

FCC EVALUATION REPORT FOR CERTIFICATION

Applicant: OHSUNG ELECTRONICS CO., LTD.**#181 Gongdan-dong , Gumi-si, Gyeongbuk****Republic of Korea.****Attn : Mr. Hak-Ki Kim / General Manager****Date of Issue: Apr. 20, 2018****Order Number: GETEC-C1-18-132****Test Report Number: GETEC-E3-18-004****Test Site: GUMI UNIVERSITY EMC CENTER****FCC Test Firm Registration No.: 269701****FCC ID. : OZ5URCMRX15****Applicant : OHSUNG ELECTRONICS CO., LTD.**

Rule Part(s)	: FCC Part 15 Subpart B
Equipment Class	: Class B computing device peripheral(JBP)
EUT Type	: BASE STATION
Type of Authority	: Certification
Model Name	: MRX-15
Trade Name	: UNIVERSAL Remote Control

This equipment has been shown to be in compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4 (2014)

I attest to the accuracy of data. 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.

Tested by,**Reviewed by,**

Soon-Hoon Jeong , Senior Engineer
GUMI UNIVERSITY EMC CENTER



Hyoung-Seop Kim, Technical Manager
GUMI UNIVERSITY EMC CENTER



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Scope: Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and / or unintentional radiators for compliance with technical rules and regulations of the Federal Communications Commission.

1. General Information

Applicant: OHSUNG ELECTRONICS CO.,LTD.

Applicant Address: #181, Gongdan 1-dong, Gumi-si, Gyeongsangbuk-do, Republic of Korea

Manufacturer: OHSUNG ELECTRONICS CO.,LTD.

Manufacturer Address: #181, Gongdan 1-dong, Gumi-si, Gyeongsangbuk-do, Republic of Korea

Contact Person: Mr. Hak-Ki Kim / General Manager

Telephone Number: +82-54-468-7281 **Fax Number:** +82-54-461-8368

- **FCC ID** OZURMRX15
- **EUT Type** BASE STAION
- **Model Name** MRX-15
- **Trade Name** UNIVERSAL Remote Control
- **Serial Number** Prototype
- **Rule Part(s)** FCC Part 15 Subpart B
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.4 (2014)
- **Dates of Test** Mar. 28 ~ 29, 2018
- **Place of Test** **GUMI UNIVERSITY EMC CENTER**
(FCC Test firm Registration Number: 269701)
37 Yaeun-ro, Gumi-si, Gyeongsangbuk-do, 730-711, Republic of Korea.
- **Test Report Number** GETEC-E3-18-004
- **Date of Issue** Apr. 20, 2018



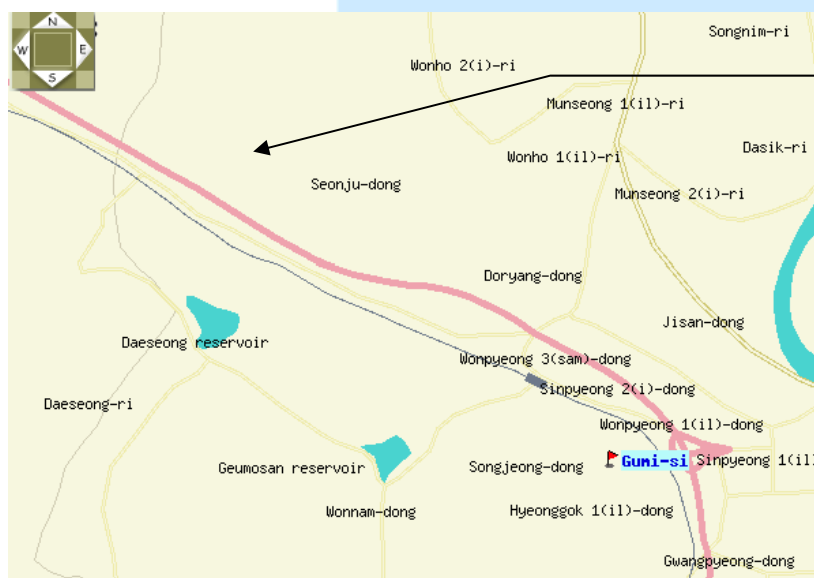
2. Introduction

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Nose Emissions From Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014) was used in determining radiated and conducted emissions emanating from **OHSUNG ELECTRONICS CO., LTD. BASE STATION (Model Name: MRX-15)**

These measurement tests were conducted at **GUMI UNIVERSITY EMC CENTER**

The site address is 37 Yaeun-ro, Gumi-si, Gyeongsangbuk-do, 730-711, Republic of Korea.

This test site is one of the highest point of Gumi University at about 200 km away from Seoul city and 40 km away from Daegu city. 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 §2.948 according to ANSI C63.4 (2014)



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Fig 1. The map above shows the Gumi university in vicinity area.



3. Product Information

3.1 Description of EUT

The Equipment under Test (EUT) is the **OHSUNG ELECTRONICS CO., LTD.**
BASE STATION (Model Name: MRX-15)

Microprocessor: I.MX6Dual 1.0GHz

Memory: 8GB eMMC, 1GB RAM

Network: One 10/100/1000M RJ45 Ethernet Port

Weight: 73.83oz

Size: 17.07" (W) x 8.3" (D) x 2.03" (H)

Power: DC 12V/3.3A

Highest Clock frequency	: 1.0 GHz
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3.2 Support Equipment / Cables used

3.2.1 Used Support Equipment

Description	Manufacturer	Model Name	S/N & FCC ID.
AMBIENT LIGHT Sensor	Ohsung Electronics Co., Ltd.	SEN-LITE	S/N : N/A FCC ID : N/A
VOLTAGE Sensor	Ohsung Electronics Co., Ltd.	SEN-VOLT	S/N : N/A FCC ID : N/A
NoteBook Computer	SAMSUNG	NT-R540	S/N : AZKW93AZC01238K FCC ID : N/A

See “Appendix E– Test Setup Photographs” for actual system test set-up

3.2.2 System configuration

Description	Manufacturer	Model Name	S/N & FCC ID.
AC/DC Adaptor ¹⁾	EDAC POWER ELECTRONICS CO LTD	EA10681B-120	S/N : N/A FCC ID. : N/A
BASE STATION	OHSUNG Electronics Co., Ltd.	MRX-15	S/N : N/A FCC ID. : OZ5URCMRX15

1) Input: AC (100-240) V ~2.0 A,(50-60) Hz ; Output: DC 12 V, 3.33A



3.2.3 Used Cable(s)

Cable Name	Condition	Description
AC Power cable	Connected to the AC/DC Adaptor and power supply	1.80 m unshielded
AC/DC Adaptor	Connected to the EUT	1.20 m Shielded with a ferrite core
IR Emitter #1	Connected to the EUT	3.00m unshielded
IR Emitter #2	Connected to the EUT	3.00m unshielded
IR Emitter #3	Connected to the EUT	3.00m unshielded
IR Emitter #4	Connected to the EUT	3.00m unshielded
IR Emitter #5	Connected to the EUT	3.00m unshielded
IR Emitter #6	Connected to the EUT	3.00m unshielded
IR Emitter #7	Connected to the EUT	3.00m unshielded
IR Emitter #8	Connected to the EUT	3.00m unshielded
AMBIENT LIGHT Sensor	Connected to the EUT	1.40m unshielded
AMBIENT LIGHT Sensor	Connected to the EUT	1.40m unshielded
VOLTAGE Sensor	Connected to the EUT	1.40m unshielded
VOLTAGE Sensor	Connected to the EUT	1.40m unshielded
LAN cable	Connected to the EUT and the Ethernet networks	10.00 m unshielded
RS232C cable	Connected to the EUT and the notebook computer	4.80 m Shielded with a ferrite core

3.3 Modification Item(s)

- None.



4. Description of tests

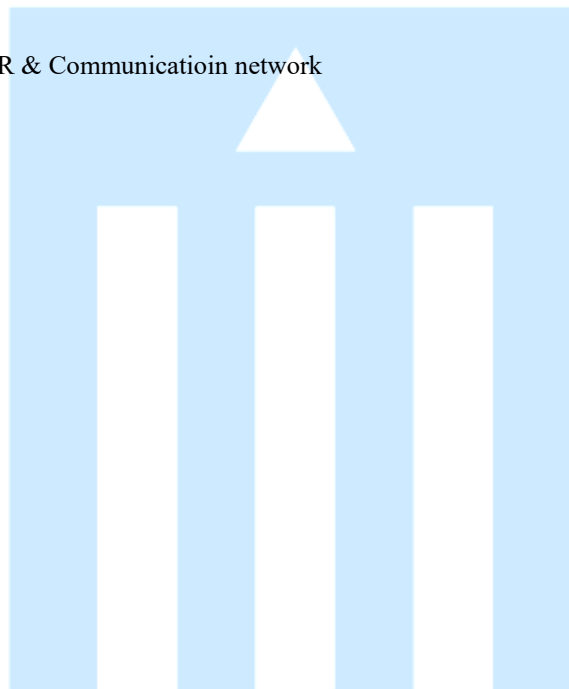
4.1 Test Condition

The EUT was installed, arranged and operated in a manner that is most representative of equipment as typically used. The measurements were carried out while varying operating modes and cable positions within typically arrangement to determine maximum emission level.

The representative and worst test mode(s) were noted in the test report.

The test conditions of the noted test mode(s) in this test report are;

- Test Voltage / Frequency : AC 120 V / 60 Hz
- Test Mode(s)
 - Normal operating mode
 - Continuous transmitting IR & Communication network





4.2 Conducted Emission

The Line conducted emission test facility is inside a 4 m × 8 m × 2.5 m shielded enclosure.

(Test firm Registration Number.: 269701)

The EUT was placed on a non-conducting 1.0 m by 1.5 m table, which is 0.8 m in height and 0.4 m away from the vertical wall of the shielded enclosure.

The EUT is powered from the Rohde & Schwarz LISN (ENV216) and the support equipment is powered from the Rohde & Schwarz LISN (ENV216). Powers to the LISN are filtered by high-current high insertion loss power line filter.

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 EMI test receiver (Rohde & Schwarz, ESCI).

Exploratory measurements were conducted to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Exploratory measurements were scanned using Peak mode of EMI Test receiver from 150 kHz to 30 MHz with 20 ms sweep time. The final measurements were measured with Quasi-Peak and Average mode.

The bandwidth of EMI Test Receiver was set to 9 kHz. Interface cables were connected to the available interface ports of the test unit. Excess cable lengths were bundled at center with 30 cm ~ 40 cm.

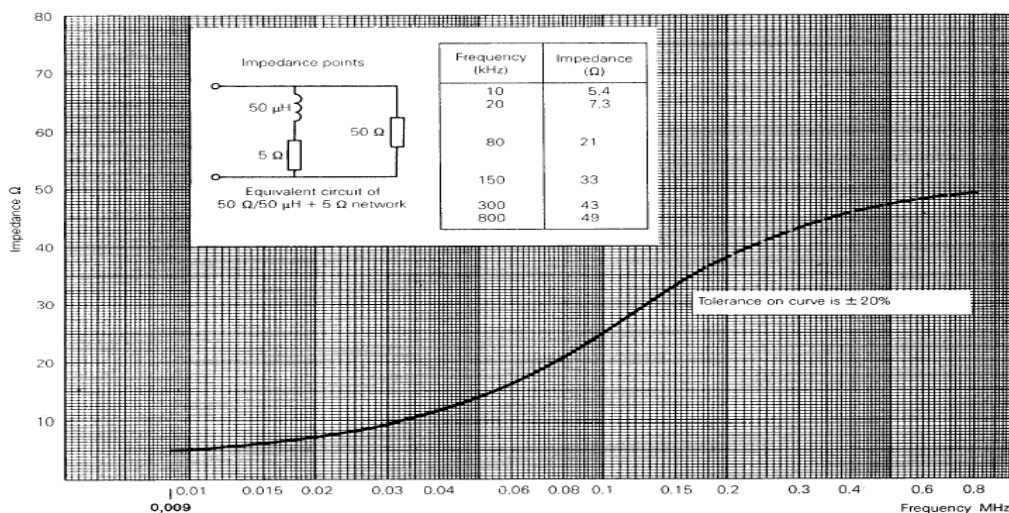


Fig 2. Impedance of LISN

4.3 Radiated Emission

Exploratory Radiated measurements were conducted at the 3 m semi anechoic chamber in order to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Final measurements of below 1GHz were made at 3 m Chamber (Test firm Registration Number.: 269701) or Open area test site (Test firm Registration Number.: 269701) that complies with CISPR 16/ANSI C63.4.

Above 1 GHz final measurements were conducted at the 3m Chamber (Test firm Registration Number.: 269701) only.

For measurements above 1GHz, the bottom side of 3 m chamber was installed with absorbers in order to meet SVSWR Limit.

Exploratory measurements were scanned using Peak mode of EMI Test receiver and final measurements were measured with Quasi-Peak mode (Below 1 GHz) and Peak & Average mode (Above 1 GHz).

The measurements were performed by rotating the EUT 360° and adjusting the receive antenna height from 1.0 m to 4.0 m. All frequencies were investigated in both horizontal and vertical antenna polarity.

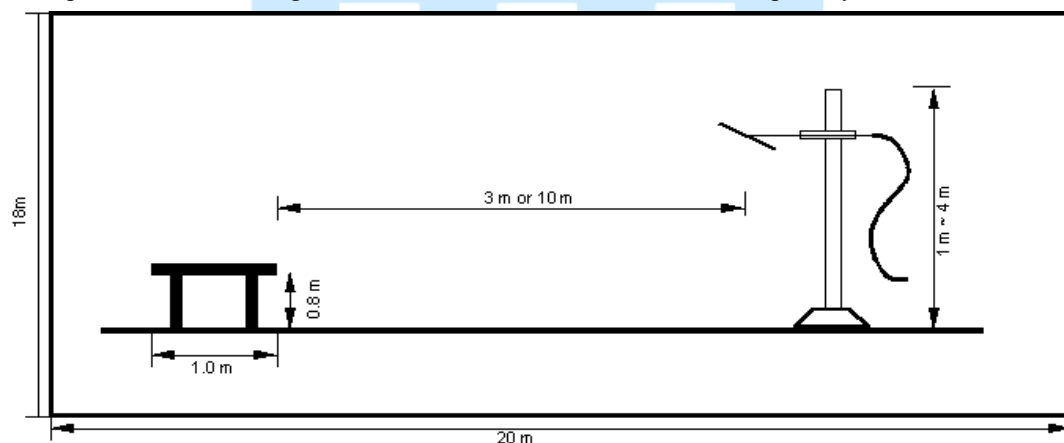


Fig 3. Dimensions of test site (Below 1 GHz)

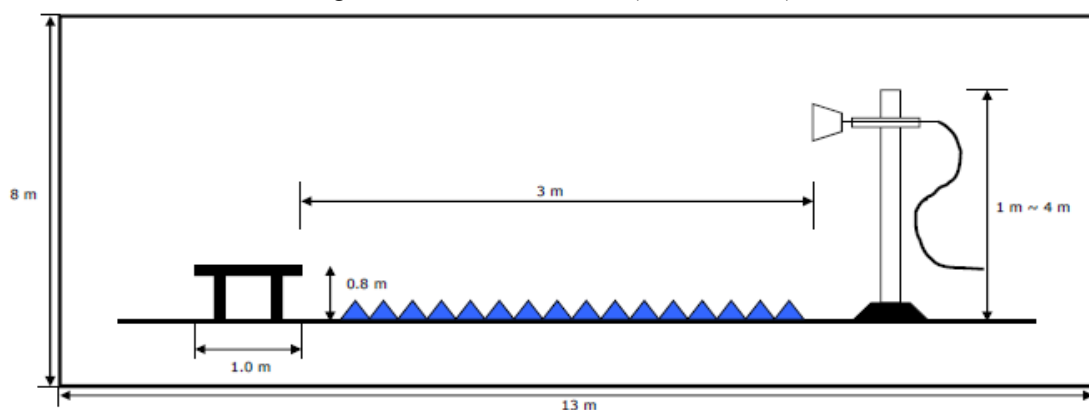


Fig 4. Dimensions of test site (Above 1 GHz)



5. Conducted Emission

5.1 Operating Environment

Temperature : 26.1 °C
Relative Humidity : 39.6 % R.H.

5.2 Test Set-up

The conducted emission measurements were performed in the shielded room.

The EUT was placed on wooden table, 0.8 m heights above the floor, 0.4 m from the reference ground plane (GRP) wall and 0.8 m from AMN & ISN.

AMN is bonded on horizontal reference ground plane.

The ground plane, which was electrically bonded to the shield room, ground system and all power lines entering the shield room, were filtered.

5.3 Measurement Uncertainty

The measurement uncertainty was calculated in accordance with ISO "Guide to the expression of uncertainty in measurement."

The measurement uncertainty was given with a confidence of 95 %.

Test Items	Uncertainty	Remark
Conducted emission (9 kHz ~ 150 kHz)	3.85 dB	Confidence level of approximately 95 % ($k = 2$)
Conducted emission (150 kHz ~ 30 MHz)	3.32 dB	Confidence level of approximately 95 % ($k = 2$)

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

The listed uncertainties are the worst case uncertainty for the entire range of measurement. please note that the uncertainty values are provided for informational purposes only are not used in determining the PASS/FAIL results



5.4 Limit

RFI Conducted	FCC Limit(dBμV/m) Class B	
Freq. Range	Quasi-Peak	Average
150 kHz ~ 0.5 MHz	66 ~ 56*	56 ~ 46*
0.5 MHz ~ 5 MHz	56	46
5 MHz ~ 30 MHz	60	50
*Limits decreases linearly with the logarithm of frequency.		

5.5 Test Equipment used

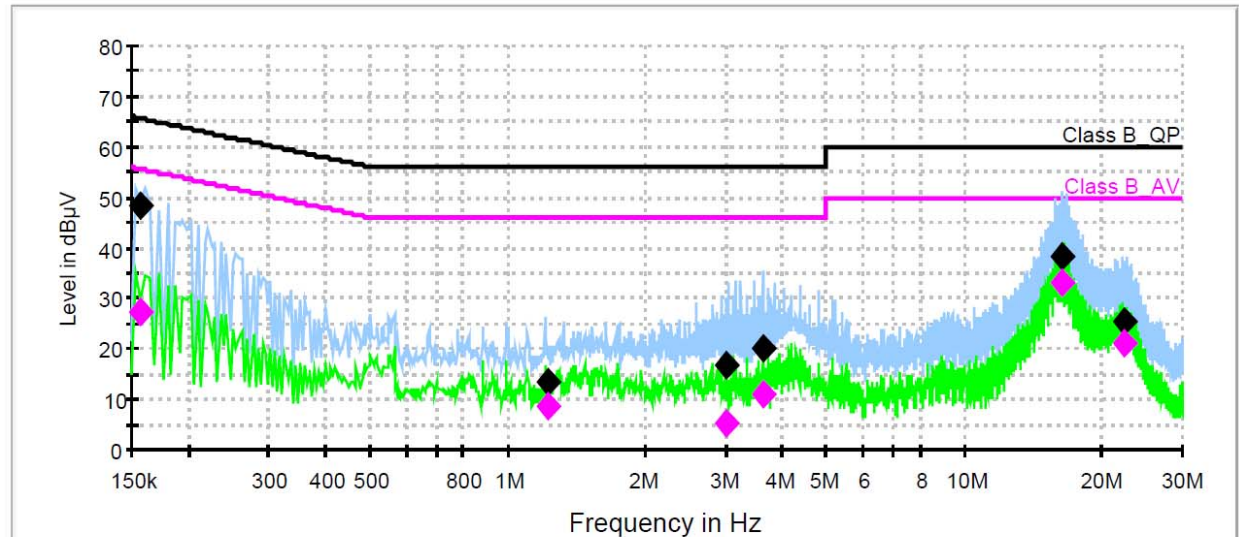
Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESCI	Rohde & Schwarz	EMI Test Receiver	100237	Apr. 18, 2018
■ - ENV216	Rohde & Schwarz	LISN	100172	Apr. 19, 2018
■ - ENV216	Rohde & Schwarz	LISN	100173	Apr. 19, 2018
■ - ENY81-CA6	Rohde & Schwarz	ISN	101573	May 22, 2018
□ - ISN T8	TESEQ.GmbH	ISN	24568	Apr. 21, 2018
■ - EMC 32	Rohde & Schwarz	Software	Ver.8.53	N/A

5.6 Test data for Conducted Emission

- Test Date : Mar. 28, 2018
- Resolution Bandwidth : 9 kHz
- Frequency Range : 0.15 MHz ~ 30 MHz
- Line : L1: Live, N: Neutral



- Operating condition: Normal operating mode



Class B_QP Class B_AV Preview Result 1-PK+
Preview Result 2-AVG Final Result 1-QPK Final Result 2-CAV

Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.253706	45.8	1000.0	9.000	Off	L1	9.6	15.9	61.6	
0.599161	41.9	1000.0	9.000	Off	L1	9.7	14.1	56.0	
0.778082	44.3	1000.0	9.000	Off	N	9.7	11.7	56.0	
0.939003	47.2	1000.0	9.000	Off	N	9.7	8.8	56.0	
1.104760	47.4	1000.0	9.000	Off	L1	9.7	8.6	56.0	
6.111658	37.1	1000.0	9.000	Off	L1	9.8	22.9	60.0	
11.861443	31.4	1000.0	9.000	Off	L1	9.9	28.6	60.0	

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.253706	41.7	1000.0	9.000	Off	L1	9.6	9.9	51.6	
0.599161	37.6	1000.0	9.000	Off	L1	9.7	8.4	46.0	
0.778082	38.4	1000.0	9.000	Off	N	9.7	7.6	46.0	
0.939003	40.7	1000.0	9.000	Off	N	9.7	5.3	46.0	
1.104760	35.0	1000.0	9.000	Off	L1	9.7	11.0	46.0	
6.111658	25.2	1000.0	9.000	Off	L1	9.8	24.8	50.0	
11.861443	23.8	1000.0	9.000	Off	L1	9.9	26.2	50.0	

< Fig 5. Graph of continuous disturbance >



6. Radiated Emission

6.1 Operating Environment

Temperature : 21.9 °C
Relative Humidity : 46.0 % R.H.

6.2 Test Set-up

A preliminary and final measurement was at 3 m anechoic chamber.

The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The turntable with EUT 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.

6.3 Measurement Uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement”.

The measurement uncertainty was given with a confidence of 95 %.

Test Items(10 m Anechoic Chamber)	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 10 m, Vertical)	3.50 dB	Confidence level of approximately 95 % (k = 2)
Radiated emission (30 MHz ~ 300 MHz, 10 m, Horizontal)	3.73 dB	Confidence level of approximately 95 % (k = 2)
Radiated emission (300 MHz ~ 1 000 MHz, 10 m, Vertical)	3.67 dB	Confidence level of approximately 95 % (k = 2)
Radiated emission (300 MHz ~ 1 000 MHz, 10 m, Horizontal)	3.64 dB	Confidence level of approximately 95 % (k = 2)
Radiated emission (1 000 MHz ~ 6 000 MHz, 3 m)	4.39 dB	Confidence level of approximately 95 % (k = 2)
Radiated emission (1 000 MHz ~ 18 000 MHz, 3 m)	4.50 dB	Confidence level of approximately 95 % (k = 2)

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

The listed uncertainties are the worst case uncertainty for the entire range of measurement. please note that the uncertainty values are provided for informational purposes only are not used in determining the PASS/FAIL results



6.4 Limit

Frequency (MHz)	FCC Limit @ 3 m. dB μ V/m	CISPR Limit @ 10 m. dB μ V/m
30 ~ 88	40.0	30.0
88 ~ 216	43.5	30.0
216 ~ 230	46.0	30.0
230 ~ 960	46.0	37.0
960 ~ 1 000	54.0	37.0

Frequency (MHz)	FCC Class B Peak Limit @ 3 m dB μ V/m	FCC Class B Average Limit@ 3 m dB μ V/m
> 1 000	74.0	54.0

6.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ ESR7	Rohde & Schwarz	EMI Test Receiver	101382	Apr. 18, 2018
■ VULB9160	Schwarzbeck	Broad Band Test Antenna	3099	Sep. 29, 2019
■ TK-PA06S	Testek	Low Noise Amplifier	170038-L	Jan. 15, 2019
■ CO3000	Innco system GmbH	Position Controller	CO03000/779/ 33050314/L	N/A
■ DT3000	Innco system GmbH	Turntable	1280314	N/A
■ MA4000-EP	Innco system GmbH	Antenna Mast	4420314	N/A
■ MA4640-XP-ET	Innco system GmbH	Antenna Mast	MA4640/558	N/A
■ EMC 32	Rohde & Schwarz	Software	Ver.9.26.01	N/A

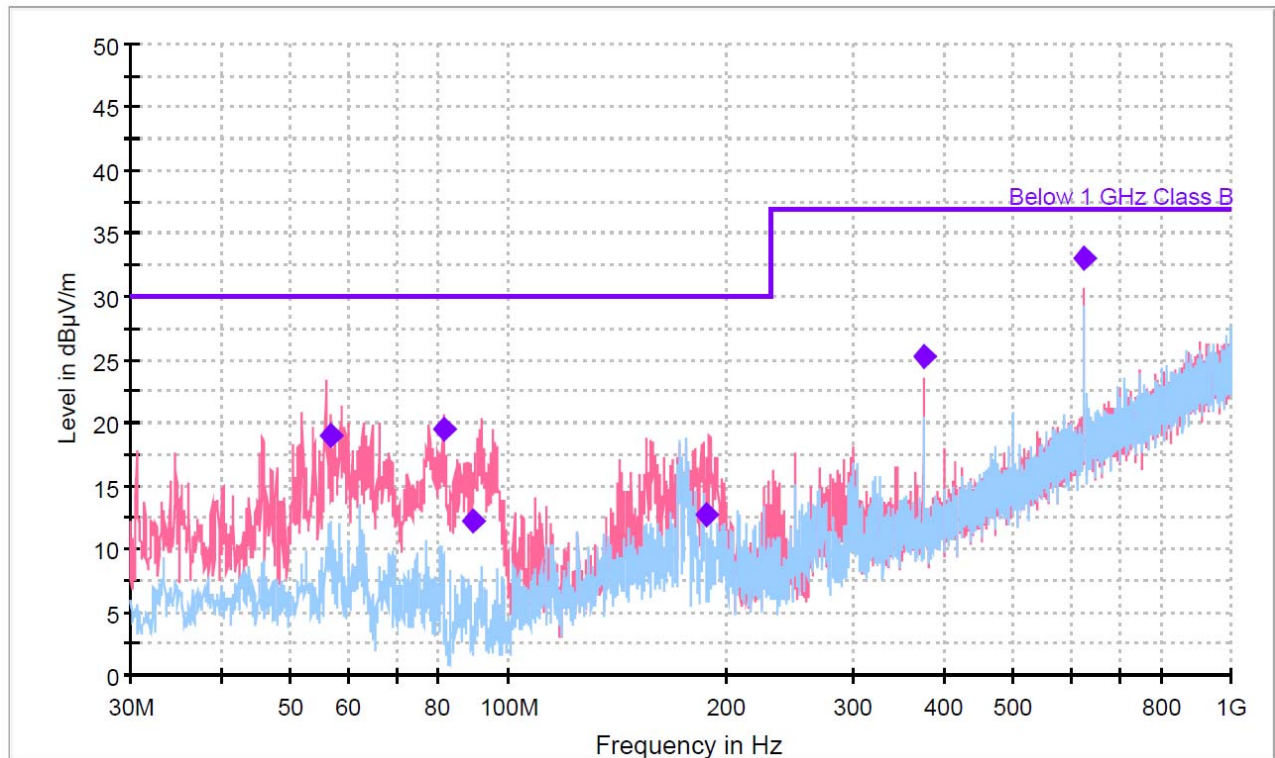
6.6 Test data for Radiated Emission

- Test Date : Mar. 29, 2018
- Measurement Distance : 10 m
- Note : The highest frequency of the internal source of the EUT is more than 108 MHz (1 000 MHz). According to Customer request has been extended up to 6 GHz.
- Measurement setting

Frequency range	30 MHz ~ 1 GHz	Above 1 GHz
Detector mode	Quasi peak	Peak / Average
Resolution bandwidth	120 kHz	1 MHz



- Operating condition: Normal operating mode



Preview Result 1V-PK+
Below 1 GHz Class B

Preview Result 1H-PK+
Final_Result QPK

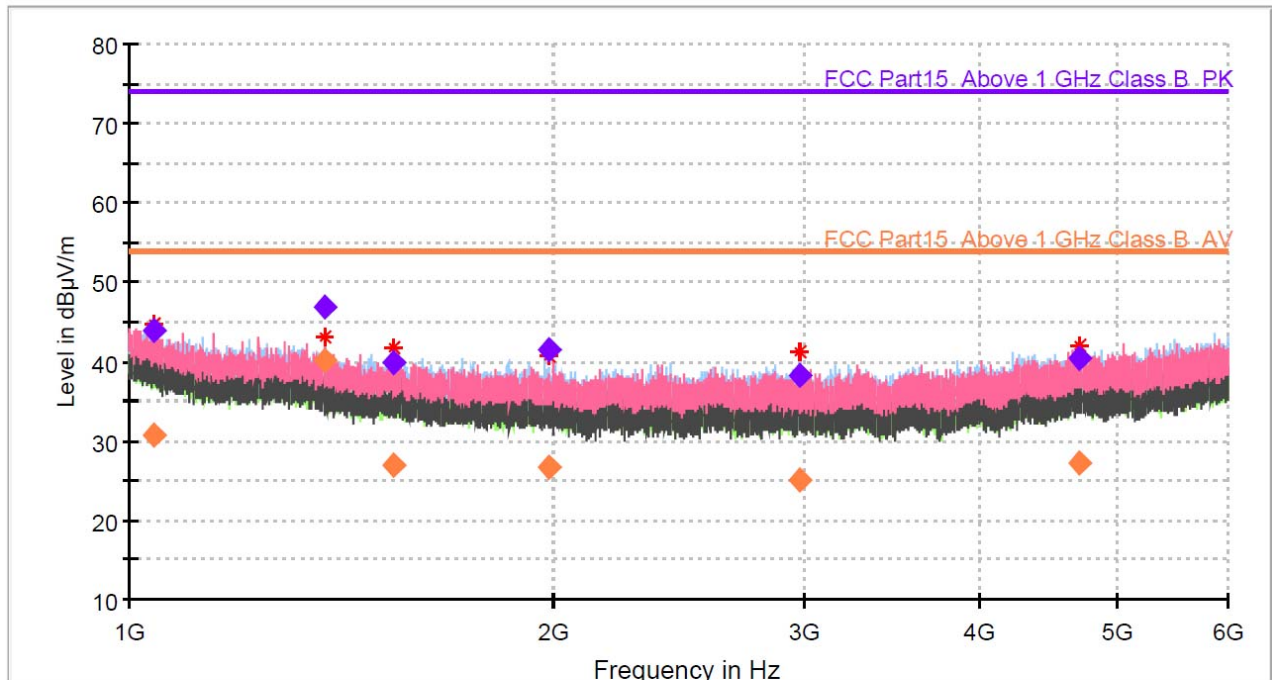
Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
56.758	18.93	30.00	11.07	1000.0	120.000	196.2	V	72.0	-21.6
81.188	19.51	30.00	10.49	1000.0	120.000	225.0	V	242.0	-25.5
89.512	12.27	30.00	17.73	1000.0	120.000	219.5	V	101.0	-25.8
188.294	12.71	30.00	17.29	1000.0	120.000	174.9	V	208.0	-21.6
374.994	25.26	37.00	11.74	1000.0	120.000	100.0	V	294.0	-16.1
624.992	33.02	37.00	3.98	1000.0	120.000	275.0	V	102.0	-9.1

< Fig 6. Radiated emission result (30 MHz ~ 1 000 MHz) >



- Operating condition: Normal operating mode



Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1041.367	43.80	---	74.00	30.20	1000.0	1000.000	225.2	H	256.0	-4.8
1041.367	---	30.61	54.00	23.39	1000.0	1000.000	225.2	H	256.0	-4.8
1375.033	47.01	---	74.00	26.99	1000.0	1000.000	225.2	H	240.0	-3.7
1375.033	---	40.26	54.00	13.74	1000.0	1000.000	225.2	H	240.0	-3.7
1538.033	---	26.87	54.00	27.13	1000.0	1000.000	225.1	H	329.0	-3.2
1538.033	39.98	---	74.00	34.02	1000.0	1000.000	225.1	H	329.0	-3.2
1980.100	---	26.64	54.00	27.36	1000.0	1000.000	205.6	H	92.0	-1.4
1980.100	41.60	---	74.00	32.40	1000.0	1000.000	205.6	H	92.0	-1.4
2988.133	---	25.18	54.00	28.82	1000.0	1000.000	225.2	H	240.0	2.7
2988.133	38.20	---	74.00	35.80	1000.0	1000.000	225.2	H	240.0	2.7
4700.267	---	27.24	54.00	26.76	1000.0	1000.000	225.3	H	-30.0	8.3
4700.267	40.42	---	74.00	33.58	1000.0	1000.000	225.3	H	-30.0	8.3

< Fig 7. Radiated emission result (1 000 MHz ~ 6 000 MHz) >



7. Sample Calculations

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \text{ Log}_{10}(\mu\text{V}/\text{m}) \\ \text{dB}\mu\text{V} &= \text{dBm} + 107 \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)} \end{aligned}$$

7.1 Example 1 :

■ 20.3 MHz

Class B Limit	= 250 μV = 48 dB μV
Reading	= 39.2 dB μV
$10^{(39.2\text{dB}\mu\text{V}/20)}$	= 91.2 μV
Margin	= 48 dB μV - 39.2 dB μV = 8.8 dB

7.2 Example 2 :

■ 66.7 MHz

Class B Limit	= 100 $\mu\text{V}/\text{m}$ = 40.0 dB $\mu\text{V}/\text{m}$
Reading	= 31.0 dB μV
Antenna Factor + Cable Loss	= 5.8 dB
Total	= 36.8 dB $\mu\text{V}/\text{m}$
Margin	= 40.0 dB $\mu\text{V}/\text{m}$ - 36.8 dB $\mu\text{V}/\text{m}$ = 3.2 dB



8. Recommendation & Conclusion

The data collected shows that the **OHSUNG ELECTRONICS CO., LTD.**
BASE STATION (Model Name: MRX-15) was complies with §15.107 and 15.109 of the FCC Rules.

- The end -

