RF Test Report

2.4 GHz Bluetooth

Report No.	:	FCCCSVD-WAY-P24120025R1
Customer	:	Glosys Inc.
Address	:	#510 Venture Valley B/D, 958, GosaekDong, GwonseonGu Suwon-si South Korea
Use of Report	:	Certification
Model Name	:	CT90118B
FCC ID	:	YE4CT90118B
Date of Test	:	2024.12.10 to 2024.12.24
Test Method Used	:	FCC 47 CFR PART 15 Subpart C (Section §15.247) KDB558074 D01v05r02, ANSI C63.10-2013
Testing Environment	:	Refer to the Test Condition

Test Result : ☒ **Pass** ☐ **Fail**

ISSUED BY: BV CPS ADT Korea Ltd., EMC/RF Laboratory

ADDRESS: Innoplex 1st complex No.2 B303, No.2 B304, 306, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Republic of Korea

TEST LOCATION: HeungAn-daero 49, DongAn-gu, Anyang-si, Gyeonggi-do, Korea, 14119

Tested by

Name : Kwangmin JUNG (Signature)

Technical Manager

Name : Donghwa SHIN (Signature)

2025. 04. 30

BV CPS ADT Korea Ltd.

RELEASE CONTROL RECORD

REPORT NO.	REASON FOR CHANGE	DATE ISSUED
FCCCSVD-WAY-P24120025	Original release	2025.04.25
FCCCSVD-WAY-P24120025R1	Update the test report	2025.04.30

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1 Summary of Test Results

The EUT has been tested according to the following specifications

Applied Standard : FCC Part 15, Subpart C 15.247					
FCC Part Section(s)	**Test Description**	**Limit**	**Test Condition**	**Test Result**	**Reference**
15.247(a)	Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.	Conduted	PASS	Section 3.4
15.247(a)	Number of Hopping Frequencies	>= 15 hops		PASS	Section 3.5
15.247(a)	20 dB Bandwidth	N/A		PASS	Section 3.2
15.247(a)	Dwell Time	=< 0.4 seconds		PASS	Section 3.6
15.247(b)	Transmitter Output Power	=< 1 Watt , if CHs >= 75 Others =< 0.125 W		PASS	Section 3.3
15.247(d)	Conducted spurious emissions	≥ 20 dBc In any 100 kHz bandwidth		PASS	Section 3.7
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in Restricted bands must meet the radiated limits detailed in 15.209	Radiated	PASS	Section 3.7
15.207	AC Conducted Emissions (150 kHz – 30 MHz)	< FCC 15.207 limits	AC Line Conduted	NA[Note3)]	Section 3.8
15.203	Antenna Requirement	FCC 15.203	-	PASS	Section 3.1

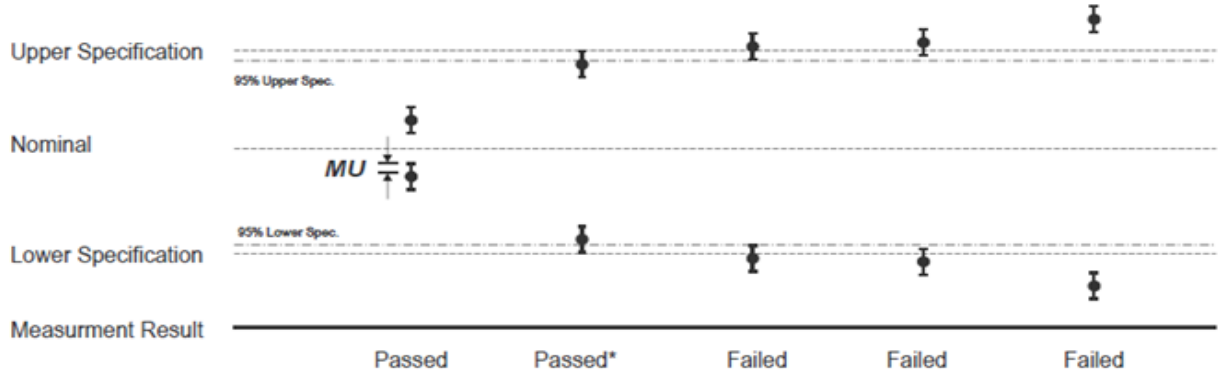
NOTES

1) The general test methods used to test on this devices are ANSI C63.10.

2) Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

3) This Devices which only employ battery power for operation.

1.1 Decision Rules for Statement of Conformity



QUA-52 Decision Rule(QA Document) was applied.

Step 1) : Reference Check, Daily Check, Peripheral device Check

Step 2) : Re-test Procedure (Repeat the test maximum 3 times, Different Test Engineer)

1) If the original test results are subject to retesting and the judgement is unclear, the retest is carried out.
2) If the result of the first retest is the same as the initial test, the judgement is made based on the value.
3) If the result of the first retest differ from the results of the initial test, the second re-test is carried out.
4) After completion of the second retest, the average of the three test results is determined as the final result. However, if the deviation of the three test values is more than 5 % of the reference value, the technical manager should review the reproducibility of the test from the beginning.

1.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2

Measurement Items	Frequency Range	Expanded Uncertainty U = *k*Uc (*k* = 2)
Radiated Spurious Emissions	9 kHz – 30 MHz	2.06
	30 MHz – 1 GHz	4.28
	1 GHz – 18 GHz	5.40
	18 GHz – 26.5 GHz	5.08
Measurement Items		**Expanded Uncertainty U = *k*Uc (*k* = 2)**
Conducted	Maximum Output Power	1.20
	Spurious Emissions	1.36

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of *k* = 2.

2 General Information

2.1 General Description of EUT

Equipment Class	Sperad Spectrum Transmitter (DSS)
Product name	Automotive CT System
FCC ID	YE4CT90118B
Model	CT90118B
Additional model name	-
Power Supply	DC 12 V
Modulation Type	GFSK, π/4DQPSK, 8DPSK
Transfer Rate	1Mbps, 2Mbps, 3Mbps
Operating Frequency	2 402 MHz to 2 480 MHz
Output Power	4.43 dBm
Antenna Type	PCB Antenna
Antenna Gain	-4.54 dBi
H/W Version	CT90118B_V1, CT90118AE_V1
S/W Version	1.2.8(OB27)-Da

NOTE 1: For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

NOTE 2: For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

2.2 Tested sample and Tested companion device information

Type	Model	Note
Test sample	CT90118B	S/N: Engineering Sample

2.3 Description of Test Mode

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics.

Test Mode		Tested Frequency (MHz)		
TM 1	GFSK (1Mpbs)	2 402	2 440	2 480
TM 2	π/4DQPSK (2Mbps)	2 402	2 440	2 480
TM 3	8DPSK (3Mbps)	2 402	2 440	2 480

Note: A test was performed for each voltage.

Information about the FHSS characteristics

A) The hopping sequence is pseudorandom

Note 1 : Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 42, 54, 72, 09, 01, 11, 33, 41, 34, 42, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 41, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 52, 71, 08, 24, 06, 24, 48, 56, 45, 46, 70, 01, 72, 06, 25, 33, 12, 28, 49, 60, 45, 58, 74, 13, 05, 18, 37, 49 etc

The System receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

B) All channels are used equally on average

C) The receiver input bandwidth equals the transmit bandwidth

D) The receiver hops in sequence with the transmit signal

2.4 INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

2.5 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.6 General Description of Applied Standards

Generally the tests were performed according to the specifications of the standard, it must comply with the requirements of the following standards.

FCC CFR 47 Part 15, Subpart C (§15.247)
KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10-2013

All test items in this test report have been performed and recorded as per the above standards.

2.7 Test Equipment

Test Equipment is traceable to the National Institute of Standards and Technology (NIST). Measurement antenna used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSW50	101403	2025-11-11
Signal Analyzer	R&S	FSV30	103631	2025-11-11
MXG Vector Signal Generator	Keysight Technologies	N5182B	MY53051310	2025-11-12
Signal Generator	R&S	SMB100A	MY41006053	2025-05-21
DC Power Supply	Agilent	6674A	MY41003717	2025-11-11
DC Power Supply	Keysight Technologies	E3632A	MY62246260	2025-05-21
Attenuator	Aeroflex	40AH2W-10	1	2025-11-11
True-RMS Digital Multimeter	Fluke	177	43240434	2025-05-21
High Pass Filter	Micro-Tronics	HPM17543	028	2025-05-22
High Pass Filter	Wt Microwave	WT-A1698-HS	WT190313-6-4	2025-11-20
Humidity Barometer TEMP Meter	LUTRON	MHB-382SD	AJ.38475	2025-11-14
Humidity Barometer TEMP Meter	LUTRON	MHB-382SD	AJ.38459	2025-11-14
EMI Test Receiver	R&S	ESW8	101170	2025-11-19
EMI Test Receiver	R&S	ESW44	101812	2025-11-18
Active Loop Antenna	R&S	HFH2-Z2E	100881	2025-02-03
Trilog Antenna (with 6 dB ATT.)	Schwarzbeck	VULB 9163	01100	2025-02-08
Horn Antenna	R&S	HF907	102773	2025-11-26
BBHA 9170 Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	00955	2025-11-15
Signal Conditioning Unit	R&S	SCU-18F	180112	2025-11-18
Signal Conditioning Unit	R&S	SCU08F2	08400015	2025-11-18
Amplifier	L3 Narda-MITEQ	JS44-18004000-33-8P	2142086	2025-11-12
Power Meter	R&S	NRX	103577	2025-11-12
Power Sensor	R&S	NRP-Z211	102377	2025-11-12
EMC 32	R&S	EMC32	1000	-
EMC 32	R&S	EMC32	1040	-

3 Test Results

3.1 Antenna Requirement

Except from §15.203 of the FCC Rules/Regulations:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of the section.

- The antenna(s) of the EUT are Permanently attached.
- There are no provisions for connection to an external antenna.

Result
The EUT complies with the requirement of §15.203

3.2 20 dB Bandwidth

3.2.1 Regulation

§15.247(a)(1) : Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

3.2.2 Test Procedure

The 20 dB bandwidth & Occupied bandwidth were measured with a spectrum analyzer connected to RF antenna Connector(conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:

RBW = 1% to 5% of the 20 dB BW & Occupied BW

VBW ≥ 3 × RBW

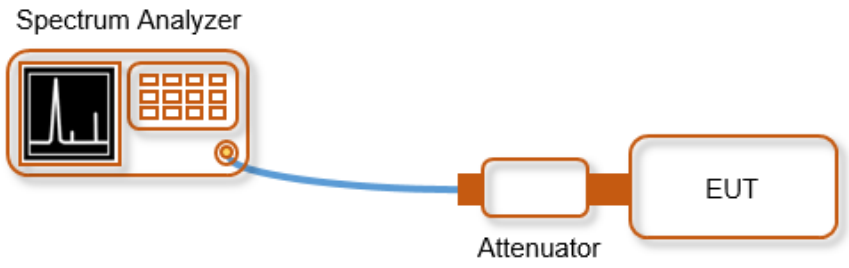
Span = between two times and five times the 20 dB bandwidth & Occupied BW

Sweep = auto

Detector function = peak

Trace = max hold

3.2.3 Test Setup



3.2.4 Test Result

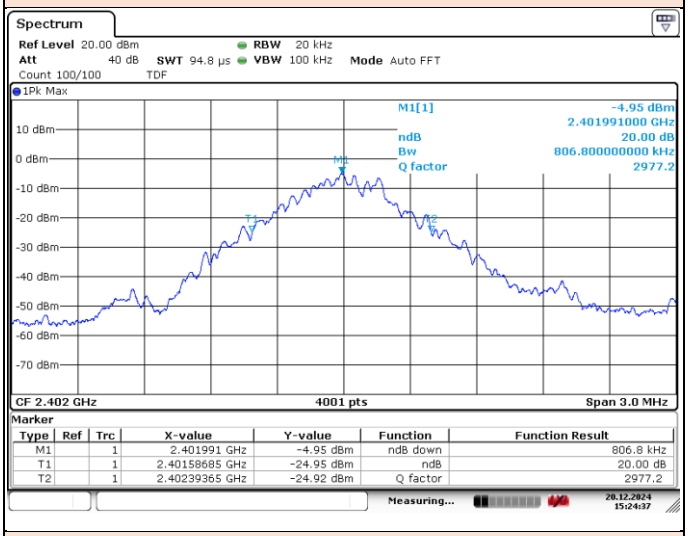
[Test Data of 20 dB Bandwidth]

Test Mode	Tested Frequency	20 dB Bandwidth [MHz]
TM 1	2 402	0.807
	2 440	0.813
	2 480	0.811
TM 2	2 402	1.233
	2 440	1.235
	2 480	1.234
TM 3	2 402	1.207
	2 440	1.206
	2 480	1.206

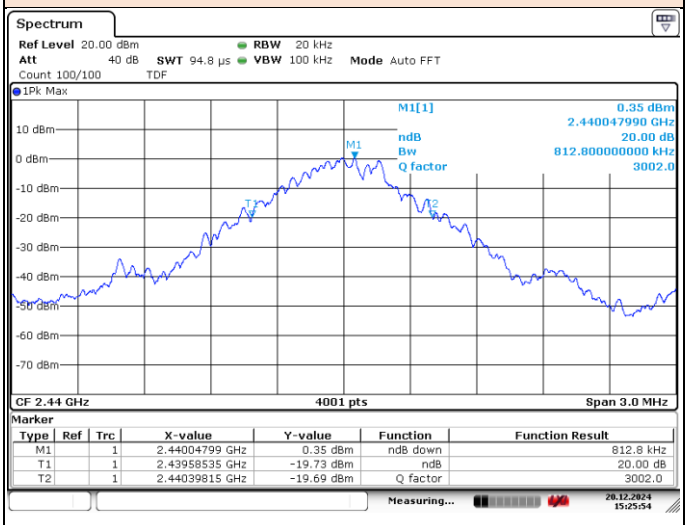
[Test Plot of 20 dB Bandwidth]

TM 1

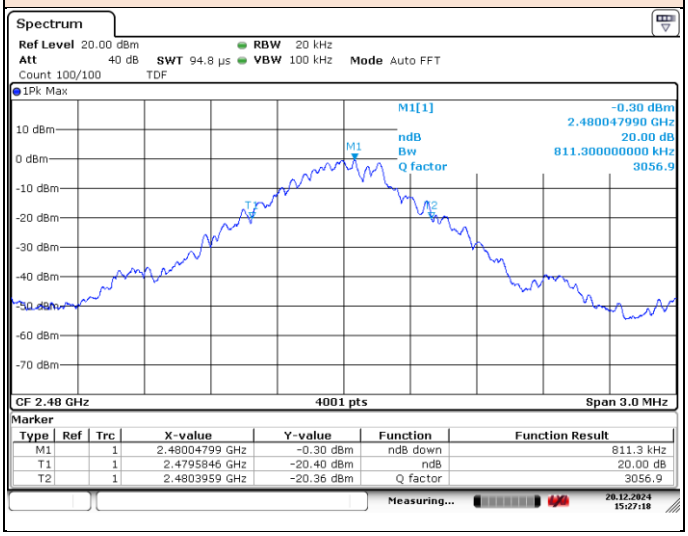
2 402 MHz



2 440 MHz

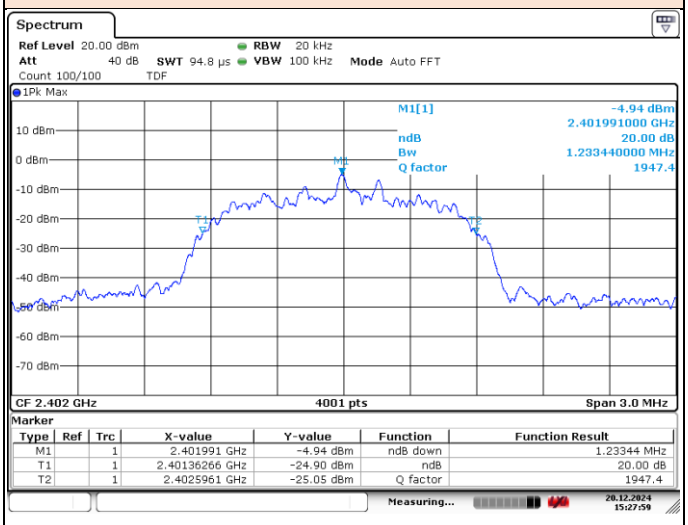


2 480 MHz

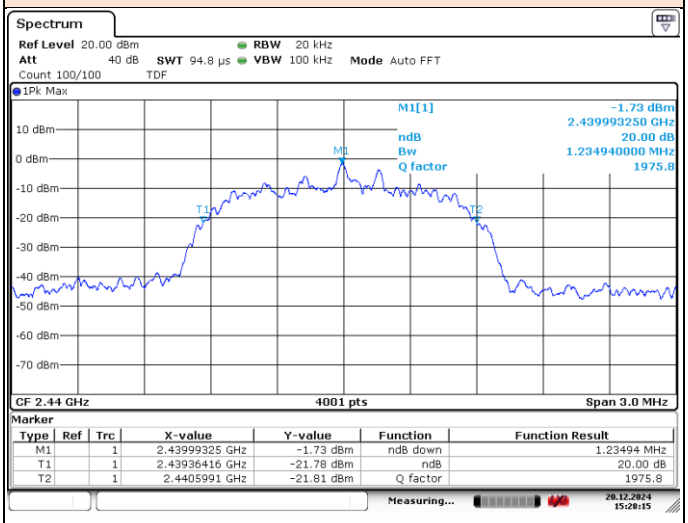


TM 2

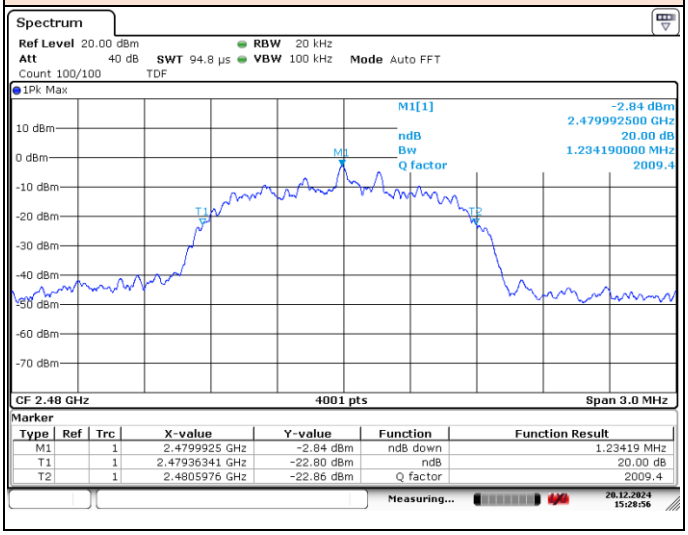
2 402 MHz



2 440 MHz

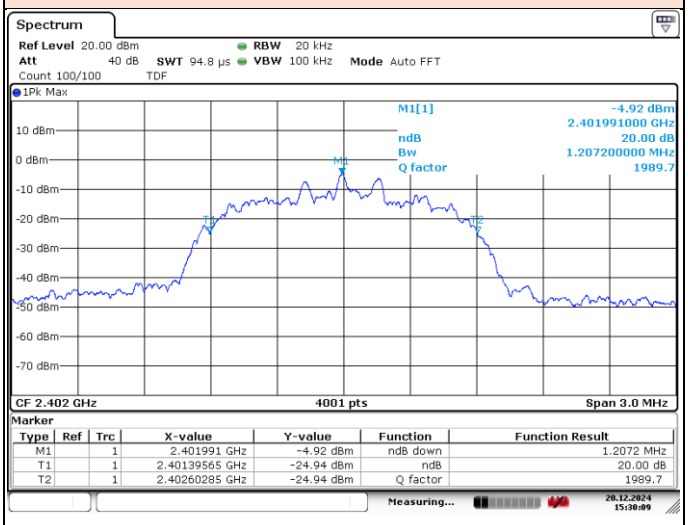


2 480 MHz

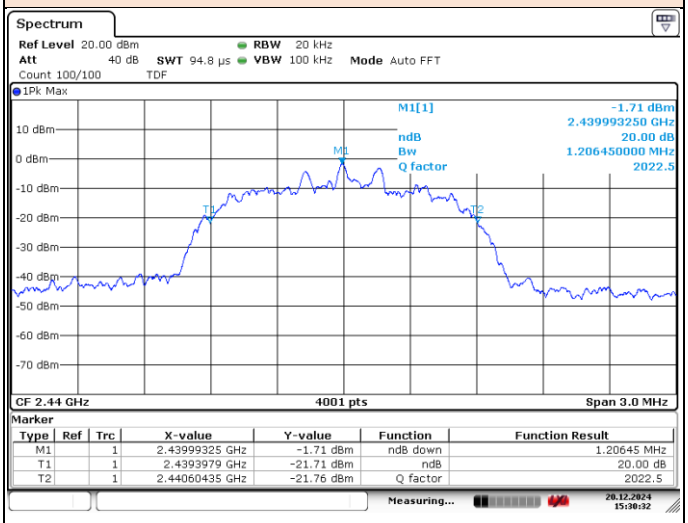


TM 3

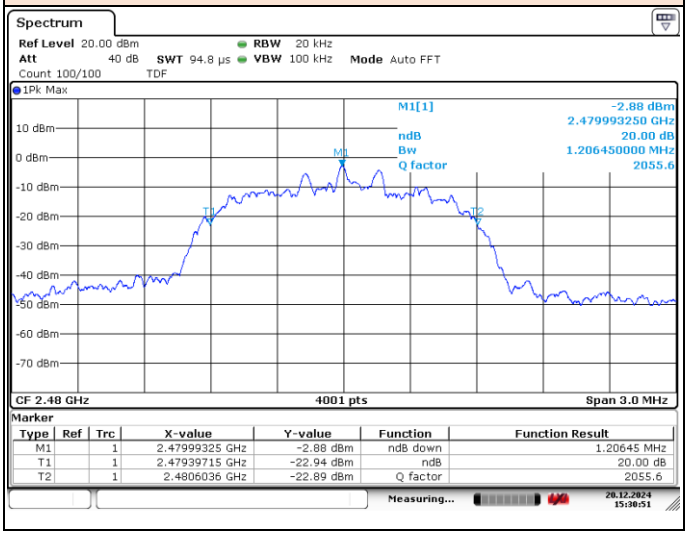
2 402 MHz



2 440 MHz



2 480 MHz



3.3 Maximum Peak Output Power

3.3.1 Regulation

§15.247(a)(1) : Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

§15.247(b)(1) : For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

§15.247(b)(4) : The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Test Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013

This is an RF conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation.

a) Use the following spectrum analyzer settings:

Peak Power Measurement

1) Span : Approximately five times the 20 dB bandwidth, centered on hopping channel.
2) RBW > 20 dB bandwidth of emission being measured.
3) VBW ≥ RBW.
4) Sweep : Auto.
5) Detector function : Peak.
6) Trace : Max hold.

b) Allow trace to stabilize

c) Use the marker-to-peak function to set the marker to the peak of the emissions

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

e) A plot of the test results and setup description shall be included in the test report.

Average Power Measurement
Measurement using a power meter.

a) Averge Power measurement using an RF average power meter, as follows:

1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.

2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.

3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

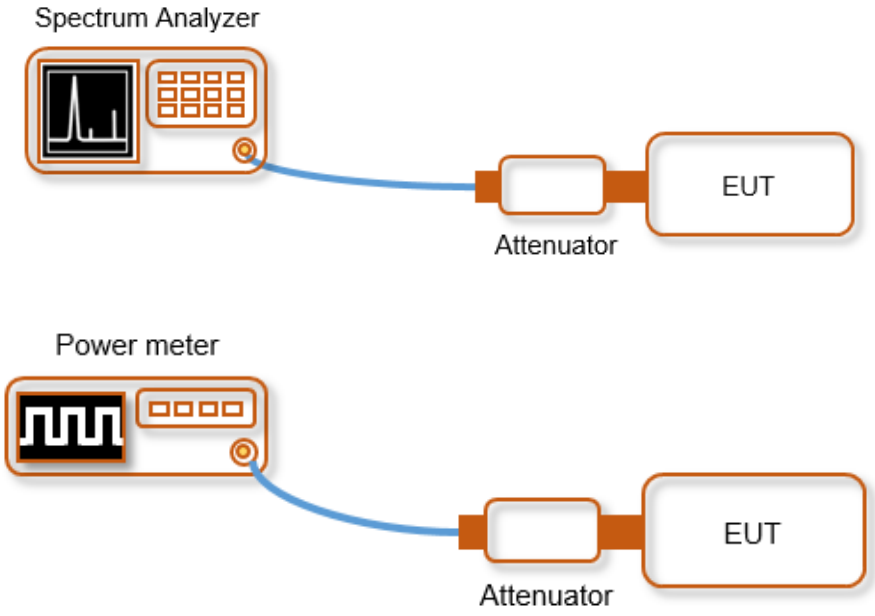
b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal.

c) Measure the average power of the transmitter.

d) This measurement is an average over both the ON and OFF periods of the transmitter.

e) Correct the measurement in dBm by adding [10 log (1 / D)], where D is the duty cycle.

3.3.3 Test Setup



3.3.4 Test Result

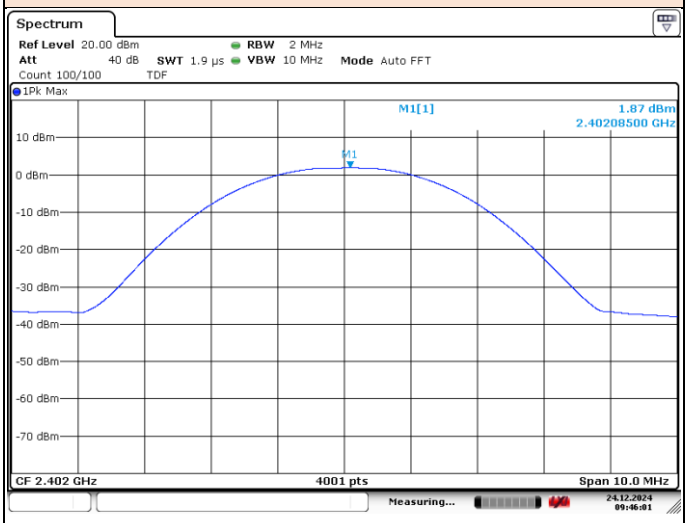
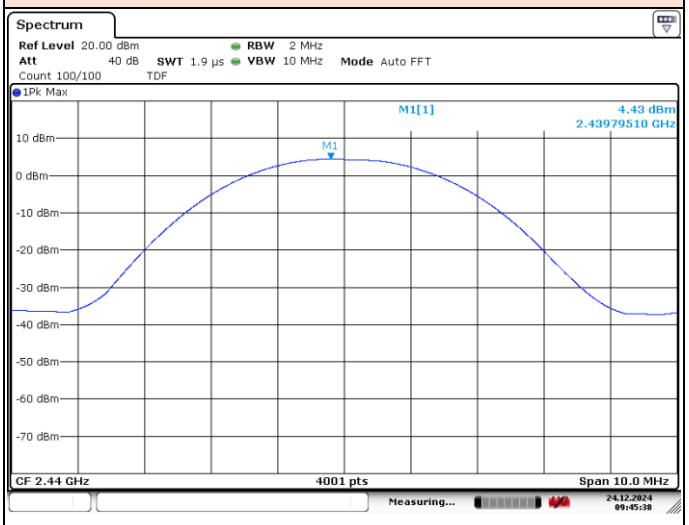
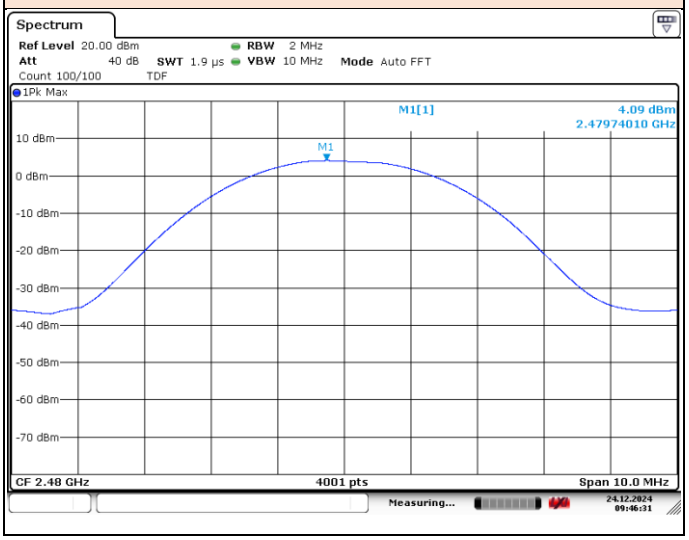
[Test Result of Peak Power & Average Power]

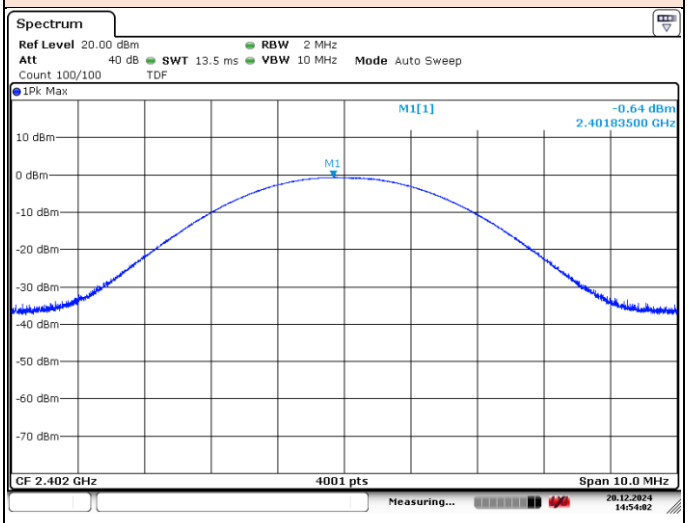
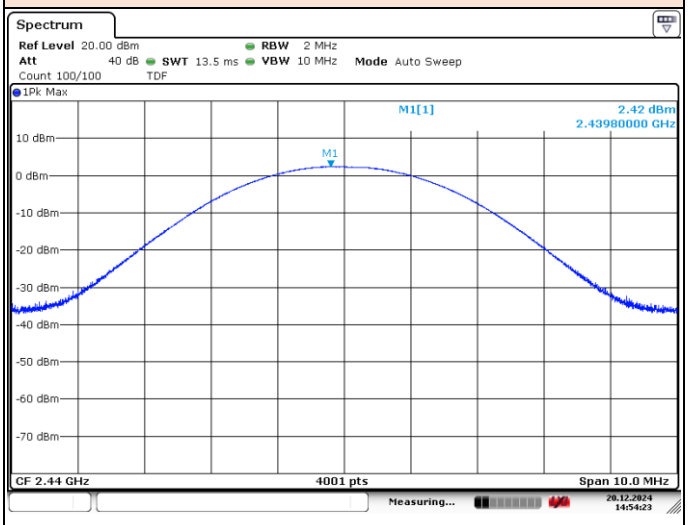
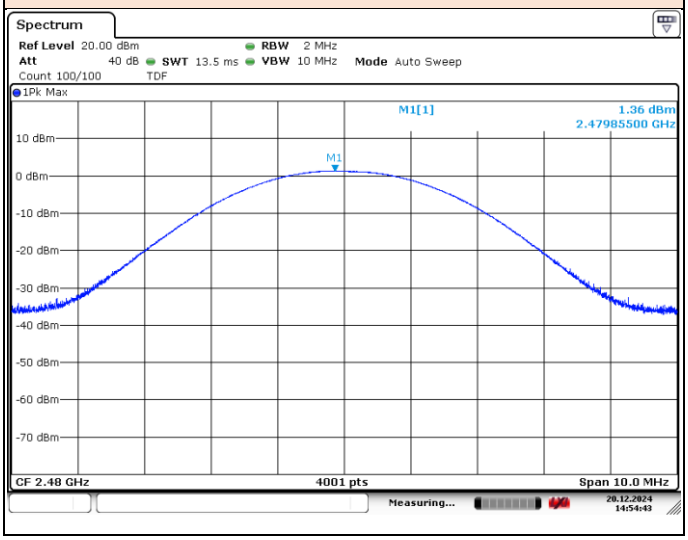
Limit: 0.125 Watt

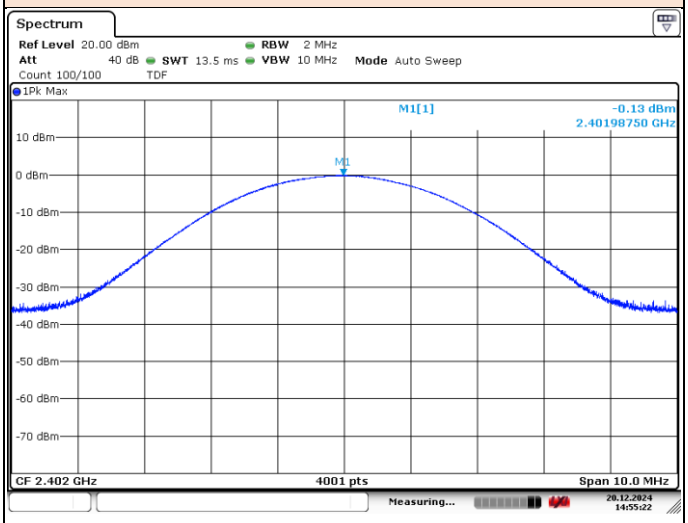
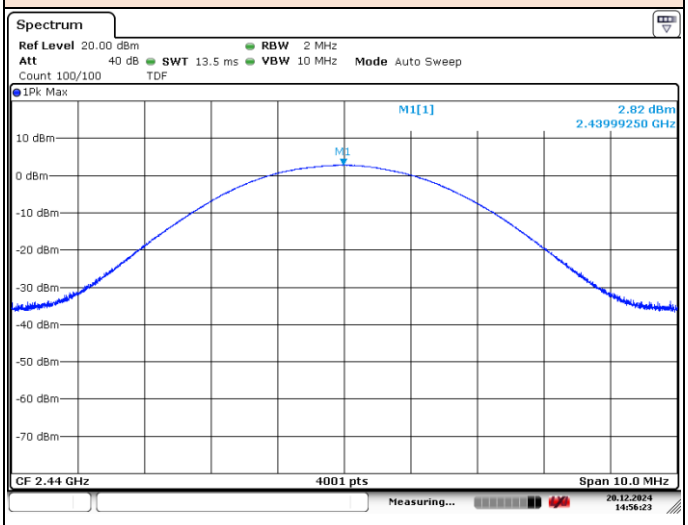
Test Mode	Tested Frequency	Measured Power [dBm]	
		PK	Average
TM 1	2 402	1.87	1.60
	2 440	**4.43**	**4.10**
	2 480	4.09	3.69
TM 2	2 402	-0.64	-2.80
	2 440	**2.42**	**0.29**
	2 480	1.36	-0.67
TM 3	2 402	-0.13	-0.67
	2 440	**2.82**	**0.35**
	2 480	1.79	-0.58

Note: Average Power = Measurement Average Power + Duty cycle factor.

[Test Plot of Peak Power]

TM 1
2 402 MHz

2 440 MHz

2 480 MHz


TM 2
2 402 MHz

2 440 MHz

2 480 MHz


TM 3
2 402 MHz

2 440 MHz

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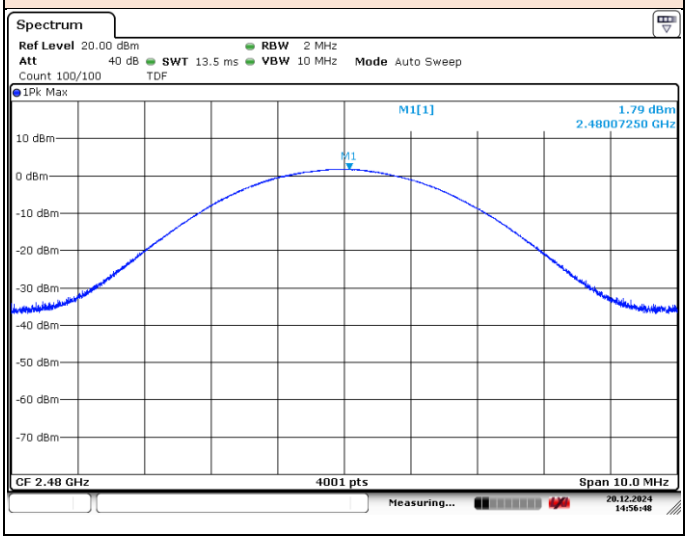


3.4 Carrier Frequency Separation

3.4.1 Regulation

§15.247(a)(1) : Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

3.4.2 Test Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

a) The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

b) Span: Wide enough to capture the peaks of two adjacent channels.

c) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

d) Video (or average) bandwidth (VBW) ≥ RBW.

e) Sweep: Auto.

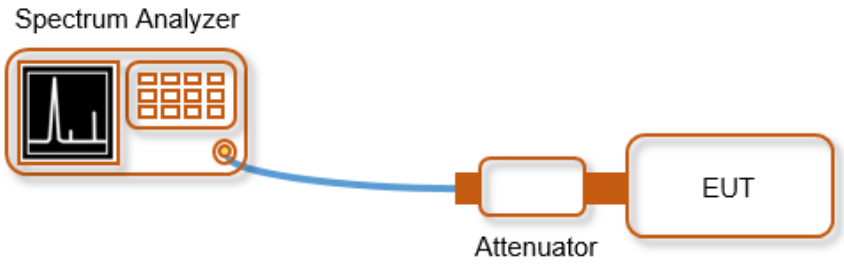
f) Detector function: Peak.

g) Trace: Max hold.

h) Allow the trace to stabilize.

i) Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

3.4.3 Test Setup



3.4.4 Test Result

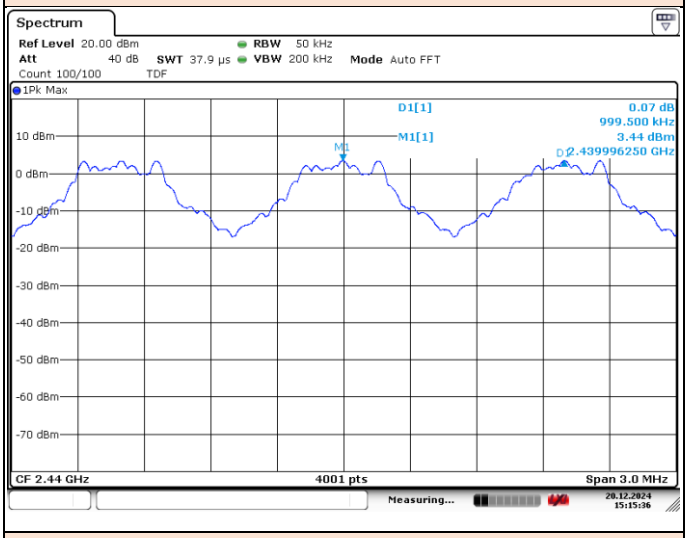
[Test Result of Carrier Frequency Separation]

Limit : ≥ 25 kHz or ≥ Two-Thirds of the 20 dB BW whichever is greater

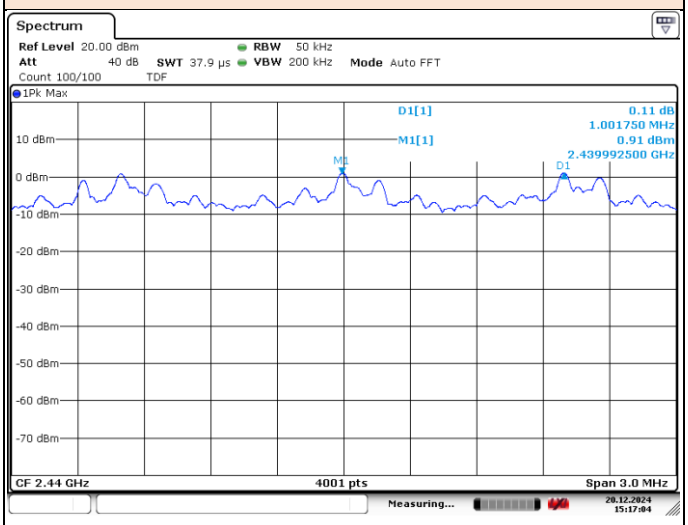
Test Mode	Tested Frequency	Measured Power [MHz]
TM 1	Hopping	1.000
TM 2	Hopping	1.002
TM 3	Hopping	0.997

[Test Plot of Carrier Frequency Separation]

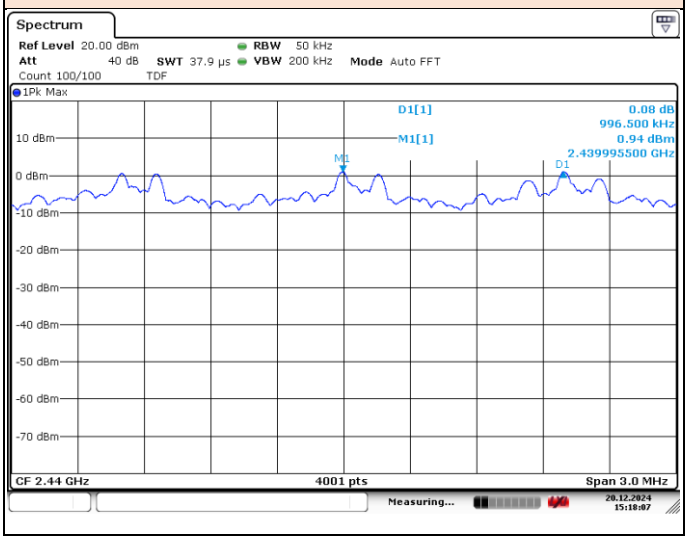
TM 1



TM 2



TM 3



3.5 Number of Hopping Channels

3.5.1 Regulation

§15.247(a)(1)(iii) : Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

§15.247(b)(1) : For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

3.5.2 Test Procedure

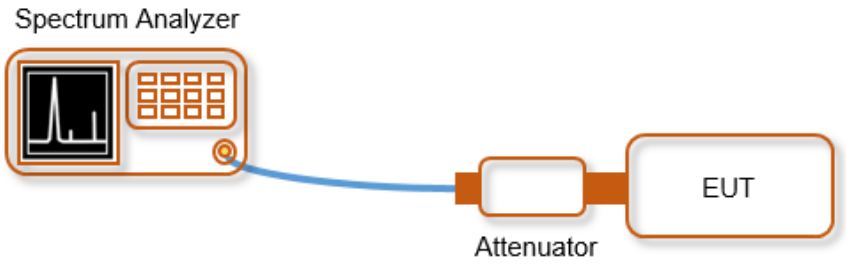
The method of measurement used to test this FHSS device is ANSI C63.10-2013.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
c) VBW ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

3.5.3 Test Setup



3.5.4 Test Result

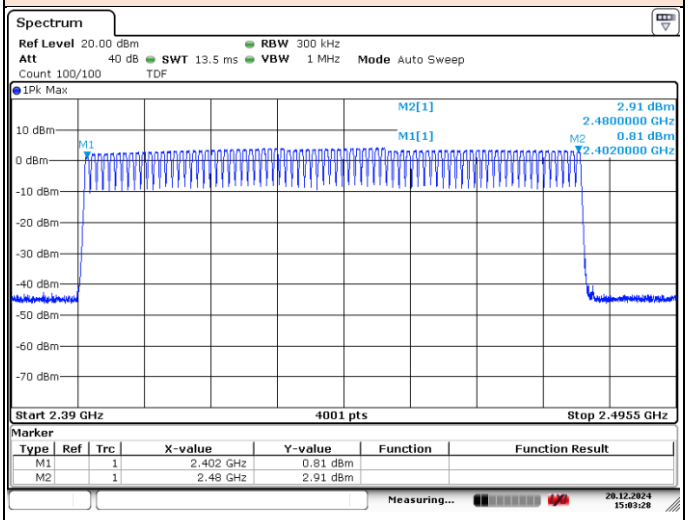
[Test Result of Number of Hopping Channels]

Limit : >= 15 hops

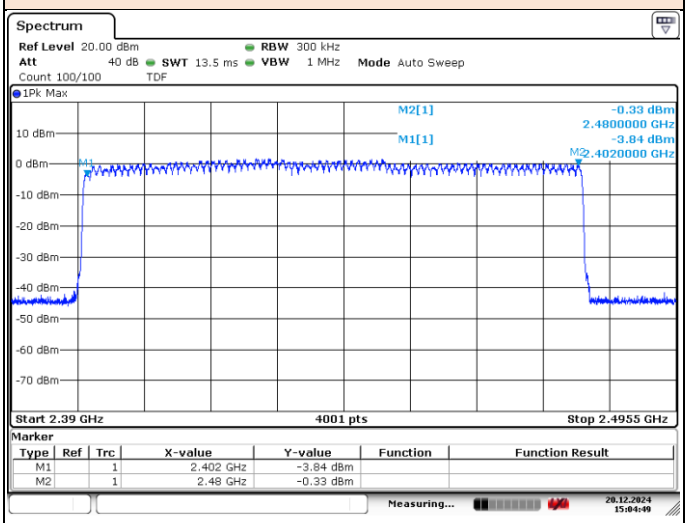
Test Mode	Tested Frequency	Test Result (Total hops)
TM 1	Hopping	79
TM 2	Hopping	79
TM 3	Hopping	79

[Test Plot of Number of Hopping Channels]

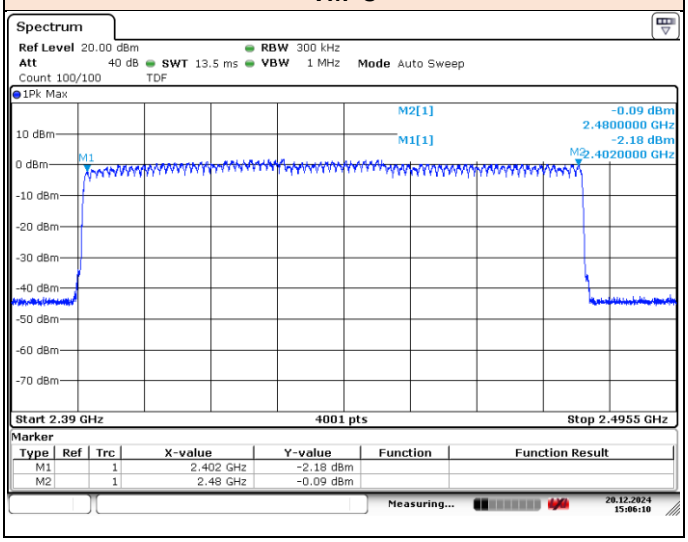
TM 1



TM 2



TM 3



3.6 Time of Occupancy (Dwell Time)

3.6.1 Regulation

§15.247(a)(1)(iii) : Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

3.6.2 Test Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
d) Detector function: Peak.
e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

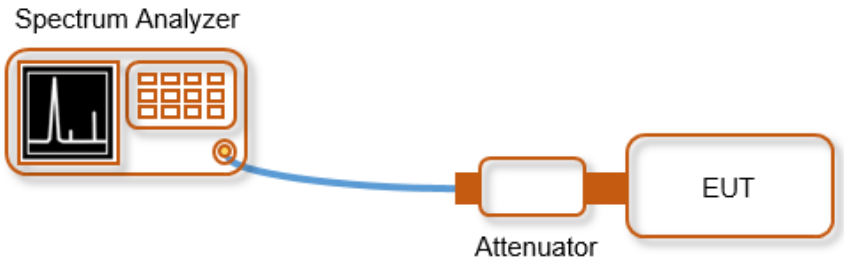
Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

3.6.3 Test Setup



3.6.4 Test Result

[Test Result of Dwell Time]

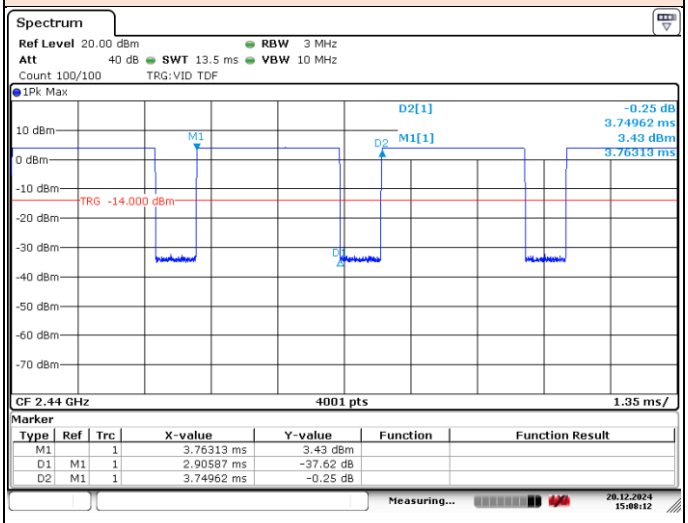
	On Time [ms]	Period [ms]	Duty Cycle[X]	Duty Cycle[D]	D.C.C.F Note1 [dB]	D.C.C.F Note2 [dB]	Channels	Dwell Time (s)
TM 1	2.906	3.750	0.775	77.50	1.11	-24.71	79	0.310
TM 2	2.919	3.750	0.779	77.86	1.09	-24.67	79	0.311
TM 3	2.919	3.750	0.779	77.86	1.09	-24.67	79	0.311

Note1
D.C.C.F Calculation. (D.C.C.F = Duty Cycle Correction Factor)
*Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = On Time
*100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H'= 2
*The Worst Case Dwell Time = T [ms] x H'
*D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB

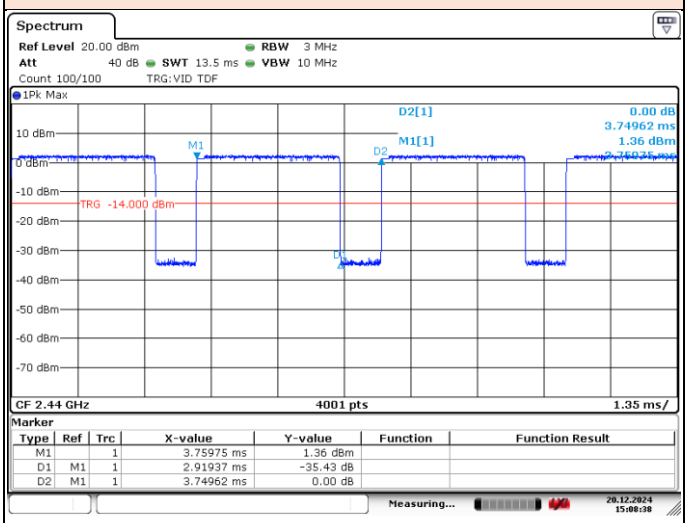
Note2
Dwell Time = 0.4 * Hopping Channels * On time * ((Hopping rate / Time slots) / Hopping channels)
* Tim slots for DH5 = 6 slots (TX = 5 slots , RX = 1 slot)
* Hopping rate = 1 600 for FH Mode

[Test Plot of Dwell Time]

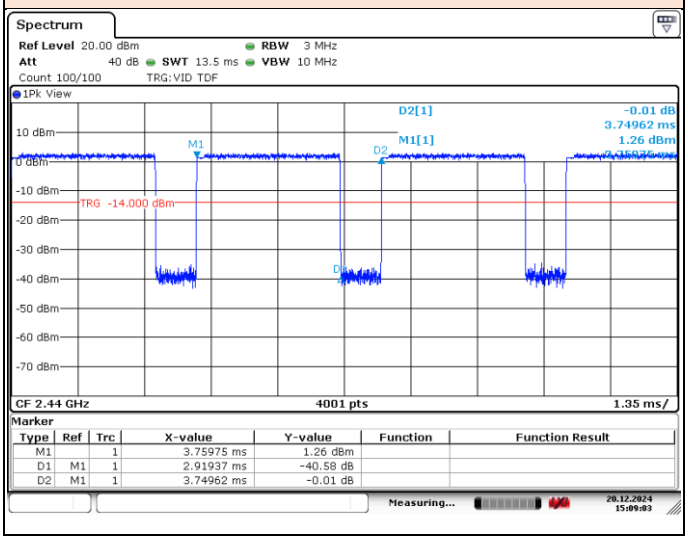
TM 1



TM 2



TM 3



3.7 Spurious Emission, Band edge and Restricted Bands

3.7.1 Regulation

§15.247(d) : In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

§15.209(a) : Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

§15.205(a) : Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

[1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2]Above 38.6

§15.205 (b) : Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

3.7.2 Test Procedure

Band-edge Compliance for RF Conducted Emissions

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

Band-edge tests are typically performed as a conducted test but may be performed as radiated measurements on a test site meeting the specifications in 5.2, at the measurement distances specified in 5.3. The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors specified in 4.1.4.2.

When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3.

For other than frequency-hopping devices, this test sequence shall be performed once. For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON. The purpose of the test with the hopping function turned on is to confirm that the RF power remains OFF while the device is changing frequencies, and that the oscillator stabilizes at the new frequency before RF power is turned back ON. Overshoot of any oscillator, including phase-lock-loop stabilized oscillators, can cause the device to be temporarily tuned to frequencies outside the authorized band, and it is important that no transmissions occur during such temporary periods. Particular attention to the hopping sequence requirements specified below is needed in the case of adaptive frequency-hopping devices:

a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).
b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).
c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation” as specified in 6.10.3.
d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.
e) Perform the test as follows:
    1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.
    2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
    3) Attenuation: Auto (at least 10 dB preferred).
    4) Sweep time: Coupled.
    5) Resolution bandwidth: 100 kHz.
    6) Video bandwidth: 300 kHz.
    7) Detector: Peak.
    8) Trace: Max hold.

f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.
g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
h) Repeat step c) through step e) for every applicable modulation.
i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).
j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Spurious RF Conducted Emissions

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results,account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

Spurious Radiated Emissions

1. The preliminary radiated measurement were performed to determine the frequency producing the maximum emissions in an semi-anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360º.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the Bi-Log antenna, and from 1000 MHz to 26500 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 x 4 meter in an semi-anechoic chamber. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The 0.8 m height is for below 1 GHz testing, and 1.5 m is for above 1GHz testing.

- Procedure for unwanted emissions measurements below 1 000 MHz

The procedure for unwanted emissions measurements below 1 000 MHz is as follows:

a) Follow the requirements in 12.7.4.
b) Compliance shall be determined using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

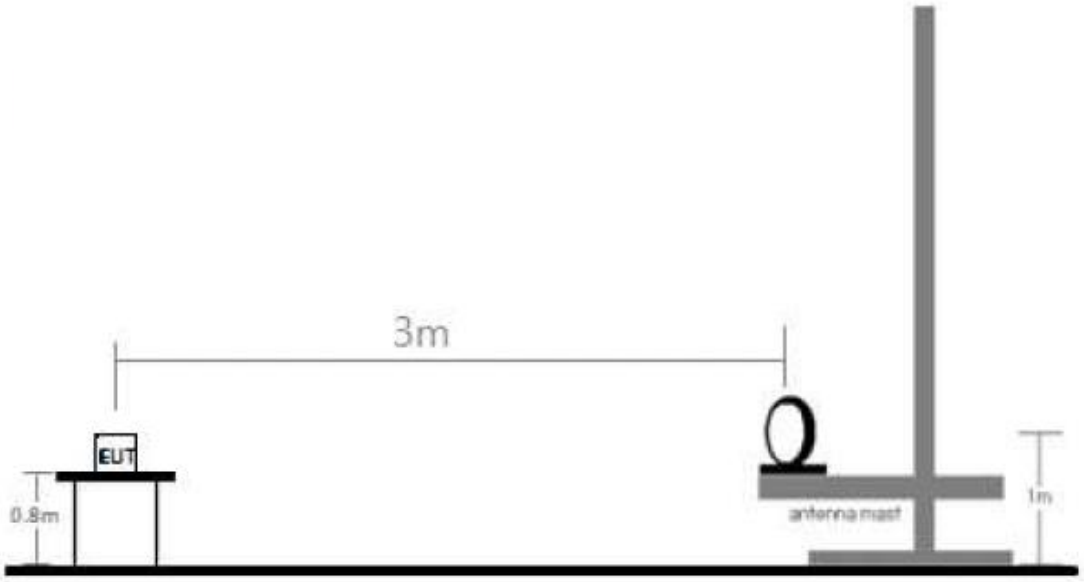
- Procedure for peak unwanted emissions measurements above 1 000 MHz

a) The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
b) The result of Average measurement is calculated using PK result and duty correction factor

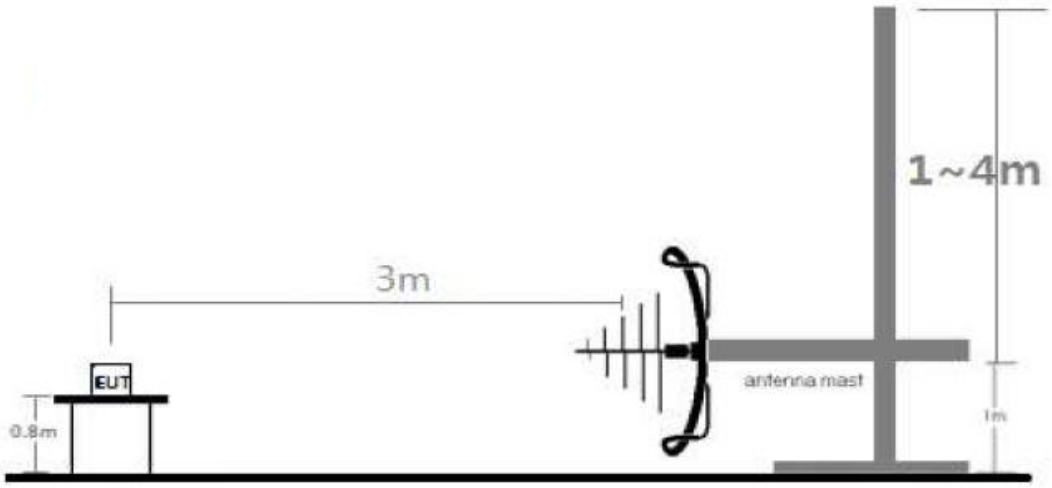
- Sample Calculation

- Field Strength Level [dBμV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + Duty Cycle Correction [dB]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable loss [dB]
- Margin [dB] = Field Strength Level [dBμV/m] – Limit [dBμV/m]

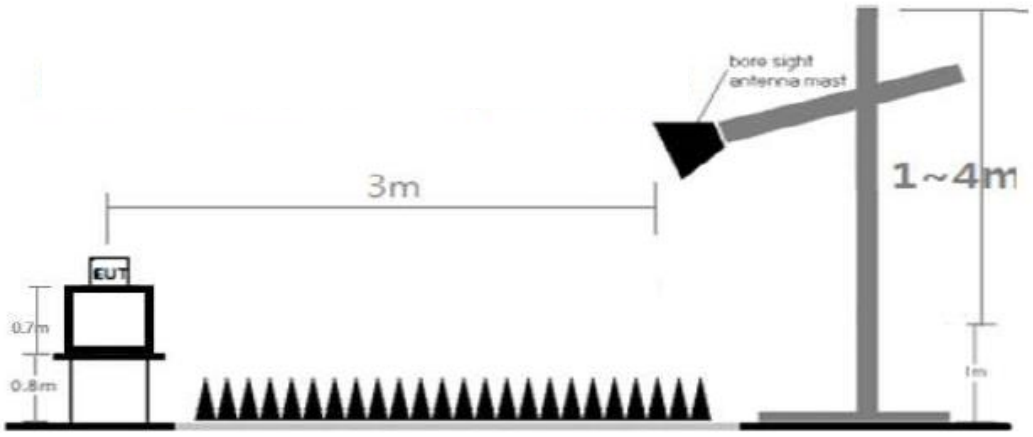
3.7.3 Test Setup

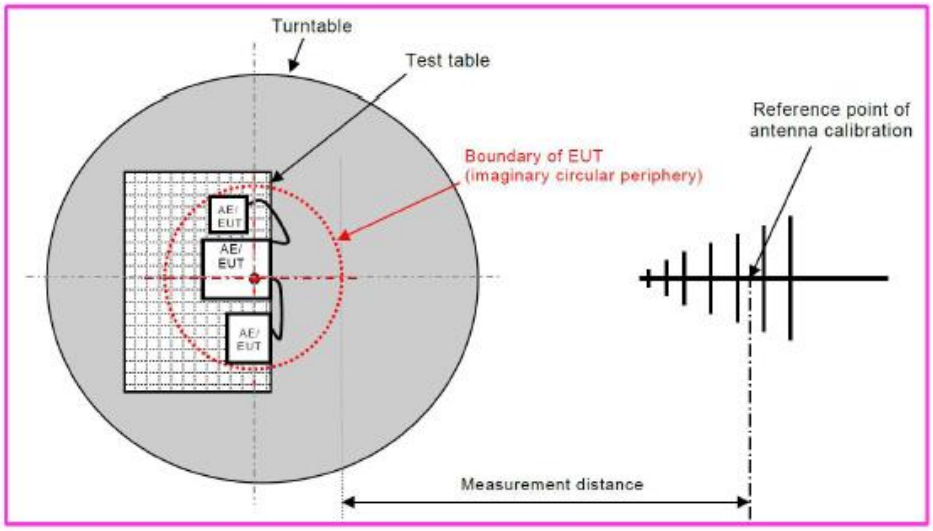


[Radiated Emission Test Setup Below 30 MHz]

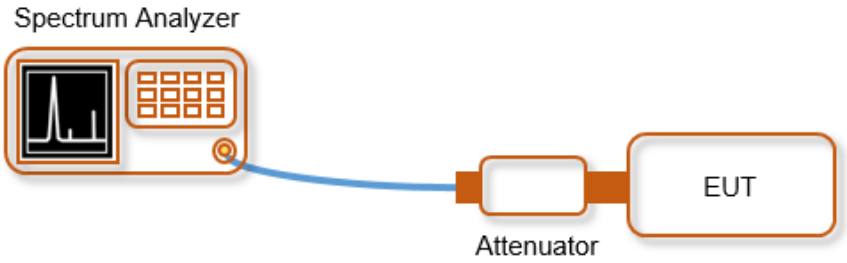


[Radiated Emission Test Setup Below 1 GHz]

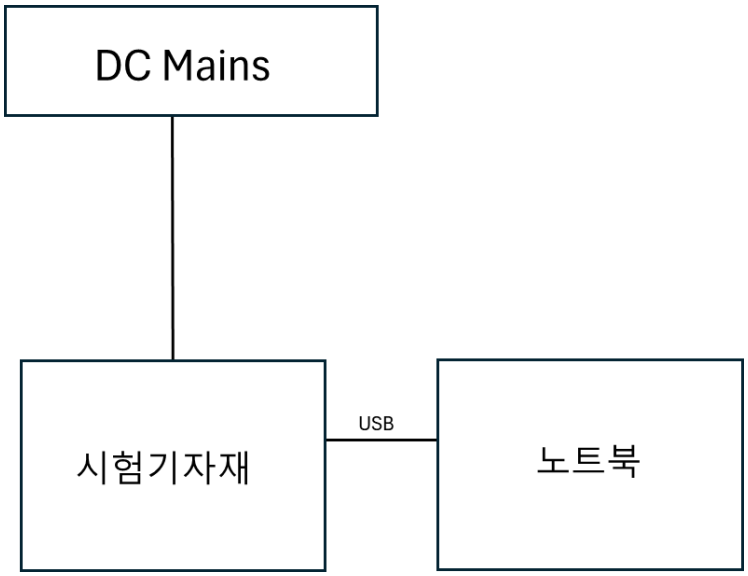




[Radiated Emission Test Setup Above 1 GHz]



[Conducted Spurious Emission]

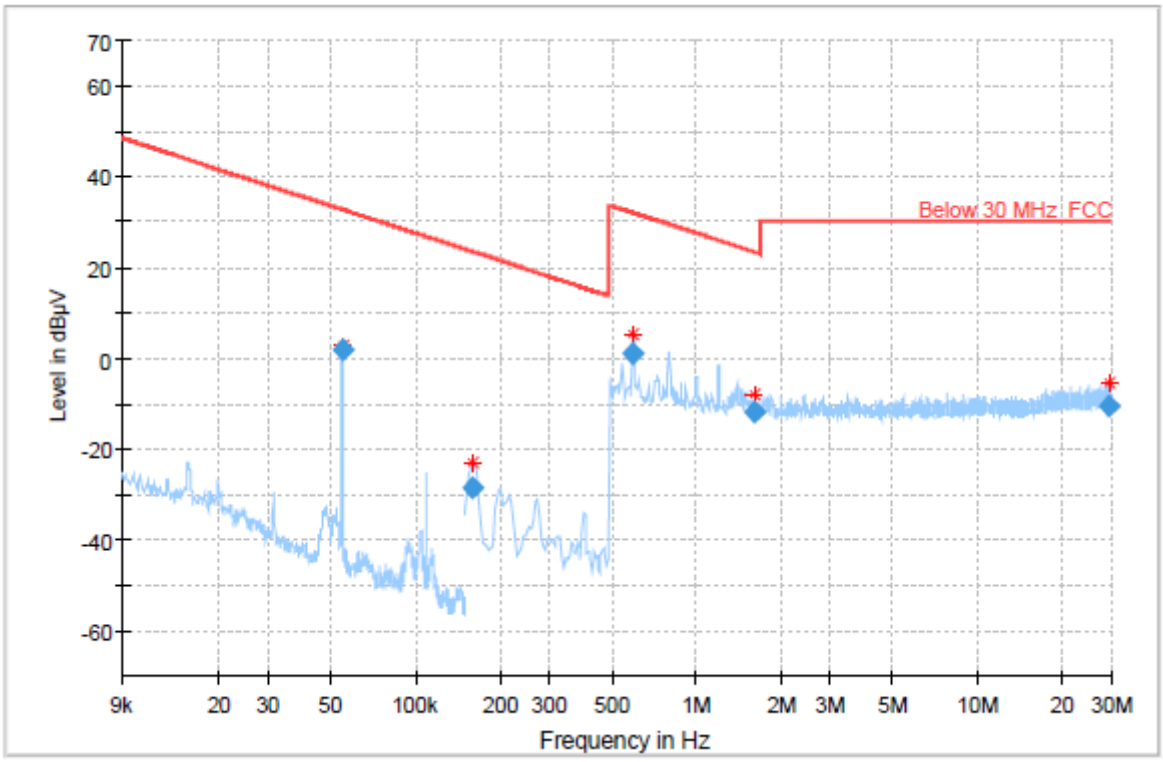


[Radiated Spurious Emission]

3.7.4 Test Result of Radiated Spurious Emission

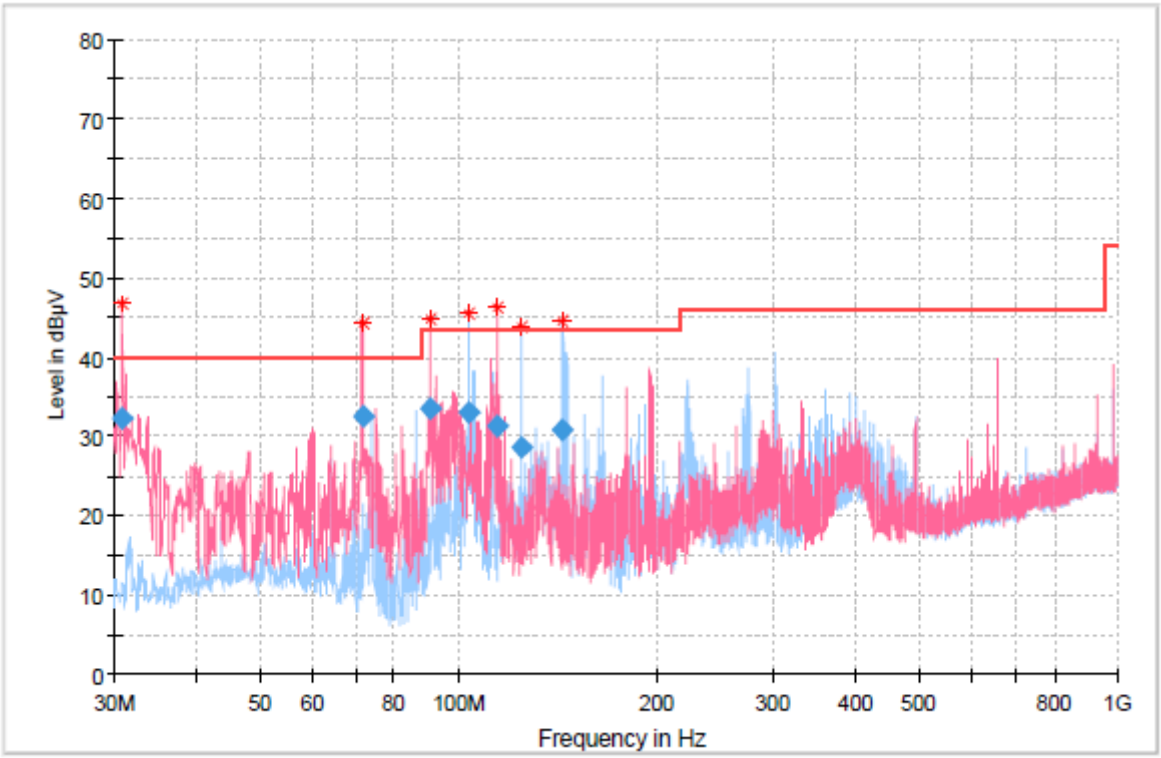
3.7.4.1 Radiated Emissions (Below 1 GHz)

Worst case – RSE (Below 30 MHz)_TM 1



Tested Frequency [MHz]	Frequency [MHz]	Reading Value [dBuV]	Pol [H/V]	EUT Axis	Detector Mode	DCCF [dB]	T.F [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
2 440	0.0546	62.02	Parallel	X	Quasi Peak	0.00	-60.00	2.02	32.84	30.82
	0.1593	31.34	Parallel	X	Quasi Peak	0.00	-59.90	-28.56	23.55	52.11
	0.5978	20.76	Parallel	X	Quasi Peak	0.00	-19.80	0.96	32.07	31.11
	1.6005	8.11	Parallel	X	Quasi Peak	0.00	-19.70	-11.59	23.52	35.11
	29.6875	5.58	Parallel	X	Quasi Peak	0.00	-16.20	-10.62	30.00	40.62

Worst case – RSE (Below 1 GHz)_TM 1



Tested Frequency [MHz]	Frequency [MHz]	Reading Value [dBuV]	Pol [H/V]	EUT Axis	Detector Mode	DCCF [dB]	T.F [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
2 440	30.8730	55.98	V	X	Quasi Peak	0.00	-23.80	32.18	40.00	7.82
	71.4675	57.95	V	X	Quasi Peak	0.00	-25.40	32.55	40.00	7.45
	90.6250	57.21	V	X	Quasi Peak	0.00	-23.80	33.41	43.50	10.09
	103.4290	55.14	H	X	Quasi Peak	0.00	-22.20	32.94	43.50	10.56
	114.1475	54.32	V	X	Quasi Peak	0.00	-23.10	31.22	43.50	12.28
	124.8660	53.46	H	X	Quasi Peak	0.00	-24.90	28.56	43.50	14.94

Remarks

1. Field Strength (dBµV/m) = S/A Reading Value(dBµV) + Total Factor(dB/m) + DCCF(dB)
2. Total Factor(dB/m) = T.F (dB/m) = Antenna Factor(dB/m) + Cable Loss(dB) – Pre-Amplifier Gain(dB)
3. Margin(dB) = Limit (dBµV/m) – Result[dBuV/m]
4. Measurement Distance = 3 m
5. DCCF = Duty Cycle Correction Factor.
6. No other spurious and harmonic emissions were found greater than listed emissions on above table
7. If the measured peak value satisfies the AVG LIMIT, the AVG value was not written.

3.7.4.2 Radiated Emissions (Above 1 GHz)

TM 1

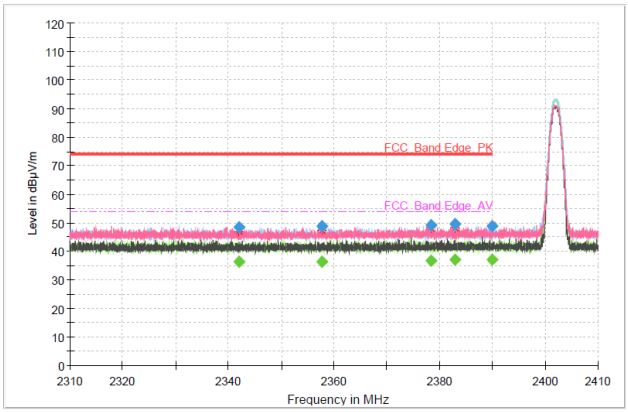
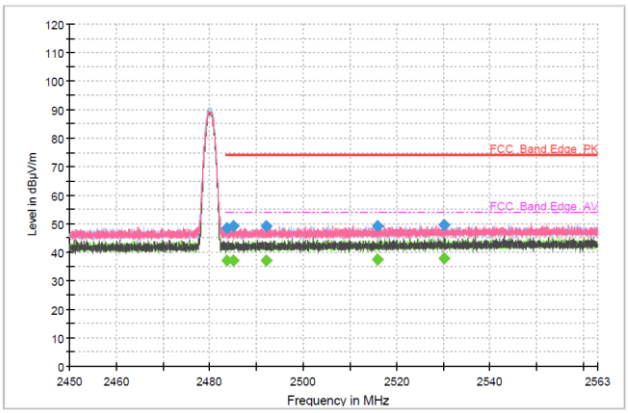
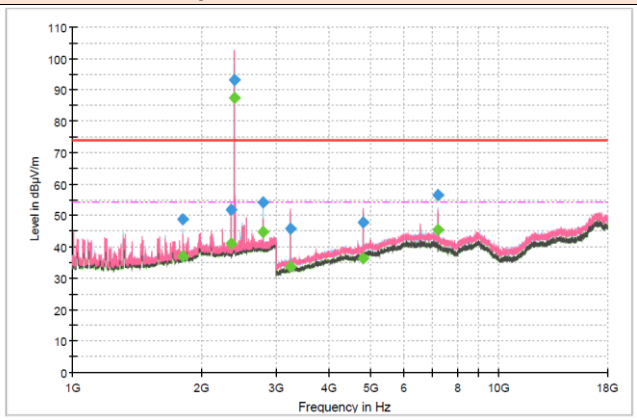
Tested Frequency [MHz]	Frequency [MHz]	Reading Value [dBuV]	Pol [H/V]	EUT Axis	Detector Mode	DCCF [dB]	T.F [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
2 402	2 382.98	44.22	V	X	Peak	0.00	5.40	49.62	74.00	24.38
	2 389.92	32.54	V	X	Average	1.11	5.50	38.04	54.00	15.96
	7 206.09	44.29	H	X	Peak	0.00	12.10	56.39	74.00	17.61
	7 206.09	34.49	H	X	Average	1.11	12.10	46.59	54.00	**7.41**
2 440	6 531.09	43.57	V	X	Peak	0.00	12.30	55.87	74.00	18.13
	6 531.09	1.11	V	X	Average	1.11	12.30	13.41	54.00	40.59
2 480	2 529.98	43.29	V	X	Peak	0.00	6.30	49.59	74.00	24.41
	2 529.98	1.11	V	X	Average	1.11	6.30	7.41	54.00	46.59
	6 531.09	43.61	V	X	Peak	0.00	12.30	55.91	74.00	18.09
	6 531.09	1.11	V	X	Average	1.11	12.30	13.41	54.00	40.59

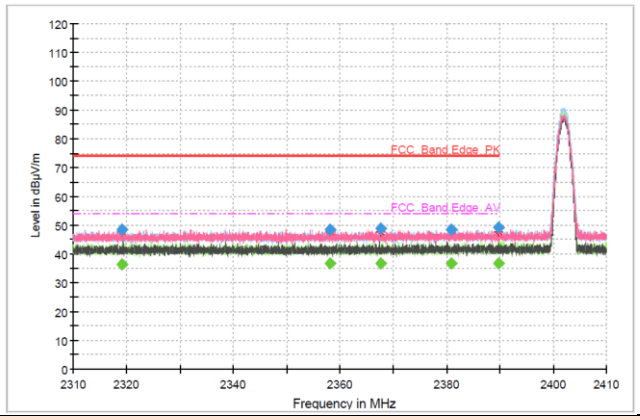
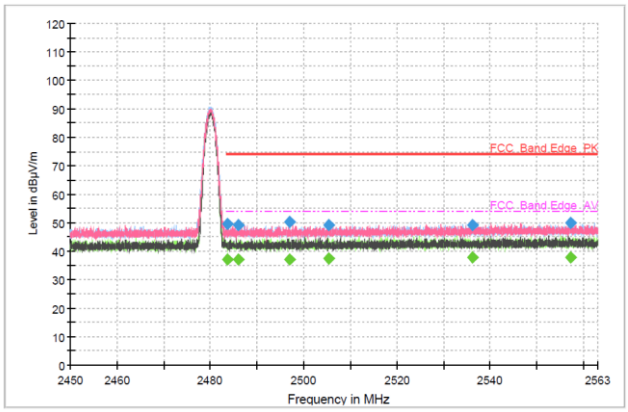
TM 2

Tested Frequency [MHz]	Frequency [MHz]	Reading Value [dBuV]	Pol [H/V]	EUT Axis	Detector Mode	DCCF [dB]	T.F [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
2 402	2 389.84	43.52	H	X	Peak	0.00	5.50	49.02	74.00	24.98
	2 389.84	32.29	H	X	Average	1.09	5.50	37.79	54.00	16.21
	6 531.09	43.11	V	X	Peak	0.00	12.30	55.41	74.00	18.59
	6 531.09	34.20	V	X	Average	1.09	12.30	46.50	54.00	7.50
2 440	6 531.09	41.97	V	X	Peak	0.00	12.30	54.27	74.00	19.73
	6 531.09	32.86	V	X	Average	1.09	12.30	45.16	54.00	8.84
2 480	2 497.04	44.25	H	X	Peak	0.00	6.00	50.25	74.00	23.75
	2 557.07	32.44	V	X	Average	1.09	6.50	38.94	54.00	15.06
	6 530.63	43.69	V	X	Peak	0.00	12.30	55.99	74.00	18.01
	6 530.63	34.63	V	X	Average	1.09	12.30	46.93	54.00	**7.07**

TM 3

Tested Frequency [MHz]	Frequency [MHz]	Reading Value [dBuV]	Pol [H/V]	EUT Axis	Detector Mode	DCCF [dB]	T.F [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
2 402	2 368.41	44.01	V	X	Peak	0.00	5.30	49.31	74.00	24.69
	2 389.70	32.34	H	X	Average	1.09	5.50	37.84	54.00	16.16
	6 531.09	44.07	V	X	Peak	0.00	12.30	56.37	74.00	17.63
	6 531.09	35.97	V	X	Average	1.09	12.30	48.27	54.00	**5.73**
2 440	6 531.09	43.61	V	X	Peak	0.00	12.30	55.91	74.00	18.09
	6 531.09	35.43	V	X	Average	1.09	12.30	47.73	54.00	6.27
2 480	2 539.54	43.26	V	X	Peak	0.00	6.40	49.66	74.00	24.34
	2 560.64	32.42	V	X	Average	1.09	6.50	38.92	54.00	15.08
	6 531.09	43.64	V	X	Peak	0.00	12.30	55.94	74.00	18.06
	6 531.09	35.50	V	X	Average	1.09	12.30	47.80	54.00	6.20

TM 1
Bandedge_2 402 MHz

Bandedge_2 480 MHz

Spurious_Worst case


TM 2
Bandedge_2 402 MHz

Bandedge_2 480 MHz

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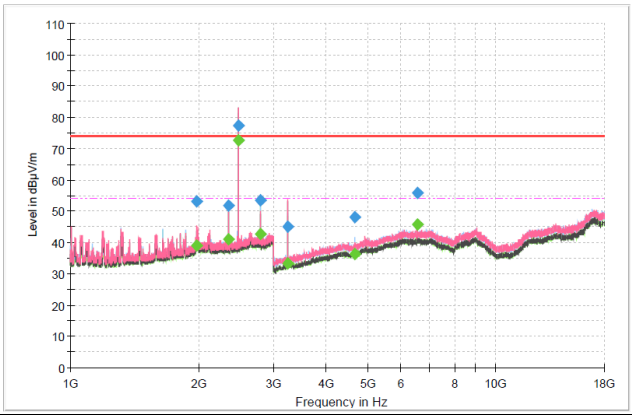
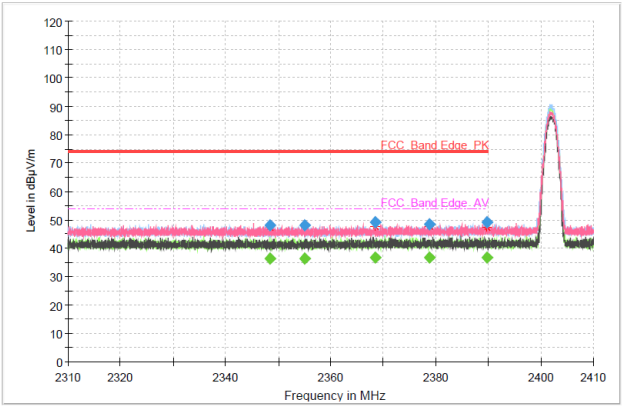
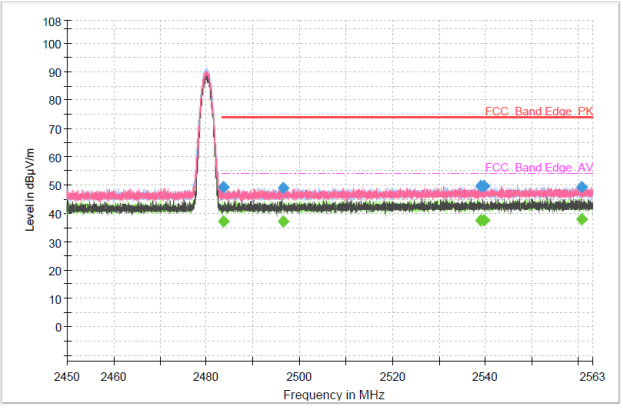
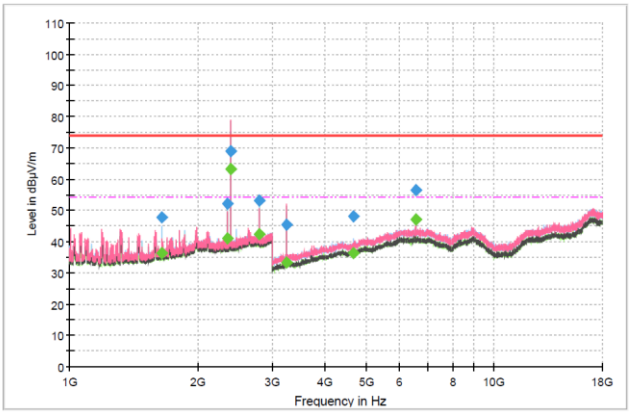
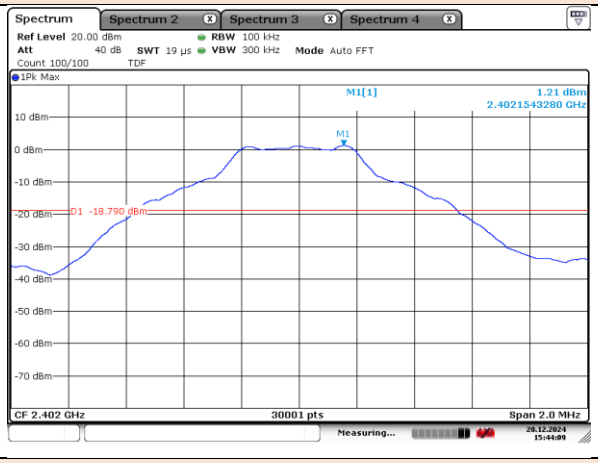
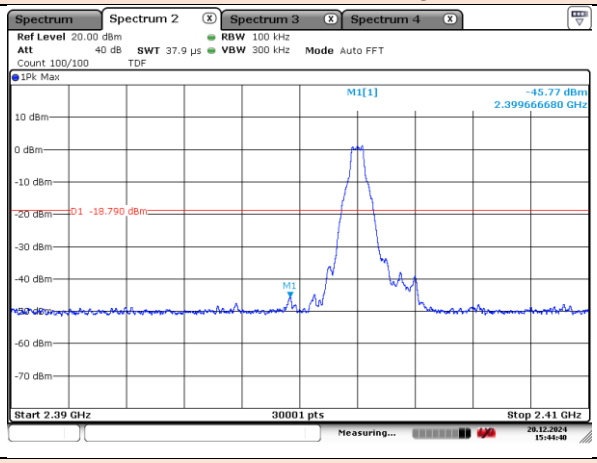
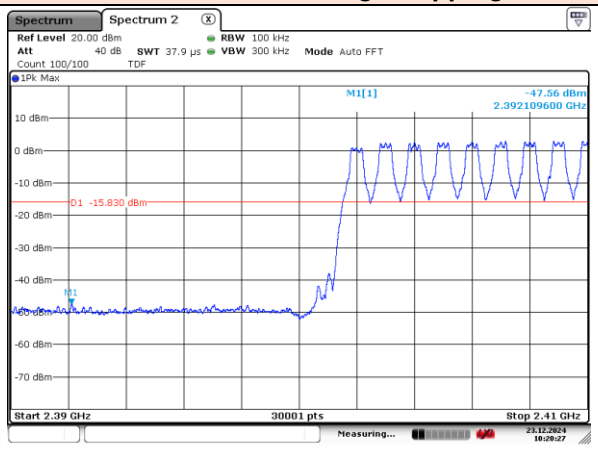


TM 3
Bandedge_2 402 MHz

Bandedge_2 480 MHz

Spurious_Worst case


3.7.5 Test Result of Conducted Spurious Emission

[Spurious Emission]

<table>
<tr><th colspan="2">TM 1</th></tr>
<tr><th>2 402 MHz _ Ref.</th><th>2 402 MHz _ Band edge</th></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><th>2 402 MHz _ Band edge Hopping</th><th>-</th></tr>
<tr><td> 
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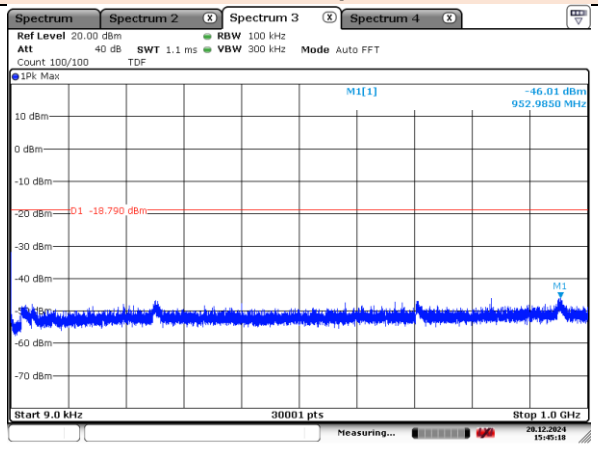
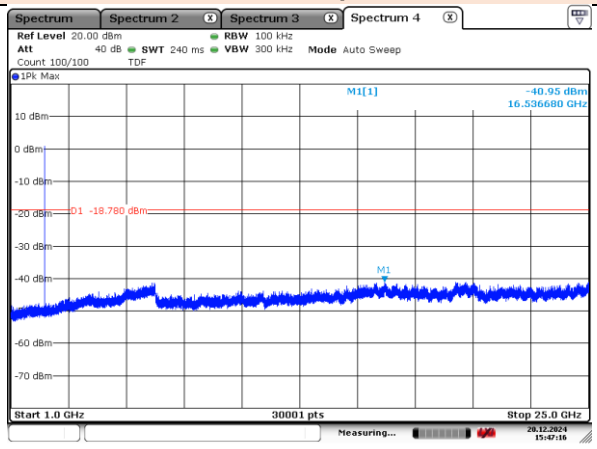
<tr><th>2 402 MHz _ Spurious</th><th>2 402 MHz _ Spurious</th></tr>
<tr><td> 
</td><td> 
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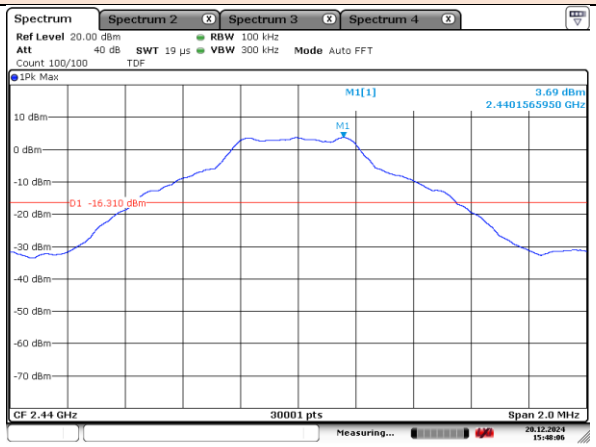
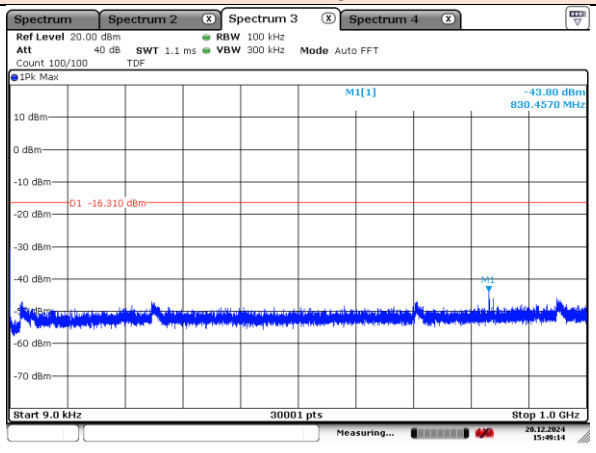
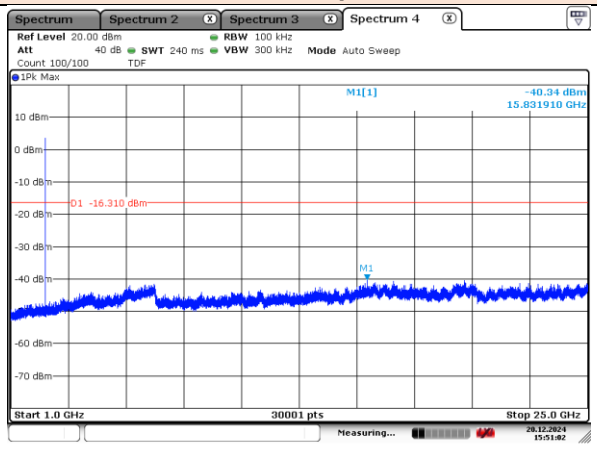
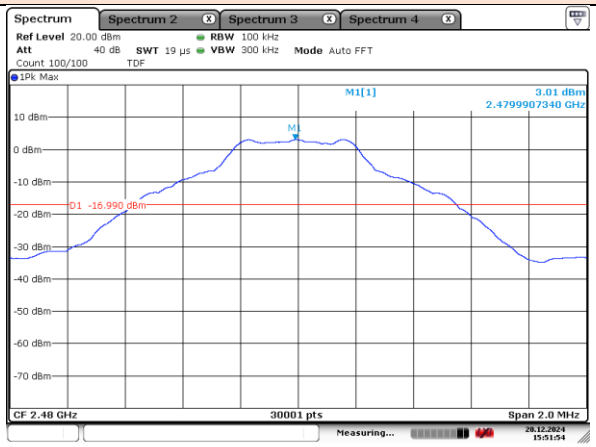
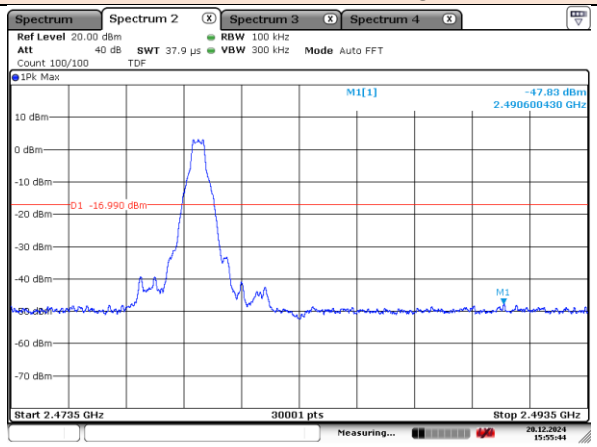
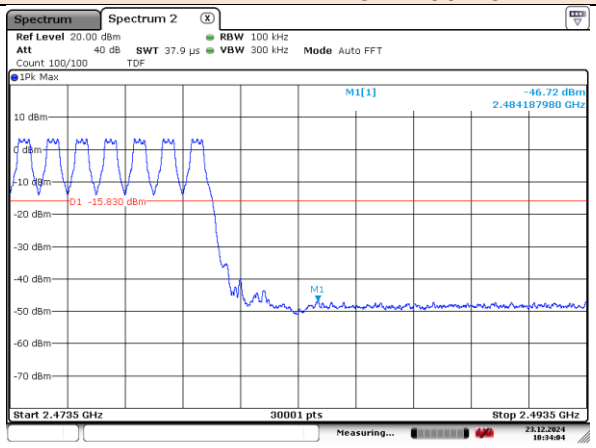
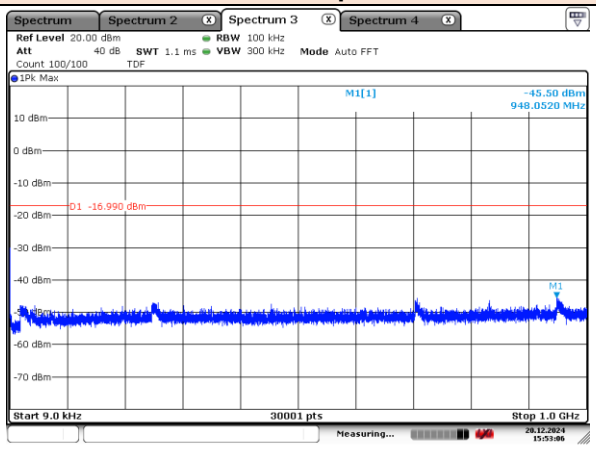
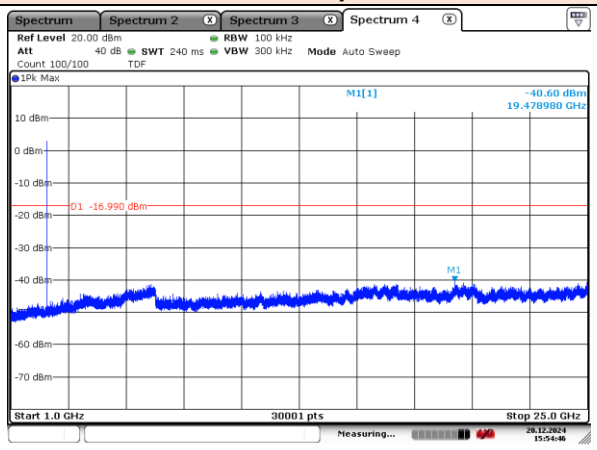
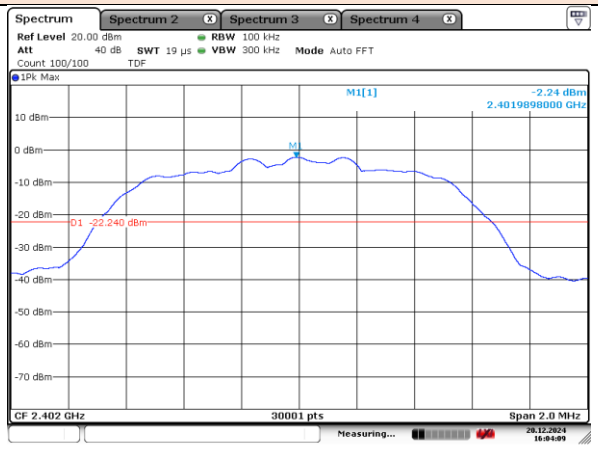
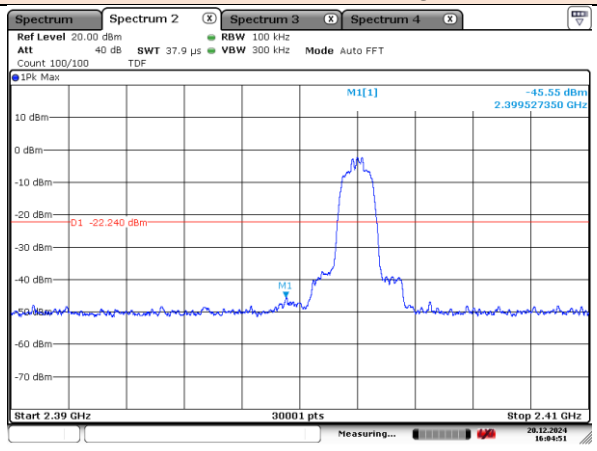
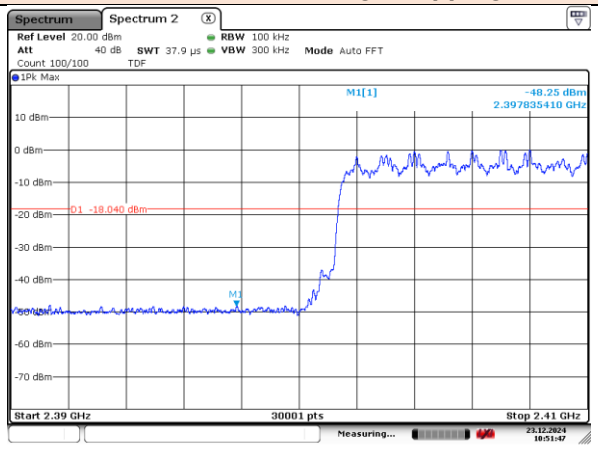
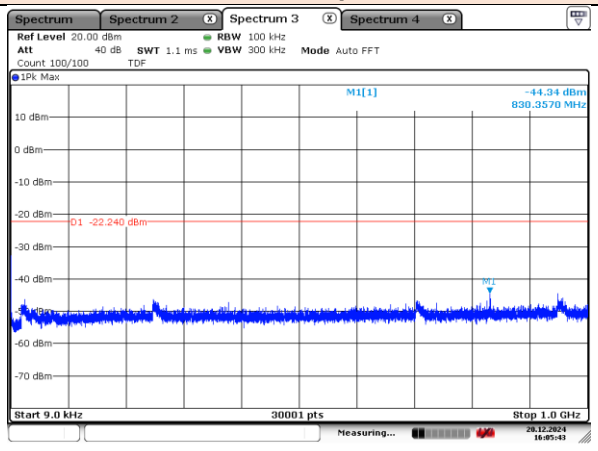
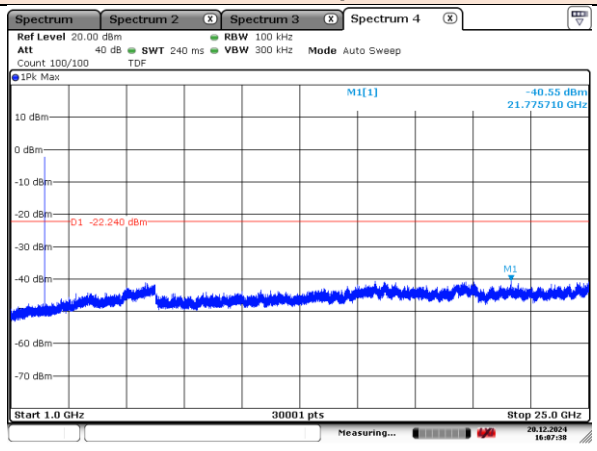
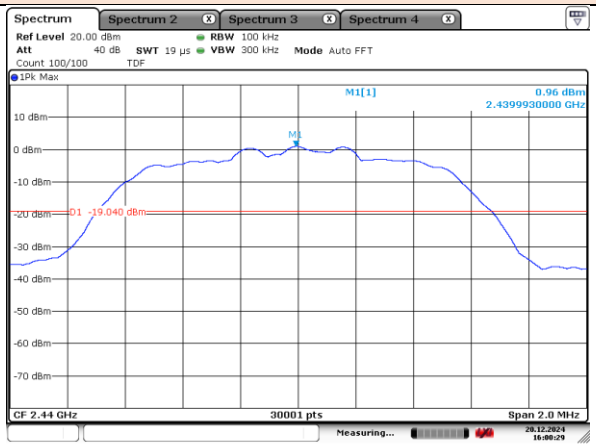
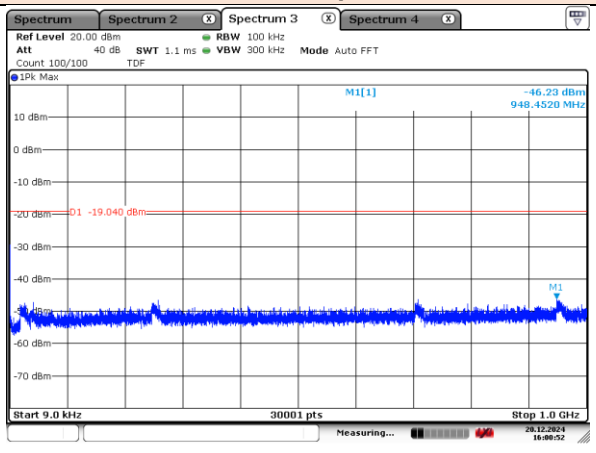
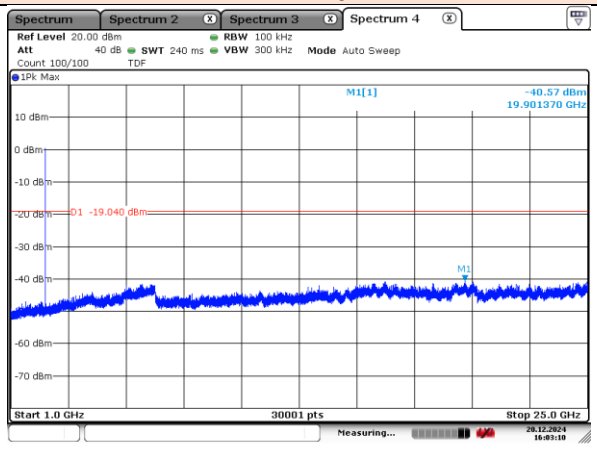
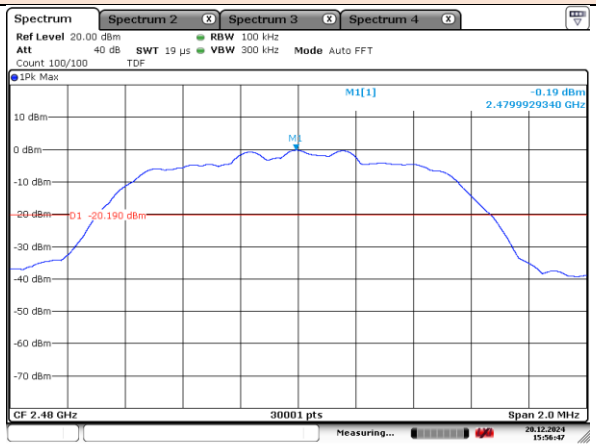
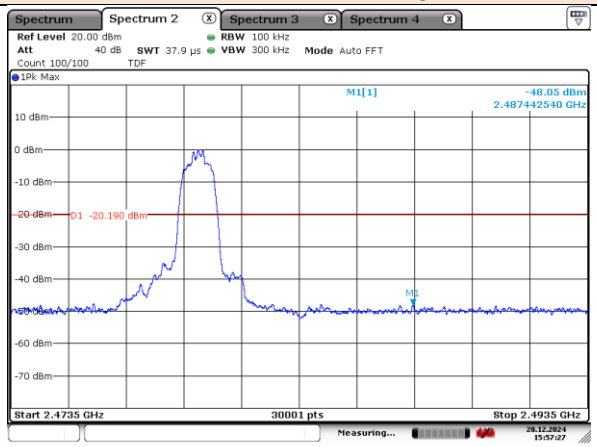
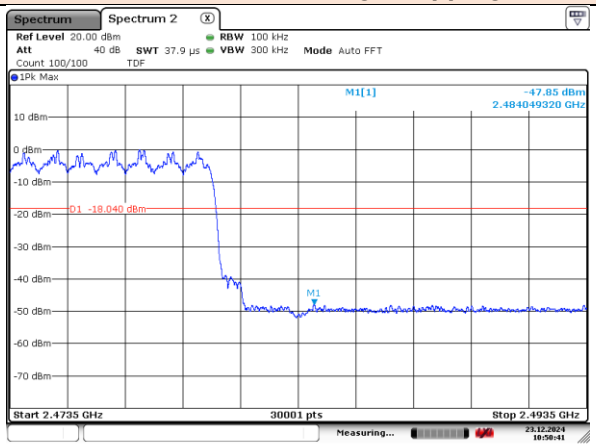
TM 1	
2 440 MHz _ Ref.	**-**
	-
2 440 MHz _ Spurious	**2 440 MHz _ Spurious**
	

TM 1	
2 480 MHz _ Ref.	**2 480 MHz _ Band edge**
	
2 480 MHz _ Band edge Hopping	**-**
	-
2 480 MHz _ Spurious	**2 480 MHz _ Spurious**
	

TM 2	
2 402 MHz _ Ref.	**2 402 MHz _ Band edge**
	
2 402 MHz _ Band edge Hopping	**-**
	
2 402 MHz _ Spurious	**2 402 MHz _ Spurious**
	

TM 2	
2 440 MHz _ Ref.	**-**
	-
2 440 MHz _ Spurious	**2 440 MHz _ Spurious**
	

TM 2	
2 480 MHz _ Ref.	**2 480 MHz _ Band edge**
	
2 480 MHz _ Band edge Hopping	**-**
	-
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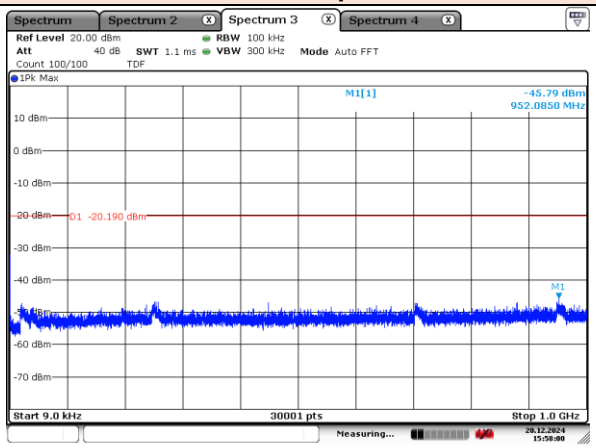
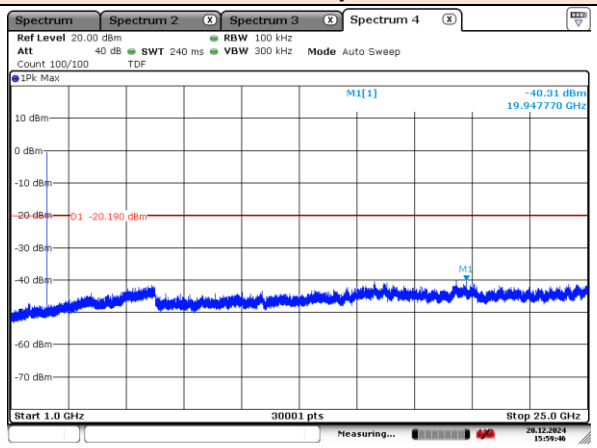
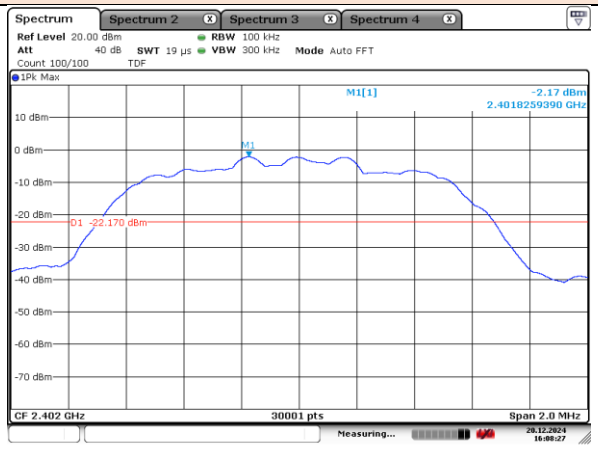
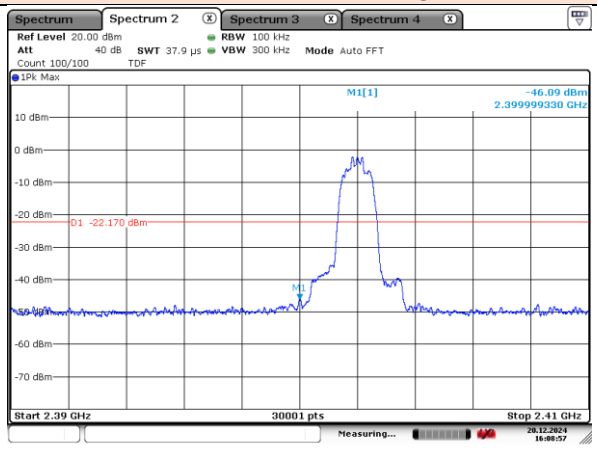
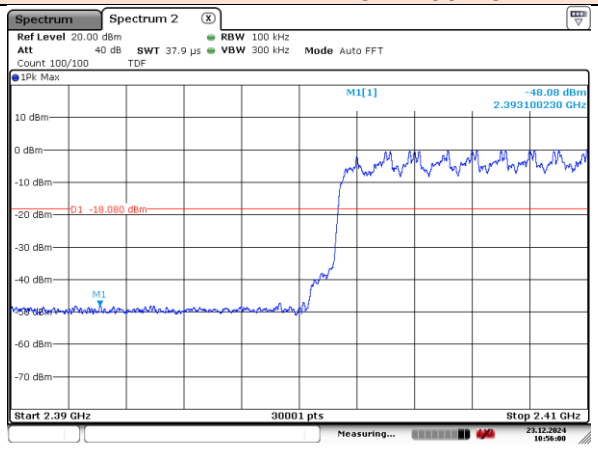
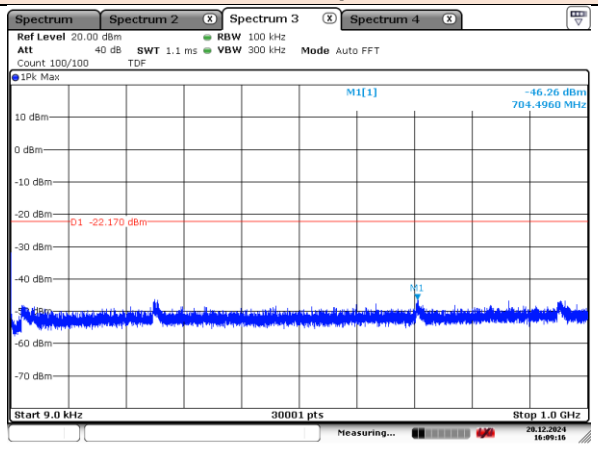
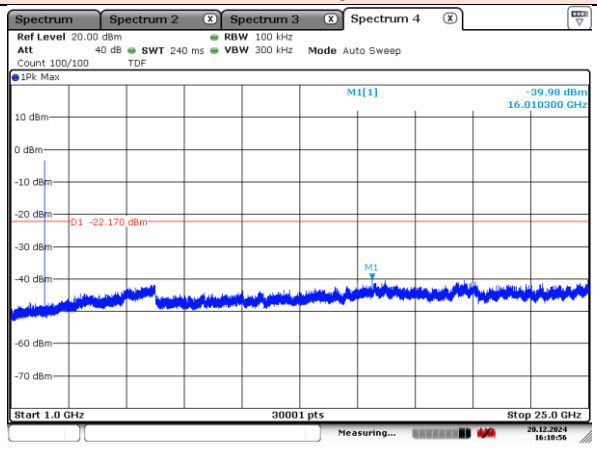
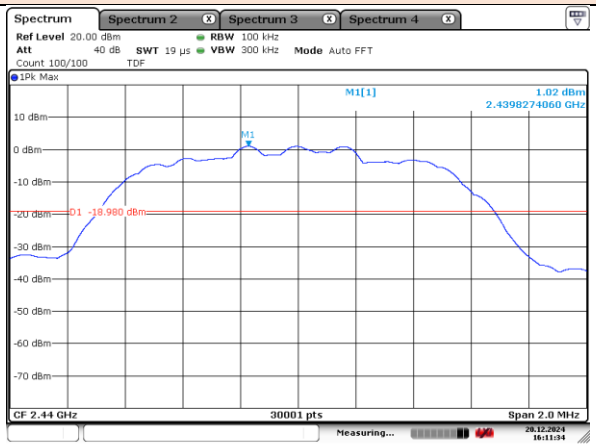
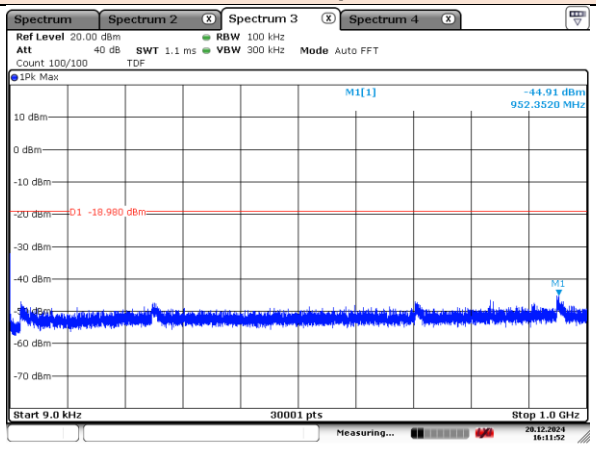
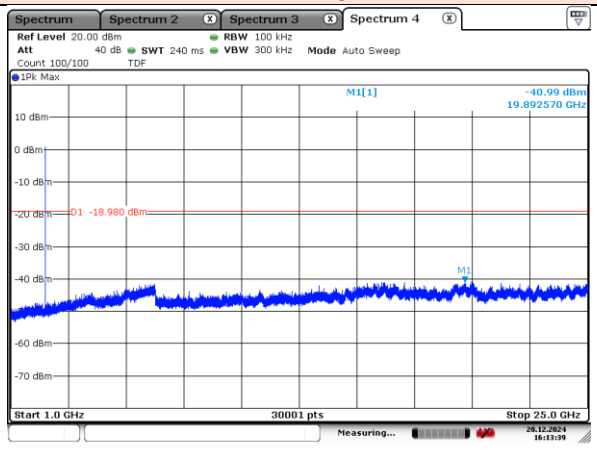
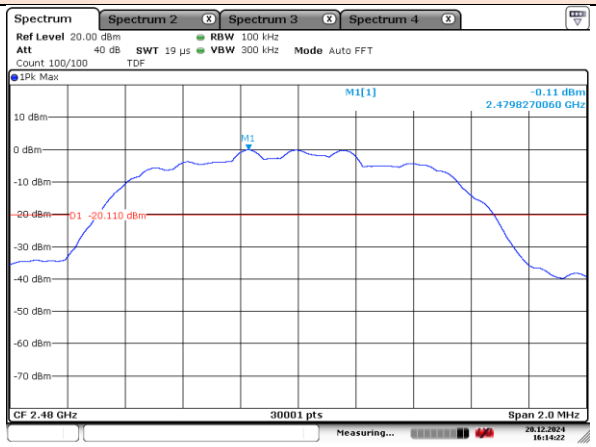
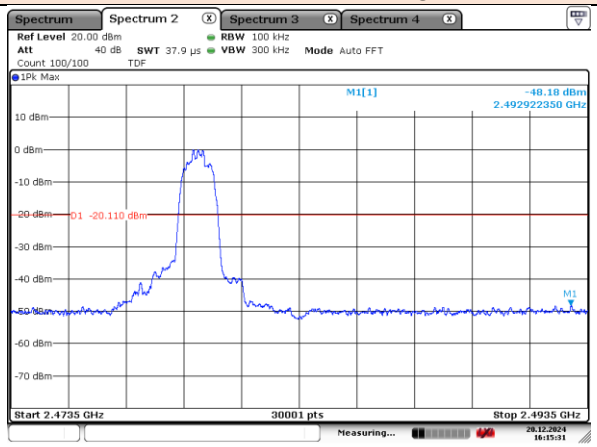
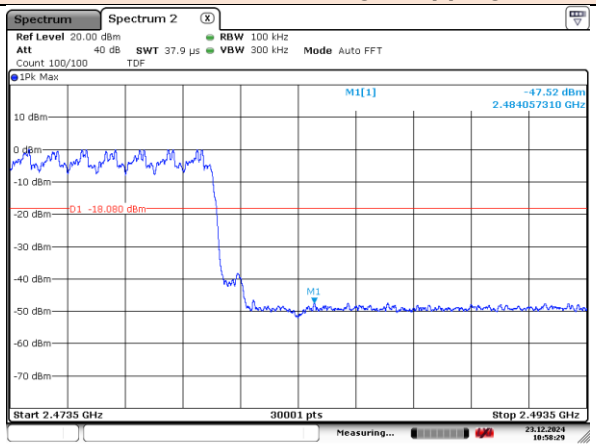
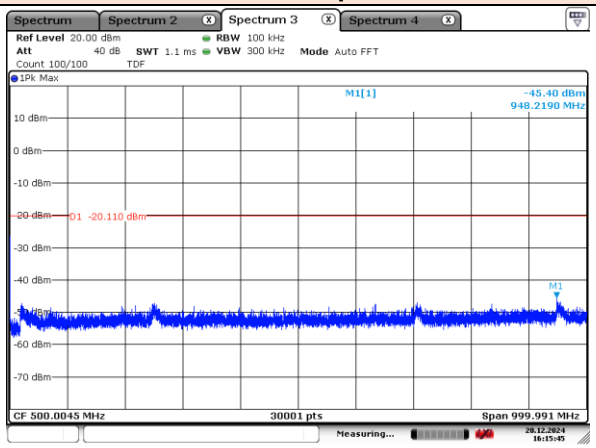
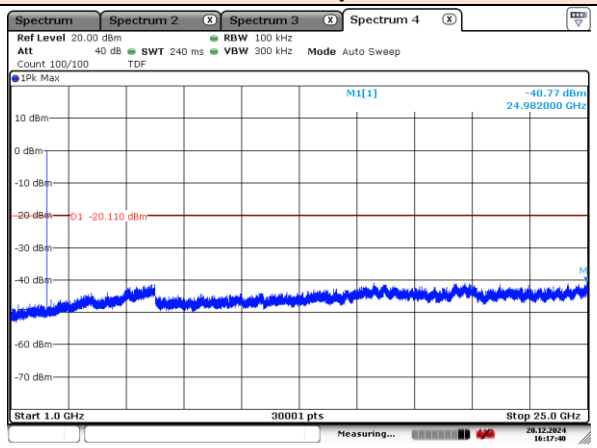
	

TM 3	
2 402 MHz _ Ref.	**2 402 MHz _ Band edge**
	
2 402 MHz _ Band edge Hopping	**-**
	
2 402 MHz _ Spurious	**2 402 MHz _ Spurious**
	

TM 3	
2 440 MHz _ Ref.	**-**
	-
2 440 MHz _ Spurious	**2 440 MHz _ Spurious**
	

TM 3	
2 480 MHz _ Ref.	**2 480 MHz _ Band edge**
	
2 480 MHz _ Band edge Hopping	**-**
	-
2 480 MHz _ Spurious	**2 480 MHz _ Spurious**
	

3.8 AC Conducted Emissions (150 kHz to 30 MHz)

3.8.1 Regulation

§15.207(a) : Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

	Conducted limit (dBμV)	
Frequency of emission (MHz)	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

3.8.2 Test Procedure

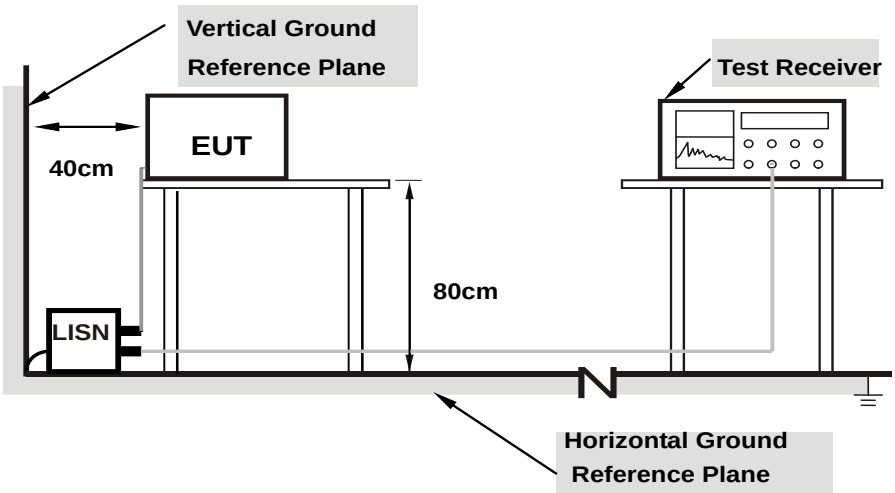
a) The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm / 50 μH of coupling impedance for the measuring instrument.

b) Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c) The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Remark : The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

3.8.3 Test Setup



3.8.4 Test Result

- N/A

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services Korea. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

Test Firm Name : BV CPS ADT Korea Ltd.

Address : Innoplex 1st complex No.2 B303, No.2 B304, 306, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Republic of Korea

FCC

Designation Number : KR0158
Test Firm Registration Number : 666061

ISED

Designation Number : KR0158
Test Firm Registration Number : 25944

If you have any comments, please feel free to contact us at the following:

Email: minkyoung.kim@bureauveritas.com
Web Site: www.bureauveritas.co.kr/cps/eaw

The address and road map of all our labs can be found in our web site also.

- End of report -