

TEST REPORT

Report number : KR22-SRT0019
Issue date : 2022.05.13

Applicant : SystemBase Co., Ltd.
Daerung Post Tower-1 16F, 288, Digital-ro, Guro-gu,
Seoul, South Korea
TEL : +82-70-4099-9731
FAX : +82-2-855-0580

Equipment under test (EUT) : SmartMesh Manager RF Module

Model name : MG-10_RF

Date of test : 2022.05.02 ~ 2022.05.03

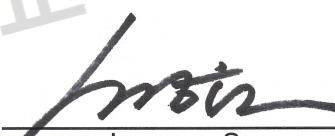
Test place : KCTL Inc.
65 Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-
do, Korea

Test results : PASS

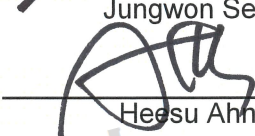
The results in this report are applicable only to the equipment tested.

This report shall not be re-produced except in full without the written approval of **KCTL Inc.**

Tested by;


Jungwon Seo

Approved by;


Heesu Ahn

1. Summary of Test

1. Purpose of test

Ordinance on Technical Standards Conformity Certification of Specified Radio Equipment
2.4GHz 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
3	Frequency Tolerance	Conducted	PASS
4	Occupied Bandwidth & Spread Bandwidth	Conducted	PASS
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	Conducted	N/A
12	Interference Prevention Function	Conducted	PASS

1) Test set up

Table-Top

2) Modification to the EUT by laboratory

None

1. Test Information

1. Applicant

SystemBase Co., Ltd.

Daerung Post Tower-1 16F, 288, Digital-ro, Guro-gu, Seoul, South Korea

2. Equipment under test

SmartMesh Manager RF Module

3. Model number

MG-10_RF

4. Serial number

N/A

5. Size

(W) 38 x (D) 56 x (H) 7.9

6. Terminal limitation

-40°C to 85°C

7. RF Specification Frequency range

2405 - 2470 MHz

8. Number of RF Channels

14 Ch

9. Modulation method

DSSS, OQPSK

10. Data rate

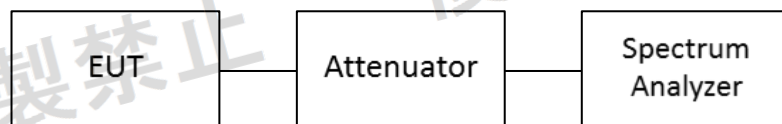
250 kbps

10. Variation of the family model(s)

None

2. Configuration of equipment

1. Frequency tolerance, Occupied Bandwidth, Spread bandwidth, Unwanted(Spurious) emission strength, Output Power Tolerance, Secondary emitted radio wave strength



3. Test results (Rated voltage)

S/N : N/A

Environment of test room	Date of test	2022-05-02	2022-05-03
	Temperature	23 °C	22 °C
	Humidity	49 %	50 %

Test category	Zigbee	
Peak Antenna Gain	5.02	dBi
Declaration Output Power	3.000	mW/MHz
Declaration Output Power	4.77	dBm/MHz
E.I.R.P.	9.79	dBm/MHz
Input Power Voltage	3.30	VDC

Test category	Zigbee	
Tested Circuit Insertion Loss	0	dB
Frequency equal to the Transmission rate	0.25	MHz
Transmission Time	ON TIME (1sec or less)	0.6354 ms
	OFF TIME (0.1sec or more)	0.067 ms
	Ratio	0.9051 %
Packet Type (Mode)	Not Applicable	mode
Transmit Speed	Not Applicable	MHz

Using TDF and offset function in Spectrum Analyzer.
Measurement of plots are included Loss value.

(Att : 10dB + Cable loss + EUT cable: 0.5dB offset)

Test category :	2.4GHz Band Low-Power Data Communication System (Zigbee/1-14ch)
The reason why the tests are performed only at rated voltage :	

Measurement Frequency	MHz	2405	2435	2470	Result	Limit	Note
Channel Number	Ch.	1	7	14	---	---	
Frequency Measurements	MHz	2405.033	2435.033	2470.034	---	---	
Frequency Tolerance	ppm	13.680	13.682	13.709	PASS	$\pm 50 \times 10^{-6}$ (50ppm)	
Occupied Bandwidth	MHz	2.418	2.398	2.448	PASS	26MHz or below	
Spread Bandwidth	MHz	1.573	1.563	1.558	PASS	500kHz or more	
RF Output Power	mW/MHz	2.514	2.994	2.445	PASS	10mW/MHz or below	
RF Output Power Tolerance	%	-16.21	-0.19	-18.50		+20 to -80%	
Unwanted (Spurious) Emission Strength (1-14ch)	30 to 2387MHz	uW/MHz	0.013	0.014	0.013	PASS	2.5uW/MHz or below
		MHz	1924.300	2143.300	2164.500	----	
	2387 to 2400MHz	uW/MHz	0.094	0.014	0.016	PASS	25uW/MHz or below
		MHz	2399.877	2399.084	2392.812	----	
	2483.5 to 2496.5MHz	uW/MHz	0.016	0.014	0.015	PASS	25uW/MHz or below
		MHz	2494.455	2485.455	2483.649	----	
	2496.5 to 12750MHz	uW/MHz	0.057	0.045	0.049	PASS	2.5uW/MHz or below
		MHz	7213.500	7305.500	7408.500	----	
Secondary Emitted Radio Wave Strength	30 to 1000MHz	nW	0.026	0.017	0.012	PASS	4nW or below
		MHz	875.480	93.470	987.890	----	
	1000 to 10000MHz	nW	0.372	0.394	0.491	PASS	20nW or below
		MHz	6938.600	6983.500	2128.400	----	
	1000 to 12750MHz	nW	0.512	0.384	0.419	PASS	20nW or below
		MHz	12449.200	12449.200	12399.700	----	
Spreading Factor	---	6.294	6.254	6.234	PASS	5 / 10 or more	
Interference Prevention Function	Good				PASS		
Transmitting antenna absolute gain	-				----	*1	
Angular width of the main radiation of the transmitting antenna	-				----	*1	

*1 Measurement only if the E.I.R.P. exceeds 12.14dBm/MHz

3. Test results (-10% voltage)

S/N : N/A

Environment of test room	Date of test	2022-05-02	2022-05-03
	Temperature	23 °C	22 °C
	Humidity	49 %	50 %

Test category	Zigbee	
Peak Antenna Gain	5.02	dBi
Declaration Output Power	3.000	mW/MHz
Declaration Output Power	4.77	dBm/MHz
E.I.R.P.	9.79	dBm/MHz
Input Power Voltage	2.97	VDC

Test category	Zigbee	
Tested Circuit Insertion Loss	0	dB
Frequency equal to the Transmission rate	0.25	MHz
Transmission Time	ON TIME (1sec or less)	0.6354 ms
	OFF TIME (0.1sec or more)	0.0666 ms
	Ratio	0.9051 %
Packet Type (Mode)	Not Applicable	mode
Transmit Speed	Not Applicable	MHz

Using TDF and offset function in Spectrum Analyzer.
Measurement of plots are included Loss value.

(Att : 10dB + Cable loss + EUT cable: 0.5dB offset)

Test category :	2.4GHz Band Low-Power Data Communication System (Zigbee/1-14ch)
The reason why the tests are performed only at rated voltage :	

Measurement Frequency	MHz	2405	2435	2470	Result	Limit	Note
Channel Number	Ch.	1	7	14	---	---	
Frequency Measurements	MHz	2405.033	2435.033	2470.034	---	---	
Frequency Tolerance	ppm	13.705	13.701	13.709	PASS	±50×10 ⁻⁶ (50ppm)	
Occupied Bandwidth	MHz	2.423	2.383	2.433	PASS	26MHz or below	
Spread Bandwidth	MHz	1.623	1.598	1.633	PASS	500kHz or more	
RF Output Power	mW/MHz	2.566	2.899	2.400	PASS	10mW/MHz or below	
RF Output Power Tolerance	%	-14.46	-3.36	-19.99		+20 to -80%	
Unwanted (Spurious) Emission Strength (1-14ch)	30 to 2387MHz	uW/MHz	0.013	0.012	0.013	PASS	2.5uW/MHz or below
		MHz	2209.200	2279.900	2136.200	----	
	2387 to 2400MHz	uW/MHz	0.091	0.014	0.014	PASS	25uW/MHz or below
		MHz	2399.942	2394.552	2398.968	----	
	2483.5 to 2496.5MHz	uW/MHz	0.014	0.015	0.016	PASS	25uW/MHz or below
		MHz	2492.260	2493.935	2488.416	----	
	2496.5 to 12750MHz	uW/MHz	0.061	0.043	0.060	PASS	2.5uW/MHz or below
		MHz	7213.500	6916.500	7408.500	----	
Secondary Emitted Radio Wave Strength	30 to 1000MHz	nW	0.101	0.015	0.014	PASS	4nW or below
		MHz	33.390	93.470	885.170	----	
	1000 to 10000MHz	nW	0.422	0.430	0.628	PASS	20nW or below
		MHz	6578.900	6623.900	2479.000	----	
	1000 to 12750MHz	nW	0.455	0.442	0.418	PASS	20nW or below
		MHz	12419.000	12504.100	12487.600	----	
Spreading Factor	---	6.494	6.394	6.533	PASS	5 / 10 or more	
Interference Prevention Function	Good				PASS		
Transmitting antenna absolute gain	-				----	*1	
Angular width of the main radiation of the transmitting antenna	-				----	*1	

*1 Measurement only if the E.I.R.P. exceeds 12.14dBm/MHz

3. Test results (+10% voltage)

S/N : N/A

Environment of test room	Date of test	2022-05-02	2022-05-03
	Temperature	23 °C	22 °C
	Humidity	49 %	50 %

Test category	Zigbee	
Peak Antenna Gain	5.02	dBi
Declaration Output Power	3.000	mW/MHz
Declaration Output Power	4.77	dBm/MHz
E.I.R.P.	9.79	dBm/MHz
Input Power Voltage	3.63	VDC

Test category	Zigbee	
Tested Circuit Insertion Loss	0	dB
Frequency equal to the Transmission rate	0.25	MHz
Transmission Time	ON TIME (1sec or less)	0.6354 ms
	OFF TIME (0.1sec or more)	0.0669 ms
	Ratio	0.9047 %
Packet Type (Mode)	Not Applicable	mode
Transmit Speed	Not Applicable	MHz

Using TDF and offset function in Spectrum Analyzer.
Measurement of plots are included Loss value.

(Att : 10dB + Cable loss + EUT cable: 0.5dB offset)

Test category :	2.4GHz Band Low-Power Data Communication System (Zigbee/1-14ch)
The reason why the tests are performed only at rated voltage :	

Measurement Frequency	MHz	2405	2435	2470	Result	Limit	Note
Channel Number	Ch.	1	7	14	---	---	
Frequency Measurements	MHz	2405.033	2435.033	2470.034	---	---	
Frequency Tolerance	ppm	13.660	13.655	13.667	PASS	±50×10 ⁻⁶ (50ppm)	
Occupied Bandwidth	MHz	2.418	2.393	2.453	PASS	26MHz or below	
Spread Bandwidth	MHz	1.613	1.608	1.628	PASS	500kHz or more	
RF Output Power	mW/MHz	2.515	2.834	2.396	PASS	10mW/MHz or below	
RF Output Power Tolerance	%	-16.18	-5.52	-20.14		+20 to -80%	
Unwanted (Spurious) Emission Strength (1-14ch)	30 to 2387MHz	uW/MHz	0.014	0.015	0.012	PASS	2.5uW/MHz or below
		MHz	2140.900	2348.100	1957.300	----	
	2387 to 2400MHz	uW/MHz	0.103	0.015	0.013	PASS	25uW/MHz or below
		MHz	2399.916	2396.383	2390.526	----	
	2483.5 to 2496.5MHz	uW/MHz	0.014	0.014	0.017	PASS	25uW/MHz or below
		MHz	2483.987	2492.312	2484.390	----	
	2496.5 to 12750MHz	uW/MHz	0.060	0.046	0.057	PASS	2.5uW/MHz or below
		MHz	7213.500	6629.500	7408.500	----	
Secondary Emitted Radio Wave Strength	30 to 1000MHz	nW	0.053	0.016	0.011	PASS	4nW or below
		MHz	874.500	94.440	690.390	----	
	1000 to 10000MHz	nW	0.418	0.384	0.408	PASS	20nW or below
		MHz	7001.500	6605.900	6794.700	----	
	1000 to 12750MHz	nW	0.446	0.414	0.500	PASS	20nW or below
		MHz	11141.500	12416.200	12402.500	----	
Spreading Factor	---	6.454	6.434	6.513	PASS	5 / 10 or more	
Interference Prevention Function	Good				PASS		
Transmitting antenna absolute gain	-				----	*1	
Angular width of the main radiation of the transmitting antenna	-				----	*1	

*1 Measurement only if the E.I.R.P. exceeds 12.14dBm/MHz

4. Measurement equipment list

USE	Equipment	Company	Model No.	Serial No.	Calibrated by	Cal. Method	Cal. Due	Cal. Date
X	Spectrum Analyzer	R&S	FSV40	100988	HCT	(c)	2022-07-19	2021-07-09
X	DC Power Supply	AGILENT	E3632A	MY40018781	HCT	(c)	2023-05-10	2022-05-02
X	Attenuator	API Inmet	40AH2W-10	14	HCT	(c)	2023-05-03	2022-05-03
X	Signal Generator	R&S	SMB100A	176206	HCT	(c)	2023-01-19	2022-01-19

Note1: "X" used equipment.

Note2: The validity of measurement equipment is one year from the first day of the following month of the calibration date.

Note3:
Cal.Method ... a) : Calibration conducted by the National Institute of Information and Communications Technology ~ NICT ~ or a designated calibration agency under Article 102-18 paragraph (1) ~ TELECOM Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc ~.

b) : Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992) ~ Japan Calibration Service System ~

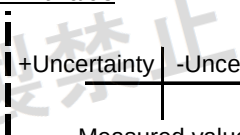
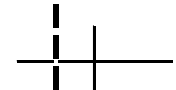
c) : Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1) ~ TELECOM Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc ~.

d) : Calibration conducted by using other equipment that listed above from a) to c)

5. Uncertainty

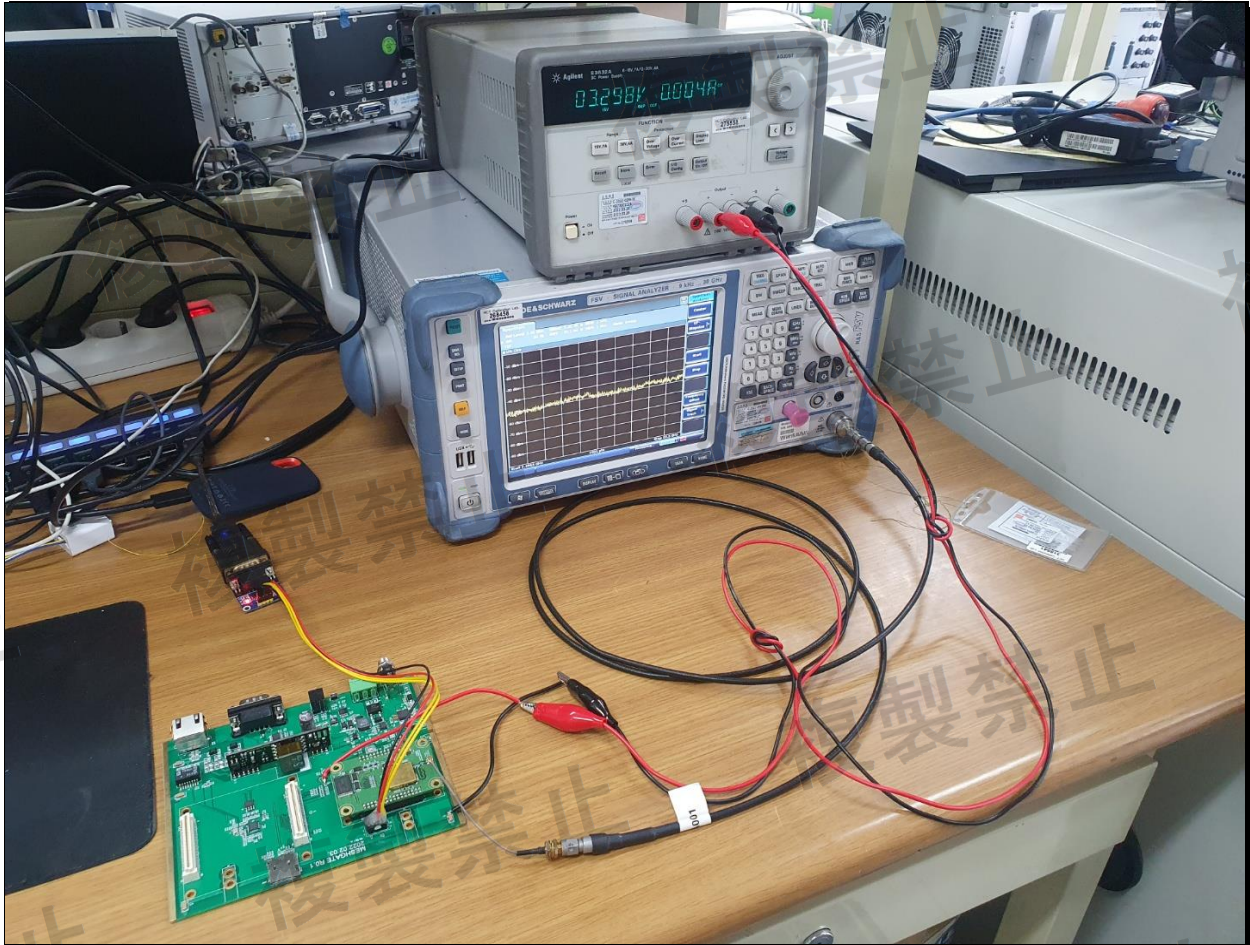
About uncertainty of measured value

Parameter	Uncertainty
Total RF power conducted	$\pm 0.9\text{dB}$
Spurious emissions conducted	$\pm 1.1\text{dB}$
Temperature	$\pm 0.9^{\circ}\text{C}$
Humidity	$\pm 4.6\%$

Judge	Measured value and standard limit value	
PASS	Standard limit value Case1  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.	

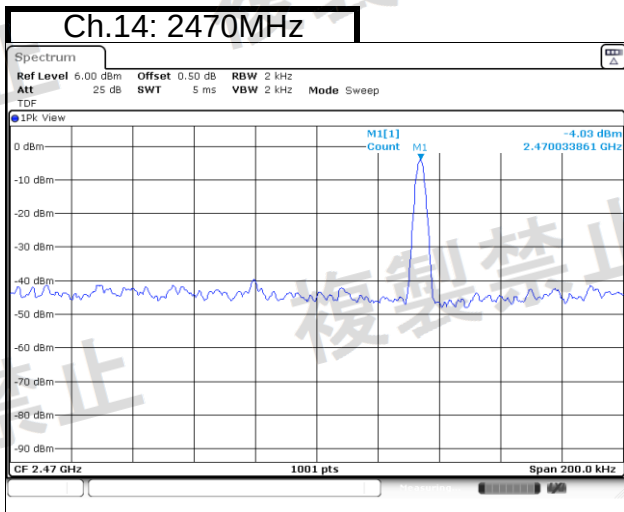
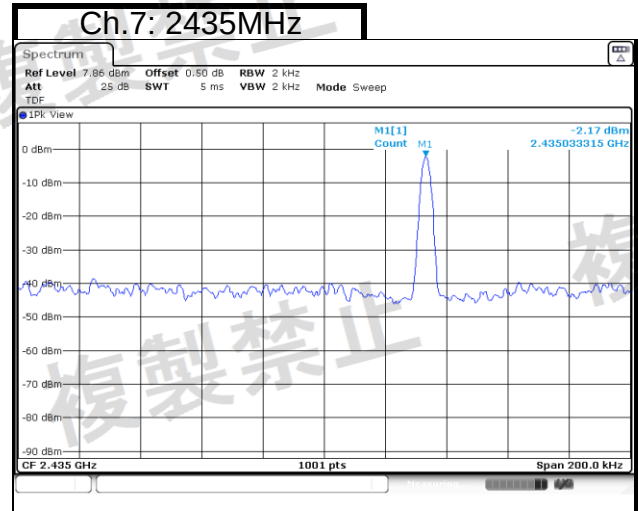
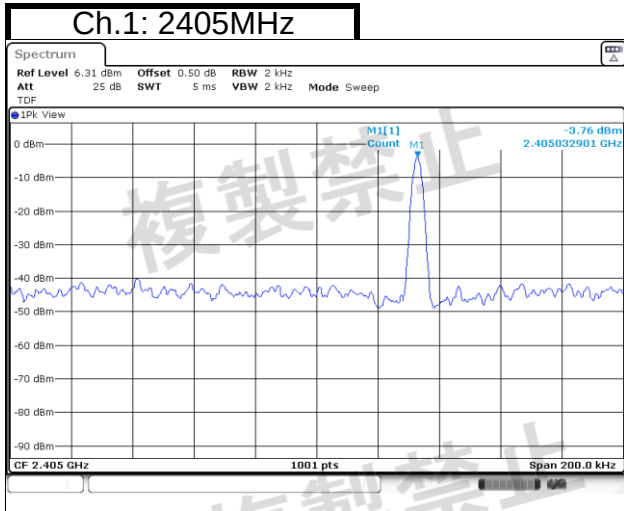
6. Photographs

Conducted Measurement Photo



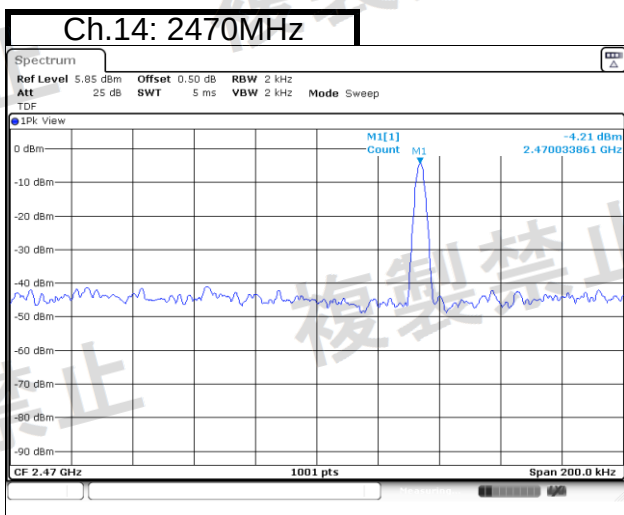
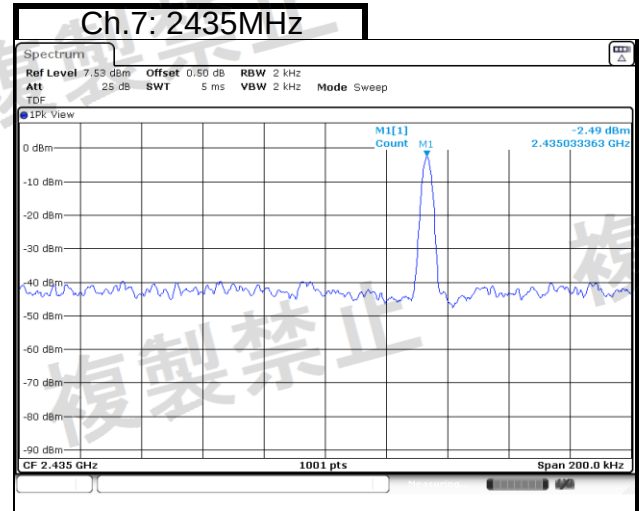
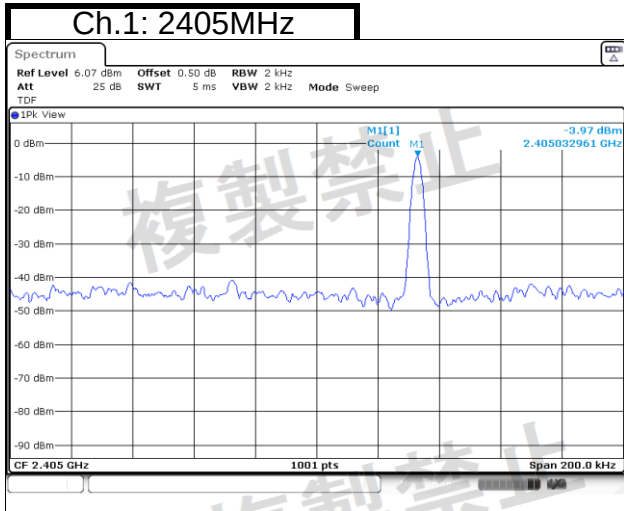
7. Test chart

7.1 Frequency tolerance (Rated voltage)



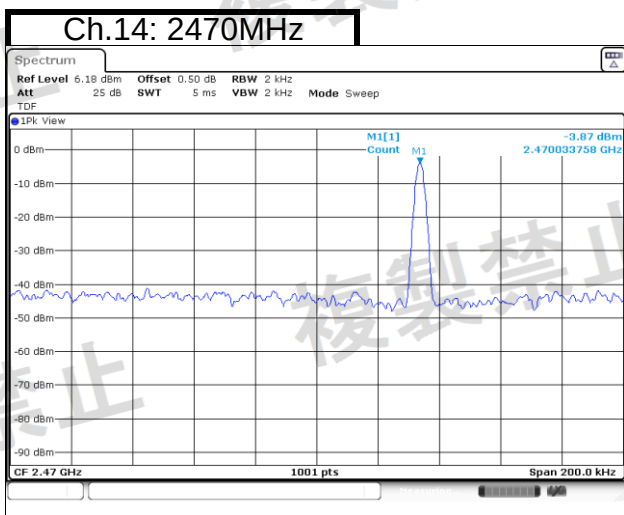
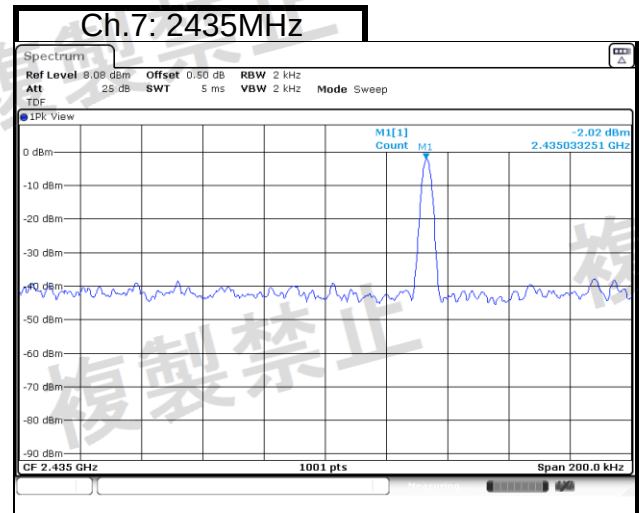
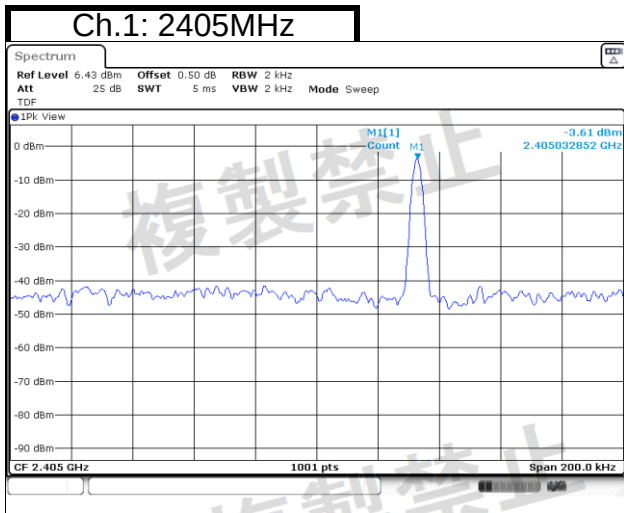
7. Test chart

7.1 Frequency tolerance (-10% voltage)



7. Test chart

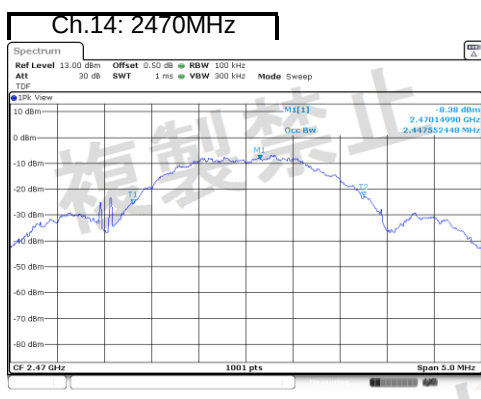
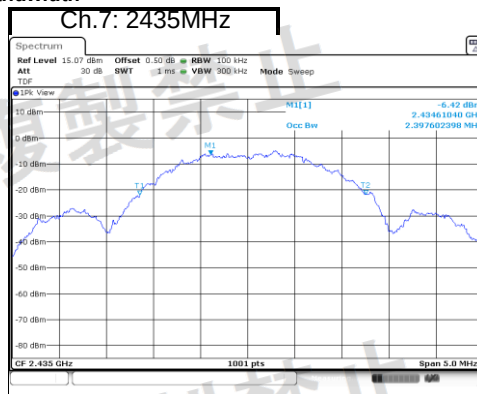
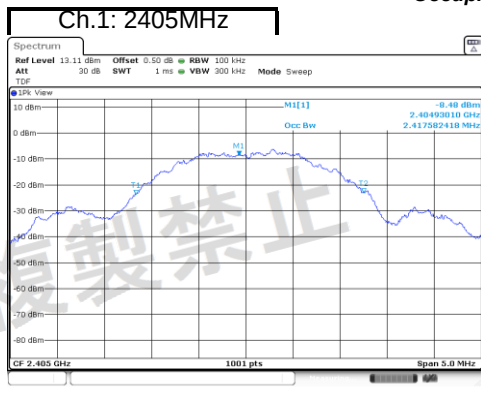
7.1 Frequency tolerance (+10% voltage)



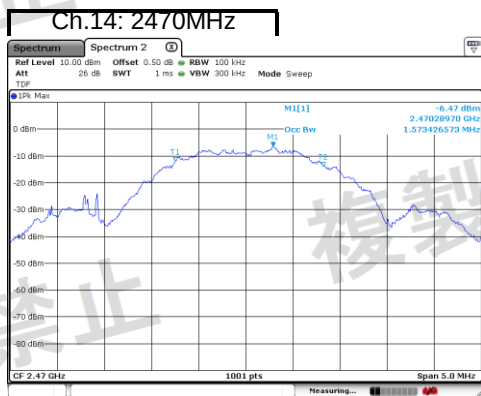
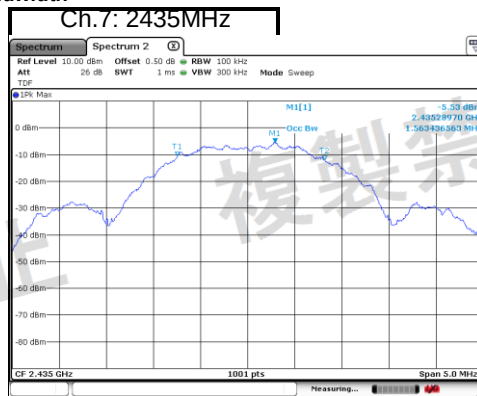
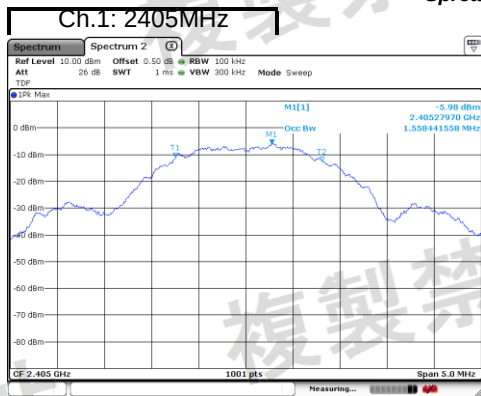
7. Test chart

7.2 Occupied bandwidth / Spread bandwidth (Rated voltage)

Occupied bandwidth



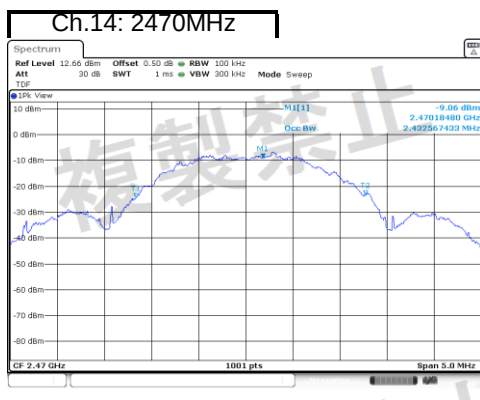
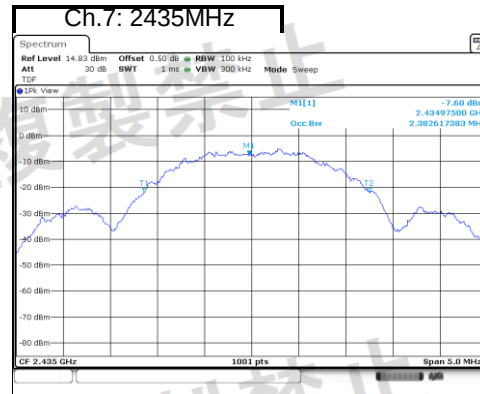
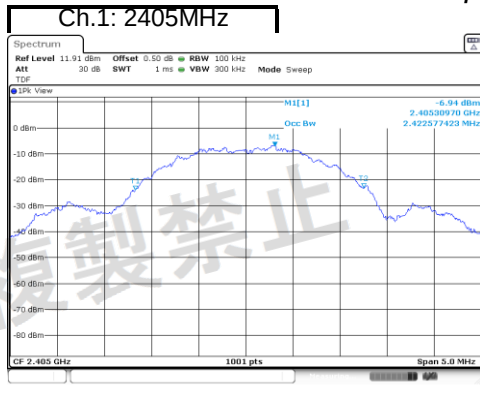
Spread bandwidth



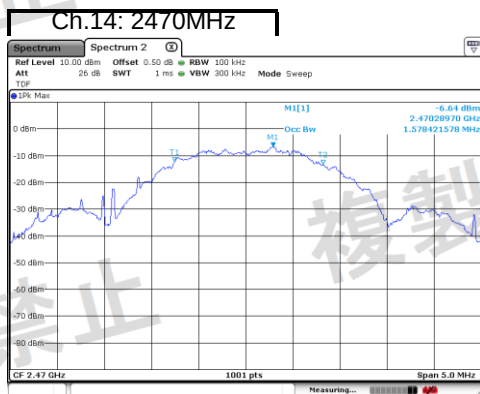
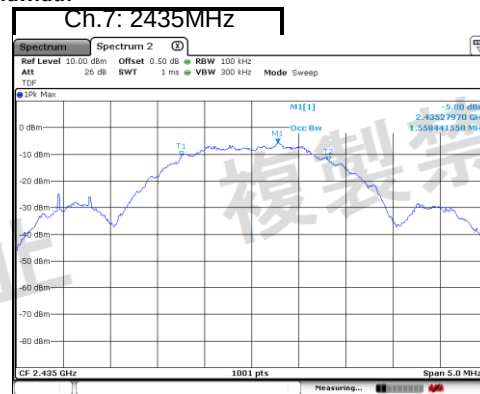
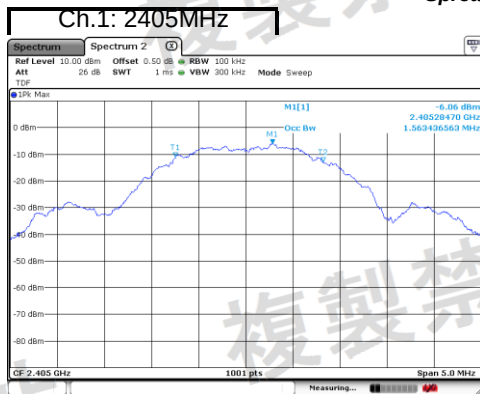
7. Test chart

7.2 Occupied bandwidth / Spread bandwidth (-10% voltage)

Occupied bandwidth



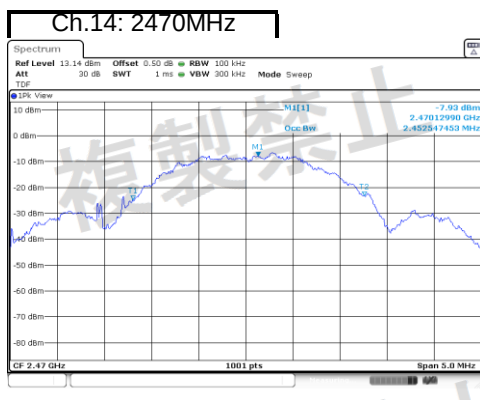
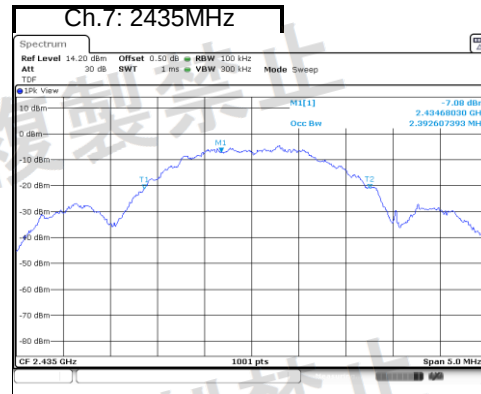
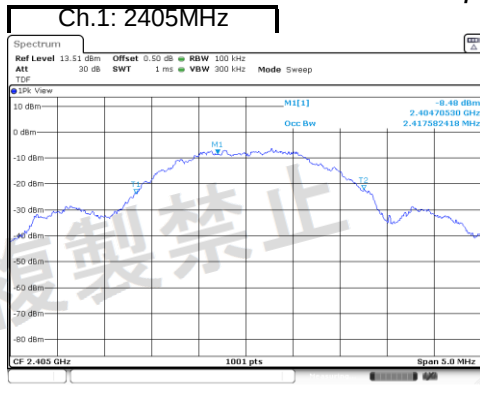
Spread bandwidth



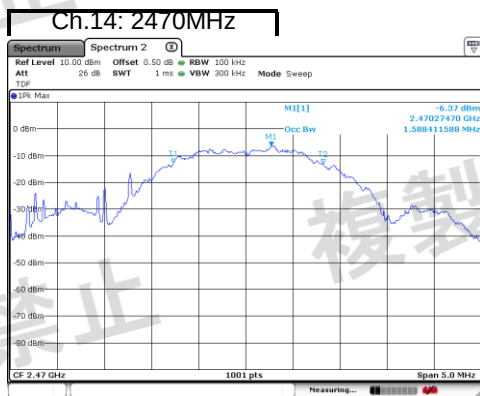
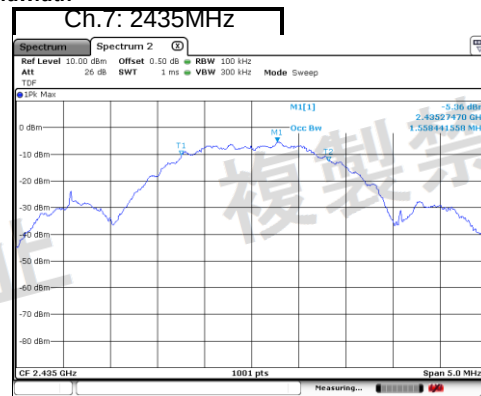
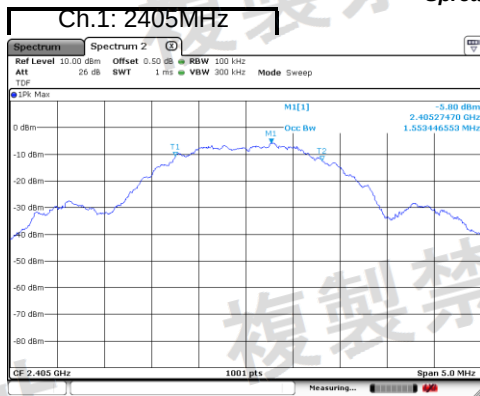
7. Test chart

7.2 Occupied bandwidth / Spread bandwidth (+10% voltage)

Occupied bandwidth

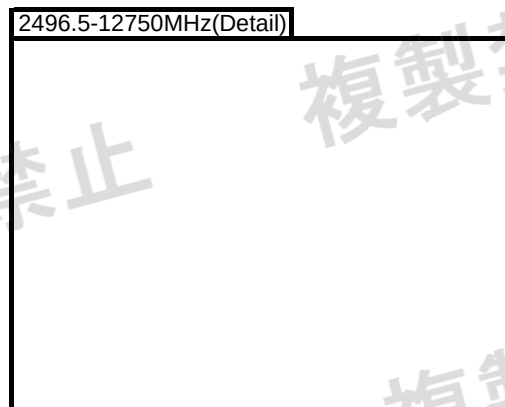
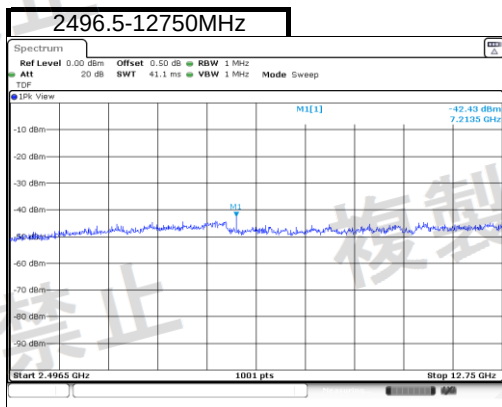
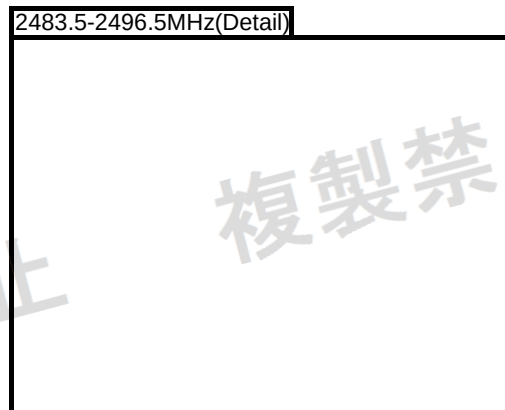
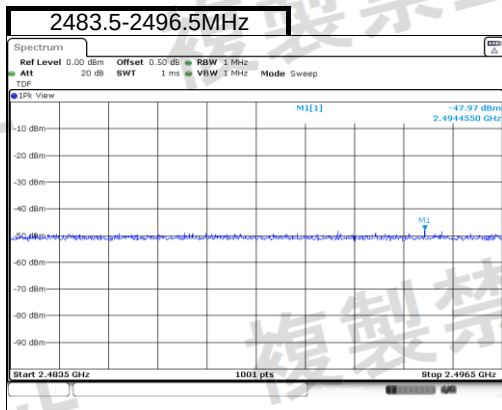
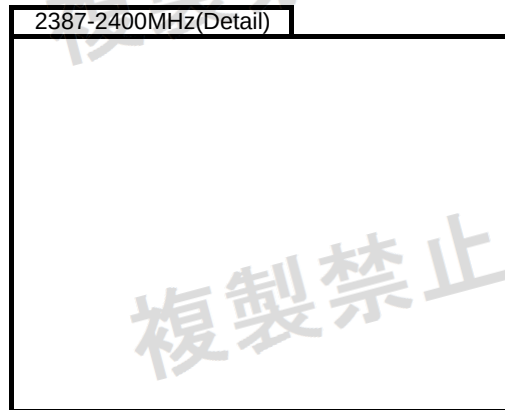
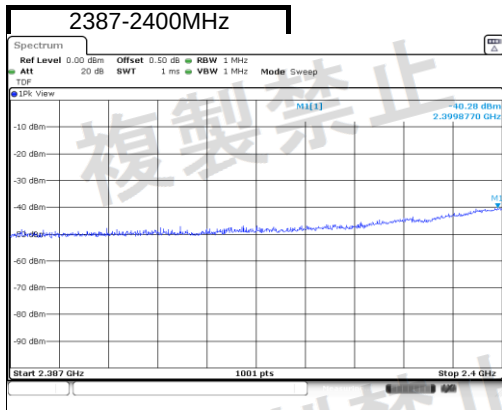
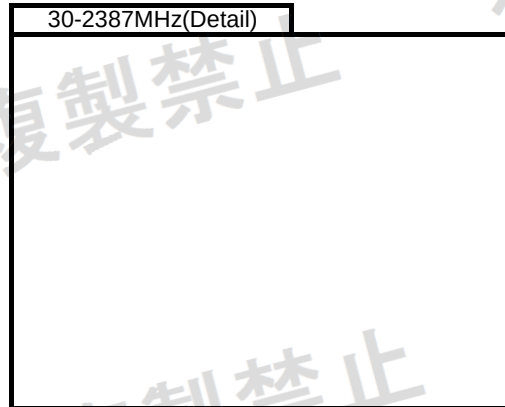
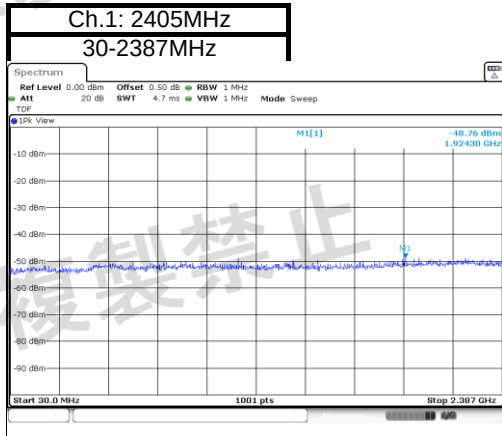


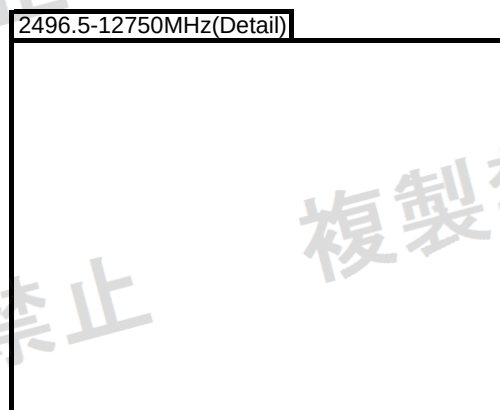
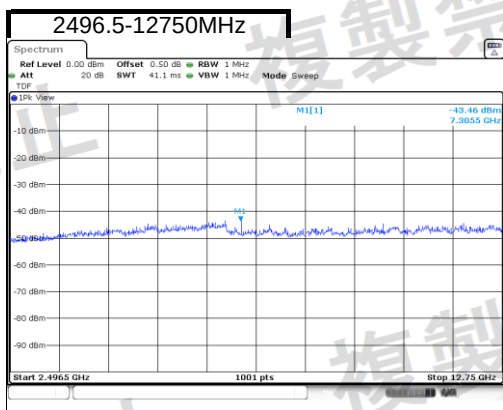
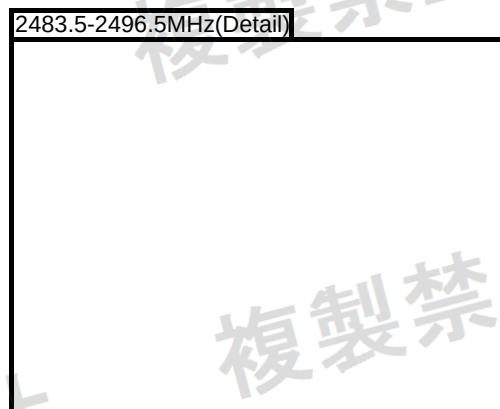
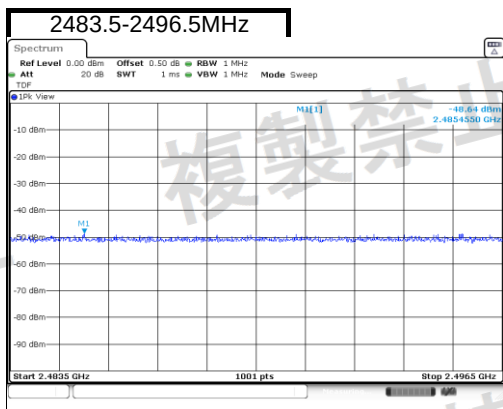
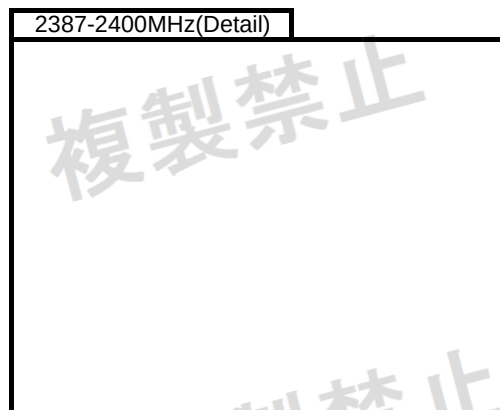
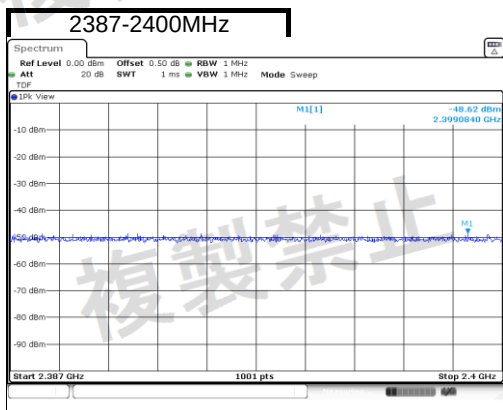
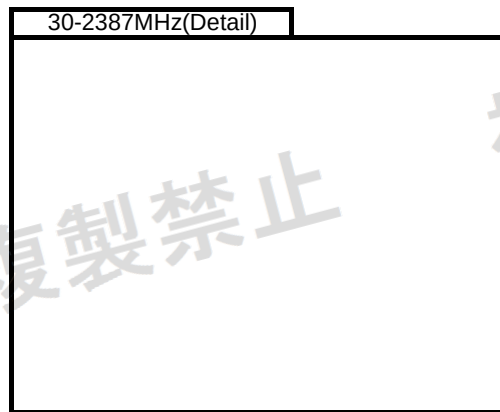
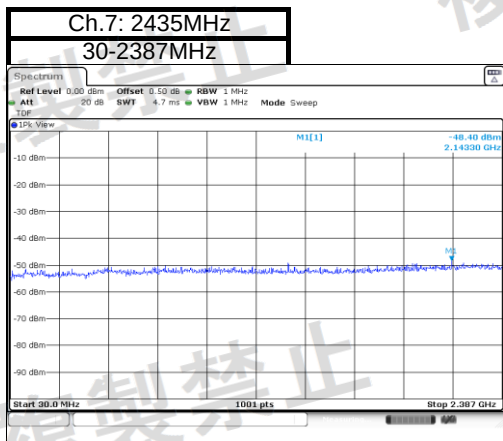
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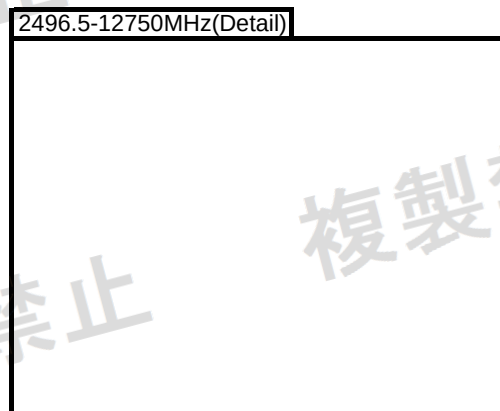
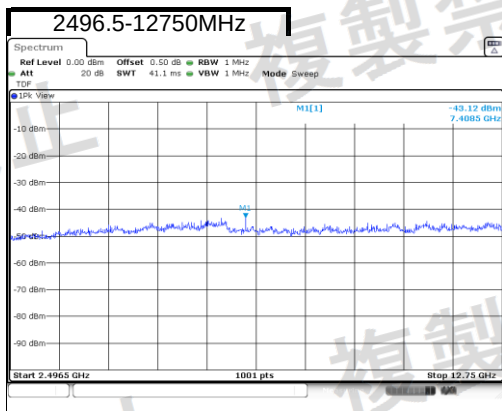
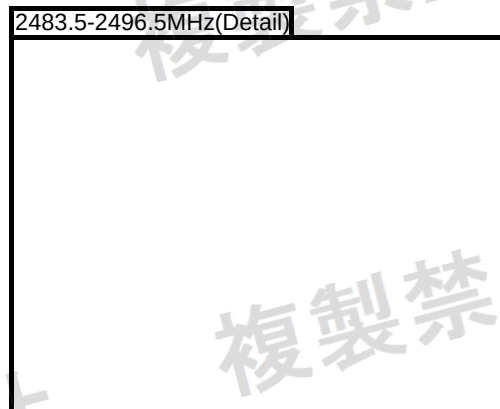
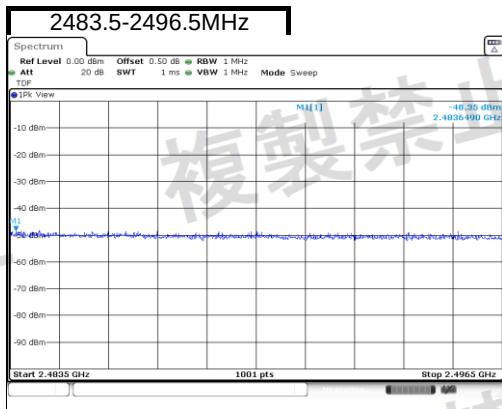
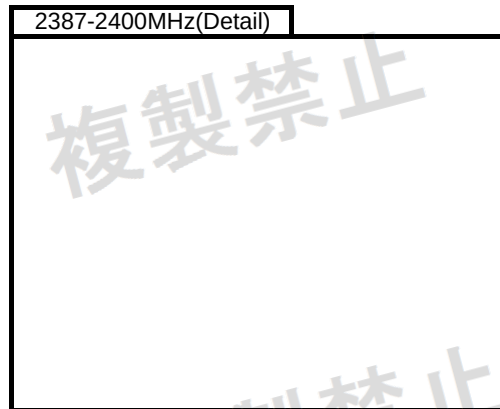
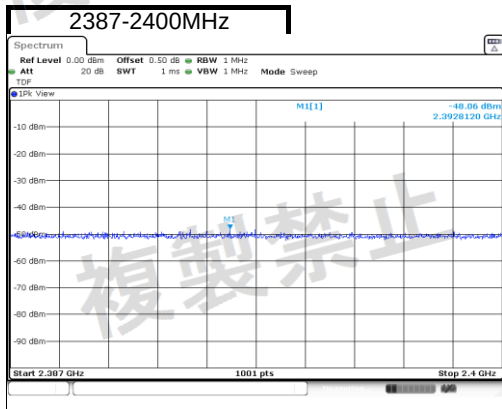
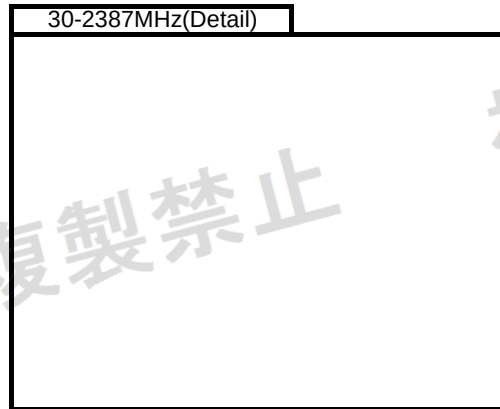
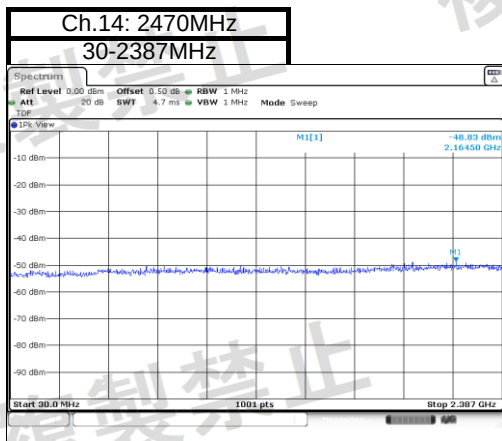


7. Test chart

7.3 Unwanted(Spurious) emission strength (Rated voltage)

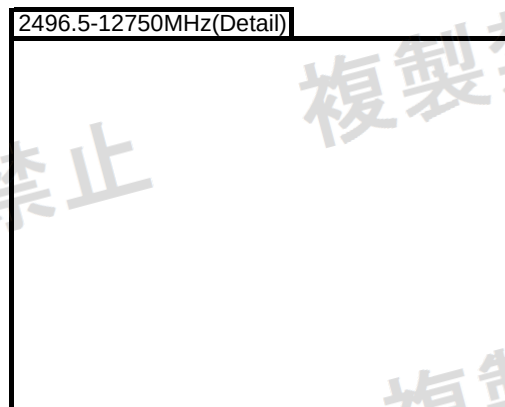
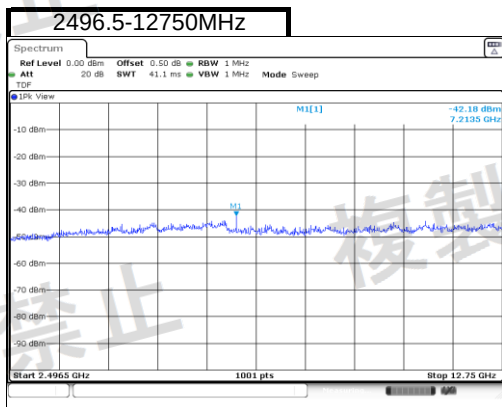
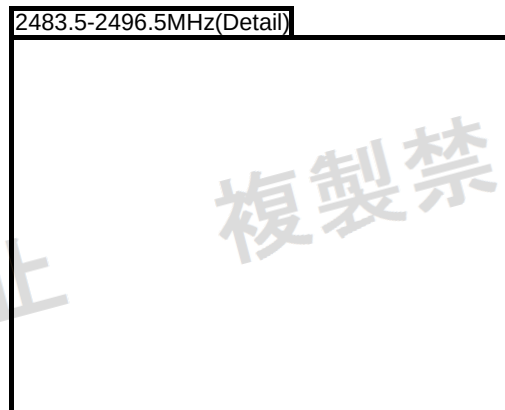
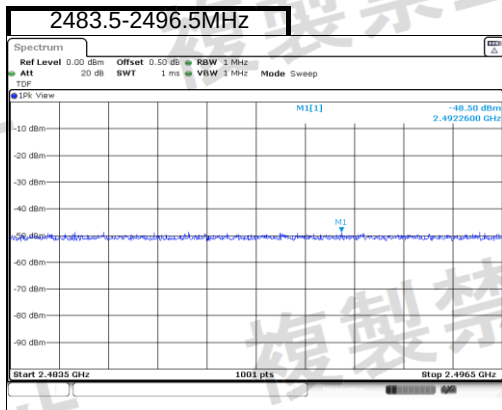
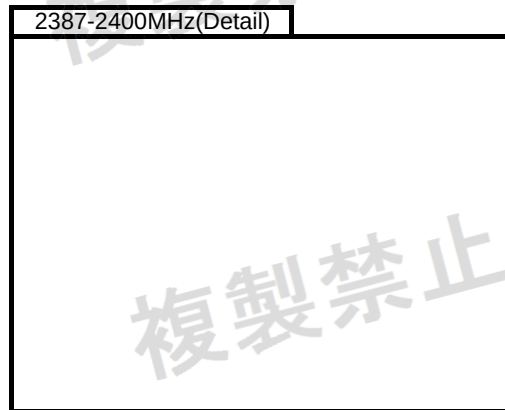
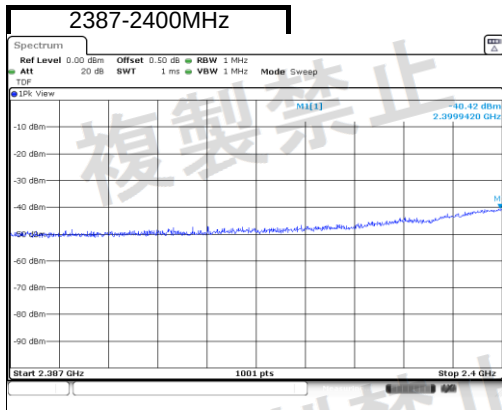
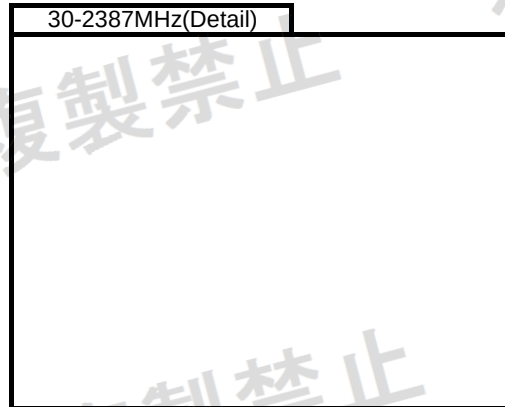
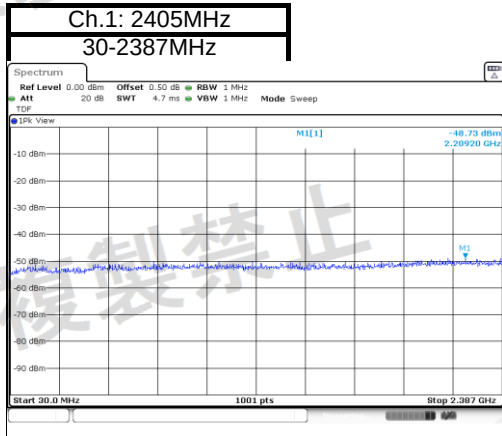


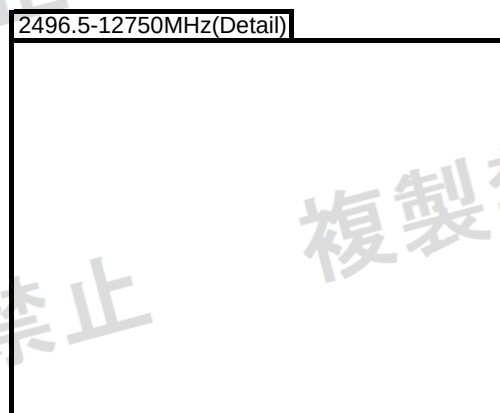
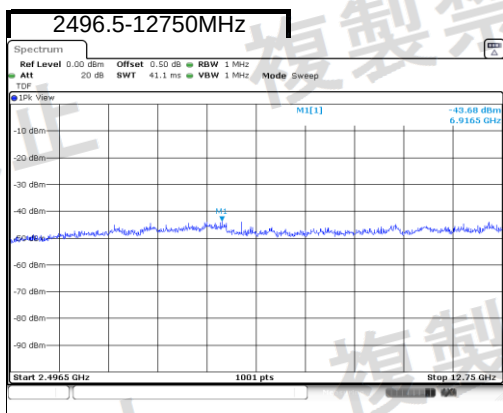
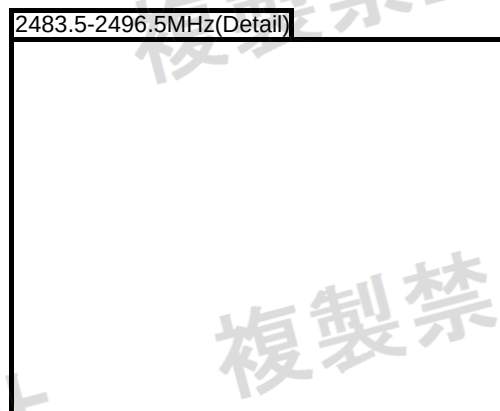
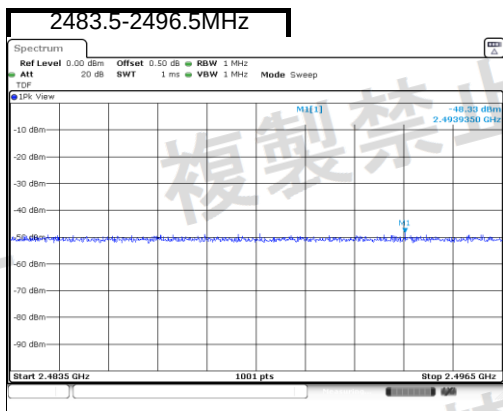
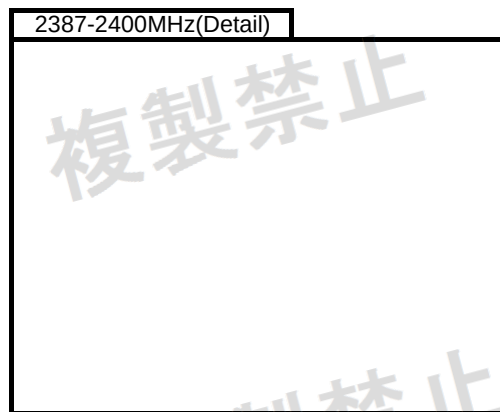
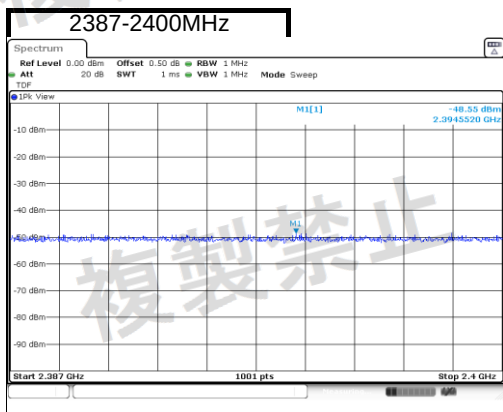
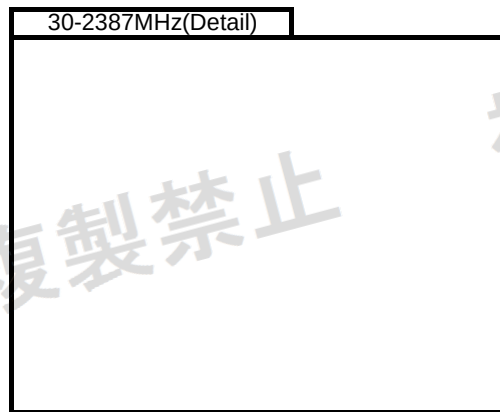
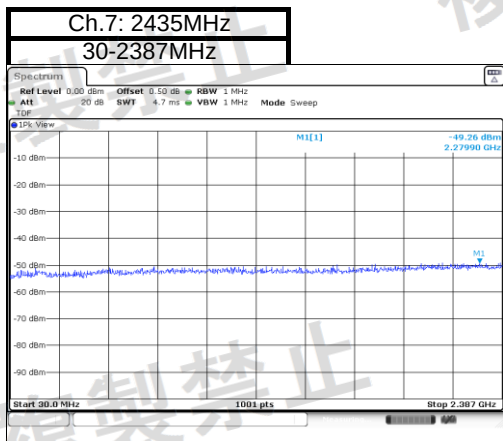


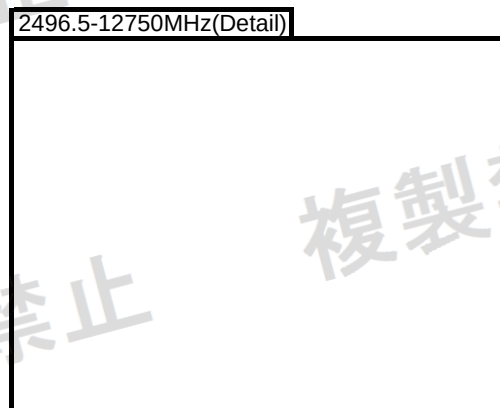
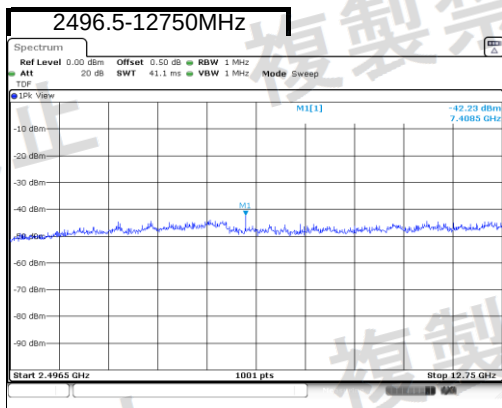
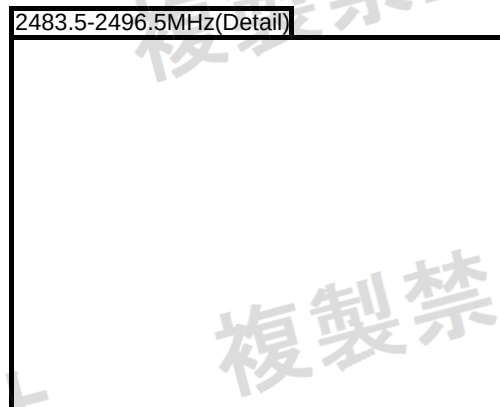
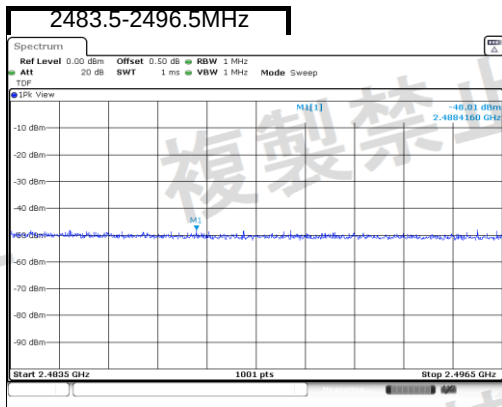
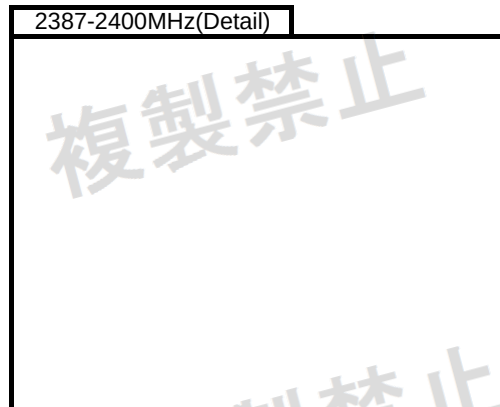
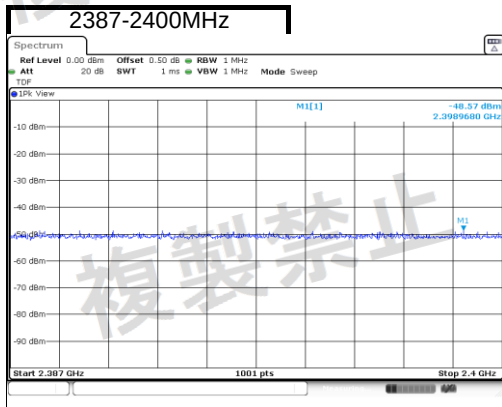
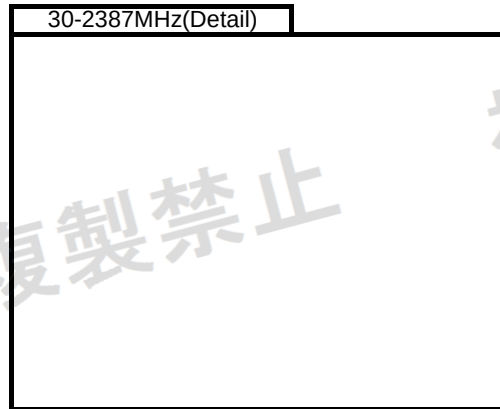
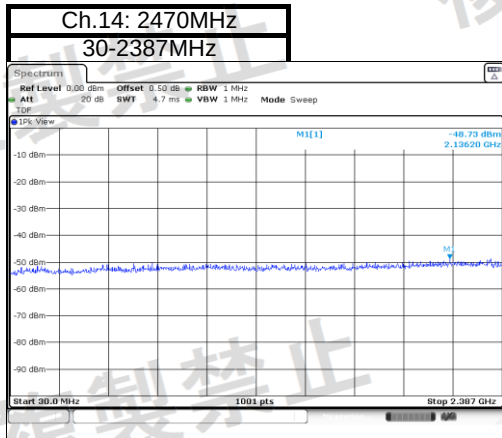


7. Test chart

7.3 Unwanted(Spurious) emission strength (-10% voltage)

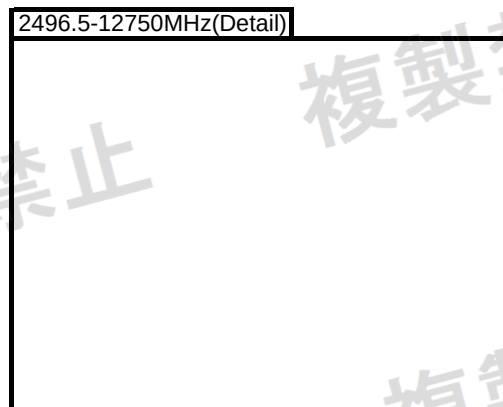
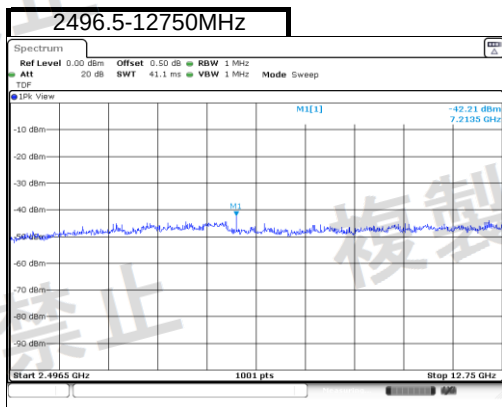
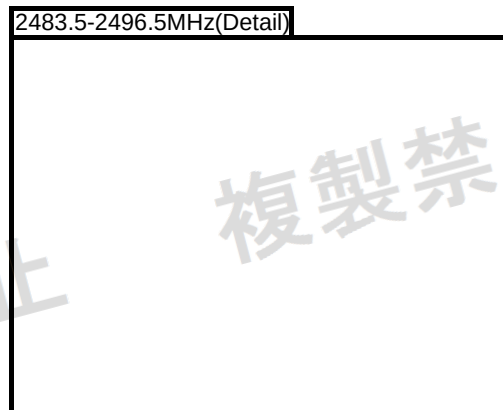
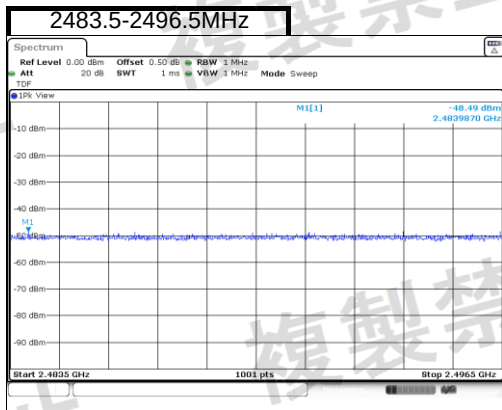
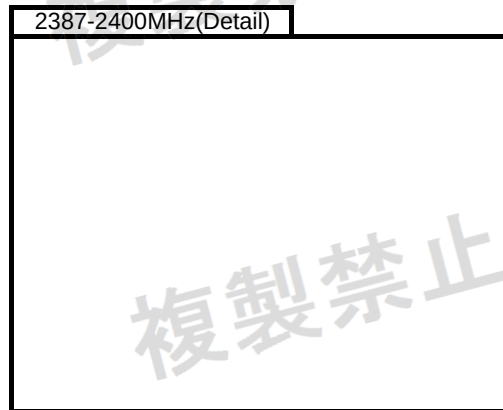
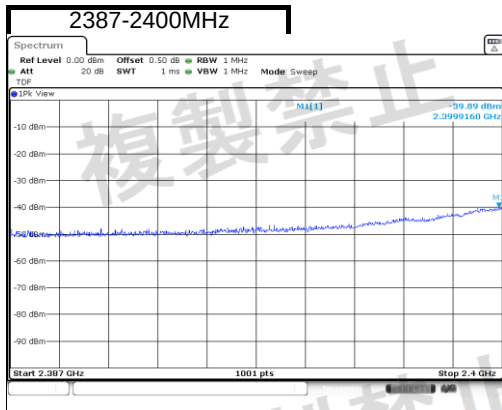
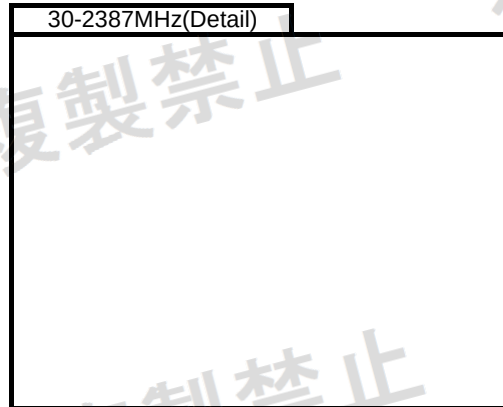
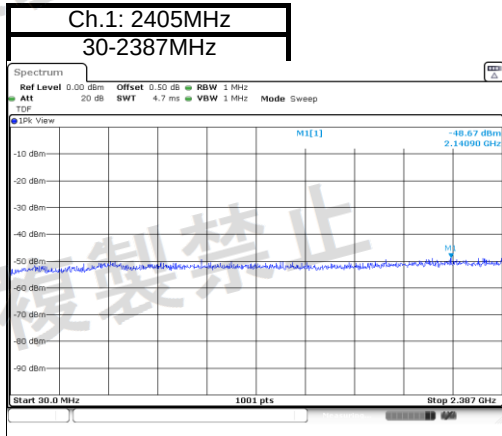


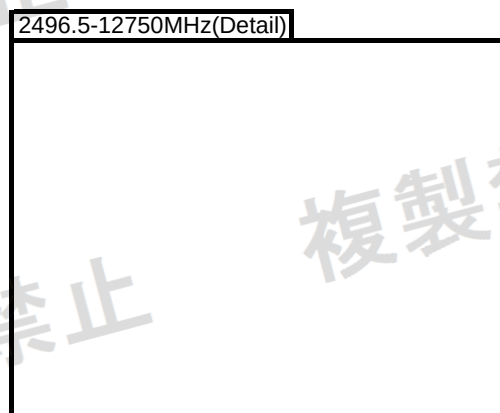
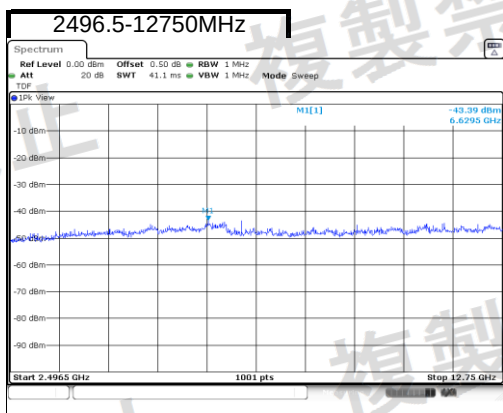
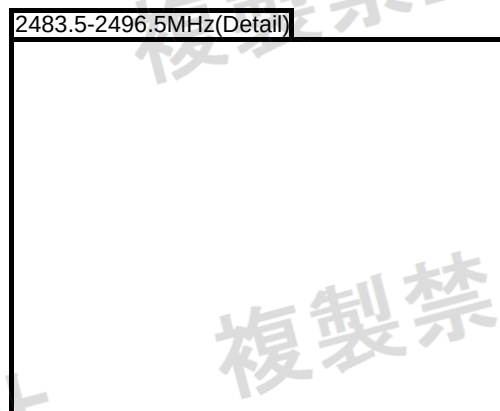
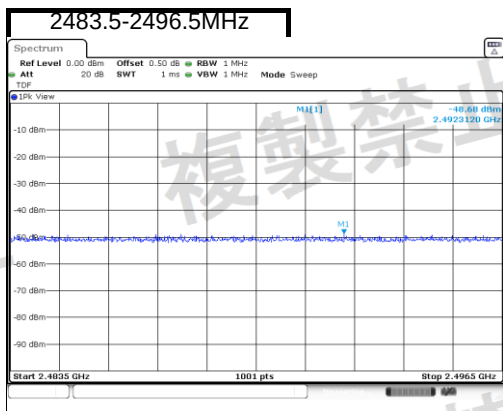
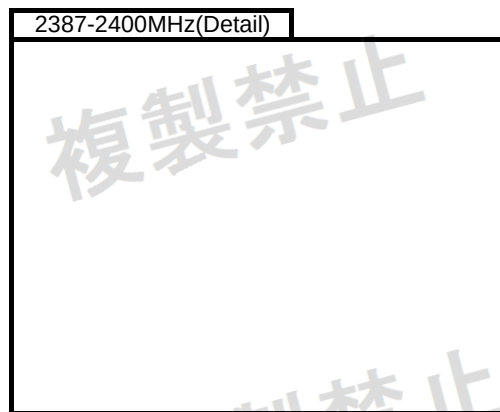
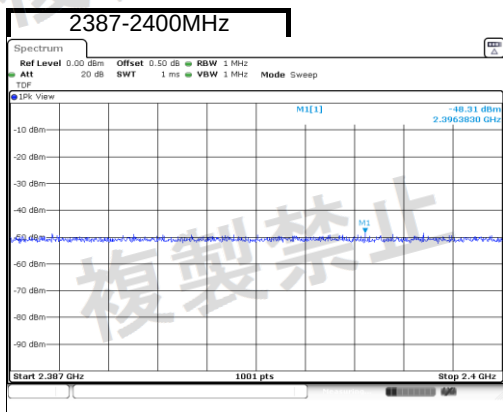
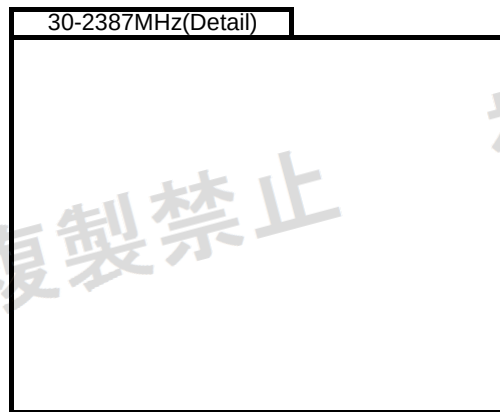
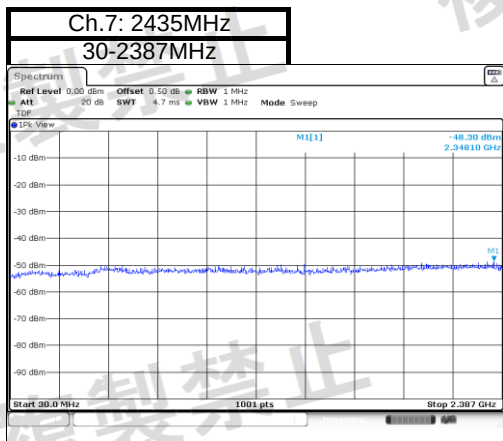


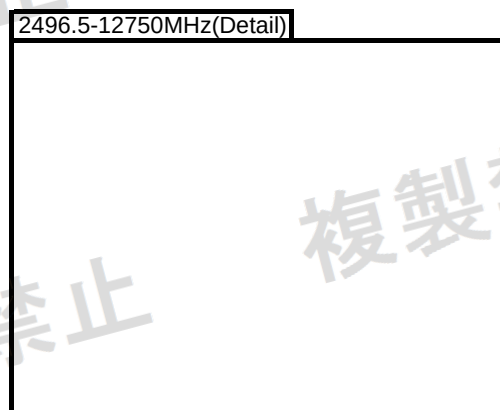
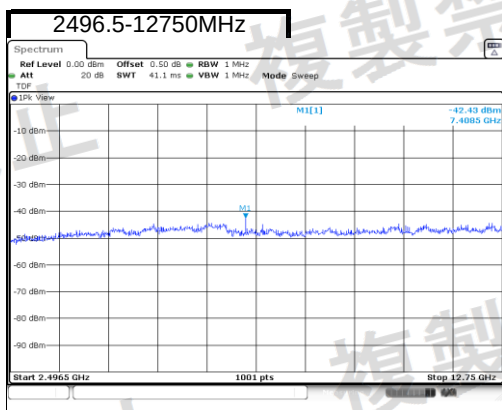
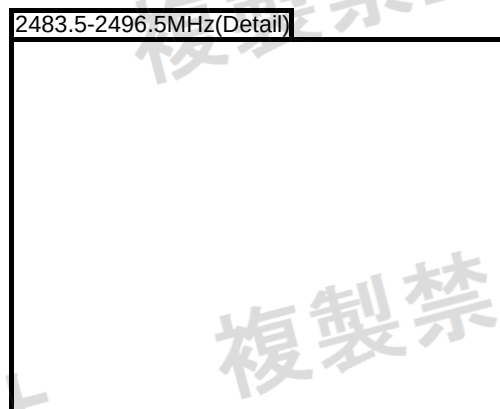
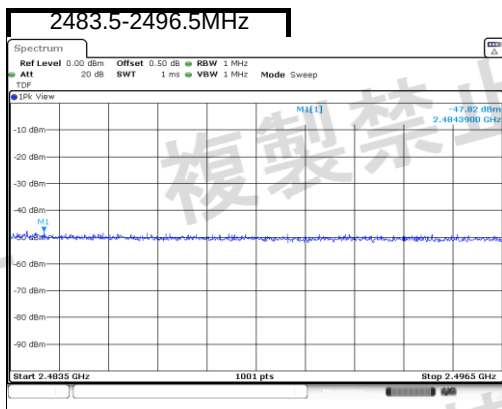
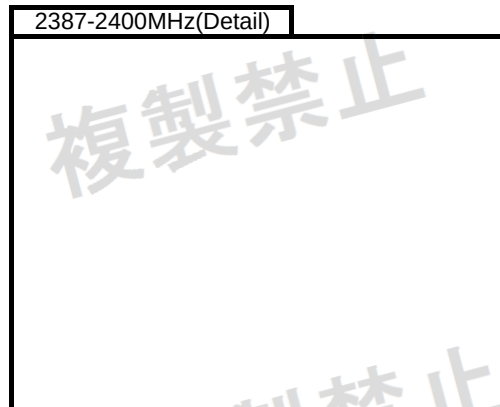
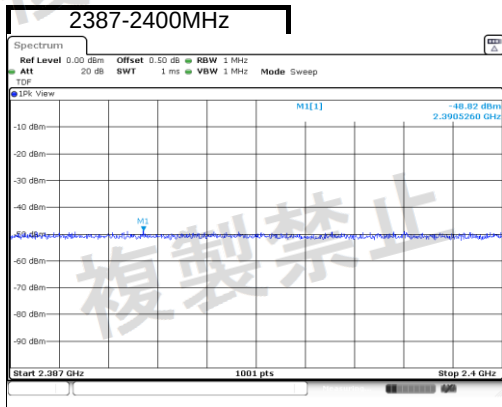
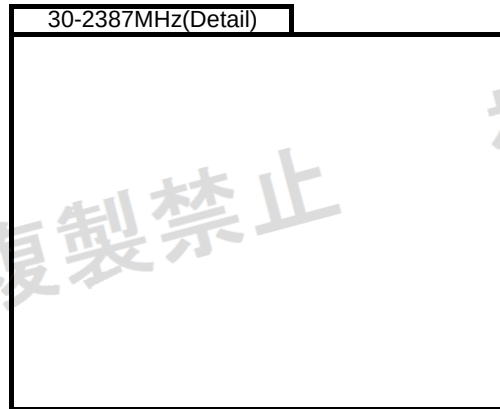
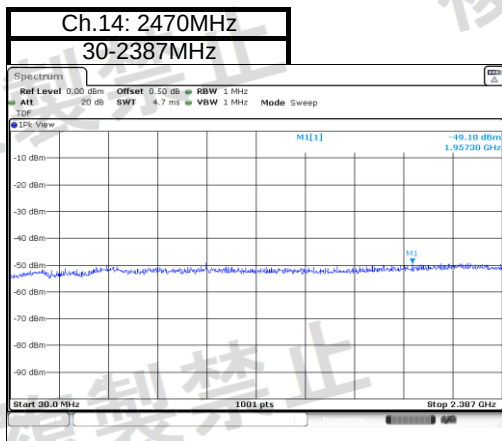


7. Test chart

7.3 Unwanted(Spurious) emission strength (+10% voltage)

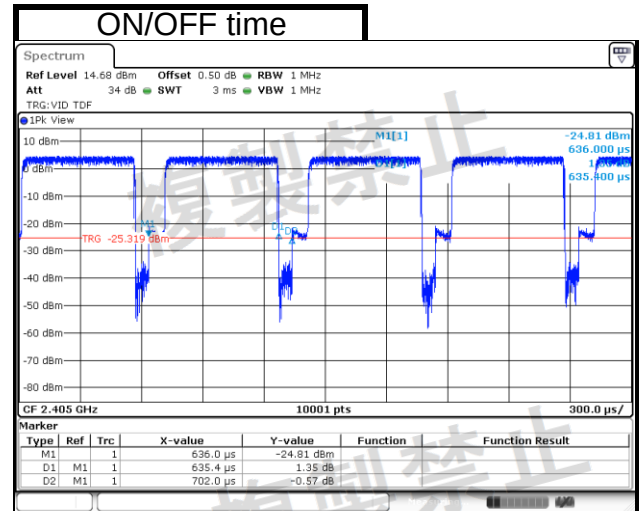
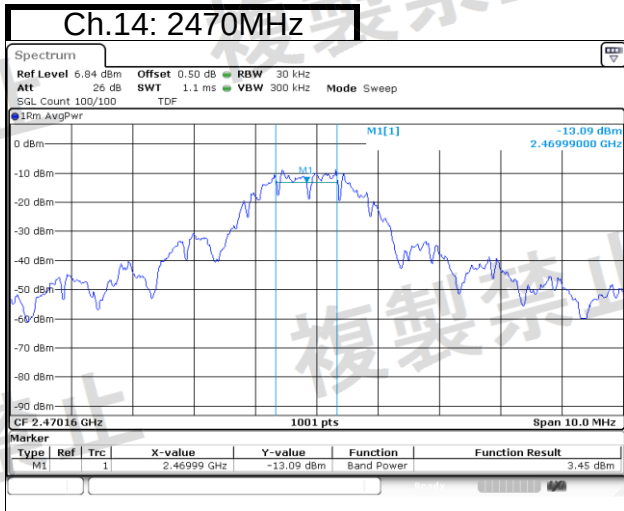
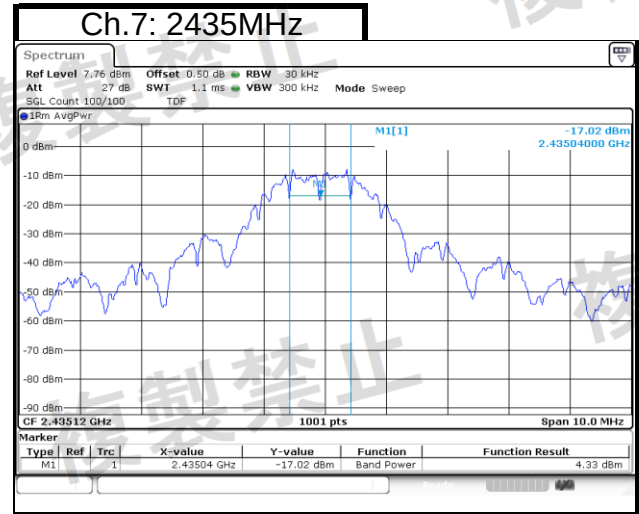
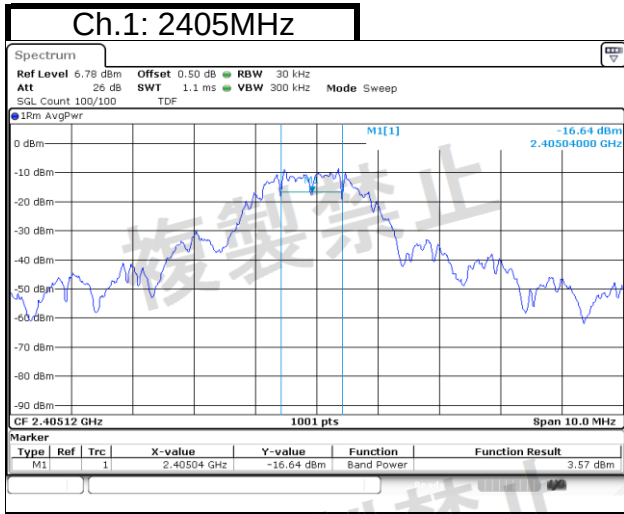






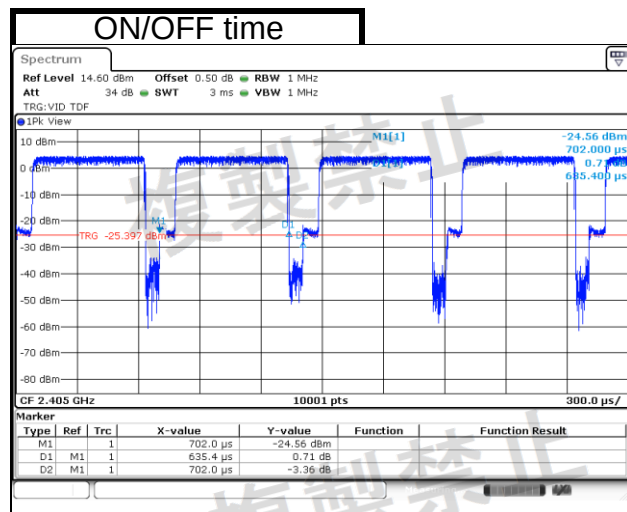
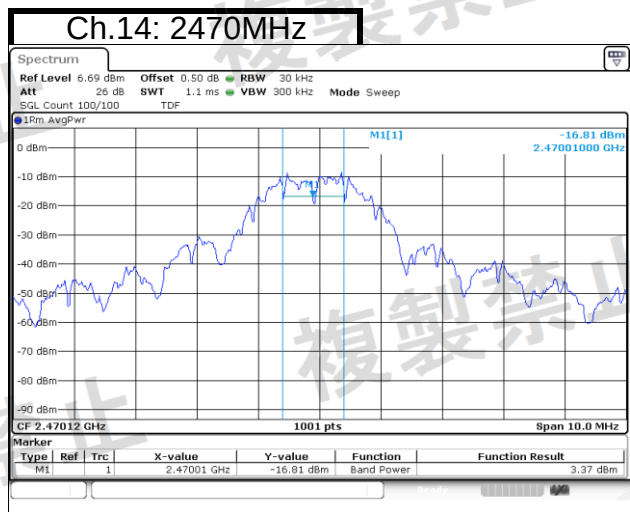
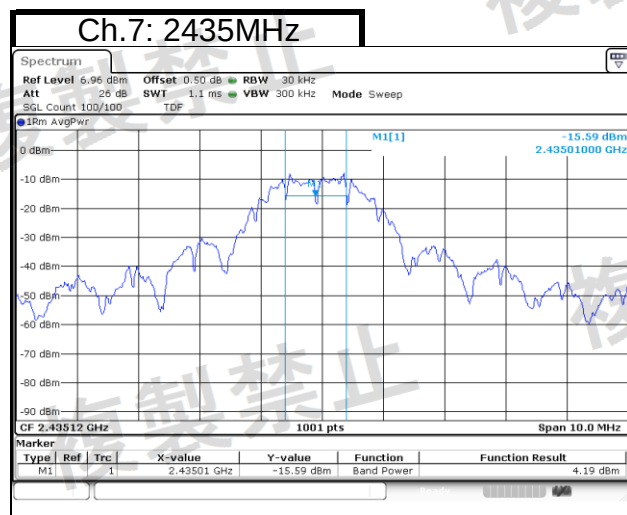
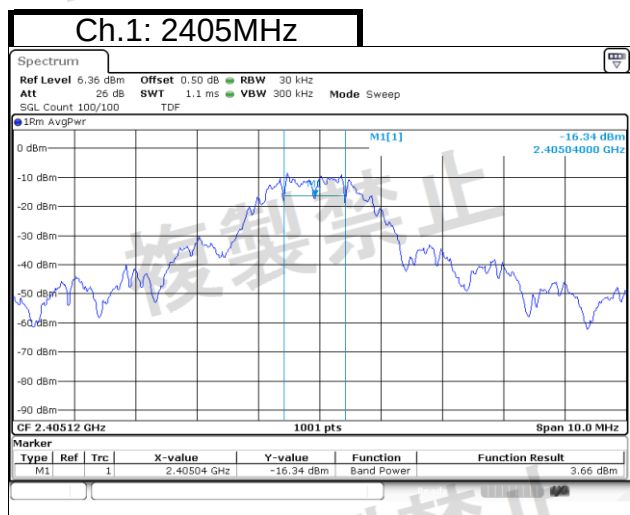
7. Test chart

7.4 RF output power tolerance (Rated voltage)



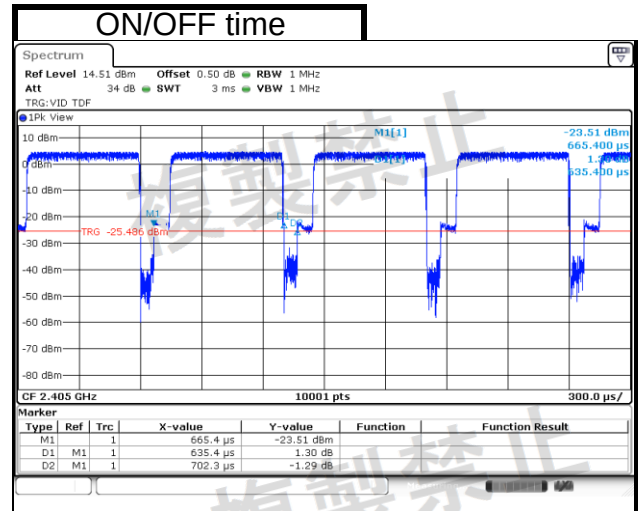
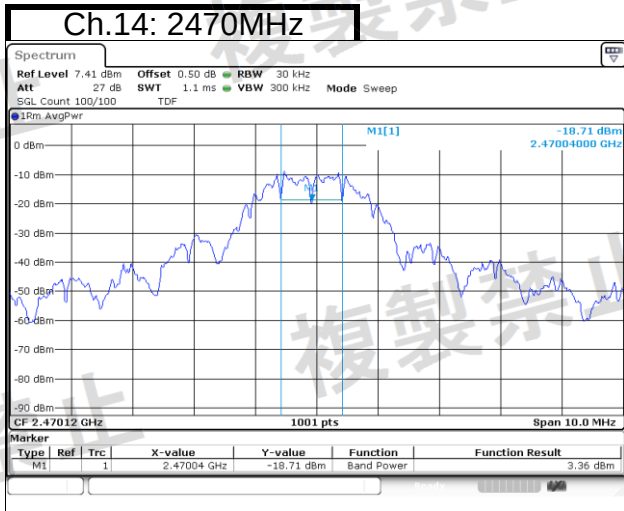
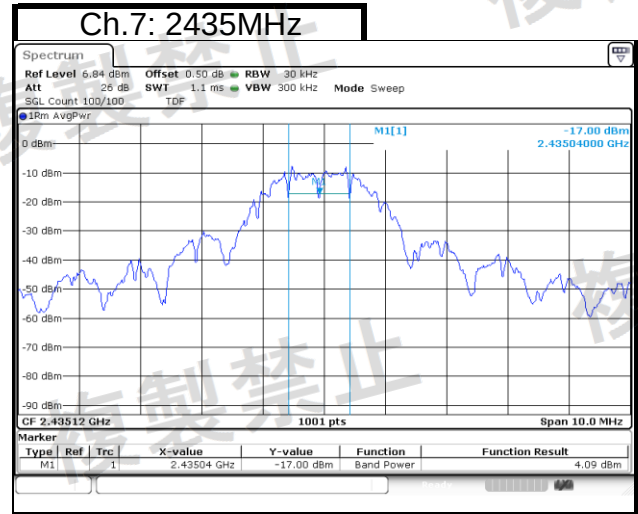
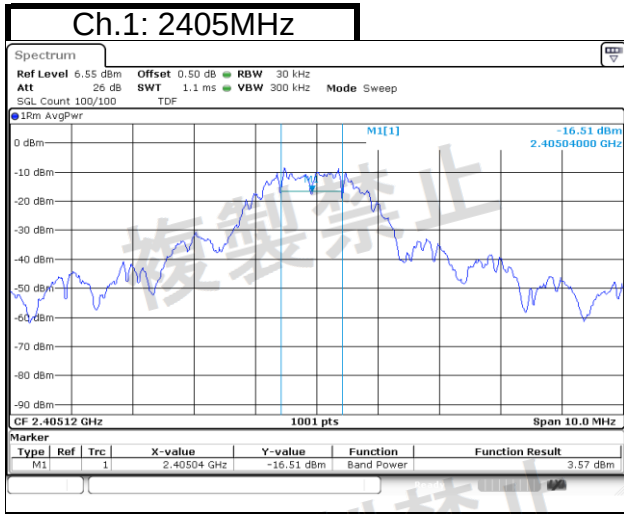
7. Test chart

7.4 RF output power tolerance (-10% voltage)



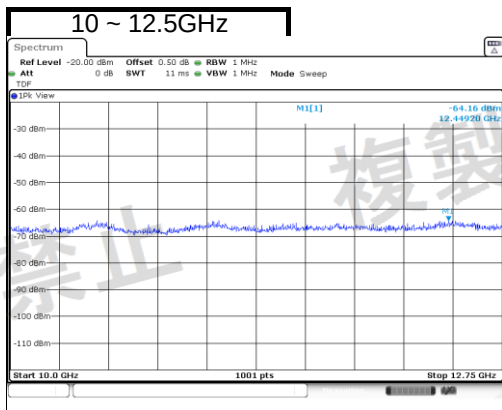
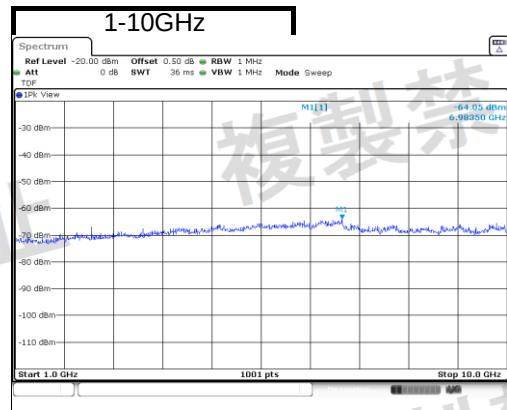
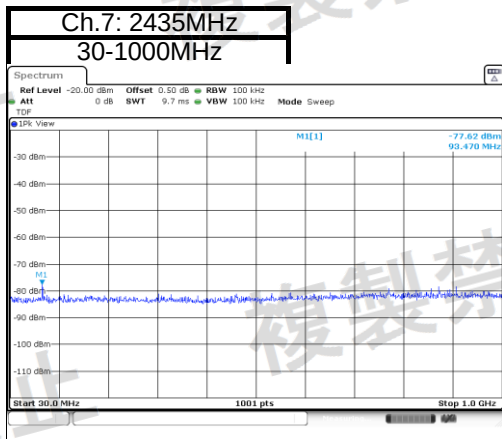
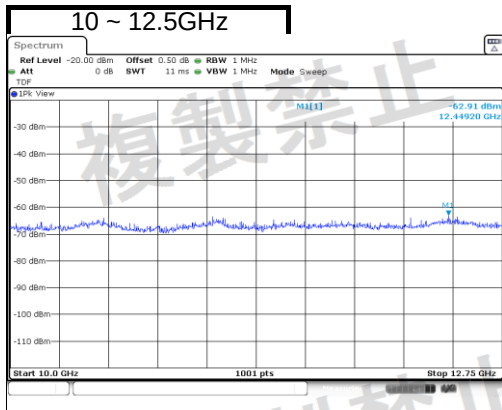
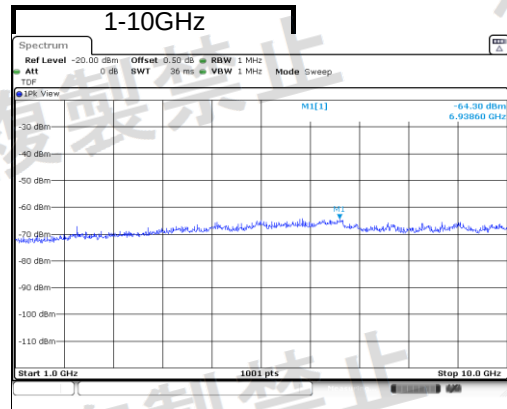
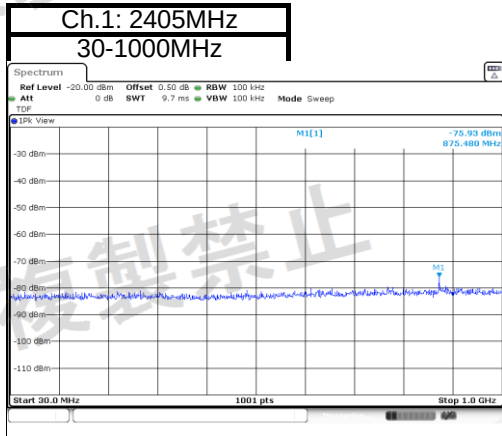
7. Test chart

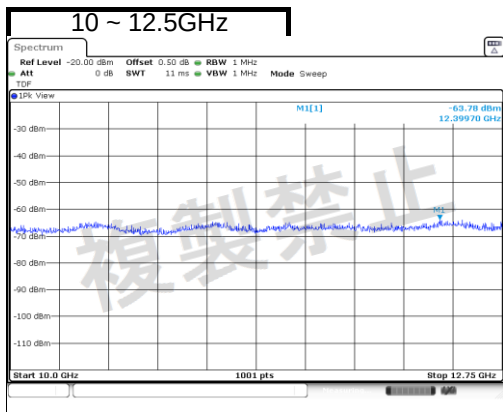
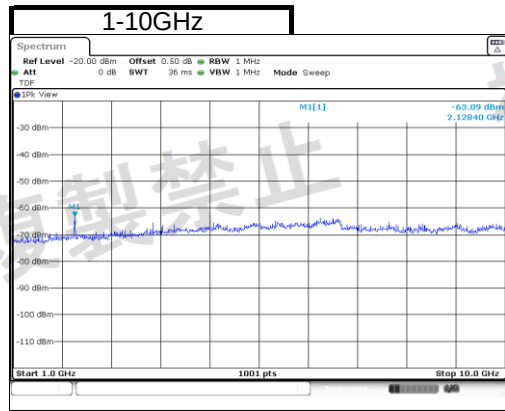
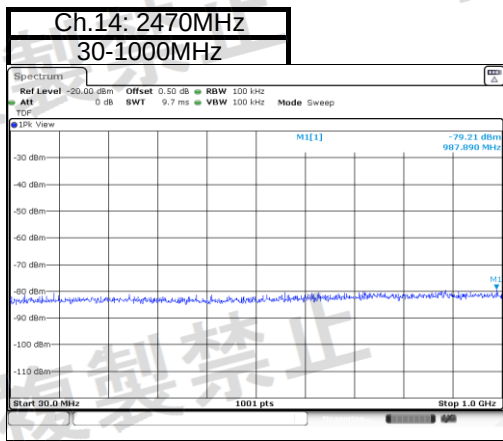
7.4 RF output power tolerance (+10% voltage)



7. Test chart

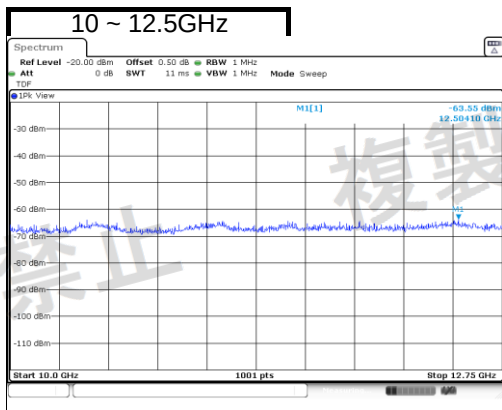
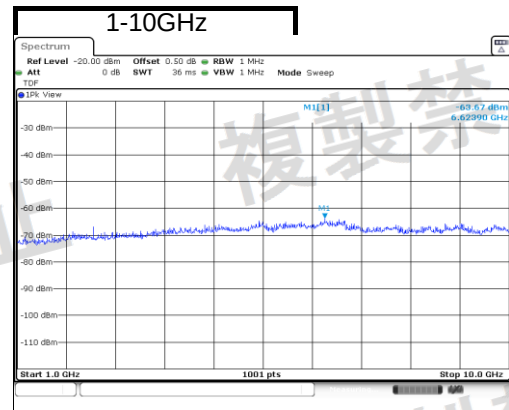
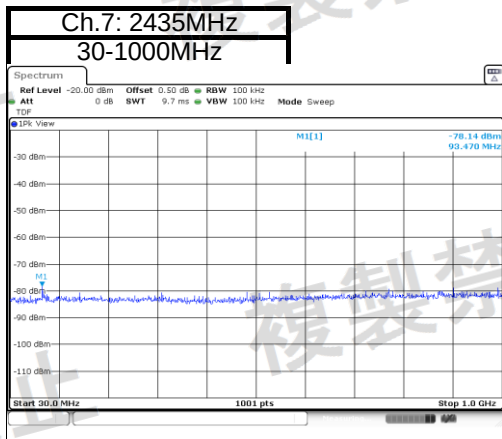
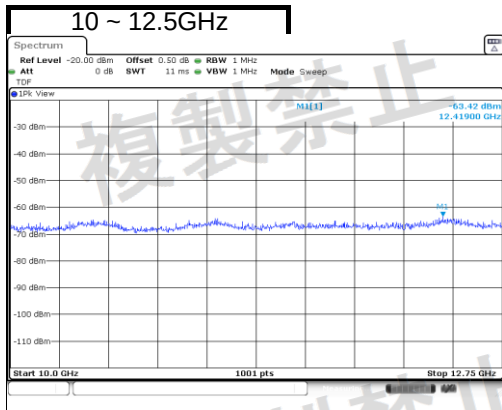
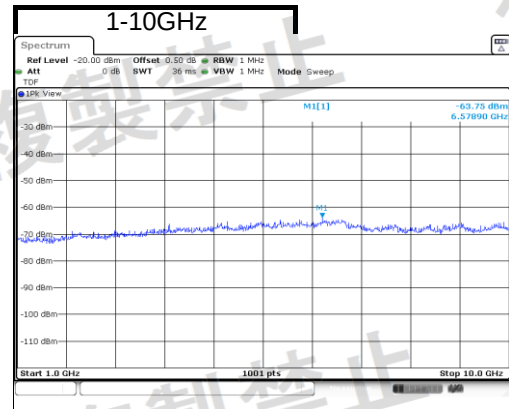
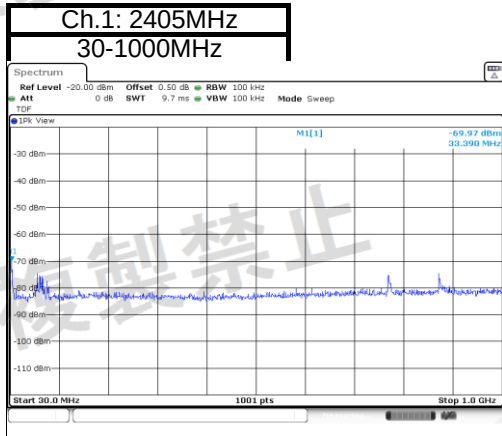
7.5 Secondary emitted radio wave strength (Rated voltage)

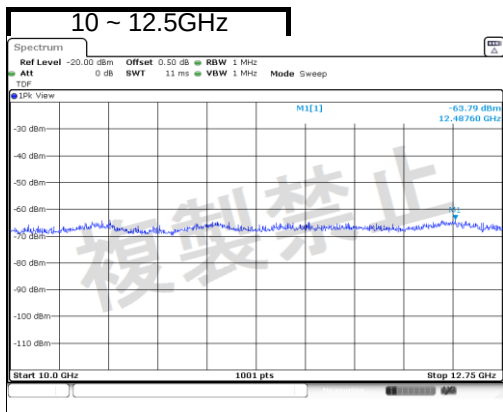
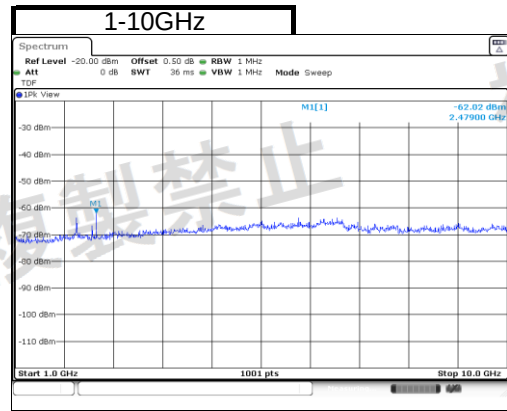
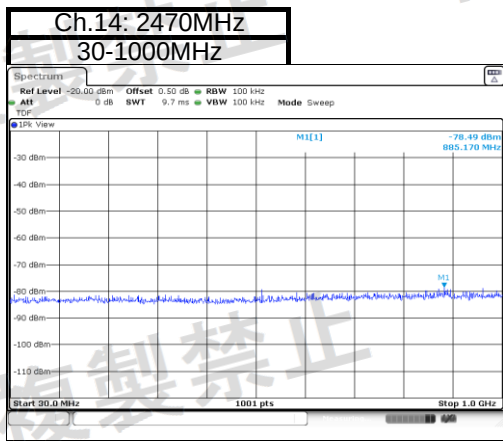




7. Test chart

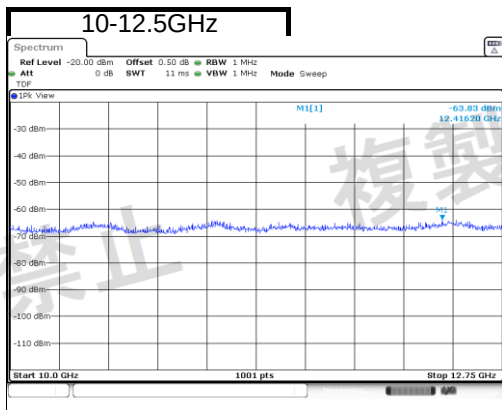
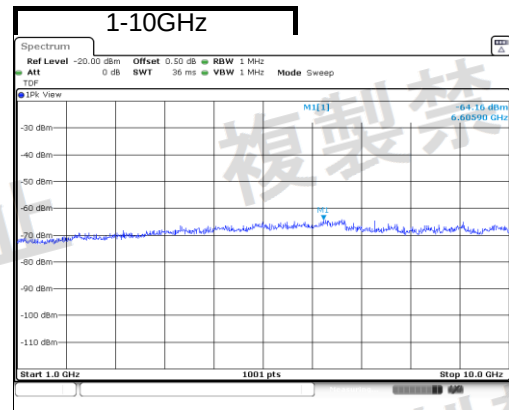
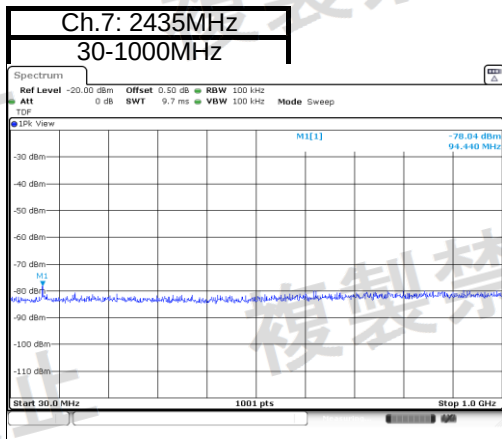
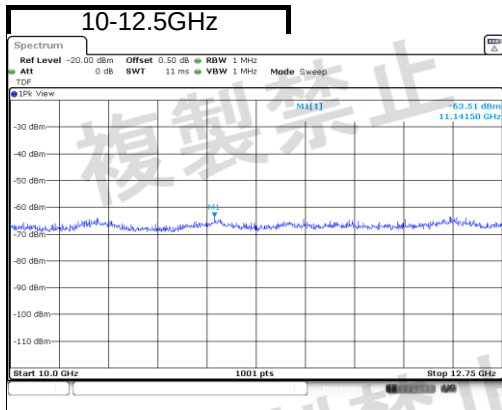
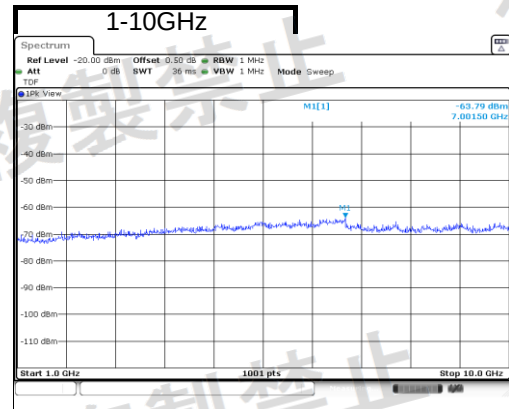
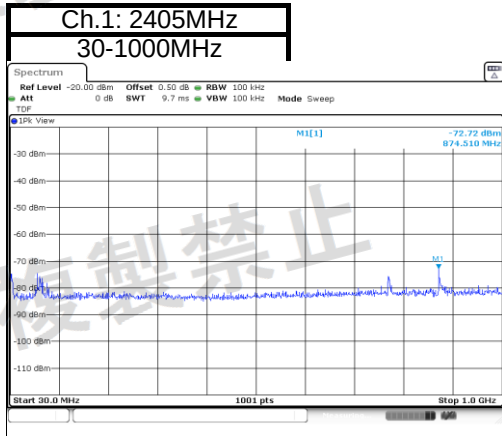
7.5 Secondary emitted radio wave strength (-10% voltage)

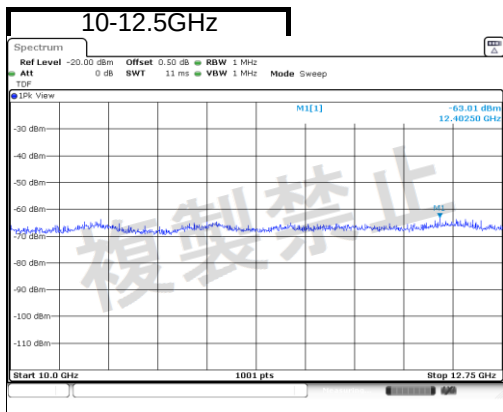
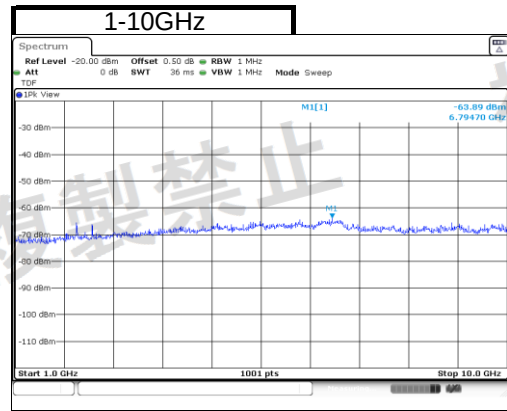
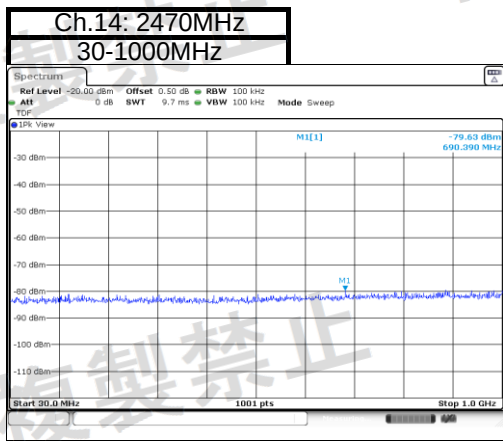




7. Test chart

7.5 Secondary emitted radio wave strength (+10% voltage)





8. Laboratory description

1. Location

Name: KCTL Inc.

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea

Telephone Number: +82 31 285 0894

Facsimile Number: +82 505 299 8311

2. Accreditation and Registration

1) FCC

Site Designation No.: KR0040

Site Registration No.: 687132

2) VCCI

Registration No.: R-3327, G-198, C-3706, T-1849

3) Industry Canada

Registration No.: 8035A

Test Site No.: 8035A-2

4) KOLAS

Registration No.: KT231