

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : E14OR-046

AGR No. : A14OA-036

Applicant : LG Innotek Co., Ltd.

Address : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731, South Korea

Manufacturer : LG Innotek Co., Ltd.

Address : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731, South Korea

Type of Equipment : Class 2 Bluetooth Multimedia Module

FCC ID. : YZP-RBFAC21SA

Model Name : RBFA-C21SA

Serial number : N/A

Total page of Report : 80 pages (including this page)

Date of Incoming : October 16, 2014

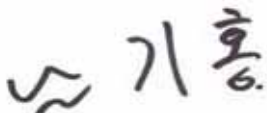
Date of issue : October 22, 2014

SUMMARY

The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247*

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

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ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E14OR-046	October 22, 2014	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

APPLICANT : LG Innotek Co., Ltd.
ADDRESS : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731, South Korea
CONTACT PERSON : Jeong Inchang / Director
TELEPHONE NO : +82-62-950-0332
FCC ID : YZP-RBFAC21SA
MODEL NAME : RBFA-C21SA
SERIAL NUMBER : N/A
DATE : October 22, 2014

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
KIND OF EQUIPMENT	Modular Transmitter Class 2 Bluetooth Multimedia Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2009
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	3 m open area test site

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (1)	Carrier Frequency Separation	Met the Limit / PASS
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (iii)	Average Time of Occupancy	Met the Limit / PASS
15.247 (b) (1)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (b) (5)	Radio Frequency Exposure Level	Met requirement / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.209	Radiated Emission Limits, General Requirement	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2009. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 301-14, Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862 Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-4617/ G-666/ T-1842 IC (Industry Canada) – Registration No. Site# 3736-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation No. 85

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3 GENERAL INFORMATION

3.1 Product Description

The LG Innotek Co., Ltd., Model RBFA-C21SA (referred to as the EUT in this report) is a Class 2 Bluetooth Multimedia Module. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Portable Device	
OPERATING FREQUENCY	2 402 MHz ~ 2 480 MHz	
RF OUTPUT POWER	1 Mbps	3.76 dBm
	2 Mbps	2.77 dBm
	3 Mbps	2.93 dBm
NUMBER OF CHANNEL	79 Channels	
MODULATION TYPE	GFSK for 1 Mbps, DQPSK for 2 Mbps, 8-DPSK for 3 Mbps	
ANTENNA TYPE	PCB Antenna	
ANTENNA GAIN	1.0 dBi	
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ.>=1 MHz)	32 MHz	
RATED SUPPLY VOLTAGE	DC 3.3 V	

3.2 Alternative type(s)/model(s); also covered by this test report.

-, None

4. EUT MODIFICATIONS

-, None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	LG Innotek Co., Ltd.	N/A	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
RBFA-C21SA	LG Innotek Co., Ltd.	Class 2 Bluetooth Multimedia Module (EUT)	Notebook PC
LGR501	LG	Notebook PC	EUT
Jig board	N/A	N/A	EUT
DC Power supply			

5.3 Mode of operation during the test

For Bluetooth function testing, software used to control the EUT for staying in continuous transmitting and receiving mode is programmed. The EUT was set at Low Channel (2 402 MHz), Middle Channel (2 441 MHz), and High Channel (2 480 MHz) with each data transfer rate, 1 Mbps, 2 Mbps, and 3 Mbps. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XZ” axis, but the worst data was recorded in this test report.

5.4 Configuration of Test System

Line Conducted Test: It is not need to test this requirement, because the EUT shall be operated by DC power supply

Radiated Emission Test: The EUT was tested in a charging mode and Transmitter mode. Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2009 8.3.1.1 and 13.1.4.1 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m open area test site.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

The transmitter antenna of the EUT is a chip antenna, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
It is not need to test this requirement, because the EUT shall be operated by DC power supply.	

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X
Receiving Mode	

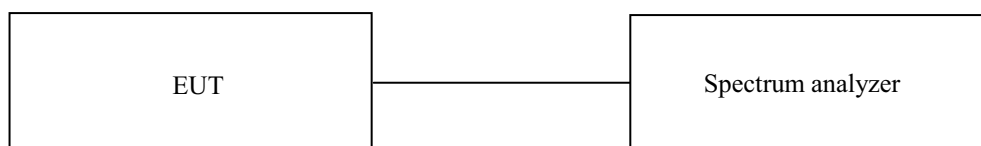
7. MINIMUM 20 dB BANDWIDTH

7.1 Operating environment

Temperature : 24.4 °C
Relative humidity : 45 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 10 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

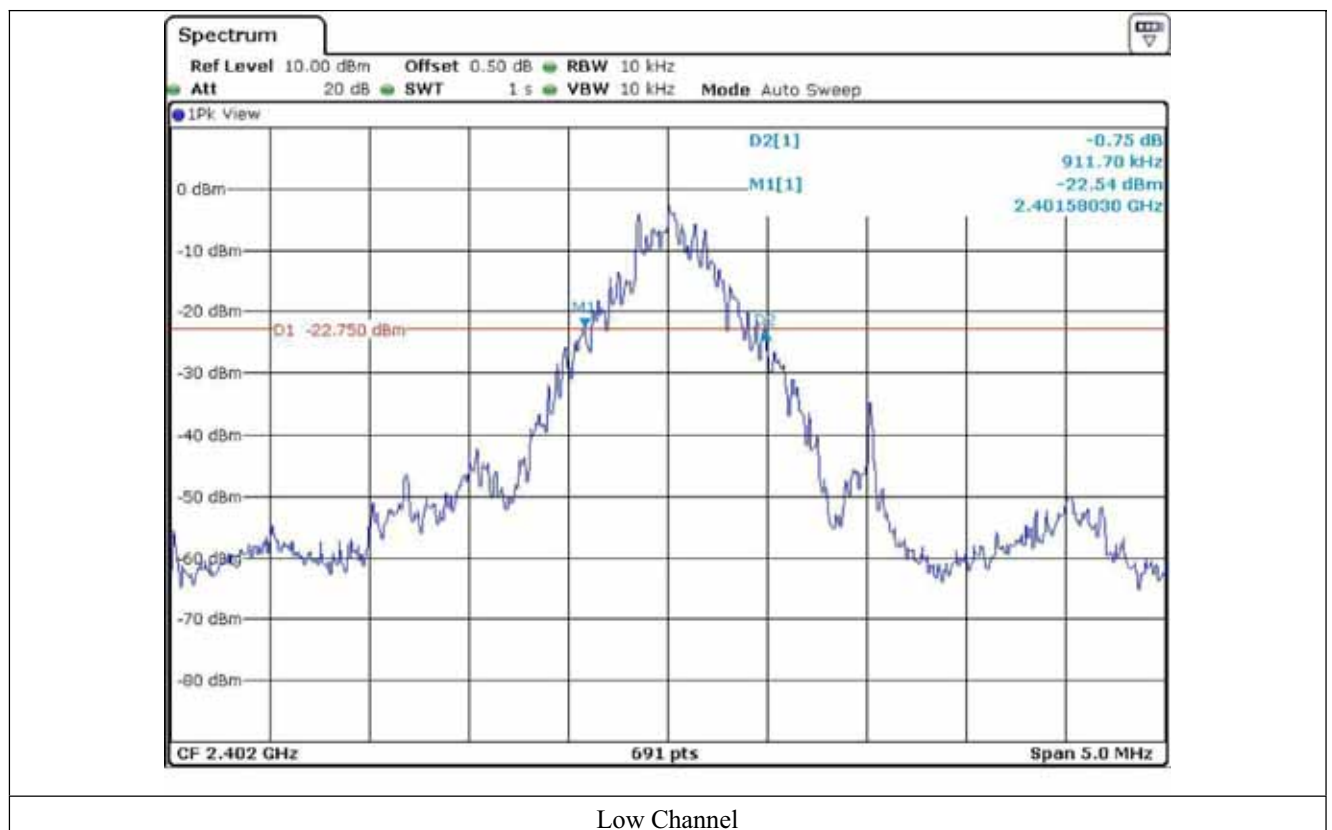
7.4 Test data for 1 Mbps

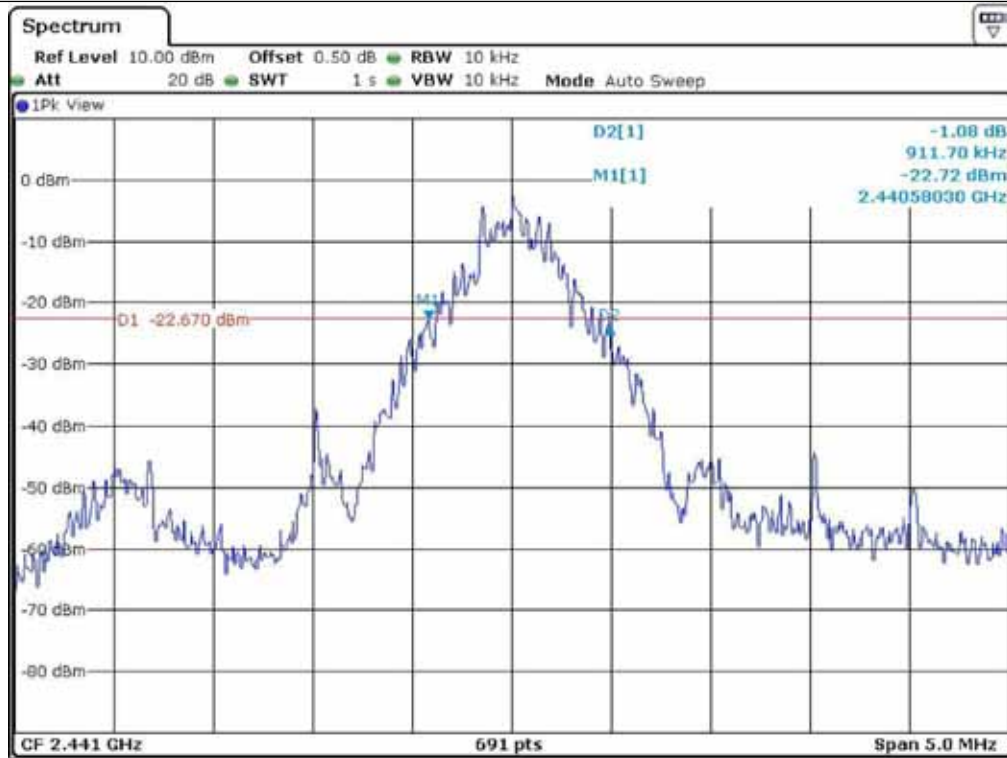
-. Test Date : October 21, 2014

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402	911.70
Middle	2 441	911.70
High	2 480	904.50

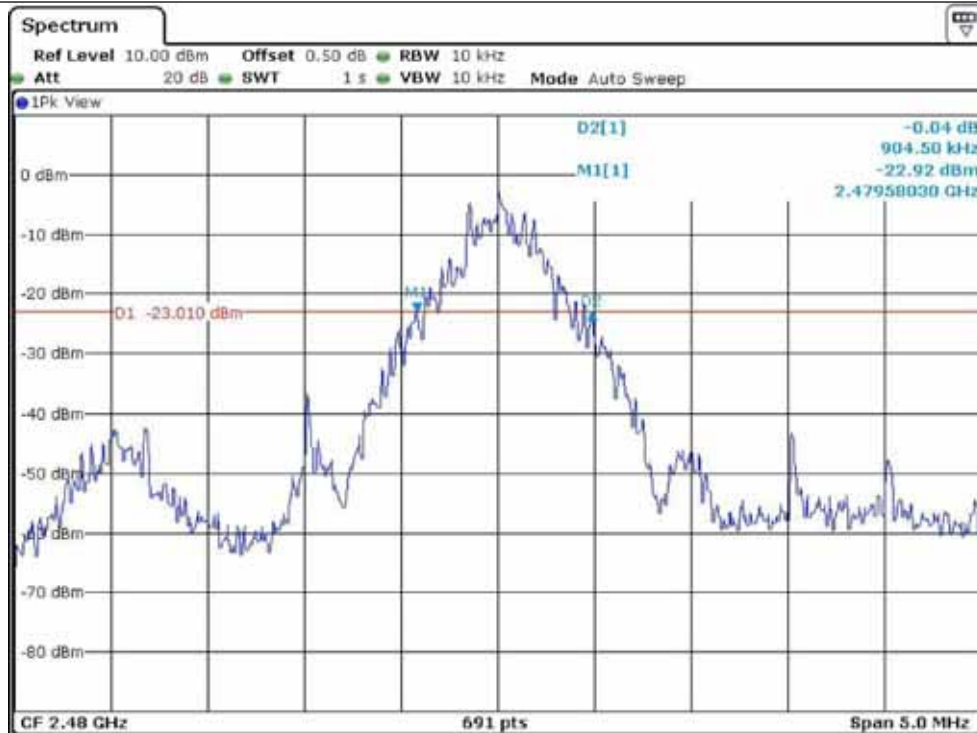


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Middle Channel



High Channel

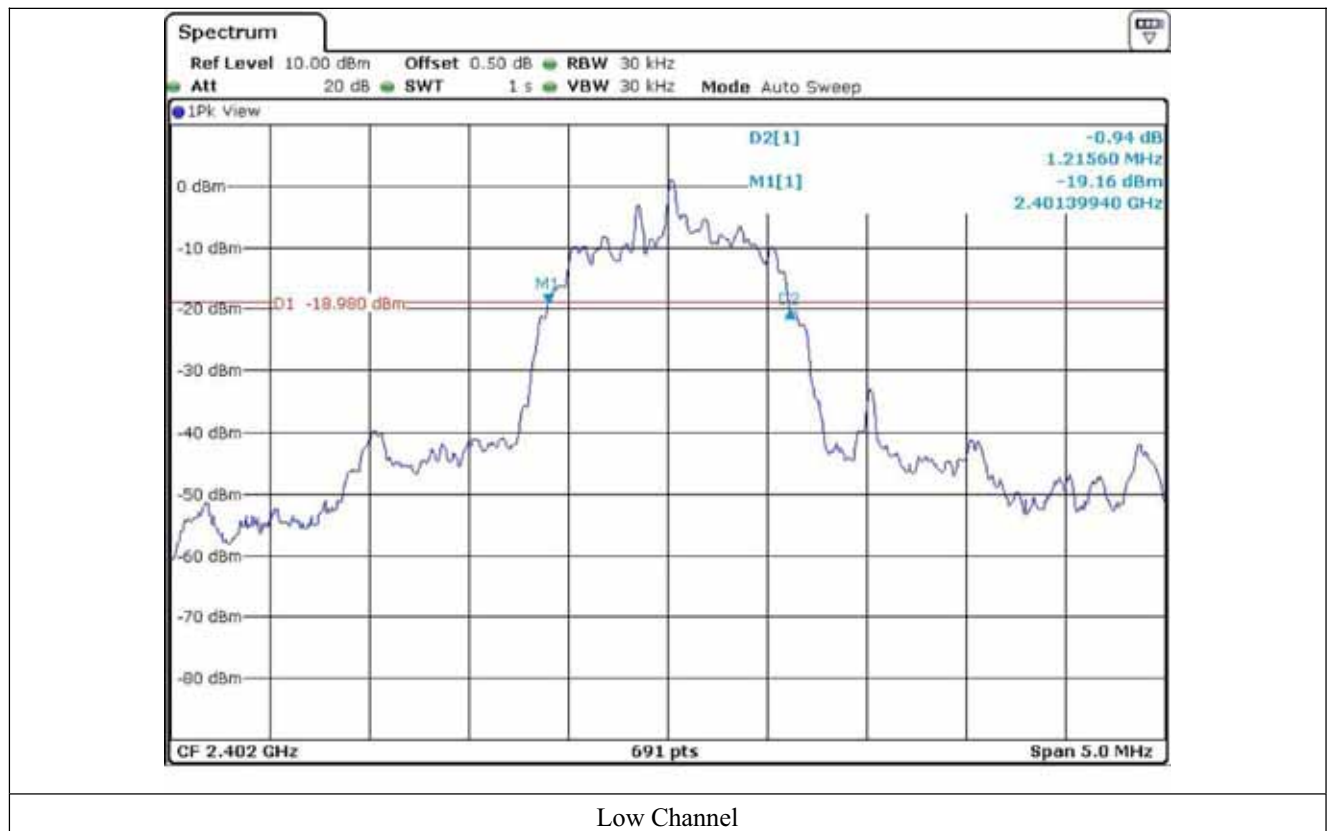
7.5 Test data for 2 Mbps

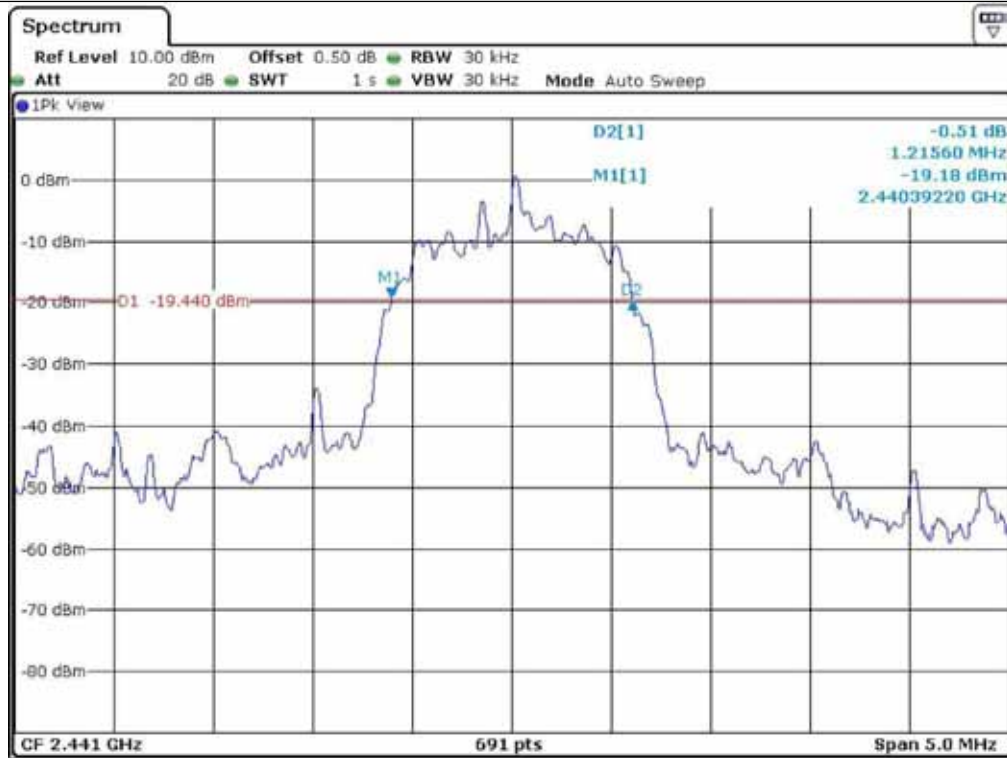
-. Test Date : October 21, 2014

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402	1 215.60
Middle	2 441	1 215.60
High	2 480	1 215.60

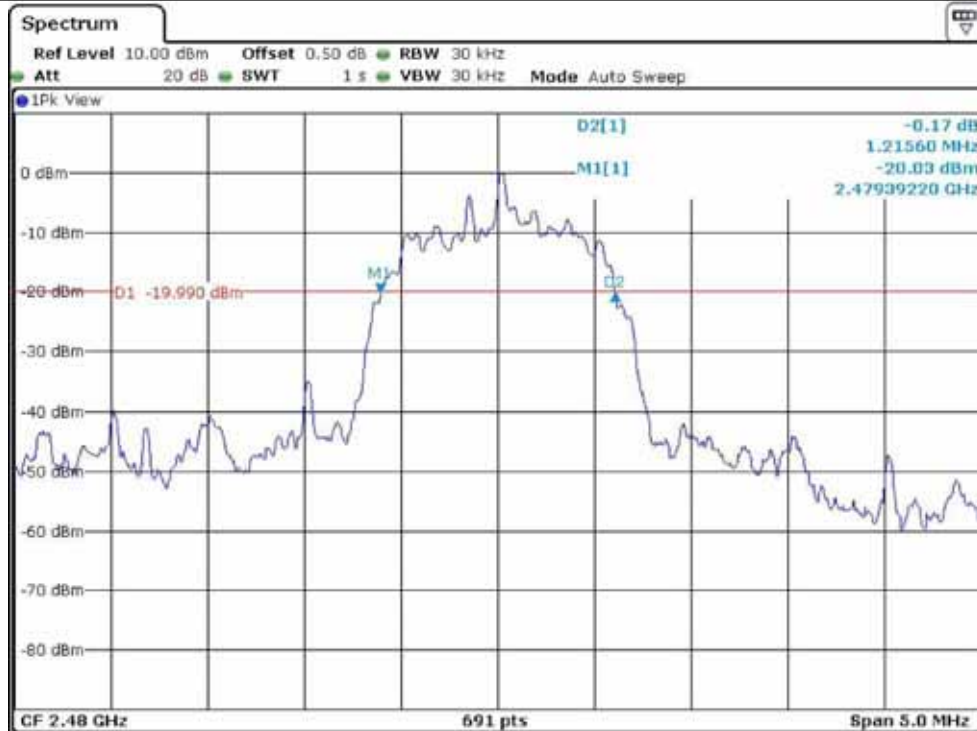


Tested by: Tae-Ho, Kim / Project Engineer





Middle Channel



High Channel

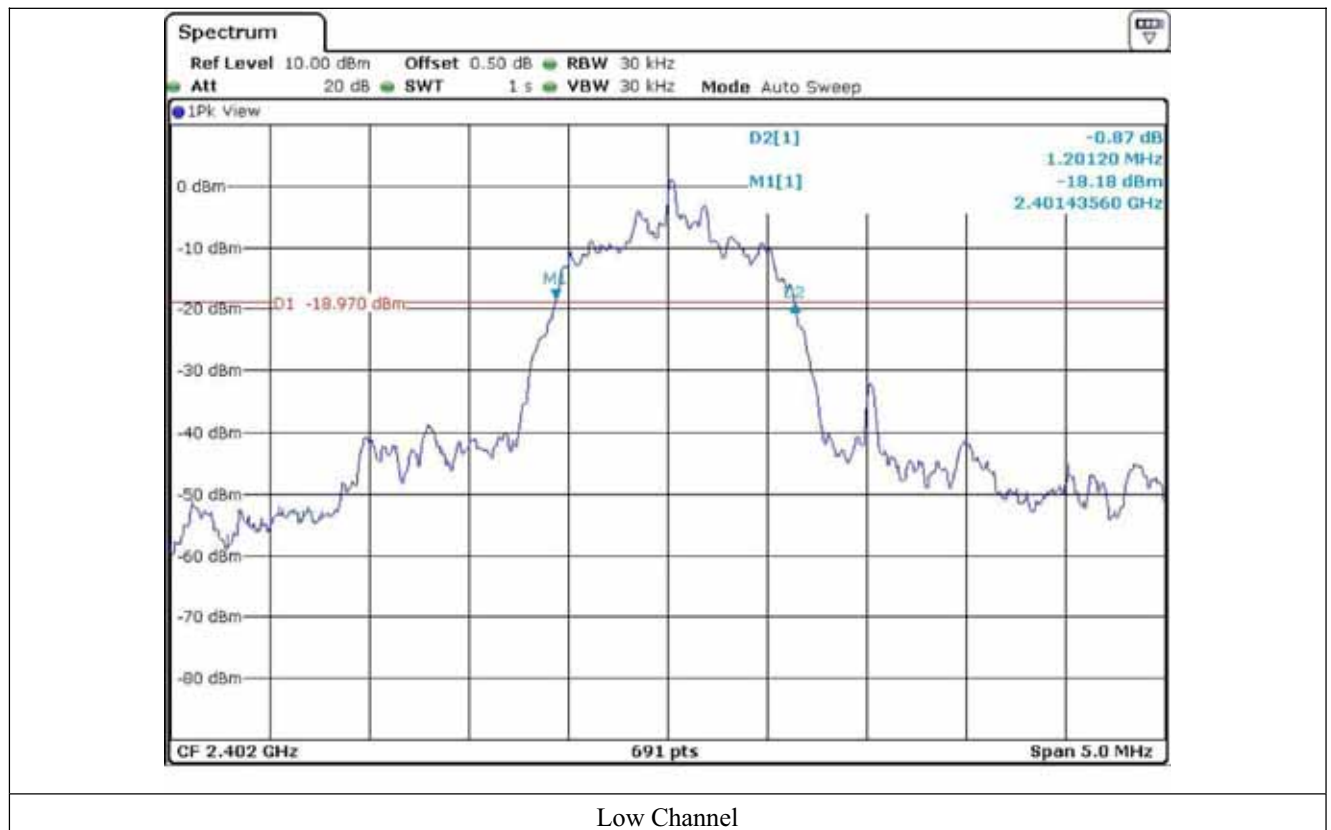
7.6 Test data for 3 Mbps

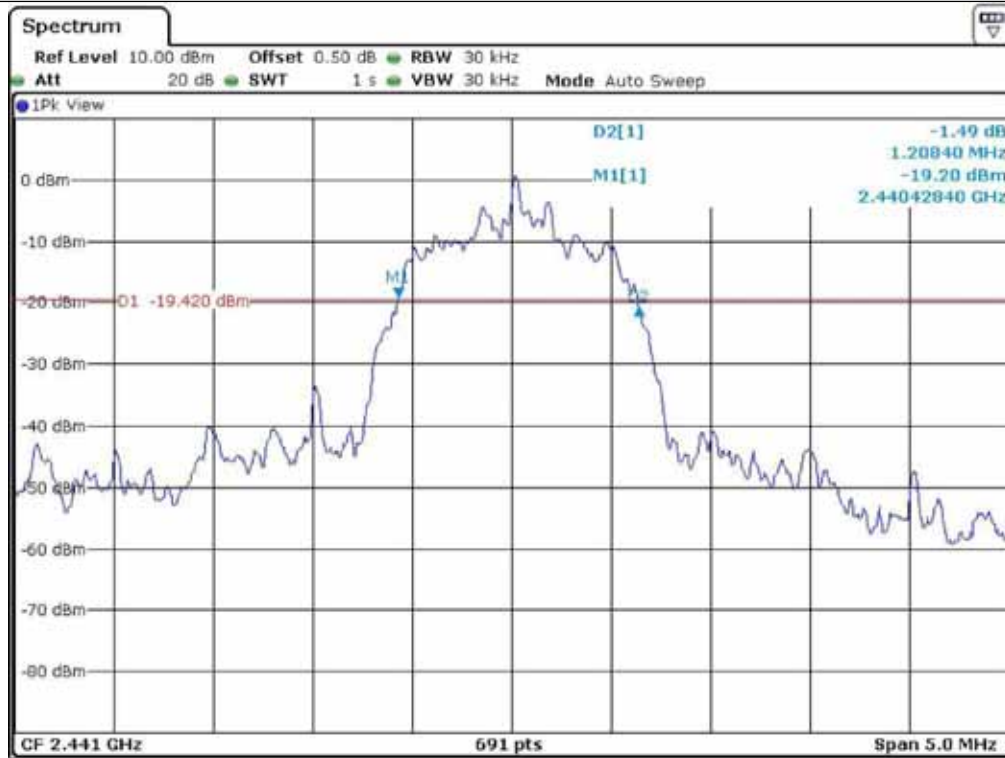
-. Test Date : October 21, 2014

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402	1 201.20
Middle	2 441	1 208.40
High	2 480	1 208.40

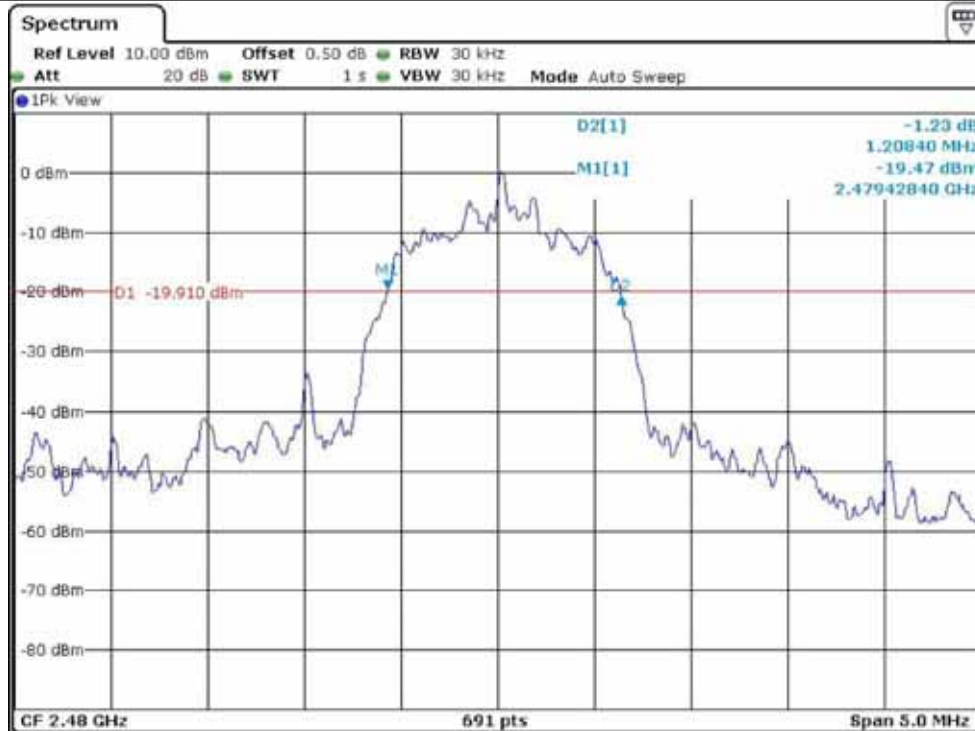


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Middle Channel



High Channel

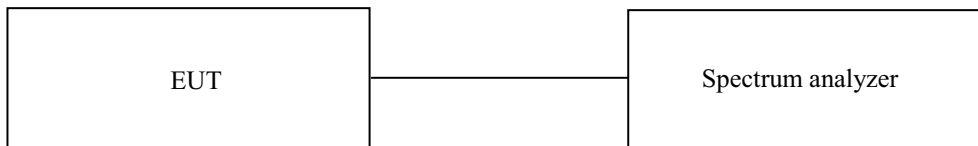
8. HOPPING FREQUENCY SEPARATION

8.1 Operating environment

Temperature : 24.4°C
Relative humidity : 45 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 10 MHz. The analyzer is set to peak hold then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for 1 Mbps

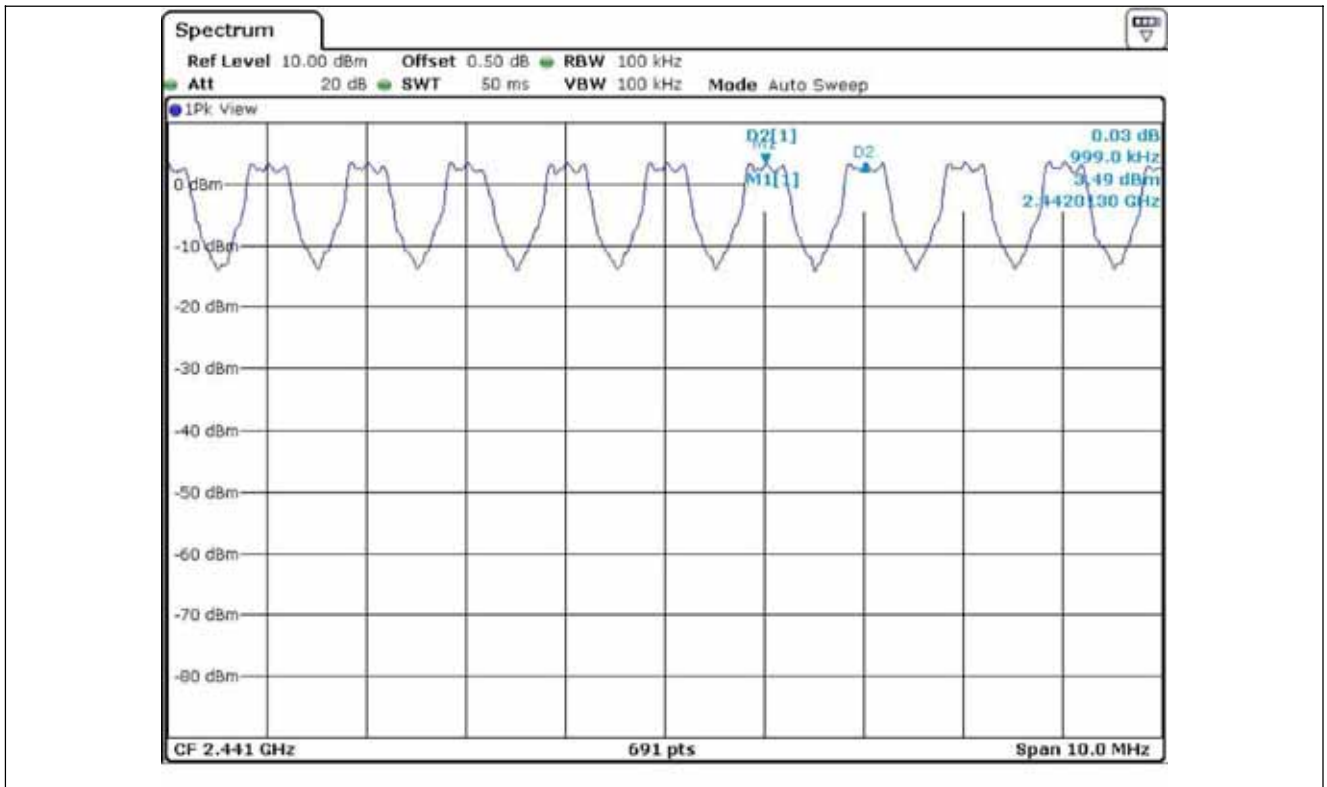
-. Test Date : October 21, 2014

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
999.00	607.8	Separated by a minimum of 25 kHz



Tested by: Tae-Ho, Kim / Project Engineer



8.5 Test data for 2 Mbps

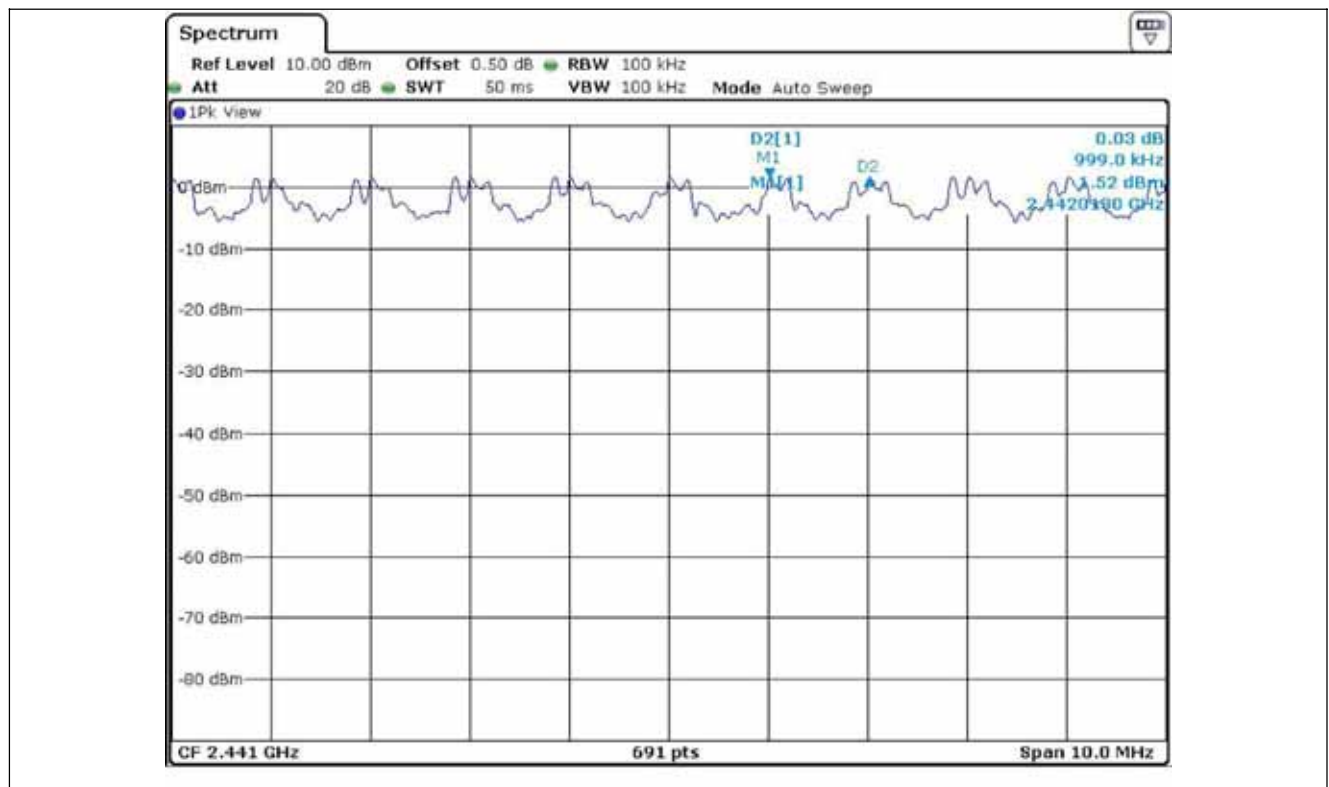
-. Test Date : October 21, 2014

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
999.00	810.4	Separated by a minimum of 25 kHz



Tested by: Tae-Ho, Kim / Project Engineer



8.6 Test data for 3 Mbps

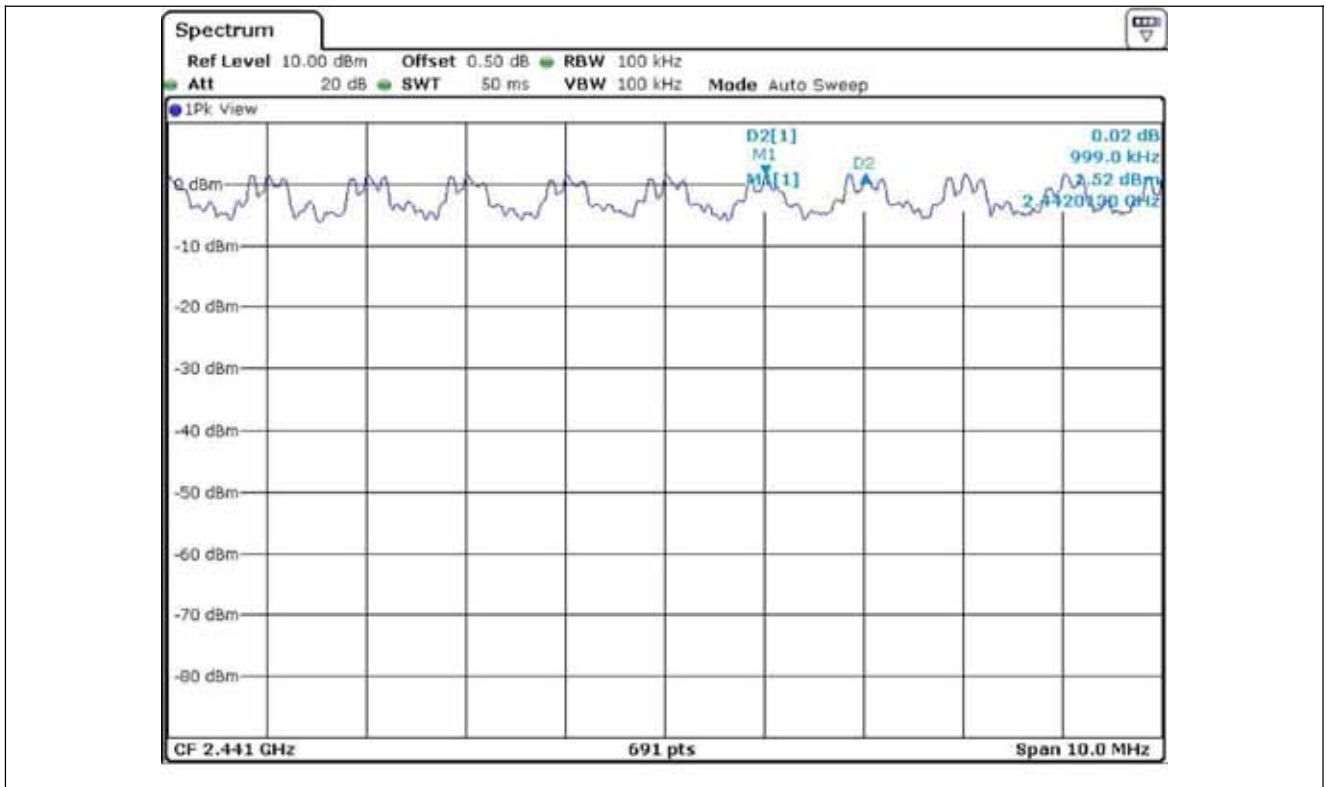
-. Test Date : October 21, 2014

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
999.00	805.6	Separated by a minimum of 25 kHz



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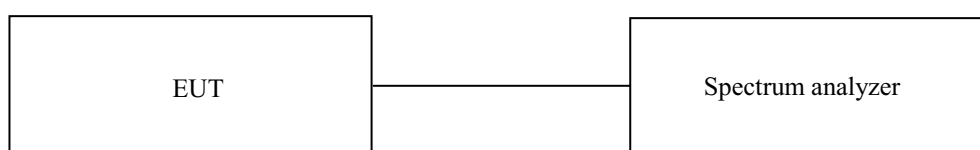
9. NUMBER OF HOPPING CHANNELS

9.1 Operating environment

Temperature : 21.4 °C
Relative humidity : 45 % R.H.

9.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 100 MHz and the resolution bandwidth is set to 1 MHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



9.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

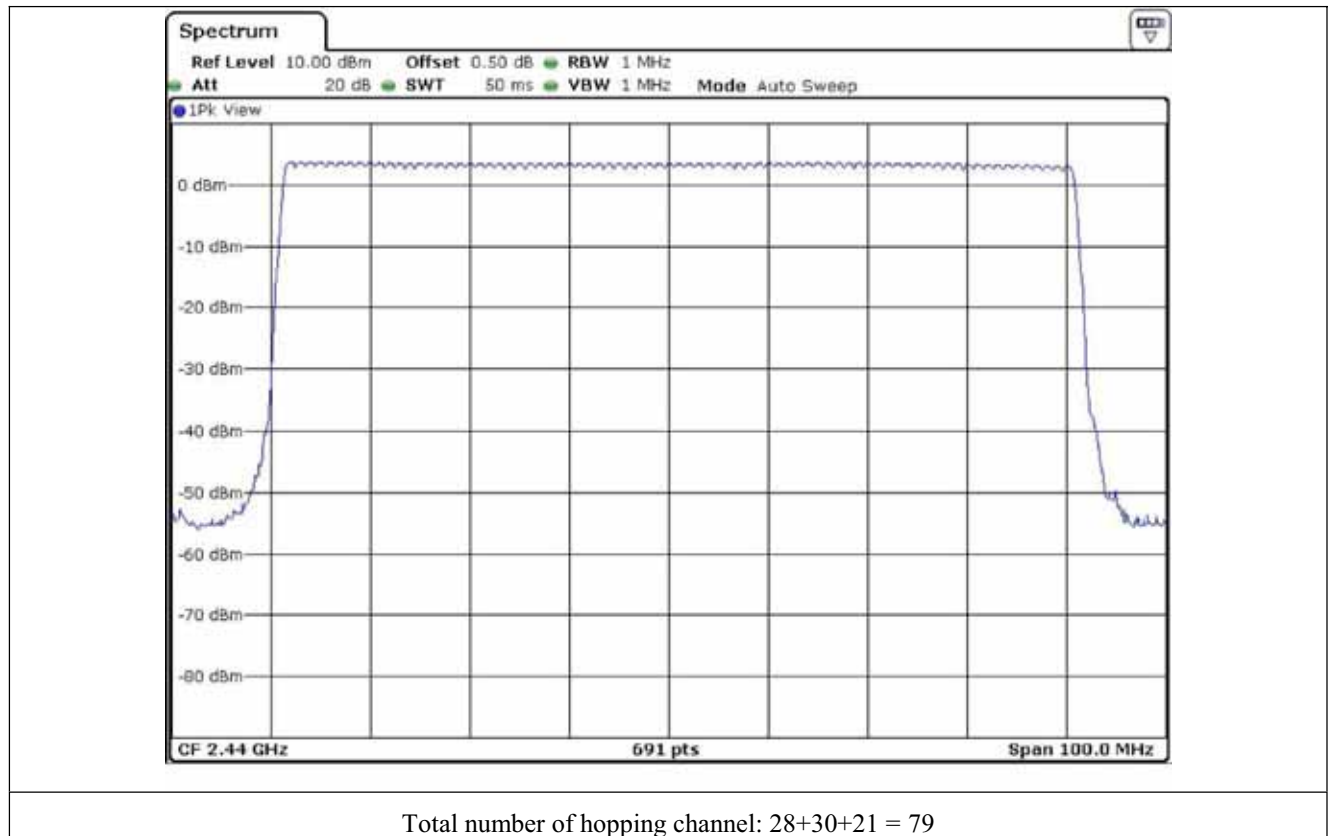
9.4 Test data for Mbps 1

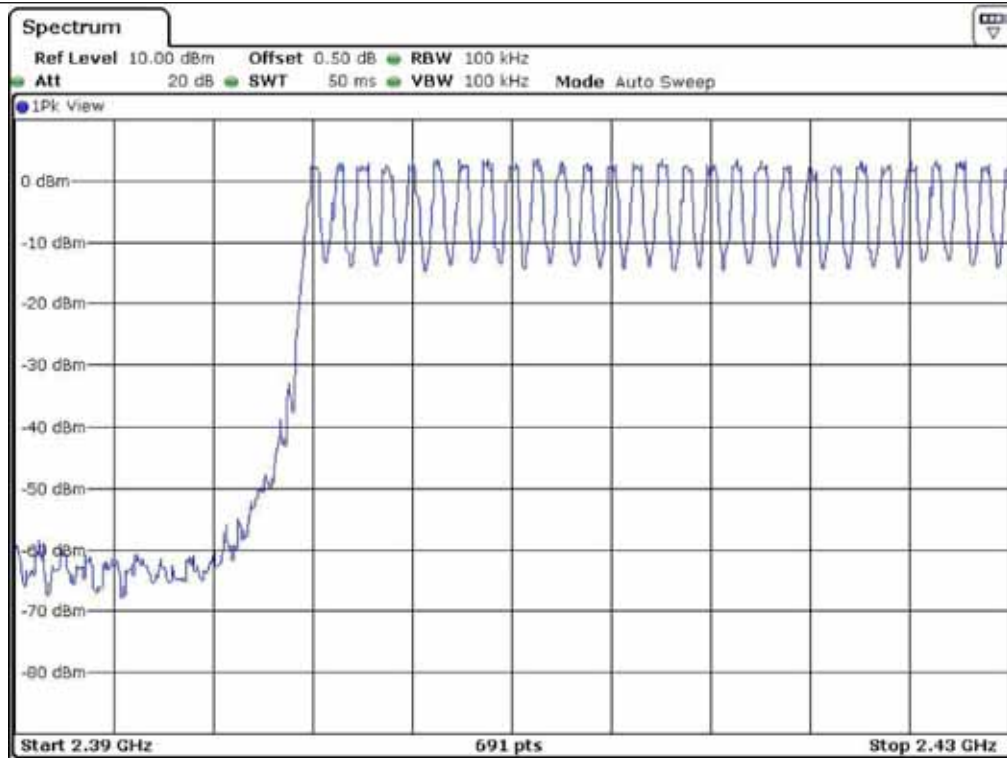
-. Test Date : October 21, 2014
-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
1 Mbps	79	Minimum of 15	64

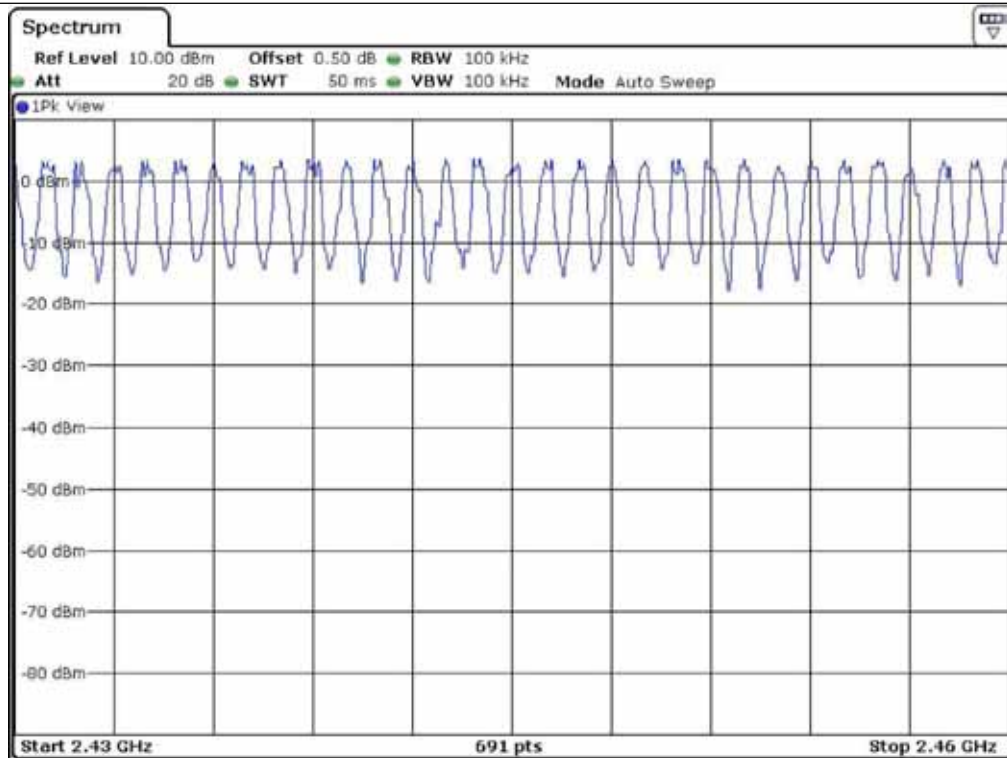


Tested by: Tae-Ho, Kim / Project Engineer

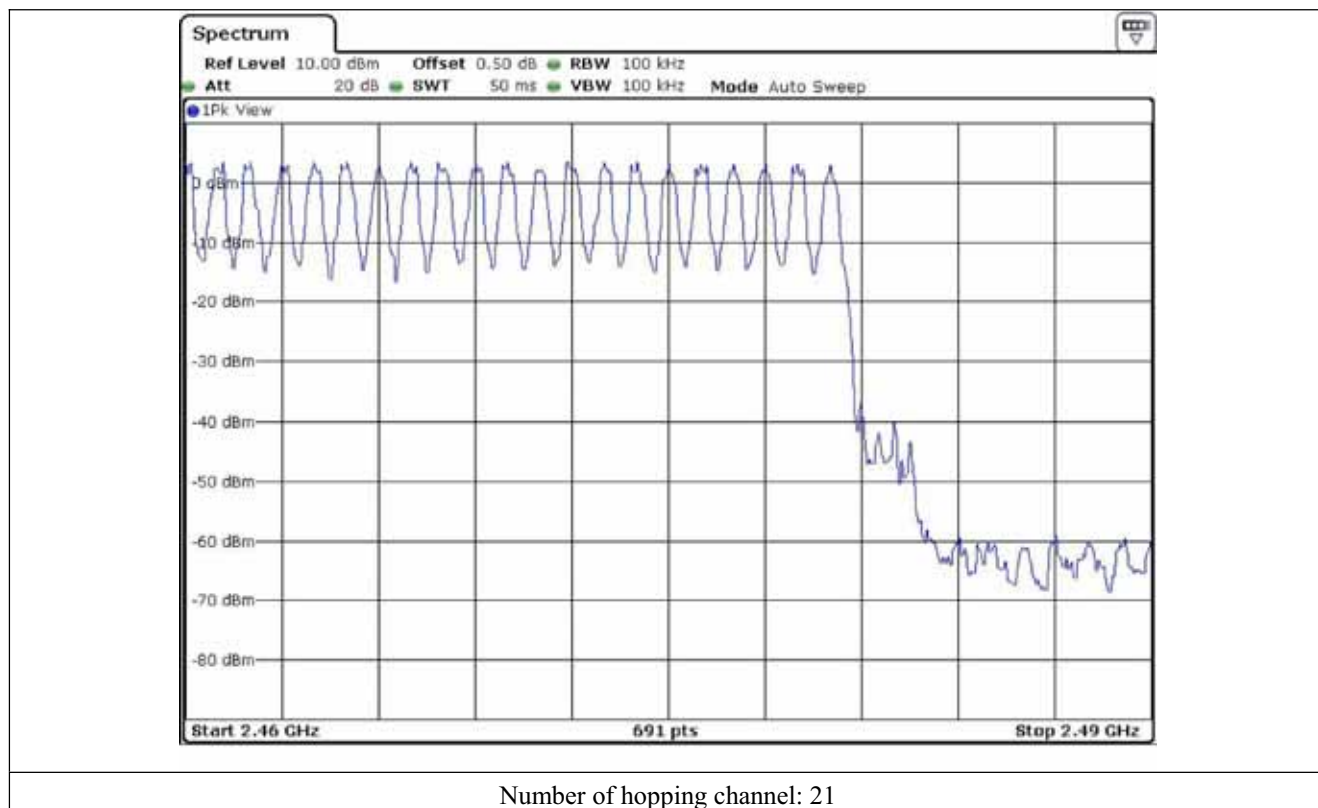




Number of hopping channel: 28



Number of hopping channel: 30



9.5 Test data for Mbps 2

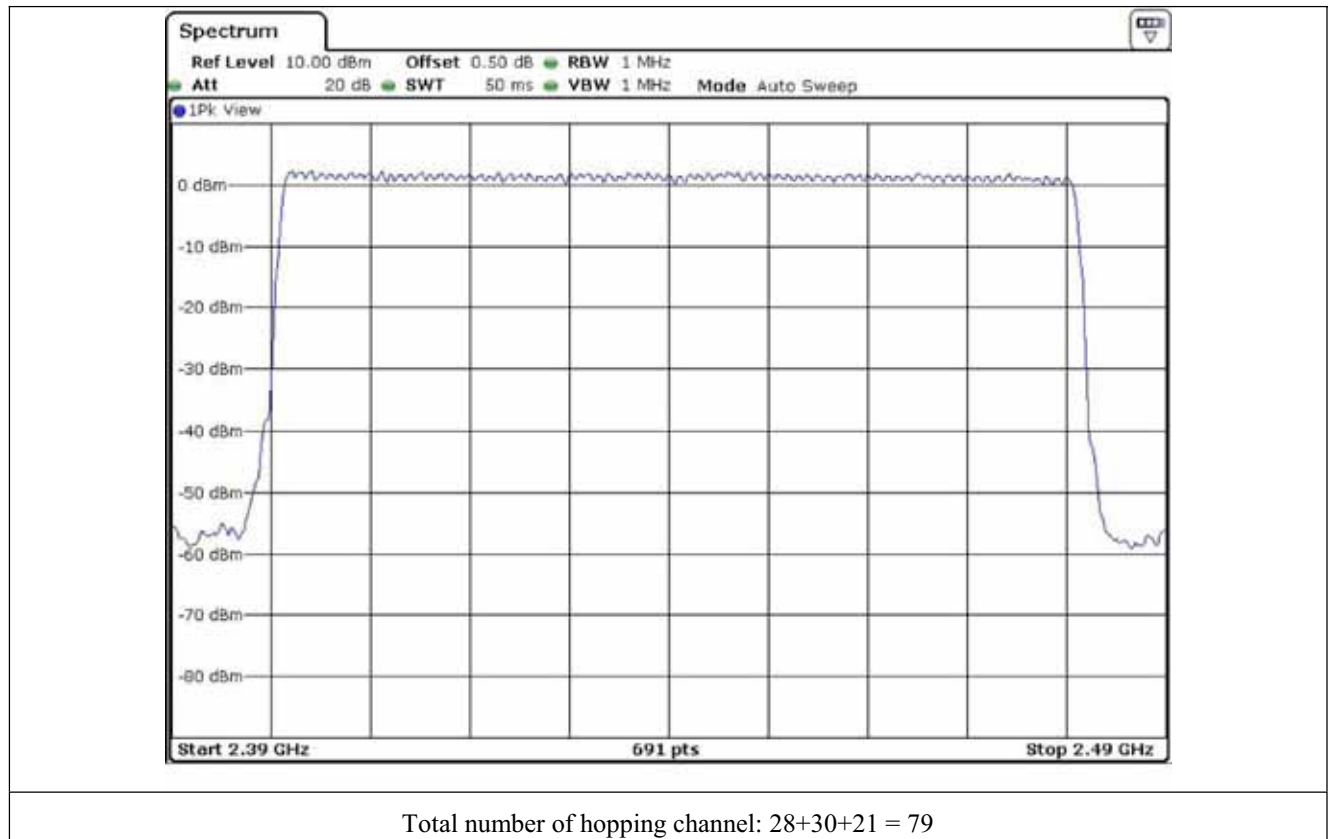
-. Test Date : October 21, 2014

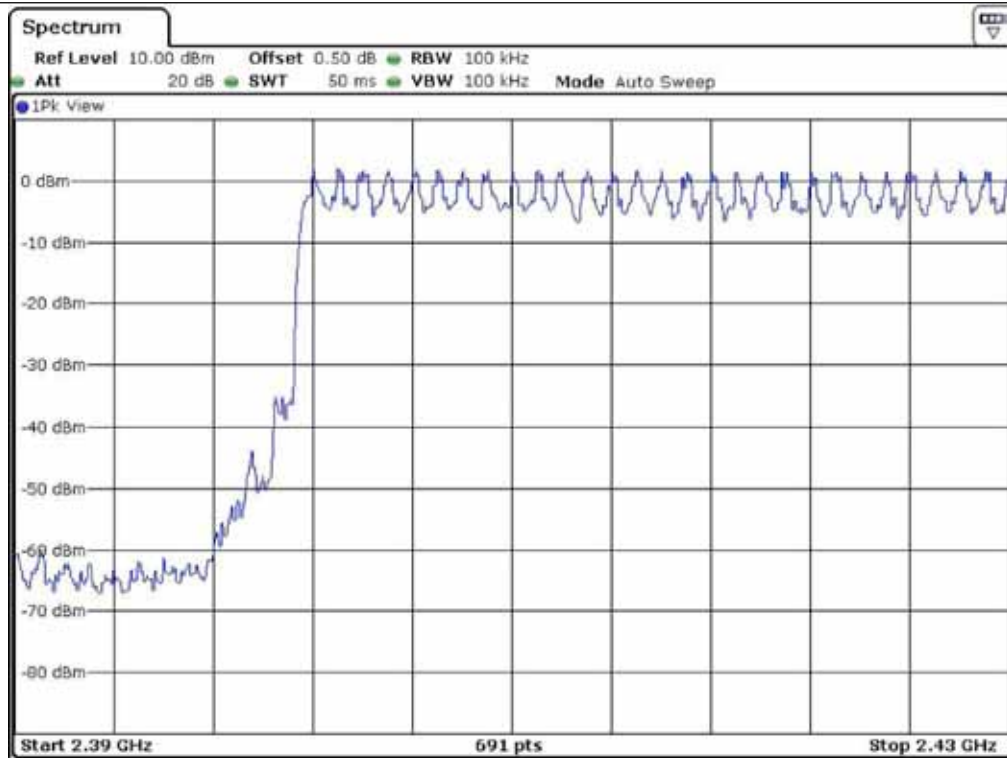
-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
2 Mbps	79	Minimum of 15	64

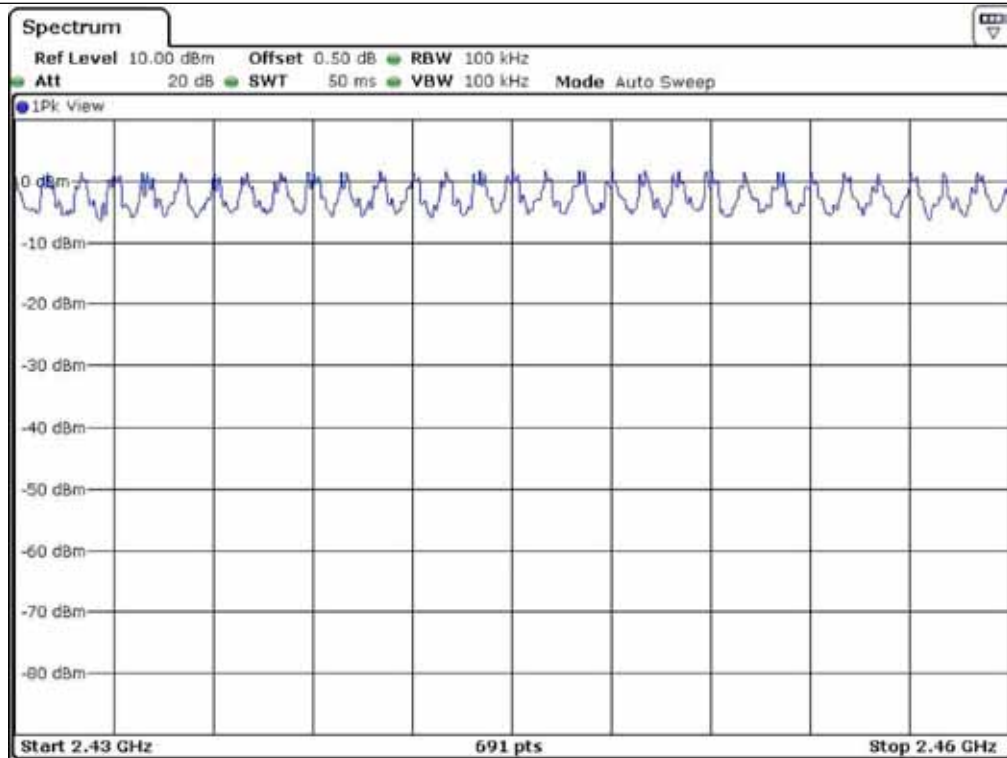


Tested by: Tae-Ho, Kim / Project Engineer

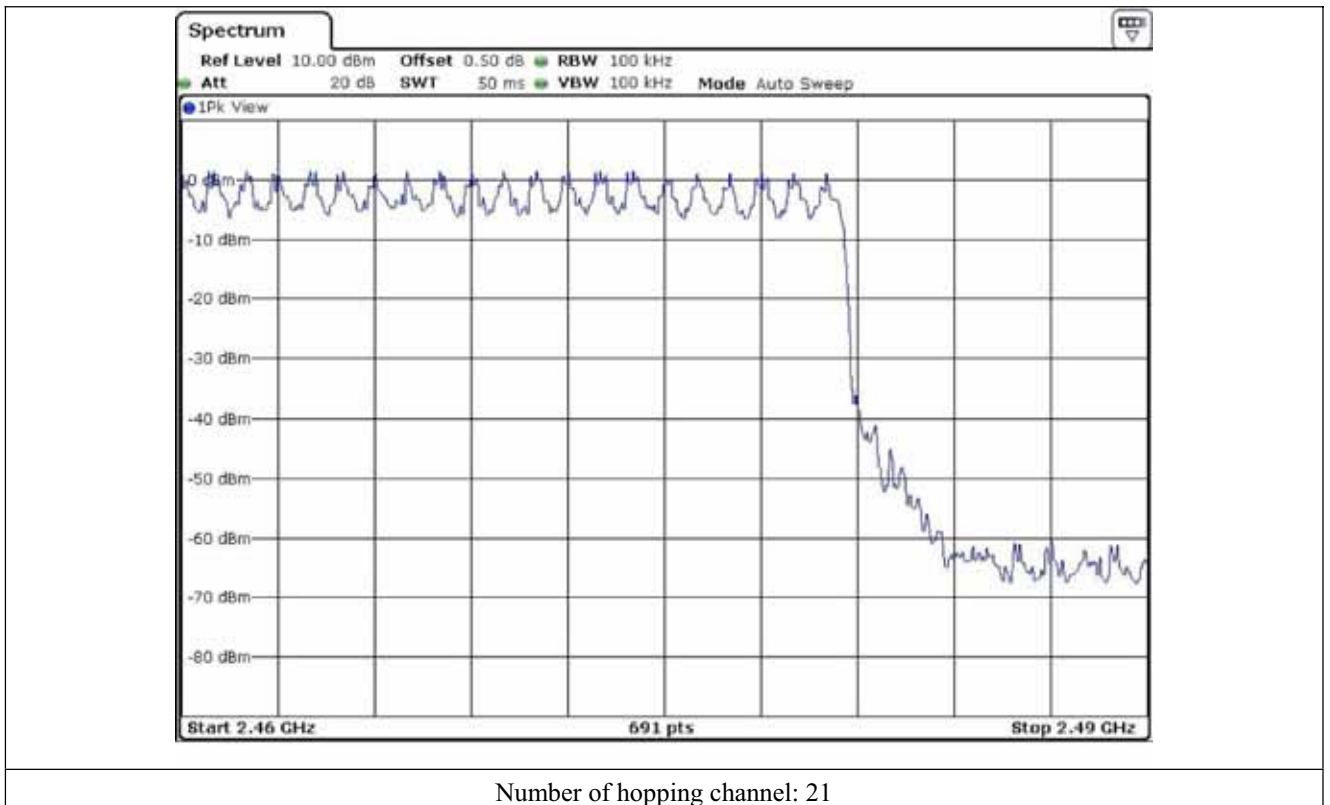




Number of hopping channel: 28



Number of hopping channel: 30



9.6 Test data for Mbps 3

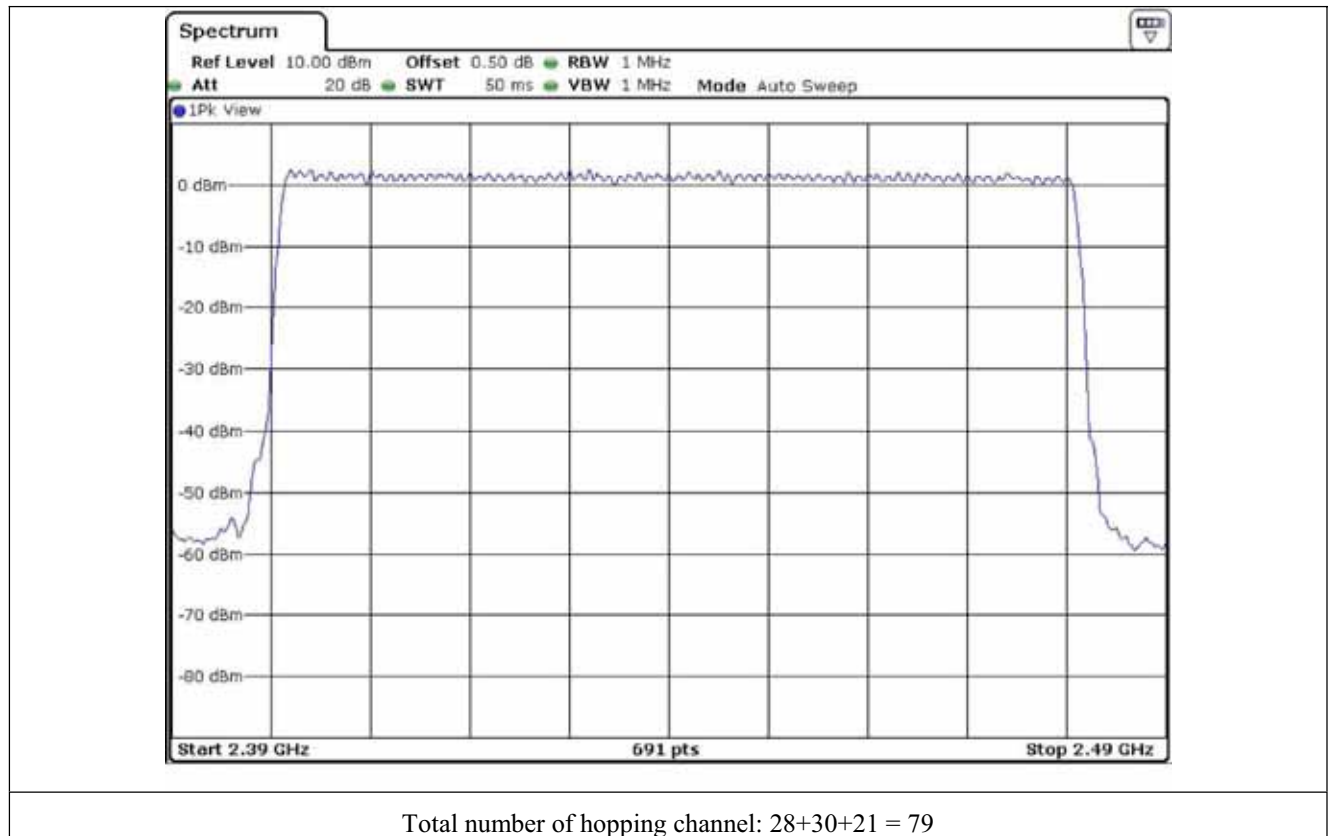
-. Test Date : October 21, 2014

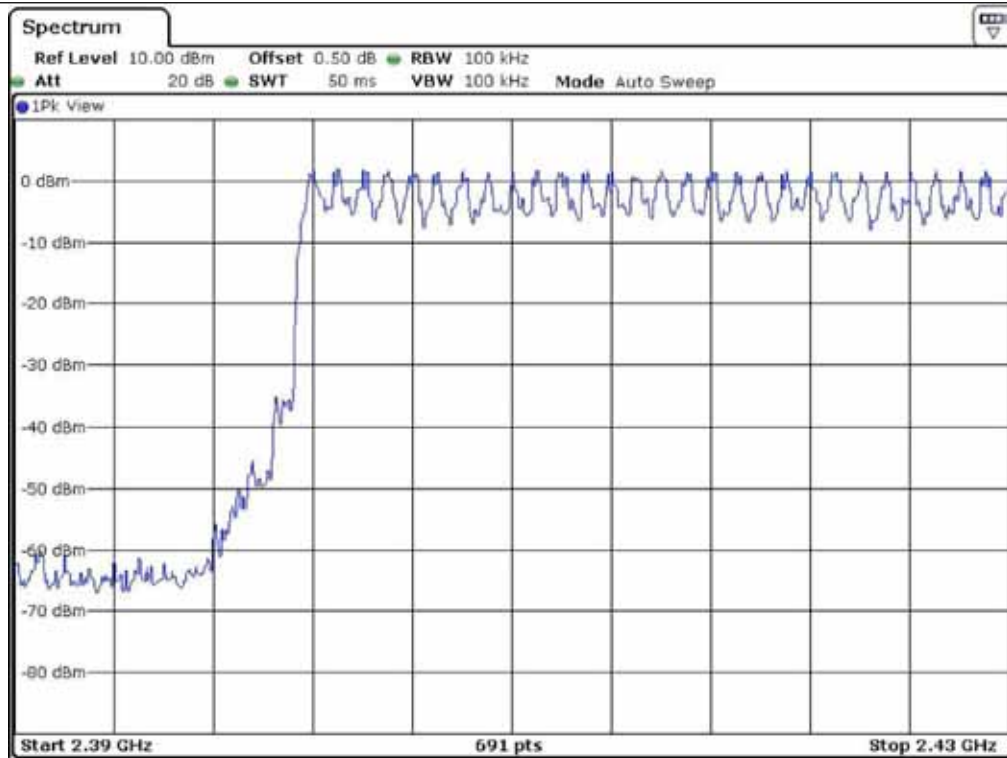
-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
3 Mbps	79	Minimum of 15	64

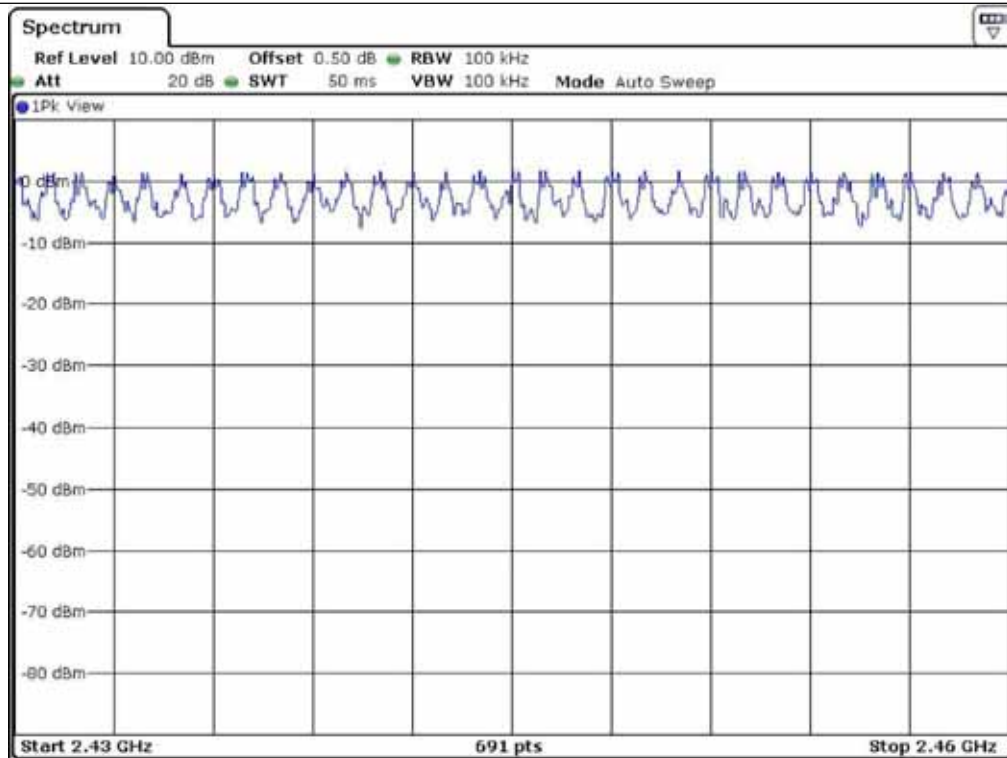


Tested by: Tae-Ho, Kim / Project Engineer

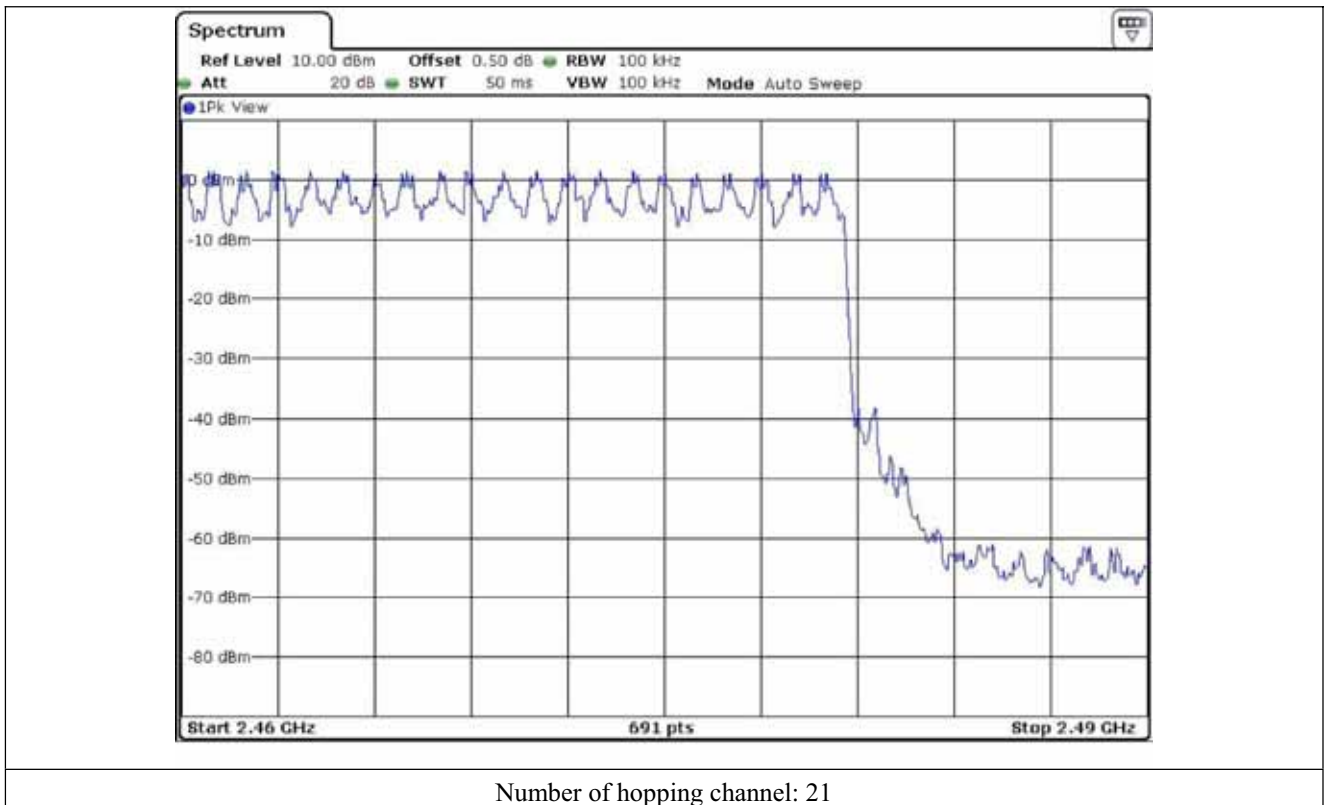




Number of hopping channel: 28



Number of hopping channel: 30



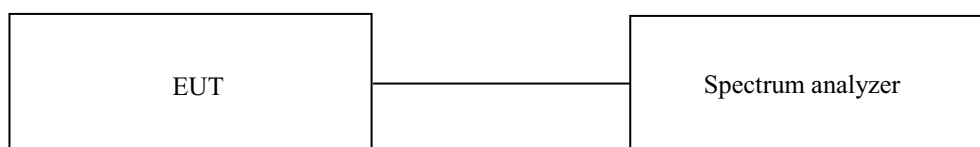
10. TIME OF OCCUPANCY

10.1 Operating environment

Temperature : 24.4 °C
Relative humidity : 45 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.



10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data for 1 Mbps

-. Test Date : October 21, 2014

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($= 1\ 600/2/79$) for DH1, and 5.06 times ($= 1\ 600/4/79$) for DH3, and 3.38 times ($= 1\ 600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.406	10.13	31.6	129.90	400	PASS
DH3	1.652	5.06	31.6	264.18	400	
DH5	2.899	3.38	31.6	309.59	400	

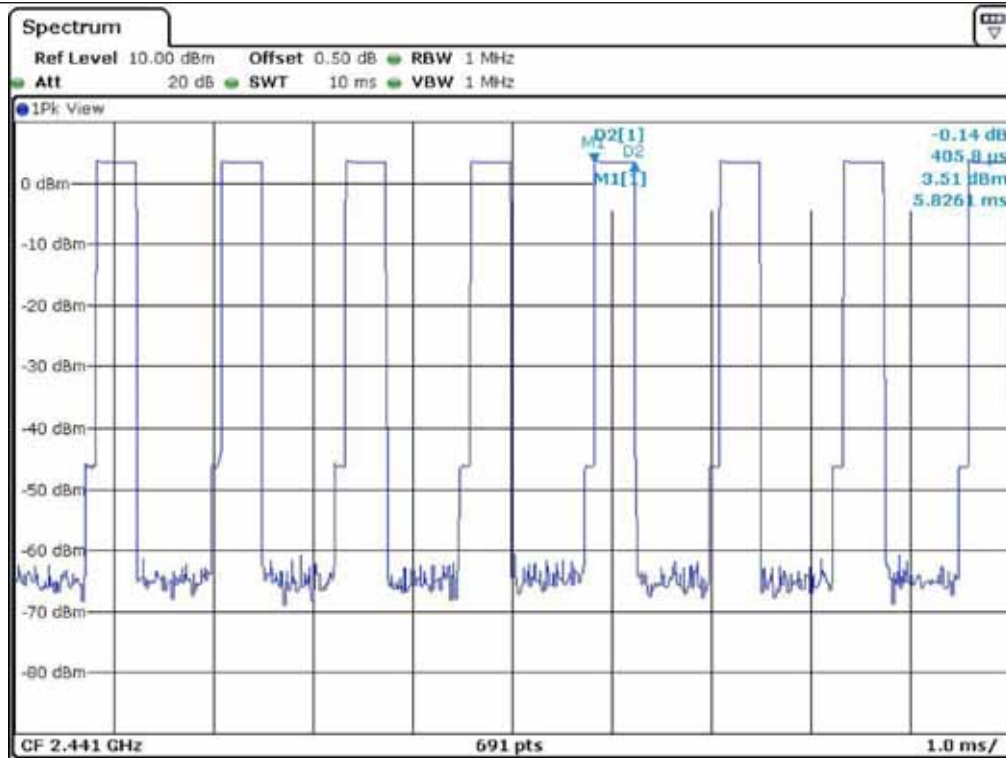
Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

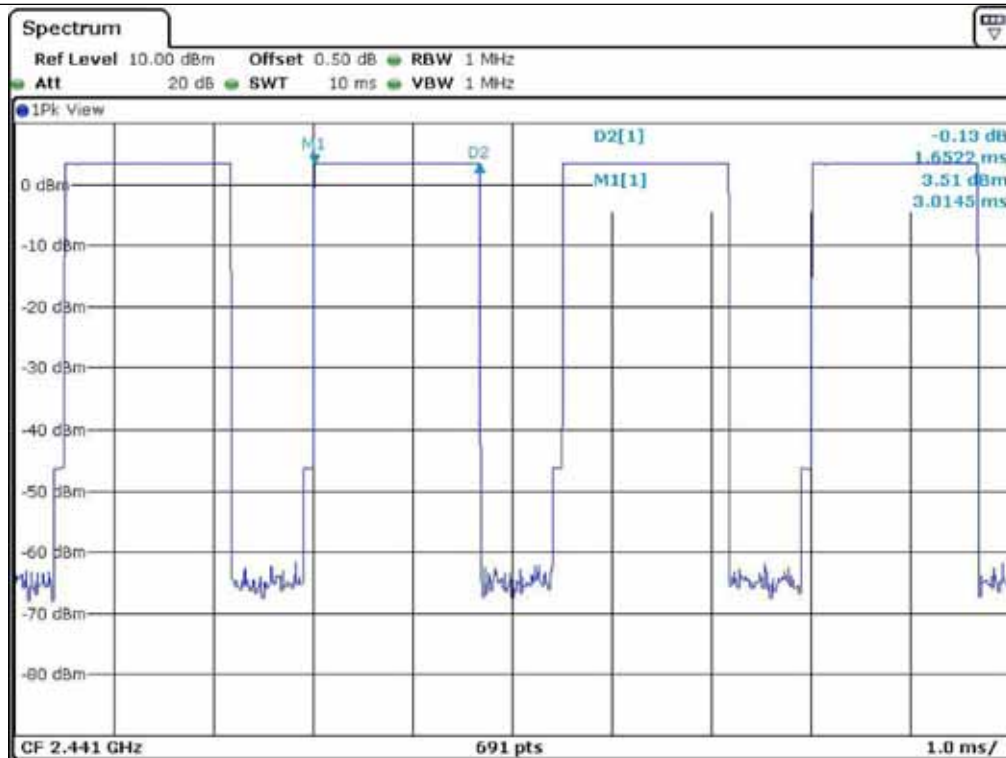
Remark: See next page for an overview sweep performed with peak detector.



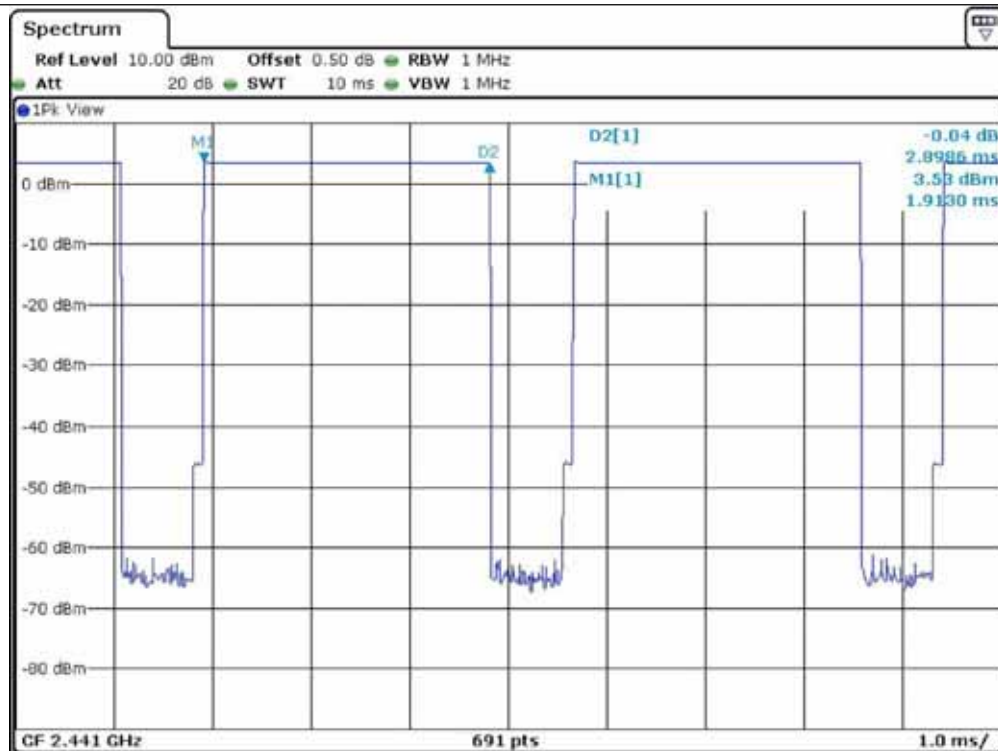
Tested by: Tae-Ho, Kim / Project Engineer



DH1



DH3



DH5

10.5 Test data for 2 Mbps

-. Test Date : October 21, 2014

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($= 1\ 600/2/79$) for DH1, and 5.06 times ($= 1\ 600/4/79$) for DH3, and 3.38 times ($= 1\ 600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.391	10.13	31.6	125.16	400	PASS
DH3	1.652	5.06	31.6	264.18	400	
DH5	2.913	3.38	31.6	311.13	400	

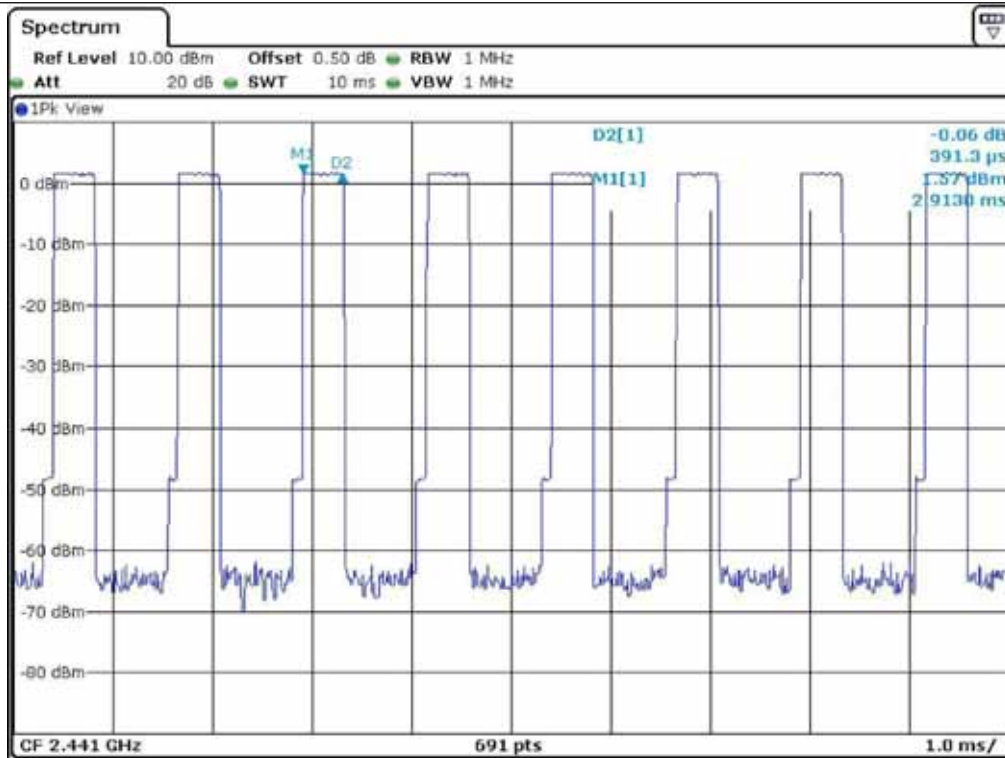
Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

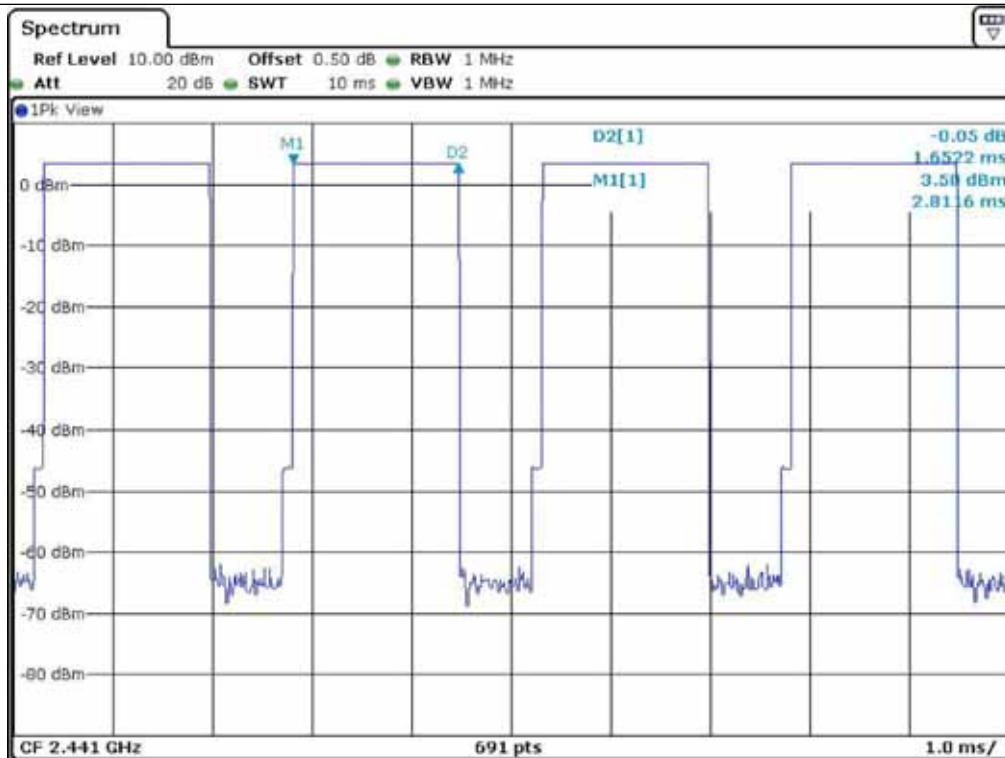
Remark: See next page for an overview sweep performed with peak detector.



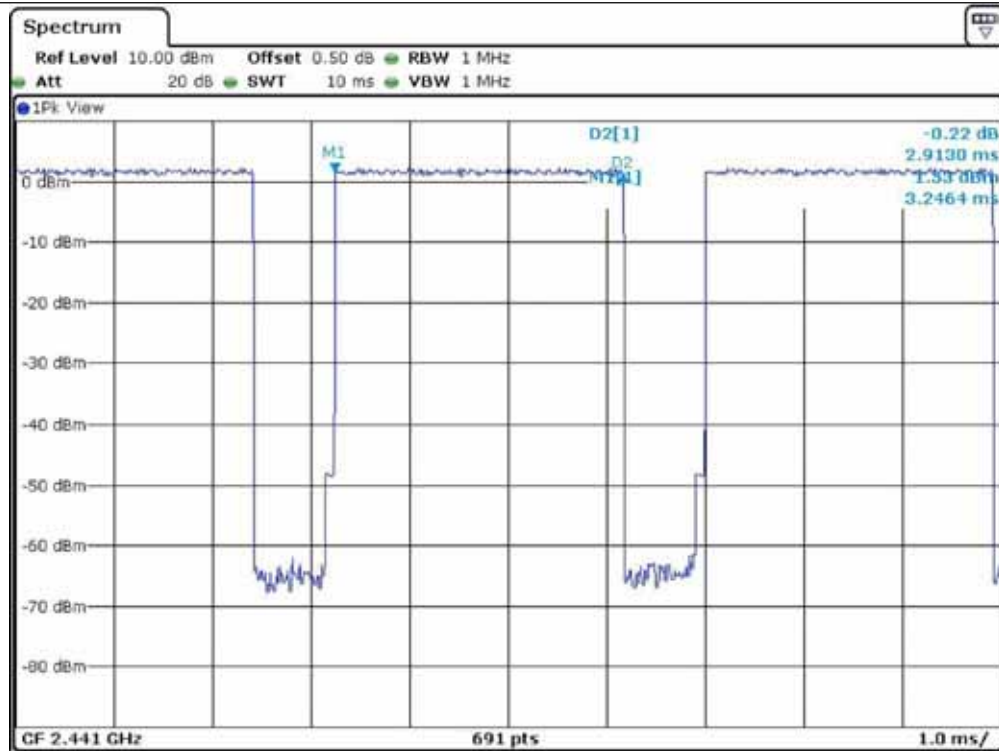
Tested by: Tae-Ho, Kim / Project Engineer



DH1



DH3



DH5

10.6 Test data for 3 Mbps

-. Test Date : October 21, 2014

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($= 1\ 600/2/79$) for DH1, and 5.06 times ($= 1\ 600/4/79$) for DH3, and 3.38 times ($= 1\ 600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.391	10.13	31.6	125.26	400	PASS
DH3	1.652	5.06	31.6	264.18	400	
DH5	2.913	3.38	31.6	311.13	400	

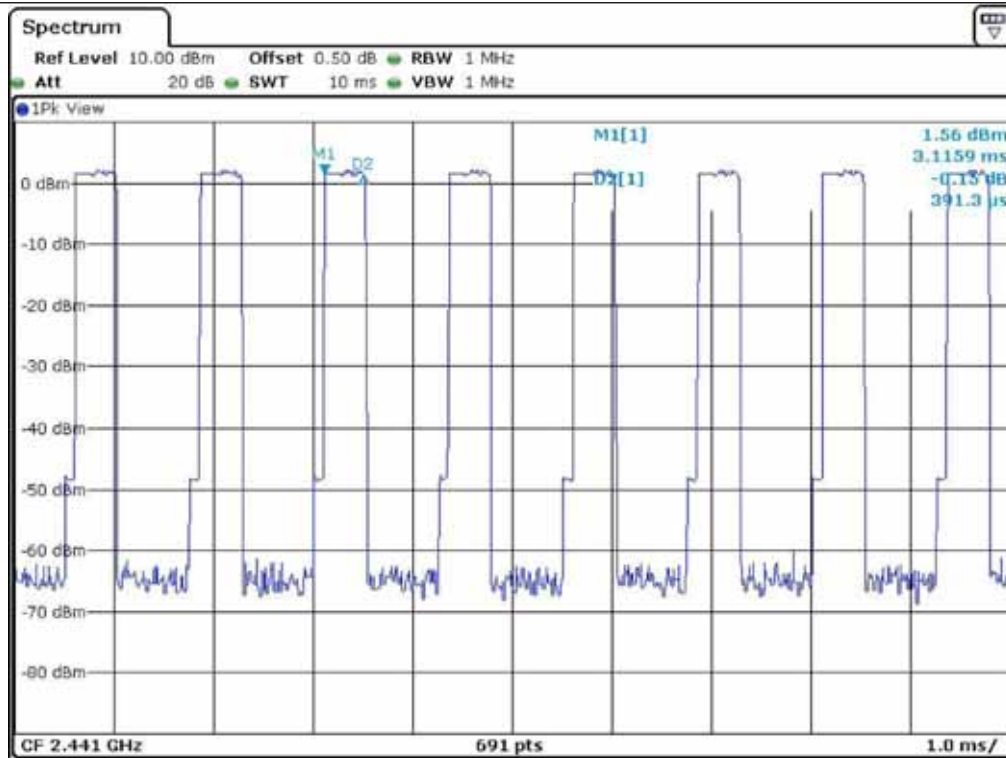
Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

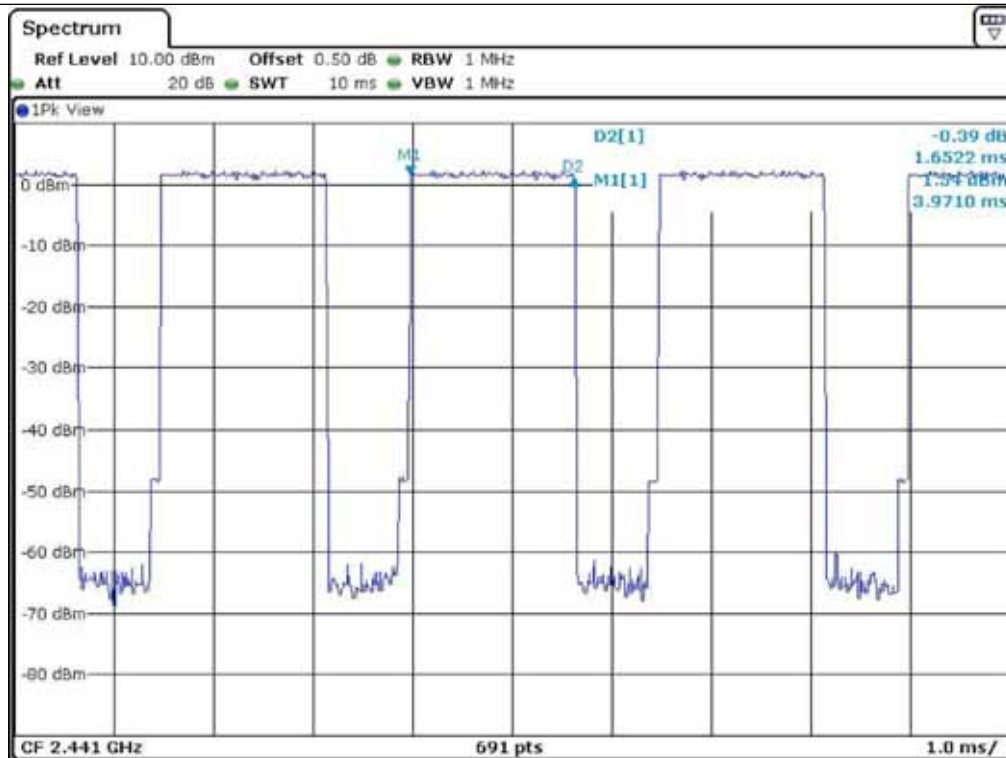
Remark: See next page for an overview sweep performed with peak detector.



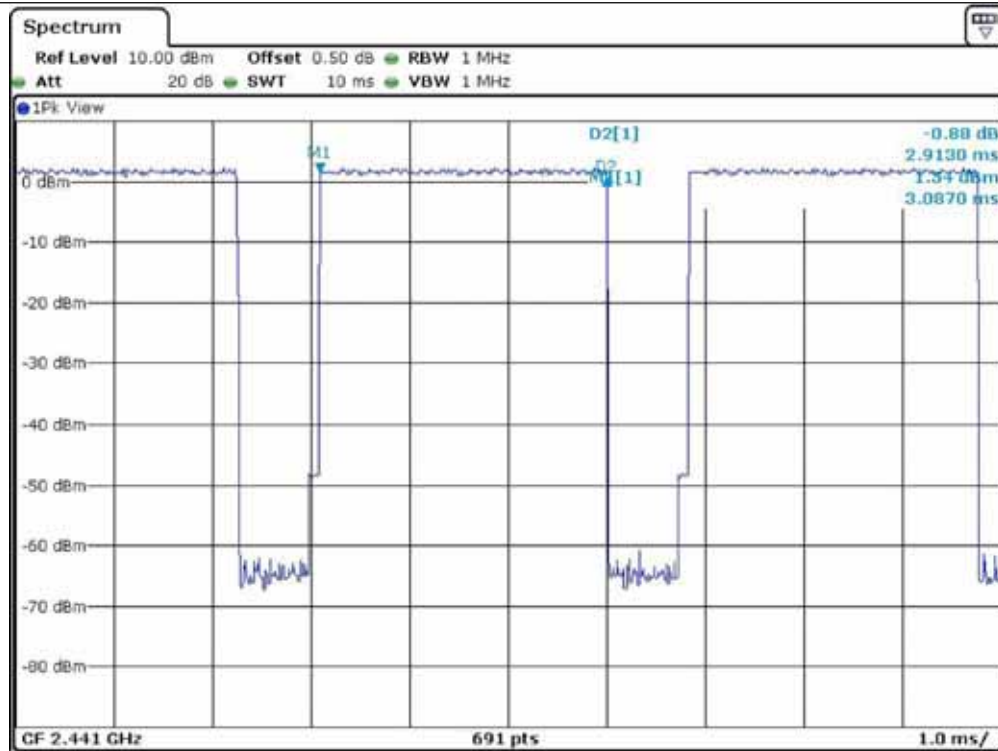
Tested by: Tae-Ho, Kim / Project Engineer



DH1



DH3



DH5

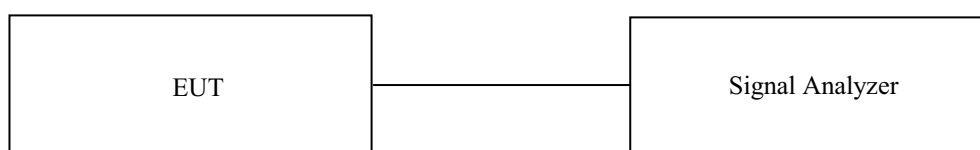
11. MAXIMUM PEAK OUTPUT POWER

11.1 Operating environment

Temperature : 24.4 °C
Relative humidity : 45 % R.H

11.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT.
The EUT was operating in transmit mode at the appropriate center frequency.



11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data for 1 Mbps

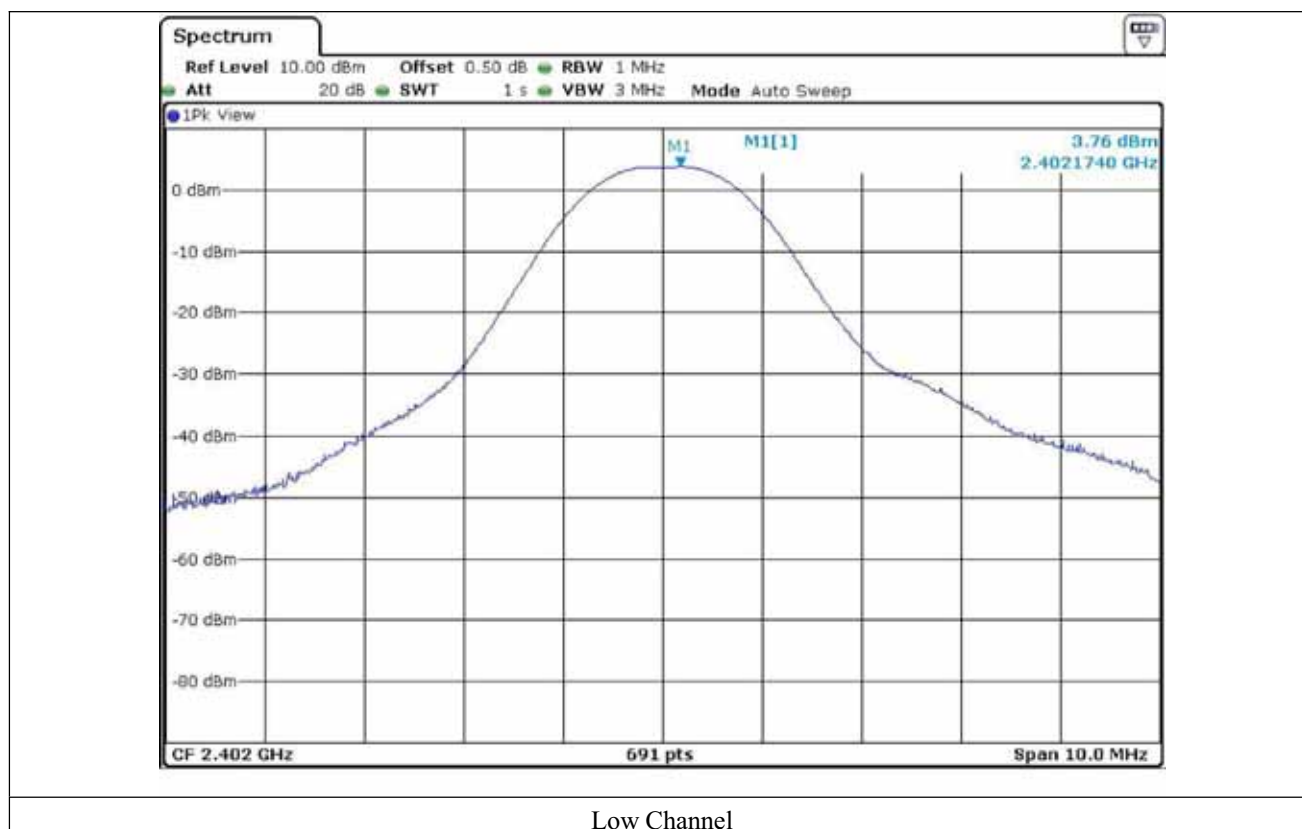
-. Test Date : October 21, 2014

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402	3.76	30.00	26.24
Middle	2 441	3.45	30.00	26.55
High	2 480	3.04	30.00	26.96



Tested by: Tae-Ho, Kim / Project Engineer





Middle Channel



High Channel

11.5 Test data for 2 Mbps

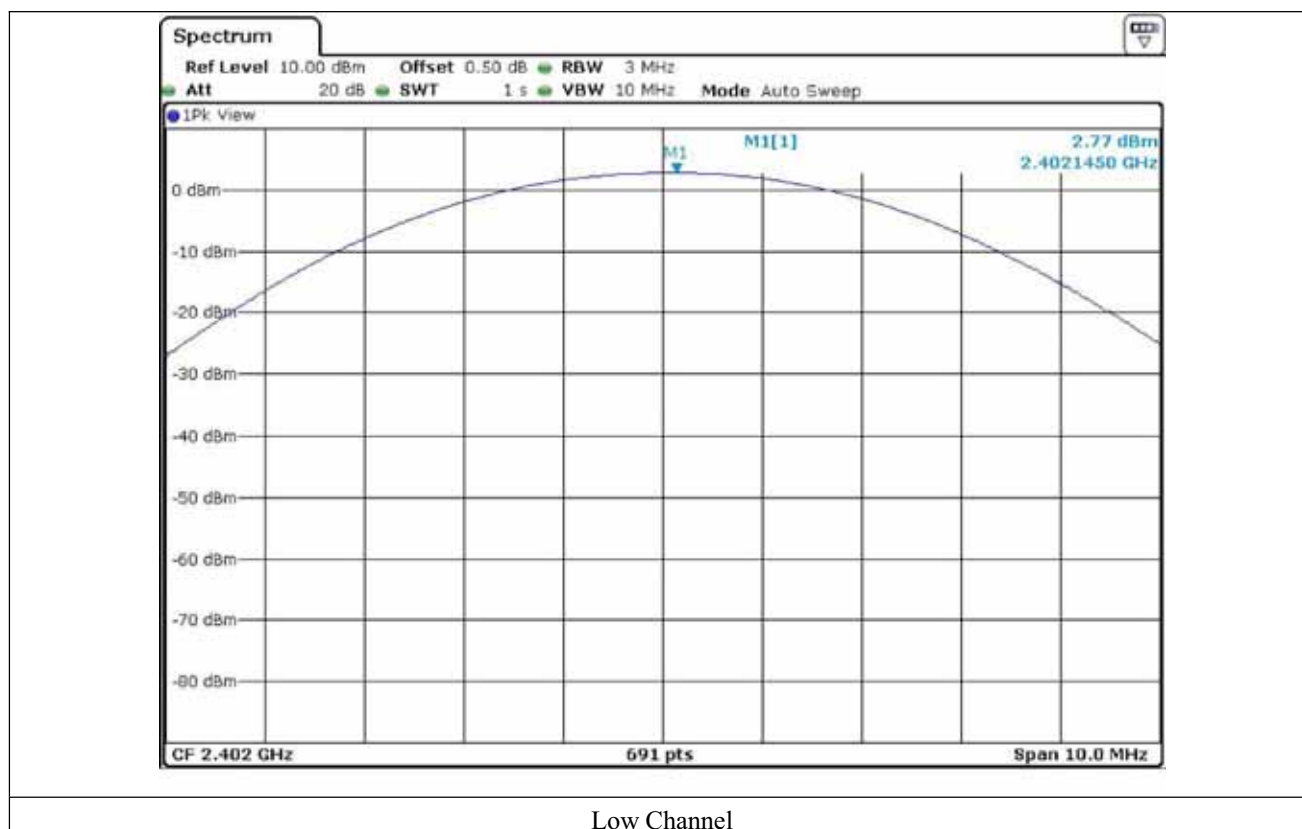
-. Test Date : October 21, 2014

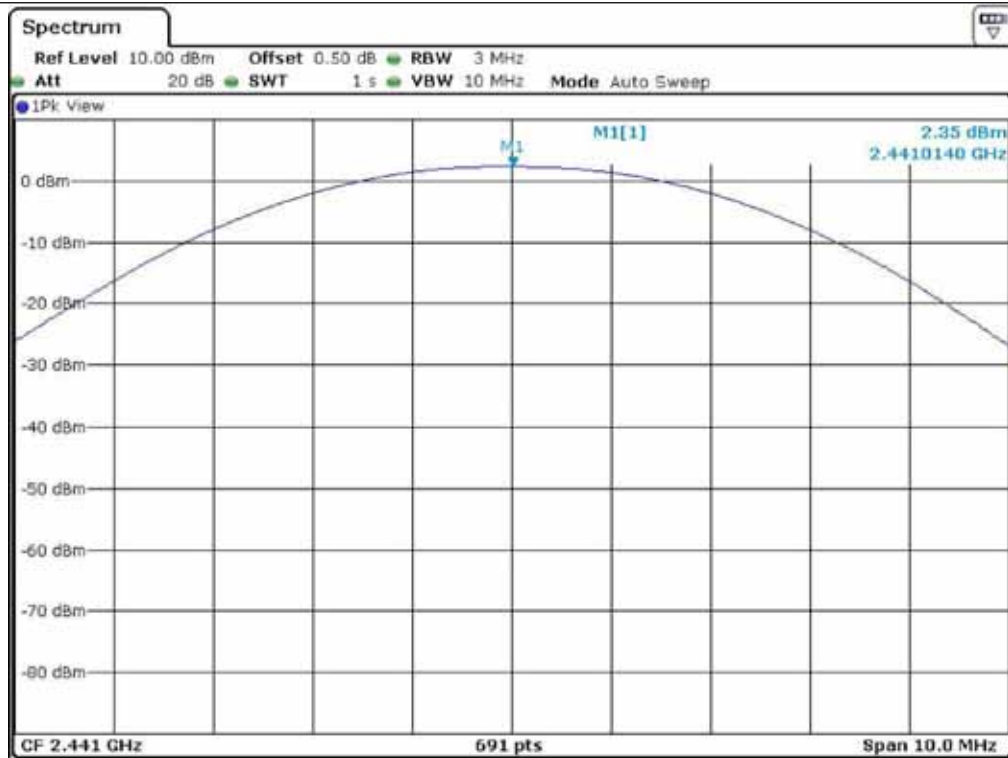
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402	2.77	30.00	27.23
Middle	2 441	2.35	30.00	27.65
High	2 480	1.83	30.00	28.17

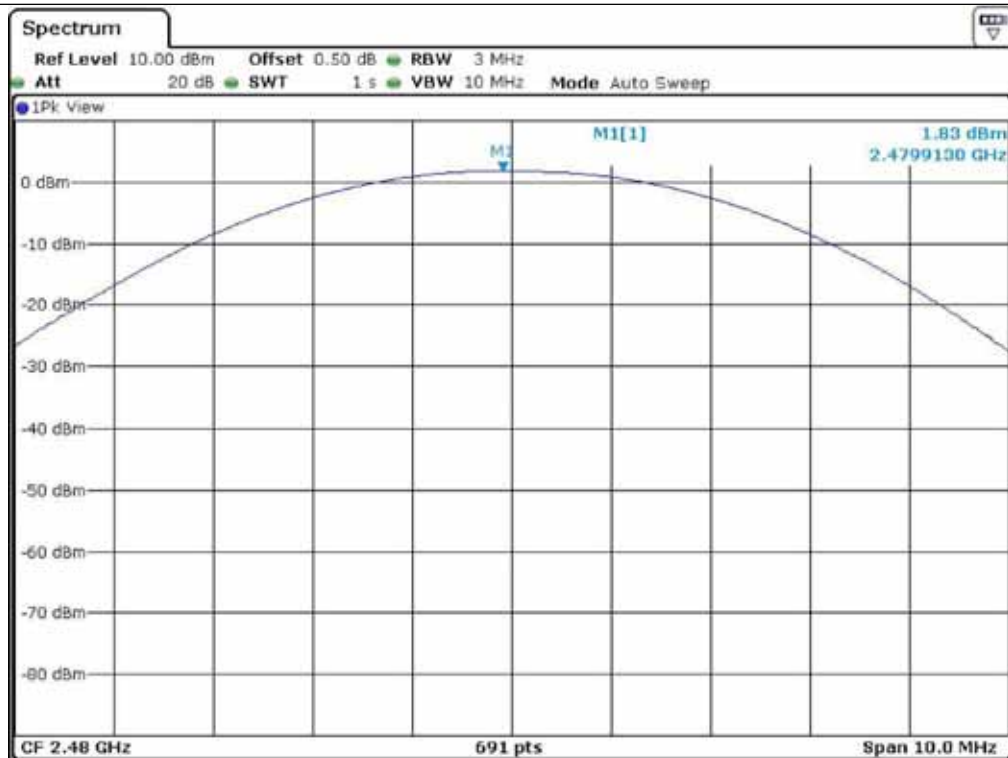


Tested by: Tae-Ho, Kim / Project Engineer





Middle Channel



High Channel

11.6 Test data for 3 Mbps

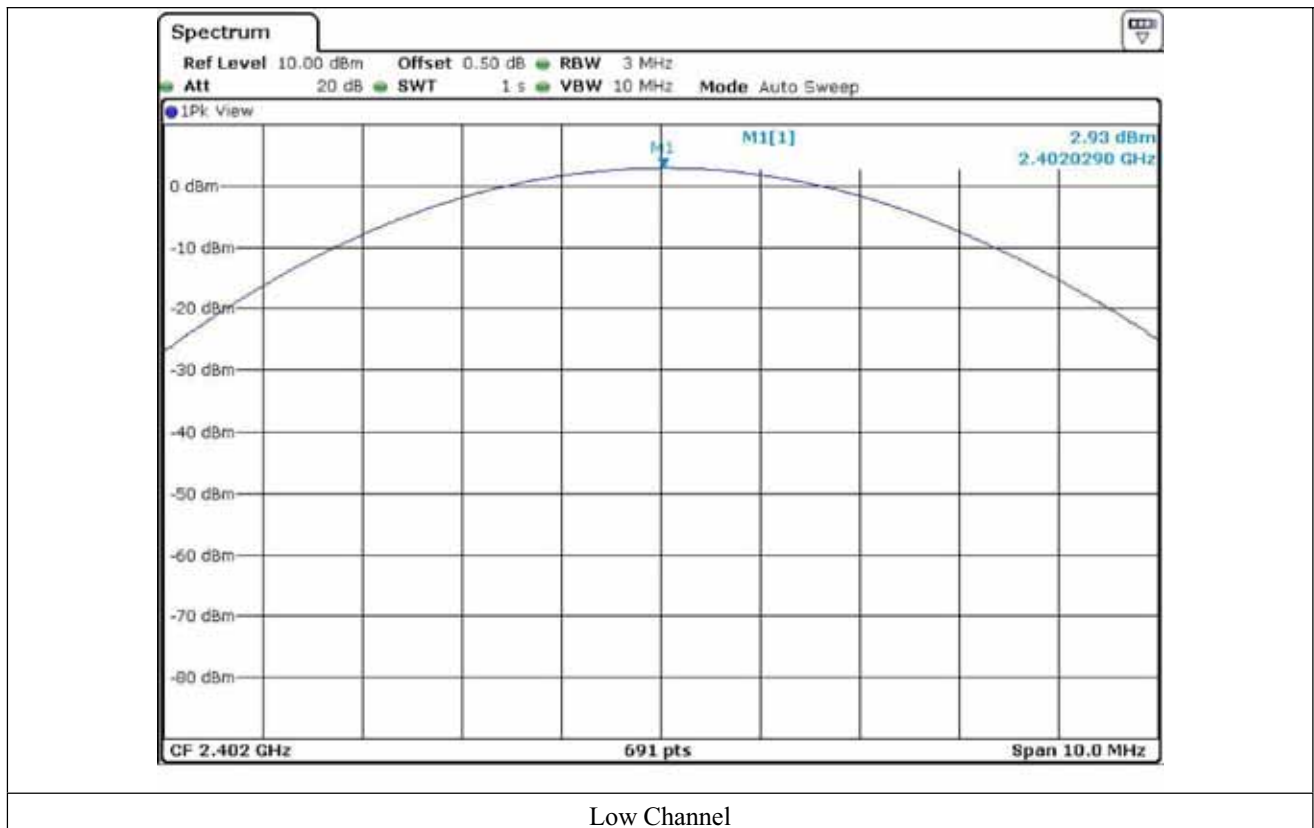
-. Test Date : October 21, 2014

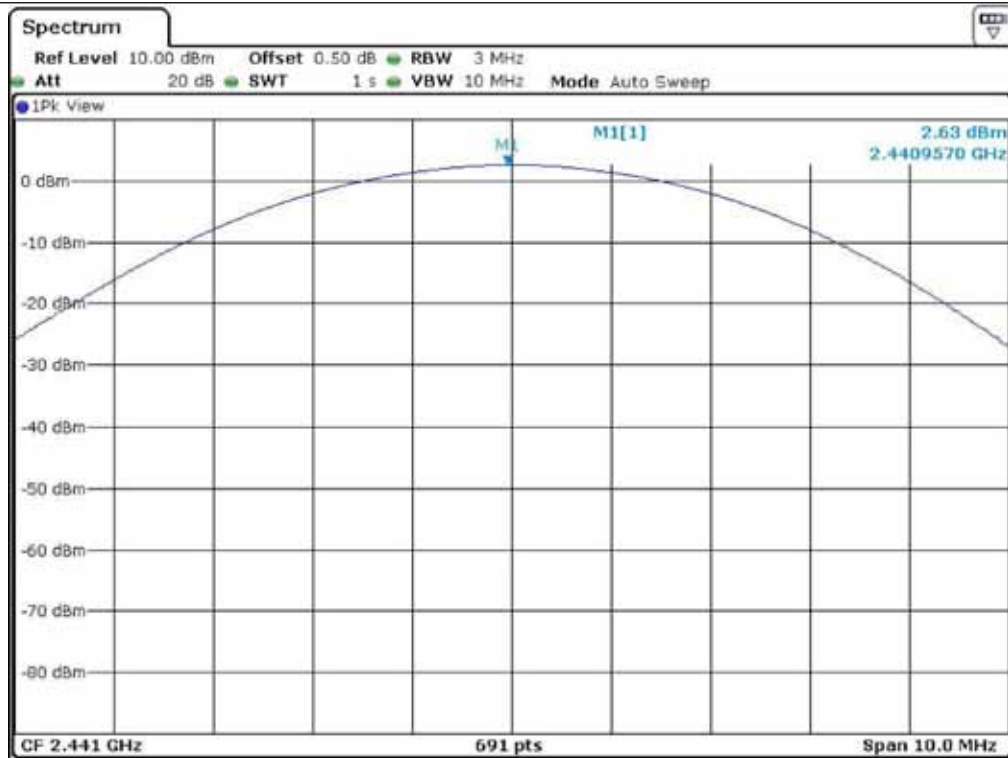
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402	2.93	30.00	27.07
Middle	2 441	2.63	30.00	27.37
High	2 480	2.15	30.00	27.85

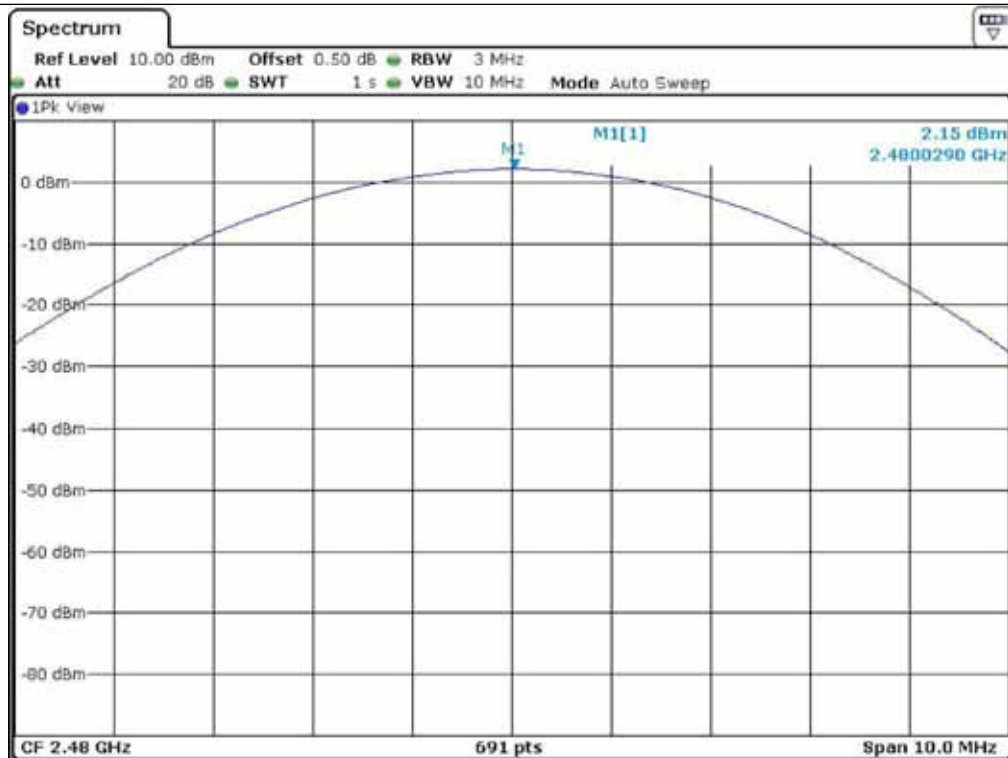


Tested by: Tae-Ho, Kim / Project Engineer





Middle Channel



High Channel

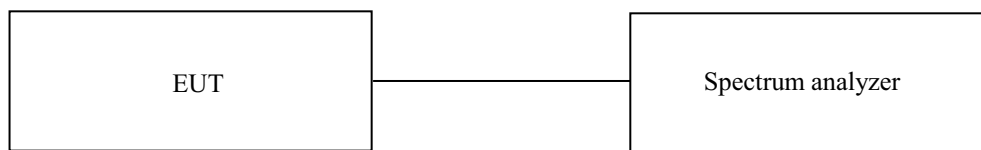
12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

12.1 Operating environment

Temperature : 24.4 °C
Relative humidity : 45 % R.H

12.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



12.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m, open-field test site. The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The frequency spectrum from 30 kHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 ms in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

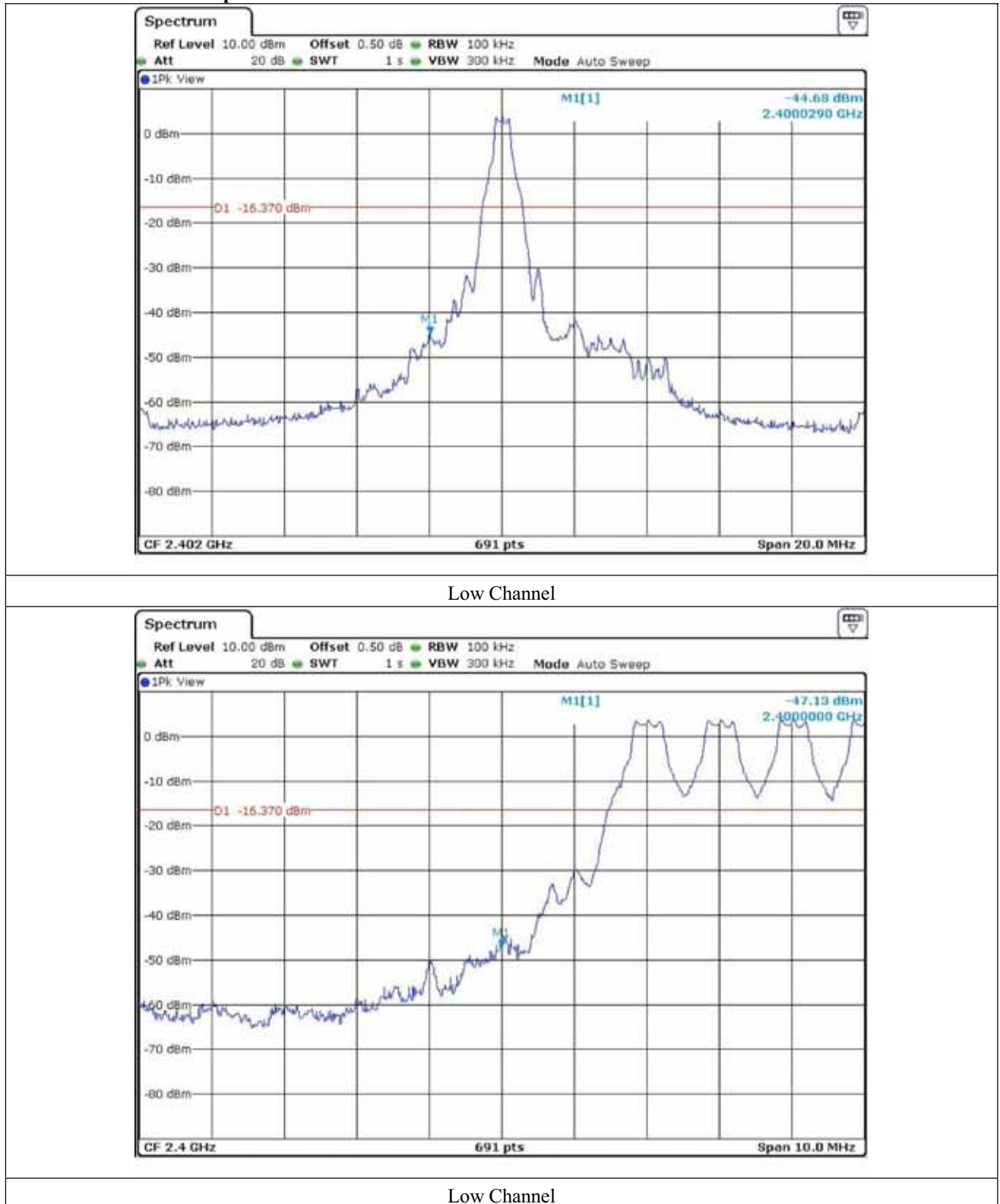
12.4 Test equipment used

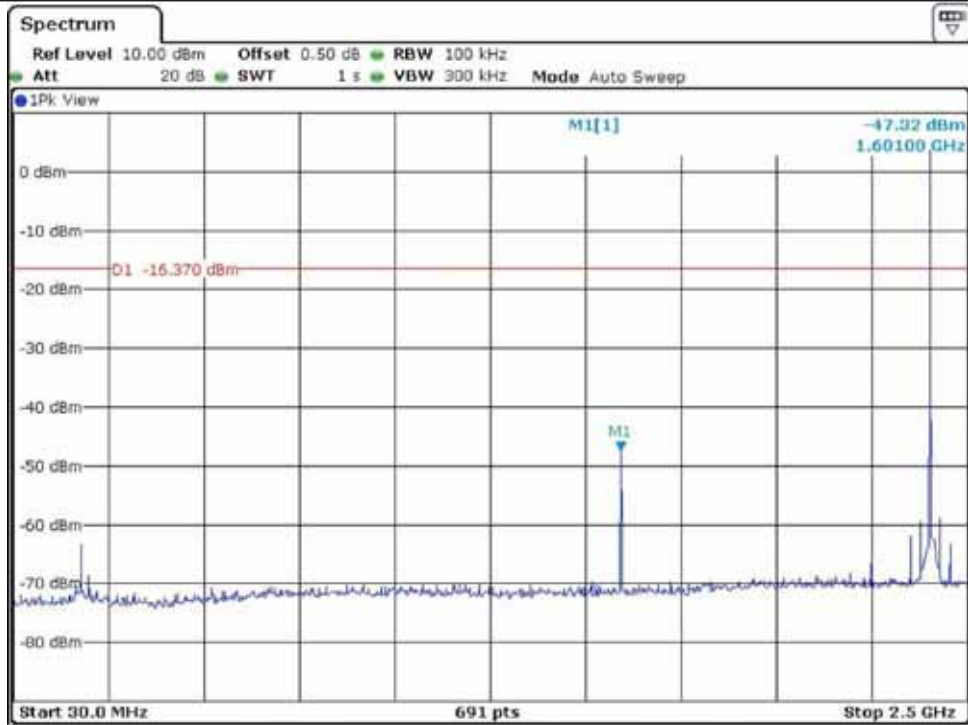
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Nov. 18, 2013(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2014(1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2014(1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Nov. 05, 2013(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 28, 2014(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Jan. 20, 2014(1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879 285/26	Dec. 11, 2012(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 05, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Sep. 05, 2013(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	N/A
■ -	83051A	Agilent	Microwave System Preamplifier	3950M00201	Apr. 30, 2014(1Y)

All test equipment used is calibrated on a regular basis.

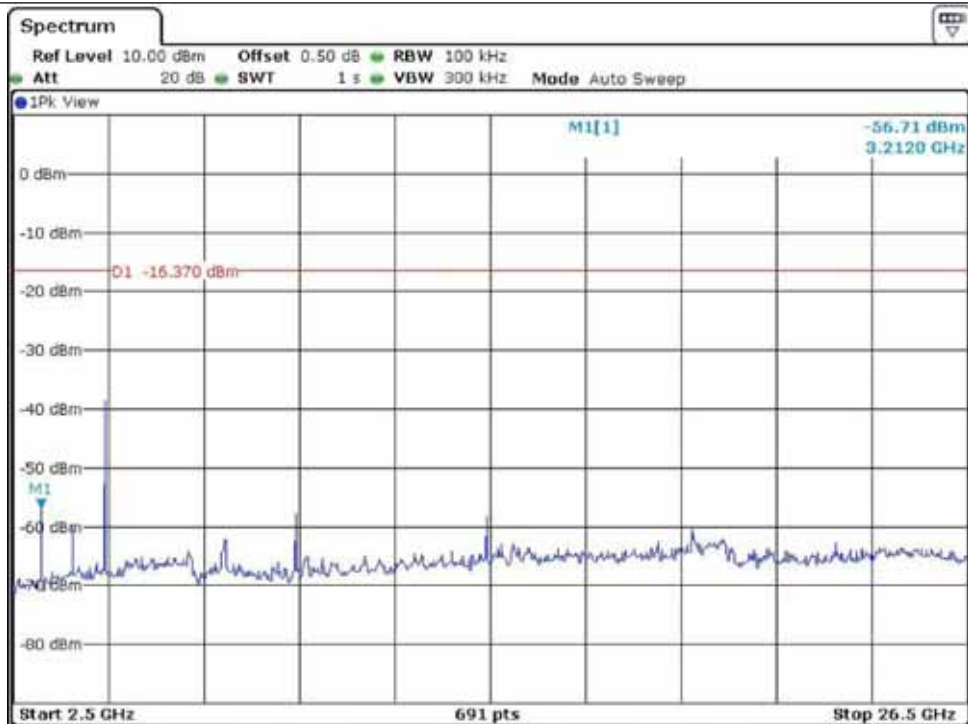
12.5 Test data for conducted emission

12.5.1 Test data for 1 Mbps

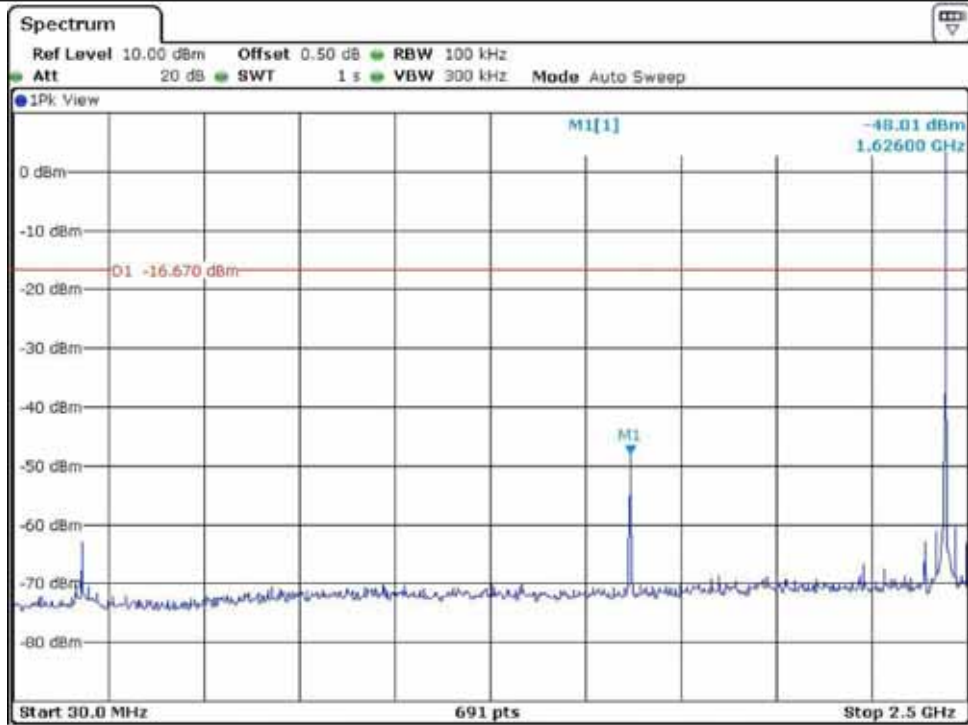




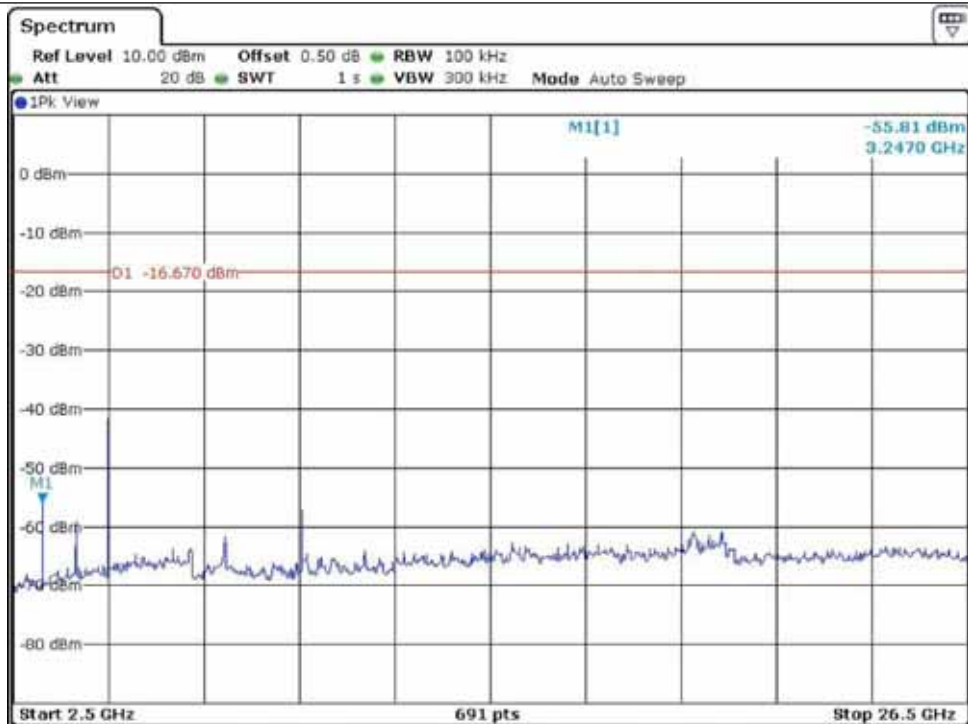
Low Channel



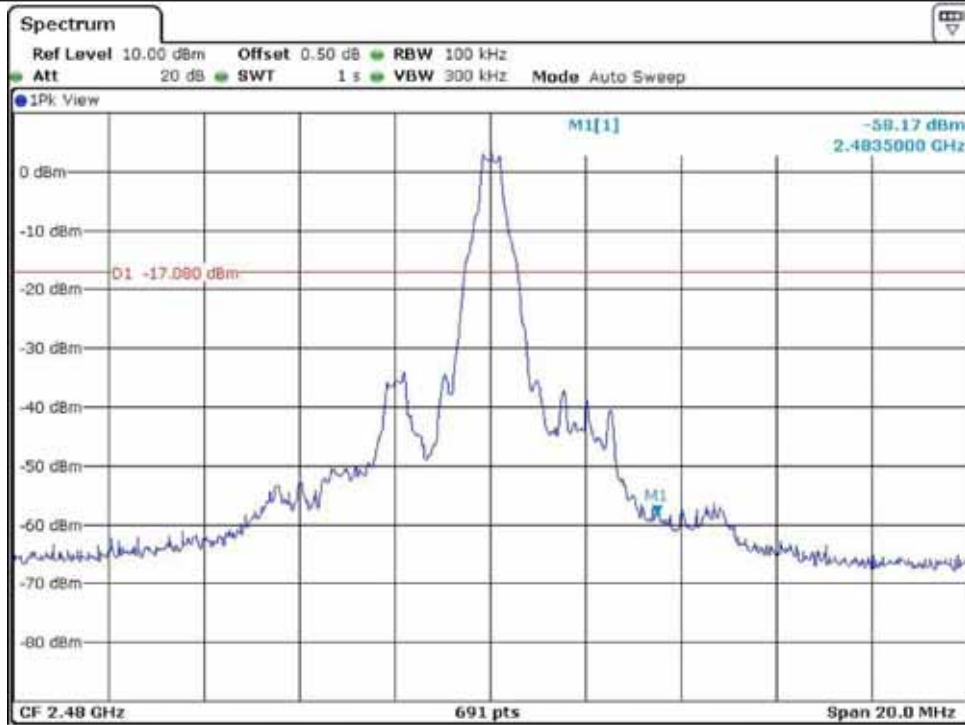
Low Channel



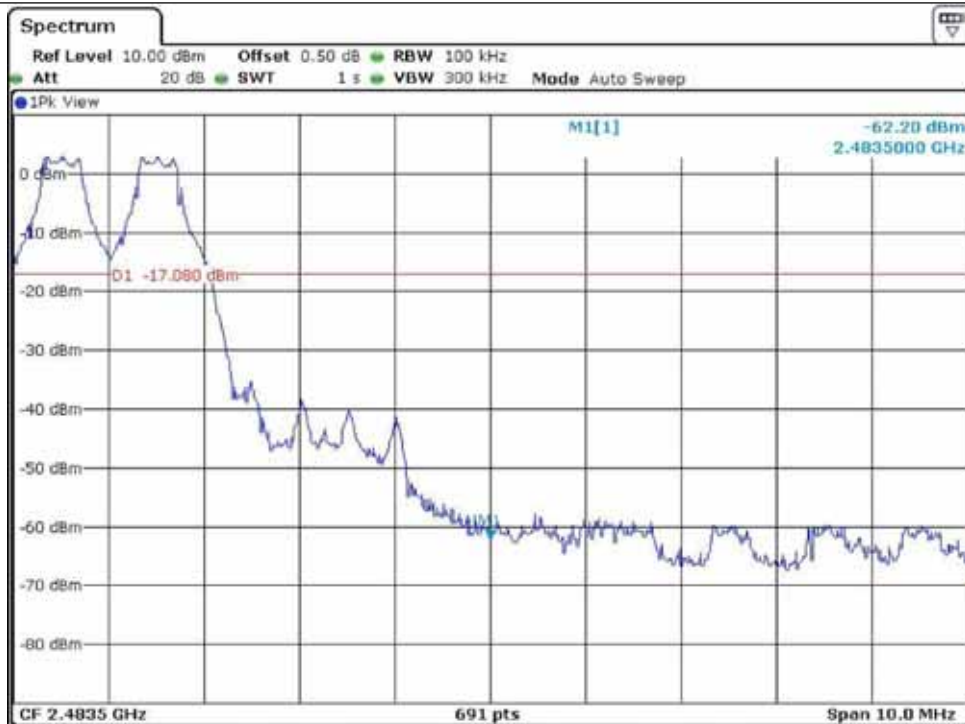
Middle Channel



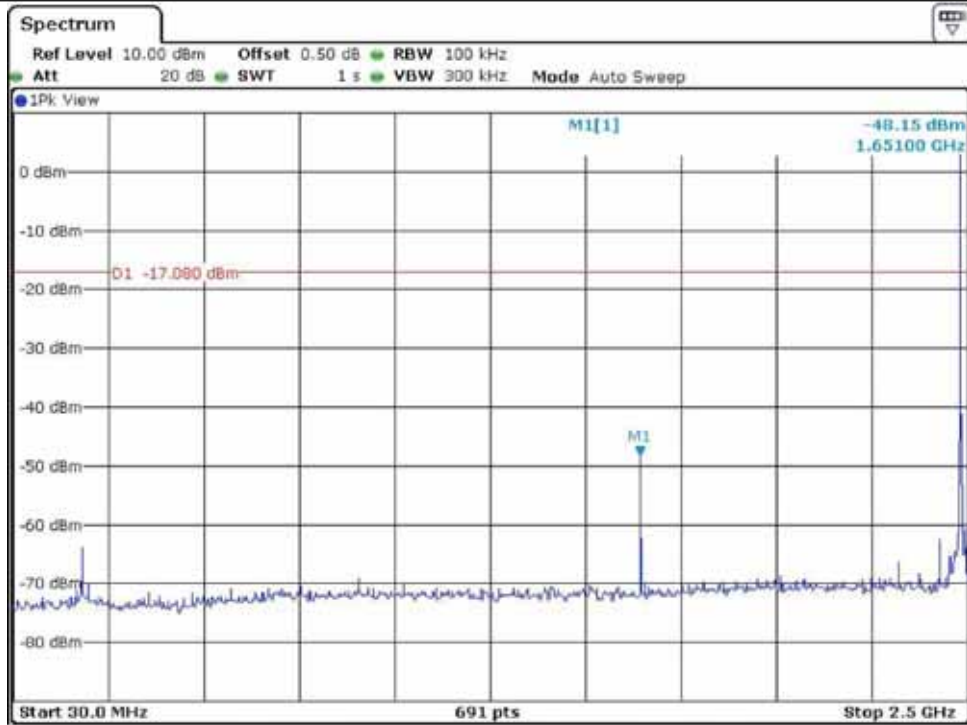
Middle Channel



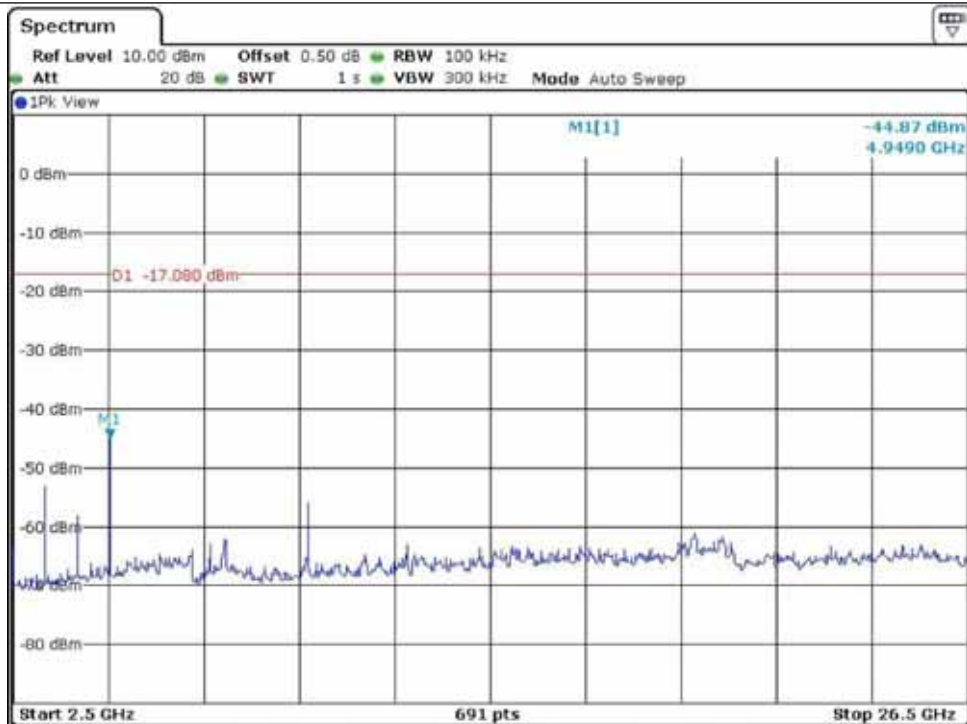
High Channel



High Channel

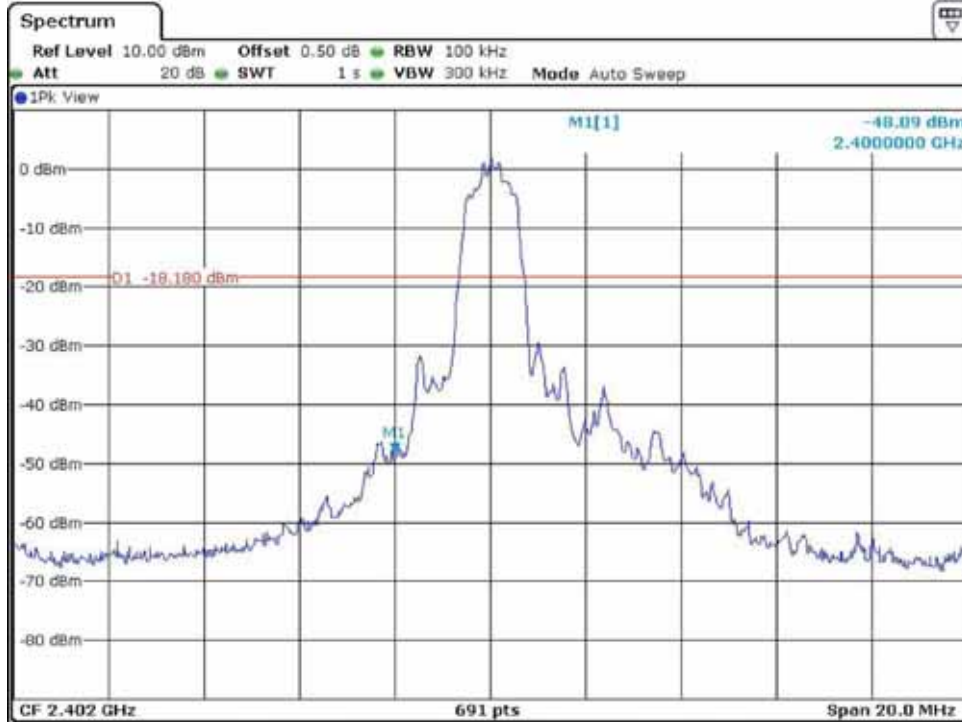


High Channel

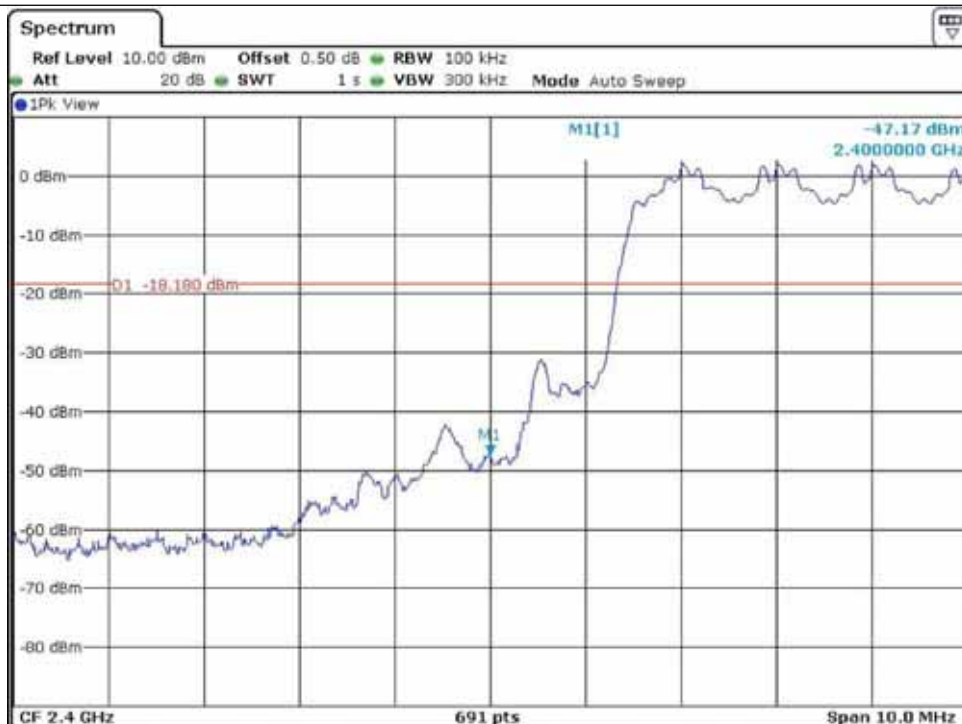


High Channel

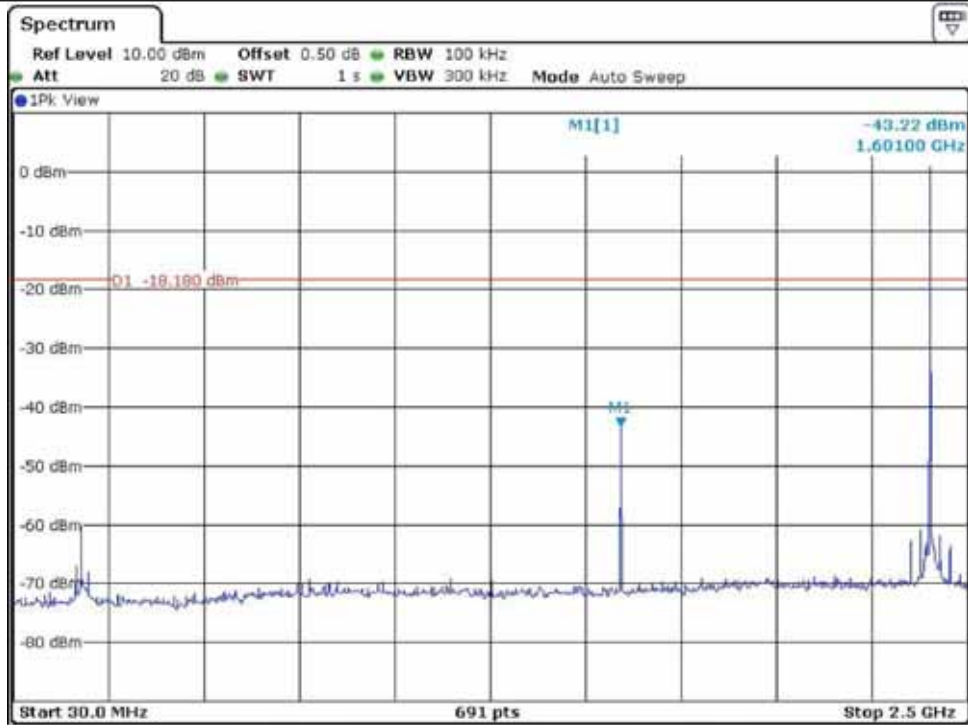
12.5.2 Test data for 2 Mbps



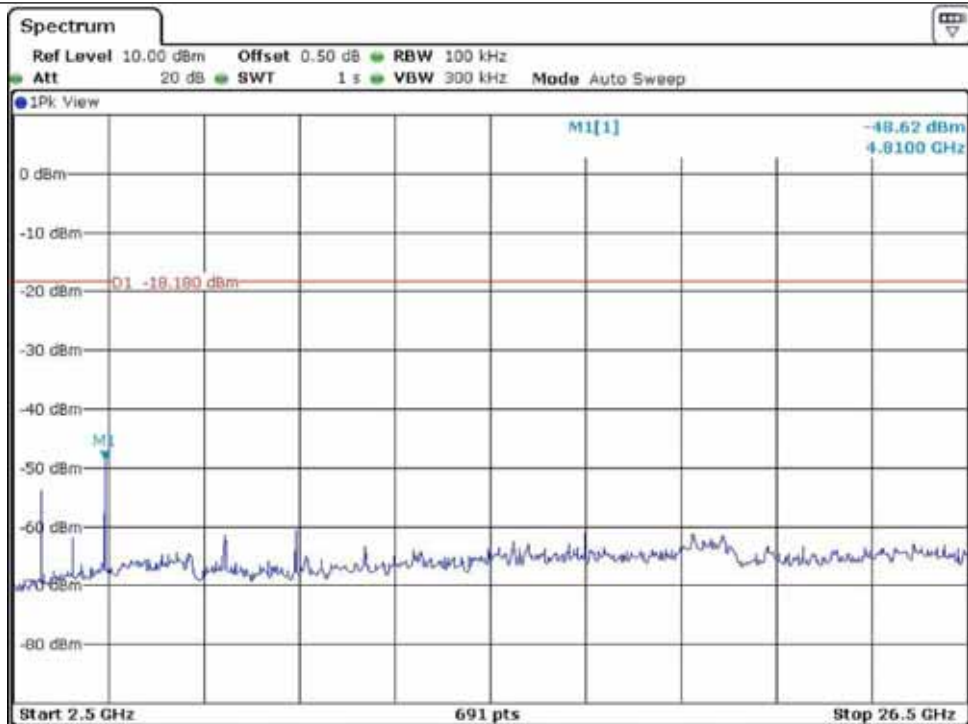
Low Channel



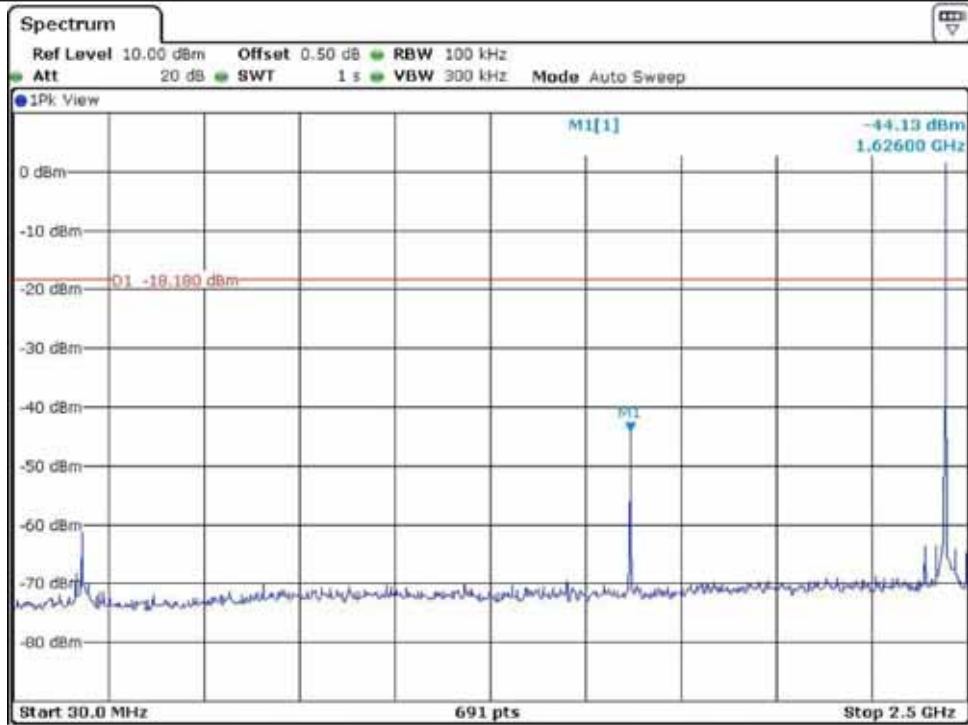
Low Channel



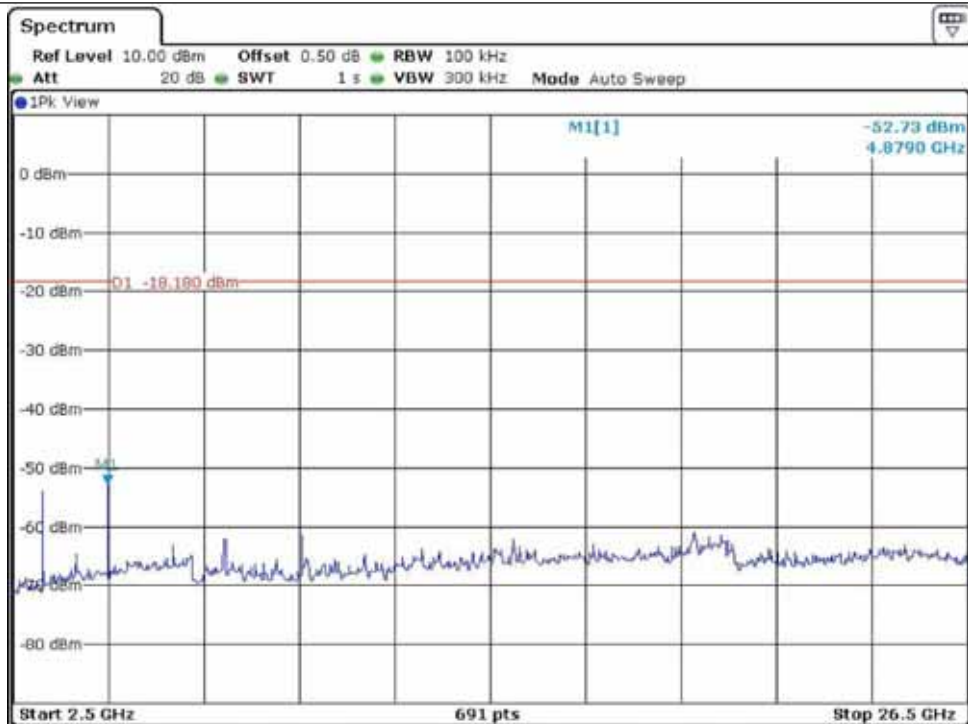
Low Channel



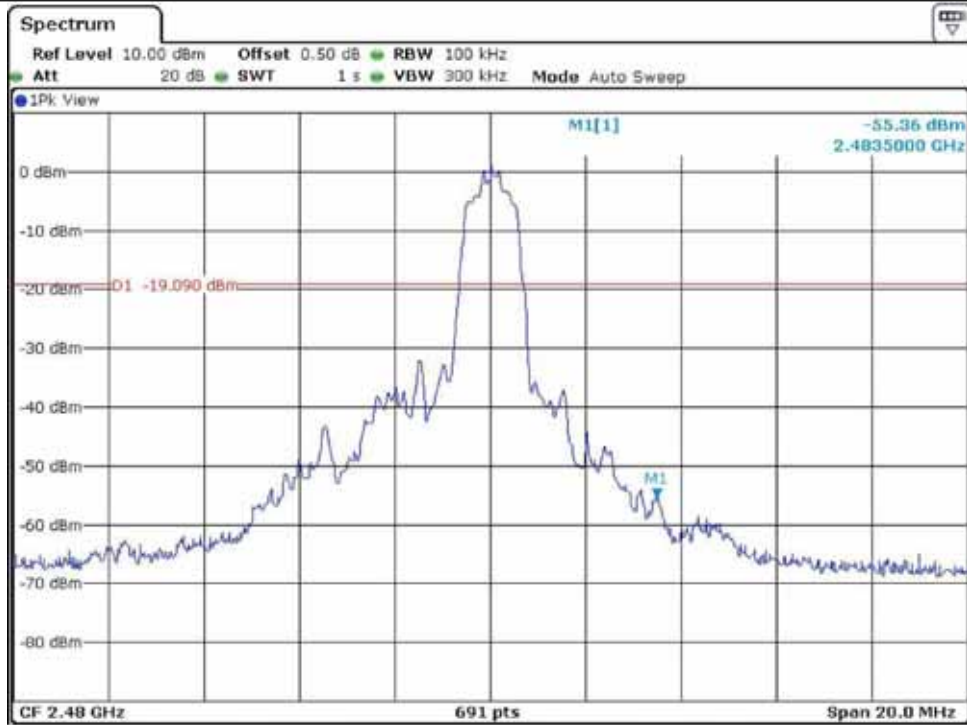
Low Channel



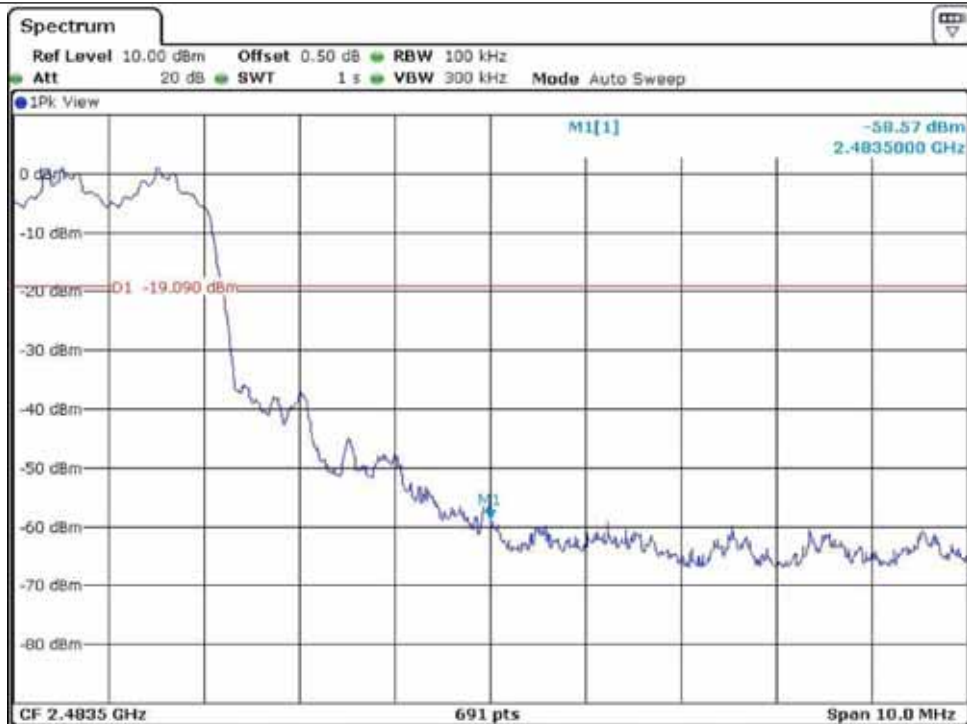
Middle Channel



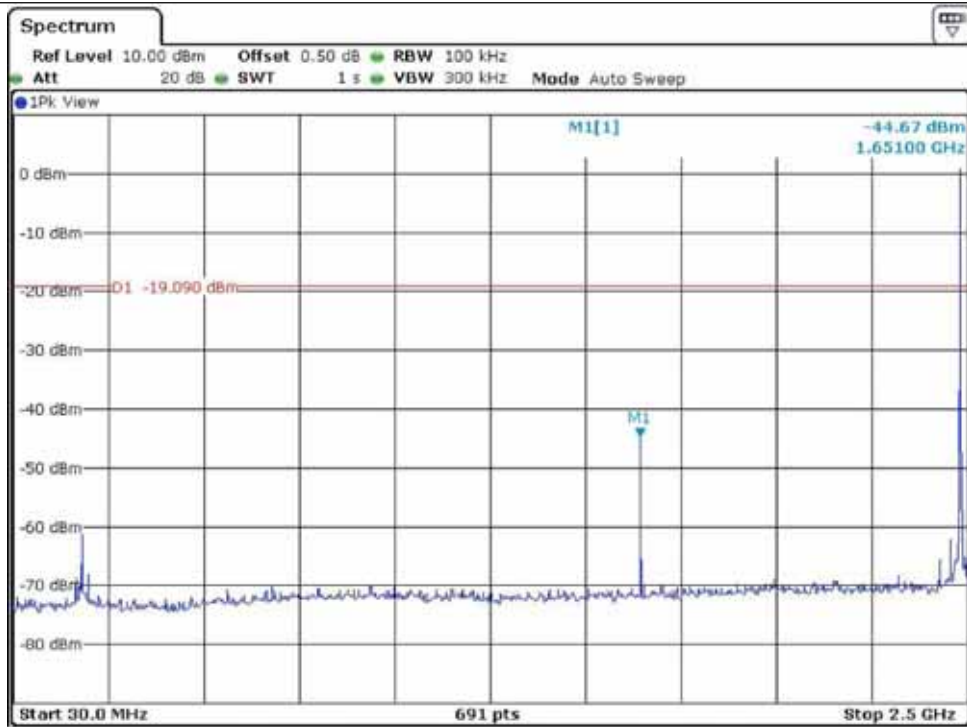
Middle Channel



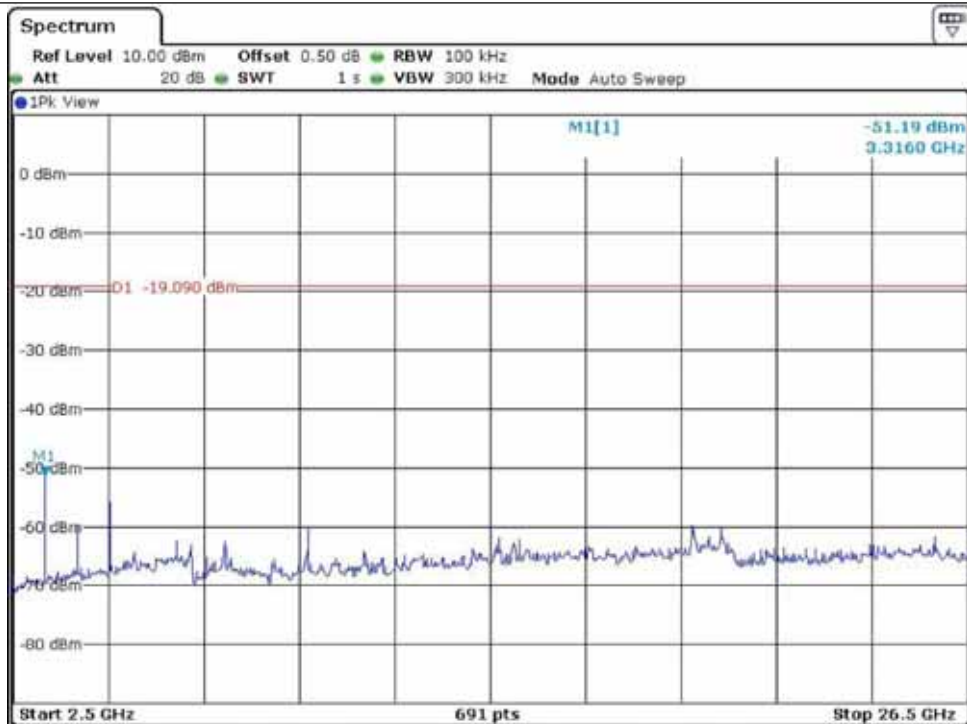
High Channel



High Channel

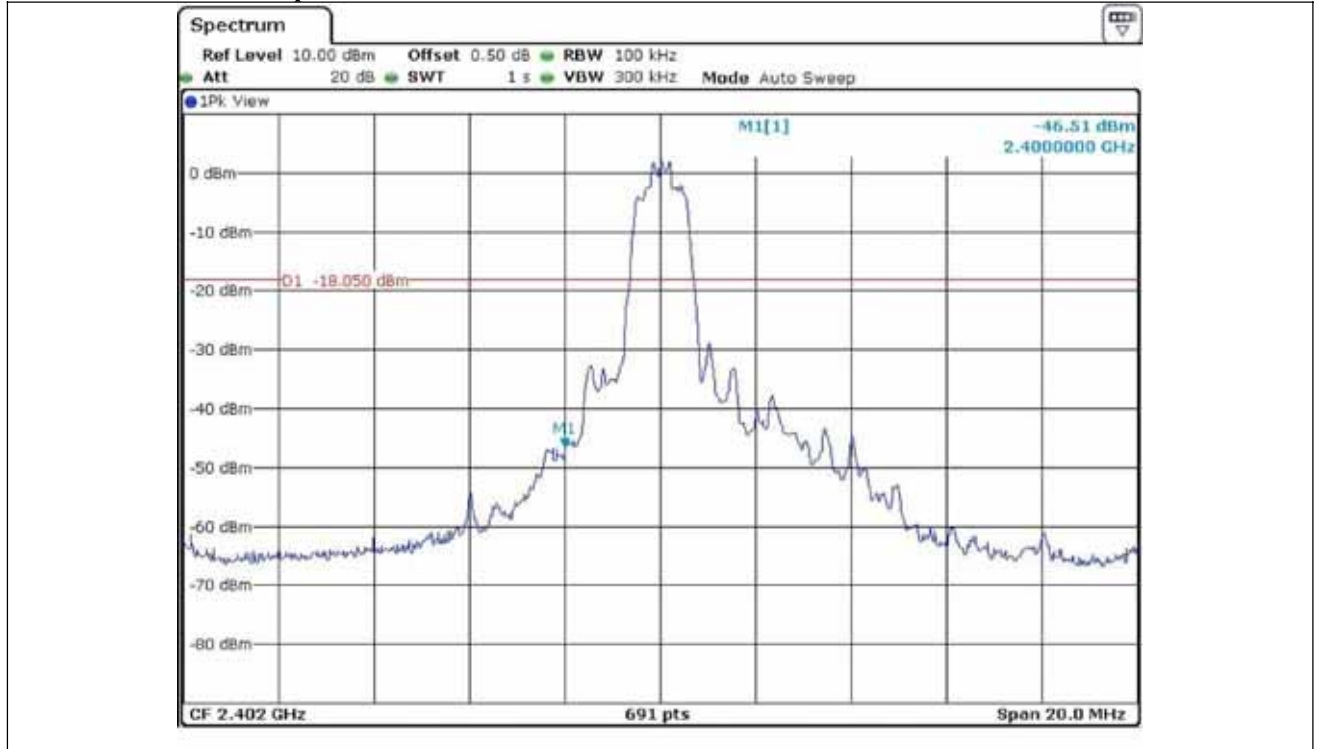


High Channel

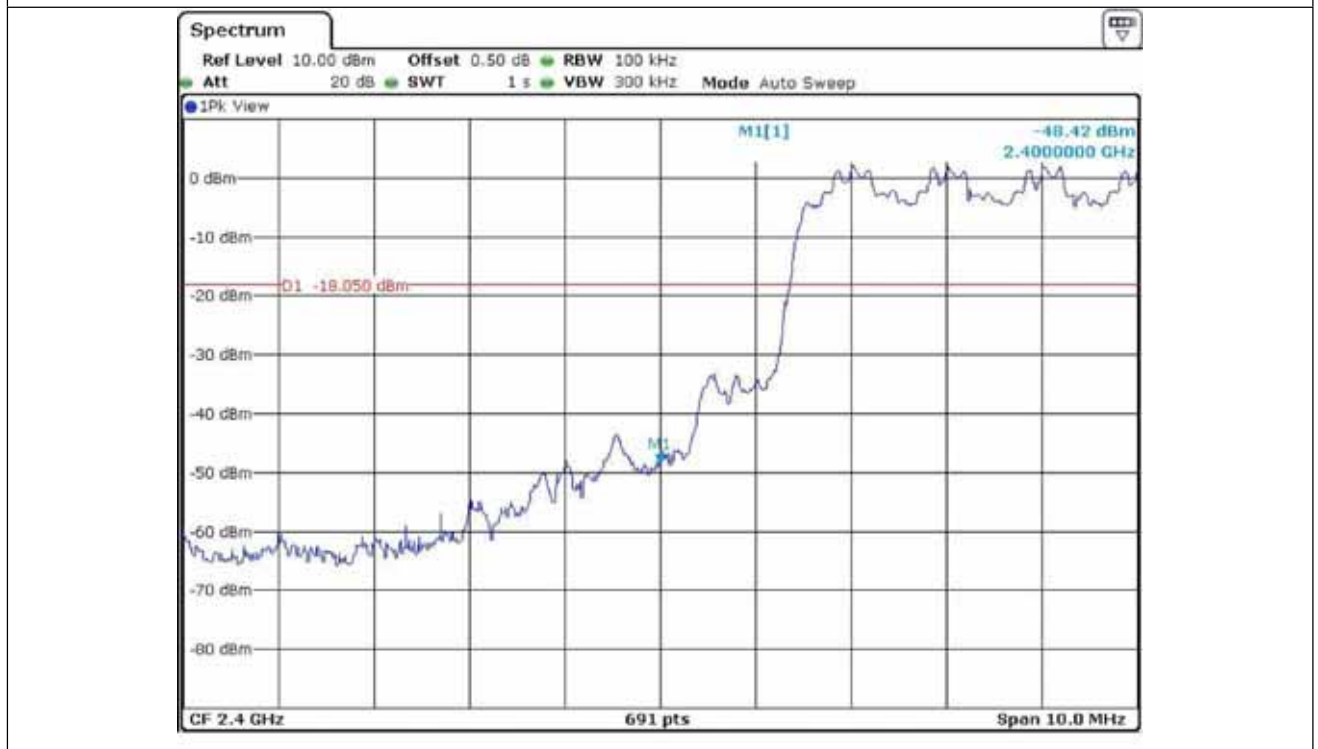


High Channel

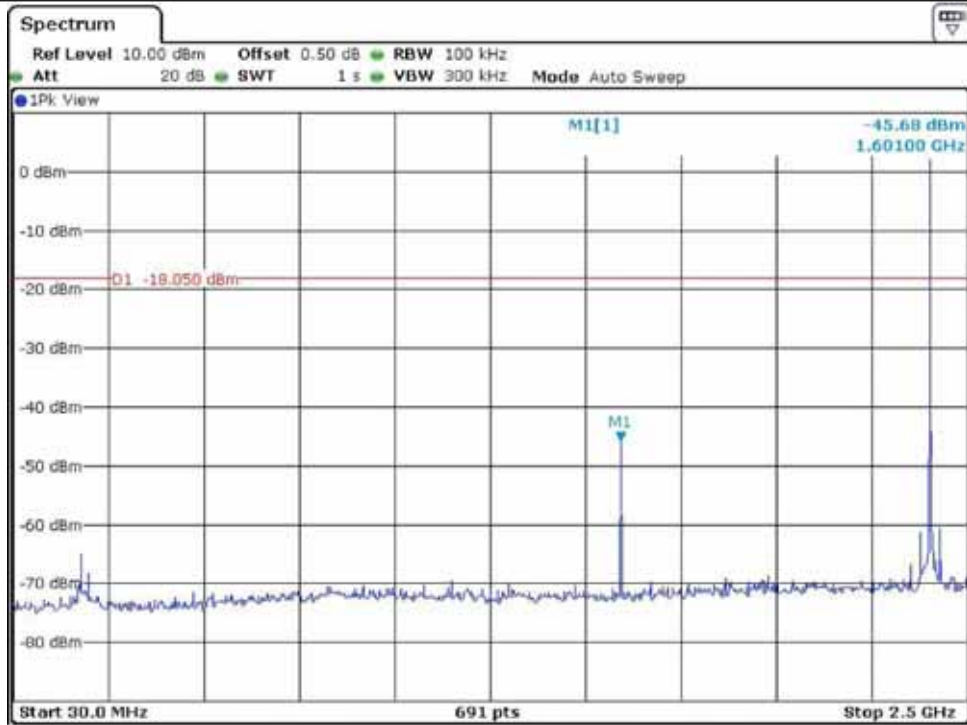
12.5.3 Test data for 3 Mbps



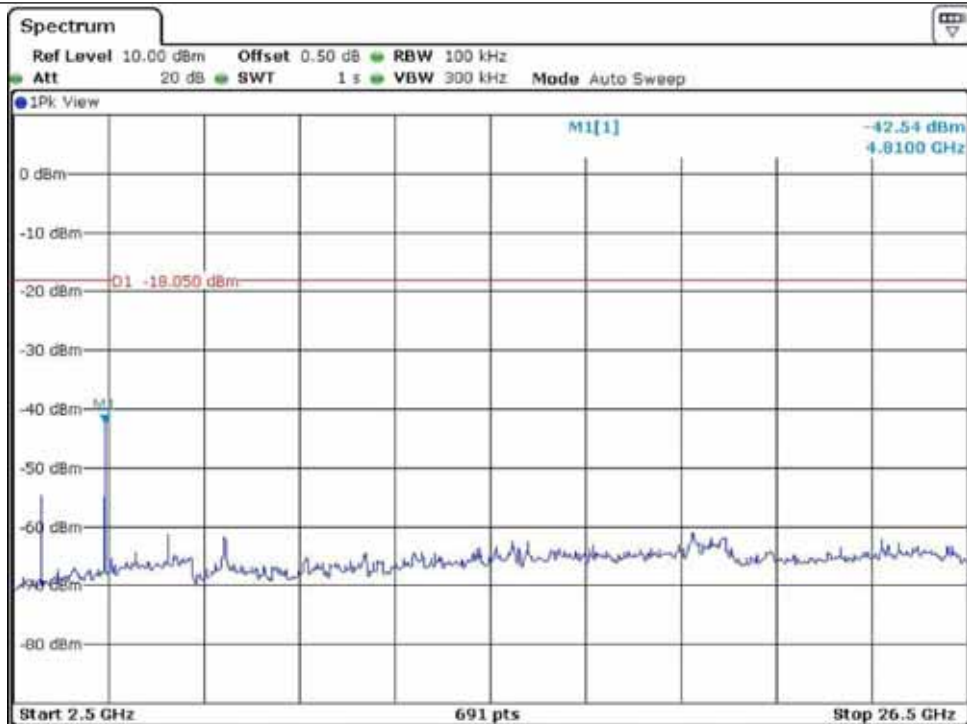
Low Channel



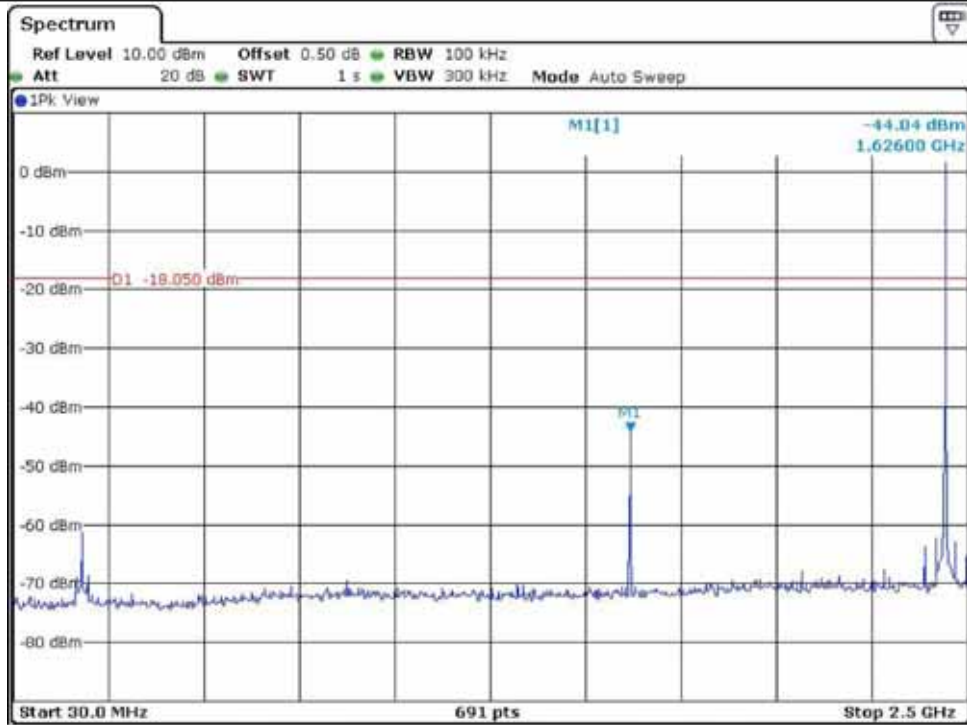
Low Channel



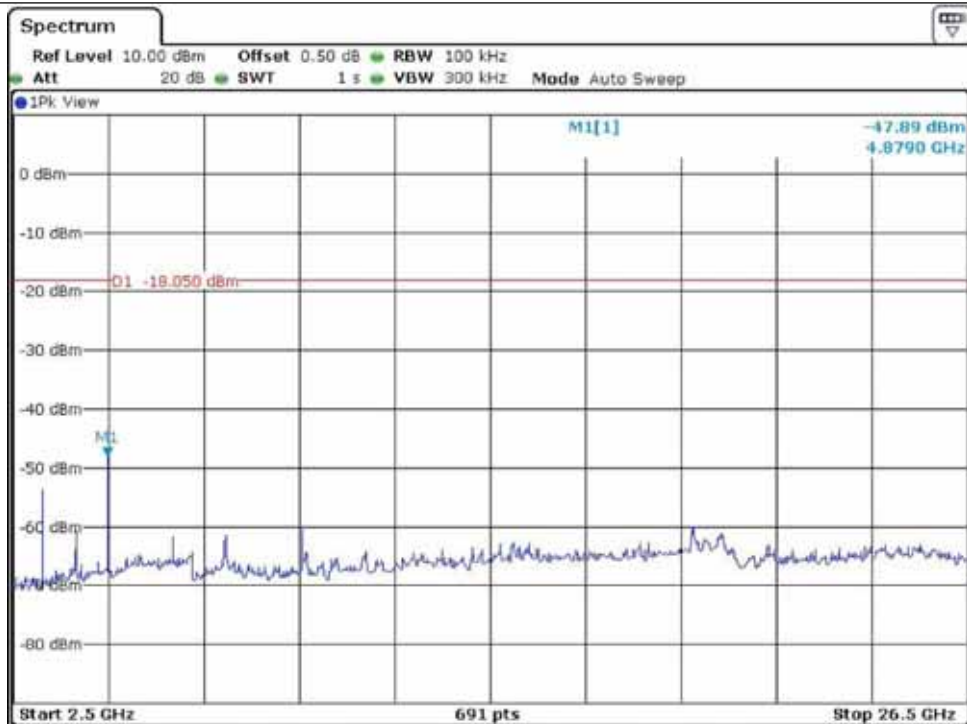
Low Channel



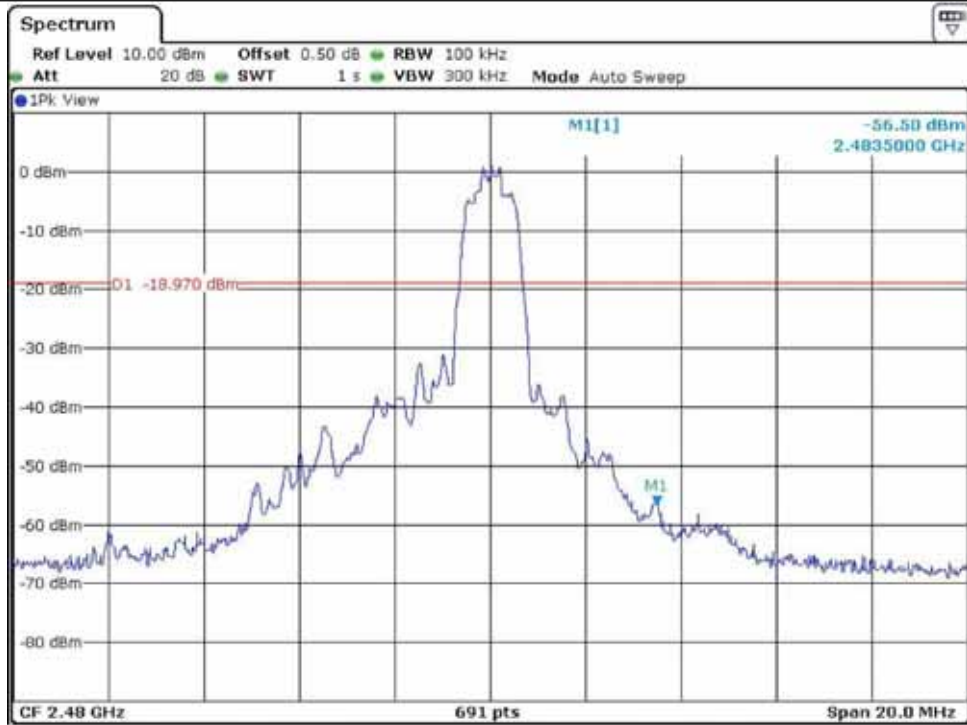
Low Channel



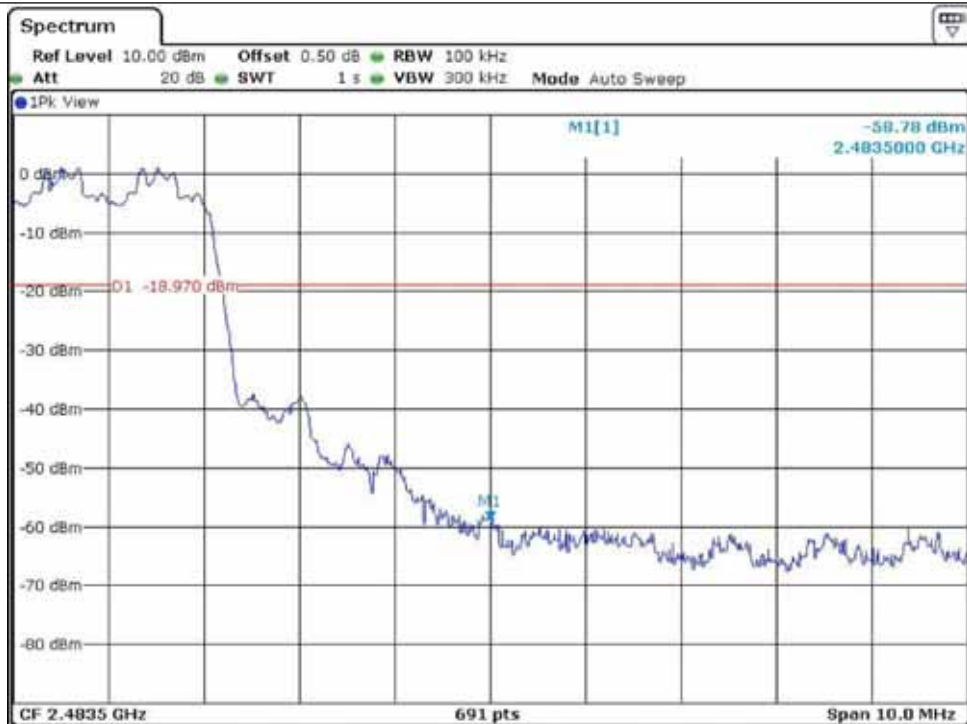
Middle Channel



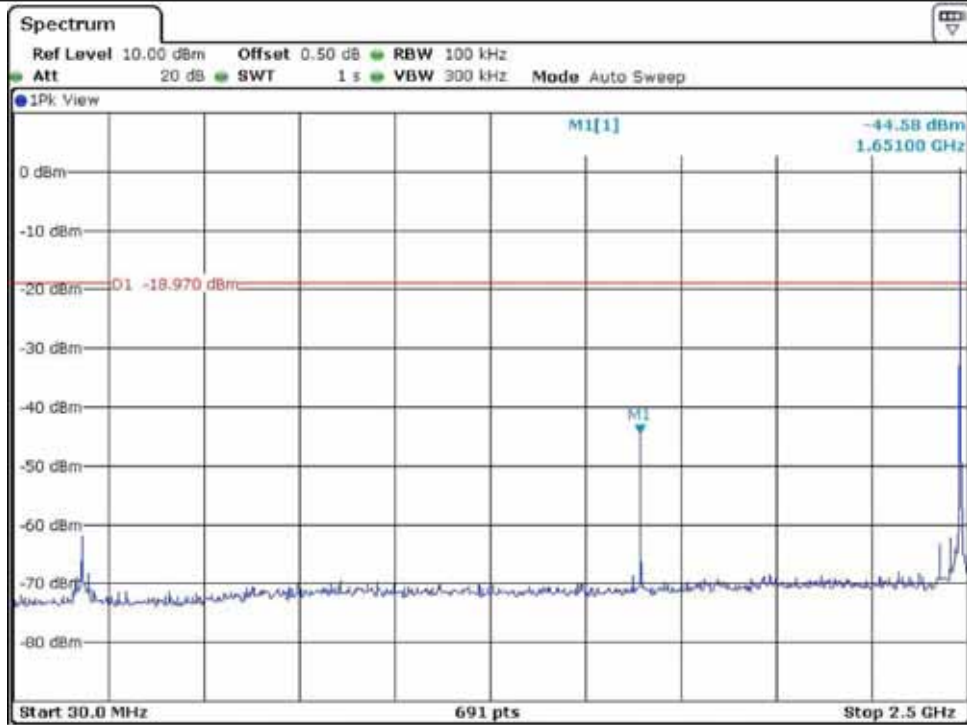
Middle Channel



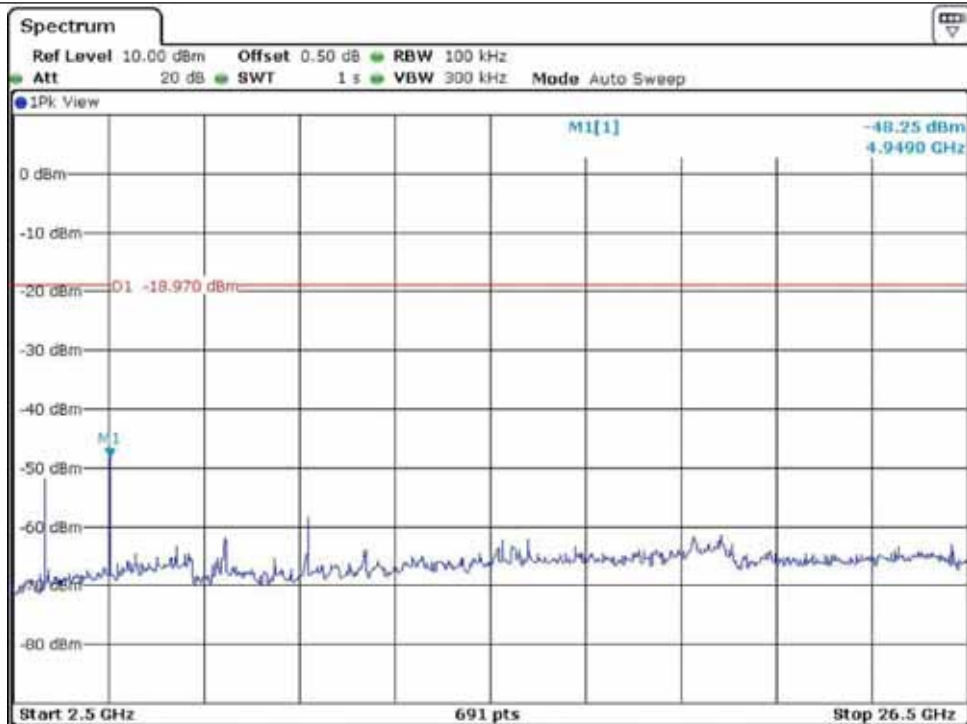
High Channel



High Channel



High Channel



High Channel

12.6 Test data for radiated emission

12.6.1 Radiated Emission which fall in the Restricted Band

12.6.1.1 Test data for 1 Mbps

- Test Date : October 21, 2014
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Operating Condition : Highest Output Power Transmitting Mode(Low Channel and High Channel)
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 400.00	52.20	Peak	H	27.10	7.50	43.00	43.80	74.00	30.20
	36.34	Average	H				27.94	54.00	26.06
2 399.47	53.44	Peak	V				45.04	74.00	28.96
	36.82	Average	V				28.42	54.00	25.58
Test Data for High Channel									
2 483.54	43.94	Peak	H	27.10	7.50	43.00	35.54	74.00	38.46
	30.13	Average	H				21.73	54.00	32.27
2 483.59	43.90	Peak	V				35.50	74.00	38.50
	30.07	Average	V				21.67	54.00	32.33

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical



Tested by: Tae-Ho, Kim / Project Engineer

12.6.1.2 Test data for 2 Mbps

- Test Date : October 21, 2014
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Operating Condition : Highest Output Power Transmitting Mode(Low Channel and High Channel)
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.84	51.90	Peak	H	27.10	7.50	43.00	43.50	74.00	30.50
	36.20	Average	H				27.80	54.00	26.20
2 389.60	53.35	Peak	V				44.95	74.00	29.05
	36.26	Average	V				27.86	54.00	26.14
Test Data for High Channel									
2 483.61	43.78	Peak	H	27.10	7.50	43.00	35.38	74.00	38.62
	30.21	Average	H				21.81	54.00	32.19
2 483.84	43.85	Peak	V				35.45	74.00	38.55
	30.06	Average	V				21.66	54.00	32.34

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical



Tested by: Tae-Ho, Kim / Project Engineer

12.6.1.3 Test data for 3 Mbps

- Test Date : October 21, 2014
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Operating Condition : Highest Output Power Transmitting Mode(Low Channel and High Channel)
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.85	50.98	Peak	H	27.10	7.50	43.00	42.58	74.00	31.42
	35.78	Average	H				27.38	54.00	26.62
2 389.63	53.22	Peak	V				44.82	74.00	29.18
	35.89	Average	V				27.49	54.00	26.51
Test Data for High Channel									
2 483.84	44.08	Peak	H	27.10	7.50	43.00	35.68	74.00	38.32
	30.35	Average	H				21.95	54.00	32.05
2 484.02	43.95	Peak	V				35.55	74.00	38.45
	29.98	Average	V				21.58	54.00	32.42

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical



Tested by: Tae-Ho, Kim / Project Engineer

12.6.2 Spurious & Harmonic Radiated Emission above 1 GHz

12.6.2.1 Test data for 1 Mbps

- Test Date : October 21, 2014
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Operating Condition : Highest Output Power Transmitting Mode
- Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 402.00	94.06	Peak	H	27.00	7.50	42.80	85.76	-	85.76
	95.85	Peak	V				87.55	-	87.55
4 804.00	52.23	Peak	H	30.60	11.10	42.50	51.43	74.00	22.57
	40.17	Average	H				39.37	54.00	14.63
	54.26	Peak	V				53.46	74.00	20.54
	41.20	Average	V				40.40	54.00	13.60
Test Data for Middle Channel									
2 441.00	93.84	Peak	H	27.20	7.60	42.80	85.84	-	85.84
	94.86	Peak	V				86.86	-	86.86
4 882.00	52.19	Peak	H	30.70	11.20	42.50	51.59	74.00	22.41
	40.23	Average	H				39.63	54.00	14.37
	53.95	Peak	V				53.35	74.00	20.65
	41.54	Average	V				40.94	54.00	13.06

Test Data for High Channel									
2 480.00	93.91	Peak	H	27.40	7.70	42.90	86.11	-	86.11
	95.04	Peak	V				87.24	-	87.24
4 960.00	51.99	Peak	H	30.80	11.30	42.50	51.59	74.00	22.41
	40.14	Average	H				39.74	54.00	14.26
	53.54	Peak	V				53.14	74.00	20.86
	40.05	Average	V				39.65	54.00	14.35

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



Tested by: Tae-Ho, Kim / Project Engineer

12.6.2.2 Test data for 2 Mbps

- . Test Date : October 21, 2014
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 402.00	91.77	Peak	H	27.00	7.50	42.80	83.47	-	83.47
	92.54	Peak	V				84.24	-	84.24
4 804.00	48.57	Peak	H	30.60	11.10	42.50	47.77	74.00	26.23
	35.91	Average	H				35.11	54.00	18.89
	49.93	Peak	V				49.13	74.00	24.87
	36.51	Average	V				35.71	54.00	18.29
Test Data for Middle Channel									
2 441.00	91.56	Peak	H	27.20	7.60	42.80	83.56	-	83.56
	91.89	Peak	V				83.89	-	83.89
4 882.00	48.32	Peak	H	30.70	11.20	42.50	47.72	74.00	26.28
	35.88	Average	H				35.28	54.00	18.72
	49.84	Peak	V				49.24	74.00	24.76
	36.25	Average	V				35.65	54.00	18.35

Test Data for High Channel									
2 480.00	91.27	Peak	H	27.40	7.70	42.90	83.47	-	83.47
	91.85	Peak	V				84.05	-	84.05
4 960.00	48.12	Peak	H	30.80	11.30	42.50	47.72	74.00	26.28
	35.84	Average	H				35.44	54.00	18.56
	49.89	Peak	V				49.49	74.00	24.51
	36.24	Average	V				35.84	54.00	18.16

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



Tested by: Tae-Ho, Kim / Project Engineer

12.6.2.3 Test data for 3 Mbps

- . Test Date : October 21, 2014
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 402.00	91.54	Peak	H	27.00	7.50	42.80	83.24	-	83.24
	92.11	Peak	V				83.81	-	83.81
4 804.00	48.68	Peak	H	30.60	11.10	42.50	47.88	74.00	26.12
	35.84	Average	H				35.04	54.00	18.96
	49.21	Peak	V				48.41	74.00	25.59
	36.25	Average	V				35.45	54.00	18.55
Test Data for Middle Channel									
2 441.00	91.01	Peak	H	27.20	7.60	42.80	83.01	-	83.01
	91.74	Peak	V				83.74	-	83.74
4 882.00	48.05	Peak	H	30.70	11.20	42.50	47.45	74.00	26.55
	35.21	Average	H				34.61	54.00	19.39
	48.84	Peak	V				48.24	74.00	25.76
	36.29	Average	V				35.69	54.00	18.31

Test Data for High Channel									
2 480.00	91.22	Peak	H	27.40	7.70	42.90	83.42	-	83.42
	91.52	Peak	V				83.72	-	83.72
4 960.00	48.23	Peak	H	30.80	11.30	42.50	47.83	74.00	26.17
	35.74	Average	H				35.34	54.00	18.66
	49.26	Peak	V				48.86	74.00	25.14
	36.84	Average	V				36.44	54.00	17.56

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



Tested by: Tae-Ho, Kim / Project Engineer

12.6.3 Spurious Radiated Emission

12.6.3.1 Test Data for 1 Mbps

12.6.3.1.1 Test Data for 30 MHz ~ 1 000 MHz

Humidity Level : (42 ~ 43) % R.H. Temperature: (22 ~ 23) °C

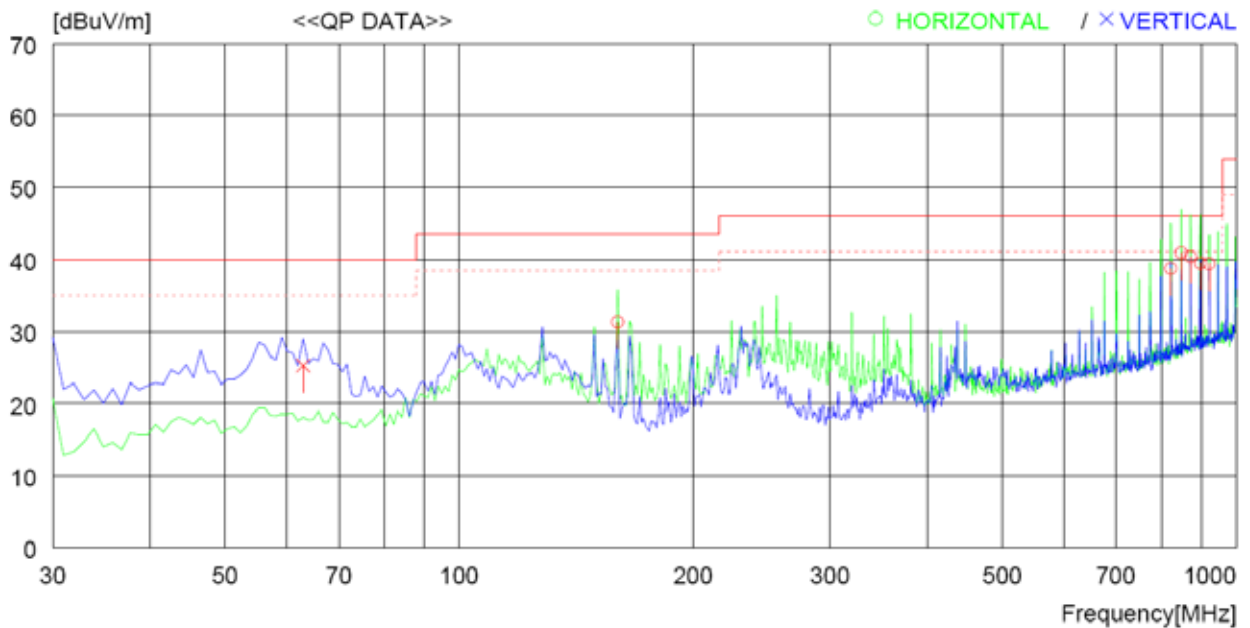
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Class 2 Bluetooth Multimedia Module

Date: October 21, 2014

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	159.980	47.7	8.6	8.0	33.0	31.3	43.5	12.2	100	359
2	823.451	38.9	20.8	11.9	32.9	38.7	46.0	7.3	100	138
3	848.670	40.5	21.1	12.0	32.7	40.9	46.0	5.1	100	359
4	872.920	39.5	21.4	12.1	32.6	40.4	46.0	5.6	100	131
5	898.139	37.9	21.8	12.2	32.4	39.5	46.0	6.5	100	124
6	922.388	37.4	21.9	12.3	32.2	39.4	46.0	6.6	100	116
----- Vertical -----										
7	62.980	39.5	11.9	7.0	33.1	25.3	40.0	14.7	100	180



Tested by: Tae-Ho, Kim / Project Engineer

12.6.3.1.2 Test Data for Below 30 MHz

- . Test Date : October 21, 2014
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.								



Tested by: Tae-Ho, Kim / Project Engineer

12.6.3.2 Test Data for 2 Mbps

12.6.3.2.1 Test Data for 30 MHz ~ 1 000 MHz

Humidity Level : (42 ~ 43) % R.H.

Temperature: (22 ~ 23) °C

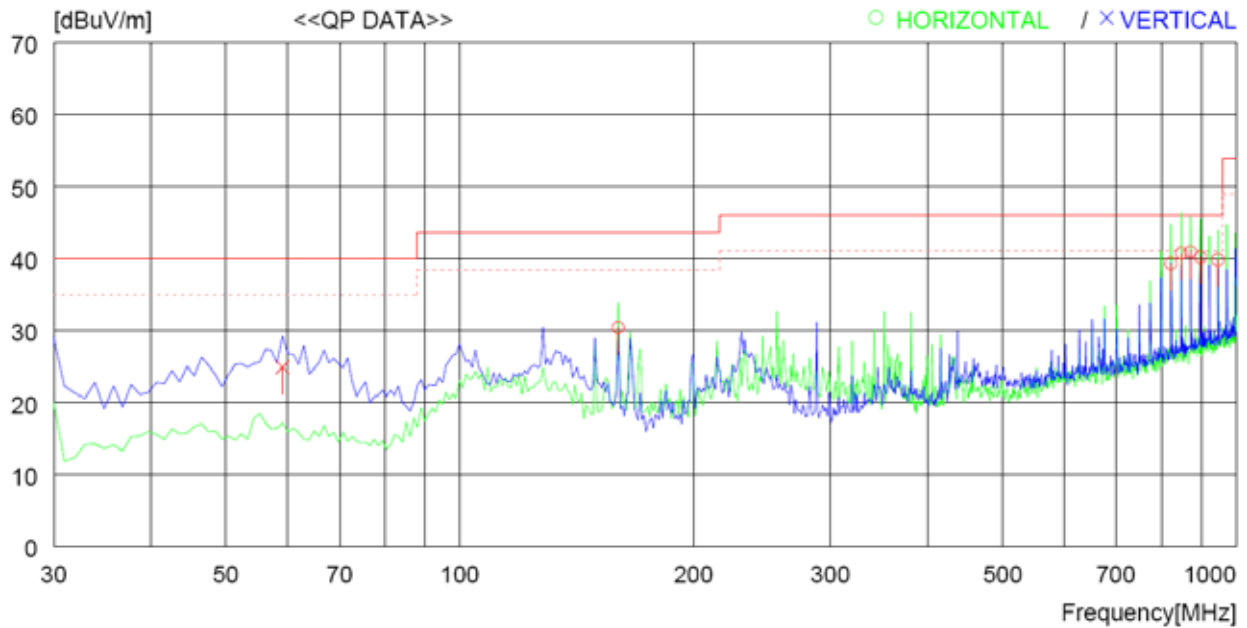
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Class 2 Bluetooth Multimedia Module

Date: October 21, 2014

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	159.980	46.8	8.6	8.0	33.0	30.4	43.5	13.1	100	117
2	823.451	39.5	20.8	11.9	32.9	39.3	46.0	6.7	100	117
3	848.670	40.3	21.1	12.0	32.7	40.7	46.0	5.3	100	117
4	872.920	40.0	21.4	12.1	32.6	40.9	46.0	5.1	100	117
5	898.139	38.6	21.8	12.2	32.4	40.2	46.0	5.8	100	117
6	946.638	37.3	22.1	12.4	32.0	39.8	46.0	6.2	100	117
----- Vertical -----										
7	59.100	38.2	12.9	6.9	33.1	24.9	40.0	15.1	100	359



Tested by: Tae-Ho, Kim / Project Engineer

12.6.3.2.2 Test Data for Below 30 MHz

- . Test Date : October 21, 2014
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.								



Tested by: Tae-Ho, Kim / Project Engineer

12.6.3.3 Test Data for 3 Mbps

12.6.3.3.1 Test Data for 30 MHz ~ 1 000 MHz

Humidity Level : (42 ~ 43) % R.H.

Temperature: (22 ~ 23) °C

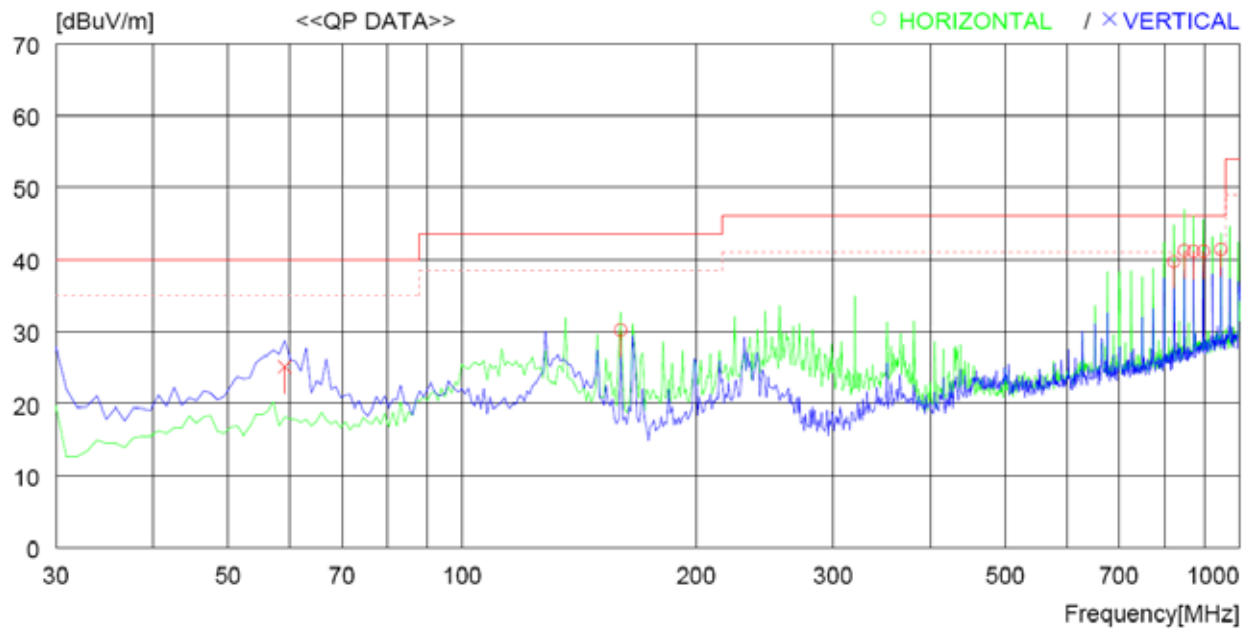
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Class 2 Bluetooth Multimedia Module

Date: October 21, 2014

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	159.980	46.6	8.6	8.0	33.0	30.2	43.5	13.3	100	124
2	823.451	39.9	20.8	11.9	32.9	39.7	46.0	6.3	100	138
3	848.670	40.8	21.1	12.0	32.7	41.2	46.0	4.8	100	124
4	872.920	40.2	21.4	12.1	32.6	41.1	46.0	4.9	100	124
5	898.139	39.5	21.8	12.2	32.4	41.1	46.0	4.9	100	124
6	946.638	38.9	22.1	12.4	32.0	41.4	46.0	4.6	100	124
----- Vertical -----										
7	59.100	38.4	12.9	6.9	33.1	25.1	40.0	14.9	100	125



Tested by: Tae-Ho, Kim / Project Engineer

12.6.3.3.2 Test Data for Below 30 MHz

- . Test Date : October 21, 2014
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.								



Tested by: Tae-Ho, Kim / Project Engineer