

# Appendix

## Main Test Instruments

| Conducted Emission   |                                    |                 |               |              |              |
|----------------------|------------------------------------|-----------------|---------------|--------------|--------------|
| Test Equipment       | Manufacturer                       | Model No.       | Inventory No. | Cal. date    | Cal.Duedate  |
|                      |                                    |                 |               | (yyyy-mm-dd) | (yyyy-mm-dd) |
| Shielding Room       | ZhongYu Electron                   | GB-88           | SEM001-06     | 2017/5/10    | 2020/5/9     |
| LISN                 | Rohde & Schwarz                    | ENV216          | SEM007-01     | 2018/9/2     | 2019/9/2     |
| LISN                 | ETS-LINDGREN                       | Feb-16          | SEM007-02     | 2019/3/2     | 2020/3/1     |
| Measurement Software | AUDIX                              | e3 V5.4.1221d   | N/A           | N/A          | N/A          |
| Coaxial Cable        | SGS                                | N/A             | SEM024-01     | 2018/7/12    | 2019/7/11    |
| 2 Line ISN           | Fischer Custom Communications Inc. | FCC-TLISN-T2-02 | EMC0122       | 2019/2/11    | 2020/2/10    |
| EMI Test Receiver    | Rohde & Schwarz                    | ESCI            | SEM004-02     | 2019/3/2     | 2020/3/1     |

| RF conducted test   |                          |                  |               |              |              |
|---------------------|--------------------------|------------------|---------------|--------------|--------------|
| Test Equipment      | Manufacturer             | Model No.        | Inventory No. | Cal. date    | Cal.Duedate  |
|                     |                          |                  |               | (yyyy-mm-dd) | (yyyy-mm-dd) |
| DC Power Supply     | Agilent Technologies Inc | 66311B           | W009-09       | 2018/9/15    | 2019/9/15    |
| Signal Analyzer     | Rohde & Schwarz          | FSV              | W025-05       | 2019/1/13    | 2020/1/12    |
| Coaxial Cable       | SGS                      | N/A              | SEM031-01     | 2018/7/13    | 2019/7/12    |
| Attenuator          | Weinschel Associates     | WA41             | SEM021-09     | N/A          | N/A          |
| Signal Generator    | KEYSIGHT                 | N5173B           | SEM006-05     | 2018/9/2     | 2019/9/2     |
| Temperature Chamber | GIANT FORCE              | ICT-150-40-CP-AR | W027-03       | 2018/11/27   | 2019/11/27   |
| Power Meter         | Rohde & Schwarz          | NRVS             | SEM014-02     | 2018/9/2     | 2019/9/2     |

## Measurement Uncertainty

| No. | Item                          | Measurement Uncertainty |
|-----|-------------------------------|-------------------------|
| 1   | Total RF power, conducted     | ±0.75dB                 |
| 2   | RF power density, conducted   | ±2.84dB                 |
| 3   | Spurious emissions, conducted | ±0.75dB                 |
| 4   | Conduct emission test         | ±3.12 dB (9KHz- 30MHz)  |
| 5   | Temperature test              | ±1°C                    |
| 6   | Humidity test                 | ±3%                     |
| 7   | DC and low frequency voltages | ±0.5%                   |

## Conducted Peak Output Power

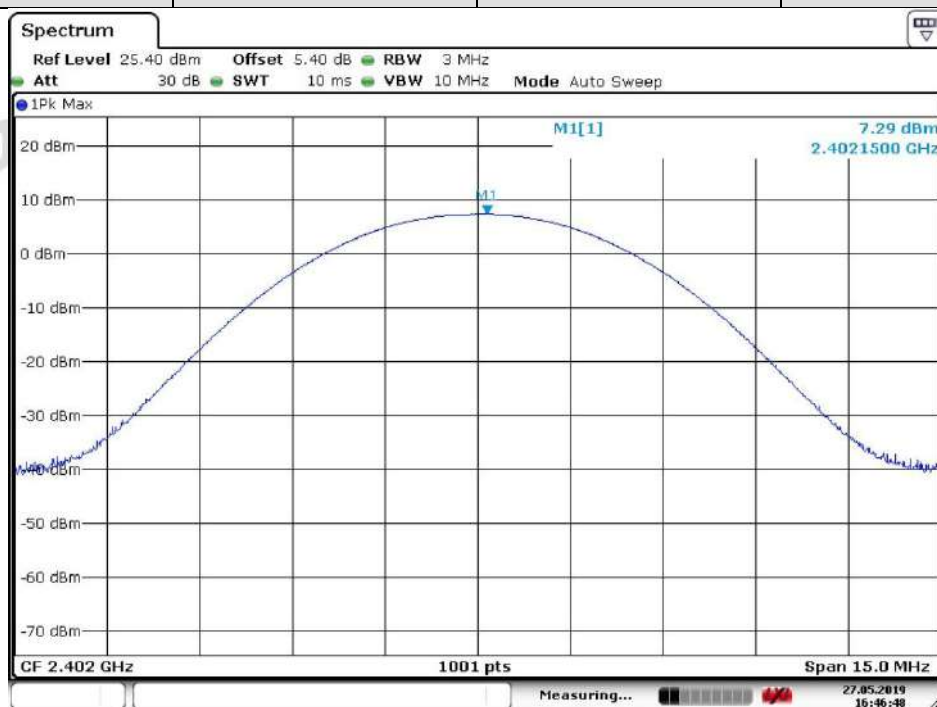
### Test Results

Measurement Data of Peak power:

| GFSK mode          |                         |             |        |
|--------------------|-------------------------|-------------|--------|
| Test channel       | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest             | 7.29                    | 20.97       | Pass   |
| Middle             | 7.43                    | 20.97       | Pass   |
| Highest            | 8.21                    | 20.97       | Pass   |
| $\pi/4$ DQPSK mode |                         |             |        |
| Test channel       | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest             | 10.03                   | 20.97       | Pass   |
| Middle             | 10.40                   | 20.97       | Pass   |
| Highest            | 10.66                   | 20.97       | Pass   |
| 8DPSK mode         |                         |             |        |
| Test channel       | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest             | 10.43                   | 20.97       | Pass   |
| Middle             | 10.75                   | 20.97       | Pass   |
| Highest            | 10.97                   | 20.97       | Pass   |

### Test plots

|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Lowest |
|------------|------|---------------|--------|



Date: 27.MAY.2019 16:46:48

|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Middle |
|------------|------|---------------|--------|



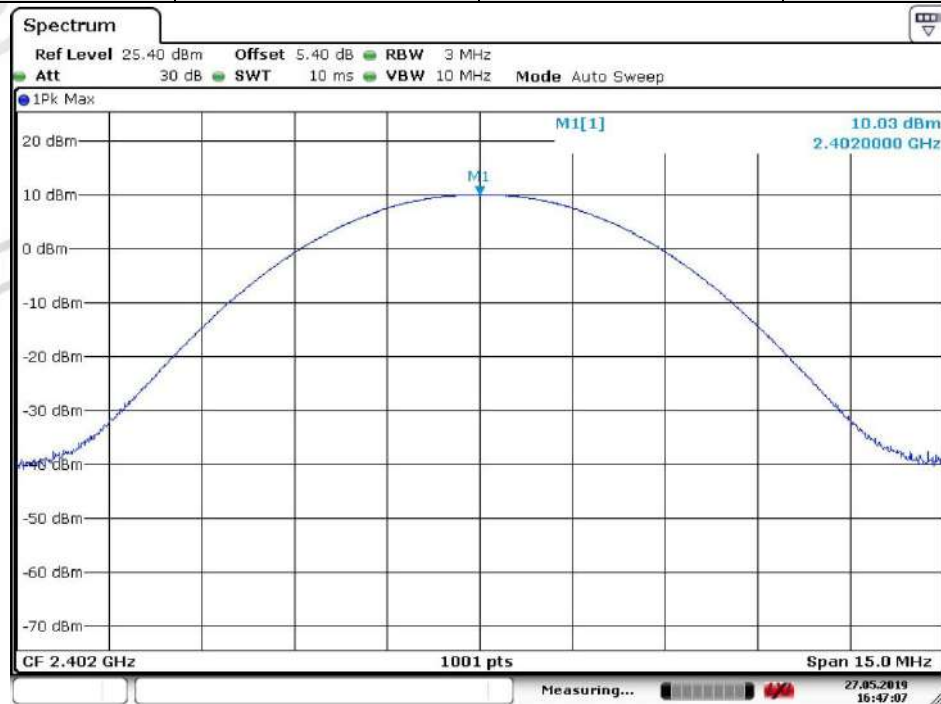
Date: 27.MAY.2019 16:52:07

|            |      |               |         |
|------------|------|---------------|---------|
| Test mode: | GFSK | Test channel: | Highest |
|------------|------|---------------|---------|



Date: 27.MAY.2019 16:52:22

|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Lowest |
|------------|---------------|---------------|--------|



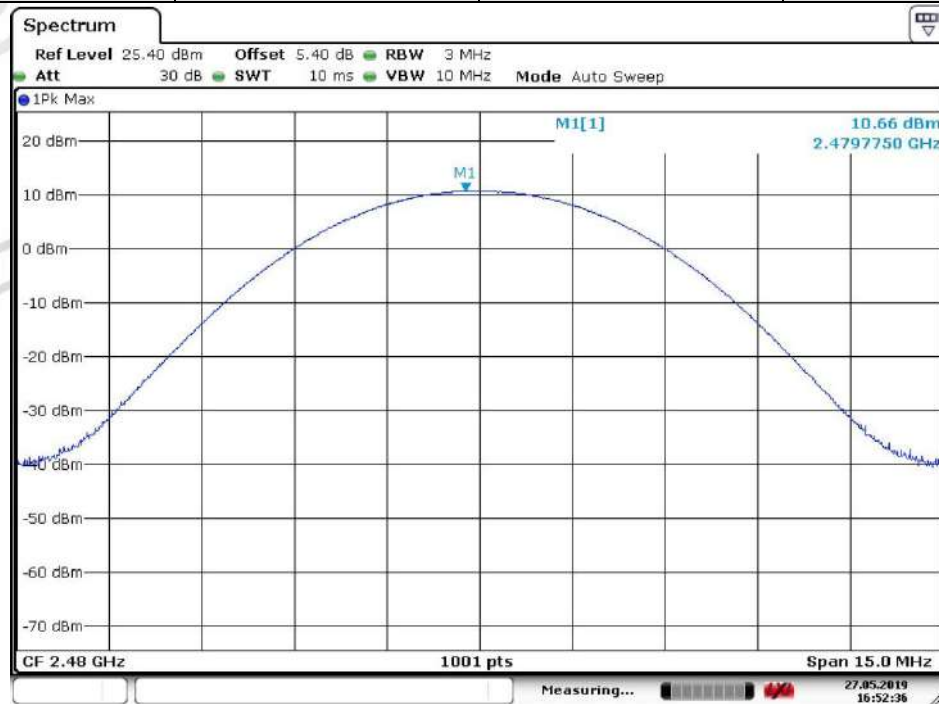
Date: 27.MAY.2019 16:47:07

|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Middle |
|------------|---------------|---------------|--------|



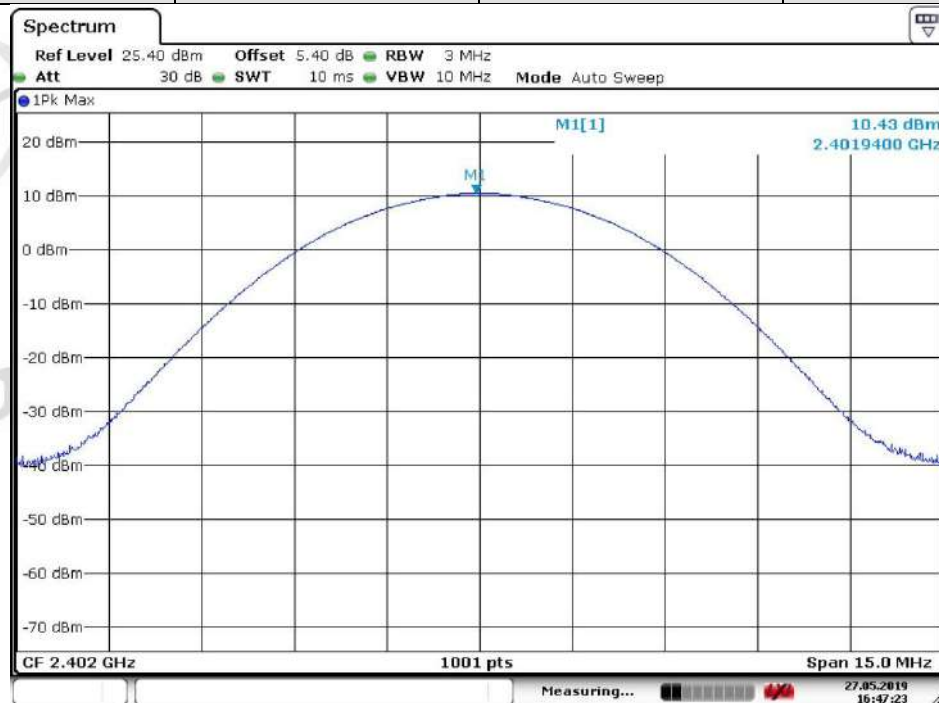
Date: 27.MAY.2019 16:51:54

|            |               |               |         |
|------------|---------------|---------------|---------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Highest |
|------------|---------------|---------------|---------|



Date: 27.MAY.2019 16:52:37

|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Lowest |
|------------|-------|---------------|--------|



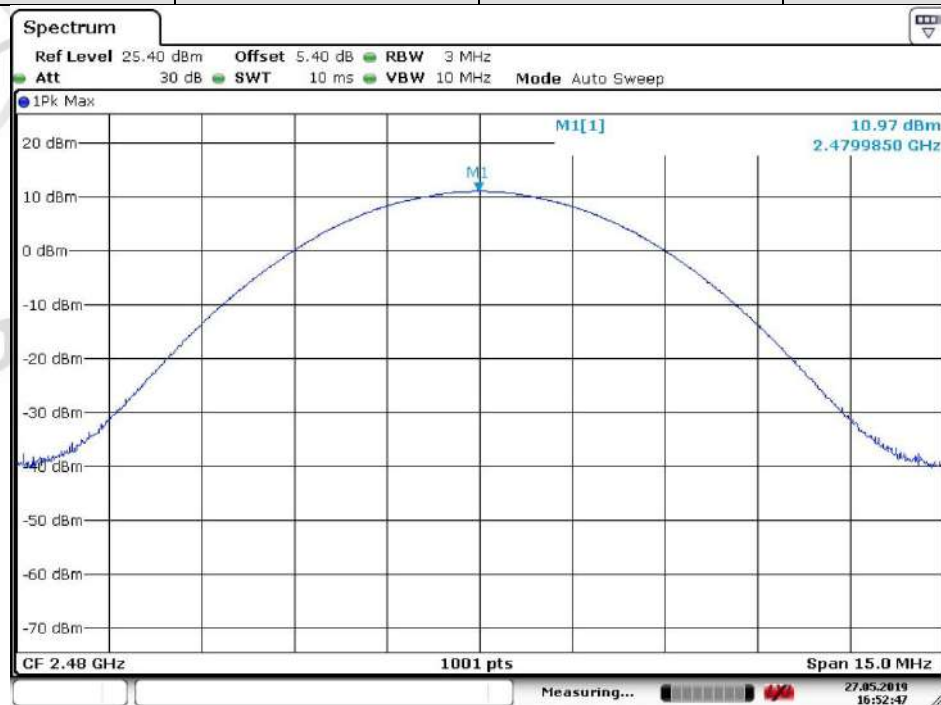
Date: 27.MAY.2019 16:47:23

|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Middle |
|------------|-------|---------------|--------|



Date: 27.MAY.2019 16:51:44

|            |       |               |         |
|------------|-------|---------------|---------|
| Test mode: | 8DPSK | Test channel: | Highest |
|------------|-------|---------------|---------|



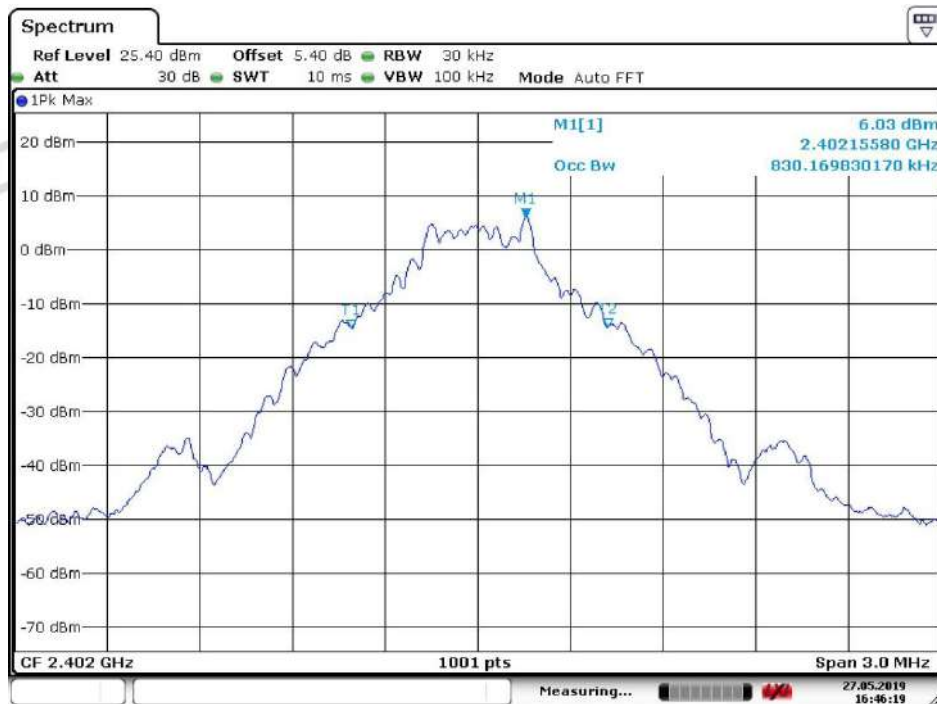
Date: 27.MAY.2019 16:52:48

**20dB Emission Bandwidth & 99% Occupied Bandwidth****Test Results**

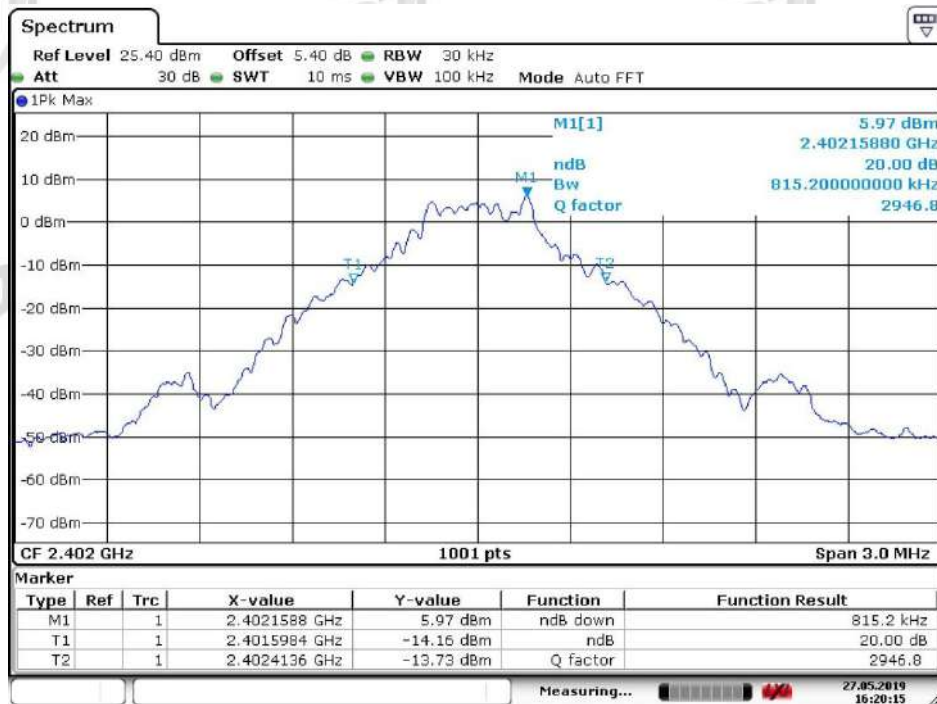
| Mode          | Test Channel | 99% Occupied Bandwidth (KHz) | 20dB Emission Bandwidth (KHz) | Result |
|---------------|--------------|------------------------------|-------------------------------|--------|
| GFSK          | Lowest       | 830.2                        | 815.2                         | Pass   |
|               | Middle       | 860.2                        | 947.1                         | Pass   |
|               | Highest      | 830.2                        | 947.1                         | Pass   |
| $\pi/4$ DQPSK | Lowest       | 1165.8                       | 1288.7                        | Pass   |
|               | Middle       | 1165.8                       | 1279.7                        | Pass   |
|               | Highest      | 1168.8                       | 1291.7                        | Pass   |
| 8DPSK         | Lowest       | 1171.8                       | 1294.7                        | Pass   |
|               | Middle       | 1159.8                       | 1294.7                        | Pass   |
|               | Highest      | 1177.8                       | 1273.7                        | Pass   |

## Test plots

## GFSK\_Lowest Channel

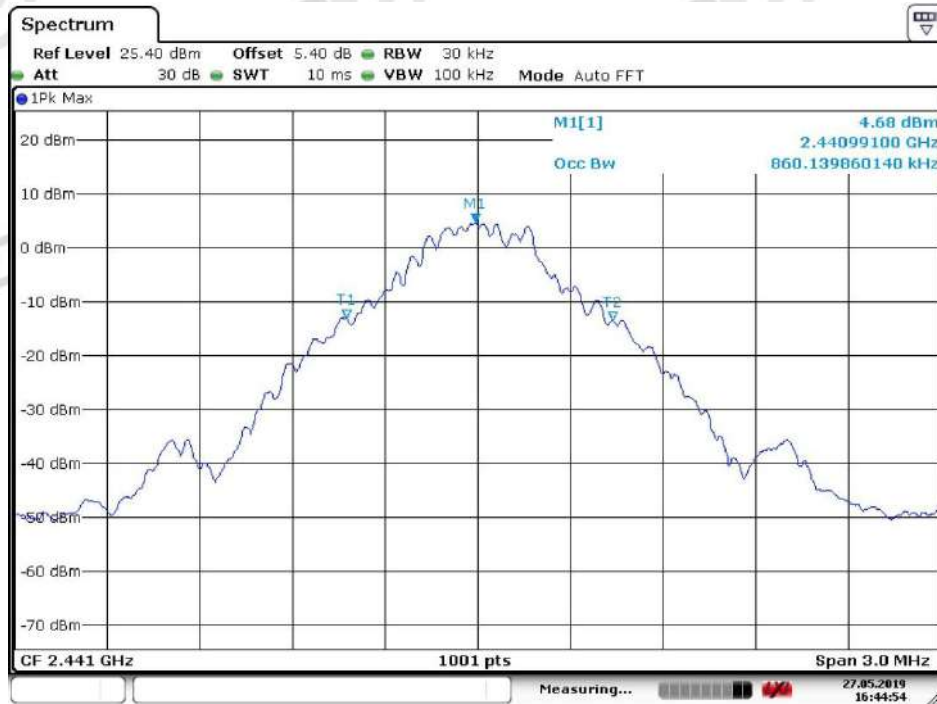


Date: 27.MAY 2019 16:46:19

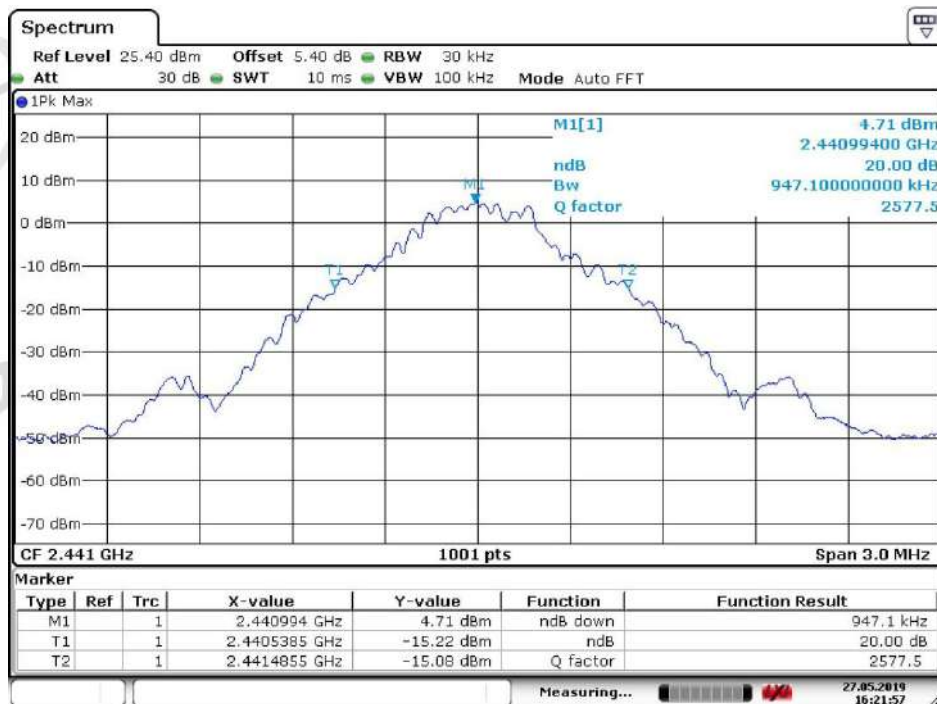


Date: 27.MAY 2019 16:20:16

## GFSK\_Middle Channel

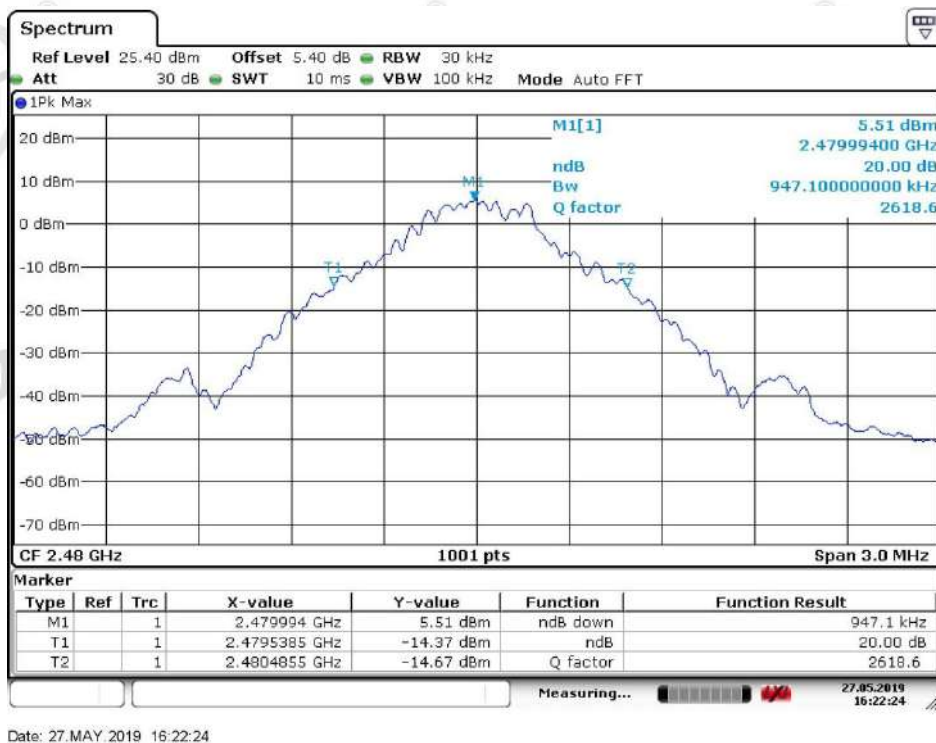
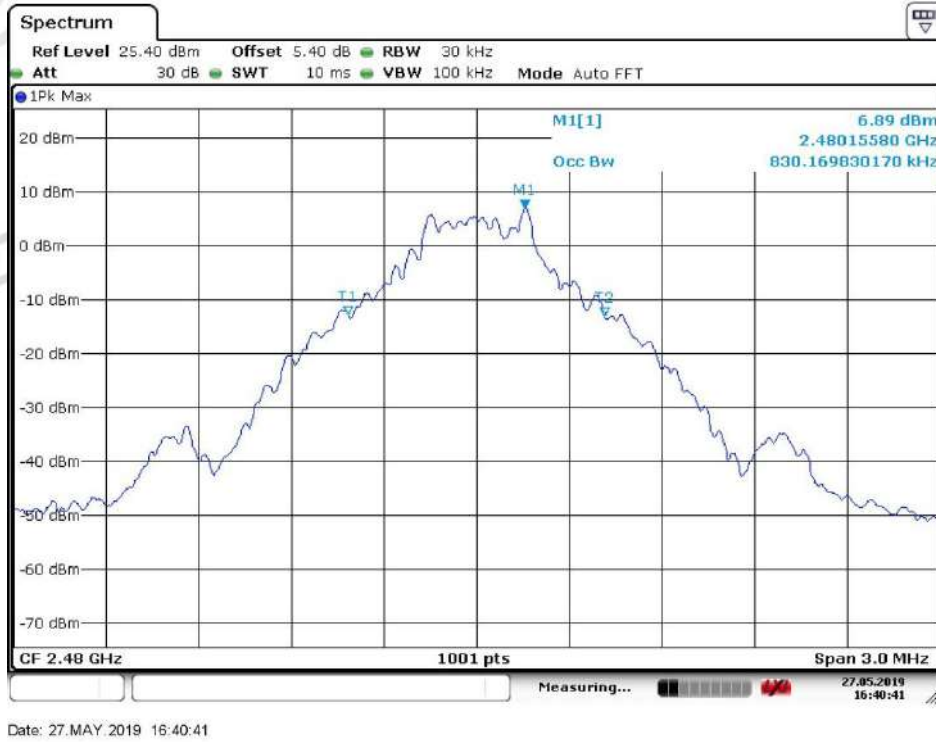


Date: 27.MAY 2019 16:44:55



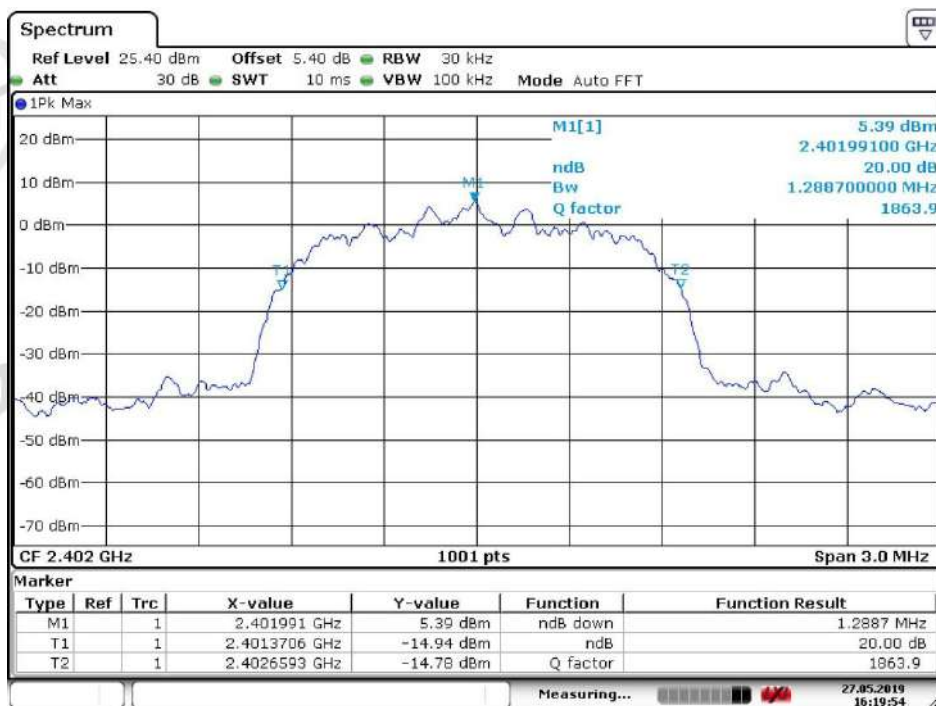
Date: 27.MAY 2019 16:21:57

## GFSK\_Highest Channel

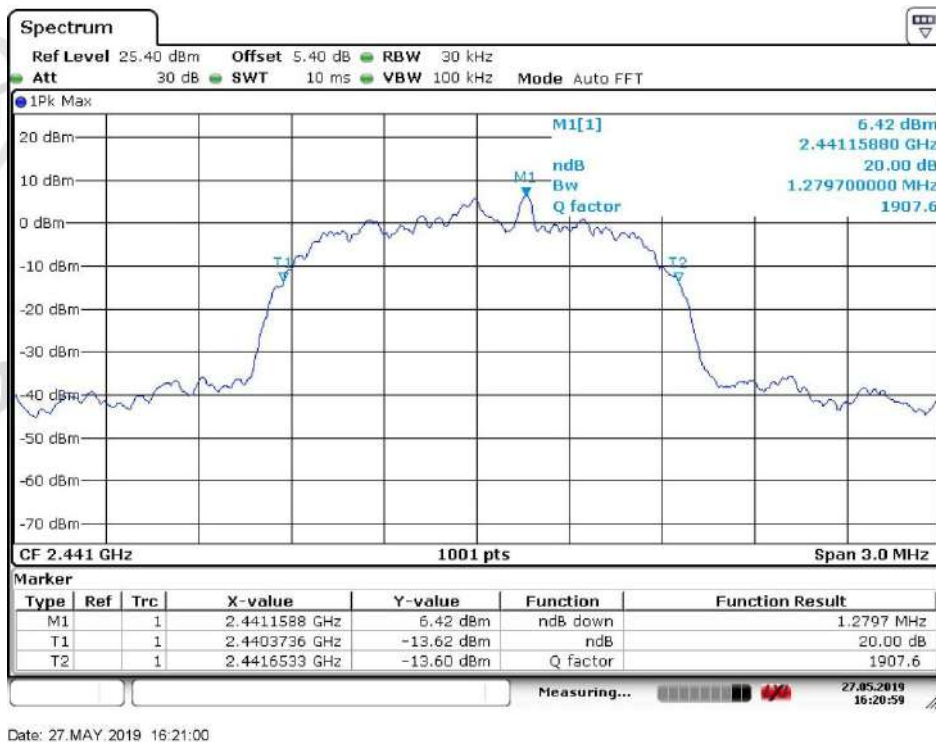
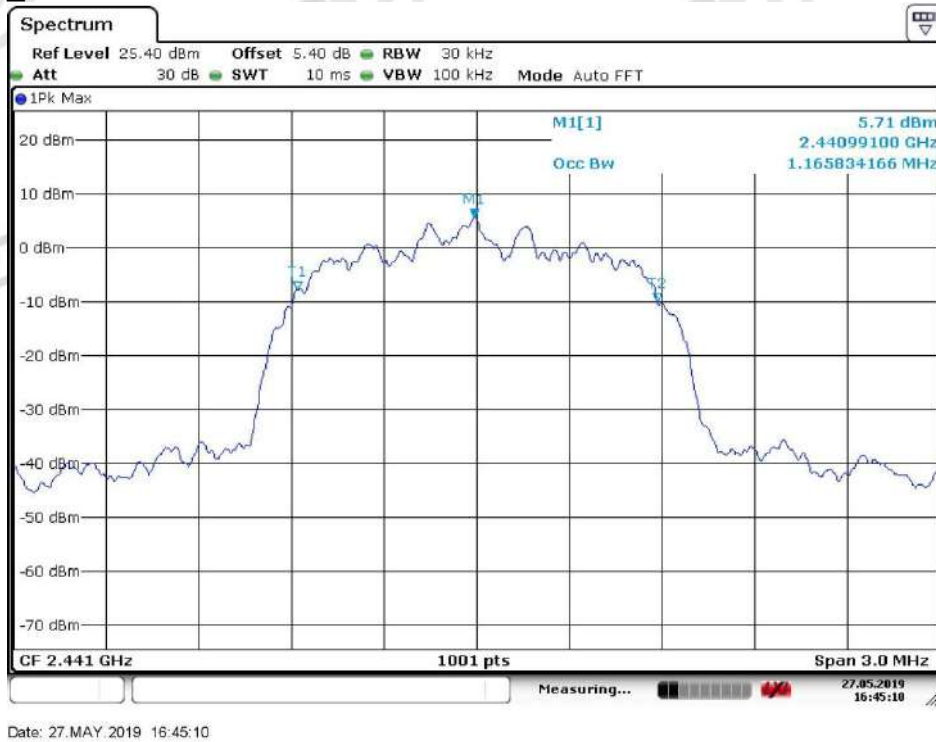


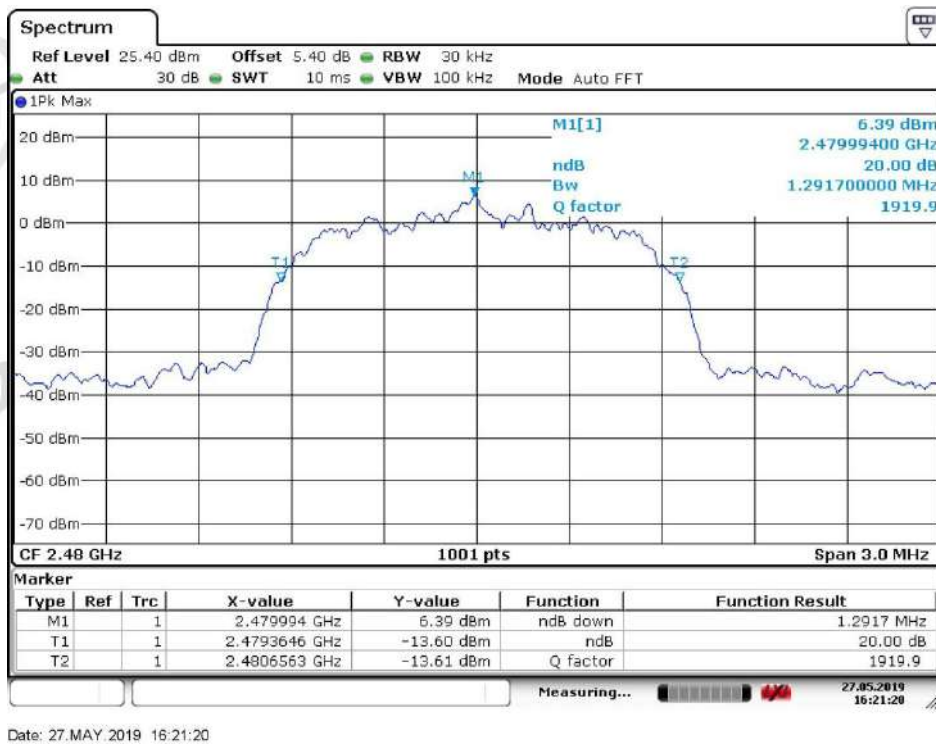
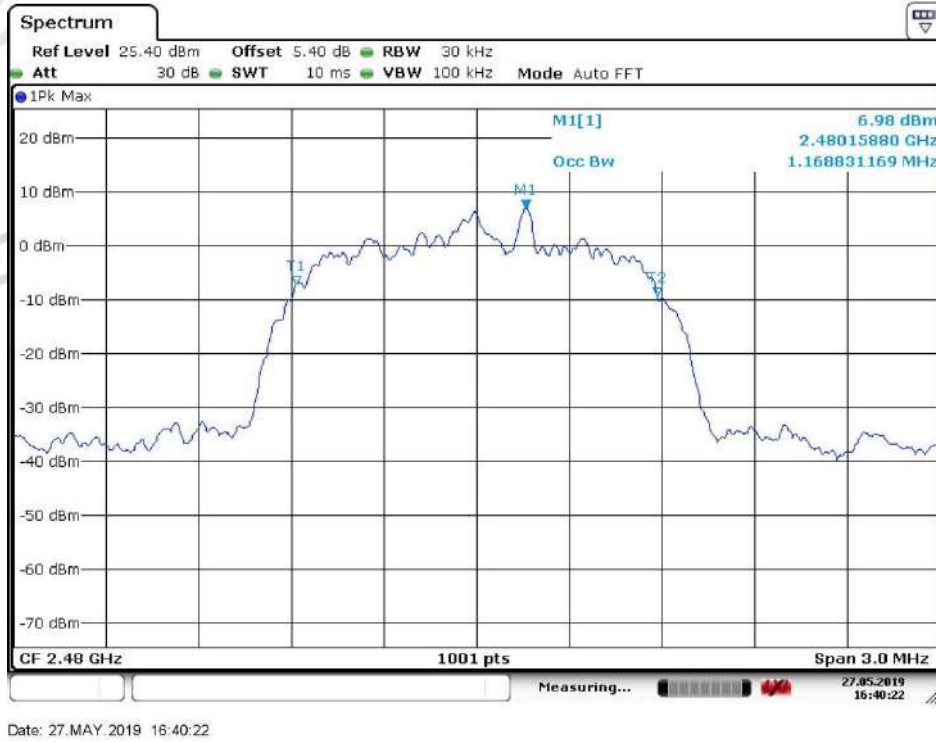
$\pi/4$ DQPSK Lowest Channel

Date: 27.MAY.2019 16:46:03

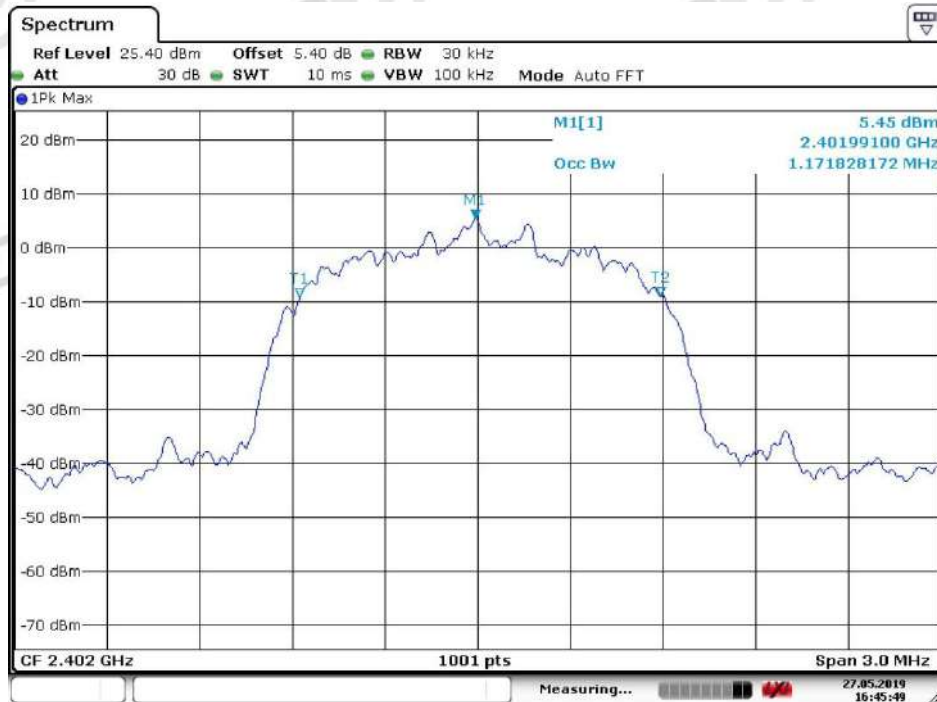


Date: 27.MAY.2019 16:19:55

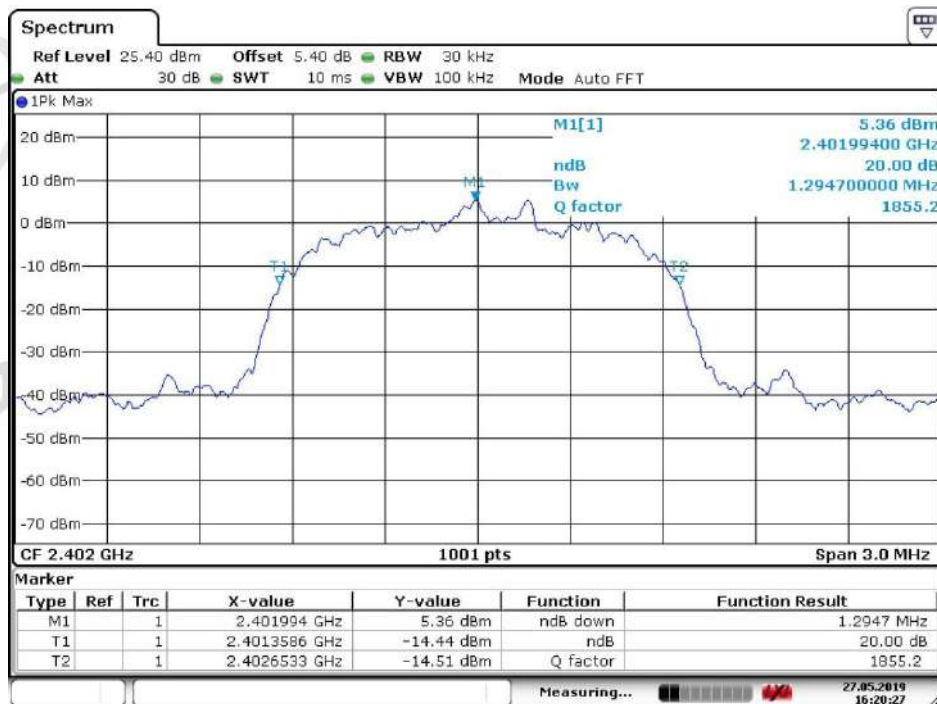
$\pi/4$ DQPSK Middle Channel

$\pi/4$ DQPSK\_Highest Channel

## 8DPSK\_Lowest Channel

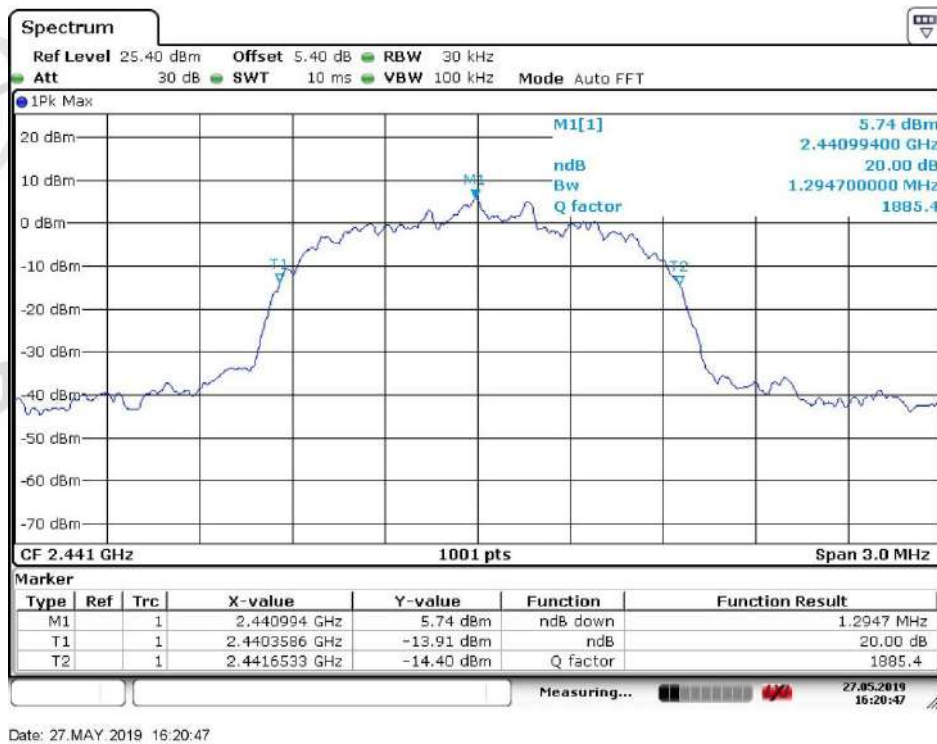
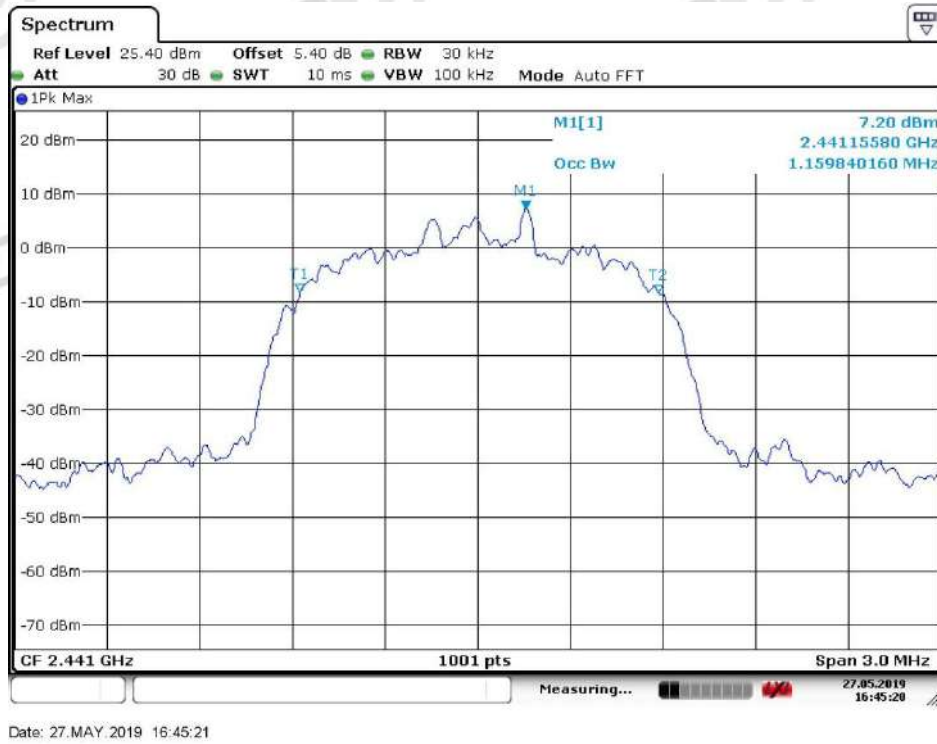


Date: 27.MAY.2019 16:45:49

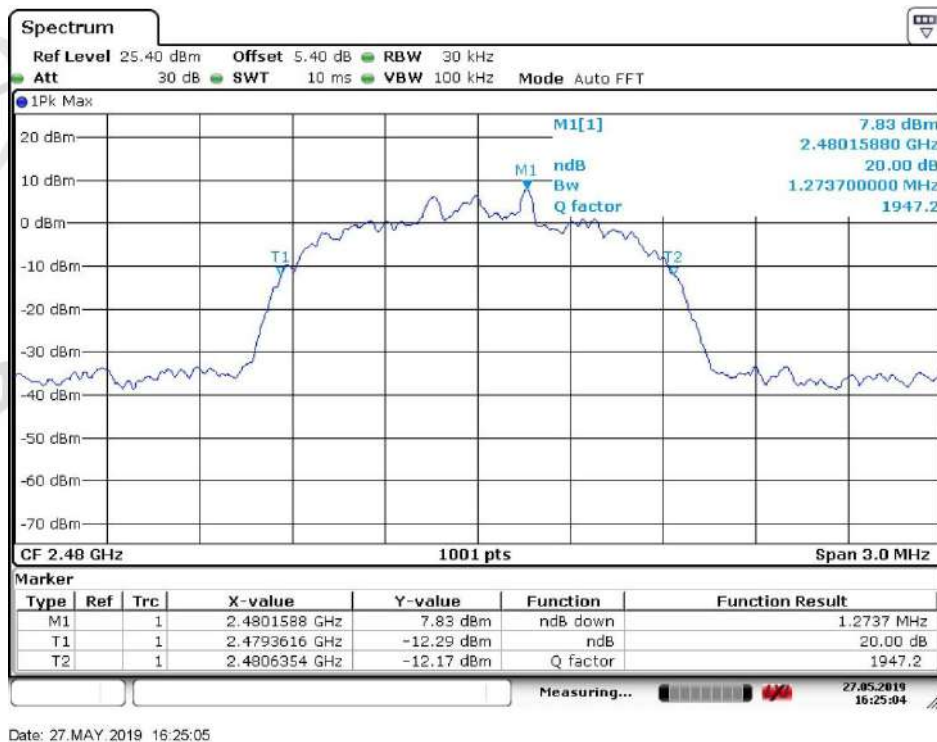
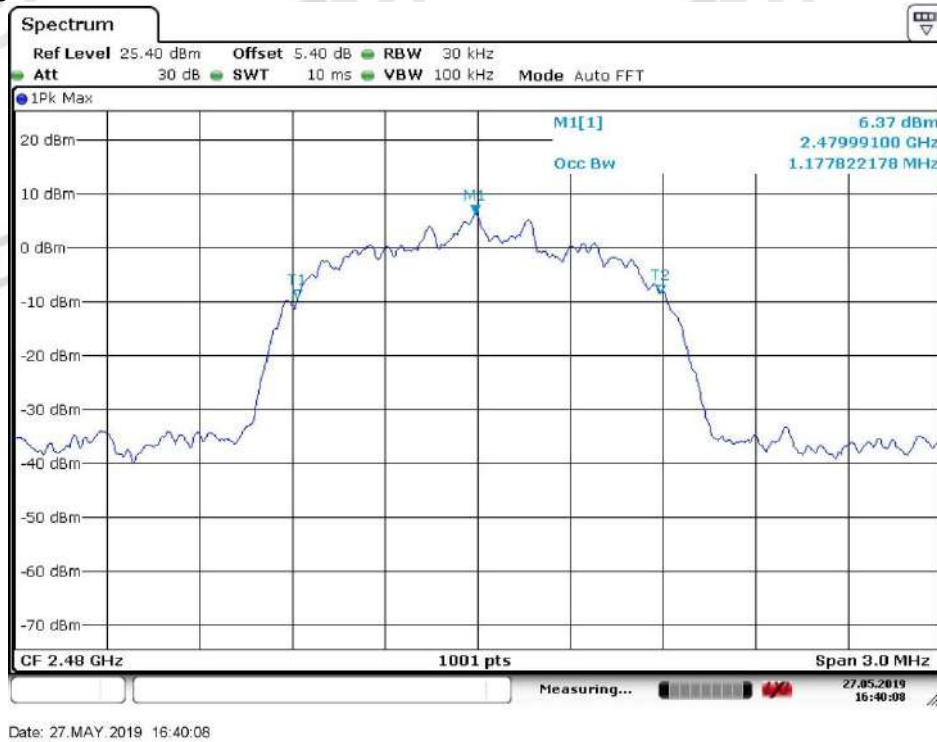


Date: 27.MAY.2019 16:20:27

## 8DPSK\_Middle Channel



## 8DPSK\_Highest Channel



## Carrier Frequencies Separation

### Test Results

| GFSK mode          |                                      |             |        |
|--------------------|--------------------------------------|-------------|--------|
| Test channel       | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Middle             | 998                                  | 631.4       | Pass   |
| $\pi/4$ DQPSK mode |                                      |             |        |
| Test channel       | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Middle             | 1001                                 | 861.1       | Pass   |
| 8DPSK mode         |                                      |             |        |
| Test channel       | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Middle             | 1001                                 | 863.1       | Pass   |

| Mode          | 20dB bandwidth (kHz)<br>(worse case) | Limit (kHz)<br>(Carrier Frequencies Separation) |
|---------------|--------------------------------------|-------------------------------------------------|
| GFSK          | 947.1                                | 631.4                                           |
| $\pi/4$ DQPSK | 1291.7                               | 861.1                                           |
| 8DPSK         | 1294.7                               | 863.1                                           |

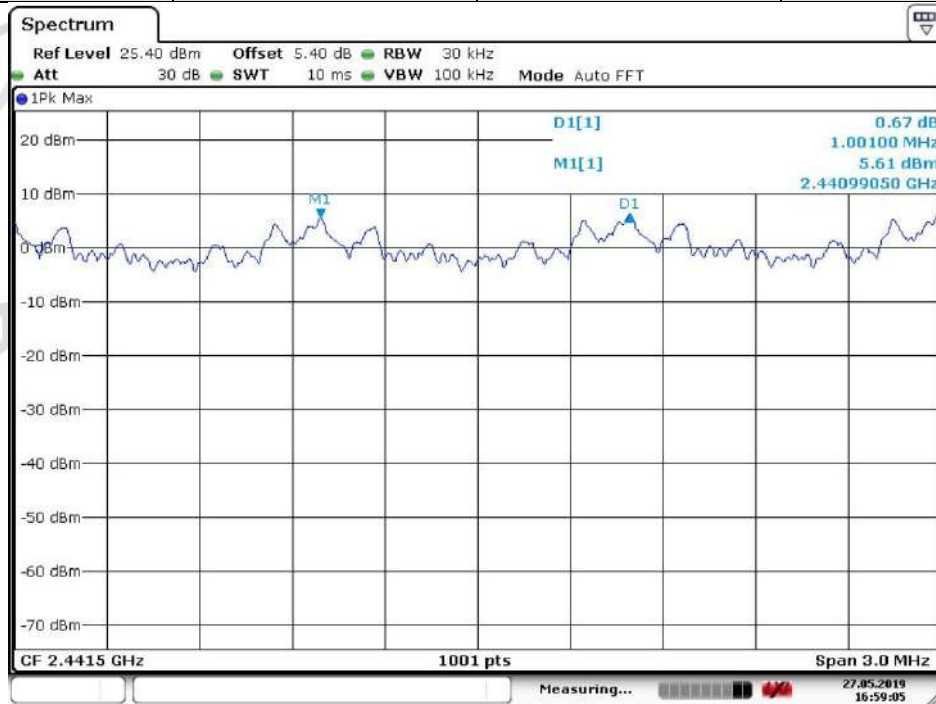
## Test plots:

|            |      |               |        |
|------------|------|---------------|--------|
| Test mode: | GFSK | Test channel: | Middle |
|------------|------|---------------|--------|



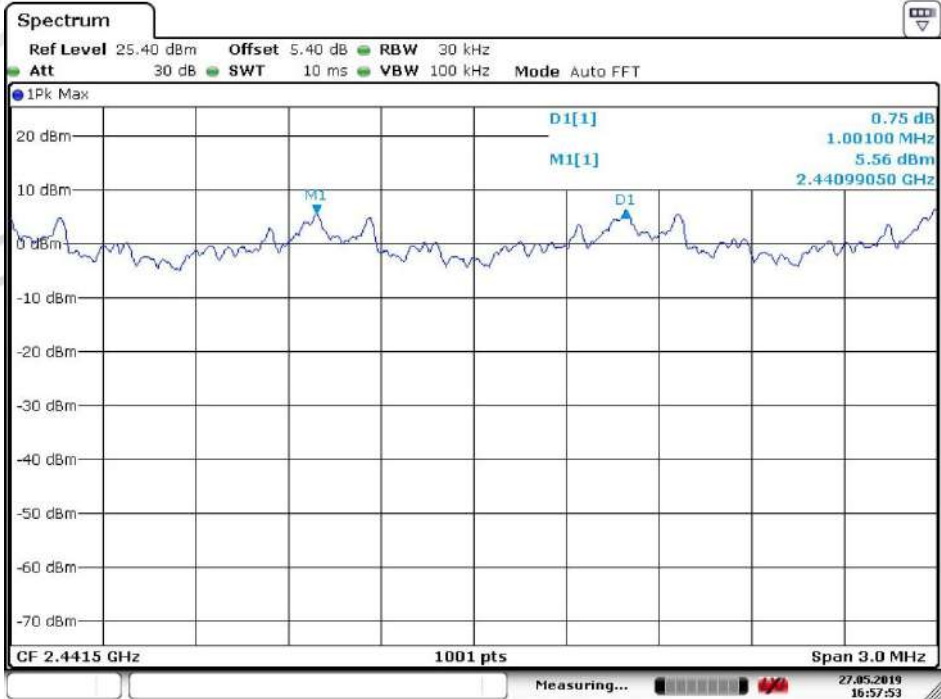
Date: 27.MAY.2019 16:59:41

|            |               |               |        |
|------------|---------------|---------------|--------|
| Test mode: | $\pi/4$ DQPSK | Test channel: | Middle |
|------------|---------------|---------------|--------|



Date: 27.MAY.2019 16:59:05

|            |       |               |        |
|------------|-------|---------------|--------|
| Test mode: | 8DPSK | Test channel: | Middle |
|------------|-------|---------------|--------|



Date: 27.MAY.2019 16:57:53

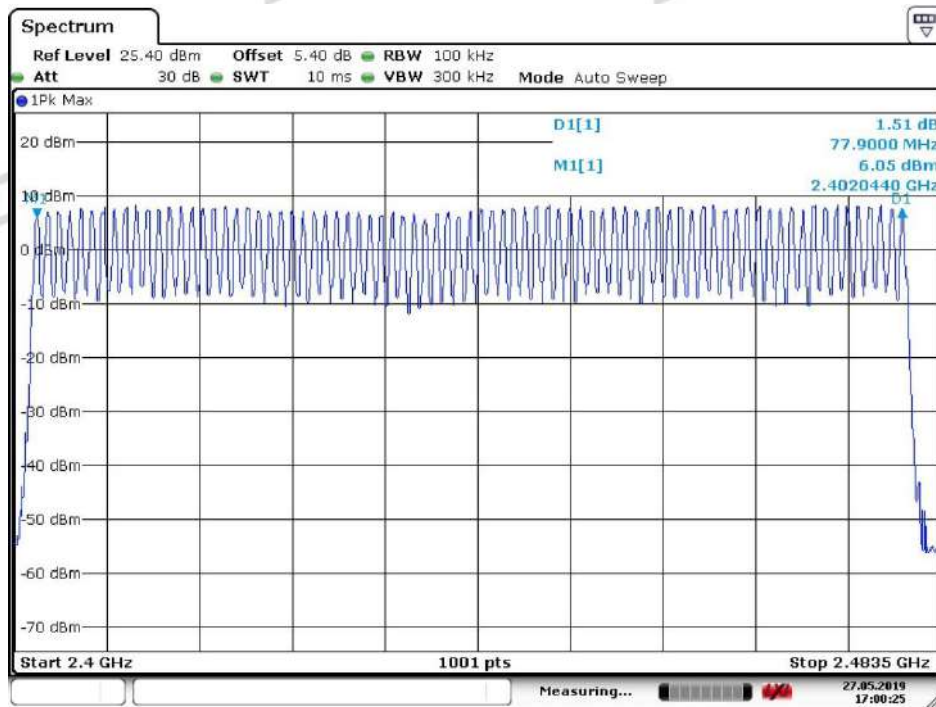
## Hopping Channel Number

### Test Results

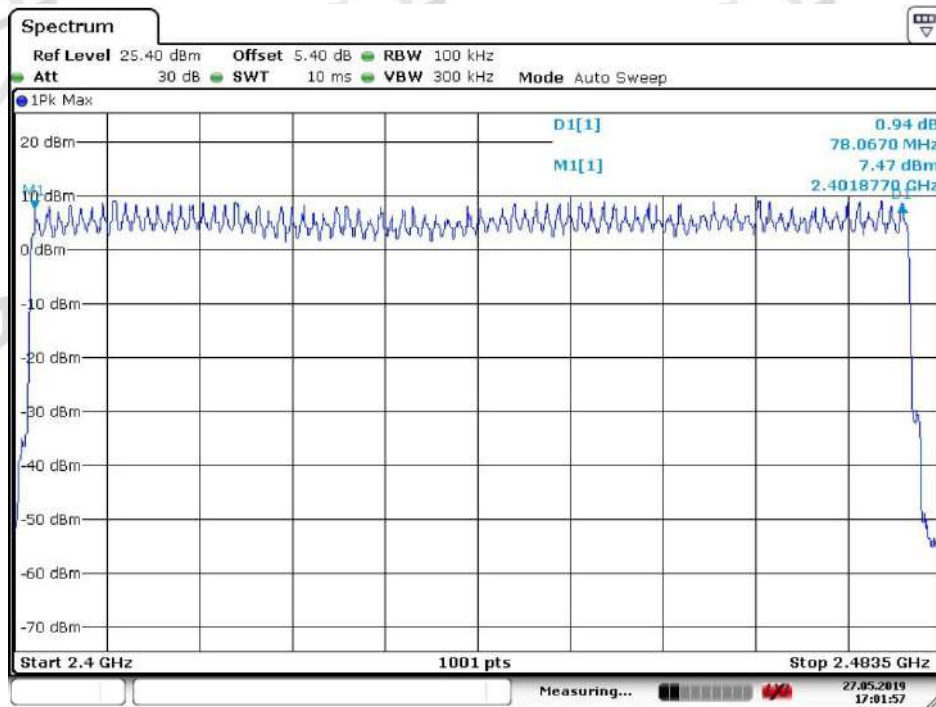
| Mode          | Hopping channel numbers | Limit     |
|---------------|-------------------------|-----------|
| GFSK          | 79                      | $\geq 15$ |
| $\pi/4$ DQPSK | 79                      | $\geq 15$ |
| 8DPSK         | 79                      | $\geq 15$ |

## Test plots

## GFSK

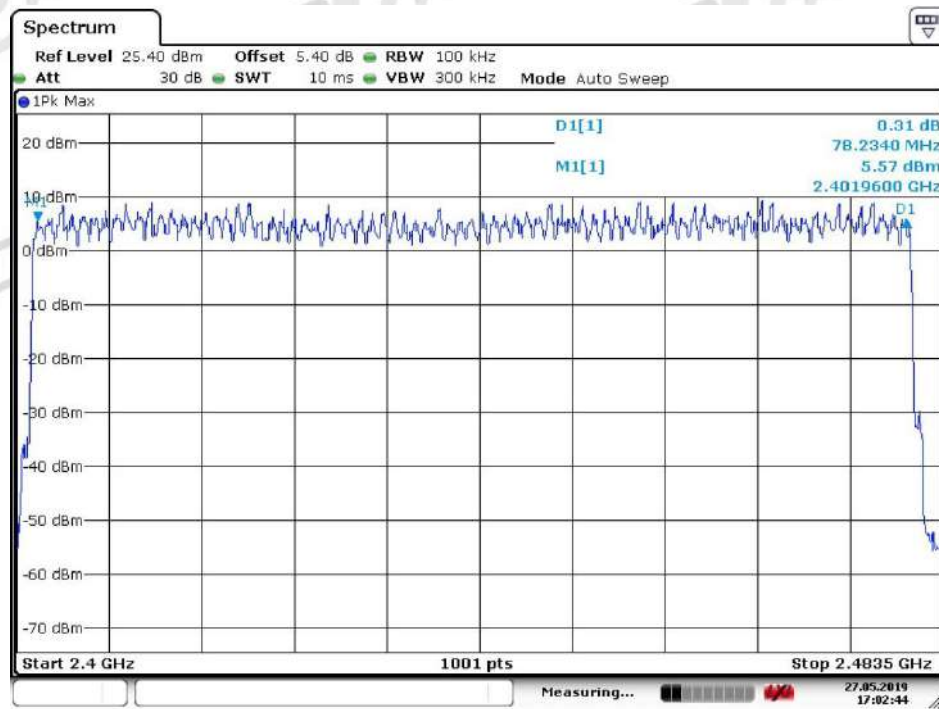


Date: 27.MAY.2019 17:00:25

 $\pi/4$ DQPSK

Date: 27.MAY.2019 17:01:58

## 8DPSK



Date: 27.MAY 2019 17:02:44

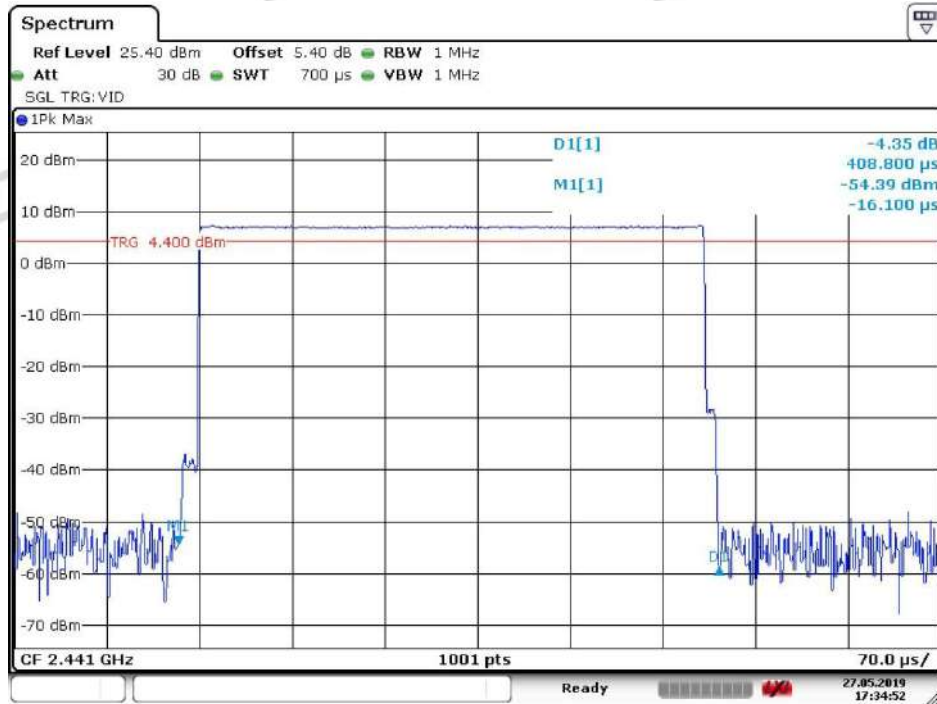
## Dwell Time

### Test Results

| Operation Modes | On time ( ms ) on one channel |
|-----------------|-------------------------------|
| DH1             | 0.408                         |
| DH3             | 1.671                         |
| DH5             | 2.924                         |
| 2-DH1           | 0.414                         |
| 2-DH3           | 1.671                         |
| 2-DH5           | 2.924                         |
| 3-DH1           | 0.414                         |
| 3-DH3           | 1.674                         |
| 3-DH5           | 2.929                         |

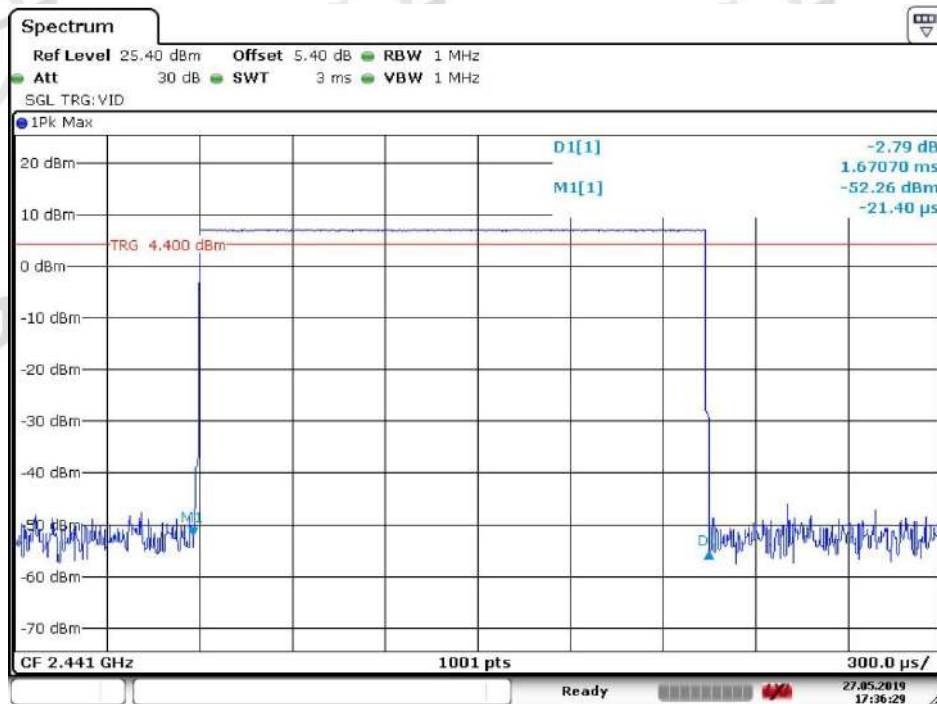
## Test plots

## DH1 \_ Middle Channel



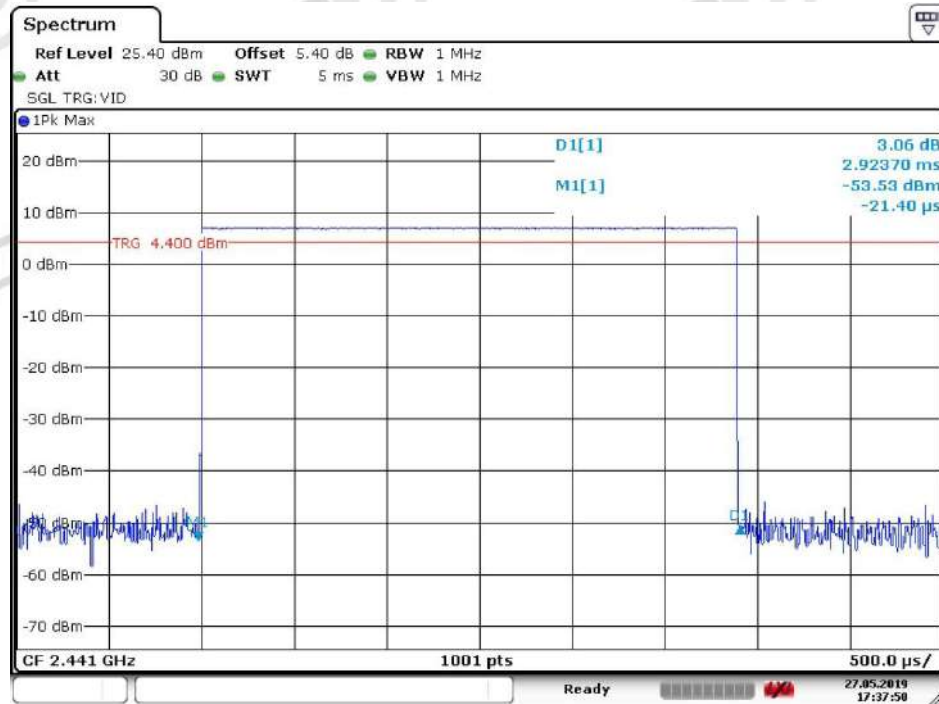
Date: 27.MAY.2019 17:34:53

## DH3 \_ Middle Channel



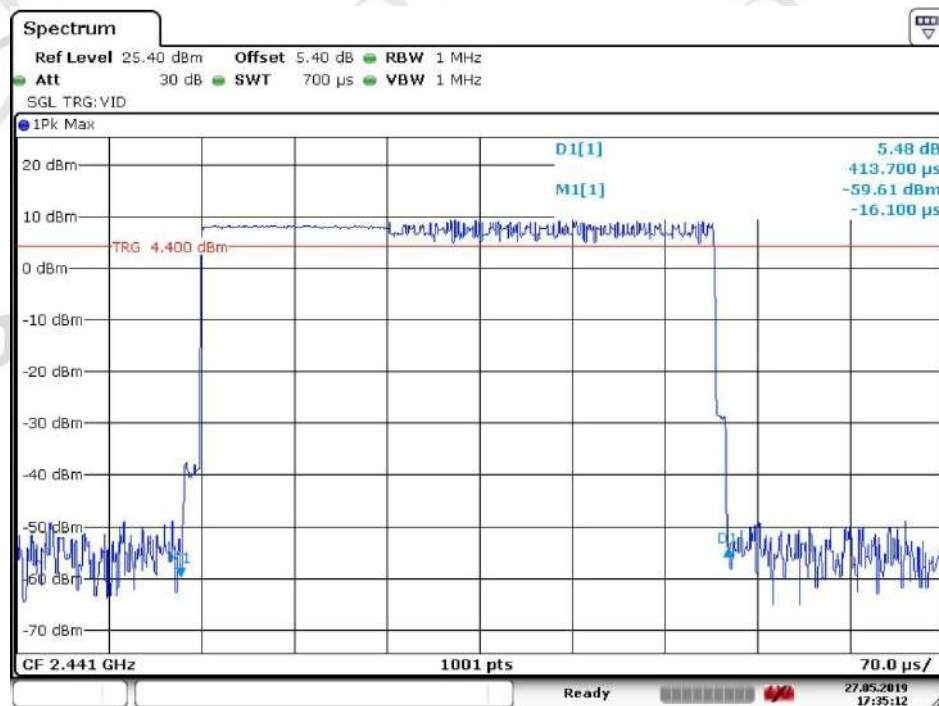
Date: 27.MAY.2019 17:36:29

## DH5 \_ Middle Channel



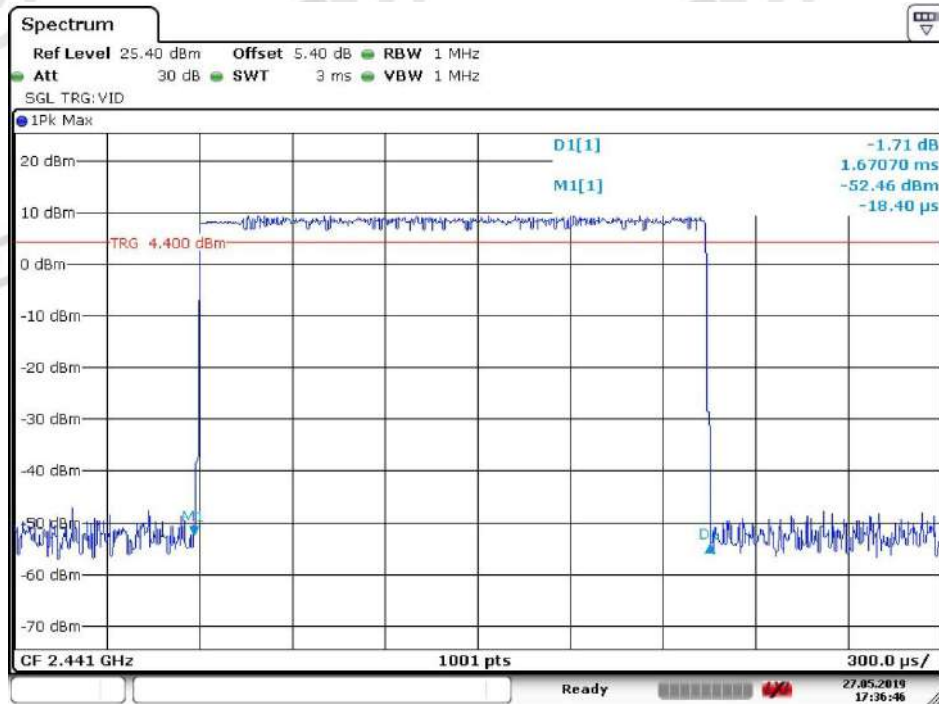
Date: 27.MAY.2019 17:37:50

## 2DH1 \_ Middle Channel



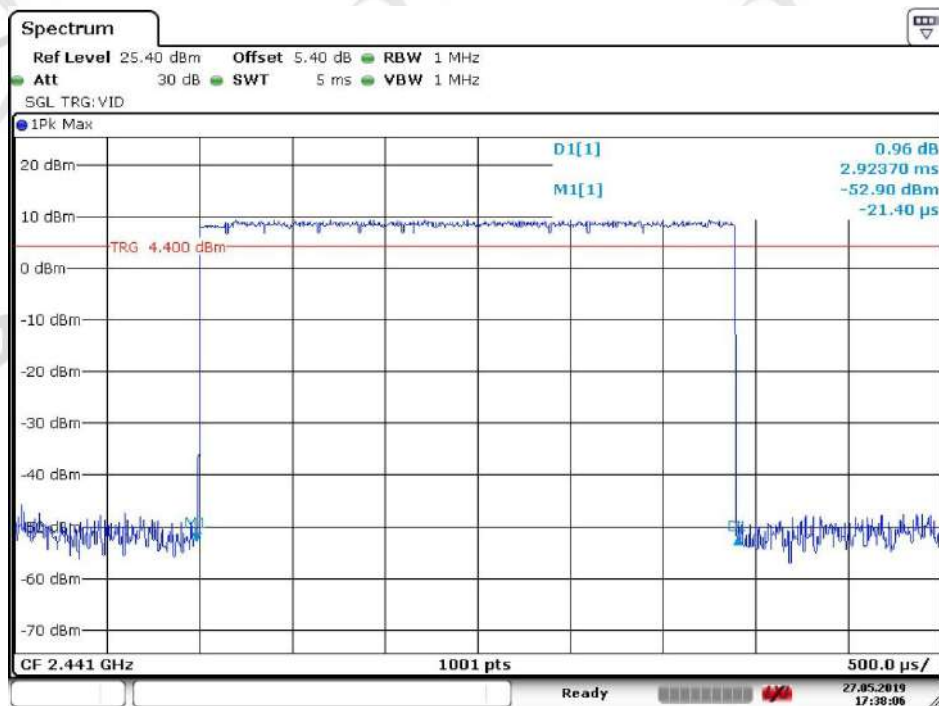
Date: 27.MAY.2019 17:35:12

## 2DH3 \_ Middle Channel



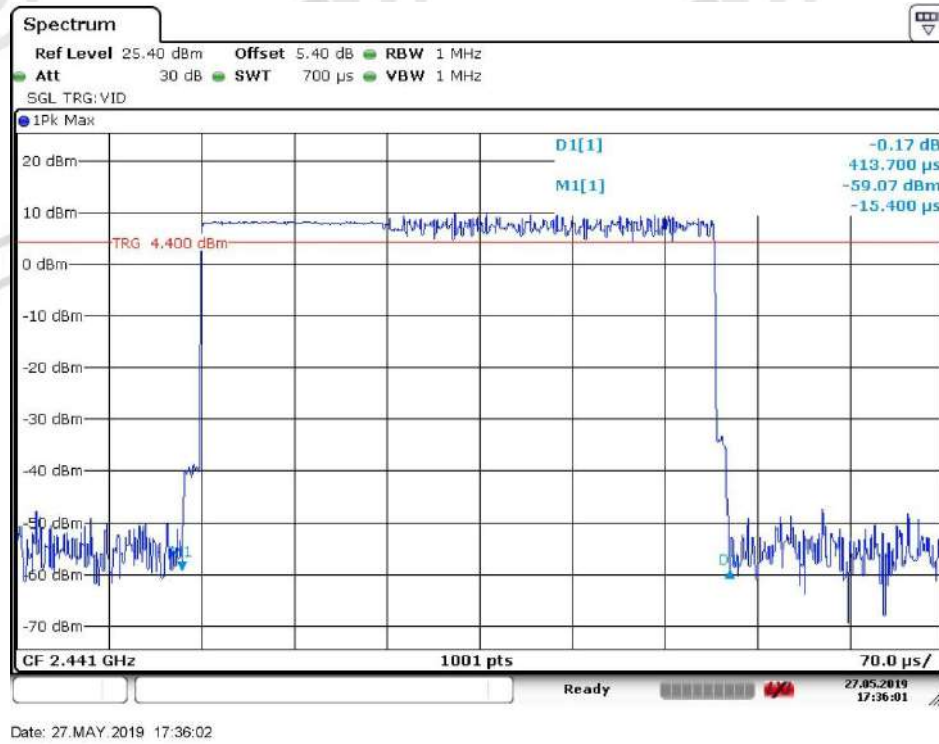
Date: 27.MAY.2019 17:36:46

## 2DH5 \_ Middle Channel

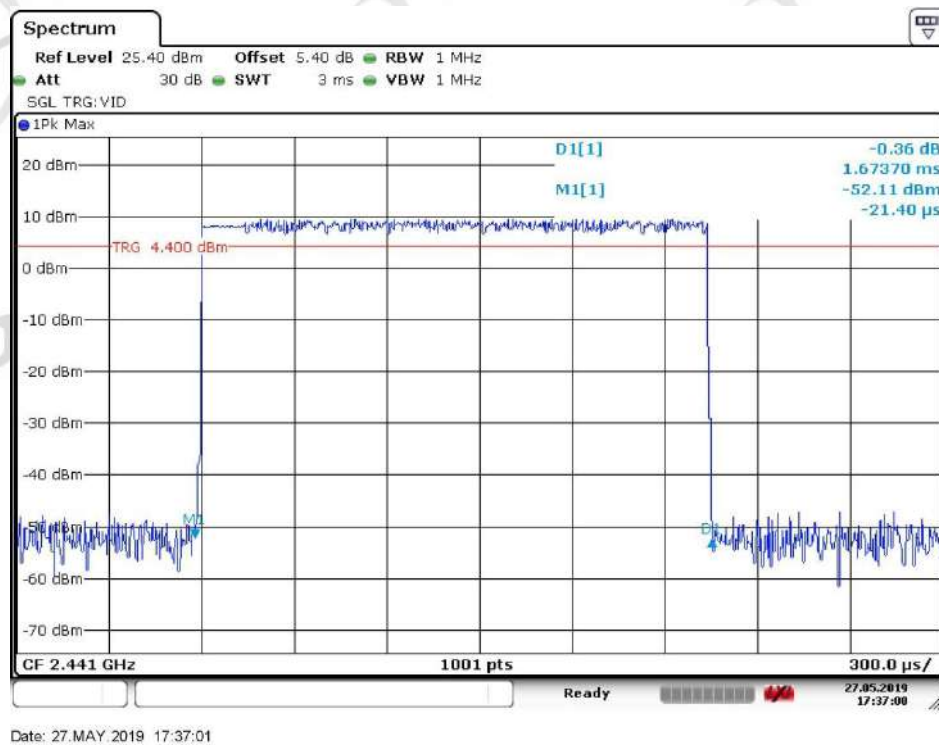


Date: 27.MAY.2019 17:38:06

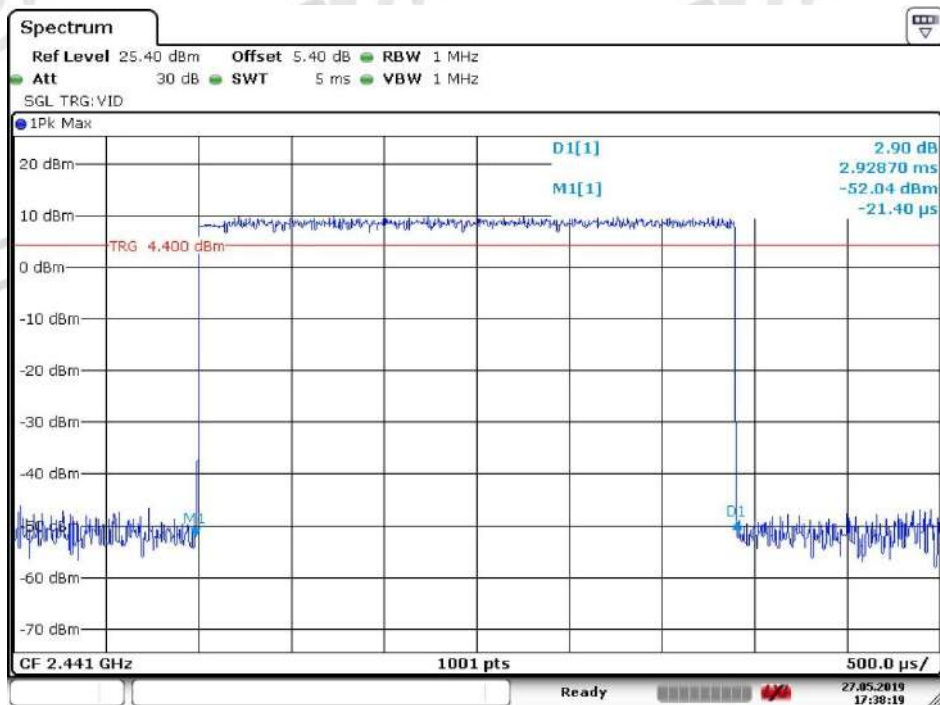
## 3DH1 \_ Middle Channel



## 3DH3 \_ Middle Channel



## 3DH5 Middle Channel

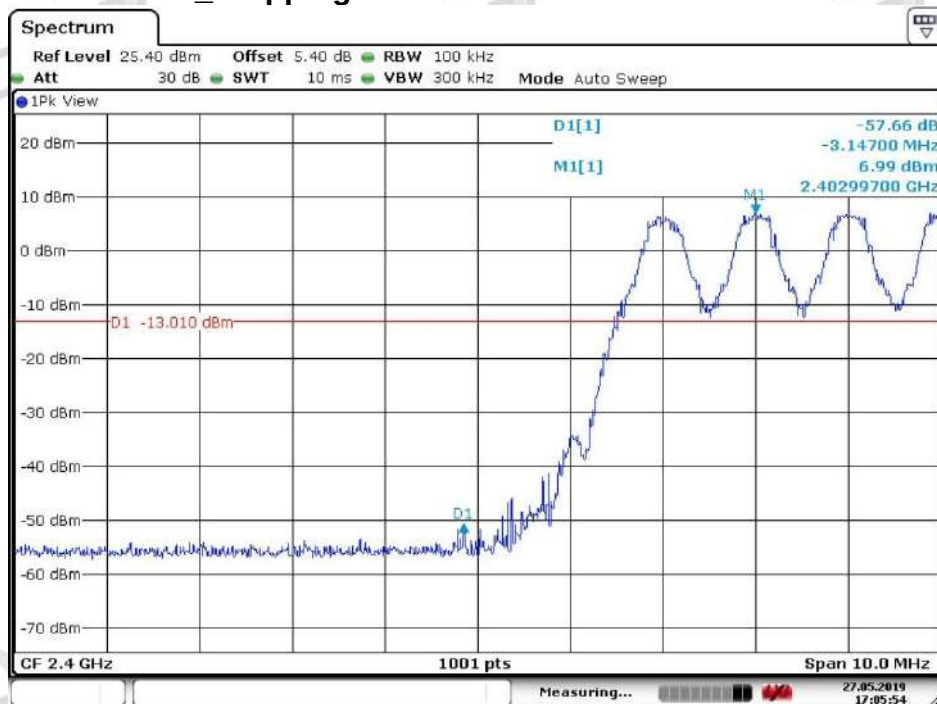


Date: 27.MAY 2019 17:38:20

## Band-edge for RF Conducted Emissions

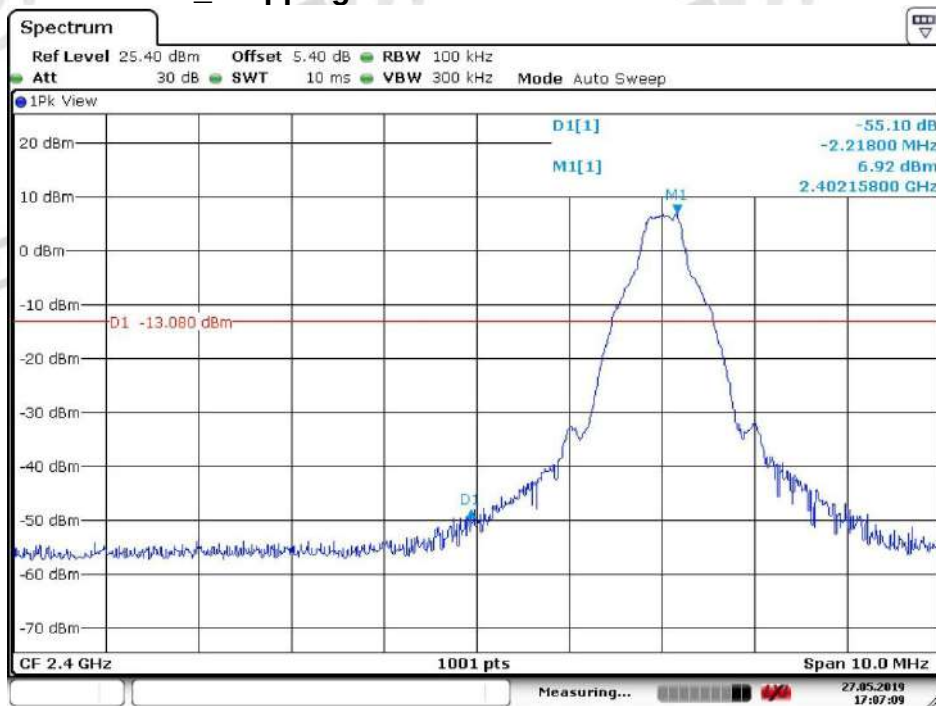
### Test plots

#### GFSK \_Lowest Channel\_ Hopping ON



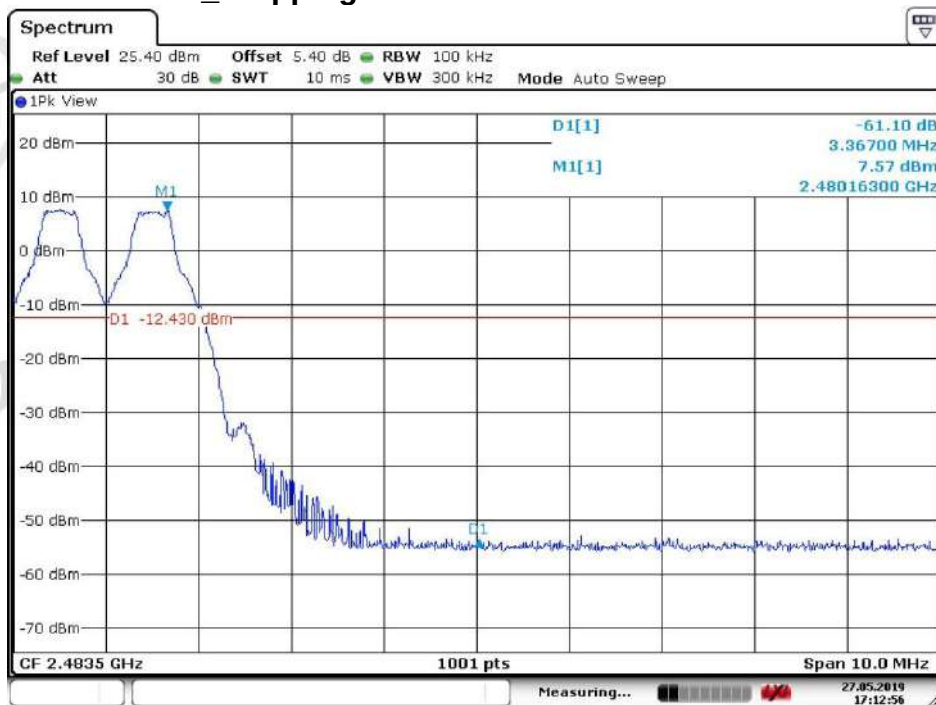
Date: 27.MAY 2019 17:05:54

## GFSK \_Lowest Channel\_ Hopping OFF



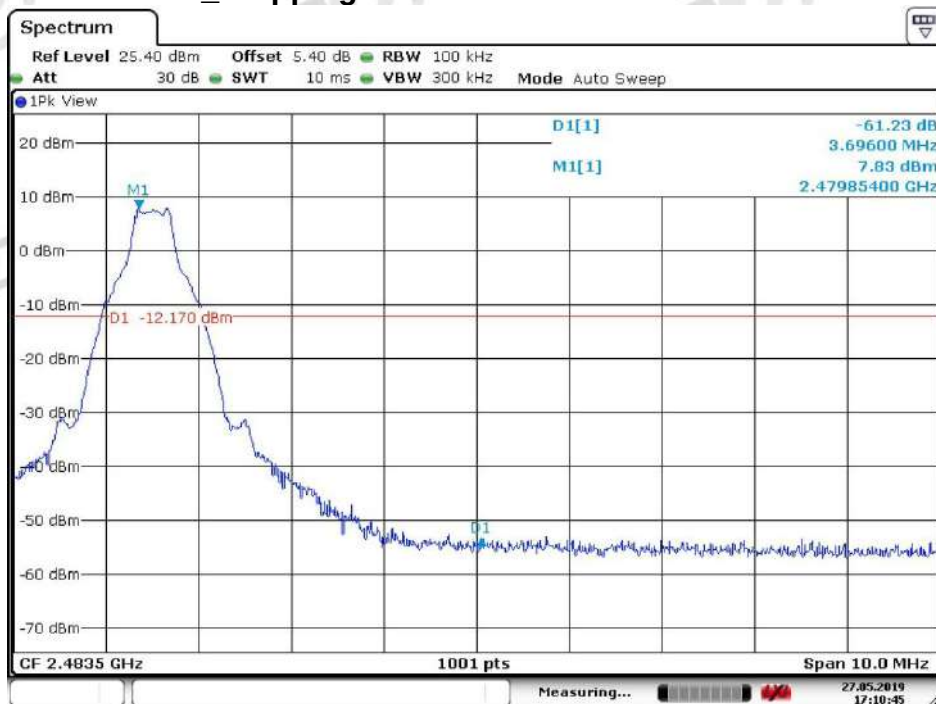
Date: 27.MAY.2019 17:07:09

## GFSK \_Highest Channel\_ Hopping ON

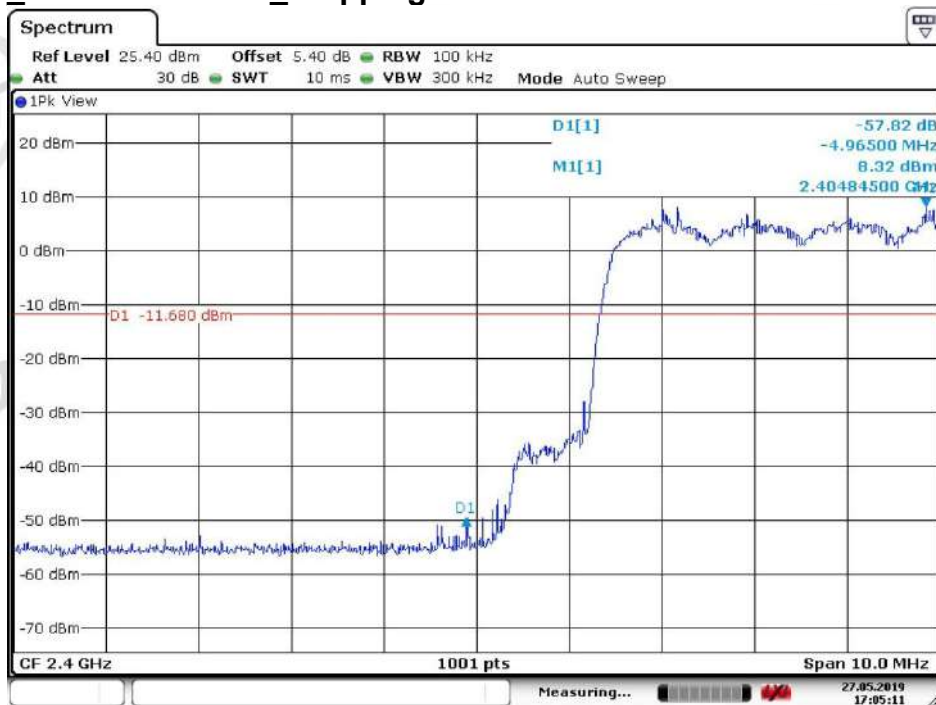


Date: 27.MAY.2019 17:12:57

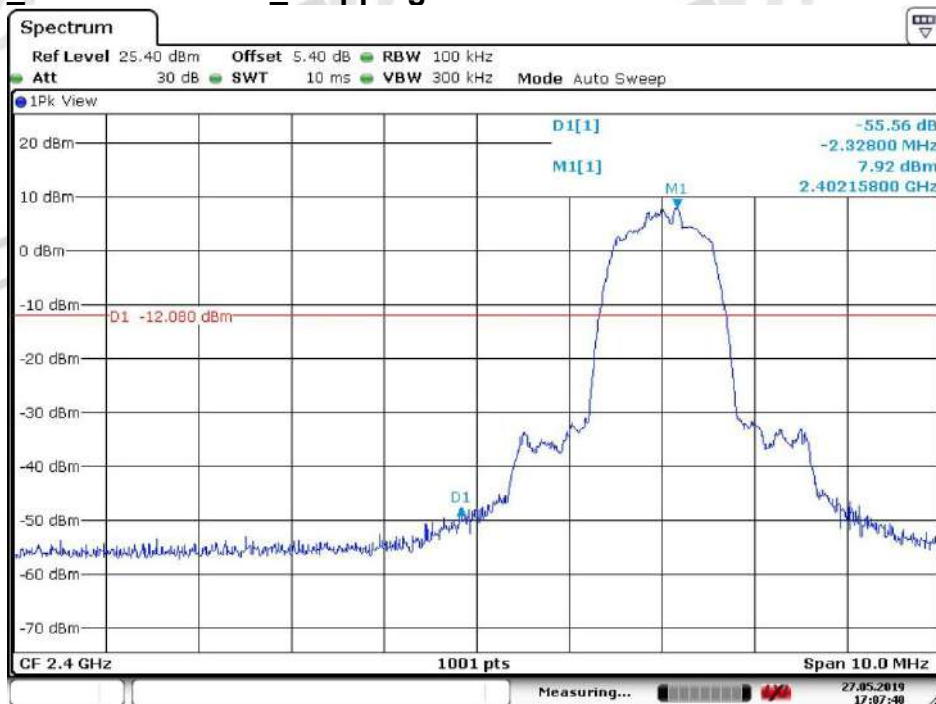
## GFSK\_Highest Channel\_Hopping OFF



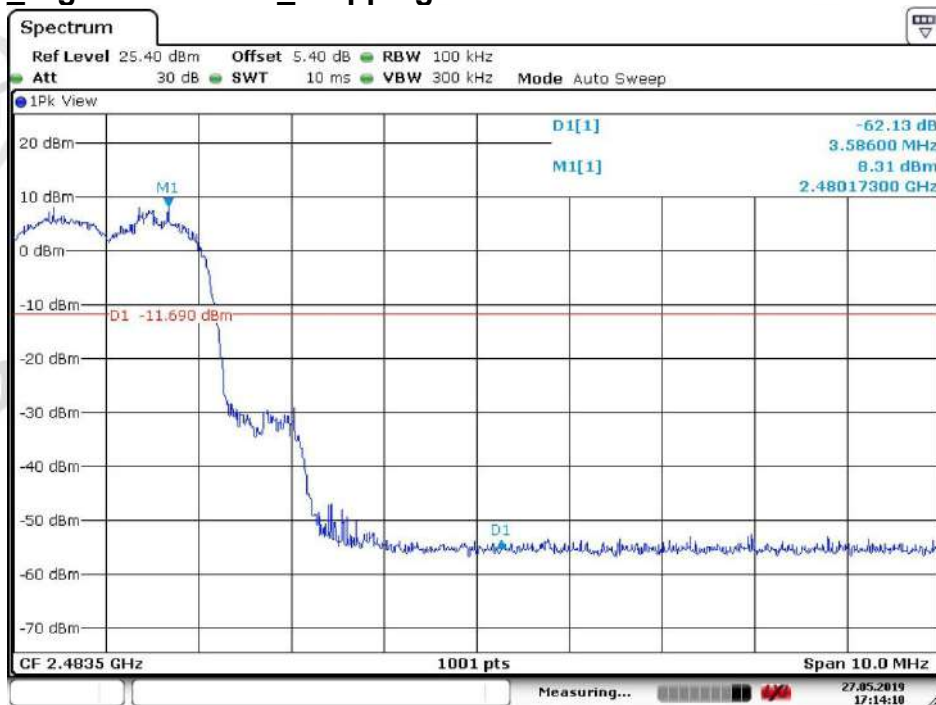
Date: 27.MAY.2019 17:10:46

 $\pi/4$ QPSK\_Lowest Channel\_Hopping ON

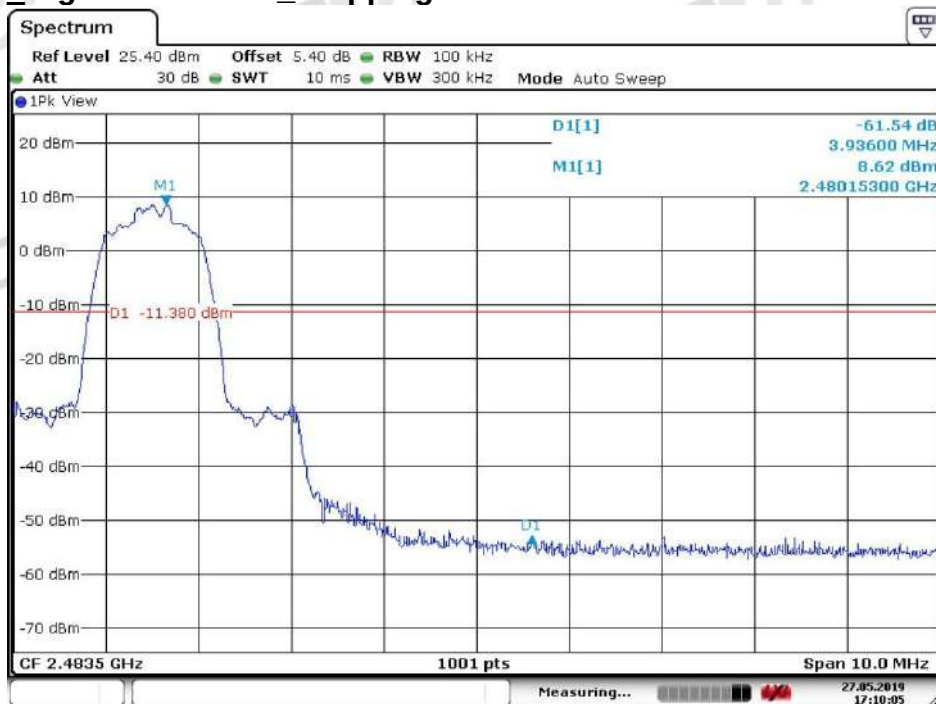
Date: 27.MAY.2019 17:05:11

$\pi/4$ DQPSK\_Lowest Channel\_Hopping OFF

Date: 27.MAY.2019 17:07:40

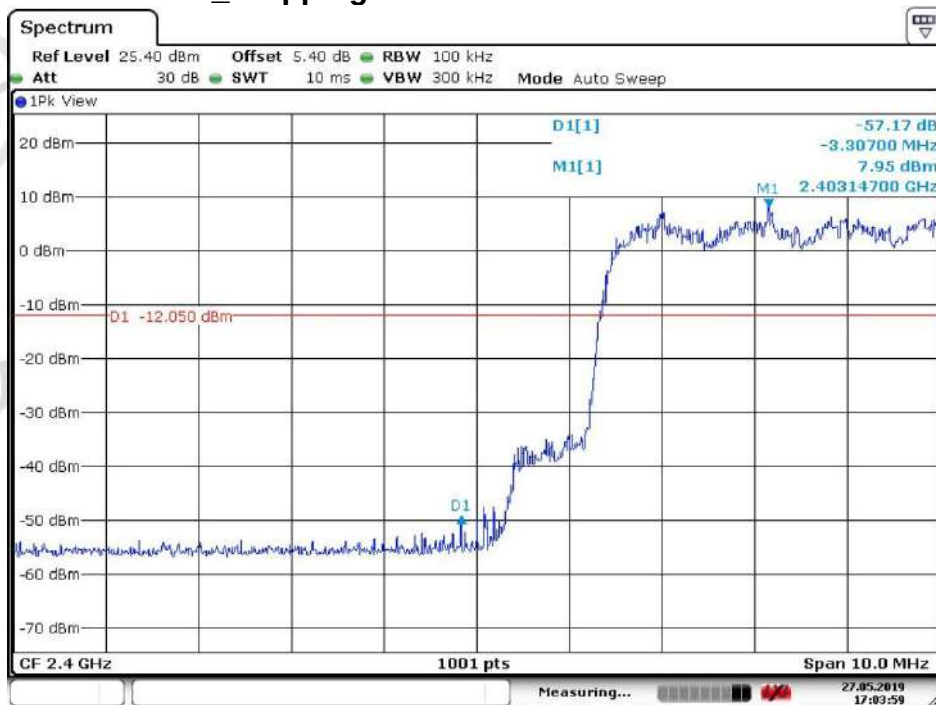
 $\pi/4$ DQPSK\_Highest Channel\_Hopping ON

Date: 27.MAY.2019 17:14:11

$\pi/4$ DQPSK\_Highest Channel\_Hopping OFF

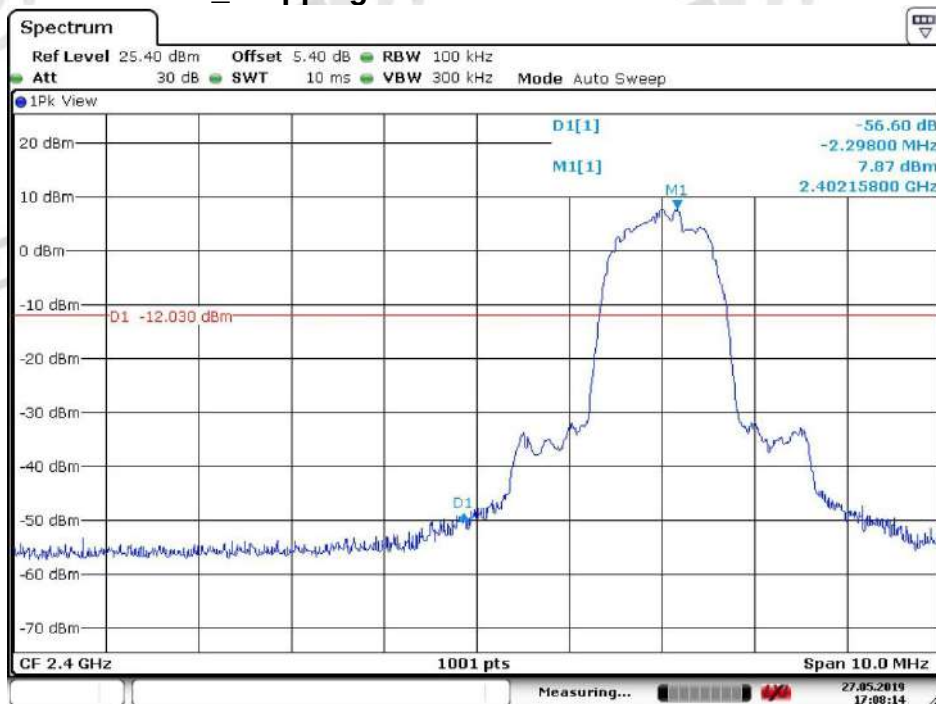
Date: 27.MAY.2019 17:10:05

## 8DPSK\_Lowest Channel\_Hopping ON



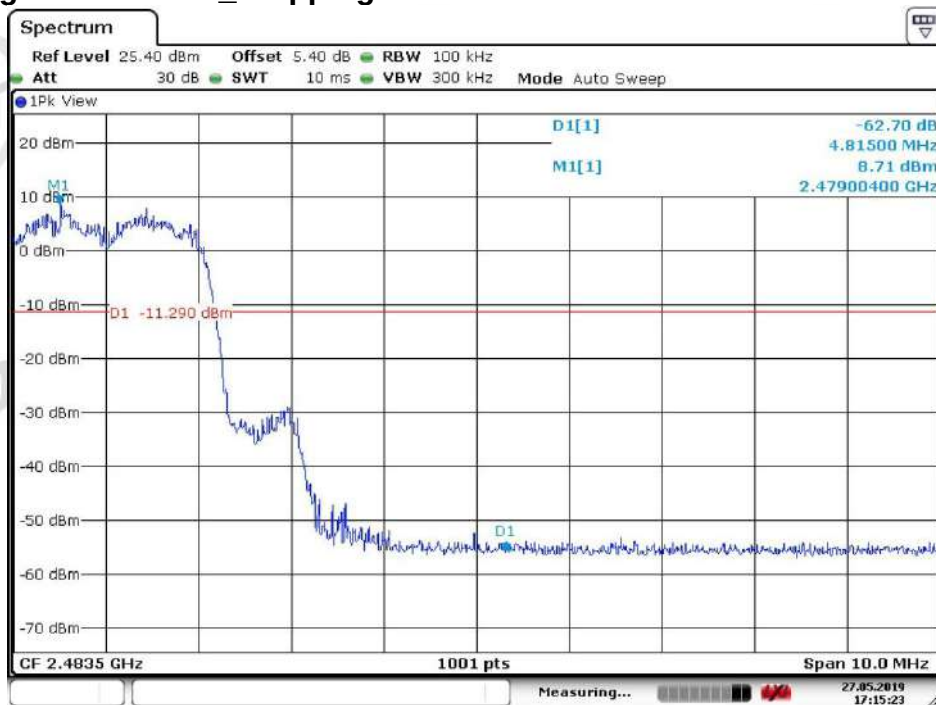
Date: 27.MAY.2019 17:03:59

## 8DPSK\_Lowest Channel\_ Hopping OFF



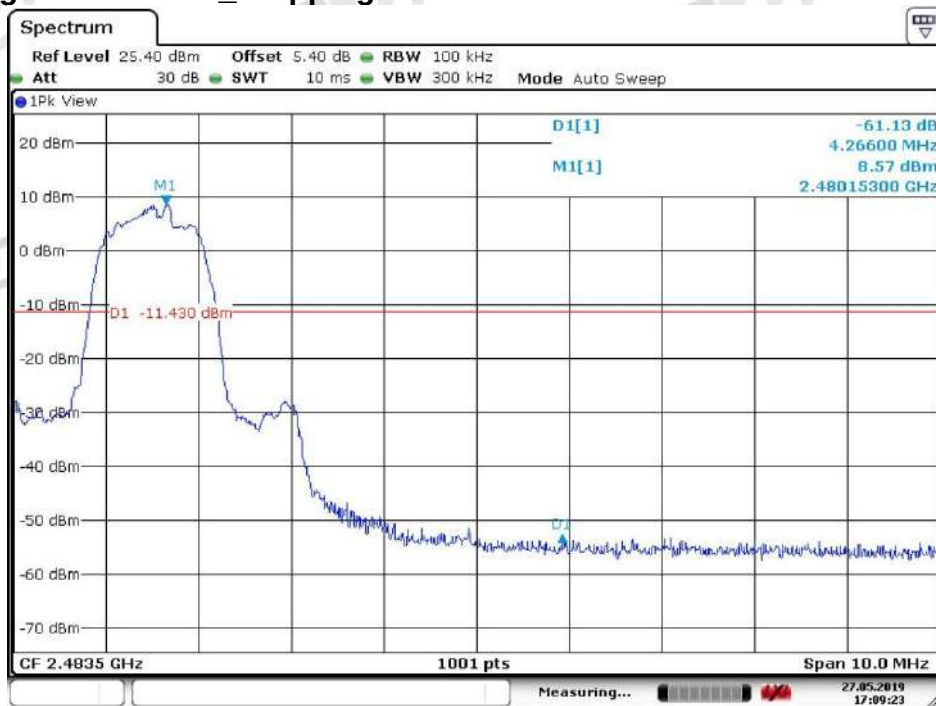
Date: 27.MAY.2019 17:08:15

## 8DPSK\_Highest Channel\_ Hopping ON



Date: 27.MAY.2019 17:15:23

## 8DPSK\_Highest Channel\_Hopping OFF

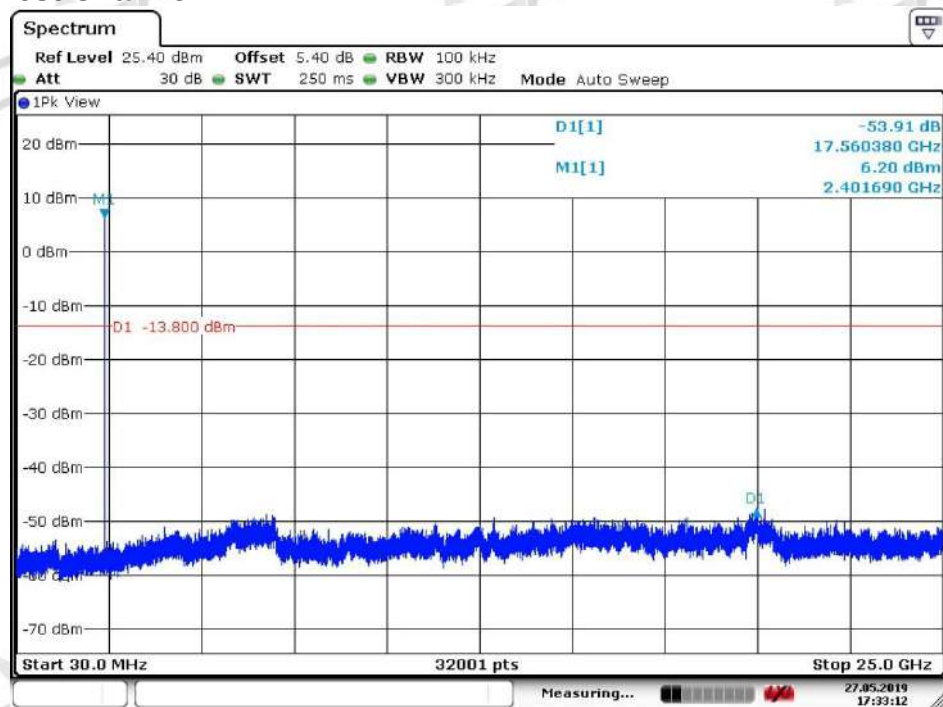


Date: 27.MAY.2019 17:09:24

## Spurious RF Conducted Emissions

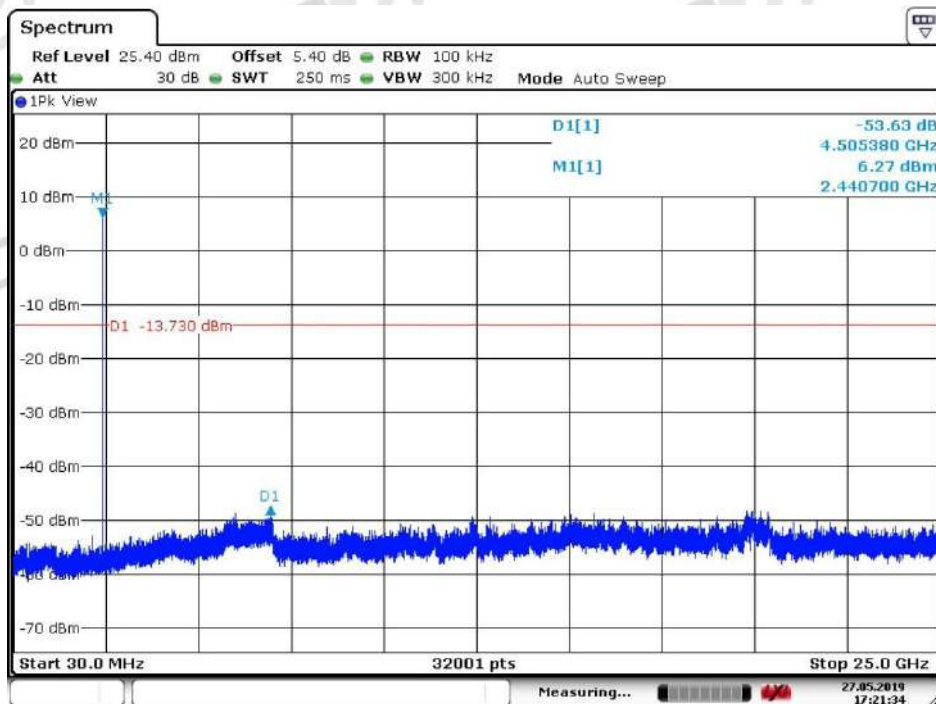
### Test plots

#### GFSK \_Lowest Channel



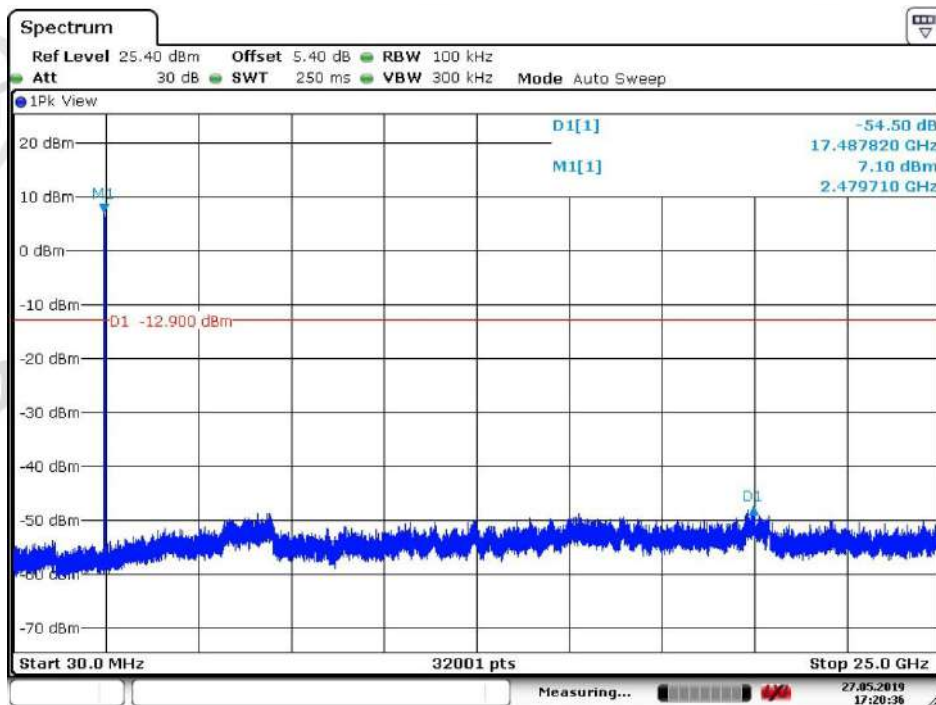
Date: 27.MAY.2019 17:33:12

## GFSK\_Middle Channel

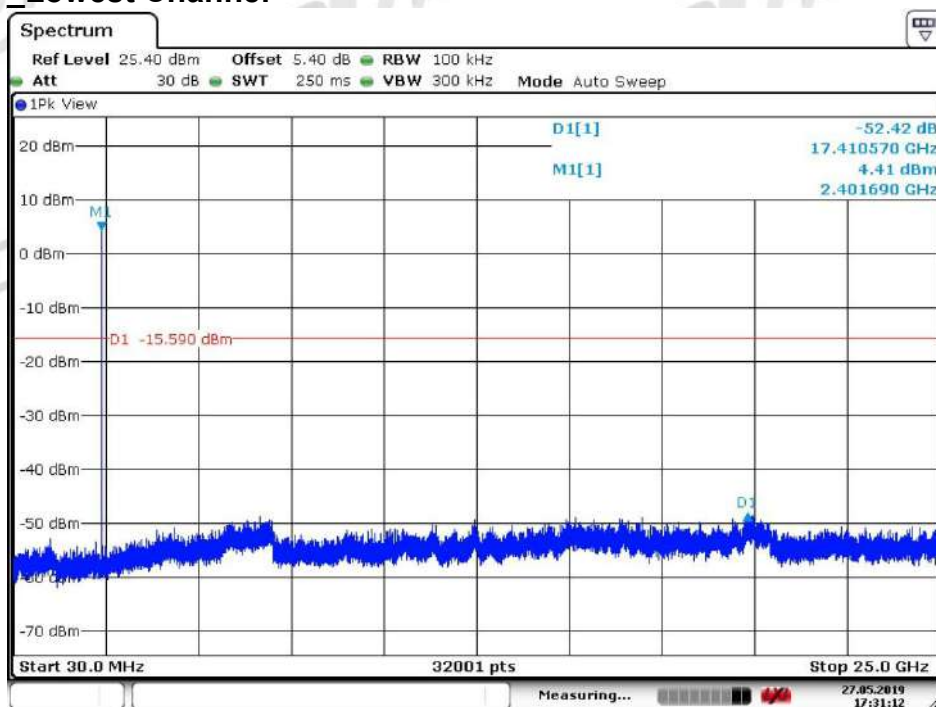


Date: 27.MAY.2019 17:21:34

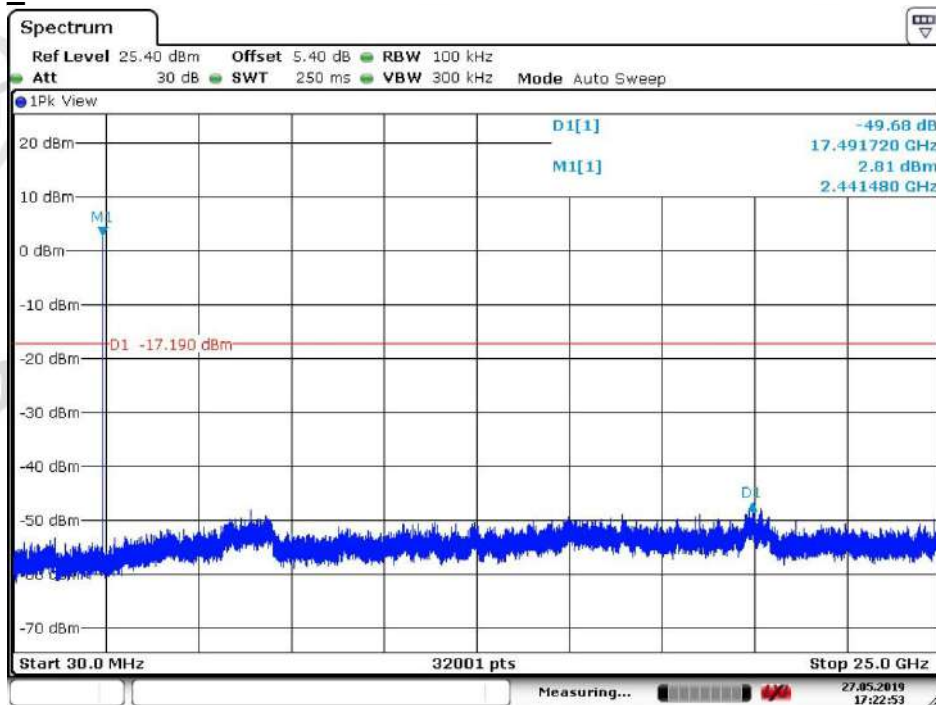
## GFSK\_Highest Channel



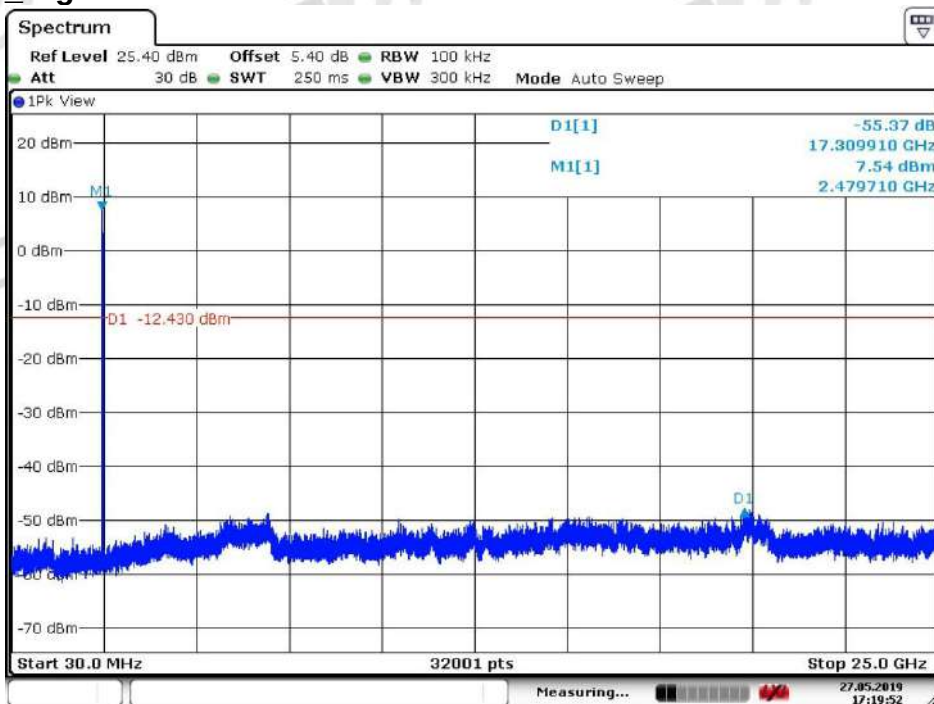
Date: 27.MAY.2019 17:20:37

$\pi/4$ DQPSK\_Lowest Channel

Date: 27.MAY.2019 17:31:13

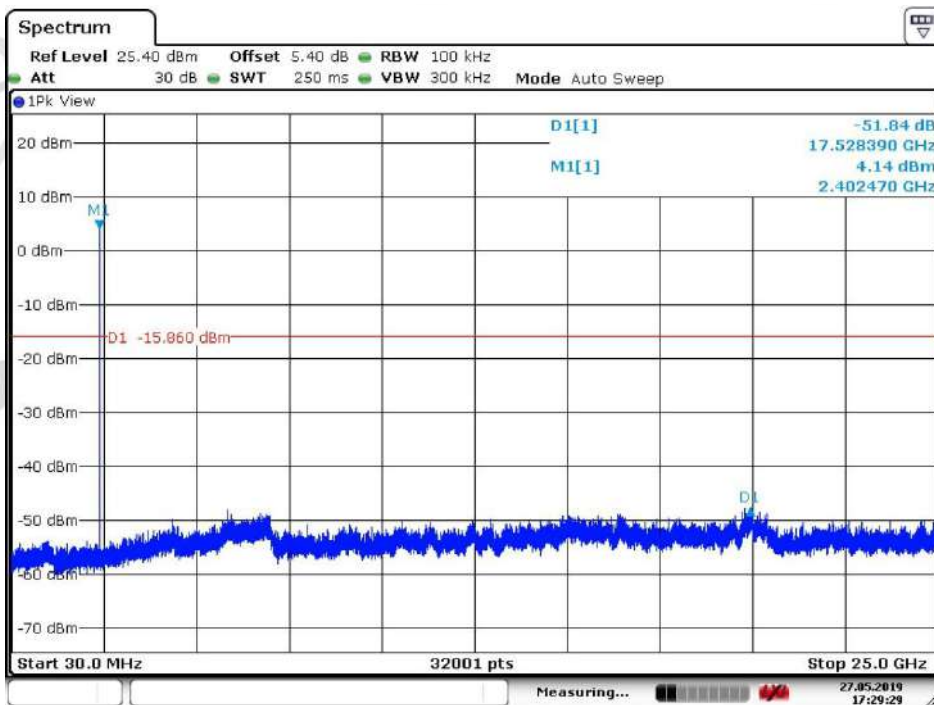
 $\pi/4$ DQPSK\_Middle Channel

Date: 27.MAY.2019 17:22:54

$\pi/4$ DQPSK\_Highest Channel

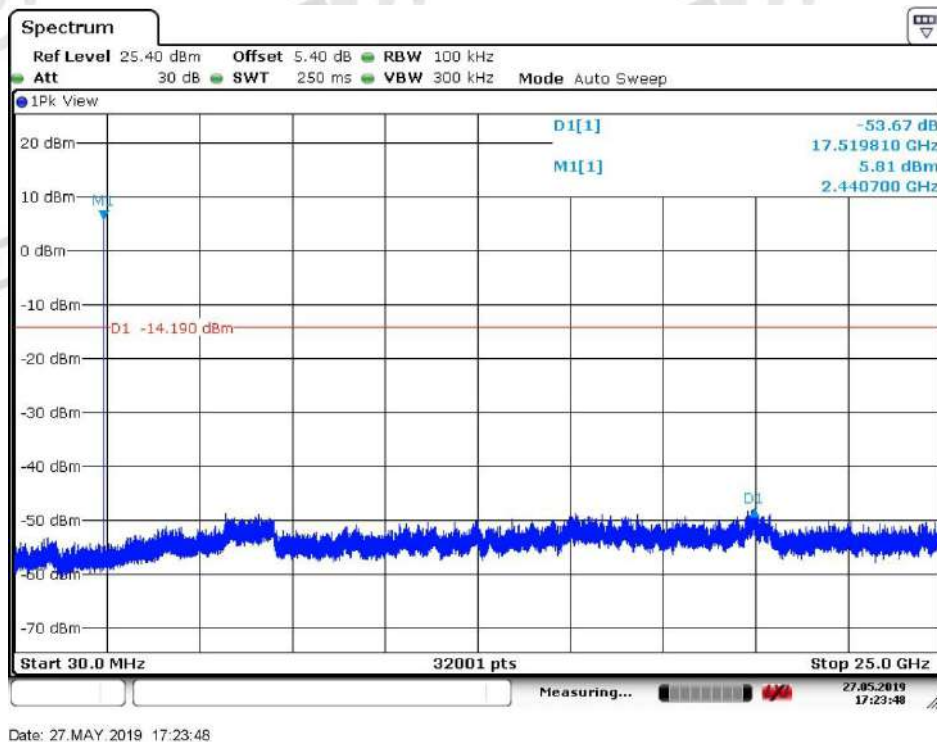
Date: 27.MAY.2019 17:19:52

## 8DPSK\_Lowest Channel

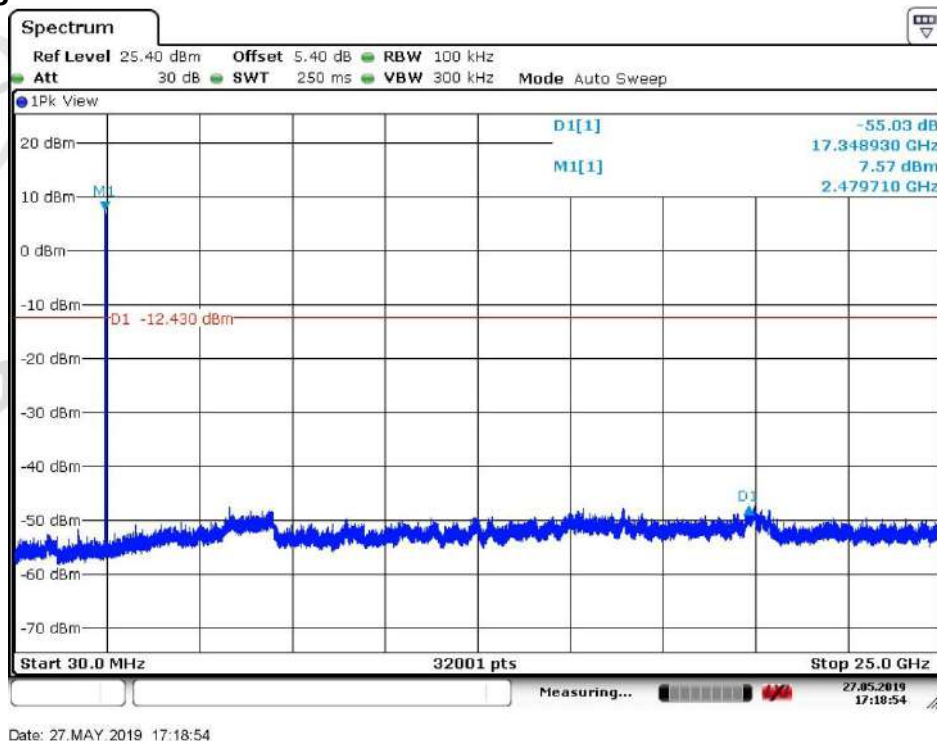


Date: 27.MAY.2019 17:29:30

## 8DPSK Middle Channel



### 8DPSK\_Highest Channel



Remark:

Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

## The End