FCC 47 CFR PART 15 SUBPART B (ICES-003) TEST REPORT

Test Report No.	**: OT-214-RED-190**
Reception No.	**: 2104001486**
Applicant	**: Fourstech.co.,ltd.**
Address	**: 202-403 bucheontechnopark SsangyongⅢ, 397, Seokcheon-ro, Bucheon-si, Gyeonggi-do**
Manufacturer	**: Fourstech.co.,ltd.**
Address	**: 202-403 bucheontechnopark SsangyongⅢ, 397, Seokcheon-ro, Bucheon-si, Gyeonggi-do**
Type of Equipment	**: GPS Smart Antenna**
Model Name	**: FST-UE1528M**
FCC ID.	**: 2AZ4VFST-UE1528M**
Multiple Model Name	**: N/A**
Serial number	**: N/A**
Total page of Report	**: 17 pages (including this page)**
Date of Incoming	**: April 14, 2021**
Date of Issuing	**: April 27, 2021**

SUMMARY

The equipment complies with the requirement of

FCC CFR 47 Part 15 Subpart B and Canadian Standard ICES-003:Issue 7.

This test report contains only the results 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: Eung-Chan, Kim / General Manager
ONETECH Corp.

Approved by: Gea-Won, Lee / Exe. Managing Director
ONETECH Corp.

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Revision History

Rev. No.	Issued Report No.	Issued Date	Revisions	Section Affected
0	OT-214-RED-190	April 27, 2021	Initial Issue	All

* Please contact us (e-mail: info@onetech.co.kr) for verification of this test report.

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1. VERIFICATION OF COMPLIANCE

-. APPLICANT : Fourstech.co.,ltd.

-. ADDRESS : 202-403 bucheontechnopark SsangyongⅢ, 397, Seokcheon-ro, Bucheon-si, Gyeonggi-do

-. Manufacturer : Fourstech.co.,ltd.

-. ADDRESS : 202-403 bucheontechnopark SsangyongⅢ, 397, Seokcheon-ro, Bucheon-si, Gyeonggi-do

-. MODEL NAME : FST-UE1528M

-. SERIAL NUMBER : N/A

-. BRAND/TRADE NAME : N/A

-. DATE : April 27, 2021

EQUIPMENT CLASS	Other Class B digital devices & peripherals
E.U.T. DESCRIPTION	GPS Smart Antenna
MEASUREMENT PROCEDURES	ANSI C63.4: 2014
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
STANDARDS	FCC Part 15 (Class B) Canadian Standard ICES-003 Issue 7
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	3 m Semi anechoic chamber

ONETECH Corp. tested the above equipment in accordance with the requirements set forth in the above standard. The test results show that equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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2. 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:

1) 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

2) 12-5, Jinsaegol-gil 75 beon-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-20122/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A

-. Site Accreditation:

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

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

These measurement tests were conducted at Onetech Corp.

The 10 m semi anechoic chamber and conducted measurement facilities are located on at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.

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3. PRODUCT INFORMATION

3.1 Description of EUT

The Fourstech.co.,ltd., Model FST-UE1528M (referred to as the EUT in this report) is a GPS Smart Antenna. Product specification described herein was obtained from product data sheet or user's manual.

CHASSIS TYPE	Plastic & Metal
LIST OF EACH OSC. OR CRY. FREQ. (FREQ. >= 1 MHz)	Crystal: 26 MHz / 32.768 MHz
RF FREQUENCY	1 575.42 MHz
POWER REQUIREMENT	DC 5 V, 300 mA
EXTERNAL CONNECTOR	2.5Ø Earjack Connector

3.2 Model Differences

-. The following lists consist of the added models and their differences.: None

3.3 Support Equipment

The model numbers for all the equipment that were used in the tested system is:

Description	Model	Manufacturer	Connected to
GPS Smart Antenna (EUT)	FST-UE1528M	Fourstech.co.,ltd.	USB Gender
Notebook PC	N/A	N/A	USB Gender
USB Gender	N/A	N/A	EUT, Notebook PC

3.4 System Configuration

DEVICE TYPE	MODEL/PART NUMBER	MANUFACTURER	FCC ID
GPS Smart Antenna	FST-UE1528M	Fourstech.co.,ltd.	2AZ4VFST-UE1528M

3.5 Cable Description

Ports Name	Shielded	Ferrite Bead	Metal Shell	Length (m)	Connected to
2.5Ø Earjack Connector	N	N	N	1.2	USB Gender

3.6 Equipment Modifications

-. None

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4. DESCRIPTION OF TESTS

4.1 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4: 2014.

Radiated testing was performed at a distance of 10 m from EUT to the antenna.

4.2 Test Condition

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

-. Test Voltage / Frequency: AC 120 V / 60 Hz

-. The EUT was connected with notebook pc through usb gender and then checked the value of data.

-. Test Mode(s)

Operating Mode 1	Normal operating

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4.3 Conducted Emission

The EUT was placed on a non-conductive 2.5 m × 1.5 m table, which is 0.8 m in height above the reference ground plane and 0.4 m away from the vertical conducting plane (over 2 m × 2 m) that is bonded to the reference ground plane.

The power of EUT is fed through a 50 Ω/ 50 μH + 5 Ω LISN and all support equipment is powered from another LISN. 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.

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 CISPR-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.

4.4 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 were made at 10 m semi anechoic chamber that complies with CISPR 16/ANSI C63.4.

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 & CISPR-Average mode (Above 1 GHz).

The system 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.

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5. FINAL RESULT OF MEASUREMENT

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

5.1 Conducted Emission Test

5.1.1 Operating Environment

Temperature : 21.4 °C

Relative humidity : 44.6 % R.H.

5.1.2 Test Setup

The EUT and all local support equipment were placed on a non-conductive table, 0.8 m height above the reference ground plane. The EUT was fed by dc power supply through a 50 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

5.1.3 Measurement uncertainty

Conducted emission, quasi-peak detection : ± 3.9 dB

Conducted emission, CISPR average detection : ± 3.9 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2. The measurement uncertainty is given with a confidence of 95 % with the coverage factor, $k = 2$.

5.1.4 Limit

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	CISPR 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		

5.1.5 Test Equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESCI	Rohde & Schwarz	Test Receiver	101420	Mar. 23, 2021 (1Y)
■ -	LT32C/10	Afj Instruments	LISN	32032039322	Oct. 22, 2020 (1Y)
■ -	11947A	Hewlett Packard	Transient Limiter	3107A02762	Mar. 23, 2021 (1Y)

All test equipment used is calibrated on a regular basis.

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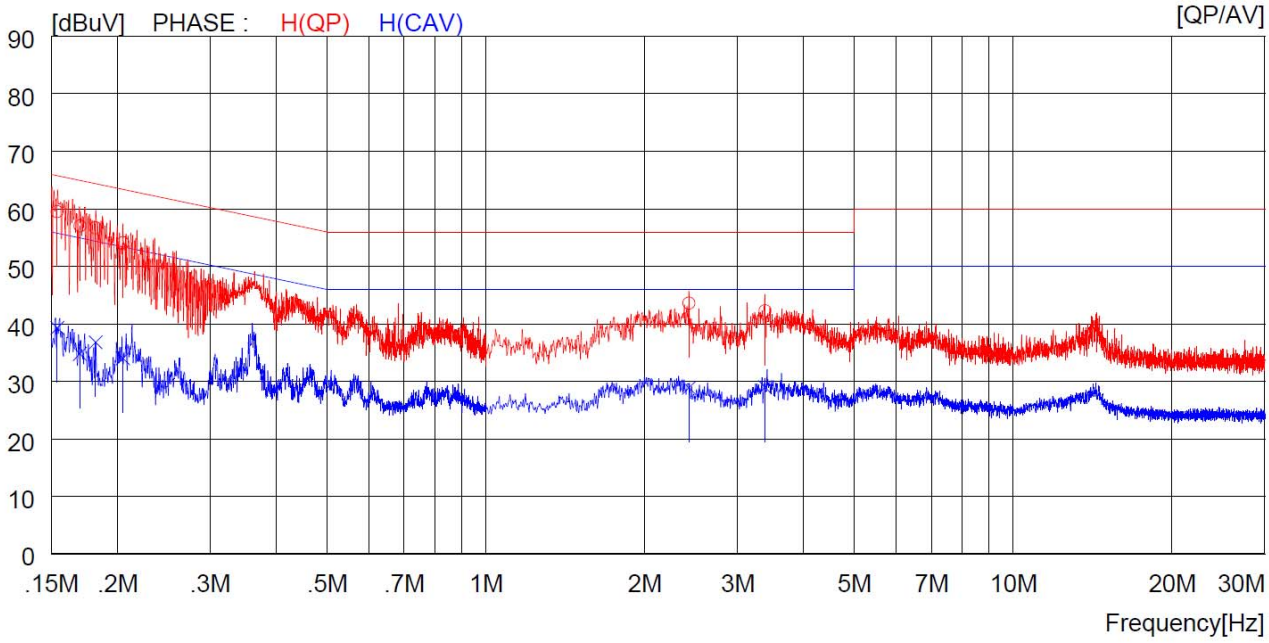
5.1.6 Test Data

-. Test Result : Pass

Tested by: Young-Ki, Kim / Manager

Operating Mode 1 (Normal operating)			
Frequency range	: 0.15 MHz ~ 30 MHz	Test Date	: April 15, 2021
Resolution bandwidth	: 9 kHz	Tested Line	: HOT LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.15400	38.0	----	21.5	59.5	----	65.8	----	6.3	----	H(QP)
2	0.17000	35.5	----	21.5	57.0	----	65.0	----	8.0	----	H(QP)
3	0.18200	35.2	----	21.5	56.7	----	64.4	----	7.7	----	H(QP)
4	0.20500	32.6	----	21.5	54.1	----	63.4	----	9.3	----	H(QP)
5	2.42800	22.0	----	21.6	43.6	----	56.0	----	12.4	----	H(QP)
6	3.38400	20.6	----	21.7	42.3	----	56.0	----	13.7	----	H(QP)
7	0.15400	----	17.8	21.5	----	39.3	----	55.8	----	16.5	H(CAV)
8	0.17000	----	13.3	21.5	----	34.8	----	55.0	----	20.2	H(CAV)
9	0.18200	----	15.3	21.5	----	36.8	----	54.4	----	17.6	H(CAV)
10	0.20500	----	12.5	21.5	----	34.0	----	53.4	----	19.4	H(CAV)
11	2.42800	----	7.3	21.6	----	28.9	----	46.0	----	17.1	H(CAV)
12	3.38400	----	7.3	21.7	----	29.0	----	46.0	----	17.0	H(CAV)

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

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

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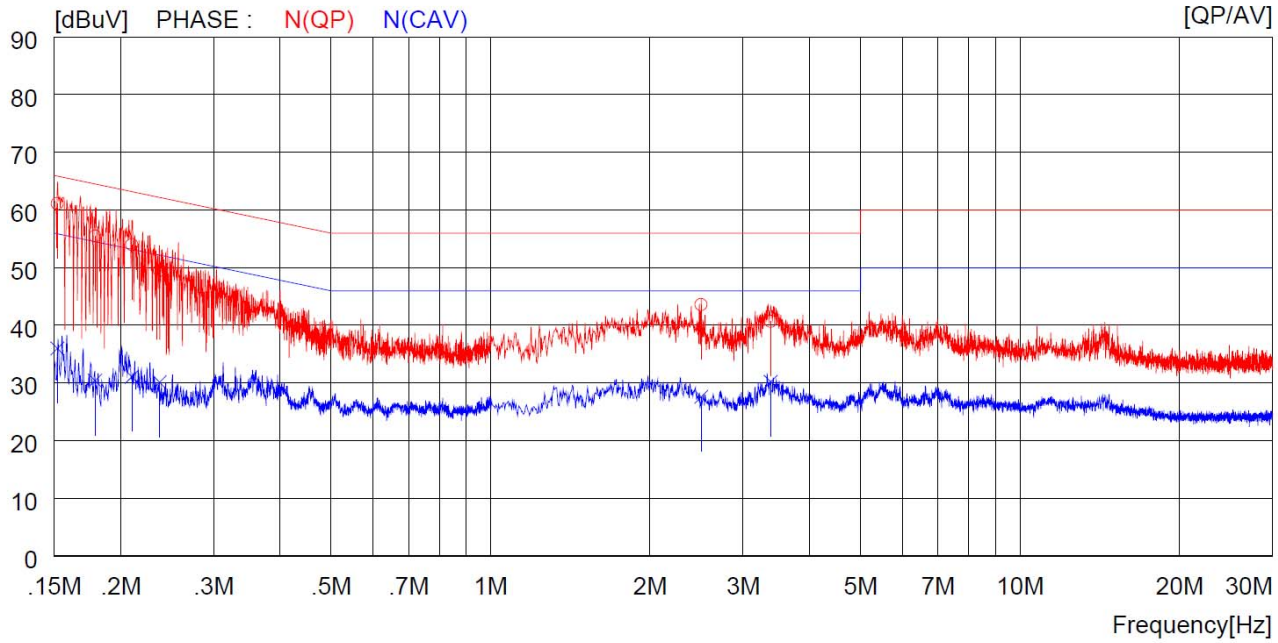
Operating Mode 1 (Normal operating)			
Frequency range	: 0.15 MHz ~ 30 MHz	Test Date	: April 15, 2021
Resolution bandwidth	: 9 kHz	Tested Line	: NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.15200	39.6	----	21.5	61.1	----	65.9	----	4.8	----	N(QP)
2	0.17900	34.0	----	21.5	55.5	----	64.5	----	9.0	----	N(QP)
3	0.21000	32.5	----	21.5	54.0	----	63.2	----	9.2	----	N(QP)
4	0.23700	28.0	----	21.5	49.5	----	62.2	----	12.7	----	N(QP)
5	2.50000	22.0	----	21.6	43.6	----	56.0	----	12.4	----	N(QP)
6	3.38000	19.0	----	21.7	40.7	----	56.0	----	15.3	----	N(QP)
7	0.15200	----	14.5	21.5	----	36.0	----	55.9	----	19.9	N(CAV)
8	0.17900	----	8.9	21.5	----	30.4	----	54.5	----	24.1	N(CAV)
9	0.21000	----	9.6	21.5	----	31.1	----	53.2	----	22.1	N(CAV)
10	0.23700	----	8.6	21.5	----	30.1	----	52.2	----	22.1	N(CAV)
11	2.50000	----	6.0	21.6	----	27.6	----	46.0	----	18.4	N(CAV)
12	3.38000	----	8.5	21.7	----	30.2	----	46.0	----	15.8	N(CAV)

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

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

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5.2 Radiated Emission Test

5.2.1 Operating Environment

Temperature : 23.5 °C

Relative humidity : 41.9 % R.H.

5.2.2 Test Setup

The radiated emissions measurements were on the 10 m semi anechoic chamber. The EUT and all local support equipments were placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The frequency spectrum from 30 MHz to 18 000 MHz was scanned and emission levels maximized at each frequency recorded. The system 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.

5.2.3 Measurement uncertainty

Radiated emission electric field intensity, 30 MHz ~ 1 000 MHz : ± 4.6 dB

Radiated emission electric field intensity, 1 GHz ~ 18 GHz : ± 6.0 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2. The measurement uncertainty is given with a confidence of 95 % with the coverage factor, $k = 2$.

5.2.4 Limit

-. FCC Part 15 Subpart B

Frequency of Emission (MHz)	Resolution bandwidth	Field strength @ 3 m (dBμV/m)	
		Quasi-peak	
30 ~ 88	120 kHz	40.0	
88 ~ 216		43.5	
216 ~ 230		46.0	
230 ~ 960		46.0	
960 ~ 1 000		54.0	
		Peak Limit	CISPR Average Limit
> 1 000	1 MHz	74.0	54.0

-. ICES-003

Frequency of Emission (MHz)	Resolution bandwidth	Field strength @ 3 m (dBμV/m)	Field strength @ 10 m (dBμV/m)
		Quasi-peak	Quasi-peak
30 ~ 88	120 kHz	40.0	30.0
88 ~ 216		43.5	33.1
216 ~ 230		46.0	35.6
230 ~ 960		47.0	37.0
960 ~ 1 000		54.0	43.5
Frequency of Emission (MHz)	Resolution bandwidth	Field strength @ 3 m (dBμV/m)	
		Peak Limit	CISPR Average Limit
> 1 000	1 MHz	74.0	54.0

5.2.5 Test Equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESR	Rohde & Schwarz	Test Receiver	102190	Oct. 16, 2020 (1Y)
■ -	VULB9163	Schwarzbeck	Trilog Broadband Antenna	9163-225	Sep. 14, 2020 (2Y)
■ -	3115	ETS-LINDGREN	Horn Antenna	34823	Aug. 14, 2020 (1Y)
■ -	8447D	Hewlett Packard	Amplifier	2944A07777	Mar. 15, 2021 (1Y)
■ -	PAM-118A	COM-POWER	Preamplifier	18040081	Oct. 12, 2020 (1Y)
■ -	CO3000	Innco Systems GmbH	Controller	N/A	N/A
■ -	DT5000	Innco Systems GmbH	Turn Table	N/A	N/A
■ -	MA4000-EP	Innco Systems GmbH	Antenna Master	N/A	N/A

All test equipment used is calibrated on a regular basis.

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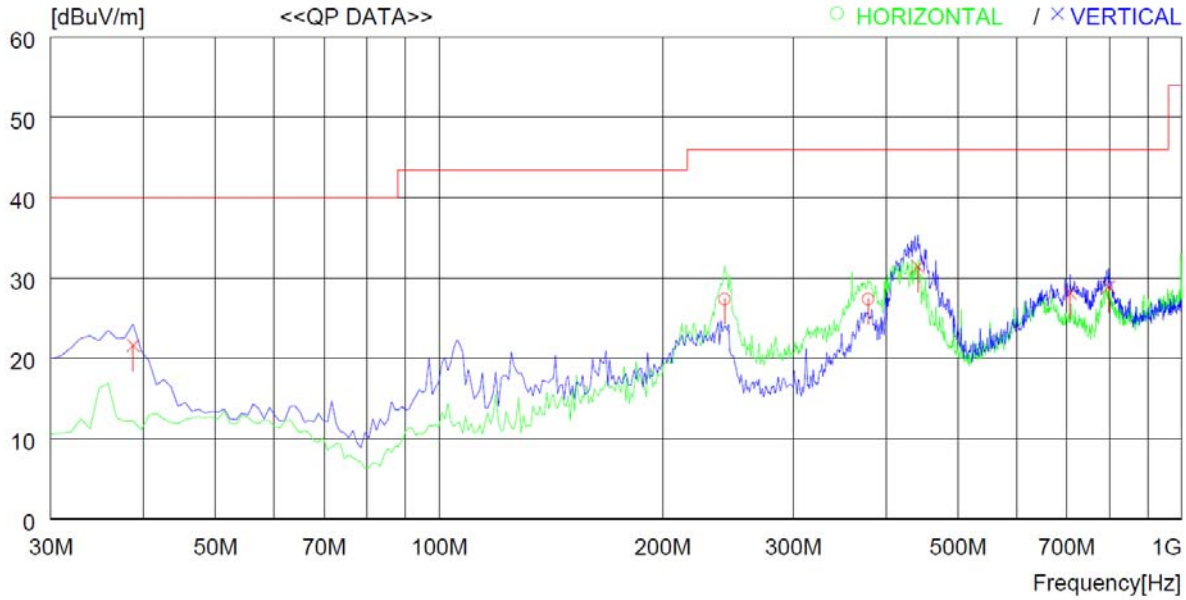
5.2.6 Test Data

-. Test Result : Pass

Tested by: Young-Ki, Kim / Manager

Operating Mode 1 (Normal operating)			
Frequency range	: 30 MHz ~ 1 000 MHz	Applied Standards	: FCC Part 15 Subpart B
Resolution bandwidth	: 120 kHz	Test Date	: April 14, 2021
Detector Mode	: Quasi-Peak	Measurement distance	: 3 m



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	242.430	37.9	12.3	4.8	27.6	27.4	46.0	18.6	100	95
2	378.230	34.0	15.2	6.3	28.1	27.4	46.0	18.6	100	358
----- Vertical ------										
3	38.730	35.0	13.3	1.6	28.3	21.6	40.0	18.4	100	10
4	441.281	36.8	16.4	6.6	28.4	31.4	46.0	14.6	100	10
5	708.025	28.0	19.7	8.9	28.5	28.1	46.0	17.9	100	332
6	797.262	27.0	20.7	9.4	28.2	28.9	46.0	17.1	100	355

Remark: Margin (dB) = Limit – Result

Result = Reading Quasi-Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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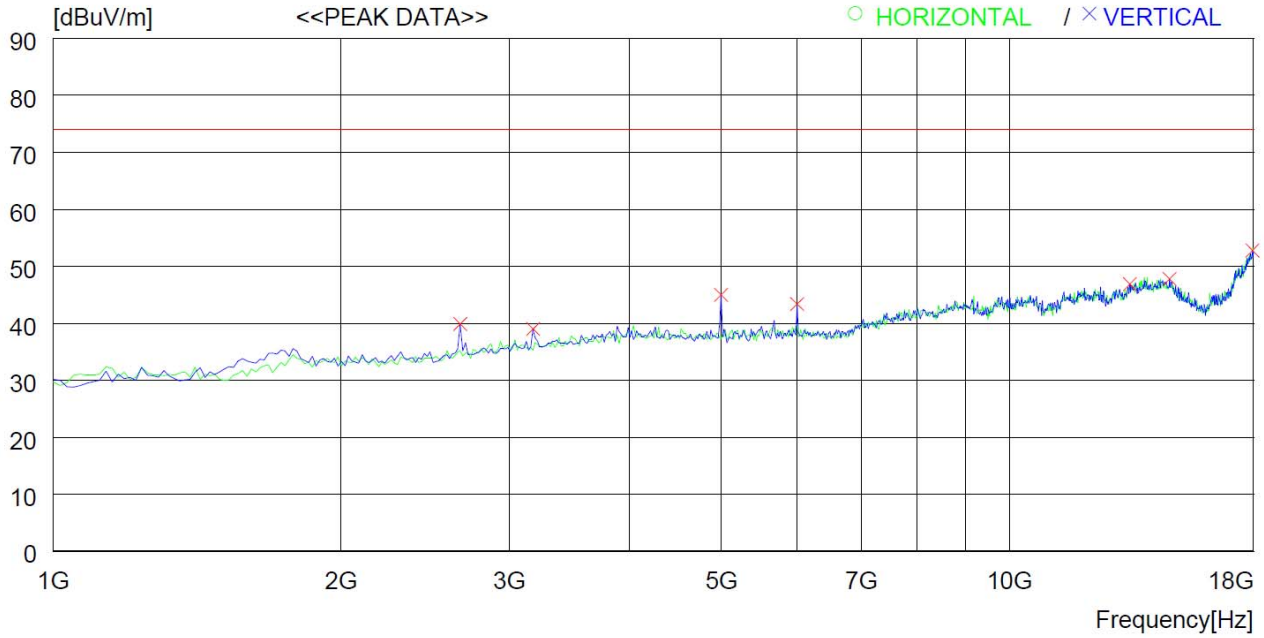
Operating Mode 1 (Normal operating)			
Frequency range	: 1 GHz ~ 18 GHz	Test Date	: April 14, 2021
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: Peak		



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	SITE FACTOR [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical ------											
1	2666.000	50.6	29.0	3.5	45.6	2.4	39.9	74.0	34.1	100	94
2	3176.000	48.1	30.5	3.9	45.9	2.4	39.0	74.0	35	100	159
3	4995.000	50.7	33.3	4.9	46.3	2.4	45.0	74.0	29	100	2
4	5998.000	47.5	34.2	5.4	46.1	2.4	43.4	74.0	30.6	100	2
5	13359.000	42.4	40.2	8.4	46.5	2.4	46.9	74.0	27.1	100	2
6	14702.000	41.7	41.3	8.6	46.2	2.4	47.8	74.0	26.2	100	2
7	17949.000	39.5	47.1	9.7	45.9	2.4	52.8	74.0	21.2	100	2

Remark 1: Margin (dB) = Limit – Result and Result = Reading Peak + C.FACTOR

Remark 2: C.FACTOR = Antenna Factor + Loss – Gain Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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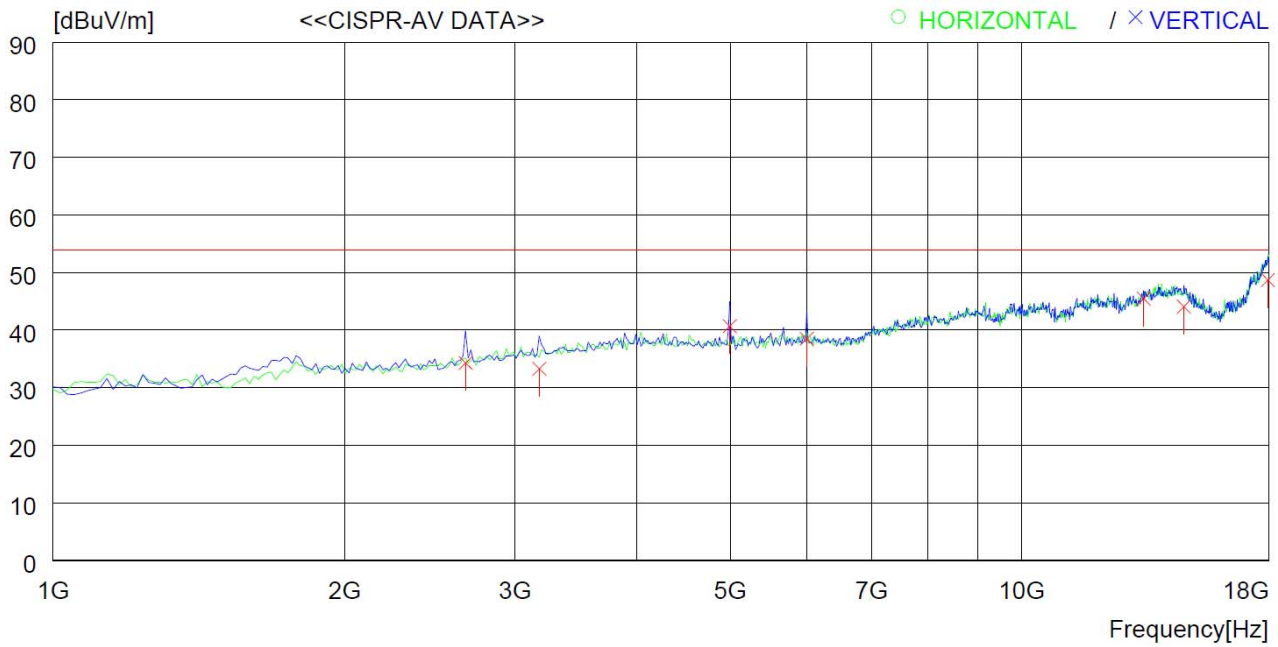
Operating Mode 1 (Normal operating)			
Frequency range	: 1 GHz ~ 18 GHz	Test Date	: April 14, 2021
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: CISPR-Average		



No.	FREQ [MHz]	READING CAV [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	SITE FACTOR [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical ------											
1	2666.000	45.0	29.0	3.5	45.6	2.4	34.3	54.0	19.7	100	94
2	3176.000	42.4	30.5	3.9	45.9	2.4	33.3	54.0	20.7	100	159
3	4995.000	46.4	33.3	4.9	46.3	2.4	40.7	54.0	13.3	100	2
4	5998.000	42.6	34.2	5.4	46.1	2.4	38.5	54.0	15.5	100	2
5	13359.000	41.0	40.2	8.4	46.5	2.4	45.5	54.0	8.5	100	2
6	14702.000	38.0	41.3	8.6	46.2	2.4	44.1	54.0	9.9	100	2
7	17949.000	35.4	47.1	9.7	45.9	2.4	48.7	54.0	5.3	100	2

Remark 1: Margin (dB) = Limit – Result and Result = Reading CISPR-Average + C.FACTOR

Remark 2: C.FACTOR = Antenna Factor + Loss – Gain Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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6. SAMPLE CALCULATIONS

$$dB\mu V = 20\ Log_{10}(\mu V)$$

Margin = Limit - Result

-. Example 1: 0.15200 MHz

Class B Limit	= 65.9 dBμV (CISPR Average)
Reading	= 39.6 dBμV
Correction Factor	= Cable Loss + Pulse Limiter
	= 21.5 dB
Total	= 61.1 dBμV
Margin	= 65.9 dBμV – 61.1 dBμV
	= 4.8 dB

-. Example 2: 441.281 MHz

Class B Limit	= 46.0 dBμV/m (Quasi-Peak)
Reading	= 36.8 dBμV
Correction Factor	= Antenna Factor (16.4 dB/m) + Cable Loss (6.6 dB) - Amp. Gain (28.4 dB)
	= -5.4 dB
Total	= 31.4 dBμV/m
Margin	= 46.0 dBμV/m – 31.4 dBμV/m
	= 14.6 dB

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