KOSTEC Co., Ltd.

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TEST REPORT

Report No: KST-FCR-090004

Applicant	Name	ID Fone Co.,Ltd.
	Address	7F Ace Techno Tower 5th B/D, 197-22 Guro-Dong, Guro-Gu Seoul, 152-766 South Korea
Manufacturer	Name	ID Fone Co.,Ltd.
	Address	7F Ace Techno Tower 5th B/D, 197-22 Guro-Dong, Guro-Gu Seoul, 152-766 South Korea
Equipment	Name	Voice Link Plus
	Model No	MV-VLP2-2.4TR
	Usage	Wireless Voice Transmitter
	FCC ID	PJ4VLP2
	CANADA IC	4477A-VLP2
Test Standard	FCC CFR 47, Part 15. Subpart C-15.247. RSS-210, RSS-Gen	
Test Date(s)	2009. 05. 20 ~ 2009. 05. 23	
Issue Date	2009. 05. 25	
Test Result	Compliance	

Supplementary Information

The device bearing the brand name and FCC ID, CANADA IC specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with measurement procedures specified in ANSI C 63.4-2003.

We attest to the accuracy of data and all measurements reported herein were performed by KOSTEC Co., Ltd. and were made under Chief Engineer's supervision. We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by	Mi Young, Lee	Approved by	Gyeong Hyeon, Park
Signature		Signature	

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1. GENERAL INFORMATION

1.1 Test Facility

Test laboratory and address

KOSTEC Co., Ltd.

180-254, Annyeong-dong, Hwaseong-si, Gyeonggi-do, South Korea

The open area field test site and conducted measurement facility are used for these testing. This site at was fully described in a reports submitted to the Federal Communications Commission (FCC).

The details of these reports have been found to be in complies with the requirements of Section 2.948 of the FCC Rules on November 14, 2002. The facility also complies with the radiated and conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission (FCC) has the reports on file and KOSTEC Co., Ltd. is listed under FCC Registration No.525762. The test site has been approved by the FCC for public use and is List in the FCC Public Access Link CORES (Commission Registration System)

Registration information

KCC (Korea Communications Commission) Number : KR0041

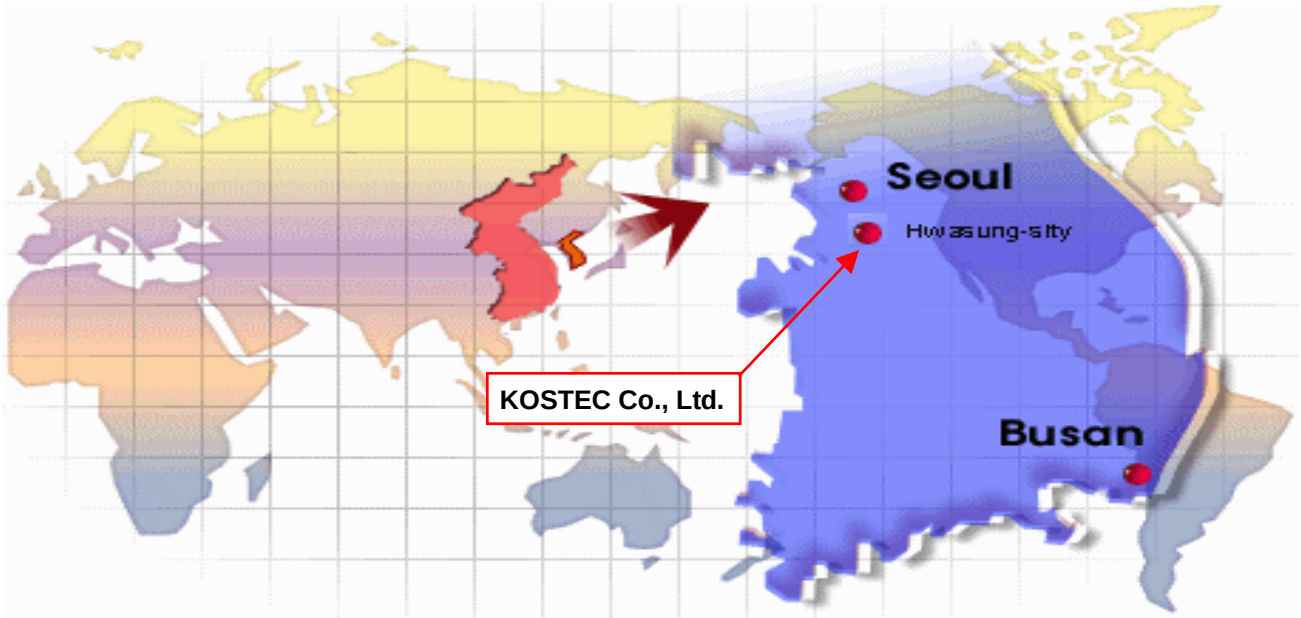
KOLAS(Korea laboratory accreditation Scheme) Number : 232

FCC Registration Number(FRN) : 525762

IC Company Number(C,N) : 8305A

VCCI Registration Number : R-1657 / C –1763

1.2 Location



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2. EQUIPMENT DESCRIPTION

The product specification described herein was declared by manufacturer. And refer to user's manual for the details.

Equipment Class	Category Ⅰ(according to RSS-Gen in Canada standard)
1) Equipment Name	Voice Link Plus
2) Model No	MV-VLP2-2.4TR
3) Usage	Wireless Voice Transmitter
4) Serial Number	None
5) Oscillation type	PLL (Phase Local Loop)
6) Data Sequence type	FHSS (Frequency Hopping Spread Spectrum)
7) ITU emission type**	1M00F1D
8) Modulation type	GFSK
9) Operated Frequency	2 401.056 MHz ~ 2 482.272 MHz
10) Max. conducted power	15 mW
11) Number of hopping channel	95 Ch
12) Communication type	Simplex
13) Microprocessor	MSP430F149
14) Weight / Dimension	135g / 45(L) mm x 24(D) mm x 60(H) mm
15) Operation temperature	- 40℃~ + 80℃
16) Power Source	3.7Vdc / 800mAH (Lithium polymer battery)
17) Antenna Description	Wire Type, Connection: Fixed, Length: 30 mm, Gain: 1.770 dBi

** it is mean maximum permitted bandwidth declared by applicant

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3. SYSTEM CONFIGURATION FOR TEST

3.1 Characteristics of equipment

This equipment is named Voice Link Plus and used to wireless voice transmitter

It is consist of internal antenna and battery , RF Module part

it is send voice to receiver and it's voice signal is loudly to speaker throughout RJ11 port which is rear back side of receiver(it is tested DoC report by our test Laboratory

The transmitter is hand type without PTT switch, and power supplied from rechargeable battery 3.7Vdc

Voice signal is translation analogue to digital by FSK modulation method

Antenna is wire type and connection is fixed to Transmitter

3.2 Used peripherals list

Description	Model No.	Serial No.	Manufacture	Remark
PC*	LS40	1402KIAW215672	LG-IBM	
Test Jig	It is between PC and RF Module chip			

* For control of S/W program in order radio test in accordance with requirement standard by FCC and IC

3.3 Product Modification

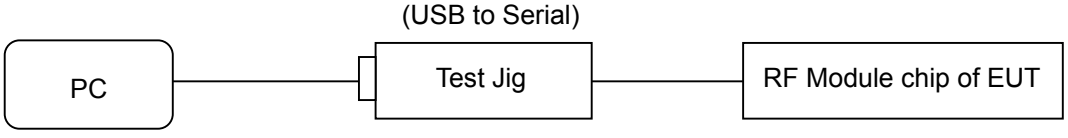
N/A

3.4 Operating Mode

All measurements were intended to emit maximum RF signal from EUT continuously.

3.5 Test Setup of EUT

The measurements were taken in continuous transmit mode using the S/W Test program.
For controlling the EUT, the test program and the test Jig were provided by the applicant.



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3.6 Table for Test condition

Test Items	Channel No	Frequency (MHz)	Operated Condition
Carrier frequency separation	0	2 401.056	Hopping on and continuous modulation setting mode
	47	2 441.664	
	94	2 482.272	
Number of hopping frequencies	0 ~ 94	2 401.056 ~ 2 482.272	Hopping on mode
Time of occupancy (Dwell Time)	47	2 441.664	Hopping on mode
Conducted peak output power	0	2 401.043	Hopping off and continuous modulation setting mode
	47	2 441.664	
	94	2 482.272	
Band-edge Compliance	0	2 401.056	Hopping off and continuous modulation setting mode
	94	2 482.272	
Spurious RF conducted emissions	-	-	Frequency band setting by required standard (FCC and IC Rules)
Spurious radiated emissions	-	-	

*above frequency channel No. for the more details, please refer to attached file(description of operating)

3.7 Table for Parameters of Test Software Setting

During testing, channel change & modulation and carrier controlling software program is provided by the Applicant.

Output power expected by the customer and is going to be fixed on the firmware of the final end product.

S/W commend value Table for Channel selecting

Frequency (MHz)	2 401.056	2 441.664	2 482.272
Channel Number	Ch 0	Ch 47	Ch 94
	Lowest channel	Middle channel	Highest channel
Channel setting commend Value	CT 1	CT 2f	CT 5e
Test Software	CVM Vesion2.0		
*Note: Please see as below display on DOS window about operation parameters			

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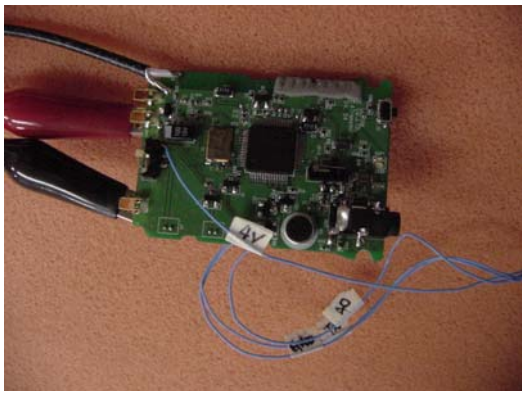
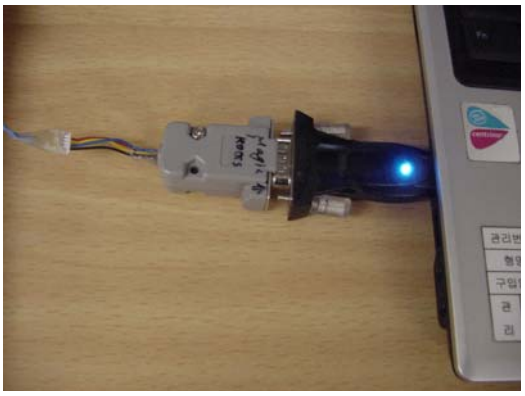
▣ Test Jig and S/W commend parameters

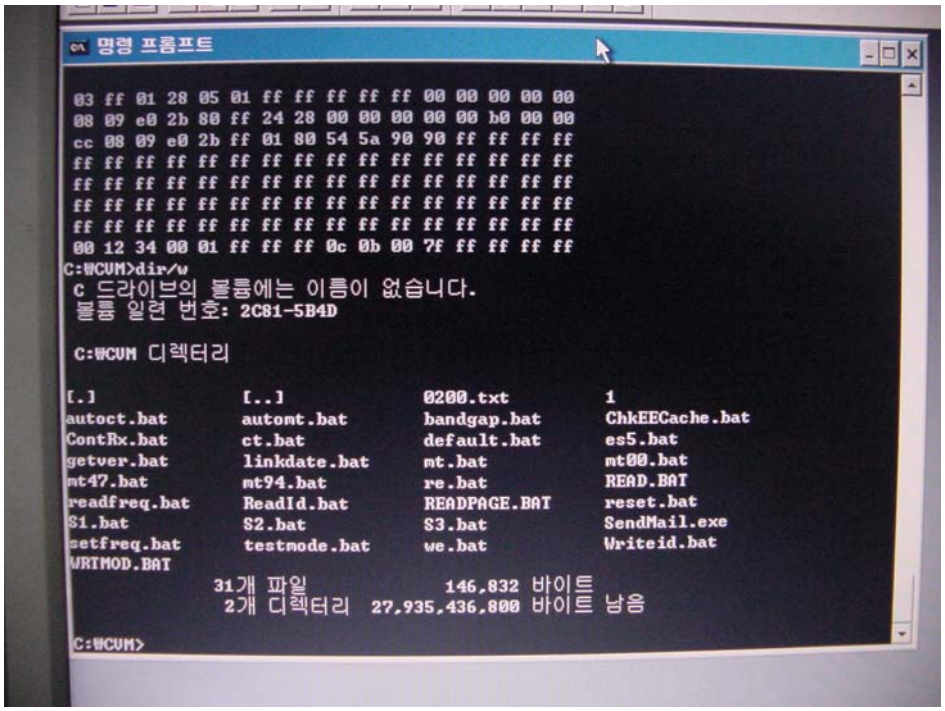
Connection line to RF Chip port



Connection Between RF Chip and PC



(S/W Test program commend parameters)



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3.8 Used Test Equipment List

No.	Instrument	Model	Serial No.	Manufacturer	Due to Cal. Date	Used
1	Spectrum Analyzer	8563E	3846A10662	Agilent Technology	2010.05.20	☒
2	Test Receiver	ESCS30	100111	Rohde & Schwarz	2010.03.07	☒
3	Test Receiver	ESPI3	100109	Rohde & Schwarz	2010.03.03	☐
4	LISN	ESH2-Z5	100044	Rohde & Schwarz	2010.03.16	☐
5	LISN	ESH3-Z5	100147	Rohde & Schwarz	2009.06.25	☐
6	Ultra broadband Antenna	HL562	100075	Rohde & Schwarz	2010.03.20	☒
7	Ultra broadband Antenna	HL562	100076	Rohde & Schwarz	2010.04.14	☐
8	Dipole Antenna	HZ-12	100005	Rohde & Schwarz	2010.04.03	☐
9	Dipole Antenna	HZ-13	100007	Rohde & Schwarz	2010.04.03	☐
10	Horn Antenna	3115	2996	EMCO	2010.06.13	☒
11	Loop Antenna	6502	9203-0493	EMCO	2009.06.15	☐
12	Digital Signal Generator	E4436B	US39260458	HP	2010.05.20	☒
13	Tracking CW Signal Source	85645A	070521-A1	HP	2010.05.20	☒
14	RF Power Amplifier	8347A	3307A01571	HP	2010.05.20	☒
15	Microwave Amplifier	8349B	2627A01037	HP	2010.05.20	☒
16	Attenuator	8498A	3318A09485	HP	2010.05.20	☒
17	Temperature & Humidity Chamber	EY-101	90E14260	TABAI ESPEC	2010.03.16	☐
18	EPM Series Power meter	E4418B	GB39512547	Agilent Technology	2010.05.20	☒
19	RF Power Sensor	ECP-E18A	US37181768	Agilent Technology	2010.05.20	☒
20	Microwave Frequency Counter	5352B	2908A00480	Agilent Technology	2010.05.20	☐
21	Band rejection filter	WTR-BRF2442-84NM	09020001	WAVE TECH Co.,Ltd.	2010.03.03	☒
22	SLIDAC	None	0207-4	Myoung-Sung Electronic Co., Ltd.	2010.05.20	☐
23	DC Power supply	DRP-5030	9028029	Digital Electronic Co.,Ltd	2010.06.04	☐
24	DC Power supply	UP-3005T	68	Unicon Co.,Ltd	2010.05.20	☐
25	DC Power supply	E3610A	KR24104505	Agilent Technology	2010.05.20	☒
26	Antenna Master	-	-	Daeil EMC	-	☒
27	Turn Table	-	-	Daeil EMC	-	☒

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4. SUMMARY TEST RESULTS

Description of Test	FCC Rule	Reference Clause	Used	Test Result
Carrier frequency separation	15.247(a)(1)	Clause 5.1	☒	Compliance
Number of hopping channel	15.247(a)(1)(iii)	Clause 5.2	☒	Compliance
Time of occupancy (Dwell Time)	15.247(a)(1)(iii)	Clause 5.3	☒	Compliance
Max. Conducted peak output power	15.247(b)(1)	Clause 5.4	☒	Compliance
Band-edge compliance	15.247(d)	Clause 5.5	☒	Compliance
Spurious RF conducted emissions	15.247(d)	Clause 5.6	☒	Compliance
Spurious radiated emissions	15.247(d), 15.209	Clause 5.7	☒	Compliance
Antenna requirement	15.203, 15.247	Clause 5.8	☒	Compliance
Compliance : The EUT complies with the essential requirements in the standard. Not Compliance : The EUT does not comply with the essential requirements in the standard. N/A : The test was not applicable in the standard.				

Description of Test	IC Rule	Reference Clause	Used	Test Result
Carrier frequency separation	RSS-210 (A 8.1)	Clause 5.1	☒	Compliance
Number of hopping channel	RSS-210 (A 8.1)	Clause 5.2	☒	Compliance
Time of occupancy (Dwell Time)	RSS-210 (A 8.1)	Clause 5.3	☒	Compliance
Max. Conducted peak output power	RSS-210 (A 8.4)	Clause 5.4	☒	Compliance
Band-edge compliance	RSS-210 (A 8.5)	Clause 5.5	☒	Compliance
Spurious RF conducted emissions	RSS-210 (2.2).(A2.9)	Clause 5.6	☒	Compliance
Spurious radiated emissions	RSS-210[2..2/A2.9 (a)]	Clause 5.7	☒	Compliance
Antenna requirement	RSS-Gen (7.1.5)	Clause 5.8	☒	Compliance
Compliance : The EUT complies with the essential requirements in the standard. Not Compliance : The EUT does not comply with the essential requirements in the standard. N/A : The test was not applicable in the standard.				

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5. MEASUREMENT RESULTS

5.1 Carrier Frequency Separation

5.1.1 Standard Applicable [FCC §15.247(a),(1)] [RSS-210 A8.1(b)] [RSS-GEN 4.6.1]

Frequency hopping systems operating in the 2 400 ~ 2 483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

5.1.2 Measurement Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peak of the adjacent channels using the marker-Delta function was recorded as the measurement results.

The spectrum analyzer is set to the as follows :

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings ;

- Span : wide enough to capture the peak of two adjacent channels
- RBW : ≥ 1% of the span
- VBW : ≥ RBW
- Sweep : auto
- Detector function : peak
- Trace : max hold

5.1.3 Measurement Result

- Environmental Conditions :

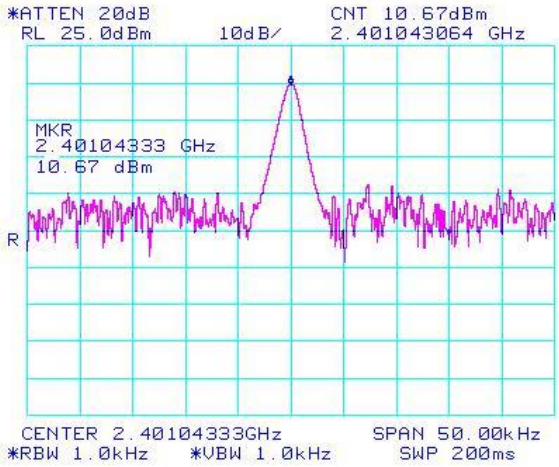
-. Temperature : 24 ℃, Relative Humidity : (54 ~ 56) % R.H.

Channel Number	Test Results		
	Measured frequency Separation Ch # 1 and # 2 [MHz]	Limit	Result
0, 1	0.883	≥ 25 kHz or 2/3 20dB bandwidth	Complies
47, 48	0.883		Complies
92, 93	0.880		Complies

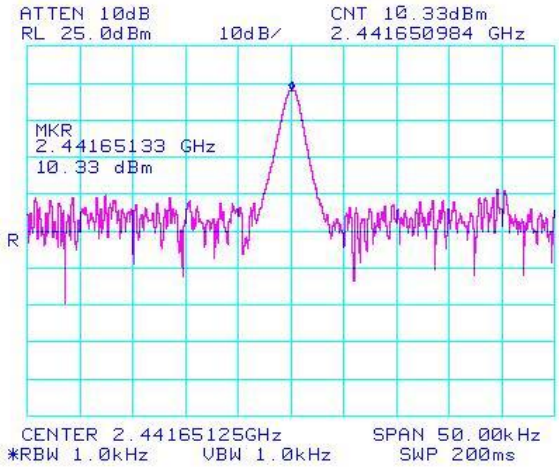
∗ please refer to as below test plot(carrier frequency, frequency separation and 20 dB bandwidth

5.1.4 Test Plot (Measured carrier frequency)

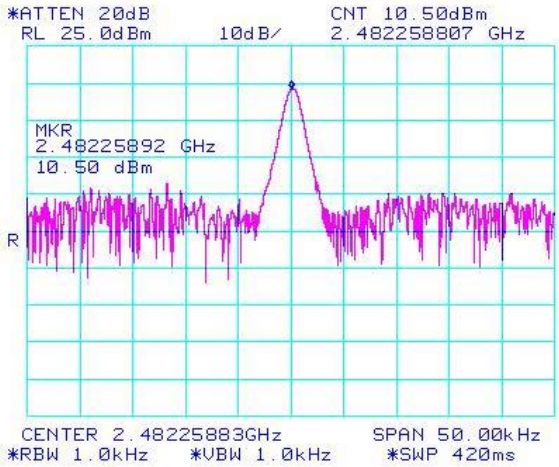
⇒ Lowest Channel _ch 0



⇒ Middle Channel _ch 47

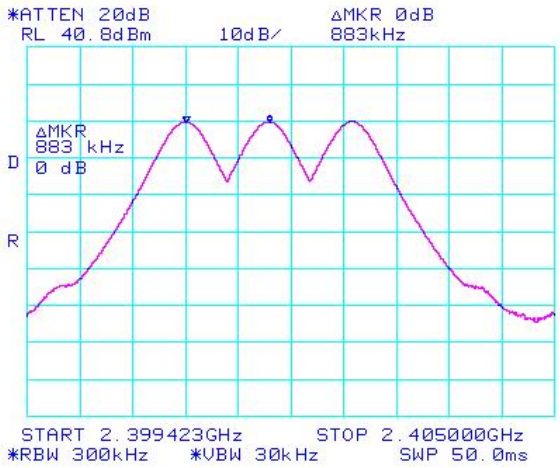


⇒ Highest Channel _ch 94

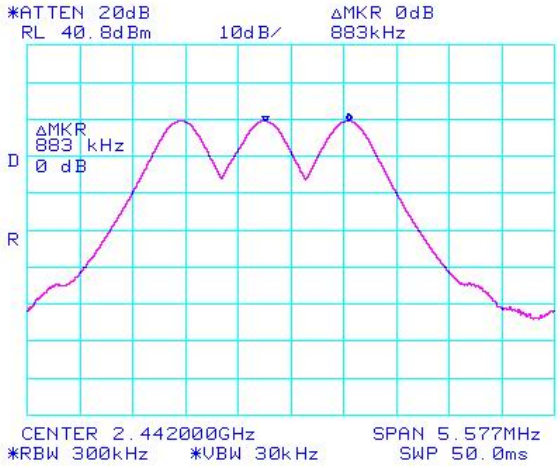


5.1.5 Test Plot (separation frequency)

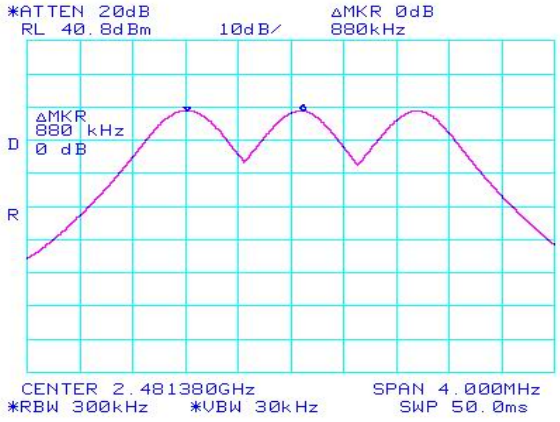
⇒ Channel _0, 1 (2 401.043 MHz, 2 401.926 MHz)



⇒ Channel 47, 48 (2 441.661 MHz, 2 442.544 MHz)



⇒ Channel 92, 93 (2 480.516 MHz, 2 481.396 MHz)

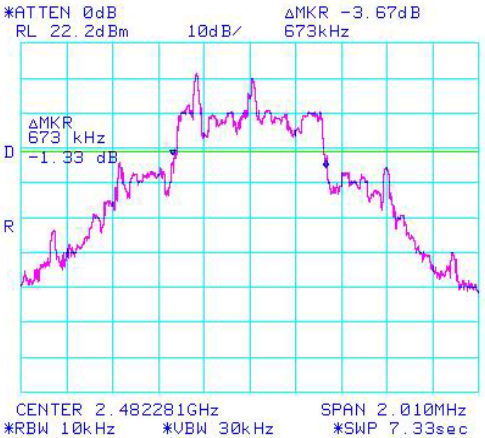


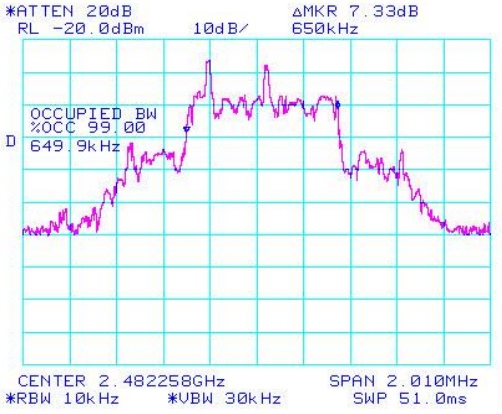
5.1.6 Test Plot (20 dB and 99% Occupied bandwidth)

⇒ Lowest Channel _ch 0

⇒ Middle Channel _ch 47

⇒ Highest Channel_ch 94





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* Note : above the 20 dB Bandwidth measurement method is described FCC Public Notice(DA 00-705), (IC RSS-Gen 4.) and setting method on spectrum analyzer is as follows ;

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

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5.2 Number of hopping Channel

5.2.1 Standard Applicable [FCC §15.247(a),(1)(iii)] [RSS-210 A8.1(d)]

Frequency hopping systems in the 2 400 MHz ~ 2 483.5 MHz band shall use at least 15 channels

5.2.2 Measurement Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna Terminal to get higher resolution, two frequency ranges within the 2 400 MHz ~ 2 483.5 MHz frequency band Hopping band were examined. The EUT must have its hoping function enabled.

The spectrum analyzer is set to the as follows :

- Span : the frequency band of operation
- RBW : ≥ 1% of the span
- VBW : ≥ RBW
- Sweep : auto
- Detector function : peak
- Trace : max hold

5.2.3 Measurement Result

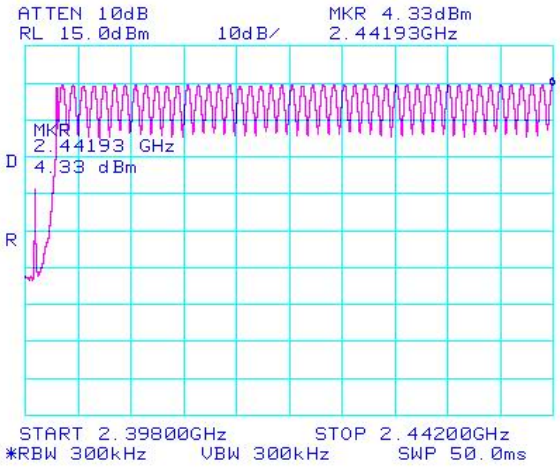
- Environmental Conditions:

-. Temperature : 24 ℃, Relative Humidity : (54 ~ 56) % R.H.

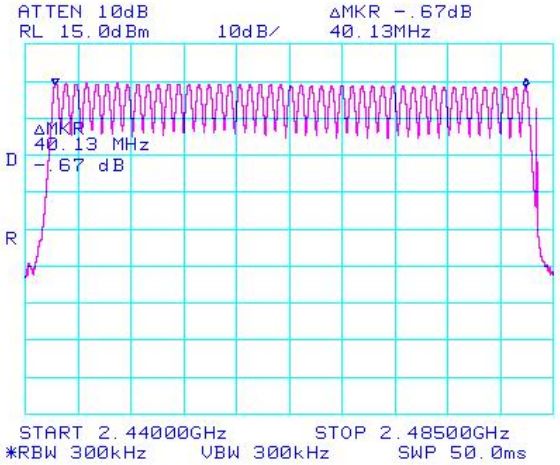
Channel Number	Hopping frequency band (MHz)	Test Results		
		Measured total number of Hopping Channels	Limit	Result
0 ~ 94	2 401.056 MHz ~ 2 482.272 MHz	95	≥ 15	Complies

5.2.4 Test Plot

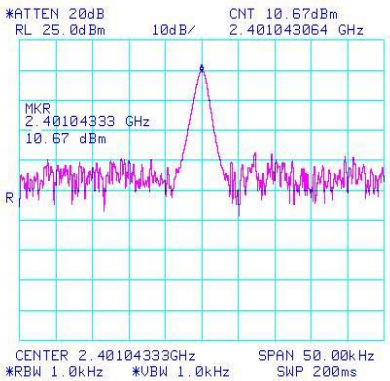
1. Hopping channel / ch0 ~ ch47



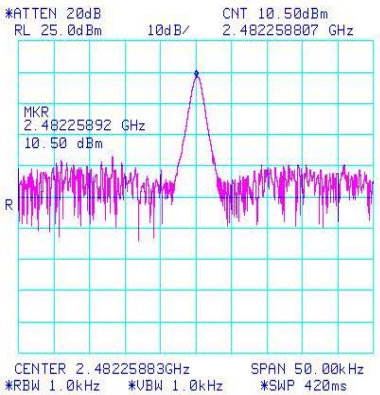
2. Hopping channel / ch48 ~ ch94



3. Hopping channel / Measured lowest channel



4. Hopping channel / Measured highest channel



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5.3 Time of occupancy (Dwell Time)

5.3.1 Standard Applicable [FCC §15.247(a),(1)(iii)] [RSS-210 A8.1(d)]

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

5.3.2 Measurement Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled. After used the marker-delta function to determine the dwell time.

The spectrum analyzer is set to the as follows :

- Span : Zero , Centered on a hopping channel
- RBW : 1 MHz
- VBW : ≥ RBW
- Sweep : auto
- Detector function : peak
- Trace : max hold

5.3.3 Measurement Result

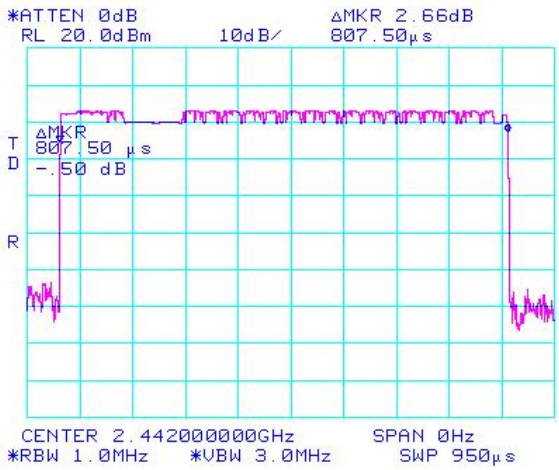
- Environmental Conditions :

-. Temperature : 24 ℃, Relative Humidity : (54 ~ 56) % R.H.

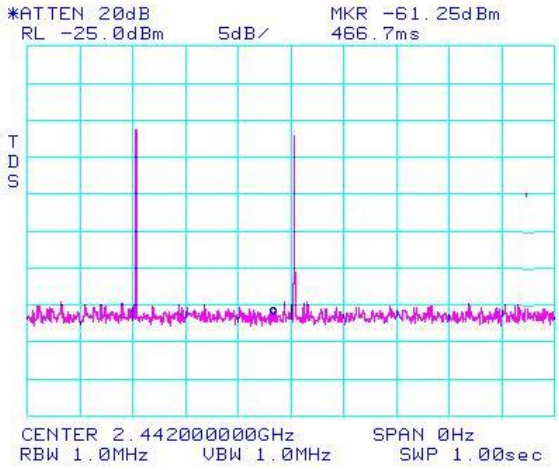
Bust width per one hop (㎲)	Test Results		
	Measured dwell time (ms)	Limit	Result
807.50	61.37	≤ 0.4 Sec	Complies

5.3.4 Test Plot

1. Burst width in one hop (㎲)



2. Number of hop channel per 1 sec



As a see at above displayed plot, hop number of any one hop channel within 95 hopping channels is 2 hop and burst width is 807.5㎲ per second. according to this system makes 2 X 95 = 190 hop times per second. so hop times per 0.4 second is 190 hop times X 0.4 second = 76 hop time. as a result average time of occupancy on 95 hopping channel is calculation as below formula ;

hop time per full hopping channel in band per 0.4 second X burst width per one hopping channel

So, in this hopping system have 76 x 807.5 ㎲ = 61.370 ms

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5.4 Max. Conducted peak output power

5.4.1 Standard Applicable [FCC §15.247(b)(1)] [RSS-210 A8.4(2)]

For frequency hopping systems operating in the 2 400 MHz ~ 2 483.5 MHz band employing at least 75 non-overlapping hopping channels, the maximum peak conducted output power shall not exceed 1 W.

5.4.2 Test Conditions

• Attenuator : 30 dB • dc Block : 1.0 dB • Cable loss : 0.5 dB

• Environmental Conditions : Ambient temperature : 23 ℃, Relative Humidity : (53 ~ 55) % R.H.

5.4.3 Measurement Procedure

① Pre-calibration for the spectrum analyzer has to be done first through a reference CW signal from CAL OUT(-10 dBm)

② Reference frequency signal generated from the signal generator is supply to RF input port in spectrum Analyzer via dc Block, RF cable and attenuator. and then, it's apply to offset value in spectrum analyzer as follows :

on Spectrum analyzer [Amplitude→1 More of 3→REF LVL OFFSET (31.5 dB)]

- dc Block(1.0 dB)+Cable loss(0.5 dB)+Attenuator (30 dB)

③ Remove the antenna from the EUT and then, connected to spectrum analyzer via a dc Block, suitable low loss RF cable and attenuator.

④ Place the EUT on the table and set it hopping function disable at the highest, middle and the lowest available channels.

⑤ After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission

⑥ The indicated level is the peak output power.

⑦ please refer to the detailed procedure method FCC Public Notice(DA 00-705) and IC(RSS-Gen)

∗The spectrum analyzer is set to the as follows ;

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

* above measurement frequency is selected to the lowest, Middle and Highest channel

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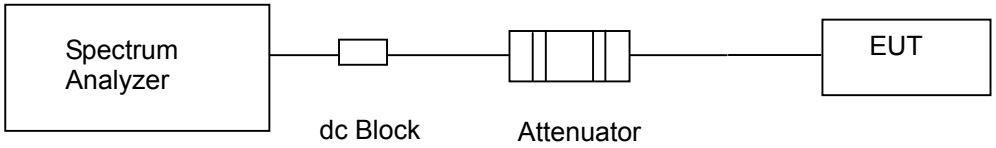
5.4.4 Test Setup Configuration



5.4.5 Measurement Result

Channel No.	Frequency [MHz]	Test Results		
		Measured power [dBm]	Limit [dBm]	Result
0	2 401.056	10.17	≤ 30	Complies
47	2 441.664	10.20		Complies
94	2 482.272	11.17		Complies

* above measured power value is not contained antennal gain(dBi)

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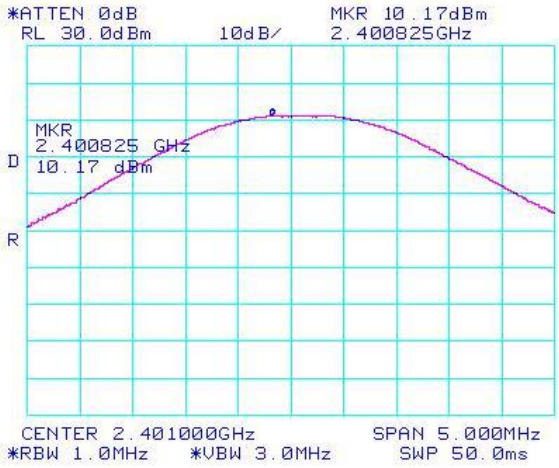
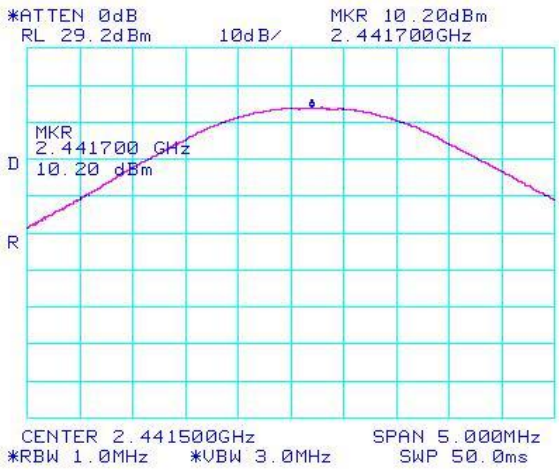
5.4.6 Test Plot

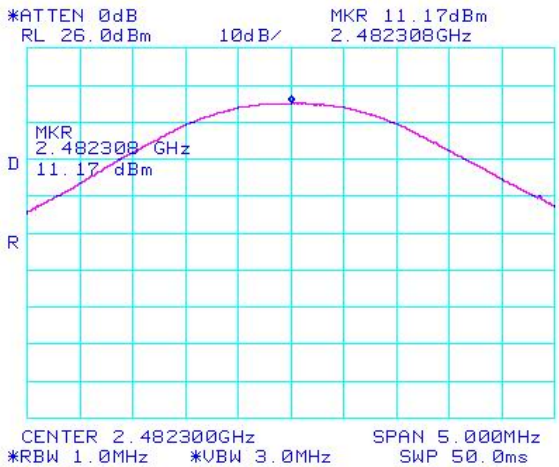
⇒ Lowest Channel _ch 0



⇒ Middle Channel _ch47



⇒Highest Channel_ch 94



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5.5 Band-edge Compliance

5.5.1 Standard Applicable [FCC §15.247(d)] [RSS-210 A8.5]

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

5.5.2 Test Conditions

• Attenuator : 30 dB • dc Block : 1.0 dB • Cable loss : 0.5 dB

• Environmental Conditions : Ambient temperature : 22 ℃, Relative Humidity : (53 ~ 54) % R.H.

5.7.2 Measurement Procedure

① Pre-calibration for the spectrum analyzer has to be done first through a reference CW signal from CAL OUT(-10 dBm)

② Reference frequency signal generated from the signal generator is supply to RF input port in spectrum Analyzer via dc Block, RF cable and attenuator. and then, it's apply to offset value in spectrum analyzer as follows :

on Spectrum analyzer [Amplitude→1 More of 3→REF LVL OFFSET (31.5 dB)]

- dc Block(1.0 dB)+Cable loss(0.5 dB)+Attenuator (30 dB)

③ Remove the antenna from the EUT and then, connected to spectrum analyzer via a dc Block, suitable low loss RF cable and attenuator.

④ Place the EUT on the table and set on the emission at the band-edge,

⑤ After the trace being stable, Use the marker-to-peak function to move the marker to the peak of the in-band emission.

⑥ The marker-delta value now displayed must comply with the limit specified in above standard.

⑦ please refer to the detailed procedure method FCC Public Notice(DA 00-705) and IC(RSS-Gen 4.)

The spectrum analyzer is set to the as follows :

• Span : Wide enough to capture the peak level of the emission operating on the channel closet to the Band-edge, as well as any modulation products which fall outside of the authorized band of operation

• RBW : ≥ 1 % of the span

• VBW : ≥ RBW

• Sweep : auto

• Detector function : peak

• Trace : Max hold

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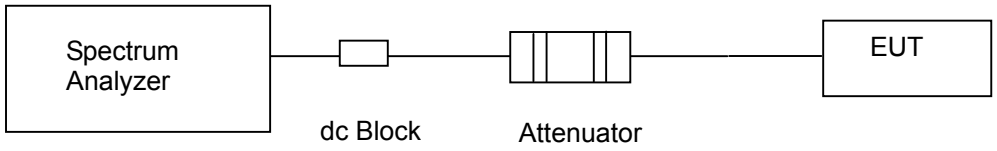
5.5.3 Test Setup Configuration

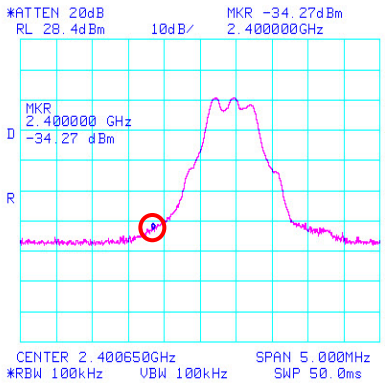


5.5.4 Measurement Result

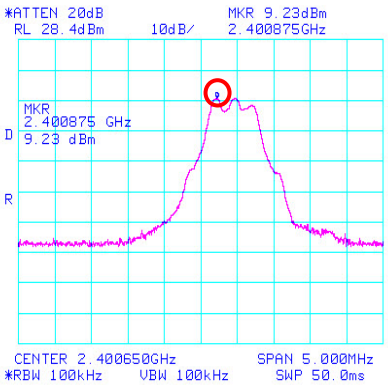
Frequency Channel	Measured Frequency [MHz]		Test Results		
			Measured value [dBm]	Limit [dBc]	Result
Lowest channel	Fundamental	2 400.875 MHz	9.23	≤ - 20	Compliance
	Band-edge point	2 400.000 MHz	- 34.27		
Highest channel	Fundamental	2 482.072 MHz	8.63		Compliance
	Band-edge point	2 483.497 MHz	- 37.70		

5.5.5 Test Plot

Lowest Channel

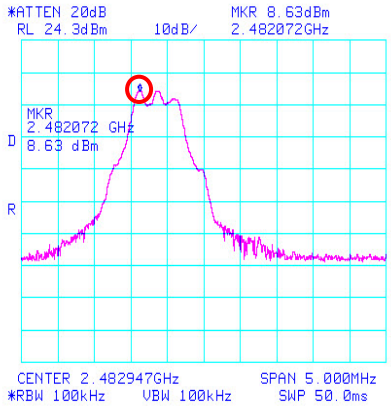


Band-edge poit

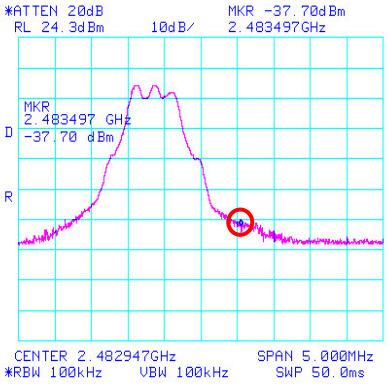


Fundamental

Highest Channel



Fundamental



Band-edge point

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5.6 Spurious RF conducted emissions

5.6.1 Standard Applicable [FCC §15.247(d)] [RSS-210 A8.5]

In additional in this clause 5.5.1 In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall e at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

5.6.2 Test Conditions

• Attenuator : 30 dB • dc Block : 1.0 dB • Cable loss : 0.5 dB

• Environmental Conditions : Ambient temperature : 22 ℃, Relative Humidity : (53 ~ 54) % R.H.

5.6.3 Measurement Procedure

① Pre-calibration for the spectrum analyzer has to be done first through a reference CW signal from CAL OUT(-10 dBm)

② Reference frequency signal generated from the signal generator is supply to RF input port in spectrum Analyzer via dc Block, RF cable and attenuator. and then, it's apply to offset value in spectrum analyzer as follows :

on Spectrum analyzer [Amplitude→1 More of 3→REF LVL OFFSET (31.5 dB)]

- dc Block(1.0 dB)+Cable loss(0.5 dB)+Attenuator (30 dB)

③ Remove the antenna from the EUT and then, connected to spectrum analyzer via a dc Block, suitable low loss RF cable and attenuator.

④ Place the EUT on the table and set on the emission at the out band

⑤ After the trace being stable, Use the marker-to-peak function to move the marker to the peak of the in-band emission.

⑥ The marker-delta value now displayed spurious emission must comply with the limit specified in above standard.

⑦ please refer to the detailed procedure method FCC Public Notice(DA 00-705)

The spectrum analyzer is set to the as follows :

• Span : wide enough to capture the peak level of the in-band emission and all spurious emissions from the Lowest frequency generated in the EUT up through the 10^{th} harmonic. Typically, several plots are required to cover this entire span.

• RBW : 100 kHz

• VBW : ≥ RBW

• Sweep : Auto

• Detector function : Peak

• Trace : Max hold

∗ Test setup of configuration is same as in this clause 5.5.3

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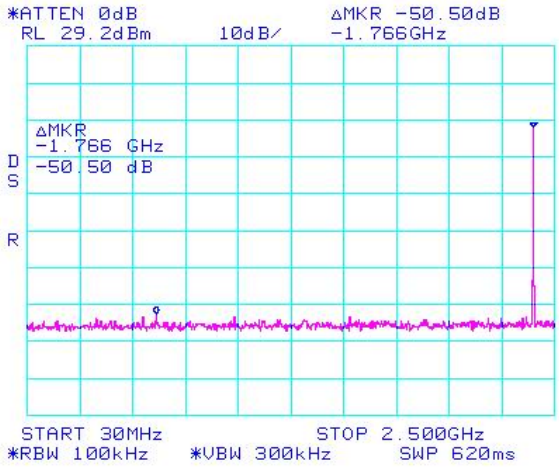
5.6.4 Measurement Result

Hopping mode	Channel Range	Frequency band [MHz]	Test Results		
			Measured value [dBc]	Limit [dBc]	Result
Hopping off	Lowest channel_ 0 (2 401.043 MHz)	30 MHz – 2.5 GHz	- 50.50	≤ - 20	Compliance
		2 GHz – 26.5 GHz	-49.83		Compliance
	Middle channel_ 47 (2 441.650 MHz)	30 MHz – 2.5 GHz	-56.84		Compliance
		2 GHz – 26.5 GHz	-48.33		Compliance
	Highest channel_ 94 (2 482.259 MHz)	30 MHz – 3.0 GHz	- 55.16		Compliance
		2 GHz – 26.5 GHz	-47.66		Compliance
Hopping on	Hopping ch (0~94)	30 MHz – 3.0 GHz	-60.66		Compliance
		2 GHz – 26.5 GHz	-45.00		Compliance

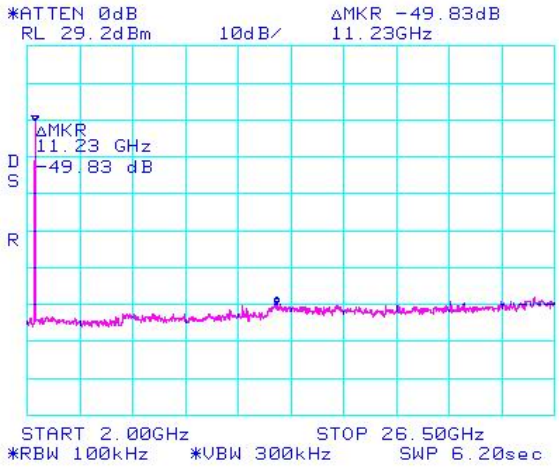
*Note: Spurious level at Hopping mode is 20dB below within the band that contains the highest level of the desired power. see to as below Test Plot of 5.6.5

5.6.5 Test Plot (Hopping off)

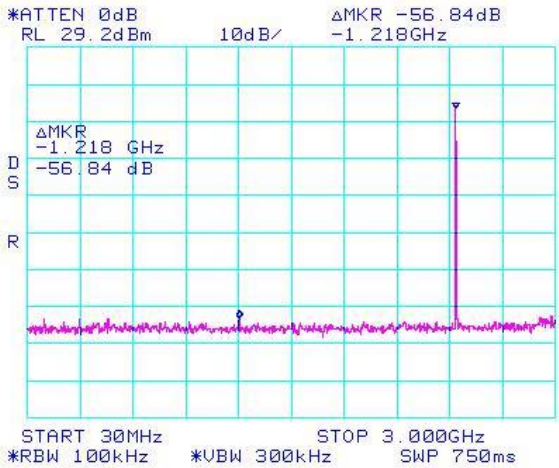
⇒Lowest Channel …… 30 MHz ~ 2.5 GHz



⇒Lowest Channel …… 2 GHz ~ 26.5 GHz



⇒Middle Channel …… 30 MHz ~ 3.0 GHz



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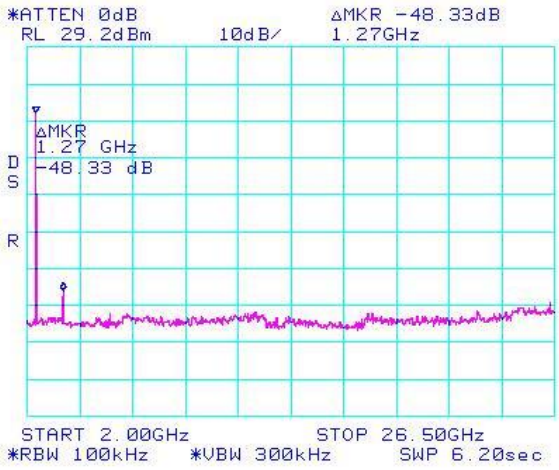
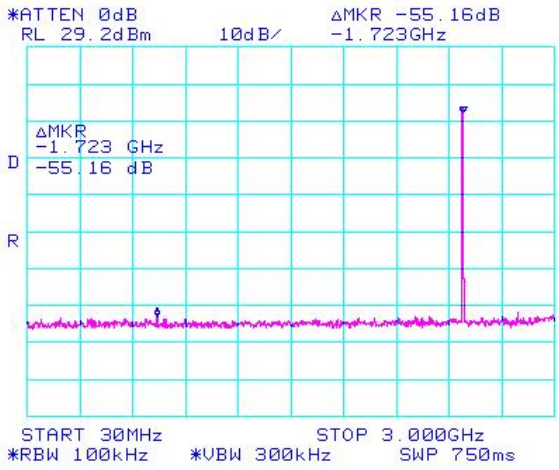
Continuous

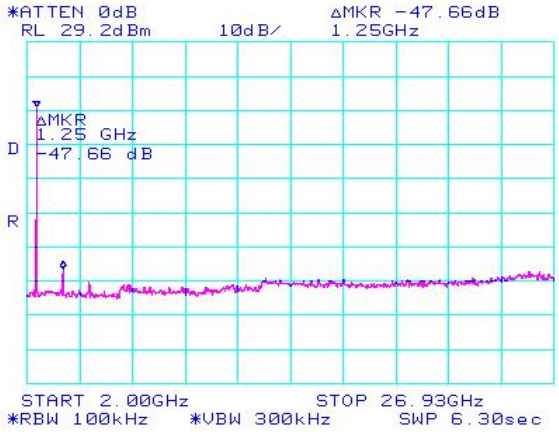
⇒Middle Channel …… 2 GHz ~ 26.5 GHz



⇒Highest Channel …… 30 MHz ~ 3.0 GHz

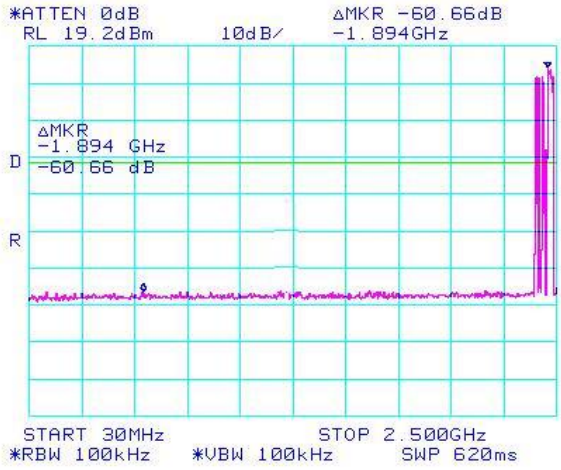


⇒Highest Channel …… 2 GHz ~ 26.5 GHz

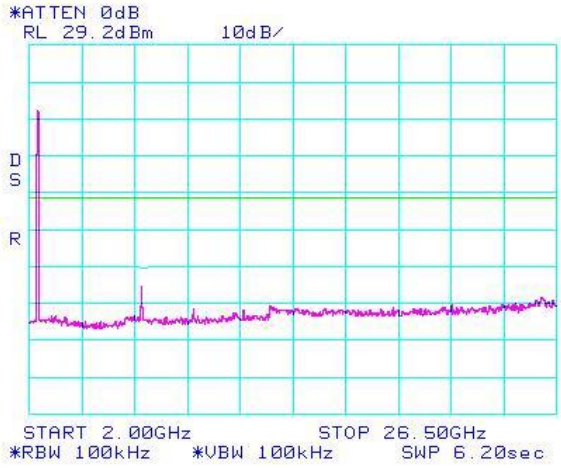


5.6.6 Test Plot (Hopping on)

⇒frequency band (30 MHz ~ 2.5 GHz)



⇒frequency band (2 GHz ~ 26.5 GHz)



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5.7 Spurious radiated emissions

5.7.1 Standard Applicable [FCC §15.247(d)] [RSS-210 2.2]

All other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10 GHz, the frequency Range of measurements : to the tenth harmonic of the highest fundamental frequency or to 40 GHz, Whichever is lower.

In addition, radiated emissions which fall in the restricted bands, as defined in Sec.15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a)

5.7.2 Measurement Procedure

① As below test setup figure, for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is test mode function. Also was placed on a non-metallic table height of 0.8 m above the reference ground plane. If EUT is connected to cables, that were fixed to cause maximum emission. antenna was used to Horn antenna for above 1 GHz and Broadband antenna below 1GHz. it made with the antenna positioned in both the horizontal and vertical planes of polarization.

② For emission frequencies measured below and above 1 GHz, a pre-scan is performed in a Shield chamber to determine the accurate frequencies before final test, after maximum emissions level will be checked on a open test site and measuring distance is 3 meter from EUT to receiver antenna.

③ For emission frequencies measured below 1 GHz, set the Test Receiver on a 120KHz
120 KHz resolution bandwidth using measurement instrumentation employing a CISPR quasi-peak detector. and for above1 GHz, set the spectrum analyzer on a 1 MHz resolution bandwidth respectively for each frequency measured in step② and then EUT is located Position X,Y,Z on turn table

④ The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0º to 360º with a speed as slow as possible, and keep the highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading.

⑤ Repeat step④ until all frequencies to be measured were complete.

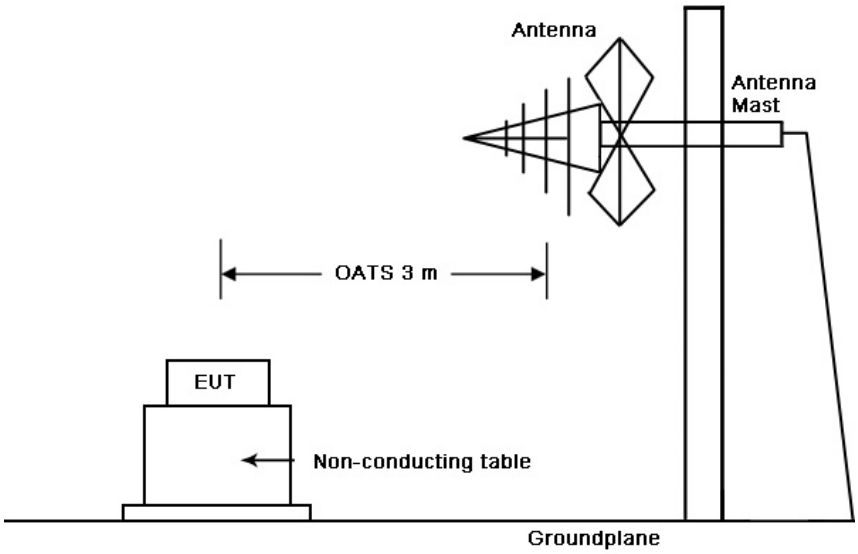
⑥ Repeat step⑤ with search antenna in vertical polarized orientations.

⑦ Check the frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worst case and record the result.

.

The measurement results are obtained as described below:

Result(dBμV/m) = Reading(dBμV/m) + Antenna factor(dB/m)+ CL(dB) + other application factor (dB)



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§15.209 and RSS-210(2.7 Table 2) : limits for radiated emissions measurements (distance at 3m)			
Frequency Band	Limit [μV/m]	Limit [dBμV/m]	Detector
30 - 88	100 (3 nW)	40.0	Quasi peak
88 - 216	150 (6.8 nW)	43.5	Quasi peak
216 - 960	200 (12 nW)	46.0	Quasi peak
Above 960	500 (75 nW)	54.0	Average

§15.249 and RSS-210(A 2.9 (a) : The field strengths measured at 3 metres shall not exceed the following:		
Fundamental Frequencies (MHz)	Field Strength (milivolts/m)	
	Fundamental	Harmonics
902 ~ 928	50 (Note 1)	0.5
2 400 ~ 2 483.5	50 (Note 1)	0.5
5 725 ~ 5 875	50 (Note 1)	0.5

§15.205 and RSS-210(2.7 Table 1) : Restrict Band of Operation : Only spurious emissions are permitted in any of the frequency bands listed below ;			
[MHz]	[MHz]	[MHz]	[GHz]
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 -614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 -1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.
4.17725 - 4.17775	37.5 -38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 -6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 -6.26825	108 - 121.94	1718.8 -1722.2	13.25 - 13.
6.31175 -6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.4142 5 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	Above 38.6

5.7.3 Measurement Result (Transmitter)

• Environmental Conditions :

- Temperature : 23 ℃, Relative Humidity : (55 ~ 57) % R.H. Pressure : 100.5 kPa

▣ Lowest Channel

Below 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss(dB)	Result	Limit	Margi
(MHz)	(dB㎶/m)	(Deg)	(Axis)	Height (m)	Pol. (H/V)	Factor (dB/m)		(dB㎶/m)	(dB㎶/m)	(dB)
612.50	15.40	185	X	1.7	V	16.97	8.50	40.87	46.02	5.15
712.00	10.01	120	Z	1.6	H	18.22	9.40	37.63	46.02	8.39

Above 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss (dB)	Result	Limit	Margi
(MHz)	(dBμV/m)	(Deg)	(Axis)	Heigh (m)	Pol. (H/V)	Factor (dB/m)		(dBμV/m)	(dBμV/m)	(dB)
2 401.56	30.85	120	Y	1.55	V	28.49	17.98	77.32	93.98	16.66
Above 2 401.56	Signal is not detected									

* Fundamental frequency : 2 401.56 MHz

▣ Middle Channel

Below 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss(dB)	Result	Limit	Margi
(MHz)	(dB㎶/m)	(Deg)	(Axis)	Height (m)	Pol. (H/V)	Factor. (dB/m)		(dB㎶/m)	(dB㎶/m)	(dB)
316.00	21.08	94	Y	1.6	H	10.91	5.90	37.89	46.02	8.13
525.12	10.18	212	Z	1.8	V	15.27	8.20	33.65	46.02	12.37

Above 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss(dB)	Result	Limit	Margi
(MHz)	(dBμV/m)	(Deg)	(Axis)	Heigh t (m)	Pol. (H/V)	Factor (dB/m)		(dBμV/m)	(dBμV/m	(dB)
2441.75	30.75	85	Y	1.64	H	28.49	18.25	77.49	93.98	16.49
above 2441.75	Signal is not detected									

* Fundamental frequency : 2 441.75 MHz

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▣ Highest Channel

Below 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss(dB)	Result	Limit	Margin
(MHz)	(dB㎶/m)	(Deg)	(Axis)	Height (m)	Pol. (H/V)	Factor (dB/m)		(dB㎶/m)	(dB㎶/m)	(dB)
375.00	21.05	90	X	1.5	H	12.32	5.80	39.17	46.02	6.85
652.50	9.28	215	Z	1.8	V	17.72	8.50	35.50	46.02	10.52

Above 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss(dB)	Result	Limit	Margin
(MHz)	(dBμV/m)	(Deg)	(Axis)	Height (m)	Pol. (H/V)	Factor (dB/m)		(dBμV/m)	(dBμV/m	(dB)
2482.41	30.77	96	Y	1.75	V	28.49	18.40	77.66	93.98	20.32
above 2482.41	Signal is not detected									

* Fundamental frequency : 2 482.41 MHz

Freq.(㎒) : Measurement frequency, Reading(dB㎶/m) : Indicated value for test receiver,
Table(Deg) : Directional degree of Turn table, PST: Position, Antenna(Pol, Factor): Polarization and Factor
CL(dB) : Cable loss, Result(dB㎶/m) : Reading(dB㎶/m) + Antenna factor.(dB/m)+ CL(dB)
FCC Limit(dB㎶/m): Limit value specified with FCC Rule, FCC Margin(dB) : FCC Limit (dB㎶/m)-
Result(dB㎶/m),

5.7.4 Measurement Result (Receiver) : N/A (Transmitter only)

• Environmental Conditions :

- Temperature : 23 ℃, Relative Humidity : (55 ~ 57) % R.H. Pressure : 100.5 kPa

▣ Below 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss(dB)	Result	Limit	Margin
(MHz)	(dBμV/m)	(Deg)	(Axis)	Height (m)	Pol. (H/V)	Fctr. (dB/m)		(dBμV/m)	(dBμV/m)	(dB)
	-									

Above 1 ㎓

Freq.	Reading	Table	PST	Antenna			Cable Loss(dB)	Result	Limit	Margin
(MHz)	(dBμV/m)	(Deg)	(Axis)	Height (m)	Pol. (H/V)	Fctr. (dB/m)		(dBμV/m)	(dBμV/m	(dB)
	-									

Freq.(㎒) : Measurement frequency, Reading(dBμV/m) : Indicated value for test receiver,
Table(Deg) : Directional degree of Turn table, PST: Position, Antenna(Pol, Fctr) : Polarization and Factor
CL(dB) : Cable loss, Result(dBμV/m) : Reading(dBμV/m) + Antenna factor.(dB/m)+ CL(dB)
FCC Limit(dBμV/m): Limit value specified with FCC Rule, FCC Margin(dB) : FCC Limit (dBμV/m)- Result(dBμV/m).

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5.8 Antenna requirement

5.8.1 Standard applicable [FCC §15.203, §15.247(4)(1)] [RSS-Gen 7.1.5]

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

The use of a permanently attached antenna or of an antenna that user a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The manufacturer may design the unit so that broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(4)(1), the conducted output power limit specified in paragraph (b) of this section. is based on the use of antennas with directional gains that do not exceed 6dBi.

According to above requirement standard's This product's antenna type is an Film type and it's gain is 1.770 dBi, So radiated emission field strength from EUT is below requirement standard limit

* For more described, please refer to attached antenna specification file

5.8.2 Antenna gain

Frequency Band	Gain [dBi]	Limit [dBi]	Results
2 400 MHz – 2 500 MHz	1.770	≤ 6	Compliance