

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

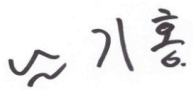
Test Report No. : E132R-034
AGR No. : A12NA-146
Applicant : Gentherm Inc.
Address : 21680 Haggerty Rd., Northville, MI 48167
Manufacturer : Season Components Co., Ltd.
Address : No. 5, Jun Da Zhong Lu, DongKeng, Dongguan, Guangdong 523451 China
Type of Equipment : Main Control Unit
FCC ID. : QYA500-2019
Model Name : MCU2.0
Serial number : N/A
Total page of Report : 28 pages (including this page)
Date of Incoming : January 14, 2013
Date of issue : February 20, 2013

SUMMARY

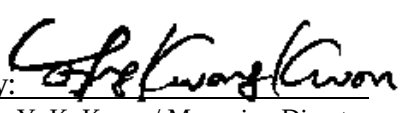
The equipment complies with the regulation; **FCC Part 15 Subpart C Section 15.247.**

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: 

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EMC/RF Center
ONETECH Corp.

Reviewed by: 

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E132R-034	February 20, 2013	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : Gentherm Inc.
Address : 21680 Haggerty Rd., Northville, MI 48167
Contact Person : Mike Chen / Sales Officer
Telephone No. : +86-769-83388030
FCC ID : QYA500-2019
Model Name : MCU2.0
Serial Number : N/A
Date : February 20, 2013

Equipment Class	<i>DTS – DIGITAL TRNSMISSION SYSTEM</i>
Kind of Equipment	Main Control Unit
This Report Concerns	Original Grant
Measurement Procedures	ANSI C63.10;2009, KDB 558074
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, 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) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / 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 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.247 (i)	Radio Frequency Exposure Level	Met the Limit / PASS
15.209	Radiated Emission Limits	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

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4: 2009. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The open area test site and conducted measurement facilities are located on 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.

3. GENERAL INFORMATION

3.1 Product Description

The Gentherm Inc., Model MCU2.0 (referred to as the EUT in this report) is a Main Control Unit for the climate control sleep system which is consisting of the EUT and a remote controller. The associated transceiver, remote controller has different ID: QYA500-1272 and shall be issued another test report for getting Certification. The EUT shall be use Zigbee technology. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Main Control Unit
Temperature Range	-10 °C ~ +50 °C
Operating Frequency	2 465 MHz
RF Output Power	-18.48 dBm
Number of Channel	1 Channel
Data Rate	250 kbps
Modulation Type	O-QPSK
Antenna Type	Inserted into the main board(PCB Pattern Antenna)
USED RF CHIP	Marker: Microchip Technology Inc. , Model Name: MRF24J40
Antenna Gain	2.09 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	8MHz, 20 MHz, 32.768 MHz
External Connector	Air flow

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	Season Components Co., Ltd.	500-1239-A	N/A
Power Board	N/A	UP-360-16	N/A
LCD Board	Season Components Co., Ltd.	WE-A	N/A

5.2 Peripheral equipment

-. None

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 465 MHz to get a maximum emission levels from the EUT.

5.4 Configuration of Test System

Line Conducted Test: 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 C63.4: 2009 7.2.3 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.4: 2009 8.3.1.1 and 13.1.4.1 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter 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 antenna of the EUT is a pattern antenna on the main board in the EUT, 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)
Normal operating mode	
TX 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)
Normal operating mode	
TX mode	X

7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 23 °C
Relative humidity : 57 % 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 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	R/S	Spectrum Analyzer	101372	May 31, 2012

All test equipment used is calibrated on a regular basis.

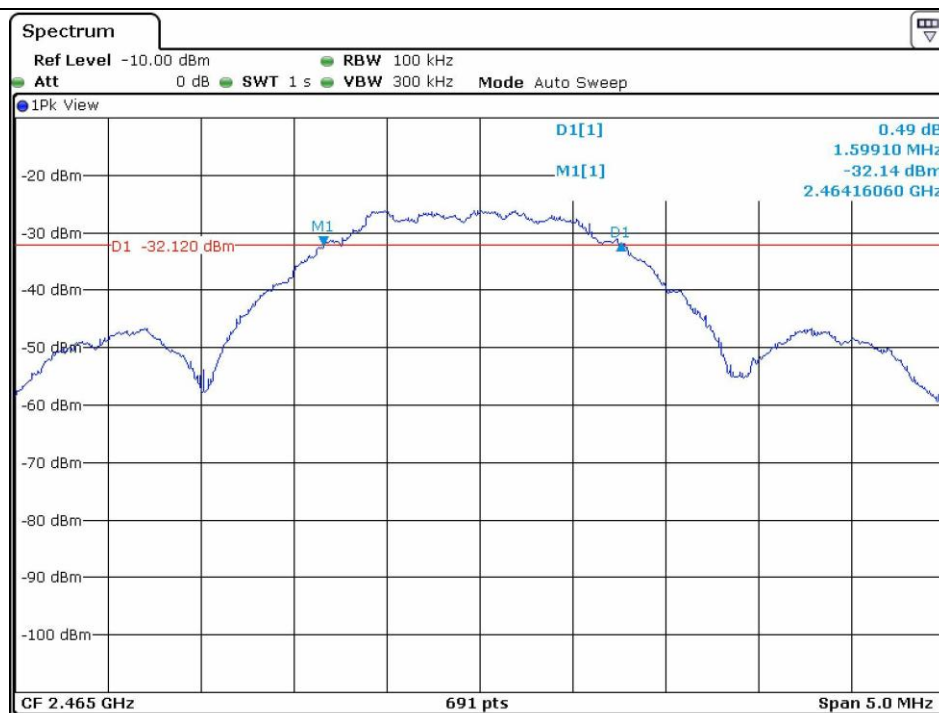
7.4 Test data

- Test Date : February 14, 2013
- Test Result : Pass

FREQUENCY(MHz)	MEASURED VLAUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
2 465	1 599.10	500	-1 099.10

기홍

Tested by: Ki-Hong, Nam / Senior Engineer



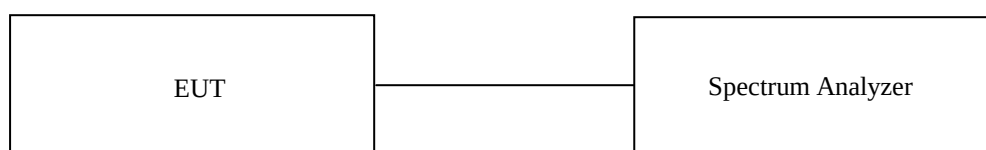
8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 23 °C
Relative humidity : 57 % 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 spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99 % bandwidth. 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.
■ - FSV30	R/S	Spectrum Analyzer	101372	May 31, 2012

All test equipment used is calibrated on a regular basis.

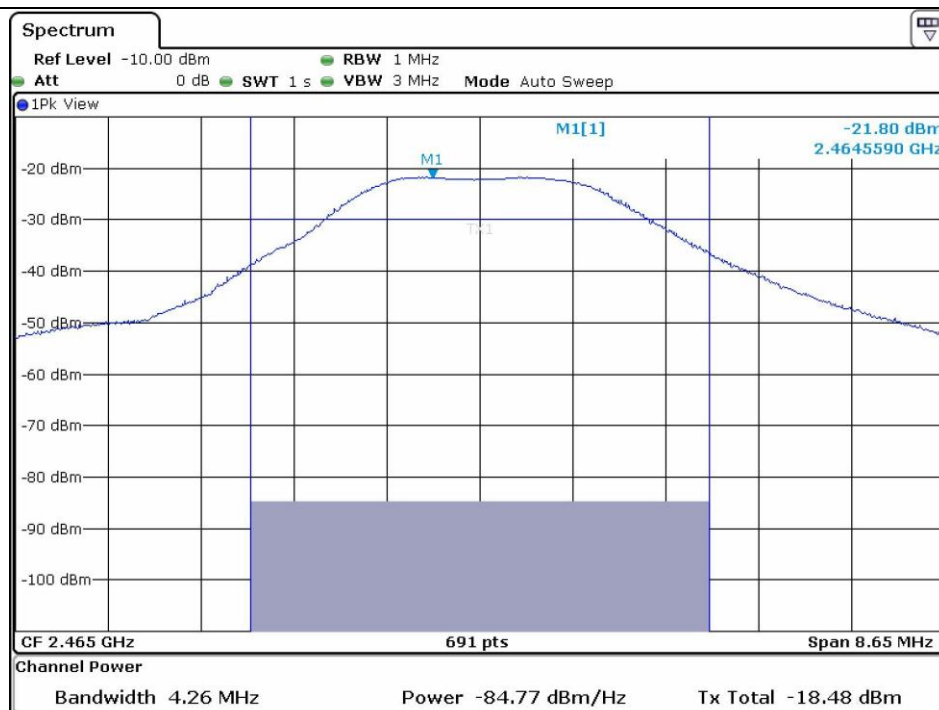
8.4 Test data

-. Test Date : February 14, 2013
-. Test Result : Pass

FREQUENCY (MHz)	99 % Occupied Bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
2 465	4.26	-18.48	30	-48.48

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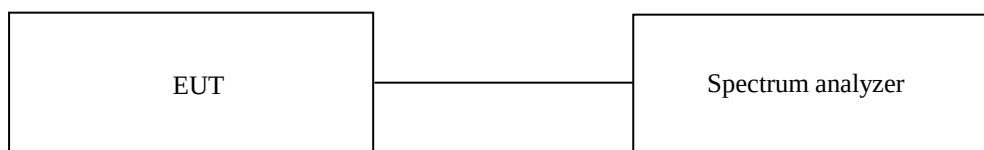
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 21 °C
Relative humidity : 50 % 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.

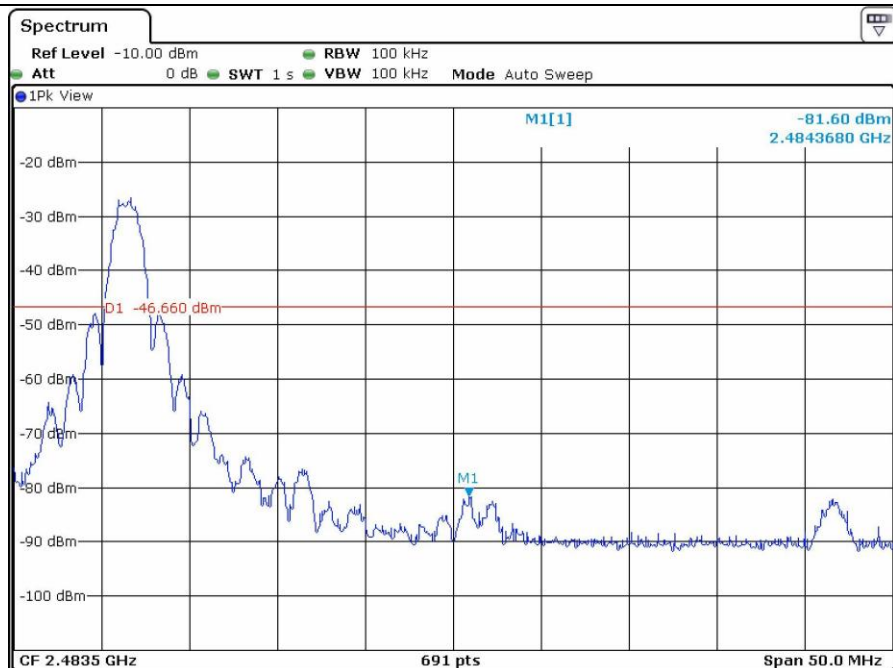
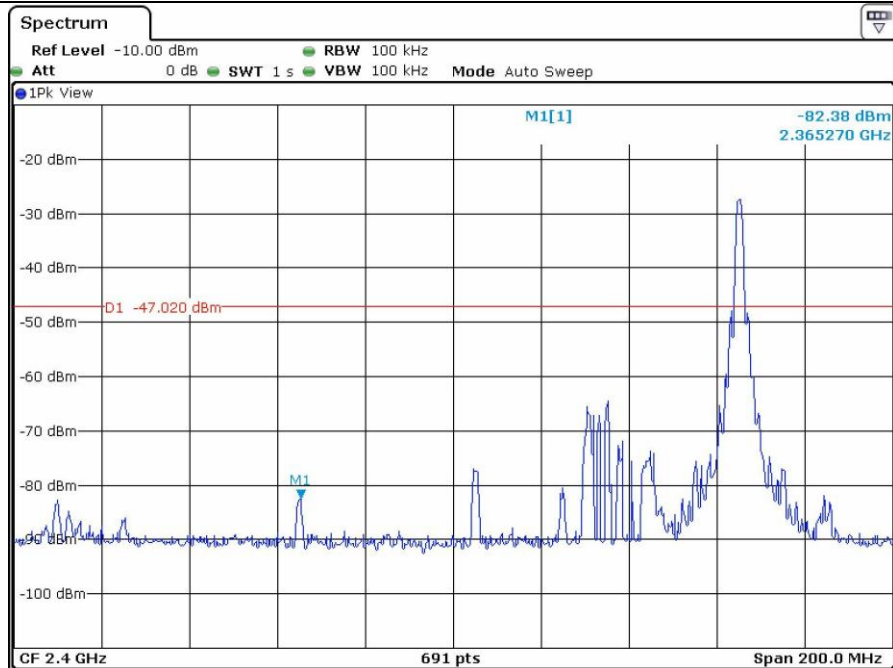
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal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

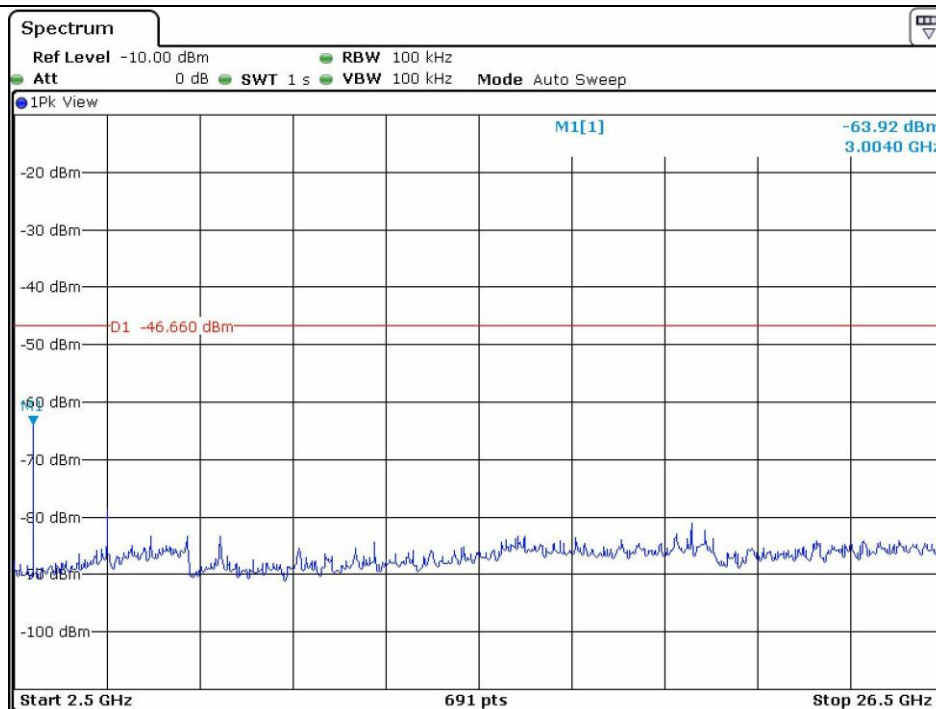
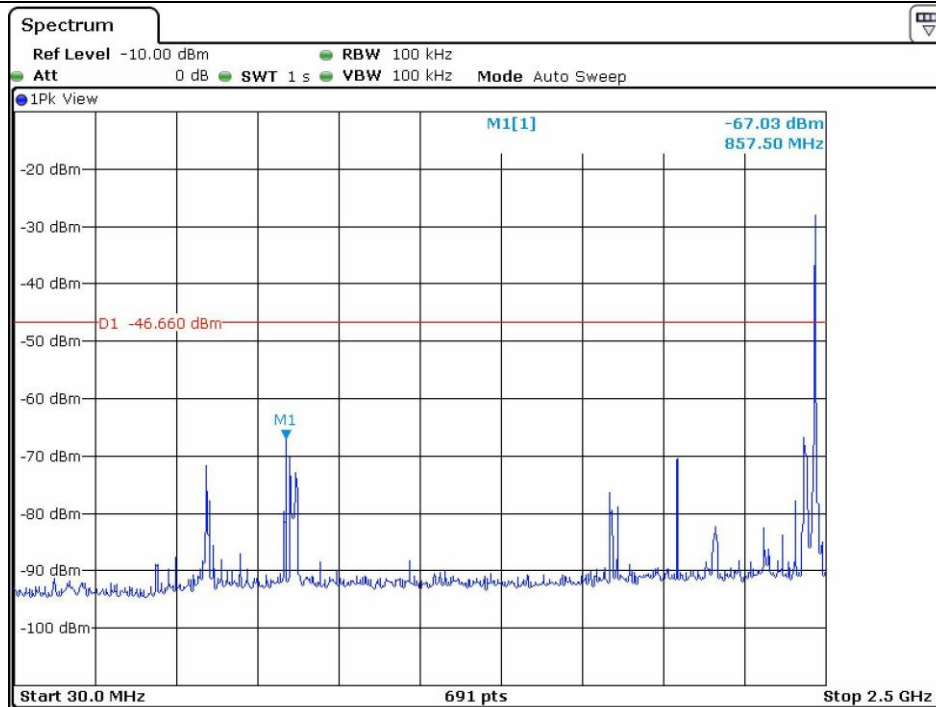
9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 04, 2012
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Sep.11, 2012 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Oct. 11, 2012(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 31, 2012(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	VULB9163-255	Apr. 24, 2012(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	Jun. 17, 2013 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jun. 17, 2013 (2Y)

All test equipment used is calibrated on a regular basis.

9.5 Test data for conducted emission





9.6 Test data for radiated emission

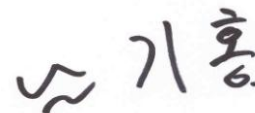
9.6.1 Radiated Emission which fall in the Restricted Band

- Test Date : February 18, 2013
- 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

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for High Channel								
2 390.00	39.25	Peak	H	27.05	3.14	26.34	73.98	-47.64
	29.19	Average	H			16.28	53.98	-37.70
2 390.00	38.80	Peak	V			25.89	73.98	-48.09
	29.12	Average	V			16.21	53.98	-37.77
Test Data for High Channel								
2 483.50	39.21	Peak	H	27.31	3.17	26.59	73.98	-47.39
	28.28	Average	H			15.66	53.98	-38.32
2 483.50	38.41	Peak	V			25.79	73.98	-48.19
	28.34	Average	V			15.72	53.98	-38.26

Tabulated test data for Restricted Band

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



Tested by: Ki-Hong, Nam / Senior Engineer

9.6.2 Spurious & Harmonic Radiated Emission

- . Test Date : February 18, 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 ~ 26.5 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 High Channel									
2 465.00	79.50	Peak	H	27.28	5.06	43.10	68.74	-	-
	68.67	Average	H				57.91	-	-
	76.25	Peak	V				65.49	-	-
	66.17	Average	V				55.41	-	-
4 930.00	42.33	Peak	H	31.30	6.97	42.80	37.80	73.98	-36.18
	31.50	Average	H				26.97	53.98	-27.01
	42.67	Peak	V				38.14	73.98	-35.84
	31.83	Average	V				27.30	53.98	-26.68

Tabulated test data for Restricted Band

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

10. PEAK POWER SPECTRUL DENSITY

10.1 Operating environment

Temperature : 22 °C
Relative humidity : 55 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	R/S	Spectrum Analyzer	101372	May 31, 2012

All test equipment used is calibrated on a regular basis.

10.4 Test data

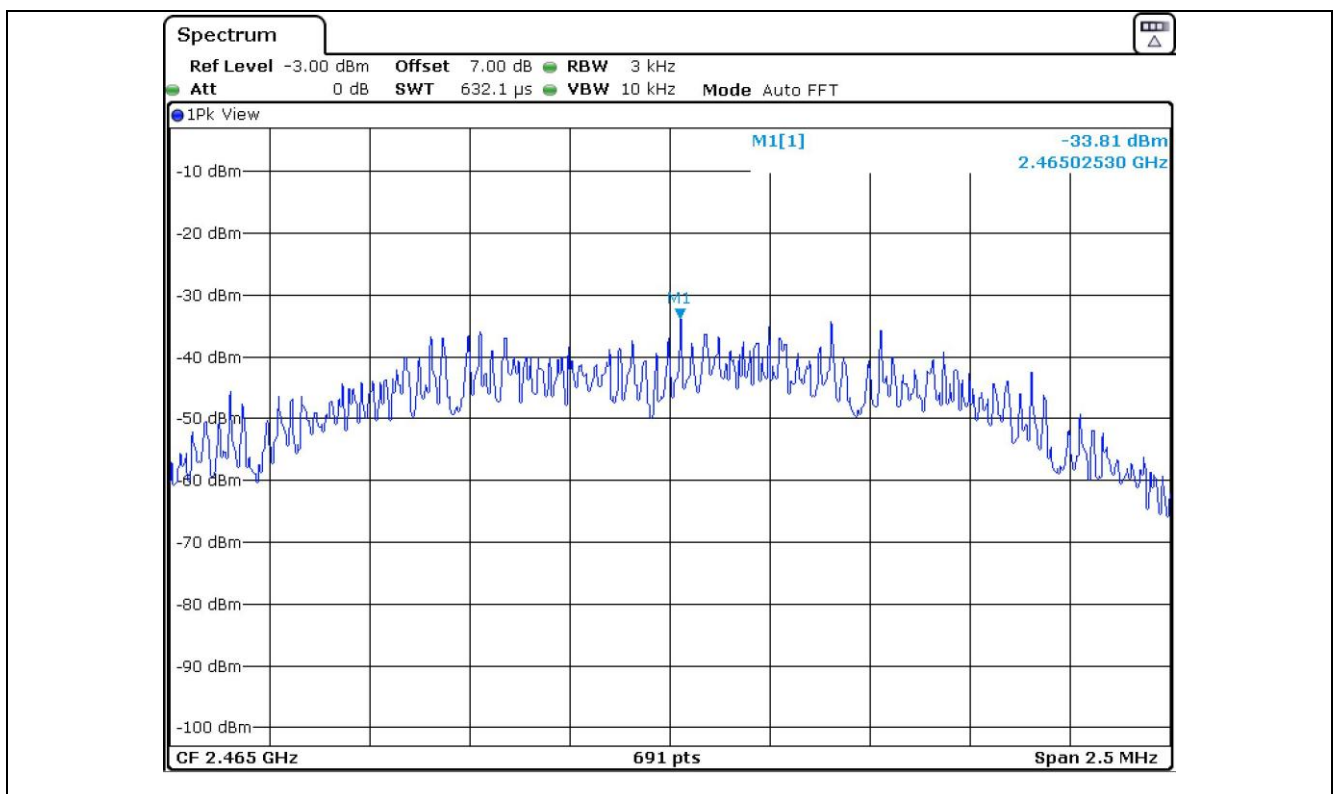
-. Test Date : February 14, 2013

-. Test Result : Pass

FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
2 465	-33.81	8.00	-41.81

기홍

Tested by: Ki-Hong, Nam / Senior Engineer



11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 21 °C
Relative humidity : 51 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m, open-field test site. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 1 000 MHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

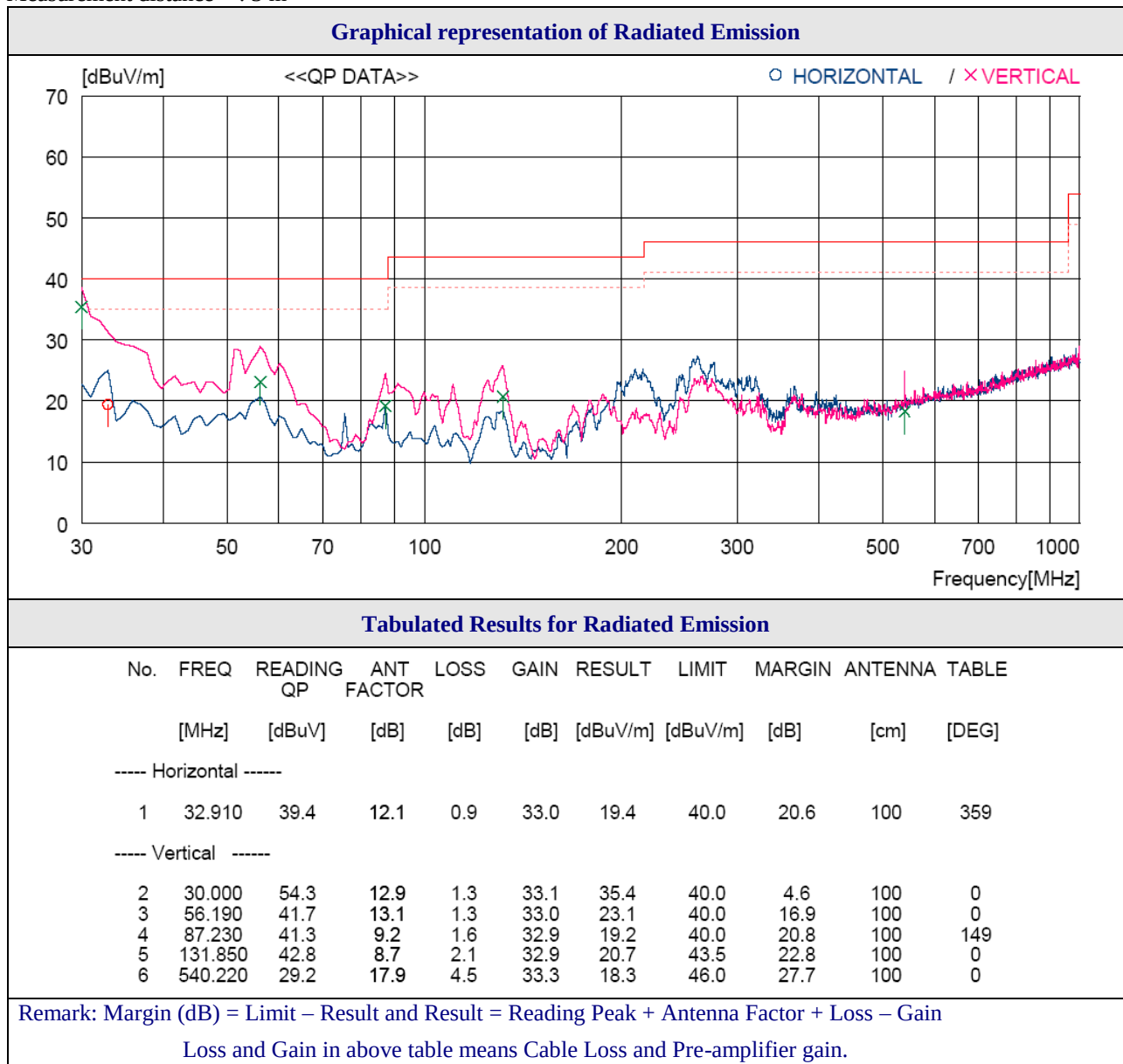
11.3 Test equipment used

	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	Sep.11, 2012 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Oct. 11, 2012(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 31, 2012(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	VULB9163-255	Apr. 24, 2012(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	Jun. 17, 2013 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jun. 17, 2013 (2Y)
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	889 285 / 26	Dec. 11, 2012 (2Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data for 30 MHz ~ 1 000 MHz

- Test Date : February 18, 2013
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m



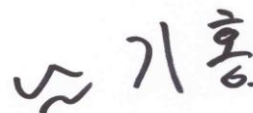
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Tested by: Ki-Hong, Nam / Senior Engineer

11.5 Test data for Below 30 MHz

- . Test Date : February 18, 2013
- . 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

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

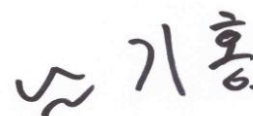


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11.6 Test data for above 1 GHz

- . Test Date : February 18, 2013
- . 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

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: Ki-Hong, Nam / Senior Engineer

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 21 °C
Relative humidity : 45 % R.H.

12.2 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.

12.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	ESiB26	Rohde & Schwarz	EMI Test Receiver	100296	Apr. 13, 2012
■ -	NSLK 8126	Schwarzbeck	AMN	8126-404	Jul. 11, 2012
□ -	3825/2	EMCO	AMN	9109-1867	May 30, 2012

All test equipment used is calibrated on a regular basis.

12.4 Test data

- . Test Date : February 18, 2013
-. Resolution bandwidth : 9 kHz
-. Frequency range : 0.15 MHz ~ 30 MHz

Frequency (MHz)	Line	Quasi-Peak (dBμV)		Margin (dB)
		Emission level	Q.P Limits	
0.15	H	41.04	66.00	24.96
0.20	H	46.71	63.61	16.90
12.37	H	32.68	60.00	27.32
15.40	N	31.59	60.00	28.41
25.65	N	46.90	60.00	13.10
25.95	H	49.23	60.00	10.77
Frequency (MHz)	Line	Average (dBμV)		Margin (dB)
		Emission level	Limits	
0.20	H	42.89	53.61	10.72
12.37	H	28.04	50.00	21.96
25.65	N	35.08	50.00	14.92
25.95	H	37.35	50.00	12.65

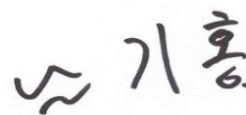
Line Conducted Emissions Tabulated Data

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

See next page for an overview sweep performed with quasi-peak and average detector modes.

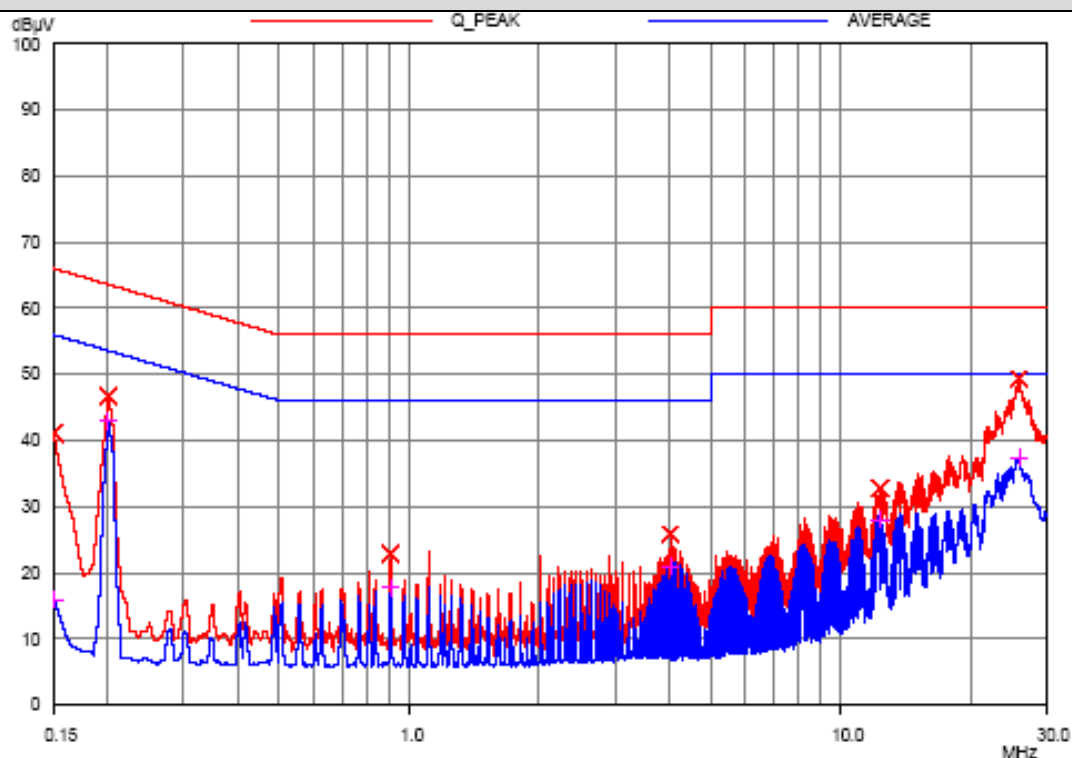
Margin (dB) = Limits (dBμV) – Emission Level (dBμV)

Emission Level = Receiver reading + Cable loss + Insertion loss of AMN

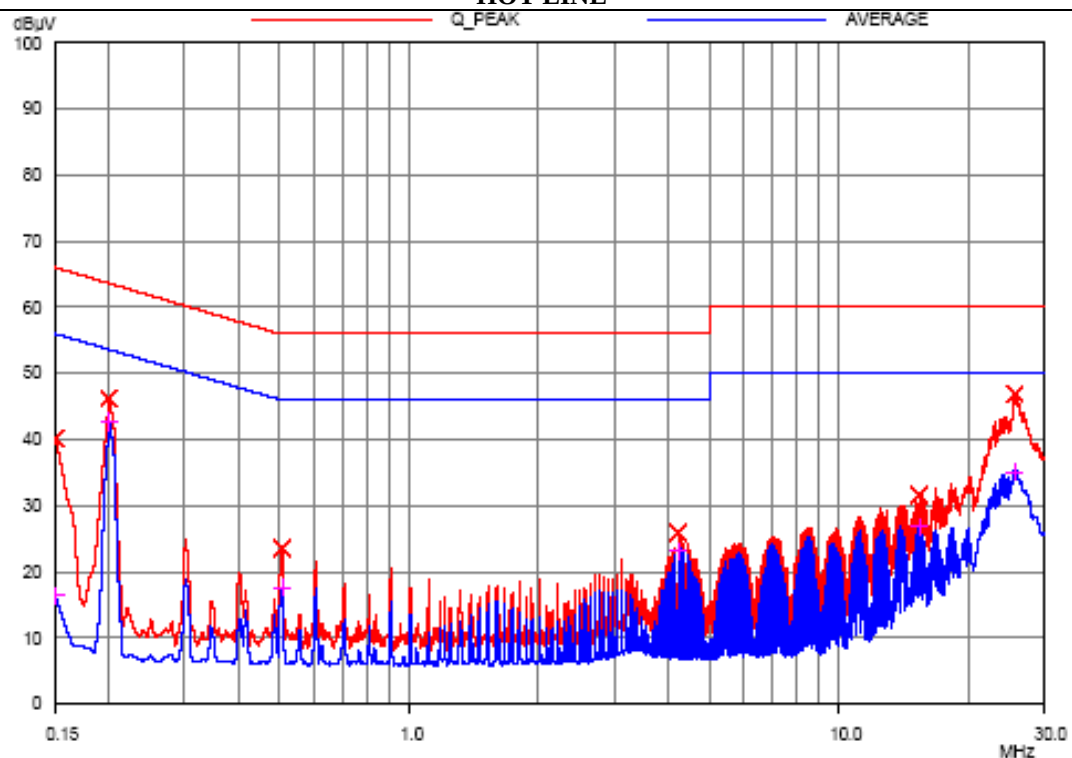


Tested by: Ki-Hong, Nam / Senior Engineer

Graphical representation of Conducted Emission



HOT LINE



NEUTRAL LINE

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EMC-003 (Rev.2)

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13. RADIO FREQUENCY EXPOSURE

13.1 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.

13.2 EUT Description

Kind of EUT	Main Control Unit
Operating Frequency Band	☐ Wireless Microphone: 494.000 MHz ~ 501.000 MHz and 498.200 MHz ~ 505.200 MHz ☐ WLAN: 2 412 MHz ~ 2 462 MHz ☐ WLAN: 5 180 MHz ~ 5 320 MHz / 5 500 MHz ~ 5 700 MHz ☐ WLAN: 5 745 MHz ~ 5 825 MHz ☐ Bluetooth: 2 402 MHz ~ 2 480 MHz ☒ Zigbee: 2 465 MHz
Device Category	☒ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ☐ Others
Max. Output Power	-18.48 dBm (0.014 mW)
Used Antenna	PCB Antenna
Used Antenna Gain	2.09 dBi
Exposure Evaluation Applied	☒ MPE ☐ SAR ☐ N/A

13.3 Test Result

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

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

$$= [(0.014/1)] \times \sqrt{2.465} = 0.021$$

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