

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT

Test Report No. : OT-19D-RWD-016
AGR No. : A19NA-198
Applicant : AMOSENSE
Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
Manufacturer : AMOSENSE
Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
Type of Equipment : MUSE-R
FCC ID : 2AS9T-SB12
Model Name : SB12
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 22 pages (including this page)
Date of Incoming : November 25, 2019
Date of Issuing : December 06, 2019

SUMMARY

The equipment complies with the requirements of **FCC CFR 47 PART 15 SUBPART C Section 15.225**

This test report contains only the result of a single test of the sample supplied for the examination.

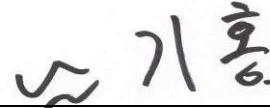
It is not a general valid assessment of the features of the respective products of the mass-production.

Reviewed by:



Tae-Ho, Kim / Senior Manager
ONETECH Corp.

Approved by:



Ki-Hong, Nam / Chief Engineer
ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-19D-RWD-016	December 06, 2019	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : AMOSENSE
Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
Manufacturer : AMOSENSE
Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
Contact Person : UIHAN JEONG/Research Engineer
Telephone No. : +82-010-4948-5676
FCC ID : 2AS9T-SB12
Model Name : SB12
Brand Name : -
Serial Number : N/A
Date : December 06, 2019

DEVICE TYPE	DXX – Low Power Communication Device Transmitter
E.U.T. DESCRIPTION	MUSE-R
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC CFR47 Part 15 Subpart C Section 15.225
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	10 m Semi Anechoic Chamber

- The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.215 (c)	20 dB BANDWIDTH	Met the Limit / PASS
15.225 (e)	FREQUENCY STABILITY WITH TEMPERATURE VARIATION / FREQUENCY STABILITY WITH VOLTAGE VARIATION	Met the Limit / PASS
15.225 (a),(b),(c)	Radiated Emission Limits	Met the Limit / PASS
15.209, 15.225(e)	SPURIOUS EMISSION TEST	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Related Submittal(s) / Grant(s)

Original submittal only

2.3 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.225.

2.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.5 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

- Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

- Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The AMOSENSE, Model SB12 (referred to as the EUT in this report) is a MUSE-R. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	MUSE-R	
Temperature Range	-20 °C ~ 50 °C	
OPERATING FREQUENCY	NFC	13.56 MHz
	Sig Fox	902.137 5 MHz ~ 904.662 5 MHz
	Bluetooth LE	2 402 MHz ~ 2 480 MHz
MODULATION TYPE	NFC	ASK
	Sig Fox	DBPSK
	Bluetooth LE	GFSK
RF OUTPUT POWER	NFC	39.79 dBuV/m at 3 M
	Sig Fox	22.14 dBm
	Bluetooth LE	0.84 dBm
ANTENNA TYPE	NFC: FPCB Antenna Sig Fox : Chip + Metal Antenna Bluetooth LE : Chip Antenna	
ANTENNA GAIN	Bluetooth LE : -0.02 dBi Sig Fox : 0.57 dBi	
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32.768 kHz, 32 MHz, 50 MHz	

3.2 Model Differences:

- None

4. SYSTEM TEST CONFIGURATION

4.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	AMOSENSE	MUSE_R Rev1.1	N/A
DC Battery	N/A	LIR2450H	N/A

4.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
SB12	AMOSENSE	MUSE-R(EUT)	-
N/A	N/A	Jig Board	EUT
ACR122	Advanced Card Systems Ltd.	Card Reader	EUT
HP Pavilion g series	HP	Notebook PC	-
PPP009C	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	-
PWS-3003DP	Protek	DC Adapter	-

4.3 Mode of operation during the test

- The EUT has 13.56 MHz RF boards for reading Card Reader and program was used for making continuous transmission mode during the test.

4.4 Equipment Modifications

- None

4.5 Configuration of Test System

Line Conducted Test :

The EUT was tested in a Charging & Transmitting mode. The EUT was connected to USB and the Power of USB was Connected to DC Adaptor. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test :

Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. The radiated emissions measurements were performed on the 10 m Semi Anechoic Chamber.

For frequencies from 150 kHz to 30 MHz measurements were made of the magnetic H field. The measuring antenna is an electrically screened loop antenna.

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

4.6 Antenna Requirement

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

Antenna Construction:

The antenna of the EUT is FPCB Antenna on the main board in the EUT, so no consideration of replacement by the user.

5. PRELIMINARY TEST

5.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
Charging & Transmitting Mode	X

5.2 Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

6. FINAL RESULT OF MEASUREMENT

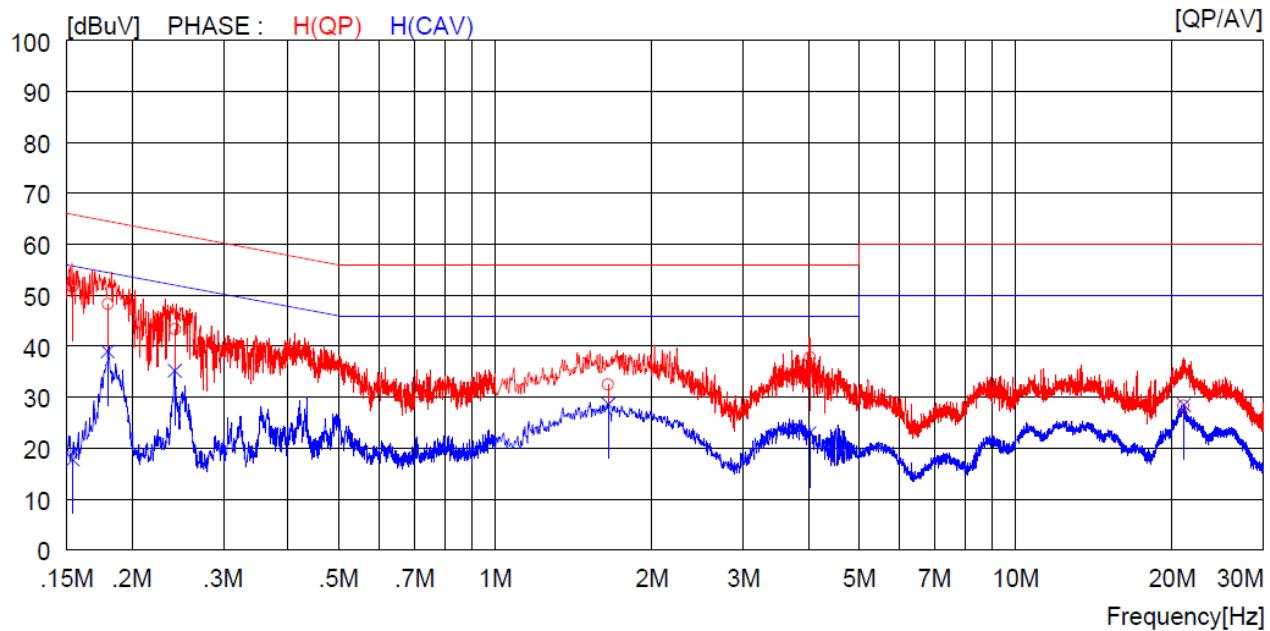
Preliminary test was done in normal operation mode. And the final measurement was selected for the maximized emission level.

6.1 Conducted Emission Test

6.1.1 Test data for Charging & Transmitting Mode

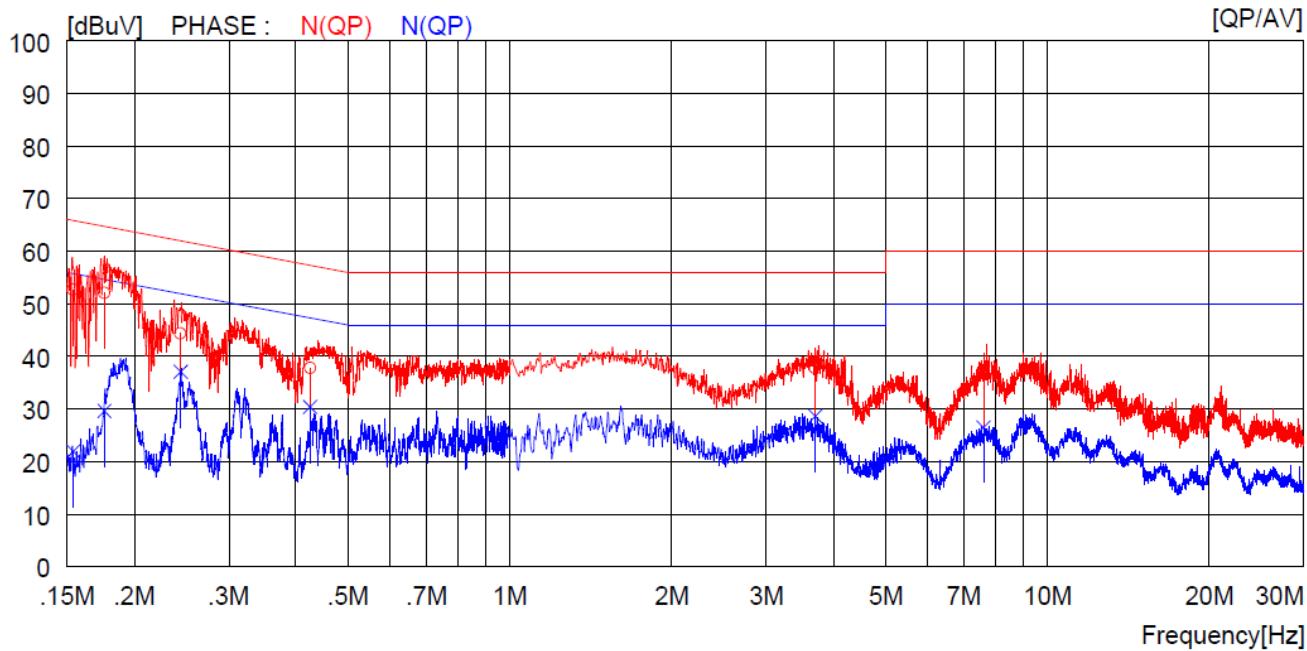
Humidity Level : 45 % R.H. Temperature: 23 °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART B, SECTION 15.207(a)
 Result : PASSED

EUT : MUSE-R Date: November 25, 2019 ~ November 28, 2019
 Detector : CISPR Quasi-Peak (6 dB Bandwidth: 9 kHz)
 Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15400	41.5	----	10.1	51.6	----	65.8	----	14.2	----	H (QP)
2	0.18000	38.1	----	10.1	48.2	----	64.5	----	16.3	----	H (QP)
3	0.24200	33.2	----	10.1	43.3	----	62.0	----	18.7	----	H (QP)
4	1.64800	22.4	----	10.1	32.5	----	56.0	----	23.5	----	H (QP)
5	4.02400	27.6	----	10.2	37.8	----	56.0	----	18.2	----	H (QP)
6	21.08000	17.8	----	10.5	28.3	----	60.0	----	31.7	----	H (QP)
7	0.15400	7.6	10.1	----	17.7	----	55.8	----	38.1	----	H (CAV)
8	0.18000	28.9	10.1	----	39.0	----	54.5	----	15.5	----	H (CAV)
9	0.24200	25.1	10.1	----	35.2	----	52.0	----	16.8	----	H (CAV)
10	1.64800	18.5	10.1	----	28.6	----	46.0	----	17.4	----	H (CAV)
11	4.02400	12.7	10.2	----	22.9	----	46.0	----	23.1	----	H (CAV)
12	21.08000	18.0	10.5	----	28.5	----	50.0	----	21.5	----	H (CAV)

Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15400	42.5	----	10.1	52.6	----	65.8	----	13.2	----	N (QP)
2	0.17600	41.9	----	10.1	52.0	----	64.7	----	12.7	----	N (QP)
3	0.24400	34.2	----	10.1	44.3	----	62.0	----	17.7	----	N (QP)
4	0.42500	27.6	----	10.1	37.7	----	57.3	----	19.6	----	N (QP)
5	3.70000	27.6	----	10.1	37.7	----	56.0	----	18.3	----	N (QP)
6	7.61000	27.0	----	10.2	37.2	----	60.0	----	22.8	----	N (QP)
7	0.15400	----	11.8	10.1	----	21.9	----	55.8	----	33.9	N (CAV)
8	0.17600	----	19.5	10.1	----	29.6	----	54.7	----	25.1	N (CAV)
9	0.24400	----	27.0	10.1	----	37.1	----	52.0	----	14.9	N (CAV)
10	0.42500	----	20.3	10.1	----	30.4	----	47.3	----	16.9	N (CAV)
11	3.70000	----	18.5	10.1	----	28.6	----	46.0	----	17.4	N (CAV)
12	7.61000	----	16.3	10.2	----	26.5	----	50.0	----	23.5	N (CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.



Tested by: Hyung-Kwon, Oh / Assistant Manager

6.2 RADIATED EMISSION TEST

6.2.1 Operation frequency band: (13.553 ~ 13.567) MHz

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Humidity Level	: <u>45 % R.H.</u>	Temperature: <u>23 °C</u>
Limits apply to	: <u>FCC CFR 47, PART 15, SUBPART C, SECTION 15.209</u>	
Type of Test	: <u>Low Power Transmitter below 1 705 kHz</u>	
Result	: <u>PASSED</u>	

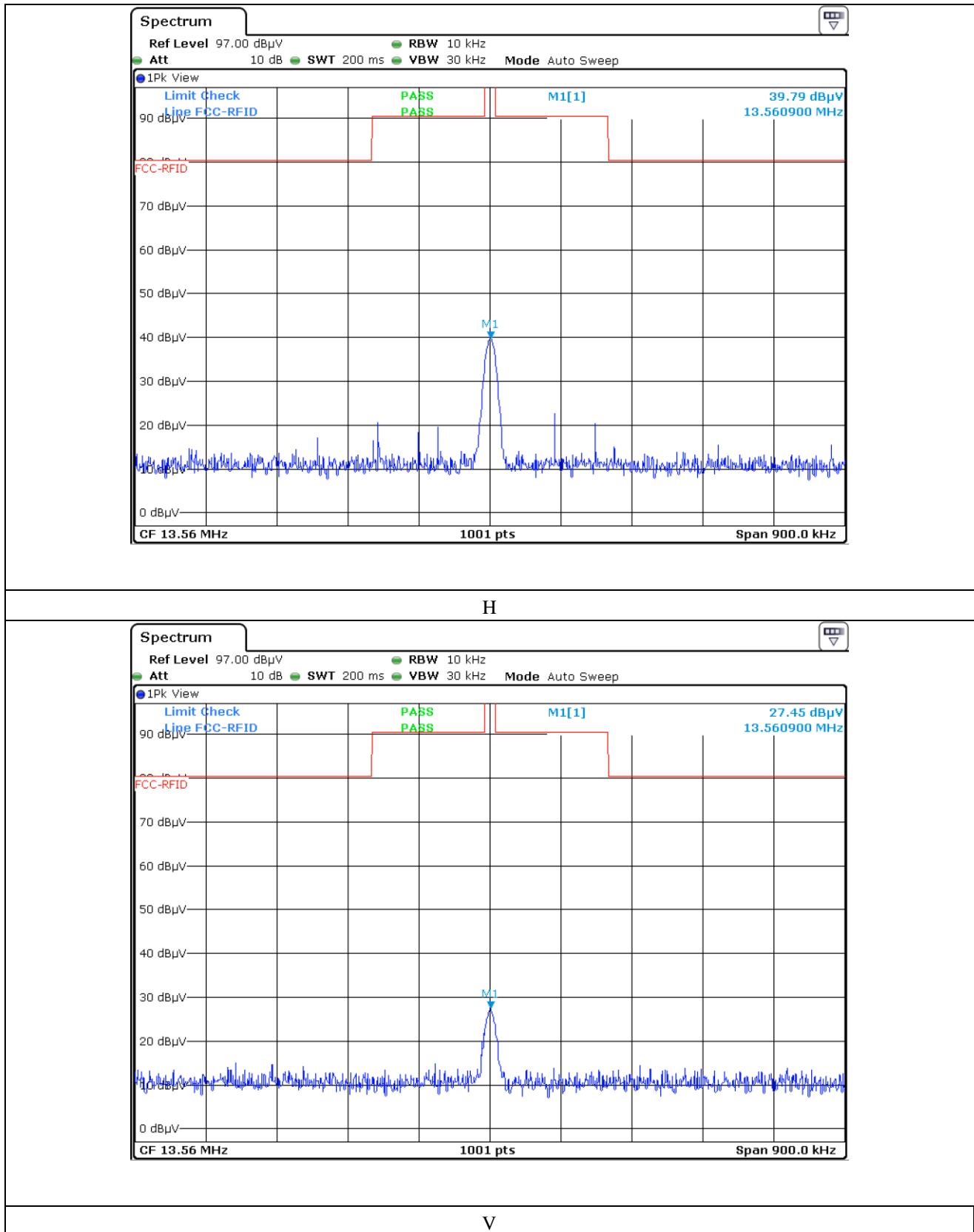
EUT	: MUSE-R	Date: November 25, 2019 ~ November 28, 2019
Operating Condition : Transmitting Mode		
Detector	: CISPR Quasi-Peak (6 dB Bandwidth: 9 kHz)	
Distance	: 3 m	

Radiated Emission		Ant	Correction Factors		Total	FCC	
Freq. (MHz)	Amplitud (dB μ V)		Antenna (dB/m)	Cable (dB)		Limit (dB μ V/m)	Margin (dB)
13.56	39.79	H	20.37	0.30	60.46	124.00	63.54
	27.45	V			48.12		75.88

Remark. The EUT was tested at 3 m.



Tested by: **Hyung-Kwon, Oh / Assistant Manager**



cc. to above test data, the field strength level of 13.56 MHz is 39.79 dB μ V/m and the worst limit subject to 15.225 (b) and (c) is 80.5 dB μ V/m, so the EUT meets the requirement.

6.3 SPURIOUS EMISSION TEST

6.3.1 Spurious Radiated Emission Below 30 MHz

Humidity Level : 45 % R.H. Temperature: 23 °C
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.209
Type of Test : Low Power Transmitter below 1 705 kHz
Frequency Range : 9 kHz ~ 30 MHz
Result : PASSED

EUT : MUSE-R Date: November 25, 2019 ~ November 28, 2019

Operating Condition : Transmitting Mode

Distance : 3 m

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


Tested by: Hyung-Kwon, Oh / Assistant Manager

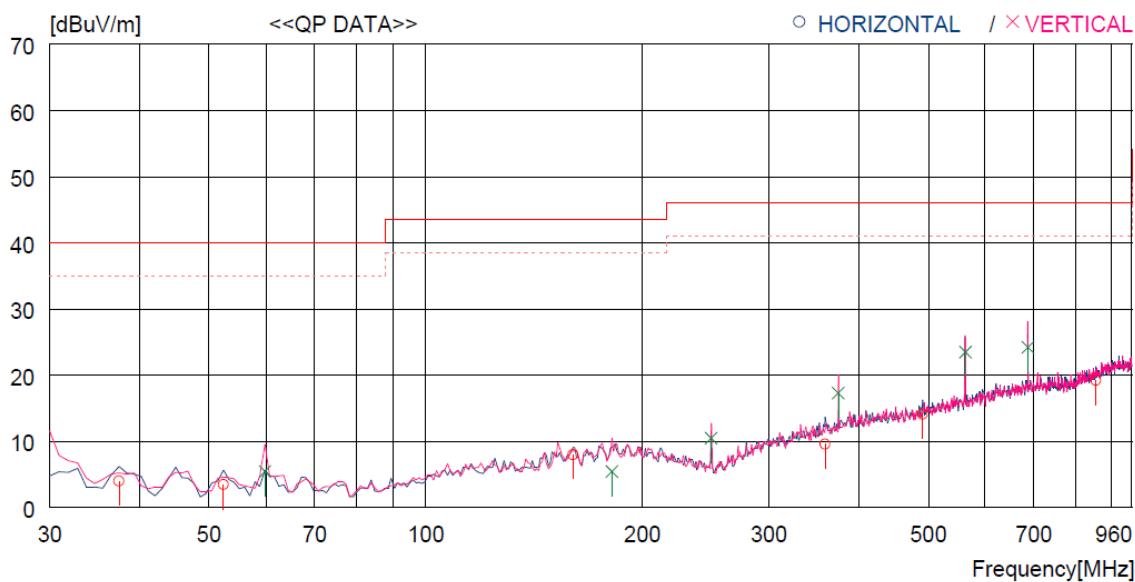
6.3.2 Spurious Radiated Emission below 1 GHz

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Humidity Level	: <u>45 % R.H.</u>	Temperature: <u>23 °C</u>
Limits apply to	: <u>FCC CFR 47, PART 15, SUBPART C, SECTION 15.209</u>	
Type of Test	: <u>Low Power Transmitter below 1 705 kHz</u>	
Result	: <u>PASSED</u>	

EUT : MUSE-R Date: November 25, 2019 ~ November 28, 2019

Distance : 3 m



No.	FREQ [MHz]	READING QP	ANT FACTOR	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE	
									[dBuV]	[cm]
----- Horizontal -----										
1	37.440	24.5	10.9	1.3	32.7	4.0	40.0	36.0	200	359
2	52.320	24.9	9.7	1.5	32.7	3.4	40.0	36.6	200	8
3	160.200	25.5	12.7	2.4	32.6	8.0	43.5	35.5	200	83
4	359.218	23.3	15.3	3.6	32.7	9.5	46.0	36.5	100	122
5	491.277	25.1	17.7	4.2	32.9	14.1	46.0	31.9	200	2
6	854.904	23.2	22.7	5.6	32.3	19.2	46.0	26.8	200	193
----- Vertical -----										
7	59.760	27.0	9.4	1.7	32.7	5.4	40.0	34.6	100	359
8	181.590	22.3	13.1	2.6	32.6	5.4	43.5	38.1	100	359
9	249.479	30.0	10.1	3.0	32.6	10.5	46.0	35.5	100	291
10	375.028	30.5	15.7	3.8	32.7	17.3	46.0	28.7	100	259
11	562.887	32.9	19.1	4.5	33.0	23.5	46.0	22.5	100	135
12	687.506	31.1	20.8	5.2	32.9	24.2	46.0	21.8	100	71

Tested by: **Hyung-Kwon, Oh / Assistant Manager**

6.4 20 dB BANDWIDTH

6.4.1 Operating environment

Temperature : 23 °C

Relative humidity : 45 % R.H.

6.4.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 10 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



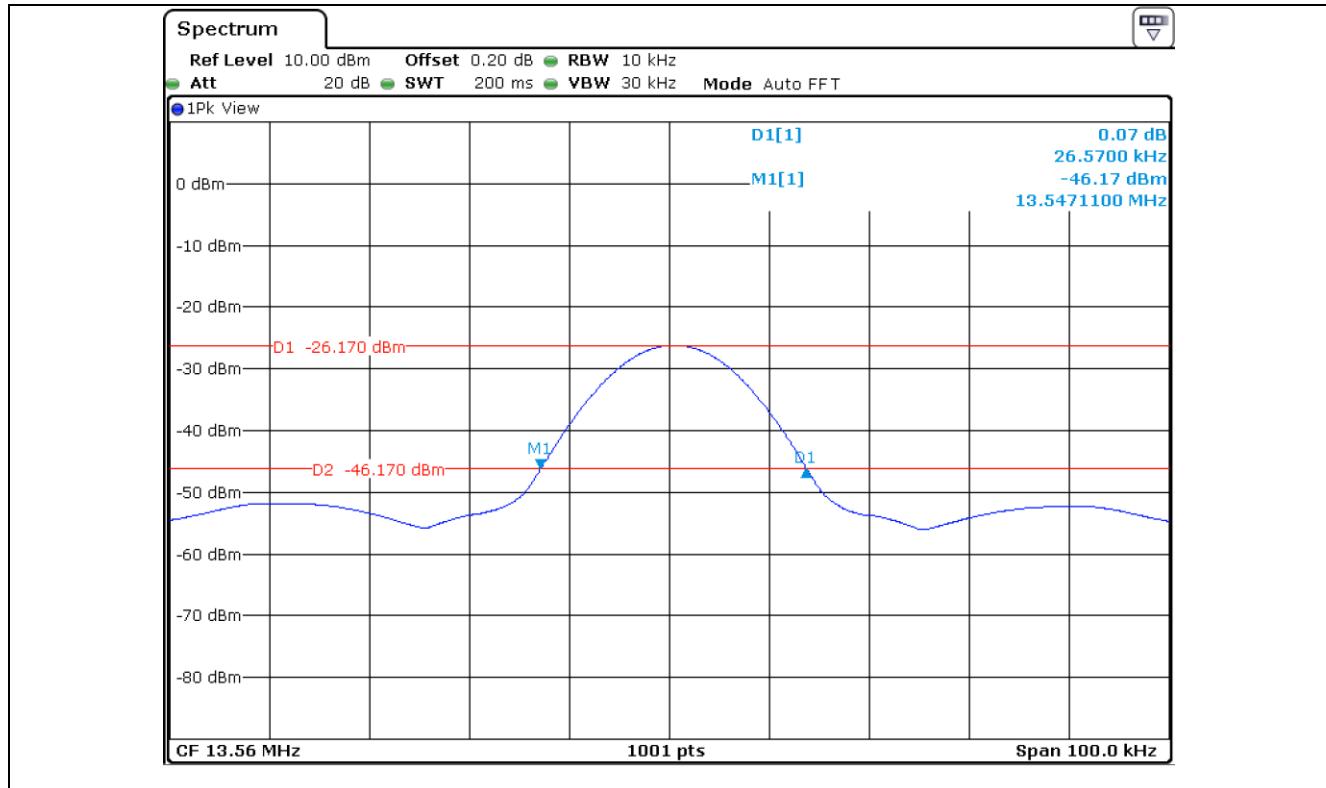
6.4.3 Test data

- Test Date : November 25, 2019 ~ November 28, 2019
- Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.209

Operating Freq. (MHz)	Measured Value (kHz)	Assigned Operating Frequency Band (kHz)	Result
13.56	26.57	900	PASS



Tested by: Hyung-Kwon, Oh / Assistant Manager



6.5 FREQUENCY STABILITY WITH TEMPERATURE VARIATION

6.5.1 Operating environment

Temperature : 23 °C
 Relative humidity : 45 % R.H.

6.5.2 Test set-up

Turn EUT off and set chamber temperature to -20 °C and then allow sufficient time (approximately 20 to 30 minutes after chamber reach the assigned temperature) for EUT to stabilize. Turn ON EUT and measure the EUT operating frequency and then turn off the EUT after the measurement. The temperature in the chamber was raised 10 °C step from -20 °C to +50°C. Repeat above method for frequency measurements every 10 °C step and then record all measured frequencies on each temperature step.

6.5.3 Test data

- Test Date : November 25, 2019 ~ November 28, 2019
 - Result : PASSED

Temperature (°C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Margin (Hz)	Limit (Hz)
-20	13,560,000.0	13,560,473	473	±1 356.00
-10		13,560,315	315	
0		13,560,153	153	
10		13,560,248	248	
20		13,560,489	489	
30		13,560,451	451	
40		13,560,312	312	
50		13,560,428	428	



Tested by: Hyung-Kwon, Oh / Assistant Manager

6.6 FREQUENCY STABILITY WITH VOLTAGE VARIATION

6.6.1 Operating environment

Temperature : 23 °C

Relative humidity : 45% R.H.

6.6.2 Test set-up

An external DC power supply was connected to the input of the EUT. The voltage of EUT set to 115 % of the nominal value and then was reduced to 85 % of nominal voltage. The output frequency was recorded at each step.

6.6.3 Test data

- Test Date : November 25, 2019 ~ November 28, 2019

- Result : PASSED

Voltage (Vdc)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Margin (Hz)	Limit (Hz)
4.255(115 %)	13,560,000	13,560,418	418	± 1 356.00
3.700(100 %)		13,560,443	443	
3.145(85 %)		13,560,214	214	



Tested by: Hyung-Kwon, Oh / Assistant Manager

7. FIELD STRENGTH CALCULATION

Meter readings are compared to the specification limit correcting for antenna and cable losses.

+ Meter reading	(dB μ V)
- Amplifier Gain	(dB)
+ Cable Loss	(dB)
- Antenna Factor	(dB/m)
= Corrected Result	(dB μ V/m)

Margin (dB)	
Specification Limit	(dB μ V/m)
- Corrected Result	(dB μ V/m)
= dB Relative to Spec	(\pm dB)

8. LIST OF TEST EQUIPMENT

No.	EQUIPMENTS	MFR.	MODEL	SER. NO.	LAST CAL	DUe CAL	USE
1.	Test receiver	R/S	ESCI	101012	Oct. 22, 2019	One Year	-
2.		R/S	ESR	101470	Oct. 22, 2019	One Year	■
3.		R/S	ESPI	101278	Oct. 20, 2019	One Year	■
4.	Spectrum analyzer	R/S	FSV30	101372	Jul. 24, 2019	One Year	■
5.	Amplifier	Sonoma Instrument	310N	312544	Mar. 18, 2019	One Year	■
6.	Amplifier	Sonoma Instrument	310N	312545	Mar. 18, 2019	One Year	-
7.	TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-255	Jun. 05, 2018	Two Year	■
8.	TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-419	Aug. 09, 2018	Two Year	-
9.	Controller	Innco System	CO3000	CO3000/904/37211215/L	N/A	N/A	■
10.	LISN	EMCO	3825/2	9109-1867	Mar. 27, 2019	One Year	-
				9109-1869	Mar. 19, 2019	One Year	■
		Schwarzbeck	NNLK8121	804	Oct. 21, 2019	One Year	■
		Schwarzbeck	NSLK8128	8128-216	Mar. 20, 2019	One Year	■
11.	Turn Table	Innco System	DT3000	930611	N/A	N/A	■
12.	Antenna Master	Innco System	MA4000-EP	MA4000/332	N/A	N/A	-
13.	Antenna Master	Innco System	MA-4000XPET	MA4000/509	N/A	N/A	■
14.	Loop Antenna	Schwarzbeck	FMZB 1513	1513-235	May 13, 2018	Two Year	■
15.	Frequency Counter	HP	53152A	US39270295	Jul. 25, 2019	One Year	■
16.	Environmental Test Chamber	ESPEC	PSL-2KP	14009407	Feb. 22, 2019	One Year	■
17.	DC Power Supply	Protek	PWS-3003D	4020409	Jul. 24, 2019	One Year	■