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Report On

FCC and Industry Canada Testing of the
Domo Ltd NETNode IP Mesh Radio (Robust)
In accordance with FCC CFR 47 Part 2 and 90 and
Industry Canada RSS-210 and RSS-Gen

COMMERCIAL-IN-CONFIDENCE

FCC ID: XRFNETNODE
IC ID: 8638A-NETNODE

Document 75910529 Report 01 Issue 2 April 2011

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COMMERCIAL-IN-CONFIDENCE

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Document 75910529 Report 01 Issue 2

April 2011

PREPARED FOR

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PREPARED BY

N Bennett
Senior Administrator

APPROVED BY

K Archer
Authorised Signatory

M Jenkins
Authorised Signatory

DATED 06 April 2011

This report has been up-issued to Issue 2 to correct typographical errors.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC Part 2 and 90 and RSS-210 and RSS-Gen. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineers;

B Airs

G Lawler

UKAS TESTING 0141

Product Service

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Product Service

SECTION 1

REPORT SUMMARY

FCC and Industry Canada Testing of the
Domo Ltd NETNode IP Mesh Radio (Robust)
In accordance with FCC CFR 47 Part 2 and 90 and
Industry Canada RSS-210 and RSS-Gen

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the FCC and Industry Canada Testing of the Domo Ltd, NETNode IP Mesh Radio (Robust) to the requirements of FCC Part 2 and 90 and RSS-210 and RSS-Gen.

Objective	To perform FCC and Industry Canada Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Domo Ltd
Model Number(s)	NETNode IP Mesh Radio (Robust)
Serial Number(s)	013149
Number of Samples Tested	One
Test Specification/Issue/Date	FCC Part 2: 2010 FCC Part 90: 2010 RSS-210: Issue 8: 2010 RSS-Gen: Issue 3: 2010
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	6402 23 July 2010
Start of Test	28 September 2010
Finish of Test	21 November 2010
Name of Engineer(s)	B Airs G Lawler

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 2 and 90 and Industry Canada RSS-210 and RSS-Gen is shown below.

Configuration 1: Stand Alone								
Section	Spec Clause				Test Description	Mode	Result	Comments
	FCC Part 2	FCC Part 90	RSS-210	RSS-Gen				
2.1	-	90.210(b)(3)	A8.5	-	Spurious Emissions Outside Emissions Mask	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	
	2.1046	90.205	A8.4 (4)	-	EIRP Peak Power	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
2.3	2.1046	90.205	A8.4 (4)	-	Power and Antenna Height Limits / Transmitter Output Power	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	
2.4	2.1047	90.207	-	-	Types of Emission / Modulation	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	
2.5	2.1049	90.209	-	-	Bandwidth Limitations	Transmit Bottom	N/A	
						Transmit Middle	Pass	
						Transmit Top	N/A	
2.6	2.1051	90.210	-		Emission Mask	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	
2.7	2.1055	90.213	-	4.5	Transmitter Frequency Stability	Transmit Bottom	N/A	
						Transmit Middle	Pass	
						Transmit Top	N/A	
2.8	2.1047	-	-	-	Modulation Characteristics	Transmit Bottom	-	Customer Declared
						Transmit Middle	-	
						Transmit Top	-	
2.9	2.1051	90.210(b)(3)	A.8.5	-	Emission Mask	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	
2.10	-	-	A8.2(a)	-	6dB Bandwidth	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	
2.11	-	-	A8.2(b)	-	Power Spectral Density	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	

Configuration 2: Stand Alone with Antenna								
Section	Spec Clause				Test Description	Mode	Result	Comments
	FCC Part 2	FCC Part 90	RSS-210	RSS-Gen				
	-	90.210(b)(3)	A8.5	-	Spurious Emissions Outside Emissions Mask	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
2.2	2.1046	90.205	A8.4 (4)	-	EIRP Peak Power	Transmit Bottom	Pass	
						Transmit Middle	Pass	
						Transmit Top	Pass	
	2.1046	90.205	A8.4 (4)	-	Power and Antenna Height Limits / Transmitter Output Power	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	2.1047	90.207	-	-	Types of Emission / Modulation	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	2.1049	90.209	-	-	Bandwidth Limitations	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	2.1051	90.210	-		Emission Mask	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	2.1055	90.213	-	4.5	Transmitter Frequency Stability	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	2.1047	-	-	-	Modulation Characteristics	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	2.1051	90.210(b)(3)	A.8.5	-	Emission Mask	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	-	-	A8.2(a)	-	6dB Bandwidth	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	
	-	-	A8.2(b)	-	Power Spectral Density	Transmit Bottom	N/A	
						Transmit Middle	N/A	
						Transmit Top	N/A	

N/A – Not Applicable

1.3 APPLICATION FORM

APPLICANT'S DETAILS
COMPANY NAME : Domo Ltd, Trading as Cobham Surveillance ADDRESS : 11/12 Manor Court, Barnes Wallis Road, Segensworth, Hampshire PO15 5TH NAME FOR CONTACT PURPOSES : Stuart Doe TELEPHONE NO: 01489 566 750 FAX NO: 01489 880 538 E-MAIL: Stuart.doe@cobham.com

EQUIPMENT INFORMATION

Equipment designator:

Model name/number NETNode IP Mesh Radio (Robust) Identification number S/N 003018

Supply Voltage:

[ ]	AC mains	State AC voltage …… V	and AC frequency …… Hz
[12]	DC (external)	State DC voltage 12V	and DC current ……1.2 A
[ ]	DC (internal)	State DC voltage …… V	and Battery type ……

Frequency characteristics:

Frequency range 2450 MHz to 2483.5 MHz Channel spacing 2.5MHz (if channelised)
Designated test frequencies:
Bottom: 2452.5 MHz Middle: 2466.75 MHz Top: 2481.0MHz

Power characteristics:

Maximum transmitter power 1W Minimum transmitter power 100mW (if variable)

[X] Continuous transmission
[ ] Intermittent transmission State duty cycle ……
If intermittent, can transmitter be set to continuous transmit test mode? Y/N

Antenna characteristics:

[X]	Antenna connector	State impedance …… 50ohm
[ ]	Temporary antenna connector	State impedance …… ohm
[ ]	Integral antenna	State gain 4 dBi

Modulation characteristics:

[ ] Amplitude [ ] Other
[ ] Frequency Details: COFDM and QPSK
[ ] Phase
Can the transmitter operate un-modulated? No
ITU Class of emission: 2M 50D7FEF (Video)

Extreme conditions:

Maximum temperature	50 ºC	Minimum temperature	-30 ºC
Maximum supply voltage	16V	Minimum supply voltage	12V

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Signature : Held on file at TÜV SÜD Product Service Ltd

Name : Stuart Doe

Position held : Programme Manager

Date : 14 December 2010

TÜV SÜD Product Service Ltd formally certifies that the manufacturer's declaration as typed out in this report is a true and accurate record of the original received from the applicant.

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Domo Ltd, NETNode IP Mesh Radio (Robust). A full technical description can be found in the manufacturer's documentation.

1.4.2 Test Configuration

Configuration 1: Stand Alone

The EUT was configured in accordance with FCC CFR 47 Part 2 and 90 and Industry Canada RSS-210 and RSS-Gen.

Configuration 2: Stand Alone with Antenna

The EUT was configured in accordance with FCC CFR 47 Part 2 and 90 and Industry Canada RSS-210 and RSS-Gen.

1.4.3 EUT Cable / Port Identification

Port	Max Cable Length specified	Usage	Type	Screened
DC Power	<3m	Power Cable	DC Lead	No

1.4.4 Modes of Operation

Modes of operation of each EUT during testing were as follows:

Mode 1 - Transmit 2452.50 MHz (Bottom)

Mode 2 - Transmit 2466.75 MHz (Middle)

Mode 3 - Transmit 2481.00 MHz (Top)

Information on the specific test modes utilised are detailed in the test procedure for each individual test.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure, test laboratories or an open test area as appropriate.

The EUT was powered from a 12V DC Power supply unit.

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation
IC2932B-1 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.7 MODIFICATION RECORD

No modifications were made to the EUT during testing.

Product Service

SECTION 2

TEST DETAILS

FCC and Industry Canada Testing of the
Domo Ltd NETNode IP Mesh Radio (Robust)
In accordance with FCC CFR 47 Part 2 and 90 and
Industry Canada RSS-210 and RSS-Gen

2.1 SPURIOUS EMISSIONS OUTSIDE EMISSION MASK

2.1.1 Specification Reference

FCC Part 2 and 90, Clause 90.210(b)(3)
RSS-210, Clause A8.5

2.1.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.1.3 Date of Test and Modification State

05 October 2010 - Modification State 0

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC Part 2 and 90 and RSS-210 and RSS-Gen.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.1.6 Environmental Conditions

	05 October 2010
Ambient Temperature	21.3°C
Relative Humidity	46%

2.1.7 Test Results

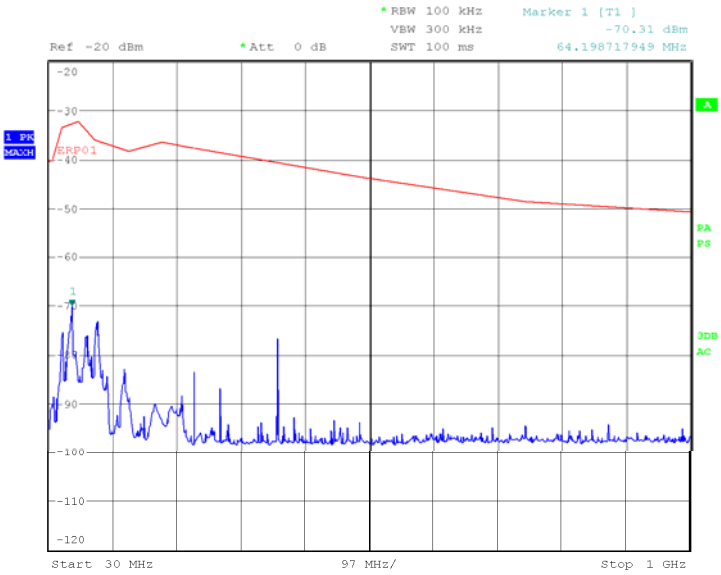
The EUT meets the requirements of FCC Part 2 and 90 and RSS-210 and RSS-Gen for Spurious Emissions Outside Emission Mask.

No emissions measured from the EUT were within 10dB of the limit.

The emission plots are shown on the following pages.

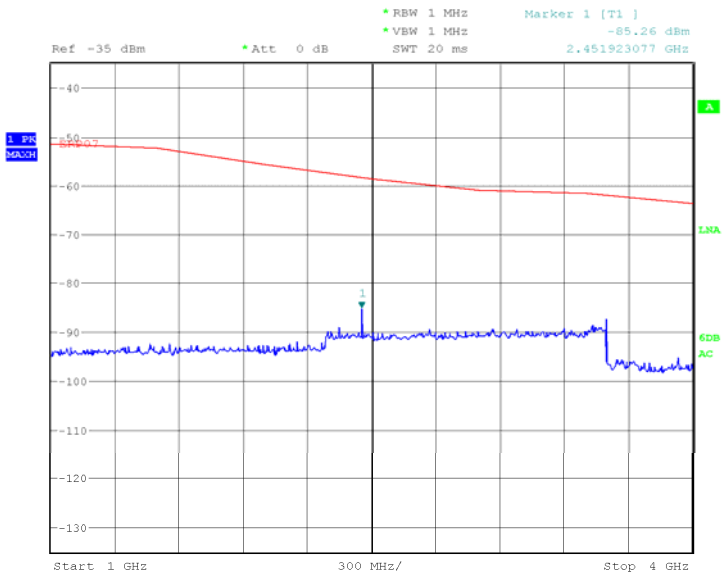
Configuration 1 - Mode 1

30MHz to 1GHz



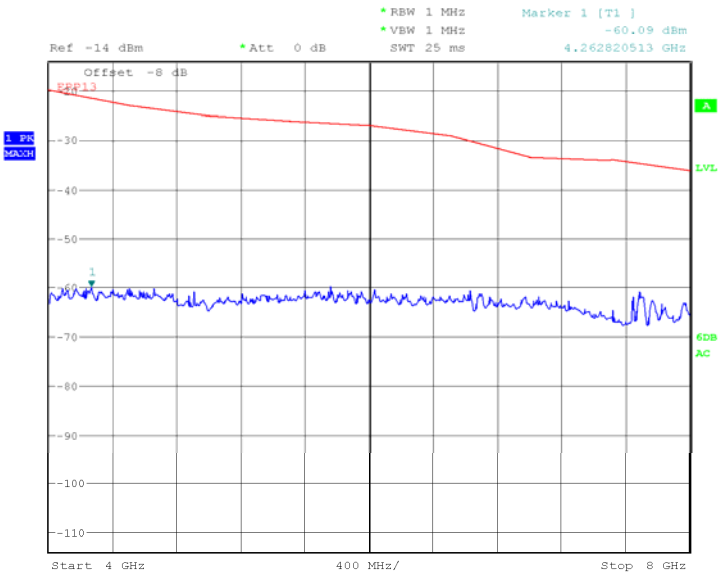
Date: 5.OCT.2010 19:47:27

1GHz to 4GHz



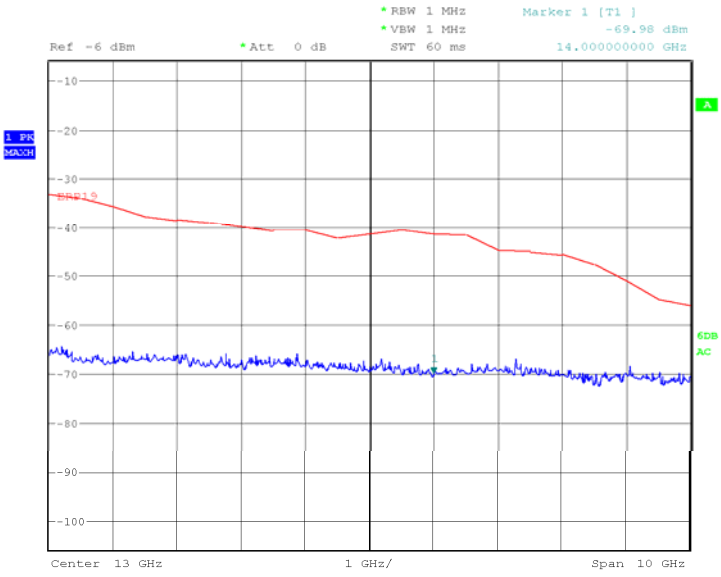
Date: 5.OCT.2010 21:06:32

4GHz to 8GHz



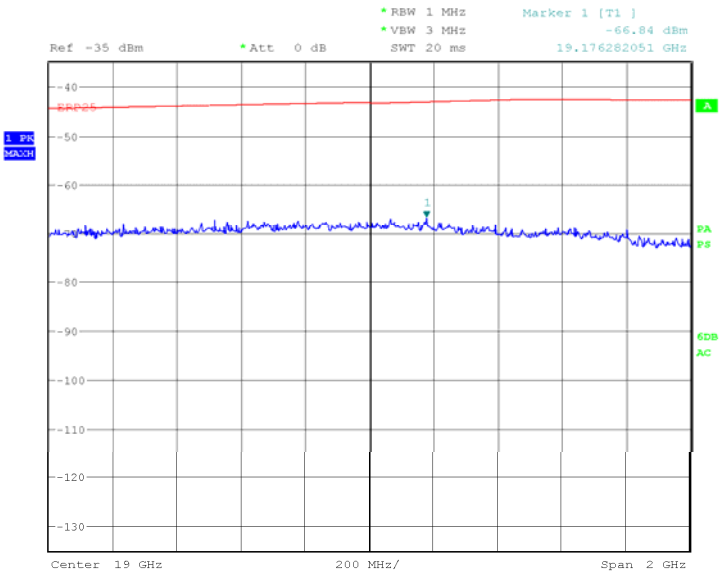
Date: 5.OCT.2010 21:46:29

8GHz to 18GHz



Date: 5.OCT.2010 22:54:14

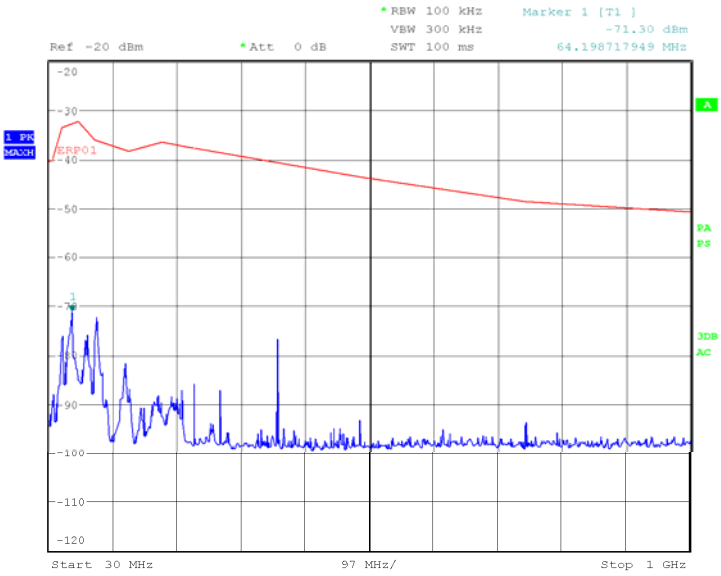
18GHz to 20GHz



Date: 7.OCT.2010 20:13:55

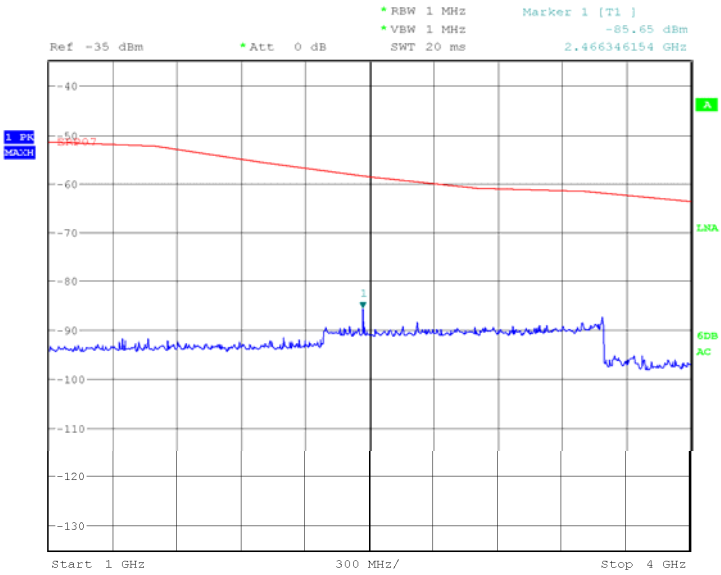
Configuration 1 - Mode 2

30MHz to 1GHz



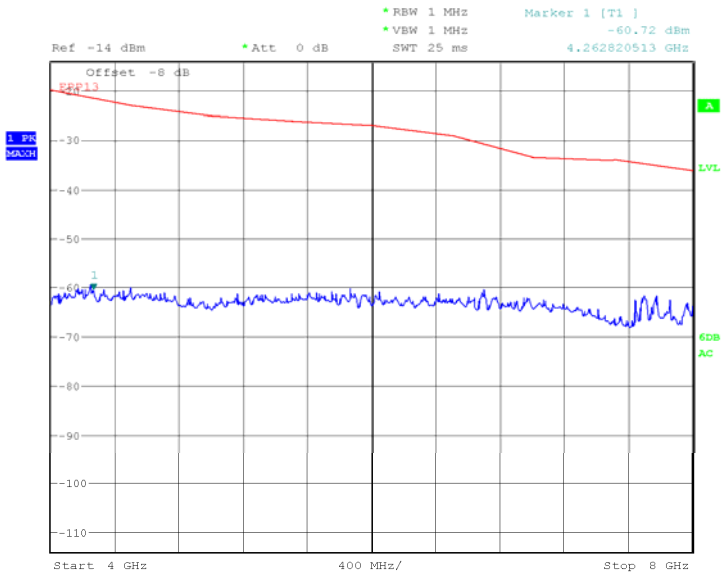
Date: 5.OCT.2010 19:38:34

1GHz to 4GHz



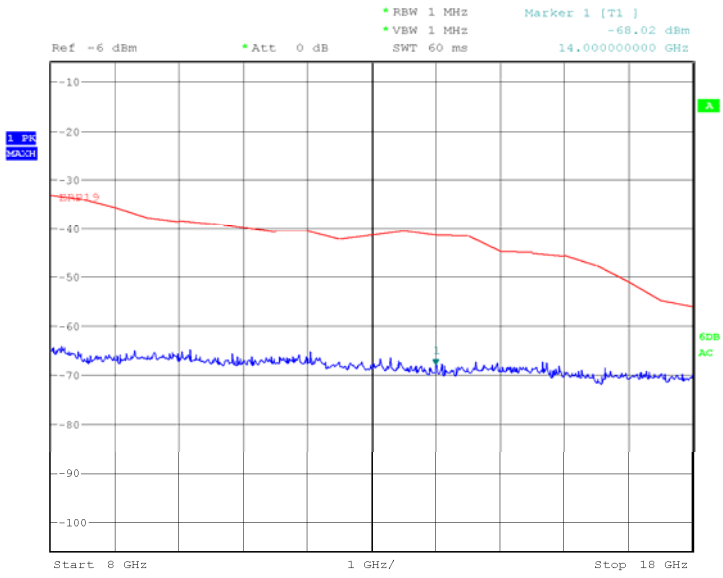
Date: 5.OCT.2010 21:01:46

4GHz to 8GHz



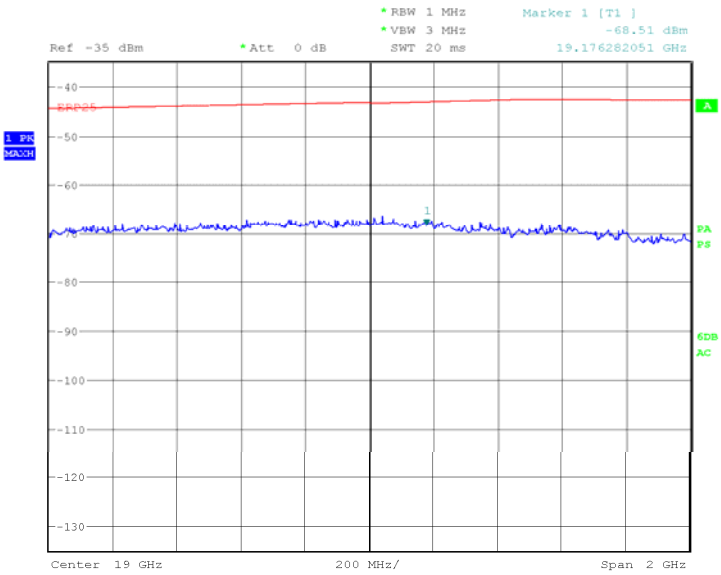
Date: 5.OCT.2010 21:50:40

8GHz to 18GHz



Date: 5.OCT.2010 22:41:04

18GHz to 20GHz



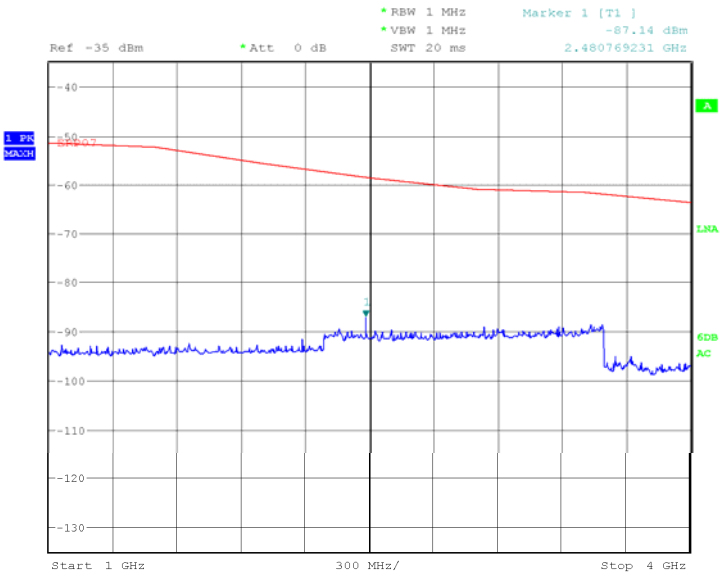
Date: 7.OCT.2010 20:22:26

Configuration 1 - Mode 3

30MHz to 1GHz

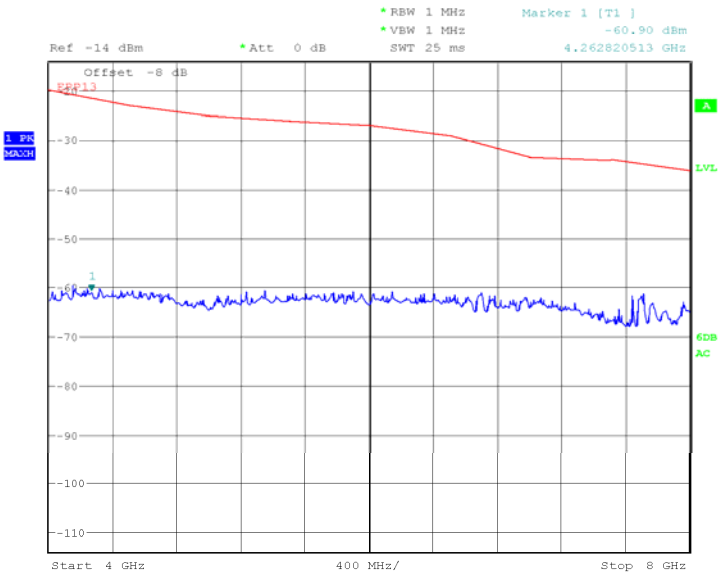
Date: 5.OCT.2010 19:35:18

1GHz to 4GHz



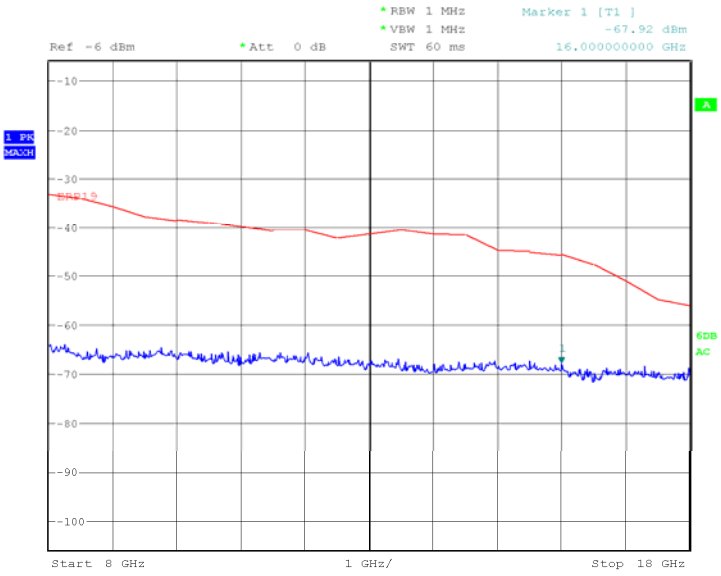
Date: 5.OCT.2010 20:48:38

4GHz to 8GHz



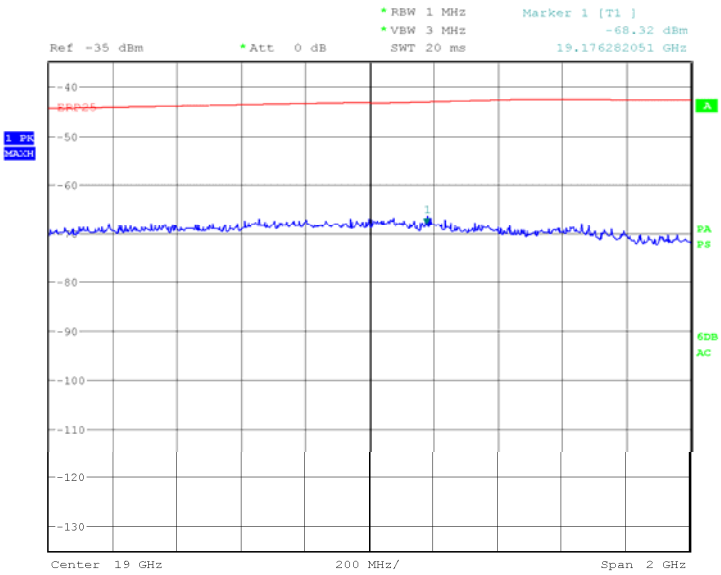
Date: 5.OCT.2010 21:54:38

8GHz to 18GHz



Date: 5.OCT.2010 22:29:06

18GHz to 20GHz



Date: 7.OCT.2010 20:30:21

2.2 EIRP PEAK POWER

2.2.1 Specification Reference

FCC Part 2 and 90, Clause 90.205, 2.1046
RSS-210, Clause A8.4 (4)

2.2.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.2.3 Date of Test and Modification State

21 November 2010 - Modification State 0

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC Part 2 and 90 and RSS-210 and RSS-Gen.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 2 - Mode 1
- Mode 2
- Mode 3

2.2.6 Environmental Conditions

	21 November 2010
Ambient Temperature	21.6°C
Relative Humidity	30%
Atmospheric Pressure	1008mbar

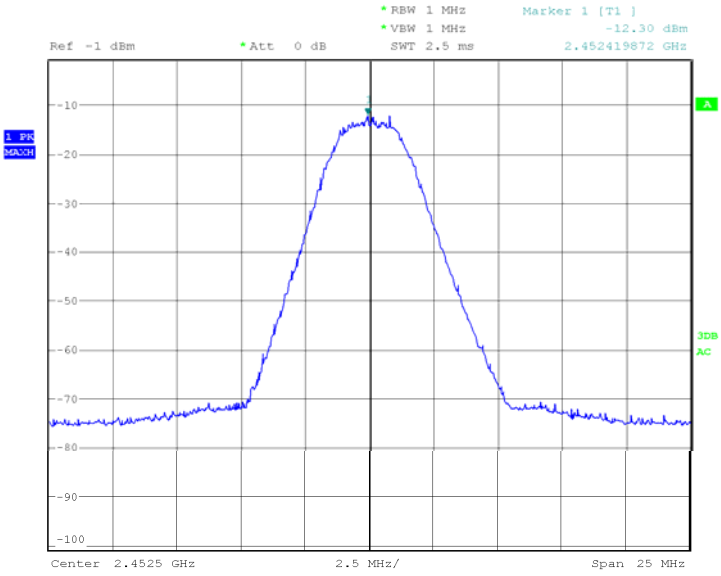
2.2.7 Test Results

For the period of test the EUT met the requirements of FCC Part 2 and 90 and RSS-210 and RSS-Gen for EIRP Peak Power.

The test results are shown below.

Configuration 2 - Mode 1

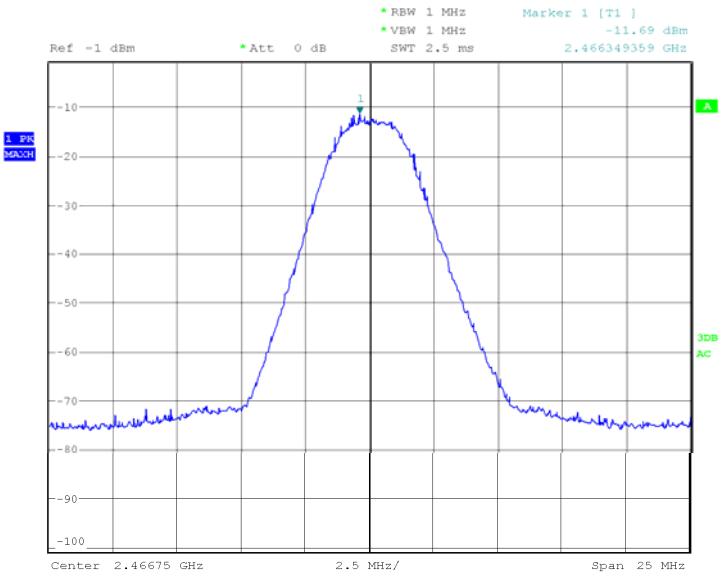
Frequency (GHz)	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
2.452	28.25	37	0.668	5



Date: 21.NOV.2010 09:03:12

Configuration 2 - Mode 2

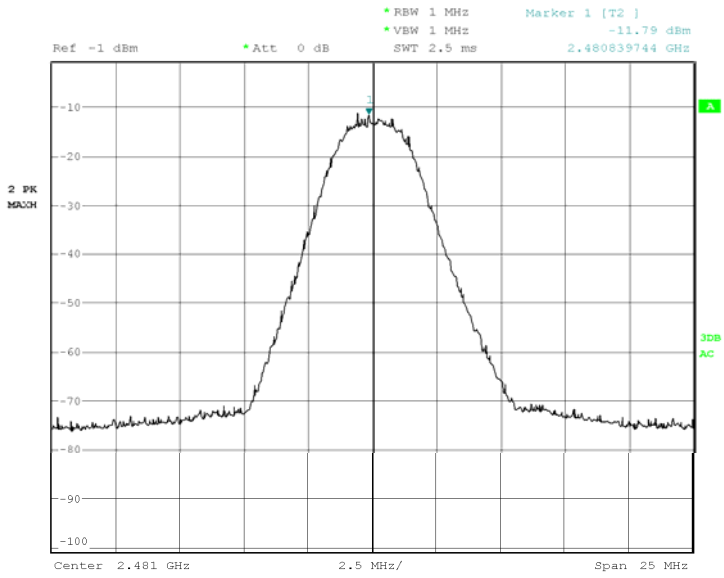
Frequency (GHz)	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
2.466	29.85	37	0.966	5



Date: 21.NOV.2010 08:51:16

Configuration 2 - Mode 3

Frequency (GHz)	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
2.481	30.35	37	1.084	5



Date: 21.NOV.2010 09:07:11

2.3 POWER AND ANTENNA HEIGHT LIMITS

2.3.1 Specification Reference

FCC Part 2 and 90, Clause 90.205, 2.1046
RSS-210, Clause A8.4 (4)

2.3.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.3.3 Date of Test and Modification State

28 September 2010 – Modification State 0

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Method and Operating Modes

Test Performed in accordance with FCC Part 2 and 90 and RSS-210.

The EUT was connected to a peak power analyser via a 20dB attenuator and cable. The path loss between the EUT and power sensor was measured and used as an offset in the measuring equipment. Both the peak and average power levels at maximum power and QPSK modulation schemes were measured. This was to demonstrate compliance with the maximum allowed power of 5W as defined in 90.205(o). Due to the nature of the carrier (COFDM), the signal has a high peak to average ratio. The manufacturer declares their power as average, thus the power has also been measured as an average to demonstrate compliance with 90.205 (s).

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.3.6 Environmental Conditions

	28 September 2010
Ambient Temperature	22°C
Relative Humidity	58%

2.3.7 Test Results

Carrier Power

Frequency (MHz)	QPSK			
	Average		Peak	
	dBm	mW	dBm	mW
2452.50	18.50	70.79	20.90	123.03
2466.75	18.30	67.61	20.78	119.67
2481.00	18.36	68.55	20.42	110.15

Limit Clause

90.205(o)

2450 – 2483.5 MHz	≤ 5W

90.205(s)

The output power shall not exceed 20% of the manufacturers rated output power 1W	Limit: 200mW or 23dBm

2.4 TYPES OF EMISSION

2.4.1 Specification Reference

FCC Part 2 and 90, Clause 90.207, 2.1047

2.4.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.4.3 Date of Test and Modification State

30 September 2010 – Modification State 0

2.4.4 Test Procedure

Test Performed in accordance with FCC Part 2 and 90.

The EUT operates with a measured channel bandwidth of 2.3MHz and has a declared authorised bandwidth of 2.5MHz. The EUT can operate with QPSK modulation. Therefore, the type of emission can be classified as follows:

QPSK: 2M5G2D

The measurements in section 2.5 Bandwidth Limitations show compliance with the emission designators described above.

2.4.5 Environmental Conditions

	30 September 2010
Ambient Temperature	24°C
Relative Humidity	47%

2.5 BANDWIDTH LIMITATIONS

2.5.1 Specification Reference

FCC Part 2 and 90, Clause 90.209, 2.1049

2.5.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.5.3 Date of Test and Modification State

28 September 2010 – Modification State 0

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Method and Operating Modes

Test Performed in accordance with FCC Part 2 and 90.

The EUT was connected to a spectrum analyser using a 20dB attenuator and cable. Using the test software supplied, the EUT was configured to transmit with a 2.5MHz channel spacing with QPSK modulation schemes at maximum power. A resolution bandwidth of 10kHz was used in conjunction with the spectrum analysers occupied bandwidth function to determine the bandwidth of the transmitted signal.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

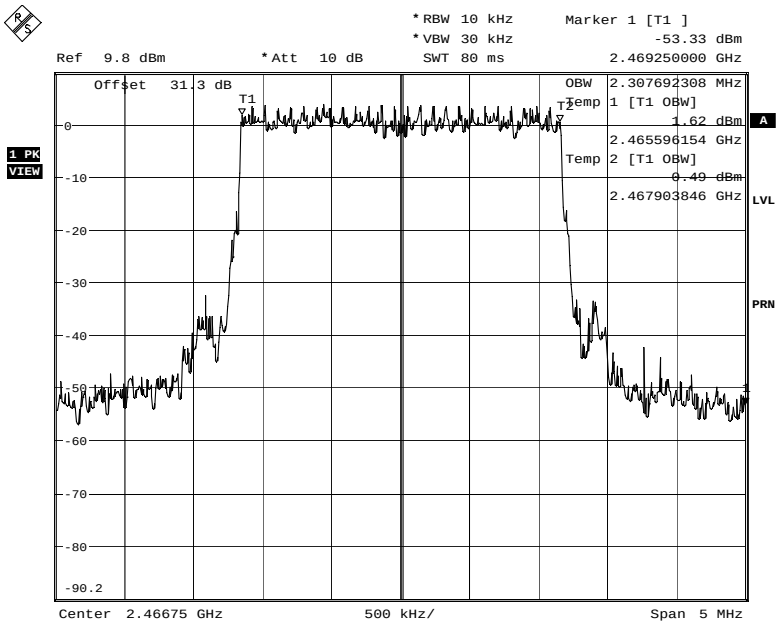
2.5.6 Environmental Conditions

	28 September 2010
Ambient Temperature	22°C
Relative Humidity	58%

2.5.7 Test Results

Frequency (MHz)	Occupied Bandwidth (99%)
	QPSK
2466.75	2.3077

QPSK



Date: 28.SEP.2010 11:15:37

Limit Clause

The maximum authorised single channel bandwidth of emission is corresponding to the type of emission specified.

2.6 EMISSION MASK

2.6.1 Specification Reference

FCC Part 2 and 90, Clause 90.210, 2.1051

2.6.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.6.3 Date of Test and Modification State

28 September 2010 – Modification State 0

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Method and Operating Modes

Test Performed in accordance with FCC Part 2 and 90.

In clause 90.210, the frequency band 2450 – 2483.5MHz is not listed in the table. Therefore, "All other bands" mask has been used. In accordance with 90.210 (n), mask B has been used to demonstrate compliance. It was not possible to transmit an unmodulated carrier, therefore the wideband power was measured. Due to the wideband nature of the signal, it was not possible to measure the emission mask using a resolution bandwidth which would show the correct power level. Therefore, the difference between the measurement bandwidth and the occupied bandwidth was established.

$$10 \log \frac{2.323\text{MHz}}{10\text{kHz}} = 23.7\text{dB}$$

Therefore, taking the worst case, (lowest power) the reference level would normally be 18.3dBm, however, because using a smaller RBW reduces the amplitude of the signal, the reference level is adjusted by 23.7dBm and becomes -5.4dBm.

The spectrum analyser RBW was chosen so the signal shape was not influenced by the RBW filter. The VBW was set to three times the RBW. The detector was set to RMS and trace averaging applied as the reference power was an average measurement. The plots were recorded and are shown on the following pages.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

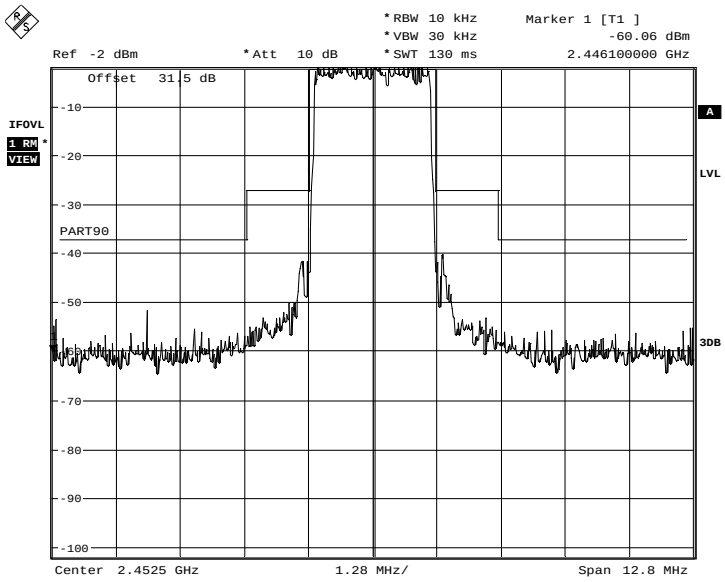
2.6.6 Environmental Conditions

	28 September 2010
Ambient Temperature	22°C
Relative Humidity	58%

2.6.7 Test Results

Configuration 1 – Mode 1

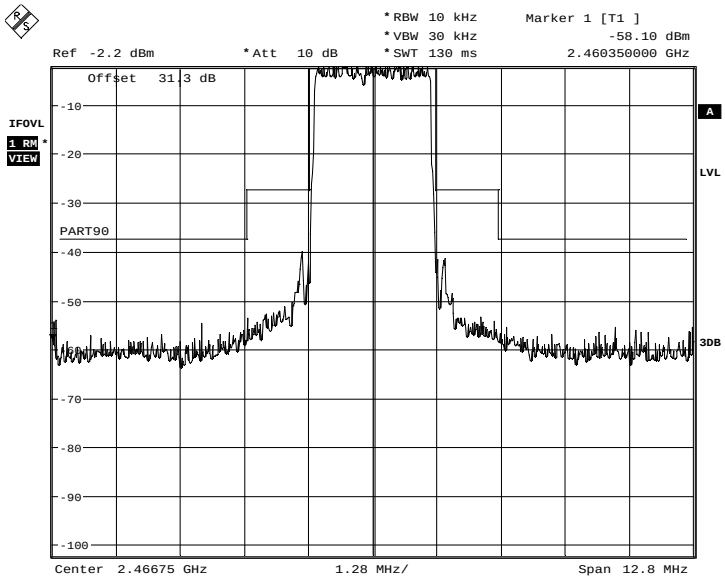
QPSK



Date: 28.SEP.2010 15:48:26

Configuration 1 – Mode 2

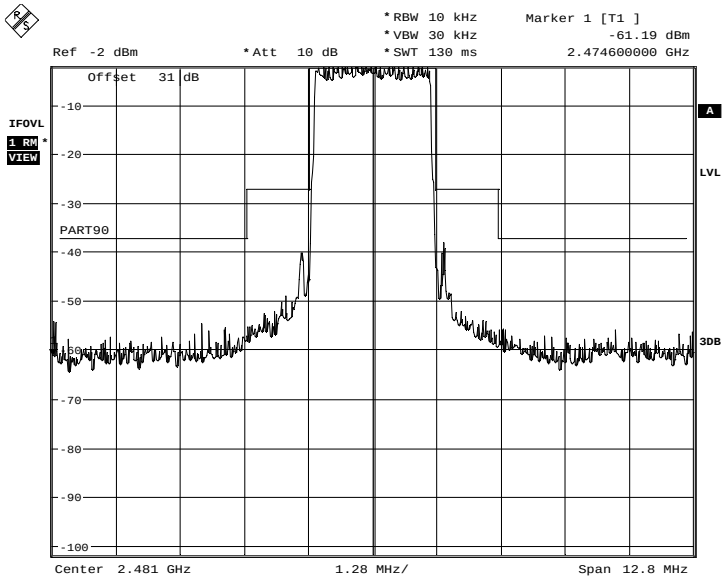
QPSK



Date: 28.SEP.2010 15:53:42

Configuration 1 – Mode 3

QPSK



Date: 28.SEP.2010 16:16:26

2.7 FREQUENCY STABILITY

2.7.1 Specification Reference

FCC Part 2 and 90, Clause 90.213, 2.1055
RSS-Gen, Clause 4.5

2.7.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.7.3 Date of Test and Modification State

29 September 2010 – Modification State 0

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Test Method and Operating Modes

Test Performed in accordance with FCC Part 2 and 90 and RSS-Gen.

The EUT was placed in a climatic chamber and set to transmit on maximum power on the middle channel. The EUT could not be operated without modulation, hence a spectrum analyser was used. To measure the frequency the -6dB points at the upper and lower part of the spectrum were recorded. The centre frequency was calculated by f1 + (f2 - f1/2), where f_1 was the lower -6dB frequency and f_2 was the upper -6dB frequency, the temperature was varied between -30°C and +50°C as defined in 2.1055. At 20°C the voltage was varied by 15% as defined in 2.1055(d)(1). The results are shown in the table below.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

2.7.6 Environmental Conditions

	29 September 2010
Ambient Temperature	22°C
Relative Humidity	59%

2.7.7 Test Results

Configuration 1 – Mode 2

Temperature	Supply Voltage	Frequency Error (Hz)	Frequency Error (ppm)
+50°C	12 V DC	0	0
+40°C	12 V DC	2404	-0.975
+30°C	12 V DC	0	0
+20°C	13.8 V DC	2404	-0.975
+20°C	12 V DC	0	0
+20°C	10.2 V DC	2404	-0.975
+10°C	12 V DC	0	0
0°C	12 V DC	2404	-0.975
-10°C	12 V DC	2404	-0.975
-20°C	12 V DC	0	0
-30°C	12 V DC	2404	-0.975
Maximum frequency error		2404	0.975
Measurement Uncertainty (Hz)		±11	

Limit

The frequency stability is to be determined by the station authorisation.

2.8 MODULATION CHARACTERISTICS

2.8.1 Specification Reference

FCC Part 2 and 90, Clause 2.1047

2.8.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.8.3 Test Method and Operating Modes

As declared by the customer.

Description of Modulation

Orthogonal frequency-division multiplexing (OFDM) – essentially identical to Coded OFDM (COFDM) – is a scheme utilised as a digital multi-carrier modulation method. A large number of closely spaced orthogonal sub-carriers are used to carry data. The data is divided into several parallel data streams or channels, one for each sub-carrier. Each sub-carrier is modulated with a conventional modulation scheme, such as Quadrature Phase Shift Keying (QPSK) or Quadrature Amplitude Modulation (QAM) at a low symbol rate, maintaining total data rates similar to conventional single-carrier modulation schemes in the same bandwidth.

Phase-shift keying (PSK) is a digital modulation scheme that conveys data by modulating the phase of the carrier wave. Quadrature phase-shift keying (QPSK) uses four points on the constellation diagram, equispaced around a circle. With four phases, QPSK can encode two bits per symbol.

2.9 EMISSION MASK

2.9.1 Specification Reference

FCC Part 2 and 90, Clause 90.210(b)(3)
RSS-210, Clause A8.5

2.9.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.9.3 Date of Test and Modification State

01 October 2010– Modification State 0

2.9.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.9.5 Test Method and Operating Modes

Test Performed in accordance with FCC Part 2 and 90 and RSS-210.

In accordance with 2.1051 and 90.210(b)(3), the spurious emissions from the antenna terminal were measured. The transmitter output power going into the spectrum analyser was attenuated using a combination of filters and attenuators with the frequency spectrum being investigated between 9kHz and 25GHz. The EUT was set to transmit on full power with QPSK modulations. The worst case path loss in each measurement range was measured and entered as a reference level offset in the spectrum analyser. The EUT was tested on bottom, middle and top channels. The RBW below 1000MHz was set to 100kHz and 1MHz above 1000MHz as defined in 90.210(o).

The detector was set to peak with the trace set to max hold.

A high frequency combiner was used with the following equipment:
From 9kHz to 4GHz a 30dB attenuator was used
From 4GHz to 18GHz a high pass filter and 10dB attenuator was used
From 18GHz to 25GHz a waveguide and 10dB attenuator was used.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.9.6 Environmental Conditions

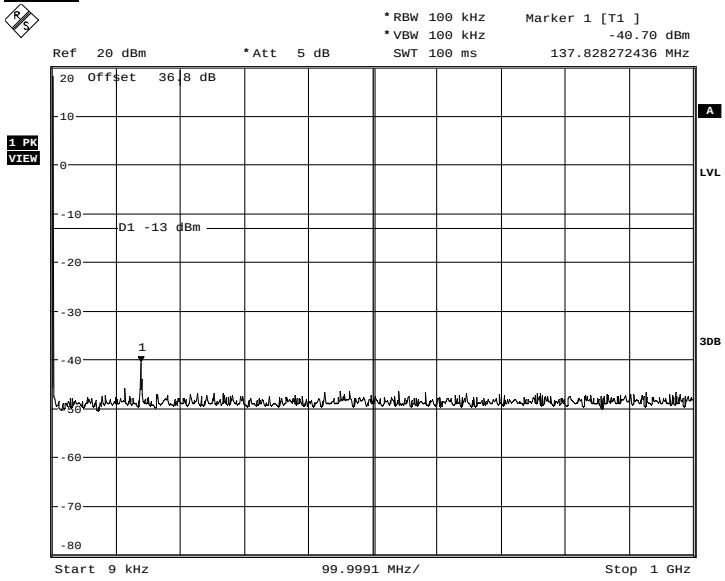
	01 October 2010
Ambient Temperature	23°C
Relative Humidity	54%

2.9.7 Test Results

Configuration 1 – Mode 1

9kHz to 1GHz

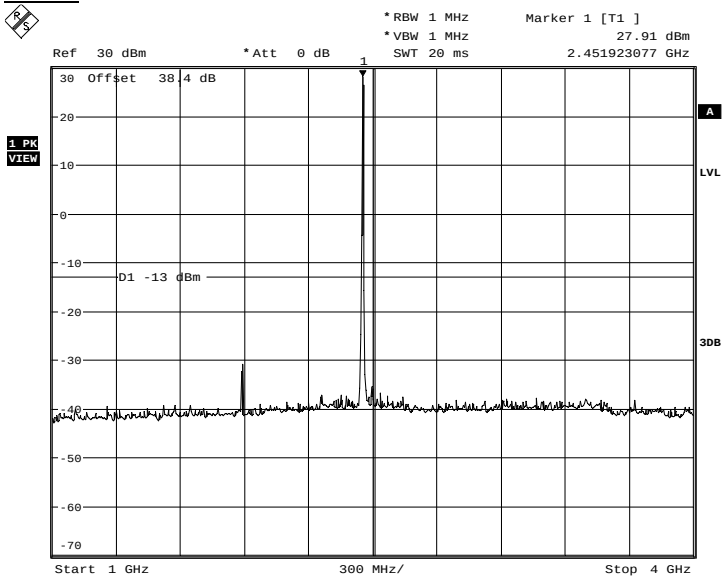
QPSK



Date: 1.OCT.2010 15:05:41

1GHz to 4GHz

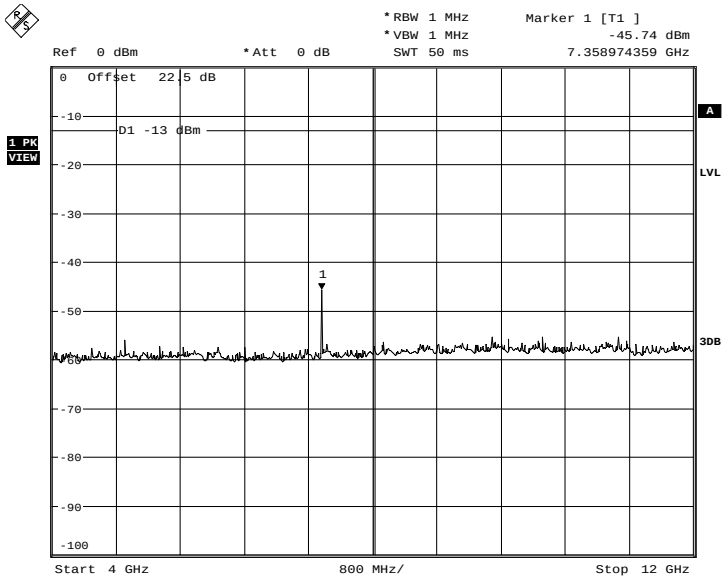
QPSK



Date: 1.OCT.2010 14:52:16

4GHz to 12GHz

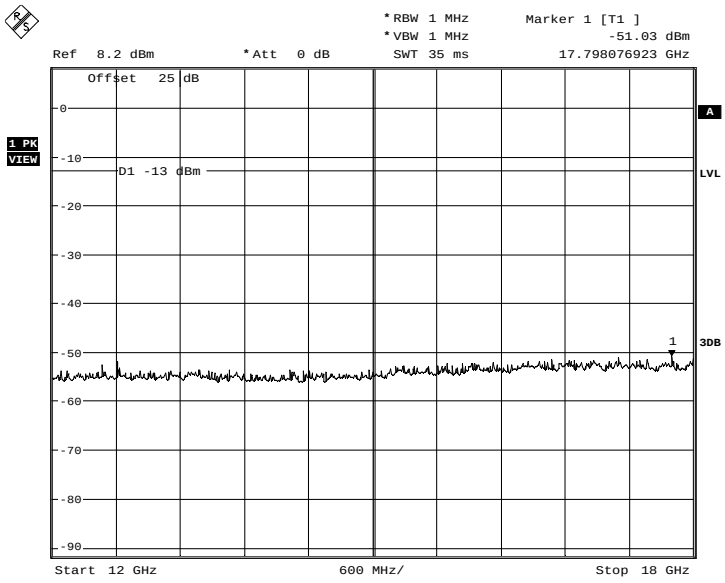
QPSK



Date: 1.OCT.2010 14:23:44

12GHz to 18GHz

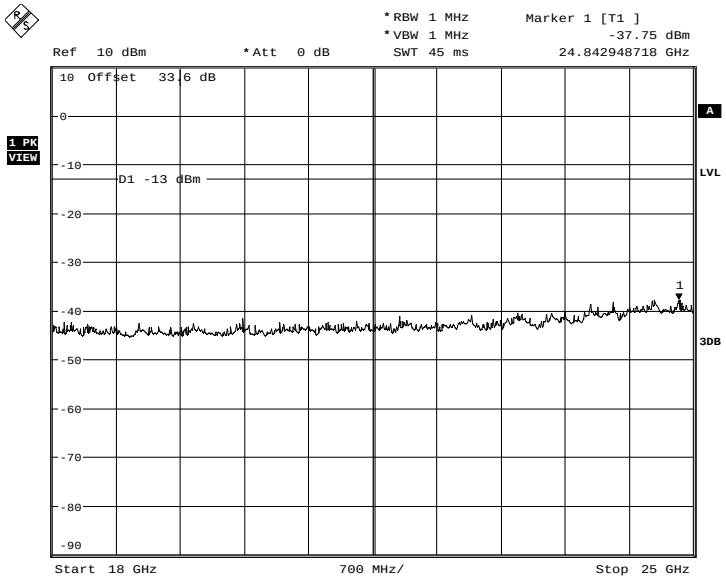
QPSK



Date: 1.OCT.2010 16:18:59

18GHz to 25GHz

QPSK

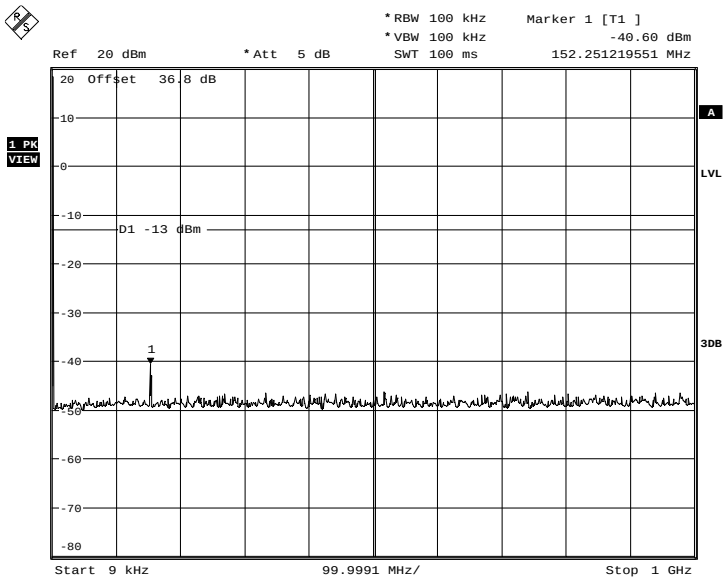


Date: 1.OCT.2010 12:55:24

Configuration 1 – Mode 2

9kHz to 1GHz

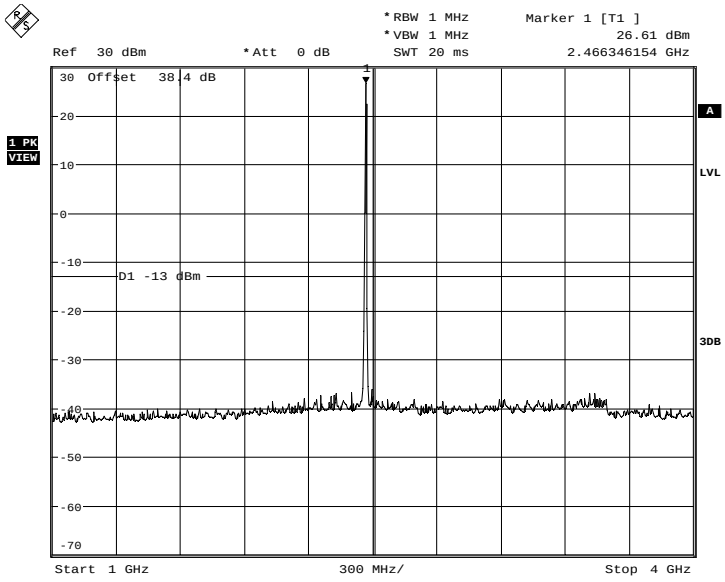
QPSK



Date: 1.OCT.2010 15:59:03

1GHz to 4GHz

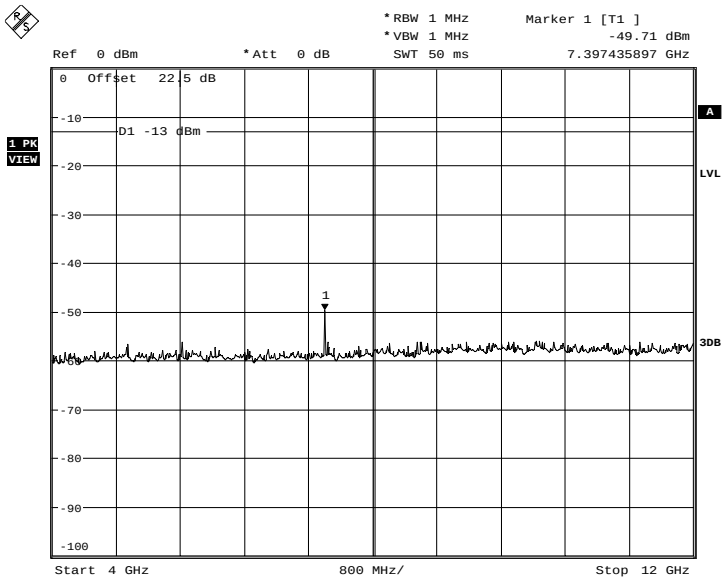
QPSK



Date: 1.OCT.2010 14:54:38

4GHz to 12GHz

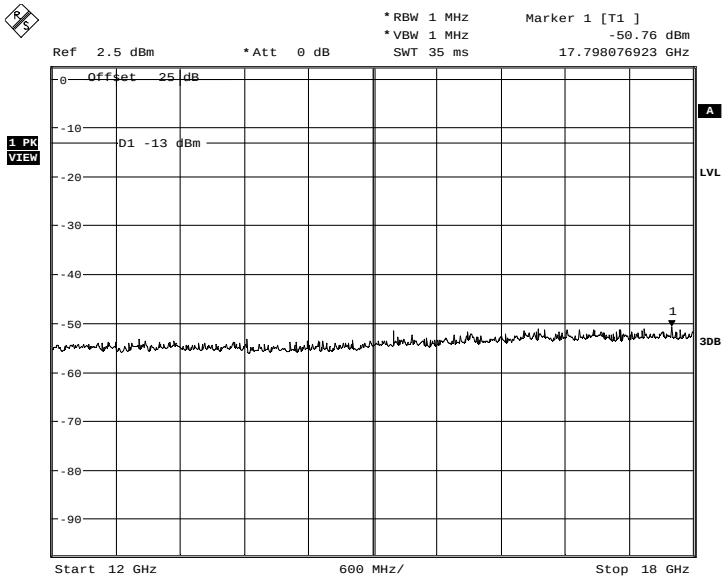
QPSK



Date: 1.OCT.2010 14:25:13

12GHz to 18GHz

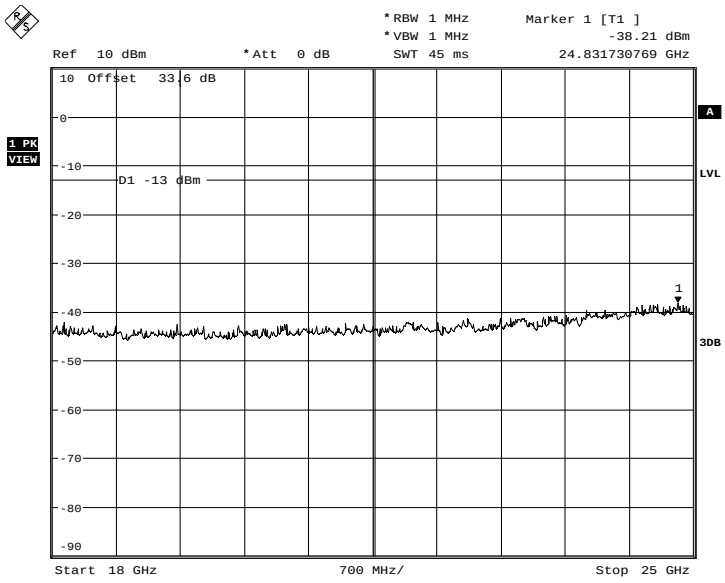
QPSK



Date: 1.OCT.2010 14:37:44

18GHz to 25GHz

QPSK

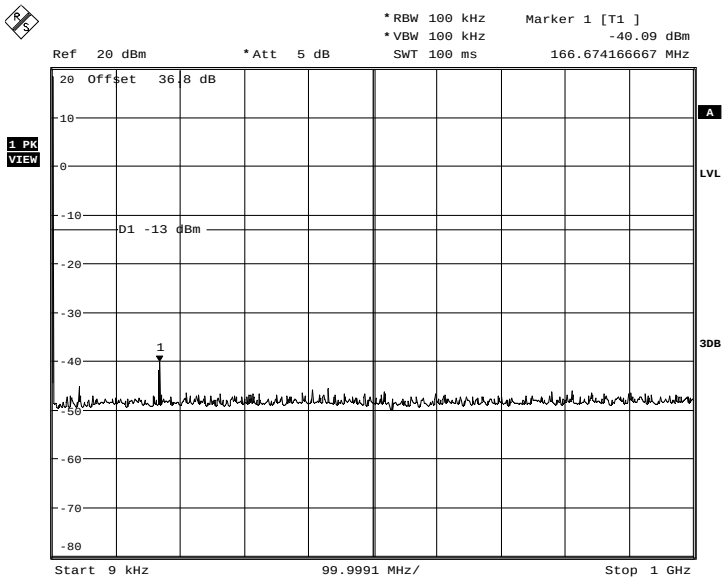


Date: 1.OCT.2010 12:48:14

Configuration 1 – Mode 3

9kHz to 1GHz

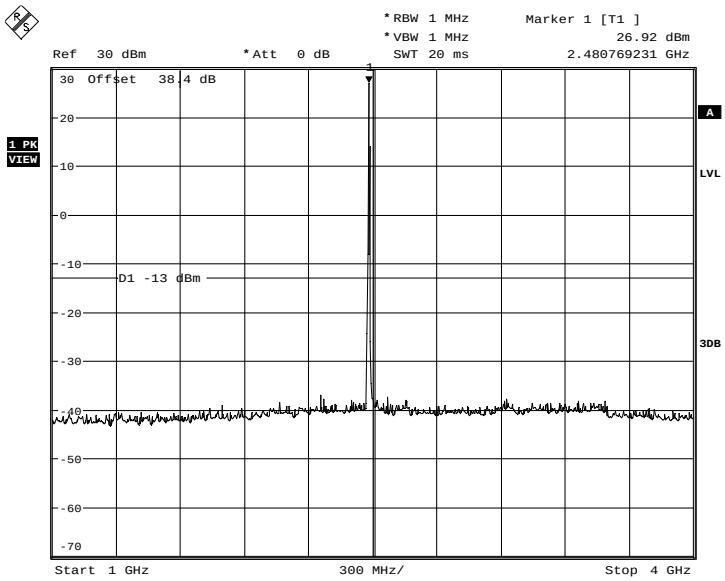
QPSK



Date: 1.OCT.2010 16:14:56

1GHz to 4GHz

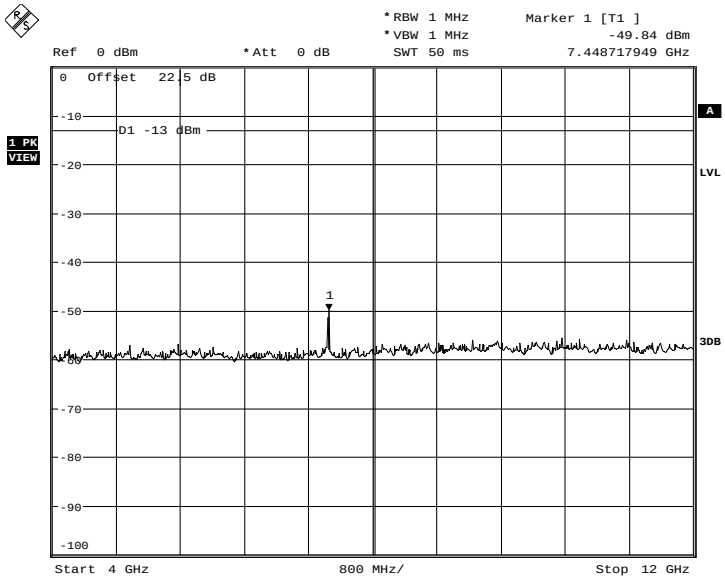
QPSK



Date: 1.OCT.2010 14:57:10

4GHz to 12GHz

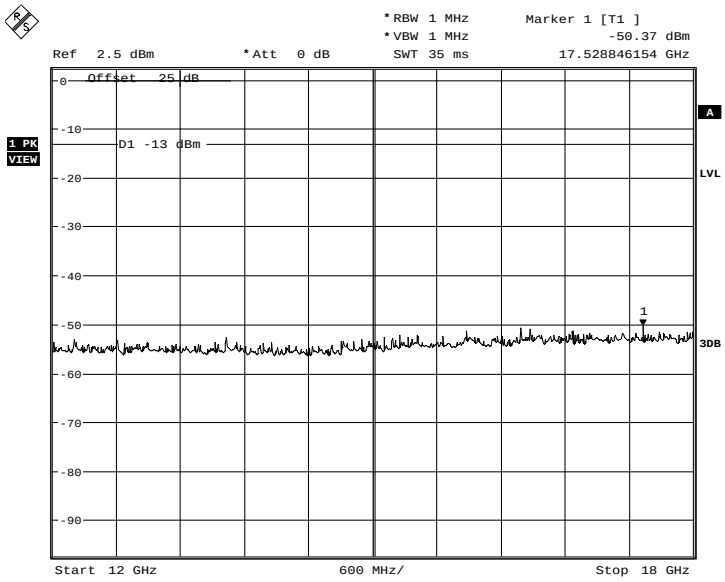
QPSK



Date: 1.OCT.2010 14:27:48

12GHz to 18GHz

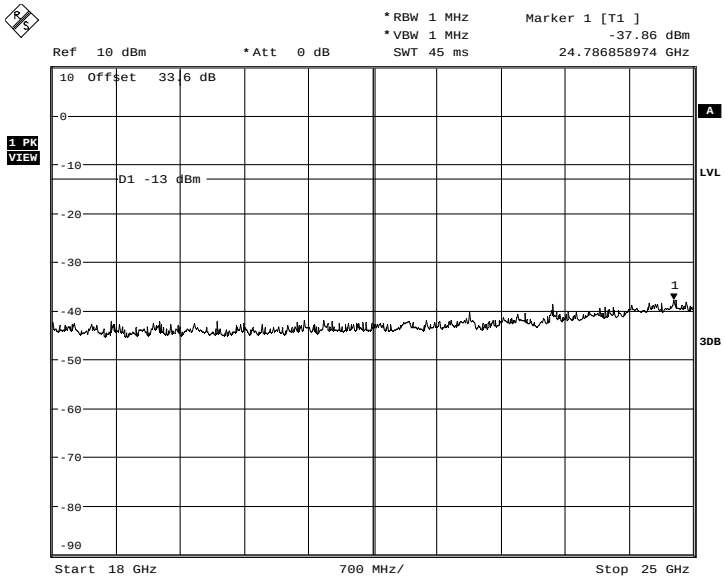
QPSK



Date: 1.OCT.2010 14:30:37

18GHz to 25GHz

QPSK



Date: 1.OCT.2010 12:57:42

Limit Clause

At least 43 + 10 log (P) dB or -13 dBm for FCC.

Please note that emissions testing has been carried out at different bandwidths to those specified in RSS-210, (100kHz). The bandwidth used was 1 MHz and the EUT meets a limit of -13 dBm.

The measured occupied bandwidth is 2.3 MHz To determine the 100 kHz power, a correction factor of 23.7 dB can be applied to the maximum measured power. The lowest maximum wideband power measured was 18.36 dBm, therefore correcting to 100 kHz, equates to -5.4 dBm. Thus, setting the limit of -20 dBc on this value makes the limit -25.4 dBm.

From these calculations, it can be seen that the EUT meets the requirement defined in RSS-210 clause A8.5.

2.10 6dB BANDWIDTH

2.10.1 Specification Reference

RSS-210, Clause A8.2(a)

2.10.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.10.3 Date of Test and Modification State

28 September 2010 – Modification State 0

2.10.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.10.5 Test Method and Operating Modes

Test Performed in accordance with RSS-210.

The EUT was connected to a spectrum analyser via a 10dB attenuator. The loss was measured between the EUT and the spectrum analyser and entered as a reference level offset. The peak response of the signal was established and the 6dB points determined using the markers.

A resolution bandwidth of 10kHz and a VBW of 30kHz were used with the trace set to max hold.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.10.6 Environmental Conditions

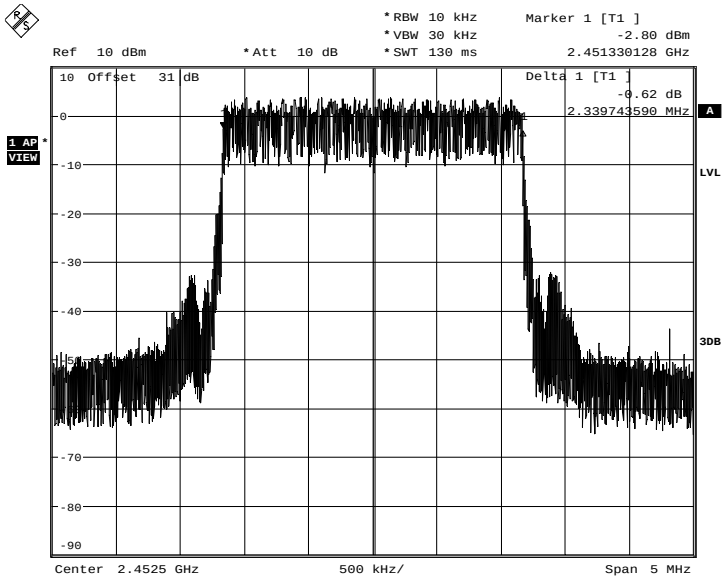
	28 September 2010
Ambient Temperature	22°C
Relative Humidity	57%

2.10.7 Test Results

Frequency (MHz)	6dB Bandwidth (MHz)	Modulation Scheme
2452.50	2.339	QPSK
2466.75	2.339	QPSK
2481.00	2.339	QPSK

Configuration 1 – Mode 1

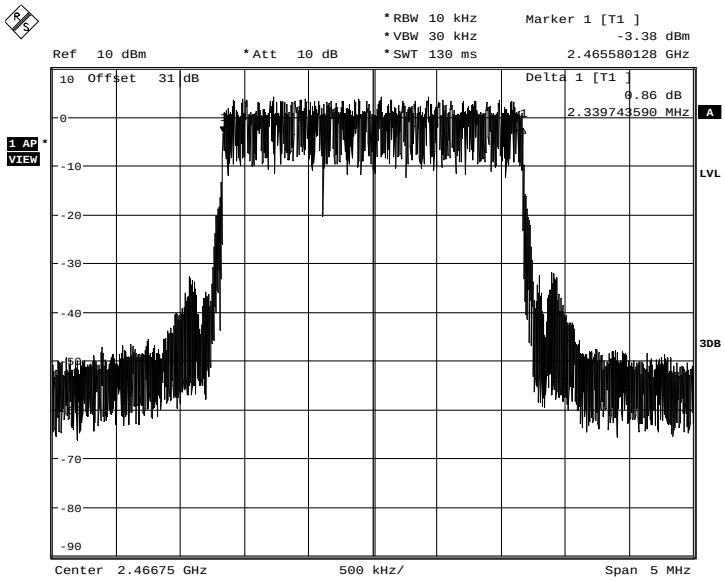
QPSK



Date: 28.SEP.2010 16:46:10

Configuration 1 – Mode 2

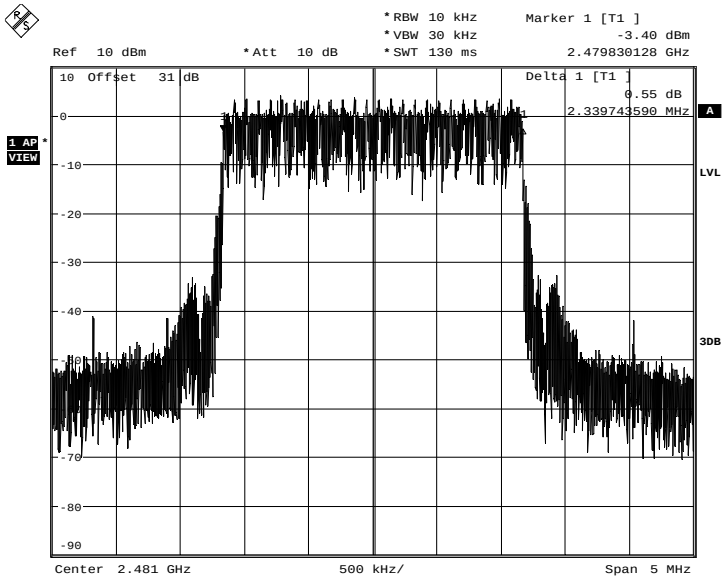
QPSK



Date: 28.SEP.2010 16:50:27

Configuration 1 – Mode 3

QPSK



Date: 28.SEP.2010 16:38:33

Limit Clause

≥ 500kHz

2.11 POWER SPECTRAL DENSITY

2.11.1 Specification Reference

RSS-210, Clause A8.2(b)

2.11.2 Equipment Under Test

NETNode IP Mesh Radio (Robust), S/N: 013149

2.11.3 Date of Test and Modification State

29 September 2010 – Modification State 0

2.11.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.11.5 Test Method and Operating Modes

Test Performed in accordance with RSS-210.

The EUT was connected to a spectrum analyser via a 20db directional coupler and a 10dB attenuator. The path loss was measured between the EUT and the spectrum analyser and entered as a reference level offset. The trace was set to max hold and using a peak detector the maximum response was established. With the spectrum analyser RBW at 3kHz and VBW at 10kHz the power density in a 3kHz bandwidth was measured. The results were recorded and are shown in the table below.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.11.6 Environmental Conditions

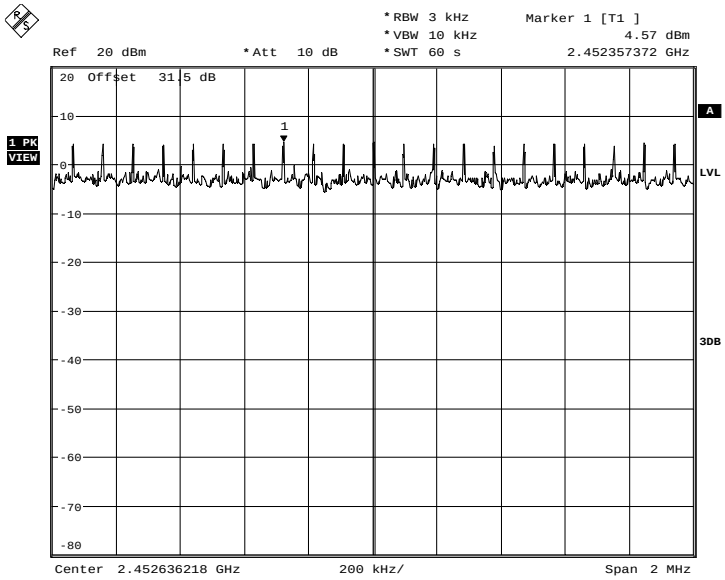
	29 September 2010
Ambient Temperature	22°C
Relative Humidity	59%

2.11.7 Test Results

Frequency (MHz)	Power Spectral Density in 3kHz band (dBm)	Modulation Scheme
2452.50	4.57	QPSK
2466.75	4.12	QPSK
2481.00	3.68	QPSK

2452.50 MHz

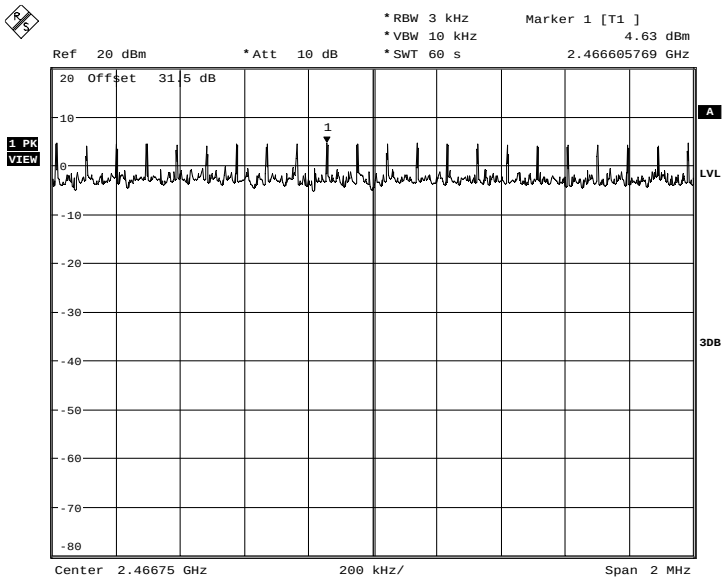
QPSK



Date: 28.SEP.2010 17:43:25

2466.75 MHz

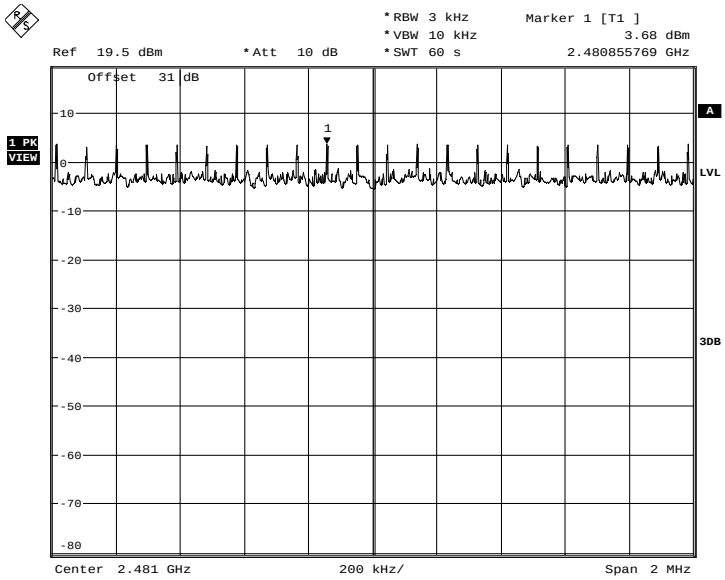
QPSK



Date: 29.SEP.2010 10:58:21

2481.00 MHz

QPSK



Date: 29.SEP.2010 11:15:44

Limit Clause

≤ +8dBm / 3kHz

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 - Spurious Emissions Outside Emission Mask					
Antenna (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	-	TU
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	12-Oct-2010
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	11-Nov-2010
Antenna (Bilog)	Schaffner	CBL6143	287	24	19-Jan-2012
Dual Power Supply Unit	Hewlett Packard	6253A	292	-	O/P Mon
Antenna (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	2-Aug-2012
Pre-Amplifier	Phase One	PS04-0086	1533	12	15-Sep-2011
Pre-Amplifier	Phase One	PSO4-0087	1534	12	22-Sep-2011
Screened Room (5)	Rainford	Rainford	1545	36	11-Feb-2011
Mast Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Turntable/Mast Controller	EMCO	2090	1607	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	4-Dec-2011
Comb Generator	Schaffner	RSG1000	3034	-	TU
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	12-Aug-2011
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	2-Jul-2011
Attenuator (30dB, 150W)	Narda	769-30	3369	12	24-May-2011
1m RF Cable sma(m)-sma(m)	Reynolds	262-0248-1000	3453	12	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	12	TU
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3703	12	26-Jan-2011
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	10-Aug-2011
Section 2.2 – EIRP Peak Power					
Antenna (Bilog)	Schaffner	CBL6143	287	24	19-Jan-2012
Screened Room (5)	Rainford	Rainford	1545	36	11-Feb-2011
Antenna (Bilog)	Chase	CBL6143	2904	24	4-Dec-2011
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	4-Dec-2010
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	12	TU
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3703	12	26-Jan-2011
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	10-Aug-2011

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.3 - Power and Antenna Height Limits					
Peak Power Analyser	Hewlett Packard	8990A	107	12	10-Feb-2011
Load (50ohm/30W)	Weinschel	50T-054	285	12	6-Sep-2011
Termination 50ohm/50W	Bird	8085	389	12	3-Sep-2011
Dual programable power supply	Thurlby	T-1000	418	-	TU
Termination (50ohm, 50W)	Bird	8085	472	12	8-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Directional Coupler	Hewlett Packard	778D	1401	12	5-Feb-2011
Signal Generator	Marconi	2031	2015	12	10-Apr-2011
Single Axis Accelerometer	Bruel & Kjaer	213E	2330	0	TU
Power Sensor	Hewlett Packard	84812A	2743	-	TU
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Nov-2010
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	28-Nov-2010
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	13-Oct-2010
Attenuator (30dB, 150W)	Narda	769-30	3369	12	24-May-2011
DMM	Fluke	73	3460	12	23-Oct-2010
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	3-Jun-2011
Section 2.5 – Bandwidth Limitations					
Load (50ohm/30W)	Weinschel	50T-054	285	12	6-Sep-2011
Termination 50ohm/50W	Bird	8085	389	12	3-Sep-2011
Dual programable power supply	Thurlby	T-1000	418	-	TU
Termination (50ohm, 50W)	Bird	8085	472	12	8-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Directional Coupler	Hewlett Packard	778D	1401	12	5-Feb-2011
Signal Generator	Marconi	2031	2015	12	10-Apr-2011
Single Axis Accelerometer	Bruel & Kjaer	213E	2330	0	TU
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Nov-2010
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	28-Nov-2010
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	13-Oct-2010
Attenuator (30dB, 150W)	Narda	769-30	3369	12	24-May-2011
DMM	Fluke	73	3460	12	23-Oct-2010
Section 2.6 and 2.9 - Emission Mask					
Load (50ohm/30W)	Weinschel	50T-054	285	12	6-Sep-2011
Termination 50ohm/50W	Bird	8085	389	12	3-Sep-2011
Dual programable power supply	Thurlby	T-1000	418	-	TU
Termination (50ohm, 50W)	Bird	8085	472	12	8-Mar-2011
Splitter	Weinschel	1593	1292	12	19-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Directional Coupler	Hewlett Packard	778D	1401	12	5-Feb-2011
Signal Generator	Marconi	2031	2015	12	10-Apr-2011
Single Axis Accelerometer	Bruel & Kjaer	213E	2330	0	TU
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Nov-2010
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	6-Sep-2011
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	28-Nov-2010
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	12-Aug-2011
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	13-Oct-2010
Attenuator (30dB, 150W)	Narda	769-30	3369	12	24-May-2011
DMM	Fluke	73	3460	12	23-Oct-2010
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	3-Jun-2011

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.7 - Frequency Stability					
Load (50ohm/30W)	Weinschel	50T-054	285	12	6-Sep-2011
Termination 50ohm/50W	Bird	8085	389	12	3-Sep-2011
Dual programable power supply	Thurlby	T-1000	418	-	TU
Temperature Chamber	Montford	2F3	467	-	O/P Mon
Termination (50ohm, 50W)	Bird	8085	472	12	8-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Directional Coupler	Hewlett Packard	778D	1401	12	5-Feb-2011
Signal Generator	Marconi	2031	2015	12	10-Apr-2011
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Nov-2010
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	28-Nov-2010
Thermocouple Thermometer	Fluke	51	3172	12	12-Jul-2011
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	13-Oct-2010
Attenuator (30dB, 150W)	Narda	769-30	3369	12	24-May-2011
DMM	Fluke	73	3460	12	23-Oct-2010
Section 2.10 - 6dB Bandwidth					
Load (50ohm/30W)	Weinschel	50T-054	285	12	6-Sep-2011
Termination 50ohm/50W	Bird	8085	389	12	3-Sep-2011
Dual programable power supply	Thurlby	T-1000	418	-	TU
Termination (50ohm, 50W)	Bird	8085	472	12	8-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Directional Coupler	Hewlett Packard	778D	1401	12	5-Feb-2011
Signal Generator	Marconi	2031	2015	12	10-Apr-2011
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Nov-2010
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	28-Nov-2010
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	13-Oct-2010
Attenuator (30dB, 150W)	Narda	769-30	3369	12	24-May-2011
DMM	Fluke	73	3460	12	23-Oct-2010
Section 2.11 - Power Spectral Density					
Load (50ohm/30W)	Weinschel	50T-054	285	12	6-Sep-2011
Termination 50ohm/50W	Bird	8085	389	12	3-Sep-2011
Dual programable power supply	Thurlby	T-1000	418	-	TU
Termination (50ohm, 50W)	Bird	8085	472	12	8-Mar-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	9-Mar-2011
Directional Coupler	Hewlett Packard	778D	1401	12	5-Feb-2011
Signal Generator	Marconi	2031	2015	12	10-Apr-2011
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	2-Nov-2010
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	28-Nov-2010
Hygrometer	Rotronic	I-1000	3220	12	27-Apr-2011
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	13-Oct-2010
Attenuator (30dB, 150W)	Narda	769-30	3369	12	24-May-2011
DMM	Fluke	73	3460	12	23-Oct-2010

TU – Traceability Unscheduled
OP/Mon – Output monitored using calibrated equipment

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Conducted Emissions, LISN	150kHz to 30MHz Amplitude	3.2dB*
Conducted Emissions, ISN	150kHz to 30MHz Amplitude	2.1dB
Substitution Antenna, Radiated Field	30MHz to 18GHz Amplitude	2.6dB
Discontinuous Interference	150kHz to 30MHz Amplitude	3.0dB*
Interference Power	30MHz to 300MHz Amplitude	3.0dB*
Radiated E-Field Susceptibility	26MHz to 2.5GHz Test Amplitude	1.4dB†
Conducted Susceptibility	100kHz to 250MHz Amplitude	1.8dB†
DC Input Ripple Immunity	Current Voltage	0.45% 0.91%
Power Frequency Magnetic Field	50Hz/60Hz Amplitude	0.45%
Magnetic Emissions	9kHz to 30MHz Amplitude	3.4dB*
Magnetic Field/Flux iaw EN 50366	10Hz to 400kHz	2.64%
Harmonics and Flicker	The test was applied using proprietary equipment that meets the requirements of EN 61000-3-2 and EN 61000-3-3	—
Mains Voltage Variations and Interrupts	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-11	—
Fast Transient Burst	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-4	—
Electrostatic Discharge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-2	—
Surge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-5	—
Vehicle Transients	The test was applied using proprietary equipment that meets the requirements of ISO 7637-1 and 2	—
Compass Safe Distance	Azimuth Accuracy	0.10°

Worst case error for both Time and Frequency measurement 12 parts in 10^6.

* In accordance with CISPR 16-4
† In accordance with UKAS Lab 34

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).