



TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Marconi Selenia Communications Ltd.
H4588 Personal Role Radio

To: FCC Part 15.247

Test Report Serial No:
RFI/MPTB1/RP45620JD06A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: Tony Henriques 
Tested By: Elin Danielsen  PP by Steven Wong	Release Version No: PDF01
Issue Date: 26 April 2004	Test Dates: 22 March 2004 to 30 March 2004

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RADIO FREQUENCY INVESTIGATION LTD.

TEST REPORT

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1. Customer Information

Company Name:	Marconi Selenia Communications Ltd.
Address:	Marconi House New Street Chelmsford Essex CM1 1PL UK
Contact Name:	Keith Starkey

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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 customer:

2.1. Identification Of Equipment Under Test (EUT)

Model Name:	Personal Role Radio
Model Number:	H4588
Unique Type Identification:	H-110-4855
Serial Number:	FCC01
FCC ID Number:	RMJPRR0001
Country of Manufacture:	UK
Date of Receipt:	22 March 2004

2.2. Ancillary Equipment

The following ancillary equipment was connected to the EUT:

Description:	Switch-pack
Model Number:	H-200-4856
Serial Number:	S11919001
Country of Manufacture:	UK

Description:	Headset
Model Number:	H-302-4856
Serial Number:	None stated
Country of Manufacture:	UK

2.3. Description Of EUT

The equipment under test is a low power, digitally modulated, simplex transceiver that operates in the 2.4 GHz frequency band. It uses proprietary Direct Sequence Spread Spectrum (DSSS) on-air waveform, giving a low probability of intercept and good resistance against interfering signals. The radio has an integral short antenna that is permanently fixed to the case.

2.4. Modifications Incorporated In EUT

During the course of testing the EUT was not modified.

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2.5. Additional Information Related To Testing

Power Supply Requirement:	Internal battery supply of 3V (2 x 1.5V AA)		
Intended Operating Environment:	Commercial, light-industrial		
Equipment Category:	Portable		
Type of Unit:	Transceiver		
Interface Ports:	None		
Transmit Frequency Range	2.4065 MHz to 2474.0 MHz		
Transmit Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	N/A	2406.5
	Middle	N/A	2439.0
	Top	N/A	2474.0
Receive Frequency Range	2405.6 MHz to 2474.0 MHz		
Receive Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	N/A	2406.5
	Middle	N/A	2439.0
	Top	N/A	2474.0
Occupied (20 dB) Bandwidth	3.2 MHz		
Highest Unintentionally Generated Frequency	2124 MHz		
Maximum Power Output (EIRP)	19.2 dBm		

2.6. Support EquipmentNo support equipment was used to exercise the EUT during testing:

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3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	FCC Part 15 Subpart C: 2003 (Section 15.247)
Title:	Code of Federal Regulations, Part 15 (47CFR15) 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:

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.

DA00-705 (2000)

Title: Filing and Frequency Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

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3.3. Definition Of Measurement Equipment

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

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4. Deviations From The Test Specification

None.

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5. Operation Of The EUT During Testing

5.1. Operating Conditions

During testing, the EUT was powered by an internal battery supply of 3V.

5.2. Operating Modes

The EUT was tested in the following operating modes, unless otherwise stated.

Preliminary radiated spurious pre-scan tests were performed in both transmit and receive modes on the highest operating frequency of the EUT (top channel). Final measurements were then performed on the top, middle and bottom channels if an emission was identified.

For all other transmit mode measurements the EUT was set to transmit on the top, middle and bottom channels as necessary.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

Configured with switch-pack connected and headset attached to the switch-pack (normal operating configuration).

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6. Summary Of Test Results

Range Of Measurements	Specification Reference	Port Type	Compliance Status
Receiver Radiated Spurious Emissions	C.F.R. 47 FCC Part 15: 2003 Section 15.109	Antenna	Complied
Transmitter Minimum 6 dB Bandwidth	C.F.R. 47 FCC Part 15: 2003 Section 15.247(a)(2)	Antenna	Complied
Transmitter 20 dB Bandwidth*	C.F.R. 47 FCC Part 2: 2003 Section 2.1049	Antenna	Complied
Transmitter Peak Power Spectral Density	C.F.R. 47 FCC Part 15: 2003 Section 15.247(d)	Antenna	Complied
Transmitter Maximum Peak Output Power	C.F.R. 47 FCC Part 15: 2003 Section 15.247(b)(3)	Antenna	Complied
Transmitter Radiated Emissions	C.F.R. 47 FCC Part 15: 2003 Sections 15.247(c) & 15.209(a)	Antenna	Complied
Transmitter Band Edge Radiated Emissions	C.F.R. 47 FCC Part 15: 2003 Sections 15.247(c) & 15.209(a)	Antenna	Complied

**Industry Canada requirement*

6.1. Location Of Tests

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

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7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only.

7.1.2. Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 9 for details of measurement uncertainties.

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7.2. Receiver Mode Radiated Emissions: Section 15.109

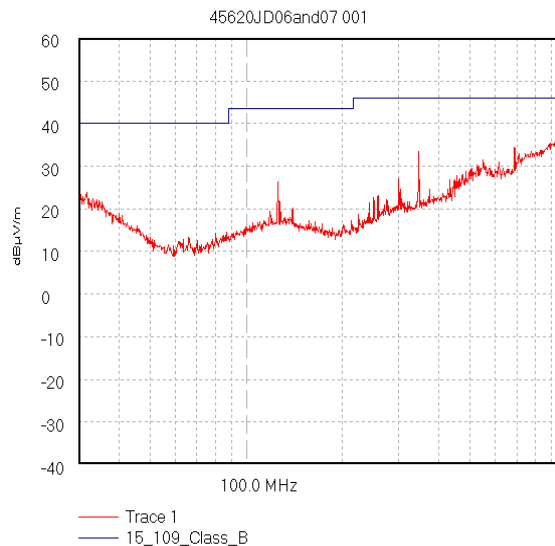
7.2.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

7.2.1.1. The EUT was configured as for radiated emissions testing as described in Section 8 of this report.

7.2.1.2. Tests were performed to identify the maximum idle mode radiated emissions levels.

Results:

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
125.433	Vert.	24.4	43.5	19.1	Complied
346.411	Vert.	26.9	46.0	19.1	Complied



Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 60 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 120.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 380.0 mS
Peak 980.707 MHz, 36.9 dB μ V/m
Limit/Mask: 15_109_Class_B; : Limit Test Passed
Transducer Factors: A490
3/22/2004 11:41:46 AM

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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Receiver Mode Radiated Emissions: Section 15.109 - (Continued)**7.2.2. Electric Field Strength Measurements (Frequency Range 1.0 to 12.5 GHz)**

7.2.2.1. The EUT was configured as for radiated emissions testing as described in Section 8 of this report.

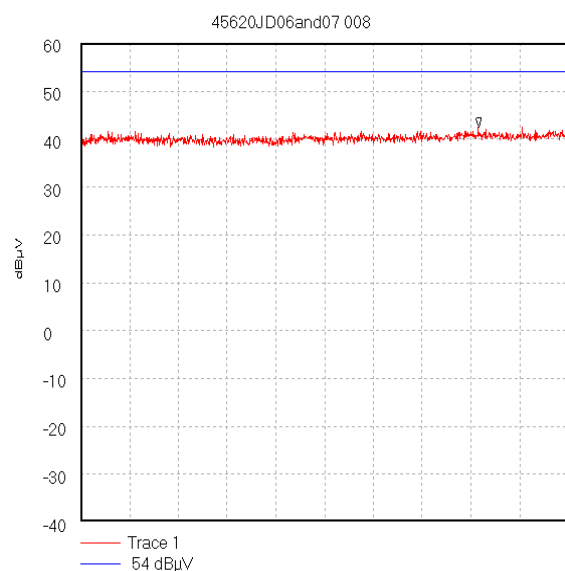
7.2.2.2. Tests were performed to identify the maximum idle mode radiated emissions levels.

Result: Highest Peak Level

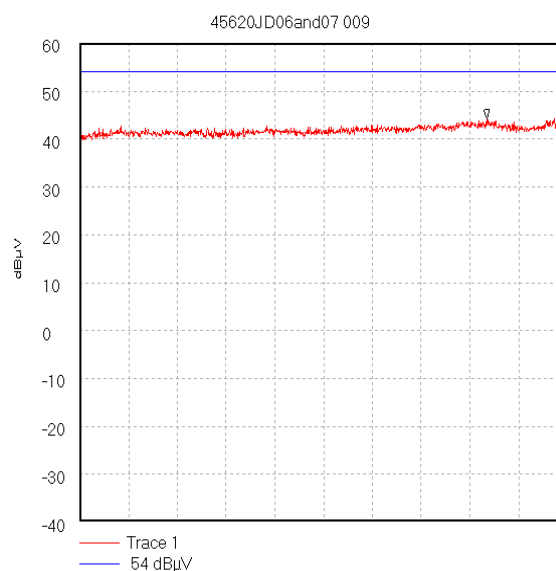
Frequency (GHz)	Antenna Polarity	Peak Detector Level (dBμV)	Antenna Factor	Cable Loss	Actual Peak Level (dBμV/m)	**Average Limit (dBμV/m)	Margin (dB)	Result
*7.592	Vert.	18.4	26.9	2.2	47.5	54.0	6.5	Complied

**Note: No spurious emissions were detected above the noise floor of the measuring receiver; therefore, the highest peak noise floor reading of the measuring receiver was recorded as shown in the table above.*

***Note: The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.*



Start 1.0 GHz; Stop 2.0 GHz
Ref 60 dBμV; Ref Offset -9.5 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 1.816 GHz; 42.48 dBμV
Display Line: 54 dBμV; : Limit Test Passed
3/22/2004 3:11:45 PM



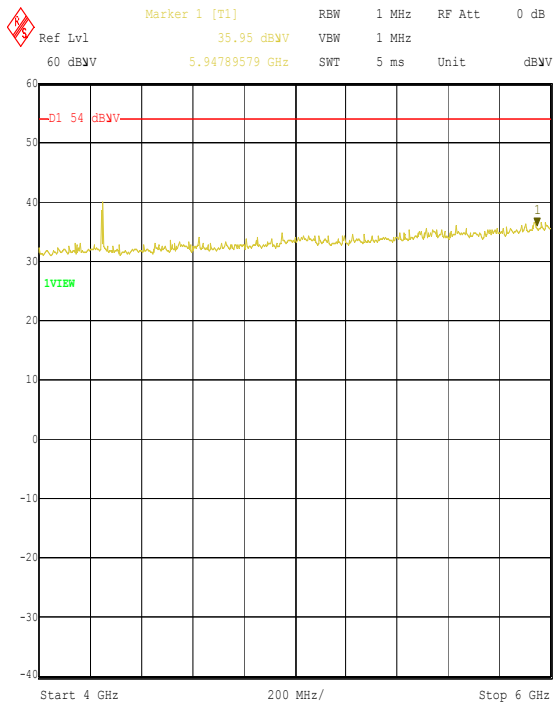
Start 2.0 GHz; Stop 4.0 GHz
Ref 60 dBμV; Ref Offset -9.5 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 3.671 GHz; 44.29 dBμV
Display Line: 54 dBμV; : Limit Test Passed
3/22/2004 3:22:21 PM

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

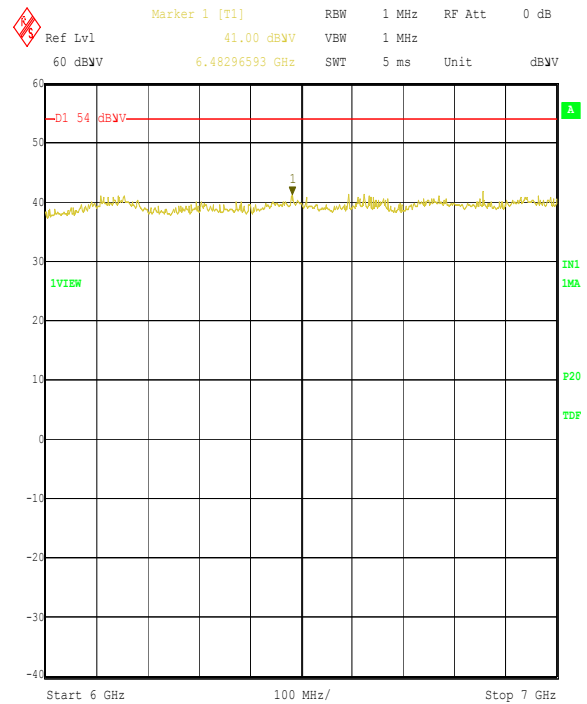
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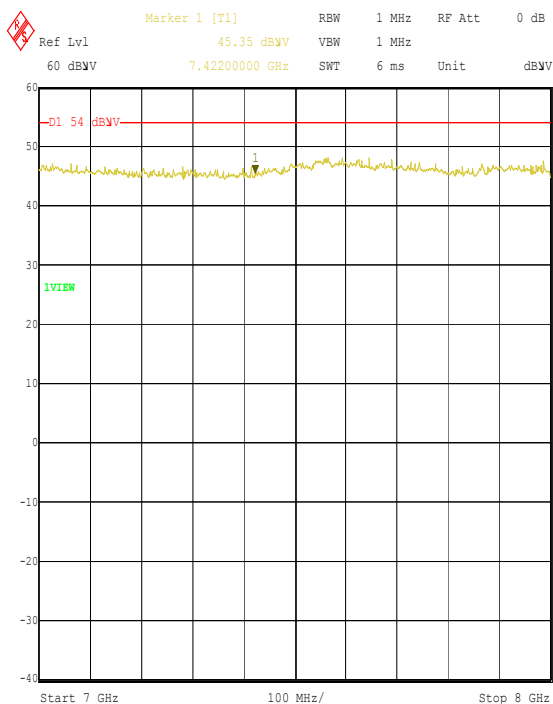
To: FCC Part 15.247

Receiver Mode Radiated Emissions: Section 15.109 - (Continued)

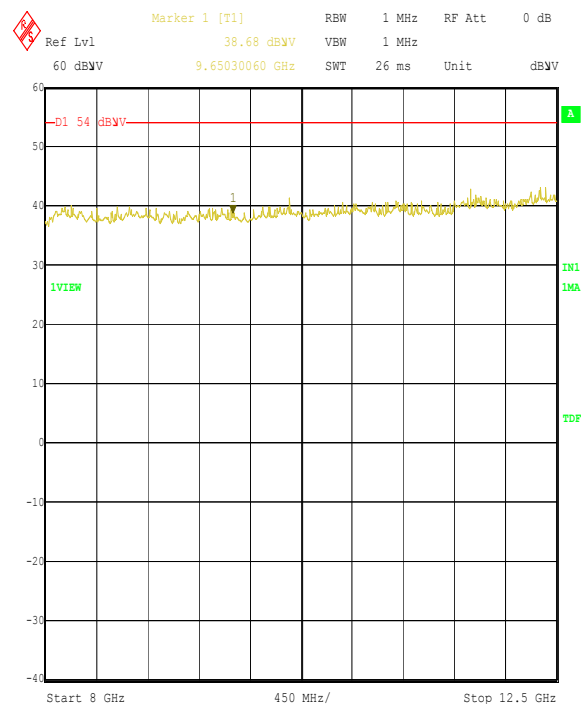
Date: 25.MAR.2004 15:00:19



Date: 25.MAR.2004 15:09:16



Date: 25.MAR.2004 15:13:27



Date: 25.MAR.2004 16:33:14

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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7.3.Transmitter Minimum 6 dB Bandwidth: Section 15.247(a)(2)

7.3.1. The EUT was configured as for transmitter minimum bandwidth measurements as described in Section 8 of this report.

7.3.2. Tests were performed to identify the 6 dB bandwidth of the fundamental signal.

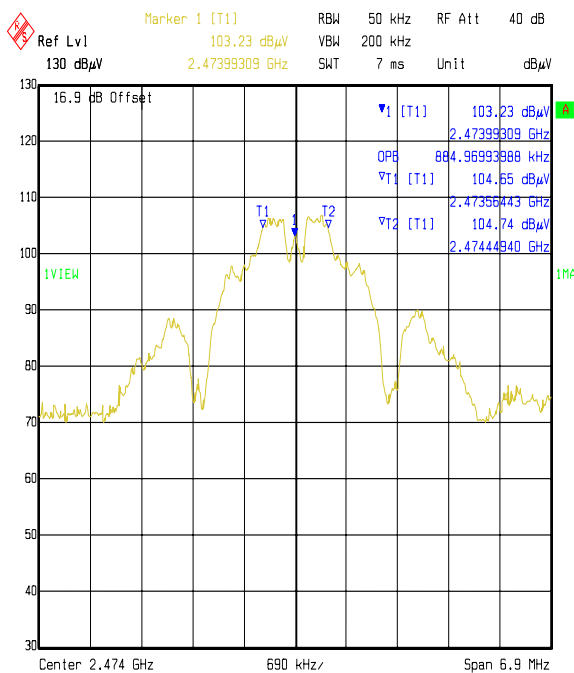
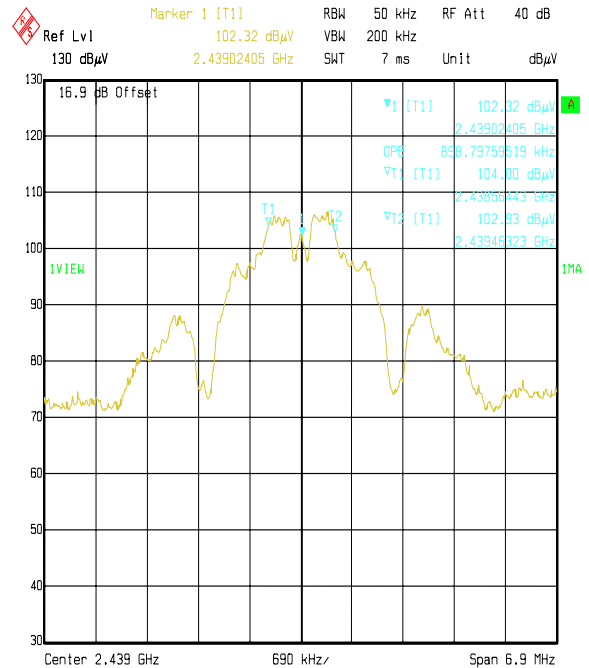
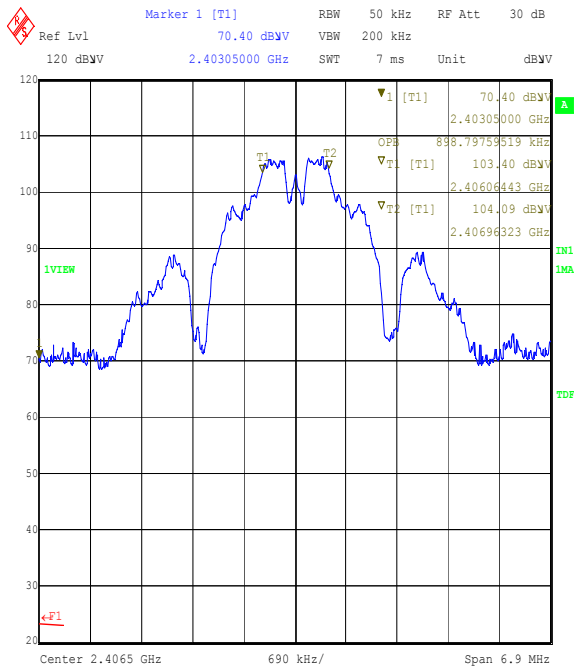
Results:

Channel	Transmitter 6 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
Bottom	0.899	≥ 0.5	0.399	Complied
Middle	0.899	≥ 0.5	0.399	Complied
Top	0.885	≥ 0.5	0.385	Complied

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Transmitter Minimum 6 dB Bandwidth: Section 15.247(a)(2) - (Continued)

Note: The 6 dB bandwidth is measured using the internal occupied bandwidth function of the measurement analyser. The analyser automatically configures the measurement bandwidths to make an accurate measurement. The vital data is reported in the upper right portion of the screen. See attached graphs.

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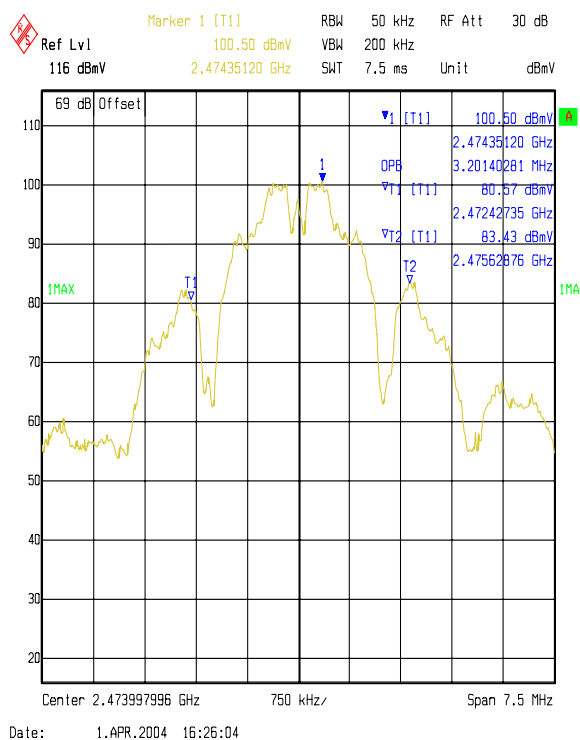
7.4. Transmitter Minimum 20 dB Bandwidth: Section 2.1049

7.4.1. The EUT was configured as for 20 dB bandwidth measurements as described in Section 8 of this report.

7.4.2. Tests were performed to identify the 20 dB bandwidth of the fundamental signal.

Results:**Transmitter 20 dB Bandwidth
(MHz)**

3.201



Note: The 20 dB bandwidth is measured using the internal occupied bandwidth function of the measurement analyser. The analyser automatically configures the measurement bandwidths to make an accurate measurement. The vital data is reported in the upper right portion of the screen. See attached graph.

Note: this test was performed, as it is a requirement for Industry Canada approval.

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7.5. Transmitter Peak Power Spectral Density: Section 15.247(d)

7.5.1. The EUT was configured as for transmitter peak power spectral density measurements as described in Section 8 of this report.

7.5.2. Tests were performed to identify the maximum peak power spectral density of the Fundamental.

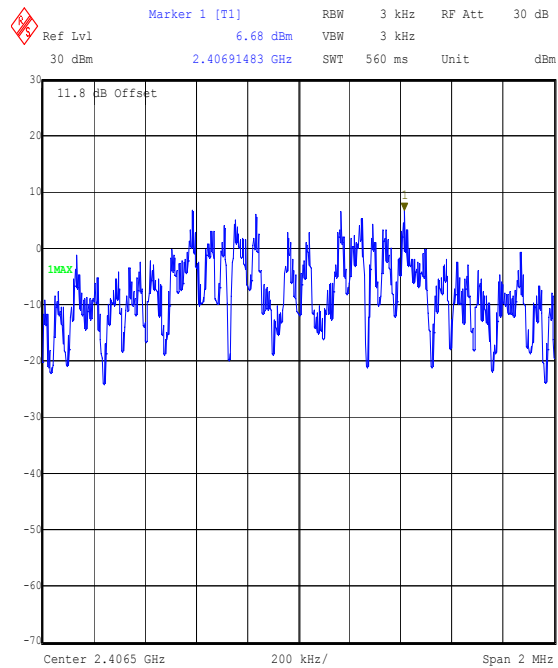
Results

Channel	Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	6.7	8.0	1.3	Complied
Middle	7.4	8.0	0.6	Complied
Top	6.6	8.0	1.4	Complied

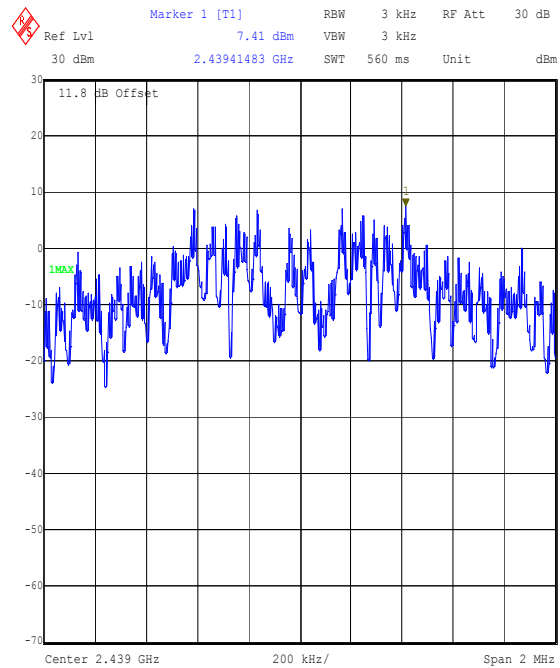
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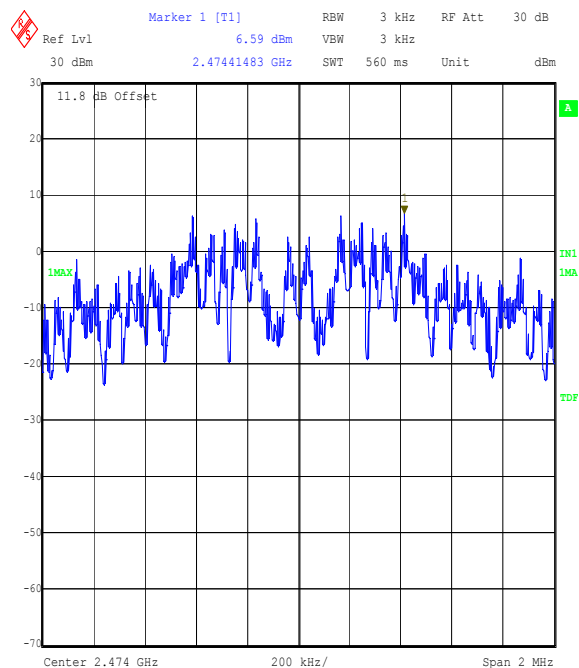
To: FCC Part 15.247

Transmitter Peak Power Spectral Density: Section 15.247(d) - (Continued)

Title: Marconi Peak Power Spectral Density
Comment A: Bottom Channel.
Date: 30.MAR.2004 18:47:28



Title: Marconi Peak Power Spectral Density
Comment A: Middle Channel.
Date: 30.MAR.2004 18:55:25



Title: Marconi Peak Power Spectral Density
Comment A: Top Channel.
Date: 30.MAR.2004 18:57:56

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7.6. Transmitter Maximum Peak Output Power: Section 15.247(b)(3)

7.6.1. The EUT was configured as for transmitter effective isotropic radiated power measurements as described in Section 8 of this report.

7.6.2. Tests were performed to identify the transmitter maximum peak output power (EIRP) of the EUT.

Results:

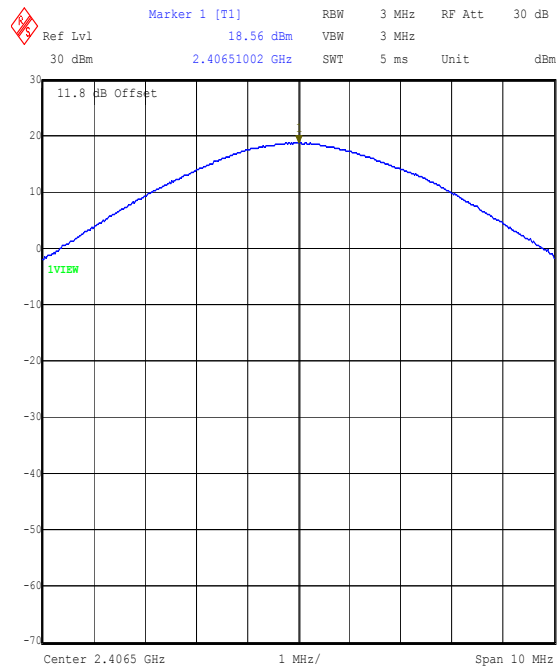
Channel	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	18.6	30.0	11.4	Complied
Middle	19.2	30.0	10.8	Complied
Top	18.4	30.0	11.6	Complied

Note: These tests were performed radiated; therefore the EUT antenna gain is encompassed in the final result and not measurable.

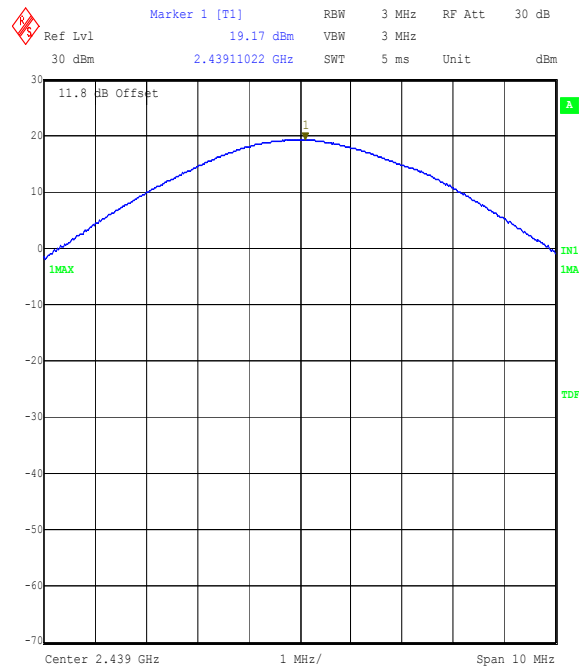
Test Of: Marconi Selenia Communications Ltd.

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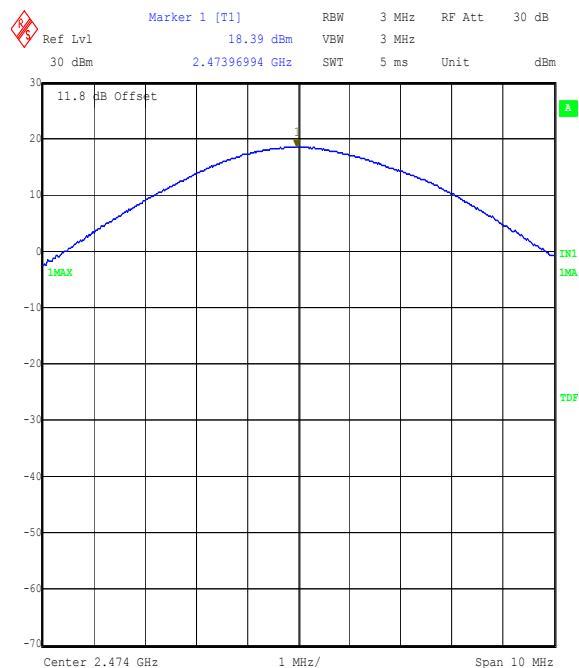
To: FCC Part 15.247

Transmitter Maximum Peak Output Power: Section 15.247(b)(3) - (Continued)

Title: Marconi Peak Output Power
Comment A: Bottom Channel.
Date: 30.MAR.2004 18:44:50



Title: Marconi Peak Output Power
Comment A: Middle Channel.
Date: 30.MAR.2004 18:53:10



Title: Marconi Peak Output Power
Comment A: Top Channel.
Date: 30.MAR.2004 18:59:50

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7.7. Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a)**7.7.1. Electric Field Strength Measurements: 30 to 1000 MHz**

7.7.1.1. The EUT was configured as for radiated emissions testing as described in Section 8 of this report.

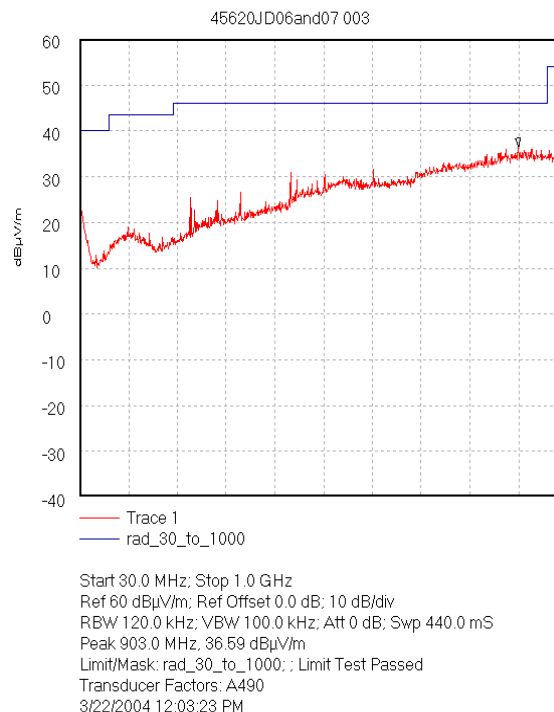
7.7.1.2. Tests were performed to identify the maximum transmitter radiated emission levels.

Top Channel

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
*903.0	Vert.	36.6	46.0	9.4	Complied

**Note: All spurious emissions were, at least, 20 dB below the relevant limit, therefore, the highest peak reading of the entire frequency range was recorded as shown in the table above.*

Note: The preliminary scans showed similar emission levels for each mode below 1 GHz, therefore final radiated emissions measurements were performed with the EUT set to the top channel only.



Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) - (Continued)**7.7.2. Electric Field Strength Measurements (Frequency Range: 1 to 25 GHz)****Highest Peak Level: Bottom Channel**

Frequency (GHz)	Antenna Polarity	Peak Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Result
4.113061	Horiz.	19.8	24.1	1.6	45.5	74.0	28.5	Complied
4.813010	Horiz.	11.5	24.2	1.6	37.3	74.0	36.7	Complied
8.226075	Vert.	8.3	30.5	2.3	41.1	74.0	32.9	Complied

Highest Average Level: Bottom Channel

Frequency (GHz)	Antenna Polarity	Average Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	Result
4.113061	Horiz.	17.3	24.1	1.6	43.0	54.0	11.0	Complied
4.813010	Horiz.	5.1	24.2	1.6	20.0	54.0	23.1	Complied
8.226075	Vert.	0.7	30.5	2.3	33.5	54.0	20.5	Complied

Highest Peak Level: Middle Channel

Frequency (GHz)	Antenna Polarity	Peak Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Result
4.178111	Horiz.	20.6	24.1	1.6	46.3	74.0	27.7	Complied
4.878005	Horiz.	12.0	24.2	1.6	37.8	74.0	36.2	Complied
8.356872	Vert.	12.1	30.5	2.3	44.9	74.0	29.1	Complied

Highest Average Level: Middle Channel

Frequency (GHz)	Antenna Polarity	Average Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	Result
4.178111	Horiz.	18.7	24.1	1.6	44.4	54.0	9.6	Complied
4.878005	Horiz.	3.9	24.2	1.6	29.7	54.0	24.3	Complied
8.356872	Vert.	6.7	30.5	2.3	39.5	54.0	14.5	Complied

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Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) - (Continued)**Highest Peak Level: Top Channel**

Frequency (GHz)	Antenna Polarity	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
4.248088	Horiz.	20.3	24.1	1.6	46.0	74.0	28.0	Complied
4.947991	Vert.	13.2	24.2	1.6	39.0	74.0	35.0	Complied
8.496048	Vert.	11.2	30.5	2.3	44.5	74.0	29.5	Complied

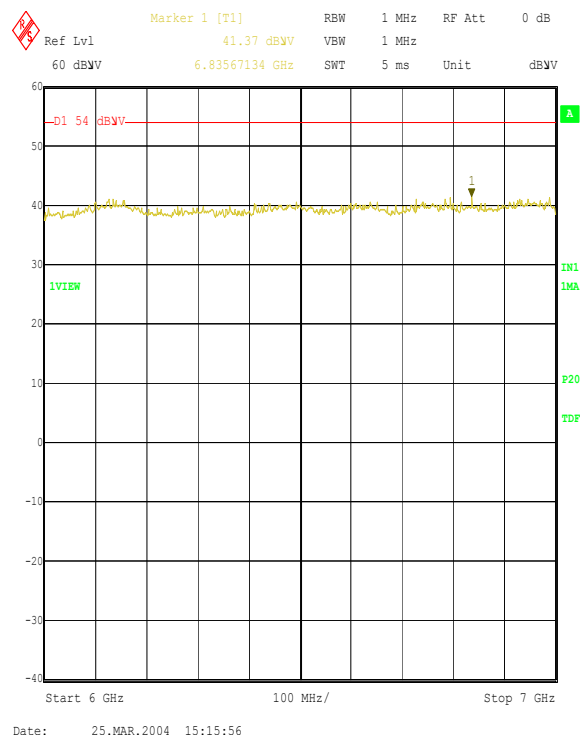
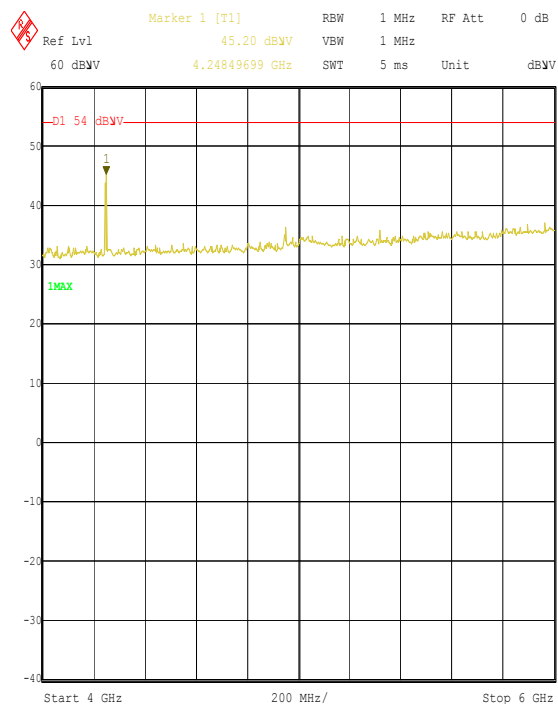
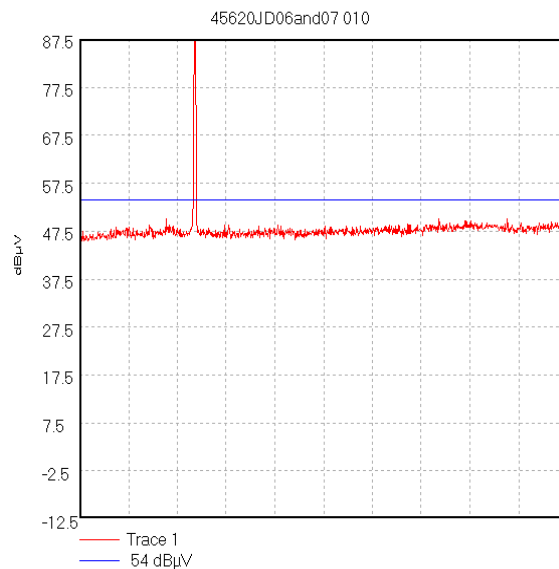
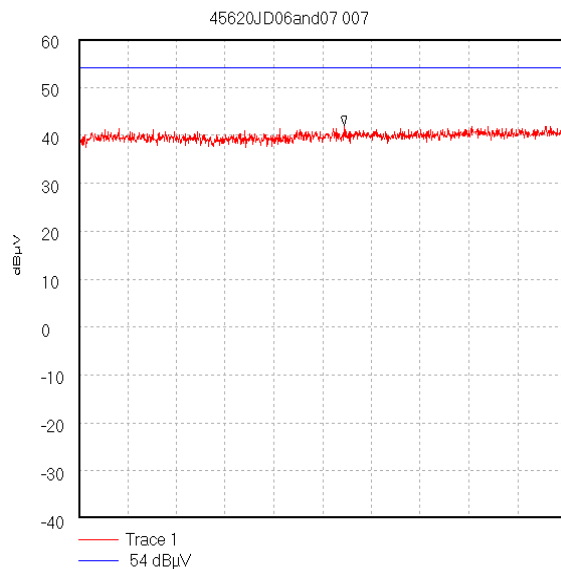
Highest Average Level: Top Channel

Frequency (GHz)	Antenna Polarity	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
4.248088	Horiz.	18.6	24.1	1.6	44.3	54.0	9.7	Complied
4.947991	Vert.	6.0	24.2	1.6	31.8	54.0	22.2	Complied
8.496048	Vert.	5.6	30.5	2.3	38.4	54.0	15.6	Complied

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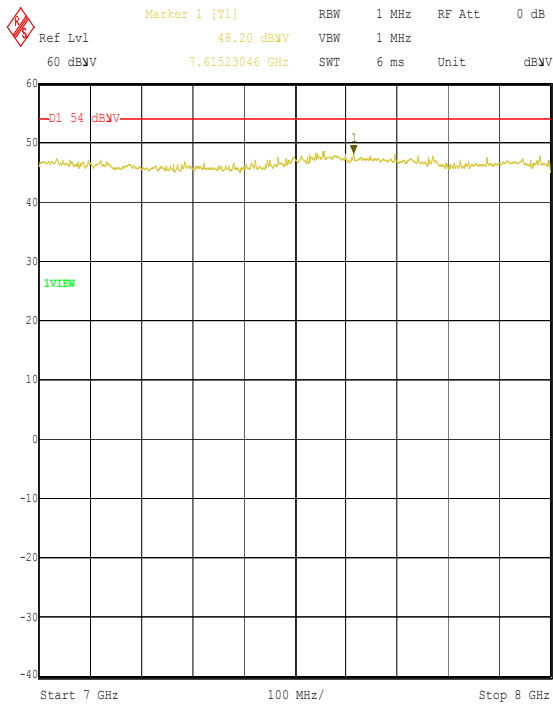
To: FCC Part 15.247

Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) - (Continued)

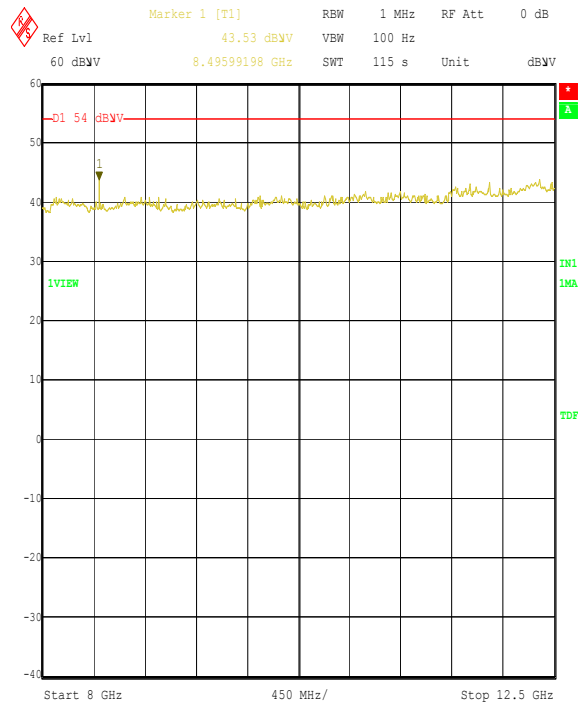
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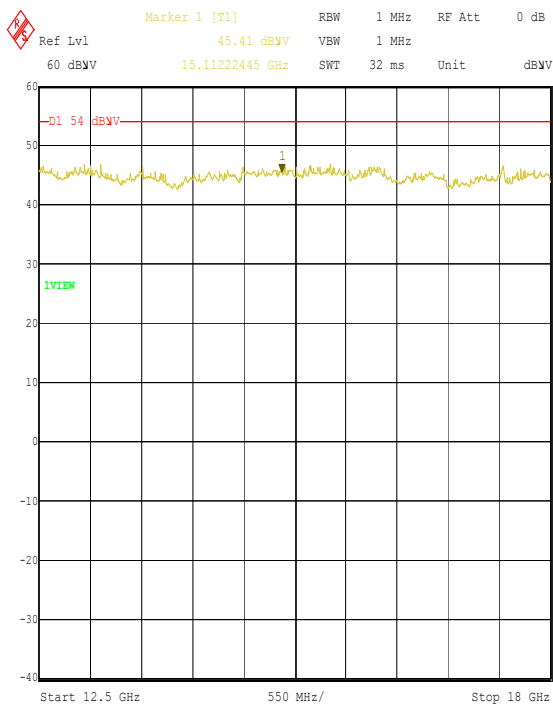
To: FCC Part 15.247

Transmitter Radiated Emissions: Section 15.247(c) and 15.209(a) - (Continued)

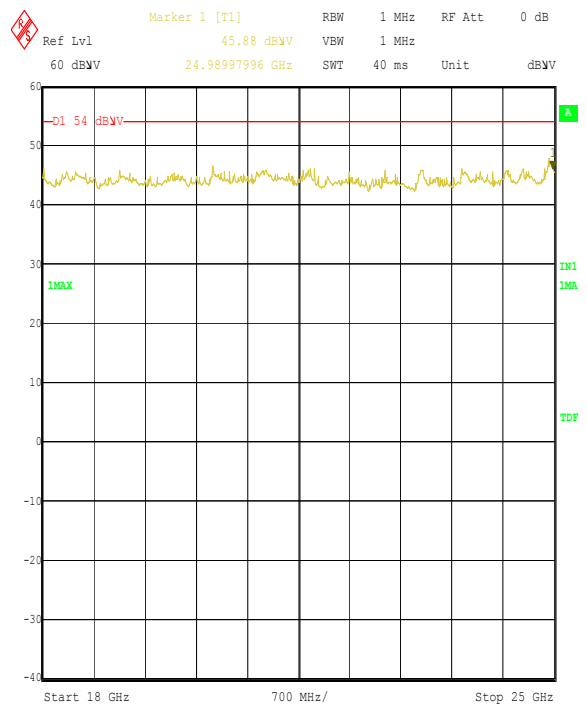
Date: 25.MAR.2004 15:24:35



Date: 25.MAR.2004 15:46:03



Date: 25.MAR.2004 16:45:43



Date: 25.MAR.2004 16:54:03

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7.8. Transmitter Band Edge Radiated Emissions: Section 15.247(c) & 15.209(a)**7.8.1. Electric Field Strength Measurements**

7.8.1.1. The EUT was configured as for band edge compliance of radiated emissions measurements as described in Section 8 of this report.

7.8.1.2. Tests were performed to identify the maximum radiated band edge emissions.

Results: Peak Power Level

Frequency (GHz)	Antenna Polarity	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
2.4000	Vert.	38.5	21.2	1.3	61.0	87.9*	26.9	Complied
2.4835	Vert.	42.0	21.4	1.3	64.7	74.0	9.3	Complied

**Note: -20 dBc limit*

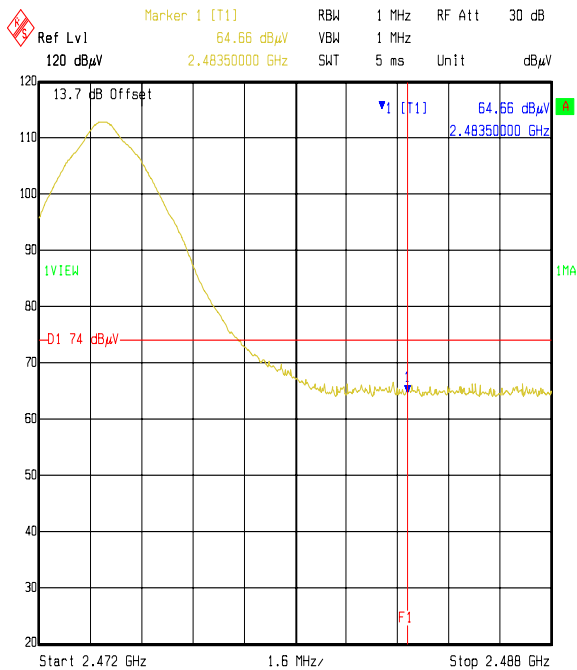
Results: Average Power Level

Frequency (GHz)	Antenna Polarity	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
2.4835	Vert.	25.8	21.4	1.3	48.5	54.0	5.5	Complied

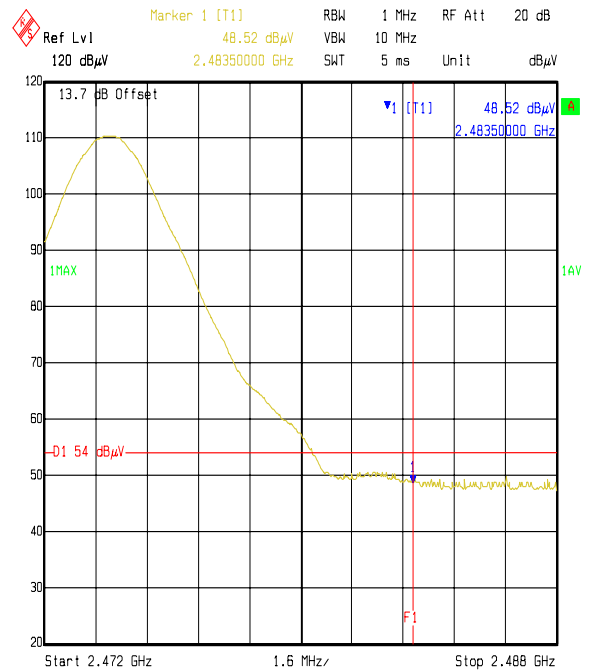
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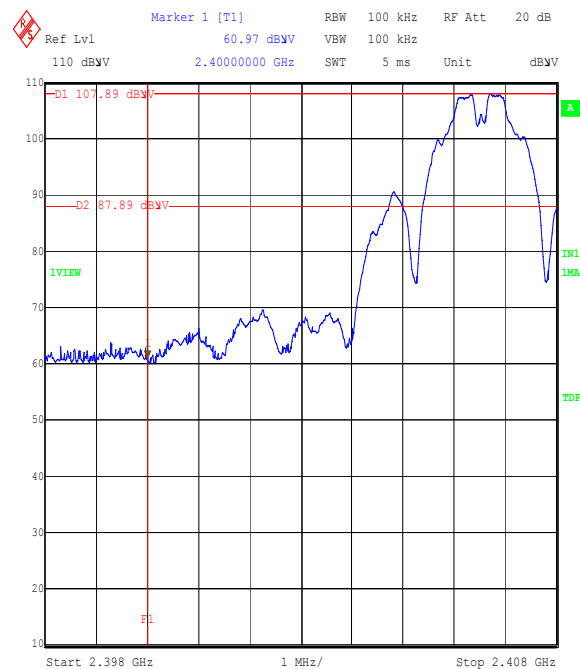
To: FCC Part 15.247

Transmitter Band Edge Radiated Emissions: Section 15.247(c) & 15.209(a)
(Continued)

Title: 45620JD06 Marconi Radiated Upper Band-Edge
Comment A: Top Channel Peak Detector
Date: 26.MAR.2004 12:04:39



Title: 45620JD06 Marconi Radiated Upper Band-Edge
Comment A: Top Channel Average Detector
Date: 26.MAR.2004 12:06:16



Title: Marconi FCC P15.247 Lower Radiated Band Edge
Comment A: 45620JD06 Bottom Channel.
Date: 30.MAR.2004 19:11:37

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8. Measurement Methods

8.1. Radiated 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.

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. Any emission within 20 dB of the limit were then measured on the open area test site, except in cases where the noise floor was within 20 dB of the limit, in these cases the highest point of the noise floor was measured.

Where an emission fell inside a restricted band, measurements were made at the appropriate test distance using a measuring receiver with a Quasi-Peak detector for measurements below 1000 MHz and an Average and Peak detector for measurements above 1000 MHz. A peak detector was used for all other measurements.

For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4. 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 to be measured, the trace was maximised by rotating a turntable through 360°. The angle at which the maximum signal was observed was locked out. For frequencies below 1000 MHz the test antenna was varied in height between 1 m and 4 m in order to further maximise the target emission.

For frequencies above 1000 MHz where a horn antenna was used, height searching was performed to locate the optimal height of the horn with respect to the EUT. At this point the horn was locked off and the turntable was again rotated through 360° to maximise the target signal. It should be noted that the received signal from the EUT would diminish very quickly after it exits the beam width of the horn antenna, for this reason it may not be necessary to fully height search with the horns.

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. Scans were performed to the upper frequency limits as stated in Section 15.33

The final field strength was determined as the indicated level in dB μ V plus cable loss and antenna factor.

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Radiated Emissions - (Continued)

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

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

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8.2. Minimum 6 dB Bandwidth

The EUT and spectrum analyser were configured as for radiated measurements.

The measurement was performed using a spectrum analyser enabled with an occupied bandwidth function.

The 6 dB Bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB or ESIB spectrum analyser. It was set to measure the bandwidth where 75% (6 dB) of the signal power was contained. The analyser settings were set as per those outlined in the spectrum analyser user manual for this measurement, i.e. $RBW \geq 1\%$ of occupied bandwidth. A value of 50 kHz was used.

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8.3. Transmitter 20 dB Bandwidth

The EUT and spectrum analyser were configured as for radiated measurements.

The 20 dB Bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB or ESIB spectrum analyser. It was set to measure the bandwidth where 99% of the signal power was contained. The analyser settings were set as per those outlined in the spectrum analyser user manual for this measurement, i.e. $RBW \geq 1\%$ of occupied bandwidth. A value of 50 kHz was used.

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8.4. Spectral Power Density

The EUT and spectrum analyser were configured as for radiated measurements and as per FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

Prior to the measurement being taken the spectrum analyser was tuned to the fundamental frequency of the EUT.

A resolution bandwidth of 3 kHz was selected and the analyser was set to a span of greater than twice the 6 dB bandwidth. The trace was max held and a reading was taken at the peak point of the trace.

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8.5. Effective Isotropic Radiated Power (EIRP)

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

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

The level of the EIRP was measured using a spectrum analyser.

The test antenna was positioned in the horizontal plane. The EUT was oriented in the X plane. The test antenna was then raised and lowered until a maximum peak was observed. The turntable was then rotated through 360 degrees and the maximum peak reading obtained. The height search was then repeated to take into consideration the new angular position of the turntable. The maximum reading observed was then recorded. This procedure was then repeated with the EUT oriented in the Y and Z planes. The highest reading taken in all 3 planes was recorded. The entire procedure was then repeated with the test antenna set in the Vertical polarity.

Once the final amplitude (maximised) had been obtained, the EUT was substituted with a substitution antenna. For EIRP measurements a Horn antenna whose gain was based on an isotropic antenna was used, ERP measurements were done using a dipole. The centre of the substitution antenna was set to approximately the same centre location as the EUT. The substitution antenna was set to the horizontal polarity. The substitution antenna was matched into a signal generator using a 6 dB or greater attenuator. The signal generator was tuned to the EUT's frequency under test.

The test antenna was then raised and lowered to obtain a maximum reading on the spectrum analyser. The level of the signal generator output was then adjusted until the maximum recorded EUT level was observed. The signal generator level was noted. This procedure was repeated with both test antenna and substitution antenna vertically polarised. The EIRP was calculated as:-

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

All measurements were performed using broadband Horn antennas.

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Effective Isotropic Radiated Power (EIRP) - (Continued)

Circumstances where the signal generator could not produce the desired power substitution was performed with the signal generator set to 0 dBm. The radiated signal was maximised as previously described. The level indicated on the measuring receiver was noted. The delta between this level and the maximum level for the EUT was calculated and also noted. The EIRP of the signal generator was calculated using the above formulae. The recorded delta was added to the calculated EIRP to obtain the substituted EUT EIRP.

$$\text{Delta (dB)} = \text{EUT} - \text{SG}$$

where :

EUT = spectrum analyser indicated EUT raw level

SG = spectrum analyser indicated signal generator raw level

The signal generator actual EIRP is calculated as:

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

The EUT EIRP is calculated as:

$$\text{EIRP EUT} = \text{EIRP SG} + \text{Delta}.$$

The test equipment settings for EIRP measurements were as follows:

Receiver Function	Setting
Detector Type:	Peak
Mode:	Not applicable
Bandwidth:	3 MHz
Amplitude Range:	100 dB
Sweep Time:	Coupled

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8.5.1. Band Edge Compliance of RF Radiated Emissions

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

To determine band edge compliance, the analyser resolution bandwidth was set to $\geq 1\%$ of 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 band edge of the allocated frequency band was produced. A limit line was set to the level of the highest in-band emission with a further limit line set to 20 dB below this. A marker was then placed on the highest out of band emission (The specification states that either the band edge level must be measured or the highest out of band emission, whichever is the greater). The plots show that the highest out of band emission complies with the 20 dBc Limit. The above procedure was then repeated for the lower band edge.

It should be noted that if the upper or lower band edges fell on a restricted band edge (as defined in Section 15.205(a) the limit set for the restricted band would be applied instead of the -20 dBc limit i.e. the general limits defined in Section 15.209(a).

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9. Measurement Uncertainty

9.1. 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.

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

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

9.4. 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
Transmitter Maximum Peak Output Power	Not applicable	95%	+/- 1.78 dB
Spectral Power Density	Not applicable	95%	+/- 1.2 dB
6 dB/20 dB Bandwidth	Not applicable	95%	+/- 0.12 %
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	+/- 1.78 dB

9.5. 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	Manufacturer	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	557
A201	WG 20 Horn Antenna	Flann Microwave Ltd	20240-20	266
A249	69 dB Variable Attenuator	Narda	745-69	02329
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
A490	Bilog Antenna	Chase	CBL6111A	1590
C178	Cable	Rosenberger	UFA210A-1-1181-70x70	None
M023	ESVP Receiver	Rohde & Schwarz	ESVP	872 991/027
M088	Receiver / Spectrum Analyser System	Rohde & Schwarz	ESBI	DU:835862/018 RU:835387/006
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016
S201	Site 1	RFI	1	
S202	Site 2	RFI	2	S202-15011990

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

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Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

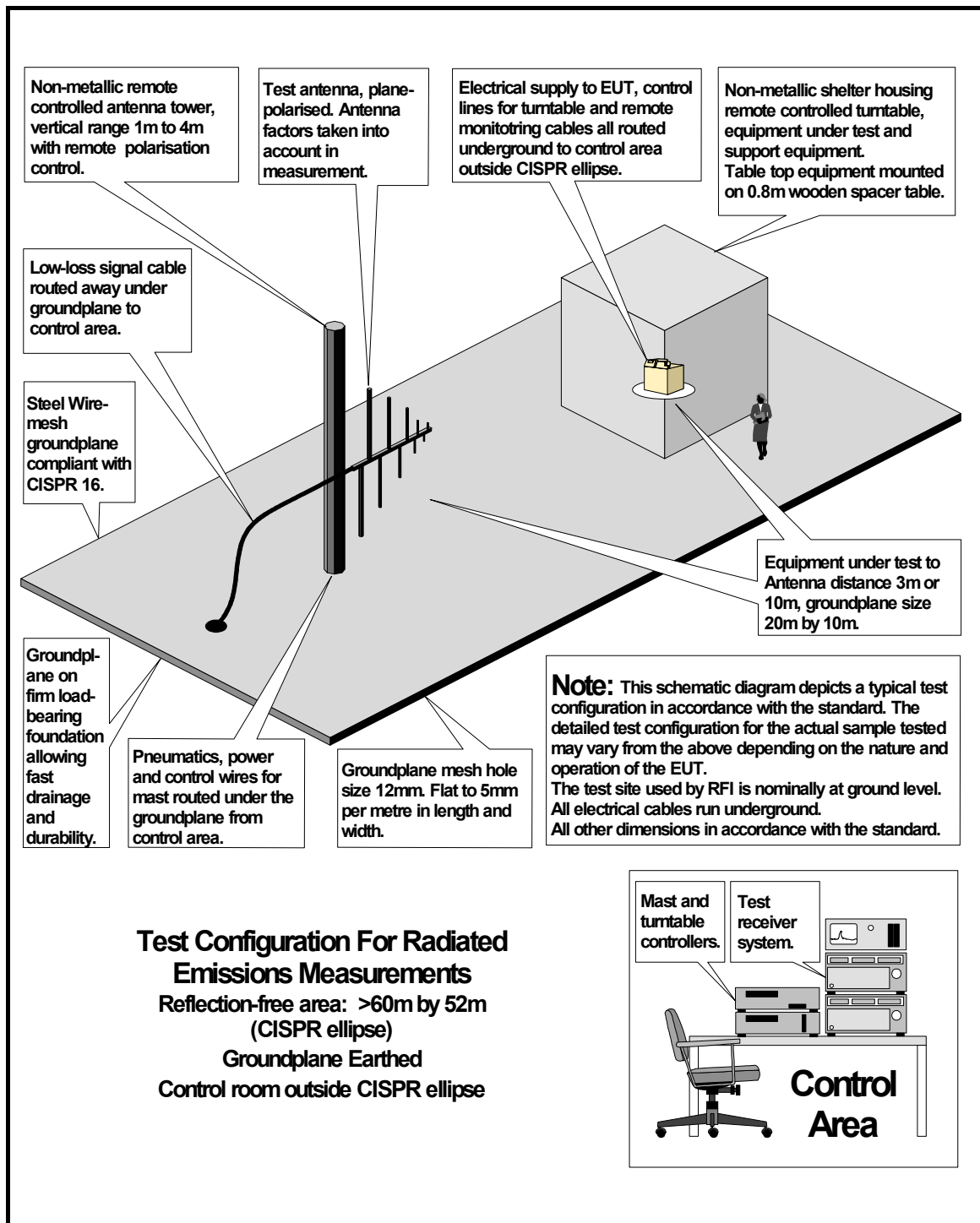
Drawing Reference Number	Title
DRG\45620JD06\EMIRAD	Test configuration for measurement of radiated emissions

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DRG\45620JD06\EMIRAD



RADIO FREQUENCY INVESTIGATION LTD.

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