

RF TEST REPORT

Test Equipment : Pivo Remote Control
Model Name : PIVO-RC-1
FCC ID : 2AS3QPIVO-RC-1
Date of receipt : 2019.11.18
Test duration : 2019.11.18 ~ 2019.11.26
Date of issue : 2020.01.13

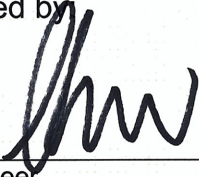
Applicant : 3i Inc.
101-117, 29, Dongbu-ro, Dong-gu, Daegu, South Korea

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

Test specification : FCC Part 15 Subpart C 15.249
Test result : Pass

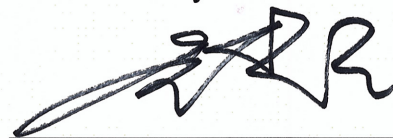
The above equipment was tested by Lab-T Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.
The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose.
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Tested by



Engineer
HyunWoo Lee

Reviewed by:



Technical Manager
SangHoon Yu

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1. Applicant Information

Applicant : 3i Inc.

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Telephone No. : +82-70-4756-2133

Person in charge : Gyuhyon Kim / hw.oem@3i.ai

Manufacturer : 3i Inc.

Address : 101-117, 29, Dongbu-ro, Dong-gu, Daegu, South Korea

Manufacturer : ZHONGSHAN SHIHONG ELECTRONIC TECHNOLOGY CO.,LTD.

Address : NO.19,3RD LONGTONG SAN ROAD, TANZHOU TOWN, ZHONGSHAN CITY,
GUANGDONG PROVINCE, CHINA

2. Laboratory Information

Test Laboratory : Lab-T, Inc.

Address : 2182-42, Baegok-daero, Mohyeon-myeon, Cheoin-gu, Yongin-si
Gyeonggi-do 17036, South Korea

Telephone No. : +82 31-322-6767

Facsimile No. : +82 31-322-6768

Certificate

FCC Designation No. : KR0159

FCC Registration No. : 133186

3. Information About Test Equipment

3.1 Equipment Information

Equipment type	Pivo Remote Control
Equipment model name	PIVO-RC-1
Equipment add model name	-
Frequency range	2 440 MHz
Modulation type	GFSK
Power supply	DC 3.0 V
H/W version	remote_V02
S/W version	Si24R1 V1.0

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

3.2 Antenna Information

Antenna	type	Chip Antenna
	gain	2.12 dBi

3.3 Tested Companion Device Information

Type	Manufacturer	Model	Note
-	-	-	-
-	-	-	-

4. Test Report

4.1 Summary

FCC Part 15			
Reference	Parameter	Clause	Status
Transmitter Requirements			
15.203	Antenna Requirement	4.4.1	C
2.1049	20 dB Channel Bandwidth	4.4.2	C
2.1049	Occupied Bandwidth	4.4.2	C
15.249(a)(b) 15.205(a) 15.209(a)	Radiated Emission, Band Edge and Restricted bands	4.4.3	C
15.207(a)	Conducted Emissions	4.4.4	N/A ^{NOTE2}
NOTE 1 : C = Comply N/C = Not Comply N/T = Not Tested N/A = Not Applicable			
NOTE 2 : EUT operates only in Battery			

* The general test methods used to test this device is ANSI C63.10:2013

4.2 Measurement Uncertainty

Mesurement items	Expanded Uncertainty	
Occupied Channel Bandwidth	11.27 kHz	(The confidence level is about 95 %, k=2)
Radiated Spurious Emissions (1 GHz under)	4.67 dB	(The confidence level is about 95 %, k=2)
Radiated Spurious Emissions (Above 1 GHz)	5.85 dB	(The confidence level is about 95 %, k=2)
Conducted emission	2.36 dB	(The confidence level is about 95 %, k=2)

4.3 Test Report Version

Test Report No.	Date	Description
TRRFCC20-0001	20-01-13	Initial issue

4.4 Transmitter Requirements

4.4.1 Antenna Requirement

4.4.1.1 Regulation

According to §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. 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 manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

4.4.1.2 Result

Comply

(The antenna of this EUT is Chip Antenna Type. Therefore the antenna is permanently attached. Please refer to the internal photo. Therefore this EUT Complies with the requirement of §15.203)

4.4.2 20 dB Bandwidth and Occupied Bandwidth

4.4.2.1 Regulation

20 dB and 99% emission bandwidth reporting only.

4.4.2.2 Measurement Procedure

ANSI C63.10 § 6.9.2 Occupied bandwidth 20dB Relative procedure

ANSI C63.10 § 6.9.3 Occupied bandwidth 99% procedure

4.4.2.3 Result

Comply (measurement data : refer to the next page)

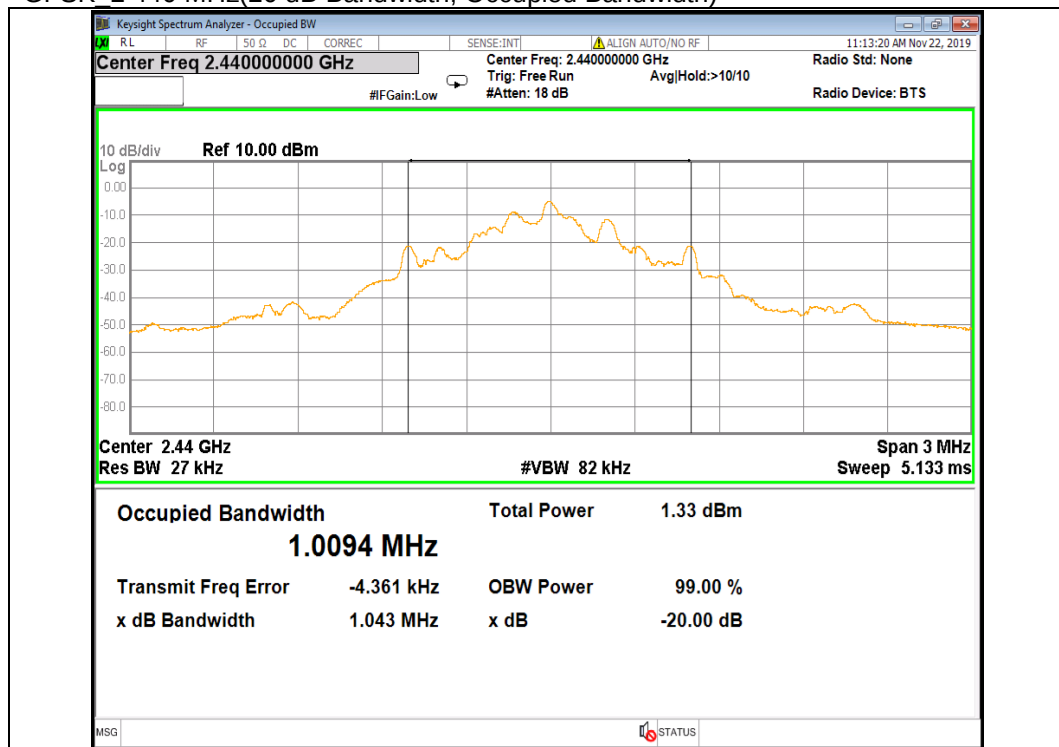
4.4.2.4 Measurement data

Test mode : GFSK

Frequency (MHz)	20 dB Bandwidth (MHz)	Occupied Bandwidth (99 % Bandwidth)(MHz)
2 440	1.043	1.009

4.4.2.5 Test Plot

GFSK 2 440 MHz(20 dB Bandwidth, Occupied Bandwidth)



4.4.3 Radiated Emission, Band Edge, and Restricted bands

4.4.3.1 Regulation

According to §15.249 (a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2 400-2 483.5 MHz	50	500
5 725-5 875 MHz	50	500
24.0-24.25 GHz	250	2500

(b) Fixed, point-to-point operation as referred to in this paragraph shall be limited to systems employing a fixed transmitter transmitting to a fixed remote location. Point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information are not allowed. Fixed, point-to-point operation is permitted in the 24.05-24.25 GHz band subject to the following conditions:

(1) The field strength of emissions in this band shall not exceed 2500 millivolts/meter.

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

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.

According to §15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 – 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 – 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 – 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 – 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 – 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 – 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 – 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 – 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 – 4 400	Above 38.6
13.36 - 13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurement

4.4.3.2 Measurement Procedure

- 1) The preliminary and final radiated measurements were performed to determine the frequency producing the maximum emissions in at 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 m height or 1.5 m 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, and from 1 000 MHz to 26 500 MHz using the horn 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 and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.

NOTE2 : The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection at frequency above 1 GHz.

The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz(1/T) for Average detection (AV) at frequency above 1 GHz. (where T = pulse width)

NOTE3 : The 0.8 m height is for below 1 GHz testing, and 1.5 m is for above 1 GHz testing.

4.4.3.3 Result

Comply (measurement data : refer to the next page)

4.4.3.4 Measurement data

Test mode : Below 1 GHz

Frequency (MHz)	Detector	Note 1	Pol (V/H)	Reading (dBμV)	Ant Factor (dB)	Loss (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
784.71	QP	S	V	21.80	22.60	-20.00	24.40	46.00	21.60
802.41	QP	S	H	22.10	22.90	-19.90	25.10	46.00	20.90

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

Note 2 : Loss : Cable loss - Amp gain

Note 3 : Result : Reading + Ant Factor + Loss

Note 4 : According to §15.31 (f)(2);

Result at 30m (dBμV/m) = Result at 3m(dBμV/m)-40log(30/3) (dBμV/m)

Result at 300m (dBμV/m) = Result at 3m(dBμV/m)-40log(300/3) (dBμV/m)

Note 5 : The radiation measurements are performed in X, Y, Z axis positioning. And worst case mode is recorded in the report.

Test mode : Above 1 GHz

Frequency (MHz)	Detector	Note 1	Pol (V/H)	Reading (dBμV)	Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 439.95	PK	F	H	80.10	-5.04	75.06	114.00	38.94
	AV	F	H	43.20	-5.04	38.16	94.00	55.84
2 440.15	PK	F	V	77.40	-5.04	72.36	114.00	41.64
	AV	F	V	41.30	-5.04	36.26	94.00	57.74

Frequency (MHz)	Detector	Note 1	Pol (V/H)	Reading (dBμV)	Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 345.08	PK	S	V	41.10	-5.14	35.96	74.00	38.04
2 353.51	PK	S	H	41.40	-5.14	36.26	74.00	37.74
2 393.66	PK	S	H	41.30	-5.04	36.26	74.00	37.74
2 394.01	PK	S	V	41.00	-5.04	35.96	74.00	38.04
2 487.54	PK	S	H	40.80	-5.04	35.76	74.00	38.24
2 492.30	PK	S	V	40.30	-5.04	35.26	74.00	38.74
2 559.84	PK	S	H	41.50	-4.74	36.76	74.00	37.24
2 604.45	PK	S	V	41.20	-4.54	36.66	74.00	37.34
Above 5GHz	Not Detected	-	-	-	-	-	-	-

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

Note 2 : Factor : Ant Factor + Cable loss - Amp gain + Distance Factor

Note 3 : Result : Reading + Factor

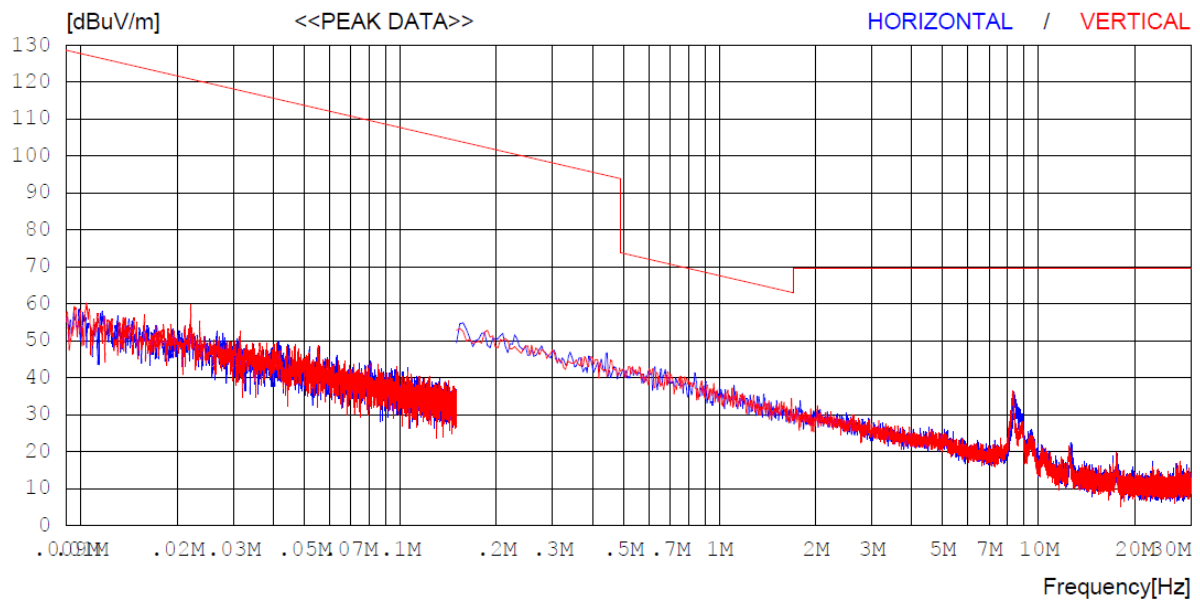
Note 4 : Below 1 GHz Measured distance : 3 m, Above 1 GHz Measured distance : 1 m

Above 1 GHz Distance Factor = $20\log(1 / 3) = -9.54$

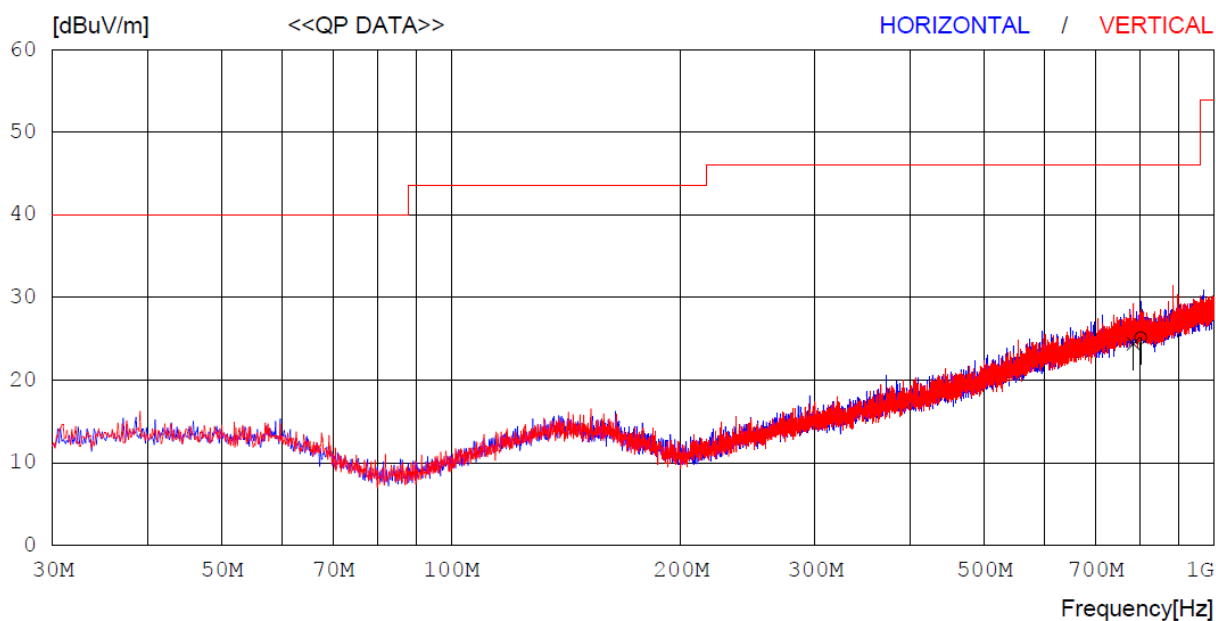
Note 5 : Not Detected means that peak data does not exceed the average limit.

4.4.3.5 Measurement Plot

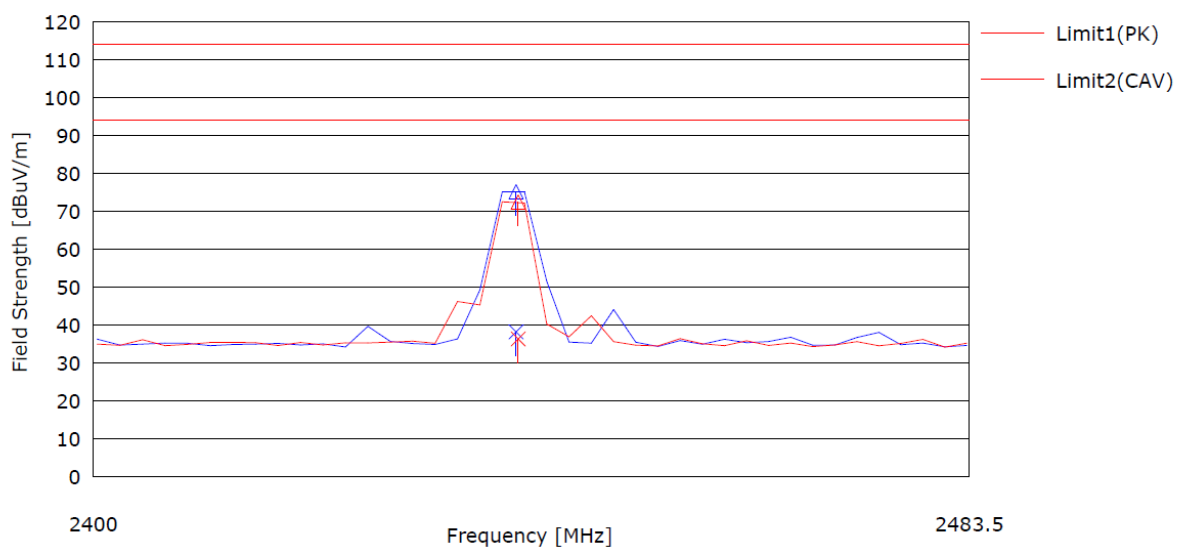
Test mode : 9 kHz ~ 30 MHz



Test mode : 30 MHz ~ 1 GHz

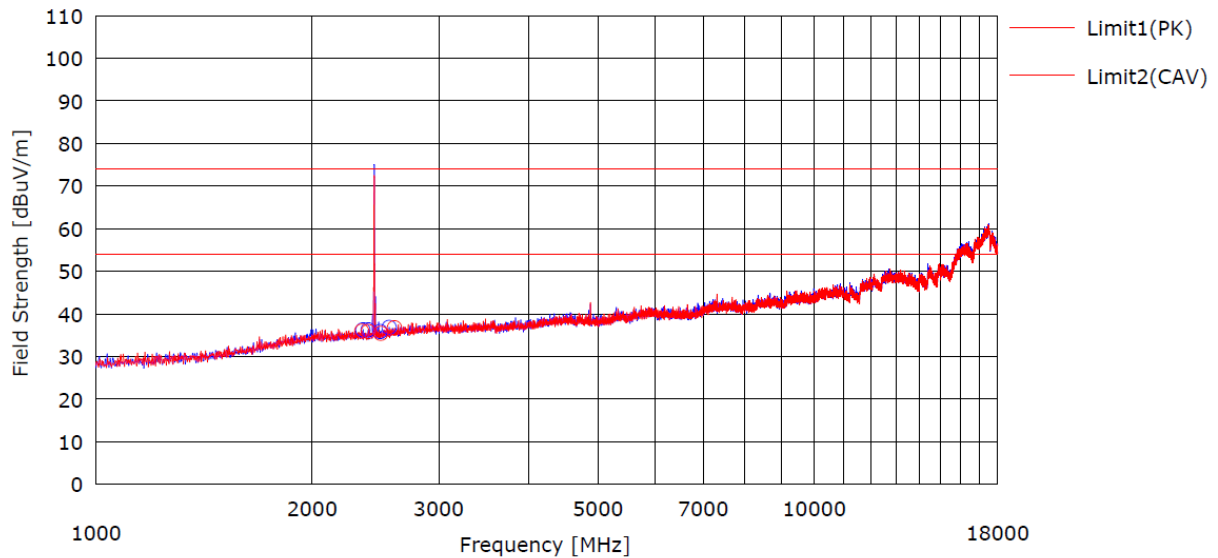


Test mode : 1 GHz ~ 18 GHz Fundamental



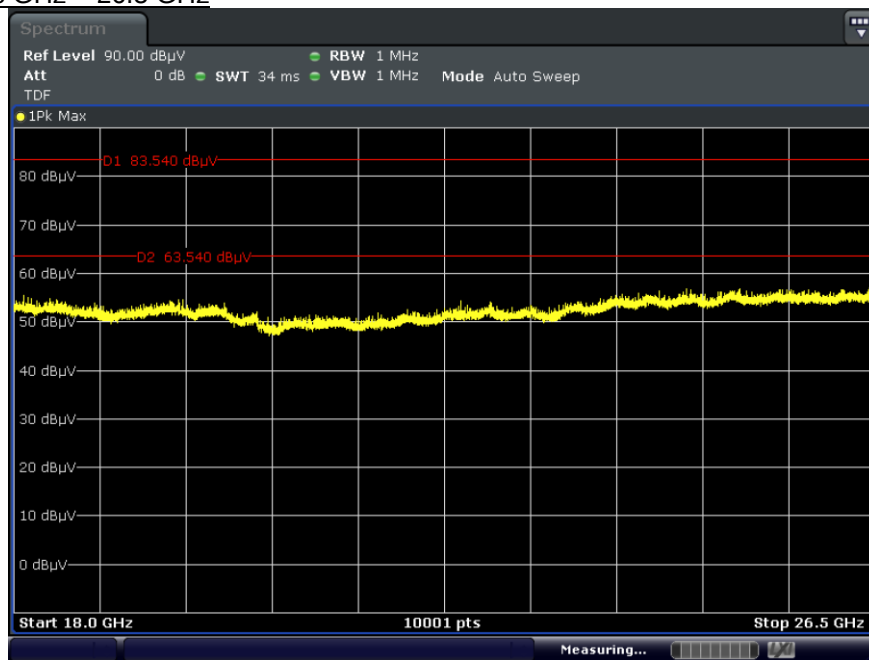
Note 1 : Measured distance : 1 m

Test mode : 1 GHz ~ 18 GHz Spurious Emission



Note 1 : Measured distance : 1 m

Test mode : 18 GHz ~ 26.5 GHz



Note 1 : Measured distance : 1 m

Note 2 : Limit : Peak : 83.54 dBuV/m
Average : 63.54 dBuV/m

4.4.4 Conducted Emission

4.4.4.1 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.

4.4.4.2 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.

4.4.4.3 Result

Not Applicable (EUT operates only in 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)
PXA Signal Analyzer	KEYSIGHT	N9030A	MY54410264	2019-01-10	2020-01-10
ATTENUATOR	INMET	26A-3	TR006	2019-10-14	2020-10-14
Digital MultiMeter	HP	34401A	US36025428	2019-01-10	2020-01-10
Signal Generator	ROHDE&SCHWARZ	SMB100A	178384	2019-10-14	2020-10-14
EMI Test Receiver	ROHDE&SCHWARZ	ESU40	100445	2018-12-14	2019-12-14
BiLog Antenna	Schwarzbeck	VULB9160	9160-3381	2019-04-09	2021-04-09
Preamplifier	TSJ	MLA-10k01- b01-27	1870369	2019-04-23	2020-04-23
Antenna Mast(10 m)	TOKIN	5977	-	-	-
Antenna Mast(10 m)	Innco	MA4640- XPET-0800	578	-	-
Controller(10 m)	TOKIN	5909L	141909L-1	-	-
Controller(10 m)	Innco	CO3000	40040217	-	-
Turn Table(10 m)	TOKIN	5983-1.5	-	-	-
10 m Semi-Anechoic Chamber	SY CORPORATION	-	-	-	-
FSV Signal Analyzer	ROHDE&SCHWARZ	FSV30	103370	2019-10-15	2020-10-15
Active Loop H-Field	ETS	6502	00150598	2019-05-15	2021-05-15
Double Ridege Horn Antenna	ETS	3117	00161011	2019-04-03	2021-04-03
Double Ridege Horn Antenna	A.H Systems, Inc	SAS-574	465	2019-04-25	2021-04-25
PREAMPLIFIER	Agilent	8449B	3008A02110	2019-01-14	2020-01-14
PREAMPLIFIER	A.H Systems, Inc	PAM-1840VH	166	2019-01-14	2020-01-14