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# TEST REPORT FOR BLUETOOTH TESTING

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Report No.: SRTC2020-9004(F)-20071002(D)

Product Name: POCKETALK S Plus

Product Model: PTSP

Applicant: SOURCENEXT CORPORATION

Manufacturer: SOURCENEXT CORPORATION

Specification: FCC Part 15 Subpart C (2019)

FCC ID: 2AOJA-PTSP

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## **1. GENERAL INFORMATION**

### **1.1 Notes of the test report**

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### **1.2 Information about the testing laboratory**

|                      |  |
|----------------------|--|
| Company:             | The State Radio_monitoring_center Testing Center (SRTC)              |
| Address:             | 15th Building, No.30 Shixing Street, Shijingshan District, P.R.China |
| City:                | Beijing  |
| Country or Region:   | P.R.China  |
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| Tel:                 | +86 10 57996183  |
| Fax:                 | +86 10 57996388  |
| Email:               | liujiaf@srtc.org.cn  |
| Registration number: | 239125   |

### **1.3 Applicant's details**

|                    |   |
|--------------------|---|
| Company:           | SOURCENEXT CORPORATION  |
| Address:           | Shiodome City Center 33F, 1-5-2 Higashi Shimbashi Minato-ku, Tokyo 105-7133 |
| City:              | Tokyo   |
| Country or Region: | Japan   |
| Contacted person:  | Yukio Aotani  |
| Tel:               | +81-50-5533-9606  |
| Fax:               | ---   |
| Email:             | dev@sourcenext.com  |

### **1.4 Manufacturer's details**

|                    |   |
|--------------------|---|
| Company:           | SOURCENEXT CORPORATION  |
| Address:           | Shiodome City Center 33F, 1-5-2 Higashi Shimbashi Minato-ku, Tokyo 105-7133 |
| City:              | Tokyo   |
| Country or Region: | Japan   |
| Contacted person:  | Yukio Aotani  |
| Tel:               | +81-50-5533-9606  |
| Fax:               | ---   |
| Email:             | dev@sourcenext.com  |

### 1.5 Test Environment

|   |            |
|---|------------|
| Date of Receipt of test sample at SRTC: | 2020-07-10 |
| Testing Start Date:                     | 2020-07-12 |
| Testing End Date:                       | 2020-11-05 |

| Environmental Data: | Temperature (°C) | Humidity (%) |
|---------------------|------------------|--------------|
| Ambient             | 25               | 47           |

|                                 |      |
|---------------------------------|------|
| Normal Supply Voltage (V d.c.): | 3.80 |
|---------------------------------|------|

## 2 DESCRIPTION OF THE DEVICE UNDER TEST

### 2.1 Final Equipment Build Status

|                   |                                  |
|-------------------|----------------------------------|
| Frequency Range   | 2.402GHz~2.480GHz                |
| Number of Channel | 79                               |
| Modulation Type   | GFSK, $\pi/4$ DQPSK, 8DPSK       |
| Duplex Mode       | TDD                              |
| Channel Spacing   | 1MHz                             |
| Data Rate         | 1Mbps, 2 Mbps, 3 Mbps            |
| Power Supply      | Battery/Charger                  |
| Hardware Version  | PT3L_MB_V1.0                     |
| Software Version  | 1.1.6                            |
| IMEI              | 864727048560505                  |
| Antenna type      | Refer to Note                    |
| Antenna connector | Refer to Note                    |
| Note              | The EUT has some color variants. |

#### **Note: Antenna requirement (FCC part 15.203)**

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

- The antenna(s) of the EUT are permanently attached.
- There are no provisions for connection to an external antenna.

Note: The antenna provides to the EUT, please refer to the following table:

| Brand | Model | Antenna gain | Frequency range (GHz) | Antenna type               | Connecter Type |
|-------|-------|--------------|-----------------------|----------------------------|----------------|
| N/A   | N/A   | 1.45dBi      | 2.402GHz~2.480GHz     | Planner Inverted-F Antenna | N/A            |

Manufacturers ensure that their designs will not be modified by the user or third party's arbitrary antenna parameters and performance. The EUT complies with the requirement of §15.203.

## 2.2 Description of Test Modes

79 channels are provided to this EUT:

| CHANNEL | FREQ. (MHz) | CHANNEL | FREQ. (MHz) | CHANNEL | FREQ. (MHz) | CHANNEL | FREQ. (MHz) | CHANNEL | FREQ. (MHz) |
|---------|-------------|---------|-------------|---------|-------------|---------|-------------|---------|-------------|
| 0       | 2402        | 16      | 2418        | 32      | 2434        | 48      | 2450        | 64      | 2466        |
| 1       | 2403        | 17      | 2419        | 33      | 2435        | 49      | 2451        | 65      | 2467        |
| 2       | 2404        | 18      | 2420        | 34      | 2436        | 50      | 2452        | 66      | 2468        |
| 3       | 2405        | 19      | 2421        | 35      | 2437        | 51      | 2453        | 67      | 2469        |
| 4       | 2406        | 20      | 2422        | 36      | 2438        | 52      | 2454        | 68      | 2470        |
| 5       | 2407        | 21      | 2423        | 37      | 2439        | 53      | 2455        | 69      | 2471        |
| 6       | 2408        | 22      | 2424        | 38      | 2440        | 54      | 2456        | 70      | 2472        |
| 7       | 2409        | 23      | 2425        | 39      | 2441        | 55      | 2457        | 71      | 2473        |
| 8       | 2410        | 24      | 2426        | 40      | 2442        | 56      | 2458        | 72      | 2474        |
| 9       | 2411        | 25      | 2427        | 41      | 2443        | 57      | 2459        | 73      | 2475        |
| 10      | 2412        | 26      | 2428        | 42      | 2444        | 58      | 2460        | 74      | 2476        |
| 11      | 2413        | 27      | 2429        | 43      | 2445        | 59      | 2461        | 75      | 2477        |
| 12      | 2414        | 28      | 2430        | 44      | 2446        | 60      | 2462        | 76      | 2478        |
| 13      | 2415        | 29      | 2431        | 45      | 2447        | 61      | 2463        | 77      | 2479        |
| 14      | 2416        | 30      | 2432        | 46      | 2448        | 62      | 2464        | 78      | 2480        |
| 15      | 2417        | 31      | 2433        | 47      | 2449        | 63      | 2465        |         |             |

### 2.2.1 Test Mode Applicability and Tested Channel Detail

| EUT CONFIGURE MODE    | APPLICABLE TO |       |     |      | DESCRIPTION |
|-----------------------|---------------|-------|-----|------|-------------|
|                       | RE ≥ 1G       | RE<1G | PLC | APCM | -           |
| GFSK, π/4DQPSK, 8DPSK | √             | √     | √   | √    | -           |

Where

RE ≥ 1G: Radiated Emission above 1GHz

RE<1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

#### Radiated Emission Test (Above 1GHz):

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE       | DATA RATE (Mbps)      |
|-------------------|----------------|-----------------------|-----------------------|
| 0 to 78           | 0, 39, 78      | GFSK, π/4DQPSK, 8DPSK | 1Mbps, 2 Mbps, 3 Mbps |

**Radiated Emission Test (Below 1GHz):**

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE            | DATA RATE (Mbps)      |
|-------------------|----------------|----------------------------|-----------------------|
| 0 to 78           | 0, 39, 78      | GFSK, $\pi/4$ DQPSK, 8DPSK | 1Mbps, 2 Mbps, 3 Mbps |

**Power Line Conducted Emission Test:**

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE | DATA RATE (Mbps) |
|-------------------|----------------|-----------------|------------------|
| 0 to 78           | 39             | GFSK            | 1Mbps            |

**Antenna Port Conducted Measurement:**

This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

| AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TYPE            | DATA RATE (Mbps)      |
|-------------------|----------------|----------------------------|-----------------------|
| 0 to 78           | 0, 39, 78      | GFSK, $\pi/4$ DQPSK, 8DPSK | 1Mbps, 2 Mbps, 3 Mbps |

### 2.3 Duty Cycle of Test Signal

| Modulation Type    | Plot  | Duty Cycle | Correction factor(dB) |
|--------------------|-------|------------|-----------------------|
| GFSK(DH5)          | Fig.1 | 76.77%     | 1.15                  |
| $\pi/4$ DQPSK(DH5) | Fig.2 | 76.76%     | 1.15                  |
| 8DPSK(DH5)         | Fig.3 | 76.89%     | 1.14                  |

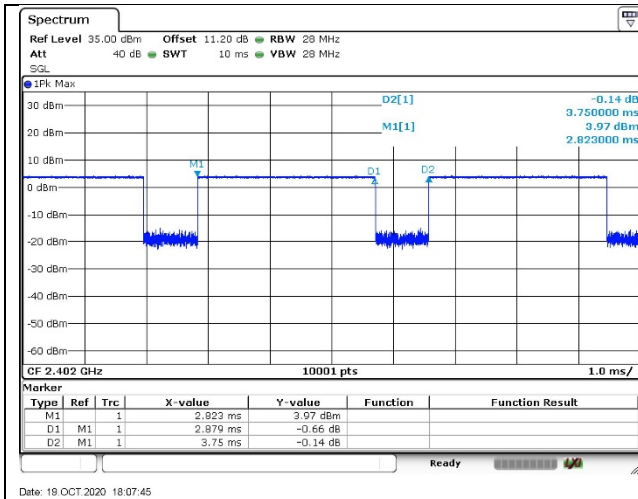


Fig.1

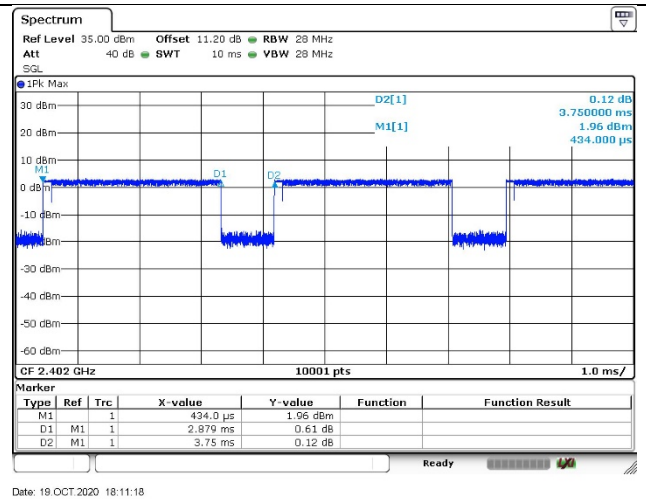


Fig.2

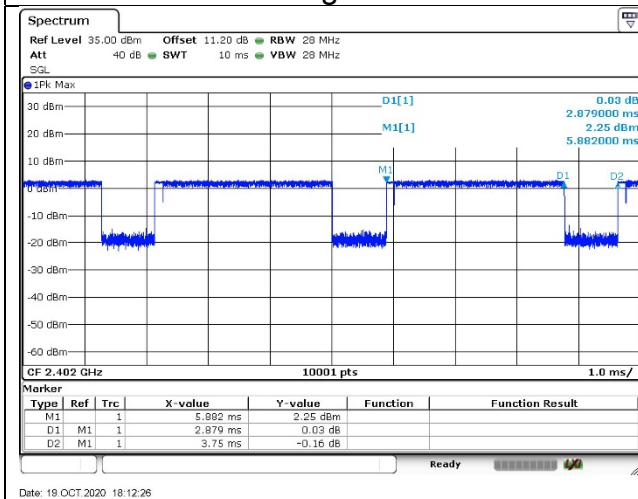


Fig.3



## 2.4 EUT operating conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

## 2.5 Support Equipment

The following support equipment was used to exercise the DUT during testing:

|              |                                       |
|--------------|---------------------------------------|
| Equipment    | Battery                               |
| Manufacturer | Guangdong Pow-Tech New Power Co.,Ltd. |
| Model Number | PT305070                              |

|              |  |
|--------------|--|
| Equipment    | Charger                                |
| Manufacturer | UNIFIVE TECHNOLOGY (SHEN ZHEN) CO;LTD. |
| Model Number | UB305-0510                             |

|              |                                    |
|--------------|------------------------------------|
| Equipment    | USB Cable                          |
| Manufacturer | Shenzhen Kailiya electronics., Ltd |
| Model Number | Type-C Cable                       |

### **3 REFERENCE SPECIFICATION**

| Specification           | Version          | Title  |
|-------------------------|------------------|--|
| FCC part15<br>Subpart C | 2019             | Intentional radiators  |
| ANSI C63.10             | 2013             | Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices   |
| KDB 558074D01<br>V05R02 | April 2,<br>2019 | Guidance for compliance measurements on Digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules |

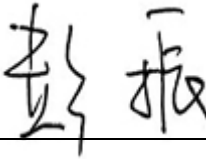

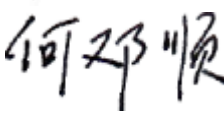
### **4 KEY TO NOTES AND RESULT CODES**

| Code | Meaning  |
|------|--|
| PASS | Test result shows that the requirements of the relevant specification have been met.     |
| FAIL | Test result shows that the requirements of the relevant specification have not been met. |
| N/T  | Test case is not tested.   |

## 5 RESULT SUMMARY

| No. | Test case                                  | Reference         | Verdict                     |
|-----|--|-------------------|-----------------------------|
| 1   | 20dB Bandwidth                             | 15.247(a)(1)(iii) | Pass                        |
| 2   | Channel Separation                         | 15.247(a)(1)      | Pass                        |
| 3   | Peak Transmitter Output Power              | 15.247(b)(1)      | Pass                        |
| 4   | Dwell Time                                 | 15.247(a)(1)(iii) | Pass                        |
| 5   | Number of Hopping Frequencies              | 15.247(a)(1)(iii) | Pass                        |
| 6   | Conducted out of band emission measurement | 15.247(d)         | Pass                        |
| 7   | Band-edge                                  | 15.247(d)         | Pass                        |
| 8   | Spurious Radiated Emissions                | 15.205/15.209     | Pass                        |
| 9   | AC Power line Conducted Emission           | 15.207            | Pass                        |
| 10  | Antenna requirement                        | 15.203            | Pass (refer to section 2.1) |

Note: The device is designed according to specifications of SIG, So it has a full support to Medium access protocol and fully compliant with the KDB558074 standard. The device is compliant Pseudorandom hopping, Equal hopping frequency, receiver bandwidth synchronize and have same bandwidth with transmitted signal. And the ability to have adaptive hopping when encountering other signals.

|  |   |
|--|---|
| This Test Report Is Issued by:<br>Mr. Peng Zhen<br> | Checked by:<br>Mr. Li Bin<br> |
| Tested by:<br>Mr. He Dengshun<br>                   | Issued date:<br><br>20201105  |

## **6 TEST RESULT**

### **6.1 20dB Bandwidth**

#### **6.1.1 Ambient condition**

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

#### **6.1.2 Test limit**

FCC Part15.247 (a.1.iii)

The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

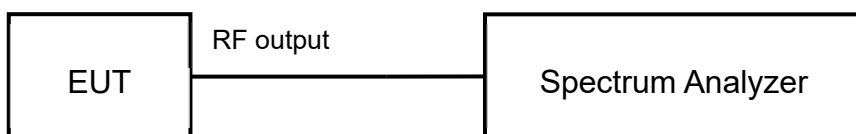
#### **6.1.3 Test Procedure Used**

ANSI C63.10-2013 – Section 6.9.2

#### **6.1.4 Test settings**

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 20dB bandwidth measurement. The "X" dB bandwidth parameter was set to  $X = 20$ . The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% OBW
3. VBW  $\geq 3 \times$  RBW
4. Reference level set to keep signal from exceeding maximum input mixer level for linear operation.
5. Detector = Peak
6. Trace mode = max hold
7. Sweep = auto couple
8. The trace was allowed to stabilize

#### **6.1.5 Test Setup**



#### **6.1.6 Test result**

The test results are shown in Appendix A.

## 6.2 Channel Separation

### 6.2.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.2.2 Test limit

FCC Part15.247 (a) (1)

Measurement is made with EUT operating in hopping mode. The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.

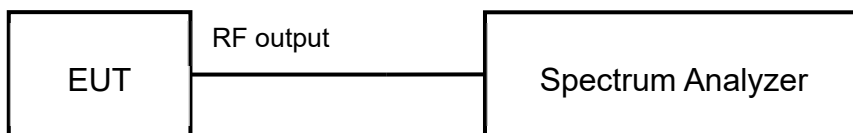
### 6.2.3 Test Procedure Used

ANSI C63.10-2013 – Section 7.8.2

### 6.2.4 Test Settings

1. Span = Wide enough to capture peaks of two adjacent channels
2. RBW = 30% of channel spacing. Adjust as necessary to best identify center of each individual channel
3. VBW  $\geq$  RBW
4. Sweep = Auto
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize.
8. Marker-delta function used to determine separation between peaks of the adjacent channels

### 6.2.5 Test Setup



### 6.2.6 Test result

The test results are shown in Appendix A.

## 6.3 Peak Transmitter Output Power

### 6.3.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.3.2 Test limit

FCC Part 15.247(b) (1)

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

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW) →

| Modulation type      | GFSK    | $\pi/4$ DQPSK | 8DPSK   |
|----------------------|---------|---------------|---------|
| Maximum Output Power | 30.0dBm | 30.0dBm       | 30.0dBm |

For all other frequency hopping systems in the 2400-2483.5 MHz band:0.125 watts.

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW) →

| Modulation type      | GFSK    | $\pi/4$ DQPSK | 8DPSK   |
|----------------------|---------|---------------|---------|
| Maximum Output Power | 21.0dBm | 21.0dBm       | 21.0dBm |

### 6.3.3 Test Procedure Used

ANSI C63.10-2013 – Section 7.8.5

ANSI C63.10-2013 – Section 11.9.2.3.2 method AVGPM-G

### 6.3.4 Test Settings

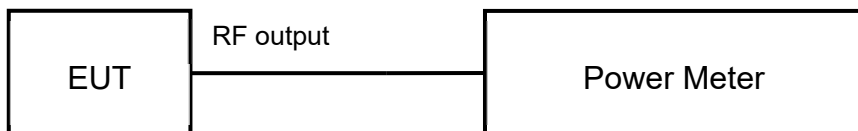
Peak Power Measurement

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than the occupied bandwidth.

Method AVGPM-G (Average Power Measurement)

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

### 6.3.5 Test Setup



### 6.3.6 Test result

The test results are shown in Appendix A.

## 6.4 Dwell Time

### 6.4.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.4.2 Test Description

The Equipment under Test (EUT) was set up in a shielded room to perform the dwell time measurements.

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss.

The time slot length is measured of three different packet types which are available in the Bluetooth technology. Those are DH1, DH3 and DH5 packets. The dwell time is calculated by:

Dwell time = time slot length \* hop rate \* 31.6/ number of hopping channels with:

- hop rate=1600/2 \* 1/s for DH1 packets =800
- hop rate=1600/4 \* 1/s for DH3 packets =400
- hop rate=1600/6 \* 1/s for DH5 packets =266.67
- Number of hopping channels=79
- 31.6 s=0.4 seconds multiplied by the number of hopping channels=0.4s \* 79

### 6.4.3 Test limit

FCC Part 15.247(a) (1) (iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

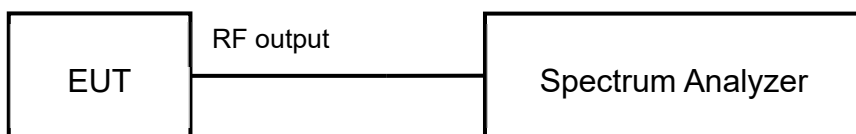
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

### 6.4.4 Test Settings

ANSI C63.10-2013 Section 7.8.4

1. Span = zero span, centered on a hopping channel
2. RBW ≤ channel spacing and >> 1/T, where T is expected dwell time per channel
3. Sweep = as necessary to capture entire dwell time. Second plot may be required to demonstrate two successive hops on a channel
4. Trigger is set with appropriate trigger delay to place pulse near the center of the plot
5. Detector = peak
6. Trace mode = max hold
7. Marker-delta function used to determine transmit time per hop

### 6.4.5 Test Setup



### 6.4.6 Test result

The test results are shown in Appendix A.

## 6.5 Number of Hopping Frequencies

### 6.5.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.5.2 Test Description

The Equipment under Test (EUT) was set up in a shielded room to perform the number of hopping frequencies measurement. The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss.

### 6.5.3 Test limit

FCC Part15.247 (a) (1) (iii)

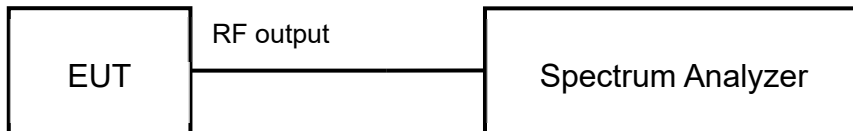
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

### 6.5.4 Test Settings

ANSI C63.10-2013 Section 7.8.3

1. Span = frequency of band of operation (divided into two plots)
2. RBW < 30% of channel spacing or 20dB bandwidth, whichever is smaller.
3. VBW ≥ RBW
4. Sweep = auto
5. Detector = peak
6. Trace mode = max hold
7. Trace was allowed to stabilize

### 6.5.5 Test Setup



### 6.5.6 Test result

The test results are shown in Appendix A.



## 6.6 Conducted out of band emission measurement

### 6.6.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.6.2 Test limit

FCC Part15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

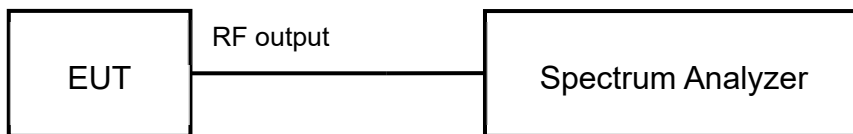
### 6.6.3 Test Procedure Used

ANSI C63.10-2013 – Section 7.8.8

### 6.6.4 Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 26GHz
2. RBW = 1MHz\* (See note below)
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

### 6.6.5 Test Setup



### 6.6.6 Test result

The test results are shown in Appendix A .

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

## 6.7 Band-edge measurement

### 6.7.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.7.2 Test limit

FCC Part15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

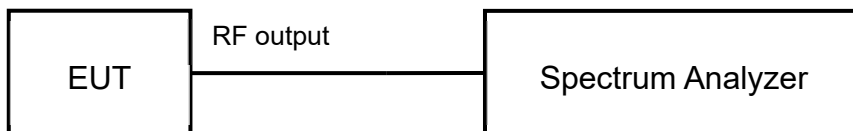
### 6.7.3 Test Procedure Used

ANSI C63.10-2013 – Section 6.10.4

### 6.7.4 Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100 kHz
4. VBW = 300 kHz
5. Detector = Peak
6. Number of sweep points  $\geq 2 \times \text{Span}/\text{RBW}$
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

### 6.7.5 Test Setup



### 6.7.6 Test result

The test results are shown in Appendix A.

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

## 6.8 Spurious Radiated Emissions

### 6.8.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.8.2 Test Description

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

### 6.8.3 Test limit

Part15.205, 15.209, 15.247(d)

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in below Table per Section 15.209. The spectrum shall be investigated from the lowest radio frequency signal generated in the device

| Frequency [MHz] | Field strength [μV/m] | Measured Distance [meters] |
|-----------------|-----------------------|----------------------------|
| 0.009~0.490     | 2400/F(kHz)           | 300                        |
| 0.490~1.705     | 24000/F(kHz)          | 30                         |
| 1.705~30.0      | 30                    | 30                         |
| 30~88           | 100                   | 3                          |
| 88~216          | 150                   | 3                          |
| 216~960         | 200                   | 3                          |
| Above 960       | 500                   | 3                          |

**Radiated Limits**

Part15.35(b):

There is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit

**Used conversion factor: Limit (dBμV/m) = 20 log (Limit (μV/m)/1μV/m)**

| Frequency [MHz]  | Detector   | Unit (dBμV/m) |
|--|------------|---------------|
| 30~88  | Quasi-peak | 40.0          |
| 88~216   | Quasi-peak | 43.5          |
| 216~960  | Quasi-peak | 46.0          |
| 960~1000   | Quasi-peak | 54.0          |
| 1000~5th harmonic of the highest frequency<br>or 40GHz, whichever is lower | Average    | 54.0          |
|  | Peak       | 74.0          |

**Conversion Radiated limits**

## 6.8.4 Test Procedure Used

ANSI C63.10-2013 – Section 11.13

### For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and recorded the reading with Maximum Hold Mode.

#### NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer complied the following setting:

| Frequency  | RBW       |
|------------|-----------|
| 9-150kHz   | 200-300Hz |
| 0.15-30MHz | 9-10kHz   |

### For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground in chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and recorded the reading with Maximum Hold Mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detector and recorded the reading with Maximum Hold Mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

### For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

#### NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Average detection (AV) at frequency above 1GHz. If duty cycle of test signal is < 98%, the duty factor need added to measured value.
4. All modes of operation were investigated and the worst-case emissions are reported.

### 6.8.5 Test Settings

#### Average Field Strength Measurements

| Frequency | Detector         |
|-----------|------------------|
| < 1000MHz | Quasi-peak       |
| >1000MHz  | Peak and average |

#### Peak Field Strength Measurements

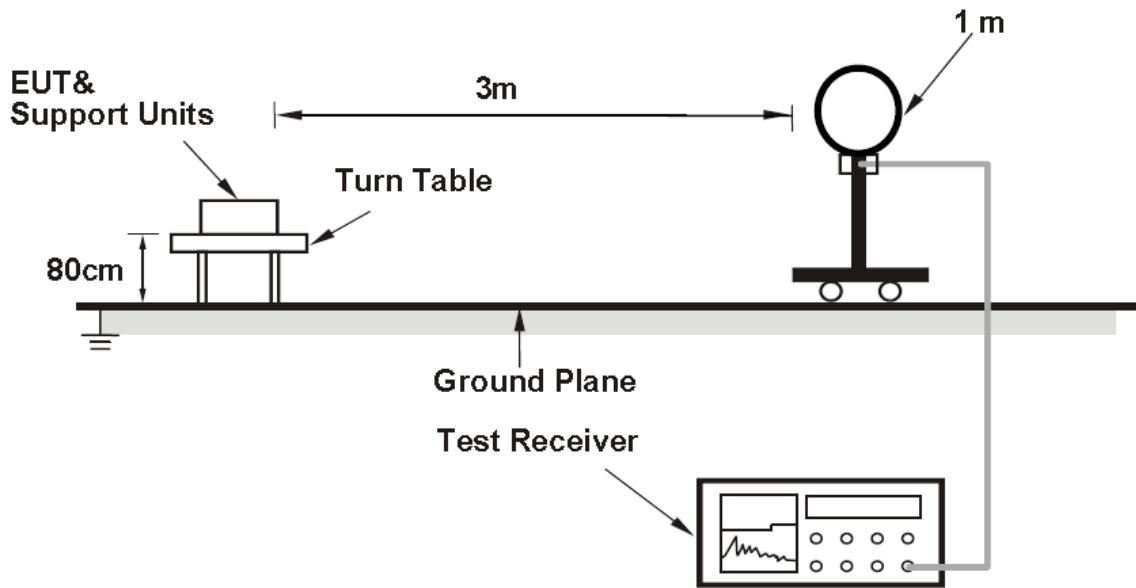
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in following table

| Frequency  | RBW        |
|------------|------------|
| 9-150kHz   | 200-300Hz  |
| 0.15-30MHz | 9-10kHz    |
| 30-1000MHz | 100-120kHz |
| >1000MHz   | 1MHz       |

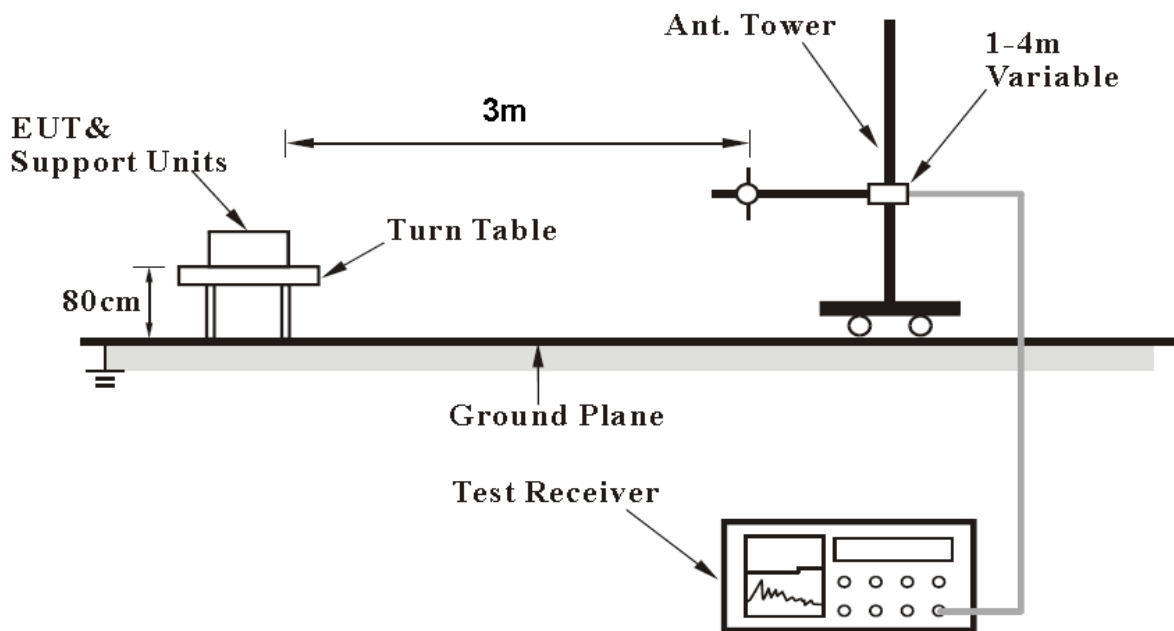
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

### 6.8.6 Test Setup

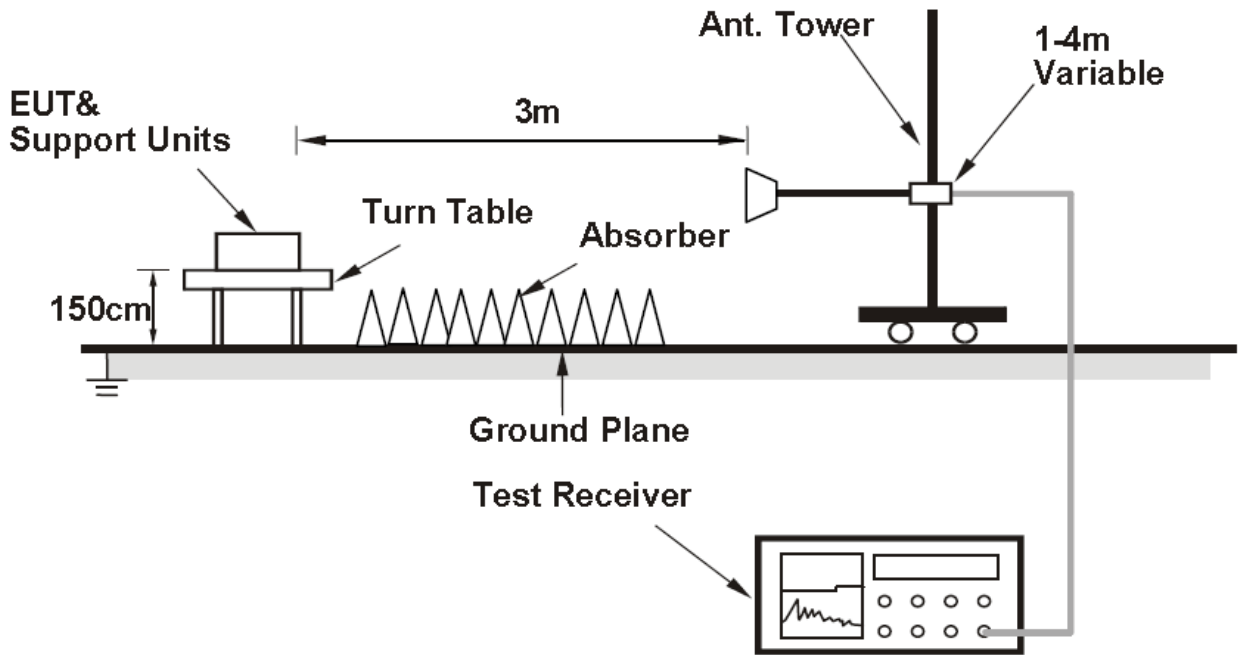
#### For Radiated emission below 30MHz



#### For Radiated emission 30MHz to 1GHz



## For Radiated emission above 1GHz



### 6.8.7 Test result

The test results are shown in Appendix B.

## 6.9 AC Power line Conducted Emission

### 6.9.1 Ambient condition

| Temperature | Relative humidity | Pressure |
|-------------|-------------------|----------|
| 25°C        | 30%               | 101.5kPa |

### 6.9.2 Test limit

FCC Part15.207

| Frequency of Emission (MHz) | Conducted Limit (dBuV) |            |
|-----------------------------|------------------------|------------|
|                             | Quasi-peak             | Average    |
| 0.15-0.5                    | 66 to 56 *             | 56 to 46 * |
| 0.5-5                       | 56                     | 46         |
| 5-30                        | 60                     | 50         |

\* Decreases with the logarithm of the frequency.

The measurement is made according to ANSI C63.10-2013

### 6.9.3 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

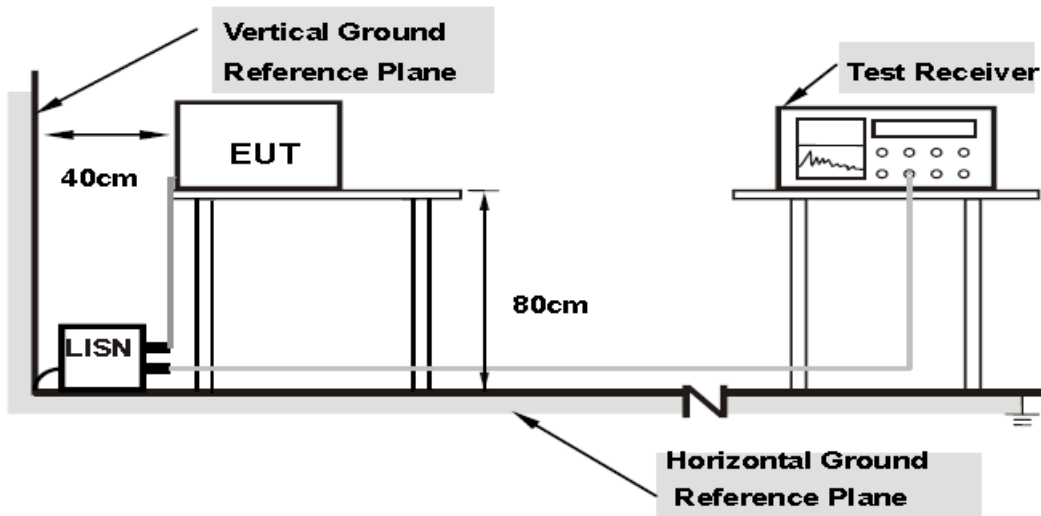
c. The frequency range from 150 kHz to 30MHz was searched. Emission levels under (Limit - 20dB) were not recorded.

**NOTE:** The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

The EUT shall test under the power AC120V/240V/60Hz.



### 6.9.4 Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo).

### 6.9.5 Test result

The test results are shown in Appendix B.

## **7 MEASUREMENT UNCERTAINTIES**

| Items                | Uncertainty    |        |
|----------------------|----------------|--------|
| Occupied Bandwidth   | 3kHz           |        |
| Peak power output    | 0.67dB         |        |
| Band edge compliance | 1.20dB         |        |
| Spurious emissions   | 30MHz~1GHz     | 2.83dB |
|                      | 1GHz~12.75GHz  | 2.50dB |
|                      | 12.75GHz~25GHz | 2.75dB |

## **8 TEST EQUIPMENTS**

| No. | Name/ Model                                 | Manufacturer  | S/N          | Cal date   | Cal Due date |
|-----|---|---------------|--------------|------------|--------------|
| 1.  | Spectrum Analyzer FSV                       | ROHDE&SCHWARZ | 101065       | 2020.08.20 | 2021.08.19   |
| 2.  | Bluetooth Test Set MT8852B                  | Anritsu       | 1142010      | 2020.03.01 | 2021.02.28   |
| 3.  | Power Divider 6007                          | Weinschel     | 6007-GJ-1    | 2020.08.20 | 2021.08.19   |
| 4.  | Power Meter E4416A                          | Agilent       | MY52370013   | 2020.03.01 | 2021.02.28   |
| 5.  | Power Sensor E9327A                         | Agilent       | MY52420006   | 2020.03.01 | 2021.02.28   |
| 6.  | 23.18m×16.88m×9.60m Semi-Anechoic Chamber   | FRANKONIA     | ---          | ----       | ----         |
| 7.  | Turn table Diameter:5m                      | FRANKONIA     | ----         | ----       | ----         |
| 8.  | Antenna master SAC(MA4.0)                   | MATURO        | ----         | ----       | ----         |
| 9.  | 9.080m×5.255m×3.525m Shielding room         | FRANKONIA     | ----         | ----       | ----         |
| 10. | HF 907 Double-Ridged Waveguide Horn Antenna | R&S           | 100512       | 2020.08.20 | 2021.08.19   |
| 11. | 3160-09 Receive antenna                     | SCHWARZ-BECK  | 002058-002   | 2020.08.20 | 2021.08.19   |
| 12. | ESI 40 EMI test receiver                    | R&S           | 100015       | 2020.08.20 | 2021.08.19   |
| 13. | ESCS30 EMI test receiver                    | R&S           | 100029       | 2020.08.20 | 2021.08.19   |
| 14. | HL562 Receive antenna                       | R&S           | 100167       | 2020.08.20 | 2021.08.19   |
| 15. | ENV216 AMN                                  | R&S           | 3560.6550.12 | 2020.08.20 | 2021.08.19   |

## APPENDIX A – TEST DATA OF CONDUCTED EMISSION

### 20dB Bandwidth

Offset 1.2dB = Temporary antenna connector loss 0.2dB+ Cable loss 1dB

Modulation type: GFSK

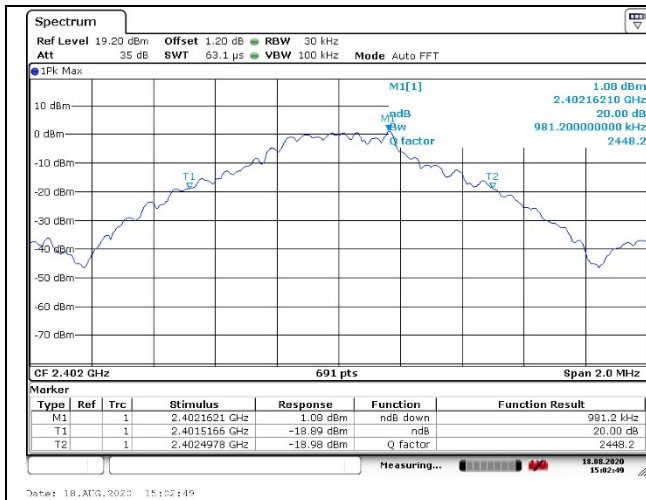
| Carrier frequency (MHz) | Channel No. | 20 dB bandwidth(kHz) |
|-------------------------|-------------|----------------------|
| 2402                    | 0           | 981.2                |
| 2441                    | 39          | 960.9                |
| 2480                    | 78          | 960.9                |

Modulation type:  $\pi/4$ DQPSK

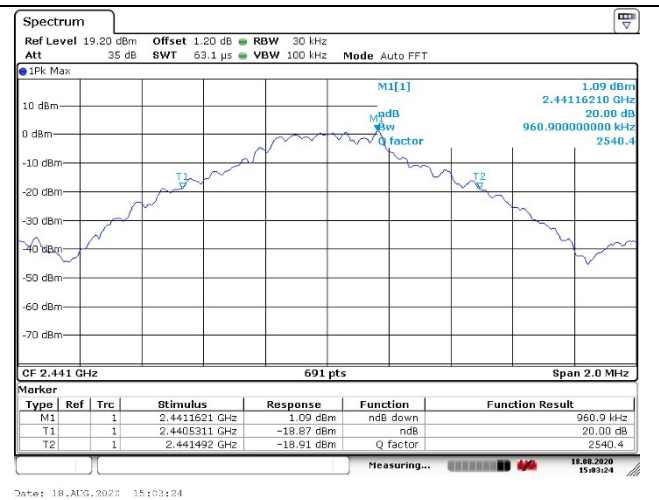
| Carrier frequency (MHz) | Channel No. | 20 dB bandwidth(kHz) |
|-------------------------|-------------|----------------------|
| 2402                    | 0           | 1282.2               |
| 2441                    | 39          | 1282.2               |
| 2480                    | 78          | 1305.4               |

Modulation type: 8DPSK

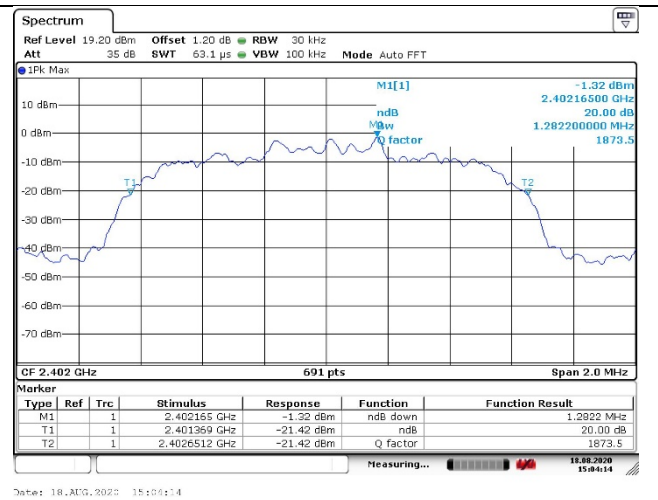
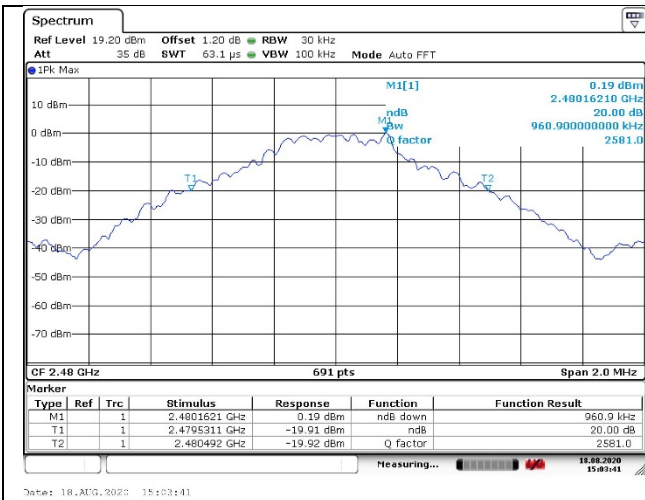
| Carrier frequency (MHz) | Channel No. | 20 dB bandwidth(kHz) |
|-------------------------|-------------|----------------------|
| 2402                    | 0           | 1276.4               |
| 2441                    | 39          | 1282.2               |
| 2480                    | 78          | 1290.9               |



Modulation type: GFSK 2402MHz

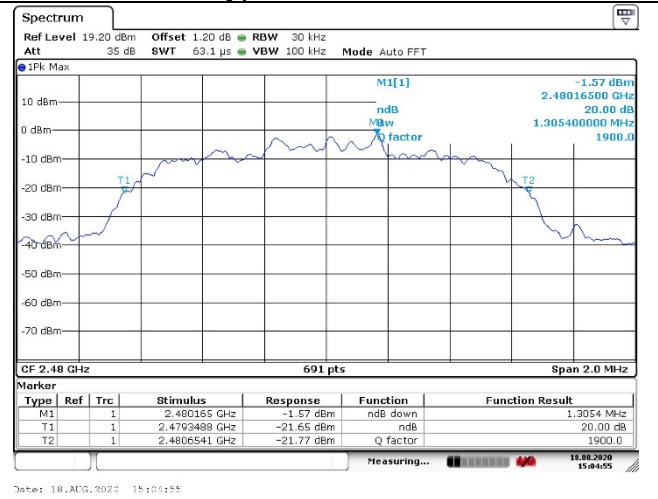
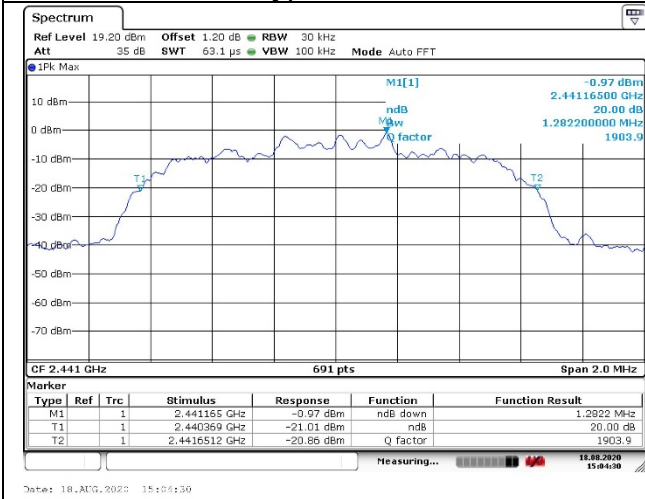


Modulation type: GFSK 2441MHz



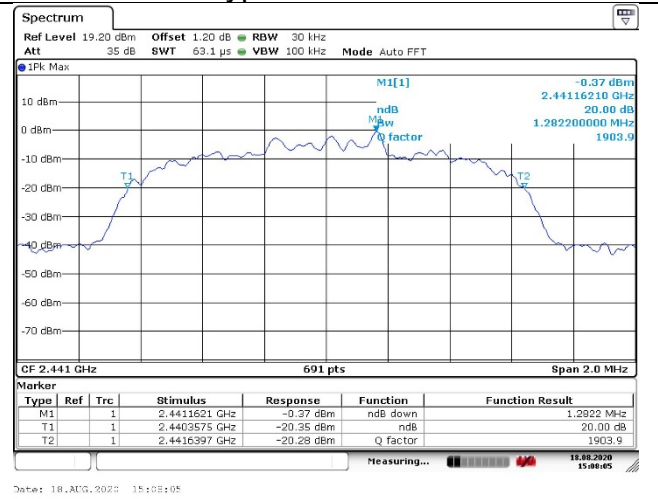
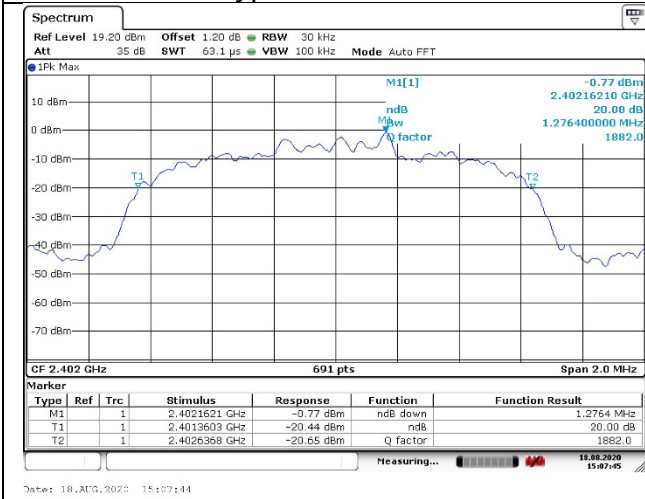
Modulation type: GFSK 2480MHz

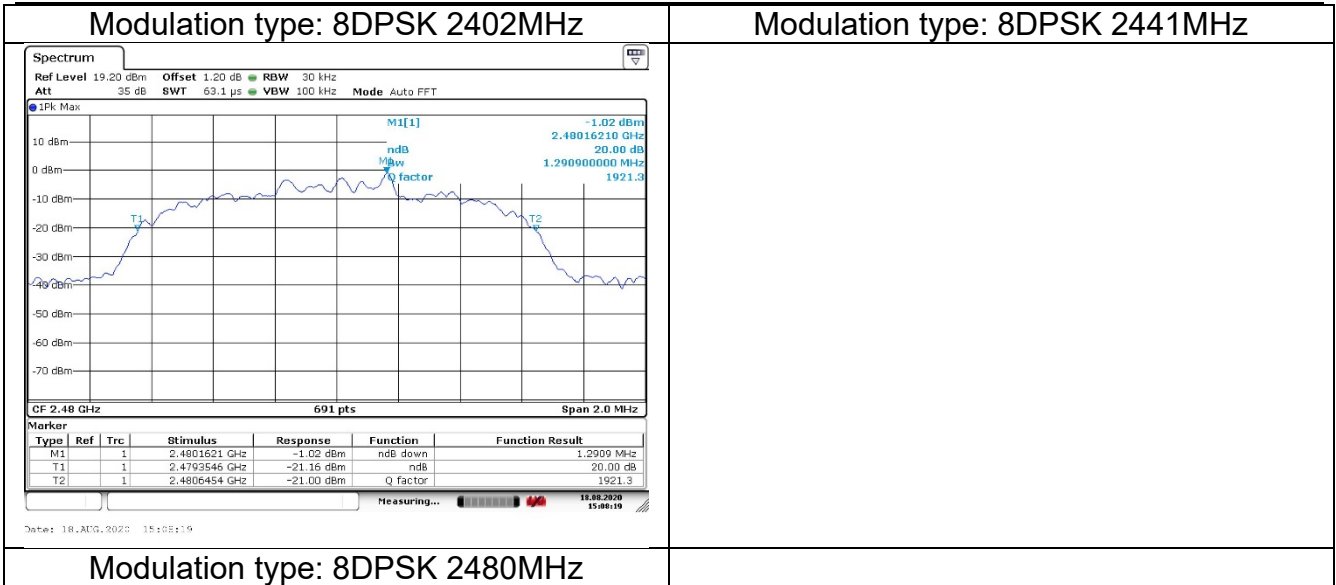
Modulation type:  $\pi/4$ DQPSK 2402MHz



Modulation type:  $\pi/4$ DQPSK 2441MHz

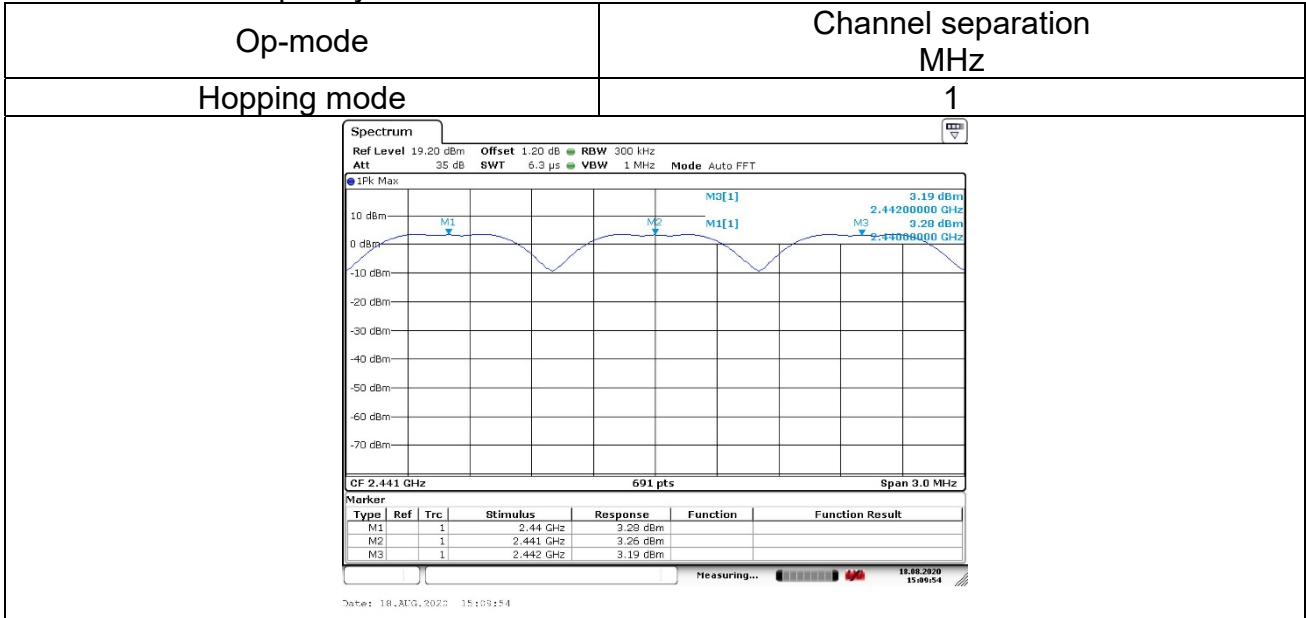
Modulation type:  $\pi/4$ DQPSK 2480MHz





### Channel Separation

Offset 1.2dB = Temporary antenna connector loss 0.2dB+ Cable loss 1dB



## Peak Power Output

| Modulation type | Peak Power Output (dBm) |         |         |
|-----------------|-------------------------|---------|---------|
|                 | 2402MHz                 | 2441MHz | 2480MHz |
| GFSK            | 5.22                    | 4.99    | 3.57    |
| $\pi/4$ DQPSK   | 4.52                    | 4.55    | 3.11    |
| 8DPSK           | 4.43                    | 4.39    | 3.19    |

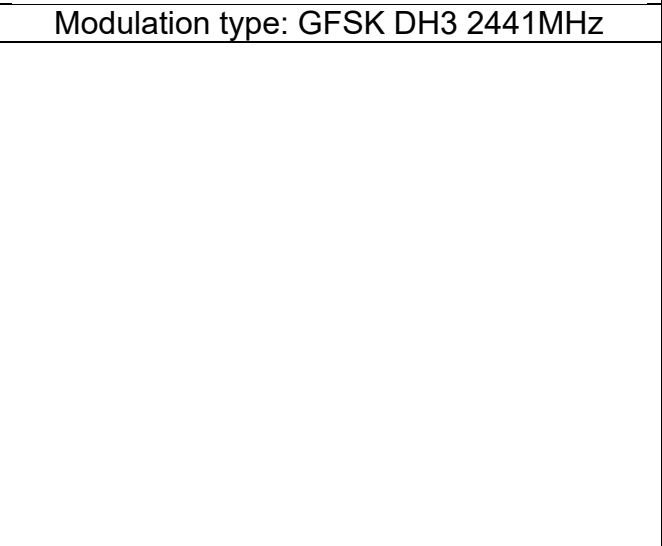
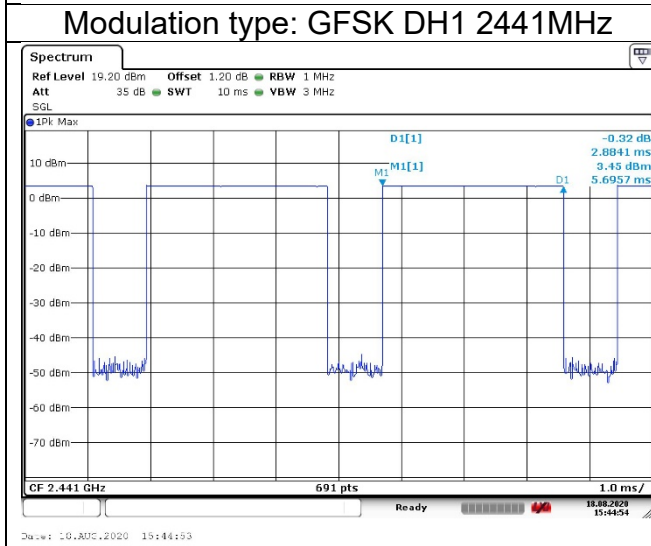
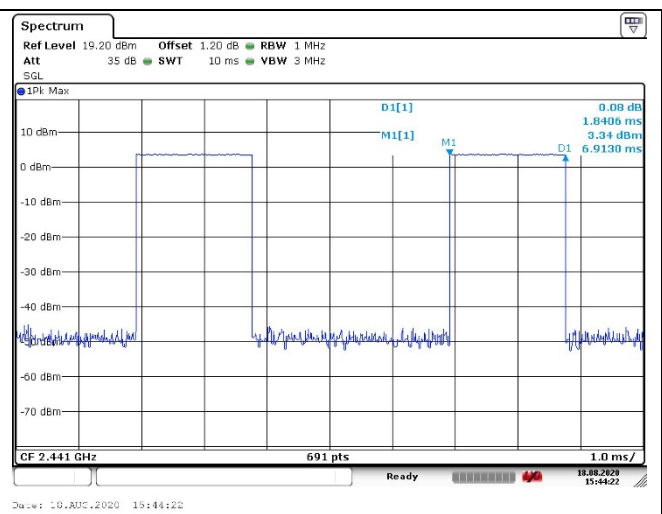
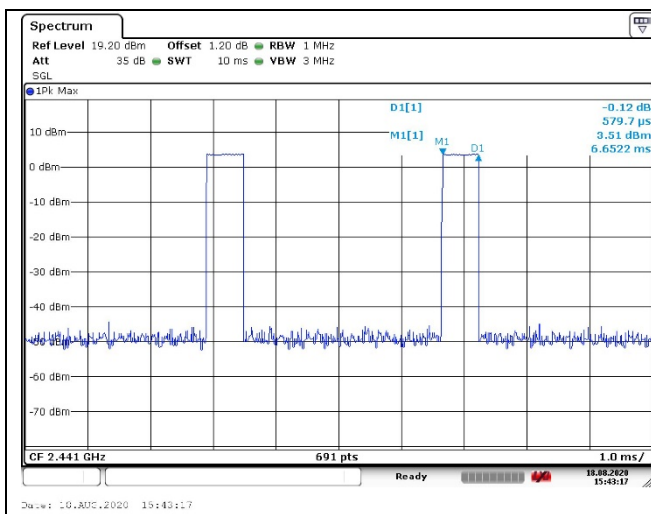
| Modulation type | Average Power Output (dBm) |         |         |
|-----------------|----------------------------|---------|---------|
|                 | 2402MHz                    | 2441MHz | 2480MHz |
| GFSK            | 4.93                       | 4.77    | 3.46    |
| $\pi/4$ DQPSK   | 1.74                       | 1.93    | 1.09    |
| 8DPSK           | 1.66                       | 1.91    | 1.12    |

**Dwell Time**

Offset 1.2dB = Temporary antenna connector loss 0.2dB+ Cable loss 1dB

Modulation type: GFSK

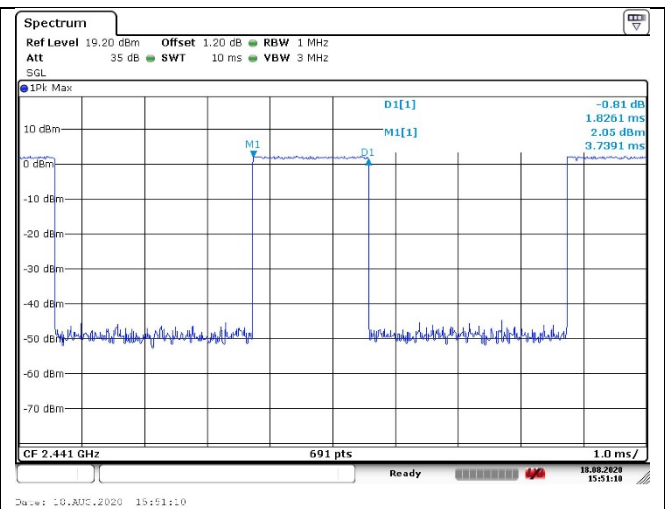
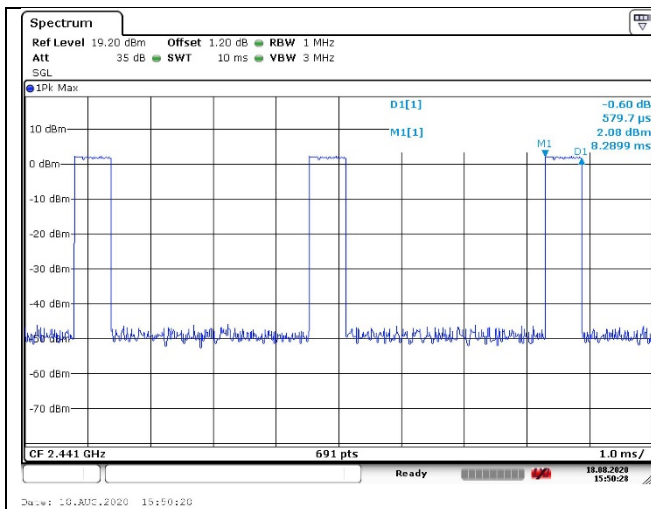
| Packet type | Time slot length (μs) | Dwell time                             | Dwell time (ms) |
|-------------|-----------------------|--|-----------------|
| DH1         | 580                   | time slot length *31.6<br>*1600/2 /79  | 185.6           |
| DH3         | 1841                  | time slot length * 31.6<br>*1600/4 /79 | 294.6           |
| DH5         | 2885                  | time slot length * 31.6<br>*1600/6 /79 | 307.7           |





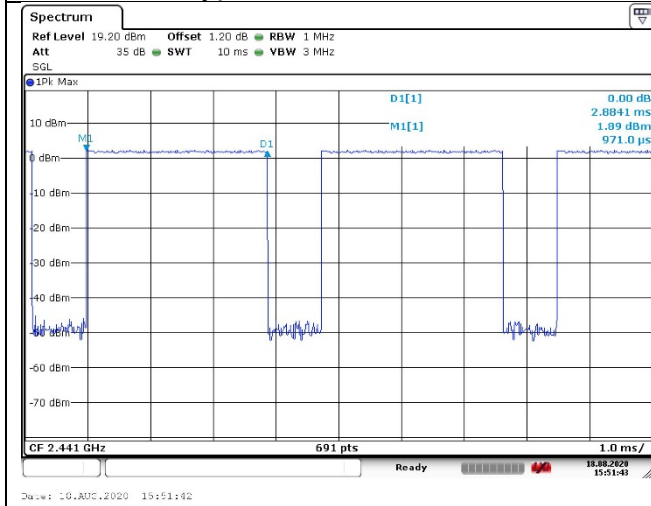
Modulation type:  $\pi/4$ DQPSK

| Packet type | Time slot length ( $\mu$ s) | Dwell time                             | Dwell time (ms) |
|-------------|-----------------------------|--|-----------------|
| DH1         | 580                         | time slot length *31.6<br>*1600/2 /79  | 185.6           |
| DH3         | 1827                        | time slot length * 31.6<br>*1600/4 /79 | 292.3           |
| DH5         | 2885                        | time slot length * 31.6<br>*1600/6 /79 | 307.7           |



Modulation type:  $\pi/4$ DQPSK DH1 2441MHz

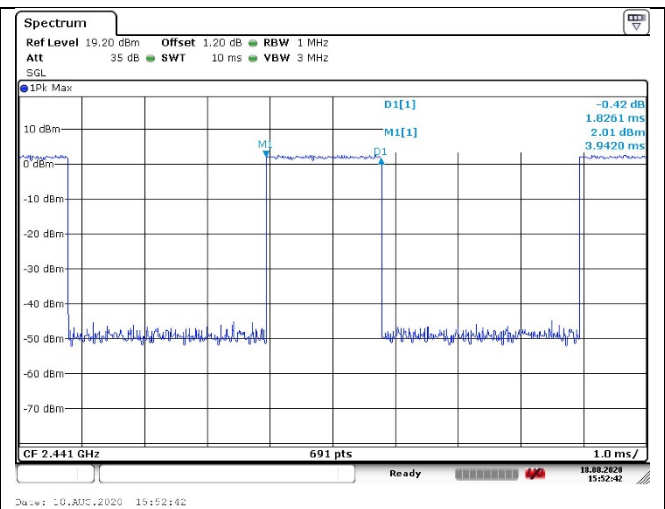
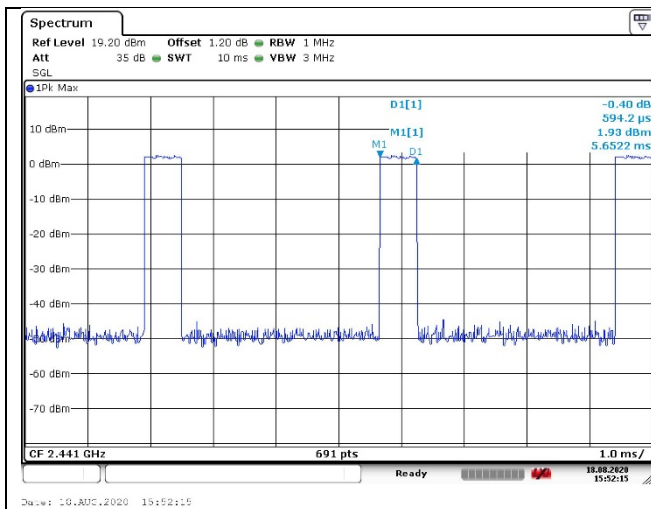
Modulation type:  $\pi/4$ DQPSK DH3 2441MHz



Modulation type:  $\pi/4$ DQPSK DH5 2441MHz

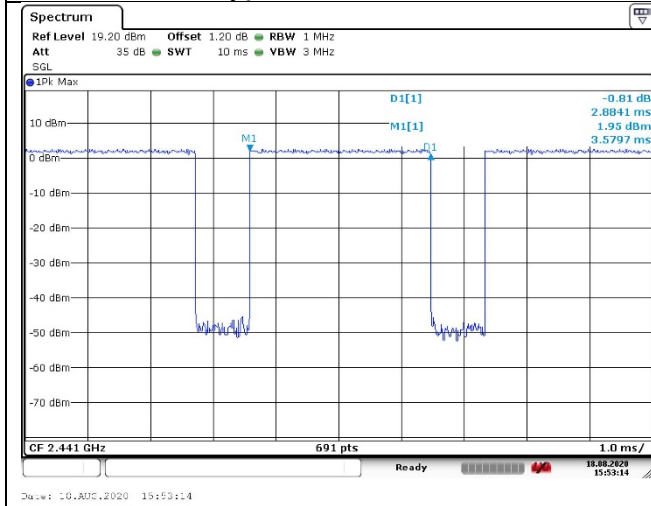
Modulation type: 8DPSK

| Packet type | Time slot length (μs) | Dwell time                             | Dwell time (ms) |
|-------------|-----------------------|--|-----------------|
| DH1         | 595                   | time slot length *31.6<br>*1600/2 /79  | 190.4           |
| DH3         | 1827                  | time slot length * 31.6<br>*1600/4 /79 | 292.3           |
| DH5         | 2885                  | time slot length * 31.6<br>*1600/6 /79 | 307.7           |



Modulation type: 8DPSK DH1 2441MHz

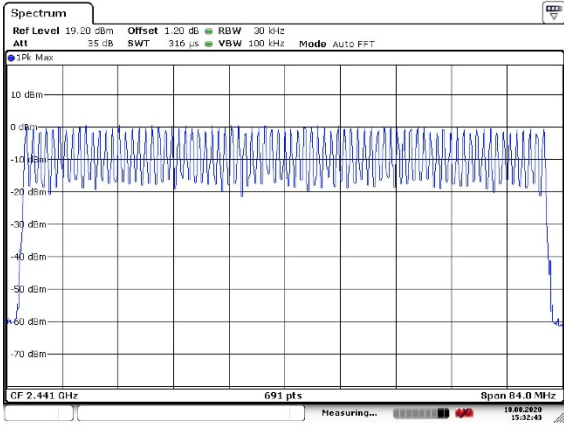
Modulation type: 8DPSK DH3 2441MHz



Modulation type: 8DPSK DH5 2441MHz

**Number of Hopping Frequencies**

Offset 1.2dB = Temporary antenna connector loss 0.2dB+ Cable loss 1dB

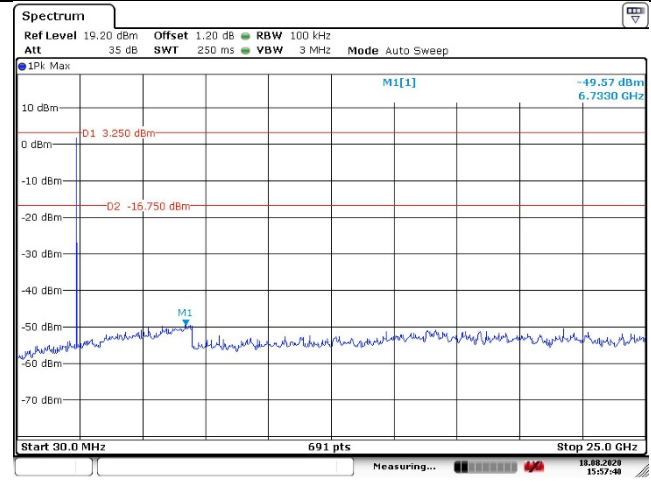
| Op-mode  | Result |
|--|--------|
| Hopping mode   | 79     |
|  |        |

**Conducted out of band emission measurement**

Offset 1.2dB = Temporary antenna connector loss 0.2dB+ Cable loss 1dB

**GFSK**

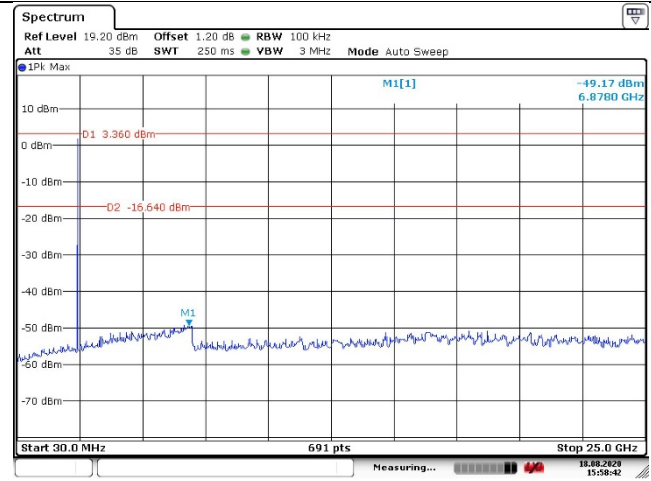
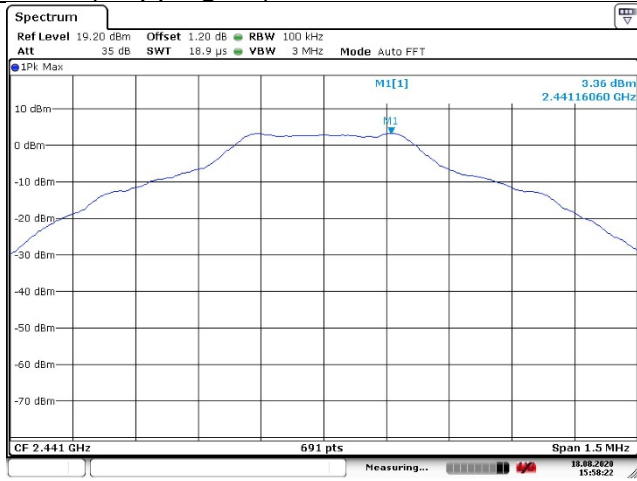
**CH0 (Hopping off)**



Date: 10\_AUG.2020 15:57:14

Date: 10\_AUG.2020 15:57:39

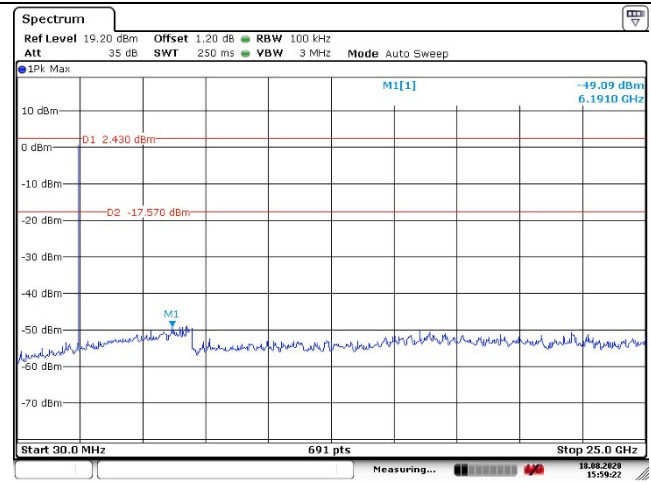
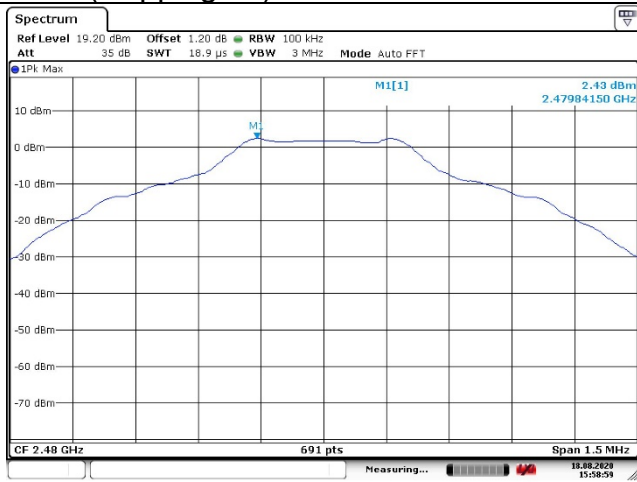
**CH39(Hopping off)**



Date: 10\_AUG.2020 15:58:22

Date: 10\_AUG.2020 15:58:42

**CH78(Hopping off)**

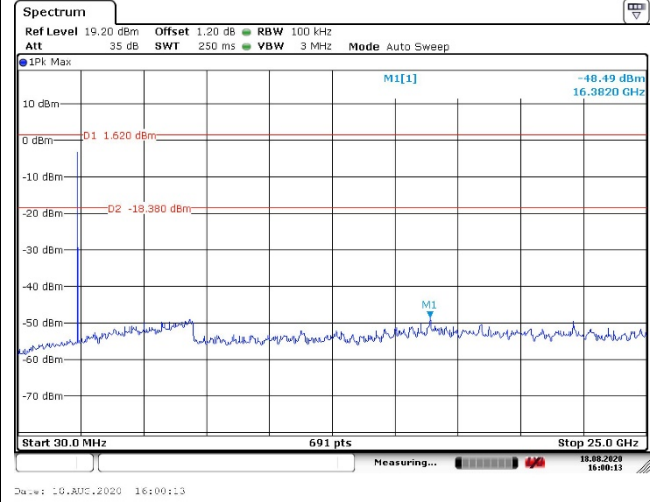
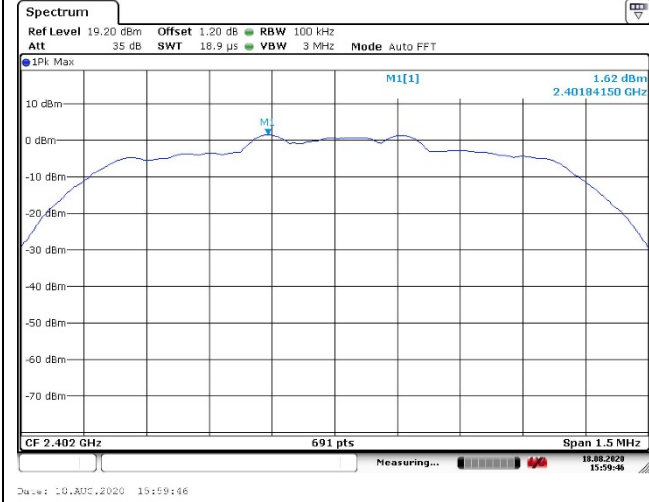


Date: 10\_AUG.2020 15:58:59

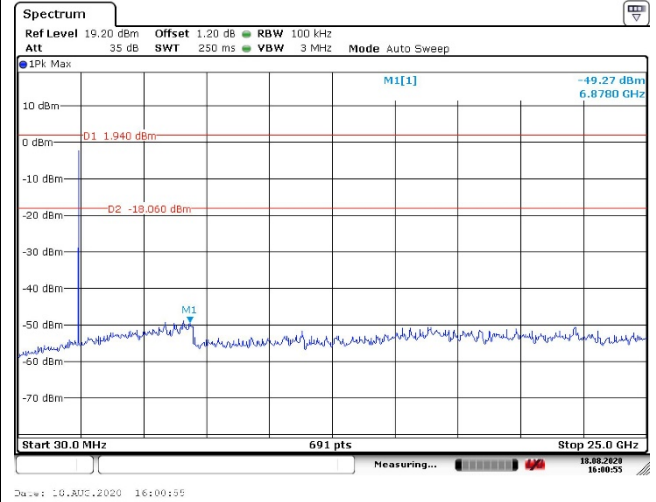
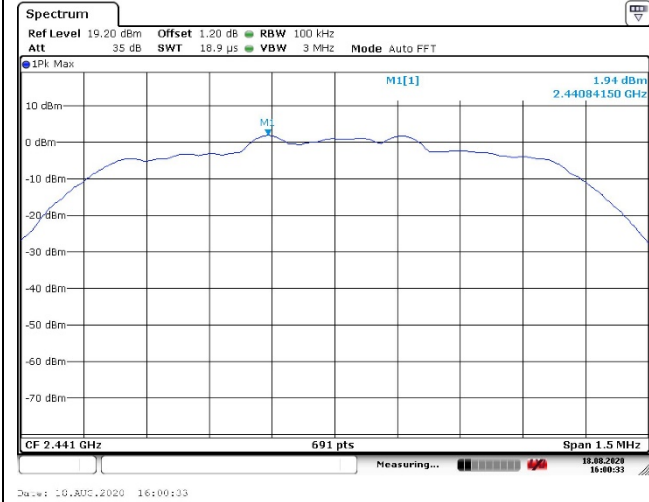
Date: 10\_AUG.2020 15:59:21

**π/4DQPSK**

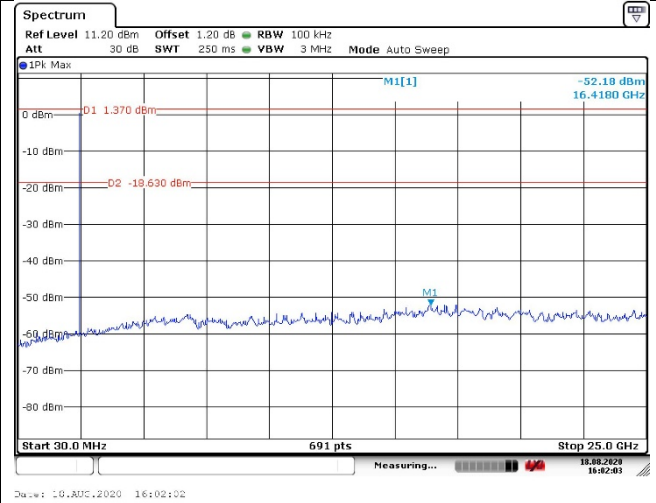
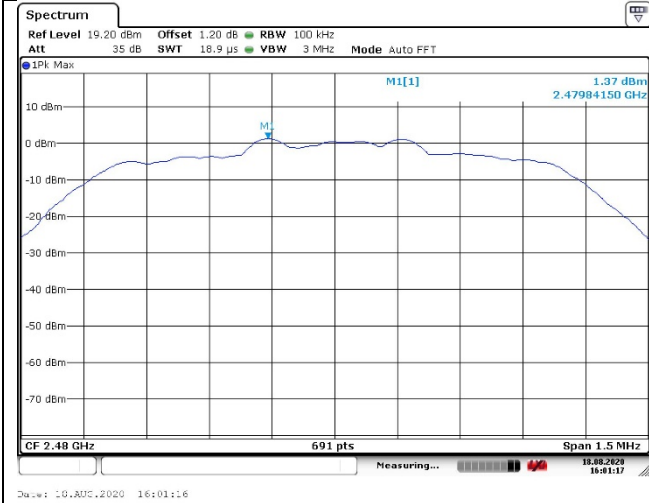
**CH0 (Hopping off)**



**CH39(Hopping off)**

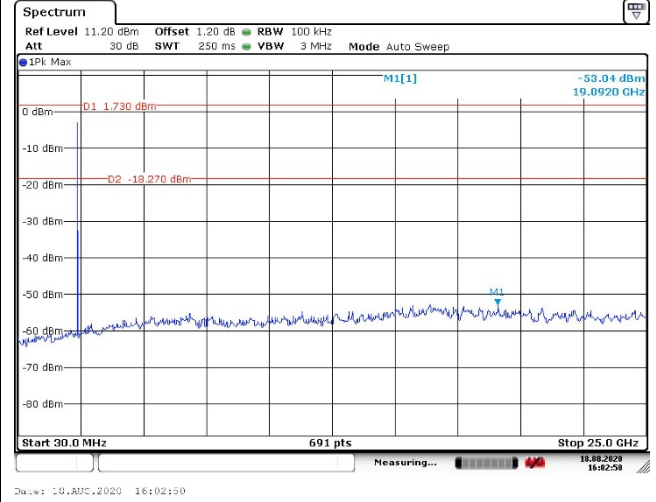
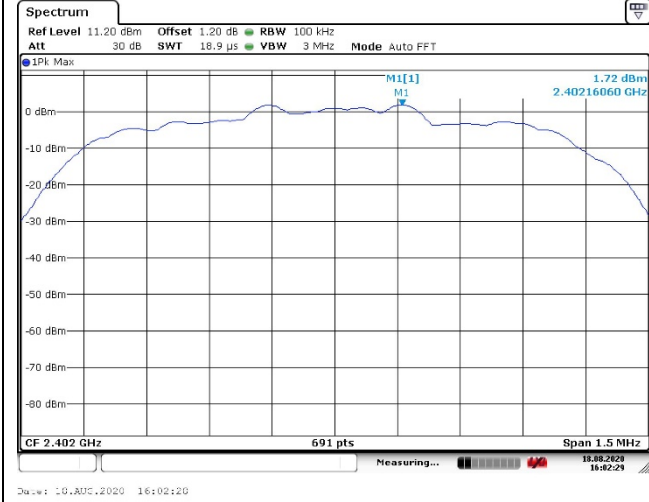


**CH78(Hopping off)**

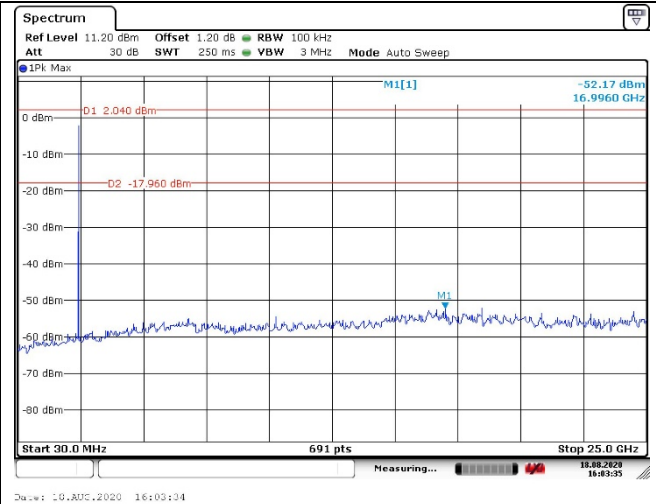
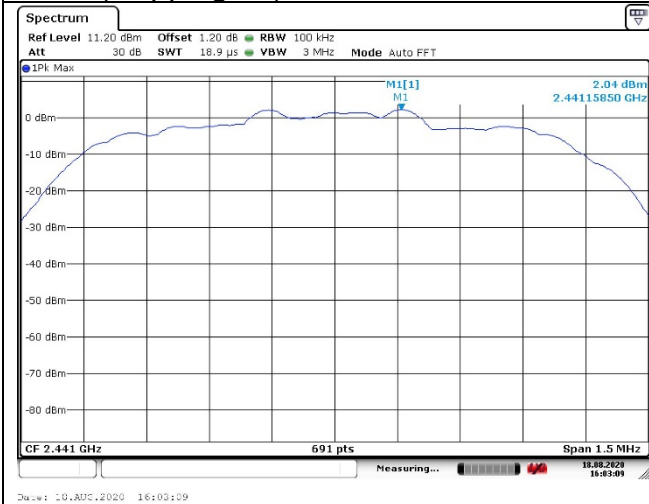


**8DPSK**

**CH0 (Hopping off)**



**CH39(Hopping off)**



**CH78(Hopping off)**

