



# **FCC 47 CFR PART 15 SUBPART C 15.247 TEST REPORT**

**FOR**

Embedded computer

Model : EC3310, SBC3300, NSD3305, NSD3307, NSD3310,  
EC3305, EC3307, K920, K330, POE-MB-A01(RT7402D),  
WLS-020

Issued to

IC NEXUS CO., LTD.

6F-1, No. 3-2 Park Street, Nan-Kang Dist., Taipei, Taiwan Post Code: 11503

Issued by

WH Technology Corp.



|                                                     |                                                                                           |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------|
| <b>Xizhi Office</b>                                 | <b>7F., No.262, Sec. 3, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)</b> |
| <b>Xizhi Lab</b>                                    | <b>No. 67-22, Baoxin St., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)</b>           |
| <b>Tel.: +886-2-7729-7707 Fax: +886-2-8648-1311</b> |                                                                                           |

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## 1. General Information

**Applicant** : IC NEXUS CO., LTD.

**Address** : 6F-1, No. 3-2 Park Street, Nan-Kang Dist., Taipei, Taiwan  
Post Code: 11503

**Manufacturer** : IC NEXUS CO., LTD.

**Address** : 6F-1, No. 3-2 Park Street, Nan-Kang Dist., Taipei, Taiwan  
Post Code: 11503

**EUT** : Embedded computer

**Model Name** : EC3310, SBC3300, NSD3305, NSD3307, NSD3310, EC3305, EC3307, K920, K330, POE-MB-A01(RT7402D), WLS-020

**Model difference** : Panel of EC3310, SBC3300, NSD3310, K920, K330, POE-MB-A01(RT7402D) and WLS-020 are 10.1 inch. There is no difference among EC3310, SBC3300, NSD3310, K920, K330, POE-MB-A01(RT7402D) and WLS-020.

Panel of NSD3305 and EC3305 are 5 inch. There is no difference between NSD3305 and EC3305.

Panel of NSD3307 and EC3307 is 7 inch. There is no difference between NSD3307 and EC3307

There is no schematics and layout difference for above models.

Worst case of EMI is model EC3310 so testing model is EC3310.

Is here with confirmed to comply with the requirements set out in the FCC Rules and Regulations Part 15 Subpart C and the measurement procedures were according to ANSI C63.10-2013. The said equipment in the configuration described in this report shows the maximum emission levels emanating from equipment are within the compliance requirements.

### FCC part 15 subpart C

Receipt Date : 03/23/2022

Final Test Date : 07/07/2022

Tested By:

Reviewed by:

Jul. 07, 2022  
Date

  
Bing Zhang / Project Engineer

Jul. 07, 2022  
Date

  
Bell Wei / Manager  
Designation Number: TW2954  
Test Firm Registration Number: 749714



## 2. Report of Measurements and Examinations

### 2.1 List of Measurements and Examinations

| FCC Rule     | Description of Test                    | Result |
|--------------|----------------------------------------|--------|
| 15.203       | Antenna Requirement                    | Pass   |
| 15.207       | Conducted Emission                     | Pass   |
| 15.209       | Radiated Emission                      | Pass   |
| 15.247(a)(1) | Channel Carrier Frequencies Separation | Pass   |
| 15.247(a)(1) | 20dB Bandwidth Measurement             | Pass   |
| 15.247(a)(1) | Dwell Time                             | Pass   |
| 15.247(b)    | Number of Hopping Channels             | Pass   |
| 15.247(b)    | Peak Output Power Measurement Data     | Pass   |
| 15.247(d)    | Band Edges Measurement Data            | Pass   |



### **3. Test Configuration of Equipment under Test**

#### **3.1 Description of the Tested Samples**

EUT Name : Embedded computer

Model Number : EC3310

FCC ID : 2ACLCECNSDSBC330J60

Receipt Date : 03/23/2022

EUT Power Rating : DC 12V from Adaptor

Operate Frequency : Refer to the channel list as described below  
(2402 ~ 2480 MHz)

Modulation Technique : GFSK,  $\pi/4$ -DQPSK, 8DPSK

Number of Channels : 79

Channel Spacing : 1 MHz

Operating Mode : ☐ Simplex ☒ Duplex

Antenna Type : dipole Antenna

Antenna Gain : 2.7 dBi



### 3.2 Carrier Frequency of Channels

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|---------|-----------------|---------|-----------------|
| 00      | 2402            | 20      | 2422            | 40      | 2442            | 60      | 2462            |
| 01      | 2403            | 21      | 2423            | 41      | 2443            | 61      | 2463            |
| 02      | 2404            | 22      | 2424            | 42      | 2444            | 62      | 2464            |
| 03      | 2405            | 23      | 2425            | 43      | 2445            | 63      | 2465            |
| 04      | 2406            | 24      | 2426            | 44      | 2446            | 64      | 2466            |
| 05      | 2407            | 25      | 2427            | 45      | 2447            | 65      | 2467            |
| 06      | 2408            | 26      | 2428            | 46      | 2448            | 66      | 2468            |
| 07      | 2409            | 27      | 2429            | 47      | 2449            | 67      | 2469            |
| 08      | 2410            | 28      | 2430            | 48      | 2450            | 68      | 2470            |
| 09      | 2411            | 29      | 2431            | 49      | 2451            | 69      | 2471            |
| 10      | 2412            | 30      | 2432            | 50      | 2452            | 70      | 2472            |
| 11      | 2413            | 31      | 2433            | 51      | 2453            | 71      | 2473            |
| 12      | 2414            | 32      | 2434            | 52      | 2454            | 72      | 2474            |
| 13      | 2415            | 33      | 2435            | 53      | 2455            | 73      | 2475            |
| 14      | 2416            | 34      | 2436            | 54      | 2456            | 74      | 2476            |
| 15      | 2417            | 35      | 2437            | 55      | 2457            | 75      | 2477            |
| 16      | 2418            | 36      | 2438            | 56      | 2458            | 76      | 2478            |
| 17      | 2419            | 37      | 2439            | 57      | 2459            | 77      | 2479            |
| 18      | 2420            | 38      | 2440            | 58      | 2460            | 78      | 2480            |
| 19      | 2421            | 39      | 2441            | 59      | 2461            | ---     | ---             |

### 3.3 Test Mode and Test Software

- During testing, the interface cables and equipment positions were varied according to ANSI C63.10-2013.
- The complete test system included Notebook and EUT for RF test.
- An executive "BLUETEST3" under WIN8 was executed to keep transmitting and receiving data via Wireless.
- The following test modes were performed for test:
  - GFSK: CH00: 2402MHz, CH39: 2441MHz, CH78: 2480MHz
  - $\pi/4$ -DQPSK: CH00: 2402MHz, CH39: 2441MHz, CH78: 2480MHz
  - 8DPSK: CH 00: 2402MHz, CH 39: 2441MHz, CH 78: 2480MHz.



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### **3.4 Test Methodology & General Test Procedures**

All testing as described bellowed were performed in accordance with ANSI C63.10-2013 and FCC CFR 47 Part 15 Subpart C.

#### **Conducted Emissions**

The EUT is placed on a wood table, which is at 0.8 m above ground plane acceding to clause 15.207 and requirements of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz are using CISPR Quasi-Peak / Average detectors.

#### **Radiated Emissions**

The EUT is a placed on a turn table, which is 0.8 m above ground plane. The turntable was rotated through 360 degrees to determine the position of maximum emission level. The EUT is placed at 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

- 1) Putting the EUT on the platform and turning on the EUT (on/off button on the bottom of the EUT).
- 2) Setting test channel described as "Channel setting and operating condition", and testing channel by channel.
- 3) For the spurious emission test based on ANSI(2013), at the frequency where below 1GHz used quasi-peak detector mode; where above 1GHz used the peak and average detector mode. IF the peak value may be under average limit, the average mode will not be performed.



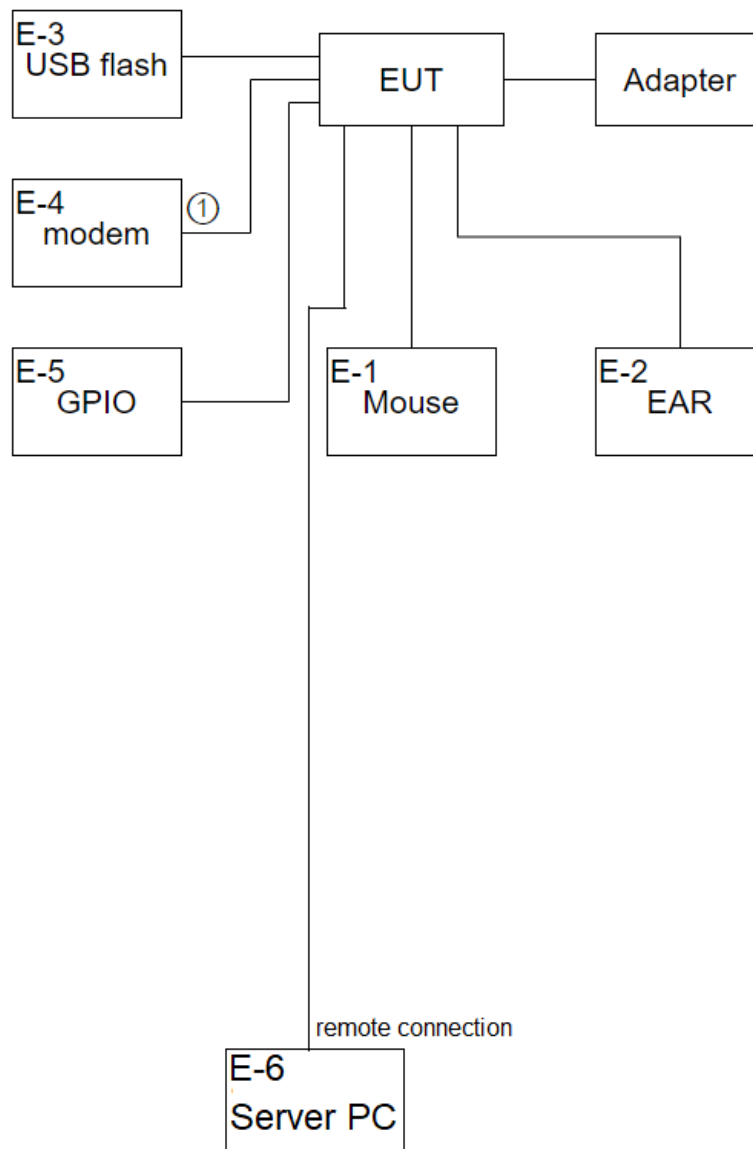


### 3.5 Measurement Uncertainty

| Measurement Item              | Uncertainty         |
|-------------------------------|---------------------|
| Radiated emission             | $\pm 4.11\text{dB}$ |
| Peak Output Power (Conducted) | $\pm 1.38\text{dB}$ |
| Peak Output Power (Radiated)  | $\pm 1.70\text{dB}$ |
| Power Spectral Density        | $\pm 1.39\text{dB}$ |
| Radiated emission (3m)        | $\pm 4.11\text{dB}$ |
| Radiated emission (10m)       | $\pm 3.89\text{dB}$ |

### 3.6 Description of the Support Equipments

#### Setup Diagram





## Support Equipment

Peripherals Devices:

| OUTSIDE SUPPORT EQUIPMENT |                           |                 |                                  |                    |               |                        |                             |
|---------------------------|---------------------------|-----------------|----------------------------------|--------------------|---------------|------------------------|-----------------------------|
| No.                       | Equipment                 | Model           | Serial No.                       | FCC ID/<br>BSMI ID | Trade<br>name | Data Cable             | Power<br>Cord/ LAN<br>Cable |
| ①                         | RS232 cable               | N/A             | N/A                              | N/A                | N/A           | Unshielded<br>1.5m     | N/A                         |
| E-1                       | Mouse                     | MS116p          | CN-04DW<br>DN-73826-<br>5CM-0120 | R41108             | DELL          | Shielded<br>1.8m / USB | N/A                         |
| E-2                       | Ear-Phone+<br>Micro-Phone | EM-1120M<br>V   | N/A                              | N/A                | i-gota        | Unshielded<br>1m*2     | N/A                         |
| E-3                       | USB 3.0                   | 32G             | AUC350-3<br>2G-CGD               | D33A23             | ADATA         | Shielded<br>1m / USB   | N/A                         |
| E-4                       | Modem                     | 2FXS/2FX<br>O   | F09NH591<br>0                    | N/A                | NA            | Unshielded<br>1.8m     | Unshielded<br>1.8m          |
| E-5                       | GPIO                      | N/A             | N/A                              | N/A                | N/A           | N/A                    | N/A                         |
| E-6                       | Server PC                 | D19M            | CYY7Y<br>A00 DC4                 | R33002             | DELL          | N/A                    | Unshielded<br>1.8m          |
| INSIDE SUPPORT EQUIPMENT  |                           |                 |                                  |                    |               |                        |                             |
| No.                       | Equipment                 | Model           | Serial No.                       | FCC ID/<br>BSMI ID | Trade<br>name | Data Cable             | Power Cord                  |
| 1.                        | ADAPTER                   | LTE36E-S2<br>-1 | N/A                              | N/A                | LTE           | N/A                    | N/A                         |

**Note:** (1) All the above equipment /cable were placed in worse case position to maximize emission signals during emission test.

(2) Grounding was in accordance with the manufacturer's requirement and conditions for the intended use.



## **4. Test and Measurement Equipment**

### **4.1 Calibration**

The measuring equipment utilized to perform the tests documented in the report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### **4.2 Equipment**

The following list contains measurement equipment used for testing. The equipment conforms to the requirement of CISPR 16-1, ANSI C63.2 and other required standards.

Calibration of all test and measurement, including any accessories that may effect such calibration, is checked frequently to ensure the accuracy. Adjustments are made and correction factors are applied in accordance with the instructions contained in the respective.

**TABLELIST OF TEST AND MEASUREMENT EQUIPMENT**

| Conducted emission           |                   |                                          |                          |               |
|------------------------------|-------------------|------------------------------------------|--------------------------|---------------|
| Instrument                   | Manufacturer      | Model No.                                | Serial No.               | Cali Due Date |
| EMI Test Receiver            | R&S               | ESHS10                                   | 830223/008               | 2022/09/14    |
| Spectrum Analyzer            | R&S               | FSP3                                     | 833387/010               | 2023/02/14    |
| Two-Line V-Network           | R&S               | NNB-2/16z                                | 98062                    | 2022/09/23    |
| Test Cable                   | N/A               | N/A                                      | WH-CON03                 | 2022/10/19    |
| Measurement Software         | AUDIX             | e3                                       | V6.101222a               | N/A           |
| Radiated emission Below 1GHz |                   |                                          |                          |               |
| Instrument                   | Manufacturer      | Model No.                                | Serial No.               | Cali Due Date |
| Bilog antenna                | ETC               | MCTD2786B                                | BLB19O04027/J<br>B-5-027 | 2022/11/10    |
| LOOP Antenna                 | EMCO              | 6507                                     | 9301-1298                | 2023/02/16    |
| Pre-amplifier                | EMCI              | EMC9135                                  | 980334                   | 2022/07/15    |
| Cable                        | EMCI              | N male on end<br>of both sides<br>(EMI4) | 30m                      | 2023/03/20    |
| Receiver                     | R&S               | ESVS30                                   | 826006/002               | 2023/02/15    |
| Spectrum Analyzer            | R&S               | FSP7                                     | 830180/006               | 2023/05/11    |
| Measurement Software         | AUDIX             | e3                                       | V6.101222a               | N/A           |
| Radiated emission Above 1GHz |                   |                                          |                          |               |
| Instrument                   | Manufacturer      | Model No.                                | Serial No.               | Cali Due Date |
| Horn antenna                 | ETS<br>LINDGREN   | 3117                                     | 00114397                 | 2022/07/28    |
| Horn antenna                 | com-power         | AH-826                                   | 81000                    | 2022/10/03    |
| Horn antenna                 | Schwarzbeck       | BBHA9170                                 | #687                     | 2023/05/12    |
| Pre-amplifier                | EMCI              | EMC051845                                | 980108                   | 2023/03/30    |
| Pre-amplifier                | MITEQ             | JS4-18002600-3<br>0-5A                   | 808329                   | 2022/09/15    |
| Pre-amplifier                | EMC<br>INSTRUMENT | EMC264035SE                              | 980288                   | 2023/05/12    |
| RF CABLE                     | SUCOFLEX          | 104PEA                                   | 27348/4PEA               | 2022/09/06    |
| RF CABLE                     | AGILENT           | EMC102-KM-K<br>M-3000                    | 160101                   | 2022/09/14    |
| RF CABLE                     | AGILENT           | EMC102-KM-K<br>M-600                     | 160102                   | 2022/09/14    |
| Spectrum Analyzer            | R&S               | FSP7                                     | 830180/006               | 2023/05/11    |
| Spectrum Analyzer            | AGILENT           | N9010A                                   | MY51280195               | 2022/09/15    |
| Spectrum Analyzer            | ADVANTEST         | R3182                                    | 150900201                | 2023/04/13    |



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|                         |       |    |            |     |
|-------------------------|-------|----|------------|-----|
| Measurement<br>Software | AUDIX | e3 | V6.101222a | N/A |
|-------------------------|-------|----|------------|-----|

**\*CALIBRATION INTERVAL OF INSTRUMENTS LISTED ABOVE IS ONE YEAR.**



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## **5. Antenna Requirements**

### **5.1 Standard Applicable**

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### **5.2 Antenna Construction and Directional Gain**

Antenna Type: dipole Antenna

Antenna Gain: 2.7 dBi



## 6. Test of Conducted Emission

### 6.1 Test Limit

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 kHz on the 120 VAC power and return leads of the EUT according to the methods defined in ANSI C63.10-2013 Section 3.1. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane as shown in section 2.2. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

| Frequency (MHz) | Quasi Peak (dBμV) | Average (dBμV) |
|-----------------|-------------------|----------------|
| 0.15 – 0.5      | 66 – 56*          | 56 – 46*       |
| 0.5 – 5.0       | 56                | 46             |
| 5.0 – 30.0      | 60                | 50             |

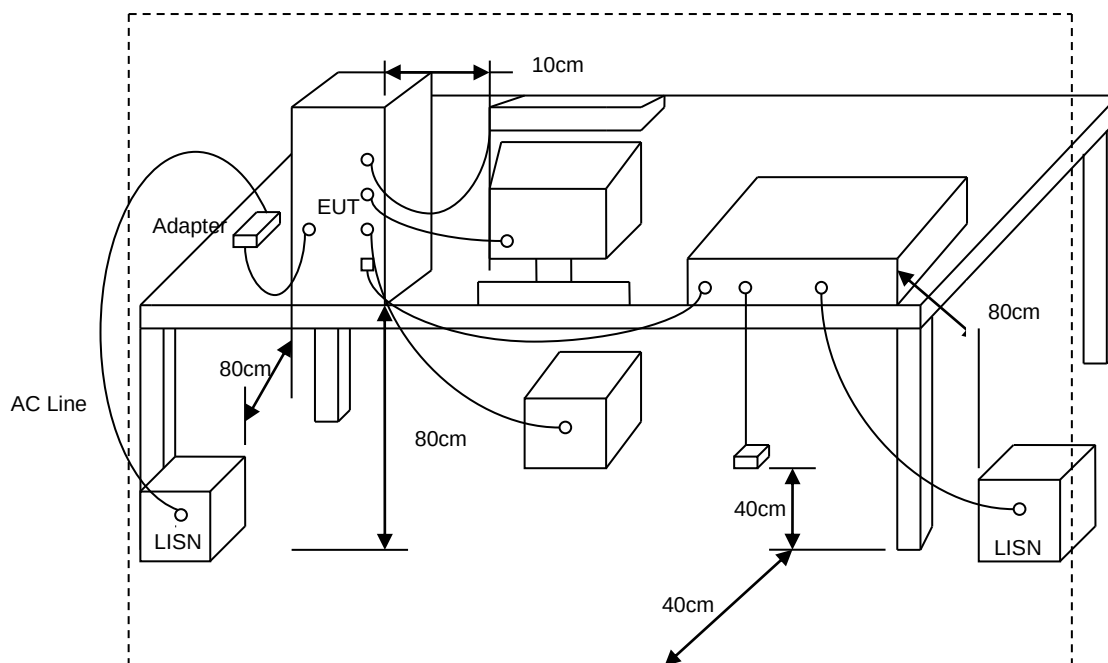
\*Decreases with the logarithm of the frequency.

### 6.2 Test Procedures

- The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The FCC states that a 50 ohm, 50 micro-Henry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system and using CISPR Quasi-Peak / Average detectors and Specified Bandwidth with Maximum Hold Mode.
- RBW=9kHz. VBW=30kHz.



### 6.3 Typical Test Setup

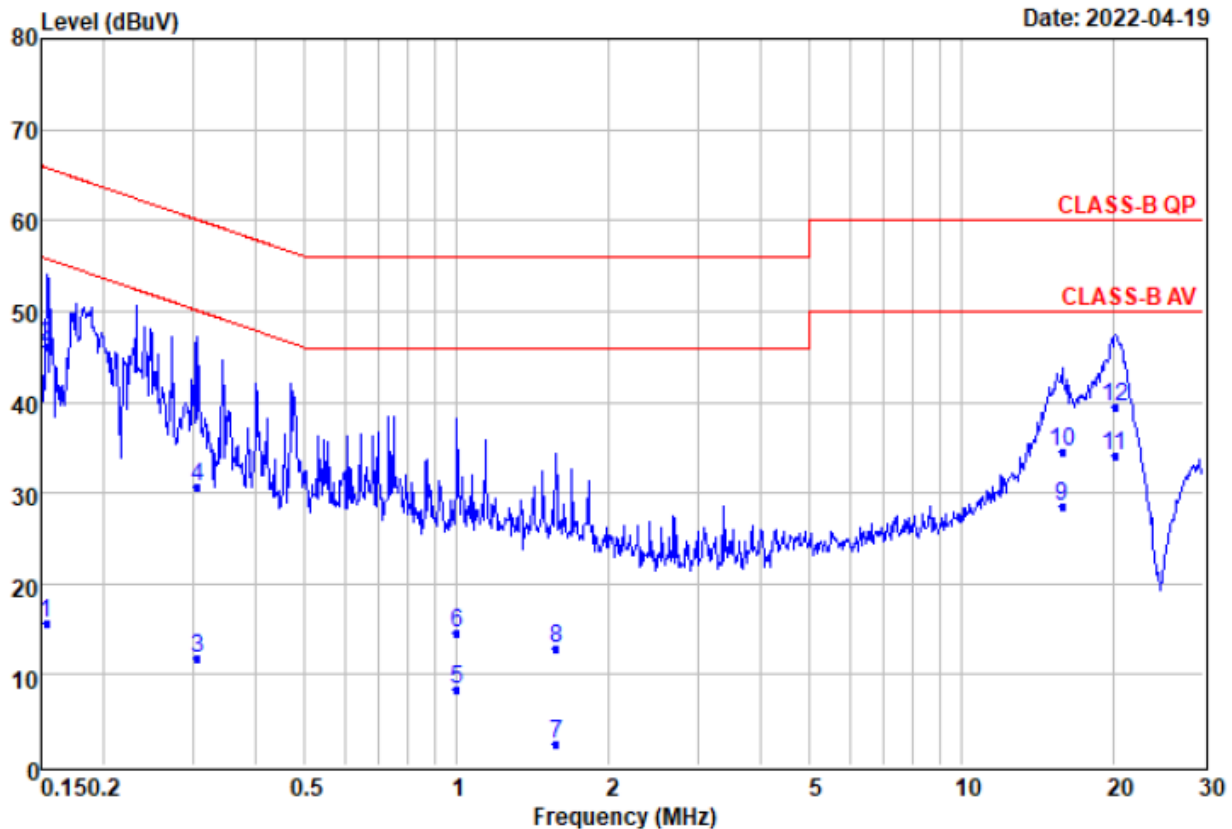






## 6.4 Test Result and Data

|             |           |           |        |
|-------------|-----------|-----------|--------|
| Power       | : DC 12V  | Pol/Phase | : LINE |
| Temperature | : 26.3 °C | Humidity  | : 52 % |

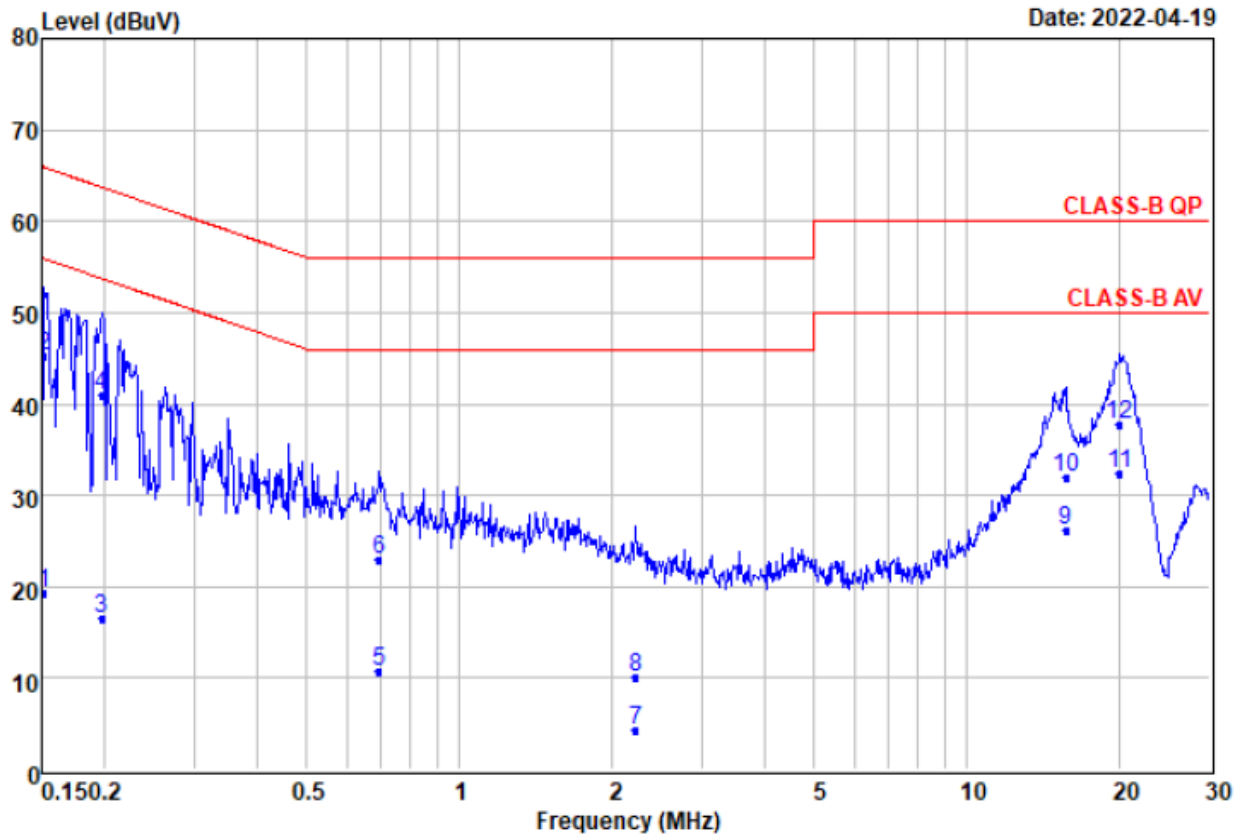


Remarks : Factor=Insertion loss+Cable loss

|      | Freq  | Read Level | Level | Factor | Over Limit | Limit Line | Remark  |
|------|-------|------------|-------|--------|------------|------------|---------|
|      | MHz   | dBuV       | dBuV  | dB     | dB         | dBuV       |         |
| 1    | 0.15  | 5.53       | 15.64 | 10.11  | -40.14     | 55.78      | Average |
| 2    | 0.15  | 36.04      | 46.15 | 10.11  | -19.63     | 65.78      | QP      |
| 3    | 0.31  | 1.75       | 11.86 | 10.11  | -38.20     | 50.06      | Average |
| 4    | 0.31  | 20.56      | 30.67 | 10.11  | -29.39     | 60.06      | QP      |
| 5    | 1.00  | -1.84      | 8.31  | 10.15  | -37.69     | 46.00      | Average |
| 6    | 1.00  | 4.44       | 14.59 | 10.15  | -41.41     | 56.00      | QP      |
| 7    | 1.57  | -7.72      | 2.45  | 10.17  | -43.55     | 46.00      | Average |
| 8    | 1.57  | 2.78       | 12.95 | 10.17  | -43.05     | 56.00      | QP      |
| 9    | 15.80 | 18.09      | 28.54 | 10.45  | -21.46     | 50.00      | Average |
| 10   | 15.80 | 24.12      | 34.57 | 10.45  | -25.43     | 60.00      | QP      |
| 11 @ | 20.06 | 23.70      | 34.20 | 10.50  | -15.80     | 50.00      | Average |
| 12   | 20.06 | 29.04      | 39.54 | 10.50  | -20.46     | 60.00      | QP      |



|             |           |           |          |
|-------------|-----------|-----------|----------|
| Power       | : DC 12V  | Pol/Phase | : NEUTRL |
| Temperature | : 26.3 °C | Humidity  | : 52 %   |



Remarks : Factor=Insertion loss+Cable loss

|      | Freq  | Read Level | Level | Factor | Over Limit | Limit Line | Remark  |
|------|-------|------------|-------|--------|------------|------------|---------|
|      | MHz   | dBuV       | dBuV  | dB     | dB         | dBuV       |         |
| 1    | 0.15  | 9.32       | 19.41 | 10.09  | -36.50     | 55.91      | Average |
| 2    | 0.15  | 35.20      | 45.29 | 10.09  | -20.62     | 65.91      | QP      |
| 3    | 0.20  | 6.43       | 16.52 | 10.09  | -37.19     | 53.71      | Average |
| 4    | 0.20  | 30.92      | 41.01 | 10.09  | -22.70     | 63.71      | QP      |
| 5    | 0.69  | 0.57       | 10.69 | 10.12  | -35.31     | 46.00      | Average |
| 6    | 0.69  | 12.84      | 22.96 | 10.12  | -33.04     | 56.00      | QP      |
| 7    | 2.22  | -5.93      | 4.23  | 10.16  | -41.77     | 46.00      | Average |
| 8    | 2.22  | -0.15      | 10.01 | 10.16  | -45.99     | 56.00      | QP      |
| 9    | 15.63 | 15.82      | 26.24 | 10.42  | -23.76     | 50.00      | Average |
| 10   | 15.63 | 21.60      | 32.02 | 10.42  | -27.98     | 60.00      | QP      |
| 11 @ | 19.95 | 21.90      | 32.36 | 10.46  | -17.64     | 50.00      | Average |
| 12   | 19.95 | 27.28      | 37.74 | 10.46  | -22.26     | 60.00      | QP      |



## 7. Test of Radiated Emission

### 7.1 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter measurement is based on the maximum conducted output power, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in section 15.205(a) the restricted bands must also comply with the radiated emission limit specified in section 15.209(a).

| Frequency (MHz) | Field Strength (microvolt/meter) | Measurement 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                             |



## 7.2 Test Procedures

- a. The EUT was placed on a rotatable table top 0.8 meter above ground.
- b. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- c. The table was rotated 360 degrees to determine the position of the highest radiation.
- d. The antenna is a broadband antenna and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- e. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- f. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
- h. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- i. "Cone of radiation" has been considered to be 3dB bandwidth of the measurement antenna.
- j. Use the following spectrum analyzer settings:

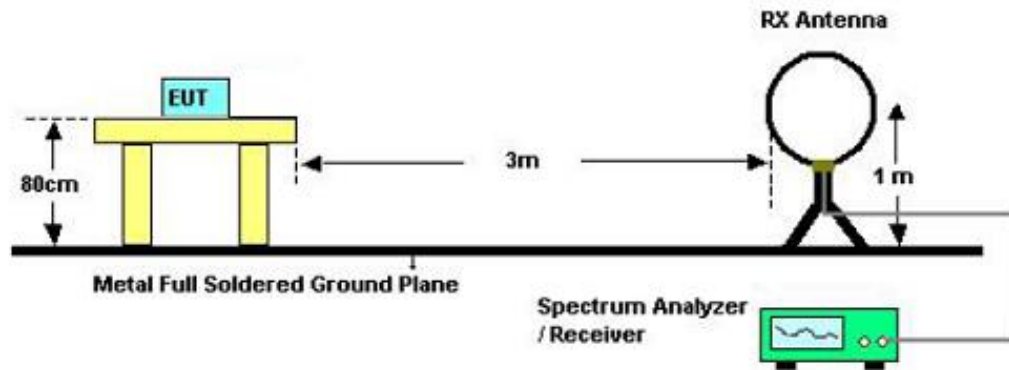
| Spectrum Parameter                    | Setting                                          |
|---------------------------------------|--------------------------------------------------|
| Attenuation                           | Auto                                             |
| Start Frequency                       | 1000 MHz                                         |
| Stop Frequency                        | 10 <sup>th</sup> carrier harmonic                |
| RB / VB (emission in restricted band) | 1 MHz / 3 MHz for Peak, 1 MHz / 10Hz for Average |

| Receiver Parameter     | Setting                          |
|------------------------|----------------------------------|
| Attenuation            | Auto                             |
| Start ~ Stop Frequency | 9kHz~150kHz / RB 200Hz for QP    |
| Start ~ Stop Frequency | 150kHz~30MHz / RB 9kHz for QP    |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB 120kHz for QP |

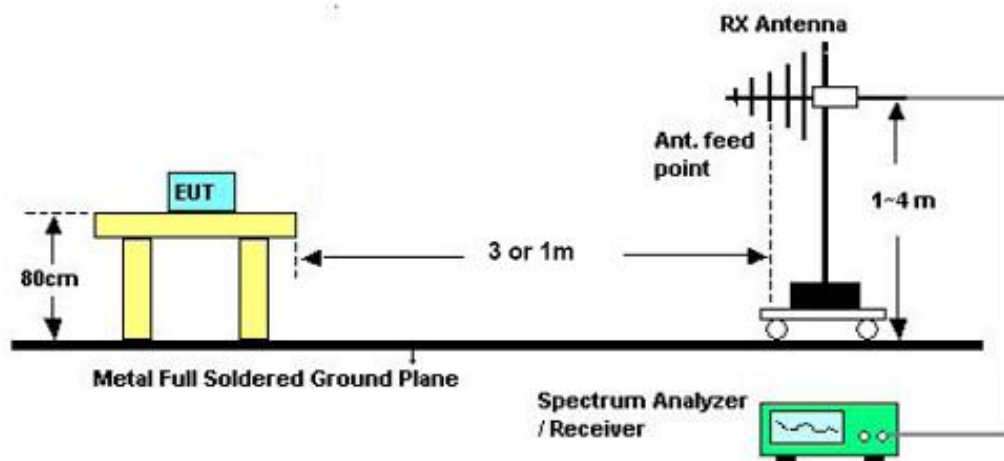


### 7.3 Typical Test Setup

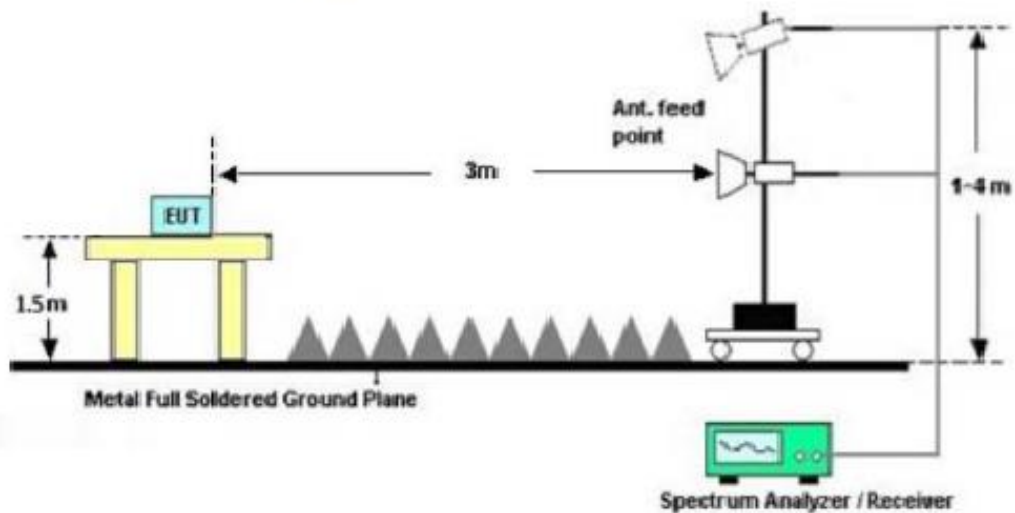
For radiated emissions below 30MHz



For radiated emissions above 30MHz



For radiated emissions above 1GHz



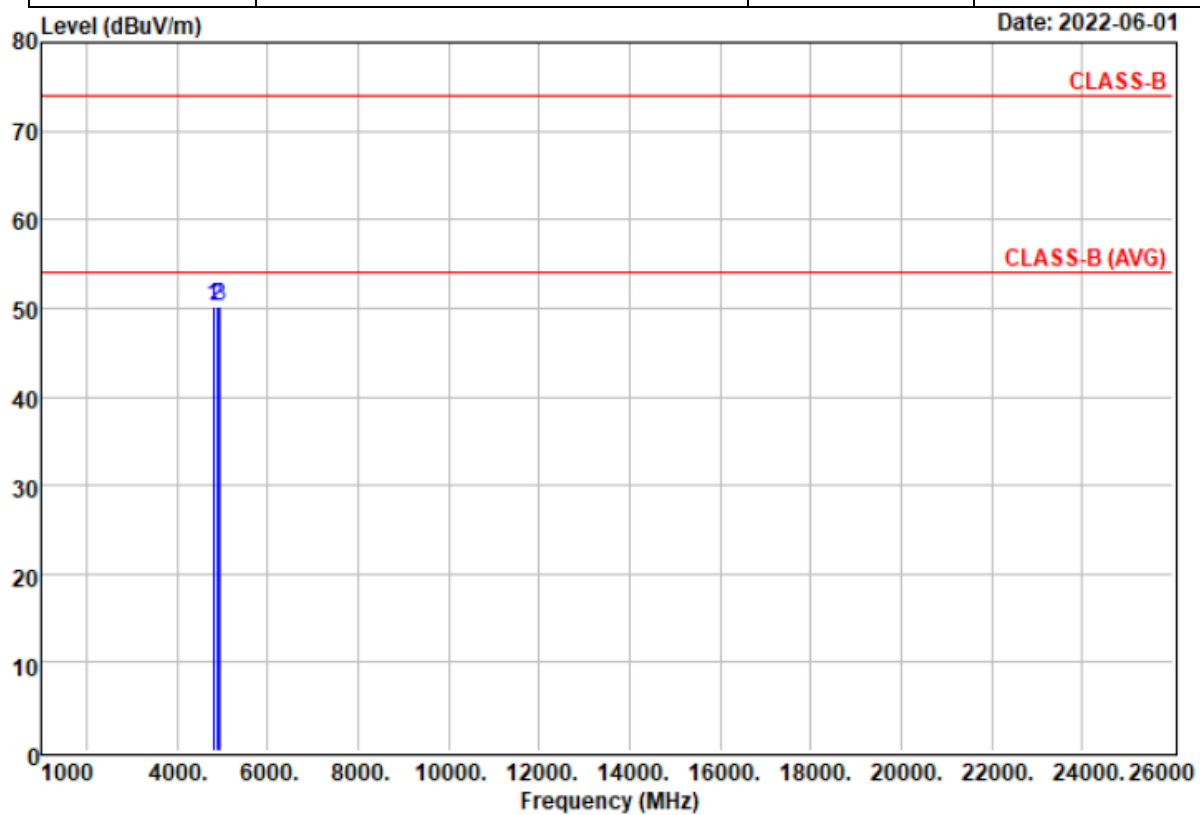


## 7.4 Test Result and Data (9kHz ~ 30MHz)

The 9kHz - 30MHz spurious emission is under limit 20dB more.

## 7.5 Test Result and Data (worst emissions found)

|             |                                                     |           |              |
|-------------|-----------------------------------------------------|-----------|--------------|
| Power       | : DC 12V                                            | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                                             | Humidity  | : 70 %       |
| Test Mode   | : GFSK: CH00: 2402MHz, CH39: 2441MHz, CH78: 2480MHz |           |              |

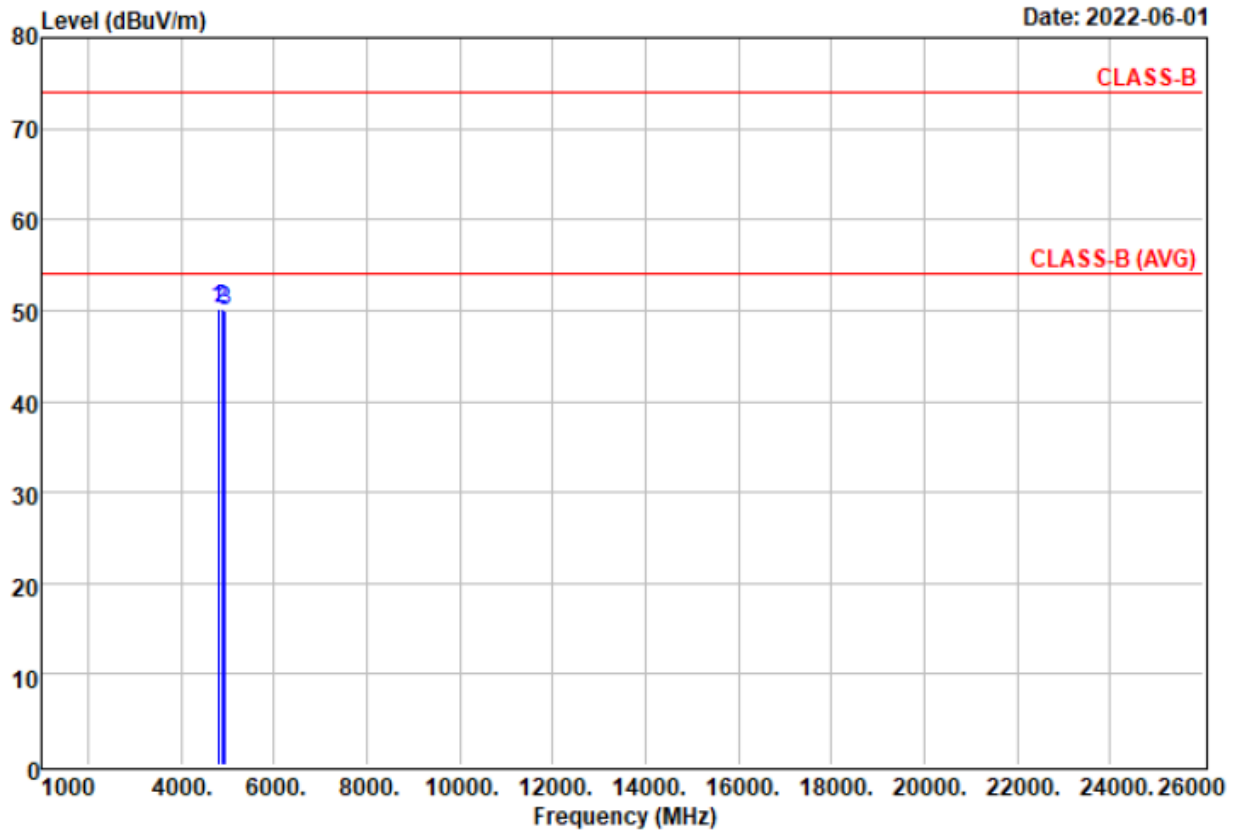


Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |          | Read  |        | Limit  | Over   |              |
|-----|----------|-------|--------|--------|--------|--------------|
|     | Freq     | Level | Factor | Level  | Line   | Limit Remark |
|     | MHz      | dBuV  | dB/m   | dBuV/m | dBuV/m | dB           |
| 1   | 4804.000 | 54.31 | -4.17  | 50.14  | 74.00  | -23.86 Peak  |
| 2 @ | 4882.000 | 54.20 | -3.99  | 50.21  | 74.00  | -23.79 Peak  |
| 3   | 4960.000 | 53.90 | -3.81  | 50.09  | 74.00  | -23.91 Peak  |



|             |                                                     |           |            |
|-------------|-----------------------------------------------------|-----------|------------|
| Power       | : DC 12V                                            | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                                             | Humidity  | : 70 %     |
| Test Mode   | : GFSK: CH00: 2402MHz, CH39: 2441MHz, CH78: 2480MHz |           |            |

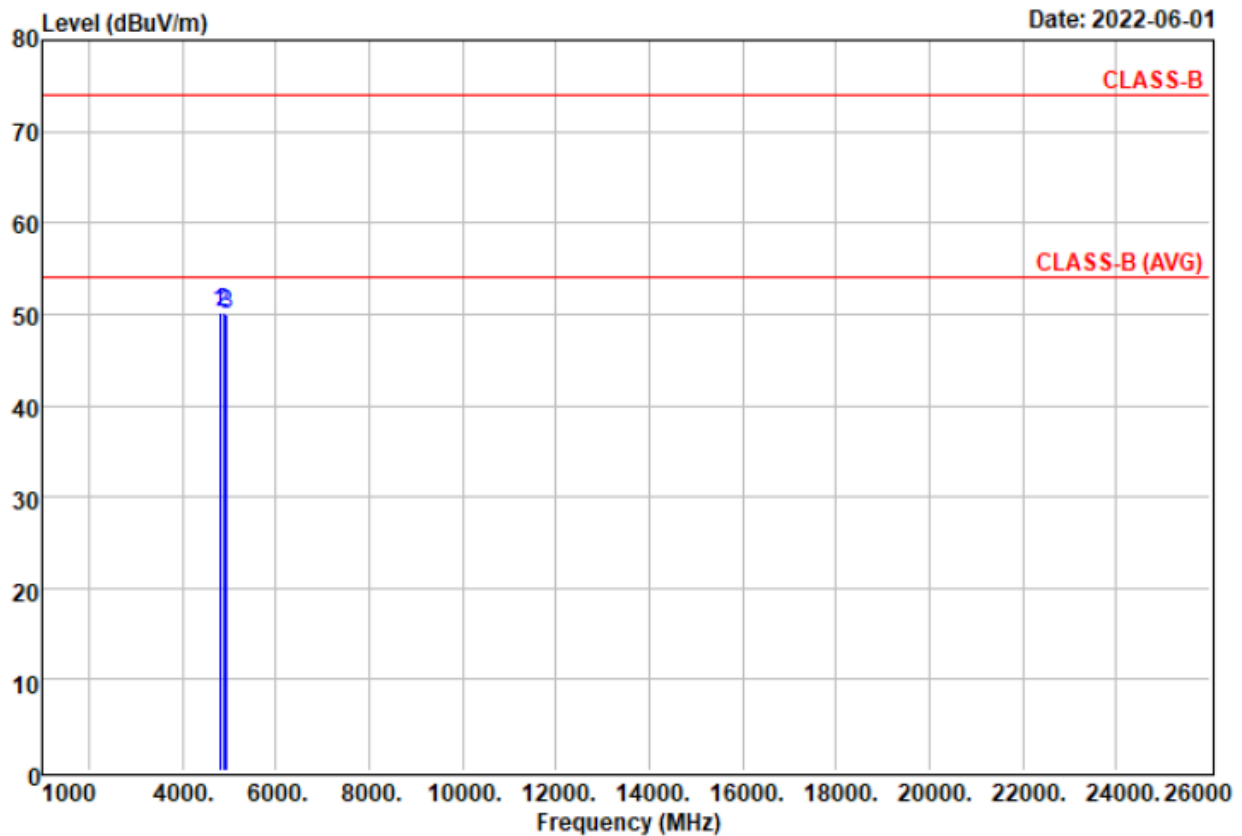


Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |          | Read  |        | Limit  | Over   |              |
|-----|----------|-------|--------|--------|--------|--------------|
|     | Freq     | Level | Factor | Level  | Line   | Limit Remark |
|     | MHz      | dBuV  | dB/m   | dBuV/m | dBuV/m | dB           |
| 1   | 4804.000 | 54.29 | -4.17  | 50.12  | 74.00  | -23.88 Peak  |
| 2 @ | 4882.000 | 54.17 | -3.99  | 50.18  | 74.00  | -23.82 Peak  |
| 3   | 4960.000 | 53.88 | -3.81  | 50.07  | 74.00  | -23.93 Peak  |



|             |                                                                  |           |              |
|-------------|------------------------------------------------------------------|-----------|--------------|
| Power       | : DC 12V                                                         | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                                                          | Humidity  | : 70 %       |
| Test Mode   | : $\pi/4$ -DQPSK: CH00: 2402MHz,<br>CH39: 2441MHz, CH78: 2480MHz |           |              |



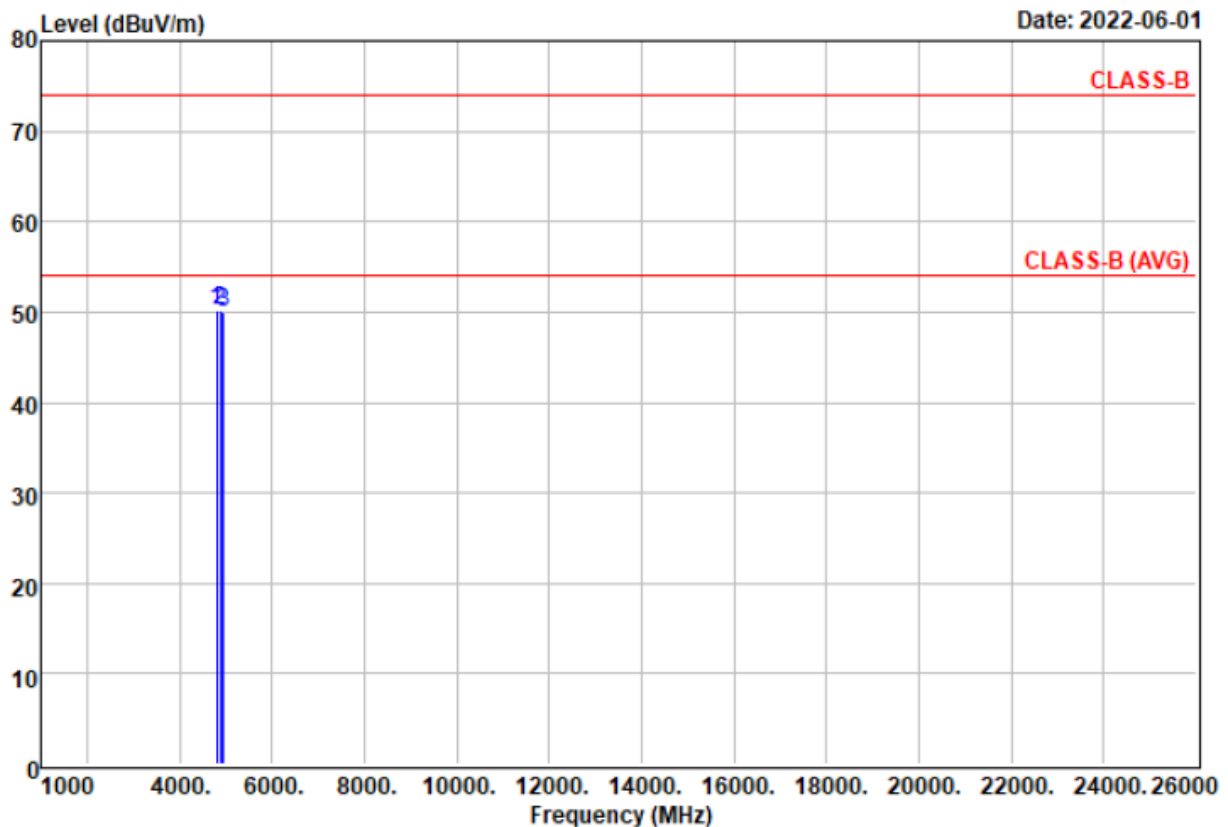
Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|      | Read     |        |        | Limit  | Over  |             |
|------|----------|--------|--------|--------|-------|-------------|
| Freq | Level    | Factor | Level  | Line   | Limit | Remark      |
| MHz  | dBuV     | dB/m   | dBuV/m | dBuV/m | dB    |             |
| 1    | 4804.000 | 54.28  | -4.17  | 50.11  | 74.00 | -23.89 Peak |
| 2 @  | 4882.000 | 54.18  | -3.99  | 50.19  | 74.00 | -23.81 Peak |
| 3    | 4960.000 | 53.87  | -3.81  | 50.06  | 74.00 | -23.94 Peak |





|             |                                                           |           |            |
|-------------|-----------------------------------------------------------|-----------|------------|
| Power       | : DC 12V                                                  | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                                                   | Humidity  | : 70 %     |
| Test Mode   | π/4-DQPSK: CH00: 2402MHz,<br>CH39: 2441MHz, CH78: 2480MHz |           |            |

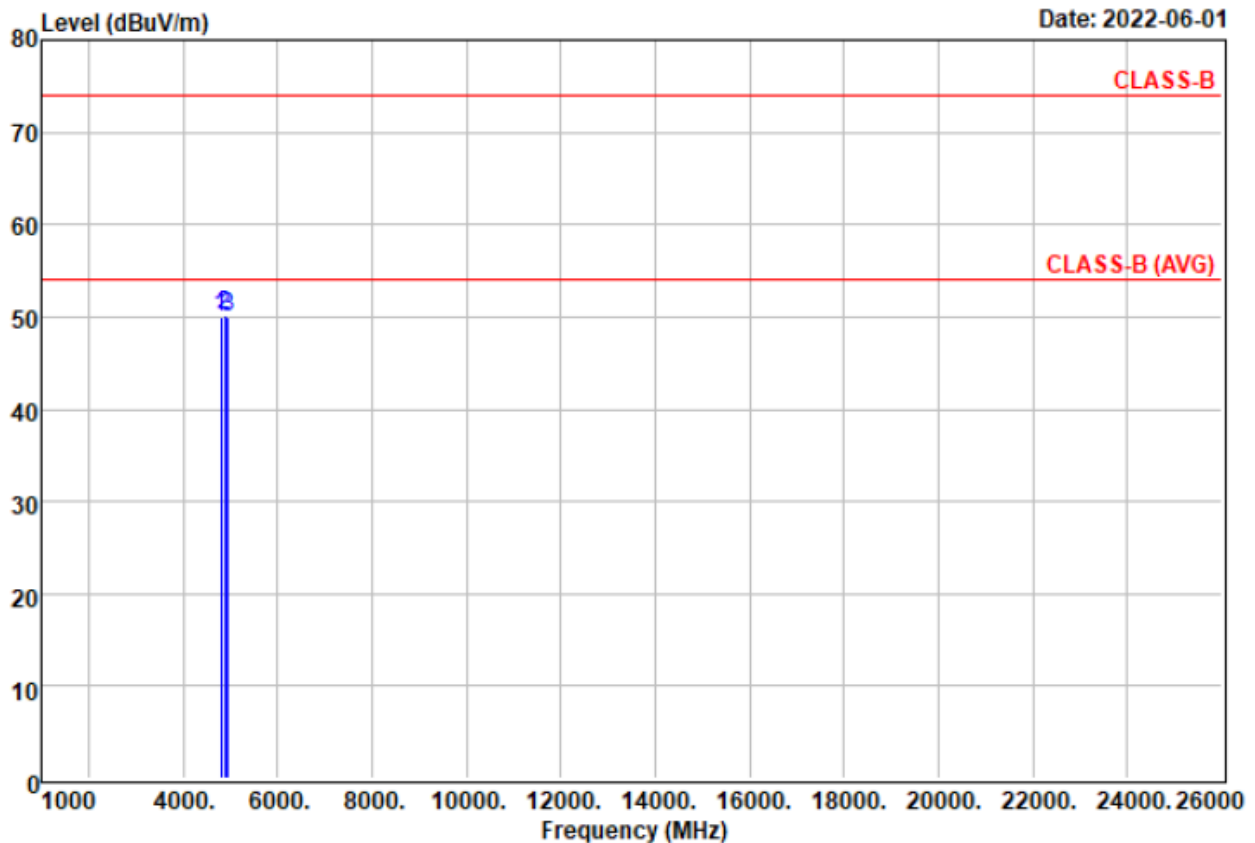


Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     | Freq     | Read Level | Factor | Level  | Limit Line | Over Limit | Remark |
|-----|----------|------------|--------|--------|------------|------------|--------|
|     | MHz      | dBuV       | dB/m   | dBuV/m | dBuV/m     | dB         |        |
| 1   | 4804.000 | 54.26      | -4.17  | 50.09  | 74.00      | -23.91     | Peak   |
| 2 @ | 4882.000 | 54.15      | -3.99  | 50.16  | 74.00      | -23.84     | Peak   |
| 3   | 4960.000 | 53.83      | -3.81  | 50.02  | 74.00      | -23.98     | Peak   |



|             |                                                         |           |              |
|-------------|---------------------------------------------------------|-----------|--------------|
| Power       | : DC 12V                                                | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                                                 | Humidity  | : 70 %       |
| Test Mode   | : 8DPSK: CH 00: 2402MHz, CH 39: 2441MHz, CH 78: 2480MHz |           |              |

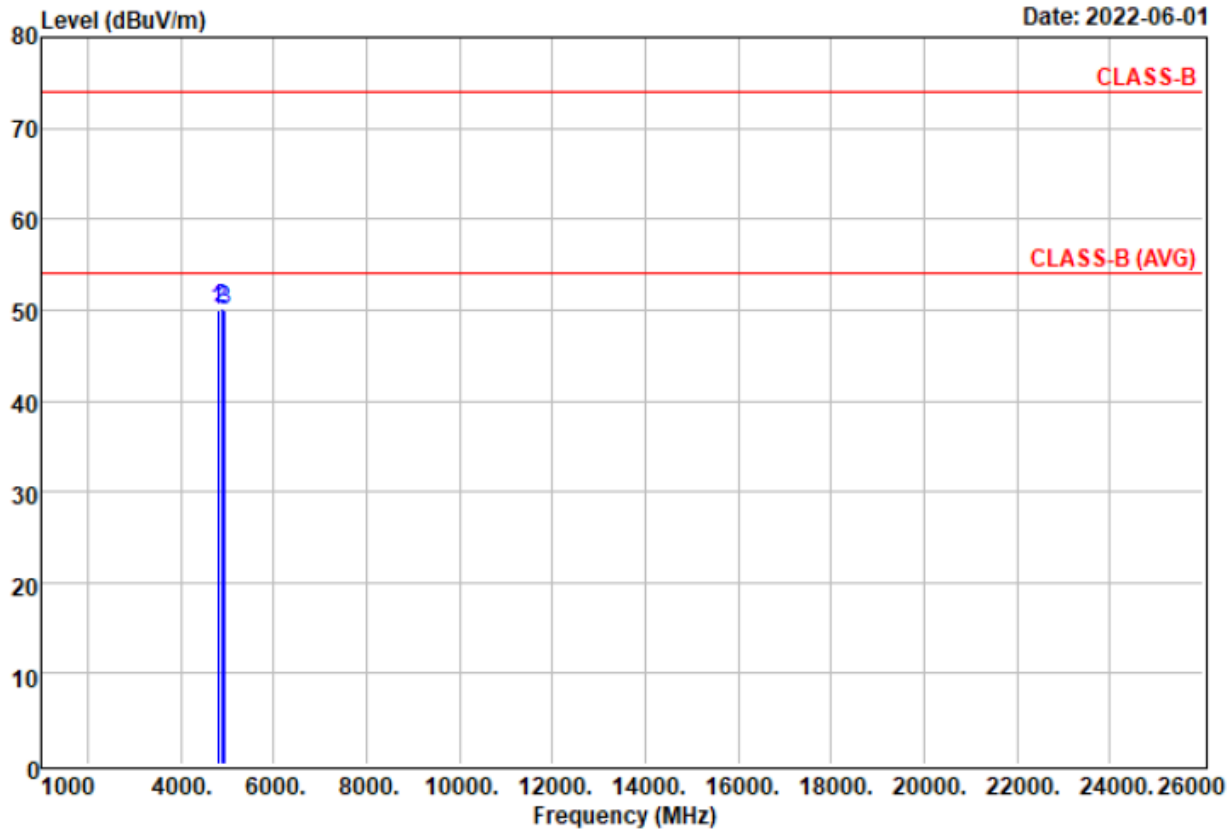


Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |          | Read  |        | Limit  | Over   |              |
|-----|----------|-------|--------|--------|--------|--------------|
|     | Freq     | Level | Factor | Level  | Line   | Limit Remark |
|     | MHz      | dBuV  | dB/m   | dBuV/m | dBuV/m | dB           |
| 1   | 4804.000 | 54.25 | -4.17  | 50.08  | 74.00  | -23.92 Peak  |
| 2 @ | 4882.000 | 54.14 | -3.99  | 50.15  | 74.00  | -23.85 Peak  |
| 3   | 4960.000 | 53.84 | -3.81  | 50.03  | 74.00  | -23.97 Peak  |



|             |                                                         |           |            |
|-------------|---------------------------------------------------------|-----------|------------|
| Power       | : DC 12V                                                | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                                                 | Humidity  | : 70 %     |
| Test Mode   | : 8DPSK: CH 00: 2402MHz, CH 39: 2441MHz, CH 78: 2480MHz |           |            |



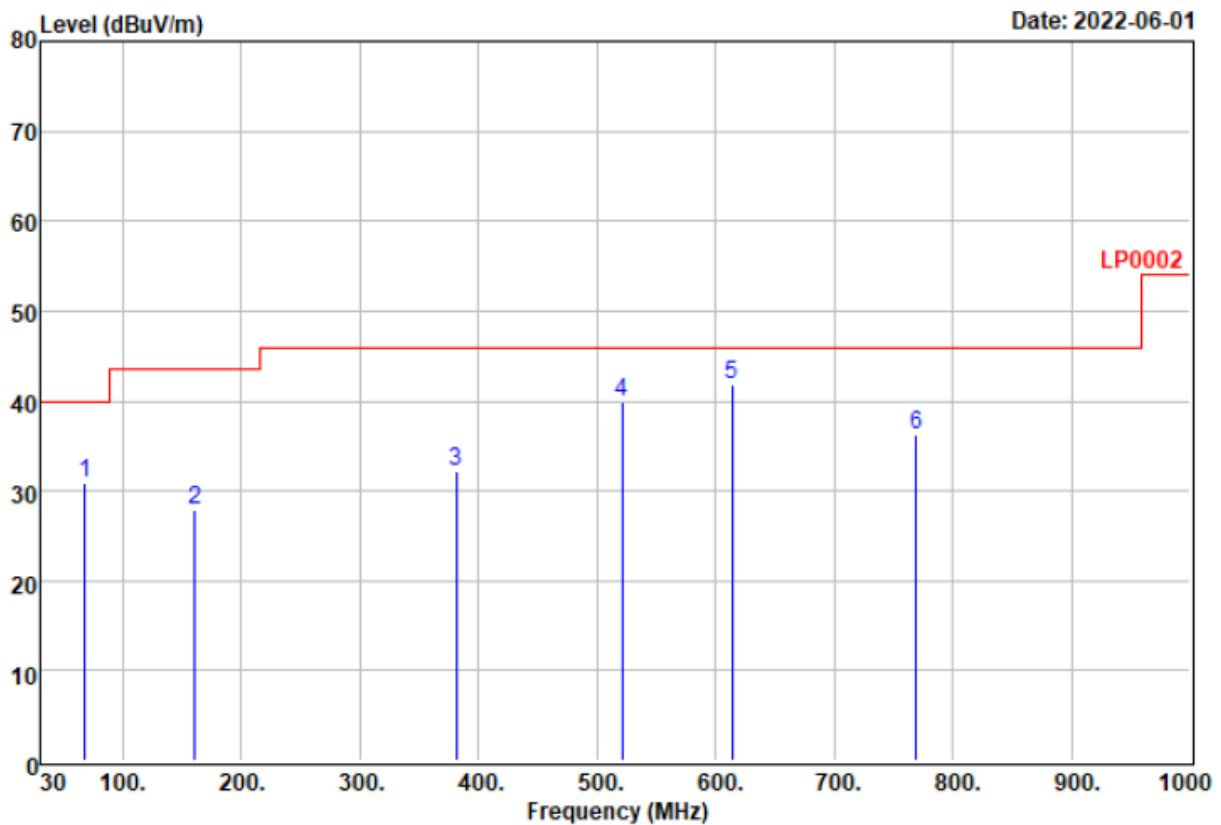
Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |          | Read  |        | Limit  | Over   |              |
|-----|----------|-------|--------|--------|--------|--------------|
|     | Freq     | Level | Factor | Level  | Line   | Limit Remark |
|     | MHz      | dBuV  | dB/m   | dBuV/m | dBuV/m | dB           |
| 1   | 4804.000 | 54.22 | -4.17  | 50.05  | 74.00  | -23.95 Peak  |
| 2 @ | 4882.000 | 54.10 | -3.99  | 50.11  | 74.00  | -23.89 Peak  |
| 3   | 4960.000 | 53.81 | -3.81  | 50.00  | 74.00  | -24.00 Peak  |



## 7.6 Test Result and Data (below 1GHz)

|             |                          |           |              |
|-------------|--------------------------|-----------|--------------|
| Power       | : DC 12V                 | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                  | Humidity  | : 70 %       |
| Test Mode   | : GFSK: CH00, CH39, CH78 |           |              |

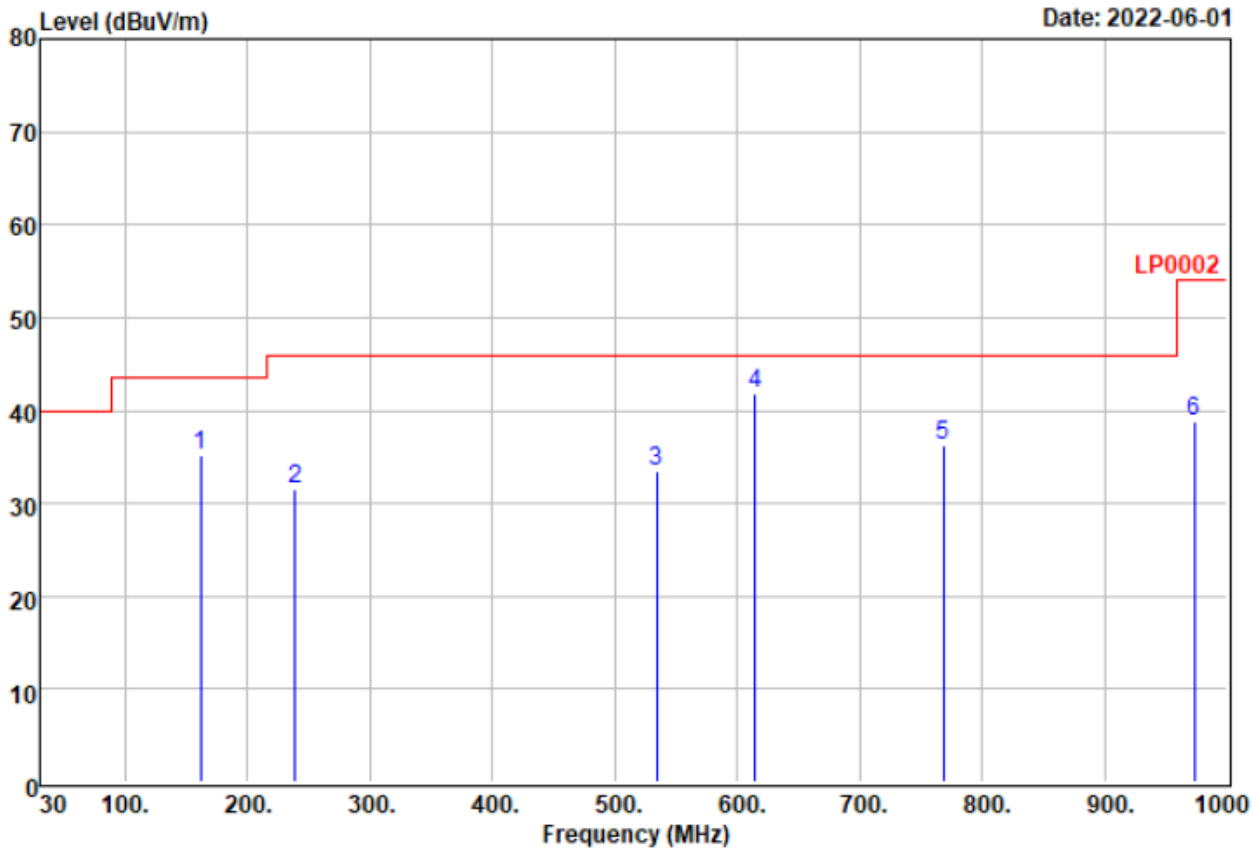


Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |         | Read  |        |        | Limit  | Over   |        |
|-----|---------|-------|--------|--------|--------|--------|--------|
|     | Freq    | Level | Factor | Level  | Line   | Limit  | Remark |
|     | MHz     | dBuV  | dB/m   | dBuV/m | dBuV/m | dB     |        |
| 1   | 67.710  | 52.34 | -21.51 | 30.83  | 40.00  | -9.17  | QP     |
| 2   | 160.440 | 45.41 | -17.46 | 27.95  | 43.50  | -15.55 | QP     |
| 3   | 381.410 | 43.50 | -11.36 | 32.14  | 46.00  | -13.86 | QP     |
| 4   | 521.350 | 48.80 | -9.01  | 39.79  | 46.00  | -6.21  | QP     |
| 5 @ | 614.120 | 50.35 | -8.44  | 41.91  | 46.00  | -4.09  | QP     |
| 6   | 768.990 | 41.78 | -5.61  | 36.17  | 46.00  | -9.83  | QP     |



|             |                          |           |            |
|-------------|--------------------------|-----------|------------|
| Power       | : DC 12V                 | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                  | Humidity  | : 70 %     |
| Test Mode   | : GFSK: CH00, CH39, CH78 |           |            |

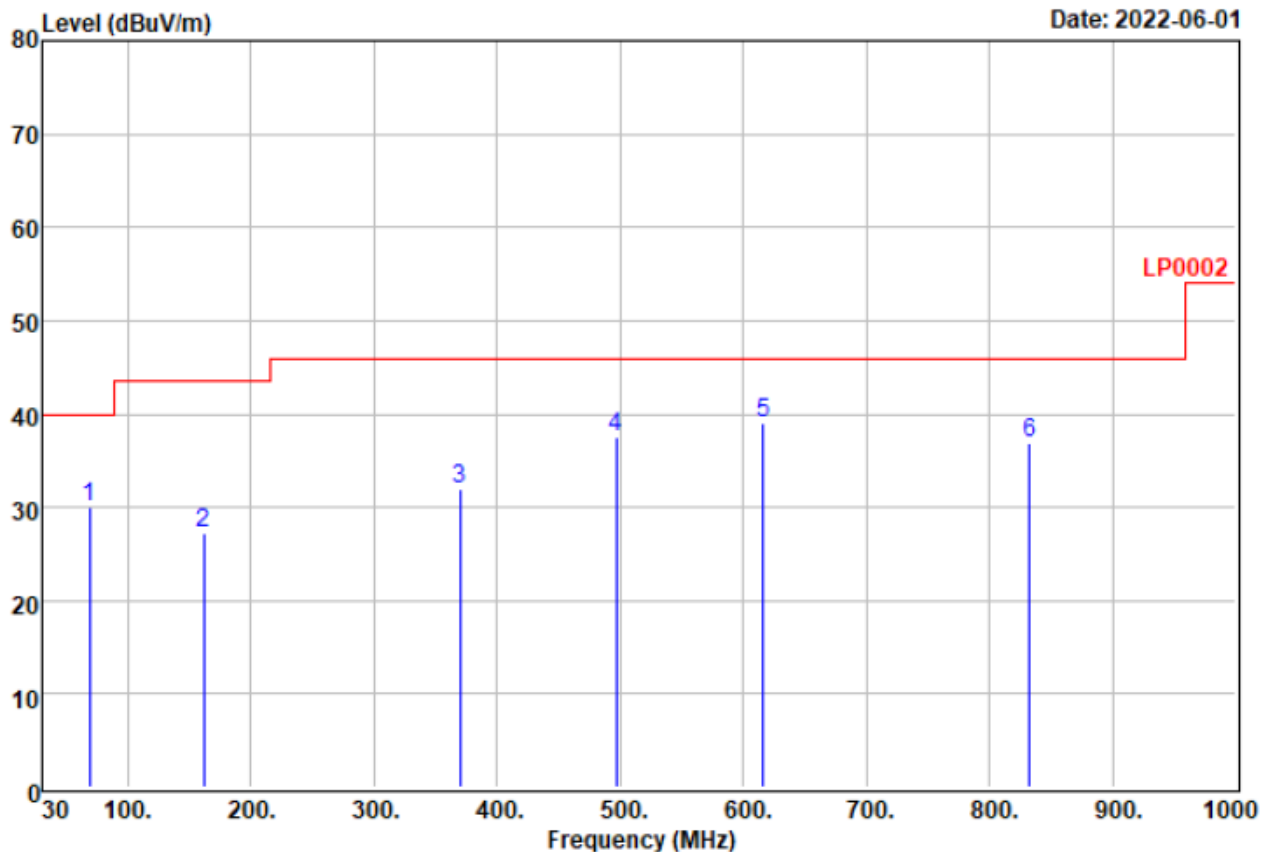


Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |         | Read  |        |        | Limit  | Over   |        |
|-----|---------|-------|--------|--------|--------|--------|--------|
|     | Freq    | Level | Factor | Level  | Line   | Limit  | Remark |
|     | MHz     | dBuV  | dB/m   | dBuV/m | dBuV/m | dB     |        |
| 1   | 161.800 | 52.71 | -17.57 | 35.14  | 43.50  | -8.36  | QP     |
| 2   | 238.740 | 47.95 | -16.40 | 31.55  | 46.00  | -14.45 | QP     |
| 3   | 534.380 | 42.12 | -8.72  | 33.40  | 46.00  | -12.60 | QP     |
| 4 @ | 614.330 | 50.34 | -8.43  | 41.91  | 46.00  | -4.09  | QP     |
| 5   | 768.190 | 41.80 | -5.63  | 36.17  | 46.00  | -9.83  | QP     |
| 6   | 973.220 | 40.58 | -1.77  | 38.81  | 54.00  | -15.19 | QP     |



|             |                                    |           |              |
|-------------|------------------------------------|-----------|--------------|
| Power       | : DC 12V                           | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                            | Humidity  | : 70 %       |
| Test Mode   | : $\pi/4$ -DQPSK: CH00, CH39, CH78 |           |              |



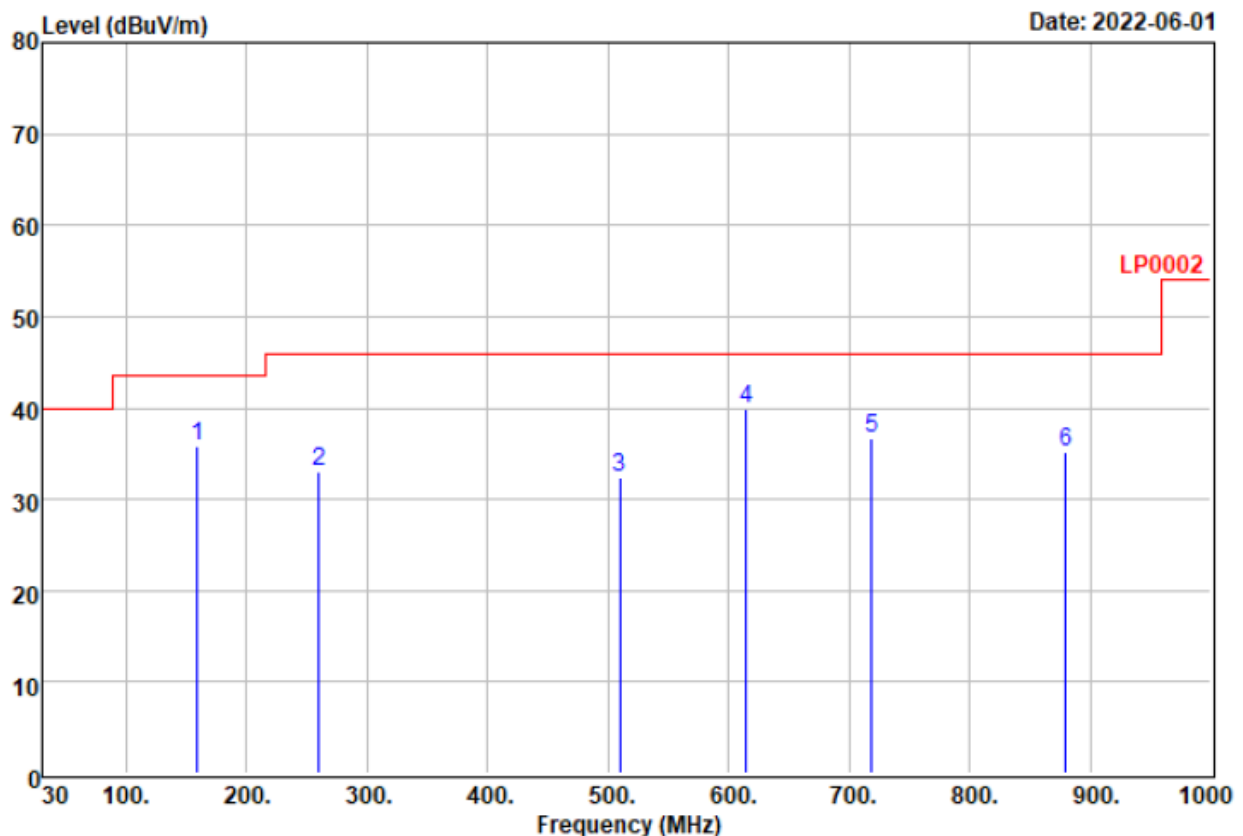
Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |         | Read  |        |        | Limit  | Over   |        |
|-----|---------|-------|--------|--------|--------|--------|--------|
|     | Freq    | Level | Factor | Level  | Line   | Limit  | Remark |
|     | MHz     | dBuV  | dB/m   | dBuV/m | dBuV/m | dB     |        |
| 1   | 68.290  | 51.76 | -21.73 | 30.03  | 40.00  | -9.97  | QP     |
| 2   | 161.560 | 44.85 | -17.56 | 27.29  | 43.50  | -16.21 | QP     |
| 3   | 369.590 | 43.97 | -12.07 | 31.90  | 46.00  | -14.10 | QP     |
| 4   | 496.650 | 46.62 | -9.11  | 37.51  | 46.00  | -8.49  | QP     |
| 5 @ | 616.080 | 47.45 | -8.39  | 39.06  | 46.00  | -6.94  | QP     |
| 6   | 833.010 | 40.80 | -3.88  | 36.92  | 46.00  | -9.08  | QP     |





|             |                                   |           |            |
|-------------|-----------------------------------|-----------|------------|
| Power       | : DC 12V                          | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                           | Humidity  | : 70 %     |
| Test Mode   | : $\pi/4$ -DQPSK:CH00, CH39, CH78 |           |            |

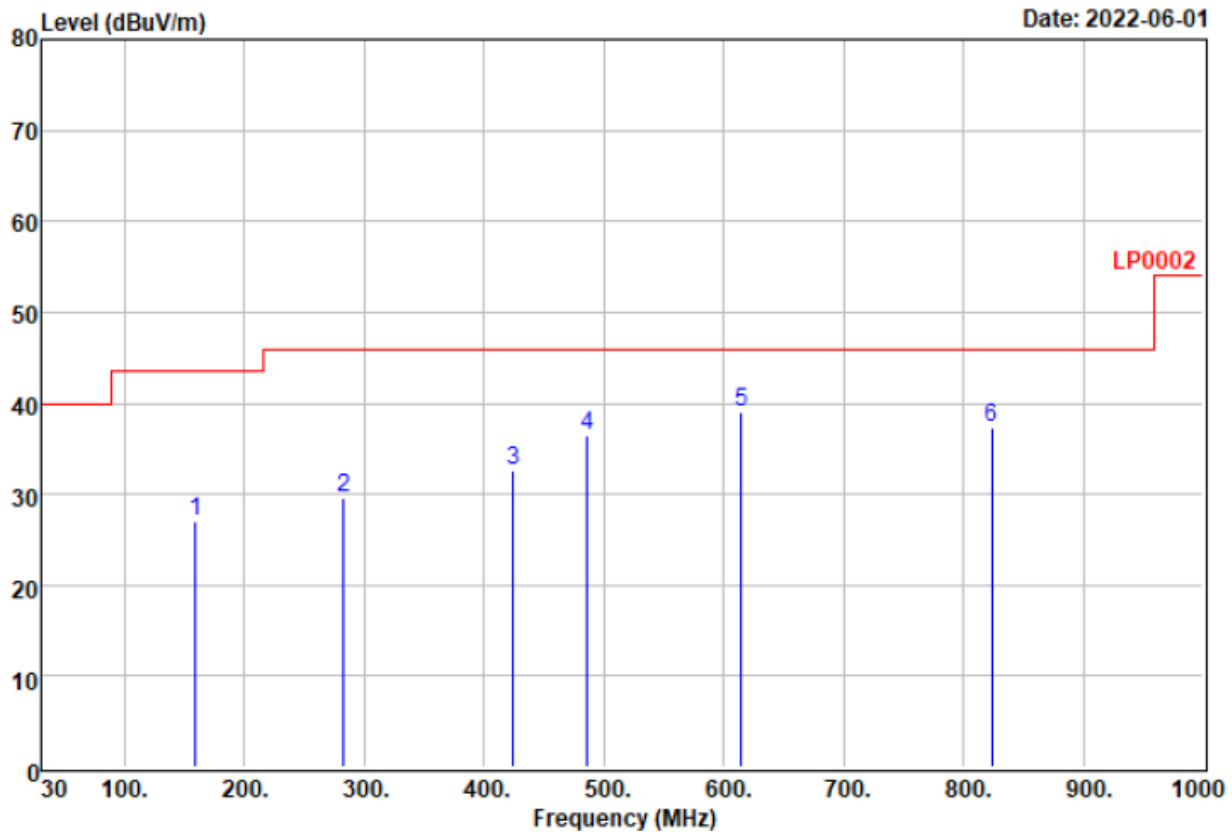


Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     |         | Read  |        |        | Limit  | Over   |        |
|-----|---------|-------|--------|--------|--------|--------|--------|
|     | Freq    | Level | Factor | Level  | Line   | Limit  | Remark |
|     | MHz     | dBuV  | dB/m   | dBuV/m | dBuV/m | dB     |        |
| 1   | 159.200 | 53.02 | -17.19 | 35.83  | 43.50  | -7.67  | QP     |
| 2   | 260.260 | 47.95 | -14.90 | 33.05  | 46.00  | -12.95 | QP     |
| 3   | 509.620 | 41.57 | -9.16  | 32.41  | 46.00  | -13.59 | QP     |
| 4 @ | 614.670 | 48.41 | -8.42  | 39.99  | 46.00  | -6.01  | QP     |
| 5   | 718.810 | 43.07 | -6.30  | 36.77  | 46.00  | -9.23  | QP     |
| 6   | 879.870 | 38.96 | -3.71  | 35.25  | 46.00  | -10.75 | QP     |



|             |                           |           |              |
|-------------|---------------------------|-----------|--------------|
| Power       | : DC 12V                  | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                   | Humidity  | : 70 %       |
| Test Mode   | : 8DPSK: CH00, CH39, CH78 |           |              |



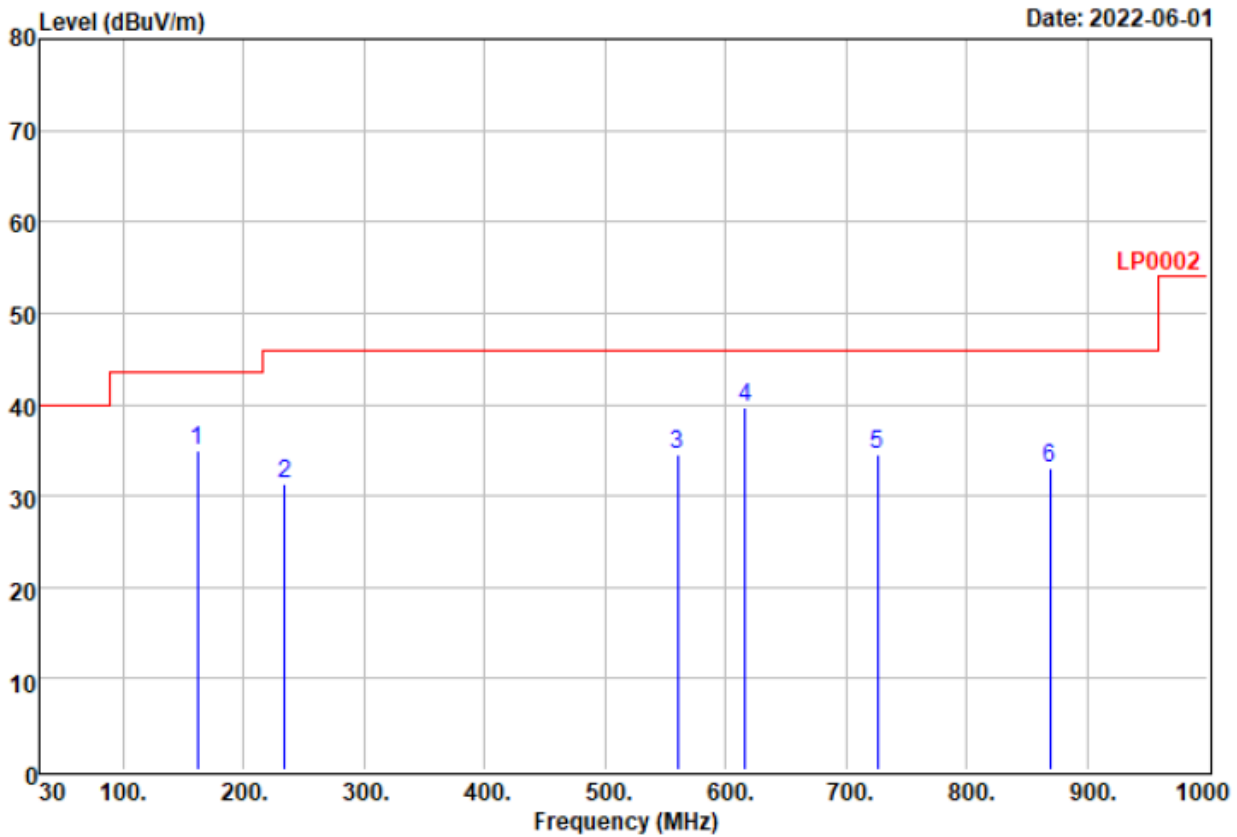
Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     | Freq    | Read Level | Factor | Level  | Limit Line | Over Limit | Remark |
|-----|---------|------------|--------|--------|------------|------------|--------|
|     | MHz     | dBuV       | dB/m   | dBuV/m | dBuV/m     | dB         |        |
| 1   | 159.040 | 44.15      | -17.14 | 27.01  | 43.50      | -16.49     | QP     |
| 2   | 282.300 | 43.81      | -14.12 | 29.69  | 46.00      | -16.31     | QP     |
| 3   | 424.120 | 43.07      | -10.56 | 32.51  | 46.00      | -13.49     | QP     |
| 4   | 486.000 | 45.91      | -9.43  | 36.48  | 46.00      | -9.52      | QP     |
| 5 @ | 614.880 | 47.34      | -8.41  | 38.93  | 46.00      | -7.07      | QP     |
| 6   | 823.860 | 41.46      | -4.15  | 37.31  | 46.00      | -8.69      | QP     |





|             |                           |           |            |
|-------------|---------------------------|-----------|------------|
| Power       | : DC 12V                  | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                   | Humidity  | : 70 %     |
| Test Mode   | : 8DPSK: CH00, CH39, CH78 |           |            |



Remarks : 1.Result=Read Value+Factor  
: 2.Factor=Antenna Factor-Cable loss-  
: Amplifier Factor

|     | Freq    | Read Level | Factor | Level  | Limit Line | Over Limit | Remark |
|-----|---------|------------|--------|--------|------------|------------|--------|
|     | MHz     | dBuV       | dB/m   | dBuV/m | dBuV/m     | dB         |        |
| 1   | 161.140 | 52.47      | -17.52 | 34.95  | 43.50      | -8.55      | QP     |
| 2   | 233.950 | 48.10      | -16.72 | 31.38  | 46.00      | -14.62     | QP     |
| 3   | 560.240 | 43.48      | -8.85  | 34.63  | 46.00      | -11.37     | QP     |
| 4 @ | 616.000 | 48.09      | -8.39  | 39.70  | 46.00      | -6.30      | QP     |
| 5   | 726.040 | 40.65      | -6.07  | 34.58  | 46.00      | -11.42     | QP     |
| 6   | 869.530 | 36.69      | -3.74  | 32.95  | 46.00      | -13.05     | QP     |



## 8. 20dB Bandwidth Measurement Data

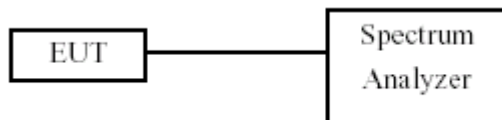
### 8.1 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400 ~ 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 8.2 Test Procedures

- The transmitter output was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 30 kHz and VBW to 100 kHz.
- The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

### 8.3 Test Setup Layout



### 8.4 Test Result and Data

Test Date: 2022.05.26

Temperature: 27°C

Atmospheric pressure: 1012 hPa

Humidity: 55%

| Modulation Standard    | Channel | Frequency (MHz) | 20dB Bandwidth (kHz) |
|------------------------|---------|-----------------|----------------------|
| GFSK (1Mbps)           | 00      | 2402            | 1125                 |
|                        | 39      | 2441            | 1125                 |
|                        | 78      | 2480            | 1135                 |
| $\pi/4$ -DQPSK (2Mbps) | 00      | 2402            | 1120                 |
|                        | 39      | 2441            | 1130                 |
|                        | 78      | 2480            | 1135                 |
| 8DPSK (3Mbps)          | 00      | 2402            | 1120                 |
|                        | 39      | 2441            | 1135                 |
|                        | 78      | 2480            | 1135                 |



GFSK (1Mbps) Channel: 00

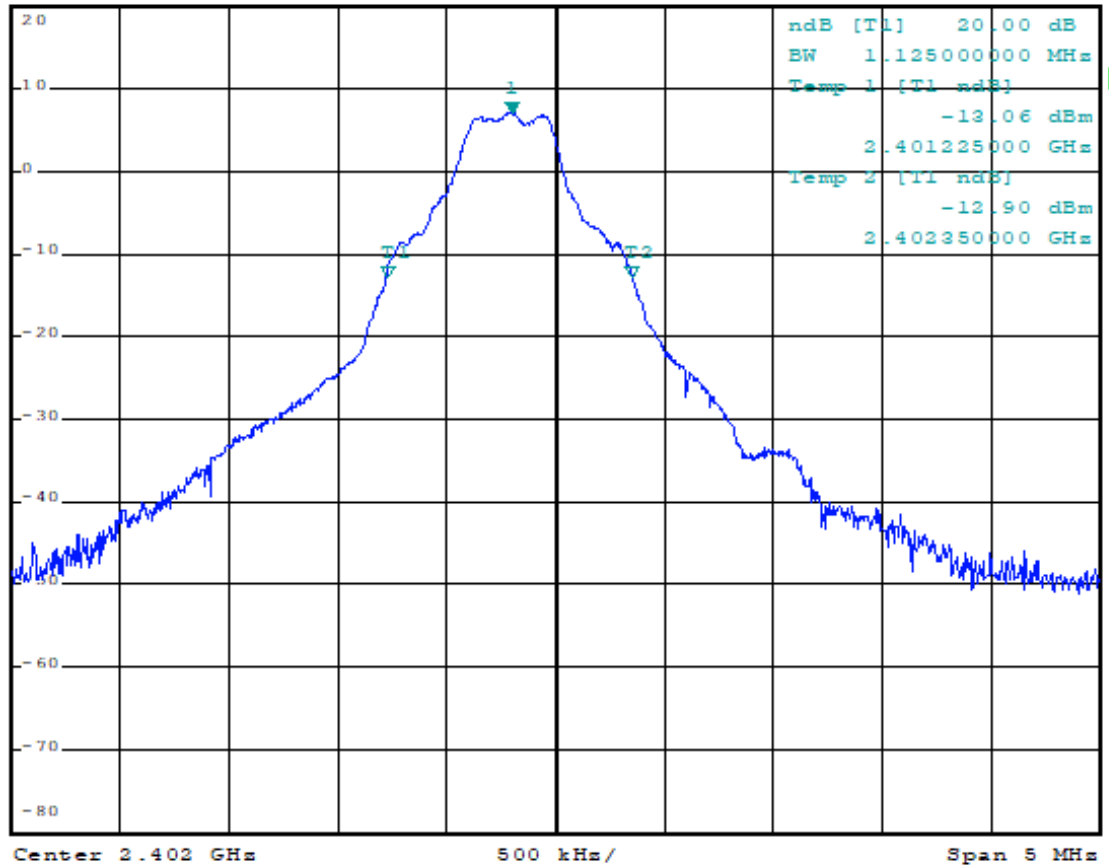


\*RBW 100 kHz Marker 1 [T1]  
VBW 300 kHz 6.98 dBm  
SWT 5 ms 2.401795000 GHz

Ref 20 dBm

\*Att 30 dB

1 PK  
VIEW



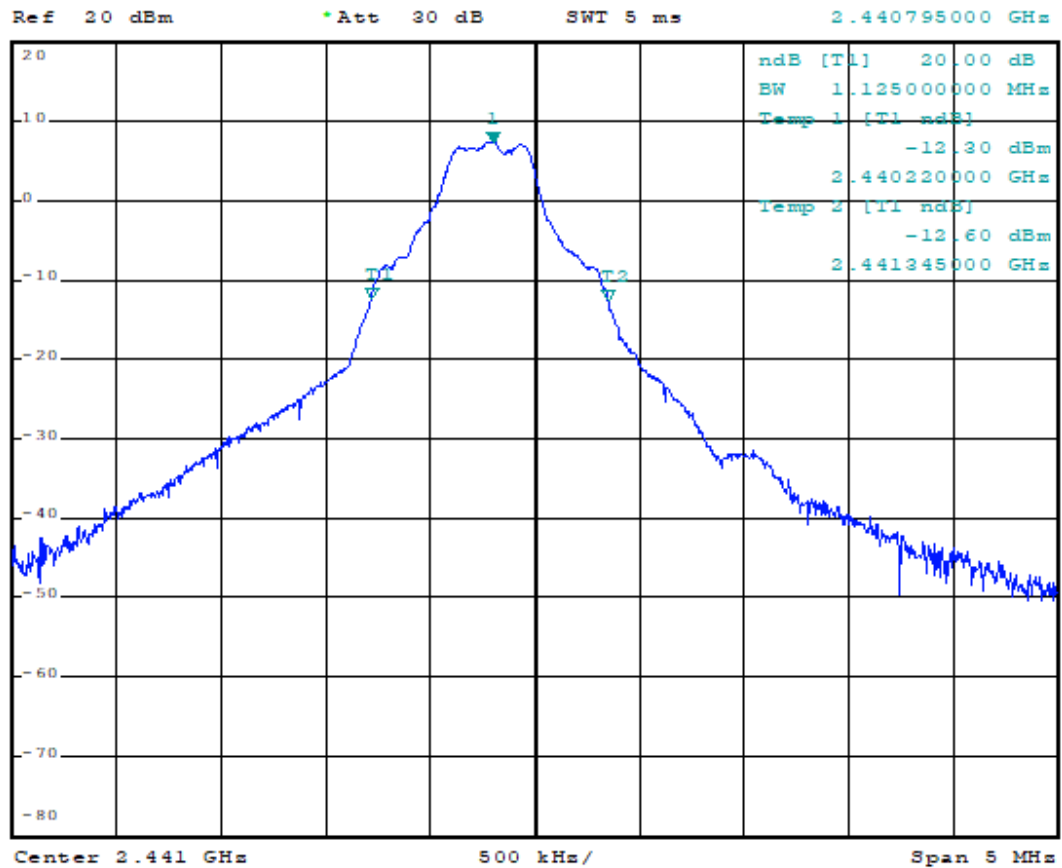
Date: 26.MAY.2022 15:14:11



GFSK (1Mbps) Channel: 39



\*RBW 100 kHz Marker 1 [T1]  
VBW 300 kHz 7.32 dBm  
SWT 5 ms 2.440795000 GHz



Date: 26.MAY.2022 15:16:34



GFSK (1Mbps) Channel: 78



\*RBW 100 kHz Marker 1 [T1]  
VBW 300 kHz 6.74 dBm  
SWT 5 ms 2.479790000 GHz

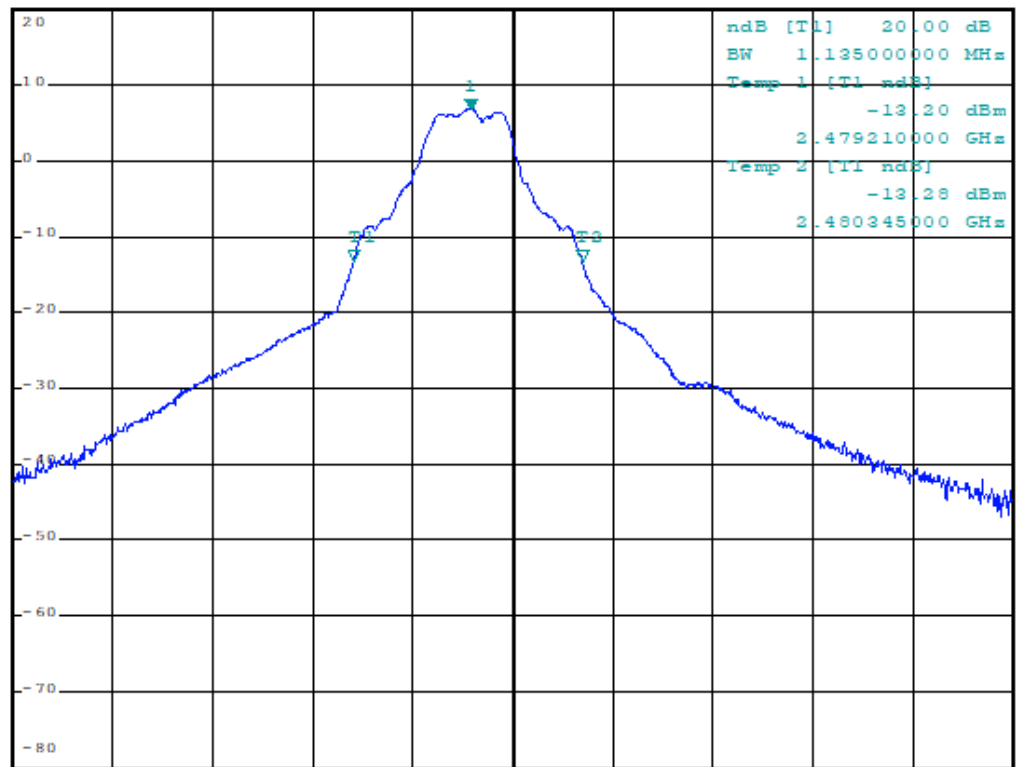
Ref 20 dBm

\*Att 30 dB

SWT 5 ms

2.479790000 GHz

1 PK  
VIEW



Center 2.48 GHz

500 kHz/

Span 5 MHz

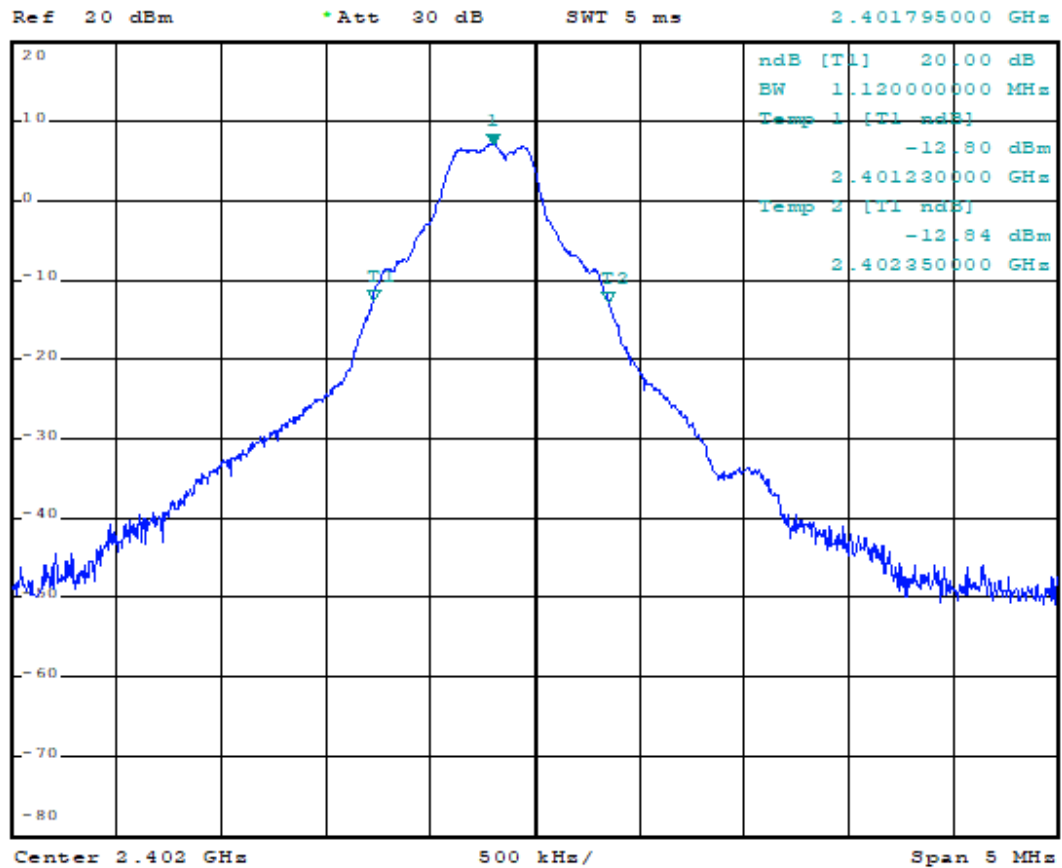
Date: 26.MAY.2022 15:17:57



$\pi/4$ -DQPSK (2Mbps) Channel: 00



\*RBW 100 kHz Marker 1 [T1]  
VBW 300 kHz 7.03 dBm  
SWT 5 ms 2.401795000 GHz



Date: 26.MAY.2022 15:22:34



$\pi/4$ -DQPSK (2Mbps) Channel: 39



\*RBW 100 kHz Marker 1 [T1]  
VBW 300 kHz 7.31 dBm  
SWT 5 ms 2.440790000 GHz

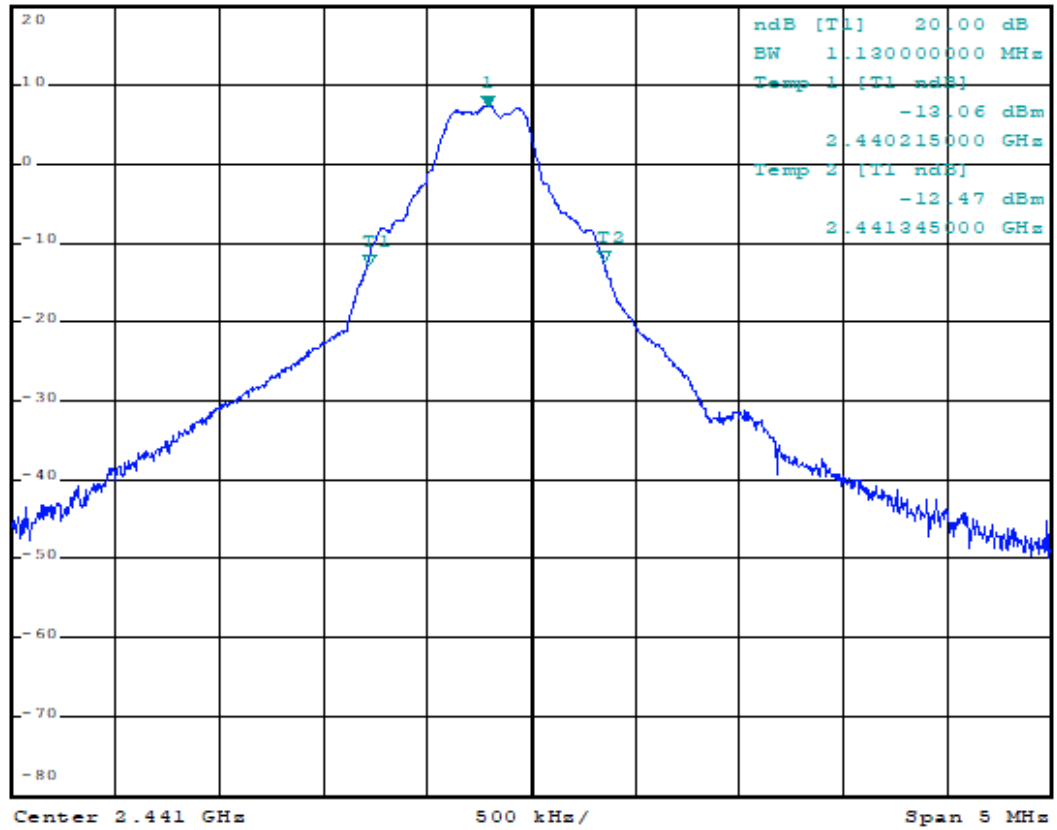
Ref 20 dBm

\*Att 30 dB

SWT 5 ms

2.440790000 GHz

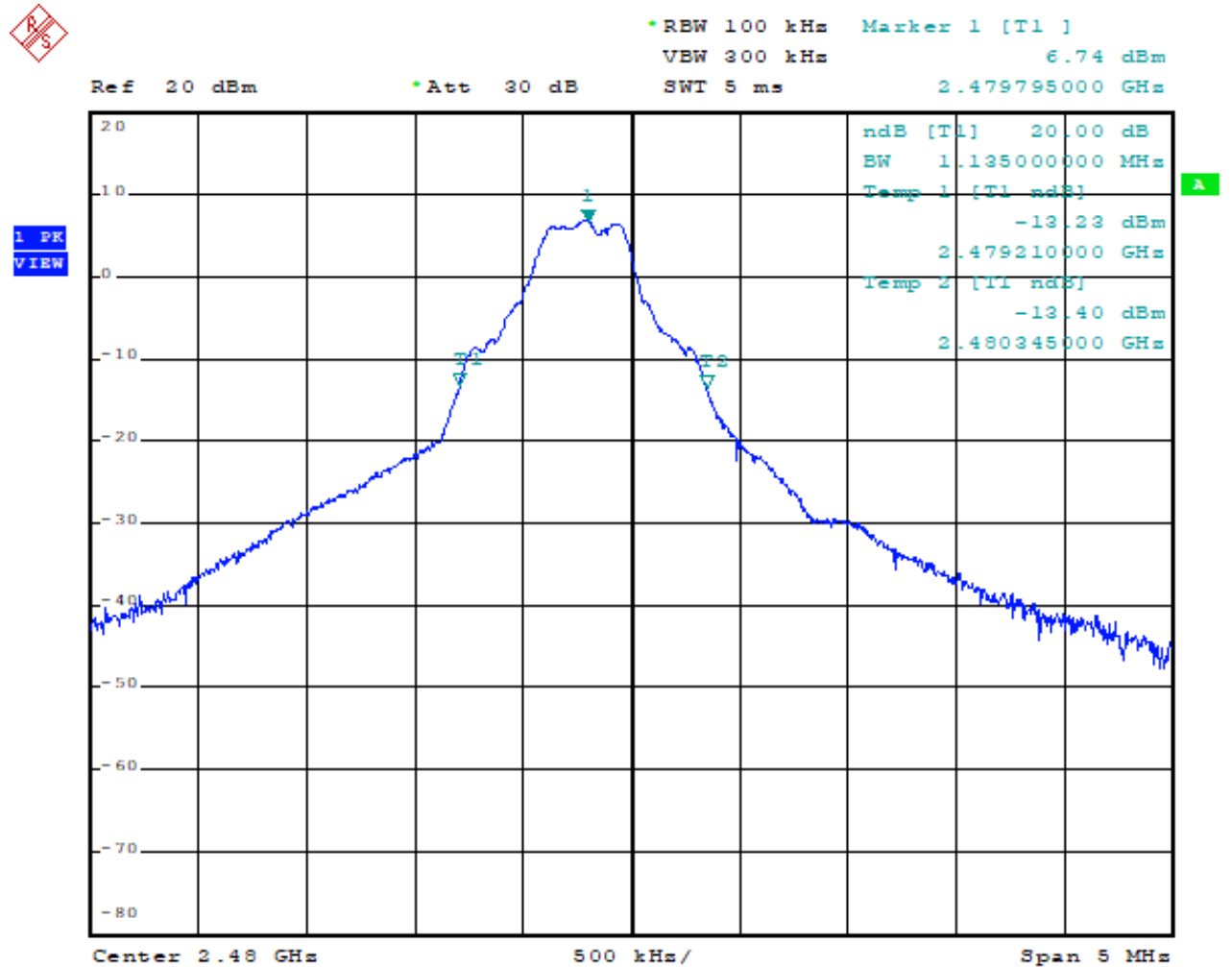
1 PK  
VIEW



Date: 26.MAY.2022 15:24:09



$\pi/4$ -DQPSK (2Mbps) Channel: 78



Date: 26.MAY.2022 15:25:14





8DPSK (3Mbps) Channel: 00



\*RBW 100 kHz Marker 1 [T1]  
VBW 300 kHz 7.07 dBm  
SWT 5 ms 2.401625000 GHz

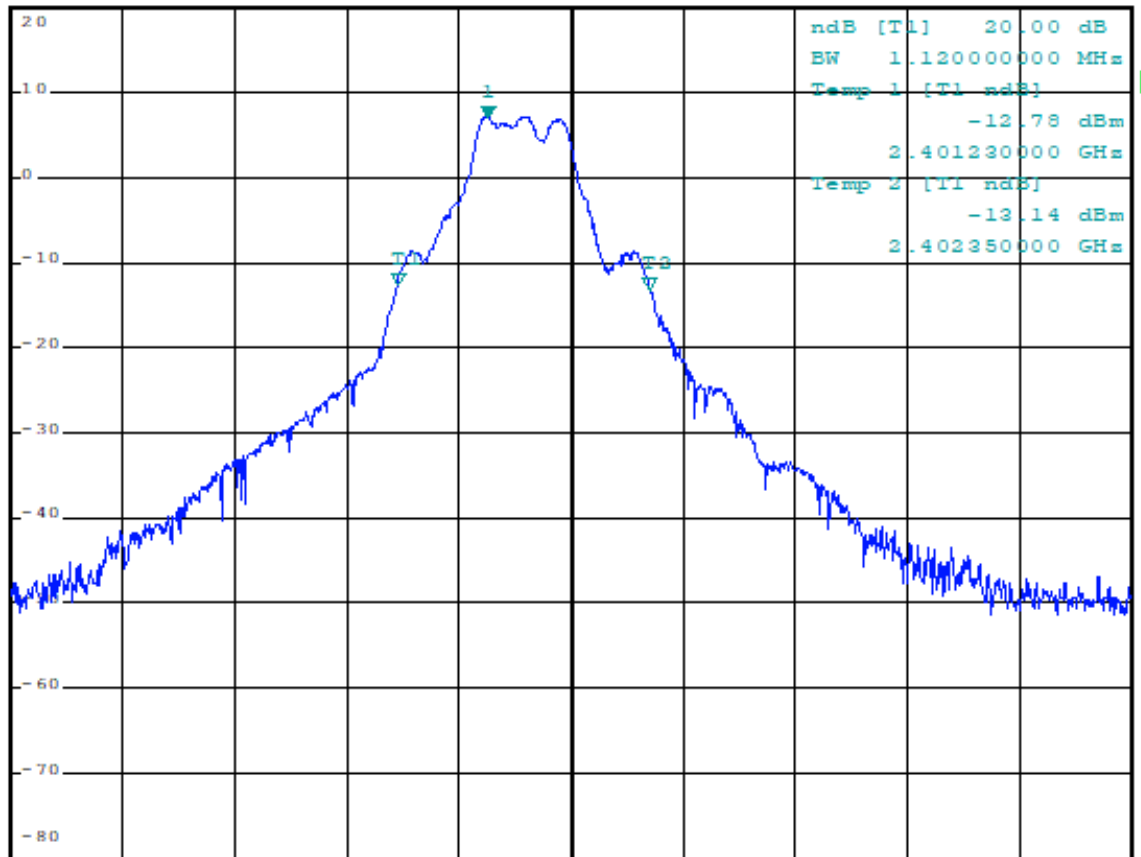
Ref 20 dBm

\*Att 30 dB

SWT 5 ms

2.401625000 GHz

1 PK  
VIEW



Center 2.402 GHz

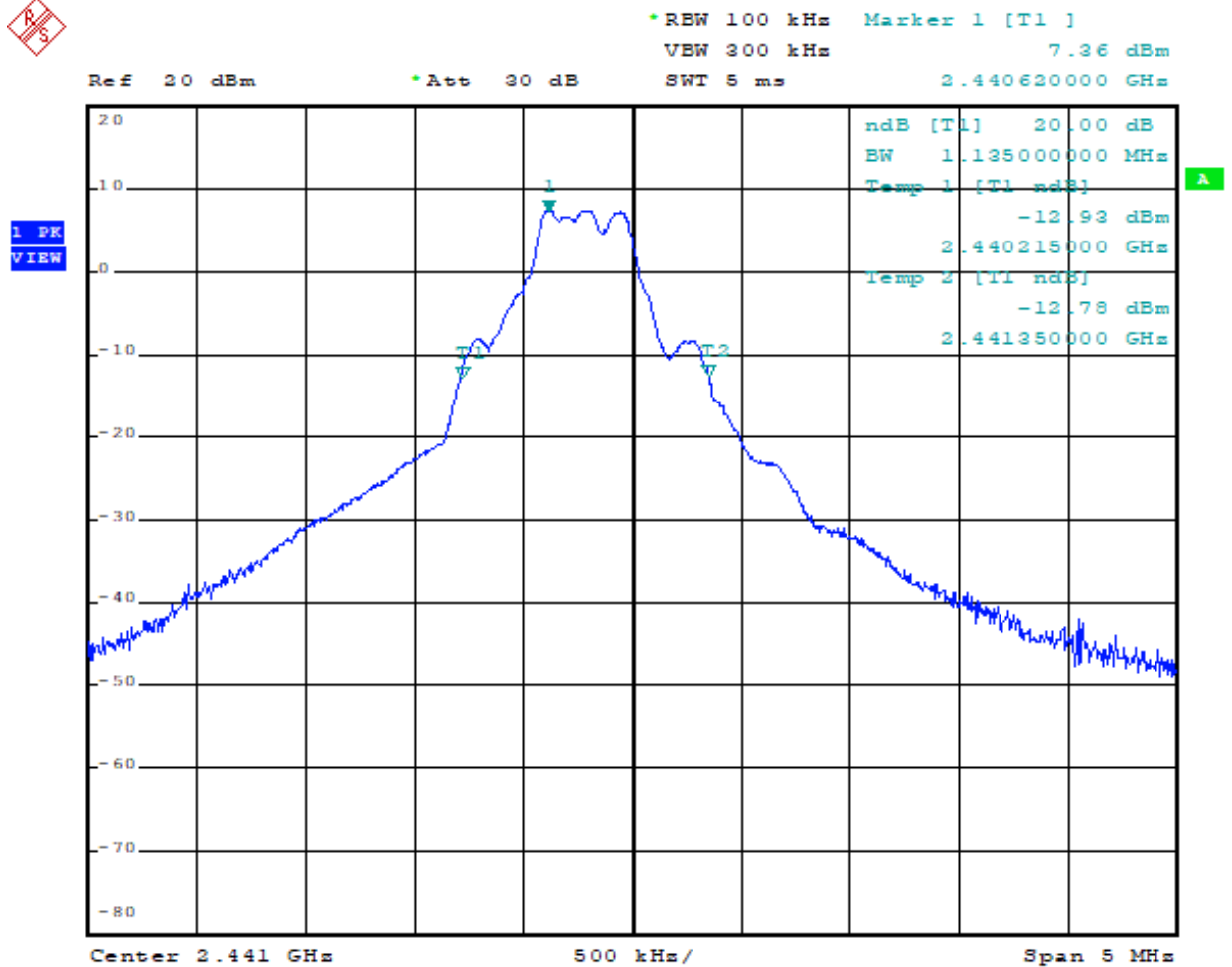
500 kHz/

Span 5 MHz

Date: 26.MAY.2022 15:28:08



8DPSK (3Mbps) Channel: 39



Date: 26.MAY.2022 15:30:18



8DPSK (3Mbps) Channel: 78

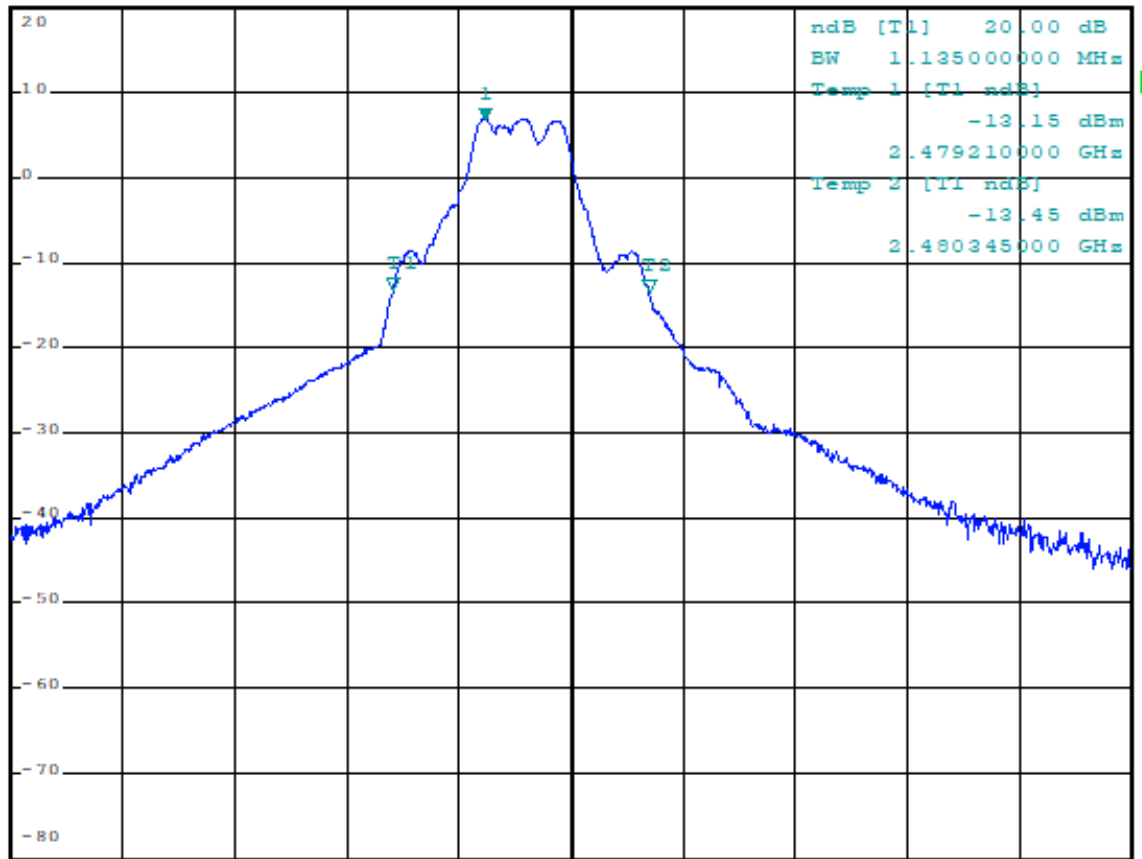


\*RBW 100 kHz Marker 1 [T1]  
VBW 300 kHz 6.73 dBm  
SWT 5 ms 2.479620000 GHz

Ref 20 dBm

\*Att 30 dB

1 PK  
VIEW



Center 2.48 GHz

500 kHz/

Span 5 MHz

Date: 26.MAY.2022 15:31:45



## 9. Frequencies Separation

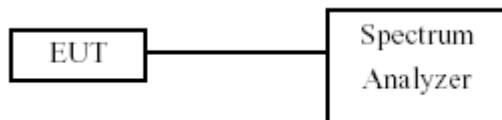
### 9.1 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 9.2 Test Procedures

- The transmitter output was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 100 kHz and VBW to 100 kHz.
- By using the MaxHold function record the separation of two adjacent channels.
- Measure the frequency difference of these two adjacent channels.

### 9.3 Test Setup Layout



### 9.4 Test Result and Data

Test Date: 2022.05.26

Temperature: 27°C

Atmospheric pressure: 1012 hPa

Humidity: 55%

| Modulation Type | Channel | Frequency (MHz) | Freq. Separation (MHz) | two-third of 20dB bandwidth(MHz) |
|-----------------|---------|-----------------|------------------------|----------------------------------|
| GFSK            | 0       | 2402            | 1.002                  | 0.75                             |
|                 | 39      | 2441            | 1.002                  | 0.75                             |
|                 | 78      | 2480            | 1.002                  | 0.756                            |
| $\pi/4$ -DQPSK  | 0       | 2402            | 1.000                  | 0.756                            |
|                 | 39      | 2441            | 1.000                  | 0.753                            |
|                 | 78      | 2480            | 1.000                  | 0.756                            |
| 8DPSK           | 0       | 2402            | 1.000                  | 0.746                            |
|                 | 39      | 2441            | 1.002                  | 0.756                            |
|                 | 78      | 2480            | 1.002                  | 0.756                            |



GFSK (1Mbps) Channel: 00



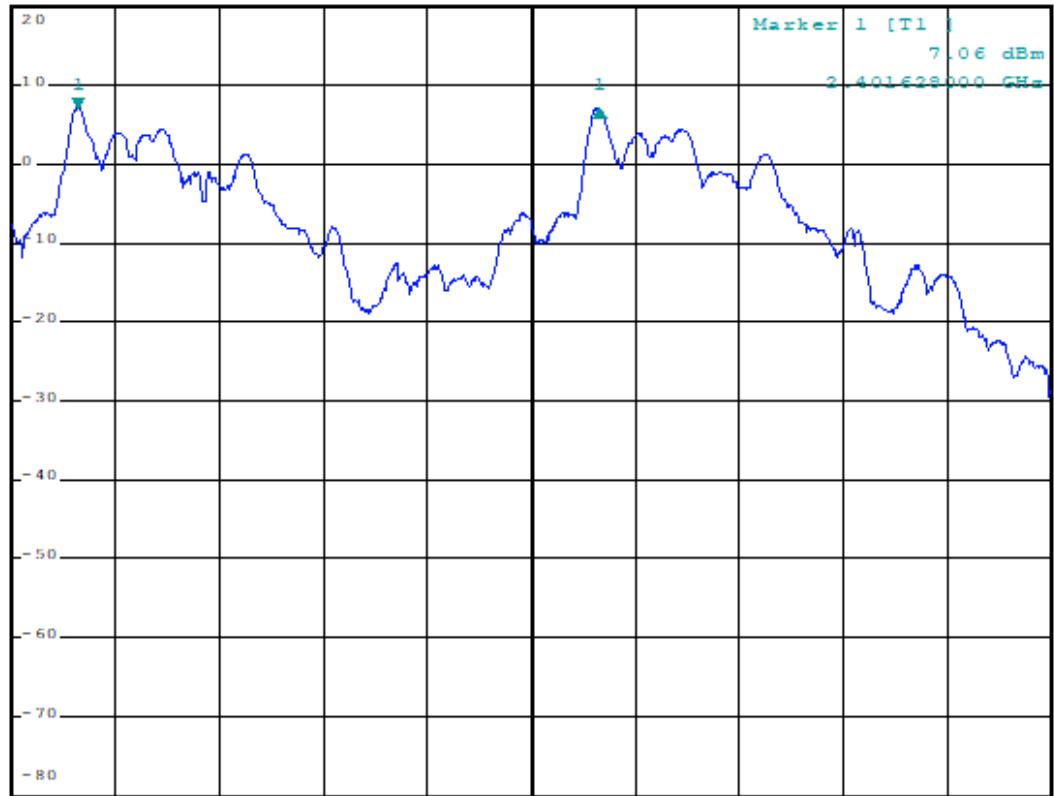
\*RBW 30 kHz Delta 1 [T1]  
VBW 100 kHz 0.01 dB  
SWT 5 ms 1.002000000 MHz

Ref 20 dBm

\*Att 30 dB

1.002000000 MHz

1 PK  
VIEW



Center 2.4025 GHz

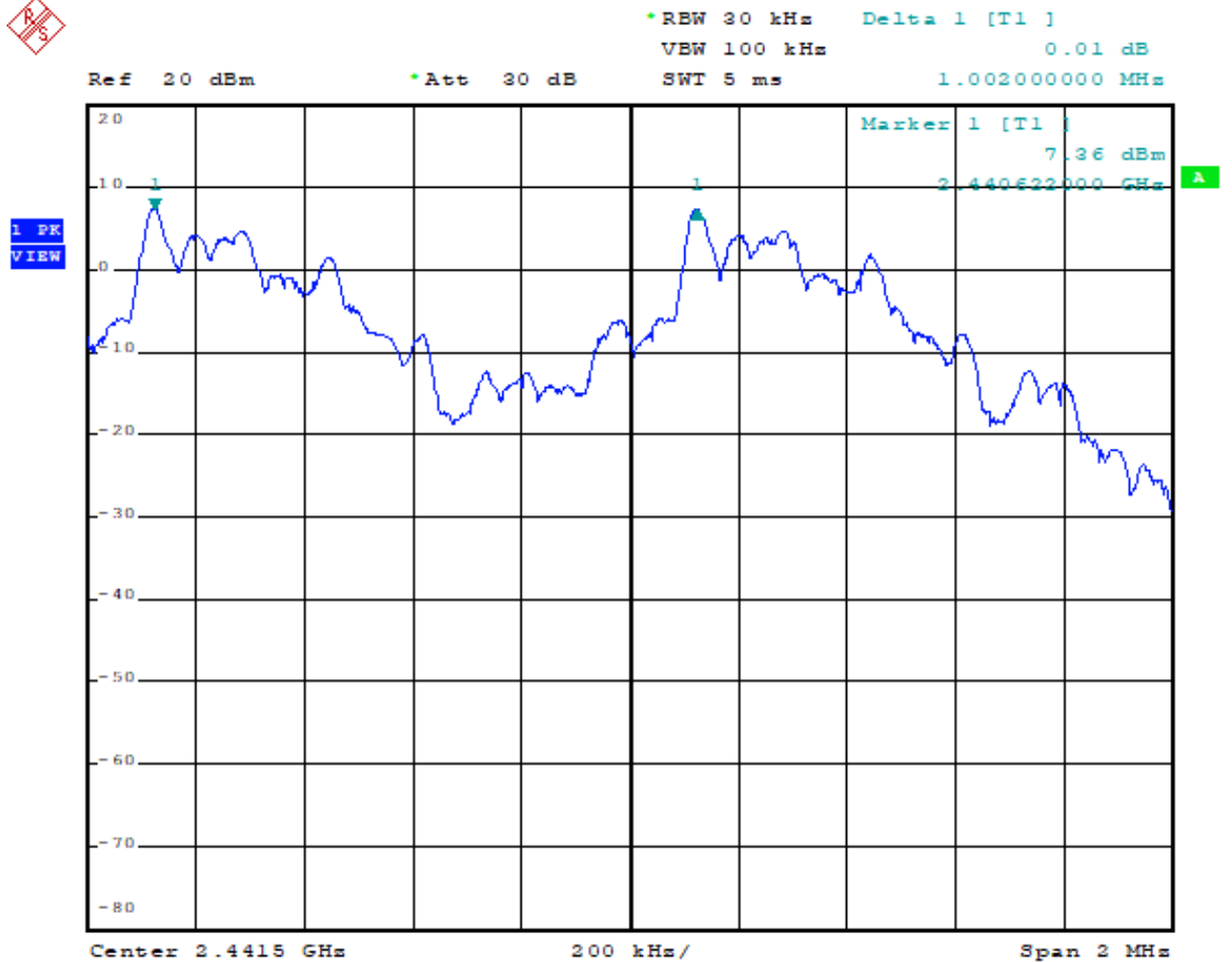
200 kHz/

Span 2 MHz

Date: 26.MAY.2022 15:50:05



GFSK (1Mbps) Channel: 39



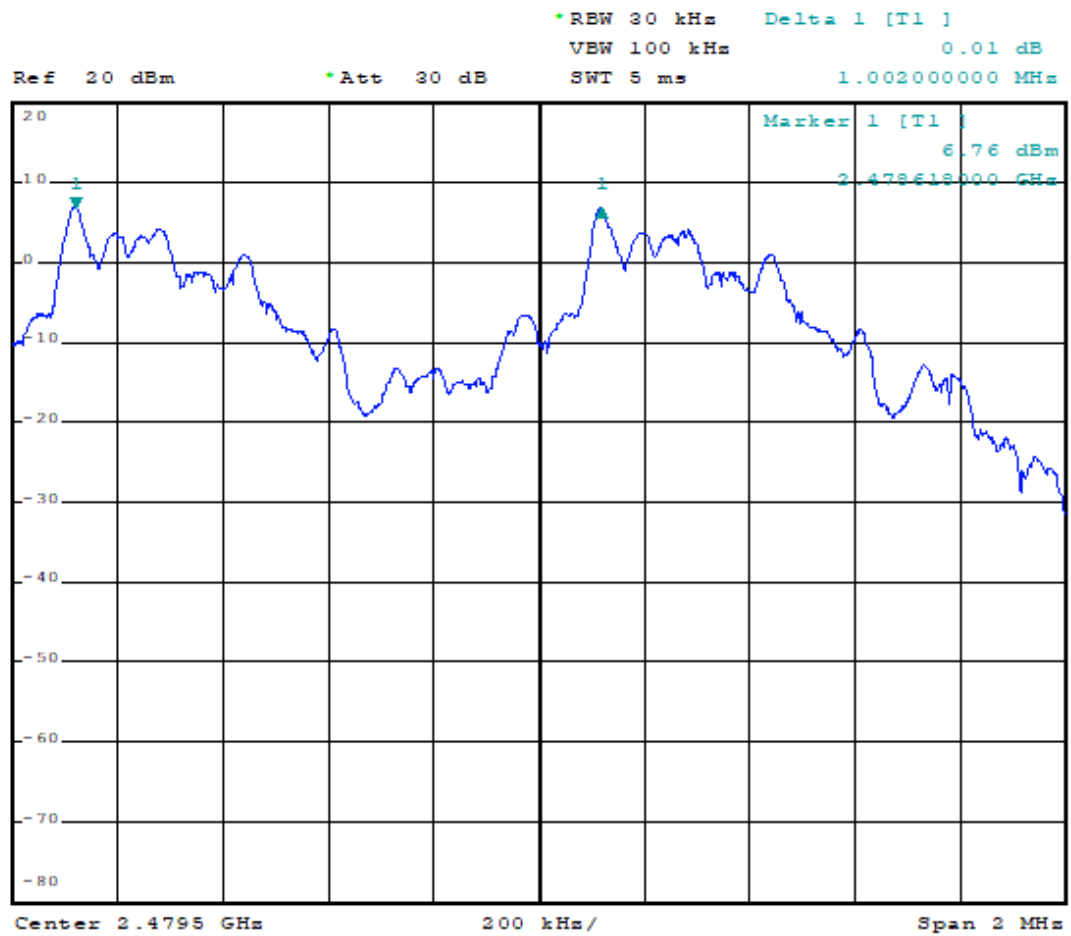
Date: 26.MAY.2022 15:51:30



GFSK (1Mbps) Channel: 78



1 PK  
VIEW



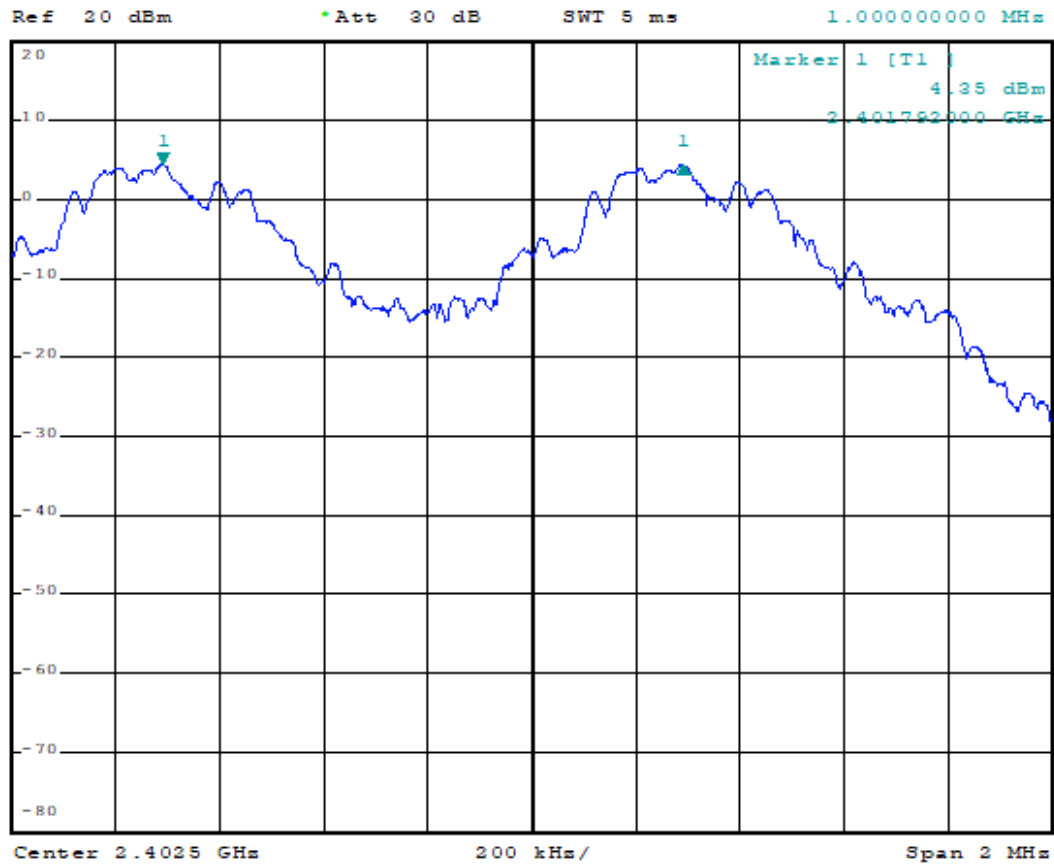
Date: 26.MAY.2022 15:52:52



$\pi/4$ -DQPSK (2Mbps) Channel: 00



\*RBW 30 kHz Delta 1 [T1 ]  
VBW 100 kHz 0.02 dB  
SWT 5 ms 1.000000000 MHz

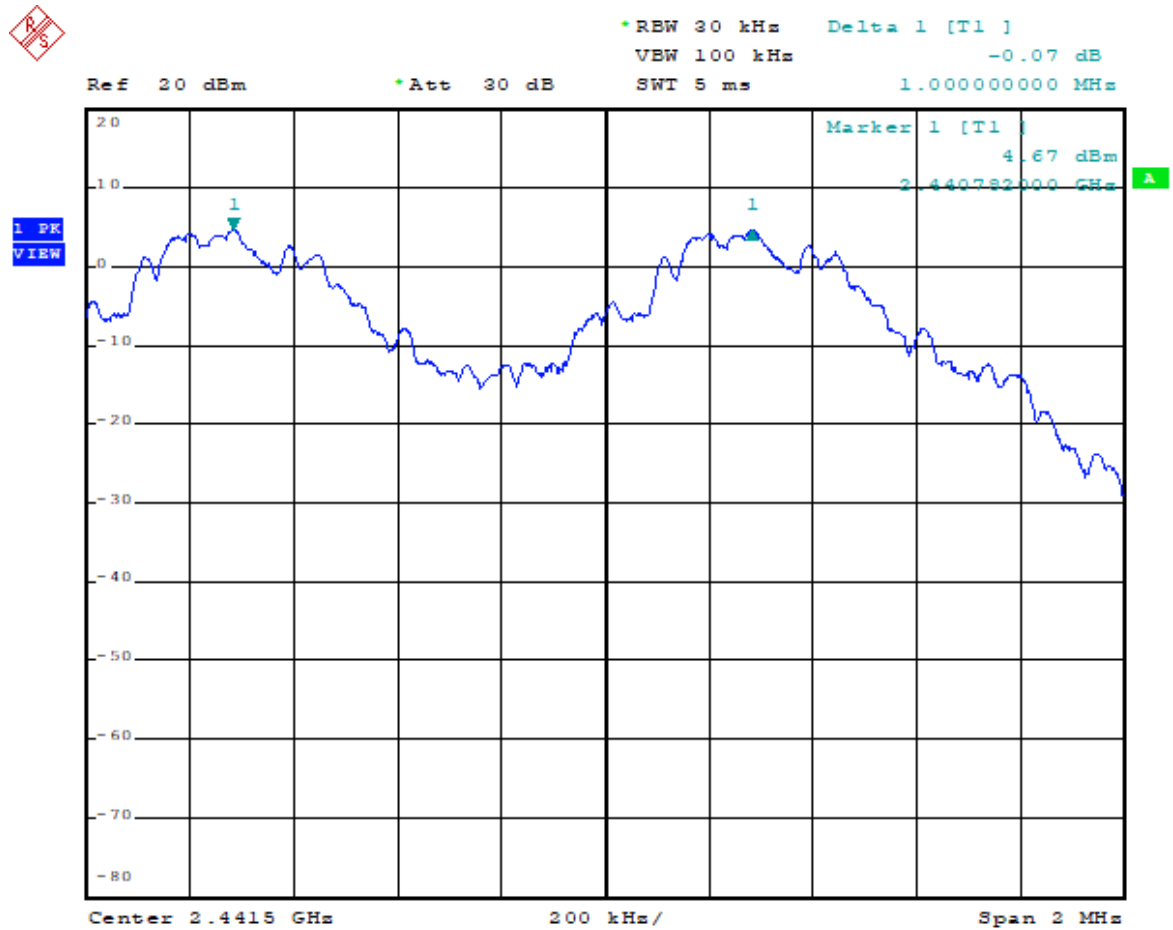


Date: 26.MAY.2022 15:54:48





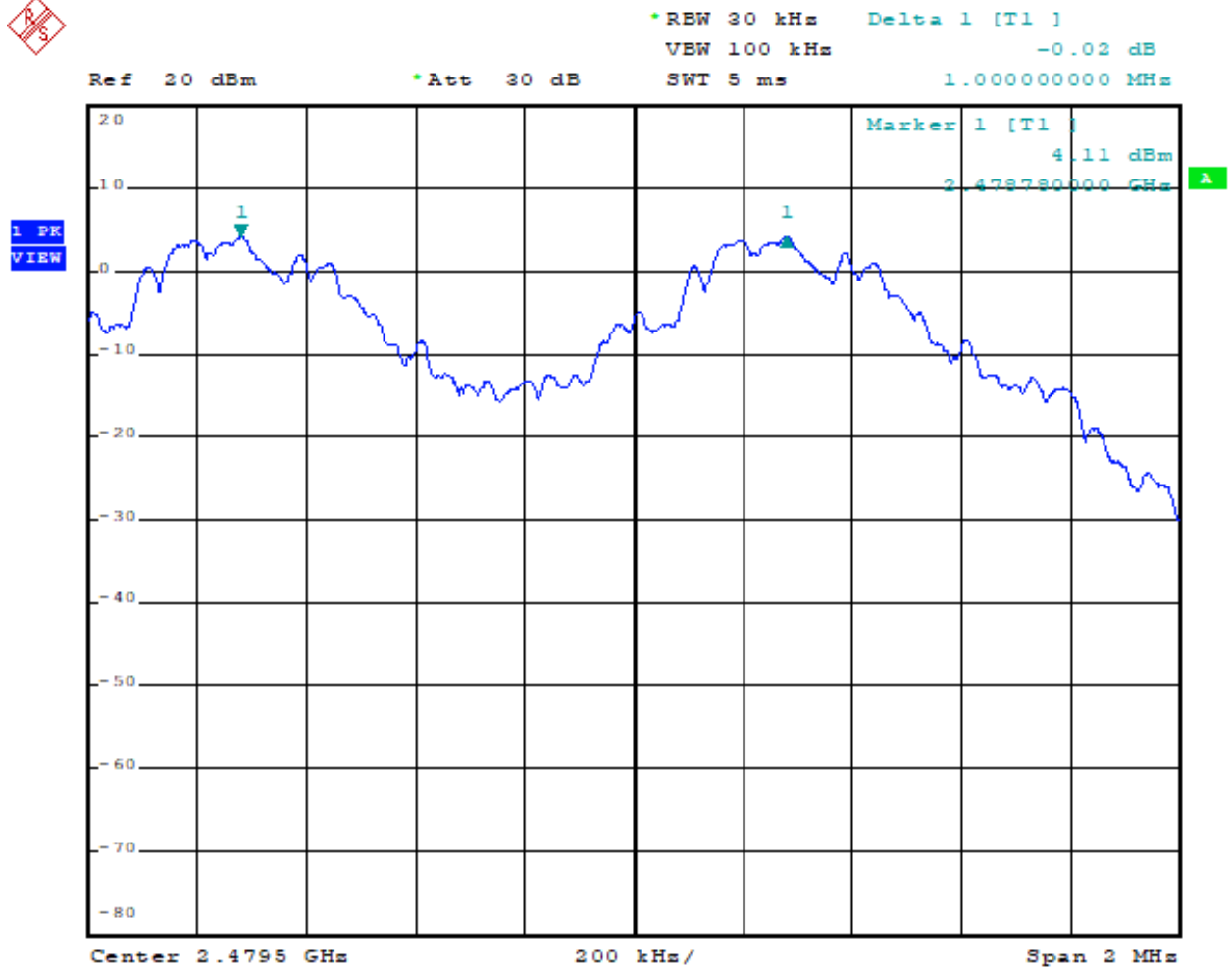
$\pi/4$ -DQPSK (2Mbps) Channel: 39



Date: 26.MAY.2022 15:56:01



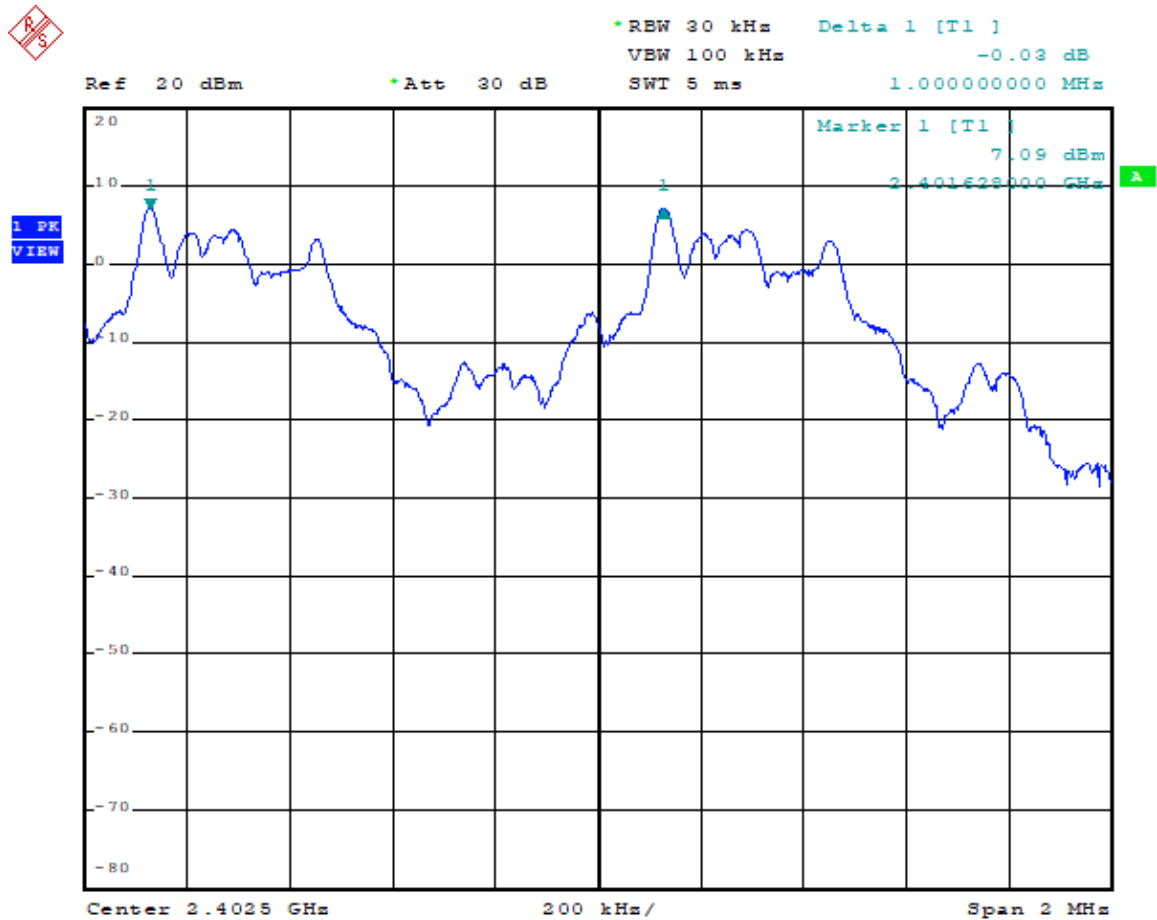
$\pi/4$ -DQPSK (2Mbps) Channel: 78



Date: 26.MAY.2022 15:58:30



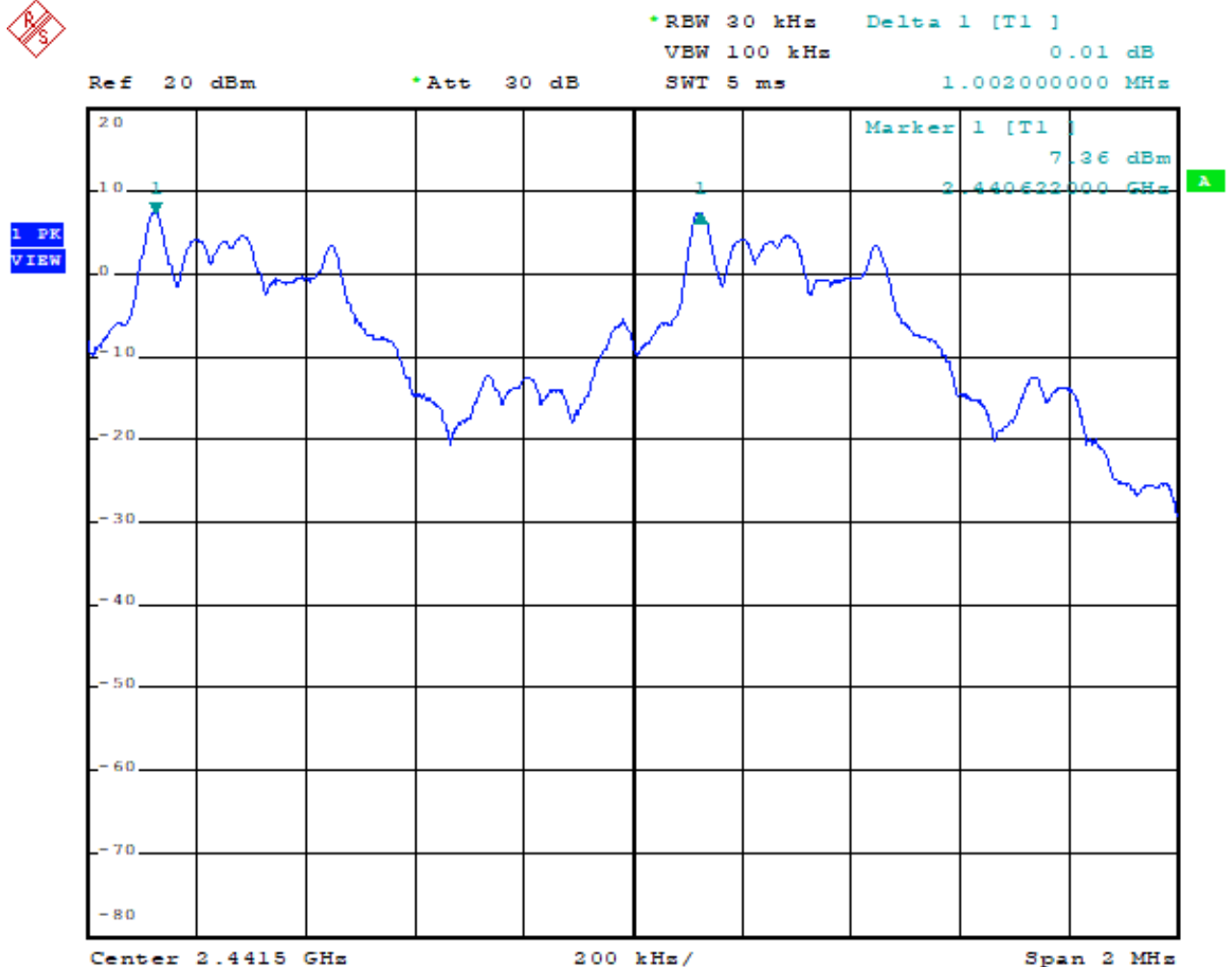
8DPSK (3Mbps) Channel: 00



Date: 26.MAY.2022 16:03:57



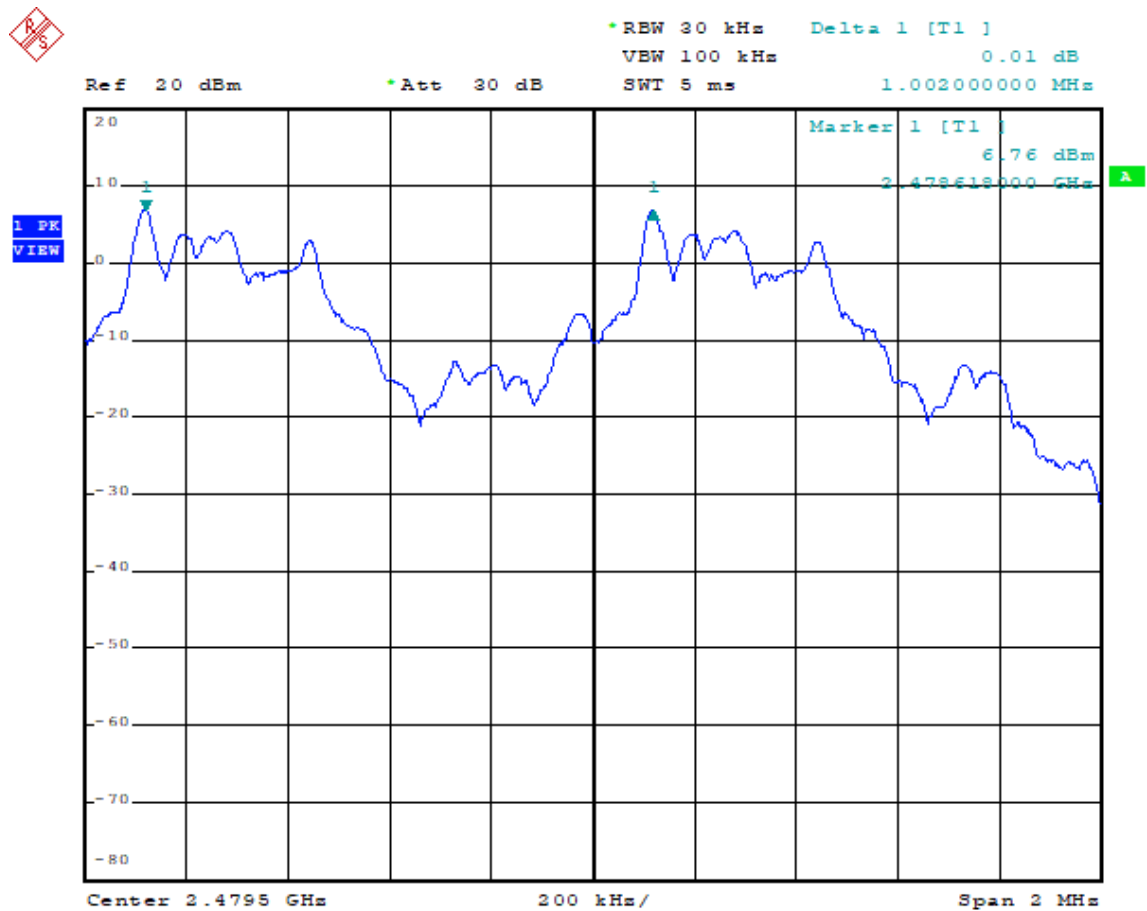
8DPSK (3Mbps) Channel: 39



Date: 26.MAY.2022 16:05:57



8DPSK (3Mbps) Channel: 78



Date: 26.MAY.2022 16:08:03



## **10. Dwell Time on each channel**

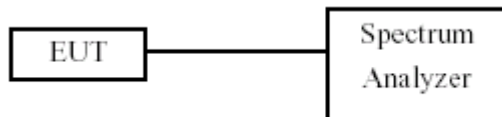
### **10.1 Test Limit**

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.

### **10.2 Test Procedures**

- a. The transmitter output was connected to the spectrum analyzer.
- b. Adjust the center frequency to measure frequency, then set zero span mode.
- c. Set RBW of spectrum analyzer to 1 MHz and VBW to 1 MHz.
- d. Measure the time duration of one transmission on the measured frequency.

### **10.3 Test Setup Layout**





#### 10.4 Test Result and Data

Test Date: 2022.05.26

Temperature: 27°C

Atmospheric pressure: 1012 hPa

Humidity: 55%

| Modulation Type       | Channel | Frequency (MHz) | Dwell Time (ms) |
|-----------------------|---------|-----------------|-----------------|
| GFSK (DH1)            | 0       | 2402            | 119.2           |
|                       | 39      | 2441            | 115.2           |
|                       | 78      | 2480            | 107.6           |
| GFSK (DH3)            | 0       | 2402            | 287.8           |
|                       | 39      | 2441            | 287.8           |
|                       | 78      | 2480            | 287.8           |
| GFSK (DH5)            | 0       | 2402            | 326.8           |
|                       | 39      | 2441            | 324.7           |
|                       | 78      | 2480            | 324.7           |
| $\pi/4$ -DQPSK (2DH5) | 0       | 2402            | 324.7           |
|                       | 39      | 2441            | 324.7           |
|                       | 78      | 2480            | 324.7           |
| 8DPSK (3DH5)          | 0       | 2402            | 324.7           |
|                       | 39      | 2441            | 324.7           |
|                       | 78      | 2480            | 324.7           |

Test period: 0.4(second/ channel) x 79 channel= 31.6 second

Example:

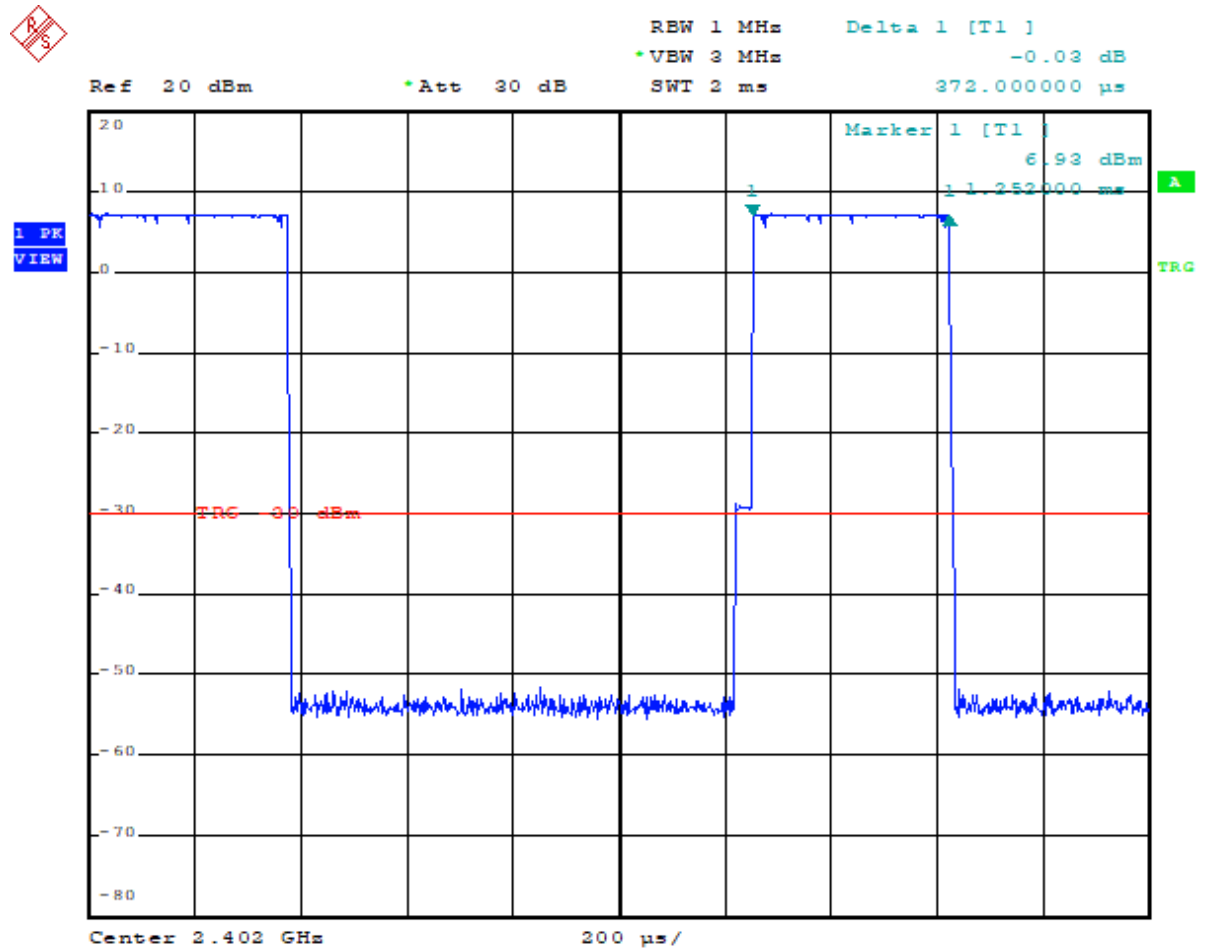
CH00,DH1 mode = 0.420 (ms)\*[(1600/2)/79]\*31.6= 134.4 (ms)

CH00,DH3 mode = 1.680 (ms)\*[(1600/4)/79]\*31.6= 268.8 (ms)

CH00,DH5 mode = 2.930 (ms)\*[(1600/6)/79]\*31.6= 312.5 (ms)



GFSK (1Mbps) Rate: DH1 Channel: 00

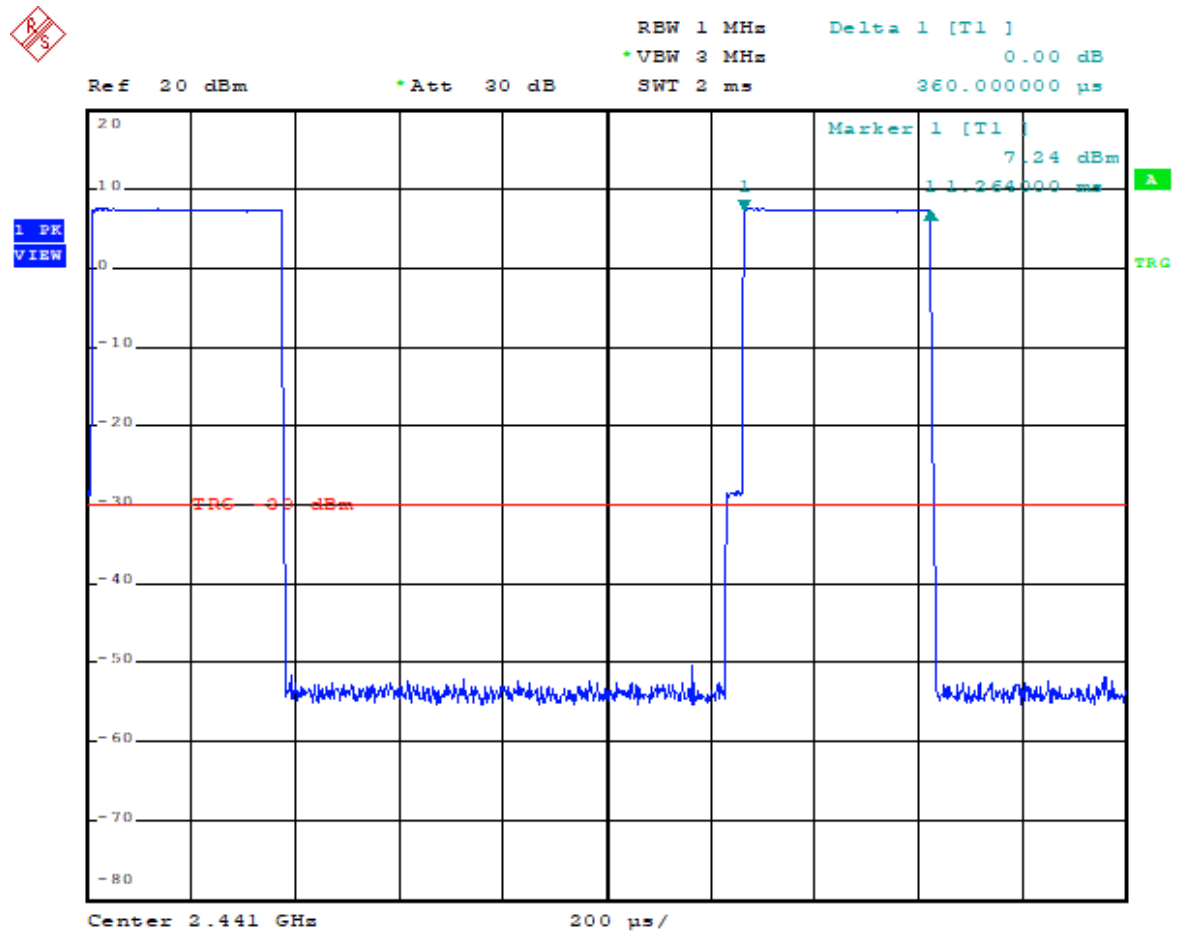


Date: 26.MAY.2022 16:20:05





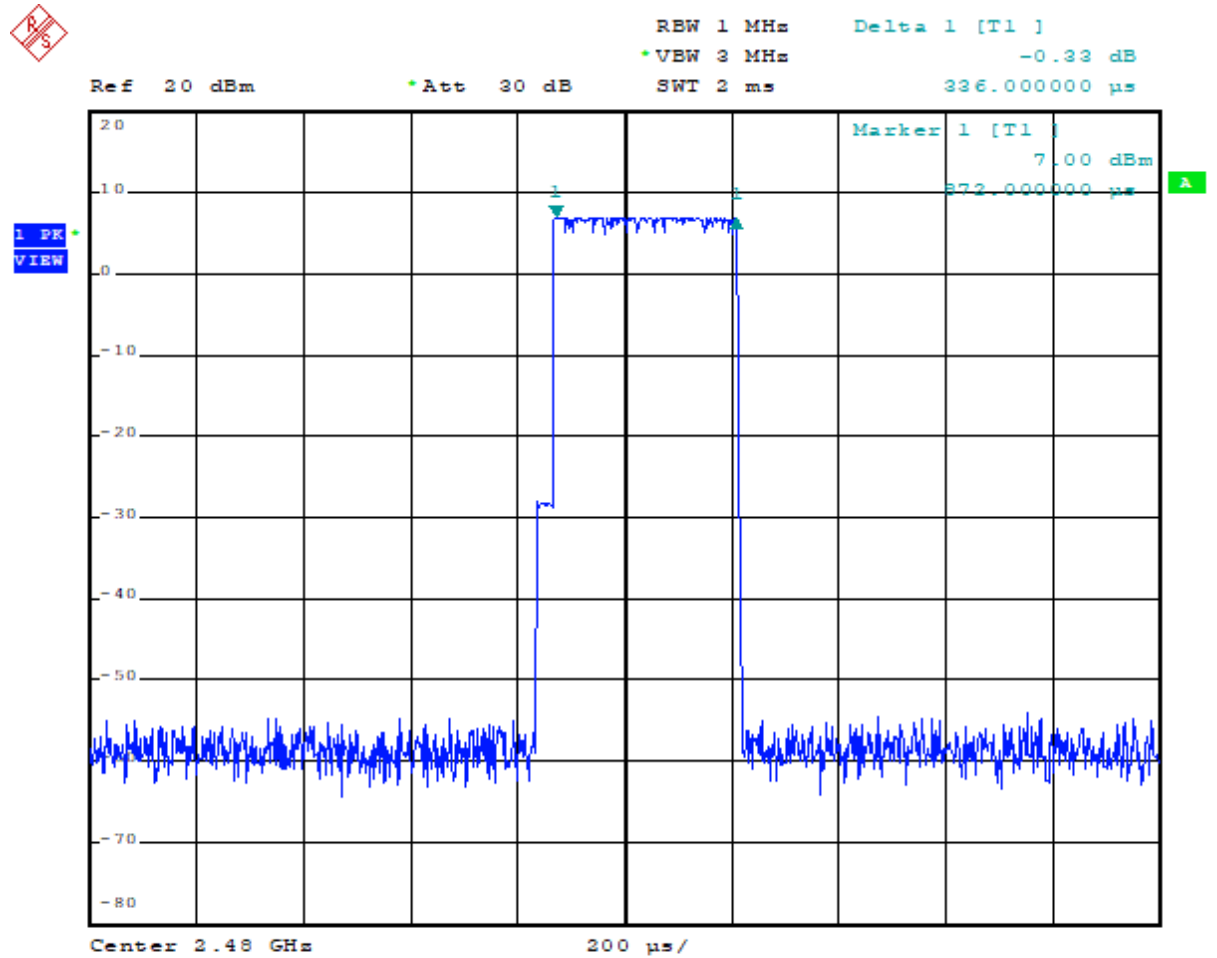
GFSK (1Mbps) Rate: DH1 Channel: 39



Date: 26.MAY.2022 16:21:55



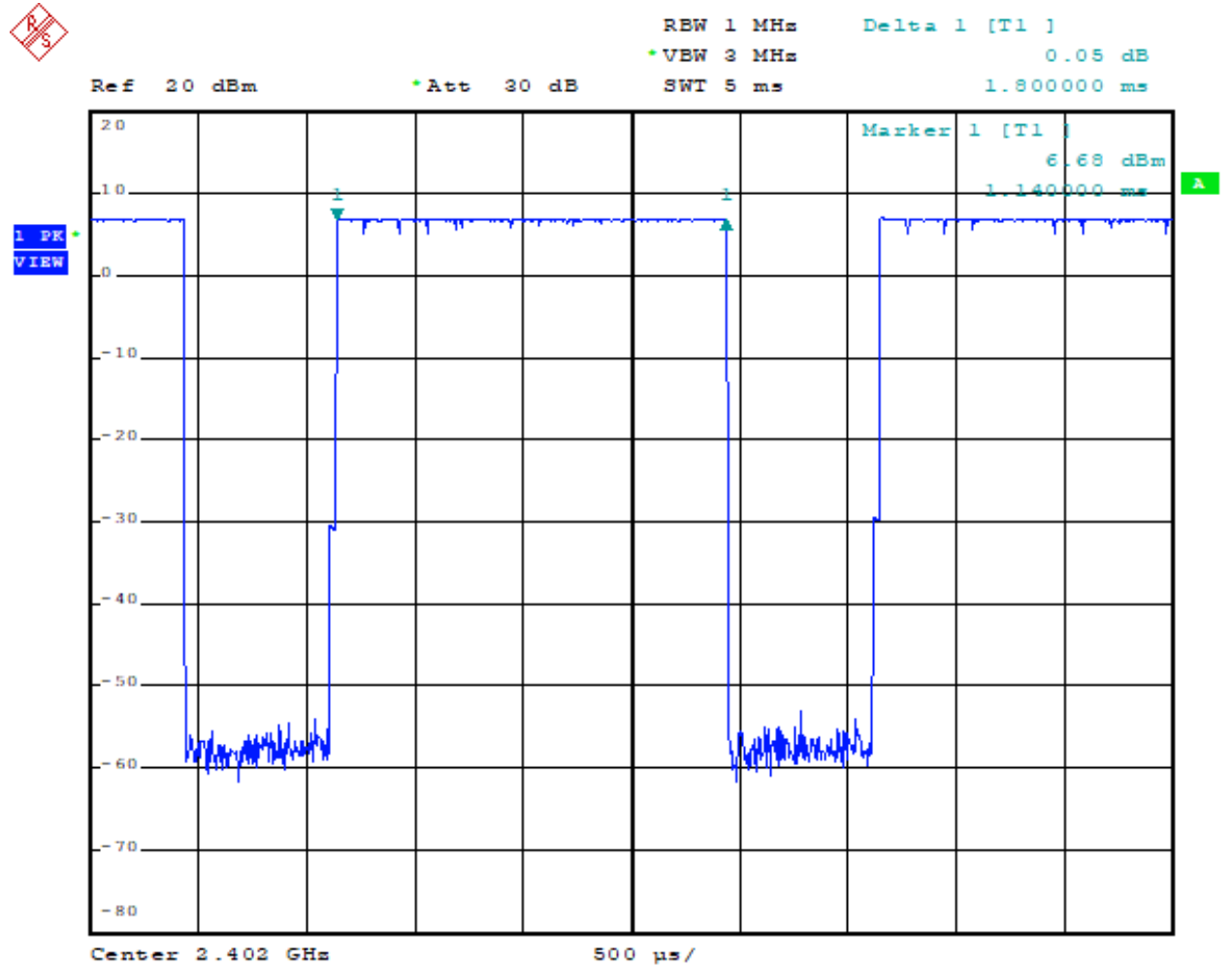
GFSK (1Mbps) Rate: DH1 Channel: 78



Date: 26.MAY.2022 16:24:07



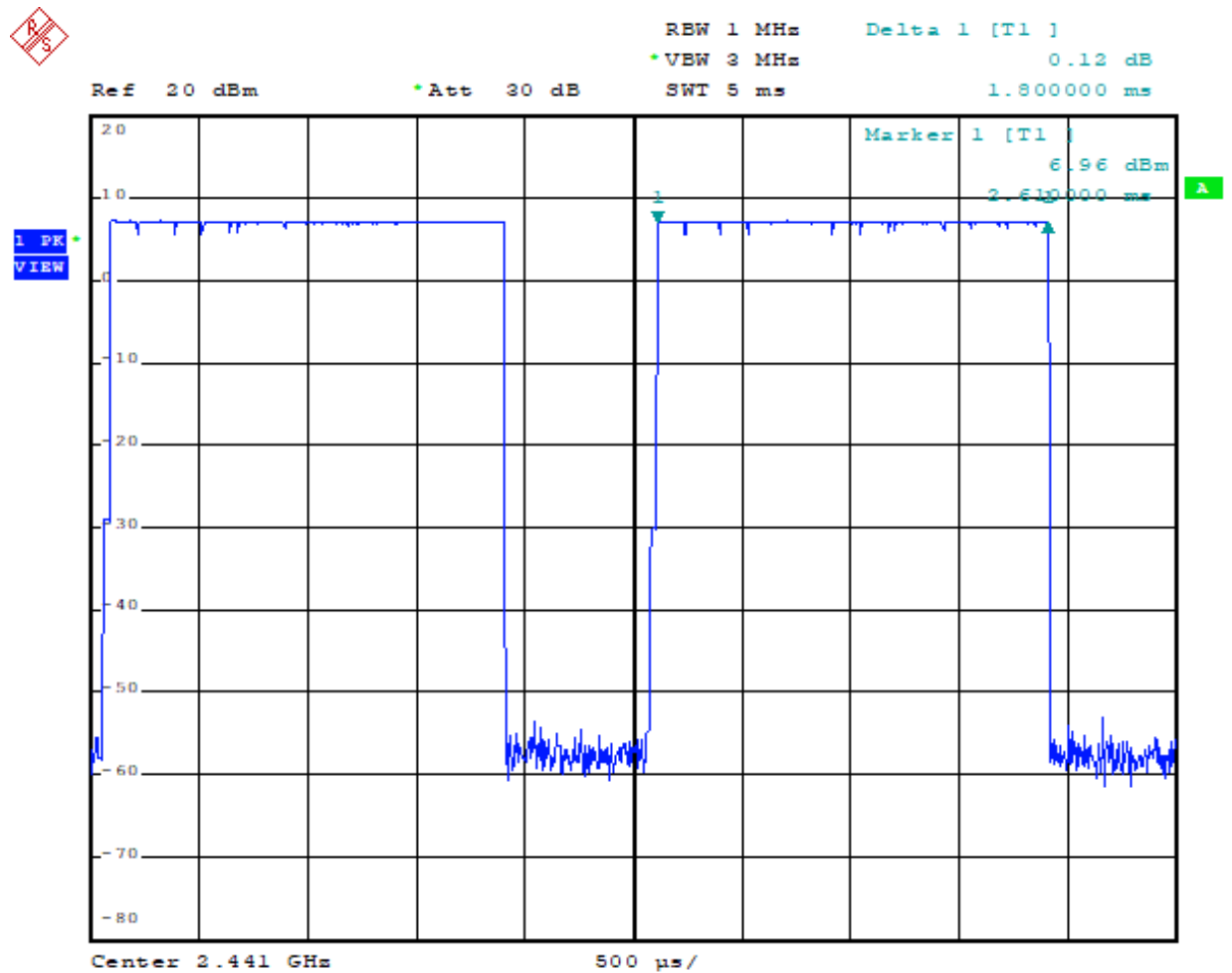
GFSK (1Mbps) Rate: DH3 Channel: 00



Date: 26.MAY.2022 16:27:55



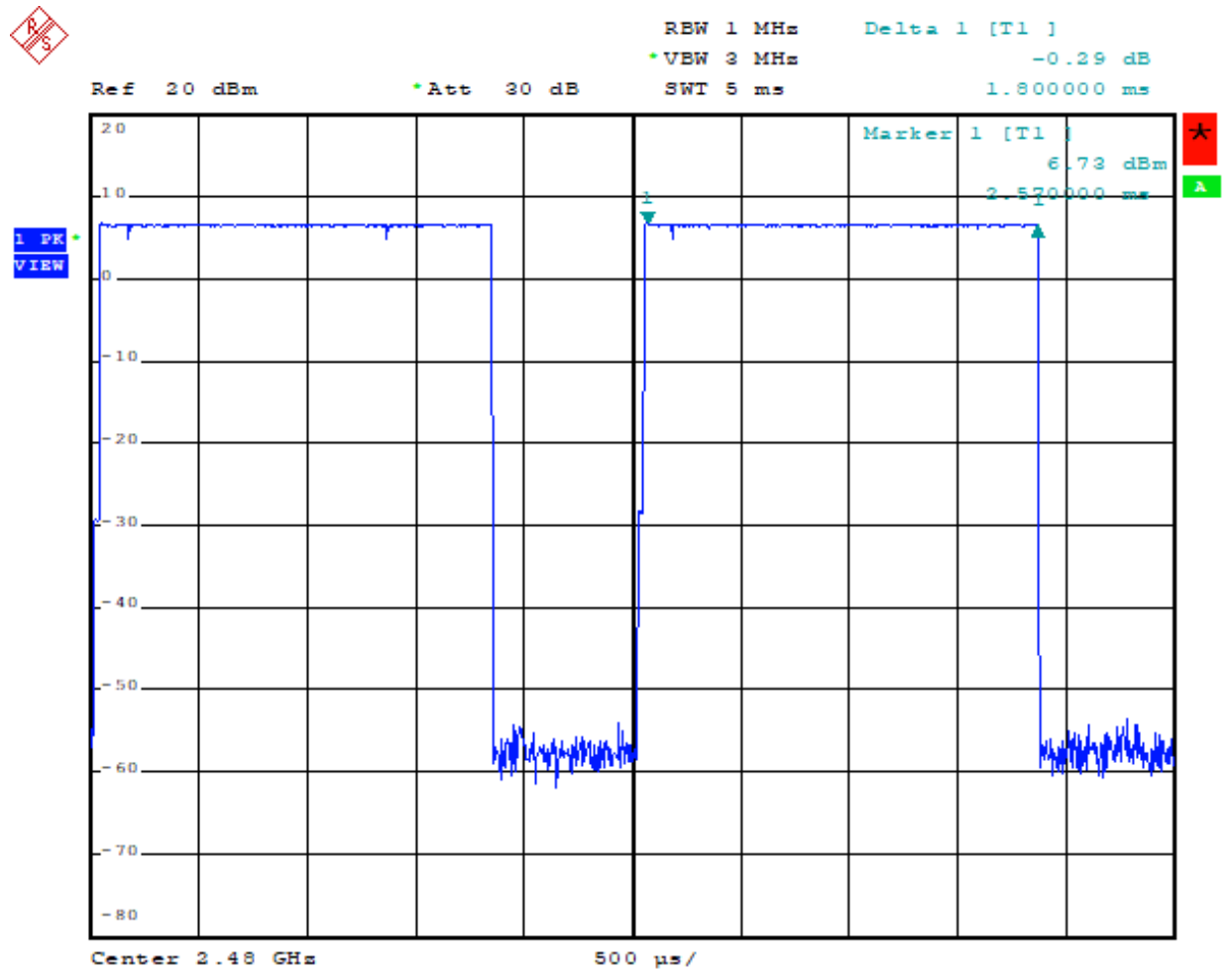
GFSK (1Mbps) Rate: DH3 Channel: 39



Date: 26.MAY.2022 16:29:25



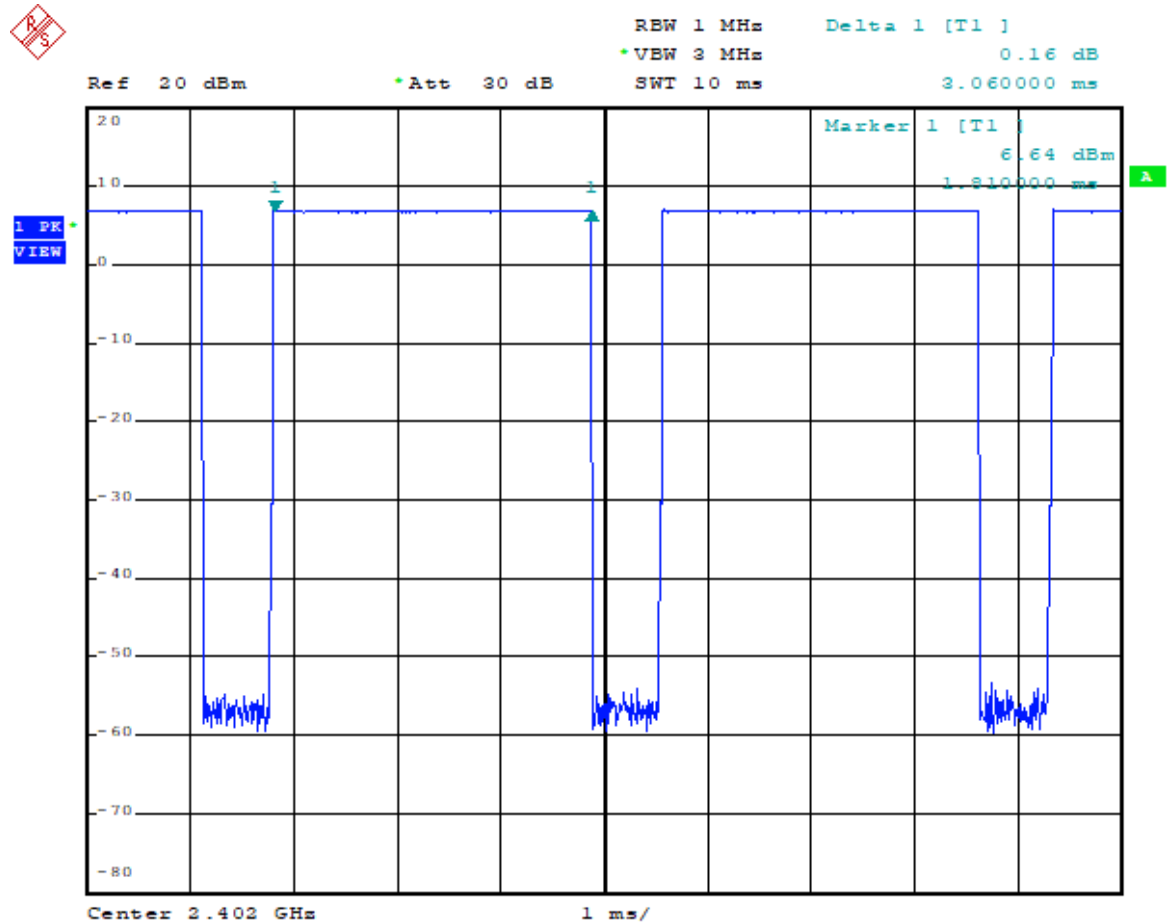
GFSK (1Mbps) Rate: DH3 Channel: 78



Date: 26.MAY.2022 16:30:01



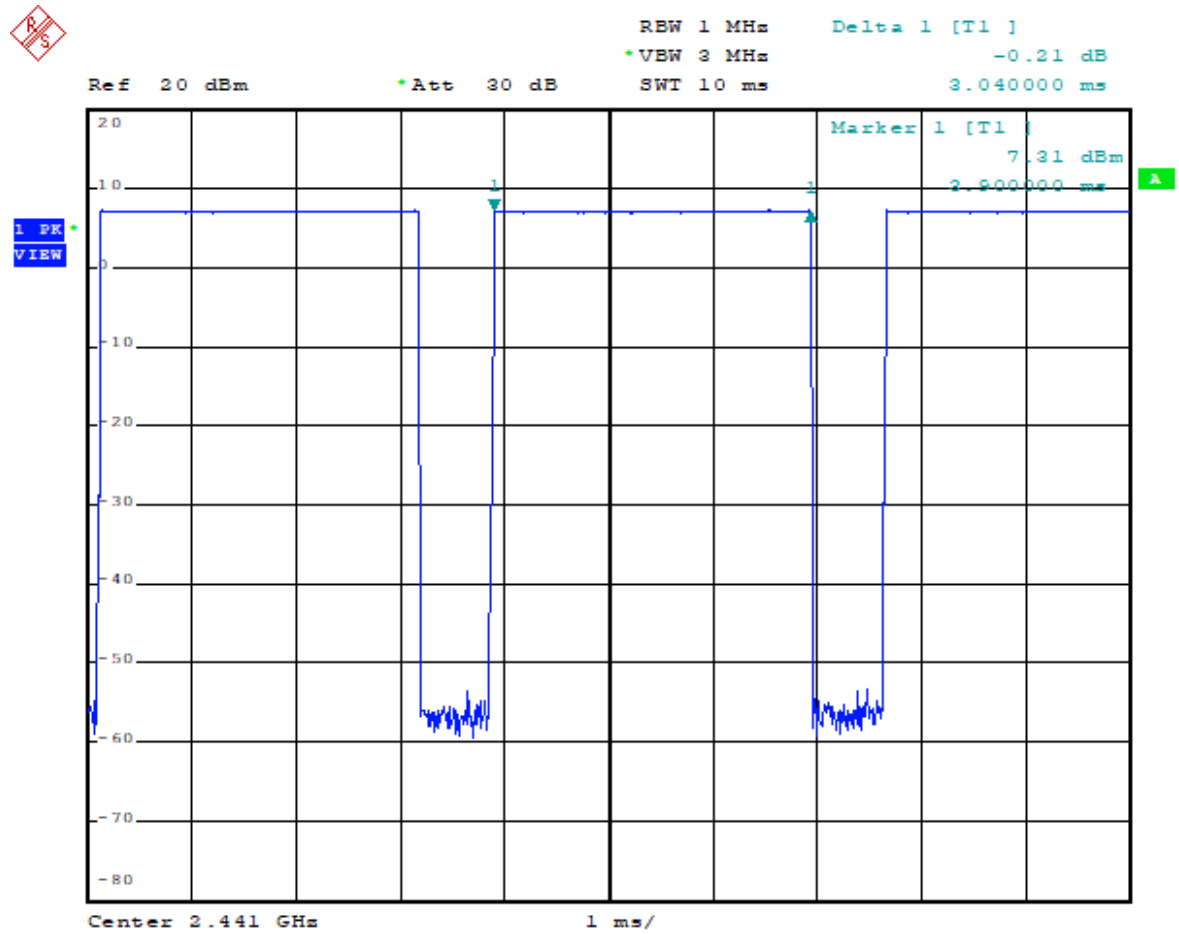
GFSK (1Mbps) Rate: DH5 Channel: 00



Date: 26.MAY.2022 16:31:34



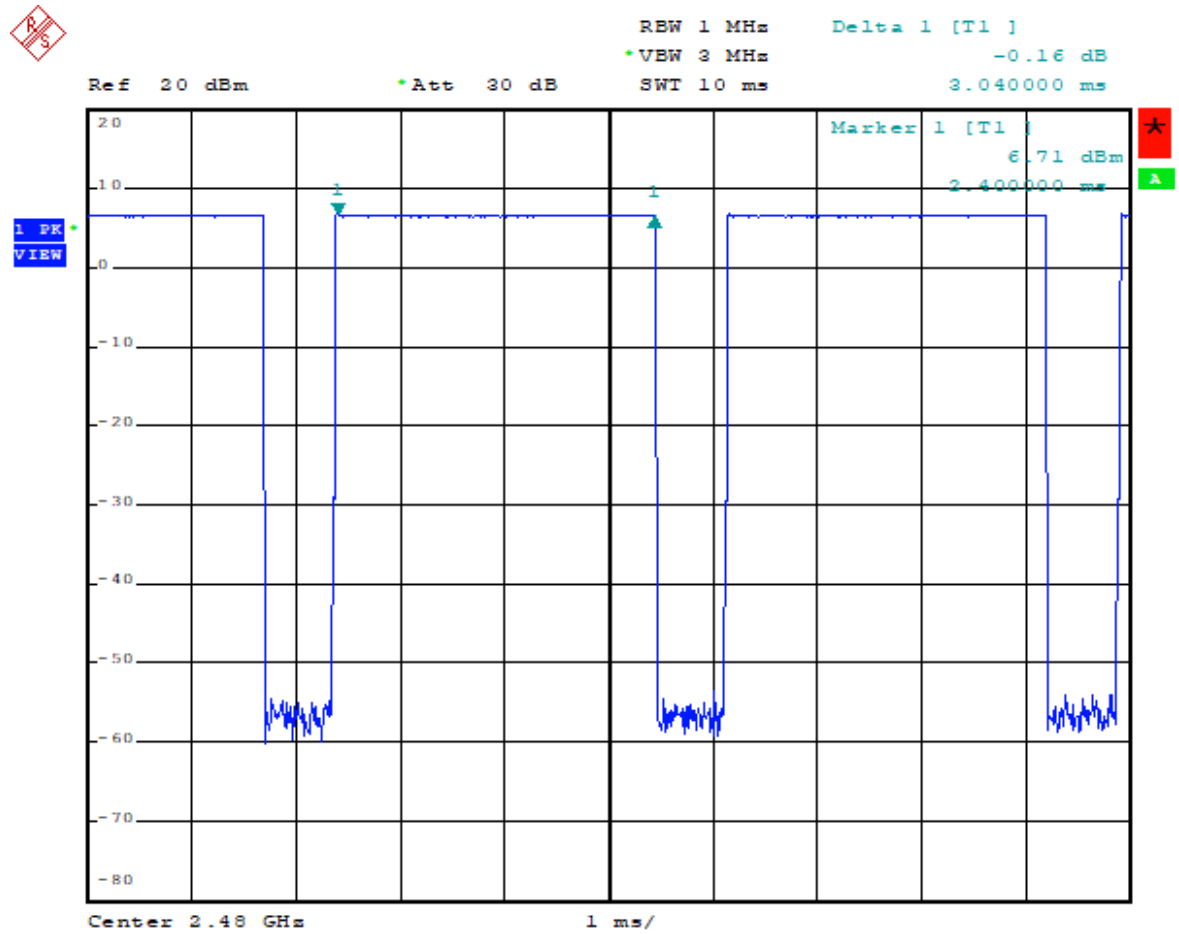
GFSK (1Mbps) Rate: DH5 Channel: 39



Date: 26.MAY.2022 16:34:32



GFSK (1Mbps) Rate: DH5 Channel: 78

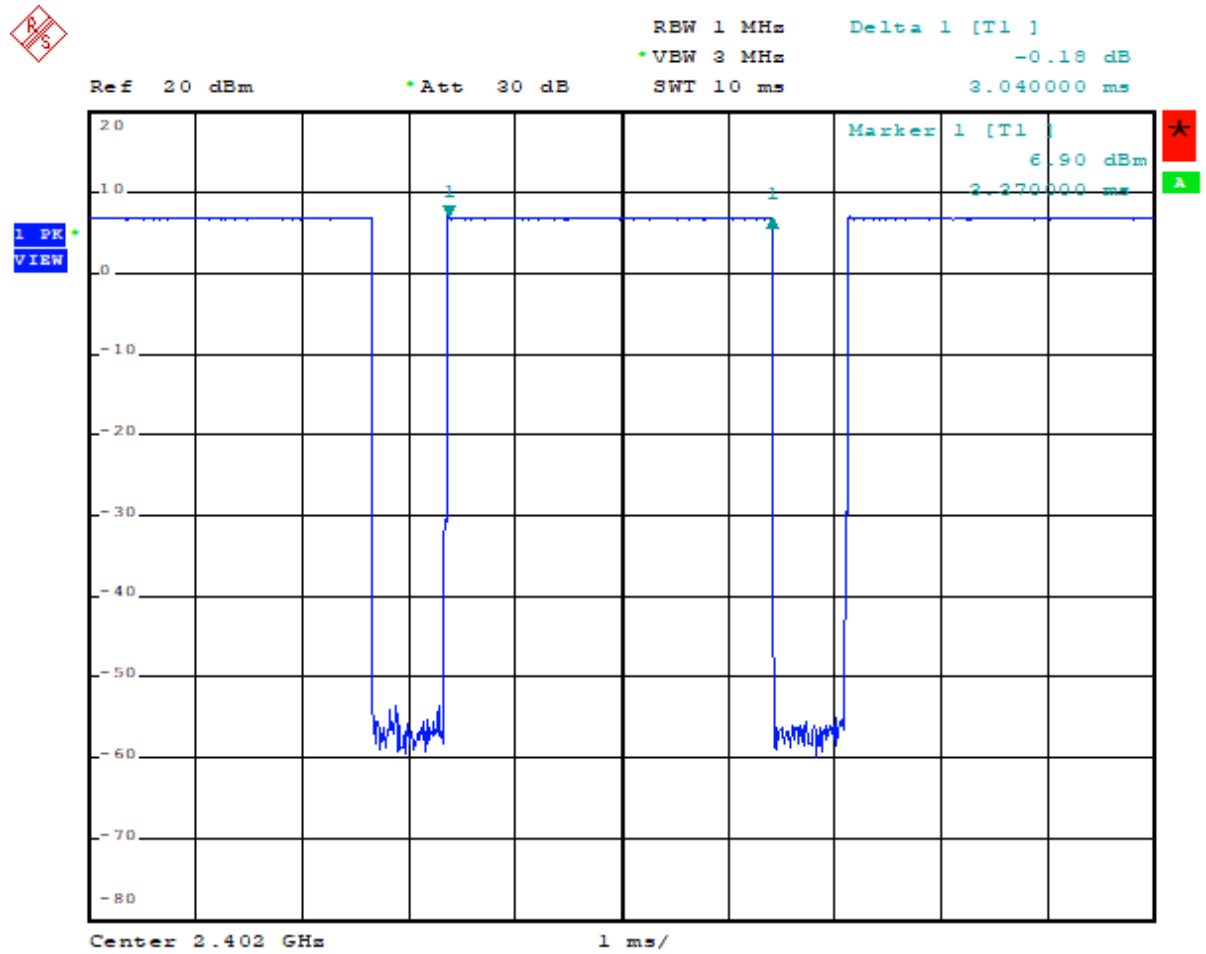


Date: 26.MAY.2022 16:36:04





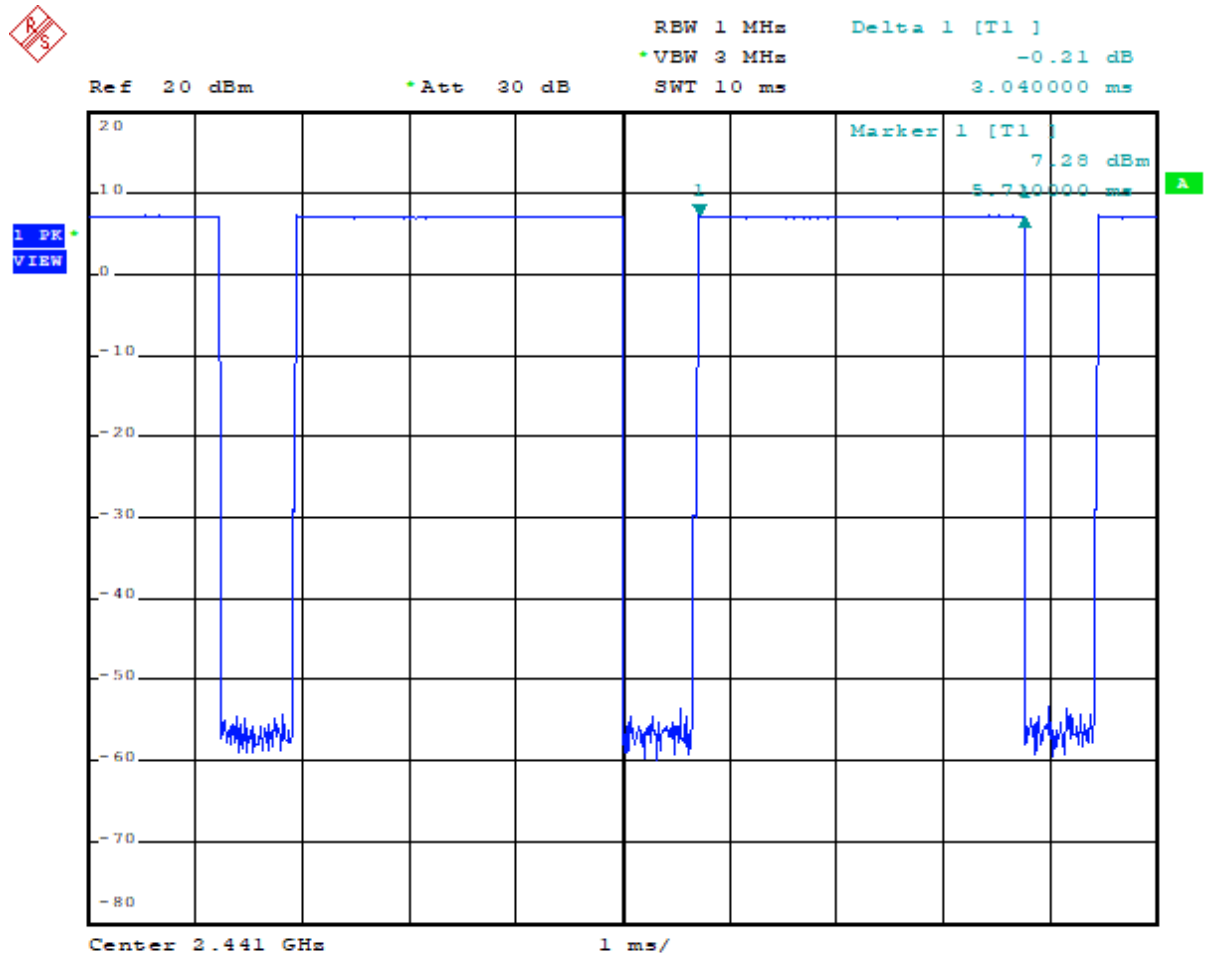
$\pi/4$ -DQPSK (2Mbps) Rate: 2DH5 Channel: 00



Date: 26.MAY.2022 16:40:37



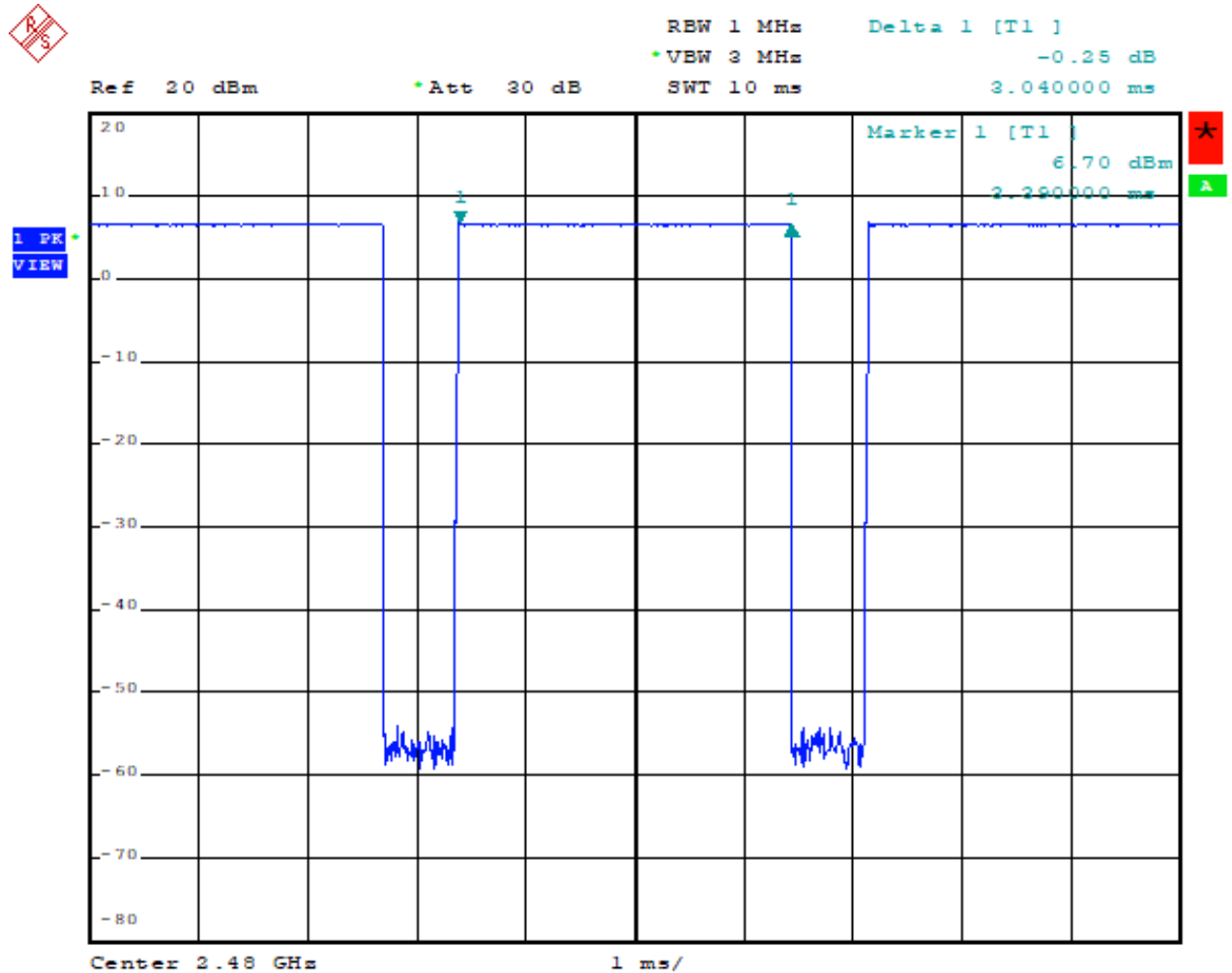
$\pi/4$ -DQPSK (2Mbps) Rate: 2DH5 Channel: 39



Date: 26.MAY.2023 16:41:28



$\pi/4$ -DQPSK (2Mbps) Rate: 2DH5 Channel: 78



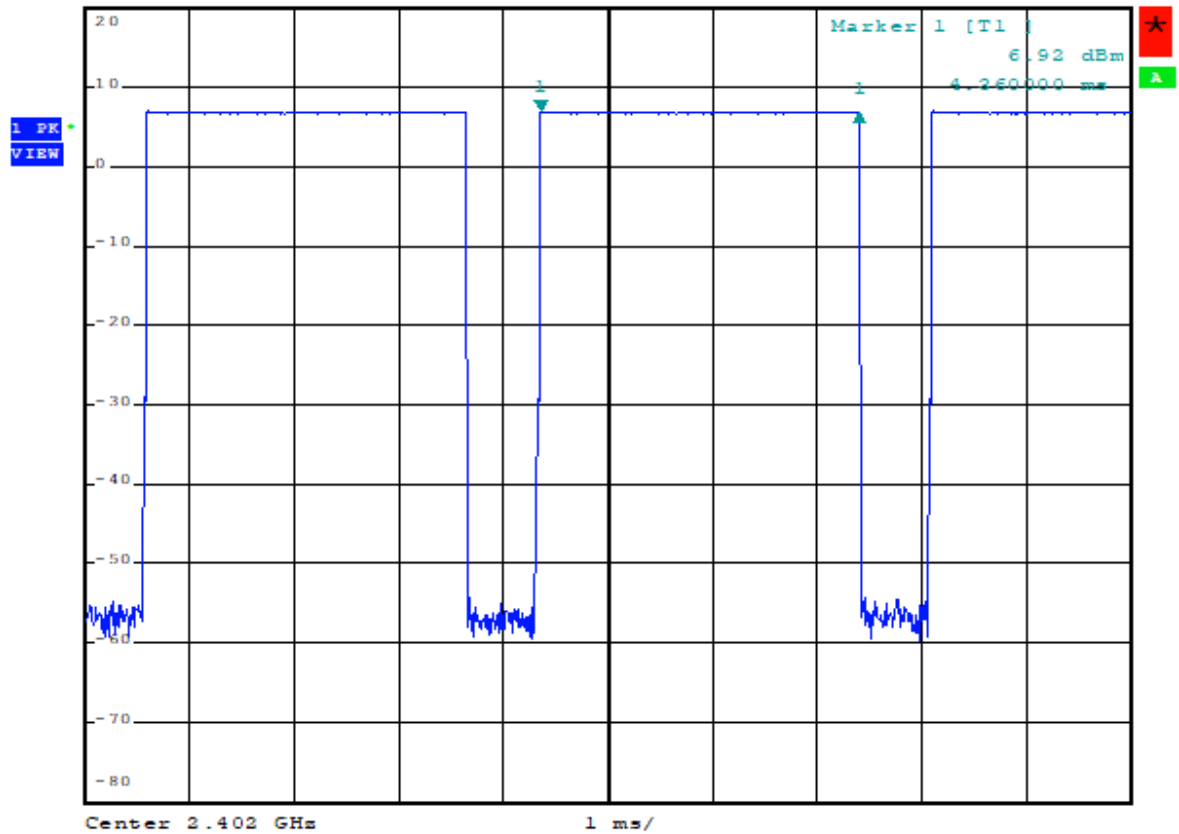
Date: 26.MAY.2022 16:42:05



8DPSK (3Mbps) Rate: 3DH5 Channel: 00



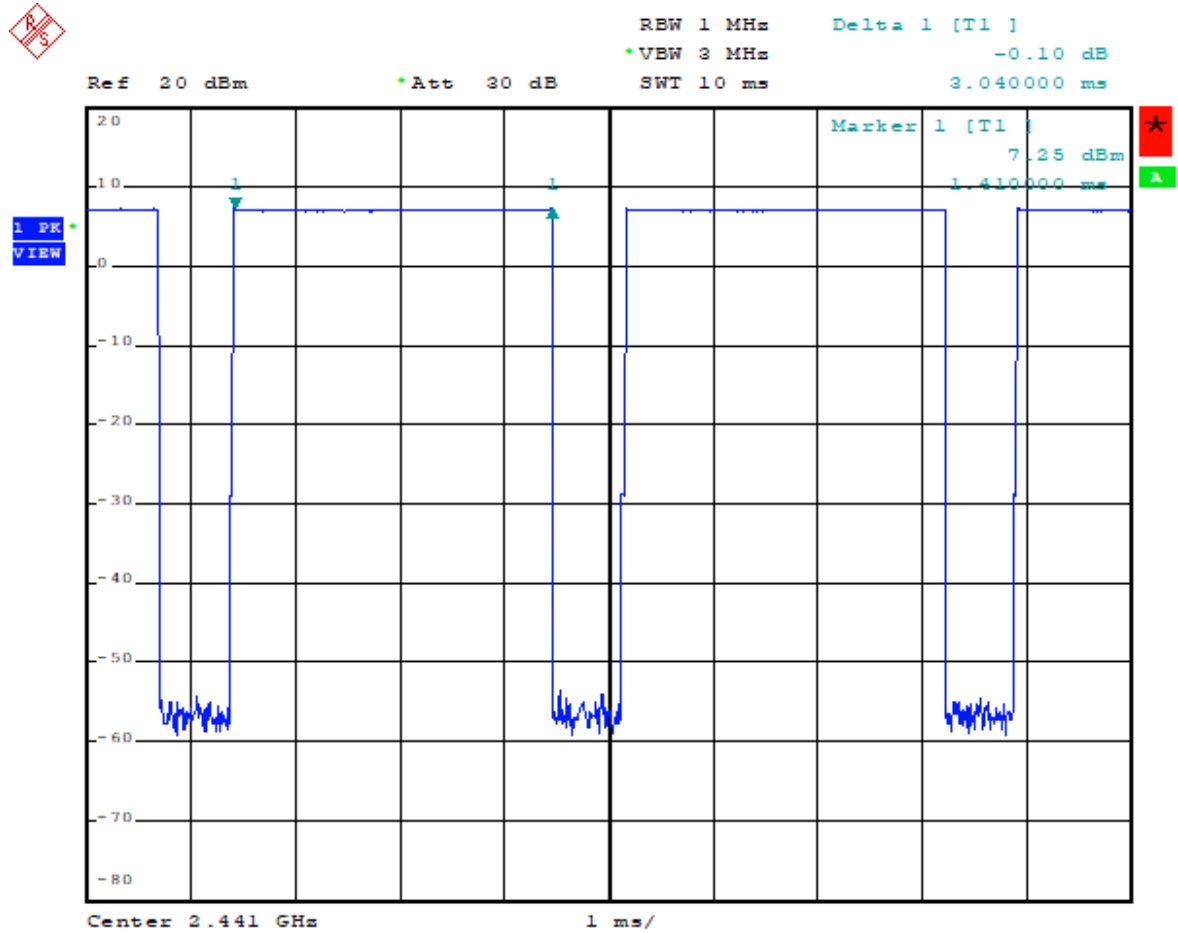
RBW 1 MHz Delta 1 [T1 ]  
VBW 3 MHz -0.17 dB  
Ref 20 dBm Att 30 dB SWT 10 ms 3.040000 ms



Date: 26.MAY.2022 16:42:52



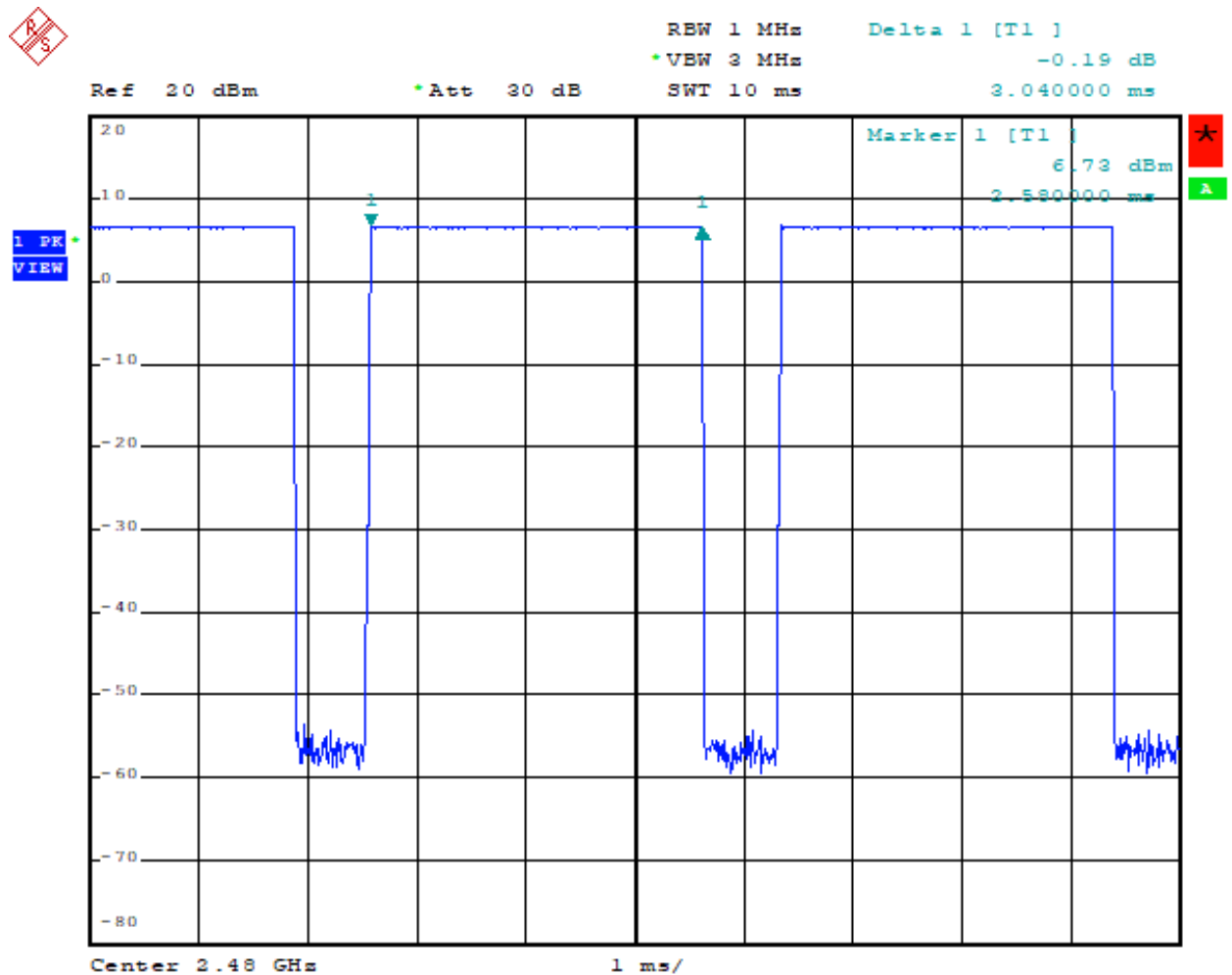
8DPSK (3Mbps) Rate: 3DH5 Channel: 39



Date: 26.MAY.2022 16:43:33



8DPSK (3Mbps) Rate: 3DH5 Channel: 78



Date: 26.MAY.2022 16:44:31



## 11. Number of Hopping Channels

### 11.1 Test Limit

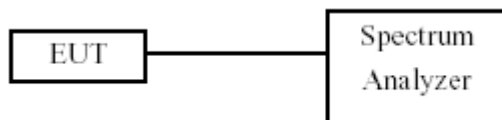
Frequency hopping systems in the 2400 ~ 2483.5 MHz band shall use at least 15 channels.

### 11.2 Test Procedures

- The transmitter output was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 100 kHz and VBW to 100 kHz.
- Set the MaxHold function, and then keep the EUT in hopping mode.

Record all the signals from each channel until each one has been record.

### 11.3 Test Setup Layout



### 11.4 Test Result and Data

Test Date: 2022.05.26

Temperature: 27°C

Atmospheric pressure: 1012 hPa

Humidity: 55%

| Modulation Standard    | Hopping Channels |
|------------------------|------------------|
| GFSK (1Mbps)           | 79               |
| $\pi/4$ -DQPSK (2Mbps) | 79               |
| 8DPSK (2Mbps)          | 79               |



GFSK (1Mbps)



REBW 100 kHz

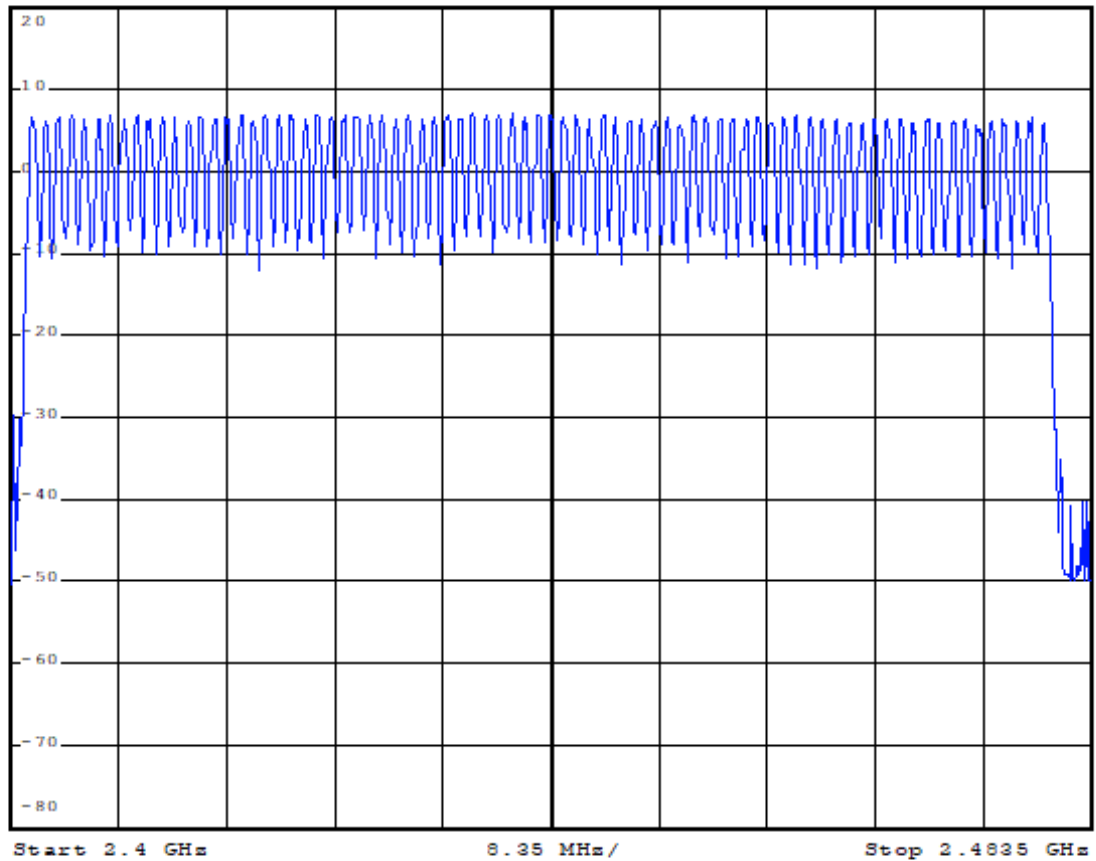
VEW 100 kHz

SWT 10 ms

Ref 20 dBm

Att 30 dB

1 PK  
VIEW



Date: 26.MAY.2022 17:18:49





$\pi/4$ -DQPSK (2Mbps)



\*RBW 100 kHz

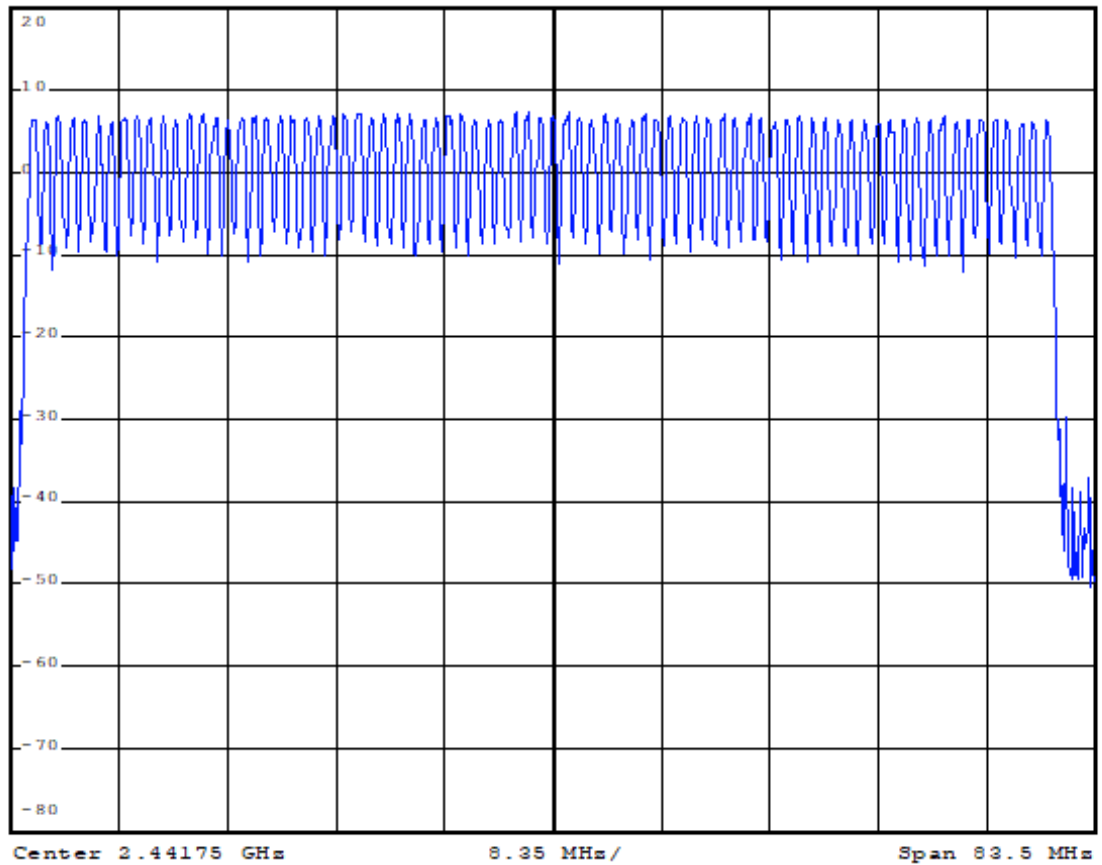
\*VBW 100 kHz

SWT 10 ms

Ref 20 dBm

\*Att 30 dB

1 PK  
VIEW



Date: 26.MAY.2022 17:20:42



8DPSK (3Mbps)



\*RBW 100 kHz

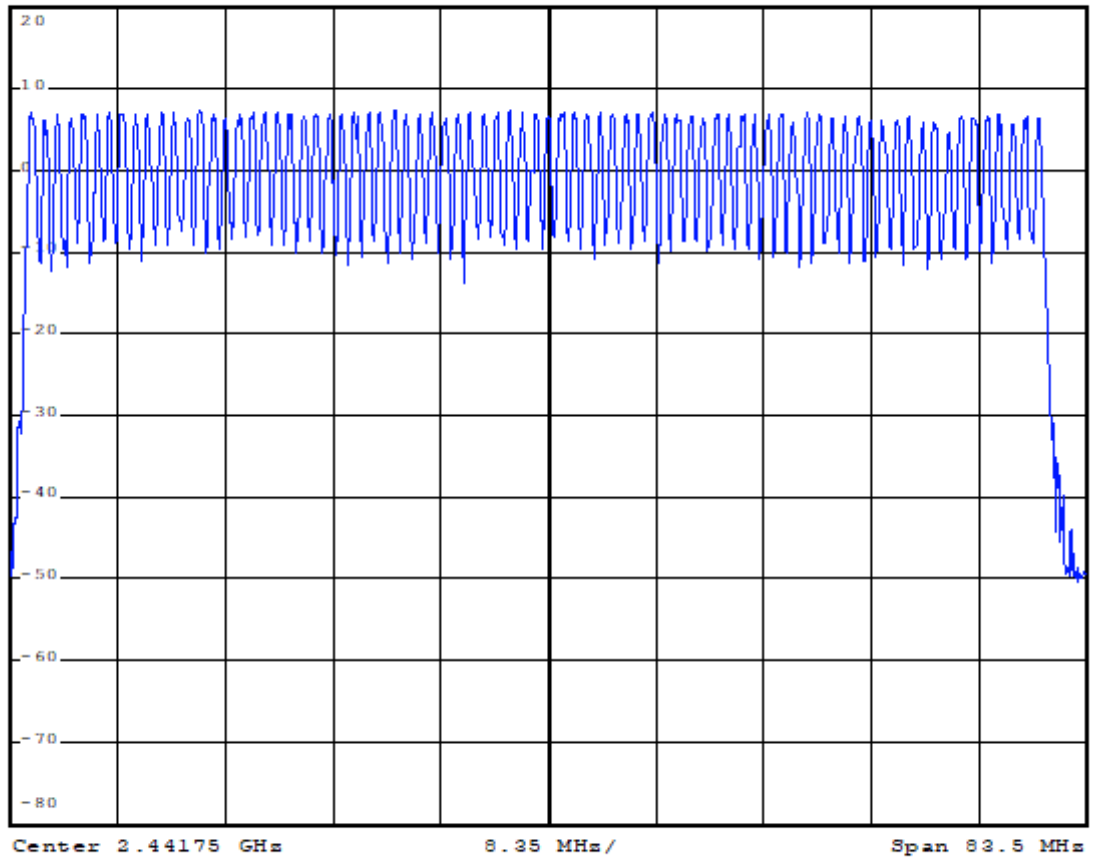
\*VBW 100 kHz

SWT 10 ms

Ref 20 dBm

\*Att 30 dB

1 PK  
VIEW



Date: 26.MAY.2022 17:16:44



## 12. Maximum Peak Output Power

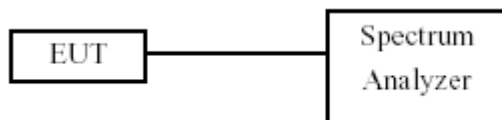
### 12.1 Test Limit

The Maximum Peak Output Power Measurement is 30 dBm.

### 12.2 Test Procedures

The transmitter output was connected to the spectrum analyzer. Power was read directly from the meter and cable loss connection was added to the reading to obtain power at the EUT antenna terminal. The EUT Output Power was set to maximum to produce the worse case test result.

### 12.3 Test Setup Layout



### 12.4 Test Result and Data

Test Date: 2022.05.26

Temperature: 27°C

Atmospheric pressure: 1012 hPa

Humidity: 55%

| Modulation Standard    | Channel | Frequency (MHz) | Output Power (dBm) |
|------------------------|---------|-----------------|--------------------|
| GFSK (1Mbps)           | 00      | 2402            | 7.61               |
|                        | 39      | 2441            | 7.98               |
|                        | 78      | 2480            | 7.46               |
| $\pi/4$ -DQPSK (2Mbps) | 00      | 2402            | 7.58               |
|                        | 39      | 2441            | 7.98               |
|                        | 78      | 2480            | 7.46               |
| 8DPSK (3Mbps)          | 00      | 2402            | 7.55               |
|                        | 39      | 2441            | 7.94               |
|                        | 78      | 2480            | 7.43               |



GFSK (1Mbps) Channel: 00



\*RBW 1 MHz Marker 1 [T1 ]  
\*VBW 10 MHz 7.61 dBm  
SWT 5 ms 2.401800000 GHz

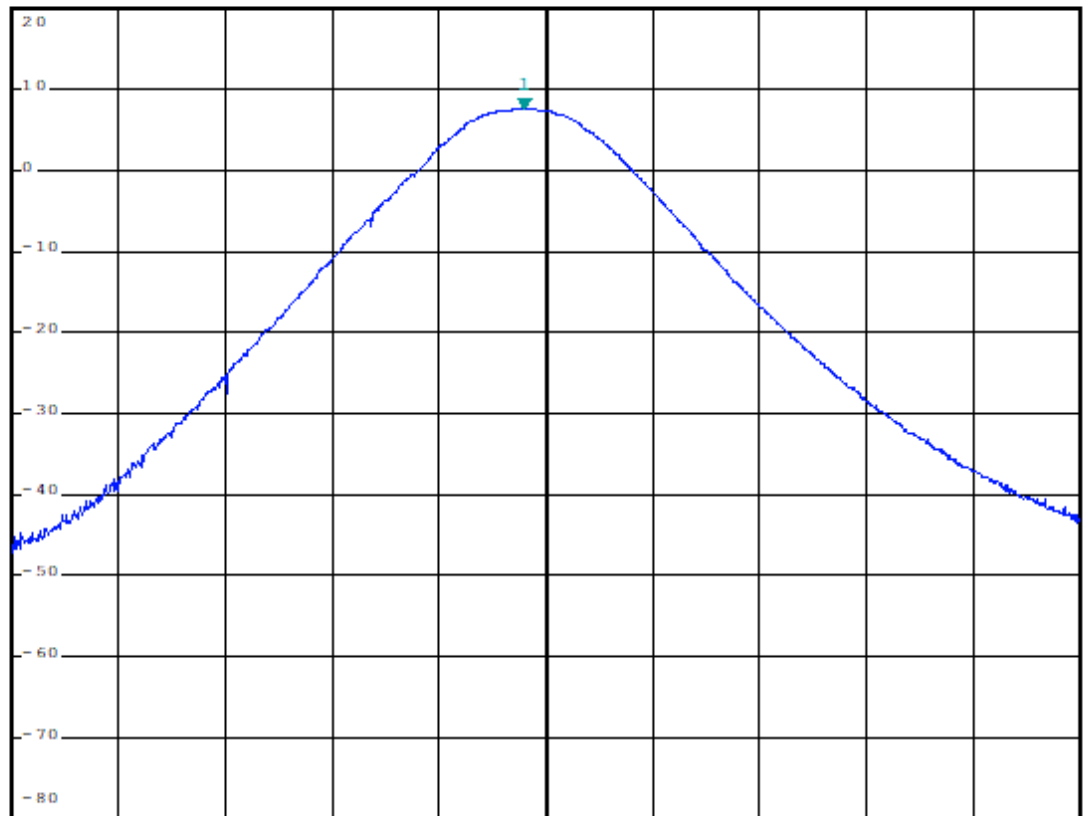
Ref 20 dBm

\*Att 30 dB

SWT 5 ms

2.401800000 GHz

1 PK  
VIEW



Center 2.402 GHz

1 MHz/

Span 10 MHz

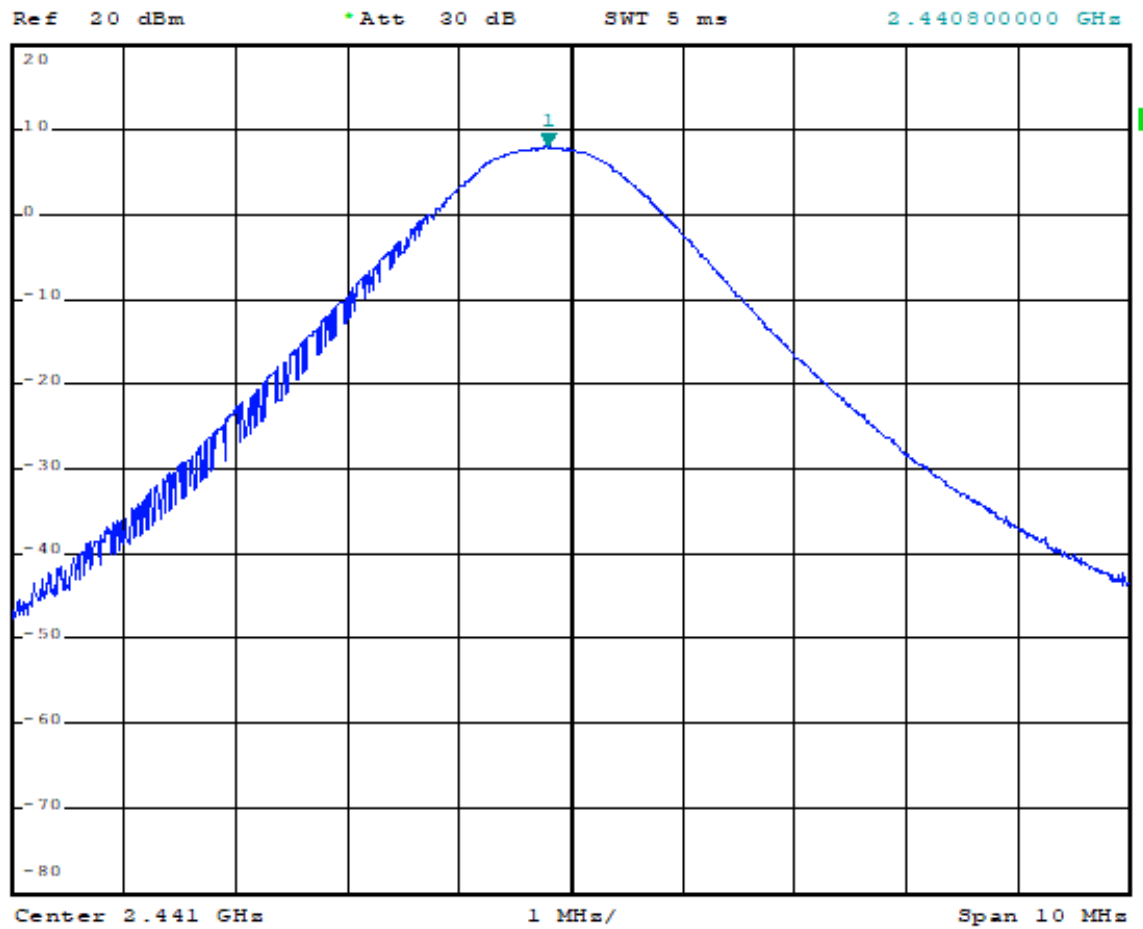
Date: 26.MAY.2022 17:27:40



GFSK (1Mbps) Channel: 39



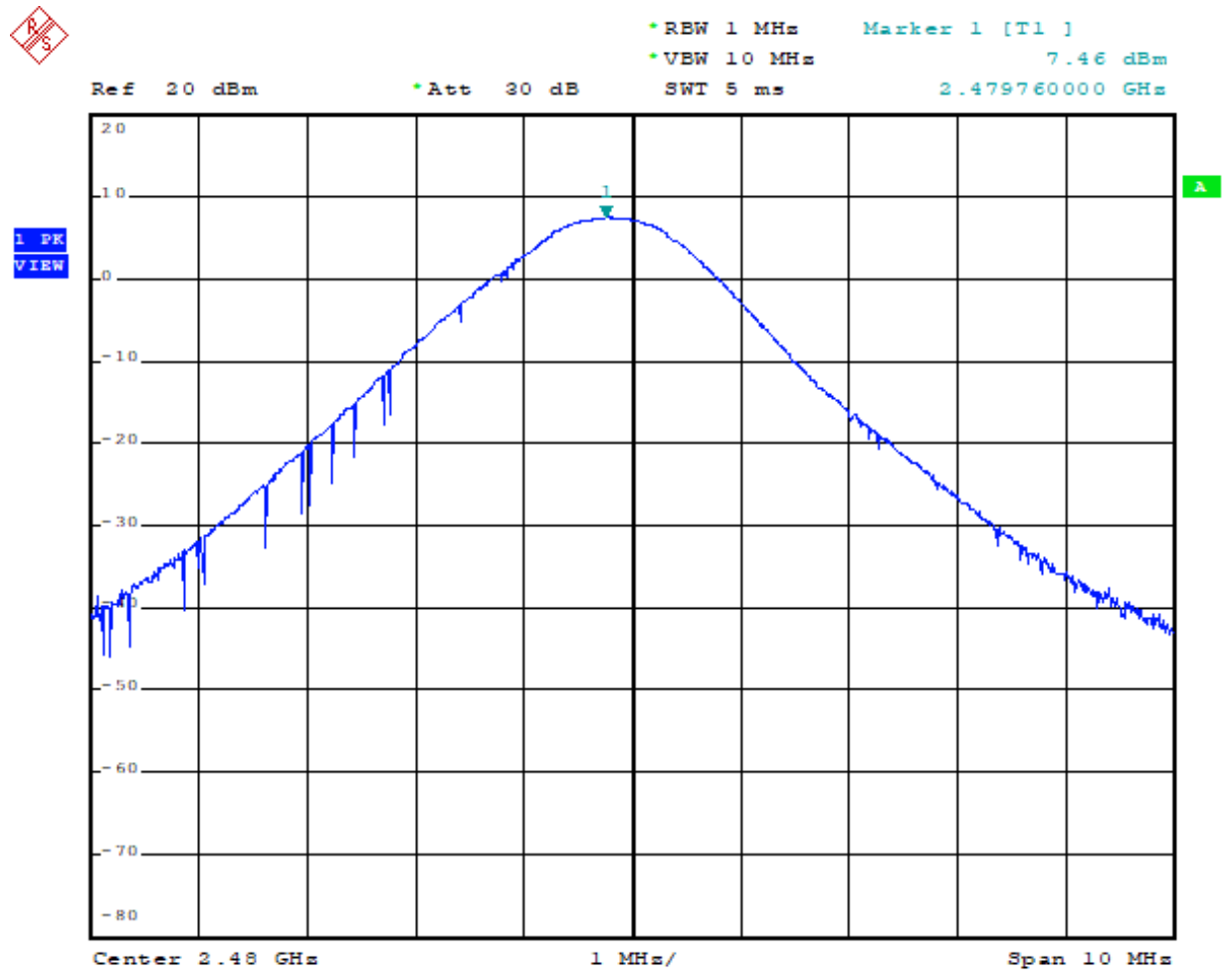
\*RBW 1 MHz Marker 1 [T1]  
\*VBW 10 MHz 7.98 dBm  
SWT 5 ms 2.440800000 GHz



Date: 26.MAY.2022 17:28:15



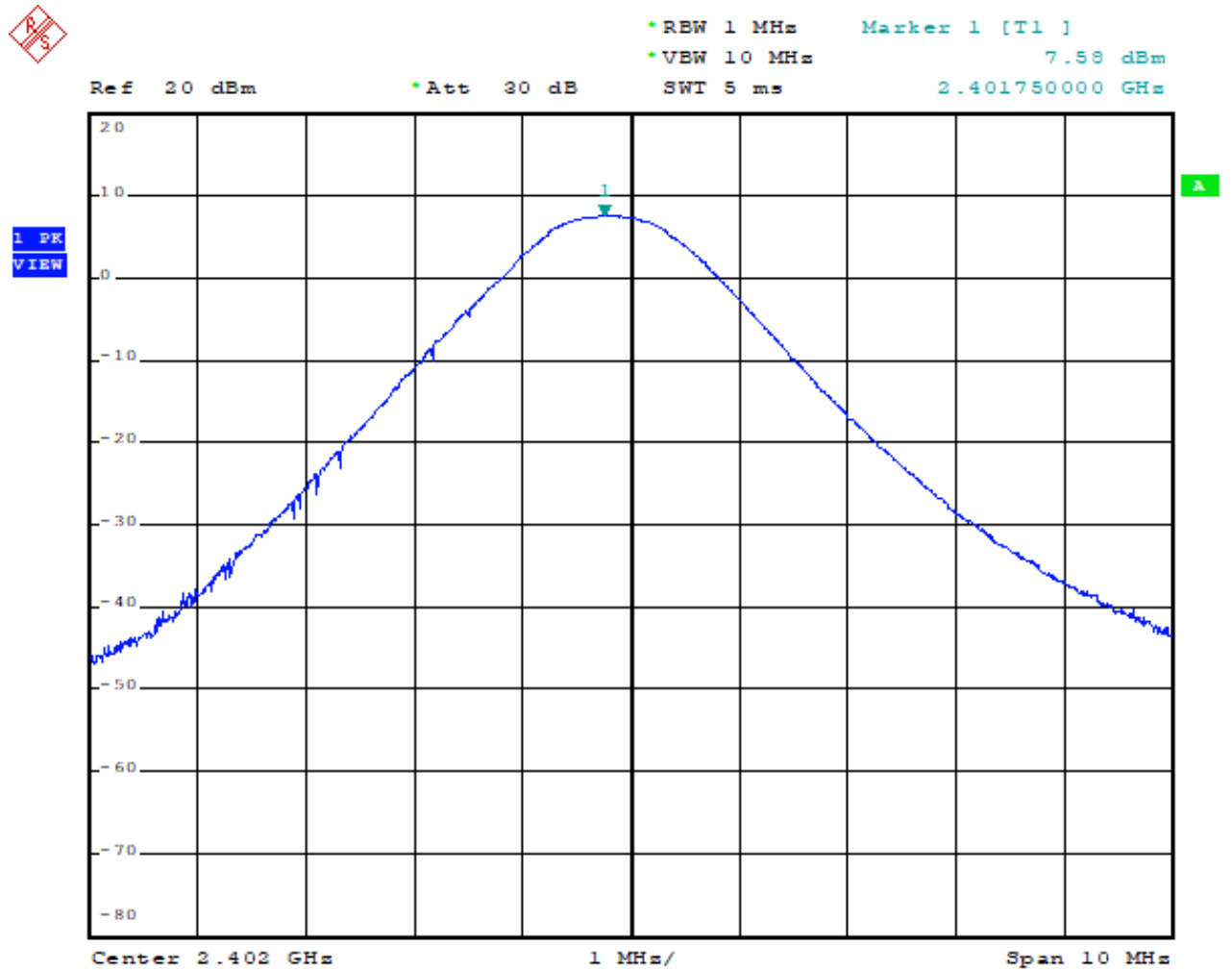
GFSK (1Mbps) Channel: 78



Date: 26.MAY.2022 17:29:16



$\pi/4$ -DQPSK (2Mbps) Channel: 00



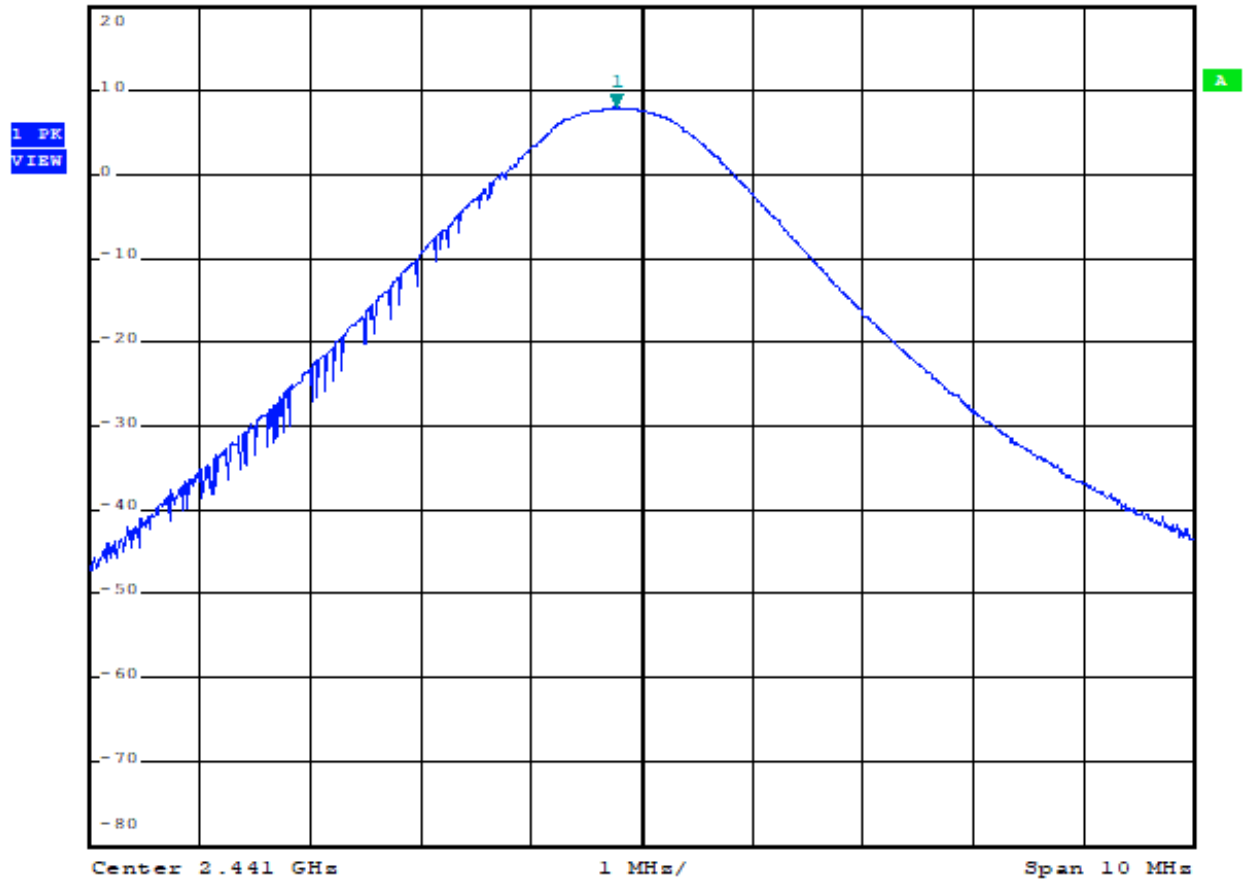
Date: 26.MAY.2022 17:30:41



$\pi/4$ -DQPSK (2Mbps) Channel: 39



\*RBW 1 MHz Marker 1 [T1 ]  
\*VBW 10 MHz 7.98 dBm  
Ref 20 dBm \*Att 30 dB SWT 5 ms 2.440780000 GHz



Date: 26.MAY.2022 17:31:28





$\pi/4$ -DQPSK (2Mbps) Channel: 78

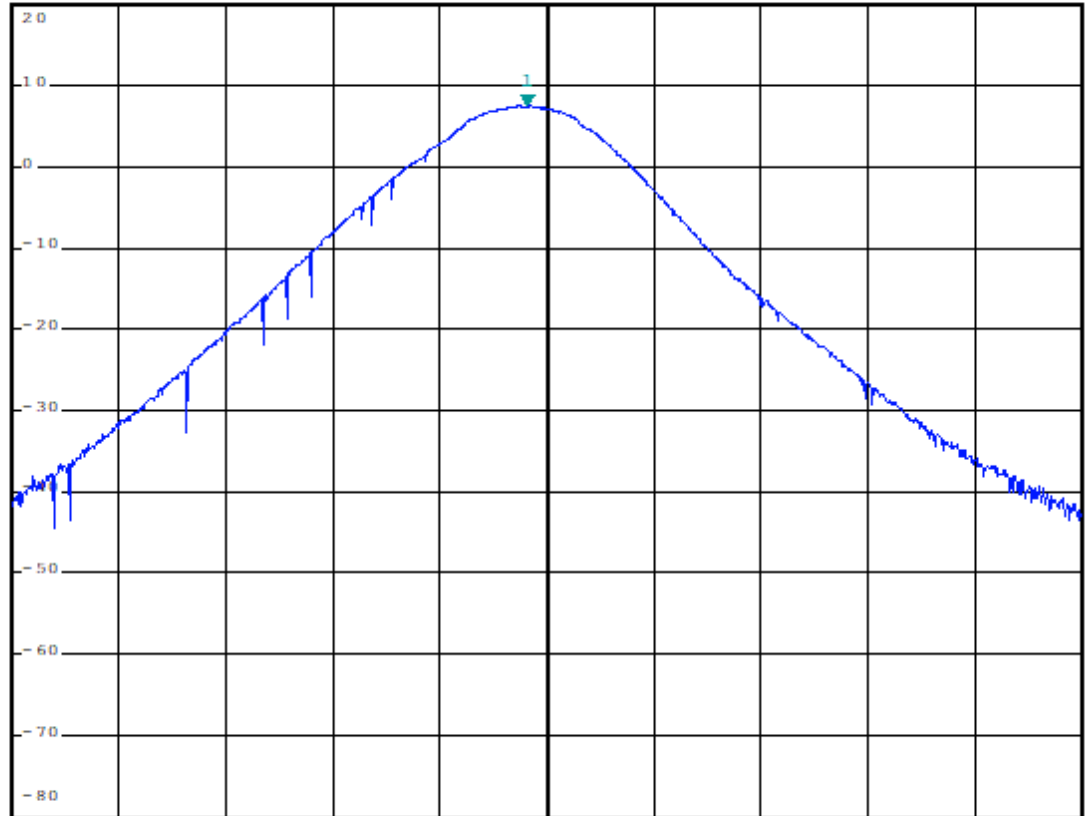


• RBW 1 MHz Marker 1 [T1 ]  
• VBW 10 MHz 7.46 dBm  
SWT 5 ms 2.479820000 GHz

Ref 20 dBm

• Att 30 dB

1 PR  
VIEW



Center 2.48 GHz

1 MHz/

Span 10 MHz

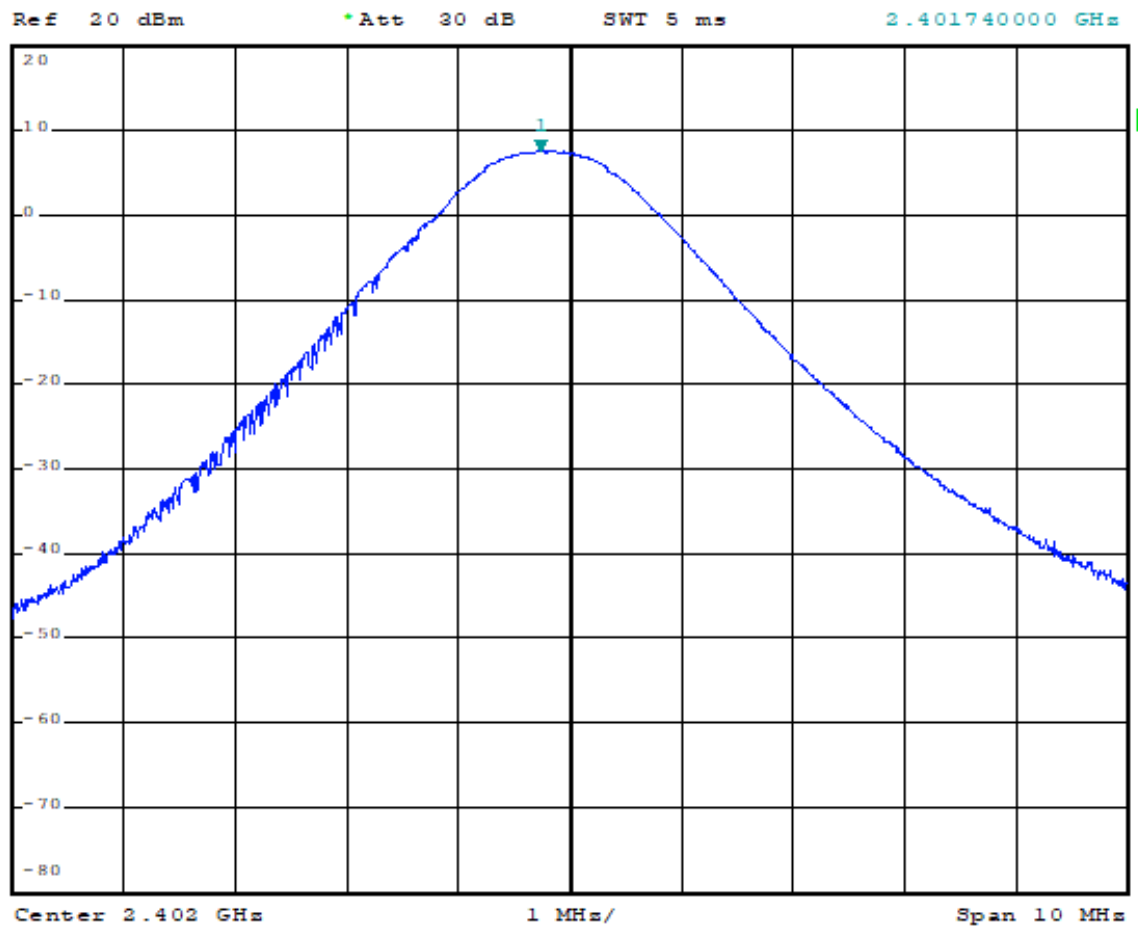
Date: 26.MAY.2022 17:32:31



8DPSK (3Mbps) Channel: 00



\*RBW 1 MHz Marker 1 [T1 ]  
\*VBW 10 MHz 7.55 dBm  
SWT 5 ms 2.401740000 GHz



Date: 26.MAY.2022 17:34:12

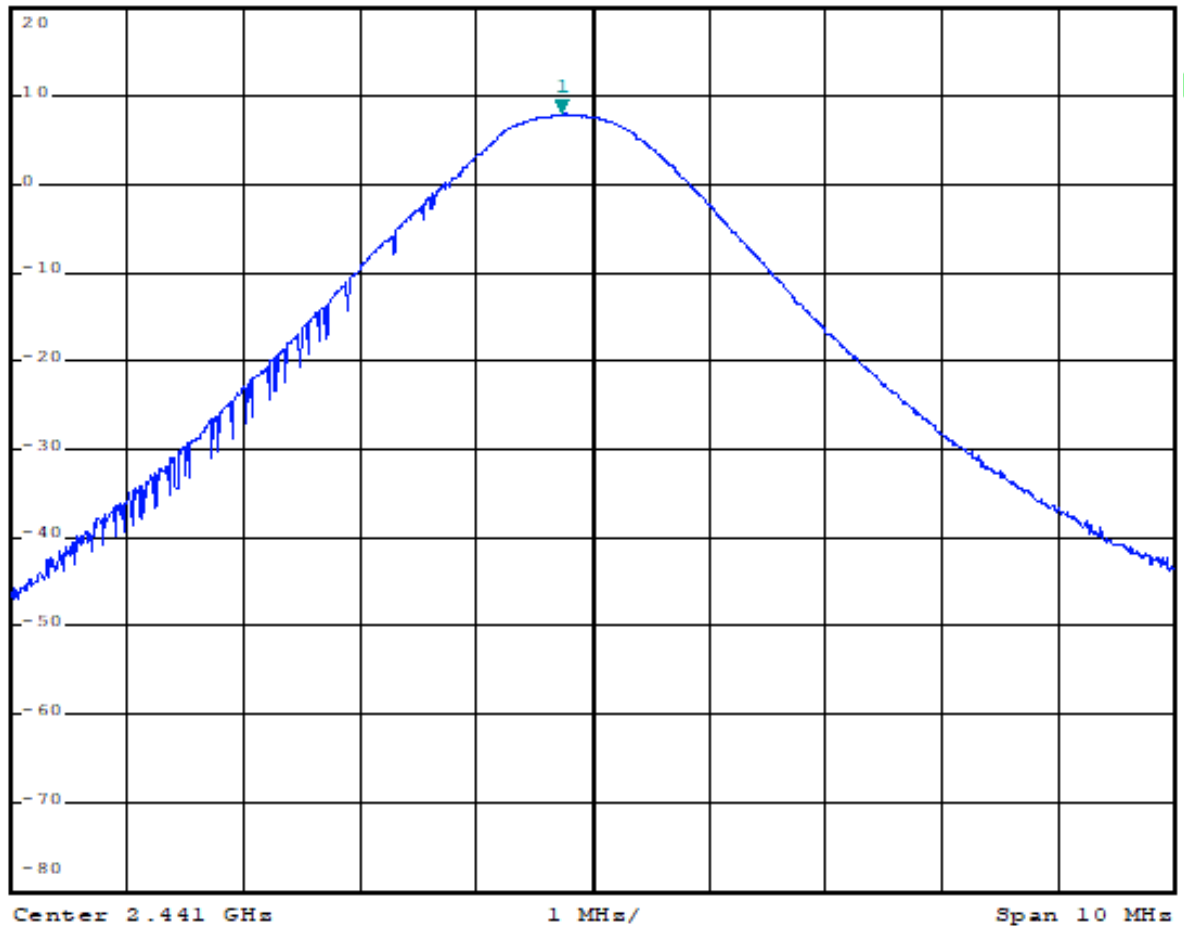


8DPSK (3Mbps) Channel: 39



\*RBW 1 MHz Marker 1 [T1]  
\*VBW 10 MHz 7.94 dBm  
Ref 20 dBm \*Att 30 dB SWT 5 ms 2.440740000 GHz

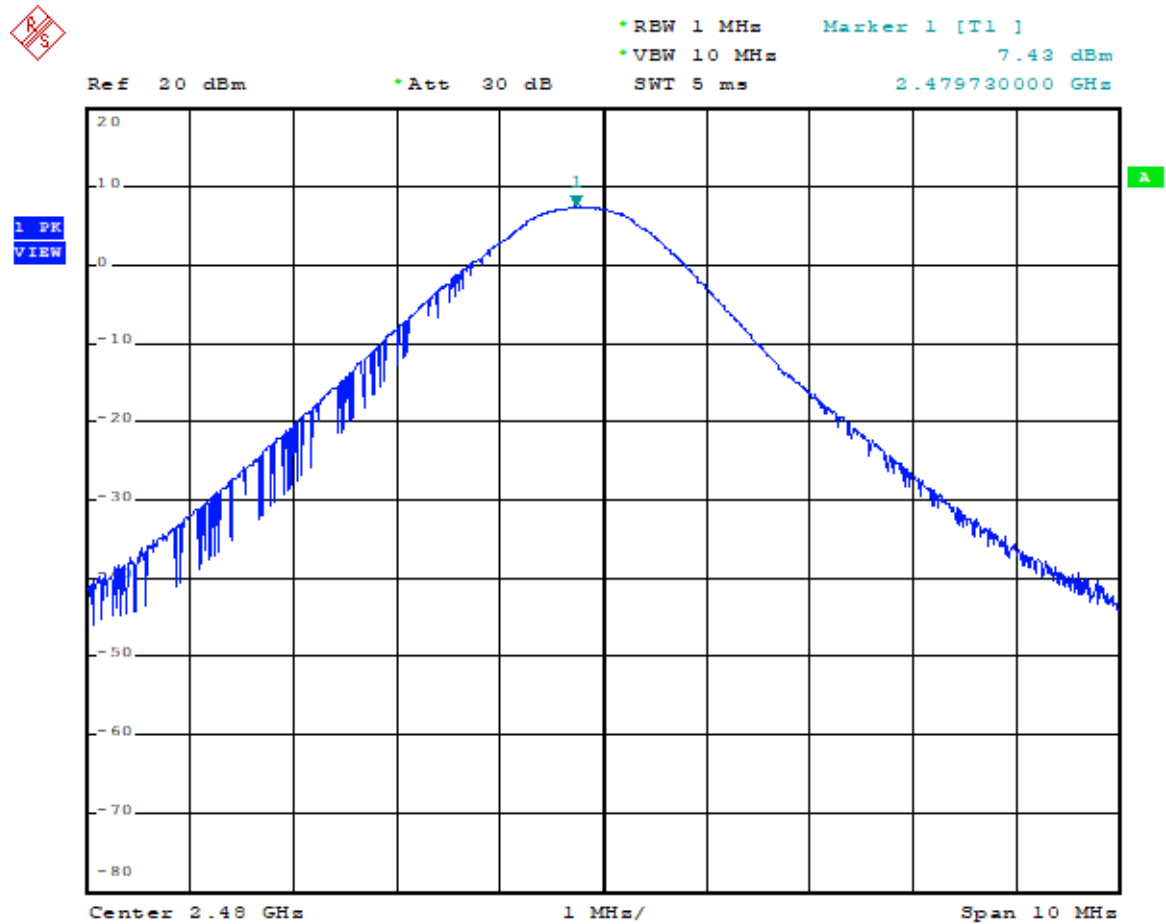
1 PK  
VIEW



Date: 26.MAY.2022 17:35:05



8DPSK (3Mbps) Channel: 78



Date: 26.MAY.2022 17:41:14



### 13. Band Edges Measurement

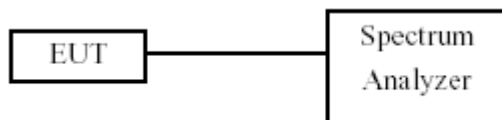
#### 13.1 Test Limit

Below – 20 dB of the highest emission level of operating band (In 100 kHz Resolution Bandwidth)

#### 13.2 Test Procedure

- The transmitter output was connected to the spectrum analyzer via a low lose cable.
- Set RBW of spectrum analyzer to 100 kHz.
- Set VBW of spectrum analyzer to 300 kHz.
- The band edges was measured and recorded.

#### 13.3 Test Setup Layout



#### 13.4 Test Result and Data

Test Date: 2022.05.26

Temperature: 27°C

Atmospheric pressure: 1012 hPa

Humidity: 55%

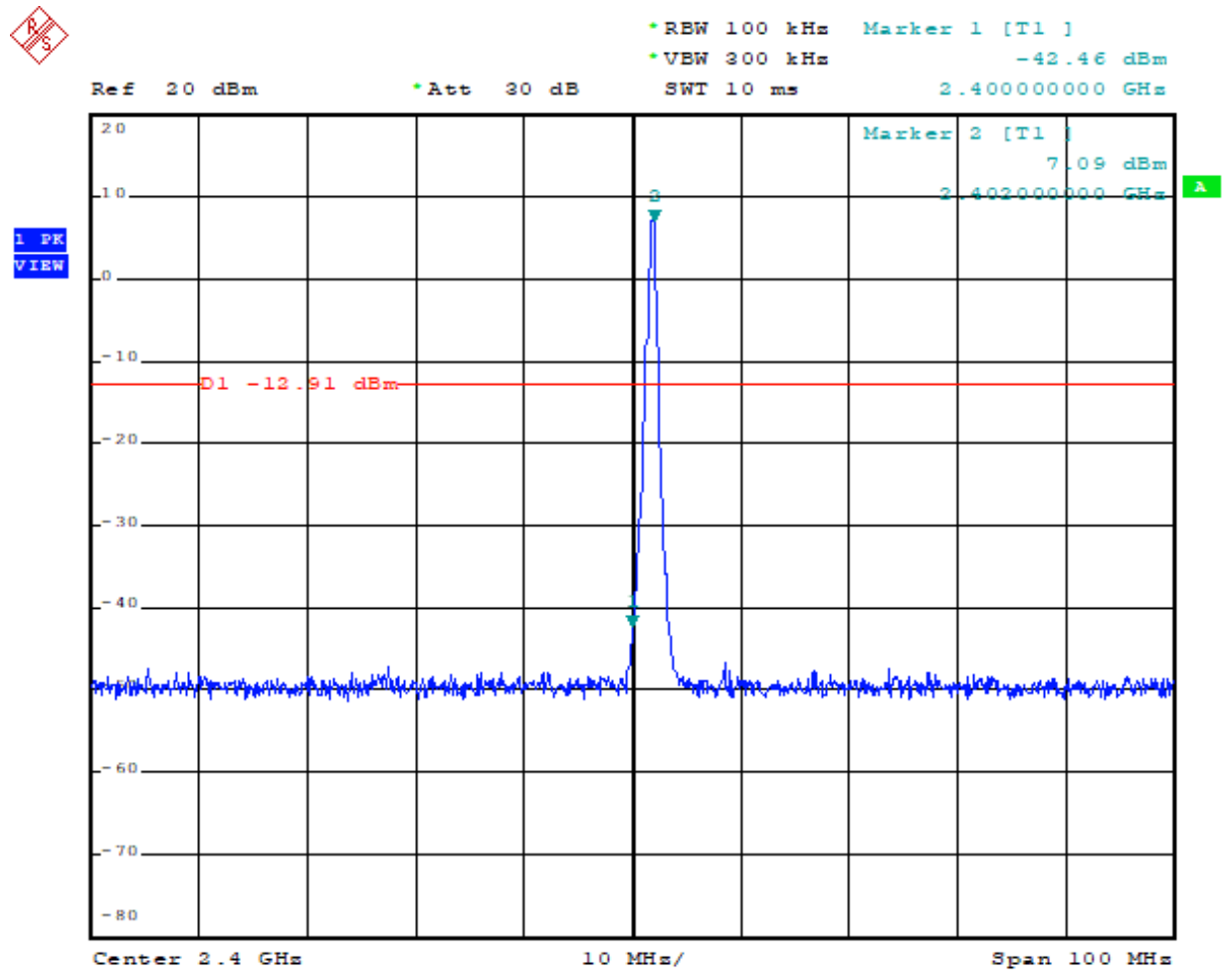
| Modulation Standard    | Channel | Frequency (MHz) | maximum value in frequency (MHz) | maximum value (dBm) |
|------------------------|---------|-----------------|----------------------------------|---------------------|
| GFSK (1Mbps)           | 00      | 2402            | 2400.0                           | -42.46              |
|                        | 78      | 2480            | 2519.5                           | -47.61              |
| $\pi/4$ -DQPSK (2Mbps) | 00      | 2402            | 2400.0                           | -43.53              |
|                        | 78      | 2480            | 2483.8                           | -47.71              |
| 8DPSK (3Mbps)          | 00      | 2402            | 2400.0                           | -44.17              |
|                        | 78      | 2480            | 2491.4                           | -47.21              |



| Hopping Band Edges |         |                 |                                  |                     |
|--------------------|---------|-----------------|----------------------------------|---------------------|
| Modulation Type    | Channel | Frequency (MHz) | Maximum Value In Frequency (MHz) | Maximum Value (dBm) |
| GFSK               | 0       | 2402            | 2400.0                           | -48.35              |
|                    | 78      | 2480            | 2483.5                           | -57.56              |
| $\pi/4$ -DQPSK     | 0       | 2402            | 2400.0                           | -54.61              |
|                    | 78      | 2480            | 2509.1                           | -56.21              |
| 8DPSK              | 0       | 2402            | 2399.6                           | -57.23              |
|                    | 78      | 2480            | 2540.7                           | -56.13              |



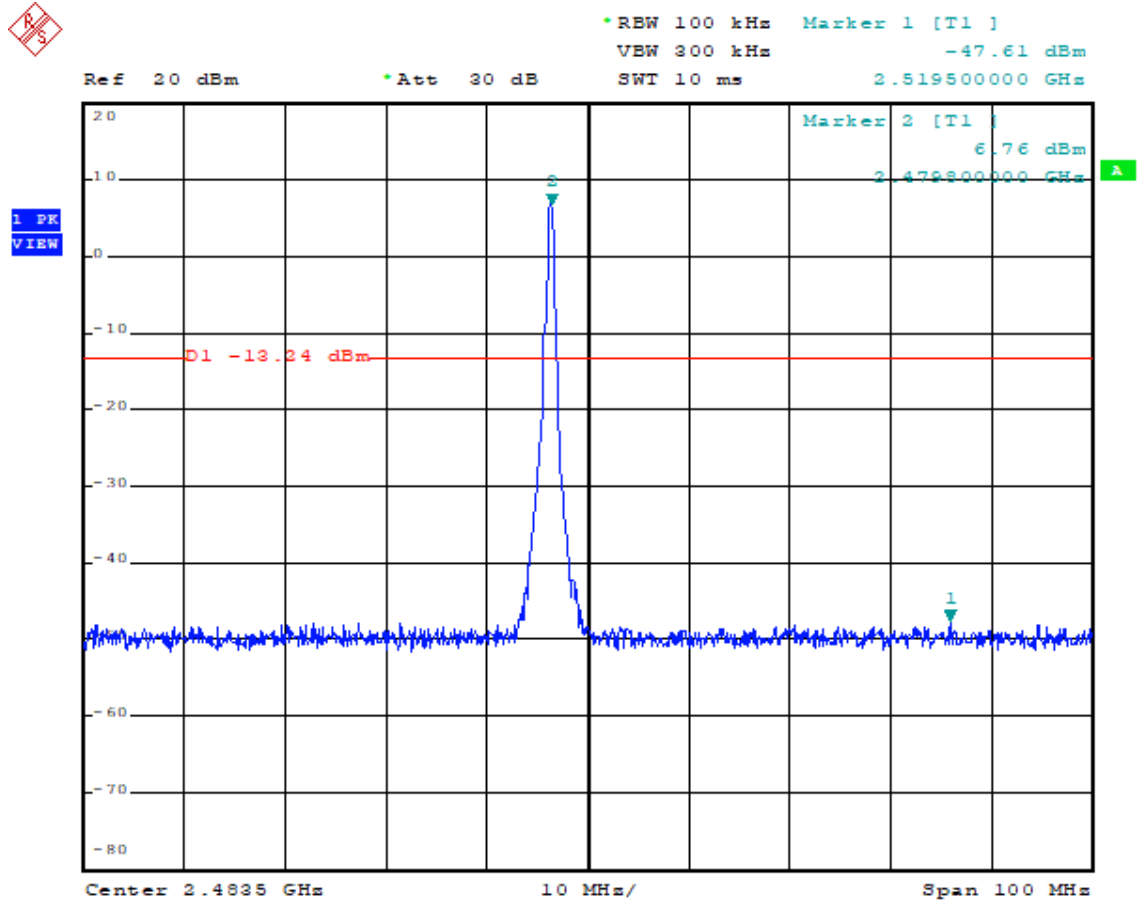
GFSK (1Mbps) Channel: 00



Date: 26.MAY.2022 17:39:32



GFSK (1Mbps) Channel: 78



Date: 26.MAY.2022 17:44:21

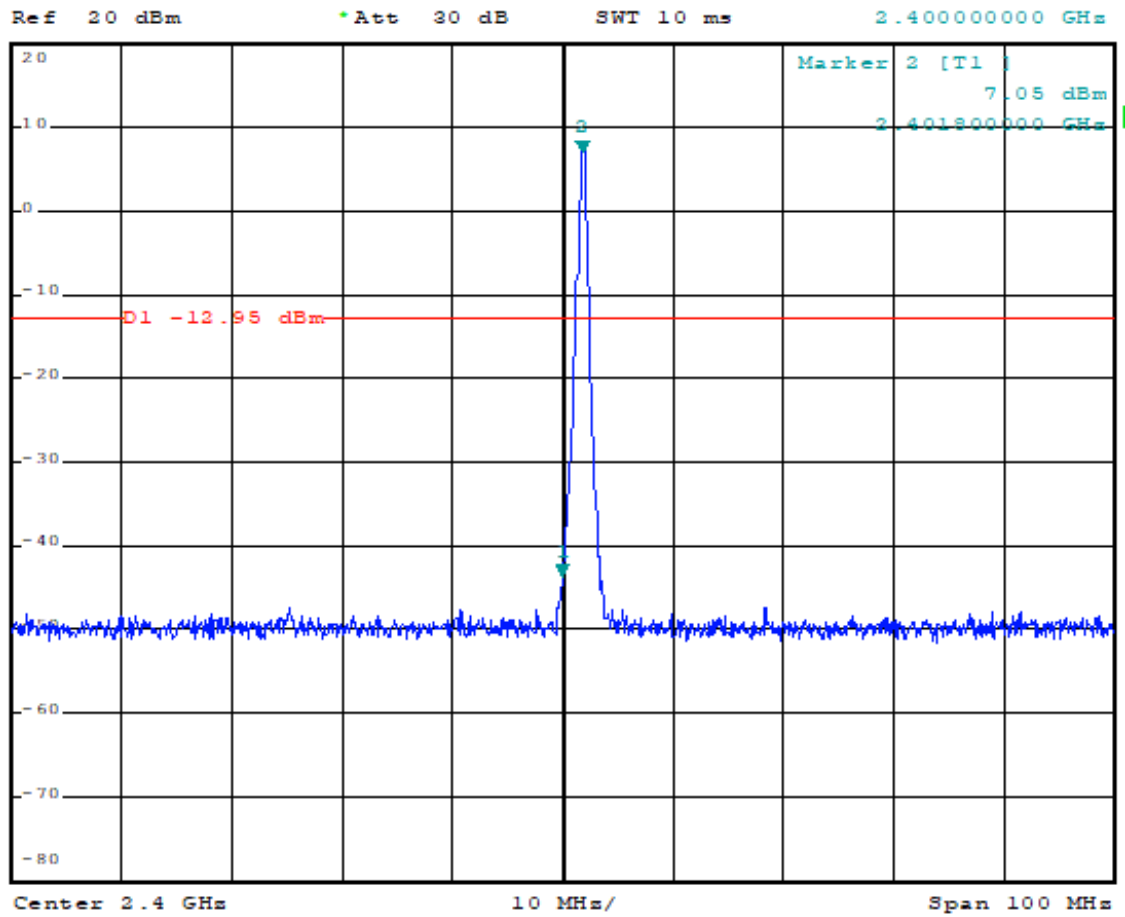




$\pi/4$ -DQPSK (2Mbps) Channel: 00



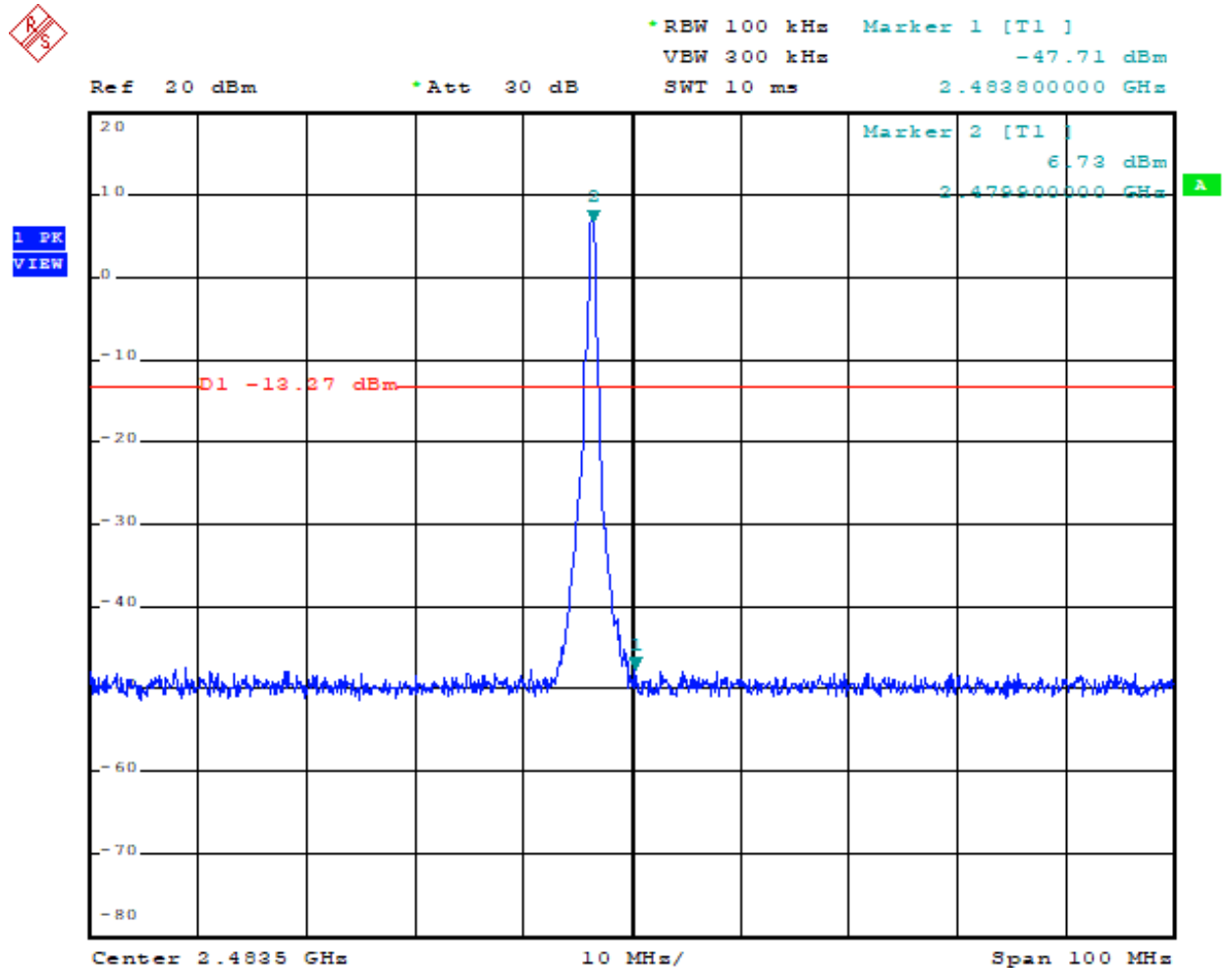
\*RBW 100 kHz Marker 1 [T1 ]  
VBW 300 kHz -43.53 dBm  
SWT 10 ms 2.400000000 GHz



Date: 26.MAY.2022 17:45:29



$\pi/4$ -DQPSK (2Mbps) Channel: 78



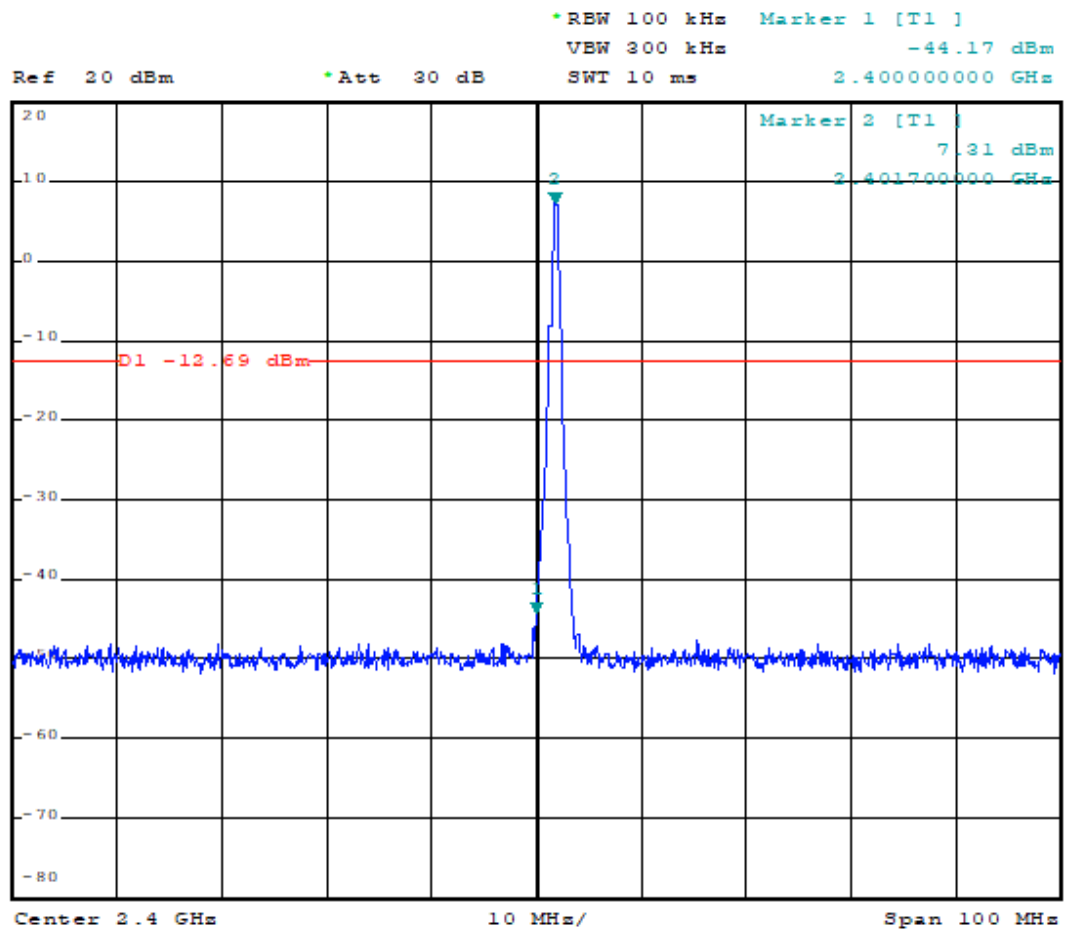
Date: 26.MAY.2022 17:52:54



8DPSK (3Mbps) Channel: 00



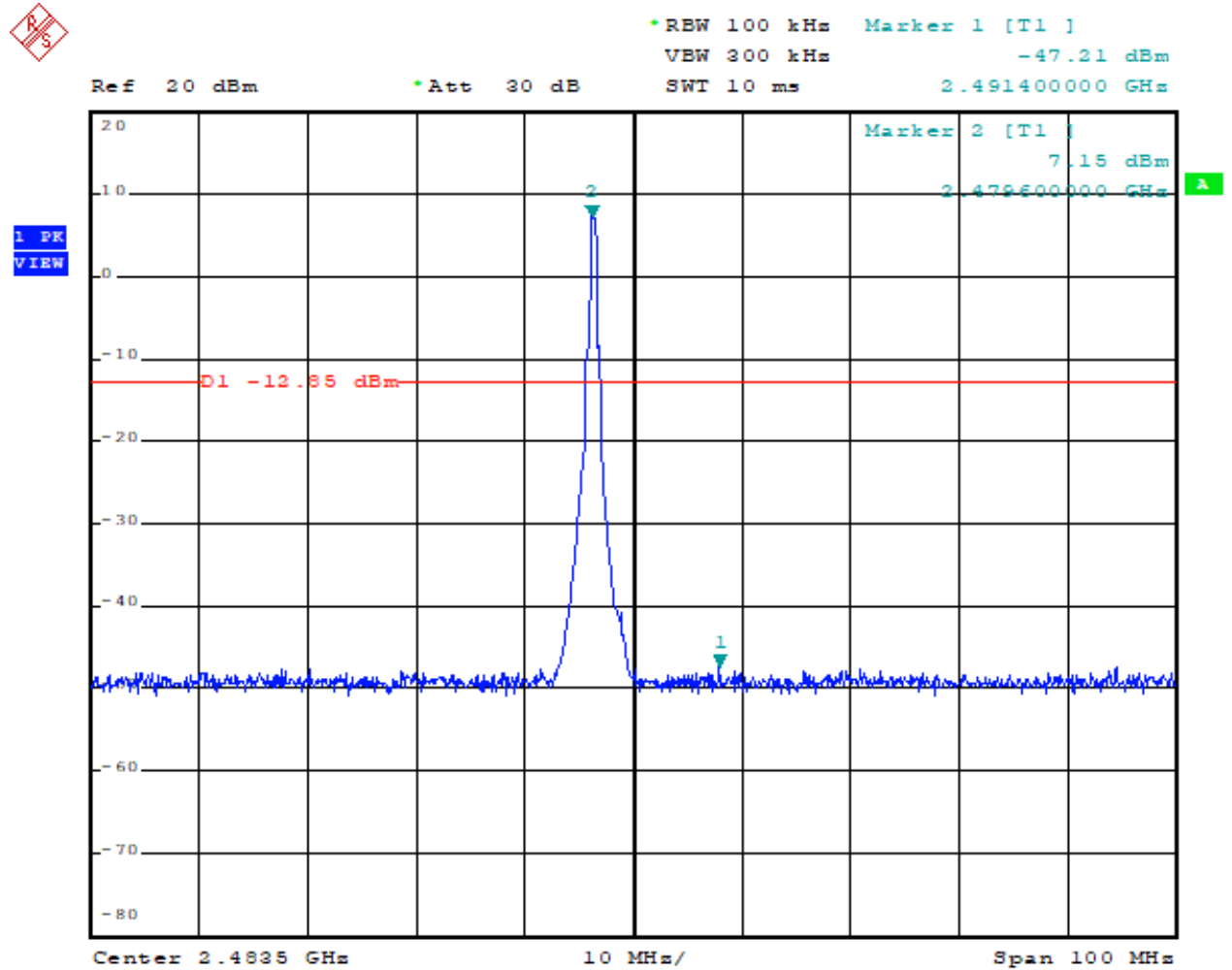
1 PK  
VIEW



Date: 26.MAY.2022 18:17:58



8DPSK (3Mbps) Channel: 78



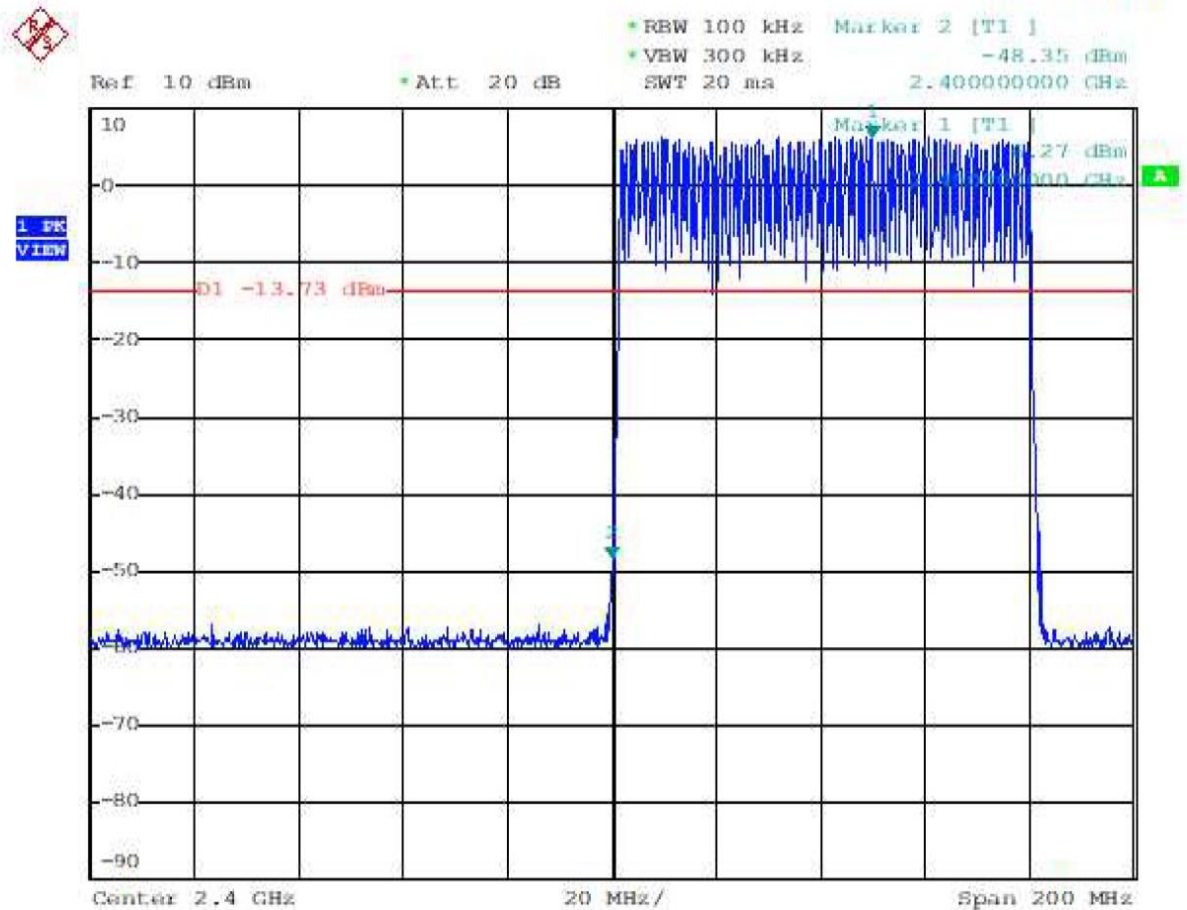
Date: 26.MAY.2022 18:20:48



### 13.5 hopping enabled mode

GFSK (1Mbps) Channel: 00

Date: 2022-07-07

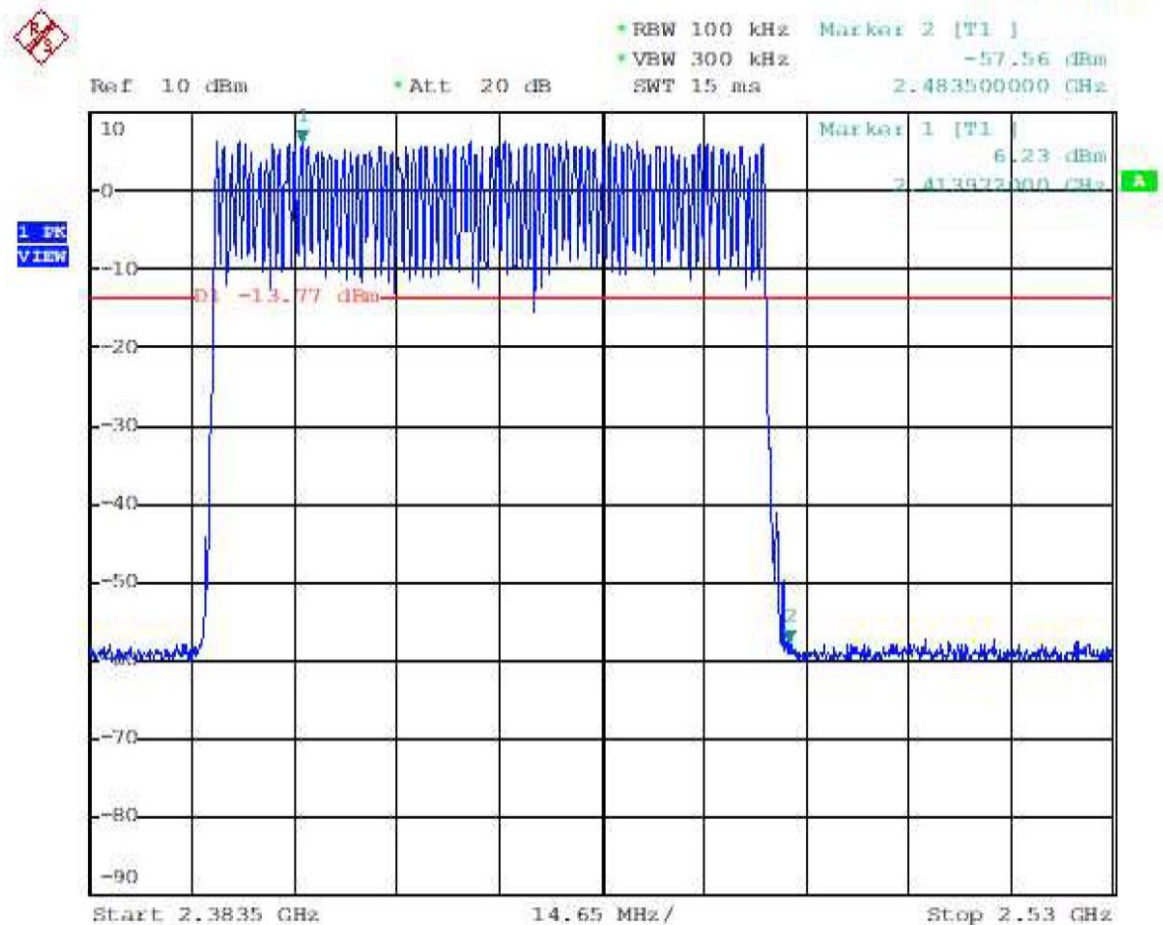


Date: 7.JUL.2022 12:01:05



GFSK (1Mbps) Channel: 78

Date: 2022-07-07

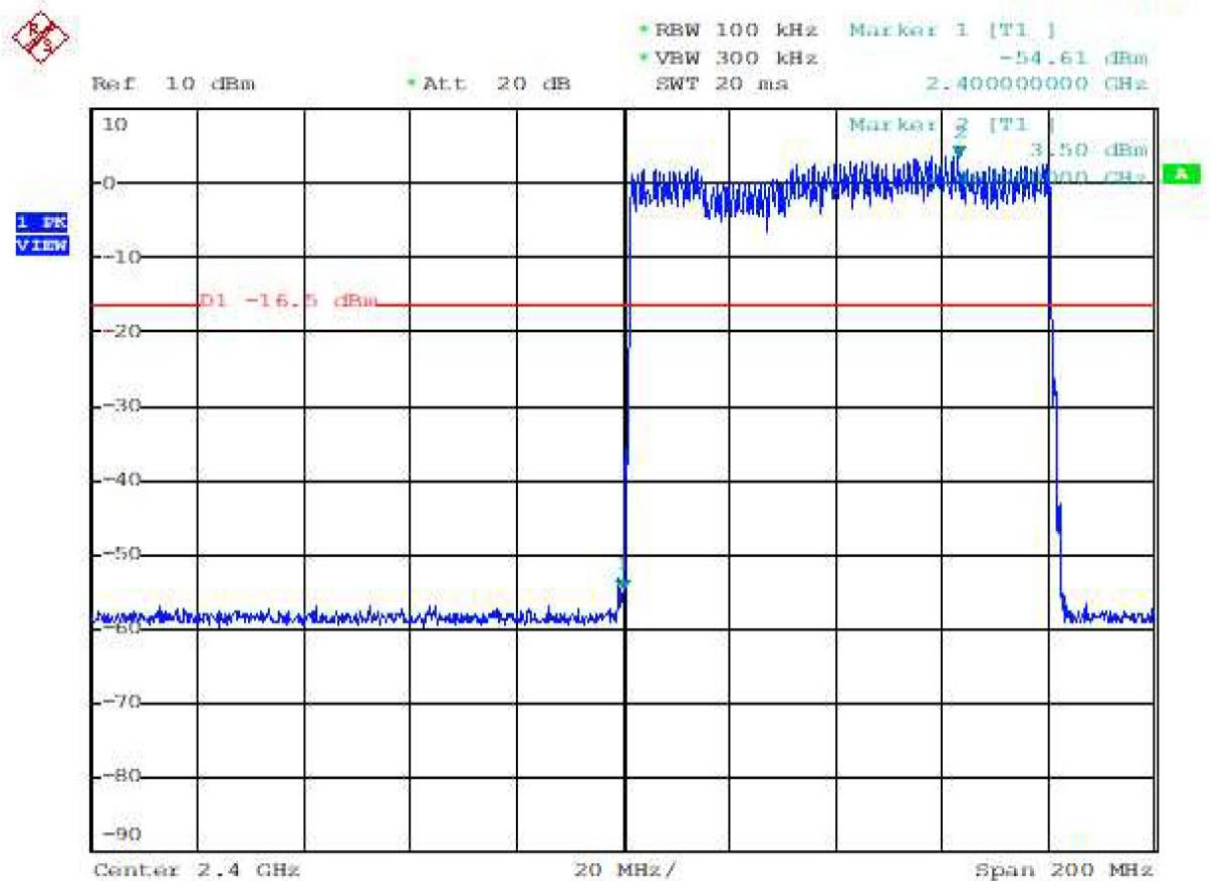


Date: 7.JUL.2022 12:13:12



$\pi/4$ -DQPSK (2Mbps) Channel: 00

Date: 2022-07-07

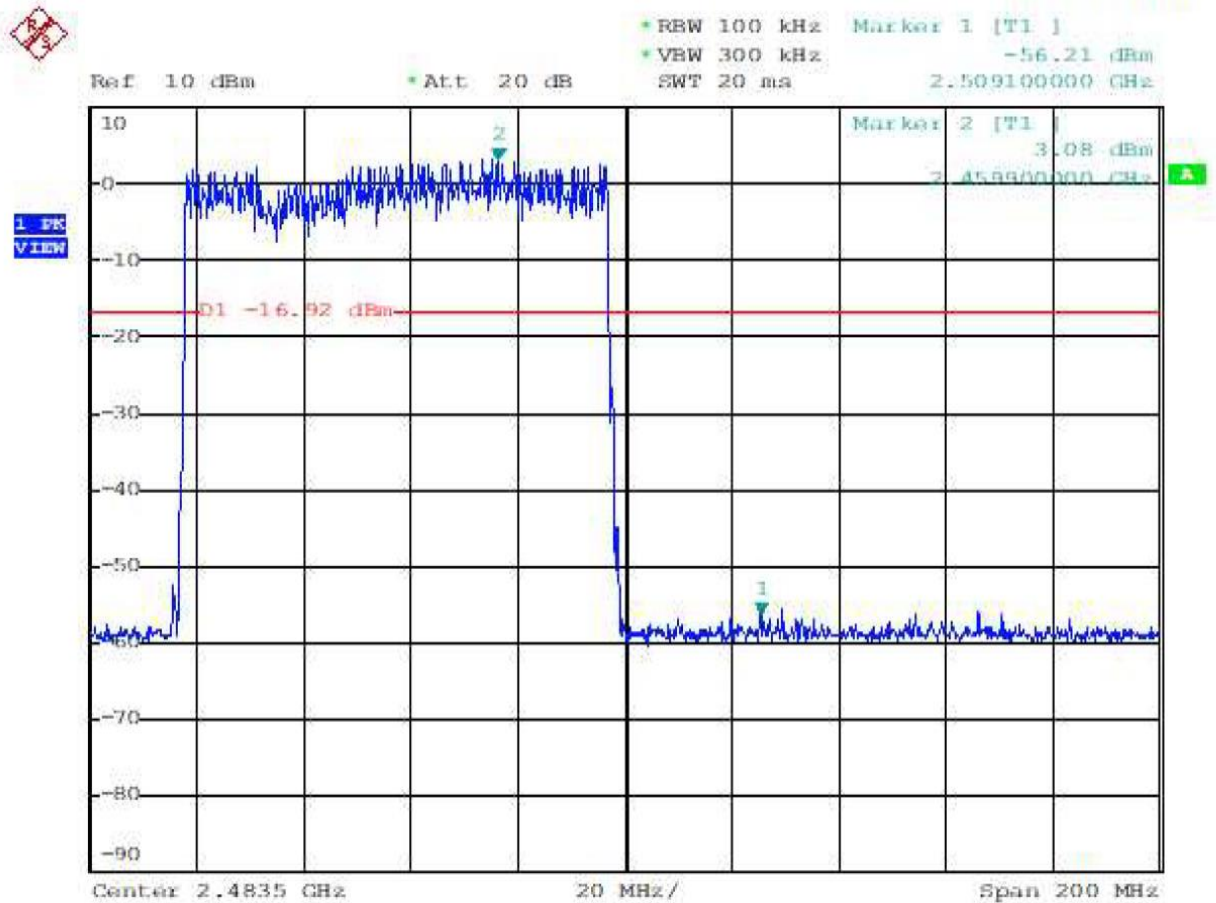


Date: 7.JUL.2022 11:45:23



$\pi/4$ -DQPSK (2Mbps) Channel: 78

Date: 2022-07-07



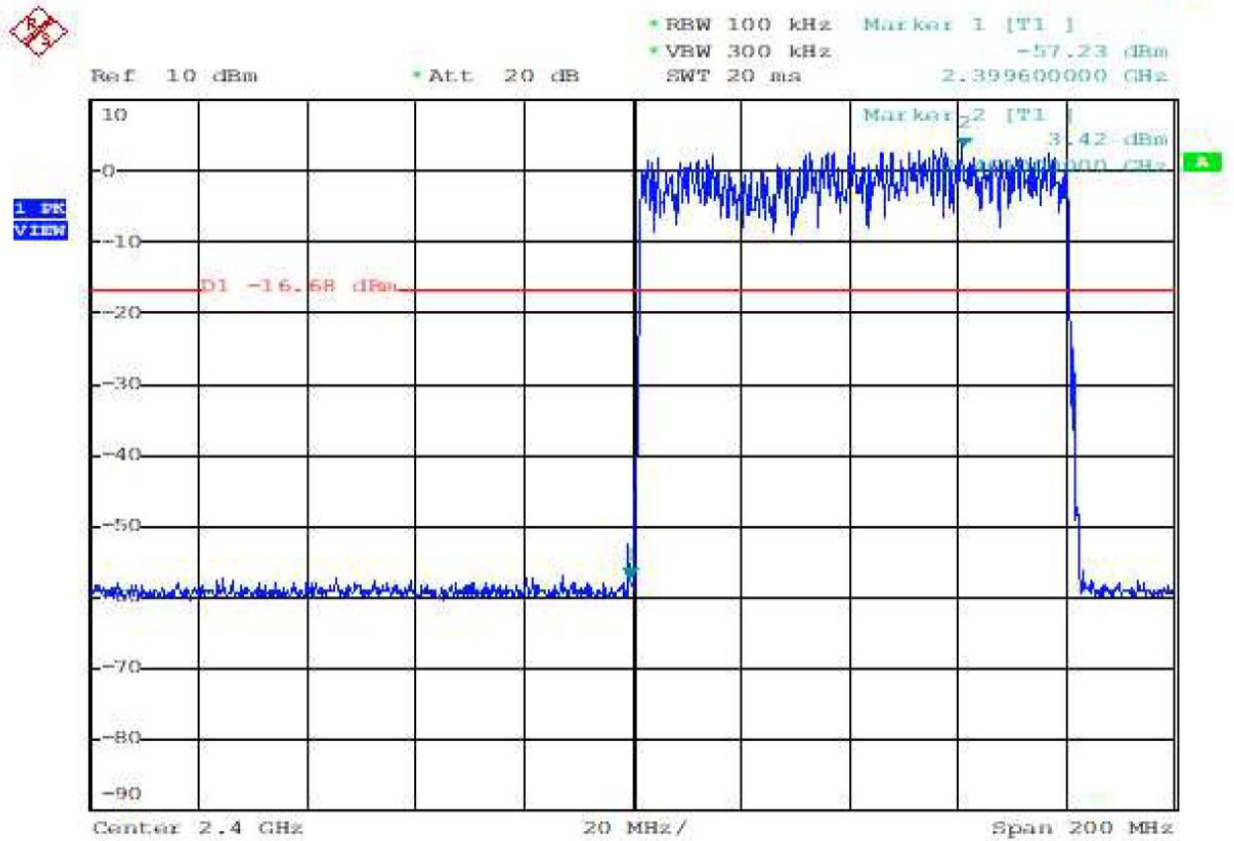
Date: 7.JUL.2022 11:49:05





8DPSK (3Mbps) Channel: 00

Date: 2022-07-07

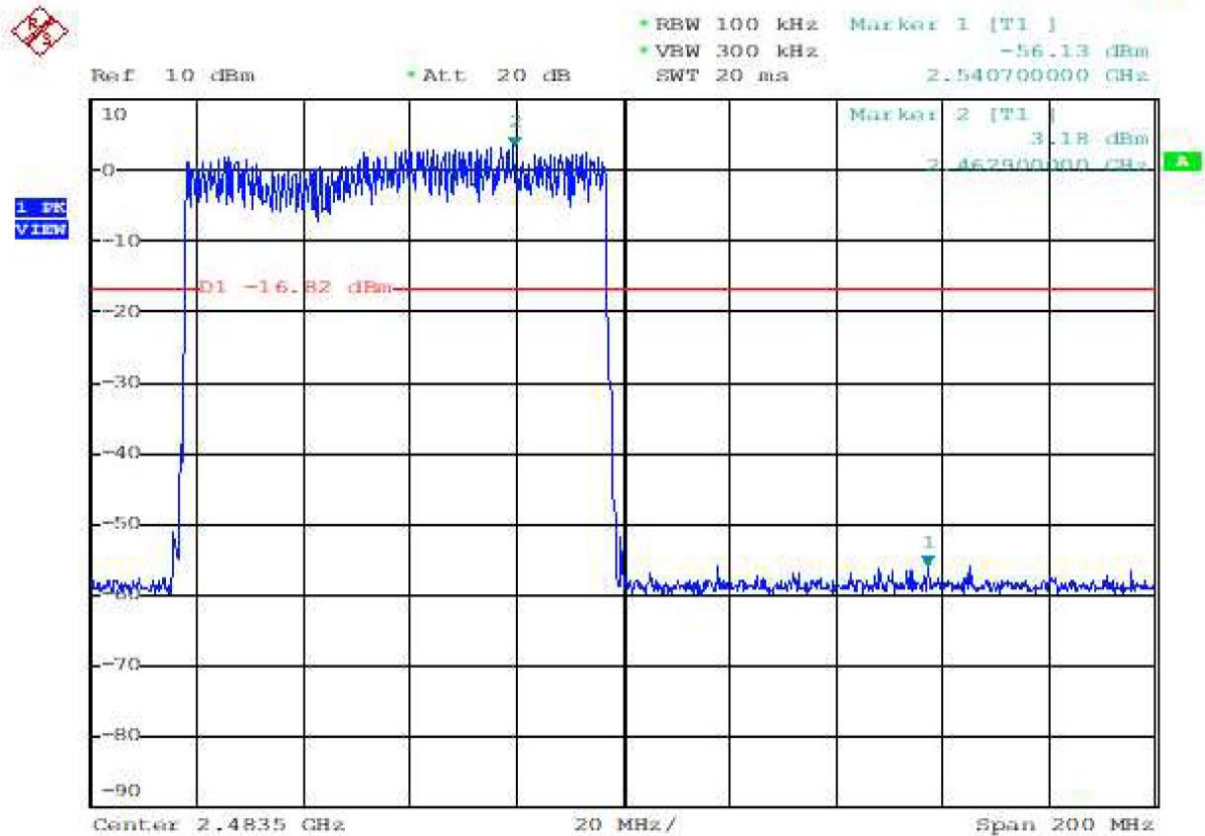


Date: 7 JUL 2022 11:52:02



8DPSK (3Mbps) Channel: 78

Date: 2022-07-07

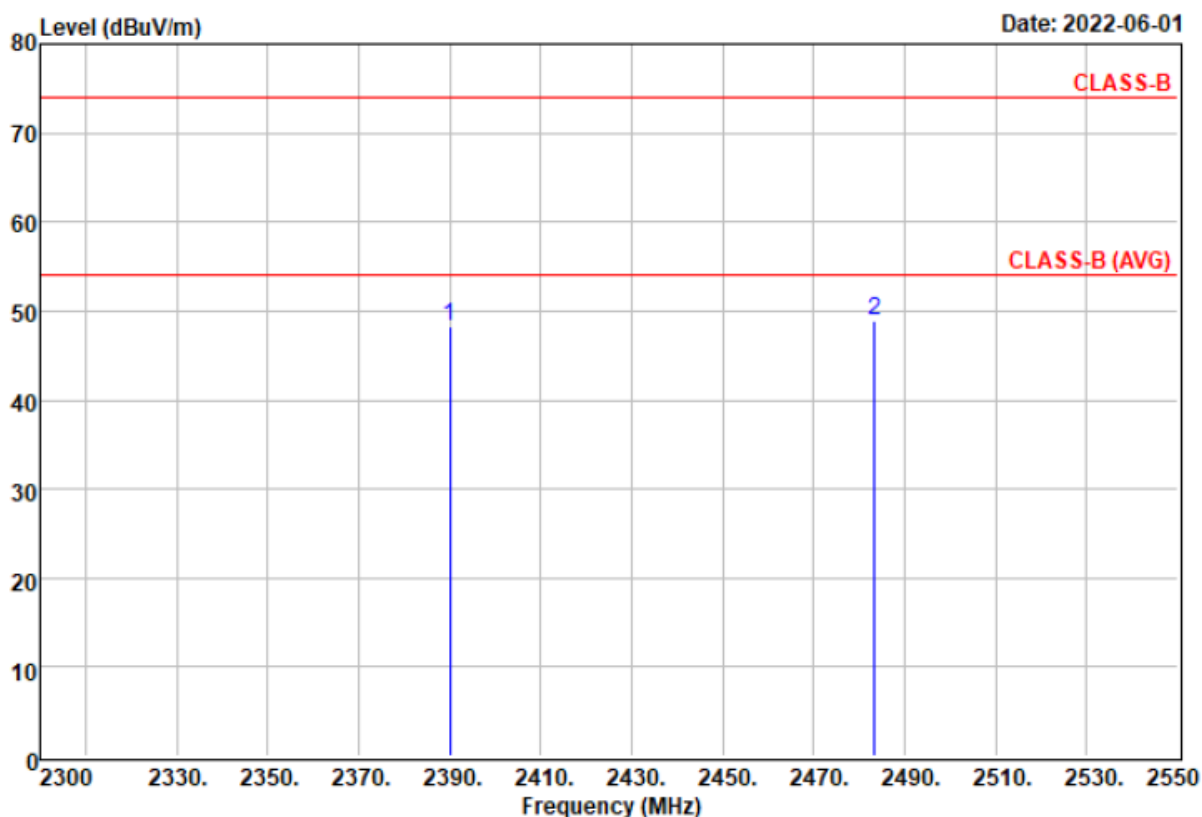


Date: 7 JUL 2022 11:55:27



### 13.6 Restrict Band Emission Measurement Data

|             |                                 |           |              |
|-------------|---------------------------------|-----------|--------------|
| Power       | : DC 12V                        | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                         | Humidity  | : 70 %       |
| Test Mode   | : CH LO & HI – Restricted Bands | Memo      | : GFSK       |



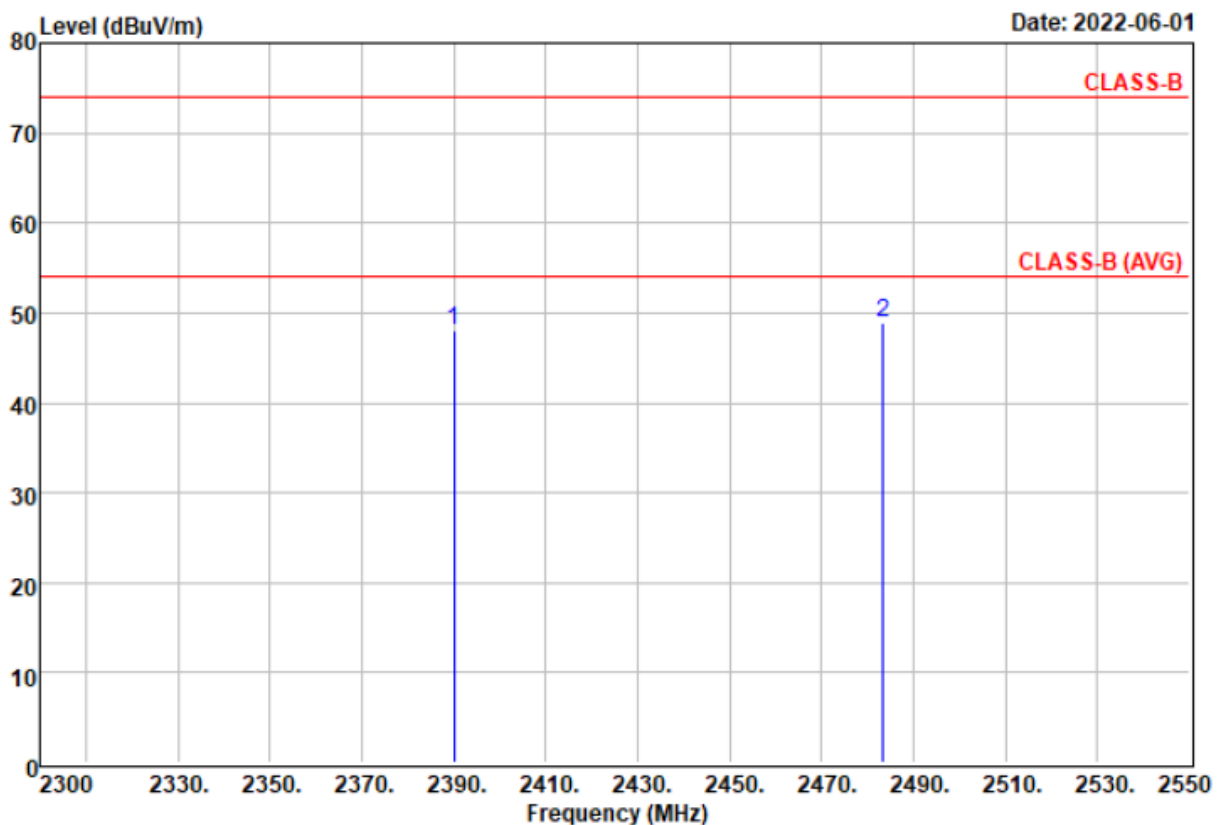
|      | Read     |        |        | Limit  | Over  |             |
|------|----------|--------|--------|--------|-------|-------------|
| Freq | Level    | Factor | Level  | Line   | Limit | Remark      |
| MHz  | dBuV     | dB/m   | dBuV/m | dBuV/m | dB    |             |
| 1    | 2390.000 | 58.04  | -9.78  | 48.26  | 74.00 | -25.74 Peak |
| 2 @  | 2483.500 | 58.24  | -9.24  | 49.00  | 74.00 | -25.00 Peak |

Note:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss - Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 10 Hz for Average detection at frequency above 1 GHz.



|             |                                 |           |            |
|-------------|---------------------------------|-----------|------------|
| Power       | : DC 12V                        | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                         | Humidity  | : 70 %     |
| Test Mode   | : CH LO & HI – Restricted Bands | Memo      | : GFSK     |



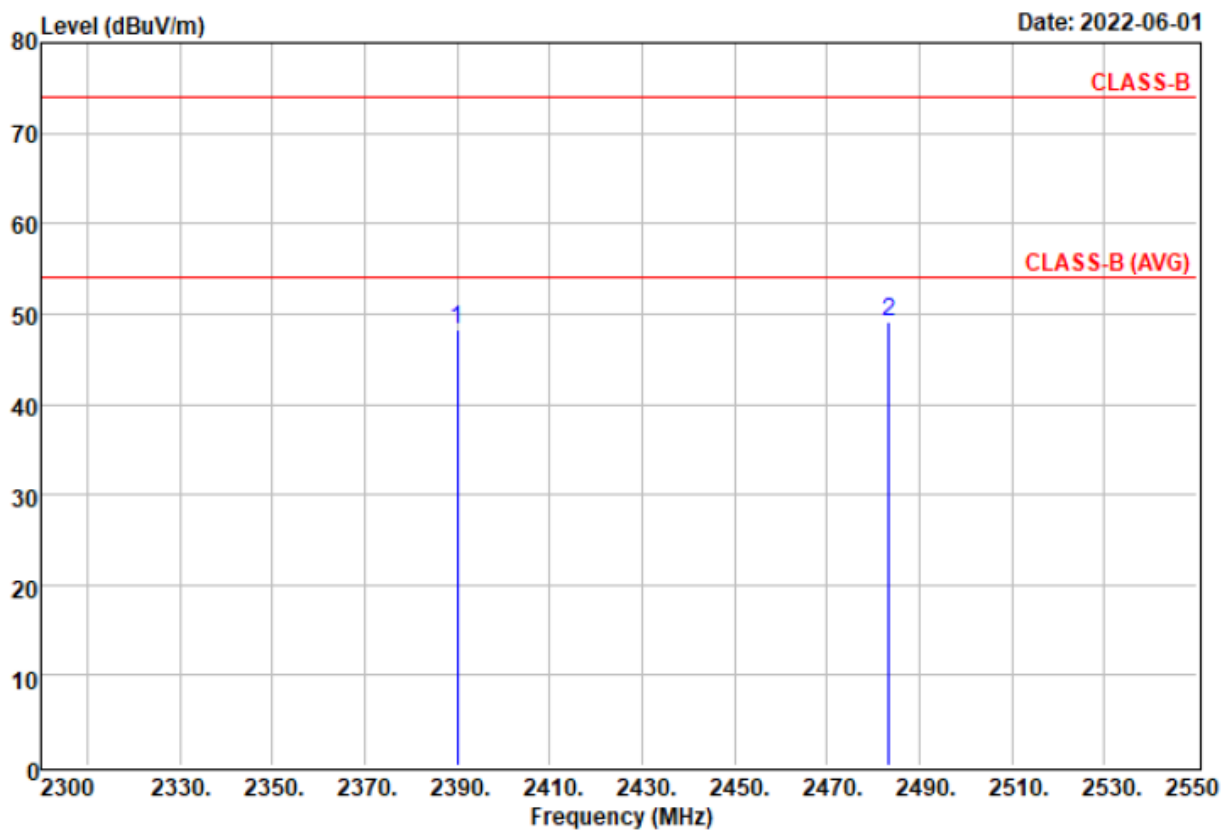
|   | Read<br>Freq | Level | Factor | Level  | Limit<br>Line | Over<br>Limit | Remark |
|---|--------------|-------|--------|--------|---------------|---------------|--------|
|   | MHz          | dBuV  | dB/m   | dBuV/m | dBuV/m        | dB            |        |
| 1 | 2390.000     | 57.89 | -9.78  | 48.11  | 74.00         | -25.89        | Peak   |
| 2 | @ 2483.500   | 58.19 | -9.24  | 48.95  | 74.00         | -25.05        | Peak   |

Note:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss - Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 10 Hz for Average detection at frequency above 1 GHz.



|             |                                 |           |                  |
|-------------|---------------------------------|-----------|------------------|
| Power       | : DC 12V                        | Pol/Phase | : HORIZONTAL     |
| Temperature | : 31 °C                         | Humidity  | : 70 %           |
| Test Mode   | : CH LO & HI – Restricted Bands | Memo      | : $\pi/4$ -DQPSK |



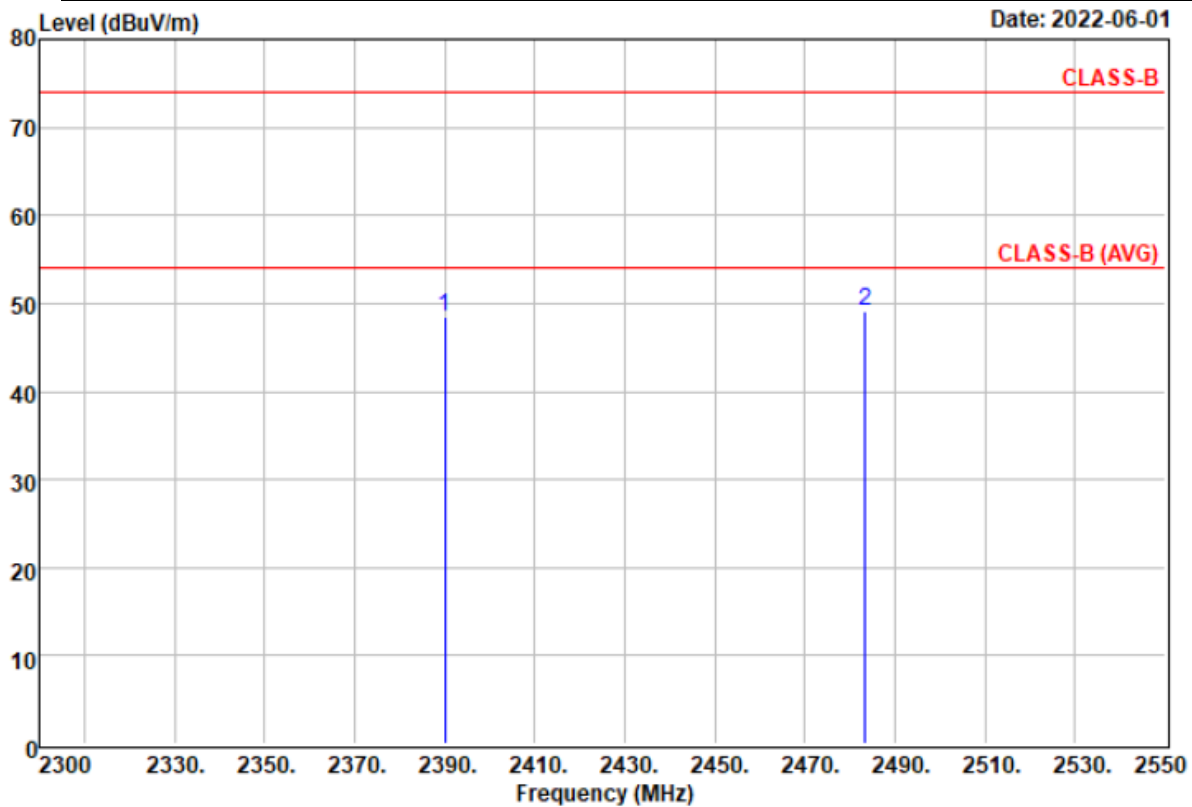
|      | Read     |        |        | Limit  | Over  |             |
|------|----------|--------|--------|--------|-------|-------------|
| Freq | Level    | Factor | Level  | Line   | Limit | Remark      |
| MHz  | dBuV     | dB/m   | dBuV/m | dBuV/m | dB    |             |
| 1    | 2390.000 | 58.11  | -9.78  | 48.33  | 74.00 | -25.67 Peak |
| 2 @  | 2483.500 | 58.31  | -9.24  | 49.07  | 74.00 | -24.93 Peak |

Note:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss - Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 10 Hz for Average detection at frequency above 1 GHz.



|             |                                 |           |                  |
|-------------|---------------------------------|-----------|------------------|
| Power       | : DC 12V                        | Pol/Phase | : VERTICAL       |
| Temperature | : 31 °C                         | Humidity  | : 70 %           |
| Test Mode   | : CH LO & HI – Restricted Bands | Memo      | : $\pi/4$ -DQPSK |



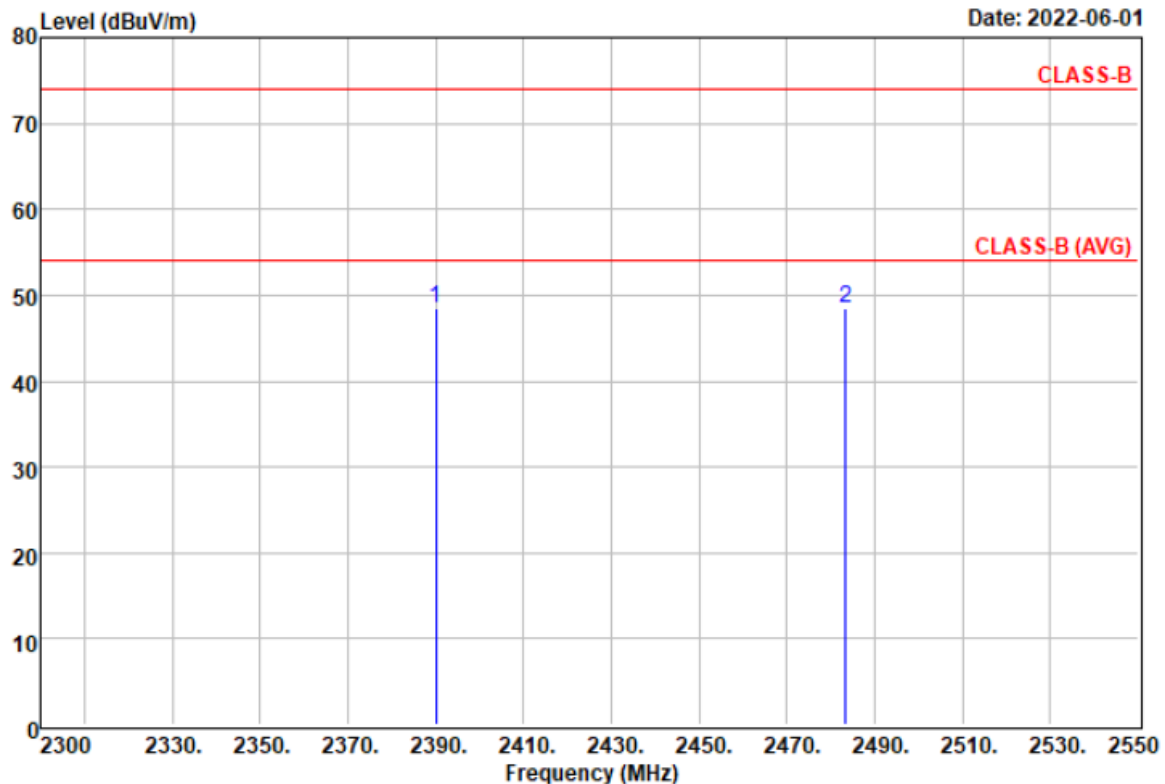
|      | Read       |        |        | Limit  | Over  |             |
|------|------------|--------|--------|--------|-------|-------------|
| Freq | Level      | Factor | Level  | Line   | Limit | Remark      |
| MHz  | dBuV       | dB/m   | dBuV/m | dBuV/m | dB    |             |
| 1    | 2390.000   | 58.17  | -9.78  | 48.39  | 74.00 | -25.61 Peak |
| 2    | @ 2483.500 | 58.30  | -9.24  | 49.06  | 74.00 | -24.94 Peak |

Note:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss - Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 10 Hz for Average detection at frequency above 1 GHz.



|             |                                 |           |              |
|-------------|---------------------------------|-----------|--------------|
| Power       | : DC 12V                        | Pol/Phase | : HORIZONTAL |
| Temperature | : 31 °C                         | Humidity  | : 70 %       |
| Test Mode   | : CH LO & HI – Restricted Bands | Memo      | : 8DPSK      |



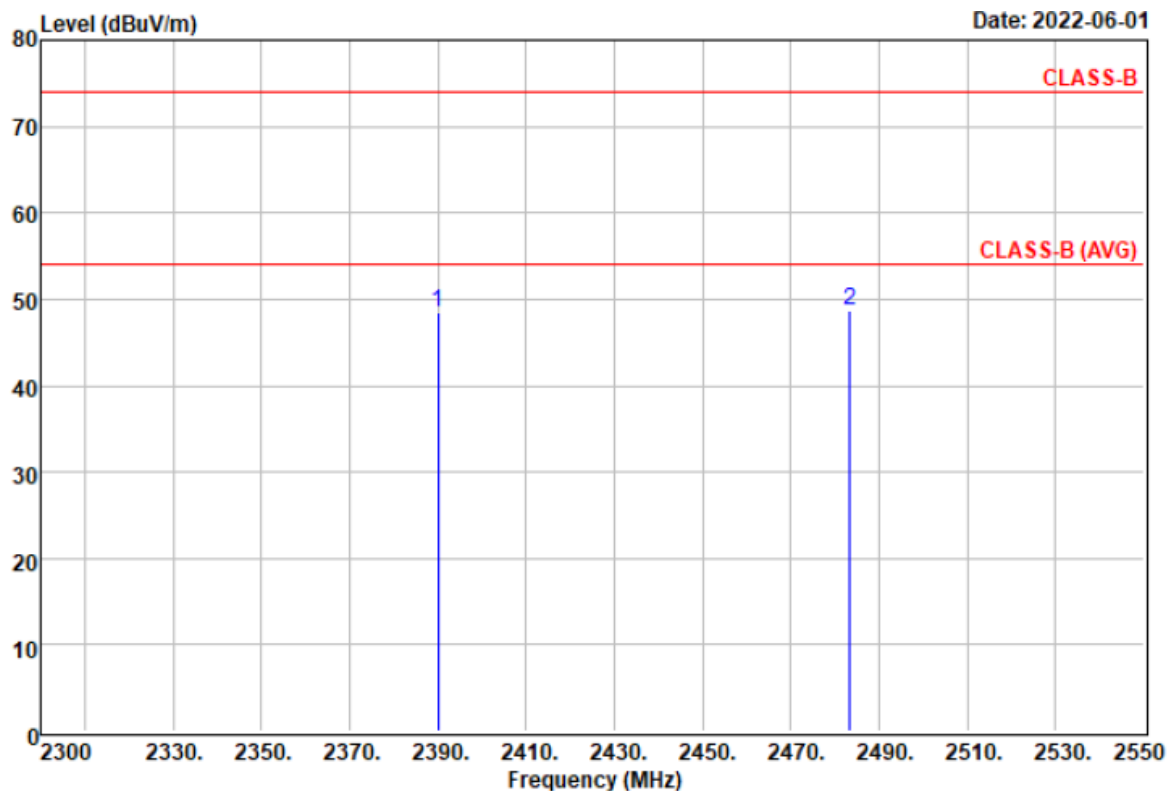
|              | Read  |        | Limit  | Over   |              |
|--------------|-------|--------|--------|--------|--------------|
| Freq         | Level | Factor | Level  | Line   | Limit Remark |
| MHz          | dBuV  | dB/m   | dBuV/m | dBuV/m | dB           |
| 1 @ 2390.000 | 58.28 | -9.78  | 48.50  | 74.00  | -25.50 Peak  |
| 2 2483.500   | 57.65 | -9.24  | 48.41  | 74.00  | -25.59 Peak  |

Note:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss - Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 10 Hz for Average detection at frequency above 1 GHz.



|             |                                 |           |            |
|-------------|---------------------------------|-----------|------------|
| Power       | : DC 12V                        | Pol/Phase | : VERTICAL |
| Temperature | : 31 °C                         | Humidity  | : 70 %     |
| Test Mode   | : CH LO & HI – Restricted Bands | Memo      | : 8DPSK    |



|              | Read  |        |        | Limit  | Over   |        |
|--------------|-------|--------|--------|--------|--------|--------|
| Freq         | Level | Factor | Level  | Line   | Limit  | Remark |
| MHz          | dBuV  | dB/m   | dBuV/m | dBuV/m | dB     |        |
| 1 2390.000   | 58.16 | -9.78  | 48.38  | 74.00  | -25.62 | Peak   |
| 2 @ 2483.500 | 58.01 | -9.24  | 48.77  | 74.00  | -25.23 | Peak   |

Note:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss - Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 10 Hz for Average detection at frequency above 1 GHz.





## 14. Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                 | MHz                   | MHz             | GHz             |
|---------------------|-----------------------|-----------------|-----------------|
| 0.09000 – 0.11000   | 16.42000 – 16.42300   | 399.9 – 410.0   | 4.500 – 5.150   |
| 0.49500 – 0.505**   | 16.69475 – 16.69525   | 608.0 – 614.0   | 5.350 – 5.460   |
| 2.17350 – 2.19050   | 16.80425 – 16.80475   | 960.0 – 1240.0  | 7.250 – 7.750   |
| 4.12500 – 4.12800   | 25.50000 – 25.67000   | 1300.0 – 1427.0 | 8.025 – 8.500   |
| 4.17725 – 4.17775   | 37.50000 – 38.25000   | 1435.0 – 1626.5 | 9.000 – 9.200   |
| 4.20725 – 4.20775   | 73.00000 – 74.60000   | 1645.5 – 1646.5 | 9.300 – 9.500   |
| 6.21500 – 6.21800   | 74.80000 – 75.20000   | 1660.0 – 1710.0 | 10.600 – 12.700 |
| 6.26775 – 6.26825   | 108.00000 – 121.94000 | 1718.8 – 1722.2 | 13.250 – 13.400 |
| 6.31175 – 6.31225   | 123.00000 – 138.00000 | 2200.0 – 2300.0 | 14.470 – 14.500 |
| 8.29100 – 8.29400   | 149.90000 – 150.05000 | 2310.0 – 2390.0 | 15.350 – 16.200 |
| 8.36200 – 8.36600   | 156.52475 – 156.52525 | 2483.5 – 2500.0 | 17.700 – 21.400 |
| 8.37625 – 8.38675   | 156.70000 – 156.90000 | 2655.0 – 2900.0 | 22.010 – 23.120 |
| 8.41425 – 8.41475   | 162.01250 – 167.17000 | 3260.0 – 3267.0 | 23.600 – 24.000 |
| 12.29000 – 12.29300 | 167.72000 – 173.20000 | 3332.0 – 3339.0 | 31.200 – 31.800 |
| 12.51975 – 12.52025 | 240.00000 – 285.00000 | 3345.8 – 3358.0 | 36.430 – 36.500 |
| 12.57675 – 12.57725 | 322.00000 – 335.40000 | 3600.0 – 4400.0 | Above 38.6      |
| 13.36000 – 13.41000 |                       |                 |                 |

\*\* : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

### 14.1 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.