

試験報告書

TEST REPORT

Report number 報告書番号 : EL-RJ2603006

Issue date 発行日 : 2026-03-19

申請者 Applicant	:	Sena Technologies Co., Ltd. 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea
型式又は名称 Model name	:	VORTEX
製造番号 Serial number	:	M03024
測定規格 Test procedure	:	証明規則第2条第19号の規定する特定無線設備の2.4GHz帯高度化小電力データ通信システム
測定方法 Test method	:	総務省告示第88号別表第43
測定日 Date of test	:	2026-03-17
試験設備名 Name of facility	:	EMC Labs Co., Ltd.
試験結果 Test Result	:	適合

この試験報告書における測定結果は試験された装置にのみ該当します。
また、完全な複製を除き、当試験所の文書による承認なしに、報告書の一部分だけを複製することを禁止します。

測定者;
Tested by;


Jong-Myoung, Shin

承認者;
Approved by;


Kyung-Taek, Lee

1. Summary of Test

1. Purpose of test

Ordinance on Technical Standards Conformity Certification of Specified Radio Equipment

2.4 GHz Band wide band low power data communication System

2. Standards

Certification Ordinance Article 2 Clause 1 Item19

1) Test Methods

Ministry of Internal Affairs and Communications Notification Article 88 Appendix 43

2) Deviation from standards

None

3. List of applied test to the EUT

Article 88 Appendix 43	Classification of EUT	Condition	Result
1	Voltage fluctuation	Conducted	PASS
3	Frequency Tolerance	Conducted	PASS
4	Occupied Bandwidth	Conducted	PASS
4	Spread Bandwidth	Conducted	N/A
5	Unwanted (Spurious) Emission Strength	Conducted	PASS
6	RF Output Power Tolerance	Conducted	PASS
7	Secondary Emitted Radio Wave Strength	Conducted	PASS
8	Carrier Sensing Function (1)	Conducted	N/A
9	Carrier Sensing Function (2)	Conducted	N/A
10	Carrier Sensing Function (3)	Conducted	N/A
11	Transmit Frequency Switching Function	Conducted	N/A
12	Absolute Gain of Transmission Antenna	Conducted	N/A
13	Angle Width of Principal Radiation from Transmission Antenna	Conducted	N/A
14	Interference Prevention Function	Conducted	PASS
15	Hopping frequency dwell time	Conducted	N/A

1) Test set up

Table-Top

2) Modification to the EUT by laboratory

None

2. Test Information

1. Applicant

Sena Technologies Co., Ltd.

19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea

2. Equipment under test

Wireless Communication Systems

3. Model number

VORTEX

4. Serial number

M03024

5. RF Specification Frequency range

Bluetooth LE 1Mbps: 2402-2480MHz

6. Number of RF Channels

Bluetooth LE 1Mbps: 40 Channels

7. Modulation method

Bluetooth LE 1Mbps: GFSK

8. Data rate

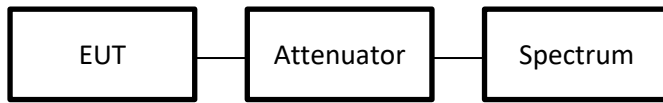
-

9. Variation of the family model(s)

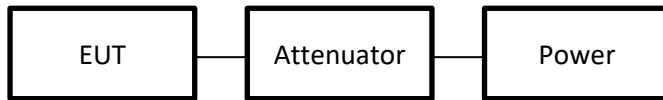
None

3. Configuration of equipment

1. Frequency Tolerance, Occupied Bandwidth, Unwanted(Spurious)Emission Strength, Secondary Emittted Radio Wave Strength



2. RF Output Power



4. 試驗結果

Test results

Environment of test room	Date of test	2026-03-17
	Temperature	24.2 °C
	Humidity	49.7 %

Peak Antenna Gain	1.37	dBi
Declaration Output Power	5	mW
Declaration Output Power	6.990	dBm
E.I.R.P.	8.360	dBm
Input Power Voltage	3.80	VDC

Frequency equal to the Transmission rate		---	MHz
Transmission Time	ON TIME (1sec or less)	0.386	ms
	OFF TIME (0.1sec or more)	0.238	ms
	Ratio	0.618	-
Packet Type (Mode)		---	mode
Transmit Speed		---	MHz

Test category :	2.4GHz Band Low-Power Data Communication System (GFSK/0-39ch)
The reason why the tests are performed only at rated voltage :	When the input voltage to receiver RF circuit varies below $\pm 1\%$ as the input voltage from the external power supply to the receiver varies $\pm 10\%$ (excluding power supply).

Measurement Frequency		MHz	2 402	2 442	2 480	Result	Limit	Note
Channel Number		Ch.	0	19	39	---	---	
Frequency Measurements		MHz	2 401.969 533	2 441.968 128	2 479.967 092	---	---	
Frequency Tolerance		ppm	-12.68	-13.05	-13.27	PASS	±50×10 ⁻⁶ (50ppm)	
Occupied Bandwidth		MHz	1.35	1.34	1.34	PASS	26MHz or below	
RF Output Power		mW	2.38	2.69	3.17	PASS	10mW or below	
RF Output Power Tolerance		%	-52.46	-46.28	-36.62	PASS	Up to +20%	
Unwanted (Spurious) Emission Strength	30 to 2 387 MHz	uW/MHz	0.042	0.007	0.008	PASS	2.5uW/MHz or below	
		MHz	2 386.999 999	2 219.653 000	2 321.004 000	----		
	2 387 to 2 400 MHz	uW/MHz	13.646	0.007	0.004	PASS	25uW/MHz or below	
		MHz	2 399.999 999	2 398.830 000	2 391.719 000	----		
	2 483.5 to 2 496.5 MHz	uW/MHz	0.004	0.009	1.811	PASS	25uW/MHz or below	
		MHz	2 491.235 000	2 484.579 000	2 483.825 000	----		
	2 496.5 to 12 500 MHz	uW/MHz	0.019	0.023	0.034	PASS	2.5uW/MHz or below	
		MHz	2 556.521 000	2 536.514 000	2 496.500 001	----		
Secondary Emitted Radio Wave Strength	30 to 1 000 MHz	nW	0.015	0.015	0.014	PASS	4nW or below	
		MHz	967.990 000	765.260 000	795.330 000	----		
	1 000 to 10 000 MHz	nW	0.209	0.176	0.198	PASS	20nW or below	
		MHz	9 271.000 000	9 775.000 000	9 847.000 000	----		
	10 000 to 12 500 MHz	nW	0.320	0.269	0.301	PASS	20nW or below	
		MHz	11 855.000 000	11 890.000 000	10 697.500 000	----		
Interference Prevention Function			Good			PASS		
Transmitting antenna absolute gain			---			---	---	
Angular width of the main radiation of the transmitting antenna			---			---	---	

5. 試験機器リスト

Measurement equipment list

USE	Equipment	Company	Model No.	Serial No.	Calibrated by	Cal. Method	Cal. Due	Cal. Date
	TEMP & HUMID CHAMBER	(주) 제이에프엠엔지니어링	JFMA-001	20200929-01	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	CONTROLLER	주식회사 삼원테크놀로지	TEMI2500	S7800VK191 0707	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
X	MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	BLUETOOTH TESTER	TESCOM	TC-3000A	3000A480088	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	ATTENUATOR	AGILENT	8493C	73193	HCT	ハ(c)	Nov. 2026	Nov. 6, 2025
	TERMINATION	HEWLETT PACKARD	909D	7492	HCT	ハ(c)	Nov. 2026	Nov. 6, 2025
	POWER DIVIDER	HEWLETT PACKARD	11636A	6916	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	SLIDE-AC	대광전자	SV-1023	NONE	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	DIGITAL MULTIMETER	휴먼테크스토어	15B+	50561541WS	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	Temperature and Humidity Datalogger	CEM	DT-172	201000251	HCT	ハ(c)	Apr. 2026	Apr. 8, 2025
	ATTENUATOR	에이스 알에프 컴	ATT SMA 20W 20dB 8G	A-0820.SM20.2	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
	TERMINATION	에이스 알에프 컴	TERM SMA F 20W 8G	A-0008.SM20.2	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
	ATTENUATOR	에이스 알에프 컴	ATT 2.92 2W 20dB 40G	A-4020.2902.1	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
	ATTENUATOR	에이스 알에프 컴	ATT 2.92 2W 20dB 40G	A-4020.2902.1	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
	ATTENUATOR	에이스 알에프 컴	ATT 2.92 2W 20dB 40G	A-4020.2902.1	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
	TERMINATION	에이스 알에프 컴	TERM 2.92 F 2W 40G	A-0040.2920.2	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
	TERMINATION	에이스 알에프 컴	TERM 2.92 F 2W 40G	A-0040.2920.2	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
	TERMINATION	에이스 알에프 컴	TERM 2.92 F 2W 40G	A-0040.2920.2	HCT	ハ(c)	Apr. 2026	Apr. 4, 2025
X	DC POWER SUPPLY	AGILENT	E3634A	MY40012120	HCT	ハ(c)	Feb. 2027	Feb. 10, 2026
X	USB Peak Power Sensor	Anritsu	MA24408A	12321	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	High Pass Filter	WT Microwave INC.	WT-A3314-HS	WT22111804-1	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	High Pass Filter	WT Microwave INC.	WT-A1935-HS	WT22111804-2	HCT	ハ(c)	Nov. 2026	Nov. 5, 2025
	TUNABLE BAND REJECT FILTER	K&L MICROWAVE	3TNF-800/1000-0.2-N/N	504	HCT	ハ(c)	Feb. 2027	Feb. 9, 2026
X	SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSU26	200444	HCT	ハ(c)	Feb. 2027	Feb. 9, 2026
X	ATTENUATOR	Mini-Circuits	BW-K3-2W44+	2318-1	HCT	ハ(c)	Feb. 2027	Feb. 9, 2026
	ATTENUATOR	Mini-Circuits	BW-K3-2W44+	2318-2	HCT	ハ(c)	May. 2026	May. 8, 2025
	ATTENUATOR	Mini-Circuits	BW-K10-2W44+	2307	HCT	ハ(c)	May. 2026	May. 8, 2025

Note1: 測定機器の較正は、1年間有効です。
The calibration of measurement equipment is valid for one year period.

Note2: "X" は使用した測定機器です。
"X" used equipment.

Note3: 較正方法 ...
Cal.Method ...

- イ): 独立行政法人情報通信研究機構(以下「機構」という。)又は第百二条の十八第一項の指定較正機関が行う較正
a): Calibration conducted by the National Institute of Information and Communications Technology(NICT)(hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1)
- ロ): 計量法(平成四年法律第五十一号)第百三十五条又は第百四十四条の規定に基づく校正
b): Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992)
- ハ): 外国において行う較正であつて、機構又は第百二条の十八第一項の指定較正機関が行う較正に相当するもの
c): Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1)
- ニ): 別表第三の下欄に掲げる測定器その他の設備であつて、イからハまでのいずれかに掲げる較正等を受けたものを用いて行う較正等
d): Calibration conducted by using measuring instruments and other equipment listed in the right column of Table No. 3 attached hereto, which shall have been given any of calibration, etc. listed above from a) to c)

6. 測定の不確かさ

About uncertainty of measured value

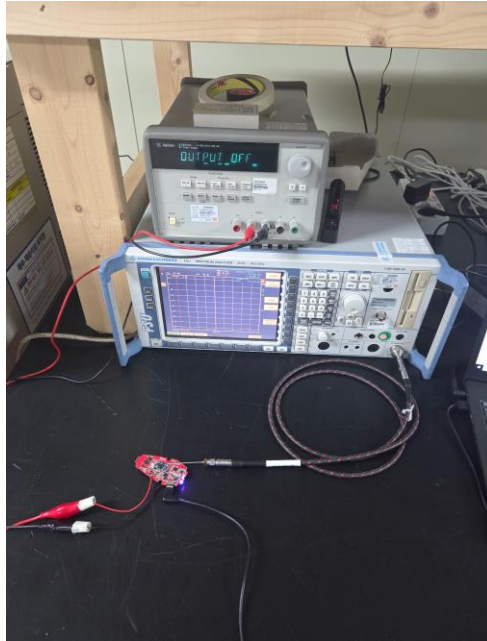
Parameter	Uncertainty
Total RF power conducted	±0.34 dB
Spurious emissions conducted	±0.34 dB
Temperature	±0.8 °C
Humidity	±4.4 %

判定	Measured value and standard limit value	
PASS	Case1 Standard limit value +Uncertainty -Uncertainty Measured value Even if it takes uncertainty into consideration, a standard limit value is fulfilled.	
	Case2 Although measured value is in a standard limit value, a limit value won't be fulfilled if uncertainty is taken into consideration.	
FAIL	Case3 Although measured value exceeds a standard limit value, a limit value will be fulfilled if uncertainty is taken into consideration.	
	Case4 Even if it takes uncertainty into consideration, a standard limit value isn't fulfilled.	

7. 測定写真

Photographs

Conducted Measurement Photo



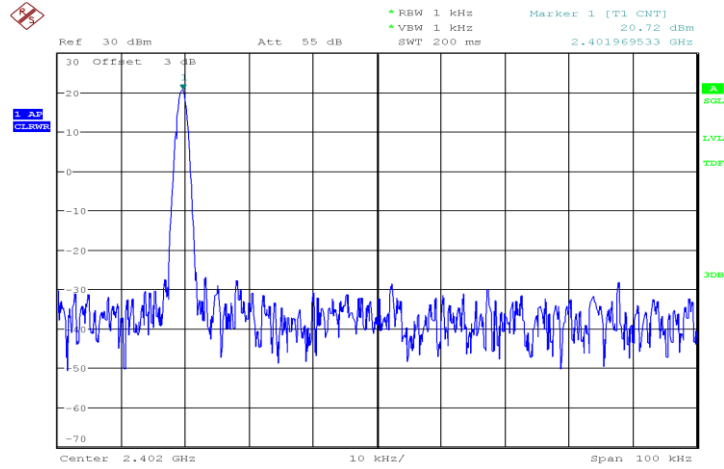
8. 測定チャート

Test chart

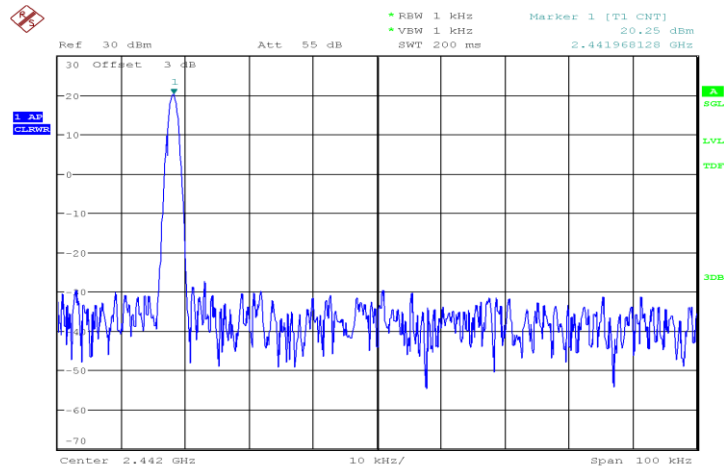
8.1 周波数の偏差

Frequency tolerance

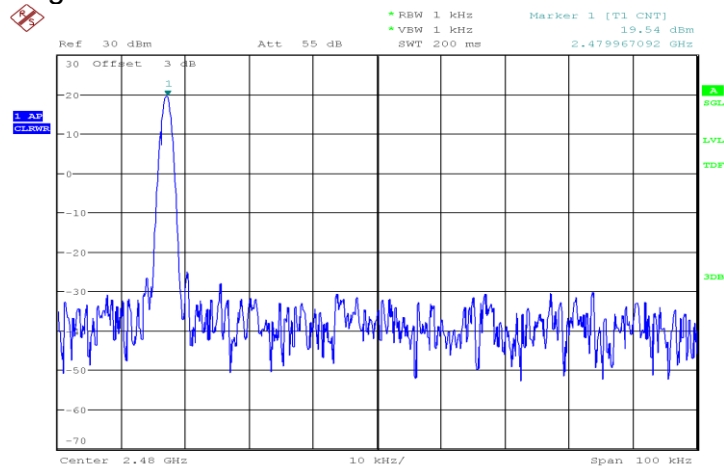
Low Channel



Middle Channel



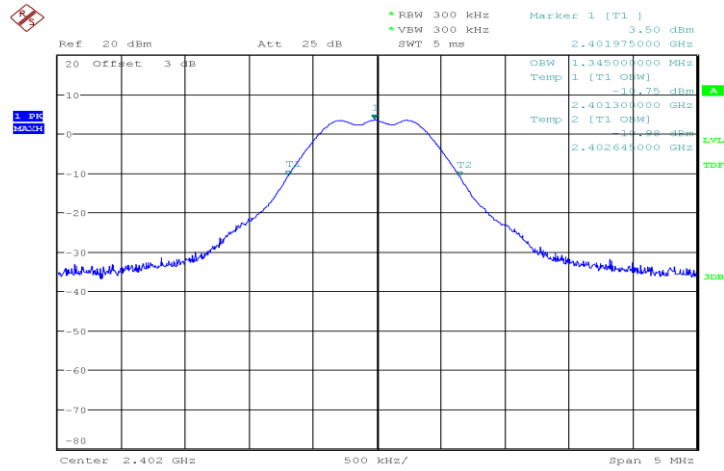
High Channel



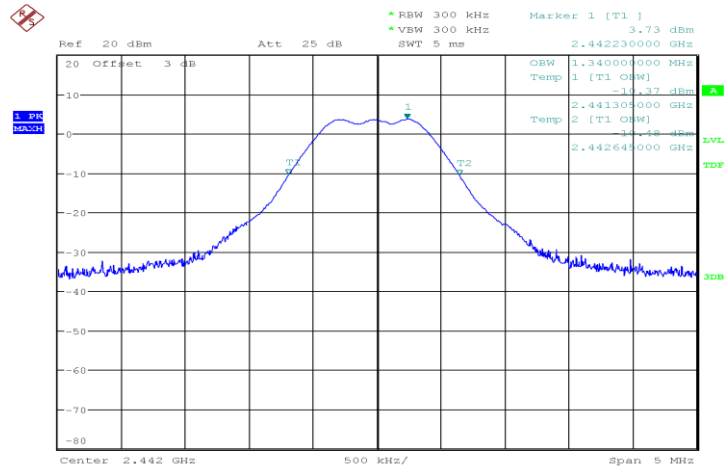
8.2 占有周波数帯幅及び拡散帯域幅

Occupied bandwidth / Spread bandwidth

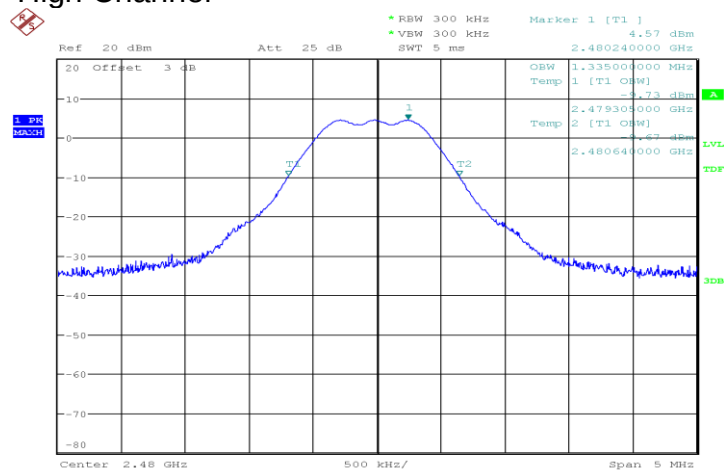
Low Channel



Middle Channel



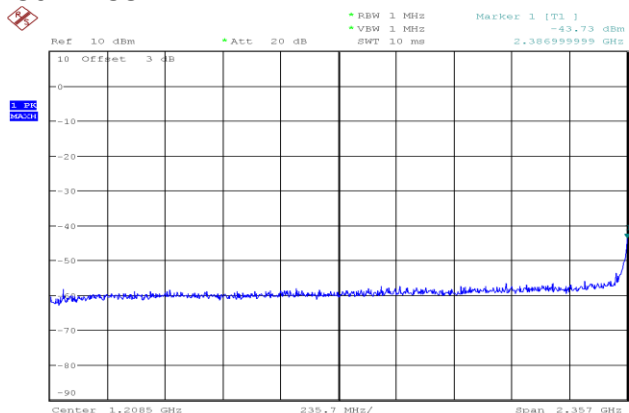
High Channel



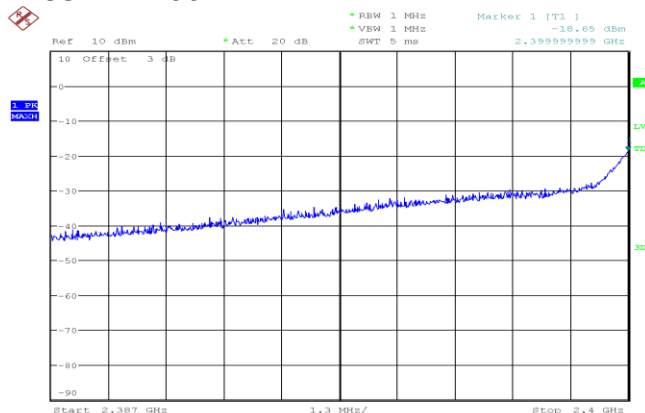
8.3 スプリアス発射又は不要発射の限度

Unwanted(Spurious) emission strength

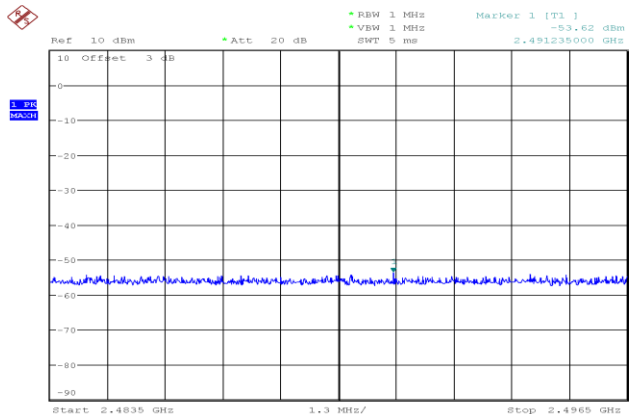
Low Channel
30 - 2 387 MHz



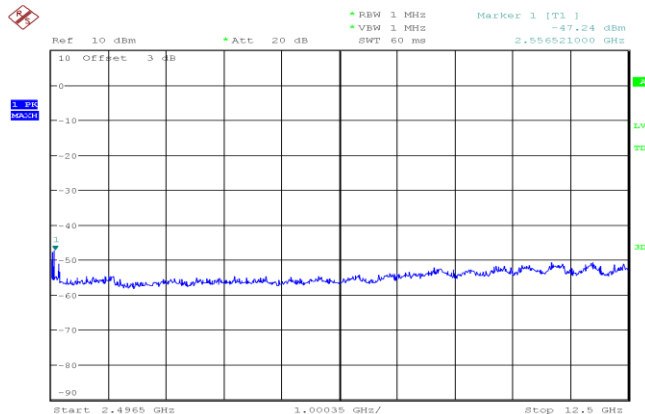
2 387 - 2 400 MHz



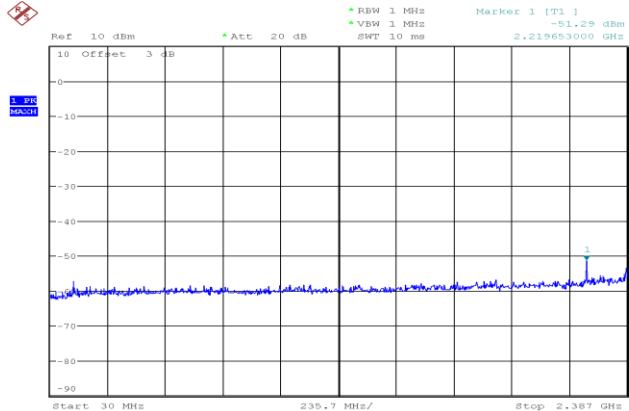
2 483.5 - 2 496.5 MHz



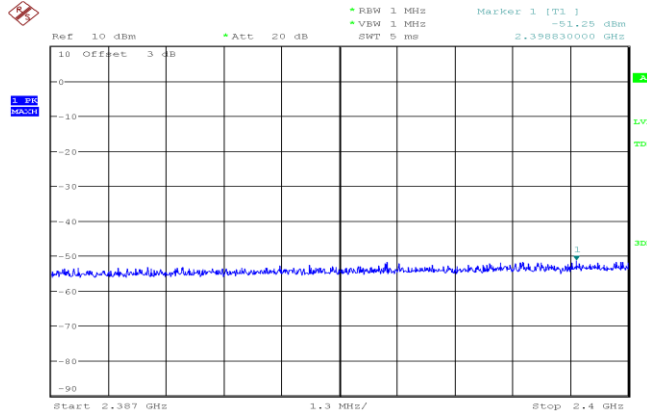
2 496.5 - 12 500 MHz



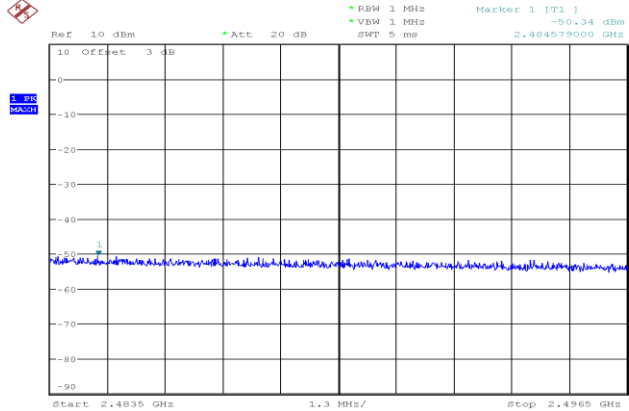
Middle Channel
30 - 2 387 MHz



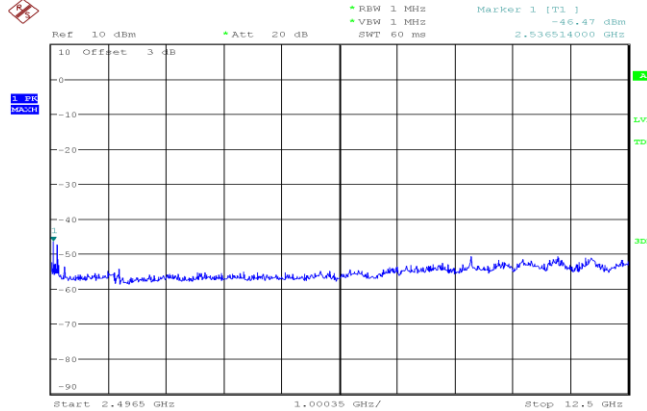
2 387 - 2 400 MHz



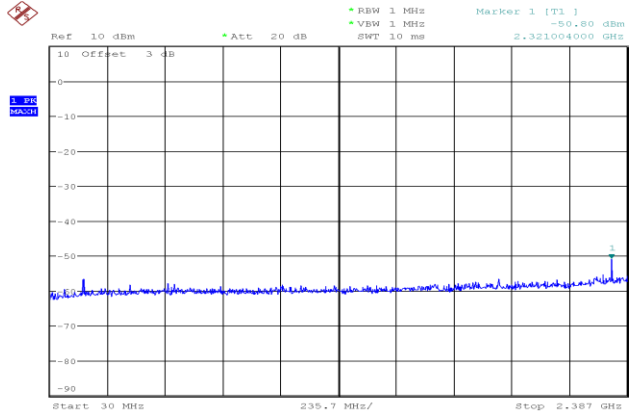
2 483.5 - 2 496.5 MHz



2 496.5 - 12 500 MHz



High Channel
30 - 2 387 MHz



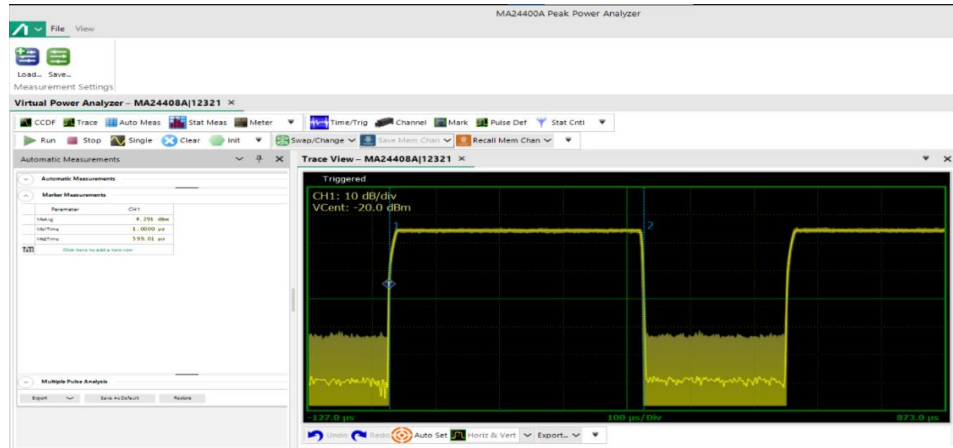
8.4 空中線電力の偏差

RF output power tolerance

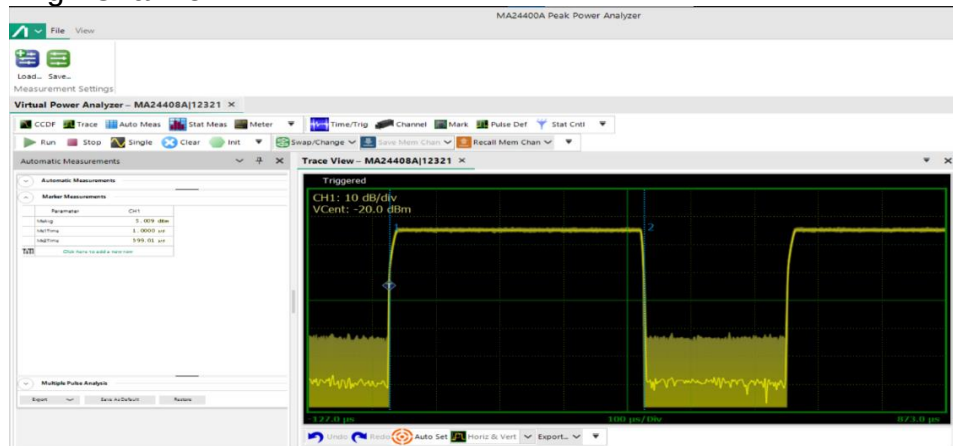
Low Channel



Middle Channel

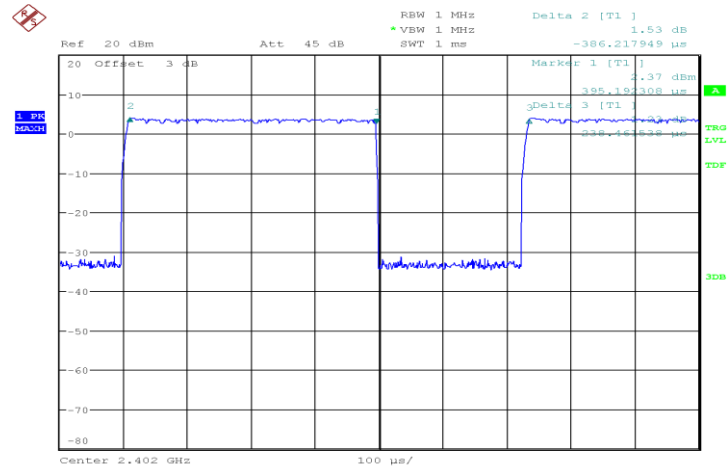


High Channel

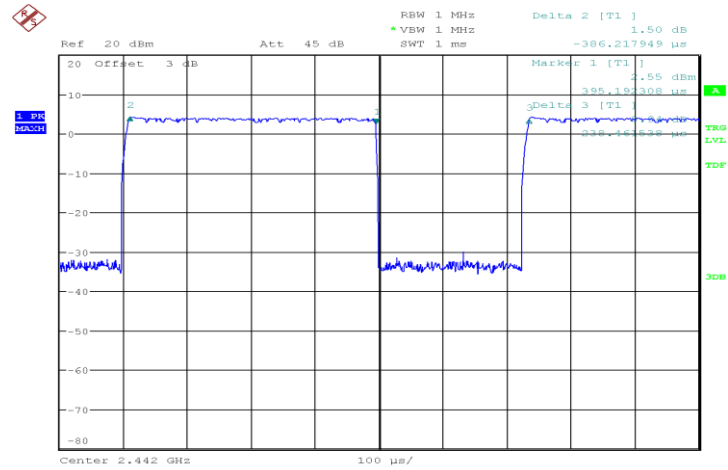


On Time / On + Off Time

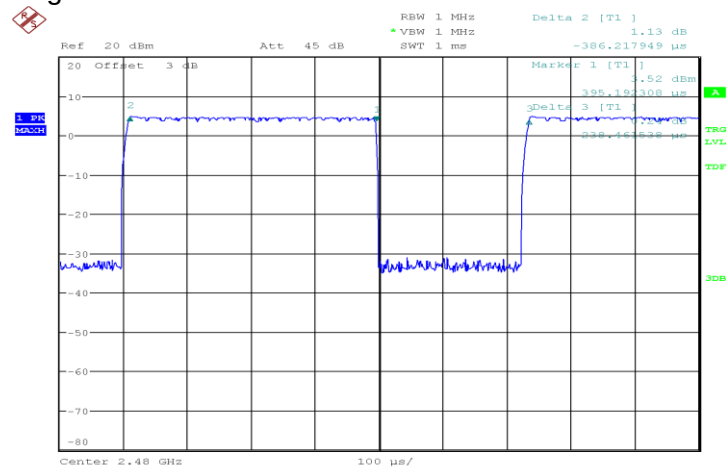
Low Channel



Middle Channel



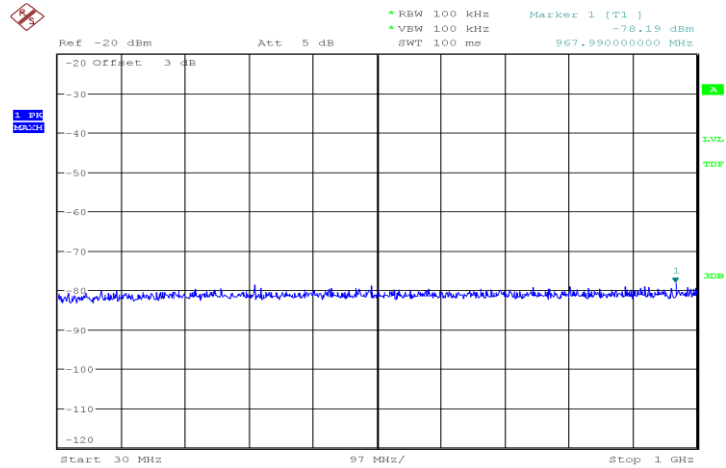
High Channel



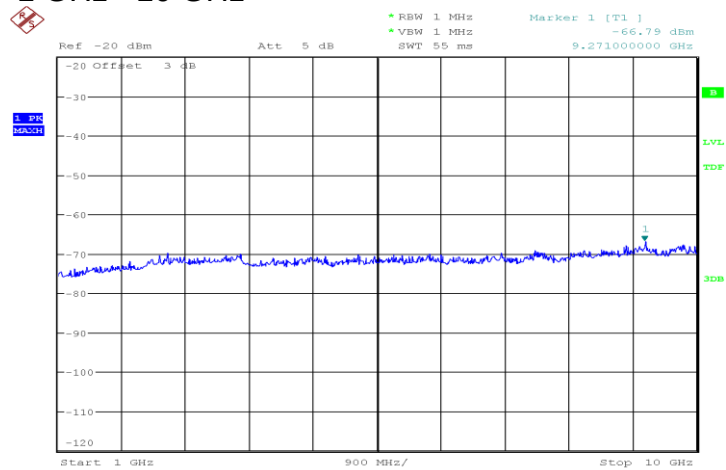
8.5 副次的に発する電波等の限度

Secondary emitted radio wave strength

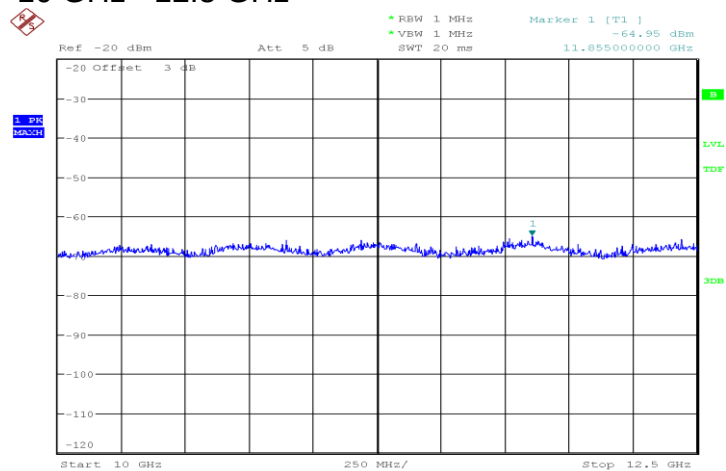
Low Channel
30 MHz - 1 GHz

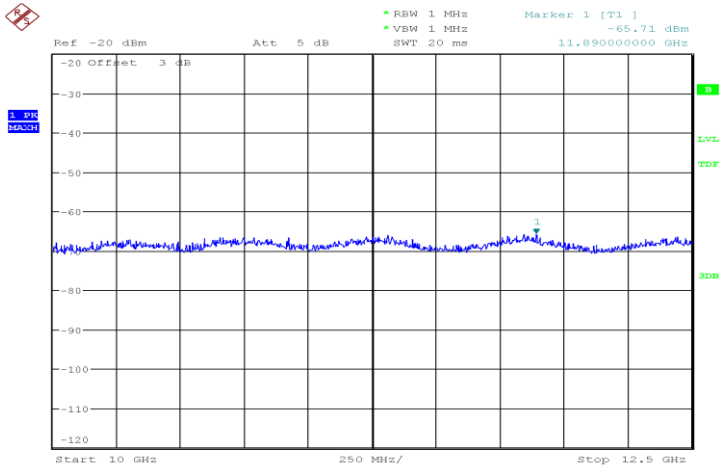
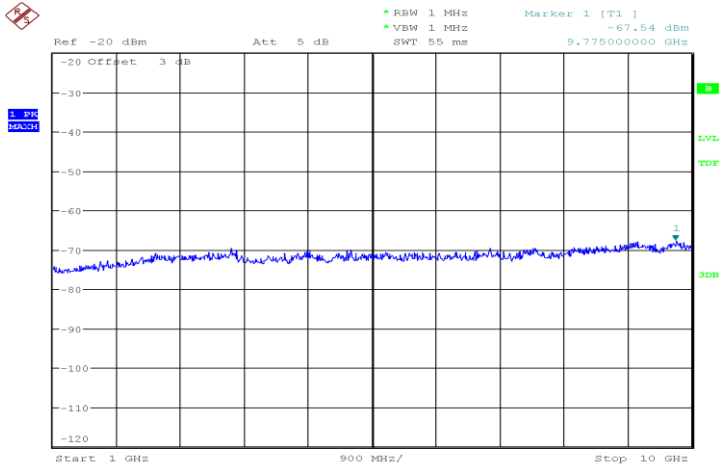
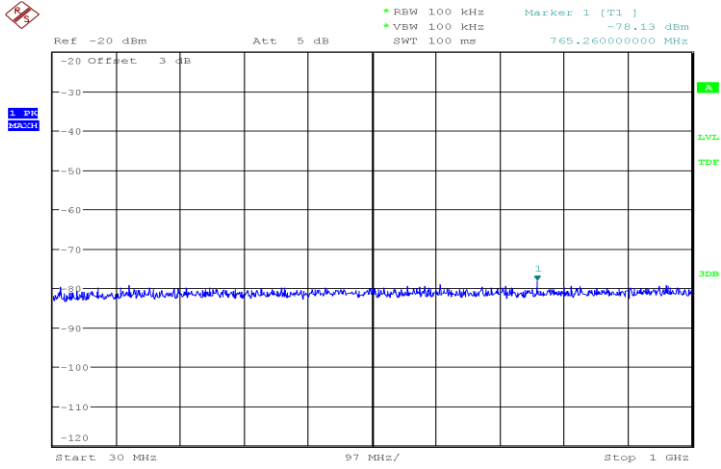


1 GHz - 10 GHz

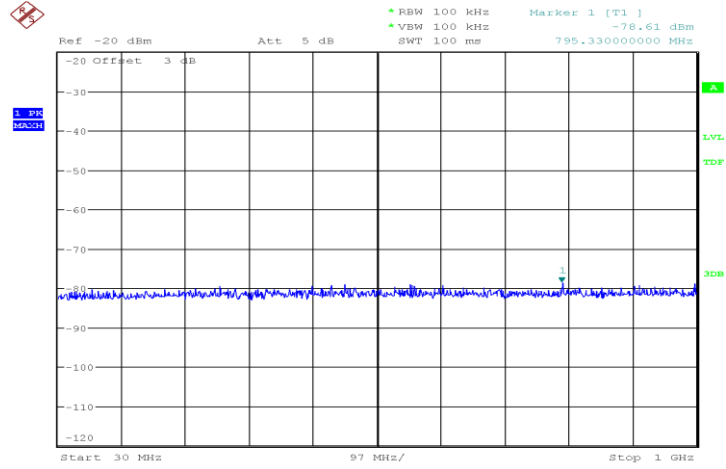


10 GHz - 12.5 GHz

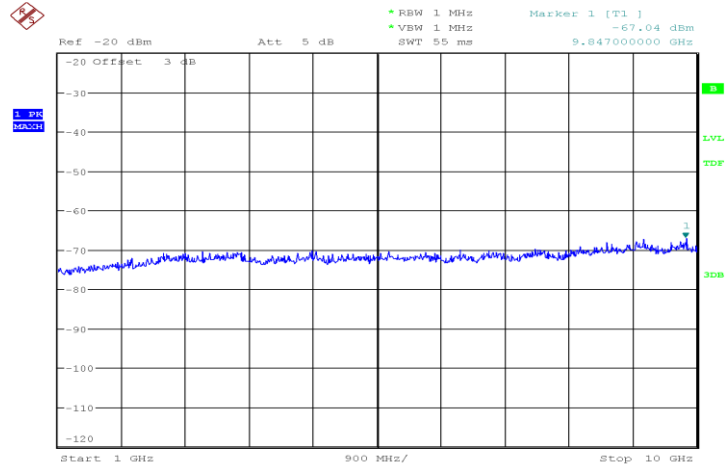




High Channel 30 MHz - 1 GHz



1 GHz - 10 GHz



10 GHz - 12.5 GHz

