TEST REPORT

Product Name : Wireless Earphones
Model Number : M2430E1
FCC ID : 2AFZZM2430E1

Prepared for	:	Xiaomi Communications Co., Ltd.
Address	:	#019, 9th Floor, Building 6, 33 Xi' erqi Middle Road, Haidian District, Beijing, China, 100085
Prepared by	:	EMTEK (SHENZHEN) CO., LTD.
Address	:	Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China Tel: (0755) 26954280 Fax: (0755) 26954282
Report Number	:	ENS2406280291W00901R
Date(s) of Tests	:	July 16, 2024 to July 27, 2024
Date of issue	:	July 29, 2024

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1 TEST RESULT CERTIFICATION

Applicant	:	Xiaomi Communications Co., Ltd.
Address	:	#019, 9th Floor, Building 6, 33 Xi' erqi Middle Road, Haidian District, Beijing, China, 100085
Manufacturer	:	Xiaomi Communications Co., Ltd.
Address	:	#019, 9th Floor, Building 6, 33 Xi' erqi Middle Road, Haidian District, Beijing, China, 100085
EUT	:	Wireless Earphones
Model No.	:	M2430E1
Trade Mark	:	Redmi

Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 47 CFR Part 2, Subpart J FCC 47 CFR Part 15, Subpart C	**PASS**

The above equipment was tested by EMTEK (SHENZHEN) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 2 and Part 15.247

The test results of this report relate only to the tested sample identified in this report.

Date of Test	:	July 16, 2024 to July 27, 2024
Prepared by	:	Una Yu/Editor
Reviewer	:	Joe Xia/Supervisor
Approved & Authorized Signer	:	Lisa Wang/Manager

Modified Information

Version	Report No.	Revision Date	Summary
Ver.1.0	ENS2406280291W00901R	/	Original Report

2 EUT TECHNICAL DESCRIPTION

Product Name:	Wireless Earphones
Model Number:	M2430E1
Test Sample S/N:	N/A
Variant Number:	N/A
Bluetooth Version:	Bluetooth V5.3
Hardware Version:	V2
Software Version:	1.0.0.5
Power level setting:	BR/EDR=60/60
Data Rate:	Up to 3 Mbps
Modulation:	GFSK, π /4-DQPSK, 8DPSK for Bluetooth-BR/EDR;
Operating Frequency:	2402-2480MHz for Bluetooth-BR/EDR
Number of Channels:	79 Channels
Antenna Type:	FPC Antenna
Antenna Gain:	-2.7 dBi (Note: The antenna information is provided by the customers, which will have a certain impact on the test results.)
Power Supply	Charging Port: Type-C Earbuds Input: 5 V 160mA Earbuds working voltage: 3.85V 54mA Charging Case Input: 5 V 600mA Charging Case Output: 5 V 320mA
Temperature Range:	0°C ~ 45°C

Note: *for more details, please refer to the user's manual of the EUT.*

The device configuration is as follows

Earbuds	Supplier No.1	Note:Supplier No.1 and Supplier No.2, Except for some battery parameters are different, the hardware and components are the same, but the supplier is different.
	Supplier No.2	
Charging Case	Supplier No.1	
	Supplier No.2	
Note:Supplier No.1 and Supplier No.2, The radio frequency is not affected. We only tested Supplier No.1		

3 SUMMARY OF TEST RESULT

FCC Part Clause	Test Parameter	Verdict	Remark
15.247(a)(1)	20dB Bandwidth	PASS	
15.247(a)(1)	Carrier Frequency Separation	PASS	
15.247(a)(1)	Number of Hopping Frequencies	PASS	
15.247(a)(1)	Average Time of Occupancy (Dwell Time)	PASS	
15.247(b)(1)	Maximum Peak Conducted Output Power	PASS	
15.247(c)	Conducted Spurious Emissions	PASS	
15.247(d) 15.209	Radiated Spurious Emissions	PASS	
15.207	Conducted Emission	PASS	
15.203	Antenna Application	PASS	
15.247 (a) (1)/g/h	Frequency Hopping System	PASS	
NOTE1: N/A (Not Applicable)			

RELATED SUBMITTAL(S) / GRANT(S):
This submittal(s) (test report) is intended for FCC ID: 2AFZZM2430E1 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

4 TEST METHODOLOGY

4.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:
FCC 47 CFR Part 2, Subpart J
FCC 47 CFR Part 15, Subpart C
FCC KDB 558074 D01 15.247 Meas Guidance v05r02

4.2 MEASUREMENT EQUIPMENT USED

For Conducted Emission Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
EMI Test Receiver	Rohde & Schwarz	ESCI	101384	2024/5/11	1Year
AMN	Rohde & Schwarz	ENV216	101161	2024/5/10	1Year
AMN	Kyoritsu	KNW-407	8-1492-9	2024/5/11	1Year

For Spurious Emissions Test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
Pre-Amplifier	Bonn	BLMA 011001N	2213967A	2023/10/23	1Year
EMI Test Receiver	Rohde & Schwarz	ESR7	102551	2023/10/23	1Year
Bilog Antenna	Schwarzbeck	VULB9163	9163142	2024/7/8	2Year
Horn antenna	Schwarzbeck	BBHA9120D	9120D-1198	2023/6/2	2Year
Pre-Amplifier	Bonn	BLMA 0118-5G	2213967B-01	2023/10/23	1Year
Spectrum Analyzer	Rohde & Schwarz	FSV3044	101290	2023/10/23	1Year
Horn antenna	Schwarzbeck	BBHA9170	9170-399	2024/5/11	2Year
Pre-Amplifier	Lunar EM	LNA18G26-40	J1012131010001	2024/5/11	1Year
Pre-Amplifier	Lunar EM	LNA26G40-40	J1013131028001	2024/5/11	1Year
Loop Antenna	Schwarzbeck	FMZB1519	1519-012	2023/5/12	2Year

For other test items:

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
Signal Analyzer	Agilent	N9010A	MY53470879	2024/5/10	1Year
Vector Signal Generater	Agilent	N5182B	MY53050878	2024/5/10	1Year
Analog Signal Generator	Agilent	N5171B	MY53050553	2024/5/10	1Year
RF Control Unit(Power Meter)	Tonscend	JS0806-2	\	2024/5/10	1Year
Temperature&Humidity Chamber	ESPEC	EL-02KA	12107166	2024/5/10	1 Year

4.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.
The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (1Mbps for GFSK modulation(DH5); 2Mbps for π/4-DQPSK modulation(2DH5);3Mbps for 8DPSK modulation(3DH5)) were used for all tests.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441	…	…
1	2403	40	2442	76	2478
2	2404	41	2443	77	2479
…	…	…	…	78	2480
Note: fc=2402MHz+(k-1)×1MHz k=1 to 79					

Test Frequency and channel list:

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441	78	2480

5 FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

Bldg 69, Majialong Industry Zone District, Nanshan District, Shenzhen, China
The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

5.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

EMC Lab. : **Accredited by CNAS**
The Certificate Registration Number is L2291
The Laboratory has been assessed and proved to be in compliance with CNAS-CL01 (identical to ISO/IEC 17025:2017)

Accredited by FCC
Designation Number: CN1204
Test Firm Registration Number: 882943

Accredited by A2LA
The Certificate Number is 4321.01

Accredited by Industry Canada
The Conformity Assessment Body Identifier is CN0008

Name of Firm : EMTEK (SHENZHEN) CO., LTD.
Site Location : Building 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China

6 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

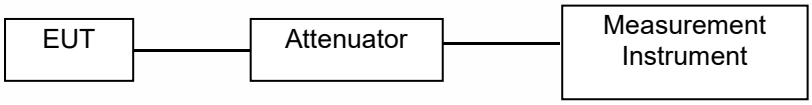
Parameter	Uncertainty
Radio Frequency	±1x10^-5
Maximum Peak Output Power Test	±1.0dB
Conducted Emissions Test	±2.0dB
Radiated Emission Test	±2.0dB
Occupied Bandwidth Test	±1.0dB
Band Edge Test	±3dB
All emission, radiated	±3dB
Antenna Port Emission	±3dB
Temperature	±0.5℃
Humidity	±3%

Measurement Uncertainty for a level of Confidence of 95%

7 SETUP OF EQUIPMENT UNDER TEST

7.1 RADIO FREQUENCY TEST SETUP 1

The BT component's antenna ports(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



7.2 RADIO FREQUENCY TEST SETUP 2

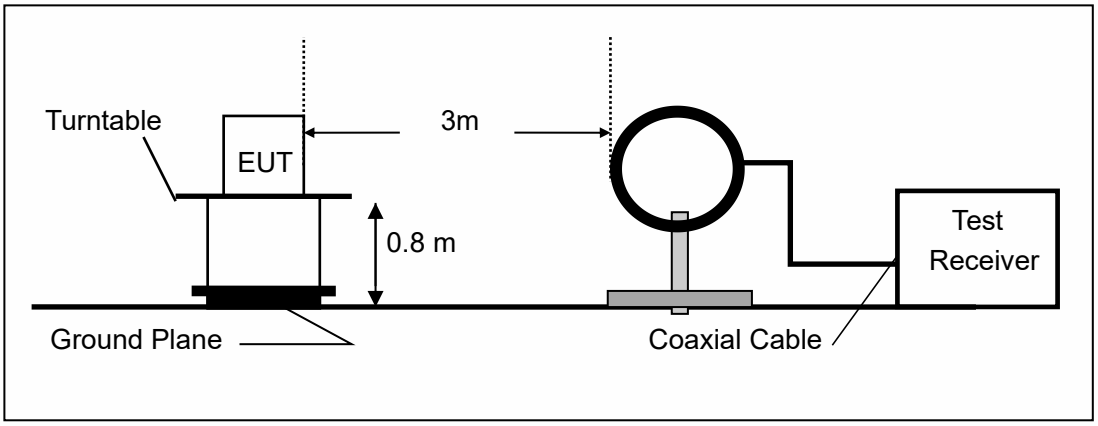
The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m.The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.

Below 30MHz：
The EUT is placed on a turntable 0.8meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

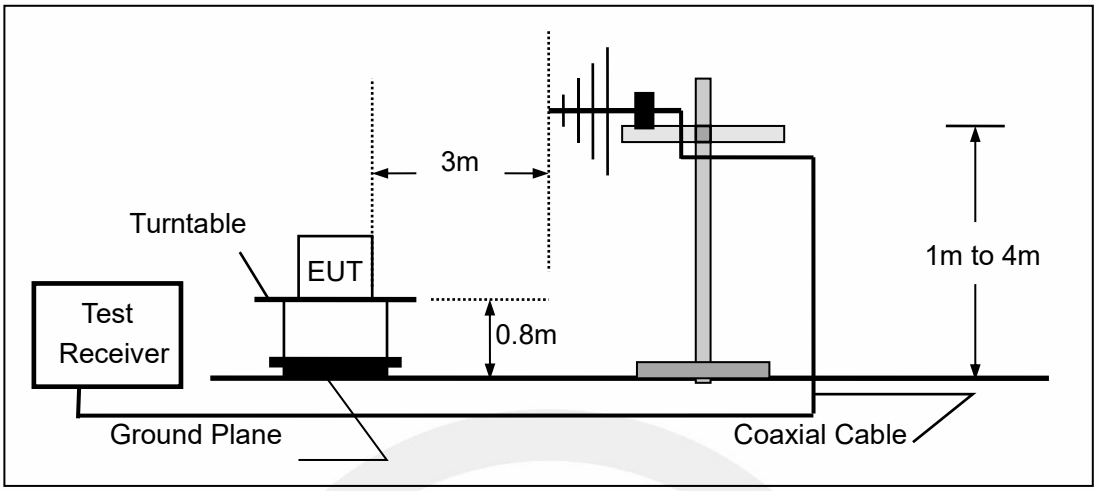
Above 30MHz：
The EUT is placed on a turntable 0.8meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

Above 1GHz:
(Note: the FCC's permission to use 1.5m as an alternative per TCBC Conf call of Dec. 2, 2014.)
The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

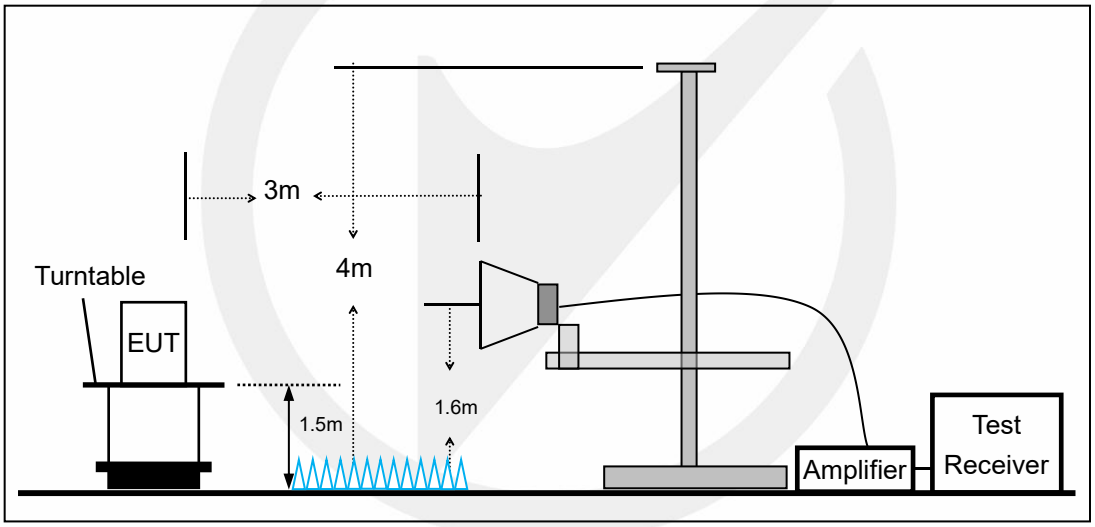
(a) Radiated Emission Test Set-Up, Frequency Below 30MHz



(b) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(c) Radiated Emission Test Set-Up, Frequency above 1000MHz

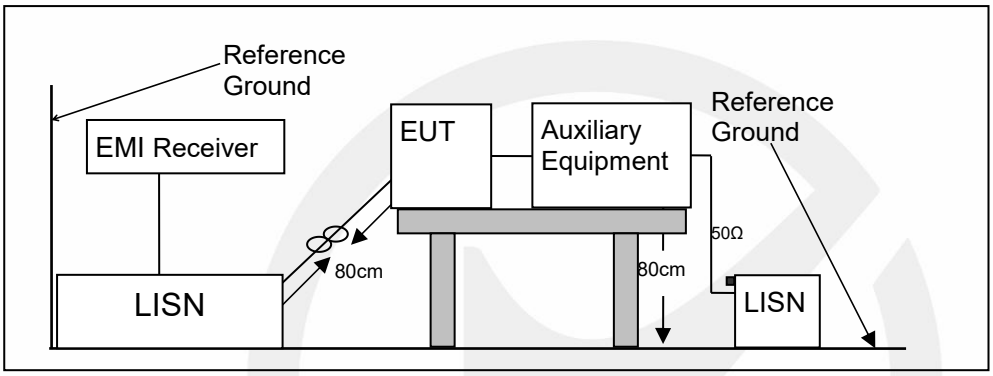


7.3 CONDUCTED EMISSION TEST SETUP

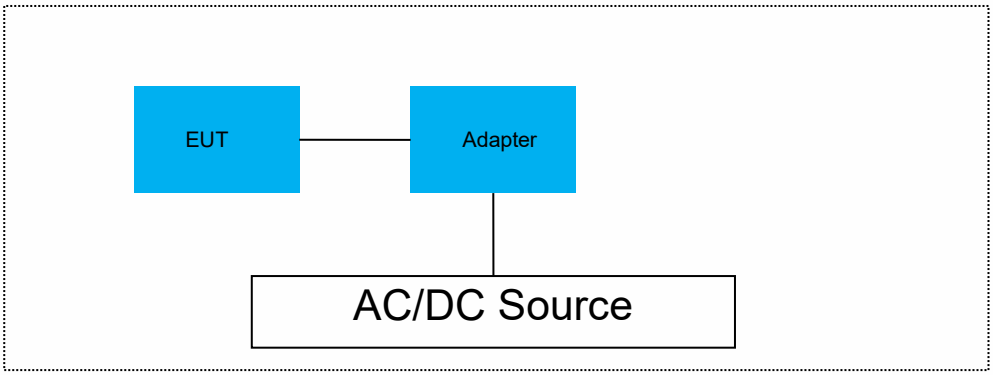
The mains cable of the EUT (Perfect Share Mini) must be connected to LISN. The LISN shall be placed 0.8m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.8m.

According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.



7.4 BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM



7.5 SUPPORT EQUIPMENT

Adapter	:	Manufacturer: HONOR M/N: HN-200325CP1 CE, FCC
USB Cable	:	Manufacturer: Cosonic M/N: / CE, FCC

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

8 FREQUENCY HOPPING SYSTEM REQUIREMENTS

8.1 Standard Applicable

According to FCC Part 15.247(a)(1), 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.

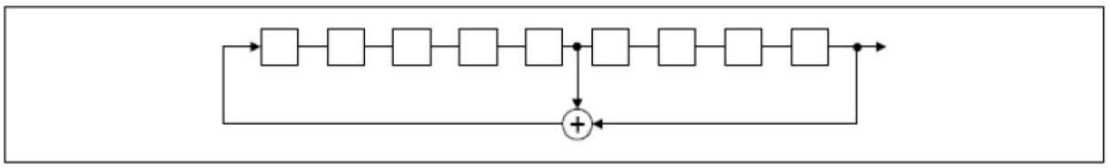
(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

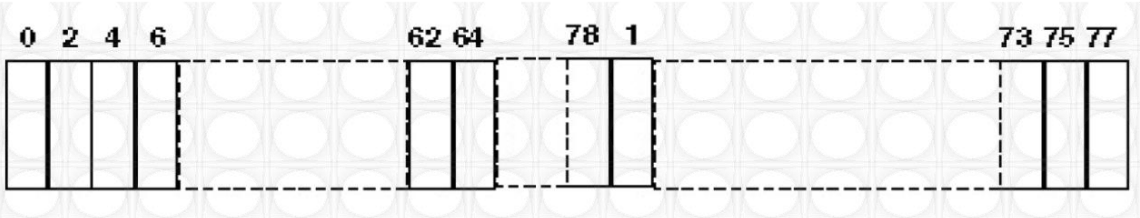
8.2 EUT Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels.
The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master.The channel is divide into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The normal hop is 1 600 hops/s.

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage, and the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones. Number of shift register stages: 9
Length of pseudo-random sequence: 29-1 = 511 bits
Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence



Each frequency used equally on the average by each transmitter.
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.

8.3 Equal Hopping Frequency Use

All Bluetooth units participating in the piconet are time and hop-synchronized to the channel.
Example of a 79 hopping sequence in data mode:
35, 27, 6, 44, 14, 61, 74, 32, 1, 11, 23, 2, 55, 65, 29, 3, 9, 52, 78, 58, 40, 25, 0, 7, 18, 26, 76, 60, 47, 50, 2, 5, 16, 37, 70, 63, 66, 54, 20, 13, 4, 8, 15, 21, 26, 10, 73, 77, 67, 69, 43, 24, 57, 39, 46, 72, 48, 33, 17, 31, 75, 19, 41, 62, 68, 28, 51, 66, 30, 56, 34, 59, 71, 22, 49, 64, 38, 45, 36, 42, 53
Each Frequency used equally on the average by each transmitter

8.4 Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.
This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH- enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

9 TEST REQUIREMENTS

9.1 20DB BANDWIDTH

9.1.1 Applicable Standard

According to FCC Part 15.247(a)(1) and KDB 558074 D01 15.247 MEAS GUIDANCE v05r02

9.1.2 Conformance Limit

No limit requirement.

9.1.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.1.4 Test Procedure

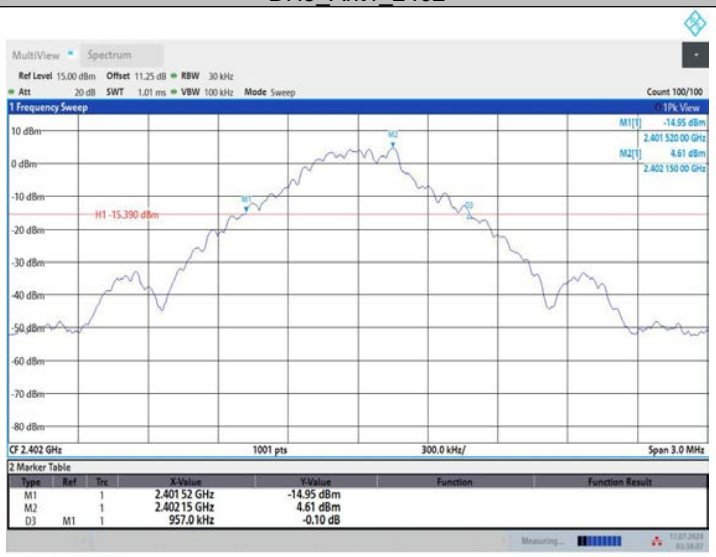
The EUT was operating in BT mode and controlled its channel. Printed out the test result from the spectrum by hard copy function.
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously
Set RBW = 30 kHz.
Set the video bandwidth (VBW) =100 kHz.
Set Span= approximately 2 to 3 times the 20 dB bandwidth
Set Detector = Peak.
Set Trace mode = max hold.
Set Sweep = auto couple.
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the markerdelta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.
If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.
Measure and record the results in the test report.

Test Results

Temperature:	25° C
Relative Humidity:	45%
ATM Pressure:	1011 mbar

20dB Emission Bandwidth

TestMode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
GFSK_DH5	Ant1	2402	0.96	2401.52	2402.48	---	---
		2441	0.96	2440.52	2441.48	---	---
		2480	0.96	2479.52	2480.48	---	---
π/4-DQPSK_2DH5	Ant1	2402	1.24	2401.37	2402.61	---	---
		2441	1.24	2440.36	2441.61	---	---
		2480	1.24	2479.36	2480.61	---	---
8DPSK_3DH5	Ant1	2402	1.27	2401.35	2402.62	---	---
		2441	1.27	2440.35	2441.62	---	---
		2480	1.27	2479.35	2480.62	---	---

DH5_Ant1_2402

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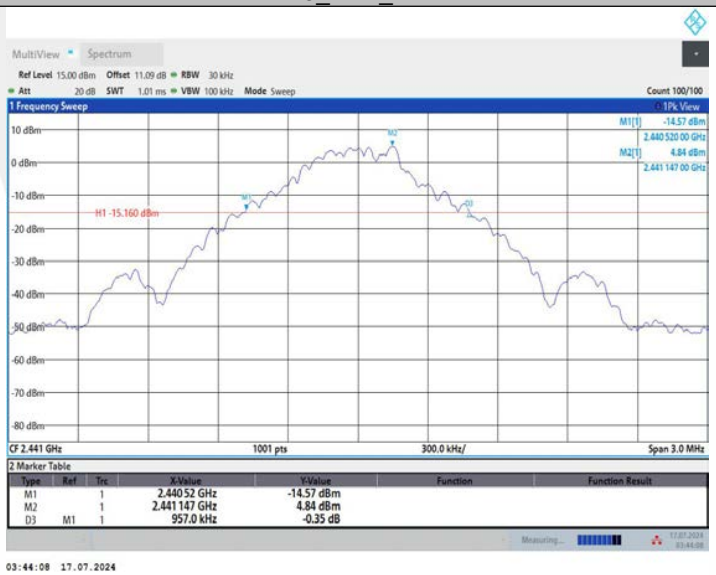
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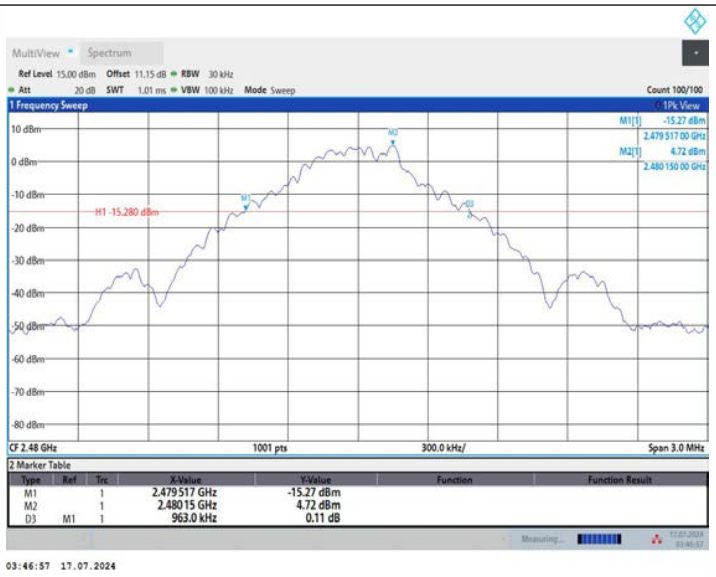

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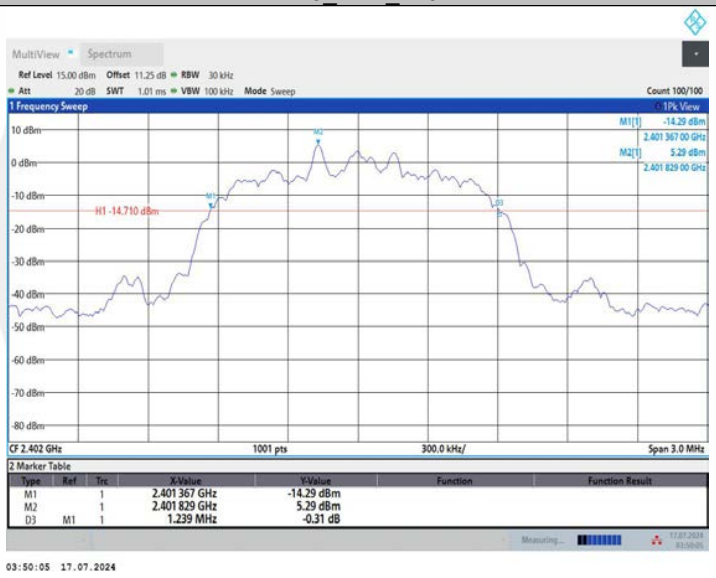

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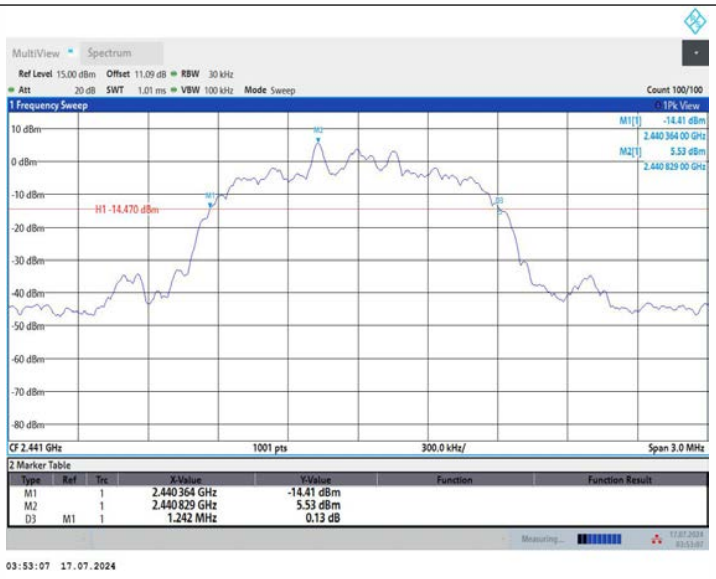

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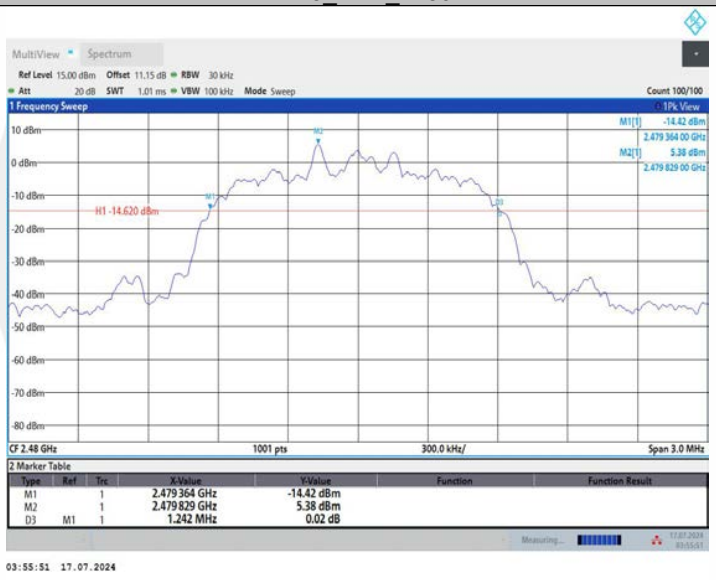
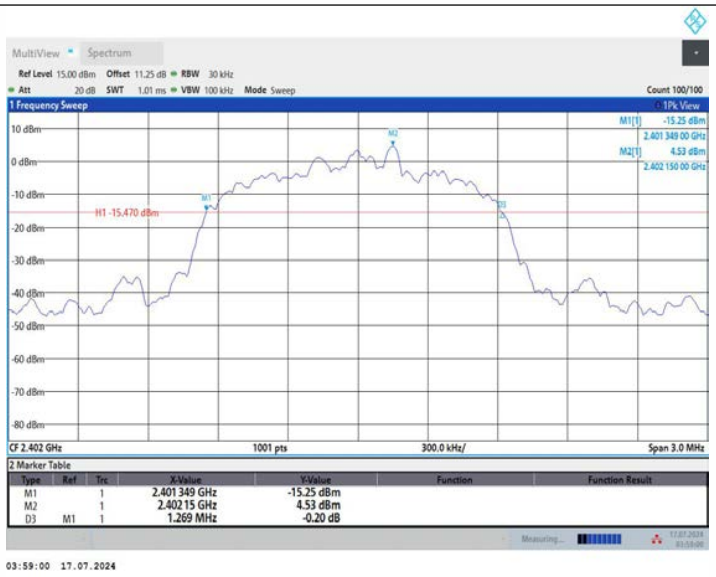
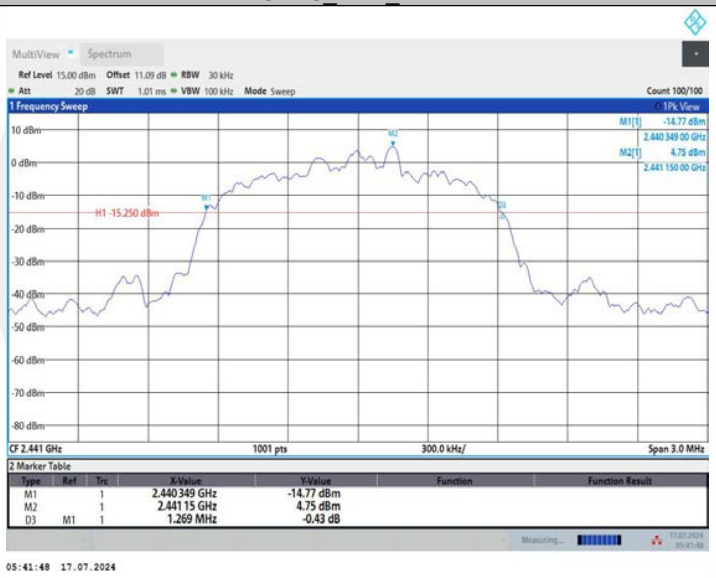


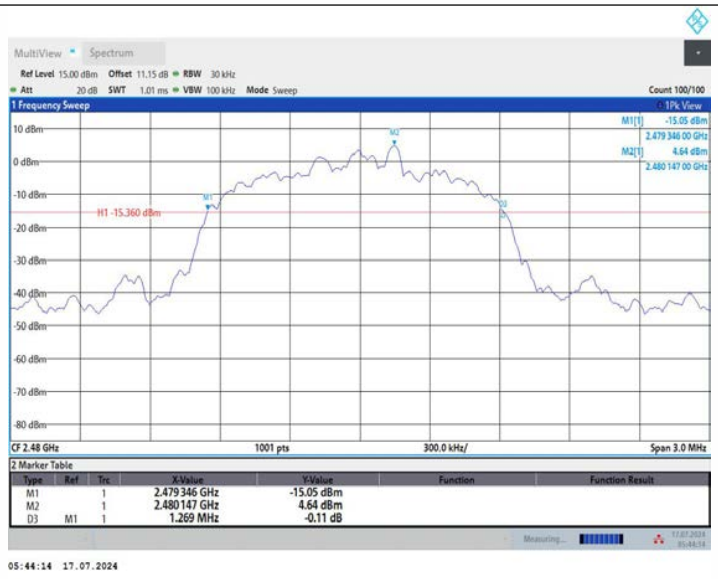
3DH5_Ant1_2402



3DH5_Ant1_2441



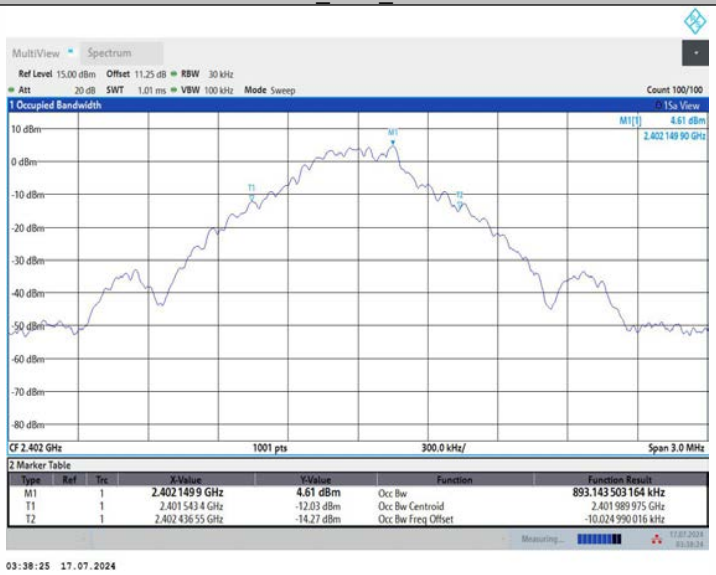
3DH5_Ant1_2480


MultiView
Spectrum
Ref Level 15.00 dBm Offset 11.15 dB RBW 30 kHz
Att 20 dB SWT 1.01 ms VBW 100 kHz Mode Sweep
Count 100/100
1 Frequency Sweep
1Pk View
M1[1] -15.05 dBm
2.479 346 00 GHz
M2[1] 4.64 dBm
2.480 147 00 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
H1 -15.360 dBm
CF 2.48 GHz
1001 pts
300.0 kHz/
Span 3.0 MHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 2.479 346 GHz -15.05 dBm
M2 1 2.480 147 GHz 4.64 dBm
D3 M1 1 1.269 MHz -0.11 dB
Measuring...
05:44:14 17.07.2024

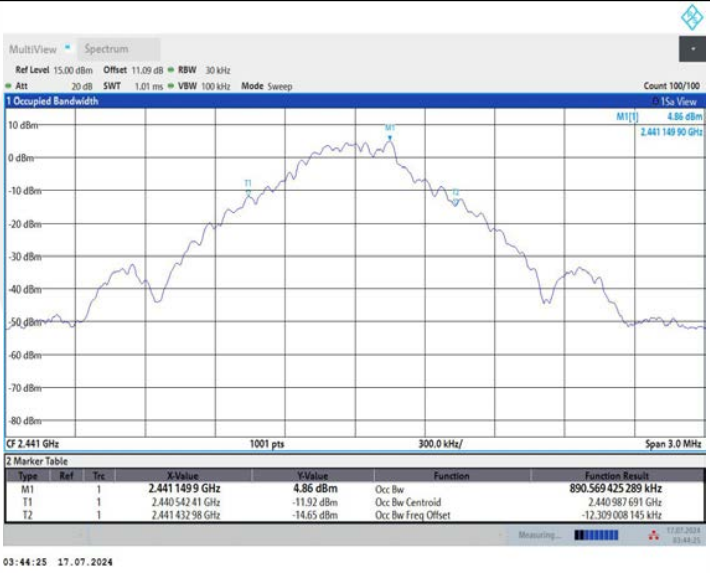
Occupied Channel Bandwidth

TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
GFSK_DH5	Ant1	2402	0.893	2401.5434	2402.4365	---	---
		2441	0.891	2440.5424	2441.4330	---	---
		2480	0.894	2479.5428	2480.4364	---	---
π/4-DQPSK_2DH5	Ant1	2402	1.154	2401.4087	2402.5623	---	---
		2441	1.154	2440.4076	2441.5617	---	---
		2480	1.155	2479.4080	2480.5627	---	---
8DPSK_3DH5	Ant1	2402	1.155	2401.4111	2402.5662	---	---
		2441	1.155	2440.4096	2441.5649	---	---
		2480	1.157	2479.4080	2480.5647	---	---

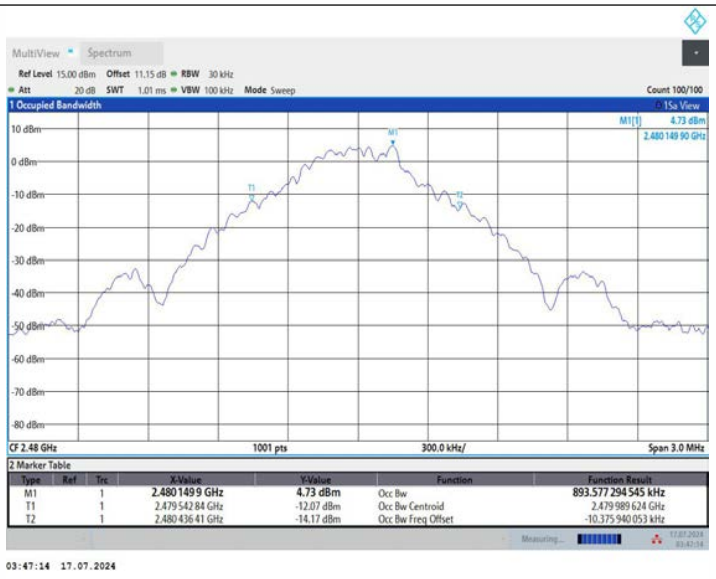
DH5_Ant1_2402



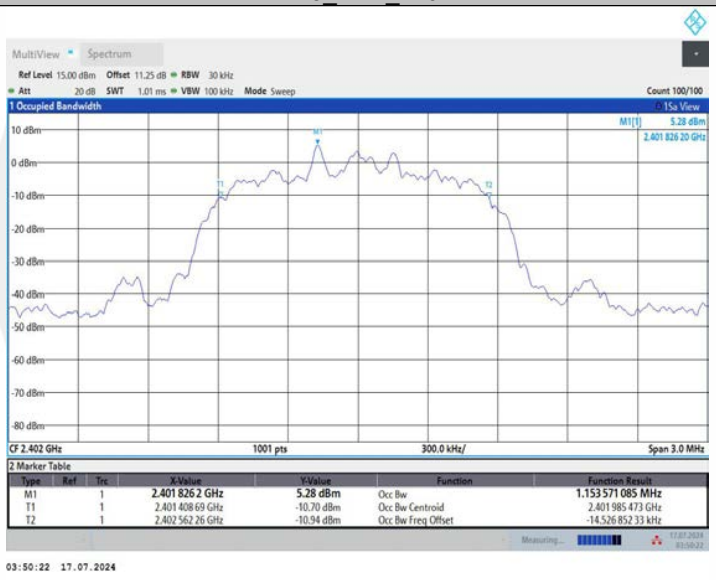
DH5_Ant1_2441



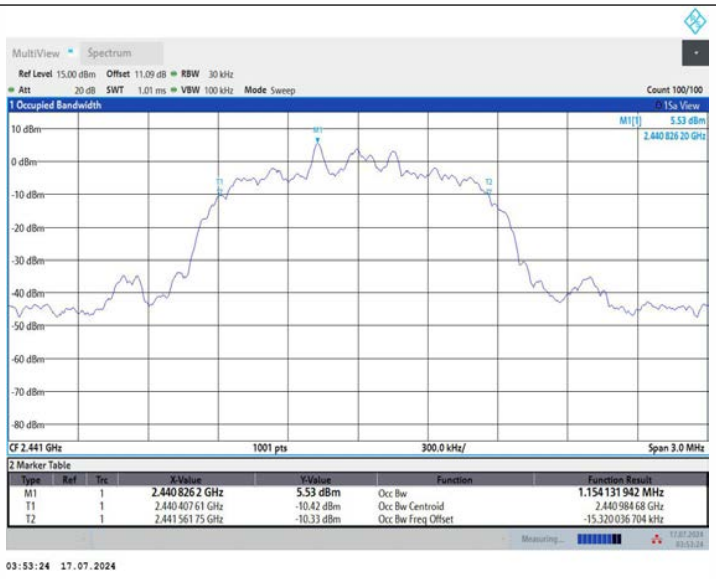
DH5_Ant1_2480



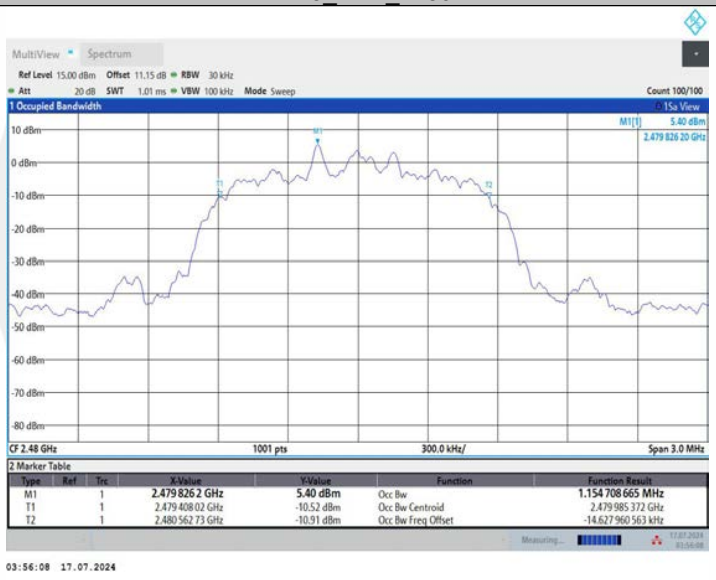
2DH5_Ant1_2402



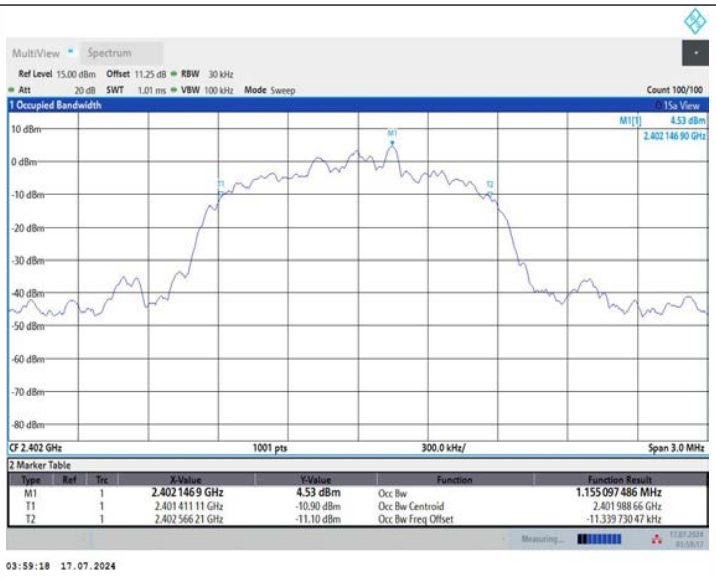
2DH5_Ant1_2441



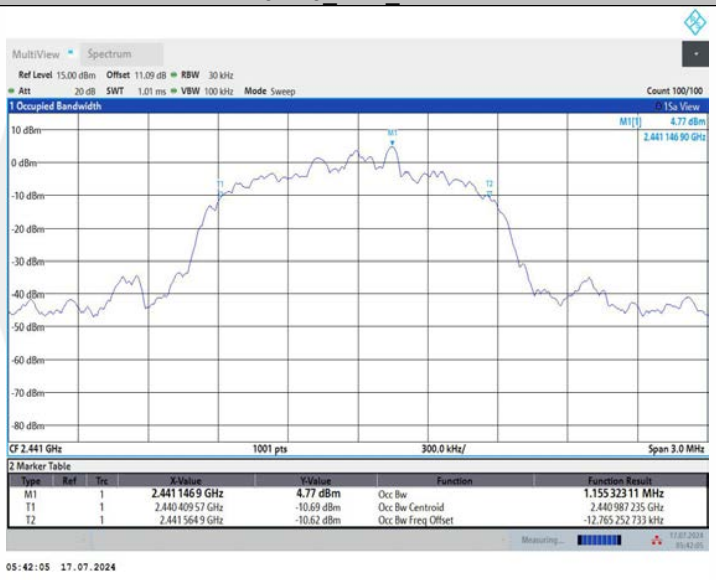
2DH5_Ant1_2480



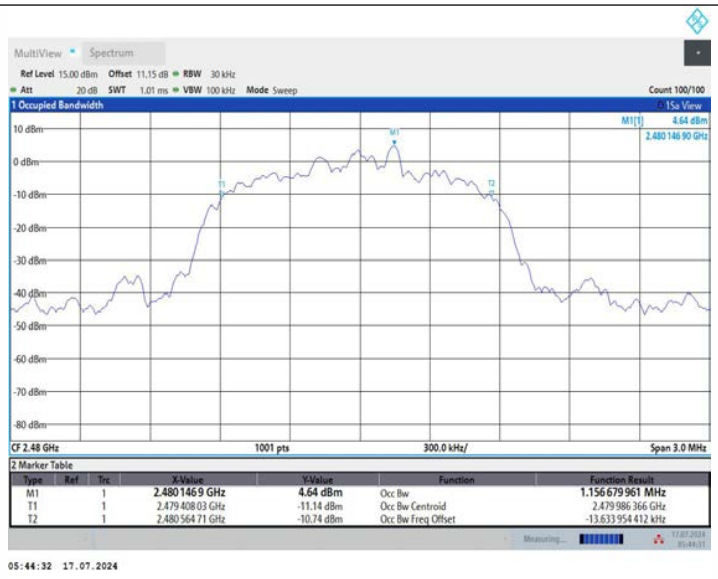
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480


MultiView
Spectrum
Ref Level 15.00 dBm Offset 11.15 dB RBW 30 kHz
Att 20 dB SWT 1.01 ms VBW 100 kHz Mode Sweep
Count 100/100
1 Occupied Bandwidth
1Sa View
M1[1] 4.64 dBm
2.480 146 90 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
1001 pts
300.0 kHz/
Span 3.0 MHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 2.480 146 9 GHz 4.64 dBm Occ Bw 1.156 679 961 MHz
T1 1 2.479 408 03 GHz -11.14 dBm Occ Bw Centroid 2.479 986 366 GHz
T2 1 2.480 564 71 GHz -10.74 dBm Occ Bw Freq Offset -13.633 954 412 kHz
05:44:32 17.07.2024

9.2 CARRIER FREQUENCY SEPARATION

9.2.1 Applicable Standard

According to FCC Part 15.247(a)(1) and KDB 558074 D01 15.247 MEAS GUIDANCE v05r02

9.2.2 Conformance Limit

Frequency hopping systems operating in the 2400-2483.5MHz band shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.
In case of an output power less than 125mW, the frequency hopping system may have channels separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

9.2.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.2.4 Test Procedure

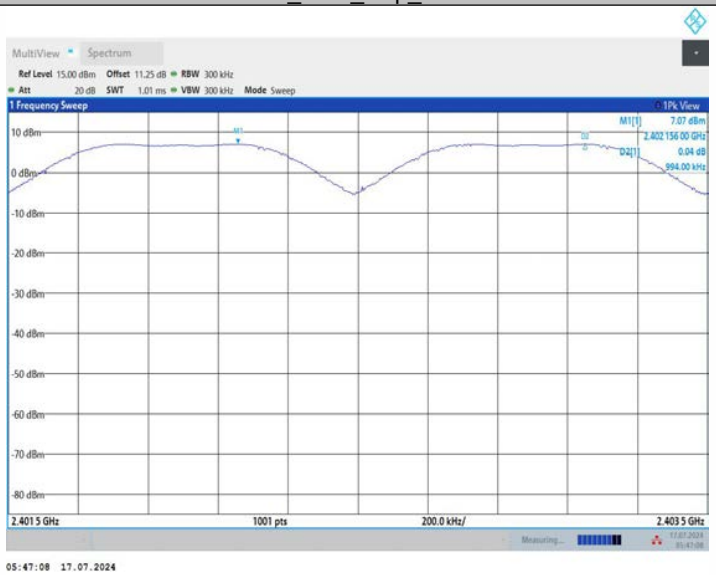
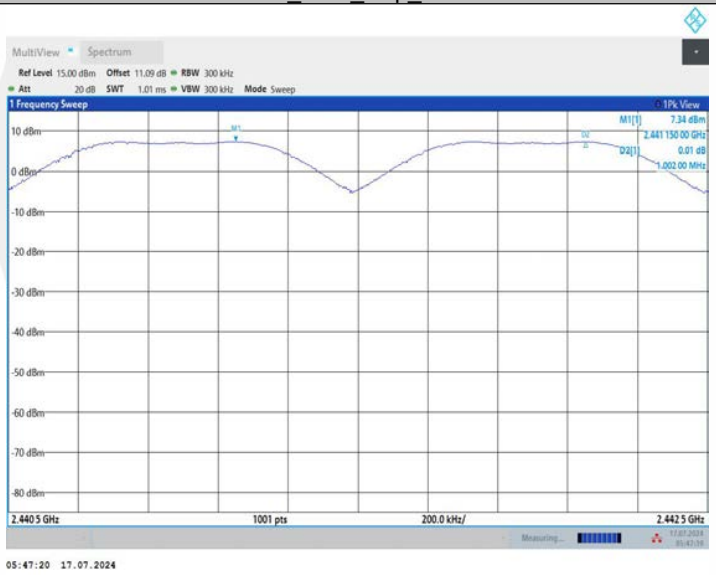
■ According to FCC Part15.247(a)(1)
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Set the RBW =100kHz. Set VBW =300kHz.
Set the span = wide enough to capture the peaks of two adjacent channels
Set Sweep time = auto couple.
Set Detector = peak. Set Trace mode = max hold.
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

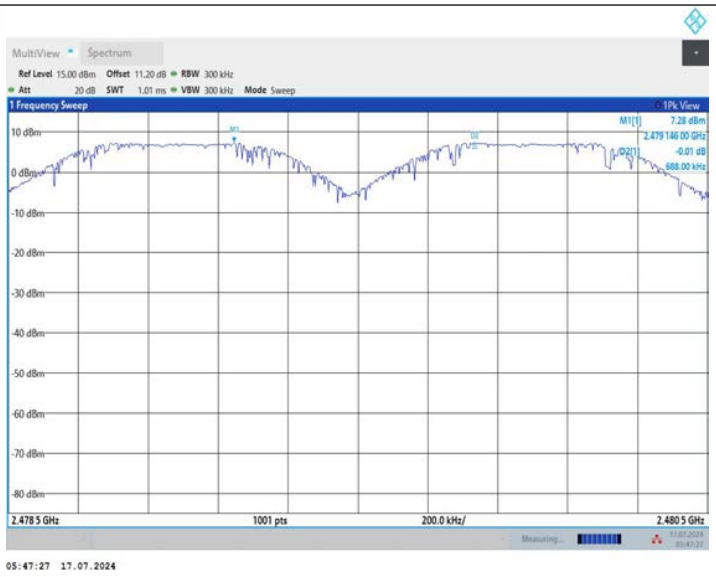
Test Results

Temperature:	25° C
Relative Humidity:	45%
ATM Pressure:	1011 mbar

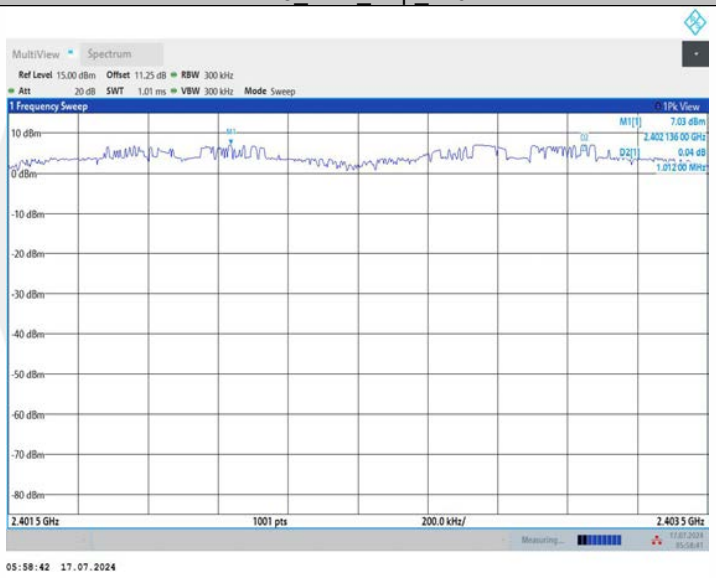
Note: For GFSK, pi/4-DQPSK, 8DPSKLimit = 20dB bandwidth * 2/3

TestMode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
GFSK_DH5	Ant1	Hop_2402	0.994	≥0.960	PASS
		Hop_2441	1.002	≥0.960	PASS
		Hop_2480	0.688	≥0.640	PASS
π/4-DQPSK_2DH5	Ant1	Hop_2402	1.012	≥0.827	PASS
		Hop_2441	1.004	≥0.827	PASS
		Hop_2480	1.174	≥0.827	PASS
8DPSK_3DH5	Ant1	Hop_2402	0.856	≥0.847	PASS
		Hop_2441	1.348	≥1.270	PASS
		Hop_2480	0.982	≥0.847	PASS

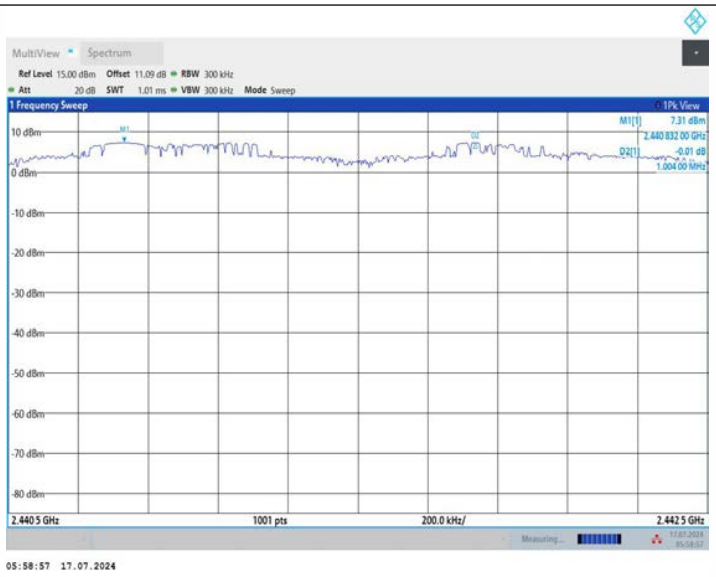
DH5_Ant1_Hop_2402

DH5_Ant1_Hop_2441

DH5_Ant1_Hop_2480



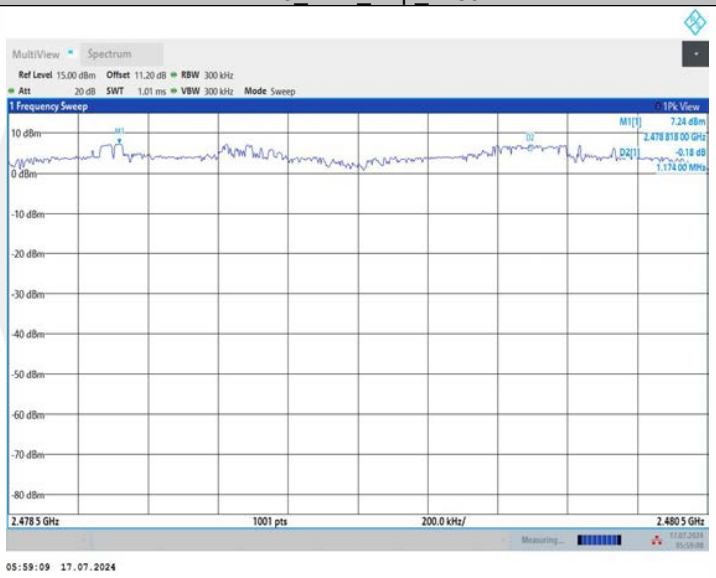
2DH5_Ant1_Hop_2402



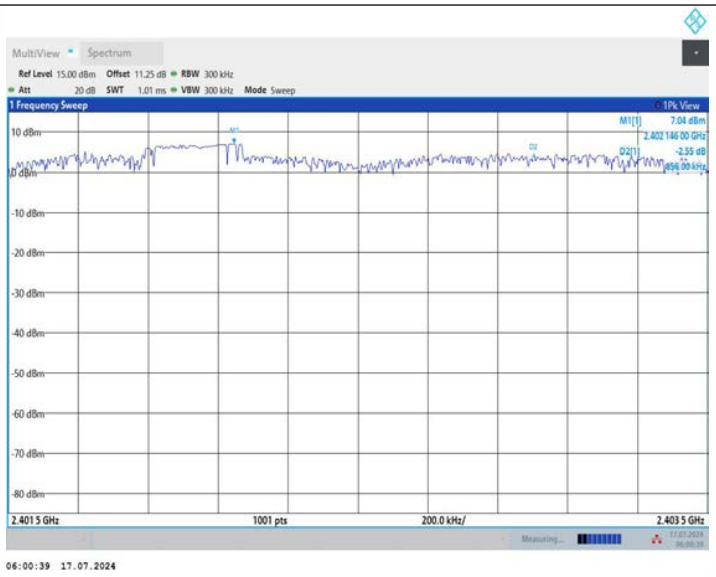
2DH5_Ant1_Hop_2441



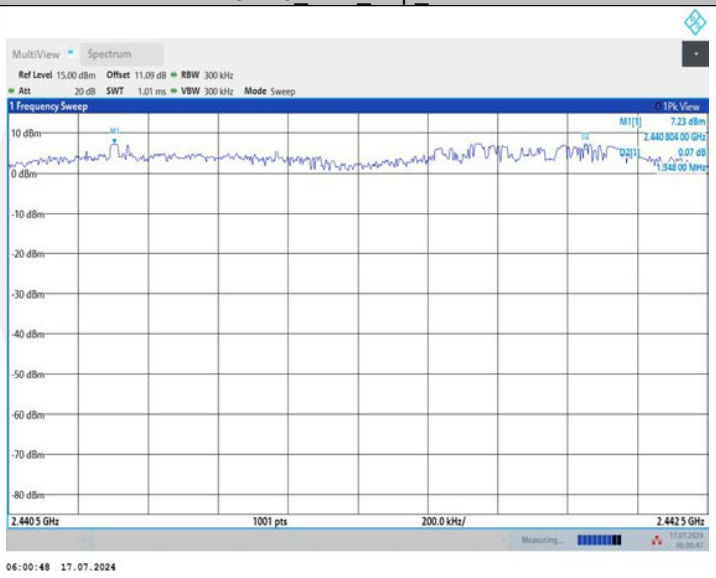
2DH5_Ant1_Hop_2480



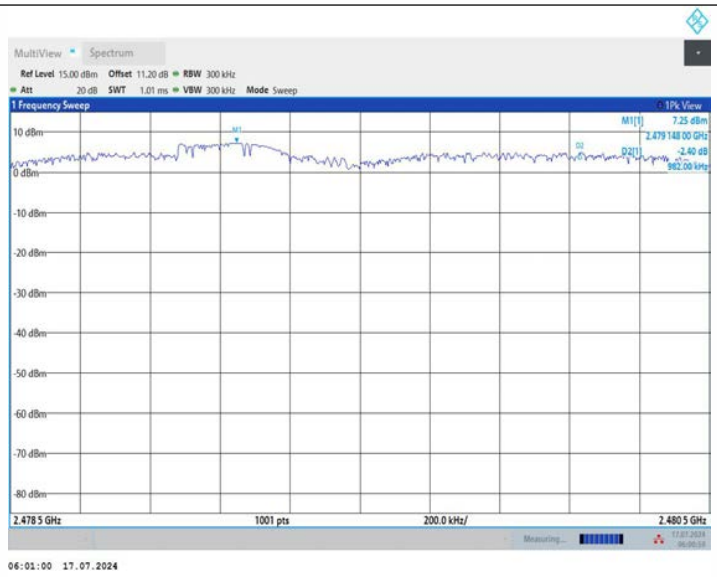
3DH5_Ant1_Hop_2402



3DH5_Ant1_Hop_2441



3DH5_Ant1_Hop_2480


MultiView
Spectrum
Ref Level 15.00 dBm Offset 11.20 dB RBW 300 kHz
Att 20 dB SWT 1.01 ms VBW 300 kHz Mode Sweep
1 Frequency Sweep
1Pk View
M1[1] 7.25 dBm
2.479 148 00 GHz
D2[1] -2.40 dB
962.00 kHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
2.478 5 GHz
1001 pts
200.0 kHz/
2.480 5 GHz
Measuring...
06:01:00 17.07.2024

9.3 NUMBER OF HOPPING FREQUENCIES

9.3.1 Applicable Standard

According to FCC Part 15.247(a)(1) (iii)and KDB 558074 D01 15.247 MEAS GUIDANCE v05r02

9.3.2 Conformance Limit

Frequency hopping systems operating in the 2400-2483.5MHz band shall use at least 15 channels.

9.3.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

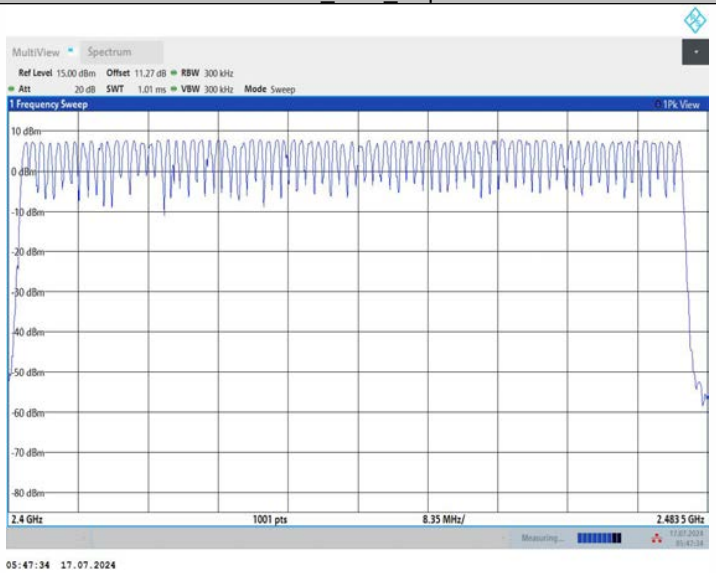
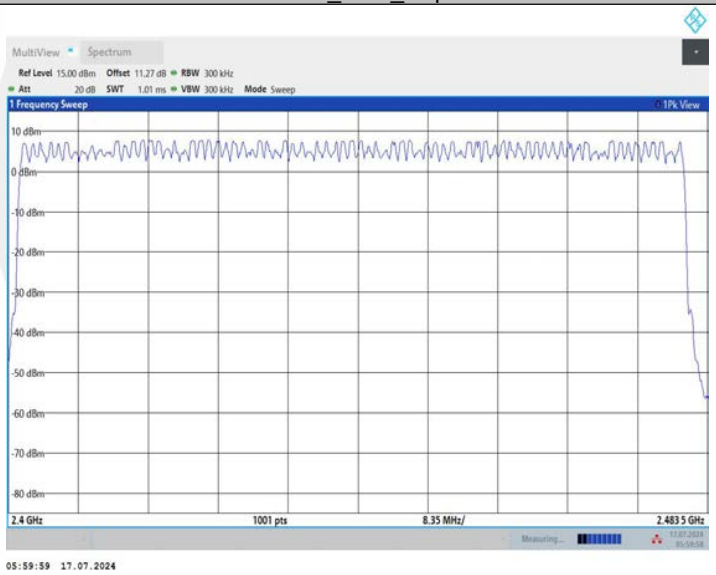
9.3.4 Test Procedure

■ According to FCC Part15.247(a)(1)(iii)
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = the frequency band of operation (2400-2483.5MHz)
RBW ≥ 100KHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

Test Results

Temperature:	25° C
Relative Humidity:	45%
ATM Pressure:	1011 mbar

TestMode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
GFSK_DH5	Ant1	Hop	79	≥15	PASS
π/4-DQPSK_2DH5	Ant1	Hop	79	≥15	PASS
8DPSK_3DH5	Ant1	Hop	79	≥15	PASS

DH5_Ant1_Hop

2DH5_Ant1_Hop

3DH5_Ant1_Hop


MultiView
Spectrum
Ref Level 15.00 dBm Offset 11.27 dB RBW 300 kHz
Att 20 dB SWT 1.01 ms VBW 300 kHz Mode Sweep
1 Frequency Sweep
1Pk View
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
2.4 GHz
1001 pts
8.35 MHz/
2.483 5 GHz
Measuring...
06:01:43 17.07.2024

9.4 AVERAGE TIME OF OCCUPANCY (DWELL TIME)

9.4.1 Applicable Standard

According to FCC Part 15.247(a)(1)(iii) and KDB 558074 D01 15.247 MEAS GUIDANCE v05r02

9.4.2 Conformance Limit

For frequency hopping systems operating in the 2400-2483.5MHz band, the average time of occupancy on any channel shall not be greater than 0.4s within a period of 0.4s multiplied by the number of hopping channels employed.

9.4.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.4.4 Test Procedure

■ According to FCC Part15.247(a)(1)(iii)
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ⩾ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold
If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section.

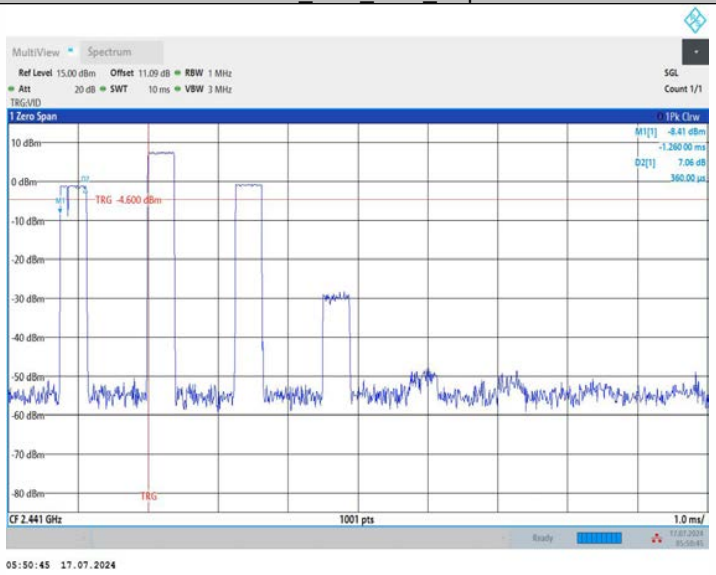
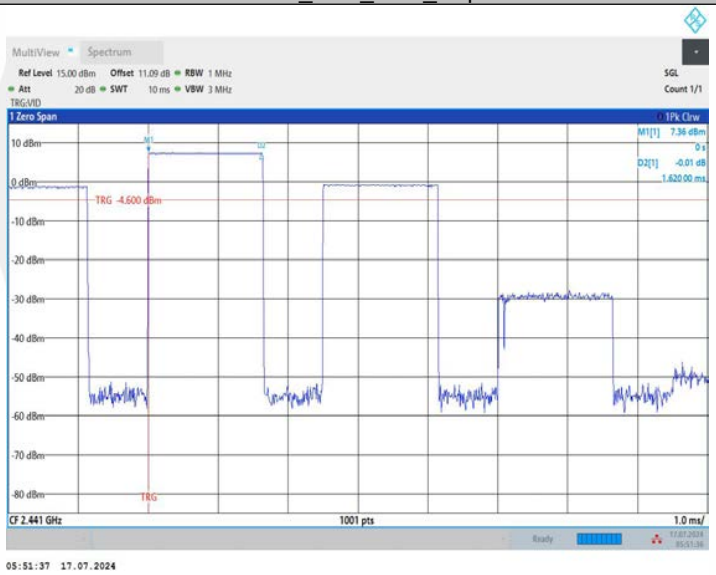
9.4.5 Test Results

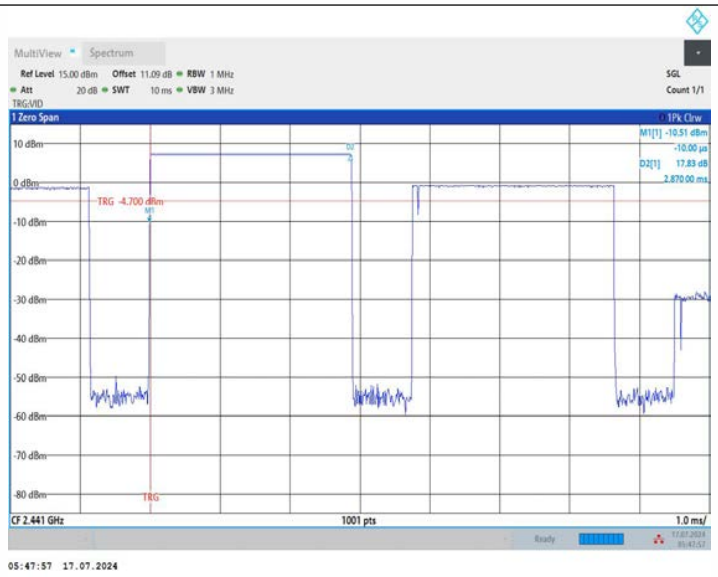
Temperature:	25° C
Relative Humidity:	45%
ATM Pressure:	1011 mbar

Note: TotalHops(DH1)=(1600/2/79)*31.6
TotalHops(DH3)=(1600/4/79)*31.6
TotalHops(DH5)=(1600/6/79)*31.6
Dwell Time= BurstWidth* TotalHops

All the antenna(Antenna 1) and modes(GFSK, π/4-DQPSK, 8DPSK) mode have been tested, and the worst(Antenna 1,GFSK) resultrecorded was report as below:

TestMode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
GFSK_DH1	Ant1	Hop	0.360	320	0.115	≤0.4	PASS
GFSK_DH3	Ant1	Hop	1.620	160	0.259	≤0.4	PASS
GFSK_DH5	Ant1	Hop	2.870	106.67	0.306	≤0.4	PASS

GFSK_DH1_Ant1_Hop

GFSK_DH3_Ant1_Hop

GFSK_DH5_Ant1_Hop


MultiView
Spectrum
Ref Level 15.00 dBm Offset 11.09 dB RBW 1 MHz
Att 20 dB SWT 10 ms VBW 3 MHz
SGL
Count 1/1
TRG/VID
1 Zero Span
1Pk Clrw
M1[1] -10.51 dBm
-10.00 µs
D2[1] 17.83 dB
2.870 00 ms
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
TRG -4.700 dBm
TRG
CF 2.441 GHz
1001 pts
1.0 ms/
Ready
05:47:57 17.07.2024

9.5 MAXIMUM PEAK CONDUCTED OUTPUT POWER

9.5.1 Applicable Standard

According to FCC Part 15.247(b)(1) and KDB 558074 D01 15.247 MEAS GUIDANCE v05r02

9.5.2 Conformance Limit

The max For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

9.5.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

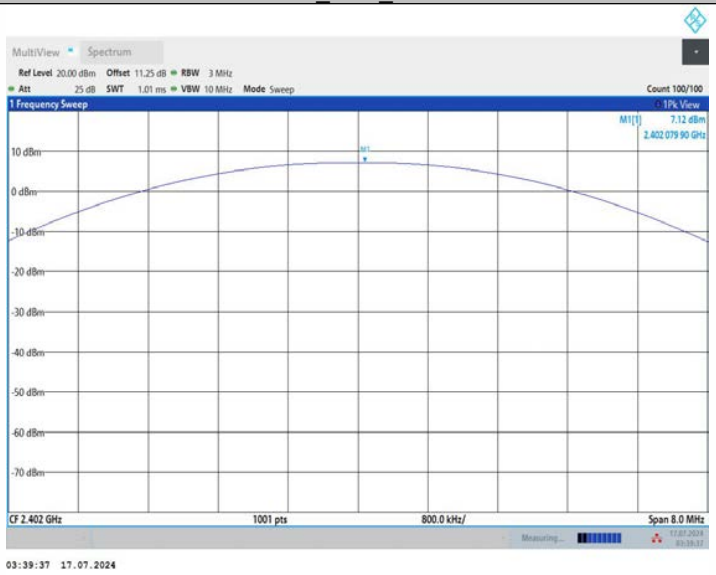
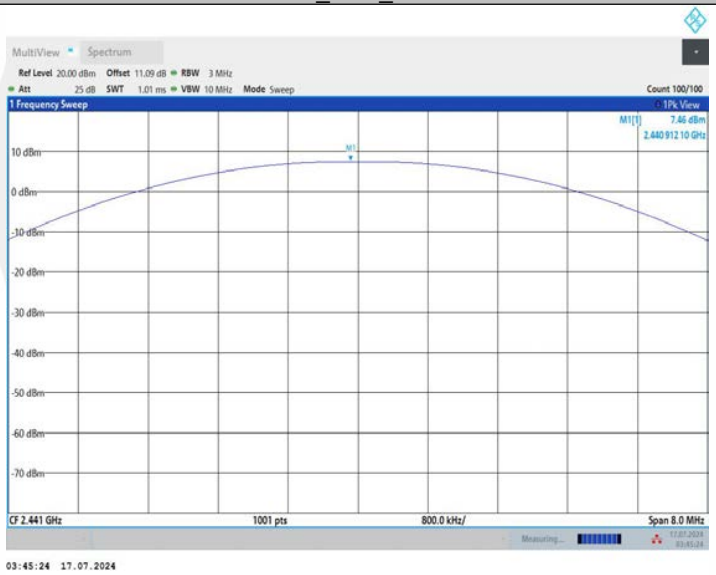
9.5.4 Test Procedure

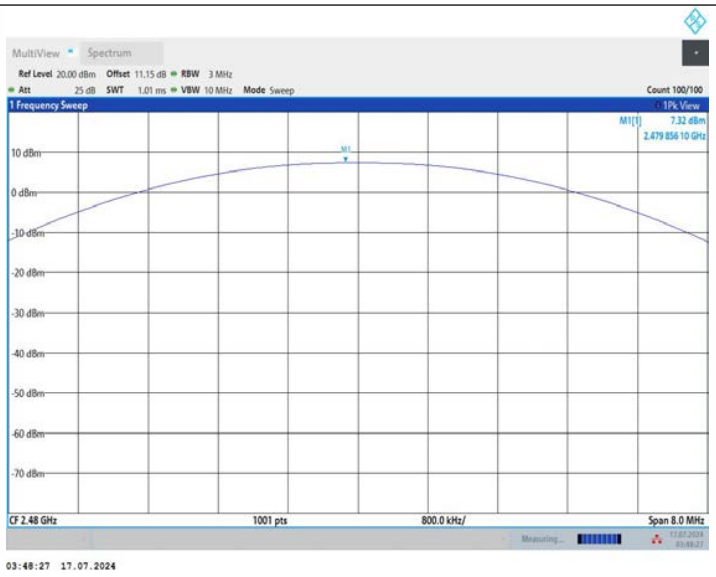
■ According to FCC Part15.247(b)(1)
As an alternative to a peak power measurement, compliance with the limit can be based on a measurement of the maximum conducted output power.
Use the following spectrum analyzer settings:
Set Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel (about 10MHz)
Set RBW > the 20 dB bandwidth of the emission being measured (about 3MHz)
Set VBW ≥ RBW
Set Sweep = auto
Set Detector function = peak
Set Trace = max hold
Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission to determine the peak amplitude level.

Test Results

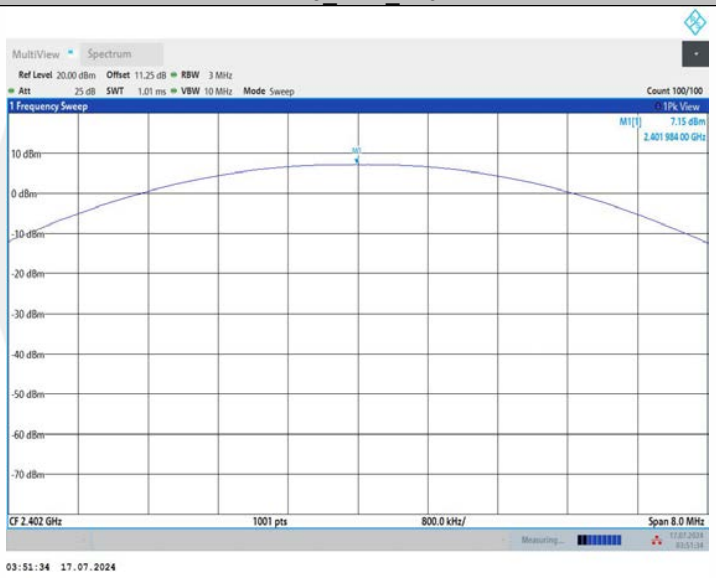
Temperature:	25° C
Relative Humidity:	45%
ATM Pressure:	1011 mbar

Test Mode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
GFSK_DH5	Ant1	2402	7.12	≤20.97	PASS
		2441	7.46	≤20.97	PASS
		2480	7.32	≤20.97	PASS
π/4-DQPSK_2DH5	Ant1	2402	7.15	≤20.97	PASS
		2441	7.38	≤20.97	PASS
		2480	7.24	≤20.97	PASS
8DPSK_3DH5	Ant1	2402	7.20	≤20.97	PASS
		2441	7.39	≤20.97	PASS
		2480	7.33	≤20.97	PASS

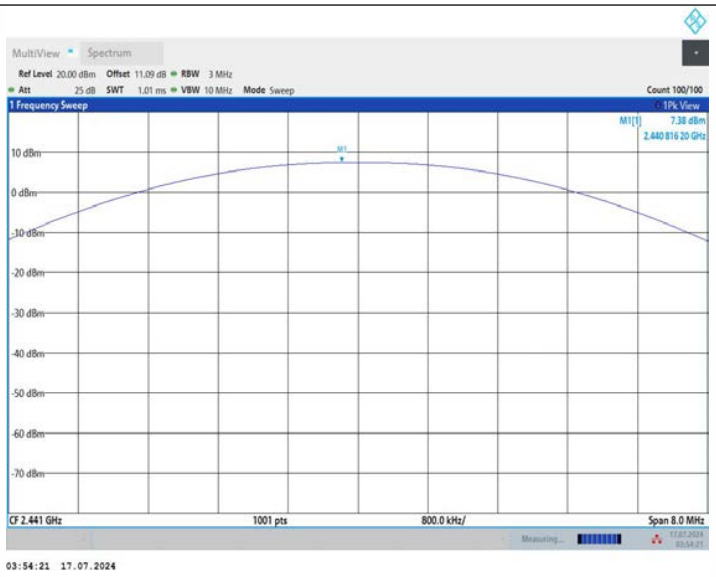
DH5_Ant1_2402

DH5_Ant1_2441

DH5_Ant1_2480



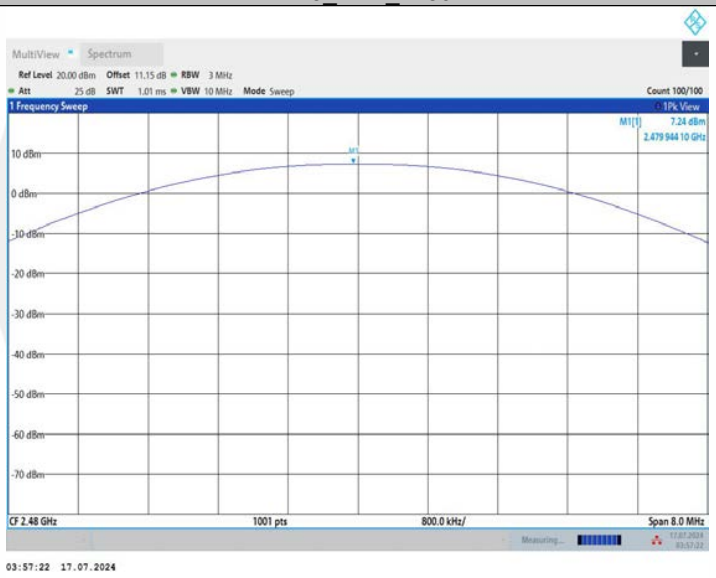
2DH5_Ant1_2402



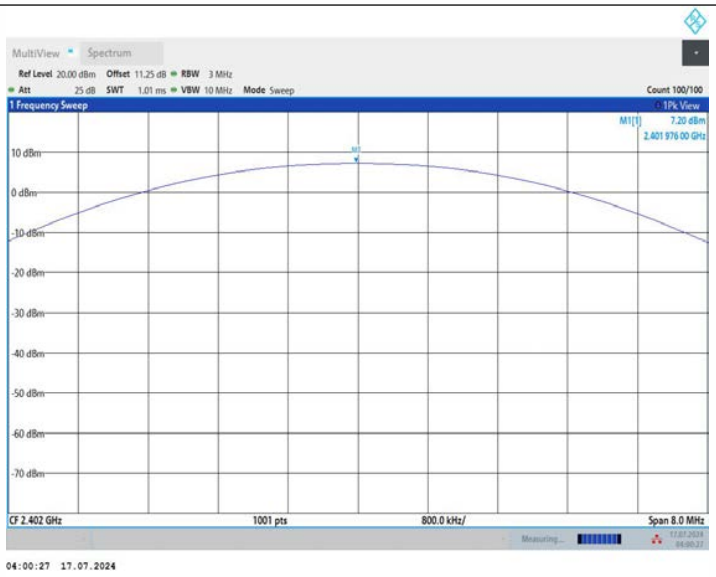
2DH5_Ant1_2441



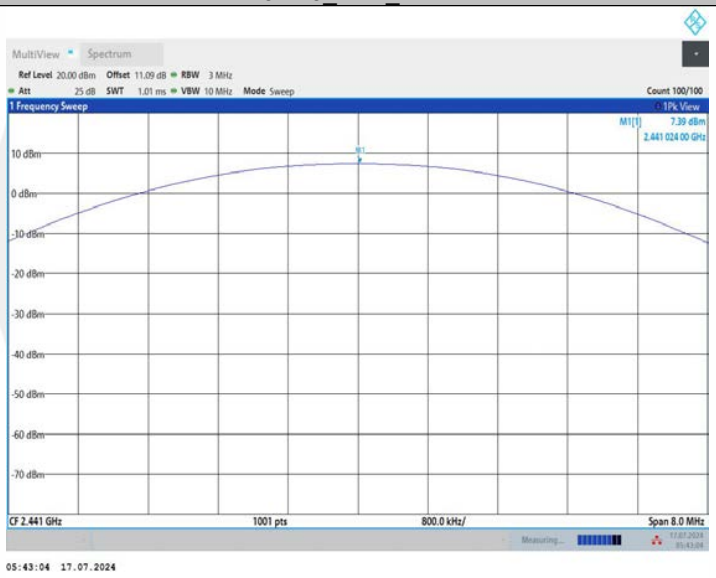
2DH5_Ant1_2480



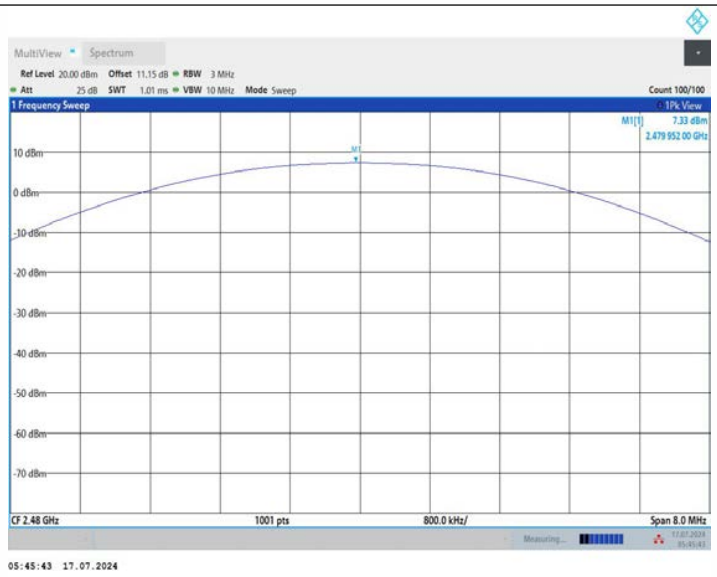
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480


MultiView
Spectrum
Ref Level 20.00 dBm Offset 11.15 dB RBW 3 MHz
Att 25 dB SWT 1.01 ms VBW 10 MHz Mode Sweep
Count 100/100
1 Frequency Sweep
1Pk View
M1[1] 7.33 dBm
2.479 952 00 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
1001 pts
800.0 kHz/
Span 8.0 MHz
Measuring...
05:45:43 17.07.2024

9.6 CONDUCTED SUPRIOUS EMISSION

9.6.1 Applicable Standard

According to FCC Part 15.247(d) and KDB 558074 D01 15.247 MEAS GUIDANCE v05r02

9.6.2 Conformance Limit

According to FCC Part 15.247(d):
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

9.6.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.6.4 Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer

- **Reference level measurement**

Establish a reference level by using the following procedure:
Set instrument center frequency to DSS channel center frequency.
Set Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.
Set the RBW = 100 kHz. Set the VBW ≥ 3 x RBW.
Set Detector = peak. Set Sweep time = auto couple.
Set Trace mode = max hold. Allow trace to fully stabilize.
Use the peak marker function to determine the maximum Maximum conduceted level.
Note that the channel found to contain the maximum conduceted level can be used to establish the reference level.

- **Band-edge Compliance of RF Conducted Emissions**

Use the following spectrum analyzer settings:
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 which fall outside of the authorized band of operation
Set RBW ≥ 1% of the span=100kHz Set VBW ≥ RBW
Set Sweep = auto Set Detector function = peak Set Trace = max hold
Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section.
Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

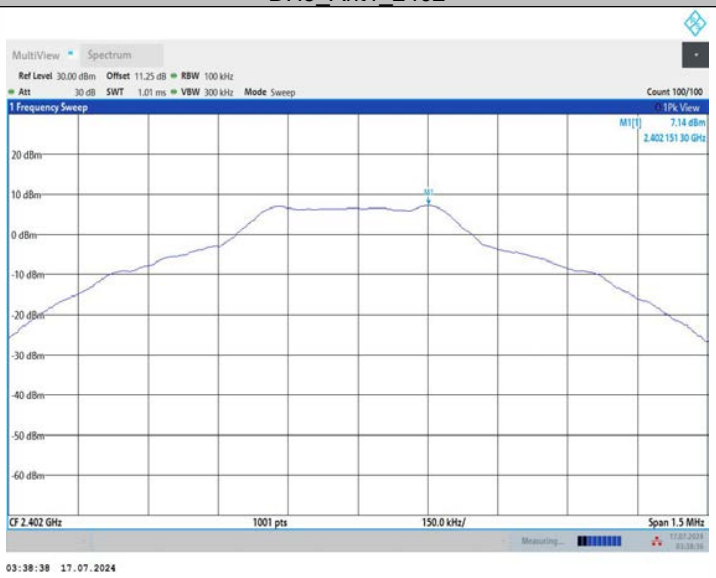
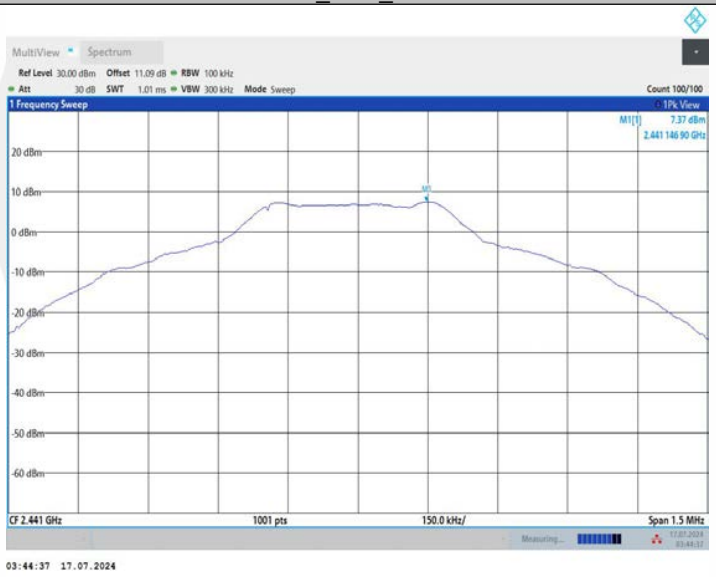
- **Conduceted Spurious RF Conducted Emission**

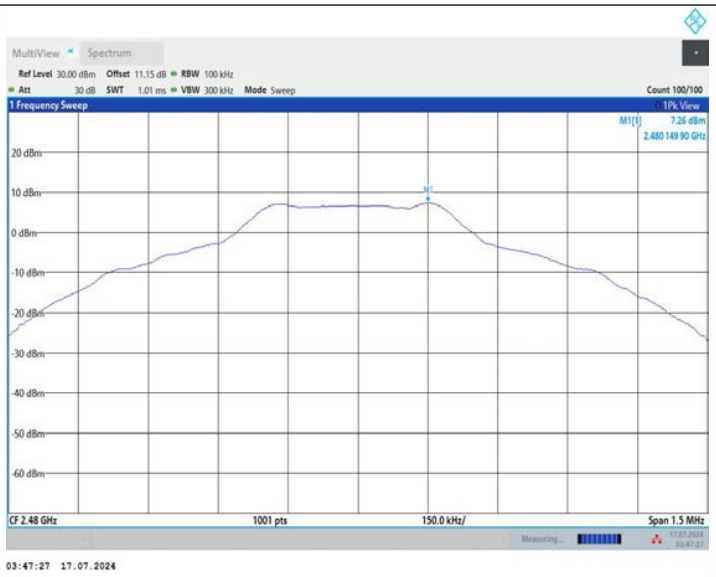
Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.(30MHz to 25GHz). Set RBW = 100 kHz Set VBW ≥ RBW
Set Sweep = auto Set Detector function = peak Set Trace = max hold
Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.

9.6.5 Test Results

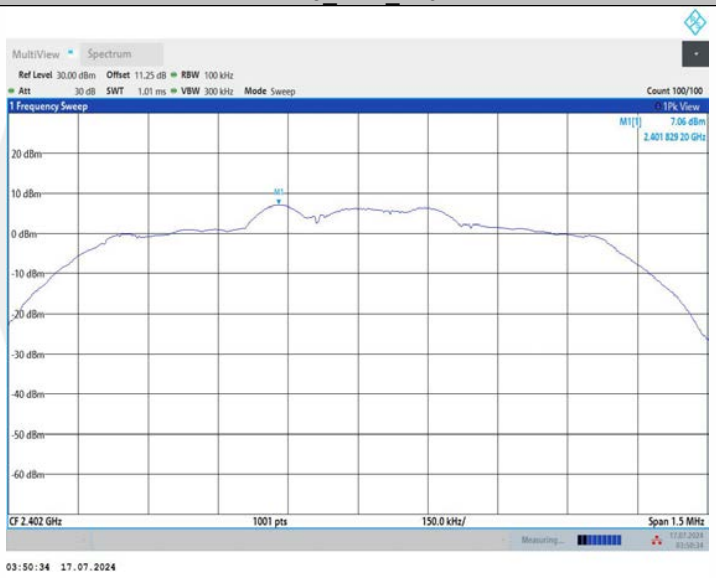
Reference level measurement

TestMode	Antenna	Freq(MHz)	Max.Point[MHz]	Result[dBm]
GFSK_DH5	Ant1	2402	2402.15	7.14
		2441	2441.15	7.37
		2480	2480.15	7.26
π/4-DQPSK_2DH5	Ant1	2402	2401.83	7.06
		2441	2440.83	7.32
		2480	2479.83	7.19
8DPSK_3DH5	Ant1	2402	2402.15	7.06
		2441	2441.15	7.28
		2480	2480.15	7.16

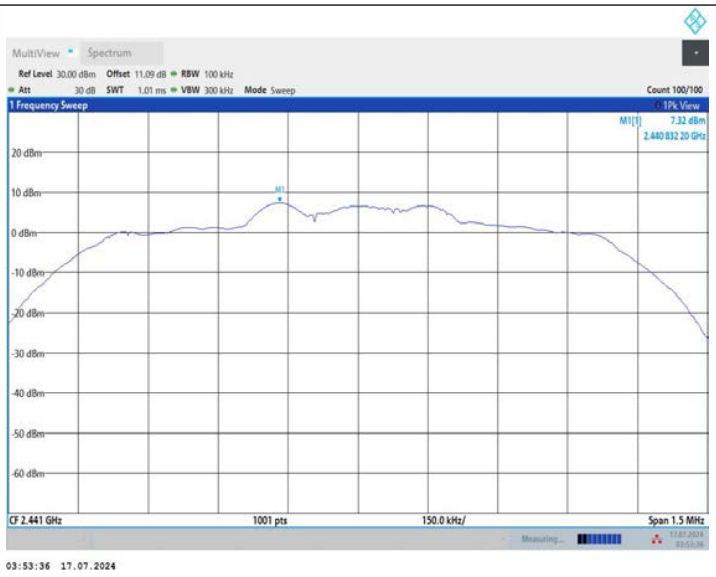
DH5_Ant1_2402

DH5_Ant1_2441

DH5_Ant1_2480



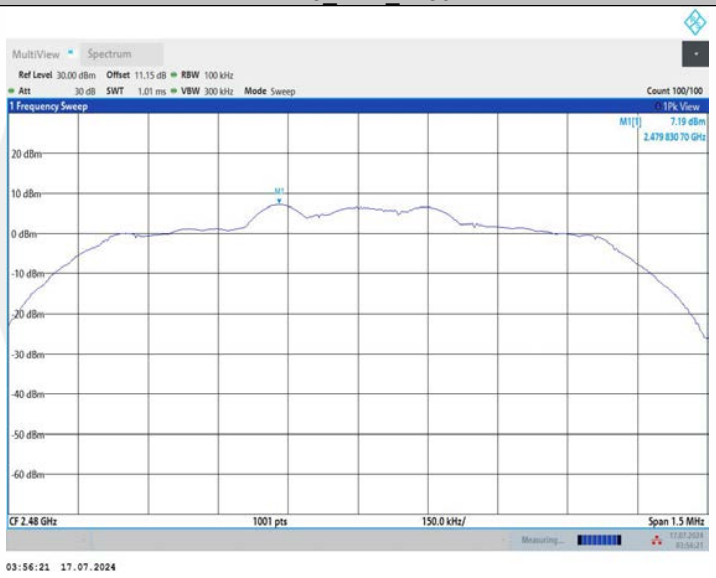
2DH5_Ant1_2402



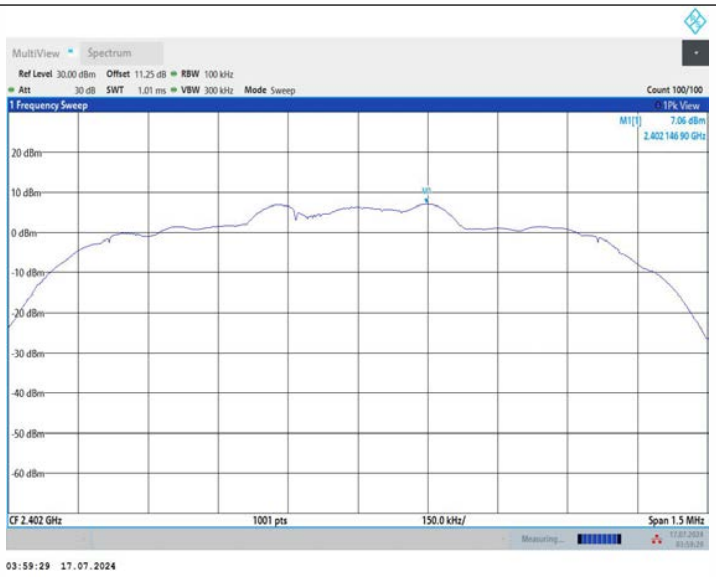
2DH5_Ant1_2441



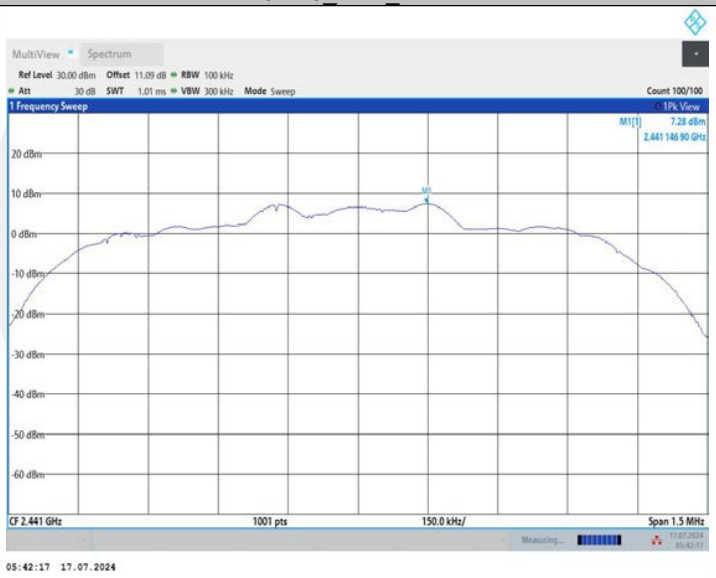
2DH5_Ant1_2480



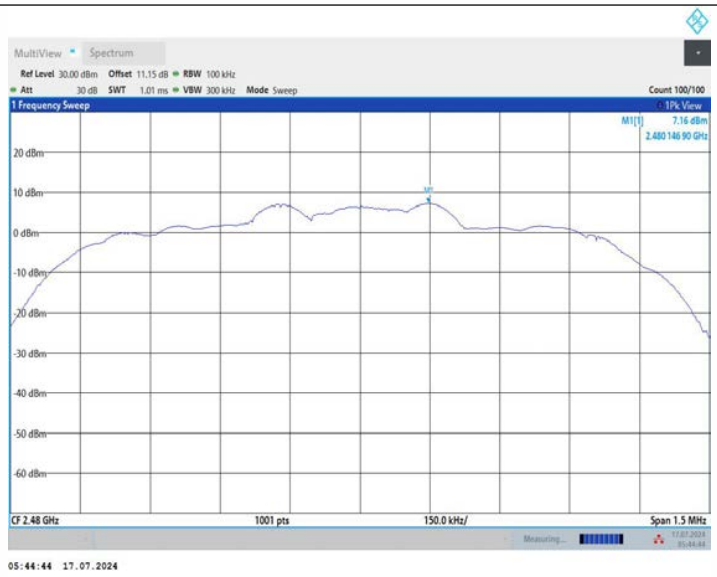
3DH5_Ant1_2402



3DH5_Ant1_2441



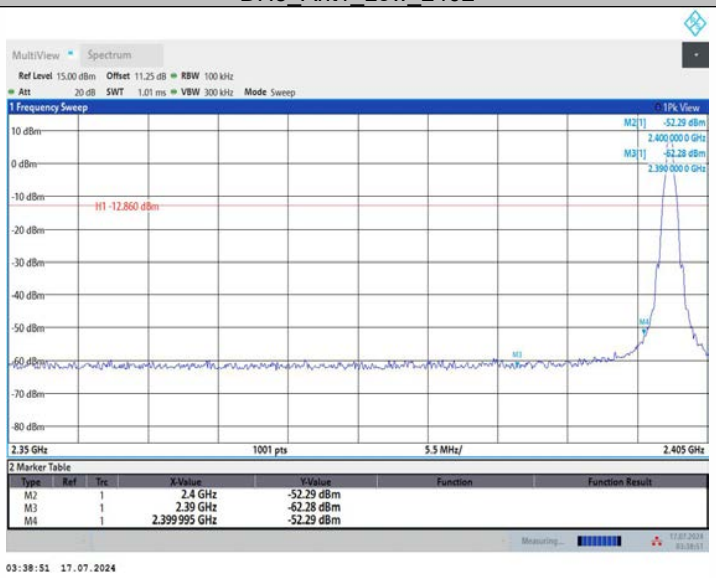
3DH5_Ant1_2480


MultiView
Spectrum
Ref Level 30.00 dBm Offset 11.15 dB RBW 100 kHz
Att 30 dB SWT 1.01 ms VBW 300 kHz Mode Sweep
Count 100/100
1 Frequency Sweep
1Pk View
M1[1] 7.16 dBm
2.480 146 90 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
CF 2.48 GHz
1001 pts
150.0 kHz/
Span 1.5 MHz
Measuring...
05:44:44 17.07.2024

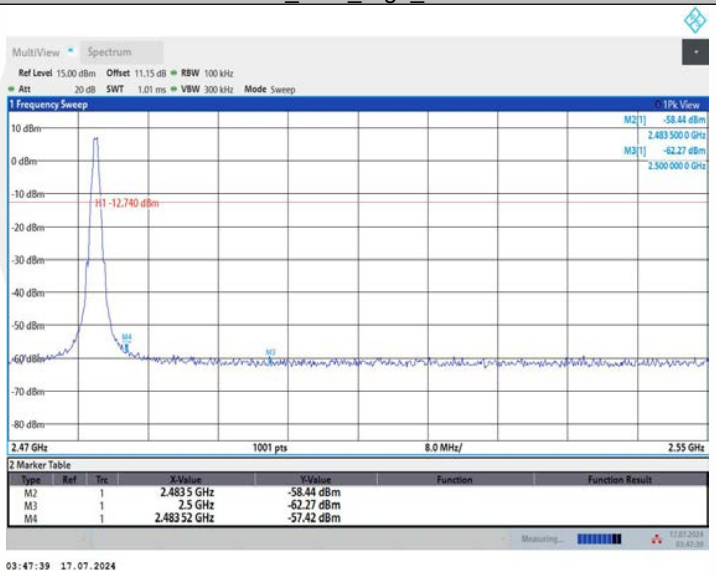
Band edge measurements

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
GFSK_DH5	Ant1	Low	2402	7.14	-52.29	≤-12.86	PASS
		High	2480	7.26	-57.42	≤-12.74	PASS
		Low	Hop_2402	6.45	-54.66	≤-13.55	PASS
		High	Hop_2480	6.95	-57.89	≤-13.05	PASS
π/4-DQPSK_2DH5	Ant1	Low	2402	7.06	-45.99	≤-12.94	PASS
		High	2480	7.19	-58	≤-12.81	PASS
		Low	Hop_2402	6.03	-52.41	≤-13.97	PASS
		High	Hop_2480	7.12	-59.43	≤-12.88	PASS
8DPSK_3DH5	Ant1	Low	2402	7.06	-48.69	≤-12.94	PASS
		High	2480	7.16	-58.1	≤-12.84	PASS
		Low	Hop_2402	7.07	-50.82	≤-12.93	PASS
		High	Hop_2480	7.14	-59.73	≤-12.86	PASS

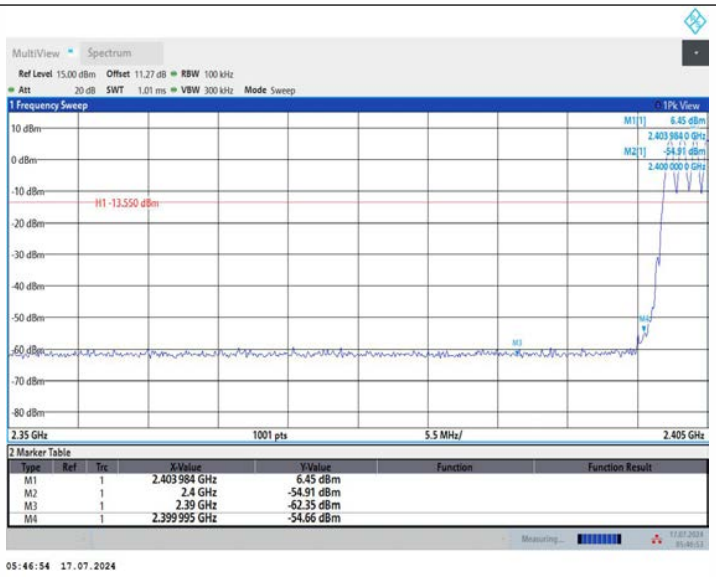
DH5_Ant1_Low_2402



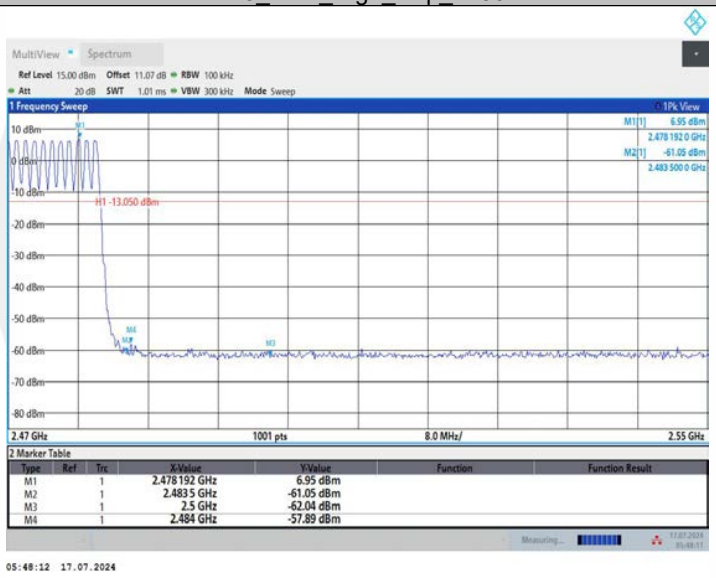
DH5_Ant1_High_2480



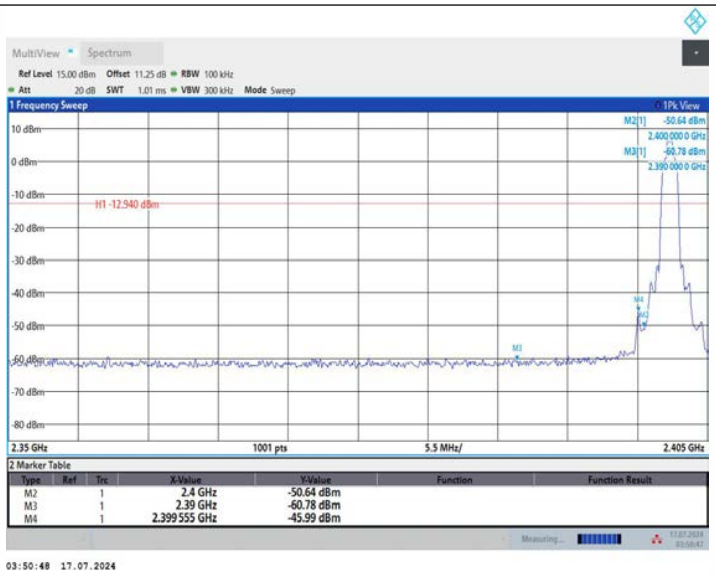
DH5_Ant1_Low_Hop_2402



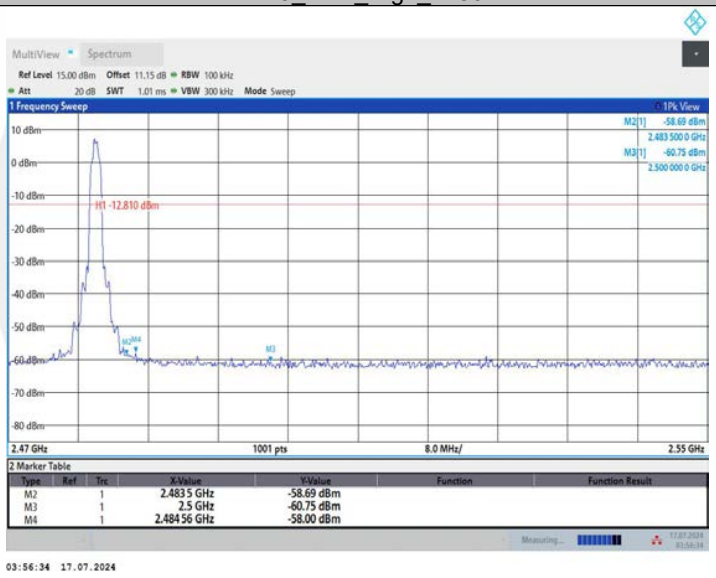
DH5_Ant1_High_Hop_2480



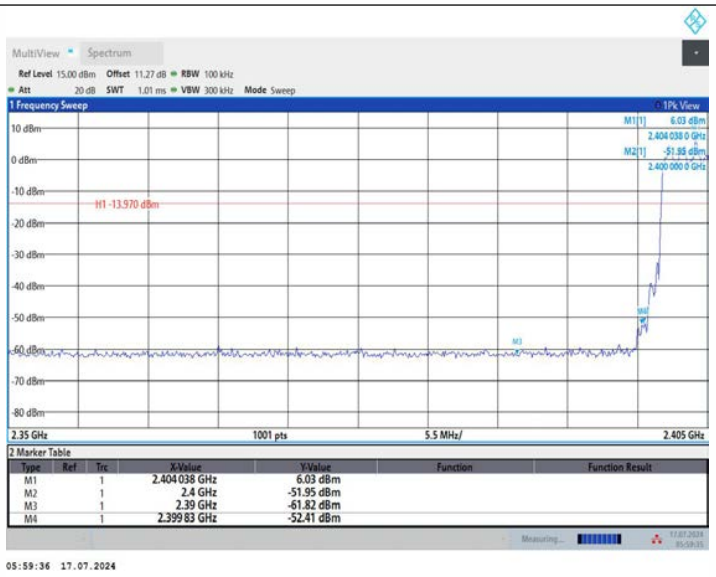
2DH5_Ant1_Low_2402



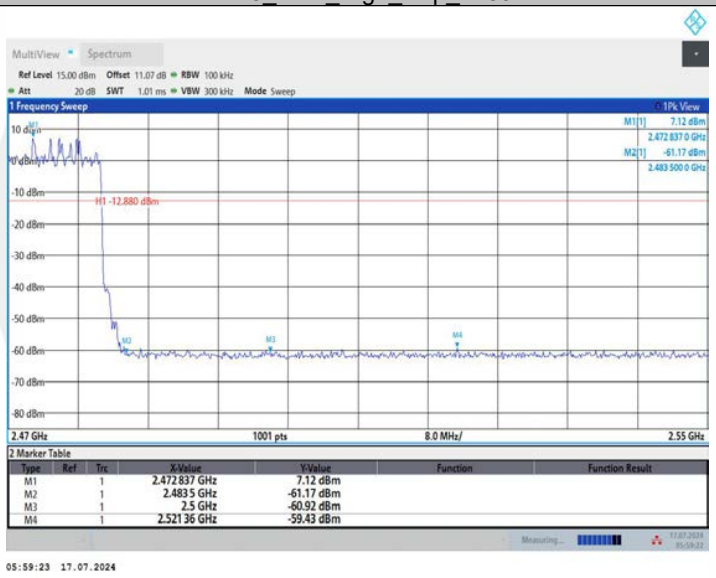
2DH5_Ant1_High_2480



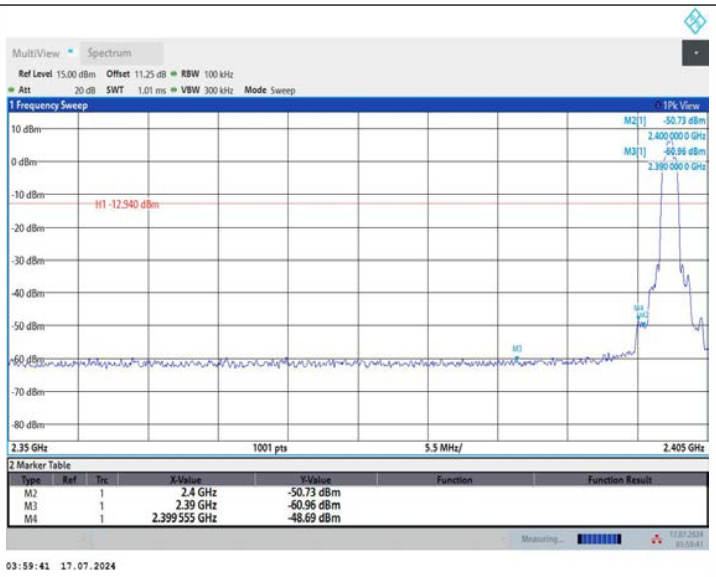
2DH5_Ant1_Low_Hop_2402



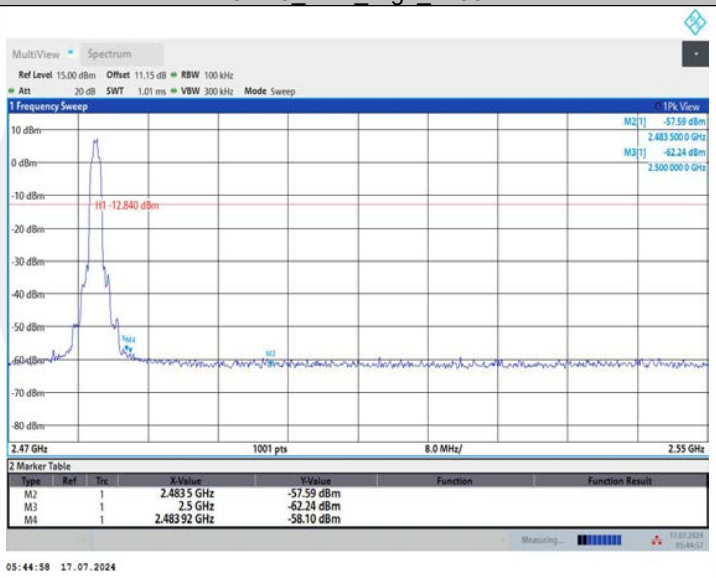
2DH5_Ant1_High_Hop_2480



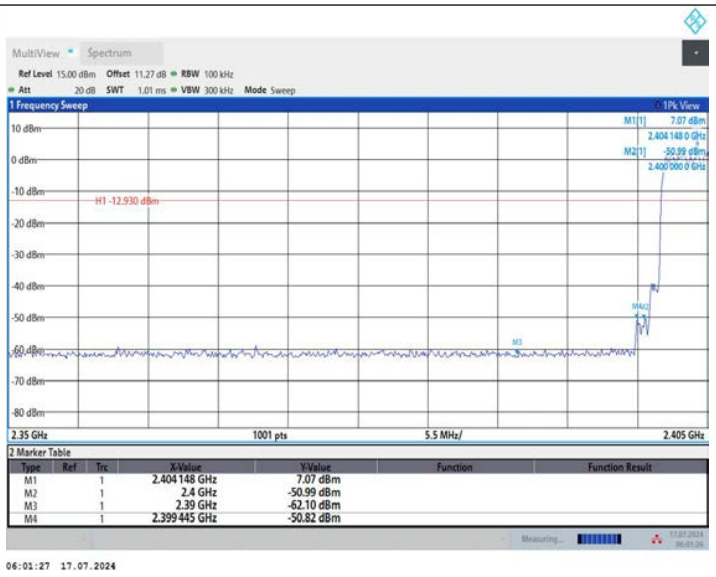
3DH5_Ant1_Low_2402



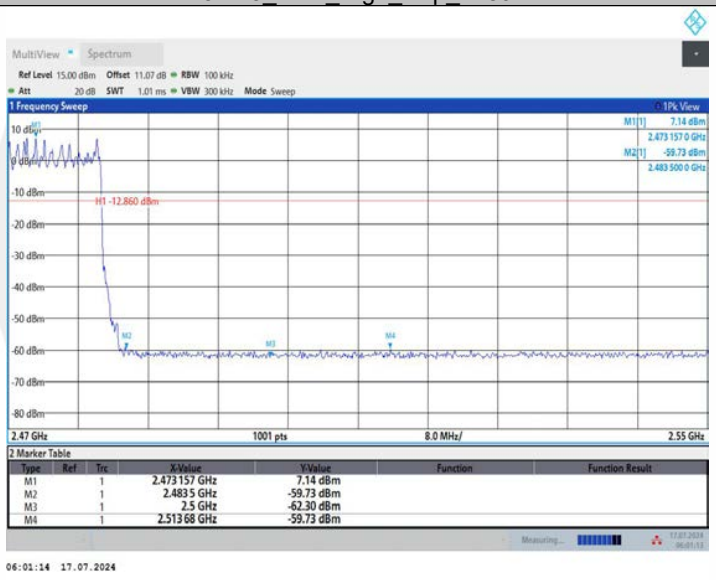
3DH5_Ant1_High_2480



3DH5_Ant1_Low_Hop_2402

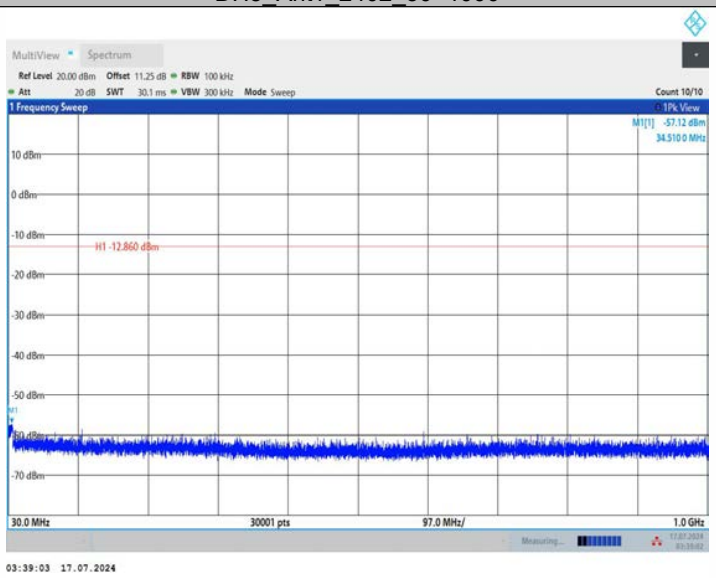
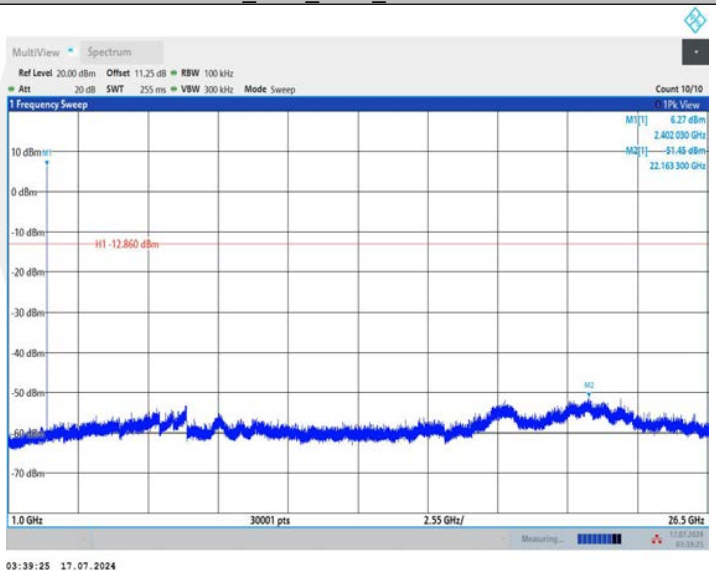


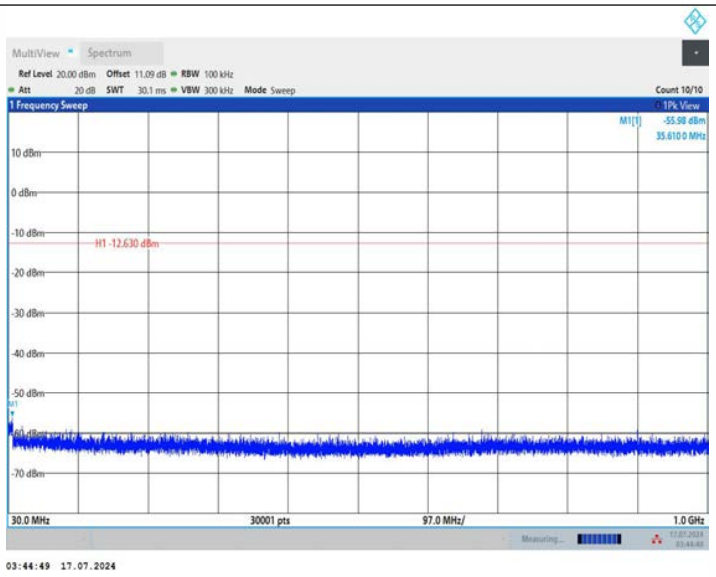
3DH5_Ant1_High_Hop_2480



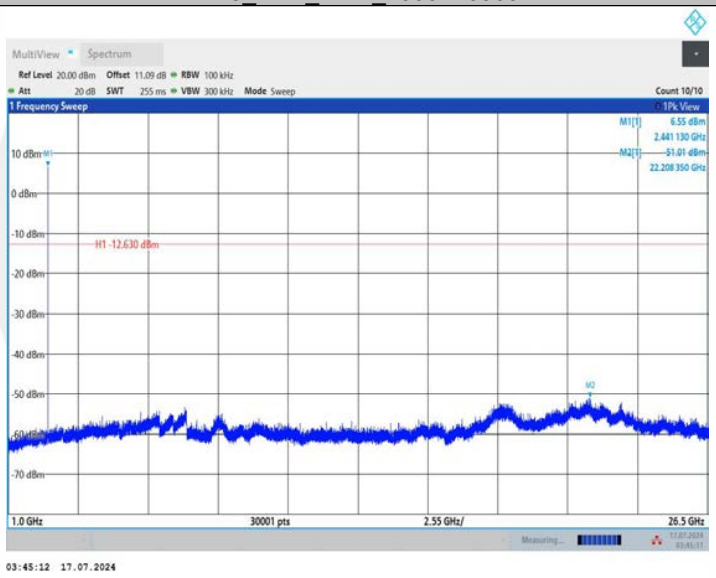
Conduceted Spurious Emission

TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
GFSK_DH5	Ant1	2402	30~1000	7.14	-57.12	≤-12.86	PASS
			1000~26500	7.14	-51.45	≤-12.86	PASS
		2441	30~1000	7.37	-55.98	≤-12.63	PASS
			1000~26500	7.37	-51.01	≤-12.63	PASS
		2480	30~1000	7.26	-55.71	≤-12.74	PASS
			1000~26500	7.26	-50.85	≤-12.74	PASS
π/4-DQPSK_2DH5	Ant1	2402	30~1000	7.06	-56.21	≤-12.94	PASS
			1000~26500	7.06	-51.26	≤-12.94	PASS
		2441	30~1000	7.32	-55.7	≤-12.68	PASS
			1000~26500	7.32	-51.47	≤-12.68	PASS
		2480	30~1000	7.19	-54.85	≤-12.81	PASS
			1000~26500	7.19	-51.45	≤-12.81	PASS
8DPSK_3DH5	Ant1	2402	30~1000	7.06	-56.15	≤-12.94	PASS
			1000~26500	7.06	-50.61	≤-12.94	PASS
		2441	30~1000	7.28	-56.45	≤-12.72	PASS
			1000~26500	7.28	-51.27	≤-12.72	PASS
		2480	30~1000	7.16	-56.51	≤-12.84	PASS
			1000~26500	7.16	-50.66	≤-12.84	PASS

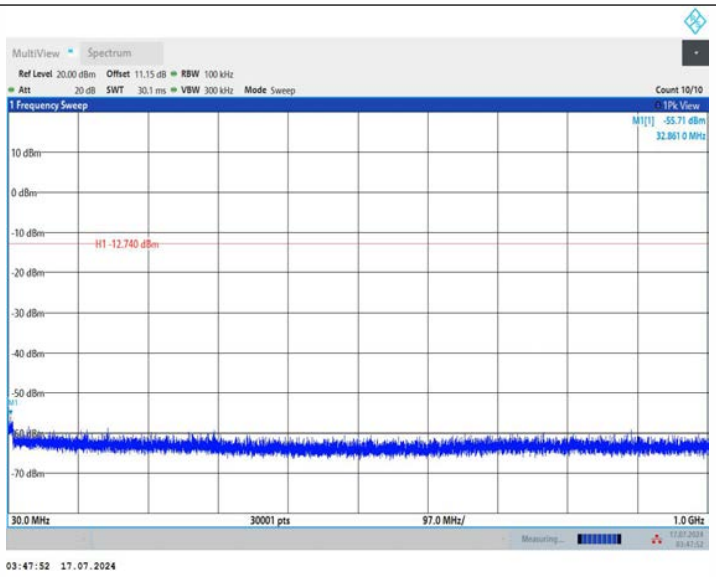
DH5_Ant1_2402_30~1000

DH5_Ant1_2402_1000~26500

DH5_Ant1_2441_30~1000



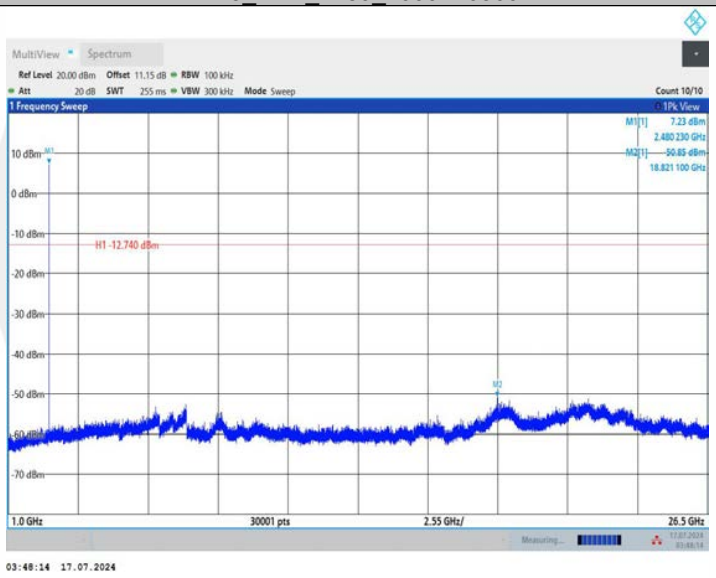
DH5_Ant1_2441_1000~26500



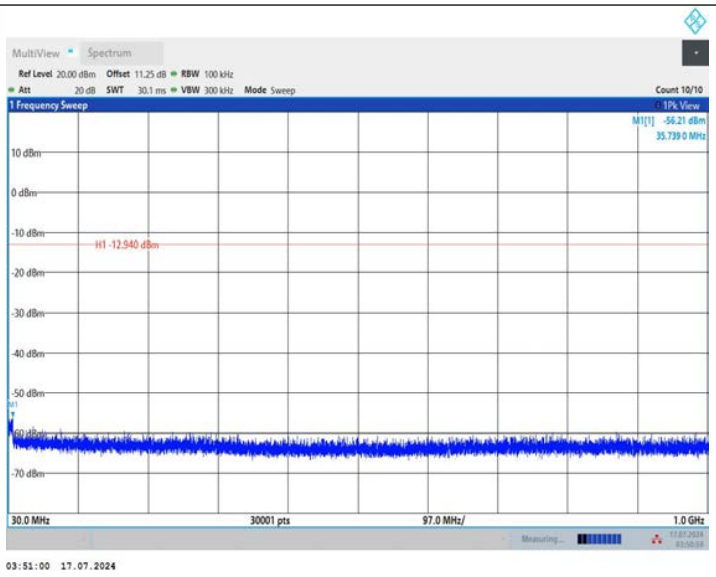
DH5_Ant1_2480_30~1000



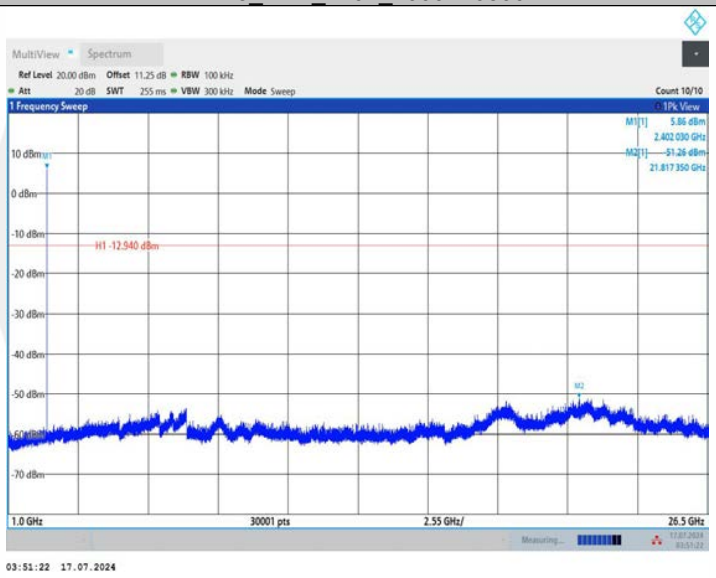
DH5_Ant1_2480_1000~26500



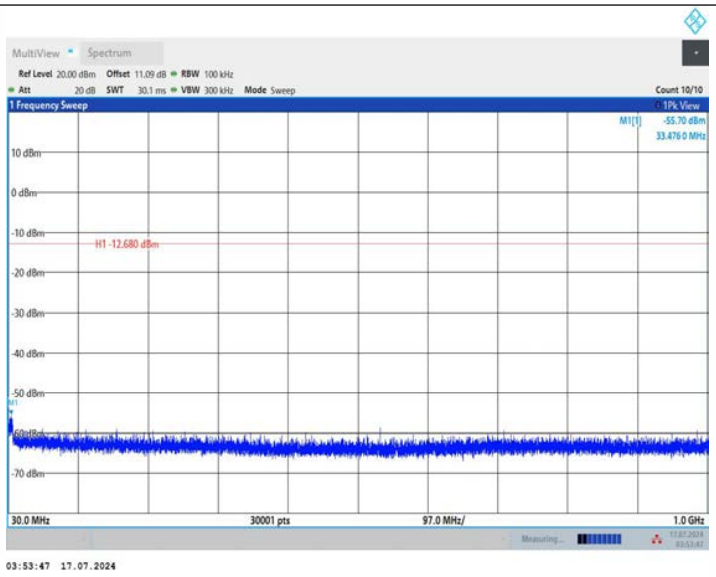
2DH5_Ant1_2402_30~1000



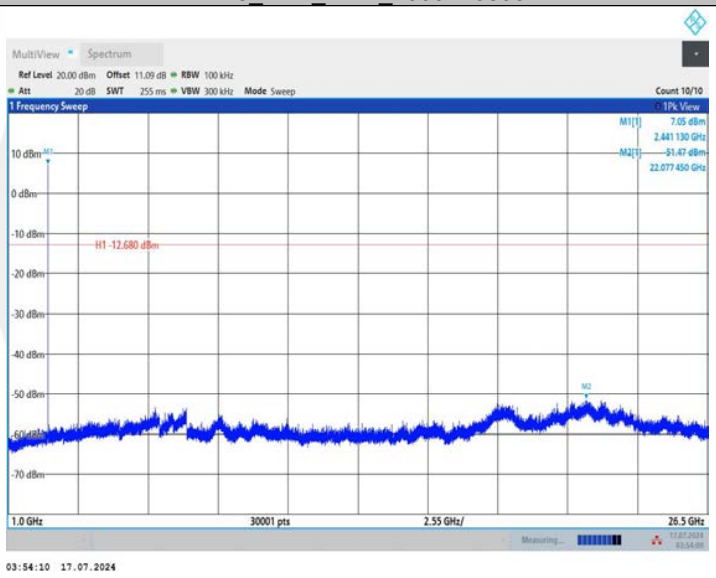
2DH5_Ant1_2402_1000~26500



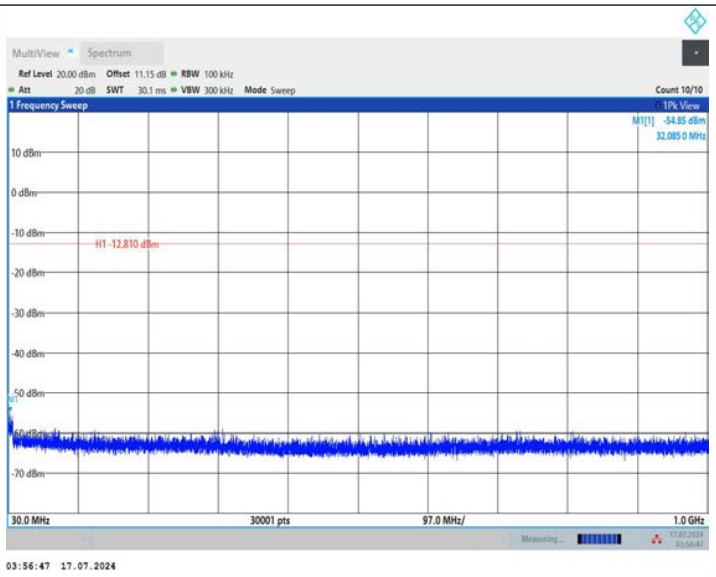
2DH5_Ant1_2441_30~1000



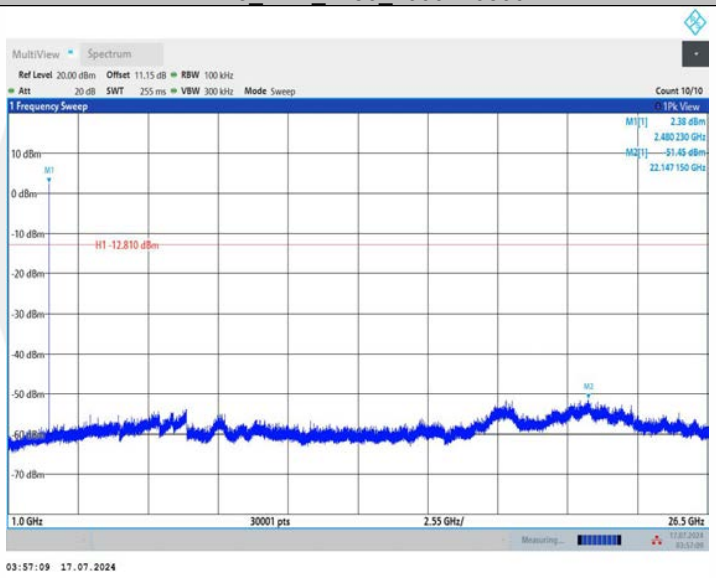
2DH5_Ant1_2441_1000~26500



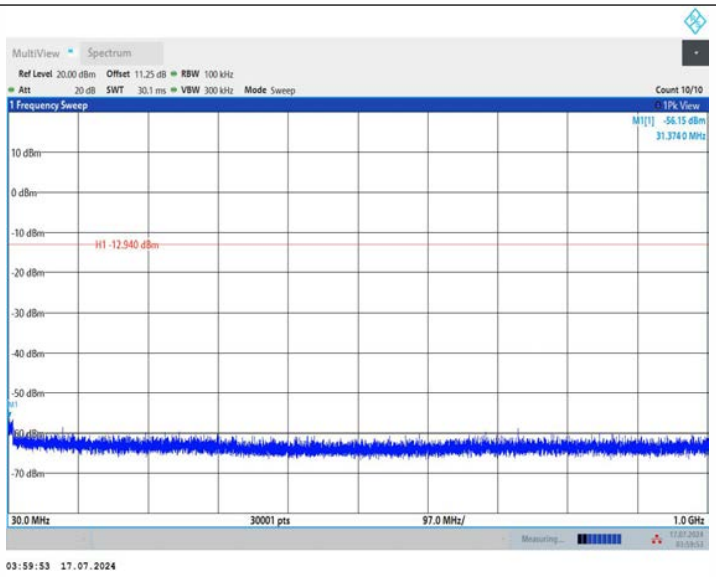
2DH5_Ant1_2480_30~1000



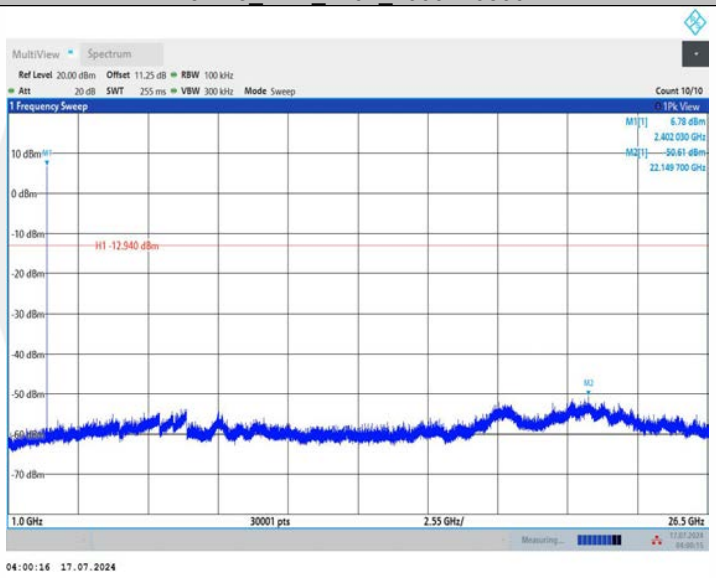
2DH5_Ant1_2480_1000~26500



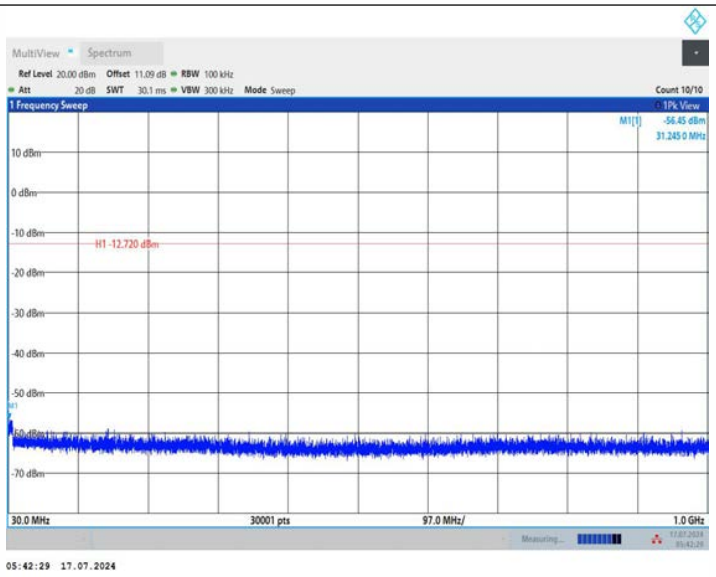
3DH5_Ant1_2402_30~1000



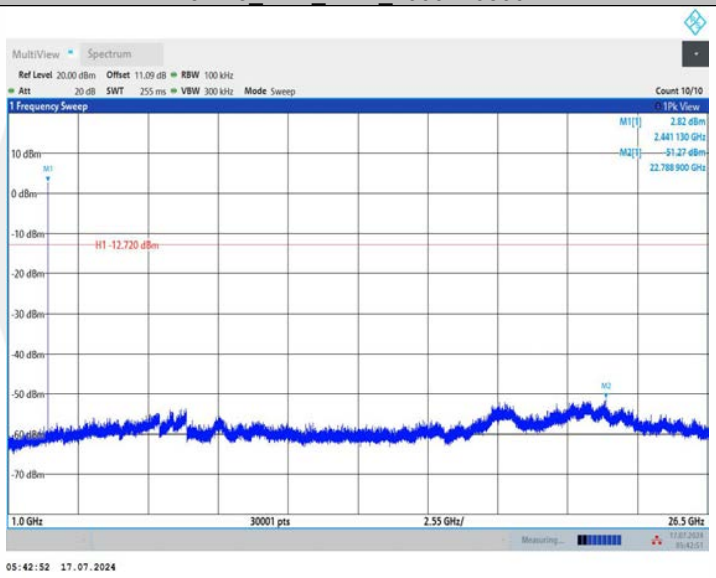
3DH5_Ant1_2402_1000~26500



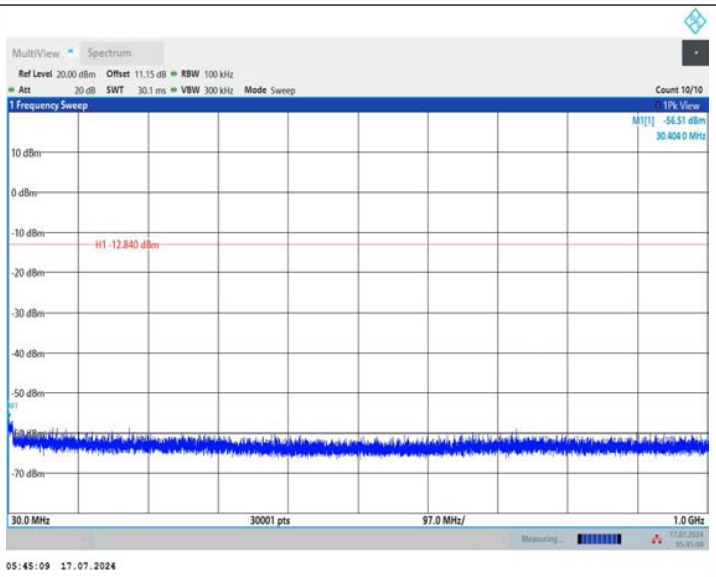
3DH5_Ant1_2441_30~1000



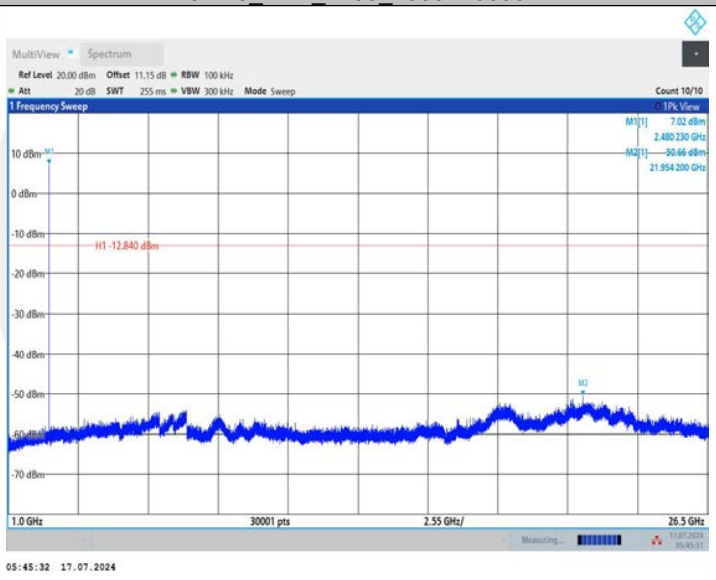
3DH5_Ant1_2441_1000~26500



3DH5_Ant1_2480_30~1000



3DH5_Ant1_2480_1000~26500



9.7 RADIATED SPURIOUS EMISSION

9.7.1 Applicable Standard

According to FCC Part 15.247(d) and 15.209 and KDB 558074 D01 15.247 MEAS GUIDANCE v05r02

9.7.2 Conformance Limit

According to FCC Part 15.247(d): 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)).
According to FCC Part15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
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	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	Above 38.6
13.36-13.41			

According to FCC Part15.205, the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (uV/m)	300
0.490-1.705	24000/F(KHz)	20 log (uV/m)	30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

9.7.3 Test Configuration

Test according to clause 7.2 radio frequency test setup 2

9.7.4 Test Procedure

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:
For Above 1GHz:
The EUT was placed on a turn table which is 1.5m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz
VBW ≥ RBW

Sweep = auto
Detector function = peak
Trace = max hold
For Below 1GHz:
The EUT was placed on a turn table which is 0.8m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Span = wide enough to fully capture the emission being measured
RBW = 100 kHz for
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
For Below 30MHz:
The EUT was placed on a turn table which is 0.8m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Span = wide enough to fully capture the emission being measured
RBW = 9kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
For Below 150KHz:
The EUT was placed on a turn table which is 0.8m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Span = wide enough to fully capture the emission being measured
RBW = 200Hz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Follow the guidelines in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.
Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.
Repeat above procedures until all frequency measured was complete.

9.7.5 Test Results

Pass

■ Spurious Emission below 30MHz (9KHz to 30MHz)

Temperature:	25° C
Relative Humidity:	60%
ATM Pressure:	1011 mbar

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
--	--	--	--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.
Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor

■ Spurious Emission Above 1GHz (1GHz to 25GHz)

Bluetooth (GFSK, π/4-DQPSK, 8DPSK) mode have been tested, and the worst result(GFSK) was report as below:

Test mode: GFSK Frequency: Channel 0: 2402MHz

Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Over(dB)	Detector
4804.0000	V	47.63	74.00	26.37	peak
7206.0000	V	52.91	74.00	21.09	peak
9608.0000	V	57.10	74.00	16.90	peak
4804.0000	V	37.71	54.00	16.29	AVG
7206.0000	V	40.27	54.00	13.73	AVG
9608.0000	V	45.43	54.00	8.57	AVG
4803.75	H	52.30	74.00	21.70	peak
7206.0000	H	52.50	74.00	21.50	peak
9608.0000	H	56.79	74.00	17.21	peak
4803.75	H	42.82	54.00	11.18	AVG
7206.0000	H	40.29	54.00	13.71	AVG
9608.0000	H	45.43	54.00	8.57	AVG

Test mode: GFSK Frequency: Channel 39: 2441MHz

Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Over(dB)	Detector
4882.0000	V	47.12	74.00	26.88	peak
7323.0000	V	53.54	74.00	20.46	peak
9764.0000	V	55.52	74.00	18.48	peak
4882.0000	V	37.38	54.00	16.62	AVG
7323.0000	V	39.97	54.00	14.03	AVG
9764.0000	V	44.24	54.00	9.76	AVG
4882.5	H	52.04	74.00	21.96	peak
7323.0000	H	52.70	74.00	21.30	peak
9764.0000	H	56.06	74.00	17.94	peak
4882.5	H	43.14	54.00	10.86	AVG
7323.0000	H	40.01	54.00	13.99	AVG
9764.0000	H	44.26	54.00	9.74	AVG

Test mode:	GFSK	Frequency:	Channel 78: 2480MHz

Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Over(dB)	Detector
4960.0000	V	46.75	74.00	27.25	peak
7440.0000	V	54.10	74.00	19.90	peak
9920.0000	V	59.73	74.00	14.27	peak
4960.0000	V	36.39	54.00	17.61	AVG
7440.0000	V	41.23	54.00	12.77	AVG
9920.0000	V	47.97	54.00	6.03	AVG
4959.375	H	51.25	74.00	22.75	peak
7440.0000	H	52.50	74.00	21.50	peak
9920.0000	H	59.78	74.00	14.22	peak
4959.375	H	43.63	54.00	10.37	AVG
7440.0000	H	41.26	54.00	12.74	AVG
9920.0000	H	47.93	54.00	6.07	AVG

Note: (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).
(2) Emission Level= Reading Level+Probe Factor +Cable Loss.
(3) The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
(4) Only records the worst data in tabular form.

■ Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

Bluetooth (GFSK, π/4-DQPSK, 8DPSK, Hopping) mode have been tested, and the worst result(GFSK, Hopping) was report as below:

Test mode:	GFSK	Frequency:	Channel 0: 2402MHz

Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Over(dB)	Detector
2387.54	V	41.80	74.00	32.20	peak
2387.54	V	37.60	54.00	16.40	AVG
2384.53	H	42.21	74.00	31.79	peak
2384.53	H	37.91	54.00	16.09	AVG

Test mode:	GFSK	Frequency:	Channel 78: 2480MHz

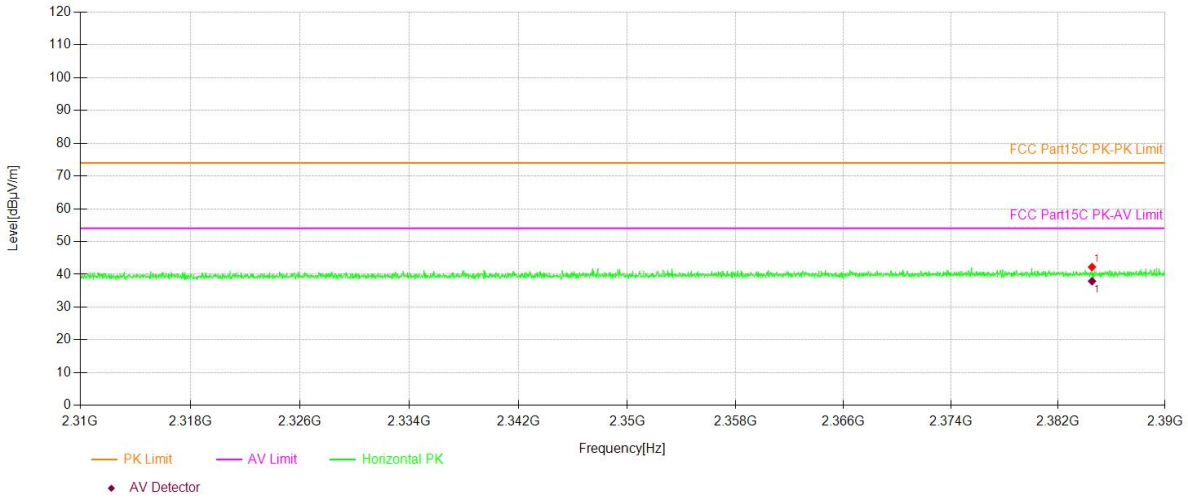
Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Over(dB)	Detector
2484.06	V	42.42	74.00	31.58	peak
2484.06	V	37.70	54.00	16.30	AVG
2484.21	H	42.81	74.00	31.19	peak
2484.21	H	37.57	54.00	16.43	AVG

Test mode:	GFSK	Frequency:	Hopping

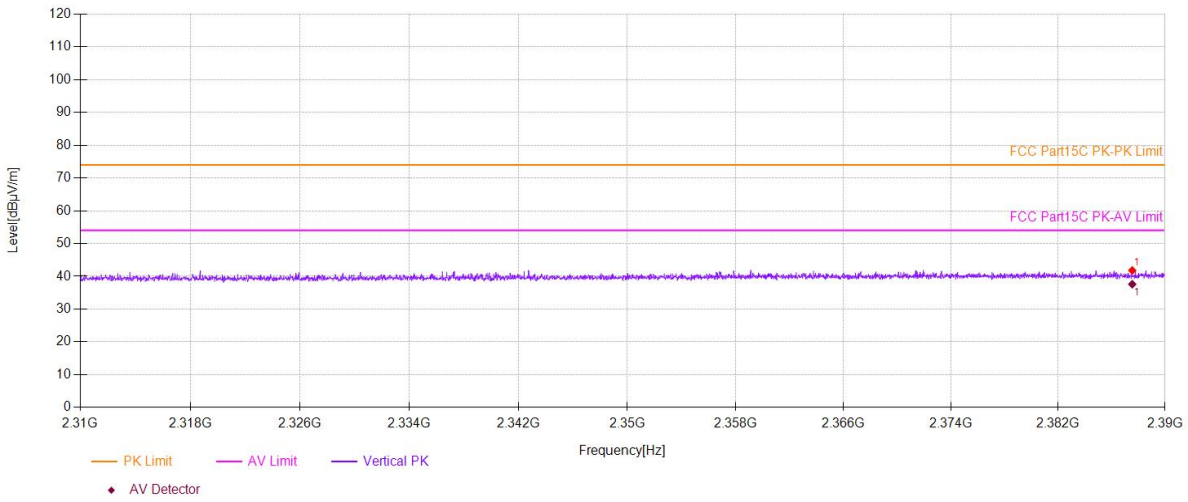
Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Over(dB)	Detector
2385.64	V	40.78	74.00	33.22	peak
2485.87	V	41.14	74.00	32.86	peak
2385.64	V	37.11	54.00	16.89	AVG
2485.87	V	37.63	54.00	16.37	AVG
2388.43	H	40.93	74.00	33.07	peak
2485.68	H	41.29	74.00	32.71	peak
2388.43	H	36.96	54.00	17.04	AVG
2485.68	H	37.26	54.00	16.74	AVG

Note: (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).
(2) Emission Level= Reading Level+Probe Factor +Cable Loss.
(3) Data of measurement within this frequency range shown " -- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

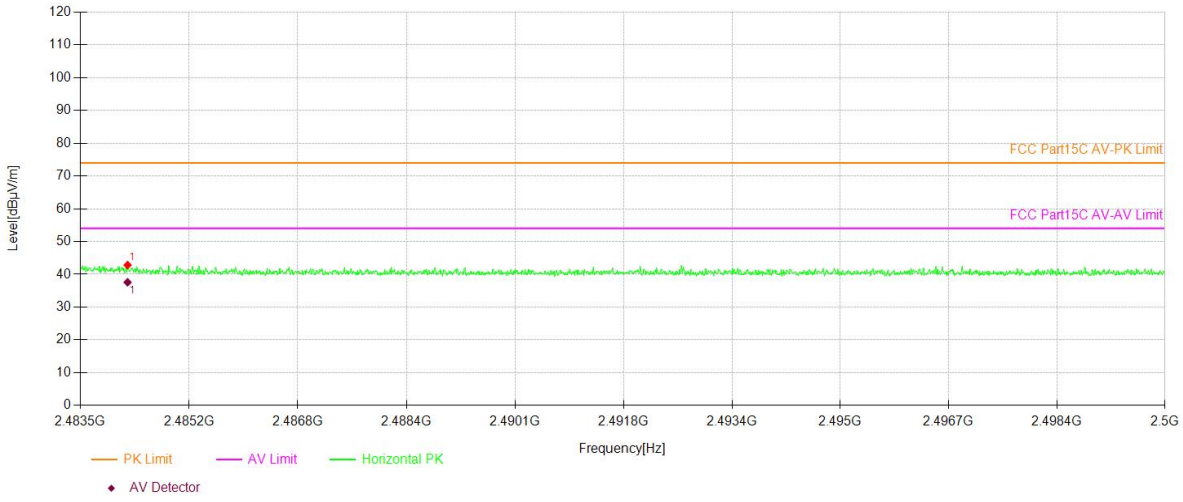
Test Model	Spurious Emission in Restricted Band 2310-2390MHz BT Channel 0: 2402MHz	GFSK Test By: HYD	H



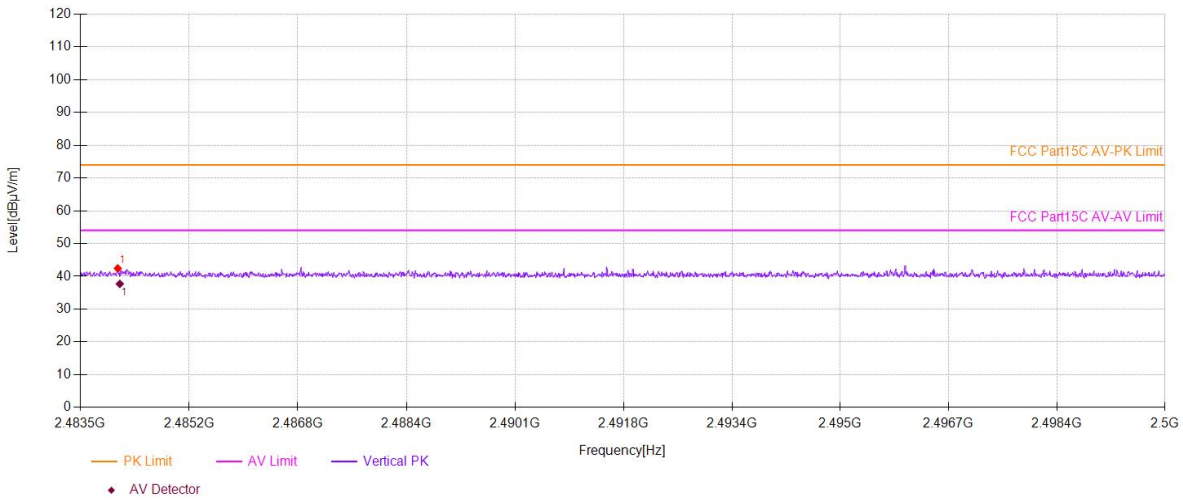
Test Model	Spurious Emission in Restricted Band 2310-2390MHz BT Channel 0: 2402MHz	GFSK Test By: HYD	V



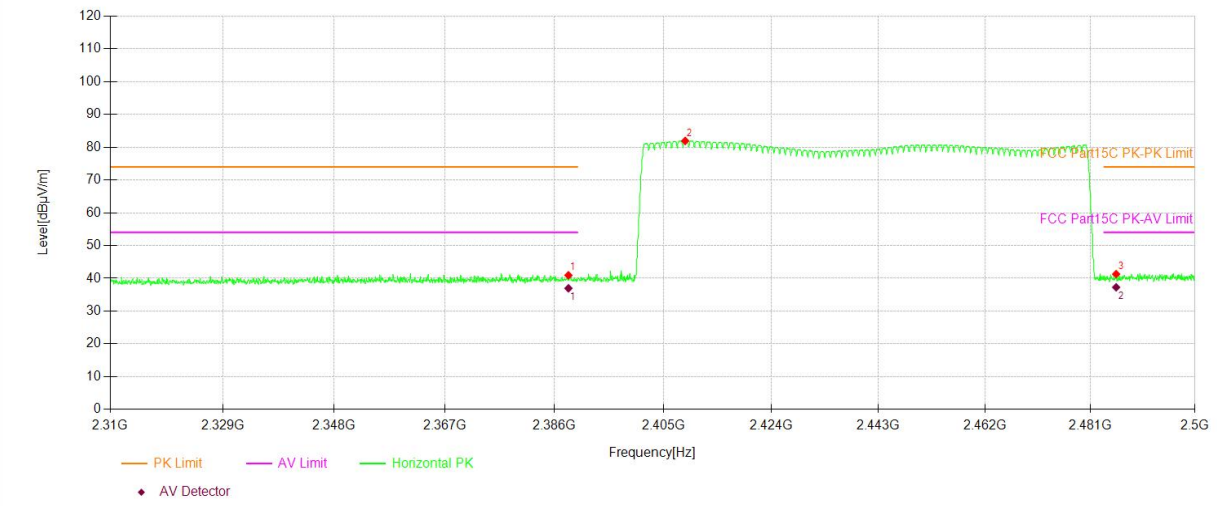
Test Model	Spurious Emission in Restricted Band 2483.5-2500MHz BT Channel 78: 2480MHz	GFSK Test By: HYD	H



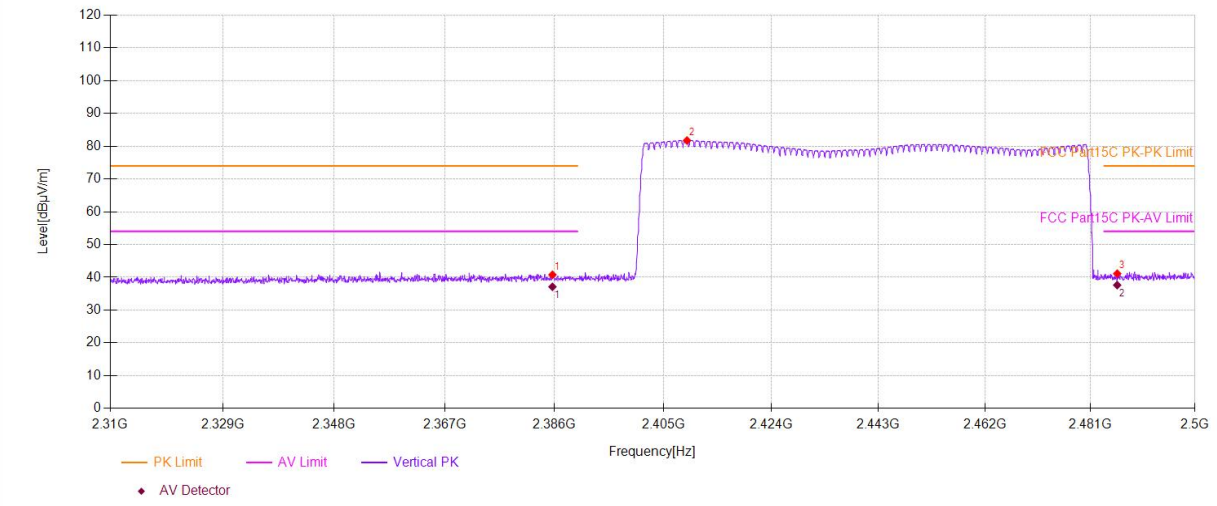
Test Model	Spurious Emission in Restricted Band 2483.5-2500MHz BT Channel 78: 2480MHz	GFSK Test By: HYD	V



Test Model	Spurious Emission in Restricted Band 2310-2390MHz and 2400-2483.5MHz BT Hopping GFSK H Test By: HYD



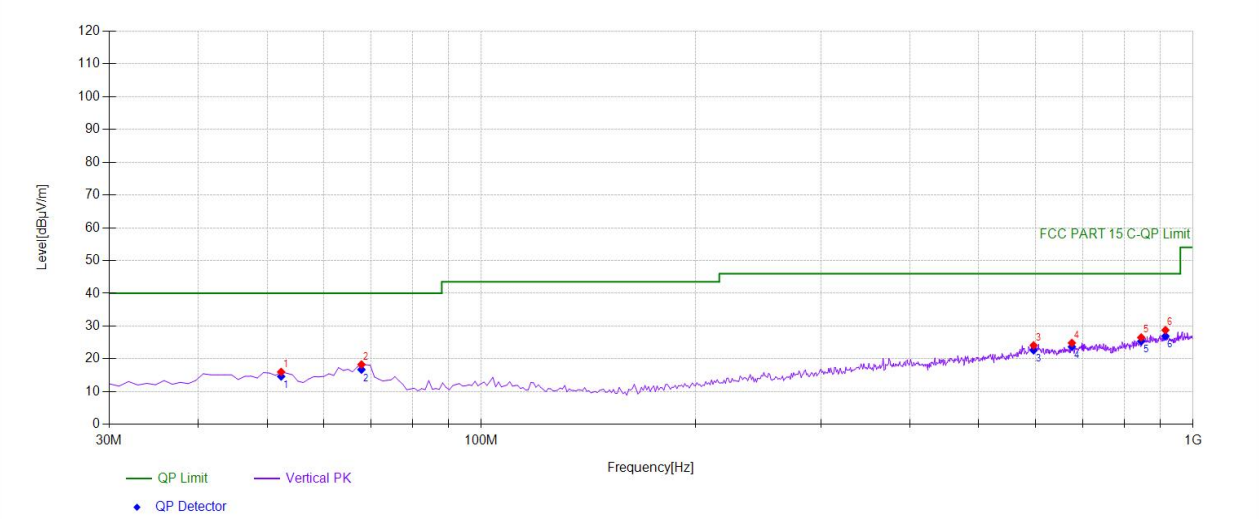
Test Model	Spurious Emission in Restricted Band 2310-2390MHz and 2400-2483.5MHz BT Hopping GFSK V Test By: HYD



■ Spurious Emission below 1GHz (30MHz to 1GHz)

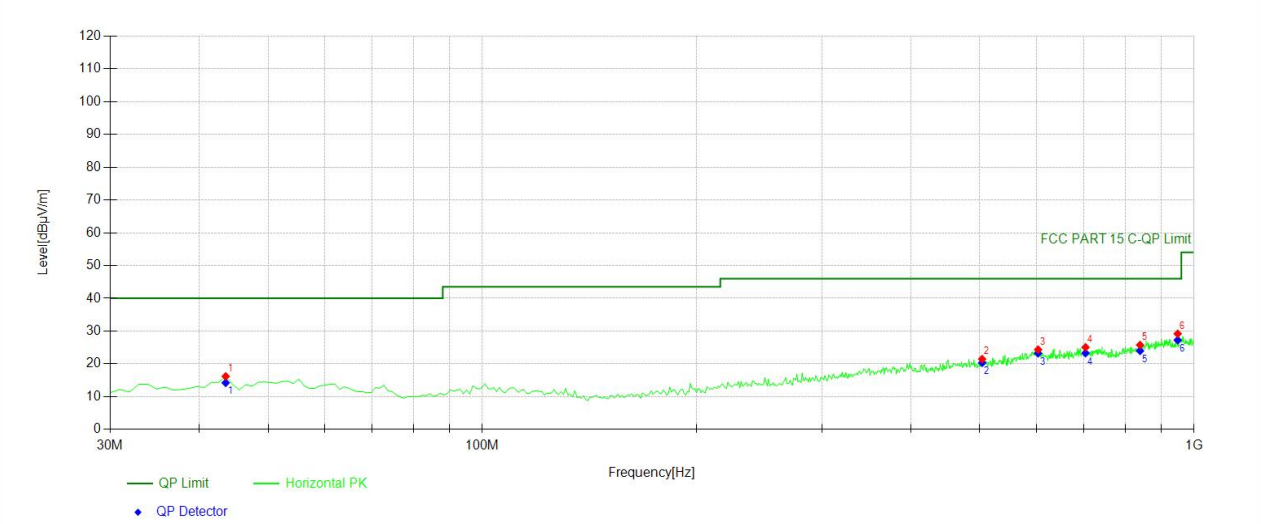
Bluetooth (GFSK, π/4-DQPSK, 8DPSK) mode have been tested, and the worst result(GFSK) was report as below:

Test mode:	GFSK	Frequency:	Channel 0: 2402MHz



Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB/m]	Level [dBµV/m]	Detector	Limit [dBµV/m]	Margin [dB]	Polarity
1	52.3323	32.32	-16.31	16.01	PK	40.00	23.99	Vertical
2	67.8679	36.67	-18.40	18.27	PK	40.00	21.73	Vertical
3	597.047	30.73	-6.59	24.14	PK	46.00	21.86	Vertical
4	675.6957	31.80	-6.94	24.86	PK	46.00	21.14	Vertical
5	845.6156	30.92	-4.38	26.54	PK	46.00	19.46	Vertical
6	914.5546	31.80	-3.03	28.77	PK	46.00	17.23	Vertical

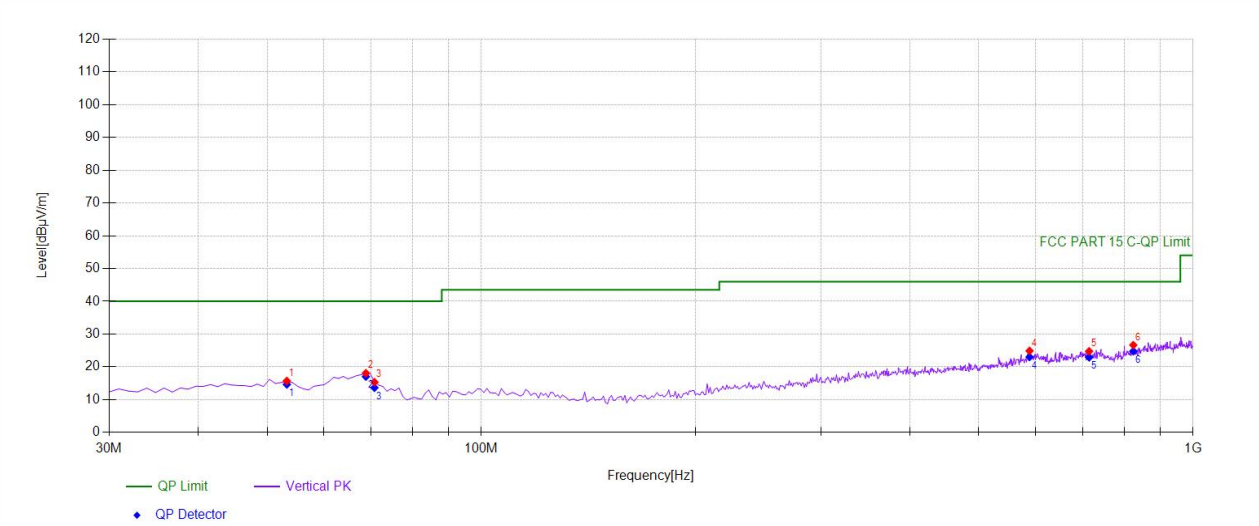
Final Data List					
NO.	Freq. [MHz]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]
1	52.3323	-16.31	14.65	40.00	25.35
2	67.8679	-18.40	16.74	40.00	23.26
3	597.047	-6.59	22.61	46.00	23.39
4	675.6957	-6.94	23.69	46.00	22.31
5	845.6156	-4.38	25.37	46.00	20.63
6	914.5546	-3.03	26.96	46.00	19.04



Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB/m]	Level [dBµV/m]	Detector	Limit [dBµV/m]	Margin [dB]	Polarity
1	43.5936	33.12	-16.91	16.21	PK	40.00	23.79	Horizontal
2	503.8338	31.46	-9.99	21.47	PK	46.00	24.53	Horizontal
3	603.8438	31.01	-6.65	24.36	PK	46.00	21.64	Horizontal
4	703.8539	31.18	-6.12	25.06	PK	46.00	20.94	Horizontal
5	839.7898	30.42	-4.66	25.76	PK	46.00	20.24	Horizontal
6	948.5385	32.21	-3.02	29.19	PK	46.00	16.81	Horizontal

Final Data List					
NO.	Freq. [MHz]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]
1	43.5936	-16.91	14.24	40.00	25.76
2	503.8338	-9.99	20.34	46.00	25.66
3	603.8438	-6.65	23.23	46.00	22.77
4	703.8539	-6.12	23.29	46.00	22.71
5	839.7898	-4.66	23.99	46.00	22.01
6	948.5385	-3.02	27.26	46.00	18.74

Test mode:	GFSK	Frequency:	Channel 39: 2441MHz

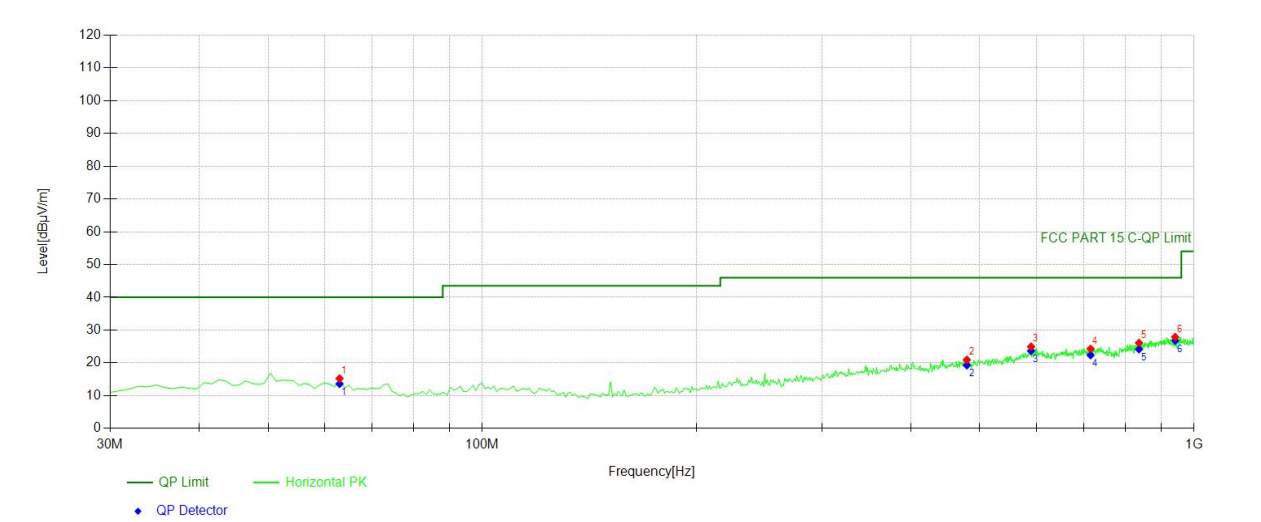


Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB/m]	Level [dBµV/m]	Detector	Limit [dBµV/m]	Margin [dB]	Polarity
1	53.3033	32.15	-16.44	15.71	PK	40.00	24.29	Vertical
2	68.8388	36.62	-18.53	18.09	PK	40.00	21.91	Vertical
3	70.7808	34.16	-18.81	15.35	PK	40.00	24.65	Vertical
4	589.2793	31.88	-6.98	24.90	PK	46.00	21.10	Vertical
5	714.5345	30.87	-6.10	24.77	PK	46.00	21.23	Vertical
6	824.2543	31.67	-5.01	26.66	PK	46.00	19.34	Vertical

Final Data List

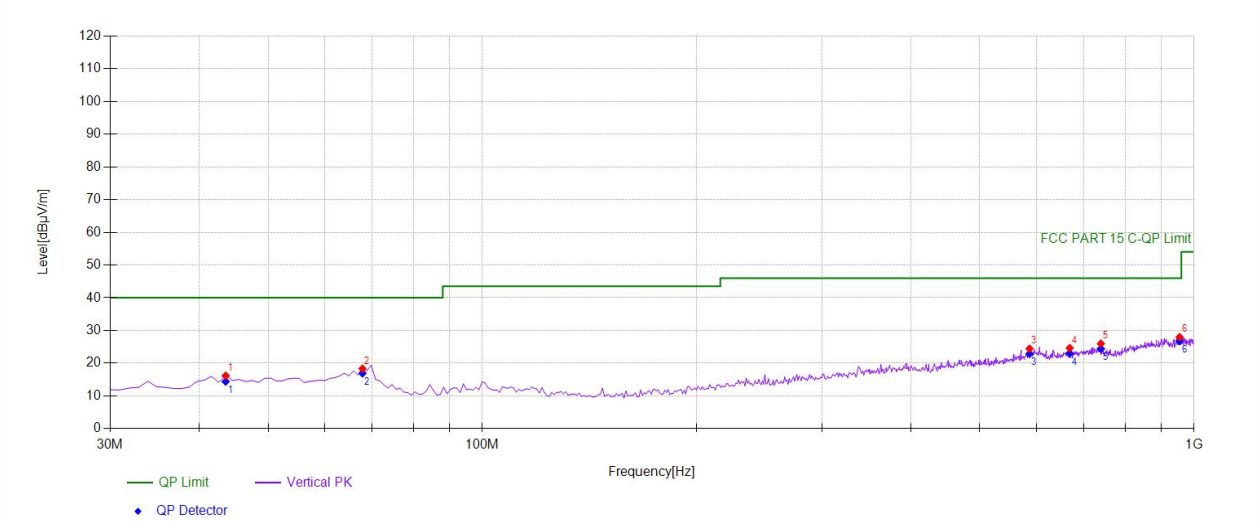
NO.	Freq. [MHz]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]
1	53.3033	-16.44	14.65	40.00	25.35
2	68.8388	-18.53	17.03	40.00	22.97
3	70.7808	-18.81	13.65	40.00	26.35
4	589.2793	-6.98	23.04	46.00	22.96
5	714.5345	-6.10	22.91	46.00	23.09
6	824.2543	-5.01	24.80	46.00	21.20



Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB/m]	Level [dBµV/m]	Detector	Limit [dBµV/m]	Margin [dB]	Polarity
1	63.013	32.98	-17.73	15.25	PK	40.00	24.75	Horizontal
2	479.5596	31.01	-10.08	20.93	PK	46.00	25.07	Horizontal
3	590.2503	31.89	-6.93	24.96	PK	46.00	21.04	Horizontal
4	715.5055	30.40	-6.11	24.29	PK	46.00	21.71	Horizontal
5	836.8769	30.85	-4.74	26.11	PK	46.00	19.89	Horizontal
6	940.7708	31.38	-3.49	27.89	PK	46.00	18.11	Horizontal

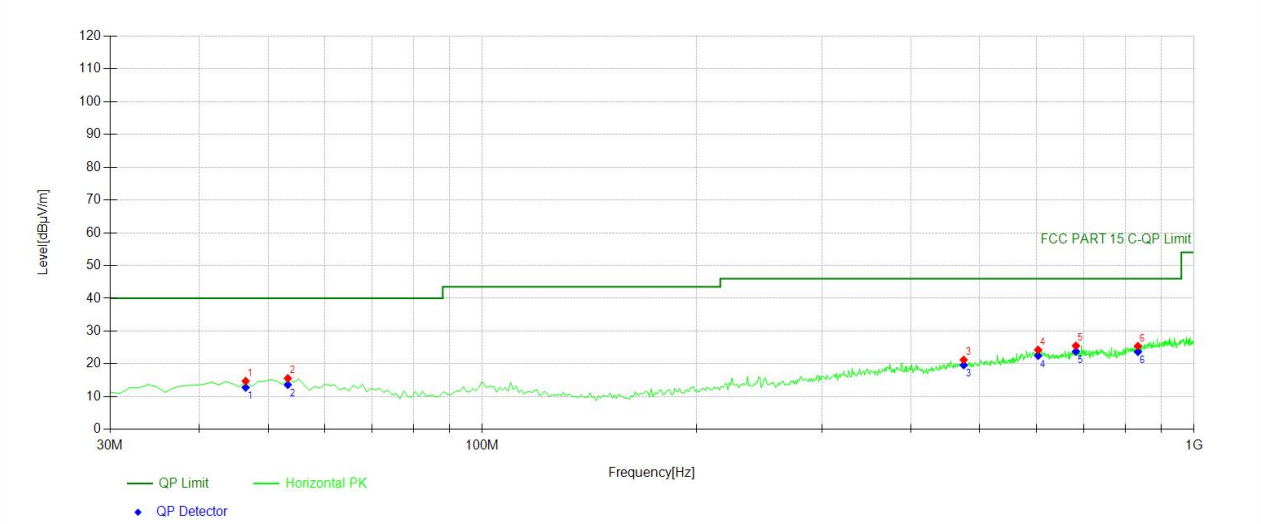
Final Data List					
NO.	Freq. [MHz]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]
1	63.013	-17.73	13.61	40.00	26.39
2	479.5596	-10.08	19.29	46.00	26.71
3	590.2503	-6.93	23.67	46.00	22.33
4	715.5055	-6.11	22.36	46.00	23.64
5	836.8769	-4.74	24.18	46.00	21.82
6	940.7708	-3.49	26.80	46.00	19.20

Test mode:	GFSK	Frequency:	Channel 78: 2480MHz



Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB/m]	Level [dBµV/m]	Detector	Limit [dBµV/m]	Margin [dB]	Polarity
1	43.5936	33.08	-16.91	16.17	PK	40.00	23.83	Vertical
2	67.8679	36.73	-18.40	18.33	PK	40.00	21.67	Vertical
3	587.3373	31.51	-7.07	24.44	PK	46.00	21.56	Vertical
4	668.8989	31.63	-7.00	24.63	PK	46.00	21.37	Vertical
5	739.7798	31.64	-5.66	25.98	PK	46.00	20.02	Vertical
6	954.3644	30.67	-2.69	27.98	PK	46.00	18.02	Vertical

Final Data List					
NO.	Freq. [MHz]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]
1	43.5936	-16.91	14.41	40.00	25.59
2	67.8679	-18.40	16.93	40.00	23.07
3	587.3373	-7.07	22.88	46.00	23.12
4	668.8989	-7.00	23.07	46.00	22.93
5	739.7798	-5.66	24.42	46.00	21.58
6	954.3644	-2.69	26.78	46.00	19.22



Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV]	Factor [dB/m]	Level [dBµV/m]	Detector	Limit [dBµV/m]	Margin [dB]	Polarity
1	46.5065	31.26	-16.50	14.76	PK	40.00	25.24	Horizontal
2	53.3033	32.03	-16.44	15.59	PK	40.00	24.41	Horizontal
3	474.7047	31.38	-10.15	21.23	PK	46.00	24.77	Horizontal
4	603.8438	30.91	-6.65	24.26	PK	46.00	21.74	Horizontal
5	682.4925	32.34	-6.81	25.53	PK	46.00	20.47	Horizontal
6	833.964	30.25	-4.82	25.43	PK	46.00	20.57	Horizontal

Final Data List					
NO.	Freq. [MHz]	Factor [dB/m]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]
1	46.5065	-16.50	12.81	40.00	27.19
2	53.3033	-16.44	13.64	40.00	26.36
3	474.7047	-10.15	19.64	46.00	26.36
4	603.8438	-6.65	22.51	46.00	23.49
5	682.4925	-6.81	23.78	46.00	22.22
6	833.964	-4.82	23.68	46.00	22.32

9.8 CONDUCTED EMISSION TEST

9.8.1 Applicable Standard

According to FCC Part 15.207(a)

9.8.2 Conformance Limit

Conducted Emission Limit		
Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50
Note: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.		

9.8.3 Test Configuration

Test according to clause 7.3 conducted emission test setup

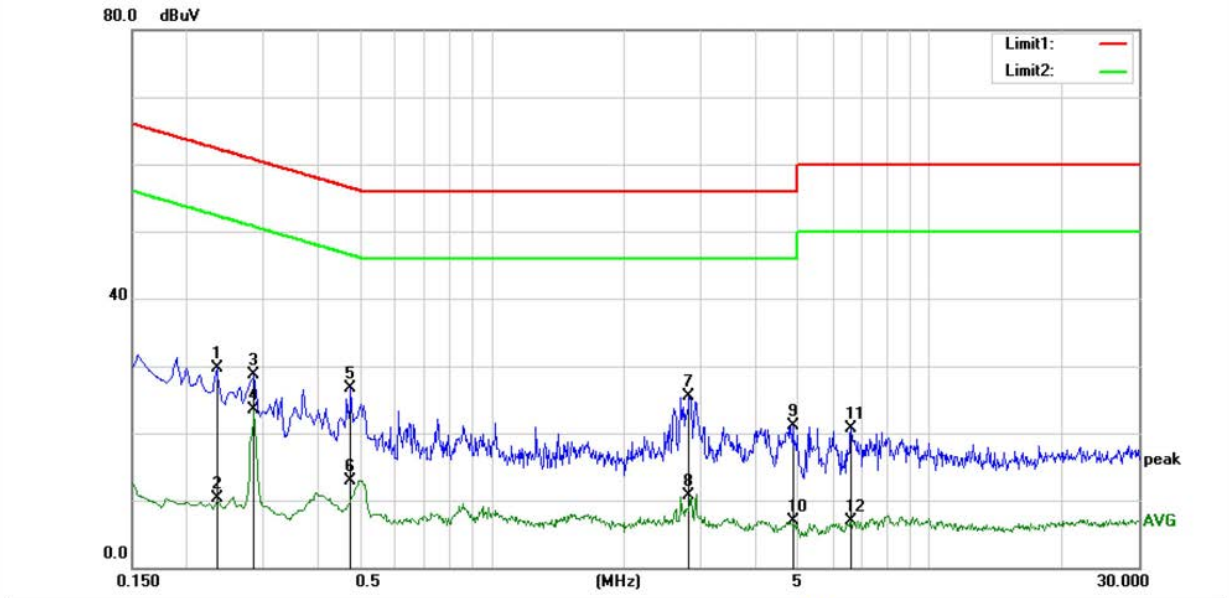
9.8.4 Test Procedure

The EUT was placed on a table which is 0.8m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Repeat above procedures until all frequency measured were complete.

9.8.5 Test Results

Pass

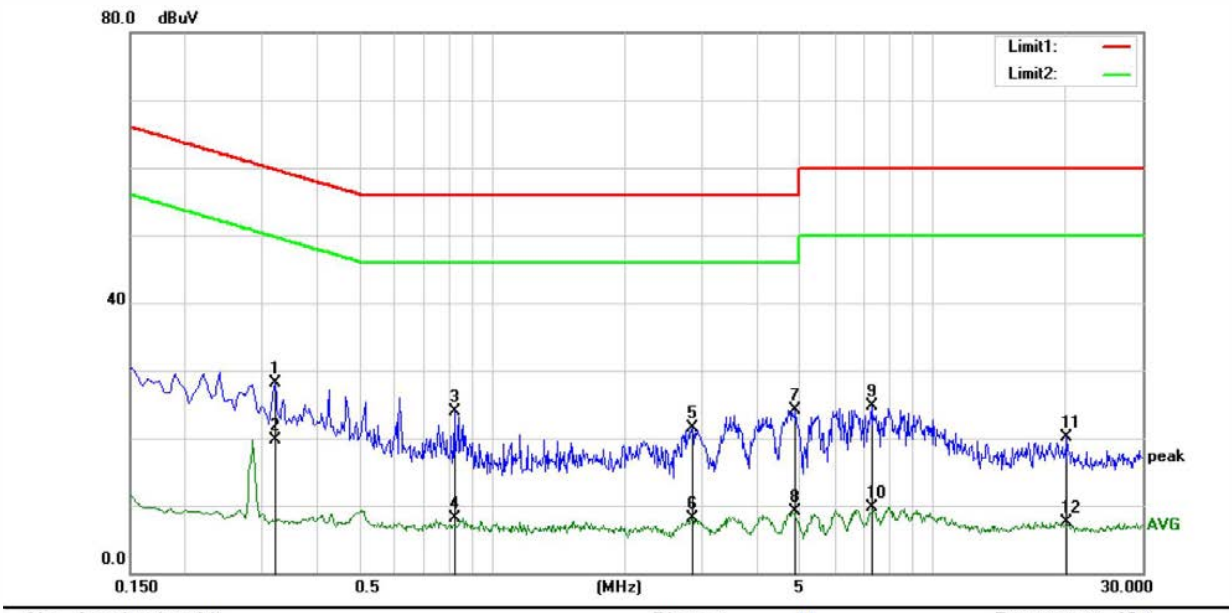
Note: The 120V &240V voltagehave been tested, and the worst result recorded was report as below



Site Conduction 2# Phase: *L1* Temperature: 25.1

Limit: (CE)FCC PART 15 class B_QP Power: DC 5V From adapter Humidity: 45 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2350	19.11	10.65	29.76	62.27	-32.51	QP	
2		0.2350	-0.35	10.65	10.30	52.27	-41.97	AVG	
3		0.2850	17.98	10.65	28.63	60.67	-32.04	QP	
4	*	0.2850	12.76	10.65	23.41	50.67	-27.26	AVG	
5		0.4750	16.12	10.66	26.78	56.43	-29.65	QP	
6		0.4750	2.25	10.66	12.91	46.43	-33.52	AVG	
7		2.8150	14.90	10.56	25.46	56.00	-30.54	QP	
8		2.8150	0.18	10.56	10.74	46.00	-35.26	AVG	
9		4.8650	10.72	10.33	21.05	56.00	-34.95	QP	
10		4.8650	-3.48	10.33	6.85	46.00	-39.15	AVG	
11		6.6050	10.30	10.45	20.75	60.00	-39.25	QP	
12		6.6050	-3.54	10.45	6.91	50.00	-43.09	AVG	



Site Conduction 2# Phase: N Temperature: 25.1

Limit: (CE)FCC PART 15 class B_QP Power: DC 5V From adapter Humidity: 45 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.3200	17.37	10.65	28.02	59.71	-31.69	QP	
2	*	0.3200	9.09	10.65	19.74	49.71	-29.97	AVG	
3		0.8200	13.24	10.66	23.90	56.00	-32.10	QP	
4		0.8200	-2.64	10.66	8.02	46.00	-37.98	AVG	
5		2.8400	10.97	10.56	21.53	56.00	-34.47	QP	
6		2.8400	-2.36	10.56	8.20	46.00	-37.80	AVG	
7		4.8800	13.79	10.32	24.11	56.00	-31.89	QP	
8		4.8800	-1.30	10.32	9.02	46.00	-36.98	AVG	
9		7.2550	14.19	10.49	24.68	60.00	-35.32	QP	
10		7.2550	-0.72	10.49	9.77	50.00	-40.23	AVG	
11		20.2050	9.05	11.15	20.20	60.00	-39.80	QP	
12		20.2050	-3.66	11.15	7.49	50.00	-42.51	AVG	

9.9 ANTENNA APPLICATION

9.9.1 Antenna Requirement

Standard	Requirement
FCC CRF Part 15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

9.9.2 Result

PASS

☒ Antenna use a permanently attached antenna which is not replaceable.
☐ Not using a standard antenna jack or electrical connector for antenna replacement
☐ The antenna has to be professionally installed (please provide method of installation)
Note: Please refer to the attached document Internal Photos to show the antenna connector.

--- End of Report ---

10 APPENDIX PHOTOGRAPHS OF EUT

Please refer to the file of External Photo and Internal Photo.

11 APPENDIX PHOTOGRAPHS OF TEST SETUP

Please refer to the file of Test Setup Photo.