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Compliance test report ID **222021-1TRFWL**

Date of issue
June 27, 2013

FCC 47 CFR Part 15 Subpart C, §15.247

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
and

RSS-210, Issue 8 Annex 8

Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

Applicant	**Technologies Humanware Inc.**
Product	**Victor Reader Stream**
Model	**503VRC**
FCC ID	**XT5503VRC**
IC Reg #	**8670A-503VRC**

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

SCC Accredited LAB
LAB Accrédité CCN

Test location

Nemko Canada Inc.
303 River Road
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Test site FCC ID: 176392 and IC ID: 2040A-4 (3 m semi anechoic chamber)

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Tested by Kevin Rose, Wireless/EMC Specialist

Reviewed by 

Andrey Adelberg, Senior Wireless/EMC Specialist

June 27, 2013
Date

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

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Section 1 Report summary

1.1 Applicant

Technologies Humanware Inc.
1800, rue Michaud
Drummondville, (Québec)
Canada J2C 7G7

1.2 Manufacturer

Technologies Humanware Inc.
1800, rue Michaud
Drummondville, (Québec)
Canada J2C 7G7

1.3 Test specifications

Standard	Description
FCC 47 CFR Part 15, Subpart C, Chapter 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
RSS-210, Issue 8 Annex 8	Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

1.4 Test guidance

558074 D01 DTS Meas. Guidance v02

1.5 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.6 Exclusions

None

1.7 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2 Summary of test results

2.1 FCC Part 15 Subpart C – general requirements, test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass

Notes:
[1] Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed
[1] For battery-operated equipment, the equipment tests shall be performed using a new battery.

2.2 FCC Part 15 Subpart C – Intentional Radiators, test results

Part	Test description	Verdict
§15.247(a)(1)	Frequency hopping systems	
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)	Maximum conducted peak output power and EIRP	
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(b)(4)	Conducted peak output power limitations	
§15.247(b)(4)(i)	Maximum peak output power for systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations.	Not applicable
§15.247(b)(4)(ii)	Maximum peak output power for systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations.	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy and power spectral density for hybrid systems	Not applicable

2.3 IC RSS-GEN, Issue 3, test results

Part	Test description	Verdict
4.6.1	Occupied bandwidth	Pass
6.1	Receiver spurious emissions limits (radiated)	Not applicable
6.2	Receiver spurious emissions limits (antenna conducted)	Not applicable
7.2.4	AC power lines conducted emission limits	Pass
Notes: [1] According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 has been revised. The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.		

2.4 IC RSS-210, Issue 8, test results

Part	Test description	Verdict
A8.1	Frequency hopping systems	
A8.1 (a)	Bandwidth of a frequency hopping channel	Not applicable
A8.1 (b)	Minimum channel spacing for frequency hopping systems	Not applicable
A8.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
A8.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
A8.2	Digital modulation systems	
A8.2 (a)	Minimum 6 dB bandwidth	Pass
A8.2 (b)	Maximum power spectral density	Pass
A8.3	Hybrid systems	
A8.3 (1)	Digital modulation turned off	Not applicable
A8.3 (2)	Frequency hopping turned off	Not applicable
A8.4	Transmitter output power and e.i.r.p. requirements	
A8.4 (1)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
A8.4 (2)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.4 (3)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
A8.4 (4)	Systems employing digital modulation techniques	Pass
A8.4 (5)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
A8.4 (6)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
A8.5	Out-of-band emissions	Pass
Notes: None		

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	October 5, 2012
Nemko sample ID number	5

3.2 EUT information

Product name	Victor Reader Stream
Model	503VRC

3.3 Technical information

Operating band	2400–2483.5 MHz
Operating frequency	2412–2462 MHz
Modulation type	802.11b, 802.11g, and 802.11n
Occupied bandwidth (99 %)	15.19 MHz, 16.34 MHz, and 17.59 MHz
Emission designator	W7D
Power requirements	3.7 Vdc (All Radio tests were performed with new battery.) the Unit comes with AC adapter for charging.
Antenna information	1.5 dBi Indica 2.4 GHz Chip Antenna PN:A10381 The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The EUT uses a WIFI connection to transmit multiple formats including DAISY, MP3 and electronic text.

3.5 EUT exercise details

The EUT used a test program to control the WIFI module.

3.6 EUT setup diagram

Diagram 3.6-1: Setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature: 15–30 °C
Relative humidity: 20–75 %
Air pressure: 86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7 Test equipment

7.1 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/13
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	May 16/13
Bilog antenna	Sunol	JB3	FA002108	1 year	Feb. 07/13
Horn antenna #2	EMCO	3115	FA000825	1 year	Feb. 24/13
Horn antenna 18–26.5 GHz	Electro-metrics	SH-50/60-1	FA000479	—	VOU
50 coax cable	Huber + Suhner	NONE	FA002392	1 year	June. 27/13
50 coax cable	Huber + Suhner	NONE	FA002074	1 year	Aug. 23/13
1–18 GHz pre-amplifier	JCA	JCA118-503	FA002091	1 year	July 03/13
18–26 GHz pre-amplifier	Narda	BBS-1826N612	FA001550	—	VOU
50 coax cable	Huber + Suhner	None	FA002394	1 year	June 27/13
LISN	Rohde & Schwarz	ENV216	FA002023	1 year	Nov. 18/12
Note: NCR - no calibration required: VOU - verify on use					

Section 8 Testing data

8.1 AC power line conducted emissions

8.1.1 Definitions and limits

FCC Clause 15.207(a): Conducted limits
RSS-Gen Clause 7.2.4: AC power line conducted emissions limits

FCC:
Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

IC:
The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 2. The tighter limit applies at the frequency range boundaries.

The conducted emissions shall be measured with a 50 Ω/50 µH line impedance stabilization network (LISN).

Table 8.1-1: Conducted emissions limit

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50
* - Decreases with the logarithm of the frequency.		

8.1.2 Test summary

Test date	October 16, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1001 mbar	**Relative humidity**	26 %

8.1.3 Observations/special notes

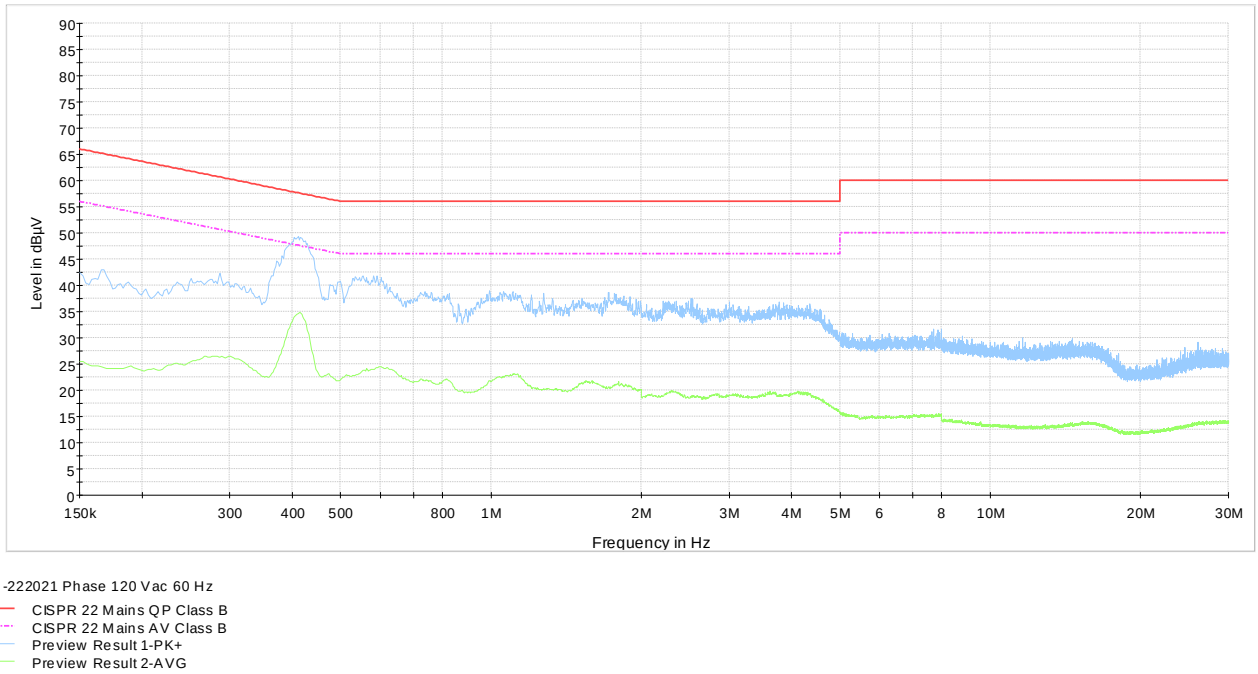
The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

Receiver/spectrum analyzer settings
Preview measurements – Receiver:
Peak and Average detector (Max hold), RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms
Final measurements – Receiver:
Q-Peak and Average detector, RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms

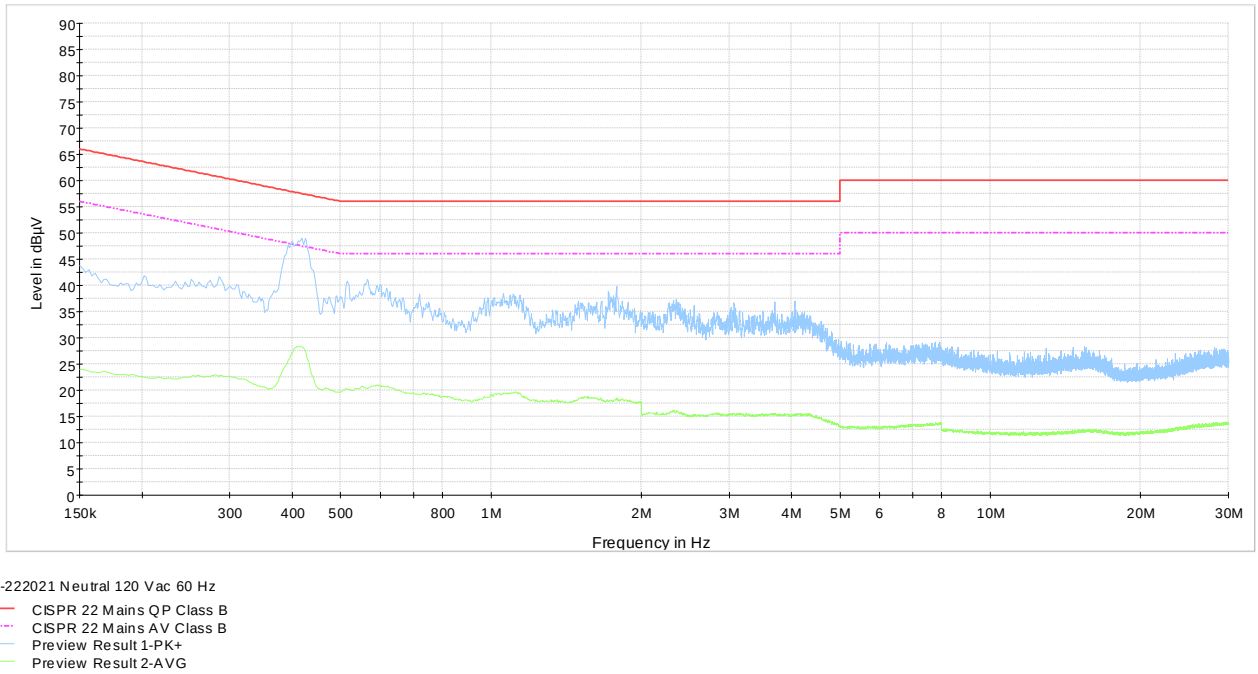
Measurement details
A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement. The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

8.1.4 Test data



Plot 8.1-1: Conducted emissions on phase line

8.1.4 Test data, continued



Plot 8.1-2: Conducted emissions on neutral line

8.2 Minimum 6 dB bandwidth for systems using digital modulation techniques

8.2.1 Definitions and limits

FCC Clause 15.247(a)(2) and RSS-210 Clause A8.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

FCC and IC:

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2.2 Test summary

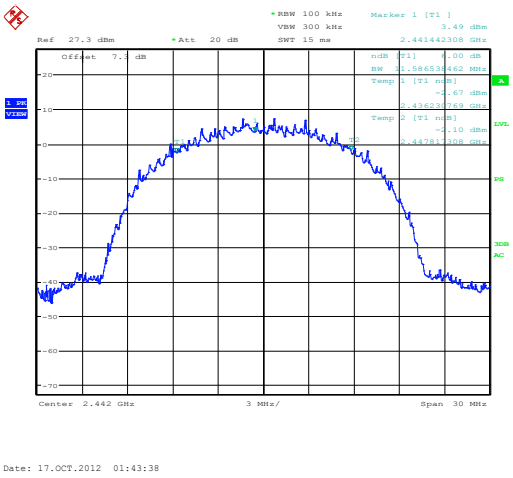
Test date	October 17, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	25 %

8.2.3 Observations/special notes and procedures

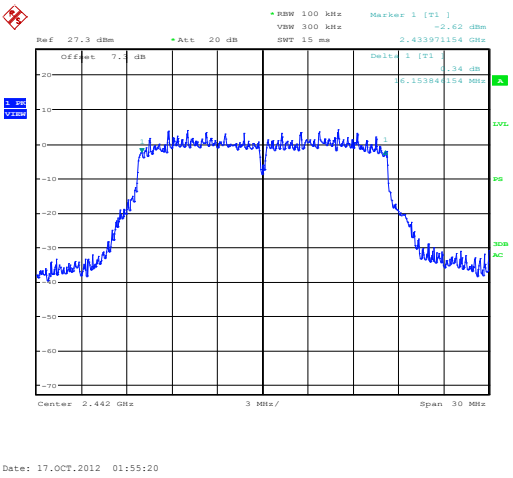
Measurement Procedure :558074 D01 DTS Meas. Guidance v02

1. Set resolution bandwidth (RBW) = 1-5% or DTS BW, not to exceed 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

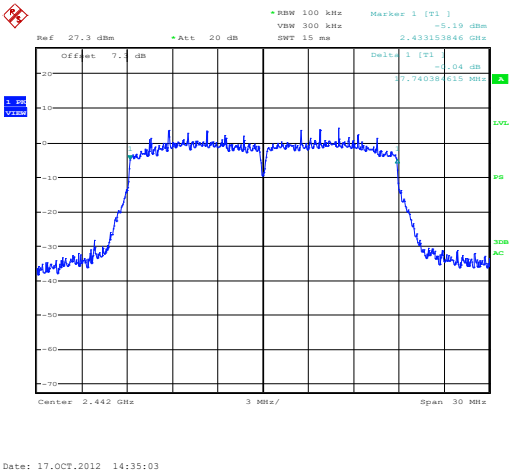
8.2.4 Test data



Plot 8.2-1: 6 dB bandwidth – 802.11b Example



Plot 8.2-2: 6 dB bandwidth – 802.11g Example



Plot 8.2-3: 6 dB bandwidth – 802.11n Example

Table 8.2-1: 6 dB bandwidth results

Modulation	Frequency (MHz)	6 dB bandwidth (MHz)	Limit (MHz)	Margin (MHz)
802.11b	2412	11.44	> 0.5	10.94
	2442	11.56	> 0.5	11.06
	2462	11.42	> 0.5	10.92
802.11g	2412	16.34	> 0.5	15.84
	2442	16.15	> 0.5	15.65
	2462	16.18	> 0.5	15.68
802.11n	2412	17.59	> 0.5	17.09
	2442	17.74	> 0.5	17.24
	2462	17.54	> 0.5	17.04

8.3 RSS-Gen Clause 4.6.1 Occupied bandwidth

8.3.1 Definitions and limits

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 percent emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

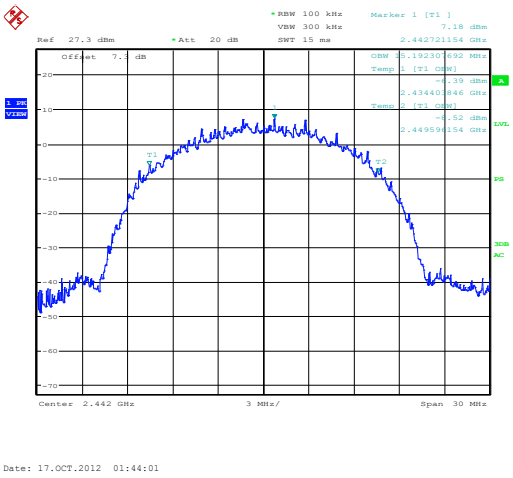
8.3.2 Test summary

Test date	October 17, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	25 %

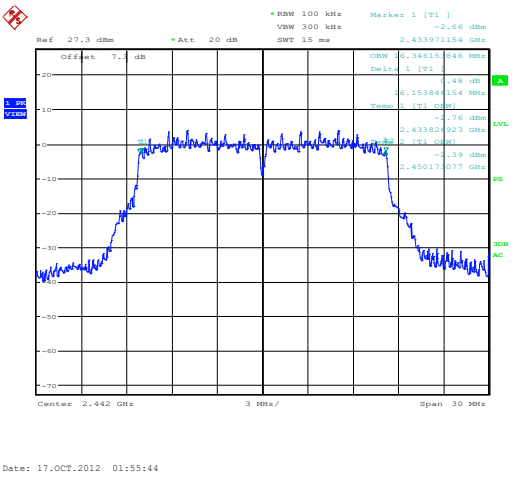
8.3.3 Observations/special notes

Measurements were performed with peak detector using RBW = 1–5 % of Span VBW was set wider than RBW.

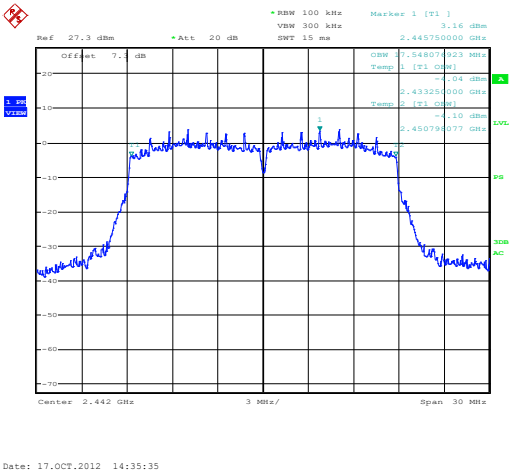
8.3.4 Test data



Plot 8.3-1: 99% bandwidth – 802.11b Example



Plot 8.3-2: 99% bandwidth – 802.11g Example



Plot 8.3-3: 99% bandwidth – 802.11n Example

Table 8.3-1: 99% bandwidth results

Modulation	Frequency (MHz)	99% bandwidth (MHz)
802.11b	2412	15.14
	2442	15.19
	2462	15.14
802.11g	2412	16.34
	2442	16.34
	2462	16.29
802.11n	2412	17.54
	2442	17.54
	2462	17.48

8.4 Transmitter output power and EIRP requirements for digital systems

8.4.1 Definitions and limits

FCC Clause 15.247(b) and RSS-210 Clause A8.4 (4) Transmitter output power and e.i.r.p. requirements

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

IC:

A8.4 (4) Transmitter Output Power and e.i.r.p. Requirements for systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands

For systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz, the maximum peak conducted output power shall not exceed 1 W (30 dBm). Except as provided in Section A8.4(5), the e.i.r.p. shall not exceed 4 W (36 dBm). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power (see RSS-Gen).

8.4.2 Test summary

Test date	October 17, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	25 %

8.4.3 Observations/special notes and procedures

Measurement Procedure :558074 D01 DTS Meas. Guidance v02

Option 2 (channel integration method)

This procedure should only be used when the maximum available RBW of the spectrum/signal analyzer is less than the DTS bandwidth.

1. Set the RBW = maximum available (at least 1 MHz).
2. Set the VBW = 3 x RBW or maximum available setting (must be ≥ RBW).
3. Set the span to fully encompass the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the spectrum analyzer's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some analyzers, this may require a manual override to ensure use of peak detector). If the spectrum analyzer does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.

8.4.4 Test data

Table 8.4-1: Conducted output power results

Modulation	Frequency (MHz)	Conducted output power (dBm)	Limit (dBm)	Margin (dB)
802.11b	2412	22.02	30	7.98
	2442	21.77	30	8.23
	2462	21.97	30	8.03
802.11g	2412	23.45	30	6.55
	2442	23.07	30	6.93
	2462	23.48	30	6.52
802.11n	2412	22.49	30	7.51
	2442	22.56	30	7.44
	2462	22.15	30	7.85

Table 8.4-2: EIRP calculation results

Modulation	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)
802.11b	2412	23.52	36	12.48
	2442	23.27	36	12.73
	2462	23.47	36	12.53
802.11g	2412	24.95	36	11.05
	2442	24.57	36	11.43
	2462	24.98	36	11.02
802.11n	2412	23.99	36	12.01
	2442	24.06	36	11.94
	2462	23.65	36	12.35

EIRP = Conducted output power [dBm] + antenna gain [dBi]
Antenna gain = 1.5 dBi

Maximum output power = 23.48 dBm Limit = 30 dBm
Maximum EIRP = 24.98 dBm Limit = 36 dBm

8.5 Spurious (out-of-band) emissions

8.5.1 Definitions and limits

FCC Clause 15.247(d): Spurious emissions
RSS-210 Clause A8.5 Out-of-band emissions

FCC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Table 8.5-1 is not required.

Table 8.5-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009–0.490*	2400/F	$67.6-20\times\log_{10}(F)$	300
0.490–1.705*	24000/F	$87.6-20\times\log_{10}(F)$	30
1.705–30.0*	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3
*– applicable only to FCC requirements			

Table 8.5-2: FCC Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.5.1 Definitions and limits, continued

Table 8.5-3: IC Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.5-3 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

8.5.2 Test summary

Test date	October 16, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	25 %

8.5.3 Observations/special notes and procedures

Unwanted Emissions into Non-Restricted Frequency Bands

If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to 15.247(b)(3) requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to 15.247(b)(3) requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured inband average PSD level.

In either case, attenuation to levels below the general emission limits specified in §15.209(a) is not required.

The following procedures can be utilized to demonstrate compliance to these limits:

First, establish a reference level by using the following procedure for measuring the peak power level in any 100 kHz bandwidth within the fundamental emission:

8.5.3 Observations/special notes and procedures, continued

Measurement Procedure – Reference Level

a. Set the RBW = 100 kHz.
b. Set the VBW ≥ 300 kHz.
c. Set the span to 5–30 % greater than the EBW.
d. Detector = peak.
e. Sweep time = auto couple.
f. Trace mode = max hold.
g. Allow trace to fully stabilize.
h. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Next, determine the power in 100 kHz band segments outside of the authorized frequency band using the following measurement:

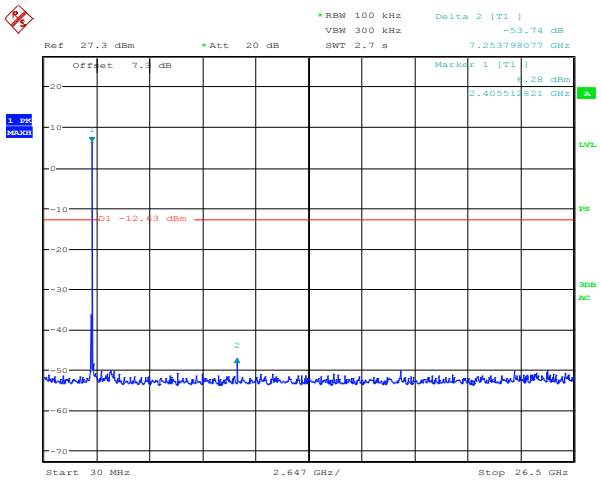
Measurement Procedure - Unwanted Emissions

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Set span to encompass the spectrum to be examined.
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize (this may take some time, depending on the extent of the span).

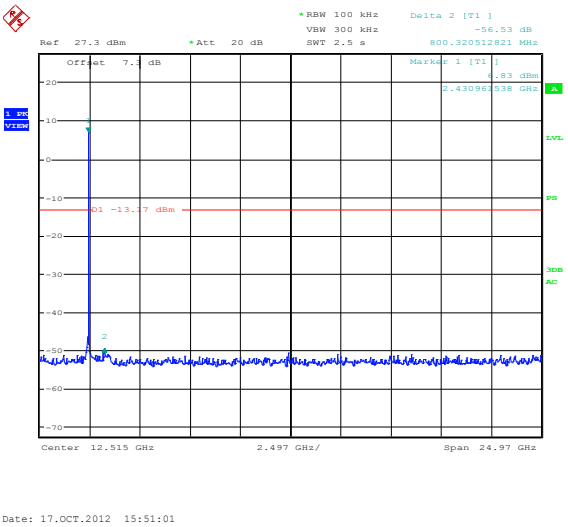
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified above.

8.5.4 Test data

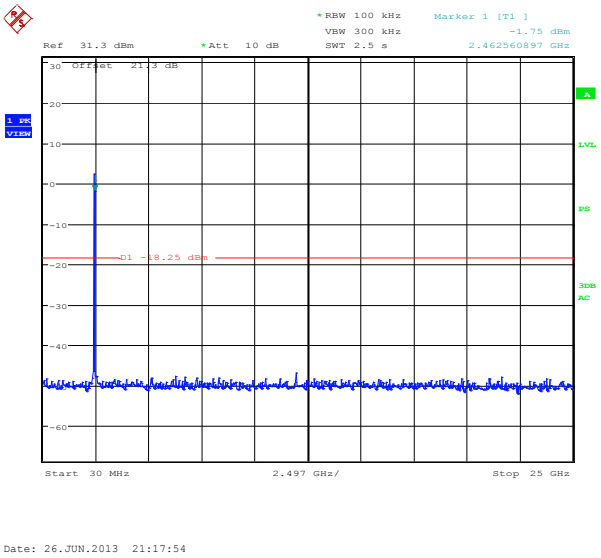
Conducted measurement



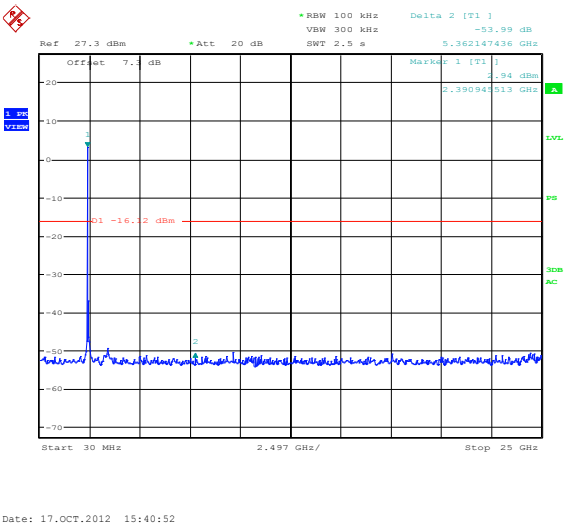
Plot 8.5-1: Conducted spurious emissions low channel 802.11 b



Plot 8.5-2: Conducted spurious emissions mid channel 802.11 b



Plot 8.5-3: Conducted spurious emissions high channel 802.11 b



Plot 8.5-4: Conducted spurious emissions low channel 802.11 g

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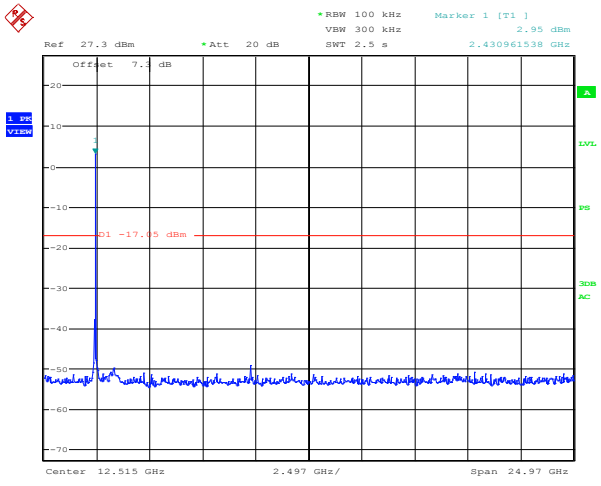
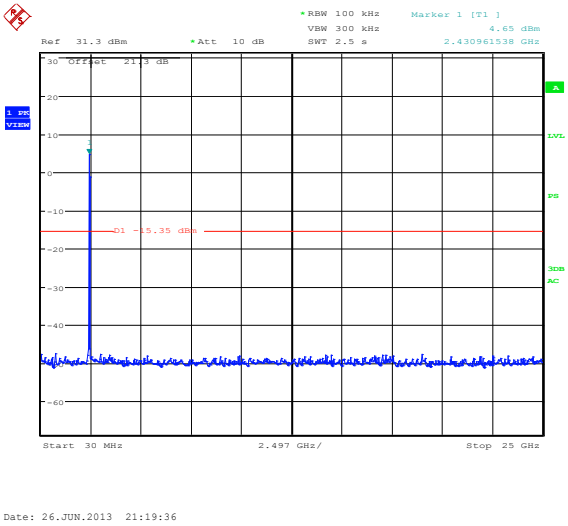
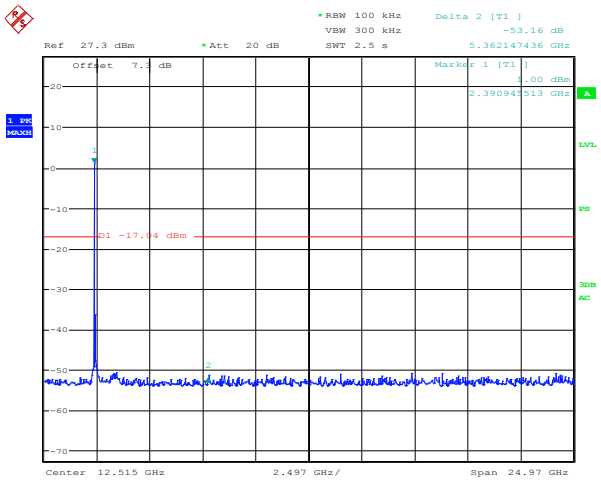
8.5.4 Test data continued



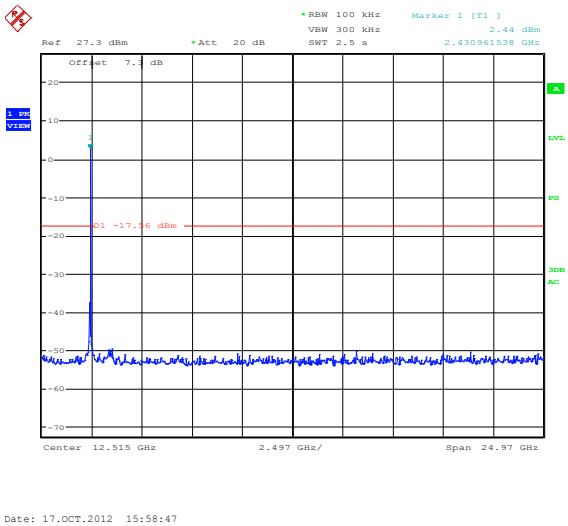
Plot 8.5-5: Conducted spurious emissions mid channel 802.11 g



Plot 8.5-6: Conducted spurious emissions high channel 802.11 g

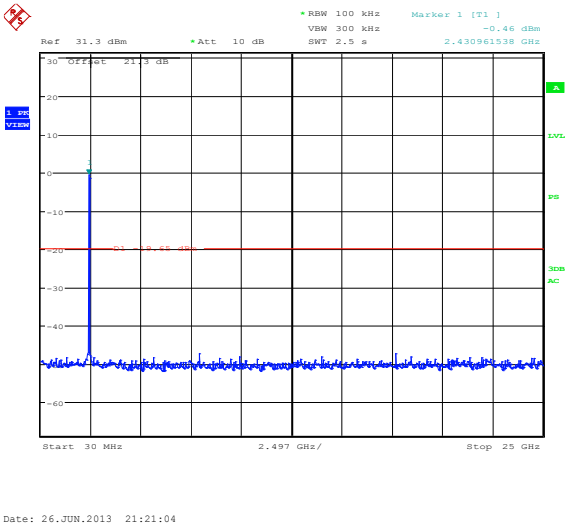


Plot 8.5-7: Conducted spurious emissions low channel 802.11 n



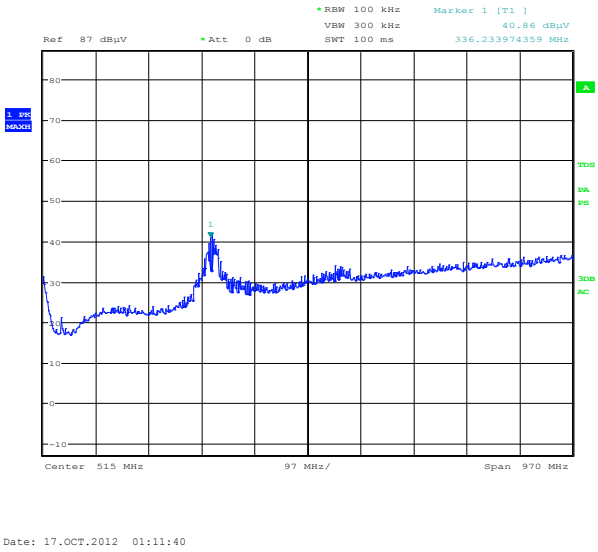
Plot 8.5-8: Conducted spurious emissions mid channel 802.11 n

8.5.4 Test data continued

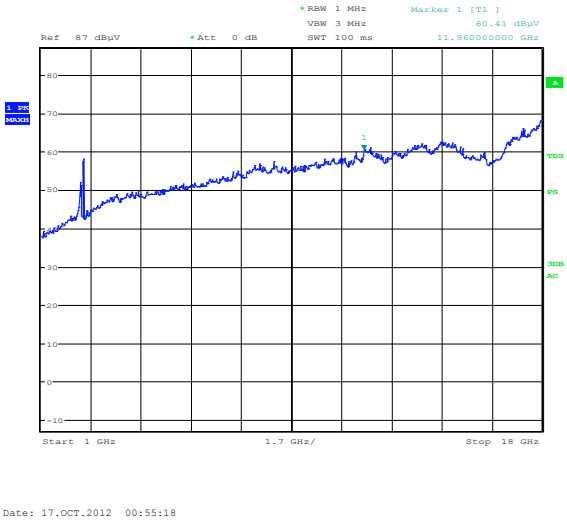


Plot 8.5-9: Conducted spurious emissions on high channel 802.11 n

Radiated measurement



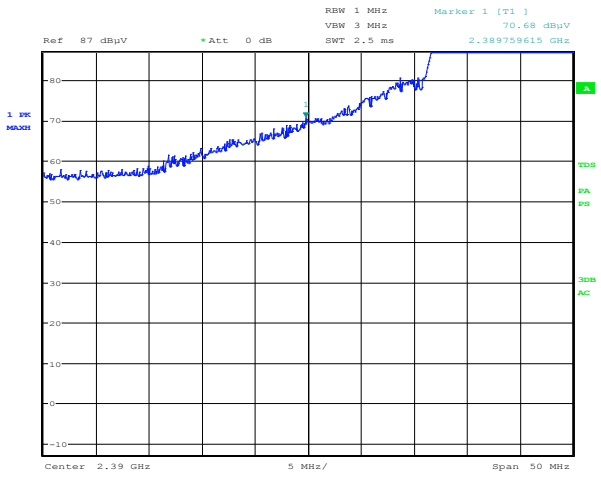
Plot 8.5-10: Radiated spurious emissions Example



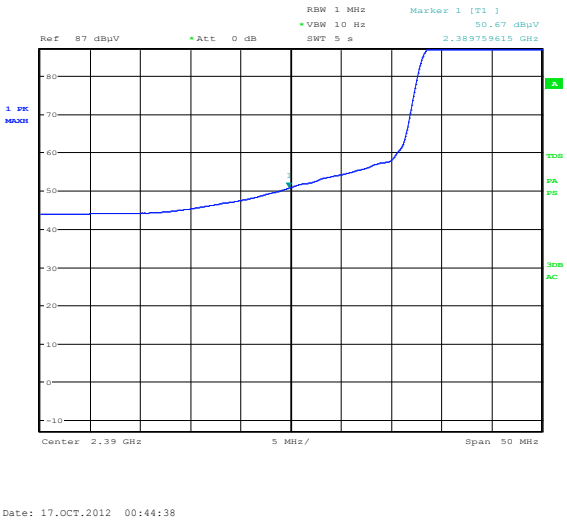
Plot 8.5-11: Radiated spurious emissions Example

8.5.4 Test data, continued

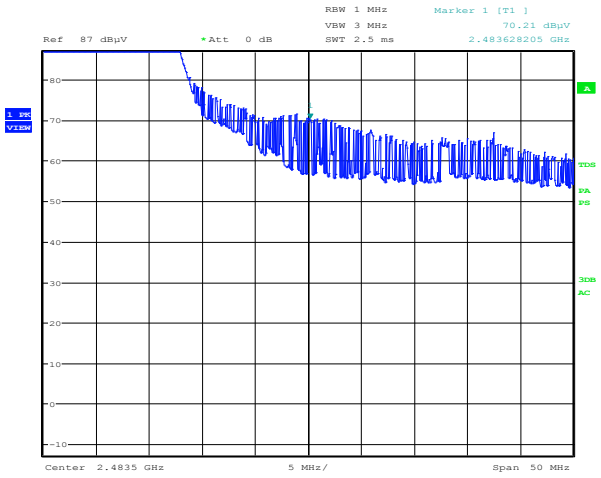
Radiated measurement Band edge



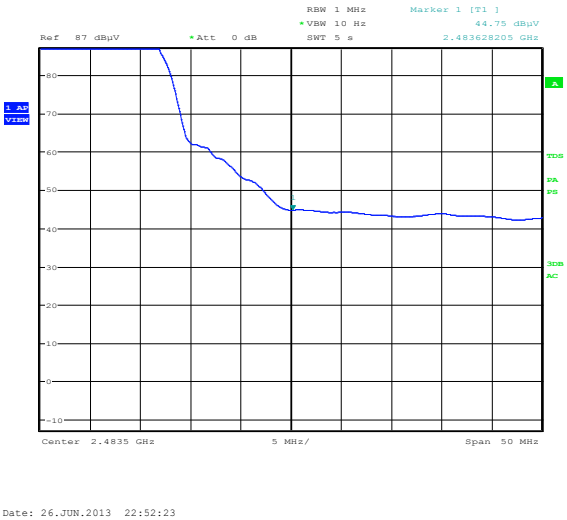
Plot 8.5-12: Lower Band edge example Peak



Plot 8.5-13: Lower Band edge example Average



Plot 8.5-14: Upper Band edge example Peak



Plot 8.5-15: Upper Band edge example Average

No emissions were detected within 10 dB of limit inside the 15.205 Restricted bands.

- All measurements were performed at a distance of 3 m. from 30-10000 MHz
- All measurements performed:
  - within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

8.6 Power spectral density for digitally modulated devices

8.6.1 Definitions and limits

FCC Clause 15.247(e) and RSS-210 Clause A8.2(b) Power spectral density for digitally modulated devices

FCC:
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

IC:
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration. This power spectral density shall be determined in accordance with the provisions of Section A8.4(4); (i.e. the power spectral density shall be determined using the same method for determining the conducted output power).

8.6.2 Test summary

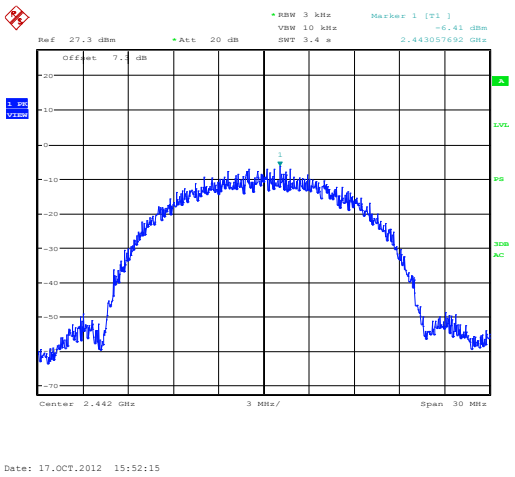
Test date	October 17, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	25 %

8.6.3 Observations/special notes

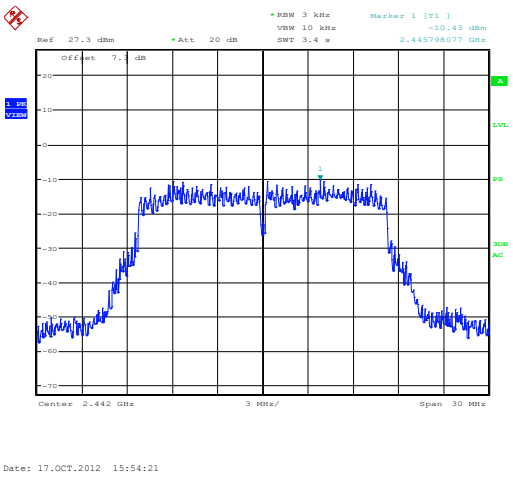
Measurement Procedure Option 1:

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

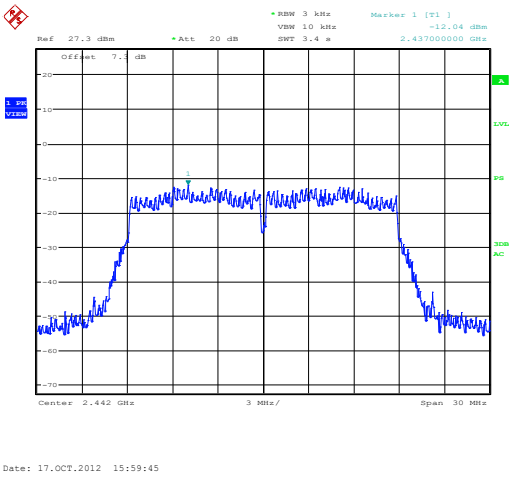
8.6.4 Test data



Plot 8.6-1: PSD 802.11b



Plot 8.6-2: PSD 802.11g



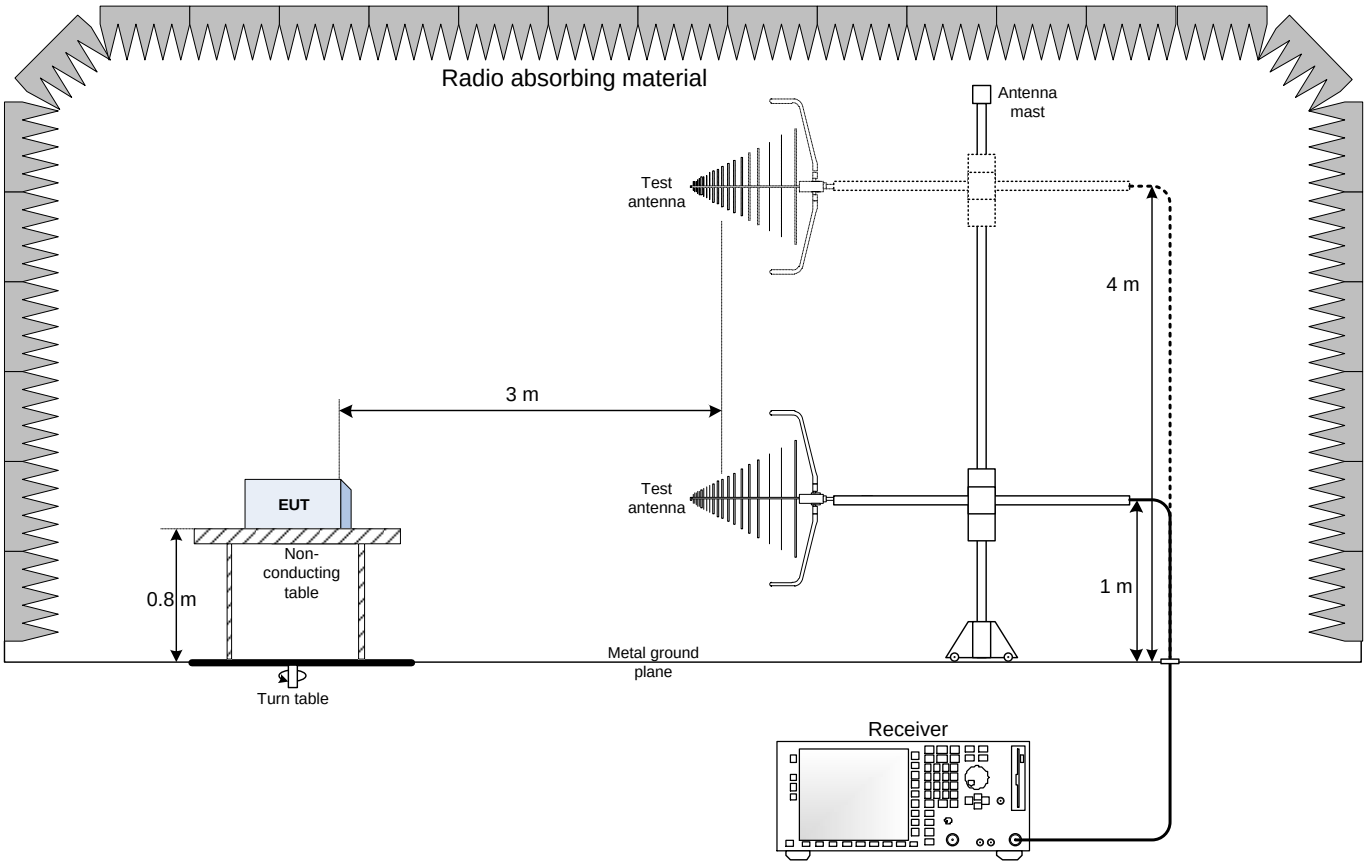
Plot 8.6-3: PSD 802.11n

Table 8.6-1: PSD results

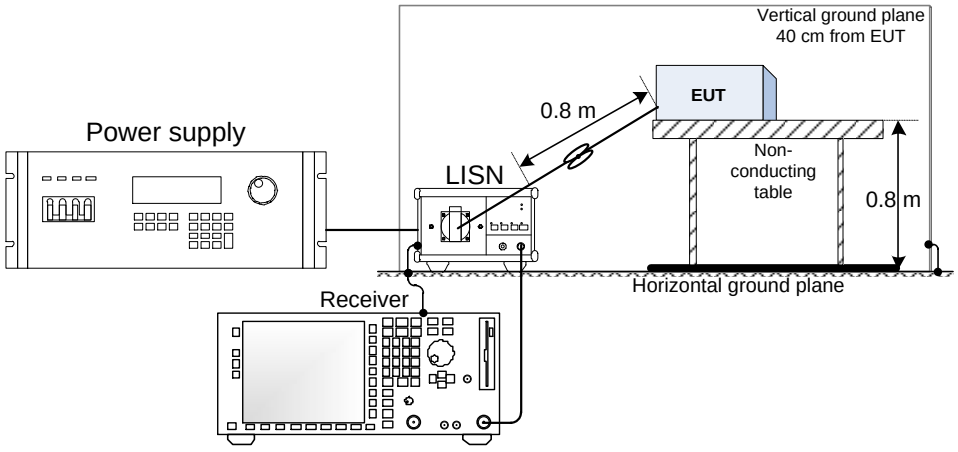
Modulation	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
802.11b	2412	-6.70	8.0	14.70
	2442	-6.41	8.0	14.41
	2462	-6.24	8.0	14.24
802.11g	2412	-10.48	8.0	18.48
	2442	-10.43	8.0	18.43
	2462	-10.8	8.0	18.80
802.11n	2412	-11.96	8.0	19.96
	2442	-12.04	8.0	20.04
	2462	-12.54	8.0	20.54

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up



Section 10 EUT photos

10.1 External photos

10.1.1 EUT front view

10.1.2 EUT rear view

10.1.3 EUT top view

10.1.4 EUT side view