# TEST REPORT

| KCTL Inc.<br>65, Sinwon-ro, Yeongtong-gu,<br>Suwon-si, Gyeonggi-do, 16677, Korea<br>TEL: 82-31-285-0894 FAX: 82-505-299-8311<br>www.kctl.co.kr | Report No.:<br>KR19-SRF0093-A<br>Page (1) of (52) | KCTL |
|---|---|---|

**1. Client**

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2019-06-17

**2. Use of Report** : -

**3. Name of Product and Model** : Smart Wearable / SM-R835U

**4. Manufacturer and Country of Origin** : Samsung Electronics Co., Ltd. / Korea

**5. FCC ID** : A3LSMR835

**6. IC Certificate No.** : 649E-SMR835

**7. Date of Test** : 2019-06-27 to 2019-07-27

**8. Test Standards** : FCC Part 15 Subpart C, 15.247
RSS-247 Issue 2 February 2017
RSS-Gen Issue 5 March 2019

**9. Test Results** : Refer to the test result in the test report

| Affirmation | Tested by | Technical Manager |
|---|---|---|
| | Name : Kwonse Kim (Signature) | Name : Seungyong Kim (Signature) |

2019-08-08

## KCTL Inc.

**Report revision history**

| Date | Revision | Page No |
|---|---|---|
| 2019-07-29 | Initial report | - |
| 2019-08-08 | Updated | 5 |
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## 1. General information

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|---|---|---|
| Client | : | Samsung Electronics Co., Ltd. |
| Address | : | 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea |
| Manufacturer | : | Samsung Electronics Co., Ltd. |
| Address | : | 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea |
| Laboratory | : | KCTL Inc. |
| Address | : | 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea |
| Accreditations | : | 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 |

## 2. Device information

| | | |
|---|---|---|
| Equipment under test | : | Smart Wearable |
| Model | : | SM-R835U |
| Derivative model | : | SM-R835F |
| Frequency range | : | Bluetooth(BDR/EDR/BLE)_2 402 ㎒ ~ 2 480 ㎒ |
| | | WIFI(802.11b/g/n20)_2 412 ㎒ ~ 2 472 ㎒ |
| | | LTE Band 12_699.7 ㎒ ~ 715.3 ㎒ |
| | | LTE Band 13_779.5 ㎒ ~ 784.5 ㎒ |
| | | LTE Band 5_824.7 ㎒ ~ 848.3 ㎒ |
| | | LTE Band 26_824.7 ㎒ ~ 848.3 ㎒, 814.7 ㎒ ~ 823.3 ㎒ |
| | | LTE Band 4_1 710.7 ㎒ ~ 1 754.3 ㎒ |
| | | LTE Band 66_1 710.7 ㎒ ~ 1 779.3 ㎒ |
| | | LTE Band 2_1 850.7 ㎒ ~ 1 909.3 ㎒ |
| | | LTE Band 25_1 850.7 ㎒ ~ 1 914.3 ㎒ |
| | | WCDMA 850_826.4 ㎒ ~ 846.6 ㎒ |
| | | WCDMA 1700_1 712.4 ㎒ ~ 1 752.6 ㎒ |
| | | WCDMA 1900_1 852.4 ㎒ ~ 1 907.6 ㎒ |
| Modulation technique | : | Bluetooth(BDR/EDR)_ GFSK, π/4DQPSK, 8DPSK |
| | | Bluetooth(BLE)_GFSK |
| | | WIFI(802.11b/g/n20)_DSSS, OFDM |
| | | LTE_QPSK, 16QAM |
| | | WCDMA_QPSK |
| Number of channels | : | Bluetooth(BDR/EDR)_79 ch |
| | | Bluetooth(BLE)_40 ch |
| | | WIFI(802.11b/g/n20)_13 ch |
| Power source | : | DC 3.85 V |

| | | |
|---|---|---|
| Antenna specification | : | LTE/WCDMA_PIFA (Housing metal) Antenna<br>WIFI/Bluetooth(BDR/EDR/BLE)_LDS Antenna |
| Antenna gain | : | WIFI/Bluetooth(BDR/EDR/BLE) : -6.4 dBi |
| Software version | : | R835U.001 |
| Hardware version | : | REV1.0 |
| Test device serial No. | : | Conducted(R3AM6002T0W, R3AM600ZPAT),<br>Radiated(R3AM600ZJNZ, R3AM600ZJPB, R3AM600ZJJF,<br>R3AM600NE0B, R3AM600NEDH, R3AM600NEJZ, R3AM600NFWP)<br>R3AM6002T0W) |
| Operation temperature | : | -30 ℃ ~ 50 ℃ |

## 2.1. Accessory information

| Equipment | Manufacturer | Model | Serial No. | Power source | FCC ID & IC |
|---|---|---|---|---|---|
| Wireless charger | Samsung Electronics Co., Ltd. | EP-OR825 | - | DC 5.0 V, 1.0 A | A3LEPOR825 / 649E-EPOR825 |

## 2.2. Information about derivative model

The difference between basic model and derivative models is:

Hardware is identical with the basic model and software is as follows.

a. For the model SM-R835U:
- 3G(B2,B4,B5), 4G(B2,B4,B5,B12,B13,B25,B26,B66) are enabled by software.

b. For the model SM-R835F:
- 3G(B2,B4), 4G(B2,B4,B12,B13,B25,B26,B66) are disabled by software.
- 3G(B1,B8), 4G(B1,B3,B7,B8,B20) are enabled by software.

c. In USA, 4G(B7) disabled by MCC code. Because device doesn't support B7 roaming in USA.

d. All other protocol part is same and all other features of Volte, SUPL is same.

## 2.3. Frequency/channel operations

This device contains the following capabilities:
Bluetooth(BDR/EDR/BLE), WIFI(802.11b/g/n20), NFC
LTE Band 12, LTE Band 13, LTE Band 5, LTE Band 26, LTE Band 4, LTE Band 66, LTE Band 2
LTE Band 25, WCDMA 850, WCDMA 1700, WCDMA 1900

| Ch. | Frequency (㎒) |
|---|---|
| 00 | 2 402 |
| . . | . . |
| 39 | 2 441 |
| . . | . . |
| 78 | 2 480 |

Table 2.2.1. Bluetooth mode

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.

## 3. Antenna requirement

Requirement of FCC part section 15.203:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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.

Requirement of RSS-Gen Section 6.8:
The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.
For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).
When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.
Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

- The transmitter has permanently attached LDS Antenna (internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.247.

## 4. Summary of tests

| FCC Part section(s) | IC Rule Referance | Parameter | Test results |
|---|---|---|---|
| 15.247(b)(1),(4) | RSS-247, 5.4 (b) | Maximum peak output power | Pass |
| 15.247(a)(1) | RSS-247, 5.1 (b) | Carrier frequency separation | Pass |
| 15.247(a)(1) | RSS-247, 5.1 (a) | 20dB channel bandwidth | Pass |
| - | RSS-Gen, 6.7 | Occupied bandwidth | Pass |
| 15.247(a)(iii)<br>15.247(b)(1) | RSS-247, 5.1(d) | Number of hopping channel | Pass |
| 15.247(a) (iii) | RSS-247, 5.1 (d) | Time of occupancy(dwell time) | Pass |
| 15.205(a),<br>15.209(a) | RSS-247, 5.5<br>RSS-Gen, 8.9, 8.10 | Spurious emission | Pass |
| 15.247(d), | | Band-edge, restricted band | Pass |

**Notes:**

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field 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 KDB 414788.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that Y orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y orientation
4. This device may be formed with two different exterior materials: Aluminum and Stainless. Aluminum model was set for full test and additional spot check verification was done with Stainless model for radiated spurious and band-edge as documented.
5. All the radiated tests have been performed two modes (with charger and without charger) and the with charger is the worst case mode.
6. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
   - KDB 558074 D01 v05r02

## 5. Measurement uncertainty

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

All measurement uncertainty values are shown with a coverage factor of $k$=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

| Parameter | Expanded uncertainty (±) | |
|---|---|---|
| Conducted RF power | 1.76 dB | |
| Conducted spurious emissions | 4.03 dB | |
| Radiated spurious emissions | 9 kHz ~ 30 MHz: | 2.28 dB |
| | 30 MHz ~ 300 MHz | 4.98 dB |
| | 300 MHz ~ 1 000 MHz | 5.14 dB |
| | 1 GHz ~ 6 GHz | 6.70 dB |
| | Above 6 GHz | 6.60 dB |

## 6. Measurement results explanation example

The offset level is set in the spectrum analyzer to compensate the RF cable loss factor between EUT conducted output port and spectrum analyzer.
With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

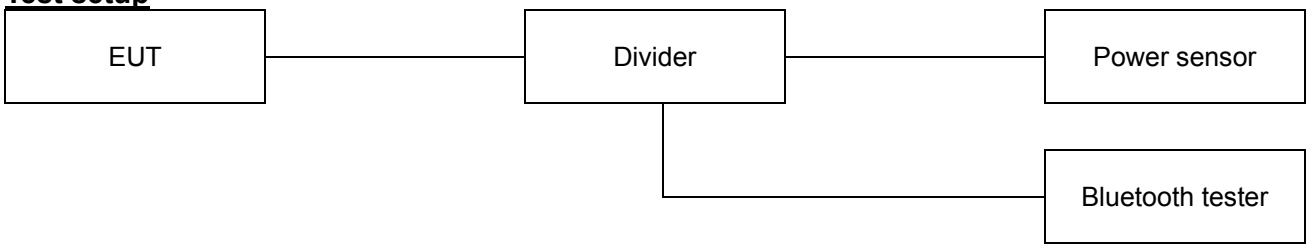
| Frequency (㎒) | Factor(㏈) | Frequency (㎒) | Factor(㏈) |
|---|---|---|---|
| 30 | 6.84 | 9 000 | 9.51 |
| 100 | 6.90 | 10 000 | 9.54 |
| 200 | 6.99 | 11 000 | 9.91 |
| 300 | 7.00 | 12 000 | 9.96 |
| 400 | 7.08 | 13 000 | 10.40 |
| 500 | 7.13 | 14 000 | 10.41 |
| 600 | 7.19 | 15 000 | 10.19 |
| 700 | 7.27 | 16 000 | 10.31 |
| 800 | 7.29 | 17 000 | 10.46 |
| 900 | 7.33 | 18 000 | 10.77 |
| 1 000 | 7.40 | 19 000 | 11.43 |
| 2 000 | 7.74 | 20 000 | 11.64 |
| 3 000 | 8.08 | 21 000 | 12.37 |
| 4 000 | 8.41 | 22 000 | 13.37 |
| 5 000 | 8.68 | 23 000 | 14.10 |
| 6 000 | 9.02 | 24 000 | 15.33 |
| 7 000 | 9.20 | 25 000 | 14.69 |
| 8 000 | 9.38 | 26 000 | 13.67 |

**Note.**
Offset(㏈) = RF cable loss(㏈) + Power Divider(㏈)

# 7. Test results

## 7.1. Maximum peak output power

**Test setup**




**Limit**

**FCC**

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 ㏈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.

**IC**

According to RSS-247 5.4(b), for FHSs operating in the band 2400-2483.5 ㎒, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels.
The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

**Test procedure**

ANSI C63.10-2013 - Section 7.8.5

**Test settings**

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:
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.
7) Allow trace to stabilize.

**Notes:**

A peak responding power sensor is used, where the power sensor system video bandwidth is greater than the occupied bandwidth of the EUT.

**Test results**

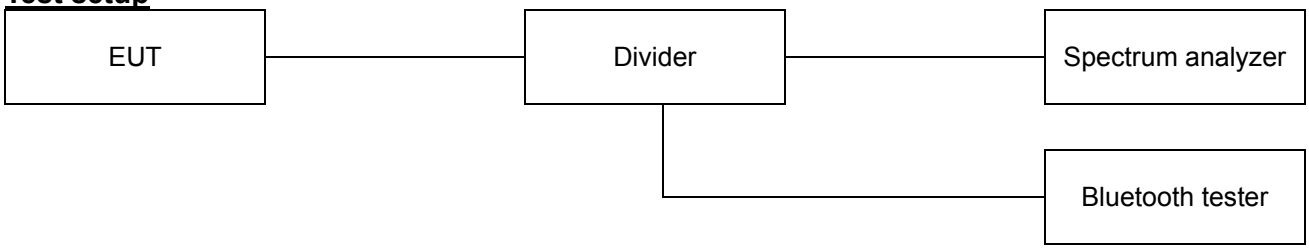
| Frequency (㎒) | Data rate (Mbps) | Conducted output power (dBm) | | Conducted Power Limit (dBm) | Ant. Gain (dBi) | Max. e.i.r.p. (dB m) | | Max. e.i.r.p. Limit (dBm) |
|---|---|---|---|---|---|---|---|---|
| | | Peak | Average | | | Peak | Average | |
| 2 402 | 1 | 15.46 | 13.77 | 20.97 | -6.40 | 9.06 | 7.37 | 36.02 |
| 2 441 | 1 | 16.86 | 15.11 | | -6.40 | 10.46 | 8.71 | |
| 2 480 | 1 | 16.16 | 14.45 | | -6.40 | 9.76 | 8.05 | |
| 2 402 | 2 | 11.15 | 7.11 | 20.97 | -6.40 | 4.75 | 0.71 | 36.02 |
| 2 441 | 2 | 11.85 | 7.81 | | -6.40 | 5.45 | 1.41 | |
| 2 480 | 2 | 10.65 | 6.59 | | -6.40 | 4.25 | 0.19 | |
| 2 402 | 3 | 11.65 | 7.22 | 20.97 | -6.40 | 5.25 | 0.82 | 36.02 |
| 2 441 | 3 | 12.45 | 7.99 | | -6.40 | 6.05 | 1.59 | |
| 2 480 | 3 | 11.25 | 6.72 | | -6.40 | 4.85 | 0.32 | |

**Notes:**

1. e.i.r.p. Calculation:
   e.i.r.p. (dB m) = Conducted output power (dB m) + Antenna gain (dB i)

## 7.2. Carrier frequency separation

**Test setup**




**Limit**

According to §15.247(a)(1) and RSS-247 5.1(b), 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 ㎽.

**Test procedure**

ANSI C63.10-2013 - Section 7.8.2

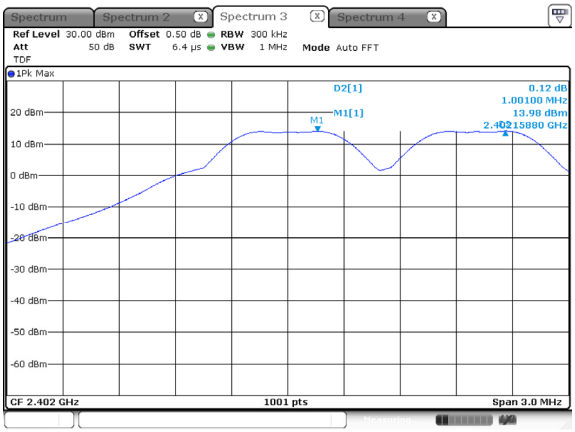
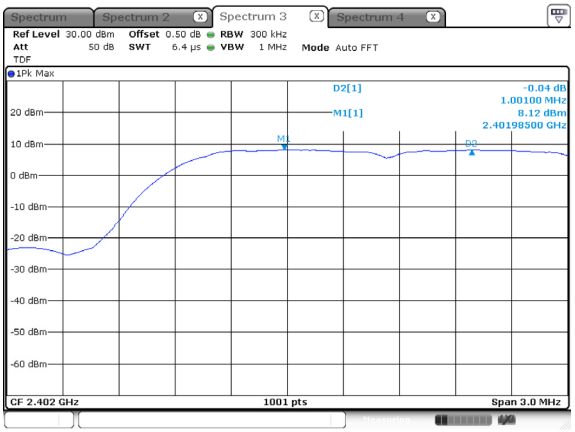
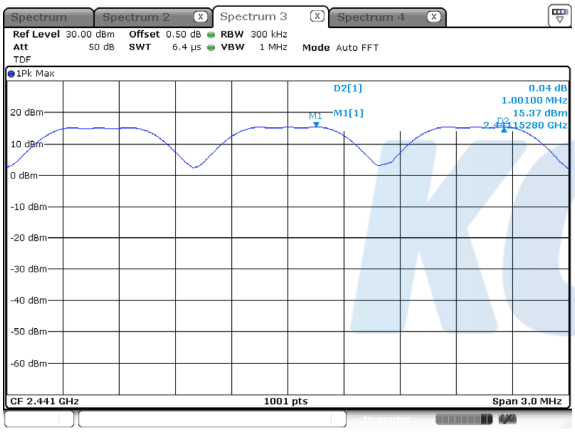
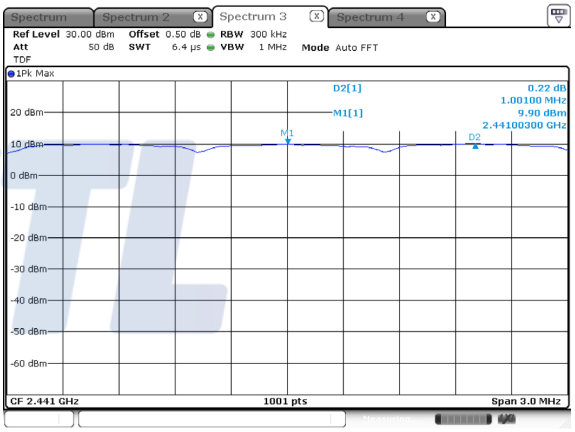
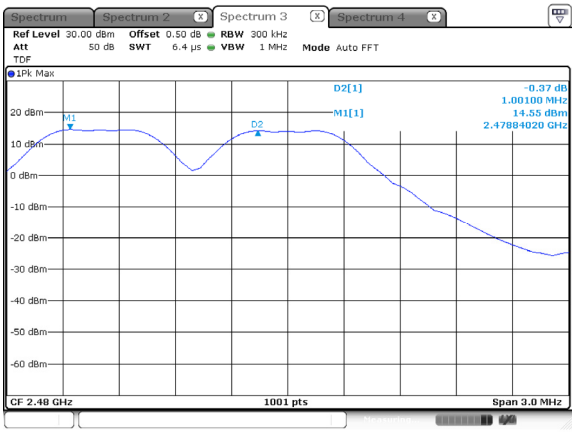
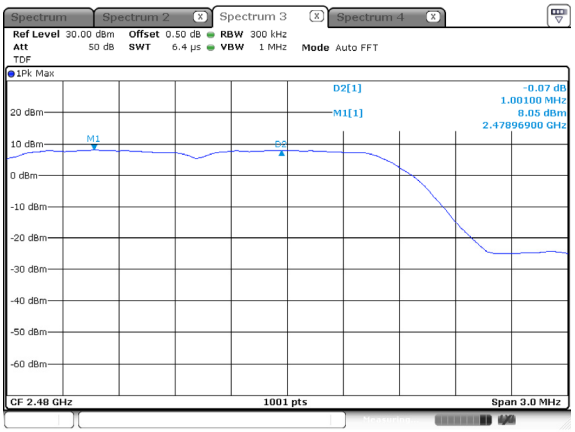
**Test settings**

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.

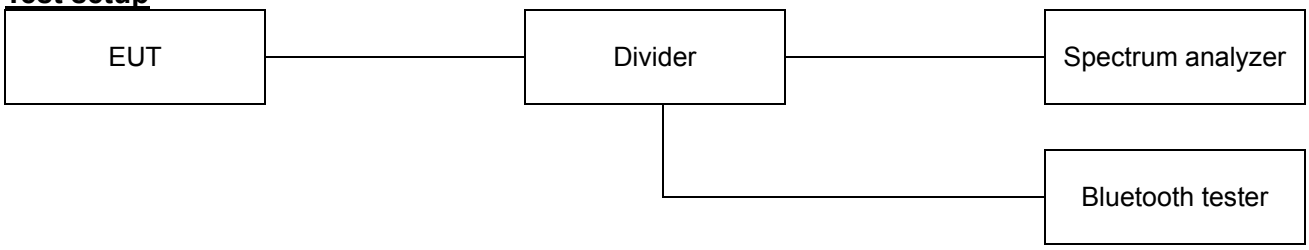
**Test results**

| Frequency(㎒) | Data rate(Mbps) | Carrier frequency separation(㎒) | Limit(㎒) |
|---|---|---|---|
| 2 402 | 1 | 1.001 | 0.695 |
| 2 441 | 1 | 1.001 | 0.693 |
| 2 480 | 1 | 1.001 | 0.695 |
| 2 402 | 3 | 1.001 | 0.889 |
| 2 441 | 3 | 1.001 | 0.891 |
| 2 480 | 3 | 1.001 | 0.891 |

| GFSK / Low ch. | 8DPSK / Low ch. |
|---|---|
|  |  |
| **GFSK / Mid ch.** | **8DPSK / Mid ch.** |
|  |  |
| **GFSK / High ch.** | **8DPSK / High ch.** |
|  |  |

## 7.3. 20dB channel bandwidth (Occupied bandwidth)

**Test setup**




**Limit**

According to §15.247(a)(1) and RSS-247 5.1(a), 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 ㎽.

**Test procedure**

ANSI C63.10-2013 - Section 6.9.2

**Test settings**

**20dB channel bandwidth and Occupied bandwidth**

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. Span: Two times and five times the OBW.
b) RBW = 1 % to 5 % of the OBW and VBW ≥ 3 x RBW
c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation.
d) 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.
e) Detector: peak
f) Trace mode: max hold.
g) Allow the trace to stabilize.
h) Determine the "−xx ㏈ 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.

**Test results**

**20 dB Bandwidth**

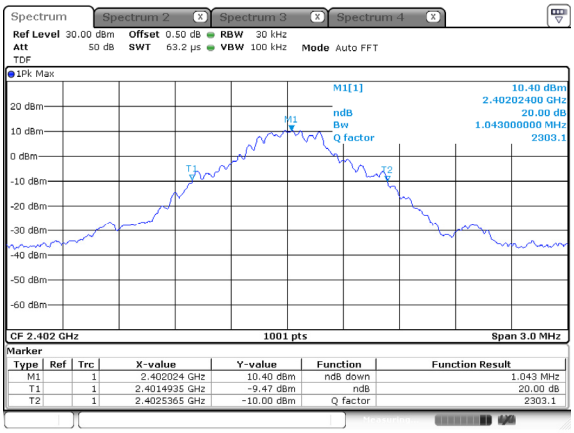
| Frequency(㎒) | Data rate (Mbps) | 20 dB Bandwidth (㎒) | Minimum Bandwidth (㎒) |
|---|---|---|---|
| 2 402 | 1 | 1.043 | 0.5 |
| 2 441 | 1 | 1.040 | |
| 2 480 | 1 | 1.043 | |
| 2 402 | 3 | 1.334 | |
| 2 441 | 3 | 1.337 | |
| 2 480 | 3 | 1.337 | |

**99% Bandwidth**

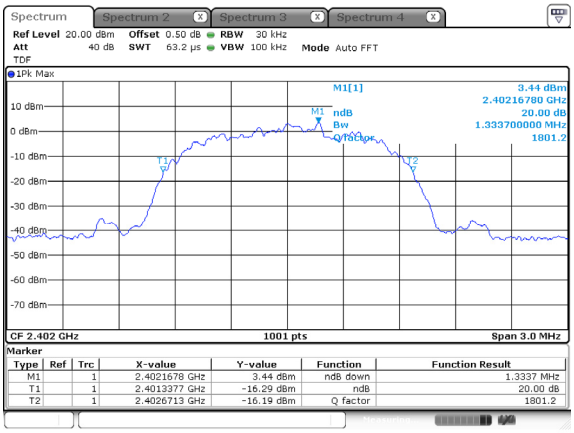
| Frequency(㎒) | Data rate (Mbps) | 99% bandwidth(㎒) |
|---|---|---|
| 2 402 | 1 | 0.950 |
| 2 441 | 1 | 0.944 |
| 2 480 | 1 | 0.950 |
| 2 402 | 3 | 1.193 |
| 2 441 | 3 | 1.196 |
| 2 480 | 3 | 1.193 |

## 20 dB bandwidth

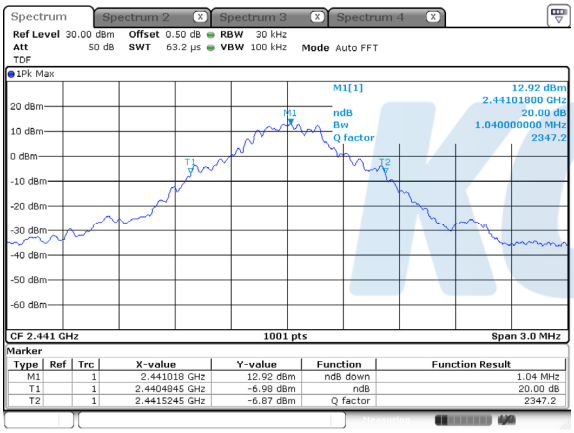
### GFSK / Low ch.



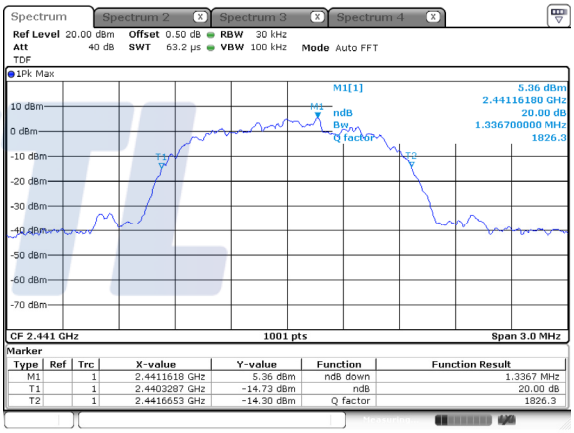

### 8DPSK / Low ch.



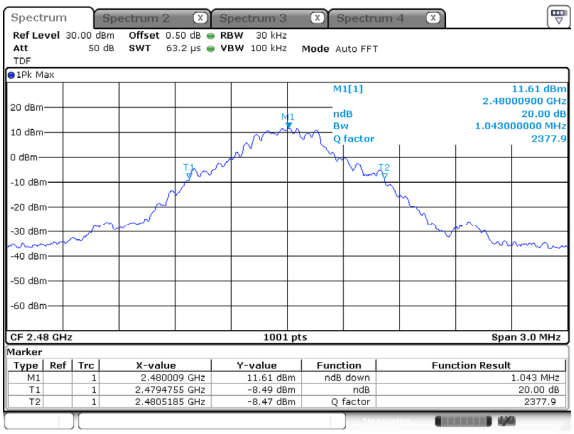

### GFSK / Mid ch.



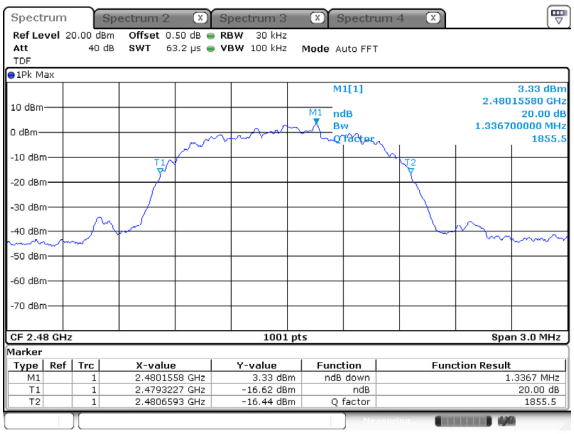

### 8DPSK / Mid ch.



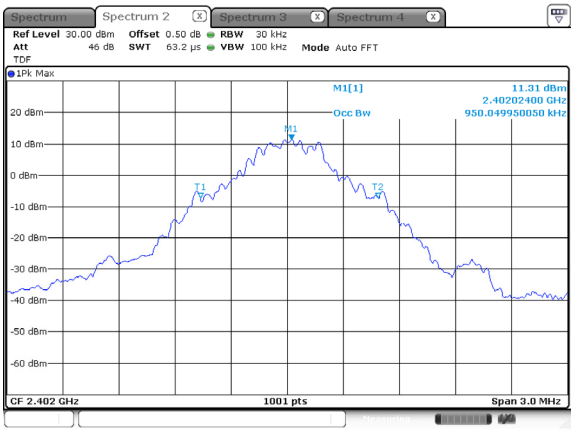
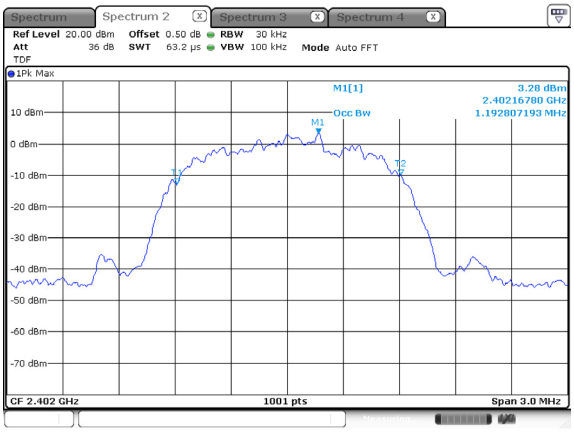
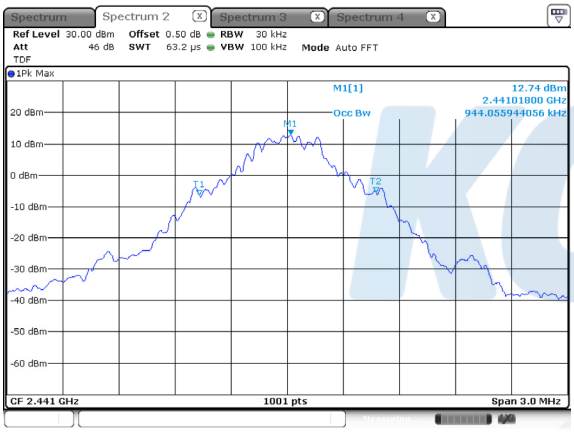
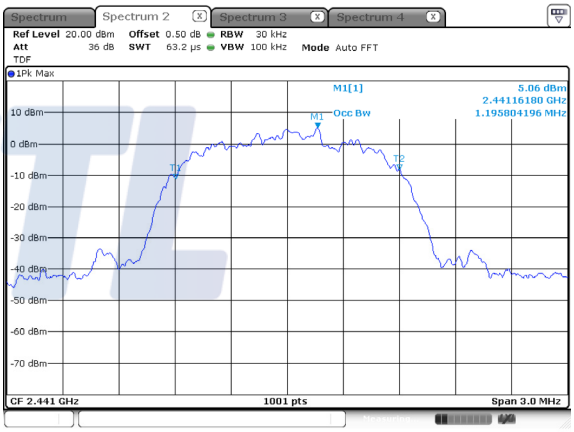
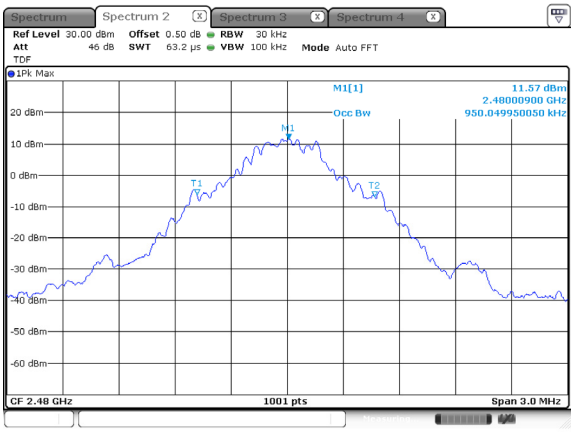
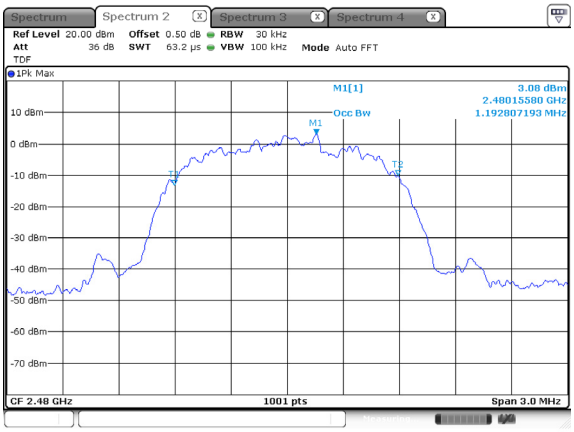

### GFSK / High ch.




### 8DPSK / High ch.

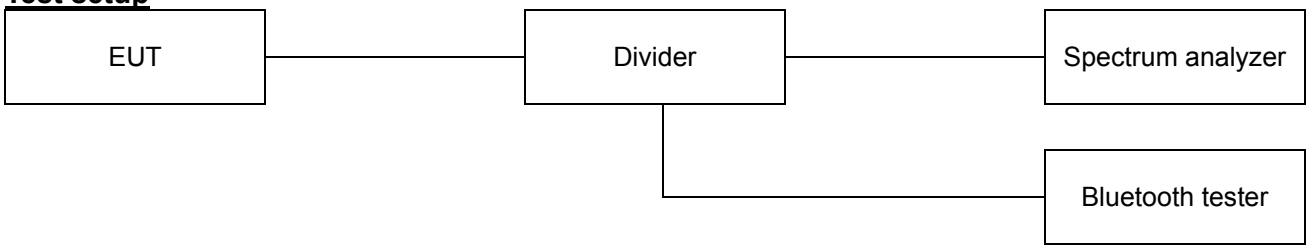


## 99 % bandwidth

| GFSK / Low ch. | 8DPSK / Low ch. |
|---|---|
|  |  |
| **GFSK / Mid ch.** | **8DPSK / Mid ch.** |
|  |  |
| **GFSK / High ch.** | **8DPSK / High ch.** |
|  |  |

## 7.4. Number of hopping channels

**Test setup**




**Limit**

According to §15.247(a)(1)(iii) and RSS-247 5.1(d), frequency hopping systems in the 2 400-2 483.5 ㎒ band shall use at least 15 channels.

**Test procedure**

ANSI C63.10-2013 - Section 7.8.3

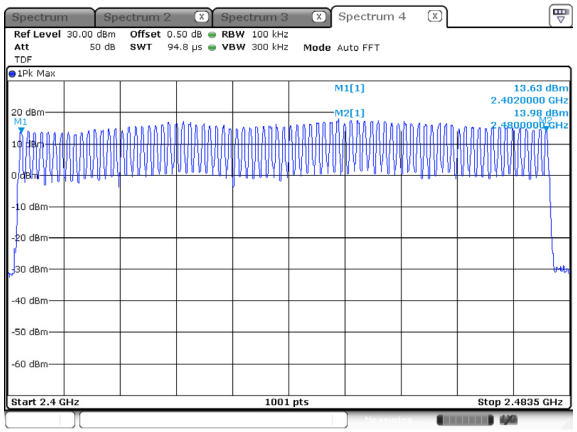
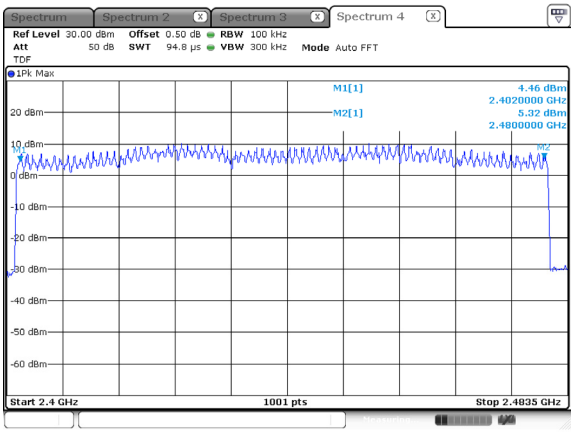
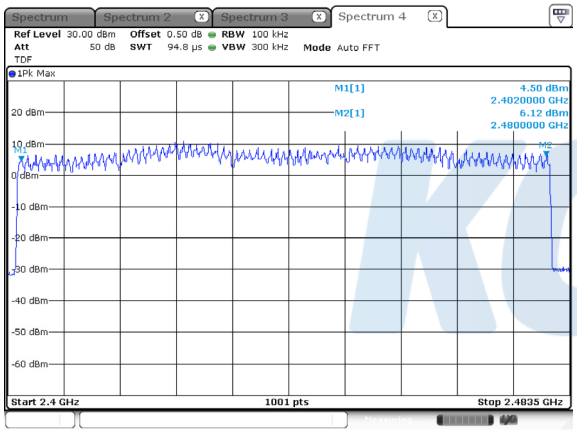
**Test settings**

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.

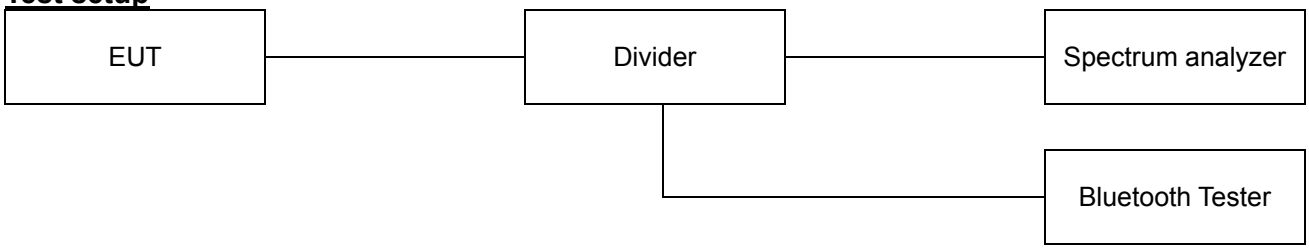
**Test results**

| Mode | Number of hopping channel | Limit |
|---|---|---|
| GFSK | 79 | ≥15 |
| π/4DQPSK | 79 | ≥15 |
| 8DPSK | 79 | ≥15 |

| GFSK | π/4DQPSK |
|---|---|
|  |  |
| **8DPSK** | |
|  | Blank |

## 7.5. Time of occupancy(Dwell time)

**Test setup**




**Limit**

According to §15.247(a)(1)(iii) and RSS-247 5.1(d), 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.

**Test procedure**

ANSI C63.10-2013 - Section 7.8.4

**Test settings**

a) Span: Zero span, centered on a hopping channel.
b) RBW ≤ channel spacing and >> 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.
f) 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.

**Test results**

**- Non-AFH**

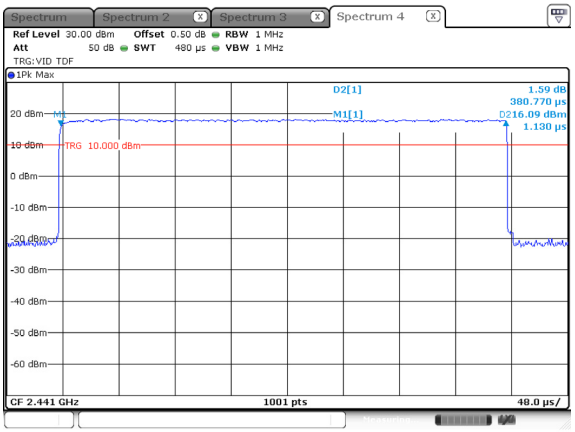
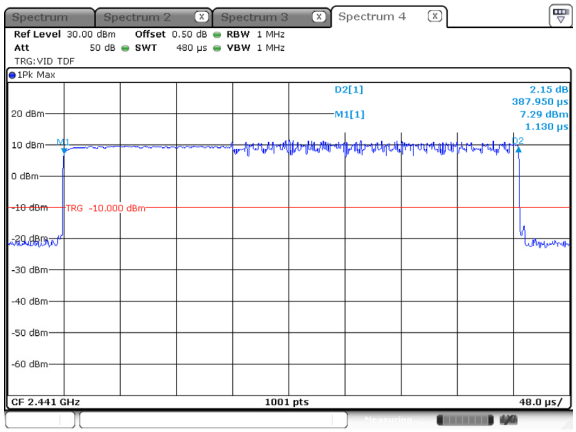
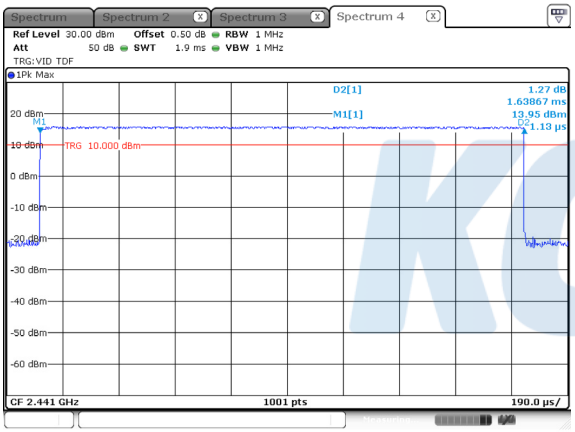
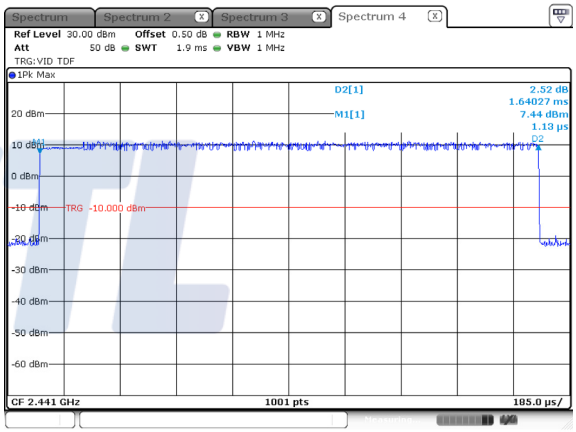
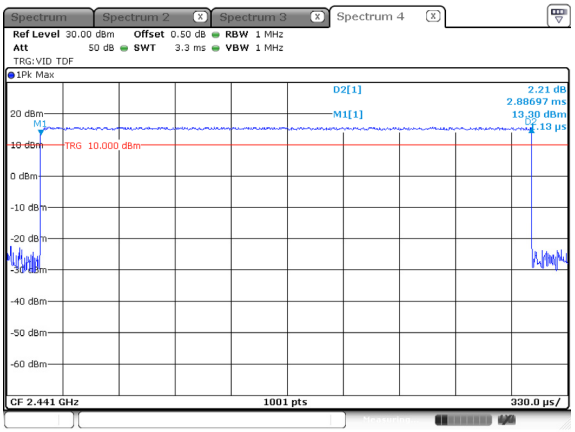
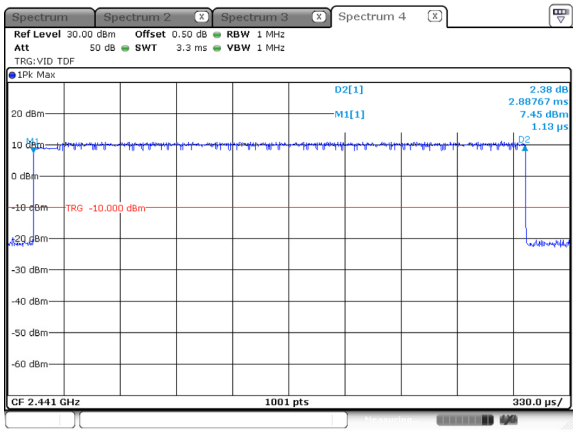
| Modulation | Frequency (㎒) | Pulse Width (㎳) | Hopping rate (hop/s) | Number of Channels | Result (s) | Limit (s) |
|---|---|---|---|---|---|---|
| DH1 | 2 441 | 0.381 | 800.000 | 79 | 0.122 | 0.400 |
| DH3 | 2 441 | 1.639 | 400.000 | 79 | 0.262 | 0.400 |
| DH5 | 2 441 | 2.887 | 266.667 | 79 | 0.308 | 0.400 |
| 2-DH1 | 2 441 | 0.388 | 800.000 | 79 | 0.124 | 0.400 |
| 2-DH3 | 2 441 | 1.640 | 400.000 | 79 | 0.262 | 0.400 |
| 2-DH5 | 2 441 | 2.888 | 266.667 | 79 | 0.308 | 0.400 |
| 3-DH1 | 2 441 | 0.388 | 800.000 | 79 | 0.124 | 0.400 |
| 3-DH3 | 2 441 | 1.640 | 400.000 | 79 | 0.262 | 0.400 |
| 3-DH5 | 2 441 | 2.885 | 266.667 | 79 | 0.308 | 0.400 |

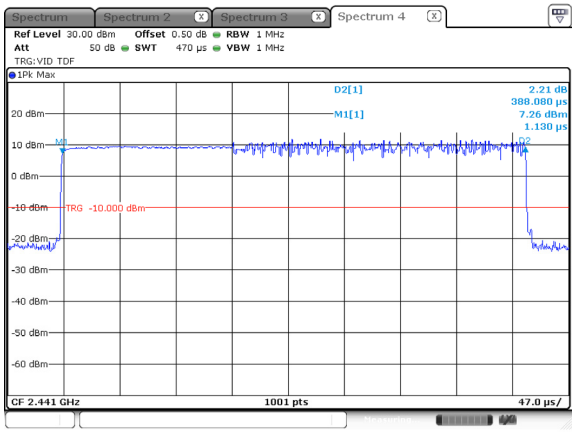
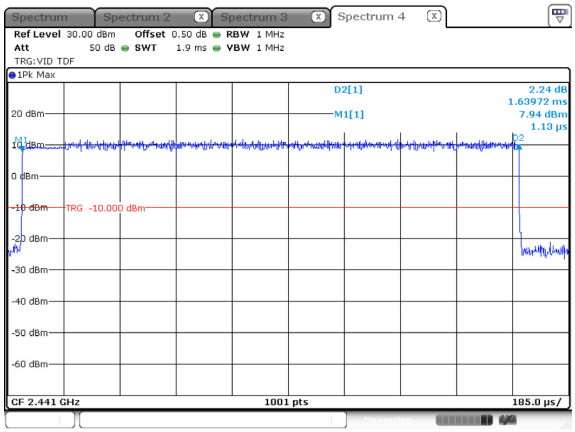
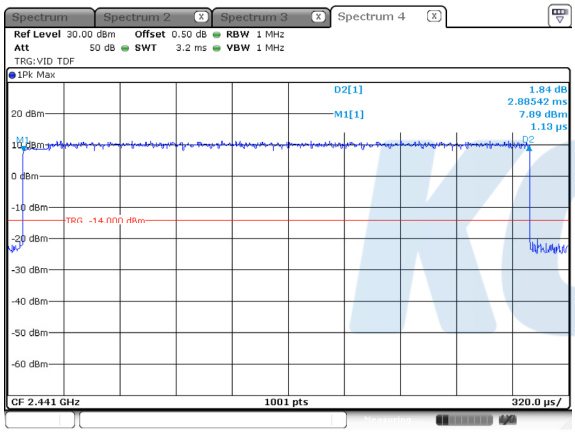
**- AFH**

| Modulation | Frequency (㎒) | Pulse Width (㎳) | Hopping rate (hop/s) | Number of Channels | Result (s) | Limit (s) |
|---|---|---|---|---|---|---|
| DH1 | 2 441 | 0.381 | 400.000 | 20 | 0.061 | 0.400 |
| DH3 | 2 441 | 1.636 | 200.000 | 20 | 0.131 | 0.400 |
| DH5 | 2 441 | 2.886 | 133.333 | 20 | 0.154 | 0.400 |
| 2-DH1 | 2 441 | 0.388 | 400.000 | 20 | 0.062 | 0.400 |
| 2-DH3 | 2 441 | 1.640 | 200.000 | 20 | 0.131 | 0.400 |
| 2-DH5 | 2 441 | 2.889 | 133.333 | 20 | 0.154 | 0.400 |
| 3-DH1 | 2 441 | 0.388 | 400.000 | 20 | 0.062 | 0.400 |
| 3-DH3 | 2 441 | 1.641 | 200.000 | 20 | 0.131 | 0.400 |
| 3-DH5 | 2 441 | 2.886 | 133.333 | 20 | 0.154 | 0.400 |

**Notes:**

1. Non-AFH
   - Period Time: 0.4 sec x 79 channels = 31.6 sec
   - Result (s)= (Hopping rate (hop/s/slot) / 79 channels) x 31.6 sec x Pulse width (ms)
2. AFH
   - Period Time: 0.4 sec x 20 channels = 8 sec
   - Result (s)= (Hopping rate (hop/s/slot) / 20 channels) x 8 sec x Pulse width (ms)

| GFSK / DH1 | π/4DQPSK / 2-DH1 |
|---|---|
|  |  |
| **GFSK / DH3** | **π/4DQPSK / 2-DH3** |
|  |  |
| **GFSK / DH5** | **π/4DQPSK / 2-DH5** |
|  |  |

| 8DPSK / 3-DH1 | 8DPSK / 3-DH3 |
|---|---|
|  |  |
| **8DPSK / 3-DH5** | |
|  | Blank |