31.80	31.80	31.80
GPRS 1 slot	31.80	31.80	31.80
GPRS 2 slot	30.10	30.10	30.10
GPRS 3 slot	28.10	28.10	28.10
GPRS 4 slot	26.00	26.00	26.00
PCS 1900	28.60	28.60	28.60
GPRS 1 slot	28.60	28.60	28.60
GPRS 2 slot	26.70	26.70	26.70
GPRS 3 slot	25.10	25.10	25.10
GPRS 4 slot	23.00	23.00	23.00
Bluetooth	7.30	7.30	7.30

Test Results:

GSM:

Band	Frequency (MHz)	Conducted Output Power	
		Meas. Power (dBm)	Meas. Power (W)
GSM 850	824.2	31.37	1.371
	836.6	31.71	1.483
	848.8	31.65	1.462
PCS 1900	1850.2	28.40	0.692
	1880.0	28.52	0.711
	1909.8	28.43	0.697

GPRS:

Band	Channel No.	Frequency (MHz)	RF Output Power (dBm)			
			1 slot	2 slot	3 slots	4 slots
GSM 850	128	824.2	31.48	30.01	28.05	25.81
	190	836.6	31.61	29.97	27.97	25.70
	251	848.8	31.70	29.98	27.95	25.75
PCS 1900	512	1850.2	28.42	26.63	25.04	22.96
	661	1880.0	28.55	26.56	25.00	22.99
	810	1909.8	28.46	26.40	24.85	22.81

For SAR, the time based average power is relevant, the difference in between depends on the duty cycle of the TDMA signal.

Number of Time slot	1	2	3	4
Duty Cycle	1:8	1:4	1:2.66	1:2
Time based Ave. power compared to slotted Ave. power	-9 dB	-6 dB	-4.25 dB	-3 dB
Crest Factor	8	4	2.66	2

The time based average power for GPRS

Band	Channel No.	Frequency (MHz)	Time based average Power (dBm)			
			1 slot	2 slot	3 slots	4 slots
GSM 850	128	824.2	22.48	24.01	23.80	22.81
	190	836.6	22.61	23.97	23.72	22.70
	251	848.8	22.70	23.98	23.70	22.75
PCS 1900	512	1850.2	19.42	20.63	20.79	19.96
	661	1880.0	19.55	20.56	20.75	19.99
	810	1909.8	19.46	20.40	20.60	19.81

Note:

1. Rohde & Schwarz Radio Communication Tester (CMU200) was used for the measurement of GSM peak and average output power for active timeslots.
2. For GSM voice, 1 timeslot has been activated with power level 5 (850 MHz band) and 0 (1900 MHz band).
3. For GPRS, 1, 2, 3 and 4 timeslots has been activated separately with power level 3(850 MHz band) and 3(1900 MHz band).

Bluetooth

Mode	Channel frequency (MHz)	Conducted Output Power	
		(dBm)	(mw)
BDR(GFSK)	(Low)2402	5.52	3.565
	(Middle)2441	6.12	4.093
	(High)2480	6.34	4.305
EDR(4-DQPSK)	(Low)2402	6.60	4.571
	(Middle)2441	7.04	5.058
	(High)2480	7.15	5.188
EDR-8DPSK	(Low)2402	6.71	4.688
	(Middle)2441	7.11	5.140
	(High)2480	7.21	5.260

SAR MEASUREMENT RESULTS

This page summarizes the results of the performed dosimetric evaluation.

SAR Test Data

Environmental Conditions

Temperature:	21-24
Relative Humidity:	50-53 %
ATM Pressure:	1001-1002 mbar

Testing was performed by Wilson Chen on 2014-12-02

GSM 850:

EUT Position	Frequency (MHz)	Test Mode	Power Drift (%)	Max. Meas. Power (dBm)	Max. Rated Power (dBm)	FCC 1g SAR (W/Kg)			
						Scaled Factor	Meas. SAR	Scaled SAR	Plot
Left Head Cheek	824.2	GSM	-1.333	31.37	31.80	1.104	0.453	0.500	/
	836.6	GSM	-3.702	31.71	31.80	1.021	0.529	0.540	1#
	848.8	GSM	-0.993	31.65	31.80	1.035	0.477	0.494	
Left Head Tilt	824.2	GSM	/	/	/	/	/	/	/
	836.6	GSM	-0.974	31.71	31.80	1.021	0.351	0.358	/
	848.8	GSM	/	/	/	/	/	/	/
Right Head Cheek	824.2	GSM	/	/	/	/	/	/	/
	836.6	GSM	-3.697	31.71	31.80	1.021	0.517	0.528	/
	848.8	GSM	/	/	/	/	/	/	/
Right Head Tilt	824.2	GSM	/	/	/	/	/	/	/
	836.6	GSM	2.692	31.71	31.80	1.021	0.327	0.334	/
	848.8	GSM	/	/	/	/	/	/	/
Body-Back-Headset (15mm)	824.2	GSM	/	/	/	/	/	/	/
	836.6	GSM	-2.864	31.71	31.80	1.021	0.437	0.446	/
	848.8	GSM	/	/	/	/	/	/	/
Body-Back (15mm)	824.2	GPRS	0.410	30.01	30.10	1.021	0.756	0.772	2#
	836.6	GPRS	/	/	/	/	/	/	/
	848.8	GPRS	/	/	/	/	/	/	/

Note:

1. When the 1-g SAR is $\leq 0.8\text{W/Kg}$, testing for other channels are optional.
2. The EUT transmit and receive through the same GSM antenna while testing SAR.
3. The Multi-slot Classes of EUT is Class 12 which has maximum 4 Downlink slots and 4 Uplink slots, the maximum active slots is 5, when perform the multiple slots scan, 3DL+2UL is the worst case .
4. When SAR or MPE is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance.

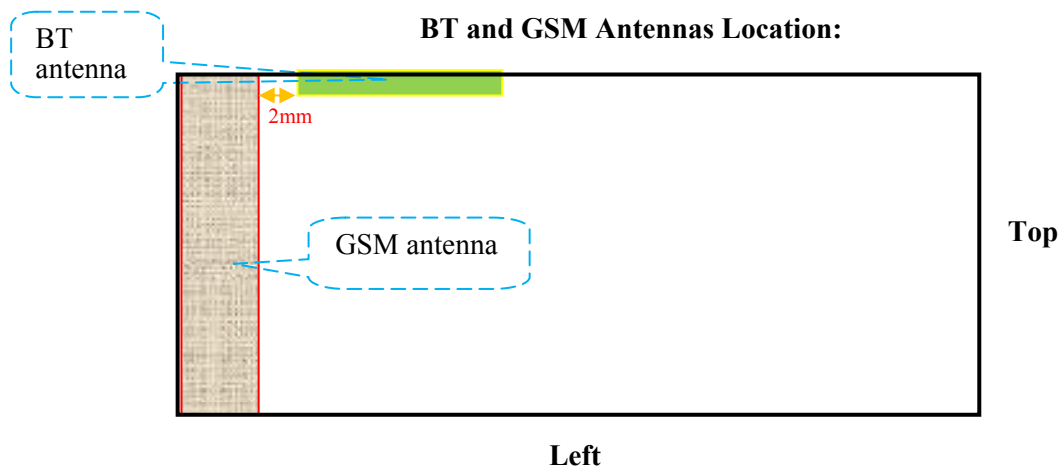
PCS Band:

EUT Position	Frequency (MHz)	Test Mode	Power Drift (%)	Max. Meas. Power (dBm)	Max. Rated Power (dBm)	FCC 1g SAR (W/Kg)			
						Scaled Factor	Meas. SAR	Scaled SAR	Plot
Left Head Cheek	1850.2	GSM	/	/	/	/	/	/	/
	1880.0	GSM	-2.697	28.52	28.60	1.019	0.152	0.155	/
	1909.8	GSM	/	/	/	/	/	/	/
Left Head Tilt	1850.2	GSM	/	/	/	/	/	/	/
	1880.0	GSM	-3.637	28.52	28.60	1.019	0.073	0.074	/
	1909.8	GSM	/	/	/	/	/	/	/
Right Head Cheek	1850.2	GSM	-4.923	28.40	28.60	1.047	0.142	0.149	/
	1880.0	GSM	2.439	28.52	28.60	1.019	0.163	0.166	3#
	1909.8	GSM	0.094	28.43	28.60	1.040	0.137	0.142	/
Right Head Tilt	1850.2	GSM	/	/	/	/	/	/	/
	1880.0	GSM	-0.087	28.52	28.60	1.019	0.067	0.068	/
	1909.8	GSM	/	/	/	/	/	/	/
Body-Back-Headset (15mm)	1850.2	GSM	/	/	/	/	/	/	/
	1880.0	GSM	0.269	28.52	28.60	1.019	0.329	0.335	/
	1909.8	GSM	/	/	/	/	/	/	/
Body-Back (15mm)	1850.2	GPRS	0.811	25.04	25.10	1.013	0.553	0.560	4#
	1880.0	GPRS	/	/	/	/	/	/	/
	1909.8	GPRS	/	/	/	/	/	/	/

Note:

1. When the 1-g SAR is $\leq 0.8\text{W/Kg}$, testing for other channels are optional.
2. The EUT transmit and receive through the same GSM antenna while testing SAR.
3. The Multi-slot Classes of EUT is Class 12 which has maximum 4 Downlink slots and 4 Uplink slots, the maximum active slots is 5, when perform the multiple slots scan, 2DL+3UL is the worst case .
4. When SAR or MPE is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance.
5. When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.

SAR SIMULTANEOUS TRANSMISSION DESCRIPTION



Simultaneous Transmission:

Description of Simultaneous Transmit Capabilities			Antennas Distance (mm)
Transmitter Combination	Simultaneous?	Hotspot?	
GSM + BT	√	×	2
GPRS + BT	√	×	2

Standalone SAR test exclusion considerations

Head Position:

Mode	Frequency (MHz)	P _{avg} (dBm)	P _{avg} (mW)	Distance (mm)	Calculated value	Threshold (1-g)	SAR Test Exclusion
GSM 835	835	22.80	190.546	0	35.1	3.0	No
PCS1900	1900	19.60	91.201	0	25.1	3.0	No
Bluetooth	2450	7.30	5.370	0	1.7	3.0	Yes

Body Position:

Mode	Frequency (MHz)	P _{avg} (dBm)	P _{avg} (mW)	Distance (mm)	Calculated value	Threshold (1-g)	SAR Test Exclusion
GPRS 835	835	24.10	257.040	15.00	15.8	3.0	No
GPRS 1900	1900	20.90	120.226	15.00	11.0	3.0	No
Bluetooth	2450	7.30	5.370	15.00	0.6	3.0	Yes

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.

4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

Standalone SAR estimation:

Mode	Frequency (GHz)	Distance (mm)	P _{avg} (dBm)	P _{avg} (mW)	Estimated 1-g (W/kg)
BT Head	2.45	0	7.30	5.370	0.224
BT Body	2.45	15	7.30	5.370	0.075

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance,mm})] \cdot [\sqrt{f(\text{GHz})}/x]$$

W/kg for test separation distances ≤ 50 mm;

where x = 7.5 for 1-g SAR.

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion

Simultaneous SAR test exclusion considerations:

Mode	Position	Reported SAR (W/kg)		ΣSAR
		GSM	BT	< 1.6W/kg
GSM835	Left Head Cheek	0.540	0.224	0.764
	Left Head Tile	0.358	0.224	0.582
	Right Head Cheek	0.528	0.224	0.752
	Right Head Tilt	0.334	0.224	0.558
	Body-Back	0.772	0.075	0.845
PCS1900	Left Head Cheek	0.155	0.224	0.379
	Left Head Tile	0.074	0.224	0.298
	Right Head Cheek	0.166	0.224	0.390
	Right Head Tilt	0.068	0.224	0.292
	Body-Back	0.560	0.075	0.635

ΣSAR < 1.6 W/kg therefore simultaneous transmission SAR with Volume Scans is **not** required. BT and Wi-Fi cannot transmit simultaneously.

SAR Plots (Summary of the Highest SAR Values)

Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)

Left Head Cheek (836.6 MHz Middle Channel)

Measurement Data

Test mode : GSM
 Crest Factor : 8
 Scan Type : Complete
 Area Scan : 11x8x1: Measurement x=10mm, y=10mm, z=4mm
 Zoom Scan : 7x7x7: Measurement x=5mm, y=5mm, z=5mm
 Power Drift-Start : 0.135 W/kg
 Power Drift-Finish : 0.130 W/kg
 Power Drift (%) : -3.702

Tissue Data

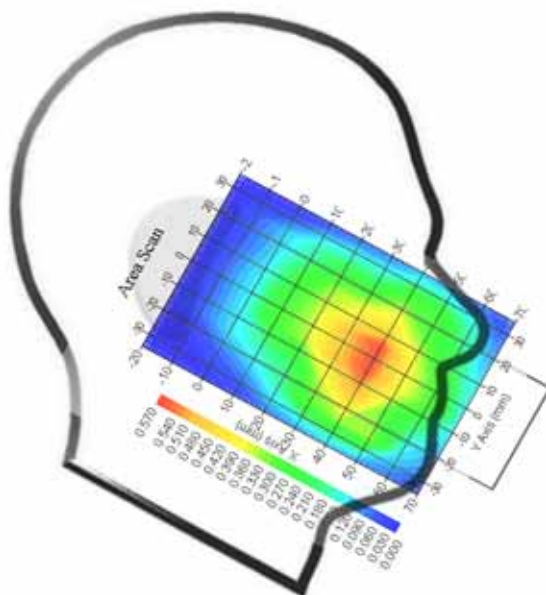
Type : Head
 Frequency : 836.6 MHz
 Epsilon : 41.21 F/m
 Sigma : 0.91 S/m
 Density : 1000.00 kg/cu. m

Probe Data

Serial No. : 500-00283
 Frequency Band : 835
 Duty Cycle Factor : 8
 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

1 gram SAR value : 0.529 W/kg
 10 gram SAR value : 0.329 W/kg
 Area Scan Peak SAR : 0.560 W/kg
 Zoom Scan Peak SAR : 0.728 W/kg

Plot 1#



Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)

Body-worn-Back (824.2 MHz Low Channel)

Measurement Data

Test mode : GPRS
 Crest Factor : 4
 Scan Type : Complete
 Area Scan : 8x11x1 : Measurement x=10mm, y=10mm, z=4mm
 Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm
 Power Drift-Start : 0.732 W/kg
 Power Drift-Finish : 0.735 W/kg
 Power Drift (%) : 0.410

Tissue Data

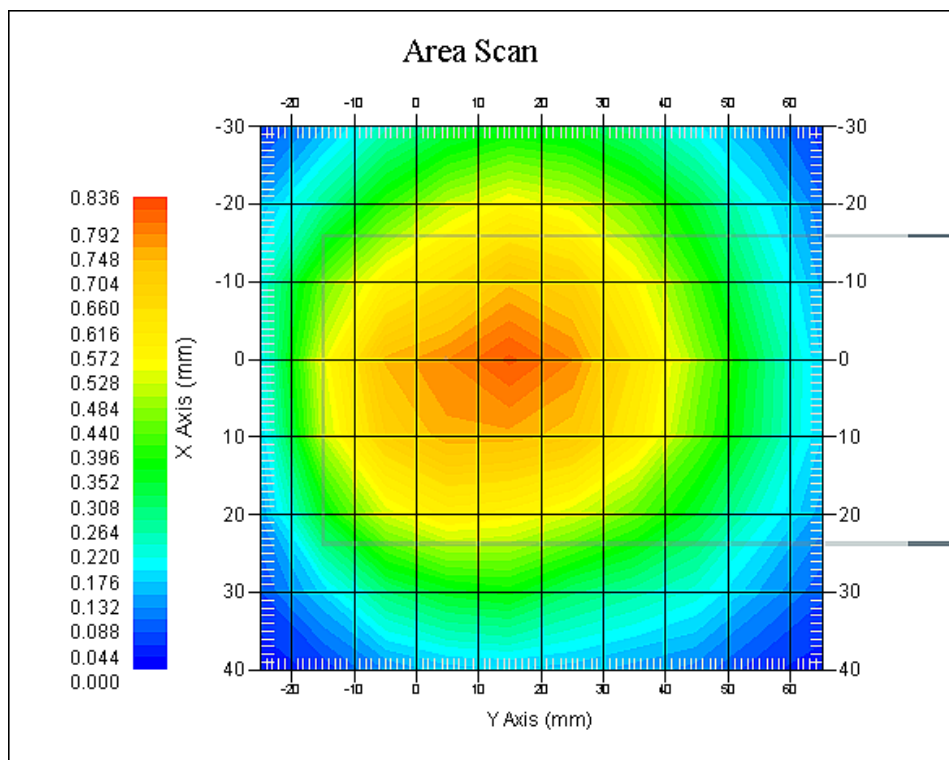
Type : Body
 Frequency : 824.2 MHz
 Epsilon : 53.94 F/m
 Sigma : 0.94 S/m
 Density : 1000.00 kg/cu. m

Probe Data

Serial No. : 500-00283
 Frequency Band : 835
 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

1 gram SAR value : 0.756 W/kg
 10 gram SAR value : 0.439 W/kg
 Area Scan Peak SAR : 0.836 W/kg
 Zoom Scan Peak SAR : 1.293 W/kg

Plot 2#



Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)

Right Head Cheek(1880.0MHz Middle Channel)

Measurement Data

Test mode : GSM
 Crest Factor : 8
 Scan Type : Complete
 Area Scan : 11x8x1 : Measurement x=10mm, y=10mm, z=4mm
 Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm
 Power Drift-Start : 0.041 W/kg
 Power Drift-Finish : 0.042 W/kg
 Power Drift (%) : 2.439

Tissue Data

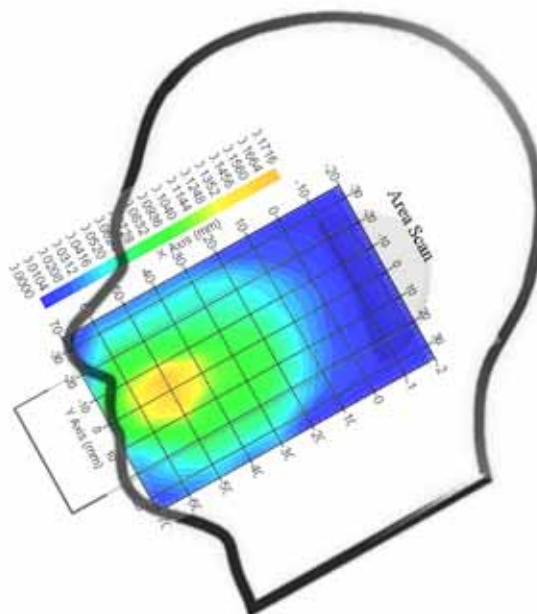
Type : Head
 Frequency : 1880.0 MHz
 Epsilon : 39.77 F/m
 Sigma : 1.38 S/m
 Density : 1000.00 kg/cu. M

Probe Data

Serial No. : 500-00283
 Frequency Band : 1900
 Duty Cycle Factor : 8
 Conversion Factor : 4.8
 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

1 gram SAR value : 0.163 W/kg
 10 gram SAR value : 0.095 W/kg
 Area Scan Peak SAR : 0.171 W/kg
 Zoom Scan Peak SAR : 0.252 W/kg

Plot 3#



Test Laboratory: Bay Area Compliance Lab Corp. (Shenzhen)

Body-worn-Back (1850.2 MHz Low Channel)

Measurement Data

Test mode : GPRS
 Crest Factor : 2.67
 Scan Type : Complete
 Area Scan : 8x11x1 : Measurement x=10mm, y=10mm, z=4mm
 Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm
 Power Drift-Start : 0.493 W/kg
 Power Drift-Finish : 0.497W/kg
 Power Drift (%) : 0.811

Tissue Data

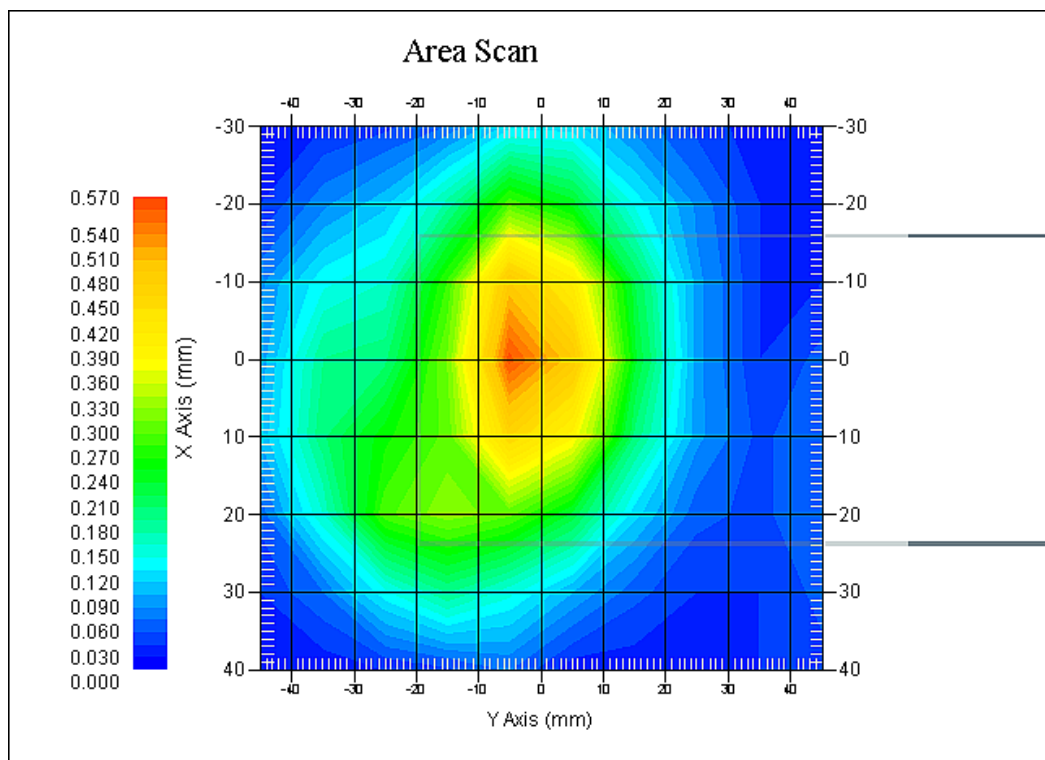
Type : Body
 Frequency : 1850.2 MHz
 Epsilon : 52.20 F/m
 Sigma : 1.46 S/m
 Density : 1000.00 kg/cu. m

Probe Data

Serial No. : 500-00283
 Frequency Band : 1900
 Duty Cycle Factor : 2.67
 Conversion Factor : 4.5
 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

1 gram SAR value : 0.553 W/kg
 10 gram SAR value : 0.318 W/kg
 Area Scan Peak SAR : 0.570 W/kg
 Zoom Scan Peak SAR : 0.773 W/kg

Plot 4#



APPENDIX A MEASUREMENT UNCERTAINTY

The uncertainty budget has been determined for the measurement system and is given in the following Table.

Measurement Uncertainty for 30MHz to 6GHz

Source of Uncertainty	Tolerance Value	Probability Distribution	Divisor	c_i^1 (1-g)	c_i^1 (10-g)	Standard Uncertainty (1-g) %	Standard Uncertainty (10-g) %
Measurement System							
Probe Calibration	3.5	normal	1	1	1	3.5	3.5
Axial Isotropy	3.7	rectangular	$\sqrt{3}$	$(1-cp)^{1/2}$	$(\frac{1-cp}{2})^{1/2}$	1.5	1.5
Hemispherical Isotropy	10.9	rectangular	$\sqrt{3}$	\sqrt{cp}	\sqrt{cp}	4.4	4.4
Boundary Effect	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6
Linearity	4.7	rectangular	$\sqrt{3}$	1	1	2.7	2.7
Detection Limit	1.0	rectangular	$\sqrt{3}$	1	1	0.6	0.6
Readout Electronics	1.0	normal	1	1	1	1.0	1.0
Response Time	0.8	rectangular	$\sqrt{3}$	1	1	0.5	0.5
Integration Time	1.7	rectangular	$\sqrt{3}$	1	1	1.0	1.0
RF Ambient Condition -Noise	0.6	rectangular	$\sqrt{3}$	1	1	0.3	0.3
RF Ambient Condition - Reflections	3.0	rectangular	$\sqrt{3}$	1	1	1.7	1.7
Probe Positioner Mech. Restrictions	0.4	rectangular	$\sqrt{3}$	1	1	0.2	0.2
Restriction							
Probe Positioning with respect to Phantom Shell	2.9	rectangular	$\sqrt{3}$	1	1	1.7	1.7
Extrapolation and Integration	3.7	rectangular	$\sqrt{3}$	1	1	2.1	2.1
Test Sample Positioning	2.3	normal	1	1	1	2.3	2.3
Device Holder Uncertainty	6.215	normal	1	1	1	6.215	6.215
Drift of Output Power	4.627	rectangular	$\sqrt{3}$	1	1	2.67	2.67
Phantom and Setup							
Phantom Uncertainty(shape & thickness tolerance)	3.4	rectangular	$\sqrt{3}$	1	1	2.0	2.0
Liquid Conductivity(target)	5.0	rectangular	$\sqrt{3}$	0.7	0.5	2.0	1.4
Liquid Conductivity(meas.)	1.938	normal	1	0.7	0.5	1.36	0.97
Liquid Permittivity(target)	5.0	rectangular	$\sqrt{3}$	0.6	0.5	1.7	1.4
Liquid Permittivity(meas.)	3.093	normal	1	0.6	0.5	1.86	1.55
Combined Uncertainty		RSS				10.78	10.55
Expanded uncertainty (coverage factor=2)		Normal(k=2)				21.56	21.10

APPENDIX B – PROBE CALIBRATION CERTIFICATES

NCL CALIBRATION LABORATORIES

Calibration File No.: PC-1598

Task No: BACL-5778

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

Record of Calibration

Head and Body

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 500-00283

Calibration Procedure: D01-032-E020-V2, D22-012-Tissue, D28-002-Dipole

Project No: BACL-5745

Calibrated: 14th October 2014

Released on: 14th October 2014

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

Released By: _____



Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES

Suite 102, 303 Terry Fox Dr,
OTTAWA, ONTARIO
CANADA K2K 3J1

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

NCL Calibration Laboratories

Division of APREL, Inc.

Introduction

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

Calibration Method

Probes are calibrated using the following methods.

<800 MHz

TEM Cell for sensitivity in air

Standard phantom using temperature transfer method for sensitivity in tissue

>800 MHz

Waveguide* method to determine sensitivity in air and tissue

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

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

References

- o IEEE Standard 1528:2013
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- o EN 62209-1:2006
Human Exposure to RF Fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to measure the Specific Absorption Rate (SAR) for hand-held mobile wireless devices
- o IEC 62209-2:2010
Human exposure to RF fields from hand-held and body-mounted wireless devices - Human models, instrumentation, and procedures - Part 2: specific absorption rate (SAR) for wireless communication devices (30 MHz - 6 GHz)
- o TP-D01-032-E020-V2 E-Field probe calibration procedure
- o D22-012-Tissue dielectric tissue calibration procedure
- o D28-002-Dipole procedure for validation of SAR system using a dipole
- o IEEE 1309 Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

Page 2 of 10

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

NCL Calibration Laboratories

Division of APREL Inc.

Conditions

Probe 500-00283 was a recalibration.

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

Primary Measurement Standards

Instrument	Serial Number	Cal due date
Tektronix USB Power Meter	11C940	May 14, 2015
Signal Generator HP 83640B	3844A00689	Feb 12, 2015

Secondary Measurement Standards

Network Analyzer Anritsu 37347C	002106	Feb. 20, 2015
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Attestation

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

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



Art Brennan, Quality Manager



Dan Brooks, Test Engineer

Page 3 of 10
This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration Laboratories

Division of APREL, Inc.

Probe Summary

Probe Type:	E-Field Probe E020
Serial Number:	500-00283
Frequency:	As presented on page 5
Sensor Offset:	1.56
Sensor Length:	2.5
Tip Enclosure:	Composite*
Tip Diameter:	< 2.9 mm
Tip Length:	55 mm
Total Length:	289 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Page 4 of 10

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

NCL Calibration Laboratories

Division of APREL, Inc.

Calibration for Tissue (Head H, Body B)

Frequency	Tissue Type	Measured Epsilon	Measured Sigma	Standard Uncertainty (%)	Calibration Frequency Range (MHz)	Conversion Factor
450 H	Head	43.59	0.86	3.5	±50	5.7
450 B	Body	56.74	0.94	3.5	±50	5.8
750 H	Head	42.98	0.92	3.5	±50	6.0
750 B	Body	43.05	0.93	3.5	±50	5.5
835 H	Head	43.42	0.94	3.5	±50	5.9
835 B	Body	55.77	1.01	3.5	±50	5.9
900 H	Head	41.87	1.06	3.5	±50	6.0
900 B	Body	55.62	1.05	3.5	±50	5.9
1450 H	Head	X	X	X	X	X
1450 B	Body	X	X	X	X	X
1500 H	Head	X	X	X	X	X
1500 B	Body	X	X	X	X	X
1640 H	Head	X	X	X	X	X
1640 B	Body	X	X	X	X	X
1750 H	Head	38.23	1.38	3.5	±75	5.4
1750 B	Body	52.88	1.54	3.5	±75	5.3
1800 H	Head	X	X	X	X	X
1800 B	Body	X	X	X	X	X
1900 H	Head	40.20	1.38	3.5	±75	4.8
1900 B	Body	52.63	1.46	3.5	±75	4.5
2000 H	Head	X	X	X	X	X
2000 B	Body	X	X	X	X	X
2100 H	Head	X	X	X	X	X
2100 B	Body	X	X	X	X	X
2300 H	Head	X	X	X	X	X
2300 B	Body	X	X	X	X	X
2450 H	Head	37.26	1.84	3.5	±75	4.9
2450B	Body	53.61	1.9	3.5	±75	4.3
3000 H	Head	X	X	X	X	X
3000 B	Body	X	X	X	X	X
3600 H	Head	37.49	3.16	3.5	±100	4.5
3600 B	Body	49.94	3.86	3.5	±100	4.0
5250 H	Head	35.51	4.78	3.5	±100	3.0
5250 B	Body	47.54	5.11	3.5	±100	2.8
5600 H	Head	36.05	5.15	3.5	±100	2.8
5600 B	Body	46.49	5.72	3.5	±100	2.2
5800 H	Head	45.99	6.01	3.5	±100	3.2
5800 B	Body	35.6	5.37	3.5	±100	2.5

NCL Calibration Laboratories

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Boundary Effect:

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

Spatial Resolution:

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

DAQ-PAQ Contribution

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

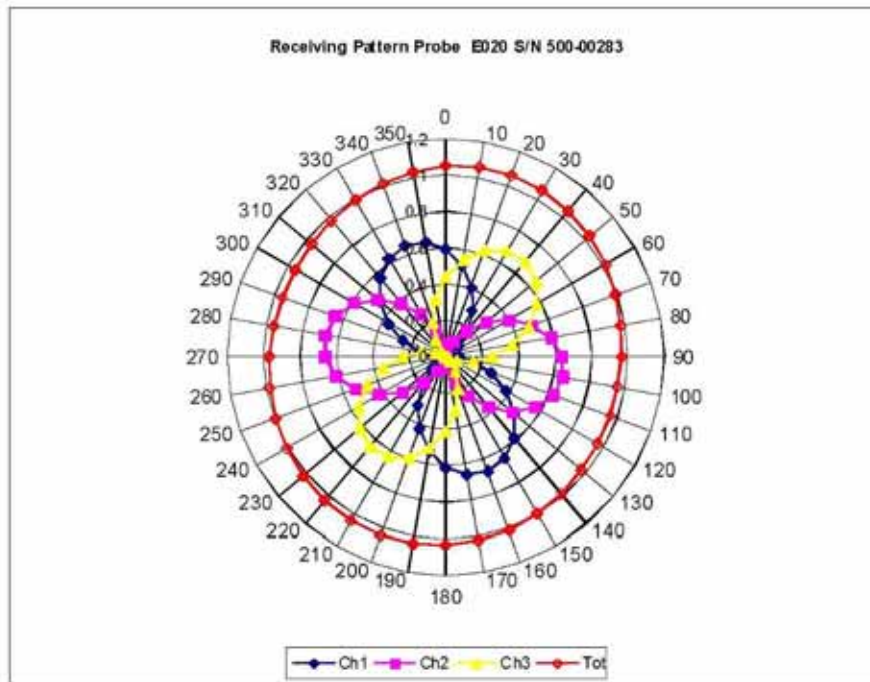
Probe Calibration Uncertainty

Uncertainty component	Tolerance (± %)	Probability distribution	Divisor	Standard uncertainty (± %)
Incident or forward power	2.5	R	√3	1.44
Reflected power	2	R	√3	1.15
Liquid conductivity measurement	1	R	√3	0.58
Liquid permittivity measurement	1	R	√3	0.58
Liquid conductivity deviation	1.5	R	√3	0.87
Liquid permittivity deviation	1.5	R	√3	0.87
Frequency deviation	2.25	R	√3	1.30
Field homogeneity	2.5	R	√3	1.44
Field-probe positioning	2.5	R	√3	1.44
Field-probe linearity	1.55	R	√3	0.89
Combined standard uncertainty		RSS		3.50

NCL Calibration Laboratories

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Receiving Pattern Air



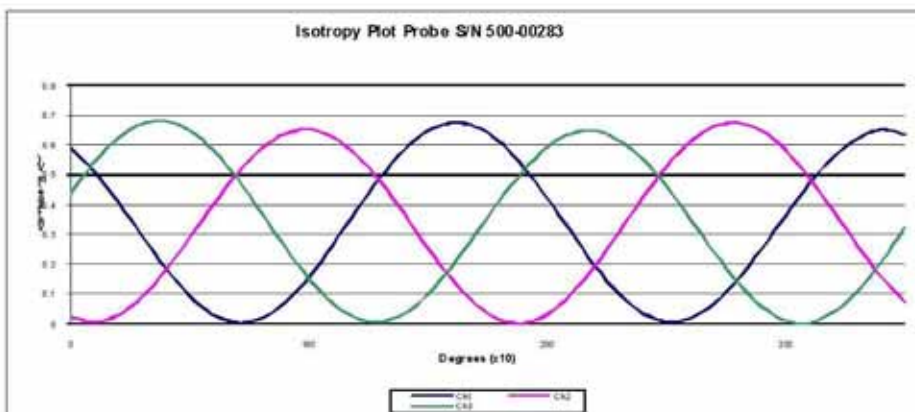
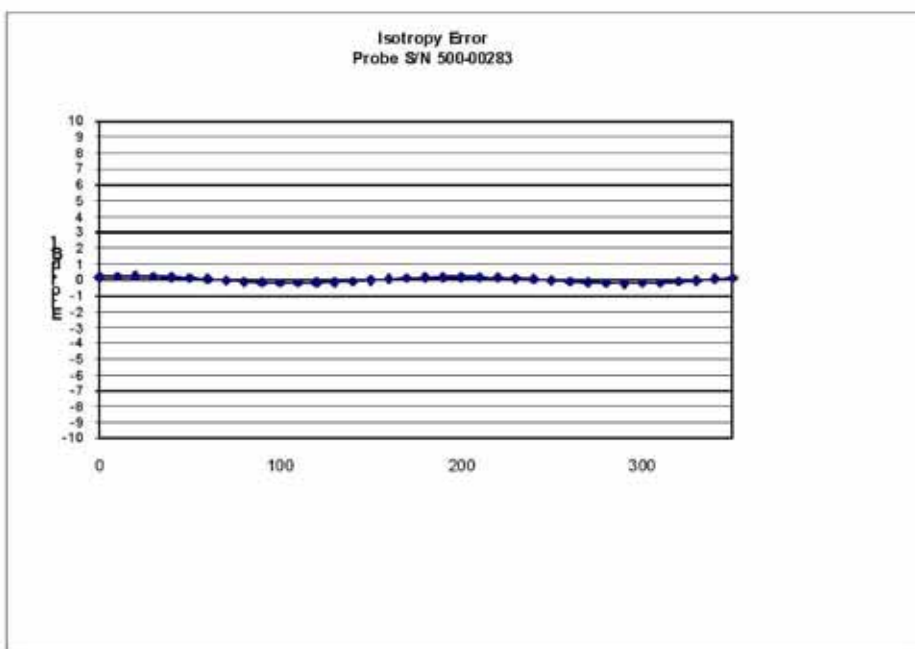
Page 7 of 10

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

NCL Calibration Laboratories

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Isotropy Error Air



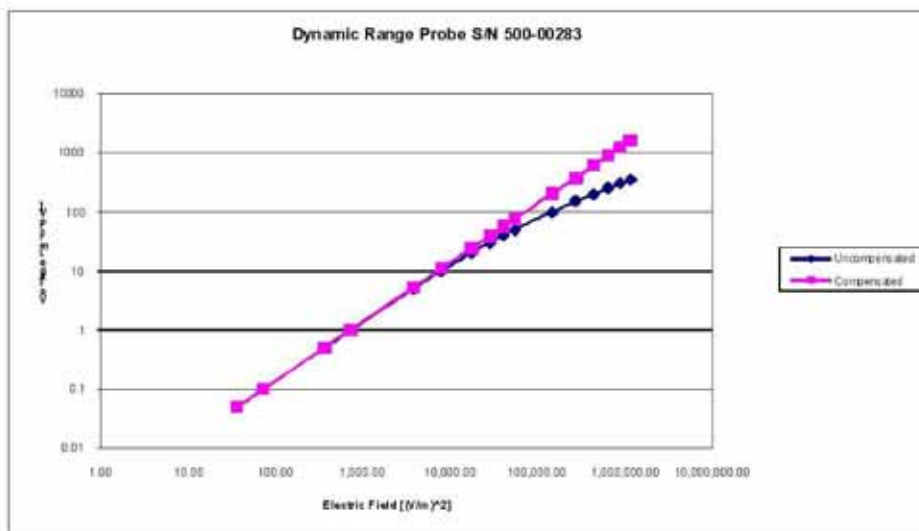
Isotropicity Tissue: 0.10 dB

Page 8 of 10
This page has been reviewed for content and attested to on Page 2 of this document.

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Dynamic Range

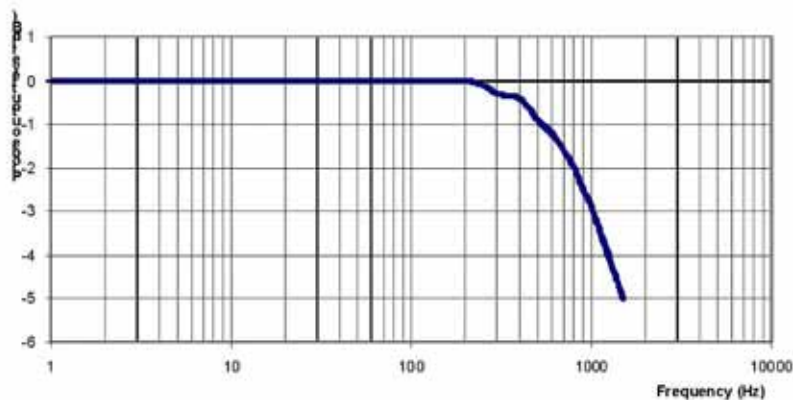


NCL Calibration Laboratories

Division of APREL Inc.

Video Bandwidth

Probe Frequency Characteristics



Video Bandwidth at 500 Hz: 1 dB
Video Bandwidth at 1.02 KHz: 3 dB

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2014.

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

APPENDIX C DIPOLE CALIBRATION CERTIFICATES

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1599
Project Number: BAC-dipole-cal-5779

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.

Validation Dipole(Head and Body)

Manufacturer: APREL Laboratories
Part number: ALS-D-835-S-2
Frequency: 835 MHz
Serial No: 180-00558

Customer: Bay Area Compliance Laboratory (China)

Calibrated: 8th October 2014
Released on: 8th October 2014

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

Released By: _____



Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES

Suite 102, 303 Terry Fox Dr.
Kanata, ONTARIO
CANADA K2K 3J1

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

NCL Calibration Laboratories

Division of APREL Laboratories,

Conditions

Dipole 180-00558 was received with a damaged connection for a re-calibration.

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

Attestation

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

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



 Art Brennan, Quality Manager



 Maryna Nesterova Calibration Engineer

Primary Measurement Standards

Instrument	Serial Number	Cal due date
Tektronix USB Power Meter	11C940	May 14, 2015
Network Analyzer Anritsu 37347C	002106	Feb. 20, 2015

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

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

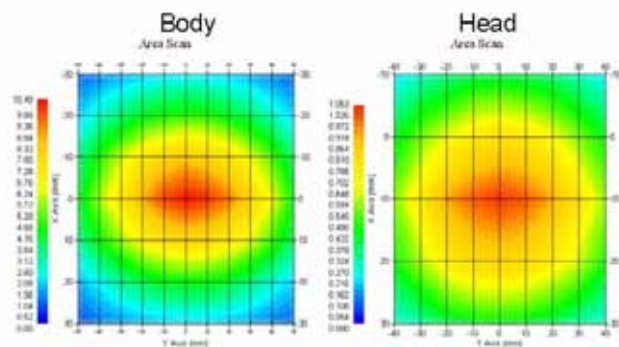
Length: 162.2 mm
 Height: 89.4 mm

Electrical Specification

Tissue	Frequency	SWR:	Return Loss	Impedance
Head	835 MHz	1.066 U	-30.344 dB	49.001 Ω
Body	835 MHz	1.089 U	-28.118 dB	53.117 Ω

System Validation Results

Tissue	Frequency	1 Gram	10 Gram	Peak
Head	835 MHz	9.773	6.174	14.713
Body	835 MHz	9.736	6.297	14.513



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

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 180-00558. 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 30 MHz to 6 GHz E-Field Probe Serial Number 225.

References

- SSI-TP-018-ALSAS Dipole Calibration Procedure
- SSI-TP-016 Tissue Calibration Procedure
- IEEE 1528:2013 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques"
- IEC-62209-1:2006 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures"
Part 1: "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)"
- IEC-62209-2:2010 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures"
Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 30 MHz to 6 GHz)"
- D28-002 Procedure for validation of SAR system using a dipole

Conditions

Dipole 180-00558 was repaired prior to this calibration. The repair reliability depends upon correct usage of the dipole.

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

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

Dipole Calibration uncertainty

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

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

4

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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	162.2 mm	89.4 mm

Electrical Verification

Tissue Type	Return Loss:	SWR:	Impedance:
Head	-30.344 dB	1.066 U	49.001 Ω
Body	-28.118 dB	1.089 U	53.117 Ω □

Tissue Validation

	Dielectric constant, ϵ_r	Conductivity, σ [S/m]
Head Tissue 835MHz	43.42	0.94
Body Tissue 835MHz	55.77	1.01

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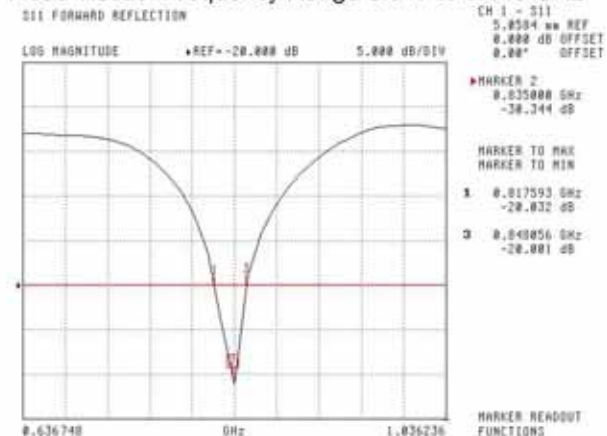
NCL Calibration Laboratories

Division of APREL Laboratories,

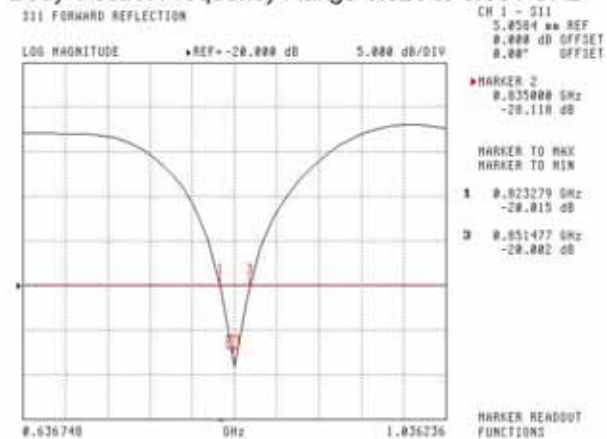
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss

Head Tissue: Frequency Range 0.817 to 0.848 GHz



Body Tissue: Frequency Range 0.823 to 0.851 GHz



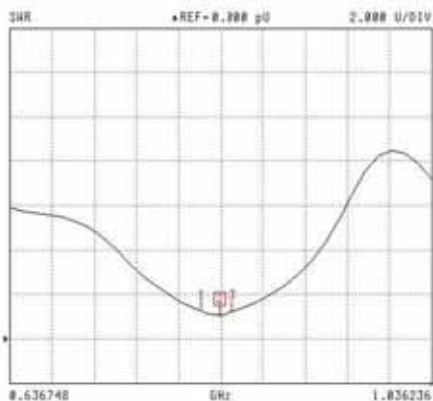
This page has been reviewed for content and attested to by signature within this document.

NCL Calibration Laboratories

Division of APREL Laboratories.

SWR
Head

S11 FORWARD REFLECTION



CH 1 - S11
5.0504 uV REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
0.83588 GHz
1.000 U

MARKER TO MAX
MARKER TO MIN

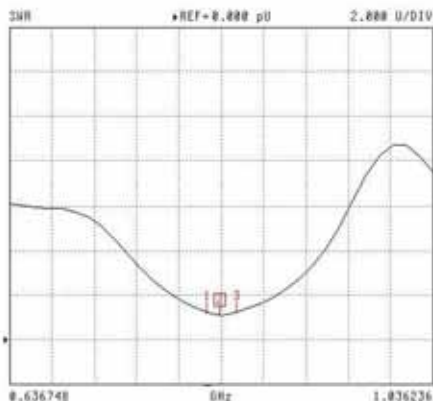
1 0.817593 GHz
1.251 U

3 0.848956 GHz
1.235 U

MARKER READOUT
FUNCTIONS

Body

S11 FORWARD REFLECTION



CH 1 - S11
5.0504 uV REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
0.83279 GHz
1.005 U

MARKER TO MAX
MARKER TO MIN

1 0.823279 GHz
1.226 U

3 0.851477 GHz
1.234 U

MARKER READOUT
FUNCTIONS

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

7

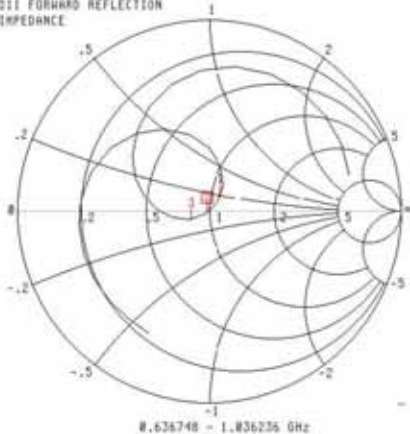
NCL Calibration Laboratories

Division of APREL Laboratories.

Smith Chart Dipole Impedance

Head

S11 FORWARD REFLECTION IMPEDANCE



CH 1 - S11
5.0504 ohm REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
0.835000 GHz
49.001 Ω
-1.317 jΩ

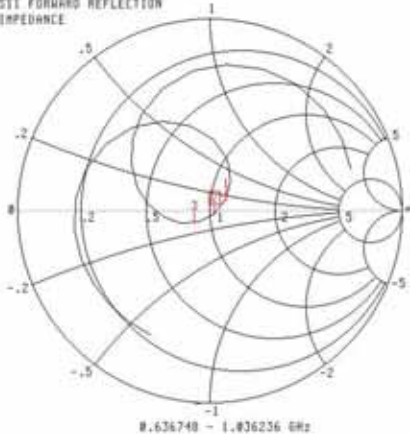
MARKER TO MAX
MARKER TO MIN

1 0.817593 GHz
55.629 Ω
10.003 jΩ
3 0.840856 GHz
41.274 Ω
-3.071 jΩ

MARKER READOUT FUNCTIONS

Body

S11 FORWARD REFLECTION IMPEDANCE



CH 1 - S11
5.0504 ohm REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
0.835000 GHz
53.117 Ω
-1.024 jΩ

MARKER TO MAX
MARKER TO MIN

1 0.823279 GHz
59.000 Ω
6.263 jΩ
3 0.851477 GHz
42.412 Ω
-5.581 jΩ

MARKER READOUT FUNCTIONS

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

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 2014.

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

9

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1601
Project Number: BAC-dipole -cal-5779

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.

Validation Dipole (Head & Body)

Manufacturer: APREL Laboratories
Part number: ALS-D-1900-S-2
Frequency: 1900 MHz
Serial No: 210-00710

Customer: Bay Area Compliance Laboratory (China)

Calibrated: 9th October, 2014
Released on: 9th October, 2014

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

Released By: 
Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES

Suite 102, 303 Terry Fox Dr. Division of APREL Lab.
Kanata, ONTARIO TEL: (613) 435-8300
CANADA K2K 3J1 FAX: (613)435-8306

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

Dipole 210-00710 was received in good condition and was a re-calibration.

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

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

Attestation

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

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



 Art Brennan, Quality Manager



 Maryna Nesterova Calibration Engineer

Primary Measurement Standards

Instrument	Serial Number	Cal due date
Tektronix USB Power Meter	11C940	May 14, 2015
Network Analyzer Anritsu 37347C	002106	Feb. 20, 2015

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

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

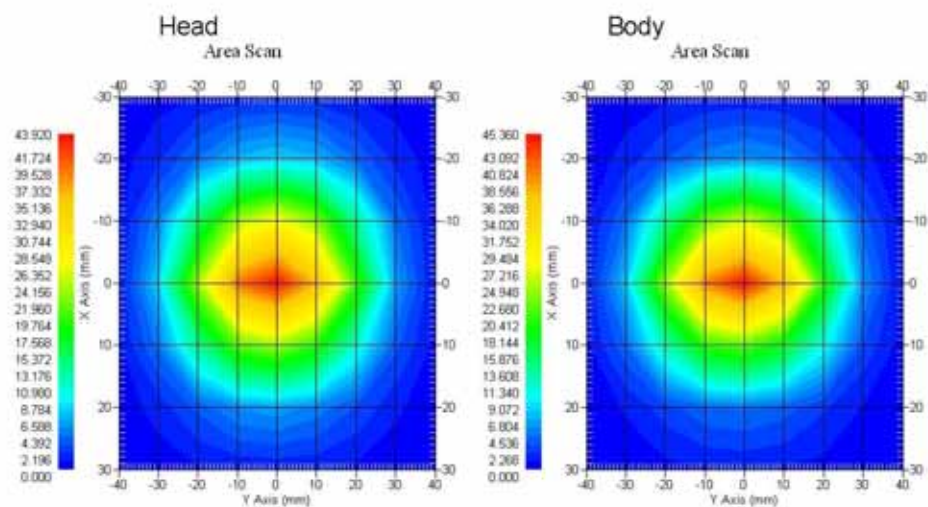
Length: 67.1 mm
Height: 38.9 mm

Electrical Specification

Tissue	Frequency	SWR:	Return Loss	Impedance
Head	1900MHz	1.084 U	-27.92 dB	52.247 Ω
Body	1900MHz	1.128 U	-24.40 dB	52.618 Ω

System Validation Results

Tissue	Frequency	1 Gram	10 Gram	Peak
Head	1900 MHz	39.481	20.44	73.364
Body	1900 MHz	39.715	20.552	73.565



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

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 210-00710. 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 30 MHz to 6 GHz E-Field Probe Serial Number 225.

References

- SSI-TP-018-ALSAS Dipole Calibration Procedure
- SSI-TP-016 Tissue Calibration Procedure
- IEEE 1528:2013 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques"
- IEC-62209-1:2006 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures"
Part 1: "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)"
- IEC-62209-2:2010 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures"
Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 30 MHz to 6 GHz)"
- D28-002 Procedure for validation of SAR system using a dipole

Conditions

Dipole 210-00710 was a recalibration.

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

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

Dipole Calibration uncertainty

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

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

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

NCL Calibration Laboratories

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Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
68.0 mm	39.5 mm	67.1mm	38.9 mm

Electrical Validation

Tissue	Frequency	SWR:	Return Loss	Impedance
Head	1900MHz	1.084 U	-27.92 dB	52.247 Ω
Body	1900MHz	1.128 U	-24.40 dB	52.618 Ω

Tissue Validation

	Dielectric constant, ϵ_r	Conductivity, σ [S/m]
Head Tissue 1900MHz	40.20	1.38
Body Tissue 1900MHz	52.63	1.46

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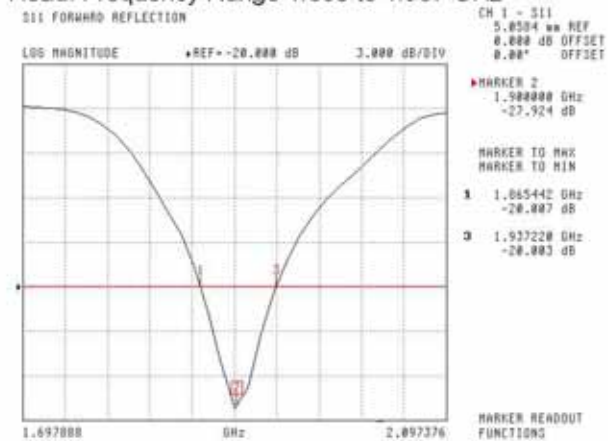
NCL Calibration Laboratories

Division of APREL Laboratories.

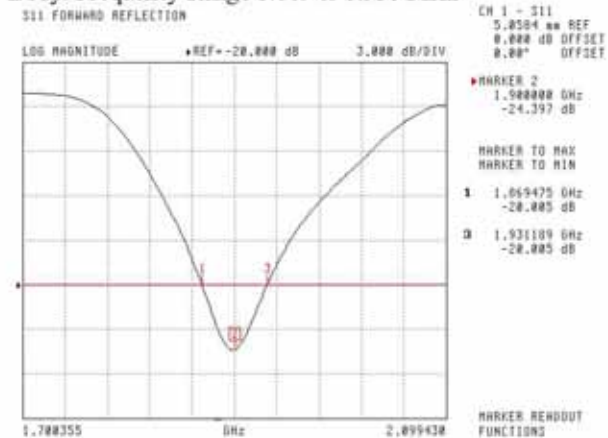
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss

Head: Frequency Range 1.865 to 1.937 GHz



Body: Frequency Range 1.869 to 1.931 MHz



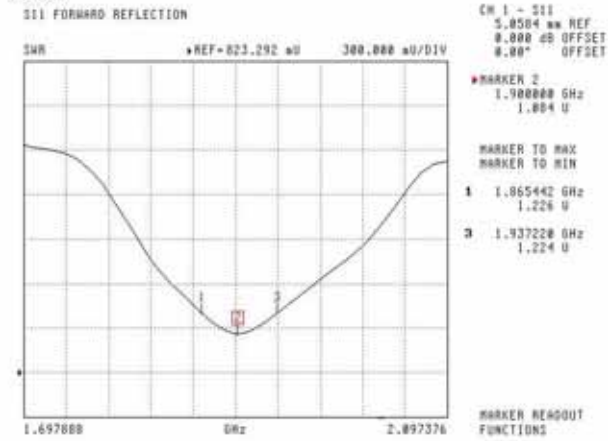
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NCL Calibration Laboratories

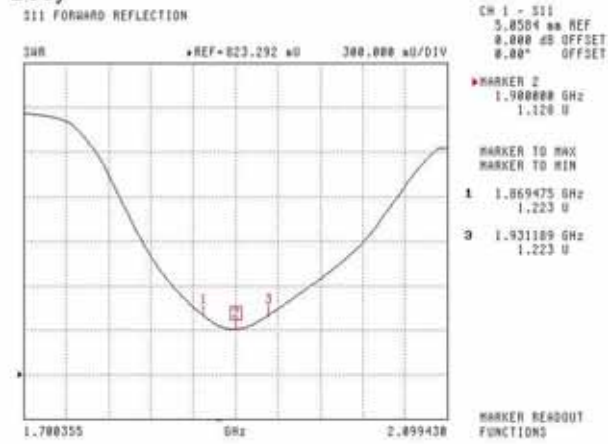
Division of APREL Laboratories.

SWR

Head



Body



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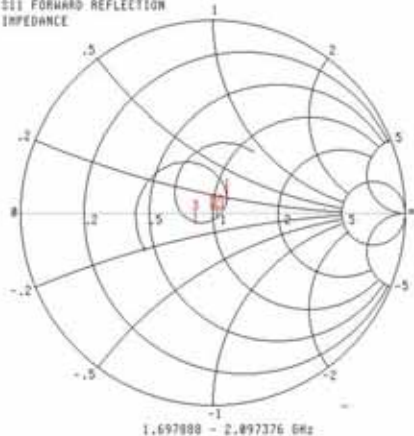
NCL Calibration Laboratories

Division of APREL Laboratories.

Smith Chart Dipole Impedance

Head

S11 FORWARD REFLECTION
IMPEDANCE



CH 1 - S11
5.0584 μ W REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
1.900000 GHz
52.247 Ω
-3.183 j Ω

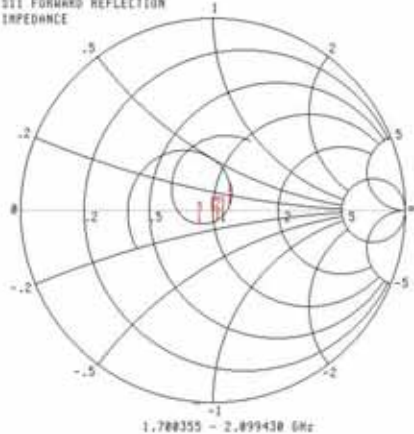
MARKER TO MAX
MARKER TO MIN

1 1.865442 GHz
57.627 Ω
7.644 j Ω
2 1.937220 GHz
41.868 Ω
-4.273 j Ω

MARKER READOUT
FUNCTIONS

Body

S11 FORWARD REFLECTION
IMPEDANCE



CH 1 - S11
5.0584 μ W REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
1.900000 GHz
52.618 Ω
-5.535 j Ω

MARKER TO MAX
MARKER TO MIN

1 1.869475 GHz
60.277 Ω
4.049 j Ω
2 1.931189 GHz
43.257 Ω
-6.479 j Ω

MARKER READOUT
FUNCTIONS

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

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 2014

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

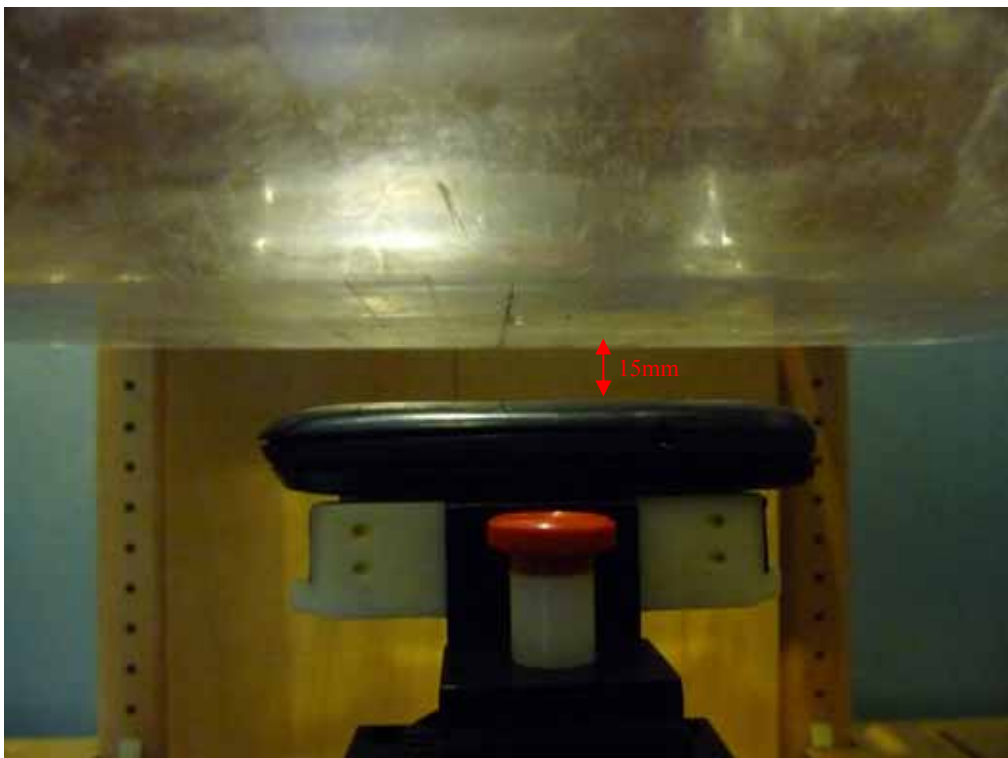
9

APPENDIX D EUT TEST POSITION PHOTOS

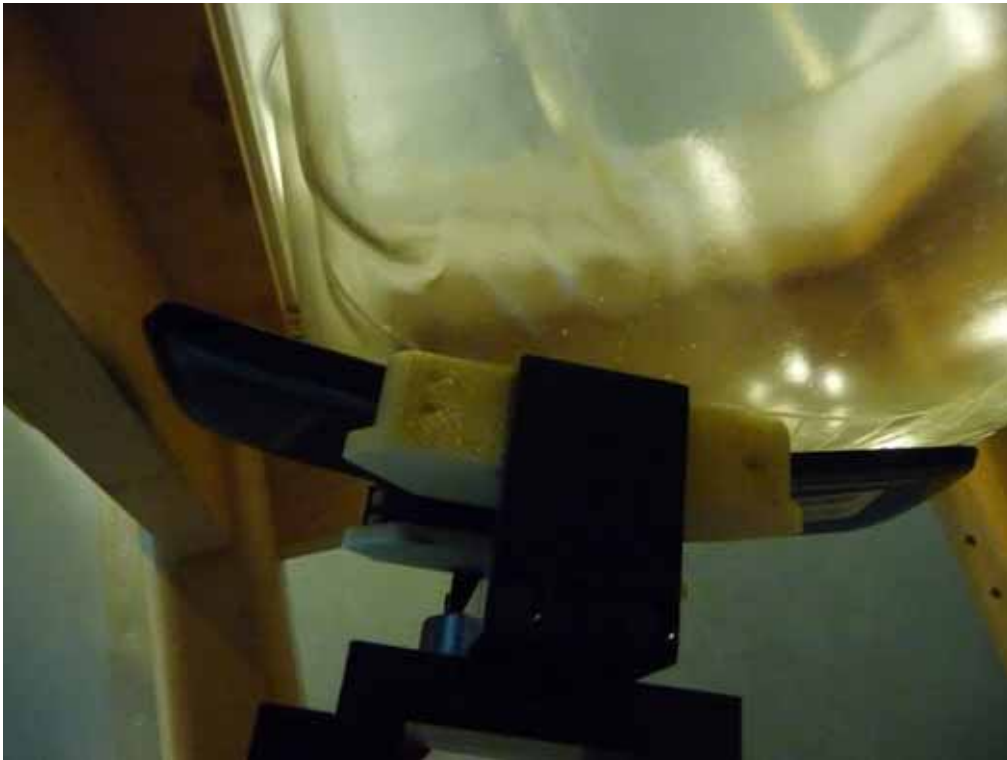
Liquid depth $\geq 15\text{cm}$



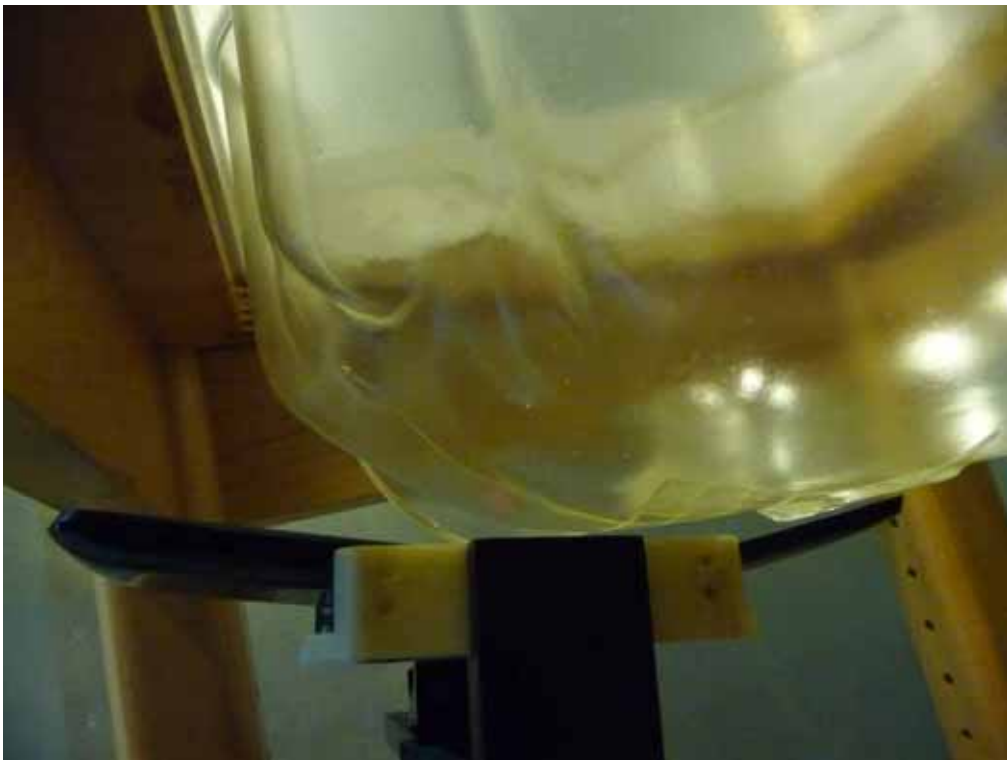
Body-worn Back Setup Photo (15mm)



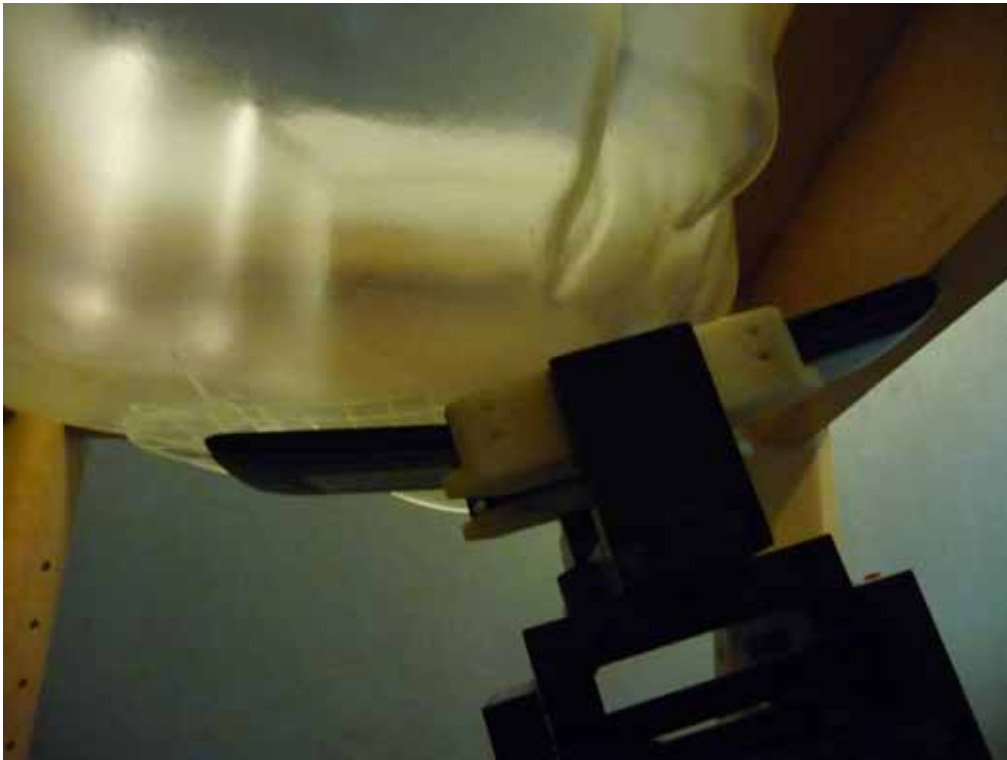
Left Head Touch Setup Photo



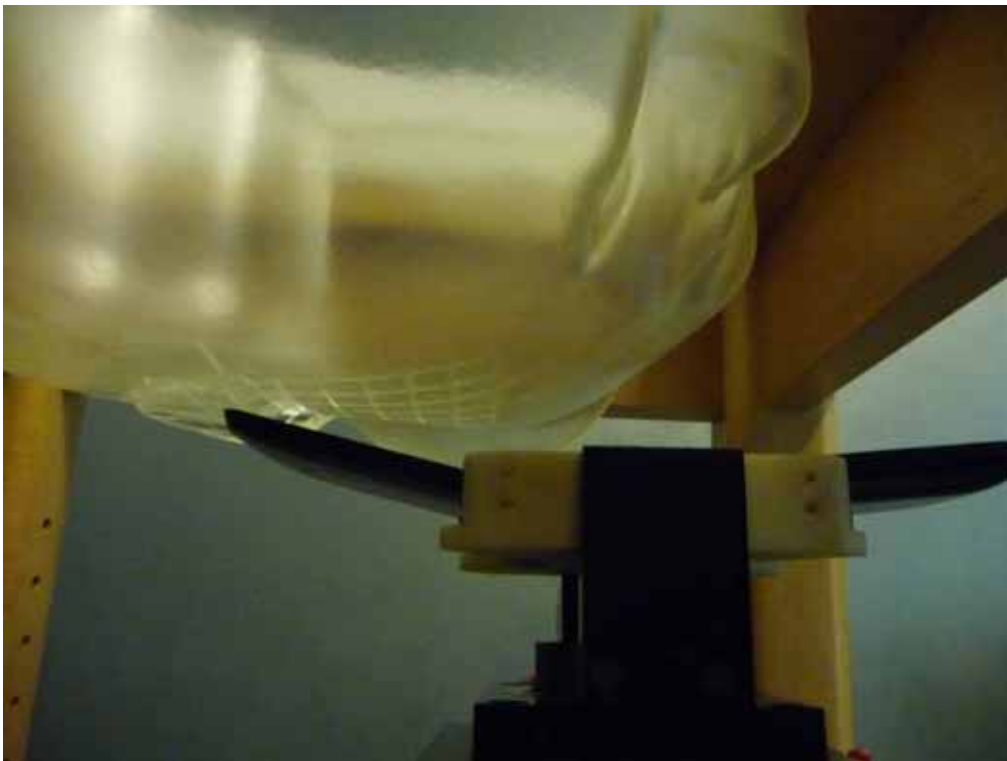
Left Head Tilt Setup Photo



Right Head Touch Setup Photo



Right Head Tilt Setup Photo



APPENDIX E EUT PHOTOS

EUT – Front View



EUT – Back View



EUT –Left Side View



EUT – Right Side View



EUT – Top View



EUT – Bottom View



EUT – Uncover View



APPENDIX F INFORMATIVE REFERENCES

- [1] Federal Communications Commission, "Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.
- [2] David L. Means Kwok Chan, Robert F. Cleveland, "Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, Office of Engineering & Technology, Washington, DC, 1997.
- [3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105-113, Jan. 1996.
- [4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with known precision", IEEE Transactions on Communications, vol. E80-B, no. 5, pp. 645-652, May 1997.
- [5] CENELEC, "Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.
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