EN 50360:2001+A1:2012
EN 50566:2013
EN 62479:2010

SAR EVALUATION REPORT

For

Vonino Electronics Limited

Miramar Tower 10F - no1010, 132 Nathan Road Tsim Sha Tsui, Kowloon, Hong Kong

Model: Pluri C8

Report Type:	**Product Type:**
Original Report	Tablet PC

Report Number:	RSZ170707006-20
Report Date:	2017-08-06
Reviewed By:	Wilson Chen SAR Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building,Shihua Road, Futian Free Trade Zone, Shenzhen,Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

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0.851 W/kg 10g Body SAR</td><td rowspan="4">2.0</td></tr>
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<tr><td rowspan="6">Applicable Standards</td><td colspan="3">EN50360: 2001+A1:2012
Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz – 3GHz)</td></tr>
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Product standard to demonstrate compliance of radio frequency fields from handheld and body-mount wireless communication devices used by the general public (30 MHz — 6 GHz)</td></tr>
<tr><td colspan="3">EN62209-1:2006
Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part1:Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3GHz)</td></tr>
<tr><td colspan="3">EN62209-2:2010
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 wireless communication devices used in close proximity to the human body
(frequency range of 30 MHz to 6 GHz)</td></tr>
<tr><td colspan="3">EN 62479:2010
Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)</td></tr>
<tr><td colspan="3">IEEE1528:2013
Draft Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.</td></tr>
<tr><td colspan="4">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 EN 50360:2001+A1:2012 and has been tested in accordance with the measurement procedures specified in EN62209-1:2006 & EN62209-2:2010.
The results and statements contained in this report pertain only to the device(s) evaluated.</td></tr>
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RSZ170707006-20	Original Report	2017-08-06

EUT DESCRIPTION

This report has been prepared on behalf of Vonino Electronics Limited and their product, Model: Pluri C8 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, WCDMA, Wi-Fi and Bluetooth
Frequency Band:	E-GSM900: 880-915 MHz(TX); 925-960 MHz(RX) DCS Band: 1710-1785 MHz(TX); 1805-1880 MHz(RX) WCDMA Band 8: 880-915 MHz(TX); 925-960 MHz(RX) WCDMA Band 1: 1920-1980MHz(TX); 2110-2170MHz(RX) Wi-Fi: 2412-2472MHz Bluetooth: 2402-2480 MHz
Dimensions (L*W*H):	207 mm (L)×122 mm (W)× 10 mm (H)
Power Source:	3.7V_{DC} Rechargeable Battery
Normal Operation:	Head and Body-worn

REFERENCE, STANDARDS, AND GUILDELINES

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 at6/F., West Wing, Third Phase of Wanli Industrial Building,Shihua Road, Futian Free Trade Zone, Shenzhen,Guangdong, 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 (Internal) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a 10mm2 step Internal, 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 32mm in the X & Y axis, and 35mm in the Z axis.

ALSAS-10U Interpolation and Extrapolation Uncertainty

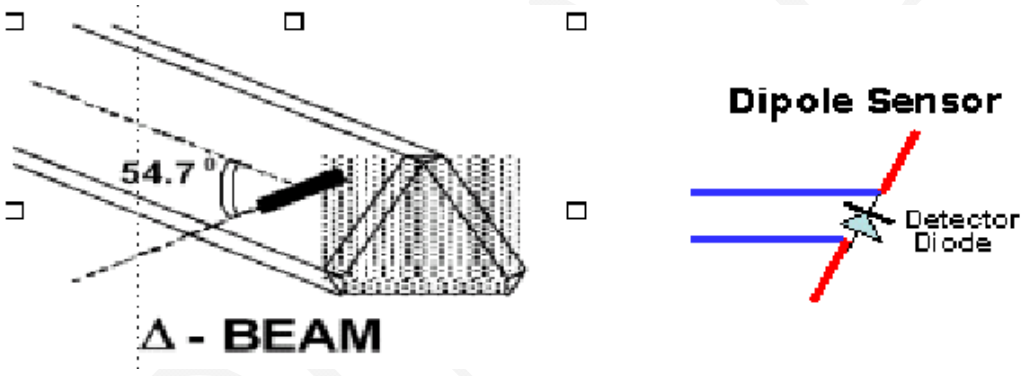
The overall uncertainty for the methodology and algorithms the used during the SAR calculation was evaluated using the data from IEEE 1528 based on the example f3 algorithm:

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

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 μV/(V/m)^2 to 0.85 μV/(V/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 5μV 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

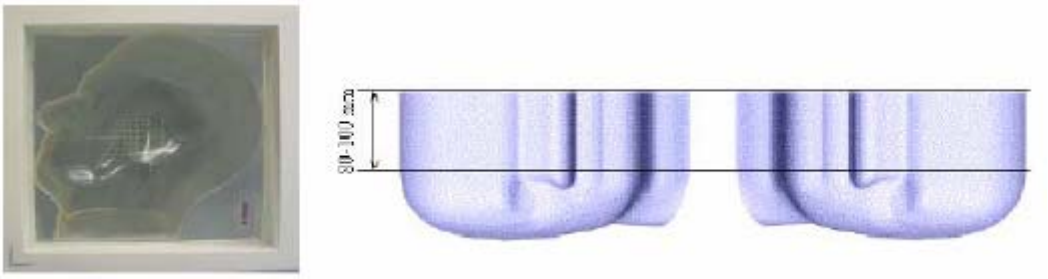
The universal device positioner allows complete freedom of movement of the EUT. Developed to hold a EUT in a free-space scenario any additional loading attributable to the material used in the construction of the positioner has been eliminated. Repeatability has been enhanced through the linear scales 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 EN62209-1:2006 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 recommended in EN62209-2:2010.

EN62209-1:2006 Recommended Tissue Dielectric Parameters

Frequency (MHz)	Head Tissue	
	εr	σ (S/m)
150	52.3	0.76
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
915	41.5	0.98
1450	40.5	1.20
1610	40.3	1.29
1800-2000	40.0	1.40
2450	39.2	1.80
3000	38.5	2.40
5800	35.3	5.27

EN62209-2:2010 Recommended Body Tissue Dielectric Parameters

Frequency (MHz)	Body Tissue	
	εr	σ (S/m)
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
1800	40.0	1.40
1900	40.0	1.40
2450	39.2	1.80
4000	37.4	3.43
5000	36.2	4.45

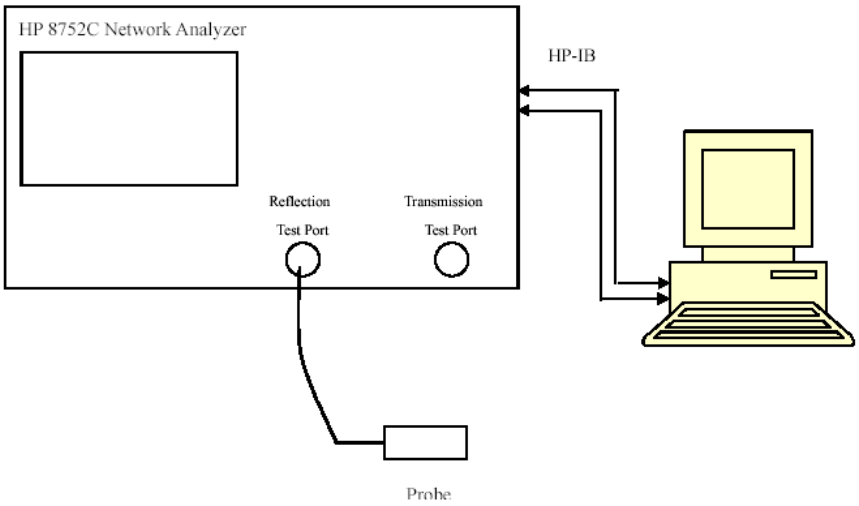
EQUIPMENT LIST AND CALIBRATION

Equipments List & Calibration Information

Equipment	Model	Calibration Date	Calibration Due Date	S/N
CRS F3 robot	ALS-F3	N/A	N/A	RAF0805352
CRS F3 Software	ALS-F3-SW	N/A	N/A	N/A
CRS C500C controller	ALS-C500	N/A	N/A	RCF0805379
Probe mounting device & Boundary Detection Sensor System	ALS-PMDPS-3	N/A	N/A	120-00270
Universal Work Station	ALS-UWS	N/A	N/A	100-00157
Data Acquisition Package	ALS-DAQ-PAQ-3	N/A	N/A	110-00212
Miniature E-Field Probe	ALS-E-020	2017-02-07	2018-02-07	500-00283
Dipole, 900MHz	ALS-D-900-S-2	2014-10-08	2017-10-08	190-00609
Dipole, 1750MHz	ALS-D-1750-S-2	2016-10-04	2019-10-04	198-00304
Dipole, 1900MHz	ALS-D-1900-S-2	2014-10-09	2017-10-09	210-00710
Dipole Spacer	ALS-DS-U	N/A	N/A	250-00907
Device holder/Positioner	ALS-H-E-SET-2	N/A	N/A	170-00510
Left ear SAM phantom	ALS-P-SAM-L	N/A	N/A	130-00311
Right ear SAM phantom	ALS-P-SAM-R	N/A	N/A	140-00359
UniPhantom	ALS-P-UP-1	N/A	N/A	150-00413
Simulated Tissue 900 MHz Head and Body	ALS-TS-900-H	Each Time	/	280-01054
Simulated Tissue 1750 MHz Head and Body	ALS-TS-1750-H	Each Time	/	290-01105
Simulated Tissue 1900 MHz Head and Body	ALS-TS-1900-H	Each Time	/	295-01103
Signal Generator	8648C	2017-04-19	2018-04-19	3426A01345
Power Amplifier	5S1G4	N/A	N/A	71377
Power Sensor	N1921A	2016-12-05	2017-12-05	MY54210016
P-Series Power Meter	N1912A	2016-12-05	2017-12-05	MY50000448
Attenuator	3dB	N/A	N/A	5402
Dielectric probe kit	HP85070B	N/A	N/A	US33020324
Network analyzer	8752C	2017-03-24	2018-03-24	3410A02356
UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	2016-10-18	2017-10-18	106891
EMI Test Receiver	ESCI	2017-06-13	2018-06-13	101746

SAR MEASUREMENT SYSTEM VERIFICATION

Liquid Verification



Liquid Verification Setup Block Diagram

Liquid Verification Results

Frequency (MHz)	Liquid Type	Liquid Parameter		Target Value		Delta (%)		Tolerance (%)
		ε_r	σ (S/m)	ε_r	σ (S/m)	$\Delta\varepsilon_r$	$\Delta\sigma$	
880.2	Head and Body	42.06	0.97	41.50	0.97	1.349	0.000	±5
882.6	Head and Body	41.80	0.98	41.50	0.97	0.723	1.031	±5
897.6	Head and Body	42.18	1.00	41.50	0.97	1.639	3.093	±5
900	Head and Body	41.41	0.99	41.50	0.97	-0.217	2.062	±5
902.0	Head and Body	41.87	0.96	41.50	0.97	0.892	-1.031	±5
912.4	Head and Body	41.87	0.98	41.50	0.97	0.892	1.031	±5
914.8	Head and Body	42.03	0.97	41.50	0.97	1.277	0.000	±5

**Liquid Verification was performed on 2017-07-10.*

Frequency (MHz)	Liquid Type	Liquid Parameter		Target Value		Delta (%)		Tolerance (%)
		ε_r	σ (S/m)	ε_r	σ (S/m)	$\Delta\varepsilon_r$	$\Delta\sigma$	
1710.4	Head and Body	40.13	1.41	40.00	1.40	0.325	0.714	±5
1747.8	Head and Body	40.38	1.41	40.00	1.40	0.950	0.714	±5
1750	Head and Body	39.59	1.39	40.00	1.40	-1.025	-0.714	±5
1784.6	Head and Body	40.00	1.38	40.00	1.40	0.000	-1.429	±5

**Liquid Verification was performed on 2017-07-11*

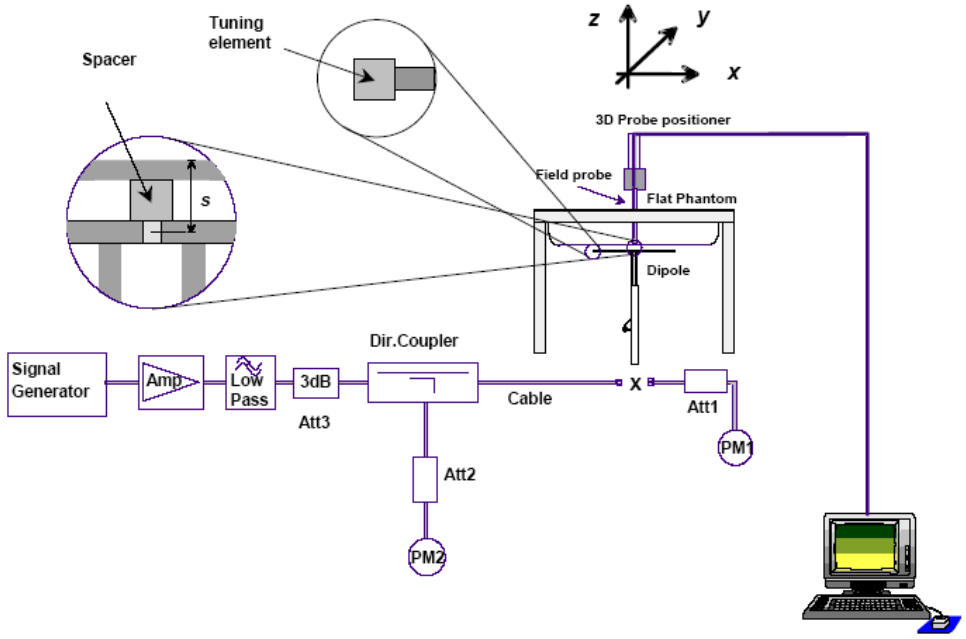
Frequency (MHz)	Liquid Type	Liquid Parameter		Target Value		Delta (%)		Tolerance (%)
		ε_r	Ơ (S/m)	ε_r	Ơ (S/m)	Δ ε_r	Δ Ơ	
1900	Head and Body	40.21	1.37	40.00	1.40	0.525	-2.143	±5
1922.6	Head and Body	40.34	1.40	40.00	1.40	0.850	0.000	±5
1950.0	Head and Body	39.97	1.39	40.00	1.40	-0.075	-0.714	±5
1977.4	Head and Body	39.91	1.41	40.00	1.40	-0.225	0.714	±5

**Liquid Verification was performed on 2017-07-12*

System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±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



System Accuracy Check Results

Date	Frequency Band	Liquid Type	Measured SAR (W/Kg)		Target Value (W/Kg)	Delta (%)	Tolerance (%)
2017-07-10	900	Head and Body	10g	7.721	7.595	1.659	±10
2017-07-11	1750	Head and Body	10g	18.814	19.9	-5.457	±10
2017-07-12	1900	Head and Body	10g	18.973	20.44	-7.177	±10

All SAR values are normalized to 1 Watt forward power.

EN62209-1:2006 recommended reference value for Head Tissue

Frequency (MHz)	1 g SAR (W/Kg)	10 g SAR (W/Kg)	Local SAR at surface (above feed point)	Local SAR at surface (y=2cm offset from feed point)
300	3.0	2.0	4.4	2.1
450	4.9	3.3	7.2	3.2
835	9.5	6.2	14.1	4.9
900	10.8	6.9	16.4	5.4
1450	29.0	16.0	50.2	6.5
1800	38.1	19.8	69.5	6.8
1900	39.7	20.5	72.1	6.6
2000	41.1	21.1	74.6	6.5
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

EN62209-2:2010 recommended reference value for Body Tissue

Frequency (MHz)	1 g SAR (W/Kg)	10 g SAR (W/Kg)	Local SAR at surface (above feed point)	Local SAR at surface (y=2cm offset from feed point)
300	2.85	1.94	4.14	2.00
450	4.58	3.06	6.75	2.98
835	9.56	6.22	14.6	4.90
900	10.9	6.99	16.4	5.40
1450	29.0	16.0	50.2	6.50
1800	38.4	20.1	69.5	6.80
1900	39.7	20.5	72.1	6.60
2000	41.1	21.1	74.6	6.50
2450	52.4	24.0	104	7.70
3000	63.8	25.7	140	9.50

SAR SYSTEM VALIDATION DATA

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

System Performance Check 900 MHz Liquid

Dipole 900 MHz; Type: ALS-D-900-S-2; S/N: 190-00609

Product Data
Device Name : Dipole 900 MHz
Serial No. : 190-00609
Type : Dipole
Model : ALS-D-900-S-2
Frequency Band : 900
Max. Transmit Pwr : 1 W
Drift Time : 3 min(s)
Power Drift-Start : 11.153 W/kg
Power Drift-Finish : 11.185 W/kg
Power Drift (%) : 0.287

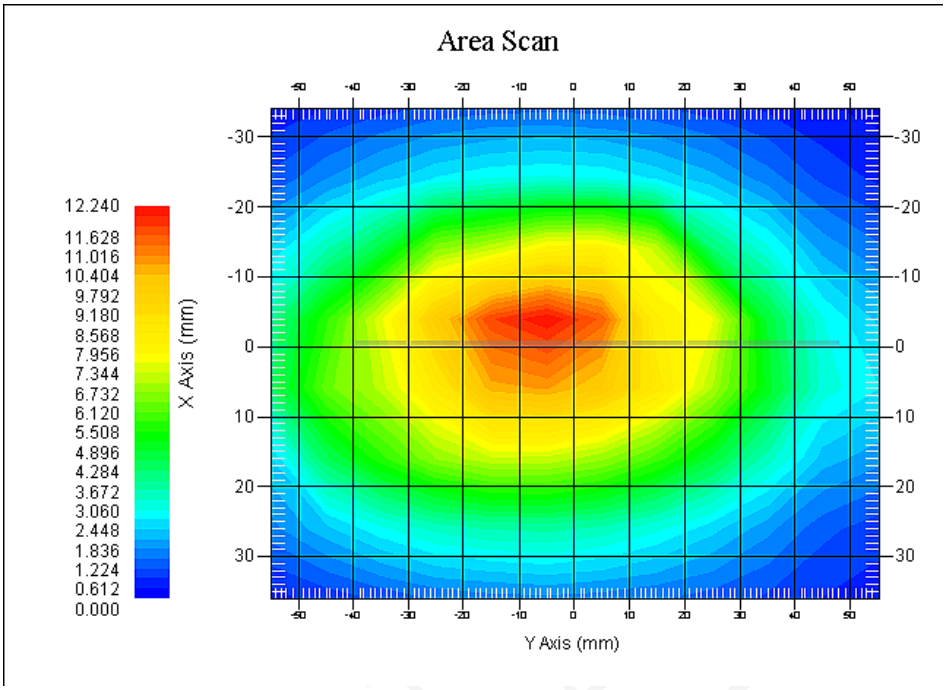
Phantom Data
Name : APREL-Uni
Type : Uni-Phantom
Serial No. : System Default
Location : Center
Description : Default

Tissue Data
Type : Head and Body
Serial No. : 280-01054
Frequency : 900.00 MHz
Temperature : 20.00 °C
Ambient Temp. : 21.00 °C
Humidity : 50.00 RH%
Epsilon : 41.41 F/m
Sigma : 0.99 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 : 7-Feb-2017
Frequency Band : 900
Duty Cycle Factor : 1
Conversion Factor : 6
Probe Sensitivity : 1.20 1.20 1.20 $\mu V/(V/m)^2$
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 : 11.773 W/kg
10 gram SAR value : 7.721 W/kg
Area Scan Peak SAR : 12.135 W/kg
Zoom Scan Peak SAR : 17.318 W/kg



900 MHz System Validation

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

System Performance Check 1750 MHz Liquid

Dipole 1750 MHz; Type: ALS-D-1750-S-2; S/N: 198-00304

Product Data
Device Name : Dipole 1750MHHz
Serial No. : 198-00304
Type : Dipole
Model : ALS-D-1750-S-2
Frequency Band : 1750
Max. Transmit Pwr : 1 W
Drift Time : 3 min(s)
Power Drift-Start : 28.537 W/kg
Power Drift-Finish : 28.889 W/kg
Power Drift (%) : 1.271

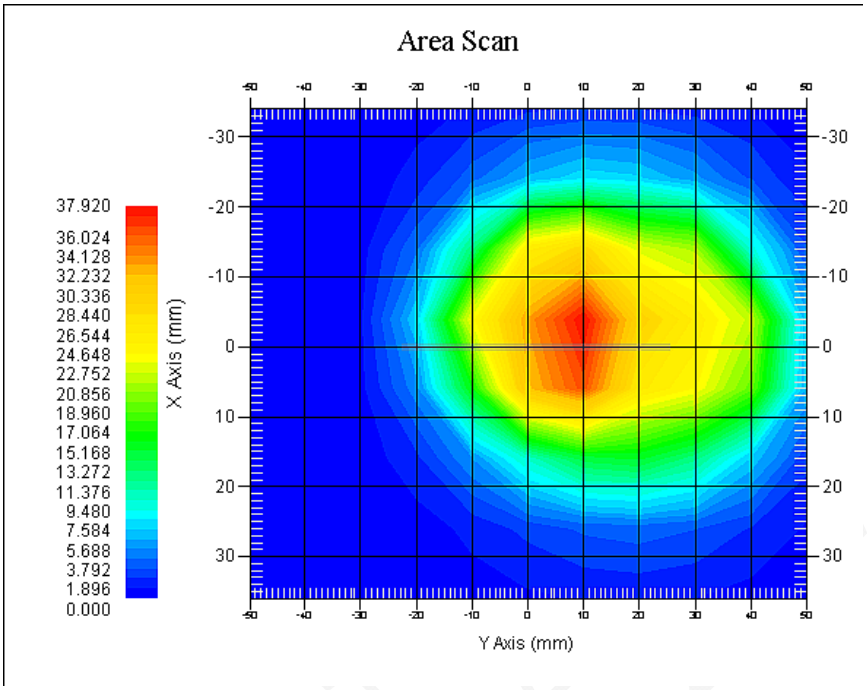
Phantom Data
Name : APREL-Uni
Type : Uni-Phantom
Serial No. : System Default
Location : Center
Description : Default

Tissue Data
Type : Head and Body
Serial No. : 290-01105
Frequency : 1750 MHz
Temperature : 20.00 °C
Ambient Temp. : 21.00 °C
Humidity : 50.00 RH%
Epsilon : 39.59 F/m
Sigma : 1.39 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 : 7-Feb-2017
Frequency Band : 1750
Duty Cycle Factor : 1
Conversion Factor : 5.4
Probe Sensitivity : 1.20 1.20 1.20 $\mu V/(V/m)^2$
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 : 37.130 W/kg
10 gram SAR value : 18.814 W/kg
Area Scan Peak SAR : 37.760 W/kg
Zoom Scan Peak SAR : 58.935 W/kg



1750 MHz System Validation

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

System Performance Check 1900 MHz 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 : 36.553 W/kg
Power Drift-Finish : 36.021 W/kg
Power Drift (%) : -1.507

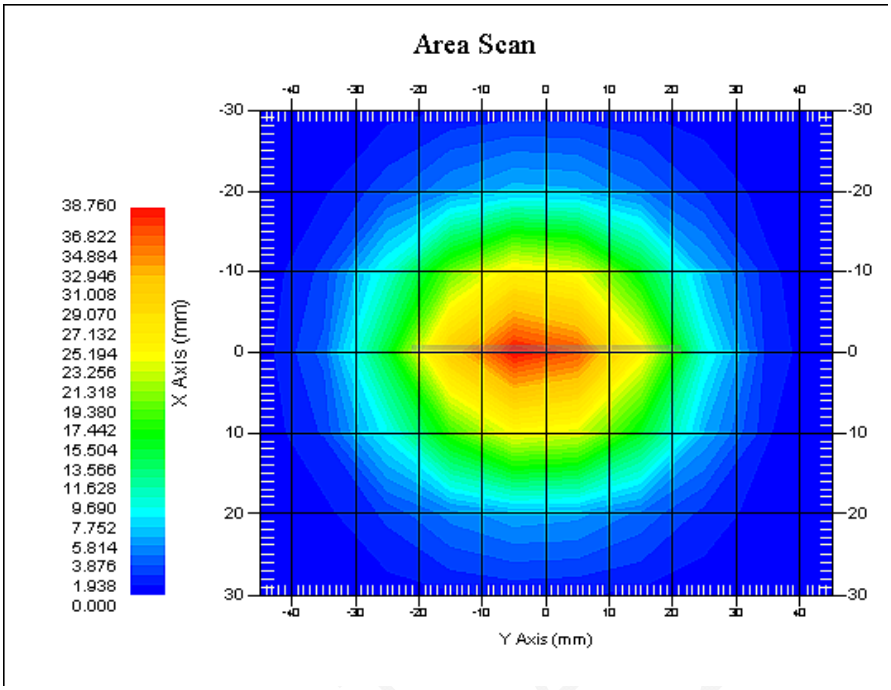
Phantom Data
Name : APREL-Uni
Type : Uni-Phantom
Serial No. : System Default
Location : Center
Description : Default

Tissue Data
Type : Head and Body
Serial No. : 295-01103
Frequency : 1900.00 MHz
Temperature : 20.00 °C
Ambient Temp. : 21.00 °C
Humidity : 56.00 RH%
Epsilon : 40.21 F/m
Sigma : 1.37 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 : 7-Feb-2017
Frequency Band : 1900
Duty Cycle Factor : 1
Conversion Factor : 4.8
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/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 : 8x10x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm

1 gram SAR value : 38.545 W/kg
10 gram SAR value : 18.973 W/kg
Area Scan Peak SAR : 38.760 W/kg
Zoom Scan Peak SAR : 57.360 W/kg



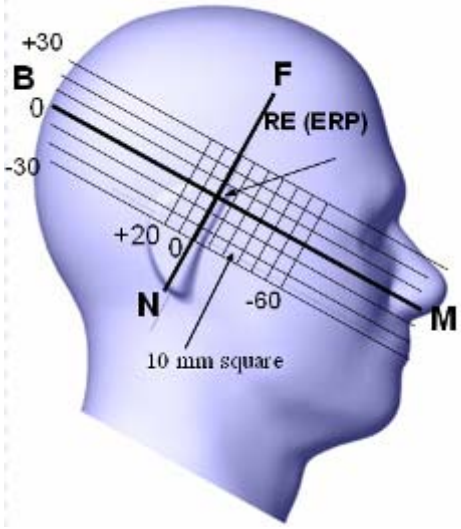
1900 MHz System Validation

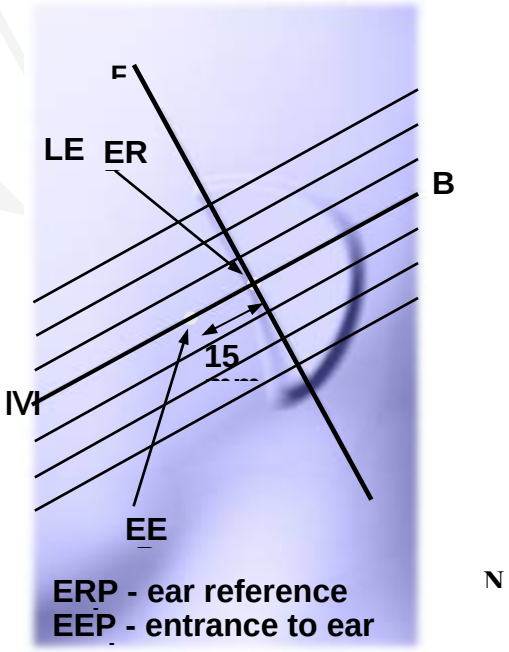
EUT TEST STRATEGY AND METHODOLOGY

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

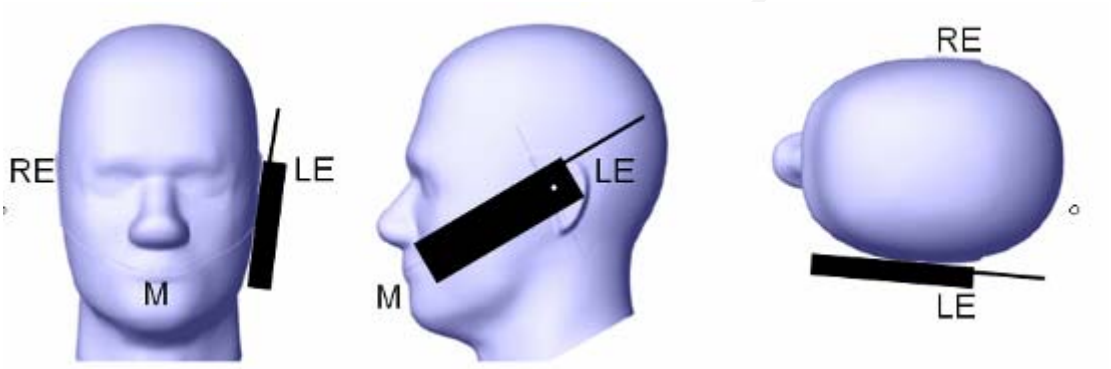
The device is brought toward the mouth of the head phantom by pivoting against the "ear reference point" or along the "N-F" line for the SCC-34/SC-2 head phantom.

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

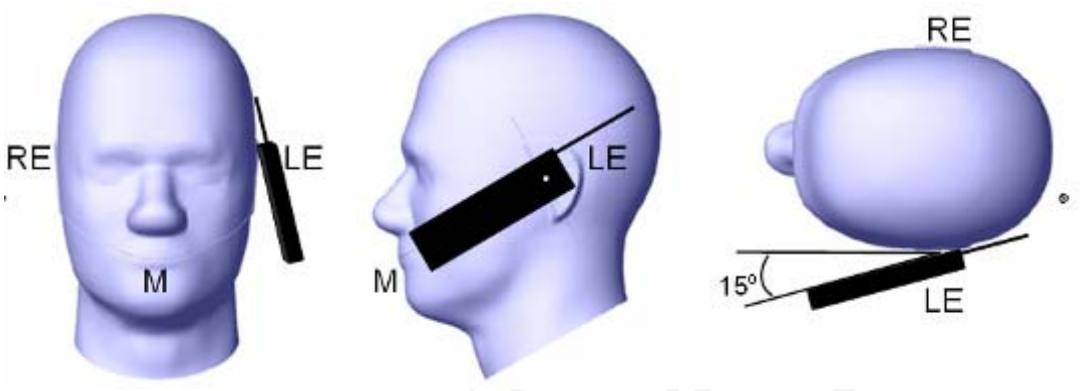
With the handset aligned in the "Cheek/Touch Position":

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°. 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.

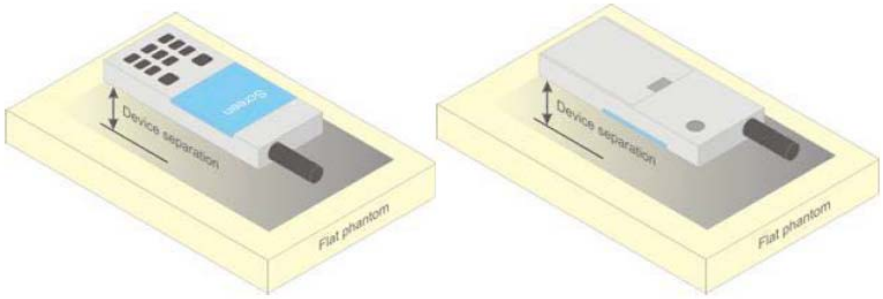


Figure 5 – Test positions for body-worn devices

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

EN50360: 2001+A1:2012
EN50566: 2013
EN62209-1:2006
EN62209-2:2010
EN 62479:2010
IEEE1528:2013

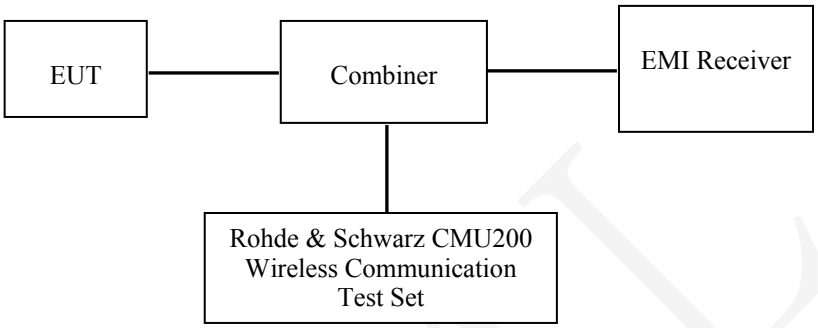
CONDUCTED OUTPUT POWER MEASUREMENT

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 Receiver through sufficient attenuation.



GSM&3G

Test Results:

GSM

Band	Frequency (MHz)	Conducted Output Power	
		(dBm)	(W)
GSM900	880.2	**32.8**	1.905
	902.0	32.7	1.862
	914.8	32.6	1.820
DCS1800	1710.4	28.7	0.741
	1747.8	28.9	0.776
	1710.6	**29.1**	0.813

GPRS

Mode	Channel No.	Frequency (MHz)	RF Output Power (dBm)			
			1 slot	2 slots	3 slots	4 slots
GSM900	975	880.2	32.76	32.18	30.46	29.19
	60	902.0	32.63	31.98	30.23	28.95
	124	914.8	32.55	31.91	29.95	28.73
DCS1800	513	1710.4	28.62	28.26	25.93	24.81
	700	1747.8	28.93	28.12	26.24	25.08
	884	1710.6	29.17	28.43	26.51	25.35

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 slots	3 slots	4 slots
GSM900	975	880.2	23.76	26.18	**26.21**	26.19
	60	902.0	23.63	25.98	25.98	25.95
	124	914.8	23.55	25.91	25.70	25.73
DCS1800	513	1710.4	19.62	22.26	21.68	21.81
	700	1747.8	19.93	22.12	21.99	22.08
	884	1710.6	20.17	**22.43**	22.26	22.35

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 (900 MHz band) and 0 (1800 MHz band).
3. For GPRS, 1, 2, 3 and 4 timeslots has been activated separately with power control level 3(900 MHz band) and 3(1800 MHz band).

WCDMA Band 8

Test Condition	Test Mode	3GPP Sub Test	Averaged Mean Power (dBm)		
			Low Channel	Mid Channel	High Channel
Normal	Rel 99 RMC		**21.40**	21.03	20.37
	HSDPA	1	20.44	20.23	20.43
		2	20.63	20.50	20.48
		3	20.79	20.70	20.60
		4	20.68	20.47	20.51
	HSUPA	1	21.55	21.15	21.01
		2	21.62	21.54	21.53
		3	21.65	21.69	21.69
		4	21.61	21.49	21.49
		5	21.77	21.70	21.64
	DC-HSDPA	1	21.14	21.44	21.27
		2	21.17	21.01	21.28
		3	21.34	21.15	21.44
		4	21.14	20.98	21.25
	HSPA+	1	21.17	20.59	21.07

WCDMA Band 1

Test Condition	Test Mode	3GPP Sub Test	Averaged Mean Power (dBm)		
			Low Channel	Mid Channel	High Channel
Normal	Rel 99 RMC		21.22	20.96	**21.33**
	HSDPA	1	20.34	20.57	20.67
		2	20.71	20.58	20.68
		3	20.84	20.46	20.82
		4	20.64	20.57	20.63
	HSUPA	1	20.26	20.63	20.72
		2	20.25	20.93	20.77
		3	20.45	20.56	20.89
		4	20.31	20.93	20.75
		5	20.39	21.13	20.95
	DC-HSDPA	1	20.87	20.64	20.27
		2	20.80	20.57	20.17
		3	20.95	20.67	20.31
		4	20.74	20.58	20.23
	HSPA+	1	21.12	20.81	20.67

Note:

The default test configuration is to measure SAR with an established radio link between the EUT and a communication test set using a 12.2 kbps RMC (reference measurement Channel) Configured in Test Loop Model 1.

Bluetooth:

Mode	Channel Frequency (MHz)	Power (dBm)	Power (mW)
BDR(GFSK)	2402	-1.90	0.646
	2441	-1.73	0.671
	2480	**-1.41**	0.723
EDR(4-DQPSK)	2402	-2.67	0.541
	2441	-2.51	0.561
	2480	-2.29	0.590
EDR-8DPSK	2402	-2.66	0.542
	2441	-2.51	0.561
	2480	-2.26	0.594
BLE	2402	-9.99	0.100
	2440	-10.31	0.093
	2480	-10.35	0.092

Note:
EN62479-SAR is not required for low-power equipment where the available antenna power and/or the average total radiated power is less than or equal to the Pmax values given in Annex A (20 mW).

Wi-Fi

Band	Frequency (MHz)	Conducted Output Power	
		(dBm)	(mW)
802.11b	2412	7.06	5.082
	2442	7.56	5.702
	2472	7.24	5.297
802.11g	2412	**7.70**	5.888
	2442	6.67	4.645
	2472	6.82	4.808
802.11n-HT20	2412	6.52	4.487
	2442	6.19	4.159
	2472	6.73	4.710
802.11n-HT40	2422	6.65	4.624
	2442	7.34	5.420
	2462	6.97	4.977

Note:

1. The output power was tested under data rate 1Mbps for 802.11b, 6Mbps for 802.11g, MCS0 for 802.11n-HT20, and MCS0 for 802.11n-HT40.
2. EN62479-SAR is not required for low-power equipment where the available antenna power and/or the average total radiated power is less than or equal to the Pmax values given in Annex A (20 mW).

SAR MEASUREMENT RESULTS

This page summarizes the results of the performed dosimetric evaluation.

Test Results:

Environmental Conditions:

Temperature:	21 ℃
Relative Humidity:	52 %
ATM Pressure:	1002 mbar

** Testing was performed by Hans Zhao on 2017-07-10 to 2017-07-12.*

EGSM 900:

EUT Position	Frequency (MHz)	Test Mode	Antenna Type	Phantom Type	10g SAR (W/Kg)		
					Measurement	Limit	Plot
Head-Cheek	880.2	GSM	Internal	SAM	0.412	2.0	/
	902.0	GSM	Internal	SAM	**0.435**	2.0	**1#**
	914.8	GSM	Internal	SAM	0.421	2.0	/
Body-Headset-Back (0mm)	880.2	GSM	Internal	Universal	/	2.0	/
	902.0	GSM	Internal	Universal	0.606	2.0	/
	914.8	GSM	Internal	Universal	/	2.0	/
Body-Back (0mm)	880.2	GPRS	Internal	Universal	0.736	2.0	/
	902.0	GPRS	Internal	Universal	**0.851**	2.0	**2#**
	914.8	GPRS	Internal	Universal	0.829	2.0	
Body-Right (0mm)	880.2	GPRS	Internal	Universal	/	2.0	/
	902.0	GPRS	Internal	Universal	0.412	2.0	/
	914.8	GPRS	Internal	Universal	/	2.0	/
Body-Bottom (0mm)	880.2	GPRS	Internal	Universal	/	2.0	/
	902.0	GPRS	Internal	Universal	0.325	2.0	/
	914.8	GPRS	Internal	Universal	/	2.0	/

Note:

1. When the 10-g SAR is ≤ 1.0W/Kg, testing for low and high channel is optional.
2. The EUT is a Class B mobile phone which can be attached to both GPRS and GSM services, using one service at a time.
3. The Multi-slot Classes of EUT is Class 12which 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. The EUT transmit and receive through the same GSM antenna while testing SAR.
5. Since the antenna located the bottom side edge, SAR probe access is not feasible with a horizontally configured SAM phantom and a flat phantom is replaced. When using a flat phantom, rectangular shaped phones should be positioned with its bottom edge positioned from the flat phantom with the same distance provided by the cheek touching position using SAM. The ear reference point (ERP, as defined for SAM) of the phone should be positioned 4 mm from the flat phantom shell.

DCS 1800:

EUT Position	Frequency (MHz)	Test Mode	Antenna Type	Phantom Type	10g SAR (W/Kg)		
					Measurement	Limit	Plot
Head-Cheek	1710.4	GSM	Internal	SAM	0.496	2.0	/
	1747.8	GSM	Internal	SAM	**0.522**	2.0	**3#**
	1710.6	GSM	Internal	SAM	0.503	2.0	**/**
Body-Headset-Back (0mm)	1710.4	GSM	Internal	Universal	/	2.0	/
	1747.8	GSM	Internal	Universal	0.800	2.0	/
	1710.6	GSM	Internal	Universal	/	2.0	/
Body-Back (0mm)	1710.4	GPRS	Internal	Universal	0.813	2.0	/
	1747.8	GPRS	Internal	Universal	**0.879**	2.0	**4#**
	1710.6	GPRS	Internal	Universal	0.852	2.0	/
Body-Right (0mm)	1710.4	GPRS	Internal	Universal	/	2.0	/
	1747.8	GPRS	Internal	Universal	0.354	2.0	/
	1710.6	GPRS	Internal	Universal	/	2.0	/
Body-Bottom (0mm)	1710.4	GPRS	Internal	Universal	/	2.0	/
	1747.8	GPRS	Internal	Universal	0.693	2.0	/
	1710.6	GPRS	Internal	Universal	/	2.0	/

Note:

1. When the 10-g SAR is ≤ 1.0W/Kg, testing for low and high channel is optional.
2. The EUT is a Class B mobile phone which can be attached to both GPRS and GSM services, using one service at a time.
3. The Multi-slot Classes of EUT is Class 12which 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. The EUT transmit and receive through the same GSM antenna while testing SAR.
5. Since the antenna located the bottom side edge, SAR probe access is not feasible with a horizontally configured SAM phantom and a flat phantom is replaced. When using a flat phantom, rectangular shaped phones should be positioned with its bottom edge positioned from the flat phantom with the same distance provided by the cheek touching position using SAM. The ear reference point (ERP, as defined for SAM) of the phone should be positioned 4 mm from the flat phantom shell.

WCDMA Band 8

EUT Position	Frequency (MHz)	Test Mode	Antenna Type	Phantom Type	10g SAR (W/Kg)		
					Measurement	Limit	Plot
Head-Cheek	882.6	RMC	Internal	SAM	0.165	2.0	/
	897.6	RMC	Internal	SAM	**0.187**	2.0	**5#**
	912.4	RMC	Internal	SAM	0.170	2.0	/
Body-Back (0mm)	882.6	RMC	Internal	Universal	0.311	2.0	/
	897.6	RMC	Internal	Universal	**0.321**	2.0	**6#**
	912.4	RMC	Internal	Universal	0.289	2.0	/
Body-Right (0mm)	882.6	RMC	Internal	Universal	/	2.0	/
	897.6	RMC	Internal	Universal	0.163	2.0	/
	912.4	RMC	Internal	Universal	/	2.0	/
Body-Bottom (0mm)	882.6	RMC	Internal	Universal	/	2.0	/
	897.6	RMC	Internal	Universal	0.091	2.0	/
	912.4	RMC	Internal	Universal	/	2.0	/

WCDMA Band 1

EUT Position	Frequency (MHz)	Test Mode	Antenna Type	Phantom Type	10g SAR (W/Kg)		
					Measurement	Limit	Plot
Head-Cheek	1922.6	RMC	Internal	SAM	0.604	2.0	/
	1950.0	RMC	Internal	SAM	**0.637**	2.0	**7#**
	1977.4	RMC	Internal	SAM	0.596	2.0	/
Body-Back (0mm)	1922.6	RMC	Internal	Universal	0.855	2.0	/
	1950.0	RMC	Internal	Universal	**0.956**	2.0	**8#**
	1977.4	RMC	Internal	Universal	0.932	2.0	/
Body-Right (0mm)	1922.6	RMC	Internal	Universal	/	2.0	/
	1950.0	RMC	Internal	Universal	0.495	2.0	/
	1977.4	RMC	Internal	Universal	/	2.0	/
Body-Bottom (0mm)	1922.6	RMC	Internal	Universal	/	2.0	/
	1950.0	RMC	Internal	Universal	0.693	2.0	/
	1977.4	RMC	Internal	Universal	/	2.0	/

Note:
1. When the 10-g SAR is ≤ 1.0W/Kg, testing for low and high channel is optional.
2. The default test configuration is to measure SAR with an established radio link between the EUT and a communication test set using a 12.2 kbps RMC (reference measurement Channel) Configured in Test Loop Mode.
3. Since the antenna located the bottom side edge, SAR probe access is not feasible with a horizontally configured SAM phantom and a flat phantom is replaced. When using a flat phantom, rectangular shaped phones should be positioned with its bottom edge positioned from the flat phantom with the same distance provided by the cheek touching position using SAM. The ear reference point (ERP, as defined for SAM) of the phone should be positioned 4 mm from the flat phantom shell.

SAR Plots (Summary of the Highest SAR Values)

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

Head Cheek (902.0 MHz Middle Channel)

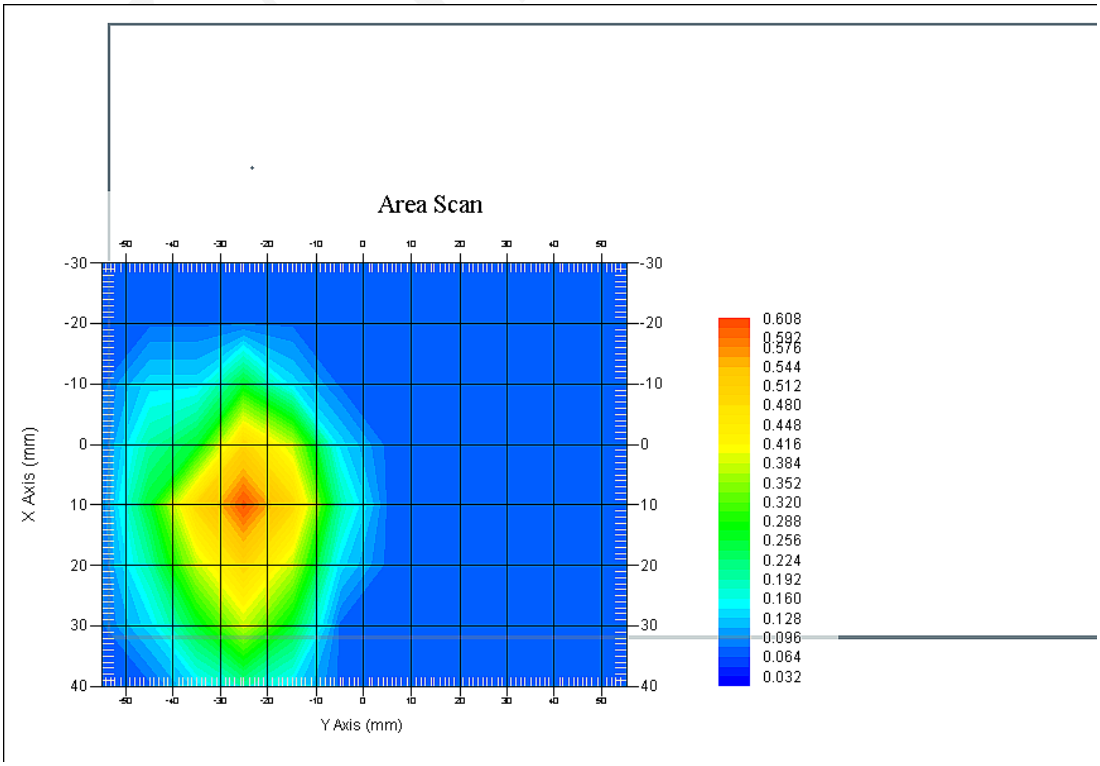
Measurement Data
Test mode : GSM
Crest Factor : 8
Scan Type : Complete
Area Scan : 11x8x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.128 W/kg
Power Drift-Finish : 0.126 W/kg
Power Drift (%) : -1.563

Tissue Data
Type : Head and Body
Frequency : 902.0 MHz
Epsilon : 41.87 F/m
Sigma : 0.96 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 900
Duty Cycle Factor : 8
Conversion Factor : 6
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV
Offset : 1.56 mm

1 gram SAR value : 0.578 W/kg
10 gram SAR value : 0.435 W/kg
Area Scan Peak SAR : 0.610 W/kg
Zoom Scan Peak SAR : 0.701 W/kg

Plot 1#



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

Body-worn-Back (902.8 MHz Mid Channel)

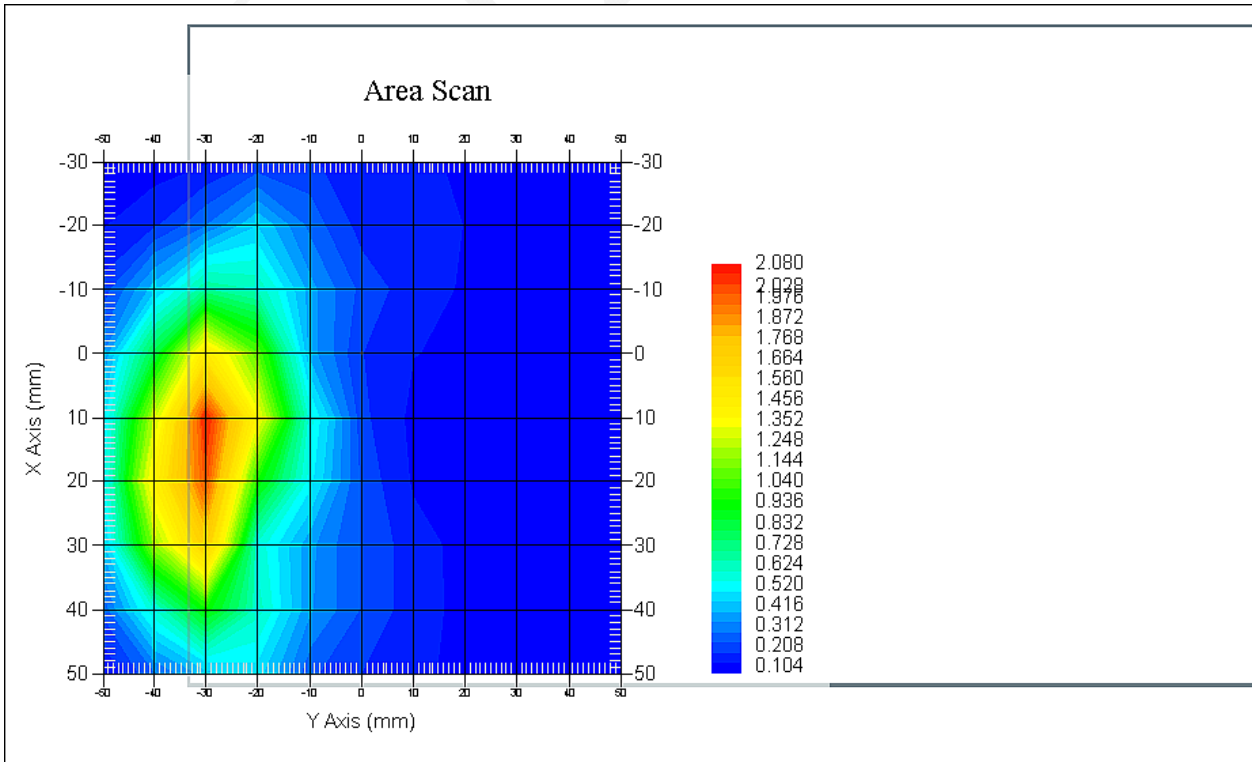
Measurement Data
Test mode : GPRS
Crest Factor : 2.67
Scan Type : Complete
Area Scan : 8x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.113 W/kg
Power Drift-Finish : 1.049 W/kg
Power Drift (%) : -0.165

Tissue Data
Type : Head and Body
Frequency : 902 MHz
Epsilon : 41.87 F/m
Sigma : 0.96 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 900
Duty Cycle Factor : 2.67
Conversion Factor : 6
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV
Offset : 1.56 mm

1 gram SAR value : 1.525 W/kg
10 gram SAR value : 0.851 W/kg
Area Scan Peak SAR : 2.035 W/kg
Zoom Scan Peak SAR : 3.232 W/kg

Plot 2#



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

Head Cheek (1747.8 MHz Mid Channel)

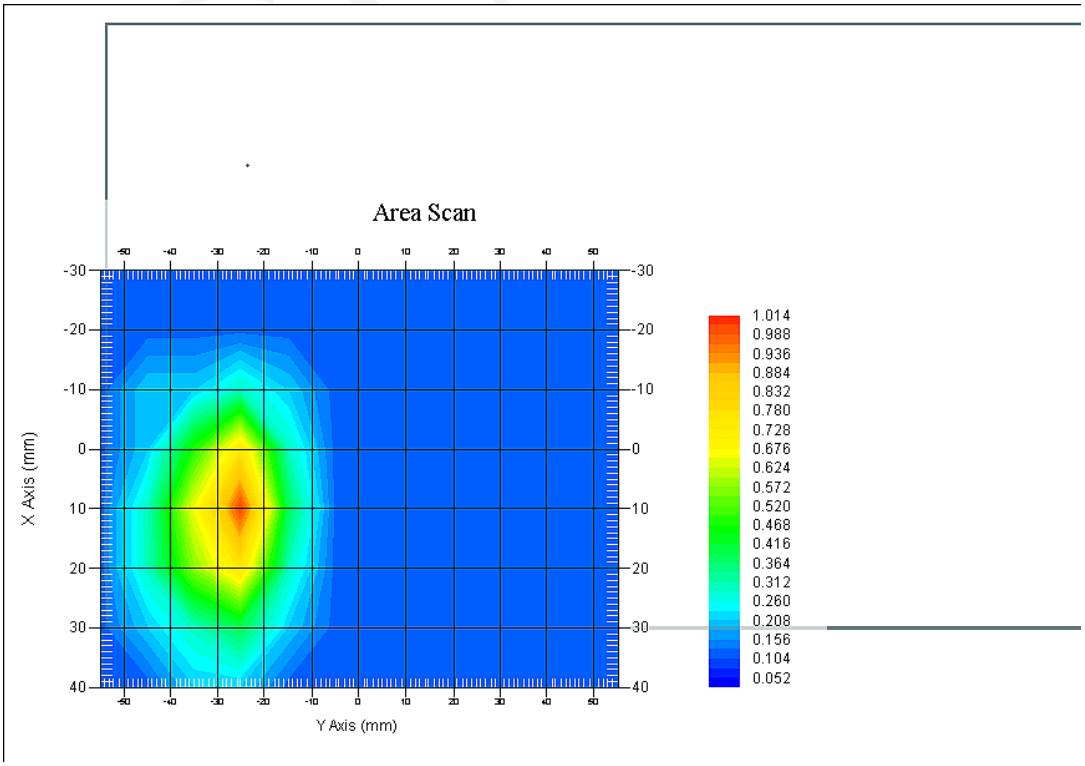
Measurement Data
Test mode : GSM
Crest Factor : 8
Scan Type : Complete
Area Scan : 11x8x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.185 W/kg
Power Drift-Finish : 0.188 W/kg
Power Drift (%) : 1.621

Tissue Data
Type : Head and Body
Frequency : 1747.8 MHz
Epsilon : 40.38 F/m
Sigma : 1.41 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 1750
Duty Cycle Factor : 8
Conversion Factor : 5.4
Offset : 1.56 mm
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV

1 gram SAR value : 0.924 W/kg
10 gram SAR value : 0.522 W/kg
Area Scan Peak SAR : 1.024 W/kg
Zoom Scan Peak SAR : 1.286 W/kg

Plot 3#



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

Body-worn-back (1747.8 MHz Middle Channel)

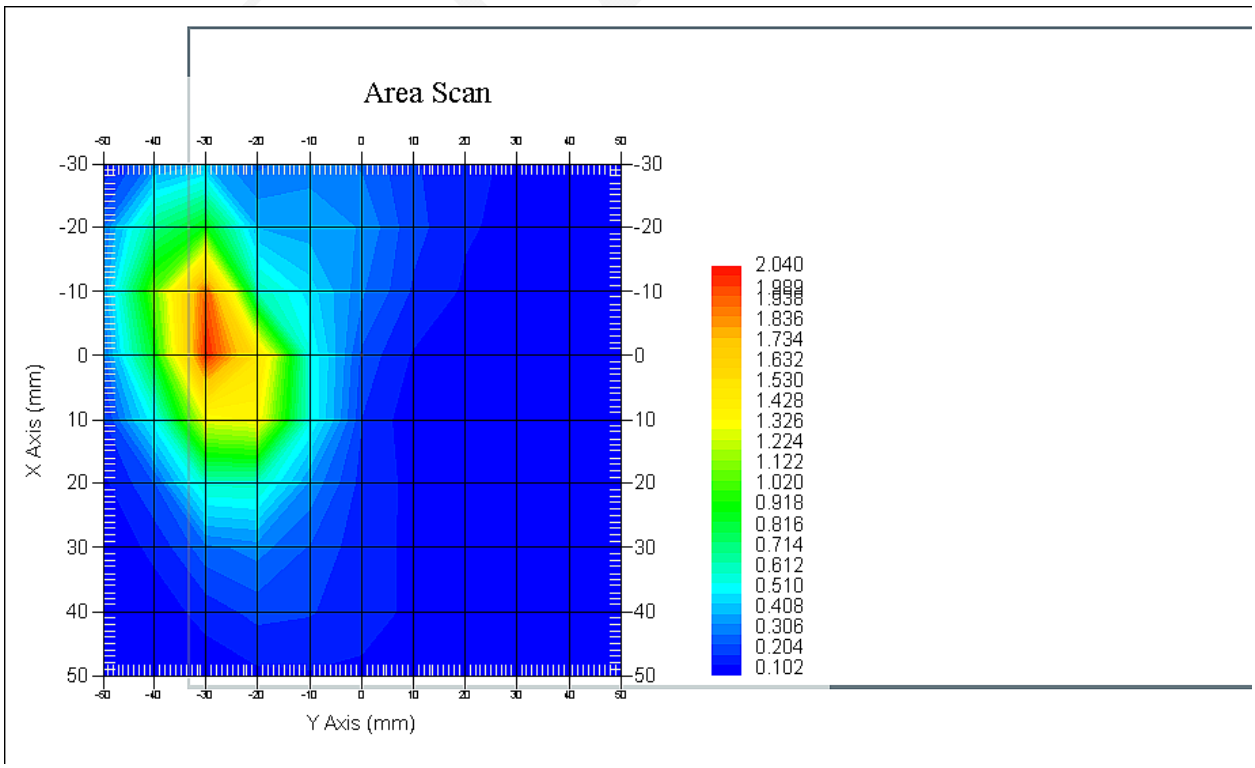
Measurement Data
Test mode : GPRS
Crest Factor : 4
Scan Type : Complete
Area Scan : 8x11x1 : Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.135 W/kg
Power Drift-Finish : 0.137 W/kg
Power Drift (%) : 1.575

Tissue Data
Type : Head and Body
Frequency : 1747.8 MHz
Epsilon : 40.38 F/m
Sigma : 1.41 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 1750
Duty Cycle Factor : 4
Conversion Factor : 5.4
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV
Offset : 1.56 mm

1 gram SAR value : 1.467 W/kg
10 gram SAR value : 0.879 W/kg
Area Scan Peak SAR : 2.002 W/kg
Zoom Scan Peak SAR : 3.112 W/kg

Plot 4#



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

WCDMA Band 8; Head-Cheek (897.6 MHz Middle Channel)

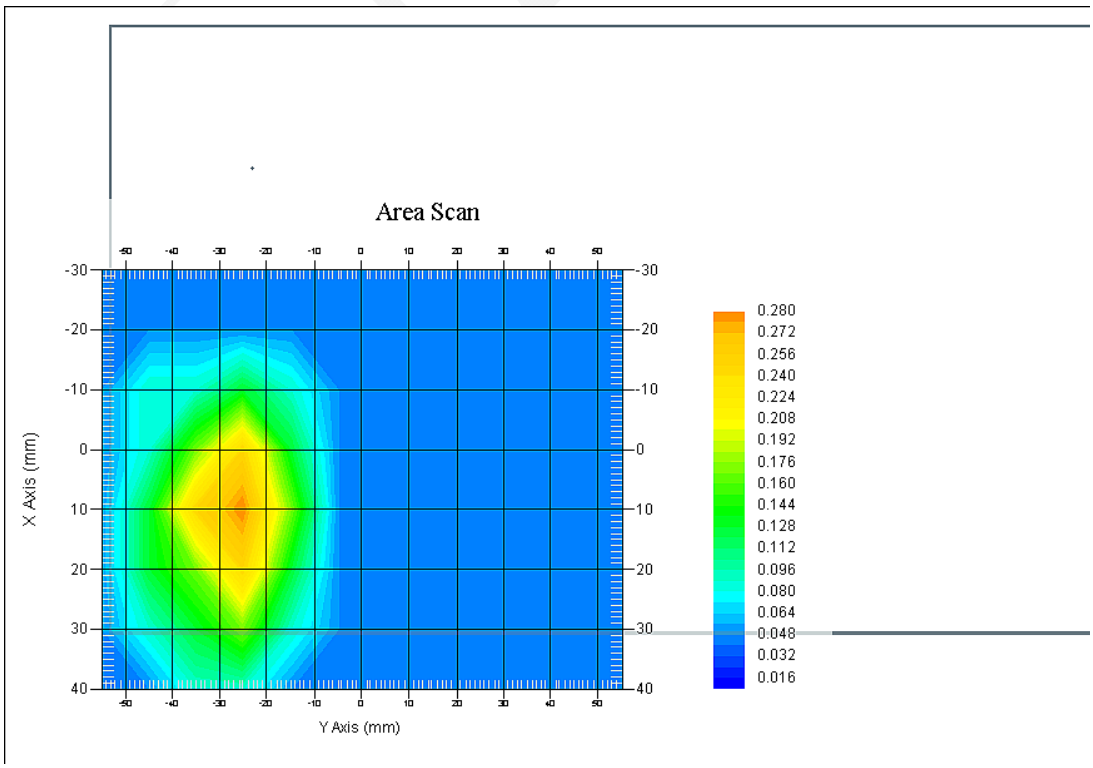
Measurement Data
Test mode : RMC
Crest Factor : 1
Scan Type : Complete
Area Scan : 11x9x1: Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7: Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.104 W/kg
Power Drift-Finish : 0.105 W/kg
Power Drift (%) : 0.962

Tissue Data
Type : Head and Body
Frequency : 897.6 MHz
Epsilon : 42.18 F/m
Sigma : 1.00 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 900
Duty Cycle Factor : 1
Conversion Factor : 6
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV
Offset : 1.56 mm

1 gram SAR value : 0.263 W/kg
10 gram SAR value : 0.187 W/kg
Area Scan Peak SAR : 0.292 W/kg
Zoom Scan Peak SAR : 0.321 W/kg

Plot 5#



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

WCDMA Band 8; Body-worn Back (897.6 MHz Middle Channel)

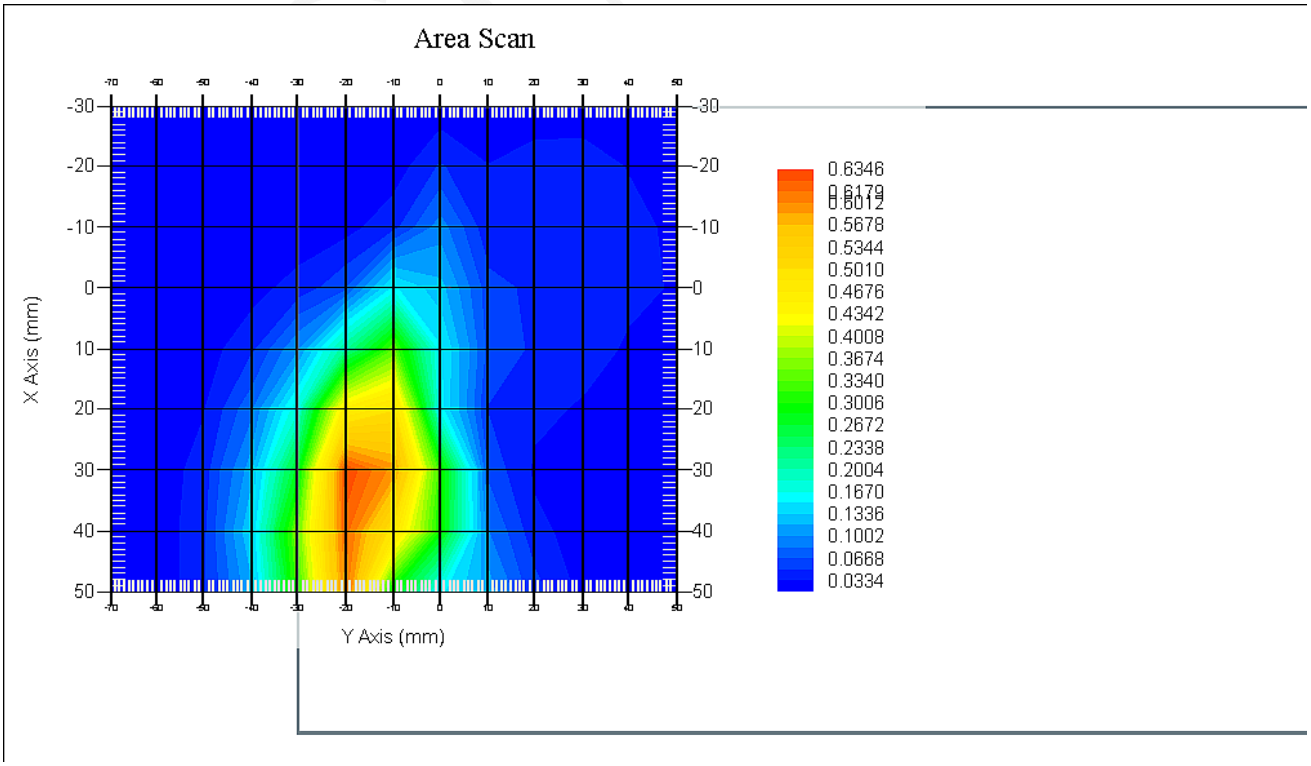
Measurement Data
Test mode : RMC
Crest Factor : 1
Scan Type : Complete
Area Scan : 9x11x1: Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7: Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.103 W/kg
Power Drift-Finish : 0.103 W/kg
Power Drift (%) : 0.547

Tissue Data
Type : Head and Body
Frequency : 897.6 MHz
Epsilon : 42.18 F/m
Sigma : 1.00 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 900
Duty Cycle Factor : 1
Conversion Factor : 6
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV
Offset : 1.56 mm

1 gram SAR value : 0.614 W/kg
10 gram SAR value : 0.321 W/kg
Area Scan Peak SAR : 0.629 W/kg
Zoom Scan Peak SAR : 1.401 W/kg

Plot 6#



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

WCDMA Band 1; Head-Cheek (1950 Middle Channel)

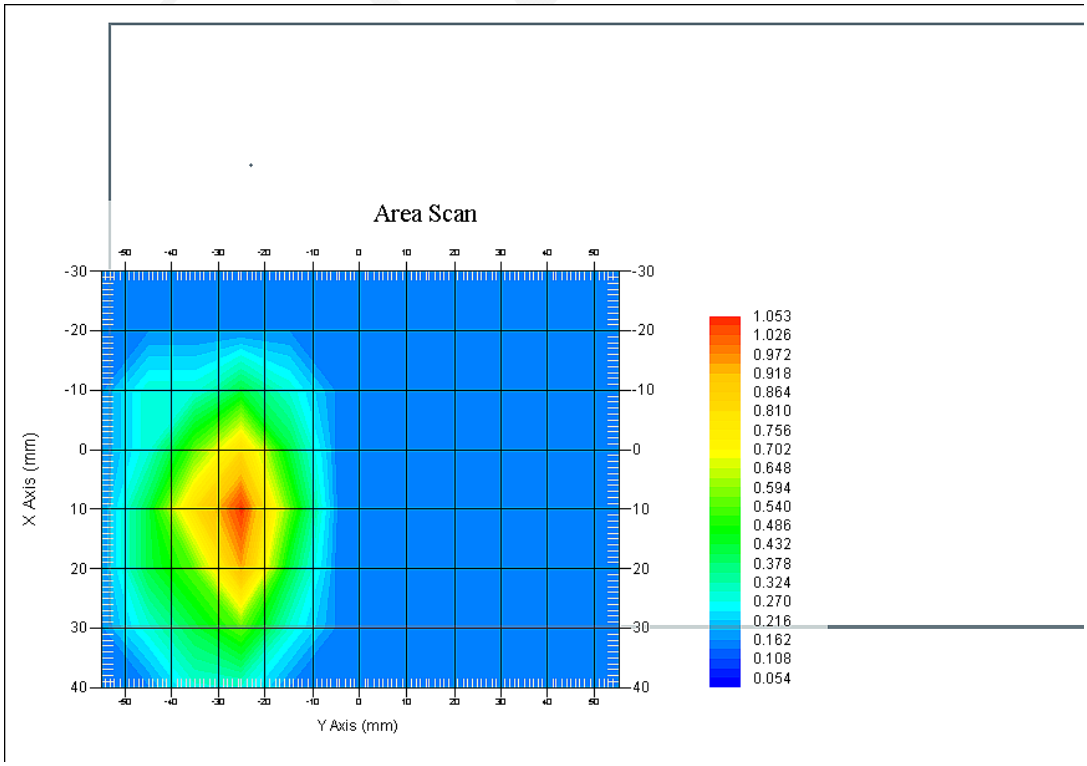
Measurement Data
Test mode : RMC
Crest Factor : 1
Scan Type : Complete
Area Scan : 8x11x1: Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7: Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.350 W/kg
Power Drift-Finish : 0.356 W/kg
Power Drift (%) : 1.714

Tissue Data
Type : Head and Body
Frequency : 1950 MHz
Epsilon : 39.97 F/m
Sigma : 1.39 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 1900
Duty Cycle Factor : 1
Conversion Factor : 4.8
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV
Offset : 1.56 mm

1 gram SAR value : 0.986 W/kg
10 gram SAR value : 0.637 W/kg
Area Scan Peak SAR : 1.105 W/kg
Zoom Scan Peak SAR : 1.466 W/kg

Plot 7#



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

WCDMA Band 1; Body-worn-Back (1950 Mid Channel)

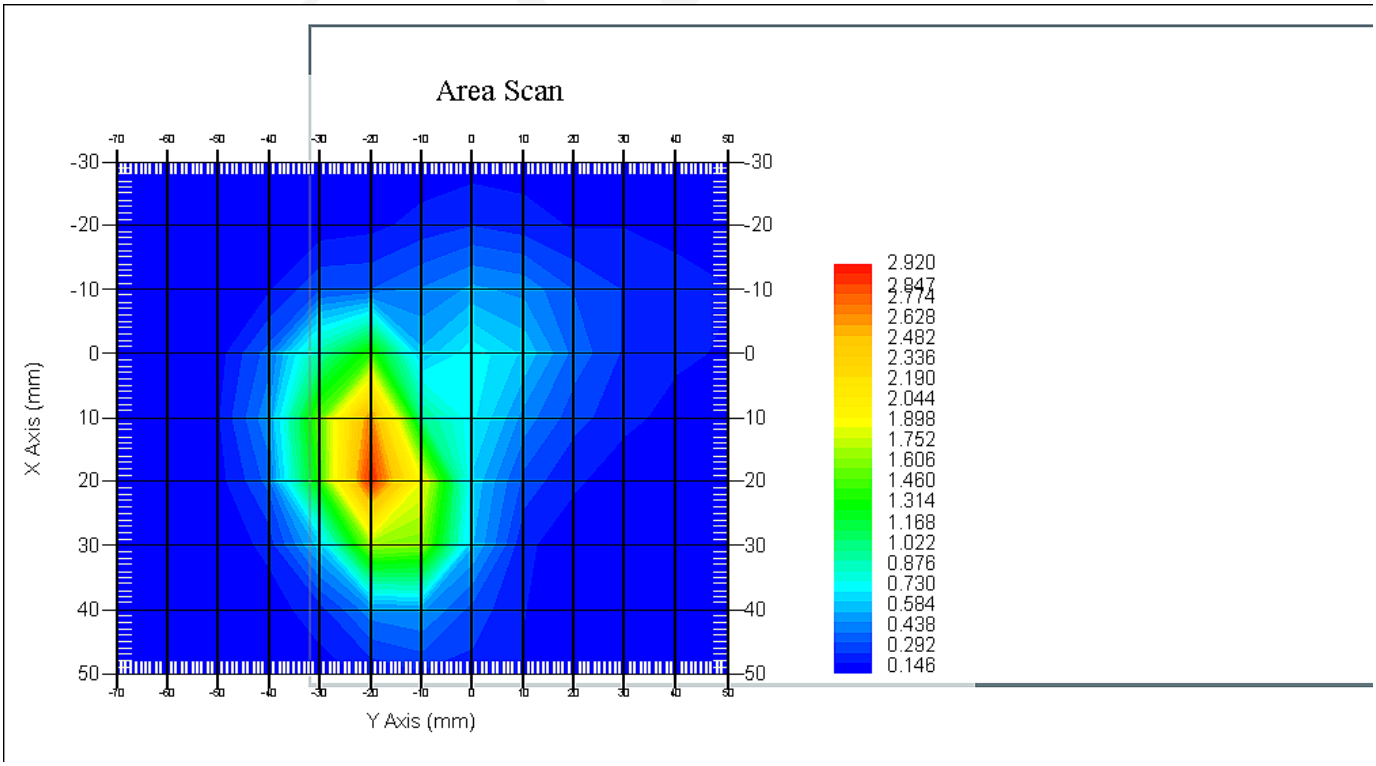
Measurement Data
Test mode : RMC
Crest Factor : 1
Scan Type : Complete
Area Scan : 8x11x1: Measurement x=10mm, y=10mm, z=4mm
Zoom Scan : 7x7x7: Measurement x=5mm, y=5mm, z=5mm
Power Drift-Start : 0.609 W/kg
Power Drift-Finish : 0.611 W/kg
Power Drift (%) : 0.985

Tissue Data
Type : Head and Body
Frequency : 1950 MHz
Epsilon : 39.97 F/m
Sigma : 1.39 S/m
Density : 1000.00 kg/cu. m

Probe Data
Serial No. : 500-00283
Frequency Band : 1900
Duty Cycle Factor : 1
Conversion Factor : 4.8
Probe Sensitivity : 1.20 1.20 1.20 µV/(V/m)2
Compression Point : 95.00 mV
Offset : 1.56 mm

1 gram SAR value : 2.195 W/kg
10 gram SAR value : 0.956 W/kg
Area Scan Peak SAR : 2.864 W/kg
Zoom Scan Peak SAR : 5.004 W/kg

Plot 8#



APPENDIX A MEASUREMENT UNCERTAINTY

According to **IEEE1528:2013**, the uncertainty budget has been determined for the Head SAR measurement system and is given in the following Table.

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	$\sqrt{3}$	$(1\text{-cp})^{1/2}$	$(1\text{-cp})^{1}/_{2}$	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
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 related							
Test sample positioning	2.0	normal	1	1	1	2.0	2.0
Device Holder Uncertainty	4.0	normal	1	1	1	6.215	6.215
Drift of Output Power	5.0	rectangular	$\sqrt{3}$	1	1	2.67	2.67
Phantom and Setup							
Phantom Uncertainty	3.4	rectangular	$\sqrt{3}$	1	1	2.0	2.0
SAR correction in permittivity and conductivity	1.2	normal	1	1	0.85	1.2	1.0
Liquid conductivity measurement	5.0	normal	1	0.78	0.71	3.9	3.6
Liquid permittivity measurement	5.0	normal	1	0.25	0.29	1.3	1.5
conductivity—temperature	1.1	rectangular	$\sqrt{3}$	0.78	0.71	0.5	0.5
permittivity—temperature	1.3	rectangular	$\sqrt{3}$	0.23	0.23	0.2	0.2
Combined Uncertainty		RSS				10.78	10.55
Expanded uncertainty (coverage factor=2)		Normal(k=2)				21.56	21.10

According to **IEC62209-2:2010**, the uncertainty budget has been determined for the Body SAR measurement system and is given in the following Table.

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	1	1.5	1.5
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
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 related							
Test sample positioning	2.0	normal	1	1	1	2.0	2.0
Device Holder Uncertainty	4.0	normal	1	1	1	6.215	6.215
Drift of Output Power	5.0	rectangular	$\sqrt{3}$	1	1	2.67	2.67
Phantom and Setup							
Phantom Uncertainty	3.4	rectangular	$\sqrt{3}$	1	1	2.0	2.0
SAR correction in permittivity and conductivity	1.2	normal	1	1	0.84	1.2	1.0
Liquid conductivity measurement	5.0	normal	1	0.78	0.71	3.9	3.6
Liquid permittivity measurement	5.0	normal	1	0.23	0.26	1.3	1.5
conductivity—temperature	1.1	rectangular	$\sqrt{3}$	0.78	0.71	0.5	0.5
permittivity—temperature	1.3	rectangular	$\sqrt{3}$	0.23	0.26	0.2	0.2
Combined Uncertainty		RSS				9.58	9.49
Expanded uncertainty (coverage factor=2)		Normal(k=2)				19.16	18.98

APPENDIX B PROBE CALIBRATION CERTIFICATES

NCL CALIBRATION LABORATORIES

Calibration File No.: PC-1717

Task No: BACL-5828

Client.: BACL Corp.
Address: 6/F, the 3rd Phase of Wan Li Industrial Bldg., Shihua Rd.,
FuTian Free Trade Zone, Shenzhen, China

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 Inc.
Model No.: ALS-E020
Serial No.: 500-00283

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

Calibrated: 7th February 2017
Released on: 8th February 2017

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. DC-1717

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.

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

- 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
- IEC 62209-1:2006
  Human Exposure to RF Fields from hand-held and body-mounted wireless communication devices - Human models. instrumentation, and procedures - Part 1: Procedure to measure the Specific Absorption Rate (SAR) for hand-held mobile wireless devices
- IEC 62209-2:2010
  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)
- TP-D01-032-E020-V2 E-Field probe calibration procedure
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

Page 2 of 9 Probe S/N 500-00283
This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration Laboratories
Division of APREL Inc. DC-1717

Conditions

Probe 500-00283 was a recalibration.

Ambient Temperature of the Laboratory:	20 °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
Power Meter Tektronix USB	11C940	Apr 2, 2017
Signal Generator Agilent E4438C	MY45094463	Dec 11, 2017

Secondary Measurement Standards

Network Analyzer Anritsu 37347C	002106	Feb. 4, 2017

Attestation

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

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

NCL Calibration Laboratories
Division of APREL Inc. DC-1717

Probe Summary

Probe Type:	E-Field Probe E-020
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
Diode Compression Point:	95 mV

Sensitivity in Air

Frequency Range	Channel X, $\mu V/(V/m)^2$	Channel Y, $\mu V/(V/m)^2$	Channel Z, $\mu V/(V/m)^2$	Tolerance, $\mu V/(V/m)^2$
150 MHz	1.211	1.201	1.199	±0.004
450 MHz	1.212	1.205	1.199	±0.004
750 MHz, 835 MHz 900 MHz	1.212	1.210	1.209	±0.004
1 GHz – 4 GHz	1.210	1.210	1.207	±0.004
5 GHz – 6 GHz	1.198	1.195	1.192	±0.005

*Resistive to recommended tissue recipes per IEEE-1528

Page 4 of 9 Probe S/N 500-00283
This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration Laboratories
Division of APREL Inc. DC-1717

Calibration for Tissue (Head H, Body B)

Frequency, MHz	Tissue Type	Measured Epsilon	Measured Sigma	Standard Uncertainty (%)	Calibration Frequency Range (MHz)	Conversion Factor
150 H	Head	49.8	0.77	3.5	±50	6.0
150 H	Body	61.27	0.88	3.5	±50	6.0
450 H	Head	45.67	086	3.5	±50	5.7
450 B	Body	56.86	0.89	3.5	±50	5.8
750 H	Head	43.70	0.91	3.5	±50	6.0
750 B	Body	56.98	0.96	3.5	±50	5.9
835 H	Head	43.44	0.94	3.5	±50	5.9
835 B	Body	54.55	1.00	3.5	±50	5.9
900 H	Head	39.54	1.00	3.5	±50	6.0
900 B	Body	55.16	1.04	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	38.98	1.39	3.5	±75	5.4
1750 B	Body	53.55	1.48	3.5	±75	5.3
1800 H	Head	X	X	X	X	X
1800 B	Body	X	X	X	X	X
1900 H	Head	39.44	1.41	3.5	±75	5.1
1900 B	Body	53.55	1.59	3.5	±75	5.0
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	X	X	X	X	X
2450B	Body	X	X	X	X	X
3000 H	Head	X	X	X	X	X
3000 B	Body	X	X	X	X	X
3600 H	Head	37.25	3.14	3.5	±100	4.4
3600 B	Body	50.51	3.85	3.5	±100	4.2
5250 H	Head	34.19	4.78	3.5	±100	3.1
5250 B	Body	44.21	5.58	3.5	±100	2.9
5600 H	Head	33.98	5.27	3.5	±100	3.0
5600 B	Body	46.98	5.75	3.5	±100	2.6
5800 H	Head	33.98	5.50	3.5	±100	3.1
5800 B	Body	46.17	6.06	3.5	±100	2.8

Page 5 of 9 Probe S/N 500-00283
This page has been reviewed for content and attested to on Page 2 of this document.

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

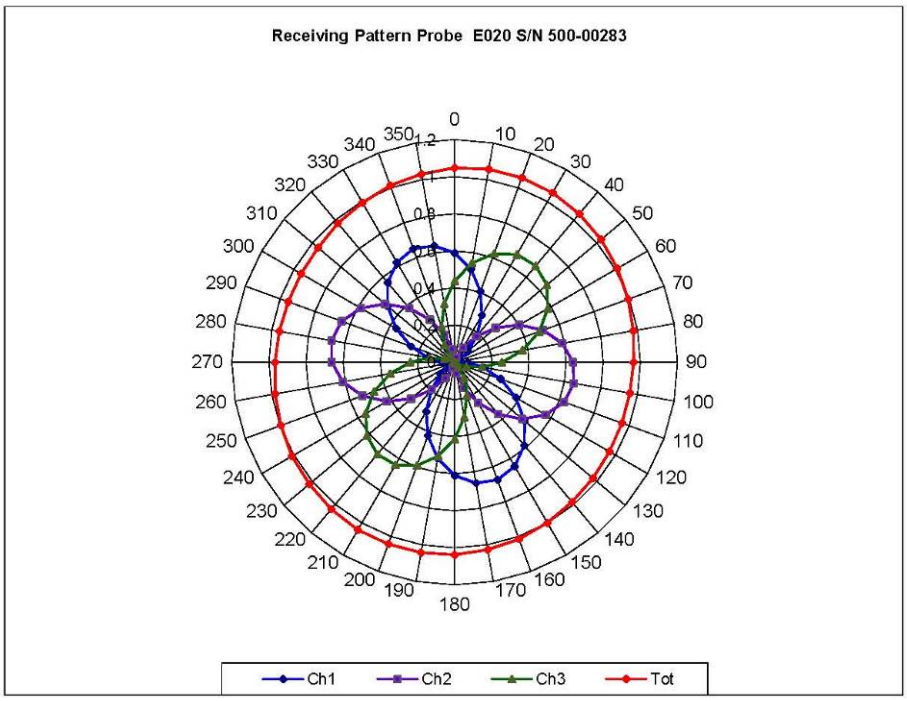
To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 MΩ.

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**

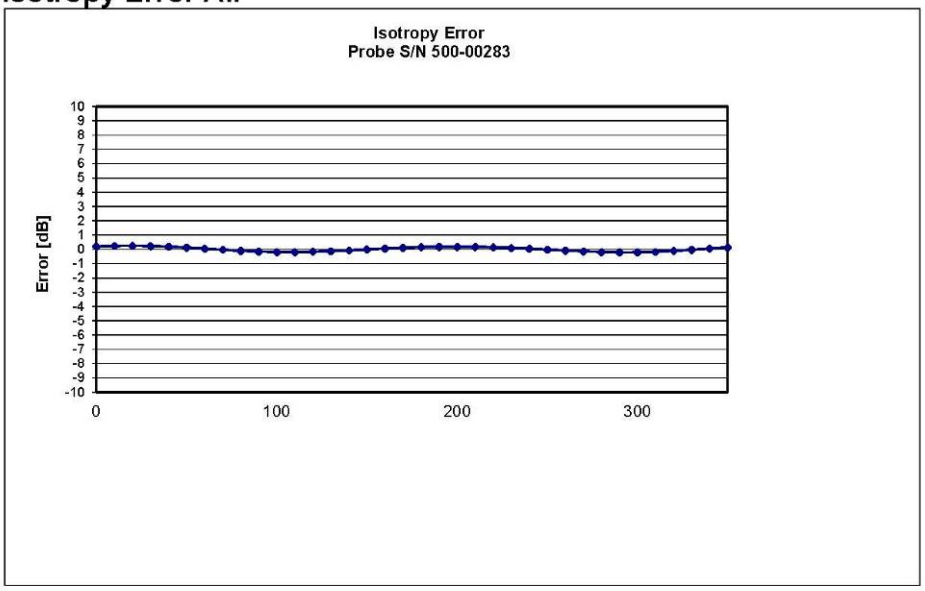
NCL Calibration Laboratories
Division of APREL Inc. DC-1717

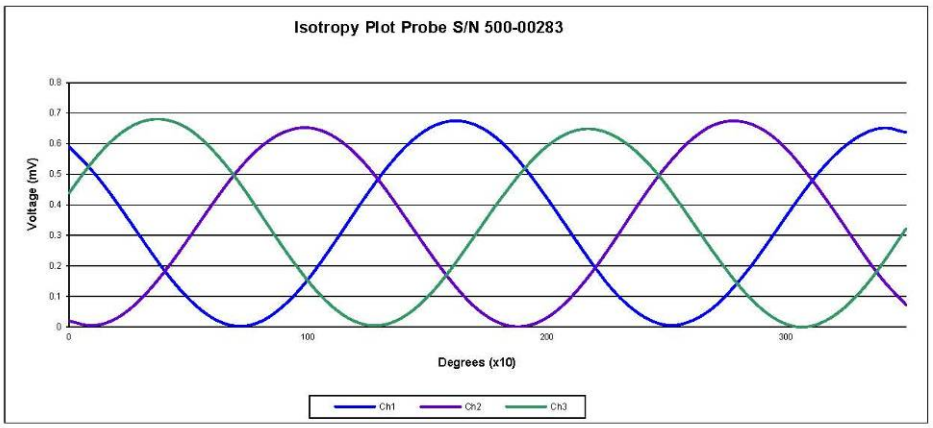
Receiving Pattern Air



NCL Calibration Laboratories
Division of APREL Inc. DC-1717

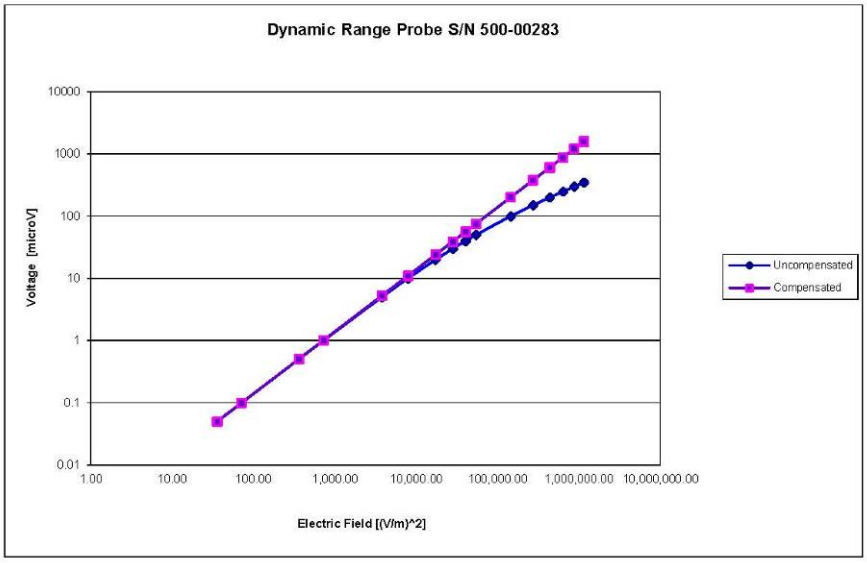
Isotropy Error Air



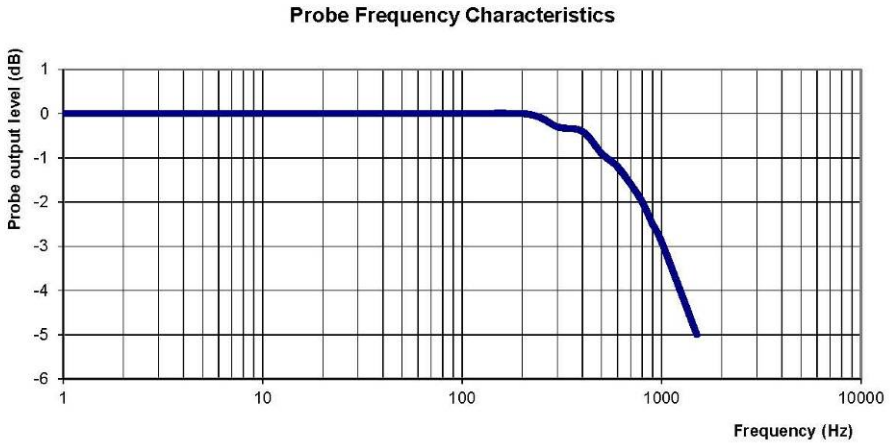


NCL Calibration Laboratories
Division of APREL Inc. DC-1717

Dynamic Range



Video Bandwidth



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

Page 9 of 9 Probe S/N 500-00283
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-1600
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-900-S-2
Frequency: 900 MHz
Serial No: 190-00609

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 190-00609 was received in good condition and was a recalibration.

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: 149.9 mm
Height: 82.8 mm

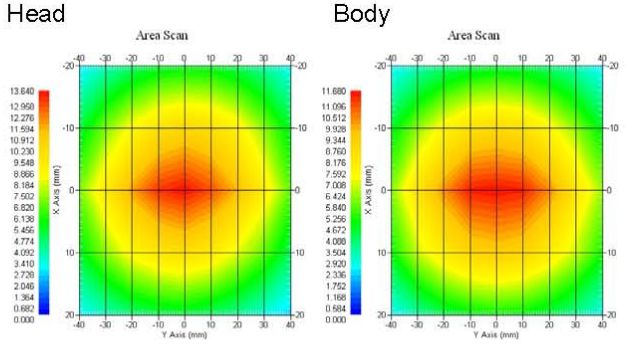
Electrical Specification

Tissue	Frequency	SWR:	Return Loss	Impedance
Head	900 MHz	1.084 U	-28.52 dB	47.029 Ω
Body	900 MHz	1.132 U	-24.34 dB	48.663 Ω

System Validation Results

Tissue	Frequency	1 Gram	10 Gram	Peak
Head	900MHz	11.828	7.595	17.616
Body	900MHz	11.072	7.07	16.715

Head Body



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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 190-00609. 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

- IEC-62209 "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)"
- TP-D01-032-E020-V2 E-Field probe calibration procedure
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

Conditions

Dipole 190-00609 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
Division of APREL Laboratories.

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
149.0 mm	83.3 mm	149.9 mm	82.8 mm

Electrical Specification

Tissue	Frequency	SWR:	Return Loss	Impedance
Head	900 MHz	1.084 U	-28.52 dB	47.029 Ω
Body	900 MHz	1.132 U	-24.34 dB	48.663 Ω

Tissue Validation

	Dielectric constant, ε_r	Conductivity, σ [S/m]
Head Tissue 900MHz	41.87	1.06
Body Tissue 900MHz	55.62	1.05

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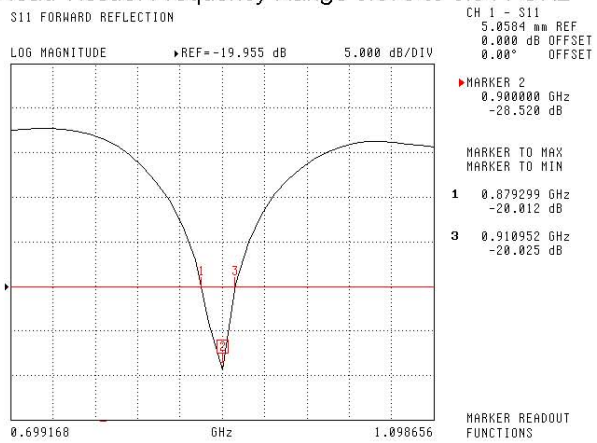
NCL Calibration Laboratories
Division of APREL Laboratories.

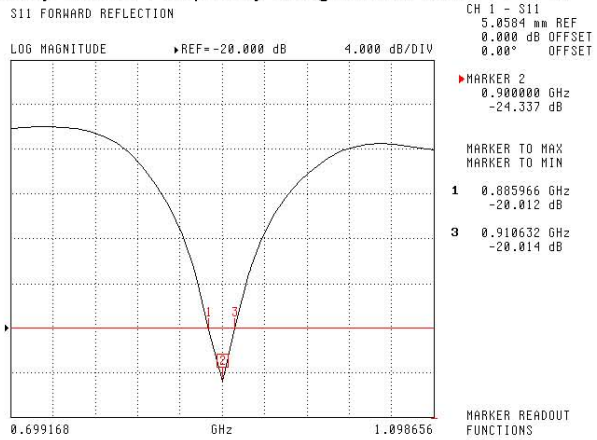
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss

Head Tissue: Frequency Range 0.879 to 0.911 GHz



Body Tissue: Frequency Range 0.886 to 0.911 GHz



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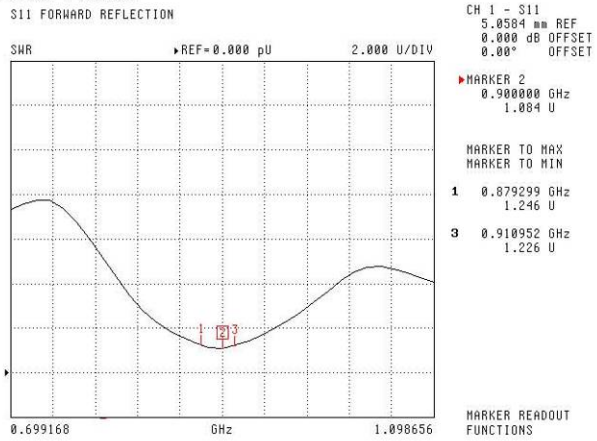
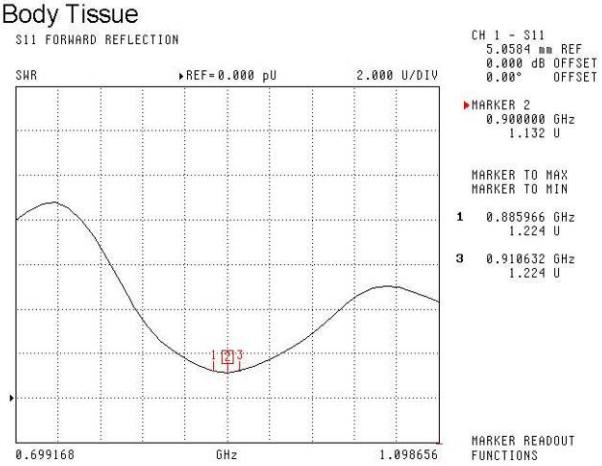
NCL Calibration Laboratories
Division of APREL Laboratories.

SWR

Head Tissue



Body Tissue



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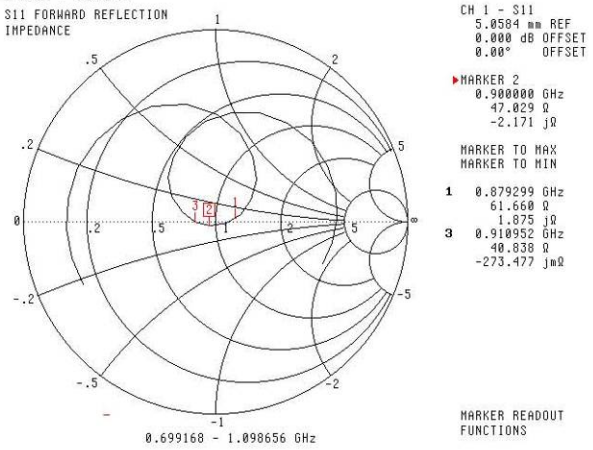
This page has been reviewed for content and attested to by signature within this document.

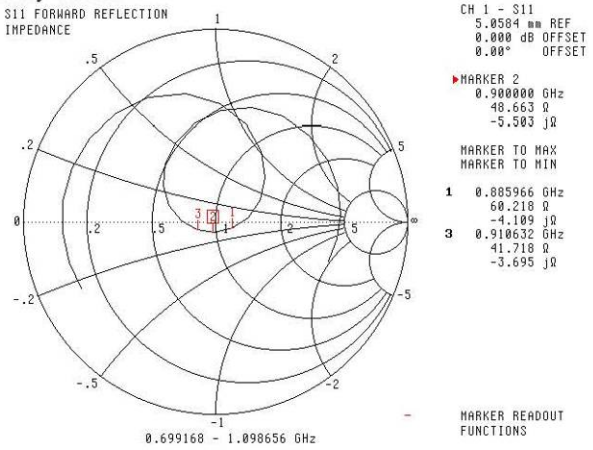
NCL Calibration Laboratories
Division of APREL Laboratories.

Smith Chart Dipole Impedance

Head Tissue



Body Tissue



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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.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1694
Project Number: 5822

Client.: BACL Corp.
Address: 6/F, the 3rd Phase of Wan Li Industrial Bldg., Shihua Rd.,
FuTian Free Trade Zone, Shenzhen, China

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-1750-S-2
Frequency: 1750 MHz
Serial No: 198-00304

Calibrated: 4rd October 2016
Released on: 6th October 2016

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 DC-1694

Conditions

Dipole 198-00304 was a re-calibration.

Ambient Temperature of the Laboratory:	21 °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 system has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Art Brennan QM

Maryna Nesterova R&D Engineer

Primary Measurement Standards

Instrument	Serial Number	Cal due date
Tektronix USB Power Meter	11C940	April 2, 2017
Network Analyzer Anritsu 37347C	002106	Feb. 4, 2017
Agilent Signal Generator	MY45094463	Dec. 11, 2017

NCL Calibration Laboratories
Division of APREL Laboratories DC-1694

Calibration Results Summary

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

Mechanical Dimensions

Length	Height	Diameter
74.3 mm	42.4 mm	3.6 mm

Tissue Validation

Tissue	Frequency	Dielectric constant, εr	Conductivity, σ [S/m]
Head	1750 MHz	38.75	1.38
Body	1750 MHz	53.57	1.47

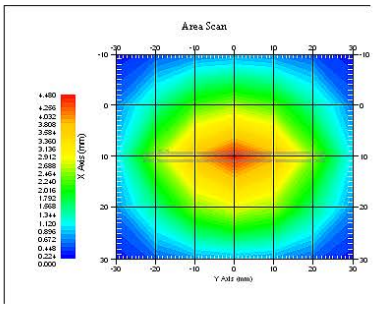
Electrical Specification

Tissue	Frequency	Return Loss	SWR	Impedance
Head	1750 MHz	-25.126 dB	1.129 U	54.575 Ω
Body	1750 MHz	-20.549 dB	1.207 U	56.487 Ω

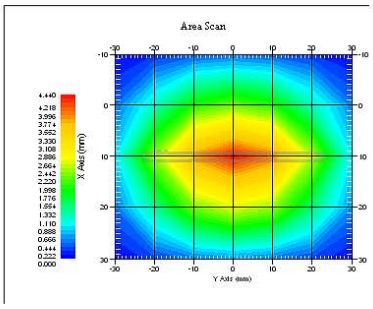
System Validation Results

Tissue	Frequency	1 Gram, W/kg	10 Gram, W/kg
Head	1750 MHz	36.85	19.9
Body	1750 MHz	35.78	19.28

Head



Body



Dipole 198-00304

Page 3 of 7
This page has been reviewed for content and attested to on Page 2 of this document.

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 198-00304. 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

- 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
- EN 62209-1:2006
  Human Exposure to RF Fields from hand-held and body-mounted wireless communication devices - Human models. instrumentation, and procedures - Part 1: Procedure to measure the Specific Absorption Rate (SAR) for hand-held mobile wireless devices
- IEC 62209-2:2010
  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)
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40 GHz

Conditions

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

Dipole Calibration uncertainty

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

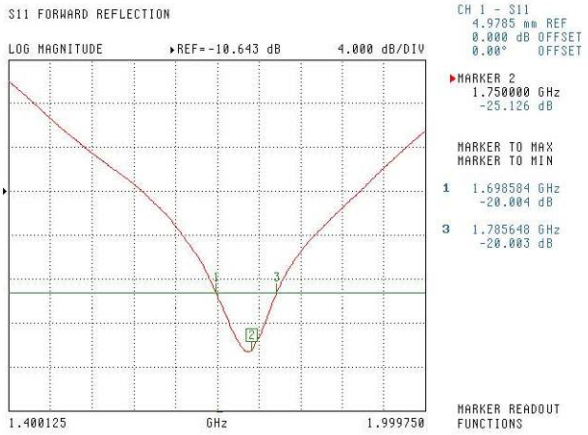
Mechanical	1%
Positioning Error	1.22%
Electrical	1.7%
Tissue	2.2%
Dipole Validation	2.2%
Combined Standard Uncertainty	**3.88% (7.76% K=2)**

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

S11 Parameter Return Loss

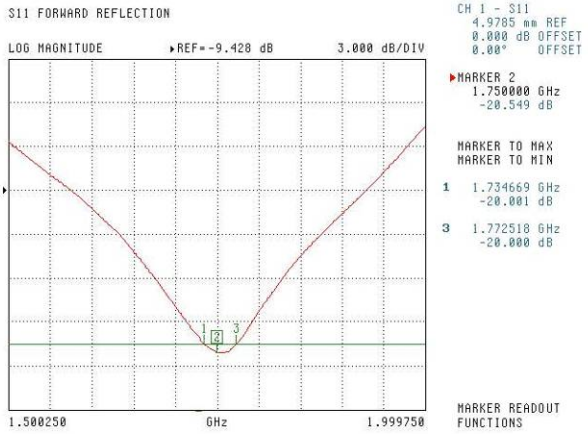
Head

Frequency Range 1698.58 MHz to 1785.65 MHz



Body

Frequency Range 1734.67 MHz to 1772.52 MHz

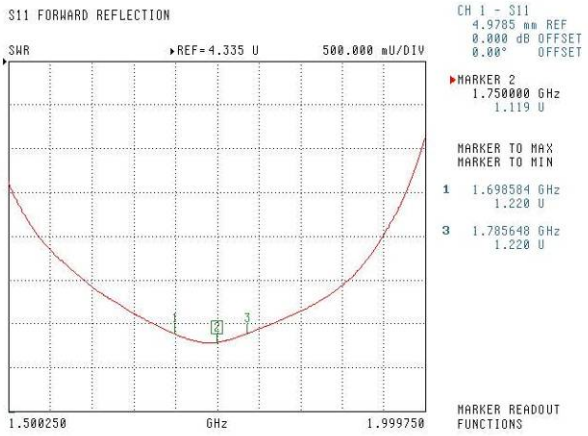


Dipole 198-00304

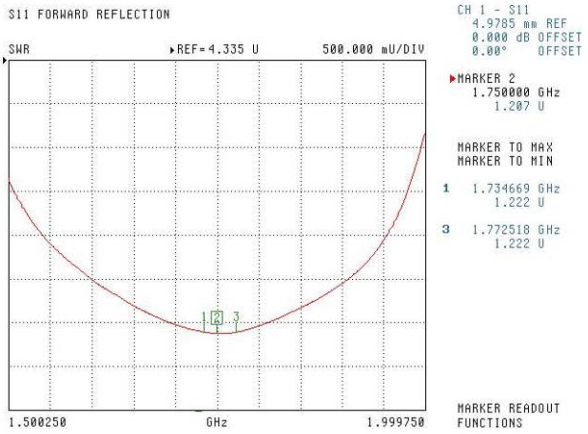
NCL Calibration Laboratories
Division of APREL Laboratories DC-1694

SWR

Head



Body



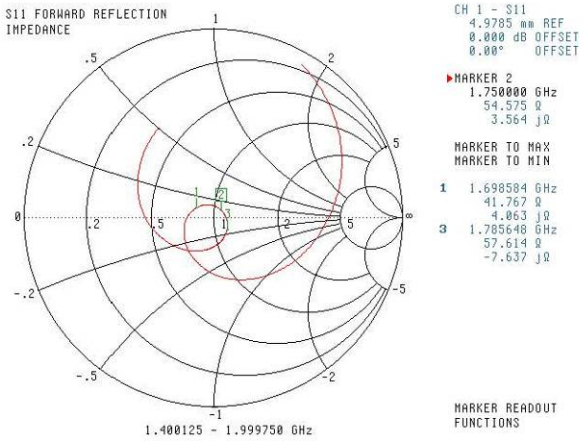
Dipole 198-00304

Page 6 of 7
This page has been reviewed for content and attested to on Page 2 of this document.

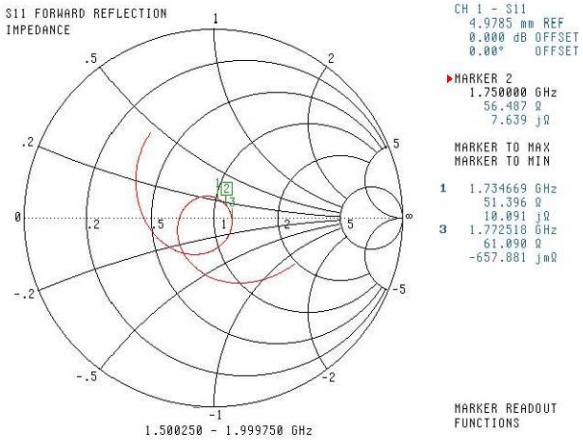
NCL Calibration Laboratories
Division of APREL Laboratories DC-1694

Smith Chart Dipole Impedance

Head



Body



Dipole 198-00304

Page 7 of 7
This page has been reviewed for content and attested to on Page 2 of this document.

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.
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 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

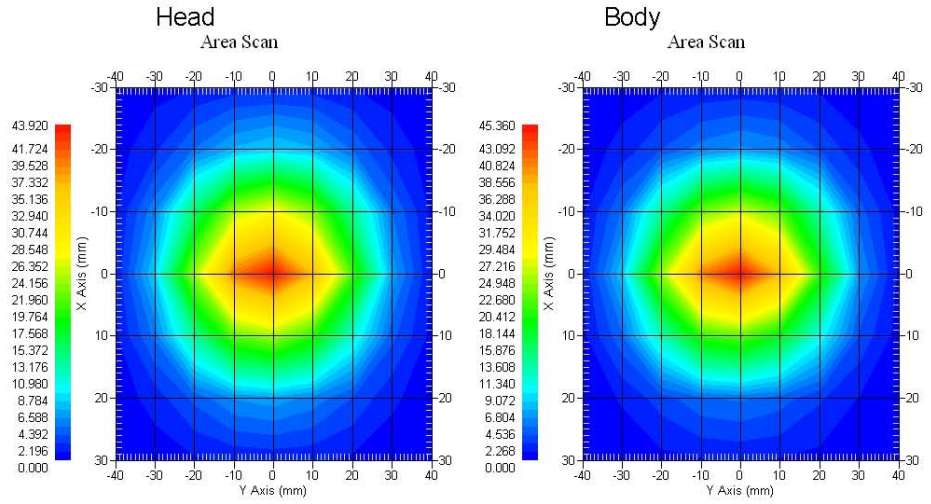
Length: 67.1 mm
Height: 38.9 mm

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



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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

- IEC-62209 "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)"
- TP-D01-032-E020-V2 E-Field probe calibration procedure
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

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)**

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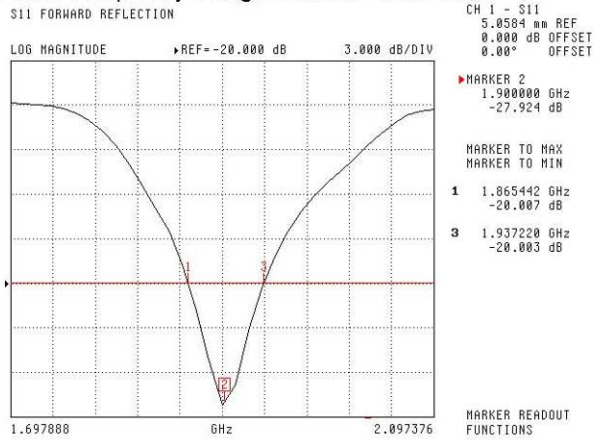
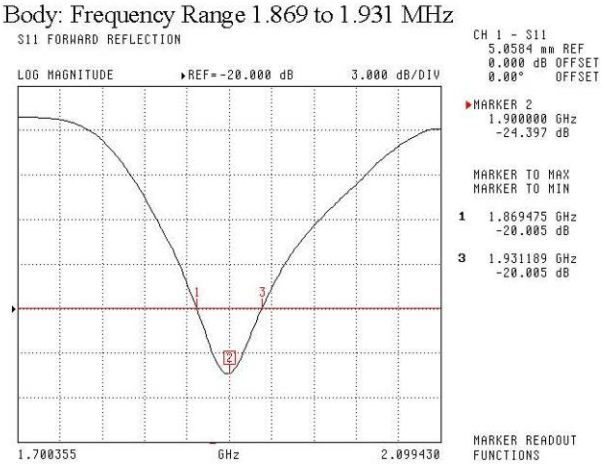
The Following Graphs are the results as displayed on the Vector Network Analyzer.

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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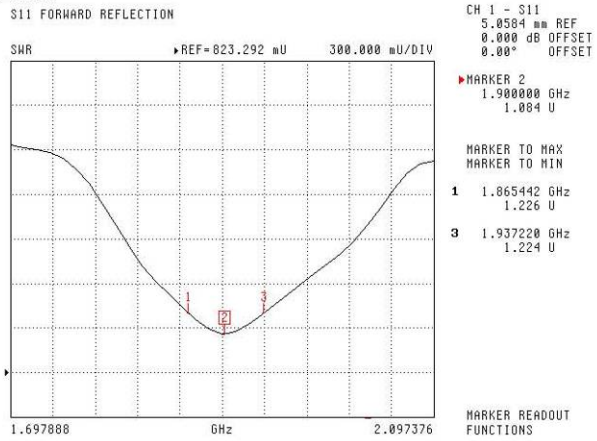
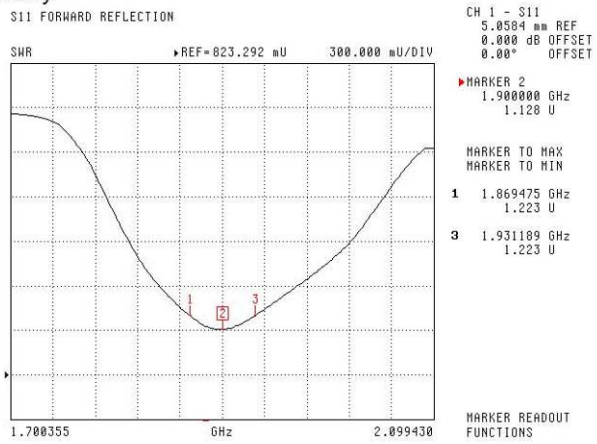
SWR

Head



Body



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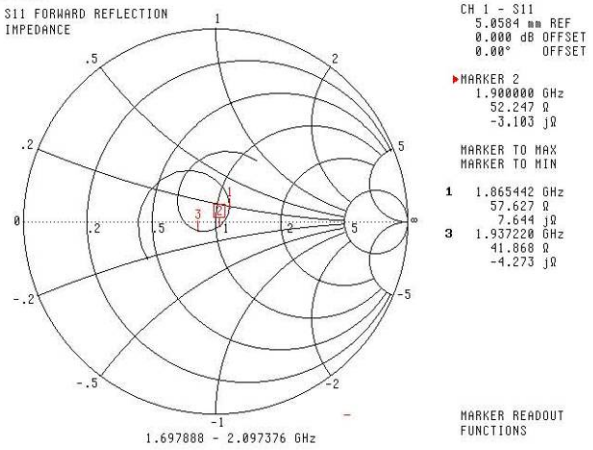
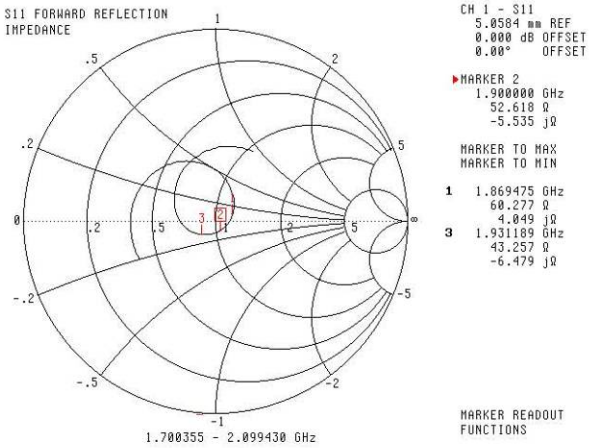
Smith Chart Dipole Impedance

Head



Body



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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

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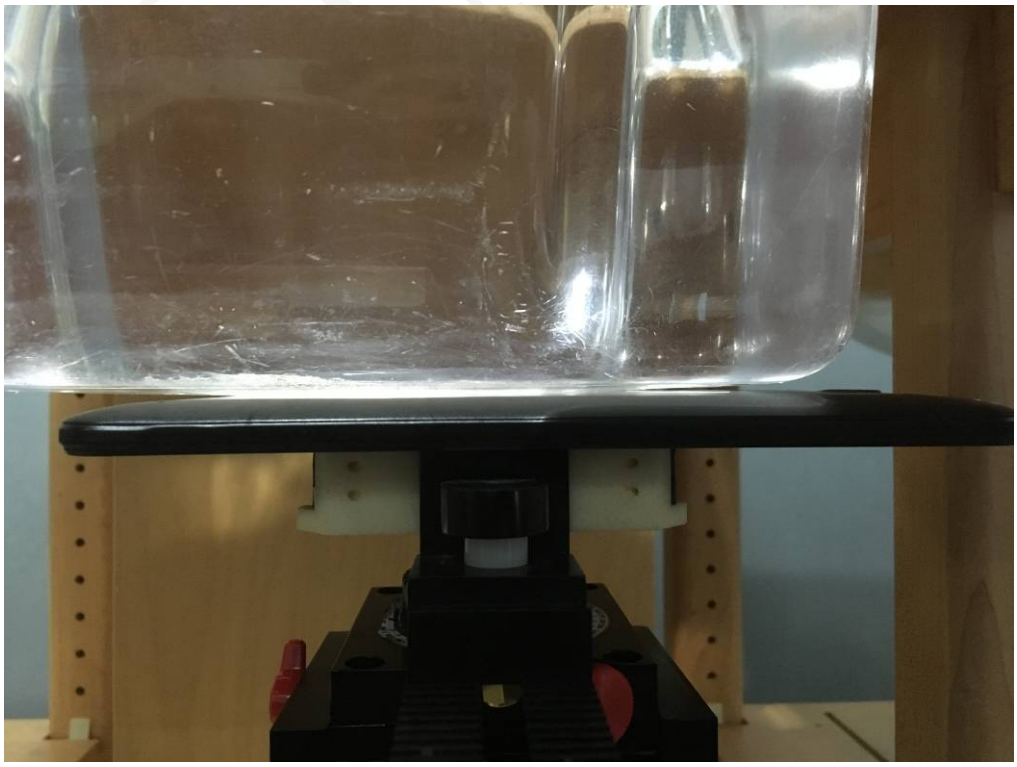
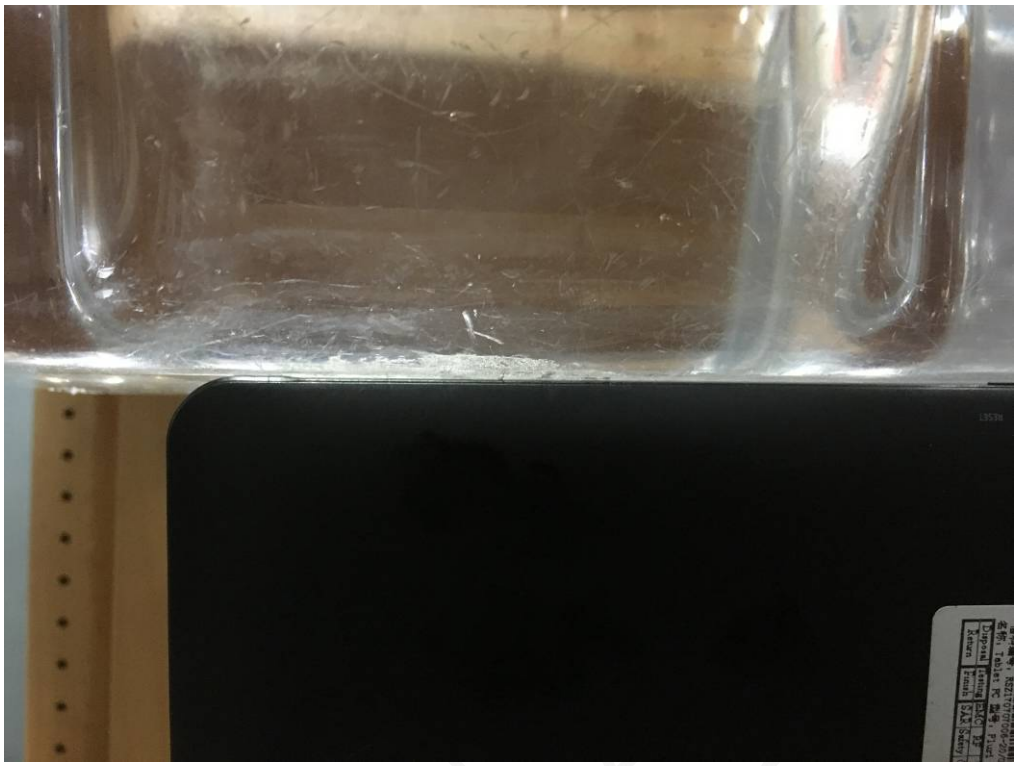
APPENDIX D EUT TEST POSITION PHOTOS

Liquid depth ≥ 15cm

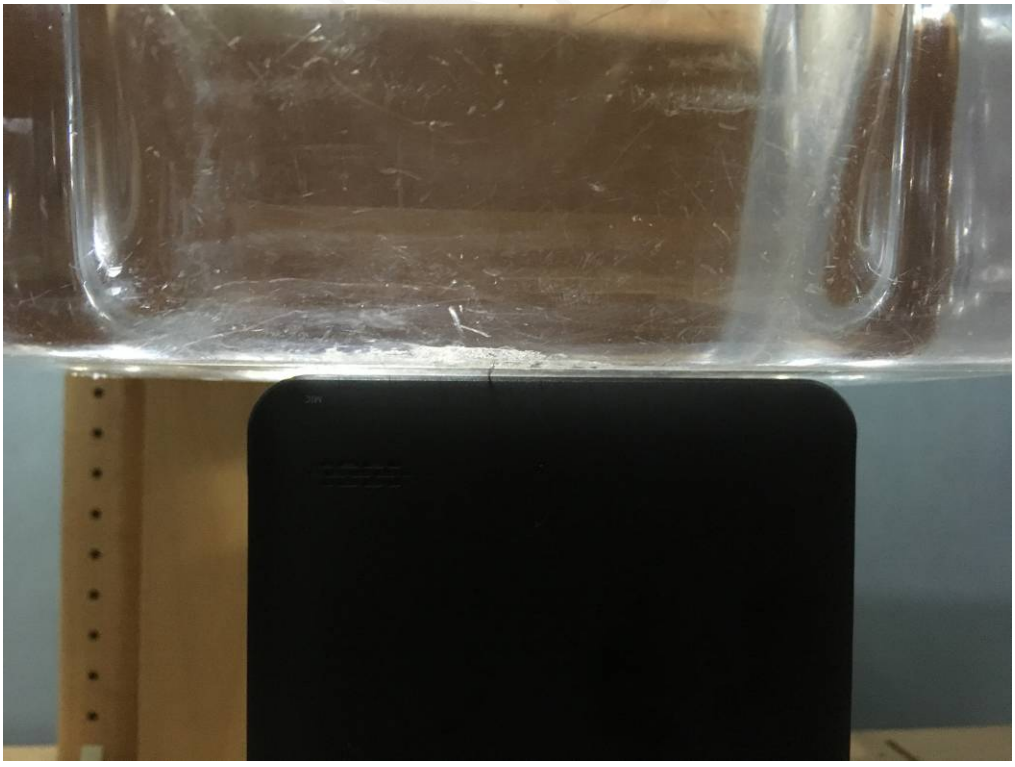
Body-worn Back Setup Photo (0.0mm)



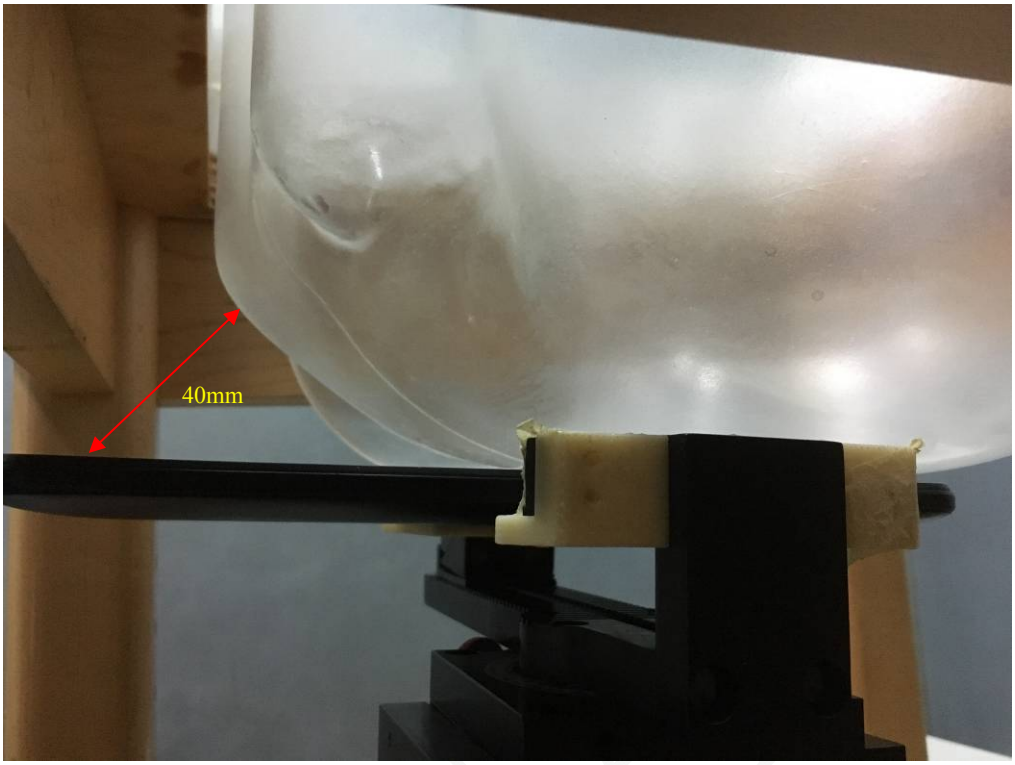
Body-worn Right Setup Photo (0.0mm)



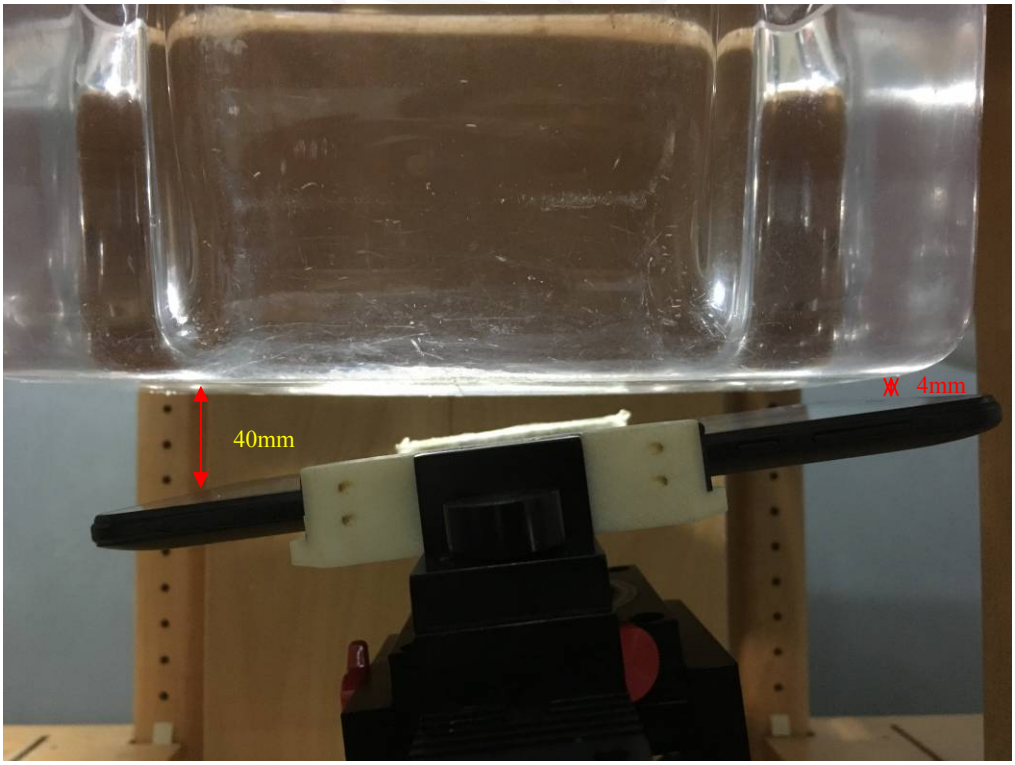
Body-worn Bottom Setup Photo (0.0mm)



Left Head Cheek Setup Photo

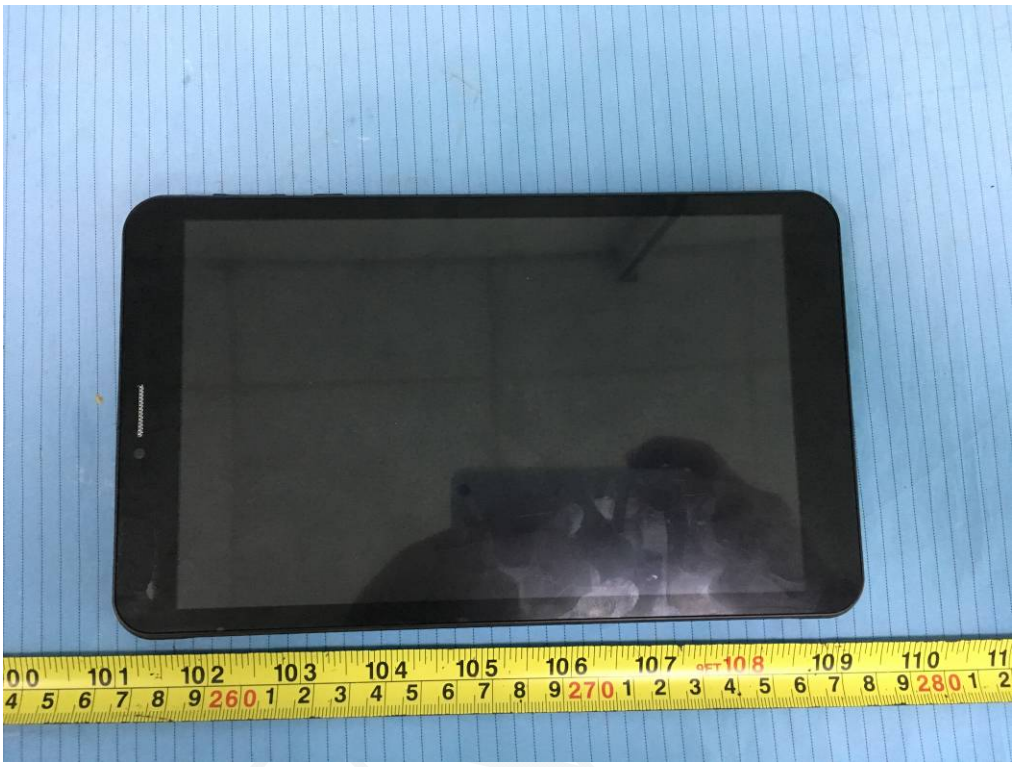


Head Cheek Setup Photo



APPENDIX E EUT PHOTOS

EUT – Front



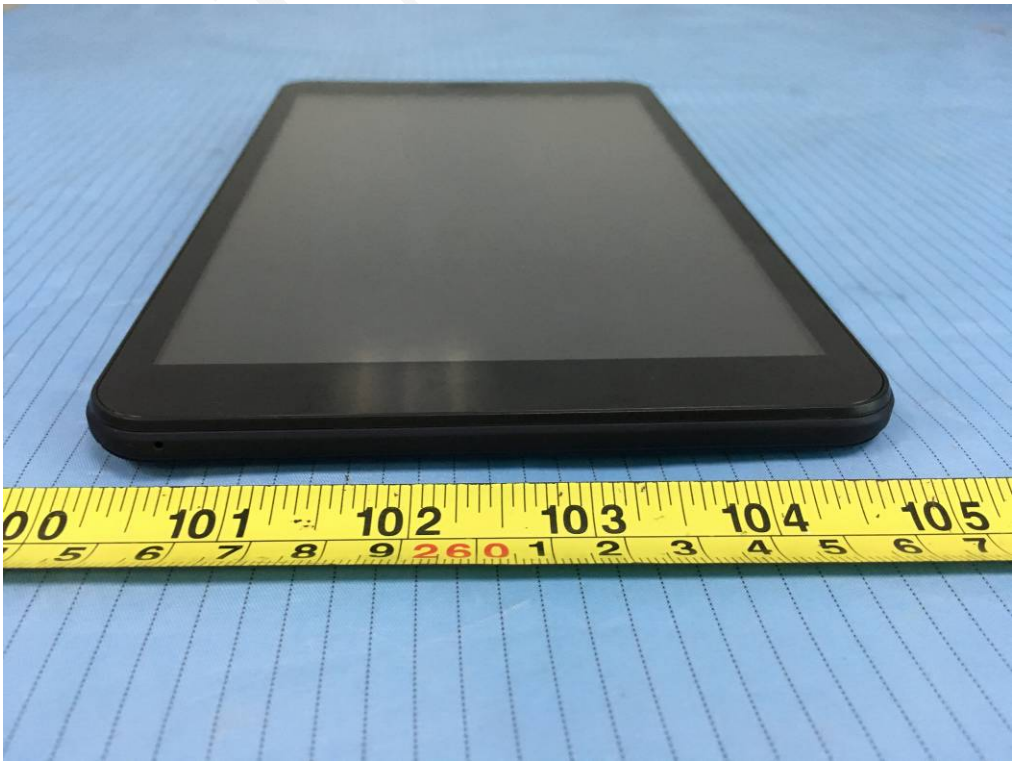
EUT – Back View

EUT – Left Side View

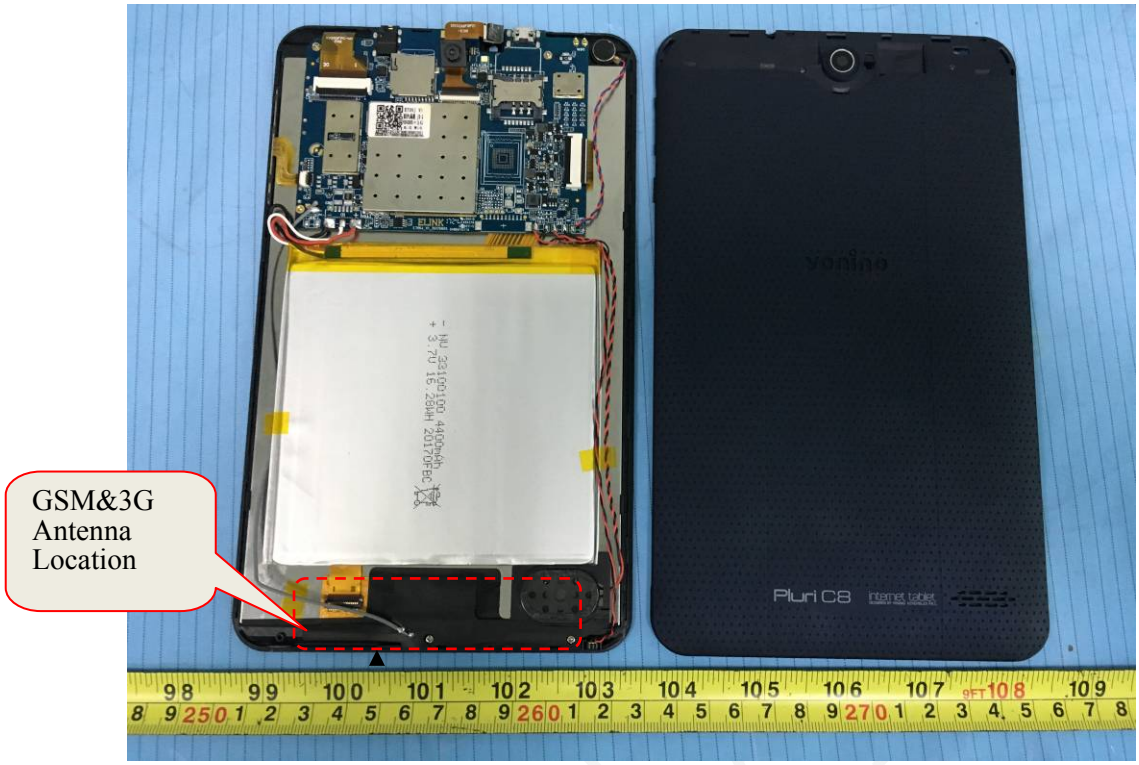
EUT – Right Side View

EUT – Top View

EUT – Bottom View



EUT – Uncovered View



APPENDIX F INFORMATIVE REFERENCES

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******* END OF REPORT *******