Certification Test Report

CFR 47 FCC Part 15, Subpart C Section 15.247
Industry Canada RSS 210, Issue 7

NovAtel Inc
SMART-MR10

FCC ID: UTU01018518
IC: 129A-01018518

Project Code CG-1418

(Report CG-1418-RA-1-3)
Revision: 3
(This report supersedes CG-1418-RA-1-2)

May 31, 2010

Prepared for:	NovAtel Inc
Author:	Deniz Demirci Senior Wireless/EMC Technologist
Approved by:	Nick Kobrosly Director of Canadian Operations

Report Summary

Test Facility:	**National Technical Systems, Canada** Product Integrity Laboratory 5151-47th Street, N.E. Calgary Alberta T3J 3R2
Accreditation Numbers:	0214.22 Electrical 0214.23 Mechanical Accredited by A2LA The American Association for Laboratory Accreditation CLIENTS SERVED: All interested parties FIELDS OF TESTING: Electrical/Electronic, Mechanical/Physical ACCREDITATION DATE:: May 14, 2009 VALID TO: December 31, 2011
Applicant:	NovAtel Inc 1120 - 68th Avenue N.E Calgary, AB T2E 8S5 Canada Phone: (403) 730-4640
Customer Representative:	Name: Jerry Davis Title: Compliance Specialist Phone #. (403) 295-4521 Email Address: jerry.davis@novatel.com

Test Summary

Appendix	Test/Requirement Description	Deviations* from:			Pass / Fail	Applicable FCC Rule Parts	Applicable Industry Canada Rule Parts
		Base Standard	Test Basis	NTS Procedure			
A	Carrier Frequency Separation	No	No	No	Pass	FCC Subpart C 15.207 (a)(1)	RSS 210 Issue 7 A8-1(b)
B	Number of Hopping Frequencies	No	No	No	Pass	FCC Subpart C 15.247 (a)(1)(iii)	RSS 210 Issue 7 A8-1(d)
C	Time of Occupancy	No	No	No	Pass	FCC Subpart C 15.247 (a)(1)(iii)	RSS 210 Issue 7 A8-1(d)
D	20 dB Bandwidth	No	No	No	Pass	FCC Subpart C 15.247 (a)(1)	RSS 210 Issue 7 A8-1
E	99% Power bandwidth	No	No	No	N/A	N/A	RSS-Gen Issue 2 4.6.1
F	Pseudorandom Frequency Hopping Sequence	No	No	No	Pass	FCC Subpart C 15.247 (a)(1)	RSS 210 Issue 7 A8-1
G	Equal Hopping Frequency Use	No	No	No	Pass	FCC Subpart C 15.247 (a)(1)	RSS 210 Issue 7 A8-1
H	Peak Output Power	No	No	No	Pass	FCC Subpart C 15.247 (a)(1)	RSS 210 Issue 7 A8-4(2)
I	Duty Cycle	No	No	No	N/A	FCC Subpart C 15.35 (c)	RSS-Gen Issue 2 4.5
J	Conducted Spurious Emissions	No	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 7 A8.5
K	Conducted Spurious Emissions Band Edge	No	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 7 A8.5
L	Radiated Spurious Emissions Band Edge	No	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 7 2.6, A8.5
M	Radiated Spurious Emissions (Tx and Rx)	No	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 7 2.7, A8.5 RSS Gen Issue 2 7.2.3

Test Result: The product presented for testing complied with test requirements as shown above.

Digitally signed by Deniz Demirci
Date: 2010.06.01 14:18:16 -06'00'

Prepared By: _____
Deniz Demirci
Senior Wireless/EMC Technologist

Glen Moore
Digitally signed by Glen Moore
DN: cn=Glen Moore, c=US, o=NTS, email=glen.moore@ntscorp.com
Reason: I have reviewed this document
Date: 2010.06.01 14:24:49 -06'00'

Reviewed By: _____
Glen Moore
Wireless/EMC Manager

Approved By: Alex Mathews
_____
Alex Mathews
Quality Management Representative

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Register of revisions

Revision	Date	Description of Revisions
1	May 20, 2010	Released to customer
2	May 28, 2010	EUT Model numbers updated per customer request
3	May 31, 2010	EUT Model numbers updated per customer request

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the tests applied by NTS Canada to demonstrate compliance of the SMART-MR10 with Bluetooth from NovAtel Inc to FCC Part 15 Subpart C section 15.247 for FHSS transmitter and the equivalent sections of Industry Canada's RSS 210, Issue 7

2.0 EUT DESCRIPTION

2.1 CONFIGURATION

	Name	Model	Revision	Serial Number
EUT (Conducted RF measurements)	SMART-MR10	01018518	C	NJD10170017
EUT (Radiated measurements)	SMART-MR10	01018518	C	NJD10170009
Power Supply	12 VDC Battery	N/A	N/A	N/A
Device Classification	Mobile			
Antenna (Bluetooth)	3 dBi Surface Mount Integral Antenna			
Modulation	GFSK			
EUT Size with Enclosure (H x W x D) (in mm)	232.7 x 232.2 x 89.0			
EUT Weight (in grams)	2200			
Channels/Frequency Range (Bluetooth)	79 channels, 2402 MHz -2480 MHz			
Functional Description	The SMART-MR10 is a rugged dual-constellation, dual-frequency smart antenna designed for on-machine applications in the agricultural, construction and industrial market segments The SMART-MR10 consists of a high-performance GNSS receiver and antenna, capable of receiving and tracking different combinations of GPS+GLONASS L1+L2+L5 code and carrier signals, and L-band signals, on a maximum of 61 channels. The SMART-MR10 has a Bluetooth capability with a Bluetooth 2.0 serial port module			

2.1.1 EUT POWERS

Voltage	12V DC Battery powered
Number of Feeds	2

2.2 EUT CABLES

Item	Part Number	Description	Length
1	None	Null Modem Shielded Cable (DB9 Female-Male)	2m
2	01018515	SMART-MR10 User Interface Cable	3.6m – 7.8m

2.3 MODE OF OPERATION DURING TESTS

See test appendices for specific EUT operating modes and conditions
For all test cases pre-scans were completed in all modes to determine worst case levels.

3.0 SUPPORT EQUIPMENT

3.1 CO-LOCATED SUPPORT EQUIPMENT

Manufacturer	Model	Description	Serial Number or Identifier
NovAtel	GPS-704X	GPS-704X Passive Antenna	N/A

3.2 OFF SITE SUPPORT EQUIPMENT

Manufacturer	Model	Description	Serial Number or Identifier
NovAtel	N/A	SMART-AG	N/A
Toshiba	Satellite	Laptop	N/A
Fluke	45	DMM	N/A
Panasonic	N/A	Battery	N/A

3.3 MONITORING SOFTWARE

Description	Version
Slog	2.00V101
HyperTerminal	N/A

4.0 TEST ENVIRONMENT

4.1 NORMAL TEST CONDITIONS

Temperature:	20 – 23 °C
Relative Humidity:	28 – 35 %
Atmospheric pressure:	883 – 890 mbar
Nominal test voltage:	12 VDC

The values are the limits registered during the test period.

APPENDICES

APPENDIX A: CARRIER FREQUENCY SEPARATION

A.1. Base Standard & Test Basis

Base Standard	FCC SUBPART C 15.247 RSS 210 Issue 7
Test Basis	FCC SUBPART C 15.247 (a) (1) RSS 210 Issue 7 A8.1 (b)
Test Method	FCC Publication da000705

A.2. Specifications

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 band 2400-2483.5 MHz 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 0.125 W. 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.

A.3. Test Procedure

The EUT must have its hopping function enabled.
Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
Video (or Average) Bandwidth (VBW) ≥ RBW, Sweep = auto, Detector function = peak
Trace = max hold

A.4. Test Result

Compliant

The carrier frequency separation is 1 MHz

The 20 dB Bandwidth ranges from 1.058 MHz to 1.062 MHz
Maximum peak output power is 0.01dBm (1 mW) which is smaller than 125 mW
Maximum “two-thirds of the 20 dB bandwidth” is 708 kHz which is smaller than channel carrier frequency separation

All final reported values are corrected values

A.5. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was set to the hopping mode at highest power and maximum data rate.

A.6. Tested By

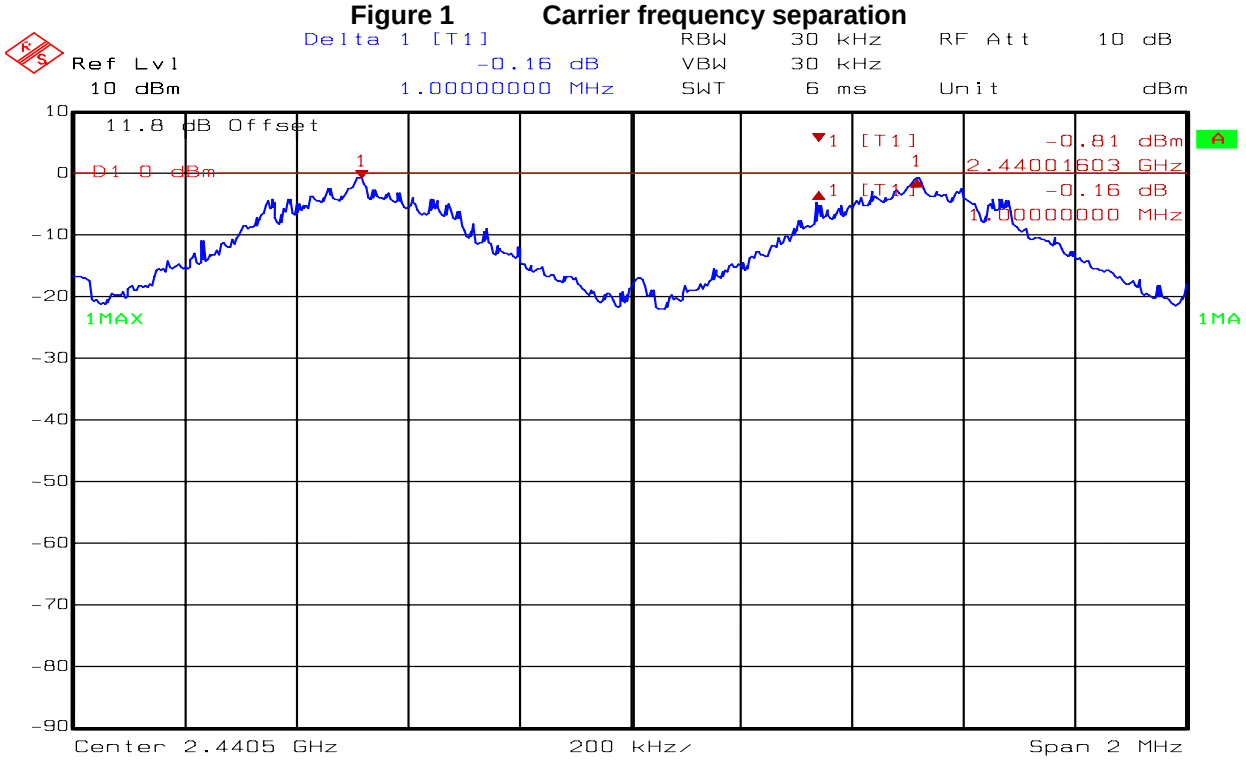
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

A.7. Test date

May 20, 2010

Figure 1 Carrier frequency separation



APPENDIX B: NUMBER OF HOPPING FREQUENCIES

B.1. Base Standard & Test Basis

Base Standard	FCC SUBPART C 15.247 RSS 210 Issue 7
Test Basis	FCC SUBPART C 15.247 (a) (1)(iii) RSS 210 Issue 7 A8.1 (d)
Test Method	FCC Publication da000705

B.2. Specifications

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 seconds within a period of 0.4 seconds 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.

B.3. Test Procedure

The EUT must have its hopping function enabled.
Span = the frequency band of operation, RBW ≥ 1% of the span, VBW ≥ RBW, Sweep = auto
Detector function = peak, Trace = max hold

B.4. Test Results

There are 79 hopping frequencies. The EUT is in compliance with the requirement as specified above

All final reported values are corrected values.

B.5. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was set to the hopping mode at highest power and maximum data rate.

B.6. Tested By

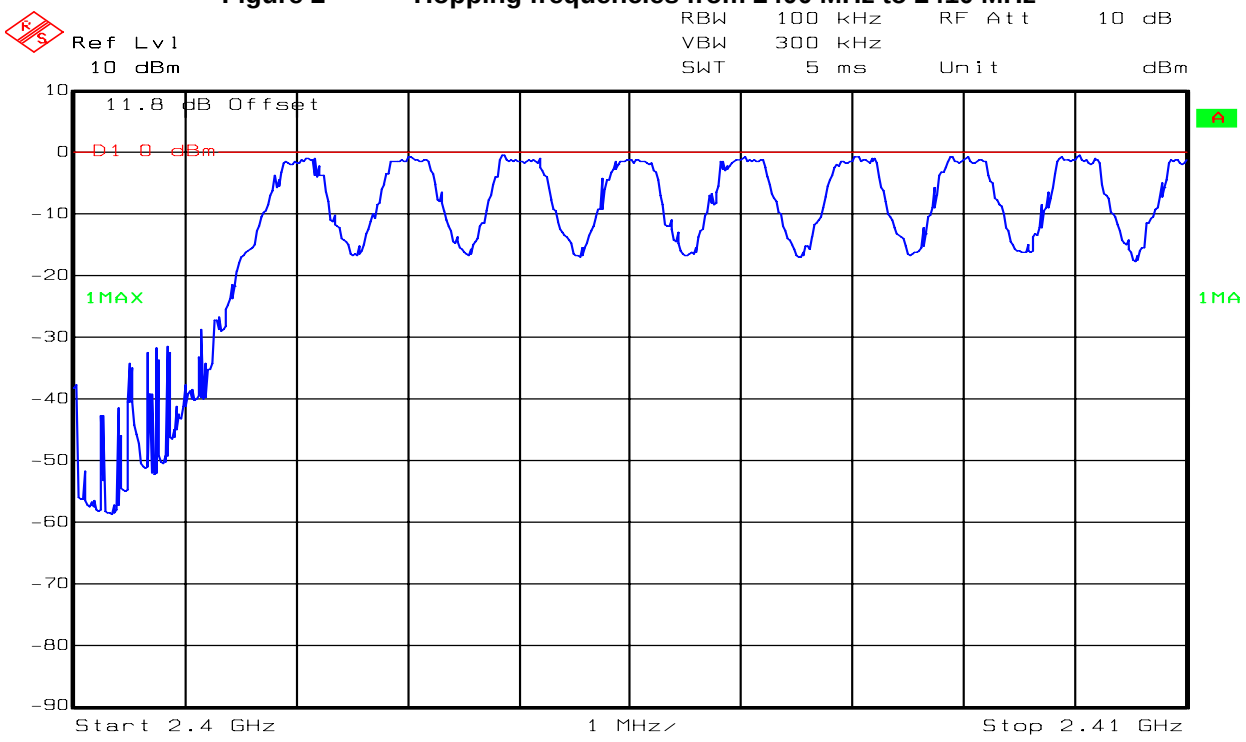
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

B.7. Test date

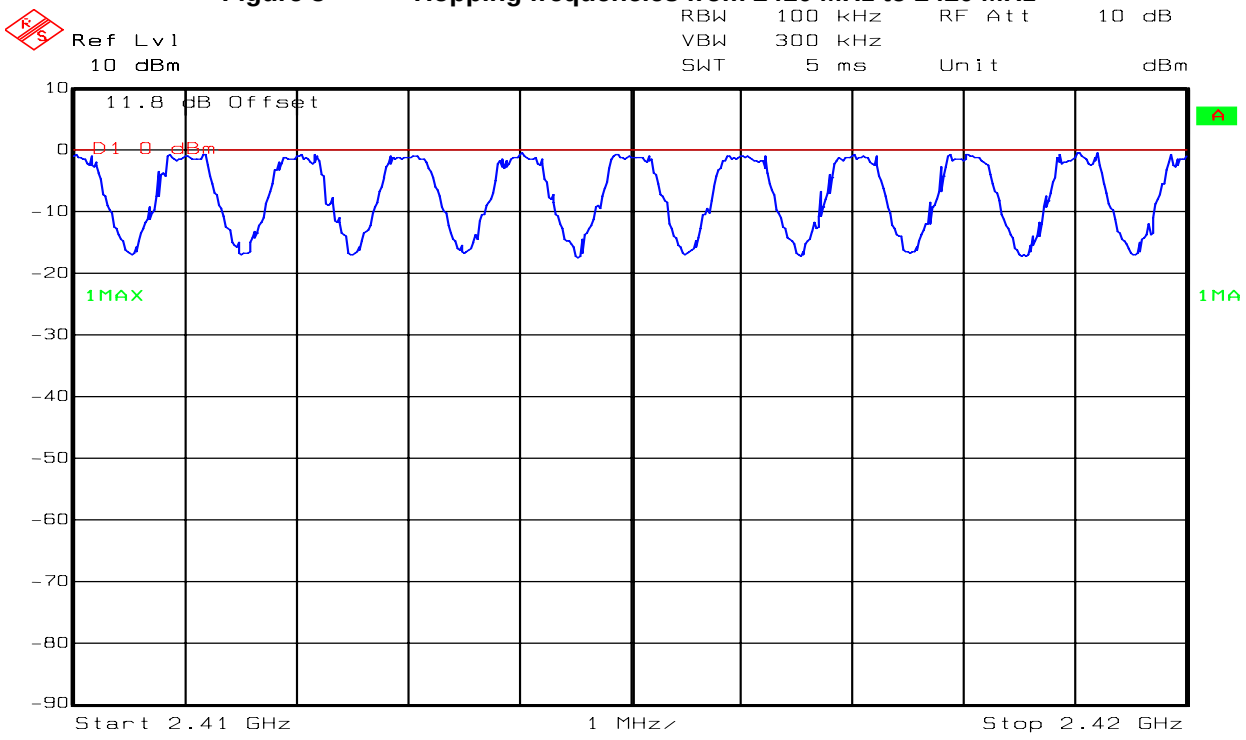
May 20, 2010

Figure 2 Hopping frequencies from 2400 MHz to 2410 MHz



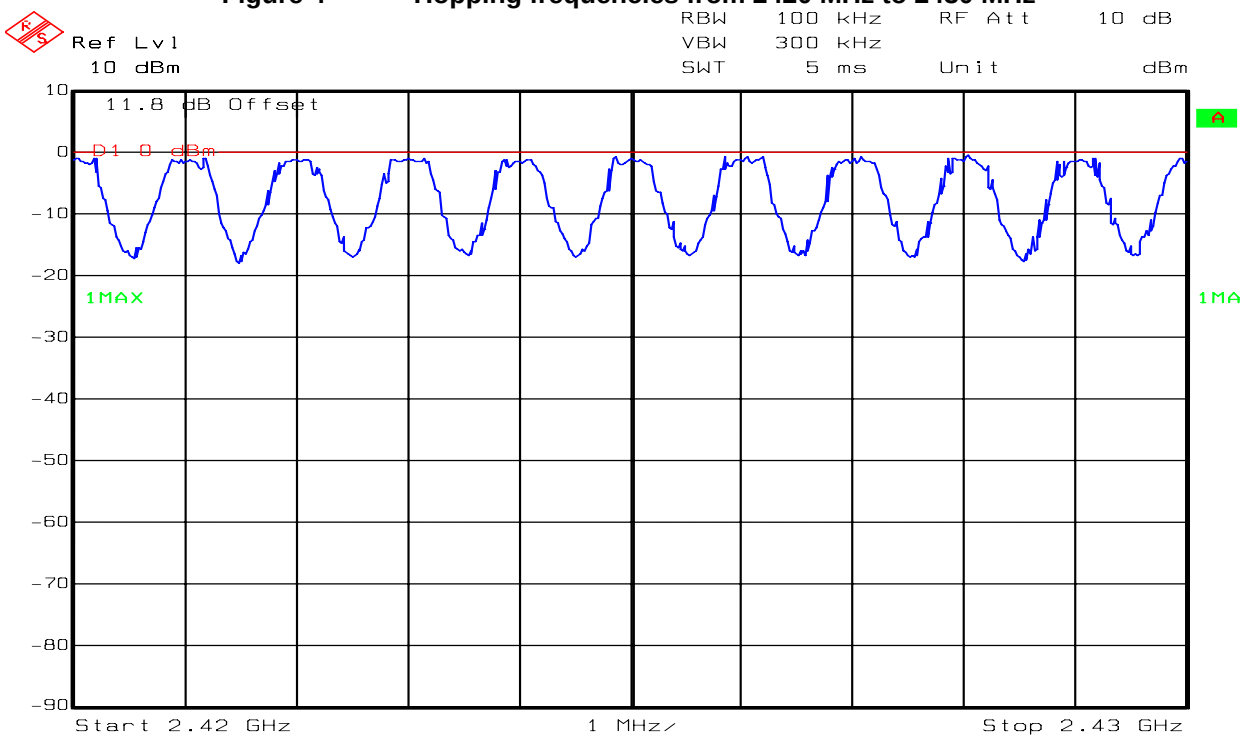
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: Frequency Hopping with DH5, PRBS9, max power
Date: 20.MAY.2010 7:37:07

Figure 3 Hopping frequencies from 2410 MHz to 2420 MHz



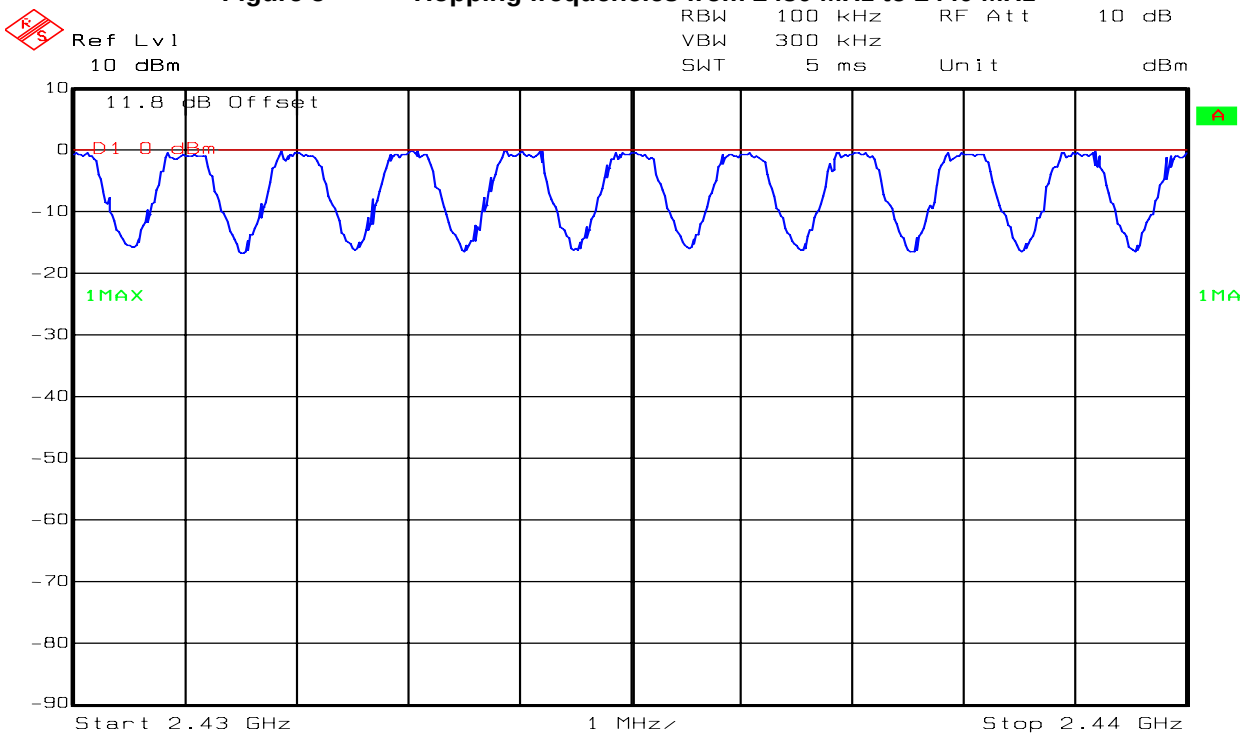
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: Frequency Hopping with DH5, PRBS9, max power
Date: 20.MAY.2010 7:40:13

Figure 4 Hopping frequencies from 2420 MHz to 2430 MHz



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: Frequency Hopping with DH5, PRBS9, max power
Date: 20.MAY.2010 7:52:28

Figure 5 Hopping frequencies from 2430 MHz to 2440 MHz



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: Frequency Hopping with DH5, PRBS9, max power
Date: 20.MAY.2010 7:58:27

Figure 6 Hopping frequencies from 2440 MHz to 2450 MHz

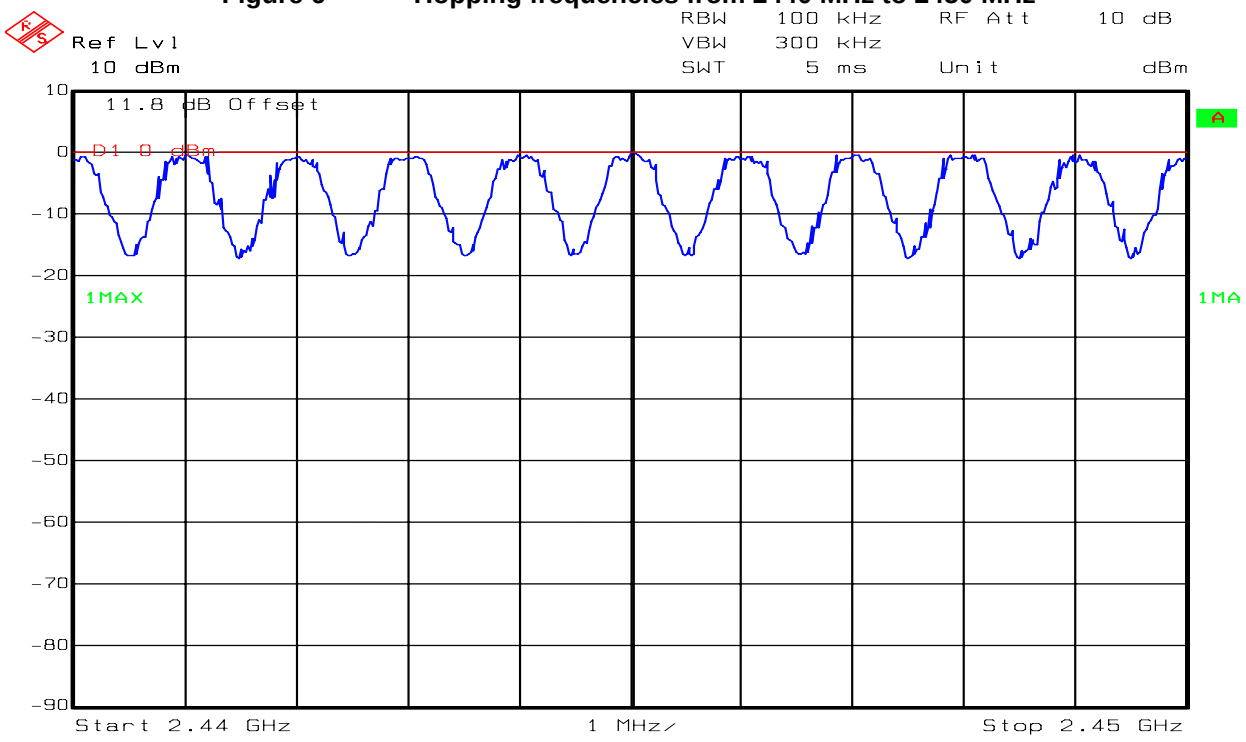


Figure 7 Hopping frequencies from 2450 MHz to 2460 MHz

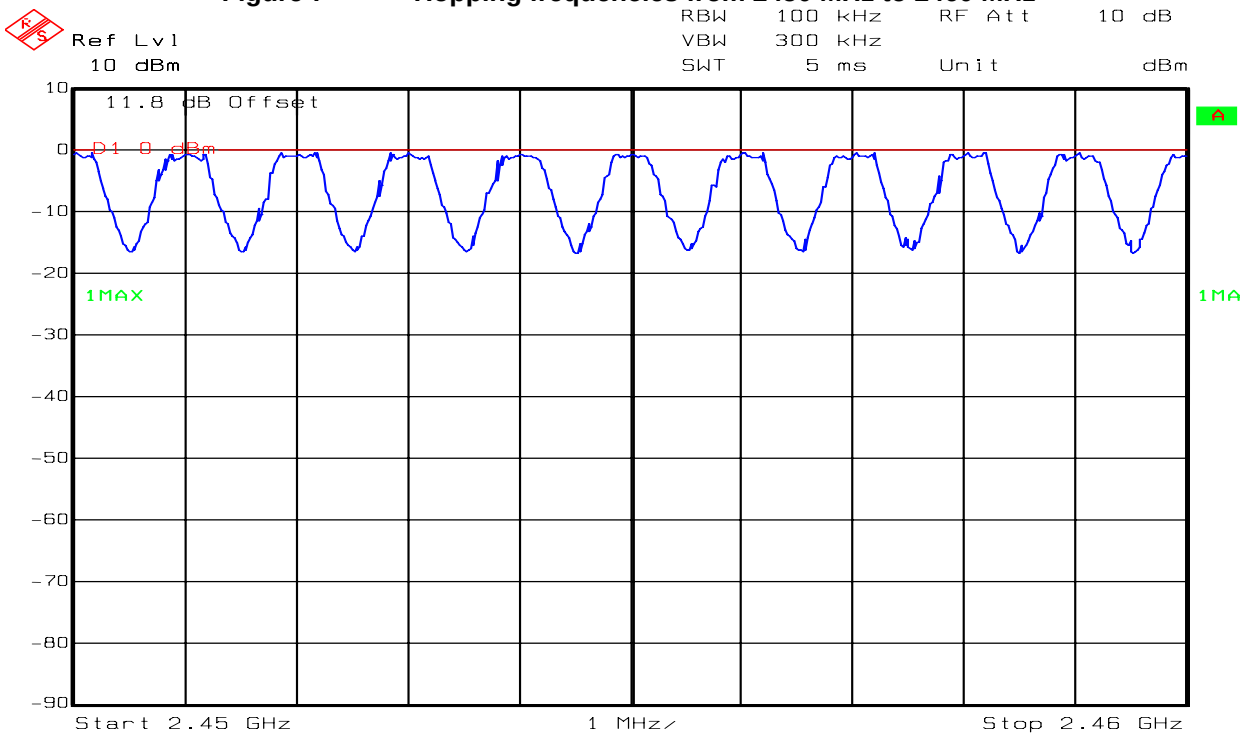
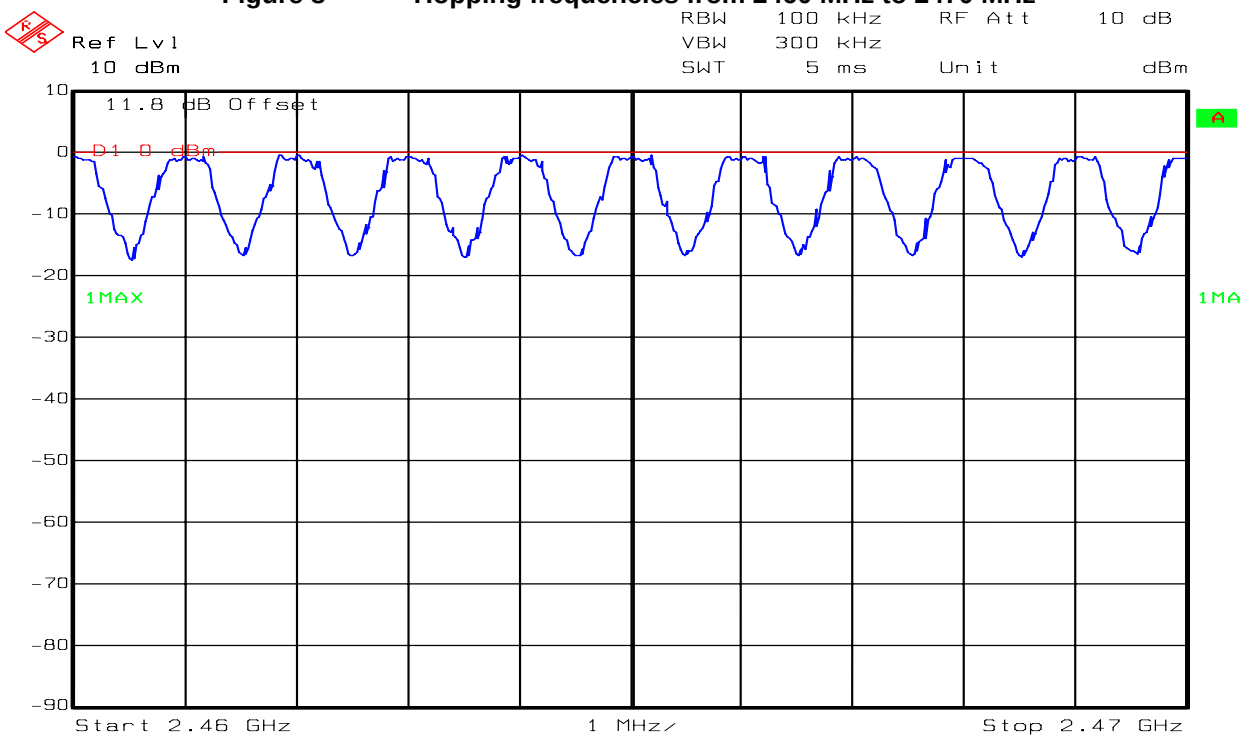
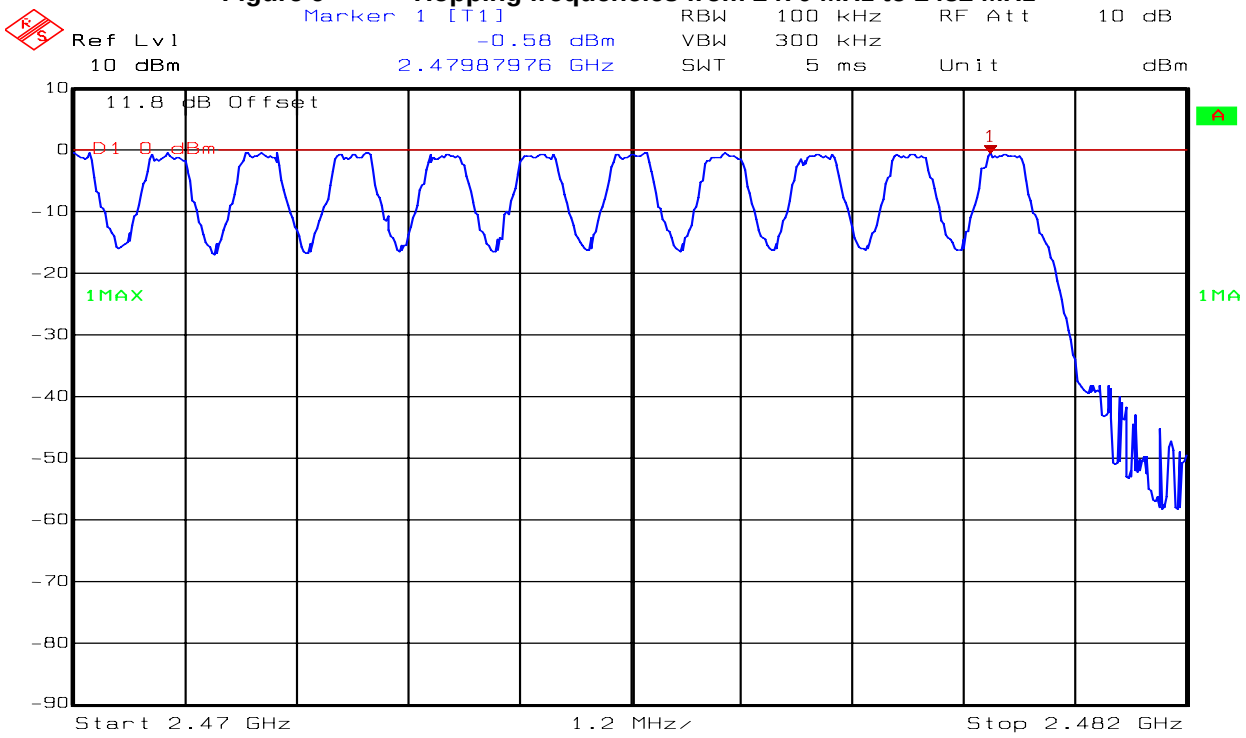


Figure 8 Hopping frequencies from 2460 MHz to 2470 MHz



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: Frequency Hopping with DH5, PRBS9, max power
Date: 20.MAY.2010 8:11:38

Figure 9 Hopping frequencies from 2470 MHz to 2482 MHz



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: Frequency Hopping with DH5, PRBS9, max power
Date: 20.MAY.2010 8:18:58

APPENDIX C: TIME OF OCCUPANCY

C.1. Base Standard & Test Basis

Base Standard	FCC SUBPART C 15.247 RSS 210 Issue 7
Test Basis	FCC SUBPART C 15.247 (a) (1)(iii) RSS 210 Issue 7 A8.1 (d)
Test Method	N/A

C.2. Specifications

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.
Period = 0.4*79 = 31.6s

C.3. Description

Compliant

According the Bluetooth Core Specification;
The dwell time of 0.4s within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is a follows:
For DH5 packed (with a maximum length of five time slots)
Dwell time = 5 * 625 µs * 1600 * 1/5 *1/s / 79 * 31.6s = 0.4s (in a 31.6 s period)
Therefore, all Bluetooth devices comply with the dwell time requirement in the data mode.

APPENDIX D: 20 DB BANDWIDTH

D.1. Base Standard & Test Basis

Base Standard	FCC 15.247 RSS 210 Issue 7
Test Basis	FCC 15.247 as per FCC Publication da000705 RSS-Gen Issue 2 A8-1
Test Method	FCC Publication da000705

D.2. Specifications

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 band 2400-2483.5 MHz 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 0.125 W.
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.

D.3. Test Procedure

FCC Publication da000705
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW, Sweep = auto, Detector function = peak
Trace = max hold

D.4. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was tuned to a low, middle and high channel with DH5, DH3 and DH1packets at highest duty cycle and highest RF power

D.5. Test Results

Compliant

The 20 dB Bandwidth ranges from 1.058 MHz to 1.062 MHz
Maximum “two-thirds of the 20 dB bandwidth” is 708 kHz which is smaller than channel carrier frequency separation of 1 MHz

All final reported values are corrected values

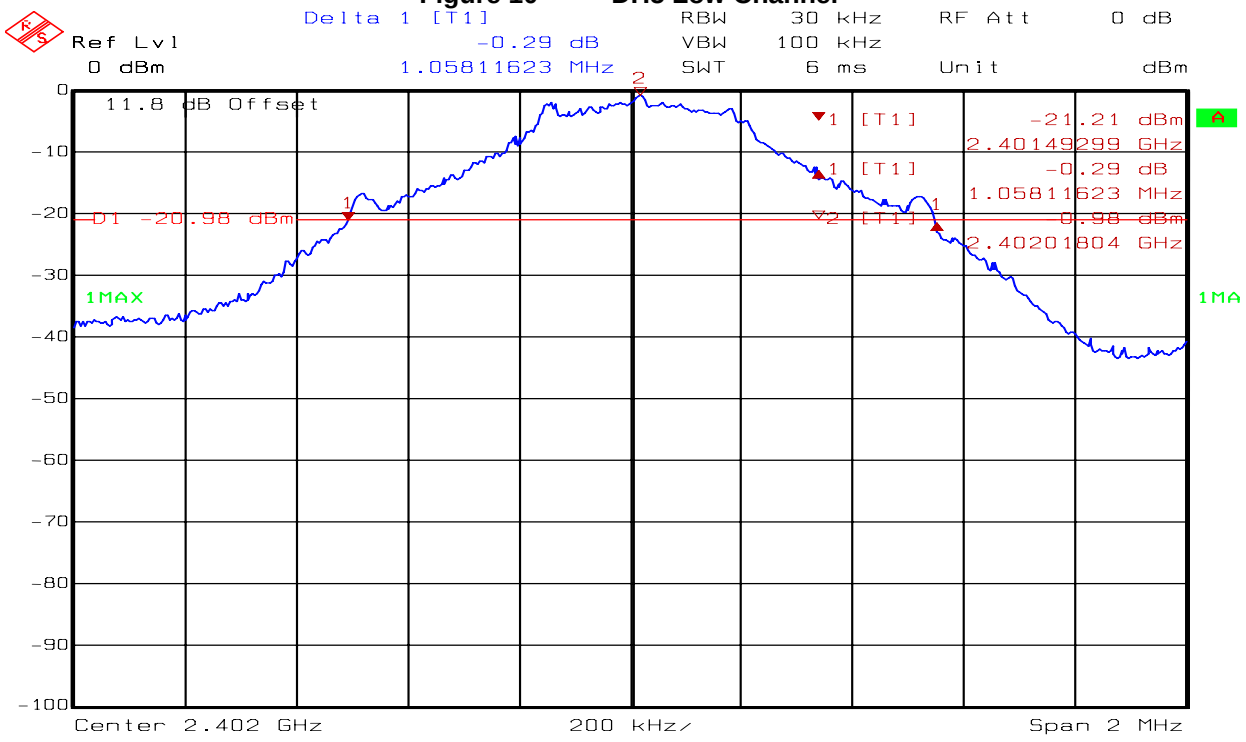
D.6. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

D.7. Test date

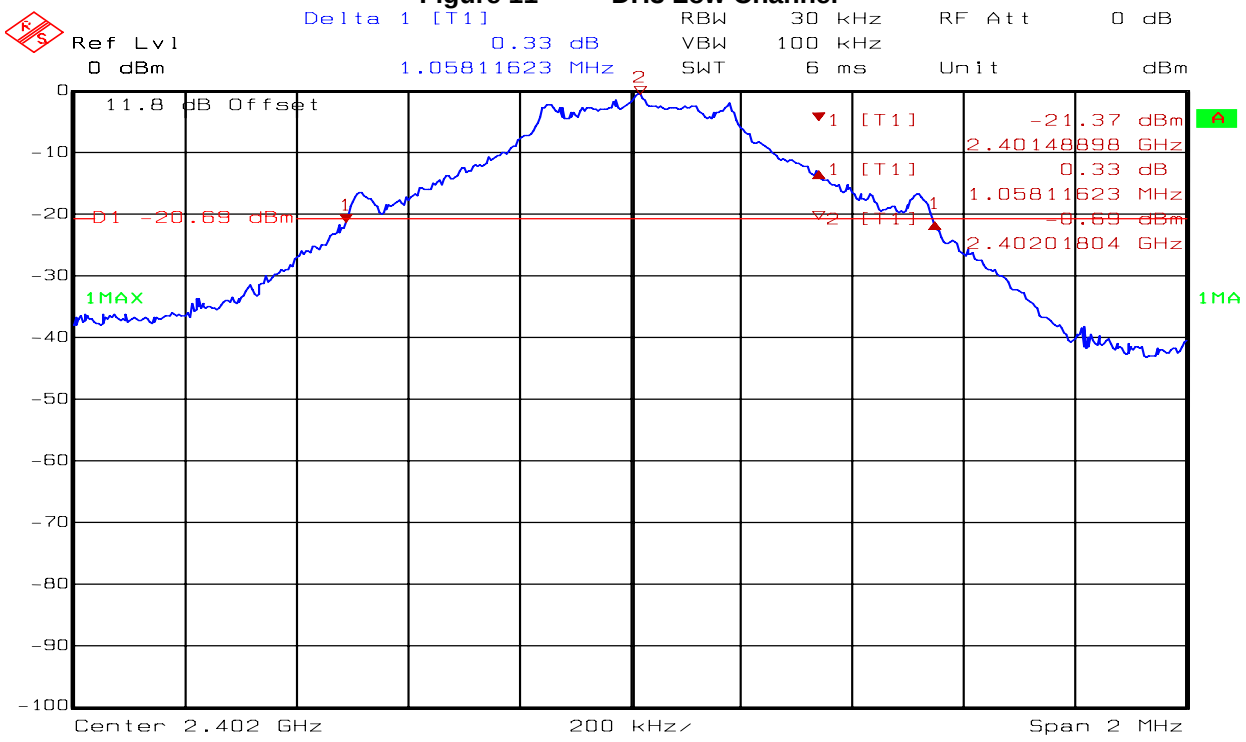
May 19, 2010

Figure 10 DH5 Low Channel



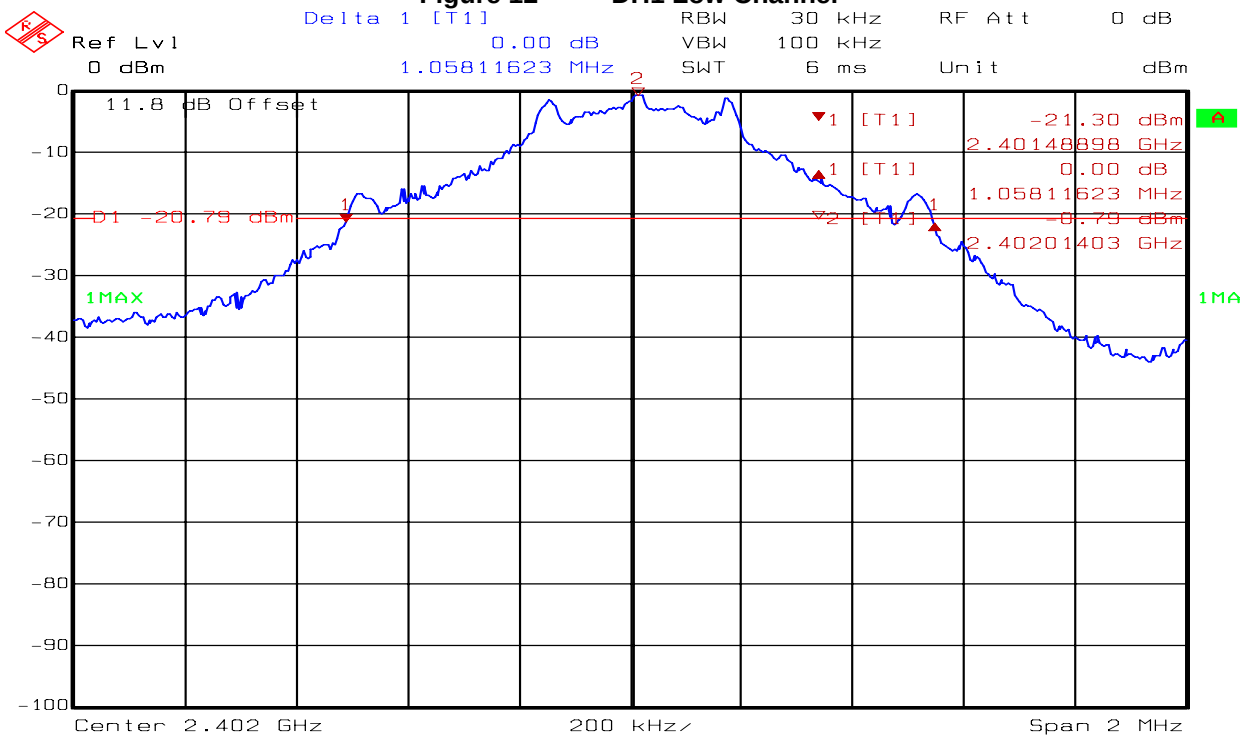
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 9:36:55

Figure 11 DH3 Low Channel



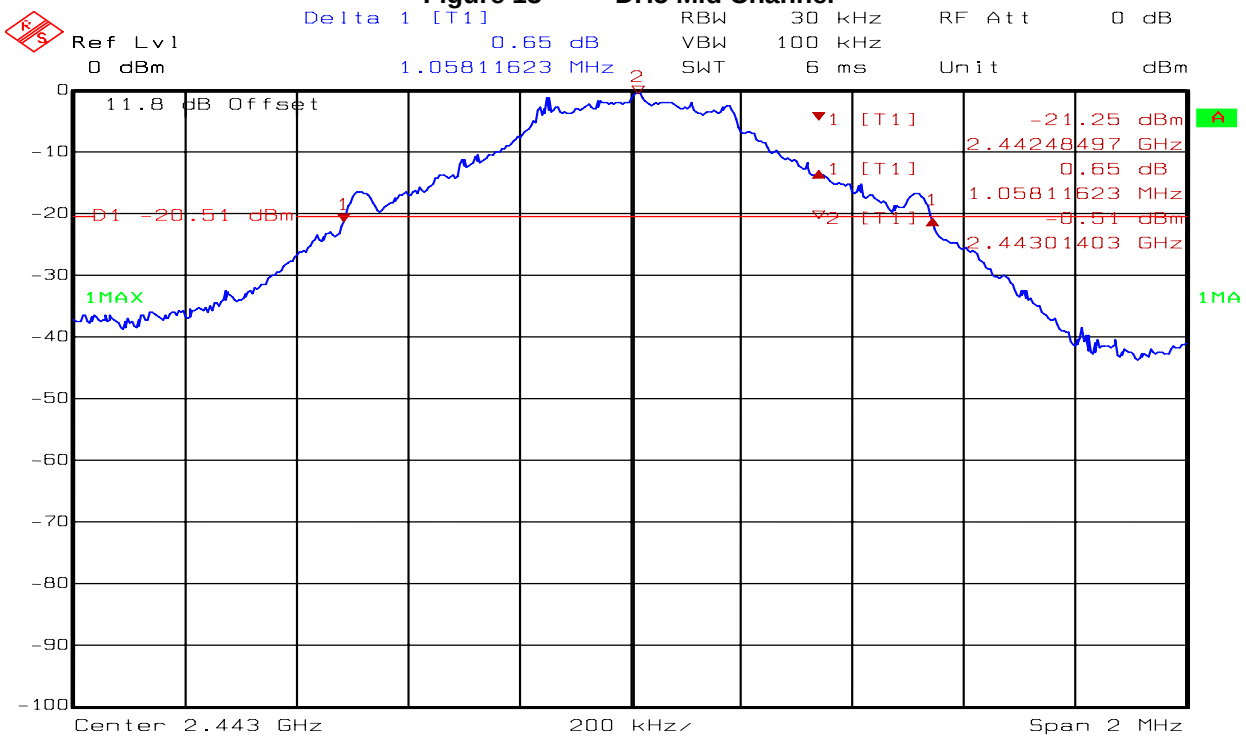
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz DH3, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 10:02:01

Figure 12 DH1 Low Channel



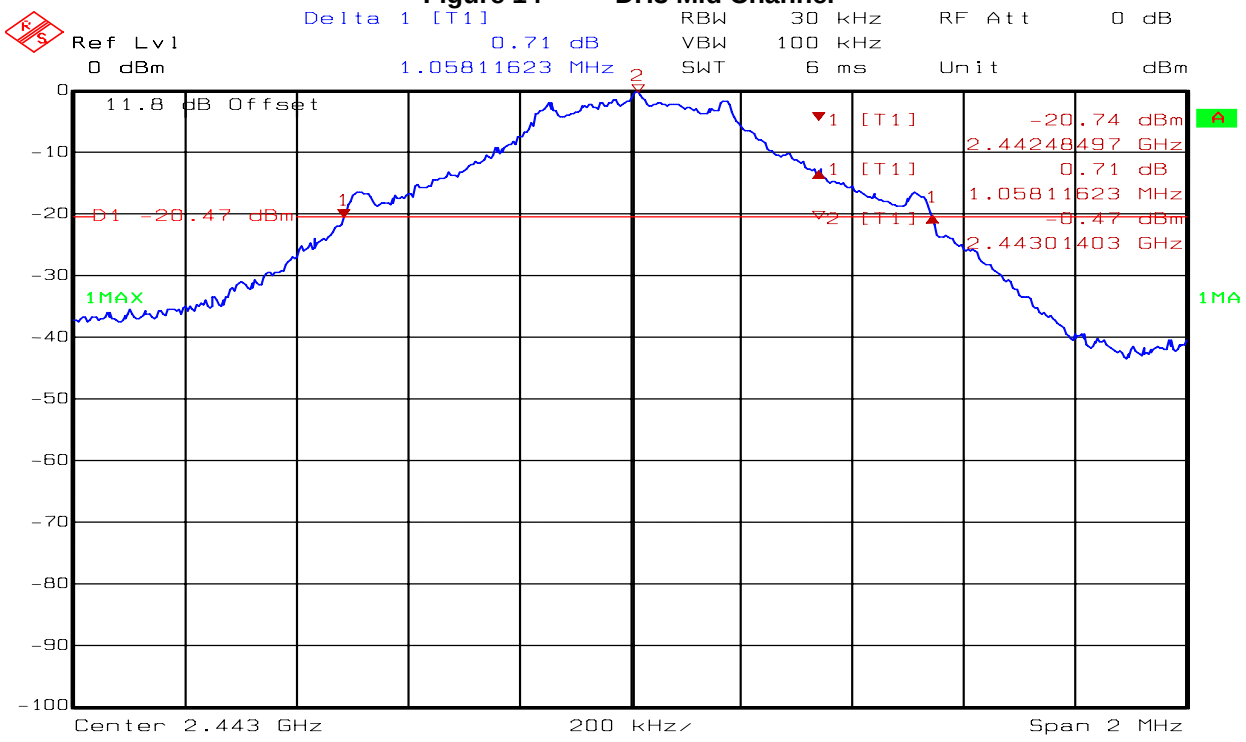
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz DH1, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 10:06:14

Figure 13 DH5 Mid Channel



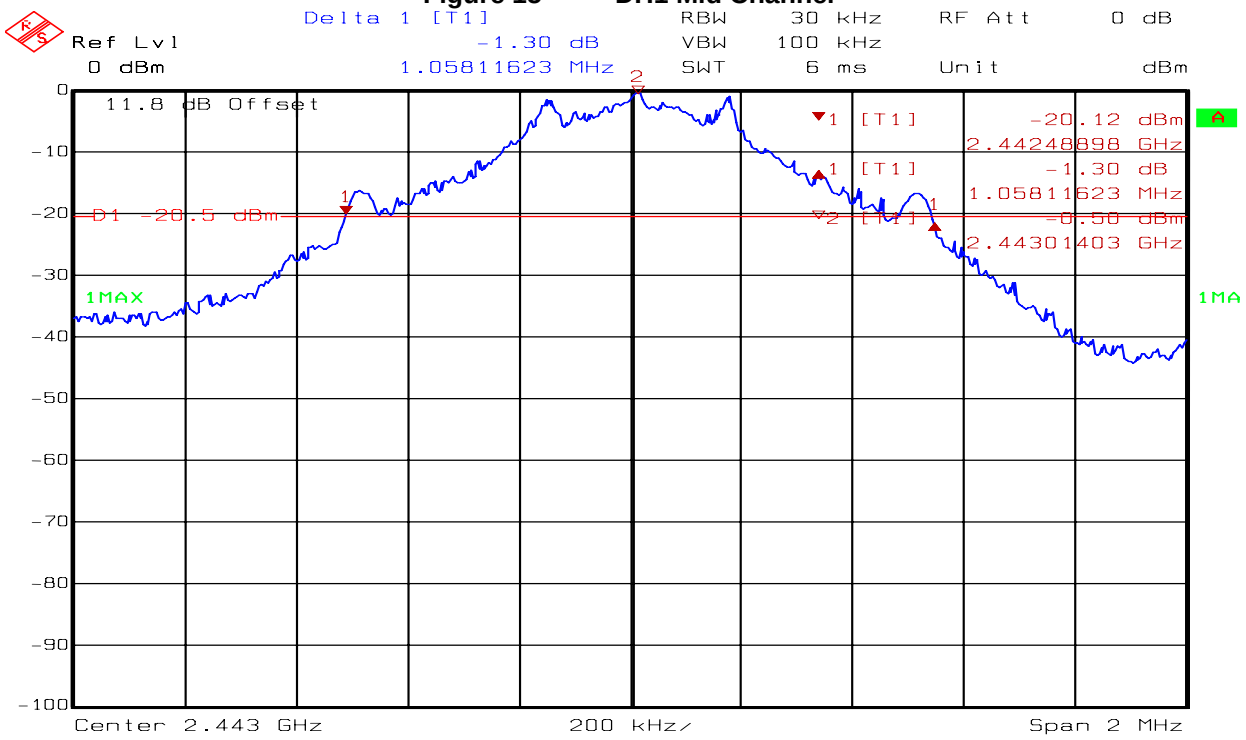
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2443 MHz (Mid Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 10:15:36

Figure 14 DH3 Mid Channel



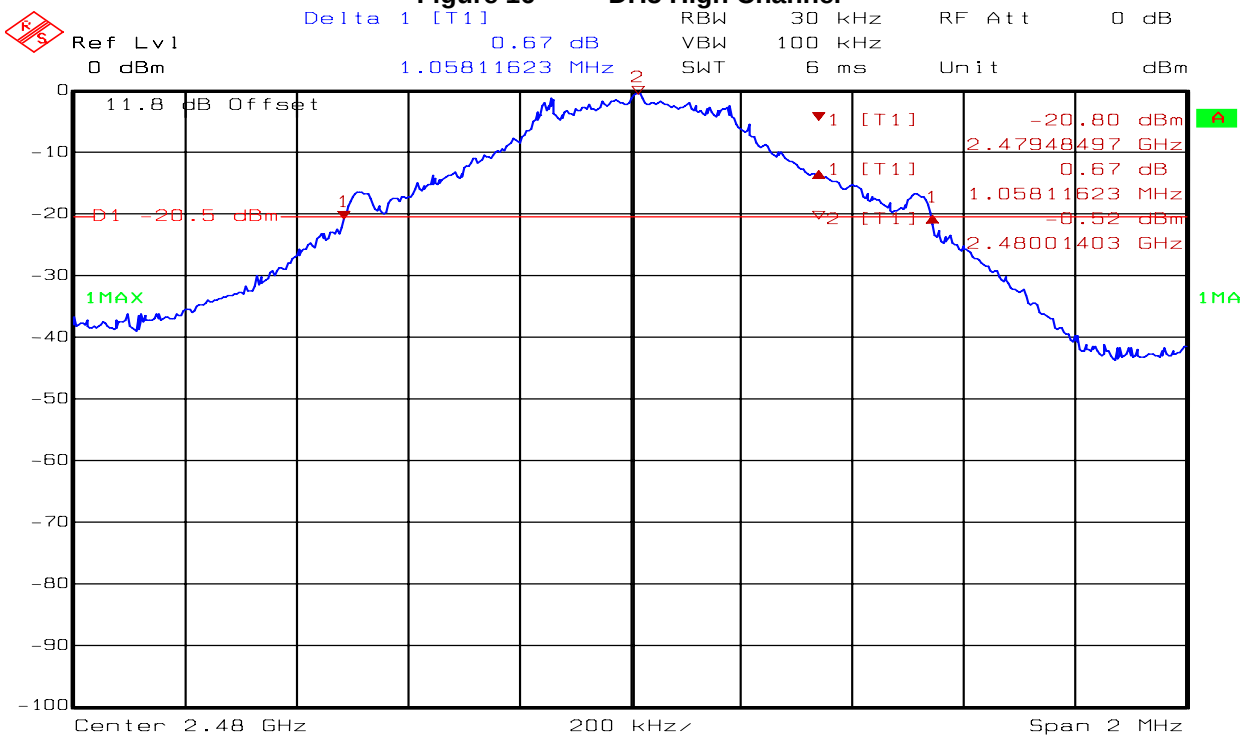
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2443 MHz (Mid Ch) DH3, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 10:20:58

Figure 15 DH1 Mid Channel



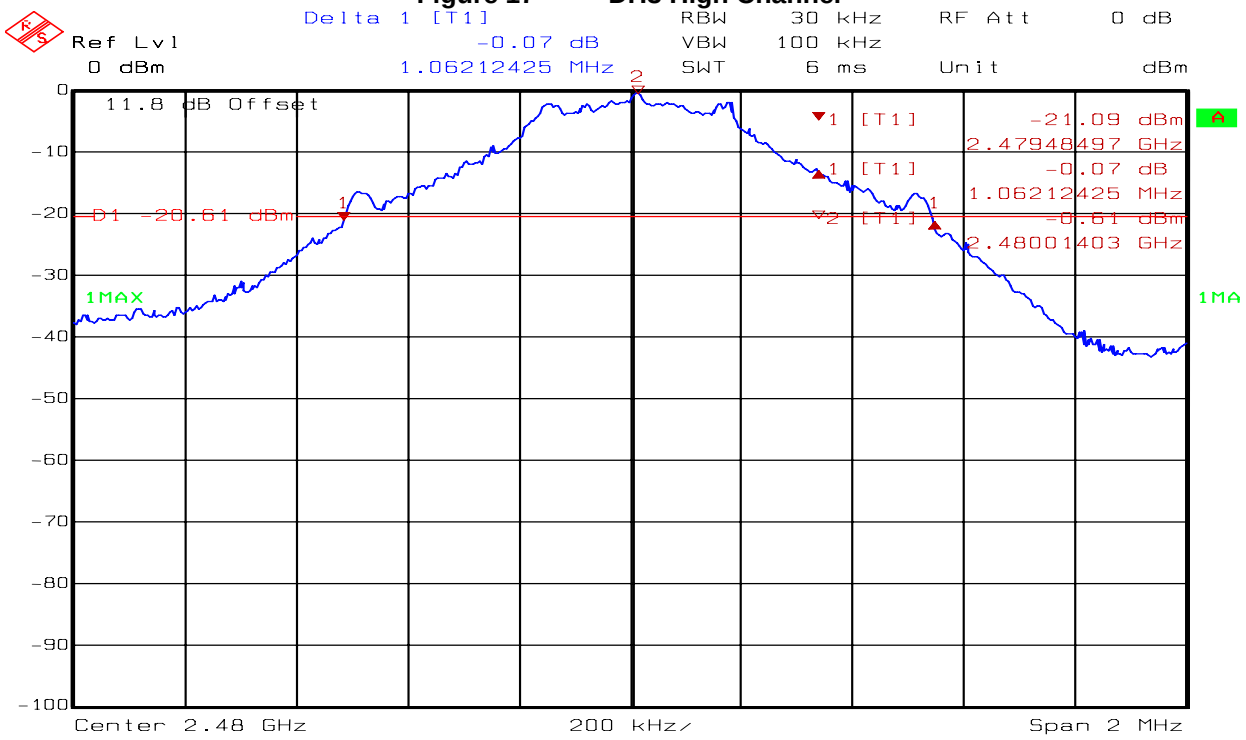
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2443 MHz (Mid Ch) DH1, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 10:37:19

Figure 16 DH5 High Channel



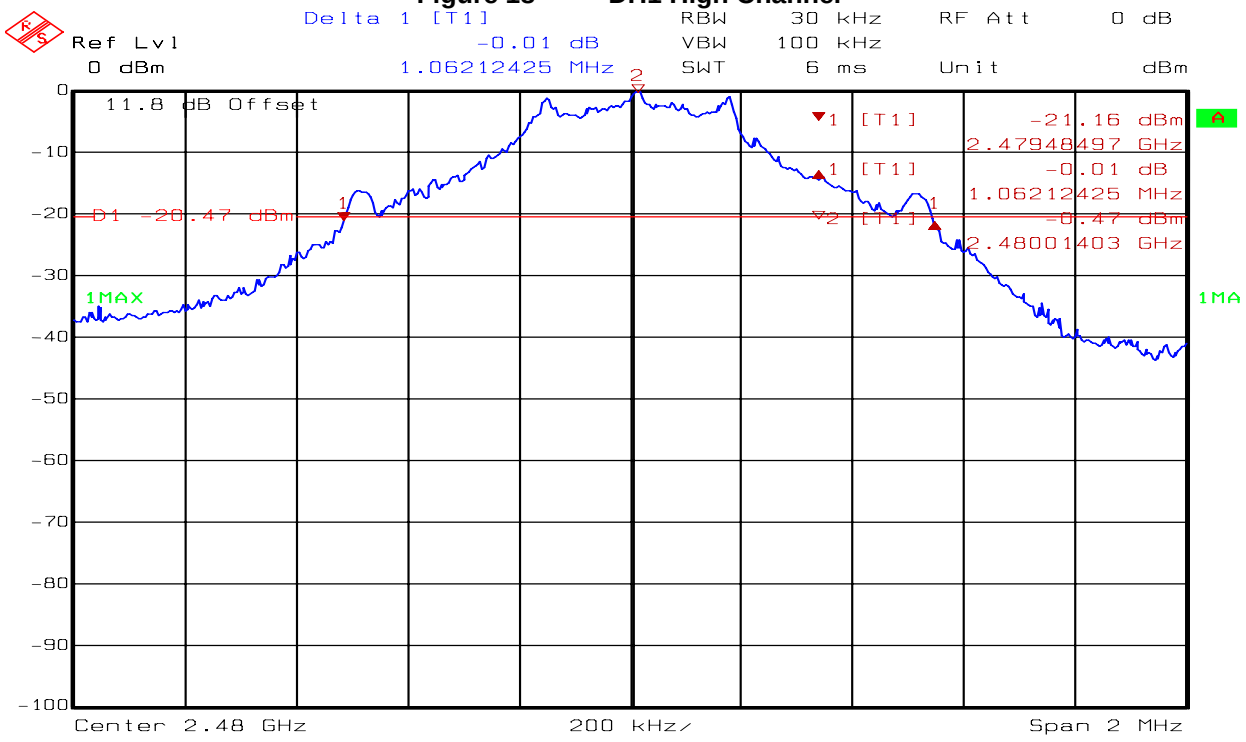
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2480 MHz (High Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 10:48:06

Figure 17 DH3 High Channel



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2480 MHz (High Ch) DH3, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 10:52:46

Figure 18 DH1 High Channel



APPENDIX E: 99 % POWER BANDWIDTH

E.1. Base Standard & Test Basis

Base Standard	RSS-Gen Issue 2 4.6.1
Test Basis	RSS-Gen Issue 2 4.6.1
Test Method	RSS-Gen Issue 2 4.6.1

E.2. Specifications

4.6.1 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.

E.3. Test Procedure

RSS-Gen Issue 2

E.4. Test Results

Channel	Frequency (MHz)	Bandwidth (MHz)
Low	2402	1.040
Mid	2443	1.058
High	2480	1.058

All final reported values are corrected values

E.5. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was tuned to a low, middle and high channel with DH5 packets at highest duty cycle and highest RF power

E.6. Tested By

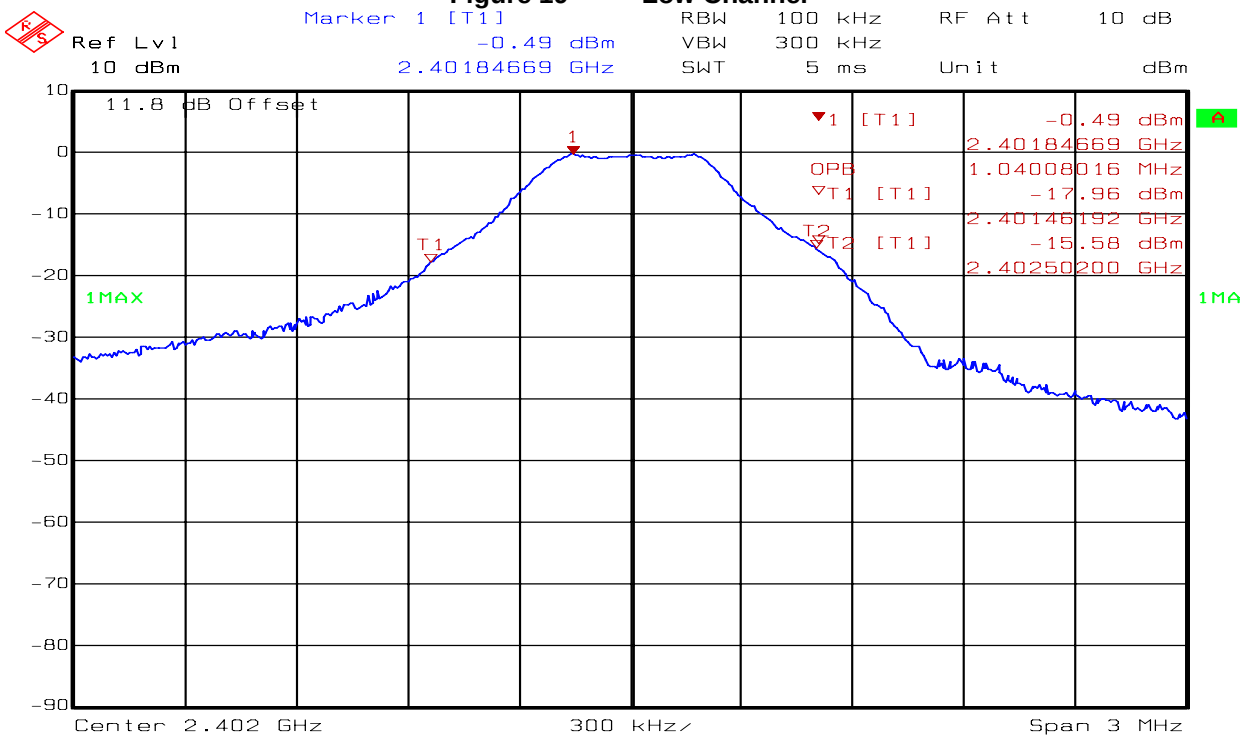
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

E.7. Test date

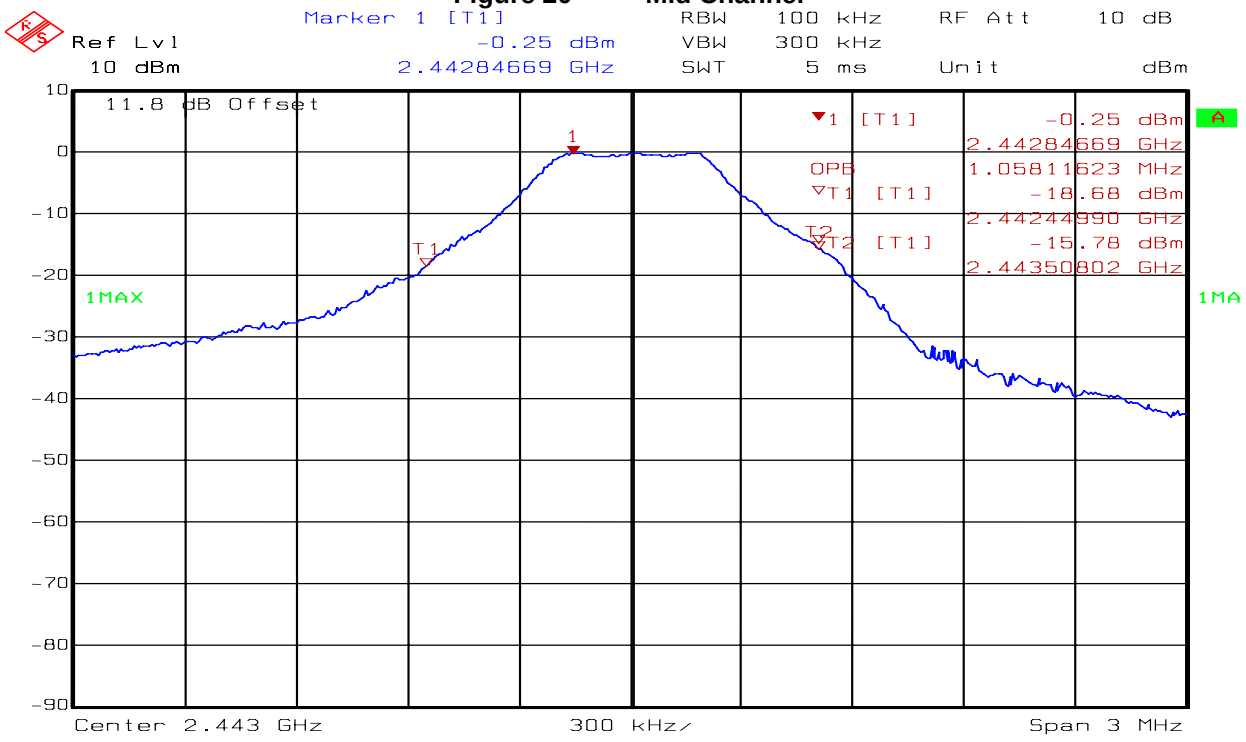
May 19, 2010

Figure 19 Low Channel



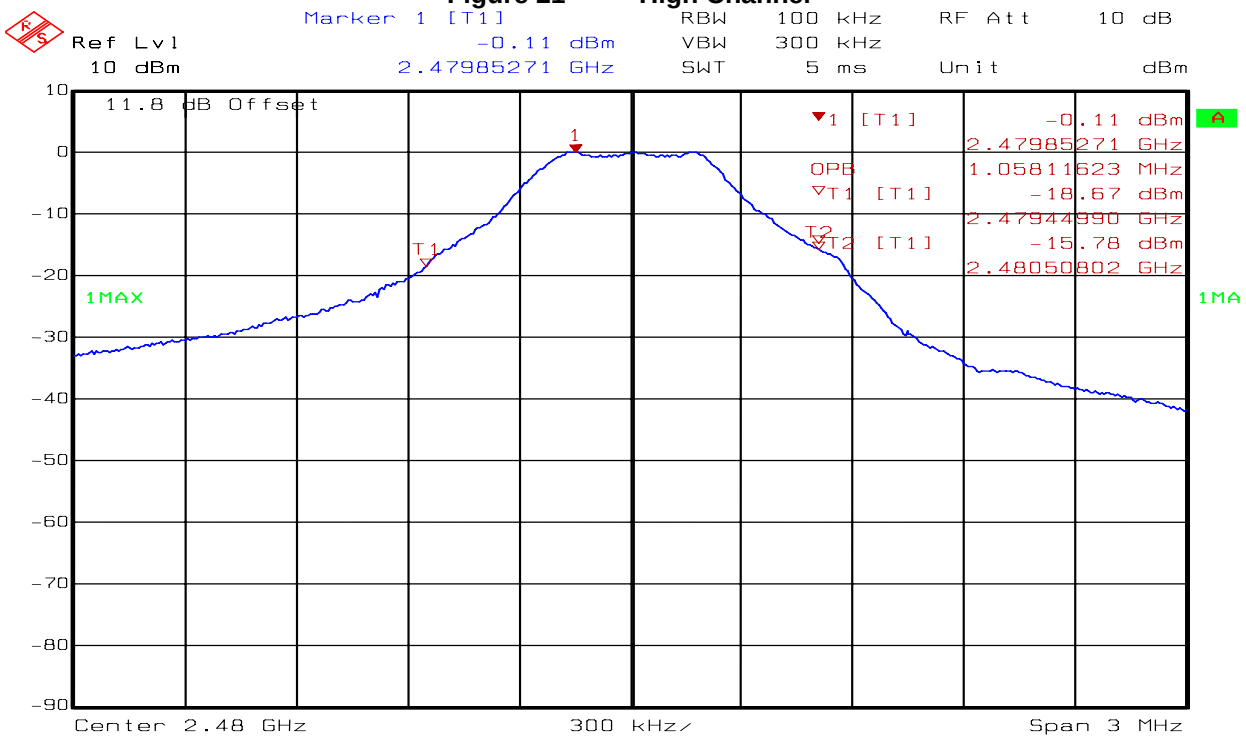
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz (Low Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 15:15:28

Figure 20 Mid Channel



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2443 MHz (Mid Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 14:23:16

Figure 21 High Channel



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2480 MHz (High Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 13:57:27

APPENDIX F: PSEUDORANDOM FREQUENCY HOPPING SEQUENCE

F.1. Base Standard & Test Basis

Base Standard	FCC SUBPART C 15.247 RSS 210 Issue 7
Test Basis	FCC SUBPART C 15.247 (a) (1) RSS 210 Issue 7 A8.1
Test Method	N/A

F.2. Specifications

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.

F.3. Description

Pass

According the Bluetooth Core Specification;
Bluetooth units which want to communicate with other units are organized in a structure called piconet. This piconet consist of maximum 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from it's BD address which is unique for every Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.
Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67,
56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59,
72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75,
09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06,
01, 51, 03, 55, 05, 04

APPENDIX G: EQUAL HOPPING FREQUENCY USE

G.1. Base Standard & Test Basis

Base Standard	FCC SUBPART C 15.247 RSS 210 Issue 7
Test Basis	FCC SUBPART C 15.247 (a) (1) RSS 210 Issue 7 A8.1
Test Method	N/A

G.2. Specifications

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.

G.3. Description

Pass

According the Bluetooth Core Specification;
The generation of the hopping sequence in connection mode depends essentially on two input values:
1. LAP/UAP of the master of the connection
2. Internal master clock
The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS. The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units, only the offsets are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions, the Bluetooth system has the following behavior:

The first connection between the two devices is established, a hopping sequence is generated.
For transmitting the wanted data, the complete hopping sequence is not used and the connection ends.
The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs).
The hopping sequence will always differ from the first one.

APPENDIX H: PEAK OUTPUT POWER

H.1. Base Standard & Test Basis

Base Standard	FCC 15.247 RSS 210 Issue 7
Test Basis	FCC 15.247 (b)(1) RSS 210 Issue 7 A8.4 (2)
Test Method	FCC Publication da000705

H.2. Specifications

15.247 (b)(1)
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 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

H.3. Test Procedure

FCC Publication da000705
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel,
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold

H.4. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was tuned to a low, middle and high channel with DH5 packets (worst case) at highest duty cycle and highest RF power

H.5. Test Results

Compliant. The maximum measured peak output power was 0.01 dBm

H.6. Test Data Summary

Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2401.56	-0.10	20.97	21.07
Mid	2442.50	-0.10	20.97	21.07
High	2479.57	0.01	20.97	20.96

All final reported values are corrected values

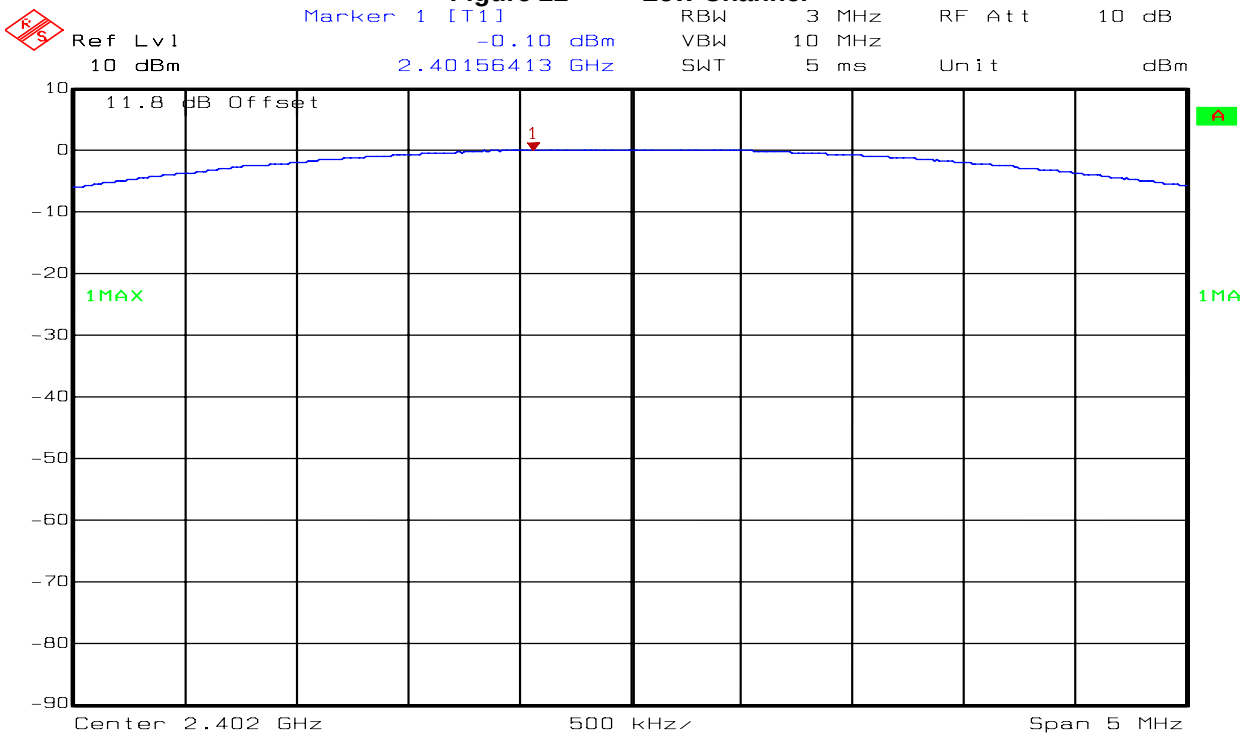
H.7. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

H.8. Test date

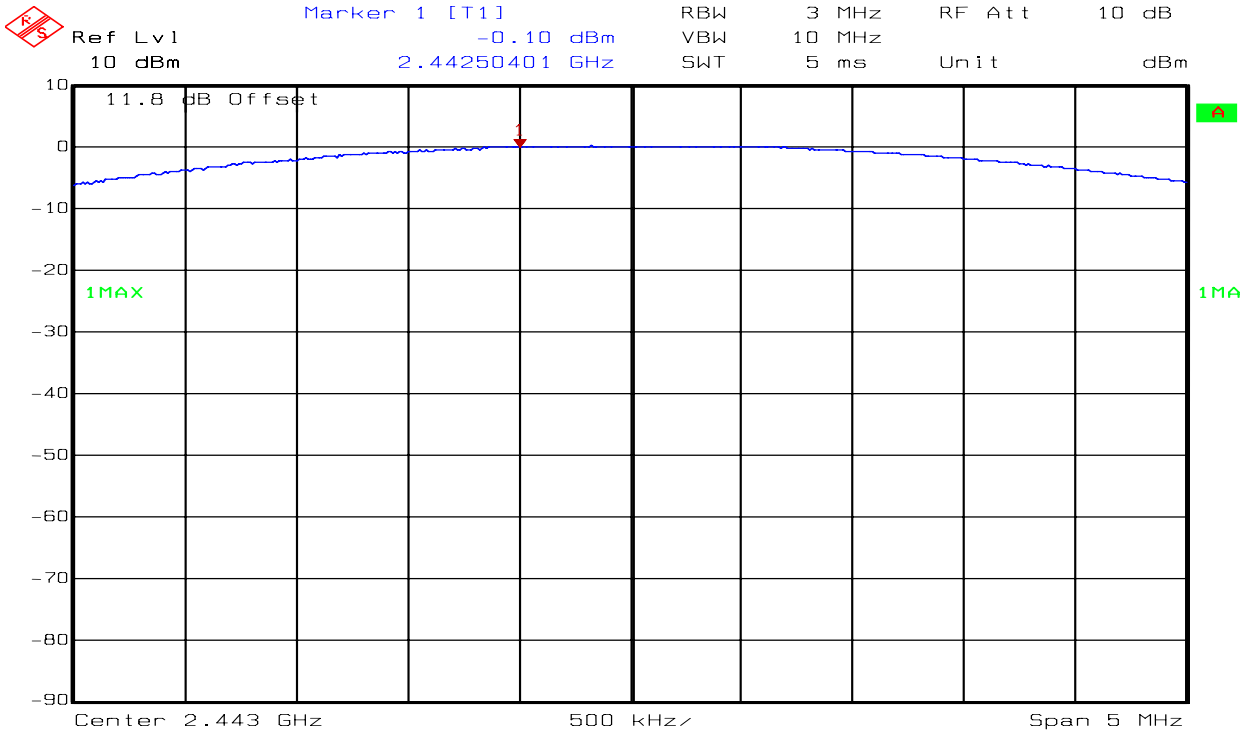
May 19, 2010

Figure 22 Low Channel



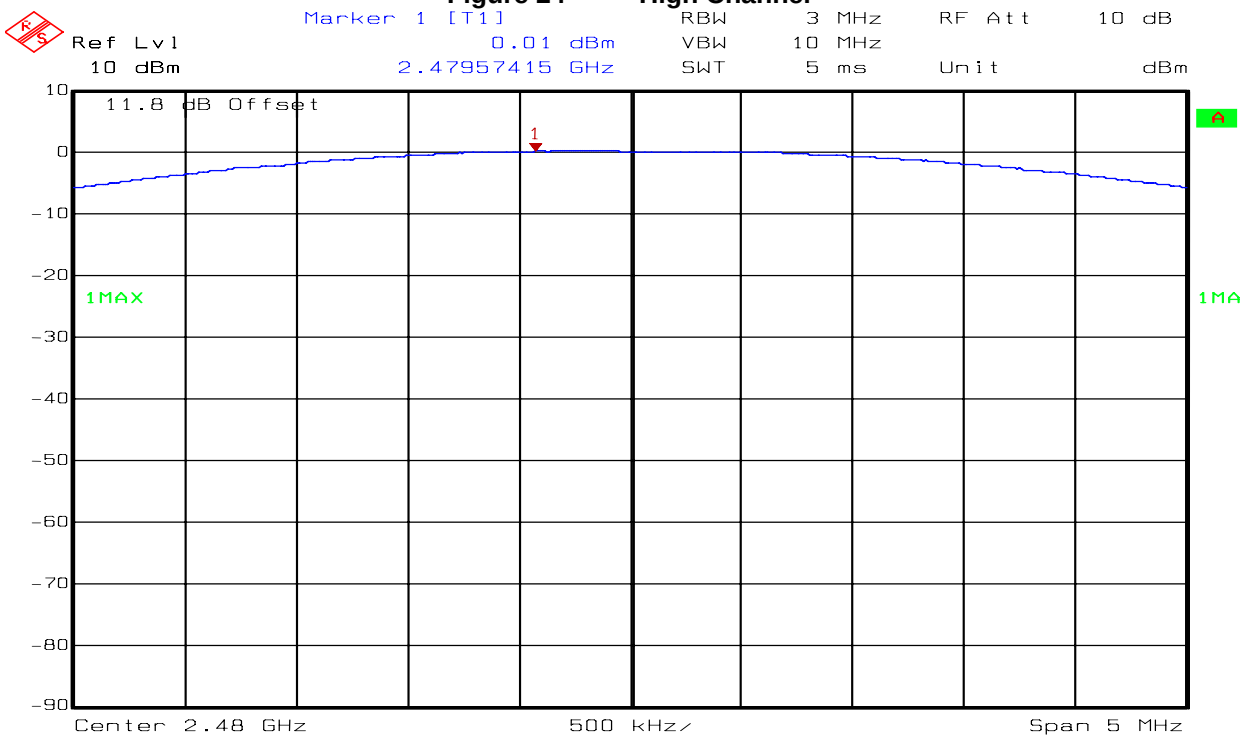
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz (Low Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 11:22:17

Figure 23 Mid Channel



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2443 MHz (Mid Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 11:28:40

Figure 24 High Channel



APPENDIX I: DUTY CYCLE

I.1. Base Standard & Test Basis

Base Standard	FCC 15.35 (c) RSS-Gen Issue 2 4.5
Test Basis	FCC 15.35 (c) as per FCC Publication 558074 RSS-Gen Issue 2 4.5
Test Method	Zero span

I.2. Specifications

15.35 (c) Unless otherwise specified, e.g. §15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

I.3. Test Procedure

As per FCC 15.35 with analyzer in Zero span mode.

I.4. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was tuned to Ch00 at highest power and maximum data rate (DH5).

I.5. Test Results

Number of hoping = 1600 / s
DH5 31.6 second period dwell time = 5 * 625 µs * 1600 * 1/5 * 1/s / 79 * 31.6s = 0.4s
(Bluetooth Core specification V 1.0B)
Duty cycle = 20*log (2.906 * 160 / 79 /100) = -24.60 dB (Worst case)
Duty cycle correction factor = -20 dB can be used as the maximum allowed correction factor

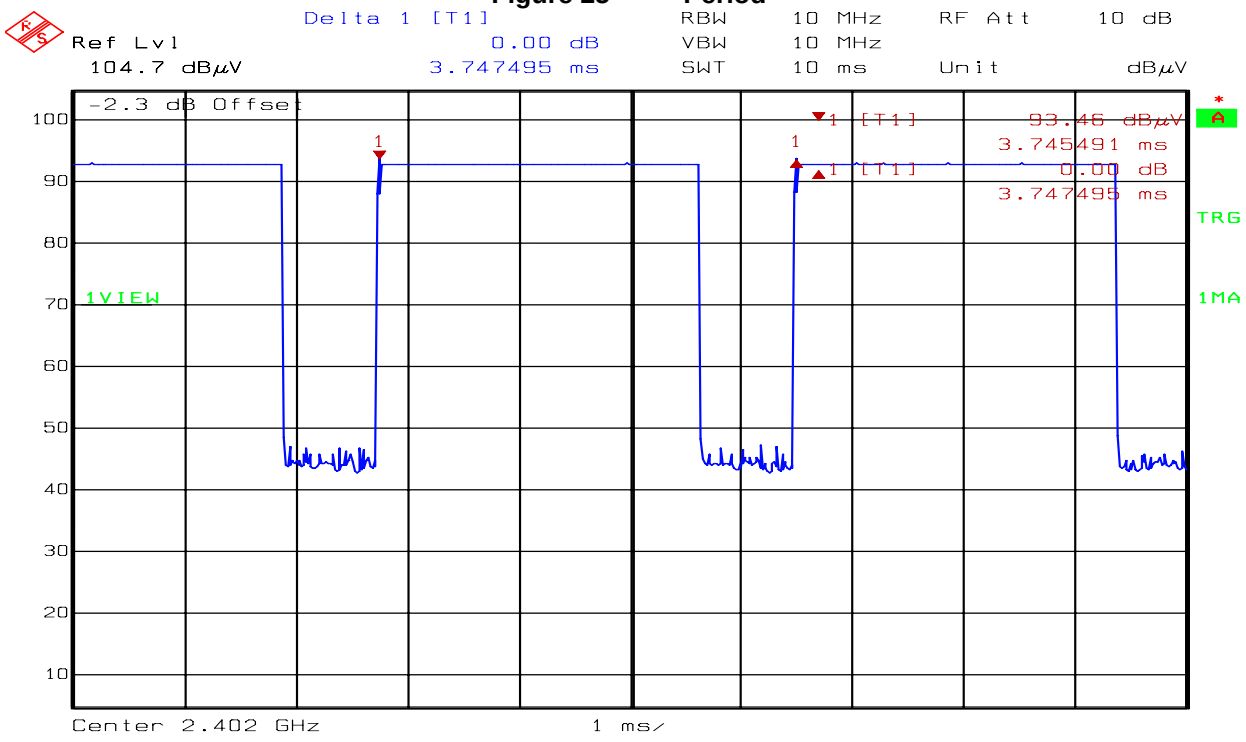
I.6. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

I.7. Test date

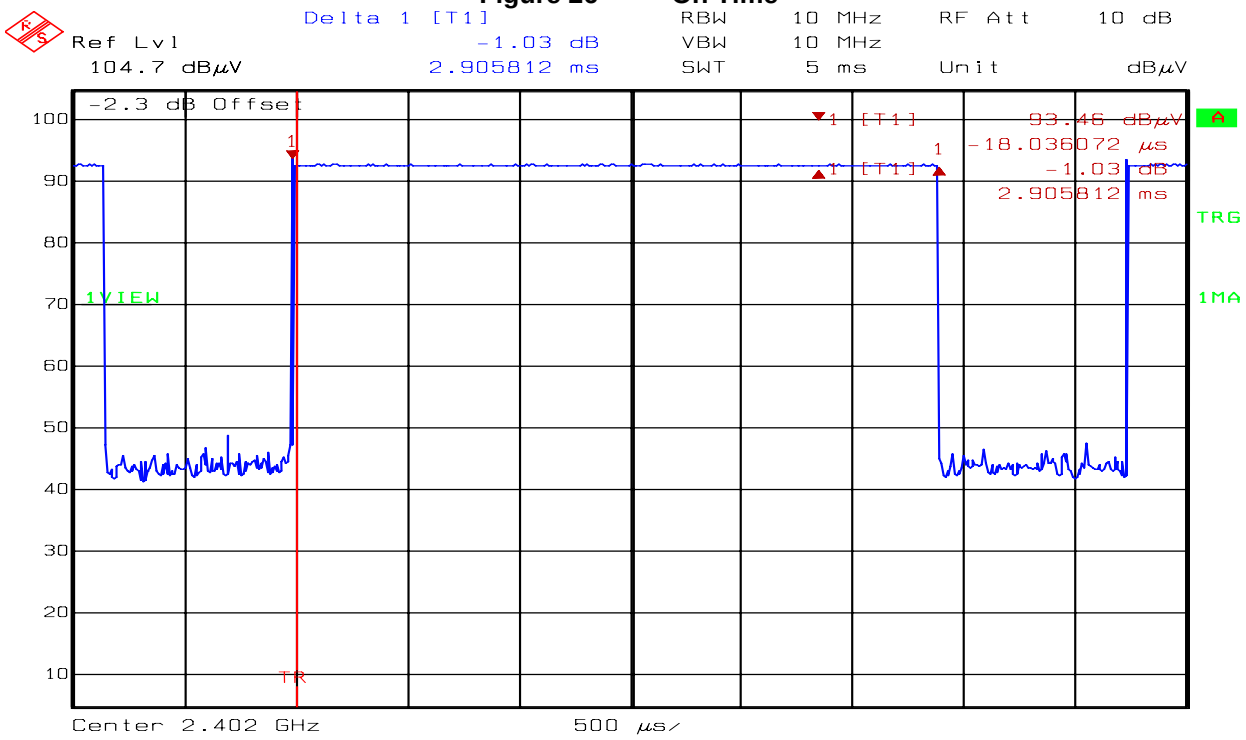
May 18, 2010

Figure 25 Period



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz, DH5, max duty cycle, PRBS9, Max power
Date: 18.MAY.2010 10:58:09

Figure 26 On Time



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz, DH5, max duty cycle, PRBS9, Max power
Date: 18.MAY.2010 11:00:03

APPENDIX J: CONDUCTED SPURIOUS EMISSIONS

J.1. Base Standard & Test Basis

Base Standards	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.247 (d) RSS-210 Issue 7 A8.5
Test Basis	RF conducted as per ANSI C63.10 and FCC Publication da000705 RSS-210 Issue 7 A8.5
Test Method	RF conducted as per ANSI C63.10 and FCC Publication da000705

J.2. Specifications

(d) 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)).

J.3. Test Procedure

FCC Publication da000705
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold

J.4. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was tuned to a low, middle and high channel with DH5 packets (worst case) at highest duty cycle and highest RF power.

J.5. Test Results Summary

Compliant.

Tx Channel	Worst Case Spurious Frequency (MHz)	Emission Level (dBc)
Low	290.22	-30.61
Mid	290.22	-32.30
High	290.22	-34.83

The worst case peak spurious emission was 30.61 dB below the carrier at Channel 00.

All final reported values are corrected values

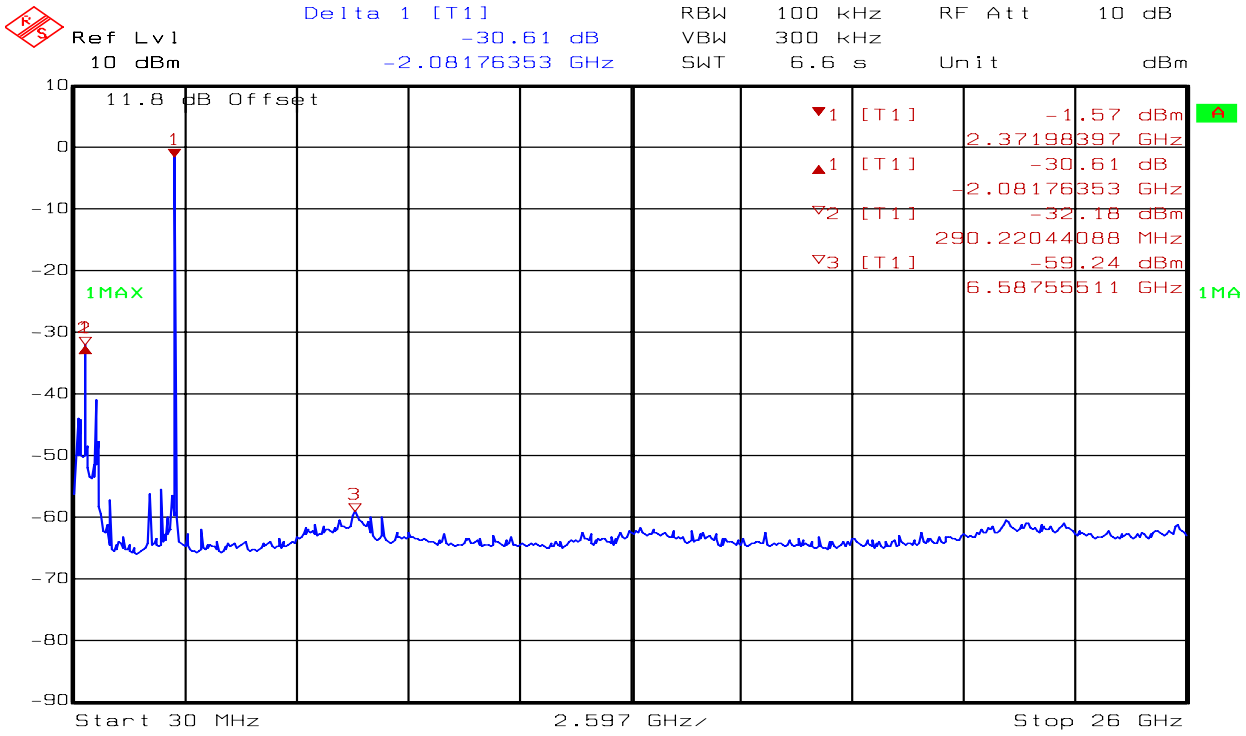
J.6. Tested By

This testing was conducted in accordance with the ISO 17025: 2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

J.7. Test date

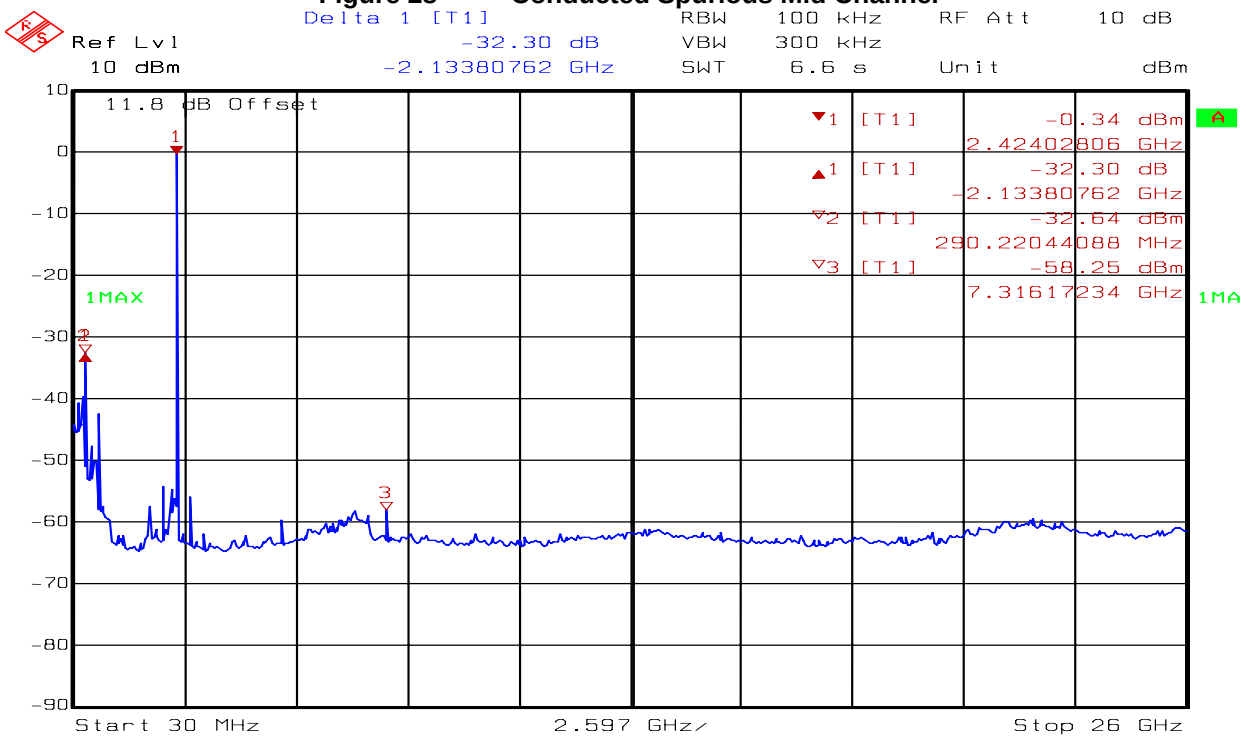
May 19, 2010

Figure 27 Conducted Spurious Low Channel



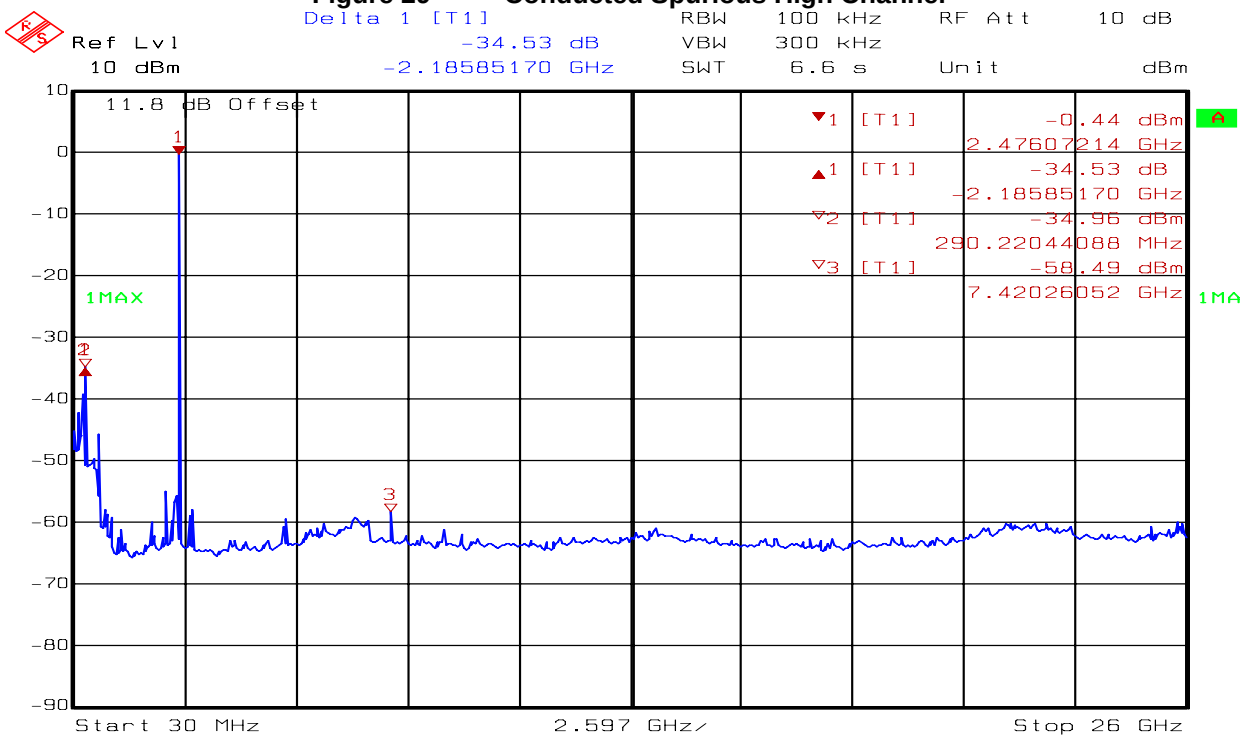
Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz (Low Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 15:02:48

Figure 28 Conducted Spurious Mid Channel



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2443 MHz (Mid Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 14:52:18

Figure 29 Conducted Spurious High Channel



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2480 MHz (High Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 12:41:01

APPENDIX K: CONDUCTED SPURIOUS EMISSIONS BAND EDGE

K.1. Base Standard & Test Basis

Base Standards	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.247 (d) RSS-210 Issue 7 A8.5
Test Basis	RF conducted as per ANSI C63.10 and FCC Publication da000705 RSS-210 Issue 7 A8.5
Test Method	RF conducted as per ANSI C63.10 and FCC Publication da000705

K.2. Specifications

(d) 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)).

K.3. Test Procedure

FCC Publication da000705
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold

K.4. Operating Mode During Test

The NovAtel SMART-MR10 Bluetooth was tuned to a low, and high channel with DH5 packets (worst case) at highest duty cycle and highest RF power.

K.5. Test Results

Compliant.

Channel/Measurement	Worst Case Spurious Frequency (MHz)	Emission Level (dBc)
00 (Lower band edge)	2400.00	-37.12
78 (Upper band edge)	2484.17	-59.24

Worst case spurious emission was 36.81 dB below the carrier at Channel 00

All final reported values are corrected values

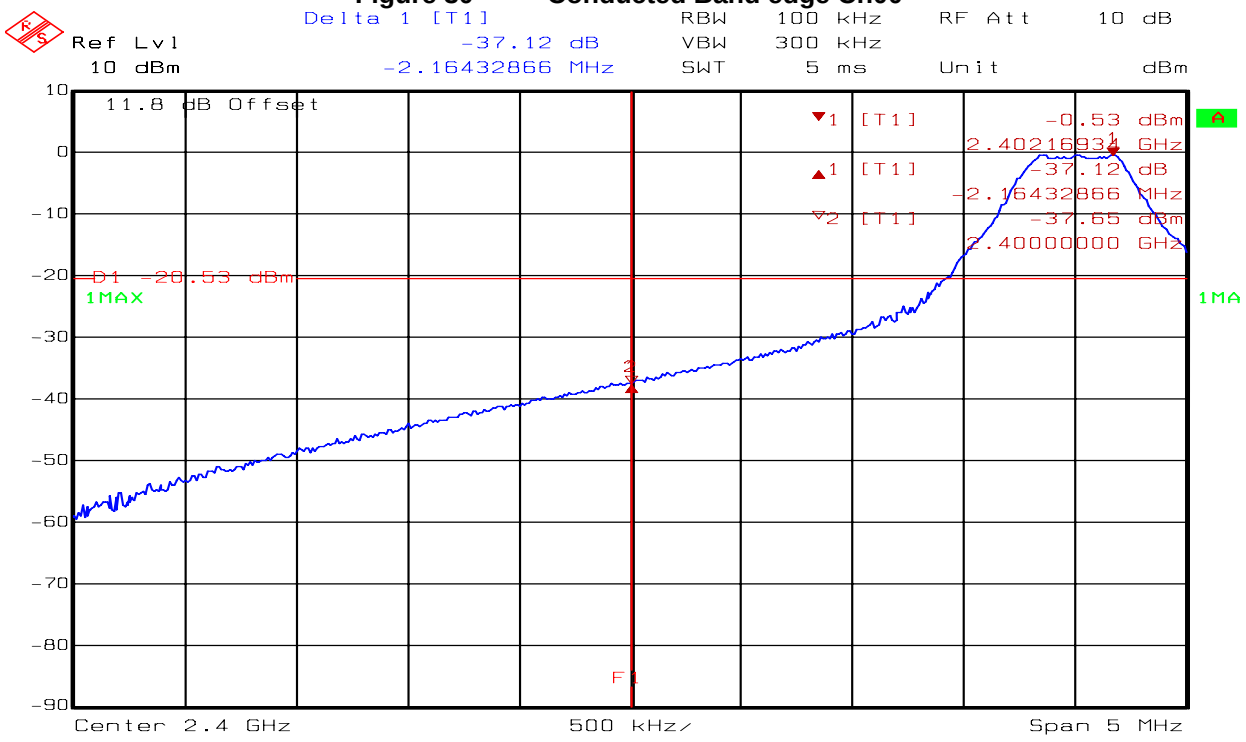
K.6. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

K.7. Test date

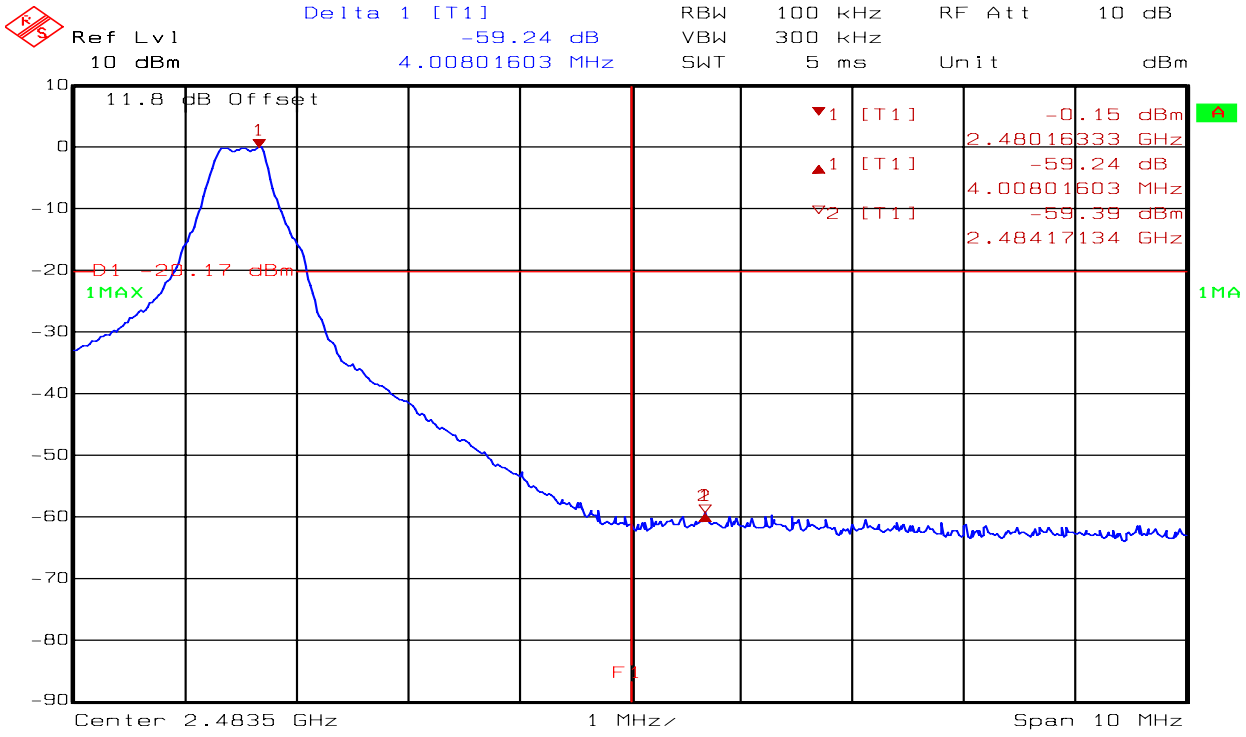
May 19, 2009

Figure 30 Conducted Band edge Ch00



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2402 MHz (Low Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 15:08:35

Figure 31 Conducted Band edge Ch78



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2480 MHz (High Ch) DH5, Max duty cycle, PRBS9, max power
Date: 19.MAY.2010 13:21:46

APPENDIX L: RADIATED SPURIOUS EMISSIONS BAND EDGE

L.1. Base Standard & Test Basis

Base Standard	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.209 – Radio Frequency Devices, Part 15.205 – Restricted bands of operation RSS 210 Issue 7 A8.5
Test Basis	ANSI C63.4-2003 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz,
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 and ANSI C63.10

L.2. Specifications

FCC 15.205 and RSS 210 Issue 7 2.2 Restricted bands of operation.

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1]0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	N/A
13.36–13.41	N/A	N/A	N/A

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

L.3. Test Procedure

RF radiated measurement at 3 meters distance.

For measurements above 1 GHz, RBW = 1 MHz, VBW = 3 MHz were used for peak measurements, Average emission value = Peak measurement - Duty cycle Correction Factor

L.4. Operating Mode During Test

The EUT was tuned to a low and high channel with DH5 packets at maximum rated RF output power with maximum duty cycle

L.5. Test Results

Compliant

Frequency (MHz)	Polarity	Peak Emission Level (dBµV/m)	Duty cycle Correction Factor (dB)	Average Emission Value (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
2389.06	Vertical	41.29	20	21.29	73.98	53.98	32.69
2483.50	Vertical	50.88	20	30.88	73.98	53.98	23.10

All final reported values are corrected values. Worst case emissions presented.

L.6. Sample Calculations

Part 15.209 Average Limit: 500 µV/m @ 3m = 20*Log (500) = 53.98 dBµV/m, Peak limit = 73.98 dBµV/m
Average Emission Value (dBµV/m) = Peak Emission Level (dBµV/m) - Duty cycle Correction Factor (dB)

L.7. Tested By

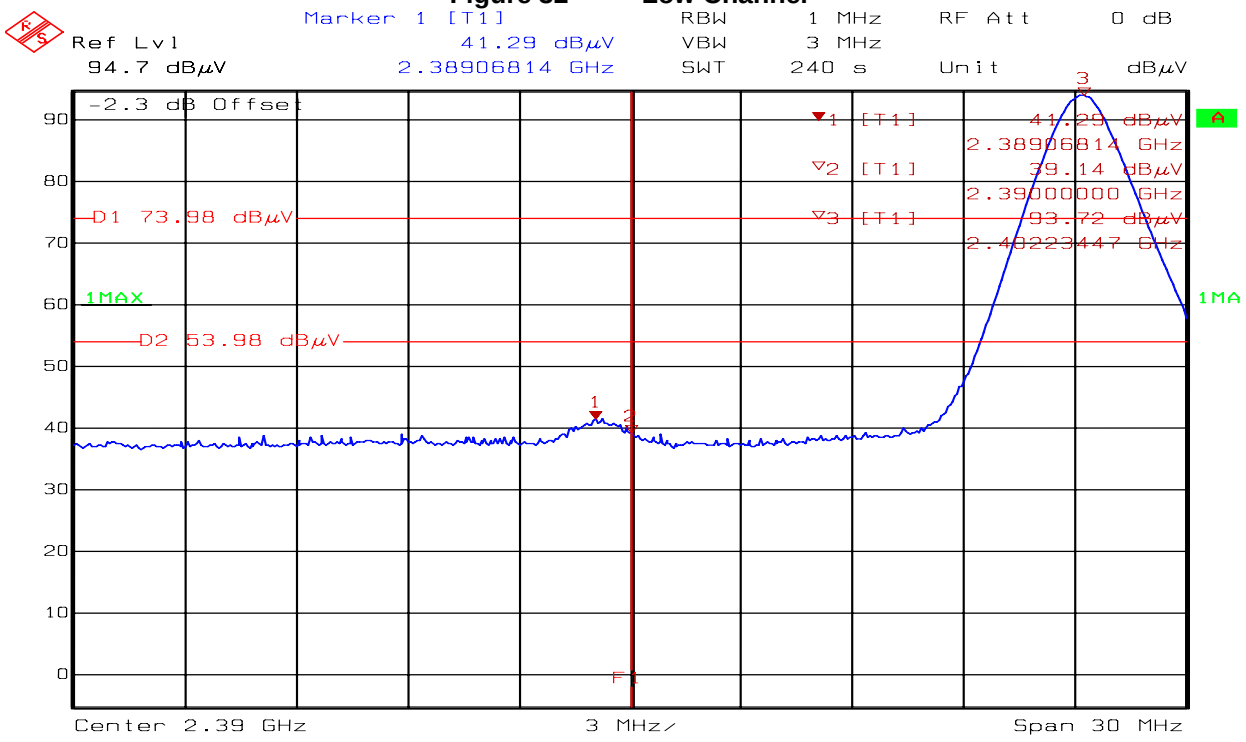
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

L.8. Test date

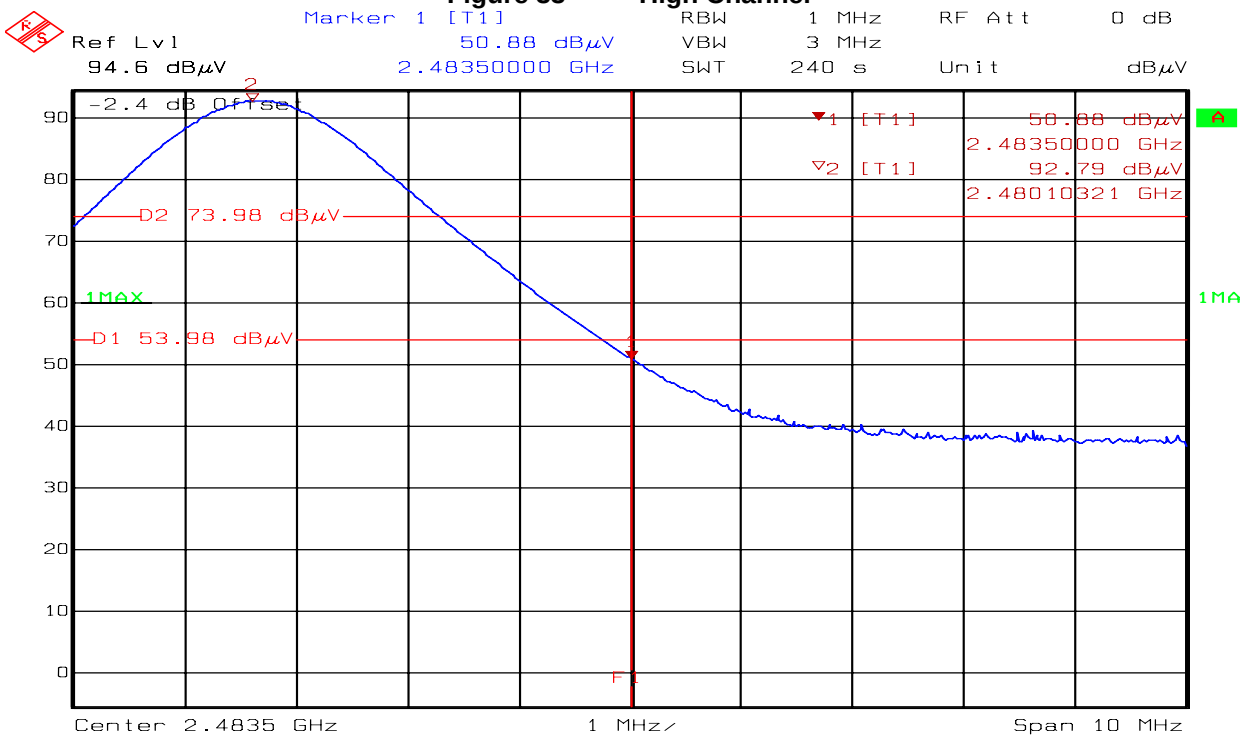
Started: May 17, 2010 Completed: May 18, 2010

Figure 32 Low Channel



Title: CG-1418 NovAtel SMART MR-10 with Bluetooth
Comment A: 2402 MHz (Ch00) DH5, Max duty cycle, PRBS9, max power
Date: 17.MAY.2010 12:45:09

Figure 33 High Channel



Title: CG-1418 NovAtel SMART-MR10 with Bluetooth
Comment A: 2480 MHz, DH5, max duty cycle, PRBS9, Max power
Date: 18.MAY.2010 9:39:14

APPENDIX M: RADIATED SPURIOUS EMISSIONS (TX AND RX)

M.1. Base Standard & Test Basis

Base Standard	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.209 – Radio Frequency Devices, Part 15.205 – Restricted bands of operation RSS 210 Issue 7 2.6 and A8.5 RSS Gen Issue 2 4.10 and 7.2.3 Receiver Spurious Emission
Test Basis	ANSI C63.4-2003 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, ANSI C63.10
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 and ANSI C63.10

M.2. Specifications

FCC 15.205 and RSS 210 Issue 7 2.2 Restricted bands of operation.

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1]0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	N/A
13.36–13.41	N/A	N/A	N/A

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

M.3. Test Procedure

M.3.1 Tx Spurious measurements

RF radiated measurement at 3 meters distance.

For measurements above 1 GHz, RBW = 1 MHz, VBW = 3 MHz were used for peak measurements, Average emission value = Peak measurement - Duty cycle Correction Factor

M.3.2 RSS Gen Issue 2, 4.10 Receiver Spurious Emission

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

Spurious Emission Limits for Receivers

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

M.4. Operating Mode During Test

For Tx spurious emissions: The EUT was tuned to a low, mid and high channel with DH5 packets at maximum rated RF output power with maximum duty cycle

For Rx spurious emissions: The EUT was tuned to receive only mode in mid channel

M.5. Test Results

Pass, Worst case results reported

M.5.1 Rx mode

Channel	Polarity	Frequency (MHz)	Emission Level (dBµV/m)	Detector	Limit (dBµV/m)	Margin (dB)
Mid	Horizontal	4881.94	44.97	Average	53.98	9.01
	Vertical	4881.96	40.36	Average	53.98	13.62

Maximum measured level with average detector was 44.97 dBµV/m at 4881.94 MHz when the receive antenna horizontally polarized. It has 9.01 dB margin to the RSS Gen Issue 2, 4.10 Receiver Spurious Emission Average limits

M.5.2 TX Mode

Channel	Polarity	Frequency (MHz)	Peak Emission Level (dBµV/m)	Duty cycle Correction Factor (dB)	Average Emission Value (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
Low	H	4803.87	44.33	20	24.33	73.98	53.98	29.65
	V	4803.74	42.45	20	22.45	73.98	53.98	31.53
Mid	H	4880.23	43.25	20	23.25	73.98	53.98	30.73
	V	4879.60	41.08	20	21.08	73.98	53.98	32.90
High	H	4954.86	45.32	20	25.32	73.98	53.98	28.66
	V	4960.24	44.57	20	24.57	73.98	53.98	29.41

Worst case peak spurious emission was 45.32 dBµV/m at 4954.86 MHz horizontal polarization in high channel. It has 28.66 dB margin to the limits.

Note:

Plots were not provided in order to reduce file size

M.6. Sample Calculations

Average Limit for above 960 MHz = 500 µV/m @ 3m = 20*Log (500) = 53.98 dBµV/m
Peak Limit for above 960 MHz = Average Limit + 20 (dB) = 73.98 dBµV/m
Average Emission Value (dBµV/m) = Peak Emission Level (dBµV/m) - Duty cycle Correction Factor (dB)

M.7. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

M.8. Test date

Started: May 17, 2010, Completed: May 18, 2010

APPENDIX N: TEST EQUIPMENT LIST

Type	Manufacturer	Model	Asset #	Cal Due	Cal Date
Bilog Antenna	Teseq	CBL 6112B	CG0314	21SEP10	29OCT08
Horn Antenna (Rx) 1 GHz – 18 GHz	EMCO	3115	CG0368	08SEP11	08SEP09
Standard Gain Horn (Rx) 18 GHz – 26.5 GHz	EMCO	3160-09	CG0075	N/A (1)	27NOV01
LNA 1 GHz < f < 18 GHz	Miteq	JSD00121	CG0761	13NOV11	13NOV09
LNA 18GHz < f < 26.5GHz	Miteq	JSD00119	CG0482	02OCT11	02OCT09
High pass filter f > 1000 MHz	MicroTronics	HPM14576	CG0963	01DEC10	01DEC08
High pass filter f > 2800 MHz	MicroTronics	HPM50111	CG0964	N/A	N/A
Spectrum Analyzer 9 kHz – 40 GHz	Rohde & Schwarz	FSEK-20	CG0118	06AUG10	06AUG09
Test Receiver	Rohde & Schwarz	ESMI	CG0123 CG0434	04JUN10	04MAY09
RF Cable	Sucoflex	104	115776	N/A	N/A
RF Attenuator	Weinschel	41-10-12	19981	N/A	N/A
HPIB Extender	HP	37204	CG0181	N/A	N/A
Mast Controller	EMCO	2090	CG0179	N/A	N/A
Turntable Controller	EMCO	2090	CG0178	N/A	N/A

(1): As per manufacturer recommend, this item does not require periodic calibration. Its electromagnetic performance is almost exclusively depended on the physical dimension of the horn. A thorough mechanical check is all that is needed to guarantee the antenna performance.

END OF DOCUMENT