Nemko Korea Co., Ltd.

155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPUBLIC OF
TEL:+82 31 330 1700 FAX:+82 31 322 2332

FCC and IC EVALUATION REPORT FOR CERTIFICATION

Applicant :
i-SENS, Inc.
43, Banpo-daero 28-gil, Seocho-gu,
Seoul 06646, Korea, republic of
(Post code : 06646)
Attn. : Da Yun Lee

Dates of Issue : January 08, 2016
Test Report No. : NK-15-R-123
Test Site : Nemko Korea Co., Ltd.

FCC ID	**OELBM001**
IC	**21003-BM001**
Contact Person	**i-SENS, Inc.** **43, Banpo-daero 28-gil, Seocho-gu, Seoul 06646,** **Korea, republic of** **Da Yun Lee** **Telephone No. : +82-2-910-0630**

Applied Standard: FCC 47 CFR Part 15C and IC RSS-247 Issue 1
Classification: Digital Transmission System
EUT Type: Bluetooth module

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Jan 08, 2016

Tested By : Wonho Son
Engineer

Jan 08, 2016

Reviewed By : Deokha Ryu
Technical Manager

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1. SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15 and IC RSS-247 Issue1.

Responsible Party : **Contact Person :**	i-SENS, Inc. Da Yun Lee
Manufacturer :	i-SENS, Inc. 43, Banpo-daero 28-gil, Seocho-gu, Seoul 06646, Korea, republic of

- FCC ID: OELBM001
- IC 21003-BM001
- Model: BM001
- EUT Type: Bluetooth module
- Classification: Digital Transmission System
- Applied Standard: FCC 47 CFR Part 15 subpart C and IC RSS-247 Issue 1
- Test Procedure(s): ANSI C63.10-2013 and FCC guidance of Guidance 558074 D01 DTS Meas Guidance v03r03
- Dates of Test: December 07, 2015 ~ December 16, 2015
- Place of Tests: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in determining radiated and conducted emissions emanating from **i-SENS, Inc. FCC ID : OELBM001** and **IC : 21003-BM001**

These measurement tests were conducted at ***Nemko Korea Co., Ltd. EMC Laboratory*** .
The site address 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPULIC OF.
The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.
It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.
The detailed description of the measurement facility was found to be in compliance with the requirements of ANSI C63.4-2014 according to §2.948.

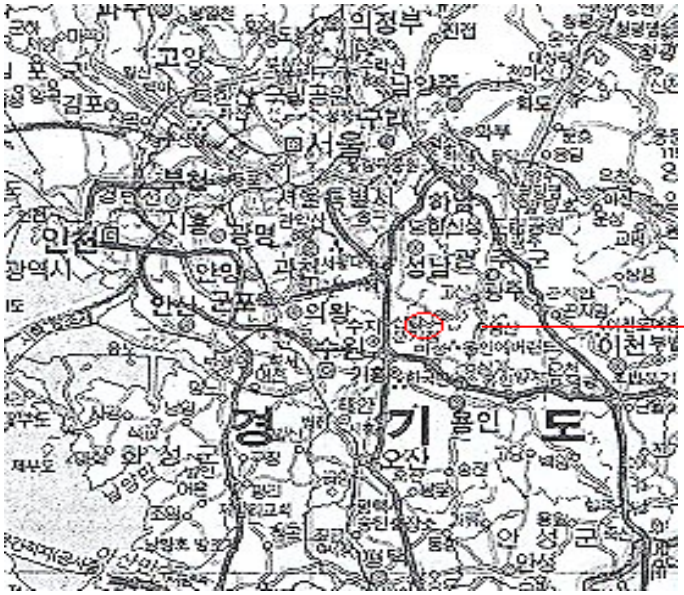


Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
Industry Canada	Canada IC Registered site	Site No. 2040E
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	-
	KCC(RRL)Designated Lab.	Registration No. KR0026

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT is the transceiver which is the Bluetooth Low Energy (BLE) 4.1 module.
The Laptop and Test Jig were used to control the EUT to transmit the wanted TX channel countinuously (dutycycle 100%) by the testing program (SmartRF Studio) which manufacturer supported. The Laptop was removed after controlling the EUT to transmit the wanted signal. The EUT was tested at the lowest channel, middle channel and the highest channel with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

The EUT was programmed with the following output power setting that was used during testing:

Frequency band	Mode	Frequency (MHz)	Channel	Power setting Level
2402~2480 MHz	LE	2402	37	0 dBm
		2442	18	0 dBm
		2480	39	0 dBm

3.1.1 Table of test channels and modes

Test Items	Mode	Modulation	Test Channel (CH)
Radiated Emissions	LE	GFSK	18
6 dB Bandwidth			37/18/39
Peak Output Power			37/18/39
Peak Power Spectral Density			37/18/39
Conducted Spurious Emission			37/18/39
Radiated Spurious Emission, Band edge Emission			37/18/39

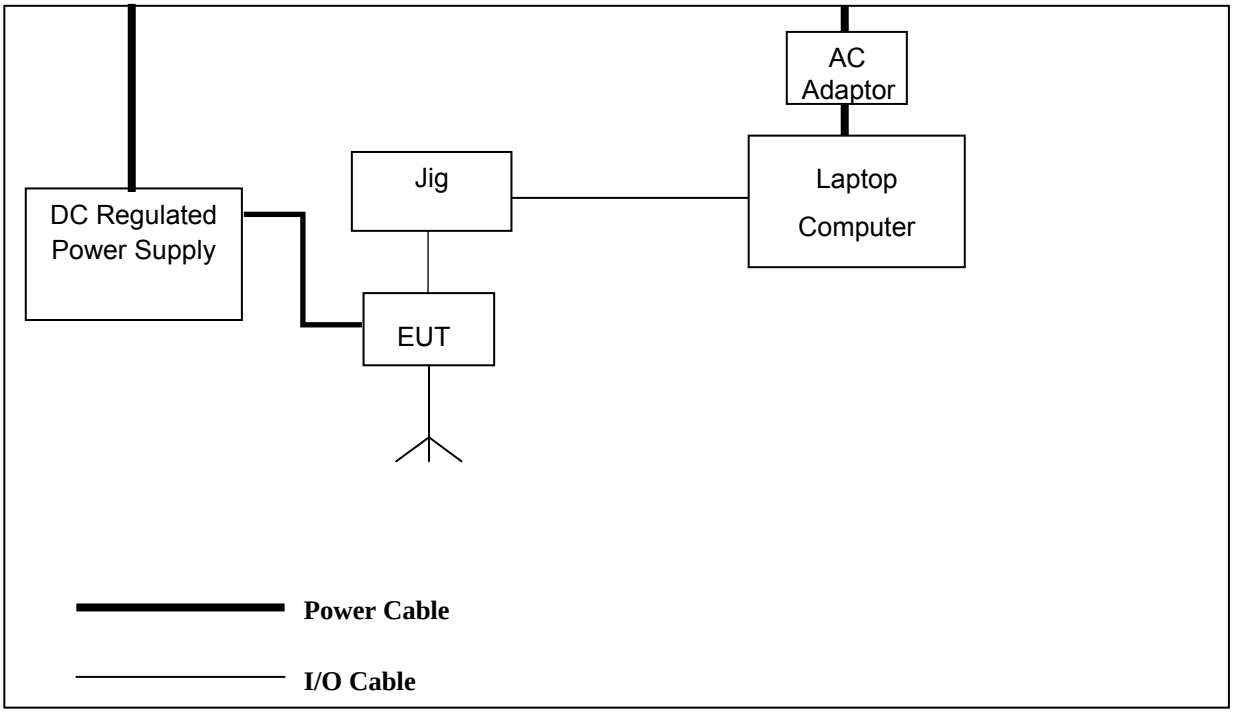
3.1.2 Antenna TX mode information:

Frequency band	Mode	Antenna TX mode	Support MIMO
2.4 GHz	LE	■ 1TX, □ 2TX	□ Yes, ■ No

3.2 Support Equipment

Bluetooth Module (EUT)	i-SENS, Inc. Model: BM001	S/N: N/A
Laptop Computer	Samsung Electronics Co., Ltd. Model : NT-R520 0.3 m shielded USB cable	FCC DOC S/N: ZK6V93FS800012Y
AC/DC Adaptor for Laptop	Chicony Power Technology Co., Ltd. Model : AD-6019R 1.5 m unshielded power cable	FCC DOC S/N: CNBA440024ADON897I2602
DC Regulated Power Supply	GS Instruments. Model : PL-5003S 1.5 m unshielded power cable	FCC DOC S/N : PL-5003S0201

3.3 Setup Drawing



** The labtop and Jig were removed after controlling the EUT to transmit the wanted signal.*

3.4 EUT Information

The EUT is the **i-SENS, Inc. Bluetooth module FCC ID: OELBM001, IC: 21003-BM001**
This unit supports only Bluetooth Low Energy (BLE) 4.1 standard system.

Specifications:

Category	Bluetooth Module
Model Name	BM001
Frequency of Operation	2402 MHz ~ 2480 MHz
Maximum Conducted Output Power	-0.44 dBm
Channels	40ch
Antenna Gain (peak)	1.5 dBi
Antenna Setup	1TX / 1RX
Modulations	GFSK(BLE)
Temperature Range	-10 ℃ ~ +50 ℃
Voltage	3 Vdc
Dimensions (H x W x D)	20 mm x 12 mm x 3 mm
Weight	Appox. 1 g
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	IC Paragraph No.	Result	Remark
Conducted Emission	15.207	RSS-GEN Issue 4 8.8	Complies	
Radiated Emission	15.209	RSS-GEN Issue 4 8.9	Complies	
6 dB Bandwidth	15.247(a)(2)	RSS-247 Issue 1 5.2	Complies	
Peak Output Power and E.I.R.P	15.247(b)(3)	RSS-247 Issue 1 5.4(4)	Complies	
Power Spectral Density	15.247(e)	RSS-247 Issue 1 5.2	Complies	
Conducted Spurious Emission	15.247(d)	RSS-247 Issue 1 5.5	Complies	
Radiated Spurious Emission	15.247(d)	RSS-247 Issue 1 5.5	Complies	
Maximum Permissible Exposure	1.1307(b)	RSS-102 Issue 5	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the **i-SEN, Inc. Bluetooth module FCC ID: OELBM001, IC : 21003-BM001** is in compliance with Part 15.247 of the FCC Rule and RSS-247 Issue 1 of the IC specification.

6. ANTENNA REQUIREMENTS

§15.203 of the FCC Rules part 15 Subpart C

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

The antenna of the **i-SEN, Inc. Bluetooth module FCC ID: OELBM001, IC : 21003-BM001** is **permanently attached** and there are no provisions for connection to an external antenna. It complies with the requirement of §15.203.

7. DESCRIPTION OF TESTS

7.1 Conducted Emissions

The Line conducted emission test facility is located inside a 4 x 7 x 2.5 meter shielded enclosure. It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6. A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 1.5 m away from the side of wall of the shielded room Rohde & Schwarz (ESH3-Z5) and (ESH2-Z5) of the 50 ohm/50 μH Line Impedance Stabilization Network (LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN (ESH3-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH2-Z5). Power to the LISNs are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1 / 2 ".

If DC power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs, All interconnecting cables more than 1 meter were shortened by non inductive bundling (serpentinefashion) to a 1 meter length.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT.

The spectrum was scanned from 150 kHz to 30 MHz with 200 msec sweep time.

The frequency producing the maximum level was re-examined using the EMI test receiver.

(Rohde & Schwarz ESCS30). The detector functions were set to CISPR quasi-peak mode & average mode. The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; whichever determined the worst case emission.

Each EME reported was calibrated using the R&S signal generator.

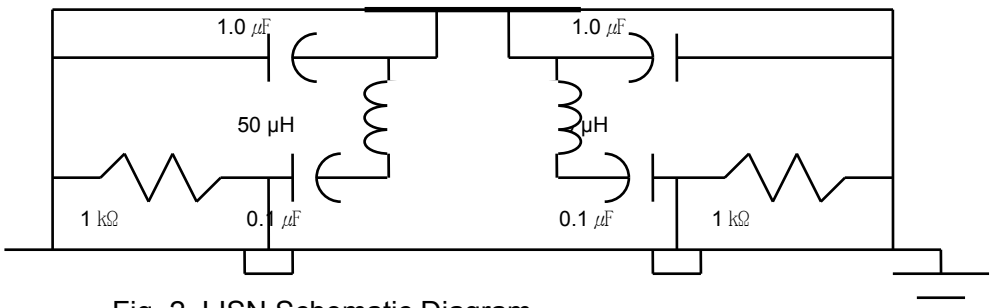


Fig. 2. LISN Schematic Diagram

7.2 Radiated Emissions

The measurement was performed at the test site that is specified in accordance with ANSI C63.10-2013.

The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz, QSH22K20: up to 40 GHz) was used.

For emissions testing at below 1GHz, The test equipment was placed on turntable with 0.8 m above ground. For emission measurements above 1 GHz, The test equipment was placed on turntable with 1.5 m above ground. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0° to 360° and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection.

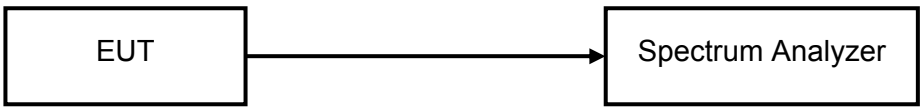
At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in KDB “558074D01 DTS Meas Guidance v03r03” in section 12.2.4 and 12.2.5.1. Peak emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = RMS, Trace averaging in power averaging (RMS) mode over a minimum of 100 traces, If continuous transmission of the EUT couldn’t be achieved and duty cycle was constant, a correction factor (10 log (1 / x)) was added to the measurement result.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

Radiated Emissions Limits per 47 CFR 15.209(a) and RSS-GEN issue 4 8.9

7.3 6 dB Bandwidth

Test Setup

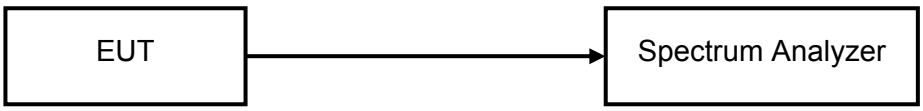


Test Procedure

EUTs 6 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.
RBW = 100 kHz
VBW ≥ 3 x RBW
Detector = Peak
Trace mode = max hold
Sweep = auto couple
Allow the trace to stabilize.
The bandwidth measurement function on the spectrum analyzer is used to measure the 6 dB bandwidth.

7.4 Peak Output Power and E.I.R.P

Test Setup

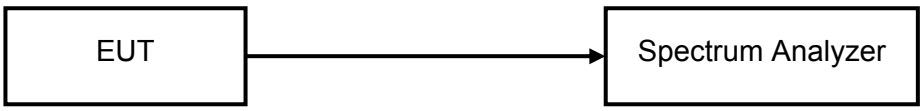


Test Procedure

EUTs Maximum Peak Conducted Output Power is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.
RBW = 1 MHz
VBW = 3 MHz
Span = fully encompass the DTS bandwidth
Detector = peak
Sweep time = auto couple
Trace mode = max hold
Allow the trace to stabilize.
Use peak marker function to determine the peak amplitude level.
E.I.R.P is calculated according to KDB412172 D01 Determining ERP and EIRP v01

7.5 Peak Power Spectral Density

Test Setup



Test Procedure

EUTs Peak Power Spectral Density is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

Center frequency = DTS channel center frequency

Span = 1.5 times the DTS channel bandwidth

RBW ≥ 3 kHz

VBW ≥ 3 x RBW

Detector = peak

Sweep time = auto couple

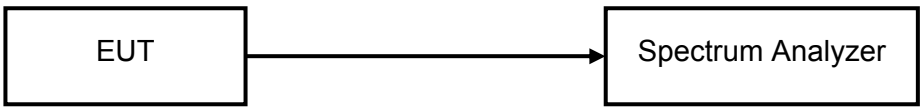
Trace mode = max hold

Allow the trace to stabilize.

The peak search function on the spectrum analyzer is used to determine the maximum amplitude level within the RBW.

7.6 Conducted Spurious Emissions

Test Setup



Test Procedure

EUTs Conducted spurious emissions are measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.

1) Reference Level
RBW = 100 kHz
VBW ≥ 300 kHz
Span = 1.5 times the DTS channel bandwidth
Detector = peak
Sweep time = auto couple
Trace mode = max hold
Allow the trace to stabilize.
Use the peak marker function to determine the maximum PSD level.
Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

2) Unwanted Emissions
RBW = 100 kHz
VBW ≥ 300 kHz
Span = encompass the spectrum to be examined
Detector = peak
Sweep time = auto couple
Trace mode = max hold
Allow the trace to stabilize.
The amplitude of all unwanted emissions outside of the authorized frequency band is confirmed that it is attenuated by at least the minimum requirements specified.

8. TEST DATA

8.1 Conducted Emissions

FCC §15.207, RSS-Gen Issue 4 8.8

Result

Frequency	Level(dBμV)		*)Factor	**) Line	Limit(dBμV)		Margin(dB)	
(MHz)	Q-Peak	Average	(dB)		Q-Peak	Average	Q-Peak	Average
0.15	25.8	9.7	10.4	N	66.0	56.0	40.2	46.3
0.17	21.3	7.4	10.3	L	65.0	55.0	43.7	47.6
0.19	17.5	12.8	10.4	N	64.0	54.0	46.5	41.2
0.23	12.6	9.1	10.4	N	62.4	52.4	49.8	43.3
24.00	20.9	9.3	11.5	L	60.0	50.0	39.1	40.7
26.00	21.3	7.8	11.8	N	60.0	50.0	38.7	42.2

Line Conducted Emissions Tabulated Data

Notes:

1. Measurements using CISPR quasi-peak mode & average mode.

2. All modes of operation were investigated and the worst -case emission are reported. See attached Plots.

*3. *) Factor = LISN + Cable Loss*

*4. **) LINE : L = Line , N = Neutral*

5. The limit is on the FCC Part section 15.207(a) and IC RSS-Gen Issue 4 8.8

PLOTS OF EMISSIONS

- ***Conducted Emission (Line)***

NEMKO KOREA (NK-15-R-0123) 12 Dec 2015 17:56

Conducted Emissions

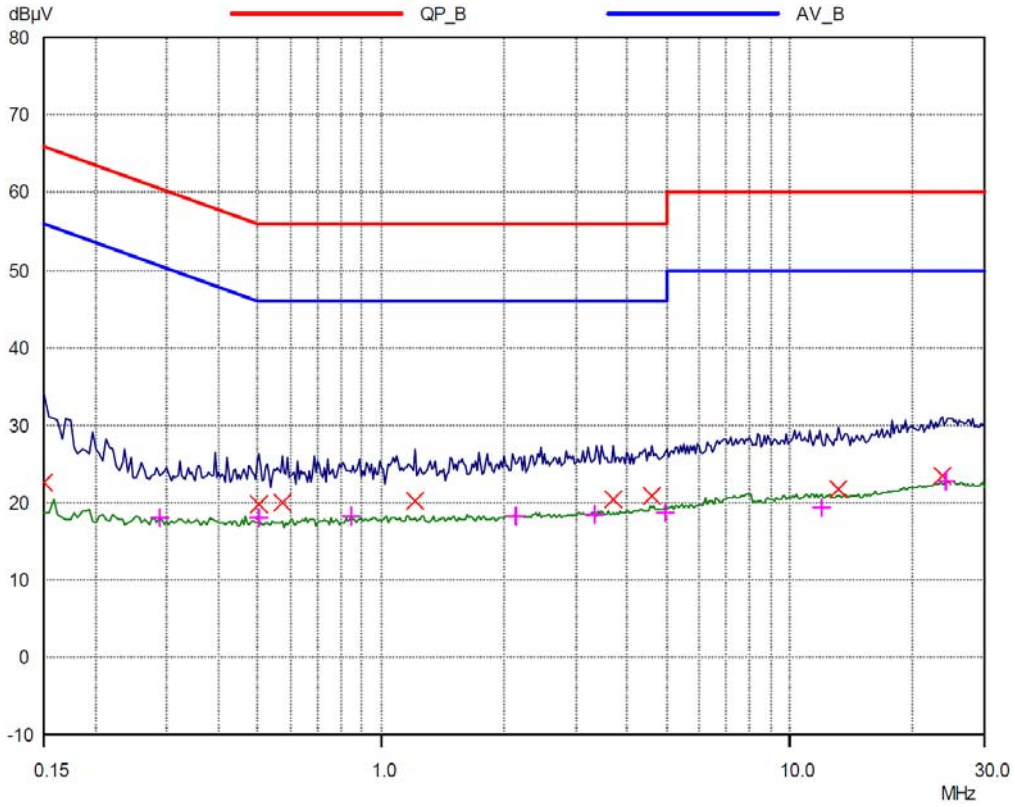
EUT:	EUT
Manuf:	i-SENS, Inc.
Op Cond:	a.c. 120 V / 60 Hz, LE
Operator:	Wonho. Son
Test Spec:	FCC Part 15
Comment:	MODEL : BM001
	LINE : LINE-PE
Result File:	r123_l.dat : New Measurement

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	20 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	150kHz	30MHz	ESH3_Z5_Line

Final Measurement:		
	Detectors:	X QP / + AV
	Meas Time:	1sec
	Subranges:	8
	Acc Margin:	60 dB



PLOTS OF EMISSIONS

- ***Conducted Emission (Neutral)***

NEMKO KOREA (NK-15-R-0123) 12 Dec 2015 17:43

Conducted Emissions

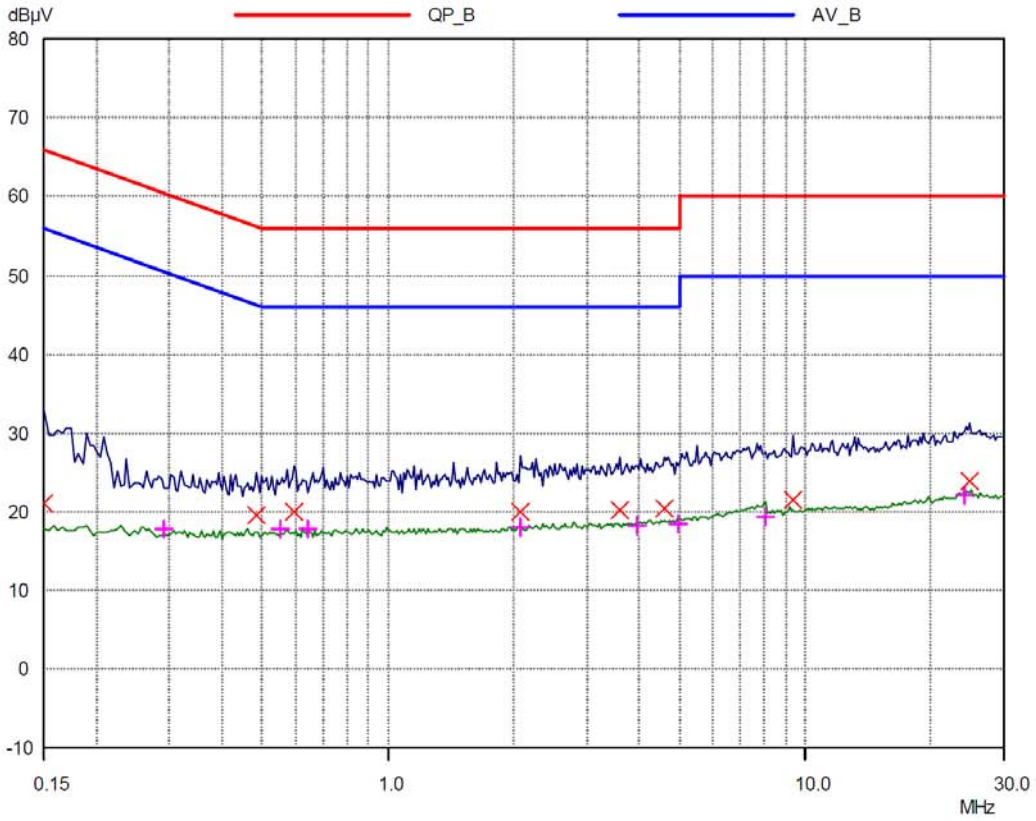
EUT:	EUT
Manuf:	i-SENS, Inc.
Op Cond:	a.c. 120 V / 60 Hz, LE
Operator:	Wonho. Son
Test Spec:	FCC Part 15
Comment:	MODEL : BM001
	LINE : NEUTRAL-PE
Result File:	r123_n.dat : New Measurement

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	20 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	150kHz	30MHz	ESH3_Z5_Neutral

Final Measurement:		
	Detectors:	X QP / + AV
	Meas Time:	1sec
	Subranges:	8
	Acc Margin:	60 dB



8.2 Radiated Emissions

FCC §15.209, RSS-Gen Issue 4 8.9

Result

Frequency (MHz)	Reading (dBµV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
350.29	48.60	H	100	101	-18.7	29.9	46.0	16.1
353.79	48.70	H	100	106	-18.6	30.1	46.0	15.9
395.06	47.90	H	100	299	-17.4	30.5	46.0	15.5
398.84	47.80	H	100	305	-17.3	30.5	46.0	15.5
401.90	47.20	H	100	314	-17.3	29.9	46.0	16.1
432.02	49.00	H	100	112	-16.5	32.5	46.0	13.5

Radiated Measurements at 3meters

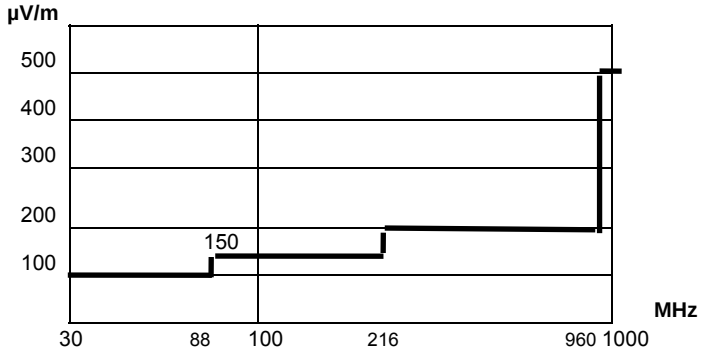


Fig. 3. Limits at 3 meters

Notes:

1. All modes were measured and the worst-case emission was reported.

2 The radiated limits are shown on Figure 3. Above 1GHz the limit is 500 µV /m.

*3. *Pol. H = Horizontal, V = Vertical*

*4. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

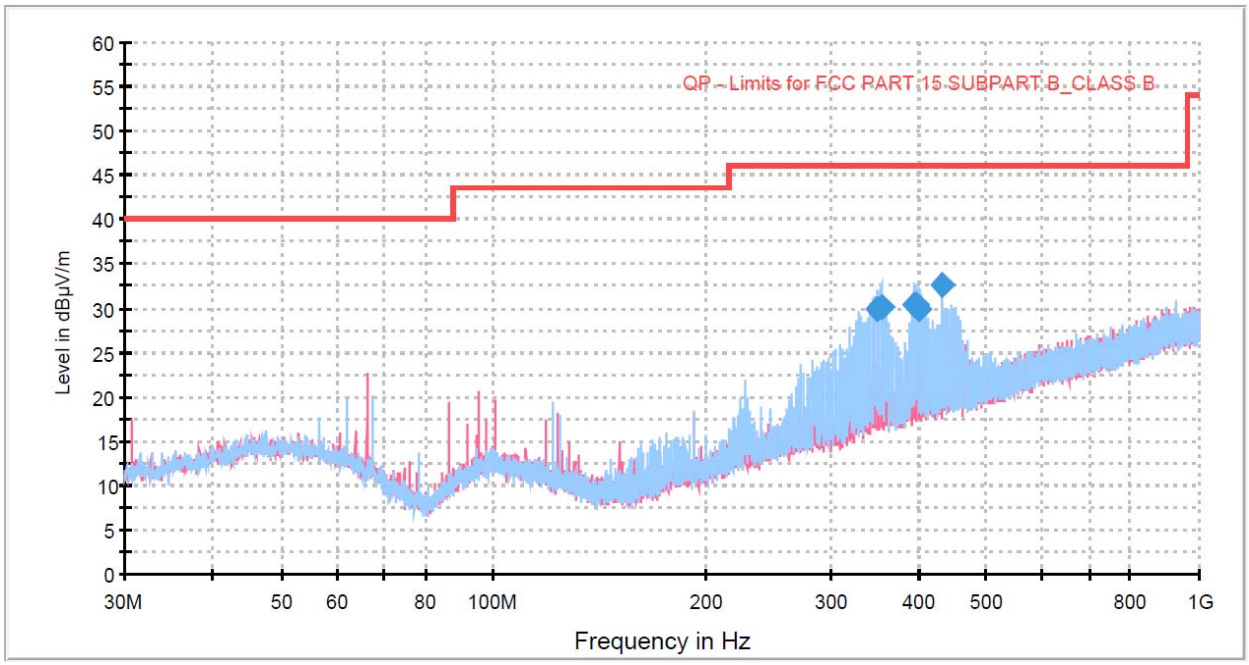
5. Measurements using CISPR quasi-peak mode below 1 GHz.

6. The radiated emissions testing were made by rotating the receive antenna with horizontal, Vertical polarization. The worst date was recorded.

7. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

PLOTS OF EMISSIONS

Worst Case : 2442 MHz GFSK modulation



8.3 6 dB Modulated Bandwidth

FCC §15.247(a)(2), IC RSS-247 Issue 1 5.2

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

Channel	Frequency (MHz)	6 dB modulated bandwidth (MHz)	Limit (MHz)	Margin (MHz)
Lowest	2402	0.78	0.50	0.28
Middle	2442	0.79	0.50	0.29
Highest	2480	0.80	0.50	0.30

PLOTS OF EMISSIONS

6 dB Bandwidth, Lowest Channel (2402 MHz)

6 dB Bandwidth, Middle Channel (2442 MHz)

PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (2480 MHz)

8.4 Peak Output Power and E.I.R.P.

FCC §15.247(b)(3), IC RSS-247 Issue 1 5.4(4)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

Modulation	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	E.I.R.P* (dBm)	Limit (dB)	Result
GFSK	2402	-0.44	30.00	1.06	36.00	Complies
GFSK	2441	-0.61	30.00	0.89	36.00	Complies
GFSK	2480	-0.96	30.00	0.54	36.00	Complies

Note:

The following formular was used for spectrum offset:

Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

***)** *E.I.R.P was calculated by following equation according to KDB412172 D01 Determining ERP and EIRP v01*

E.I.R.P = P_T + G_T – Lc

P_T = Peak outputpower (dBm)

G_T = Gain of the transmitting antenna in dBi, Peak antenna gain is 1.5dBi.

L_C = Signal attenuation in the connecting cable between the transmitter and antenna in dB. This factor of an integral antenna is negligible.

PLOT OF TEST DATA

Maximum Peak Output Power, Lowest Channel (2402 MHz)

Maximum Peak Output Power, Middle Channel (2442 MHz)

PLOT OF TEST DATA

Maximum Peak Output Power, Highest Channel (2480 MHz)

8.5 Peak Power Spectral Density

FCC §15.247(e), IC RSS-247 Issue 1 5.2

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

Channel	Frequency(MHz)	Result(dBm)	Limit (dBm)
Low	2402	-1.84	8.0
Middle	2442	-2.19	8.0
High	2480	-2.56	8.0

Note:

The following equation was used for spectrum offset:

Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

PLOT OF TEST DATA

Peak Power Spectral Density, Lowest Channel (2402 MHz)

Peak Power Spectral Density, Middle Channel (2442 MHz)

PLOT OF TEST DATA

Peak Power Spectral Density, Highest Channel (2480 MHz)

8.6 Conducted Spurious Emissions

FCC §15.247(d), IC RSS-247 Issue 1 5.5

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

Channel	Frequency (MHz)	Reference Level (dBm)*	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2402	-1.84	More than 20 dBc	20
Middle	2442	-2.19	More than 20 dBc	20
High	2480	-2.59	More than 20 dBc	20

Note:

The cable and attenuator loss from 30 MHz to 25 GHz was reflected in spectrum analyzer with correction factor for the spurious emissions test.

**) Peak power spectral density measured in 8.5 was used for reference level.*

PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2402 MHz)

Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2442 MHz)

PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2480 MHz)

PLOT OF TEST DATA

Band Edge, Lowest Channel (2402 MHz)

Band Edge, Highest Channel (2480 MHz)

8.7 Radiated Spurious Emissions

FCC §15.247(d), IC RSS-247 Issue 1 5.5

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

Lowest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4803.94	44.4	V	peak	9.4	53.8	74.0	20.2
4803.94	34.3	V	average	9.4	43.7	54.0	10.3
7205.92	43.7	H	peak	16.3	60.0	74.0	14.0
7205.92	30.5	H	average	16.3	46.8	54.0	7.2

Middle Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4883.79	45.1	V	peak	9.7	54.8	74.0	19.2
4883.79	32.5	V	average	9.7	42.2	54.0	11.8
7326.34	43.5	H	peak	16.8	60.3	74.0	13.7
7326.34	30.6	H	average	16.8	47.4	54.0	6.6

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4960.01	45.3	H	peak	9.9	55.2	74.0	18.8
4960.01	36.0	H	average	9.9	45.9	54.0	8.1
7440.29	44.8	H	peak	17.0	61.8	74.0	12.2
7440.29	34.7	H	average	17.0	51.7	54.0	2.3

Note:

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

3. Other spurious was under 20 dB below Fundamental.

4. GFSK modulation mode was the worst condition.

5. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.

6. Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.

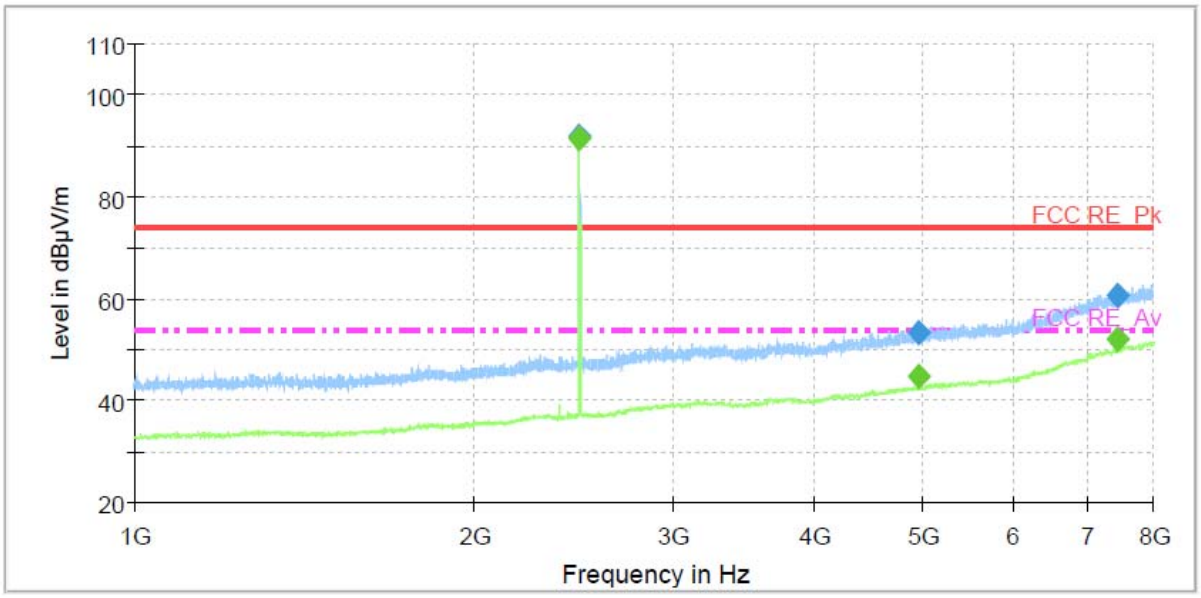
7. For average measurements, "12.2.5.1 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r03" was used.

8. The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 3nd harmonic for this device.

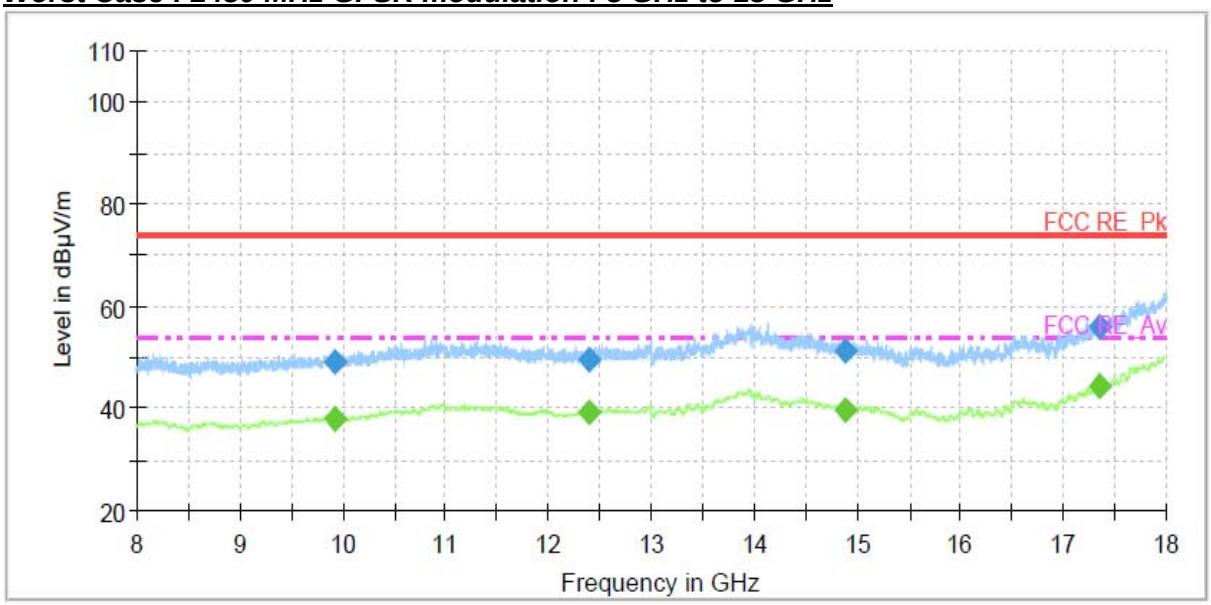
9. At frequencies above 1 GHz, EUT was placed at a height of 1.5m above the floor on a support according to ANSI 63.10-2013.

PLOTS OF EMISSIONS

Worst Case : 2480 MHz GFSK modulation : 1 GHz to 8 GHz

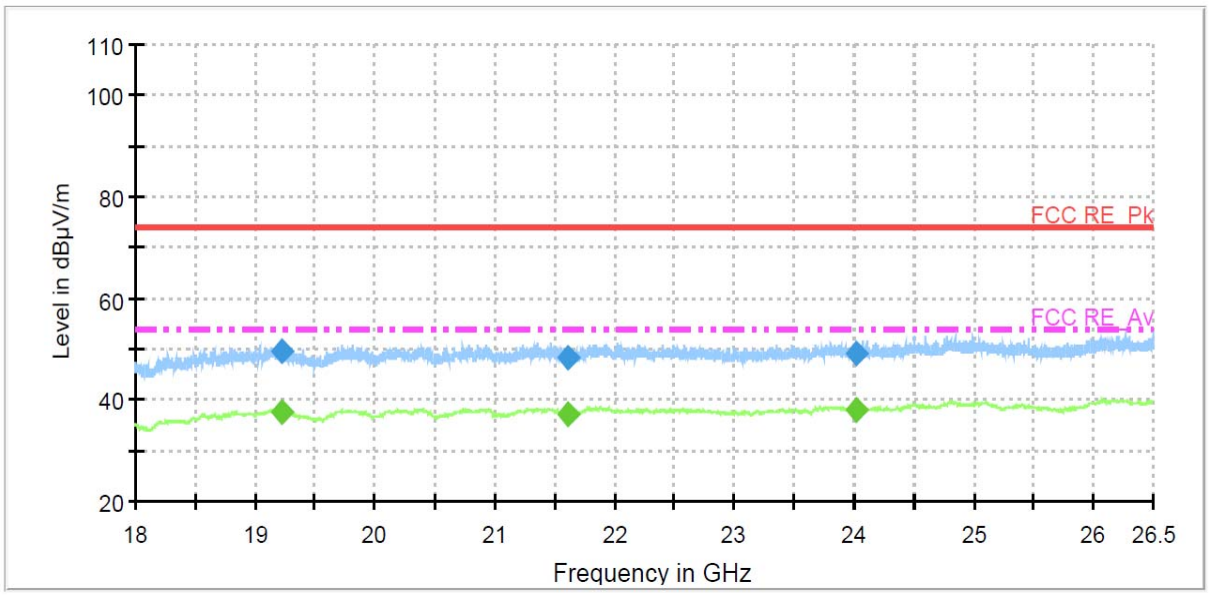


Worst Case : 2480 MHz GFSK modulation : 8 GHz to 18 GHz



PLOTS OF EMISSIONS

Worst Case : 2480 MHz GFSK modulation : 18 GHz to 26.5 GHz



8.8 Radiated Band Edge

FCC §15.247(d), RSS-247 Issue 1 5.5

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

Lowest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2390.00	45.70	V	peak	0.40	45.30	74.0	28.70
2390.00	34.37	V	average	0.40	33.97	54.0	20.03

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2483.50	54.60	H	peak	0.80	53.80	74.0	20.20
2483.50	52.45	H	average	0.80	51.65	54.0	2.35

Note:

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

3. Other spurious was under 20 dB below Fundamental.

4. GFSK modulation mode was the worst condition.

5. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.

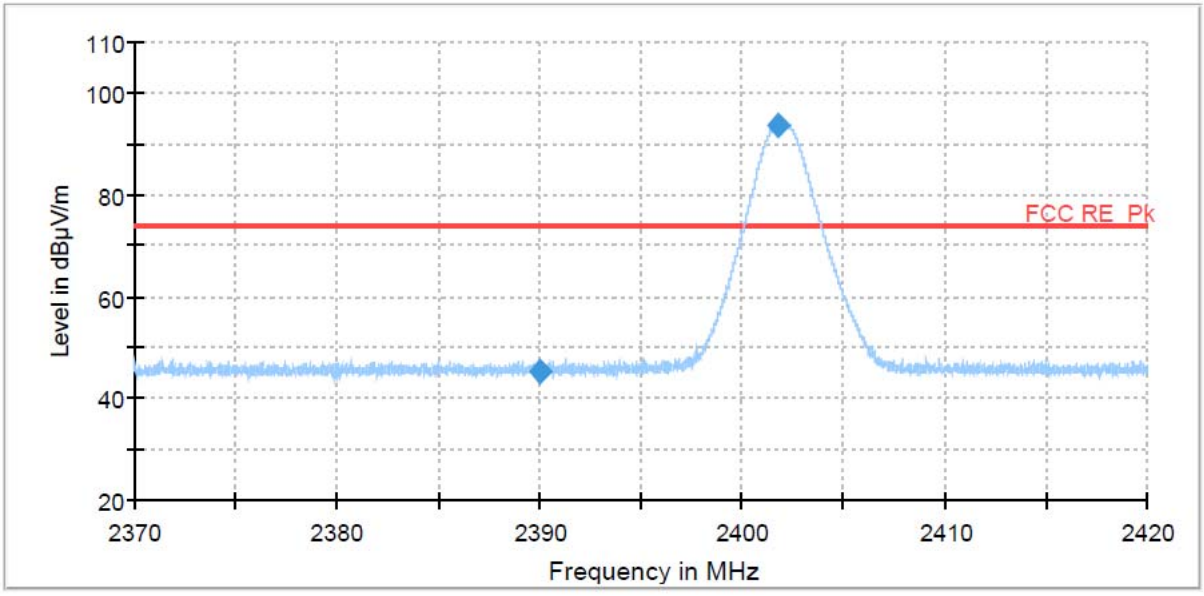
6. Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.

7. For average measurements, "12.2.5.1 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r03" was used.

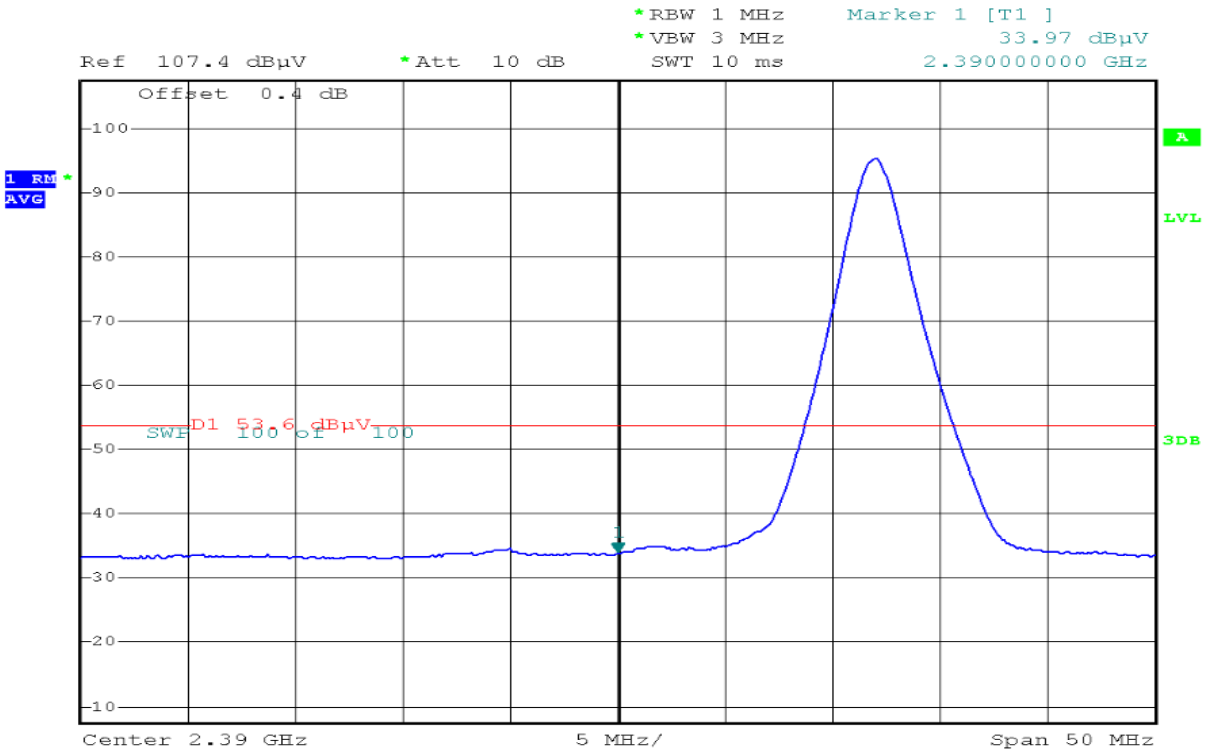
8. At frequencies above 1 GHz, EUT was placed at a height of 1.5m above the floor on a support according to ANSI 63.10-2013.

PLOT OF TEST DATA

Restricted Band Spurious Emissions, Lowest channel (Peak)

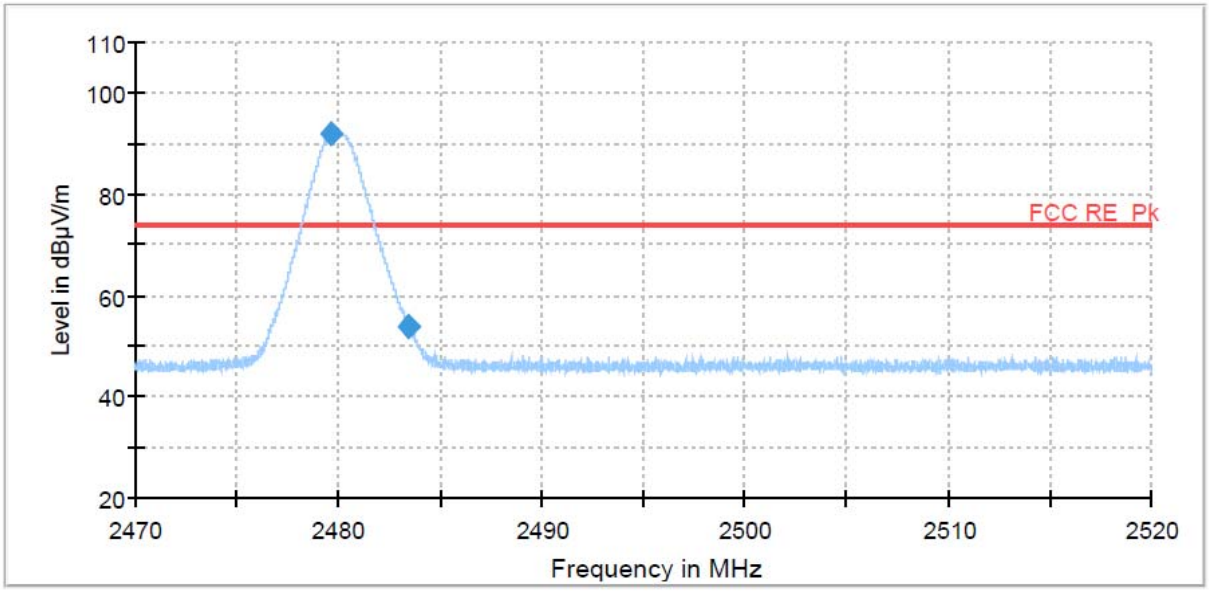


Restricted Band Spurious Emissions, Lowest channel (Average)

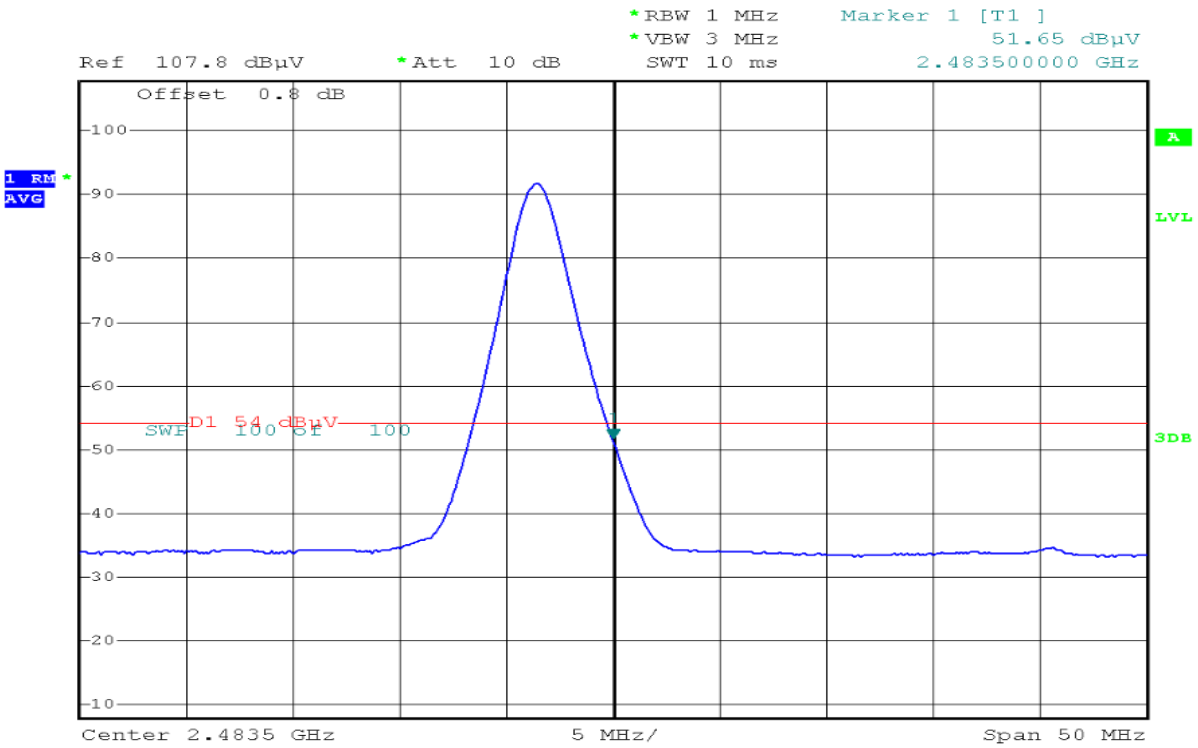


PLOT OF TEST DATA

Restricted Band Spurious Emissions, Highest channel (Peak)



Restricted Band Spurious Emissions, Highest channel (Average)



9. TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESU 40	100202	Apr. 01 2015	1 year
2	*Test Receiver	R & S	ESCS30	100302	Oct. 06 2015	1 year
3	Attenuator	AGILENT	8491B	57773	Oct. 06 2015	1 year
4	*Attenuator	FAIRVIEW	SA3N5W-06	N/A	Apr. 01 2015	1 year
5	*Attenuator	FAIRVIEW	SA3N5W-10	N/A	Apr. 01 2015	1 year
6	*Attenuator	WEINSCHEL	56-10	58765	Apr. 02 2015	1 year
7	*Amplifier	R & S	SCU 01	10030	Apr. 01 2015	1 year
8	*Amplifier	R & S	SCU18	10065	Apr. 01 2015	1 year
9	*Amplifier	R & S	SCU26	10011	Jul. 17 2015	1 year
10	Amplifier	R & S	SCU40	10008	Aug. 10 2015	1 year
11	*Pre Amplifier	HP	8449B	3008A00107	Jan. 09 2015	1 year
12	Spectrum Analyzer	R & S	FSW43	100732	Apr. 07 2015	1 year
13	*Spectrum Analyzer	Agilent	E4440A	MY44022567	Apr. 01 2015	1 year
14	*Spectrum Analyzer	R&S	FSP40	100361	Jul. 16 2015	1 year
15	*DC Power Supply	Protek	PL-5003S	PL5003S0201	Jul. 17 2015	1 year
16	*Loop Antenna	R & S	HFH2-Z2	100279	Feb. 13 2014	2 year
17	*Wideband Power Sensor	R & S	NRP-Z81	100634	Jul. 17 2015	1 year
18	*Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-474	Sep. 01 2014	2 year
19	*Horn Antenna	Q-par Angus	QSH20S20	8179	Apr. 30 2015	2 year
20	Horn Antenna	Q-par Angus	QSH22K20	8180	Apr. 30 2015	2 year
21	*Trilog-Broadband Antenna	SCHWARZBECK	VULB 9163	9163-454	Nov. 11 2014	2 year
22	*LISN	R & S	ESH3-Z5	833874/006	Oct. 06 2015	1 year
23	*Controller	INNCO	CO2000-G	CO2000/562/23890210/L	N/A	N/A
24	*Turn Table	INNCO	DT3000-3T	N/A	N/A	N/A
25	*Antenna Mast	INNCO	MA4000-EP	N/A	N/A	N/A
26	*Open Switch And Control Unit	R & S	OSP-120	100015	N/A	N/A
27	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
28	*Position Controller	INNCO	CO2000	12480406/L	N/A	N/A
29	*Turn Table	INNCO	DS1200S	N/A	N/A	N/A
30	*Antenna Mast	INNCO	MA4000	N/A	N/A	N/A
31	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
32	Shielded Room	Seo-Young EMC	N/A	N/A	N/A	N/A
33	*Open Switch And Control Unit	R & S	OSP-120	100081	N/A	N/A

*) Test equipment used during the test

10. ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of measurement uncertainty contained in CISPR 16-4-2 with the confidence level of 95%

1. Conducted Uncertainty Calculation

Source of Uncertainty	Xi	Uncertainty of Xi		Coverage factor k	u(Xi) (dB)	Ci	Ci u(Xi) (dB)
		Value (dB)	Probability Distribution				
Receiver reading	RI	± 0.1	normal 1	1.000	0.1	1	0.1
Attenuation AMN-Receiver	LC	± 0.08	normal 2	2.000	0.04	1	0.04
AMN Voltage division factor	LAMN	± 0.8	normal 2	2.000	0.4	1	0.4
Sine wave voltage	dVSW	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	dVPA	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	dVPR	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	dVNF	± 0.00	-	-	0.00	1	0.00
AMN Impedance	dZ	± 1.80	triangular	2.449	0.73	1	0.73
ⓐ Mismatch	M	+ 0.70	U-Shaped	1.414	0.49	1	0.49
ⓑ Mismatch	M	- 0.80	U-Shaped	1.414	- 0.56	1	- 0.56
Measurement System Repeatability	RS	0.05	normal 1	1.000	0.05	1	0.05
Remark	ⓐ: AMN-Receiver Mismatch : + ⓑ: AMN-Receiver Mismatch : -						
Combined Standard Uncertainty	Normal			± 1.88			
Expended Uncertainty U	Normal (k = 2)			± 3.76			

2. Radiation Uncertainty Calculation

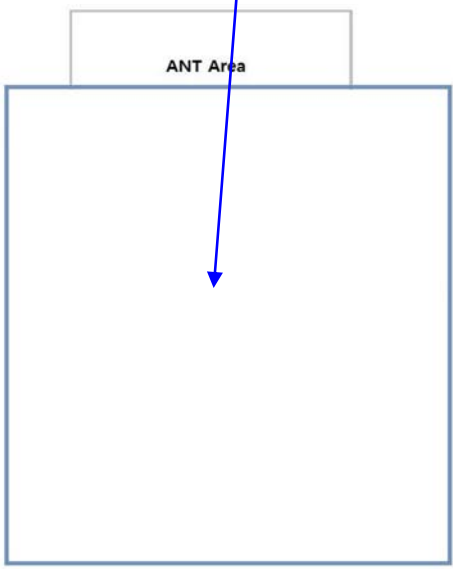
Source of Uncertainty	Xi	Uncertainty of Xi		Coverage factor k	u(Xi) (dB)	Ci	Ci u(Xi) (dB)
		Value (dB)	Probability Distribution				
Measurement System Repeatability	***RI***	0.34	normal 1	1.00	0.34	1	0.34
Receiver reading	***dVsw***	± 0.02	normal 2	2.00	0.01	1	0.01
Sine wave voltage	***dVpa***	± 0.17	normal 2	2.00	0.09	1	0.09
Pulse amplitude response	***dVpr***	± 0.92	normal 2	2.00	0.46	1	0.46
Pulse repetition rate response	***dVnf***	± 0.35	normal 2	2.00	0.18	1	0.18
Noise floor proximity	***AF***	± 0.50	normal 2	2.00	0.25	1	0.25
Antenna Factor Calibration	***CL***	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Cable Loss	***AD***	± 1.00	normal 2	2.00	0.50	1	0.50
Antenna Directivity	***AH***	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
Antenna Factor Height Dependence	***AP***	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Antenna Phase Centre Variation	***AI***	± 0.20	rectangular	$\sqrt{3}$	0.12	1	0.12
Antenna Factor Frequency Interpolation	***SI***	± 0.25	rectangular	$\sqrt{3}$	0.14	1	0.14
Site Imperfections	***DV***	± 4.00	triangular	$\sqrt{6}$	1.63	1	1.63
Measurement Distance Variation	***Dbal***	± 0.60	rectangular	$\sqrt{3}$	0.35	1	0.35
Antenna Balance	***DCross***	± 0.90	rectangular	$\sqrt{3}$	0.52	1	0.52
Cross Polarisation	***M***	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.18
Mismatch	***M***	+ 0.98 - 1.11	U-Shaped	$\sqrt{2}$	0.74	1	0.74
EUT Volume Diameter	***M***	0.33	normal 1	1.00	0.33	1	0.11
Remark							
Combined Standard Uncertainty	Normal						
Expended Uncertainty U	Normal (k = 2)						

APPENDIX A – LABELLING REQUIREMENTS

Labelling Requirements

The sample label shown shall be *permanently affixed* at a conspicuous location on the device and be readily visible to the user at the time of purchase.

※ See other informations in the manual



< Front Side of EUT >