



# TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Intel Mobile Communications Division  
PRO/Wireless GPRS 3110 PC Card

To: FCC Part 24: 2001 and FCC Part 15: 2001

**Test Report Serial No:**  
RFI/MPTB1/RP70438JD06A

|                                                                                                                                                                                           |                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>This Test Report Is Issued Under The Authority<br/>Of Richard Jacklin, Operations Director:</b><br> | <b>Checked By:</b><br> |
| <b>Tested By:</b><br><br><b>PP.</b>                                                                    | <b>Release Version No: PDF01</b>                                                                           |
| <b>Issue Date: 27 November 2002</b>                                                                                                                                                       | <b>Test Dates: 20 October to 07 November 2002</b>                                                          |

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The results in this report apply only to the sample(s) tested.

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**TEST REPORT**

**Conformance Testing Department**

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## **1. Client Information**

|                      |                                                                           |
|----------------------|---------------------------------------------------------------------------|
| <b>Company Name:</b> | INTEL Mobile Communications Division                                      |
| <b>Address:</b>      | 1357 Garden of the Gods Road – XG1<br>Colorado Springs<br>CO 80903<br>USA |
| <b>Contact Name:</b> | Mr J Youngman                                                             |

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## **2. Equipment Under Test (EUT)**

The following information has been supplied by the client:

### **2.1. Identification Of Equipment Under Test (EUT)**

|                                    |                 |
|------------------------------------|-----------------|
| <b>Brand Name:</b>                 | Intel ®         |
| <b>Model Name or Number:</b>       | PRO/Wireless    |
| <b>Unique Type Identification:</b> | IG3110          |
| <b>Serial Number:</b>              | 0010220004296   |
| <b>Country of Manufacture:</b>     | Malaysia        |
| <b>FCC ID Number:</b>              | PUKIG3110       |
| <b>Date of Receipt:</b>            | 20 October 2002 |

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## **2.2. Description Of EUT**

The equipment under test is a GSM/GPRS terminal in a PC-Card (PCMCIA) form factor, intended for use in PC-compatible notebook computers.

Features of this product included:

Tri-band 900/1800/1900 functionality. (Note: Only the 1900 Band is available inside the USA)

GPRS – Type 1, Class B, multishot class 10 operation.

Full GSM CSD functionality – single slot data, SMS, etc.

Full GSM voice functionality with use of removable external headset,

Detachable Antenna, Host PC Applications / drivers to enable voice and data functionality, including phone dialler, SMS handler, email and internet interface, and so forth.

## **2.3. Modifications Incorporated In EUT**

The EUT has not been modified from what is described by the Model Name and Unique Type Identification stated above.

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**2.4. Additional Information Related To Testing**

|                                                                          |                                                                                                       |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Power Supply Requirement:<br/>(non-removable lithium ion battery)</b> | Powered by host notebook PC (3.3 V)                                                                   |
| <b>Power Supply Requirement:<br/>(AC Battery Charger)</b>                | Nominal 115 V, 60 Hz Ac Mains Supply 13 Amp (max)<br>Source to Notebook.                              |
| <b>Intended Operating Environment:</b>                                   | Residential, Commercial, light industrial (suitable for<br>notebook PC use)                           |
| <b>Equipment Category:</b>                                               | PCMICA Card                                                                                           |
| <b>Type of Unit:</b>                                                     | PCS Terminal                                                                                          |
| <b>Weight:</b>                                                           | 45 g                                                                                                  |
| <b>Dimensions:</b>                                                       | 11.5 x 5.5 x 1.5 cm (Type 2 PC Card with external "cab").                                             |
| <b>Interface Ports:</b>                                                  | Enclosure (extended Type 2)<br>RF (semi-custom connector, removable antenna)<br>Headset (3.5 mm jack) |
| <b>Transmit Frequency</b>                                                | 1850 MHz to 1910 MHz                                                                                  |
| <b>Receive Frequency</b>                                                 | 1930 MHz to 1990 MHz                                                                                  |
| <b>Maximum Power Output</b>                                              | 28.6 dBm                                                                                              |

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**2.5. Support Equipment**

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

|                              |              |
|------------------------------|--------------|
| <b>Description:</b>          | Laptop       |
| <b>Brand Name:</b>           | IBM          |
| <b>Model Name or Number:</b> | Thinkpad 600 |
| <b>Serial Number:</b>        | 78-DUY75     |
| <b>Connected to Port:</b>    | PCMCIA       |

|                              |                |
|------------------------------|----------------|
| <b>Description:</b>          | Laptop         |
| <b>Brand Name:</b>           | Toshiba        |
| <b>Model Name or Number:</b> | Satellite S221 |
| <b>Serial Number:</b>        | 72100202IP     |
| <b>Connected to Port:</b>    | PCMCIA         |

|                              |                          |
|------------------------------|--------------------------|
| <b>Description:</b>          | Laptop                   |
| <b>Brand Name:</b>           | DELL                     |
| <b>Model Name or Number:</b> | Latitude C600/C500       |
| <b>Serial Number:</b>        | TW-09C748-12800-17Q-6510 |
| <b>Connected to Port:</b>    | PCMCIA                   |

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**Support Equipment (continued)**

|                              |                                    |
|------------------------------|------------------------------------|
| <b>Description:</b>          | Dell Power Supply                  |
| <b>Brand Name:</b>           | DELL                               |
| <b>Model Name or Number:</b> | AA20031                            |
| <b>Serial Number:</b>        | CN-09364U-16291-16K 04TN           |
| <b>Cable Length and Type</b> | 3 m ( 1.5 m twin mains / 1.5 twin) |
| <b>Connected to Port:</b>    | DC Power in                        |

|                              |                                    |
|------------------------------|------------------------------------|
| <b>Description:</b>          | IBM Power Supply                   |
| <b>Brand Name:</b>           | IBM                                |
| <b>Model Name or Number:</b> | 02K6810                            |
| <b>Serial Number:</b>        | 11502K6810ZIZ3BJZ4A5GE             |
| <b>Cable Length and Type</b> | 3 m ( 1.5 m twin mains / 1.5 twin) |
| <b>Connected to Port:</b>    | DC Power in                        |

|                              |                                    |
|------------------------------|------------------------------------|
| <b>Description:</b>          | Toshiba Power Supply               |
| <b>Brand Name:</b>           | Toshiba                            |
| <b>Model Name or Number:</b> | PA3201U-1ACA 5ED100P2-150          |
| <b>Serial Number:</b>        | 02671577                           |
| <b>Cable Length and Type</b> | 3 m ( 1.5 m twin mains / 1.5 twin) |
| <b>Connected to Port:</b>    | DC Power in                        |

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**Support Equipment (continued)**

|                              |                        |
|------------------------------|------------------------|
| <b>Description:</b>          | RS252 Adaptor          |
| <b>Brand Name:</b>           | Intel                  |
| <b>Model Name or Number:</b> | Cougar 11              |
| <b>Serial Number:</b>        | #102                   |
| <b>Cable Length and Type</b> | 3 m 9 Pin Serial Cable |
| <b>Connected to Port:</b>    | Serial (Com 1)         |

|                              |                |
|------------------------------|----------------|
| <b>Description:</b>          | Hands Free Kit |
| <b>Brand Name:</b>           | Intel          |
| <b>Model Name or Number:</b> | None stated    |
| <b>Serial Number:</b>        | None stated    |
| <b>Cable Length and Type</b> | 1.5 m Audio    |
| <b>Connected to Port:</b>    | Headphone      |

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### **3. Test Specification, Methods And Procedures**

#### **3.1. Test Specifications**

|                         |                                                                                                                           |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Reference:</b>       | FCC Part 24: 2001 Sections 24.232, 24.235, 24.238                                                                         |
| <b>Title:</b>           | Code of Federal Regulations, Part 24 (47CFR)<br>Personal Communication Services.                                          |
| <b>Comments:</b>        | None.                                                                                                                     |
| <b>Purpose of Test:</b> | To determine whether the equipment complied with the requirements of the specification for the purposes of certification. |

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**Test Specifications (continued)**

|                         |                                                                                                                              |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference:</b>       | FCC Part 2: 2001 Sections 2.1046 2.1049 2.1051 2.1053 2.1055                                                                 |
| <b>Title:</b>           | Code of Federal Regulations, Part 2 (47CFR)<br>Frequency allocations and radio treaty matters; General Rules and Regulations |
| <b>Comments:</b>        | None.                                                                                                                        |
| <b>Purpose of Test:</b> | To determine whether the equipment complied with the requirements of the specification for the purposes of certification.    |

|                         |                                                                                                                                                                                       |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference:</b>       | FCC Part 15: 2001 Class B, Sections: 15.107 and 15.109                                                                                                                                |
| <b>Title:</b>           | Code of Federal Regulations, Part 15 (47CFR)<br>Radio Frequency Devices: Digital Devices.                                                                                             |
| <b>Comments:</b>        | A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules. |
| <b>Purpose of Test:</b> | To determine whether the equipment complied with the requirements of the specification for the purposes of certification.                                                             |

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### **3.2. Methods And Procedures**

The methods and procedures used were as detailed in:

47CFR: Part 24 (2001)

Title: Federal Communications Commission: Code of Federal Regulations 47:  
Personal Communication Services.

47CFR: Part 15 (2001)

Title: Federal Communications Commission: Code of Federal Regulations 47:  
Telecommunication

47CFR: Part 2 (2001)

Title: Federal Communications Commission: Code of Federal Regulations 47:  
Telecommunication

ANSI C63.2 (1996)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2001)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1998)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1 (1999)

Title: Specification for radio disturbance and immunity measuring apparatus and methods. Part 1. Radio disturbance and immunity measuring apparatus.

### **3.3. Definition Of Measurement Equipment**

The measurement equipment used complied with the requirements of the standards referenced in the Methods & Procedures section above. Appendix 1 contains a list of the test equipment used.

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#### **4. Deviations From The Test Specification**

None.

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## **5. Operation Of The EUT During Testing**

### **5.1. Operating Conditions**

The EUT was tested in a normal laboratory environment.

### **5.2. Operating Modes**

The EUT was tested in the following operating modes:

Normal operation – GSM call established (transmit & receive).

Idle/Standby – no call established.

### **5.3. Configuration and Peripherals**

The EUT was tested in the following configuration:

The EUT was tested installed in three separate representative host laptops all with headsets connected.

For all tests the EUT was connected to a GSM test set either by direct connection or via an air link.

The EUT was powered from one of three laptops via an 115 VAC adapter.

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## **6. Summary Of Test Results**

### **6.1. Transmit Mode**

| <b>Range Of Measurements</b>                    | <b>Specification Reference</b>                 | <b>Mode of Operation</b> | <b>Port Type</b>  | <b>Compliance Status</b> |
|-------------------------------------------------|------------------------------------------------|--------------------------|-------------------|--------------------------|
| Conducted RF Output Power (PCS 1900 Mode)       | Part 24 of CFR 47: 2001, Section 2.1046(a)     | Transmit                 | Antenna Terminals | Complied                 |
| Carrier Output Power (EIRP)                     | Part 24 of CFR 47: 2001, Section 24.232(b)     | Transmit                 | Antenna           | Complied                 |
| Frequency Stability (Temperature Variation)     | Part 24 of CFR 47: 2001, Section 2.1055/24.235 | Transmit                 | Antenna Terminals | Complied                 |
| Frequency Stability (Voltage Variation)         | Part 24 of CFR 47: 2001, Section 2.1055/24.235 | Transmit                 | Antenna Terminals | Complied                 |
| Occupied Bandwidth                              | Part 24 of CFR 47: 2001, Section 2.1049 (i)    | Transmit                 | Antenna Terminals | Complied                 |
| Emissions at Band Edges                         | Part 24 of CFR 47: 2001, Section 24.238        | Transmit                 | Antenna Terminals | Complied                 |
| Emissions at Band Edges                         | Part 2 of CFR 47: 2001, Section 2.1053         | Transmit                 | Antenna           | Complied                 |
| Emissions Outside of Authorised Frequency Block | Part 24 of CFR 47: 2001, Section 2.1051/24.238 | Transmit                 | Antenna Terminals | Complied                 |

### **6.2. Receive Mode**

| <b>Range Of Measurements</b>                                     | <b>Specification Reference</b>          | <b>Mode of Operation</b> | <b>Port Type</b> | <b>Compliance Status</b> |
|------------------------------------------------------------------|-----------------------------------------|--------------------------|------------------|--------------------------|
| Electric Field Strength, Radiated Emissions (30 MHz to 1000 MHz) | Part 15 of CFR 47: 2001, Section 15.109 | Receive                  | Enclosure        | Complied                 |
| Electric Field Strength, Spurious Emissions (1 GHz to 10.0 GHz)  | Part 15 of CFR 47: 2001, Section 15.109 | Receive                  | Enclosure        | Complied                 |
| Conducted Emissions (450 kHz to 30 MHz)                          | Part 15 of CFR 47: 2001, Section 15.107 | Transmit                 | AC Mains Input   | Complied                 |

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### **6.3. Location Of Tests**

All the measurements described in this report were performed at the premises of Radio Frequency Investigation Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

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## **7. Measurements, Examinations And Derived Results**

### **7.1. General Comments**

7.1.1. This section contains test results only.

7.1.2. 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 8 for details of measurement uncertainties.

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**7.2. Conducted RF Output Power: Section 2.1046(a)**

7.2.1. The EUT, spectrum analyser and GSM test set were configured for conducted port measurements.

7.2.2. Tests were performed to identify the maximum transmit power in accordance with FCC Part 2.1046(a) for conducted power.

7.2.3. Results are shown for the EUT set to Bottom, Middle and Top channels using a Dell Laptop as Host PC.

**Results:**

| Channel | Frequency (MHz) | Level (dBm) | Limit (dBm) | Margin | Result   |
|---------|-----------------|-------------|-------------|--------|----------|
| Bottom  | 1.85022         | 28.50       | 33.00       | 4.50   | Complied |
| Middle  | 1.87972         | 28.60       | 33.00       | 4.40   | Complied |
| Top     | 1.90983         | 27.97       | 33.00       | 5.03   | Complied |

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**7.3. Carrier Output Power (EIRP):- Section 24.232(b)**

7.3.1. Tests were performed to identify the maximum transmit power in accordance with FCC Part 24.232(b) for EIRP.

7.3.2. Results are shown for the EUT set to Bottom, Middle and Top channels using 3 host configurations.

**Results: IBM Laptop**

| Channel | Frequency (MHz) | Antenna Polarity (H/V) | Level EIRP (dBm) | Limit EIRP (dBm) | Margin | Result   |
|---------|-----------------|------------------------|------------------|------------------|--------|----------|
| Bottom  | 1850.32         | Vert.                  | 25.94            | 33.00            | 7.06   | Complied |
| Middle  | 1879.70         | Vert.                  | 26.06            | 33.00            | 6.94   | Complied |
| Top     | 1909.83         | Vert.                  | 26.76            | 33.00            | 6.24   | Complied |

**Results: DELL Laptop**

| Channel | Frequency (MHz) | Antenna Polarity (H/V) | Level EIRP (dBm) | Limit EIRP (dBm) | Margin | Result   |
|---------|-----------------|------------------------|------------------|------------------|--------|----------|
| Bottom  | 1850.33         | Vert.                  | 26.53            | 33.00            | 6.47   | Complied |
| Middle  | 1879.80         | Vert.                  | 25.57            | 33.00            | 7.43   | Complied |
| Top     | 1909.87         | Horiz.                 | 26.68            | 33.00            | 6.32   | Complied |

**Results: TOSHIBA Laptop**

| Channel | Frequency (MHz) | Antenna Polarity (H/V) | Level EIRP (dBm) | Limit EIRP (dBm) | Margin | Result   |
|---------|-----------------|------------------------|------------------|------------------|--------|----------|
| Bottom  | 1850.30         | Vert.                  | 26.08            | 33.00            | 6.92   | Complied |
| Middle  | 1879.78         | Horiz.                 | 25.14            | 33.00            | 7.86   | Complied |
| Top     | 1909.81         | Horiz.                 | 26.14            | 33.00            | 6.86   | Complied |

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**7.4. Frequency Stability Measurements: (Temperature and Voltage Variation):  
Sections 2.1055/24.235**

7.4.1. The EUT and GSM communication test set were configured for conducted antenna port measurements.

7.4.2. Measurements were performed to determine the frequency stability of the fundamental emission from the EUT, when subjected to variation of ambient temperature and variation of supply voltage.

7.4.3. The ambient temperature was varied from -30°C to +50°C in 10°C steps. During the test the fundamental frequency of the EUT shall stay within the declared frequency block.

7.4.4. The ppm frequency error is calculated using the following formulae taken from the TIA\_EIA\_603A document.

$$\text{ppm error} = \left( \frac{MCF_{\text{MHz}}}{ACF_{\text{MHz}}} - 1 \right) * 10^6$$

where  $MCF_{\text{MHz}}$  is the measured carrier frequency in MHz  
 $ACF_{\text{MHz}}$  is the assigned carrier frequency in MHz

7.4.5. The limit to the lower band edge from the bottom channel and the limit to the upper band edge from the top channel was calculated in ppm. The actual error in ppm is then calculated and subtracted from the calculated limit. If the margin was less than 0 the frequency would be outside of the authorised frequency block.

7.4.6. The client has stated that the authorised frequency block is:-

|                  |          |
|------------------|----------|
| Lower Block Edge | 1850 MHz |
| Upper Block Edge | 1910 MHz |

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**Frequency Stability Measurements: (continued)****Results: Bottom Channel (1850.20 MHz)**

| Temperature (°C) | DC Input Voltage (Volts) | Absolute Peak Frequency Error (Hz) | Frequency Error (ppm) | Limit to band Edge (ppm) | Margin (ppm) | Result   |
|------------------|--------------------------|------------------------------------|-----------------------|--------------------------|--------------|----------|
| -30              | 3.0                      | 0.000054                           | 0.029                 | 108.108                  | 108.079      | Complied |
|                  | 3.6                      | 0.000032                           | 0.017                 | 108.108                  | 108.091      | Complied |
| -20              | 3.0                      | 0.000035                           | 0.019                 | 108.108                  | 108.089      | Complied |
|                  | 3.6                      | 0.000012                           | 0.006                 | 108.108                  | 108.102      | Complied |
| -10              | 3.0                      | 0.000040                           | 0.022                 | 108.108                  | 108.086      | Complied |
|                  | 3.6                      | 0.000042                           | 0.022                 | 108.108                  | 108.086      | Complied |
| +0               | 3.0                      | 0.000022                           | 0.012                 | 108.108                  | 108.096      | Complied |
|                  | 3.6                      | 0.000024                           | 0.013                 | 108.108                  | 108.095      | Complied |
| +10              | 3.0                      | 0.000026                           | 0.014                 | 108.108                  | 108.094      | Complied |
|                  | 3.6                      | 0.000017                           | 0.009                 | 108.108                  | 108.099      | Complied |
| +20              | 3.0                      | 0.000021                           | 0.012                 | 108.108                  | 108.097      | Complied |
|                  | 3.6                      | 0.000023                           | 0.012                 | 108.108                  | 108.096      | Complied |
| +30              | 3.0                      | 0.000034                           | 0.018                 | 108.108                  | 108.090      | Complied |
|                  | 3.6                      | 0.000039                           | 0.021                 | 108.108                  | 108.087      | Complied |
| +40              | 3.0                      | 0.000023                           | 0.012                 | 108.108                  | 108.096      | Complied |
|                  | 3.6                      | 0.000029                           | 0.016                 | 108.108                  | 108.093      | Complied |
| +50              | 3.0                      | 0.000027                           | 0.015                 | 108.108                  | 108.093      | Complied |
|                  | 3.6                      | 0.000033                           | 0.018                 | 108.108                  | 108.091      | Complied |

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**Frequency Stability Measurements: (continued)****Results: Top Channel (1909.80 MHz)**

| Temperature (°C) | DC Input Voltage (Volts) | Absolute Peak Frequency Error (Hz) | Frequency Error (ppm) | Limit (ppm) | Margin (ppm) | Result   |
|------------------|--------------------------|------------------------------------|-----------------------|-------------|--------------|----------|
| -30              | 3.0                      | 0.000038                           | 0.020                 | 104.712     | 104.692      | Complied |
|                  | 3.6                      | 0.000019                           | 0.010                 | 104.712     | 104.702      | Complied |
| -20              | 3.0                      | 0.000038                           | 0.020                 | 104.712     | 104.692      | Complied |
|                  | 3.6                      | 0.000056                           | 0.029                 | 104.712     | 104.683      | Complied |
| -10              | 3.0                      | 0.000037                           | 0.019                 | 104.712     | 104.693      | Complied |
|                  | 3.6                      | 0.000052                           | 0.027                 | 104.712     | 104.685      | Complied |
| +0               | 3.0                      | 0.000014                           | 0.007                 | 104.712     | 104.705      | Complied |
|                  | 3.6                      | 0.000021                           | 0.011                 | 104.712     | 104.701      | Complied |
| +10              | 3.0                      | 0.000039                           | 0.021                 | 104.712     | 104.692      | Complied |
|                  | 3.6                      | 0.000030                           | 0.016                 | 104.712     | 104.696      | Complied |
| +20              | 3.0                      | 0.000042                           | 0.022                 | 104.712     | 104.690      | Complied |
|                  | 3.6                      | 0.000023                           | 0.012                 | 104.712     | 104.700      | Complied |
| +30              | 3.0                      | 0.000044                           | 0.023                 | 104.712     | 104.689      | Complied |
|                  | 3.6                      | 0.000028                           | 0.015                 | 104.712     | 104.697      | Complied |
| +40              | 3.0                      | 0.000038                           | 0.020                 | 104.712     | 104.692      | Complied |
|                  | 3.6                      | 0.000039                           | 0.020                 | 104.712     | 104.692      | Complied |
| +50              | 3.0                      | 0.000021                           | 0.011                 | 104.712     | 104.701      | Complied |
|                  | 3.6                      | 0.000018                           | 0.009                 | 104.712     | 104.703      | Complied |

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**7.5. Transmitter Conducted Measurements: (Occupied Bandwidth): Sections 2.1049 (i)**

7.5.1. The EUT and spectrum analyser were configured for conducted antenna port measurements.

7.5.2. The device was operating in its normal mode of operation.

7.5.3. Measurements were performed to determine the Occupied Bandwidth in accordance with FCC Part 2.1049. The Occupied Bandwidth was measured from the fundamental emission at the bottom, middle and top channels.

7.5.4. The Occupied Bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB spectrum analyser. It was set to measure the bandwidth where 99% of the signal power was contained. The analyser settings were set as per those outlined in the FSEB user manual for this measurement, i.e., RBW  $\leq$  1/20 of occupied bandwidth.

**Results:**

| Channel      | Frequency (MHz) | Resolution Bandwidth (kHz) | Video Bandwidth (kHz) | Occupied Bandwidth (kHz) |
|--------------|-----------------|----------------------------|-----------------------|--------------------------|
| Bottom (512) | 1850.2          | 3                          | 10                    | 297.7                    |
| Middle (660) | 1879.8          | 3                          | 10                    | 296.6                    |
| Top (810)    | 1909.8          | 3                          | 10                    | 294.2                    |

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**7.6. Transmitter Conducted Measurements: (Emissions at Band Edges):  
Section 24.238**

7.6.1. The EUT and spectrum analyser were configured as for conducted antenna port measurements.

7.6.2. A temporary antenna port was provided by the applicant to allow for conducted measurements.

7.6.3. FCC Part 24.238 states that emissions shall be attenuated by at least  $43 + 10 \log(P)$  dB below the transmitter power (P), where (P) is the power measured at the EUT antenna terminals.

7.6.4. FCC Part 24.238 also states that the 1<sup>st</sup> MHz band immediately adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. This bandwidth was found to be 3 kHz.

7.6.5. The highest level within these 1 MHz bands was thus measured and recorded in the tables below.

7.6.6. The spurious attenuation level in dB is described in TIA\_EIA\_603A and is defined as: -

$$\text{dB} = 10 \log_{10} \left( \frac{\text{TX power in watts}}{0.001} \right) - \text{spurious level (dBm)}$$

**Results:**

| Frequency (MHz) | Peak Emission Level (dBm) | Spurious Attenuation (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|---------------------------|----------------------------|-------------|-------------|----------|
| 1850.000        | -15.89                    | 44.38                      | 41.50       | 1.88        | Complied |
| 1910.000        | -17.69                    | 45.66                      | 40.97       | 4.69        | Complied |

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**7.7. Transmitter Conducted Measurements: (Emissions Outside of Authorised Frequency Block): Section 2.1051/24.238**

7.7.1. The EUT and spectrum analyser were configured as for conducted antenna port measurements.

7.7.2. FCC Part 24.238 states that emissions shall be attenuated by at least  $43 + 10 \log(P)$  dB below the transmitter power (P), where (P) is the power measured at the EUT antenna terminals in each channel.

**Results:**

| Channel | Frequency (MHz) | Peak Emission Level (dBm) | Spurious Attenuation (dBc) | Limit (dBc) | Margin (dB) | Result   |
|---------|-----------------|---------------------------|----------------------------|-------------|-------------|----------|
| Bottom  | 895.456         | -45.50                    | 74.00                      | 41.5        | 32.50       | Complied |
| Middle  | 616.311         | -43.62                    | 72.22                      | 41.6        | 30.62       | Complied |
| Top     | 73.111          | -41.61                    | 69.58                      | 40.97       | 28.61       | Complied |

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### **7.8. Transmitter Radiated Measurements: (Emissions at Band Edges):** **Section 2.1053**

7.8.1.FCC Part 24.238 states that emissions shall be attenuated by at least  $43+10 \log(P)$  dB below the transmitter power (P). It also states that the 1<sup>st</sup> MHz band immediately adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. This bandwidth was found to be 3 kHz.

7.8.2. The highest level within these 1 MHz bands was thus measured and recorded.

7.8.3.The radiated spurious emission level in dB is described in TIA\_EIA\_603A and is defined as: -

$$\text{dB} = 10 \log_{10} \left( \frac{\text{TX power in watts}}{0.001} \right) - \text{spurious level (dBm)}$$

7.8.4. The emissions limit was determined by first calculating the spurious attenuation based on conducted power (P). The EUT was then replaced by a dipole and signal generator, the generator was set to power level (P) and the equivalent field strength was determined at 3 meters. The spurious attenuation level calculated in the previous step was then subtracted from the measured field strength to obtain the correct spurious attenuation limit.

#### **Results: IBM Laptop**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 1850.000        | 70.39                        | 55.51                            | 41.5        | 14.0        | Complied |
| 1910.000        | 71.48                        | 54.52                            | 41.6        | 12.9        | Complied |

#### **Results: DELL Laptop**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 1850.000        | 73.57                        | 55.51                            | 41.5        | 18.06       | Complied |
| 1910.000        | 69.68                        | 56.32                            | 41.6        | 14.72       | Complied |

#### **Results: Toshiba Laptop**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 1850.000        | 71.97                        | 53.93                            | 41.5        | 12.4        | Complied |
| 1910.000        | 69.23                        | 56.77                            | 41.6        | 15.2        | Complied |

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## **7.9. Transmitter Radiated Emissions: Section 2.1053/24.238**

### **7.9.1. Electric Field Strength Measurements: 30 to 1000 MHz**

7.9.1.1. Preliminary Radiated spurious scans were performed with the EUT set to the Middle channel. Any visible spurious was then measured with the device set to top, bottom and middle channels.

7.9.1.2. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

7.9.1.3. The limit is specified as  $43 + 10 \log(P)$  dB below the transmitter power (P), where (P) is the power measured at the EUT antenna terminals.

7.9.1.4. Radiating -13dBm from a dipole located in place of the EUT and measuring the equivalent field strength at the 3 meters determined the limit line.

7.9.1.5. All emissions observed between 30 and 1000 MHz were >20 dB below the relevant limit, therefore no result were recorded.

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**7.10. Transmitter Radiated Emissions: Section 2.1053/24.238****7.10.1. Electric Field Strength Measurements: 1.0 to 20.0 GHz**

7.10.1.1. The client has stated that the highest clock frequency for the EUT was 1.9101 GHz. Therefore tests were performed up to 20 GHz.

7.10.1.2. Preliminary radiated spurious scans were performed with the EUT set to Bottom, Middle and Top channels as stated in section (Operation of EUT).

7.10.1.3. The following table lists frequencies at which emissions were measured using a Peak detector.

7.10.1.4. Due to dynamic range limitations of the measuring receiver, scans at high frequencies above 12 GHz were performed at 1 metre measurement distances, with a corrected limit line for the reduced test distance. All final measured results were then corrected by a factor of -9.54 dB as determined by the equation  $20\log(D1/D2)$  where D1 is 1 meter and D2 is 3 meters.

7.10.1.5. The limit is specified as  $43+10 \log (P)$  dB below the transmitter power (P), where (P) is the power measured at the EUT antenna terminals. Radiating -13dBm from a dipole located in place of the EUT and measuring the equivalent field strength at the 3 meters determined the limit line.

**Results: IBM Laptop****Highest Peak Level:- Bottom Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.70043         | 79.74                        | 46.16                            | 41.5        | 4.7         | Complied |
| 3.70043         | 77.35                        | 48.55                            | 41.5        | 7.1         | Complied |

**Highest Peak Level:- Middle Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.75983         | 79.73                        | 46.27                            | 41.6        | 4.7         | Complied |
| 3.75983         | 77.34                        | 48.66                            | 41.6        | 7.1         | Complied |

**Highest Peak Level:- Top Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.81967         | 83.56                        | 41.81                            | 40.97       | 0.8         | Complied |
| 3.81967         | 82.27                        | 43.10                            | 40.97       | 2.1         | Complied |

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**Transmitter Radiated Emissions: Section 2.1053/24.238 (continued)****Results: Dell Laptop****Highest Peak Level:- Bottom Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.70044         | 76.44                        | 49.46                            | 41.5        | 8.0         | Complied |
| 3.70044         | 76.77                        | 49.13                            | 41.5        | 7.6         | Complied |

**Highest Peak Level:- Middle Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.7598          | 83.46                        | 42.54                            | 41.6        | 0.9         | Complied |
| 3.7598          | 82.62                        | 43.38                            | 41.6        | 1.8         | Complied |

**Highest Peak Level:- Top Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.81964         | 83.61                        | 41.76                            | 40.97       | 0.8         | Complied |
| 3.81964         | 79.22                        | 46.15                            | 40.97       | 5.2         | Complied |

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**Transmitter Radiated Emissions: Section 2.1053/24.238 (continued)****Results: Toshiba Laptop****Highest Peak Level:- Bottom Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.70038         | 81.01                        | 44.89                            | 41.5        | 3.4         | Complied |
| 3.70038         | 83.53                        | 42.37                            | 41.5        | 0.9         | Complied |

**Highest Peak Level:- Middle Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.75934         | 79.41                        | 46.59                            | 41.6        | 5.0         | Complied |
| 3.75934         | 76.74                        | 49.26                            | 41.6        | 7.7         | Complied |

**Highest Peak Level:- Top Channel**

| Frequency (MHz) | Peak Emission Level (dBuV/m) | Radiated Spurious Emission (dBc) | Limit (dBc) | Margin (dB) | Result   |
|-----------------|------------------------------|----------------------------------|-------------|-------------|----------|
| 3.81955         | 77.76                        | 47.61                            | 40.97       | 6.6         | Complied |
| 3.81955         | 81.21                        | 44.16                            | 40.97       | 3.2         | Complied |

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**7.11. Receiver Radiated Emissions: Section 15.109****7.11.1. Electric Field Strength (Frequency Range: 30 to 1000 MHz)**

7.11.1.1. The following table indicates measured results with the EUT operated in receive mode to the limits specified in Part 15.109.

7.11.1.2. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 3m (results incorporate antenna factors and cable losses):

**Results : IBM Laptop**

| Frequency (MHz) | Ant. Pol. | Q-P Level (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|-----------|--------------------------|----------------------|-------------|----------|
| 71.906          | Vert.     | 20.9                     | 40.0                 | 19.1        | Complied |
| 114.187         | Vert.     | 15.6                     | 43.5                 | 27.9        | Complied |
| 235.935         | Vert.     | 18.0                     | 46.0                 | 28.0        | Complied |
| 452.456         | Vert.     | 29.0                     | 46.0                 | 17.0        | Complied |
| 511.766         | Vert.     | 28.0                     | 46.0                 | 18.0        | Complied |
| 579.333         | Vert.     | 35.9                     | 46.0                 | 10.1        | Complied |
| 744.080         | Horiz.    | 34.2                     | 46.0                 | 11.8        | Complied |

**Results : DELL Laptop**

| Frequency (MHz) | Ant. Pol. | Q-P Level (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|-----------|--------------------------|----------------------|-------------|----------|
| 46.658          | Vert.     | 23.8                     | 40.0                 | 16.2        | Complied |
| 80.001          | Vert.     | 21.5                     | 40.0                 | 18.5        | Complied |
| 133.430         | Vert.     | 22.8                     | 43.5                 | 20.7        | Complied |
| 210.000         | Horiz.    | 31.5                     | 43.5                 | 12.0        | Complied |
| 299.583         | Horiz.    | 30.0                     | 46.0                 | 16.0        | Complied |
| 479.214         | Horiz.    | 27.8                     | 46.0                 | 18.2        | Complied |
| 505.779         | Vert.     | 25.8                     | 46.0                 | 20.2        | Complied |
| 847.004         | Horiz.    | 33.0                     | 46.0                 | 13.0        | Complied |

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**Receiver Radiated Emissions: Section 15.109 (continued)****Results : Toshiba Laptop**

| <b>Frequency<br/>(MHz)</b> | <b>Ant.<br/>Pol.</b> | <b>Q-P Level<br/>(dB<math>\mu</math>V/m)</b> | <b>Limit<br/>(dB<math>\mu</math>V/m)</b> | <b>Margin<br/>(dB)</b> | <b>Result</b> |
|----------------------------|----------------------|----------------------------------------------|------------------------------------------|------------------------|---------------|
| 73.738                     | Vert.                | 20.8                                         | 40.0                                     | 19.2                   | Complied      |
| 126.681                    | Vert.                | 19.9                                         | 43.5                                     | 23.6                   | Complied      |
| 133.136                    | Vert.                | 20.6                                         | 43.5                                     | 22.9                   | Complied      |
| 208.871                    | Horiz.               | 26.7                                         | 43.5                                     | 16.8                   | Complied      |
| 266.297                    | Horiz.               | 16.2                                         | 46.0                                     | 29.8                   | Complied      |
| 536.122                    | Horiz.               | 30.8                                         | 46.0                                     | 15.2                   | Complied      |

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## **7.12. Receiver Radiated Emissions: Section 15.109**

### **7.12.1. Electric Field Strength Measurements: 1.0 to 10.0 GHz**

7.12.1.1. The following table indicates measured results with the EUT operated in receive mode to the limits specified in Part 15.109.

7.12.1.2. All emissions were >20 dB below the relevant limit therefore no results were recorded.

7.12.1.3. Plots of the initial scans can be found in Appendix 4.

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**7.13. AC Mains Conducted Emissions: Section 15.107****7.13.1. Quasi-Peak Detector Measurements On Live And Neutral Lines**

7.13.1.1. Preliminary conducted spurious scans were performed with the EUT set to Middle channel. Any visible spurious was then measured with the device set to top, bottom and middle channels.

7.13.1.2. Plots of the initial scans can be found in Appendix 4.

7.13.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector:

| Frequency (MHz) | Line         | Q-P Level (dB $\mu$ V) | Q-P Limit (dB $\mu$ V) | Margin (dB) | Result   |
|-----------------|--------------|------------------------|------------------------|-------------|----------|
| 0.15448         | Live/Neutral | 53.53                  | 65.76                  | 13.25       | Complied |
| 0.18762         | Live/Neutral | 48.69                  | 64.14                  | 15.45       | Complied |
| 0.20276         | Live/Neutral | 47.53                  | 63.50                  | 15.97       | Complied |
| 0.24351         | Live/Neutral | 42.27                  | 61.98                  | 19.71       | Complied |
| 0.27578         | Live/Neutral | 40.67                  | 60.94                  | 22.70       | Complied |

**7.13.2. Average Detector Measurements On Live And Neutral Lines**

7.13.2.1. Following the initial scans and Quasi-Peak measurements, further measurements were made at the relevant frequencies using an average detector. The measured levels were as follows:

| Frequency (MHz) | Line         | Av. Level (dB $\mu$ V) | Av. Limit (dB $\mu$ V) | Margin (dB) | Result   |
|-----------------|--------------|------------------------|------------------------|-------------|----------|
| 0.15448         | Live/Neutral | 23.63                  | 55.76                  | 32.13       | Complied |
| 0.18762         | Live/Neutral | 38.79                  | 54.14                  | 15.35       | Complied |
| 0.20276         | Live/Neutral | 38.89                  | 53.50                  | 14.61       | Complied |
| 0.24351         | Live/Neutral | 17.82                  | 51.98                  | 34.16       | Complied |
| 0.27578         | Live/Neutral | 28.66                  | 50.94                  | 22.28       | Complied |

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## **8. Measurement Uncertainty**

8.1. 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.

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

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

8.4. 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".

| <b>Measurement Type</b>             | <b>Range</b>        | <b>Confidence Level</b> | <b>Calculated Uncertainty</b> |
|-------------------------------------|---------------------|-------------------------|-------------------------------|
| Conducted Emissions Antenna Port    | 0.009 kHz to 26 GHz | 95%                     | +/- 1.2 dB                    |
| Transmitter Conducted Carrier Power | 1850 to 1910 MHz    | 95%                     | +/- 0.46 dB                   |
| Carrier Output Power (EIRP)         | 1850 to 1910 MHz    | 95%                     | +/- 1.78 dB                   |
| Conducted (AC) Emissions            | 0.15 MHz to 30 MHz  | 95%                     | +/- 3.25 dB                   |
| Radiated Emissions at 3.0 metres    | 30 MHz to 1000 MHz  | 95%                     | +/- 5.26 dB                   |
| Radiated Emissions at 3.0 metres    | 1 GHz to 26 GHz     | 95%                     | +/- 1.78 dB                   |
| Frequency Stability                 | Not applicable      | 95%                     | +/- 20 Hz                     |
| Occupied Bandwidth                  | 1850 to 1910 MHz    | 95%                     | +/- 0.12 %                    |
| Emissions at Band Edges             | 1850 to 1910 MHz    | 95%                     | +/- 1.78 dB                   |

8.5. 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.

## **Appendix 1. Test Equipment Used**

| <b>RFI No.</b> | <b>Instrument</b>                | <b>Manufacturer</b> | <b>Type No.</b>           | <b>Serial No.</b> |
|----------------|----------------------------------|---------------------|---------------------------|-------------------|
| A027           | Horn Antenna                     | Eaton               | 9188-2                    | 301               |
| A031           | 2 to 4 GHz Eaton<br>Horn Antenna | Eaton               | 91889-2                   | 557               |
| A1027          | Termination                      | Rosenberger         | 53 S 15R - 020            | 1801              |
| A1077          | 3020A                            | Narda               | 3020A                     | 40140             |
| A1141          | HP 11691D                        | Hewlett Packerd     | 11691D                    | 1212A02494        |
| A1149          | N-type Terminator                | Suhner              | A114909/02/2000           | 6042 7            |
| A1255          | Power supply                     | Farnell             | 11E302BT                  | 000263            |
| A145           | 10 dB Attenuator                 | Narda               | NONE                      | NONE              |
| A243           | 20 dB Attenuator                 | Schaffner           | 6820-17-B                 | None              |
| A244           | 20 dB Attenuator                 | Schaffner           | 6820-17-B                 | None              |
| A429           | WG 16 horn                       | Flann               | 16240-20                  | 561               |
| A436           | WG 20 horn                       | Flann               | 20240-20                  | 330               |
| A438           | WG 18 horn                       | Narda               | 439                       | 8508              |
| A439           | WG 14 horn                       | Narda               | 642                       | 8610              |
| C1003          | Cable                            | Rosenberger         | FA210A1030M505<br>09      | 001               |
| C223           | Cable                            | Rosenberger         | UFA 210A-1-0788-<br>50x50 | 96A0118           |
| C322           | Cable                            | Rosenberger         | UFA 210A-1-0788-<br>50x50 | 96A0118           |
| C573           | C573-N-N-2                       | Rosenberger         | UFA210A-1-788-<br>50x50   | 97E0936           |
| C574           | C574-N-N-2                       | Rosenberger         | UFA210A-1-788-<br>50x50   | 97E0937           |
| E013           | PCN Environmental<br>Chamber     | Sanyo               | ATMOS chamber             | None              |
| G011           | SMGU Signal<br>Generator         | Rohde & Schwarz     | SMGU                      | 894 054/004       |
| G013           | SMHU Signal<br>Generator         | Rohde & Schwarz     | SMHU                      | 894 055/003       |
| G048           | SMY Signal<br>Generator          | Rohde & Schwarz     | SMY 01                    | 841 104/032       |

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**Test Equipment Used (continued)**

| RFI No. | Instrument                          | Manufacturer    | Type No. | Serial No.                             |
|---------|-------------------------------------|-----------------|----------|----------------------------------------|
| M025    | Fluke 87 Multimeter                 | Fluke           | 87       | 473 50093                              |
| M069    | ESMI Spectrum Analyser / Receiver   | Rohde & Schwarz | ESMI     | 829 808/007 (DU)<br>/ 827 063/008 (RU) |
| M1013   | GSM Test set                        | Hewlett Packard | 8922M    | 3503U00372                             |
| M1014   | DCS Test set                        | Hewlett Packard | 83220E   | 3741U02702                             |
| M1093   | Wiltek                              | Wiltek          | 4202S    | 0513018                                |
| M133    | Temperature/Humidity/Pressure Meter | RS Components   | None     | None                                   |
| M198    | Thermal Power Sensor                | Rohde & Schwarz | NRV-Z52  | 827 191/003                            |
| M199    | Power Meter                         | Rohde & Schwarz | NRVS     | 827023/075                             |
| S207    | Site 7                              | RFI             | 7        | 473 50093                              |

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

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## **Appendix 2. Measurement Methods**

### **A2.1 FCC Part 24.232: Effective Isotropic Radiated Power (EIRP)**

A2.1.1 EIRP measurements were performed in accordance with the standard, against appropriate limits.

A2.1.2 The EIRP was measured with the EUT arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4. The transmitter was fitted with an integral antenna; as such, all tests were performed with the unit operating into the integral antenna.

A2.1.3 The level of the EIRP was measured using a spectrum analyser. Its amplitude was maximised by first raising and lowering the test antenna in the horizontal plane. The level was then further maximised by rotating the turntable through 360 degrees. This level was then recorded. This procedure was performed on both antenna polarities.

A2.1.4 Once the final amplitude (maximised) had been obtained, the EIRP was measured by using a substitution method.

A2.1.5 The substitution method involved replacing the EUT with an horn antenna whose gain was referenced to an isotropic. The centre of the substitution antenna was set to approximately the same centre location as the EUT. The substitution antenna was set to the horizontal polarity. The substitution antenna was then connected to and fed by a signal generator tuned to the EUT's operating frequency. The test antenna was then raised and lowered to obtain a maximum reading on the spectrum analyser. The level of the signal generator output was then adjusted until the previously recorded maximum level for this set of conditions was obtained. This procedure was repeated with both antennas vertically polarised. The EIRP was then calculated as: -

$$\text{EIRP} = \text{Signal Generator Level} - \text{Cable Loss} + \text{Antenna Gain}$$

A2.1.6 All measurements were performed using broadband Horn antennas.

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A2.1.7 The test equipment settings for EIRP measurements were as follows:

| <b>Receiver Function</b> | <b>Final Measurements</b> |
|--------------------------|---------------------------|
| Detector Type:           | Peak                      |
| Mode:                    | Not applicable            |
| Bandwidth:               | 1 MHz                     |
| Amplitude Range:         | 20 dB                     |
| Measurement Time:        | > 1 s                     |
| Observation Time:        | > 15 s                    |
| Sweep Time:              | Coupled                   |

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**A2.2 FCC Part 2.1055: Frequency Stability**

A2.2.1 The EUT was situated within an environmental test chamber and connected to test equipment via an access port.

A2.2.1 Measurements were performed with the EUT operating under extremes of temperature in 10 degree increments within the range –30 to 50 Deg C.

A2.2.1 Measurements were also performed at voltage extremes between the declared nominal supply voltage and at the declared endpoint voltage.

A2.2.1 The requirement was to determine the frequency stability of the device under specified environmental operating conditions.

A2.2.2 Measurements were made on the top, middle and bottom channels.

A2.2.3 The EUT was switched off for a minimum of 30 minutes between each stage of testing while the environmental chamber stabilised at the next temperature within the stated temperature range.

A2.2.4 The frequency error measured was converted to an error in ppm using the following formula as defined by TIA\_EIA\_603A :-

$$\text{ppm error} = \left( \frac{MCF_{\text{MHz}}}{ACF_{\text{MHz}}} - 1 \right) * 10^6$$

where  $MCF_{\text{MHz}}$  is the measured carrier frequency in MHz  
 $ACF_{\text{MHz}}$  is the assigned carrier frequency in MHz

A2.2.5 The measured ppm had to be less then the relevant limits in order to comply.

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**A2.3 Conducted Antenna Port Measurements: FCC Part 2.1051:**

A2.3.1 Spurious measurements at the Antenna port were performed from the lowest generated frequency within the EUT to the lower frequency of the allocated frequency block and from the highest frequency of the allocated frequency block to 10 times the highest EUT generated frequency.

A2.3.2 A measuring receiver was connected to the antenna port of the EUT via a suitable cable and RF Attenuator. The total loss of both the cable and the attenuator were measured and entered as a reference level offset into the measuring receiver to correct for the losses.

A2.3.3 The specified frequency band was investigated with the transmitter operating at full power on the middle channel. Any spurious noted was then measured with the transmitter set to top, bottom and middle channels.

A2.3.1 The EUT was then replaced with a signal generator who's frequency was set to the indicated spurious frequency and who's level was adjusted to equal that recorded in section from the EUT. The level final recorded level was that reported by the signal generated.

A2.3.2 The test equipment settings for conducted antenna port measurements were as follows:

| Receiver Function | Initial Scan     | Final Measurements Below 1GHz | Final Measurements Above 1 GHz |
|-------------------|------------------|-------------------------------|--------------------------------|
| Detector Type:    | Peak             | Quasi-Peak (CISPR)            | Peak/Average                   |
| Mode:             | Max Hold         | Not applicable                | Not applicable                 |
| Bandwidth:        | 100 kHz          | 120 kHz                       | 1 MHz                          |
| Amplitude Range:  | 60 dB            | 20 dB                         | 20 dB (typical)                |
| Measurement Time: | Not applicable   | > 1 s                         | > 1 s                          |
| Observation Time: | Not applicable   | > 15 s                        | > 15 s                         |
| Step Size:        | Continuous sweep | Not applicable                | Not applicable                 |
| Sweep Time:       | Coupled          | Not applicable                | Not applicable                 |

\* The resolution bandwidth used for measurements in the 1 MHz blocks either side of the declared operating frequency block was set to 3 kHz.

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## **A2.4 FCC Part 2.1049 (i): Occupied Bandwidth**

A2.4.1 The EUT was connected to a spectrum analyser via its temporary antenna port.

A2.4.1 Measurements were performed to determine the Occupied Bandwidth in accordance with FCC Part 2.1049. The Occupied Bandwidth was measured from the fundamental emission at the bottom middle and top channels. The EUT is a PCS phone therefore no modulation input port was available. A call was thus setup using the PCS/GSM simulator and using normal modulation. The Occupied Bandwidth was measured in this configuration.

A2.4.2 The Occupied Bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB spectrum analyser. It was set to measure the bandwidth where 99% of the signal power was contained. The analyser settings were set as per those outlined in the FSEB user manual for this measurement, i.e., RBW  $\leq 1/20$  of occupied bandwidth. A value of 3kHz was used.

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## **A2.5 FCC Part 15: AC Mains Conducted Emissions**

A2.5.1 AC mains conducted emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

A2.5.2 The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane.

A2.5.3 Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.5.4 During the swept measurements (and also during subsequent final measurements on single frequencies) any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

A2.5.5 Following the initial scans, a graph was produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested (at individual frequencies) using the appropriate detector function.

A2.5.6 The test equipment settings for conducted emissions measurements were as follows:

| <b>Receiver Function</b> | <b>Initial Scan</b> | <b>Final Measurements</b>  |
|--------------------------|---------------------|----------------------------|
| Detector Type:           | Peak                | Quasi-Peak (CISPR)/Average |
| Mode:                    | Max Hold            | Not applicable             |
| Bandwidth:               | 10 kHz*             | 9 kHz*                     |
| Amplitude Range:         | 60 dB               | 20 dB                      |
| Measurement Time:        | Not applicable      | > 1 s                      |
| Observation Time:        | Not applicable      | > 15 s                     |
| Step Size:               | Continuous sweep    | Not applicable             |
| Sweep Time:              | Coupled             | Not applicable             |

\* Where measurements were made below 150 kHz a 200 Hz bandwidth was used.

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## **A2.6 Radiated Emissions: FCC Part 15 and 24**

A2.6.1 Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

A2.6.2 Initial pre-scans covering the entire measurement band from the lowest generated frequency up to the highest specified frequency were performed within a screened chamber in order to identify frequencies on which the EUT was generating interference. This determined the frequencies from the EUT with required further attention. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT.

A2.6.3 The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested on the open area test site, at the appropriate distance. For Part 15 spurious measurements a measuring receiver with a Quasi-Peak detector (below 1000 MHz) and above 1000 MHz average and peak detectors were used. Part 24 measurements we made using a peak detector.

A2.6.4 For the main (final) measurements the EUT arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4.

A2.6.5 On the open area test site, at each frequency where a signal was found, the levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m in the horizontal polarisation. At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT. The procedure was repeated for the vertical polarisation.

A2.6.6 The final field strength was determined as the indicated level in dBuV plus cable loss and antenna factor. The limit for Part 24 transmitter spurious at the antenna terminal is presented as  $43+10\log(P)$  where P is the transmitter power in watts. Radiating this level (-13dBm) and measuring its equivalent field strength at 3 meters enable the spurious attenuation of the emission in question to be calculated as : -

$$(\text{Radiated Limit} - \text{Radiated Spurious}) + 43+10\log(P)$$

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A2.6.7 The test equipment settings for radiated emissions measurements were as follows:

| <b>Receiver Function</b> | <b>Initial Scan</b>               | <b>Final Measurements<br/>Below 1GHz</b> | <b>Final Measurements<br/>Above 1 GHz</b> |
|--------------------------|-----------------------------------|------------------------------------------|-------------------------------------------|
| Detector Type:           | Peak                              | Quasi-Peak (CISPR)                       | Peak/Average                              |
| Mode:                    | Max Hold                          | Not applicable                           | Not applicable                            |
| Bandwidth:               | (120 kHz < 1GHz)<br>(1MHz > 1GHz) | 120 kHz                                  | 1 MHz<br>(If Applicable)                  |
| Amplitude Range:         | 60 dB                             | 20 dB                                    | 20 dB (typical)                           |
| Measurement Time:        | Not applicable                    | > 1 s                                    | > 1 s                                     |
| Observation Time:        | Not applicable                    | > 15 s                                   | > 15 s                                    |
| Step Size:               | Continuous sweep                  | Not applicable                           | Not applicable                            |
| Sweep Time:              | Coupled                           | Not applicable                           | Not applicable                            |

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### **Appendix 3. Test Configuration Drawings**

This appendix contains the following drawings:

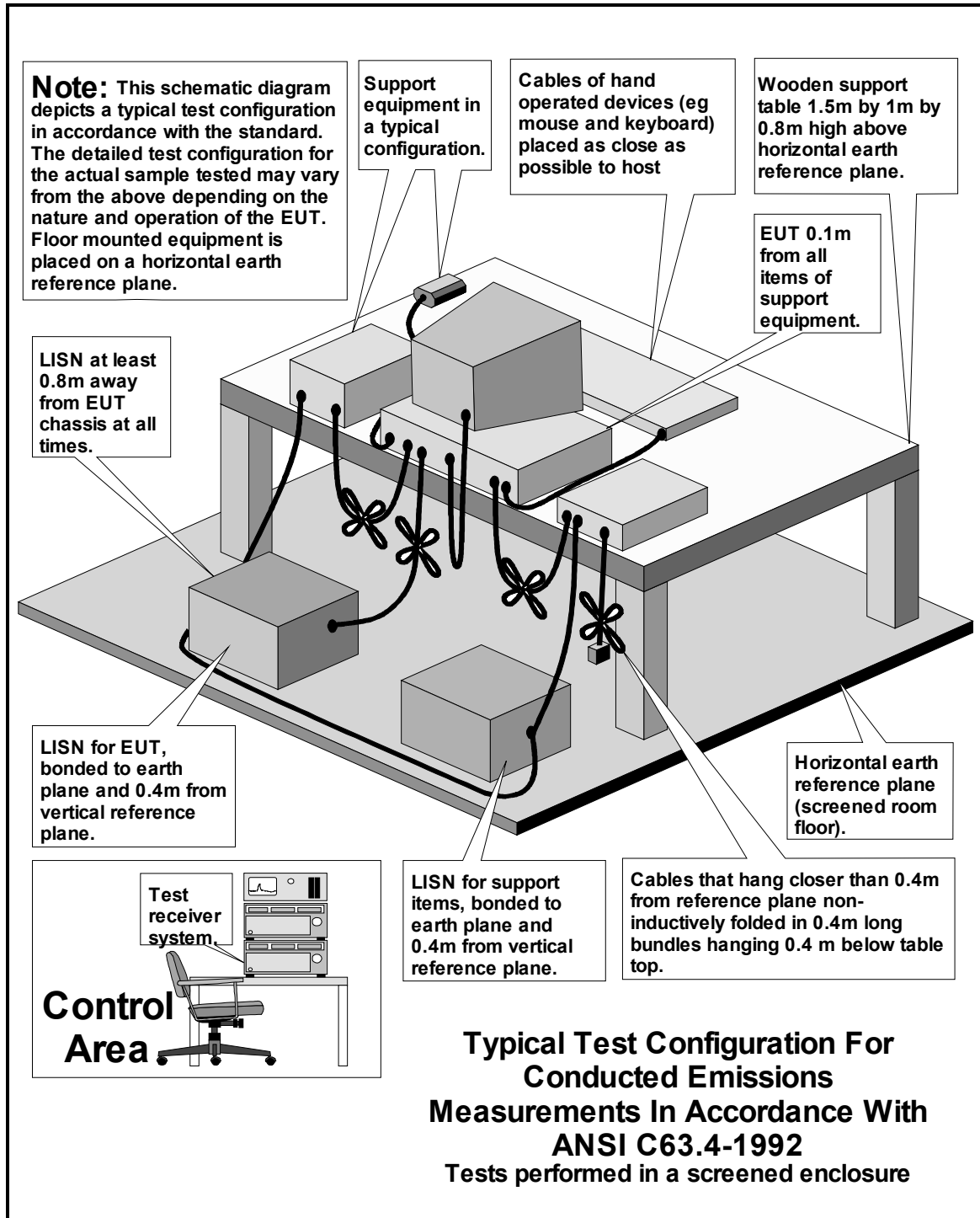
| <b>Drawing Reference Number</b> | <b>Title</b>                                                                                 |
|---------------------------------|----------------------------------------------------------------------------------------------|
| DRG\70438JD06\EMICON            | Test configuration for measurement of conducted emissions                                    |
| DRG\70438JD06\EMIRAD            | Test configuration for measurement of radiated emissions                                     |
| DRG\70438JD06\001               | Schematic diagram of the EUT, support equipment and interconnecting cables used for the test |

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DRG\70438JD06\EMICON

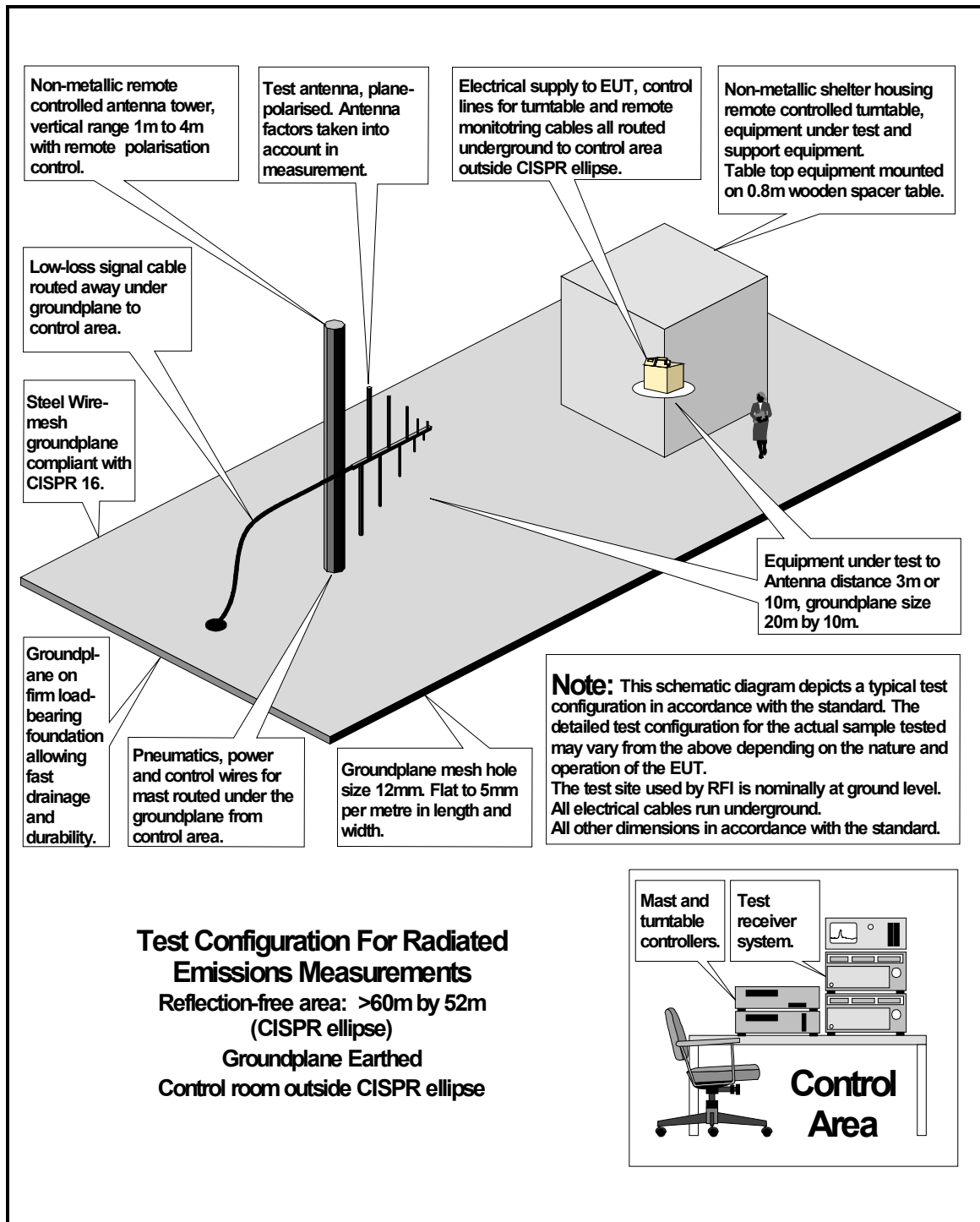


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DRG\70438JD06\EMIRAD



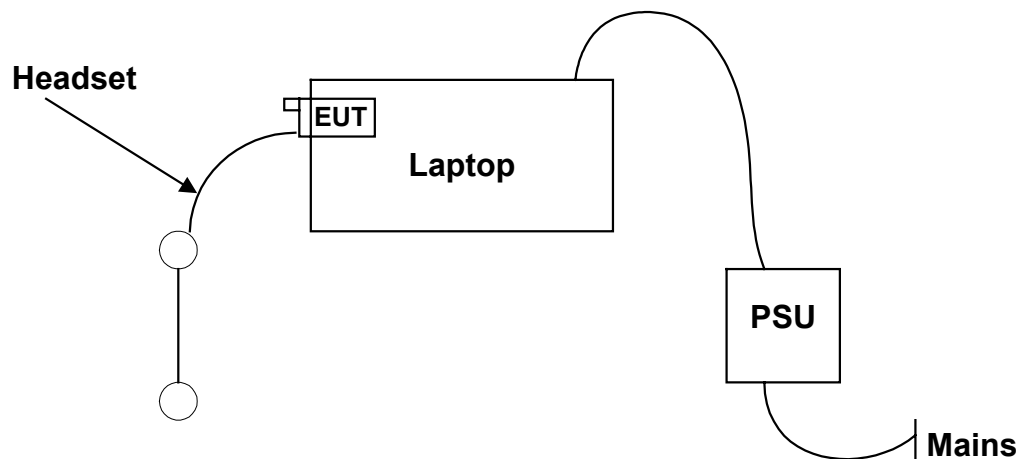
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### Configuration of EUT and Local Support Equipment



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## **Appendix 4. Graphical Test Results**

Please refer to document RP70438JD06A\_Graph Section

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## **Appendix 5. Photographs of EUT**

Please refer to document RP70438JD06A\_PhotoGraph Section