# TEST REPORT
# FROM
# RFI GLOBAL SERVICES LTD

Test of: Psion Teklogix UK Ltd.
7535 + RA3020.

To: OET Bulletin 65 Supplement C: (2001-01)

Measurements were performed on the DASY4 System

**Test Report Serial No:**
RFI/SARE1/RP47892JD03A

| | |
|---|---|
| **This Test Report Is Issued Under The Authority Of Andrew Brown, Operations Manager:**  | |
| **Tested By: Richelieu Quoi**  | **Checked By: Scott D'Adamo**  |
| **Report Copy No:** **PDF01** | |
| **Issue Date: 30 January 2006** | **Test Dates: 18 January 2006 to 20 January 2006** |

**It should be noted that the standard, OET Bulletin 65 Supplement C: (2001-01) is not listed on RFI's current UKAS schedule and is therefore "not UKAS accredited".**

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7535 + RA3020.
**To:** OET Bulletin 65 Supplement C: (2001-01)

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## Table of Contents

## 1. Client Information

| | |
|---|---|
| **Company Name:** | Psion Teklogix UK Ltd. |
| **Address:** | Bourne End Business Centre<br>Cores End Road<br>Bourne End<br>Bucks<br>SL8 5AS |
| **Contact Name:** | Mr S Lucas |

**Test Laboratory**

| | |
|---|---|
| **Company Name:** | RFI Global Services Ltd. |
| **Address:** | Ewhurst Park<br>Ramsdell<br>Basingstoke<br>Hampshire<br>RG26 5RQ. |
| **Contact Name:** | Mr A Brown |

## 2. Equipment Under Test (EUT)

The following information (with the exception of the date of receipt) has been supplied by the client:

### 2.1. Identification of Equipment Under Test (EUT)

| | |
|---|---|
| **Brand Name:** | Psion Teklogix |
| **Model Name or Number:** | 7535 + RA3020 |
| **IMEI Number:** | 010666.00.002061.10 |
| **Hardware Version Number:** | 7535RA3020A |
| **Software Version Number:** | 1.0 |
| **Serial Number:** | HU0025489641 |
| **FCC ID:** | GM37535GSMA |
| **Country of Manufacture:** | Canada |
| **Date of Receipt:** | 18 January 2006 |

| | |
|---|---|
| **Brand Name:** | Psion Teklogix |
| **Model Name or Number:** | CJ |
| **Part Number:** | 1030070-003 |
| **Battery Type:** | Lithium-ion Rechargeable Battery |
| **Country of Manufacture:** | Japan |
| **Date of Receipt:** | 18 January 2006 |

### 2.2. Description of EUT

The equipment under test is a rugged handheld 7535 terminal (i.e. PC) running Windows CE, NET 4.2 Pro and Dual Band PCS Radio RA3020A, that is integrated inside the 7535 to offer the user the ability to access / send data in real time. Operating at 850 MHz / 1900 MHz.

### 2.3. Modifications Incorporated in the EUT

During testing no modifications were made to the EUT, Hardware Version 7535RA3020A.

## 2.4. Additional Information Related to the EUT

| | | | |
|---|---|---|---|
| **Equipment Class:** | GSM 850 / GSM 1900 | | |
| **FCC Rule Part(s):** | OET Bulletin 65 Supplement C | | |
| **Device Category:** | Portable (Standalone battery powered device) | | |
| **Application Type:** | Certification | | |
| **Maximum Power Output:** | GSM 850 at 33 dBm<br>GSM 1900 at 30 dBm | | |
| **Transmitter Frequency Range:** | 850 MHz at (824.0 to 849.0) MHz<br>1900 MHz at (1850.0 to 1910.0) MHz | | |
| **Transmit Frequency Allocation of EUT When Under Test (Channels):** | **Channel Number** | **Channel Description** | **Frequency (MHz)** |
| | 128 | Low | 824.2 |
| | 189 | Middle | 836.4 |
| | 251 | High | 848.8 |
| | 512 | Low | 1850.2 |
| | 660 | Middle | 1879.8 |
| | 810 | High | 1909.8 |
| **Modulation(s):** | 217 Hz | | |
| **Modulation Scheme (Crest Factor):** | 8.3 | | |
| **Battery Type(s):** | Lithium-ion | | |
| **Antenna Type:** | 0.25 Wave Monopole | | |
| **Number Of Antenna Positions:** | 1 Permanent (Integral) | | |
| **Intended Operating Environment:** | Residential. Commercial, Light Industry and Within GSM Coverage | | |
| **Power Supply Requirement:** | | | |
| **AC Supply (Volts/Amps)** | | | |
| **Internal Battery Supply:** | 7.4 V (1900 mAh) | | |
| **Ports:** | SIM<br>Portable Docking Module<br>Tether port | | |

## 2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

| | |
|---|---|
| **Description:** | Universal Radio Communication Tester |
| **Brand Name:** | Rohde & Schwarz |
| **Model Name or Number:** | CMU 200 |
| **Serial Number:** | 836202/093 |
| **RFI Asset Number:** | M1138 |
| **Cable Length and Type:** | 1.5m (Rosenberger) |
| **Connected to Port:** | Air Link to Antenna (RF2 port) |

# 3. Test Specification, Methods and Procedures

## 3.1. Test Specification

| | |
|---|---|
| **Reference:** | OET Bulletin 65 Supplement C: (2001-01) |
| **Title:** | Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields. |

## 3.2. Methods and Procedures

The methods and procedures used were as detailed in:

EN 50361: 2001
Title: Basic standard for the measurement of specific absorption rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz).

ANSI/IEEE C95.1: 1999
IEEE standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz.

Federal Communications Commission, “Evaluating compliance with FCC Guidelines for human exposure to radio frequency electromagnetic fields”, OET Bulletin 65 Supplement C, FCC, Washington, D.C, 20554, 2001.

Thomas Schmid, Oliver Egger and Neils Kuster, “Automated E-field scanning system for dosimetric assessments”, IEEE Transaction on microwave theory and techniques,
Vol. 44, pp. 105-113, January 1996.

Neils Kuster, Ralph Kastle and Thomas Schmid, “Dosimetric evaluation of mobile communications equipment with know precision”, IEICE Transactions of communications, Vol. E80-B, No.5, pp. 645-652, May 1997.

## 3.3. Definition Of Measurement Equipment

The measurement equipment used complied with the requirements as detailed in OET Bulletin 65 Supplement C, Appendix D.

## 4. Deviations from the Test Specification

At the clients request testing was performed with the EUT operating in GSM850 and GSM1900 data call allocation only.

# 5. Operation of the EUT During Testing

## 5.1. Operating Modes

The EUT was tested in the following operating mode(s):

Standalone, GSM data call configuration.

## 5.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

Fully Powered.

## 6. Summary of Test Results

| Test Name | Specification Reference | Compliancy Status |
|---|---|---|
| Specific Absorption Rate (SAR) | OET Bulletin 65 Supplement C | Complied |

### 6.1. Location of Tests

All the measurements described in this report were performed at the premises of
RFI Global Services Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ.

# 7. Measurements, Examinations and Derived Results

## 7.1. General Comments

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 18 for details of measurement uncertainties.

## 7.2. Test Results

### 7.2.1. Test Results for Specific Absorption Rate – GSM850 Body

**Test Summary:**

| | |
|---|---|
| **Maximum Level (W/kg):** | 0.529 |
| **Limit (W/kg):** | 1.600 |
| **Margin (W/kg):** | 1.071 |

**Environmental Conditions:**

| | |
|---|---|
| **Temperature Variation in Lab (°C):** | 25.0 to 26.0 |
| **Temperature Variation in Liquid (°C):** | 23.8 to 24.1 |

| | |
|---|---|
| **ERP Measurements before Test:** | Refer to section 7.2.3 |

**Results:**

| Position | Section of Phantom | Channel Number | Level 1g (W/kg) | Limit 1g (W/kg) | Margin 1g (W/kg) | Result |
|---|---|---|---|---|---|---|
| Front of EUT Upper with Display Facing Phantom | Flat | 189 | 0.469 | 1.6 | 1.131 | Complied |
| Front of EUT Lower with Display Facing Phantom | Flat | 189 | 0.197 | 1.6 | 1.403 | Complied |
| Rear of EUT Upper | Flat | 189 | 0.411 | 1.6 | 1.189 | Complied |
| Rear of EUT Lower | Flat | 189 | 0.170 | 1.6 | 1.430 | Complied |
| EUT in Case (Upper Section) | Flat | 189 | 0.341 | 1.6 | 1.259 | Complied |
| EUT in Case (Lower Section) | Flat | 189 | 0.079 | 1.6 | 1.521 | Complied |
| Front of EUT Upper with Display Facing Phantom | Flat | 128 | 0.529 | 1.6 | 1.071 | Complied |
| Front of EUT Upper with Display Facing Phantom | Flat | 251 | 0.452 | 1.6 | 1.148 | Complied |
| Rear of EUT Upper | Flat | 128 | 0.420 | 1.6 | 1.180 | Complied |
| Rear of EUT Upper | Flat | 251 | 0.331 | 1.6 | 1.269 | Complied |

## 7.2.2. Test Results for Specific Absorption Rate – GSM1900 Body

### Test Summary:

| | |
|---|---|
| **Maximum Level (W/kg):** | 0.197 |
| **Limit (W/kg):** | 1.600 |
| **Margin (W/kg):** | 1.403 |

### Environmental Conditions:

| | |
|---|---|
| **Temperature Variation in Lab (°C):** | 25.0 to 26.0 |
| **Temperature Variation in Liquid (°C):** | 23.8 to 24.0 |

| | |
|---|---|
| **EIRP Measurements before Test:** | Refer to section 7.2.4 |

### Results:

| Position | Section of Phantom | Channel Number | Level 1g (W/kg) | Limit 1g (W/kg) | Margin 1g (W/kg) | Result |
|---|---|---|---|---|---|---|
| Front of EUT Upper with Display Facing Phantom | Flat | 660 | 0.195 | 1.6 | 1.405 | Complied |
| Front of EUT Lower with Display Facing Phantom | Flat | 660 | 0.092 | 1.6 | 1.508 | Complied |
| Rear of EUT Upper | Flat | 660 | 0.071 | 1.6 | 1.529 | Complied |
| Rear of EUT Lower | Flat | 660 | 0.013 | 1.6 | 1.587 | Complied |
| EUT in Case (Upper Section) | Flat | 660 | 0.041 | 1.6 | 1.559 | Complied |
| EUT in Case (Lower Section) | Flat | 660 | 0.034 | 1.6 | 1.566 | Complied |
| Front of EUT Upper with Display Facing Phantom | Flat | 512 | 0.197 | 1.6 | 1.403 | Complied |
| Front of EUT Upper with Display Facing Phantom | Flat | 810 | 0.167 | 1.6 | 1.433 | Complied |

### 7.2.3. ERP Measurement

**Date: 03 January 2006**

| Channel | Frequency (MHz) | TX Power before Test (dBm) |
|---|---|---|
| Bottom | 824.2 | 31.2 |
| Middle | 836.6 | 31.1 |
| Top | 848.8 | 29.8 |

### 7.2.4. EIRP Measurement

**Date: 03 January 2006**

| Channel | Frequency (MHz) | TX Power before Test (dBm) |
|---|---|---|
| Bottom | 1850.2 | 30.7 |
| Middle | 1879.8 | 30.5 |
| Top | 1909.8 | 30.9 |

**Note(s):**

1. *EIRP and ERP measurements are performed before testing only.*
2. *The test configuration for the 'EUT in case' set-up was performed with the EUT antenna placed closest to the body.*

## 8. SAR Measurement System

RFI Global Services Ltd, SAR measurement facility utilises the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the SAM phantom containing brain or muscle equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller; teach pendant (Joystick), and remote control. This is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. The data acquisition electronics (DAE) performs signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection etc. The DAE is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE3 utilises a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching mulitplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

## 9. SAR Safety Limits

| Exposure Limits (General Populations/Uncontrolled Exposure Environment) | SAR (W/Kg) |
|---|---|
| Spatial Peak (averaged over any 1 g of tissue) | 1.600 |

**Note(s):**

1. *OET Bulletin 65 Supplement C SAR safety limits specified in the table above applies to devices operated in the general population / uncontrolled exposure environment.*
2. *Uncontrolled environments are defined as locations where there is exposure of individuals who have no knowledge or control of their exposure.*

## 10. Details of SAR Evaluation

The equipment under test was found to be compliant for localised Specific Absorption Rate (SAR) based on the following provisions and conditions:

a) The Handheld terminal with integrated radio was exercised positioned under the flat section of the phantom.

b) Measurements were performed with the EUT, display facing the phantom, rear facing the facing and side facing the phantom consecutively.

c) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimise the drift.

d) The device was keyed to operate continuously in Tranceive Mode for the duration of the test.

e) The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the EUT and its antenna.

f) The EUT was tested with a fully charged battery.

## 11. Evaluation Procedures

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

a) (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices worn about the ear during normal operation, both the left and right ear positions were evaluated at the centre frequency of the band at maximum power. The side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head worn device relative to the phantom was dictated by FCC OET Bulletin 65 Supplement C.

(ii) For body worn devices or devices which can be operated within 20 cm of the body, the flat section of the phantom was used. The type of device being evaluated dictated the distance of the EUT to the outer surface of the phantom flat section.

b) The SAR was determined by a pre-defined procedure within the DASY4 software. The exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm or appropriate resolution.

c) A 7x7x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.

d) If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

## 12. System Validation

Prior to the assessment, the system was verified in the flat region of the phantom.
A 900 MHz and 1900 MHz dipole were used respectively. A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of ±5% for the 900 MHz and 1900 MHz dipoles. The applicable verification (normalised to 1 Watt) is as follows:

| Dipole Validation Kit | Target SAR 1g (W/kg) | Measured SAR 1g (W/kg) |
|---|---|---|
| D900V2: SN124 | 10.50 | 10.56 |
| D900V2: SN124 | 10.50 | 10.52 |
| D1900V2: SN540 | 39.10 | 38.80 |

## 13. Simulated Tissues

The body mixture consists of water and glycol. Visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

| Ingredient | Frequency |
|---|---|
| | **900 MHz Body** |
| De-Ionised Water | 50.75% |
| Sugar | 48.21% |
| Salt | 0.94% |
| Kathon | 0.10% |

| Ingredient | Frequency |
|---|---|
| | **1900 MHz Body** |
| De-Ionised Water | 69.79% |
| Diglycol Butyl Ether (DGBE) | 30.00% |
| Salt | 0.20% |

## 14. Tissue Parameters

The dielectric parameters of the fluids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an 8753E network analyser. The dielectric parameters of the fluid are as follows:

| Frequency (MHz) | Equivalent Tissue | Dielectric Constant $\varepsilon_r$ | Conductivity $\sigma$ (mho/m) |
|---|---|---|---|
| 900 | Body | 52.39 | 1.00 |
| 1900 | Body | 51.54 | 1.55 |

# 15. DASY4 Systems Specifications

## Robot System

| | |
|---|---|
| **Positioner:** | Stäubli Unimation Corp. Robot Model: RX90L |
| **Repeatability:** | 0.025 mm |
| **No. of Axis:** | 6 |
| **Serial Number:** | F00/SD89A1/A/01 |
| **Reach:** | 1185 mm |
| **Payload:** | 3.5 kg |
| **Control Unit:** | CS7 |
| **Programming Language:** | V+ |

## Data Acquisition Electronic (DAE) System

### Cell Controller

| | |
|---|---|
| **PC:** | Dell Precision 340 |
| **Operating System:** | Windows NT |
| **Data Card:** | DASY4 Measurement Server |
| **Serial Number:** | 1080 |

### Data Converter

| | |
|---|---|
| **Features:** | Signal Amplifier, multiplexer, A/D converter and control logic. |
| **Software:** | DASY4 Software |
| **Connecting Lines:** | Optical downlink for data and status info. Optical uplink for commands and clock. |

## PC Interface Card

| | |
|---|---|
| **Function:** | 24 bit (64 MHz) DSP for real time processing Link to DAE3 16 nit A/D converter for surface detection system serial link to robot direct emergency stop output for robot. |

## E-Field Probe

| | |
|---|---|
| **Model:** | ET3DV6 |
| **Serial No:** | 1528 |
| **Construction:** | Triangular core fibre optic detection system |
| **Frequency:** | 10 MHz to 3 GHz |
| **Linearity:** | ±0.2 dB (30 MHz to 3 GHz) |
| **Probe Length (mm):** | 337 |
| **Probe Diameter (mm):** | 12 |
| **Tip Length (mm):** | 10 |
| **Tip Diameter (mm):** | 6.8 |
| **Sensor X Offset (mm):** | 2.7 |
| **Sensor Y Offset (mm):** | 2.7 |
| **Sensor Z Offset (mm):** | 2.7 |

## Phantom

| | |
|---|---|
| **Phantom:** | SAM Phantom |
| **Shell Material:** | Fibreglass |
| **Thickness:** | 2.0 ±0.1 mm |

# 16. Validation Results – 900 MHz Band (Body)

**Date: 18 January 2006**

## 16.1. System Validation

Validation of the system test configuration was carried out prior to testing.

| Validation Dipole Type and Serial No. | Calibrated Value of SAR in 1g volume (W/kg) at 900 MHz | Measured Value of SAR in 1g volume (W/kg) at 900 MHz | Percentage Difference (≤5%) |
|---|---|---|---|
| D900V2: SN124 | 10.50 | 10.56 | (+0.57%) Yes |

A 900 MHz dipole was used to perform 850 MHz body system validation. This was possible as the device centre frequency is within ±100 MHz of the verification frequency.

## 15.2 Liquid Properties

Properties of the tissue simulating liquid were measured prior to testing.

| Property | Target Value (900 MHz) | Measured/Calculated Value (900 MHz) | Percentage Difference (≤5%) |
|---|---|---|---|
| Relative Permittivity | 55.00 | 52.39 | (+4.74%) Yes |
| Conductivity | 1.05 | 1.00 | (+4.64%) Yes |

## 15.3 Temperature Variation

The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15.0 ºC to +30.0 ºC.

The actual temperature measured at the beginning and end of each test was recorded and the maximum range is shown below:

| Measurement | Maximum Temperature (˚C) | Minimum Temperature (˚C) |
|---|---|---|
| Laboratory | 26.0 | 25.0 |
| Tissue Simulating Liquid | 24.1 | 23.8 |

# 17. Validation Results – 900 MHz Band (Body)

**Date: 20 January 2006**

## 17.1. System Validation

Validation of the system test configuration was carried out prior to testing.

| Validation Dipole Type and Serial No. | Calibrated Value of SAR in 1g volume (W/kg) at 900 MHz | Measured Value of SAR in 1g volume (W/kg) at 900 MHz | Percentage Difference (≤5%) |
|---|---|---|---|
| D900V2: SN124 | 10.50 | 10.52 | (+0.19%) Yes |

A 900 MHz dipole was used to perform 850 MHz body system validation. This was possible as the device centre frequency is within ±100 MHz of the verification frequency.

## 16.2. Liquid Properties

Properties of the tissue simulating liquid were measured prior to testing.

| Property | Target Value (900 MHz) | Measured/Calculated Value (900 MHz) | Percentage Difference (≤5%) |
|---|---|---|---|
| Relative Permittivity | 55.00 | 52.39 | (+4.74%) Yes |
| Conductivity | 1.05 | 1.00 | (+4.64%) Yes |

## 16.3. Temperature Variation

The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15.0 ºC to +30.0 ºC.

The actual temperature measured at the beginning and end of each test was recorded and the maximum range is shown below:

| Measurement | Maximum Temperature (˚C) | Minimum Temperature (˚C) |
|---|---|---|
| Laboratory | 26.0 | 25.0 |
| Tissue Simulating Liquid | 24.3 | 23.8 |

# 18. Validation Results – 1900 MHz Band (Body)

**Date: 19 January 2006**

## 18.1. System Validation

Validation of the system test configuration was carried out prior to testing.

| Validation Dipole Type and Serial No. | Calibrated Value of SAR in 1g volume (W/kg) at 1900 MHz | Measured Value of SAR in 1g volume (W/kg) at 1900 MHz | Percentage Difference (≤5%) |
|---|---|---|---|
| D1900V2: SN540 | 39.10 | 38.80 | (-0.77%) Yes |

## 16.2. Liquid Properties

Properties of the tissue simulating liquid were measured prior to testing.

| Property | Target Value (1900 MHz) | Measured/Calculated Value (1900 MHz) | Percentage Difference (≤5%) |
|---|---|---|---|
| Relative Permittivity | 53.30 | 51.54 | (-3.30%) Yes |
| Conductivity | 1.52 | 1.55 | (+2.04%) Yes |

## 16.3. Temperature Variation

The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15.0 ºC to +30.0 ºC.

The actual temperature measured at the beginning and end of each test was recorded and the maximum range is shown below:

| Measurement | Maximum Temperature (˚C) | Minimum Temperature (˚C) |
|---|---|---|
| Laboratory | 26.0 | 25.0 |
| Tissue Simulating Liquid | 24.0 | 23.8 |

## 19. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

| Measurement Type | Range | Confidence Level | Calculated Uncertainty |
|---|---|---|---|
| Specific Absorption Rate | 850 MHz | 95% | ± 17.12 |
| Specific Absorption Rate | 1900 MHz | 95% | ± 17.12 |

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environment. However, the estimated measurement uncertainties in SAR are less than 30%.

According to ANSI/IEEE C95.3, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy’s of ±1 to 3 dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least ±2 dB can be expected.

According to CENELEC, typical worst-case uncertainty of field measurements is ±5 dB. For well-defined modulation characteristics the uncertainty can be reduced to ±3 dB.

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## Measurement Uncertainty (Continued)

### Specific Absorption Rate Uncertainty at 850 MHz, GSM Modulation Scheme calculated in accordance with IEEE 1528-200X

| Type | Source of uncertainty | + Value | - Value | Probability Distribution | Divisor | $c_i$ | Standard Uncertainty | | $\upsilon_i$ or $\upsilon_{eff}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | + u (dBµV) | - u (dBµV) | |
| B | Probe calibration | 8.900 | 8.900 | normal (k=2) | 2.0000 | 1.0000 | 4.450 | 4.450 | ∞ |
| B | Axial Isotropy | 0.100 | 0.100 | normal (k=2) | 2.0000 | 1.0000 | 0.050 | 0.050 | ∞ |
| B | Hemispherical Isotropy | 0.100 | 0.100 | normal (k=2) | 2.0000 | 1.0000 | 0.050 | 0.050 | ∞ |
| B | Spatial Resolution | 0.500 | 0.500 | Rectangular | 1.7321 | 1.0000 | 0.289 | 0.289 | ∞ |
| B | Boundary Effect | 0.769 | 0.769 | Rectangular | 1.7321 | 1.0000 | 0.444 | 0.444 | ∞ |
| B | Linearity | 2.330 | 2.330 | Rectangular | 1.7321 | 1.0000 | 1.345 | 1.345 | ∞ |
| B | Detection Limits | 0.200 | 0.200 | Rectangular | 1.7321 | 1.0000 | 0.115 | 0.115 | ∞ |
| B | Readout Electronics | 0.650 | 0.650 | normal (k=2) | 2.0000 | 1.0000 | 0.325 | 0.325 | ∞ |
| B | Response Time | 0.000 | 0.000 | Rectangular | 1.7321 | 1.0000 | 0.000 | 0.000 | ∞ |
| B | Integration Time | 0.005 | 0.005 | Rectangular | 1.7321 | 1.0000 | 0.003 | 0.003 | ∞ |
| B | RF Ambinet conditions | 3.000 | 3.000 | Rectangular | 1.7321 | 1.0000 | 1.732 | 1.732 | ∞ |
| B | Probe Positioner Mechanical Restrictions | 4.000 | 4.000 | Rectangular | 1.7321 | 1.0000 | 2.309 | 2.309 | ∞ |
| B | Probe Positioning with regard to Phantom Shell | 2.850 | 2.850 | Rectangular | 1.7321 | 1.0000 | 1.645 | 1.645 | ∞ |
| B | Extrapolation and integration/ Maximum SAR evaluation | 5.080 | 5.080 | Rectangular | 1.7321 | 1.0000 | 2.933 | 2.933 | ∞ |
| A | Test Sample Positioning | 0.584 | 0.584 | normal (k=1) | 1.0000 | 1.0000 | 0.584 | 0.584 | 10 |
| A | Device Holder uncertainty | 0.154 | 0.154 | normal (k=1) | 1.0000 | 1.0000 | 0.154 | 0.154 | 10 |
| B | Phantom Uncertainty | 4.000 | 4.000 | Rectangular | 1.7321 | 1.0000 | 2.309 | 2.309 | ∞ |
| B | Drit of output power | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| B | Liquid Conductivity (target value) | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| B | Liquid Conductivity (measured value) | 2.440 | 2.440 | Rectangular | 1.7321 | 1.0000 | 1.409 | 1.409 | ∞ |
| B | Liquid Permittivity (target value) | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| B | Liquid Permittivity (measured value) | 2.440 | 2.440 | Rectangular | 1.7321 | 1.0000 | 1.409 | 1.409 | ∞ |
| | Combined standard uncertainty | | | t-distribution | | | 8.74 | 8.74 | >500 |
| | Expanded uncertainty | | | k = 1.96 | | | 17.12 | 17.12 | >500 |

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**Measurement Uncertainty (Continued)**

## Specific Absorption Rate Uncertainty at 1900 MHz, GSM Modulation Scheme calculated in accordance with IEEE 1528-200X

| Type | Source of uncertainty | + Value | - Value | Probability Distribution | Divisor | $c_i$ | Standard Uncertainty | | $\upsilon_i$ or $\upsilon_{eff}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | + u (dBµV) | - u (dBµV) | |
| B | Probe calibration | 8.900 | 8.900 | normal (k=2) | 2.0000 | 1.0000 | 4.450 | 4.450 | ∞ |
| B | Axail Isotropy | 0.100 | 0.100 | normal (k=2) | 2.0000 | 1.0000 | 0.050 | 0.050 | ∞ |
| B | Hemispherical Isotropy | 0.100 | 0.100 | normal (k=2) | 2.0000 | 1.0000 | 0.050 | 0.050 | ∞ |
| B | Spatial Resolution | 0.500 | 0.500 | Rectangular | 1.7321 | 1.0000 | 0.289 | 0.289 | ∞ |
| B | Boundary Effect | 0.769 | 0.769 | Rectangular | 1.7321 | 1.0000 | 0.444 | 0.444 | ∞ |
| B | Linearity | 2.330 | 2.330 | Rectangular | 1.7321 | 1.0000 | 1.345 | 1.345 | ∞ |
| B | Detection Limits | 0.200 | 0.200 | Rectangular | 1.7321 | 1.0000 | 0.115 | 0.115 | ∞ |
| B | Readout Electronics | 0.650 | 0.650 | normal (k=2) | 2.0000 | 1.0000 | 0.325 | 0.325 | ∞ |
| B | Response Time | 0.000 | 0.000 | Rectangular | 1.7321 | 1.0000 | 0.000 | 0.000 | ∞ |
| B | Integration Time | 0.005 | 0.005 | Rectangular | 1.7321 | 1.0000 | 0.003 | 0.003 | ∞ |
| B | RF Ambinet conditions | 3.000 | 3.000 | Rectangular | 1.7321 | 1.0000 | 1.732 | 1.732 | ∞ |
| B | Probe Positioner Mechanical Restrictions | 4.000 | 4.000 | Rectangular | 1.7321 | 1.0000 | 2.309 | 2.309 | ∞ |
| B | Probe Positioning with regard to Phantom Shell | 2.850 | 2.850 | Rectangular | 1.7321 | 1.0000 | 1.645 | 1.645 | ∞ |
| B | Extrapolation and integration/ Maximum SAR evaluation | 5.080 | 5.080 | Rectangular | 1.7321 | 1.0000 | 2.933 | 2.933 | ∞ |
| A | Test Sample Positioning | 0.584 | 0.584 | normal (k=1) | 1.0000 | 1.0000 | 0.584 | 0.584 | 10 |
| A | Device Holder uncertainty | 0.154 | 0.154 | normal (k=1) | 1.0000 | 1.0000 | 0.154 | 0.154 | 10 |
| B | Phantom Uncertainty | 4.000 | 4.000 | Rectangular | 1.7321 | 1.0000 | 2.309 | 2.309 | ∞ |
| B | Drit of output power | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| B | Liquid Conductivity (target value) | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| B | Liquid Conductivity (measured value) | 2.440 | 2.440 | Rectangular | 1.7321 | 1.0000 | 1.409 | 1.409 | ∞ |
| B | Liquid Permittivity (target value) | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| B | Liquid Permittivity (measured value) | 2.440 | 2.440 | Rectangular | 1.7321 | 1.0000 | 1.409 | 1.409 | ∞ |
| | Combined standard uncertainty | | | t-distribution | | | 8.74 | 8.74 | >500 |
| | Expanded uncertainty | | | k = 1.96 | | | 17.12 | 17.12 | >500 |

## Appendix 1. Test Equipment Used

| RFI No. | Instrument | Manufacturer | Type No. | Serial No. |
|---|---|---|---|---|
| A034 | Narda 20W Termination | Narda | 374BNM | 8706 |
| A1094 | Sony MVC FD-81 | Sony | MVC - FD81 | 125805 |
| A1097 | SMA Directional Coupler | MiDISCO | MDC6223-30 | None |
| A1174 | Dielectric Probe Kit | Agilent Technologies | 85070C | Us99360072 |
| A1185 | Probe | Schmid & Partner | ET3 DV6 | 1528 |
| A1234 | Data Acquisition Electronics | Schmid & Partner | DAE3 | 450 |
| A1235 | 900MHz Validation Dipole | Schmid & Partner | D900V2 | 124 |
| A1237 | 1900MHz Validation Dipole | Schmid & Partner | D1900V2 | 540 |
| A1238 | SAM Phantom | Schmid & Partner | 001 | 001 |
| A1410 | DC -4 GHz 3 dB | Omni Spectra | FSC 16179 | 20510-3 |
| A1497 | Amplifier | Mini-Circuits | zhl-42w (sma) | e020105 |
| A1566 | SAM Phantom | SPEAG | 002 | 002 |
| A215 | 20 dB Attenuator | Narda | 766-20 | 9402 |
| C1092 | Cable | RS | 293-334 | 1087200-3 3402 |
| C1144 | Cable | Rosenberger MICRO-COAX | FA147AF001503030 | 41842-1 |
| C1145 | Cable | Rosenberger MICRO-COAX | FA147AF003003030 | 41843-1 |
| C1146 | Cable | Rosenberger MICRO-COAX | FA147AF030003030 | 41752-1 |
| G051 | Signal Generator | Gigatronics | 7100/.01-20 | 749472 |
| G058 | Microphone Amplifier Kit | Bruel & Kjaer | 2639 | 1677113 |
| G087 | PSU | Thurlby Thandar | CPX200 | 100701 |
| M010 | NRV Power Meter | Rohde & Schwarz | NRV | 882 317/065 |
| M1015 | Network Analyser | Agilent Technologies | 8753ES | US39172406 |
| M1047 | Robot Arm | Staubli | RX908 L | F00/SD89A1/A/01 |
| M1069 | Diode Power Sensor | Rohde & Schwarz | NRV-Z2 | 838824/010 |
| M1129 | Insertion Unit | Rohde & Schwarz | URY-Z2 | 890242/16 |

## Test Equipment Used (Continued)

| RFI No. | Instrument | Manufacturer | Type No. | Serial No. |
|---|---|---|---|---|
| M1138 | CMU 200 | Rohde & Schwarz | CMU 200-1100.0008.02 | 836202/093 |
| M136 | Temperature/Humidity/ Pressure Meter | RS Components | None | None |
| M509 | Thermometer | Testo | 110 | 40378800433 |
| S256 | Site 56 | RFI | N/A | N/A |

**NB** In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.