TEST REPORT

KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR18-SRF0050-C Page (1) of (68)	KCTL

1. Client

- Name : MOTREX CO., LTD.
- Address : (Mullae-dong 3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongin-ro, Yeongdeungpo-gu, Seoul, Korea
- Date of Receipt : 2018-04-10

2. Use of Report : -

3. Name of Product and Model : Smart display / MTXNC10HC

4. Manufacturer and Country of Origin : MOTREX CO., LTD. / Korea

5. FCC ID : BP9-MTXNC10HC

6. Date of Test : 2018-04-12 to 2018-04-14

7. Test Standards : FCC Part 15 Subpart C, 15.247

8. Test Results : Refer to the test result in the test report

Affirmation	Tested by Name : Seonjun Yun (Signature)	Technical Manager Name : Seungyong Kim (Signature)

2018-09-14

KCTL Inc.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2018-04-17	Originally issued	-
2018-09-07	Revised a typo and added test plots	52, 55 ~ 67
2018-09-13	Revised AV data and plots	51 ~ 54, 62
2018-09-14	Deleted AV plot	62

[Contents]

1. Client information

Applicant: MOTREX CO., LTD.

Address: (Mullae-dong 3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongin-ro, Yeongdeungpo-gu, Seoul, Korea

Telephone number: +82 (70) 5070 2279

Contact person: Yunyoung Kwon / yykwon@motrex.co.kr

Manufacturer: MOTREX. CO., LTD.

Address: (Mullae-dong 3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongin-ro, Yeongdeungpo-gu, Seoul, Korea

2. Laboratory information

Address

KCTL Inc.

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea

Telephone Number: +82 31 285 0894

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FCC Site Designation No: KR0040, FCC Site Registration No: 687132

VCCI Registration No. : R-3327, G-198, C-3706, T-1849

Industry Canada Registration No. : 8035A

KOLAS NO.: KT231

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant	MOTREX CO., LTD.
Address of Applicant	(Mullae-dong 3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongin-ro, Yeongdeungpo-gu, Seoul, Korea
Manufacturer	MOTREX. CO., LTD.
Address of Manufacturer	(Mullae-dong 3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongin-ro, Yeongdeungpo-gu, Seoul, Korea
Type of equipment	Smart display
Basic Model	MTXNC10HC

3.2 General description

Frequency Range	2 402 ㎒ ~ 2 480 ㎒
Type of Modulation	GFSK, π/4DQPSK, 8DPSK
The number of channels	79 ch
Type of Antenna	Chip Antenna
Antenna Gain	0 dBi
Transmit Power	4.53 dBm
Operation temperature	-20 ℃ ~ 50 ℃
Power supply	DC 12.00 V
Product SW/HW version	REV 1.0 / REV 1.2
Radio SW/HW version	REV 1.0 / REV 1.2
Test SW Version	Bluetooth Tester v2.76
RF power setting in TEST SW	Referred the measuring instrument from manufacturer

Note : The above EUT information was declared by the manufacturer.

3.3 Ambient Conditions

	Temperature [℃]	Relative humidity [%]
Ambient Conditions	21	65

3.4 Test frequency

	Frequency
Lowest frequency	2 402 ㎒
Middle frequency	2 441 ㎒
Highest frequency	2 480 ㎒

3.5 Test Voltage

Mode	Voltage
Nominal Voltage	DC 12.00 V

- 15.247 Requirements for Bluetooth transmitter

- 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.

4. Summary of test results

4.1 Standards & results

FCC Rule	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	Antenna Requirement	5.1	C
15.247(b)(1), (4)	Maximum Peak Output Power	5.2	C
15.247(a)(1)	Carrier Frequency Separation	5.3	C
15.247(a)(1)	20dB Channel Bandwidth	5.4	C
-	Occupied Bandwidth	5.4	C
15.247(a)(iii) 15.247(b)(1)	Number of Hopping Channel	5.5	C
15.247(a) (iii)	Time of Occupancy(Dwell Time)	5.6	C
15.247(d),15.205(a),15.209(a)	Spurious Emission, BandEdge, Restricted Band	5.7	C
15.207(a)	Conducted Emissions	5.8	NA (Note2)

Note1) : C = Complies, NC = Not Complies, NT = Not Tested, NA = Not Applicable
Note2) : This test is not applicable because the EUT falls into the automotive device and it's not to be Connected to the public utility(AC) power line.

- The general test methods used to test on this device are ANSI C63.10-2013

4.2 Uncertainty

Measurement Item	Expanded Uncertainty U = *k*Uc (*k* = 2)	
Conducted RF power	1.44 ㏈	
Conducted Spurious Emissions	1.52 ㏈	
Radiated Spurious Emissions	30 ㎒ ~ 300 ㎒:	+4.94 ㏈, -5.06 ㏈
		+4.93 ㏈, -5.05 ㏈
	300 ㎒ ~ 1 000 ㎒:	+4.97 ㏈, -5.08 ㏈
		+4.84 ㏈, -4.96 ㏈
	1 ㎓ ~ 25 ㎓:	+6.03 ㏈, -6.05 ㏈
Conducted Emissions	9 ㎑ ~ 150 ㎑:	3.75 ㏈
	150 ㎑ ~ 30 ㎒:	3.36 ㏈

5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §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.

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

5.1.2 Result

-Complied

The transmitter has permanently attached Chip Antenna (internal antenna) on PCB.

5.2 Maximum Peak Output Power

5.2.1 Regulation

According to §15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2 400-2 483.5 ㎒ band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-thirds of the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

According to §15.247(b)(1), for frequency hopping systems operating in the 2 400-2 483.5 ㎒ band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725-5 850 ㎒ band: 1 watt. For all other frequency hopping systems in the 2 400-2 483.5 ㎒ band: 0.125 watts.

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

5.2.2 Measurement Procedure

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

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

The hopping shall be disabled for this test:

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

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

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

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

NOTE:
A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

5.2.3 Test Result

- Complied

- GFSK

Channel	Frequency [㎒]	Result [dBm]	Limit [dBm]	Margin [dB]	Average Power [dBm]
Lowest	2 402	3.43	30.00	26.57	1.43
Middle	2 441	3.43	30.00	26.57	1.43
Highest	2 480	3.43	30.00	26.57	1.32

- π/4DQPSK

Channel	Frequency [㎒]	Result [dBm]	Limit [dBm]	Margin [dB]	Average Power [dBm]
Lowest	2 402	4.43	20.97	16.54	0.78
Middle	2 441	4.13	20.97	16.84	0.40
Highest	2 480	4.03	20.97	16.94	0.05

- 8DPSK

Channel	Frequency [㎒]	Result [dBm]	Limit [dBm]	Margin [dB]	Average Power [dBm]
Lowest	2 402	4.53	20.97	16.44	0.78
Middle	2 441	4.23	20.97	16.74	0.42
Highest	2 480	4.13	20.97	16.84	0.09

<u>NOTE:</u>
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.3 Carrier Frequency Separation

5.3.1 Regulation

According to §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2 400-2 483.5 ㎒ band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-thirds of the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

5.3.2 Measurement Procedure

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

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

a) Span: Wide enough to capture the peaks of two adjacent channels.
b) 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.
c) Video (or average) bandwidth (VBW) ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

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.

5.3.3 Test Result

- Complied

- GFSK

Channel	Frequency [㎒]	Carrier frequency separation [㎒]	Limit
Lowest	2 402	0.980	≥25 ㎑ or 20 ㏈ Bandwidth
Middle	2 441	1.001	≥25 ㎑ or 20 ㏈ Bandwidth
Highest	2 480	0.998	≥25 ㎑ or 20 ㏈ Bandwidth

- 8DPSK

Channel	Frequency [㎒]	Carrier frequency separation [㎒]	Limit
Lowest	2 402	0.995	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth
Middle	2 441	0.989	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth
Highest	2 480	0.998	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth

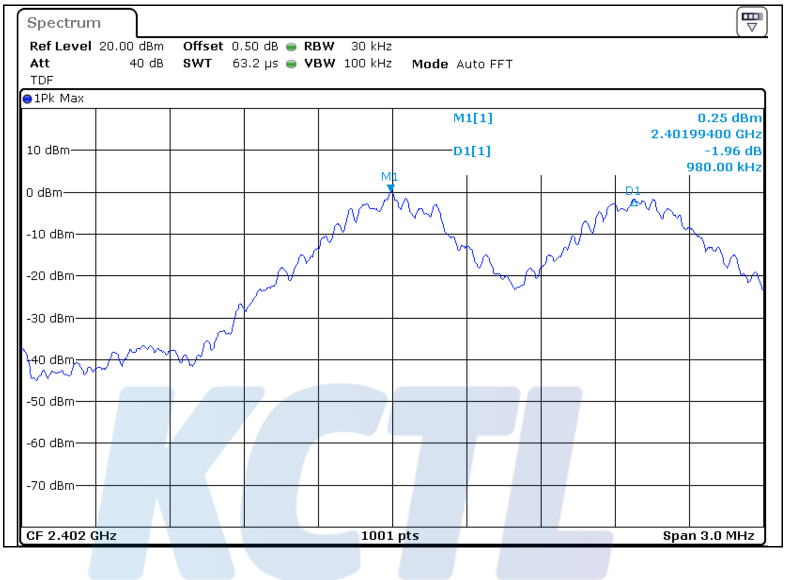
NOTE:
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.3.4 Test Plot

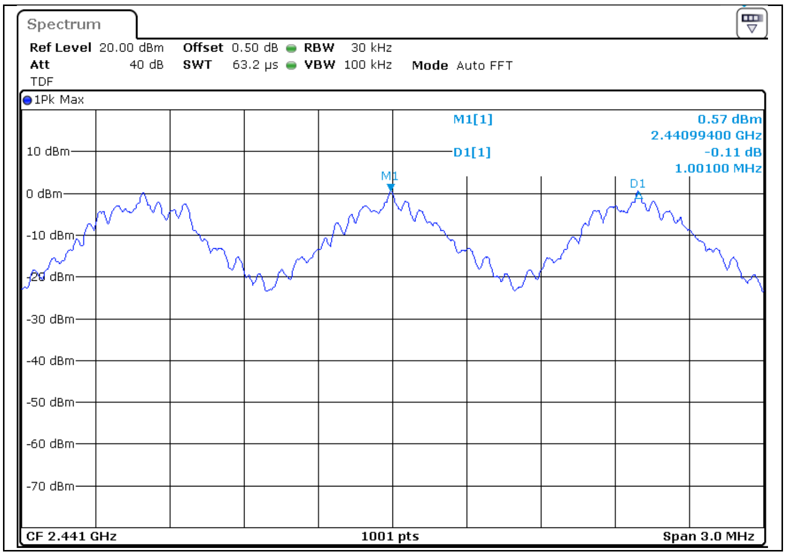
Figure 1. Plot of the Carrier Frequency Separation

- GFSK

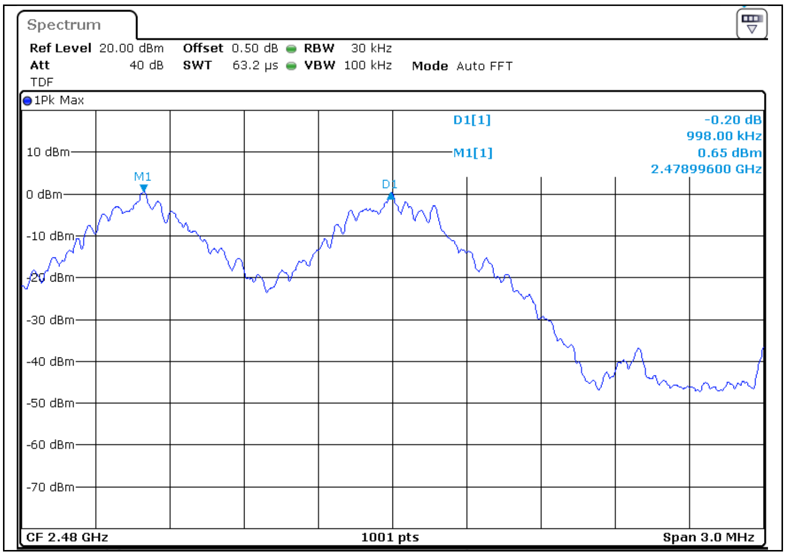
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)

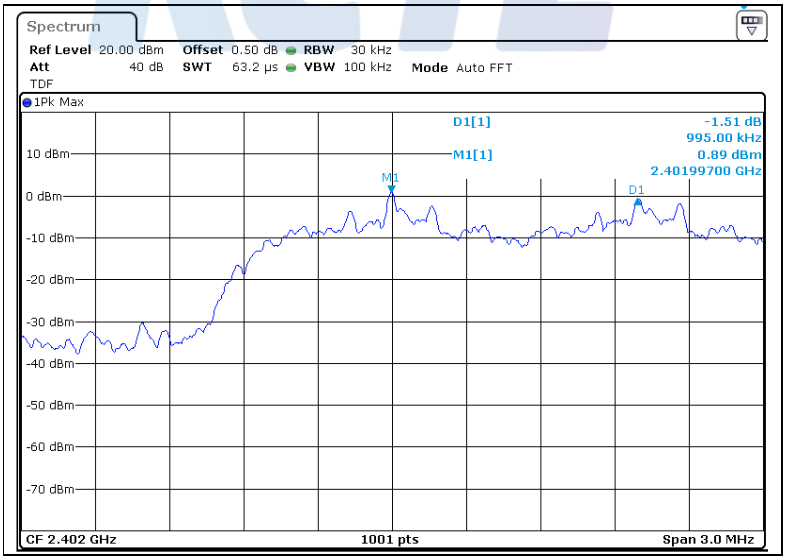


Highest Channel (2 480 ㎒)

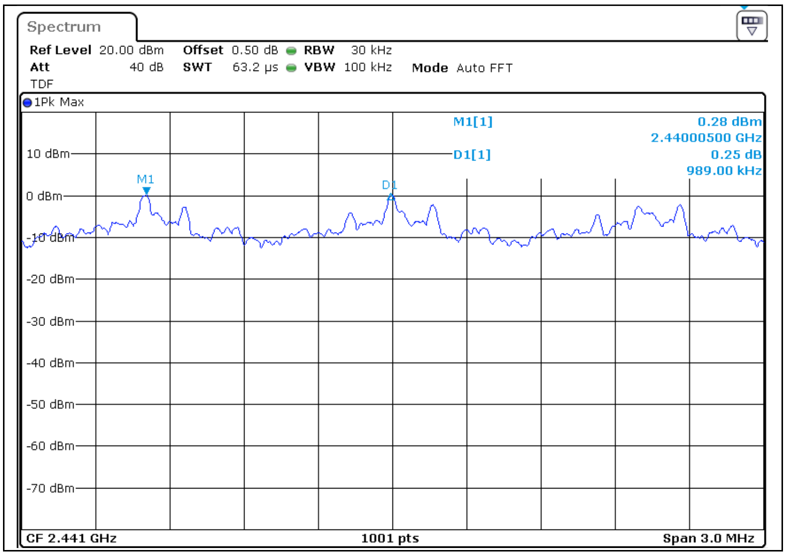


- 8DPSK

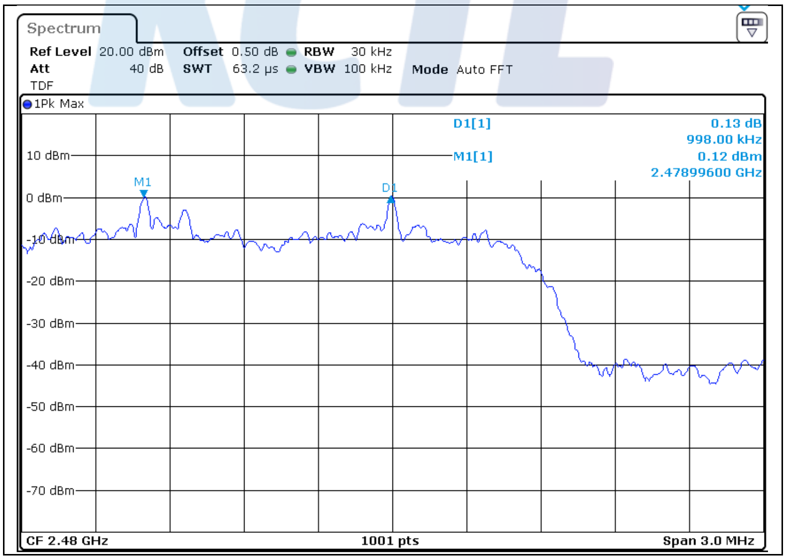
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)



Highest Channel (2 480 ㎒)



5.4 20 dB Channel Bandwidth

5.4.1 Regulation

According to §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2 400-2 483.5 ㎒ band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-thirds of the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

5.4.2 Measurement Procedure

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

The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of ㏈ down from the reference value). Typical ratios, expressed in dB, are −6 ㏈, −20 ㏈, and −26 ㏈,corresponding to 6 ㏈ BW, 20 ㏈ BW, and 26 ㏈ BW, respectively. In this subclause, the ratio is designated by "−xx ㏈." The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. Some requirements might specify a specific maximum or minimum value for the "−xx ㏈" bandwidth; other requirements might specify that the "−xx ㏈" bandwidth be entirely contained within the authorized or designated frequency band.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and Five times the OBW.
b) The nominal IF filter bandwidth (3 ㏈ RBW) shall be in the range of 1 % to 5 % of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
d) Steps a) through c) might require iteration to adjust within the specified tolerances.
e) The dynamic range of the instrument at the selected RBW shall be more than 10 ㏈ below the target "−xx ㏈ down" requirement; that is, if the requirement calls for measuring the −20 ㏈ OBW, the instrument noise floor at the selected RBW shall be at least 30 ㏈ below the reference value.
f) Set detection mode to peak and trace mode to max hold.

g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h) Determine the "−xx dB down amplitude" using [(reference value) − xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "−xx dB down amplitude" determined in step h). If a marker is below this "−xx dB down amplitude" value,then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "−xx dB down amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

5.4.3 Test Result

- Complied

Mode	Channel	Frequency [㎒]	20 ㏈ Channel Bandwidth [㎒]	Occupied Bandwidth (99 % BW) [㎒]
GFSK	Lowest	2 402	0.887	0.875
	Middle	2 441	0.881	0.869
	Highest	2 480	0.827	0.869
8DPSK	Lowest	2 402	1.289	1.226
	Middle	2 441	1.274	1.217
	Highest	2 480	1.271	1.202

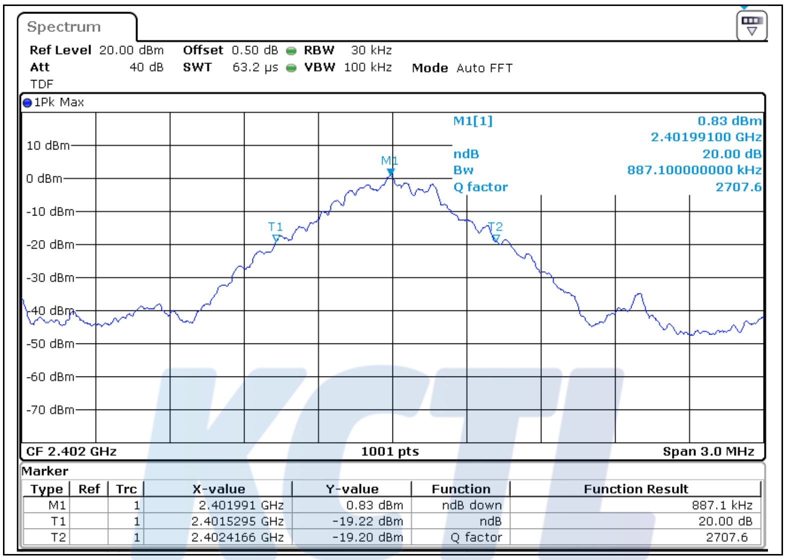
NOTE:
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.4.4 Test Plot

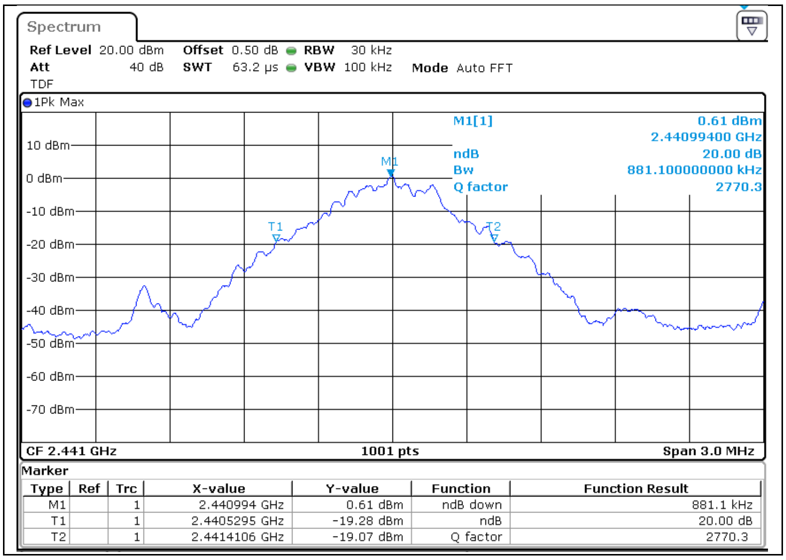
Figure 2. Plot of the 20 dB Channel Bandwidth & Occupied Bandwidth (Conducted)

- GFSK_20 dB Channel Bandwidth

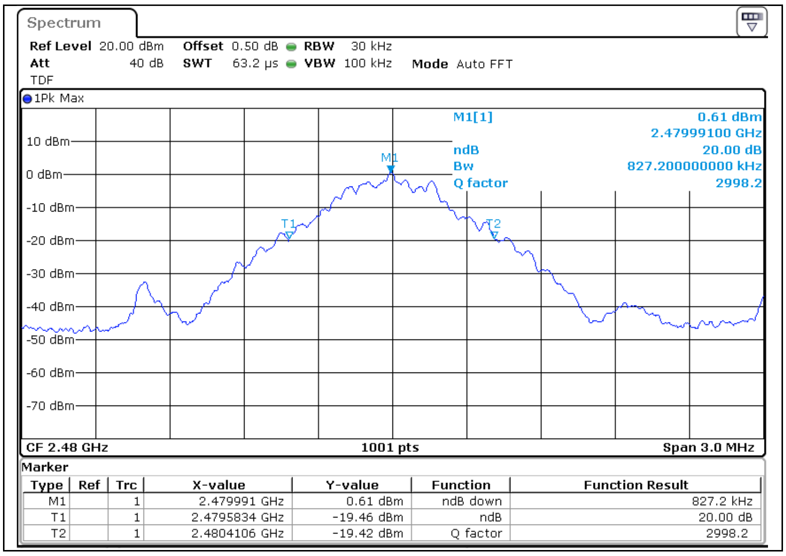
Lowest Channel (2 402 MHz)



Middle Channel (2 441 MHz)

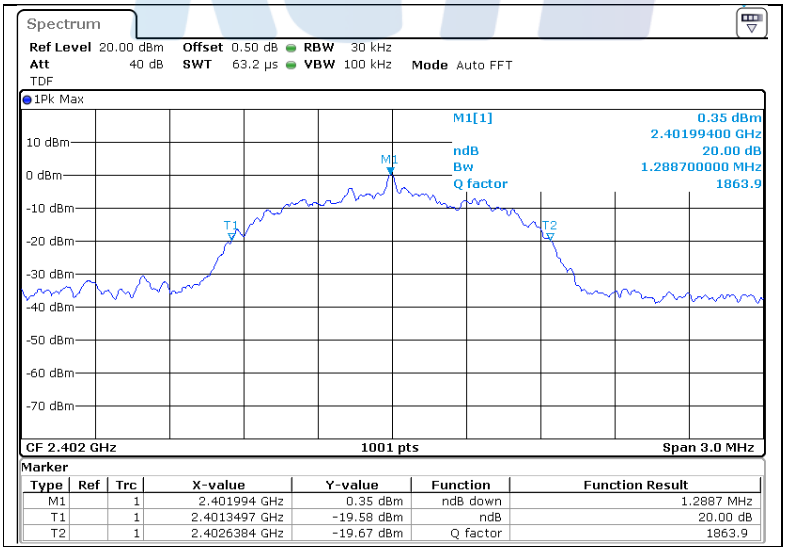


Highest Channel (2 480 ㎒)

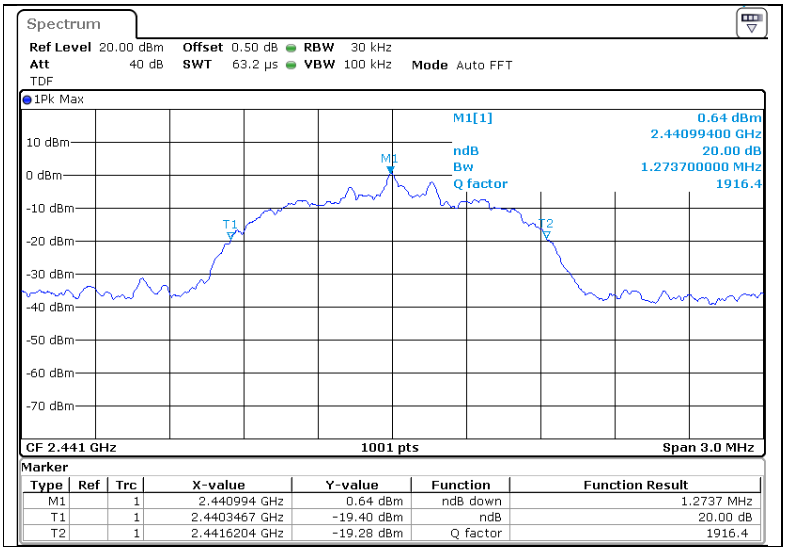


- 8DPSK_20 ㏈ Channel Bandwidth

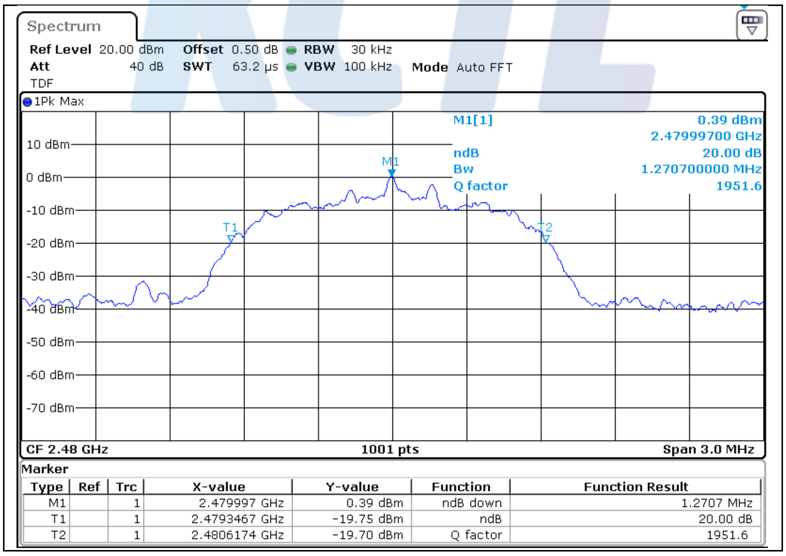
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)

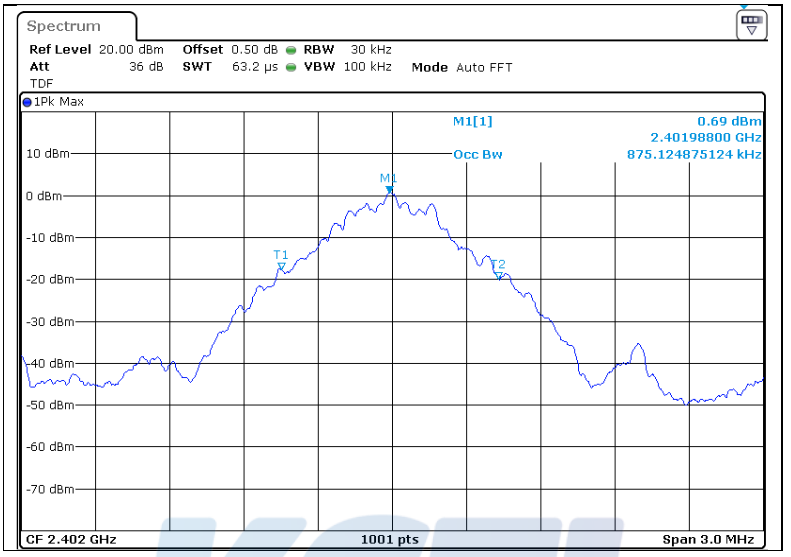


Highest Channel (2 480 ㎒)

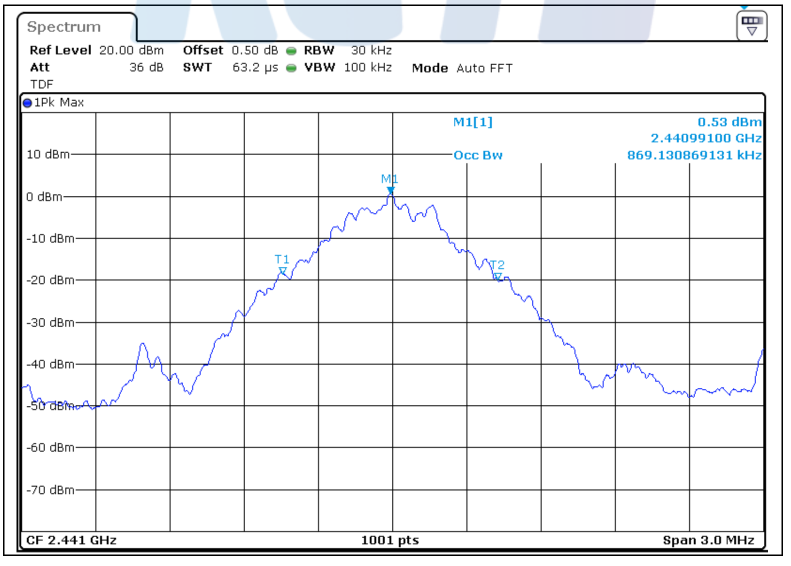


- GFSK_Occupied Bandwidth

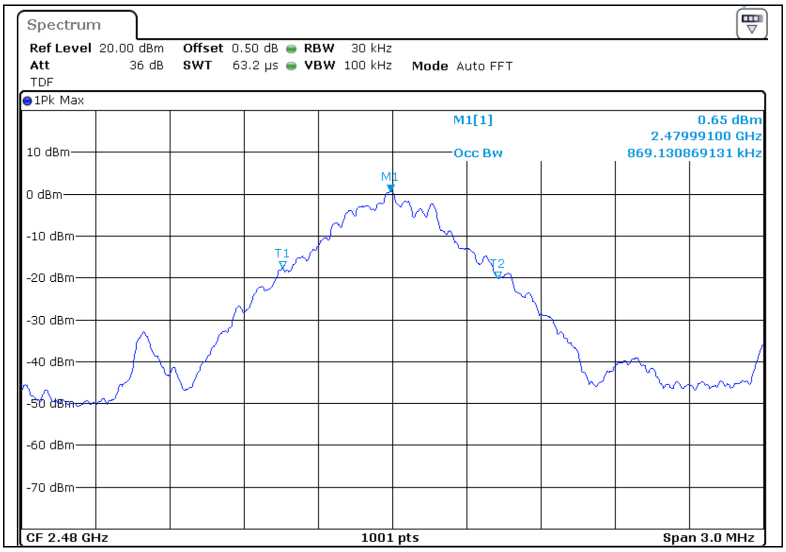
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)

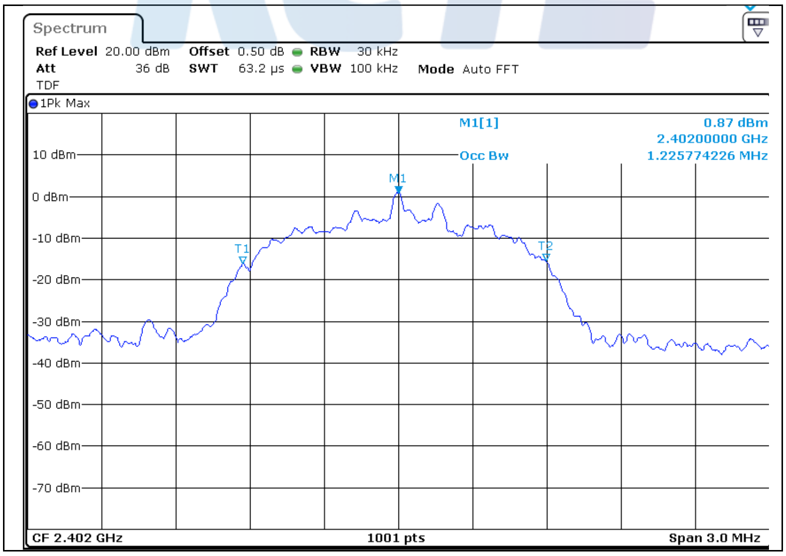


Highest Channel (2 480 ㎒)

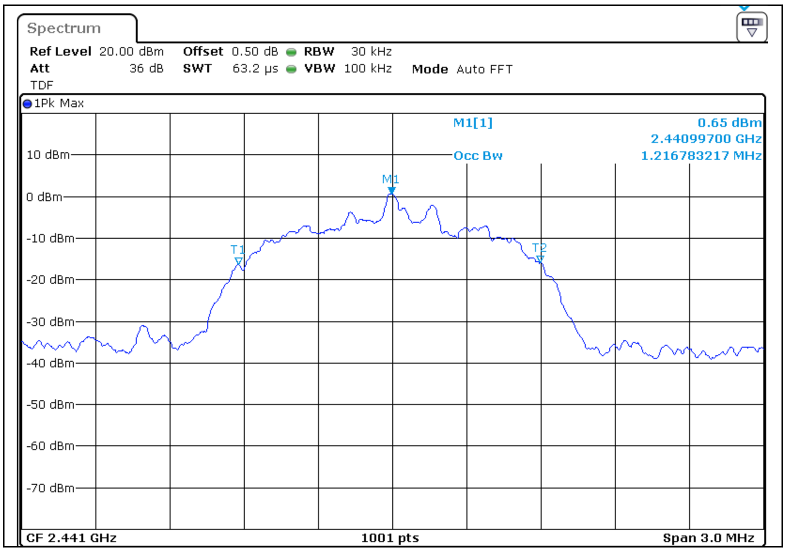


- 8DPSK_Occupied Bandwidth

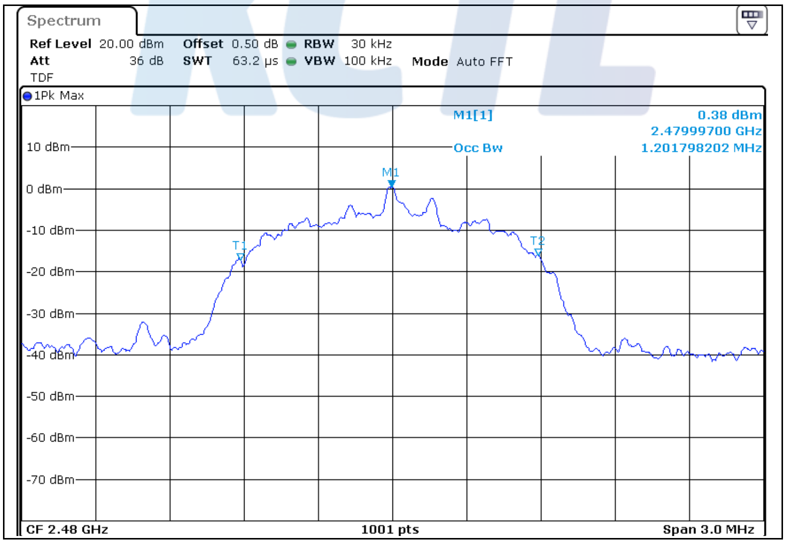
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)



Highest Channel (2 480 ㎒)



5.5 Number of Hopping Channels

5.5.1 Regulation

According to §15.247(a)(1)(iii), Frequency hopping systems in the 2 400-2 483.5 ㎒ band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. According to §15.247(b)(1), For frequency hopping systems operating in the 2 400-2 483.5 ㎒ band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725-5 850 ㎒ band: 1 watt. For all other frequency hopping systems in the 2 400-2 483.5 ㎒ band: 0.125 watts.

5.5.2 Measurement Procedure

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

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

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

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

5.5.3 Test Result

- Complied

Mode	Frequency [㎒]	Number of hopping channel	Limit
GFSK	2 402 – 2 480	79	≥15
8DPSK	2 402 – 2 480	79	≥15

NOTE:

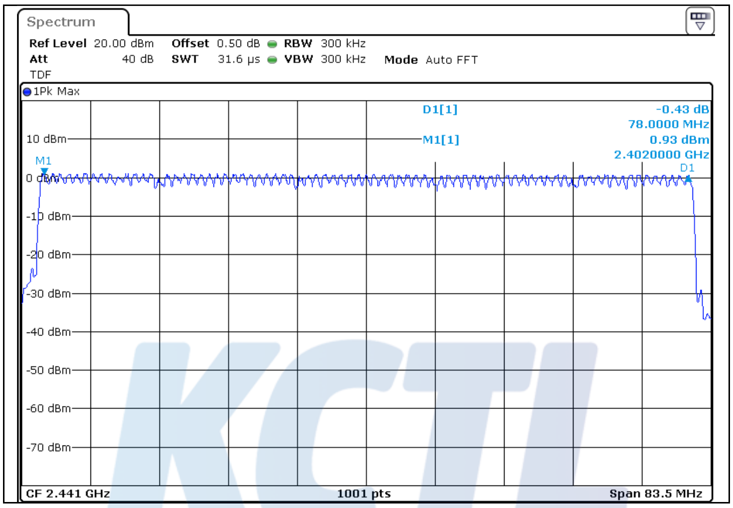
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.
2. Measurement is made with EUT operating in hopping mode between 79 channels providing a worse case scenario as compared to AFH mode hopping between 20 channels.

5.5.4 Test Plot

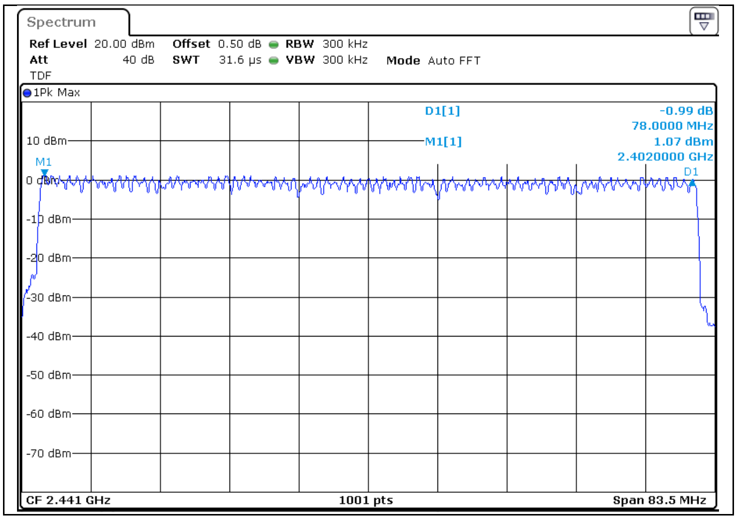
Figure 3. Plot of the Number of Hopping Channels (Conducted)

Non-AFH Mode

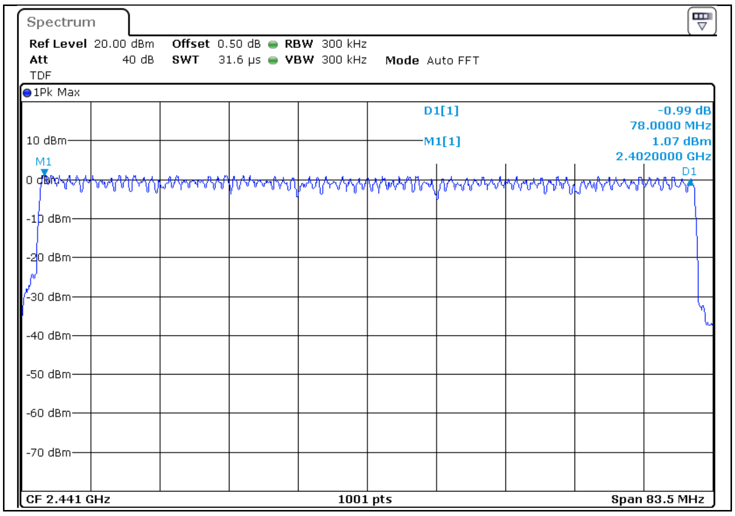
- GFSK



- π/4DQPSK

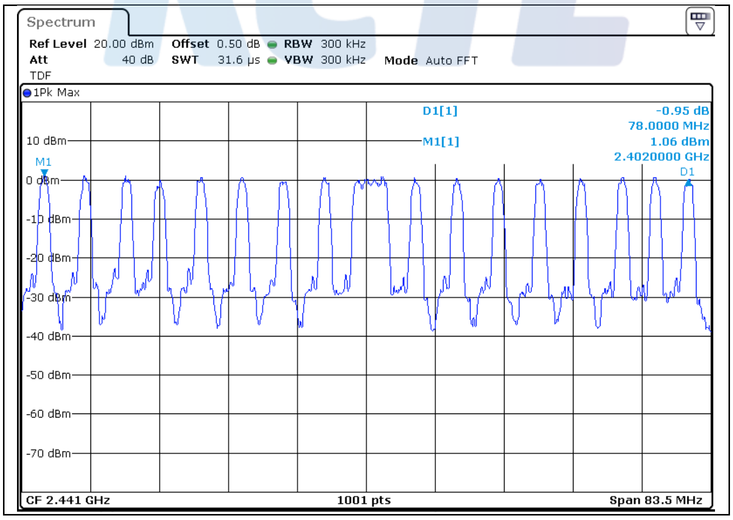


- 8DPSK

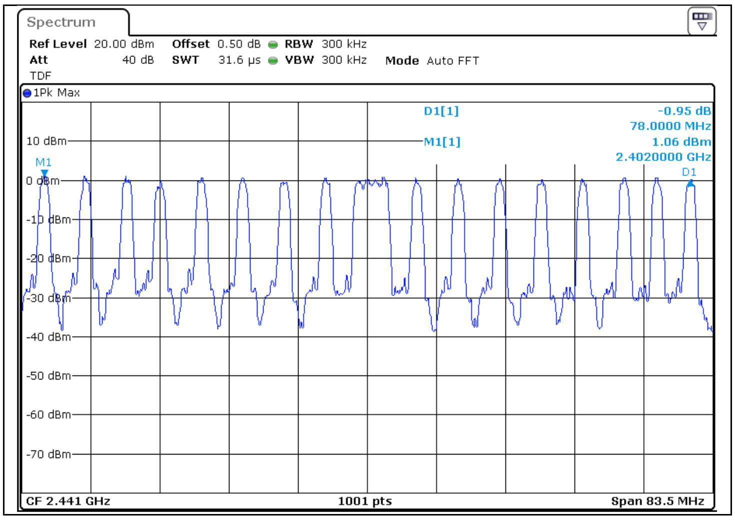


AFH Mode

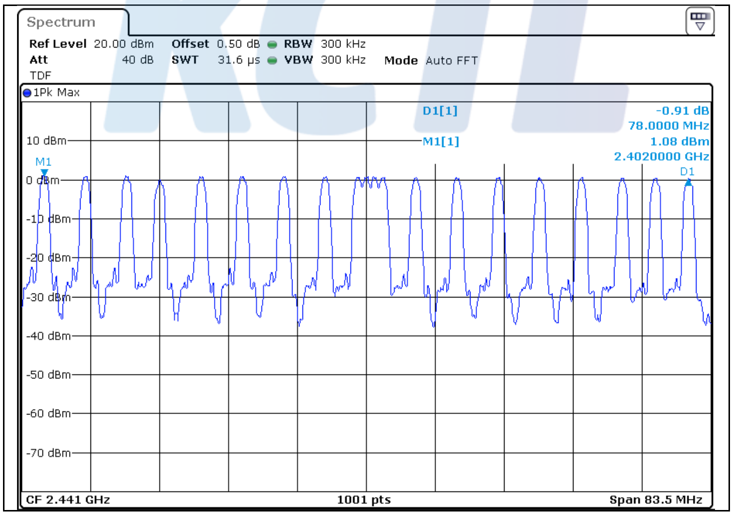
- GFSK



- π/4DQPSK



- 8DPSK



5.6 Time of Occupancy(Dwell Time)

5.6.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2 400-2 483.5 ㎒ band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.6.2 Measurement Procedure

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

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

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

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.
Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

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

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

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

5.6.3 Test Result

- Complied

- Non-AFH

Packet type	Frequency [㎒]	Reading [㎳]	Hopping rate [hop/s]	Number of Channels	Result [s]	Limit [s]
DH1	2 441	0.394	800.000	79	0.126	0.400
DH3	2 441	1.650	400.000	79	0.264	0.400
DH5	2 441	2.896	266.667	79	0.309	0.400
2-DH1	2 441	0.407	800.000	79	0.130	0.400
2-DH3	2 441	1.659	400.000	79	0.265	0.400
2-DH5	2 441	2.904	266.667	79	0.310	0.400
3-DH1	2 441	0.407	800.000	79	0.130	0.400
3-DH3	2 441	1.659	400.000	79	0.265	0.400
3-DH5	2 441	2.904	266.667	79	0.310	0.400

- AFH

Packet type	Frequency [㎒]	Reading [㎳]	Hopping rate [hop/s]	Number of Channels	Result [s]	Limit [s]
DH1	2 441	0.394	400.000	20	0.063	0.400
DH3	2 441	1.648	200.000	20	0.130	0.400
DH5	2 441	2.896	133.333	20	0.153	0.400
2-DH1	2 441	0.408	400.000	20	0.065	0.400
2-DH3	2 441	1.662	200.000	20	0.133	0.400
2-DH5	2 441	2.896	133.333	20	0.154	0.400
3-DH1	2 441	0.408	400.000	20	0.065	0.400
3-DH3	2 441	1.662	200.000	20	0.133	0.400
3-DH5	2 441	2.904	133.333	20	0.155	0.400

NOTE 1. **Non AFH**

Result = Reading x (Hopping rate / Number of channels) x Test Period
Hopping rate = 1600/time slot
Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds]

NOTE 2. **AFH**

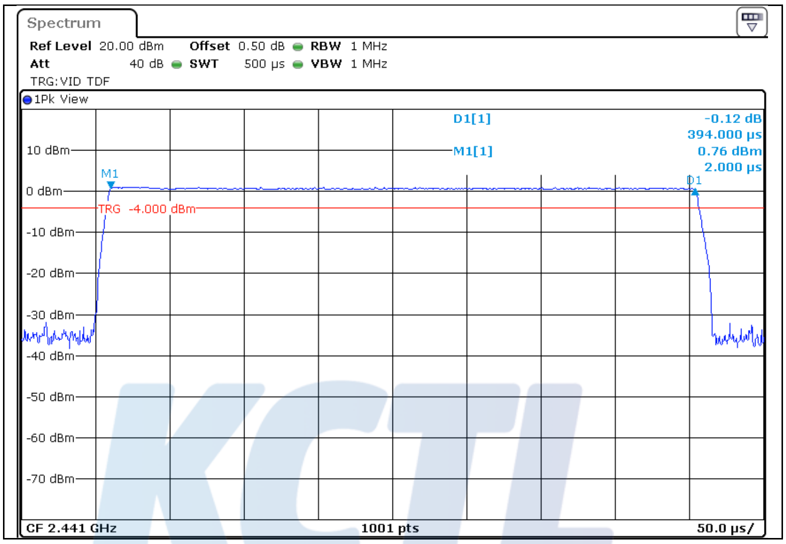
Result = Reading x (Hopping rate / Number of channels) x Test Period
Hopping rate = 800/time slot
Test period = 0.4 [seconds / channel] × 20 [channel] = 8 [seconds]

5.6.4 Test Plot

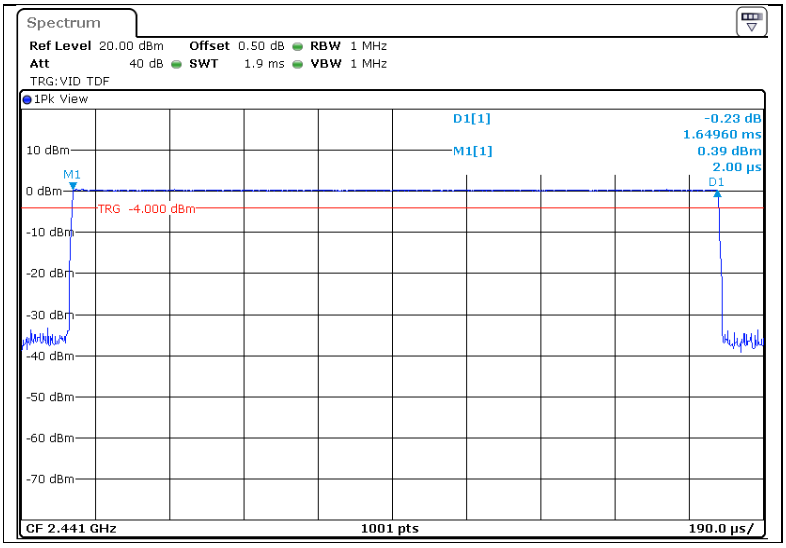
Figure 4. Plot of the Time of Occupancy (Conducted)

- GFSK_Non AFH mode

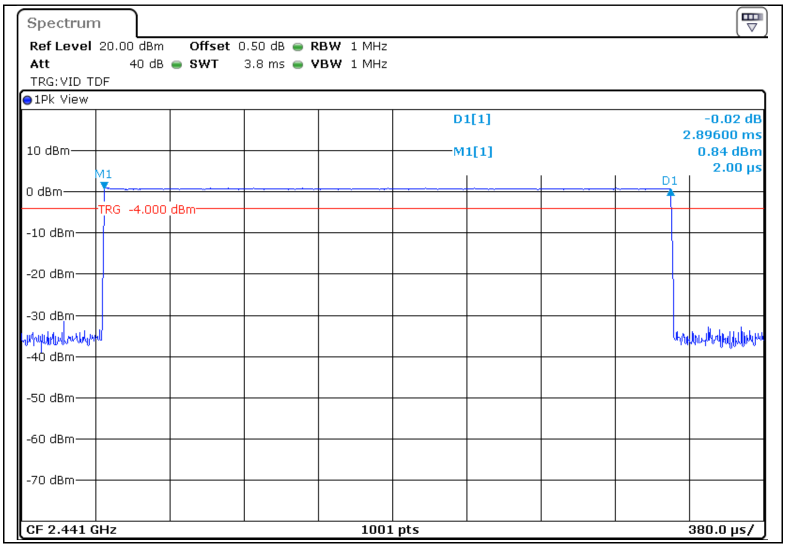
DH1 (2 441 ㎒)



DH3 (2 441 ㎒)

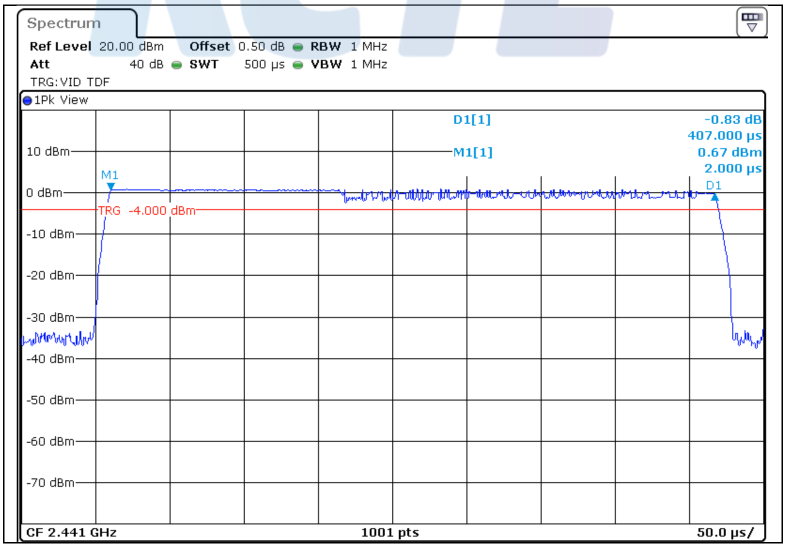


DH5 (2 441 ㎒)

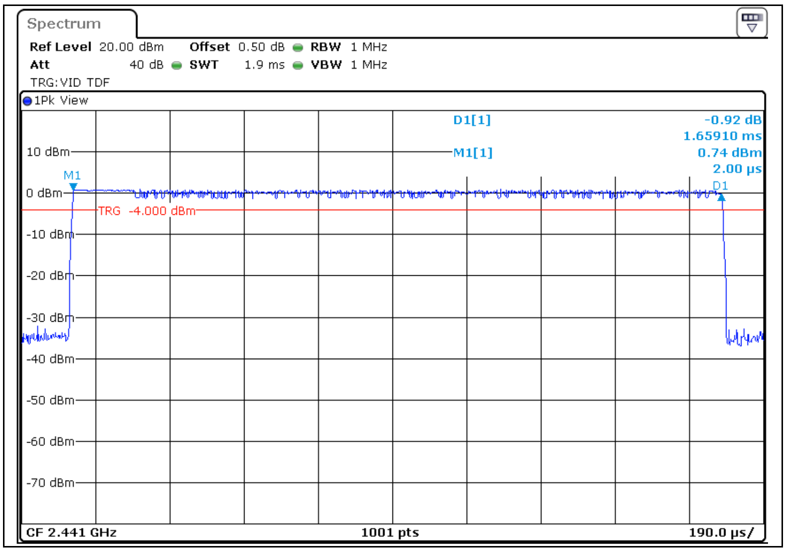


- π/4DQPSK_Non AFH mode

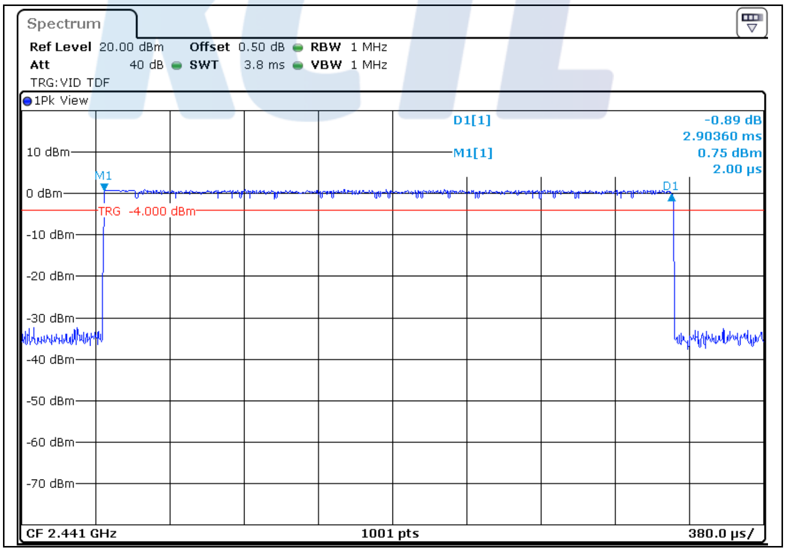
2-DH1 (2 441 ㎒)



2-DH3 (2 441 ㎒)

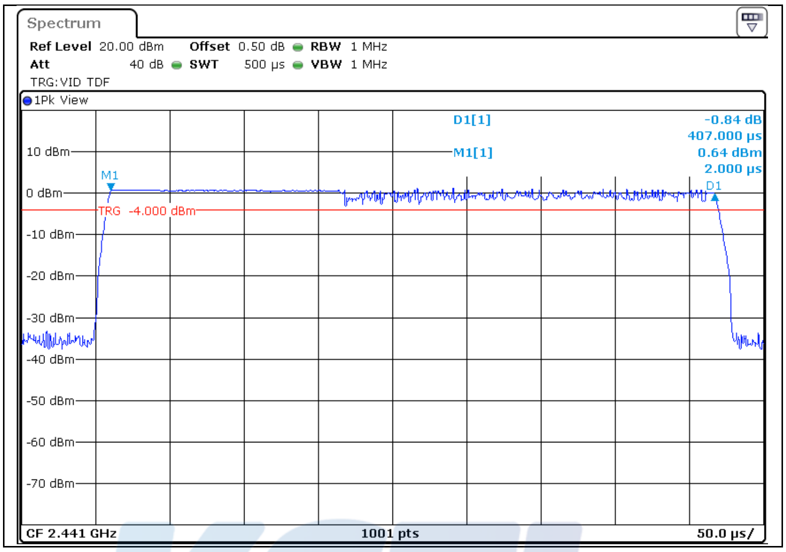


2-DH5 (2 441 ㎒)

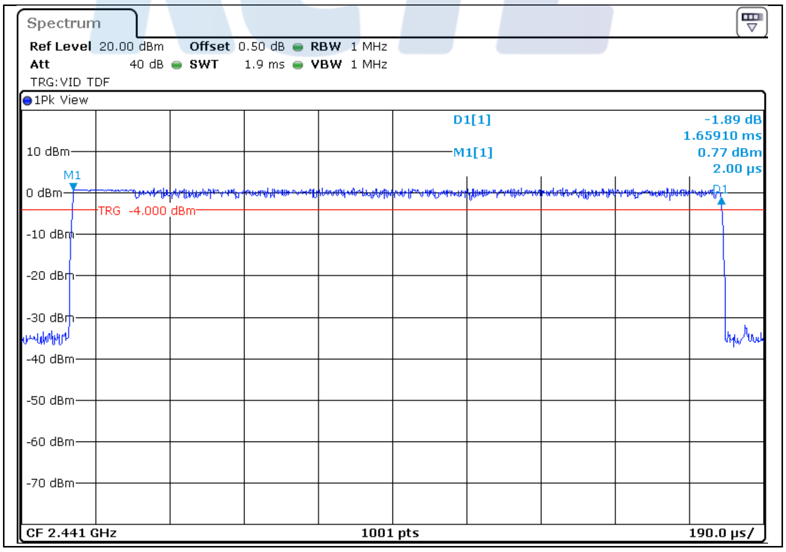


- 8DPSK_Non AFH mode

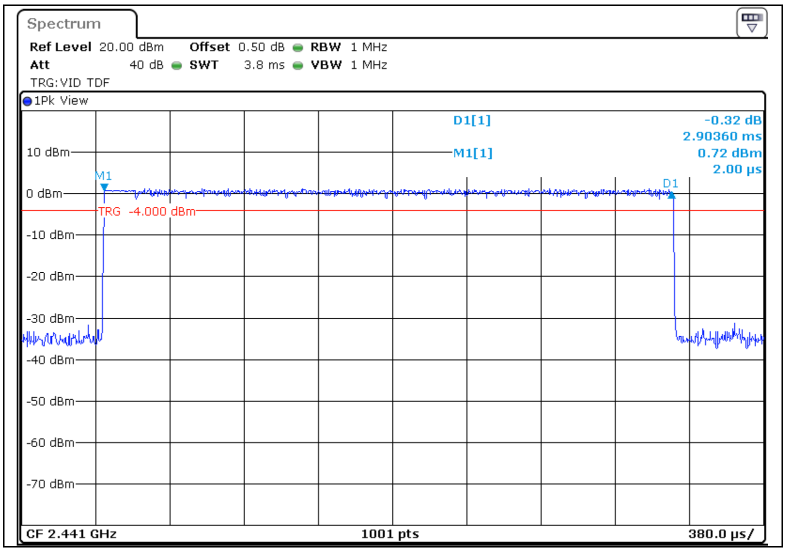
3-DH1 (2 441 ㎒)



3-DH3 (2 441 ㎒)

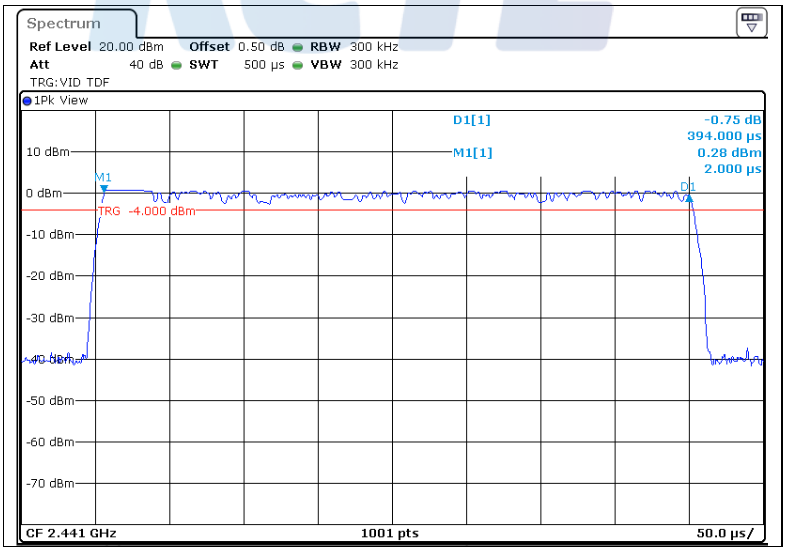


3-DH5 (2 441 ㎒)

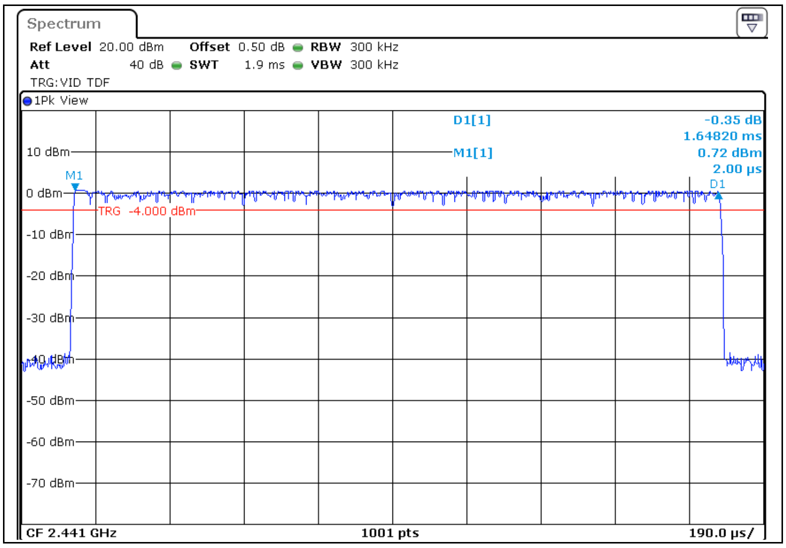


- GFSK_AFH mode

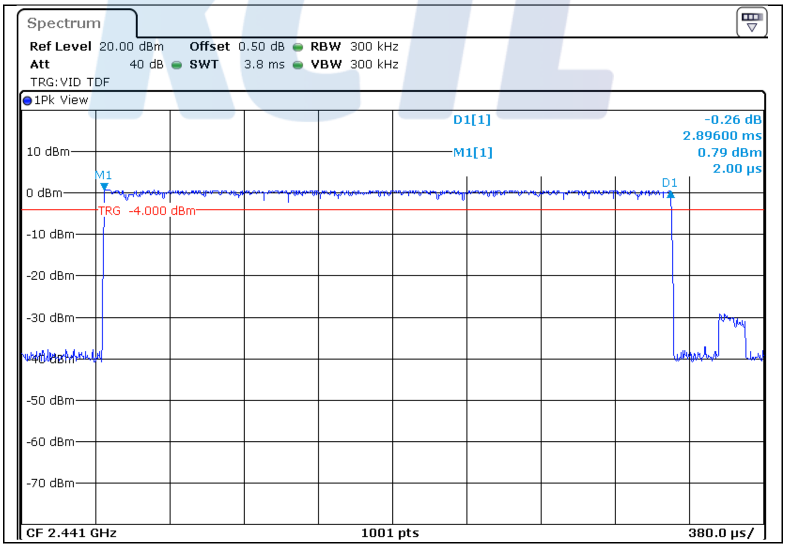
DH1 (2 441 ㎒)



DH3 (2 441 ㎒)

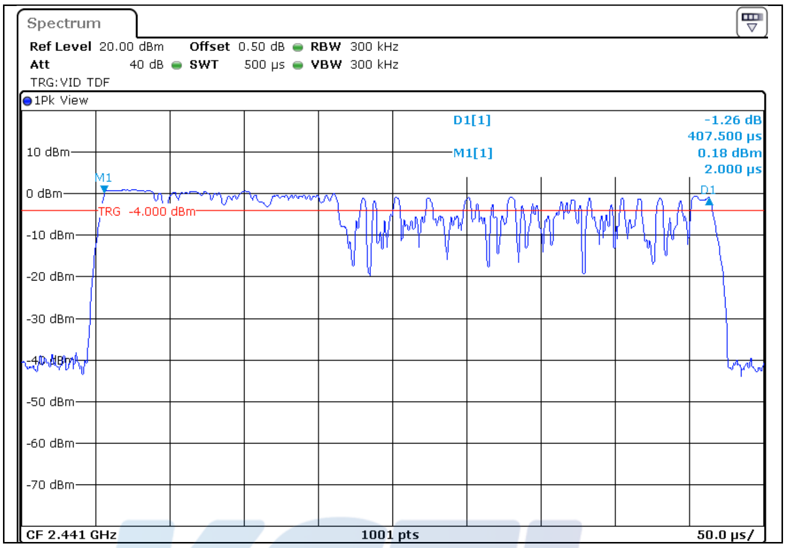


DH5 (2 441 ㎒)

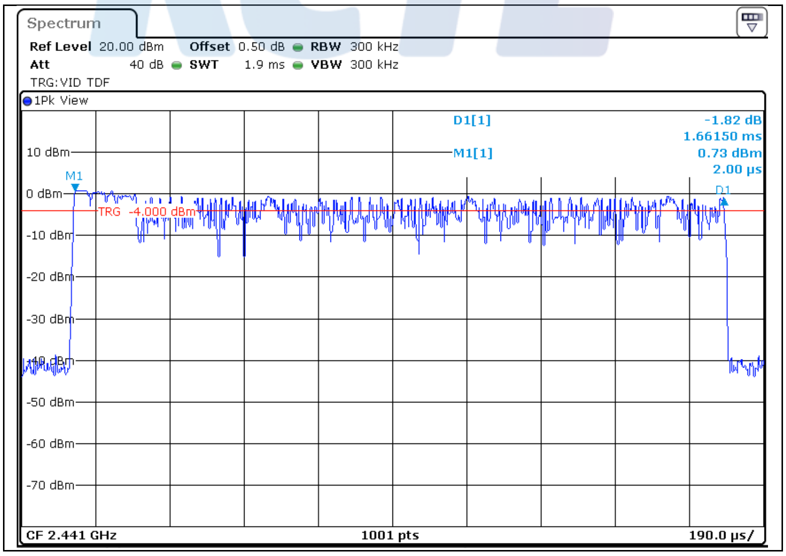


- π/4DQPSK_AFH mode

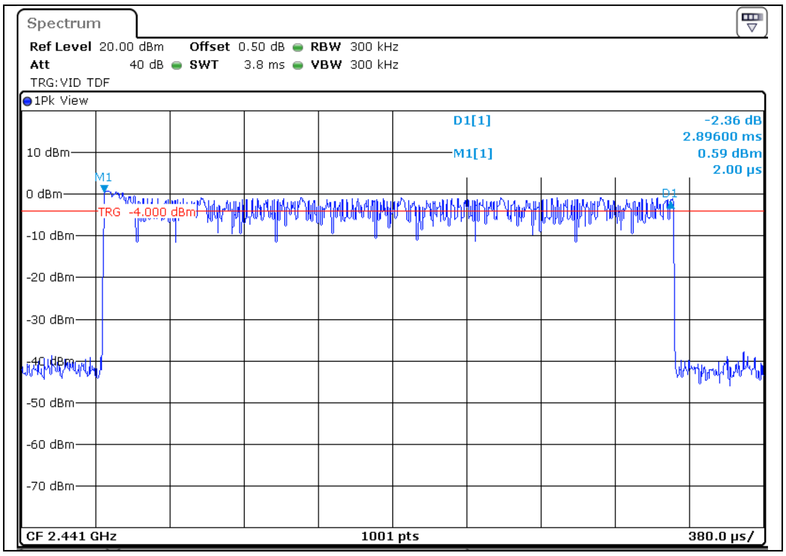
2-DH1 (2 441 ㎒)



2-DH3 (2 441 ㎒)

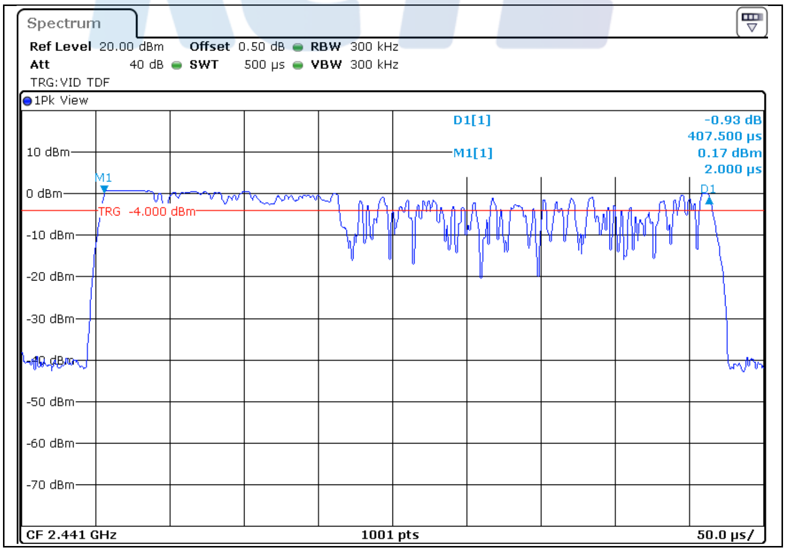


2-DH5 (2 441 ㎒)

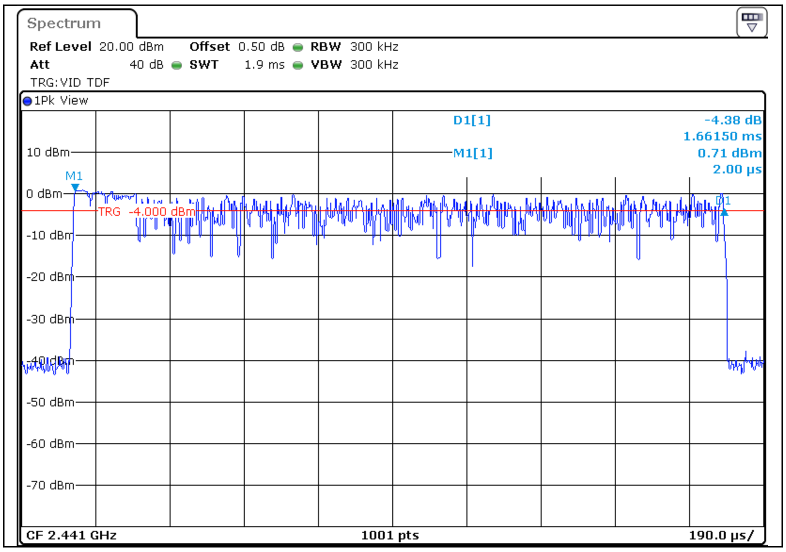


- 8DPSK_AFH mode

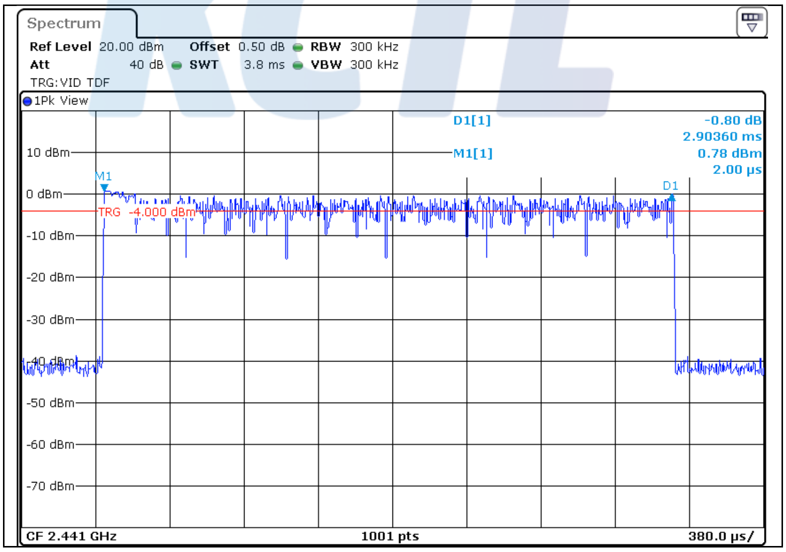
3-DH1 (2 441 ㎒)



3-DH3 (2 441 ㎒)



3-DH5 (2 441 ㎒)



5.7 Spurious Emission, Band edge and Restricted bands

5.7.1 Regulation

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

According to §15.209(a), Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall notexceed the field strength levels specified in the following table:

Frequency (㎒)	Field strength (㎶/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(㎑)	300
0.490 -1.705	24 000/F(㎑)	30
1.705 – 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

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

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

㎒	㎒	㎒	㎓
0.009 - 0.110 0.495 - 0.505 2.1735 - 2.1905 4.125 - 4.128 4.17725 - 4.17775 4.20725 - 4.20775 6.215 - 6.218 6.26775 - 6.26825 6.31175 - 6.31225 8.291 - 8.294 8.362 - 8.366 8.37625 - 8.38675 8.41425 - 8.41475 12.29 - 12.293 12.51975 - 12.52025 12.57675 - 12.57725 13.36 - 13.41	16.42 - 16.423 16.69475 - 16.69525 16.80425 - 16.80475 25.5 - 25.67 37.5 - 38.25 73 - 74.6 74.8 - 75.2 108 - 121.94 123 - 138 149.9 - 150.05 156.52475 - 156.52525 156.7 - 156.9 162.0125 - 167.17 167.72 - 173.2 240 - 285 322 - 335.4	399.9 - 410 608 - 614 960 - 1240 1300 - 1427 1435 - 1626.5 1645.5 - 1646.5 1660 - 1710 1718.8 - 1722.2 2200 - 2300 2310 - 2390 2483.5 - 2500 2690 - 2900 3260 - 3267 3332 - 3339 3345.8 - 3358 3600 - 4400	4.5 - 5.15 5.35 - 5.46 7.25 - 7.75 8.025 - 8.5 9.0 - 9.2 9.3 - 9.5 10.6 - 12.7 13.25 - 13.4 14.47 - 14.5 15.35 - 16.2 17.7 - 21.4 22.01 - 23.12 23.6 - 24.0 31.2 - 31.8 36.43 - 36.5 Above 38.6

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1 000 ㎒, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 ㎒, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

5.7.2 Measurement Procedure

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

1) Band-edge Compliance of RF Conducted Emissions

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).
Band-edge tests are typically performed as a conducted test but may be performed as Radiated measurements on a test site meeting the specifications in 5.2, at the measurement distances specified in 5.3. The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors Specified in 4.1.4.2.
When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3.

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

a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).

b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).

c) Set the EUT to operate at maximum output power and 100 % duty cycle, or equivalent "normal mode of operation" as specified in 6.10.3.

d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.

e) Perform the test as follows:

1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

3) Attenuation: Auto (at least 10 dB preferred).

4) Sweep time: Coupled.

5) Resolution bandwidth: 100 kHz.

6) Video bandwidth: 300 kHz.

7) Detector: Peak.

8) Trace: Max hold.

f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.

g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

h) Repeat step c) through step e) for every applicable modulation.

i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).

j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

2) Spurious RF Conducted Emissions:

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the Maximum transmit powers.
Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer.
The instrument shall span 30 ㎒ to 10 times the operating frequency in ㎓, with a resolution bandwidth of 100 ㎑, video bandwidth of 300 ㎑, and a coupled sweep time with a peak detector. The band 30 ㎒ to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an semi-anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 ㎑ to 30 ㎒ using the loop antenna, and from 30 to 1 000 ㎒ using the Bi-Log antenna, and from 1 000 ㎒ to 26 500 ㎒ using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter in an semi-anechoic chamber. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The 0.8m height is for below 1 G testing, and 1.5m is for above 1G testing.

- **Procedure for unwanted emissions measurements below 1 000 ㎒**

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

a) Follow the requirements in 12.7.4.

b) Compliance shall be determined using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- Procedure for peak unwanted emissions measurements above 1 000 ㎒

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

a) Follow the requirements in 12.7.4.

b) Peak emission levels are measured by setting the instrument as follows:

1) RBW = 1 ㎒.

2) VBW ≥ [3 ㎒ RBW].

3) Detector = peak.

4) Sweep time = auto.

5) Trace mode = max hold.

6) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not continuous, then the time required for the trace to stabilize will increase by a factor of approximately 1 / D, where *D* is the duty cycle. For example, at 50 % duty cycle, the measurement time will increase by a factor of two, relative to measurement time for continuous transmission.

- Procedures for average unwanted emissions measurements above 1 000 ㎒

Method VB-A is averaging using reduced video bandwidth. The procedure for this method is as follows:

a) RBW = 1 ㎒.

b) Video bandwidth:

1) If the EUT is configured to transmit with D ≥ 98 %, then set VBW ≤ RBW / 100 (i.e., 10 ㎑), but not less than 10 Hz.

2) If the EUT D is < 98%, then set VBW ≥ 1 / T, where T is defined in item a1) of 12.2.

c) Video bandwidth mode or display mode:

1) The instrument shall be set with video filtering applied in the power domain. Typically, this requires setting the detector mode to RMS (power averaging) and setting the average-VBW type to power (rms).

2) As an alternative, the instrument may be set to linear detector mode. Video filtering shall be applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode to accomplish this. Others have a setting for average-VBW type, which can be set to “voltage” regardless of the display mode.

d) Detector = peak.

e) Sweep time = auto.

f) Trace mode = max hold.

g) Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98% duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of 1/x, where D is the duty cycle. For example, use at least 200 traces if the duty cycle is 25%. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 50 traces should be averaged.)

5.7.3 Test Result

- Complied

1. Conducted Spurious Emissions was shown in figure 3.
   Note: We took the insertion loss of the cable into consideration within the measuring instrument.
2. Measured value of the Field strength of spurious Emissions (Radiated)
3. It tested x,y and z – 3 axis each, mentioned only worst case data at this report.

- Below 1 ㎓ data (Worst-case: 8DPSK)

Lowest Channel (2 402 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 ㎒										
9.80	9	H	35.70	1.37	-32.67	19.70	-11.60	24.10	48.60	24.50
24.51	9	H	33.80	3.27	-32.68	19.21	-10.20	23.60	48.00	24.40
Quasi-Peak DATA. Emissions below 1 ㎓										
46.49	120	V	41.80	1.40	-30.83	15.68	-13.75	28.05	40.00	11.95
78.14	120	H	39.60	1.86	-34.92	12.99	-20.07	19.53	40.00	20.47
344.04	120	H	41.90	4.18	-35.40	20.30	-10.92	30.98	46.00	15.02
406.72	120	H	45.00	4.60	-35.66	21.81	-9.25	35.75	46.00	10.25
469.29	120	H	40.90	4.96	-35.79	22.81	-8.02	32.88	46.00	13.12
825.04	120	H	39.40	6.70	-34.43	25.90	-1.83	37.57	46.00	8.43

NOTE 1. Factor = Cable loss + Amplifier gain + Antenna factor
NOTE 2. Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site.
Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB414788.
NOTE 3. Duty Cycle Correction Factor Calculation
- Worst case : AFH mode
- Channel hop rate = 800 hops/second
- Hopping rate for DH5 mode = 133.33 hops/second
- Time per channel hop = 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50 x 20 channels(AFH mode) = 150 ms
- Number of times transmitter hits on one channel = 100 ms / Time to cycle through all channels [ms] = 100 ms / 150 ms = 1 time
- Worst case Dwell time = 7.5 ms
- Duty Cycle Correction Factor = 20log(7.5 ms/100 ms) = -22.5 dB

- Above 1 ㎓ data

GFSK_Lowest channel (2 402 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(μV)]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	DCCF [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓											
1 555.86[1)]	1 000	V	85.50	3.00	-63.43	26.02	-34.41	-	51.09	74.00	22.91
2 370.74[2)]	1 000	H	68.34	3.69	-63.08	28.50	-30.89	-	37.45	74.00	36.55
3 241.88	1 000	H	82.13	4.29	-62.03	30.35	-27.39	-	54.74	74.00	19.26
4 803.97[3)]	1 000	H	88.38	5.34	-61.21	32.80	-23.07	-	65.31	74.00	8.69
14 957.27	1 000	V	59.54	9.75	-56.02	40.33	-5.94	-	53.60	74.00	20.40
21 877.59	1 000	V	46.89	12.10	-49.53	45.00	7.57	-	54.47	74.00	19.53
26 086.16	1 000	H	46.34	13.70	-46.66	45.70	12.74	-	59.09	74.00	14.91
Average DATA. Emissions above 1 ㎓											
1 555.86[1)]	1 000	V	57.60	3.00	-63.43	26.02	-34.41	-	23.19	54.00	30.81
2 370.74[2)]	1 000	H	68.34	3.69	-63.08	28.50	-30.89	-22.50	14.95	54.00	39.05
4 803.97[3)]	1 000	H	88.38	5.34	-61.21	32.80	-23.07	-22.50	42.81	54.00	11.19

[1)] Restricted band
[2)] Bandedge
[3)] Harmonic

GFSK_Middle channel (2 441 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(μV)]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	DCCF [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓											
1 626.80	1 000	V	73.17	3.07	-63.35	26.31	-33.97	-	39.20	74.00	34.80
3 287.58	1 000	H	79.15	4.32	-62.02	30.48	-27.22	-	51.93	74.00	22.07
4 881.98[1)]	1 000	H	83.33	5.39	-61.12	32.84	-22.89	-	60.43	74.00	13.57
15 233.22	1 000	V	59.56	9.84	-56.47	39.65	-6.98	-	52.58	74.00	21.42
21 786.75	1 000	V	47.97	12.10	-49.54	45.00	7.56	-	55.53	74.00	18.47
25 996.91	1 000	V	44.66	13.70	-46.60	45.70	12.80	-	57.46	74.00	16.54
Average DATA. Emissions above 1 ㎓											
4 881.98[1)]	1 000	H	83.33	5.39	-61.12	32.84	-22.89	-22.50	37.93	54.00	16.07

[1)] Harmonic

GFSK_Highest channel (2 480 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(μV)]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	DCCF [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓											
2 488.44[1,2)]	1 000	V	68.66	3.77	-63.08	28.73	-30.58	-	38.08	74.00	35.92
3 320.00	1 000	H	81.79	4.34	-61.95	30.56	-27.05	-	54.74	74.00	19.26
4 960.00[3)]	1 000	H	84.67	5.44	-60.94	32.88	-22.62	-	62.05	74.00	11.95
15 019.34	1 000	V	60.27	9.76	-56.12	40.25	-6.11	-	54.15	74.00	19.85
21 908.94	1 000	V	48.55	12.10	-49.52	45.00	7.58	-	56.13	74.00	17.87
25 976.19	1 000	H	44.68	13.60	-46.55	45.70	12.75	-	57.44	74.00	16.56
Average DATA. Emissions above 1 ㎓											
2 488.44[1,2)]	1 000	V	68.66	3.77	-63.08	28.73	-30.58	-22.50	15.58	54.00	38.42
4 960.00[3)]	1 000	H	84.67	5.44	-60.94	32.88	-22.62	-22.50	39.55	54.00	14.45

[1)] Restricted band
[2)] Bandedge
[3)] Harmonic

8DPSK_Lowest channel (2 402 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(μV)]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	DCCF [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓											
2 380.16[1)]	1 000	H	67.35	3.70	-63.11	28.52	-30.89	-	36.69	74.00	37.31
3 242.11	1 000	H	81.33	4.29	-62.03	30.35	-27.39	-	45.95	74.00	28.05
4 803.99[2)]	1 000	H	83.59	5.34	-61.21	32.80	-23.07	-	60.52	74.00	13.48
15 027.95	1 000	V	59.96	9.77	-56.14	40.22	-6.15	-	53.81	74.00	20.19
21 819.16	1 000	H	47.17	12.10	-49.53	45.00	7.57	-	54.73	74.00	19.27
26 046.31	1 000	H	45.04	13.70	-46.63	45.70	12.77	-	57.82	74.00	16.18
Average DATA. Emissions above 1 ㎓											
2 380.16[1)]	1 000	H	67.35	3.70	-63.11	28.52	-30.89	-22.50	13.95	54.00	40.05
4 803.99[2)]	1 000	H	83.59	5.34	-61.21	32.80	-23.07	-22.50	38.02	54.00	15.98

[1)] Restricted band
[2)] Harmonic

8DPSK _Middle channel (2 441 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(μV)]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	DCCF [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓											
1 243.91	1 000	H	68.49	2.70	-63.95	24.78	-36.47	-	32.02	74.00	41.98
3 280.86	1 000	H	73.44	4.32	-62.02	30.46	-27.24	-	46.19	74.00	27.81
4 882.05[1)]	1 000	H	76.87	5.39	-61.12	32.84	-22.89	-	53.97	74.00	20.03
15 013.91	1 000	H	60.29	9.76	-56.11	40.26	-6.09	-	54.19	74.00	19.81
21 906.28	1 000	V	47.41	12.10	-49.52	45.00	7.58	-	54.99	74.00	19.01
26 231.72	1 000	H	44.87	13.70	-46.67	45.60	12.63	-	57.50	74.00	16.50
Average DATA. Emissions above 1 ㎓											
4 882.05[1)]	1 000	H	76.87	5.39	-61.12	32.84	-22.89	-22.50	31.47	54.00	22.53

[1)] Harmonic

8DPSK_Highest channel (2 480 ㎒)

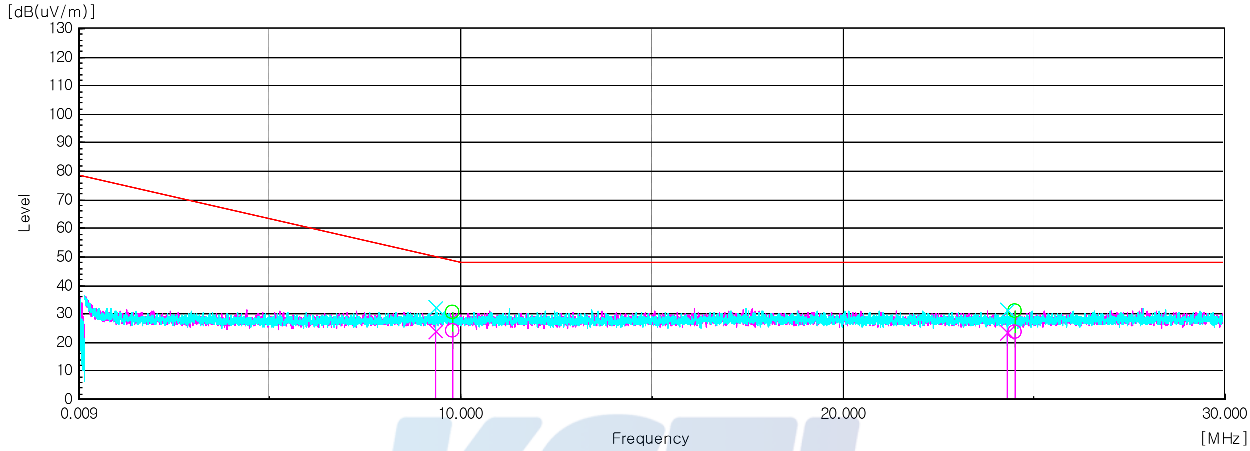
Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(μV)]	Cable Loss [dB]	Amp Gain [dB]	Antenna Factor [dB]	Factor [dB]	DCCF [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓											
2 488.80[1)]	1 000	V	67.92	3.78	-63.08	28.73	-30.57	-	37.35	74.00	36.65
3 326.48	1 000	H	77.32	4.35	-61.95	30.58	-27.02	-	50.30	74.00	23.70
4 960.00[2)]	1 000	H	77.39	5.44	-60.94	32.88	-22.62	-	54.77	74.00	19.23
15 027.05	1 000	V	59.74	9.77	-56.14	40.22	-6.15	-	53.60	74.00	20.40
21 799.23	1 000	V	47.41	12.10	-49.54	45.00	7.56	-	54.97	74.00	19.03
25 670.19	1 000	H	46.00	13.40	-46.86	45.50	12.04	-	58.05	74.00	15.95
Average DATA. Emissions above 1 ㎓											
2 488.80[1)]	1 000	V	67.92	3.78	-63.08	28.73	-30.57	-22.50	14.85	54.00	39.15
4 960.00[2)]	1 000	H	77.39	5.44	-60.94	32.88	-22.62	-22.50	32.27	54.00	21.73

[1)] Restricted band
[2)] Harmonic

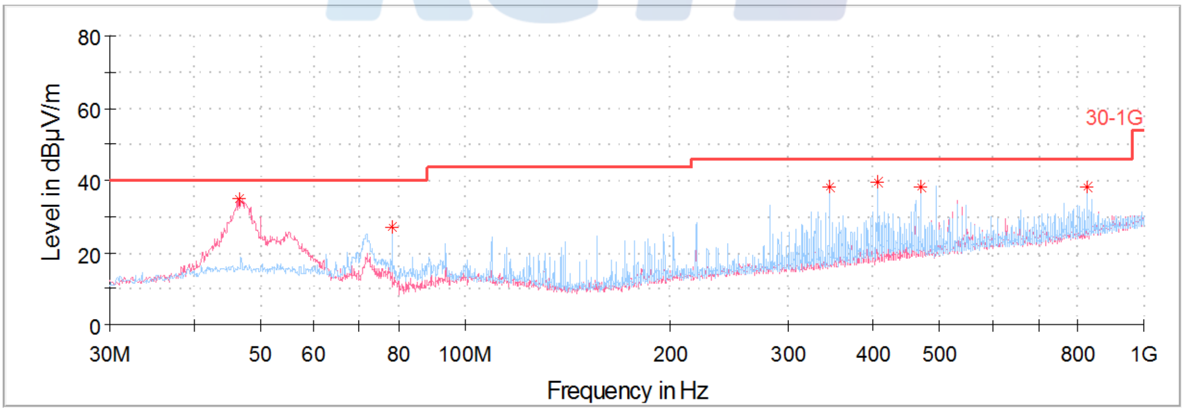
5.7.3.1 Test Plot

Figure 1. Plot of the Spurious Emissions (Radiated)

- 9 ㎑ ~ 30 ㎒ data



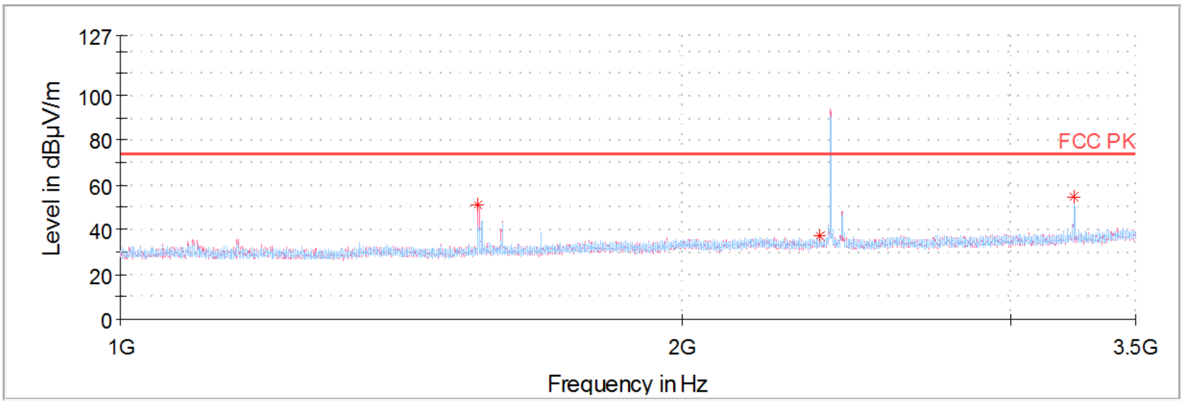
- 30 ㎒ ~ 1 ㎓ data



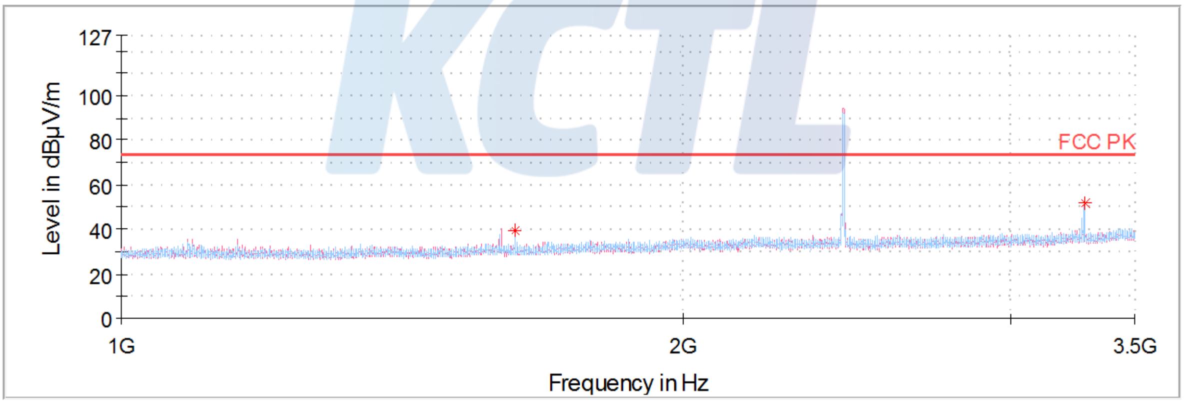
- 1 ㎓ ~ 3.5 ㎓ data

- GFSK

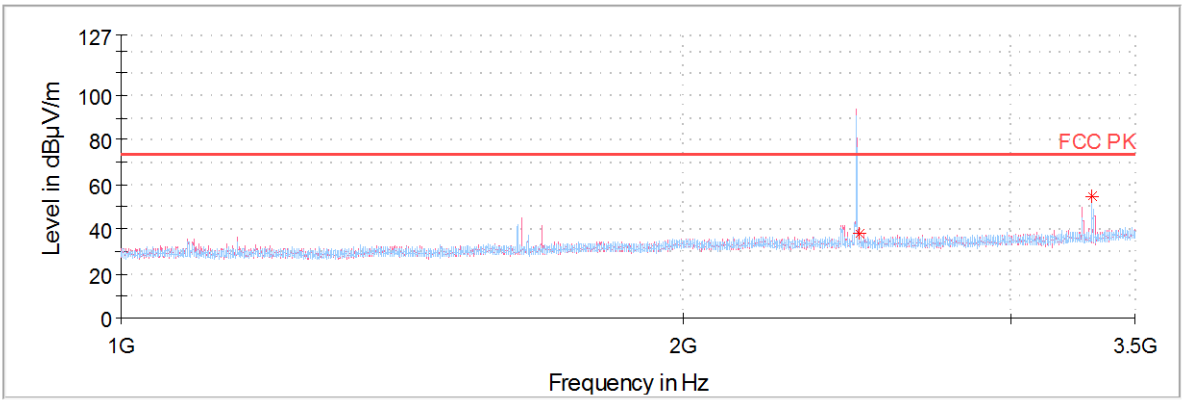
Lowest channel (2 402 ㎒)



Middle channel (2 441 ㎒)



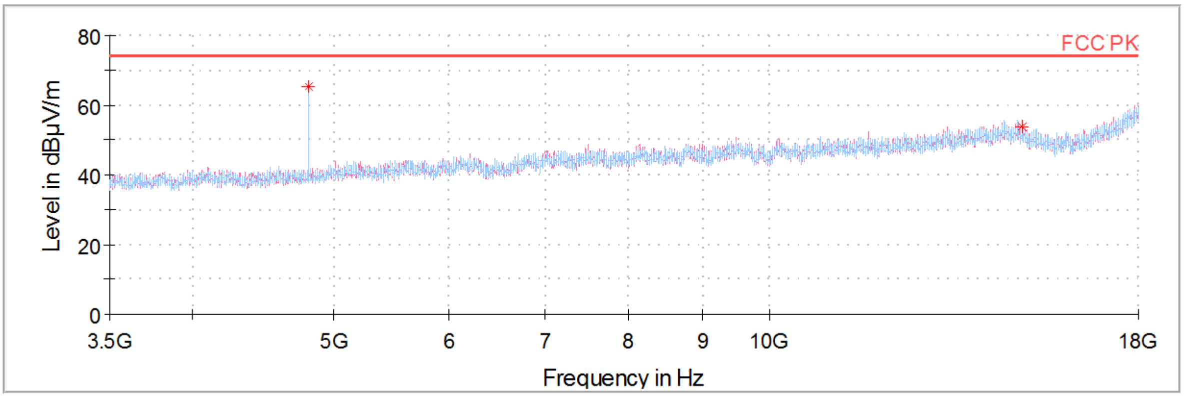
Highest channel (2 480 ㎒)



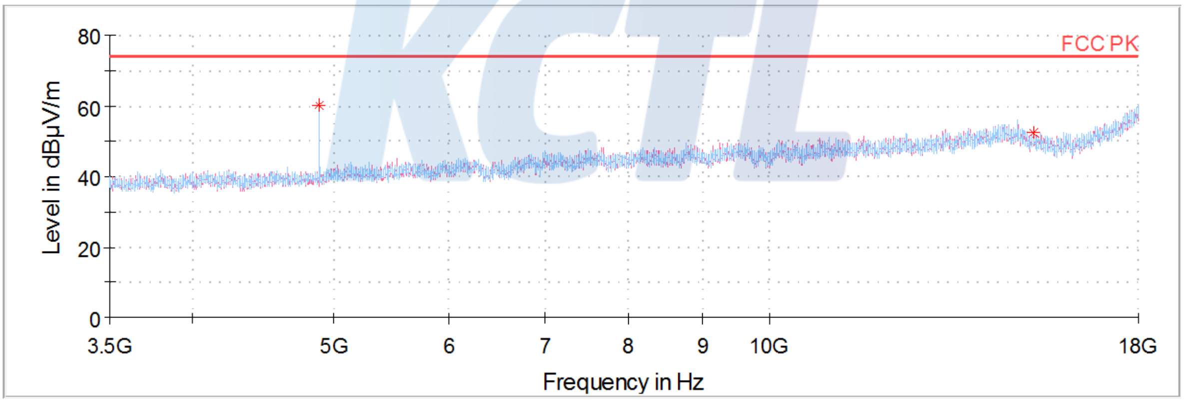
- 3.5 ㎓ ~ 18 ㎓ data

- GFSK

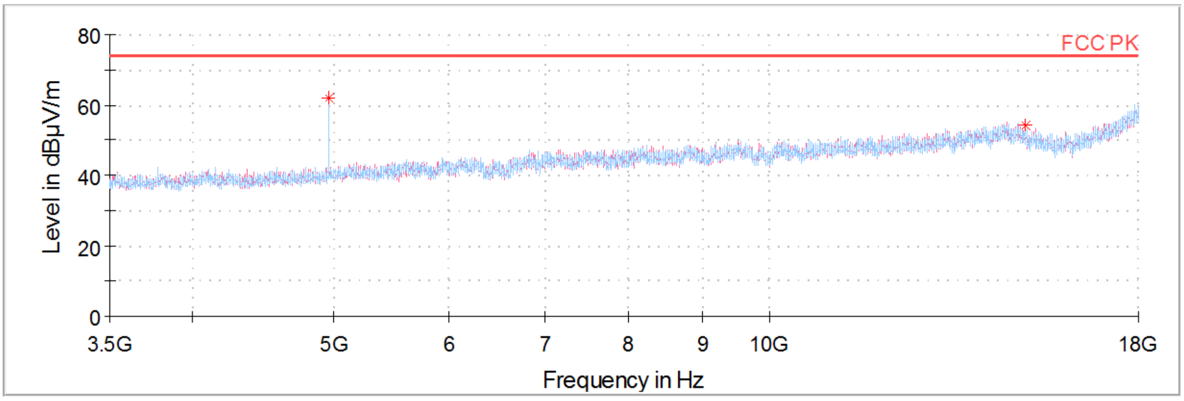
Lowest channel (2 402 ㎒)



Middle channel (2 441 ㎒)



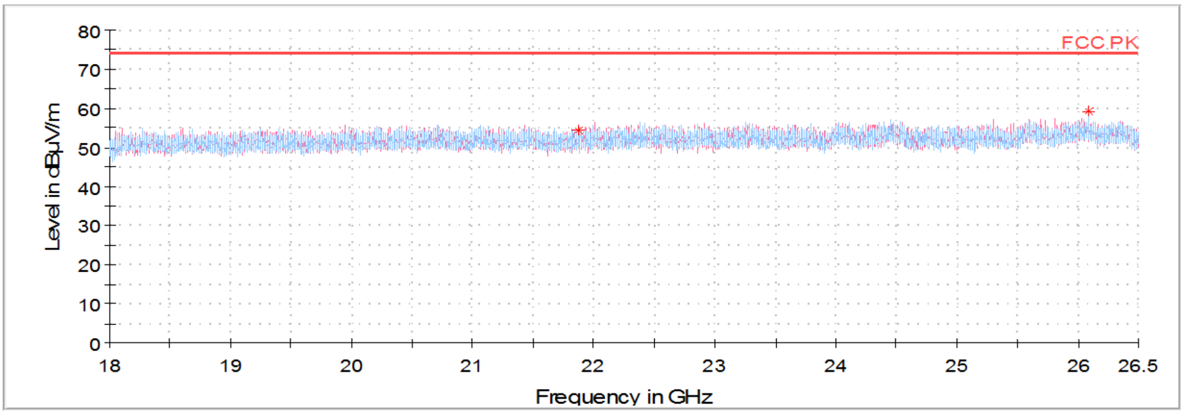
Highest channel (2 480 ㎒)



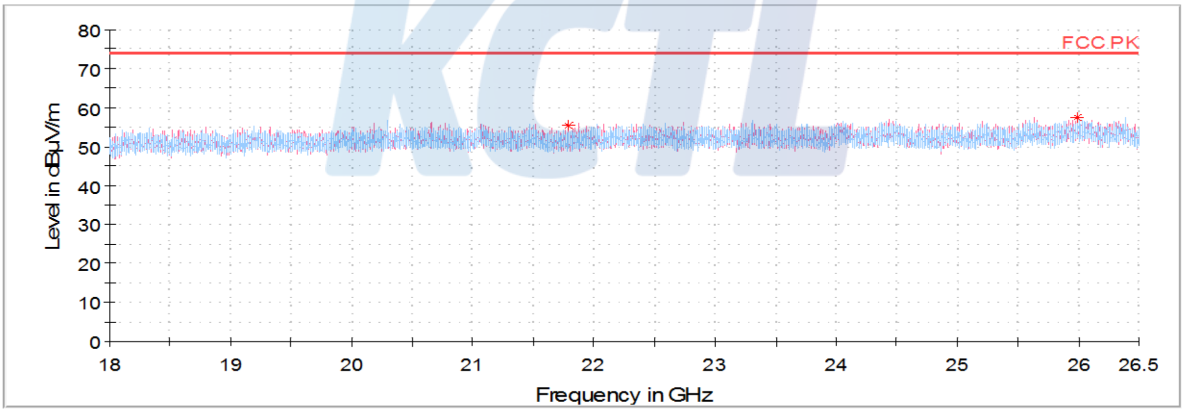
- 18 ㎓ ~ 26.5 ㎓ data

- GFSK

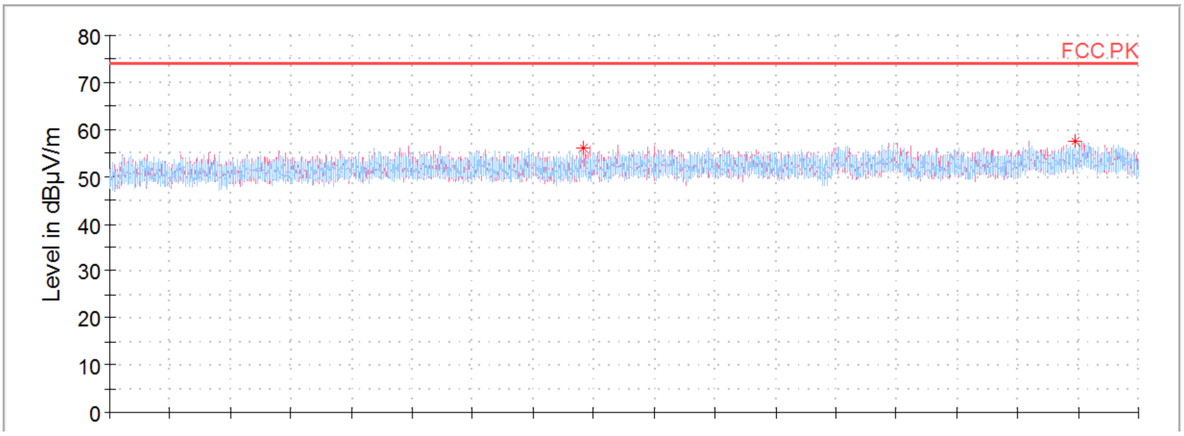
Lowest channel (2 402 ㎒)



Middle channel (2 441 ㎒)



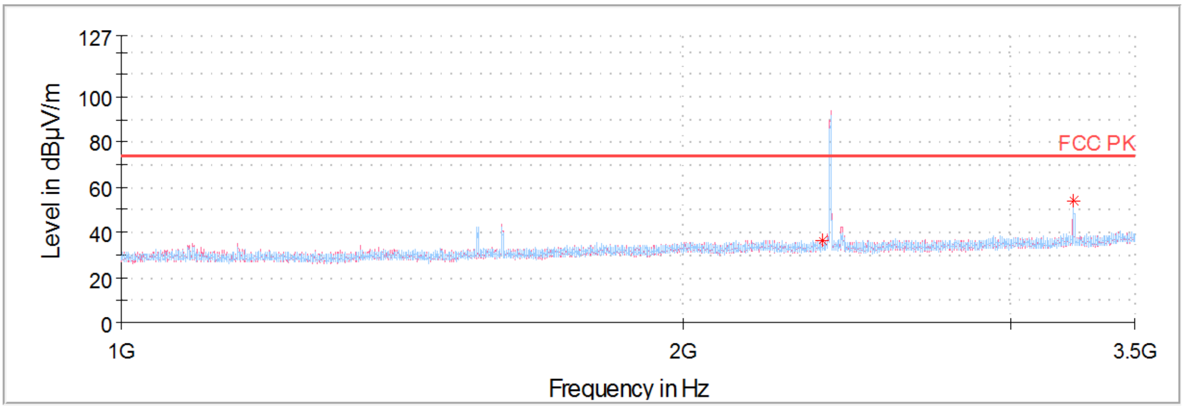
Highest channel (2 480 ㎒)



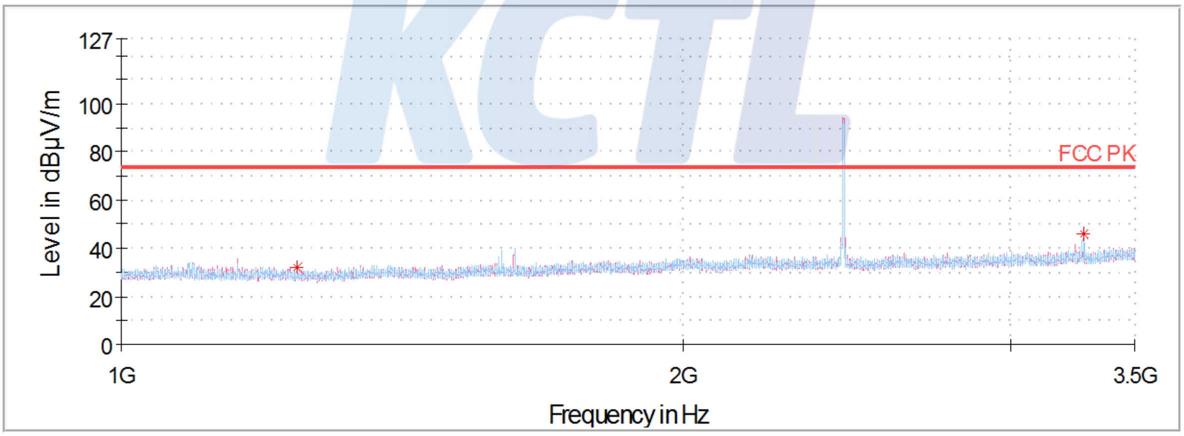
- 1 ㎓ ~ 3.5 ㎓ data

- 8DPSK

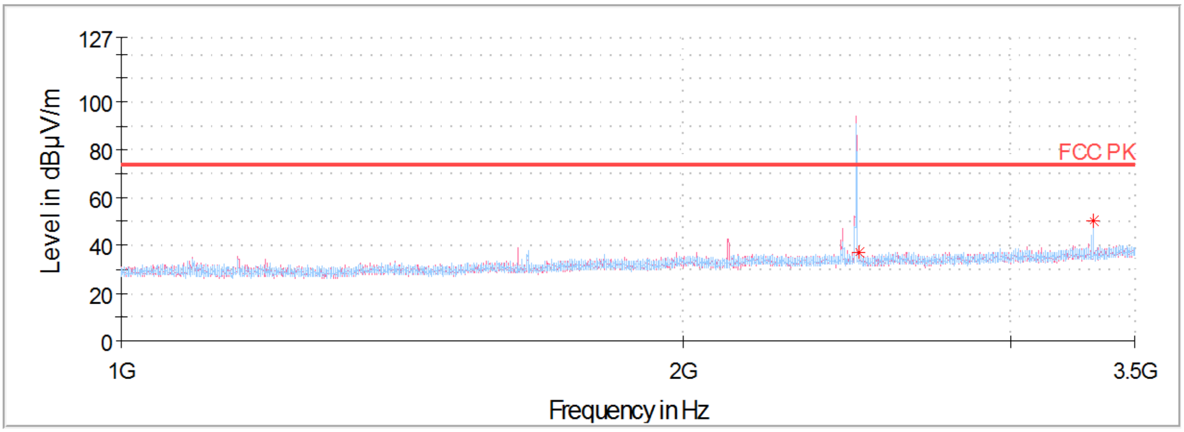
Lowest channel (2 402 ㎒)



Middle channel (2 441 ㎒)



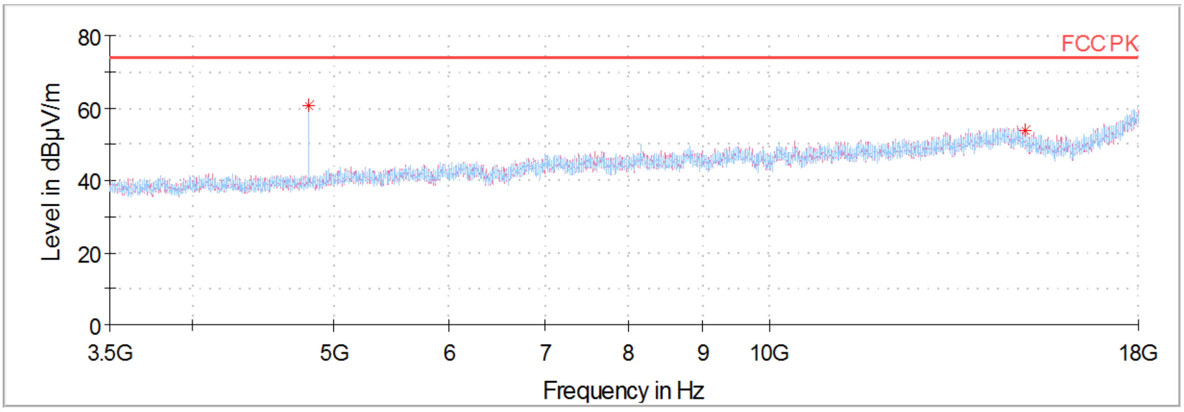
Highest channel (2 480 ㎒)



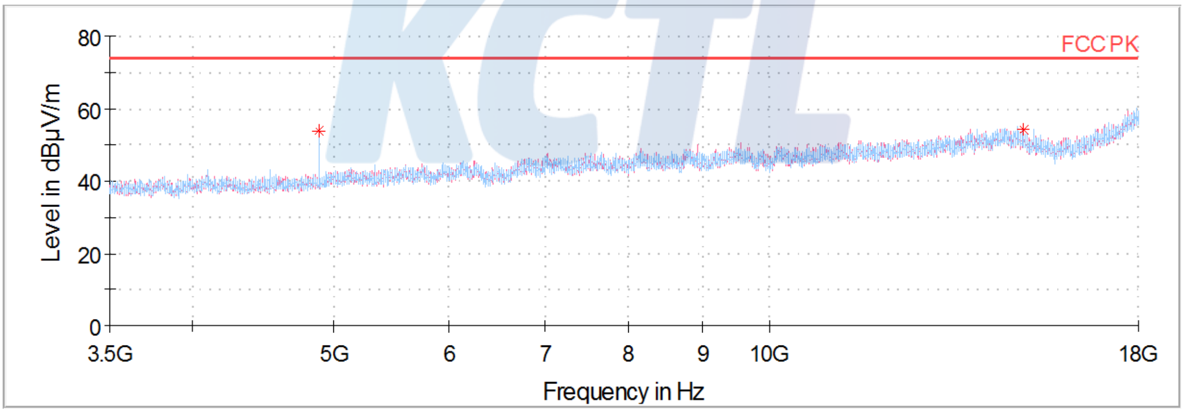
- 3.5 ㎓ ~ 18 ㎓ data

- 8DPSK

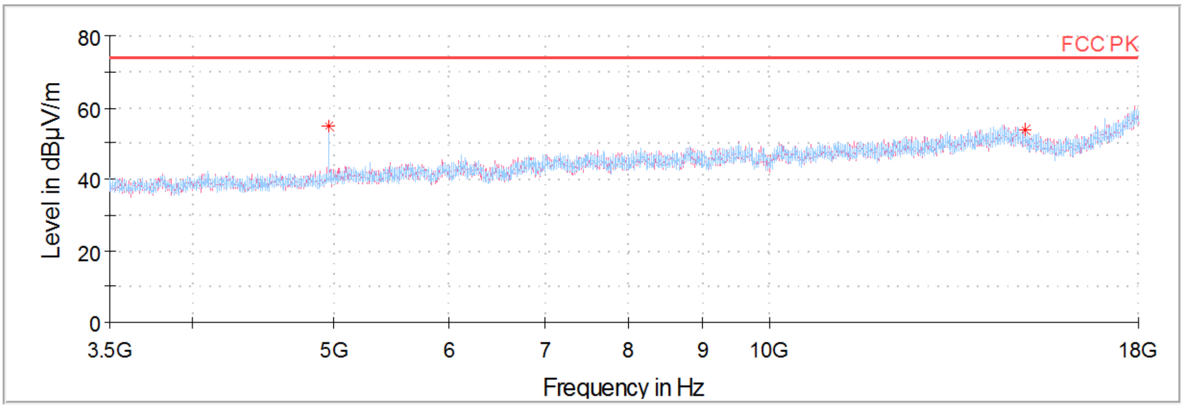
Lowest channel (2 402 ㎒)



Middle channel (2 441 ㎒)



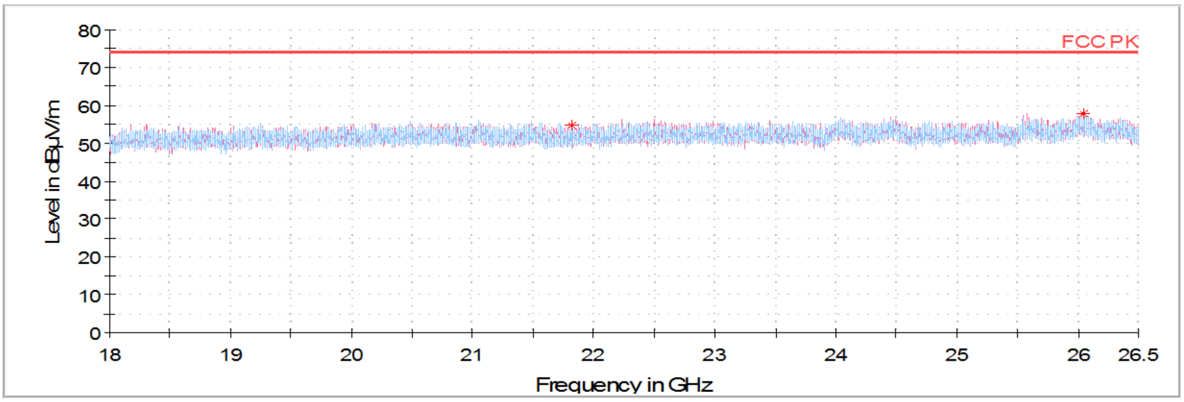
Highest channel (2 480 ㎒)



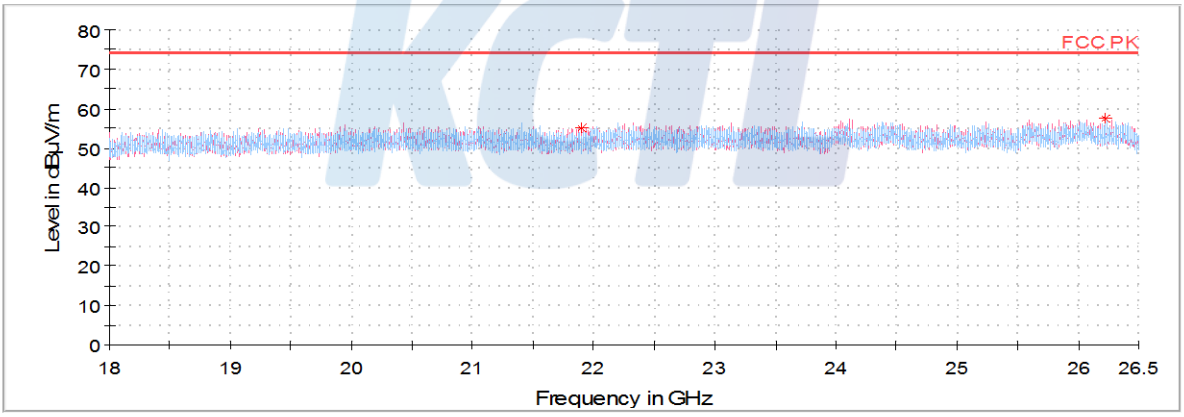
- 18 ㎓ ~ 26.5 ㎓ data

- 8DPSK

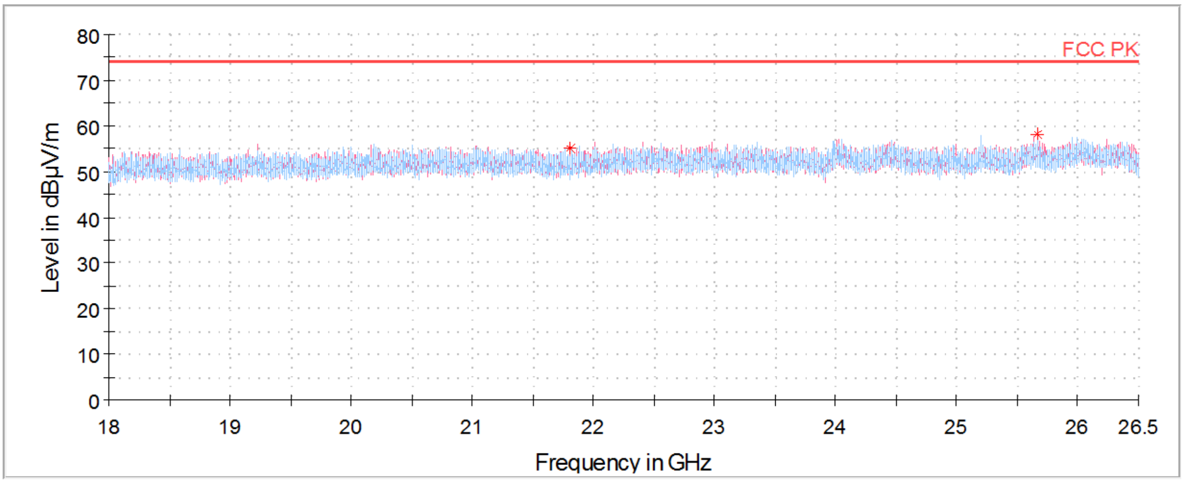
Lowest channel (2 402 ㎒)



Middle channel (2 441 ㎒)



Highest channel (2 480 ㎒)

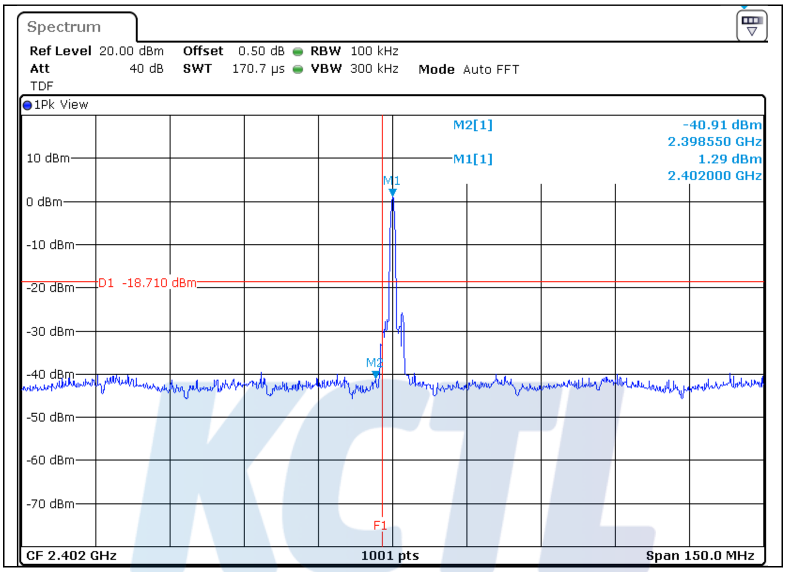


5.7.4 Test Plot

Figure 5. Plot of the Band Edge (Conducted)

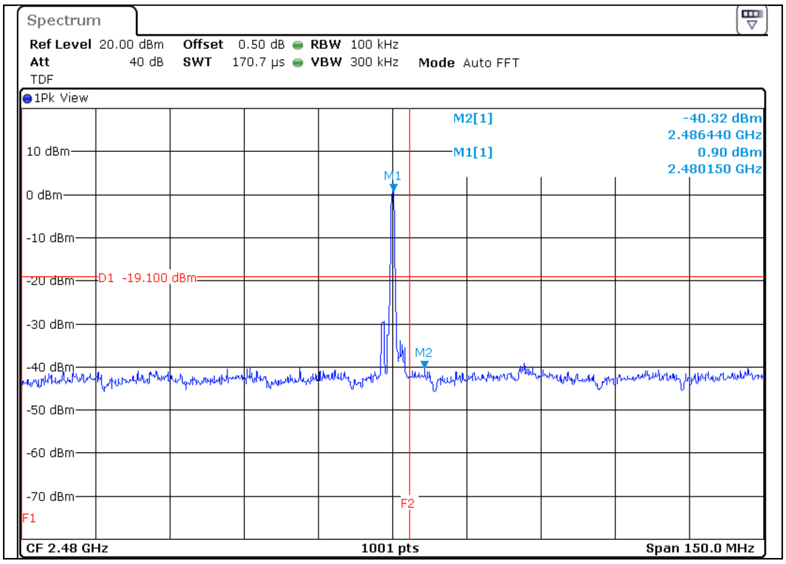
- GFSK (Without hopping)

Lowest Channel (2 402 ㎒)



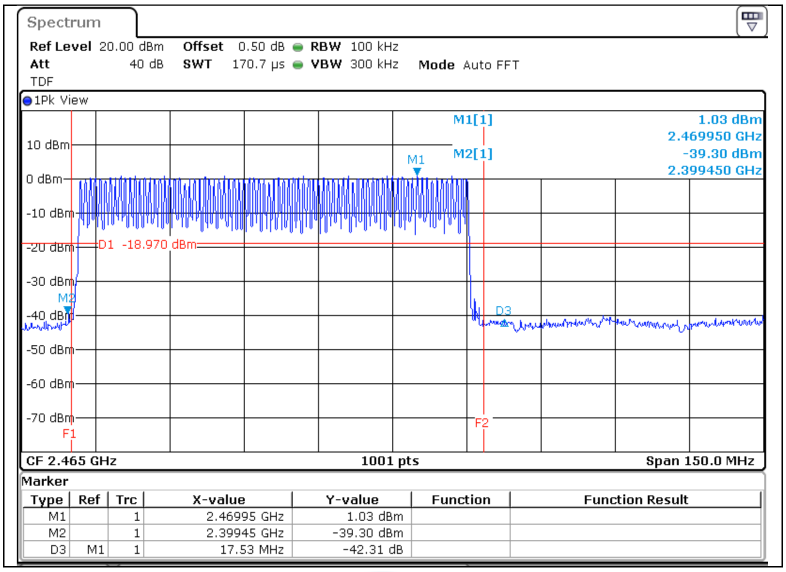
- Result of 2 400.0 ㎒

Highest Channel (2 480 ㎒)



- Result of 2 483.5 ㎒

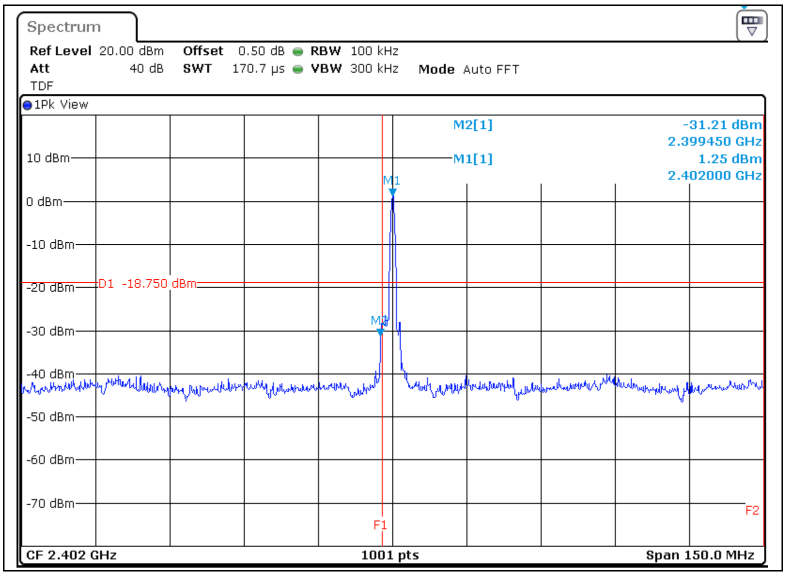
- GFSK (With hopping)



- Result of 2 400.0 ㎒ - 2 483.5 ㎒

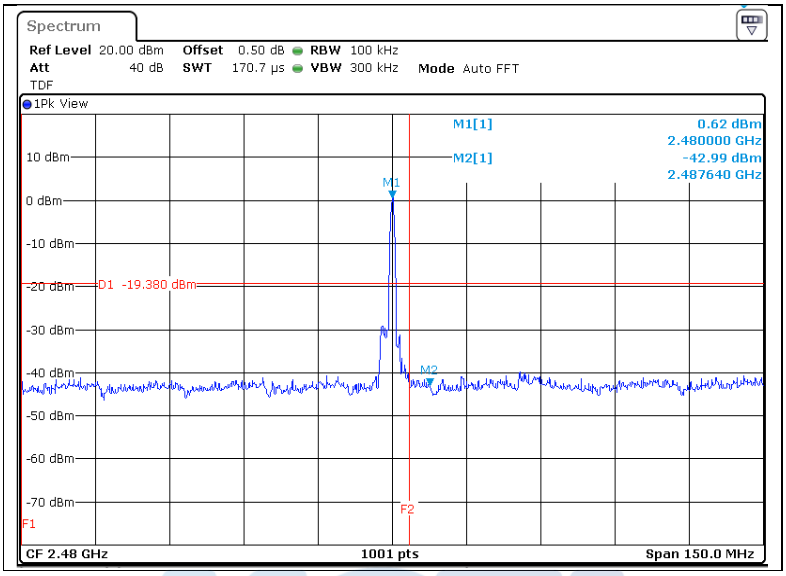
- 8DPSK (Without hopping)

Lowest Channel (2 402 ㎒)



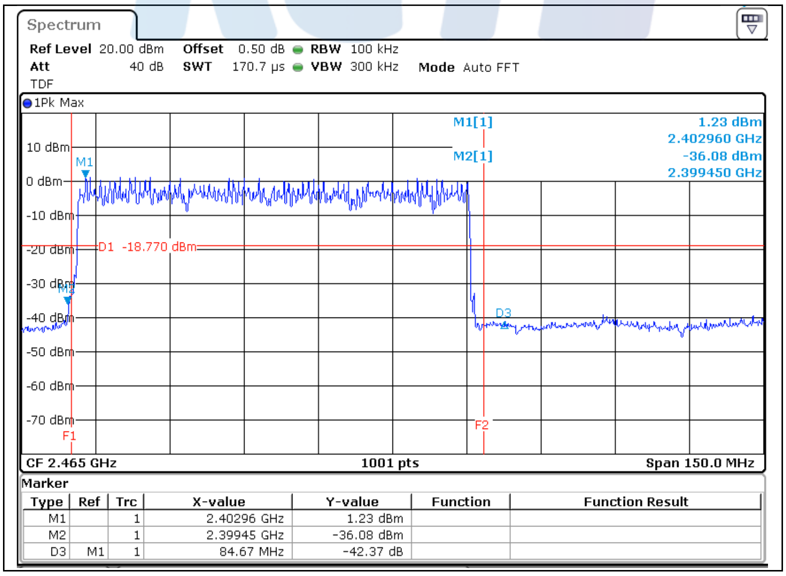
- Result of 2 400.0 ㎒

Highest Channel (2 480 ㎒)



- Result of 2 483.5 ㎒

- 8DPSK (With hopping)

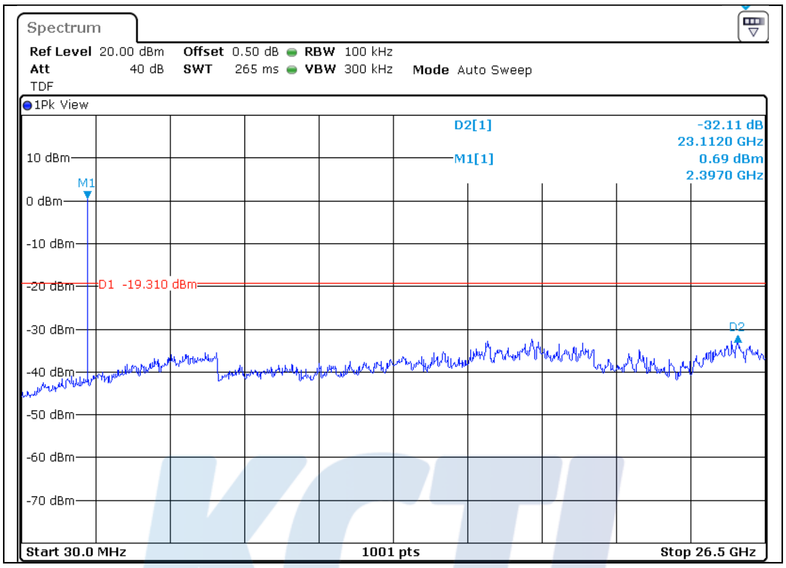


- Result of 2 400.0 ㎒ - 2 483.5 ㎒

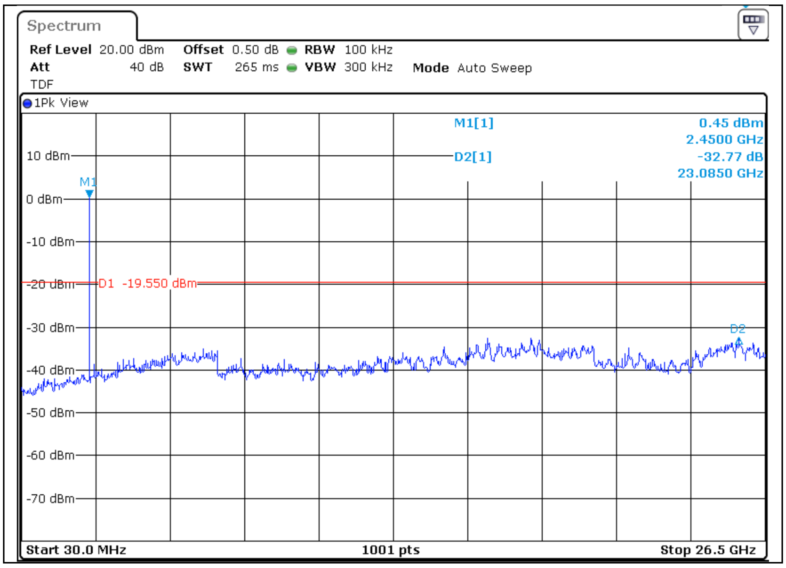
Figure 6. Plot of the Spurious RF conducted emissions

- GFSK

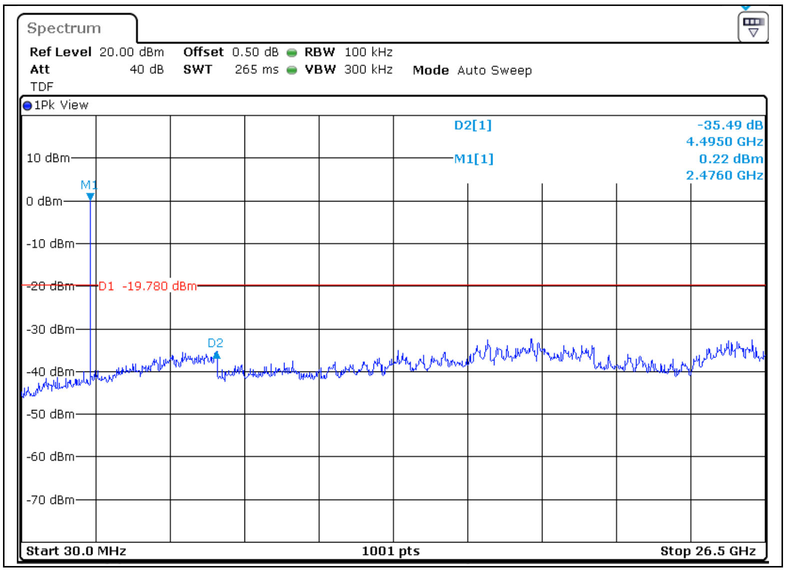
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)

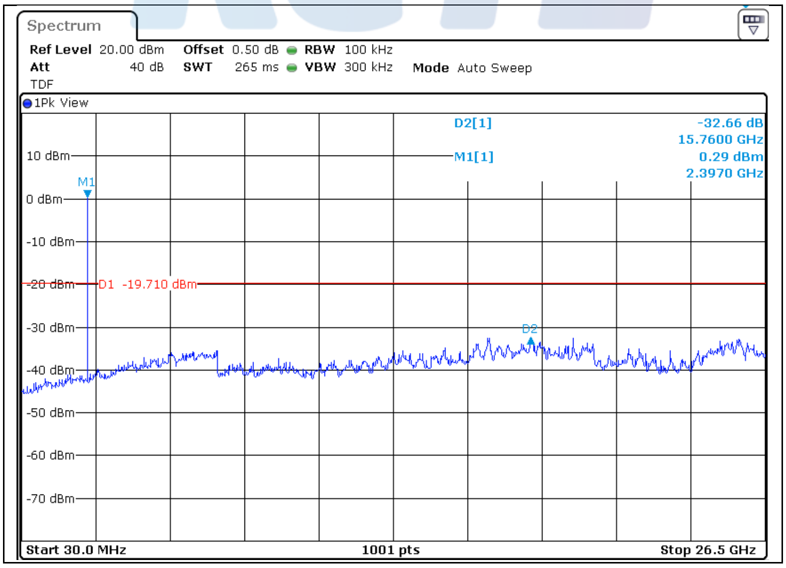


Highest Channel (2 480 ㎒)

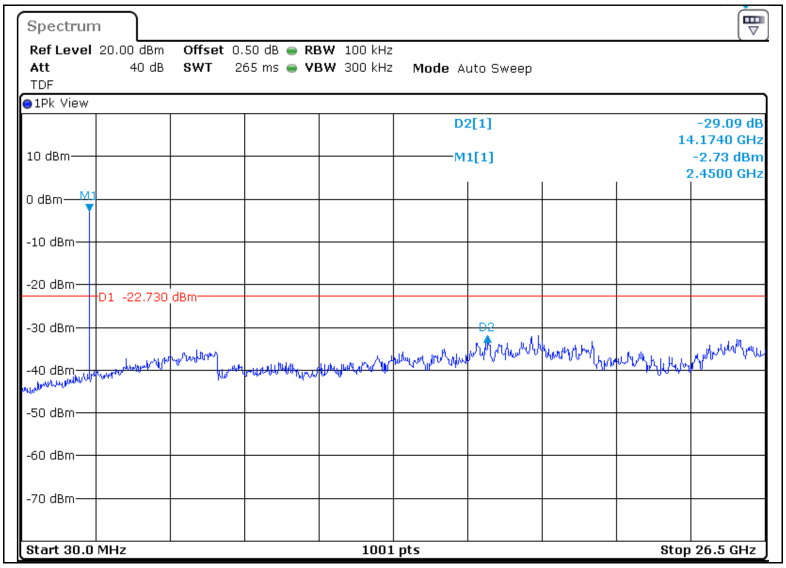


- 8DPSK

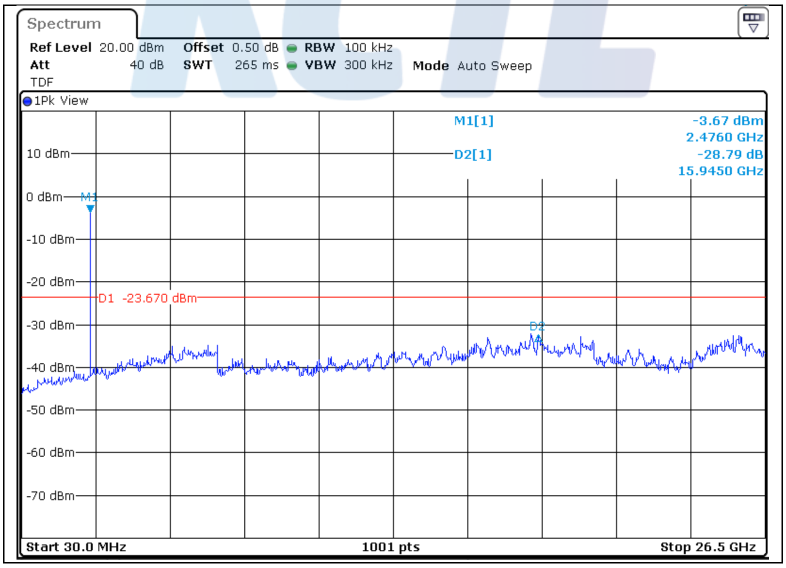
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)



Highest Channel (2 480 ㎒)



6. Test equipment used for test

	Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
■	Spectrum Analyzer	R & S	FSV30	100810	18.08.01
■	DC Power Supply	Agilent	E3632A	MY40007371	18.07.06
■	Bluetooth Tester	TESCOM	TC-3000B	3000B640056	19.01.31
■	Power Divider	Aeroflex/ Weinschel,Inc	1580-1	PE430	18.09.28
■	Wideband Power Sensor	R & S	NRP-Z81	102398	19.01.31
■	ATTENUATOR	R & S	DNF Dämpfungsglied 10 dB in N-50 Ohm	31212	18.05.15
■	EMI TEST RECEIVER	R&S	ESCI 3	101408	18.08.24
■	Bi-Log Antenna	SCHWARZBECK	VULB 9163	552	18.05.10
■	Amplifier	SONOMA INSTRUMENT	310N	284608	18.08.24
■	AMPLIFIER	SONOMA	310N	186402	19.01.05
■	AMPLIFIER	SONOMA	310N	344922	18.08.25
■	Horn antenna	ETS.lindgren	3116	00086635	18.04.25
■	Horn antenna	ETS.lindgren	3115	62589	18.11.21
■	AMPLIFIER	L-3 Narda-MITEQ	AMF-7D-01001800-22-10P	2003683	18.06.12
■	AMPLIFIER	L-3 Narda-MITEQ	JS44-18004000-33-8P	2000997	18.08.09
■	LOOP Antenna	R & S	HFH2-Z2	100355	20.01.31
■	Antenna Mast	Innco Systems	MA4640-XP-ET	-	-
■	Turn Table	Innco Systems	DT2000	79	-
■	Antenna Mast	Innco Systems	MA4000-EP	303	-
■	Highpass Filter	WT	WT-A1698-HS	WT160411001	18.05.15
■	Vector Signal Generator	R & S	SMBV100A	257566	19.01.05
■	Signal Generator	R & S	SMR40	100007	18.05.15
■	Cable Assembly	RadiAll	2301761768000PJ	17.30.38	-
■	Cable Assembly	gigalane	RG-400	-	-
■	Cable Assembly	HUBER+SUHNER	SUCOFLEX 104	MY4342/4	-