SAR EVALUATION REPORT

For

Ingenico Canada Ltd.

79 Torbarrie Road, Toronto
Ontario M3L 1G5, Canada

FCC ID: O34-E790CDMA

2004-02-12

This Report Concerns:	**Equipment Type:**
☒ Original Report	Wireless Point of Sale Terminal

Test Engineer:	Eric Hong
Report No.:	R0312229S
Test Date:	2004-01-23
Reviewed By:	Hans Mellberg
Prepared By:	Bay Area Compliance Laboratory Corporation 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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SUMMARY

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1].

The 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.

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.

There was no SAR of any concern measured on the device for any of the investigated configurations.

1 - REFERENCE

[1] Federal Communications Commission, \Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.

[2] David L. Means Kwok Chan, Robert F. Cleveland, \Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, O_ce of Engineering & Technology, Washington, DC, 1997.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-_eld scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.

[4] Niels Kuster, Ralph K.astle, and Thomas Schmid, \Dosimetric evaluation of mobile communications equipment with known precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp. 645{652, May 1997.

[5] CENELEC, \Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.

[6] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.

[7] Katja Pokovic, Thomas Schmid, and Niels Kuster, \Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM _ 97, Dubrovnik, October 15{17, 1997, pp. 120-24.

[8] Katja Pokovic, Thomas Schmid, and Niels Kuster, \E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23{25 June, 1996, pp. 172-175.

[9] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard K. uhn, and Niels Kuster, \The depen-dence of EM energy absorption upon human head modeling at 900 MHz", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1865-1873, Oct. 1996.

[10] Klaus Meier, Ralf Kastle, Volker Hombach, Roger Tay, and Niels Kuster, \The dependence of EM energy absorption upon human head modeling at 1800 MHz", IEEE Transactions on Microwave Theory and Techniques, Oct. 1997, in press.

[11] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.

[12] W. H. Press, S. A. Teukolsky,W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.Dosimetric Evaluation of Sample device, month 1998 9

[13] NIS81 NAMAS, \The treatment of uncertainity in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddington, Middlesex, England, 1994.

[14] Barry N. Taylor and Christ E. Kuyatt, \Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994. Dosimetric Evaluation of Sample device, month 1998 10

2 - TESTING EQUIPMENT

2.1 Equipments List & Calibration Info

Type / Model	Cal. Date	S/N:
DASY3 Professional Dosimetric System	N/A	N/A
Robot RX60L	N/A	F00/5H31A1/A/01
Robot Controller	N/A	F01/5J72A1/A/01
Dell Computer Optiplex GX110	N/A	N/A
Pentium III, Windows NT	N/A	N/A
SPEAG EDC3	N/A	N/A
SPEAG DAE3	08/26/02	456
SPEAG E-Field Probe ET3DV6	08/26/02	1604
SPEAG Dummy Probe	N/A	N/A
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
SPEAG Validation Dipole D-1800-S-2	11/6/01	BCL-049
SPEAG Validation Dipole D900V2	9/3/02	122
Brain Equivalent Matter (800MHz)	Daily	N/A
Brain Equivalent Matter (1900MHz)	Daily	N/A
Muscle Equivalent Matter (800MHz)	Daily	N/A
Muscle Equivalent Matter (1900MHz)	Daily	N/A
Robot Table	N/A	N/A
Phone Holder	N/A	N/A
Phantom Cover	N/A	N/A
HP Spectrum Analyzer HP8593GM	6/20/02	3009A00791
Microwave Amp. 8349B	N/A	2644A02662
Power Meter HP436A	4/2/02	2709A29209
Power Sensor HP8482A	4/2/02	2349A08568
Signal Generator RS SMIQ O3	2/10/02	1084800403
Network Analyzer HP-8753ES	7/30/02	820079
Dielectric Probe Kit HP85070A	N/A	N/A
Hewlett Packard HP8566B Spectrum Analyzer	7/23/02	None
Hewlett Packard HP 7470A Plotter	7/23/02	None
A.H. System SAS0200 Horn Antenna	7/23/02	None
Com-Power AB-100 Dipole Antenna	7/23/02	None
Agilent E4419b	4/8/02	GB40202891
Agilent E4412a	4/8/02	US38486529

2.2 Equipment Calibration Certificate

Please see the attached file for detailed information.

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1604**
Place of Calibration:	**Zurich**
Date of Calibration:	**August 26, 2002**
Calibration Interval	**12 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by	N. Vetter
Approved by	[signature]

ET3DV6 SN:1604

August 26, 2002

DASY3 - Parameters of Probe: ET3DV6 SN:1604

Sensitivity in Free Space

NormX	1.73 $\mu V/(V/m)^2$
NormY	1.68 $\mu V/(V/m)^2$
NormZ	1.72 $\mu V/(V/m)^2$

Diode Compression

DCP X	93	mV
DCP Y	93	mV
DCP Z	93	mV

Sensitivity in Tissue Simulating Liquid

Head	900 MHz	ε_r = 41.5 ± 5%	σ = 0.97 ± 5% mho/m
Head	835 MHz	ε_r = 41.5 ± 5%	σ = 0.90 ± 5% mho/m

ConvF X	6.5	± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.5	± 9.5% (k=2)	Alpha	0.36
ConvF Z	6.5	± 9.5% (k=2)	Depth	2.82

Head	1800 MHz	ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m
Head	1900 MHz	ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m

ConvF X	5.5	± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.5	± 9.5% (k=2)	Alpha	0.50
ConvF Z	5.5	± 9.5% (k=2)	Depth	2.46

Boundary Effect

Head **900 MHz** **Typical SAR gradient: 5 % per mm**

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	11.1	6.6
SAR_{be} [%]	With Correction Algorithm	0.4	

Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	12.3	8.1
SAR_{be} [%]	With Correction Algorithm	0.1	0.1

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.3 ± 0.2	mm

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

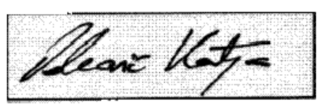
Additional Conversion Factors

for Dosimetric E-Field Probe

Type	ET3DV6
Serial Number:	1604
Place of Assessment	Zurich
Date of Assessment:	October 4, 2002
Probe Calibration Date	August 26, 2002

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by



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Conversion factor (± standard deviation)

835 MHz	**ConvF**	**6.4 ± 8%**	ε_r = 55.2 ± 5% σ = 0.97 ± 5% mho/m (body tissue)
1900 MHz	**ConvF**	**4.9 ± 8%**	ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m (body tissue)

1900MHz Body Liquid Validation

frequency	e'	e'
1850000000.0000	52.9519	14.2863
1852000000.0000	52.9308	14.2630
1854000000.0000	52.9296	14.2410
1856000000.0000	52.9333	14.2758
1858000000.0000	52.9170	14.2733
1860000000.0000	52.8914	14.2566
1862000000.0000	52.9252	14.2445
1864000000.0000	52.8860	14.2776
1866000000.0000	52.9179	14.2756
1868000000.0000	52.8984	14.2971
1870000000.0000	52.9157	14.2732
1872000000.0000	52.8331	14.2813
1874000000.0000	52.8921	14.3065
1876000000.0000	52.9152	14.3278
1878000000.0000	52.9181	14.2851
1880000000.0000	52.9137	14.2886
1882000000.0000	52.9463	14.2819
1884000000.0000	52.9510	14.2721
1886000000.0000	52.8984	14.2852
1888000000.0000	52.9278	14.2831
1890000000.0000	52.9148	14.2845
1892000000.0000	52.9431	14.3021
1894000000.0000	52.9250	14.2985
1896000000.0000	52.9269	14.2831
1898000000.0000	52.8784	14.2463
1900000000.0000	52.8856	14.2724
1902000000.0000	52.9100	14.2631
1904000000.0000	52.8856	14.2478
1906000000.0000	52.8911	14.2287
1908000000.0000	52.8498	14.2295
1910000000.0000	52.8434	14.1959
1912000000.0000	52.8574	14.2013
1914000000.0000	52.8318	14.1922
1916000000.0000	52.8498	14.1837
1918000000.0000	52.8266	14.1383
1920000000.0000	52.7568	14.1181
1922000000.0000	52.7801	14.1272
1924000000.0000	52.7627	14.1824
1926000000.0000	52.7068	14.1935
1928000000.0000	52.6785	14.1971
1930000000.0000	52.6779	14.1853
1932000000.0000	52.6763	14.1729
1934000000.0000	52.6550	14.1617
1936000000.0000	52.6556	14.1594
1938000000.0000	52.5905	14.0429
1940000000.0000	52.5423	14.0262
1942000000.0000	52.5013	13.9917
1944000000.0000	52.4929	13.9824
1946000000.0000	52.4407	13.9803
1948000000.0000	52.4526	14.0119
1950000000.0000	52.4309	14.0327

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\,\pi f\, \varepsilon_o\, \varepsilon''=1.5086$

where $f = 1900x\ 10^6$

$\varepsilon_o = 8.854\ x\ 10^{-12}$

$\varepsilon'' = 14.2724$

1900MHz Head Liquid Validation

frequency	e'	e''
1850000000.0000	40.1734	14.1437
1852000000.0000	40.1353	14.1634
1854000000.0000	40.1375	14.1792
1856000000.0000	40.0481	14.1671
1858000000.0000	39.9532	14.0244
1860000000.0000	39.8446	13.9733
1862000000.0000	39.7627	13.9445
1864000000.0000	39.7269	13.9117
1866000000.0000	39.7585	13.9385
1868000000.0000	39.7879	13.9618
1870000000.0000	39.8043	13.9595
1872000000.0000	39.7896	13.9958
1874000000.0000	39.8352	13.9733
1876000000.0000	39.8541	13.8286
1878000000.0000	39.8757	13.8191
1880000000.0000	39.8466	13.8447
1882000000.0000	39.8192	13.8438
1884000000.0000	39.8024	13.8445
1886000000.0000	39.8128	13.8382
1888000000.0000	39.7869	13.8357
1890000000.0000	39.8152	13.8534
1892000000.0000	39.8043	13.8887
1894000000.0000	39.8037	13.8679
1896000000.0000	39.7855	13.8588
1898000000.0000	39.7881	13.8373
1900000000.0000	39.7626	13.8024
1902000000.0000	39.7512	13.9136
1904000000.0000	39.7781	13.9485
1906000000.0000	39.8010	14.0622
1908000000.0000	39.7593	14.0654
1910000000.0000	39.7622	14.1762
1912000000.0000	39.7634	14.1639
1914000000.0000	39.7147	14.1583
1916000000.0000	39.7259	14.1564
1918000000.0000	39.7421	14.1761
1920000000.0000	39.7188	14.1738
1922000000.0000	39.7372	14.1712
1924000000.0000	39.7182	14.2254
1926000000.0000	39.7431	14.1994
1928000000.0000	39.7325	14.2454
1930000000.0000	39.7358	14.2486
1932000000.0000	39.7633	14.2981
1934000000.0000	39.7584	14.2765
1936000000.0000	39.8016	14.3142
1938000000.0000	39.7721	14.3287
1940000000.0000	39.7282	14.2796
1942000000.0000	39.7425	14.2974
1944000000.0000	39.7419	14.3118
1946000000.0000	39.7513	14.3522
1948000000.0000	39.7272	14.3718
1950000000.0000	39.7415	14.3857

$\sigma = \omega\,\varepsilon_o\,\varepsilon'' = 2\,\pi f\,\varepsilon_o\,\varepsilon''=1.4589$

where $f = 1900 \times 10^{6}$

$\varepsilon_o = 8.854 \times 10^{-12}$

$\varepsilon'' = 13.8024$

3 - EUT DESCRIPTION

Applicant:	Ingenico Canada Ltd.
Product Description:	Wireless Point of Sale Terminal
Product Model Number:	Elite 790 CDMA
FCC ID:	O34-E790CDMA
Serial Number:	34600341-00300013
Maximum RF Output Power:	23.83 dBm
RF Exposure environment:	General Population/Uncontrolled
Applicable Standard	FCC CFR 47, Part 24
Application Type:	Certification

4 - SYSTEM TEST CONFIGURATION

4.1 Justification

The system was configured for testing in a typical fashion (as normally used by a typical user).

4.2 EUT Exercise Procedure

The EUT exercising program used during SAR testing was designed to exercise the various system components in a manner similar to a typical use. The EUT was tested by pushing the PTT bottom during the testing.

4.3 Equipment Modifications

No modification(s) were made to ensure that the EUT complies with the applicable limits.

5 – CONDUCTED OUTPUT POWER MEASUREMENTS

5.1 Provision Applicable

According to §15.247(b) (3), for systems using digital modulation, the maximum peak output power of the intentional radiator shall not exceed 1 Watt.

According to FCC §22.913 (a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts. According to FCC § 24.232(b), EIRP peak power for mobile/portable stations are limited to 2 watts.

5.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

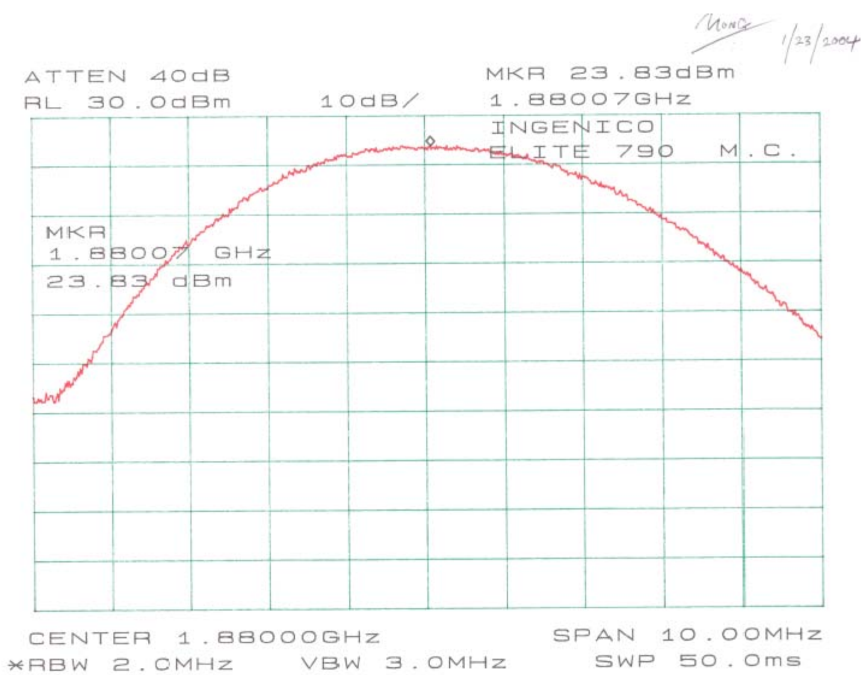
5.3 Test equipment

Hewlett Packard HP8564E Spectrum Analyzer, Calibration Due Date: 2003-08-01.
Hewlett Packard HP 7470A Plotter, Calibration not required.
A.H. Systems SAS200 Horn Antenna, Calibration Due Date: 2003-05-31
Com-Power AB-100 Dipole Antenna, Calibration Due Date: 2003-09-05

5.4 Test Results

Channel	Frequency (MHz)	Output Power in dBm	Output Power in W	Limit (W)
Middle	1880.00	23.83	0.242	7

Please refer to the following plots.



6 - DOSIMETRIC ASSESSMENT SETUP

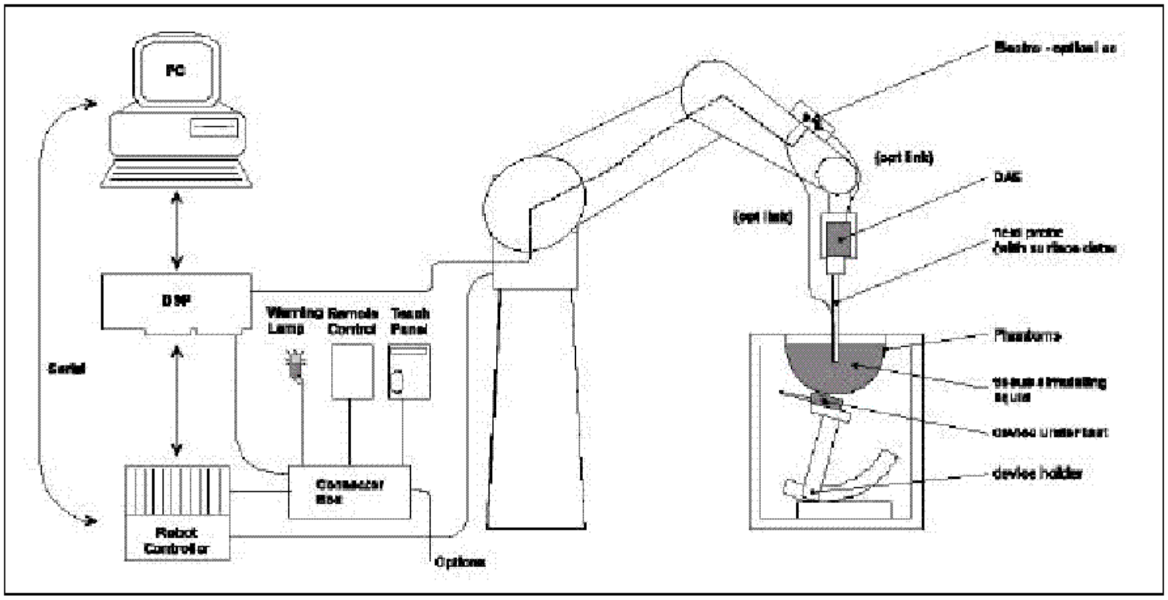
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.02mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The system is described in detail in [3].

The SAR measurements were conducted with the dosimetric probe ET3DV6 SN: 1577 (manufactured by SPEAG), designed in the classical triangular configuration [3] and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure described in [8] and found to be better than ±0.25dB.

The phantom used was the \Generic Twin Phantom" described in [4]. The ear was simulated as a spacer of 4 mm thickness between the earpiece of the phone and the tissue simulating liquid. The Tissue simulation liquid used for each test is in according with the FCC OET65 supplement C as listed below.

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

6.1 Measurement System Diagram

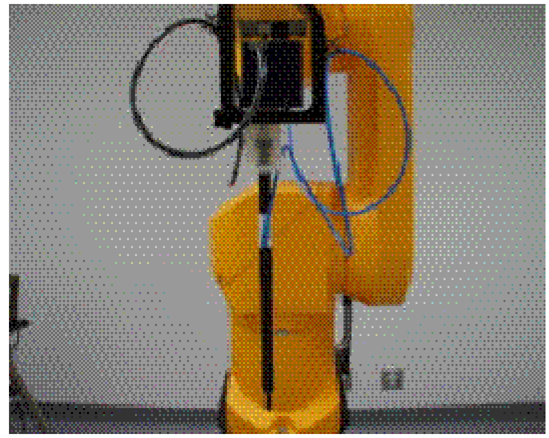


The DASY3 system for performing compliance tests consist of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
2. An arm extension for accommodating the data acquisition electronics (DAE).
3. 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.
4. A data acquisition electronic (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.
5. A unit to operate the optical surface detector, which is connected to the EOC. The Electro-optical coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the PC plug-in card. The functions of the PC plug-in card based on a DSP is to perform the time critical task such as signal filtering, surveillance of the robot operation fast movement interrupts.
6. A computer operating Windows 95 or larger
7. DASY3 software
8. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld EUT.
11. Tissue simulating liquid mixed according to the given recipes (see Application Note).
12. System validation dipoles to validate the proper functioning of the system.

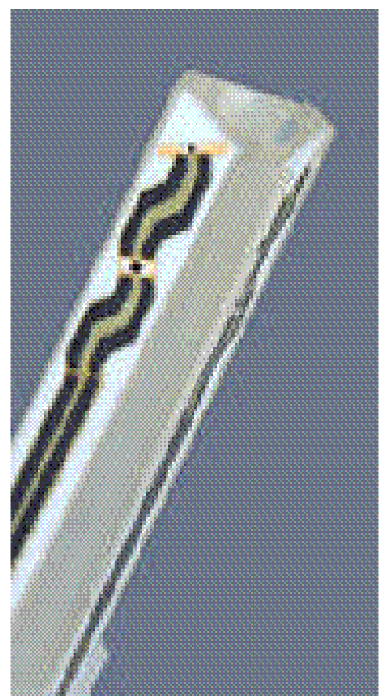
6.2. System Components

ET3DV6 Probe Specification



Photograph of the probe

Construction Symmetrical design with triangular core
Built-in optical fiber for surface detection System
Built-in shielding against static charges
Calibration In air from 10 MHz to 2.5 GHz
In brain and muscle simulating tissue at
Frequencies of 450 MHz, 900 MHz and
1.8 GHz (accuracy ± 8%)
Frequency 10 MHz to > 6 GHz; Linearity: ± 0.2 dB
(30 MHz to 3 GHz)
Directivity ± 0.2 dB in brain tissue (rotation around probe axis)
± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic 5 mW/g to > 100 mW/g;
Range Linearity: ± 0.2 dB
Surface ± 0.2 mm repeatability in air and clear liquids
Detection over diffuse reflecting surfaces.
Dimensions Overall length: 330 mm
Tip length: 16 mm
Body diameter: 12 mm
Tip diameter: 6.8 mm
Distance from probe tip to dipole centers: 2.7 mm
Application General dosimetric up to 3 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms



Inside view of ET3DV6 E-field Probe

The SAR measurements were conducted with the dosimetric probe ET3DV6 designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY3 software reads the reflection during a software approach and looks for the maximum using a 2 nd order fitting. The approach is stopped when reaching the maximum.

E-Field Probe Calibration Process

Each probe is calibrated according to a dosimetric assessment procedure described in [6] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [7] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz, and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

Data Evaluation

The DASY3 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe Parameter:	-Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	-Conversion Factor	ConvFi
	-Diode compression point	Dcp_i
Device parameter:	-Frequency	f
	-Crest Factor	cf
Media parameter:	-Conductivity	σ
	-Density	ρ

These parameters must be set correctly in the software. They can either be found in the component documents or be imported into the software from the configuration files issued for the DASY3 components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$Vi = Ui + (Ui)^2 \, cf / dcp_i$$

With Vi = compensated signal of channel i (i =x, y, z)
Ui = input signal of channel i (i =x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes: $E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$

H-field probes: $H_i = \sqrt{Vi} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$

With Vi = compensated signal of channel i (i =x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i =x, y, z)
μV/ $(V/m)^2$ for E-field probes
ConF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strenggy of channel i in V/m
H_i = diode compression point (DASY parameter)

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \text{Square Root } [(E_x)^2 + (E_y)^2 + (E_z)^2]$$

The primary field data are used to calculate the derived field units.

$$SAR = (E_{tot})^2 \cdot \sigma / (\rho \cdot 1000)$$

With SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

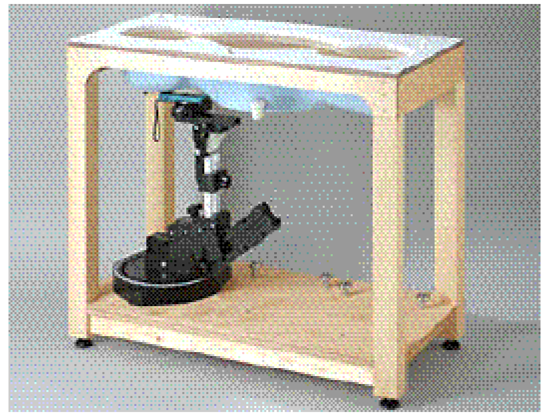
The power flow density is calculated assuming the excitation field as a free space field.

$$P_{pwe} = (E_{tot})^2 / 3770 \text{ or } P_{pwe} = (H_{tot})2 \cdot 37.7$$

With P_{pwe} = equivalent power density of a plane wave in mW/cm3
E_{tot} = total electric filed strength in V/m
H_{tot} = total magnetic filed strength in V/m

Generic Twin Phantom

The Generic Twin Phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [9][10]. 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 the evaporation of the liquid. Reference markings on the Phantom allows the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.
Shell Thickness 2 ± 0.1 mm
Filling Volume Approx. 20 liters
Dimensions 810 x 1000 x 500 mm (H x L x W)

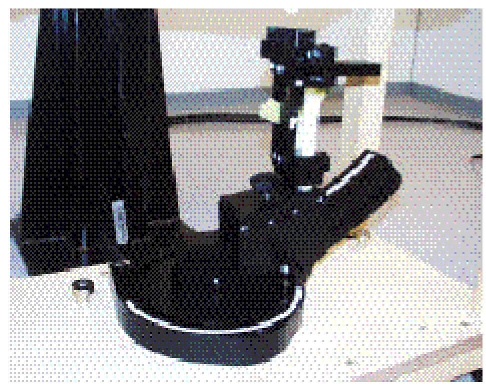


Generic Twin Phantom

Device Holder

In combination with the Generic Twin Phantom V3.0, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations [10]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Device Holder

6.3 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [13] and the NIST1297 [14] documents and is given in the following Table.

Uncertainty Description	Error	Distribution	Weight	Std. Dev.	Offset
Probe Uncertainty					
Axial isotropy	± 0.2 dB	U-shape	0.5	±2.4 %	/
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %	/
Isotropy from gradient	±0.5 dB	U-shape	0	/	/
Spatial resolution	±0.5 %	Normal	1	±0.5 %	/
Linearity error	±0.2 dB	Rectangle	1	±2.7 %	/
Calibration error	±3.3 %	Normal	1	± 3.3 %	/
SAR Evaluation Uncertainty					
Data acquisition error	±1%	Rectangle	1	±0.6 %	/
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %	/
Conductivity assessment	±10 %	Rectangle	1	± 5.8 %	/
Spatial Peak SAR Evaluation Uncertainty					
Extrapol boundary effect	±3%	Normal	1	±3%	± 5%
Probe positioning error	±0.1 mm	Normal	1	± 1%	/
Integrat. and cube orient	±3%	Normal	1	±3%	/
Cube shape inaccuracies	±2%	Rectangle	1	±1.2 %	/
Device positioning	±6%	Normal	1	± 6%	/
Combined Uncertainties	/	/	1	±11.7 %	± 5%
Extended uncertainty (K = 2)	/	/	/	± 23.5 %.	/

7 - EVALUATION PROCEDURE

7.1 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.

Step 2: The SAR distribution at the exposed side of the head was measured at a distance of 3.9 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 20 mm x 20 mm. Based on these data, the area of the maximum absorption was determined by spline interpolation.

Step 3: Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 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 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm [11]. 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 onedimensional splines with the “Not a knot"-condition (in x, y and z-directions) [11], [12]. The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

3. 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.

7.2 Exposure Limits

Table 1: Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.4	8.0	20.0

Table 2: Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.08	1.6	4.0

Note: Whole-body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube SAR for hands, writs, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

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).

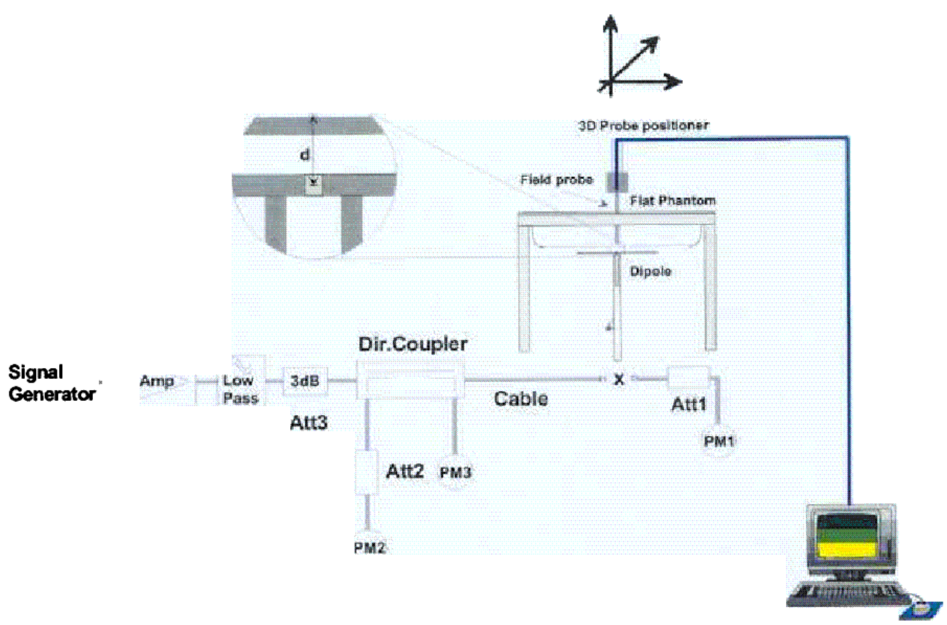
Population/uncontrolled environments Partial-body limit 1.6W/kg applied to the EUT.

7.3 Simulated Tissue Liquid Parameter Confirmation

The dielectric parameters were checked prior to assessment using the HP85070A dielectric probe kit. The dielectric parameters measured are reported in each correspondent section:

7.4 SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First, the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at he dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. after connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM 2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed form the previous value. The reflected power should be 20dB below the forward power.

The SAR measurements were performed in order to achieve repeatability and to establish an average target value.

7.5 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.

IEEE P1528 recommended reference value for head

Frequency (MHz)	1 g SAR	10 g SAR	Local SAR at surface (above feed point)	Local SAR at surface (v=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

Validation Dipole SAR Reference Test Result for Body (1900 MHz)

Validation Measurement	SAR @ 0.126W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.126W Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	3.1	24.61	1.42	11.27
Test 2	3.1	24.61	1.41	11.20
Test 3	3.2	25.41	1.43	11.35
Test 4	3.2	25.41	1.42	11.27
Test 5	3.1	24.61	1.42	11.27
Test 6	3.2	25.61	1.41	11.20
Test 7	3.2	25.61	1.43	11.35
Test 8	3.1	24.61	1.42	11.27
Test 9	3.1	24.61	1.42	11.27
Test 10	3.1	24.61	1.43	11.35
Average	3.14	24.97	1.421	11.28

7.6 Liquid Measurement Result

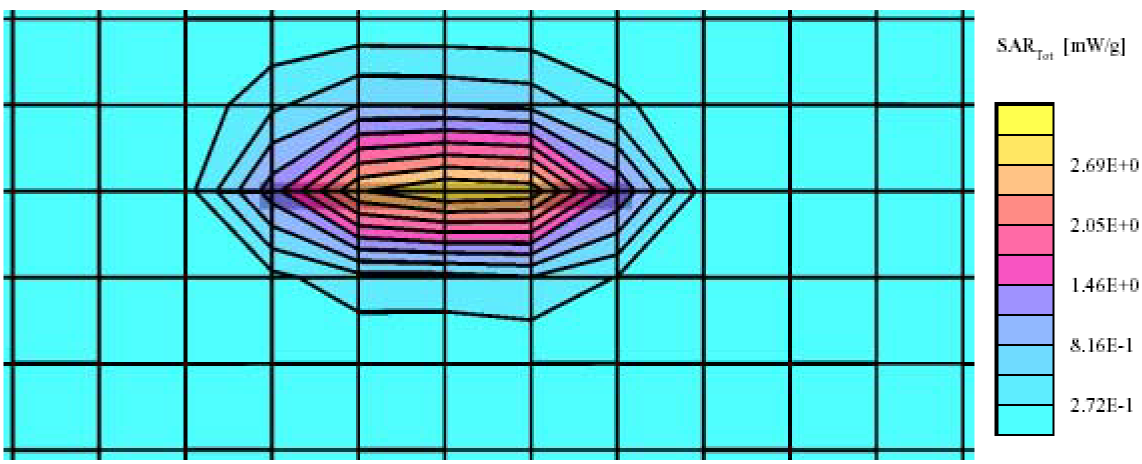
Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation	Limits [%]
Body	1900	ε_r	21.0	54.0	52.9	-2.04	±5
		σ	21.0	1.45	1.51	4.14	±5
		1g SAR	21.0	24.97	24.11	-3.44	±10
Head	1900	ε_r	21.0	39.9	39.8	-0.25	±5
		σ	21.0	1.42	1.46	2.82	±5
		1g SAR	21.0	39.7	38.11	-4.01	±10

ε_r = relative permittivity, σ = conductivity and ρ=1000kg/m^3

Forward Power = 20.21 dBm = 104.95 mW

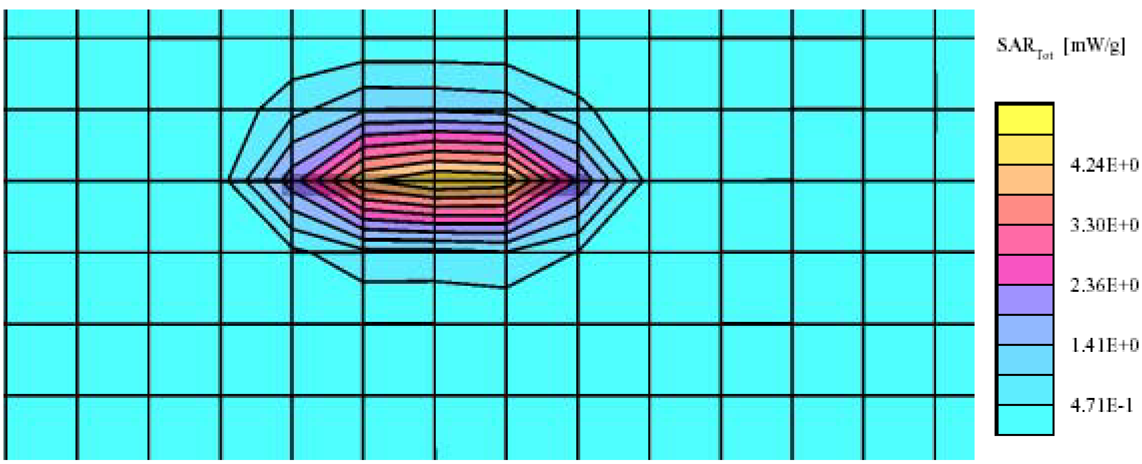
1900 MHz Body Liquid System Validation (Ambient Temp = 22 C, Liquid Temp = 21 C, Forward Power = 20.03 dBm, 1/23/2004)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1900 MHz
Probe: ES3DV2 - SN3019; ConvF(4.60,4.60,4.60); Crest factor: 1.0; Body Liquid 1900 MHz: σ = 1.51 mho/m ε_r = 52.9 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 2.53 mW/g, SAR (10g): 1.11 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.01 dB



1900 MHz Head Liquid System Validation (Ambient Temp = 22 C, Liquid Temp = 21 C, Forward Power = 20.03 dBm, 1/23/2004)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1900 MHz
Probe: ES3DV2 - SN3019; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Head Liquid 1900 MHz: σ = 1.46 mho/m ε_r = 39.8 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 4.00 mW/g, SAR (10g): 1.80 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.01 dB



8 - SAR TEST RESULTS

This page summarizes the results of the performed dosimetric evaluation. The plots with the corresponding SAR distributions, which reveal information about the location of the maximum SAR with respect to the device could be found in the following pages.

8.1 SAR Body and Head Worst-Case Test Data

Ambient Temperature (ºC): 22.0
Relative Humidity (%): 49.3

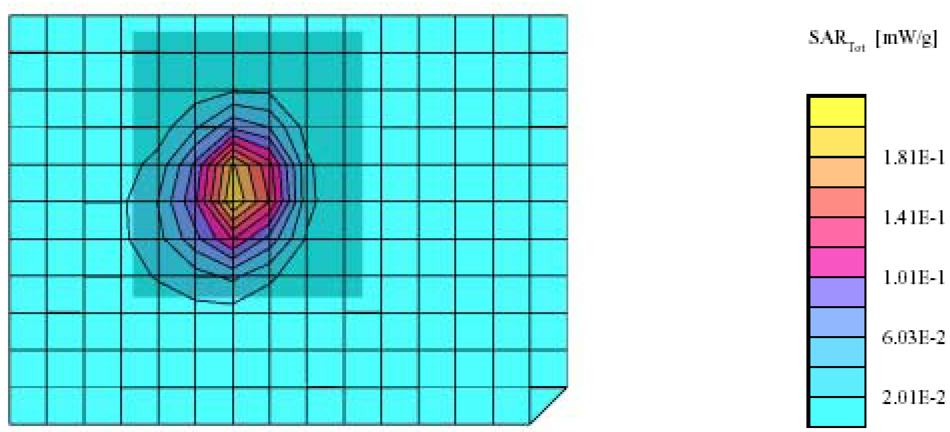
Position	Frequency (MHz)	Output Power (dBm)	Test Type	Liquid	Phantom	Measured (mW/g)	Limit (mW/g)	Plot #
Top Side Touching	1880	23.83	Body worn	Body	Flat	0.208	1.6	1
Back Side Touching						0.222		2
Right Side Touching						0.109		3
Left Side Touching						0.105		4

8.2 Plots of Test Result

The plots of test result were attached as reference.

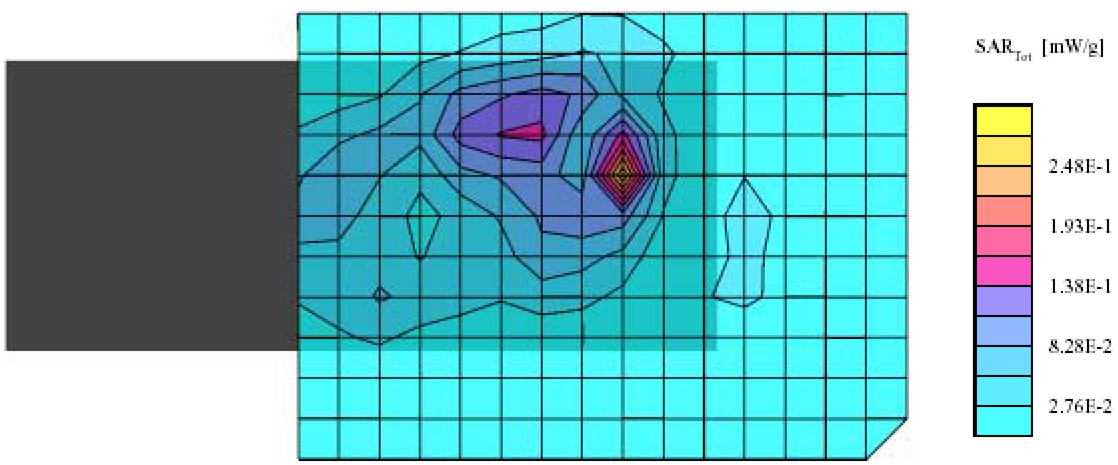
Ingenico, Elite 790 CDMA (Top side in touch to the flat phantom, Ambient Temp = 22 C, Liquid Temp = 21 C, Mid Channel, 1/23/2004)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1880 MHz
Probe: ES3DV2 - SN3019; ConvF(4.60,4.60,4.60); Crest factor: 1.0; Body Liquid 1900 MHz: σ = 1.51 mho/m ε_r = 52.9 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.208 mW/g, SAR (10g): 0.109 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.00 dB



Plot #1

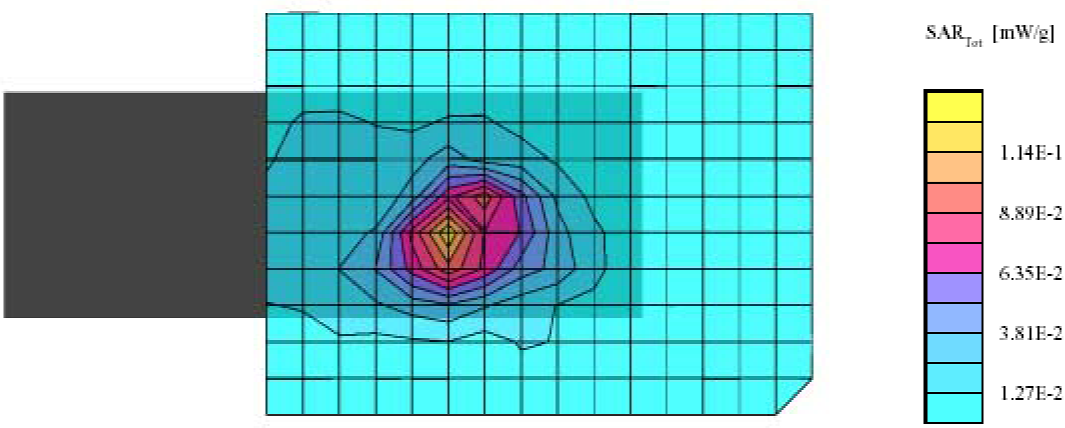
Ingenico, Elite 790 CDMA (Back side in touch to the flat phantom, Ambient Temp = 22 C, Liquid Temp = 21 C, Mid Channel, 1/23/2004)
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1880 MHz
Probe: ES3DV2 - SN3019; ConvF(4.60,4.60,4.60); Crest factor: 1.0; Body Liquid 1900 MHz: σ = 1.51 mho/m ε_r = 52.9 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.222 mW/g, SAR (10g): 0.0857 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.05 dB



Plot #2

Ingenico, Elite 790 CDMA (Right side in touch to the flat phantom, Ambient Temp = 22 C, Liquid Temp = 21 C, Mid Channel, 1/23/2004)

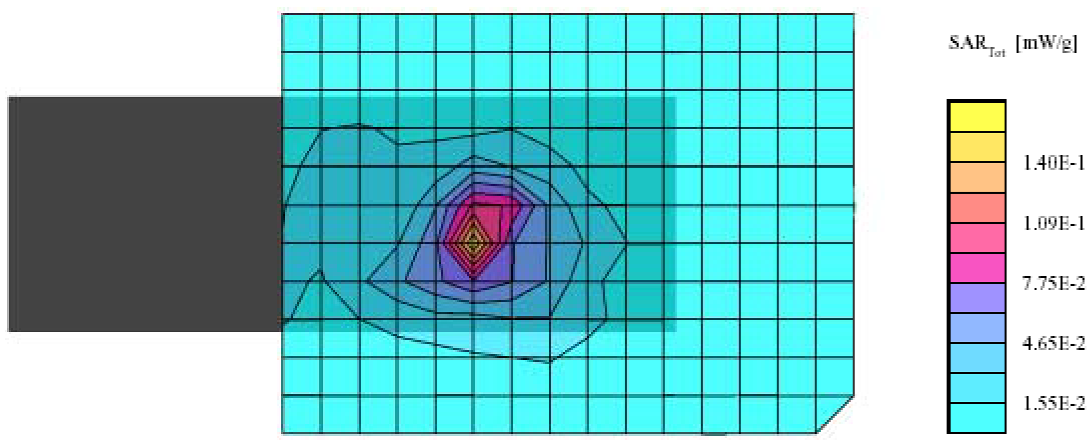
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1880 MHz
Probe: ES3DV2 - SN3019; ConvF(4.60,4.60,4.60); Crest factor: 1.0; Body Liquid 1900 MHz: σ = 1.51 mho/m ε_r = 52.9 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.109 mW/g, SAR (10g): 0.0536 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.02 dB



Plot #3

Ingenico, Elite 790 CDMA (Left side in touch to the flat phantom, Ambient Temp = 22 C, Liquid Temp = 21 C, Mid Channel, 1/23/2004)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1880 MHz
Probe: ES3DV2 - SN3019; ConvF(4.60,4.60,4.60); Crest factor: 1.0; Body Liquid 1900 MHz: σ = 1.51 mho/m ε_r = 52.9 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.105 mW/g, SAR (10g): 0.0566 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.03 dB



Plot #4

EXHIBIT A - SAR SETUP PHOTOGRAPHS

EUT Top Side Touching Flat Phantom

EUT Back Side Touching Flat Phantom

EUT Right Side Touching Flat Phantom

EUT Left Side Touching Flat Phantom

EXHIBIT B – EUT PHOTOGRAPHS

Chassis - Front View

Chassis – Rear View

Chassis – Rear View without Battery

EUT – Base Top View

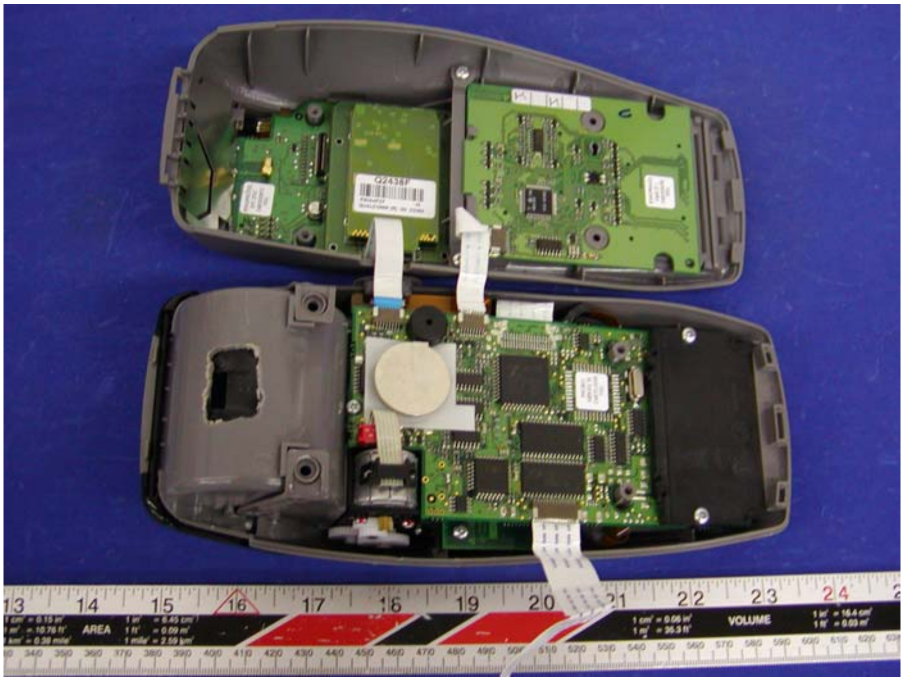
EUT – Base Bottom View

EUT – Base Port View

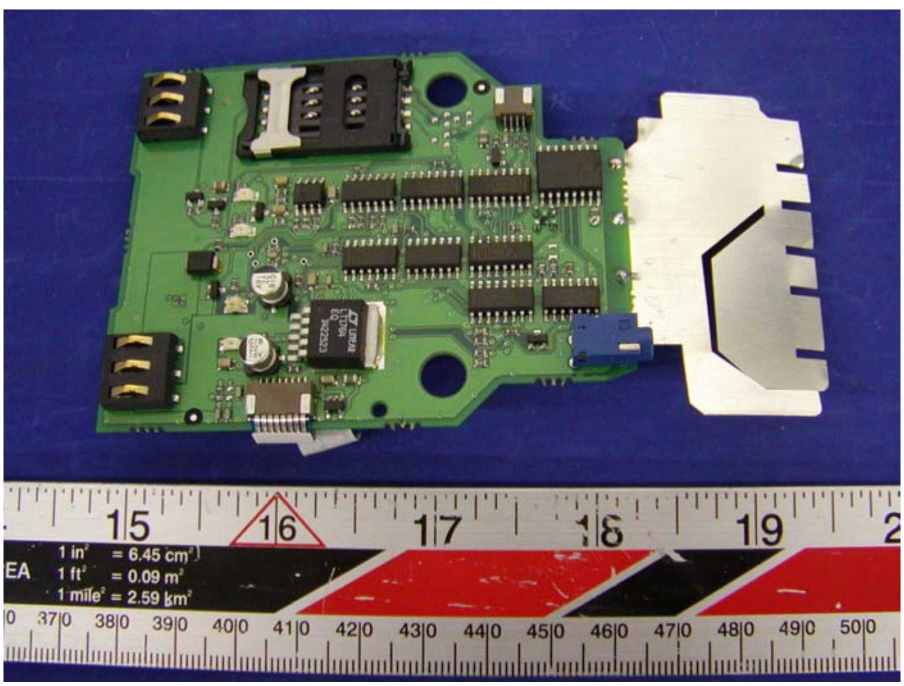
Battery – Top View

Battery – Bottom View

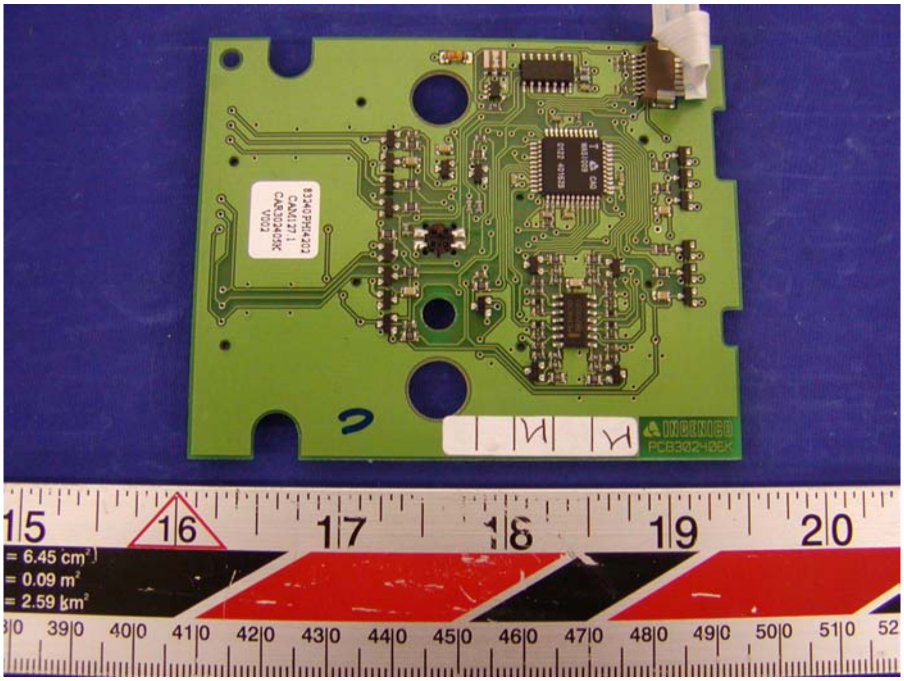
Chassis – Cover off View



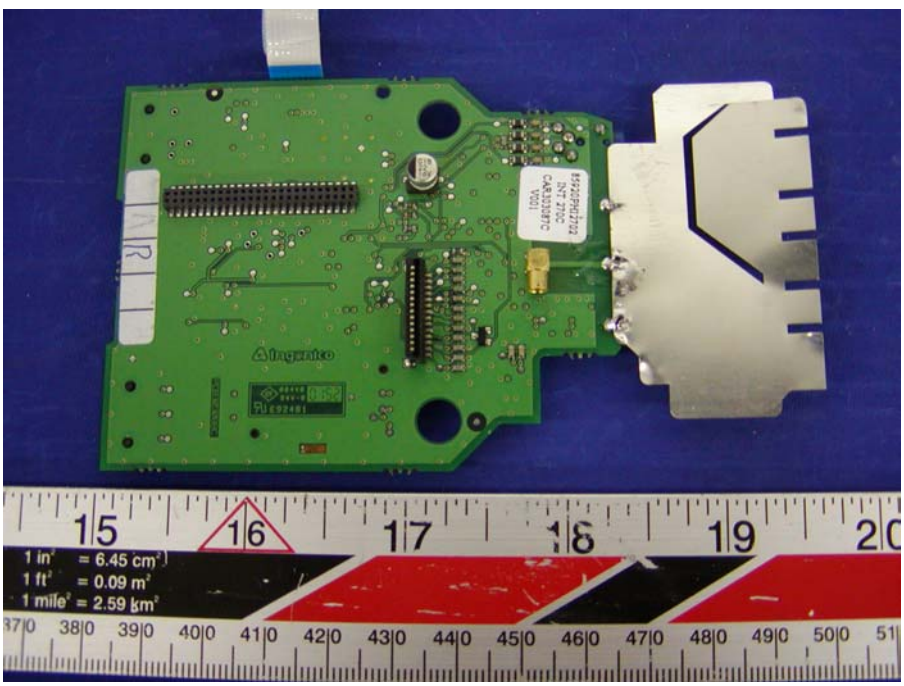
EUT – Component View 1



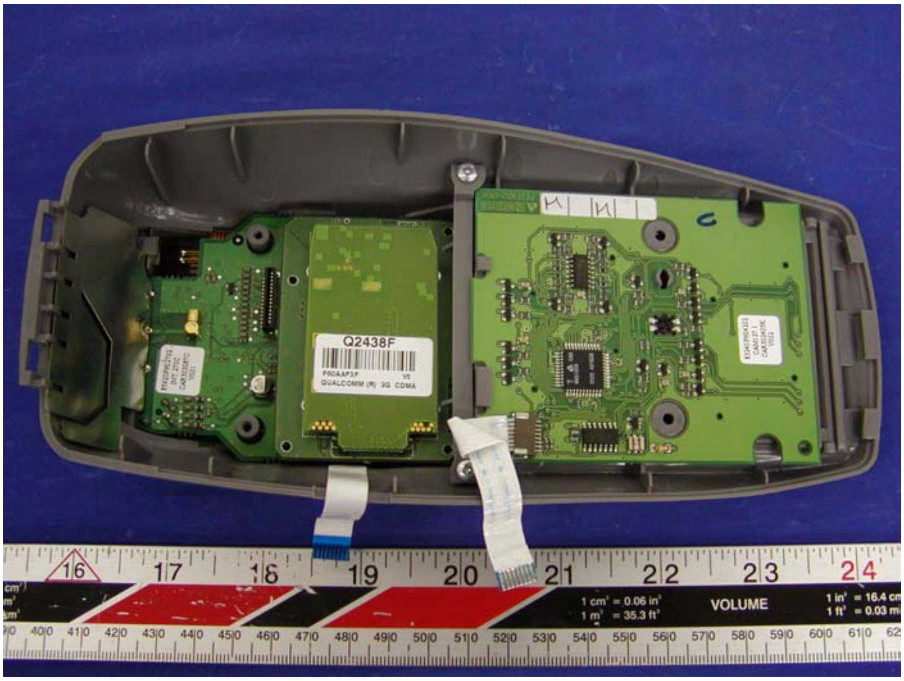
EUT – Component View 2



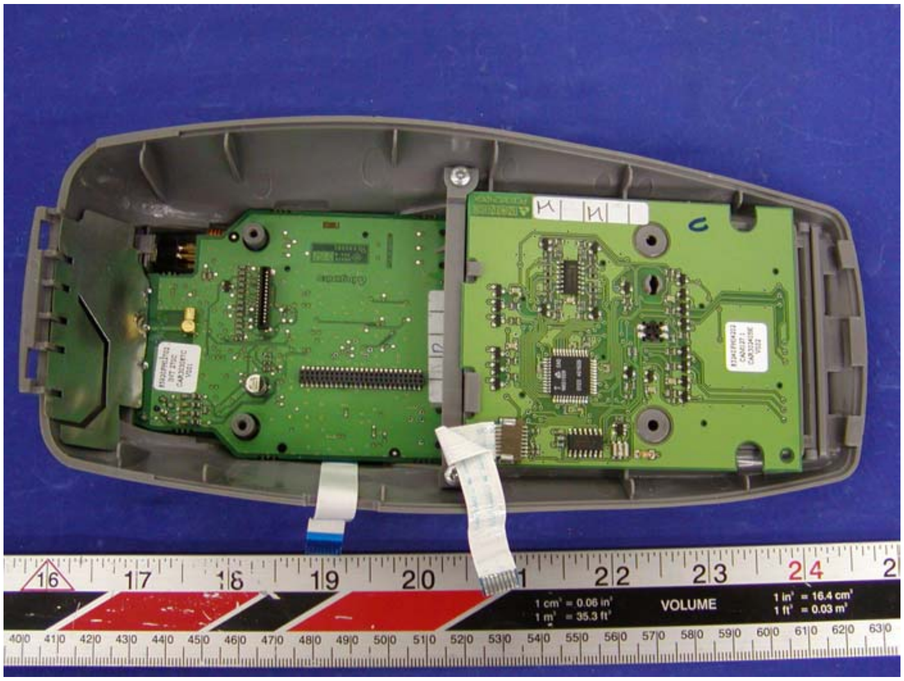
EUT – Solder View



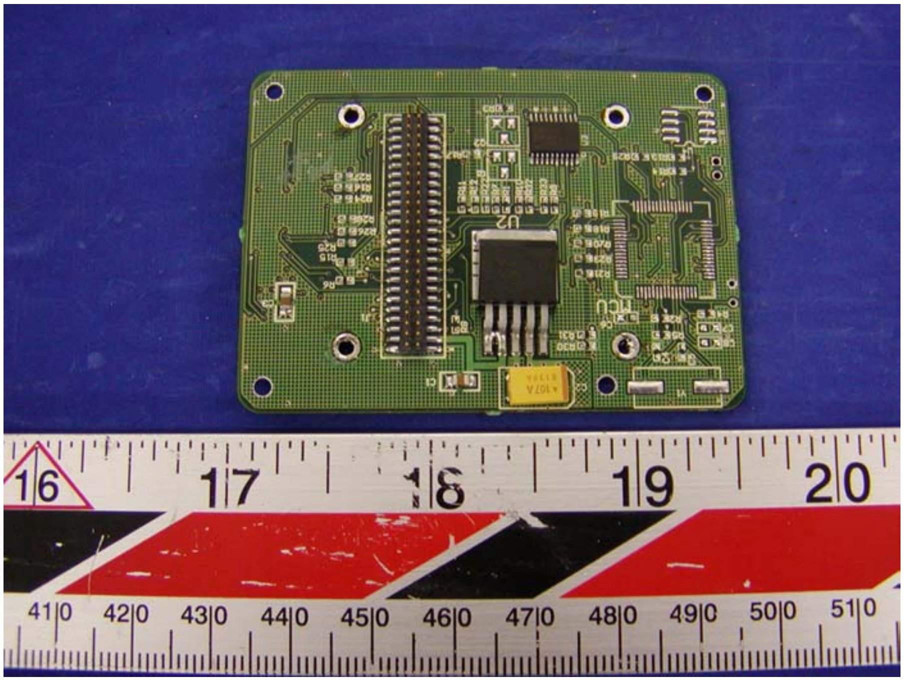
EUT – Solder View with Transceiver



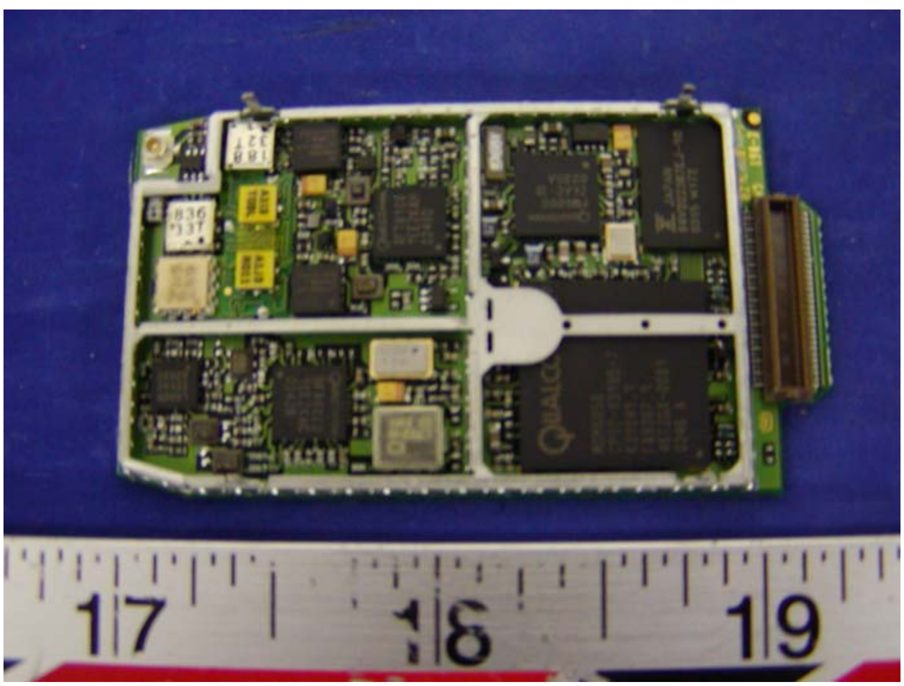
EUT – Solder View without Transceiver



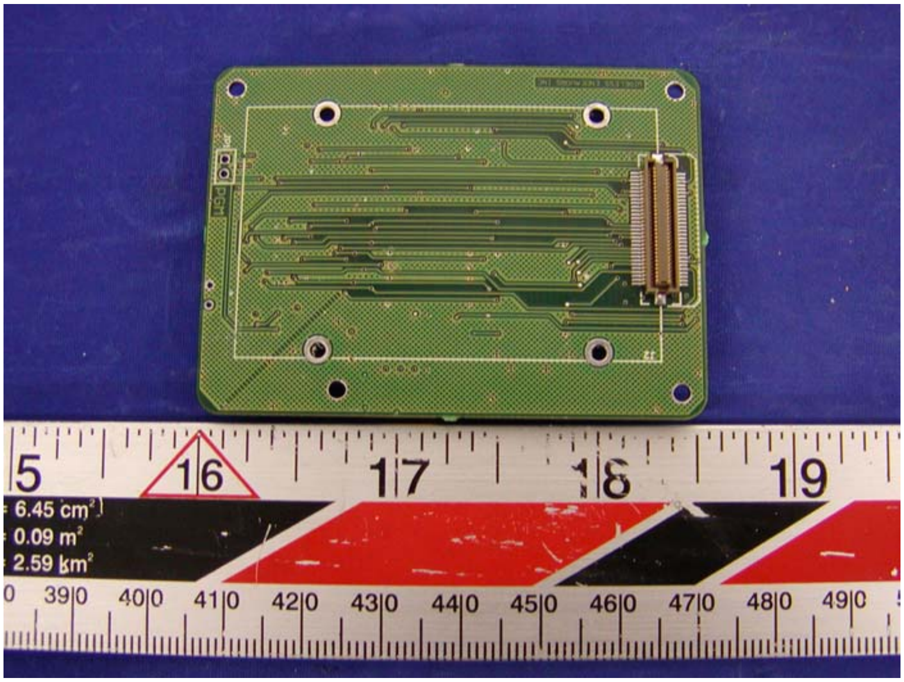
Transceiver – Layer 1 Component View



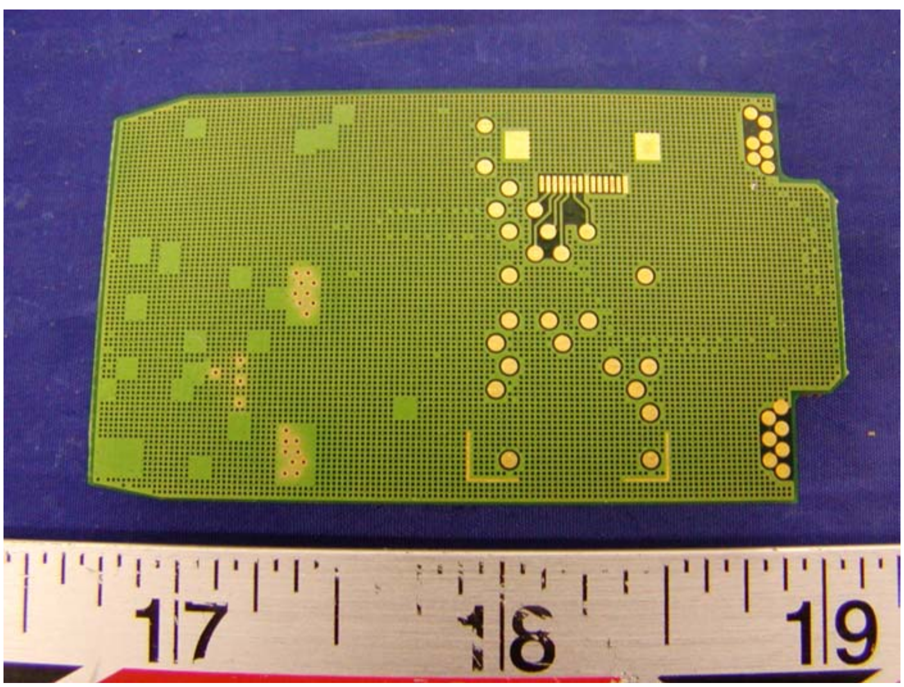
Transceiver – Layer 2 Component View



Transceiver – Layer 1 Solder View



Transceiver – Layer 2 Solder View



Transceiver – Solder View

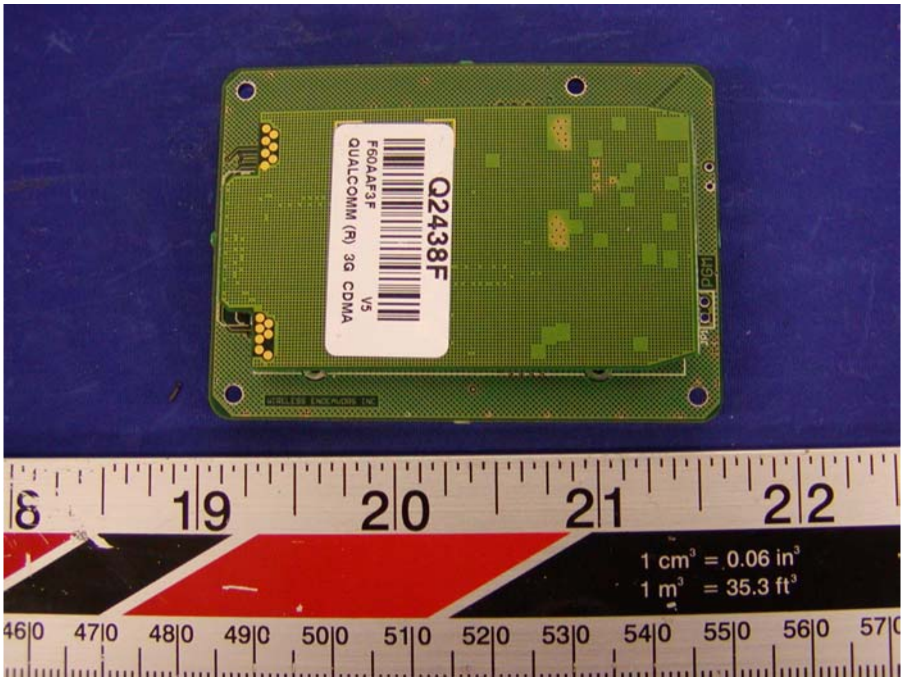


EXHIBIT C – Z-Axis

Ingenico, Elite 790 CDMA (Back side in touch to the flat phantom, Ambient Temp = 22 C, Liquid Temp = 21 C, Mid Channel, 1/23/2004)

SAM Phantom; Section; Position: ; Frequency: 1900 MHz

Probe: ET3DV2 - SN3019; ConvF(4.60,4.60,4.60); Crest factor: 1.0; Body Liquid 1900 MHz: σ = 1.51 mho/m ε_r = 52.9 ρ = 1.00 g/cm³

: , 0

Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 2.0