Nemko Test Report:	133553-1TRFWL
Applicant:	SMART Technologies ULC 3636 Research Road NW Calgary, AB Canada, T2L 1Y1
Apparatus:	Wireless Dongle (Jasper)
FCC ID:	QCIWC602
In Accordance With:	FCC Part 15 Subpart C, 15.247 FHSS System and Digitally Modulated Radiators 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
Authorized By:	Andrey Adelberg, Senior Wireless/EMC Specialist
Date:	October 8, 2009
Total Number of Pages:	25

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Section 1 : Report Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C. Radiated tests were conducted in accordance with ANSI C63.4-2003.

The assessment summary is as follows:

Apparatus Assessed:	Wireless Dongle (Jasper)
Specification:	FCC Part 15 Subpart C, 15.247
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None
Report Release History:	Original Release
Test Location:	Nemko Canada Inc. 303 River Road Ottawa, Ontario K1V 1H2
Registration Number:	176392 (3 m Semi-Anechoic Chamber)
Tests Performed By:	Kevin Ma, Wireless/EMC Specialist
Test Dates:	September 20 to 24, 2009

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Section 2 : Equipment Under Test

2.1 Identification of Equipment Under Test (EUT)

The following information identifies the EUT under test:

Type of Equipment:	Bluetooth Wireless Dongle (Jasper)
Brand Name:	SMART Technologies
Model Name or Number:	GU3705
Serial Number:	N/A
Nemko Sample Number:	6
FCC ID:	QCIWC602
Date of Receipt:	September 17 2009

2.2 Accessories

The following information identifies accessories used to exercise the EUT during testing:

Description:	Laptop
Brand Name:	IBM
Model Name or Number:	T23
Serial Number:	78-1VRMP
Connection Port:	USB
Cable Length and Type:	1 m

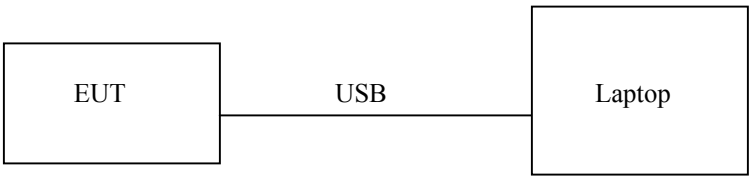
2.3 EUT Description

The EUT is a Bluetooth transceiver designed to operate in the 2.4–2.4835 GHz band. The Jasper Dongle is a part of WC6 system.

2.4 Technical Specifications of the EUT

Operating Band:	2400–2483.5 MHz
Operating Frequency:	2402–2480 MHz
Modulation:	GFSK
Occupied Bandwidth:	801 kHz
Emission Designator:	8K01F1D
Antenna Data:	Integrated SMD antenna, max. 2.1 dBi
Power Supply Requirements:	Powered by USB

2.5 EUT Setup diagram



2.6 Operation of the EUT during testing

The EUT was controlled to transmit at desired frequency and power from laptop.

2.7 Modifications incorporated in the EUT

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

Section 3 : Test Conditions

3.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.247
FHSS System and Digitally Modulated Radiators
902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

3.2 Deviations From Laboratory Test Procedures

No deviations were made from laboratory test procedures.

3.3 Test Environment

All tests were performed under the following environmental conditions:

Temperature range	:	15–30 °C
Humidity range	:	20–75 %
Pressure range	:	86–106 kPa
Power supply range	:	±5 % of rated voltages

3.4 Measurement Uncertainty

Nemko Canada measurement uncertainty has been calculated using guidance of UKAS LAB 34:2003 and TIA-603-B Nov 7, 2002. All calculations have been performed to provide a confidence level of 95 % and can be found in Nemko Canada document MU-003.

3.5 Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Cal. Date	Next Cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/09	May 06/10
Bilog	Sunol	JB3	FA002108	Jan. 27/09	Jan. 27/10
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR	NCR
Controller	Sunol	SC104V	FA002060	NCR	NCR
Mast	Sunol	TLT2	FA002061	NCR	NCR
International Power Supply	California Inst.	3001i	FA001021	Jan. 13/09	Jan. 13/10
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 16/08	Dec. 16/09
LISN	Rohde & Schwarz	ENV216	FA002023	Sept. 08/10	LISN
Horn Antenna #2	EMCO	3115	FA000825	Jan. 21/09	Jan. 21/10
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 2/08	Oct 2/09
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 40	FA002071	Nov. 25/08	Nov. 25/09
Horn 18 – 26.5 GHz	Electro-Metrics	SH-50/60-1	FA000479	COU	COU
18.0 – 26.0 GHz Amplifier	NARDA	BBS-1826N612	FA001550	COU	COU
Multimeter	Fluke	16	FA001831	Jan 13/09	Jan 13/10
Notch Filter	Microwave Circuits	2400-2483MHz	FA001940	COU	COU
Attenuator	Narda	776B-20	FA001153	COU	COU

COU – Calibrate on Use
NCR – No Calibration Required

Section 4 : Results Summary

This section contains the following:

FCC Part 15 Subpart C : Test Results

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N No : not applicable / not relevant.

Y Yes : Mandatory i.e. the apparatus shall conform to these tests.

N/T Not Tested, mandatory but not assessed. (See Report Summary)

4.1 FCC Part 15 Subpart C : Test Results

Part 15	Test Description	Required	Result
15.31(e)	Variation of power supply	Y	PASS
15.207(a)	Powerline Conducted Emissions	Y	PASS
15.209(a)	Radiated Emissions within Restricted Bands	Y	PASS
15.247(a)(1)	Frequency hopping systems	Y	PASS
15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	N	
15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	N	
15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Y	PASS
15.247(a)(2)	Systems using digital modulation techniques	N	
15.247(b)(1)	Maximum peak output power of Frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Y	PASS
15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	N	
15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	N	
15.247(b)(4)	Maximum peak output power	N	
15.247(c)(1)	Fixed point-to-point Operation with directional antenna gains greater than 6 dBi	N	
15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	N	
15.247(d)	Radiated Emissions Not in Restricted Bands	Y	PASS
15.247(e)	Power Spectral Density for Digitally Modulated Devices	N	
15.247(f)	Time of Occupancy for Hybrid Systems	N	

Appendix A : Test Results

Clause 15.207(a) Powerline Conducted Emissions

Frequency of Conducted limit (dBµV)

Emission (MHz)	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

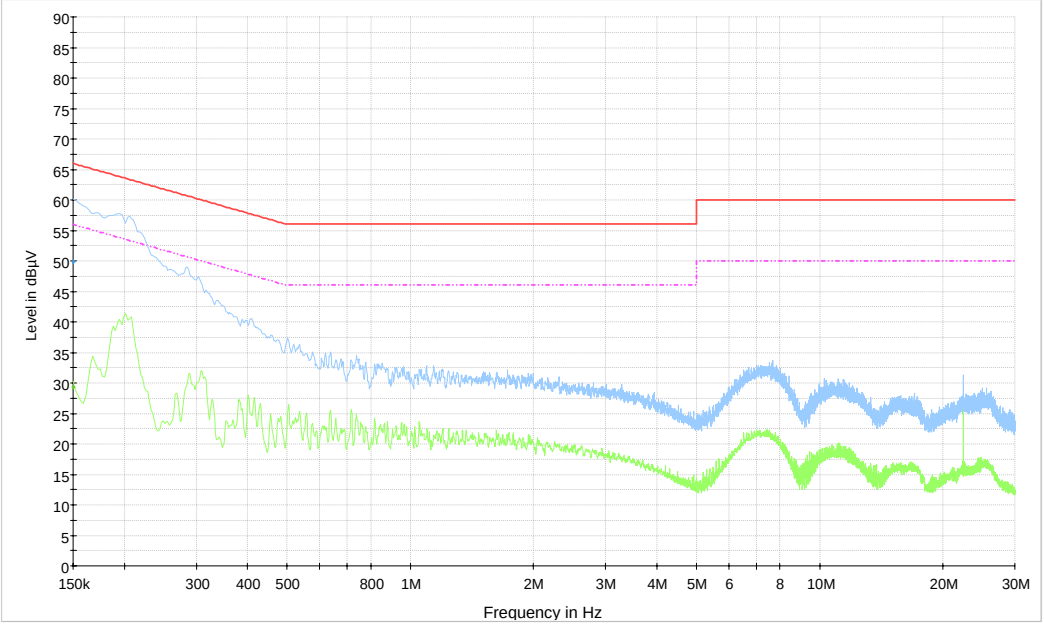
* Decreases with the logarithm of the frequency.

Test Results: Pass

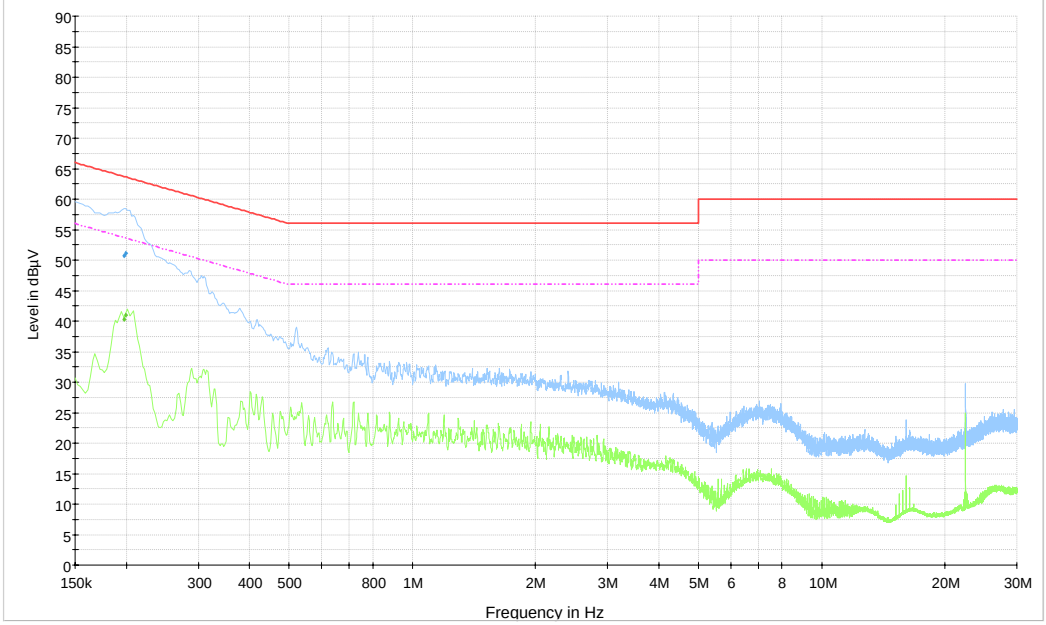
Additional Observations:

All plots were obtained using a sweeping receiver with an IF of 9 kHz using a Peak and Average detector. The plots have been corrected with the cable loss and LISN loss to show compliance.

Phase



Neutral



Clause 15.209(a) Radiated Emissions within Restricted Bands

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:

Frequency (MHz)	Field Strength		Measurement Distance (meters)
	(µV/m)	(dBµV/m)	
0.009–0.490	2400/F	67.6−20log(F)	300
0.490–1.705	24000/F	87.6−20log(F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
Above 960	500	54.0	3

Note: F = fundamental frequency in kHz

Test Results: Pass

Additional Observations:

The Spectrum was searched from 30 MHz to the 10th Harmonic.

These results apply to emissions found in the Restricted bands defined in FCC Part 15 Subpart C, 15.205.

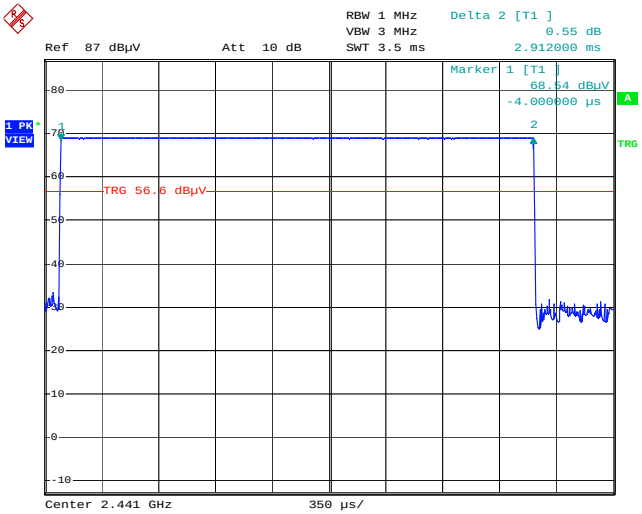
The EUT was tested in 3 orthogonal positions.

All measurements were performed at the distance of 3 m. Peak detector was used with 100 kHz RBW/300 kHz VBW below 1 GHz and 1 MHz/3 MHz RBW/VBW above 1 GHz.

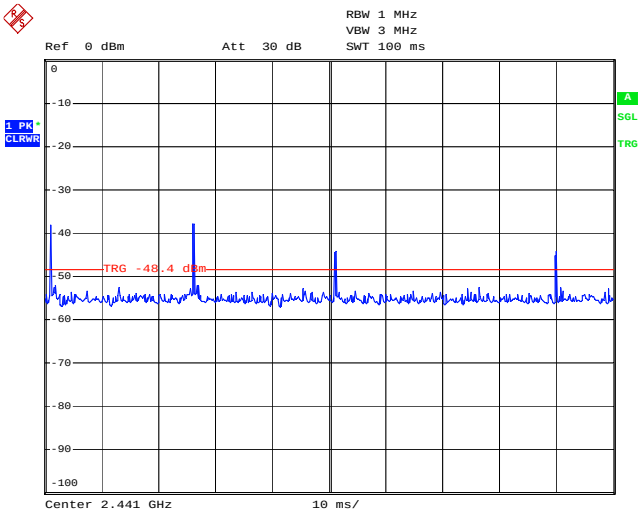
Channel	Freq. MHz	Pol.	Peak Field Strength dBµV/m	Peak Limit dBµV/m	Margin dB	Average Factor dB	Average Field Strength dBµV/m	Average Limit dBµV/m	Margin dB
0	4804.1	V	50.3	74.00	23.7	-18.67	31.63	54.00	22.37
0	4804.1	H	49.5	74.00	24.5	-18.67	30.83	54.00	23.17
39	4882.5	V	51.1	74.00	22.9	-18.67	32.43	54.00	21.57
39	4882.5	H	49.6	74.00	24.4	-18.67	30.93	54.00	23.07
78	4960.5	V	52.6	74.00	21.4	-18.67	33.93	54.00	20.07
78	4960.5	H	51.9	74.00	22.1	-18.67	33.23	54.00	20.77

Note: Antenna Factor, cable loss and amplifier gain are included in the Peak Field Strength result.

Duty Cycle:
Transmission On Time



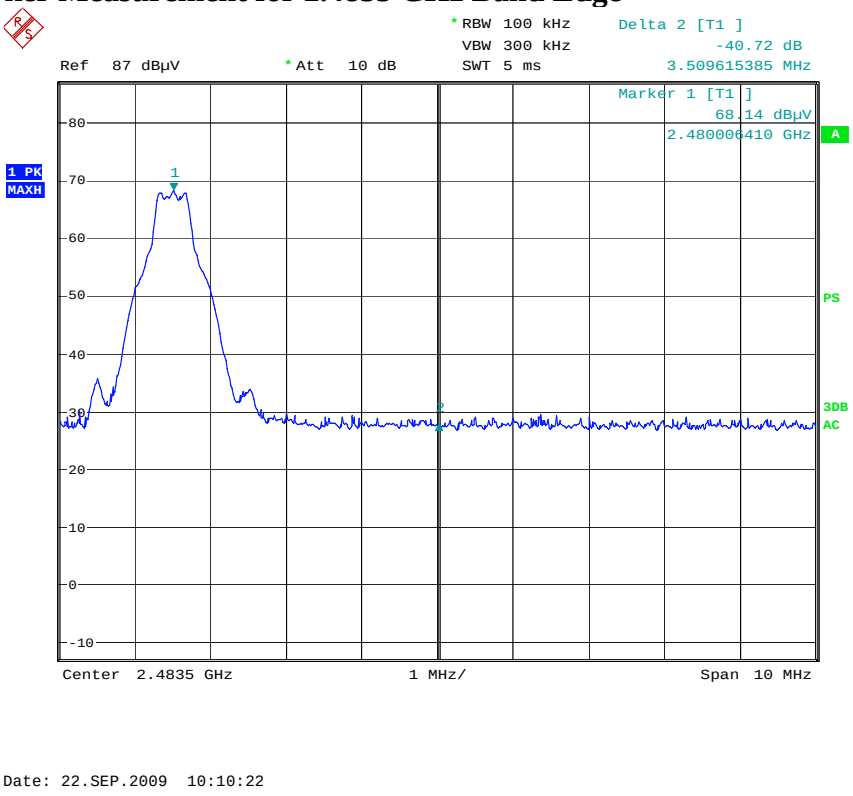
Transmission within 100 ms



T_{ON} (ms)	Maximum number of pulses within 100 ms	T_{ON} (ms) within 100 ms	Average factor (dB)
2.912	4	11.648	-18.67

Duty Cycle Correction (Average Factor) = 20 $\log_{10}$(T / 100ms) = -18.67 dB
20 $\log_{10}$(1.624 ms / 100 ms) = -18.67 dB

Delta Marker Measurement for 2.4835 GHz Band Edge



Measured Field Strength for High Channel in 1 MHz/3 MHz RBW/VBW = 101.53 dBµV/m

Delta Marker = -40.72 dB

Therefore, Peak Field Strength = 101.53 dBµV/m – 40.72 dB = 60.81 dBµV/m
Limit = 74 dBµV/m
Average Field Strength = 60.81 dBµV/m –18.67 dB (Duty Cycle) = 42.14 dBµV/m
Limit = 54 dBµV/m

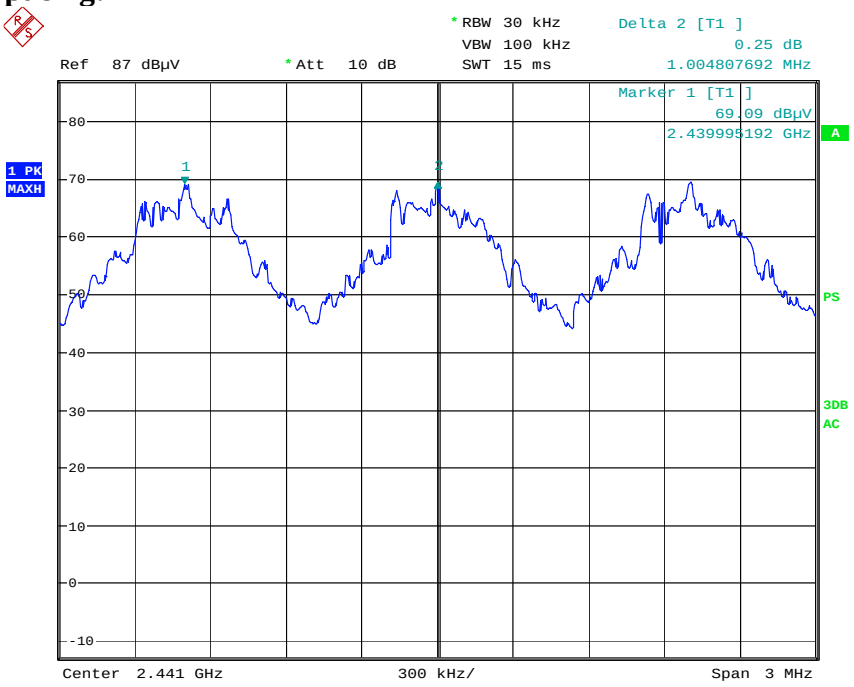
Peak Field Strength (dBµV/m)	**Peak Field Strength Limit (dBµV/m)**	**Margin (dB)**
60.81	74.00	13.19
Average Field Strength (dBµV/m)	**Average Field Strength Limit (dBµV/m)**	**Margin (dB)**
42.14	54.00	11.86

Clause 15.247(a)(1) Frequency hopping systems

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Results: Pass

Channel Spacing:



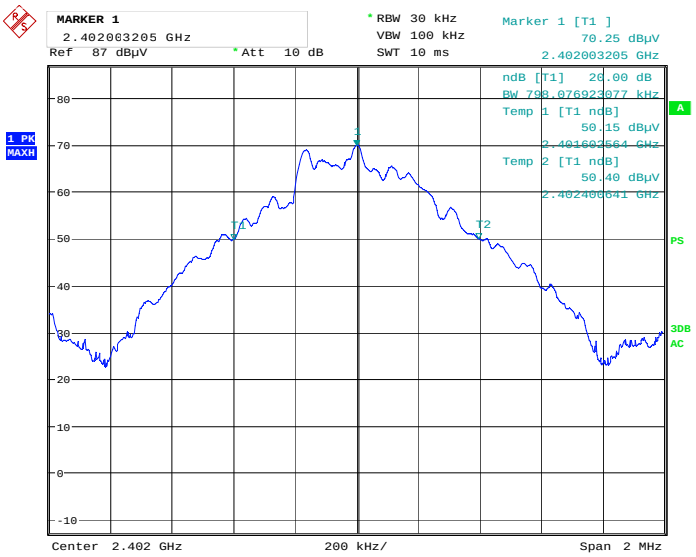
Limit calculation:

0.801 MHz (20 dB BW) x 2/3 = 0.534 MHz

Channel Spacing (MHz)	Limit (MHz)	Margin (MHz)
1.004	0.534	0.470

20dB Bandwidth:

Low Channel Bandwidth



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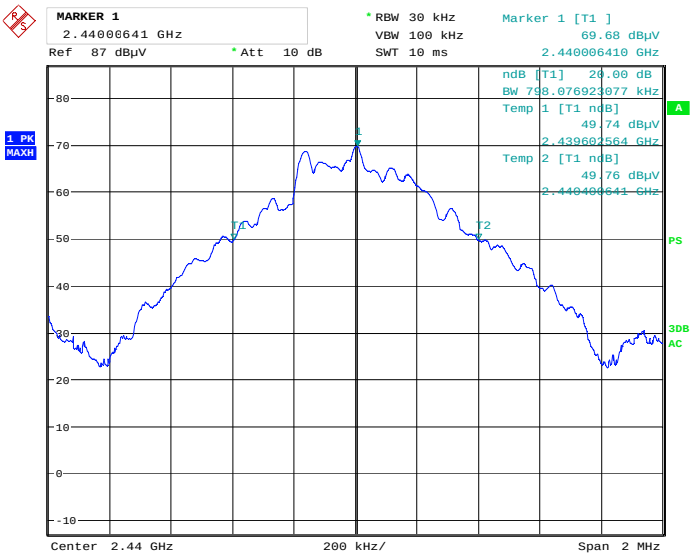
Mid Channel Bandwidth



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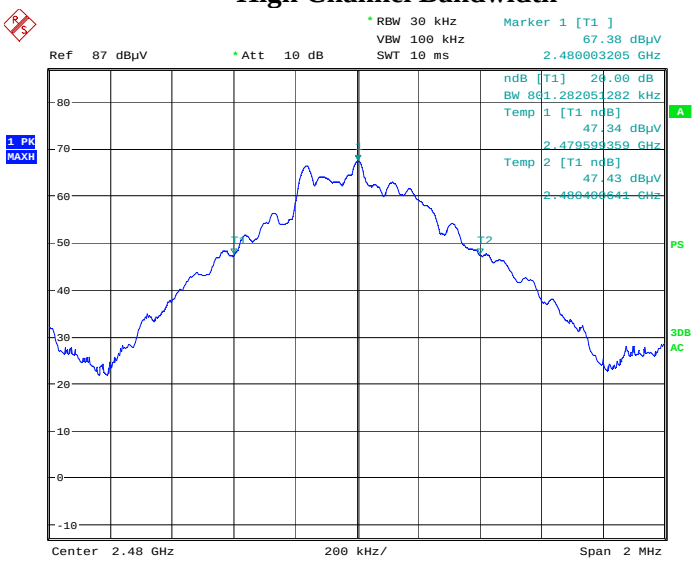
High Channel Bandwidth



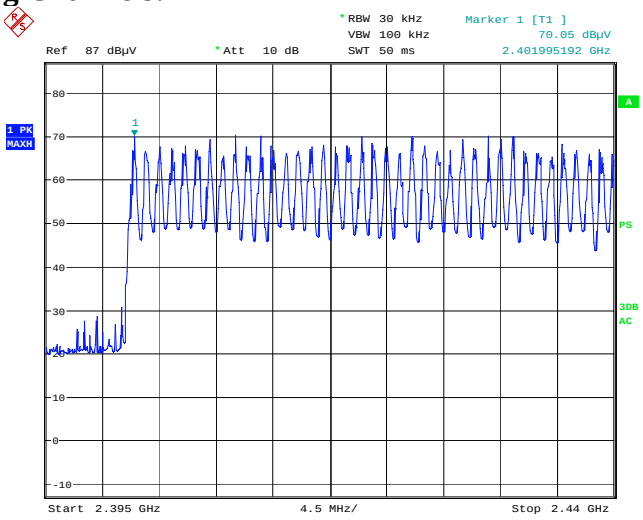
Low Channel 20 dB Bandwidth (MHz)	Mid Channel 20 dB Bandwidth (MHz)	High Channel 20 dB Bandwidth (MHz)
0.798	0.798	0.801

Clause 15.247(a)(1)(iii) Frequency hopping systems operating in the 2400–2483.5 MHz band

Frequency hopping systems in the 2400–-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 s within a period of 0.4 s multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used

Test Results: Pass

Number of Hopping Channels:



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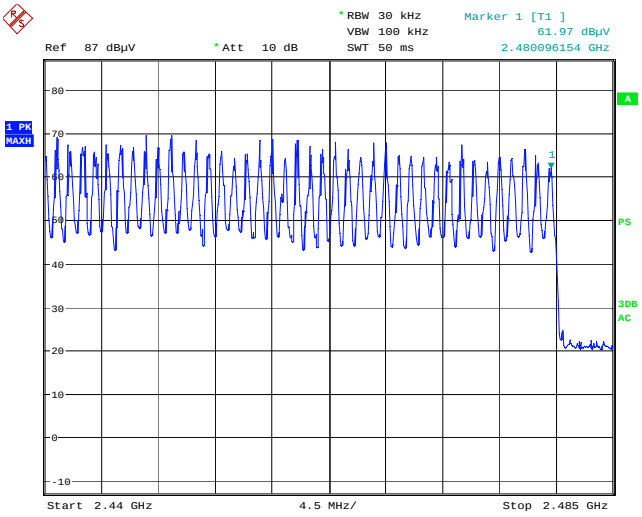

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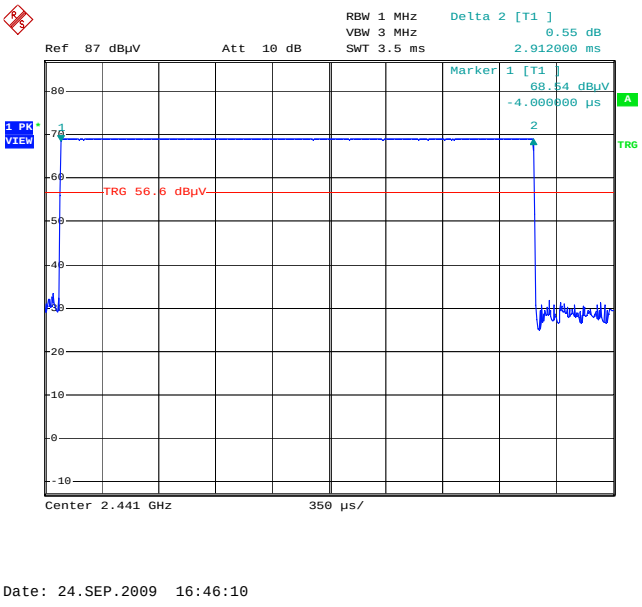
Number of channels: 37 + 41 = 79

Time of Occupancy:

For DH5 Packets it needs 5 time slots for transmission and 1 for reception, so the system makes in worst case 1600_{hops} / 5 = 320 hops per second with 79 channels. Therefore each channel has 4.05 times per second; it yields 128 times of appearance within 31.6 seconds (79 channels times 0.4 sec).
Time of occupancy: 128 x 2.912 ms=372.7 ms per 31.6 sec < 400 ms



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Clause 15.247(b)(1) Maximum peak output power of Frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 W. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 W.

Test Results: Pass

The supplied voltage of the host Laptop was altered by ±15%. No noticeable difference was observed. Field Strength measurements were performed using peak detector function of Spectrum Analyzer.

The EUT was tested in 3 orthogonal positions.

EUT Antenna Gain = 2.1dBi

All Measurements were performed at 3 m using a 3 MHz RBW/VBW.

Radiated Output Power:

Channel	Frequency (MHz)	Polarity V/H	Antenna type	Rx (dBµV)	Cable loss(dB)	Ant Factor (dB/m)	F.S. (dBµV/m)
Low	2402.000	V	Horn	67.72	4.6	28.3	100.62
	2402.000	H	Horn	69.40	4.6	28.1	102.10
Mid	2441.000	V	Horn	68.07	4.6	28.4	101.07
	2441.000	H	Horn	70.29	4.6	28.2	103.09
High	2480.000	V	Horn	67.14	4.6	28.5	100.24
	2480.000	H	Horn	68.98	4.6	28.3	101.88

$$E\ (V/m) = \frac{10^{(FS/20)}}{1\times10^{6}} = \left(10^{\left(\frac{103.09}{20}\right)}\right)\times10^{-6} = 0.1427\ V/m$$

$$G\ (numeric) = 10^{(Ag/10)} = 10^{\left(\frac{2.1}{10}\right)} = 1.62$$

$$P\ (W) = \frac{E^2R^2}{30G} = 0.003772\ W = 3.772\ mW$$

FS = Field Strength (dBµV/m)
Ag = Antenna gain (dBi)
E = Measured Value (V/m)
R = Measurement distance (m)
G = Antenna Gain (numeric)
P = Output power (W)

Output Power (dBm) = $10 \times \log(Output\ Power(mW)) = 10 \times \log(3.772)$ = 5.77 dBm
Conducted Output Power Limit = 30 dBm

EIRP: Conducted Output power + antenna Gain = 5.77 + 2.1 = 7.87 dBm.
EIRP limit = 36 dBm.

Chan.	Freq. MHz	Pol.	Peak Field Strength dBµV/m	Conducted Output power dBm	Conducted Power Limit dBm	Margin dB
Low	2402.000	V	100.62	3.29	30	26.71
	2402.000	H	102.10	4.77	30	25.23
Mid	2441.000	V	101.07	3.74	30	26.26
	2441.000	H	103.09	5.77	30	24.23
High	2480.000	V	100.24	2.91	30	27.09
	2480.000	H	101.88	4.55	30	25.45

Clause 15.247(d) Radiated Emissions Not in Restricted Bands

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

Test Results: Pass

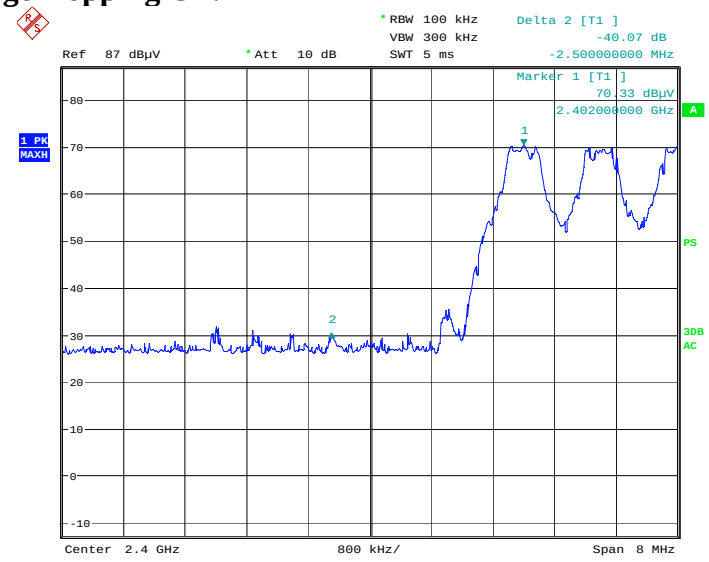
The Spectrum was searched from 30 MHz to the 10th Harmonic.

These results apply to emissions found not in the restricted bands defined in FCC Part 15 Subpart C, 15.205.

The EUT was tested in 3 orthogonal positions.

No emissions were found less than 20 dB below the fundamental emission with 100 kHz RBW/300 kHz VBW.

Lower Band Edge Hopping On:



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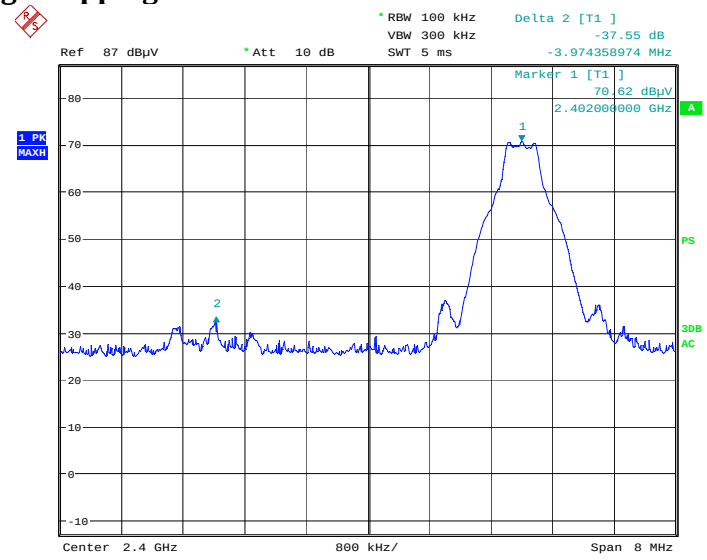

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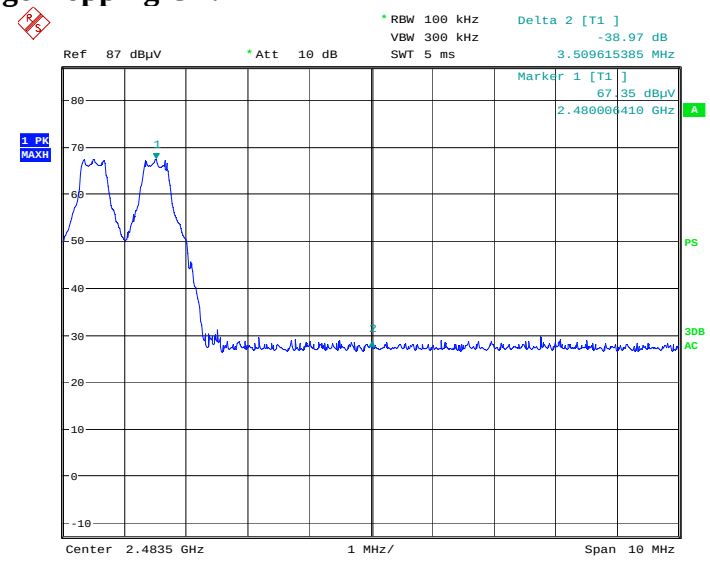

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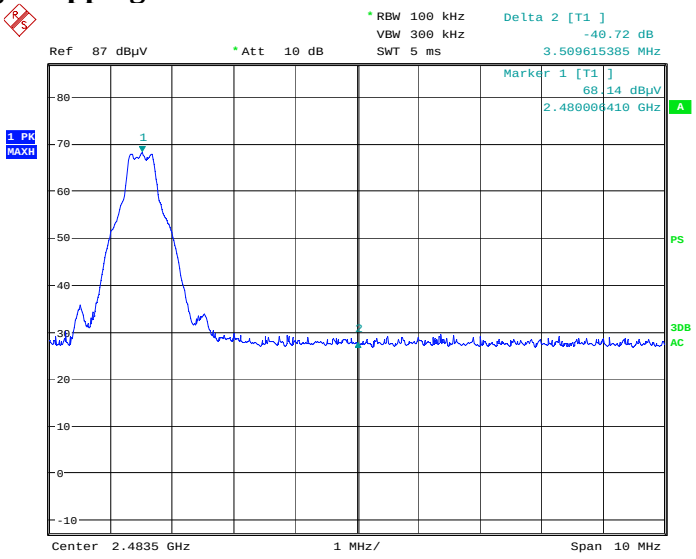

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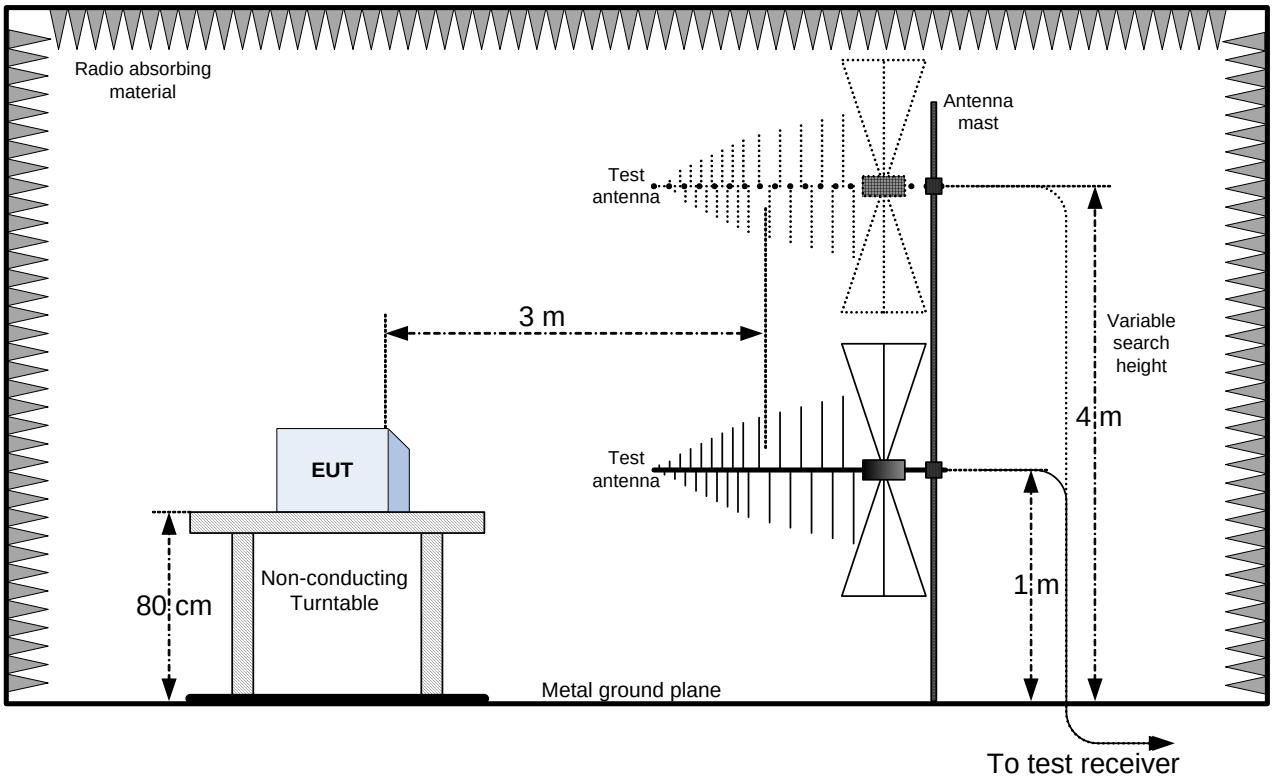
Appendix B : Setup Photographs

Spurious Emissions Setup:

Conducted Emissions Setup:

Appendix C : Block Diagram of Test Setups

Radiated Emissions above 30 MHz Test Site



Conducted Emissions