Test of NetScout Systems BCM43460 Enterprise Radio Module

To: FCC 47 CFR Part 15.247 & IC RSS-247

Test Report Serial No.: FLUK48-U2 Rev A

MiCOM Labs

opening wireless markets

TEST REPORT

FROM

Test of NetScout Systems BCM43460 Enterprise Radio Module

to

To FCC 47 CFR Part 15.247 & IC RSS-247

Test Report Serial No.: FLUK48-U2 Rev A

Note: this report contains data with regard to the 2400-2483.5 MHz operational mode of the NetScout Systems BCM43460 Enterprise Radio Module. Test data for the frequency bands 5,150 - 5,250; 5,250 – 5,350, 5,470–5,725 and 5,725 – 5,850 MHz are reported in MiCOM Labs test report FLUK48-U5.

This report supersedes: NONE

Applicant: NetScout Systems Inc.
310 Littleton Road
Westford MA 01886-4105
USA

Product Function: 802.11 a/b/g/n/ac Wireless Module

Copy No: pdf Issue Date: 23rd December 2015

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
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ACCREDITED
TESTING CERT # 2381.01

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ACCREDITATION, LISTINGS & RECOGNITION

Testing Accreditation

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 28th day of February 2014.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to December 31, 2015
Revised November 18, 2015

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Recognition

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

EU MRA – European Union Mutual Recognition Agreement.
NB – Notified Body
APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing
Phase II – recognition for both product testing and certification

Product Certification

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 28th day of February 2014.

President & CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to December 31, 2015
Revised November 18, 2015

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	8th December 2015	To bring report into line with the FCC new rules the 5725 – 5850 MHz frequency band has been removed from this document. This frequency band is now reported in MiCOM Labs UNII report FLUK48-U5.
Rev A	23rd December 2015	Second Release
This report was originally issued under FLUK14-U3		
Rev B	6th August 2014	EUT model number corrected.

TEST RESULT CERTIFICATE

Manufacturer:	NetScout Systems Inc. 310 Littleton Road Westford MA 01886-4105 USA	Tested By:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California, 94566 USA
EUT:	802.11 a/b/g/n/ac Wireless Module	Telephone:	+1 925 462 0304
Model(s):	BCM43460	Fax:	+1 925 462 0306
S/N's:	000E8E38271E		
Test Date(s):	29th April - 25th June 2014	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247 & IC RSS-247	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

ACCREDITED
TESTING CERT # 2381.01

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

1. REFERENCES AND MEASUREMENT UNCERTAINTY

1.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
i.	FCC 47 CFR Part 15, Subpart C	2014	Title 47: Telecommunication PART 15—RADIO FREQUENCY DEVICES Subpart C—Intentional Radiators
ii.	RSS-247, Issue 1	May 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
iii.	FCC OET KDB 662911	4th April 2011	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
iv.	DA 00-705	2000	FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems" released March 30, 2000
v.	RSS-Gen, Issue 4	Nov 2014	General Requirements and Information for the Certification of Radiocommunication Equipment
vi.	ICES-003	Issue 5 2012	Spectrum Management and Telecommunications; Interference-Causing Equipment Standard. Information Technology Equipment (ITE) – Limits and methods of measurement.
vii.	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
viii.	CISPR 22/ EN 55022	2008 2006+A1: 2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
ix.	M 3003	Edition 2 Jan 2007	Expression of Uncertainty and Confidence in Measurements
x.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
xi.	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
xii.	A2LA	April 2014	Reference to A2LA Accreditation Status – A2LA Advertising Policy

1.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

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2. PRODUCT DETAILS AND TEST CONFIGURATIONS

2.1. Technical Details

Details	Description
Purpose:	Test of the NetScout Systems BCM43460 Enterprise Radio Module to FCC Part 15.247 and Industry Canada RSS-247 Issue 1 regulations.
Applicant:	NetScout Systems Inc. 310 Littleton Road, Westford MA 01886-4105, USA
Manufacturer:	As applicant.
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court, Pleasanton, California 94566 USA
Test report reference number:	FLUK48-U2 Rev A
Date EUT received:	20th April 2014
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-247
Dates of test (from - to):	29th April - 25th June 2014
No of Units Tested:	One
Type of Equipment:	802.11a/b/g/n/ac Wireless Access Point 3x3 MIMO
Manufacturers Trade Name:	Wireless Access Point
Model(s):	BCM43460
Location for use:	Indoor only
Declared Frequency Range(s):	2400 - 2483.5 MHz
Hardware Rev	303
Software Rev	mtool 1.0
Type of Modulation:	Per 802.11 –CCK, BPSK, QPSK, DSSS, OFDM
EUT Modes of Operation:	Legacy 802.11a/b/g/n/ac
Declared Nominal Average Output Power:	2.4 GHz Operation 802.11b/g/n: +27 dBm 5 GHz Operation 802.11a/n/ac: +23 dB m
System Beam Forming:	BCM43460 has no capability for antenna beam forming
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	3.3Vdc 1.5 A
Operating Temperature Range:	Declared range 0° to +45°
ITU Emission Designator:	2400 – 2483.5 MHz 802.11b 13M7G1D 2400 – 2483.5 MHz 802.11g 19M8D1D 2400 – 2483.5 MHz 802.11n – HT-20 20M0D1D 2400 – 2483.5 MHz 802.11n – HT-40 44M4D1D
Equipment Dimensions:	29.9mm x 50.8mm x 3.3mm
Weight:	Less than 12 grams
Primary function of equipment:	Wireless network test

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2.2. Scope of Test Program

NetScout Systems BCM43460 Enterprise Radio Module

The scope of the test program was to test the NetScout Systems BCM43460 Enterprise Radio Module, 3x3 Spatial Multiplexing MIMO configurations in the frequency range 2400 - 2483.5 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-247 specifications.

FCC OET KDB Implementation

This test program implements the following FCC KDB – 662911 4/4/2011;
Emissions Testing of Transmitters with Multiple Outputs in the Same Band

The KDB document provides guidance for measurements of conducted output emissions of devices that employ a single transmitter with multiple outputs in the same band, with the outputs occupying the same or overlapping frequency ranges. It applies to EMC compliance measurements on devices that transmit on multiple antennas simultaneously in the same or overlapping frequency ranges through a coordinated process. Examples include, but are not limited to, devices employing beam forming or multiple-input and multiple-output (MIMO.) This guidance applies to both licensed and unlicensed devices wherever the FCC rules call for conducted output measurements. Guidance is provided for in-band, out-of-band and spurious emission measurements.

This guidance does not apply to the multiple transmitters included in a composite device, such as a device that combines an 802.11 modem with a cell phone in one enclosure with each driving its own antenna.

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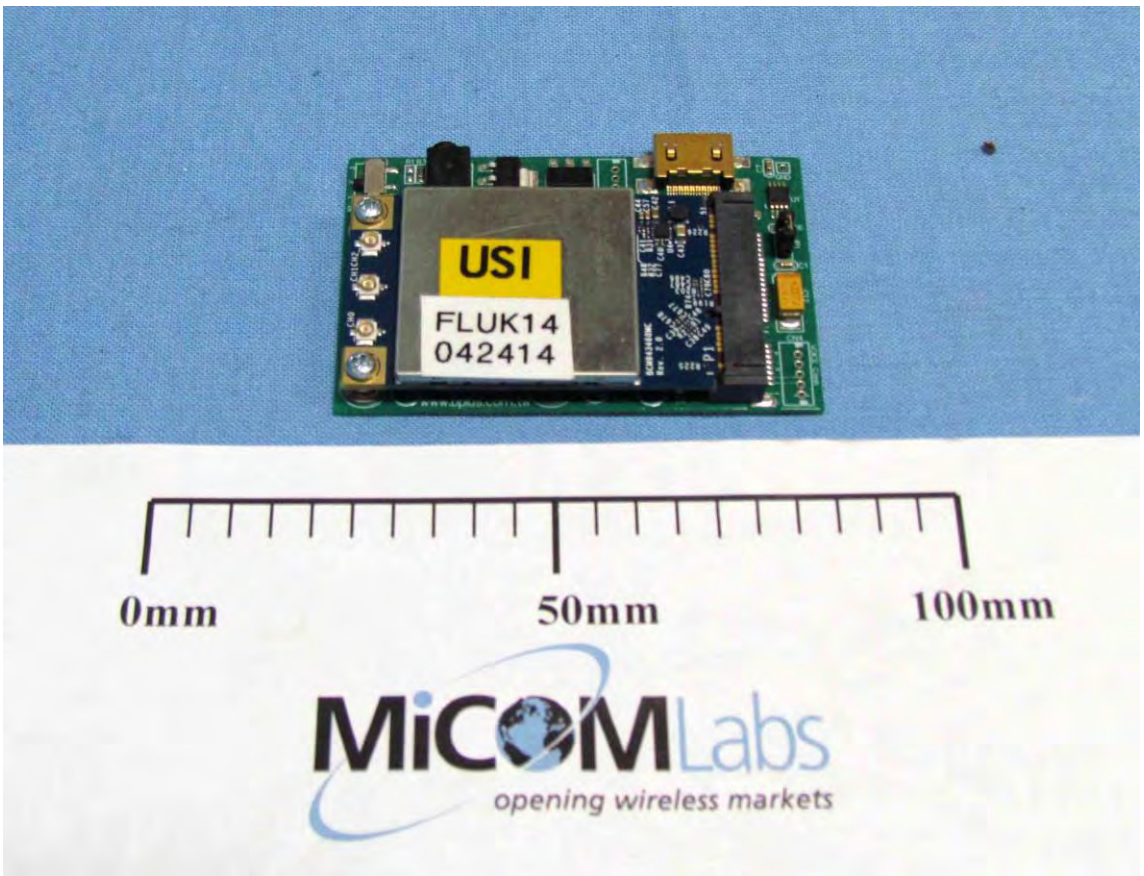
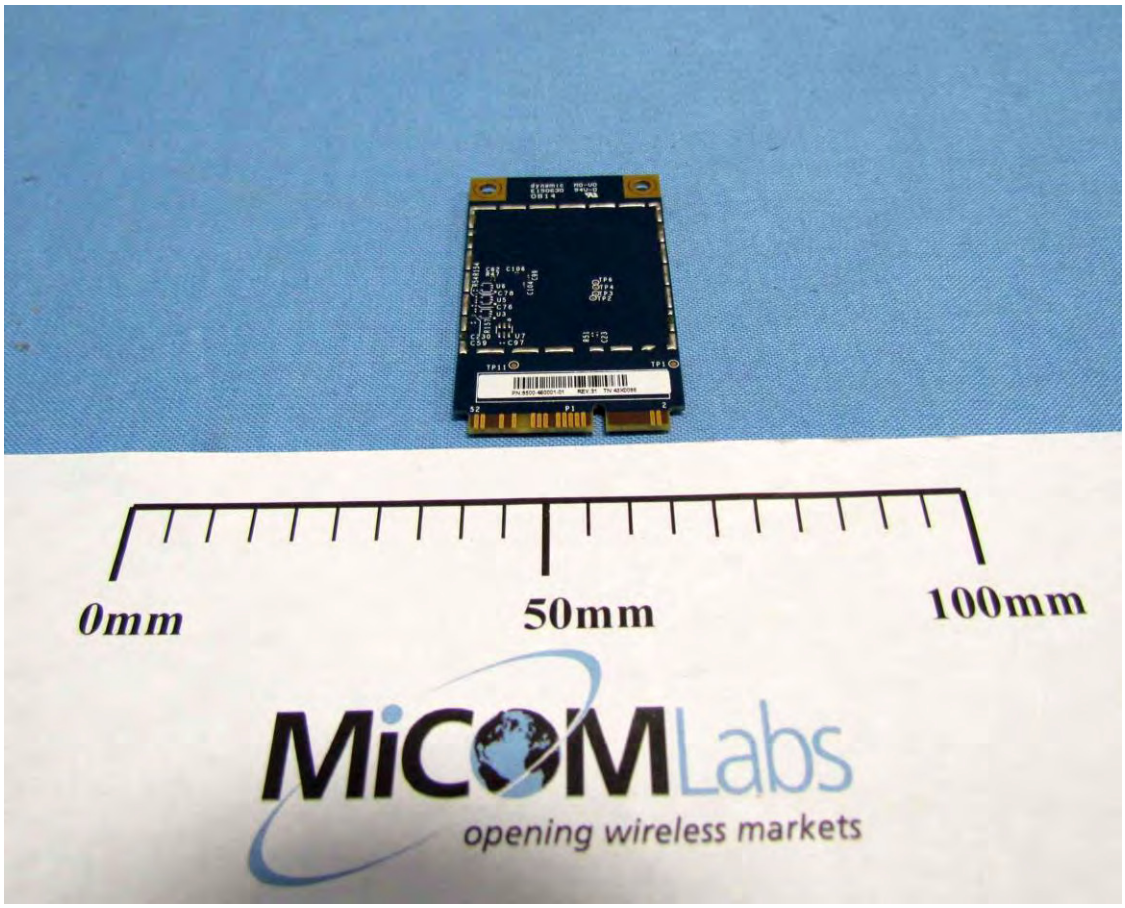
NetScout Systems BCM43460 Enterprise Radio Module



NetScout Systems BCM43460 Enterprise Radio Module



2.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	802.11 a/b/g/n/ac Wireless Module	Netscout Systems	BCM43460	XX
Support	Laptop PC	IBM	Thinkpad	None

2.4. Antenna Details

Manufacturer	Model	Type	Gain	Freq. Band
			dBi	MHz
Ethertronics	M830510	Chip – Omni (Internal)	1.1	2400 - 2500
Centurion	WTS2450RPSMA	Dipole – Omni (External)	2.1	2400 - 2500
NanoGreen	IP04	PCB – Omni (Internal)	0.9	2400 - 2500
Wanshih Electric Co	WSS013 Dual Band Antenna	Dipole – Omni (External)	2.0	2400 - 2500

2.5. Cabling and I/O Ports

Number and type of I/O ports

1. 10/100/1000 Ethernet (POE)
2. RF Antenna Connectors (x3) – UFL

2.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. The variant with the highest power was used to exercise the product.

Operational Mode(s) (802.11a/b/g/n/ac)	Variant	Data Rate with Highest Power	Frequencies (MHz)
2.4 GHz			
b	Legacy	1 MBit/s	2,412 2,437 2,462
g	Legacy	6 MBit/s	
n	HT-20	6.5 (MCS 0)	
	HT-40	13.5 (MCS 0)	2,422 2,437 2,452

Legacy – data rates for 802.11abg products

Results for the above configurations are provided in this report

.

Antenna Test Configurations for Radiated Emissions

Results for the following configurations are provided in this report.

Radiated emissions testing was performed for all possible configurations on the integral antenna, the table below identifies all radiated testing completed on the device.

2,400 – 2483.5 MHz

15.247	
802.11b,g, 802.11n HT-20	SE 2412
	SE 2437
	SE 2462
	BE 2390
	BE 2483.5
802.11n HT-40	SE 2412
	SE 2437
	SE 2462
	BE 2390
	BE 2483.5

KEY;-

SE – Spurious Emission
BE – Band-Edge

2.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

2.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

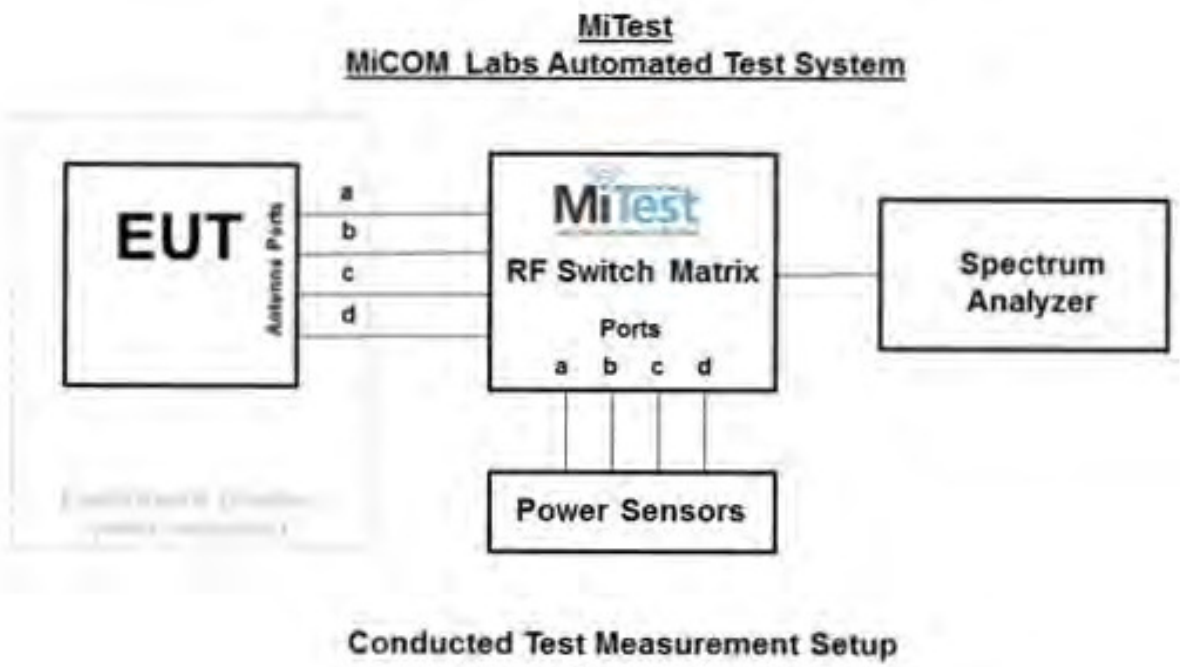
3. TEST EQUIPMENT CONFIGURATION(S)

3.1. Conducted RF Emission Test Set-up

The following tests were performed using the conducted test set-up shown in the diagram below.

1. Section 6.1.1.1. 6 dB and 99% Bandwidth
2. Section 6.1.1.2. Peak Output Power
3. Section 6.1.1.3. Power Spectral Density
4. Section 6.1.1.4. Conducted Spurious Emissions

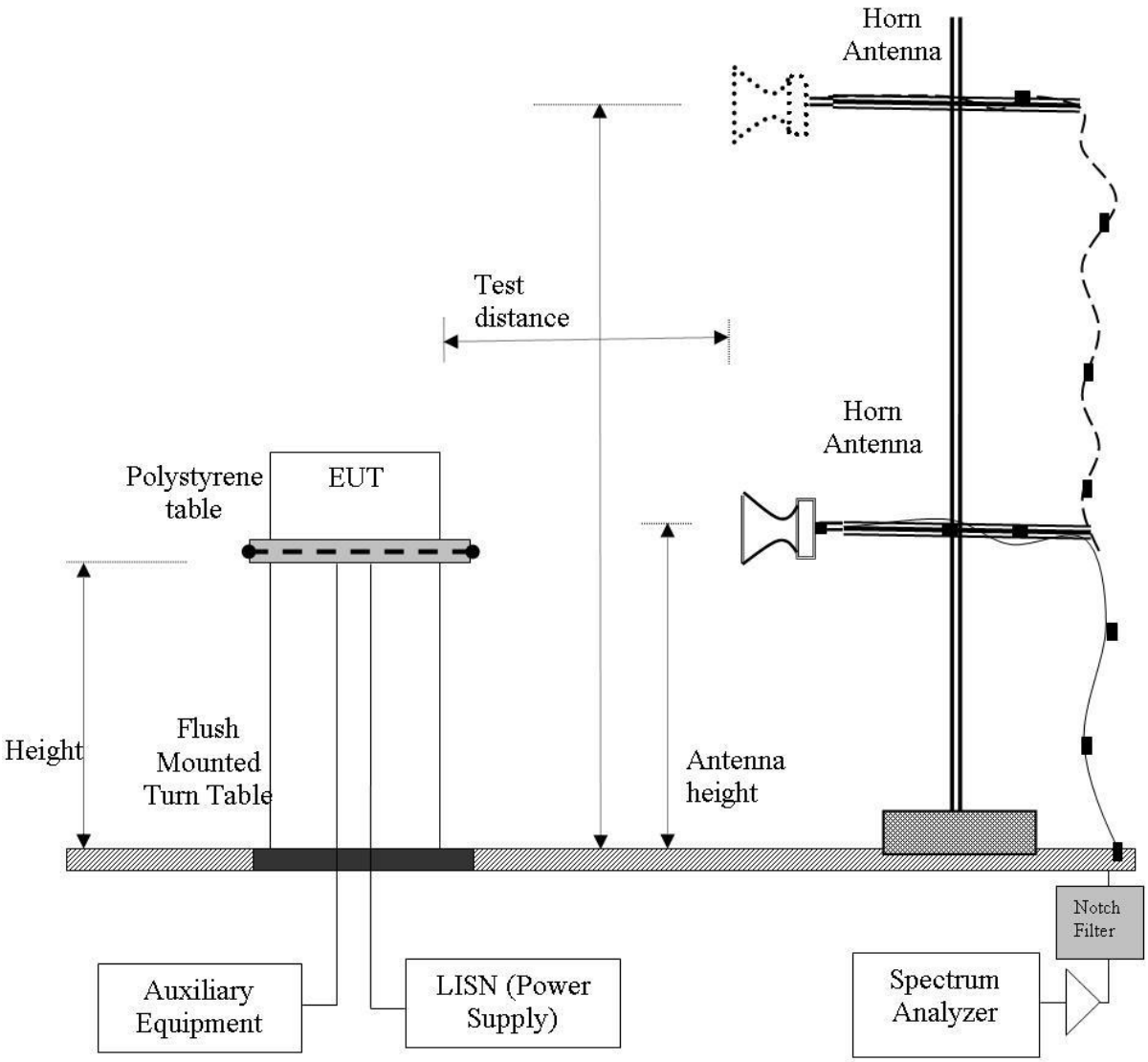
Conducted Test Set-Up Pictorial Representation



3.2. Radiated Spurious Emission Test Set-up > 1 GHz

The following tests were performed using the conducted test set-up shown in the diagram below.

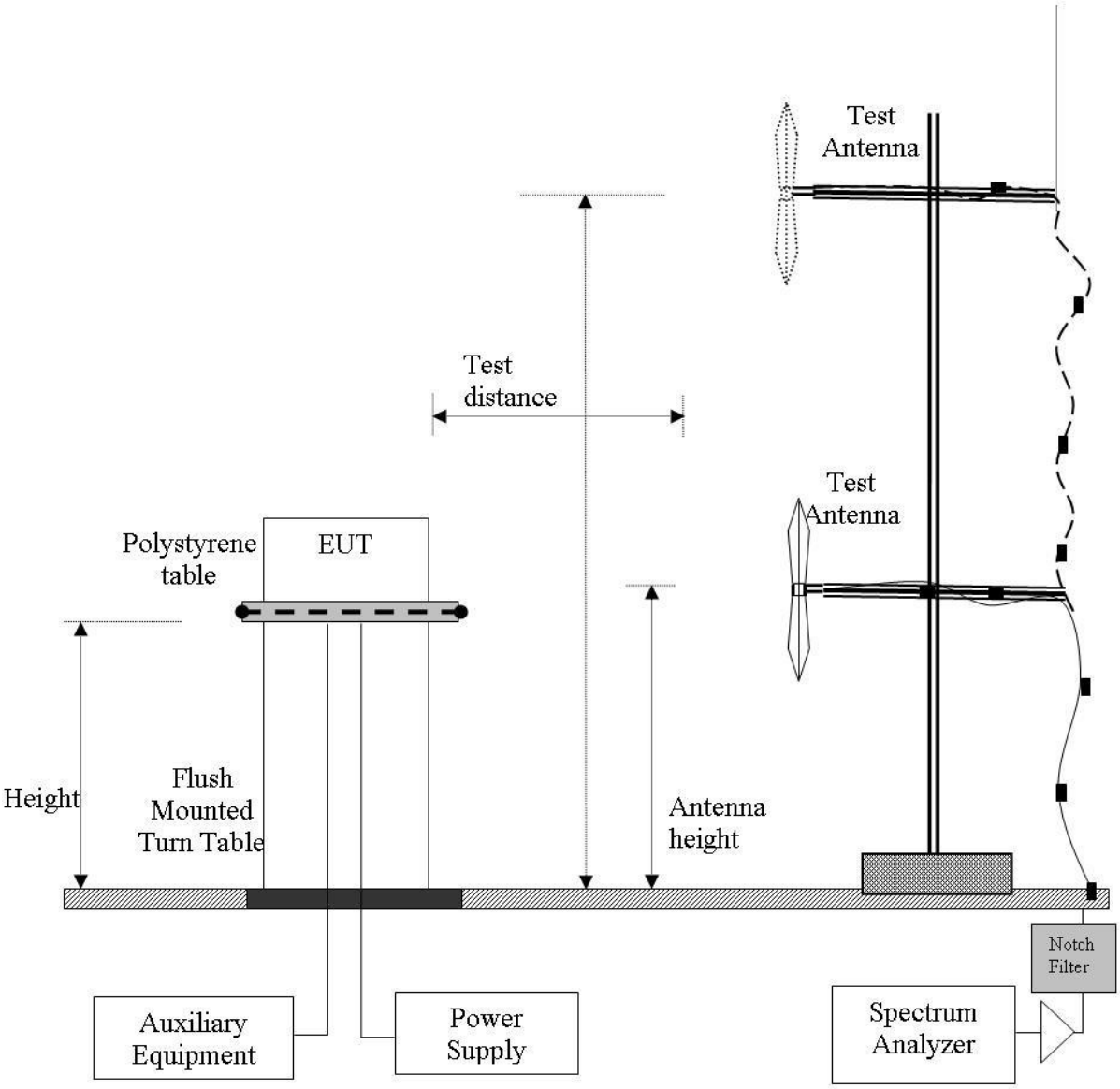
Radiated Emission Measurement Setup – Above 1 GHz



3.3. Digital Emissions Test Set-up (0.03 – 1 GHz)

The following tests were performed using the conducted test set-up shown in the diagram below.

Digital Emission Measurement Setup – Below 1 GHz

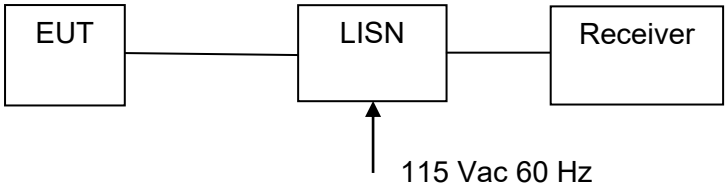


3.4. ac Wireline Emission Test Set-up

The following tests were performed using the conducted test set-up shown in the diagram below.

1. Section 5.1.3 ac Wireline Conducted Emissions

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247** and **Industry Canada RSS-247** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(b)(3) **15.31(e)** **A8.4(4)**	Peak Output Power	Shall not exceed 1W	Conducted	Complies	5.1.1.1
15.247(e) **A8.2**	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.1.2
15.247(a)(2) **A8.2(1)** **4.4**	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	5.1.1.3
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **4.7**	Spurious Emissions (30MHz - 26 GHz b/g and 30 MHz – 40 GHz a)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.1.4

List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247, Industry Canada RSS-247,** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **2.6** **4.7**	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.2
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	
	Radiated Band Edge	Band-edge results Peak Emissions		Complies	
15.205 / **15.209** **2.2**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*5.1.2.5*
15.207 **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	*5.1.3*

Note 1: *Test results reported in this document relate only to the items tested*
Note 2: *The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria*
Note 3: *Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

5.1. Device Characteristics

5.1.1. Conducted Testing

5.1.1.1. Peak Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Emission Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.2 Fundamental Emission Output Power KDB 662911 was implemented for In-band power measurements. The measure and sum technique was implemented in all cases.		

Test Procedure for Fundamental Emission Output Power Measurement

Selection of the detector type is determined by the client, either a peak detector or average power detector can be selected however the same detector type **must** be used for each of the following tests;

A). Output Power

B).. Power Density

C).. Conducted Spurious Emissions

Average Power
To measure average power a power meter measuring average power is implemented

Peak Detector
To measure peak power a spectrum analyser is used with the peak detector selected. The transmitter terminal of EUT was connected to the input of the spectrum analyser. The resolution filter bandwidth was set for 6 dB and the analyzers built-in power function used to integrate peak power over the EUT's 20 dB bandwidth.

Supporting Information
Calculated Power = A + G + 10 log (1/x) dBm
A = Total Power [10 Log10 ($10^{a/10}$ + $10^{b/10}$ + $10^{c/10}$ + $10^{d/10}$)], G = Antenna Gain,
x = Duty Cycle

15.247 (C) Operation with directional antenna gains greater than 6 dBi.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c) (2) (ii) (A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

Equipment Configuration for Average Output Power			
Variant:	802.11b	**Duty Cycle (%):**	99.0
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	0.9
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s) + DCCF Duty Cycle Correction Factor : +0.04 dB	Limit	Margin	EUT Power Setting
	Port(s)							
MHz	a	b	c	d	dBm	dBm	dB	
2412.0	21.93	22.65	22.09		27.05	30.00	-2.95	100.00
2437.0	21.36	23.13	21.88		27.00	30.00	-3.00	100.00
2462.0	21.62	22.50	22.01		26.87	30.00	-3.13	100.00

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

Equipment Configuration for Average Output Power			
Variant:	802.11g	**Duty Cycle (%):**	94.0
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	0.9
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s) + DCCF Duty Cycle Correction Factor : +0.27 dB	Limit	Margin	EUT Power Setting
	Port(s)							
MHz	a	b	c	d	dBm	dBm	dB	
2412.0	19.21	20.35	19.71		24.82	30.00	-5.18	100.00
2437.0	18.60	19.25	18.91		23.97	30.00	-6.03	82.00
2462.0	18.68	19.35	18.92		24.03	30.00	-5.97	82.00

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

Equipment Configuration for Average Output Power			
Variant:	802.11n HT-20	**Duty Cycle (%):**	94.6
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	0.9
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power Σ Port(s) + DCCF Duty Cycle Correction Factor : +0.22 dB	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	dBm	dBm	dB	
2412.0	18.52	19.17	18.51		23.76	30.00	-6.24	82.00
2437.0	18.89	19.58	19.06		24.20	30.00	-5.80	82.00
2462.0	18.93	19.58	19.15		24.24	30.00	-5.76	82.00

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

Equipment Configuration for Average Output Power			
Variant:	802.11n HT-40	**Duty Cycle (%):**	85.6
Data Rate:	13.5 MBit/s	**Antenna Gain (dBi):**	0.9
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s) + DCCF Duty Cycle Correction Factor : +0.66 dB	Limit	Margin	EUT Power Setting
	Port(s)							
MHz	a	b	c	d	dBm	dBm	dB	
2422.0	18.91	19.67	19.12		24.69	30.00	-5.31	82.00
2437.0	18.94	19.53	19.03		24.62	30.00	-5.38	82.00
2452.0	18.69	19.64	19.03		24.58	30.00	-5.42	82.00

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

Antenna Type V's Power Setting

The following **Antenna Types V's Power Setting** tables consolidates the results of all tests performed on the Fluke Networks BCM43460 module to finalize the power setting for each antenna's tested;

M830510 Chip Antenna

Channel	2.4 GHz			
	b	g	HT-20	HT-40
Low	70	76	70	65
Mid	67	82	82	82
High	67	67	67	58

NANO PCB Antenna

Channel	2.4 GHz			
	b	g	HT-20	HT-40
Low	75	69	65	61
Mid	80	82	82	82
High	80	62	56	40

WSS013 Antenna

Channel	2.4 GHz			
	b	g	HT-20	HT-40
Low	84	73	68	63
Mid	84	82	82	82
High	85	65	65	58

WTS2450RPSMA Antenna

Channel	2.4 GHz			
	b	g	HT-20	HT-40
Low	80	76	70	77
Mid	75	82	82	82
High	80	65	64	54

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Specification

Limits

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

> **§15.247 (b) (3)** For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1.0 watt.

15.247 (b) (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.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(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 conducted 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.

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

§15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

§ RSS-247 A8.4(4) For systems employing digital modulation techniques operating in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands the maximum peak conducted power shall not exceed 1 watt.

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

5.1.1.2. Power Spectral Density

Conducted Test Conditions for Power Spectral Density			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Power Spectral Density	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (e)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.3 Maximum Power Spectral Density Level in the Emission Bandwidth		

Test Procedure for Power Spectral Density

The transmitter output was connected to a spectrum analyzer and the maximum spectral emission was measured in a 3 kHz bandwidth for each antenna chain. Sweep time was auto selected by the analyzer which was set for single sweep. Once the maximum emission was found the emission(s) were summed for each chain, see Determining Peak Power Spectral Density Compliance below.

Detector Selection

Selection of the analyzer detector is determined by the client, however the same detector type **must** be used for each of the following tests;

A). Output Power
B).. Power Density
C).. Conducted Spurious Emissions

Determining Peak Power Spectral Density Compliance

For a MIMO device measurements were made on each antenna port and compared to the following limit;

Individual antenna limit = Power Spectral Density Limit – 10* Log (n); where n is the number of antenna ports

Individual measurements could potentially fail this limit however this does not imply a compliance failure at this stage. To determine compliance with PSD limits it involves summing the entire spectra across corresponding frequency bins on the various outputs. Consistency is maintained for any device with n transmitter outputs to be certain the individual outputs are all aligned with the same span and same number of points. In this instance, the linear power spectrum value within the first spectral bin of antenna 0 is summed with that in the first spectral bin of antenna 1, and the first spectral bin of antenna 2, and so on up to the Nth output to obtain the true value for the first frequency bin of the summed spectrum. The summed spectrum value for each frequency bin is computed in this fashion.

In the results matrix the column “Amplitude Summation” is the summed plot with any duty cycle offset included. The summed plot is a true representation of system performance and the key to determining compliance.

Supporting Information

Calculated Power = A + 10 log (1/x) dBm

x = Duty Cycle

Limit Line: KDB 662911 was implemented for In-band power spectral density (PSD) measurements - Option (2) measure and subtract 10 log (n) dB from the limit for devices with multiple RF ports.

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Equipment Configuration for Power Spectral Density - Average			
Variant:	802.11b	**Duty Cycle (%):**	99.0
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	0.90
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results							
Test Frequency	**Measured Power Spectral Density**				**Amplitude Summation + DCCF Duty Cycle Correction Factor : +0.04 dB**	**Limit**	**Margin**
	Port(s) (dBm/3KHz)						
MHz	**a**	**b**	**c**	**d**	**dBm/3KHz**	**dBm/3KHz**	**dB**
2412.0	-10.670	-10.325	-10.462		-5.880	8.0	-13.9
2437.0	-10.776	-10.002	-10.767		-6.423	8.0	-14.4
2462.0	-10.839	-9.945	-10.539		-6.084	8.0	-14.1

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Power Spectral Density - Average			
Variant:	802.11g	**Duty Cycle (%):**	94.0
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	0.90
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density Port(s) (dBm/3KHz)				Amplitude Summation + DCCF Duty Cycle Correction Factor : +0.27 dB	Limit	Margin
MHz	a	b	c	d	dBm/3KHz	dBm/3KHz	dB
2412.0	-14.959	-14.096	-14.973		-9.905	8.0	-17.9
2437.0	-16.146	-15.267	-15.950		-10.770	8.0	-18.7
2462.0	-15.002	-15.119	-14.902		-10.144	8.0	-18.1

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Power Spectral Density - Average			
Variant:	802.11n HT-20	**Duty Cycle (%):**	94.6
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	0.90
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density Port(s) (dBm/3KHz)				Amplitude Summation + DCCF Duty Cycle Correction Factor : +0.24 dB	Limit	Margin
MHz	**a**	**b**	**c**	**d**	**dBm/3KHz**	**dBm/3KHz**	**dB**
2412.0	-16.245	-15.917	-15.648		-11.212	8.0	-19.2
2437.0	-15.790	-14.690	-15.342		-10.572	8.0	-18.5
2462.0	-15.134	-14.537	-14.945		-10.087	8.0	-18.1

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Power Spectral Density - Average			
Variant:	802.11n HT-40	**Duty Cycle (%):**	85.6
Data Rate:	13.5 MBit/s	**Antenna Gain (dBi):**	0.90
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results							
Test Frequency	**Measured Power Spectral Density**				**Amplitude Summation + DCCF Duty Cycle Correction Factor : +0.67 dB**	**Limit**	**Margin**
	Port(s) (dBm/3KHz)						
MHz	**a**	**b**	**c**	**d**	**dBm/3KHz**	**dBm/3KHz**	**dB**
2422.0	-18.481	-17.796	-18.100		-12.699	8.0	-20.7
2437.0	-19.016	-18.121	-18.481		-13.229	8.0	-21.2
2452.0	-18.163	-16.995	-18.142		-12.286	8.0	-20.3

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Specification

Peak Power Spectral Density Limits

§15.247(e) 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

RSS-247 §**A8.2(2)** The transmitter power spectral density (into 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.

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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5.1.1.3. 6 dB and 99 % Bandwidth

Conducted Test Conditions for 6 dB and 99% Bandwidth			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	6 dB and 99 % Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.1 Emission Bandwidth		

Test Procedure for 6 dB and 99% Bandwidth Measurement
The bandwidth at 6 dB and 99 % was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

Equipment Configuration for 6 dB & 99% Bandwidth			
Variant:	802.11b	**Duty Cycle (%):**	99
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)							
MHz	a	b	c	d	Highest	Lowest	KHz	MHz
2412.0	9.218	9.218	9.699		9.699	9.218	≥500.0	-8.72
2437.0	9.619	9.780	9.699		9.780	9.619	≥500.0	-9.12
2462.0	9.218	9.699	9.218		9.699	9.218	≥500.0	-8.72

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)		
	Port(s)						
MHz	a	b	c	d			
2412.0	13.547	13.948	13.707		13.948		
2437.0	12.986	14.269	13.467		14.269		
2462.0	13.066	13.707	13.547		13.707		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for 6 dB & 99% Bandwidth			
Variant:	802.11g	**Duty Cycle (%):**	94
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)							
MHz	a	b	c	d	Highest	Lowest	KHz	MHz
2412.0	15.872	15.872	15.872		15.872	15.872	≥500.0	-15.37
2437.0	16.273	15.952	16.513		16.513	15.952	≥500.0	-15.45
2462.0	15.872	15.872	15.872		15.872	15.872	≥500.0	-15.37

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)		
	Port(s)						
MHz	a	b	c	d			
2412.0	20.601	22.846	22.124		22.846		
2437.0	20.040	19.880	20.441		20.441		
2462.0	19.719	19.399	19.800		19.800		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for 6 dB & 99% Bandwidth			
Variant:	802.11n HT-20	**Duty Cycle (%):**	95
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)							
MHz	a	b	c	d	Highest	Lowest	KHz	MHz
2412.0	16.513	17.074	16.754		17.074	16.513	≥500.0	-16.01
2437.0	17.395	17.154	17.796		17.796	17.154	≥500.0	-16.65
2462.0	16.513	17.074	17.154		17.154	16.513	≥500.0	-16.01

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)		
	Port(s)						
MHz	a	b	c	d			
2412.0	19.960	19.960	19.800		19.960		
2437.0	21.242	21.483	21.884		21.884		
2462.0	21.242	20.762	21.242		21.242		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

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Equipment Configuration for 6 dB & 99% Bandwidth			
Variant:	802.11n HT-40	**Duty Cycle (%):**	86
Data Rate:	13.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)							
MHz	a	b	c	d	Highest	Lowest	KHz	MHz
2422.0	35.431	35.431	34.148		35.431	34.148	≥500.0	-33.65
2437.0	36.232	36.072	36.072		36.232	36.072	≥500.0	-35.57
2452.0	36.072	36.713	36.072		36.713	36.072	≥500.0	-35.57

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)		
	Port(s)						
MHz	a	b	c	d			
2422.0	44.409	42.806	42.485		44.409		
2437.0	48.898	48.417	50.020		50.020		
2452.0	45.210	51.784	50.180		51.784		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

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Specification
Limits

§15.247 (a)(2) & RSS-247 §A8.2(1)
The minimum 6 dB bandwidth shall be at least 500 kHz.

§ IC RSS-Gen 4.4.1 Occupied Bandwidth When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

§ IC RSS-Gen 4.4.2 6 dB Bandwidth Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in –band spectral density of the modulated signal, with the transmitter modulated by a representative signal.

Traceability

Test Equipment Used
0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

5.1.1.4. Conducted Spurious Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Max Unwanted Emission Levels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (d)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.4 Maximum Unwanted Emission Levels		

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement
Transmitter Conducted Spurious and Band-Edge emissions were measured with a spectrum analyzer connected to the antenna terminal using one of the following limits;

1).. Peak Detector - 20 dB below the highest in-band spectral density (i.e. 20 dBc)

2).. Average Detector – 30 dB below the highest in-band spectral density (i.e. 30 dBc)

Selection of the analyzer detector is determined by the client, however the same detector type **must** be used for each of the following tests;

A). Output Power

B).. Power Density

C).. Conducted Spurious Emissions

Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Equipment Configuration for Conducted Low Band-Edge Emissions - Average			
Variant:	802.11b	**Duty Cycle (%):**	99
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2412.0 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2422.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M1 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-37.03	-25.52	2401.50			-1.500
b	-36.12	-25.31	2401.40			-1.400
c	-35.35	-25.98	2401.40			-1.400

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Per KDB 558074 D01 DTS Meas Guidance
Amended Limit – Channel found to contain the maximum PSD level can be used to establish the reference level.

Equipment Configuration for Conducted Low Band-Edge Emissions - Average			
Variant:	802.11g	**Duty Cycle (%):**	94
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2412.0 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2422.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M1 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-27.42	-25.32	2395.90	-27.42	2401.70	-1.700
b	-26.40	-25.32	2395.30	-26.40	2400.80	-0.800
c	-27.14	-25.32	2395.30	-27.14	2401.40	-1.400

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Per KDB 558074 D01 DTS Meas Guidance
Amended Limit – Channel found to contain the maximum PSD level can be used to establish the reference level.

Equipment Configuration for Conducted Low Band-Edge Emissions - Average			
Variant:	802.11n HT-20	**Duty Cycle (%):**	95
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2412.0 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2422.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M1 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-27.20	-25.31	2395.00	-27.20	2401.10	-1.100
b	-26.43	-25.31	2394.00	-26.43	2400.80	-0.800
c	-26.66	-25.31	2395.00	-26.66	2401.10	-1.100

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

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Equipment Configuration for Conducted Low Band-Edge Emissions - Average			
Variant:	802.11n HT-40	**Duty Cycle (%):**	86
Data Rate:	13.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2422.0 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2292.0 - 2442.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M1 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-27.24	-25.31	2384.30	-27.24	2402.60	-2.600
b	-26.87	-25.31	2384.00	-26.87	2402.60	-2.600
c	-27.02	-25.31	2383.70	-27.02	2402.30	-2.300

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted High Band-Edge Emissions - Average			
Variant:	802.11b	**Duty Cycle (%):**	99
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2462.0 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2452.0 - 2524.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M3 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-57.54	-25.98	2472.60			-10.900
b	-51.74	-25.32	2472.60			-10.900
c	-57.34	-25.86	2472.60			-10.900

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted High Band-Edge Emissions - Average			
Variant:	802.11g	**Duty Cycle (%):**	94
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2462.0 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2452.0 - 2524.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M3 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-35.31	-30.84	2481.10			-2.400
b	-36.39	-31.08	2481.10			-2.400
c	-36.01	-31.17	2481.10			-2.400

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted High Band-Edge Emissions - Average			
Variant:	802.11n HT-20	**Duty Cycle (%):**	95
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2462.0 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2452.0 - 2524.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M3 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-32.63	-30.78	2482.70			-0.800
b	-32.76	-30.56	2482.40			-1.100
c	-32.84	-30.81	2482.70			-0.800

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

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Equipment Configuration for Conducted High Band-Edge Emissions - Average			
Variant:	802.11n HT-40	**Duty Cycle (%):**	86
Data Rate:	13.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2452.0 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2432.0 - 2582.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Amended Limit**		**Margin**
	M3 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	-29.54	-25.32	2493.90	-29.54	2474.40	-9.100
b	-27.52	-25.32	2496.30	-27.52	2477.70	-5.800
c	-28.38	-25.32	2494.80	-28.38	2478.00	-5.500

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Conducted Spurious Emissions			
Variant:	802.11b	**Duty Cycle (%):**	99
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2412.0	30.0 - 26000.0	-67.504	-41.82	-67.504	-40.43	-67.504	-40.94		
2437.0	30.0 - 26000.0	-67.504	-41.91	-66.480	-40.13	-67.504	-41.41		
2462.0	30.0 - 26000.0	-67.504	-42.18	-67.504	-40.52	-67.504	-41.54		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Conducted Spurious Emissions			
Variant:	802.11g	**Duty Cycle (%):**	94
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2412.0	30.0 - 26000.0	-67.504	-43.69	-67.504	-42.98	-67.504	-43.73		
2437.0	30.0 - 26000.0	-67.504	-42.67	-67.504	-41.97	-67.504	-42.47		
2462.0	30.0 - 26000.0	-67.504	-42.99	-67.504	-42.42	-67.504	-42.81		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Conducted Spurious Emissions			
Variant:	802.11n HT-20	**Duty Cycle (%):**	95
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2412.0	30.0 - 26000.0	-68.663	-43.66	-67.504	-42.41	-67.504	-43.00		
2437.0	30.0 - 26000.0	-67.504	-41.82	-67.504	-41.34	-67.504	-41.79		
2462.0	30.0 - 26000.0	-67.504	-42.37	-67.504	-41.89	-67.504	-42.28		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Transmitter Conducted Spurious Emissions			
Variant:	802.11n HT-40	**Duty Cycle (%):**	86
Data Rate:	13.5 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2422.0	30.0 - 26000.0	-67.504	-43.82	-66.480	-43.06	-67.504	-43.65		
2437.0	30.0 - 26000.0	-68.663	-39.95	-67.504	-39.25	-67.504	-39.70		
2452.0	30.0 - 26000.0	-67.504	-40.04	-67.504	-38.92	-67.504	-39.49		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Note: click the links in the above matrix to view the graphical image (plot).

Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB
5725 MHz	5850 MHz	

§15.247(d) and RSS-247 §A8.5 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

§15.247(d)
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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

RSS-247 §A8.5 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 Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

RSS-Gen §4.7
The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

Method
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'

5.1.2. Radiated Emission Testing

Transmitter Radiated Spurious Emissions (above 1 GHz); Peak Field Strength Measurements; and Radiated Band Edge Measurements – Restricted Bands

FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-247 §A8.5, §2.2, §2.6
Industry Canada RSS-Gen §4.7

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Operational Modes

Operational mode(s) tested for spurious emissions were the modes which delivered maximum spectral density 802.11b and 802.11a.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

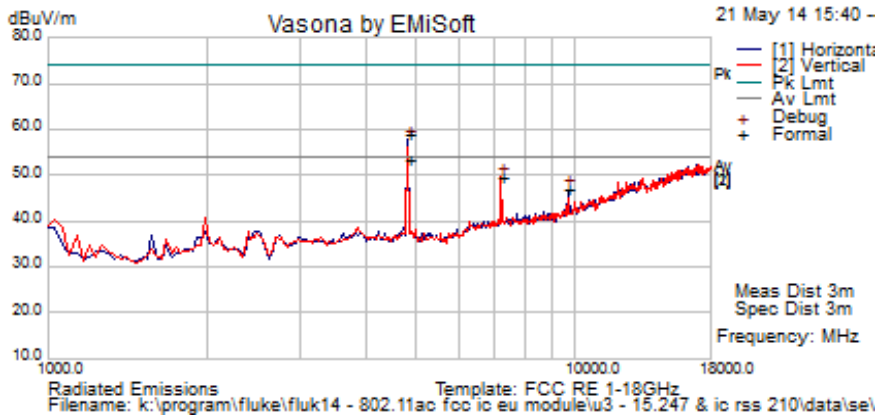
Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

NOTE: KDB 662911 was implemented for Out-of-Band measurements. Where necessary Option (2) Measure and add 10 log (N) dB was implemented

5.1.2.1. M830510 Chip antenna – Spurious and Band-Edge Emissions

Test Freq.	2412 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	46
Power Setting	85	**Press. (mBars)**	1001
Antenna	M830510 Chip	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Reduced power setting from 85 to 70;		

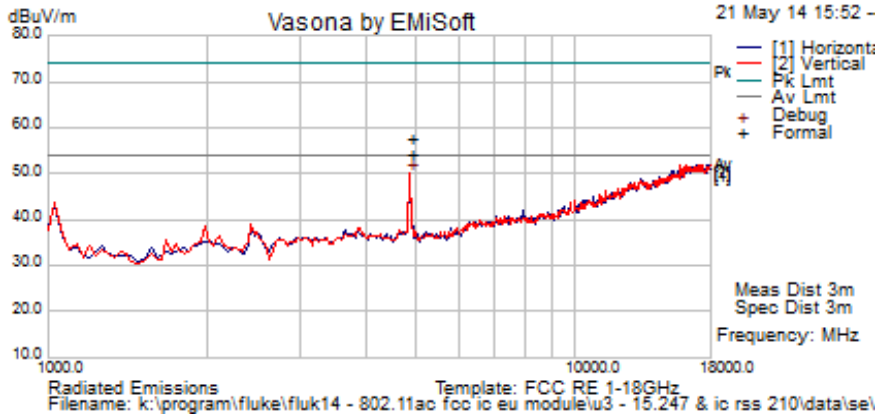


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4823.998	55.4	5.7	-2.3	58.7	Peak Max	H	157	336	74.0	-15.3	Pass	RB
4823.948	49.8	5.7	-2.3	53.2	Average Max	H	158	336	54.0	-0.8	Pass	RB
7234.469	42.7	7.2	-0.2	49.6	Peak [Scan]	V	200					NRB
9652.909	36.0	8.5	2.3	46.7	Peak [Scan]	H	100					NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2437 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	46
Power Setting	100	**Press. (mBars)**	1001
Antenna	M830510 Chip	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Reduced power setting from 100 to 67;		

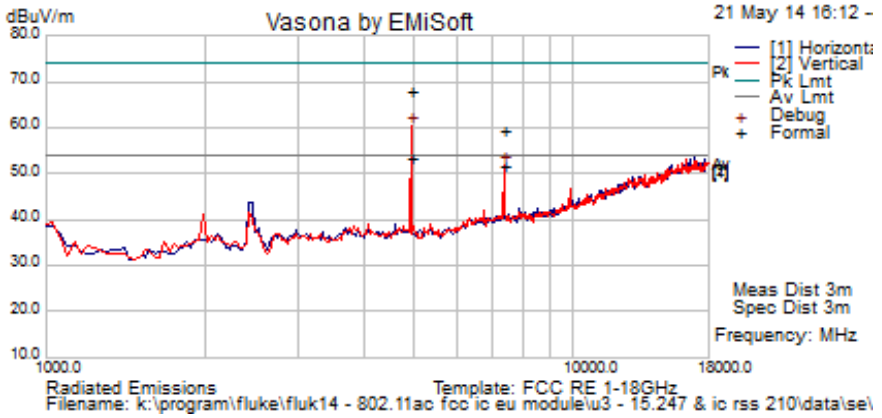


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4874.048	54.4	5.7	-2.3	57.8	Peak Max	V	99	77	74.0	-16.2	Pass	RB
4873.999	49.8	5.7	-2.3	53.2	Average Max	V	98	77	54.0	-0.8	Pass	RB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2462 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	46
Power Setting	95	**Press. (mBars)**	1001
Antenna	M830510 Chip	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Reduced power setting from 95 to 67;		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4923.929	64.6	5.7	-2.5	67.9	Peak Max	V	109	73	74.0	-6.2	Pass	RB
7386.874	52.1	7.3	-0.1	59.3	Peak Max	V	126	53	74.0	-14.7	Pass	RB
4923.930	50.2	5.7	-2.5	53.5	Average Max	V	109	73	54	-0.6	Pass	RB
7386.874	44.6	7.3	-0.1	51.8	Average Max	V	126	53	54	-2.2	Pass	RB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Band-Edge Results - M830510 Chip Antenna

Equipment Configuration for Radiated Low Band-Edge Emissions

Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	1.1
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	M830510 Chip		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2412.0, 2422.0 MHz
Band-Edge Frequency:	2390.0 MHz
Frequency Range:	2310.0 - 2390.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	55.83	74	-18.17	2390	47.7	54	-6.3	2389.61	85
g	73.17	74	-0.83	2390	53.65	54	-0.35	2390	76
HT20	73.18	74	-0.82	2389.61	51.02	54	-2.98	2390	70
HT40	71.37	74	-2.63	2389.61	52.39	54	-1.61	2386.84	65

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Equipment Configuration for Radiated High Band-Edge Emissions			
Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	1.1
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	M830510 Chip		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2452, 2462 MHz
Band-Edge Frequency:	2483.5 MHz
Test Frequency Range:	2483.5 - 2500.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	59.14	74	-14.86	2484.32	50.92	54	-3.08	2484.69	95
g	71.11	74	-2.89	2483.53	52.27	54	-1.73	2483.5	67
HT20	72.82	74	-1.18	2483.53	50.38	54	-3.62	2483.5	67
HT40	73.91	74	-0.09	2485.58	53.6	54	-0.4	2483.5	58

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

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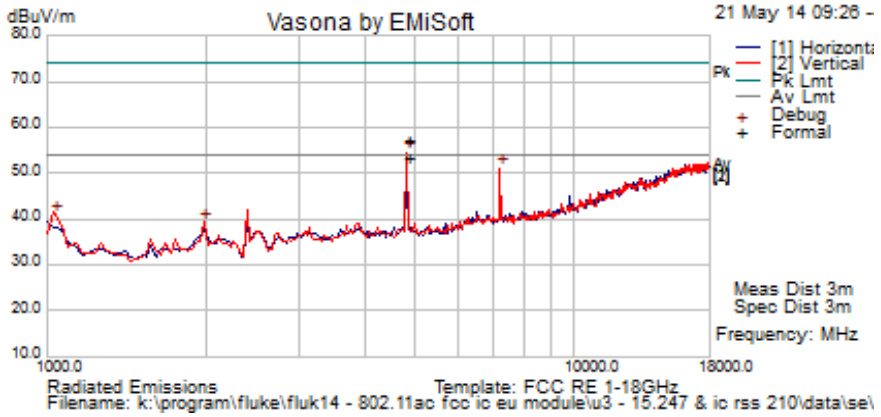
5.1.2.2. Nano PCB antenna – Spurious and Band-Edge Emissions

Test Freq.	2412 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	46
Power Setting	85	**Press. (mBars)**	1001
Antenna	Nano PCB	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Reduced power setting from 85 to 75;		

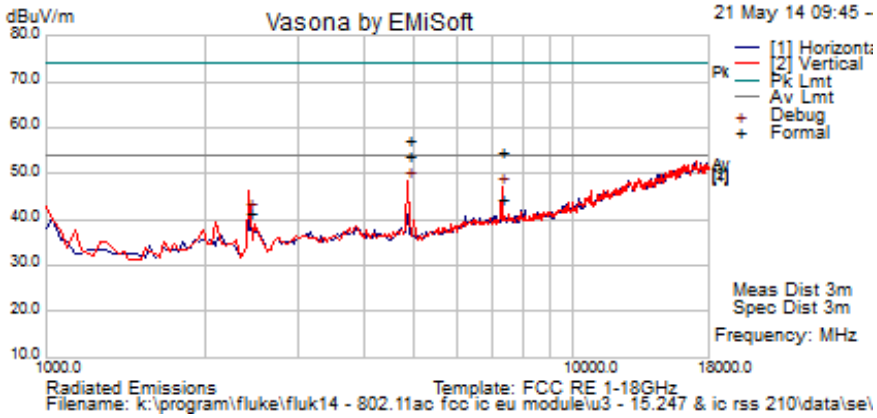


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4823.979	53.7	5.7	-2.3	57.1	Peak Max	V	105	58	74.0	-16.9	Pass	RB
4823.979	50.1	5.7	-2.3	53.4	Average Max	V	105	58	54.0	-0.6	Pass	RB
7236.774	44.1	7.2	-0.2	51.1	Peak [Scan]	V	100					NRB
1039.791	47.8	2.5	-9.4	41.0	Peak [Scan]	V	104	58	54	-13.1	Pass	RB
1986.677	41.6	3.5	-6.1	39.1	Peak [Scan]	V	104					NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2437 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	46
Power Setting	80	**Press. (mBars)**	1001
Antenna	Nano PCB	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Reduced power setting from 100 to 80;		

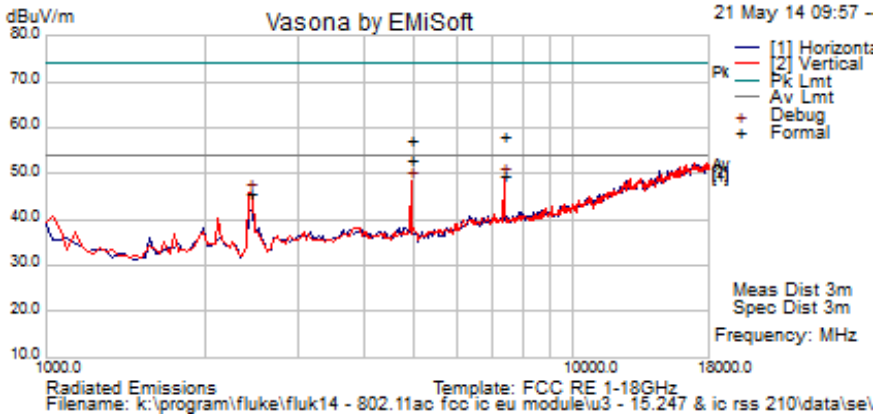


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4873.898	53.9	5.7	-2.3	57.3	Peak Max	V	148	34	74.0	-16.7	Pass	RB
7311.193	47.9	7.2	-0.3	54.8	Peak Max	V	147	52	74.0	-19.2	Pass	RB
4873.898	50.2	5.7	-2.3	53.6	Average Max	V	148	34	54	-0.4	Pass	RB
7311.193	37.2	7.2	-0.3	44.2	Average Max	V	147	52	54	-9.8	Pass	RB
2446.284	42.7	4.0	-5.2	41.4	Peak [Scan]	V	98					FUND

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2462 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	46
Power Setting	95	**Press. (mBars)**	1001
Antenna	Nano PCB	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Reduced power setting from 95 to 80;		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7386.874	50.9	7.3	-0.1	58.0	Peak Max	V	119	45	74.0	-16.0	Pass	RB
4923.807	53.8	5.7	-2.5	57.0	Peak Max	V	105	160	74.0	-17.0	Pass	RB
7386.874	42.3	7.3	-0.1	49.4	Average Max	V	119	45	54	-4.6	Pass	RB
4923.807	49.7	5.7	-2.5	53.0	Average Max	V	105	160	54	-1.0	Pass	RB
2446.284	46.9	4.0	-5.2	45.7	Peak [Scan]	V	98					FUND

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Band-Edge Results – NANO PCB Antenna

Equipment Configuration for Radiated Low Band-Edge Emissions			
Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	0.9
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	Nano Green PCB		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2412.0, 2422.0 MHz
Band-Edge Frequency:	2390.0 MHz
Frequency Range:	2310.0 - 2390.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	59.82	74	-14.18	2390	51.46	54	-2.54	2389.61	85
g	73.59	74	-0.41	2390	50.96	54	-3.04	2390	69
HT20	72.12	74	-1.88	2390	48.59	54	-5.41	2390	65
HT40	73.74	74	-0.26	2390	51.7	54	-2.3	2390	61

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

Equipment Configuration for Radiated High Band-Edge Emissions			
Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	0.9
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	Nano Green PCB		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2452, 2462 MHz
Band-Edge Frequency:	2483.5 MHz
Test Frequency Range:	2483.5 - 2500.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	63.68	74	-10.32	2483.66	53	54	-1	2491.3	89
g	73.32	74	-0.68	2483.53	52.79	54	-1.21	2483.5	62
HT20	72.92	74	-1.08	2483.53	51.36	54	-2.64	2483.5	56
HT40	72.99	74	-1.01	2485.38	52.22	54	-1.78	2483.5	40

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

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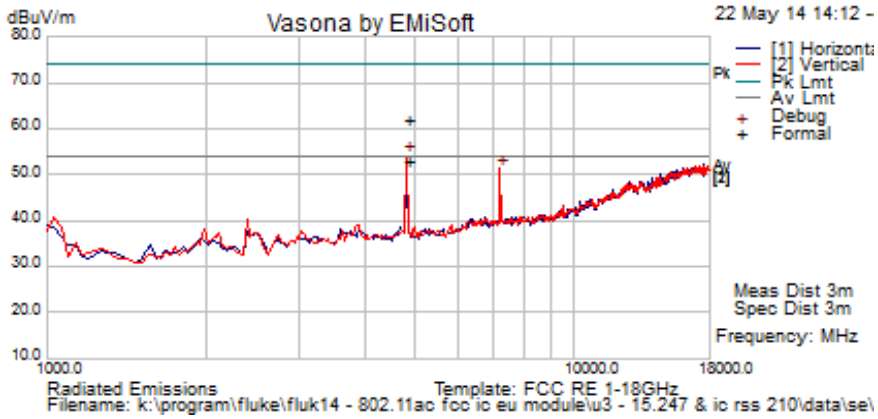
5.1.2.3. WSS013 Dual band antenna – Spurious and Band-Edge Emissions

Test Freq.	2412 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	24.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	39
Power Setting	92	**Press. (mBars)**	1000
Antenna	WSS013	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Power setting reduced from 92 to 84;		

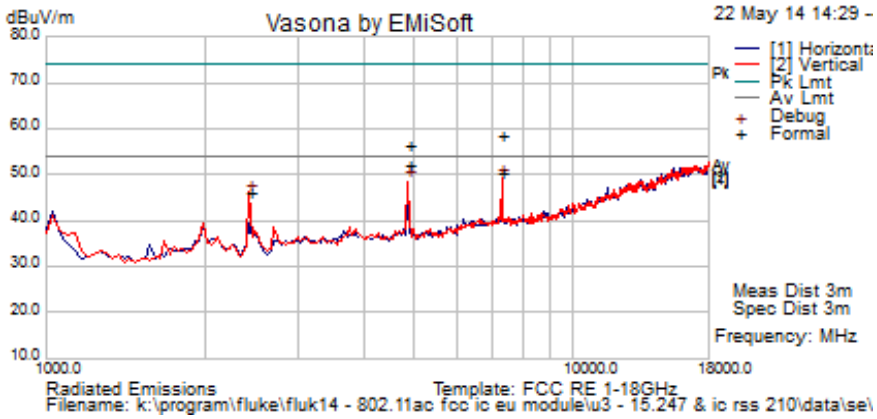


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4823.998	58.6	5.7	-2.3	62.0	Peak Max	V	109	79	74.0	-12.0	Pass	RB
4823.998	49.6	5.7	-2.3	52.9	Average Max	V	108	79	54.0	-1.1	Pass	RB
7234.469	44.5	7.2	-0.2	51.4	Peak [Scan]	V	100					NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2437 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	24.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	39
Power Setting	92	**Press. (mBars)**	1000
Antenna	WSS013	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Power setting reduced from 92 to 84;		

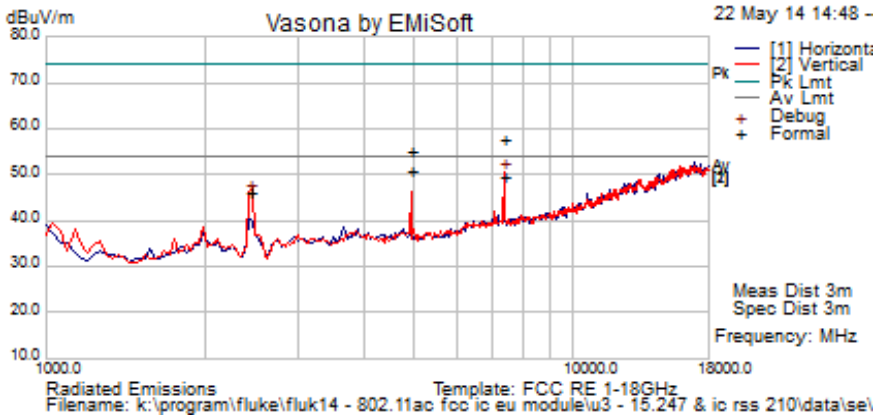


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7311.824	51.4	7.2	-0.3	58.4	Peak Max	V	99	63	74.0	-15.6	Pass	RB
4874.098	53.0	5.7	-2.3	56.4	Peak Max	V	153	108	74.0	-17.6	Pass	RB
7311.824	43.5	7.2	-0.3	50.4	Average Max	V	99	63	54	-3.6	Pass	RB
4874.098	48.7	5.7	-2.3	52.1	Average Max	V	153	108	54	-1.9	Pass	RB
2429.590	47.2	3.9	-5.3	45.9	Peak [Scan]	V	98					FUND

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2462 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	24.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	39
Power Setting	92	**Press. (mBars)**	1000
Antenna	WSS013	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Power setting reduced from 92 to 85;		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7387.976	50.3	7.3	-0.1	57.5	Peak Max	V	100	87	74.0	-16.5	Pass	RB
4923.935	51.9	5.7	-2.5	55.2	Peak Max	V	140	55	74.0	-18.8	Pass	RB
7387.976	42.3	7.3	-0.1	49.4	Average Max	V	100	87	54	-4.6	Pass	RB
4923.935	47.3	5.7	-2.5	50.6	Average Max	V	140	55	54	-3.4	Pass	RB
2429.590	47.2	3.9	-5.3	45.9	Peak [Scan]	V	98					FUND

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Band-Edge Results – WSS013 Antenna

Equipment Configuration for Radiated Low Band-Edge Emissions			
Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	2
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	WSS013 Dual Band Antenna		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2412.0, 2422.0 MHz
Band-Edge Frequency:	2390.0 MHz
Frequency Range:	2310.0 - 2390.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	60.98	74	-13.02	2387.71	52.96	54	-1.04	2387.33	89
g	73.56	74	-0.44	2390	53.35	54	-0.65	2390	73
HT20	72.9	74	-1.1	2390	50.82	54	-3.18	2390	68
HT40	72.9	74	-1.1	2388.47	50.5	54	-3.5	2390	63

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

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Equipment Configuration for Radiated High Band-Edge Emissions			
Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	2
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	WSS013 Dual Band Antenna		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2452, 2462 MHz
Band-Edge Frequency:	2483.5 MHz
Test Frequency Range:	2483.5 - 2500.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	60.56	74	-13.44	2487.93	49.06	54	-4.94	2488.09	95
g	69.17	74	-4.83	2437.97	50.38	54	-3.62	2483.5	65
HT20	73.74	74	-0.26	2483.73	52.62	54	-1.38	2483.53	65
HT40	71.29	74	-2.71	2483.59	53.6	54	-0.4	2483.5	58

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

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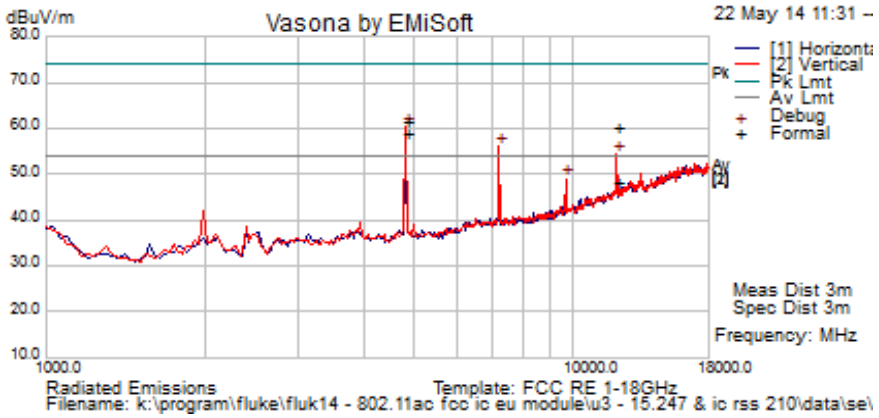
5.1.2.4. WTS2450RPSMA antenna – Spurious and Band-Edge Emissions

Test Freq.	2412 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	22
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	42
Power Setting	90	**Press. (mBars)**	1000
Antenna	WTS2450RPSMA	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Power setting reduced from 92 to 80;		

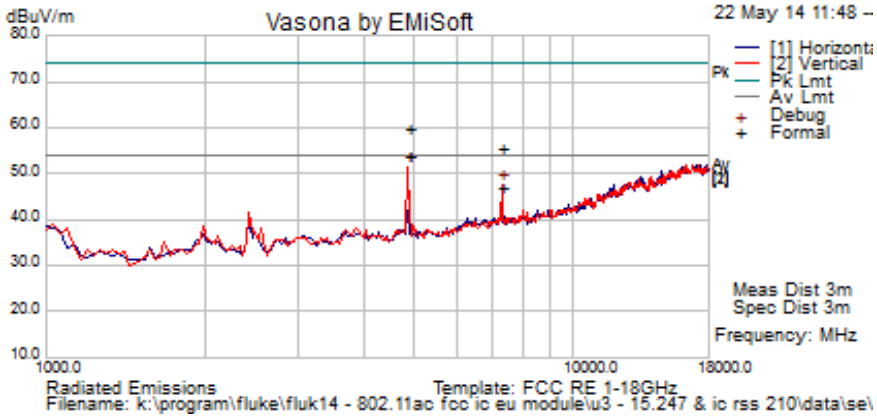


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4823.898	58.3	5.7	-2.3	61.6	Peak Max	V	99	5	74.0	-12.4	Pass	RB
12059.869	44.7	9.5	5.9	60.1	Peak Max	V	150	19	74.0	-14.0	Pass	RB
4823.899	50.6	5.7	-2.3	53.9	Average Max	V	99	5	54	-0.1	Pass	RB
12059.869	32.6	9.5	5.9	48.0	Average Max	V	150	19	54	-6.0	Pass	RB
7234.469	49.2	7.2	-0.2	56.1	Peak [Scan]	V	100					NRB
9653.307	38.3	8.5	2.3	49.0	Peak [Scan]	V	100					NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2437 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	22
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	42
Power Setting	90	**Press. (mBars)**	1000
Antenna	WTS2450RPSMA	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Power setting reduced from 100 to 75;		

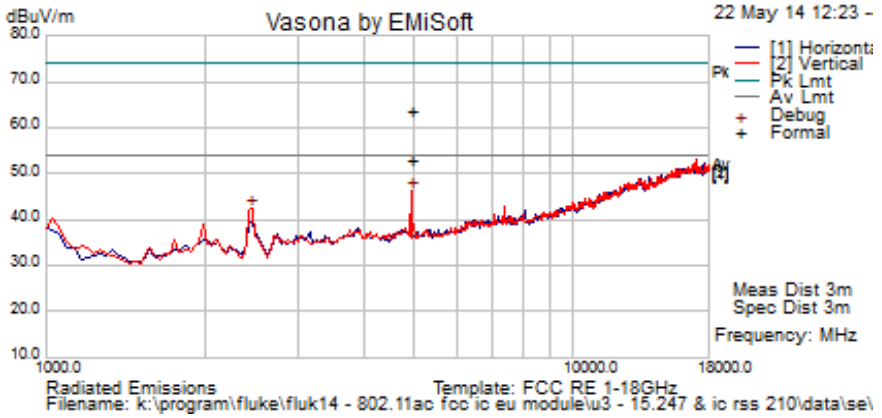


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4873.892	56.2	5.7	-2.3	59.6	Peak Max	V	99	-1	74.0	-14.4	Pass	RB
7310.022	48.6	7.2	-0.3	55.6	Peak Max	V	112	-1	74.0	-18.4	Pass	RB
4873.893	50.3	5.7	-2.3	53.7	Average Max	V	99	-1	54	-0.3	Pass	RB
7310.022	39.9	7.2	-0.3	46.8	Average Max	V	112	-1	54	-7.2	Pass	RB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2462 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	22
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	42
Power Setting	90	**Press. (mBars)**	1000
Antenna	WTS2450RPSMA	**Duty Cycle (%)**	100
Test Notes 1	Laptop w/ PCMCIA Adapter mini HDMI cable to radio module;		
Test Notes 2	Power setting reduced from 95 to 80;		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4924.080	60.4	5.7	-2.5	63.7	Peak Max	V	112	67	74.0	-10.4	Pass	RB
4924.03	49.7	5.7	-2.5	52.9	Average	V	111	67	54.0	-1.1	Pass	RB
2446.284	43.4	4.0	-5.2	42.2	Peak [Scan]	V	99					NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Band-Edge Results – WTS2450RPSMA Antenna

Equipment Configuration for Radiated Low Band-Edge Emissions			
Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	2.1
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	WTS2450RPSMA		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2412.0, 2422.0 MHz
Band-Edge Frequency:	2390.0 MHz
Frequency Range:	2310.0 - 2390.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	59.88	74	-14.12	2386.19	53.79	54	-0.21	2385.81	92
g	71.82	74	-2.18	2390	52.05	54	-1.95	2390	76
HT20	71.49	74	-2.51	2389.61	48.91	54	-5.09	2390	70
HT40	71.5	74	-2.5	2388.09	53.12	54	-0.88	2390	77

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

f

Equipment Configuration for Radiated High Band-Edge Emissions			
Variant:	802.11b,g, HT-20, HT40	**Duty Cycle (%):**	100
Data Rate:	1-13.5 Mbit/s	**Antenna Gain (dBi):**	2.1
Modulation:	CCK, OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Antenna:	WTS2450RPSMA		
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2452, 2462 MHz
Band-Edge Frequency:	2483.5 MHz
Test Frequency Range:	2483.5 - 2500.0 MHz

modes	Band-Edge Markers and Limit								
	Peak Amplitude (dBuV)	Peak Limit (dBuV)	Peak Margin dB	Peak Frequency (MHz)	AVG Amplitude (dBuV)	AVG Limit (dBuV)	AVG Margin dB	AVG Frequency (MHz)	Power Setting
b	56.11	74	-17.89	2485.12	46.34	54	-7.66	2484.78	95
g	67.92	74	-6.08	2483.53	48.38	54	-5.62	2483.5	65
HT20	72.95	74	-1.05	2483.69	50.6	54	-3.4	2483.5	64
HT40	72.08	74	-1.92	52.96	52.96	54	-1.04	2483.5	54

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	≤40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

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Specification Limits

FCC §15.247(d) and RSS-247 §A8.5 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

FCC §15.247(d)
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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

IC RSS-247 §A8.5 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 Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

IC RSS-Gen §4.7
The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

FCC §15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC §15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

§15.209 (a) Limit Matrix

Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.2.5. Digital Emissions (0.03-1 GHz)

FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-247 §2.2

Test Procedure
Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

Field Strength Calculation
The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

For example:
Given a Receiver input reading of 51.5dBμV; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

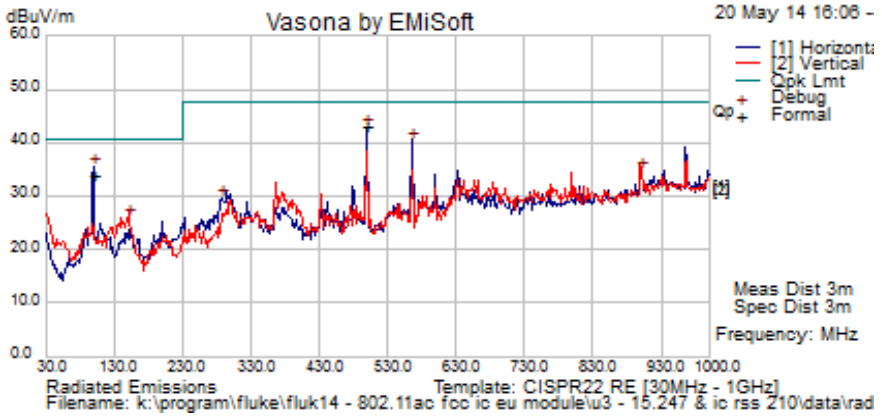
$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 dB\mu V/m$$

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

$$Level\ (dB\mu V/m) = 20 * Log\ (level\ (\mu V/m))$$

40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

Test Freq.	2437 MHz	**Engineer**	SB
Variant	Digital Emissions	**Temp (ºC)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	41
Power Setting	90	**Press. (mBars)**	1002
Antenna	Nano Green PCB		
Test Notes 1	Laptop on battery;		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
99.875	50.6	4.1	-20.9	33.9	Quasi Max	H	168	346	40.5	-6.6	Pass	
498.753	49.8	5.8	-12.7	42.9	Quasi Max	H	176	329	47.5	-4.6	Pass	
288.020	41.9	5.0	-17.2	29.6	Peak [Scan]	H	148	361	47.5	-17.9	Pass	
565.626	45.8	6.1	-11.6	40.3	Peak [Scan]	H	148	361	47.5	-7.2	Pass	
151.735	39.9	4.4	-18.5	25.8	Peak [Scan]	V	148	361	40.5	-14.7	Pass	
901.060	34.7	7.1	-7.2	34.6	Peak [Scan]	V	148	361	47.5	-12.9	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) *Except as shown in paragraphs (d) and* (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

§15.209 (a) and **RSS-Gen §2.2** Limit Matrix

Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

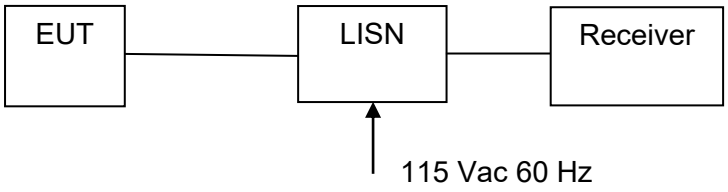
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.3. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

Test Procedure
The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test Measurement Set up



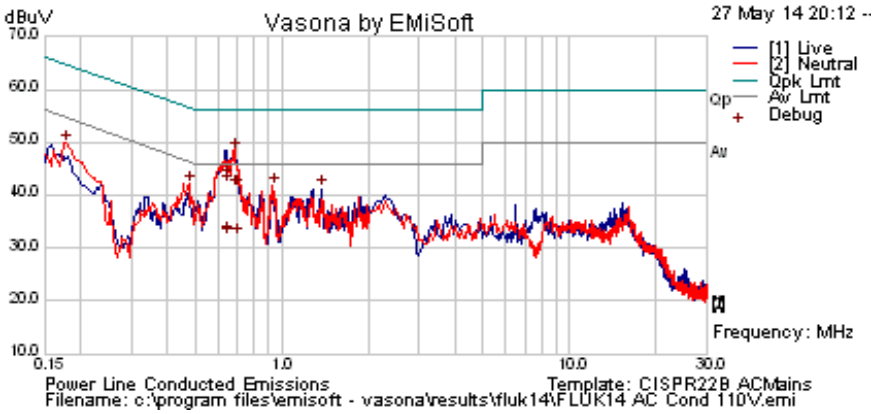
Measurement set up for AC Wireline Conducted Emissions Test

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

ac/dc Adaptor Wireline Emissions

Test Freq.	N/A	**Engineer**	JMH
Variant	AC Line Emissions	**Temp (ºC)**	18
Freq. Range	0.150 MHz - 30 MHz	**Rel. Hum.(%)**	35
Power Setting	NA	**Press. (mBars)**	1004
Antenna	N/A		
Test Notes 1	115VAC		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.643	32.1	10.0	0.1	42.2	Quasi Peak	Neutral	56	-13.8	Pass	
0.643	22.3	10.0	0.1	32.3	Average	Neutral	46	-13.7	Pass	
0.645	33.1	10.0	0.1	43.1	Quasi Peak	Live	56	-12.9	Pass	
0.645	22.5	10.0	0.1	32.5	Average	Live	46	-13.5	Pass	
0.685	31.4	10.0	0.1	41.4	Average	Live	46	-4.6	Pass	
0.685	38.1	10.0	0.1	48.1	Quasi Peak	Live	56	-7.9	Pass	
0.699	22.2	10.0	0.1	32.3	Average	Neutral	46	-13.7	Pass	
0.699	31.4	10.0	0.1	41.4	Quasi Peak	Neutral	56	-14.6	Pass	
0.476	32.2	9.9	0.1	42.2	Peak [Scan]	Neutral	46.4	-4.2	Pass	
0.929	31.6	9.9	0.1	41.7	Peak [Scan]	Neutral	46	-4.4	Pass	
1.373	31.2	10.0	0.1	41.3	Peak [Scan]	Live	46	-4.8	Pass	
0.176	39.9	9.9	0.1	49.9	Peak [Scan]	Neutral	54.67	-4.8	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

Specification

Limit

§15.207 (a) 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 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. 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.

RSS-Gen §7.2.2
The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

§15.207 (a) and **RSS-Gen §7.2.2** Limit Matrix
The lower limit applies at the boundary between frequency ranges

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

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	±2.64 dB

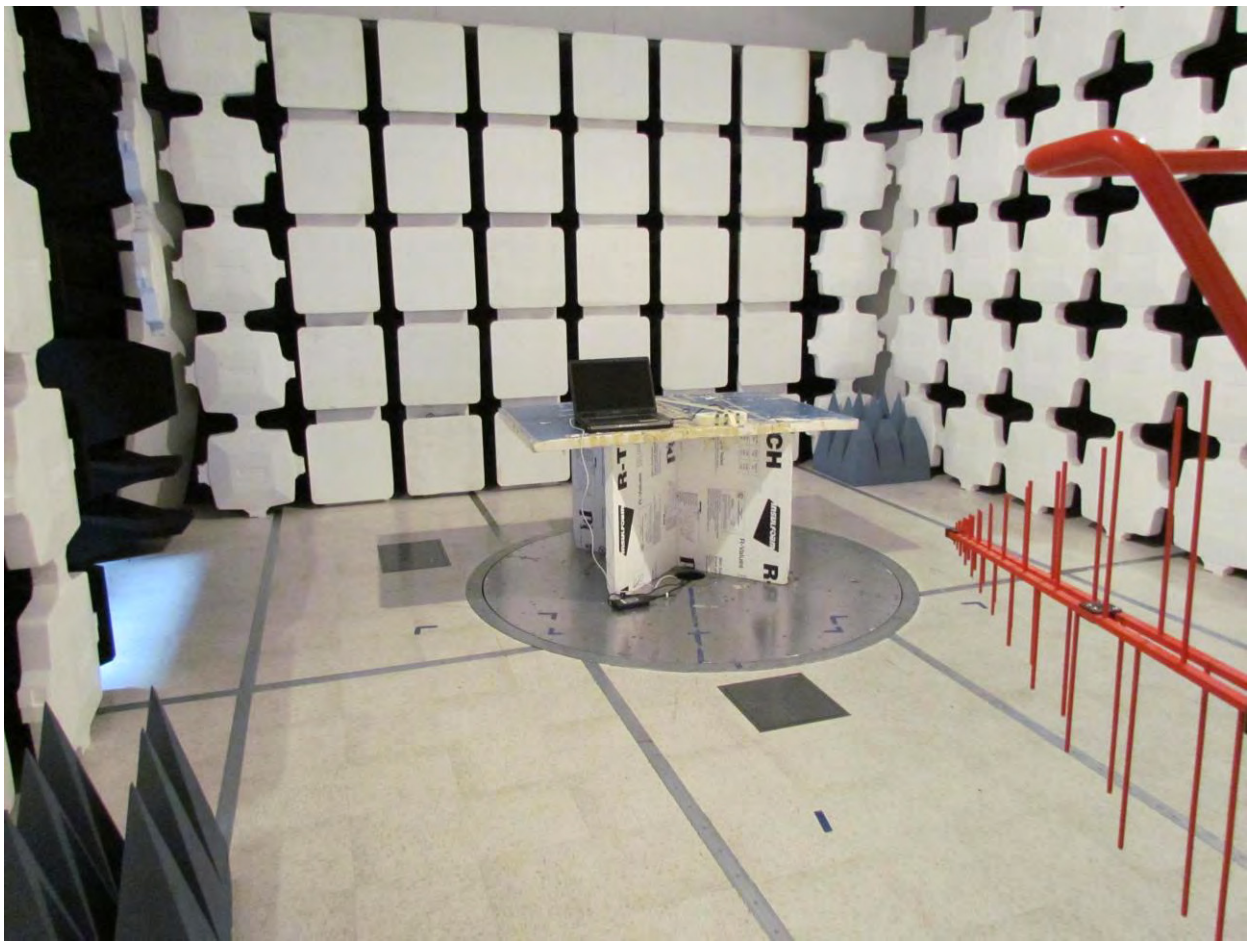
Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0287, 0190, 0293, 0307

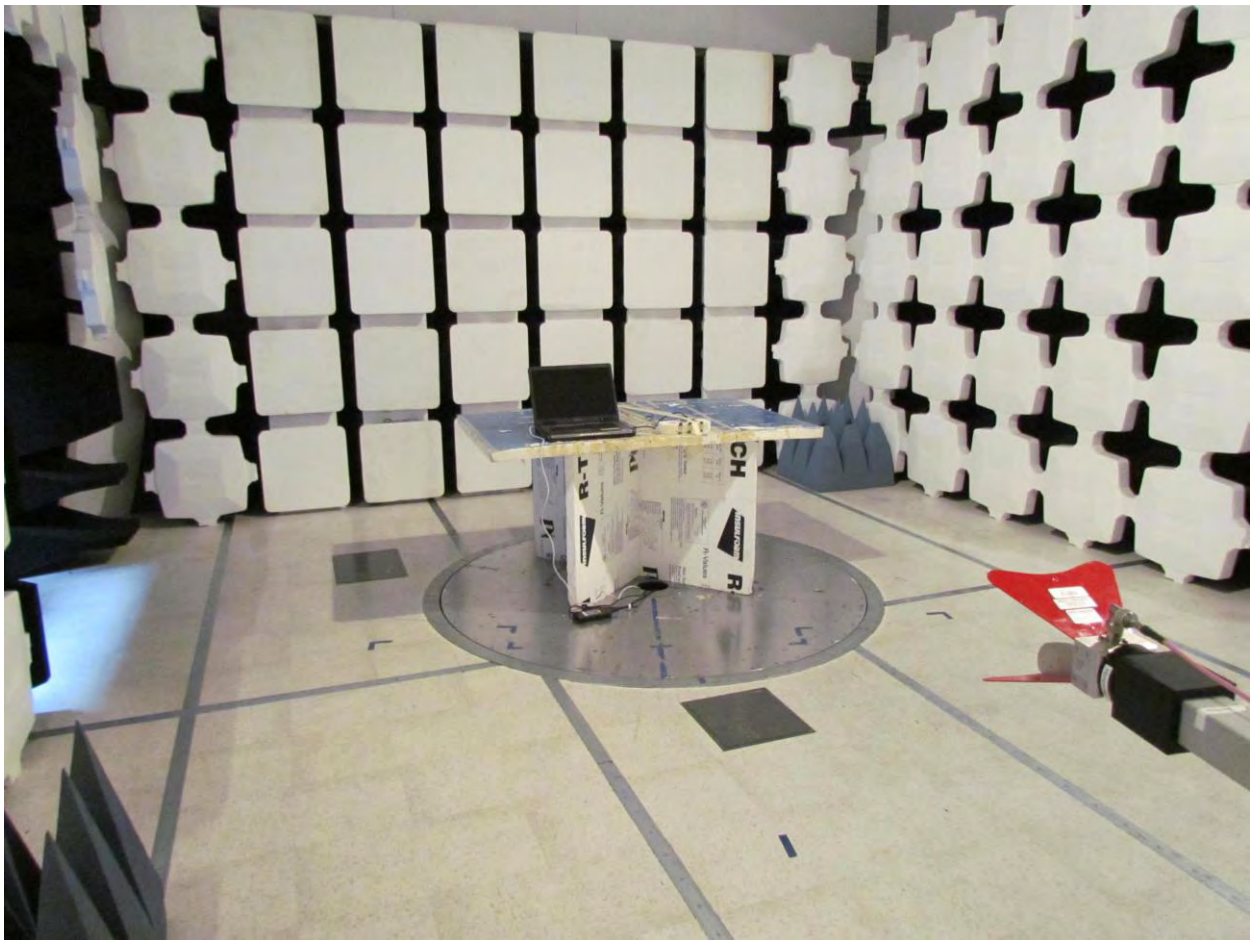
6. PHOTOGRAPHS

6.1. Conducted Test Setup

6.2. Radiated Emissions < 1 GHz



6.3. Radiated Emissions > 1 GHz



7. TEST EQUIPMENT

Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration Due Date
0117	Power Sensor	Hewlett Packard	8487D	3318A00371	18th Oct 14
0223	Power Meter	Hewlett Packard	EPM-442A	US37480256	18th Oct 14
0376	Power Sensor	Agilent	U2000A	MY51440005	28th Oct 14
0390	Power Sensor	Agilent	U2002A	MY50000103	17th Oct 14
0158	Barometer /Thermometer	Control Co.	4196	E2846	6th Dec 14
0287	EMI Receiver	Rhode & Schwartz	ESIB40	100201	31st Jul 14
0378	EMI Receiver	Rhode & Schwartz	ESIB40	100107/040	17th Jul 14
0338	30 - 3000 MHz Antenna	Sunol	JB3	A052907	14th Aug 14
0399	1-18 GHz Horn Antenna	EMCO	3117	00154575	10th Oct 14
0252	SMA Cable	Megaphase	Sucoflex 104	None	N/A
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001	N/A
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001	N/A
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623	N/A
0359	DFS Test System	Aeroflex	PXI-1042	300001/004	21st Oct 14
0299	DFS Test Software	Aeroflex	PXIModule	Version 7.1.0	N/A
0502	EMC Test Software	EMISoft	Vasona	5.0051	N/A
0503	RF Conducted Test Software	National Instruments	Labview	Version 8.2	N/A
0398	RF Conducted Test Software	MiCOM Labs ATS	--	Version 1.8	N/A
0380	RF Switch	MiCOM Labs	MIC001	MIC001	20th Sept 14

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