TEST REPORT

KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 443-390, Korea TEL: 82 70 5008 1021 FAX: 82 505 299 8311	Report No.: KCTL15-FR0057 Page(1) / (47) Pages	KCTL http://www.kctl.co.kr

1. Applicant

Name: MOTREX CO., LTD.

Address: (Mullae-dong3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongjin-ro, Yeongdeungpo-gu, Seoul, Korea

2. Sample Description:

FCC ID: BP9-MTXM100TL

Type of equipment: Car Audio Video System

Basic Model: MTXM100TL

3. Date of Test: August 24 ~ August 26, 2015

4. Test method used: FCC Part 15 Subpart C 15.247

5. Test Results

Test Item: Refer to page 7

Result: Refer to page 8 ~ page 46

Measurement Uncertainty: Refer to page 7

This result shown in this report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by Name: NAM, TAEK YONG	Technical Manager Name: SON, MIN GI

2015. 10. 21

KCTL Inc. Testing Laboratory

[Contents]

1. Client information

Applicant:	MOTREX CO., LTD.
Address:	(Mullae-dong3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongjin-ro, Yeongdeungpo-gu, Seoul, Korea
Telephone number:	+81-70-4892-6206
Facsimile number:	+81-2-6280-1170
Contact person:	Cha Hye Ran / chahyeran@motrex.co.kr

Manufacturer:	MOTREX CO., LTD.
Address:	(Mullae-dong3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongjin-ro, Yeongdeungpo-gu, Seoul, Korea

2. Laboratory information

Address

KCTL Ltd.
65 Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea
Telephone Number: 82-70-5008-1016   Facsimile Number: 82-505-299-8311

Certificate

KOLAS No.: 231
FCC Site Designation No: KR0040
FCC Site Registration No: 687132
VCCI Site Registration No.: R-3327, G-198, C-3706, T-1849
IC Site Registration No.:8035A-2

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant:	MOTREX CO., LTD.
Address of Applicant	(Mullae-dong3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongjin-ro, Yeongdeungpo-gu, Seoul, Korea
Manufacturer	MOTREX CO., LTD.
Address of Manufacturer	(Mullae-dong3(sam)-ga, Ace High-Tech City B/D), 1-1103, 775, Gyeongjin-ro, Yeongdeungpo-gu, Seoul, Korea
Type of equipment	Car Audio Video System
Basic Model	MTXM100TL
Serial number	N/A

3.2 General description

Frequency Range	2 402 ㎒ ~ 2 480 ㎒ (Bluetooth), 2 412 ㎒ ~ 2 462 ㎒ (802.11b/g/n_HT20)
Type of Modulation	GFSK, π/4DQPSK, 8DPSK (Bluetooth), DSSS (802.11b), OFDM (802.11g/n_HT20)
Number of Channels	79 ch (Bluetooth), 11 ch (802.11b/g/n_HT20)
Type of Antenna	Chip Antenna
Antenna Gain	1.99 dBi (Bluetooth, 802.11b/g/n_HT20)
Transmit Power	6.28 dBm
Power supply	DC 12 V
Product SW/HW version	1.0
Radio SW/HW version	1.0
Test SW Version	CSR BlueTest3 V2.4.8.0
RF power setting in TEST SW	Default

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

3.3 Test frequency

	Frequency
Low frequency	2 402 ㎒
Middle frequency	2 441 ㎒
High frequency	2 480 ㎒

3.4 Test Voltage

Mode	Voltage
Norminal voltage	DC 12 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	IC Rule	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	-	Antenna Requirement	5.1	C
15.247(b)(1), (4)	RSS-247, 5.4 (2)	Maximum Peak Output Power	5.2	C
15.247(a)(1)	RSS-247, 5.1 (2)	Carrier Frequency Separation	5.3	C
15.247(a)(1)	RSS-247, 5.1 (1)	20dB Channel Bandwidth	5.4	C
-	RSS-GEN, 6.6	Occupied Bandwidth	5.4	C
15.247(a)(iii) 15.247(b)(1)	RSS-247, 5.1	Nunber of Hopping Channel	5.5	C
15.247(a) (iii)	RSS-247, 5.1 (4)	Time of Occupancy(Dwell Time)	5.6	C
15.247(d), 15.205(a), 15.209(a)	RSS-247, 5.5 RSS-GEN, 8.9, 10	Spurious Emission, BandEdge, Restricted Band	5.7	C
15.207(a)	RSS-GEN, 8.8V	Conducted Emissions	-	N/A1)

Note: C=complies
NC= Not complies
NT=Not tested
NA=Not Applicable

N/A1) : 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 method of measurement used to test this DSS device is FCC Public Notice DA 00-705
* The general test methods used to test on this device are ANSI C63.10:2013

4.2 Uncertainty

Measurement Item	Expanded Uncertainty U = KUc (K = 2)	
Conducted RF power	± 1.30 dB	
Conducted Spurious Emissions	± 1.52 dB	
Radiated Spurious Emissions	30 MHz ~ 300 MHz:	+ 4.94 dB, - 5.06 dB
		+ 4.93 dB, - 5.05 dB
	300 MHz ~ 1 000 MHz:	+ 4.97 dB, - 5.08 dB
		+ 4.84 dB, - 4.96 dB
	1 GHz ~ 25 GHz:	+ 6.03 dB, - 6.05 dB
Conducted Emissions	9 kHz ~ 150 kHz:	± 3.75 dB
	150 kHz ~ 30 MHz:	± 3.36 dB

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 a Chip antenna. The transmitter has a Internal Antenna which is attached on PCB board permanently.

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 2400-2483.5 ㎒ 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 2400-2483.5 ㎒ band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 ㎒ band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 ㎒ 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 ㏈i. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 ㏈i 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 ㏈i.

5.2.2 Measurement Procedure

The method of measurement used to test this DSS device is FCC Public Notice DA 00-705.

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface or Bluetooth tester and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer as follows: Span = approximately 5 times the 20 ㏈ bandwidth, centered on a hopping channel RBW > the 20 ㏈ bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold
5. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
6. Repeat above procedures until all frequencies measured were complete.

5.2.3 Test Result

- Complied

* GFSK

Channel	Frequency (㎒)	Result (dBm)	Limit (dBm)	Margin (dB)	Avarage Power (dBm)
Low	2 402	5.19	30.00	24.81	4.10
Middle	2 441	6.22	30.00	23.78	5.09
High	2 480	6.28	30.00	23.72	5.53

* 8DPSK

Channel	Frequency (㎒)	Result (dBm)	Limit (dBm)	Margin (dB)	Avarage Power (dBm)
Low	2 402	3.90	20.97	17.07	0.10
Middle	2 441	4.79	20.97	16.18	1.30
High	2 480	4.85	20.97	16.12	1.76

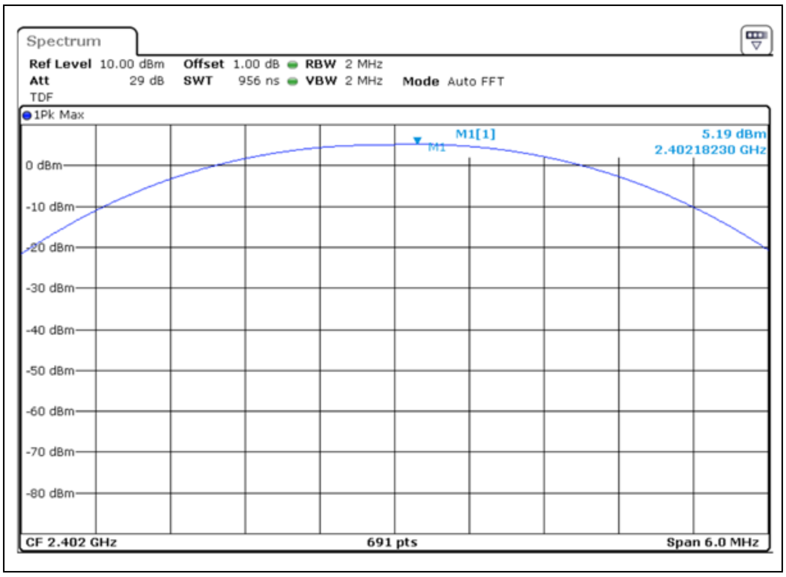
NOTE:
1. Since the directional gain of the Chip antenna declared by the manufacturer (G_{ANT} = 1.99 dBi) does not exceed 6.0 dBi, there was no need to reduce the output power.
2. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.2.4 Test Plot

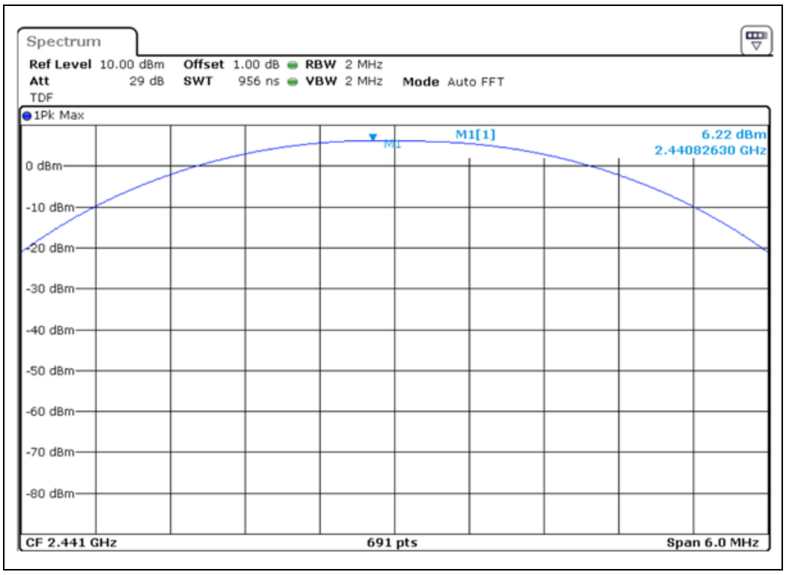
Figure 1. Plot of the Maximum Peak Output Power (Conducted)

*** GFSK**

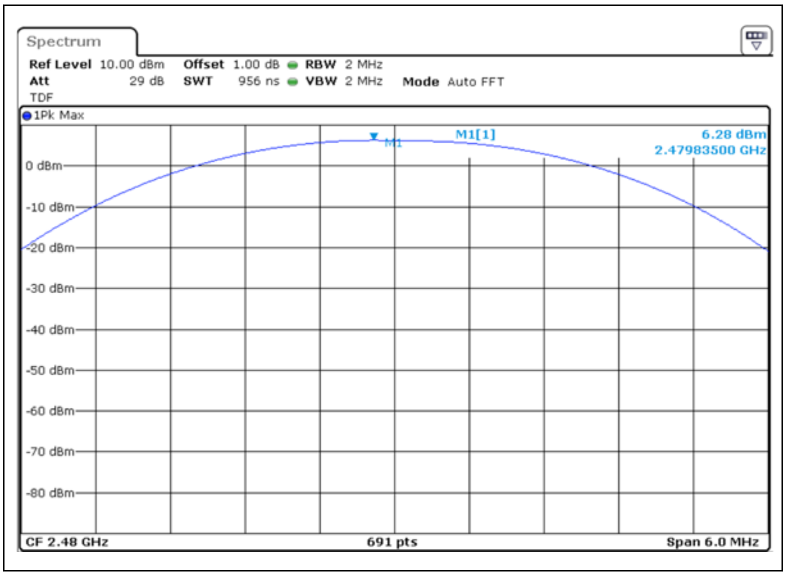
Lowest Channel(2 402 ㎒)



Middle Channel (2 441 ㎒)

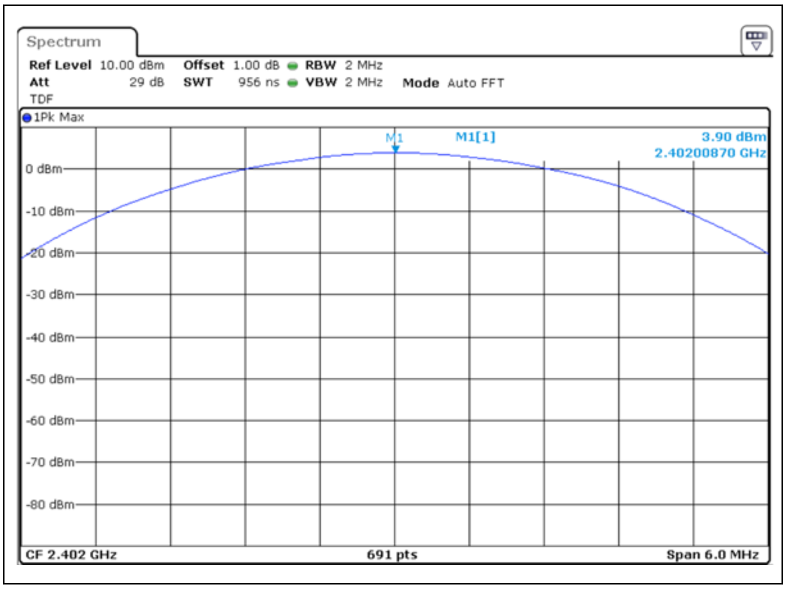


Highest Channel (2 480 ㎒)

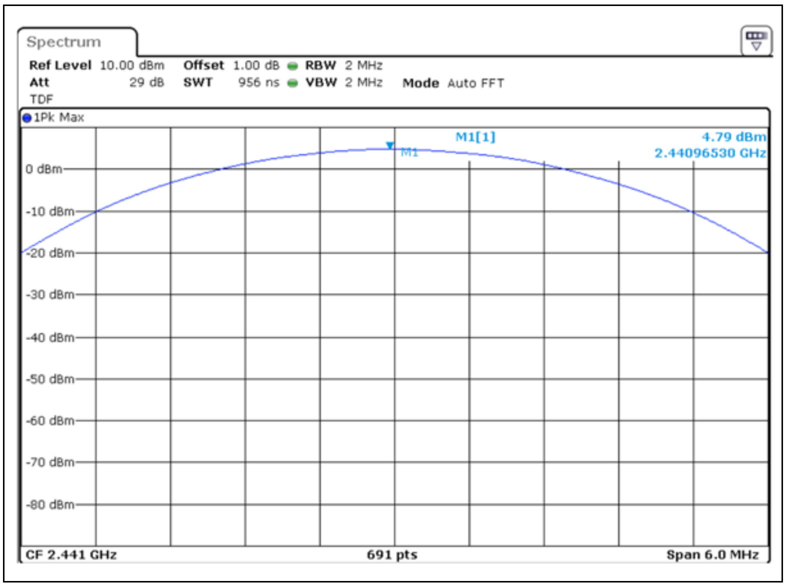


*** 8DPSK**

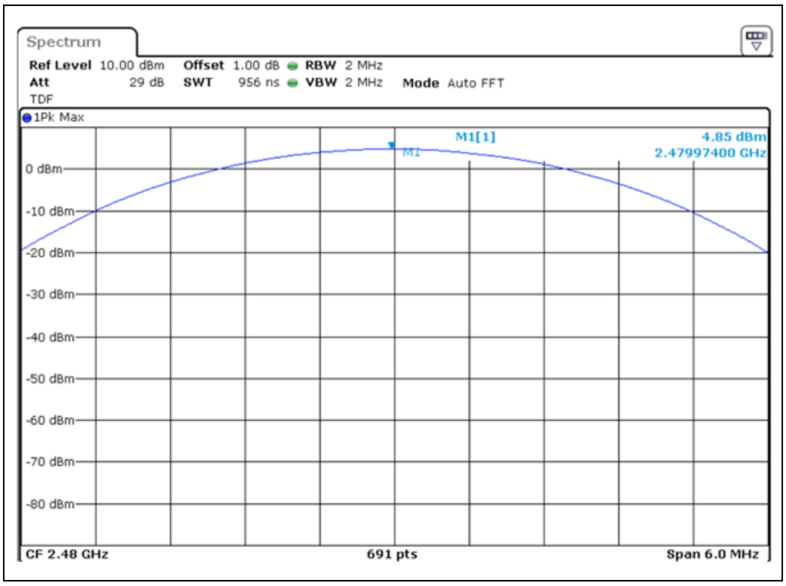
Lowest Channel(2 402 ㎒)



Middle Channel (2 441 ㎒)



Highest Channel (2 480 ㎒)



5.3 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 2400-2483.5 ㎒ 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 DSS device is FCC Public Notice DA 00-705.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface or Bluetooth tester.
4. Set the spectrum analyzer as follows: Span = wide enough to capture the peaks of two adjacent channels Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span Video (or Average) Bandwidth (VBW) ≥ RBW Sweep = auto Detector function = peak Trace = max hold
5. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
6. Repeat above procedures until all frequencies measured were complete.

5.3.3 Test Result

- Complied

*** GFSK**

Frequency (㎒)	Operating Mode	Carrier frequency separation (㎒)	Limit
2 402	Hopping	1.002	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth
2 441	Hopping	0.998	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth
2 480	Hopping	0.998	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth

*** 8DPSK**

Frequency (㎒)	Operating Mode	Carrier frequency separation (㎒)	Limit
2 402	Hopping	0.998	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth
2 441	Hopping	0.998	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth
2 480	Hopping	0.998	≥25 ㎑ or two-thirds of the 20 ㏈ bandwidth

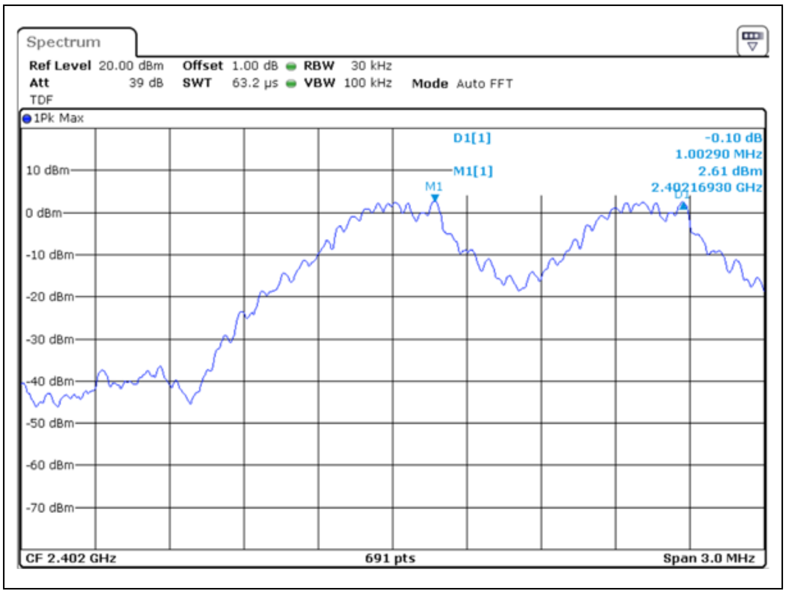
NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.3.4 Test Plot

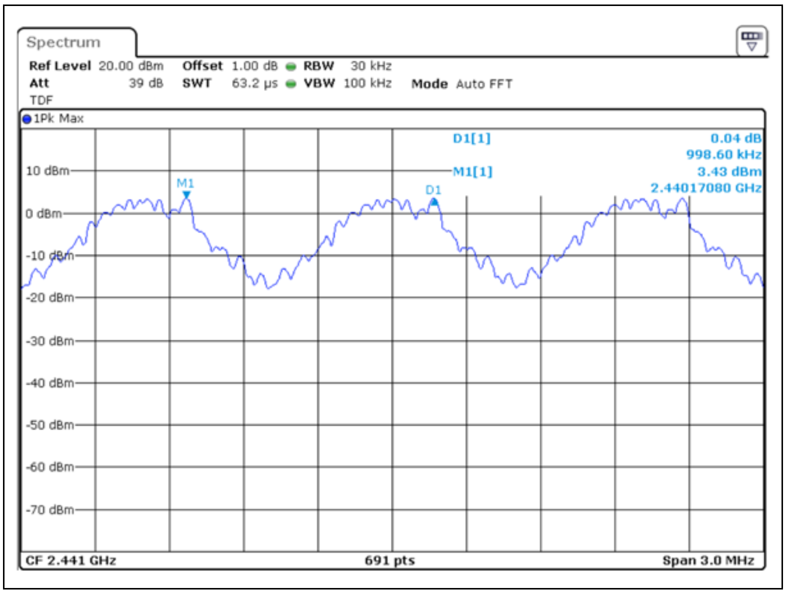
Figure 2.Plot of the Carrier Frequency Separation (Conducted)

*** GFSK**

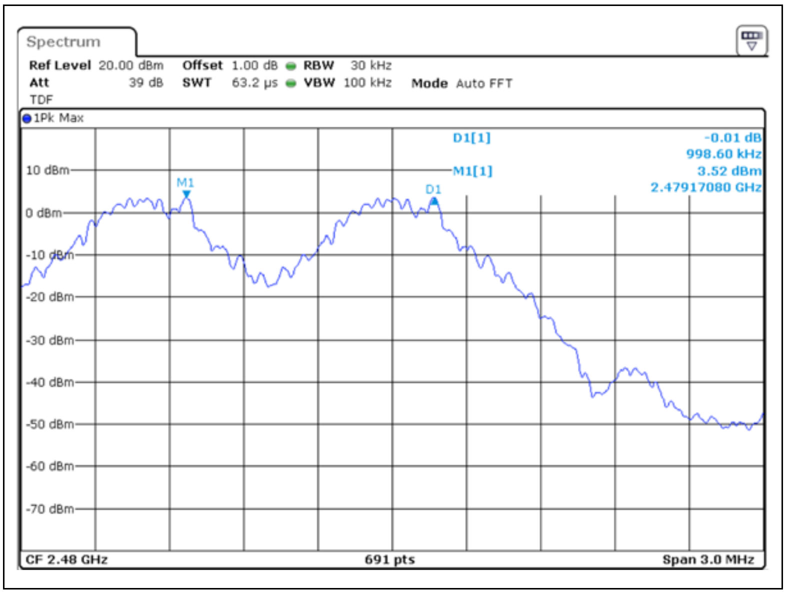
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)

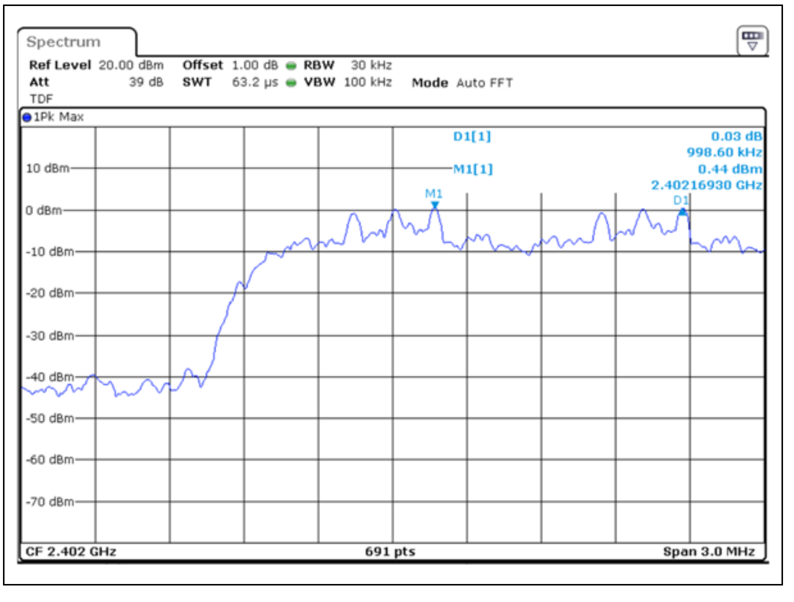


Highest Channel (2 480 ㎒)

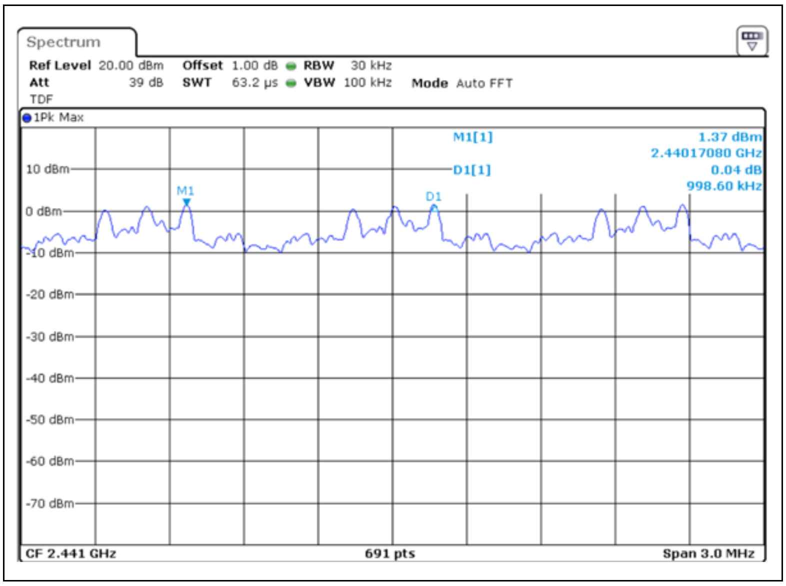


*** 8DPSK**

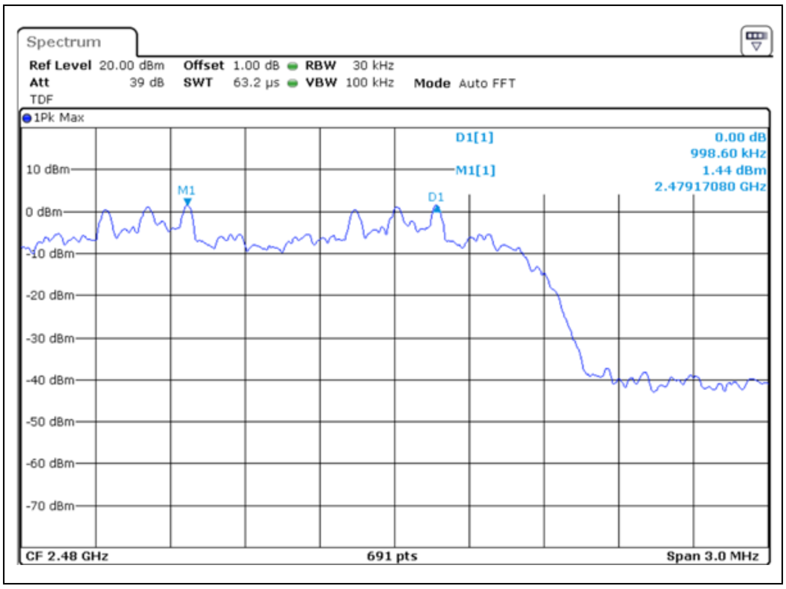
Lowest Channel (2 402 ㎒)



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 2400-2483.5 ㎒ 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 DSS device is FCC Public Notice DA 00-705.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface or Bluetooth tester and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer as follows: Span = approximately 2 to 3 times the 20 ㏈ bandwidth, centered on a hopping channel RBW ≥ 1% of the 20 ㏈ bandwidth VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold
5. Set a reference level on it equal to the highest peak value.
6. Measure the frequency difference of two frequencies that were attenuated 20 ㏈ from the reference level. Record the frequency difference as the emission bandwidth.
7. Repeat above procedures until all frequencies measured were complete..

5.4.3 Test Result

- Complied

Mode	Channel	20 ㏈ Channel Bandwidth(㎒)	Occupied Bandwidth (99 % BW)(㎒)
GFSK	Low	0.955	0.868
	Middle	0.955	0.868
	High	0.907	0.859
8DPSK	Low	1.285	1.163
	Middle	1.276	1.163
	High	1.276	1.163

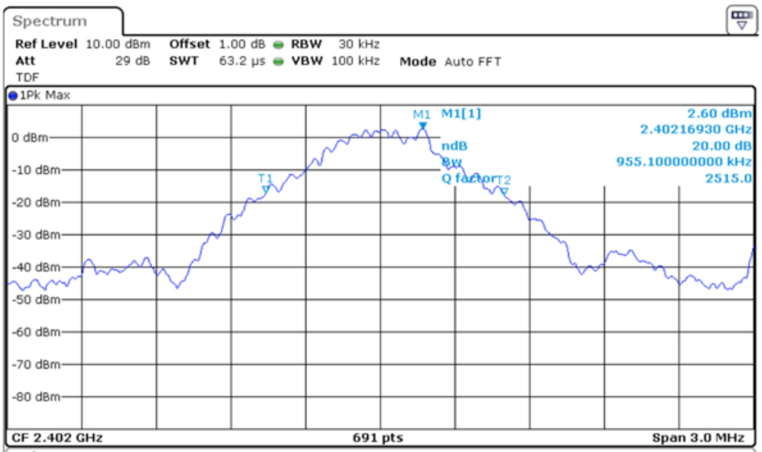
NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.4.4 Test Plot

Figure 3.Plot of the 20 ㏈ Channel Bandwidth / Occupied Bandwidth (Conducted)

*** GFSK (20 ㏈ Channel Bandwidth)**

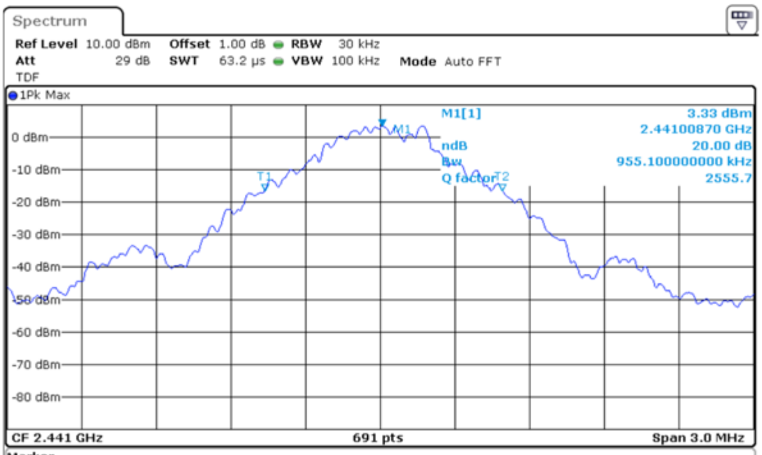
Lowest Channel(2 402 ㎒)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4021693 GHz	2.60 dBm	ndB down	955.1 kHz
T1		1	2.4015398 GHz	-17.10 dBm	ndB	20.00 dB
T2		1	2.4024949 GHz	-17.60 dBm	Q factor	2515.0

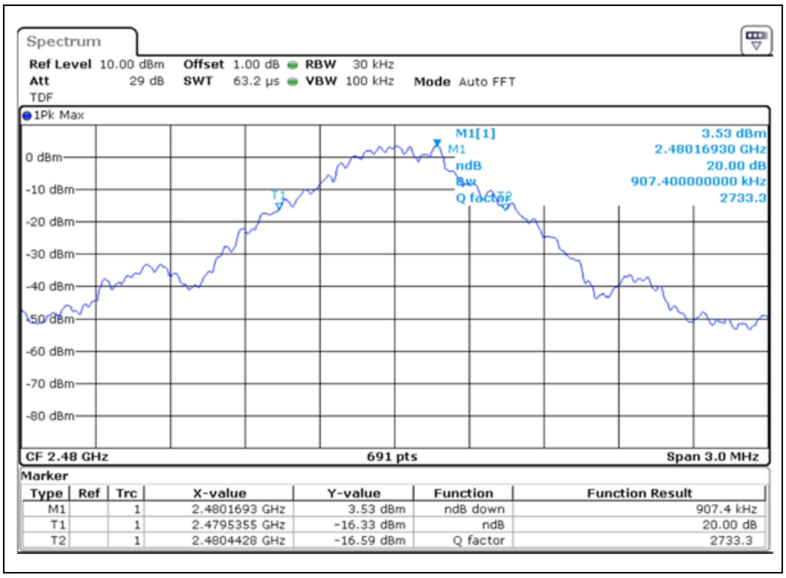
Middle Channel (2 441 ㎒)



Marker

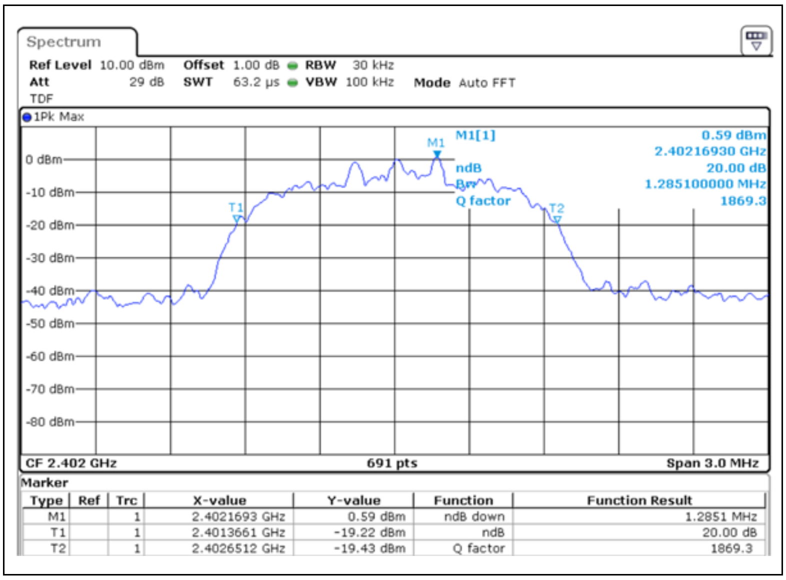
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4410087 GHz	3.33 dBm	ndB down	955.1 kHz
T1		1	2.4405355 GHz	-16.44 dBm	ndB	20.00 dB
T2		1	2.4414906 GHz	-16.45 dBm	Q factor	2555.7

Highest Channel (2 480 ㎒)

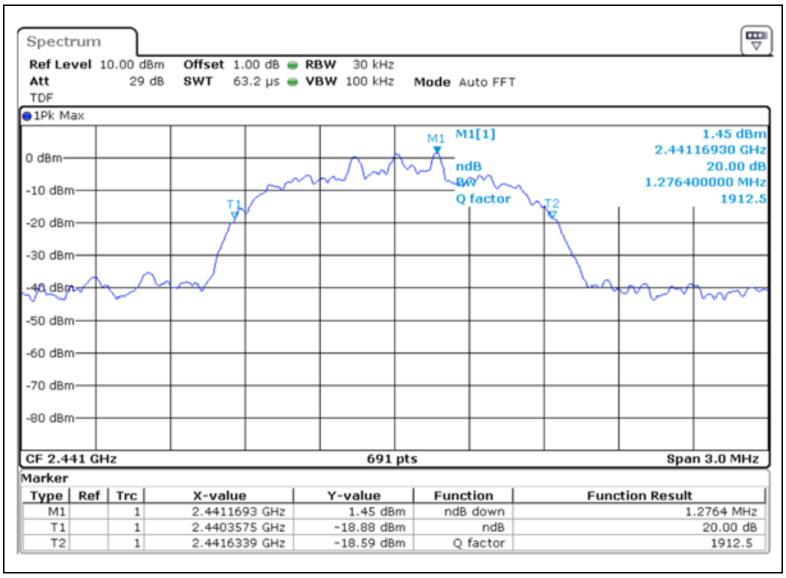


*** 8DPSK (20 ㏈ Channel Bandwidth)**

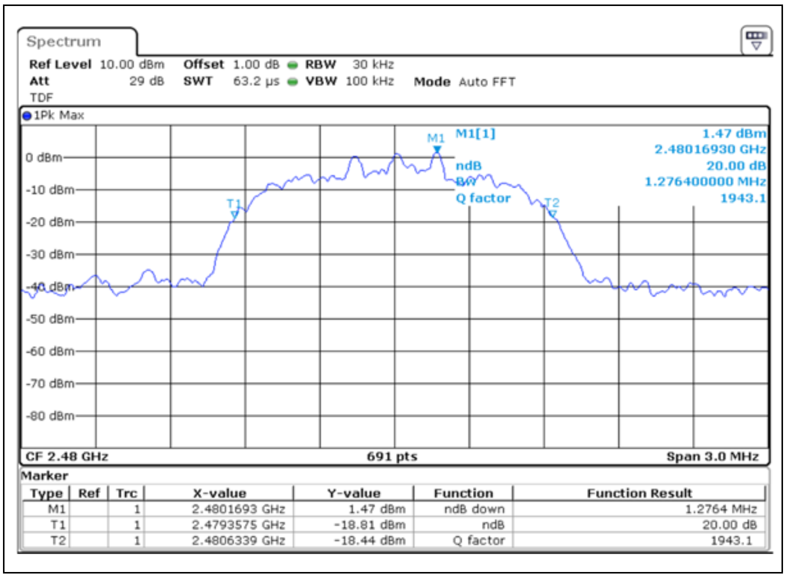
Lowest Channel(2 402 ㎒)



Middle Channel (2 441 ㎒)

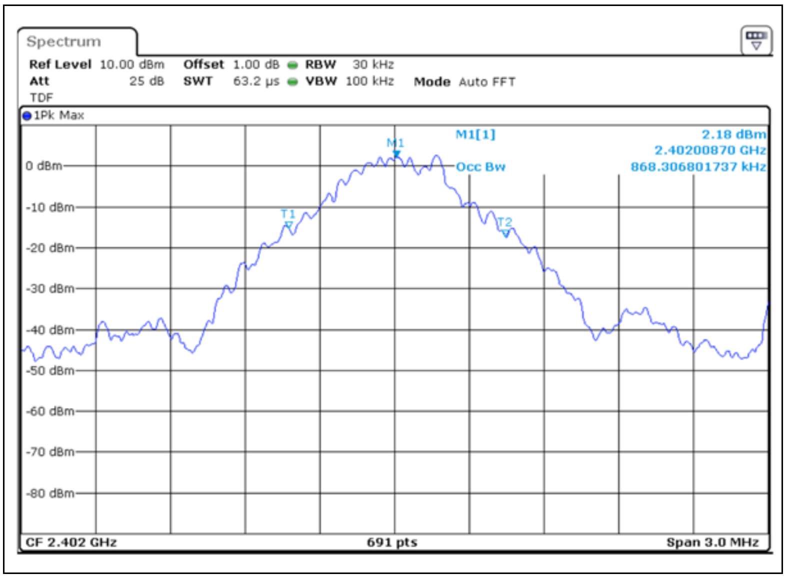


Highest Channel (2 480 ㎒)

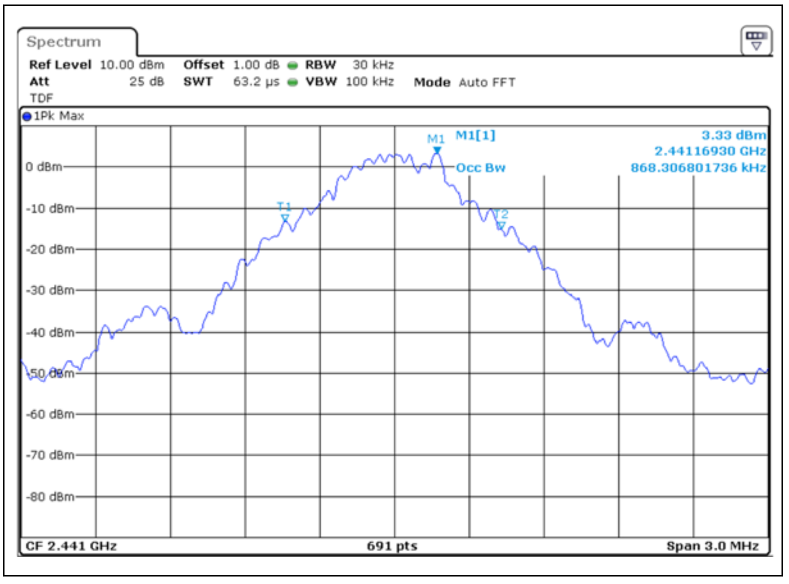


*** GFSK (Occupied Bandwidth)**

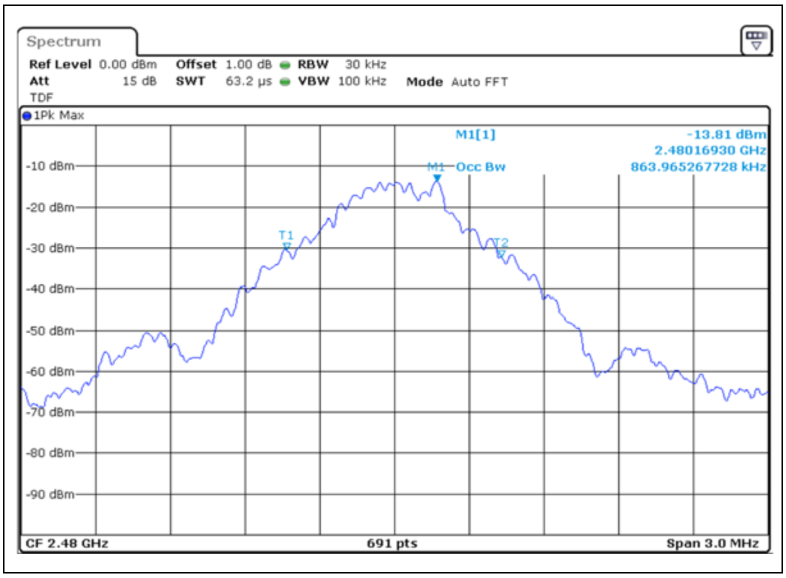
Lowest Channel(2 402 ㎒)



Middle Channel (2 441 ㎒)

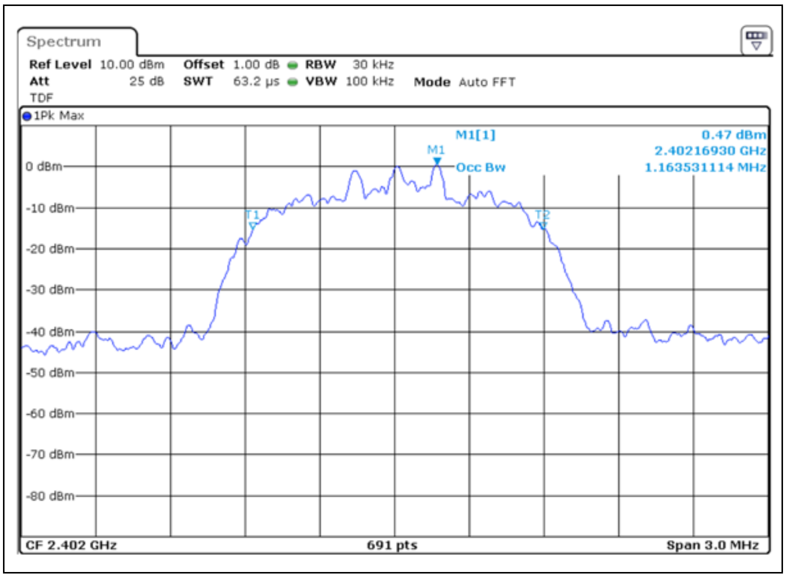


Highest Channel (2 480 ㎒)

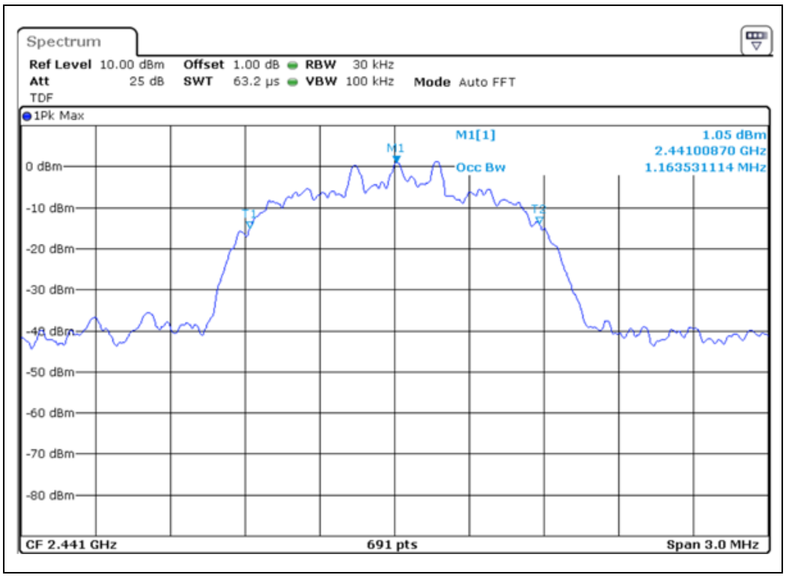


*** 8DPSK (Occupied Bandwidth)**

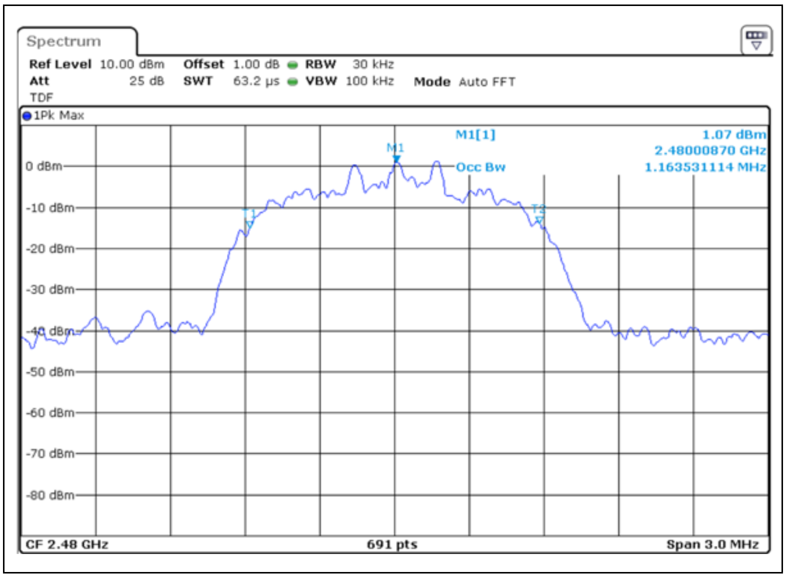
Lowest Channel(2 402 ㎒)



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

5.5.2 Measurement Procedure

The method of measurement used to test this DSS device is FCC Public Notice DA 00-705.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and set the hopping function enabled by controlling it via UART interface or Bluetooth tester.
4. Set the spectrum analyzer as follows: Span = the frequency band of operation RBW ≥ 1% of the span VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold
5. Record the number of hopping channels.

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

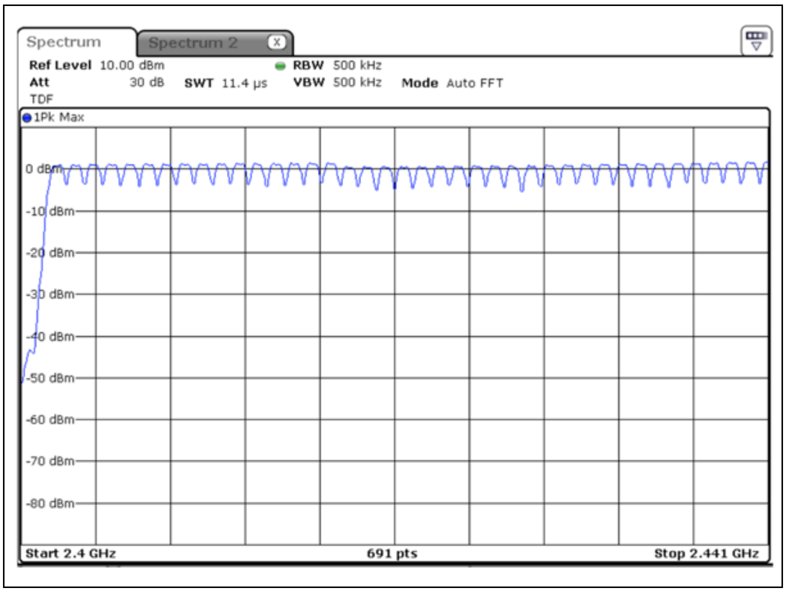
NOTE:

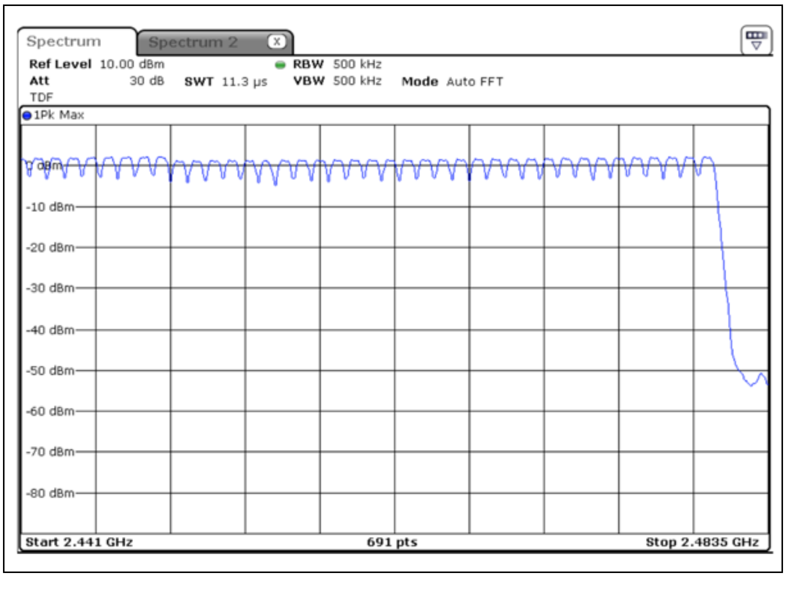
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.
2. Measurement is made with EUT operating in hopping mode between 79 channels providing a worse case scenario as compared to AFH mode hopping between 20 channels.

5.5.4 Test Plot

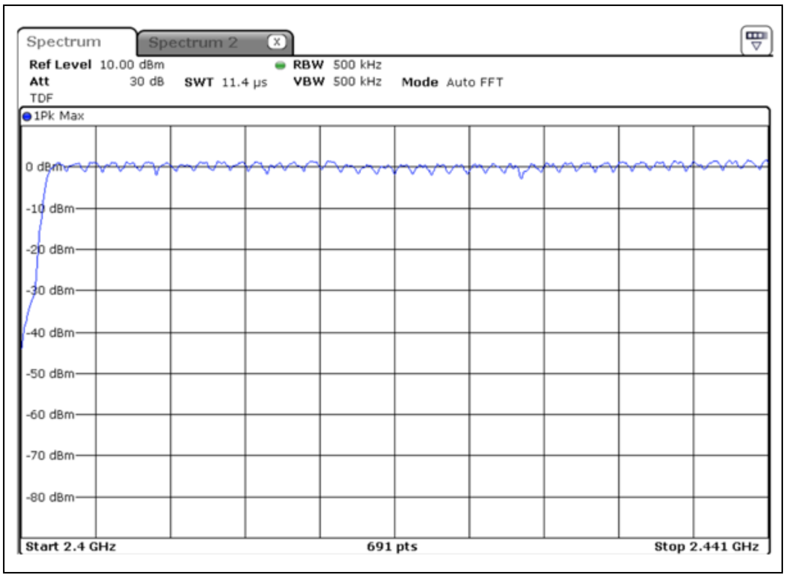
Figure 4. Plot of the Number of Hopping Channels (Conducted)

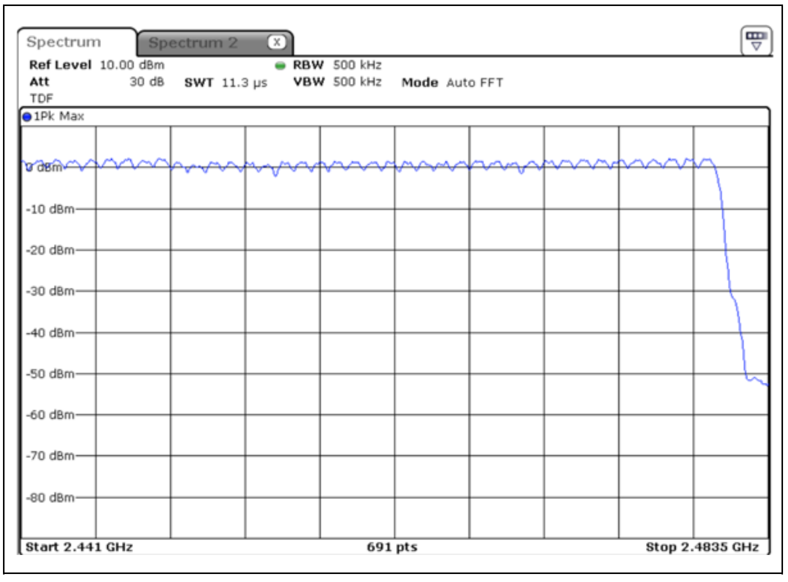
*** GFSK**





*** 8DPSK**


Spectrum
Spectrum 2
Ref Level 10.00 dBm
Att 30 dB
TDF
SWT 11.4 µs
RBW 500 kHz
VBW 500 kHz
Mode Auto FFT
1Pk Max
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
Start 2.4 GHz
691 pts
Stop 2.441 GHz


Spectrum
Spectrum 2
Ref Level 10.00 dBm
Att 30 dB
TDF
SWT 11.3 µs
RBW 500 kHz
VBW 500 kHz
Mode Auto FFT
1Pk Max
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
Start 2.441 GHz
691 pts
Stop 2.4835 GHz

5.6 Time of Occupancy(Dwell Time)

5.6.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 ㎒ 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 DSS device is FCC Public Notice DA 00-705.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface or Bluetooth tester.
4. Set the spectrum analyzer as follows: Span = zero span, centered on a hopping channel RBW = 1 ㎒ VBW ≥ RBW Sweep = as necessary to capture the entire dwell time per hopping channel Detector function = peak Trace = max hold
5. Measure the dwell time using the marker-delta function.
6. Repeat above procedures until all frequencies measured were complete.
7. Repeat this test for different modes of operation (e.g., data rate, modulation format, etc.), if applicable.

5.6.3 Test Result

- Complied

Hopping mode	Modulation	Packet Type	Reading[ms]	Hopping rate [hop/s]	Number of Channels	Actual[s]	Limit[s]
Non-AFH	GFSK	DH1	0.376	266.667	79	0.040	0.40
		DH3	1.628	266.667	79	0.174	0.40
		DH5	2.874	266.667	79	0.307	0.40
	8DPSK	3-DH1	0.392	266.667	79	0.042	0.40
		3-DH3	1.640	266.667	79	0.175	0.40
		3-DH5	2.895	266.667	79	0.309	0.40
AFH	GFSK	DH1	0.376	133.333	20	0.020	0.40
		DH3	1.628	133.333	20	0.087	0.40
		DH5	2.874	133.333	20	0.153	0.40
	8DPSK	3-DH1	0.392	200.000	20	0.031	0.40
		3-DH3	1.640	133.333	20	0.087	0.40
		3-DH5	2.895	133.333	20	0.154	0.40

NOTE 1. Non AFH

Actual = Reading × (Hopping rate / Number of channels) × Test period
Hopping rate = 1 600/time slot
Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds]

2. AFH

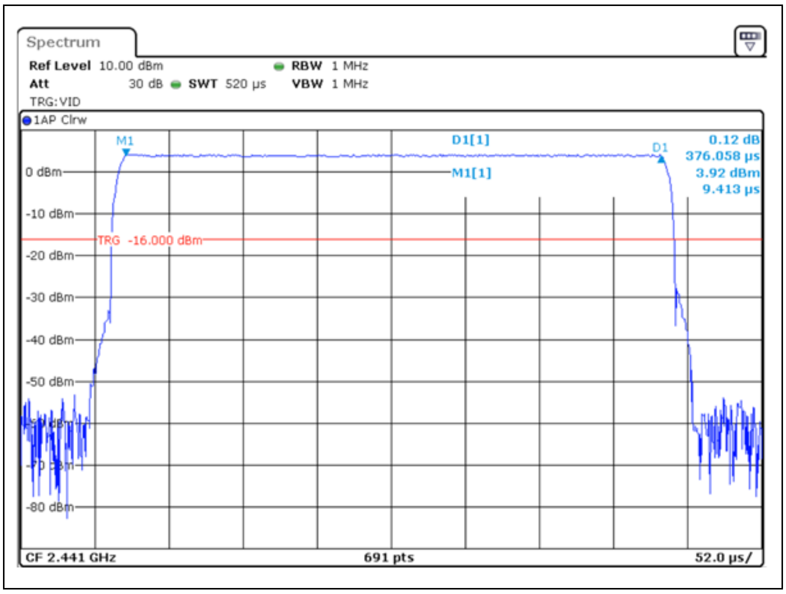
Actual = Reading × (Hopping rate / Number of channels) × Test period
Hopping rate = 800/time slot
Test period = 0.4 [seconds / channel] × 20 [channel] = 8 [seconds]

5.6.4 Test Plot

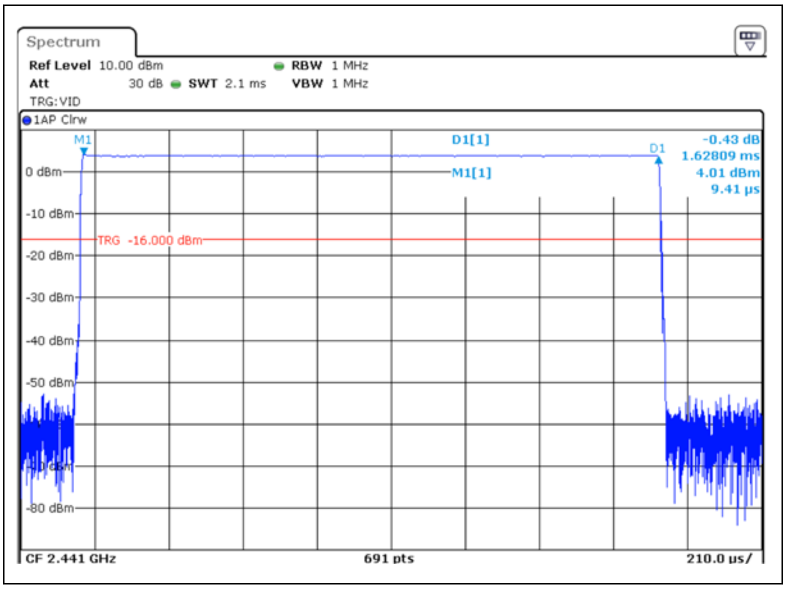
Figure 5. Plot of the Time of Occupancy (Conducted)

*** GFSK**

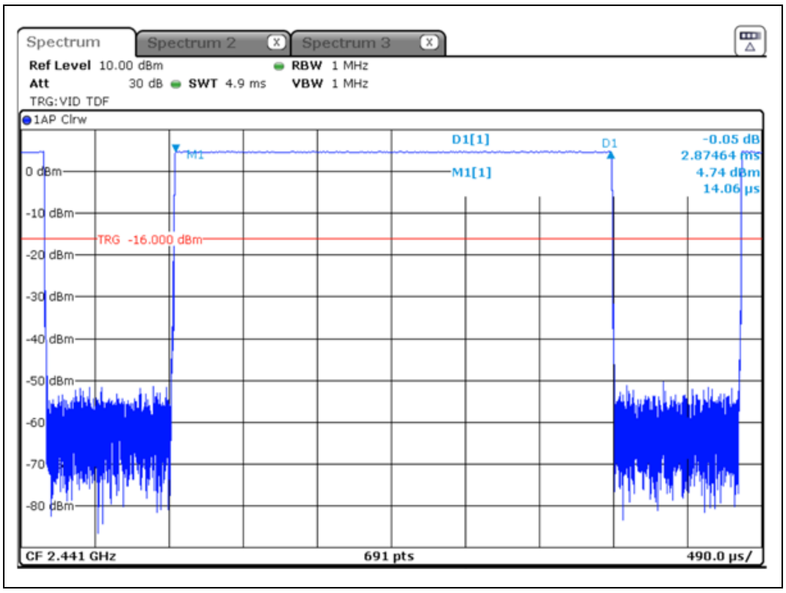
Lowest Channel(2 402 ㎒)



Middle Channel (2 441 ㎒)

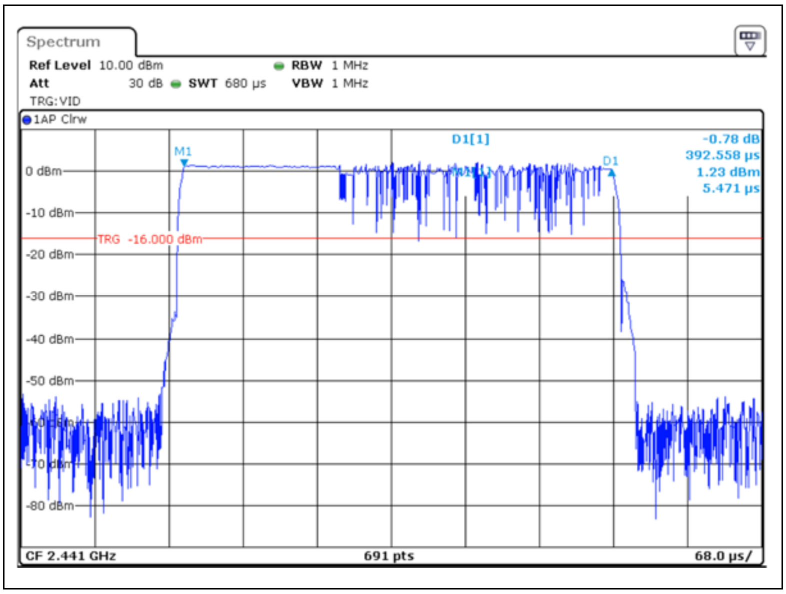


Highest Channel (2 480 ㎒)

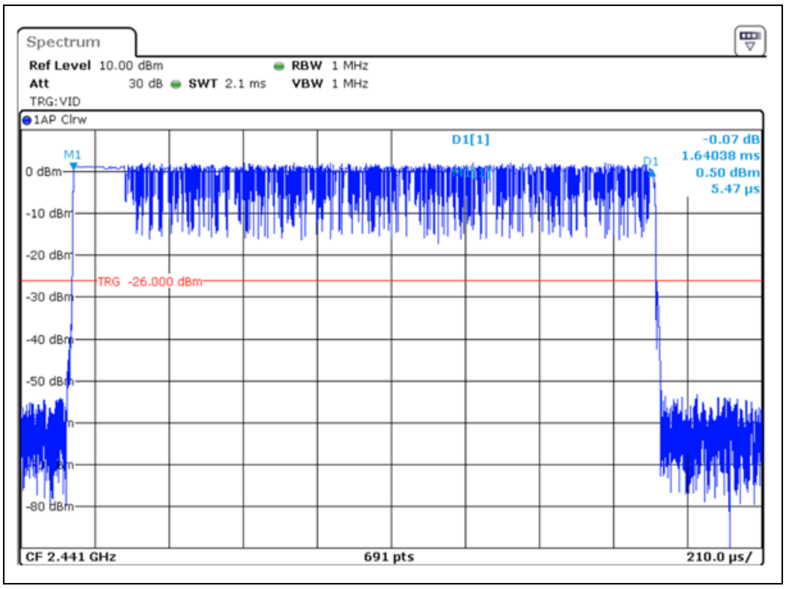


*** 8DPSK**

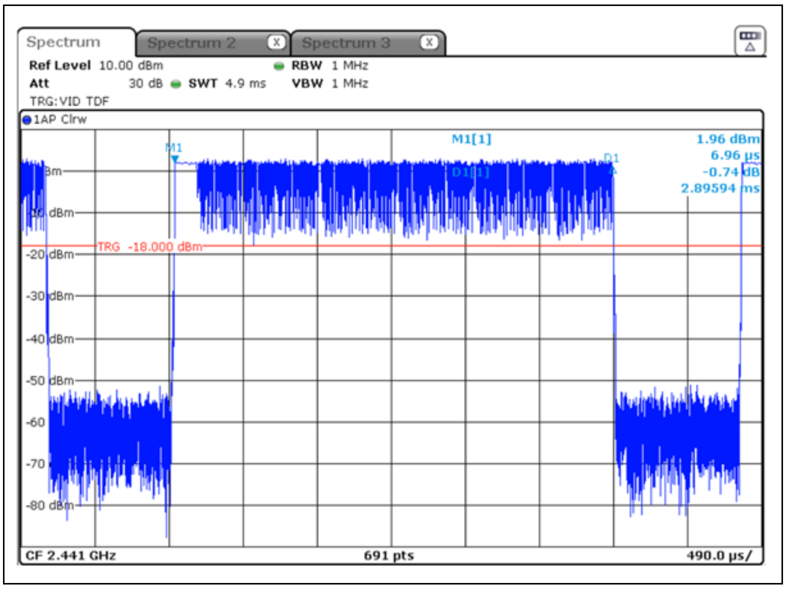
Lowest Channel(2 402 ㎒)



Middle Channel (2 441 ㎒)



Highest Channel (2 480 ㎒)



5.7 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	2400/F(㎑)	300
0.490 -1.705	24000/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:

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

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

5.7.2 Measurement Procedure

The method of measurement used to test this DSS device is FCC Public Notice DA 00-705.

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. 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.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 ㎑
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
   a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
3. 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.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an 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 1000 ㎒ using the TRILOG broadband antenna, and from 1000 ㎒ to 26500 ㎒ using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. 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.

Note
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 10 ㎐ for Average detection (AV) at frequency above 1㎓.

5.7.3 Test Result

- Complied

1. Band edge compliance of RF Conducted Emissions was shown in figure 6& 7.
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: GFSK)**

8DPSK_Highest channel (2 480 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 ㎒							
Below 30.00	Not Detected	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1 ㎓							
80.93	120	H	32.9	-22.9	10.0	40.0	30.0
377.99	120	H	33.6	-12.8	20.8	46.0	25.2
756.05	120	H	21.5	-6.1	15.4	46.0	30.6
648.01	120	V	34.8	-7.2	27.6	46.0	18.4
Above 700.00	**Not Detected**	-	-	-	-	-	-

*** Above 1 ㎓ data**

GFSK _Low channel (2 402 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
* 2 339.75	1 000	V	30.2	6.0	36.2	54.0	17.8
Above 3 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
* 2 339.75	1 000	V	30.2	6.0	36.2	54.0	17.8
Above 3 000.00	**Not Detected**	-	-	-	-	-	-

* This Asterisk means restricted band.

GFSK _Middle channel (2 441 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
Above 3 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
Above 3 000.00	**Not Detected**	-	-	-	-	-	-

GFSK _High channel (2 480 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
*2 491.00	1 000	H	42.6	6.5	49.1	74.0	24.9
Above 3 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
*2 491.00	1 000	H	28.8	6.5	35.3	54.0	18.7
Above 3 000.00	**Not Detected**	-	-	-	-	-	-

* This Asterisk means restricted band.

8DPSK _Low channel (2 402 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
* 2 377.50	1 000	H	43.0	6.1	49.1	74.0	24.9
Above 3 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
* 2 377.50	1 000	H	30.1	6.1	36.2	54.0	17.8
Above 3 000.00	**Not Detected**						

* This Asterisk means restricted band.

8DPSK _Middle channel (2 441 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
-	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
-	**Not Detected**	-	-	-	-	-	-

8DPSK _High channel (2 480 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
* 2 498.50	1 000	H	42.0	6.5	48.5	74.0	25.5
Above 3 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
* 2 498.50	1 000	H	28.9	6.5	35.4	54.0	18.6
Above 3 000.00	**Not Detected**						

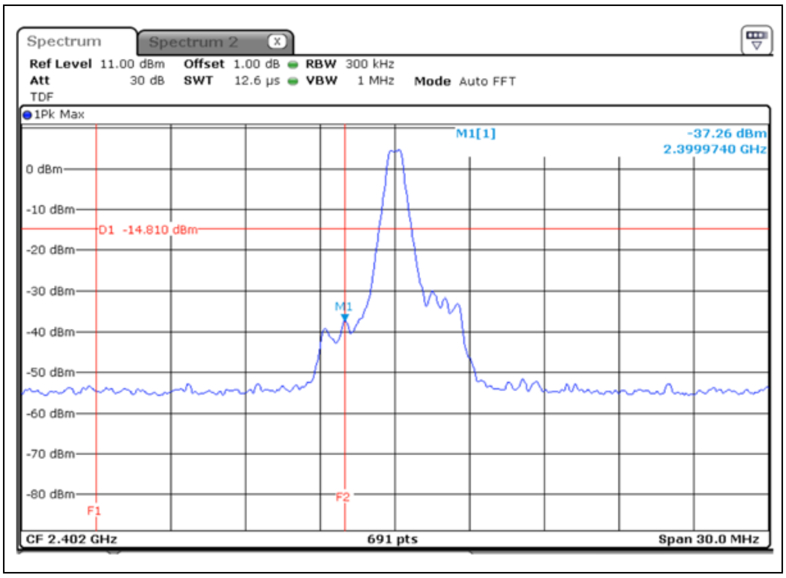
* This Asterisk means restricted band.

5.7.4 Test Plot

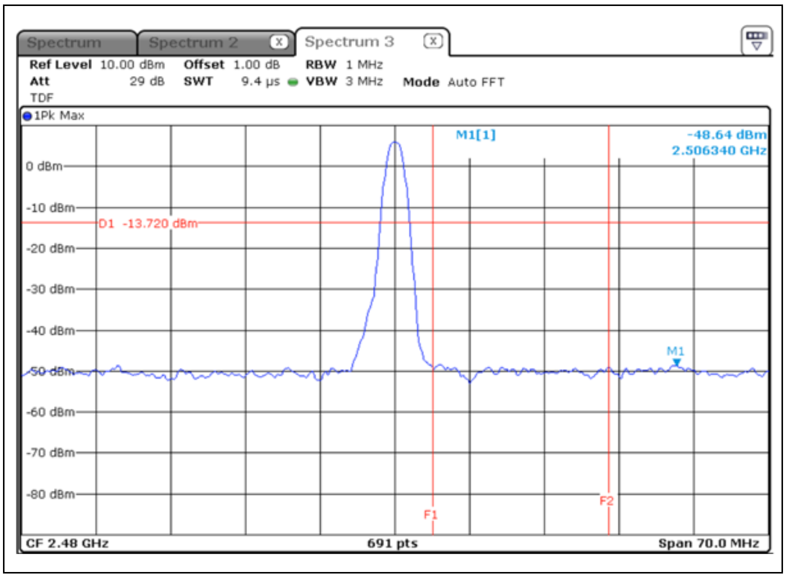
Figure 6. Plot of the Band Edge (Conducted)

*** GFSK (Without hopping)**

Lowest Channel(2 402 ㎒)



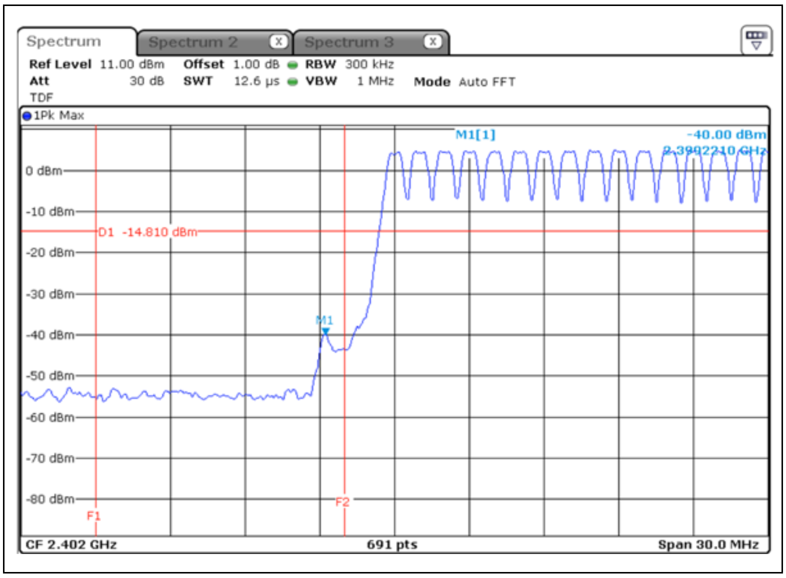
Highest Channel (2 480 ㎒)



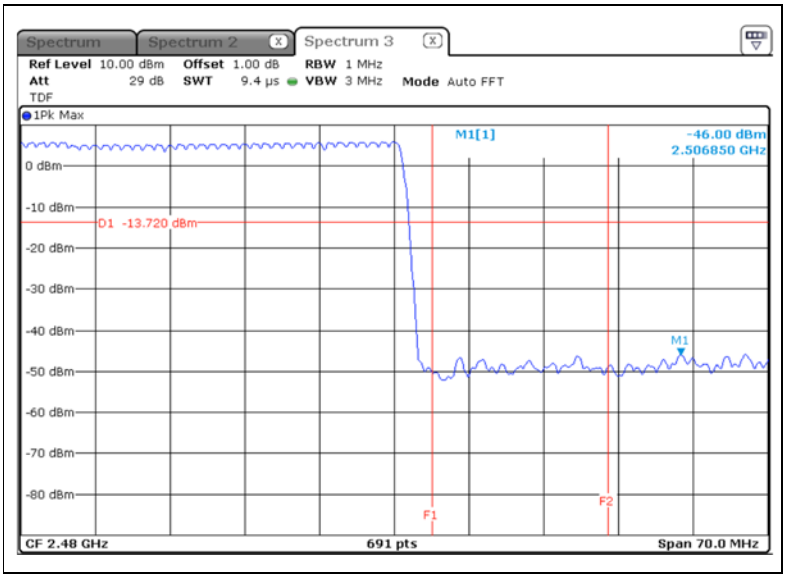
* Reasult of 2 483.5 ㎒

*** GFSK (With hopping)**

Lowest Channel(2 402 ㎒)



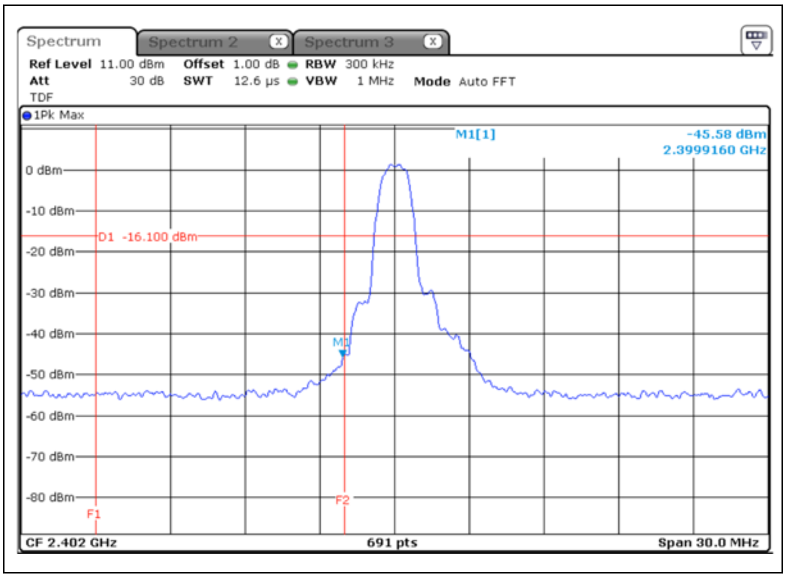
Highest Channel (2 480 ㎒)



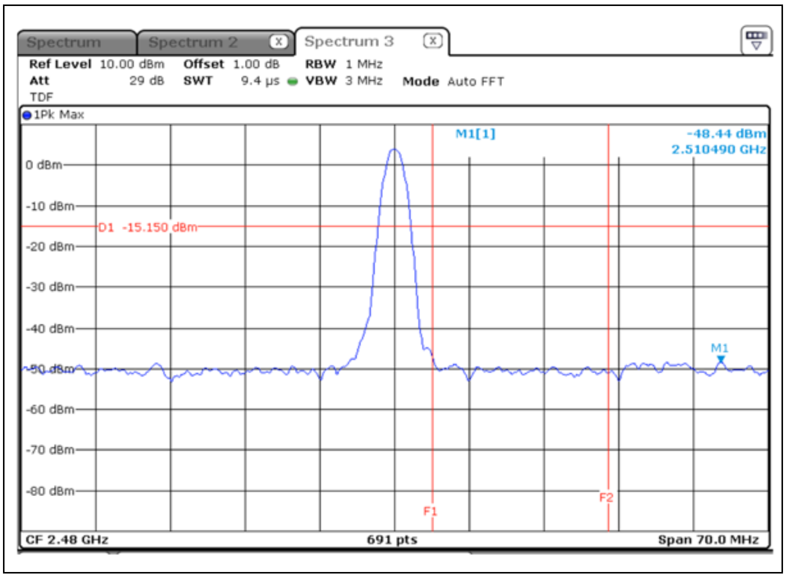
* Reasult of 2 483.5 ㎒

*** 8DPSK (Without hopping)**

Lowest Channel(2 402 ㎒)



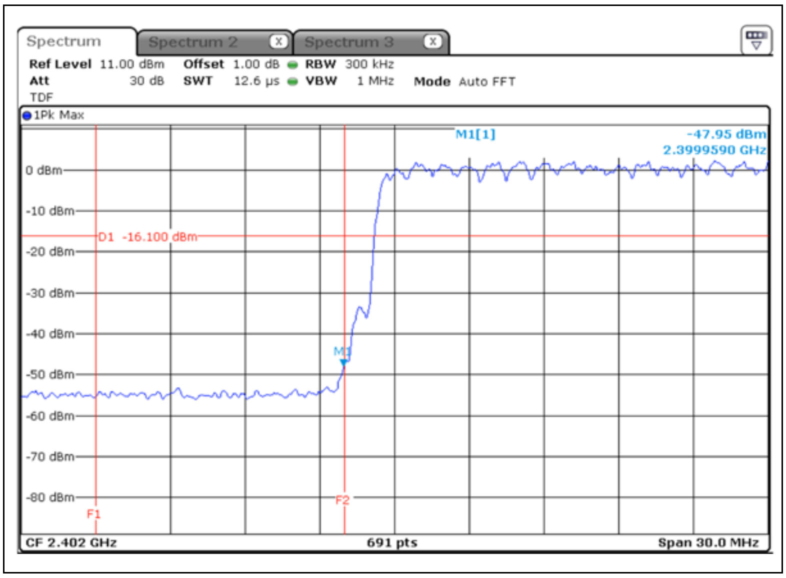
Highest Channel (2 480 ㎒)



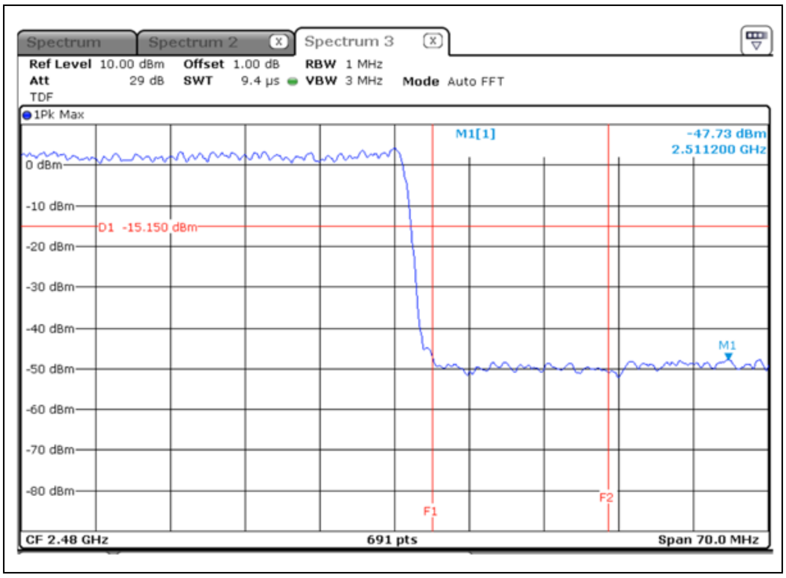
* Reasult of 2 483.5 ㎒

*** 8DPSK (With hopping)**

Lowest Channel(2 402 ㎒)



Highest Channel (2 480 ㎒)

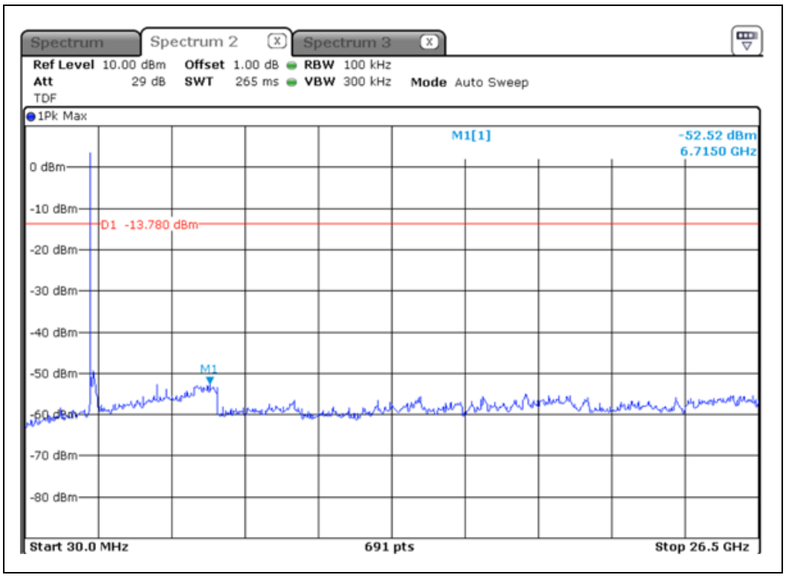


* Reasult of 2 483.5 ㎒

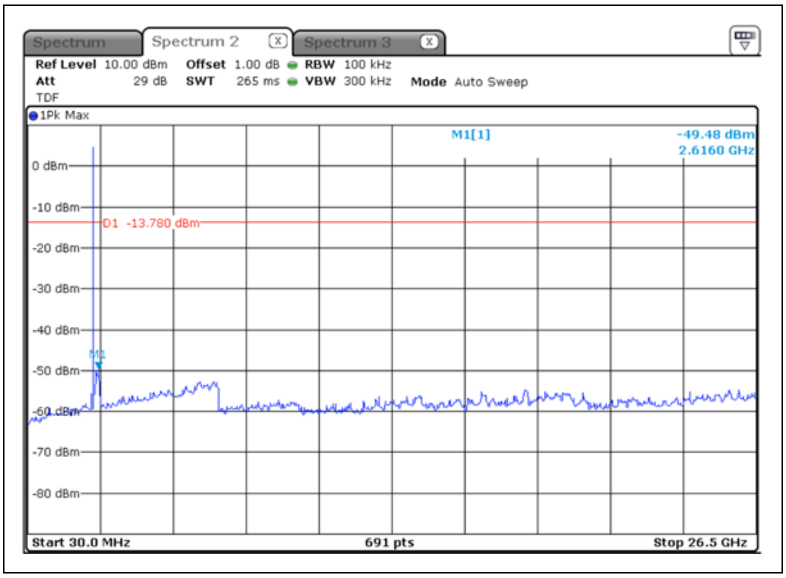
Figure 7. Plot of the Spurious RF conducted emissions

*** GFSK**

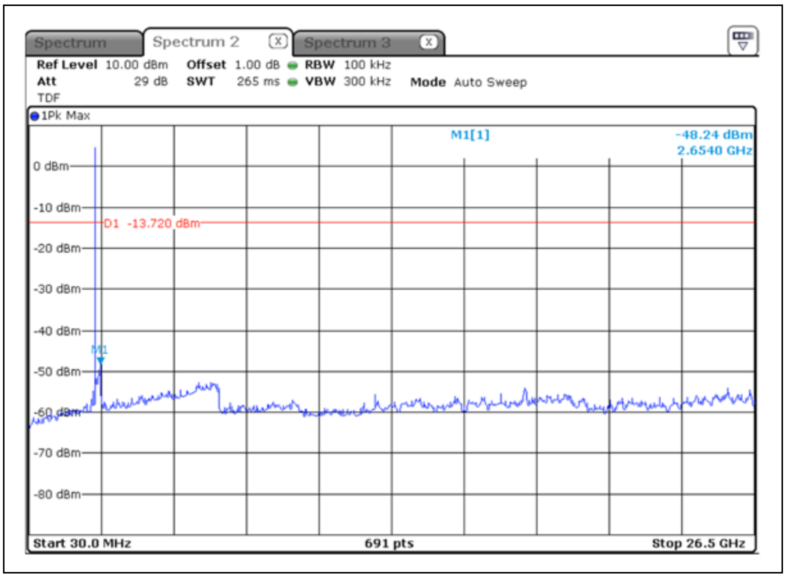
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)

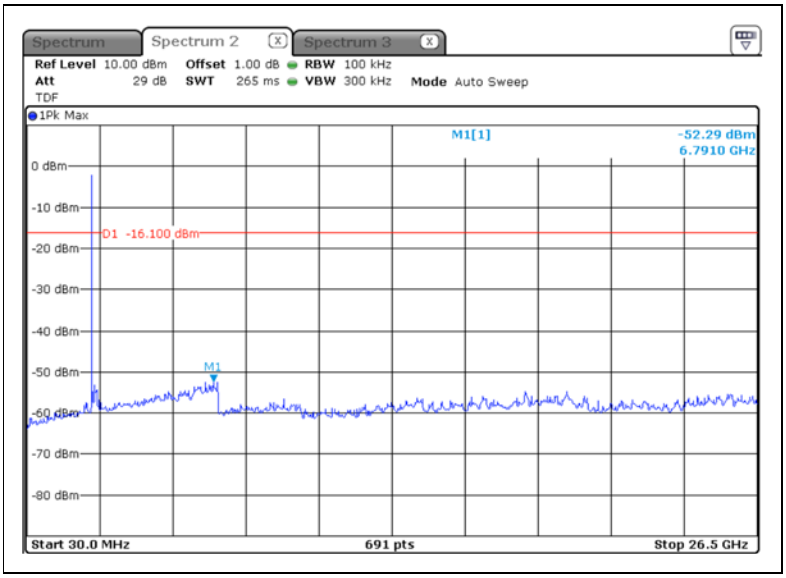


Highest Channel (2 480 ㎒)

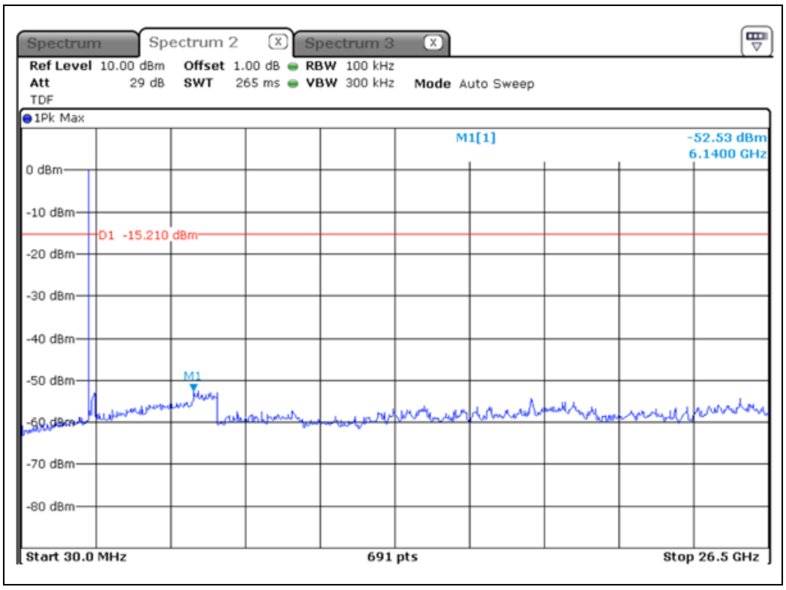


*** 8DPSK**

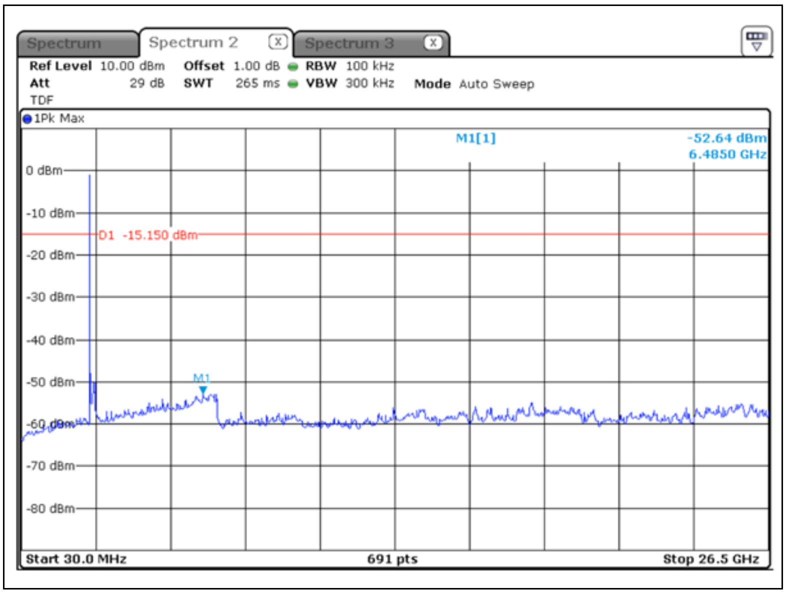
Lowest Channel (2 402 ㎒)



Middle Channel (2 441 ㎒)



Highest Channel (2 480 ㎒)



6. Test equipment used for test

	Description	Manufacturer	Model No.	Serial No.	Next Cal Date.
■	Spectrum Analyzer	R&S	FSV30	100807	16.09.02
■	Spectrum Analyzer	R&S	FSV40	100989	16.01.26
■	Signal generator	R&S	SMR40	100007	16.06.15
■	Wideband Power Sensor	R&S	NRP-Z81	100677	16.01.26
■	DC Power Supply	AGILENT	E3632A	MY40004399	16.01.06
■	Loop Antenna	R&S	HFH2-Z2	861971/003	17.03.03
■	Bi-Log Antenna	SCHWARZBECK	VULB9163	552	16.06.14
■	Horn Antenna	SCHWARZBECK	3117	155787	16.02.05
■	Horn Antenna	ETS.lindgren	3116	00086635	16.04.29
■	Preamplifier	AGILENT	3008A02343	8449B	16.09.02
■	Amplifier	SONOMA INSTRUMENT	310	186280	16.09.01
■	Emi Test Receiver	R&S	ESR	101078	16.02.16
■	Attenuator	R&S	DNF Dämpfungsglied 10 dB in N-50 Ohm	0001	16.06.15
■	Attenuator	AGILENT	8491A	MY52460424	16.07.13
■	Antenna Mast	Innco Systems	MA4000-EP	-	-
■	Turn Table	Innco Systems	DT2000	-	-
■	Highpass Filter	Wainwright Instruments GmbH	WHKX3.0/ 18G-12SS	'44	16.02.02