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: 05U3780-3B

ISSUE DATE: MARCH 29, 2006

Prepared for

SIERRA WIRELESS
2290 COSMOS CT
CARLSBAD CA 92009
UNITED STATES

Prepared by

COMPLIANCE CERTIFICATION SERVICES
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LAB CODE:200065-0

Revision History

Rev.	Issued date	Revisions	Revised By
A	December 8, 2005	Initial Issue	HS
B	March 29, 2006	Correction of WLAN FCC ID	ND

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: November 22 - 23 & December 6, 2005

APPLICANT: ADDRESS:	SIERRA WIRELESS 2290 COSMOS CT CARLSBAD CA 92009 UNITED STATES
FCC ID: MODEL:	N7N-MC5720 MC5720
DEVICE CATEGORY: EXPOSURE CATEGORY:	Portable Device General Population/Uncontrolled Exposure

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

Test Sample is a:	Production unit	
Host devices:	Host Devices 14" & 15" Lenovo D-Note	WLAN Module / FCC ID 1. Gwinette / PPD-AR5BXB6 2. Intel / PD9LEN3945ABG

FCC Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]
22H	824.7 – 848.31	The highest reported SAR values are: Body-worn: 0.097 W/kg, Collocated: 0.103 W/kg
24E	1851.25 – 1908.75	The highest reported SAR values are: Body-worn: 0.114 W/kg, Collocated: 0.115 W/kg

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.

Approved & Released For CCS By:

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Hsin Fu Shih
Senior Engineer
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Tested By:

Ninous Davoudi
EMC Engineer
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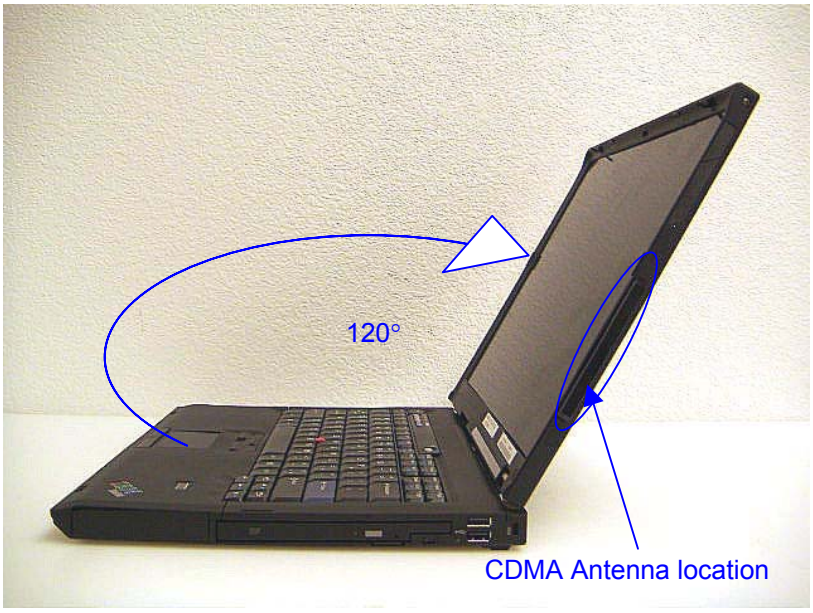
1 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

Express MINI-PCI USB Wireless CDMA Modem Module installed in host devices	
Host devices:	Host Devices: 14" & 15" Lenovo D-Note WLAN Module / FCC ID: 1. Gwinette / PPD-AR5BXB6; 2. Intel / PD9LEN3945ABG
Normal operation:	Lap-held position 
Power supply:	Power supplied through the laptop computer (host device)
CDMA Antenna:	1. For 14 inch laptop - FOXCONN, Type WDAN-B1DA1003 2. For 15 inch laptop - FOXCONN, Type WDAN-B1DA2003

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."

NVLAP®

LAB CODE:200065-0

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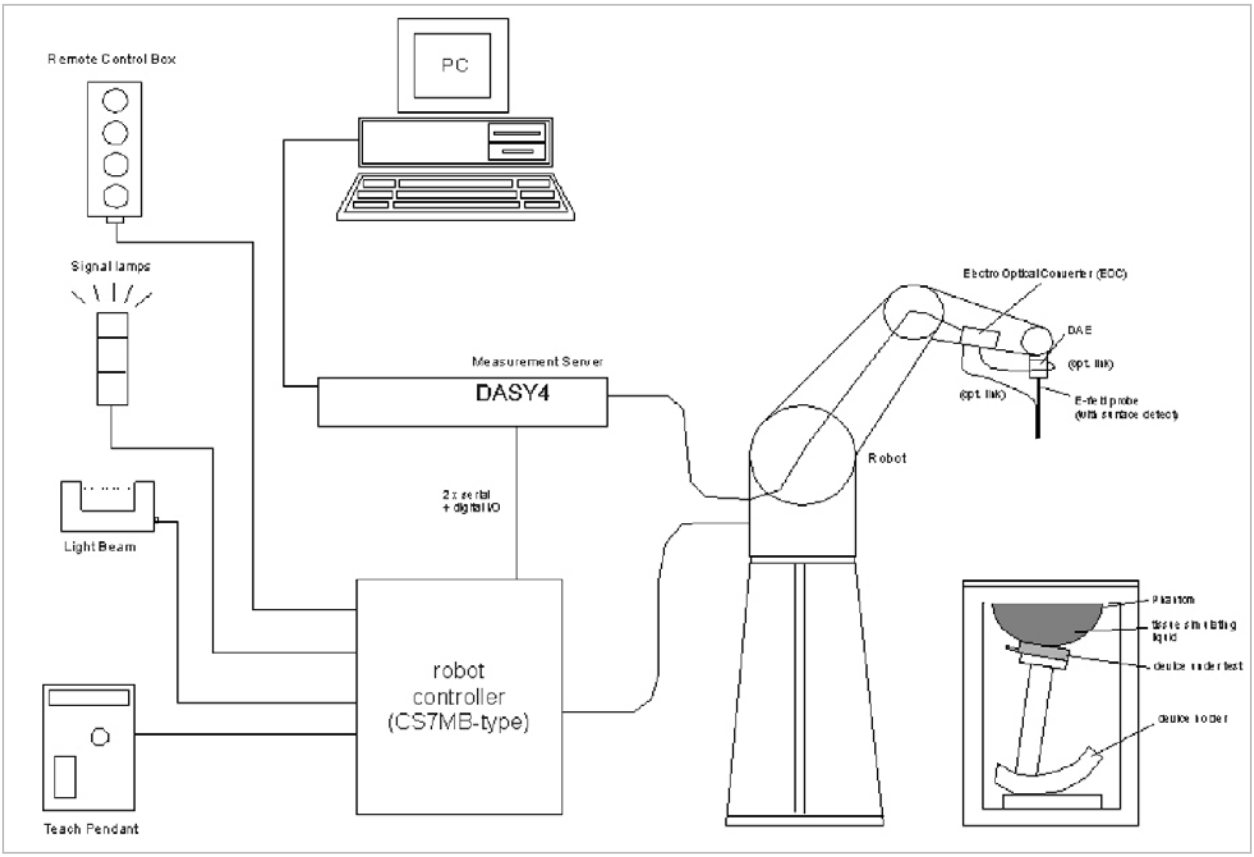
No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

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 µW/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Dimensions:	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application:	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

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 l/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

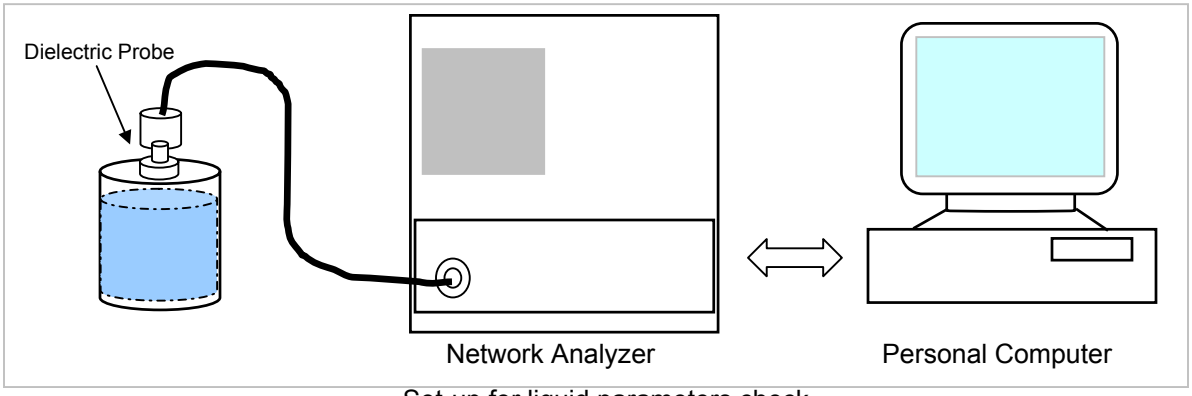
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

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 SIMULATING LIQUID PARAMETERS CHECK

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



Set-up for liquid parameters check

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 ρ = 1000 kg/m^3)

5.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Parameter Check Result @ Muscle 835 MHz

Room Ambient Temperature = 22.6°C; Relative humidity = 35% Measured by: Ninous Davoudi

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
835	21.4	15	e'	Relative Permittivity (e"):	55.2	54.0940	-2.00	± 5
			21.2786	Conductivity (σ):	0.97	0.9884	1.90	± 5

Liquid Check
Ambient temperature: 22.6 deg. C; Liquid temperature: 21.4 deg C
November 22, 2005 08:40 AM

Frequency	e'	e"
750000000.	54.9506	21.7453
755000000.	54.9077	21.7072
760000000.	54.8446	21.6763
765000000.	54.7652	21.6632
770000000.	54.7260	21.6601
775000000.	54.6770	21.6254
780000000.	54.6116	21.5734
785000000.	54.5752	21.5351
790000000.	54.5299	21.5349
795000000.	54.4786	21.5138
800000000.	54.4218	21.5063
805000000.	54.3720	21.4511
810000000.	54.3461	21.4444
815000000.	54.3031	21.3876
820000000.	54.2577	21.3993
825000000.	54.2300	21.3489
830000000.	54.1505	21.3066
835000000.	54.0940	21.2786
840000000.	54.0564	21.2990
845000000.	54.0247	21.2732
850000000.	53.9581	21.2388
855000000.	53.9056	21.2104
860000000.	53.8541	21.1820
865000000.	53.7978	21.1666
870000000.	53.7295	21.1452
875000000.	53.7068	21.1282
880000000.	53.6569	21.1216
885000000.	53.6081	21.1149
890000000.	53.5511	21.1114
895000000.	53.5392	21.0590
900000000.	53.4895	21.0426
905000000.	53.4471	21.0288
910000000.	53.4091	20.9979
915000000.	53.3532	20.9847
920000000.	53.3204	20.9625

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6
ε_0 = 8.854 * 10^{-12}

Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 22.6°C; Relative humidity = 35% Measured by: Ninous Davoudi

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	21.6	15	ε"	Relative Permittivity (ϵ_r):	53.3	52.9464	-0.66	± 5
			14.0685	Conductivity (σ):	1.52	1.48703	-2.17	± 5

Liquid Check
Ambient temperature: 22.6 deg. C; Liquid temperature: 21.6 deg C
November 22, 2005 09:40 AM

Frequency	e'	e"
1710000000.	53.6604	13.4443
1720000000.	53.6408	13.4772
1730000000.	53.5878	13.5158
1740000000.	53.5339	13.5593
1750000000.	53.4912	13.6046
1760000000.	53.4626	13.6381
1770000000.	53.4188	13.6556
1780000000.	53.3701	13.7031
1790000000.	53.3321	13.7308
1800000000.	53.2987	13.7657
1810000000.	53.2529	13.8007
1820000000.	53.1949	13.8359
1830000000.	53.1578	13.8676
1840000000.	53.1126	13.8960
1850000000.	53.0875	13.9285
1860000000.	53.0640	13.9525
1870000000.	53.0287	13.9692
1880000000.	53.0077	13.9877
1890000000.	52.9719	14.0236
1900000000.	52.9464	14.0685
1910000000.	52.9138	14.0839

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

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

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Parameter Check Result @ Muscle 835 MHz

Room Ambient Temperature = 22°C; Relative humidity = 35% Measured by: Ninous Davoudi

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
835	21.2	15	e'	Relative Permittivity (e"):	55.2	53.7033	-2.71	± 5
			21.1453	Conductivity (σ):	0.97	0.9822	1.26	± 5

Liquid Check
Ambient temperature: 22 deg. C; Liquid temperature: 21.2 deg C
November 23, 2005 08:57 AM

Frequency	e'	e"
750000000.	54.5589	21.5762
755000000.	54.4895	21.5255
760000000.	54.4497	21.4891
765000000.	54.3933	21.4705
770000000.	54.3627	21.4551
775000000.	54.3120	21.4116
780000000.	54.2554	21.3822
785000000.	54.2035	21.3631
790000000.	54.1425	21.3474
795000000.	54.1103	21.3449
800000000.	54.0784	21.3079
805000000.	54.0106	21.2953
810000000.	53.9742	21.2718
815000000.	53.9148	21.2286
820000000.	53.8778	21.2450
825000000.	53.8219	21.1901
830000000.	53.7545	21.1622
835000000.	53.7033	21.1453
840000000.	53.6831	21.1502
845000000.	53.6207	21.1268
850000000.	53.5488	21.0746
855000000.	53.4992	21.0798
860000000.	53.4554	21.0398
865000000.	53.3725	21.0362
870000000.	53.3330	20.9739
875000000.	53.2781	20.9819
880000000.	53.2336	20.9859
885000000.	53.1944	20.9458
890000000.	53.1425	20.9529
895000000.	53.1071	20.8909
900000000.	53.0888	20.8853
905000000.	53.0364	20.8566
910000000.	52.9983	20.8226
915000000.	52.9475	20.8197
920000000.	52.8976	20.8166

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 22.0°C; Relative humidity = 35% Measured by: Ninous Davoudi

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	21.7	15	ε"	Relative Permittivity (ε_r):	53.3	52.0205	-2.40	± 5
			14.0868	Conductivity (σ):	1.52	1.48897	-2.04	± 5

Liquid Check
Ambient temperature: 22 deg. C; Liquid temperature: 21.7 deg C
November 23, 2005 09:16 AM

Frequency	e'	e"
1710000000.	52.7323	13.5107
1720000000.	52.7051	13.5371
1730000000.	52.6573	13.5803
1740000000.	52.6029	13.6038
1750000000.	52.5712	13.6523
1760000000.	52.5189	13.6820
1770000000.	52.4871	13.7165
1780000000.	52.4323	13.7597
1790000000.	52.3890	13.7756
1800000000.	52.3702	13.8392
1810000000.	52.3152	13.8620
1820000000.	52.2639	13.8784
1830000000.	52.2145	13.9116
1840000000.	52.1871	13.9511
1850000000.	52.1427	13.9770
1860000000.	52.1134	13.9936
1870000000.	52.0857	14.0018
1880000000.	52.0575	14.0357
1890000000.	52.0402	14.0637
1900000000.	52.0205	14.0868
1910000000.	51.9769	14.1210

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

ε_0 = 8.854 * 10^{-12}

Simulating Liquid Parameter Check Result @ Muscle 835 MHz

Room Ambient Temperature = 23.0°C; Relative humidity = 30% Measured by: Ninous Davoudi

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
835	22.2	15	e'	Relative Permittivity (e"):	55.2	53.5299	-3.03	± 5
			21.0320	Conductivity (σ):	0.97	0.9770	0.72	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.2 deg C
December 06, 2005 09:21 AM

Frequency	e'	e"
750000000.	54.4047	21.4717
755000000.	54.3539	21.4041
760000000.	54.2828	21.3793
765000000.	54.2555	21.4109
770000000.	54.2184	21.3751
775000000.	54.1754	21.3532
780000000.	54.1163	21.3487
785000000.	54.0580	21.3093
790000000.	54.0115	21.3009
795000000.	53.9661	21.2921
800000000.	53.9182	21.2730
805000000.	53.8542	21.2371
810000000.	53.7996	21.1927
815000000.	53.7410	21.1502
820000000.	53.7274	21.1368
825000000.	53.6809	21.1074
830000000.	53.5937	21.0543
835000000.	53.5299	21.0320
840000000.	53.4911	21.0448
845000000.	53.4391	21.0187
850000000.	53.4132	20.9724
855000000.	53.3285	20.9699
860000000.	53.3244	20.9484
865000000.	53.2761	20.9221
870000000.	53.2042	20.9155
875000000.	53.1393	20.8960
880000000.	53.0917	20.8914
885000000.	53.0430	20.9085
890000000.	52.9869	20.8759
895000000.	52.9499	20.8362
900000000.	52.9316	20.8158
905000000.	52.8836	20.7707
910000000.	52.8227	20.7568
915000000.	52.7808	20.7101
920000000.	52.7431	20.6980

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Dielectric Parameters Check Result @ Muscle 1900 MHz

Room Ambient Temperature = 23.0°C; Relative humidity = 30% Measured by: Ninous Davoudi

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
1900	22	15	ε"	Relative Permittivity (ε_r):	53.3	52.5466	-1.41	± 5
			14.0698	Conductivity (σ):	1.52	1.48717	-2.16	± 5

Liquid Check
Ambient temperature: 23.0 deg. C; Liquid temperature: 22.0 deg C
December 06, 2005 08:35 AM

Frequency	e'	e"
1710000000.	53.2285	13.3776
1720000000.	53.1951	13.4026
1730000000.	53.1507	13.4513
1740000000.	53.1227	13.4866
1750000000.	53.0776	13.5290
1760000000.	53.0453	13.5754
1770000000.	53.0168	13.6151
1780000000.	52.9636	13.6615
1790000000.	52.9420	13.6956
1800000000.	52.8904	13.7303
1810000000.	52.8718	13.7548
1820000000.	52.8347	13.7847
1830000000.	52.7984	13.8215
1840000000.	52.7496	13.8623
1850000000.	52.7098	13.9026
1860000000.	52.6774	13.9368
1870000000.	52.6522	13.9647
1880000000.	52.6065	14.0077
1890000000.	52.5888	14.0473
1900000000.	52.5466	14.0698
1910000000.	52.5108	14.1012

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

ε_0 = 8.854 * 10^{-12}

6 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 ±10%.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with **Body** simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E Field Probe EX3DV3 SN:3531 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 f 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=7.5mm; dz=5mm).
- Distance between probe sensors and phantom surface was set to 2.5 (below 3 G) mm.
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

Reference SAR Values for body-tissue

In the table below, the numerical reference SAR values of a SPEAG validation dipoles placed below the flat phantom filled with body-tissue simulating liquid are given. The reference SAR values were calculated using the finite-difference time-domain method and the geometry parameters.

Dipole Type	Distance (mm)	Frequency (MHz)	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D450V2	15	450	5.01	3.36	7.22
D835V2	15	850	9.71	6.38	14.1
D900V2	15	900	11.1	7.17	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1800V2	10	1800	38.5	20.3	67.5
D1900V2	10	1900	39.8	20.8	69.6
D2000V2	10	2000	40.9	21.2	71.5
D2450V2	10	2450	51.2	23.7	97.6

Note: All SAR values normalized to 1 W forward power.

6.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D835V2 SN:4d002

Date: November 22, 2005

Ambient Temperature = 22.6°C; Relative humidity = 35% Measured by: Ninous Davoudi

Body Simulating Liquid			Mrasured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
835	21.4	15	2.42	9.68	9.71	-0.31	± 10
			10g	Normalized to 1 W	Target_10g	Deviation[%]	Limit [%]
			1.59	6.36	6.38	-0.31	± 10

Date: November 23, 2005

Ambient Temperature = 22.0°C; Relative humidity = 35% Measured by: Ninous Davoudi

Body Simulating Liquid			Mrasured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
835	21.2	15	2.4	9.68	9.71	-0.31	± 10
			10g	Normalized to 1 W	Target_10g	Deviation[%]	Limit [%]
			1.59	6.36	6.38	-0.31	± 10

Date: December 6, 2005

Ambient Temperature = 23.0°C; Relative humidity = 30% Measured by: Ninous Davoudi

Body Simulating Liquid			Mrasured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
835	22.2	15	2.34	9.36	9.71	-3.60	± 10
			10g	Normalized to 1 W	Target_10g	Deviation[%]	Limit [%]
			1.53	6.12	6.38	-4.08	± 10

@ System Validation Dipole: D1900V2 SN:5d043

Date: November 22, 2005

Body Simulating Liquid			Mrasured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
1900	21.6	15	9.31	37.24	39.8	-6.43	± 10
			10g	Normalized to 1 W	Target_10g	Deviation[%]	Limit [%]
			4.9	19.6	20.8	-5.77	± 10

Date: November 23, 2005

Body Simulating Liquid			Mrasured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
1900	21.7	15	9.33	37.32	39.8	-6.23	± 10
			10g	Normalized to 1 W	Target_10g	Deviation[%]	Limit [%]
			4.91	19.64	20.8	-5.58	± 10

Date: December 6, 2005

Ambient Temperature = 23.0°C; Relative humidity = 30% Measured by: Ninous Davoudi

Body Simulating Liquid			Mrasured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
1900	22	15	9.48	37.92	39.8	-4.72	± 10
			10g	Normalized to 1 W	Target_10g	Deviation[%]	Limit [%]
			5.01	20.04	20.8	-3.65	± 10

7 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.

8 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 or 0

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:

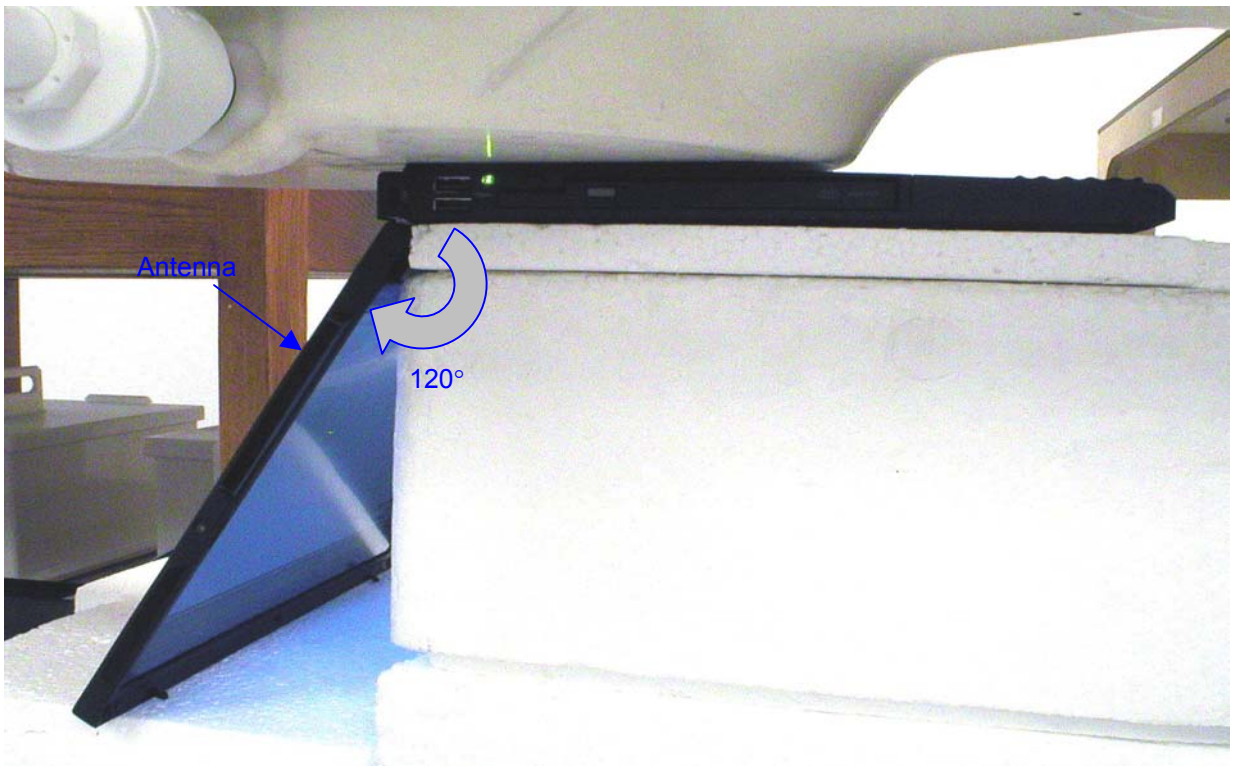
Ch	f (MHz)	Conducted Power Avg Power
1013	824.70	26.10
384	836.52	25.88
777	848.31	25.40

CDMA PCS Bnad:

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

9 SAR TEST SUMMARY

9.1 14" LENOVO D-Note

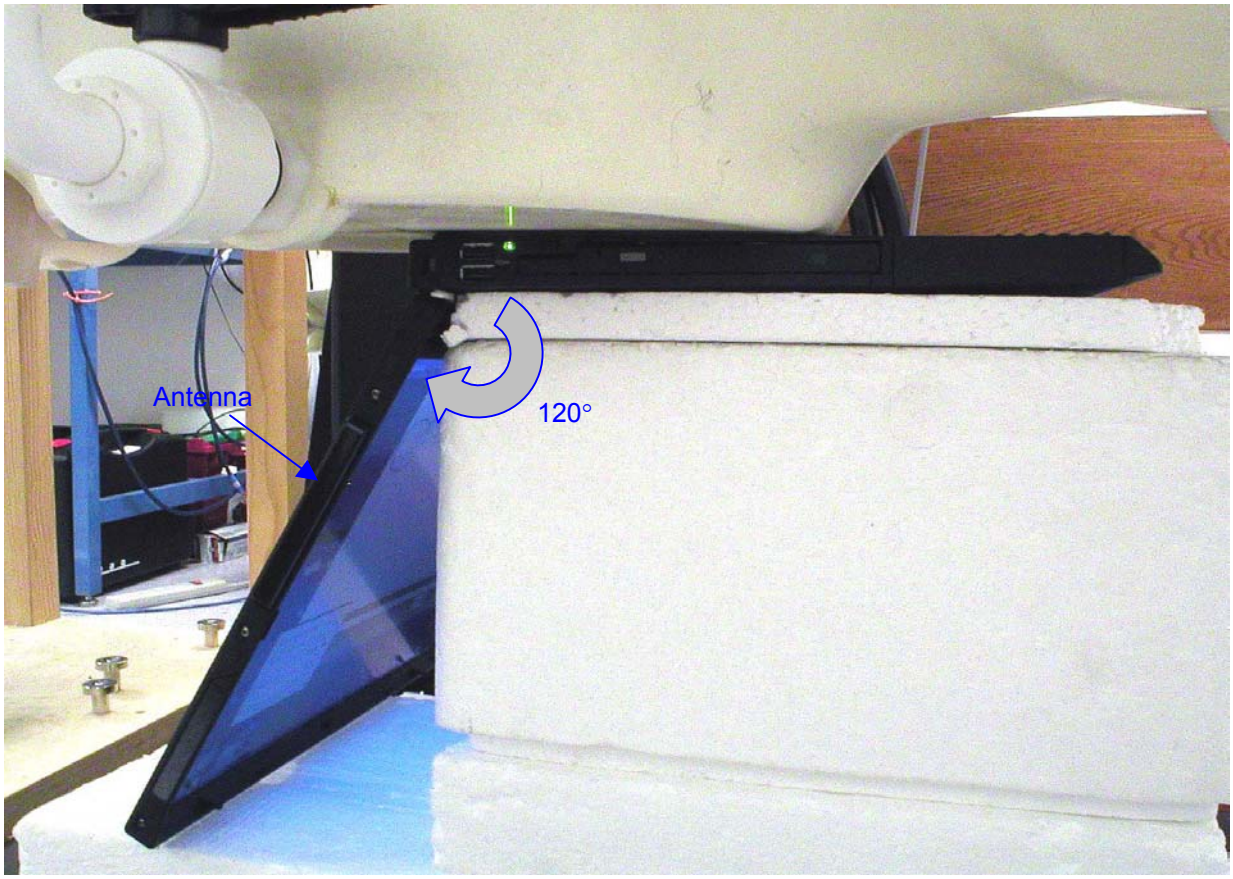


CDMA Cell band						
Channel	f (MHz)	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	3 dB Limit (mW/g)	Limit (mW/g)
1013	824.70	0.086	0.000	0.086	0.80	1.6
384	836.52	0.097	0.000	0.097	0.80	1.6
777	848.31	0.093	-0.055	0.094	0.80	1.6
384 [4)]	836.52	0.100	-0.121	**0.103**	0.80	1.6
384 [5)]	836.52	0.099	-0.106	0.102	0.80	1.6
CDMA PCS band						
Channel	f (MHz)	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	3 dB Limit (mW/g)	Limit (mW/g)
25	1851.25	0.107	0.000	0.107	0.80	1.6
600	1880.00	0.110	-0.100	0.113	0.80	1.6
1175	1908.75	0.111	-0.129	0.114	0.80	1.6
1175 [4)]	1908.75	0.111	-0.132	0.114	0.80	1.6
1175 [5)]	1908.75	0.110	-0.184	**0.115**	0.80	1.6

Notes:

1) The exact method of extrapolation is *measured SAR x 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.
4) Co-location with WLAN Gwinnet, FCC ID: PPD-AR5BXB6
5) Co-location with WLAN Golan, FCC ID: PD9LEN3945ABG

9.2 15” LENOVO D-NOTE



CDMA Cell band						
Channel	f (MHz)	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	3 dB Limit (mW/g)	Limit (mW/g)
1013	824.70					
384	836.52	0.051	-0.031	0.052	0.80	1.6
777	848.31					
384 [4)]	836.52	0.056	0.000	0.056	0.80	1.6
384 [5)]	836.52	0.051	-0.139	0.053	0.80	1.6
CDMA PCS band						
Channel	f (MHz)	Measured 1g (mW/g)	Power Drift (dBm)	Extrapolated 1g (mW/g)	3 dB Limit (mW/g)	Limit (mW/g)
25	1851.25					
600	1880.00					
1175	1908.75	0.0213	0.000	0.0213	0.80	1.6
1175 [4)]	1908.75	0.0230	0.000	0.0230	0.80	1.6
1175 [5)]	1908.75	0.0225	0.000	0.0225	0.80	1.6

Notes:

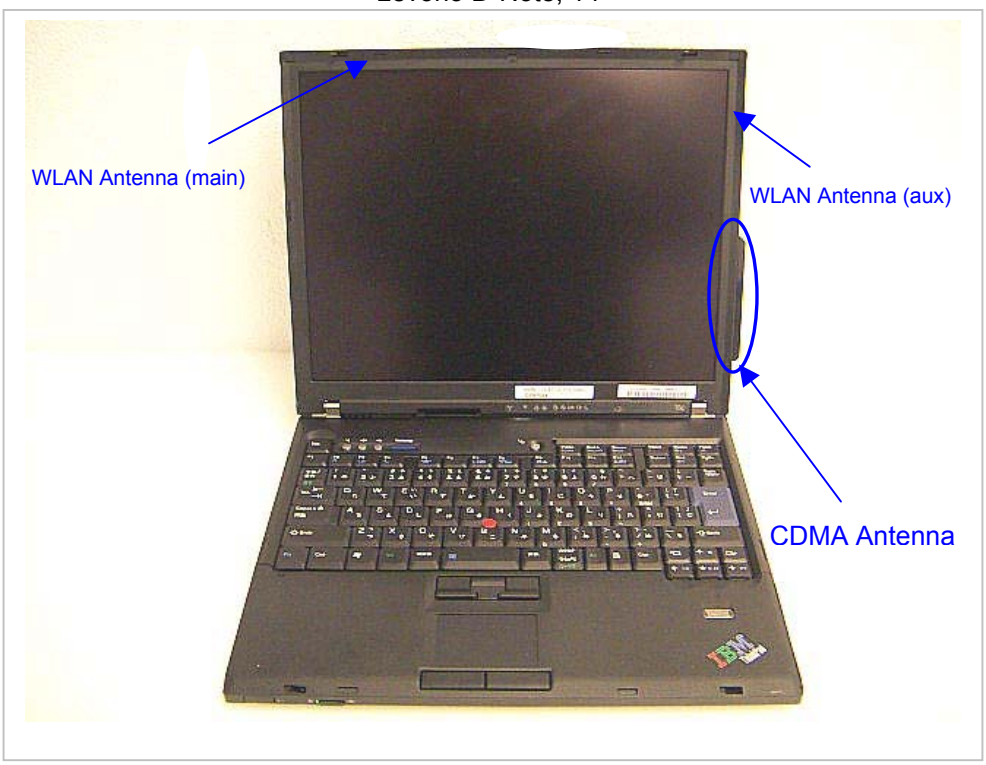
1) The exact method of extrapolation is *measured SAR x 10^(-drift/10)*. The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2) Spot check test performed on the 15” laptop based on the HIGHEST SAR measurements from 14” laptop for each band.
3) Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.
4) Co-location with WLAN Gwinnet, FCC ID: PPD-AR5BXB6
5) Co-location with WLAN Golan, FCC ID: PD9LEN3945ABG

10 PHOTO

10.1 EUT

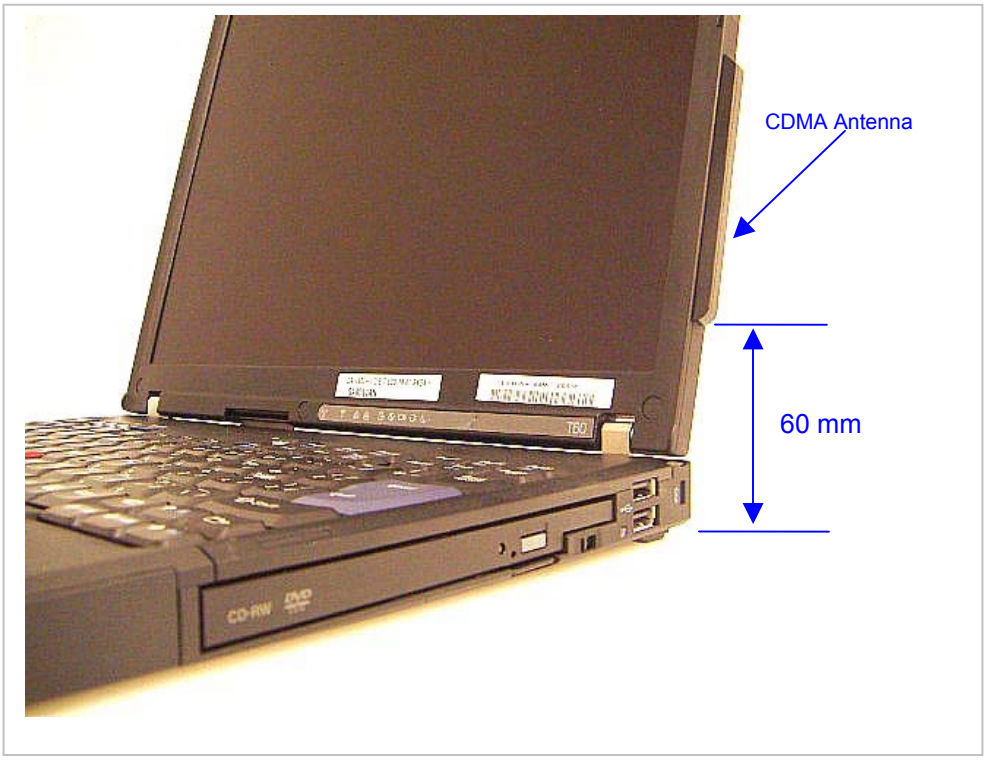
10.2 HOST DEVICE

Levono D-Note, 14”



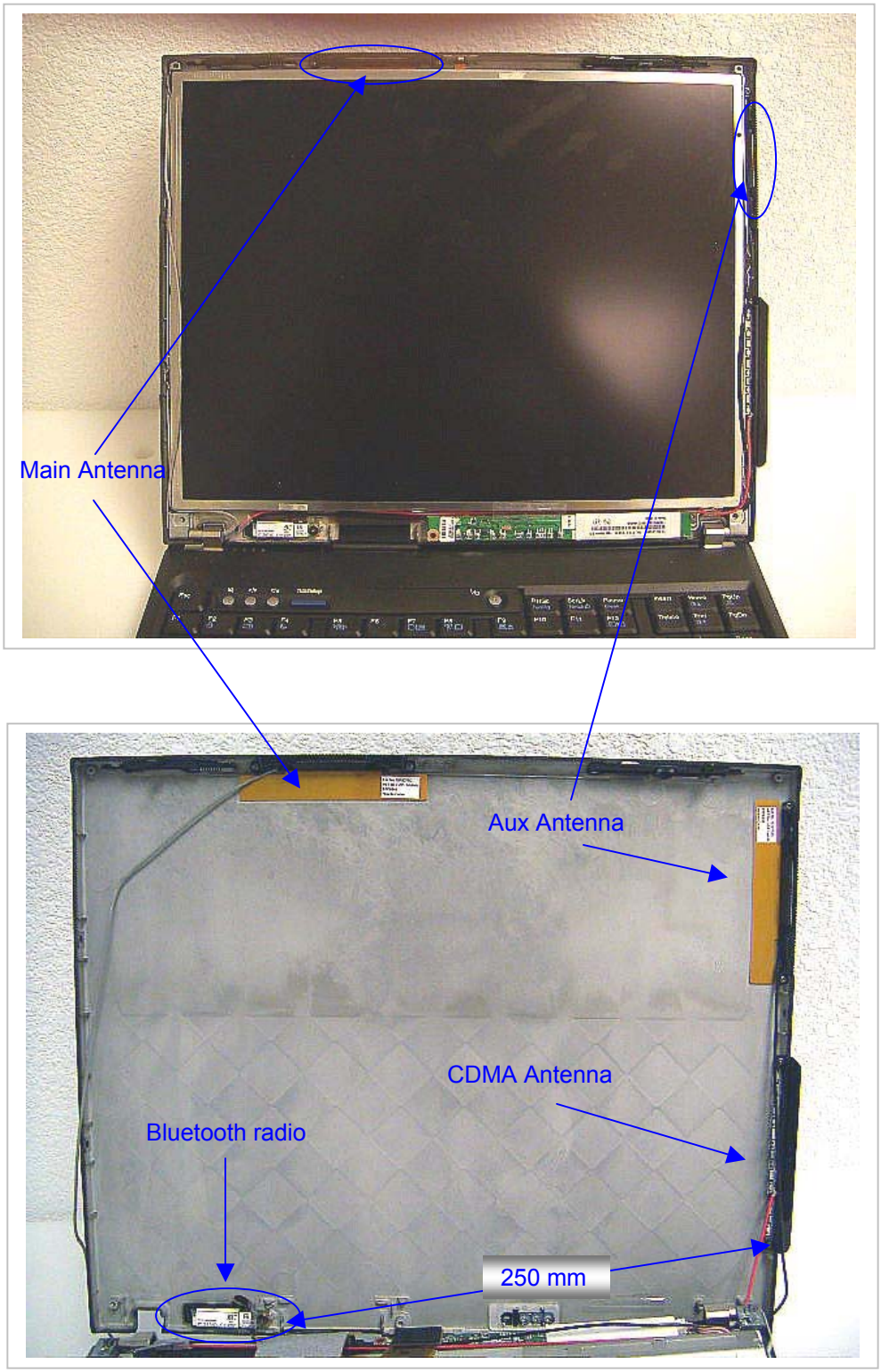
Levono D-Note, 15”

Levono D-Note, 14”

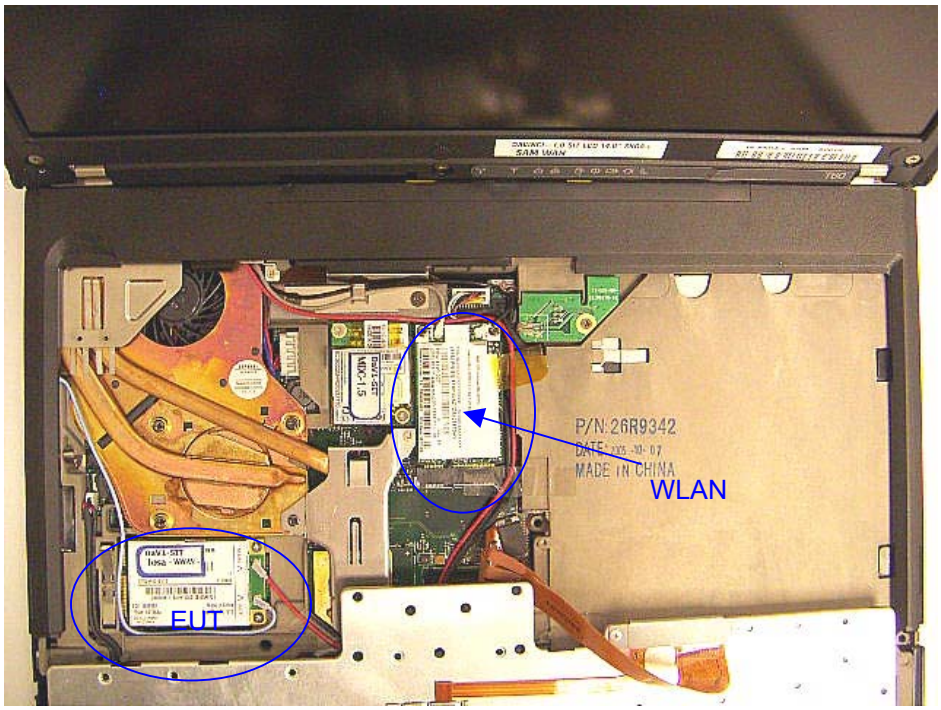


Levono D-Note 15”

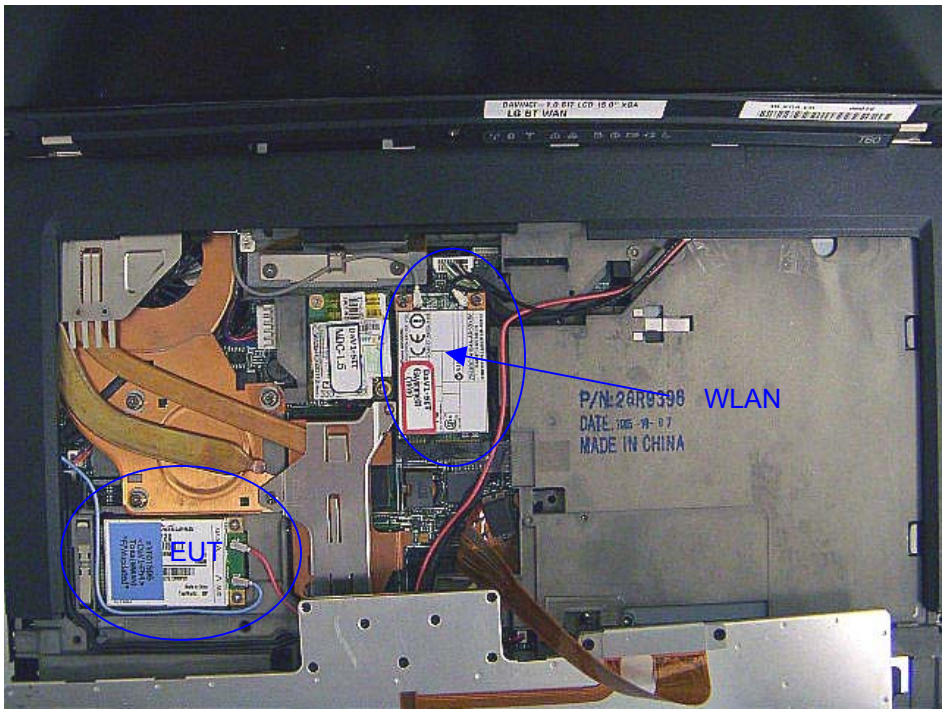
Levono D-Note 14”



Levono D-Note, 14”



Levono D-Note, 15”



11 MEASUREMENT UNCERTAINTY

11.1 MEASUREMENT UNCERTAINTY FOR 300 MHZ – 3GHZ

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 Mechnical 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	10.49
Expanded Uncertainty (95% Confidence Interval)			K=2			22.87	20.98

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

11.2 MEASUREMENT UNCERTAINTY 3 GHZ – 6 GHZ

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	3.00	R	1.732	1	1	1.73	1.73
RF Ambient Conditions - Reflections	3.00	R	1.732	1	1	1.73	1.73
Probe Positioner Mechnical 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			11.66	10.73
Expanded Uncertainty (95% Confidence Interval)			K=2			23.32	21.46

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

12 TEST EQUIPMENT LIST

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date
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	2/9/07
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
E-Field Probe	SPEAG	EX3DV3	3531	7/21/06
E-Field Probe	SPEAG	EX3DV4	3552	3/19/06
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	D835V2	4d002	2/11/06
System Validation Dipole	SPEAG	D1900V2	5d043	2/16/06
System Validation Dipole	SPEAG	D2000V2	1016	8/29/2007
System Validation Dipole	SPEAG	D2450V2	748	5/14/06
Signal General	R&H	SMP 04	DE34210	6/2/06
Power Meter	Giga-tronics	8651A	8651404	12/27/06
Power Sensor	Giga-tronics	80701A	1834588	12/27/07
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
Simulating Liquid	CCS	M835	N/A	Within 24 hrs of first test
Simulating Liquid	CCS	M1900	N/A	Within 24 hrs of first test

13 ATTACHMENT

No.	Contents	No. of page (s)
1	System Performance Check Plot	12
2_1	SAR Test Plot - 14” laptop	12
2_2	SAR Test Plot - 15” laptop	8
3	Certificate of E-filed Probe EX3DV4 SN 3531	10
4	Certificate of System Validation Dipole D835V2 SN 4d002	6
5	Certificate of System Validation Dipole D1900V2 SN 5d043	6

END OF REPORT