

TEST REPORT

FCC BT Test for DA651ZZZGG
Certification

APPLICANT
Hyundai Mobis Co., Ltd

REPORT NO.
HCT-RF-2506-FC045

DATE OF ISSUE
June 11, 2025

Tested by
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Accredited by KOLAS, Republic of KOREA

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TEST REPORT

REPORT NO.

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DATE OF ISSUE

June 11, 2025

Additional Model

DA653ZZZGG, DA654ZZZGG, DA656ZZZGG

Applicant

Hyundai Mobis Co., Ltd

203, Teheran-ro, Gangnam-gu, Seoul, Republic of Korea

Product Name

Car infotainment system

Model Name

DA651ZZZGG

FCC ID

TQ8-DA651ZZZGG

FCC Classification

FCC Part 15 Spread Spectrum Transmitter

Date of Test

February 25, 2025 ~ June 11, 2025

Test Standard Used

FCC Rule Part(s): Part 15 subpart C 15.247

Location of Test

☒ Permanent Testing Lab ☐ On Site Testing Lab

(Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)

Test Results

PASS

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	June 11, 2025	Initial Release

Notice

Content

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.

The test results have only been applied with the test methods required by the standard(s).

The laboratory is not accredited for the test results marked *.

Information provided by the applicant is marked **.

Test results provided by external providers are marked ***.

When confirmation of authenticity of this test report is required, please contact www.hct.co.kr

This test report provides test result(s) under the scope accredited by the Korea Laboratory Accreditation Scheme (KOLAS), which signed the ILAC-MRA.

(KOLAS (KS Q ISO/IEC 17025) Accreditation No. KT197)

This test report provides test result(s) under the lab's valid Scope of Accreditation by A2LA (American Association for Laboratory Accreditation), signatory of the ILAC-MRA.

(A2LA (ISO/IEC 17025) Certificate No. 4114.01)

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1. EUT DESCRIPTION

Model	DA651ZZZGG
Additional Model	DA653ZZZGG, DA654ZZZGG, DA656ZZZGG
EUT Type	Car infotainment system
Power Supply	DC 14.4 V
Frequency Range	2 402 MHz - 2 480 MHz
Max. RF Output Power	2.949 dBm (1.97 mW)
BT Operating Mode	Normal, EDR, AFH
Modulation Type	GFSK(Normal), π /4DQPSK and 8DPSK(EDR)
Modulation Technique	FHSS
Number of Channels	79 Channels, Minimum 20 Channels(AFH)
Antenna Specification	Type: PCB Pattern ANT Peak Gain: 4.22 dBi
Serial number	Conducted : HC3P300147D Radiated : HC3P300101D

This device supports simultaneous transmission operation.

Simultaneous transmission Scenario	2.4 GHz WiFi	5 GHz WiFi	BT	Test Case
Bluetooth + 2.4 GHz WiFi	on	-	on(BT)	Scenario1
Bluetooth + 5 GHz WiFi	-	on	on(BT)	Scenario2
Bluetooth + 2.4 GHz WiFi	on	-	on(BTLE)	Scenario3
Bluetooth + 5 GHz WiFi	-	on	on(BTLE)	Scenario4

2. Requirements for Bluetooth transmitter(15.247)

This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:

- 1) This system is hopping pseudo-randomly.
- 2) Each frequency is used equally on the average by each transmitter.
- 3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
- 4) The receiver shifts frequencies in synchronization with the transmitted signals.
 - 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.
 - 15.247(h): 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.

3. TEST METHODOLOGY

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device (ANSI C63.10-2013, KDB 558074) is used in the measurement of the test device.

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.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :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 modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1 GHz. Above 1 GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013). To record the final measurements, the analyzer detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 120 kHz for frequencies below 1 GHz or 1 MHz for frequencies above 1 GHz. For average measurements above 1 GHz, the analyzer was set to peak detector and add the DCCF calculations.

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

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 equipment's, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated March 11, 2024 (Registration Number: KR0032).

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203:

"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 this section."

- (1) The antennas of this E.U.T are permanently attached.
- (2) The E.U.T Complies with the requirement of § 15.203

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicate a 95 % level of confidence.

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (\pm kHz)
X dB, 99% Bandwidth	95 (Confidence level about 95 %, $k=2$)
Frequency stability	28 (Confidence level about 95 %, $k=2$)
Carrier Frequency Separation Number of Hopping Frequencies Time of Occupancy	49 (Confidence level about 95 %, $k=2$)

Parameter	Expanded Uncertainty (\pm dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.54 (Confidence level about 95 %, $k=2$)
Conducted Output Power(Signal Analyzer)	0.68 (Confidence level about 95 %, $k=2$)
Power Spectral Density	1.03 (Confidence level about 95 %, $k=2$)
Conducted Spurious Emissions	0.70 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.36 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.68 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.75 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.82 (Confidence level about 95 %, $k=2$)

8. DESCRIPTION OF TESTS

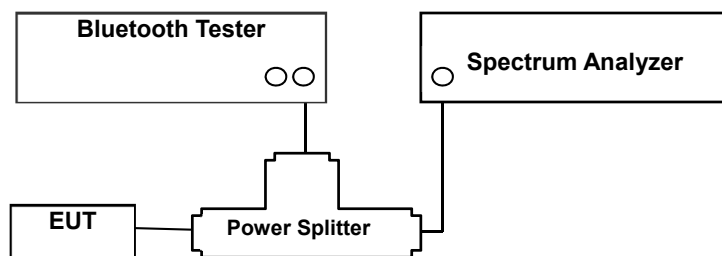
8.1. Conducted Maximum Peak Output Power

Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

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 W.
For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 W.
2. 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.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.5 in ANSI 63.10-2013& Procedure 9(b) in KDB 558074 v05r02)

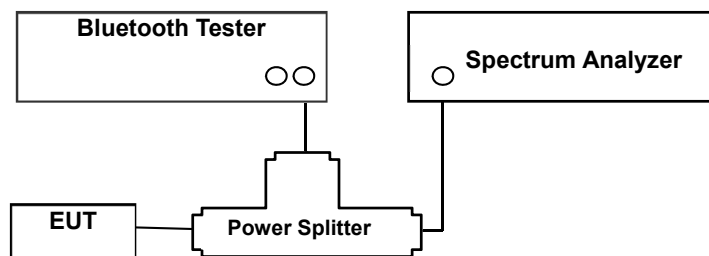
- 1) Span: approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- 2) RBW > the 20 dB bandwidth of the emission being measured
- 3) VBW \geq RBW
- 4) Sweep = Auto
- 5) Detector = Peak
- 6) Trace = Max hold

8.2. Conducted Band Edge(Out of Band Emissions)

Limit

According to § 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.

Test Configuration



Test Procedure

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (6.10.4 in ANSI 63.10-2013& Procedure 8.5 and 8.6 in KDB 558074 v05r02)

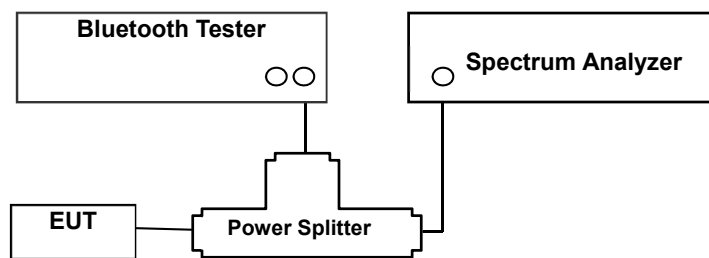
- 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
- 2) Reference level: As required to keep the signal from exceeding the maximum instrument input 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.
- 3) Attenuation: Auto (at least 10 dB preferred).
- 4) Sweep time: Coupled.
- 5) RBW: 100 kHz
- 6) VBW: 300 kHz
- 7) Detector: Peak
- 8) Trace: Max hold

8.3. Frequency Separation & 20 dB Bandwidth

Limit

According to § 15.247(a)(1), 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.

Test Configuration



Test Procedure(Frequency Separation)

The Channel Separation test is performed with hopping on.

And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.2 in ANSI 63.10-2013& Procedure 9(b) in KDB 558074 v05r02)

- 1) Span: Wide enough to capture the peaks of two adjacent channels
- 2) 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.
- 3) VBW \geq RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) All the trace to stabilize.
- 8) 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.

Test Procedure (20 dB Bandwidth)

And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (6.9.2 in ANSI 63.10-2013)

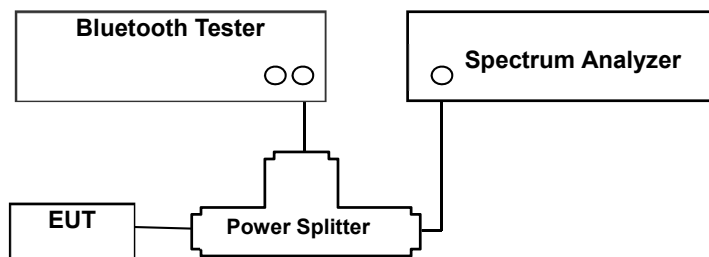
- 1) Span: Set between two times and five times the OBW
- 2) RBW: 1 % to 5 % of the OBW.
- 3) VBW $\geq 3 \times$ RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) All the trace to stabilize.

8.4. Number of Hopping Frequencies

Limit

According to § 15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands shall use at least 15 hopping frequencies.

Test Configuration



Test Procedure

The Bluetooth frequency hopping function of the EUT was enabled.

The Spectrum Analyzer is set to (7.8.3 in ANSI 63.10-2013& Procedure 9(b) in KDB 558074 v05r02)

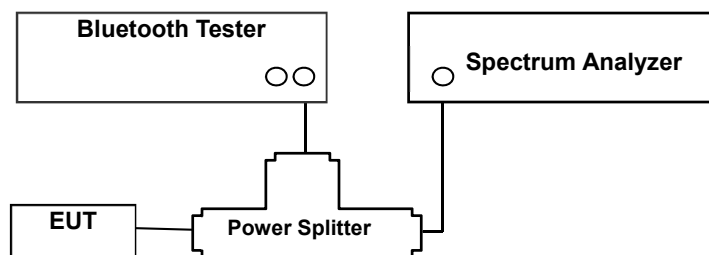
- 1) Span: the frequency band of operation
- 2) RBW: To identify clearly the individual channels, set the RBW to less than 30 % of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- 3) VBW \geq RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) Allow the trace to stabilize.

8.5. Time of Occupancy

Limit

According to § 15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration



Test Procedure

This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.4 in ANSI 63.10-2013& Procedure 9(b) in KDB 558074 v05r02)

- 1) Span: Zero span, centered on a hopping channel
- 2) RBW shall be \leq channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel.
- 3) Sweep = as necessary to capture the entire dwell time per hopping channel
- 4) Detector: Peak
- 5) Trace: Max hold

The marker-delta function was used to determine the dwell time.

Sample Calculation

The following calculation process is not relevant to our measurement results. It is just an example.

(1) Non-AFH Mode

- DH 5 (GFSK) : $2.890 \times (1600/6)/79 \times 31.6 = 308.27 \text{ (ms)}$
- 2-DH 5 ($\pi/4$ DQPSK) : $2.890 \times (1600/6)/79 \times 31.6 = 308.27 \text{ (ms)}$
- 3-DH 5 (8DPSK) : $2.890 \times (1600/6)/79 \times 31.6 = 308.27 \text{ (ms)}$

(2) AFH Mode

- DH 5 (GFSK) : $2.890 \times (800/6)/20 \times 8.0 = 154.13 \text{ (ms)}$
- 2-DH 5 ($\pi/4$ DQPSK) : $2.890 \times (800/6)/20 \times 8.0 = 154.13 \text{ (ms)}$
- 3-DH 5 (8DPSK) : $2.890 \times (800/6)/20 \times 8.0 = 154.13 \text{ (ms)}$

Note :

DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving.

Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.667 times of appearance.

Each tx-time per appearance of DH5 is 2.890 ms.

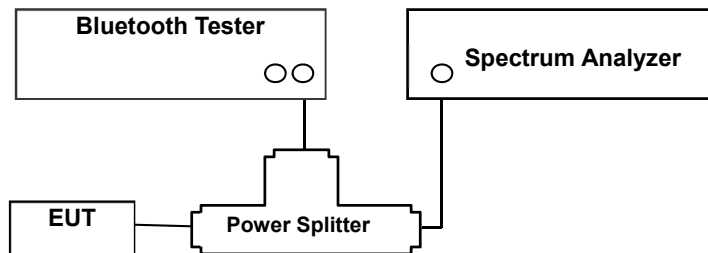
Dwell time = Tx-time x 106.667 = 308.27 (ms)

8.6. Conducted Spurious Emissions

Limit

Conducted > 20 dBc

Test Configuration



Test Procedure

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer.

The Spectrum Analyzer is set to (7.8.8 in ANSI 63.10-2013& Procedure 8.5 and 8.6 in KDB 558074 v05r02)

- 1) Span: 30 MHz to 10 times the operating frequency in GHz.
- 2) RBW: 100 kHz
- 3) VBW: 300 kHz
- 4) Sweep: Coupled
- 5) Detector: Peak

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

This test is performed with hopping off.

Factors for frequency

Freq(MHz)	Factor(dB)
30	16.20
100	16.27
200	16.30
300	16.28
400	16.39
500	16.47
600	16.50
700	16.64
800	16.76
900	16.86
1000	16.88
2000	16.88
2400	16.92
2500	16.92
3000	17.14
4000	17.58
5000	18.66
6000	18.66
7000	18.74
8000	18.75
9000	18.79
10000	18.86
11000	18.85
12000	18.88
13000	18.90
14000	19.03
15000	18.98
16000	19.04
17000	19.08
18000	19.12
19000	19.18
20000	19.22
21000	19.24
22000	19.28
23000	19.35
24000	19.39
25000	19.40
26000	19.44

Note : 1. 2400 ~ 2500 MHz is fundamental frequency range.

2. Factor = Attenuator + Cable loss(2 EA) + Splitter loss(6 dB)

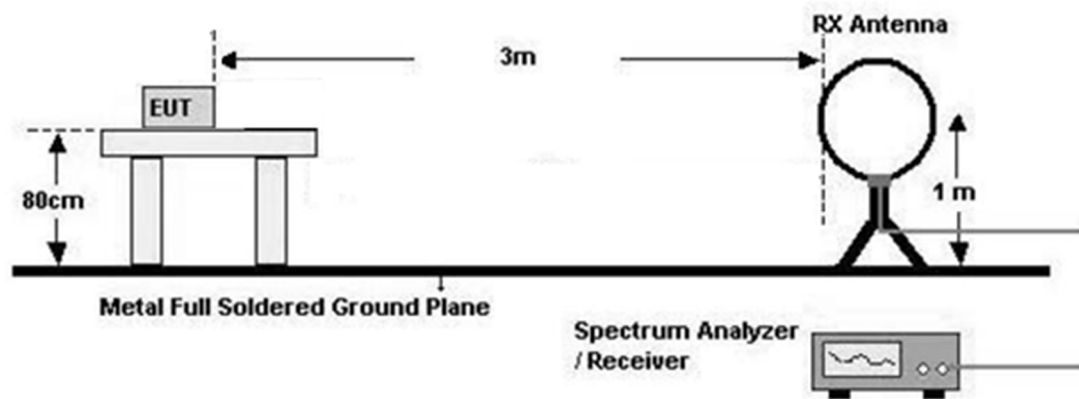
8.7. Radiated Test

Limit

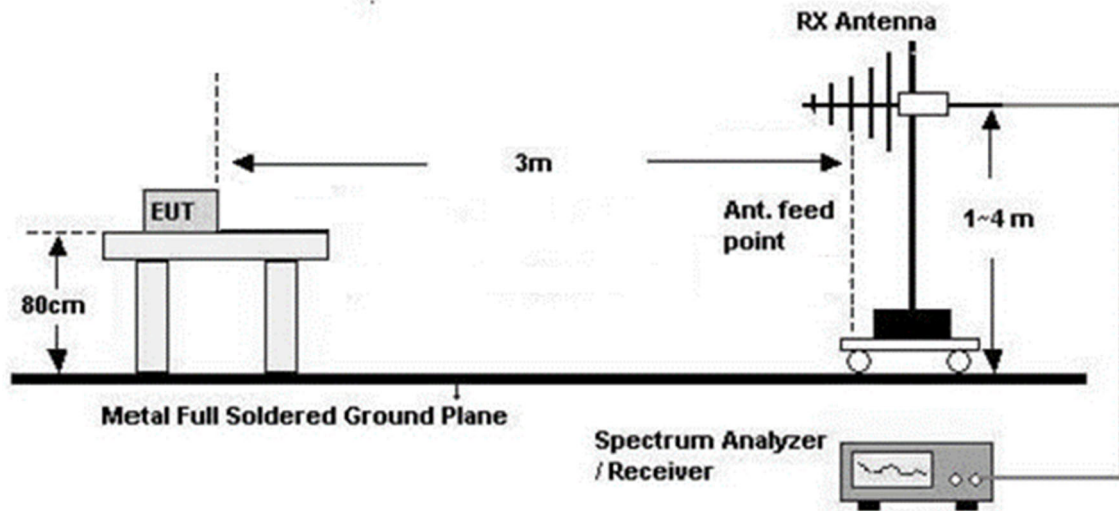
Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (m)
0.009 – 0.490	$2400/F(\text{kHz})$	300
0.490 – 1.705	$24000/F(\text{kHz})$	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

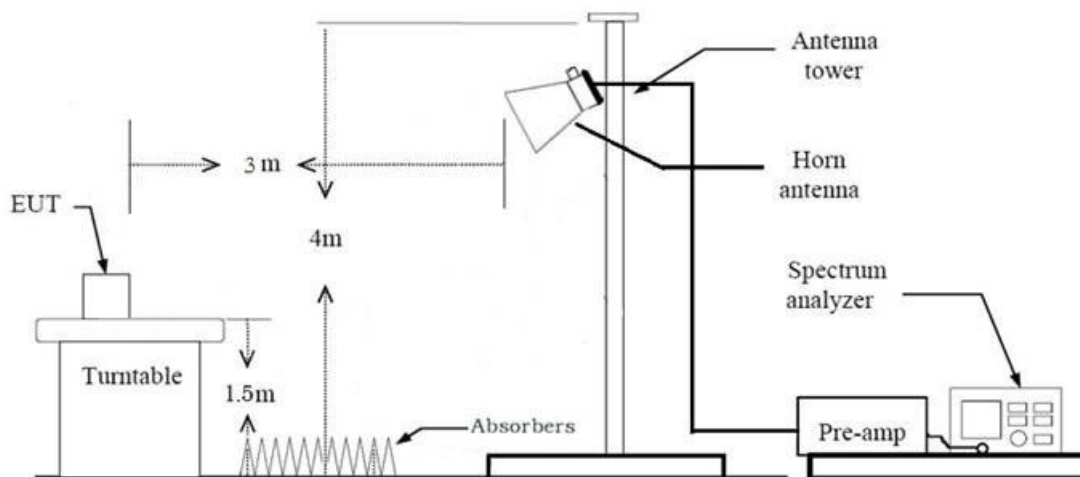
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions(Below30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = $40\log(3\text{ m}/300\text{ m}) = -80\text{ dB}$
Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = $40\log(3\text{ m}/30\text{ m}) = -40\text{ dB}$

Measurement Distance : 3 m

8. Spectrum Setting

- Frequency Range = 9 kHz ~ 30 MHz
- Detector = Peak
- Trace = Max hold
- RBW = 9 kHz
- VBW $\geq 3 \times$ RBW

9.Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Test Procedure of Radiated spurious emissions(Below 1 GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. The Hybrid antenna was placed at a location 3m from the EUT, which is varied from 1m to 4m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Spectrum Setting

(1) Measurement Type(Peak):

- Measured Frequency Range : 30 MHz – 1 GHz
- Detector = Peak
- Trace = Max hold
- RBW = 100 kHz
- VBW $\geq 3 \times$ RBW

(2) Measurement Type(Quasi-peak):

- Measured Frequency Range : 30 MHz – 1 GHz
- Detector = Quasi-Peak
- RBW = 120 kHz

※In general, (1) is used mainly

7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)

8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions

from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. Radiated test is performed with hopping off.
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. Spectrum Setting
 - (1) Measurement Type(Peak):
 - Measured Frequency Range : 1 GHz – 25 GHz
 - Detector = Peak
 - Trace = Max hold
 - RBW = 1 MHz
 - VBW $\geq 3 \times$ RBW
 - (2) Measurement Type(Average):
 - Average value of pulsed emissions
 - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determine from the peak field strength after correcting for the worst-case duty cycle as described in Number.14
- ◆ Duty Cycle Correction(AFH) = $20\log (\text{Worst Case Dwell Time}/ 100\text{ms}) \text{ dB} = -24.7314 \text{ dB}$
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = $20\log (\text{test distance} / \text{specific distance}) \text{ (dB)}$
11. Total(Measurement Type : Peak)
= Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F) – Amp Gain(A.G)
Total(Measurement Type : Average)
= Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F) - Amp Gain(A.G) + D.C.C.F(AFH)
12. Duty Cycle Correction Factor (79 channel hopping)

- a. Time to cycle through all channels = $\Delta t = \tau \text{ [ms]} \times 79 \text{ channels} = 229.100 \text{ ms}$, where τ = pulse width
 - b. $100 \text{ ms} / \Delta t \text{ [ms]} = H \rightarrow$ Round up to next highest integer, $H' = 1$
 - c. Worst Case Dwell Time = $\tau \text{ [ms]} \times H' = 2.9 \text{ ms}$
 - d. Duty Cycle Correction = $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = -30.752 \text{ dB}$
13. Duty Cycle Correction Factor (AFH mode – minimum channel number case - 20 channels)
- a. Time to cycle through all channels = $\Delta t = \tau \text{ [ms]} \times 20 \text{ channels} = 58.00 \text{ ms}$, where τ = pulse width
 - b. $100 \text{ ms} / \Delta t \text{ [ms]} = H \rightarrow$ Round up to next highest integer, $H' = 2$
 - c. Worst Case Dwell Time = $\tau \text{ [ms]} \times H' = 5.800 \text{ ms}$
 - d. Duty Cycle Correction (AFH) = $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = -24.7314 \text{ dB}$

Test Procedure of Radiated Restricted Band Edge

1. Radiated test is performed with hopping off.
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Spectrum Setting
 - (1) Measurement Type (Peak):
 - Detector = Peak
 - Trace = Max hold
 - RBW = 1 MHz
 - VBW $\geq 3 \times$ RBW
 - (2) Measurement Type (Average):
 - Average value of pulsed emissions
 - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determine from the peak field strength after correcting for the worst-case duty cycle as described in Number.13
 - ◆ Duty Cycle Correction (AFH) = $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = -24.7314 \text{ dB}$
8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
9. Distance extrapolation factor = $20 \log (\text{test distance} / \text{specific distance}) \text{ (dB)}$

10. Total

(1) Measurement(Peak)

= Measured Value(Peak)

(2) Measurement(Avg)

= Measured Value(Peak) + D.C.C.F(AFH)

- We apply to the offset in range 1 GHz - 18 GHz

- The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

11. Duty Cycle Correction Factor (79 channel hopping)

a. Time to cycle through all channels = $\Delta t = \tau$ [ms] x 79 channels = 229.100 ms, where τ = pulse widthb. $100 \text{ ms} / \Delta t$ [ms] = H \rightarrow Round up to next highest integer, H' = 1c. Worst Case Dwell Time = τ [ms] x H' = 2.9 msd. Duty Cycle Correction = $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms})$ dB = -30.752 dB

12. Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)

a. Time to cycle through all channels = $\Delta t = \tau$ [ms] x 20 channels = 58.00 ms, where τ = pulse widthb. $100 \text{ ms} / \Delta t$ [ms] = H \rightarrow Round up to next highest integer, H' = 2c. Worst Case Dwell Time = τ [ms] x H' = 5.800 msd. Duty Cycle Correction(AFH) = $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms})$ dB = -24.7314 dB

8.8. AC Power line Conducted Emissions

Limit

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 μ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56 ^(a)	56 to 46 ^(a)
0.50 to 5	56	46
5 to 30	60	50

^(a)Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.
5. The EUT is the device operating below 30MHz.
 - For unterminated the Antenna, the AC line conducted tests are performed with the antenna connected
 - For terminated the Antenna, the AC line conducted tests are performed with a dummy load connected to the EUT antenna output terminal.

Sample Calculation

Quasi-peak(Final Result) = Measured Value + Correction Factor

8.9. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
 - Mode : Stand alone + Shark Antenna, Stand alone + Shark Antenna + External accessories
 - Worstcase : Stand alone + Shark Antenna + External accessories
2. EUT Axis
 - Radiated Spurious Emissions : Z
 - Radiated Restricted Band Edge : Z
3. All data rate of operation were investigated and the test results are worst case in highest data rate of each mode.
 - GFSK : DH5
 - $\pi/4$ DQPSK : 2-DH5
 - 8DPSK : 3-DH5
4. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.
 - Position : Horizontal, Vertical, Parallel to the ground plane
5. DA651ZZZGG, Additional Models were tested and the worst case results are reported.
(Worst case : DA651ZZZGG)

AC Power line Conducted Emissions

1. We don't perform powerline conducted emission test. The device only employ battery power for operation.

Conducted test

1. The EUT was configured with data rate of highest power.
 - GFSK : DH5
 - $\pi/4$ DQPSK : 2-DH5
 - 8DPSK : 3-DH5
2. AFH & Non-AFH were tested and the worst case results are reported.
(Worst case : Non-AFH)
3. DA651ZZZGG, Additional Models were tested and the worst case results are reported.
(Worst case : DA651ZZZGG)

Radiated test(Simultaneous transmission Scenario)

1. All modes of operation were investigated and the worst case configuration results are reported.

- Mode : Stand alone + Shark Antenna, Stand alone + Shark Antenna + External accessories

- Worstcase : Stand alone + Shark Antenna + External accessories

2. EUT Axis

- Radiated Spurious Emissions : Z

3. All of Simultaneous transmission Scenario were investigated and the worst case configuration results are reported.

Simultaneous transmission Scenario	2.4 GHz WiFi	5 GHz WiFi	BT	Test Case
Bluetooth + 2.4 GHz WiFi	on	-	on(BT)	Scenario1
Bluetooth + 5 GHz WiFi	-	on	on(BT)	Scenario2
Bluetooth + 2.4 GHz WiFi	on	-	on(BTLE)	Scenario3
Bluetooth + 5 GHz WiFi	-	on	on(BTLE)	Scenario4

4. The Simultaneous transmission mode test investigated both intermodulation and radiated spurious emissions. And the worst results were reported.

- Worst result: Radiated spurious emissions

- Intermodulation: No signals are generated.

- Radiated spurious emissions: cf. Section 10.6.2

Scenario	Description	Bluetooth Emission	2.4 GHz Emission
1	Antenna	BT/BTLE ANT	WLAN ANT
	Channel	78	6
	Data Rate	1 Mbps	1 Mbps
	Mode	GFSK	802.11b

Note : DTS Simultaneous transmission Scenario Data refer to [DTS] Test Report

Scenario	Description	Bluetooth Emission	5 GHz Emission
2	Antenna	BT/BTLE ANT	WLAN ANT
	Channel	78	161
	Data Rate	1 Mbps	6 Mbps
	Mode	GFSK	802.11a

Note : UNII Simultaneous transmission Scenario Data refer to [UNII] Test Report

9. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§ 15.247(a)(1)	N/A	Conducted	PASS
Occupied Bandwidth	N/A	N/A		N/A
Conducted Maximum Peak Output Power	§ 15.247(b)(1)	<0.125 W		PASS
Carrier Frequency Separation	§ 15.247(a)(1)	>25 kHz or >2/3 of the 20 dB BW		PASS
Number of Hopping Frequencies	§ 15.247(a)(1)(iii)	≥ 15		PASS
Time of Occupancy	§ 15.247(a)(1)(iii)	<400 ms		PASS
Conducted Spurious Emissions	§ 15.247(d)	> 20 dB for all out-of band emissions		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	> 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	§ 15.207(a)	cf. Section 8.8		N/A (Note1)
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	cf. Section 8.7	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	cf. Section 8.7		PASS

Note

1. The device only employ battery power for operation.
2. The decision rule applies 'simple acceptance'

10. TEST RESULT

10.1 PEAK POWER

Channel	Frequency (MHz)	Output Power (GFSK)		Limit (mW)
		(dBm)	(mW)	
Ch. 0	2402	0.490	1.12	125
Ch. 39	2441	0.541	1.13	
Ch. 78	2480	0.646	1.16	

Channel	Frequency (MHz)	Output Power (8DPSK)		Limit (mW)
		(dBm)	(mW)	
Ch. 0	2402	2.559	1.80	125
Ch. 39	2441	2.581	1.81	
Ch. 78	2480	2.949	1.97	

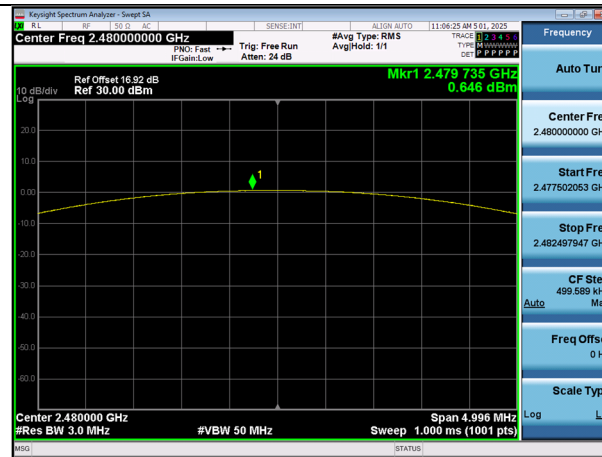
Channel	Frequency (MHz)	Output Power (π /4DQPSK)		Limit (mW)
		(dBm)	(mW)	
Ch. 0	2402	1.955	1.57	125
Ch. 39	2441	2.024	1.59	
Ch. 78	2480	2.487	1.77	

TEST PLOTS(Peak Power)

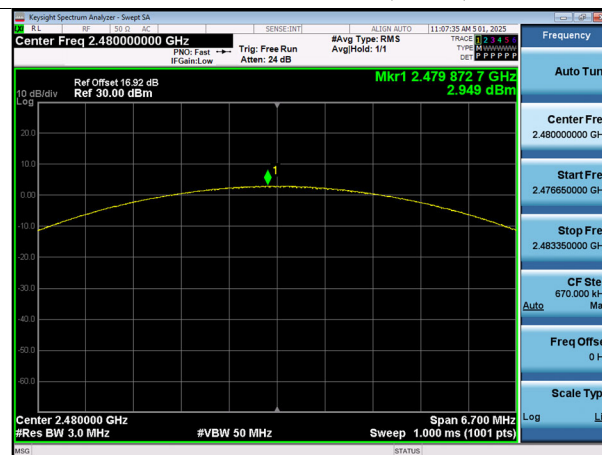
Note :

In order to simplify the report, attached plots were only the worst case channel.

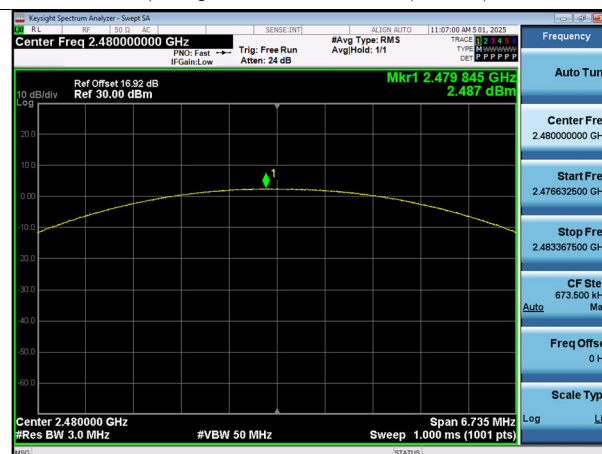
GFSK : Peak Power (Ch. 78)



8DPSK : Peak Power (Ch. 78)



$\pi/4$ DQPSK : Peak Power (Ch. 78)



10.2 BAND EDGES

Without hopping

Outside Frequency Band	GFSK (dB)	8DPSK (dB)	π /4DQPSK (dB)	Limit (dBc)
Lower	47.778	46.706	47.588	20
Upper	47.187	48.404	48.501	

With hopping

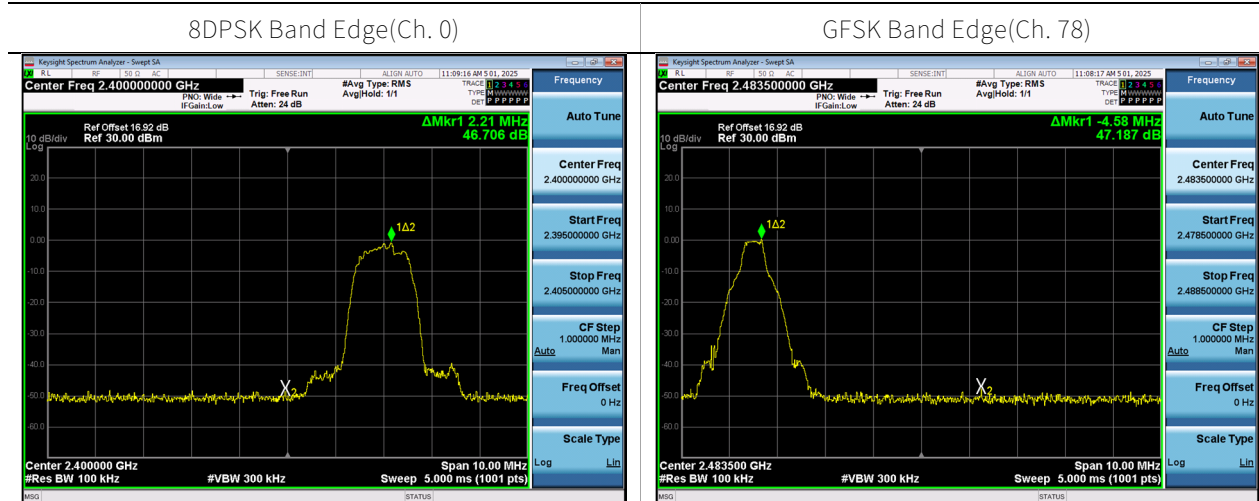
Outside Frequency Band	GFSK (dB)	8DPSK (dB)	π /4DQPSK (dB)	Limit (dBc)
Lower	48.104	46.373	46.152	20
Upper	48.177	47.144	47.466	

TEST PLOTS(BAND EDGES)

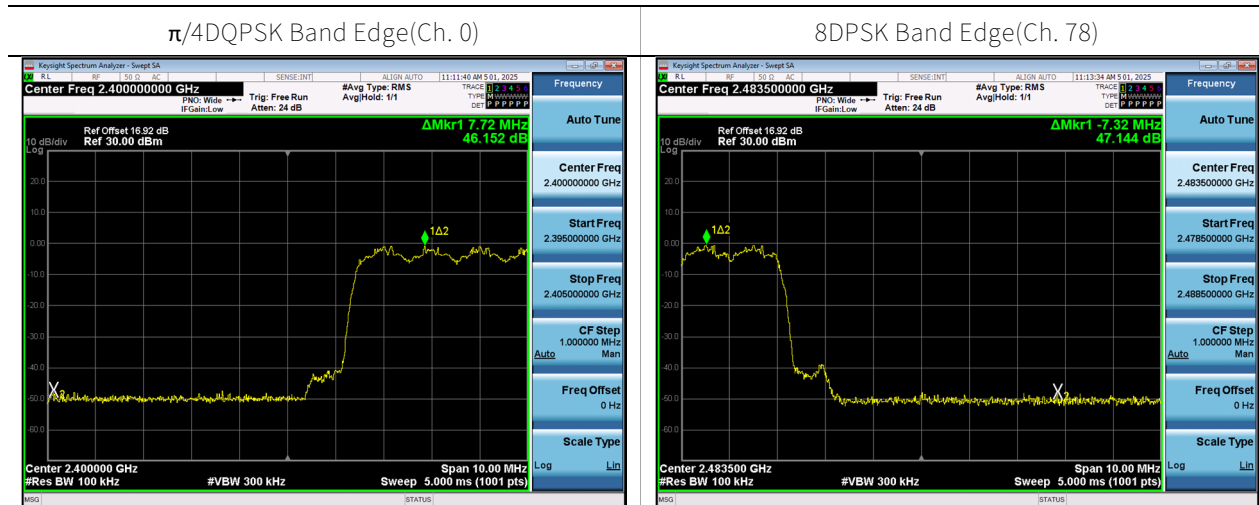
Note :

In order to simplify the report, attached plots were only the worst case mode.

Without hopping



-With hopping



10.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99 % BW)

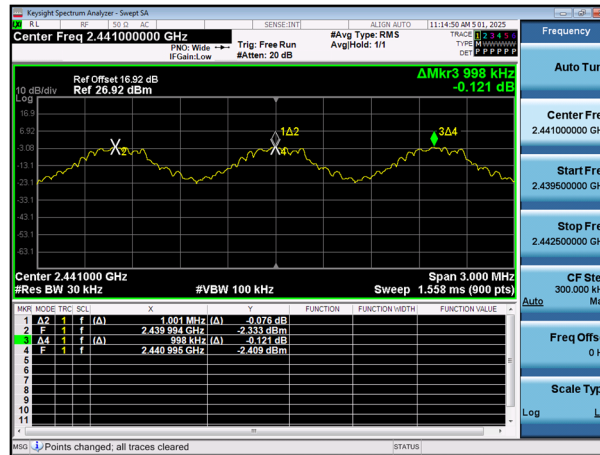
99% BW (kHz)			
Channel	GFSK	8DPSK	$\pi/4$ DQPSK
Ch. 0	902.84	1209.9	1199.1
Ch. 39	903.43	1209.7	1199.5
Ch. 78	902.14	1212.6	1200.9

20dB Bandwidth (kHz)			
Channel	GFSK	8DPSK	$\pi/4$ DQPSK
Ch. 0	998.89	1337	1348
Ch. 39	1007	1337	1345
Ch. 78	999.18	1340	1347

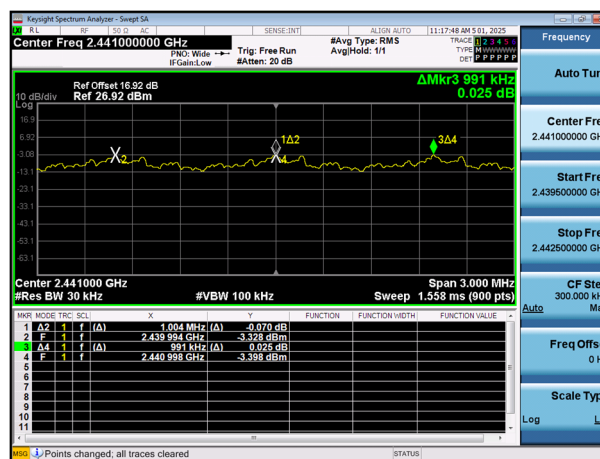
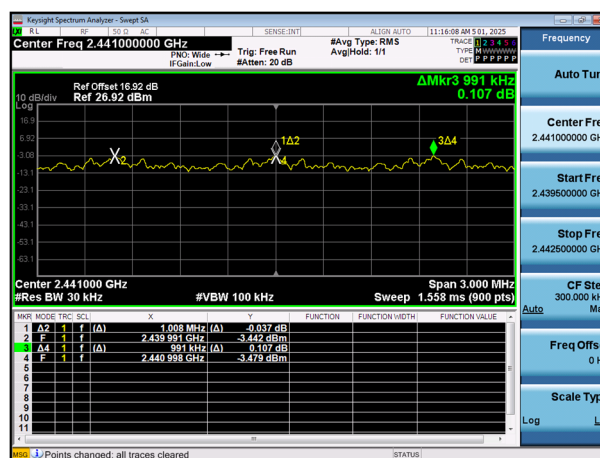
Channel Separation (kHz)			Limit (kHz)
GFSK	8DPSK	$\pi/4$ DQPSK	
998	991	991	>25 kHz or >2/3 of the 20 dB BW

TEST PLOTS(Channel Separation)

Test Plot (GFSK)



Test Plot (8DPSK)

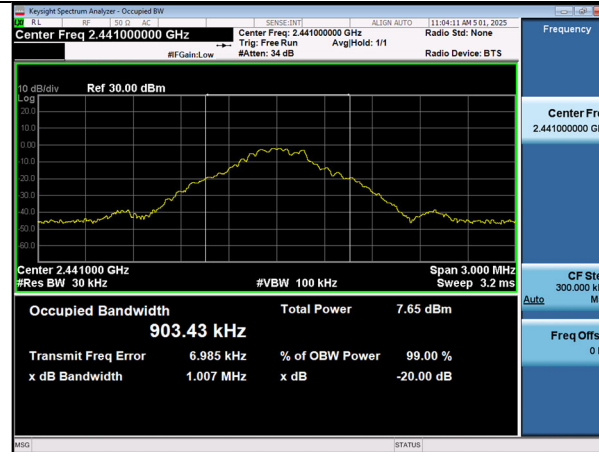

Test Plot ($\pi/4$ DQPSK)


TEST PLOTS(20 dB Bandwidth & 99% OBW)

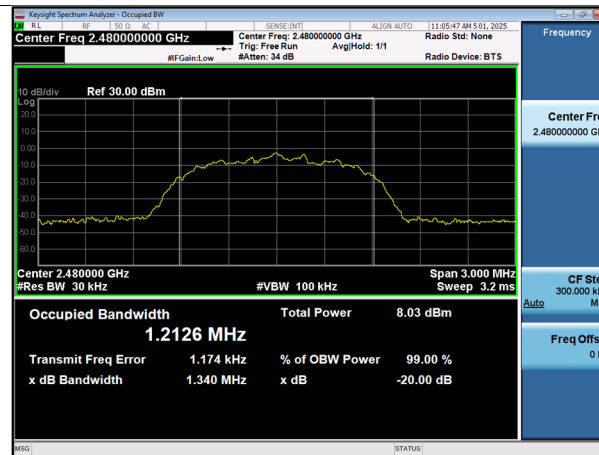
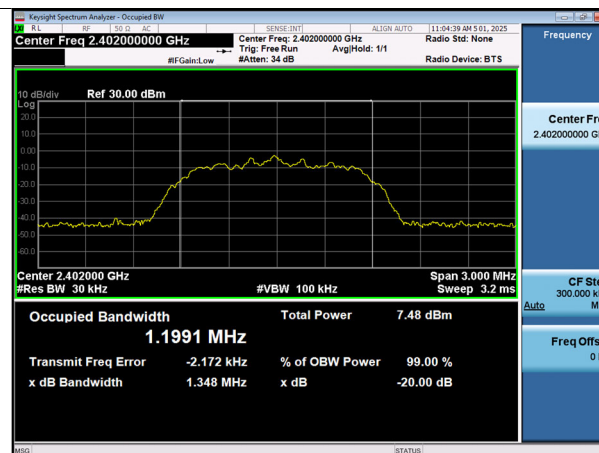
Note:

In order to simplify the report, attached plots were only the widest 20 dB BW channel.

GFSK 20 dB BW & 99% OBW (Ch. 39)



8DPSK 20 dB BW & 99% OBW (Ch. 78)


 $\pi/4$ DQPSK 20 dB BW & 99% OBW (Ch. 0)


10.4 NUMBER OF HOPPING FREQUENCY

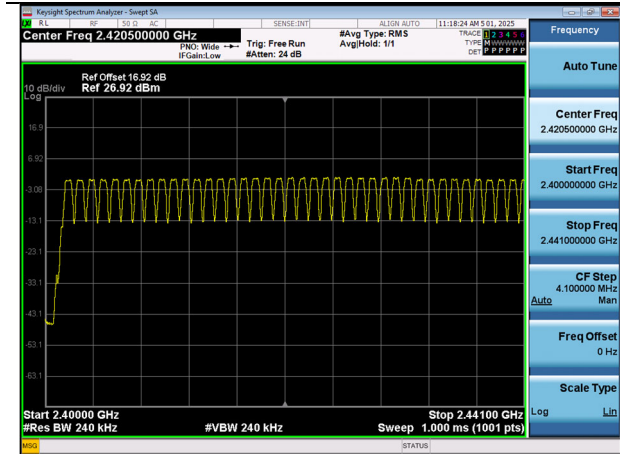
Result (No. of CH)			Limit
GFSK	8DPSK	$\pi/4$ DQPSK	
79	79	79	>15

Note :

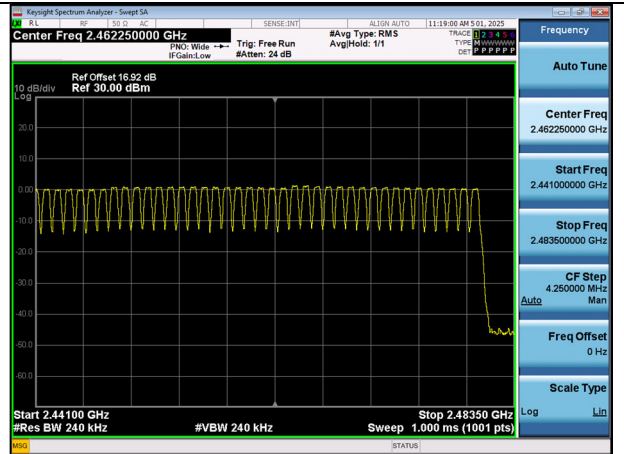
In case of AFH mode, minimum number of hopping channels is 20.

TEST PLOTS(NUMBER OF HOPPING FREQUENCY)

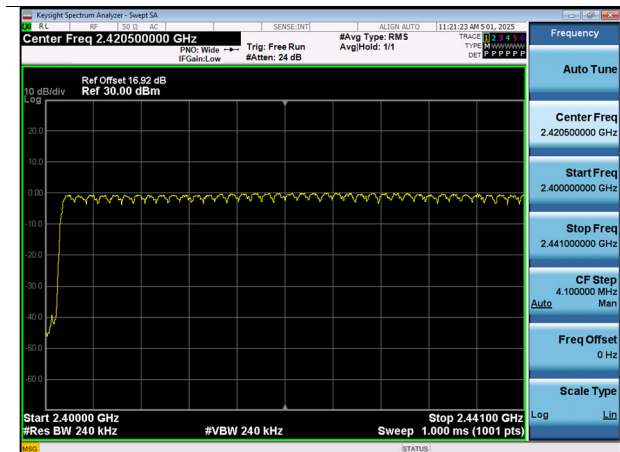
GFSK (2.4 GHz - 2.441 GHz)



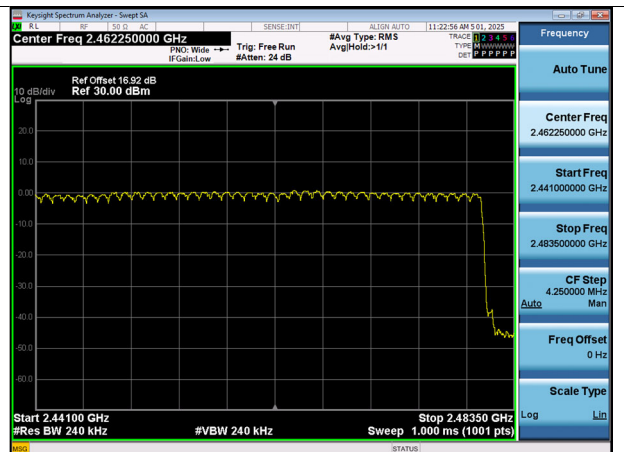
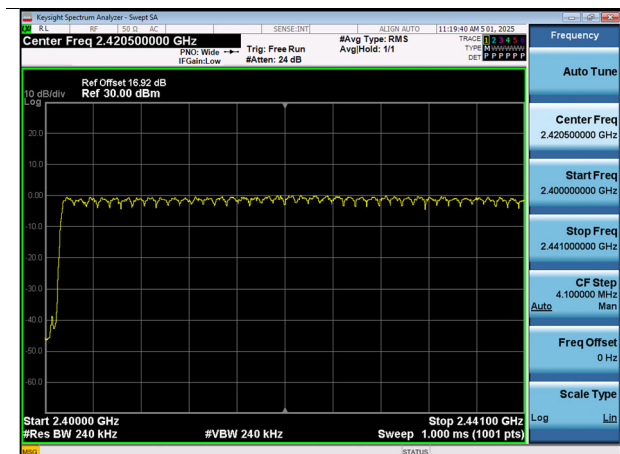
GFSK (2.441 GHz - 2.483.5 GHz)



8DPSK (2.4 GHz - 2.441 GHz)



8DPSK (2.441 GHz - 2.483.5 GHz)


 $\pi/4$ DQPSK (2.4 GHz - 2.441 GHz)

 $\pi/4$ DQPSK (2.441 GHz - 2.483.5 GHz)


10.5 TIME OF OCCUPANCY (DWELL TIME)

	Channel	GFSK	8DPSK	$\pi/4$ DQPSK
Pulse Time (ms)	Ch. 0	2.885	2.890	2.890
	Ch. 39	2.890	2.890	2.890
	Ch. 78	2.890	2.895	2.890

Non-AFH Mode

	Channel	GFSK	8DPSK	$\pi/4$ DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Ch. 0	307.73	308.27	308.27	31.6	400
	Ch. 39	308.27	308.27	308.27	31.6	
	Ch. 78	308.27	308.80	308.27	31.6	

AFH Mode

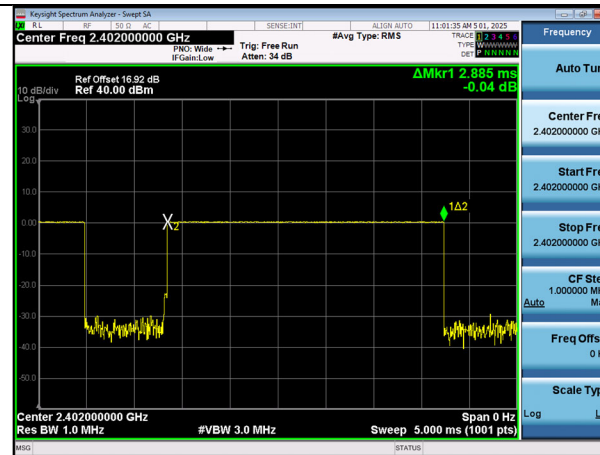
	Channel	GFSK	8DPSK	$\pi/4$ DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Ch. 0	153.87	154.13	154.13	8	400
	Ch. 39	154.13	154.13	154.13	8	
	Ch. 78	154.13	154.40	154.13	8	

TEST PLOTS(Dwell Time)

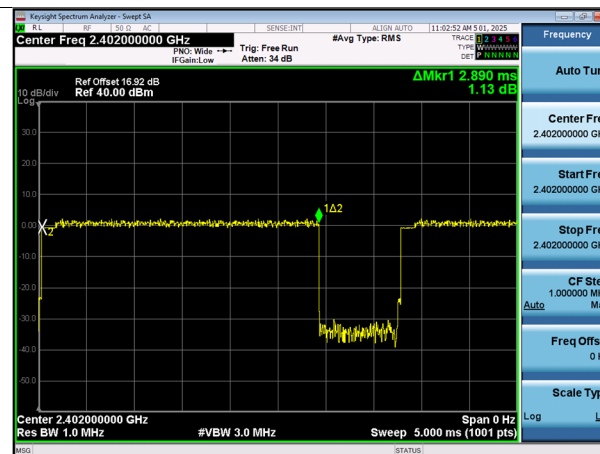
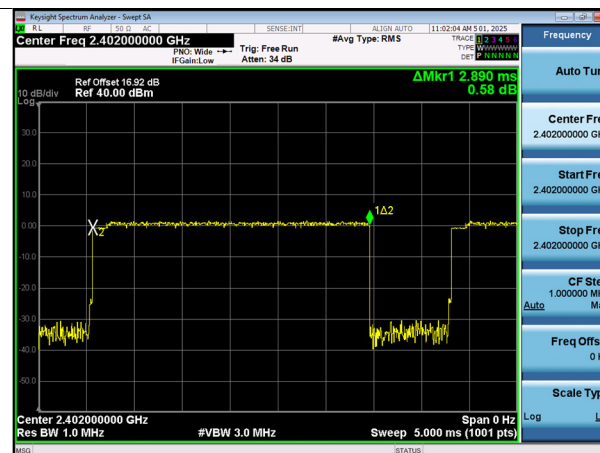
Note:

In order to simplify the report, attached plots were only the lowest channel.

GFSK : Dwell Time(Ch. 0)



8DPSK : Dwell Time(Ch. 0)

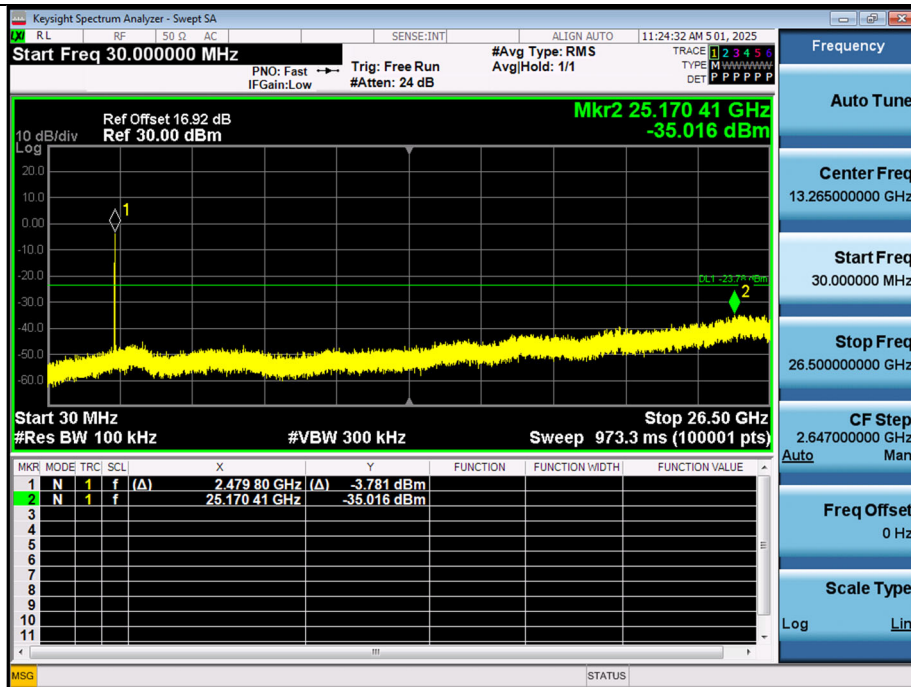

 $\pi/4$ DQPSK : Dwell Time(Ch. 0)


10.6 SPURIOUS EMISSIONS

10.6.1 CONDUCTED SPURIOUS EMISSIONS

▣ TEST PLOTS (Worst case : 8DPSK_CH.78)

Spurious Emission (30 MHz – 26.5 GHz)



Note:

1. In order to simplify the report, attached plots were only the worst case channel and data rate.
2. Limit: -23.781 dBm

10.6.2 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Value	A.F+C.L+D.F	POL	Total	Limit	Margin
[MHz]	[dB μ V]	[dB/m]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]

No Critical peaks found

Note:

1. The Measured of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = $40\log$ (specific distance / test distance) (dB)
3. Limit line = Specific Limits (dB μ V) + Distance extrapolation factor
4. Radiated test is performed with hopping off.

Frequency Range : Below 1 GHz

Frequency	Measured Value	A.F+C.L	POL	Total	Limit	Margin
[MHz]	[dB μ V]	[dB/m]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]

No Critical peaks found

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
2. Radiated test is performed with hopping off.

Frequency Range : Above 1 GHz

CH 0	2402	MHz	Mode :			Normal(GFSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4804	44.51	3.16	V	0.00	47.67	73.98	26.31	PK
4804	44.51	3.16	V	-24.73	22.94	53.98	31.04	AV
7206	41.99	9.93	V	0.00	51.92	73.98	22.06	PK
7206	41.99	9.93	V	-24.73	27.19	53.98	26.79	AV
4804	44.66	3.16	H	0.00	47.82	73.98	26.16	PK
4804	44.66	3.16	H	-24.73	23.09	53.98	30.89	AV
7206	42.14	9.93	H	0.00	52.07	73.98	21.91	PK
7206	42.14	9.93	H	-24.73	27.34	53.98	26.64	AV
CH 39	2441	MHz	Mode :			Normal(GFSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4882	43.10	4.11	V	0.00	47.21	73.98	26.77	PK
4882	43.10	4.11	V	-24.73	22.48	53.98	31.50	AV
7323	41.86	10.60	V	0.00	52.46	73.98	21.52	PK
7323	41.86	10.60	V	-24.73	27.73	53.98	26.25	AV
4882	43.15	4.11	H	0.00	47.26	73.98	26.72	PK
4882	43.15	4.11	H	-24.73	22.53	53.98	31.45	AV
7323	42.05	10.60	H	0.00	52.65	73.98	21.33	PK
7323	42.05	10.60	H	-24.73	27.92	53.98	26.06	AV
CH 78	2480	MHz	Mode :			Normal(GFSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4960	43.28	2.88	V	0.00	46.16	73.98	27.82	PK
4960	43.28	2.88	V	-24.73	21.43	53.98	32.55	AV
7440	42.11	11.34	V	0.00	53.45	73.98	20.53	PK
7440	42.11	11.34	V	-24.73	28.71	53.98	25.27	AV
4960	43.54	2.88	H	0.00	46.42	73.98	27.56	PK
4960	43.54	2.88	H	-24.73	21.69	53.98	32.29	AV
7440	42.40	11.34	H	0.00	53.74	73.98	20.24	PK
7440	42.40	11.34	H	-24.73	29.00	53.98	24.98	AV

CH 0	2402	MHz	Mode :			EDR ($\pi/4$ DQPSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[dB/m]	[H/V]	[dB]	[dB μ V/m]	[dB μ V/m]	[dB]	
4804	44.16	3.16	V	0.00	47.32	73.98	26.66	PK
4804	44.16	3.16	V	-24.73	22.59	53.98	31.39	AV
7206	41.59	9.93	V	0.00	51.52	73.98	22.46	PK
7206	41.59	9.93	V	-24.73	26.79	53.98	27.19	AV
4804	44.21	3.16	H	0.00	47.37	73.98	26.61	PK
4804	44.21	3.16	H	-24.73	22.64	53.98	31.34	AV
7206	41.72	9.93	H	0.00	51.65	73.98	22.33	PK
7206	41.72	9.93	H	-24.73	26.92	53.98	27.06	AV

CH 39	2441	MHz	Mode :			EDR ($\pi/4$ DQPSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[dB/m]	[H/V]	[dB]	[dB μ V/m]	[dB μ V/m]	[dB]	
4882	41.87	4.11	V	0.00	45.98	73.98	28.00	PK
4882	41.87	4.11	V	-24.73	21.25	53.98	32.73	AV
7323	41.39	10.60	V	0.00	51.99	73.98	21.99	PK
7323	41.39	10.60	V	-24.73	27.26	53.98	26.72	AV
4882	42.08	4.11	H	0.00	46.19	73.98	27.79	PK
4882	42.08	4.11	H	-24.73	21.46	53.98	32.52	AV
7323	41.58	10.60	H	0.00	52.18	73.98	21.80	PK
7323	41.58	10.60	H	-24.73	27.45	53.98	26.53	AV

CH 78	2480	MHz	Mode :			EDR ($\pi/4$ DQPSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[dB/m]	[H/V]	[dB]	[dB μ V/m]	[dB μ V/m]	[dB]	
4960	42.63	2.88	V	0.00	45.51	73.98	28.47	PK
4960	42.63	2.88	V	-24.73	20.78	53.98	33.20	AV
7440	41.59	11.34	V	0.00	52.93	73.98	21.05	PK
7440	41.59	11.34	V	-24.73	28.19	53.98	25.79	AV
4960	42.88	2.88	H	0.00	45.76	73.98	28.22	PK
4960	42.88	2.88	H	-24.73	21.03	53.98	32.95	AV
7440	41.81	11.34	H	0.00	53.15	73.98	20.83	PK
7440	41.81	11.34	H	-24.73	28.41	53.98	25.57	AV

CH 0	2402	MHz	Mode :			EDR (8DPSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4804	44.00	3.16	V	0.00	47.16	73.98	26.82	PK
4804	44.00	3.16	V	-24.73	22.43	53.98	31.55	AV
7206	41.26	9.93	V	0.00	51.19	73.98	22.79	PK
7206	41.26	9.93	V	-24.73	26.46	53.98	27.52	AV
4804	44.08	3.16	H	0.00	47.24	73.98	26.74	PK
4804	44.08	3.16	H	-24.73	22.51	53.98	31.47	AV
7206	41.41	9.93	H	0.00	51.34	73.98	22.64	PK
7206	41.41	9.93	H	-24.73	26.61	53.98	27.37	AV

CH 39	2441	MHz	Mode :			EDR (8DPSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4882	42.81	4.11	V	0.00	46.92	73.98	27.06	PK
4882	42.81	4.11	V	-24.73	22.19	53.98	31.79	AV
7323	41.73	10.60	V	0.00	52.33	73.98	21.65	PK
7323	41.73	10.60	V	-24.73	27.60	53.98	26.38	AV
4882	42.94	4.11	H	0.00	47.05	73.98	26.93	PK
4882	42.94	4.11	H	-24.73	22.32	53.98	31.66	AV
7323	41.81	10.60	H	0.00	52.41	73.98	21.57	PK
7323	41.81	10.60	H	-24.73	27.68	53.98	26.30	AV

CH 78	2480	MHz	Mode :			EDR (8DPSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4960	42.96	2.88	V	0.00	45.84	73.98	28.14	PK
4960	42.96	2.88	V	-24.73	21.11	53.98	32.87	AV
7440	41.67	11.34	V	0.00	53.01	73.98	20.97	PK
7440	41.67	11.34	V	-24.73	28.27	53.98	25.71	AV
4960	43.18	2.88	H	0.00	46.06	73.98	27.92	PK
4960	43.18	2.88	H	-24.73	21.33	53.98	32.65	AV
7440	42.03	11.34	H	0.00	53.37	73.98	20.61	PK
7440	42.03	11.34	H	-24.73	28.63	53.98	25.35	AV

[Simultaneous transmission Scenario]

Scenario 1

Bluetooth DH5_Ch.78 + WLAN 2.4 GHz 802.11b_Ch. 6

CH 78	2480	MHz	Mode :			Normal(GFSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4960	42.99	2.88	V	0.00	45.87	73.98	28.11	PK
4960	42.99	2.88	V	-24.73	21.14	53.98	32.84	AV
7440	42.60	11.34	V	0.00	53.94	73.98	20.04	PK
7440	42.60	11.34	V	-24.73	29.20	53.98	24.78	AV
4960	43.14	2.88	H	0.00	46.02	73.98	27.96	PK
4960	43.14	2.88	H	-24.73	21.29	53.98	32.69	AV
7440	42.63	11.34	H	0.00	53.97	73.98	20.01	PK
7440	42.63	11.34	H	-24.73	29.23	53.98	24.75	AV

Scenario 2

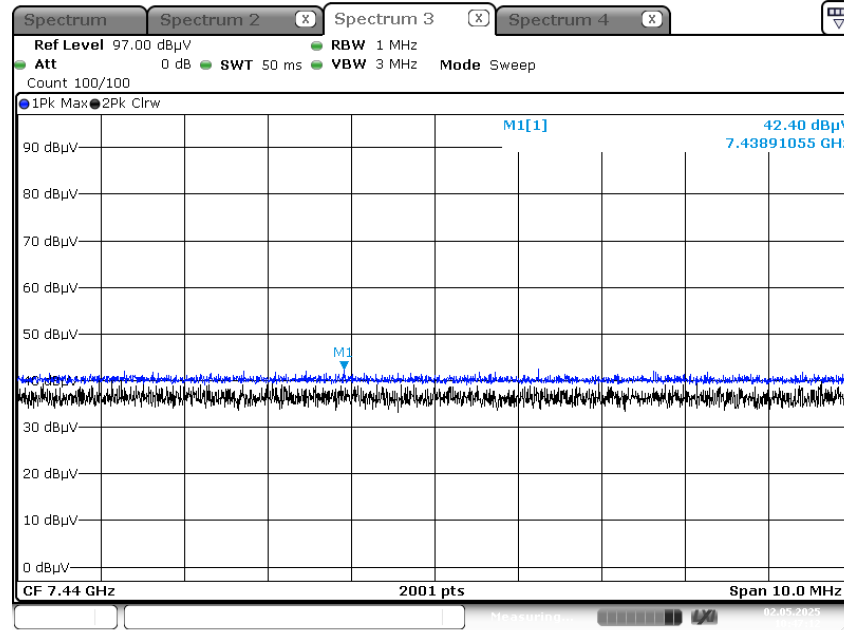
Bluetooth DH5_Ch.78 + WLAN 5 GHz 802.11a_Ch. 161

CH 78	2480	MHz	Mode :			Normal(GFSK)		
Frequency	Measured value	A.F+C.L-A.G+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
4960	42.45	2.88	V	0.00	45.33	73.98	28.65	PK
4960	42.45	2.88	V	-24.73	20.60	53.98	33.38	AV
7440	41.92	11.34	V	0.00	53.26	73.98	20.72	PK
7440	41.92	11.34	V	-24.73	28.52	53.98	25.46	AV
4960	43.26	2.88	H	0.00	46.14	73.98	27.84	PK
4960	43.26	2.88	H	-24.73	21.41	53.98	32.57	AV
7440	42.12	11.34	H	0.00	53.46	73.98	20.52	PK
7440	42.12	11.34	H	-24.73	28.72	53.98	25.26	AV

Test Plots

Note: Plot of worst case was only reported.

Radiated Spurious Emissions plot – Average & Peak Result (GFSK, Ch.78 3rd Harmonic, Z-H)



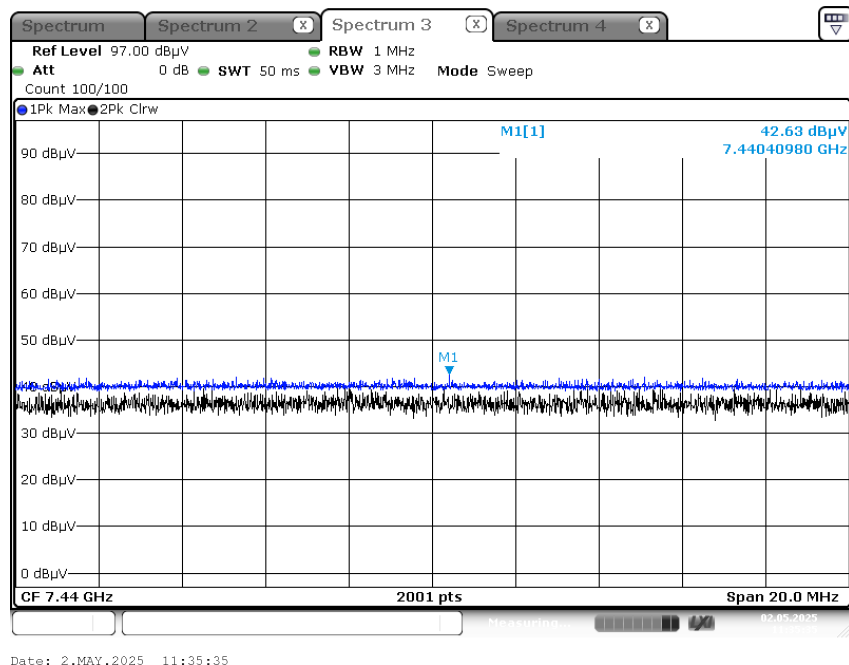
Date: 2.MAY.2025 10:47:12

[Simultaneous transmission Scenario]

Scenario 1

Bluetooth DH5_Ch.78 + WLAN 2.4 GHz 802.11b_Ch. 6

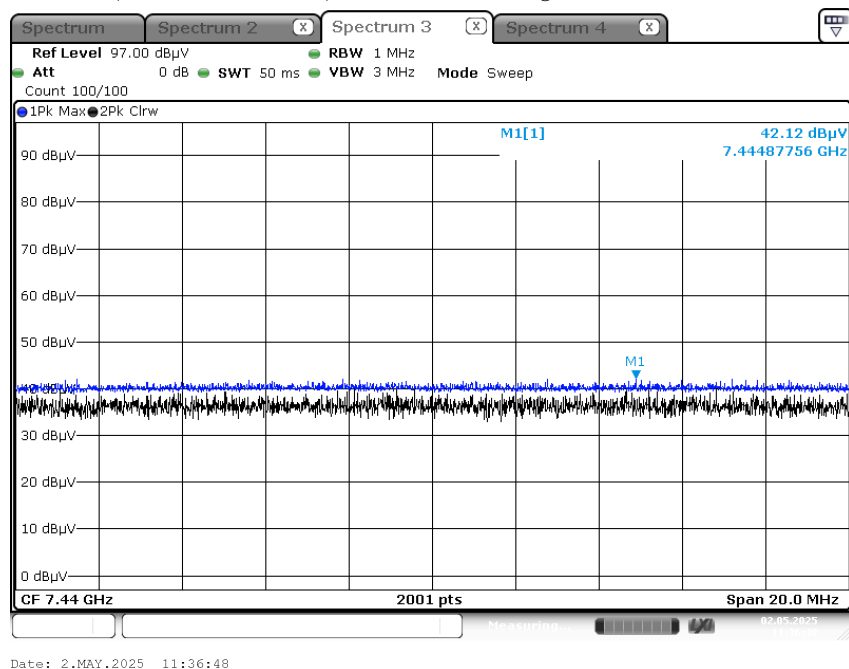
Radiated Spurious Emissions plot – Peak & Average Result (3rd Harmonic, Z-H)



Scenario 2

Bluetooth DH5_Ch.78 + WLAN 5 GHz 802.11a_Ch. 161

Radiated Spurious Emissions plot – Peak & Average Result (3rd Harmonic, Z-H)



10.6.3 RADIATED RESTRICTED BAND EDGES

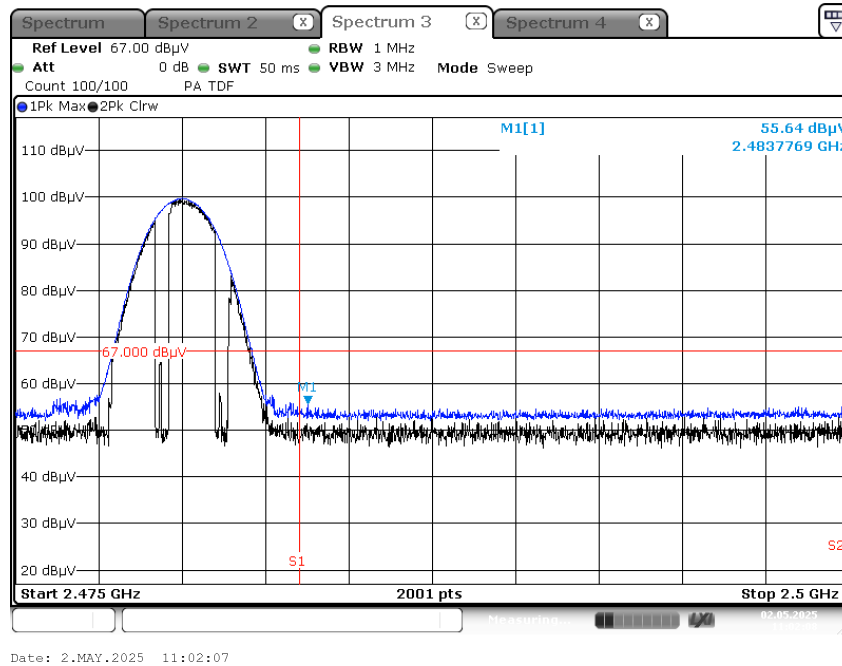
Normal(GFSK)	Channel	CH. 0, CH. 78		Channel Frequency		2402 MHz, 2480 MHz		
Frequency	Measured Value	A.F+C.L+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
2390.0	55.53	0.00	V	0.00	55.53	73.98	18.45	PK
2390.0	55.53	0.00	V	-24.73	30.80	53.98	23.18	AV
2483.5	55.06	0.00	V	0.00	55.06	73.98	18.92	PK
2483.5	55.06	0.00	V	-24.73	30.33	53.98	23.65	AV

EDR($\pi/4$ DQPSK)	Channel	CH. 0, CH. 78		Channel Frequency		2402 MHz, 2480 MHz		
Frequency	Measured Value	A.F+C.L+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
2390.0	55.26	0.00	V	0.00	55.26	73.98	18.72	PK
2390.0	55.26	0.00	V	-24.73	30.53	53.98	23.45	AV
2483.5	54.75	0.00	V	0.00	54.75	73.98	19.23	PK
2483.5	54.75	0.00	V	-24.73	30.02	53.98	23.96	AV

EDR(8DPSK)	Channel	CH. 0, CH. 78		Channel Frequency		2402 MHz, 2480 MHz		
Frequency	Measured Value	A.F+C.L+D.F	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dB]	[dBμV/m]	[dBμV/m]	[dB]	
2390.0	55.45	0.00	V	0.00	55.45	73.98	18.53	PK
2390.0	55.45	0.00	V	-24.73	30.72	53.98	23.26	AV
2483.5	55.64	0.00	V	0.00	55.64	73.98	18.34	PK
2483.5	55.64	0.00	V	-24.73	30.91	53.98	23.07	AV

Test Plots

Radiated Restricted Band Edges plot – Average & Peak Result (8DPSK, Ch.78, Z-V)



Note:

Plot of worst case was only reported.

11. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	07/17/2025	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	07/02/2025	Annual
Temperature Chamber	SU-642	ESPEC	93022487	06/27/2025	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	08/23/2025	Annual
Power Measurement Set	OSP 120	Rohde & Schwarz	100935	08/01/2025	Annual
Power Meter	N1911A	Agilent	MY45100523	02/21/2026	Annual
Power Sensor	N1921A	Agilent	MY57820067	02/04/2026	Annual
Directional Coupler	87300B	Agilent	3116A03621	10/21/2025	Annual
Power Splitter	11667B	Hewlett Packard	10545	01/23/2026	Annual
DC Power Supply	E3632A	Agilent	KR75305528	12/24/2025	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C-010	Agilent	08285	05/28/2025	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	02/18/2026	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A
Bluetooth Tester	CBT	Rohde & Schwarz	100752	12/27/2025	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	S3AM	07/30/2025	Annual
Turn Table	DS1500-S-1t	Innco system	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/07/2026	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/28/2026	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/07/2025	Biennial
Horn Antenna(15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	03/28/2025	Biennial
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	12/26/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	05/27/2026	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	05/27/2026	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	01/09/2026	Annual
Amp & Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
RF Switching System	FBSR-03A (3G HPF+LNA)	T&M SYSTEM	S3L1	10/31/2025	Annual
RF Switching System	FBSR-03A (10dB ATT+LNA)	T&M SYSTEM	S3L2	10/31/2025	Annual
RF Switching System	FBSR-03A (7G HPF+LNA)	T&M SYSTEM	S3L3	10/31/2025	Annual
RF Switching System	FBSR-03A (3dB ATT+LNA)	T&M SYSTEM	S3L4	10/31/2025	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/07/2025	Annual
Power Amplifier	CBL26405040	CERNEX	25956	02/19/2026	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	03/12/2026	Annual
Spectrum Analyzer	FSV40 (9 kHz ~ 40 GHz)	Rohde & Schwarz	100900	08/27/2025	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
3. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5(Version : 2017).

12. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2506-FC045-P