

# TEST REPORT

of

## ARIB STD-T66

1. Equipment Under Test : RFID Smart Reader
2. Model Name : a711F
3. Variant Mode Name(s) : -
4. Applicant : Apulse Technology Co., Ltd.
5. Manufacturer : Apulse Technology Co., Ltd.
6. Date of Receipt : 2020.04.03
7. Date of Test(s) : 2020.05.11 ~ 2020.05.18
8. Date of Issue : 2020.05.27

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.

Tested by:



James Bae

Technical  
Manager:



Hyunhae You

**SGS Korea Co., Ltd. Gunpo Laboratory**

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## 1. General information

### 1.1. Testing laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

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### 1.2. Details of applicant

Applicant : Apulse Technology Co., Ltd.

Address : C-1211, 60, Haan-ro, Gwangmyeong-si, Gyeonggi-do, Republic of Korea

Contact Person : Kim, Nam-joong

Phone No. : +82 10 5526 0605

### 1.3. Details of manufacturer

Company : Apulse Technology Co., Ltd.

Address : C-1211, 60, Haan-ro, Gwangmyeong-si, Gyeonggi-do, Republic of Korea

### 1.4. Description of EUT

|                             |                                                      |                                                                                                   |
|-----------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>Kind of Product</b>      |                                                      | RFID Smart Reader                                                                                 |
| <b>Model Name</b>           |                                                      | a711F                                                                                             |
| <b>Power Supply</b>         |                                                      | DC 3.7 V                                                                                          |
| <b>Frequency Range</b>      |                                                      | 2 402 MHz ~ 2 480 MHz (Bluetooth, Bluetooth Low Energy),<br>2 412 MHz ~ 2 472 MHz (11b/g/n_HT20), |
| <b>Modulation Technique</b> |                                                      | DSSS, OFDM, GFSK, $\pi/4$ DQPSK, 8DPSK                                                            |
| <b>Number of Channels</b>   |                                                      | 79 channels (Bluetooth),<br>40 channels (Bluetooth Low Energy),<br>13 channels (11b/g/n_HT20),    |
| <b>Antenna Type</b>         |                                                      | PIFA Antenna                                                                                      |
| <b>Antenna Gain</b>         | <b>Bluetooth,<br/>Bluetooth Low Energy,<br/>WLAN</b> | 2 400 MHz ~ 2 483.5 MHz: 0.07 dBi                                                                 |

## 1.5. Test Equipment List

| Equipment           | Manufacturer     | Model     | Serial No.  | Cal. Date     | Cal. Authority | Cal. Method |
|---------------------|------------------|-----------|-------------|---------------|----------------|-------------|
| Spectrum Analyzer   | R&S              | FSV30     | 103102      | Jun. 19, 2019 | SICT           | c)          |
| Signal Generator    | Agilent          | E8257D    | MY51501169  | Nov. 21, 2019 | SICT           | c)          |
| Directional Coupler | KRYTAR           | 152613    | 122661      | Feb. 17, 2020 | SICT           | c)          |
| Attenuator          | AEROFLEX / INMET | 26A-10 dB | 3           | Feb. 18, 2020 | SICT           | c)          |
| Bluetooth Tester    | TESCOM           | TC-3000C  | 3000C000560 | Sep. 18, 2019 | SICT           | c)          |
| DC Power Supply     | R&S              | HMP2020   | 019922876   | Apr. 27, 2020 | SICT           | c)          |
| DIGITAL MULTIMETER  | HIOKI            | DT4211    | N0301231    | Sep. 18, 2019 | SICT           | c)          |

### Note;

- a): Calibration conducted by the National Institute of Information and Communications Technology or a designated calibration agency under Article 102-18 paragraph (1).
- b): Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law. (Law No. 51 of 1992)
- c): Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
- d): Calibration conducted by using other equipment that listed above from a) to c).

## 1.6. Test method

Measurement was conducted by the following test method:  
the test method of Ordinance Concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment in Annex 1, the Ministry of Internal Affairs and Communication notification in Annex 43 of Article 88, Paragraph 1 and Annex 43 or the test method more than equivalent.

## 1.7. Summary of test results

The EUT has been tested according to the following specifications:

| Applied standard : Radio equipment regulations and ARIB STD-T66 |                                                       |          |
|-----------------------------------------------------------------|-------------------------------------------------------|----------|
| Article Reference                                               | Test item                                             | Result   |
| STD-T66 3.2                                                     | Frequency Tolerance                                   | Complied |
| STD-T66 3.2                                                     | Occupied Bandwidth (99 %) and Spread Bandwidth (90 %) | Complied |
| STD-T66 3.2                                                     | Spurious Emission Intensity                           | Complied |
| STD-T66 3.2                                                     | Antenna Power                                         | Complied |
| STD-T66 3.3                                                     | Secondary Radiated Emissions                          | Complied |
| STD-T66 3.2                                                     | Dwell Time                                            | Complied |
| STD-T66 3.4                                                     | Interference Prevention Function                      | Complied |

## 1.8. Test report revision

| Revision | Report number        | Date of issue | Description |
|----------|----------------------|---------------|-------------|
| 0        | F690501-RF-RTL000723 | 2020.05.27    | Initial     |

## 2. Frequency Tolerance

### 2.1. Test Setup



### 2.2. Limit

$\pm 50 \times 10^{-6}$  (50 ppm or below)

### 2.3. Test procedure

1. Set the EUT as un-modulated .
2. Connect transmitter output to the spectrum analyzer input port.
3. The EUT should be transmitting at low, middle and high channel.
4. Frequency Tolerance is measured by following setting:
  - 1) Setting for 20 MHz system
 

|                    |                                   |
|--------------------|-----------------------------------|
| Center Frequency:  | 2 402 MHz , 2 441 MHz , 2 480 MHz |
| Span:              | 1 MHz                             |
| RBW:               | 10 kHz                            |
| VBW:               | 10 kHz                            |
| Sweep data points: | 1 001 or greater                  |
| Sweep time:        | Auto                              |
| Detector mode:     | Positive peak                     |
| Indication mode:   | Max hold                          |
5. Find the peak carrier signal and measure its frequency.

## 2.4. Test result

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.

|                              | Low Ch.<br>(2 402 MHz) | Middle Ch.<br>(2 441 MHz) | High Ch.<br>(2 480 MHz) |
|------------------------------|------------------------|---------------------------|-------------------------|
| Reading<br>frequency (MHz)   | 2 402.028 000          | 2 441.033 000             | 2 480.038 000           |
| Frequency<br>tolerance (ppm) | 11.66                  | 13.52                     | 15.32                   |

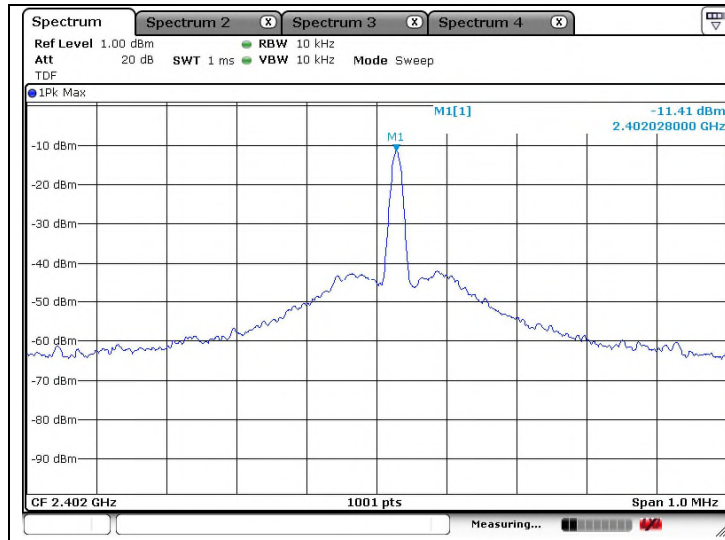
Note;

$$1. FT (ppm) = [(RF - MF) / MF] \times 10^6$$

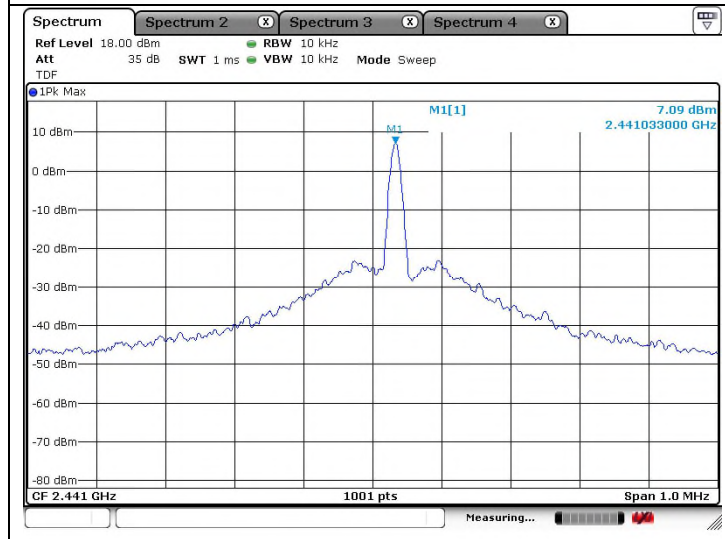
- FT: Frequency Tolerance, RF: Reading Frequency and MF: Measurement Frequency

**- Test mode: Un-Modulated**

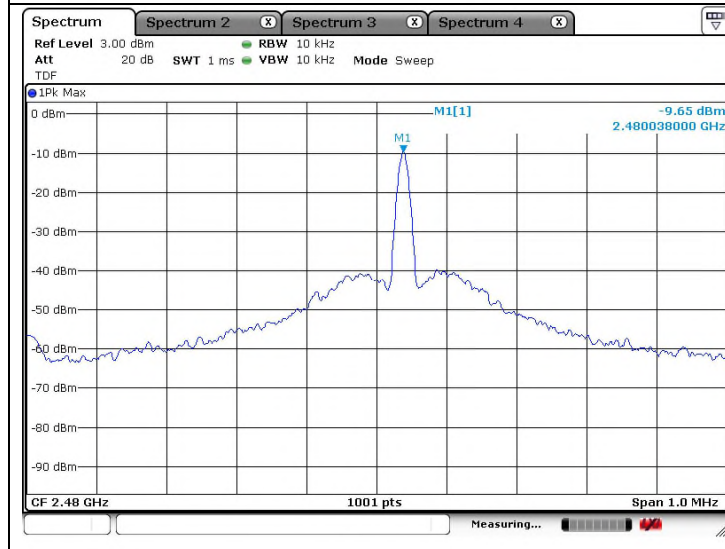
**2 402 MHz**



**2 441 MHz**



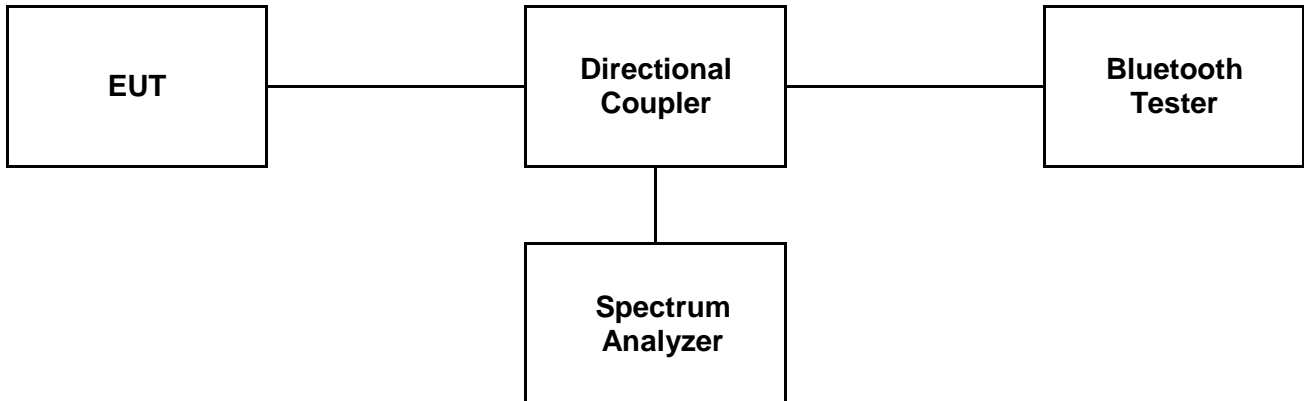
**2 480 MHz**





### 3. Occupied Bandwidth (99 %) and Spread Bandwidth (90 %)

#### 3.1. Test Setup



#### 3.2. Limit

[Occupied Bandwidth]

BDR, EDR: 83.5 MHz or less

[Spread Bandwidth]

BDR, EDR: 500 kHz or more

### 3.3. Test Procedure

#### 3.3.1. Occupied Bandwidth (99 %)

1. Connect transmitter output to the spectrum analyzer input port.
2. Set the EUT to transmit using the 79-channel hopping mode.
3. Measure the signal bandwidth using a spectrum analyzer.
4. Set the spectrum analyzer to below.

[Occupied Bandwidth (99 %)]

|                    |          |                  |
|--------------------|----------|------------------|
| Center frequency:  | BDR, EDR | 2 441 MHz        |
| Span:              | BDR, EDR | 160 MHz          |
| RBW:               |          | 300 kHz          |
| VBW:               |          | 300 kHz          |
| Sweep time         |          | Auto             |
| Sweep data points: |          | 1 001 or greater |
| Detector mode      |          | Positive peak    |
| Indication mode    |          | Max hold         |
| BW setting:        |          | 99 %             |

#### 3.3.2. Spread Bandwidth (90 %)

1. Connect transmitter output to the spectrum analyzer input port.
2. Set the EUT to transmit using the 79-channel hopping mode.
3. Measure the signal bandwidth using a spectrum analyzer.
4. Set the spectrum analyzer to below.

[Spectrum spread bandwidth (90 %)]

|                    |                  |
|--------------------|------------------|
| Center frequency:  | 2 441 MHz        |
| Span:              | 160 MHz          |
| RBW:               | 300 kHz          |
| VBW:               | 300 kHz          |
| Sweep time:        | Auto             |
| Sweep data points: | 1 001 or greater |
| Detector mode:     | Positive peak    |
| Indication mode:   | Max hold         |
| BW setting:        | 90 %             |

5. In case of AFH mode, find the frequency of highest amplitude ( $f_{HA}$ ) in the signal bandwidth.
6. Set 20-channel hopping mode according to below.
  - Frequency Range (A) –if  $f_{HA}$  occupies in the middle section (2 411 MHz to 2 471 MHz) of the 79-channel band, then set the 20-channel continuous hopping so that  $f_{HA}$  is located between the 10<sup>th</sup> and 11<sup>th</sup> channels.
7. Measure the signal bandwidth using a spectrum analyzer.

### 3.4. Test result

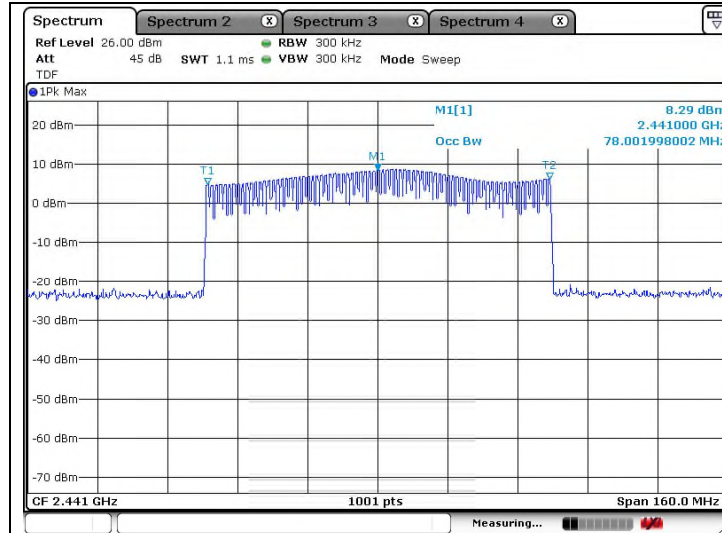
Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

|                           | Occupied Bandwidth (99 %) |                   | Spread Bandwidth (90 %) |                 |
|---------------------------|---------------------------|-------------------|-------------------------|-----------------|
|                           | Result(MHz)               | Limit             | Result(MHz)             | Limit           |
| <b>GFSK (NON AFH)</b>     | 78.00                     | 83.50 MHz or less | 68.25                   | 500 kHz or more |
| <b>GFSK (AFH)</b>         | -                         |                   | 17.90                   |                 |
| <b>π/4DQPSK (NON AFH)</b> | 78.48                     |                   | 70.81                   |                 |
| <b>π/4DQPSK (AFH)</b>     | -                         |                   | 18.22                   |                 |
| <b>8DPSK (NON AFH)</b>    | 78.64                     |                   | 68.73                   |                 |
| <b>8DPSK (AFH)</b>        | -                         |                   | 18.38                   |                 |

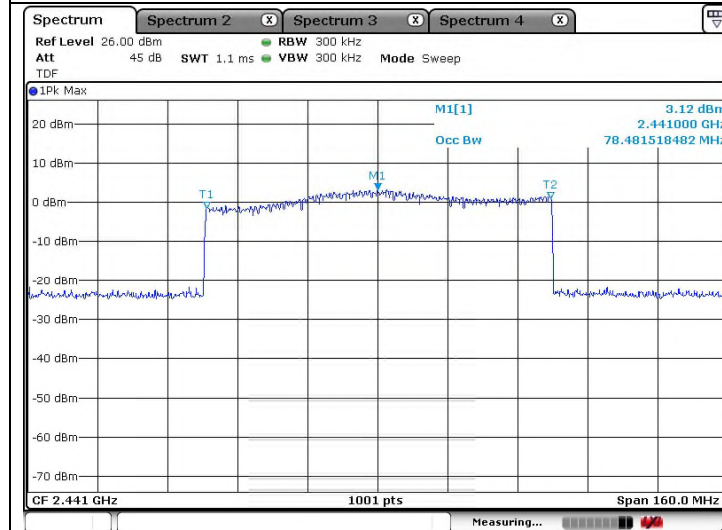
## Occupied Bandwidth (99 %)

- Test mode: NON AFH

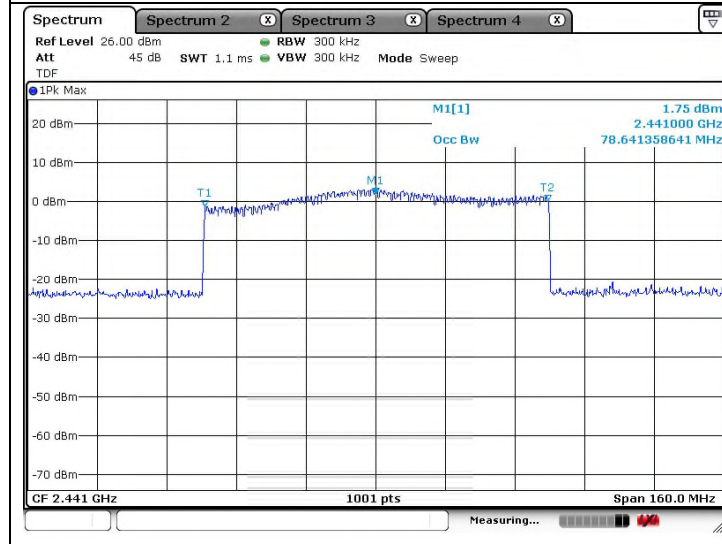
GFSK



$\pi/4$ DQPSK

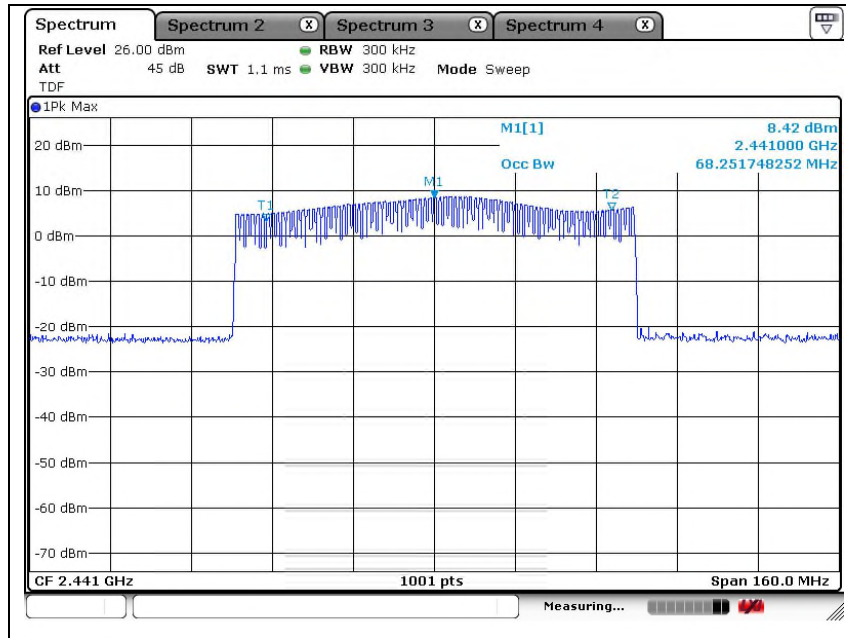


8DPSK

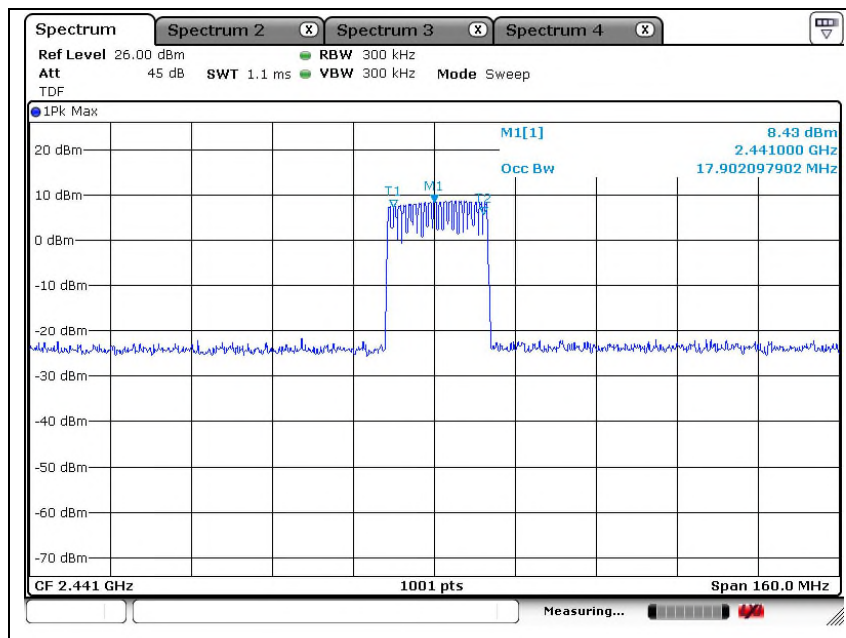


## Spread Bandwidth (90 %)

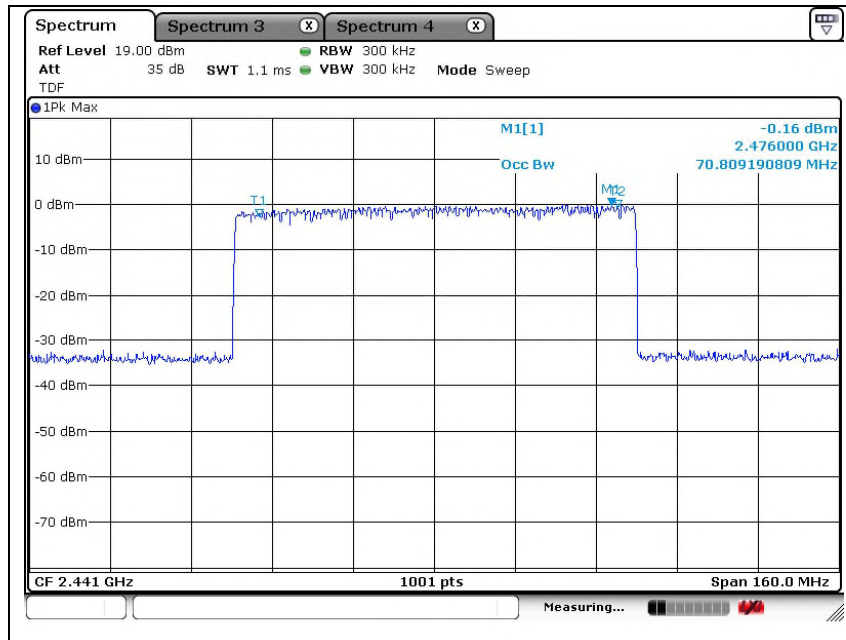
- Test mode: GFSK (NON AFH)



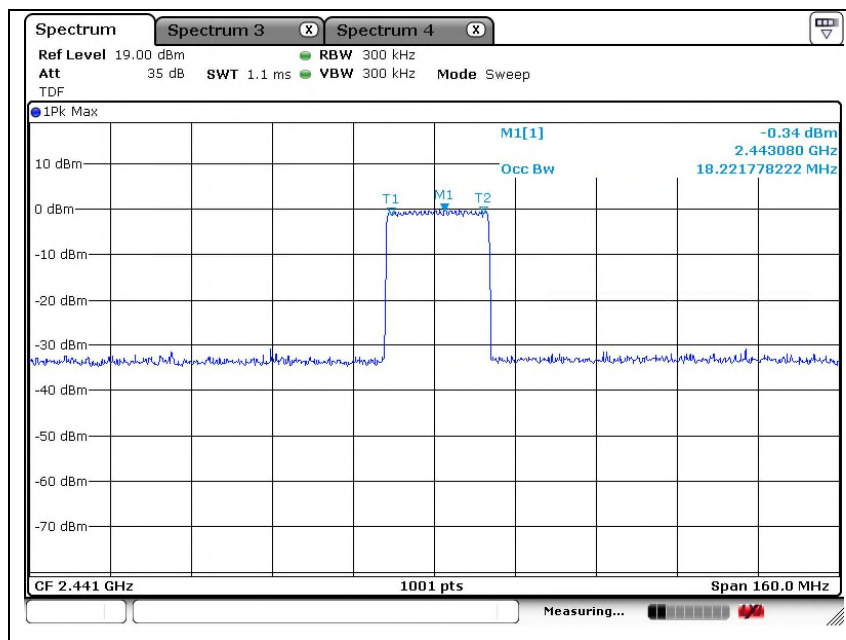
- Test mode: GFSK (AFH)



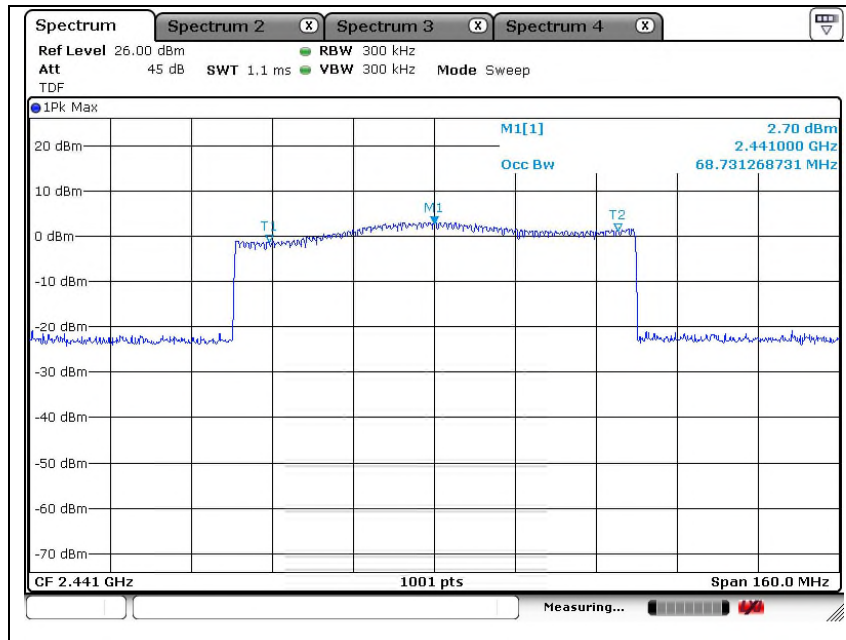
- Test mode:  $\pi/4$ DQPSK (NON AFH)



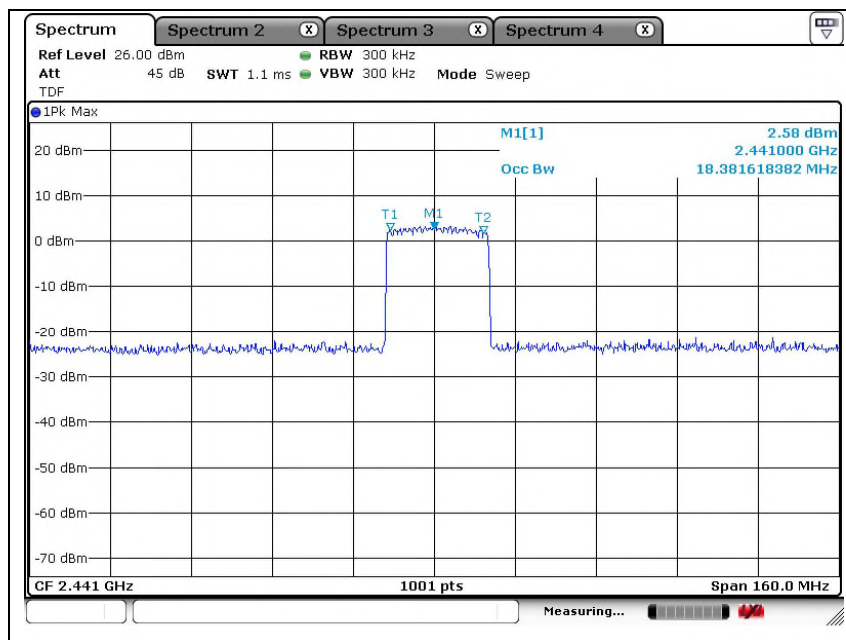
- Test mode:  $\pi/4$ DQPSK (AFH)



- Test mode: 8DPSK (NON AFH)

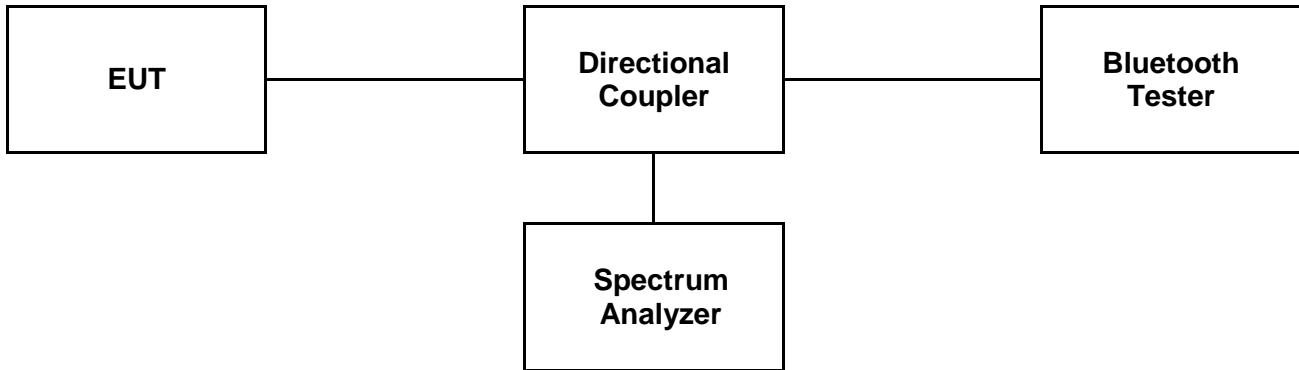


- Test mode: 8DPSK (AFH)



## 4. Spurious Emission Intensity

### 4.1. Test Setup



### 4.2. Limit

Below 2 387 MHz: 2.5  $\mu$ W (-26 dB m)/MHz or less  
 2 387 to 2 400 MHz: 25.0  $\mu$ W (-16 dB m)/MHz or less  
 2 483.5 to 2 496.5 MHz: 25.0  $\mu$ W (-16 dB m)/MHz or less  
 Over 2 496.5 MHz: 2.5  $\mu$ W (-26 dB m)/MHz or less

### 4.3. Test Procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. Configure the EUT
  - Hopping using all channels
  - Modulated
  - Maximum payload size (BDR: DH5, EDR: 3DH5)

Set the Spectrum Analyzer to below

#### [Setting 1]

|                    |          |                                                         |
|--------------------|----------|---------------------------------------------------------|
| Frequency range:   | BDR, EDR | 30 MHz to 12.5 GHz, except for 2 374 MHz to 2 509.5 MHz |
| RBW:               |          | 1 MHz                                                   |
| VBW:               |          | 1 MHz                                                   |
| Sweep time:        |          | Minimum time required to make an accurate measurement   |
| Sweep data points: |          | 1 001 or greater                                        |
| Detector mode:     |          | Positive peak                                           |
| Indication mode:   |          | Max hold                                                |

Note: sweep shall be repeated until the max hold waveform is stable.

#### [Setting 2]

|                    |          |                                                        |
|--------------------|----------|--------------------------------------------------------|
| Frequency range:   | BDR, EDR | 2 374 MHz to 2 400 MHz<br>2 483.5 MHz to 2 509.5 MHz   |
| RBW:               |          | 30 kHz                                                 |
| VBW:               |          | 30 kHz                                                 |
| Sweep time:        |          | Minimum time required to make an accurate measurement. |
| Sweep data points: |          | 1 001 or greater                                       |
| Detector mode:     |          | Positive peak                                          |
| Indication mode:   |          | Max hold                                               |

Calculate the spurious value (Calculated Value) using following formula:

Calculated Value = (Measured Value using [Setting 2] + 15.2 dB)

Note: 15.2 dB adjustment is derived from the Conversion Factor of RBW

Conversion Factor of RBW = 10 x Log (Reference Bandwidth / RBW of measurement) = 15.2 [dB]

Where: Reference Bandwidth = 1 MHz

RBW of measurement = 30 kHz

3. Search for spurious emissions from 30 MHz to 12.5 GHz.



#### 4.4. Test result

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

##### - Test mode: GFSK (NON AFH)

|                            | Measured frequency | Measured level        | Limit           |
|----------------------------|--------------------|-----------------------|-----------------|
| 30 MHz to 2 374 MHz        | 0.956 GHz          | 0.005 598 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -52.52 dB m/MHz       | -26 dB m/MHz    |
| 2 374 MHz to 2 387 MHz     | 2.384 GHz          | 0.007 998 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -50.97 dB m/MHz       | -26 dB m/MHz    |
| 2 387 MHz to 2 400 MHz     | 2.392 GHz          | 0.008 531 $\mu$ W/MHz | 25 $\mu$ W/MHz  |
|                            |                    | -50.69 dB m/MHz       | -16 dB m/MHz    |
| 2 483.5 MHz to 2 496.5 MHz | 2.488 GHz          | 0.010 447 $\mu$ W/MHz | 25 $\mu$ W/MHz  |
|                            |                    | -49.81 dB m/MHz       | -16 dB m/MHz    |
| 2 496.5 MHz to 2 509.5 MHz | 2.497 GHz          | 0.010 864 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -49.64 dB m/MHz       | -26 dB m/MHz    |
| 2 509.5 MHz to 12.5 GHz    | 12.246 GHz         | 0.023 933 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -46.21 dB m/MHz       | -26 dB m/MHz    |

##### - Test mode: GFSK (AFH)

|                            | Measured frequency | Measured level        | Limit           |
|----------------------------|--------------------|-----------------------|-----------------|
| 30 MHz to 2 374 MHz        | 0.673 GHz          | 0.005 000 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -53.01 dB m/MHz       | -26 dB m/MHz    |
| 2 374 MHz to 2 387 MHz     | 2.384 GHz          | 0.005 445 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -52.64 dB m/MHz       | -26 dB m/MHz    |
| 2 387 MHz to 2 400 MHz     | 2.397 GHz          | 0.005 943 $\mu$ W/MHz | 25 $\mu$ W/MHz  |
|                            |                    | -52.26 dB m/MHz       | -16 dB m/MHz    |
| 2 483.5 MHz to 2 496.5 MHz | 2.487 GHz          | 0.013 243 $\mu$ W/MHz | 25 $\mu$ W/MHz  |
|                            |                    | -48.78 dB m/MHz       | -16 dB m/MHz    |
| 2 496.5 MHz to 2 509.5 MHz | 2.507 GHz          | 0.009 099 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -50.41 dB m/MHz       | -26 dB m/MHz    |
| 2 509.5 MHz to 12.5 GHz    | 12.475 GHz         | 0.025 061 $\mu$ W/MHz | 2.5 $\mu$ W/MHz |
|                            |                    | -46.01 dB m/MHz       | -26 dB m/MHz    |

**- Test mode: 8DPSK (NON AFH)**

|                            | Measured frequency | Measured level        | Limit            |
|----------------------------|--------------------|-----------------------|------------------|
| 30 MHz to 2 374 MHz        | 0.860 GHz          | 0.016 144 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -47.92 dB m/MHz       | -26 dB m/MHz     |
| 2 374 MHz to 2 387 MHz     | 2.376 GHz          | 0.005 248 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -52.80 dB m/MHz       | -26 dB m/MHz     |
| 2 387 MHz to 2 400 MHz     | 2.395 GHz          | 0.005 728 $\mu$ W/MHz | 25 $\mu$ W /MHz  |
|                            |                    | -52.42 dB m/MHz       | -16 dB m/MHz     |
| 2 483.5 MHz to 2 496.5 MHz | 2.486 GHz          | 0.006 012 $\mu$ W/MHz | 25 $\mu$ W /MHz  |
|                            |                    | -52.21 dB m/MHz       | -16 dB m/MHz     |
| 2 496.5 MHz to 2 509.5 MHz | 2.507 GHz          | 0.005 970 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -52.24 dB m/MHz       | -26 dB m/MHz     |
| 2 509.5 MHz to 12.5 GHz    | 2.544 GHz          | 0.071 945 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -41.43 dB m/MHz       | -26 dB m/MHz     |

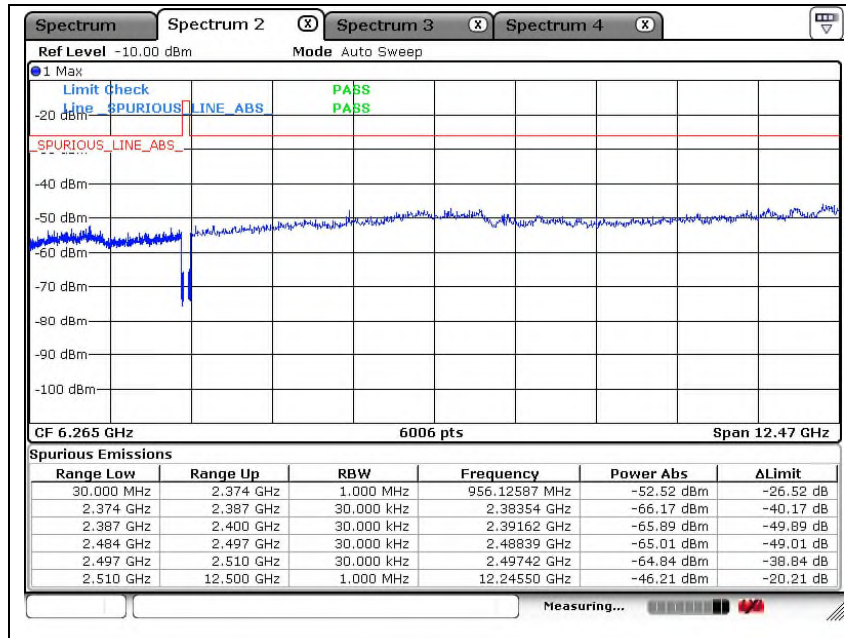
**- Test mode: 8DPSK (AFH)**

|                            | Measured frequency | Measured level        | Limit            |
|----------------------------|--------------------|-----------------------|------------------|
| 30 MHz to 2 374 MHz        | 0.673 GHz          | 0.005 370 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -52.70 dB m/MHz       | -26 dB m/MHz     |
| 2 374 MHz to 2 387 MHz     | 2.378 GHz          | 0.004 539 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -53.43 dB m/MHz       | -26 dB m/MHz     |
| 2 387 MHz to 2 400 MHz     | 2.390 GHz          | 0.004 786 $\mu$ W/MHz | 25 $\mu$ W /MHz  |
|                            |                    | -53.20 dB m/MHz       | -16 dB m/MHz     |
| 2 483.5 MHz to 2 496.5 MHz | 2.484 GHz          | 0.006 281 $\mu$ W/MHz | 25 $\mu$ W /MHz  |
|                            |                    | -52.02 dB m/MHz       | -16 dB m/MHz     |
| 2 496.5 MHz to 2 509.5 MHz | 2.502 GHz          | 0.048 195 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -43.17 dB m/MHz       | -26 dB m/MHz     |
| 2 509.5 MHz to 12.5 GHz    | 12.295 GHz         | 0.021 727 $\mu$ W/MHz | 2.5 $\mu$ W /MHz |
|                            |                    | -46.63 dB m/MHz       | -26 dB m/MHz     |

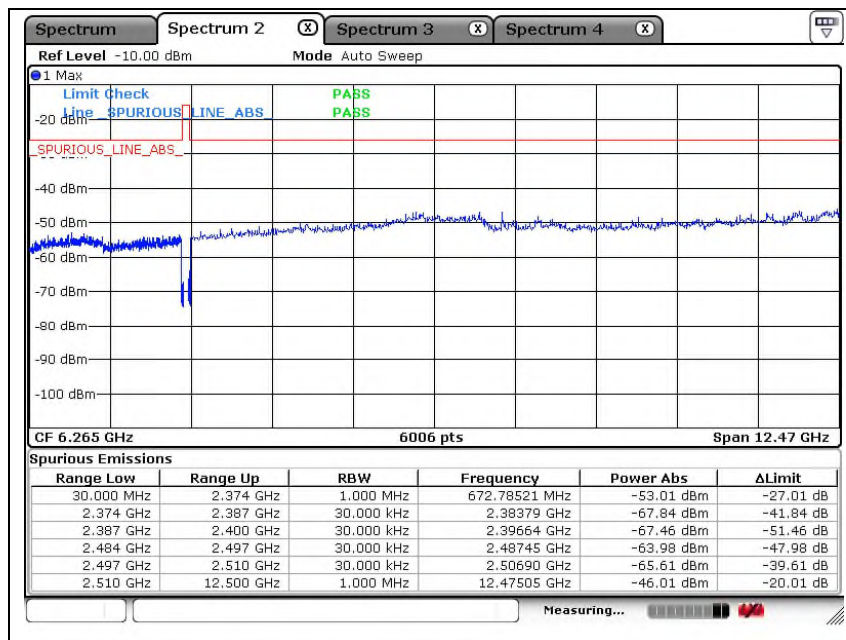
Note;

The levels within 2 374 ~ 2 400 MHz and 2 483.5 ~ 2 509.5 MHz are final results investigated by Resolution Bandwidth 30 kHz and considered by conversion factor of RBW.  
Conversion factor:  $10\log(1 \text{ MHz}/30 \text{ kHz})=15.2 \text{ dB}$

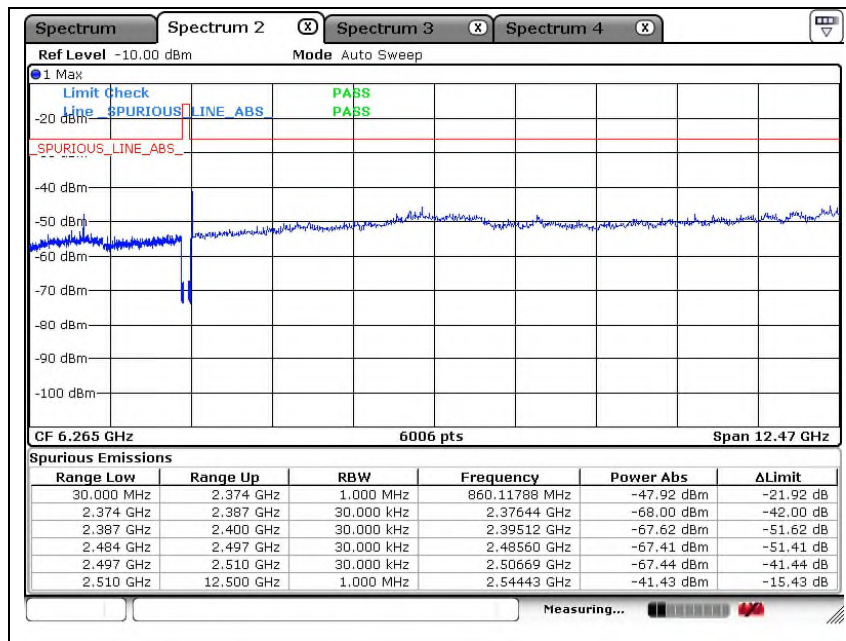
- Test mode: GFSK (NON AFH)



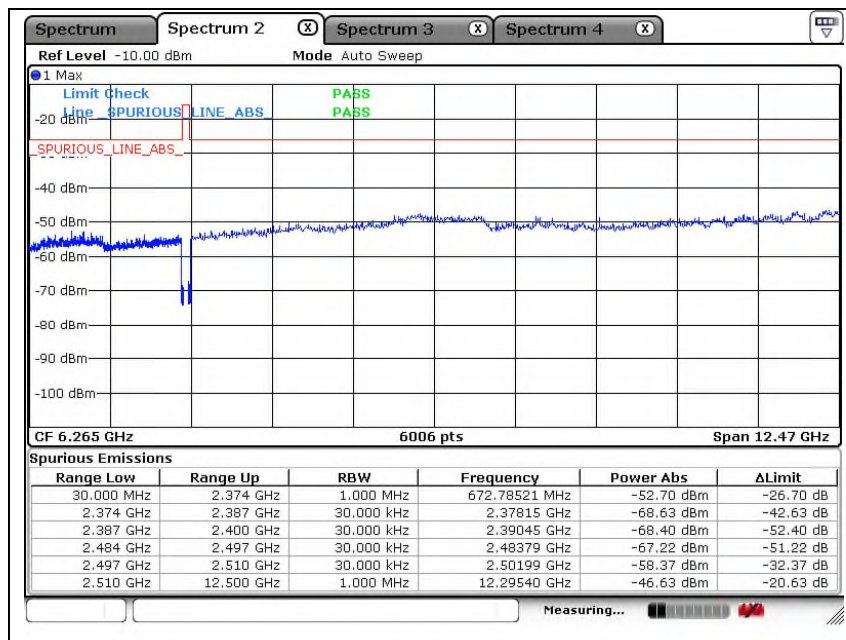
- Test mode: GFSK (AFH)



- Test mode: 8DPSK (NON AFH)

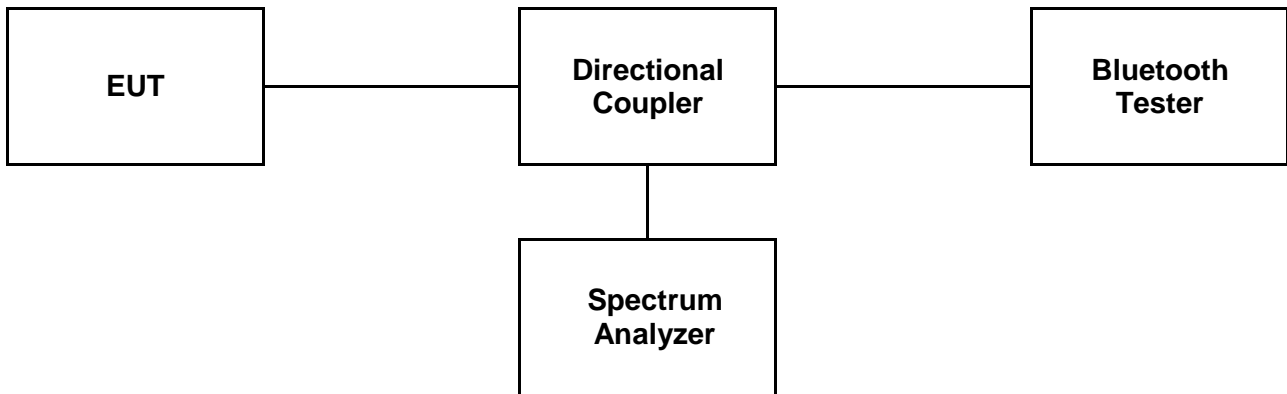


- Test mode: 8DPSK (AFH)



## 5. Antenna Power

### 5.1. Test Setup



### 5.2. Limit

The difference between measured output power and the rated output power shall be within a tolerance of +20 % to -80 %. In addition, the rated output power shall not be over the limits shown below.

Limit (rated output power, upper limit)

- BDR, EDR: 3 mW/MHz or less

### 5.3. Test Procedure

1. Connect transmitter output to the spectrum analyzer input port.

2. Configure the EUT

- Hopping over all channels
- Maximum payload size (BDR: DH5, EDR: 3DH5)

–Search for peak power frequency according to below settings.

|                    |          |                  |
|--------------------|----------|------------------|
| Center frequency:  | BDR, EDR | 2 441 MHz        |
| Span:              | BDR, EDR | 100 MHz          |
| RBW:               |          | 1 MHz            |
| VBW:               |          | 3 MHz            |
| Sweep time:        |          | Auto             |
| Sweep data points: |          | 1 001 or greater |
| Detector mode:     |          | Positive peak    |
| Indication mode:   |          | Max hold         |

Find the frequency of maximum transmitted power.

–Measurement of average antenna power according to below settings.

|                    |                                                                                                  |
|--------------------|--------------------------------------------------------------------------------------------------|
| Center frequency:  | Frequency of peak power                                                                          |
| Span:              | 0 Hz                                                                                             |
| RBW:               | 3 MHz                                                                                            |
| Detector mode:     | Sample                                                                                           |
| Sweep time:        | 10 ms                                                                                            |
|                    | Minimum time required to make an accurate measurement.                                           |
|                    | For burst type (intermittent) transmission, sweep time shall be greater than one burst interval. |
| Sweep data points: | 1 001 or greater                                                                                 |

Measure the Average Burst Power of the frequency.

#### 5.4. Test result

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

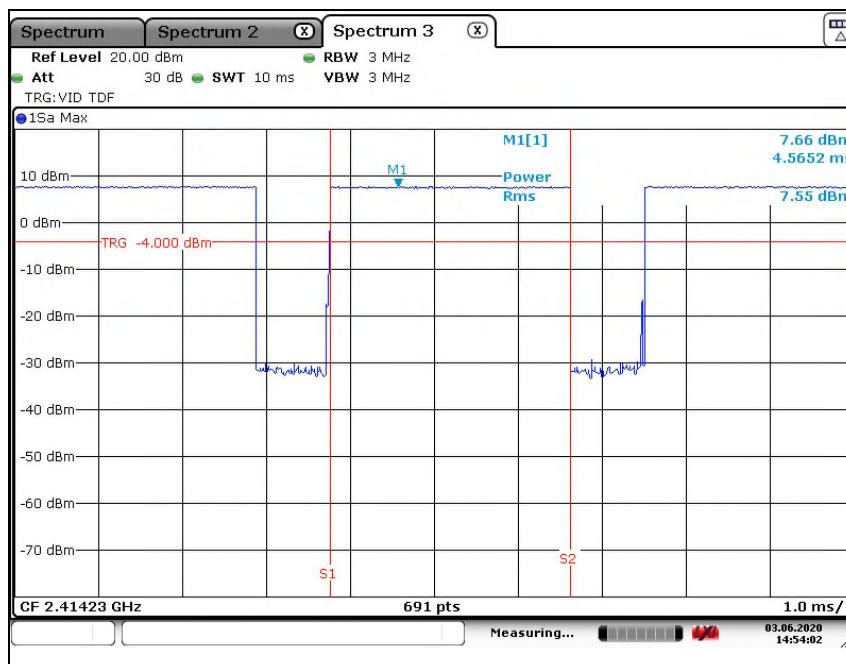
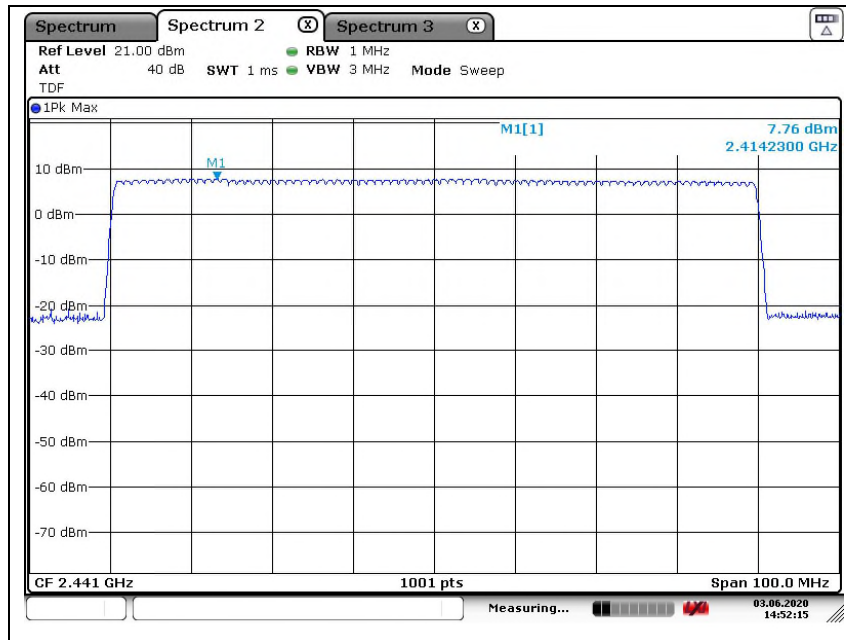
|                                    | GFSK<br>(NON AFH) | GFSK<br>(AFH) | 8DPSK<br>(NON AFH) | 8DPSK<br>(AFH) |
|------------------------------------|-------------------|---------------|--------------------|----------------|
| <b>Average Burst Power (mW)</b>    | 5.69              | 5.56          | 2.71               | 2.90           |
| <b>Average Burst Power (dB m)</b>  | 7.55              | 7.45          | 4.33               | 4.62           |
| <b>Spread Bandwidth (MHz)</b>      | 68.25             | 17.90         | 68.73              | 18.38          |
| <b>Antenna Power (mW/MHz)</b>      | 0.083             | 0.311         | 0.039              | 0.158          |
| <b>Rated Output Power (mW/MHz)</b> | 0.10              | 0.35          | 0.10               | 0.35           |
| <b>Power Tolerance (%)</b>         | -17.00            | -11.14        | -61.00             | -54.86         |

**Note;**

Antenna Power (mW/MHz) = Average Burst Power (mW) / Spread Bandwidth (MHz)

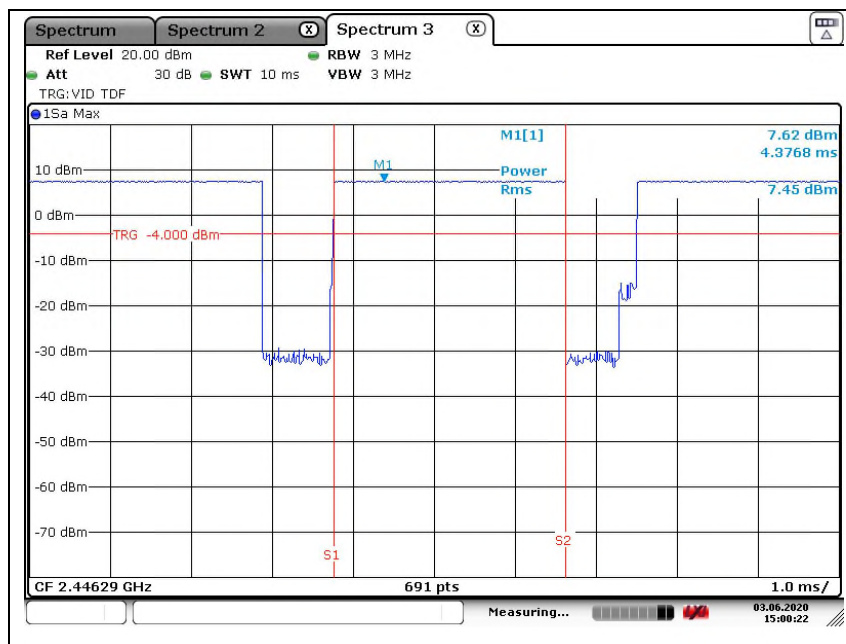
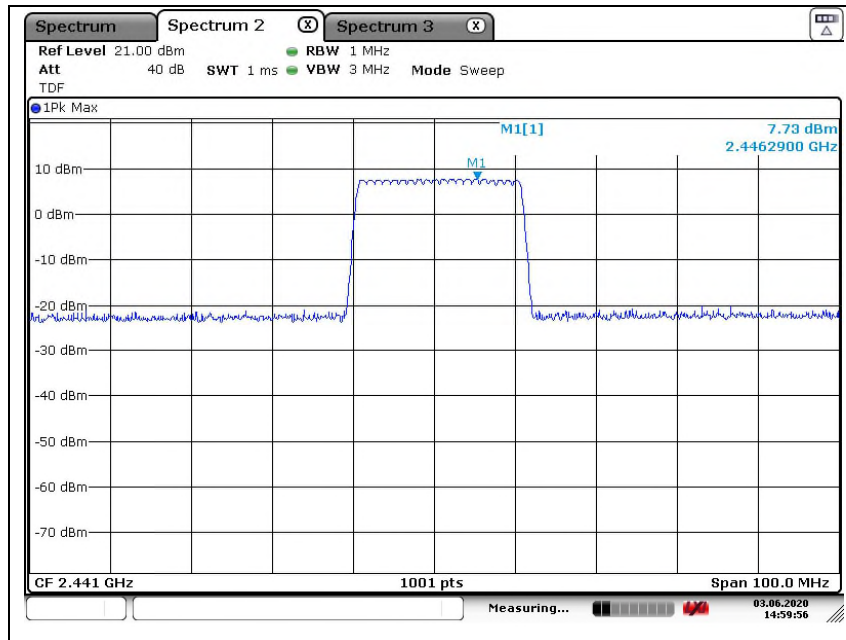
Power Tolerance (%) = {[Antenna Power (mW/MHz) - Rated Output Power (mW/MHz)] ÷ Rated Output Power (mW/MHz)} × 100

- Test mode: GFSK (NON AFH)



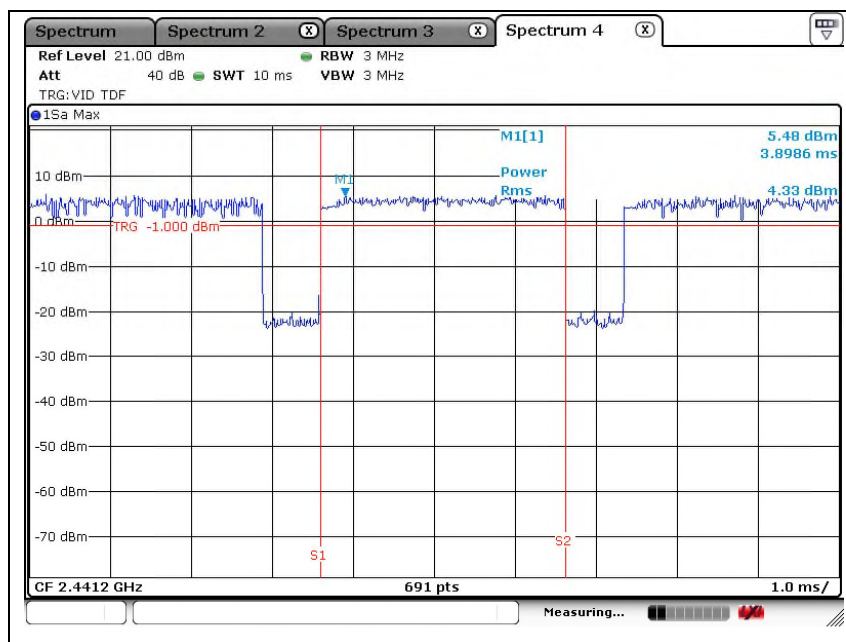
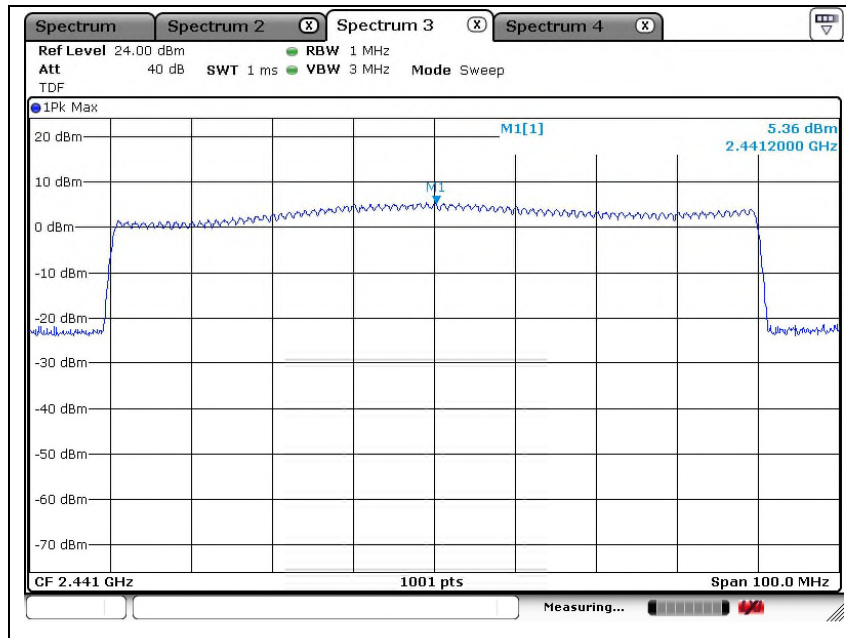


- Test mode: GFSK (AFH)

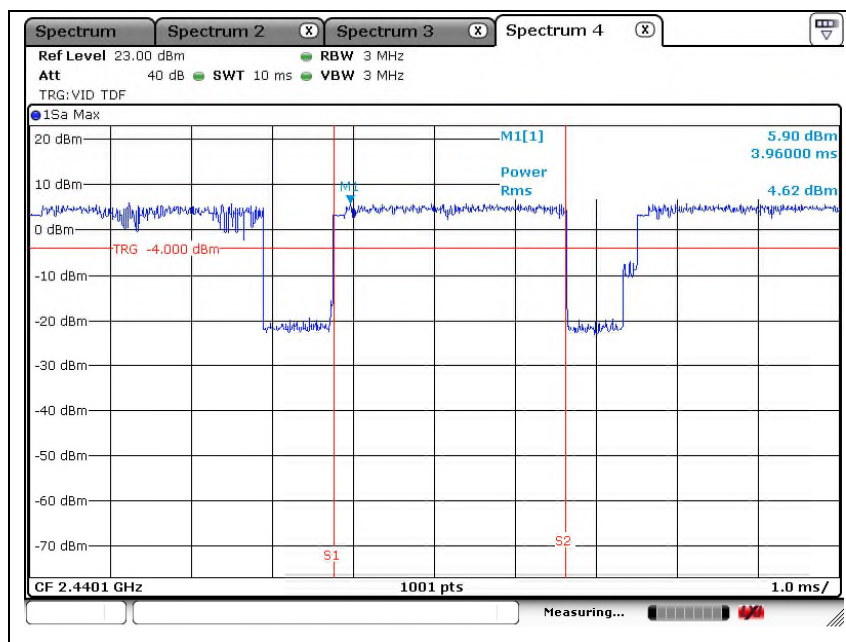
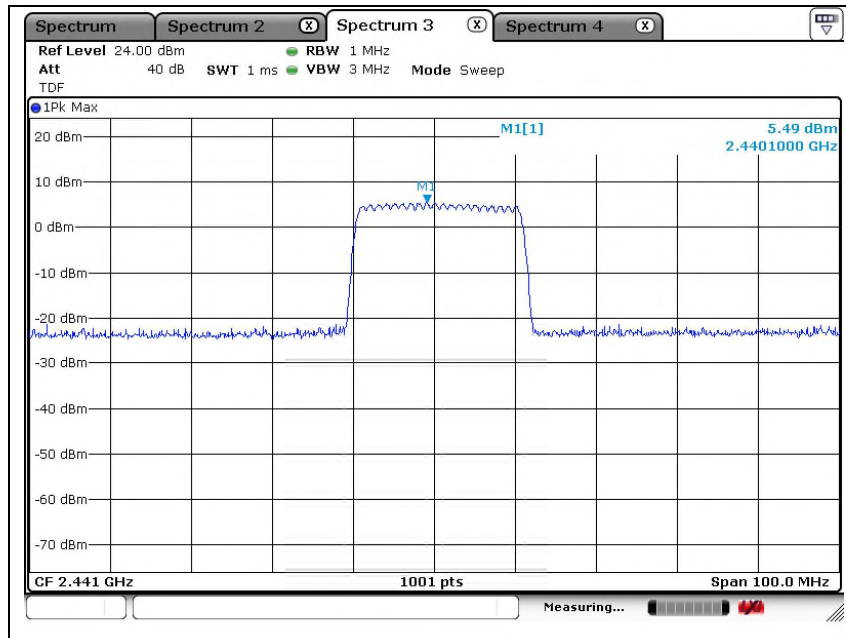




- Test mode: 8DPSK (NON AFH)

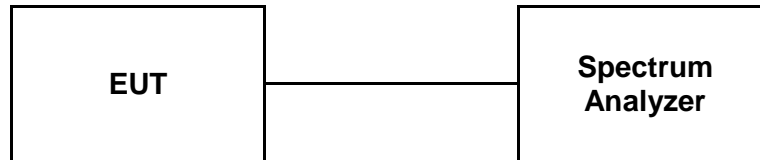


- Test mode: 8DPSK(AFH)



## 6. Secondary Radiated Emissions

### 6.1. Test Setup



### 6.2. Limit

Below 1 GHz: 4 nW (-54 dB m) or less  
 Above 1 GHz: 20 nW (-47 dB m) or less

### 6.3. Test Procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be receiver at low, middle and high channel.
3. Secondary Radiated Emissions is measured by following setting:

[Setting 1]

Frequency range: 30 MHz - 12.5 GHz  
 RBW: Below 1 GHz: 100 kHz  
       Above 1 GHz: 1 MHz  
 VBW: Below 1 GHz: 100 kHz  
       Above 1 GHz: 1 MHz  
 Sweep time: Auto  
 Sweep data points: 1 001 or greater  
 Detector mode: Positive peak  
 Indication mode: Max hold

[Setting 2]

Center Frequency: Frequency of spurious emission found using [Setting 1]  
 Span: 0Hz  
 RBW: Below 1 GHz: 100 kHz  
       Above 1 GHz: 1 MHz  
 VBW: Below 1 GHz: 100 kHz  
       Above 1 GHz: 1 MHz  
 Sweep time: Auto  
 Sweep data points: 1 001 or greater  
 Detector mode: Sample

4. Search for spurious emissions in the range 30 MHz to 12.5 GHz.
5. (1) After configuring the spectrum analyzer to [Setting 1], search for spurious emissions from 30 MHz to 12.5 GHz. If the sweep range does not cover the required measurement frequency range then the measurement range will need to be divided into sufficient sections of size [RBW x Sweep Data Points]. If spurious emissions greater than [Limit 10 dB] are found, then more detailed measurements are required, go to step (2)

(2) Configure the spectrum analyzer using [Setting 2] and measure average signal amplitude.

If the spurious emission is burst type (intermittent), then the average value shall not include signal OFF time.

## 6.4. Test result

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.

### - Test mode: GFSK

#### 2 402 MHz

|                          | Measured frequency | Measured level       | Limit        |
|--------------------------|--------------------|----------------------|--------------|
| 30 MHz<br>to 1 000 MHz   | 0.672 GHz          | 0.127 057 nW/100 kHz | 4 nW/MHz     |
|                          |                    | -68.96 dBm/100 kHz   | -54 dB m/MHz |
| 1 000 MHz<br>to 12.5 GHz | 2.442 GHz          | 1.137 627 nW/MHz     | 20 nW/MHz    |
|                          |                    | -59.44 dB m/MHz      | -47 dB m/MHz |

#### 2 441 MHz

|                          | Measured frequency | Measured level       | Limit        |
|--------------------------|--------------------|----------------------|--------------|
| 30 MHz<br>to 1 000 MHz   | 0.820 GHz          | 0.360 579 nW/100 kHz | 4 nW/MHz     |
|                          |                    | -64.43* dBm/100 kHz  | -54 dB m/MHz |
| 1 000 MHz<br>to 12.5 GHz | 2.442 GHz          | 1.778 279 nW/MHz     | 20 nW/MHz    |
|                          |                    | -57.50 dB m/MHz      | -47 dB m/MHz |

#### 2 480 MHz

|                          | Measured frequency | Measured level       | Limit        |
|--------------------------|--------------------|----------------------|--------------|
| 30 MHz<br>to 1 000 MHz   | 0.672 GHz          | 0.118 304 nW/100 kHz | 4 nW/MHz     |
|                          |                    | -69.27 dBm/100 kHz   | -54 dB m/MHz |
| 1 000 MHz<br>to 12.5 GHz | 2.442 GHz          | 1.119 438 nW/MHz     | 20 nW/MHz    |
|                          |                    | -59.51 dB m/MHz      | -47 dB m/MHz |

‘\*’ means [Setting 2] test result

**- Test mode: 8DPSK**

**2 402 MHz**

|                          | Measured frequency | Measured level       | Limit        |
|--------------------------|--------------------|----------------------|--------------|
| 30 MHz<br>to 1 000 MHz   | 0.817 GHz          | 0.262 422 nW/100 kHz | 4 nW/MHz     |
|                          |                    | -65.81 dB m/100 kHz  | -54 dB m/MHz |
| 1 000 MHz<br>to 12.5 GHz | 2.442 GHz          | 0.935 406 nW/MHz     | 20 nW/MHz    |
|                          |                    | -60.29 dB m/MHz      | -47 dB m/MHz |

**2 441 MHz**

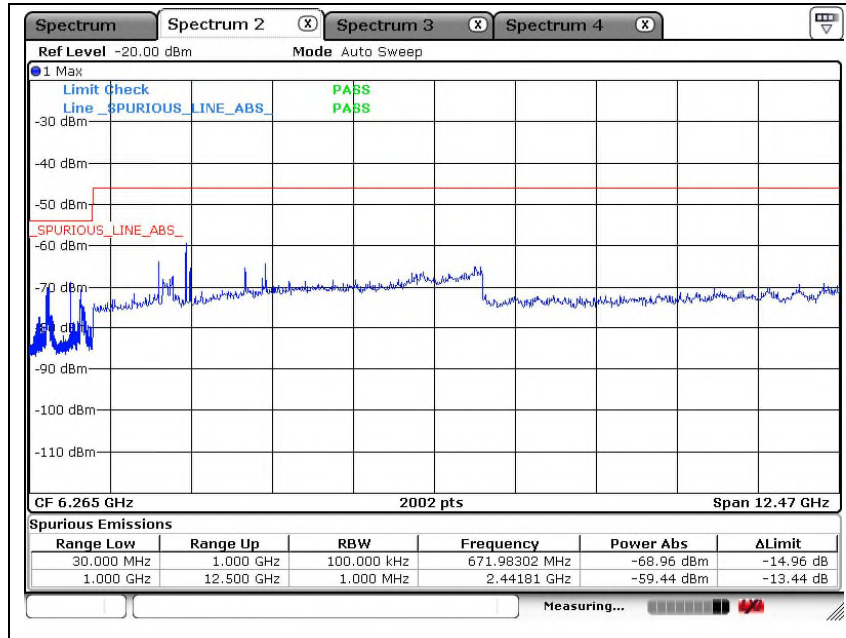
|                          | Measured frequency | Measured level       | Limit        |
|--------------------------|--------------------|----------------------|--------------|
| 30 MHz<br>to 1 000 MHz   | 0.672 GHz          | 0.177 828 nW/100 kHz | 4 nW/MHz     |
|                          |                    | -67.50 dB m/100 kHz  | -54 dB m/MHz |
| 1 000 MHz<br>to 12.5 GHz | 2.442 GHz          | 0.403 645 nW/MHz     | 20 nW/MHz    |
|                          |                    | -63.94 dB m/MHz      | -47 dB m/MHz |

**2 480 MHz**

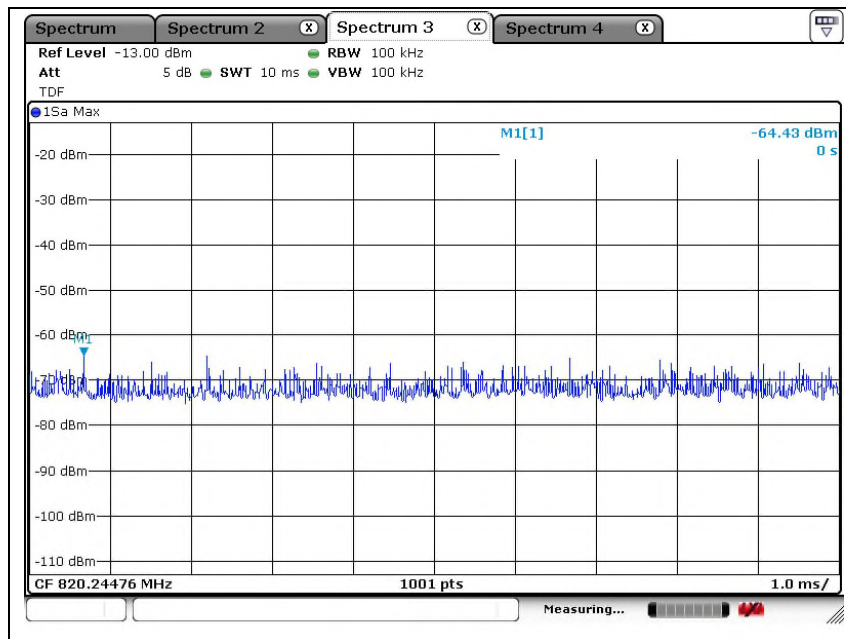
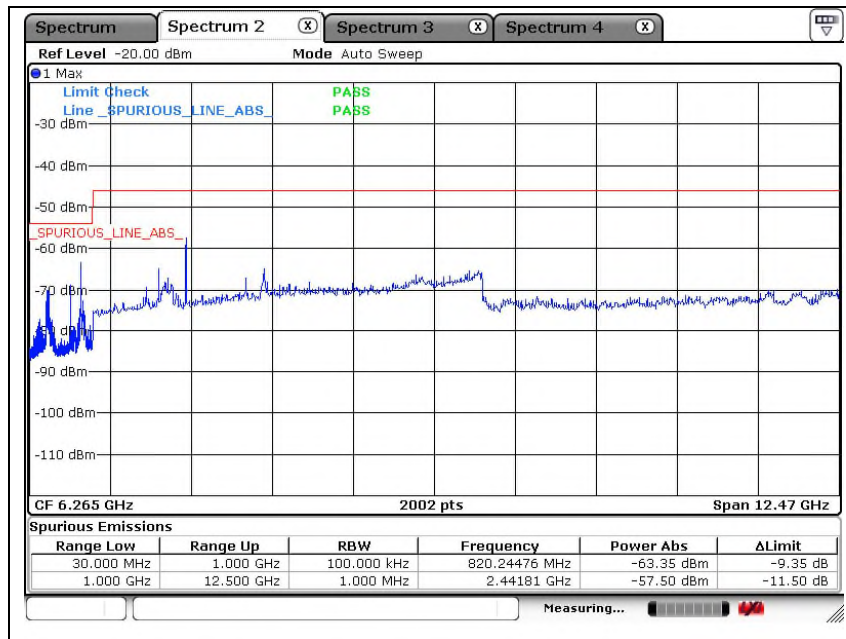
|                          | Measured frequency | Measured level       | Limit        |
|--------------------------|--------------------|----------------------|--------------|
| 30 MHz<br>to 1 000 MHz   | 0.861 GHz          | 0.152 405 nW/100 kHz | 4 nW/MHz     |
|                          |                    | -68.17 dB m/100 kHz  | -54 dB m/MHz |
| 1 000 MHz<br>to 12.5 GHz | 2.430 GHz          | 0.514 044 nW/MHz     | 20 nW/MHz    |
|                          |                    | -62.89 dB m/MHz      | -47 dB m/MHz |

- Test mode: GFSK

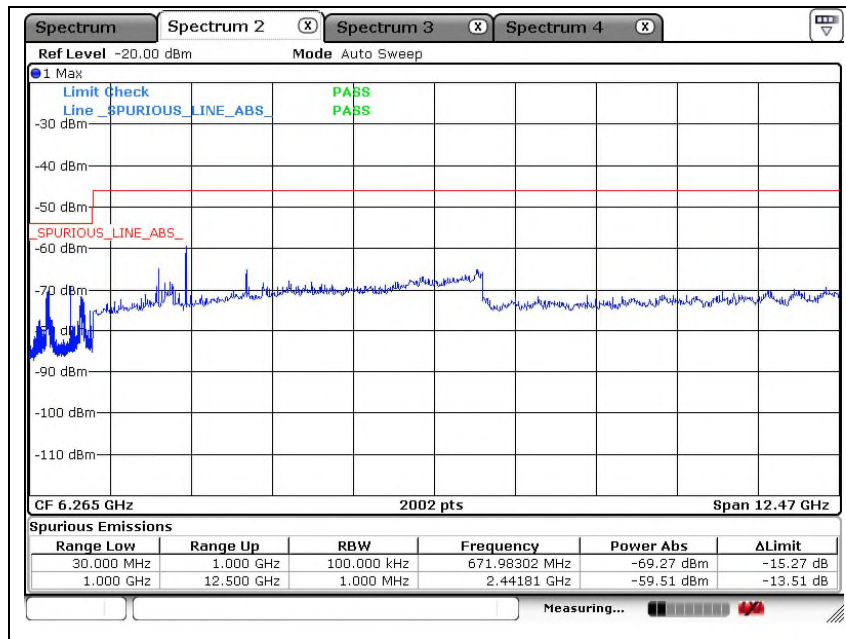
2 402 MHz



2 441 MHz

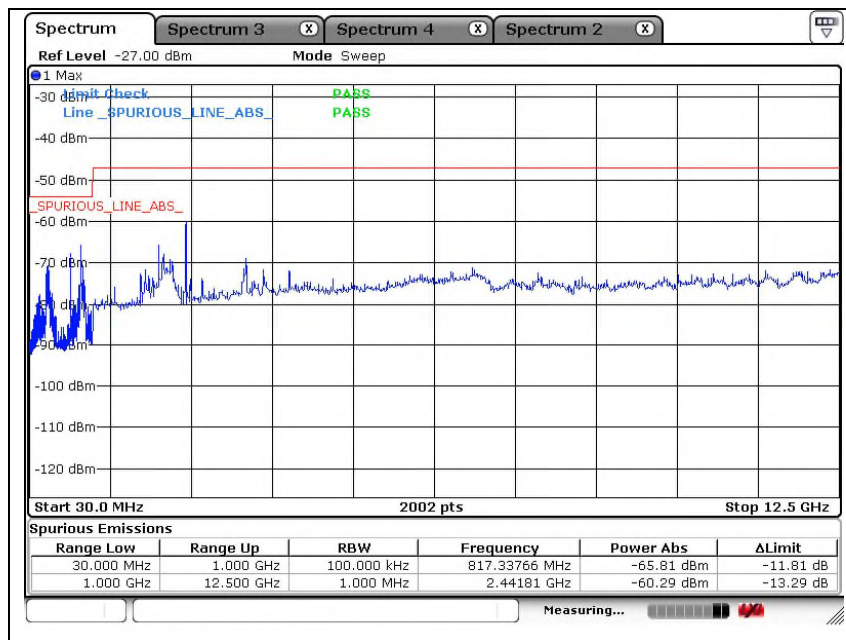


2 480 MHz



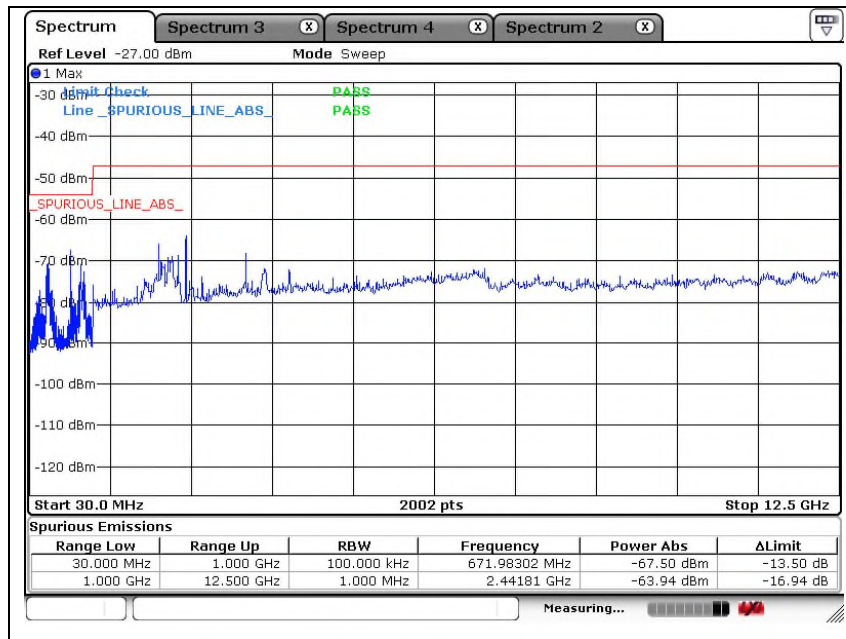
- Test mode: 8DPSK

2 402 MHz

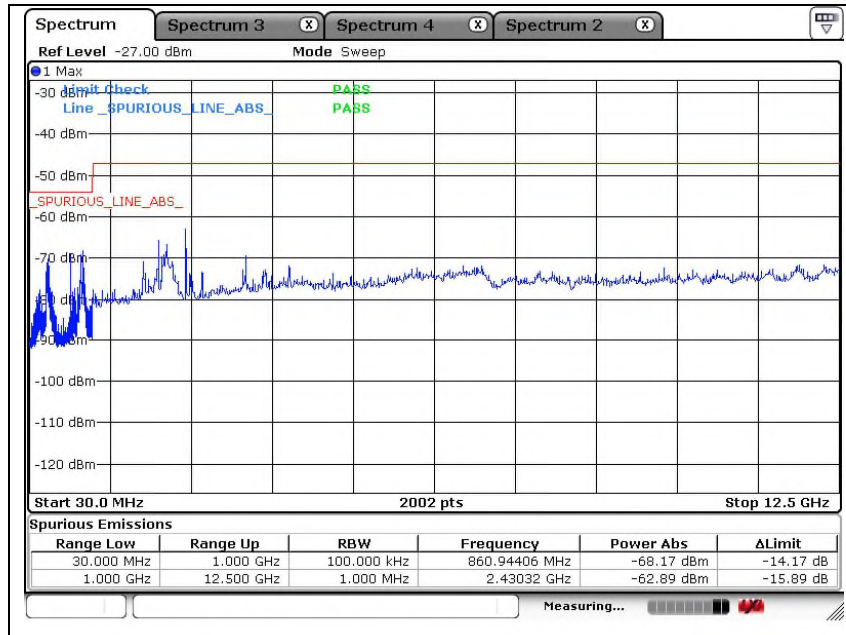




2 441 MHz

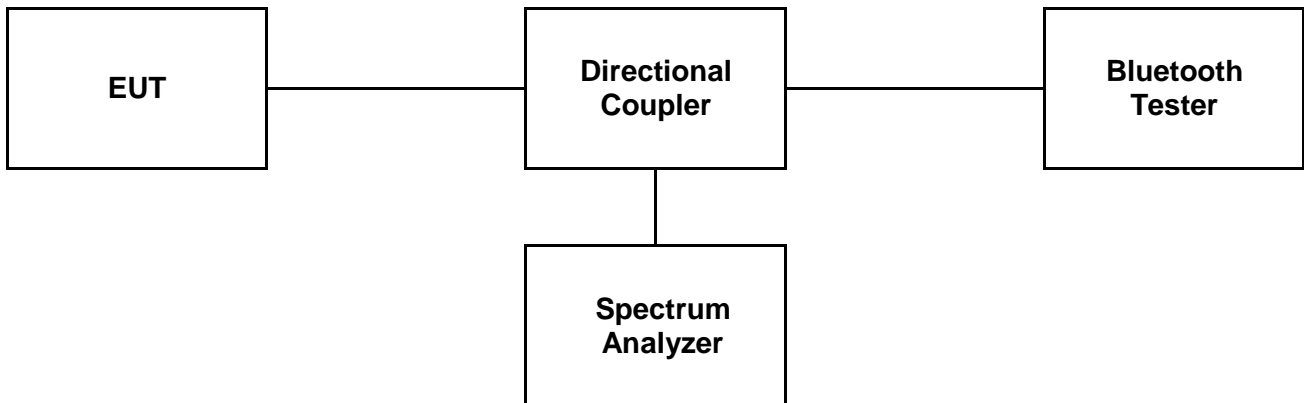


2 480 MHz



## 7. Dwell Time

### 7.1. Test Setup



### 7.2. Limit

- Transmit ON Time shall be less than 0.4 seconds
- Total Dwell Time shall be less than 0.4 seconds

### 7.3. Test Procedure

1. Configure the spectrum analyzer to below

Frequency: 2 441 MHz  
 Span: 0 Hz  
 RBW: 1 MHz  
 VBW: 1 MHz  
 Detection mode: Positive peak

Measure the Burst Cycle and Transmit ON time

## 7.4. Test result

Ambient temperature :  $(23 \pm 1) ^\circ\text{C}$   
Relative humidity : 47 % R.H.

|                         | Packet type | Total Dwell time(ms) | Limit (ms) |
|-------------------------|-------------|----------------------|------------|
| GFSK (NON AFH)          | DH5         | 264.48               | 400        |
| GFSK (AFH)              | DH5         | 273.99               | 400        |
| $\pi/4$ DQPSK (NON AFH) | 2DH5        | 289.88               | 400        |
| $\pi/4$ DQPSK (AFH)     | 2DH5        | 294.62               | 400        |
| 8DPSK (NON AFH)         | 3DH5        | 266.77               | 400        |
| 8DPSK (AFH)             | 3DH5        | 295.25               | 400        |

### Total Dwell Time

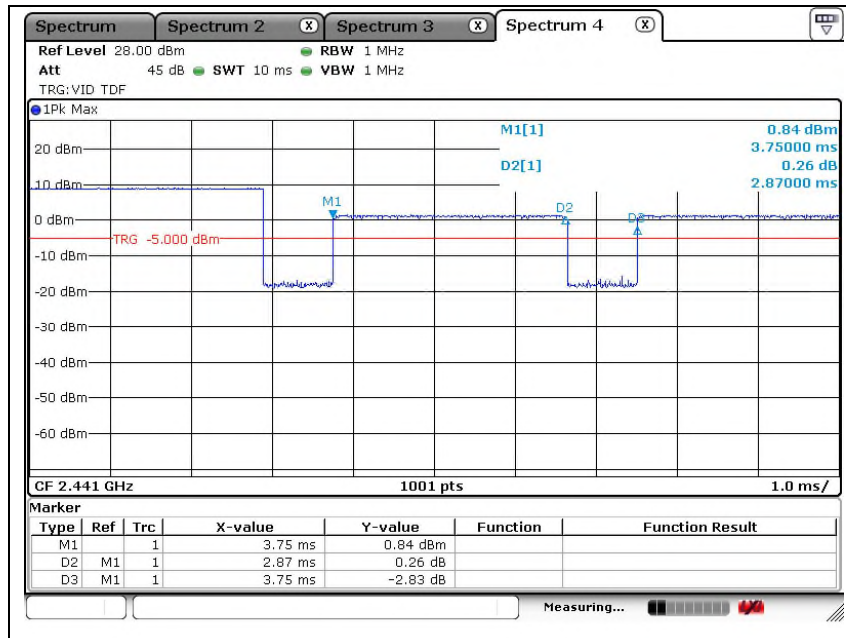
GFSK (NON AFH) :  $(0.4 * 68.25 * 2.87) / (3.75 * 79) = 264.48 \text{ (ms)}$   
 GFSK (AFH) :  $(0.4 * 17.90 * 2.87) / (3.75 * 20) = 273.99 \text{ (ms)}$   
 $\pi/4$ DQPSK (NON AFH) :  $(0.4 * 70.81 * 3.04) / (3.76 * 79) = 289.88 \text{ (ms)}$   
 $\pi/4$ DQPSK (AFH) :  $(0.4 * 18.22 * 3.04) / (3.76 * 20) = 294.62 \text{ (ms)}$   
 8DPSK (NON AFH) :  $(0.4 * 68.73 * 2.89) / (3.77 * 79) = 266.77 \text{ (ms)}$   
 8DPSK (AFH) :  $(0.4 * 18.38 * 3.02) / (3.76 * 20) = 295.25 \text{ (ms)}$

Note;

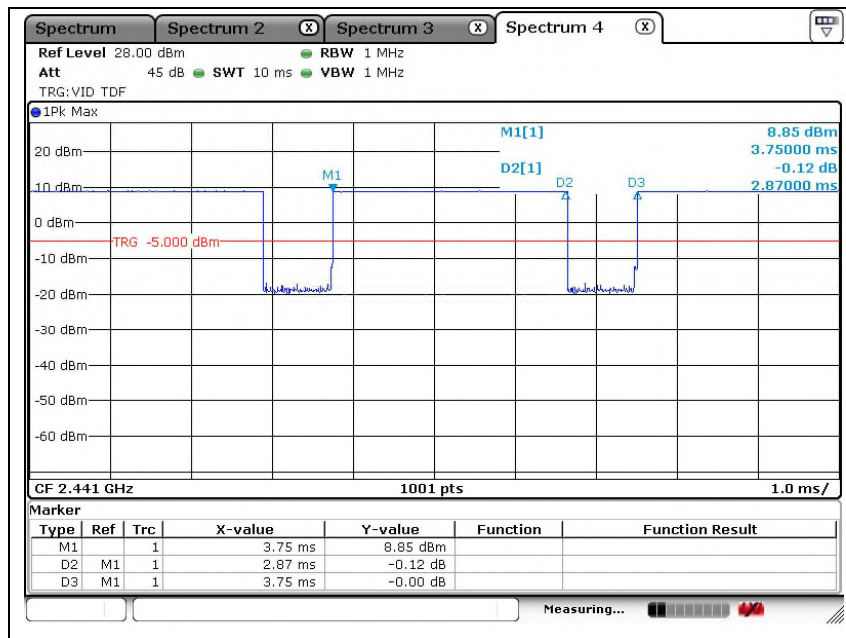
Total Dwell Time =  $(0.4 \times \text{Spreading Rate} \times \text{Transmit ON Time}) / (\text{Burst Cycle} \times \text{Number of Hopping Channels})$

1. Spreading Rate = Spread Bandwidth (measured value) / Transmission Rate
2. Transmit ON Time and Burst Cycle are both measured in Seconds

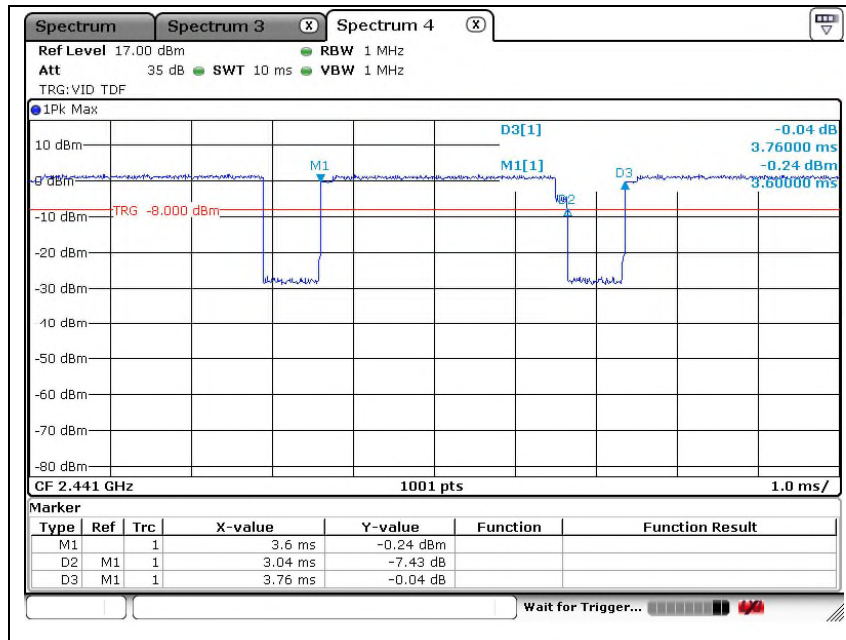
- Test mode: GFSK (NON AFH)



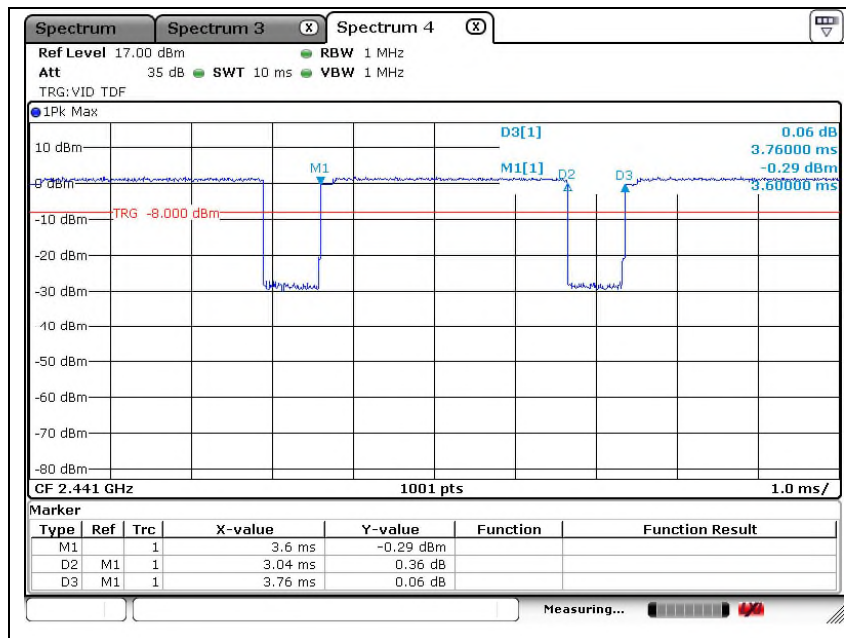
- Test mode: GFSK (AFH)



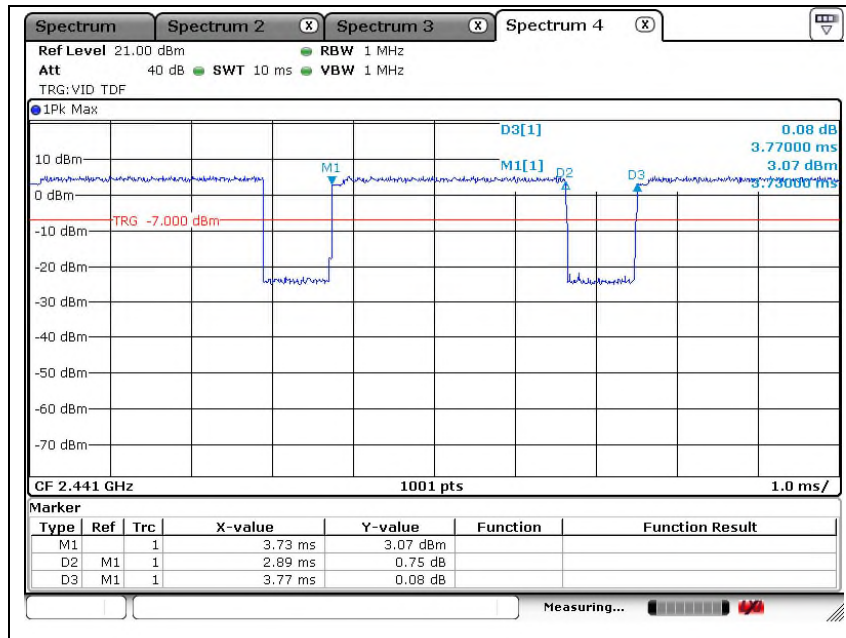
- Test mode:  $\pi/4$ DQPSK (NON AFH)



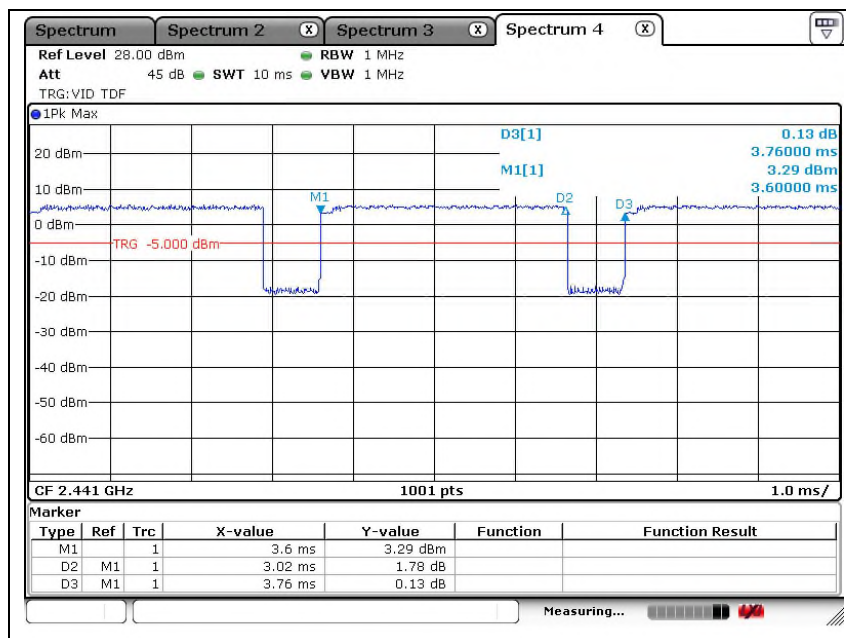
- Test mode:  $\pi/4$ DQPSK (AFH)



- Test mode: 8DPSK (NON AFH)



- Test mode: 8DPSK (AFH)



## 8. Interference Prevention Function

### 8.1. Test Procedure

- (1) For EUTs capable of automatically transmitting identification data
  - a. Transmit identification data from EUT to Demodulator
  - b. Confirm identification data is correctly received by Demodulator
- (2) For EUTs capable of automatically receiving identification data
  - c. Transmit identification data from Link Partner to EUT
  - d. Confirm communication link is established
  - e. Link Partner shall respond by transmitting different identification data back to the EUT
  - f. Confirm EUT stops transmitting, or confirm EUT recognizes that the two identification data are different

If the applicant has documentary evidence to show that their EUT complies with the requirements of the Interference Prevent Function then the EUT can be exempt from this test.

### 8.2. Test result

EUT Details : 98:3B:16:00:00:00

The unit does meet the requirements. (Pass)

## 9. Test Methodology & Conditions

### 9.1. Test Condition

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

| Voltage Fluctuation Test                       | Normal Voltage | High voltage + 10 %<br>of normal voltage | Low voltage - 10 %<br>of normal voltage |
|------------------------------------------------|----------------|------------------------------------------|-----------------------------------------|
| EUT Input voltage<br>(V <sub>d.c.</sub> )      | 3.70           | 4.07                                     | 3.33                                    |
| RF Part Output voltage<br>(V <sub>d.c.</sub> ) | 3.308          | 3.308                                    | 3.307                                   |

Voltage Variation (%) = (Output high or Low Voltage - Output normal voltage) / Output normal voltage \* 100  
 During the input supply voltage to the EUT from the external power source is varied by +/- 10 % if output voltage had been confirmed that the fluctuation of power supply to the RF circuit of EUT (excluding power source) is equal to or less than +/- 1 %. Exempt extremely high and low supply voltage condition tests, EUT only operated in normal voltage to test all regulations.

- End of the Test Report -