

Test Report No:
79876RRF.003

Test Report

Ordinance Regulating Radio Equipment, Radio Regulatory
Commission Regulations No 18 - November 30, 1950 (as amended).
Second generation low power data communication system / Wireless
LAN system.

(*) Identification of item tested	DA14592 USB Development Kit
(*) Trademark	Renesas
(*) Model and /or type reference	DA14592 USB Kit
Other identification of the product	FCC ID: Y82 IC: 9576A
(*) Features	Bluetooth LE 5.2 HW version: 469-14-C SW version: SDK 10.1.4.99
Applicant	Renesas Design Netherlands B.V. Het Zuiderkruis 53, 5215 MV 's-Hertogenbosch, The Netherlands
Test method requested, standard	平成十六年総務省告示第八十八号(特定無線設備の技術基準適合証明等 に関する規則別表第一号一(3)の規定に基づく特性試験の試験方法)別表 第四十三 Public notice of MIC No. 88 test method of specified radio equipment Annex 43, Article 2 Paragraph 1 Item 19
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager  Firmado digitalmente por 53680346W JOSE MANUEL GOMEZ (C:A29507456)
Date of issue	2024-10-15
Report template No	FDT08_25 (*) "Data provided by the client"

Index

Competences and guarantees 3

General conditions 3

Uncertainty 3

Data provided by the client.....4

Usage of samples 7

Test sample description 7

Identification of the client.....8

Testing period and place 8

Document history 8

Environmental conditions 8

Remarks and comments 9

Testing verdicts.....9

Summary 10

Appendix A: Test results. Bluetooth Low Energy (2M) 11

Appendix B: Test results. Bluetooth Low Energy (1M) 34

Appendix C: Photographs 58

Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification S.A.U.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

- Transmitting equipment. Antenna power and tolerances for antenna power Measurement uncertainty $\leq \pm 2.01$ dB
- Transmitting equipment. Frequency tolerance Measurement uncertainty $\leq \pm 4.75$ kHz
- Transmitting equipment. Spurious emission intensity Measurement uncertainty $\leq \pm 2.85$ dB
- Transmitting equipment. Permissible value for occupied bandwidth Measurement uncertainty $\leq \pm 6.35$ kHz
- Transmitting equipment. Spread bandwidth Measurement uncertainty $\leq \pm 710.28$ kHz
- Receiving equipment. Limit on secondary radiated emissions Measurement uncertainty $\leq \pm 2.95$ dB

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample consists of a DA14592 USB Development Kit. DA14592 USB Development Kit is a development board based on Renesas Electronics' DA14592 Bluetooth® Smart SoC. The DA14592 is a multi-core wireless microcontroller, combining the latest Arm® Cortex® M33TM application processor with floating-point unit, advanced power management functionality, a cryptographic security engine, analog and digital peripherals, a software configurable protocol engine with a radio that is compliant to the Bluetooth® 5.2 Low Energy standard and 256 kB of embedded FLASH accompanied by 96 kB of RAM.
3. Declaration of the Applicant, 'Voltage variation':

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results. The laboratory is not responsible for such information and it is not covered by accreditation.

Date:25-Sept-2024

We, Renesas Design Netherlands B.V. located at Het Zuiderkruis 53, 5215 MV 's-Hertogenbosch / THE NETHERLANDS, responsible of manufacturing the following product:

Model: DA14592 USB Kit

Brand: Renesas

Hereby declare that the product mentioned above has an external power supply of 3.3 Vdc. According to Public notice of MIC No. 88 test method of specified radio equipment Annex 43, our product must perform voltage fluctuation test ($\pm 10\%$) at the following test points in order to check extreme conditions as recorded in the notice:

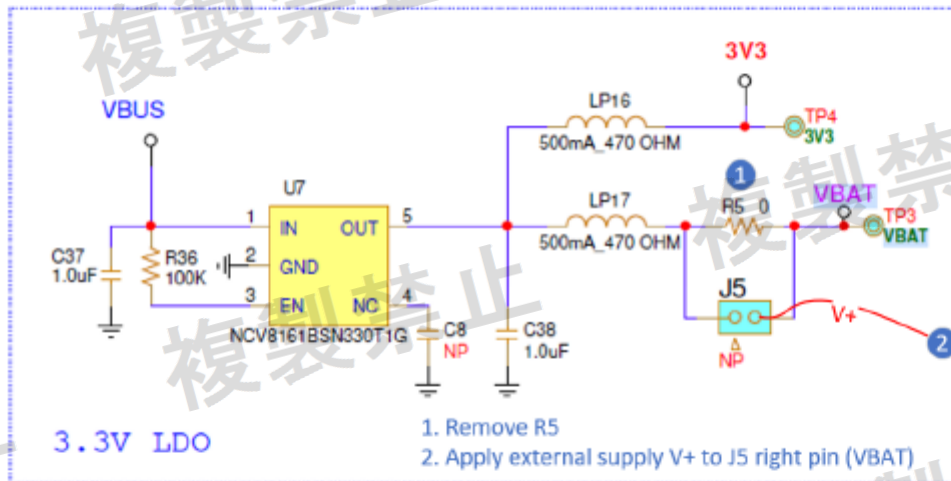


Figure 1. External power supply can be applied on bottom side battery pads, SW1 to BATT

The DA14592 has a complete integrated Power Management Unit (PMU). This includes a buck DCDC converter, several LDOs for the different power rails of the system, and brownout detection. The system diagram of the integrated PMU is shown in Figure 2.

Features

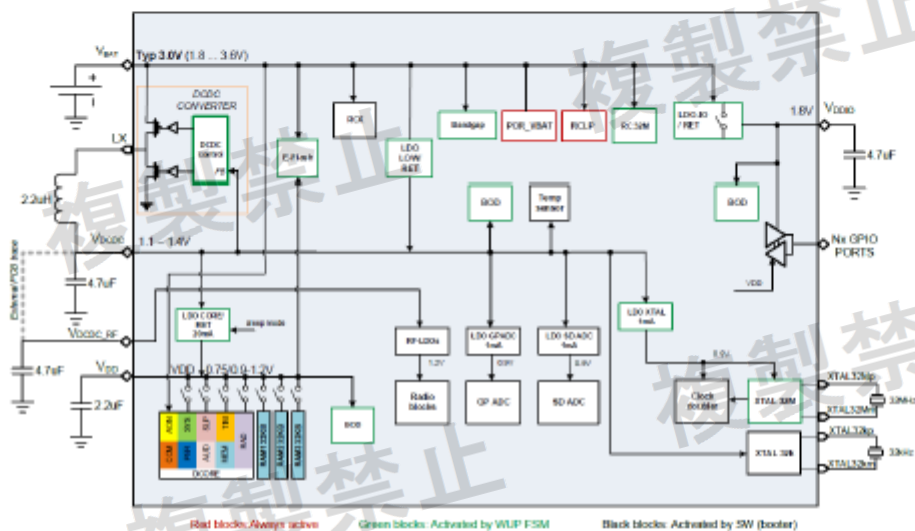
- Synchronous Single Inductance Single Output Buck PCM DCDC converter with programmable output 1.1 V to 1.4 V.
- Capability of using the DCDC converter both in active as well as in Sleep modes.
- An LDO that can be used to instead of the DCDC converter in active and Sleep mode.

Renesas Design Netherlands B.V.

Het Zuiderkruis 53, 5215 MV 's-Hertogenbosch, the Netherlands tel. +31(0)736408822 fax. +31(0)736408823 Chamber of Commerce #17177191 URL: <http://www.renesas.com>

- Active and retention LDO for the digital core with 20 mA/2 mA driving capability.
- Active and retention LDO for the I/O-s with bypass functionality.
- Separate LDOs for the radio operation supporting High-Performance and Low Power modes.
- Brownout detection on all internal voltage rails.

The DA14592 SoC Internal voltages are regulated voltages. They are within the margin of $\pm 1\%$.



Based on these results and considering orange square in Figure 2 named 'RADIO BLOCKS', performing voltage fluctuation in the indicated test points ensures that the input voltage to the RF Bluetooth LE SoC is in the mentioned margin.

Therefore, only nominal voltage will be used to perform all the test for this product according to the aforementioned notice.

Sincerely,
(Signature)

DocuSigned by:
Steven Leussink
C35C005E98E64C9

Name: Steven Leussink

Designation: Director

Renesas Design Netherlands B.V.

Het Zuidenkruis 53, 5215 MV 's-Hertogenbosch, the Netherlands tel. +31(0)736408822 fax. +31(0)736408823 Chamber of Commerce #17177191 URL: <http://www.renesas.com>

Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	Serial N°	Date of Reception	Application
S/01	79876B/022	DA14592 USB Development Kit	DA14592 USB Kit	-	2024-08-14	Element Under Test

Notes referenced to samples during the project:

Id	Type
S/01	Sample used for all tests.

Test sample description

Ports.....:	Port name and description	Cable					
		Specified max length [m]	Attached during test		Shielded		
	RF Port for conducted measurements	-	☒		☐		
Supplementary information to the ports.....:	-						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐ AC:		☐	☐	☐	☐	☐
	☒ DC:	3.3V					
Rated Power.....:	+6 dBm						
Clock frequencies.....:	32MHz						
Other parameters	-						
Software version.....:	SDK 10.1.4.99						
Hardware version	469-14-C						
Dimensions in cm (W x H x D) ...:	8.57 x 2.78 cm						
Mounting position	☐	Table top equipment					
	☐	Wall/Ceiling mounted equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
	☒	Other:					
Modules/parts.....:	Module/parts of test item		Type	Manufacturer			
	-		-	-			
Accessories (not part of the test item)	Description		Type	Manufacturer			
	-		-	-			
Documents as provided by the applicant.....:	Description		File name	Issue date			
	-		-	-			

⁽³⁾ Only for Medical Equipment

Identification of the client

Renesas Design Netherlands B.V.
Het Zuiderkruis 53, 5215 MV 's-Hertogenbosch, The Netherlands

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2024-09-18
Date (finish)	2024-09-18

Document history

Report number	Date	Description
78857RRF.011	2024-10-15	First release.

Environmental conditions

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 5 °C Max. = 35 °C
Relative humidity	Min. = 45 % Max. = 85 %

Remarks and comments

The tests have been performed by the technical personnel: Carmen Vázquez.
Used instrumentation:

Control No.	Equipment	Model	Serial number	Manufacturer	Calibration date	Calibration Authority	Calibration Method
06792	SHIELDED ROOM	S101	N/A	ETS LINDGREN	N/A	N/A	c)
06158	SIGNAL AND SPECTRUM ANALYZER 10 Hz - 40 GHz	FSV40	101713	ROHDE AND SCHWARZ	2024-02-05	ROHDE AND SCHWARZ	c)
06092	DC POWER SUPPLY 30 V / 5 A	U8002A	N/A	KEYSIGHT TECHNOLOGIES	N/A	N/A	c)
06615	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	60038029105	HW GROUP	2024-04-04	DEKRA TC	c)
04848	EMC/RF MEASUREMENT SOFTWARE	EMC32	N/A	ROHDE AND SCHWARZ	N/A	N/A	c)
04530	AVG POWER SENSOR 6 GHZ	NRP-Z91	102310	ROHDE AND SCHWARZ	2024-07-29	ROHDE AND SCHWARZ	c)

Note: Calibration Method

- a) Calibration conducted by the National Institute of Information and Communications Technology (NICT) or a designed calibration agency under Article 102-18 paragraph (1) of the Radio Law.
- b) Calibration 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).
- d) Calibration conducted by using other equipment that is listed above from a) to c).

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

Bluetooth Low Energy (2M, 1M):

MIC No. 88 Annex 43			
Requirement – Test case		Verdict	Remark
Article 49-20 and Article 14.7 Table 8	Transmitting equipment. Antenna power. Tolerances for antenna power.	P	--
Article 5 and Annex 1 table 7-8	Transmitting equipment. Frequency tolerance.	P	--
Article 7 and Annex 3. 26	Transmitting equipment. Spurious emission intensity.	P	--
Article 6 and Annex 2. 30	Transmitting equipment. Permissible value for occupied bandwidth.	P	--
Article 24.2	Receiving equipment. Limit on secondary radiated emissions.	P	--
Article 9.4-5	Controlling equipment. Interference prevention function. Identification code transmission/reception.	P	--
Article 49-20	Antenna. Antenna gain	P	--
<u>Supplementary information and remarks:</u> None.			

Appendix A: Test results. Bluetooth Low Energy (2M)

INDEX

Article 49-20 and Article 14.7 Table 8. Transmitting equipment. Antenna power. Tolerances for antenna power 15

Article 5 and Annex 1 table 7-8. Transmitting equipment. Frequency tolerance 16

Article 7 and Annex 3. 26. Transmitting equipment. Spurious emission intensity 17

Article 6 and Annex 2. 30. Transmitting equipment. Permissible value for occupied bandwidth 25

Article 24.2. Receiving equipment. Limit on secondary radiated emissions.....28

Article 9.4-5. Controlling equipment. Interference prevention function. Identification code transmission/reception 32

Article 49-20. Antenna. Antenna gain 33

TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal: 3.3 Vdc

Type of Power Supply: USB.

TEST FREQUENCIES (*):

Modulation	Data rates	Low Channel:	Middle Channel	High Channel
BLE GFSK	2 Mbit/s	2402 MHz	2440 MHz	2480 MHz

During transmitter test the EUT was controlled by a SW tool provided by the client to operate in a continuous transmit mode on the modulation schemes and test channels as required.

ENVIRONMENTAL CONDITIONS DURING TESTING:

Date	Temperature	Humidity
2024-09-18	22.11 – 23.51 °C	51.2 – 55.6 %

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and its antenna port (SMA type) is connected to the spectrum analyser through a low loss RF cable. The reading of the spectrum analyser is corrected with the cable loss.

The DC supply voltage is applied using a power supply.

The Equipment Under Test (E.U.T.) is set in continuous transmission with modulation using an implemented test mode. The test mode also permits to set the E.U.T. in receiving mode with the transmission disabled.

PRODUCT INFORMATION

The following information is provided by the client, in accordance with clause 5.4.1:

Information	Description
Modulation:	GFSK.
Spread spectrum system:	No (Other digital modulation methods).
Nominal necessary Bandwidth:	2 MHz.
Maximum declared antenna gain:	-1.5 dBi.
Rated Antenna Power:	6 dBm (0.00399 mW).
Type of Antenna:	Integrated Printed Inverted F
Operating nominal frequency range:	2400 MHz to 2483.5 MHz.
Nominal power supply:	3.3 Vdc.
Type of power supply:	USB

Article 49-20 and Article 14.7 Table 8. Transmitting equipment. Antenna power.
Tolerances for antenna power

Limits:

Mode	Limit	Tolerance
a) FH, FH+DS, FH+OFDM	3 mW/MHz	+20%
b) OFDM (Narrow bandwidth), DS	10 mW/MHz	
c) Other than a & b	10 mW	
d) OFDM (Wide band)	5 mW/MHz	

Results:

Mode: Other digital modulation methods than a & b.

Maximum Rated Antenna Power: 6 dBm (0.00399 mW)

Vnom:

Channel	Measured antenna power (dBm)	Radiated power EIRP (dBm)	Antenna power EIRP (mW)	Deviation from maximum rated antenna power (%)
Low (2402 MHz)	5.56000	4.06	2.55	-9.635052628
Middle (2440 MHz)	5.22000	3.72	2.36	-16.43969818
High (2480 MHz)	4.78000	3.28	2.13	-24.49077723

Measurement uncertainty: < ± 2.01 dB

Verdict:

PASS

Article 5 and Annex 1 table 7-8. Transmitting equipment. Frequency tolerance

Limits:

Frequency tolerance shall be $\pm 50 \times 10^{-6}$ (50 ppm).

Results:

Vnom:

Channel	Frequency error (Hz)	Frequency error (ppm)
Low (2402 MHz)	-5415	-2.25437
Middle (2440 MHz)	-5745	-2.35450
High (2480 MHz)	-5965	-2.40524
Measurement uncertainty	<± 7.10 kHz	

Verdict:

PASS

Article 7 and Annex 3. 26. Transmitting equipment. Spurious emission intensity

Limits:

Permissible mean power of spurious emission of each frequency supplied to a feeder, that is, mean power of spurious emission in the 1 MHz bandwidth at frequency f other than frequency band used shall be as follows:

- a. $2,387\text{ MHz} \leq f \leq 2,400\text{ MHz}$ and $2,483.5\text{ MHz} < f \leq 2,496.5\text{ MHz}$ 25 μW (-16 dBm) or less.
- b. $2,387\text{ MHz} > f$ and $2,496.5\text{ MHz} < f$ 2.5 μW (-26 dBm) or less.

Results:

Vnom:

- LOW CHANNEL:

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)
2399.998	-17.06	-16.00

- MIDDLE CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

- HIGH CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

Measurement uncertainty<± 2.77 dB

Verdict:

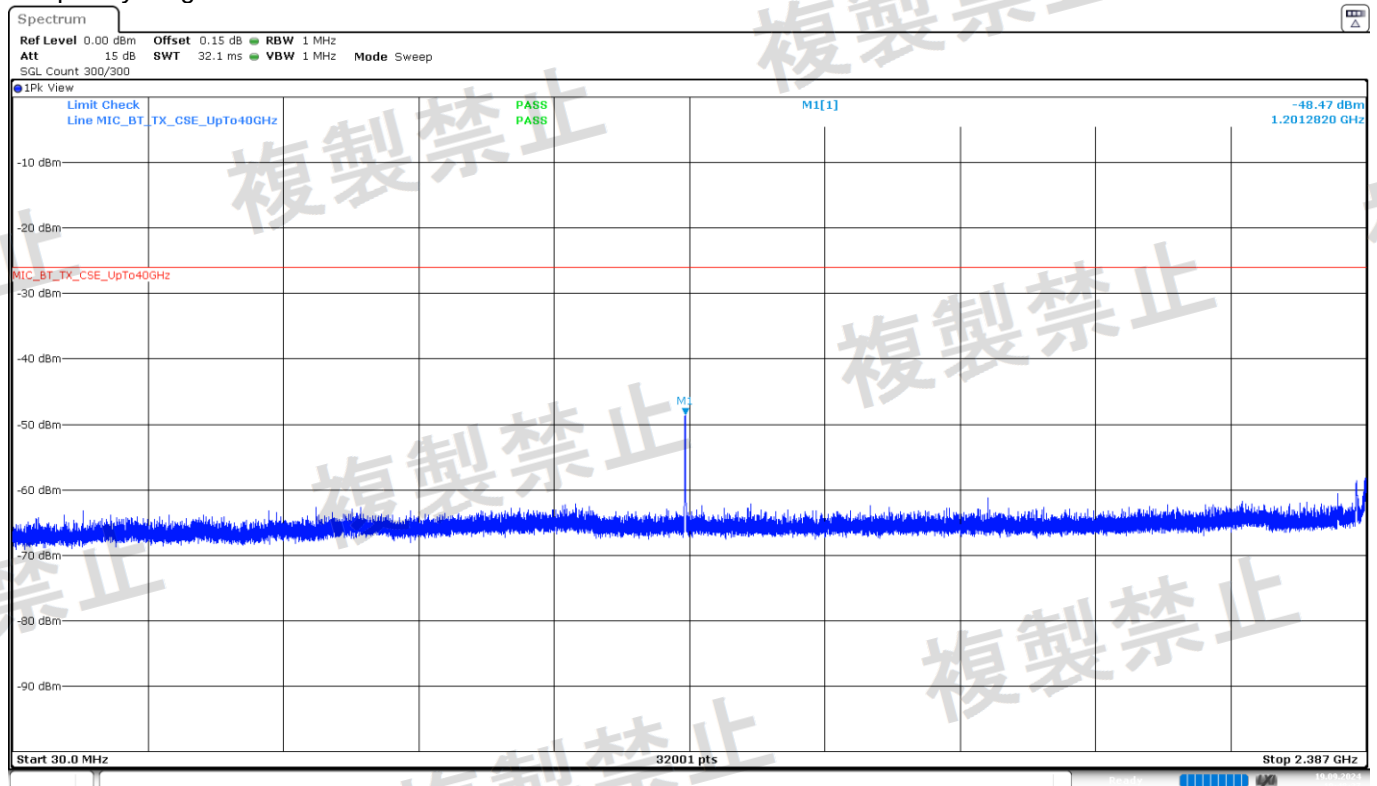
PASS

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
9 kHz - 150 kHz	141 Hz	PK+	300 Hz	1 s	0 dB
150 kHz - 30 MHz	3.317 kHz	PK+	10 kHz	1 s	0 dB
30 MHz - 1 GHz	97 kHz	PK+	1 MHz	1 s	0 dB
1 GHz - 2.3 GHz	130 kHz	PK+	1 MHz	1 s	0 dB
2.3 GHz - 2.6 GHz	30 kHz	PK+	1 MHz	1 s	0 dB
2.6 GHz - 12.5 GHz	330 kHz	PK+	1 MHz	1 s	0 dB
12.5 GHz - 25 GHz	416.667 kHz	PK+	1 MHz	1 s	0 dB

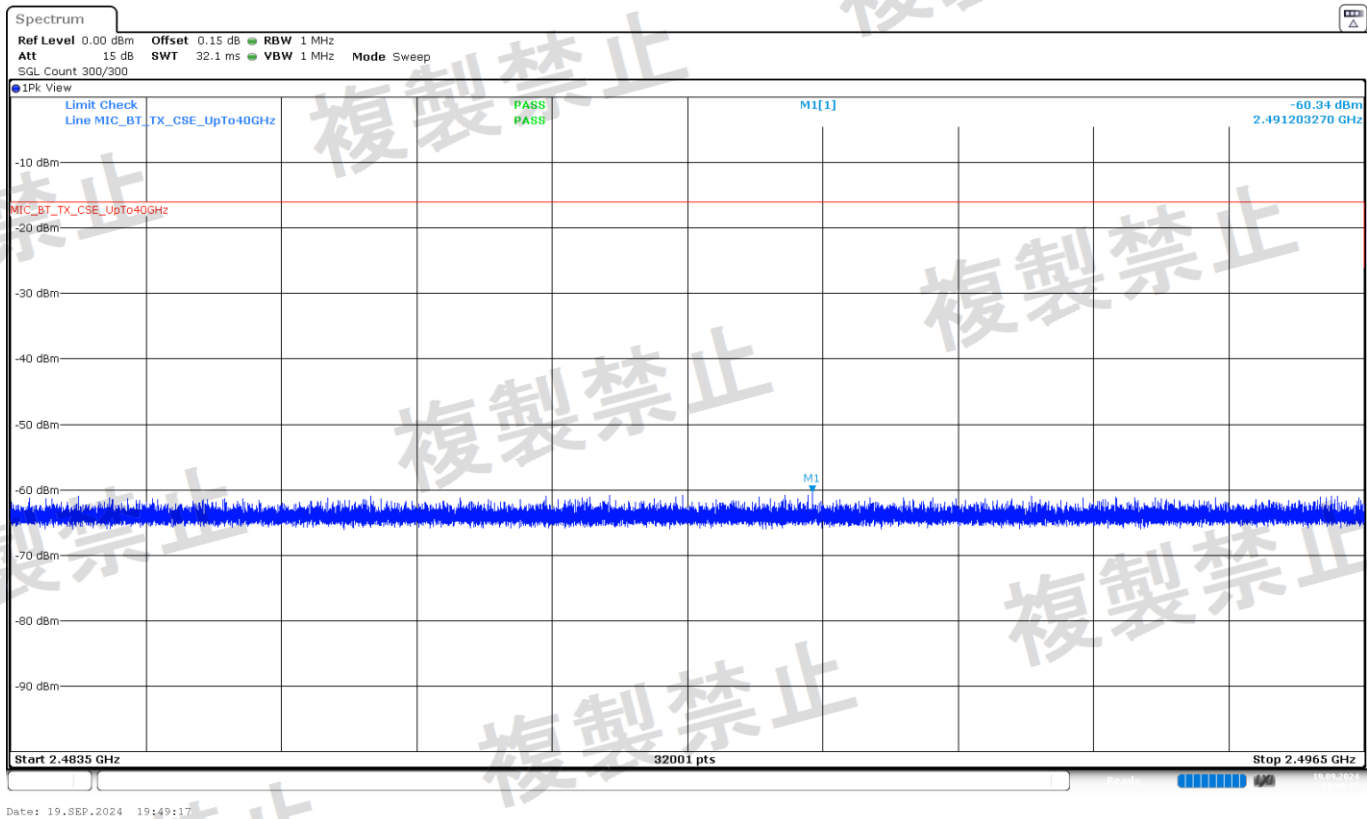
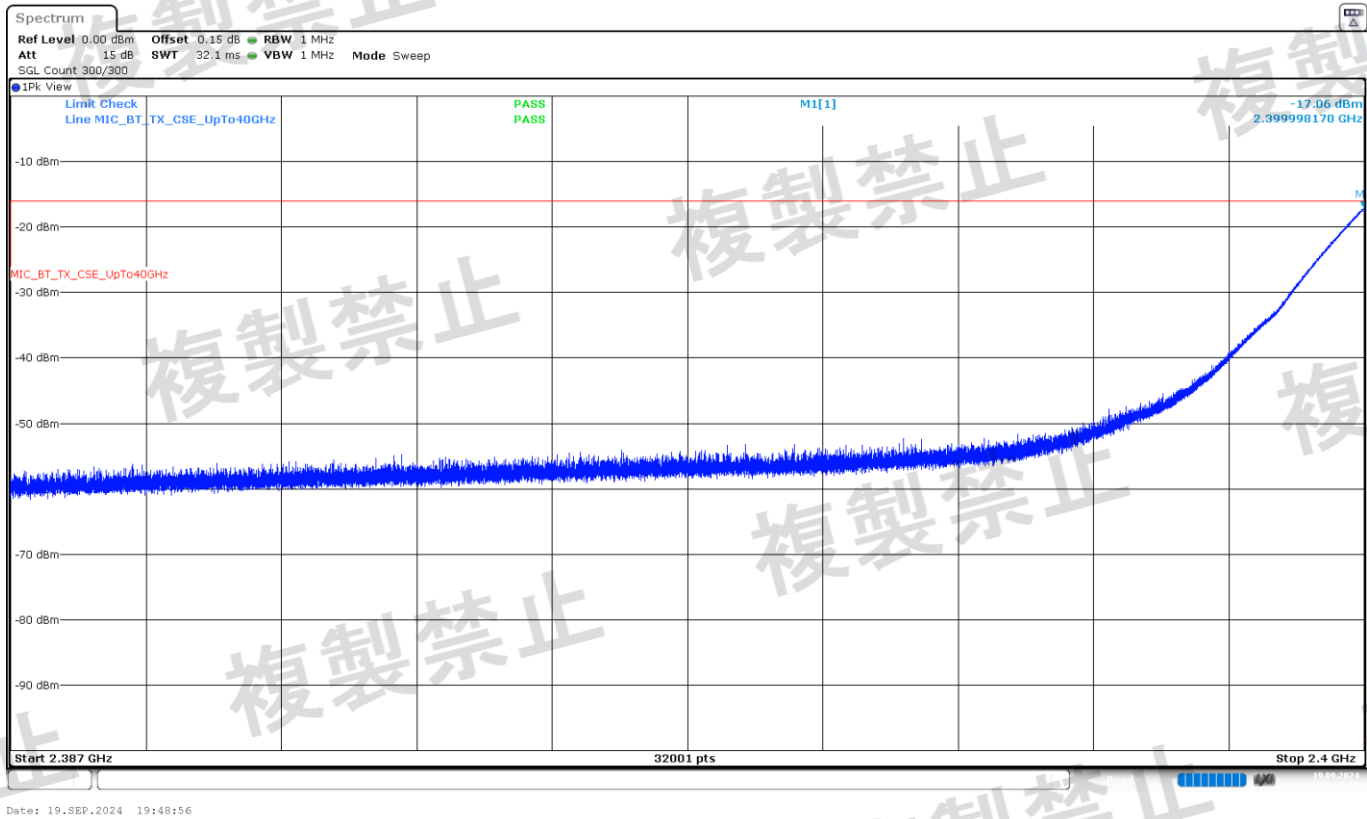
Vnom:

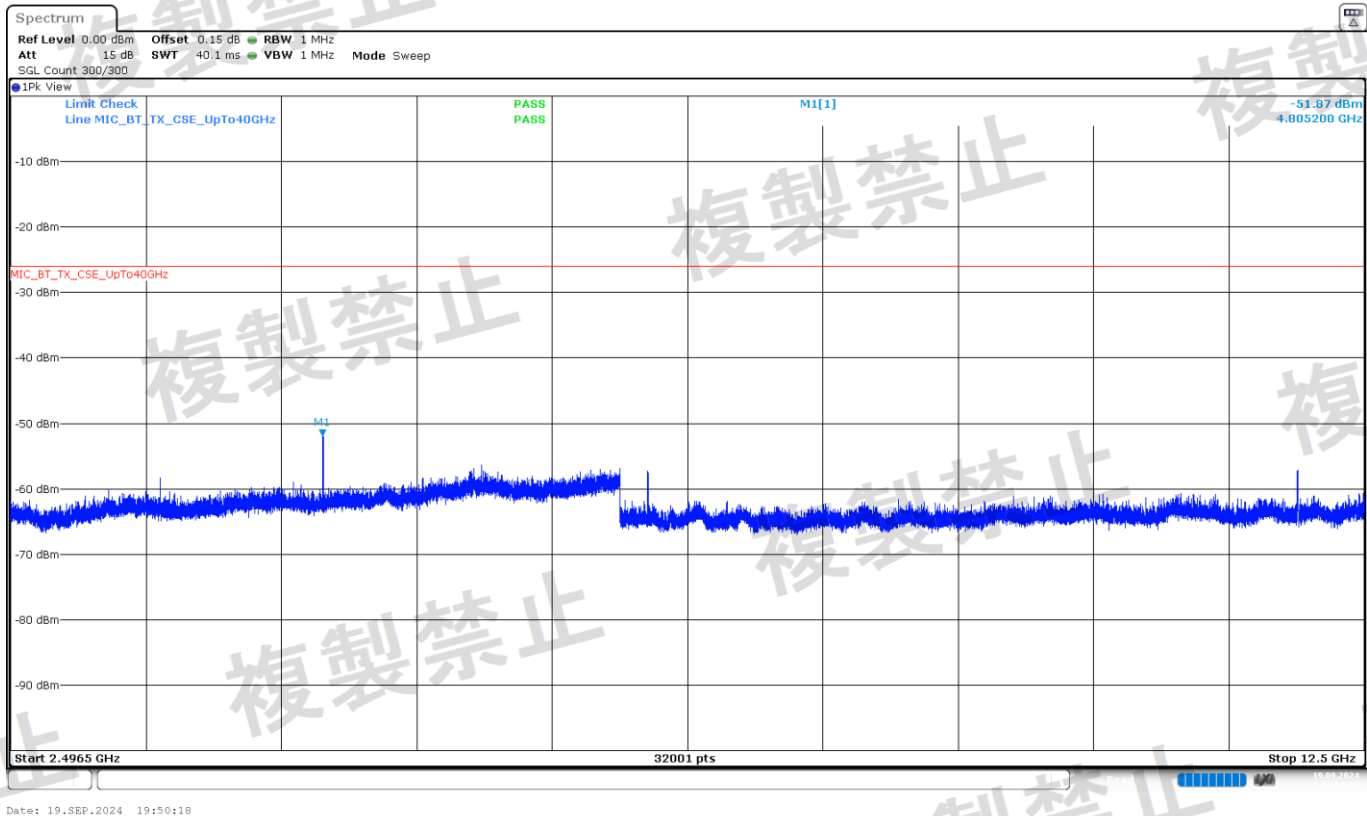
- LOW CHANNEL:

Frequency range 30 MHz – 12.5 GHz



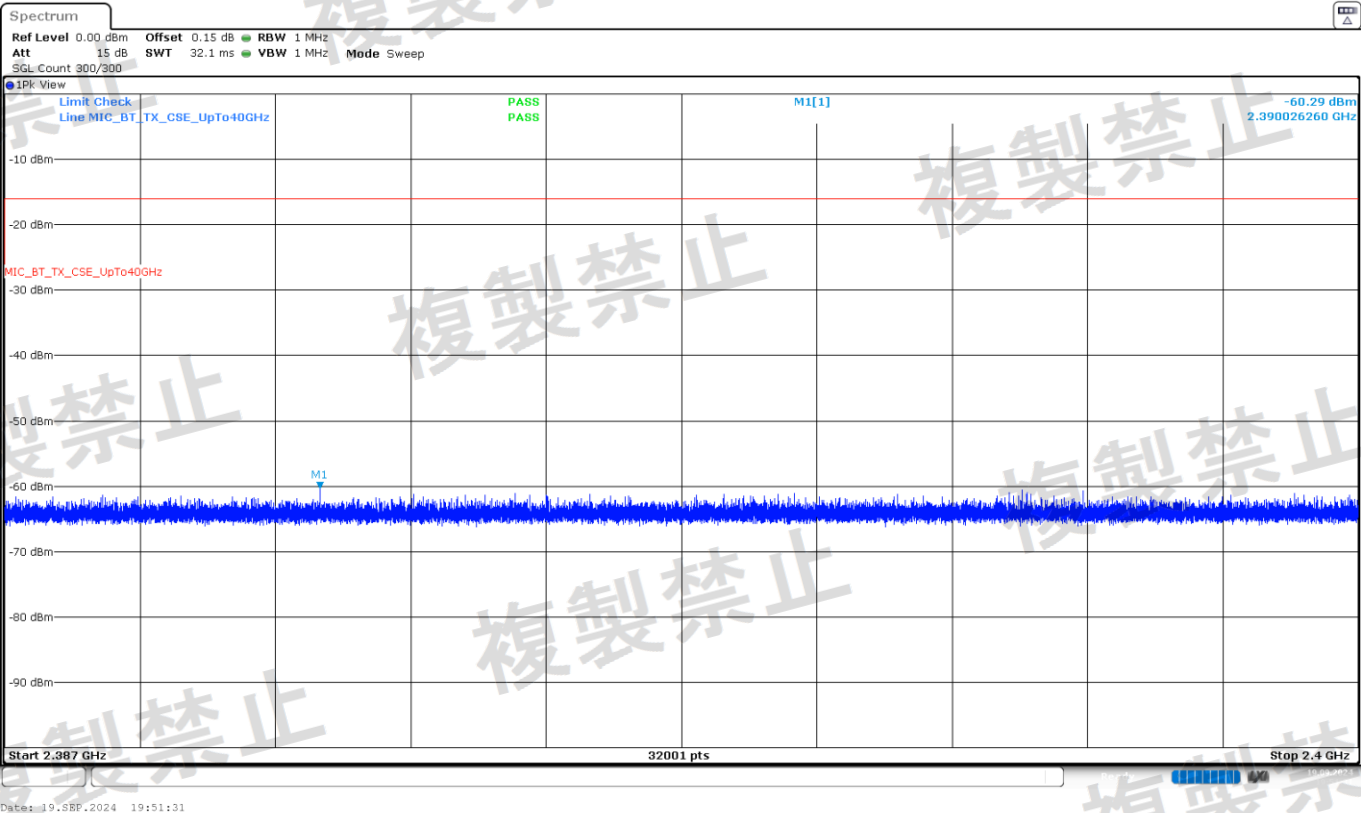
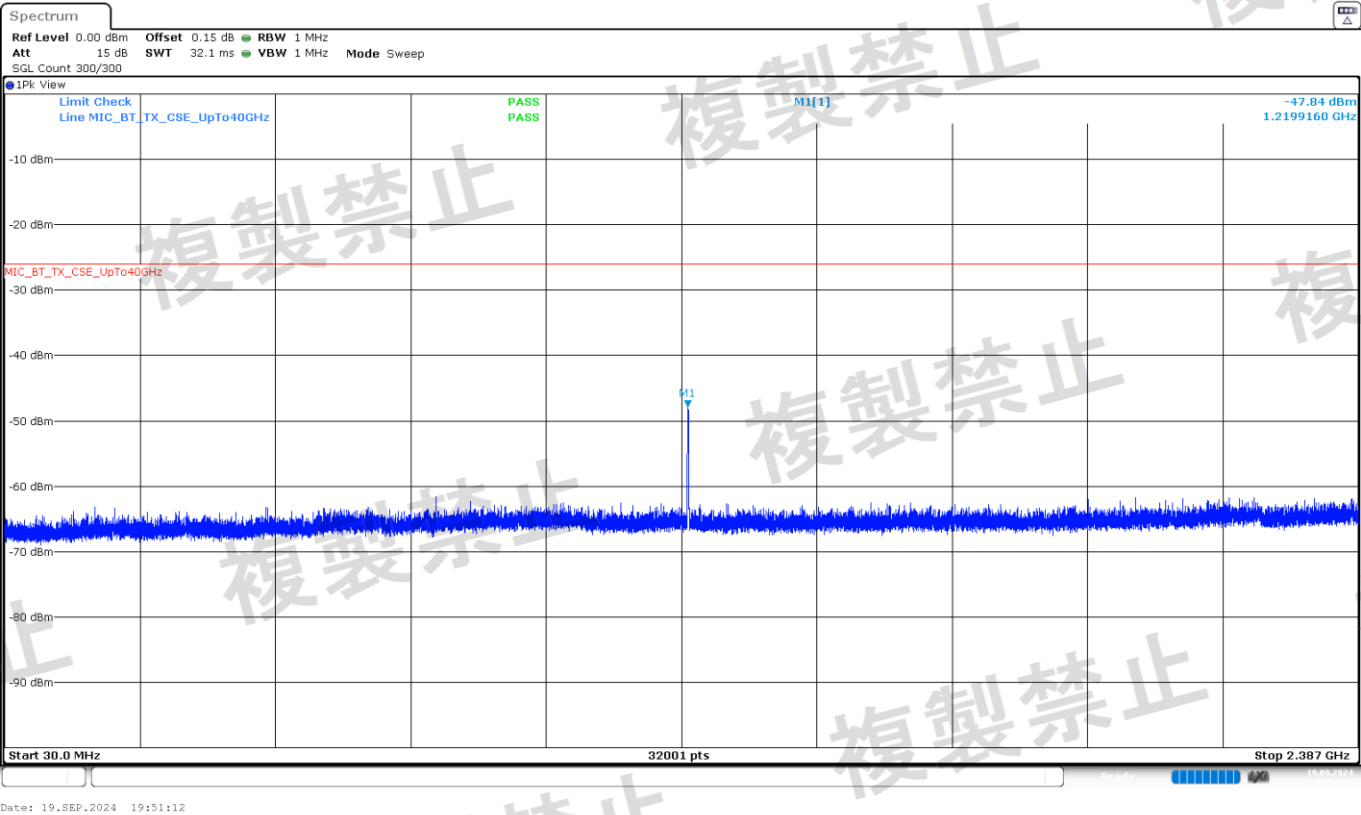
Date: 19.SEP.2024 19:48:37

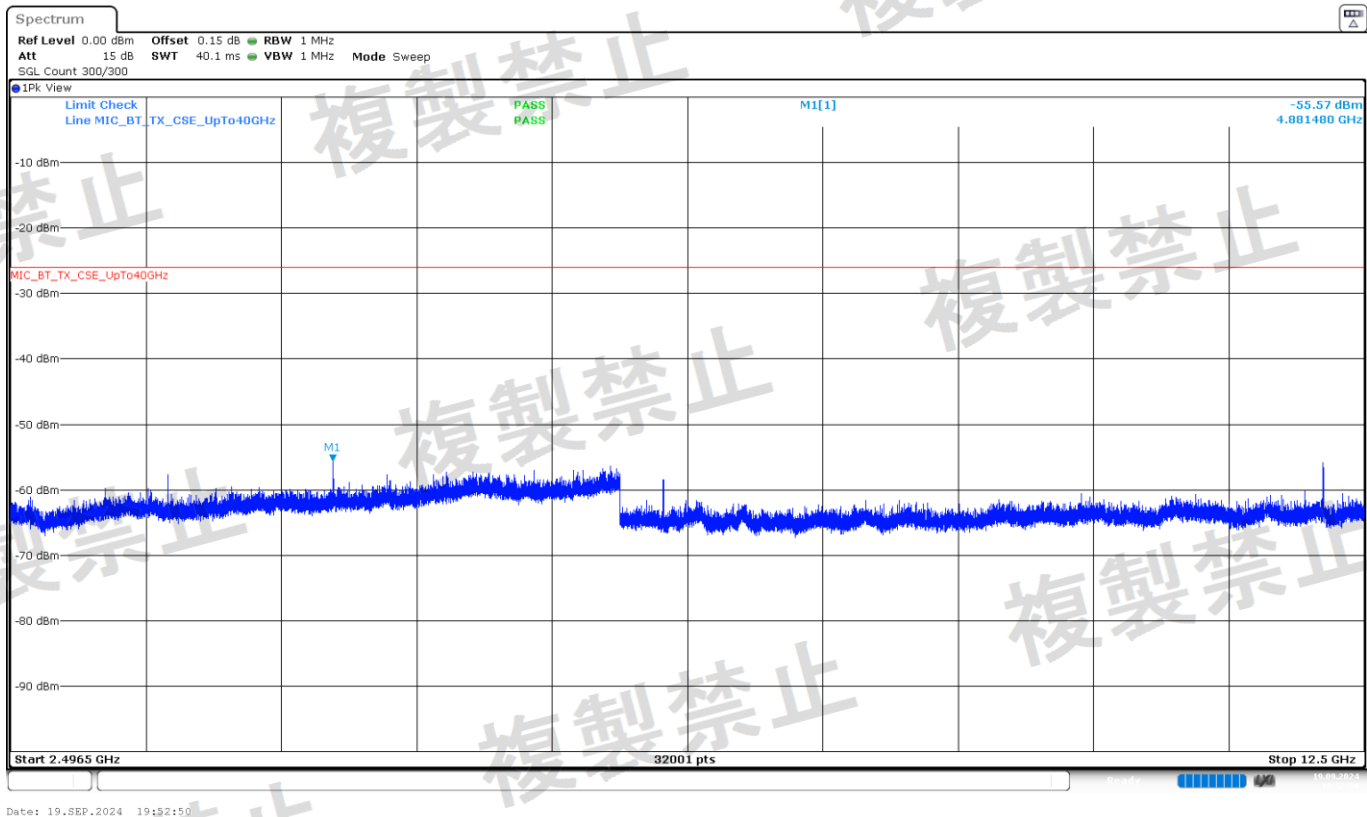
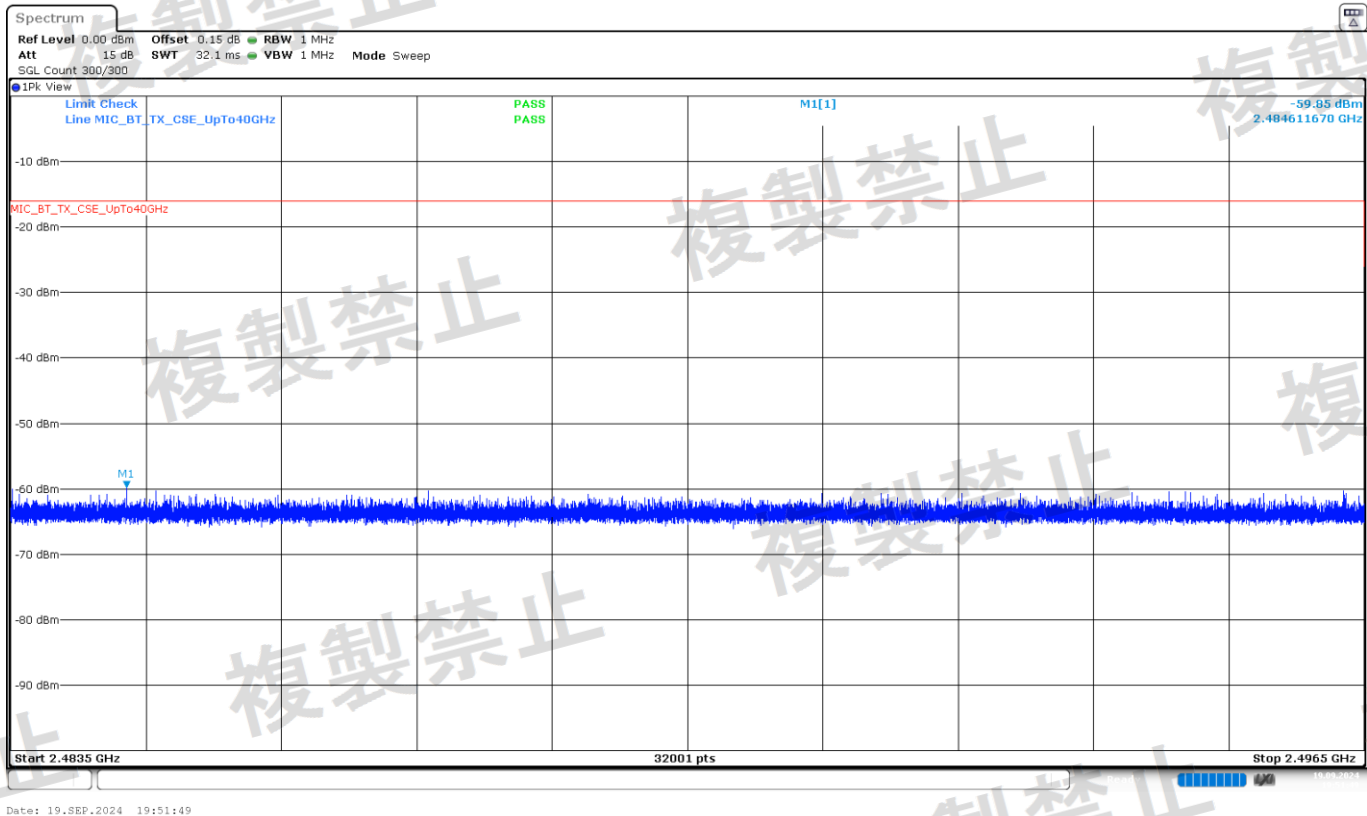




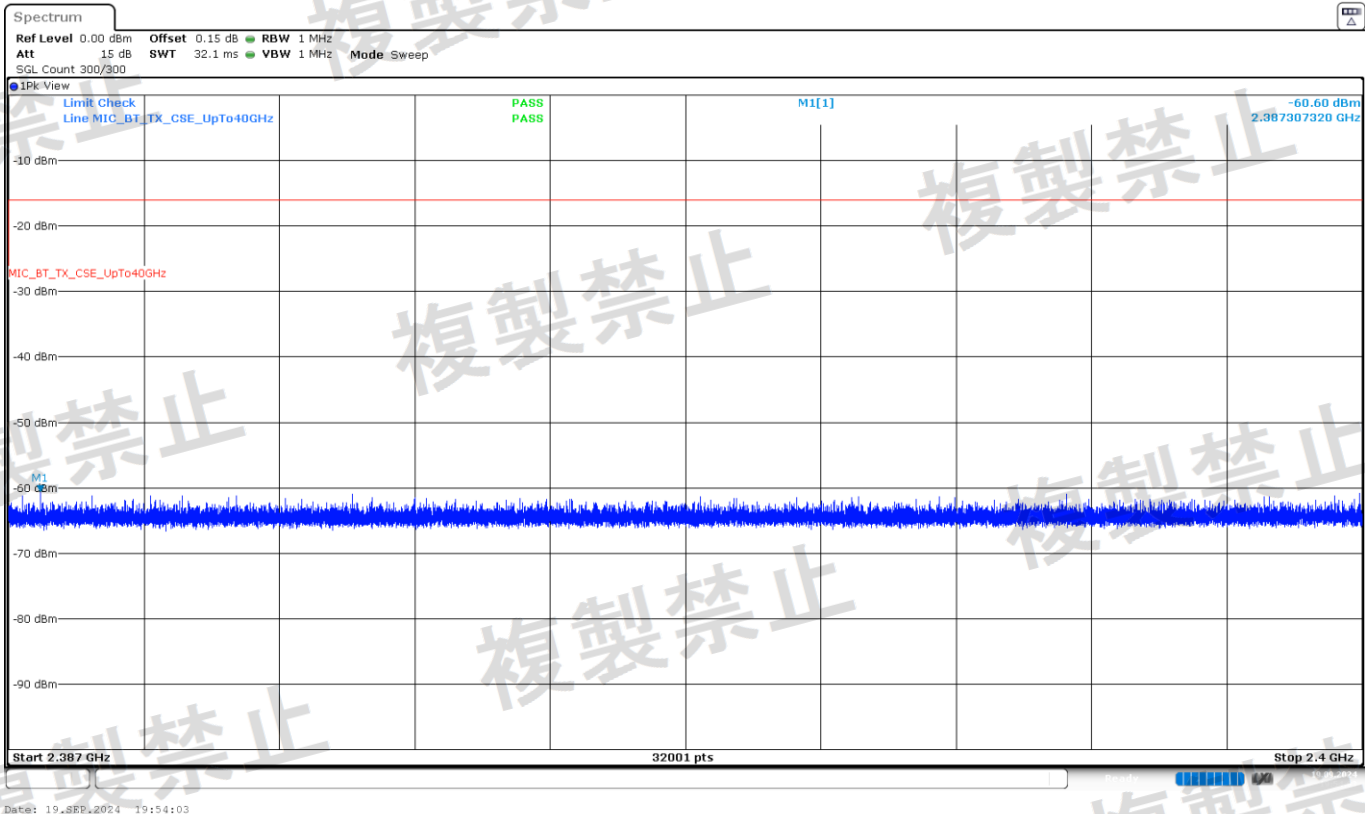
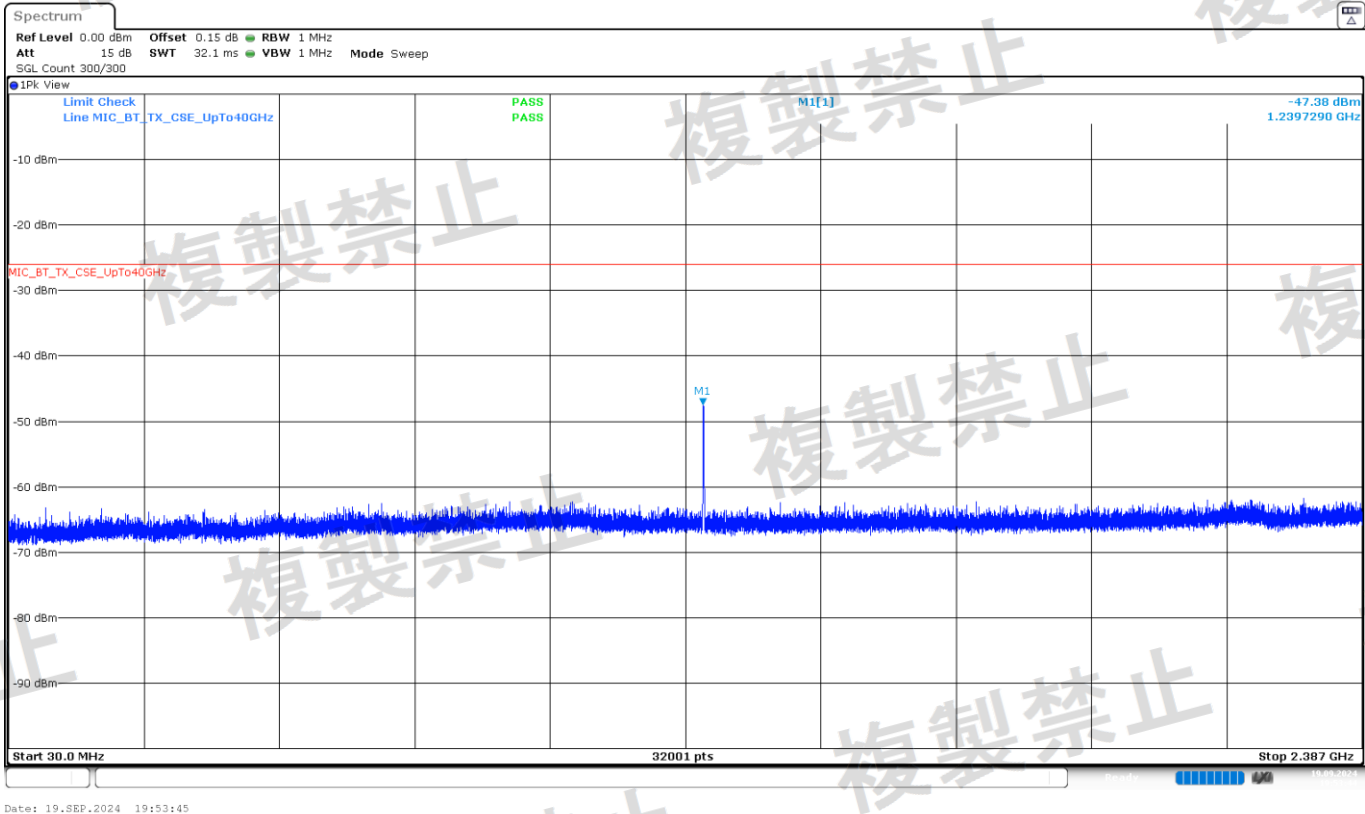
MIDDLE CHANNEL:

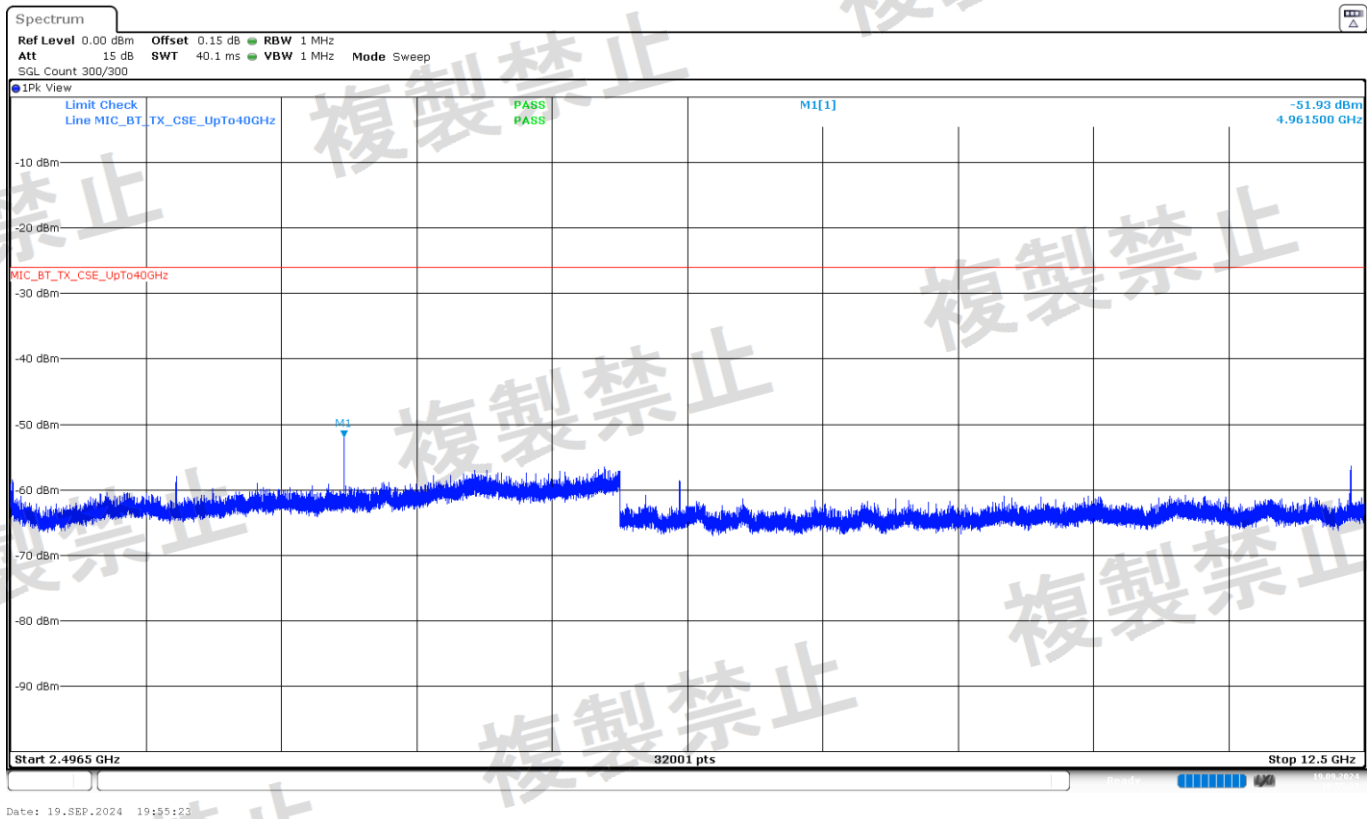
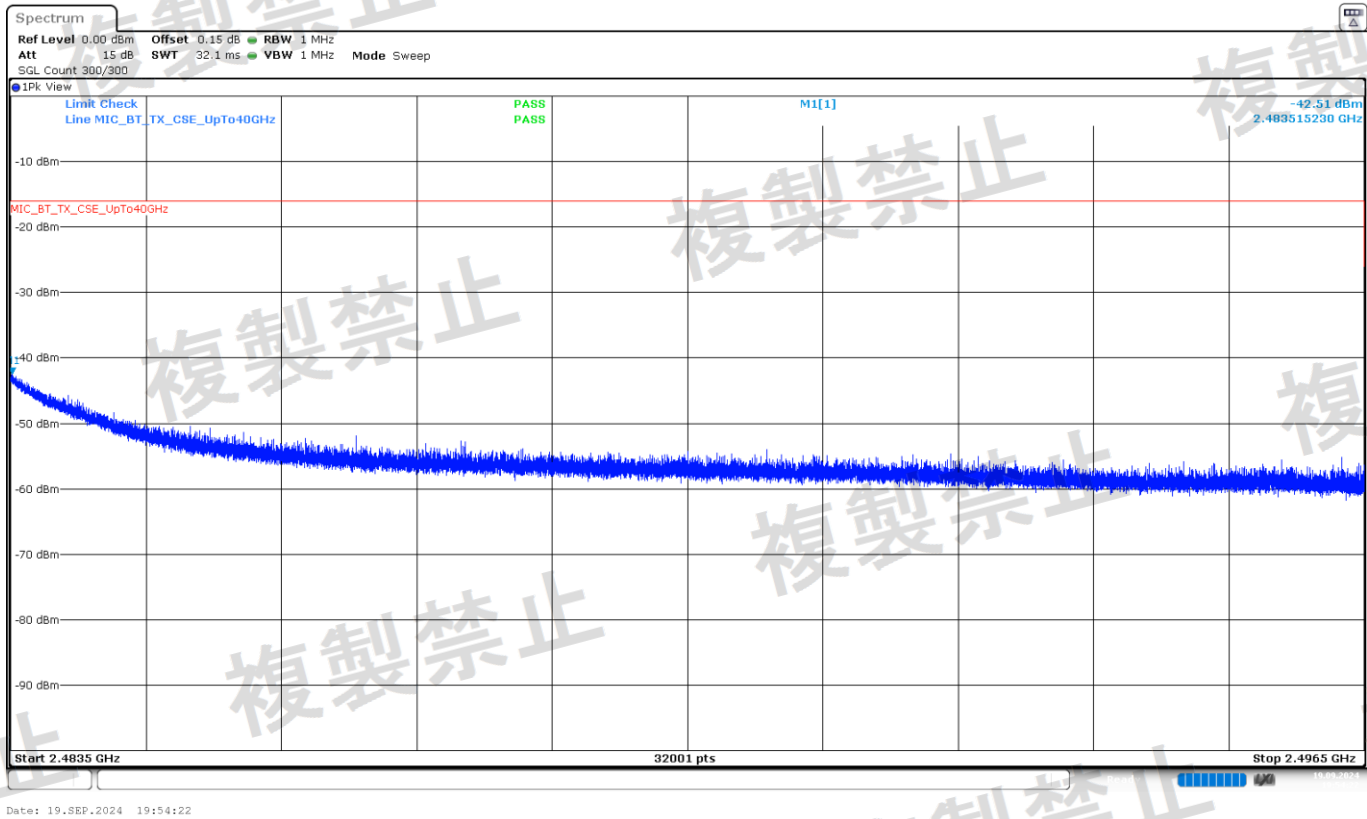
Frequency range 30 MHz – 12.5 GHz:





- HIGH CHANNEL:
Frequency range 30 MHz – 12.5 GHz:





Article 6 and Annex 2. 30. Transmitting equipment. Permissible value for occupied bandwidth

Limits:

Mode	Limit
FH	83.5 MHz
FH+DS	83.5 MHz
FH+OFDM	83.5 MHz
OFDM (Narrow bandwidth), DS	26 MHz
OFDM (Wide band)	38 MHz
Others	26 MHz

Results:

Mode: Other digital modulation methods.

Vnom:

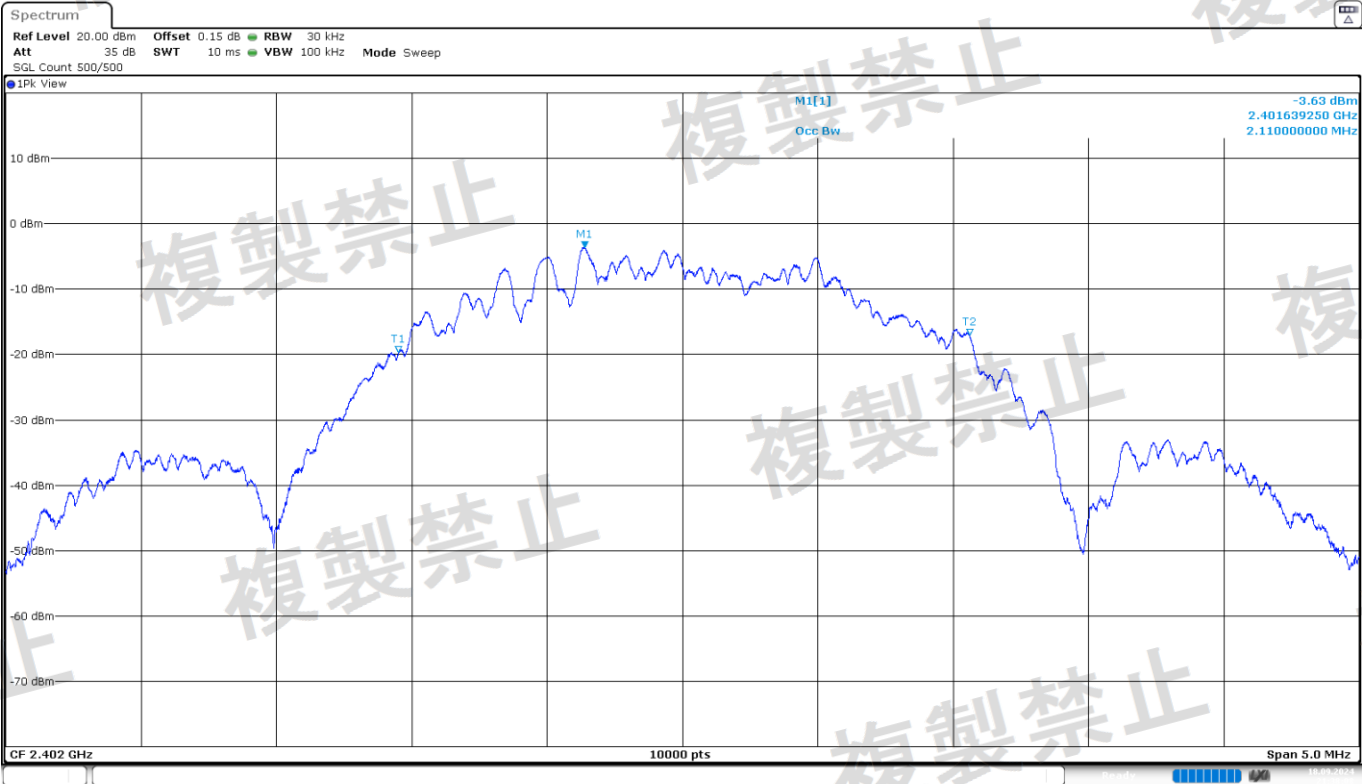
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% occupied bandwidth (MHz)	2.110000	2.111000	2.111500
Limit	<26 MHz		
Measurement uncertainty (kHz)	<± 6.06		

Verdict:

PASS

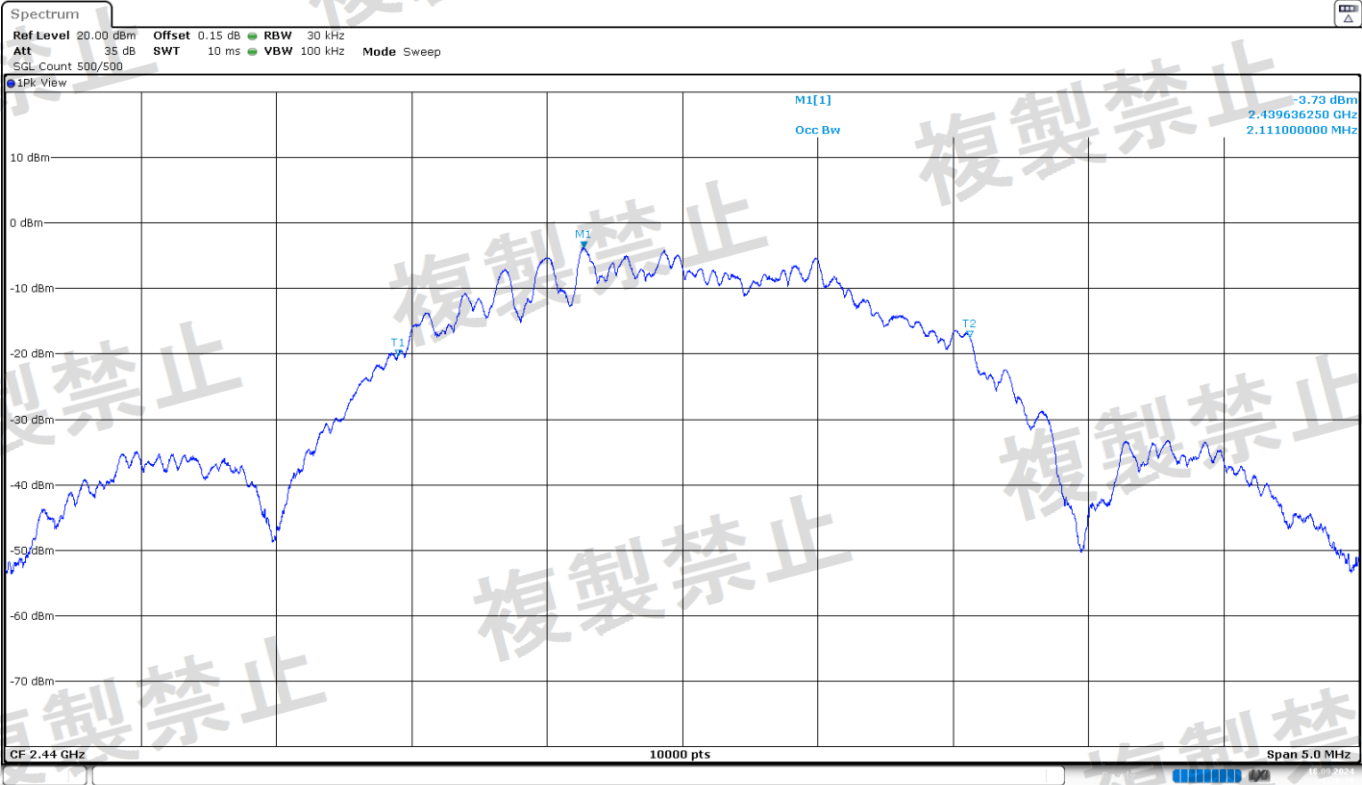
Vnom:

• LOW CHANNEL:



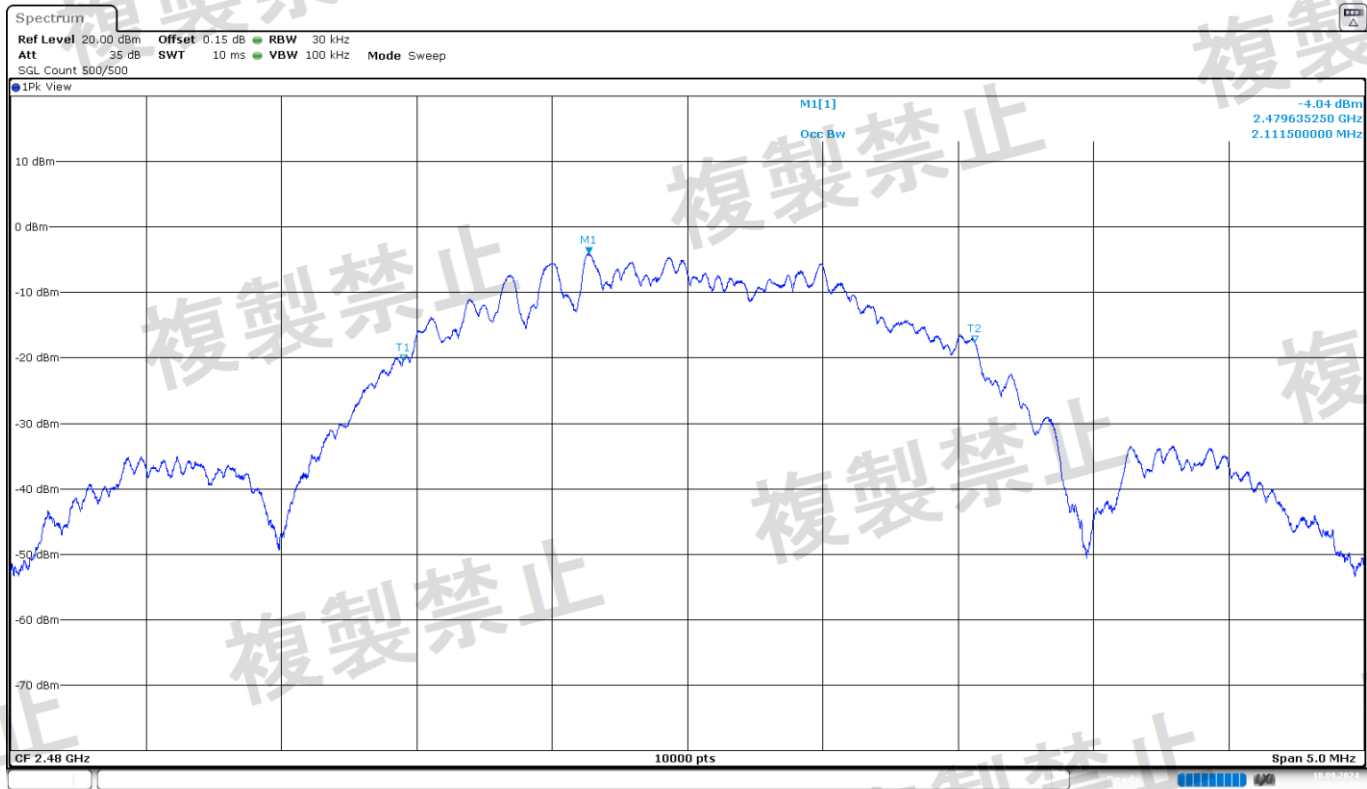
Date: 18.SEP.2024 21:38:09

• MIDDLE CHANNEL:



Date: 18.SEP.2024 21:38:40

HIGH CHANNEL:



Date: 18.SEP.2024 21:39:18

Article 24.2. Receiving equipment. Limit on secondary radiated emissions

Limits:

The limit on secondary emissions radiated from the receiving equipment within which the function of other radio equipment will not be impaired shall be, in terms of the power of a dummy antenna circuit that has the same electrical constant as the receiving antenna, 4 nW (-54 dBm) or less at a frequency below 1 GHz and 20 nW (-47 dBm) or less at a frequency of 1 GHz or higher as measured using the circuit.

Results:

Vnom:

- LOW CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

- MIDDLE CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

- HIGH CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

Measurement uncertainty $< \pm 2.94$ dB

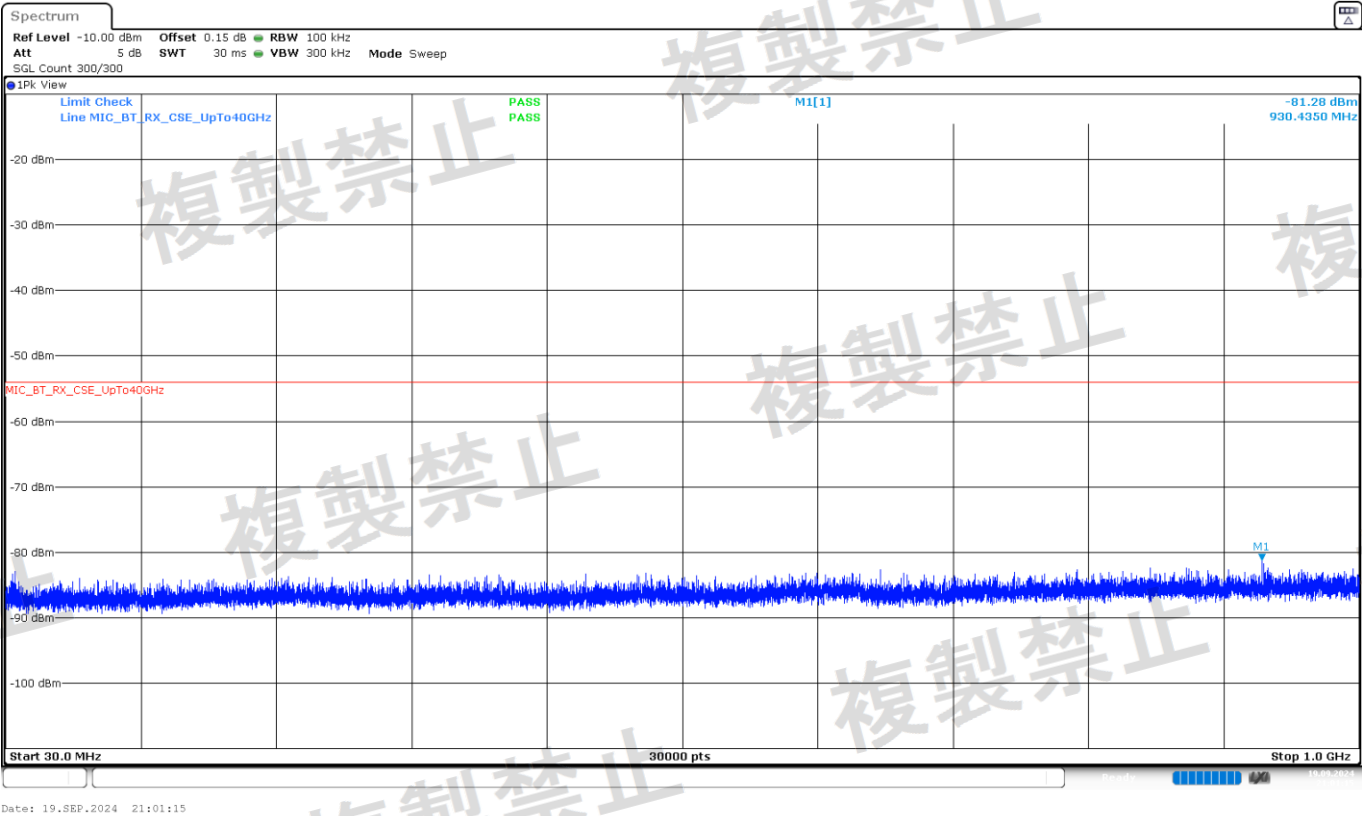
Verdict:

PASS

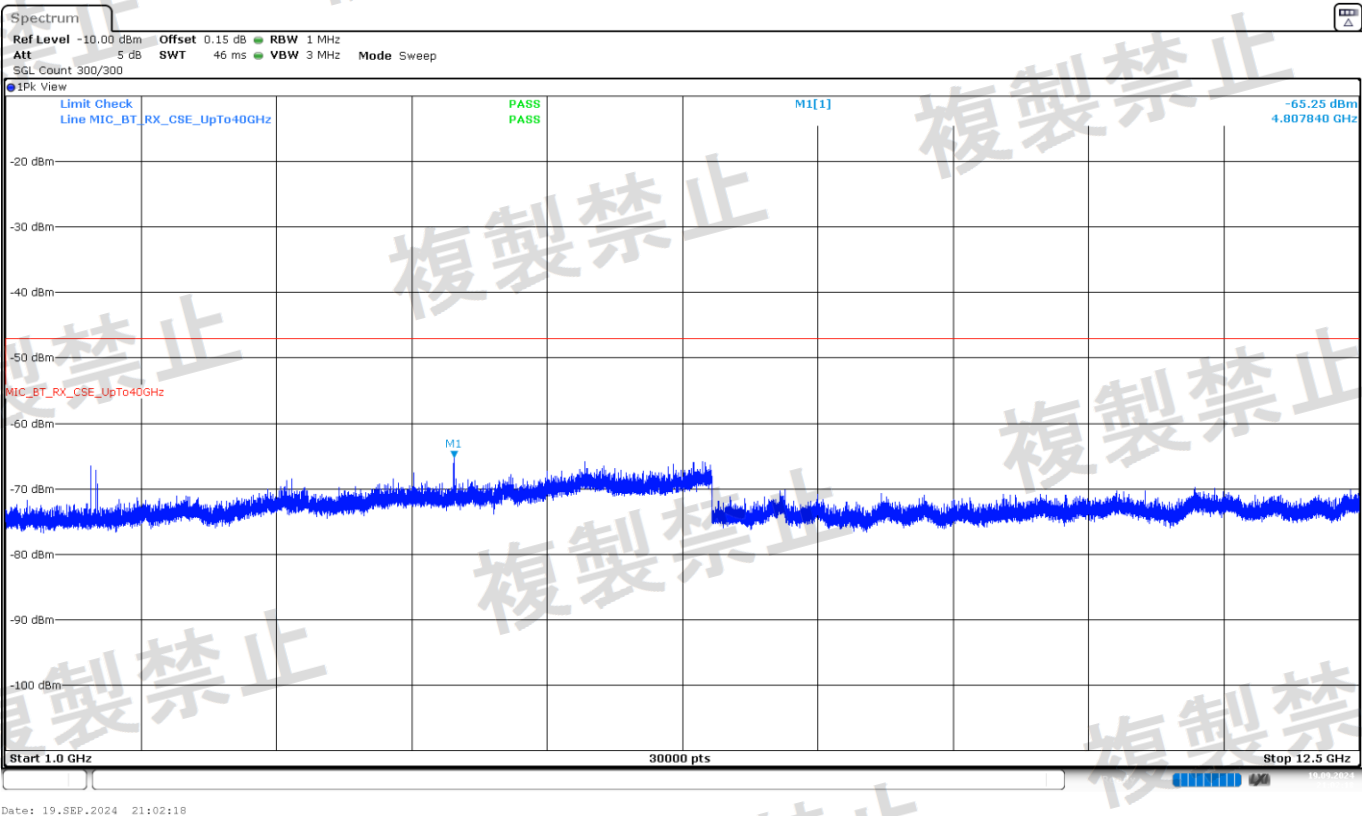
Vnom:

- LOW CHANNEL:

Frequency range 30 MHz - 1 GHz:

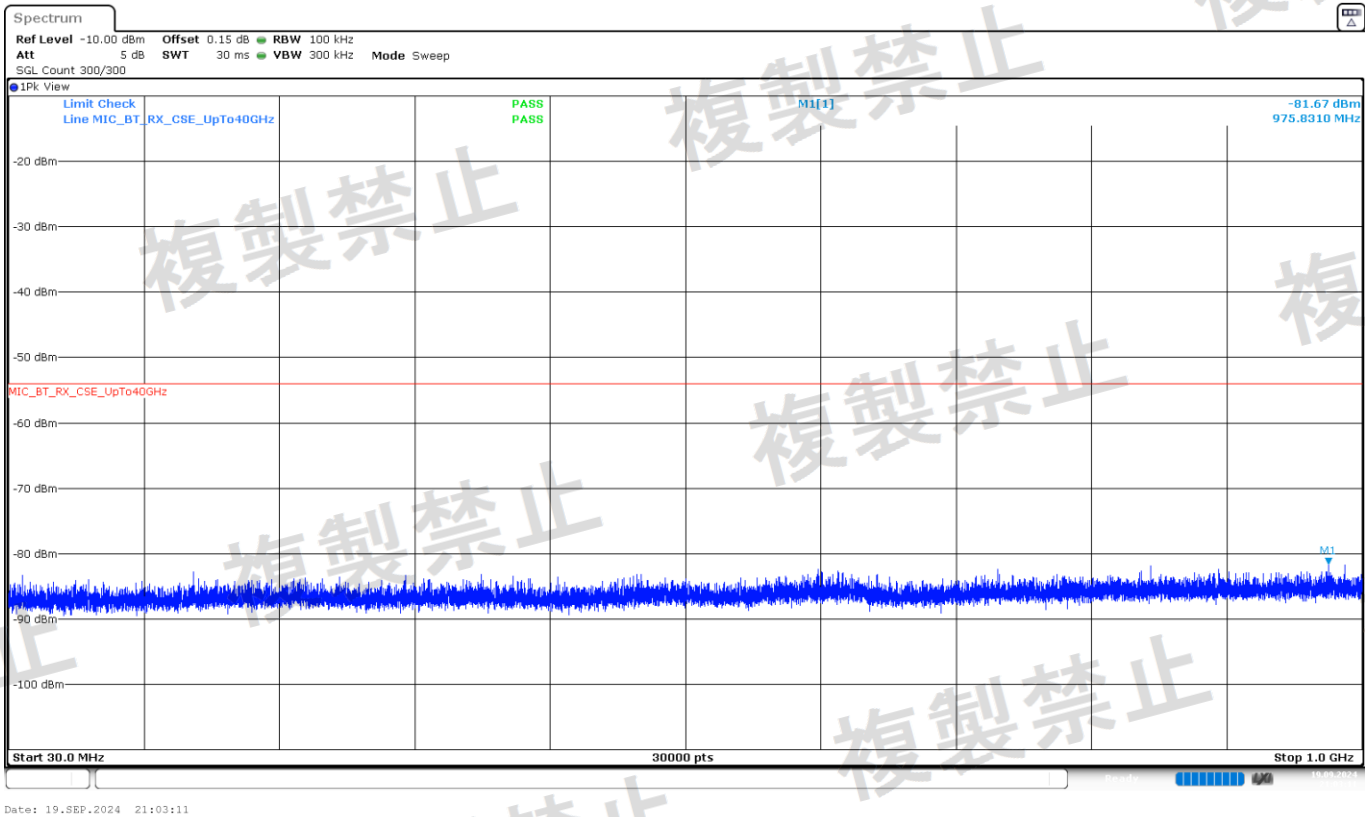


Frequency range 1 – 12.5 GHz:

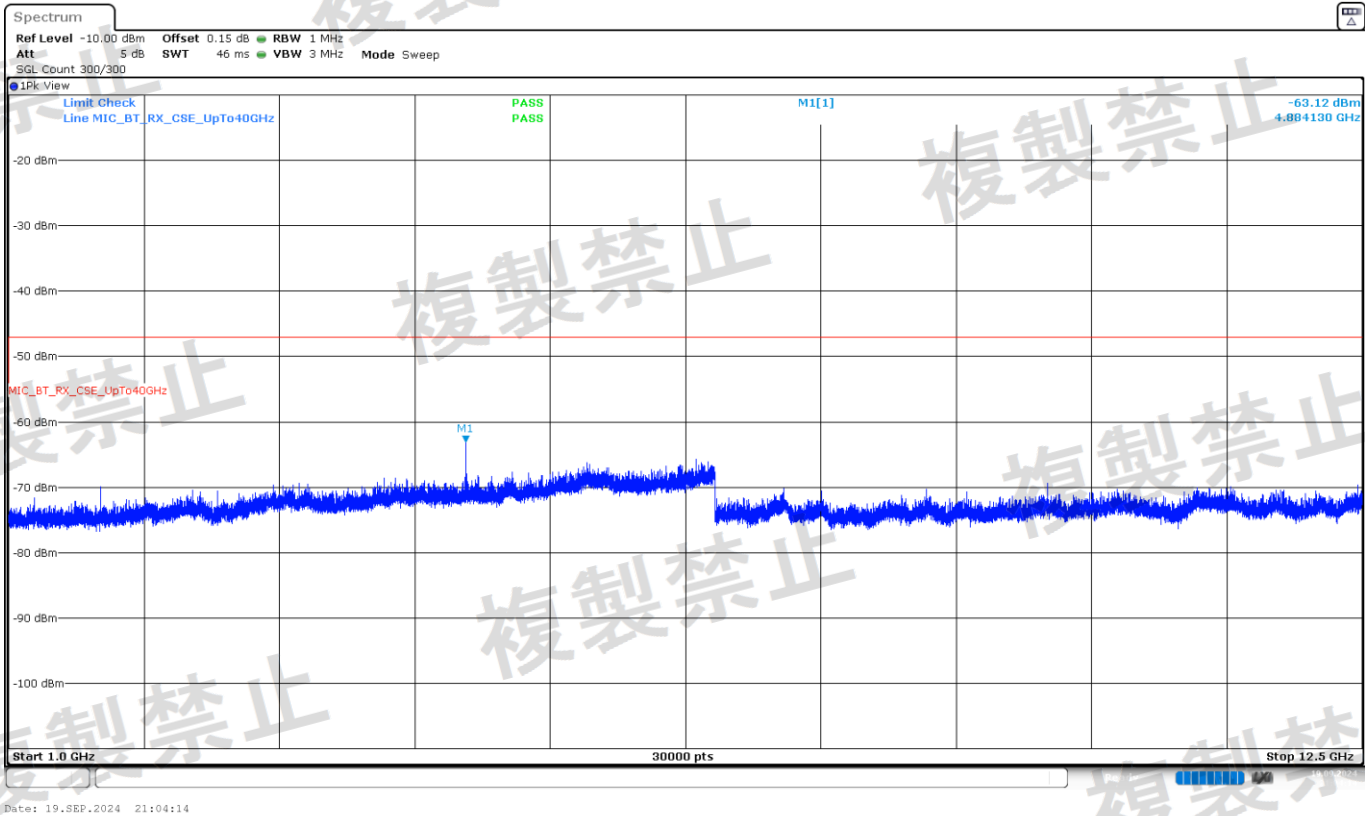


MIDDLE CHANNEL:

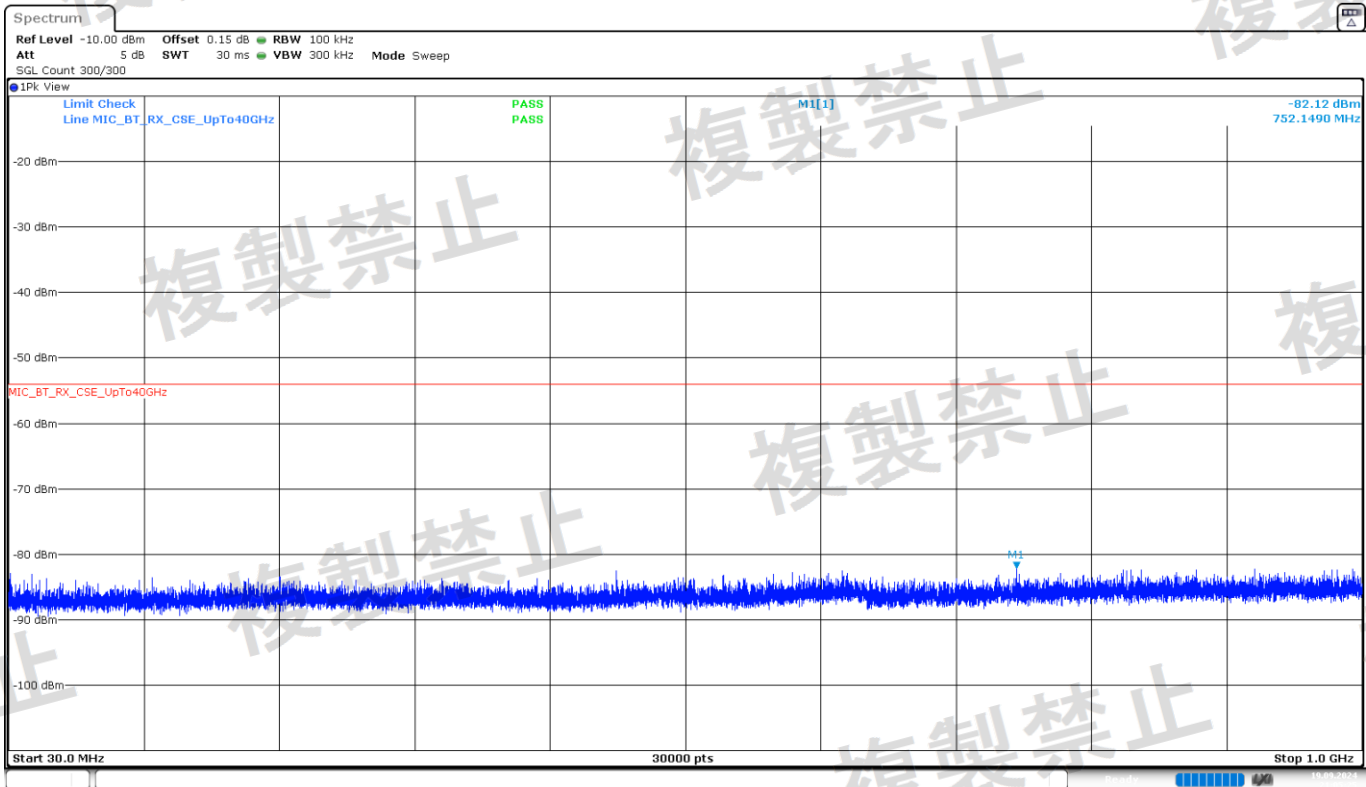
Frequency range 30 MHz - 1 GHz:



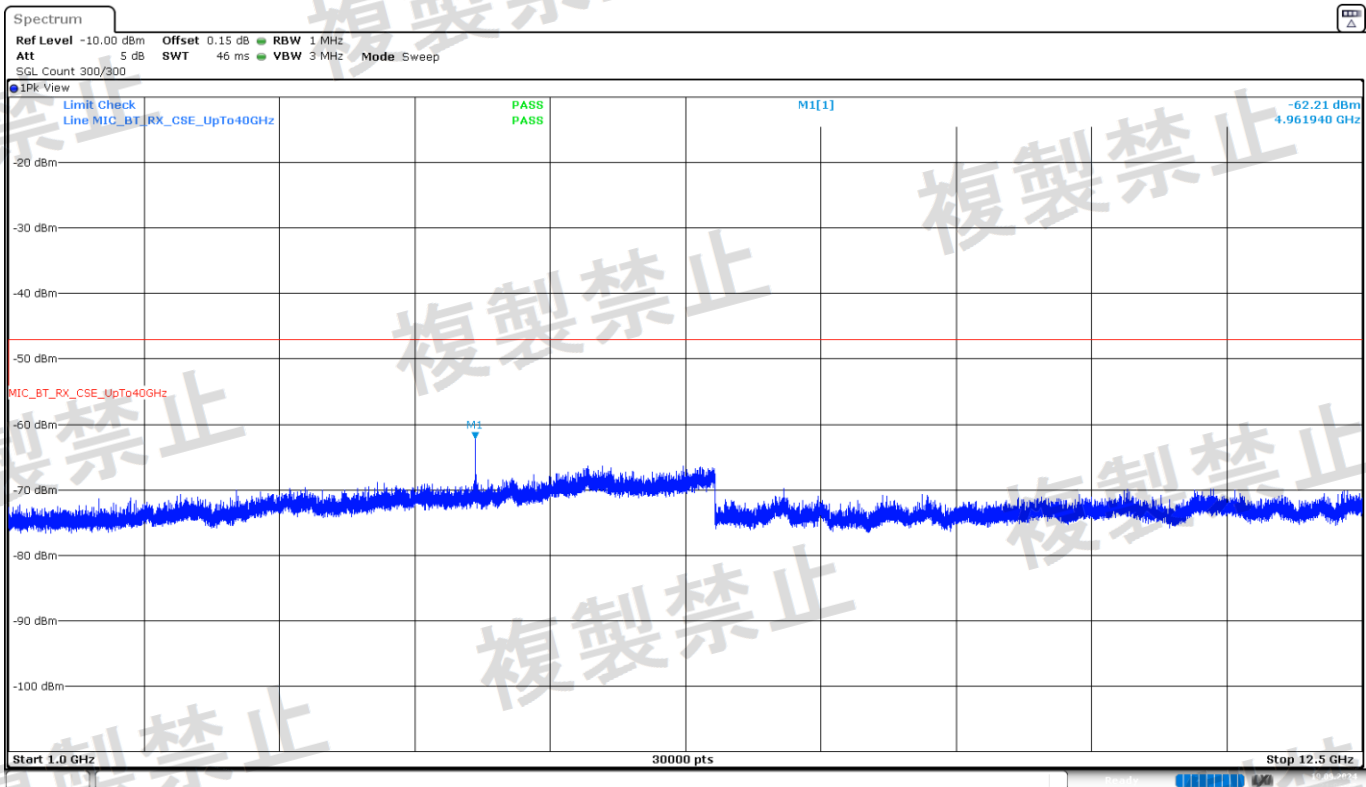
Frequency range 1 – 12.5 GHz:



- HIGH CHANNEL:
- Frequency range 30 MHz - 1 GHz:



Frequency range 1 – 12.5 GHz:



Article 9.4-5. Controlling equipment. Interference prevention function.
Identification code transmission/reception

Limits:

Radio equipment used mainly on the same premises and automatically transmits or receives identification code.

Results:

BLE MAC
48:23:35:F4:00:06

LIST OF DEVICES				
N	Name	Address	RSSI	Ad
1	Renesas ADV Demo	482335F40006	-50	1x1 struct

Verdict:

PASS

Article 49-20. Antenna. Antenna gain

Limits:

a: The absolute gain of the transmitting antenna shall be 12.14 dB or less. However, when the equivalent isotropic radiated power EIRP (equivalent isotropic radiated power in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems) is equal to or less than the value obtained by applying an antenna power with the mean power of 10 mW with its absolute gain being 12.14 dB, the shortage shall be compensated for by the gain of the transmitting antenna (Note that mean power is 10 mW in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems; however, mean power of 3 mW in the 1 MHz bandwidth is applied if the FH system, a hybrid system combining DS and FH systems, or a hybrid system combining FH and OFDM systems is employed and the frequency band of 2,427 - 2,470.75 MHz is used).

b: The Half-Power Beam width Angle HPBA (angle between two points at which radiated power becomes 1/2) of the transmitting antenna's horizontal and vertical planes shall not exceed the value as determined by the following formula:

$$HPBA \leq 360 / A \text{ [degrees]}$$

where constant A is equal to the value obtained by dividing the equivalent isotropic radiated power EIRP (equivalent isotropic radiated power in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems) by the value obtained by applying an antenna power with the mean power of 10 mW with its absolute gain being 2.14 dB, and shall be assumed to be 1 if it is less than 1 (Note that mean power is 10 mW in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems; however, mean power of 3 mW in the 1 MHz bandwidth is applied if the FH system, a hybrid system combining DS and FH systems, or a hybrid system combining the FH and OFDM systems is employed and the frequency band of 2,427 - 2,470.75 MHz is used).

Therefore

$$A = \text{EIRP (mW)} / (10 \text{ mW} \times \text{absolute gain}) = \text{EIRP (mW)} / 16.37$$

Where absolute gain is the linear value corresponding to 2.14 dB = 1.637.

Results:

Maximum Declared Antenna Gain: -1.5 dBi

Vnom:

Channel	Measured antenna power (dBm)	Radiated power EIRP (dBm)	Radiated power EIRP (mW)	A = EIRP (mW) / 16.37
Low (2402 MHz)	5.56000	4.06	2.55	< 1
Middle (2440 MHz)	5.22000	3.72	2.36	< 1
High (2480 MHz)	4.78000	3.28	2.13	< 1

Since A is < 1, it is assumed to be 1, and therefore the half-power beam width must be 360° or less.

Verdict:

PASS

Appendix B: Test results. Bluetooth Low Energy (1M)

INDEX

INDEX.....35

TEST CONDITIONS.....36

PRODUCT INFORMATION 37

Article 49-20 and Article 14.7 Table 8. Transmitting equipment. Antenna power. Tolerances for antenna power.....38

Article 5 and Annex 1 table 7-8. Transmitting equipment. Frequency tolerance 39

Article 7 and Annex 3. 26. Transmitting equipment. Spurious emission intensity 40

Article 6 and Annex 2. 30. Transmitting equipment. Permissible value for occupied bandwidth 49

Article 24.2. Receiving equipment. Limit on secondary radiated emissions.....52

Article 9.4-5. Controlling equipment. Interference prevention function. Identification code transmission/reception 56

Article 49-20. Antenna. Antenna gain.....57

TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal: 3.3 Vdc

Type of Power Supply: USB

TEST FREQUENCIES (*):

Modulation	Data rates	Low Channel:	Middle Channel	High Channel
BLE GFSK	1 Mbit/s	2402 MHz	2440 MHz	2480 MHz

During transmitter test the EUT was controlled by a SW tool provided by the client to operate in a continuous transmit mode on the modulation schemes and test channels as required.

ENVIRONMENTAL CONDITIONS DURING TESTING:

Date	Temperature	Humidity
2024-09-18	22.11 – 23.51 °C	51.2 – 55.6 %

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and its antenna port (SMA type) is connected to the spectrum analyser through a low loss RF cable. The reading of the spectrum analyser is corrected with the cable loss.

The DC supply voltage is applied using a power supply.

The Equipment Under Test (E.U.T) is set in continuous transmission with modulation using an implemented test mode. The test mode also permits to set the E.U.T. in receiving mode with the transmission disabled

PRODUCT INFORMATION

Modulation:	GFSK.
Spread spectrum system:	No (Other digital modulation methods).
Nominal necessary Bandwidth:	1 MHz
Maximum declared antenna gain:	-1.5 dBi.
Rated Antenna Power:	6 dBm (3.981071706 mW).
Type of Antenna:	Integrated Printed Inverted F
Operating nominal frequency range:	2400 MHz to 2483.5 MHz.
Nominal power supply:	3.3 Vdc.
Type of power supply:	USB.

Article 49-20 and Article 14.7 Table 8. Transmitting equipment. Antenna power.
Tolerances for antenna power

Limits:

Mode	Limit	Tolerance
a) FH, FH+DS, FH+OFDM	3 mW/MHz	+20%
b) OFDM (Narrow bandwidth), DS	10 mW/MHz	
c) Other than a & b	10 mW	
d) OFDM (Wide band)	5 mW/MHz	

Results:

Mode: Other digital modulation methods than a & b.

Maximum Rated Antenna Power: 6 dBm (3.981071706 mW)

Vnom:

Channel	Measured antenna power (dBm)	Radiated power EIRP (dBm)	Antenna power EIRP (mW)	Deviation from maximum rated antenna power (%)
Low (2402 MHz)	5.560	4.06	2.55	-9.6350
Middle (2440 MHz)	5.220	3.72	2.36	-16.4396
High (2480 MHz)	4.780	3.28	2.13	-24.4907

Measurement uncertainty: < ± 2.01 dB

Verdict:

PASS

Article 5 and Annex 1 table 7-8. Transmitting equipment. Frequency tolerance

Limits:

Frequency tolerance shall be $\pm 50 \times 10^{-6}$ (50 ppm).

Results:

Vnom:

Channel	Frequency error (Hz)	Frequency error (ppm)
Low (2402 MHz)	-5505	-2.2918
Middle (2440 MHz)	-5505	-2.2561
High (2480 MHz)	-5395	-2.1754
Measurement uncertainty	< $\pm$ 7.10 kHz	

Verdict:

PASS

Article 7 and Annex 3. 26. Transmitting equipment. Spurious emission intensity

Limits:

Permissible mean power of spurious emission of each frequency supplied to a feeder, that is, mean power of spurious emission in the 1 MHz bandwidth at frequency f other than frequency band used shall be as follows:

- | | |
|---|--------------------------------------|
| a. $2,387 \text{ MHz} \leq f \leq 2,400 \text{ MHz}$ and $2,483.5 \text{ MHz} < f \leq 2,496.5 \text{ MHz}$ | 25 μW (-16 dBm) or less. |
| b. $2,387 \text{ MHz} > f$ and $2,496.5 \text{ MHz} < f$ | 2.5 μW (-26 dBm) or less. |

Results:

Vnom:

- LOW CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

- MIDDLE CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

- HIGH CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

Measurement uncertainty $< \pm 2.77 \text{ dB}$

Verdict:

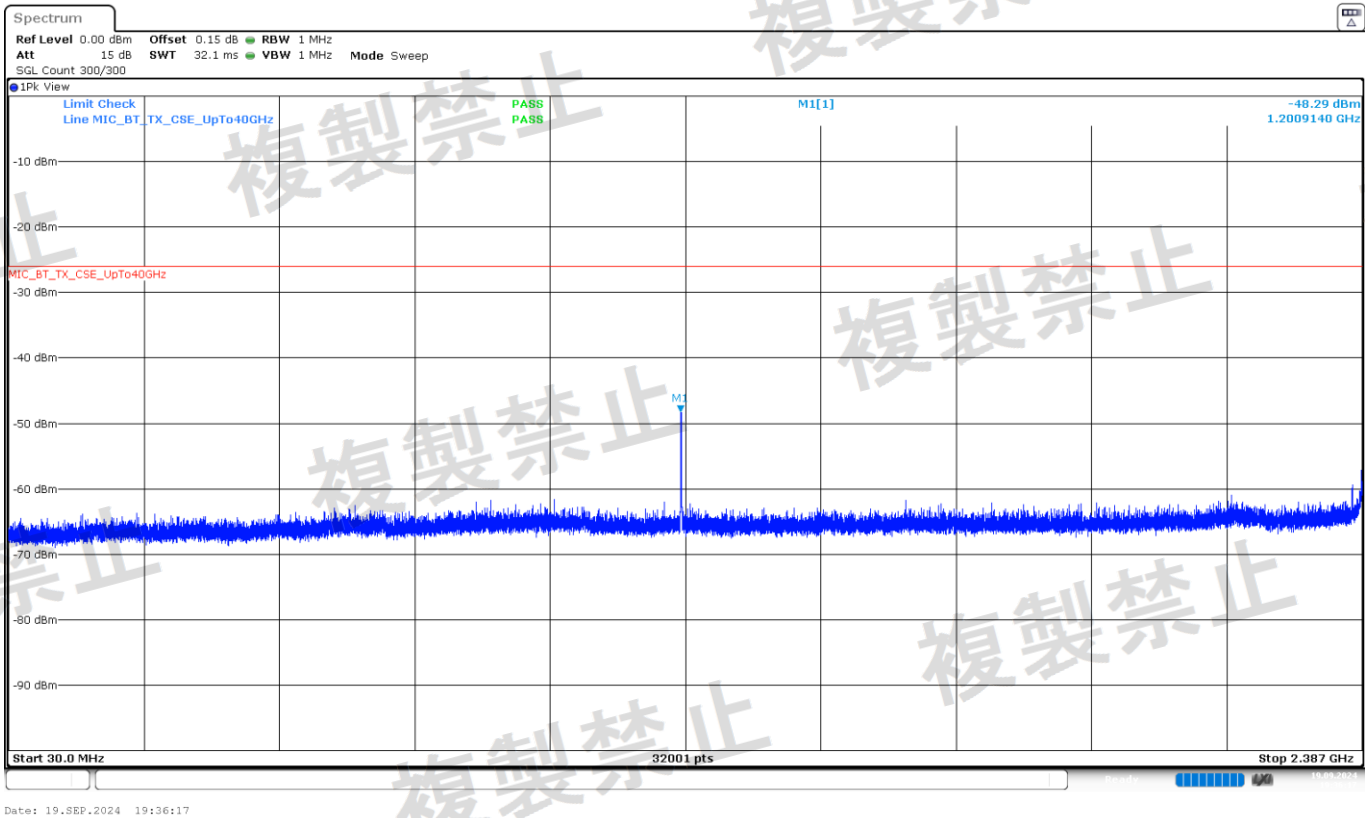
PASS

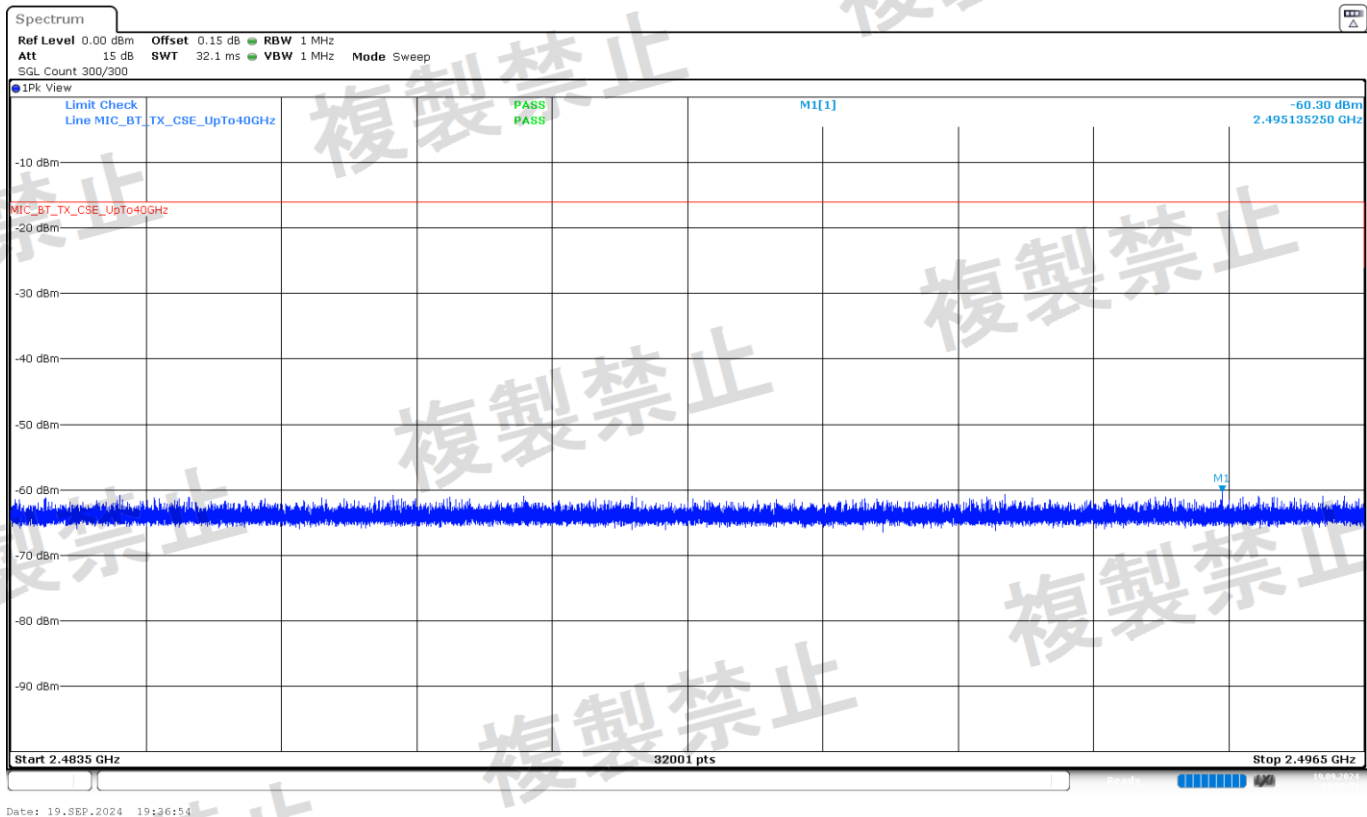
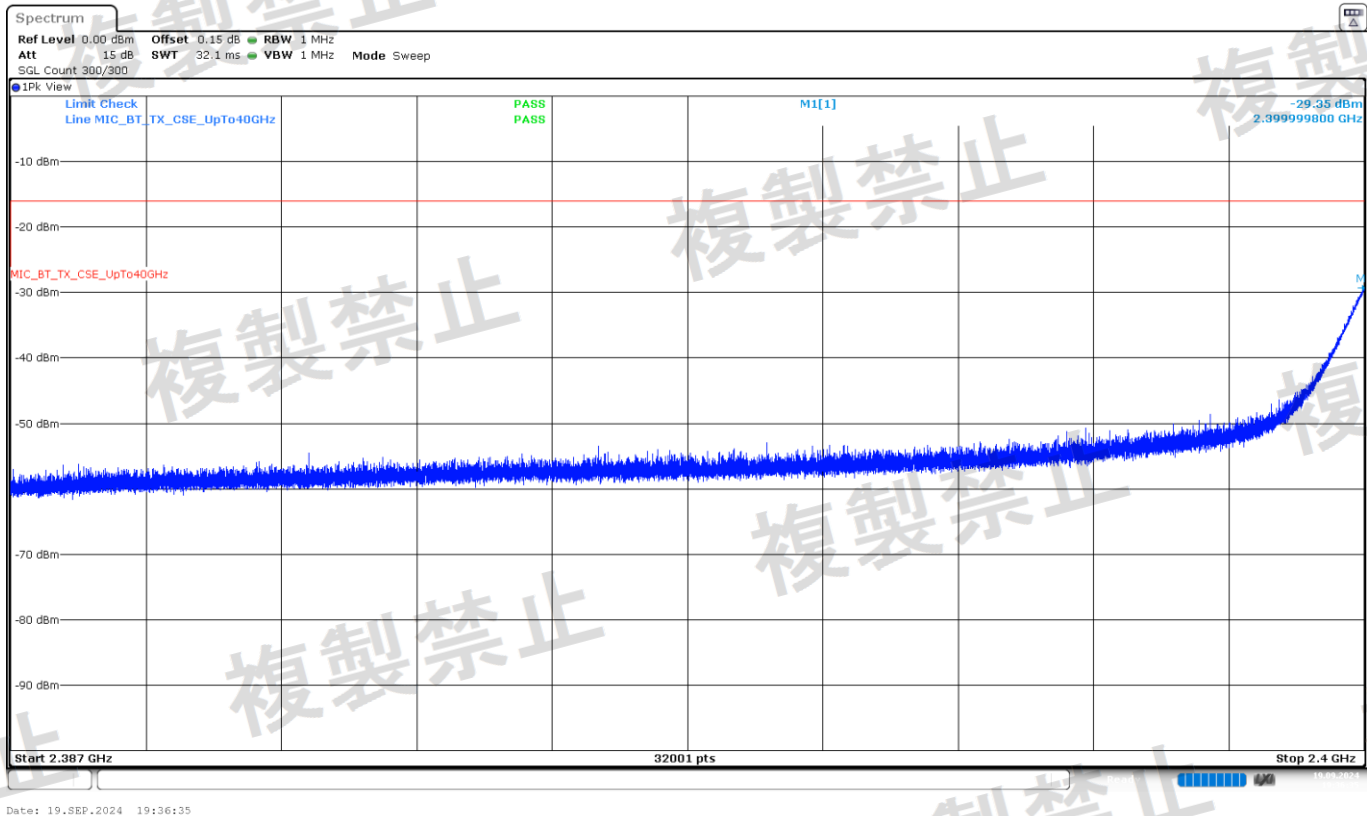
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
9 kHz - 150 kHz	141 Hz	PK+	300 Hz	1 s	0 dB
150 kHz - 30 MHz	3.317 kHz	PK+	10 kHz	1 s	0 dB
30 MHz - 1 GHz	97 kHz	PK+	1 MHz	1 s	0 dB
1 GHz - 2.3 GHz	130 kHz	PK+	1 MHz	1 s	0 dB
2.3 GHz - 2.6 GHz	30 kHz	PK+	1 MHz	1 s	0 dB
2.6 GHz - 12.5 GHz	330 kHz	PK+	1 MHz	1 s	0 dB
12.5 GHz - 25 GHz	416.667 kHz	PK+	1 MHz	1 s	0 dB

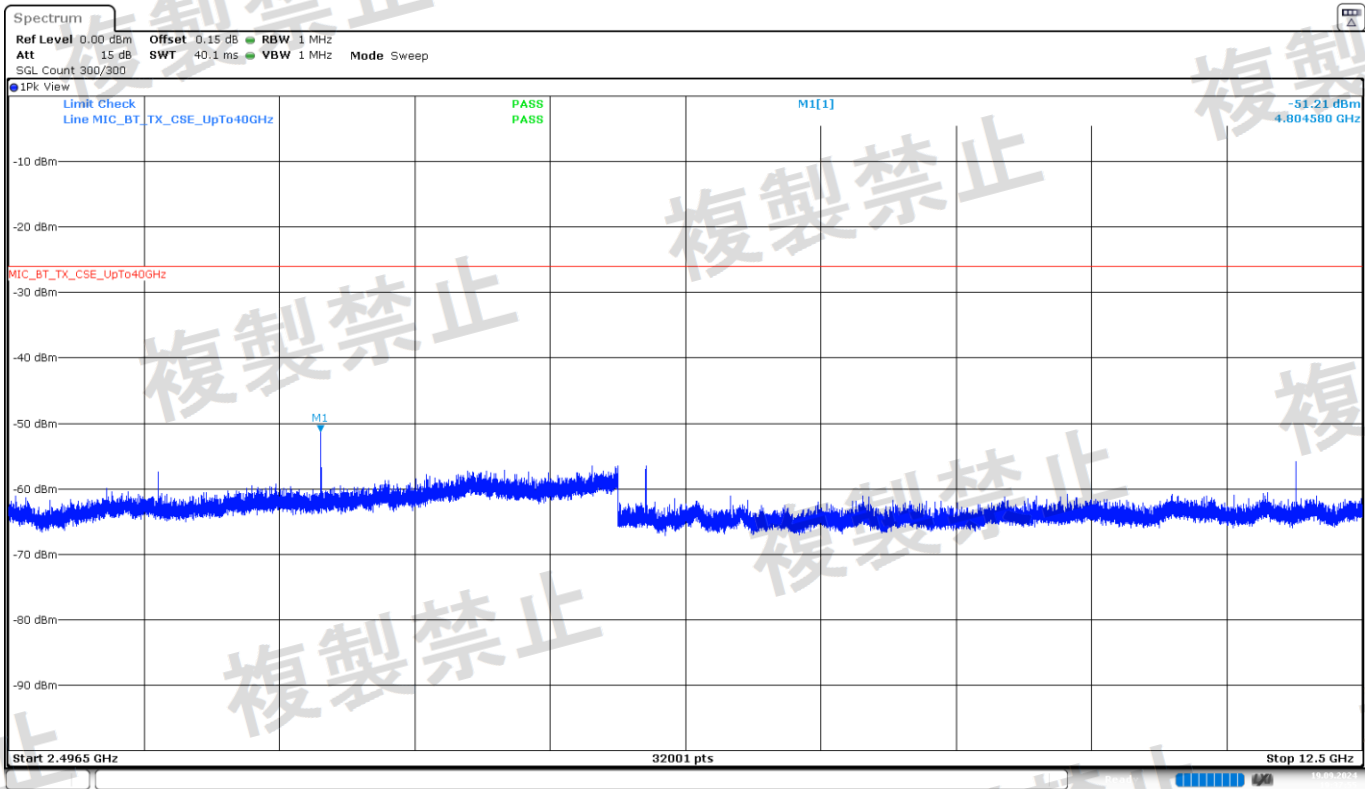
Vnom:

- LOW CHANNEL:

Frequency range 30 MHz – 12.5 GHz:



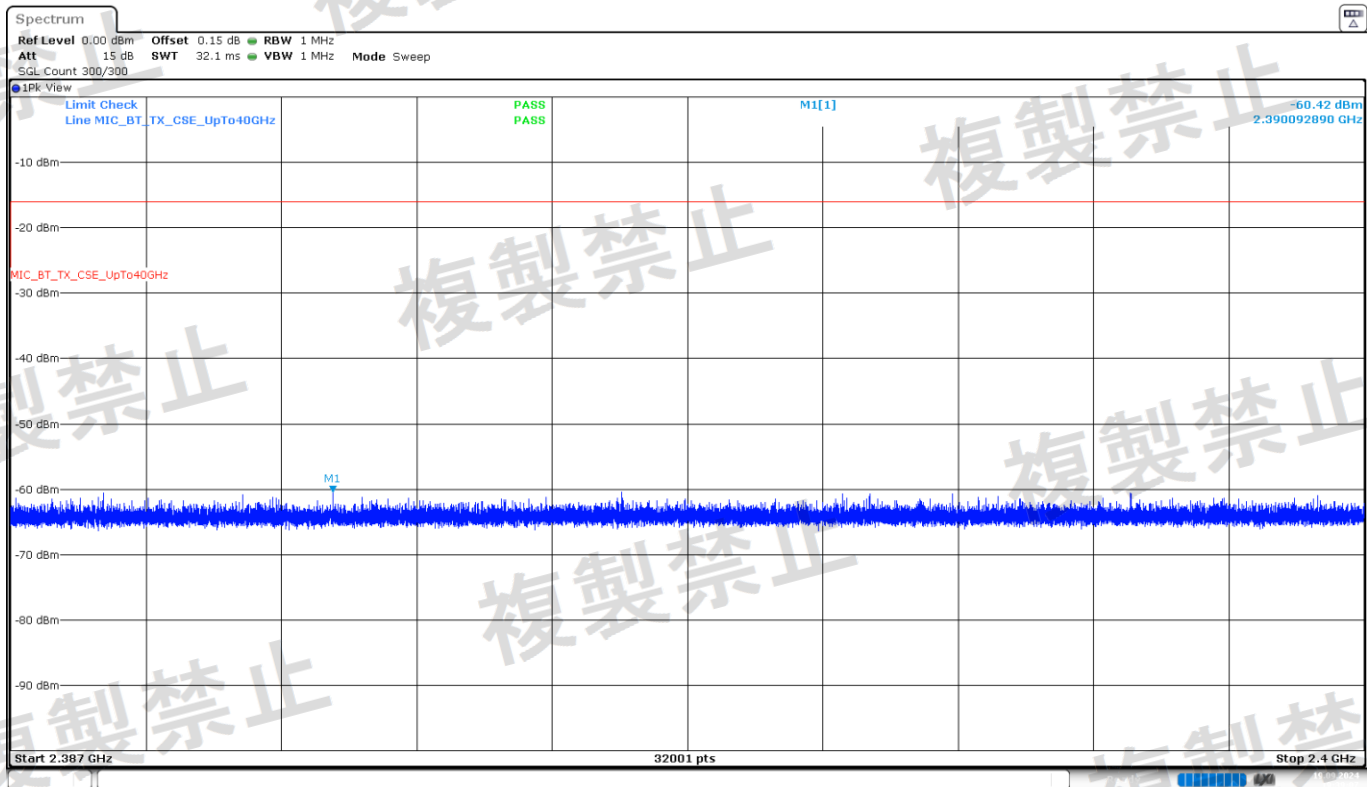
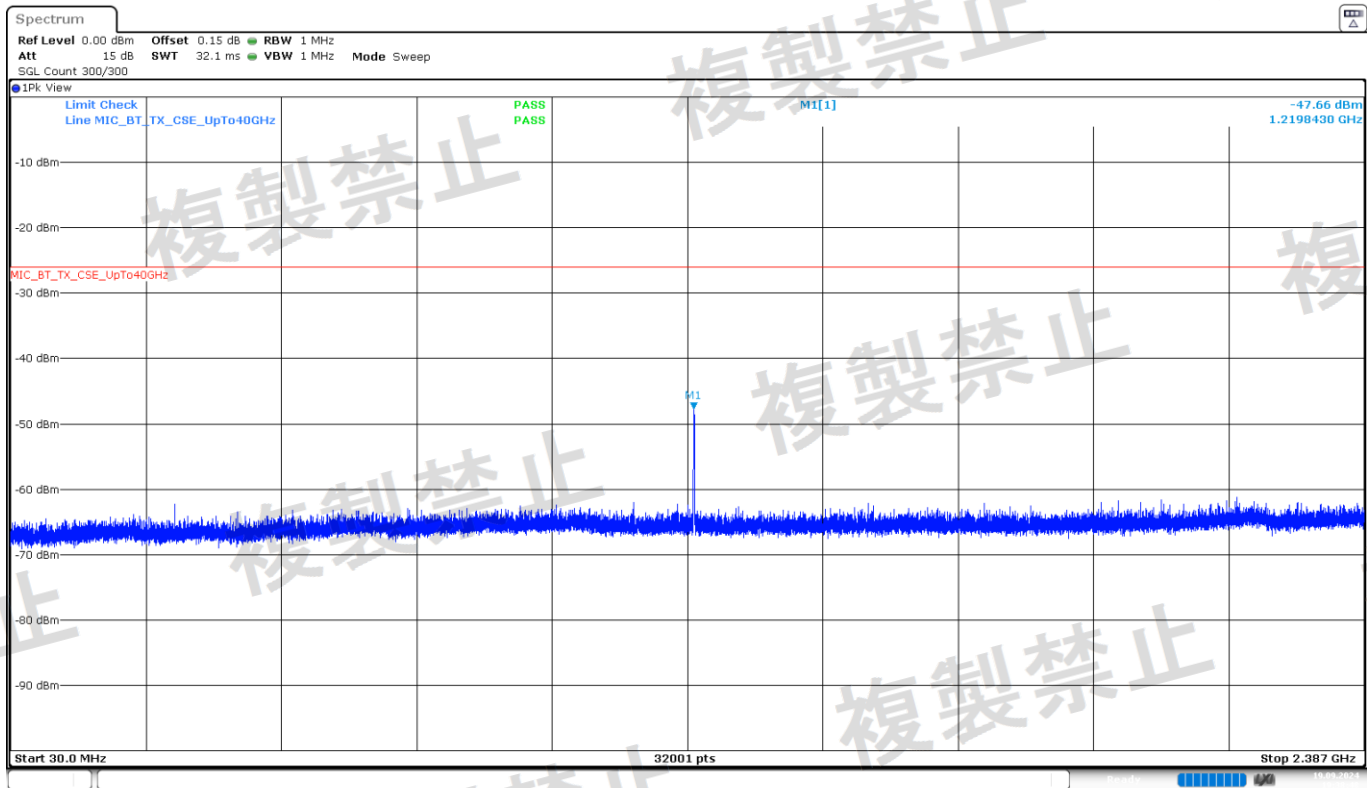


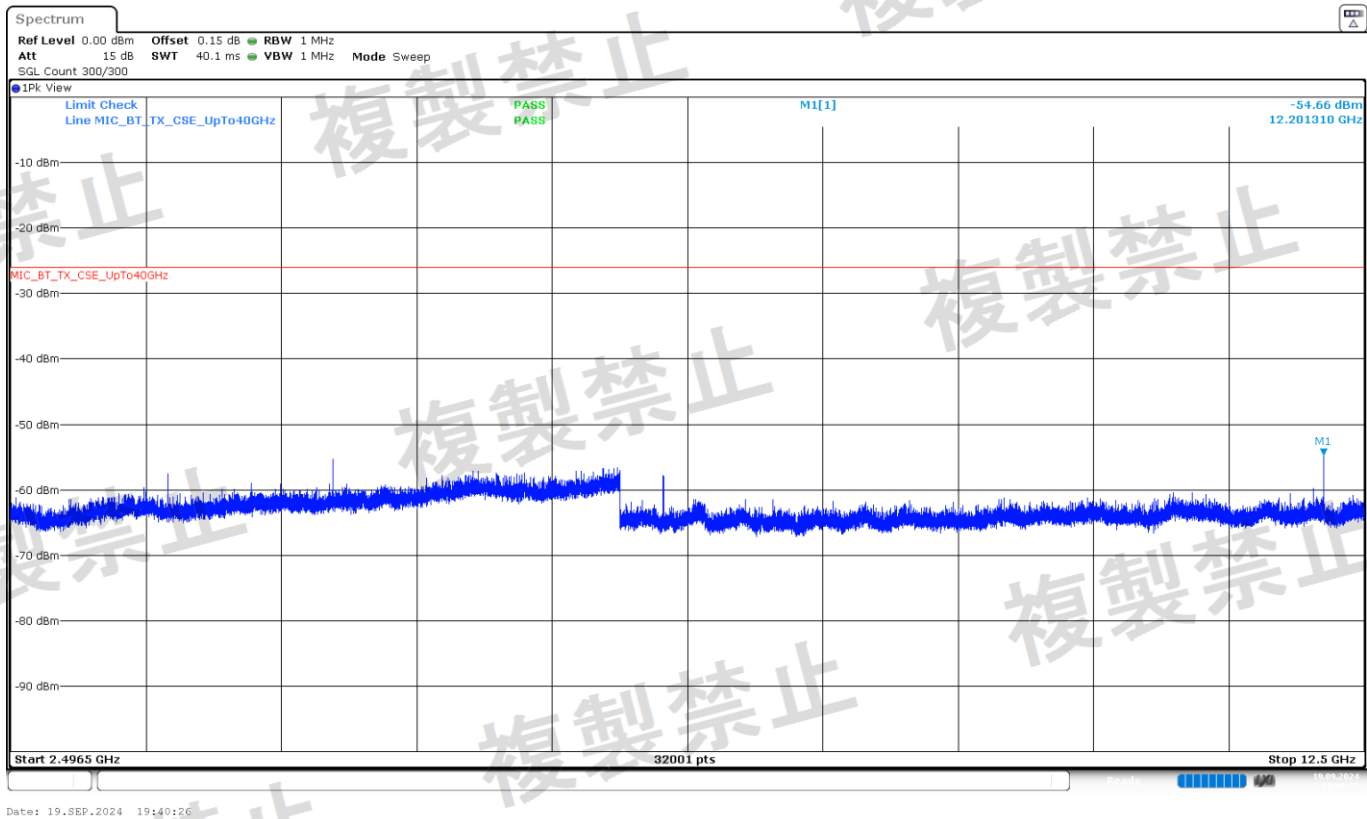
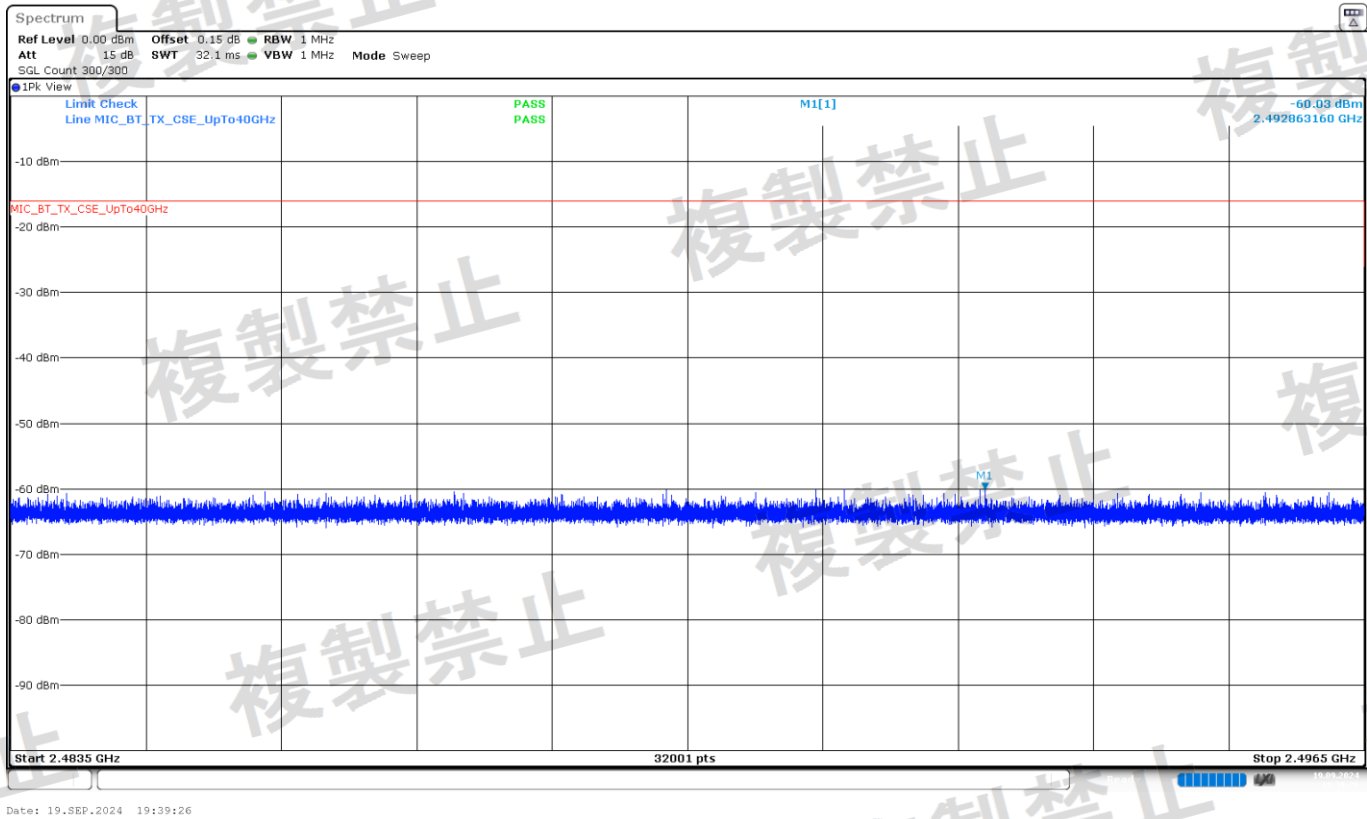


Date: 19.SEP.2024 19:37:55

MIDDLE CHANNEL:

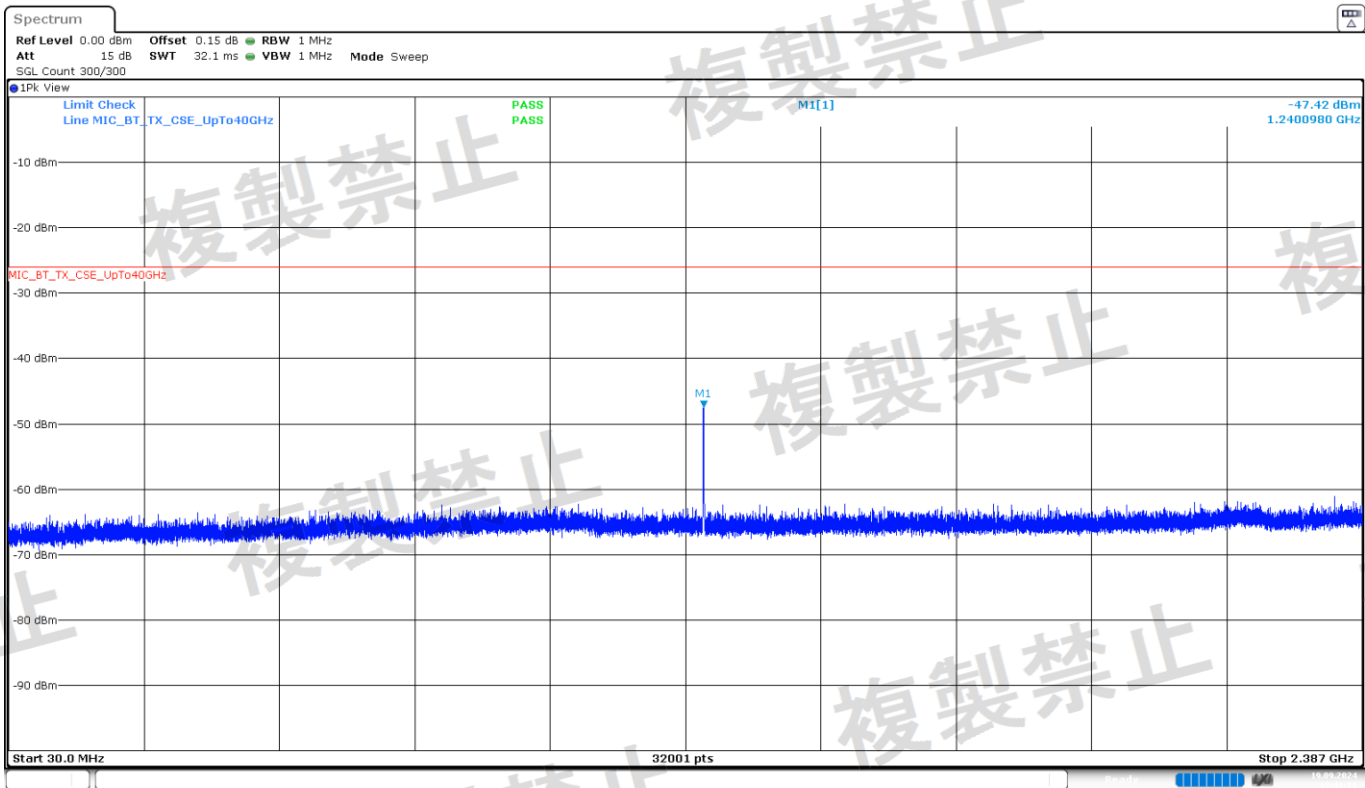
Frequency range 30 MHz – 12.5 GHz:



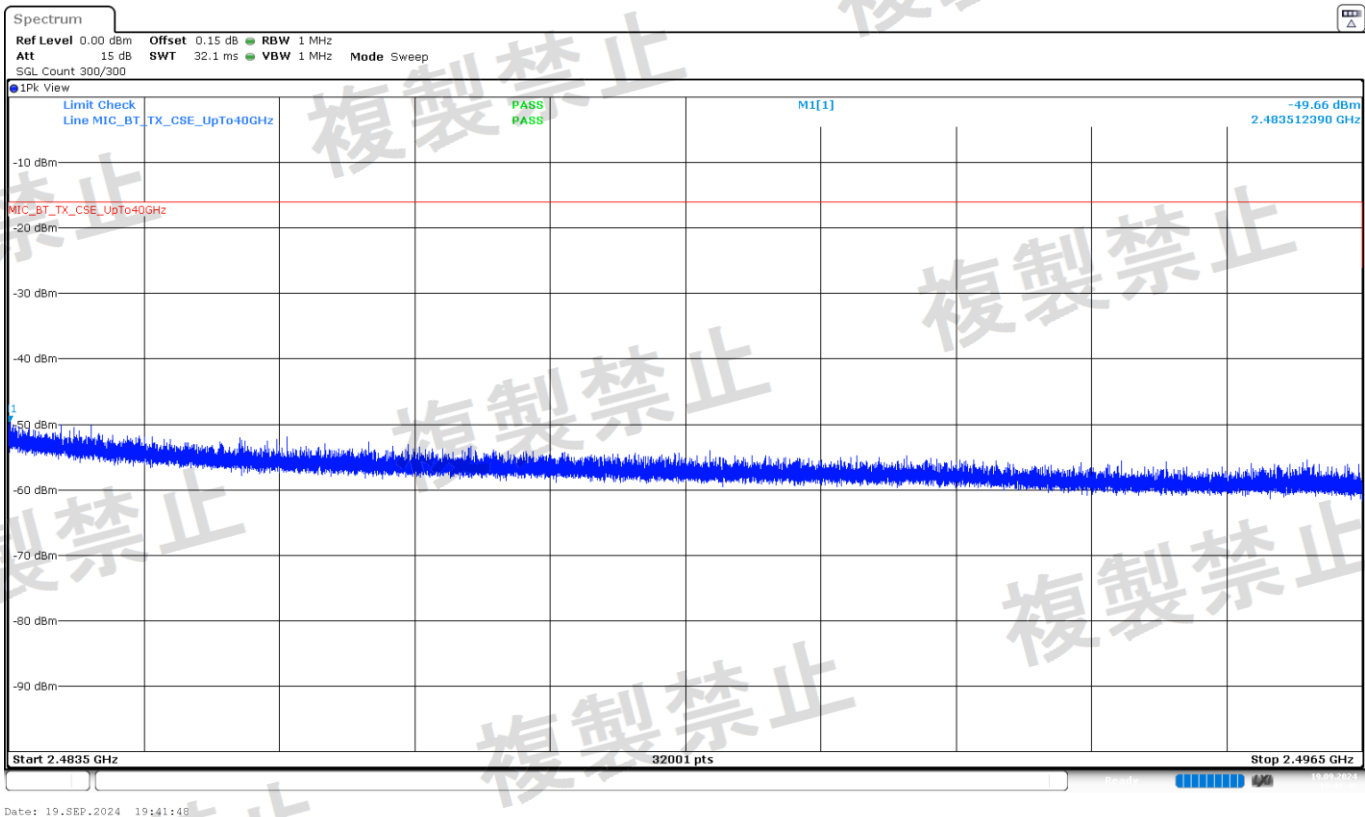
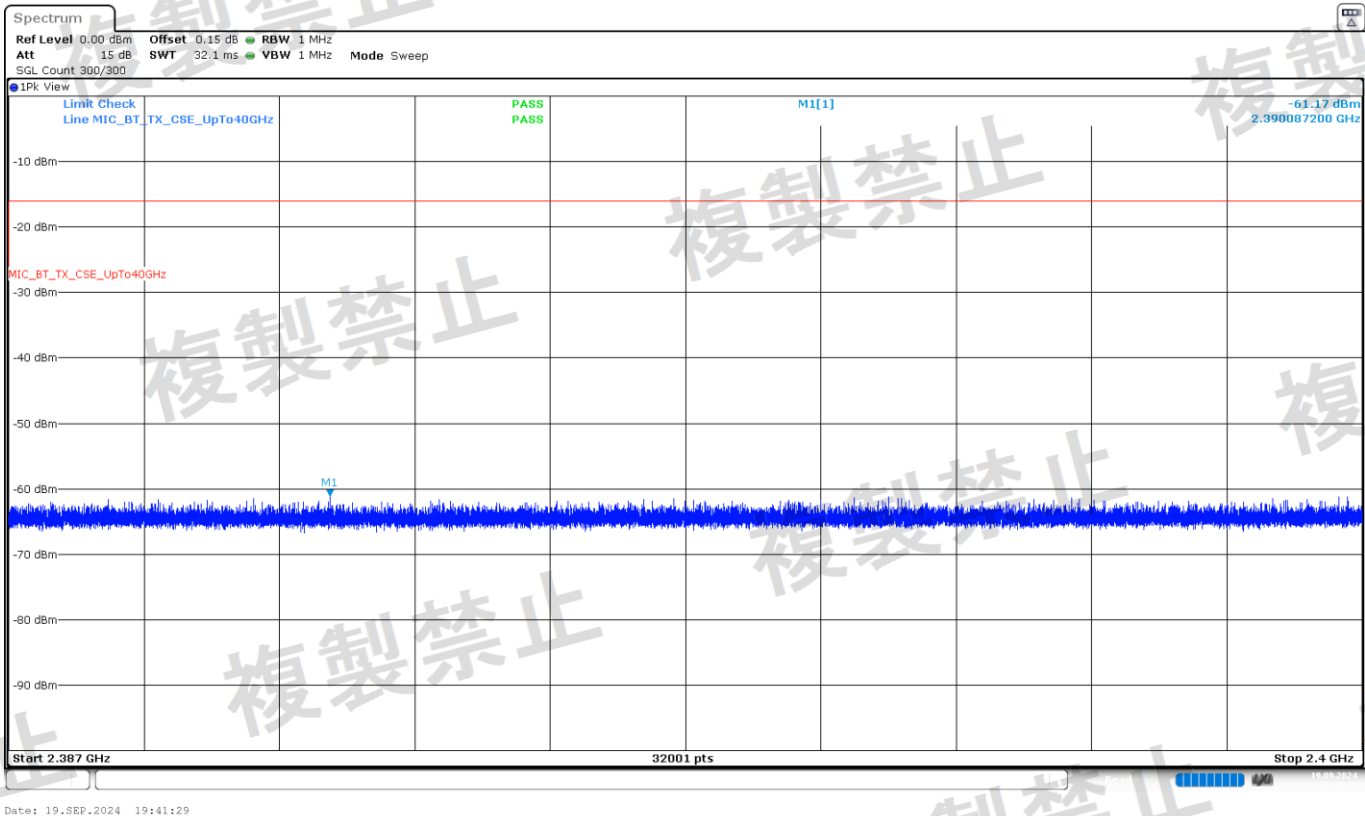


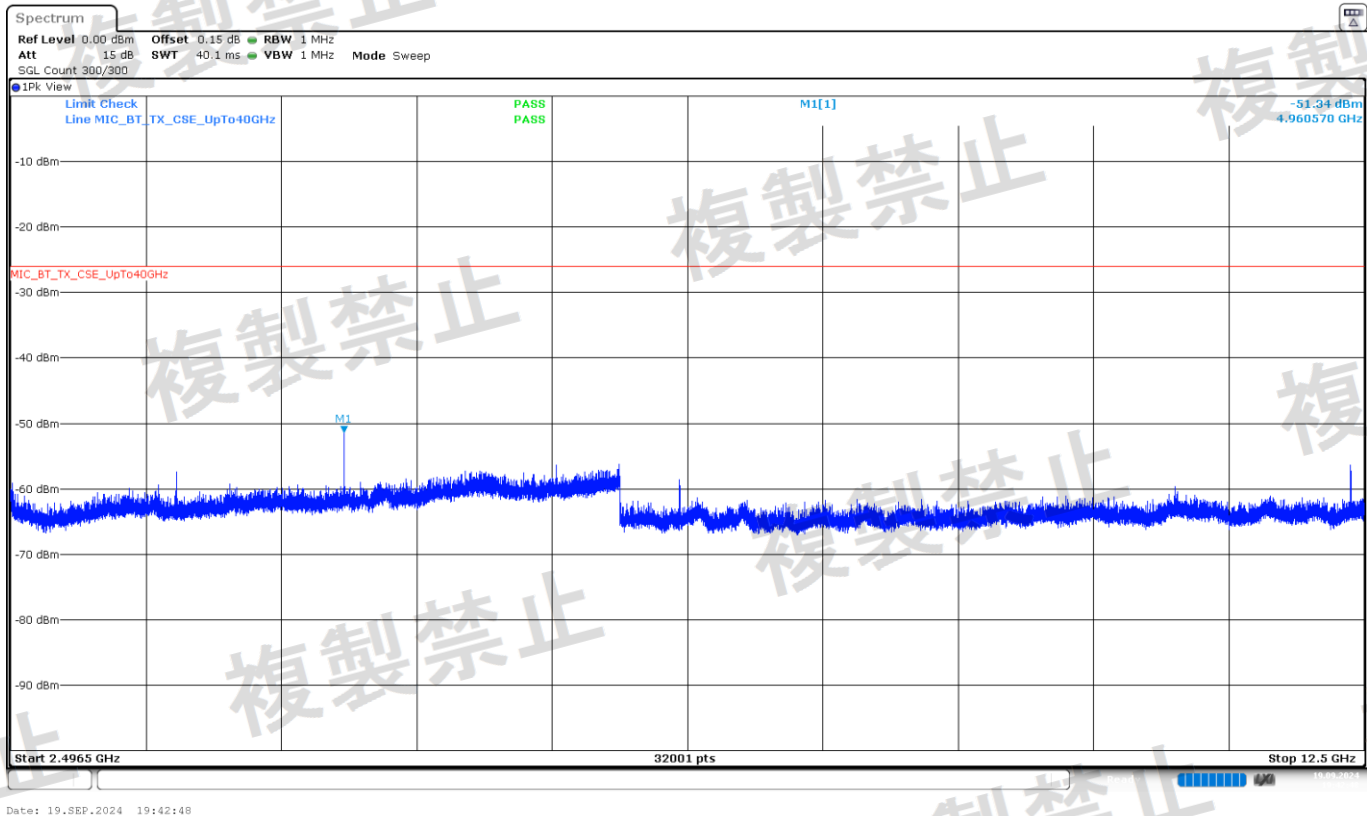
- HIGH CHANNEL:

Frequency range 30 MHz – 12.5 GHz:



Date: 19.SEP.2024 19:41:11





Article 6 and Annex 2. 30. Transmitting equipment. Permissible value for occupied bandwidth

Limits:

Mode	Limit
FH	83.5 MHz
FH+DS	83.5 MHz
FH+OFDM	83.5 MHz
OFDM (Narrow bandwidth), DS	26 MHz
OFDM (Wide band)	38 MHz
Others	26 MHz

Results:

Mode: Other digital modulation methods.

Vnom:

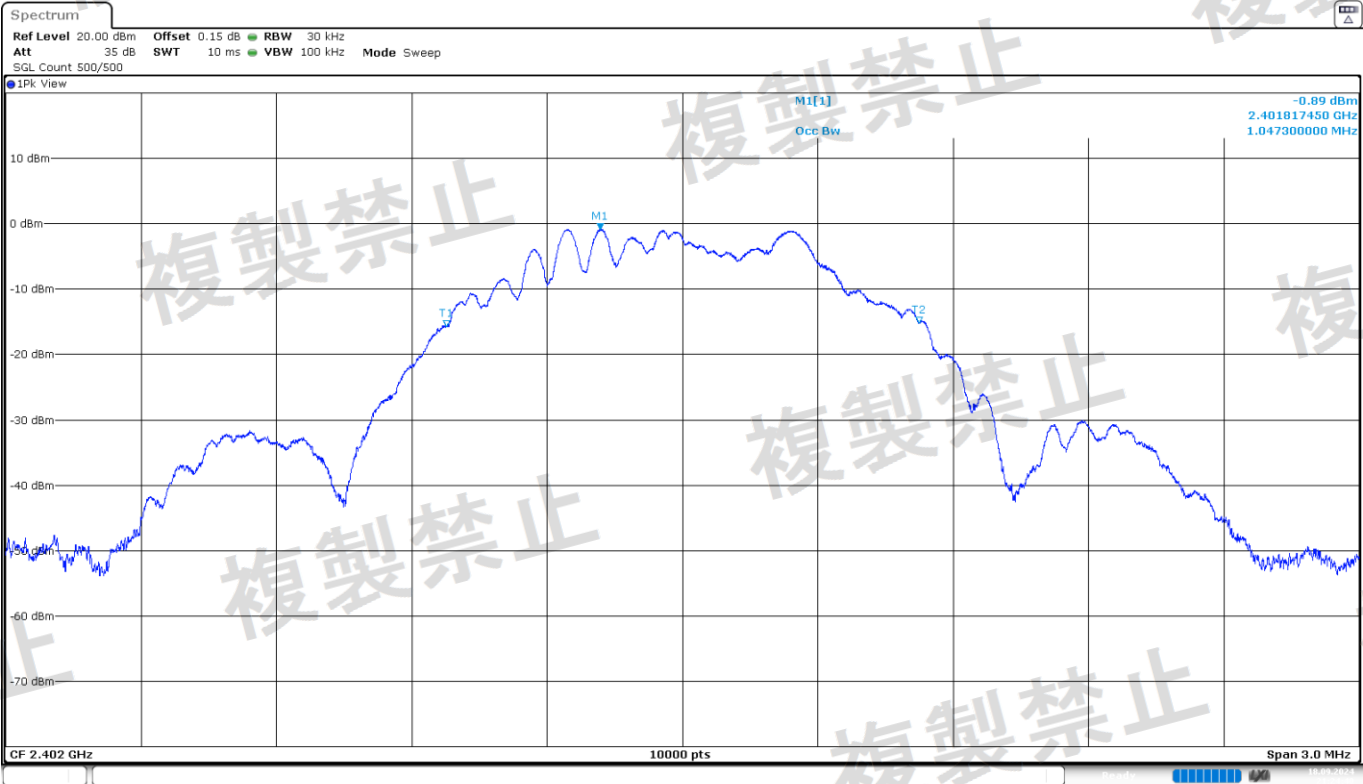
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% occupied bandwidth (MHz)	1.047300	1.052400	1.052100
Limit	<26 MHz		
Measurement uncertainty (kHz)	<± 6.06		

Verdict:

PASS

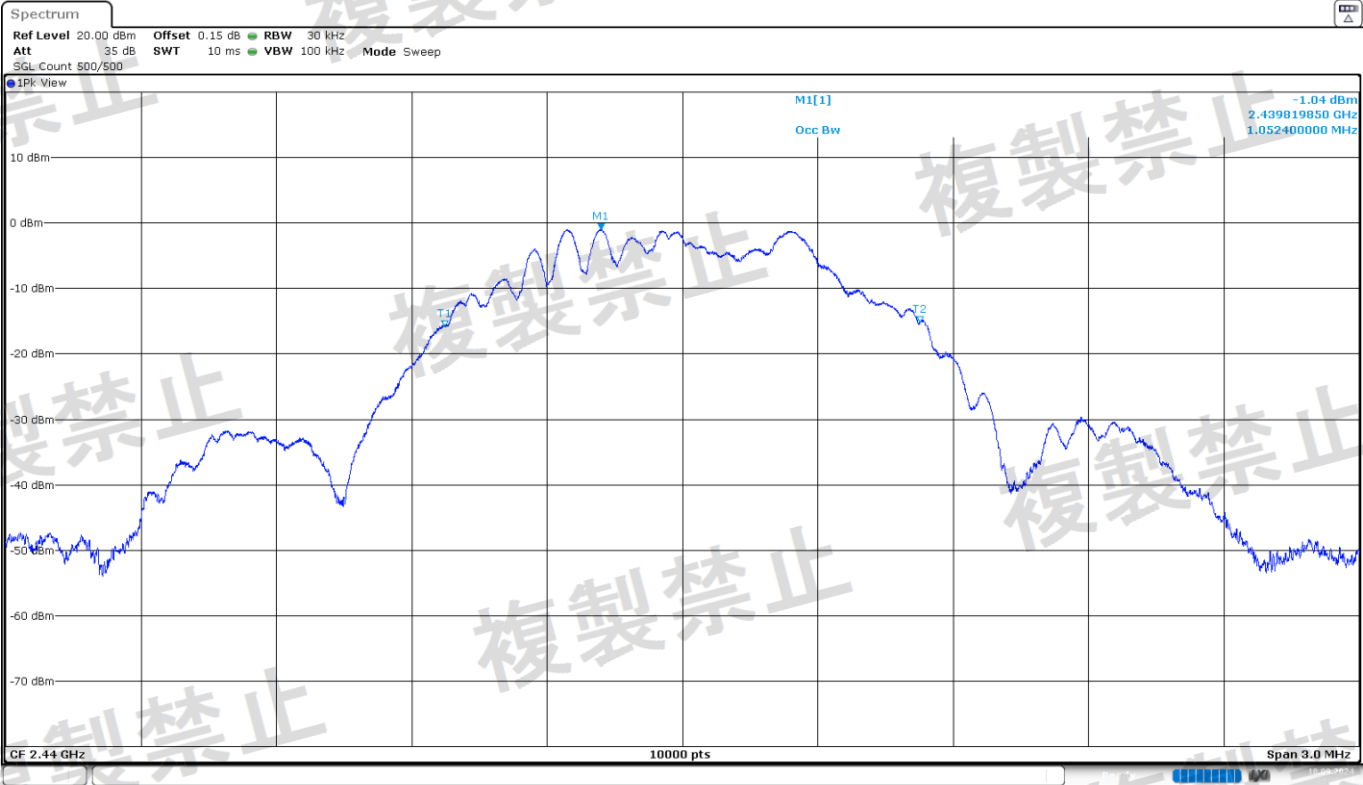
Vnom:

• LOW CHANNEL:



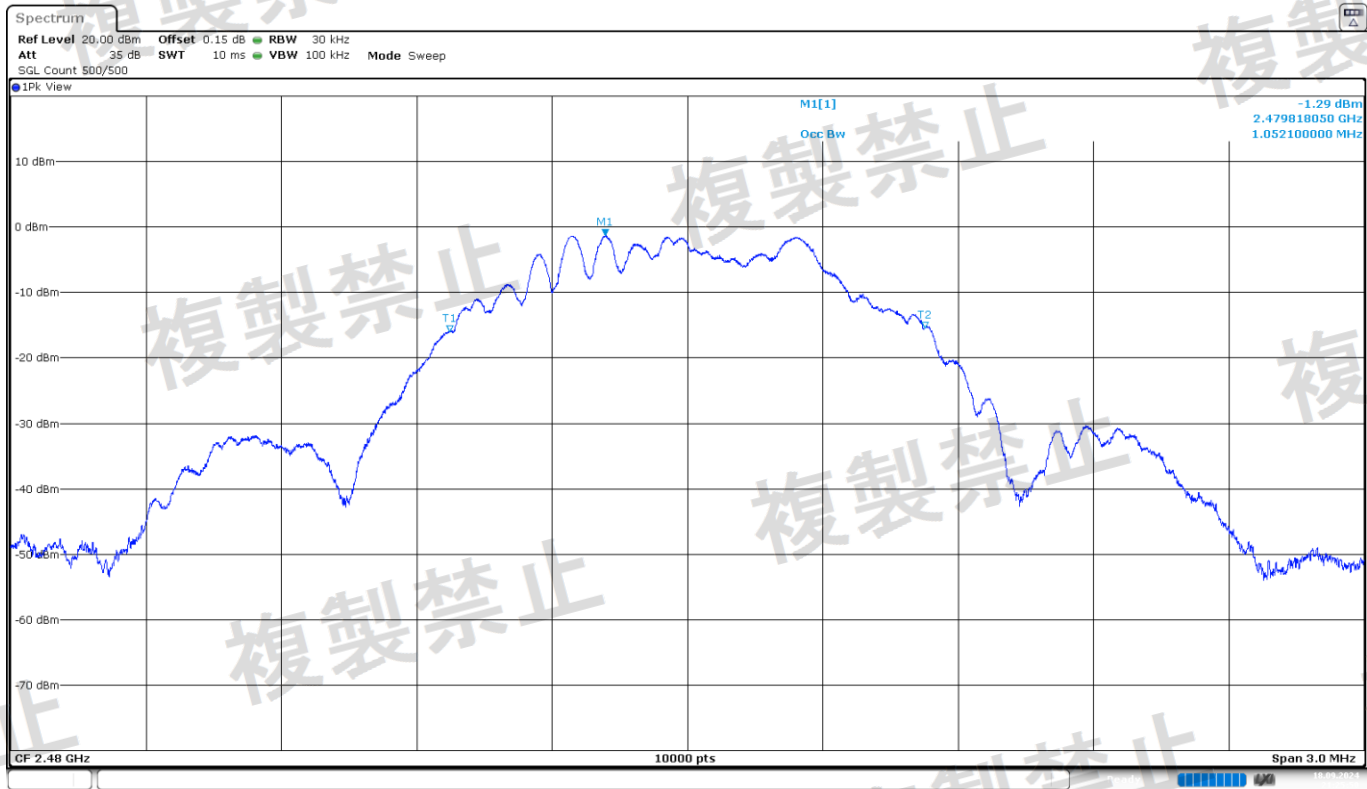
Date: 18.SEP.2024 21:24:41

• MIDDLE CHANNEL:



Date: 18.SEP.2024 21:25:15

HIGH CHANNEL:



Date: 18.SEP.2024 21:25:50

Article 24.2. Receiving equipment. Limit on secondary radiated emissions

Limits:

The limit on secondary emissions radiated from the receiving equipment within which the function of other radio equipment will not be impaired shall be, in terms of the power of a dummy antenna circuit that has the same electrical constant as the receiving antenna, 4 nW (-54 dBm) or less at a frequency below 1 GHz and 20 nW (-47 dBm) or less at a frequency of 1 GHz or higher as measured using the circuit.

Results:

Vnom:

- LOW CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

- MIDDLE CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

- HIGH CHANNEL:

No spurious frequencies detected at less than 10 dB below the limit.

Measurement uncertainty $< \pm 2.94$ dB

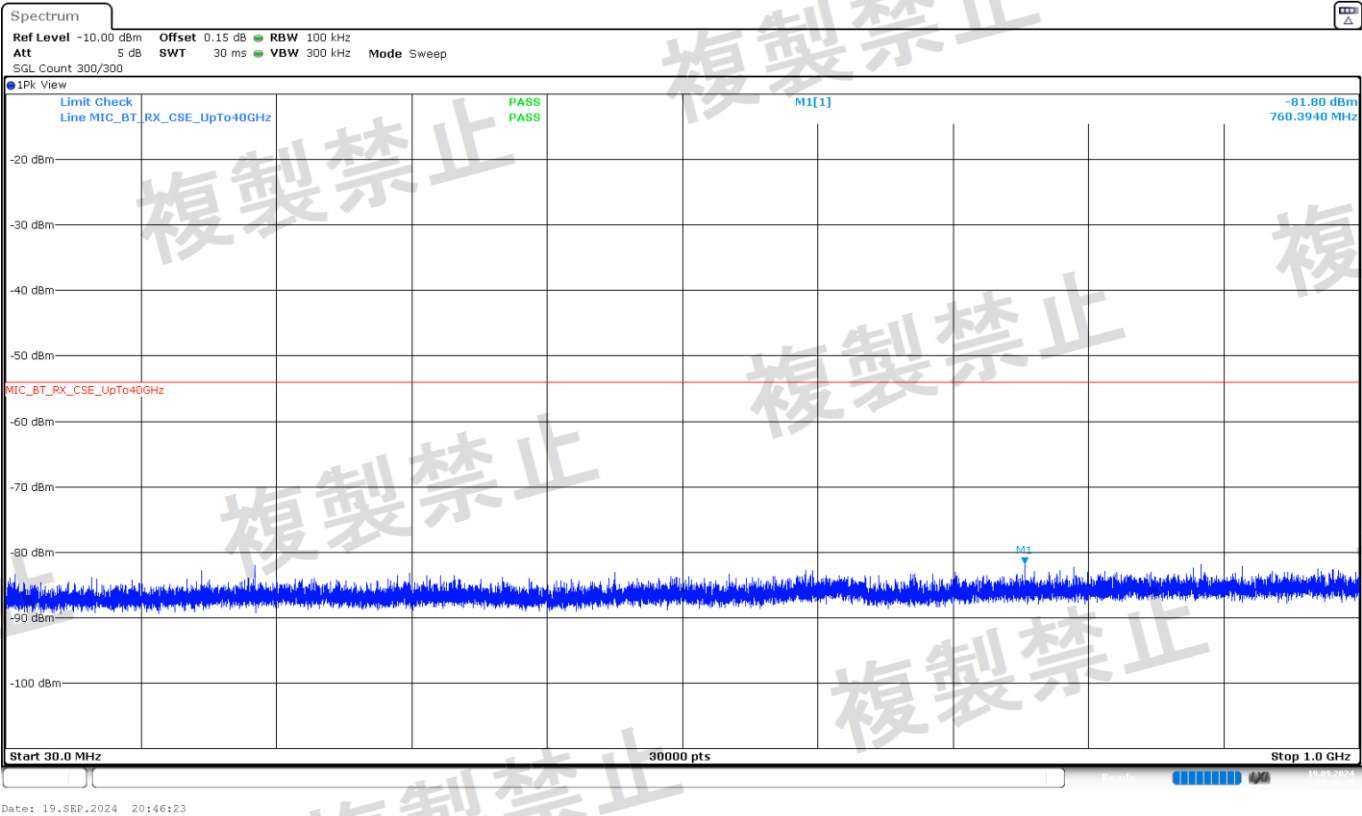
Verdict:

PASS

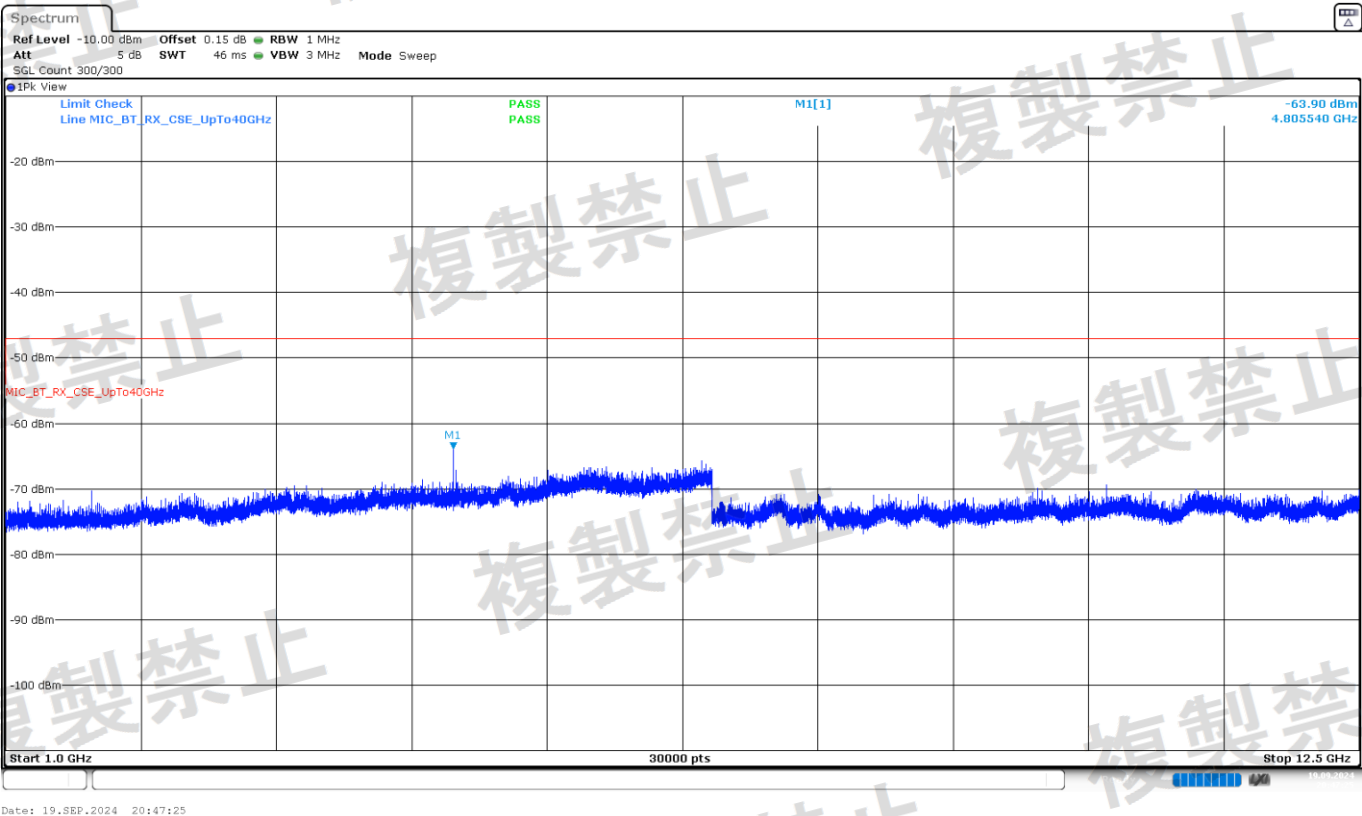
Vnom:

- LOW CHANNEL:

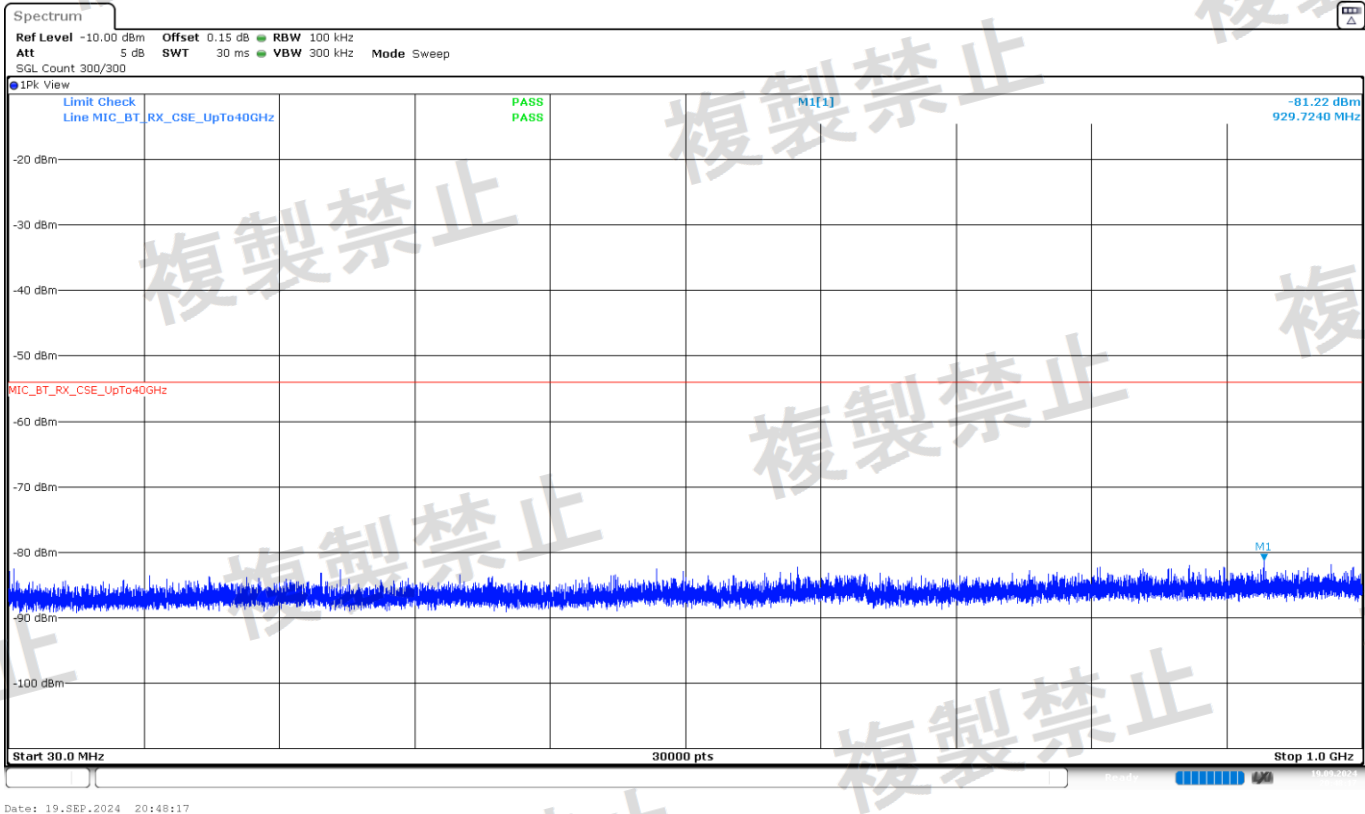
Frequency range 30 MHz - 1 GHz:



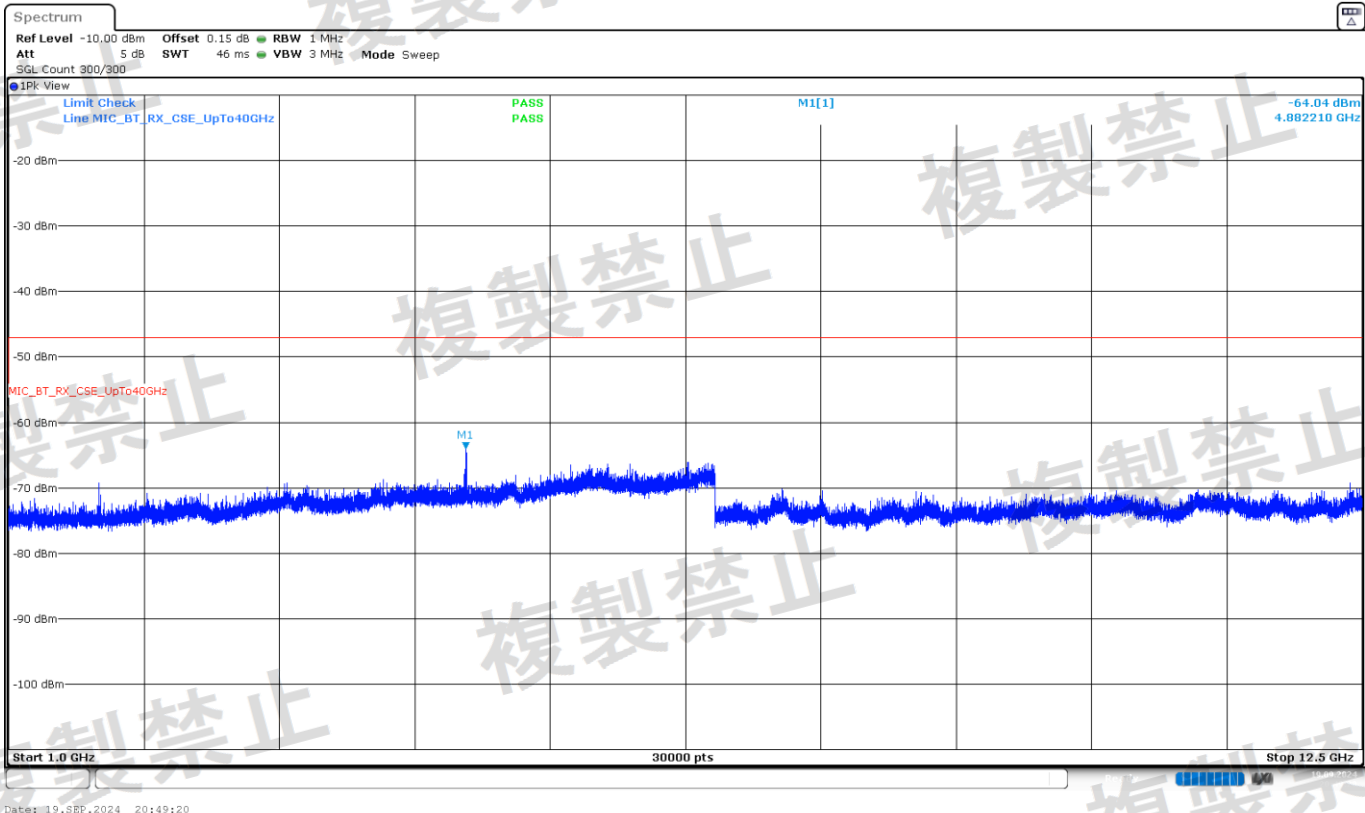
Frequency range 1 – 12.5 GHz:



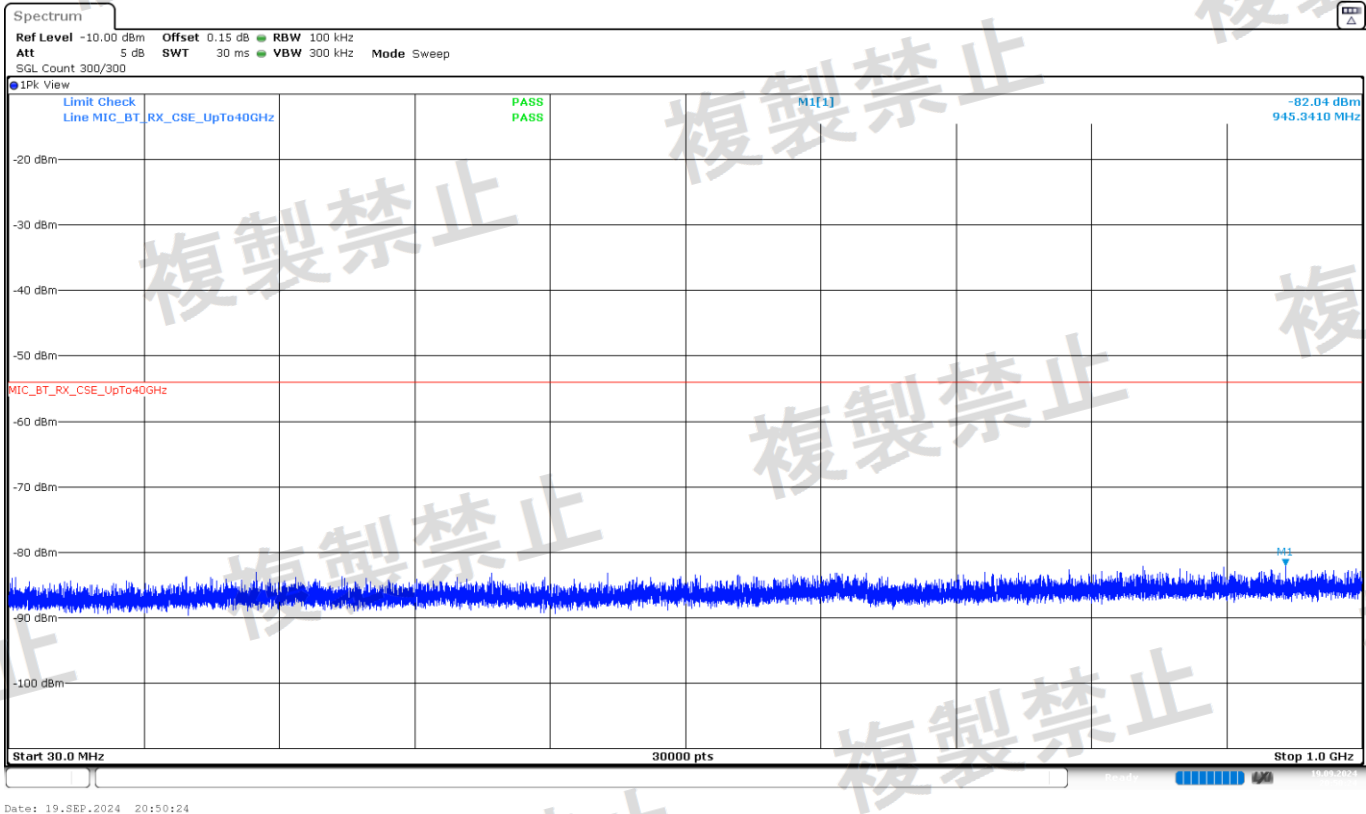
- MIDDLE CHANNEL:
Frequency range 30 MHz - 1 GHz:



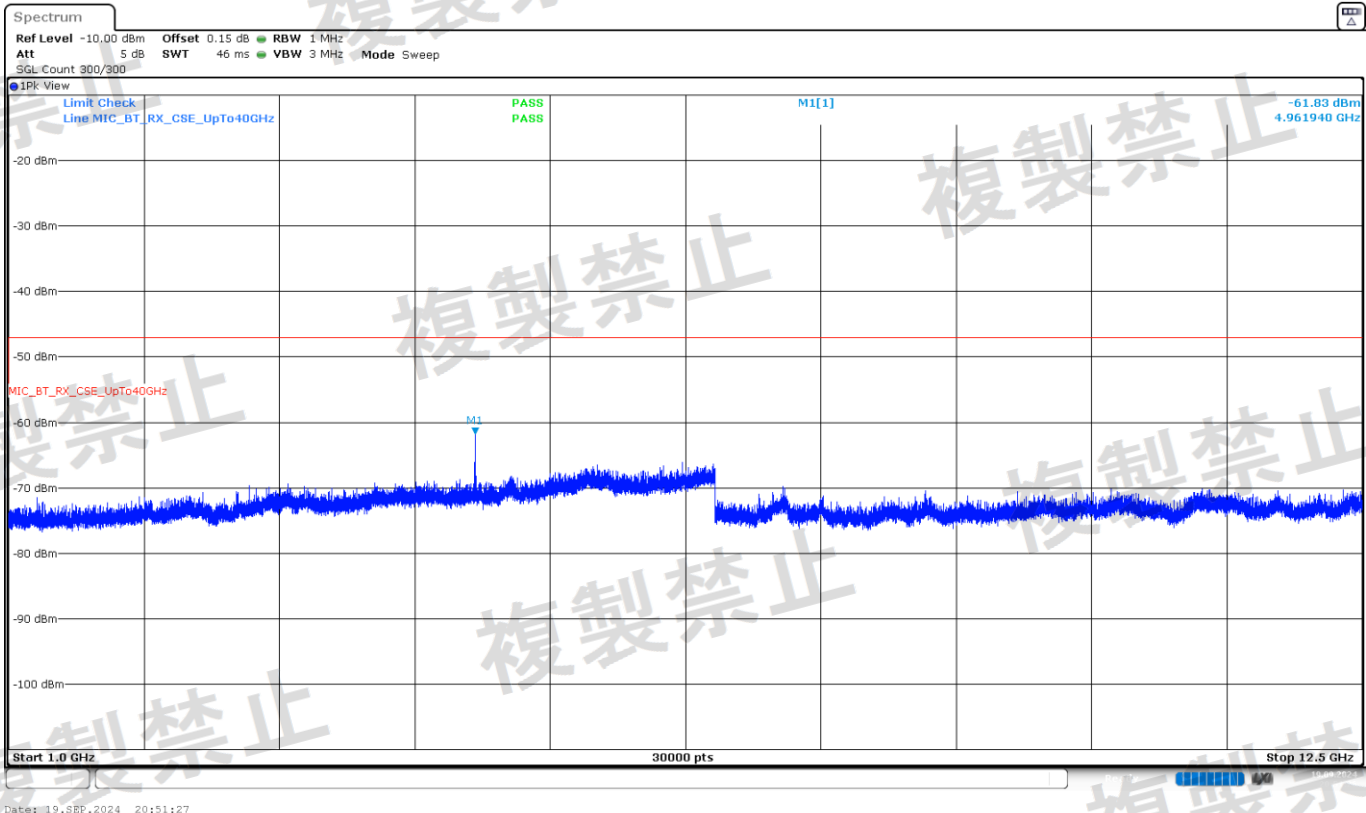
- Frequency range: 1 – 12.5 GHz:



- HIGH CHANNEL:
Frequency range 30 MHz - 1 GHz:



- Frequency range 1 – 12.5 GHz:



Article 9.4-5. Controlling equipment. Interference prevention function.
Identification code transmission/reception

Limits:

Radio equipment used mainly on the same premises and automatically transmits or receives identification code.

Results:

BLE MAC
48:23:35:F4:00:06

LIST OF DEVICES				
N	Name	Address	RSSI	Ad
1	Renesas ADV Demo	482335F40006	-50	1x1 struct

Verdict:

PASS

Article 49-20. Antenna. Antenna gain

Limits:

a: The absolute gain of the transmitting antenna shall be 12.14 dB or less. However, when the equivalent isotropic radiated power EIRP (equivalent isotropic radiated power in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems) is equal to or less than the value obtained by applying an antenna power with the mean power of 10 mW with its absolute gain being 12.14 dB, the shortage shall be compensated for by the gain of the transmitting antenna (Note that mean power is 10 mW in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems; however, mean power of 3 mW in the 1 MHz bandwidth is applied if the FH system, a hybrid system combining DS and FH systems, or a hybrid system combining FH and OFDM systems is employed and the frequency band of 2,427 - 2,470.75 MHz is used).

b: The Half-Power Beam width Angle HPBA (angle between two points at which radiated power becomes 1/2) of the transmitting antenna's horizontal and vertical planes shall not exceed the value as determined by the following formula:

$$HPBA \leq 360 / A \text{ [degrees]}$$

where constant A is equal to the value obtained by dividing the equivalent isotropic radiated power EIRP (equivalent isotropic radiated power in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems) by the value obtained by applying an antenna power with the mean power of 10 mW with its absolute gain being 2.14 dB, and shall be assumed to be 1 if it is less than 1 (Note that mean power is 10 mW in the 1 MHz bandwidth in the case of spread spectrum and OFDM systems; however, mean power of 3 mW in the 1 MHz bandwidth is applied if the FH system, a hybrid system combining DS and FH systems, or a hybrid system combining the FH and OFDM systems is employed and the frequency band of 2,427 - 2,470.75 MHz is used).

Therefore

$$A = \text{EIRP (mW)} / (10 \text{ mW} \times \text{absolute gain}) = \text{EIRP (mW)} / 16.37$$

Where absolute gain is the linear value corresponding to 2.14 dB = 1.637.

Results:

Maximum Declared Antenna Gain: -1.5 dBi

Vnom:

Channel	Measured antenna power (dBm)	Radiated power EIRP (dBm)	Radiated power EIRP (mW)	A = EIRP (mW) / 16.37
Low (2402 MHz)	5.560	4.06	2.55	< 1
Middle (2440 MHz)	5.220	3.72	2.36	< 1
High (2480 MHz)	4.780	3.28	2.13	< 1

Since A is < 1, it is assumed to be 1, and therefore the half-power beam width must be 360° or less.

Verdict:

PASS

Appendix C: Photographs

EQUIPMENT VIEW FOR THE TESTS

