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

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	**Checked By:** 
Tested By:  **PP.**	**Release Version No: PDF01**
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The results in this report apply only to the sample(s) tested.

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1. Client Information

Company Name:	INTEL Mobile Communications Division
Address:	1357 Garden of the Gods Road – XG1 Colorado Springs CO 80903 USA
Contact Name:	Mr J Youngman

2. Equipment Under Test (EUT)

The following information has been supplied by the client:

2.1. Identification Of Equipment Under Test (EUT)

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

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.

2.4. Additional Information Related To Testing

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

2.5. Support Equipment

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

Description:	Laptop
Brand Name:	IBM
Model Name or Number:	Thinkpad 600
Serial Number:	78-DUY75
Connected to Port:	PCMCIA

Description:	Laptop
Brand Name:	Toshiba
Model Name or Number:	Satellite S221
Serial Number:	72100202IP
Connected to Port:	PCMCIA

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

Support Equipment (continued)

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

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

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

Support Equipment (continued)

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

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

3. Test Specification, Methods And Procedures

3.1. Test Specifications

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

Test Specifications (continued)

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

Reference:	FCC Part 15: 2001 Class B, Sections: 15.107 and 15.109
Title:	Code of Federal Regulations, Part 15 (47CFR) Radio Frequency Devices: Digital Devices.
Comments:	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.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

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.

4. Deviations From The Test Specification

None.

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.

6. Summary Of Test Results

6.1. Transmit Mode

Range Of Measurements	Specification Reference	Mode of Operation	Port Type	Compliancy Status
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

Range Of Measurements	Specification Reference	Mode of Operation	Port Type	Compliancy Status
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

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.

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.

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

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

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.

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

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

7.4.5. The limit to the lower band edge form 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

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

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

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 <= 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

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 1st 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.

7.6.6.7.6.6.The spurious attenuation level in dB is described in TIA_EIA_603A and is defined as: -

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

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

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

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 1st 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: -

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

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

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.

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 20log(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

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

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

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 (dBμV/m)	Limit (dBμV/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 (dBμV/m)	Limit (dBμV/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

Receiver Radiated Emissions: Section 15.109 (continued)

Results : Toshiba Laptop

Frequency (MHz)	Ant. Pol.	Q-P Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
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

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.

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 (dBμV)	Q-P Limit (dBμV)	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 (dBμV)	Av. Limit (dBμV)	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

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”.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
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

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Eaton 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 09	001
C223	Cable	Rosenberger	UFA 210A-1-0788-50x50	96A0118
C322	Cable	Rosenberger	UFA 210A-1-0788-50x50	96A0118
C573	C573-N-N-2	Rosenberger	UFA210A-1-788-50x50	97E0936
C574	C574-N-N-2	Rosenberger	UFA210A-1-788-50x50	97E0937
E013	PCN Environmental Chamber	Sanyo	ATMOS chamber	None
G011	SMGU Signal Generator	Rohde & Schwarz	SMGU	894 054/004
G013	SMHU Signal Generator	Rohde & Schwarz	SMHU	894 055/003
G048	SMY Signal Generator	Rohde & Schwarz	SMY 01	841 104/032

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) / 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.

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 who's 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 tests 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: -

EIRP = Signal Generator Level - Cable Loss + Antenna Gain

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

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

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

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 :-

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

where MCF_{MHz} is the measured carrier frequency in MHz
ACF_{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.

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.

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 <= 1/20 of occupied bandwidth. A value of 3kHz was used.

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:

Receiver Function	**Initial Scan**	**Final Measurements**
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.

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+10log(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 : -

(Radiated Limit – Radiated Spurious) + 43+10Log(P)

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

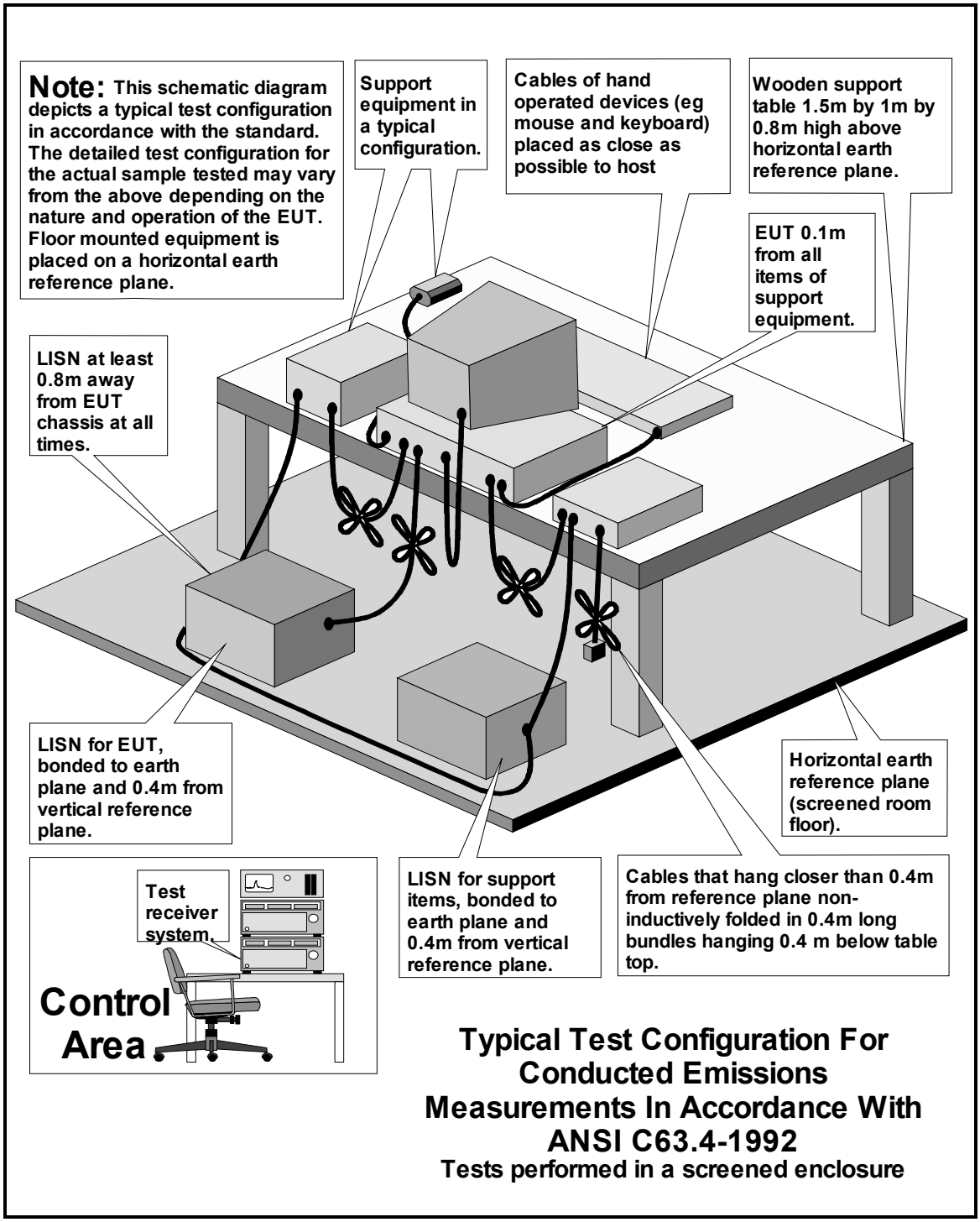
Receiver Function	**Initial Scan**	**Final Measurements Below 1GHz**	**Final Measurements Above 1 GHz**
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak/Average
Mode:	Max Hold	Not applicable	Not applicable
Bandwidth:	(120 kHz < 1GHz) (1MHz > 1GHz)	120 kHz	1 MHz (If Applicable)
Amplitude Range:	60 dB	20 dB	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

Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
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

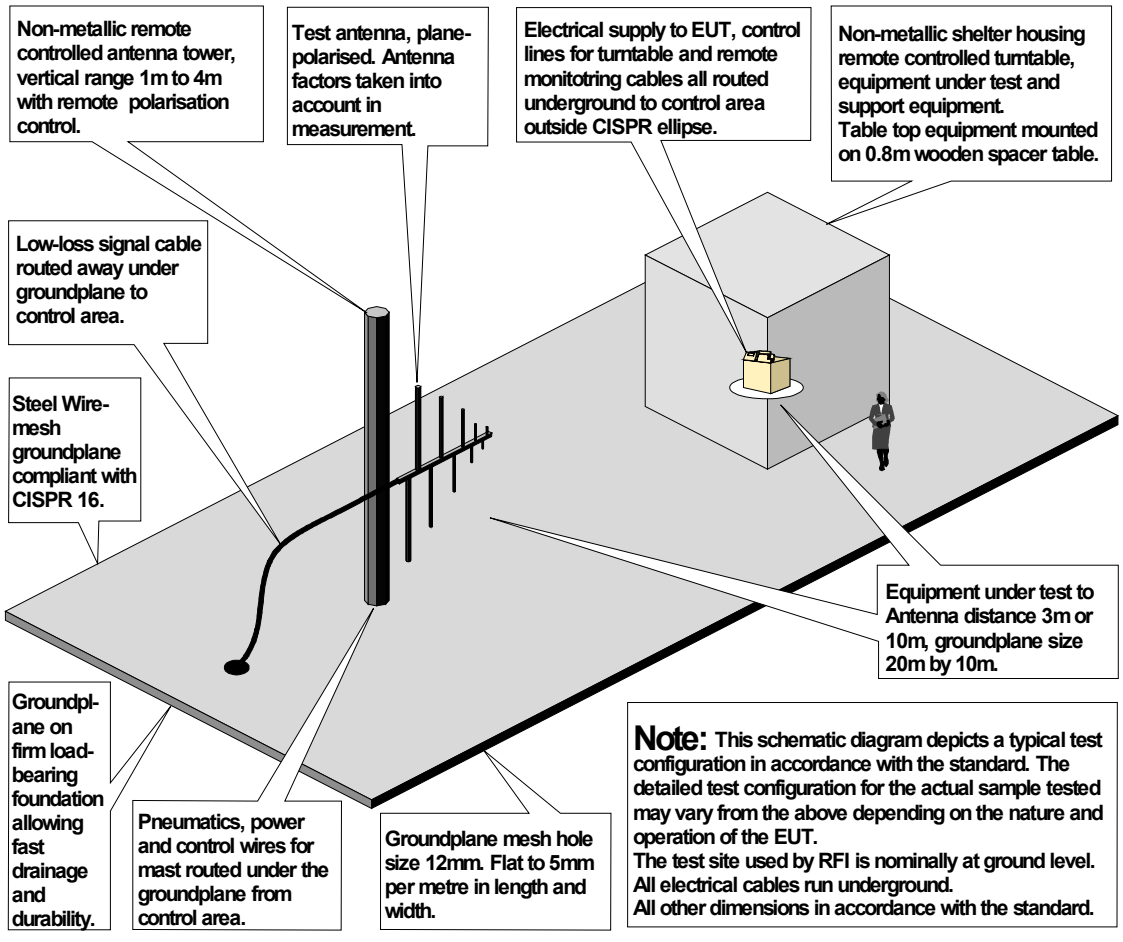
DRG\70438JD06\EMICON



Typical Test Configuration For Conducted Emissions Measurements In Accordance With ANSI C63.4-1992

Tests performed in a screened enclosure

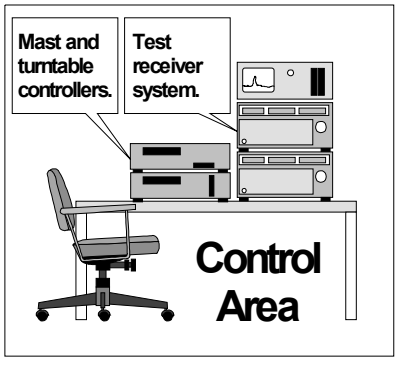
DRG\70438JD06\EMIRAD



Note: This schematic diagram depicts a typical test configuration in accordance with the standard. The detailed test configuration for the actual sample tested may vary from the above depending on the nature and operation of the EUT.
The test site used by RFI is nominally at ground level.
All electrical cables run underground.
All other dimensions in accordance with the standard.

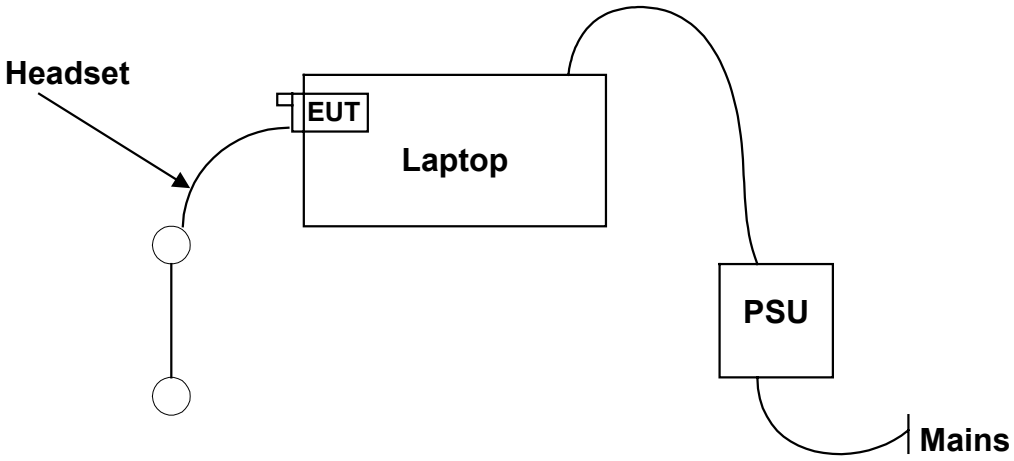
Test Configuration For Radiated Emissions Measurements

Reflection-free area: >60m by 52m (CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse



DRG\70438JD06\001

Configuration of EUT and Local Support Equipment



Appendix 4. Graphical Test Results

Please refer to document RP70438JD06A_Graph Section

Appendix 5. Photographs of EUT

Please refer to document RP70438JD06A_Photograph Section