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TEST REPORT

of

FCC Part 15 Subpart E §15.407

FCC ID: RMN-CTS-CFHD

Equipment Under Test	:	iMAN+
Model Name	:	CTS-CFHD
Variant Model Name(s)	:	Refer to the page 3
Applicant	:	CanTops Co., Ltd.
Manufacturer	:	CanTops Co., Ltd.
Date of Receipt	:	2023.06.07
Date of Test(s)	:	2023.06.12 ~ 2024.04.18
Date of Issue	:	2024.04.18

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

1) The results of this test report are effective only to the items tested.
2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
3) This test report cannot be reproduced, except in full, without prior written permission of the Company.
4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.
We are responsible for all the information of this test report except for the data(※) provided by the customer.

Tested by: Murphy Kim

Technical Manager: Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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Phone No. : +82 31 688 0901
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1.2. Details of Applicant

Applicant : CanTops Co., Ltd.
Address : A 1002 - 1008, Digital Empire BLDG, 16, Deongyeong-daero 1556beon-gil, Yeongtong-gu, Suwon-si, Gyeonggi-do, South Korea, 16690
Contact Person : Han, Sang-gyu
Phone No. : +82 10 4607 6910

1.3. Details of Manufacturer

Company : Same as applicant
Address : Same as applicant

1.4. Description of EUT

Kind of Product		iMAN+
Model Name		CTS-CFHD
Variant Model Names		CTS-CFHD-AA-FL, CTS-CFHD-AA-CN
Serial Number		Conducted sample: SS-10106 Radiated sample: SS-10101
Power Supply		DC 7.2 V
Frequency Range		5 736 ㎒ ~ 5 847 ㎒
Modulation Technique		GFSK
Number of Channels		5 736 ㎒ ~ 5 847 ㎒: 112 channels
Antenna Type		Multilayer monopole antenna
Antenna Gain※	**EA port**	2.40 ㏈i
	IA port	2.40 ㏈i
H/W Version		2.1
S/W Version		1.0

1.5. Declaration by the Manufacturer

- The EUT has two antennas, but it can not operate simultaneously.

1.6. Automatically Discontinue Transmission

1.6.1. Limit of Automatically Discontinue Transmission

The device shall automatically discontinue transmission in case of either absence of information to transmit or operating failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

1.6.2. Test Result of Automatically Discontinue Transmission

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.

1.7. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMA100B	106887	Oct. 06, 2023	Annual	Oct. 06, 2024
Spectrum Analyzer	R&S	FSV30	103453	Oct. 31, 2023	Annual	Oct. 31, 2024
Spectrum Analyzer	R&S	FSW43	100637	Apr. 08, 2024	Annual	Apr. 08, 2025
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 01, 2023	Annual	Sep. 01, 2024
Spectrum Analyzer	Agilent	N9030A	US51350132	Nov. 27, 2023	Annual	Nov. 27, 2024
Power Sensor	R&S	NRP-Z81	100669	May 16, 2023	Annual	May 16, 2024
Power Sensor	Anritsu	MA2411B	1207272	May 30, 2023	Annual	May 30, 2024
Attenuator	AEROFLEX / INMET	40AH2W-10	40G-1	Jun. 14, 2023	Annual	Jun. 14, 2024
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-2	Feb. 09, 2023	Annual	Feb. 09, 2024
High Pass Filter	Wainwright Instrument GmbH	WHKX6.0/18G-10SS	51	Jun. 14, 2023	Annual	Jun. 14, 2024
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	11	Oct. 17, 2023	Annual	Oct. 17, 2024
DC Power Supply	R&S	HMP2020	019922876	Apr. 27, 2023	Annual	Apr. 27, 2024
Preamplifier	H.P.	8447F	2944A03909	Aug. 04, 2023	Annual	Aug. 04, 2024
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	Oct. 06, 2023	Annual	Oct. 06, 2024
Signal Conditioning Unit	R&S	SCU-18F	101058	Dec. 07, 2023	Annual	Dec. 07, 2024
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 21, 2023	Biennial	Aug. 21, 2025
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	9163-437	May 31, 2023	Biennial	May 31, 2025
Horn Antenna	R&S	HF906	100326	Feb. 19, 2024	Annual	Feb. 19, 2025
EMI Test Receiver	R&S	ESU26	100109	Jan. 16, 2024	Annual	Jan. 16, 2025
Test Receiver	R&S	ESCI 7	100911	Feb. 26, 2024	Annual	Feb. 26, 2025
Two-Line V-network	R&S	ENV216	100190	May 17, 2023	Annual	May 17, 2024
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/38330516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/38330516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Shield Room	SY Corporation	L × W × H (6.5 m × 3.5 m × 3.5 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SENSORVIEW	NMST-13A26-NMST-5 m	TPC2402190004	Apr. 03, 2024	Semi-Annual	Oct. 03, 2024
Coaxial Cable	SENSORVIEW	NMST-13A26-NMST-10 m	TPC2402190001	Apr. 03, 2024	Semi-Annual	Oct. 03, 2024
Coaxial Cable	RFONE	PL360P-292M292M-1.5M-A	20200324002	Apr. 12, 2024	Semi-Annual	Oct. 12, 2024

■ Support equipment

Equipment	Manufacturer	Model	FCC ID
SWITCHING ADAPTOR	SHENZHEN FUJIA APPLIANCE CO., LTD.	FJ-SW1202000N	-

Note;

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date

1.8. Summary of Test Result

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart E		
Section	**Test Item(s)**	**Result**
15.205(a) 15.209(a) 15.407(b)(4)	Transmitter Radiated Spurious Emissions	Complied
15.407(a)	26 ㏈ Bandwidth	Complied
15.407(e)	6 ㏈ Bandwidth	Complied
15.407(a)(3)	Maximum Conducted Output Power	Complied
15.407(a)(3)	Peak Power Spectral Density	Complied
15.207	AC Power Line Conducted Emission	Complied

1.9. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 789033 D02 General UNII Test Procedures New Rules v02r01 were used in the measurement of the DUT.

1.10. Sample Calculation

Where relevant, the following sample calculation is provided:

1.10.1. Conducted Test

Offset value (㏈) = Attenuator (㏈) + Cable loss (㏈)

1.10.2. Radiation Test

Field strength level (㏈㎶/m) = Measured level (㏈㎶) + Antenna factor (㏈/m) + Cable loss (㏈) - Amplifier gain (㏈) + Duty factor (㏈)

1.11. Information of Software for test

- Using the software of CTS_SERIAL_PROGRAM_1.0.9.0 to testing of EUT.

1.12. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter		Uncertainty
Maximum Conducted Output Power		0.34 dB
Maximum Power Spectral Density		0.65 dB
26 dB Bandwidth		0.03 MHz
6 dB Bandwidth		0.06 MHz
AC Power Line Conducted Emission		3.10 dB
Radiated Emission, 9 kHz to 30 MHz	H	3.60 dB
	V	3.60 dB
Radiated Emission, below 1 GHz	H	4.60 dB
	V	4.90 dB
Radiated Emission, above 1 GHz	H	3.90 dB
	V	3.80 dB

All measurement uncertainty values are shown with a coverage factor *k* = 2 to indicate a 95 % level of confidence

1.13. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL004974	2024.04.18	Initial

1.14. Information of Variant Models

Model Names		Description
Basic model	CTS-CFHD	- Basic Model
Variant Models	CTS-CFHD-AA-FL	- Appearance and circuit are same as basic model, but use different name for sales purpose.
	CTS-CFHD-AA-CN	- Appearance and circuit are same as basic model, but CID-R port was blocked.

Note;

All the test were performed with the basic model.

1.15. Duty Cycle of EUT

Regarding to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, Ⅱ.B, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.
Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value, Set VBW ≥ RBW.
Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

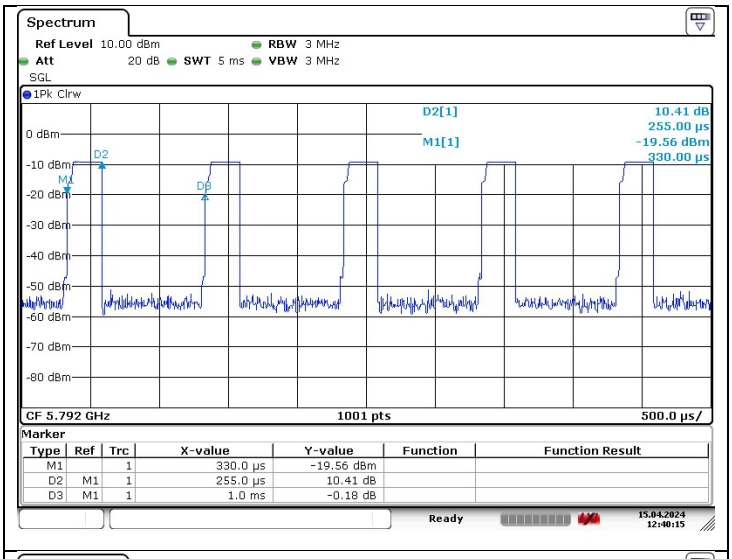
Antenna port	Frequency (㎒)	Duty Cycle (%)	Correction factor (㏈)
EA	5 792	25.50	5.93
IA	5 792	25.00	6.02

Remark;

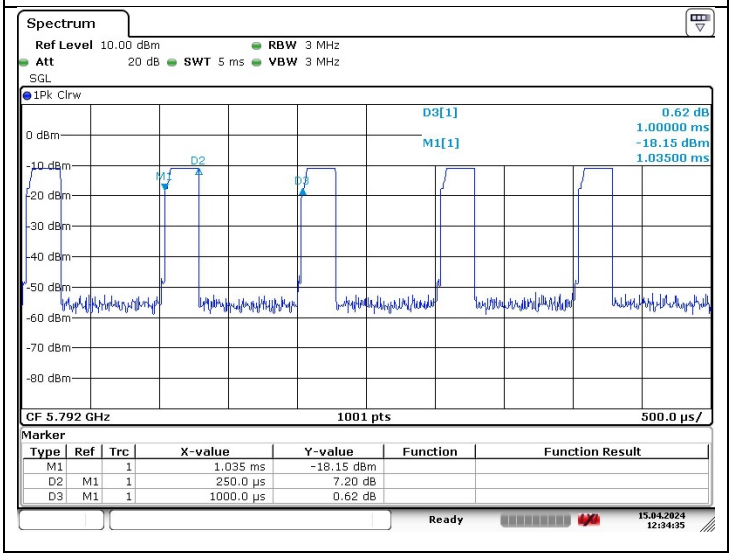
1. Duty Cycle (%) = (Tx on time / Tx on + off time) x 100
2. Correction Factor (㏈) = 10 log (1 / Duty Cycle)

- Test plots

EA port
5 792 ㎒



IA port
5 792 ㎒

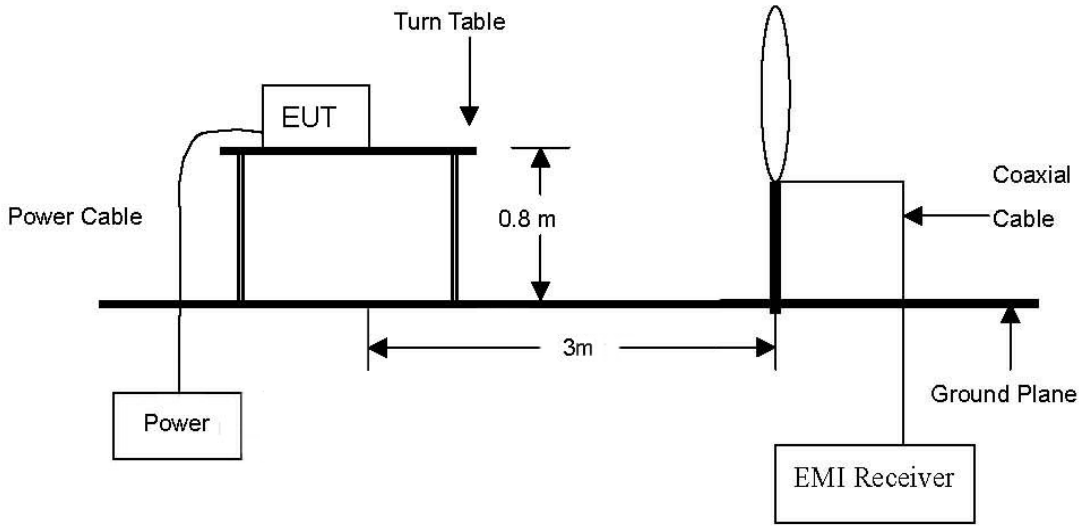


2. Transmitter Radiated Spurious Emissions

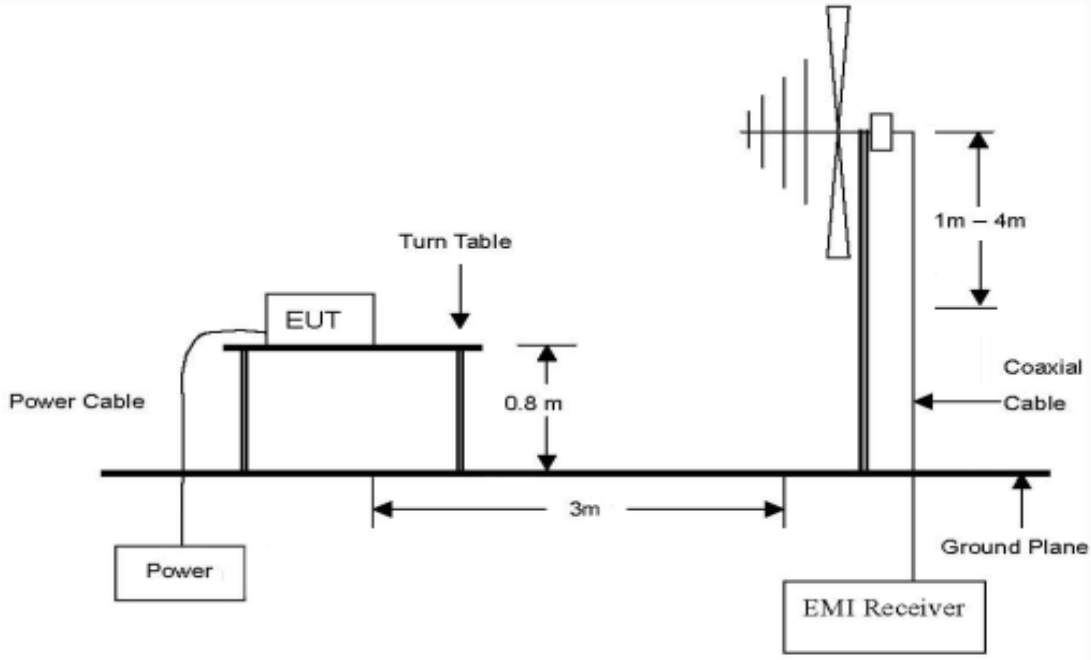
2.1. Test Setup

2.1.1. Transmitter radiated spurious emissions

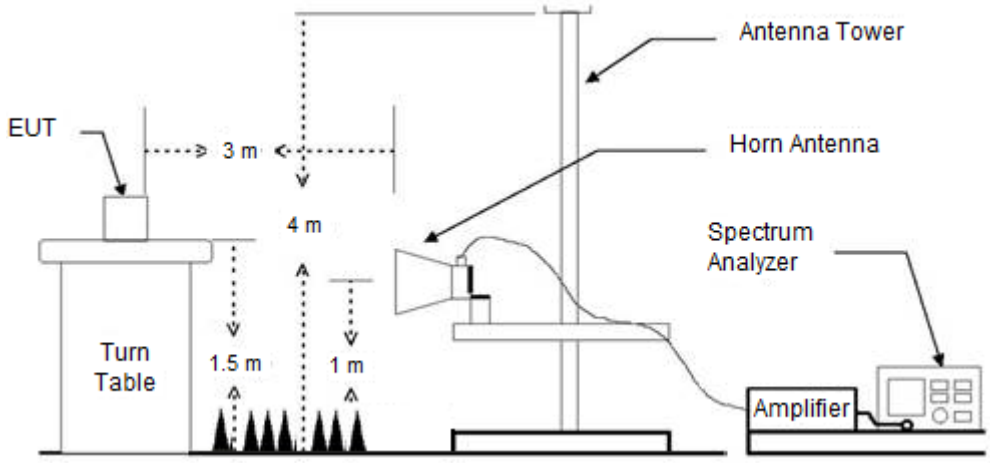
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



2.2. Limit

According to § 15.407(b)
(4) For transmitters operating in the 5.725-5.85 ㎓ band:
(i) All emissions shall be limited to a level of -27 ㏈m/㎒ at 75 ㎒ or more above or below the band edge increasing linearly to 10 ㏈m/㎒ at 25 ㎒ above or below the band edge, and from 25 ㎒ above or below the band edge increasing linearly to a level of 15.6 ㏈m/㎒ at 5 ㎒ above or below the band edge, and from 5 ㎒ above or below the band edge increasing linearly to a level of 27 ㏈m/㎒ at the band edge.

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 (㎒)	Field Strength (㎶/m)	Measurement Distance (Meters)
0.009-0.490	2 400/F(㎑)	300
0.490-1.705	24 000/F(㎑)	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 ㎒, 76-88 ㎒, 174-216 ㎒ or 470-806 ㎒. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.3. Test Procedures

Radiated spurious emissions from the EUT were measured according to the dictates in section G of KDB 789033 D02 General UNII Test Procedures New Rules v02r01 and ANSI C63.10-2013.

2.3.1. Test Procedures for emission below 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 ㎓ and 1.5 meter above the ground at a 3 meter anechoic chamber test site above 1 ㎓. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. For measurements below 1 ㎓ resolution bandwidth is set to 100 ㎑ for peak detection measurements or 120 ㎑ for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.
6. For measurements Above 1 ㎓ resolution bandwidth is set to 1 ㎒, the video bandwidth is set to 3 ㎒ for peak measurements and as applicable for average measurements.

- II.G.4. Unwanted emissions measurements below 1 ㎓.
Compliance shall be demonstrated using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- II.G.5. Unwanted maximum emissions measurements above 1 ㎓.
Peak emission levels are measured by setting the analyzer as follows:
Set to RBW = 1 ㎒, VBW ≥ 3 ㎒, Detector = Peak, Sweep time = auto, Trace mode= Max hold.

- II.G.6. Average unwanted emissions measurements above 1 ㎓.
Set to RBW = 1 ㎒, VBW ≥ 3 ㎒, Detector = power averaging (rms), Averaging type = power averaging (rms), Sweep time = auto, Perform a trace average of at least 100 traces If the transmission is continuous, If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50 % duty cycle, at least 200 traces shall be averaged.

If tests are performed with the EUT transmitting at a duty cycle less than 98 %, a correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle. The correction factor is computed as follows:

- If power averaging (rms) mode was used in II.G.6.c)(iv), the correction factor is 10 log (1 / x), where x is the duty cycle. For example, if the transmit duty cycle was 50 %, then 3 ㏈ must be added to the measured emission levels.

- The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z described in the test setup photo. All radiated testing of EUT was performed with worst case axis.

2.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

2.4.1. Radiated Spurious Emission below 1 000 ㎒

The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. All reading values are peak values.

- EA port, 5 847 ㎒

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
37.80	40.90	Peak	V	17.72	-27.48	31.14	40.00	8.86
48.11	34.70	Peak	V	19.70	-27.35	27.05	40.00	12.95
295.66	39.20	Peak	V	19.00	-25.44	32.76	46.00	13.24
403.41	39.00	Peak	H	21.47	-25.04	35.43	46.00	10.57
549.80	41.10	Peak	H	23.50	-25.68	**38.92**	46.00	7.08
609.82	36.30	Peak	V	25.20	-25.47	36.03	46.00	9.97
Above 700.00	Not detected	-	-	-	-	-	-	-

- IA port, 5 847 ㎒

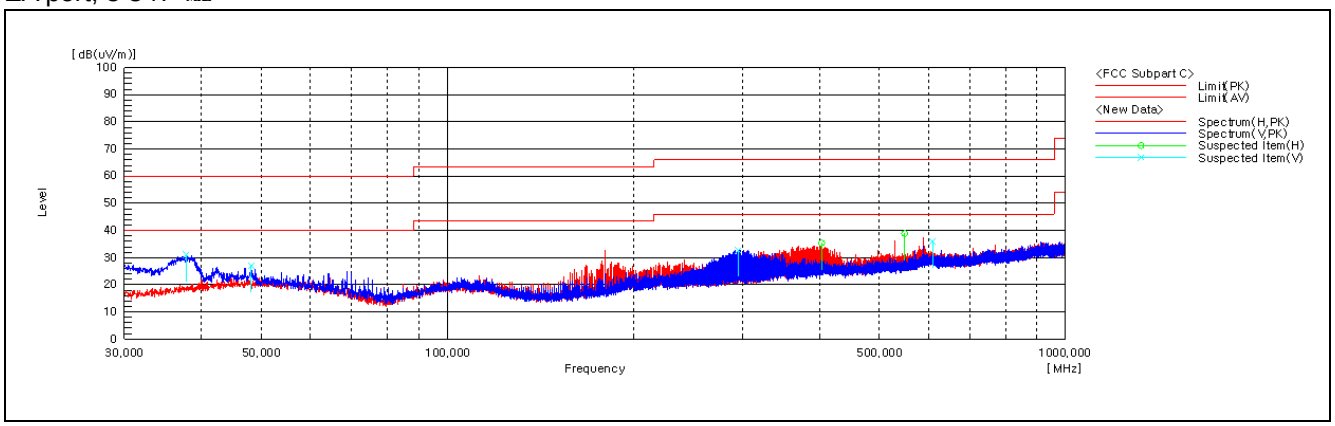
Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
36.79	41.50	Peak	V	17.32	-27.48	31.34	40.00	8.66
179.99	43.40	Peak	H	15.20	-26.14	32.46	43.50	11.04
292.26	39.80	Peak	V	18.91	-25.48	33.23	46.00	12.77
361.01	39.80	Peak	H	20.20	-25.27	34.73	46.00	11.27
590.22	39.30	Peak	H	24.71	-25.35	**38.66**	46.00	7.34
650.19	34.80	Peak	V	25.10	-25.44	34.46	46.00	11.54
Above 700.00	Not detected	-	-	-	-	-	-	-

Remark;

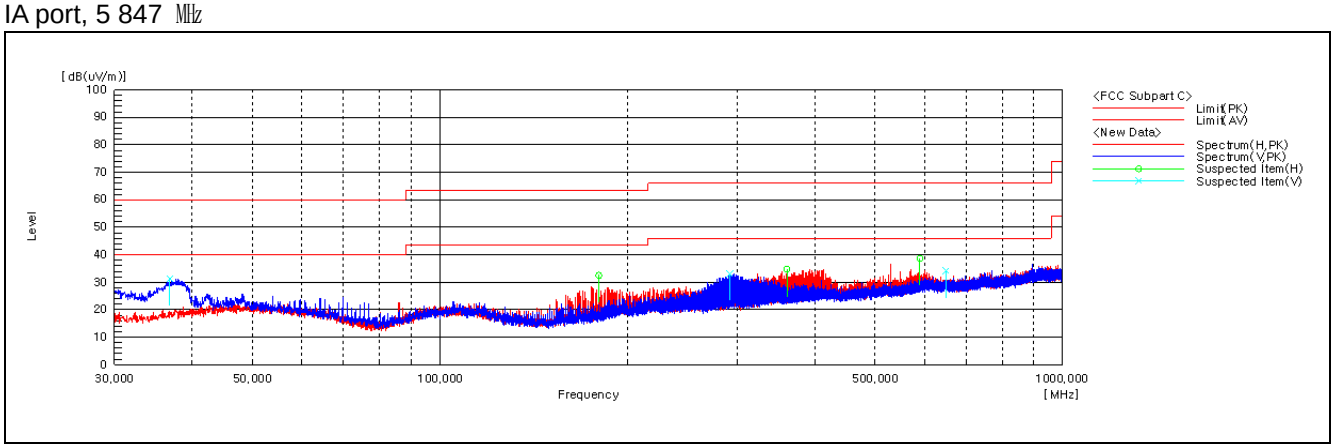
1. Spurious emissions for all channels were investigated and almost the same below 1 ㎓.
2. Test from 30 ㎒ to 1 000 ㎒ was performed using the software of EP5RE(V5.3.70) from TOYO.
3. Reported spurious emissions are measured in the channel with the highest maximum peak conducted output power.
4. Radiated spurious emission measurement as below.
   (Actual = Reading + AF + AMP + CL)
5. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

- Test plots

EA port, 5 847 ㎒



IA port, 5 847 ㎒



2.4.2. Radiated Spurious Emission above 1 000 ㎒

- EA port: 5 736 ㎒ ~ 5 847 ㎒

A. Low Channel (5 736 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
5 633.57	12.66	Peak	V	34.10	9.70	56.46	68.23	11.77
5 668.38	12.76	Peak	V	34.10	9.72	56.58	81.83	25.25
5 703.11	12.93	Peak	V	34.11	9.73	56.77	106.10	49.33
5 722.99	12.56	Peak	V	34.15	9.78	56.49	117.64	61.15

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 792 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 847 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
5 850.44	31.63	Peak	V	34.40	9.93	75.96	121.22	45.26
5 855.58	31.18	Peak	V	34.41	9.91	75.50	110.67	35.17
5 875.00	25.48	Peak	V	34.45	9.85	69.78	105.23	35.45
5 933.41	12.76	Peak	V	34.57	9.93	57.26	68.23	10.97

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

- IA port: 5 736 ㎒ ~ 5 847 ㎒

A. Low Channel (5 736 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
5 620.24	13.44	Peak	V	34.10	9.68	57.22	68.23	11.01
5 672.26	12.74	Peak	V	34.10	9.72	56.56	84.70	28.14
5 718.76	12.09	Peak	V	34.14	9.77	56.00	110.48	54.48
5 723.45	11.80	Peak	V	34.15	9.79	55.74	118.69	62.95

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 792 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 847 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
5 850.58	29.69	Peak	V	34.40	9.93	74.02	120.91	46.89
5 855.44	29.00	Peak	V	34.41	9.91	73.32	110.70	37.38
5 875.29	20.74	Peak	V	34.45	9.85	65.04	105.01	39.97
5 934.28	13.47	Peak	V	34.57	9.93	57.97	68.23	10.26

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

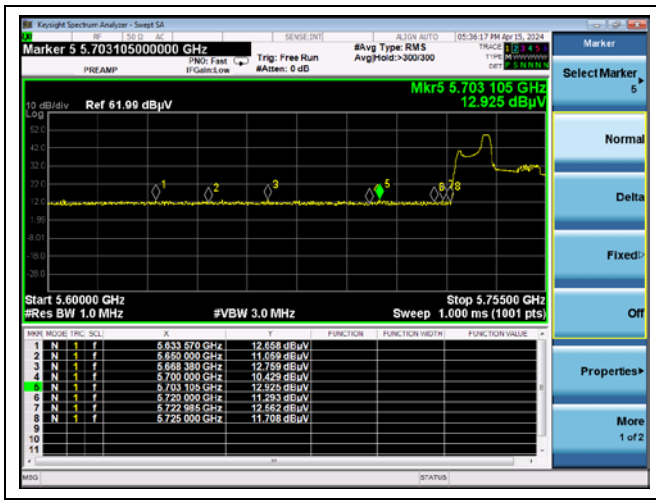
Remark;

1. "*" means the restricted band.
2. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using Peak / average detector mode if frequency was in restricted band. Otherwise the frequency was out of restricted band, only peak detector should be used.
3. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
4. If frequency was out of restricted band, the calculation method for peak limit is same as below.
   68.23 ㏈㎶/m = EIRP - 20 log (d) + 104.77 = -27 - 20 log (3) + 104.77
5. In case of the emissions within ±75 ㎒ from band edge of band 3, limit should be adjusted to emission mask of 15.407(4)(i).
6. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.
7. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.

- Test plots

EA port: 5 736 ㎒ ~ 5 847 ㎒

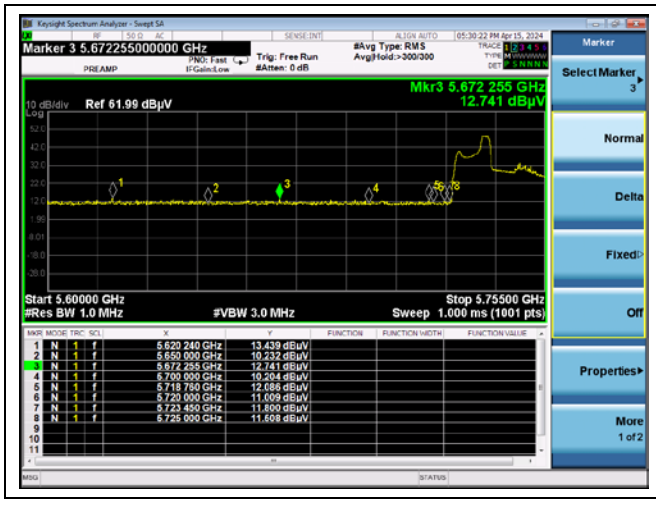
Low channel band edge (Peak)



High channel band edge (Paek)

IA port: 5 736 ㎒ ~ 5 847 ㎒

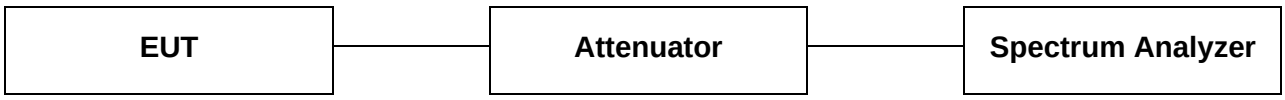
Low channel band edge (Peak)



High channel band edge (Paek)

3. 26 dB Bandwidth

3.1. Test Setup



3.2. Limit

None; for reporting purpose only.

3.3. Test Procedure

1. This measurement settings are specified in section Ⅱ.C.1 of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
2. Set RBW = approximately 1 % of the emission bandwidth.
3. Set the VBW > RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

3.4. Test Result

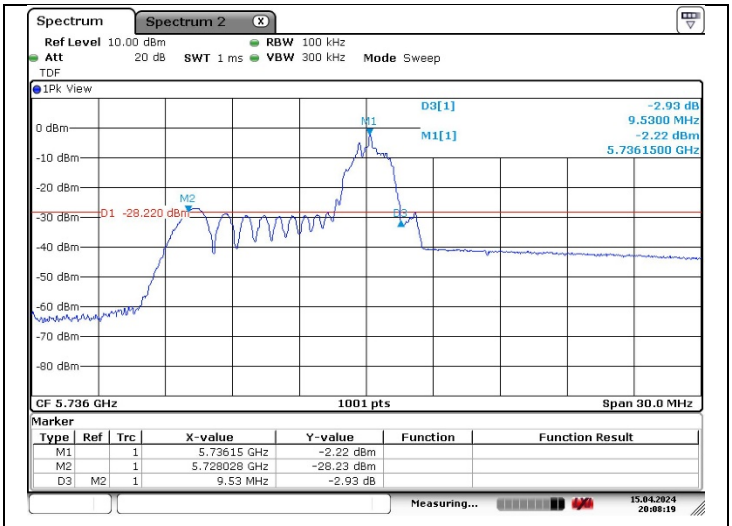
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Mode	Channel	Frequency (㎒)	26 ㏈ Bandwidth (㎒)	
			EA port	IA port
GFSK	Low	5 736	9.530	9.500
	Middle	5 792	11.149	11.119
	High	5 847	11.449	11.479

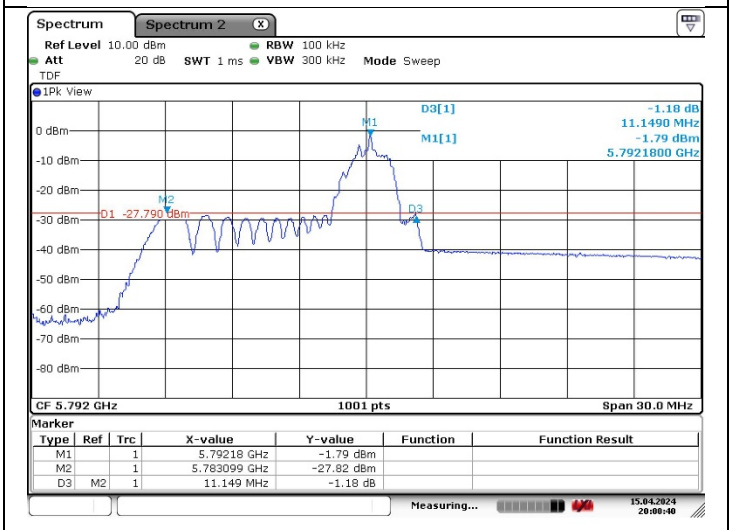
- Test plots

EA port: 5 736 ㎒ ~ 5 847 ㎒

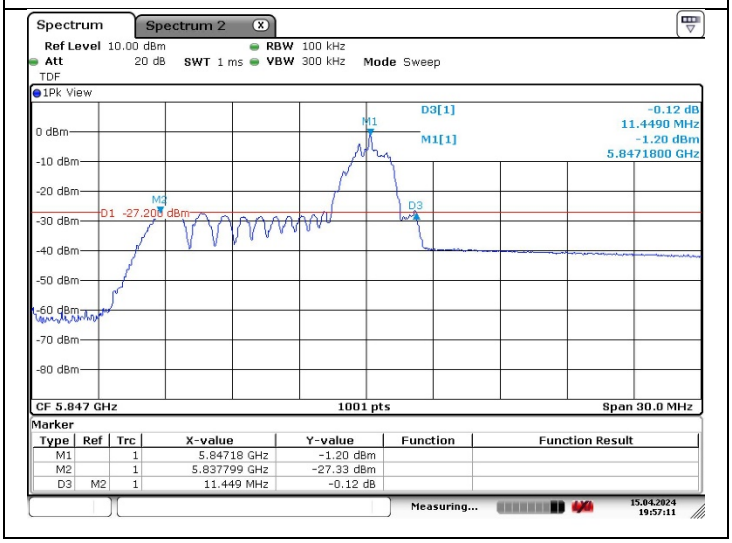
Low Channel
(5 736 ㎒)



Middle Channel
(5 792 ㎒)

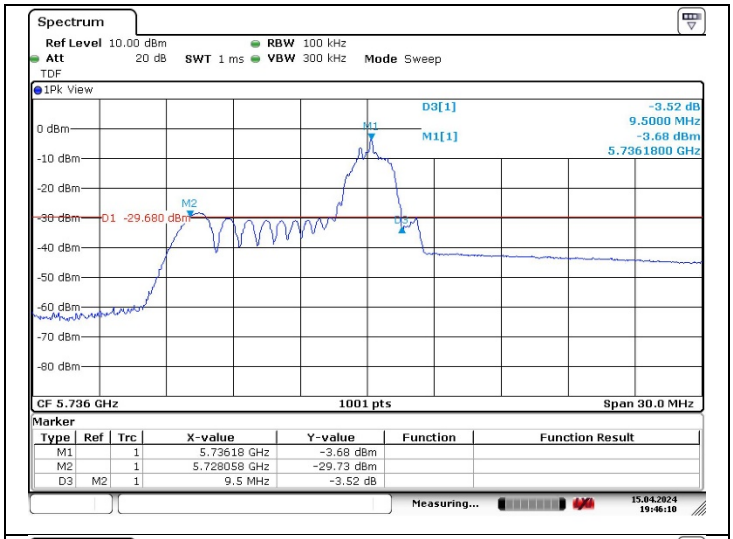


High Channel
(5 847 ㎒)

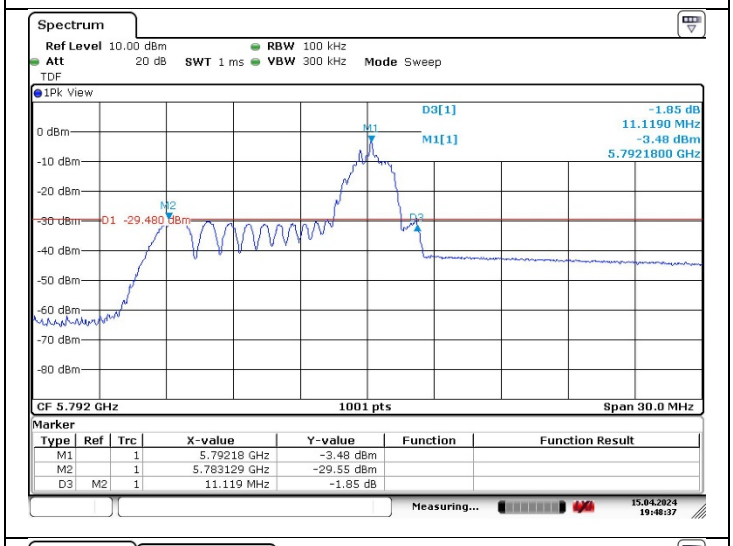


IA port: 5 736 ㎒ ~ 5 847 ㎒

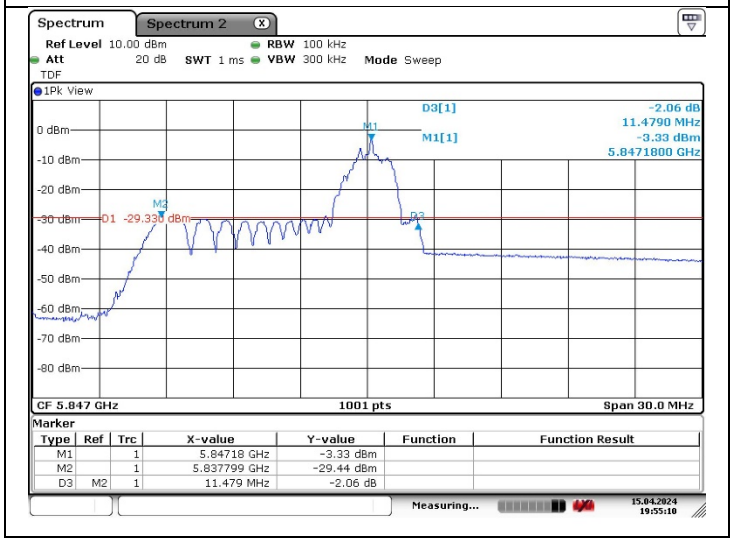
Low Channel
(5 736 ㎒)



Middle Channel
(5 792 ㎒)

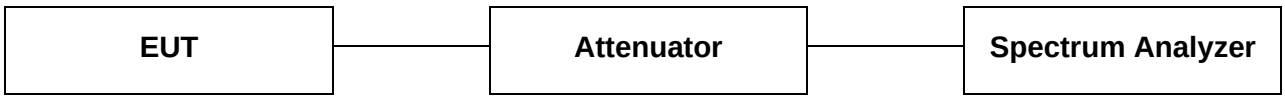


High Channel
(5 847 ㎒)



4. 6 dB Bandwidth

4.1. Test Setup



4.2. Limit

According to §15.407(e), within the 5.725-5.85 ㎓ band, the minimum 6 ㏈ bandwidth of U-NII devices shall be at least 500 ㎑.

4.3. Test Procedure

1. This measurement settings are specified in section Ⅱ.C.2 of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
2. Set RBW = 100 ㎑.
3. Set the video bandwidth (VBW) ≥ 3 x RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 ㏈ relative to the maximum level measured in the fundamental emission.

4.4. Test Result

Ambient temperature : (23 ± 1) ℃

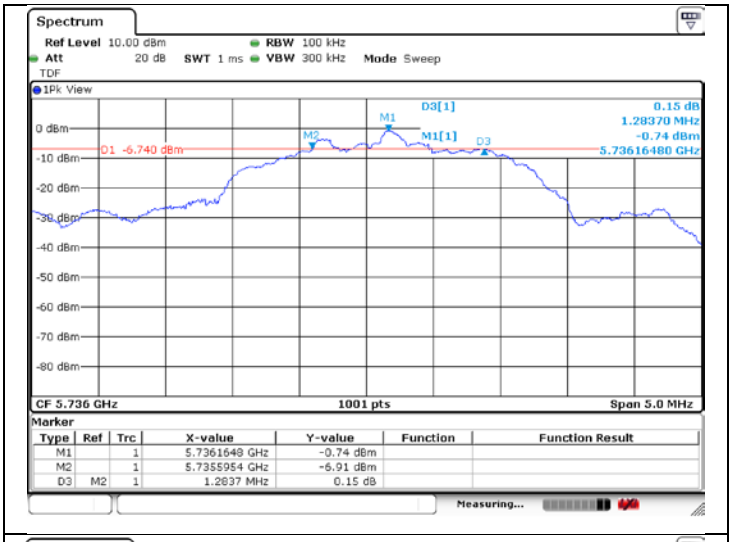
Relative humidity : 47 % R.H.

Mode	Channel	Frequency (㎒)	6 ㏈ Bandwidth (㎒)	
			EA port	IA port
GFSK	Low	5 736	1.284	1.309
	Middle	5 792	1.294	1.309
	High	5 847	1.374	1.394

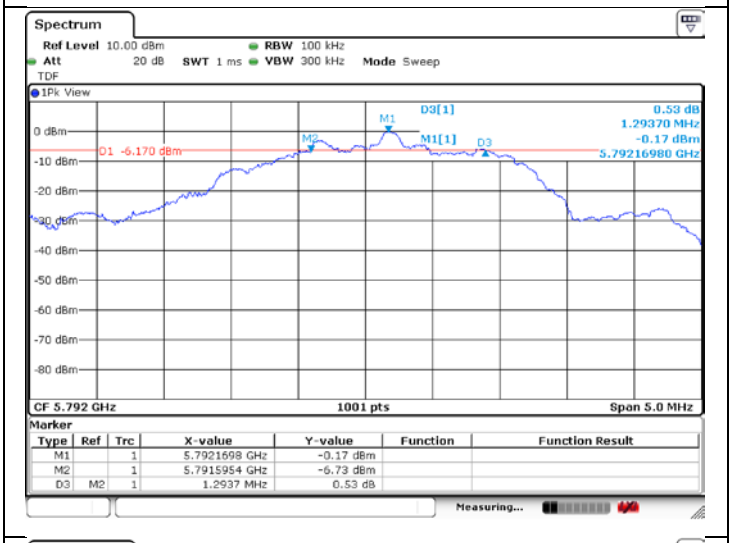
- Test plots

EA port: 5 736 ㎒ ~ 5 847 ㎒

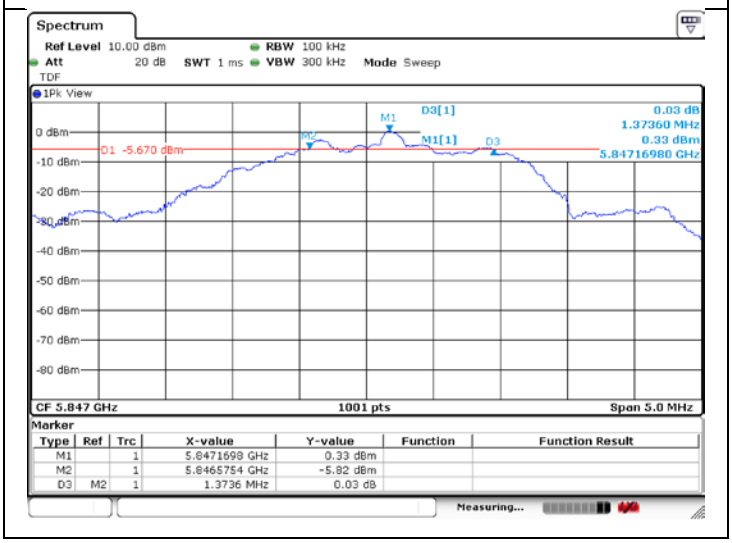
Low Channel
(5 736 ㎒)



Middle Channel
(5 792 ㎒)

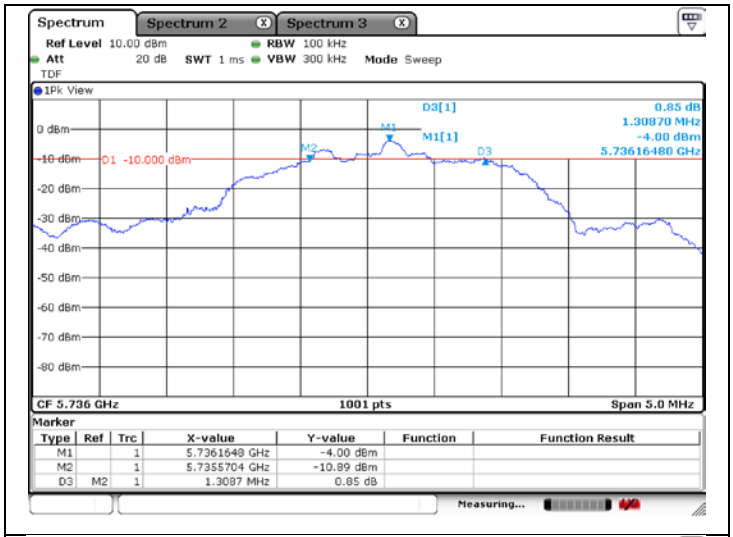


High Channel
(5 847 ㎒)

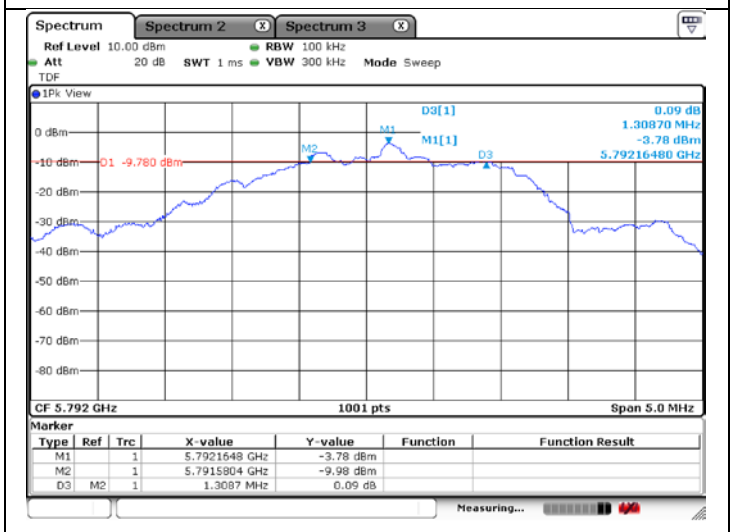


IA port: 5 736 ㎒ ~ 5 847 ㎒

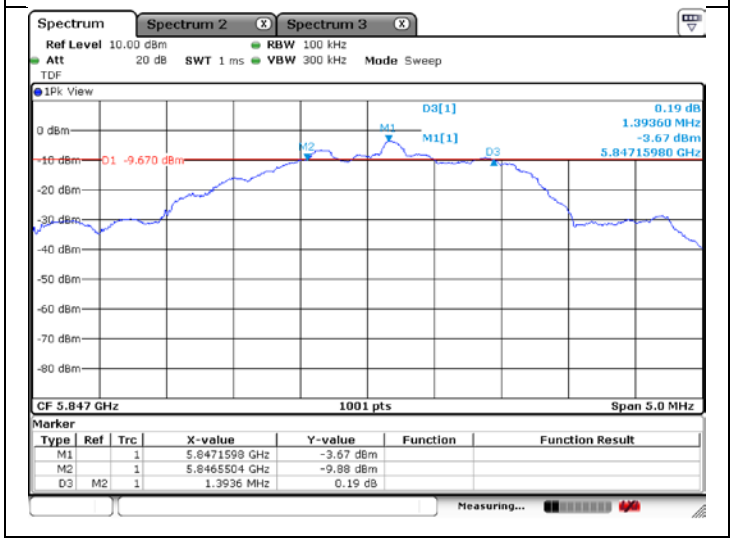
Low Channel
(5 736 ㎒)



Middle Channel
(5 792 ㎒)

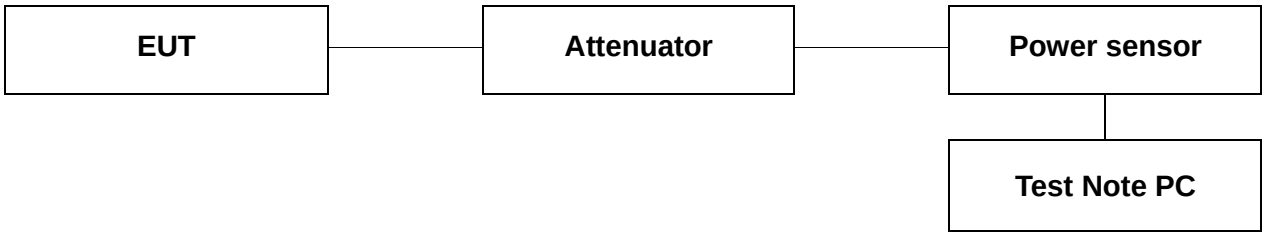


High Channel
(5 847 ㎒)



5. Maximum Conducted Output Power

5.1. Test Setup



5.2. Limit

According to 15.407(a)(3)
For the band 5.725-5.85 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 ㏈m in any 500-㎑ band. If transmitting antennas of directional gain greater than 6 ㏈i are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i. However, fixed point-to point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 ㏈i without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

5.3. Test Procedure

1. This measurement settings are specified in section Ⅱ.E.3.a of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
2. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied:
   - The EUT is configured to transmit continuously or to transmit with a consistent duty cycle.
   - At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
   - The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
3. If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in section II.B.
4. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
5. Adjust the measurement in dBm by adding 10 log (1/x) where x is the duty cycle (e.g., 10 log (1/0.25) if the duty cycle is 25 %).

5.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

- EA port: 5 736 ㎒ ~ 5 847 ㎒

Mode	Channel	Frequency (㎒)	Average Power (dB m)	Duty Cycle Correction Factor (dB)	Average Power Result (dB m)
GFSK	Low	5 736	-8.45	5.93	-2.52
	Middle	5 792	-8.06		-2.13
	High	5 847	-7.46		-1.53

Mode	Limit					
	Frequency (㎒)	Fixed Limit (dB m)	26 dB BW (㎒)	11+10LogB (dB m)	Antenna Gain (dB i)	Limit (dB m)
GFSK	5 736	30			2.4	30
	5 792					
	5 847					

Remark;

1. Average Power Result (dB m) = Average Power (dB m) + Duty Cycle Correction Factor (dB)

- IA port: 5 736 ㎒ ~ 5 847 ㎒

Mode	Channel	Frequency (㎒)	Average Power (dB m)	Duty Cycle Correction Factor (dB)	Average Power Result (dB m)
GFSK	Low	5 736	-9.86	6.02	-3.84
	Middle	5 792	-9.65		-3.63
	High	5 847	-9.42		-3.40

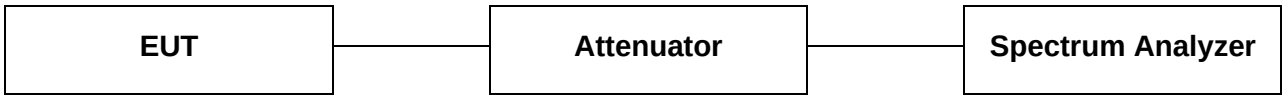
Mode	Limit					
	Frequency (㎒)	Fixed Limit (dB m)	26 dB BW (㎒)	11+10LogB (dB m)	Antenna Gain (dB i)	Limit (dB m)
GFSK	5 736	30			2.4	30
	5 792					
	5 847					

Remark;

1. Average Power Result (dB m) = Average Power (dB m) + Duty Cycle Correction Factor (dB)

6. Maximum Power Spectral Density

6.1. Test Setup



6.2. Limit

According to 15.407(a)(3)
For the band 5.725-5.85 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 ㏈m in any 500-㎑ band. If transmitting antennas of directional gain greater than 6 ㏈i are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i. However, fixed point-to point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 ㏈i without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

6.3. Test Procedure

1. This measurement settings are specified in section Ⅱ.F of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

2. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power…”. (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)

3. Use the peak search function on the instrument to find the peak of the spectrum and record its value.

4. Make the following adjustments to the peak value of the spectrum, if applicable:

   a) **If Method SA-2 or SA-2 Alternative was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.**
   b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 ㏈ to the final result to compensate for the difference between linear averaging and power averaging.

5. The result is the Maximum PSD over 1 ㎒ reference bandwidth.

6. For devices operating in the bands 5.15-5.25 ㎓, 5.25-5.35 ㎓, and 5.47-5.725 ㎓, the above procedures make use of 1 ㎒ RBW to satisfy directly the 1 ㎒ reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 ㎓, the rules specify a measurement bandwidth of 500 ㎑. Many spectrum analyzers do not have 500 ㎑ RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 ㎒, or 500 ㎑, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (*i.e.,* 1 ㎒, or 500 ㎑). If measurements are performed using a reduced resolution bandwidth (< 1 ㎒, or < 500 ㎑) and integrated over 1 ㎒, or 500 ㎑ bandwidth, the following adjustments to the procedures apply:

   a) Set RBW ≥ 1/*T*, where *T* is defined in section II.B.1.a).
   b) Set VBW ≥ 3 RBW.
   c) If measurement bandwidth of Maximum PSD is specified in 500 ㎑, add 10 log(500 ㎑/RBW) to the measured result, whereas RBW (< 500 ㎑) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
   d) If measurement bandwidth of Maximum PSD is specified in 1 ㎒, add 10 log(1 ㎒/RBW) to the measured result, whereas RBW (< 1 ㎒) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
   e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

7. In case of band crossing channels 138, 142 and 144, the measurement is complied with section Ⅲ.A of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

6.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

- EA port: 5 736 ㎒ ~ 5 847 ㎒

Mode	Channel	Frequency (㎒)	Measured PPSD (㏈ m)	Duty Cycle Correction Factor (㏈)	Final PPSD (㏈ m)	Limit (㏈ m/500 ㎑)
GFSK	Low	5 736	-11.57	5.93	-5.64	30
	Middle	5 792	-10.71		-4.78	
	High	5 847	-10.44		-4.51	

Remark;

1. Final PPSD (㏈ m) = Measured PPSD (㏈ m) + Duty Cycle Correction Factor (㏈)

- IA port: 5 736 ㎒ ~ 5 847 ㎒

Mode	Channel	Frequency (㎒)	Measured PPSD (㏈ m)	Duty Cycle Correction Factor (㏈)	Final PPSD (㏈ m)	Limit (㏈ m/500 ㎑)
GFSK	Low	5 736	-13.88	6.02	-7.86	30
	Middle	5 792	-13.52		-7.50	
	High	5 847	-13.67		-7.65	

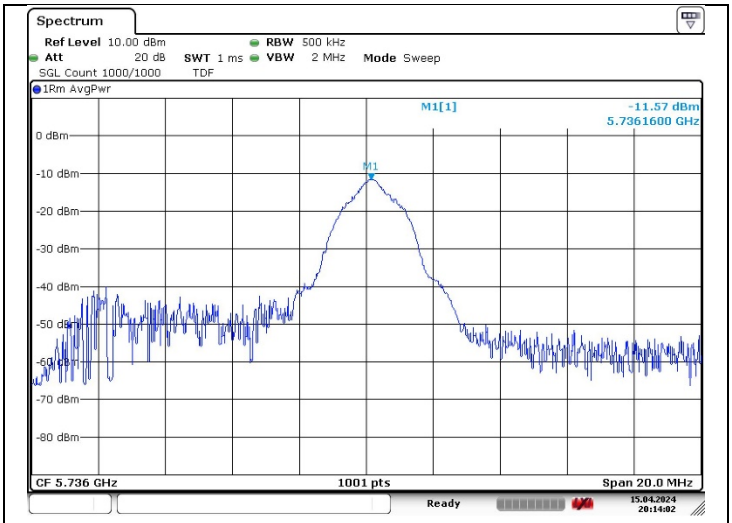
Remark;

1. Final PPSD (㏈ m) = Measured PPSD (㏈ m) + Duty Cycle Correction Factor (㏈)

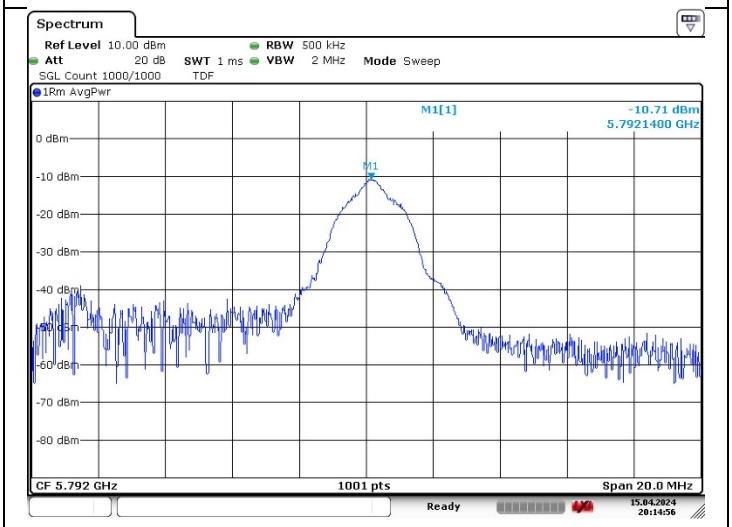
- Test plots

- EA port: 5 736 ㎒ ~ 5 847 ㎒

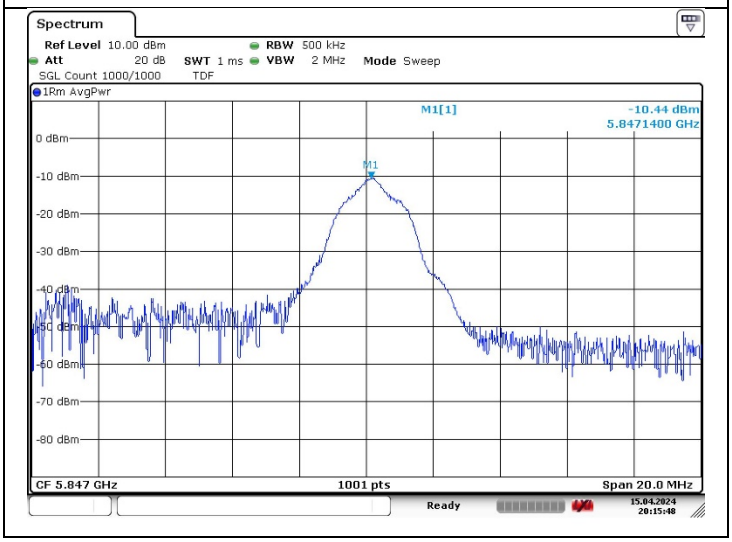
Low Channel
(5 736 ㎒)



Middle Channel
(5 792 ㎒)

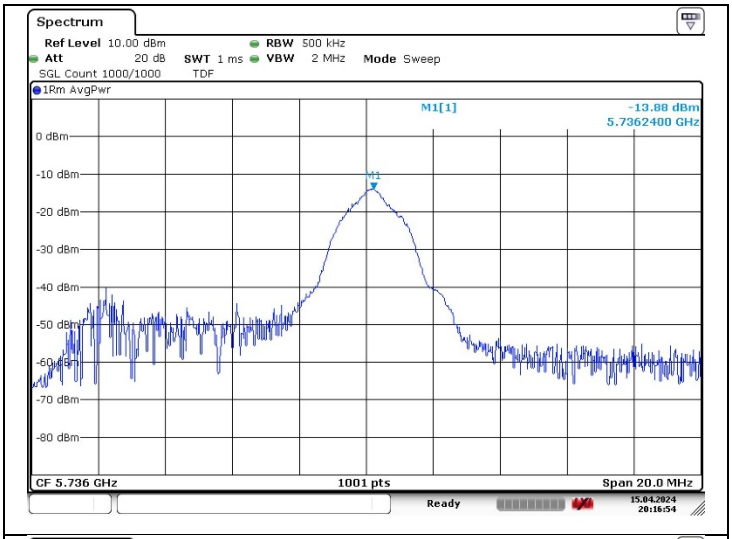


High Channel
(5 847 ㎒)

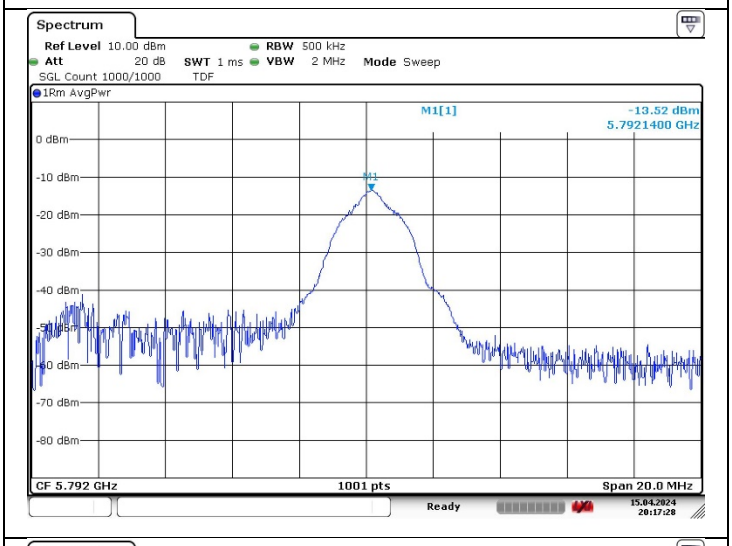


- IA port: 5 736 ㎒ ~ 5 847 ㎒

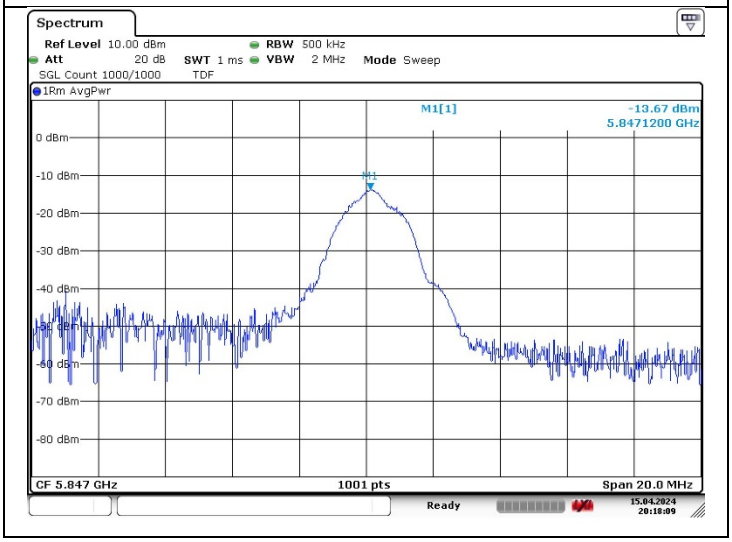
Low Channel
(5 736 ㎒)



Middle Channel
(5 792 ㎒)

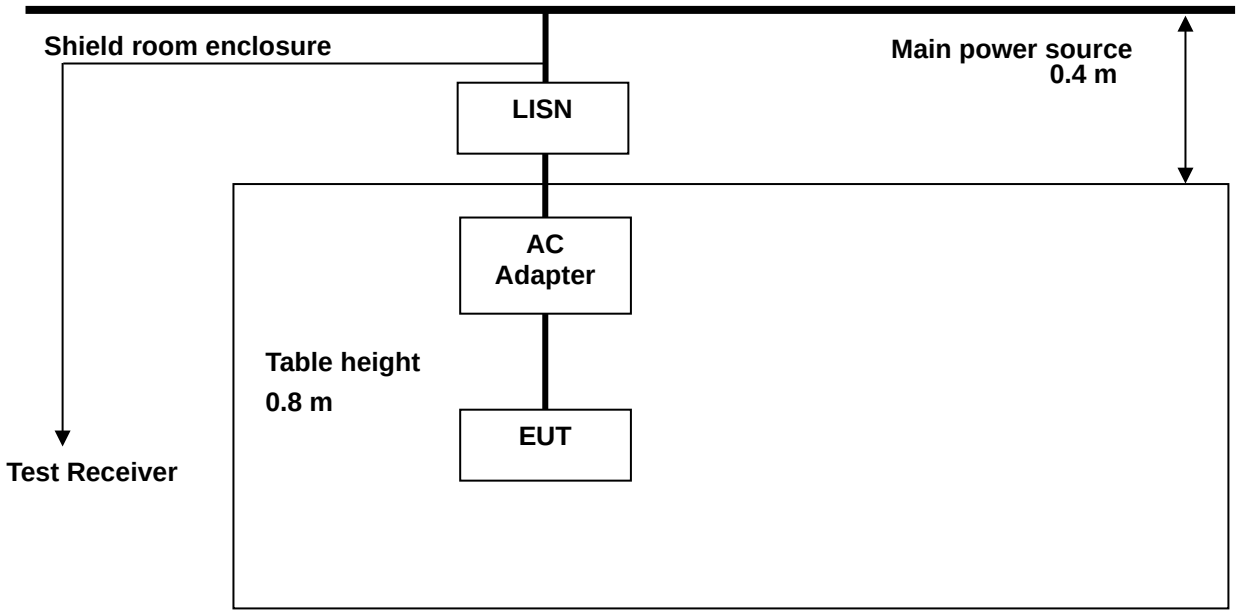


High Channel
(5 847 ㎒)



7. AC Power Line Conducted Emission

7.1. Test Setup



7.2. Limit

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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 ㎌ H /50 ohms line impedance stabilization network (LISN).
Compliance with the provision 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 (㎒)	Conducted limit (dB㎶)	
	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.

7.3. Test Procedures

AC conducted emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

7.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Frequency range : 0.15 ㎒ - 30 ㎒
Measured Bandwidth : 9 ㎑

- EA port: 5 736 ㎒ ~ 5 847 ㎒

Freq.	Level (dBμV)		Line	Limit (dBμV)		Margin (dB)	
(㎒)	Quasi-peak	Average		Quasi-peak	Average	Quasi-peak	Average
0.17	49.10	33.50	N	64.96	54.96	15.86	21.46
0.21	44.90	30.20	N	63.21	53.21	18.31	23.01
0.27	39.20	26.50	N	61.12	51.12	21.92	24.62
0.41	45.70	36.40	N	57.65	47.65	11.95	11.25
13.76	32.90	26.10	N	60.00	50.00	27.10	23.90
27.51	20.20	12.40	N	60.00	50.00	39.80	37.60
0.15	49.10	30.30	H	66.00	56.00	16.90	25.70
0.17	48.00	28.10	H	64.96	54.96	16.96	26.86
0.18	46.80	28.80	H	64.49	54.49	17.69	25.69
0.41	38.60	30.20	H	57.65	47.65	19.05	17.45
13.75	30.10	23.20	H	60.00	50.00	29.90	26.80
27.52	30.20	26.00	H	60.00	50.00	29.80	24.00

Remark;

1. Line (H): Hot, Line (N): Neutral.
2. All channels were investigated and the worst-case emissions were reported using **High channel.**
3. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section of the Title 47 CFR.
4. Traces shown in plot were made by using a Quasi-peak detector and average detector.
5. Deviations to the Specifications: None.

- IA port: 5 736 ㎒ ~ 5 847 ㎒

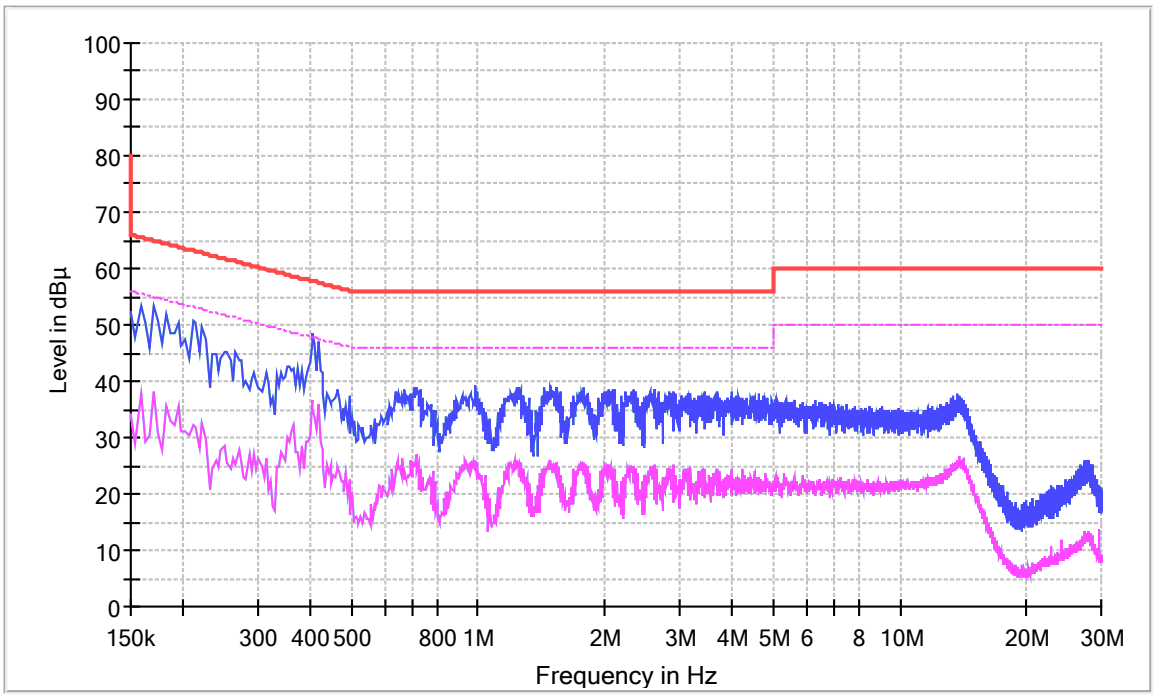
Freq.	Level (dB㎶)		Line	Limit (dB㎶)		Margin (dB)	
(㎒)	Quasi-peak	Average		Quasi-peak	Average	Quasi-peak	Average
0.16	47.90	32.00	N	65.46	55.46	17.56	23.46
0.19	46.20	33.30	N	64.04	54.04	17.84	20.74
0.41	45.20	35.40	N	57.65	47.65	12.45	12.25
0.71	35.00	26.30	N	56.00	46.00	21.00	19.70
13.60	33.30	26.40	N	60.00	50.00	26.70	23.60
27.68	20.30	12.40	N	60.00	50.00	39.70	37.60
0.15	48.10	29.20	H	66.00	56.00	17.90	26.80
0.17	47.10	28.20	H	64.96	54.96	17.86	26.76
0.19	45.80	28.50	H	64.04	54.04	18.24	25.54
0.41	39.00	30.20	H	57.65	47.65	18.65	17.45
13.91	30.60	23.60	H	60.00	50.00	29.40	26.40
27.50	30.20	25.90	H	60.00	50.00	29.80	24.10

Remark;

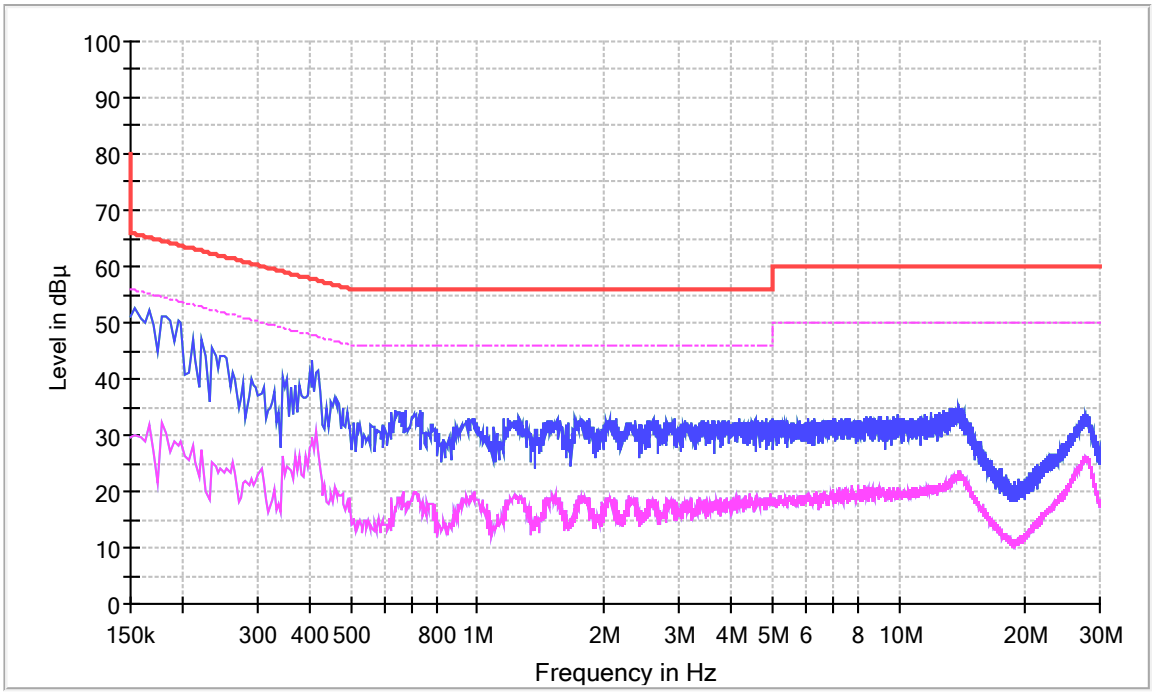
1. Line (H): Hot, Line (N): Neutral.
2. All channels were investigated and the worst-case emissions were reported using **High channel.**
3. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section of the Title 47 CFR.
4. Traces shown in plot were made by using a Quasi-peak detector and average detector.
5. Deviations to the Specifications: None.

- Test plots

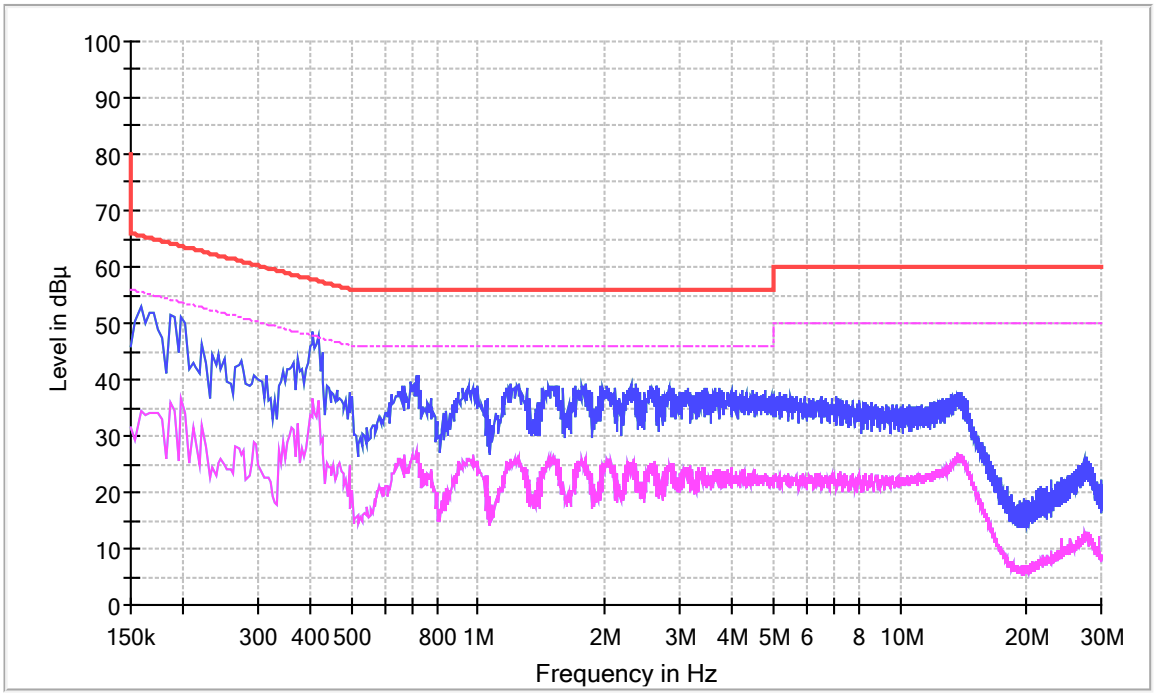
EA port: 5 736 ㎒ ~ 5 847 ㎒
Test mode: (Neutral)



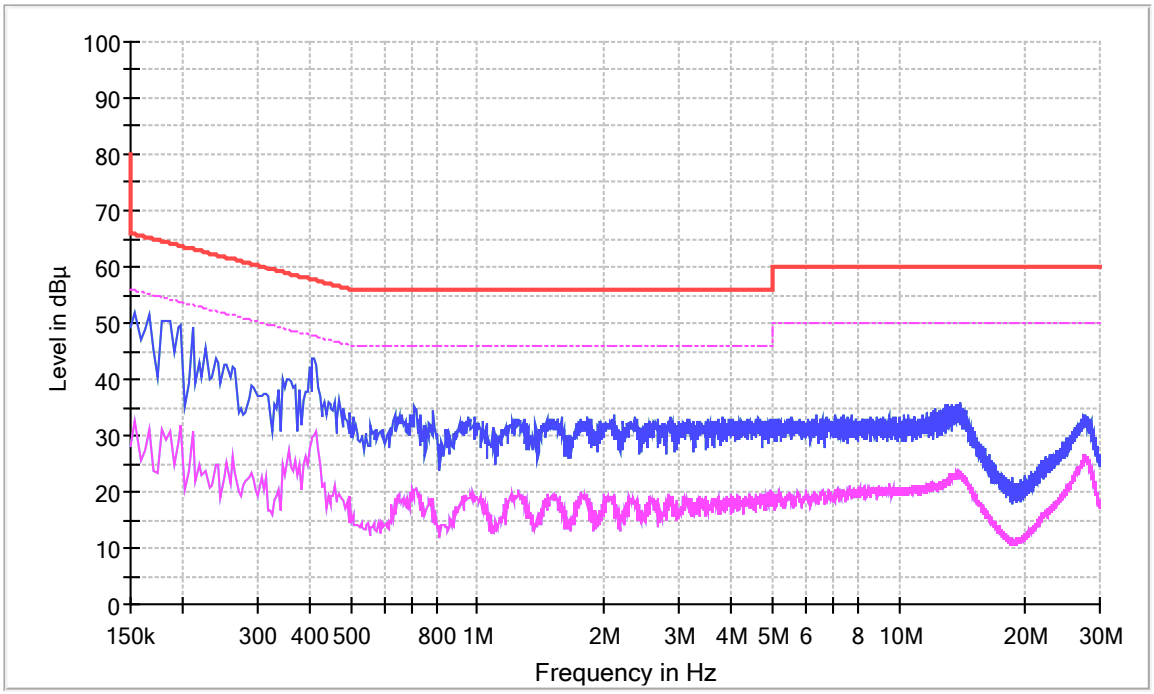
Test mode: (Hot)



IA port: 5 736 ㎒ ~ 5 847 ㎒
Test mode: (Neutral)



Test mode: (Hot)



8. Antenna Requirement

8.1. Standard Applicable

For intentional device, according to FCC 47 CFR 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. 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. And according to FCC 47 CFR Section §15.407(a) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

8.2. Antenna Connected Construction

Antenna used in this product is Multilayer monopole antenna and the antenna gains are as follows.

Antenna	Frequency range	Gain [dBi]
EA port	5 736 ㎒ ~ 5 847 ㎒	2.40
IA port	5 736 ㎒ ~ 5 847 ㎒	2.40

- End of the Test Report -