

TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA

To: FCC Part 27

Test Report Serial No:
RFI/MPTE1/RP46660JD03A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director:  pp	
Tested By: Tony Henriques 	Checked By: Nigel Davison 
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To: 2.5 GHz V4 Node B Model: RK/RA
FCC Part 27

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1. Client Information

Company Name:	IPWireless (UK) Ltd.
Address:	Unit 7 Greenways Business Park Bellinger Close Chippenham Wilts SN15 1BN
Contact Name:	Mr P Warburg

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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:	IPWireless
Description:	2.5 GHz Rack Mount Node B Radio Shelf
Model No:	RK
Serial Number:	RK1A437000010
FCC ID Number:	PKTNODEBRK
Country of Manufacture:	UK
Date of Receipt:	07 January 2005

Brand Name:	IPWireless
Description:	2.5 GHz Rack Mount Node B Digital Shelf
Model No:	RA
Serial Number:	RA1A451000210
FCC ID Number:	PKTNODEBRK
Country of Manufacture:	UK
Date of Receipt:	07 January 2005

2.2. Description of EUT

The equipment under test is a wireless broadband base station. The base station provides high-speed internet access networks.

2.3. Modifications Incorporated in EUT

During the course of testing the EUT was not modified.

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2.4. Additional Information Related to Testing

Power Supply Requirement:	-48 VDC		
Intended Operating Environment:	Residential, Commercial and Light industry		
Equipment Category:	Miscellaneous Wireless Communications Services		
Type of Unit:	Wireless Broadband Base Station		
Chip Rate:	High: 7.68 Mcps; Low : 3.84 Mcps		
Transmit Frequency Range:	High Chip Rate: 2506 MHz to 2680 MHz Low Chip Rate: 2503 MHz to 2683 MHz		
Transmit Channels Tested: (High Chip Rate: 7.68 Mcps):	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	N/A	2506
	Middle	N/A	2596
	Top	N/A	2680
Transmit Channels Tested: (Low Chip Rate: 3.84 Mcps)	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	N/A	2503
	Middle	N/A	2596
	Top	N/A	2683
Highest Fundamental Frequency:	2683 MHz		
Maximum Power Output:	High Chip Rate: 37.0 dBm per 12 MHz channel Low Chip Rate: 39.7 dBm per 6 MHz channel		

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2.5. Interface Ports

Port	
1	Tx/Rx Antenna Port x2
2	Ethernet Port x 1
3	E1/T1 Port x 4
4	E3/T3 Port x 2
5	Serial Port x 1
6	Alarm Interface x 2
7	GPS Interface x 2
8	LNA Port x 3
9	I/O & Clock Interface (1 per radio shelf, 3 per digital shelf [2 unused])
10	CTRL & CPLD Interface (1 per radio shelf, 3 per digital shelf [2 unused])
11	LMT Port x 1
12	Debug Interface x 1
13	-48 V DC Input (one per shelf)

2.6. Support Equipment

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

Description:	Laptop PC
Brand Name:	Dell Latitude
Model Name or Number:	PP01X
Serial Number:	CN-03J010-12961-34F-3624
Cable Length and Type:	N/A, not connected during testing
Connected to Port:	N/A, not connected during testing

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3. Test Specification, Methods and Procedures

3.1. Test Specification

Reference:	FCC Part 27: 2004 Sections 27.50, 27.53 and 27.54
Title:	Code of Federal Regulations, Part 27 (47CFR) Subpart C Miscellaneous Wireless Communications Services
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/TIA-603-B-2003

Land Mobile Communications Equipment, Measurements and performance Standards

ANSI C63.2 (1987)

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

ANSI C63.4 (2003)

Title: American National Standard for Methods of Measurement of Radio-Noise 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.

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 Modes

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

Transmit Modes:

Preliminary radiated and conducted spurious emissions pre-scans were performed in both high and low chip rate modes (3.84 Mcps and 7.68 Mcps) on the highest operating frequency of the EUT (top channel of each chip rate). Final measurements were then performed on the top, middle and bottom channels of each chip rate if an emission was identified.

All other measurements were performed on the bottom, middle and top channels of both chip rates as applicable.

All measurements with the exception of EIRP measurements were performed with the EUT transmitting at full power for 10 of the 15 time slots (the maximum allowable number of time slots that can be used for transmit when the equipment is operating normally i.e. the worst case mode of operation).

EIRP measurements were performed with the EUT transmitting at full on all 15 timeslots i.e. the absolute maximum power the EUT can output.

5.2. Configuration and Peripherals

The EUT was tested in the following configuration:

Radio shelf and digital shelf connected and supplied via a -48V DC supply.

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6. Summary of Test Results

Transmit Mode (3.84 Mcps & 7.68 Mcps)

Range Of Measurements	Specification Reference	Port Type	Compliance Status
Effective Isotropic Radiated Power (EIRP)	CFR 47: 2003 FCC Part 2.1046, Part 27.50	Antenna Terminals	Complied
Frequency Stability (Temperature Variation)	CFR 47: 2003 FCC Part 2.1055, Part 27.54	Antenna Terminals	Complied
Frequency Stability (Voltage Variation)	CFR 47: 2003 FCC Part 2.1055, Part 27.54	Antenna Terminals	Complied
Occupied Bandwidth	CFR 47: 2003 FCC Part 2.1049	Antenna Terminals	Complied
Conducted Spurious Emissions at Band Edges	CFR 47: 2003 FCC Part 2.1051, Part 27.53	Antenna Terminals	Complied
Conducted Spurious Emissions	CFR 47: 2003 FCC Part 2.1051, Part 27.53	Antenna Terminals	Complied
Radiated Spurious Emissions	CFR 47: 2003 FCC Part 2.1053, Part 27.53	Antenna	Complied

6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services 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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Test Results:- 3.84 Mcps Chip Rate

7.2. Transmitter Effective Isotropic Radiated Power (EIRP): Part 2.1046 & Part 27.50

7.2.1. The EUT was configured as for conducted RF output power and Effective Isotropic Radiated Power (EIRP) as described in Section 9 of this report.

7.2.2. The effective isotropic radiated power (EIRP) was calculated by adding the manufacturer's declared antenna gain to the figure measured for conducted RF output power.

Results:

Channel	Frequency (MHz)	Conducted RF O/P Power (dBm)*	Antenna Gain (dBi)	EIRP (dBm)	EIRP (dBW)	Limit EIRP (dBW)	Margin (dB)	Result
Bottom	2503	39.7	20.0	59.7	29.7	33.4	3.7	Complied
Middle	2596	39.3	20.0	59.3	29.3	33.0	3.7	Complied
Top	2683	38.8	20.0	58.8	28.8	33.4	4.6	Complied

* per 6 MHz Channel

Note(s):

1. The limit is calculated as $33+10 \log (X/Y)$ where X is the actual channel width i.e. 6 MHz and Y is 6 MHz for channels in the MBS and 5.5 MHz for channels in the LBS and UBS.
2. The antenna gain is typically a maximum of 20 dBi and, hence, is the figure used in the above table. IP Wireless do not supply the antenna, the MDS licensee supplies this. IP Wireless will, in their user information, inform all MDS licensees of the device, that the combination of measured conducted RF output power and antenna gain must not, under any circumstances whatsoever, exceed the maximum allowable EIRP limit as detailed above.

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7.3. Transmitter Frequency Stability (Temperature Variation): Part 2.1055 & Part 27.54

7.3.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

7.3.2. Tests were performed to identify the maximum frequency error of the EUT with variations in ambient temperature.

Results:

Bottom Channel (2503 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (kHz)
-30	2502.99671	3.29
-20	2502.99671	3.29
-10	2502.99655	3.45
0	2502.99655	3.45
10	2502.99639	3.61
20	2502.99639	3.61
30	2502.99639	3.61
40	2502.99639	3.61
50	2502.99623	3.77

Middle Channel (2596 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (kHz)
-30	2595.99655	3.45
-20	2595.99655	3.45
-10	2595.99655	3.45
0	2595.99639	3.61
10	2595.99639	3.61
20	2595.99639	3.61
30	2595.99639	3.61
40	2595.99623	3.77
50	2595.99623	3.77

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Transmitter Frequency Stability (Temperature Variation) (Continued)**Top Channel (2683 MHz)**

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (kHz)
-30	2682.99655	3.45
-20	2682.99655	3.45
-10	2682.99639	3.61
0	2682.99639	3.61
10	2682.99639	3.61
20	2682.99607	3.93
30	2682.99607	3.93
40	2682.99607	3.93
50	2682.99623	3.77

As can be seen from the above frequency stability results above, the fundamental emissions at the highest and lowest operating frequencies of the EUT (in addition to the fundamental emission at the centre of the operating band) stay, under all test conditions, within the authorised bands of operation i.e. 2496 MHz to 2690 MHz. The EUT is, therefore, compliant.

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7.4. Transmitter Frequency Stability (Voltage Variation): Part 2.1055 & Part 27.54

7.4.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

7.4.2. Tests were performed to identify the maximum frequency error of the EUT with variations in nominal operating voltage.

Results:

Bottom Channel (2503 MHz)

Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (kHz)
93.5	2502.99639	3.61
110.0	2502.99639	3.91
126.5	2502.99639	3.91

Middle Channel (2596 MHz)

Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (kHz)
93.5	2595.99639	3.61
110.0	2595.99639	3.61
126.5	2595.99639	3.61

Top Channel (2683 MHz)

Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (kHz)
93.5	2682.99607	3.93
110.0	2682.99607	3.93
126.5	2682.99607	3.93

As can be seen from the above frequency stability results above, the fundamental emissions at the highest and lowest operating frequencies of the EUT (in addition to the fundamental emission at the centre of the operating band) stay, under all test conditions, within the authorised bands of operation i.e. 2496 MHz to 2690 MHz. The EUT is, therefore, compliant.

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7.5. Transmitter Occupied Bandwidth: Part 2.1049

7.5.1. The EUT was configured as for Occupied Bandwidth measurements as described in Section 9 of this report.

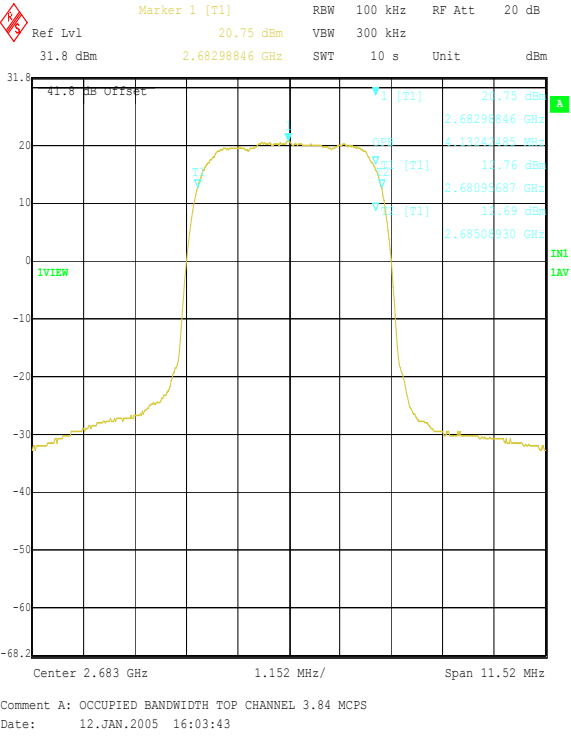
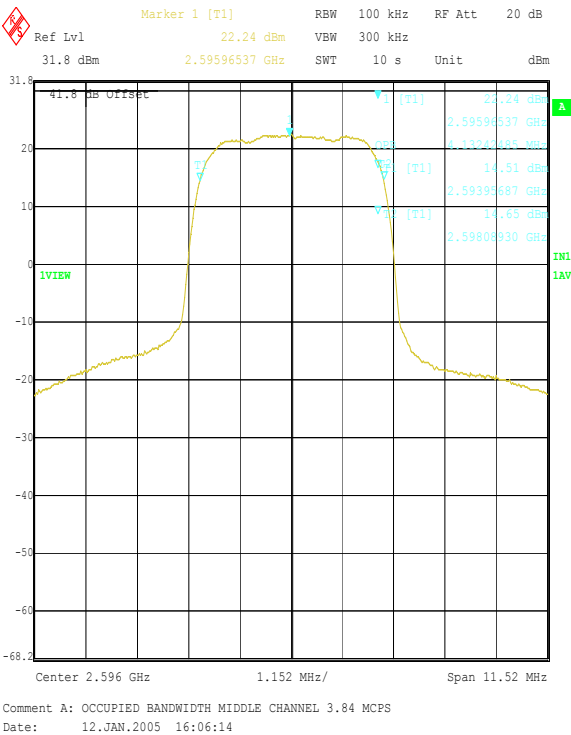
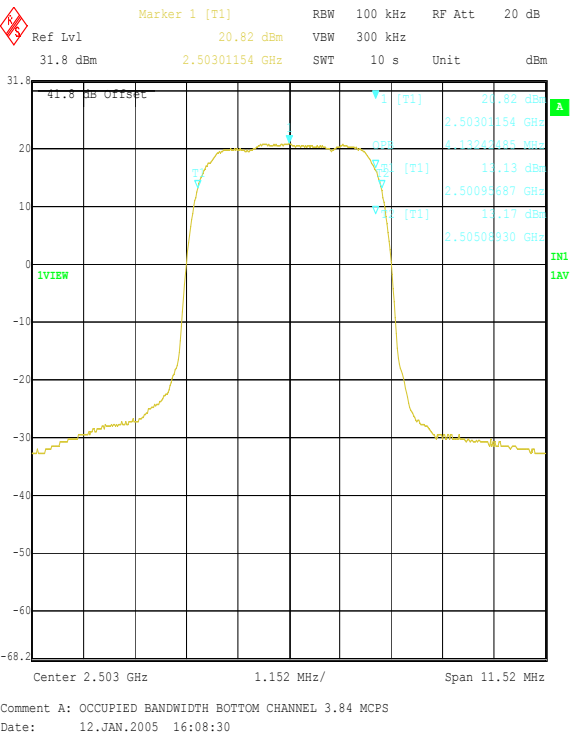
7.5.2. Tests were performed to identify the maximum bandwidth occupied by the fundamental frequency of the EUT.

Results:

Channel	Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	2503	100	300	4.132
Middle	2596	100	300	4.132
Top	2683	100	300	4.132

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Transmitter Occupied Bandwidth (Continued)



Note: The occupied bandwidth is measured using the internal OBW function of the measurement analyser. The analyser automatically configures the measurement bandwidths to make an accurate measurement. The results can be observed in the right hand corner of the graphs

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7.6. Transmitter Conducted Emissions at Band Edges: Part 2.1051 & Part 27.53

7.6.1. The EUT was configured as for conducted emissions measurements as described in Section 9 of this report.

7.6.2. Tests were performed to identify the maximum emissions level at the band edges of the frequency band that the EUT will operate over.

Results:

Bottom Band Edge

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
2500	-24.7	39.7	-64.4	-52.7	11.7	Complied

Top Band Edge

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
2686	-28.2	38.8	-67.0	-51.8	15.2	Complied

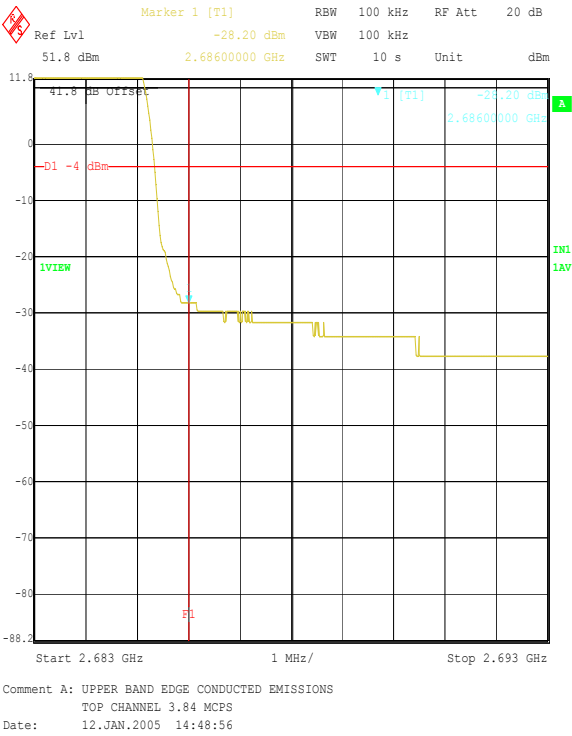
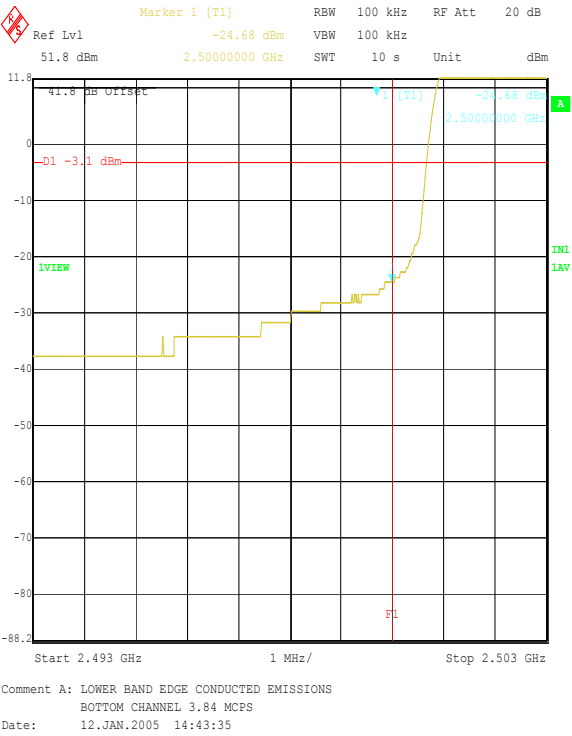
**per 6 MHz channel*

Note(s):

1. The limit is calculated according to FCC Section 27.53(l)(2) as follows: $43 + 10\log(P)$ where P is the transmitter power in Watts.

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Transmitter Conducted Emissions at Band Edges (Continued)



Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

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7.7. Transmitter Conducted Emissions: Part 2.1051 & Part 27.53

7.7.1. The EUT was configured as for transmitter conducted emissions measurements as described in Section 9 of this report.

7.7.2. Tests were performed to identify the maximum transmitter conducted emission levels.

Results:

Bottom Channel

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
1.058	-61.4	39.7	-101.1	-52.7	48.4	Complied
2497.000	-30.8	39.7	-70.5	-52.7	17.8	Complied
2509.000	-29.3	39.7	-69.0	-52.7	16.3	Complied
5007.583	-33.7	39.7	-73.4	-52.7	20.7	Complied
7511.425	-44.5	39.7	-84.2	-52.7	31.5	Complied

Middle Channel

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
1.058	-61.4	39.3	-100.7	-52.3	48.4	Complied
2590.000	-30.3	39.3	-69.6	-52.3	17.3	Complied
2602.000	-28.2	39.3	-67.5	-52.3	15.2	Complied
5193.663	-30.6	39.3	-69.9	-52.3	17.6	Complied
7790.505	-41.7	39.3	-81.0	-52.3	28.7	Complied

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Transmitter Conducted Emissions (Continued)**Top Channel**

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
1.058	-61.4	38.8	-100.2	-51.8	48.4	Complied
2677.000	-30.7	38.8	-69.5	-51.8	17.7	Complied
2689.000	-29.7	38.8	-68.5	-51.8	16.7	Complied
5367.593	-35.2	38.8	-74.0	-51.8	22.2	Complied
8051.555	-44.1	38.8	-82.9	-51.8	31.1	Complied

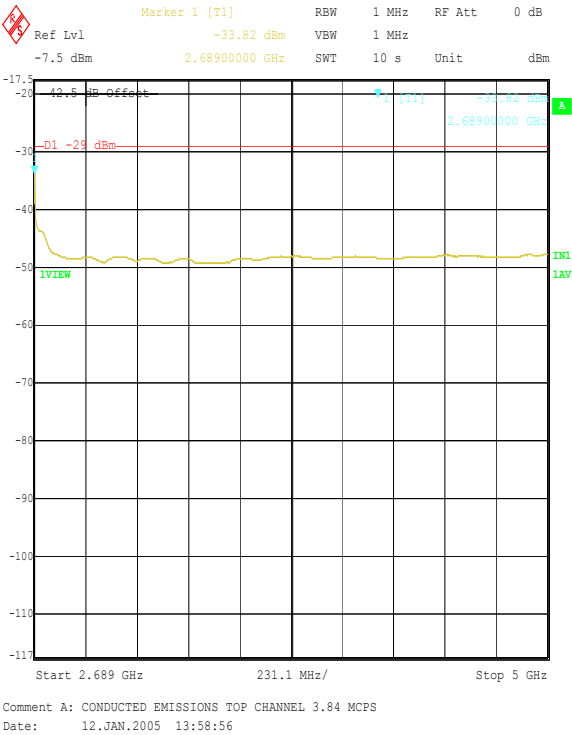
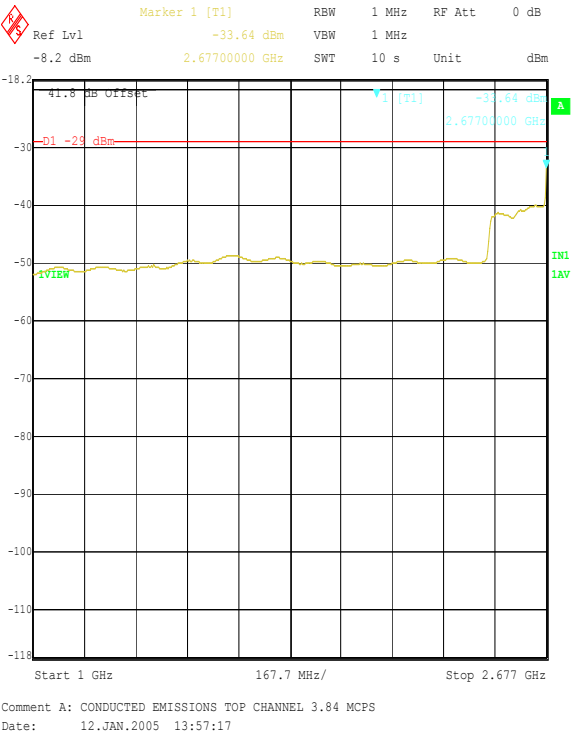
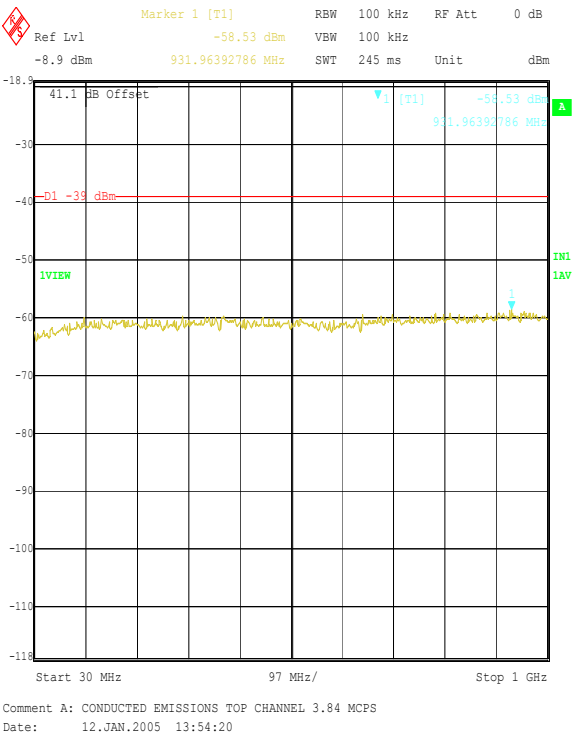
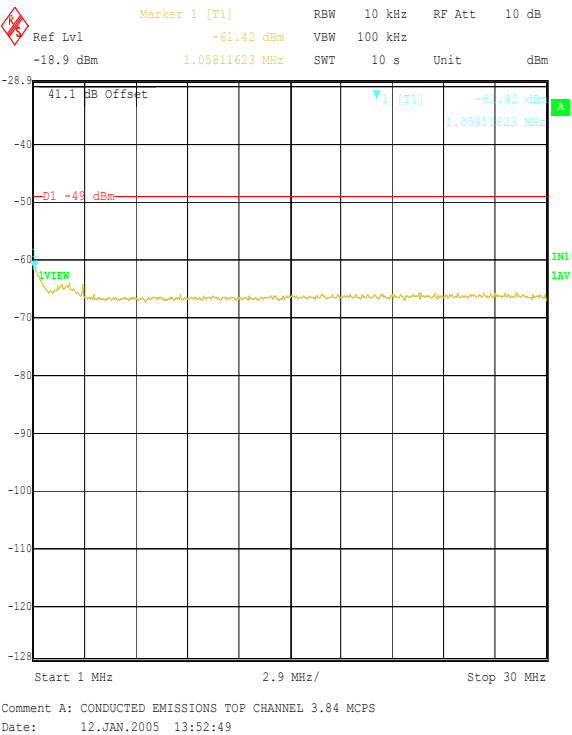
*per 6 MHz channel

Note(s):

1. The limit is calculated according to FCC Section 27.53(l)(2) as follows: $43 + 10\log(P)$ where P is the transmitter power in Watts.

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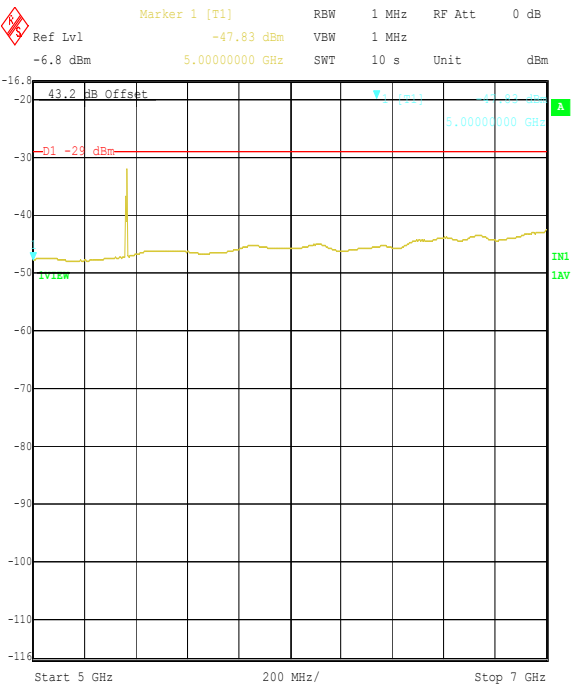
Transmitter Conducted Emissions (Continued)



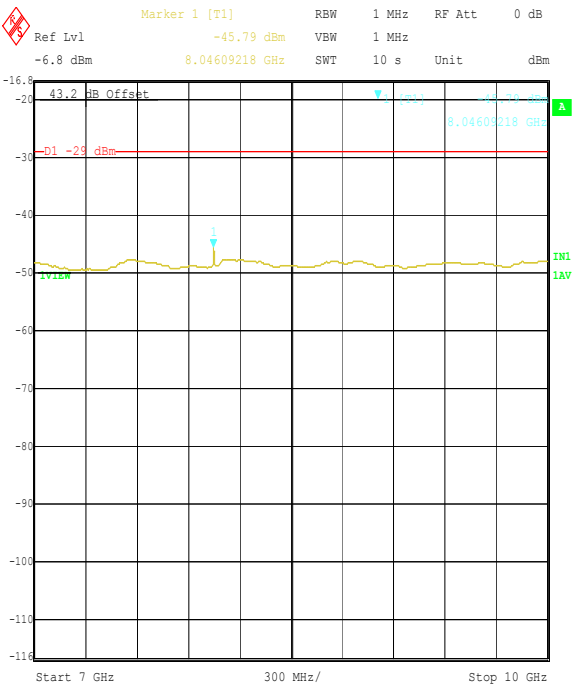
Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

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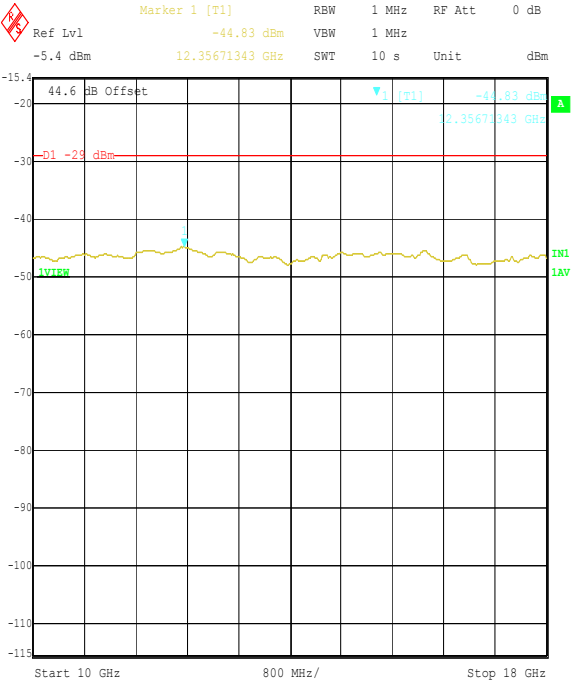
Transmitter Conducted Emissions (Continued)



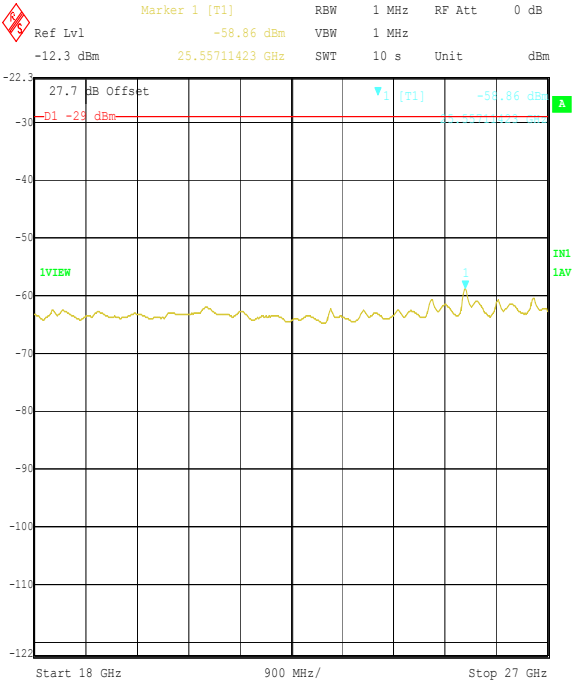
Comment A: CONDUCTED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 12.JAN.2005 14:00:21



Comment A: CONDUCTED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 12.JAN.2005 14:01:16



Comment A: CONDUCTED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 12.JAN.2005 14:02:44



Comment A: CONDUCTED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 12.JAN.2005 14:13:31

Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

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7.8. Transmitter Conducted Emissions (Channel Edge): Part 2.1051 & Part 27.53

7.8.1. The EUT was configured as for conducted emissions measurements as described in Section 9 of this report.

7.8.2. Tests were performed to determine compliance with the out of band power requirements at frequencies adjacent to the channel occupied by the fundamental frequency of the EUT.

Results:

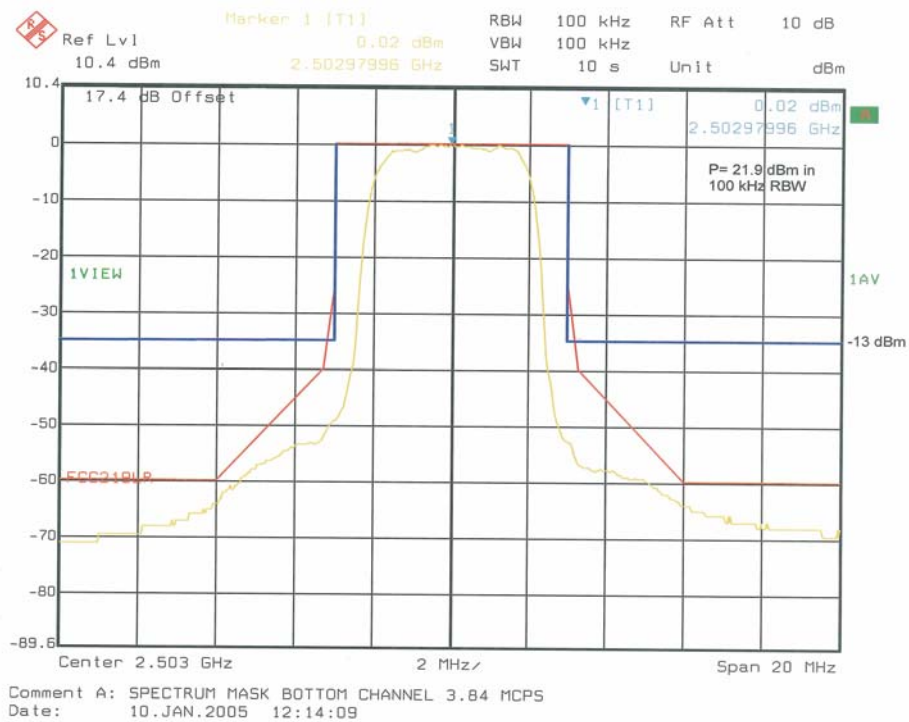
Results are presented graphically in the following graphs. As can be seen from the plots the EUT complies with the requirements of relevant part of the regulations.

Note(s):

- 1. The following plots were set with a 0 dB reference point as testing was originally performed to FCC Parts 21 and 74. This 0 dB reference point equates to the power level of each fundamental emission measured in a 100 kHz Resolution Bandwidth which is 17.8 dB below the actual power measured in a 6 MHz channel bandwidth (C_{BW}). N.B. 17.8 dB is derived from $10\log(C_{BW}/R_{BW})$ where $C_{BW} = 6$ MHz and $R_{BW} = 100$ kHz. The actual power measured in a 100 kHz Resolution Bandwidth is detailed in the right hand corner of each plot.*
- 2. A revised spectrum mask has been added to each plot to indicate the absolute -13 dBm limit which was derived from the $43 + 10\log(P)$ where P is the measured transmitter power in Watts in a 6 MHz channel.*
- 3. Measurements in the 2 MHz strip greater than 1 MHz away from the channel edge were performed using a 100 kHz Resolution Bandwidth (in line with the original requirements of to FCC Parts 21 and 74). Part 27 requires that these measurements be performed using a 1 MHz Resolution Bandwidth. In order to correct for this bandwidth change 10 dB shall be added to the levels shown in each plots in these 2 MHz strips. Therefore a pass margin of at least 8 dB exists at the highest point of the fundamental emission in these 2 MHz strips.*

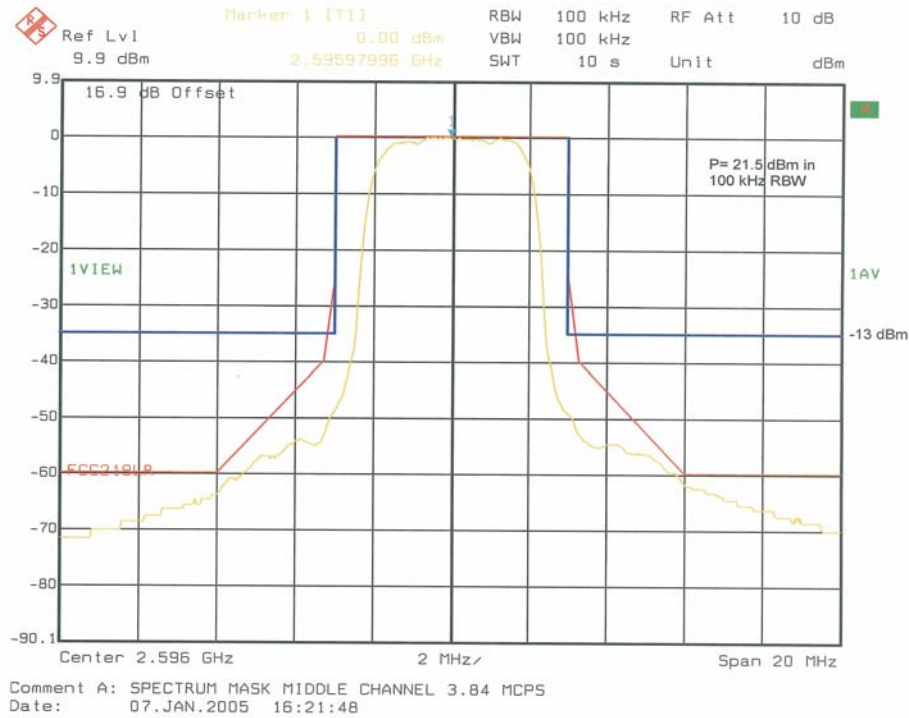
Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Transmitter Conducted Emissions (Channel Edge) – Bottom Channel (Continued)



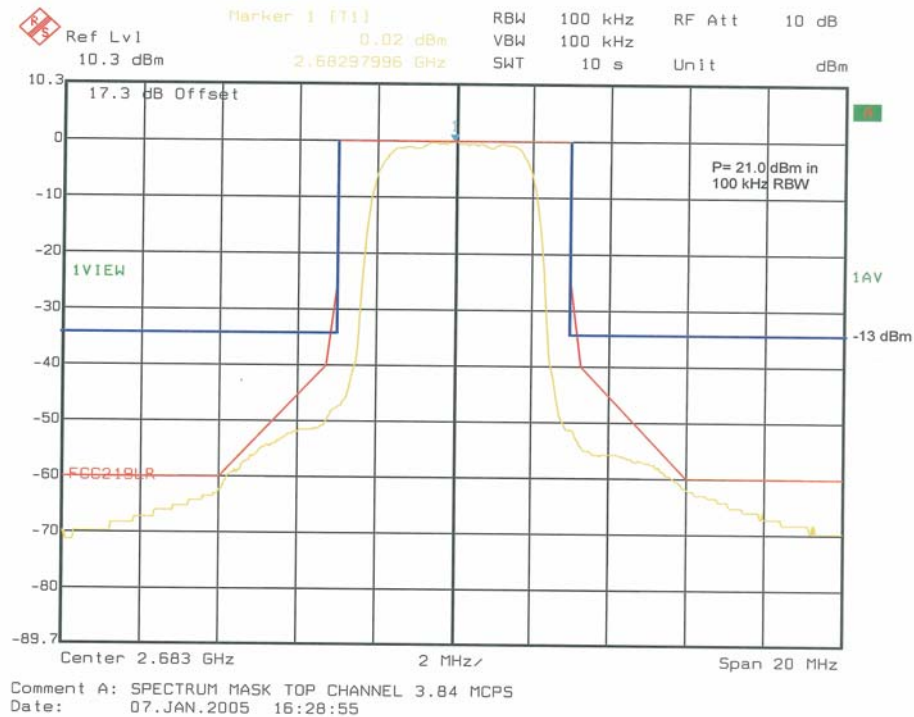
Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Transmitter Conducted Emissions (Channel Edge) – Middle Channel (Continued)



Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Transmitter Conducted Emissions (Channel Edge) – Top Channel (Continued)



Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

7.9. Transmitter Radiated Emissions: Part 2.1053 & Part 27.53

7.9.1. The EUT was configured as for transmitter radiated emissions testing as described in Section 9 of this report.

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

Results:

Bottom Channel

Frequency (MHz)	Spurious Emission (dBm)	Carrier EIRP (dBm)	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
2506.000	-40.7	39.7	-80.4	-52.7	27.7	Complied

Middle Channel

Frequency (MHz)	Spurious Emission (dBm)	Carrier EIRP (dBm)	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
2599.000	-38.0	39.3	-77.3	-52.3	25.0	Complied

Note(s):

1. The limit is calculated according to FCC Section 27.53(l)(2) as follows: $43 + 10\log(P)$ where P is the transmitter power in Watts.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Transmitter Radiated Emissions (Continued)

Top Channel

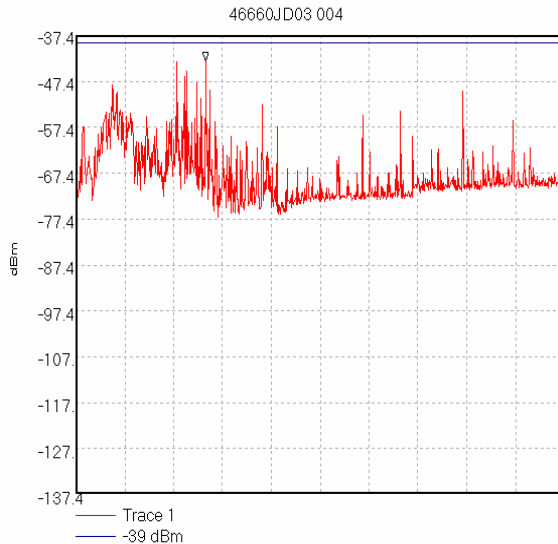
Frequency (MHz)	Spurious Emission (dBm)	Carrier EIRP (dBm)	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
102.293	-71.3	38.8	-110.1	-51.8	58.3	Complied
111.483	-73.1	38.8	-111.9	-51.8	60.1	Complied
230.000	-51.2	38.8	-90.0	-51.8	38.2	Complied
245.761	-56.9	38.8	-95.7	-51.8	43.9	Complied
250.000	-58.8	38.8	-97.6	-51.8	45.8	Complied
270.000	-58.1	38.8	-96.9	-51.8	45.1	Complied
290.000	-64.1	38.8	-102.9	-51.8	51.1	Complied
292.125	-55.5	38.8	-94.3	-51.8	42.5	Complied
400.000	-58.3	38.8	-97.1	-51.8	45.3	Complied
600.000	-56.5	38.8	-95.3	-51.8	43.5	Complied
675.841	-52.6	38.8	-91.4	-51.8	39.6	Complied
800.000	-56.8	38.8	-95.6	-51.8	43.8	Complied
2686.000	-35.1	38.8	-73.9	-51.8	22.1	Complied

Note(s):

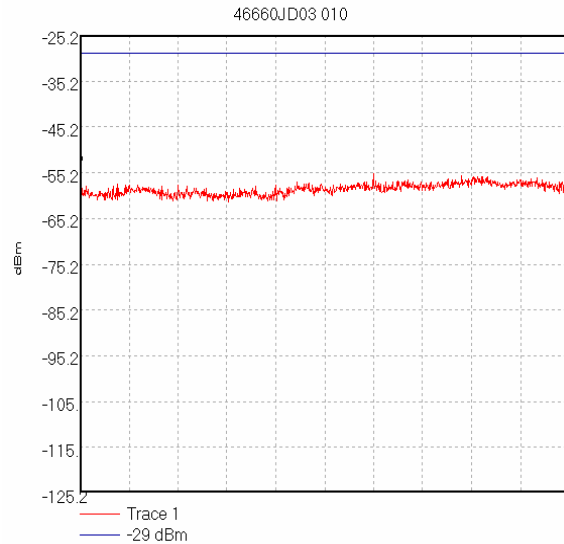
1. The limit is calculated according to FCC Section 27.53(l)(2) as follows: $43 + 10\log(P)$ where P is the transmitter power in Watts.
2. Preliminary scans indicated similar emissions levels for each channel below 1 GHz, therefore final measurements of emissions below 1 GHz were performed with the EUT set to top channel only.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

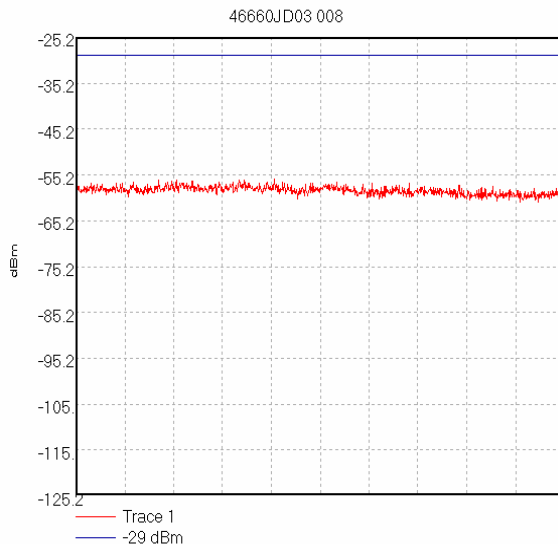
Transmitter Radiated Emissions (Continued)



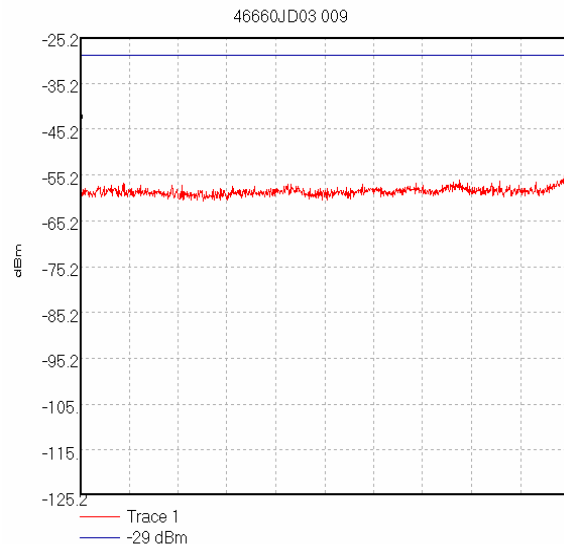
Start 30.0 MHz; Stop 1.0 GHz
Ref -37.4 dBm; Ref Offset 9.6 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 620.0 mS
Peak 287.589 MHz; -43.01 dBm
Display Line: -39 dBm; ; Limit Test Passed
Transducer Factors: A1037
10/01/2005 15:30:46



Start 1.0 GHz; Stop 2.0 GHz
Ref -25.2 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 1.0 GHz; -53.81 dBm
Display Line: -29 dBm; ; Limit Test Passed
Transducer Factors: A1037
11/01/2005 10:25:32



Start 2.0 GHz; Stop 2.68 GHz
Ref -25.2 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 2.68 GHz; -53.66 dBm
Display Line: -29 dBm; ; Limit Test Passed
Transducer Factors: A1037
11/01/2005 10:12:19



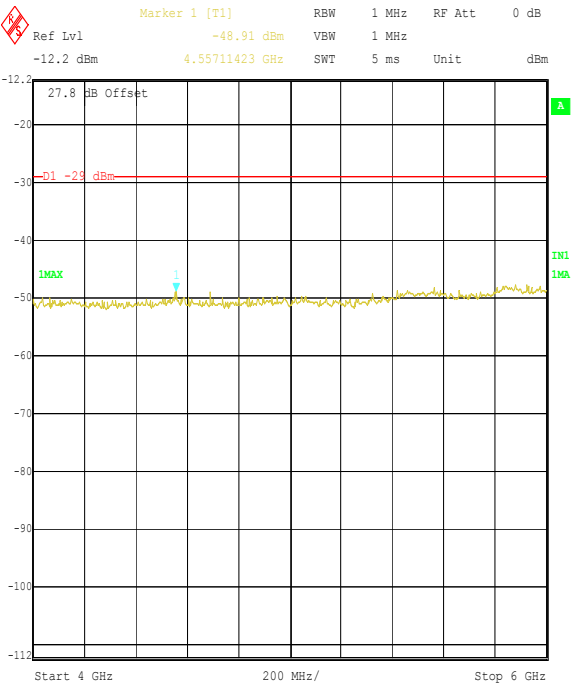
Start 2.686 GHz; Stop 4.0 GHz
Ref -25.2 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 2.686 GHz; -44.04 dBm
Display Line: -29 dBm; ; Limit Test Passed
Transducer Factors: A1037
11/01/2005 10:18:43

Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

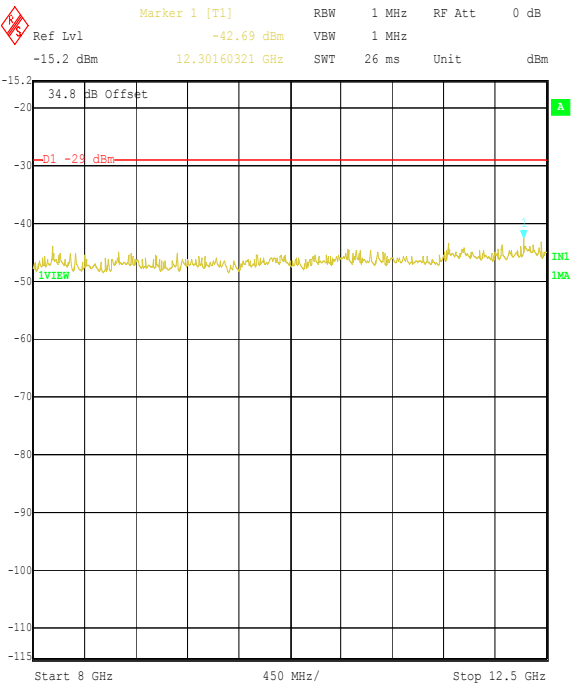
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

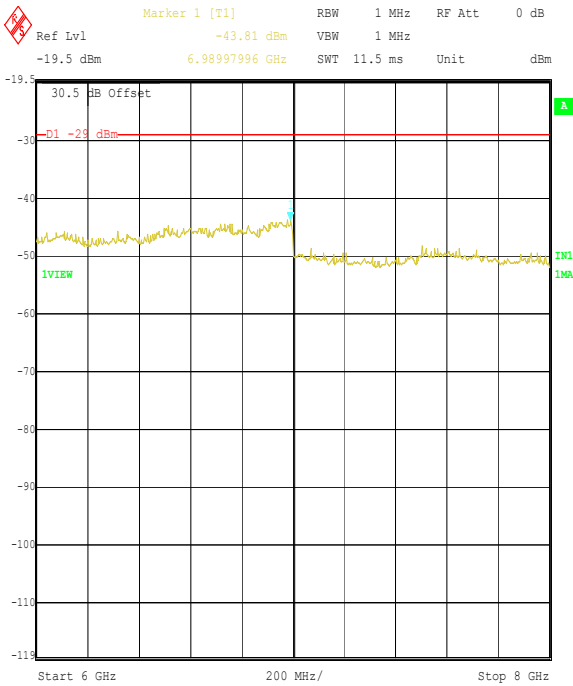
Transmitter Radiated Emissions (Continued)



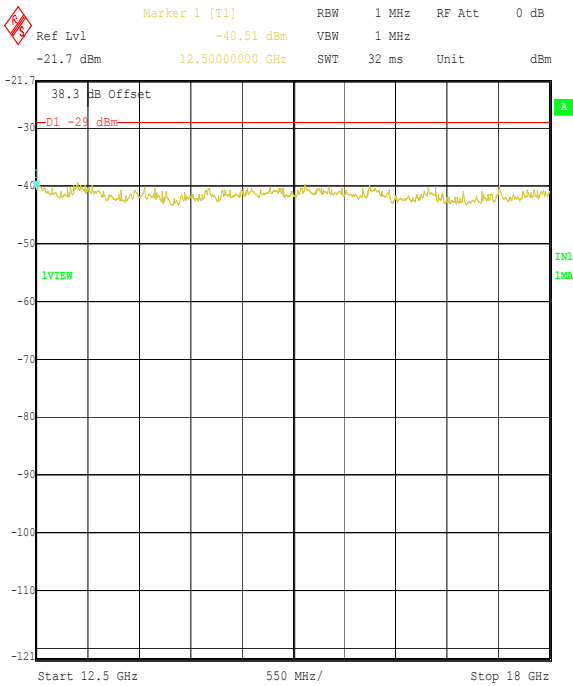
Comment A: RADIATED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 13.JAN.2005 10:35:54



Comment A: RADIATED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 13.JAN.2005 10:48:18



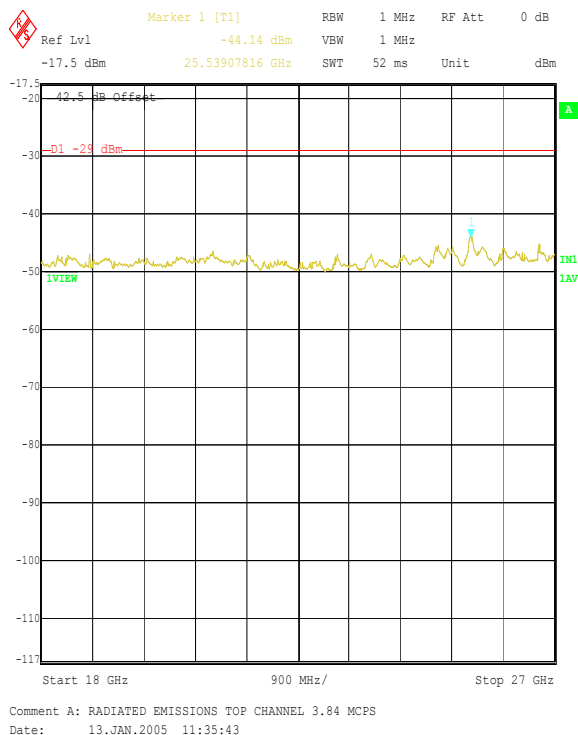
Comment A: RADIATED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 13.JAN.2005 10:42:37



Comment A: RADIATED EMISSIONS TOP CHANNEL 3.84 MCPS
Date: 13.JAN.2005 11:04:00

Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27



Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

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

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Test Results:- 7.68 Mcps Chip Rate**7.10. Transmitter Effective Isotropic Radiated Power (EIRP): Part 2.1046 & Part 27.50**

7.10.1. The EUT was configured as for conducted RF output power and Effective Isotropic Radiated Power (EIRP) as described in Section 9 of this report.

7.10.2. The effective isotropic radiated power (EIRP) was calculated by adding the manufacturer's declared antenna gain to the figure measured for conducted RF output power.

Results:

Channel	Frequency (MHz)	Conducted RF O/P Power (dBm)*	Antenna Gain (dBi)	EIRP (dBm)	EIRP (dBW)	Limit EIRP (dBW)	Margin (dB)	Result
Bottom	2506	36.5	20.0	56.5	26.5	36.4	9.9	Complied
Middle	2596	37.0	20.0	57.0	27.0	36.0	9.0	Complied
Top	2680	36.6	20.0	56.6	26.6	36.4	9.8	Complied

* per 12 MHz Channel

Note(s):

1. The limit is calculated as $33+10 \log (X/Y)$ where X is the actual channel width i.e. 12 MHz and Y is 6 MHz for channels in the MBS and 5.5 MHz for channels in the LBS and UBS.
2. The antenna gain is typically a maximum of 20 dBi and, hence, is the figure used in the above table. IP Wireless do not supply the antenna, the MDS licensee supplies this. IP Wireless will, in their user information, inform all MDS licensees of the device, that the combination of measured conducted RF output power and antenna gain must not, under any circumstances whatsoever, exceed the maximum allowable EIRP limit as detailed above.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

7.11. Transmitter Frequency Stability (Temperature Variation): Part 2.1055 & Part 27.54

7.11.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

7.11.2. Tests were performed to identify the maximum frequency error of the EUT with variations in ambient temperature.

Results:

Bottom Channel (2506 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (kHz)
-30	2505.99671	3.29
-20	2505.99671	3.29
-10	2505.99671	3.29
0	2505.99639	3.61
10	2505.99655	3.45
20	2505.99639	3.61
30	2505.99623	3.77
40	2505.99655	3.45
50	2505.99639	3.61

Middle Channel (2596 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (kHz)
-30	2595.99655	3.45
-20	2595.99655	3.45
-10	2595.99655	3.45
0	2595.99639	3.61
10	2595.99639	3.61
20	2595.99639	3.61
30	2595.99623	3.77
40	2595.99639	3.61
50	2595.99639	3.61

Test of: IPWireless (UK) Ltd
To: 2.5 GHz V4 Node B Model: RK/RA
FCC Part 27

Transmitter Frequency Stability (Temperature Variation) (Continued)**Top Channel (2680 MHz)**

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (kHz)
-30	2679.99655	3.45
-20	2679.99639	3.61
-10	2679.99639	3.61
0	2679.99623	3.77
10	2679.99623	3.77
20	2679.99607	3.93
30	2679.99607	3.93
40	2679.99607	3.93
50	2679.99607	3.93

As can be seen from the above frequency stability results above, the fundamental emissions at the highest and lowest operating frequencies of the EUT (in addition to the fundamental emission at the centre of the operating band) stay, under all test conditions, within the authorised bands of operation i.e. 2496 MHz to 2690 MHz. The EUT is, therefore, compliant.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

7.12. Transmitter Frequency Stability (Voltage Variation): Part 2.1055 & Part 27.54

7.12.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

7.12.2. Tests were performed to identify the maximum frequency error of the EUT with variations in nominal operating voltage.

Results:

Bottom Channel (2506 MHz)

Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (kHz)
93.5	2505.99639	3.61
110.0	2505.99639	3.61
126.5	2505.99639	3.61

Middle Channel (2596 MHz)

Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (kHz)
93.5	2595.99639	3.61
110.0	2595.99639	3.61
126.5	2595.99639	3.61

Top Channel (2680 MHz)

Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (kHz)
93.5	2679.99607	3.93
110.0	2679.99607	3.93
126.5	2679.99607	3.93

As can be seen from the above frequency stability results above, the fundamental emissions at the highest and lowest operating frequencies of the EUT (in addition to the fundamental emission at the centre of the operating band) stay, under all test conditions, within the authorised bands of operation i.e. 2496 MHz to 2690 MHz. The EUT is, therefore, compliant.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

7.13. Transmitter Occupied Bandwidth: Part 2.1049

7.13.1. The EUT was configured as for Occupied Bandwidth measurements as described in Section 9 of this report.

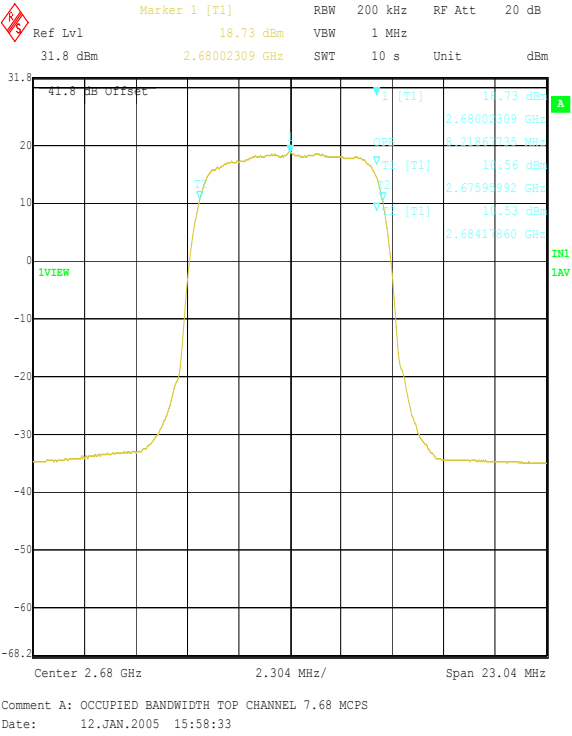
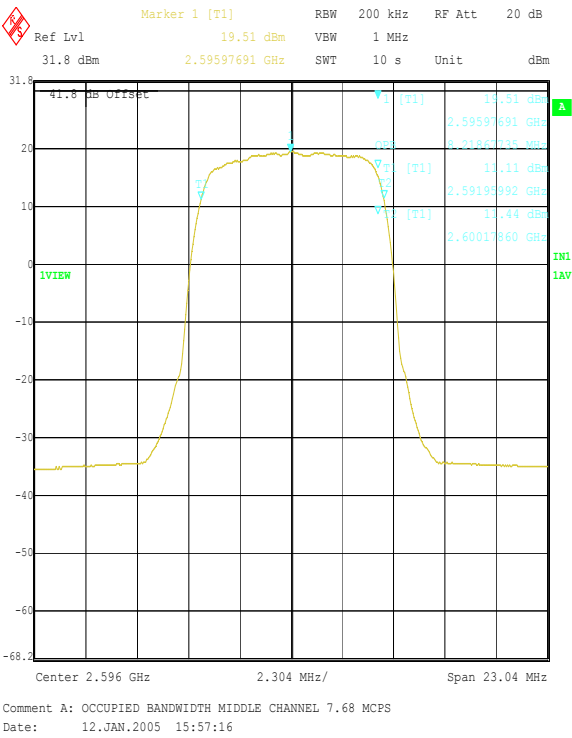
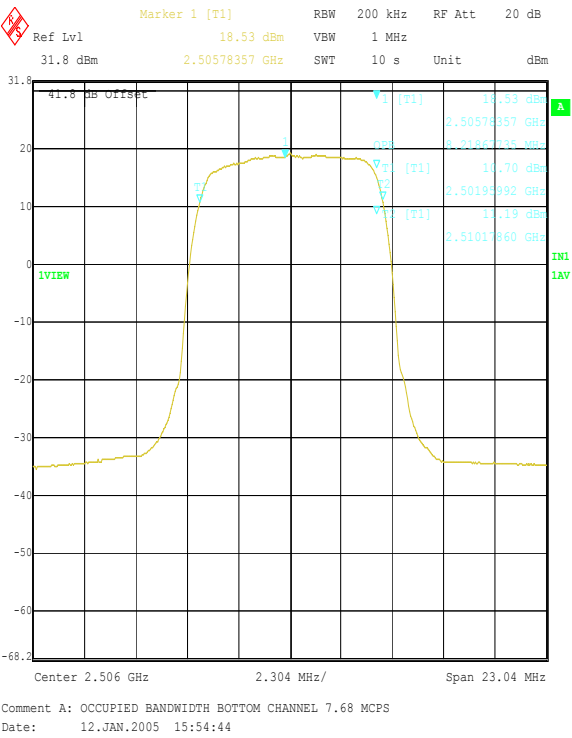
7.13.2. Tests were performed to identify the maximum bandwidth occupied by the fundamental frequency of the EUT.

Results:

Channel	Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	2506	200	1000	8.219
Middle	2596	200	1000	8.219
Top	2680	200	1000	8.219

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Transmitter Occupied Bandwidth (Continued)



Note: The occupied bandwidth is measured using the internal OBW function of the measurement analyser. The analyser automatically configures the measurement bandwidths to make an accurate measurement. The results can be observed in the right hand corner of the graphs

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

7.14. Transmitter Conducted Emissions at Band Edges: Part 2.1051 & Part 27.53

7.14.1. The EUT was configured as for conducted emissions measurements as described in Section 9 of this report.

7.14.2. Tests were performed to identify the maximum emissions level at the band edges of the frequency band that the EUT will operate over.

Results:

Bottom Band Edge

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
2500	-34.2	36.5	-70.7	-49.5	21.2	Complied

Top Band Edge

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
2686	-34.2	36.6	-70.8	-49.6	21.2	Complied

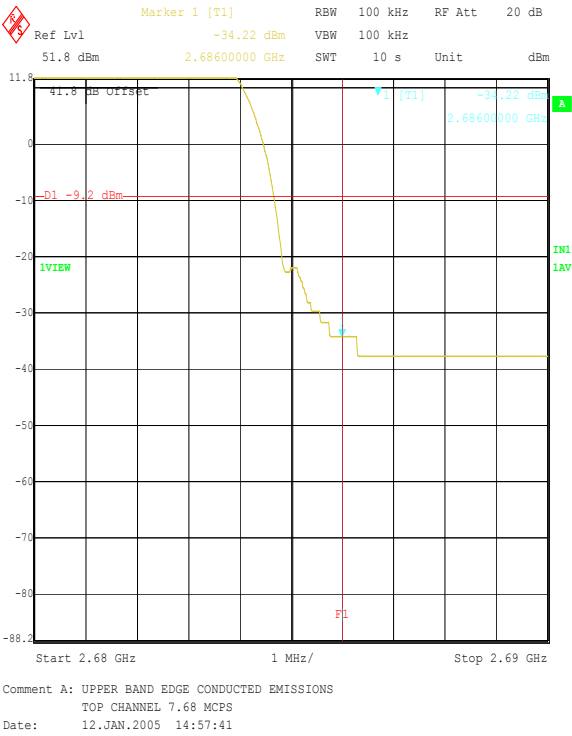
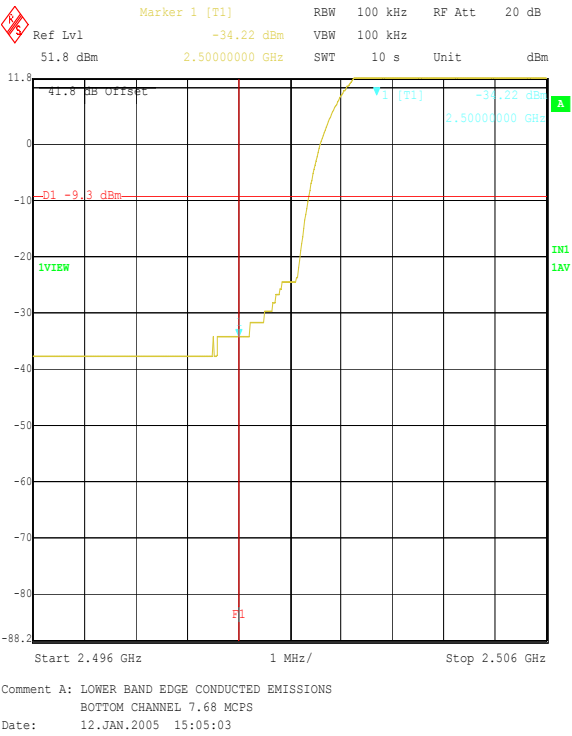
**per 12 MHz channel*

Note(s):

1. The limit is calculated according to FCC Section 27.53(l)(2) as follows: $43 + 10\log(P)$ where P is the transmitter power in Watts.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Transmitter Conducted Emissions at Band Edges (Continued)



Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

7.15. Transmitter Conducted Emissions: Part 2.1051 & Part 27.53

7.15.1. The EUT was configured as for transmitter conducted emissions measurements as described in Section 9 of this report.

7.15.2. Tests were performed to identify the maximum transmitter conducted emission levels.

Results:**Bottom Channel**

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
1.058	-61.4	36.5	-97.9	-49.5	48.4	Complied
2497.000	-34.4	36.5	-70.9	-49.5	21.4	Complied
2515.000	-34.8	36.5	-71.3	-49.5	21.8	Complied
5015.397	-35.9	36.5	-72.4	-49.5	22.9	Complied
7523.080	-47.5	36.5	-84.0	-49.5	34.5	Complied

Middle Channel

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
1.058	-61.4	37.0	-98.4	-50.0	48.4	Complied
2587.000	-36.6	37.0	73.6	-50.0	23.6	Complied
2605.000	-35.2	37.0	-72.2	-50.0	22.2	Complied
5195.487	-35.4	37.0	-72.4	-50.0	22.4	Complied
7793.200	-46.9	37.0	-83.9	-50.0	33.9	Complied

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

Transmitter Conducted Emissions (Continued)**Top Channel**

Frequency (MHz)	Emission Level (dBm)	Carrier Level (dBm)*	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
1.058	-61.4	36.6	-98.0	-49.6	48.4	Complied
2671.000	-34.8	36.6	-71.4	-49.6	21.8	Complied
2689.000	-36.4	36.6	-73.0	-49.6	23.4	Complied
5363.467	-36.5	36.6	-73.1	-49.6	23.5	Complied
8045.310	-46.8	36.6	-83.4	-49.6	33.8	Complied

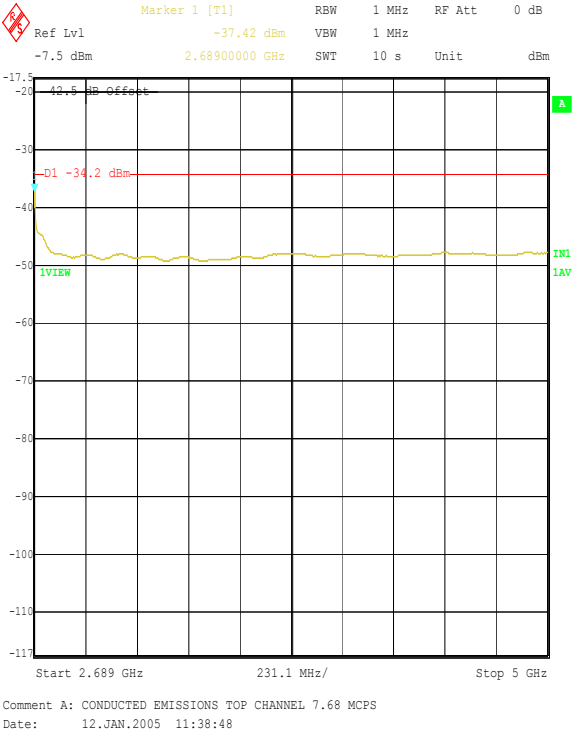
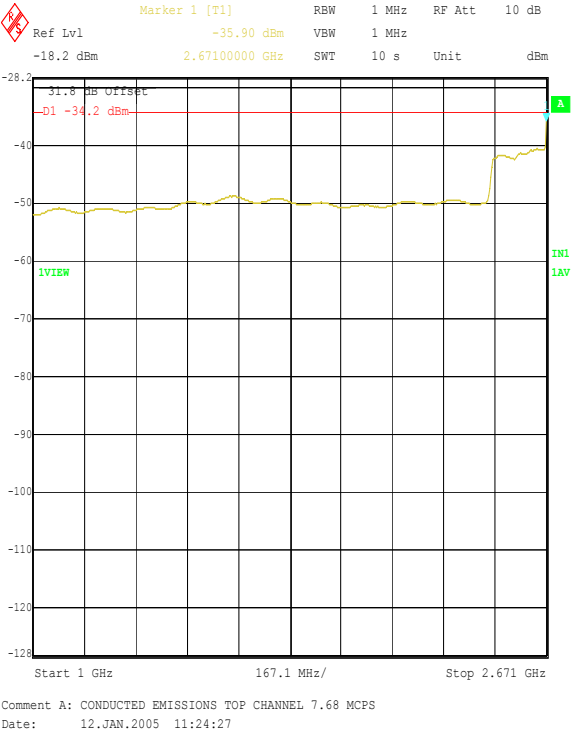
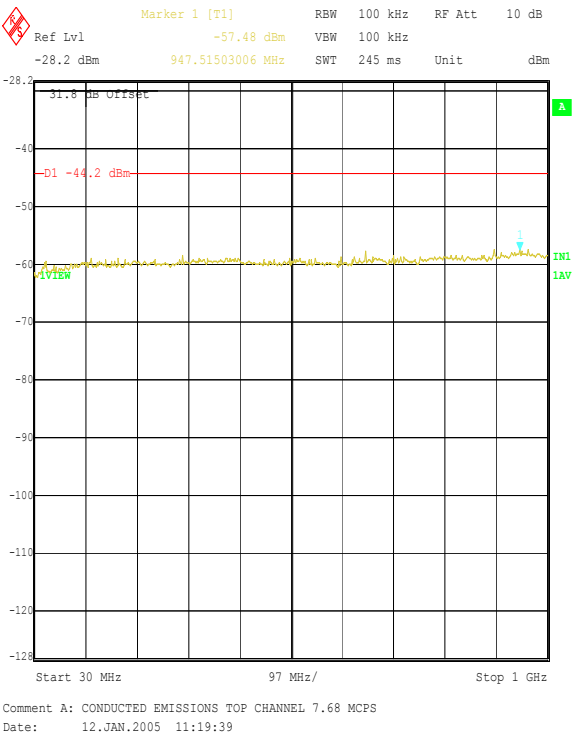
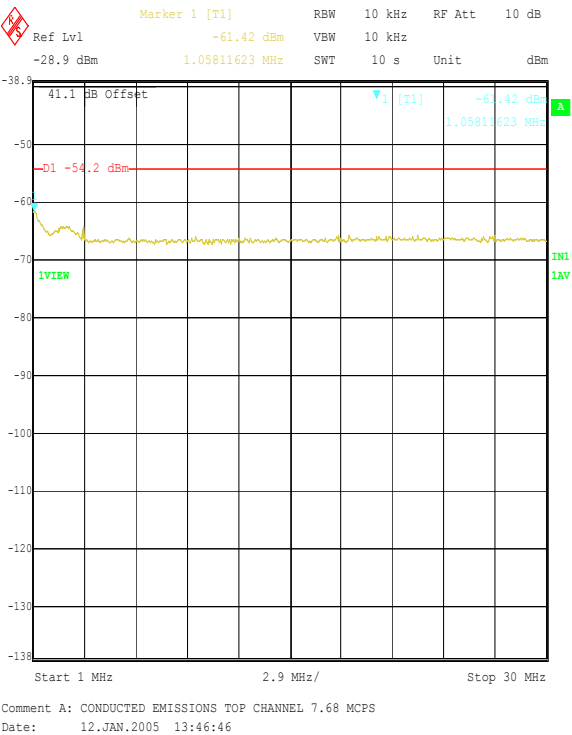
**per 12 MHz channel*

Note(s):

1. The limit is calculated according to FCC Section 27.53(l)(2) as follows: $43 + 10\log(P)$ where P is the transmitter power in Watts.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

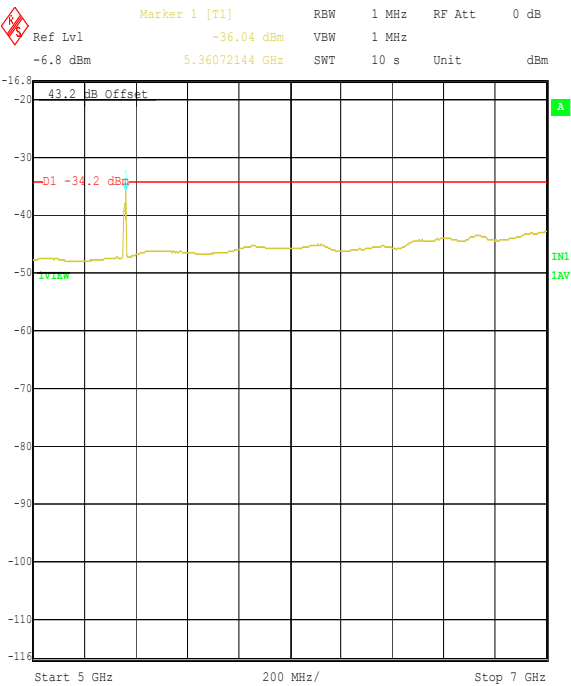
Transmitter Conducted Emissions (Continued)



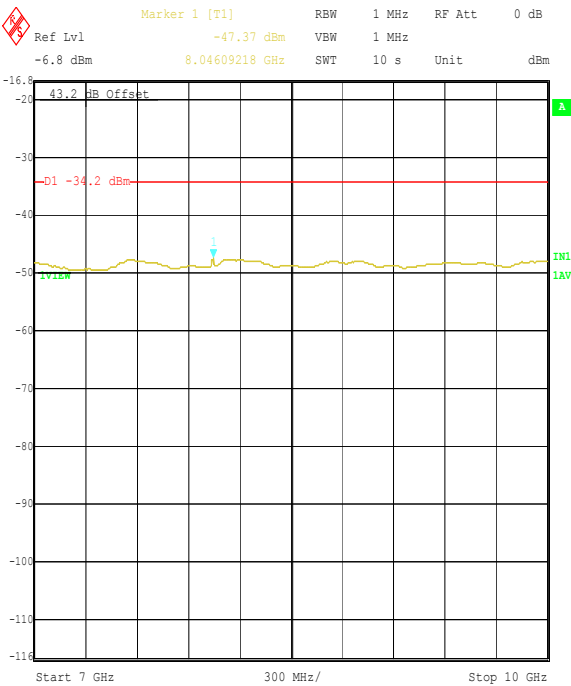
Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

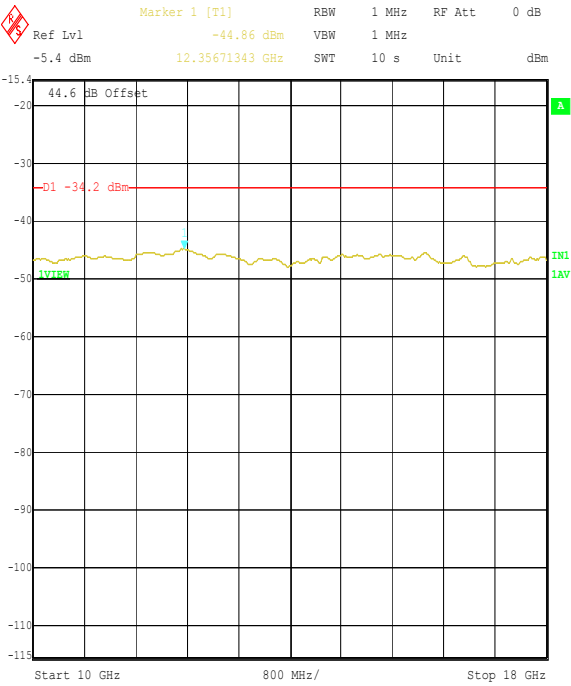
Transmitter Conducted Emissions (Continued)



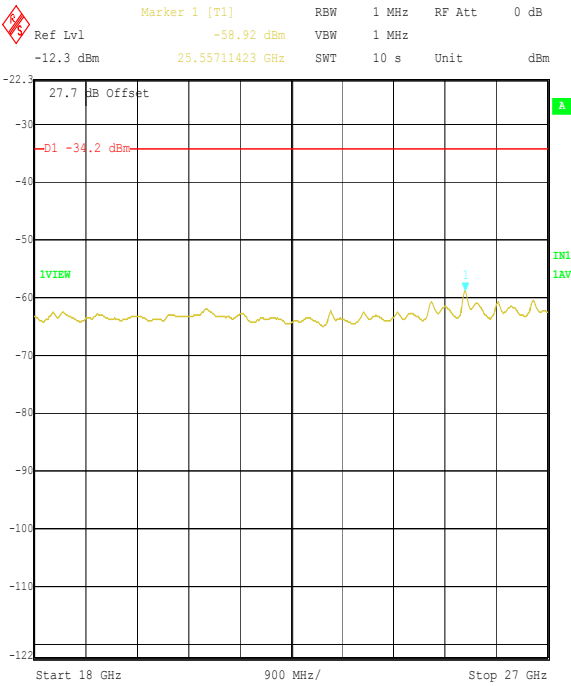
Comment A: CONDUCTED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 12.JAN.2005 11:42:29



Comment A: CONDUCTED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 12.JAN.2005 11:46:24



Comment A: CONDUCTED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 12.JAN.2005 11:50:32



Comment A: CONDUCTED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 12.JAN.2005 11:56:53

Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
To: FCC Part 27

7.16. Transmitter Conducted Emissions (Channel Edge): Part 2.1051 & Part 27.53

7.16.1. The EUT was configured as for conducted emissions measurements as described in Section 9 of this report.

7.16.2. Tests were performed to determine compliance with the out of band power requirements at frequencies adjacent to the channel occupied by the fundamental frequency of the EUT.

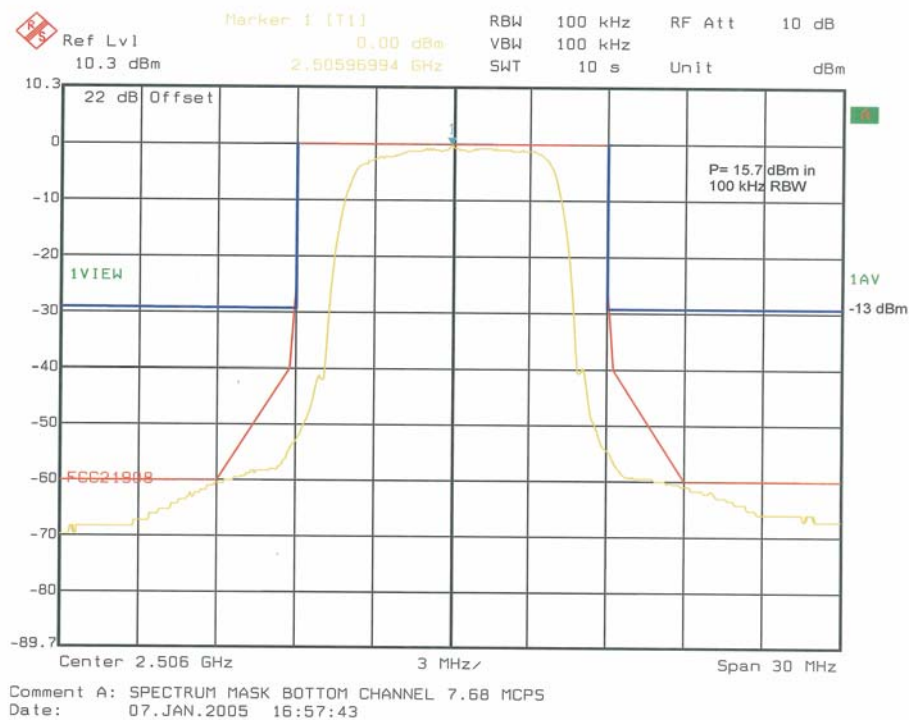
Results:

Results are presented graphically in the following graphs. As can be seen from the plots the EUT complies with the requirements of relevant part of the regulations.

Note(s):

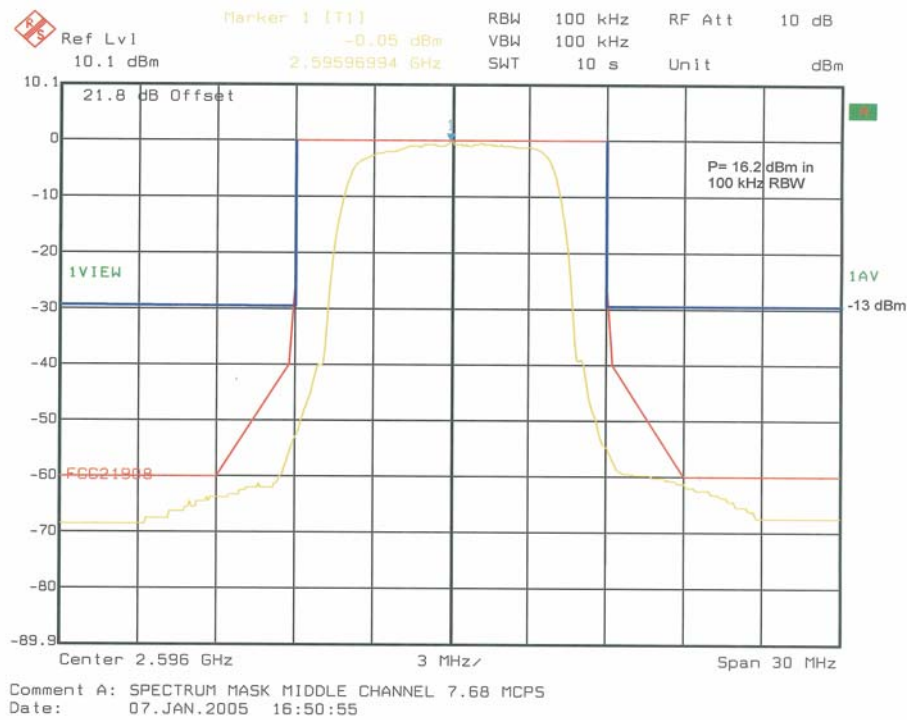
4. *The following plots were set with a 0 dB reference point as testing was originally performed to FCC Parts 21 and 74. This 0 dB reference point equates to the power level of each fundamental emission measured in a 100 kHz Resolution Bandwidth which is 20.8 dB below the actual power measured in a 12 MHz channel bandwidth (C_{BW}). N.B. 20.8 dB is derived from $10\log(C_{BW}/R_{BW})$ where $C_{BW} = 12$ MHz and $R_{BW} = 100$ kHz. The actual power measured in a 100 kHz Resolution Bandwidth is detailed in the right hand corner of each plot.*
5. *A revised spectrum mask has been added to each plot to indicate the absolute -13 dBm limit which was derived from the $43 + 10\log(P)$ where P is the measured transmitter power in Watts in a 12 MHz channel.*
6. *Measurements in the 2 MHz strip greater than 1 MHz away from the channel edge were performed using a 100 kHz Resolution Bandwidth (in line with the original requirements of to FCC Parts 21 and 74). Part 27 requires that these measurements be performed using a 1 MHz Resolution Bandwidth. In order to correct for this bandwidth change 10 dB shall be added to the levels shown in each plots in these 2 MHz strips. Therefore a pass margin of at least 10 dB exists at the highest point of the fundamental emission in these 2 MHz strips.*

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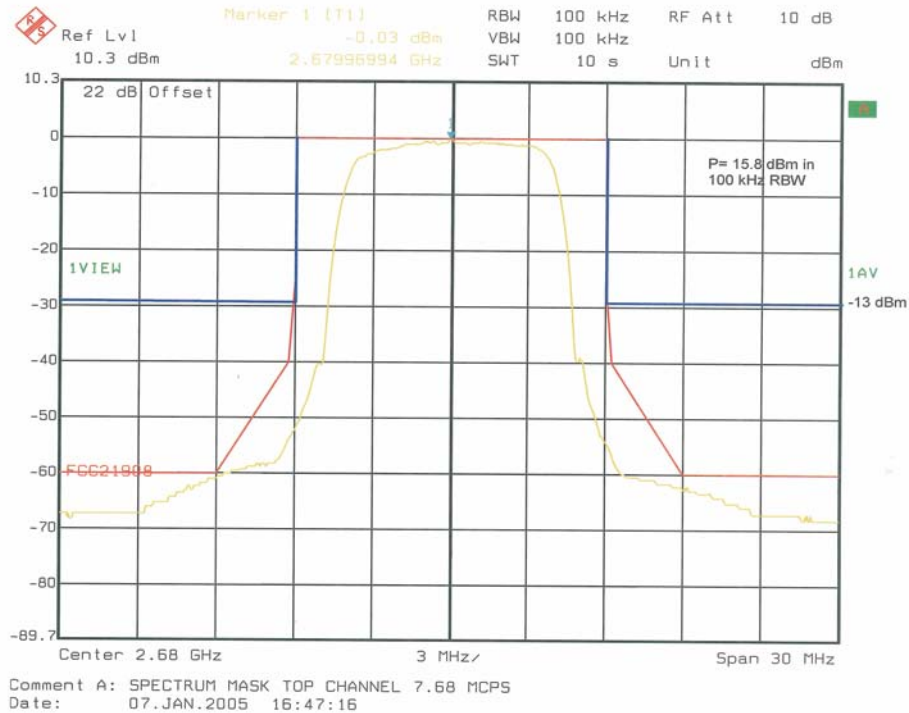
Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
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Transmitter Conducted Emissions (Channel Edge) – Middle Channel (Continued)



Test of: IPWireless (UK) Ltd
2.5 GHz V4 Node B Model: RK/RA
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Transmitter Conducted Emissions (Channel Edge) – Top Channel (Continued)



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7.17. Transmitter Radiated Emissions: Part 2.1053 & Part 27.53

7.17.1. The EUT was configured as for transmitter radiated emissions testing as described in Section 9 of this report.

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

Results:

Top Channel

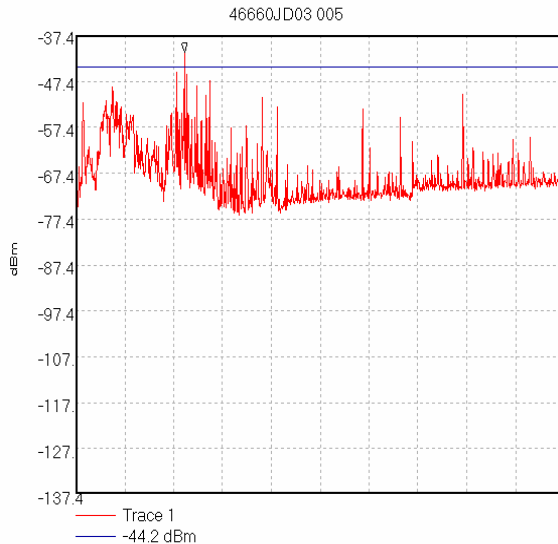
Frequency (MHz)	Spurious Emission (dBm)	Carrier EIRP (dBm)	Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
44.165	-79.1	36.6	-115.7	-49.6	66.1	Complied
111.483	-75.1	36.6	-111.7	-49.6	62.1	Complied
230.000	-51.0	36.6	-87.6	-49.6	38.0	Complied
245.761	-54.3	36.6	-90.9	-49.6	41.3	Complied
270.000	-59.9	36.6	-96.5	-49.6	46.9	Complied
280.000	-65.6	36.6	-102.2	-49.6	52.6	Complied
292.125	-55.3	36.6	-91.9	-49.6	42.3	Complied
400.000	-58.2	36.6	-94.8	-49.6	45.2	Complied
430.081	-62.5	36.6	-99.1	-49.6	49.5	Complied
600.000	-57.3	36.6	-93.9	-49.6	44.3	Complied
675.841	-53.0	36.6	-86.6	-49.6	37.0	Complied
800.000	-56.5	36.6	-93.1	-49.6	43.5	Complied

Note(s):

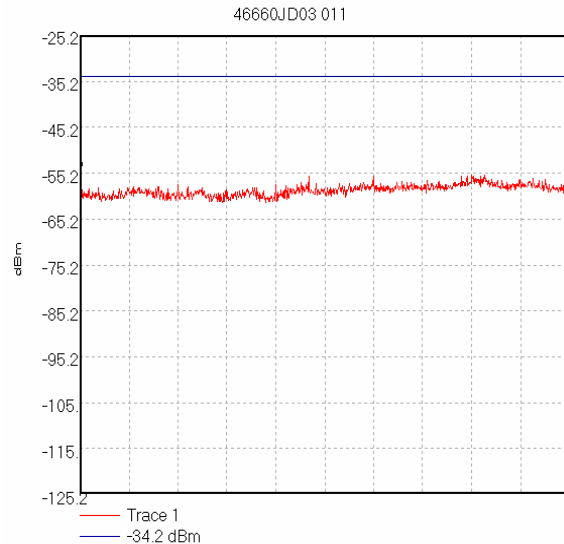
1. The limit is calculated according to FCC Section 27.53(l)(2) as follows: $43 + 10\log(P)$ where P is the transmitter power in Watts.
2. Preliminary scans indicated similar emissions levels for each channel below 1 GHz, therefore final measurements of emissions below 1 GHz were performed with the EUT set to top channel only.

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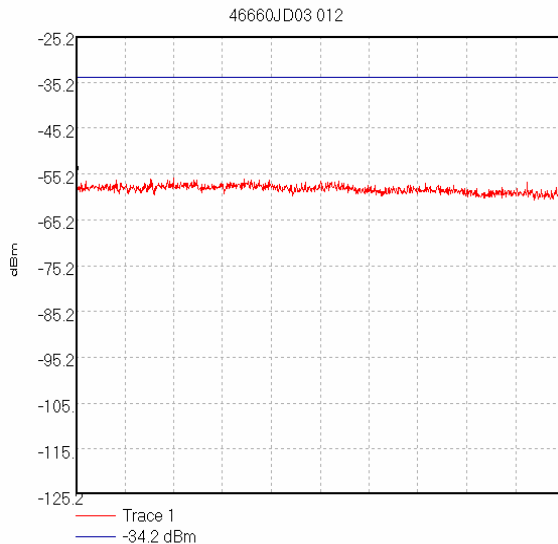
Transmitter Radiated Emissions (Continued)



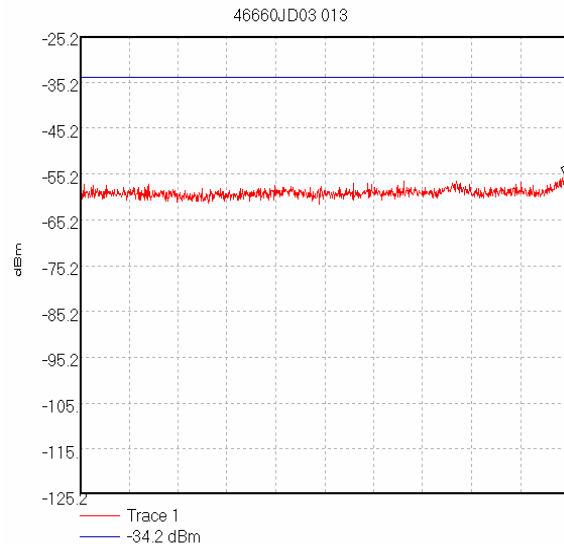
Start 30.0 MHz; Stop 1.0 GHz
Ref -37.4 dBm; Ref Offset 9.6 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 620.0 mS
Peak 245.556 MHz, -41.08 dBm
Display Line: -44.2 dBm; : Limit Test Failed
Transducer Factors: A1037
10/01/2005 15:54:54



Start 1.0 GHz; Stop 2.0 GHz
Ref -25.2 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 1.0 GHz, -54.85 dBm
Display Line: -34.2 dBm; : Limit Test Passed
Transducer Factors: A1037
11/01/2005 10:42:32



Start 2.0 GHz; Stop 2.674 GHz
Ref -25.2 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 2.0 GHz, -55.54 dBm
Display Line: -34.2 dBm; : Limit Test Passed
Transducer Factors: A1037
11/01/2005 10:49:39



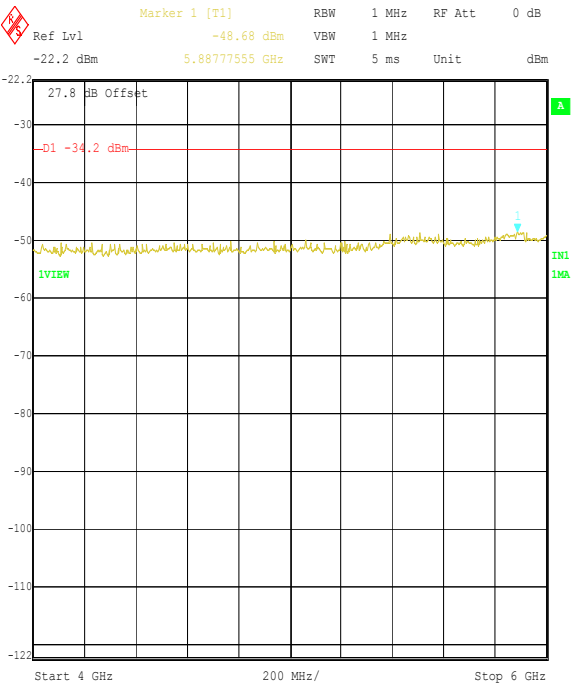
Start 2.686 GHz; Stop 4.0 GHz
Ref -25.2 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 3.988 GHz, -55.67 dBm
Display Line: -34.2 dBm; : Limit Test Passed
Transducer Factors: A1037
11/01/2005 10:54:20

Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

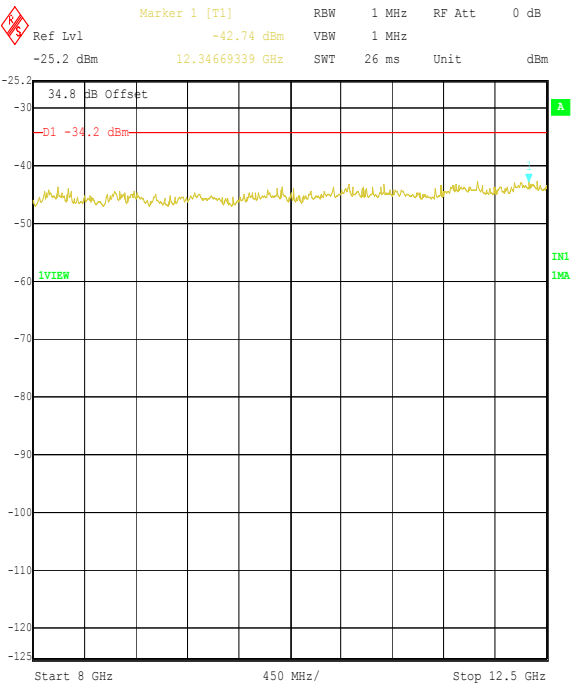
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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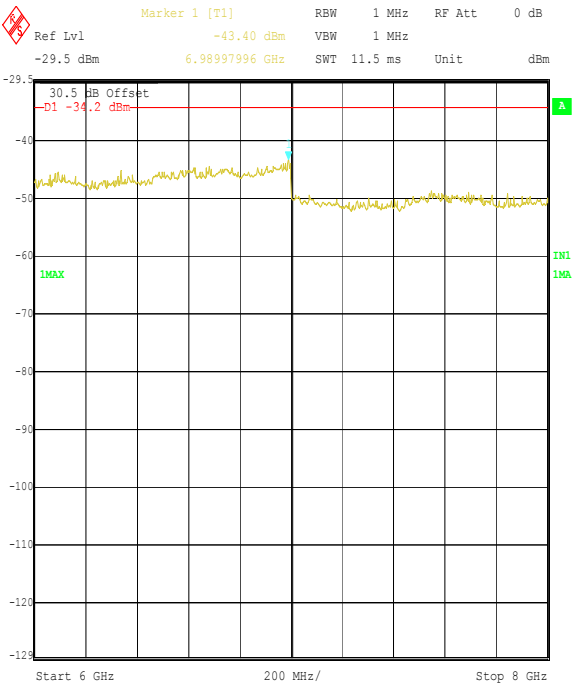
Transmitter Radiated Emissions (Continued)



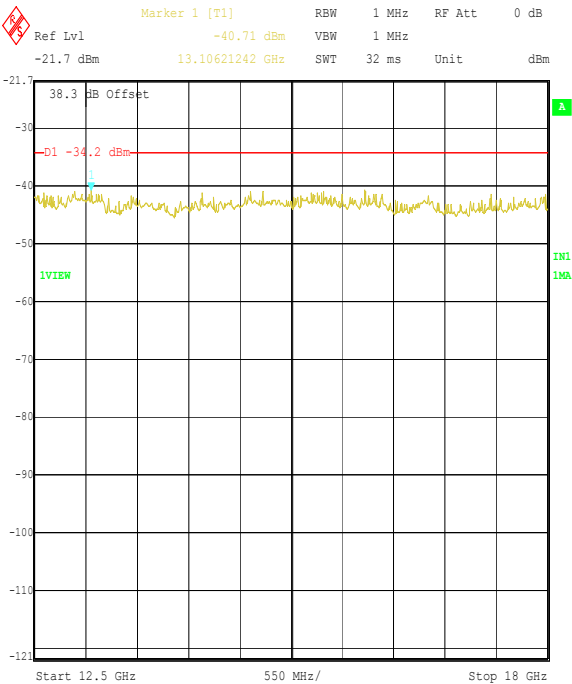
Comment A: RADIATED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 13.JAN.2005 11:54:31



Comment A: RADIATED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 13.JAN.2005 11:45:18



Comment A: RADIATED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 13.JAN.2005 11:50:28

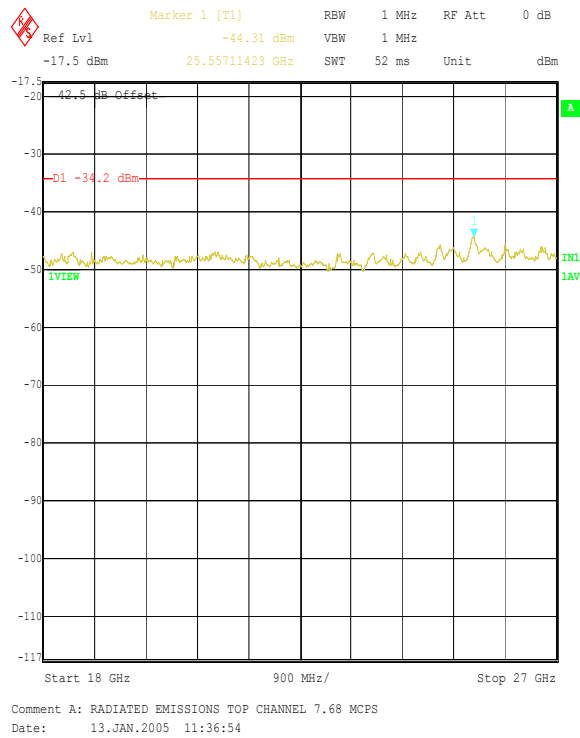


Comment A: RADIATED EMISSIONS TOP CHANNEL 7.68 MCPS
Date: 13.JAN.2005 11:42:01

Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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Transmitter Radiated Emissions (Continued)



Note: The limit shown in the above plots was the derived limit for testing according to Part 21.908, the limit for Part 27.53 is -13 dBm. It is confirmed that the position of the limit line on the plot has no bearing on the measurement result.

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

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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
Carrier Output Power	Not applicable	95%	+/- 0.46 dB
Conducted Emissions	9 kHz to 27 GHz	95%	+/- 1.2 dB
Frequency Stability	Not applicable	95%	+/- 20 Hz
Occupied Bandwidth	Not applicable	95%	+/- 0.12 %
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1 GHz to 27 GHz	95%	+/- 1.78 dB

8.5. The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

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9. Measurement Methods

9.1. Conducted RF Output Power & Effective Isotropic Radiated Power (EIRP)

There are no conducted power limits specified in Part 27, therefore measurements were performed as a requirement of Part 2.1046.

The levels obtained were also used in conjunction with spurious attenuation measurements where the results are based on the conducted carrier power (P).

The EUT's antenna port was connected to a wideband power meter with an average power head via suitable attenuation.

The total loss of the cables & attenuators were measured and entered as a reference level offset into the power meter to correct for these losses.

The EUT was set to a specified channel and the transmitter set to operate at full power.

This test was carried out on the bottom, middle and top channels.

In order to obtain an EIRP measurement the manufacturer's declared antenna gain was added to the measured conducted RF output power.

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9.2. Frequency Stability

The EUT was situated within an environmental test chamber and its antenna port was connected to a spectrum analyser via suitable cables and RF attenuators.

Measurements were performed with the EUT operating under extremes of temperature in 10 degree increments within the range -30 to 50°C.

Measurements were also performed at voltage extremes by varying the primary supply voltage from 85% to 115% of the nominal value.

The requirement was to determine the frequency stability of the device under specified environmental operating conditions and ensure they remained within specified operating parameters.

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

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

Once the environmental chamber had reached thermal equilibrium, the nominal frequency of the EUT was measured and recorded.

The reported data shows the nominal frequency drift and its margin from the declared frequency.

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9.3. Occupied Bandwidth

The EUT was connected to a spectrum analyser enabled with an occupied bandwidth function via its antenna port.

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

The occupied 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 automatically configures the measurement bandwidths to make an accurate measurement based on the channel bandwidth and channel spacing of the EUT. A value of 200 kHz was used for EUT's operating with a high chip rate of 7.68 Mcps whilst a value of 100 kHz was used for EUT's operating with a low chip rate of 3.84 Mcps.

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9.4. Conducted Emissions

Spurious emission measurements at the antenna port were performed from the lowest declared frequency to 10 times the highest EUT fundamental frequency.

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

The frequency band described above was investigated with the transmitter operating at full power on the bottom, middle and top channels. Any spurious emissions noted were then measured.

The recorded emission level was then calculated as a spurious attenuation level using the following formula as described in TIA-EIA-603B.

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

The limit in the standard states that emissions shall be attenuated by at least $43 + 10 \log(P)$ dB below the transmitter power (P), where (P) is the maximum measured fundamental power in Watts for the channel under test. This calculation always gives an absolute level of -13 dBm therefore the limit is -13 dBm, however the results have been presented as decibels relative to the carrier i.e. the tabulated results in the results section of this report show the spurious emission in dBm and as attenuation relative to the carrier in dBc.

The frequency band described above was investigated with the transmitter operating at full power. Any spurious observed were then recorded and compared to the -13 dBm limit. The requirement is for the emission to be less than -13 dBm. The margin between emission and limit is recorded and should always be positive to indicate compliance.

It should be noted that FCC Part 27.53 states that in the 1 MHz bands immediately outside and adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. The resolution bandwidth used was 100 kHz which exceeded the 1% value for both the 3.84 Mcps and 7.68 Mcps chip rates.

For the measurements of emissions at the channel edge, plots of the spectral distribution including the fundamental frequency were recorded using a spectrum analyser for the EUT transmitting on bottom, middle and top channels. The method is in accordance with the measurement method detailed in Part 27.53 for measurements in the 1 MHz bands immediately outside and adjacent to the channel edge. A resolution bandwidth of 100 kHz was used.

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

Receiver Function	Settings
Detector Type:	Average
Mode:	Max Hold
Bandwidth:	1 MHz >1 GHz
Bandwidth:	100 kHz <1 GHz
Bandwidth:	10 kHz <30 MHz
Amplitude Range:	100 dB
Sweep Time:	Coupled

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9.5. Transmitter Radiated Emissions

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

Initial pre-scans covering the entire measurement band from the lowest generated frequency declared up to 10 times the highest fundamental frequency were performed in order to identify frequencies on which the EUT was generating spurious emissions. This determined the frequencies from the EUT that required further examination. Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m, below 4 GHz; above 4 GHz a 1 m measurement distance was used. A limit line was set to the specification limit. Levels within 20 dB of this limit were measured where possible, on occasion; the receiver noise floor came within the 20 dB boundary. On these occasions, the system noise floor may have been recorded.

An open area test site using the appropriate test distance and spectrum analyser with an average detector was used for final measurements.

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

Once the final amplitude (maximised) had been obtained and noted, the EUT was replaced by a substitution antenna, and a substitution method applied. The substitution antennas used were a horn antenna for measurements greater than or equal to 1 GHz and a dipole for measurements below 1 GHz. 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:-

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

Once the EIRP was obtained, the difference between it and the level of the fundamental emission for the EIRP of the channel under test was noted at the spurious attenuation level in dBc. The following formula was used as described in TIA_EIA_603B

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

The limit in the standard states that emissions shall be attenuated by at least $43 + 10 \log(P)$ dB below the transmitter power (P), where (P) is the maximum measured fundamental power in Watts for the channel under test. This calculation always gives an absolute level of -13 dBm therefore the limit is -13 dBm, however the results have been presented as decibels relative to the carrier i.e. the tabulated results in the results section of this report show the spurious emission in dBm and as attenuation relative to the carrier in dBc.

The frequency band described above was investigated with the transmitter operating at full power. Any spurious observed were then recorded and compared to the -13 dBm limit. The requirement is for the emission to be less than -13 dBm. The margin between emission and limit is recorded and should always be positive to indicate compliance.

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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	Horn Antenna	Eaton	91889-2	557
A1037	Bilog Antenna	Chase EMC	CBL6112B	2413
A1392	20 dB Attenuator	Huber + Suhner	757456	6820.17.B
A1441	Waveguide to coax adapter	Unknown	MFR 01456	42AC206
A1442	Waveguide to coax adapter	Unknown	A7589-3	N/A
A244	20 dB Attenuator	Schaffner	6820-17-B	None
A254	Horn Antenna	Flann Microwave	14240-20	139
A255	Horn Antenna	Flann Microwave	16240-20	519
A256	Horn Antenna	Flann Microwave	18240-20	400
A259	Bilog Antenna	Chase	CBL6111	1513
A392	3 dB attenuator	Suhner	6803.17.B	None
A428	Horn Antenna	Flann	12240-20	134
A436	Horn Antenna	Flann	20240-20	330
E011	Environmental Chamber	Design Environmental	WIR3-40	11-96-A2103
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M023	Test Receiver	Rohde & Schwarz	ESVP	872 991/027
M072	Spectrum Analyser	Rohde & Schwarz	FSM	862 967/010 (RU); 863 912/048 (DU)
M105	DVM	Fluke	77	963580770
M1122	Power Sensor	Boonton Electronics	57340	3297
M1123	RF Power Meter	Boonton	4531	138201
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K
M505/ M506	Spectrum Analyser	Rohde & Schwarz	ESBI	825316/010 (DU); 827060/004 (RU)
S003	Power Control	Zen	E08	736699
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\46660JD03\EMIRAD	Test configuration for measurement of radiated emissions.

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DRG\46660JD03\EMIRAD

