

RF TEST REPORT

Test Equipment : Coding Board
Model Name : Coding Board
FCC ID : 2A39PCODINGBOARD
Date of Receipt : 2021.12.07
Test Duration : 2021.12.22 ~ 2021.12.27
Date of Issue : 2022.01.20

Applicant : ROBOROBO Co., Ltd
6, Dobong-ro 54-gil, Gangbuk-gu, Seoul, Republic of Korea

Test Laboratory : Lab-T, Inc.
2182-42 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si
Gyeonggi-do 17036, Republic of Korea

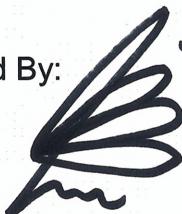
Test Specification : FCC Part 15 Subpart C 15.225
Test Result : Pass

The above equipment was tested by Lab-T Testing Laboratory for compliance
with the requirements of FCC Rules and Regulations.

The test results presented in this test report are limited only to the sample supplied by applicant
and the use of this test report is inhibited other than its purpose.

This test report shall not be reproduced except in full, without the written approval of Lab-T, Inc

Tested By:



Engineer
Namhyoung Kwon

Reviewed By:



Technical Manager
SangHoon Yu

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1. Revision History

Test Report #	Date	Description
TRRFCC22-0001	22.01.20	Initial issue

2. Information

2.1 Applicant Information

Applicant Name	ROBOROBO Co., Ltd
Address	6, Dobong-ro 54-gil, Gangbuk-gu, Seoul, Republic of Korea
Telephone No.	+82-10-3894-3072
Person in Charge	Suhan Park / Assistant Manager
Manufacturer	ROBOROBO Co., Ltd
Address	6, Dobong-ro 54-gil, Gangbuk-gu, Seoul, Republic of Korea

2.2 Test Laboratory Information

Corporate Name	Lab-T, Inc.
Representative	Duke(Jongyoung) Kim
Address	2182-42 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of)
Telephone	+82-31-322-6767
Fax	+82-31-322-6768
E-mail	info@lab-t.net
FCC Designation No.	KR0159
FCC Registration No.	133186
IC Registration No.	22000

2.3 Test Site

Test Site	used	Address
Building L	<input checked="" type="checkbox"/>	2182-40 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of)
Building T	<input checked="" type="checkbox"/>	2182-42 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of)
Building A	<input type="checkbox"/>	2182-44 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of)

3. Information About Test Equipment

3.1 Equipment Information

Equipment Type	Coding Board
Model Name	Coding Board
Variant Model Name	-
Frequency Range	13.56 MHz
Modulation Type	ASK
Power Supply	DC 6 V
S/W Version	1.1.0
H/W Version	1.1

Note 1 : The above EUT information was declared by the manufacturer.

3.2 Antenna Information

Antenna 1	Type	Loop Antenna	Antenna 2	Type	Loop Antenna
	Gain	-		Gain	-
Antenna 3	Type	Loop Antenna	Antenna 4	Type	Loop Antenna
	Gain	-		Gain	-
Antenna 5	Type	Loop Antenna	Antenna 6	Type	Loop Antenna
	Gain	-		Gain	-
Antenna 7	Type	Loop Antenna	Antenna 8	Type	Loop Antenna
	Gain	-		Gain	-
Antenna 9	Type	Loop Antenna	Antenna 10	Type	Loop Antenna
	Gain	-		Gain	-
Antenna 11	Type	Loop Antenna	Antenna 12	Type	Loop Antenna
	Gain	-		Gain	-

Note 1 : After testing each of the antennas, the worst result was reported.

3.3 Test Frequency

Test Mode	Test Frequency (MHz)
ASK	13.56

3.4 Tested Companion Device Information

Type	Manufacturer	Model	Note
-		-	-

4. Test Report

4.1 Summary

FCC Part 15C 225			
Reference	Parameter	Clause	Status
Transmitter Requirements			
15.215(c)	20 dB Bandwidth	4.3.1	C
15.225(e)	Frequency Tolerance of Carrier Signal	4.3.2	C
15.225(a) 15.225(b) 15.225(c) 15.225(d) 15.205(a) 15.209(a)	In-band Fundamental Emission, In-band and Out-band Spurious Emission	4.3.3	C
15.207(a)	Conducted Emissions	4.3.4	N/A ^{Note 2}

Note 1 : C = Comply N/C = Not Comply N/T = Not Tested N/A = Not Applicable
Note 2 : This device gets power supply from only battery

* The general test methods used to test this device is ANSI C63.10:2020

4.2 Measurement Uncertainty

Mesurement Items	Expanded Uncertainty	
Radiated Spurious Emissions (1 GHz under)	4.84 dB	(The confidence level is about 95 %, $k=2$)
Conducted emission	2.50 dB	(The confidence level is about 95 %, $k=2$)

4.3 Transmitter Requirements

4.3.1 20 dB Bandwidth

4.3.1.1 Regulation

According to §15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.3.1.2 Measurement Procedure

These test measurement settings are specified in section 6.9.2 of ANSI C63.10-2020

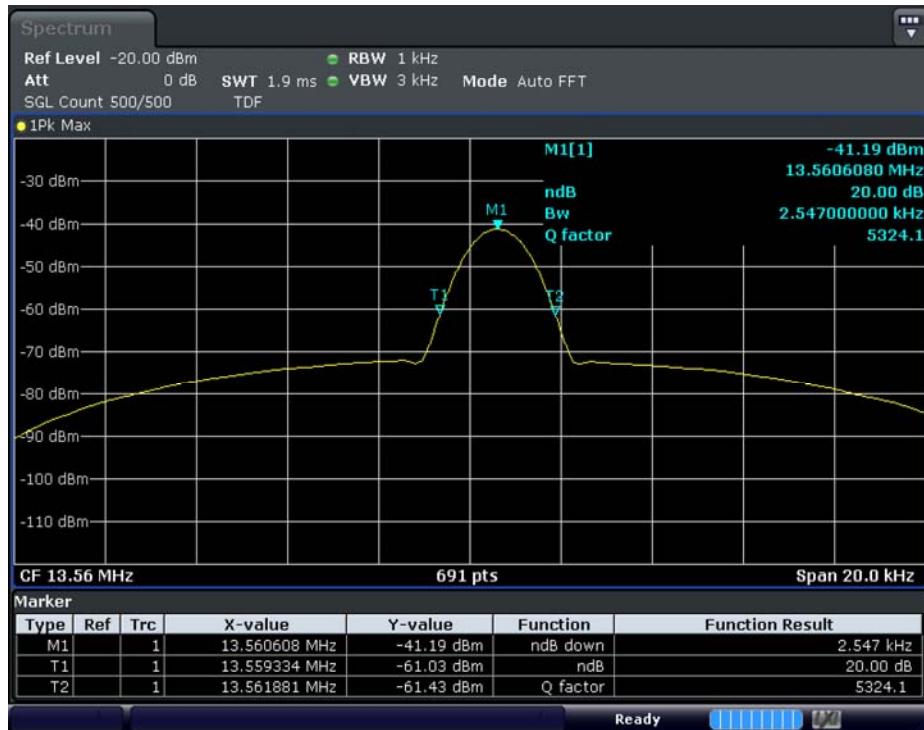
4.3.1.3 Result

Comply (measurement data : refer to the next page)

4.3.1.4 Measurement data

Test mode :

Frequency (MHz)	Results (kHz)	Lowest Frequency (MHz)	Highest Frequency (MHz)
13.560 0	2.547 0	13.559 3	13.561 9



4.3.2 Frequency Tolerance of Carrier Signal

4.3.2.1 Regulation

According to §15.225(e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+ 50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

4.3.2.2 Measurement Procedure

These test measurement settings are specified in section 6.8.1 and 6.8.2 of ANSI C63.10-2020

4.3.2.3 Result

Comply (measurement data : refer to the next page)

4.3.2.4 Measurement data

Test mode : 0 min

Frequency (MHz)	Temp (°C)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Center Frequency (Hz)	Tolerance (%)
13.560 0	-20	13.560 462	13.560 718	13 560 590	0.004 351
	-10	13.560 499	13.560 753	13 560 626	0.004 616
	0	13.560 509	13.560 761	13 560 635	0.004 682
	10	13.560 497	13.560 752	13 560 624	0.004 605
	20	13.560 473	13.560 726	13 560 599	0.004 421
	30	13.560 468	13.560 723	13 560 595	0.004 391
	40	13.560 457	13.560 713	13 560 585	0.004 314
	50	13.560 459	13.560 717	13 560 588	0.004 336
	Voltage(%)				
	85	N/A ^{Note 1}	-	-	-
	115	N/A ^{Note 1}	-	-	-

Note 1: According to §15.225(e), This device was tested by installed a new battery

Test mode : 2 min

Frequency (MHz)	Temp (°C)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Center Frequency (Hz)	Tolerance (%)
13.560 0	-20	13.560 486	13.560 742	13 560 614	0.004 528
	-10	13.560 507	13.560 762	13 560 634	0.004 678
	0	13.560 508	13.560 761	13 560 634	0.004 678
	10	13.560 494	13.560 746	13 560 620	0.004 572
	20	13.560 473	13.560 728	13 560 600	0.004 428
	30	13.560 464	13.560 721	13 560 592	0.004 369
	40	13.560 455	13.560 712	13 560 583	0.004 303
	50	13.560 456	13.560 712	13 560 584	0.004 306
	Voltage(%)				
	85	N/A ^{Note 1}	-	-	-
	115	N/A ^{Note 1}	-	-	-

Note 1: According to §15.225(e), This device was tested by installed a new battery

Test mode : 5 min

Frequency (MHz)	Temp (°C)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Center Frequency (Hz)	Tolerance (%)
13.560 0	-20	13.560 491	13.560 745	13 560 618	0.004 557
	-10	13.560 508	13.560 762	13 560 635	0.004 682
	0	13.560 507	13.560 761	13 560 634	0.004 675
	10	13.560 493	13.560 746	13 560 619	0.004 568
	20	13.560 476	13.560 730	13 560 603	0.004 447
	30	13.560 464	13.560 719	13 560 591	0.004 362
	40	13.560 455	13.560 711	13 560 583	0.004 299
	50	13.560 454	13.560 712	13 560 583	0.004 299
	Voltage(%)				
	85	N/A ^{Note 1}	-	-	-
	115	N/A ^{Note 1}	-	-	-

Note 1: According to §15.225(e), This device was tested by installed a new battery

Test mode : 10 min

Frequency (MHz)	Temp (°C)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Center Frequency (Hz)	Tolerance (%)
13.560 0	-20	13.560 493	13.560 748	13 560 620	0.004 576
	-10	13.560 509	13.560 763	13 560 636	0.004 690
	0	13.560 507	13.560 761	13 560 634	0.004 675
	10	13.560 494	13.560 750	13 560 622	0.004 587
	20	13.560 477	13.560 730	13 560 603	0.004 450
	30	13.560 464	13.560 720	13 560 592	0.004 365
	40	13.560 455	13.560 711	13 560 583	0.004 299
	50	13.560 452	13.560 708	13 560 580	0.004 277
	Voltage(%)				
	85	N/A ^{Note 1}	-	-	-
	115	N/A ^{Note 1}	-	-	-

Note 1: According to §15.225(e), This device was tested by installed a new battery

4.3.3 In-band Fundamental Emission, In-band and Out-band Spurious Emission

4.3.3.1 Regulation

According to §15.225(a),(b),(c),(d) (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

According to §15.209(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

4.3.3.2 Measurement Procedure

- 1) The preliminary and final radiated measurements were performed to determine the frequency producing the maximum emissions in a 10m anechoic chamber. The EUT was tested at a distance 3 meters.
- 2) The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
- 3) The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1 000 MHz using the TRILOG broadband antenna.
- 4) Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

Note1 : The resolution bandwidth of test receiver/spectrum analyzer is 200 Hz for Quasi-peak detection (QP) at frequency below 150 kHz.

Note2 : The resolution bandwidth of test receiver/spectrum analyzer is 9 kHz for Quasi-peak detection (QP) at frequency 150 kHz to 30 MHz

Note3 : The resolution bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.

Note4 : The video bandwidth of test receiver/spectrum analyzer is three times as much as resolution bandwidth

4.3.3.3 Result

Comply (measurement data : refer to the next page)

4.3.3.4 Measurement data

Test mode : 9 kHz ~ 30 MHz(Worst Case_Antenna 1)

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dB μ V)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dB μ V/m)	Result at 30m (dB μ V/m)	Limit at 30m (dB μ V/m)	Margin (dB)
13.560 6	QP	F	H	32.30	10.70	0.50	43.50	3.50	84.00	80.50
13.560 6	QP	F	V	27.20	10.70	0.50	38.40	-1.60	84.00	85.60

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dB μ V)	Ant Factor (dB)	Cable Loss (dB)	Result at 3m (dB μ V/m)	Result at 300m (dB μ V/m)	Limit at 300m (dB μ V/m)	Margin (dB)
Spurious	Not Detected	S	-	-	-	-	-	-	-	-

Note 1 : "F" : Fundamental, "S" : Spurious

Note 2 : Result : Reading + Ant Factor + Cable Loss

Note 3 : According to §15.31 (f)(2);

 Result at 30m (dB μ V/m) = Result at 3m(dB μ V/m)-40log(30/3) (dB μ V/m)

 Result at 300m (dB μ V/m) = Result at 3m(dB μ V/m)-40log(300/3) (dB μ V/m)

Note 4 : Not Detected means peak measurement did not take place because it is more than 20dB difference in the limit

Test mode : 30 MHz ~ 1 GHz (Worst Case_Antenna 1)

Frequency (MHz)	Detector	Note 1	Pol. (V/H)	Reading (dB μ V)	Ant Factor (dB)	Loss (dB)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
393.255	QP	S	H	43.40	21.60	-26.50	38.50	46.00	7.50
718.854	QP	S	H	38.50	27.60	-26.00	40.10	46.00	5.90
895.002	QP	S	H	39.40	29.40	-24.60	44.20	46.00	1.80
908.561	QP	S	H	37.50	29.60	-24.50	42.60	46.00	3.40

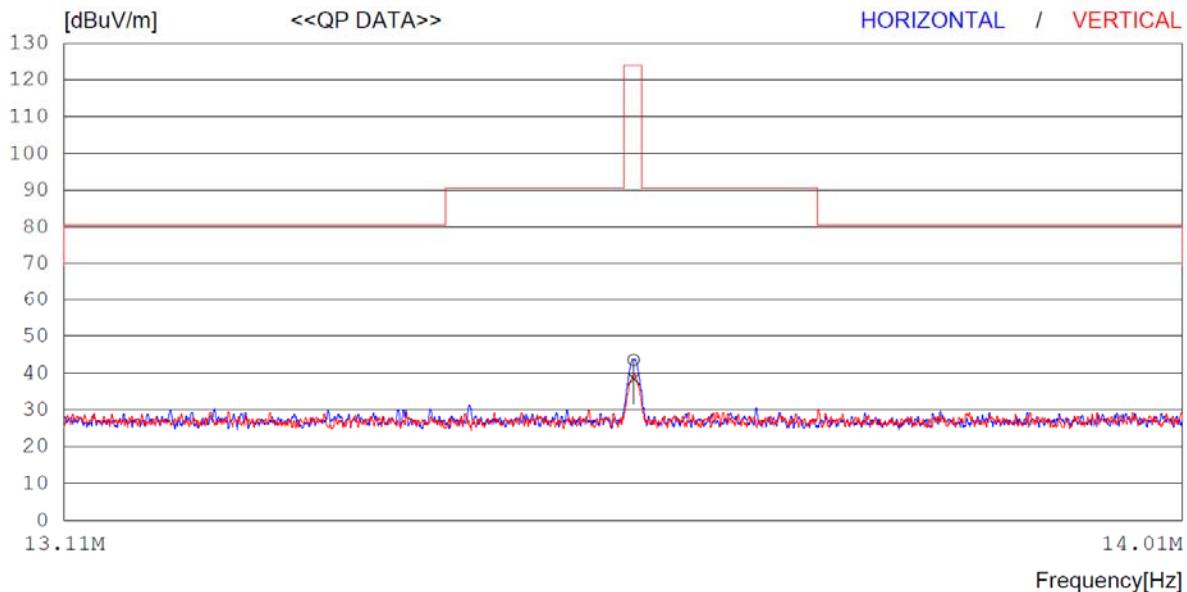
Note 1 : "F" : Fundamental, "S" : Spurious

Note 2 : Loss : Cable loss - Amp gain

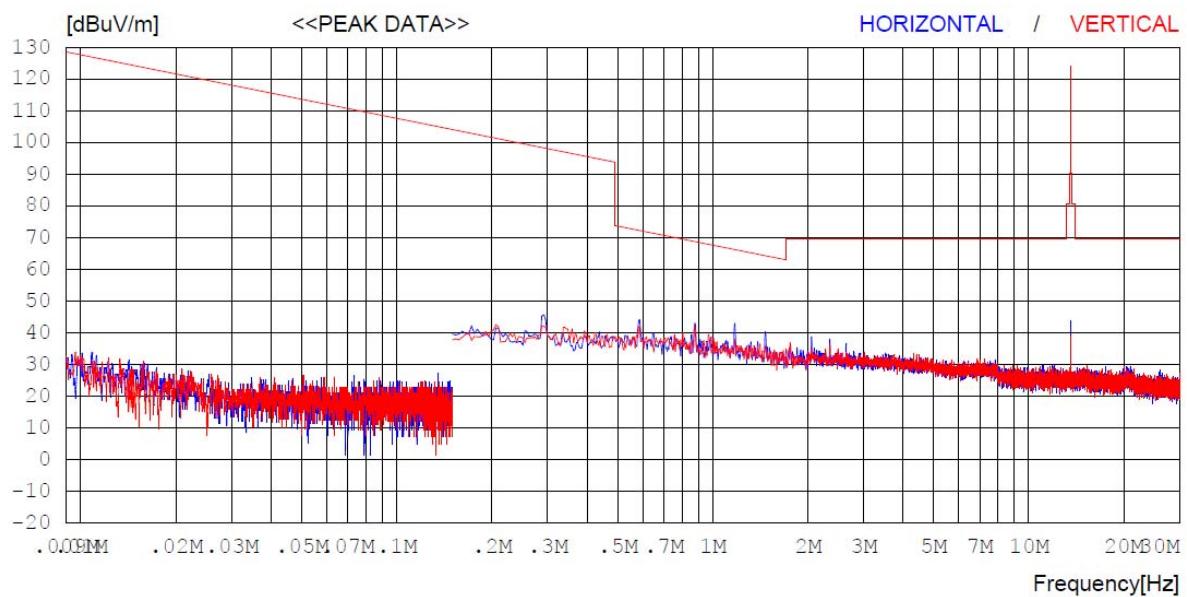
Note 3 : Result : Reading + Ant Factor + Loss

4.3.3.5 Measurement Plot

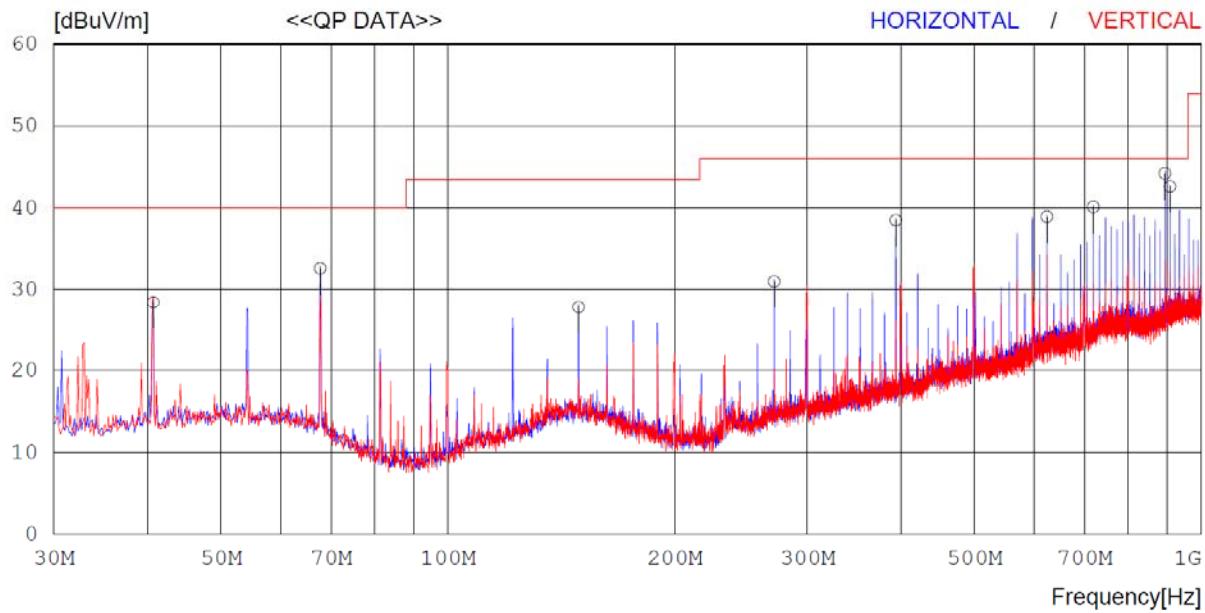
Test mode : 9 kHz ~ 30 MHz In-band Fundamental, Spurious Emission(Worst Case Antenna 1)



Test mode : 9 kHz ~ 30 MHz Out-band Spurious Emission(Worst Case Antenna 1)



Test mode : 30 MHz ~ 1 GHz(Worst Case Antenna 1)



4.3.4 Conducted Emission

4.3.4.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

4.3.4.2 Measurement Procedure

- 1) The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5 m away from the side wall of the shielded room.
- 2) Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω /50 μ H LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
- 3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
- 4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
- 5) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASIPEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

4.3.4.3 Result

Not Applicable (This device gets power supply from only battery)

APPENDIX I

TEST EQUIPMENT USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment.

Equipment	Manufacturer	Model	Serial No.	Cal. Date (yy.mm.dd)	Next Cal.Date (yy.mm.dd)
FSV Signal Analyzer	ROHDE&SCHWARZ	FSV40	101010	2021-04-20	2022-04-20
HUMIDITY/TEMP DATA RECORDER	LUTRON	MHB-382SD	79735	2021-04-21	2022-04-21
Digital MultiMeter	HP	34401A	US36025428	2022-01-10	2023-01-10
Signal Generator	ROHDE&SCHWARZ	SMB100A	178384	2021-10-13	2022-10-13
Temp & Humi Test Chamber	SJ-TH-S50	SJ SCIENCE	170719	2021-07-30	2022-07-30
EMI Test Receiver	ROHDE&SCHWARZ	ESU40	100445	2021-09-10	2022-09-10
BiLog Antenna	Schwarzbeck	VULB9160	9160-3381	2021-03-31	2023-03-31
Attenuator	JFW	50F-006	6 dB-3	2021-04-22	2022-04-22
Antenna Mast	TOKIN	5977	-	-	-
Controller	TOKIN	5909L	141909L-1	-	-
Turn Table	TOKIN	5983-1.5	-	-	-
Semi-Anechoic Chamber	SY-CORPORATION	-	-	-	-
PREAMPLIFIER	TSJ	MLA-10k01-b01-27	1870367	2021-04-21	2022-04-21
Active Loop H-Field	ETS	6502	00150598	2021-05-25	2023-05-25