

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

Test Report No. : E13OR-050

AGR No. : A137A-030R

Applicant : SEWOO TECH CO., Ltd.

Address : 28-6, Gajangsaneopdong-ro, Osan-si, Gyeonggi-do, 447-210, Korea

Manufacturer : SEWOO TECH CO., Ltd.

Address : 28-6, Gajangsaneopdong-ro, Osan-si, Gyeonggi-do, 447-210, Korea

Type of Equipment : Single Modular Transmitter

FCC ID. : WF5SBTM1

Model Name : SBT-M1

Serial number : N/A

Total page of Report : 41 pages (including this page)

Date of Incoming : July 11, 2013

Date of issue : October 31, 2013

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.

Prepared by: 
Ki-Hong, Nam / Senior Engineer
ONETECH Corp.

Approved by: 
Gea-Won, Lee / Managing Director
ONETECH Corp.

CONTENTS

PAGE

1. VERIFICATION OF COMPLIANCE	5
2. TEST SUMMARY.....	6
2.1 TEST ITEMS AND RESULTS.....	6
2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS	6
2.3 RELATED SUBMITTAL(S) / GRANT(S)	6
2.4 PURPOSE OF THE TEST	6
2.5 TEST METHODOLOGY	6
2.6 TEST FACILITY	6
3. GENERAL INFORMATION.....	7
3.1 PRODUCT DESCRIPTION.....	7
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.	7
4. EUT MODIFICATIONS	7
5. SYSTEM TEST CONFIGURATION.....	8
5.1 JUSTIFICATION	8
5.2 PERIPHERAL EQUIPMENT.....	8
5.3 MODE OF OPERATION DURING THE TEST.....	8
5.4 CONFIGURATION OF TEST SYSTEM	8
5.5 ANTENNA REQUIREMENT	9
6. PRELIMINARY TEST	9
6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	9
6.2 GENERAL RADIATED EMISSIONS TESTS.....	9
7. OCCUPIED BANDWIDTH	10
7.1 20 dB BANDWIDTH	10
7.1.1 Operating environment.....	10
7.1.2 Test set-up	10
7.1.3 Test equipment used	10
7.1.4 Test data	11
7.2 HOPPING FREQUENCY SEPARATION.....	13
7.2.1 Operating environment.....	13
7.2.2 Test set-up	13
7.2.3 Test equipment used	13

7.2.4 Test data	13
7.3 NUMBER OF HOPPING CHANNELS	15
7.3.1 Operating environment.....	15
7.3.2 Test set-up	15
7.3.3 Test equipment used	15
7.3.4 Test data	15
7.4 TIME OF OCCUPANCY	18
7.4.1 Operating environment.....	18
7.4.2 Test set-up	18
7.4.3 Test equipment used	18
7.4.4 Test data	19
8 MAXIMUM PEAK OUTPUT POWER.....	22
8.1 OPERATING ENVIRONMENT	22
8.2 TEST SET-UP	22
8.3 TEST EQUIPMENT USED	22
8.4 TEST DATA	22
9 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND	25
9.1 OPERATING ENVIRONMENT	25
9.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	25
9.3 TEST SET-UP FOR RADIATED MEASUREMENT	25
9.4 TEST EQUIPMENT USED	25
9.5 TEST DATA	26
9.5.1 Test data for conducted emission	26
9.5.2 Test data for radiated emission	31
10. CONDUCTED EMISSION TEST	38
10.1 OPERATING ENVIRONMENT	38
10.2 TEST SET-UP	38
10.3 TEST EQUIPMENT USED	38
10.4 TEST DATA	39
11. RADIO FREQUENCY EXPOSURE.....	41
11.1 RF EXPOSURE LIMIT	41
11.2 EUT DESCRIPTION	41
11.3 TEST RESULT.....	41

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E13OR-050	October 31, 2013	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

APPLICANT : SEWOO TECH CO., Ltd.
 ADDRESS : 28-6, Gajangsaneopdong-ro, Osan-si, Gyeonggi-do, 447-210, Korea
 CONTACT PERSON : Min-Seok, Song / R&D Center. Senior Research Engineer
 TELEPHONE NO : +82-31-459-8200
 FCC ID : WF5SBTM1
 MODEL NAME : SBT-M1
 BRAND NAME : -
 SERIAL NUMBER : N/A
 DATE : October 31, 2013

EQUIPMENT CLASS	<i>DSS – PART 15 SPREAD SPECTRUM TRANSMITTER</i>
KIND OF EQUIPMENT	Single Modular Transmitter
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	10 m Semi Anechoic Chamber

-. 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
15.247 (d)	Peak Power Spectral Density	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 section 2.1.

2.5 Test Methodology

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

2.6 Test Facility

The open area test site is located at 307-51 Daessangryung-ri, Chowol-eup, Gwangju-si, Gyeonggi-do and 10 m Semi Anechoic Chamber (SAC) and conducted measurement facilities are located at 301-14, Daessangryung-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862, Korea. The Onetech Corp. has been accredited as a Conformity Assessment Body (CAB) with designation number KR0013 under APEC TEL MAR between the RRA and the FCC.

3. GENERAL INFORMATION

3.1 Product Description

The SEWOO TECH CO., Ltd., Model SBT-M1 (referred to as the EUT in this report) is a Single Modular Transmitter. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Single Modular Transmitter
OPERATING FREQUENCY	2 402 MHz ~ 2 480 MHz
RF OUTPUT POWER	-6.92 dBm
NUMBER OF CHANNEL	79 Channels
MODULATION TYPE	GFSK
ANTENNA TYPE	Chip Antenna
ANTENNA GAIN	3.5 dBi
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ.>=1 MHz)	26 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	SEWOO TECH CO., Ltd.	N/A	N/A

5.2 Peripheral equipment

-. None

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. 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: The jig board of the EUT was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2009 to determine the worse operating conditions.

Radiated Emission Test: 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)
Standby/Receiving Mode	-
Transmitting Mode	X

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)
Standby/Receiving Mode	-
Transmitting Mode	X

7. OCCUPIED BANDWIDTH

7.1 20 dB BANDWIDTH

7.1.1 Operating environment

Temperature : 25 °C

Relative humidity : 47 % R.H.

7.1.2 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.



7.1.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)

All test equipment used is calibrated on a regular basis.

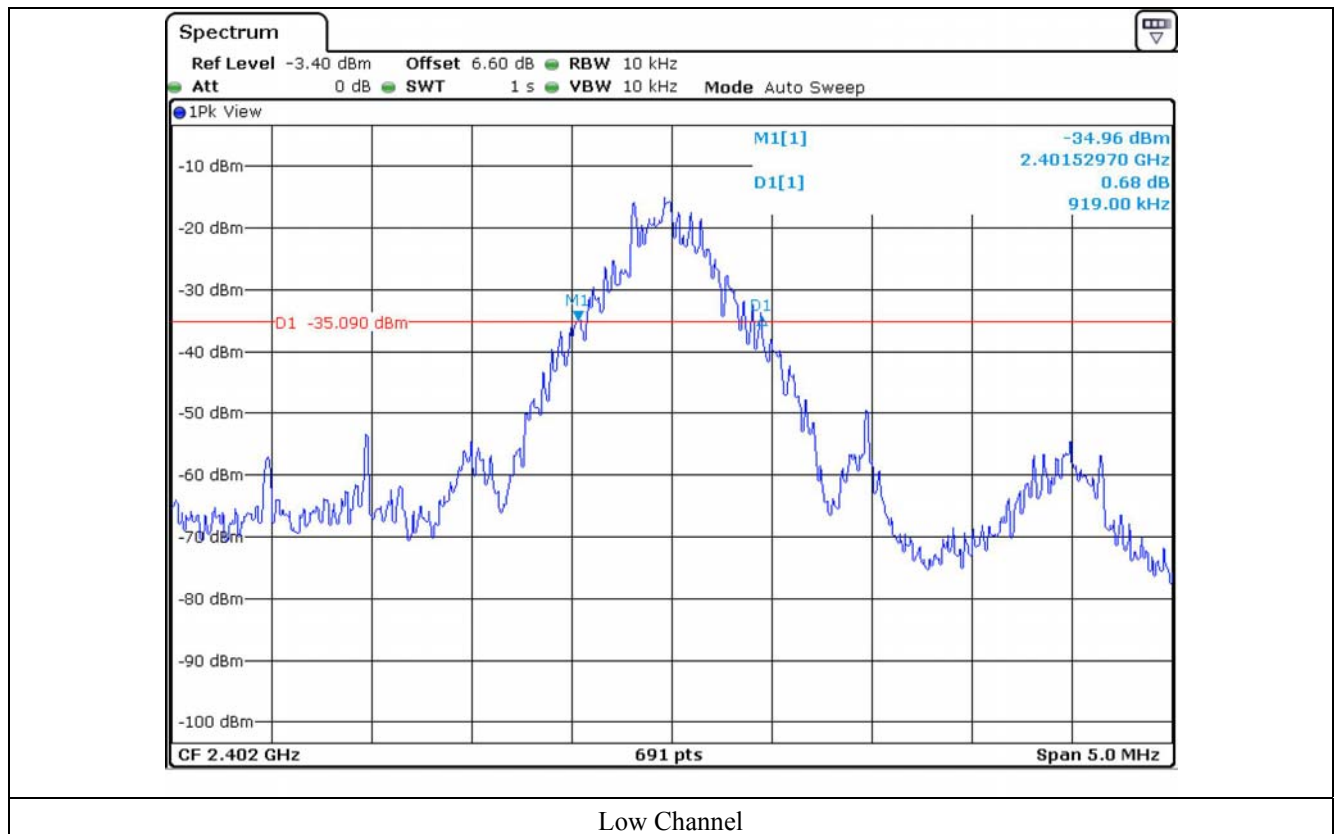
7.1.4 Test data

-. Test Date : September 24, 2013

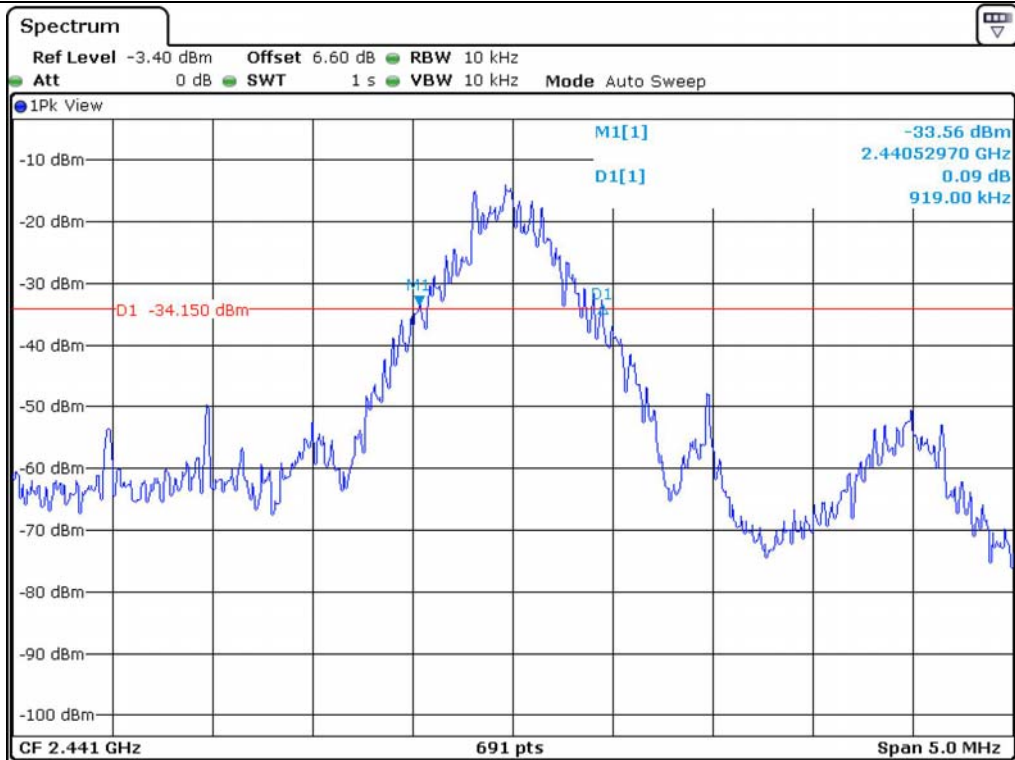
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (kHz)
Low	2 402	919.00
Middle	2 441	919.00
High	2 480	919.00

0 | 30 2.

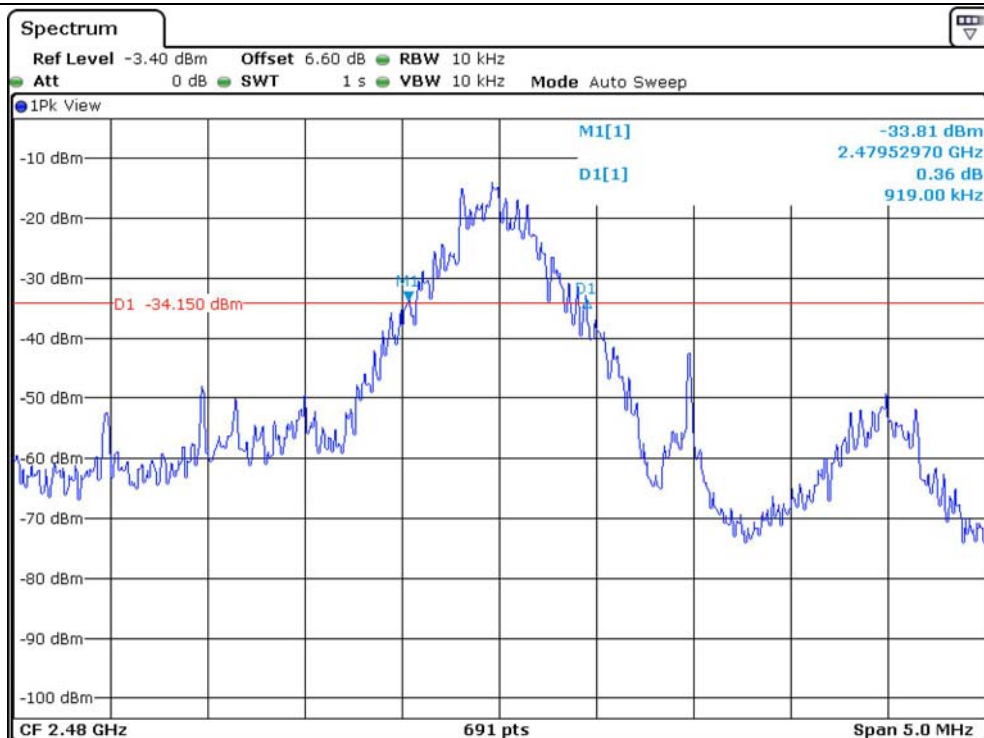
Tested by: Hong-Kyu, Lee/ Engineer



Low Channel



Middle Channel



High Channel

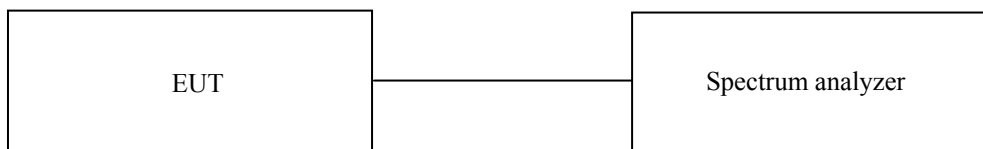
7.2 HOPPING FREQUENCY SEPARATION

7.2.1 Operating environment

Temperature : 25 °C
Relative humidity : 47 % R.H.

7.2.2 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.



7.2.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)

All test equipment used is calibrated on a regular basis.

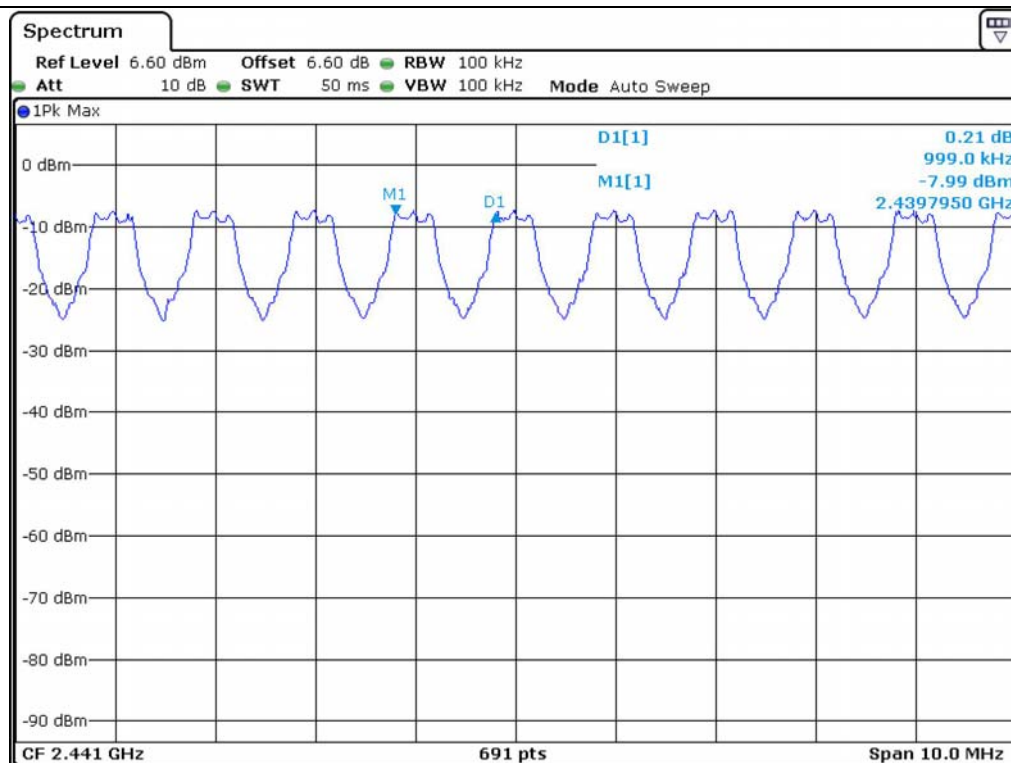
7.2.4 Test data

-. Test Date : September 24, 2013
-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
999.00	612.7	Separated by a minimum of 25 kHz

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

Tested by: Hong-Kyu, Lee/ Engineer



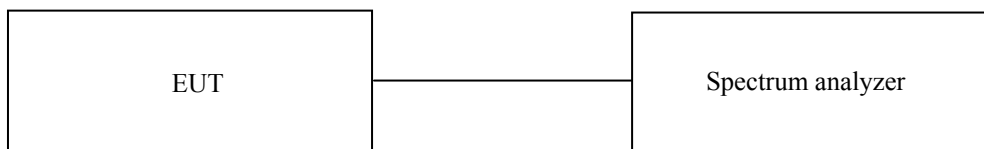
7.3 NUMBER OF HOPPING CHANNELS

7.3.1 Operating environment

Temperature : 25 °C
Relative humidity : 47 % R.H.

7.3.2 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 100 kHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



7.3.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)

All test equipment used is calibrated on a regular basis.

7.3.4 Test data

-. Test Date : September 24, 2013
-. Test Result : Pass

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

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

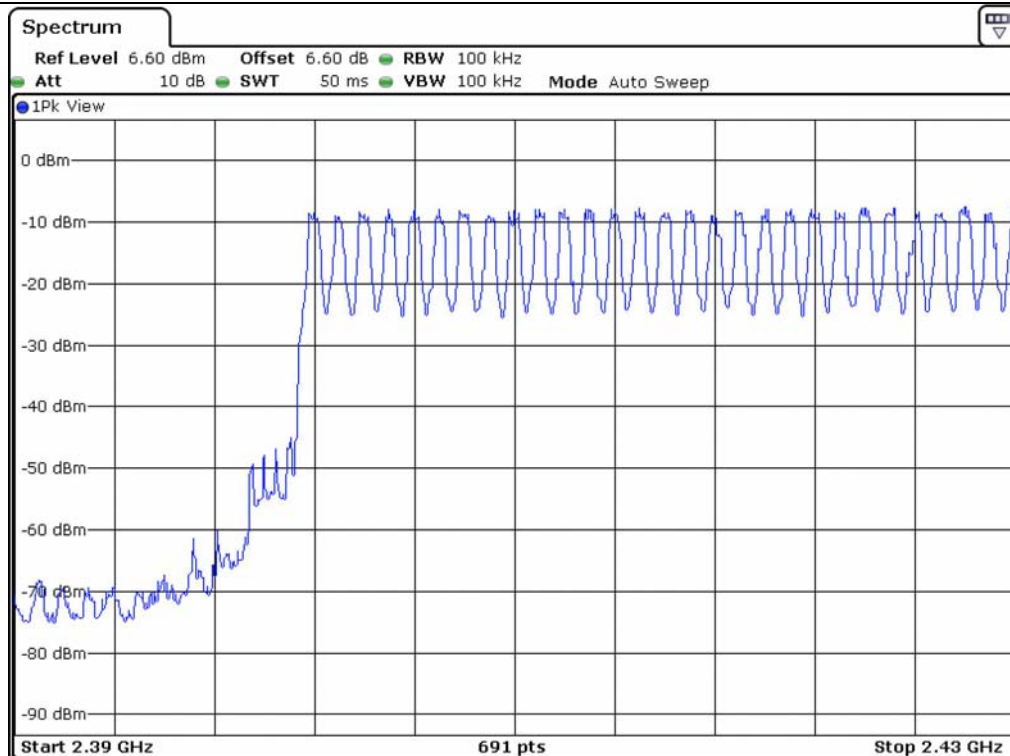


Tested by: Hong-Kyu, Lee/ Engineer

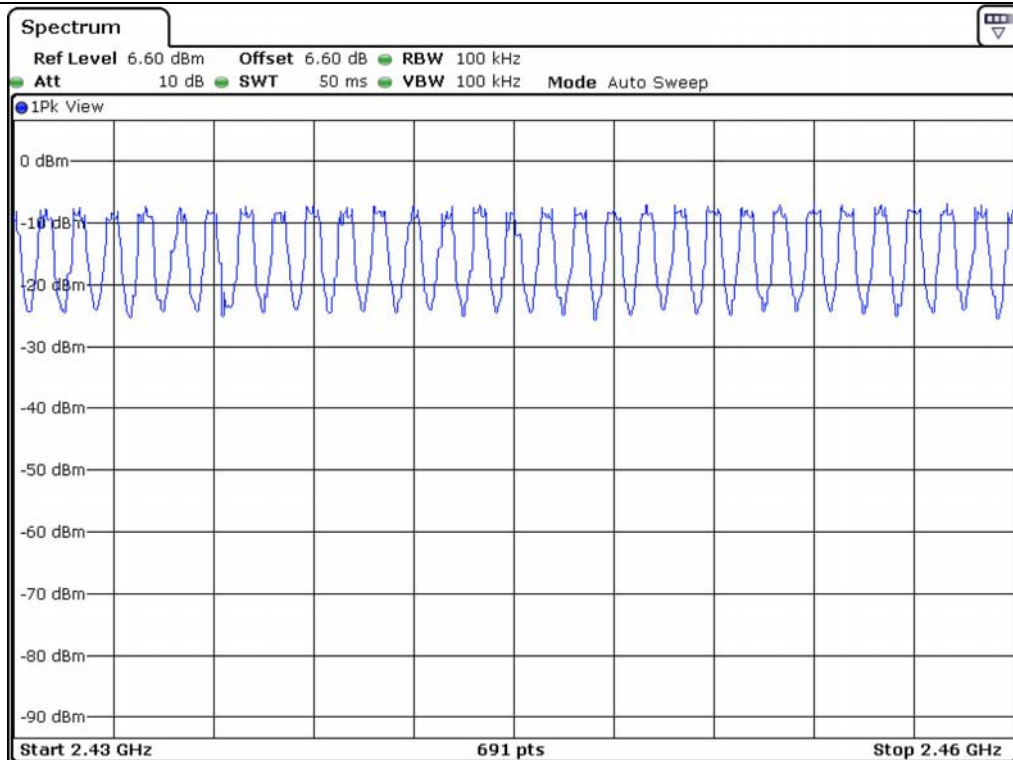
1 Mbps



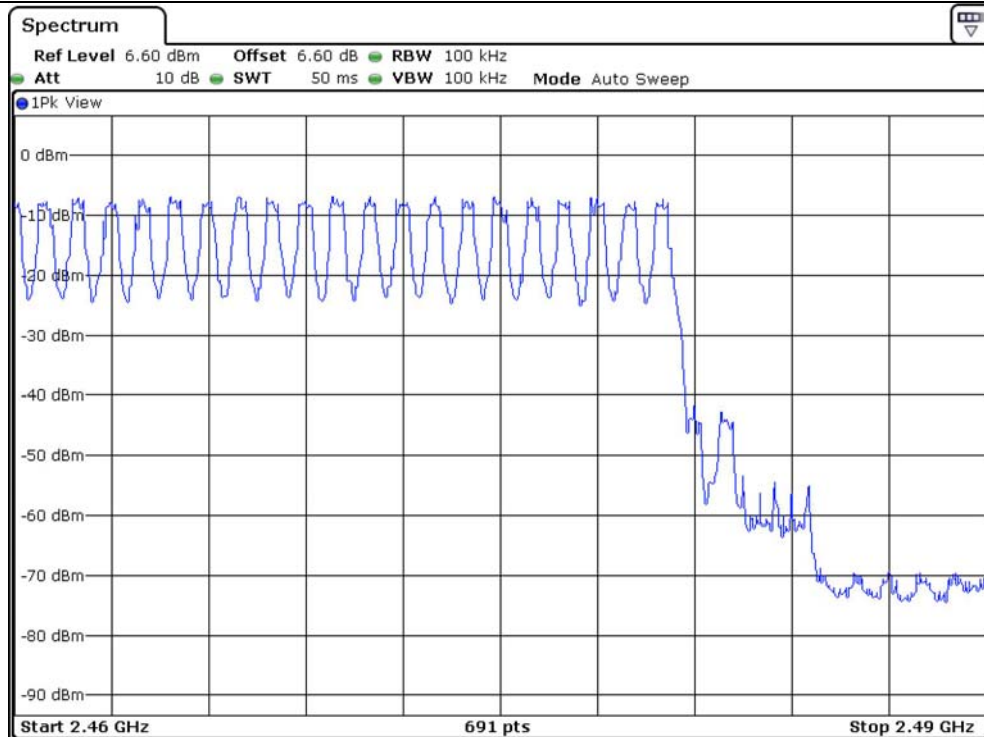
Total number of hopping channel: $28+30+21 = 79$



Number of hopping channel: 28



Number of hopping channel: 30



Number of hopping channel: 21

7.4 TIME OF OCCUPANCY

7.4.1 Operating environment

Temperature : 25 °C
Relative humidity : 47 % R.H.

7.4.2 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.



7.4.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)

All test equipment used is calibrated on a regular basis.

7.4.4 Test data

-. Test Date : September 24, 2013

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	1.638	5.06	31.6	261.91	400	
DH5	2.899	3.38	31.6	309.59	400	

Total dwell time is calculated as following.

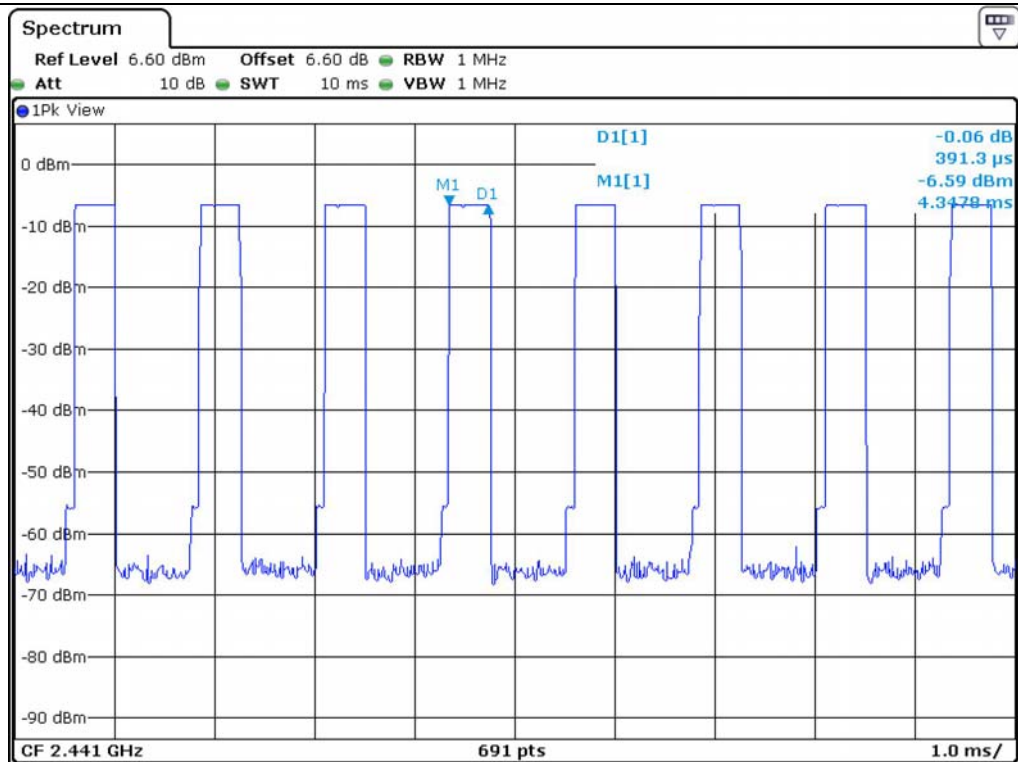
Total Dwell Time = Pulse time * Hops per second with channels * period time

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

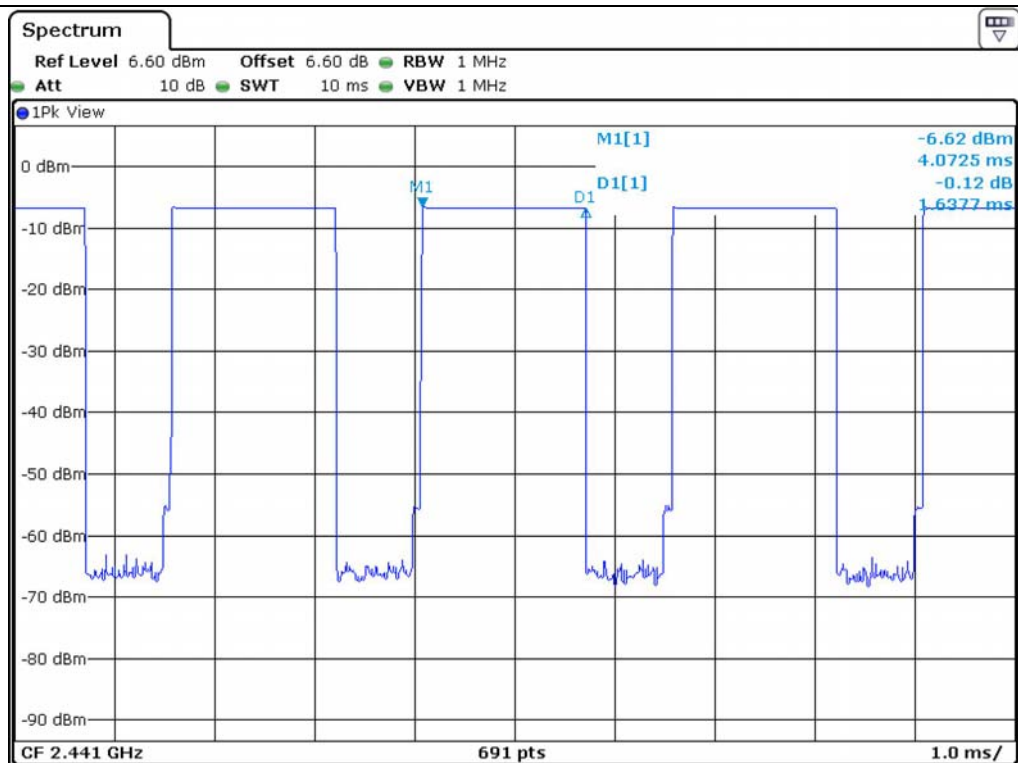


Tested by: Hong-Kyu, Lee/ Engineer

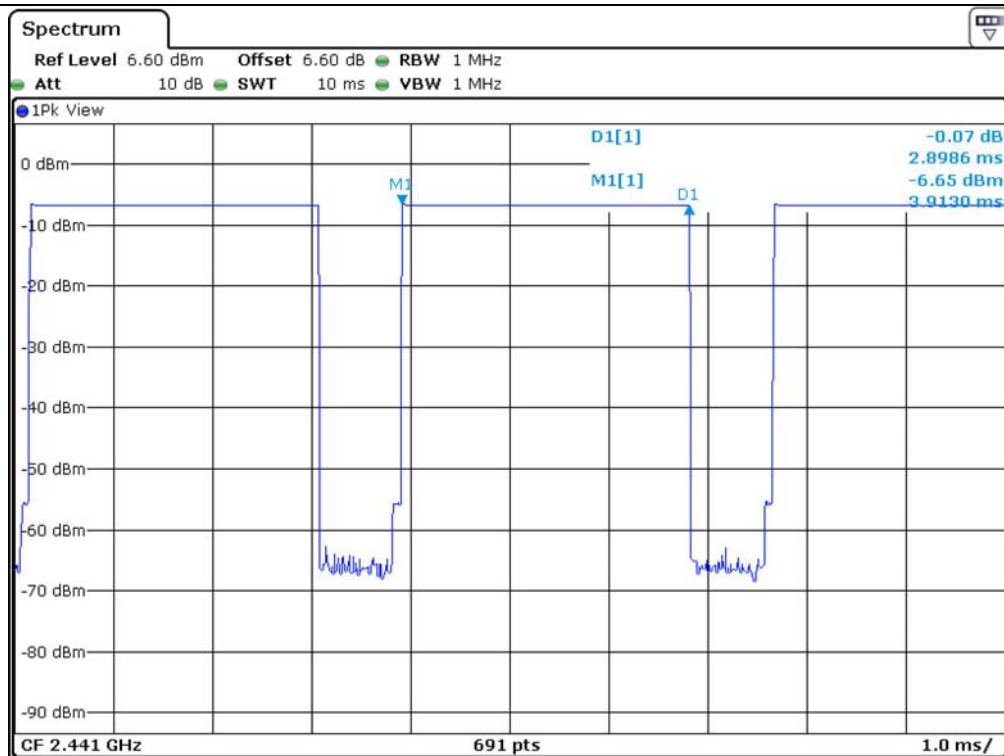
1 Mbps



DH1



DH3



DH5

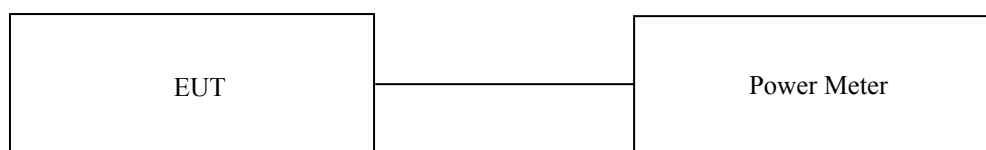
8 MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 25 °C
Relative humidity : 47 % R.H.

8.2 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.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)

All test equipment used is calibrated on a regular basis.

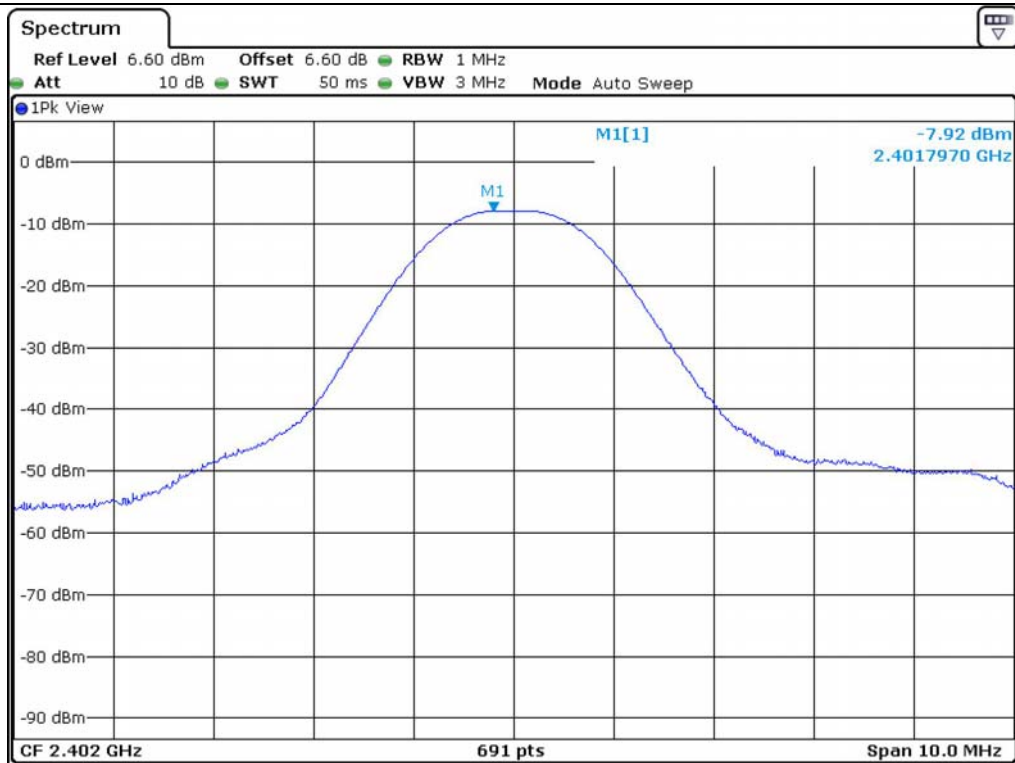
8.4 Test data

- Test Date : September 24, 2013
- Test Result : Pass

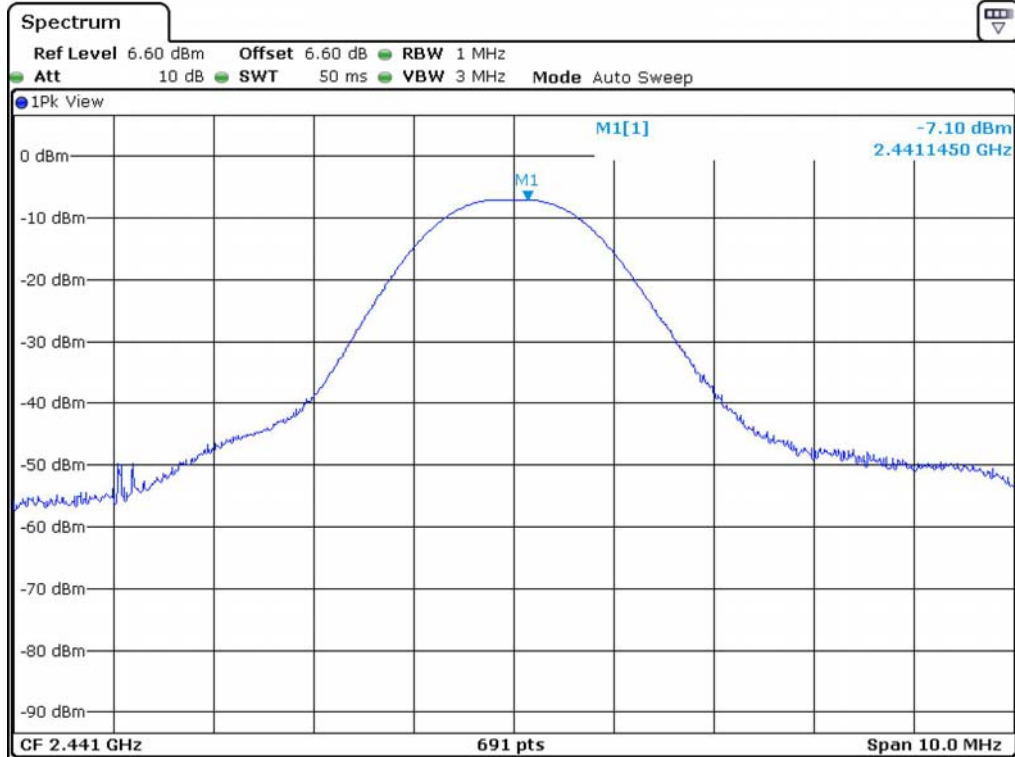
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402	-7.92	30.0	37.92
Middle	2 441	-7.10	30.0	37.10
High	2 480	-6.92	30.0	36.92

01 30 21

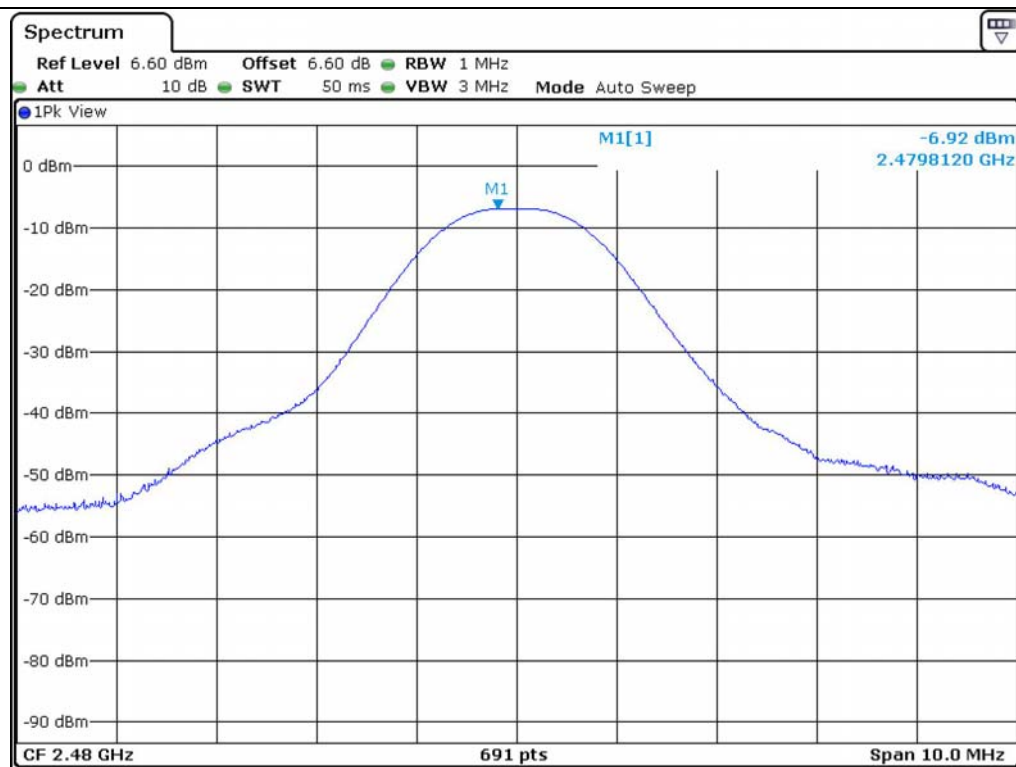
Tested by: Hong-Kyu, Lee/ Engineer



Low Channel



Middle Channel



High Channel

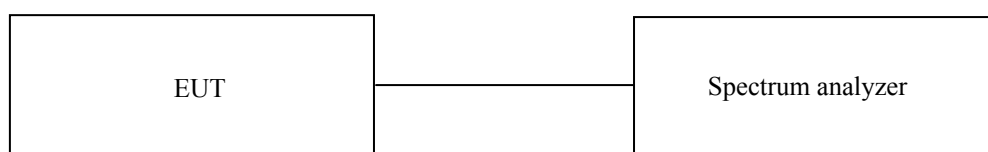
9 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 24 °C
Relative humidity : 44 % R.H.

9.2 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.



9.3 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 9 KHz to 25 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.

9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Feb. 06, 2013(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	May 27, 2013(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	May 21, 2013(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Jan. 25, 2013(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
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	VULB9163-202	Dec. 17, 2012(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	Sep. 30, 2013(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Mar. 06, 2013(2Y)
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879285/26	Dec. 11, 2012(2Y)
■ -	83051A	Agilent	Microwave System Preamplifier	3950M00201	May. 22, 2013(1Y)

All test equipment used is calibrated on a regular basis.

It should not be reproduced except in full, without the written approval of ONETECH Corp.

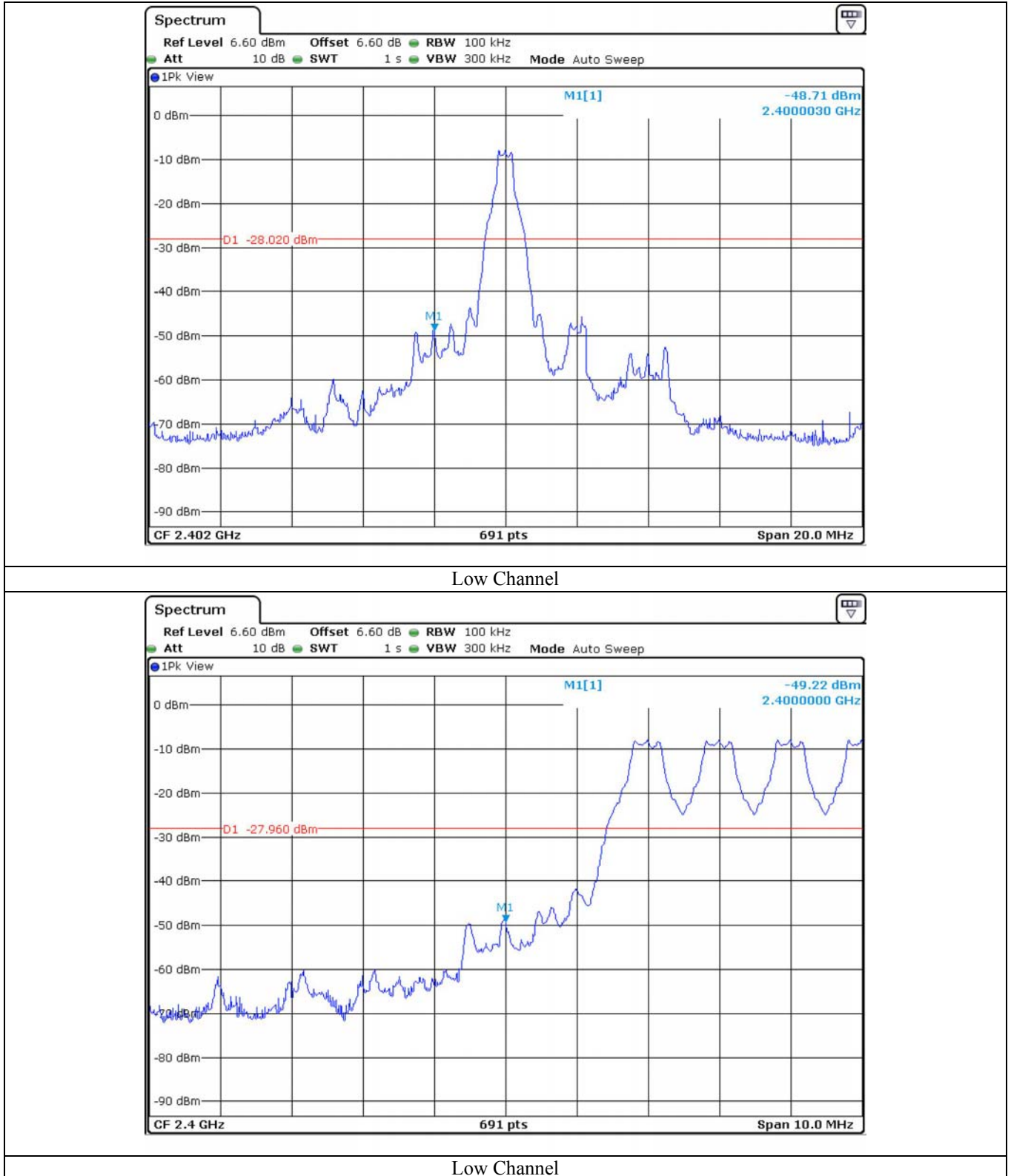
EMC-002 (Rev.2)

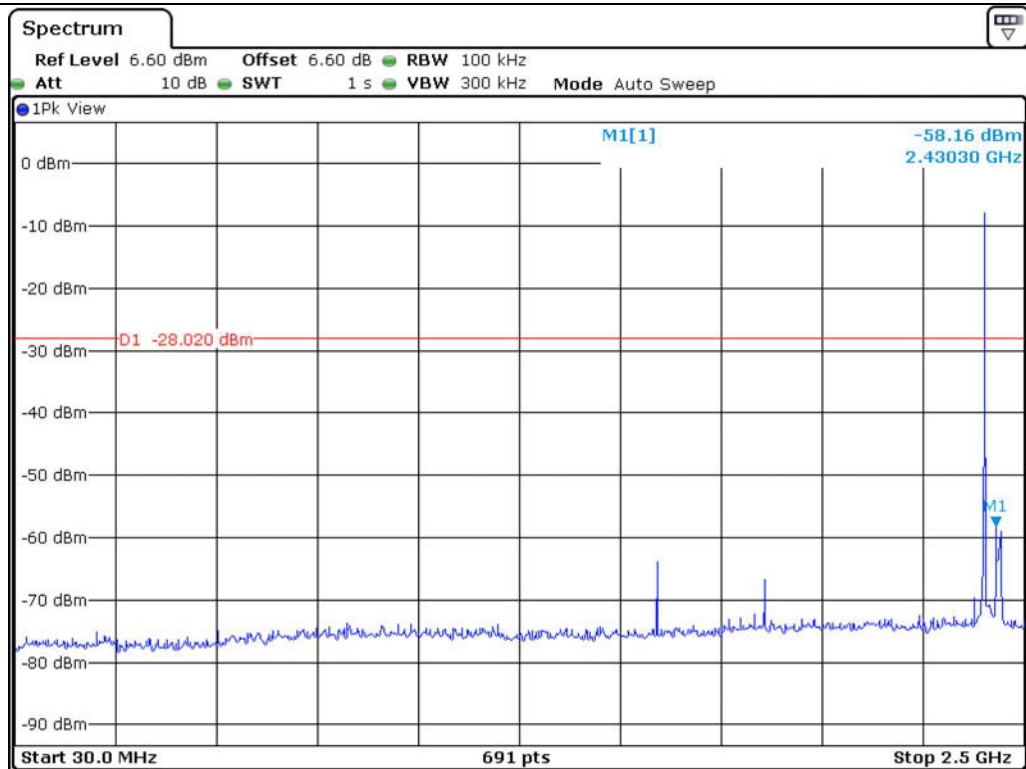
HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

EMC Testing Div : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

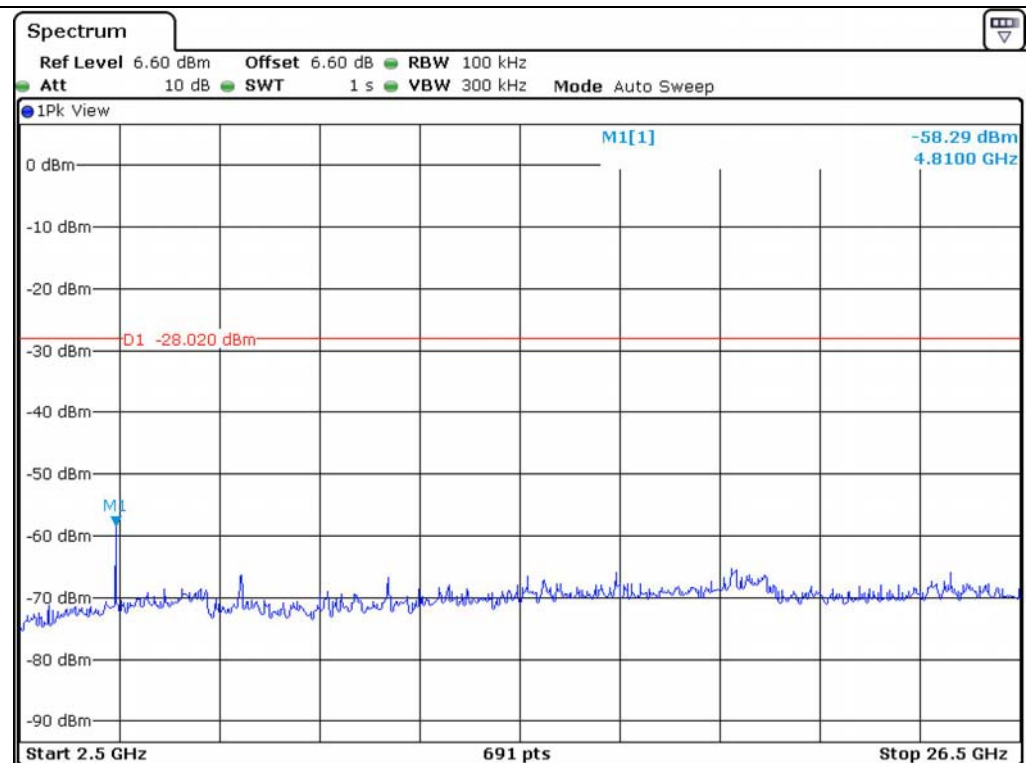
9.5 Test data

9.5.1 Test data for conducted emission

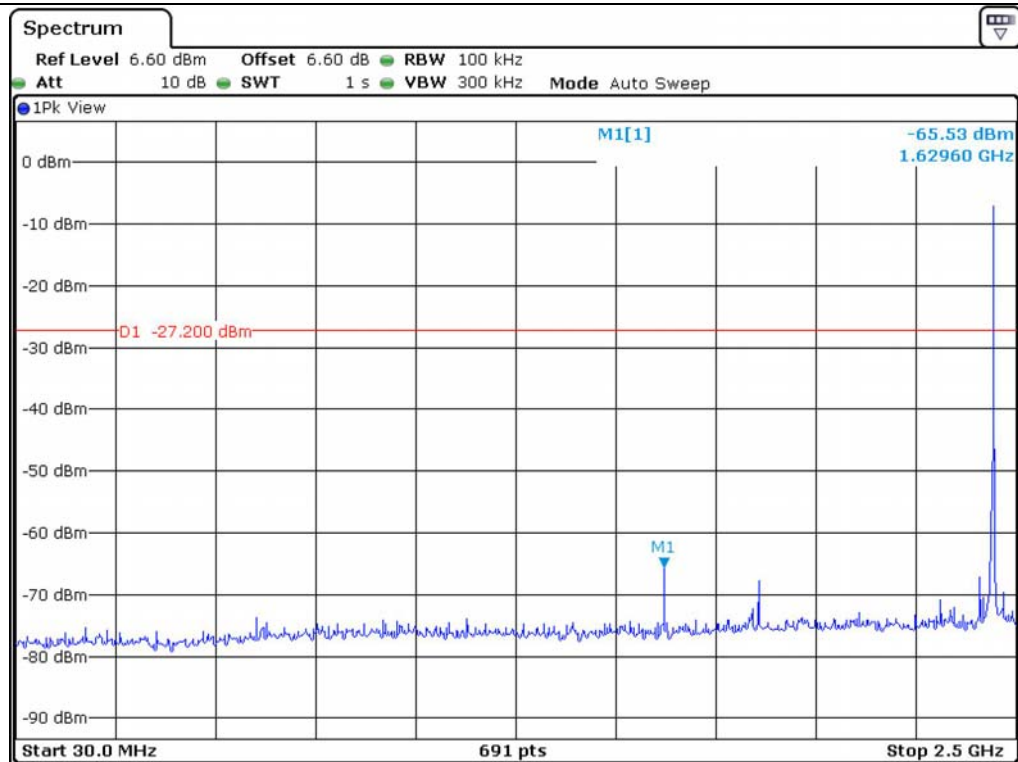




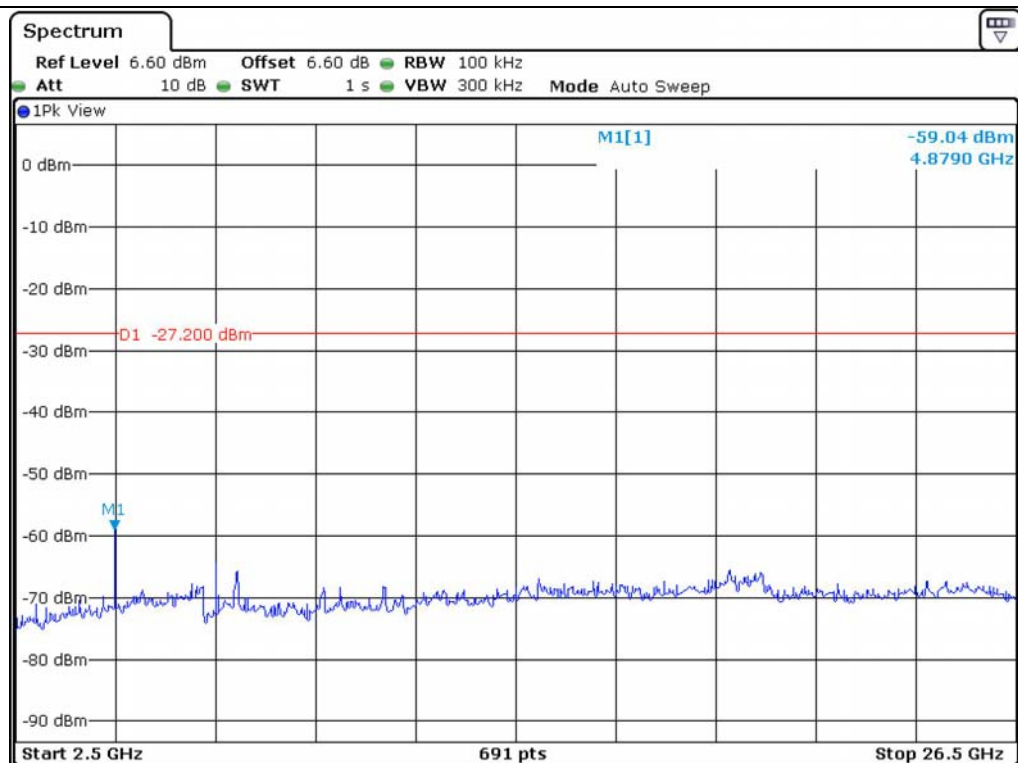
Low Channel



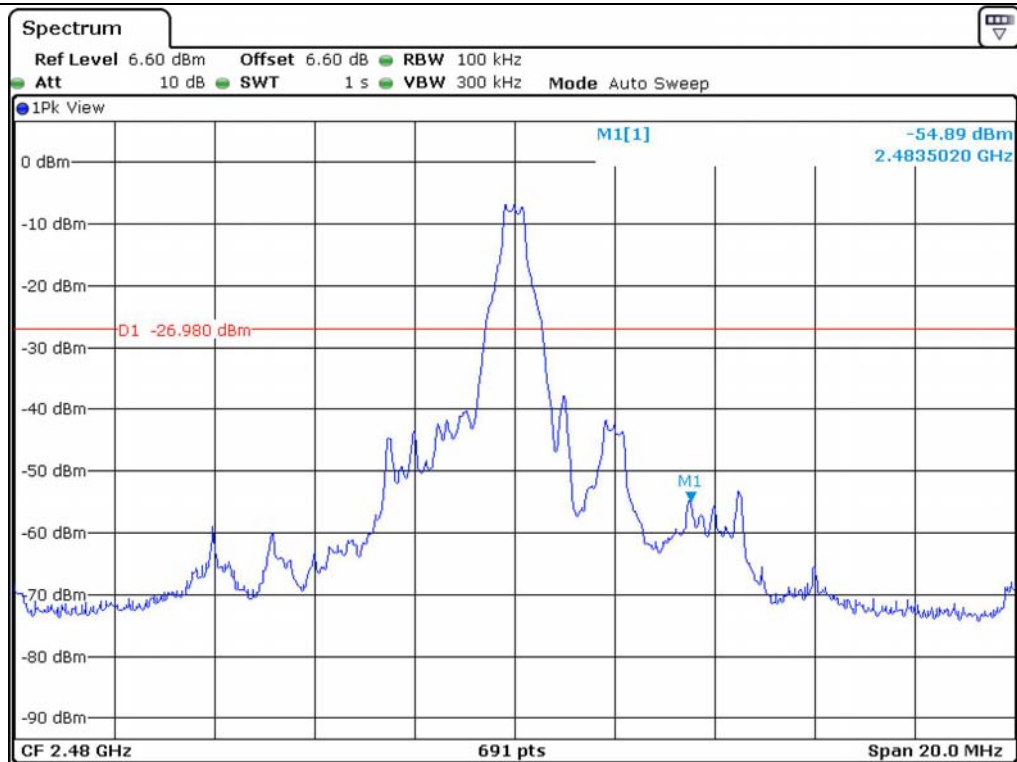
Low Channel



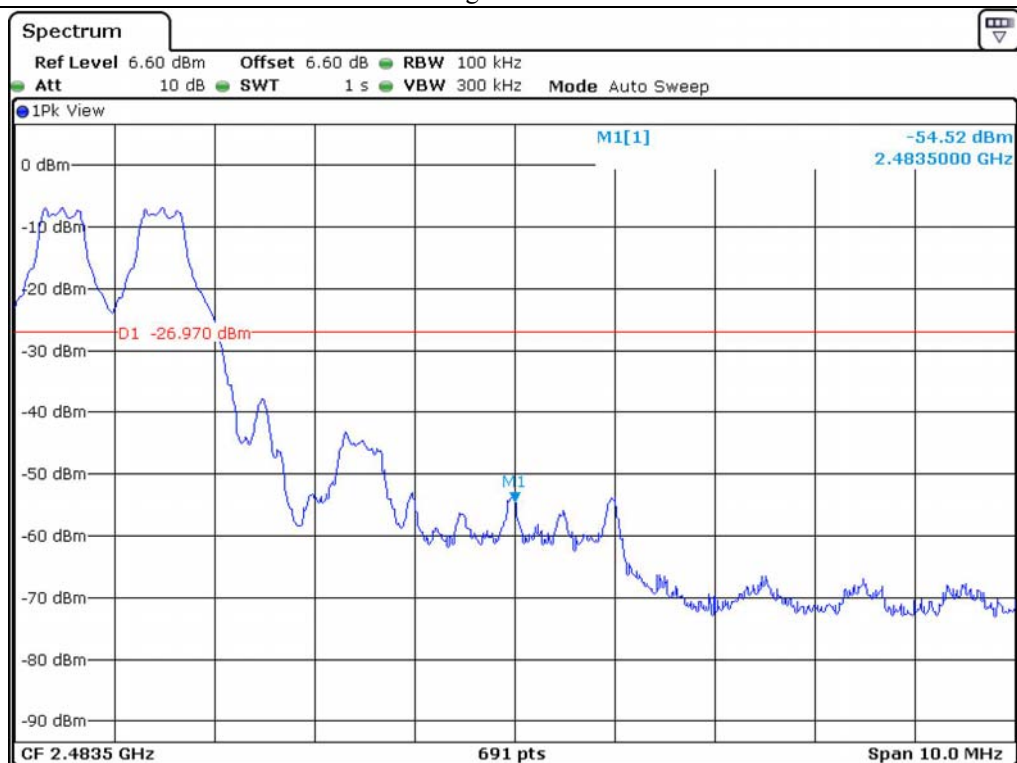
Middle Channel



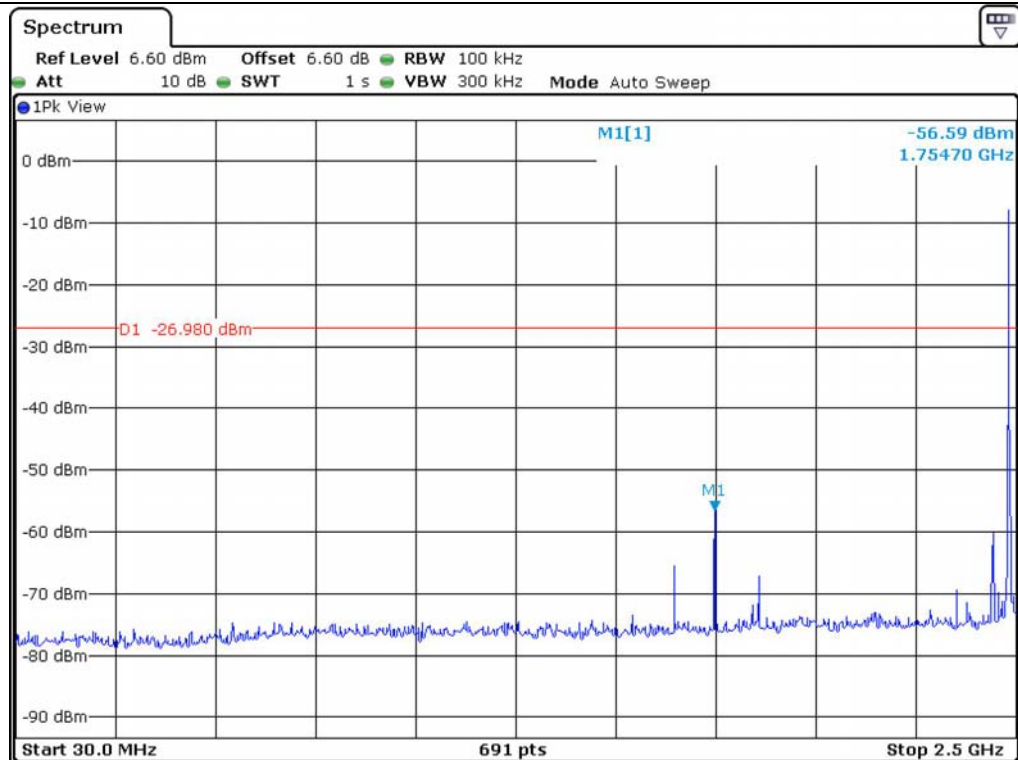
Middle Channel



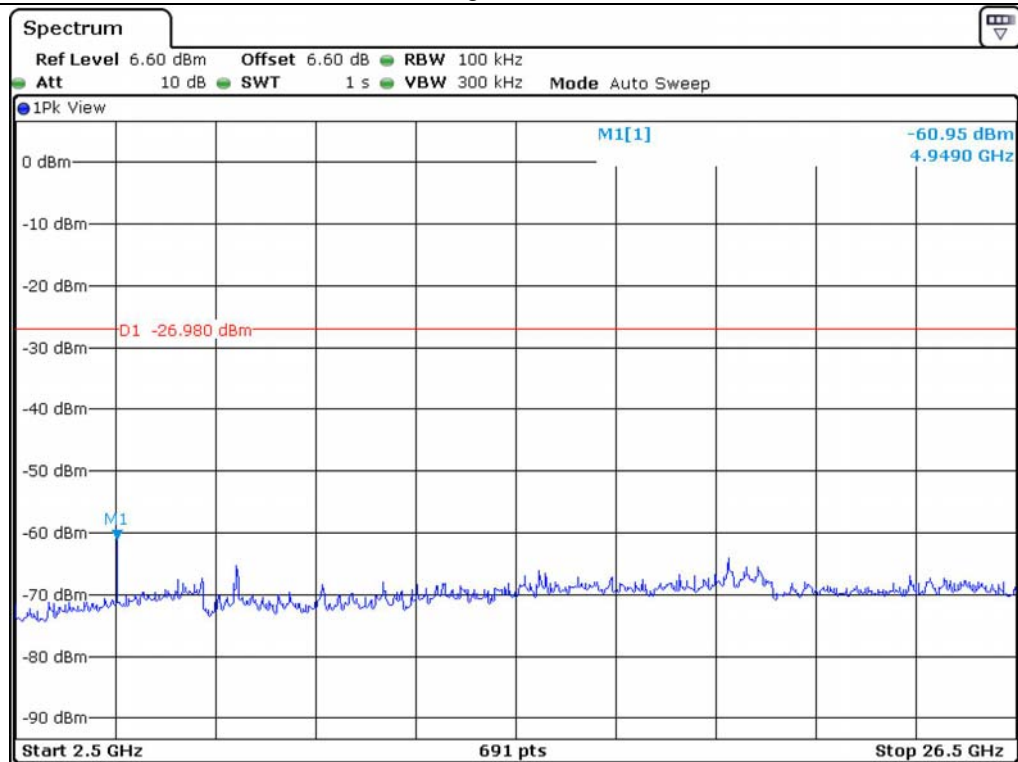
High Channel



High Channel



High Channel



High Channel

9.5.2 Test data for radiated emission

9.5.2.1 Radiated Emission which fall in the Restricted Band

- . Test Date : September 30, 2013
- . 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 : Low / 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									
2 390.00	57.89	Peak	H	27.00	7.50	42.80	49.59	74.00	24.41
	40.26	Average	H				31.96	54.00	22.04
	52.75	Peak	V				44.45	74.00	29.55
	39.30	Average	V				31.00	54.00	23.00
Test Data for High Channel									
2 483.97	49.54	Peak	H	27.40	7.70	42.90	41.74	74.00	32.26
	37.51	Average	H				29.71	54.00	24.29
2 484.34	50.19	Peak	V				42.39	74.00	31.61
	36.06	Average	V				28.26	54.00	25.74

Tabulated test data for Restricted Band

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



Tested by: Hong-Kyu, Lee/ Engineer

9.5.2.2 Spurious & Harmonic Radiated Emission above 1 GHz

- Test Date : September 30, 2013
- 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 ~ 25 GHz
- Measurement distance : 3 m
- 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									
2 402.00	95.85	Peak	H	27.00	7.50	42.80	87.55	-	87.55
	90.95	Peak	V				82.65	-	82.65
4 804.00*	57.05	Peak	H	30.60	11.10	42.50	56.25	74.00	17.75
	43.41	Average	H				42.61	54.00	11.39
	51.68	Peak	V				50.88	74.00	23.12
	39.91	Average	V				39.11	54.00	14.89
Test Data for Middle Channel									
2 441.00	94.56	Peak	H	27.20	7.60	42.80	86.56	-	86.56
	89.78	Peak	V				81.78	-	81.78
4 882.00*	56.74	Peak	H	30.70	11.20	42.50	56.14	74.00	17.86
	43.08	Average	H				42.48	54.00	11.52
	51.11	Peak	V				50.51	74.00	23.49
	39.27	Average	V				38.67	54.00	15.33

Tabulated test data for Restricted Band

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

-Continued

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 High Channel									
2 480.00	94.14	Peak	H	27.40	7.70	42.90	86.34	-	86.34
	89.08	Peak	V				81.28	-	81.28
4 960.00*	56.21	Peak	H	30.80	11.30	42.50	55.81	74.00	18.19
	42.45	Average	H				42.05	54.00	11.95
	50.78	Peak	V				50.38	74.00	23.62
	38.82	Average	V				38.42	54.00	15.58

Tabulated test data for Restricted Band

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



Tested by: Hong-Kyu, Lee/ Engineer

9.5.2.3 Spurious Radiated Emission 30 MHz ~ 1 000 MHz

Humidity Level : 45 % R.H.

Temperature: 26 °C

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

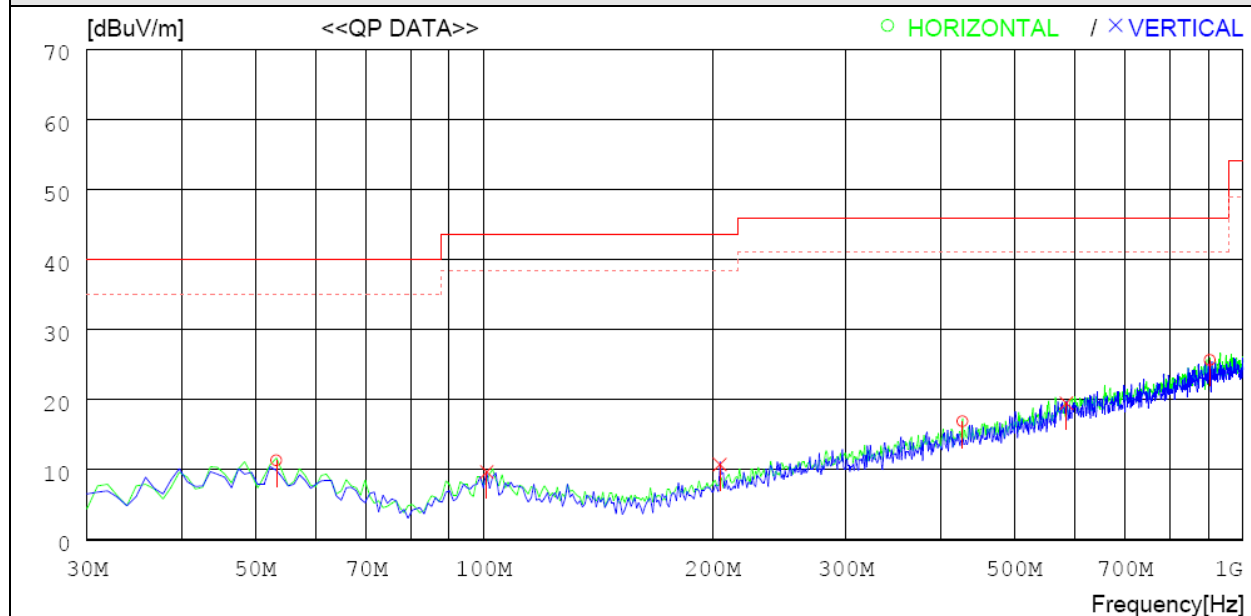
EUT : Single Modular Transmitter

Date: September 30, 2013

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

Operating condition : Low Channel

Graphical representation of Radiated Emission



Tabulated Results for Radiated Emission

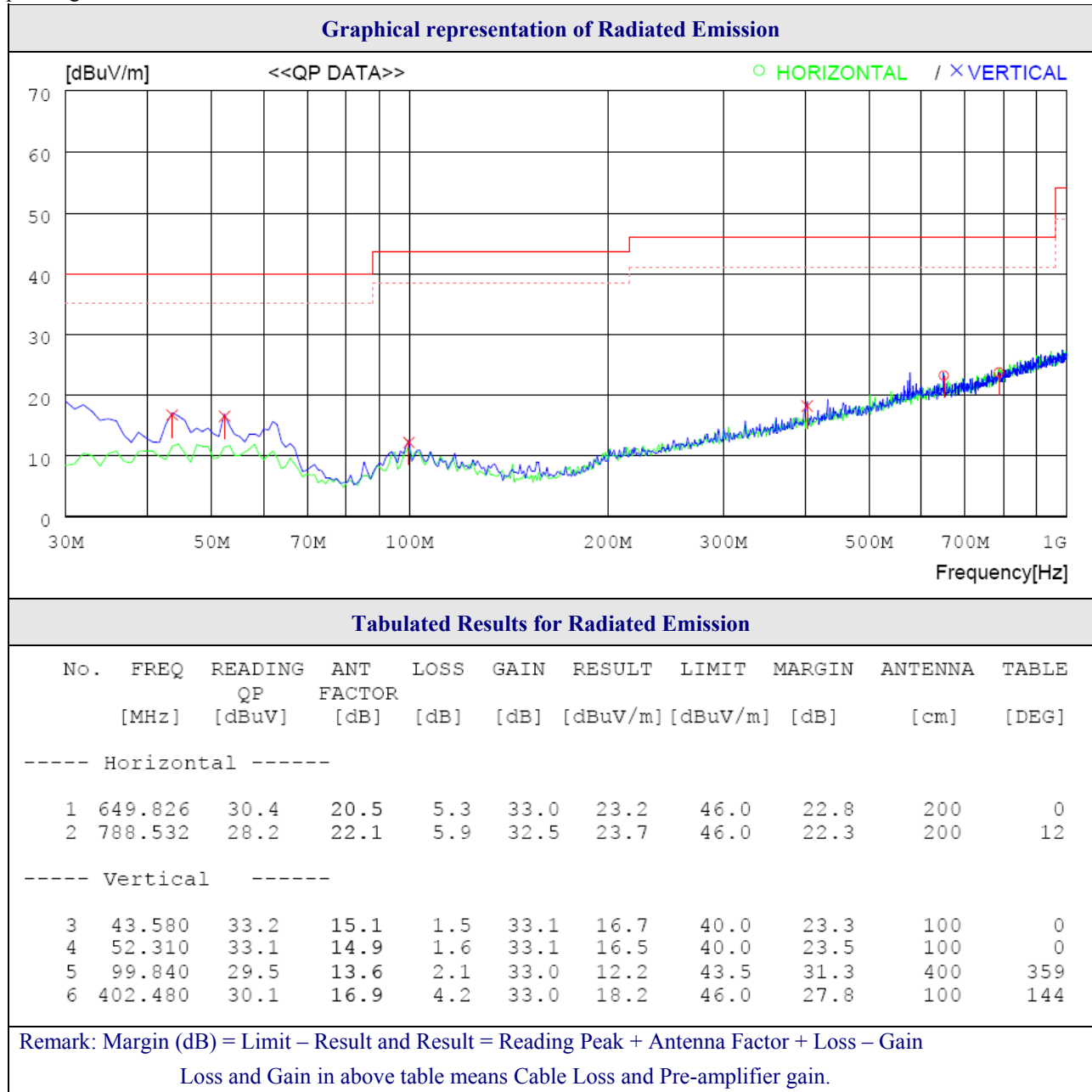
No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	53.280	28.9	13.7	1.8	33.1	11.3	40.0	28.7	100	334
2	426.731	28.8	16.3	4.8	33.0	16.9	46.0	29.1	100	218
3	904.929	28.3	22.4	7.0	32.1	25.6	46.0	20.4	100	218
----- Vertical -----										
4	100.810	28.1	12.2	2.4	33.0	9.7	43.5	33.8	100	342
5	204.600	29.5	10.9	3.3	33.0	10.7	43.5	32.8	100	358
6	584.838	27.9	19.1	5.6	33.1	19.5	46.0	26.5	100	358

Remark: Margin (dB) = Limit – Result and Result = Reading Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Tested by: Hong-Kyu, Lee/ Engineer

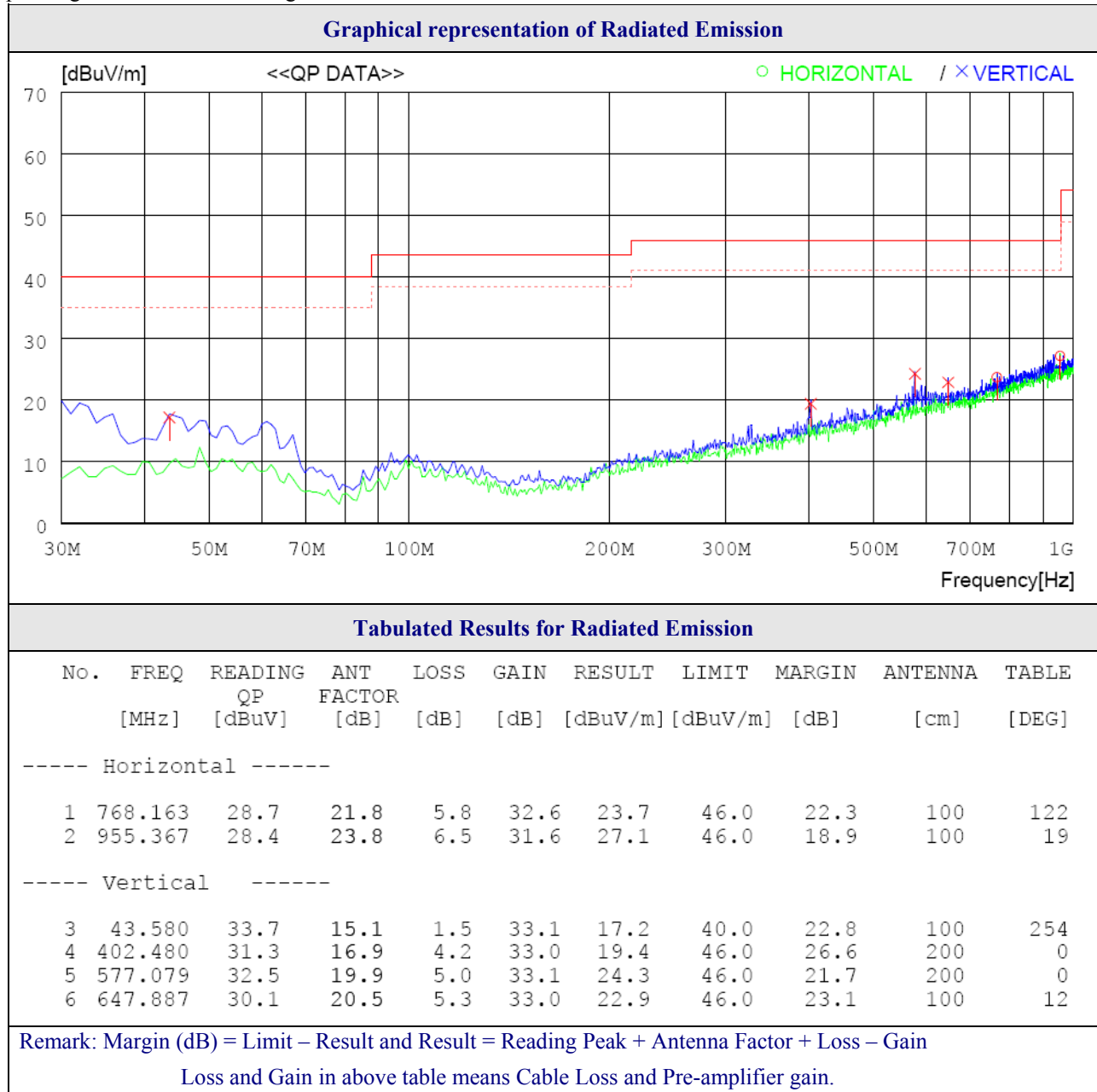
Operating condition : Middle Channel



01 2024

Tested by: Hong-Kyu, Lee/ Engineer

Operating condition : High Channel



01 30 21

Tested by: Hong-Kyu, Lee/ Engineer

9.5.2.4 Test Data for Below 30 MHz

Humidity Level : 45 % R.H. Temperature: 26 °C
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
Result : PASSED

EUT : Single Modular Transmitter Date: September 30, 2013
Detector : CISPR Quasi-Peak (Resolution Bandwidth: 9 kHz)

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

9.5.2.5 Test data for above 1 GHz

Humidity Level : 45 % R.H. Temperature: 26 °C
Resolution bandwidth : 1 MHz for Peak and Average Mode
Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
Frequency range : 1 GHz ~ 26.5 GHz
Measurement distance : 3 m
Result : PASSED

EUT : Single Modular Transmitter Date: September 30, 2013
Detector : CISPR Quasi-Peak (Resolution Bandwidth: 9 kHz)

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



Tested by: Hong-Kyu, Lee/ Engineer

10. CONDUCTED EMISSION TEST

10.1 Operating environment

Temperature : (22 ~ 23) °C
Relative humidity : (42 ~ 43) % R.H.

10.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Jul. 02, 2013 (1Y)
■ -	NSLK 8128	Schwarzbeck	LISN	8128-216	Jun. 07, 2013 (1Y)
□ -	3825/2	EMCO	LISN	9109-1867	May 20, 2013 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data

- Test Date : September 27, 2013
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Test Result : Passed

Frequency (MHz)	Line	Peak (dBμV)		Margin (dB)
		Emission level	Q.P Limits	
0.17	H	35.61	64.96	29.35
0.40	H	24.48	57.96	33.48
18.55	N	31.93	60.00	28.07
18.82	H	30.68	60.00	29.32
25.60	N	46.65	60.00	13.35
26.02	H	45.88	60.00	14.12
Frequency (MHz)	Line	Average (dBμV)		Margin (dB)
		Emission level	Limits	
0.40	N	12.56	47.96	35.40
18.82	H	13.48	50.00	36.52
25.60	N	32.24	50.00	17.76
26.02	H	31.91	50.00	18.09

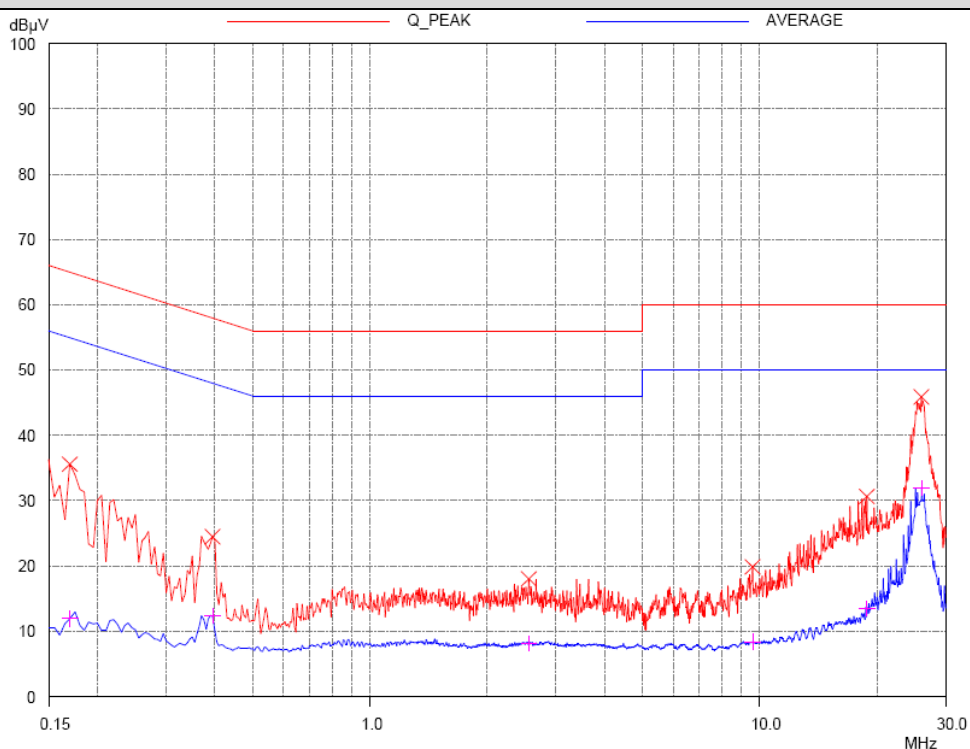
Line Conducted Emissions Tabulated Data

Remark : “H”: Hot Line, “N”: Neutral Line

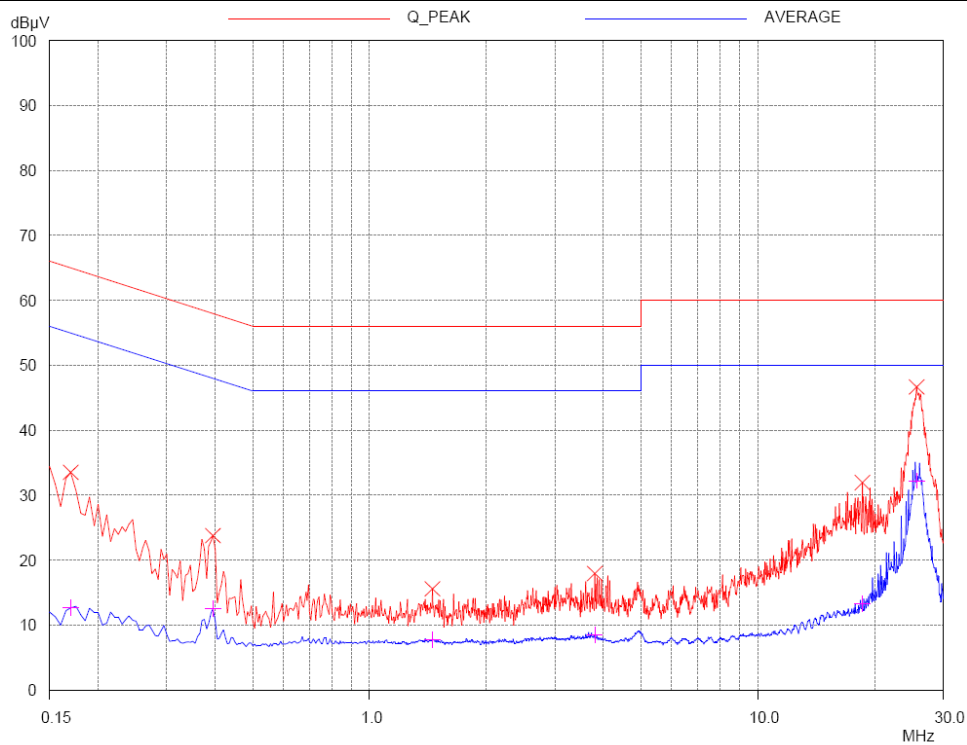


Tested by: Hong-Kyu, Lee/ Engineer

Graphical representation of Conducted Emission



HOT LINE



NEUTRAL LINE

11. RADIO FREQUENCY EXPOSURE

11.1 RF Exposure Limit

According to the FCC rule §1.1310, the limit for General Population/Uncontrolled exposure is 1 mW/cm² for the device operating 1 500 ~ 100 000 MHz.

11.2 EUT Description

Kind of EUT	Main Control Unit
Operating Frequency Band	<input type="checkbox"/> Wireless Microphone: 494.000 MHz ~ 501.000 MHz and 498.200 MHz ~ 505.200 MHz <input type="checkbox"/> WLAN: 2 412 MHz ~ 2 462 MHz <input type="checkbox"/> WLAN: 5 180 MHz ~ 5 320 MHz / 5 500 MHz ~ 5 700 MHz <input type="checkbox"/> WLAN: 5 745 MHz ~ 5 825 MHz <input checked="" type="checkbox"/> Bluetooth: 2 402 MHz ~ 2 480 MHz <input type="checkbox"/> Zigbee: 2 465 MHz
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others
Max. Output Power	-6.92 dBm
Used Antenna	Chip Antenna
Used Antenna Gain	3.5 dBi
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A

11.3 Test Result

According to the procedure, KDB 447498 D01, the standalone SAR test exclusion threshold is

$$[(\text{Max. Power of channel, including tune-up tolerance, mW})/(\text{Min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] < 3$$

$$= [(0.203/5)] \times \sqrt{2.480} = 0.064$$

Conclusion: The SAR test exclusion threshold is less than 3, so the device meets the RF Exposure Requirement and excluded SAR Test.