

TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Red-M (Communications) Ltd.
PEY1150AP Access Point

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

Test Report Serial No:
RFI/EMCB3/RP43324B

This Test Report supersedes RFI Test Report No.:
RFI/EMCB1/RP43324B and RFI/EMCB2/RP43324B

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: 
Tested By: <i>N. J. Steele</i>	Release Version No: PDF01
Issue Date: 21 May 2002	Test Dates: 27 March 2002 to 17 April 2002

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1. Client Information

Company Name:	Red-M (Communications) Ltd.
Address:	Neptune House Mercury Park Wycombe Lane Wooburn Green, Bucks HP10 0HH
Contact Name:	Mark Bailey

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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, 1050AP
Unique Type Identification:	PEY1150AP
Serial Number:	25 (rev 03)
Country of Manufacture:	UK
FCC ID Number:	Not applicable
Date of Receipt:	27 March 2002

2.2. Description Of EUT

The equipment under test is Bluetooth LAN access point. The 1000AP Access Point shares identical hardware with the PEY1050AP LAN Access Point, the differences in functionality are enabled by different software only.

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)
Intended Operating Environment:	Commercial, Light Industry
Weight:	0.2 kg
Dimensions:	140 mm x 120 mm x 40 mm
Interface Ports:	10/100 Ethernet Ports (x2), DC Power Supply Port (x1),

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2.5. Support Equipment

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

Description:	Personal Computer
Brand Name:	Dell
Model Name or Number:	Latitude CP M233XT
Serial Number:	MJ218
Cable Length And Type:	2m Power, 3m CAT 5 UTP
Connected to Port:	DC power port, 3Com PCMCIA NIC

Description:	Mains Power Adapter
Brand Name:	Dell
Model Name or Number:	PA-2
Serial Number:	17971-8BB-8Q7L
Cable Length And Type:	2m Mains, 2m DC Power
Connected to Port:	AC port, Fixed.

Description:	Network Interface Card (NIC)
Brand Name:	3Com Corp.
Model Name or Number:	Megahertz 10/100 LAN PC Card (Model 3CCFE574BT)
Serial Number:	0001039BDF81
Cable Length And Type:	3m CAT 5 UTP
Connected to Port:	Ethernet port.

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Support Equipment (continued)

Description:	8 Port Ethernet Hub
Brand Name:	3Com
Model Name or Number:	Office Connect Dual Speed Hub 8 (1675-010-051-2.00)
Serial Number:	010/7P1F135443
FCC ID Number	PEY3000AS2
Cable Length And Type:	2m DC Power, 2 x 5m CAT 5 UTP
Connected to Port:	DC Power Input, Ethernet Ports

Description:	Linux Server
Brand Name:	Red-M
Model Name or Number:	3000AS Access Server
Serial Number:	Approvals01
Cable Length And Type:	2m Mains, 0.3 CAT 5 UTP
Connected to Port:	AC port, 10/100 (Office LAN) port.

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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.

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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 (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 (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.

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4. Deviations From The Test Specification

The applicant has requested that testing be performed at the lower extreme of 85 V AC as opposed to 85% of the nominal voltage.

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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.

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6. Summary Of Test Results

6.1. Emissions: Transmit Mode

Range Of Measurements	Specification Reference	Compliance 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 Peak Power Spectral Density	C.F.R. 47 FCC Part 15: 2000. Section 15.247 (d)	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	Compliance 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.

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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. 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. 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 (a) and (b).

7.2.1.2. Preliminary Conducted spurious scans were performed with the EUT set to Top, Middle and Bottom channels stated in section 5.2.

7.2.1.3. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

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

Bottom Channel

Frequency (kHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.565	Live	36.7	48.0	11.3	Complied
0.565	Neutral	37.4	48.0	10.6	Complied
1.409	Live	37.2	48.0	10.8	Complied
1.410	Neutral	38.5	48.0	9.5	Complied
2.538	Live	41.1	48.0	6.9	Complied
2.538	Neutral	42.3	48.0	5.7	Complied
2.820	Live	41.4	48.0	6.6	Complied
2.820	Neutral	42.8	48.0	5.2	Complied
13.248	Live	46.1	48.0	1.9	Complied
13.248	Neutral	46.8	48.0	1.2	Complied
21.664	Live	38.9	48.0	9.1	Complied
21.664	Neutral	39.2	48.0	8.8	Complied

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Test Results For AC Mains Conducted Emissions: Transmit Mode (continued)**Middle Channel**

Frequency (kHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.563	Live	36.5	48.0	11.5	Complied
0.564	Neutral	37.7	48.0	10.3	Complied
1.410	Live	37.2	48.0	10.8	Complied
1.410	Neutral	38.4	48.0	9.6	Complied
2.257	Live	39.2	48.0	8.8	Complied
2.257	Neutral	40.3	48.0	7.7	Complied
2.541	Live	39.8	48.0	8.2	Complied
2.541	Neutral	41.4	48.0	6.6	Complied
12.974	Live	46.5	48.0	1.5	Complied
12.974	Neutral	47.1	48.0	0.9	Complied
21.665	Live	38.2	48.0	9.8	Complied
21.665	Neutral	37.2	48.0	10.8	Complied

Top Channel

Frequency (kHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.566	Live	36.4	48.0	11.6	Complied
0.566	Neutral	37.1	48.0	10.9	Complied
1.410	Live	36.9	48.0	11.1	Complied
1.412	Neutral	38.3	48.0	9.7	Complied
2.541	Live	41.4	48.0	6.6	Complied
2.541	Neutral	42.6	48.0	5.4	Complied
2.824	Live	41.4	48.0	6.6	Complied
2.824	Neutral	42.8	48.0	5.2	Complied
13.266	Live	46.0	48.0	2.0	Complied
13.266	Neutral	46.9	48.0	1.1	Complied
21.664	Live	38.5	48.0	9.5	Complied
21.664	Neutral	38.4	48.0	9.6	Complied

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Test Results For AC Mains Conducted Emissions: Transmit Mode (continued)**All Channels Active**

Frequency (kHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.564	Live	37.0	48.0	11.0	Complied
0.564	Neutral	37.8	48.0	10.2	Complied
1.409	Live	37.1	48.0	8.9	Complied
1.409	Neutral	38.5	48.0	9.5	Complied
2.536	Live	41.2	48.0	6.8	Complied
2.536	Neutral	42.5	48.0	5.5	Complied
2.819	Live	41.1	48.0	6.9	Complied
2.819	Neutral	42.5	48.0	5.5	Complied
13.246	Live	43.8	48.0	4.2	Complied
13.246	Neutral	44.2	48.0	3.8	Complied
21.663	Live	39.5	48.0	8.5	Complied
21.663	Neutral	37.6	48.0	10.4	Complied

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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 accompanying document RP43324B_GraphSection.

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 (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.736	Live	31.4	48.0	16.6	Complied
1.322	Live	31.8	48.0	16.2	Complied
2.055	Live	31.9	48.0	16.1	Complied
2.841	Live	32.9	48.0	15.1	Complied
12.720	Live	39.3	48.0	8.7	Complied
21.664	Live	37.1	48.0	10.9	Complied
0.846	Neutral	34.4	48.0	13.6	Complied
1.411	Neutral	34.5	48.0	13.5	Complied
1.974	Neutral	34.3	48.0	13.7	Complied
2.820	Neutral	37.7	48.0	10.3	Complied
12.680	Neutral	43.8	48.0	4.2	Complied
21.664	Neutral	34.9	48.0	13.1	Complied

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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/43324/CE002 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/43324/CE06 to GPH/42147/08 and GPH/43324/CE013 to GPH/43324/CE018 in the accompanying document RP43324B_GraphSection.

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

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

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (Watts)	Limit (Watts)	Margin	Result
Top	85	0.011974	1.0	0.988026	Complied
Top	110	0.011068	1.0	0.988932	Complied
Top	126.5	0.011757	1.0	0.988243	Complied

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (Watts)	Limit (Watts)	Margin	Result
Middle	85	0.011188	1.0	0.988812	Complied
Middle	110	0.009466	1.0	0.990534	Complied
Middle	126.5	0.011188	1.0	0.988812	Complied

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (Watts)	Limit (Watts)	Margin	Result
Bottom	85	0.011868	1.0	0.988132	Complied
Bottom	110	0.011073	1.0	0.988927	Complied
Bottom	126.5	0.011459	1.0	0.988541	Complied

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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 by 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 at the Top, Middle and Bottom channels, as specified within clause 15.31 (m) and with all channels active (transmitting data on pseudo random hopping channels) stated in section 5.2. Initial scans indicate 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 accompanying document RP43324B_GraphSection.

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7.6. Peak Power Spectral Density For Direct Sequence Systems

7.6.1. The EUT employs less than 75 channels in the acquisition mode, as such, the device must be classified as a hybrid system FCC Part 15.247(f), and must also comply with the requirements for direct sequence systems. Tests were performed to identify the maximum transmit peak power spectral density in accordance with FCC Part 15.247(d).

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

7.6.3. Testing was performed on the Bottom, Middle and Top channels used for the accusation mode. Spectral power density in the 3 kHz bandwidth was then measured as specified in FCC Part 15.247(d).

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (dBm/3kHz)	Limit (dBm/3kHz)	Margin	Result
Bottom	110	-10.4	8.0	18.4	Complied

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (dBm/3kHz)	Limit (dBm/3kHz)	Margin	Result
Middle	110	-8.0	8.0	18.0	Complied

Channel	Input Voltage (AC)	Maximum Transmitter Output Level (dBm/3kHz)	Limit (dBm/3kHz)	Margin	Result
Top	110	-8.0	8.0	18.0	Complied

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

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

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

7.7.1.2. 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.

7.7.1.3. Plots of the initial scans can be found in the accompanying document RP43324B_GraphSection.

7.7.1.4. 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):

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

Bottom Channel

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
46.361	Vert.	28.2	40.0	11.8	Complied
49.636	Vert.	23.4	40.0	16.6	Complied
55.688	Vert.	26.9	40.0	23.1	Complied
59.988	Vert.	33.1	40.0	6.9	Complied
64.260	Vert.	29.5	40.0	10.5	Complied
68.906	Vert.	22.7	40.0	17.3	Complied
75.003	Vert.	27.4	40.0	12.6	Complied
79.463	Vert.	21.5	40.0	18.5	Complied
81.490	Vert.	25.2	40.0	14.8	Complied
90.879	Vert.	26.4	43.5	17.1	Complied
91.546	Vert.	28.1	43.5	15.4	Complied
99.990	Vert.	40.4	43.5	3.1	Complied (Note 1)
106.713	Vert.	31.8	43.5	11.7	Complied
111.486	Vert.	31.7	43.5	11.8	Complied
117.346	Vert.	23.9	43.5	19.6	Complied

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121.493	Vert.	25.4	43.5	18.1	Complied
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Test Results For Radiated Emissions: Transmit Mode - Continued**Bottom Channel**

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
128.520	Vert.	25.8	43.5	17.7	Complied
136.896	Vert.	35.4	43.5	8.1	Complied
143.253	Vert.	24.3	43.5	19.2	Complied
150.006	Vert.	25.7	43.5	17.8	Complied
200.403	Horiz.	19.7	43.5	23.8	Complied
239.993	Horiz.	40.1	46.0	5.9	Complied
252.760	Horiz.	23.4	46.0	22.6	Complied
299.990	Horiz.	32.1	46.0	13.9	Complied
340.346	Vert.	24.2	46.0	21.8	Complied
362.990	Vert.	24.6	46.0	21.4	Complied
374.993	Horiz.	29.3	46.0	16.7	Complied
400.010	Horiz.	37.8	46.0	8.2	Complied

Test Of: Red-M (Communications) Ltd.

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Test Results For Radiated Emissions: Transmit Mode - Continued**Bottom Channel**

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
428.550	Horiz.	28.5	46.0	17.5	Complied
450.006	Horiz.	35.7	46.0	10.3	Complied
500.016	Vert.	35.2	46.0	10.8	Complied
544.286	Vert.	31.8	46.0	14.2	Complied
600.026	Vert.	41.4	46.0	4.6	Complied
655.750	Vert.	24.5	46.0	21.5	Complied (Note 2)
724.283	Horiz.	34.2	46.0	11.8	Complied
754.433	Horiz.	34.7	46.0	11.3	Complied
780.053	Vert.	39.1	46.0	6.9	Complied
878.690	Horiz.	34.9	46.0	11.1	Complied

Note 1: At the frequency of 99.990 MHz, an ambient was measured. With the manufacturers consent, this was taken as a final measurement as the maximum measured ambient was below the limit.

Note 2: Due to the presence of an ambient signal this emission was re-measured using a substitution method. At the emission frequency a high level signal was generated in the screened room used for the initial swept measurements. This measurement was then repeated on the open area test site. The difference in amplitude between the screened room measurement and free-field measurement was then used to correct the value obtained in the screened room for the test sample.

Test Of: Red-M (Communications) Ltd.

PEY1150AP Access Point

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

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
46.361	Vert.	28.3	40.0	11.7	Complied
49.636	Vert.	25.8	40.0	14.2	Complied
55.688	Vert.	28.5	40.0	11.5	Complied
59.988	Vert.	35.3	40.0	4.7	Complied
64.260	Vert.	28.2	40.0	11.8	Complied
68.996	Vert.	28.5	40.0	11.5	Complied
75.003	Vert.	26.7	40.0	13.3	Complied
79.463	Vert.	25.5	40.0	14.5	Complied
81.490	Vert.	25.9	40.0	14.1	Complied
90.879	Vert.	28.3	43.5	15.2	Complied
91.546	Vert.	33.4	43.5	10.1	Complied
99.990	Vert.	40.6	43.5	2.9	Complied (Note 1)
106.713	Vert.	37.3	43.5	6.2	Complied
111.486	Vert.	25.9	43.5	17.6	Complied
117.346	Vert.	18.7	43.5	24.8	Complied
121.493	Vert.	20.3	43.5	23.2	Complied
128.520	Vert.	27.2	43.5	16.3	Complied
136.896	Vert.	29.4	43.5	14.1	Complied
143.253	Vert.	22.5	43.5	21.0	Complied
150.006	Vert.	25.8	43.5	17.7	Complied
200.403	Horiz.	19.2	43.5	24.3	Complied
239.993	Horiz.	40.0	46.0	6.0	Complied
252.760	Horiz.	22.0	46.0	24.0	Complied

Test Of: Red-M (Communications) Ltd.

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

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
299.990	Horiz.	33.0	46.0	13.0	Complied
362.990	Horiz.	25.1	46.0	20.9	Complied
374.993	Horiz.	35.0	46.0	11.0	Complied
400.010	Horiz.	39.8	46.0	6.2	Complied
428.550	Vert.	28.6	46.0	17.4	Complied
450.006	Vert.	32.1	46.0	13.9	Complied
501.613	Vert.	29.8	46.0	16.2	Complied
544.286	Horiz.	33.3	46.0	12.7	Complied
604.310	Vert.	33.4	46.0	12.6	Complied
655.750	Vert.	24.5	46.0	21.5	Complied (Note 2)
724.283	Horiz.	34.0	46.0	12.0	Complied
754.433	Vert.	34.7	46.0	11.3	Complied
780.053	Vert.	39.0	46.0	7.0	Complied
878.670	Vert.	34.9	46.0	11.1	Complied

Note 1: At the frequency of 99.990 MHz, an ambient was measured. With the manufacturers consent, this was taken as a final measurement as the maximum measured ambient was below the limit.

Note 2: Due to the presence of an ambient signal this emission was re-measured using a substitution method. At the emission frequency a high level signal was generated in the screened room used for the initial swept measurements. This measurement was then repeated on the open area test site. The difference in amplitude between the screened room measurement and free-field measurement was then used to correct the value obtained in the screened room for the test sample.

Test Of: Red-M (Communications) Ltd.

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

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
46.361	Vert.	30.3	40.0	9.7	Complied
49.636	Vert.	22.3	40.0	17.7	Complied
55.688	Vert.	22.4	40.0	17.6	Complied
59.988	Vert.	35.1	40.0	4.9	Complied
64.260	Vert.	27.3	40.0	12.7	Complied
68.996	Vert.	26.2	40.0	13.8	Complied
75.003	Vert.	26.0	40.0	14.0	Complied
79.463	Vert.	23.4	40.0	16.6	Complied
81.490	Vert.	25.0	40.0	15.0	Complied
90.879	Vert.	31.5	43.5	12.0	Complied
91.546	Vert.	27.0	43.5	16.5	Complied
99.990	Vert.	40.2	43.5	3.3	Complied (Note 1)
106.713	Vert.	30.9	43.5	12.6	Complied
111.486	Vert.	28.1	43.5	15.4	Complied
117.346	Vert.	24.2	43.5	19.3	Complied
121.493	Vert.	25.0	43.5	18.5	Complied
128.520	Vert.	24.2	43.5	19.3	Complied
136.896	Vert.	24.3	43.5	19.2	Complied
143.253	Vert.	24.3	43.5	19.2	Complied
150.006	Vert.	25.5	43.5	18.0	Complied
163.281	Vert.	22.1	43.5	21.4	Complied
200.403	Horiz.	15.2	43.5	28.3	Complied
239.993	Horiz.	38.2	46.0	7.8	Complied
252.760	Vert.	13.5	46.0	32.5	Complied
299.990	Horiz.	32.3	46.0	13.7	Complied
340.346	Vert.	16.2	46.0	29.8	Complied
362.990	Vert.	15.2	46.0	30.8	Complied
374.993	Vert.	37.4	46.0	8.6	Complied
400.010	Horiz.	38.4	46.0	7.6	Complied

Test Of: Red-M (Communications) Ltd.

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

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
428.550	Vert.	22.6	46.0	23.4	Complied
450.006	Vert.	31.8	46.0	14.2	Complied
500.016	Horiz.	32.6	46.0	13.4	Complied
544.286	Horiz.	27.2	46.0	18.8	Complied
604.900	Vert.	21.0	46.0	25.0	Complied
655.750	Vert.	24.5	46.0	21.5	Complied (Note 2)
724.283	Horiz.	26.9	46.0	19.1	Complied
754.433	Horiz.	26.0	46.0	20.0	Complied
780.053	Horiz.	31.1	46.0	14.9	Complied
878.670	Vert.	24.4	46.0	21.6	Complied

Note 1: At the frequency of 99.990 MHz, an ambient was measured. With the manufacturers consent, this was taken as a final measurement as the maximum measured ambient was below the limit.

Note 2: Due to the presence of an ambient signal this emission was re-measured using a substitution method. At the emission frequency a high level signal was generated in the screened room used for the initial swept measurements. This measurement was then repeated on the open area test site. The difference in amplitude between the screened room measurement and free-field measurement was then used to correct the value obtained in the screened room for the test sample.

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Test Results For Radiated Emissions: Transmit Mode (continued)**All Channels Active**

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
46.361	Vert.	29.4	40.0	10.6	Complied
49.636	Vert.	24.0	40.0	16.0	Complied
55.688	Vert.	28.5	40.0	11.5	Complied
59.988	Vert.	34.5	40.0	5.5	Complied
64.260	Vert.	33.4	40.0	6.6	Complied
68.996	Vert.	25.4	40.0	14.6	Complied
75.003	Vert.	25.4	40.0	14.6	Complied
79.463	Vert.	20.8	40.0	19.2	Complied
81.490	Vert.	24.2	40.0	15.8	Complied
90.879	Vert.	26.9	43.5	16.6	Complied
91.546	Vert.	27.2	43.5	16.3	Complied
99.990	Vert.	41.5	43.5	2.0	Complied (Note 1)
106.713	Vert.	35.1	43.5	8.4	Complied
111.486	Vert.	27.2	43.5	16.3	Complied
117.346	Vert.	14.7	43.5	28.8	Complied
121.493	Vert.	17.1	43.5	26.4	Complied
128.520	Vert.	24.5	43.5	19.0	Complied
136.896	Vert.	26.8	43.5	16.7	Complied
143.253	Vert.	22.2	43.5	21.3	Complied
150.006	Vert.	26.3	43.5	17.2	Complied
200.403	Vert.	28.0	43.5	15.5	Complied
239.993	Vert.	33.4	46.0	12.6	Complied
252.760	Vert.	26.4	46.0	19.6	Complied
299.990	Horiz.	41.2	46.0	4.8	Complied
340.346	Horiz.	16.7	46.0	29.3	Complied
362.990	Vert.	19.2	46.0	26.8	Complied
374.993	Vert.	28.0	46.0	18.0	Complied
400.010	Horiz.	39.5	46.0	6.5	Complied
428.550	Horiz.	21.7	46.0	24.3	Complied
450.006	Vert.	28.9	46.0	17.1	Complied

Test Of: Red-M (Communications) Ltd.

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Test Results For Radiated Emissions: Transmit Mode (continued)**All Channels Active**

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
500.016	Horiz.	30.7	46.0	15.3	Complied
544.286	Horiz.	31.7	46.0	14.3	Complied
600.026	Horiz.	37.0	46.0	9.0	Complied
655.750	Vert.	24.5	46.0	21.5	Complied (Note 2)
724.283	Horiz.	26.2	46.0	19.4	Complied
754.433	Vert.	24.2	46.0	21.8	Complied
780.053	Vert.	29.7	46.0	16.3	Complied
878.670	Vert.	25.0	46.0	21.0	Complied

Note 1: At the frequency of 99.990 MHz, an ambient was measured. With the manufacturers consent, this was taken as a final measurement as the maximum measured ambient was below the limit.

Note 2: Due to the presence of an ambient signal this emission was re-measured using a substitution method. At the emission frequency a high level signal was generated in the screened room used for the initial swept measurements. This measurement was then repeated on the open area test site. The difference in amplitude between the screened room measurement and free-field measurement was then used to correct the value obtained in the screened room for the test sample.

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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 bands as specified in section 15.205 and other frequencies that fell within 20 dB's of the limit.

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 Bottom, Middle, Top Channels and a pseudo random hopping mode as stated in section 5.2.

7.8.1.4. Due to dynamic range limitations of the measuring receiver, scans at high frequencies above 12 GHz were performed at 1 metre measurement distances, with an corrected limit line for the reduced test distance.

7.8.1.5. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

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 (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
4.803833	Ver	31.2	20.0	1.9	53.1	54.0	0.9	Complied
7.206147	Ver	21.6	20.5	2.2	44.3	54.0	9.7	Complied

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
4.803833	Ver	39.8	20.0	1.9	61.7	74.0	12.3	Complied
7.206147	Ver	28.2	20.5	2.2	50.9	74.0	29.7	Complied

Test Of: Red-M (Communications) Ltd.

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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 bands as specified in section 15.205 and other frequencies that fell within 20 dB's of the limit.

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 Bottom, Middle, Top Channels and a pseudo random hopping mode as stated in section 5.2.

7.9.1.4. Due to dynamic range limitations of the measuring receiver, scans at high frequencies above 12 GHz were performed at 1 metre measurement distances, with an corrected limit line for the reduced test distances.

7.9.1.5. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

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 (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
4.881700	Ver	28.6	20.0	1.9	50.5	54.0	3.5	Complied
7.323200	Ver	18.0	20.5	2.2	40.7	54.0	13.3	Complied

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
4.881700	Ver	37.9	20.0	1.9	59.8	74.0	14.2	Complied
7.323200	Ver	25.2	20.5	2.2	47.9	74.0	26.1	Complied

Test Of: Red-M (Communications) Ltd.

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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 bands as specified in section 15.205 and other frequencies that fell within 20 dB's of the limit.

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 Bottom, Middle, Top Channels and a pseudo random hopping mode as stated in section 5.2.

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 an corrected limit line for the reduced test distances.

7.10.1.5. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

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 (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
4.959866	Ver	29.4	20.0	1.9	51.3	54.0	2.7	Complied
7.440261	Ver	16.7	20.5	2.2	39.4	54.0	14.6	Complied
9.920633	Ver	18.4	19.5	2.6	40.5	54.0	13.5	Complied

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
4.959866	Ver	36.1	20.0	1.9	58.0	74.0	16.0	Complied
7.440261	Ver	25.2	20.5	2.2	47.9	74.0	26.1	Complied
9.920633	Ver	29.1	19.5	2.6	51.2	74.0	22.8	Complied

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7.11. Test Results For Radiated Emissions: Transmit Mode (Hopping Mode)**7.11.1. Electric Field Strength Measurements: 1.0 to 26.0 GHz**

7.11.1.1. The following table specifies frequencies, which fall within the bands as specified in section 15.205 and other frequencies that fell within 20 dB's of the limit.

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

7.11.1.3. Preliminary Radiated spurious scans were performed with the EUT set to Bottom, Middle, Top Channels and a pseudo random hopping mode as stated in section 5.2.

7.11.1.4. Due to dynamic range limitations of the measuring receiver, scans at high frequencies above 12 GHz were performed at 1 metre measurement distances, with an corrected limit line for the reduced test distances.

7.11.1.5. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

7.11.1.6. 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 (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
4.804852	Ver	4.3	20.0	1.9	26.2	54.0	27.8	Complied
9.284910	Ver	12.5	20.5	2.2	34.6	54.0	19.4	Complied

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
4.804852	Ver	31.2	20.0	1.9	53.1	74.0	20.9	Complied
9.284910	Ver	27.9	20.5	2.2	50.0	74.0	24.0	Complied

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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. Radiated receiver tests were performed with the EUT operating in receive mode. and tested to the limits specified in FCC Part 15.109.

7.12.1.2. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

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

7.12.1.4. Preliminary Radiated spurious scans were performed with the EUT configured in the receive mode as stated in section 5.2.

7.12.1.5. Due to dynamic range limitations of the measuring receiver, scans at high frequencies above 12 GHz were performed at 1 metre, with an indicated limit line corrected for the reduced test distances.

7.12.1.6. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

7.12.1.7. No spurious emissions were noted in the initial scans for frequencies above 1 GHz. As such, final measurements were not required.

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7.13. Test Results For Radiated Emissions: Receive Mode**7.13.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)**

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

7.13.1.2. Plots of the initial scans can be found in the accompanying document RP43324B_GraphSection.

7.13.1.3. 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 (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
46.361	Vert.	23.5	40.0	16.5	Complied
55.688	Vert.	29.8	40.0	10.2	Complied
55.688	Vert.	37.2	40.0	2.8	Complied
64.260	Vert.	34.7	40.0	5.3	Complied
68.996	Vert.	25.8	40.0	14.2	Complied
75.003	Vert.	23.9	40.0	16.1	Complied
79.463	Vert.	22.6	40.0	17.4	Complied
81.490	Vert.	24.6	40.0	15.4	Complied
90.879	Vert.	25.4	43.5	18.1	Complied
99.990	Vert.	41.2	43.5	2.3	Complied (Note 1)
106.713	Vert.	35.2	43.5	8.3	Complied
111.486	Vert.	29.3	43.5	14.2	Complied
121.493	Vert.	22.1	43.5	21.4	Complied
128.520	Vert.	26.4	43.5	17.1	Complied
150.006	Vert.	27.5	43.5	16.0	Complied
175.740	Horiz.	25.1	43.5	18.4	Complied
200.403	Horiz.	15.1	43.5	28.4	Complied
252.760	Horiz.	20.9	46.0	25.1	Complied
299.990	Horiz.	31.3	46.0	14.7	Complied

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Test Results For Radiated Emissions: Receive Mode (continued)

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
362.990	Vert.	15.3	46.0	30.7	Complied
400.010	Horiz.	36.8	46.0	9.2	Complied
428.550	Vert.	23.3	46.0	22.7	Complied
500.016	Vert.	33.3	46.0	12.7	Complied
544.286	Vert.	282	46.0	17.8	Complied
600.026	Vert.	41.0	46.0	5.0	Complied
655.750	Vert.	24.5	46.0	21.5	Complied (Note 2)
754.433	Horiz.	26.2	46.0	19.8	Complied
878.670	Horiz.	25.9	46.0	20.1	Complied

Note 1: At the frequency of 99.990 MHz, an ambient was measured. With the manufacturers consent, this was taken as a final measurement as the maximum measured ambient was below the limit.

Note 2: Due to the presence of an ambient signal this emission was re-measured using a substitution method. At the emission frequency a high level signal was generated in the screened room used for the initial swept measurements. This measurement was then repeated on the open area test site. The difference in amplitude between the screened room measurement and free-field measurement was then used to correct the value obtained in the screened room for the test sample.

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7.14. Radiated Emissions: Receive Mode

7.14.1. Electric Field Strength Measurements (Frequency Range: 1.0 to 26.0 GHz)

7.14.1.1. Radiated receiver tests were performed with the EUT operating in receive mode. and tested to the limits specified in FCC Part 15.109.

7.14.1.2. Plots of all the initial scans can be found in the accompanying document RP43324B_GraphSection.

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

7.14.1.4. Preliminary Radiated spurious scans were performed with the EUT configured in the receive mode as stated in section 5.2.

7.14.1.5. Due to dynamic range limitations of the measuring receiver, scans at high frequencies above 12 GHz were performed at 1 metre, with an indicated limit line corrected for the reduced test distances.

7.14.1.6. No spurious emissions were noted in the initial scans for frequencies above 1 GHz. As such, final measurements were not required.

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

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

Occupied Bandwidth and Channel Separation:

7.15.2. 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.

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

20 dB Bandwidth: 782kHz. (Refer to Plot GPH/43324/CE005)

Channel Separation: 998kHz. (Refer to Plot GPH/43324/CE001)

Time Occupancy:

7.15.4. The time occupancy of the system was tested on a single carrier. The maximum packet length was measured to be 2.848ms and can be seen in the accompanying document RP43324B_GraphSection (Plot GPH/43324/CE003). The maximum time the carrier was used in a 30 second period was measured as 0.297 seconds and can be seen in the accompanying document RP43324B_GraphSection (Plot GPH/43324/CE0004).

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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”.

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

8.5. 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.

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Appendix 1. Test Equipment Used

RFI No.	Instrument	Maker	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	557
A1069	ESH3-Z5	Rohde & Schwarz	ESH3-Z5	837469/012
A201	WG 20 Horn Antenna	Flann Microwave Ltd	20240-20	266
A243	20 dB Attenuator	Schaffner	6820-17-B	None
A253	WG 12 Microwave Horn	Flann Microwave	12240-20	128
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A255	WG 16 Microwave Horn	Flann Microwave	16240-20	519
A256	WG 18 Microwave Horn	Flann Microwave	18240-20	400
A259	Bilog Antenna	Chase	CBL6111	1513
G013	SMHU Signal Generator	Rohde & Schwarz	SMHU	894 055/003
G051	Signal Generator	Gigatronics	7100/.01-20	749472

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Test Equipment Used (continued)

RFI No.	Instrument	Maker	Type No.	Serial No.
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M069	ESMI Spectrum Analyser / Receiver	Rohde & Schwarz	ESMI	829 808/007 (DU) / 827 063/008 (RU)
M105	Fluke 77 DVM	Fluke	77	963580770
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016
M170	Thermometer/Barometer/Hydrometer	Oregan Scientific	BA-116	None
M198	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	827 191/003
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075
S003	Power Control	Zen	E08	736699
S201	Site 1	RFI	1	
S212	Site 12	RFI	12	

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

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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.

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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.

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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

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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.

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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.

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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.

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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.

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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 $\geq 1\%$ 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.

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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.

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Peak Power Spectral Density For Direct Sequence Systems FCC Part 15.247(d).

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

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 with a fully charged battery as specified in FCC Part 15.31(e) for battery operated devices:

Testing was performed on the Bottom, Middle and Top channels used for the accusation mode. Spectral power density in the 3 kHz bandwidth was then measured as specified in FCC Part 15.247(d).

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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 $\geq$ 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.

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Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

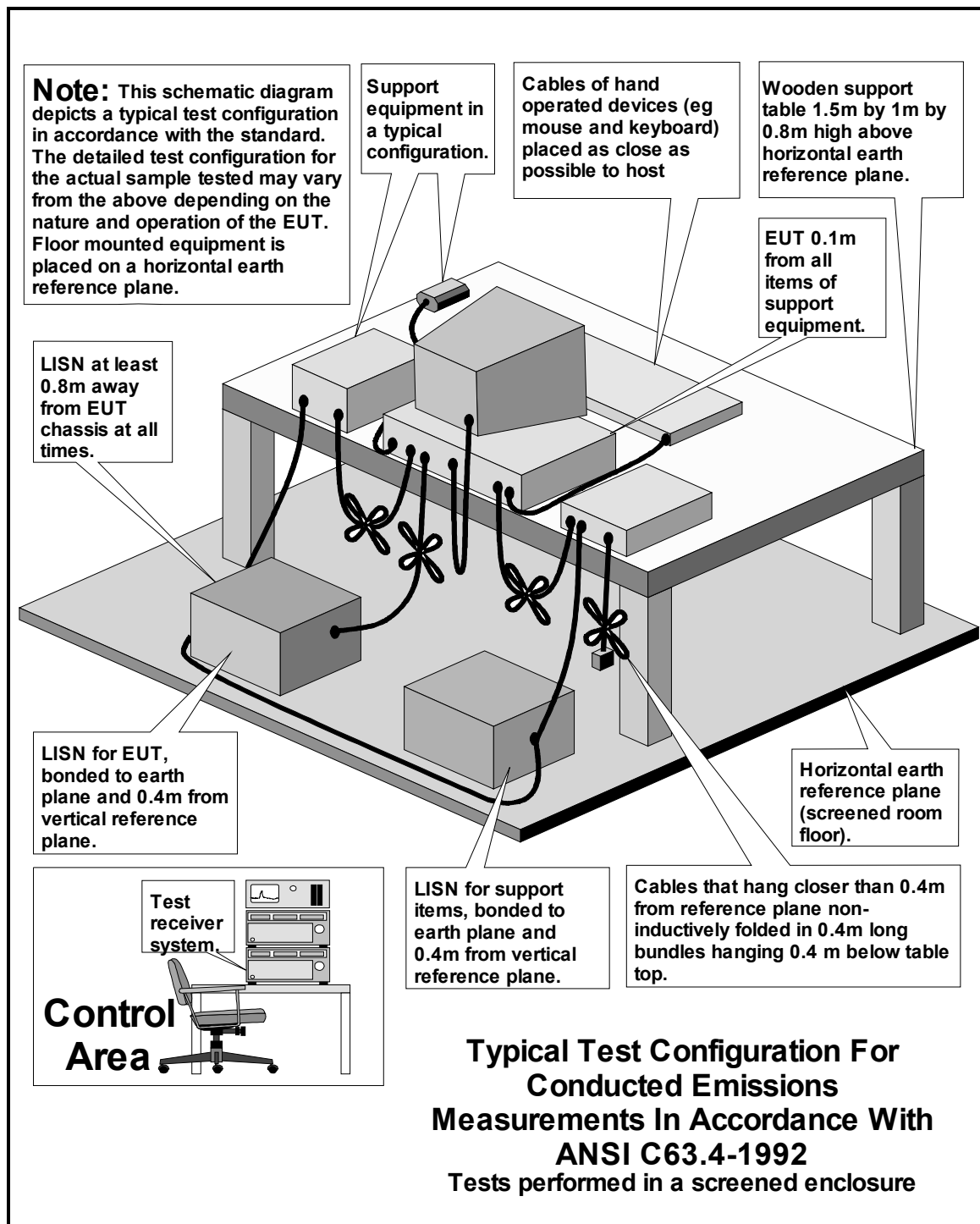
Drawing Reference Number	Title
DRG\43324JD02\EMICON	Test configuration for measurement of conducted emissions
DRG\43324JD02\EMIRAD	Test configuration for measurement of radiated emissions
DRG\43324JD02\001	Test configuration for Conducted RF Antenna Port
DRG\43324JD02\002	Schematic diagram of the EUT, support equipment and interconnecting cables used for the test

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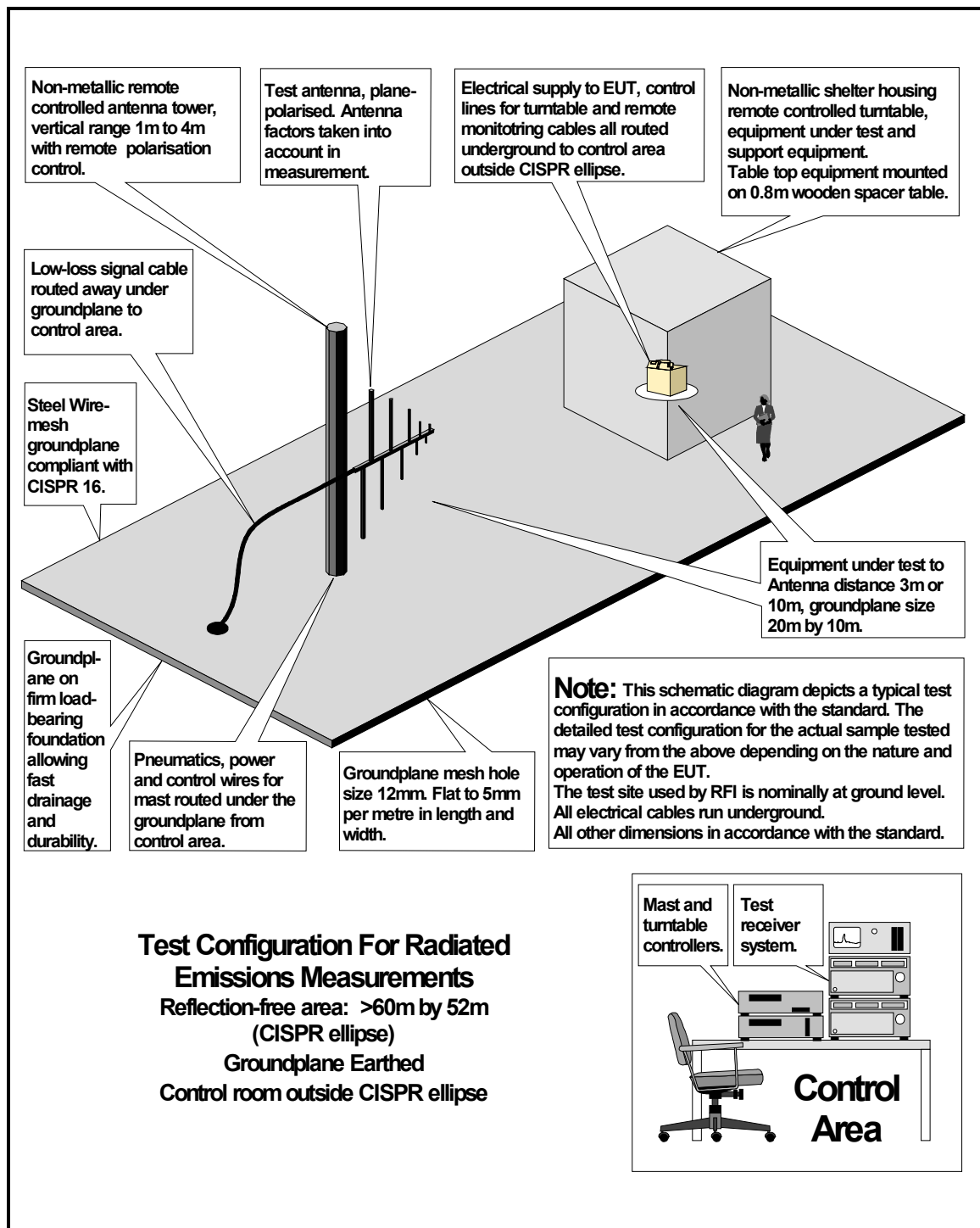


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Test Of: Red-M (Communications) Ltd.

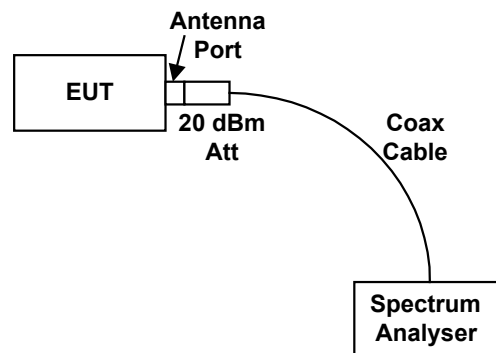
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DRG\43324JD02\001

Conducted RF Antenna Port Configuration

Antenna Port
Emissions



EMC Department

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Configuration of EUT and Support Equipment

