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SAR Test Report

Report Number: M071031_CERT_MC8781_SAR_GSM-UMTS

Test Sample: Portable Tablet Computer
Radio Modules: WWAN MC8781, WLAN & Bluetooth
Model Number: T2010
Tested For: Fujitsu Australia Pty Ltd
FCC ID: N7NMC8781-F
IC: 2417C-MC8781
Date of Issue: 15th February 2008

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SAR TEST REPORT**Report Number: M071031_CERT_MC8781_SAR_GSM-UMTS****FCC ID: N7NMC8781-F****IC: 2417C-MC8781****1.0 GENERAL INFORMATION**

Test Sample: Portable Tablet Computer
Model Name: T2010
Radio Modules: GSM/UMTS WWAN Module MC8781,
WLAN AR5BXB6 & Bluetooth EYTF3CS FT
Interface Type: Mini-PCI Module
Device Category: Portable Transmitter
Test Device: Pre-Production Unit
FCC ID: N7NMC8781-F
IC: 2417C-MC8781
RF exposure Category: General Population/Uncontrolled
Manufacturer: Fujitsu Limited

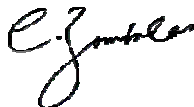
Test Standard/s:

1. Evaluating Compliance with FCC Guidelines For Human Exposure to Radiofrequency Electromagnetic Fields Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01)
2. Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields. RSS-102 Issue 1 (Provisional) September 25, 1999

Statement Of Compliance: The Fujitsu TABLET Computer T2010 GSM/UMTS Module with Wireless LAN model AR5BXB6 and Bluetooth module EYTF3CS FT complied* with the FCC General public/uncontrolled RF exposure limits of 1.6mW/g per requirements of 47CFR2.1093(d). It also complied with IC RSS-102 requirements.
*. Refer to compliance statement section 9.

Test Date: 27th - 29th November 2007, 4th - 5th, 11th February 2008

Tested for: Fujitsu Australia Pty Ltd
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Technical Director

SAR TEST REPORT

Portable Tablet Computer

Model: T2010

Report Number: M071031_CERT_MC8781_SAR_GSM-UMTS

2.0 INTRODUCTION

Testing was performed on the Fujitsu Tablet PC, Model: T2010 with SIERRA Mini-PCI Wireless WAN Module Model: MC8781, with Atheros CORPORATION Mini-PCI Wireless LAN Module (Atheros XB62 802.11a/b/g), Model: AR5XB6 & TAIYO YUDEN Bluetooth Module, Model: EYTF3CS FT, Bluetooth Transmitter nominal power is less than 5mW. The Atheros XB62 module is an OEM product. The Mini-PCI Wireless WAN (WWAN) was tested in the dedicated host – LIFEBOOK T SERIES, Model T2010.

3.0 SAMPLE TECHNICAL INFORMATION

(Information supplied by the client)

3.1 WWAN Details

Transmitter:	Mini-Card Wireless WAN Module
Model Number:	MC8781
Manufacturer:	Sierra Wireless Incorporated
Modulation Type:	TDMA for GSM/GPRS QPSK and QAM for UMTS
GSM Frequency Bands:	850 / 1900 MHz
UMTS Frequency Bands:	Band II (1900MHz)/Band V (835MHz)
Frequency Ranges:	824.2 – 848.8 MHz and 1850.2 – 1909.8 MHz for GPRS 826.4 – 846.6 MHz and 1852.4 – 1907.6 MHz for UMTS
Antenna Type:	Nissei Electric
Antenna Gain:	Peak gain 2.34 dBi
Output Power:	32 ± 1 dBm in 900 band 29 ± 1 dBm in 1800 band 23 ± 1 dBm in UMTS band

3.2 Test Signal, Frequency and Output Power

The EUT was provided by Fujitsu Australia Pty Ltd. It was put into operation using a Rhodes & Schwarz Radio Communication Tester CMU200. The channels utilised in the measurements were the traffic channels shown in the table below. The power level was set to Class 4 for 850 MHz and Class 1 for 1900 MHz GSM bands and class 3 for 850 and 1900 MHz UMTS bands.

Channels and Output power:

Channel and Mode	Frequency MHz	Average Output Power dBm
GPRS Mode		
Channels 128, 190 and 251	824.2, 836.6 and 848.8	33
Channels 512, 661 and 810	1850.2, 1880 and 1909.8	30
UMTS Mode		
Channels 4132, 4183 and 4233	826.4, 836.6 and 846.6	24
Channels 9262, 9400 and 9538	1852.4, 1880 and 1907.6	24



3.3 WLAN Details

Transmitter:	Mini-Card Wireless LAN Module
Wireless Module:	ATHEROS XB62 (802.11a/b/g)
Model Number:	AR5XB6
Manufacturer:	Atheros Corporation
Modulation Type:	Direct Sequence Spread Spectrum (DSSS for 802.11b) Orthogonal Frequency Division Multiplexing (OFDM for 802.11g) Orthogonal Frequency Division Multiplexing (OFDM for 802.11a)
2.4 GHz (802.11b/g):	DBPSK, DQPSK, CCK, 16QAM and 64QAM
5 GHz (802.11a/n):	BPSK, QPSK, 16QAM and 64QAM
Maximum Data Rate:	802.11b = 11Mbps, 802.11g and 802.11a = 54Mbps 802.11n = 300 Mbps
Frequency Ranges:	2.412 – 2.462 GHz for 802.11b/g 5.18 - 5.32 GHz, 5500 – 5700 GHz and 5.745 - 5.825 GHz for 802.11a
Number of Channels:	11 channels for 802.11b/g 28 channels for 802.11a
Antenna Types:	Tx: Yokowo Monopole Antenna - Model: CP335166 Location: Top edge of LCD screen
Power Supply:	3.3 VDC from PCI bus

3.4 EUT (Notebook PC) Details

EUT:	LIFEBOOK T SERIES
Model Name:	T2010
Serial Number:	Pre-production Sample
Manufacturer:	FUJITSU LIMITED
CPU Type and Speed:	Core2 Duo U7600 1.20GHz/U7500 1.06GHz
LCD	12.1" WXGA
Wired LAN:	Marvell 88E8055 : 10 Base-T/100 Base-TX/1000Base-T
Modem:	Agere MDC1.5 modem Model: D40
Port Replicator Model:	FPCPR77 / FPCPR79 / FPCPR80
AC Adapter Model:	60W:SEC80N2-16.0(Sanken)
Voltage:	16V
Current Specs:	3.75A
Watts:	60W

3.5 Test sample Accessories

3.5.1 Battery Types

One type of Fujitsu Lithium Ion Battery is used to power the Portable Tablet Computer Wireless WAN Model: MC8781. SAR measurements were performed with the battery as shown below.

Standard Battery

Model	CP343809-01
V/mAh	10.8V / 5800mAh
Cell No.	6



4.0 TEST SIGNAL, FREQUENCY AND OUTPUT POWER

The Portable Tablet Computer Wireless WAN had a total of 423 channels (USA model) within the 824.2 to 848.8 MHz and 1850.2 to 1909.8 MHz GSM frequency bands and 379 channels within the frequency ranges 826.4 to 846.6 MHz and 1852.4 to 1907.6 MHz. For the SAR measurements the device was operating at full transmit power. The fixed frequency channels used in the testing are shown in table below.

ATHEROS Corporation's ART test tool was used to configure the WLAN for testing. The Portable Tablet Computer Wireless LAN had a total of 11 channels (USA model) within the 2412 to 2462 MHz frequency band and 17 channels within the frequency range 5180 – 5825 MHz. In The frequency range 2412 MHz to 2462 MHz the device operates in 2 modes, OFDM and DSSS. Within the 5180 – 5825 MHz frequency range the device operates in OFDM mode only. For the SAR measurements the device was operating in continuous transmit mode using programming codes supplied by Fujitsu. The fixed frequency channels used in the testing are shown in the table below.

The frequency span of the GSM and UMTS bands was greater than 10MHz consequently; the SAR levels of the test sample were measured for lowest, centre and highest channels in the applicable modes. There were no wires or other connections to the Portable Tablet Computer during the SAR measurements.

At the beginning and at the completion of the SAR tests, the conducted power of the device was measured after temporary modification of antenna connector inside the device's TX /RX compartment. Measurements were performed with a calibrated Power Meter. The results of this measurement are listed in the table below.

Table: Frequency and Conducted Power Results GSM

Coding Scheme	GPRS Power Class	RF Channel	Measured Power (dBm)
CS1	10	128	30.39
CS1	10	190	30.42
CS1	10	251	30.67
CS1	11	128	27.38
CS1	11	190	27.38
CS1	11	251	27.58
CS1	12	128	24.47
CS1	12	190	24.40
CS1	12	251	24.62

Coding Scheme	EGPRS Power Class	RF Channel	Measured Power (dBm)
MCS5	10	128	25.32
MCS5	10	190	25.72
MCS5	10	251	25.93
MCS5	11	128	25.15
MCS5	11	190	25.62
MCS5	11	251	25.84
MCS5	12	128	25.12
MCS5	12	190	25.52
MCS5	12	251	25.78



Coding Scheme	GPRS Power Class	RF Channel	Measured Power (dBm)
CS1	10	512	28.55
CS1	10	661	28.42
CS1	10	810	28.44
CS1	11	512	28.40
CS1	11	661	28.30
CS1	11	810	28.36
CS1	12	512	28.32
CS1	12	661	28.23
CS1	12	810	28.16

Coding Scheme	EGPRS Power Class	RF Channel	Measured Power (dBm)
MCS5	10	512	25.61
MCS5	10	661	25.60
MCS5	10	810	25.59
MCS5	11	512	25.53
MCS5	11	661	25.46
MCS5	11	810	25.61
MCS5	12	512	25.54
MCS5	12	661	25.48
MCS5	12	810	25.50

Conducted Power Measurement UMTS 850 MHz

Configuration:

12.2 kbps RMC

Test Loop Mode 1

$\beta_c = 8$, $\beta_d = 15$ (3GPP default)

TPC (Transmit Power Control) = All 1s

Channel No.	β_c	β_d	Result (dBm)
4132	8	15	22.52
4183	8	15	22.39
4233	8	15	22.50



Conducted Power Measurement UMTS + HSDPA 850 MHz

Configuration:

Device HSDPA Category 6 (Downlink 3.6 Mbps and Uplink 384 kbps)

H-Set = 3

QPSK in H-Set (3)

CQI Feedback Cycle = 4ms; CQI Repetition Rate = 2ms

3GPP default HS-DPCCH power offset parameters $\Delta AKN = 5$; $\Delta NAKN = 5$; $\Delta CQI = 2$

Sub Test No.	βc	βd	ΔAKN	$\Delta NAKN$	ΔCQI	Result (dBm)		
						4132	4183	4233
1	2	15	8	8	8	22.60	22.31	22.26
2	12	15	8	8	8	22.06	21.71	21.82
3	15	8	8	8	8	22.10	21.70	21.87
4	15	4	8	8	8	21.58	21.30	21.44
1	2	15	5	5	2	22.62	22.27	22.27
2	12	15	5	5	2	22.20	21.90	22.13
3	15	8	5	5	2	20.91	20.74	20.64
4	15	4	5	5	2	20.17	20.02	19.97

Conducted Power Measurement UMTS 1900 MHz

Configuration:

12.2 kbps RMC

Test Loop Mode 1

 $\beta c = 8$, $\beta d = 15$ (3GPP default)

TPC (Transmit Power Control) = All 1s

Channel No.	βc	βd	Result (dBm)
9262	8	15	24.74
9400	8	15	24.67
9538	8	15	23.75



Conducted Power Measurement UMTS + HSDPA 1900 MHz

Configuration:

Device HSDPA Category 6 (Downlink 3.6 Mbps and Uplink 384 kbps)

H-Set = 3

QPSK in H-Set (3)

CQI Feedback Cycle = 4ms; CQI Repetition Rate = 2ms

3GPP default HS-DPCCH power offset parameters $\Delta AKN = 5$; $\Delta NAKN = 5$; $\Delta CQI = 2$

Sub Test No.	β_c	β_d	ΔAKN	$\Delta NAKN$	ΔCQI	Result (dBm)		
						9262	9400	9538
1	2	15	8	8	8	24.79	24.72	23.73
2	12	15	8	8	8	25.14	25.17	23.88
3	15	8	8	8	8	25.47	25.43	24.28
4	15	4	8	8	8	25.15	25.06	23.70
1	2	15	5	5	2	24.77	24.66	23.58
2	12	15	5	5	2	25.11	25.03	23.69
3	15	8	5	5	2	24.43	24.36	23.11
4	15	4	5	5	2	24.12	23.92	22.84

4.1 Battery Status

The device battery was fully charged prior to commencement of measurement. Each SAR test was completed within 30 minutes. The battery condition was monitored by measuring the RF field at a defined position inside the phantom before the commencement of each test and again after the completion of the test. It was not possible to perform conducted power measurements at the output of the device, at the beginning and end of each scan due to lack of a suitable antenna port. The uncertainty associated with the power drift was less than 12% and was assessed in the uncertainty budget.

5.0 DETAILS OF TEST LABORATORY

5.1 Location

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5.2 Accreditations

EMC Technologies Pty. Ltd. is accredited by the National Association of Testing Authorities, Australia (NATA).
NATA Accredited Laboratory Number: 5292

EMC Technologies Pty Ltd is NATA accredited for the following standards:

AS/NZS 2772.1:	RF and microwave radiation hazard measurement
ACMA:	Radio communications (Electromagnetic Radiation - Human Exposure) Standard 2003
FCC:	Guidelines for Human Exposure to RF Electromagnetic Field OET65C 01/01
EN 50360: 2001	Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)
EN 50361: 2001	Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300MHz – 3GHz)
IEEE 1528: 2003	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Measurement Techniques.

Refer to NATA website www.nata.asn.au for the full scope of accreditation.

5.3 Environmental Factors

The measurements were performed in a shielded room with no background RF signals. The temperature in the laboratory was controlled to within $21\pm1^{\circ}\text{C}$, the humidity was in the range 53% to 65%. The liquid parameters are measured daily prior to the commencement of each test. Tests were performed to check that reflections within the environment did not influence the SAR measurements. The noise floor of the DASY4 SAR measurement system using the SN1377 and SN1380 probes was less than $5\mu\text{V}$ in both air and liquid mediums.



6.0 DESCRIPTION OF SAR MEASUREMENT SYSTEM

Applicable Head Configurations	: None
Applicable Body Configurations	: Tablet Position : Lap On Position : Edge On Position

6.1 Probe Positioning System

The measurements were performed with the state-of-the-art automated near-field scanning system **DASY4 V4.7 Build 53** from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision 6-axis robot (working range greater than 1.1m), which positions the SAR measurement probes with a positional repeatability of better than ± 0.02 mm. The DASY4 fully complies with the OET65 C (01-01), IEEE 1528 and EN50361 SAR measurement requirements.

6.2 E-Field Probe Type and Performance

The SAR measurements were conducted with SPEAG dosimetric probes ET3DV6 Serial: 1377 and 1380 designed in the classical triangular configuration and optimised for dosimetric evaluation. The probes have been calibrated and found to be accurate to better than ± 0.25 dB. The probe is suitable for measurements close to material discontinuity at the surface of the phantom. The sensors of the probe are directly loaded with Schottky diodes and connected via highly resistive lines (length = 300 mm) to the data acquisition unit.

6.3 Data Acquisition Electronics

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. The input impedance of the DAE3 box is 200 M Ω ; the inputs are symmetrical and floating. Common mode rejection is above 80dB. Transmission to the PC-card 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.

6.4 Validation

6.4.1 Validation Results

The following tables lists the dielectric properties of the tissue simulating liquid measured prior to SAR validation. The results of the validation are listed in columns 4 and 5. The forward power into the reference dipole for SAR validation was adjusted to 250 mW.

Table: Validation Results

1. Validation Date & Frequency	2. ϵ_r (measured)	3. σ (mho/m) (measured)	4. Measured SAR 1g (mW/g)	5. Measured SAR 10g (mW/g)
27 th Nov 07 900 MHz	42.2	1.00	2.81	1.80
28 th Nov 07 1800 MHz	38.1	1.36	9.03	4.80
29 th Nov 07 1800 MHz	38.5	1.38	9.27	4.95
29 th Nov 07 900 MHz	40.3	0.95	2.72	1.73
4 th Feb 08 2450 MHz	39.9	1.81	14.0	6.55
5 th Feb 08 5800 MHz	36.4	5.43	18.8	5.30
11 th Feb 08 5800 MHz	34.3	5.34	18.8	5.30

6.4.2 Deviation from reference validation values

The reference SAR values are derived using a reference dipole and flat section of the SAM phantom suitable for a centre frequency of 900, 1800, 2450 and 5800 MHz. These reference SAR values are obtained from the IEEE Std 1528-2003 and are normalized to 1W.

The SPEAG calibration reference SAR value is the SAR validation result obtained in a specific dielectric liquid using the validation dipole during calibration. The measured one-gram SAR should be within 10% of the expected target reference values shown in table below.

Table: Deviation from reference validation values

Frequency and Date	Measured SAR 1g (mW/g)	Measured SAR 1g (Normalized to 1W)	SPEAG Calibration reference SAR Value 1g (mW/g)	Deviation From SPEAG Reference (1g) %	IEEE Std 1528 reference SAR value 1g (mW/g)	Deviation From IEEE (1g) %
27 th Nov 07 900 MHz	2.81	11.24	10.9	3.12	10.8	4.07
28 th Nov 07 1800 MHz	9.03	36.12	39.3	-8.09	38.1	-5.20
29 th Nov 07 1800 MHz	9.27	37.08	39.3	-5.65	38.1	-2.78
29 th Nov 07 900 MHz	2.72	10.88	10.9	-0.18	10.8	0.74
4 th Feb 08 2450 MHz	14.0	56.00	54.0	3.70	52.4	6.87
5 th Feb 08 5800 MHz	18.8	75.20	80.8	-6.93	78.2	-3.84
11 th Feb 08 5800 MHz	18.8	75.20	80.8	-6.93	78.2	-3.84

NOTE: All reference validation values are referenced to 1W input power.

6.4.3 Liquid Depth 15cm

During the SAR measurement process the liquid level was maintained to a level of 15cm with a tolerance of 0.5cm.



Photo of liquid Depth in Flat Phantom

6.5 Phantom Properties (Size, Shape, Shell Thickness)

The phantom used during the validations was the SAM Phantom model: TP – 1060 and TP - 1260 from SPEAG. It is a phantom with a single thickness of 2 mm and was filled with the required tissue simulating liquid. The SAM phantom support structures were all non-metallic and spaced more than one device width away in transverse directions.

For SAR testing in the body worn positions an AndreT Flat phantom P 10.1 was used. The phantom thickness is 2.0mm $\pm$ 0.2 mm and was filled with the required tissue simulating liquid. Below table provides a summary of the measured phantom properties. Refer to Appendix C Part 4, for details of P 10.1 phantom dielectric properties and loss tangent.

Table: Phantom Properties

Phantom Properties	Required	Measured
Thickness of flat section	2.0mm $\pm$ 0.2mm (bottom section)	2.12-2.20mm
Dielectric Constant	<5.0	4.603 @ 300MHz (worst-case frequency)
Loss Tangent	<0.05	0.0379 @ 2500MHz (worst-case frequency)

Depth of Phantom	200mm
Length of Flat Section	620mm
Width of Flat Section	540mm

P 10.1 Flat Phantom



P 10.1 Flat Phantom



6.6 Tissue Material Properties

The dielectric parameters of the brain simulating liquid were measured prior to SAR assessment using the HP85070A dielectric probe kit and HP8753ES Network Analyser. The actual dielectric parameters are shown in the following table.

Table: Measured Brain Simulating Liquid Dielectric Values for Validations

Frequency Band	ϵ_r (measured range)	ϵ_r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m ³
900 MHz Brain	40.3 - 42.2	41.5 $\pm$ 5% (39.4 to 43.6)	0.95 - 1.00	0.97 $\pm$ 5% (0.92 to 1.02)	1000
1800 MHz Brain	38.1 - 38.5	40.0 $\pm$ 5% (38.0 to 42.0)	1.36 - 1.38	1.40 $\pm$ 5% (1.33 to 1.47)	1000
2450 MHz Brain	39.9	39.2 $\pm$ 5% (37.2 to 41.2)	1.81	1.80 $\pm$ 5% (1.71 to 1.89)	1000
5800 MHz Brain	36.4	35.3 $\pm$ 5% (33.5 to 37.1)	5.42	5.27 $\pm$ 5% (5.01 to 5.53)	1000

NOTE: The brain liquid parameters were within the required tolerances of $\pm$ 5%.

Table: Measured Body Simulating Liquid Dielectric Values at 850MHz

Frequency Band	ϵ_r (measured range)	ϵ_r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m ³
825 MHz Body	53.2 - 53.3	55.2 $\pm$ 5% (52.4 to 58.0)	0.94 - 0.96	0.97 $\pm$ 5% (0.92 to 1.02)	1000
835 MHz Body	53.0 - 53.1	55.2 $\pm$ 5% (52.4 to 58.0)	0.96 - 0.97	0.97 $\pm$ 5% (0.92 to 1.02)	1000
850 MHz Body	52.9 - 53.1	55.2 $\pm$ 5% (52.4 to 58.0)	0.98 - 0.96	0.97 $\pm$ 5% (0.92 to 1.02)	1000

Note: The body liquid parameters were within the required tolerances of $\pm$ 5%.

Table: Measured Body Simulating Liquid Dielectric Values at 1880MHz

Frequency Band	ϵ_r (measured range)	ϵ_r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m ³
1850 MHz Body	51.1 - 51.2	53.3 $\pm$ 5% (50.6 to 56.0)	1.52 - 1.53	1.52 $\pm$ 5% (1.44 to 1.60)	1000
1880.0 MHz Body	51.0 - 51.1	53.3 $\pm$ 5% (50.6 to 56.0)	1.54 - 1.55	1.52 $\pm$ 5% (1.44 to 1.60)	1000
1910 MHz Body	50.9 - 51.0	53.3 $\pm$ 5% (50.6 to 56.0)	1.56 - 1.57	1.52 $\pm$ 5% (1.44 to 1.60)	1000

Note: The body liquid parameters were within the required tolerances of $\pm$ 5%.

Table: Measured Body Simulating Liquid Dielectric Values for WLAN

Frequency Band	ϵ_r (measured range)	ϵ_r (target)	σ (mho/m) (measured range)	σ (target)	ρ kg/m ³
2437 MHz Body	51.7	52.7 $\pm$ 5% (50.1 to 55.3)	1.99	1.95 $\pm$ 5% (1.85 to 2.05)	1000
5825 MHz Muscle	47.7	48.2 $\pm$ 10% (43.38 to 53.02)	6.16	6.0 $\pm$ 10% (5.4 to 6.60)	1000

Note: The body liquid parameters were within the required tolerances of $\pm 5\%$.

6.6.1 Liquid Temperature and Humidity

The humidity and dielectric/ambient temperatures were recorded during the assessment of the tissue material dielectric parameters. The difference between the ambient temperature of the liquid during the dielectric measurement and the temperature during tests was less than $|2|^\circ\text{C}$.

Table: Temperature and Humidity recorded for each day

Date	Ambient Temperature ($^\circ\text{C}$)	Liquid Temperature ($^\circ\text{C}$)	Humidity (%)
27 th Nov 2007	21.6	20.9	53.0
28 th Nov 2007	21.5	21.1	61.0
29 th Nov 2007	21.7	21.1 – 21.2	59.0 – 62.0
4 th Feb 2008	21.8	21.2	65.0
5 th Feb 2008	22.2	21.5	65
11 th Feb 2008	21.9	21.5	57.0

6.7 Simulated Tissue Composition Used for SAR Test

The tissue simulating liquids are created prior to the SAR evaluation and often require slight modification each day to obtain the correct dielectric parameters.

Table: Tissue Type: Brain @ 850/900MHz
Volume of Liquid: 30 Litres

Approximate Composition	% By Weight
Distilled Water	41.05
Salt	1.35
Sugar	56.5
HEC	1.0
Bactericide	0.1

Table: Tissue Type: Brain @ 1800/1950MHz MHz
Volume of Liquid: 30 Litres

Approximate Composition	% By Weight
Distilled Water	61.17
Salt	0.31
Bactericide	0.29
Triton X-100	38.23

Table: Tissue Type: Body @ 850/900MHz
Volume of Liquid: 30 Litres

Approximate Composition	% By Weight
Distilled Water	56
Salt	0.76
Sugar	41.76
HEC	1.21
Bactericide	0.27

Table: Tissue Type: Body @ 1800/1950MHz MHz
Volume of Liquid: 30 Litres

Approximate Composition	% By Weight
Distilled Water	40.4
Salt	0.5
Sugar	58
HEC	1
Bactericide	0.1

*Refer "OET Bulletin 65 97/01 P38"

Table: Tissue Type: Brain @ 2450MHz
Volume of Liquid: 30 Litres

Approximate Composition	% By Weight
Distilled Water	62.7
Salt	0.5
Triton X-100	36.8

Table: Tissue Type: Muscle @ 2450MHz
Volume of Liquid: 60 Litres

Approximate Composition	% By Weight
Distilled Water	73.2
Salt	0.04
DGBE	26.7

*Refer "OET Bulletin 65 97/01 P38"

Table: Tissue Type: Muscle @ 5600MHz

Volume of Liquid: 60 Litres

EMCT Liquid

Composition
Distilled Water
Salt
Triton X-100

6.8 Device Holder for Laptops and P 10.1 Phantom

A low loss clamp was used to position the Tablet underneath the phantom surface. Small pieces of foam were then used to press the Tablet flush against the phantom surface.

Refer to Appendix A for photographs of device positioning

7.0 SAR MEASUREMENT PROCEDURE USING DASY4

7.1 Description of Standard Procedure

The SAR evaluation was performed with the SPEAG DASY4 system. 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 3.9 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. The actual Area Scan has dimensions of 81mm x 111mm surrounding the test device. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first “pre-scans” covered an area of 61 mm x 151 mm to ensure that the hotspot was correctly identified.
- c) Around this point, a volume of 30 mm x 30 mm x 30 mm is assessed by measuring 7 x 7 x 7 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 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 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.

7.2 Multi-band Evaluation Procedure

Multi-band evaluations are used in cases where a wireless device co-transmits multiple frequencies at the same time. Such devices may be compliant with the regulatory SAR limit at each frequency while the composite SAR from simultaneous transmission is above the limit. Therefore, multi-band evaluation is used for more accurate SAR measurements.

For Multi-band evaluation separate Volume Scan job was performed for each band to conduct the measurement of volumes with sufficient spatial extent. The resulting measurement jobs were then evaluated and combined using the SEMCAD Postprocessor.



8.0 MEASUREMENT UNCERTAINTY

The uncertainty analysis is based on the template listed in the IEEE Std 1528-2003 for both Handset SAR tests and Validation uncertainty. The measurement uncertainty of a specific device is evaluated independently and the total uncertainty for both evaluations (95% confidence level) must be less than 30%.

Table: Uncertainty Budget for DASY4 V4.7 Build 53 – EUT SAR

a	b	c	d	e= f(d,k)	f	g	h=cxf/e	i=cxg/e	k
Uncertainty Component	Sec.	Tol. (%)	Prob. Dist.	Div.	C _i (1g)	C _i (10g)	1g u _i (%)	10g u _i (%)	v _i
Measurement System									
Probe Calibration (k=1) (numerical calibration)	7.2.1	4.8	N	1	1	1	4.8	4.8	∞
Axial Isotropy	7.2.1	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	7.2.1	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	7.2.1	1	R	1.73	1	1	0.6	0.6	∞
Linearity	7.2.1	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	7.2.1	1	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	7.2.1	1	N	1	1	1	1.0	1.0	∞
Response Time	7.2.1	0.8	R	1.73	1	1	0.5	0.5	∞
Integration Time	7.2.1	2.6	R	1.73	1	1	1.5	1.5	∞
RF Ambient Conditions	7.2.3	0.05	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	7.2.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	7.2.2	2.9	R	1.73	1	1	1.7	1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	7.2.4	1	R	1.73	1	1	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	7.2.2	1.61	N	1	1	1	1.6	1.6	11
Device Holder Uncertainty	E.4.1	3.34	N	1	1	1	3.3	3.3	7
Output Power Variation – SAR Drift Measurement	7.2.3	11.81	R	1.73	1	1	6.8	6.8	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	7.2.2	4	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity – Deviation from target values	7.2.3	5	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity – Measurement uncertainty	7.2.3	4.3	N	1	0.64	0.43	2.8	1.8	5
Liquid Permittivity – Deviation from target values	7.2.3	5	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity – Measurement uncertainty	7.2.3	4.3	N	1	0.6	0.49	2.6	2.1	5
Combined standard Uncertainty			RSS				12.0	11.6	154
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				23.9	23.13	



Table: Uncertainty Budget for DASY4 Version V4.7 Build 53 – EUT SAR test 5GHz

a	b	c	d	e= f(d,k)	f	g	h=cxf/e	i=cxg/e	k
Uncertainty Component	Sec.	Tol. (%)	Prob. Dist.	Div.	C _i (1g)	C _i (10g)	1g u _i (%)	10g u _i (%)	v _i
Measurement System									
Probe Calibration (k=1) (numerical calibration)	E.2.1	6.8	N	1	1	1	6.8	6.8	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	2	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	1	N	1	1	1	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1	1	1.5	1.5	∞
RF Ambient Conditions	E.6.1	0.075	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.73	1	1	0.5	0.5	∞
Probe Positioning with respect to Phantom Shell	E.6.3	5.7	R	1.73	1	1	3.3	3.3	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	4	R	1.73	1	1	2.3	2.3	∞
Test Sample Related									
Test Sample Positioning	E.4.2	2.9	N	1	1	1	2.9	2.9	11
Device Holder Uncertainty	E.4.1	3.6	N	1	1	1	3.6	3.6	7
Output Power Variation – SAR Drift Measurement	6.6.2	3	R	1.73	1	1	1.7	1.7	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E.3.1	4	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity – Deviation from target values	E.3.2	10	R	1.73	0.64	0.43	3.7	2.5	∞
Liquid Conductivity – Measurement uncertainty	E.3.3	2.5	N	1	0.64	0.43	1.6	1.1	5
Liquid Permittivity – Deviation from target values	E.3.2	10	R	1.73	0.6	0.49	3.5	2.8	∞
Liquid Permittivity – Measurement uncertainty	E.3.3	2.5	N	1	0.6	0.49	1.5	1.2	5
Combined standard Uncertainty			RSS				12.4	11.9	154
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.8	23.72	

Estimated total measurement uncertainty for the DASY4 measurement system was $\pm 12.4\%$. The extended uncertainty ($K = 2$) was assessed to be $\pm 24.8\%$ based on 95% confidence level. The uncertainty is not added to the measurement result.