

TESTREPORT

Applicant Name : Shenzhen Ai-Thinker Technology Co., Ltd
Address : 410,BlockC,HuafengSmartInnovationPort.Gushu2ndRoad,
GushuCommunity,XixiangStreet,BaoanDistrict,Shenzhen,China
ReportNumber: SZNS2220902-39863E-RF-07A

Test Standard (s)

Japan item 19 of Article 2 Paragraph 1

Sample Description

Product Type: 2.4G Wi-Fi Bluetooth Module
Model No.: Ai-WB2-12F, Ai-WB2-12S
Date Received: 2022-09-02
Date of Test: 2022-09-08 to 2022-11-24
Report Date: 2022-11-29

Test Result:	Pass*
--------------	-------

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Roger.Ling

Roger.Ling
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*”.

Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk “*”. Customer model name, addresses, names, trademarks etc. are not considered data.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

Shenzhen Accurate Technology Co., Ltd.

1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China

Tel: +86 755-26503290

Fax: +86 755-26503396

Web: www.atc-lab.com

TABLE OF CONTENTS

GENERAL INFORMATION	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
TEST METHODOLOGY	3
EUT TEST CONFIGURATION	4
DESCRIPTION OF TEST CONFIGURATION	4
EUT EXERCISE SOFTWARE	4
TEST VOLTAGE	4
EQUIPMENT MODIFICATIONS	4
SUPPORT EQUIPMENT LIST AND DETAILS	4
EXTERNAL I/O CABLE.....	5
CONFIGURATION OF TEST SETUP	5
SUMMARY OF TEST RESULTS	6
TEST EQUIPMENT LIST	7
FREQUENCY ERROR	8
LIMIT	8
TEST PROCEDURE	8
TEST DATA	8
OCCUPIED BANDWIDTH	16
LIMIT	16
TEST PROCEDURE	16
TEST DATA	16
TRANSMITTER SPURIOUS EMISSION STRENGTH AND UNWANTED EMISSION INTENSITY	24
LIMIT	24
TEST PROCEDURE	24
TEST DATA	24
ANTENNA OUTPUT POWER AND ANTENNA POWER TOLERANCE	31
LIMIT	31
TEST PROCEDURE	31
TEST DATA	31
RECEIVER SPURIOUS EMISSION AND UNWANTED EMISSION INTENSITY	34
LIMIT	34
TEST PROCEDURE	34
MEASUREMENT RESULT	34
INTERFERENCE PREVENTION FUNCTION.....	41
CONSTRUCTION PROTECTION CONFIRMATION	42

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Equipment Name		2.4G Wi-Fi Bluetooth Module
Tested Model		Ai-WB2-12F
Multiple Model		Ai-WB2-12S
Model difference		Please refer to DOS letter
Radio Type		BLE 1M
Bluetooth Technical Parameters	Modulation Type	GFSK
	Frequency Range	2402-2480 MHz
	Output Power	3.0 mW
	Antenna Gain*	2.46dBi (provided by the applicant)
Nominal Power Supply:		DC 2.7-3.6V(typical DC 3.3V)
Sample serial number		SZNS2220902-39863E-RF-S1(assigned by ATC)
Sample/EUT Status		Good condition

Note: the series model Ai-WB2-12F and Ai-WB2-12S have same circuit and antenna design, the difference is Ai-WB2-12S PCBA deleted 6 pin pads, as the 6 pin was used for control flash component but the module's flash are inside, the extra 6 pins are unavailable which was confirmed by manufacturer. The output power was tested use both the two models and verified they have same setting, so other items was only test on model Ai-WB2-12F.

Objective

The objective of the manufacturer is to demonstrate compliance with Radio Law of Japan item 19 of Article 2 Paragraph 1, rules and limits for this device including:

- Frequency Error
- Occupied Bandwidth
- Transmitter Spurious Emission and Unwanted Emission Intensity
- Antenna Output Power And Output Power Tolerance
- Receiver Spurious Emission Strength
- Interference Prevention Function
- Construction Protection Confirmation

Test Methodology

All measurements contained in this report were conducted with technical regulations of the Radio Law of Japan.

EUT TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

40 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
...
...
...
18	2438	38	2478
19	2440	39	2480

EUT was tested with channel 0, 19 and 39.

EUT Exercise Software

“BouffaloLabDevCube” exercise software was made to the EUT tested and the power level was 4*. The software and power level was provided by the applicant.

Test Voltage

Test voltage:

The extreme voltage test conditions which were declared by the manufacturer and the normal conditions are as below:

NV: Normal Voltage DC 3.3V

LV: Low Voltage DC 2.7V

HV: High Voltage DC 3.6V

Equipment Modifications

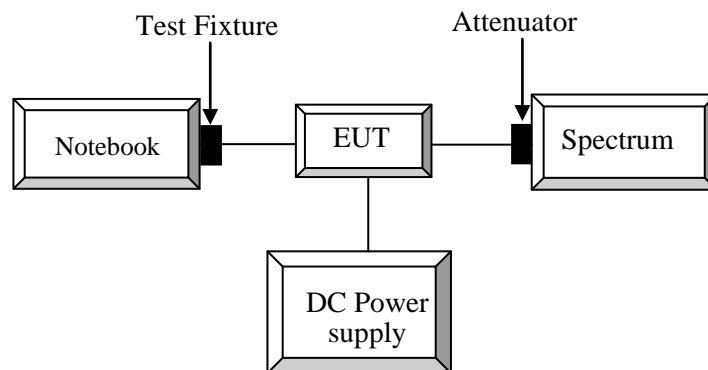
No modification was made to the EUT tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Unknown	Test Fixture	Unknown	Unknown
LENOVO	Notebook	ThinkPad x240	SL10F31638JS
UNI-T	DC Power Supply	UTP8305B	10584

External I/O Cable

Cable Description	Length (m)	From/Port	To
Data Cable	0.1	Test Fixture	EUT
Power cable	1.0	DC Power Supply	EUT

Configuration of Test Setup

SUMMARY OF TEST RESULTS

MIC Notice No.88 Appendix No.43 Article 2, Paragraph 1, Item 19 Rules Section	Description of Test	Result
3	Frequency Error	Compliant
4	Occupied Bandwidth	Compliant
5	Transmitter Spurious Emission and Unwanted Emission Intensity	Compliant
6	Antenna Output Power and Out- put Power Tolerance	Compliant
7	Receiver Spurious Emission and Unwanted Emission Intensity	Compliant
8 & 9	Carrier sense capability	Not Applicable**
10	Transmission Antenna Gain	Not Applicable
11	Transmission Radiation Angle Width	Not Applicable
12	Interference Prevention Function	Compliant
13	Frequency Hopping Dwell Time	Not Applicable*
Note 1	Construction Protection Confir- mation	Compliant

Not Applicable* -Testing is only required for FHSS system devices.

Not Applicable**-The OBW of EUT is less than 26 MHz and the EUT is not radio control model aircraft.

Not Applicable - This test item was not required for the output power less than 12.14 dBm (E.I.R.P)

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date	Calibration Authority	Calibration Method
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101948	2021/12/13	2022/12/12	CCIC	C
Rohde & Schwarz	Wideband Radio Communication Tester	CMW-500	154606	2021/12/13	2022/12/12	CCIC	C
Rohde & Schwarz	Open Switch and Control Unit	OSP120 + OSP-B157	101244 + 100866	2021/12/13	2022/12/12	CCIC	C
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13	BACL	C
Fluke	Multi Meter	45	7664009	2021/12/14	2022/12/13	BACL	C
UNI-T	DC Power Supply	UTP8305B	10584	NCR	NCR	/	/

* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Note

- 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)
- B. Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992)
- 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)
- D. Calibration conducted by using measuring instruments and other equipment which shall have been given any of calibration, etc. listed above from A to C.

FREQUENCY ERROR

Limit

50ppm or below

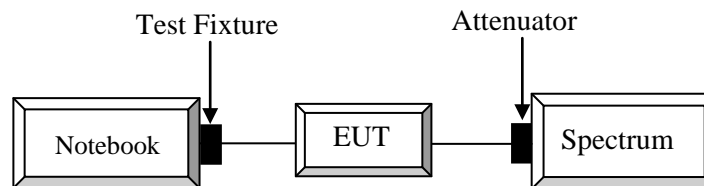
Test Procedure

Set the EUT to the measurement frequency without modulation.
Setting of SA is following as:

- Center Frequency: Frequency to measure
- RBW: 10kHz, VBW: 10kHz
- Span: 1 MHz
- Sweep time: Auto
- Log scale: 10dB/Div, Data points: 400 points or more
- Reference level: Enough level for maximum dynamic range
- Detection: Positive Peak
- Sweep mode: Single Sweep
- Marker: Spot

Record the peak spot frequency.

If the EUT can't set at un-modulation mode, measure the 10dBc center frequency.



Test Data

Environmental Conditions

Temperature:	24°C
RelativeHumidity:	49%
ATM Pressure:	101.0kPa

The testing was performed by Glenn.jiang on 2022-10-27.

Test Result: Compliant

Test Mode: Transmitting

Normal Voltage

Frequency (MHz)	Measure frequency (MHz)	Frequency tolerance (ppm)	Limit (ppm)
2402	2401.997	-1.25	< 50
2440	2439.997	-1.23	
2480	2479.997	-1.21	

Low Voltage

Frequency (MHz)	Measure frequency (MHz)	Frequency tolerance (ppm)	Limit (ppm)
2402	2401.997	-1.25	< 50
2440	2439.997	-1.23	
2480	2479.997	-1.21	

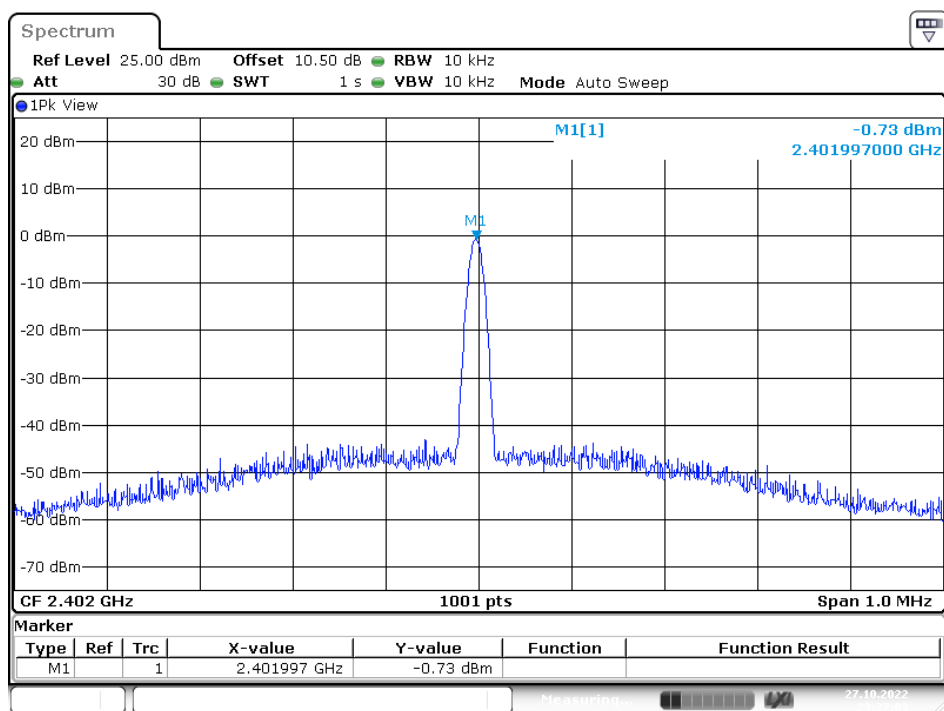
High Voltage

Frequency (MHz)	Measure frequency (MHz)	Frequency tolerance (ppm)	Limit (ppm)
2402	2401.997	-1.25	< 50
2440	2439.997	-1.23	
2480	2479.997	-1.21	

Please refer to the plots as below.

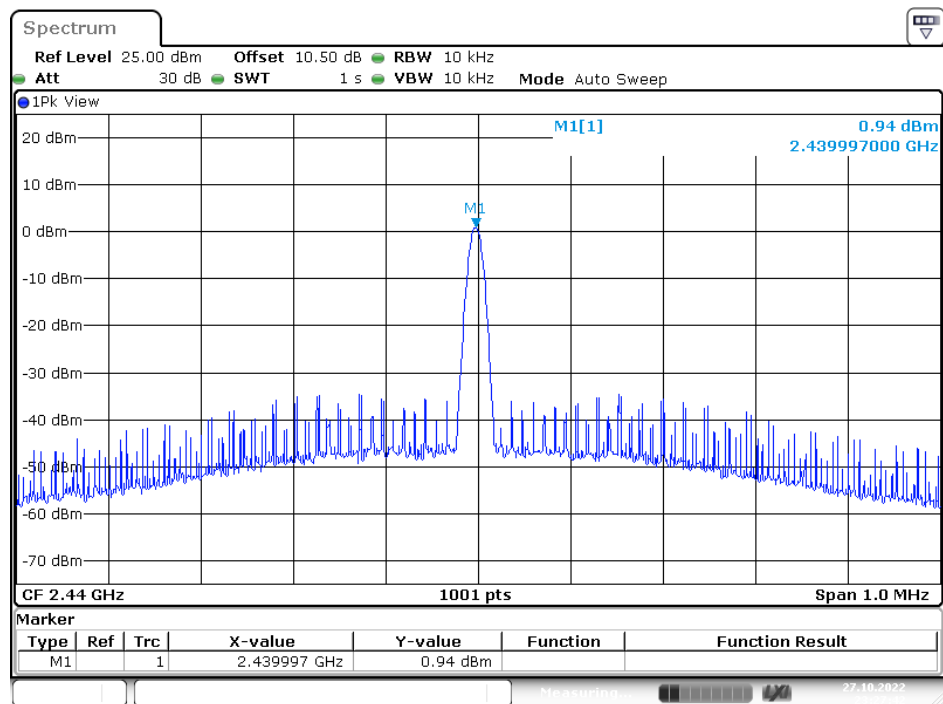
Normal Voltage

Low Channel



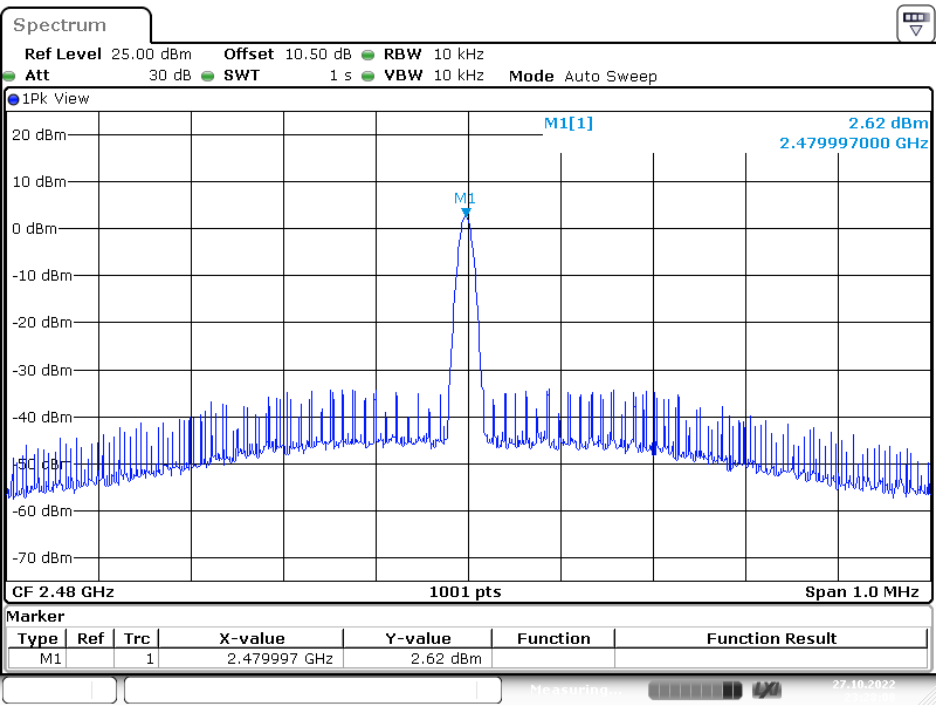
Date: 27.OCT.2022 23:27:04

Middle Channel



Date: 27.OCT.2022 23:27:43

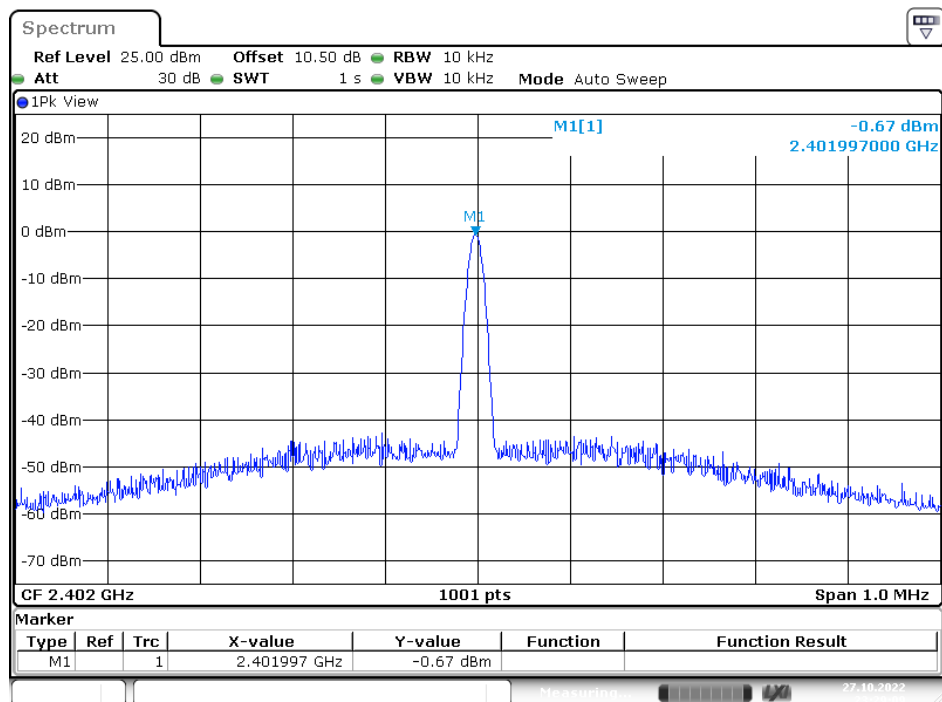
High Channel



Date: 27.OCT.2022 23:28:08

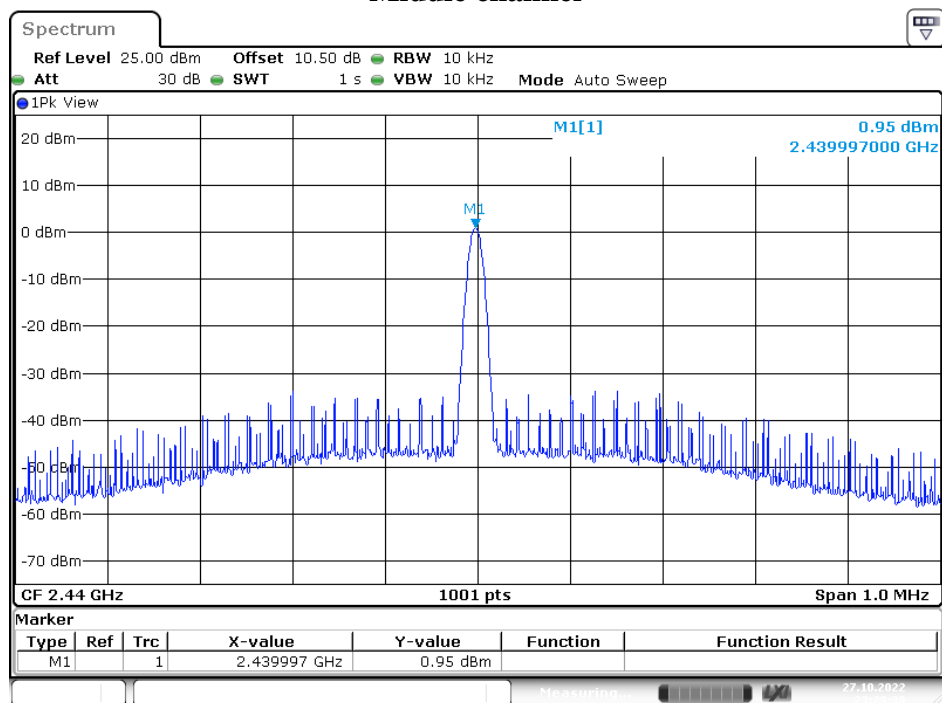
Low Voltage

Low Channel



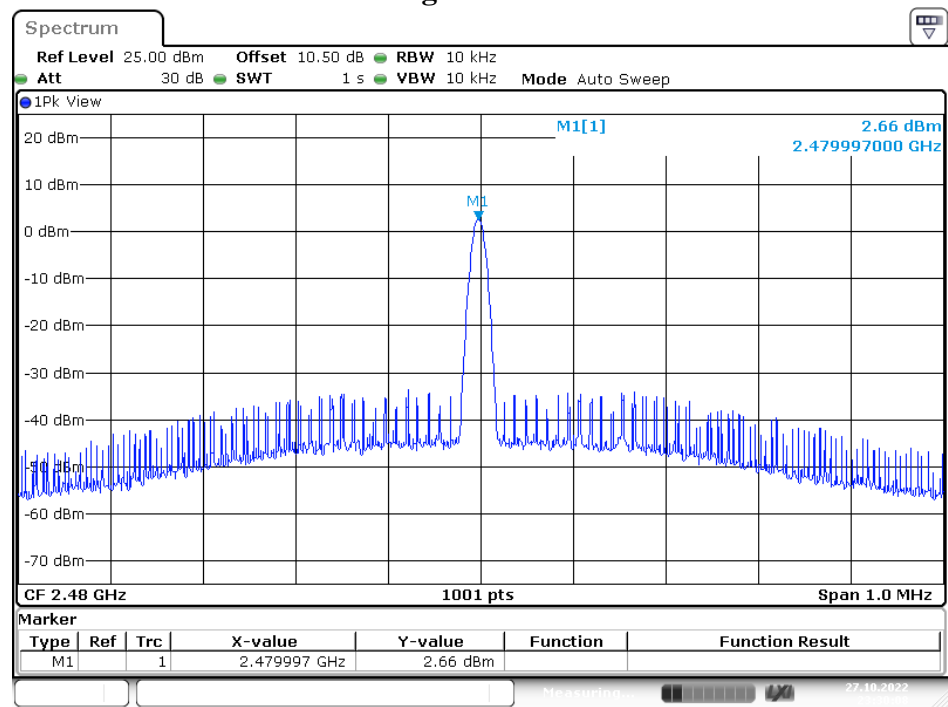
Date: 27.OCT.2022 23:29:10

Middle channel



Date: 27.OCT.2022 23:29:39

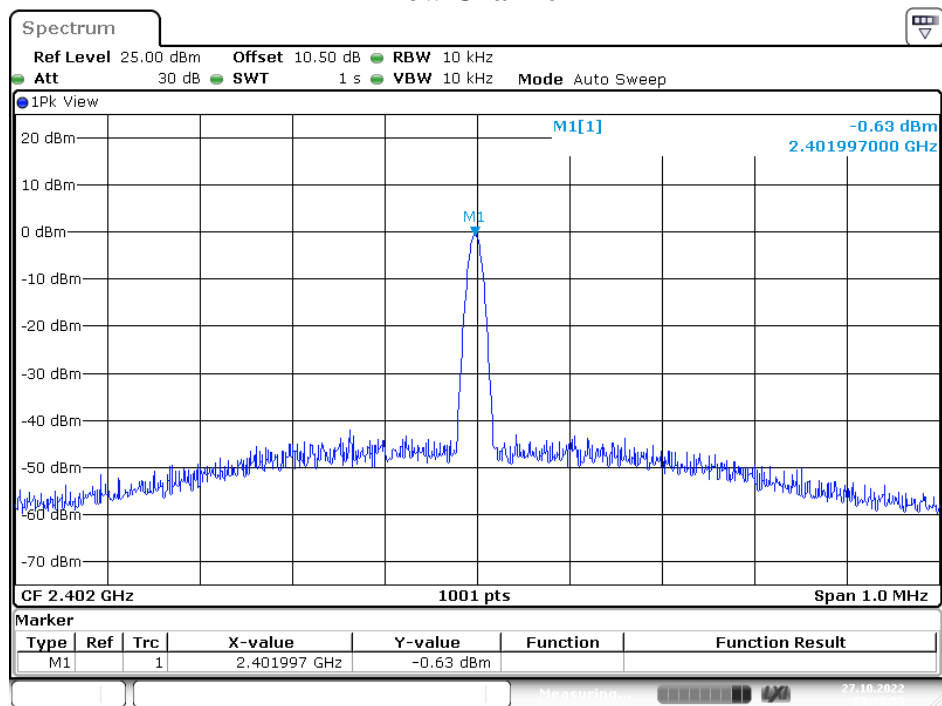
High channel



Date: 27.OCT.2022 23:30:08

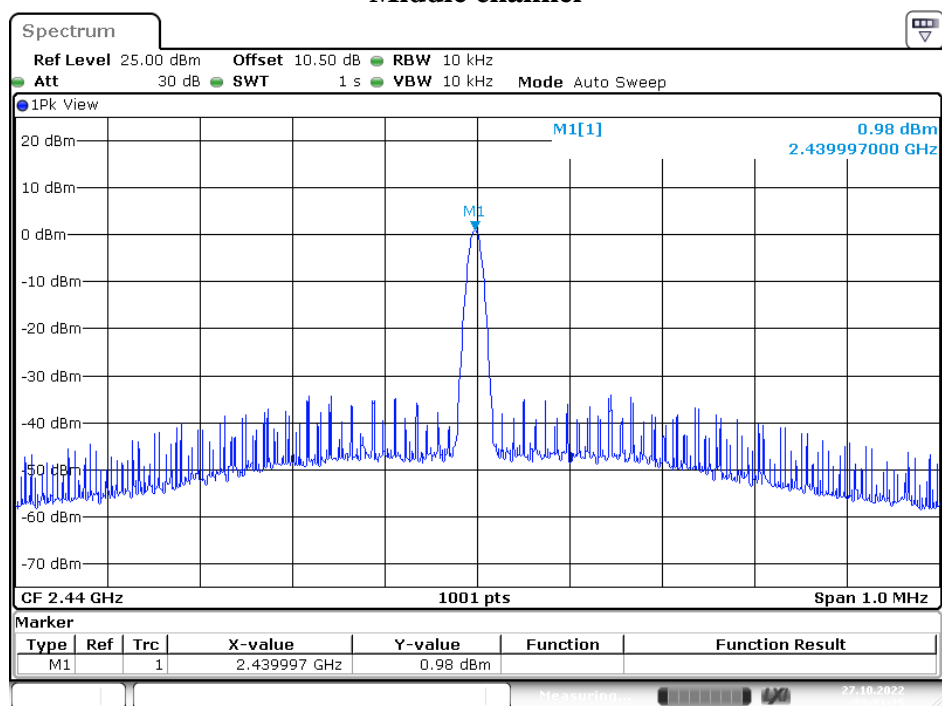
High Voltage

Low Channel



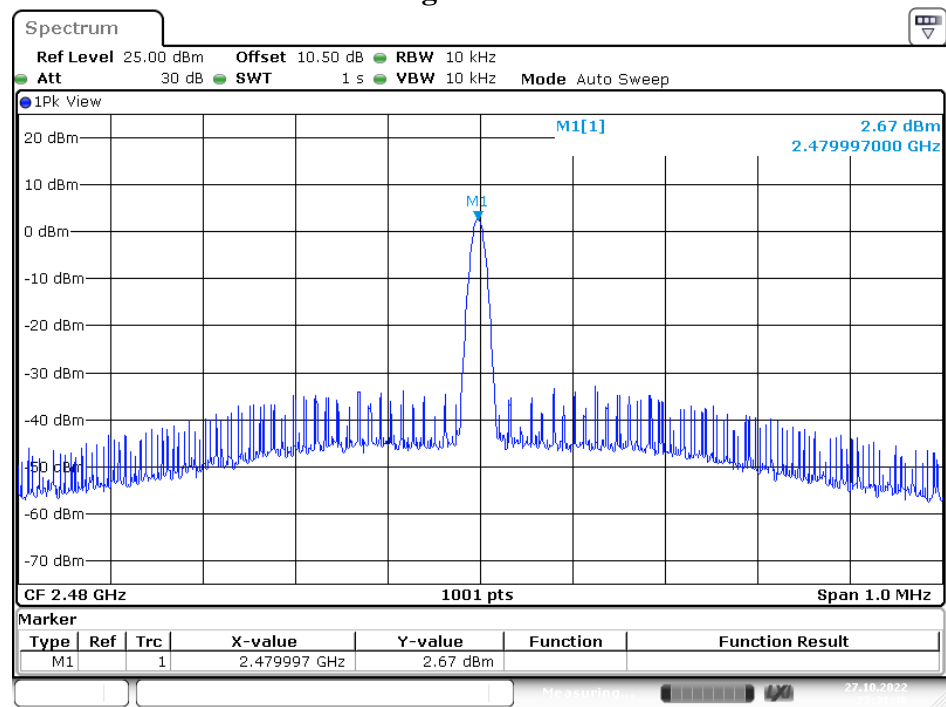
Date: 27.OCT.2022 23:31:00

Middle channel



Date: 27.OCT.2022 23:31:25

High channel



Date: 27.OCT.2022 23:31:47

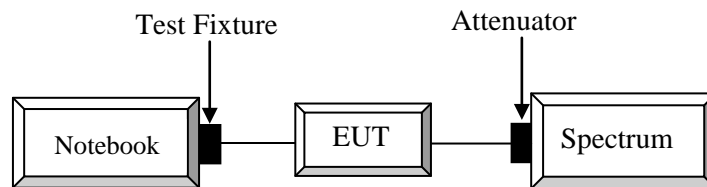
OCCUPIED BANDWIDTH

Limit

- Occupied bandwidth: FH \leq 83.5 MHz; OFDM, DS \leq 26 MHz; Others \leq 26 MHz

Test Procedure

- Setting of SA is following as:
 - Center Frequency: Frequency to measure
 - RBW: 30 kHz, VBW: 30kHz
 - Span: 5MHz
 - Sweep time: Auto
 - Log scale: 10dB/Div, Data points: 400 points or more
 - Reference level: Enough level for maximum dynamic range
 - Detection: Positive Peak
 - Sweep mode: Continuous Sweep
 - Marker: Spot
- EUT have transmitted the maximum modulation signal and fixed channelize. SA set to 99% of occupied bandwidth to measure occupied bandwidth.



Test Data

Environmental Conditions

Temperature:	24°C
RelativeHumidity:	49%
ATM Pressure:	101.0kPa

The testing was performed by Glenn.jiang from 2022-09-08 to 2022-10-28.

Test Result: Compliant

Test Mode: Transmitting

Normal Voltage

Mode	2402 MHz	2440 MHz	2480MHz	Limit
BLE 1M	1.025	1.025	1.025	$\leq 26\text{MHz}$

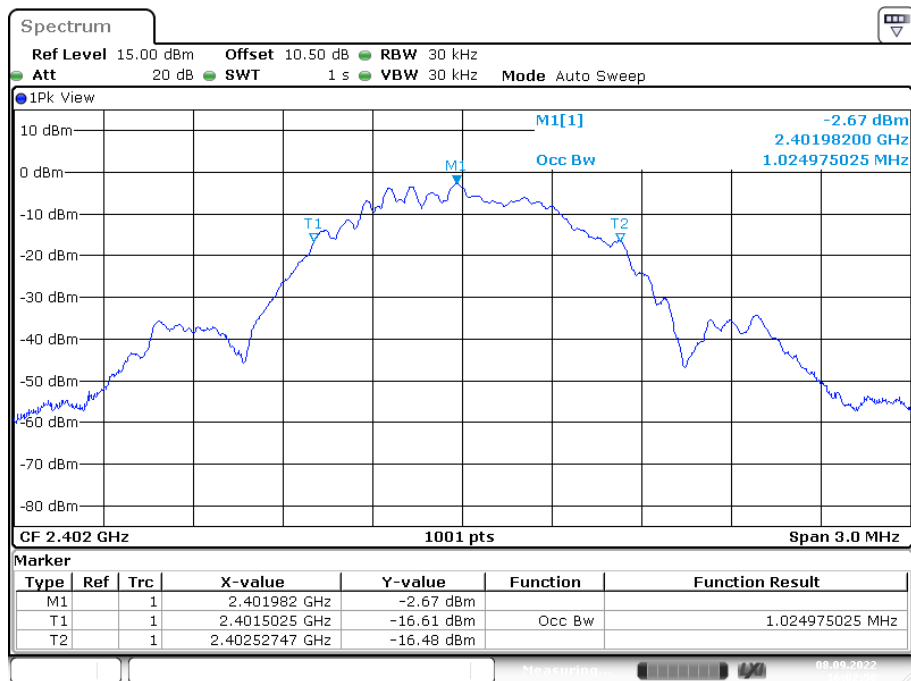
Low Voltage

Mode	2402 MHz	2440 MHz	2480MHz	Limit
BLE 1M	1.025	1.025	1.025	$\leq 26\text{MHz}$

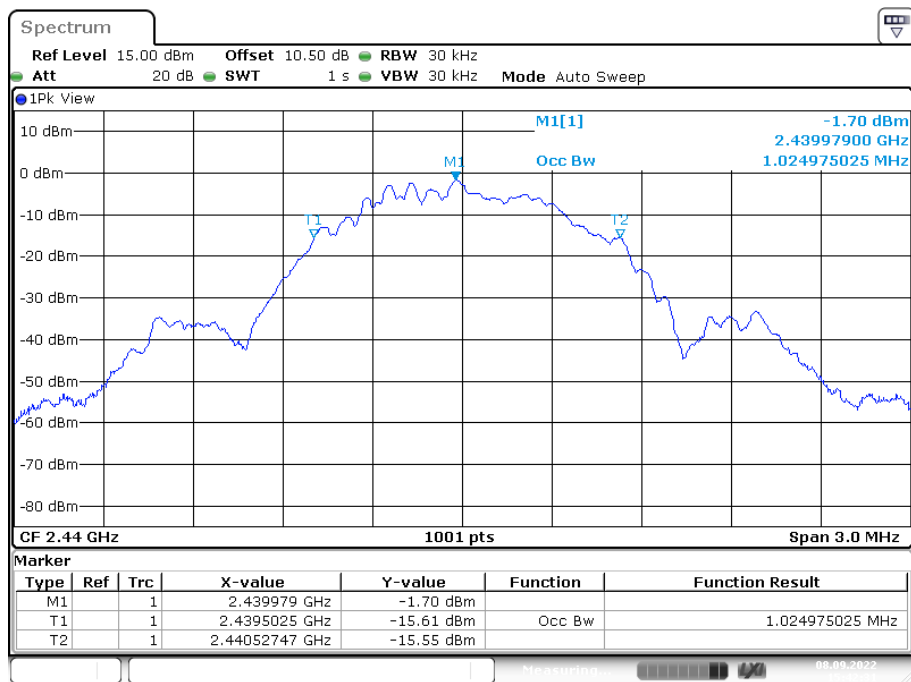
High Voltage

Mode	2402 MHz	2440 MHz	2480MHz	Limit
BLE 1M	1.025	1.025	1.022	$\leq 26\text{MHz}$

Please refer to the plots as below.

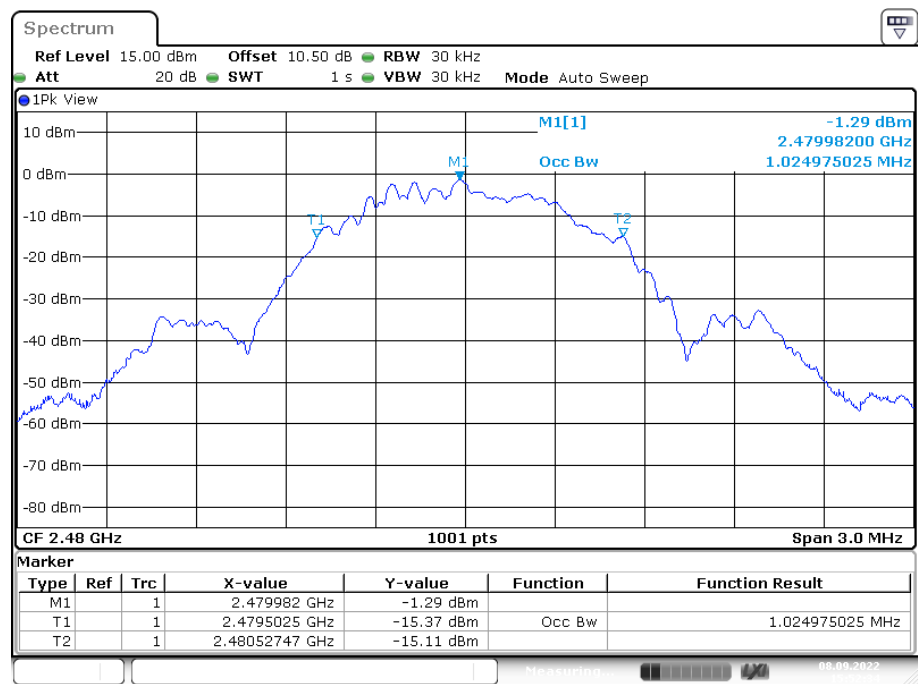
**Occupied Bandwidth:
Normal Voltage****Low Channel**

Date: 8.SEP.2022 16:02:50

Middle Channel

Date: 8.SEP.2022 15:42:31

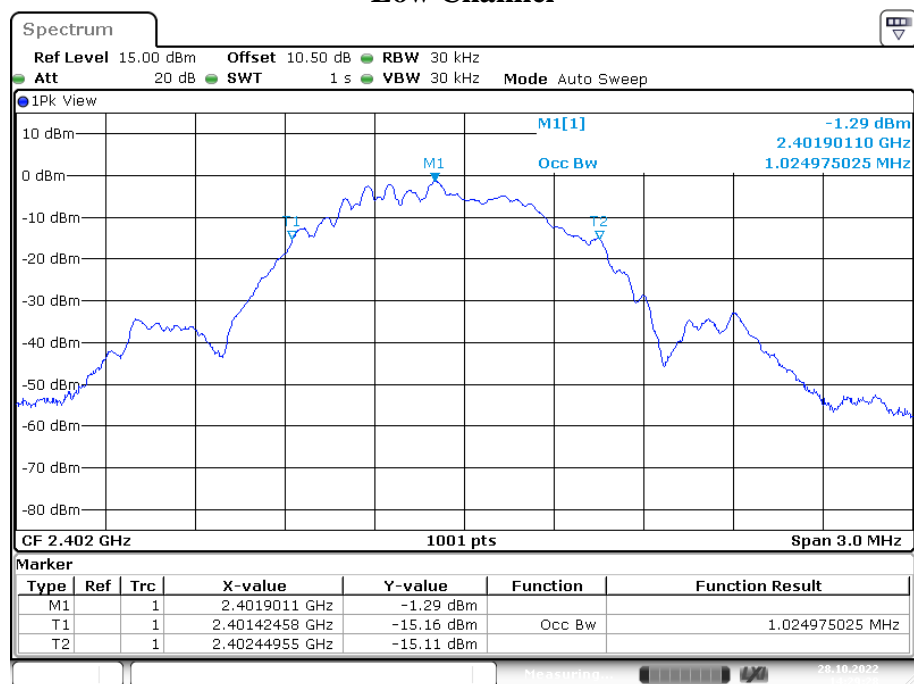
High Channel



Date: 8.SEP.2022 15:52:34

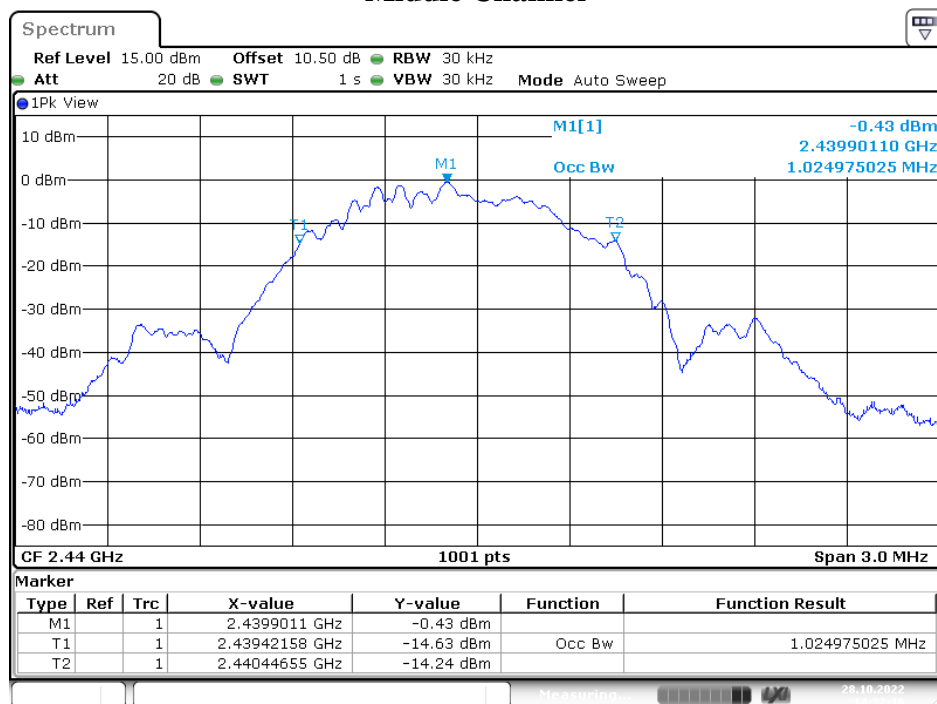
Low Voltage

Low Channel



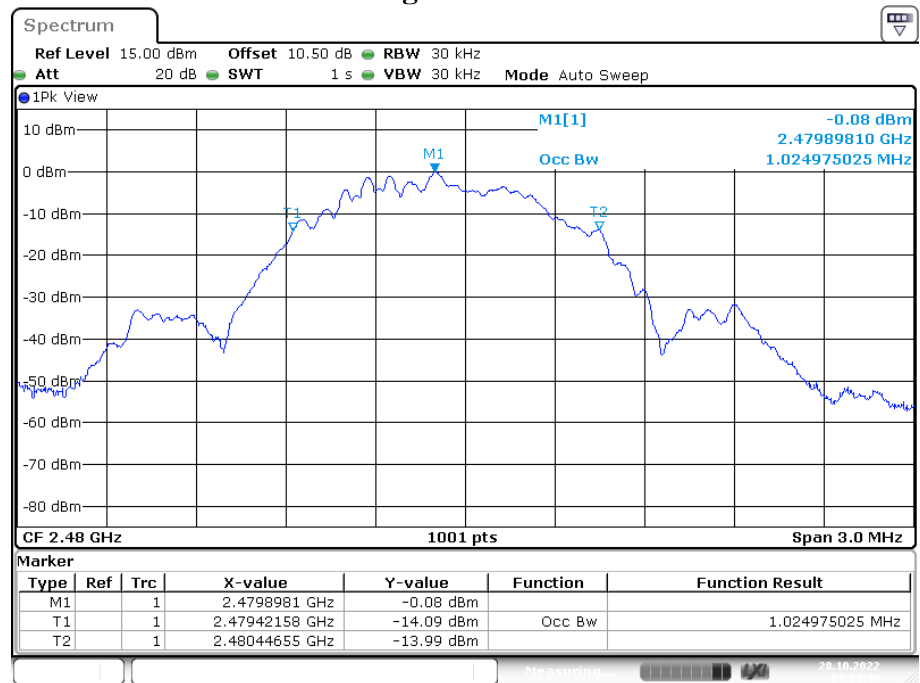
Date: 28.OCT.2022 14:29:28

Middle Channel



Date: 28.OCT.2022 14:32:16

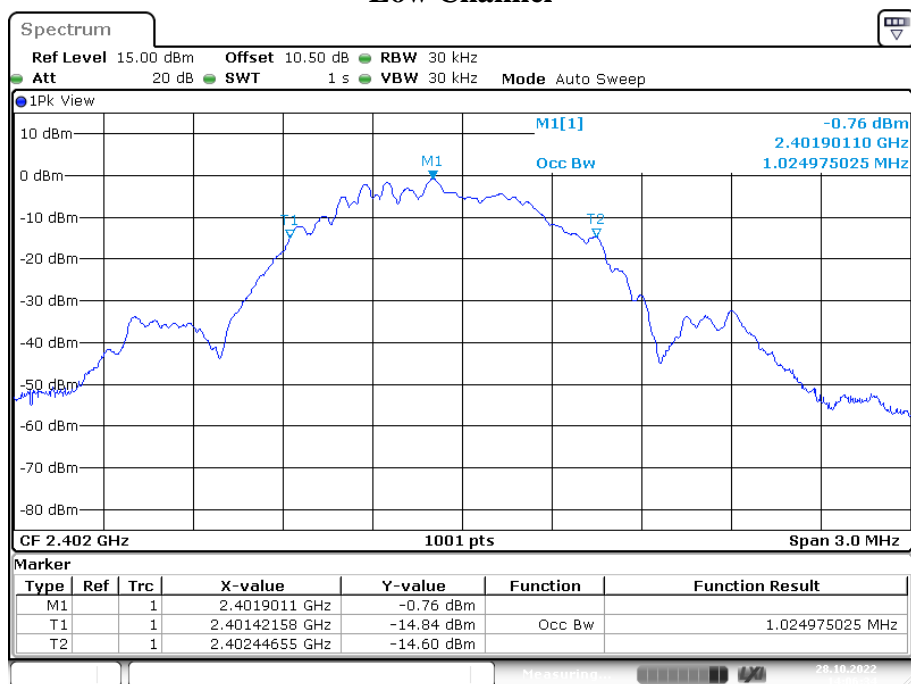
High Channel



Date: 28.OCT.2022 14:34:44

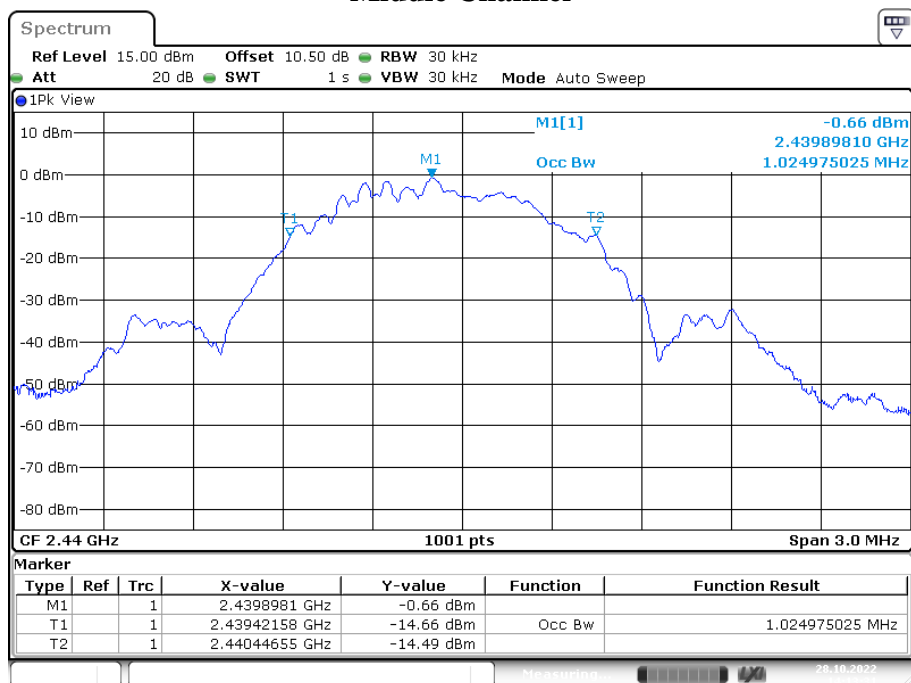
High Voltage

Low Channel



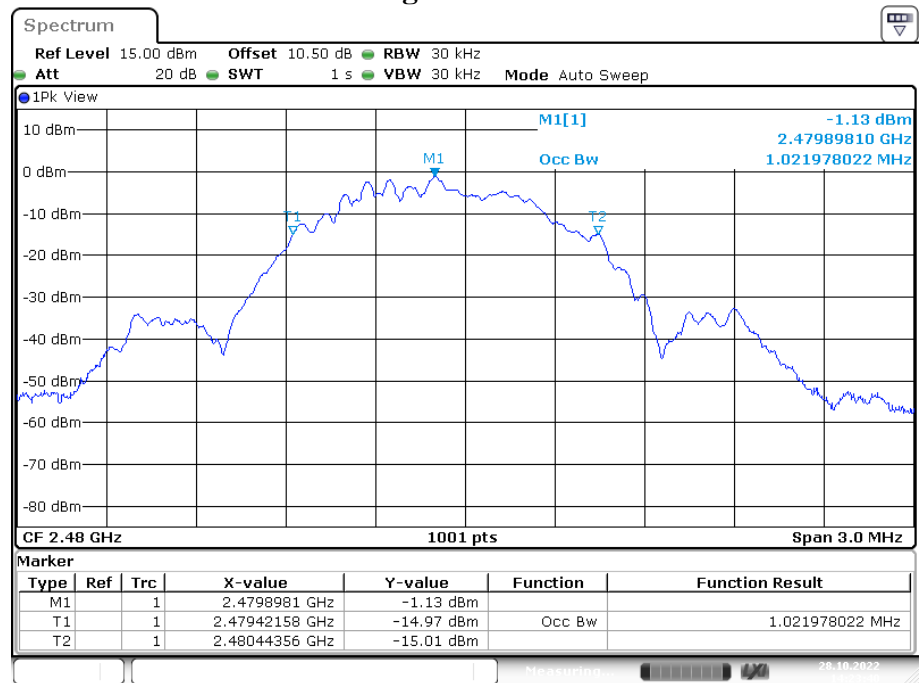
Date: 28.OCT.2022 14:06:35

Middle Channel



Date: 28.OCT.2022 14:13:31

High Channel



Date: 28.OCT.2022 14:23:40

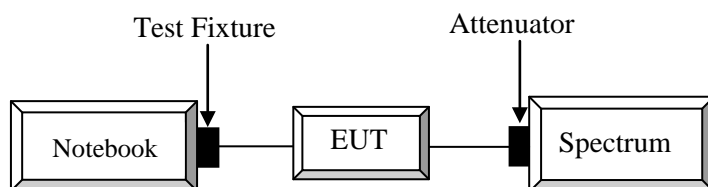
TRANSMITTER SPURIOUS EMISSION STRENGTH AND UNWANTED EMISSION INTENSITY

Limit

- $f < 2387 \text{ MHz}, f > 2496.5 \text{ MHz}: \leq 2.5 \mu\text{W}/\text{MHz}$
- $2387 \text{ MHz} \leq f \leq 2400 \text{ MHz}; 2483.5 \text{ MHz} < f \leq 2496.5 \text{ MHz}: \leq 25 \mu\text{W}/\text{MHz}$

Test Procedure

Measurement System Diagram



Conditions of Application Equipment (EUT)

- The modulation state shall be in continuously transmitting mode.

Spectrum Analyzer Conditions

- Span: Measuring Frequency Range
- RBW: 1MHz (frequency range; 1GHz over), 100kHz (frequency range; 30MHz to 1GHz)
- VBW: Same as RBW (1MHz or 100kHz)
- Sweep time: Auto (Minimum time to ensure measurement accuracy.)
- Data points : 400 points or more
- Reference level: Enough level for maximum dynamic range
- Detection: Positive Peak

If the measured value is under the technical standard value, do not need to measure more detail.

Test Data

Environmental Conditions

Temperature:	24°C
Relative Humidity:	49%
ATM Pressure:	101.0kPa

The testing was performed by Glenn.jiang from 2022-09-08 to 2022-10-28.

Test Result: Compliant

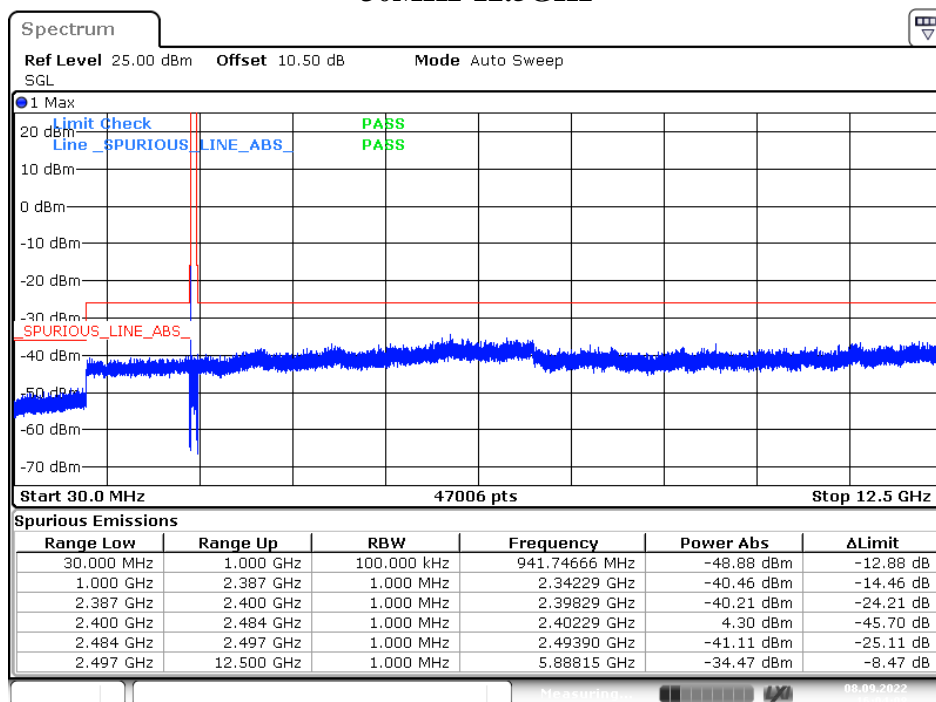
Please refer to the below plots and table.

Test Mode: Transmitting

Normal Voltage

Low Channel:

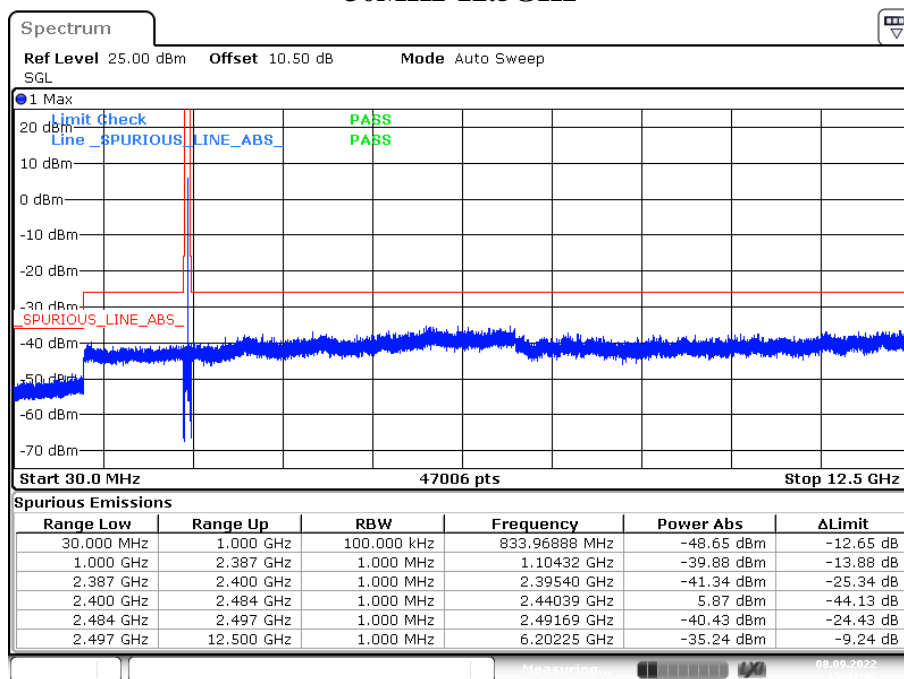
30MHz-12.5GHz



Date: 8.SEP.2022 16:04:08

Middle Channel:

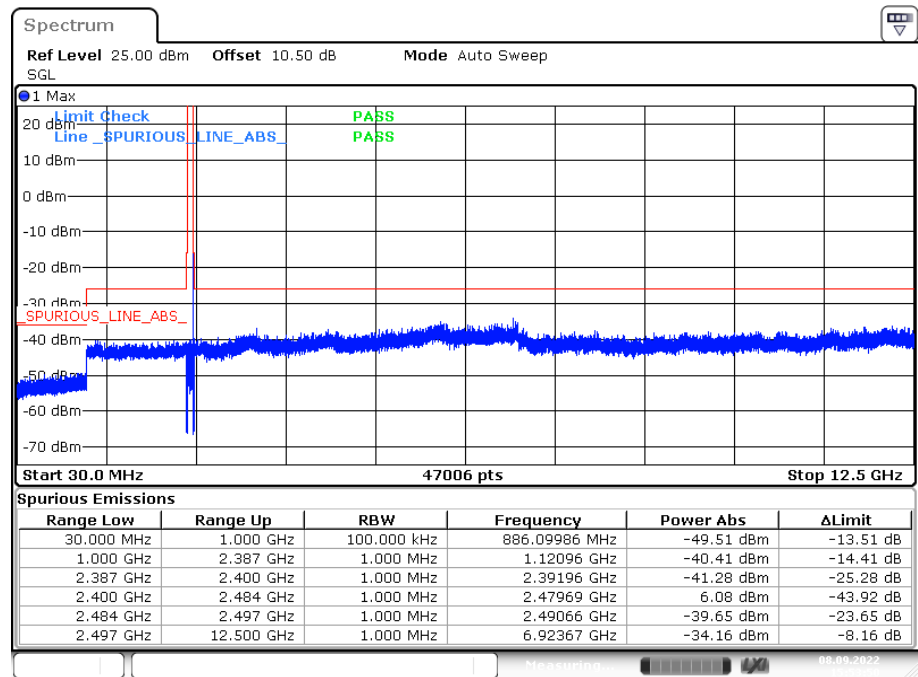
30MHz-12.5GHz



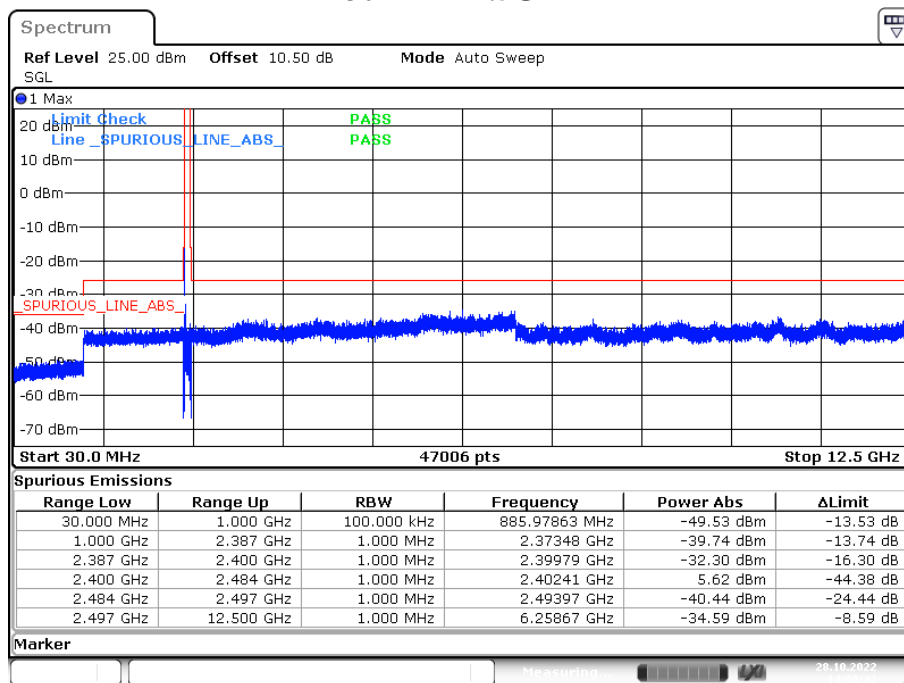
Date: 8.SEP.2022 15:43:47

High Channel:

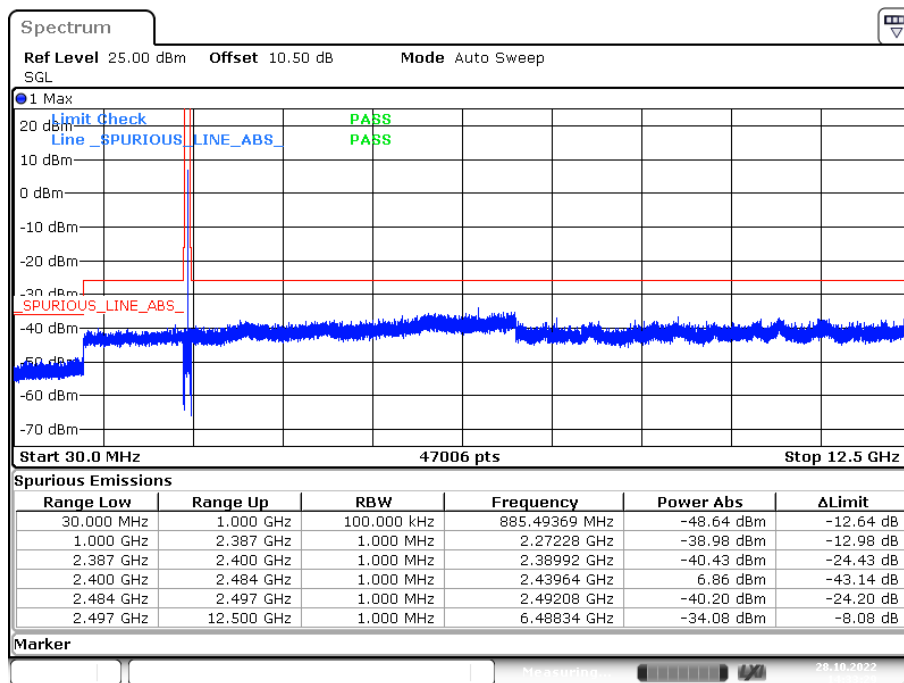
30MHz-12.5GHz



Date: 8.SEP.2022 15:53:50

Low Voltage**Low Channel:****30MHz-12.5GHz**

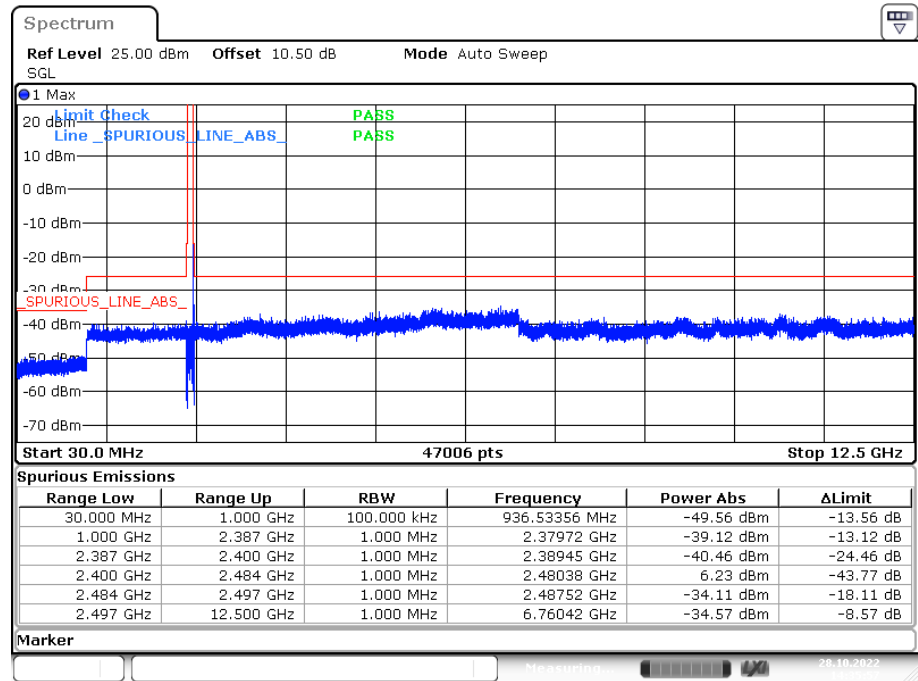
Date: 28.OCT.2022 14:30:42

Middle Channel:**30MHz-12.5GHz**

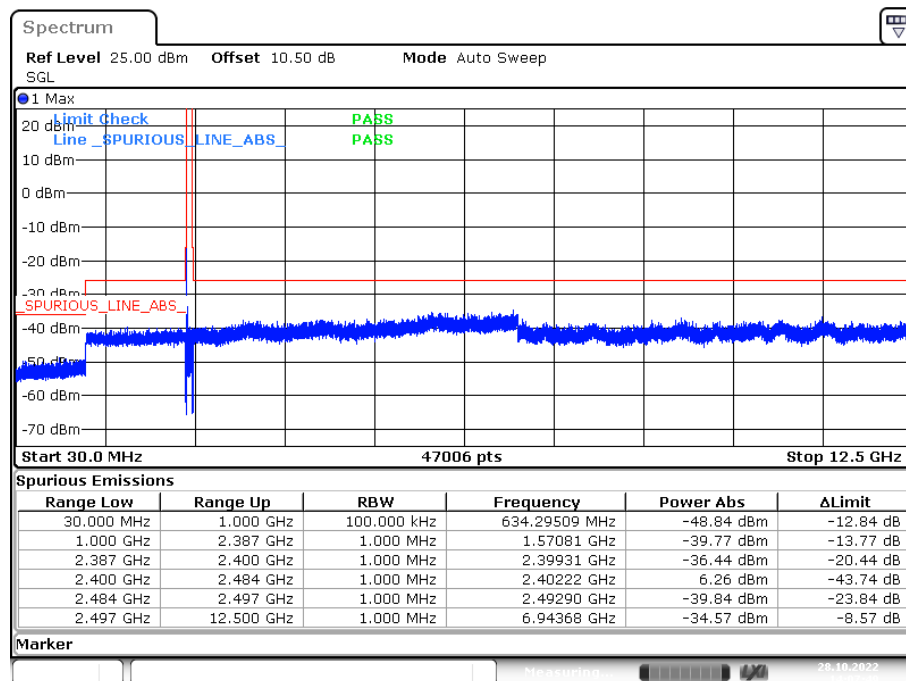
Date: 28.OCT.2022 14:33:29

High Channel:

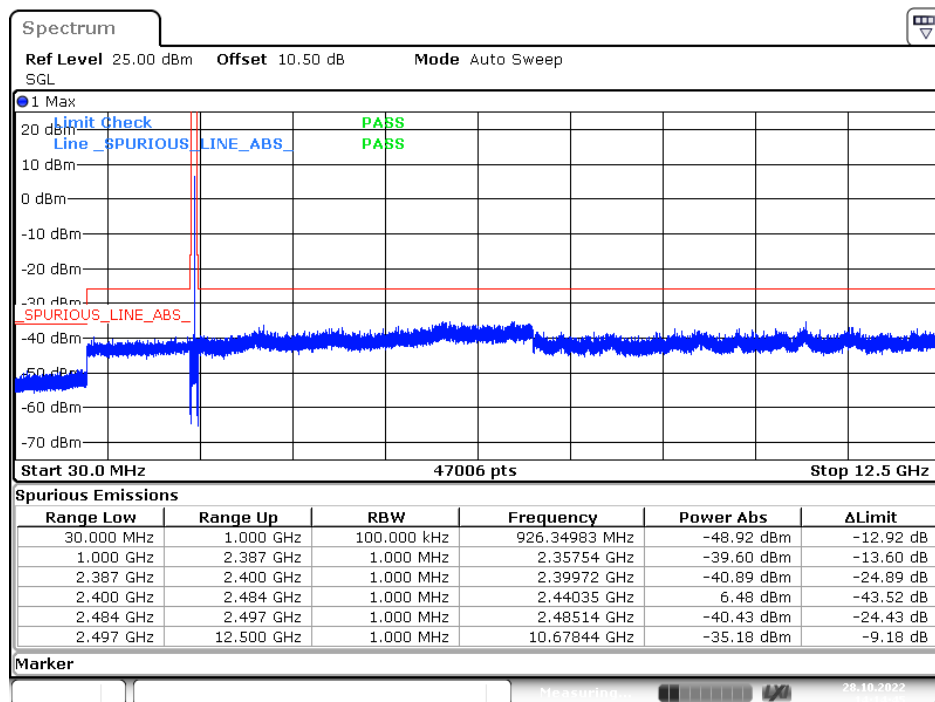
30MHz-12.5GHz



Date: 28.OCT.2022 14:35:57

High Voltage**Low Channel:****30MHz-12.5GHz**

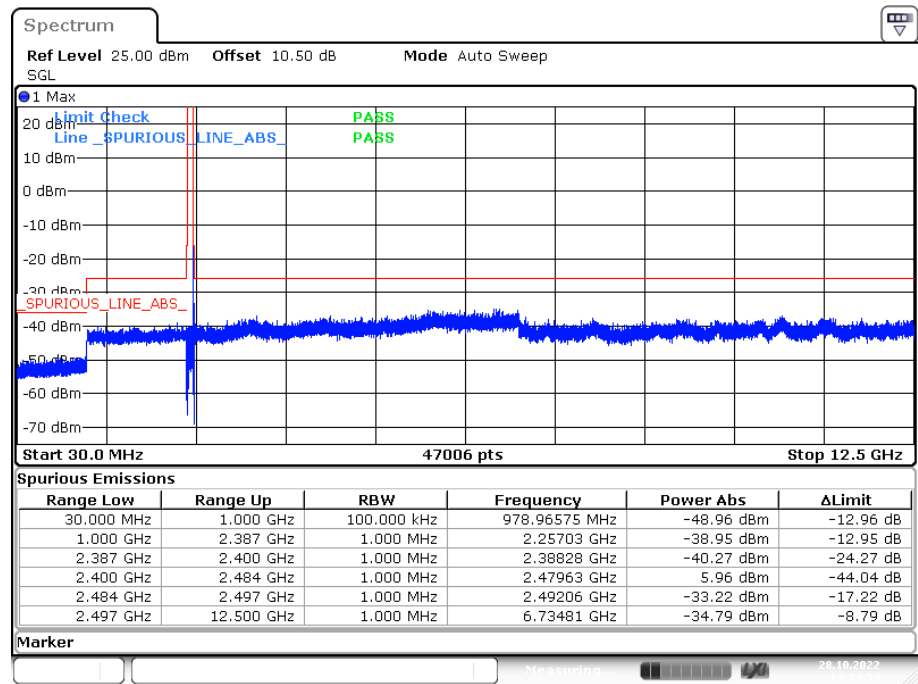
Date: 28.OCT.2022 14:07:50

Middle Channel:**30MHz-12.5GHz**

Date: 28.OCT.2022 14:14:45

High Channel:

30MHz-12.5GHz



Date: 28.OCT.2022 14:24:54

ANTENNA OUTPUT POWER AND ANTENNA POWER TOLERANCE

Limit

- $\leq 3 \text{ mW /MHz}$ (FHSS from 2402-2480 MHz)
- $\leq 10 \text{ mW/MHz}$ (OFDM, DSSS from 2400-2483.5 MHz)
- $\leq 10 \text{ mW}$ (other from 2400-2483.5 MHz)

The Output Power Tolerance must be within +20%, -80%.

Test Procedure

Step 1: Measure the total power by Power Meter in a state of hopping mode or non-hopping mode (with Average Sensor)

Step 2: If it's the burst wave, please measure the burst ratio. Then calculate the real total power by burst ratio.

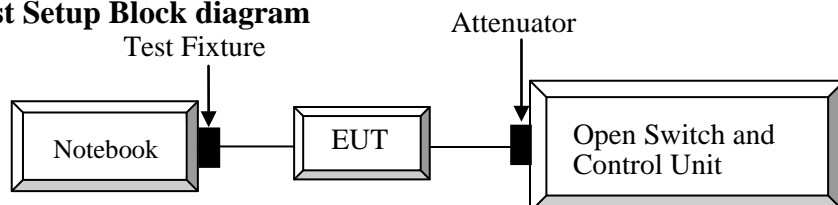
Step 3: Calculate the mean power.

Antenna output power (mW) = Antenna output power Reading (mW) / Burst Ratio

Note: The burst ratio has been calculated to result by power meter, so the equation updated as below:

Antenna output power (mW) = Antenna output power Reading (mW)

Test Setup Block diagram



Test Data

Environmental Conditions

Temperature:	24°C
RelativeHumidity:	49%
ATM Pressure:	101.0kPa

The testing was performed by Glenn.jiang from 2022-09-08 to 2022-11-24.

Test Mode: Transmitting

Test Result: Compliant

Normal voltage

For Model: Ai-WB2-12F

Frequency	Low channel	Middle channel	High channel	Limit
Antenna Output Power (dBm)	1.72	2.69	3.06	10
Antenna Output Power (mW)	1.49	1.86	2.02	10
Antenna Output Power Tolerance (%)	-50.33	-38	-32.67	-80 ~ +20
EIRP(dBm)	4.18	5.15	5.52	12.14

For Model: Ai-WB2-12S

Low voltage: Frequency	Low channel	Middle channel	High channel	Limit
Antenna Output Power (dBm)	1.97	2.74	3.17	10
Antenna Output Power (mW)	1.57	1.88	2.07	10
Antenna Output Power Tolerance (%)	-47.67	-37.33	-31	-80 ~ +20
EIRP(dBm)	4.43	5.2	5.63	12.14

Low voltage:

For Model: Ai-WB2-12F

Frequency	Low channel	Middle channel	High channel	Limit
Antenna Output Power (dBm)	2.52	3.83	3.66	10
Antenna Output Power (mW)	1.79	2.42	2.32	10
Antenna Output Power Tolerance (%)	-40.33	-19.33	-22.67	-80 ~ +20
EIRP(dBm)	4.98	6.29	6.12	12.14

For Model: Ai-WB2-12S

Frequency	Low channel	Middle channel	High channel	Limit
Antenna Output Power (dBm)	2.1	2.89	3.46	10
Antenna Output Power (mW)	1.62	1.95	2.22	10
Antenna Output Power Tolerance (%)	-46	-35	-26	-80 ~ +20
EIRP(dBm)	4.56	5.35	5.92	12.14

High voltage:

For Model: Ai-WB2-12F

Frequency	Low channel	Middle channel	High channel	Limit
Antenna Output Power (dBm)	2.99	2.92	2.59	10
Antenna Output Power (mW)	1.99	1.96	1.82	10
Antenna Output Power Tolerance (%)	-33.67	-34.67	-39.33	-80 ~ +20
EIRP(dBm)	5.45	5.38	5.05	12.14

For Model: Ai-WB2-12S

High voltage: Frequency	Low channel	Middle channel	High channel	Limit
Antenna Output Power (dBm)	2.05	2.93	3.61	10
Antenna Output Power (mW)	1.60	1.96	2.30	10
Antenna Output Power Tolerance (%)	-46.67	-34.67	-23.33	-80 ~ +20
EIRP(dBm)	4.51	5.39	6.07	12.14

Note 1:

The nominal Output power is 3mW, which was declared by manufacturer.

Antenna output power tolerance(%) = (Antenna output power - declared power)/declared power*100

EIRP(dBm)= Antenna Output Power Reading(dBm)+ Antenna gain

Antenna gain is 2.46dBi.

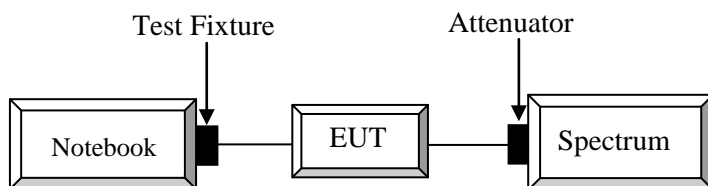
RECEIVER SPURIOUS EMISSION AND UNWANTED EMISSION INTENSITY

Limit

- $\leq 4\text{nW}$ ($30\text{ MHz} \leq f \leq 1000\text{ MHz}$)
- $\leq 20\text{ nW}$ ($1\text{ GHz} \leq f \leq 12.5\text{ GHz}$)

Test Procedure

Measurement System Diagram



Conditions of Application Equipment (EUT)

- The modulation state shall be “continuous receiving mode”.

Spectrum Analyzer Conditions

- Start Frequency: Start Frequency of frequency range to measure (30MHz or 1GHz)
- Stop Frequency: Stop Frequency of frequency range to measure (1GHz or 12.5GHz)
- Span: AUTO (Measurement Range)
- RBW: 100 kHz, VBW: 100 kHz for Frequency < 1 GHz
- RBW: 1MHz, VBW: 1MHz for Frequency > 1 GHz
- Sweep time: AUTO or more
- Sweep mode: Auto Sweep
- Detection: Positive Peak
- Reference Level: Enough level for maximum dynamic range

Measurement Result

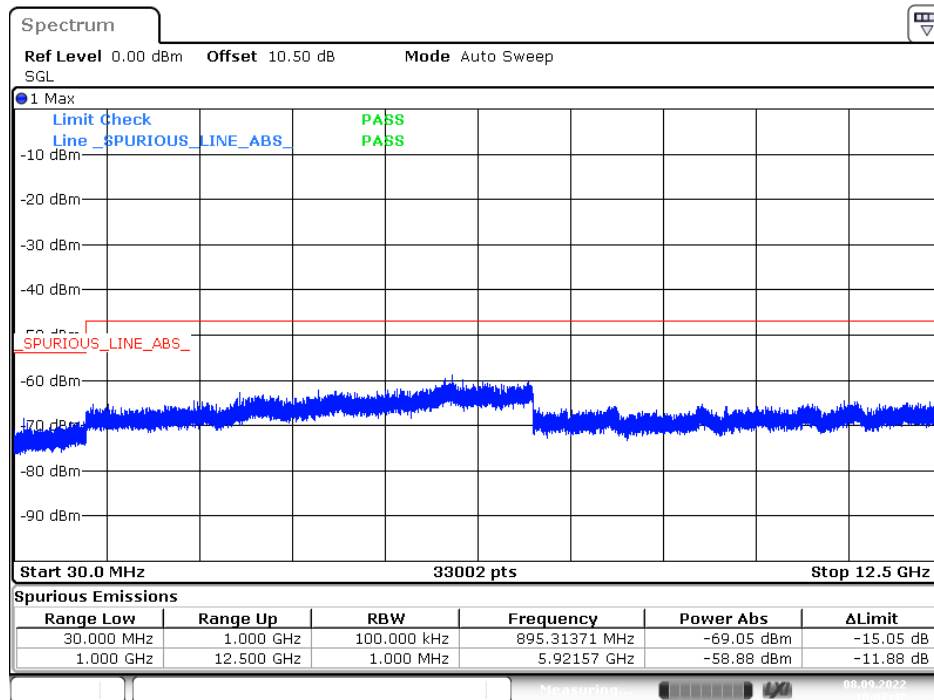
Environmental Conditions

Temperature:	24°C
RelativeHumidity:	49%
ATM Pressure:	101.0kPa

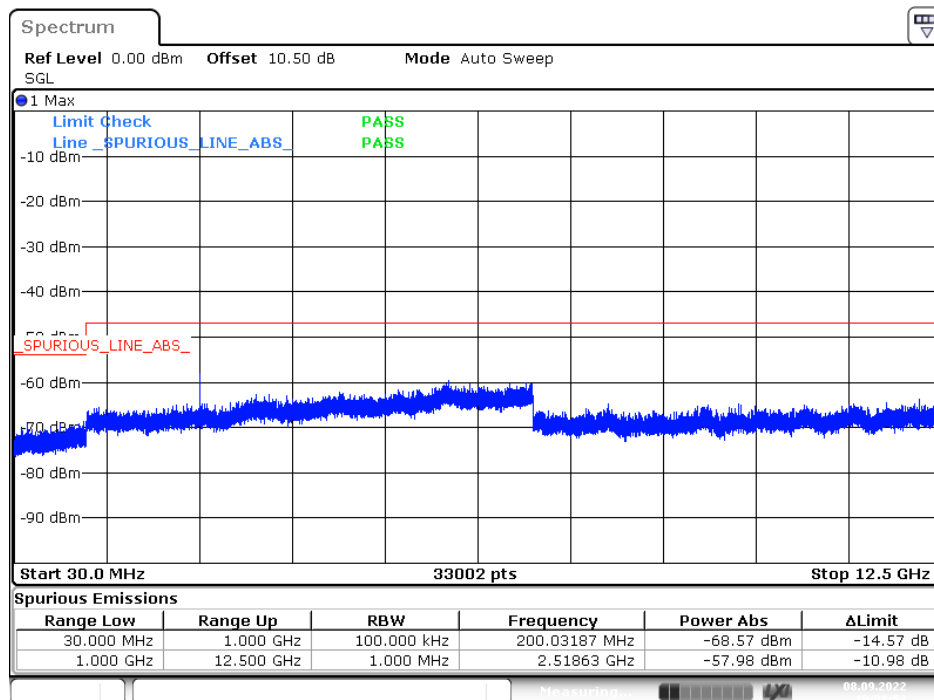
The testing was performed by Glenn.jiang from 2022-09-08 to 2022-10-28.

Test Mode: Receiving

Test Result: Compliant, please see the below plots

Normal Voltage
Low Channel:**30MHz-12.5GHz**

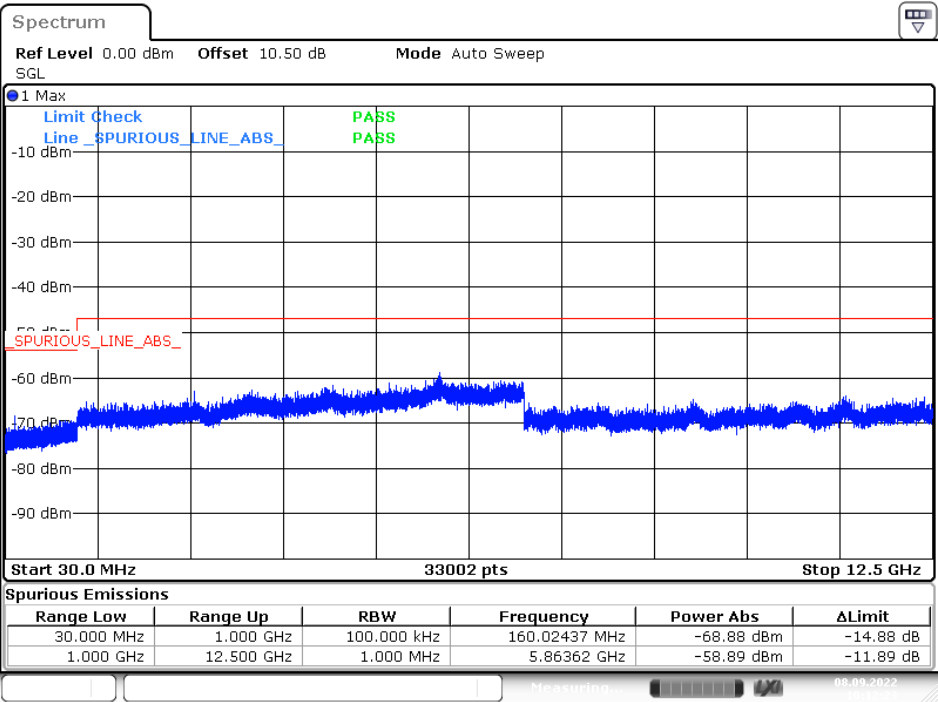
Date: 8.SEP.2022 10:07:43

Middle Channel:**30MHz-12.5GHz**

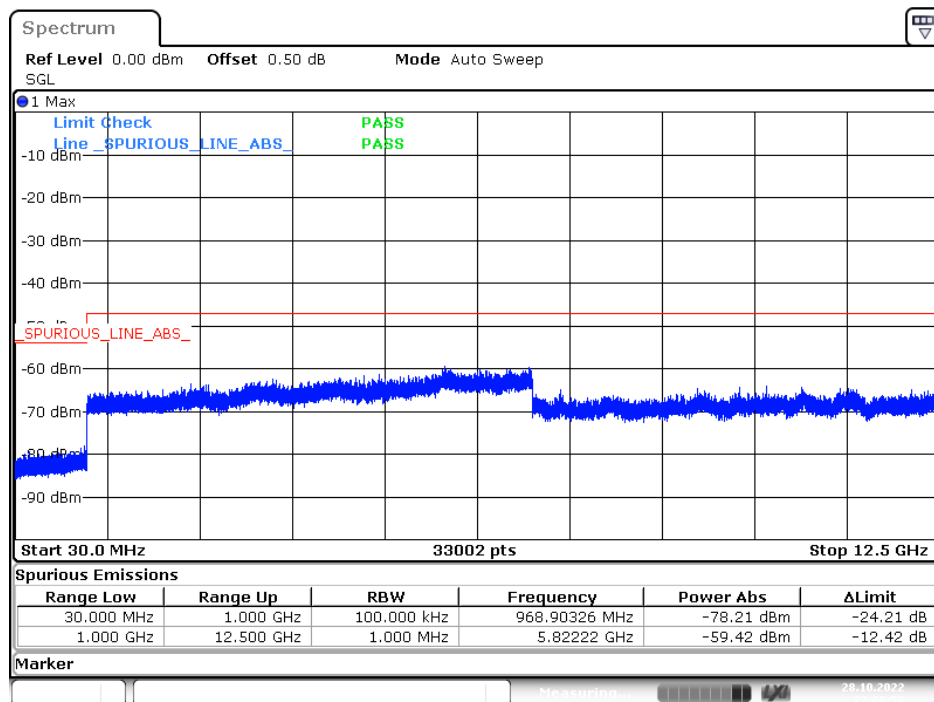
Date: 8.SEP.2022 10:08:52

High Channel:

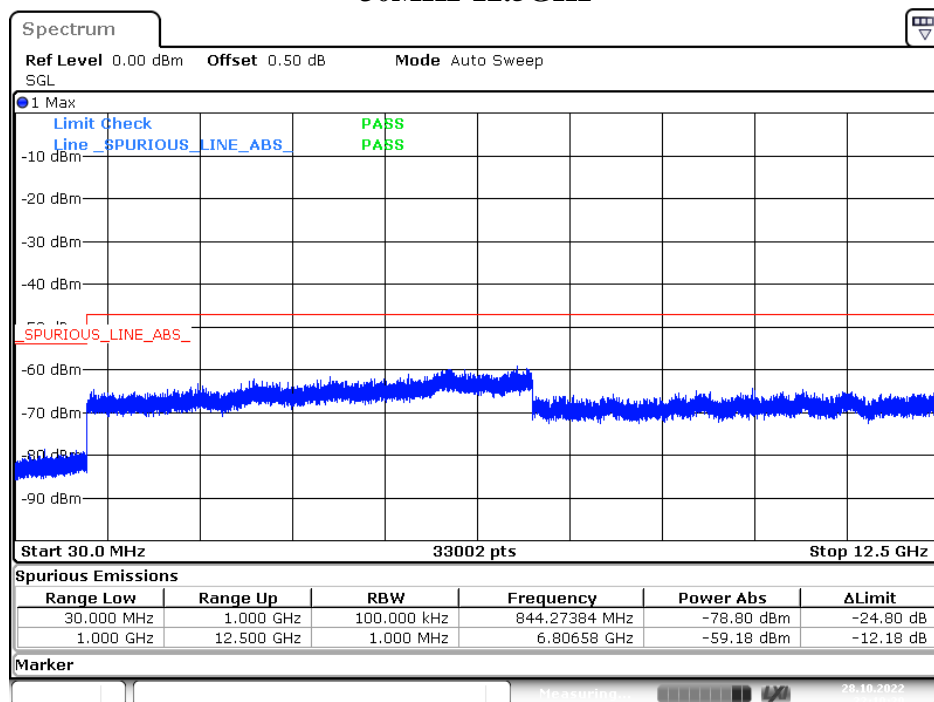
30MHz-12.5GHz



Date: 8.SEP.2022 10:12:23

**Low Voltage
Low Channel:****30MHz-12.5GHz**

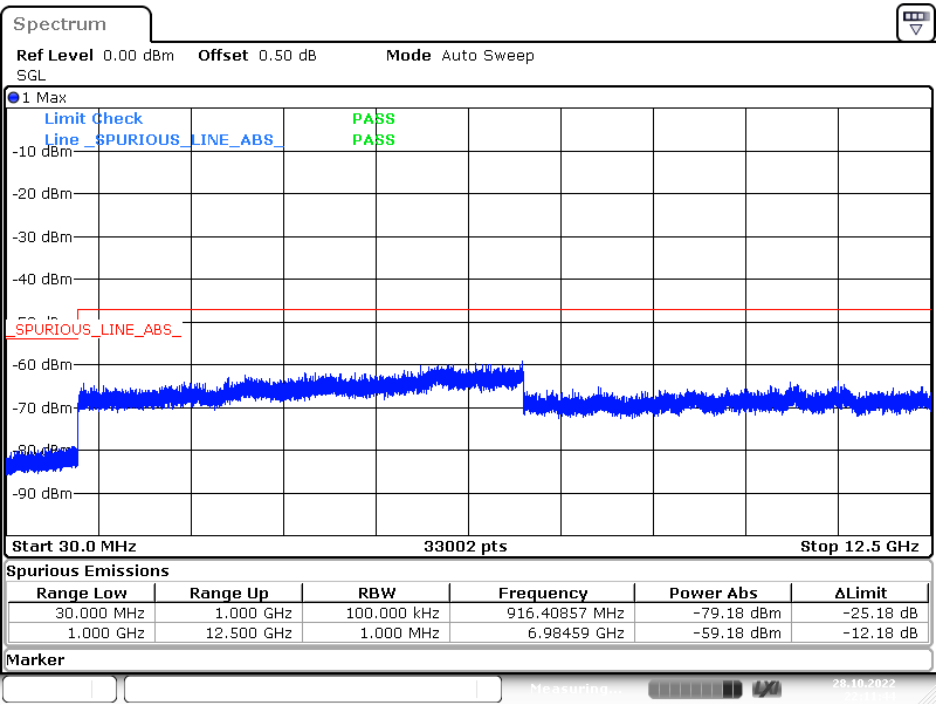
Date: 28.OCT.2022 22:06:59

Middle Channel:**30MHz-12.5GHz**

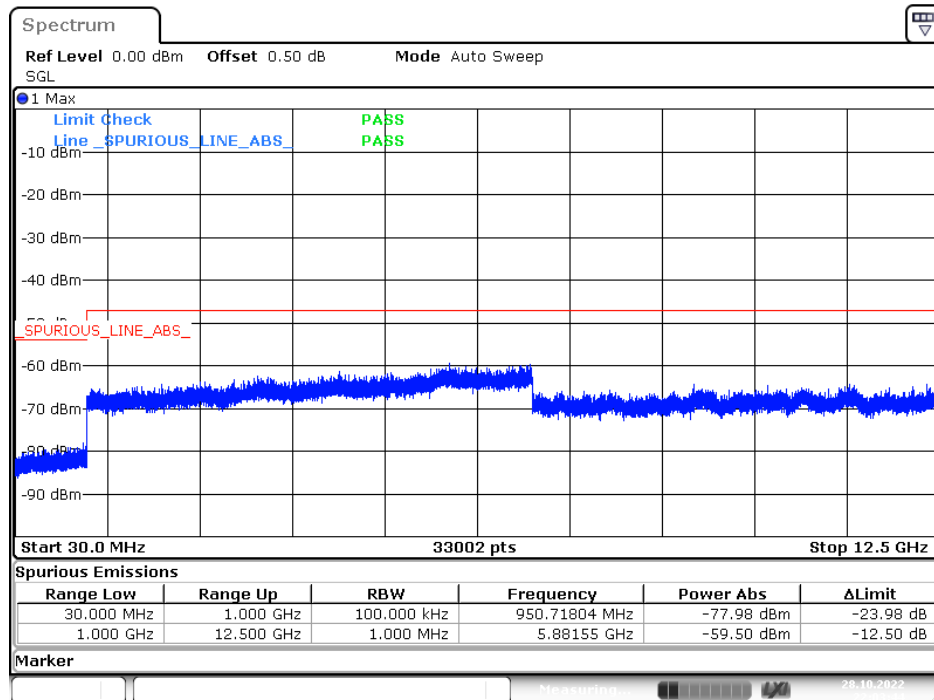
Date: 28.OCT.2022 22:10:29

High Channel:

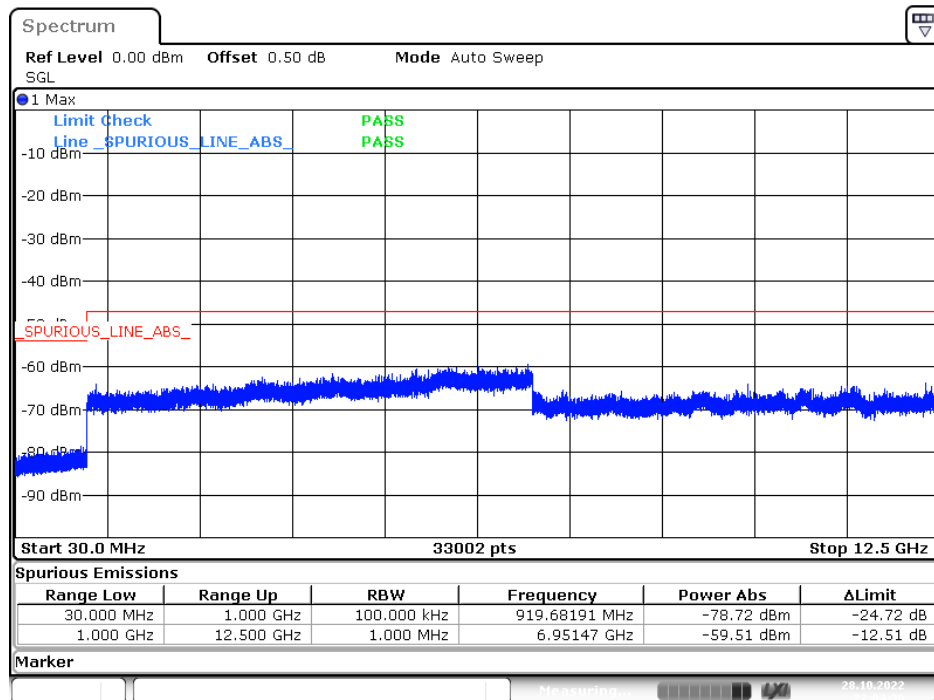
30MHz-12.5GHz



Date: 28.OCT.2022 22:11:45

**High Voltage
Low Channel:****30MHz-12.5GHz**

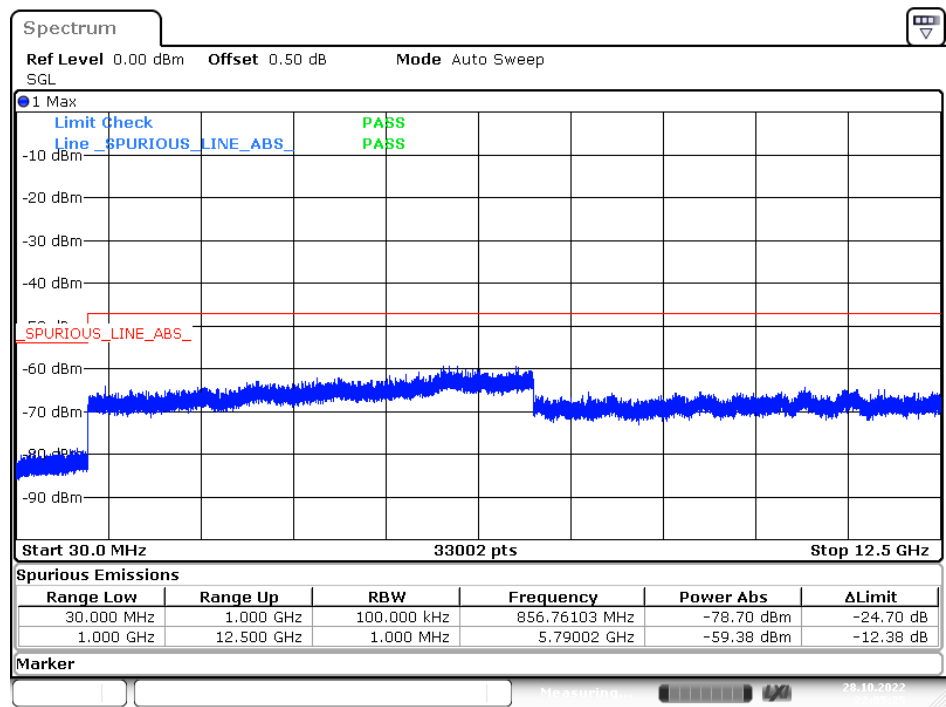
Date: 28.OCT.2022 22:03:45

Middle Channel:**30MHz-12.5GHz**

Date: 28.OCT.2022 22:04:37

High Channel:

30MHz-12.5GHz



Date: 28.OCT.2022 22:05:26

INTERFERENCE PREVENTION FUNCTION

Requirement

The EUT shall have the interference prevention capability to transmit or to receive the identification automatically, so that sender and receiver shall exclude other equipment.

Test Procedure

In the case that the EUT has the function of automatically transmitting the identification code:

1. Transmit the predetermined identification codes from EUT
2. Check the transmitted identification codes with the demodulator.

In the case of receiving the identification codes:

1. Transmit the predetermined identification codes from the counterpart.
2. Check if communication is normal
3. Transmit the signal other than predetermined ID codes from the counterpart.
4. Check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

Test Data

Environmental Conditions

Temperature:	24°C
Relative Humidity:	49%
ATM Pressure:	101.0kPa

The testing was performed by Glenn.jiang from 2022-09-08 to 2022-10-28.

Test Result: Good.

Construction Protection Confirmation

Limit

The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

Confirmation Method

The EUT has shielding cover for the high-frequency section and modulation section of the radio which can't be opened easily, please see the EUT photos.

*****END OF REPORT*****