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ENSAYOS Nº 51/LE342

TEST REPORT

REFERENCE STANDARDS:

FCC 47CFR Part 2.1093

FCC OET Bulletin 65, Supplement C (Edition 01-01)

NIE ..... :	32459RET.002
Approved by (name / position & signature) ..... :	A. Llamas / RF Lab Manager
Elaboration date ..... :	2010-11-18

Alejandro Llamas Rodríguez
Firmado digitalmente por Alejandro Llamas Rodríguez
Fecha: 2010.12.15 08:31:37 +01'00'

Identification of item tested ..... :	TERRESTAR GENUS
Trademark ..... :	Genus
Model and/or type reference ..... :	TSN-1.1
Serial number ..... :	EBL0002205, EBL0002154, EBL0002270, EBL0001511
Other identification of the product ..... :	FCC ID: OBW120897
Features ..... :	Windows Mobile 6.5 GSM850 / GSM900 / GSM1800 / GSM1900 / WCDMA FDD V/ WCDMA FDD II / GMR-1 3G / BT / WiFi / A-GPS
Description ..... :	PDA
Applicant ..... :	ELEKTROBIT
Address ..... :	Tutkijantie 9 / FI-90590, Oulu / Finland
CIF/NIF/Passport ..... :	FI17375650
Contact person:	Jarmo Koivula
Telephone / Fax ..... :	Phone: +358 40 3443877
e-mail: ..... :	jarmo.koivula@elektrobit.com
Test samples supplier ..... :	Same as applicant
Manufacturer ..... :	Same as applicant

Test method requested .....:	See Standard
Standard .....:	1. FCC 47 CFR Part 2.1093. Radiofrequency radiation exposure evaluation: portable devices. 2. FCC OET Bulletin 65, Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields". 3. FCC OET KDB 450824 – SAR Probe Calibration and System Verification Considerations for measurements at 150 MHz – 3 GHz (January 2007). 4. FCC OET KDB 941225 D01 – SAR Measurement Procedures for 3G Devices (October 2007). 5. FCC OET KDB 941225 D03 – Recommended SAR Test Reduction Procedures for GSM/GPRS/EDGE. 6. FCC OET KDB 248227 – SAR Measurements Procedures 802.11a/b/g Transmitters (May 2007 – Revised). 7. FCC OET KDB 648474 D01 – SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas (Sept 2008). 8. FCC OET KDB Inquiry 654565.
Test procedure .....:	Same as standards.
Non-standardized test method .....:	N/A
Used instrumentation .....:	N/A
Report template No. .....:	FDT08_12

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Competences and guarantees

AT4 wireless is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 342.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance programme for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the following documents:

1. FCC OET Bulletin 65, Supplement C (Edition 01-01), “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”.

Usage of samples

No actual testing was performed for the simultaneous transmission evaluation.

Testing period

No actual testing was performed for the simultaneous transmission evaluation.

Environmental conditions

N/A

Summary

Considering the results of the performed test according to FCC 47CFR Part 2.1093, the item under test is **IN COMPLIANCE** with the requested specifications specified in the standards.

The maximum 1g volume averaged SAR found for this item has been 1.23 W/kg, for the head position and Satellite band (π/2 BPSK 31.25KHz BW mode), as stated at the previous report 30931RET.002 (dated on 2010-01-19).

The maximum simultaneous transmission combined SAR for this item has been 1.003 W/kg, for the GSM/GPRS/EDGE mode at 850MHz and 802.11b/g combination.

NOTE: The results presented in this Test Report apply only to the particular item under test established in page 1 of this document, as presented for test on the date(s) shown in section, "USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS".

Remarks and comments

1: This report only evaluates the simultaneous multi-band transmission of the referred item, using the testing results provided at the previous reports 29742RET.005 (dated on 2009-11-24) and 30931RET.002 (dated on 2010-01-19), so no actual testing was performed for this evaluation.

Testing verdicts

Not applicable ..... : NA

Pass..... : P

Fail ..... : F

Not measured..... : NM

FCC 47CFR Part 2.1093 Paragraph	VERDICT			
	NA	P	F	NM
(d)(2) Simultaneous multi-band transmission[1]		P		

1: See remarks and comments.

APPENDIX A: Test Configuration

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1. GENERAL INTRODUCTION

1.1. Application Standard

The Federal Communications Commission (FCC) sets the limits for General Population / Uncontrolled exposure to radio frequency electromagnetic fields for transmitting devices designed to be used within 20 centimetres of the body of the user under FCC 47 CFR Part 2.1093 - "Radiofrequency radiation exposure evaluation: portable devices", paragraph (d)(2).

Specific requirements and procedure for SAR assessment are describe under FCC OET Bulletin 65, Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields", and all the documents referred at the beginning of this document.

1.2. General requirements

The SAR measurement has been performed continuing the following considerations and environment conditions:

- The ambient temperature shall be in the range of 18ºC to 25ºC and the variation shall not exceed +/-2ºC during the test.
- The ambient humidity shall be in the range of and 30% - 70%.
- The device battery shall be fully charged before each measurement.

1.3. Measurement system requirements

The measurement system used for SAR tests fulfils the procedural and technical requirements described at the reference standards used.

1.4. Phantom requirements

The phantom is a simplified representation of the human anatomy and comprised of material with electrical properties similar to the corresponding tissues in human body. The human model has the following proportions:

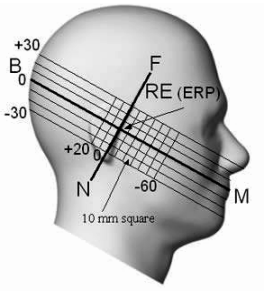

Figure 1: Proportions of Phantom

The shell model is a shaped container and it has the representation shown in the following figure:

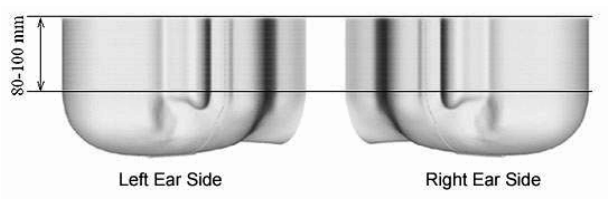

Figure 2: Proportions and shape of Phantom shell

1.5. Measurement Liquids requirements.

The liquids used to simulate the human tissues, must fulfils the requirements of the dielectric properties required. These target dielectric properties per FCC OET KDB 450824 instructions come from the dipole and probe calibration data which are included in Appendix B, Section 3, of this document.

2. MEASUREMENT SYSTEM

2.1. Measurement System

Manufacturer	Device	Type
Schmid & Partner Engineering AG	Dosimetric E-Fiel Probe	ES3DV3
Schmid & Partner Engineering AG	Data Acquisition Electronics	DAE4
Schmid & Partner Engineering AG	Electro-Optical Converter	EOC5
Schmid & Partner Engineering AG	900 MHz System Validation Dipole	D900V2
Schmid & Partner Engineering AG	1800 MHz System Validation Dipole	D1800V2
Schmid & Partner Engineering AG	2000 MHz System Validation Dipole	D2000V2
Schmid & Partner Engineering AG	2450 MHz System Validation Dipole	D2450V2
Stäubli	Robot	RX60BL
Stäubli	Robot controller	CM7MB
Schmid & Partner Engineering AG	SAM head-body simulator	TWIN SAM V4.0
Schmid & Partner Engineering AG	Measurement Software	DASY V4.7 Build 80
Schmid & Partner Engineering AG	Measurement Server	DASY4 SE UMS 001 DC
Rohde & Schwarz	Universal Radio Communication Tester	CMU 200
Agilent	Vector Network Analyser	E5071C
Agilent	Dielectric Probe Kit	85070C
Rohde & Schwarz	Power Meter	NRVD
Rohde & Schwarz	Power Sensor	NRV-Z51
Rohde & Schwarz	Power Sensor	NRV-Z1
Agilent	RF Generator	ESG E4438C
NARDA	Dual directional coupler	FSCM 99899
HP	Dual directional coupler	778D
MITEQ	Power amplifier	AMF-4D-00400600-50-30P
Schmid & Partner Engineering AG	Handset Positioner	SD000 HD1 HA

Table 1: Measurement Equipment

2.2. Test Positions of device relative to body

The standard FCC OET Bulletin 65, Supplement C (Edition 01-01) requires two test positions for the handset in the head. These positions are the "cheek" position and the “tilted” position. The tests positions used are described below. The handset should be tested in both positions (left and right sides) in the SAM phantom.

The EUT shall be placed in the Phantom in such way that the main point of the mobile terminal (acoustic output) coincides with the reference point located at the Phantom’s ear.

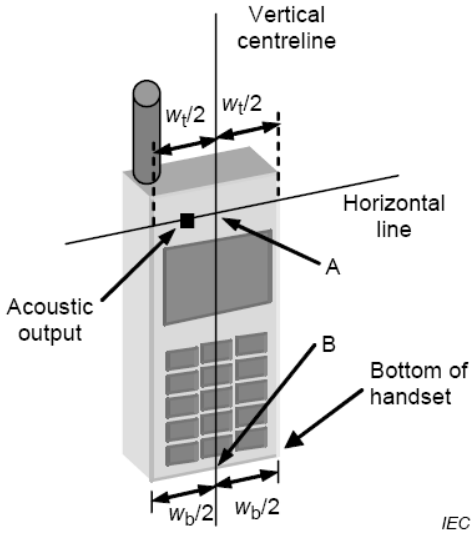

Figure 3: EUT’s basic scheme

SAR measurements will be performed for the following configurations as indicated in the reference standard:

- Right side of Phantom, Cheek position.
- Right side of Phantom, 15º Tilted position.
- Left side of Phantom, Cheek position.
- Left side of Phantom, 15º Tilted position.

Definition of the “cheek” position

The "cheek" position relative to Phantom is described as follows:

1. - Position the device with the vertical centre line of the body of the device and the horizontal line crossing the centre of the ear piece in a plane parallel to the sagital plane of the Phantom. While maintaining the device in this plane, aligning the centre line with the reference plane containing the three ear and mouth reference points (M, RE and LE).

2. - Translate the mobile phone box towards the Phantom until the ear-piece touches the ear reference point (RE or LE). While maintaining the device in the reference plane, move the bottom of the box until any point of the front side is in contact with the cheek of the Phantom.

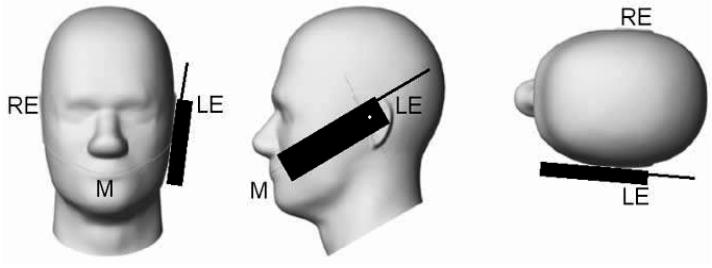

Figure 4: "Cheek" position of EUT

Definition of the tilted position:

The "15º tilted" position relative to Phantom is described as follows:

1. - Position the device in the "cheek" position described above.

2. - While maintaining the device in the reference plane described above and pivoting against the ear, move it outward away from the mouth by an angle of 15 degrees.

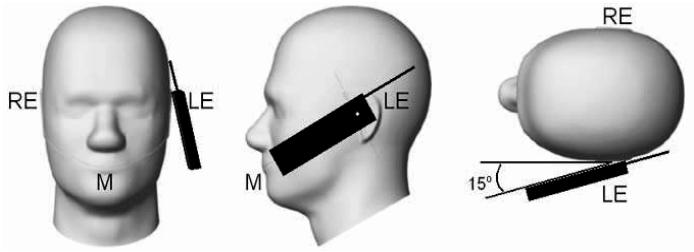

Figure 5: "Tilted" position of EUT

Also, according to the FCC OET Bulletin 65, Supplement C (Edition 01-01), for devices that are designed to operate in body-worn configurations SAR compliance should be evaluated using a flat phantom.

2.3. Test to be performed

Test shall be performed at both phone positions previously described, on each side of the head (left and right side) and using the centre frequency of each operating band.

Additionally, the configuration giving to the maximum mass averaged SAR shall be used to test the low-end and the high-end frequencies of each transmitting band. Thus, the tests to be performed in mobile phones are as follows:

- Measurements at Central Channel of application band:
  1. SAR measurement at the left side of Phantom and the cheek position of the EUT.
  2. SAR measurement at the left side of Phantom and the tilted 15º position of the EUT.
  3. SAR measurement at the right side of Phantom and the cheek position of the EUT.
  4. SAR measurement at the right side of Phantom and the tilted 15º position of the EUT.
- Measurements at Low Channel of application band:

  SAR measurement at the side and position where the maximum SAR level, measured at Central channel, was found.
- Measurements at High Channel of application band:

  SAR measurement at the side and position where the maximum SAR level, measured at Central channel, was found.

As noted above, measurements shall be performed using a flat phantom for body worn configuration. EUT will be placed at the center of flat phantom. The EUT position using during the body SAR tests will be that where maximum peak SAR was found. Low and high channels for each band should be tested at this position.

If the mobile phone is also designed to transmit with other configurations (antenna fully extended/retracted, keypad cover opened/closed…), all tests described above shall be performed for each configuration. When considering multi-mode and multi-band mobile phones, all of the above tests shall be performed at each transmitting mode/band with the corresponding maximum peak power level.

2.4. Description of interpolation/extrapolation scheme

The local SAR inside the Phantom is measured using small dipole sensing elements inside a probe element. The probe tip must not be in contact with the Phantoms surface in order to minimise measurement errors, but the highest local SAR is obtained from measurements at a certain distances from the shell trough extrapolation. The accurate assessment of the maximum SAR averaged over 1gr. requires a very fine resolution in the three dimensional scanned data array. Since the measurements have to be performed over a limited time, the measured data have to be interpolated to provide an array of sufficient resolution.

The interpolation of 2D area scan is used after the initial area scan, at a fixed distance from the Phantom shell wall. The initial scan data are collected with approx. 15 mm spatial resolution and this interpolation is used to find the location of the local maximum for positioning the subsequent 3D scanning to within a 1mm resolution.

For the 3D scan, data are collected on a spatially regular 3D grid having 5 mm steps in both directions. After the data collection by the SAR probe, the data are extrapolated in the depth direction to assign values to points in the 3D array closer to the shell wall. A notional extrapolation value is also assigned to the first point outside the shell wall so that subsequent interpolation schemes will de applicable right up to the shell wall boundary.

2.5. Determination of the largest peak spatial-average SAR

To determine the maximum value of the peak spatial-average SAR of a EUT, all device positions, configurations and operational modes should be tested for each frequency band.

According to FCC OET Bulletin 65, Supplement C (Edition 01-01), the averaging volume shall be chosen as 1gr. of contiguous tissue. The cubic volumes, over which the SAR measurements are averaged after extrapolation and interpolation, are chosen in order to include the highest values of local SAR.

The maximum SAR level for the EUT will be the maximum level obtained of the performed measurements, and indicated in the previous points.

2.6. System Validation

Prior to the SAR measurements, system verification is done daily to verify the system accuracy. FCC OET Bulletin 65 – Supplement C, Appendix D “SAR measurement procedures” Paragraph “System Verification” specifies, a complete SAR evaluation is done using a half-wavelength dipole as source with the frequency of the mid-band channel of the operating band, or within 10% of this channel.

The measured one-gram SAR should be within 10% of the expected target values specified in the calibration certificate of the dipole, for the specific tissue and frequency used.

3. UNCERTAINTY

Uncertainty for 300 MHz – 6 GHz

ERROR SOURCES	Uncertainty value (%)	Probability distribution	Divisor	(c_i) 1g	(c_i) 10g	Standard uncertainty (1g) (%)	Standard uncertainty (10g) (%)	v_i v_{eff}
Measurement Equipment								
Probe Calibration	±4.480	Normal	1	1	1	±4.480	±4.480	∞
Axial Isotropy	±7.558	Rectangular	$\sqrt{3}$	1	1	±4.364	±4.364	∞
Hemispherical Isotropy	±2.000	Rectangular	$\sqrt{3}$	1	1	±1.155	±1.155	∞
Boundary effect	±4.700	Rectangular	$\sqrt{3}$	1	1	±2.714	±2.714	∞
Linearity	±1.000	Rectangular	$\sqrt{3}$	1	1	±0.577	±0.577	∞
System detection limits	±0.300	Rectangular	$\sqrt{3}$	1	1	±0.300	±0.300	∞
Readout electronics	±1.010	Normal	1	1	1	±0.583	±0.583	∞
Response time	±2.600	Rectangular	$\sqrt{3}$	1	1	±1.501	±1.501	∞
Integration time	±3.000	Rectangular	$\sqrt{3}$	1	1	±1.732	±1.732	∞
RF Ambient conditions	±3.000	Rectangular	$\sqrt{3}$	1	1	±1.732	±1.732	∞
Probe positioner	±0.800	Rectangular	$\sqrt{3}$	1	1	±0.462	±0.462	∞
Probe positioning	±9.900	Rectangular	$\sqrt{3}$	1	1	±5.716	±5.716	∞
Maximum SAR evaluation	±1.000	Rectangular	$\sqrt{3}$	1	1	±0.577	±0.577	∞
Test Sample Related								
Device positioning	±2.900	Normal	1	1	1	±2.900	±2.900	145
Device Holder	±3.600	Normal	1	1	1	±3.600	±3.600	5
Power Drift	±5.000	Rectangular	$\sqrt{3}$	1	1	±2.887	±2.887	∞
Phantom and Setup								
Phantom uncertainty	±4.000	Rectangular	$\sqrt{3}$	1	1	±2.309	±2.309	∞
Liquid conductivity (deviation from target)	±5.000	Rectangular	$\sqrt{3}$	0.64	0.43	±1.848	±1.241	∞
Liquid conductivity (measurement error)	±3.100	Normal	1	0.64	0.43	±1.984	±1.333	∞
Liquid permittivity (deviation from target)	±5.000	Rectangular	$\sqrt{3}$	0.64	0.43	±1.848	±1.241	∞
Liquid permittivity (measurement error)	±4.410	Normal	1	0.64	0.43	±2.822	±1.896	∞
Combined standard uncertainty	$u_c = \sqrt{\sum_{1=1}^{m} c_i^2 \cdot u_i^2}$					**±11.99**	**±11.56**	330
Expanded uncertainty (confidence interval of 95%)	*ue =2.00 uc*					**±23.98**	**±23.11**	

Table 3: Uncertainty Assessment for 300 MHz - 6 GHz

4. SAR LIMIT

Having a worst case measurement, the SAR limit is valid for general population/uncontrolled exposure.

The SAR values have to be averaged over a mass of 1 gr. ($SAR_{1\ gr.}$) with the shape of a cube. This level couldn't exceed the values indicated in the application Standard:

Standard	SAR	SAR Limit (W/Kg)
FCC 47 CFR Part 2.1093 Paragraph (d)(2)	$SAR_{1\ gr.}$	1.6

Table 3: SAR limit

APPENDIX B: Test results

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1. TEST CONDITIONS

1.1. Power supply (V):

V_n = 3.7 Li-ion polymer rechargeable battery
Type of power supply = DC Voltage from rechargeable Li-Ion 3.7 V battery.

1.2. Test signal, Output Power and Frequencies

All the testing details are described at the previous reports 29742RET.005 (dated on 2009-11-24) and 30931RET.002 (dated on 2010-01-19).

The detailed simultaneous transmission combination is:

	GSM / GPRS / EDGE	WCDMA / HSDPA	Satellite	802.11b/g	Bluetooth
GSM / GPRS / EDGE		Not supported	Not supported	Supported	Supported
WCDMA / HSDPA	Not supported		Not supported	Supported	Supported
Satellite	Not supported	Not supported		Not supported	Supported
802.11b/g	Supported	Supported	Not supported		Not supported

The distances between antennas are (please check the antennas location diagram in the appendix C):

- Bluetooth/WLAN and Satellite antenna → 6 cm.
- Bluetooth/WLAN and GSM/WCDMA antenna → 6.4 cm.
- Satellite and GSM/WCDMA antenna → 9 cm.

The Bluetooth transmission mode is not considered for simultaneous transmission evaluation, following the FCC OET KDB 648474 D01 – SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas (Sept 2008), because the output power is $< 2 \cdot P_{Ref}$ and the antenna is located >5cm from other antennas.

2. CONDUCTED AVERAGE POWER MEASUREMENTS[1]

		Average Conducted Power (dB)		
Band	**Mode**	**CH Low**	**CH Mid**	**CH High**
850 MHz	GSM	23.67	23.53	23.43
	GPRS 1slot	23.62	23.49	23.37
	GPRS 2slot	26.20	26.22	26.24
	EGPRS 1slot	17.74	17.62	17.45
	EGPRS 2slot	21.31	21.24	21.19
	WCDMA Band V	24.52	24.36	24.69
	HSDPA Band V	24.21	24.09	24.28
1900 MHz	GSM	20.40	20.41	20.45
	GPRS 1slot	20.31	20.32	20.36
	GPRS 2slot	21.91	21.90	21.93
	EGPRS 1slot	16.97	17.15	17.21
	EGPRS 2slot	20.28	20.33	20.40
	WCDMA Band II	24.74	24.08	23.95
	HSDPA Band II	24.39	23.8	23.6
2000 MHz	π/2 BPSK (31.25KHz BW)	26.76	26.65	26.54
	π/4 QPSK (31.25KHz BW)	26.68	26.70	26.63
	π/4 QPSK (62.5KHz BW)	26.90	26.82	26.75
	π/4 QPSK (156.25KHz BW)	24.84	24.79	24.73
2450 MHz	802.11b	13.85	14.05	13.60
	802.11g	14.91	15.06	14.64
	Bluetooth	-1.03	-1.14	-1.35

1: See remarks and comments.

3. Results for Simultaneous multi-band transmission[1]

Transmission Mode	Band	Max. SAR averaged over 1g (W/kg)	$\sum SAR_i$ (W/kg)	Limit (W/kg)	Verdict
GSM / GPRS / EDGE	850 MHz	0.950	1.003	1.6	Pass
802.11b/g	2.4 GHz	0.053			
GSM / GPRS / EDGE	1900 MHz	0.493	0.546	1.6	Pass
802.11b/g	2.4 GHz	0.053			
WCDMA / HSDPA	FDD V	0.657	0.710	1.6	Pass
802.11b/g	2.4 GHz	0.053			
WCDMA / HSDPA	FDD II	0.920	0.973	1.6	Pass
802.11b/g	2.4 GHz	0.053			

1: See remarks and comments.