



SAR Evaluation Report

IN ACCORDANCE WITH THE REQUIREMENTS OF
FCC REPORT AND ORDER:
ET DOCKET 93-62, AND OET BULLETIN 65 SUPPLEMENT C

FOR

Express MINI-PCI USB Wireless CDMA Modem Module

Model: MC5720

FCC ID: N7N-MC5720

REPORT NUMBER: 05U3650-2

ISSUE DATE: August 18, 2005

Prepared for

SIERRA WIRELESS
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NVLAP[®]
LAB CODE:200065-0

Revision History

Rev.	Revisions	Revised By
A	Initial Issue	HS
B	Corrected typo on page 3 of 33	HS

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)**DATES OF TEST:** August 16-17, 2005

APPLICANT:	Sierra Wireless
ADDRESS:	2290 Cosmos Ct. Carlsbad CA 92009, United States
FCC ID:	N7N-MC5720
MODEL:	MC5720
DEVICE CATEGORY:	Portable Device
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure

Express MINI-PCI USB Wireless CDMA Modem Module installed in host devices.

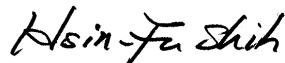
Application type:	Class II Permissive Change (Added alternative antenna)		
Test Sample is a:	Production unit		
Host devices:	<u>Host Devices</u> Lenovo W-Note	<u>LCD Cover</u> Plastic	<u>WLAN Module / FCC ID</u> ①Calexico 2 / S2L20040601CX2 ②Bartlette / S2L20040600BTL
FCC Rule Parts	Frequency Range [MHz]		The Highest SAR Values [1g_mW/g]
22H	824.7 – 848.31		0.071
24E	1851.25 – 1908.75		0.071

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for General Population/Uncontrolled Exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC OET 65 Supplement C (Edition 01-01). And RSS-102 Issue 1 (Provisional) September 25, 1999.

The maximum 1g SAR level measured for all the tests performed did not exceed the limits for General Population/Uncontrolled Exposure (W/kg) Partial Body of 1.6 W/kg. Level defined in Supplement C (Edition 01-01) to OET Bulletin 65 (97-01).

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Released For CCS By:

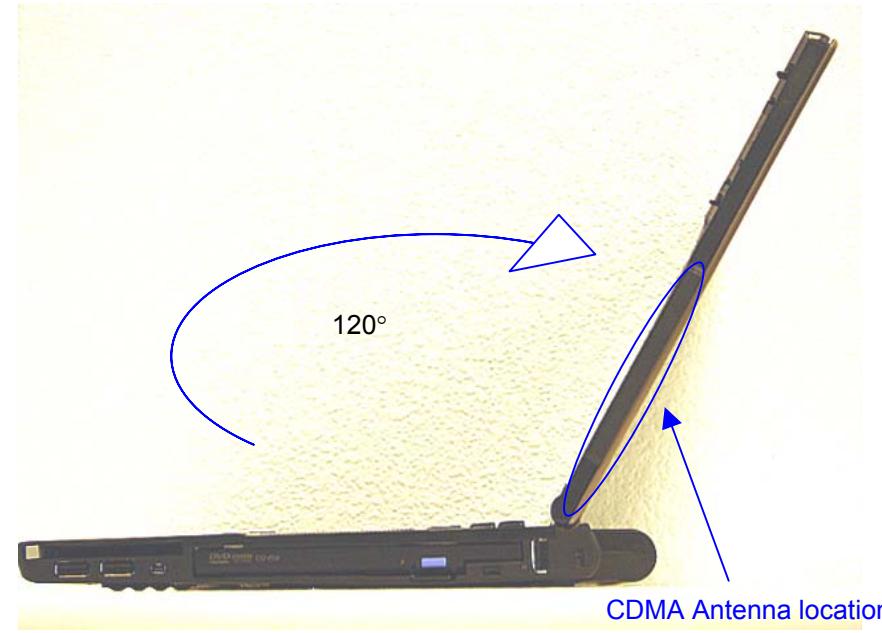


Hsin Fu Shih
SENIOR ENGINEER
COMPLIANCE CERTIFICATION SERVICES

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1 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

Express MINI-PCI USB Wireless CDMA Modem Module installed in host devices			
Host devices:	<u>Host Devices</u> Lenovo W-Note	<u>LCD Cover</u> Plastic	<u>WLAN Module / FCC ID</u> ①Calexico 2 / S2L20040601CX2 ②Bartlette / S2L20040600BTL
Normal operation:	Lap-held position 		
Power supply:	Power supplied through the laptop computer (host device)		

2 FACILITIES AND ACCREDITATION

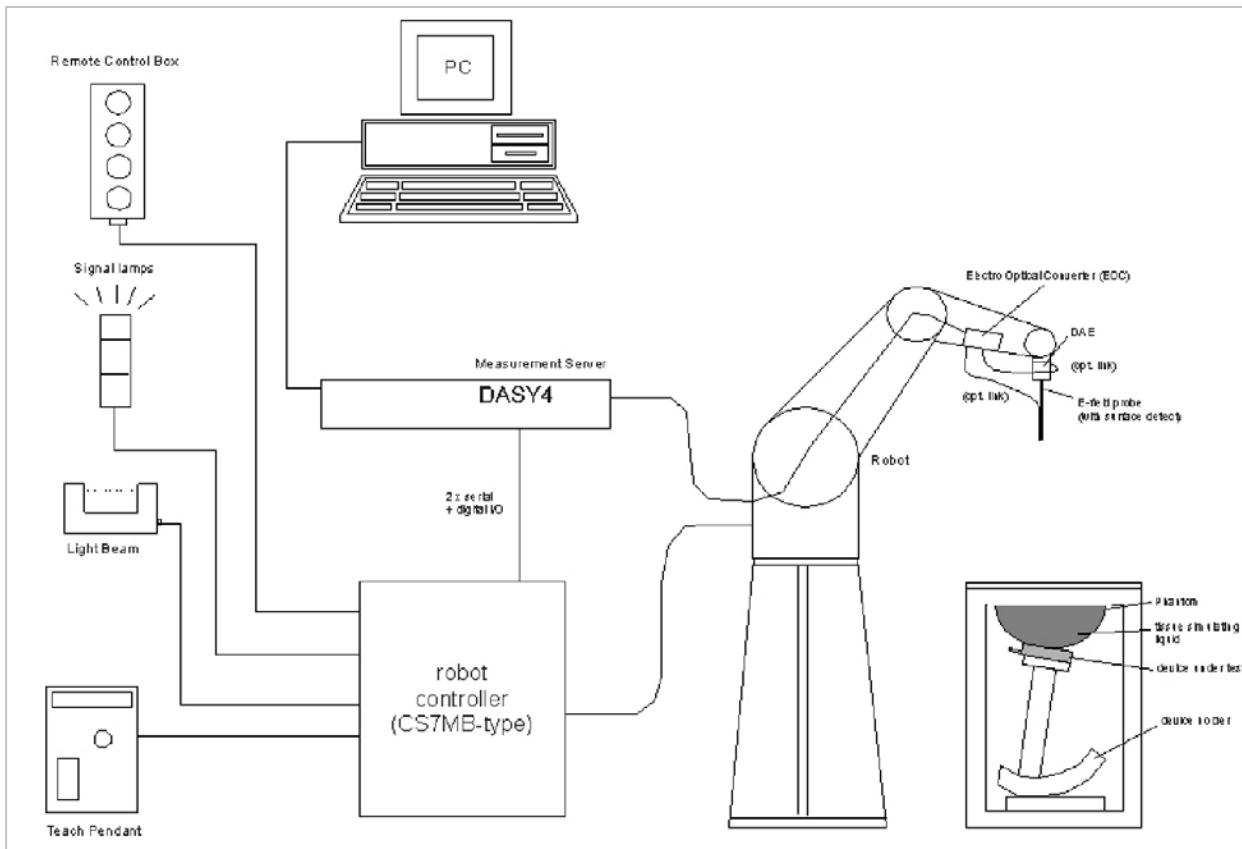
The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."



CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

3 SYSTEM DESCRIPTION



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

4 SYSTEM COMPONENT

4.1 DASY4 MEASUREMENT SERVER



The DASY4 measurement server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chip disk and 64MB RAM. The necessary circuits for communication with either the DAE3 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4 I/O-board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

4.2 DATA ACQUISITION ELECTRONICS (DAE)

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



4.3 EX3DV3 ISOTROPIC E-FIELD PROBE FOR DOSIMETRIC MEASUREMENTS

Construction: Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

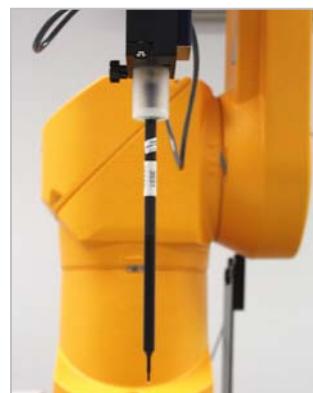
Frequency: 10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)

Directivity: ± 0.3 dB in HSL (rotation around probe axis);
 ± 0.5 dB in tissue material (rotation normal to probe axis)

Dynamic Range: 10 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)

Dimensions: Overall length: 330 mm (Tip: 20 mm)
 Tip diameter: 2.5 mm (Body: 12 mm)
 Typical distance from probe tip to dipole centers: 1 mm

Application: High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.



4.4 LIGHT BEAM UNIT

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



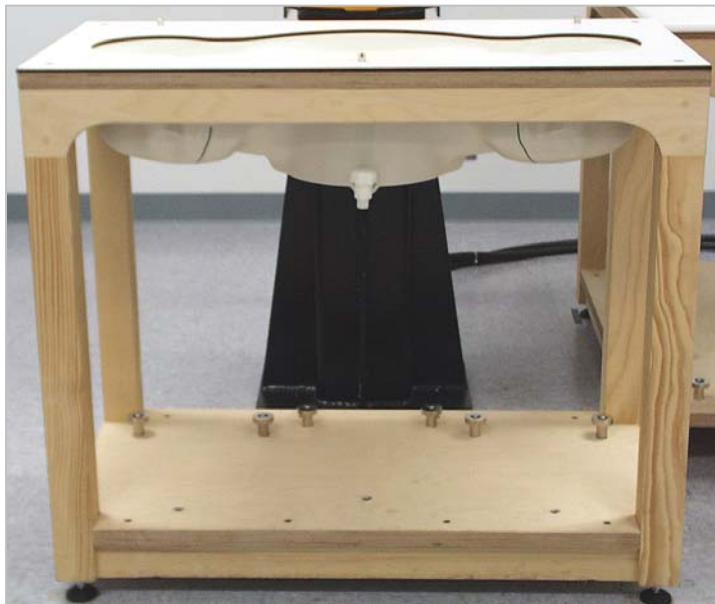
4.5 SAM PHANTOM (V4.0)

Construction: The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness: 2 ± 0.2 mm

Filling Volume: Approx. 25 liters

Dimensions: Height: 810mm; Length: 1000mm; Width: 500mm



4.6 DEVICE HOLDER FOR SAM TWIN PHANTOM

Construction: In combination with the Twin SAM Phantom V4.0 or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



4.7 SYSTEM VALIDATION KITS

Construction: Symmetrical dipole with I/4 balun. Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions. Includes distance holder and tripod adaptor.

Frequency: 450, 900, 1800, 2450, 5800 MHz

Return loss: > 20 dB at specified validation position

Power capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Dimensions: 450V2: dipole length: 270 mm; overall height: 330 mm
 D900V2: dipole length: 149 mm; overall height: 330 mm
 D1800V2: dipole length: 72 mm; overall height: 300 mm
 D835V2: dipole length: 161; overall height: 330
 D1900V2: dipole length: 68; overall height: 300
 D2450V2: dipole length: 51.5 mm; overall height: 300 mm
 D5GHzV2: dipole length: 25.5 mm; overall height: 290 mm

4.8 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUID

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16 MΩ+ resistivity

HEC: Hydroxyethyl Cellulose

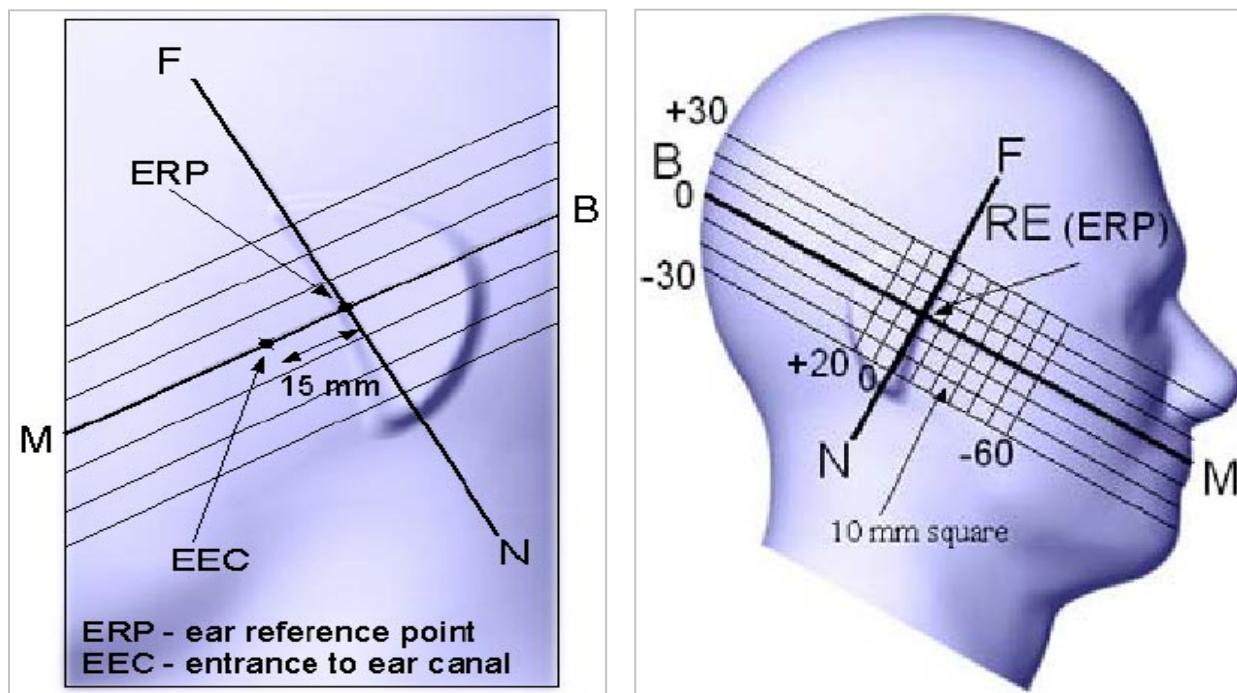
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

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

5 TEST POSITIONS FOR DEVICES 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 1/4 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:



5.1 CHEEK/TOUCH POSITION

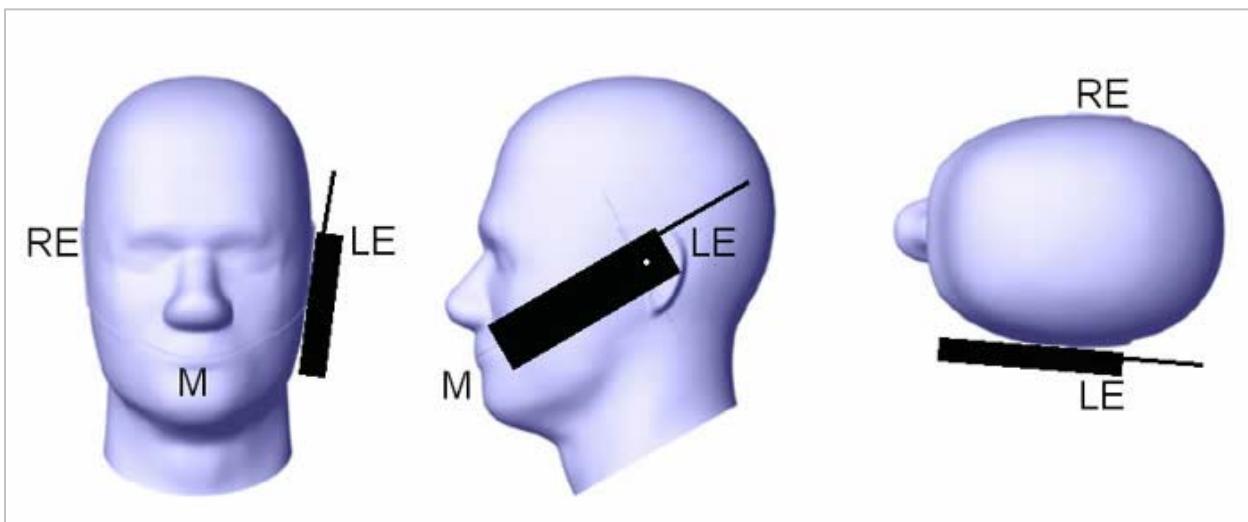
The device is brought toward the mouth of the head phantom by pivoting against the "ear reference point" or along the "N-F" line for the SCC-34/SC-2 head phantom.

This test position is established:

- i. When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.
- ii. (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

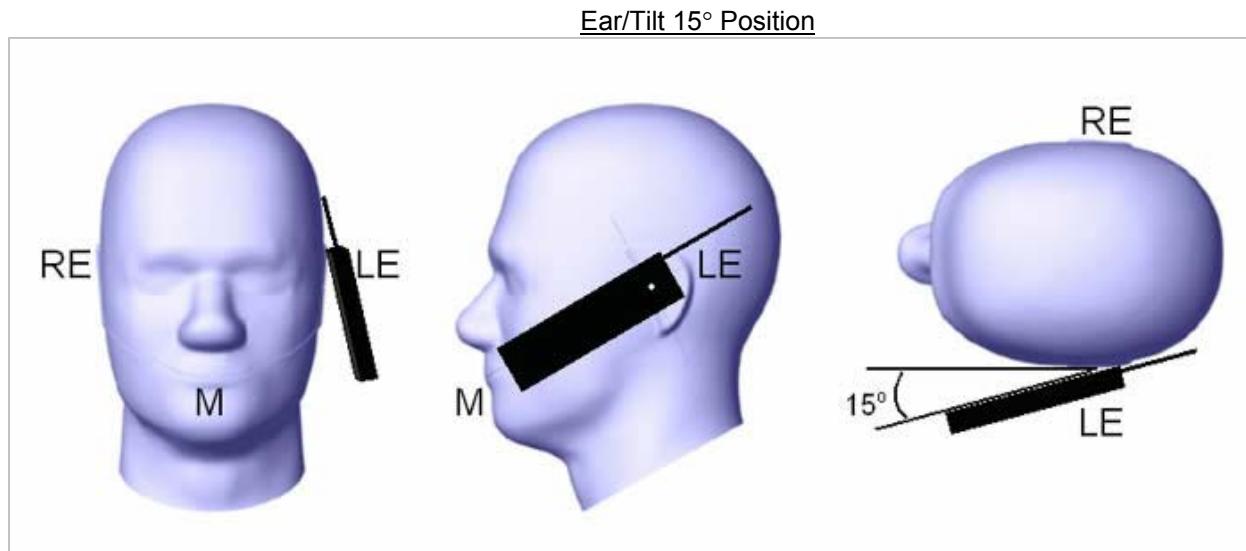


5.2 EAR/TILT POSITION

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

- i. 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.
- ii. (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, Ear/Ear, extended and retracted) is at least 3.0 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.



6 TEST POSITIONS FOR BODY-WORN AND OTHER SIMILAR CONFIGURATIONS

With the belt-clips or holsters

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. For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do.

When multiple accessories

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.

Without the belt-clips or holsters

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.

Transmitter that is designed to operate in front of a person's face (face-held)

Transmitters that are designed to operate in front of a person's face, in push-to-talk configurations, should be tested for SAR compliance with the front of the device positioned at 2.5 cm from a flat phantom. Frontal face-phantoms are typically not recommended because of the potential of higher E-field probe boundary-effects errors in the non-smooth regions of these face phantoms, such as the nose, lips and eyes etc. For devices that are carried next to the body, such as shoulder, waist or chest-worn transmitters, SAR compliance should be tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in normal use configurations.

With neck-strap or lanyard

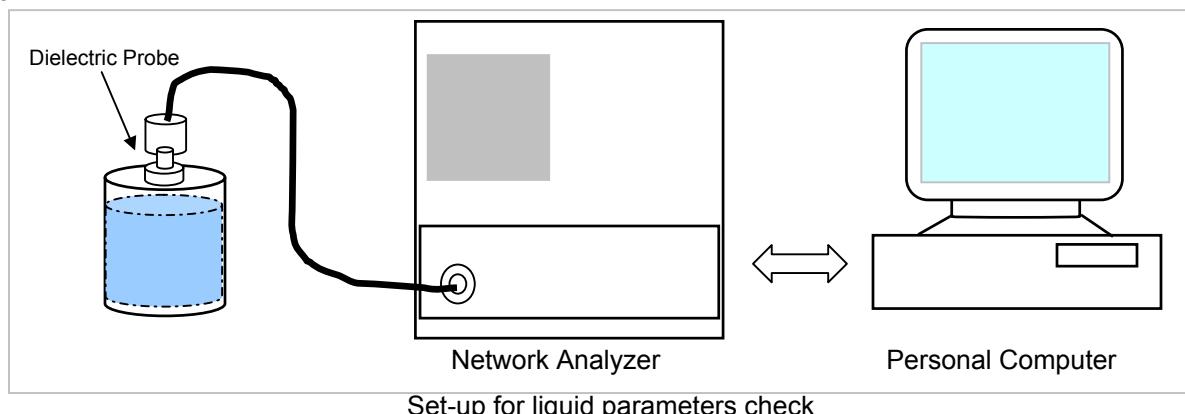
SAR data is requested for cellphones designed to be used with a headset while worn next to the body using a neck-strap or lanyard; device should be tested with front and back sides in contact with a flat phantom

Lap-held

SAR is tested for a lap-held position with the bottom of the computer in direct contact against a flat phantom.

7 SIMULATING LIQUID PARAMETERS CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within $\pm 5\%$ of the values given in the table below.



Reference Values of Tissue Dielectric Parameters for Head and Body Phantom

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE Standard 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE Standard 1528.

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

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

7.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameters Check Result @ Head 1900 MHz

Room Ambient Temperature = 23°C; Relative humidity = 45%

Measured by: Sunny Shih

f (MHz)	Simulating Liquid		Parameters		Target	Measured	Deviation (%)	Limit (%)
	Temp. (°C)	Depth (cm)	ε'	Relative Permittivity (ε'): Conductivity (σ):				
1900	22	15	13.6947	40.4591	40.0	40.4591	1.15	± 5
				1.40	1.4475	3.39		± 5

Liquid Check

Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C

August 16, 2005 12:22 PM

Frequency	e'	e"
1710000000.	41.4868	13.1833
1720000000.	41.4016	13.2045
1730000000.	41.2804	13.2260
1740000000.	41.1944	13.2300
1750000000.	41.1296	13.2715
1760000000.	41.0919	13.3341
1770000000.	41.0498	13.4272
1780000000.	41.0001	13.5000
1790000000.	40.9713	13.5039
1800000000.	40.9691	13.4944
1810000000.	40.9843	13.4768
1820000000.	40.9583	13.4853
1830000000.	40.9022	13.4883
1840000000.	40.8096	13.4754
1850000000.	40.7290	13.4981
1860000000.	40.6681	13.5208
1870000000.	40.5930	13.5804
1880000000.	40.5316	13.6586
1890000000.	40.4755	13.6820
1900000000.	40.4591	13.6947
1910000000.	40.5076	13.6947

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon''$$

where $f = \text{target } f * 10^6$

$$\epsilon_0 = 8.854 * 10^{-12}$$

Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 23°C; Relative humidity = 45%

Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)	ε"	Relative Permittivity (ϵ_r):	53.3	52.7325	-1.06	± 5
1900	22	15	15.0269	Conductivity (σ):	1.52	1.58833	4.50	± 5

Liquid Check

Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C

August 16, 2005 02:02 PM

Frequency	ε'	ε"
1710000000.	53.6092	14.5193
1720000000.	53.5161	14.5269
1730000000.	53.4063	14.5565
1740000000.	53.3421	14.5714
1750000000.	53.2833	14.6082
1760000000.	53.2543	14.6866
1770000000.	53.2216	14.7793
1780000000.	53.1749	14.8437
1790000000.	53.1584	14.8458
1800000000.	53.1673	14.8114
1810000000.	53.1820	14.8161
1820000000.	53.1642	14.8194
1830000000.	53.0921	14.8301
1840000000.	52.9975	14.8212
1850000000.	52.9219	14.8402
1860000000.	52.8759	14.8738
1870000000.	52.8104	14.9363
1880000000.	52.7556	15.0043
1890000000.	52.7051	15.0179
1900000000.	52.7325	15.0269
1910000000.	52.7839	15.0246

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon''$$

where $f = \text{target } f * 10^6$

$$\epsilon_0 = 8.854 * 10^{-12}$$

Simulating Liquid Dielectric Parameters Check Result @ Head 1900 MHz

Room Ambient Temperature = 23°C; Relative humidity = 45%

Measured by: Sunny Shih

f (MHz)	Simulating Liquid		Parameters		Target	Measured	Deviation (%)	Limit (%)
	Temp. (°C)	Depth (cm)	ε"	Relative Permittivity (ε'): Conductivity (σ):				
1900	22	15	13.8116	40.0	39.9692	1.40	-0.08	± 5

Liquid Check

Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C

August 17, 2005 10:48 AM

Frequency	ε'	ε"
1710000000.	41.0266	13.2690
1720000000.	40.9389	13.2777
1730000000.	40.8342	13.2972
1740000000.	40.7552	13.2893
1750000000.	40.6822	13.3561
1760000000.	40.6227	13.4522
1770000000.	40.5608	13.5465
1780000000.	40.5083	13.6072
1790000000.	40.4774	13.6300
1800000000.	40.4802	13.6105
1810000000.	40.5002	13.5832
1820000000.	40.4755	13.5715
1830000000.	40.4311	13.5661
1840000000.	40.3532	13.5639
1850000000.	40.2658	13.5925
1860000000.	40.1772	13.6407
1870000000.	40.0803	13.7065
1880000000.	40.0098	13.7588
1890000000.	39.9565	13.7793
1900000000.	39.9692	13.8116
1910000000.	40.0158	13.7884

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon''$$

where $f = \text{target } f * 10^6$

$$\epsilon_0 = 8.854 * 10^{-12}$$

Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 23°C; Relative humidity = 45%

Measured by: Sunny Shih

f (MHz)	Simulating Liquid		Parameters		Target	Measured	Deviation (%)	Limit (%)
	Temp. (°C)	Depth (cm)	ε"	Relative Permittivity (εᵣ):				
1900	22	15	15.0912	Conductivity (σ):	53.3	52.1449	-2.17	± 5

Liquid Check

Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C

August 17, 2005 11:53 AM

Frequency	ε'	ε"
1710000000.	53.0692	14.5181
1720000000.	52.9871	14.5198
1730000000.	52.8903	14.5415
1740000000.	52.8160	14.5567
1750000000.	52.7515	14.6302
1760000000.	52.7147	14.7252
1770000000.	52.6435	14.8415
1780000000.	52.6004	14.9093
1790000000.	52.5879	14.9152
1800000000.	52.5908	14.8898
1810000000.	52.6233	14.8464
1820000000.	52.5940	14.8231
1830000000.	52.5546	14.8159
1840000000.	52.4769	14.8170
1850000000.	52.3933	14.8676
1860000000.	52.2970	14.9300
1870000000.	52.1979	15.0029
1880000000.	52.1241	15.0651
1890000000.	52.0974	15.0718
1900000000.	52.1449	15.0912
1910000000.	52.2102	15.0882

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon''$$

where $f = \text{target } f * 10^6$

$$\epsilon_0 = 8.854 * 10^{-12}$$

Simulating Liquid Parameter Check Result @ Head 835 MHz

Room Ambient Temperature = 24.0°C; Relative humidity = 45%

Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)	e'	Relative Permittivity (e''):	41.5	40.9826	-1.25	± 5
835	23	15	19.6601	Conductivity (σ):	0.90	0.9133	1.47	± 5

Liquid Check

Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C

August 17, 2005 02:19 PM

Frequency	e'	e''
750000000.	42.0041	20.0269
755000000.	41.9359	20.0461
760000000.	41.9331	20.0484
765000000.	41.8269	20.0432
770000000.	41.7353	20.0009
775000000.	41.6300	20.0302
780000000.	41.5549	20.0404
785000000.	41.4675	19.9986
790000000.	41.4048	19.9621
795000000.	41.3533	19.9231
800000000.	41.2748	19.9027
805000000.	41.2280	19.8744
810000000.	41.2223	19.8354
815000000.	41.1709	19.8250
820000000.	41.1282	19.7645
825000000.	41.0511	19.7512
830000000.	40.9993	19.7102
835000000.	40.9826	19.6601
840000000.	40.9510	19.6302
845000000.	40.8592	19.6070
850000000.	40.8494	19.6132
855000000.	40.8609	19.5824
860000000.	40.7841	19.5662
865000000.	40.6908	19.5961
870000000.	40.6324	19.6365
875000000.	40.5456	19.6442
880000000.	40.4481	19.6452
885000000.	40.3704	19.6408
890000000.	40.2581	19.6166
895000000.	40.1786	19.5637
900000000.	40.1363	19.5504

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$$

where $f = \text{target } f * 10^6$

$$\epsilon_0 = 8.854 * 10^{-12}$$

Simulating Liquid Parameter Check Result @ Muscle 835 MHz

Room Ambient Temperature = 23.0 °C; Relative humidity = 45%

Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)	e'	Relative Permittivity (e'')	55.2	54.9339	-0.48	± 5
835	22	15	20.9793	Conductivity (σ):	0.97	0.9745	0.47	± 5

Liquid Check

Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C

August 17, 2005 03:31 PM

Frequency	e'	e''
750000000.	55.7260	21.4125
755000000.	55.6497	21.3965
760000000.	55.6495	21.3904
765000000.	55.5720	21.3634
770000000.	55.4855	21.3401
775000000.	55.4010	21.3516
780000000.	55.3279	21.3244
785000000.	55.2974	21.2826
790000000.	55.2062	21.2626
795000000.	55.1879	21.2171
800000000.	55.1500	21.1790
805000000.	55.1202	21.1609
810000000.	55.1145	21.1285
815000000.	55.0678	21.1055
820000000.	55.0683	21.0709
825000000.	55.0099	21.0414
830000000.	54.9464	21.0252
835000000.	54.9339	20.9793
840000000.	54.9352	20.9394
845000000.	54.8757	20.9115
850000000.	54.8532	20.8918
855000000.	54.8576	20.8835
860000000.	54.7965	20.9002
865000000.	54.7163	20.8919
870000000.	54.6648	20.9265
875000000.	54.5650	20.9156
880000000.	54.4959	20.9251
885000000.	54.4301	20.9123
890000000.	54.3490	20.8847
895000000.	54.3019	20.8336
900000000.	54.2656	20.7945

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$$

where $f = \text{target } f * 10^6$

$$\epsilon_0 = 8.854 * 10^{-12}$$

8 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of $\pm 10\%$.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3552 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
- Special 5 x 5 x 7 fine cube was chosen for cube integration($dx=dy=7.5\text{mm}$; $dz=5\text{mm}$).
- Distance between probe sensors and phantom surface was set to 2.5 (below 3 G) mm.
- The dipole input power (forward power) was $250\text{ mW}\pm 3\%$.
- The results are normalized to 1 W input power.

Reference SAR Values

IEEE Standard 1528 Recommended Reference Value

Frequency (MHz)	1 g SAR	10 g SAR	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
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

8.1 SYSTEM PERFORMANCE CHECK RESULTS

@ System Validation Dipole: D1900V2 SN:5d043

Date: August 16, 2005

Ambient Temperature = 23°C; Relative humidity = 45%

Measured by: Sunny Shih

Head Simulating Liquid			Measured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
1900	22	15	9.77	39.08	39.7	-1.56	± 10

Date: August 17, 2005

Ambient Temperature = 23°C; Relative humidity = 45%

Measured by: Sunny Shih

Head Simulating Liquid			Measured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
1900	22	15	9.81	39.24	39.7	-1.16	± 10

@ System Validation Dipole: D835V2 SN:4d002

Date: August 17, 2005

Ambient Temperature = 23°C; Relative humidity = 45%

Measured by: Sunny Shih

Head Simulating Liquid			Measured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
835	22	15	2.47	9.88	9.5	4.00	± 10

9 SAR MEASUREMENT PROCEDURE

A summary of the procedure follows:

- a) A measurement of the SAR value at a fixed location is used as a reference value for assessing the power drop of the EUT. The SAR at this point is measured at the start of the test, and then again at the end of the test.
- b) The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 2.5 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 15 mm x 15 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.
- c) Around this point, a volume of X=Y=Z=30 mm is assessed by measuring 5 x 5 x 7 mm points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:
 - (i) The data at the surface are extrapolated, since the centre 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 is based on a least square algorithm. A polynomial of the fourth order is calculated through the points in z-axes. This polynomial is then used to evaluate the points between the surface and the probe tip.
 - (ii) The maximum interpolated value is searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g and 10 g) are computed using 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-direction). The volume is integrated with the trapezoidal – algorithm. One thousand points (10 x 10 x 10) are interpolated to calculate the averages.
 - (iii) All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.
 - (iv) The SAR value at the same location as in Step (a) is again measured to evaluate the actual power drift.

DASY4 SAR MEASUREMENT PROCEDURE

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 1.2 mm for an EX3DV3 probe type).

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures 5 x 5 x 7 mm points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

10 PROCEDURES USED TO ESTABLISH TEST SIGNAL

The manufacturer supplied a special driving program (Hyper Terminal) by using the following commands to turn the transmitter on and change the channels and bands:

at!oem=176

OK

at!diag

OK

at!tx=1

OK

at!chan=XXXX,1

OK

at!allup=1

OK

"at!chan=" changes both the band and the channels. Channels the first # then the comma followed by the band 0= cellular and 1= PCS.

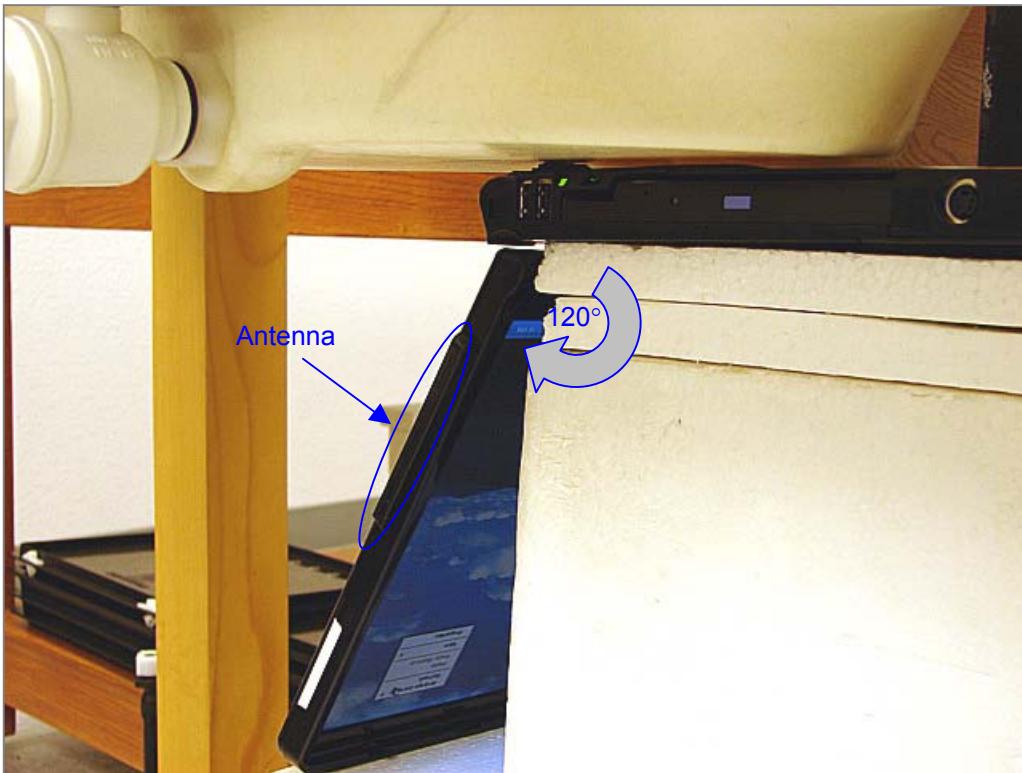
Conducted powers were measured prior to SAR measurement.

CDMA Cell Band:		Conducted Power
Ch	f (MHz)	Avg Power
1013	824.70	26.10
384	836.52	25.88
777	848.31	25.40

CDMA PCS Band:		Conducted Power
Ch	f (MHz)	Avg Power
25	1851.25	26.02
600	1880.00	26.31
1175	1908.75	25.80

11 SAR TEST SUMMARY

11.1 Lenovo W-note with Calexico 2 WLAN module

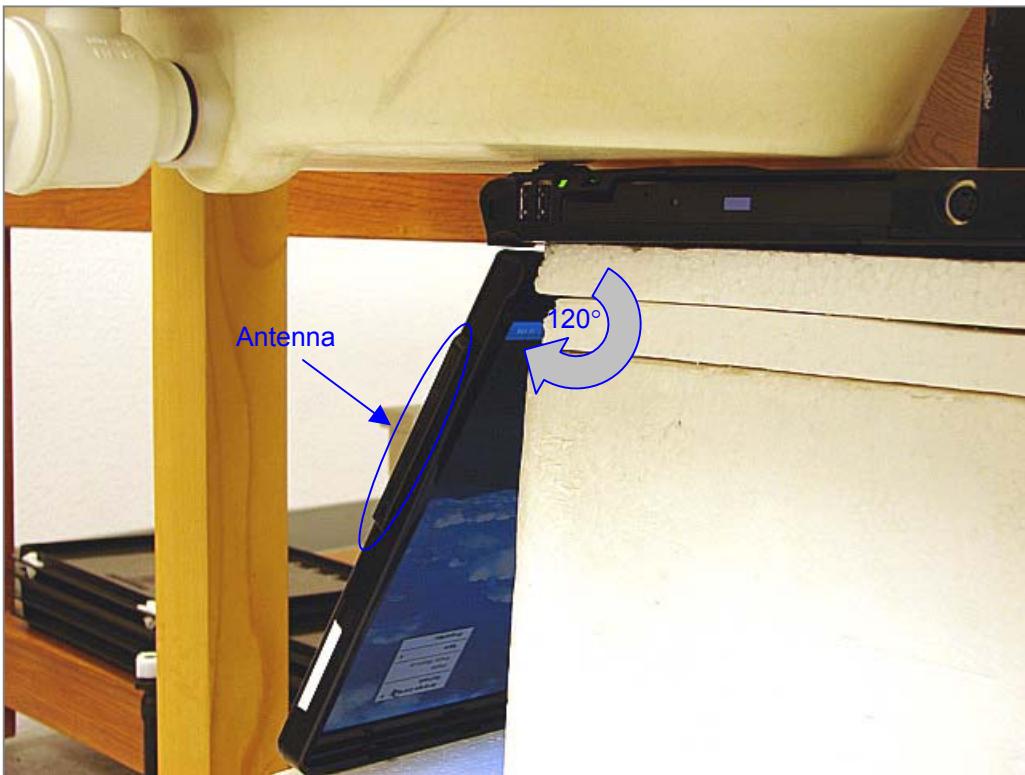


CDMA Cell band						
Channel	f (MHz)	WLAN on/off	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	Limit (mW/g)
1013	824.70	off				
384	836.52	off	0.055	-0.102	0.056	1.6
777	848.31	off				
1013	824.70	on				
384	836.52	on	0.056	-0.118	0.058	1.6
777	848.31	on				
CDMA PCS band						
Channel	f (MHz)	WLAN on/off	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	Limit (mW/g)
25	1851.25	off				
600	1880.00	off	0.060	-0.096	0.061	1.6
1175	1908.75	off				
25	1851.25	on	0.065	-0.078	0.066	1.6
600	1880.00	on	0.069	-0.105	0.071	1.6
1175	1908.75	on	0.056	-0.185	0.058	1.6

Notes:

- 1) The exact method of extrapolation is *measured SAR x 10⁸(-drift/10)*. The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
- 2) The SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, thus testing at low & high channel is optional.
- 3) Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

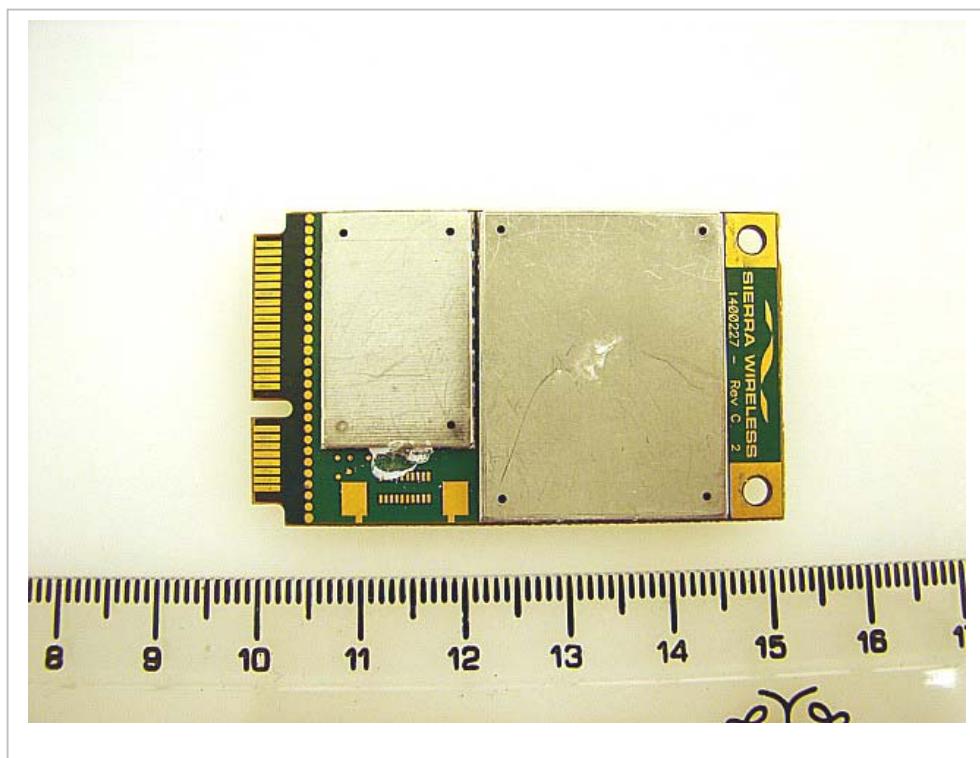
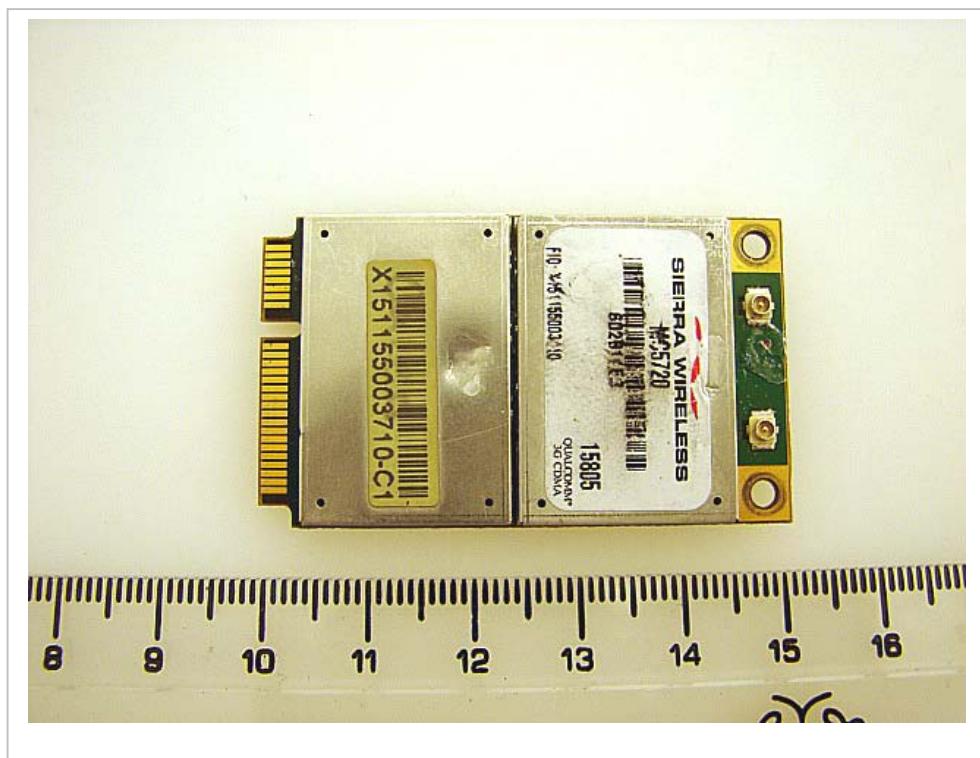
11.2 Lenovo W-note with Bartlette WLAN module



CDMA Cell band						
Channel	f (MHz)	WLAN on/off	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	Limit (mW/g)
1013	824.70	off	0.052	-0.180	0.054	1.6
384	836.52	off	0.069	-0.098	0.071	1.6
777	848.31	off	0.060	-0.183	0.063	1.6
1013	824.70	on				
384	836.52	on	0.066	-0.051	0.067	1.6
777	848.31	on				
CDMA PCS band						
Channel	f (MHz)	WLAN on/off	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	Limit (mW/g)
25	1851.25	off				
600	1880.00	off	0.049	-0.014	0.049	1.6
1175	1908.75	off				
25	1851.25	on				
600	1880.00	on	0.051	-0.180	0.053	1.6
1175	1908.75	on				

Notes:

- 1) The exact method of extrapolation is $measured\ SAR \times 10^{(-drift/10)}$. The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
- 2) The SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, thus testing at low & high channel is optional.
- 3) Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

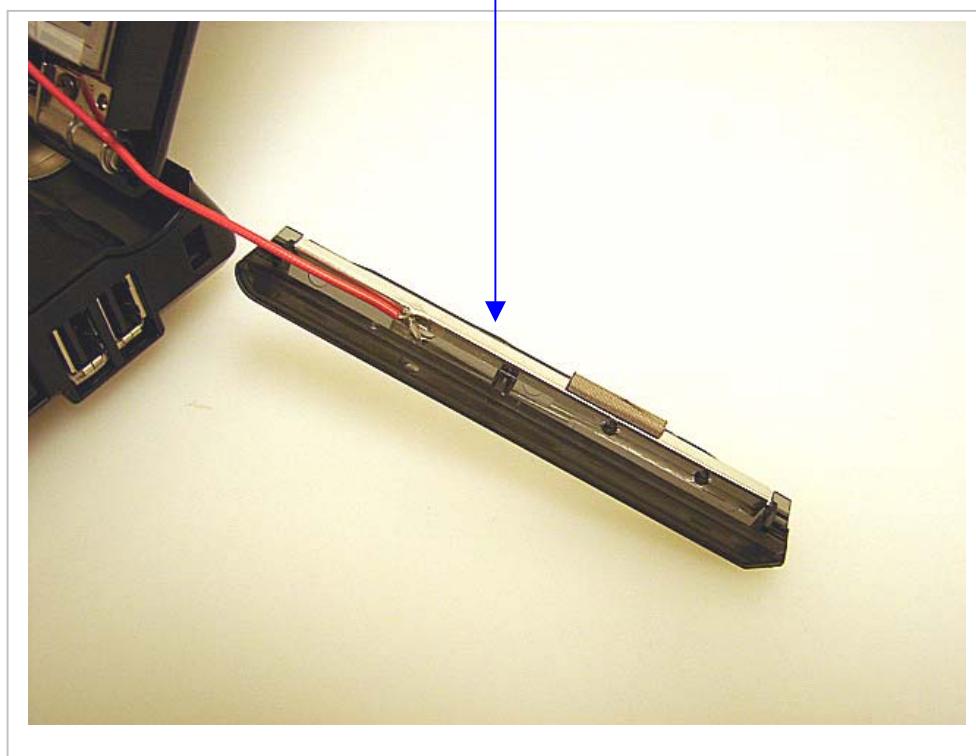
12 PHOTO**12.1 EUT**

12.2 HOST DEVICE

Front View
Levono W-note



Antenna



Rear View
Levono W-note – Plastic LCD Cover



13 MEASUREMENT UNCERTAINTY

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechanical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty						RSS	11.44
Expanded Uncertainty (95% Confidence Interval)						K=2	22.87
Notes for table							
1. Tol. - tolerance in influence quality							
2. N - Nominal							
3. R - Rectangular							
4. Div. - Divisor used to obtain standard uncertainty							
5. Ci - is the sensitivity coefficient							

14 EQUIPMENT LIST

<u>Name of Equipment</u>	<u>Manufacturer</u>	<u>Type/Model</u>	<u>Serial Number</u>	<u>Cal. Due date</u>
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A
S-Parameter Network Analyzer	Agilent	8753ES-6	US39173569	9/19/05
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
E-Field Probe	SPEAG	EX3DV4	3552	3/19/06
Thermometer	ERTCO	639-1	8402	10/13/2005
Thermometer	ERTCO	639-1	8404	10/21/2005
Thermometer	ERTCO	637-1	8661	10/21/2005
SAM Phantom (SAM1)	SPEAG	TP-1185	QD000P40CA	N/A
SAM Phantom (SAM2)	SPEAG	TP-1015	N/A	N/A
Data Acquisition Electronics	SPEAG	DAE3 V1	500	2/7/06
System Validation Dipole	SPEAG	D2450V2	748	5/14/06
System Validation Dipole	SPEAG	D5GHzV2	1003	10/5/05
Signal General	R&H	SMP 04	DE34210	6/2/06
Power Meter	Giga-tronics	8651A	8651404	9/16/05
Power Sensor	Giga-tronics	80701A	1834588	9/16/05
Amplifier	Mini-Circuits	ZVE-8G	0360	N/A
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A
Radio Communication Tester	Rohde & Schwarz	CMU 200	838114/032	12/17/06
Wireless Communication Test Set	Agilent	E5515C	GB44051333	5/5/06
Simulating Liquid	CCS	H835 MHz	N/A	within 24 hrs of first test
Simulating Liquid	CCS	M835 MHz	N/A	within 24 hrs of first test
Simulating Liquid	CCS	H1900 MHz	N/A	within 24 hrs of first test
Simulating Liquid	CCS	M1900 MHz	N/A	within 24 hrs of first test

15 ATTACHMENT

No.	Contents	No. of page (s)
1	System Performance Check Plot	6
2	SAR Test Plot	13
3	Certificate of E-filed Probe EX3DV4 SN 3552	10
4	Certificate of System Validation Dipole D835V2 SN 4d002	6
5	Certificate of System Validation Dipole D1900V2 SN 5d043	6

END OF REPORT