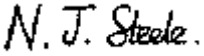
TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: Red-M (Communications) Ltd.
1000AP

To: F.C.C. Part 15 Subpart C: 2000
(Intentional Radiators)
Section 15.247

Test Report Serial No:
RFI/EMCB1/RP42147B

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	**Checked By:** 
Tested By: 	**Release Version No:** **PDF01**
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UKAS TESTING 0644

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1. Client Information

Company Name:	Red-M (Communications) Ltd.
Address:	Wexham Springs Framewood Road Wexham Slough SL3 6PJ.
Contact Name:	Mark Bailey.

2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification Of Equipment Under Test (EUT)

Brand Name:	Red-M
Model Name or Number:	1000AP
Unique Type Identification:	None stated by client
Serial Number:	003
Country of Manufacture:	UK
FCC ID Number:	Not applicable
Date of Receipt:	10 April 2001

2.2. Description Of EUT

The equipment under test is Bluetooth networking device.

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:	Nominal 115 V, 60 Hz AC Mains Supply 13 Amp (max) OR Nominal 230/240 V, 50 Hz AC Mains Supply 13 Amp (max)
Intended Operating Environment:	Commercial, Light Industry
Weight:	0.5 kg
Dimensions:	125 mm x 135 mm x 40 mm
Interface Ports:	BRI RJ-45 10/100 Ethernet Ports (x3), RJ45 Serial Ports (x2), 9 Pin D-sub

2.5. Support Equipment

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

Description:	3000AS Radio Tester
Brand Name:	Red-M
Model Name or Number:	3000AS
Serial Number:	red-m2810400A8
FCC ID Number:	Verified
Cable Length And Type:	2m Mains, 1 x CAT 5 UTP
Connected to Port:	Mains Input, 10/100 Office LAN Port

Description:	Ethernet Hub
Brand Name:	3Com
Model Name or Number:	Office Connect Dual Speed Hub 8
Serial Number:	010/7P1F135443
FCC ID Number:	None given by client
Cable Length And Type:	2m DC Power, 2 x 5m CAT 5 UTP
Connected to Port:	DC Power Input, Ethernet Ports

Description:	Computer
Brand Name:	Dell
Model Name or Number:	Latitude CP M233XT
Serial Number:	0009321C-128000-841-2517
FCC ID Number:	None given by client
Cable Length And Type:	1 x 5m CAT 5 UTP
Connected to Port:	Ethernet Port

3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	FCC Part 15 Subpart C: 2000 (Section 15.247)
Title:	Code of Federal Regulations, Part 15 (47CFR15) 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.

Reference:	FCC Part 15 Subpart B: 2000. (Section 15.107 and 15.109)
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices: Radio Frequency 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:

FCC Code of Federal Regulations 47.
Telecommunication. Parts 0 to 19, October 2000.

ANSI C63.2 (1987)
Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (1992)
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 (1988)
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.

During testing, the EUT was powered by a 115 V, 60 Hz AC Mains supply.

5.2. Operating Modes

The EUT was tested in the following operating modes:

1: Test Mode: The EUT operated in a test mode with all channels active (transmitting data on pseudo random hopping channels).and Fixed on Top, Bottom or Middle channel, as specified in FCC Part 15.31(m) and FCC Public Notice DA 00-705.

2: Receive Mode: The EUT did not transmit on any channels but received on all hopping frequencies.

The reason for choosing these modes was that it was defined by the client as being likely to be the worst case with regards EMC.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

During the tests, the EUT was configured as intended with all ports terminated. However due to the operation of the EUT the following tests were performed with the antenna removed, and test equipment connected to the antenna port:

1: Conducted Antenna Port Transmit Power.

2: Conducted Antenna Port Spurious Emissions (30 to 26000 MHz)

3: Modulation Requirements / Channel Spacing / Timing Requirements.

NB Section 2 of this report contains a full list of support equipment used and Appendix 3 contains a schematic diagram of the test configuration.

6. Summary Of Test Results

6.1. Emissions: Transmit Mode

Range Of Measurements	Specification Reference	Compliancy Status
Conducted AC Mains Emissions	C.F.R. 47 FCC Part 15: 2000. Section 15.207	Complied
Conducted Antenna Port Transmit Power	C.F.R. 47 FCC Part 15: 2000. Section 15.247 (b)	Complied
Conducted Antenna Port Spurious Emissions (30 to 26000 MHz)	C.F.R. 47 FCC Part 15: 2000. Section 15.247 (c)	Complied
Modulation Requirements / Channel Spacing / Timing Requirements	C.F.R. 47 FCC Part 15: 2000. Section 15.247 (a)	Complied
Isotropic Effective Radiated Power (EIRP)	C.F.R. 47 FCC Part 15: 2000. Section 15.247 (b) (1)	Complied
Radiated Electric Field Strength Spurious Emissions (30 to 26000 MHz)	C.F.R. 47 FCC Part 15: 2000. Section 15.247 (c) (15.209)	Complied

6.2. Emissions: Receive Mode

Range Of Measurements	Specification Reference	Compliancy Status
Conducted AC Mains Emissions	C.F.R. 47 FCC Part 15: 2000. Section 15.107	Complied
Radiated Electric Field Strength Spurious Emissions (30 to 26000 MHz)	C.F.R. 47 FCC Part 15: 2000. Section 15.109	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. Details of the test methods and procedures can be found in Appendix 2 of this report.

7.1.2. The measurement uncertainties stated were calculated in accordance with the requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Section 8 for details of measurement uncertainties.

7.2. Test Results For AC Mains Conducted Emissions: Transmit Mode

7.2.1. Quasi-Peak Detector Measurements On Live And Neutral Lines

7.2.1.1. The following table indicates measured results to the limits specified in Part 15.207.

7.2.1.2. Preliminary Conducted spurious scans were performed with the EUT set to Top, Middle and Bottom channels and with all channels active (transmitting data on pseudo random hopping channels) stated in section 5.2. These preliminary scans showed similar emission levels for each mode, therefore final Conducted emissions measurements were performed with the EUT set to pseudo random hopping mode.

7.2.1.3. Plots of all the initial scans can be found in the Graphical Test Results issued separately.

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

Frequency (MHz)	Line	Q-P Level (dBmV)	Q-P Limit (dBmV)	Margin (dB)	Result
0.194	Live	45.6	48.0	2.4	Complied
0.292	Live	39.7	48.0	8.2	Complied
0.293	Neutral	39.4	48.0	8.5	Complied
0.682	Live	32.3	48.0	15.7	Complied
2.629	Live	33.9	48.0	14.0	Complied
2.635	Neutral	33.2	48.0	14.7	Complied
12.855	Live	36.3	48.0	11.6	Complied
12.881	Neutral	30.5	48.0	17.4	Complied
23.128	Neutral	45.5	48.0	2.4	Complied
23.372	Live	35.4	48.0	12.5	Complied

7.3. Test Results For AC Mains Conducted Emissions: Receive Mode

7.3.1. Quasi-Peak Detector Measurements On Live And Neutral Lines

7.3.1.1. The following table indicates measured results to the limits specified in Part 15.207.

7.3.1.2. Plots of the initial scans can be found in the Graphical Test Results issued separately.

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

Frequency (MHz)	Line	Q-P Level (dBmV)	Q-P Limit (dBmV)	Margin (dB)	Result
0.684	Live	33.5	48.0	14.4	Complied
2.735	Neutral	35.3	48.0	12.6	Complied
2.738	Live	36.2	48.0	11.7	Complied
2.931	Neutral	36.5	48.0	11.4	Complied
13.001	Live	36.8	48.0	11.1	Complied
13.479	Neutral	36.8	48.0	11.1	Complied
23.128	Live	45.9	48.0	2.0	Complied
23.128	Neutral	46.1	48.0	1.8	Complied

7.4. Test Results for Conducted Transmitter Power: Transmit Mode.

7.4.1. Tests were performed to identify the maximum transmit power in accordance with FCC Part 15.247(b)(1) and FCC Public Notice DA 00-705.

7.4.2. The client has provided a temporary antenna port to allow a direct connection to be made.

7.4.3. The client has specified that the EUT employs frequency hopping with 79 hopping channels. Therefore the maximum transmitter power level under FCC Part 15.247(b)(1) is 1 Watt.

7.4.4. It can be confirmed from Plot GPH/42147/03 that the number of hopping channels employed by the EUT was 79.

7.4.5. Results are shown for the EUT set to Top, Middle and Bottom channels as stated in FCC Part 15.31 (m) and section 5.2 of this report. Graphical measurements are shown for the transmit power levels within GPH/42147/07 to GPH/42147/18.

7.4.6. Measurements were performed on the Top, Middle and Bottom channels for the specified extremes of input voltages:

Test Results for Conducted Transmitter Power: Transmit Mode (continued)

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (Watts)	Limit (Watts)	Margin	Result
Top	85	0.00678	1.0	0.99322	Complied
Top	110	0.00678	1.0	0.99322	Complied
Top	126.5	0.00603	1.0	0.99397	Complied
Top	276	0.00745	1.0	0.99255	Complied

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (Watts)	Limit (Watts)	Margin	Result
Middle	85	0.00471	1.0	0.99529	Complied
Middle	110	0.00479	1.0	0.99521	Complied
Middle	126.5	0.00718	1.0	0.99282	Complied
Middle	276	0.00743	1.0	0.99257	Complied

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (Watts)	Limit (Watts)	Margin	Result
Bottom	85	0.00399	1.0	0.99601	Complied
Bottom	110	0.00481	1.0	0.99519	Complied
Bottom	126.5	0.00393	1.0	0.99607	Complied
Bottom	276	0.00512	1.0	0.99488	Complied

7.5. Test Results for Conducted Antenna Port Spurious Emissions: Transmit Mode.

7.5.1. Spurious emissions tests on the antenna port were performed in accordance with FCC Part 15.247(c).

7.5.2. Section 15.247(c) specifies that all spurious emissions should be attenuated at least 20 dB below the level of the highest fundamental level measured between the range of 2400 to 2483.5 MHz.

7.5.3. Scans were performed between 30 and 26000MHz with the EUT operating in Top, Middle and Bottom channels, as specified within clause 15.31 (m). Initial scans indicated that all spurious emissions were of an amplitude of at least 20dB below the reference limit line, therefore final measurements were not required.

7.5.4. Plots of all the all the initial scans can be found in the Graphical Test Results issued separately.

7.6. Test Results For Radiated Emissions: Transmit Mode. (Hopping on all Channels)

7.6.1. Electric Field Strength Measurements: 30 to 1000 MHz.

7.6.1.1. The following table specifies frequencies, which fall close to the restricted bands as specified in section 15.205.

7.6.1.2. Preliminary Radiated spurious scans were performed with the EUT set to Top, Middle and Bottom channels and with all channels active (transmitting data on pseudo random hopping channels) stated in section 5.2. These preliminary scans showed similar emission levels for each mode, therefore final Radiated emissions measurements were performed with the EUT set to pseudo random hopping mode.

7.6.1.3. Plots of the initial scans can be found in the Graphical Test Results issued separately.

7.6.1.4. 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):

7.6.1.5. The following results are for the EUT configured with an internal antenna connected and operating.

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Limit (dBmV/m)	Margin (dB)	Result
150.5	Vert.	18.1	43.5	15.4	Complied
378.8	Vert.	23.5	46.0	22.5	Complied

7.7. Test Results For Radiated Emissions: Transmit Mode (Hopping on all Channels)

7.7.1. Electric Field Strength Measurements: 1.0 to 26.0 GHz

7.7.1.1. The following table specifies frequencies, which fall within the restricted bands as specified in section 15.209.

7.7.1.2. The client has stated that the highest clock frequency for the EUT was 2.480 GHz. Therefore tests were performed up to 26 GHz.

7.7.1.3. Preliminary Radiated spurious scans were performed with the EUT set to Top, Middle and Bottom channels and with all channels active (transmitting data on pseudo random hopping channels) stated in section 5.2. These preliminary scans showed similar emission levels for each mode, therefore final Radiated emissions measurements were performed with the EUT set to pseudo random hopping mode. As no spurious emission were seen above 4 GHz, from 4 GHz to 26 GHz, preliminary radiated spurious scans were performed with the EUT set pseudo random hopping mode.

7.7.1.4. Plots of all the initial scans can be found in the Graphical Test Results issued separately.

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

7.7.1.6. The following results are for the EUT configured with an internal antenna connected and operating.

Highest Average Level:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
2.3500	Horiz.	27.6	22.3	1.1	49.9	54.0	3.0	Complied
2.3760	Vert.	26.5	22.3	1.1	48.8	54.0	4.1	Complied
2.3900	Vert.	26.3	22.3	1.1	48.6	54.0	4.3	Complied
2.4835	Vert.	27.2	22.3	1.1	49.5	54.0	4.3	Complied
2.4960	Vert.	26.9	22.3	1.1	49.2	54.0	3.7	Complied

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Test Results For Radiated Emissions: Transmit Mode (Hopping on all Channels) (continued)

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
2.3500	Horiz.	40.7	22.3	1.1	63.0	74.0	9.9	Complied
2.3760	Vert.	40.3	22.3	1.1	62.6	74.0	10.3	Complied
2.3900	Vert.	39.4	22.3	1.1	61.7	74.0	11.2	Complied
2.4835	Vert.	42.6	22.3	1.1	64.9	74.0	8.0	Complied
2.4960	Vert.	40.9	22.3	1.1	63.2	74.0	9.7	Complied

7.8. Test Results For Radiated Emissions: Transmit Mode (Bottom Channel)

7.8.1. Electric Field Strength Measurements: 1.0 to 26.0 GHz

7.8.1.1. The following table specifies frequencies, which fall within the restricted bands as specified in section 15.209.

7.8.1.2. The client has stated that the highest clock frequency for the EUT was 2.480 GHz. Therefore tests were performed up to 26 GHz.

7.8.1.3. Preliminary Radiated spurious scans were performed with the EUT set to Top, Middle and Bottom channels and with all channels active (transmitting data on pseudo random hopping channels) stated in section 5.2. These preliminary scans showed similar emission levels for each mode, therefore final Radiated emissions measurements were performed with the EUT set to pseudo random hopping mode. As no spurious emissions were seen above 4 GHz, from 4 GHz to 26 GHz, preliminary radiated spurious scans were performed with the EUT set pseudo random hopping mode.

7.8.1.4. Plots of all the initial scans can be found in the Graphical Test Results issued separately.

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

7.8.1.6. The following results are for the EUT configured with an internal antenna connected and operating.

Highest Average Level:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
2.3379	Horiz.	28.3	22.3	1.1	50.6	54.0	2.3	Complied
2.3700	Horiz.	27.5	22.3	1.1	49.8	54.0	3.1	Complied
2.3861	Horiz.	26.9	22.3	1.1	49.2	54.0	3.7	Complied
2.3900	Horiz.	26.4	22.3	1.1	48.7	54.0	4.2	Complied
2.4385	Horiz.	27.1	22.3	1.1	49.4	54.0	3.5	Complied

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Test Results For Radiated Emissions: Transmit Mode (Bottom Channel) (continued)

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
2.3379	Horiz.	40.3	22.3	1.1	62.6	74.0	10.3	Complied
2.3700	Horiz.	39.9	22.3	1.1	62.2	74.0	10.7	Complied
2.3861	Horiz.	39.4	22.3	1.1	61.7	74.0	11.2	Complied
2.3900	Horiz.	38.9	22.3	1.1	61.2	74.0	11.7	Complied
2.4385	Horiz.	39.5	22.3	1.1	61.8	74.0	11.1	Complied

7.9. Test Results For Radiated Emissions: Transmit Mode (Middle Channel)

7.9.1. Electric Field Strength Measurements: 1.0 to 26.0 GHz

7.9.1.1. The following table specifies frequencies, which fall within the restricted bands as specified in section 15.209.

7.9.1.2. The client has stated that the highest clock frequency for the EUT was 2.480 GHz. Therefore tests were performed up to 26 GHz.

7.9.1.3. Preliminary Radiated spurious scans were performed with the EUT set to Top, Middle and Bottom channels and with all channels active (transmitting data on pseudo random hopping channels) stated in section 5.2. These preliminary scans showed similar emission levels for each mode, therefore final Radiated emissions measurements were performed with the EUT set to pseudo random hopping mode. As no spurious emissions were seen above 4 GHz, from 4 GHz to 26 GHz, preliminary radiated spurious scans were performed with the EUT set pseudo random hopping mode.

7.9.1.4. Plots of the initial scans can be found in the Graphical Test Results issued separately.

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

7.9.1.6. The following results are for the EUT configured with an internal antenna connected and operating.

Highest Average Level:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
2.3700	Horiz.	26.8	22.3	1.1	49.1	54.0	3.8	Complied
2.3900	Horiz.	26.3	22.3	1.1	48.6	54.0	4.3	Complied
2.4835	Horiz.	27.1	22.3	1.1	49.4	54.0	3.5	Complied

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
2.3700	Horiz.	40.1	22.3	1.1	62.4	74.0	10.8	Complied
2.3900	Horiz.	39.2	22.3	1.1	61.5	74.0	11.4	Complied
2.4835	Horiz.	40.1	22.3	1.1	62.4	74.0	10.5	Complied

7.10. Test Results For Radiated Emissions: Transmit Mode (Top Channel)

7.10.1. Electric Field Strength Measurements: 1.0 to 26.0 GHz

7.10.1.1. The following table specifies frequencies, which fall within the restricted bands as specified in section 15.209.

7.10.1.2. The client has stated that the highest clock frequency for the EUT was 2.480 GHz. Therefore tests were performed up to 26 GHz.

7.10.1.3. Preliminary Radiated spurious scans were performed with the EUT set to Top, Middle and Bottom channels and with all channels active (transmitting data on pseudo random hopping channels) stated in section 5.2. These preliminary scans showed similar emission levels for each mode, therefore final Radiated emissions measurements were performed with the EUT set to pseudo random hopping mode. As no spurious emissions were seen above 4 GHz, from 4 GHz to 26 GHz, preliminary radiated spurious scans were performed with the EUT set pseudo random hopping mode.

7.10.1.4. Plots of all the initial scans can be found in the Graphical Test Results issued separately.

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

7.10.1.6. The following results are for the EUT configured with an internal antenna connected and operating.

Highest Average Level:

Frequency (GHz)	Antenna Polarity (H/V)	Average Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
2.3900	Horiz.	26.3	22.3	1.1	48.6	54.0	4.3	Complied
2.4835	Vert.	30.1	22.3	1.1	52.4	54.0	0.5	Complied
2.4999	Horiz.	26.9	22.3	1.1	49.2	54.0	3.7	Complied

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBmV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
2.3900	Horiz.	39.5	22.3	1.1	61.8	74.0	11.1	Complied
2.4835	Vert.	42.7	22.3	1.1	65.0	74.0	7.9	Complied
2.4999	Horiz.	39.8	22.3	1.1	62.1	74.0	10.9	Complied

7.11. Test Results For Radiated Emissions: Receive Mode

7.11.1. Electric Field Strength Measurements (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. Plots of the initial scans can be found in the Graphical Test Results issued separately.

7.11.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 10m (results incorporate antenna factors and cable losses):

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Limit (dBmV/m)	Margin (dB)	Result
35.341	Vert.	26.3	40.0	13.7	Complied
43.768	Vert.	24.3	40.0	15.7	Complied
49.999	Vert.	35.6	40.0	4.4	Complied
69.110	Vert.	28.4	40.0	11.6	Complied
84.651	Vert.	23.3	40.0	16.7	Complied
124.998	Horiz.	26.4	43.5	17.1	Complied
199.997	Vert.	35.4	43.5	8.1	Complied
474.994	Horiz.	42.7	46.0	3.3	Complied
499.993	Vert.	39.6	46.0	6.4	Complied
524.993	Vert.	41.4	46.0	4.6	Complied

7.12. Radiated Emissions: Receive Mode

7.12.1. Electric Field Strength Measurements (Frequency Range: 1.0 to 26.0 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. Initial scans indicated that all spurious emissions were below the reference limit line, therefore final measurements were not required.

7.12.1.3. Plots of all the initial scans can be found in the Graphical Test Results issued separately.

7.13. Test Results for Occupied Bandwidth, Channel Separation and Time Occupancy.

7.13.1. Tests were performed to identify the Occupied Bandwidth, Channel Separation and Time Occupancy to FCC Part 15.247.

Occupied Bandwidth and Channel Separation:

7.13.2. Section 15.247 (a)(1) specifies that the channels should be separated by at least 25kHz or the 20dB bandwidth of the channel, and section 15.247 (a1)(ii) specifies that the maximum bandwidth of the channel should be 1MHz.

7.13.3. A graphical plot of the characteristics of two adjacent channels was performed. The following results were noted:

20 dB Bandwidth: 877kHz. (Refer to Plot GPH/42147/02 in the Graphical Test Results issued separately).

Channel Separation: 985.9kHz. (Refer to Plot GPH/42147/01 in the Graphical Test Results issued separately.)

Time Occupancy:

7.13.4. The time occupancy of the system was tested on a single carrier. The maximum packet length was measured to be 2.866ms and can be seen in the Graphical Test Results issued separately (Plot GPH/42147/06B). The maximum time the carrier was used in a 30 second period was measured as 0.289 seconds and can be seen in the Graphical Test Results issued separately (Plot GPH/42147/06A).

8. Measurement Uncertainty

8.1. Company Policy, as based on the NAMAS Accreditation Standard, M10, paragraph 12.11 (o), states that Test Reports shall include estimated uncertainty of the calibration or test result (this information need only appear in test reports and test certificates where it is relevant to the validity or application of the test result, where a client's instructions so require or where uncertainty affects compliance to a specification or limit).

8.2. 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. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Conducted Emissions	0.15 MHz to 30 MHz	95%	+/- 3.25 dB
Time Occupancy	Not applicable	95%	+/- 10 %
Channel Separation	Not applicable	95%	+/- 10 %
Occupied Bandwidth	Not applicable	95%	+/- 2.5 kHz
Effective Isotropic Radiated Power	1.0 GHz to 26 GHz	95%	+/- 4.0 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%	+/- 4.18 dB

8.3. Measurement uncertainties have been applied in accordance with UKAS document NIS 81 (edition 1, May 1994), and in the absence of any specification criteria, guidance, or code of practice, compliance has been judged on the basis of shared risk.

8.4. In the case of emissions tests, the measured value of the disturbance from the product sample shall be compared directly with the limits. If the measured value is equal to or less than the limit the product is deemed to pass the test.

8.5. In the case of immunity tests, the equipment is deemed to pass the test if it fulfils the stated performance criteria at the required or a higher severity level. The measurement uncertainty has been taken into account in the calibration procedures stated in the relevant basic standard.

8.6. The methods used to calculate the above uncertainties are in line with those used for calibration laboratories contained in NAMAS document NIS 3003 Edition 8 “The Expression of Uncertainty and Confidence in Measurement” May 1995, which align with international recommendations “Guide to the Expression of Uncertainty in Measurement” ISO/IEC/OIML/BIPM (Prepared by ISO/TAG 4: January 1993).

Appendix 1. Test Equipment Used

Instrument	Manufacturer	Model	RFI No.
Horn Antenna	Eaton	9188-2	A027
2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	A031
ESH3-Z5	Rohde & Schwarz	ESH3-Z5	A1069
WG 20 Horn Antenna	Flann Microwave Ltd	20240-20	A201
20 dB Attenuator	Schaffner	6820-17-B	A243
WG 12 Microwave Horn	Flann Microwave	12240-20	A253
WG 14 Microwave Horn	Flann Microwave	14240-20	A254
WG 16 Microwave Horn	Flann Microwave	16240-20	A255
WG 18 Microwave Horn	Flann Microwave	18240-20	A256
Bilog Antenna	Chase	CBL6111	A259
SMHU Signal Generator	Rohde & Schwarz	SMHU	G013
Spectrum Monitor	Rohde & Schwarz	EZM	M003
ESMI Spectrum Analyser / Receiver	Rohde & Schwarz	ESMI	M069
Fluke 77 DVM	Fluke	77	M105
Spectrum Analyser	Rohde & Schwarz	FSEB 30	M127
Thermometer/Barometer/Hydrometer	Oregan Scientific	BA-116	M170
Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	M198
Power Meter	Rohde & Schwarz	NRVS	M199
Power Control	Zen	E08	S003
Site 1	RFI	1	S201
Site 15	RFI	15	S215

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

Appendix 2. Measurement Methods

AC Mains Conducted Emissions

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

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 and with the EUT powered via a 60 Hz AC mains supply.

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.

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.

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

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)*
Mode:	Max Hold	Not applicable
Bandwidth:	9 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

* In some instances an Average detector function may also have been used.

Radiated Field Strength Emissions

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

Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF 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. The test configuration was the same for the initial scans as for the final measurements.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Following the initial scans, graphs were 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 on the open area test site, at the appropriate distance, using a measuring receiver with a Quasi-Peak (below 1000 MHz), Average and Peak (above 1000 MHz) detector, where applicable.

For the main (final) measurements the EUT was arranged on a non-conducting table on an open area test site, as detailed in the specification.

All measurements on the open area test site were performed using broadband antennas.

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°. For frequencies below 1000 MHz, the antenna was varied in height between 1 m and 4 m. For frequencies above 1000 MHz, the antenna was fixed at a height of 1.5m. 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 test equipment settings for radiated emissions measurements were as follows:

Receiver Function	**Initial Scan Below 1000 MHz**	**Final Measurements Below 1000 MHz**
Detector Type:	Peak	Quasi-Peak (CISPR)
Mode:	Max Hold	Not applicable
Bandwidth:	100 kHz	120 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

Receiver Function	**Initial Scan Above 1000 MHz**	**Final Measurements Above 1000 MHz**
Detector Type:	Peak	Peak/Average
Mode:	Max Hold	Not applicable
Bandwidth:	1 MHz	1 MHz
Amplitude Range:	60 dB	20 dB (typical)
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

Conducted Antenna Port Emissions

Conducted Antenna Port Emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Prior to testing being performed a suitable RF attenuator and cable were calibrated for the required frequency range. For each measurement range performed, the calibrated level of the attenuator and cable were entered as an offset into the spectrum analyser to compensate for the measurement setup.

Initial measurements covering the entire measurement band in the form of swept scans were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which measurements were performed. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF 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. The test configuration was the same for the initial scans as for the final measurements.

Due to the design of the EUT, conducted antenna port measurements were common for both the internal and external antenna connection.

To determine the transmitter output power, the EUT was operated as intended with the spectrum analyser operated in a maximum hold mode over the full operating frequency range of the EUT to identify the highest emission within the band.

To determine spurious emissions levels, the EUT was operated as intended with the spectrum analyser operated in a maximum hold mode over selected frequency ranges between 30 MHz and 26 GHz. A reference limit line of 20dB below the maximum output of the transmitter was noted. Levels within 20dB of this limit line were then recorded.

Channel Separation FCC 15.247(1)

The EUT and spectrum analyser was configured as for conducted antenna port measurements, And as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

To determine the bandwidth and separation of each transmission channel the analyser was configured to measure two adjacent channels.

To determine the occupied bandwidth, A resolution bandwidth of 10 kHz was used, which is greater than 1% of the 20 dB bandwidth. A video bandwidth of a least the same value was used. The analyser was set for a maximum hold scan to capture the profile of the signal. The peak level was then determined, and a reference line was drawn 20dB below the peak level. The bandwidth was determined at the points where the 20dB reference crossed the profile of the emission.

Occupied Bandwidth FCC 15.247(1)

For channel separation, the analyser was configured with a resolution bandwidth and video bandwidth of at least 1% of the frequency span set on the analyser. A setting of 50 kHz was used.

The EUT was operated as intended and the analyser set to a maximum hold mode scan to capture the profile of the signals.

The peak points on the two adjacent channels were noted and the separation between them recorded.

The channel separation was then determined as the greater of 25kHz or the 20dB bandwidth.

Average Time of Occupancy FCC 15.247(1)(ii)

The EUT and spectrum analyser was configured as for conducted antenna port measurements

To determine the maximum packet length on any given channel, the analyser was configured in the time domain mode and the EUT was configured to operate as intended.

To determine the average occupancy time on any given channel the analyser was configured in the time domain and a 30 second sweep carried out. The number of times the channel was occupied in any 30 second period multiplied by the maximum packet length will give the total time on the given channel.

Number Of Hopping Frequencies FCC 15.247(a)(1)(ii)

The EUT and spectrum analyser was configured as for conducted antenna port measurements, And as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

To determine the number of hopping frequencies the EUT was set to operate in its normal mode of operation, hopping over all channels that it is intended to operate on.

The spectrum analyser had a span set to cover the frequency band of operation. The resolution bandwidth was set to >= 1% of the span. The video bandwidth was set to be no less than the resolution bandwidth. The sweep was set to auto, the detector function to peak and trace to max hold. This test was also performed with the span set to the lower half the operating frequency range and then to the upper half of the operating frequency range for better resolution.

Peak Output Power FCC 15.247(b)

The EUT and spectrum analyser was configured as for conducted antenna port measurements, And as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

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

As the frequency range of operation was greater than 10 MHz, The test was performed on the BOTTOM, MIDDLE and TOP channels as per FCC 15.31(m).

The tests were performed at extremes of voltage of +/- 15%. The test was also performed at 240 Volts + 15% at the applicants request.

The analyser was setup as per FCC Public Notice DA 00-705.

Band Edge Compliance of RF Conducted Emissions FCC 15.247(c)

The EUT and spectrum analyser was configured as for conducted antenna port measurements, And as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

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

To determine band-edge compliance, the analyser bandwidth resolution bandwidth was set to >= the analyser span. The video bandwidth was set to be no less than the resolution bandwidth. The sweep was set to auto and the detector to peak. The trace was set to max hold and a trace was produced.

A Plot of the upper channel and the protected band closest to the upper channel was produced. A marker was set to the peak of the highest channel and a delta marker set to the highest out of band peak. (The specification states that either the band edge level must be measured or the highest out of band emission. Which ever is greater). The plots show that the emission complies with the 20 dBc limit.

A Plot of the lower channel and the protected band closest to the lower channel was produced. A marker was set to the peak of the lowest channel and a delta marker set to the highest out of band peak. (The specification states that either the band edge level must be measured or the highest out of band emission. Which ever is greater). The plots show that the emission complies with the 20 dBc limit.

Four plots were produced, Two times top and bottom channels with hopping on and two time top and bottom channels with hopping off.

Measurement Anomalies

During pre-scan testing it can be seen on plots GPH/42147/24 through GPH/42147/28 that at low frequencies there is broadband noise exceeding the indicated limit line. This is broadband EUT/system noise that is greatly exaggerated due the characteristics of the test chamber used for the pre scan phase of the test. These emissions fell considerably below the specified limit once the test was reproduced on an open area test site.

Plots GPH/42147/43 and GPH/42147/50 show a sudden drop in the noise floor of the analyser. This is an analyser internal mixer characteristic and does effect the result of the test in any way.

Plots GPH/42147/46 and GPH/42147/47 show an emission at 14 GHz which is over the indicated limit line. This is an analyser generated response and is present with no signal at the front end of the analyser.

Appendix 3. Test Configuration Drawings

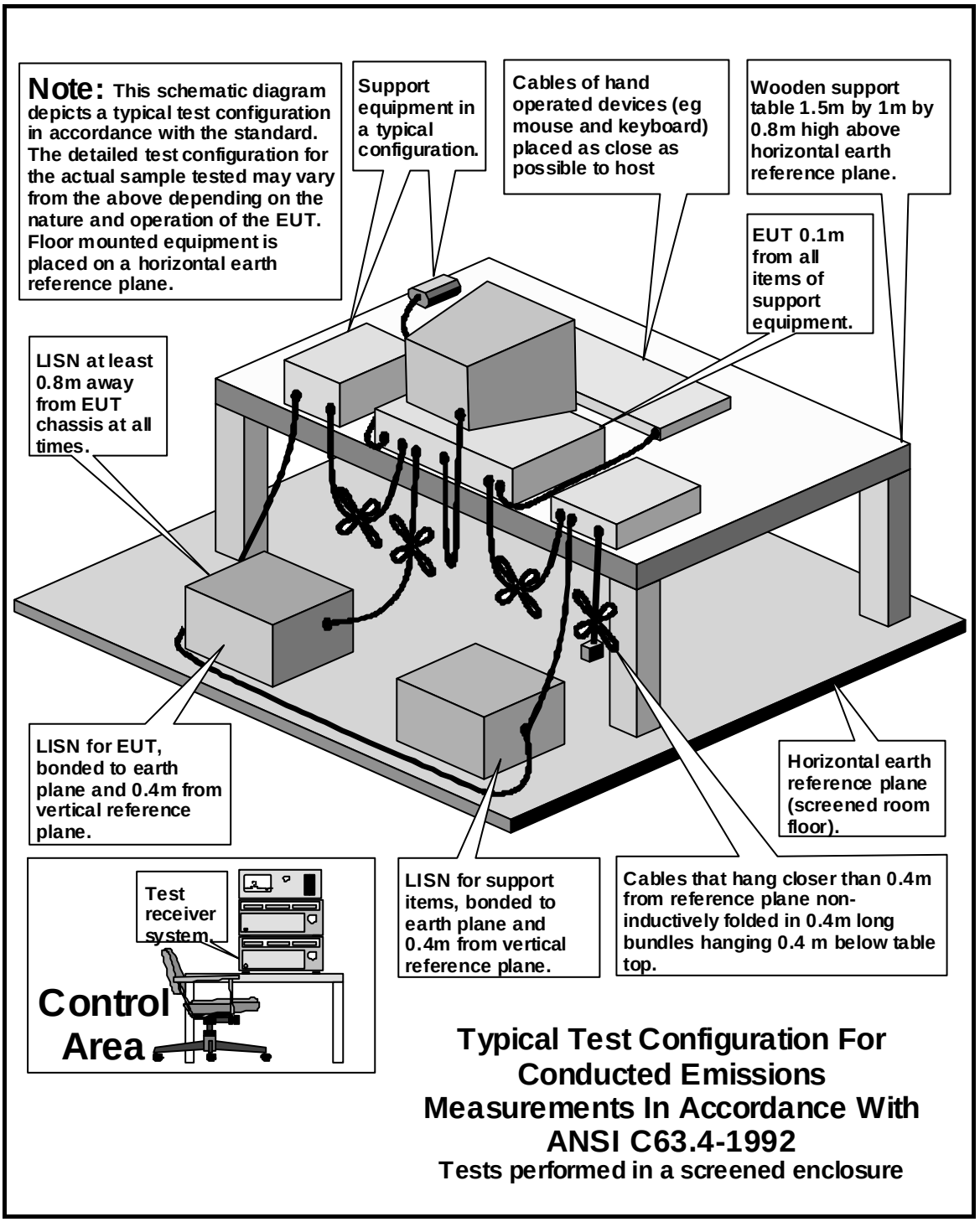
This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\42147JD02\EMICON	Test configuration for measurement of conducted emissions
DRG\42147JD02\EMIRAD	Test configuration for measurement of radiated emissions
DRG\42147JD02\001	Test configuration for Conducted RF Antenna Port
DRG\42147JD02\002	Schematic diagram of the EUT, support equipment and interconnecting cables used for the test

Test Of: Red-M (Communications) Ltd.
1000AP

To: F.C.C. Part 15 Subpart C: 1998 (Intentional Radiators) Section 15.247

DRG\42147JD02\EMICON

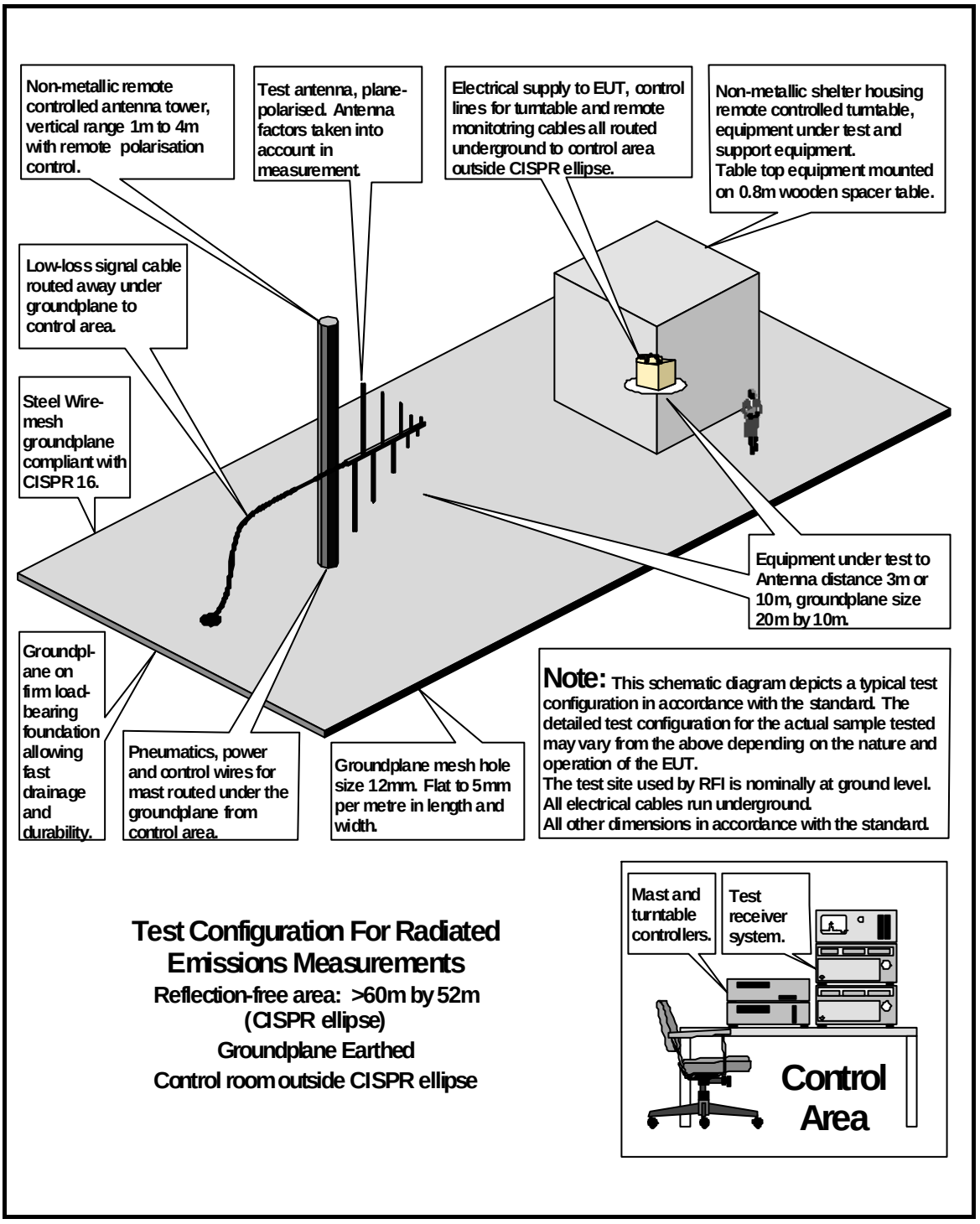


Typical Test Configuration For Conducted Emissions Measurements In Accordance With ANSI C63.4-1992

Tests performed in a screened enclosure

Test Of: **Red-M (Communications) Ltd. 1000AP**
To: **F.C.C. Part 15 Subpart C: 1998 (Intentional Radiators) Section 15.247**

DRG\42147JD02\EMIRAD



Test Configuration For Radiated Emissions Measurements

Reflection-free area: >60m by 52m (CISPR ellipse)

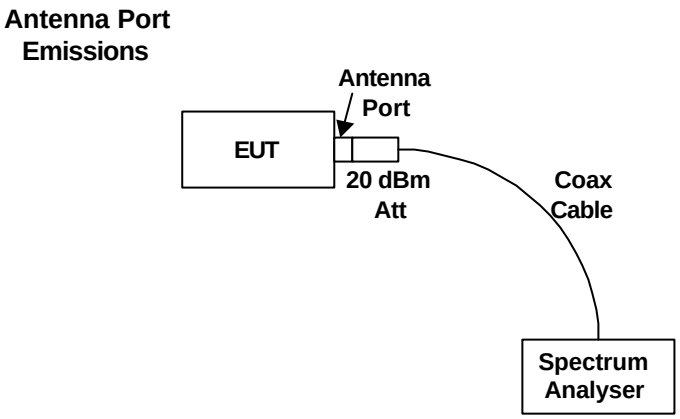
Groundplane Earthed

Control room outside CISPR ellipse

Test Of: **Red-M (Communications) Ltd.**
1000AP
To: **F.C.C. Part 15 Subpart C: 1998 (Intentional Radiators) Section 15.247**

DRG\42147JD02\001

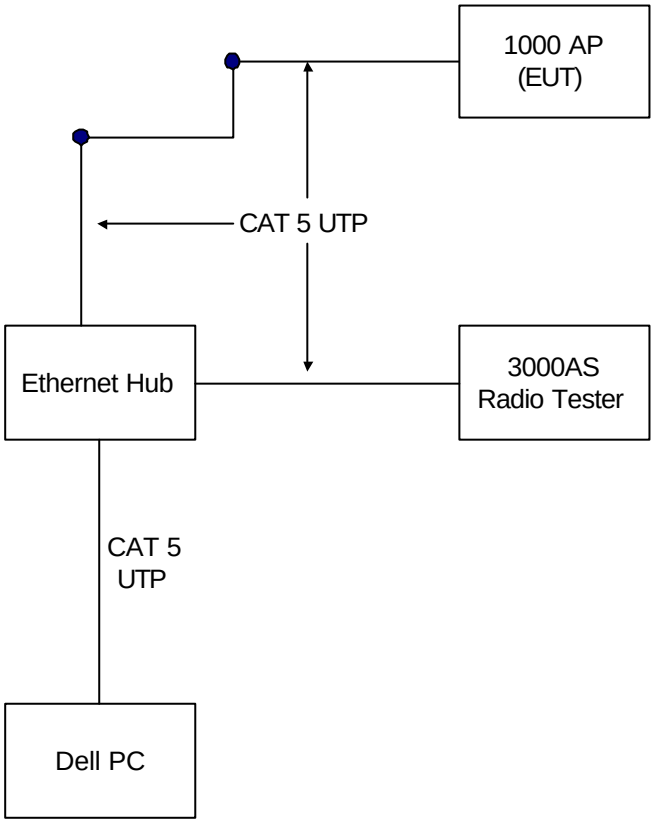
Conducted RF Antenna Port Configuration



Test Of: **Red-M (Communications) Ltd.**
1000AP
To: **F.C.C. Part 15 Subpart C: 1998 (Intentional Radiators) Section 15.247**

DRG\42147JD02\002

Configuration of EUT and Support Equipment



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