



# TEST REPORT

**No. I19D00071-SRD01**

*For*

**Client: Toast, Inc.**

**Production: Data Processing Machine**

**Model Name: TT200/TK200/TT201/TT202**

**Brand Name: Toast**

**FCC ID : 2AMNG-TT200**

**IC ID : 23177-TT200**

**Hardware Version: CT541MB80C**

**Software Version: 1.2.6/121**

**Issued date: 2019-08-12**

## NOTE

1. The test results in this test report relate only to the devices specified in this report.
2. This report shall not be reproduced except in full without the written approval of East China Institute of Telecommunications.
3. For the test results, the uncertainty of measurement is not taken into account when judging the compliance with specification, and the results of measurement or the average value of measurement results are taken as the criterion of the compliance with specification directly.

### Test Laboratory:

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**Revision Version**

| Report Number   | Revision | Date       | Memo                            |
|-----------------|----------|------------|---------------------------------|
| I19D00071-SRD01 | 00       | 2019-08-12 | Initial creation of test report |

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## 1. Test Laboratory

### 1.1. Testing Location

|                     |                                                            |
|---------------------|------------------------------------------------------------|
| Company Name        | East China Institute of Telecommunications                 |
| Address             | 7-8/F., Area G, No.668, Beijing East Road, Shanghai, China |
| Postal Code         | 200001                                                     |
| Telephone           | +86 21 63843300                                            |
| Fax                 | +86 21 63843301                                            |
| FCC registration No | 958356                                                     |

### 1.2. Testing Environment

|                    |           |
|--------------------|-----------|
| Normal Temperature | 15°C-35°C |
| Relative Humidity  | 20%-75%   |

### 1.3. Project Data

|                    |            |
|--------------------|------------|
| Project Leader     | Zhou Yan   |
| Testing Start Date | 2019-05-16 |
| Testing End Date   | 2019-05-24 |

### 1.4. Signature



**Wang Liang**  
(Prepared this test report)



**Fan Songyan**  
(Reviewed this test report)



**Zheng Zhongbin**  
(Approved this test report)

## 2. Client Information

### 2.1. Applicant Information

|              |                                                  |
|--------------|--------------------------------------------------|
| Company Name | Toast, Inc.                                      |
| Address      | 401 Park Drive, Suite 801, Boston, MA 02215, USA |
| Telephone    | (562) 546-2272                                   |
| Postcode     | /                                                |

### 2.2. Manufacturer Information

|              |                                                  |
|--------------|--------------------------------------------------|
| Company Name | Toast, Inc.                                      |
| Address      | 401 Park Drive, Suite 801, Boston, MA 02215, USA |
| Telephone    | (562) 546-2272                                   |
| Postcode     | /                                                |

### 3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

#### 3.1. About EUT

|                                   |                                                                   |
|-----------------------------------|-------------------------------------------------------------------|
| Production                        | Data Processing Machine                                           |
| Model name                        | TT200/TK200/TT201/TT202                                           |
| BT Frequency                      | 2402MHz-2480MHz                                                   |
| BT Channel                        | Channel0-Channel78                                                |
| BT type of modulation             | GFSK; $\pi/4$ DQPSK; 8DPSK                                        |
| Additional Communication Function | BT/BLE/2.4G WLAN 802.11 b/g/n20<br>5G WLAN 802.11 a/n/ac20/40/ 80 |
| Extreme Temperature               | 0/+55℃                                                            |
| Nominal Voltage                   | 24V                                                               |
| Extreme High Voltage              | 28V                                                               |
| Extreme Low Voltage               | 20V                                                               |
| Maximum of Antenna Gain           | Bluetooth: 1.92dBi                                                |

Note:

- Photographs of EUT are shown in ANNEX A of this test report.
- The value of the antenna gain is provided by the customer. For specific antenna information, please check the antenna specifications of the customer.

#### 3.2. Internal Identification of EUT used during the test

| EUT ID* | SN or IMEI | HW Version | SW Version | Date of receipt |
|---------|------------|------------|------------|-----------------|
| N01     | /          | CT541MB80C | 1.2.6/121  | 2019-05-14      |
| N07     | /          | CT541MB80C | 1.2.6/121  | 2019-05-14      |

\*EUT ID: is used to identify the test sample in the lab internally.

#### 3.3. Internal Identification of AE used during the test

| AE ID* | Description | Type | Manufacturer |
|--------|-------------|------|--------------|
| AE1    | RF cable    | ---  | AE1          |

\*AE ID: is used to identify the test sample in the lab internally.

## 4. Reference Documents

### 4.1. Documents supplied by applicant

All technical documents are supplied by the client or manufacturer, which is the basis of testing.

### 4.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

| Reference   | Title                                                                                                                                                                                                                    | Version    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| FCC Part15  | FCC CFR 47, Part 15, Subpart C:<br>15.205 Restricted bands of operation;<br>15.209 Radiated emission limits, general requirements;<br>15.247 Operation within the bands 902-928MHz,<br>2400-2483.5MHz, and 5725-5850MHz. | 2018-10-01 |
| ANSI C63.10 | American National Standard of Procedures for Compliance<br>Testing of Unlicensed Wireless Devices                                                                                                                        | 2013       |
| RSS-247     | Digital Transmission Systems (DTSs), Frequency Hopping<br>Systems (FHSs) and Licence-Exempt Local Area Network<br>(LE-LAN) Devices                                                                                       | 2017       |
| RSS-Gen     | General Requirements for Compliance of Radio Apparatus                                                                                                                                                                   | 2018       |
| KDB 558074  | Guidance for Performing Compliance Measurements on<br>Frequency Hopping Spread Spectrum systems (DSS)<br>Operating Under §15.247                                                                                         | v05r02     |

## 5. Test Results

### 5.1. Summary of Test Results

| Measurement Items                       | Sub-clause of Part15C | Sub-clause of IC | Verdict |
|-----------------------------------------|-----------------------|------------------|---------|
| Maximum Peak Output Power               | 15.247(b)             | RSS-247<br>5.4   | P       |
| 20dB Occupied Bandwidth                 | 15.247(a)             | RSS-247<br>5.2   | P       |
| Band Edges Compliance                   | 15.247(b)             | RSS-247<br>5.2   | P       |
| Time Of Occupancy (Dwell Time)          | 15.247(a)             | RSS-247<br>5.5   | P       |
| Carrier Frequency Separation            | 15.247(a)             | RSS-247<br>5.2   | P       |
| Number Of Hopping Channels              | 15.247(a)             | RSS-247<br>5.2   | P       |
| Transmitter Spurious Emission-Conducted | 15.247                | RSS-247<br>5.2   | P       |
| Transmitter Spurious Emission-Radiated  | 15.247,15.209         | RSS-247<br>5.5   | P       |
| AC Powerline Conducted Emission         | 15.107,15.207         | RSS-247<br>5.5   | P       |

Note: please refer to Annex A in this test report for the detailed test results.

The following terms are used in the above table.

|    |                                                                                |
|----|--------------------------------------------------------------------------------|
| P  | Pass, the EUT complies with the essential requirements in the standard.        |
| NP | Not Perform, the test was not performed by ECIT.                               |
| NA | Not Applicable, the test was not applicable.                                   |
| F  | Fail, the EUT does not comply with the essential requirements in the standard. |

#### Test Conditions

|      |                    |
|------|--------------------|
| Tnom | Normal Temperature |
| Tmin | Low Temperature    |
| Tmax | High Temperature   |
| Vnom | Normal Voltage     |
| Vmin | Low Voltage        |
| Vmax | High Voltage       |
| Hnom | Norm Humidity      |

|      |                   |
|------|-------------------|
| Anom | Norm Air Pressure |
|------|-------------------|

For this report, all the test case listed above are tested under Normal Temperature and Normal Voltage, and also under norm humidity, the specific conditions as following:

|              |      |         |
|--------------|------|---------|
| Temperature  | Tnom | 25°C    |
| Voltage      | Vnom | 24V     |
| Humidity     | Hnom | 48%     |
| Air Pressure | Anom | 1010hPa |

**Note:**

- All the test data for each data were verified, but only the worst case was reported.
- The GFSK,  $\pi/4$  DQPSK and 8DPSK were set in DH1 for GFSK, 2-DH1 for  $\pi/4$  DQPSK, 3-DH1 for 8DPSK.
- The DC and low frequency voltages' measurement uncertainty is  $\pm 2\%$ .

**5.2. Statements**

The TT200/TK200/TT201/TT202 is an initial product for testing.

ECIT only performed test cases which identified with P/NP/NA/F results in Annex A.

ECIT has verified that the compliance of the tested device specified in section 3 of this test report is successfully evaluated according to the procedure and test methods as defined in type certification requirement listed in section 4 of this test report.

## 6. Test Equipments Utilized

### 6.1. Conducted Test System

| Item | Instrument Name        | Type     | SN                   | Manufacturer | Cal. Date  | Cal. interval |
|------|------------------------|----------|----------------------|--------------|------------|---------------|
| 1    | Vector Signal Analyzer | FSQ26    | 101091               | R&S          | 2019-05-10 | 1 year        |
| 2    | DC Power Supply        | ZUP60-14 | LOC-220Z<br>006-0007 | TDL-Lambda   | 2019-05-10 | 1 year        |

### 6.2. Radiated Emission Test System

| Item | Instrument Name                      | Type     | SN               | Manufacturer | Cal. Date  | Cal. interval |
|------|--------------------------------------|----------|------------------|--------------|------------|---------------|
| 1    | Universal Radio Communication Tester | CMU200   | 123123           | R&S          | 2019-05-10 | 1 year        |
| 2    | EMI Test Receiver                    | ESU40    | 100307           | R&S          | 2019-05-10 | 1 year        |
| 3    | TRILOG Broadband Antenna             | VULB9163 | VULB9163<br>-515 | Schwarzbeck  | 2017-02-25 | 3 years       |
| 4    | Double- ridged Waveguide Antenna     | ETS-3117 | 00135890         | ETS          | 2017-01-11 | 3 years       |
| 5    | 2-Line V-Network                     | ENV216   | 101380           | R&S          | 2019-05-10 | 1 year        |

#### **Anechoic chamber**

Fully anechoic chamber by ETS.

## 7. Measurement Uncertainty

Measurement uncertainty for all the testing in this report are within the limit specified in ECIT documents . The detailed measurement uncertainty is defined in ECIT documents.

| Measurement Items                      | Range              | Confidence Level | Calculated Uncertainty |
|----------------------------------------|--------------------|------------------|------------------------|
| Peak Output Power-Conducted            | 2402MHz-2480MHz    | 95%              | $\pm 0.544\text{dB}$   |
| Frequency Band Edges-Conducted         | 2402MHz-2480MHz    | 95%              | $\pm 0.544\text{dB}$   |
| Conducted Emission                     | 30MHz-2GHz         | 95%              | $\pm 0.90\text{dB}$    |
| Conducted Emission                     | 2GHz-3.6GHz        | 95%              | $\pm 0.88\text{dB}$    |
| Conducted Emission                     | 3.6GHz-8GHz        | 95%              | $\pm 0.96\text{dB}$    |
| Conducted Emission                     | 8GHz-20GHz         | 95%              | $\pm 0.94\text{dB}$    |
| Conducted Emission                     | 20GHz-22GHz        | 95%              | $\pm 0.88\text{dB}$    |
| Conducted Emission                     | 22GHz-26GHz        | 95%              | $\pm 0.86\text{dB}$    |
| Transmitter Spurious Emission-Radiated | 9KHz-30MHz         | 95%              | $\pm 5.66\text{dB}$    |
| Transmitter Spurious Emission-Radiated | 30MHz-1000MHz      | 95%              | $\pm 4.98\text{dB}$    |
| Transmitter Spurious Emission-Radiated | 1000MHz -18000MHz  | 95%              | $\pm 5.06\text{dB}$    |
| Transmitter Spurious Emission-Radiated | 18000MHz -40000MHz | 95%              | $\pm 5.20\text{dB}$    |
| Dwell Time                             | 2402MHz-2480MHz    | 95%              | $\pm 0.218\text{ms}$   |
| 20dB Bandwidth                         | 2402MHz-2480MHz    | 95%              | $\pm 62.04\text{Hz}$   |
| AC Power line Conducted Emission       | 0.15MHz-30MHz      | 95%              | $\pm 3.66\text{ dB}$   |

## 8. Test Environment

**Shielding Room1** (6.0 meters×3.0 meters×2.7 meters) did not exceed following limits along the conducted RF performance testing:

|                          |                            |
|--------------------------|----------------------------|
| Temperature              | Min. = 15 °C, Max. = 35 °C |
| Relative humidity        | Min. = 20 %, Max. = 75 %   |
| Shielding effectiveness  | > 100 dB                   |
| Ground system resistance | < 0.5 Ω                    |

**Control room** did not exceed following limits along the EMC testing:

|                          |                            |
|--------------------------|----------------------------|
| Temperature              | Min. = 15 °C, Max. = 35 °C |
| Relative humidity        | Min. = 30 %, Max. = 60 %   |
| Shielding effectiveness  | > 100 dB                   |
| Electrical insulation    | > 10 kΩ                    |
| Ground system resistance | < 0.5 Ω                    |

**Fully-anechoic chamber1** (6.9 meters×10.9 meters×5.4 meters) did not exceed following limits along the EMC testing:

|                              |                                            |
|------------------------------|--------------------------------------------|
| Temperature                  | Min. = 15 °C, Max. = 35 °C                 |
| Relative humidity            | Min. = 25 %, Max. = 75 %                   |
| Shielding effectiveness      | > 100 dB                                   |
| Electrical insulation        | > 10 kΩ                                    |
| Ground system resistance     | < 0.5 Ω                                    |
| VSWR                         | Between 0 and 6 dB, from 1GHz to 18GHz     |
| Site Attenuation Deviation   | Between -4 and 4 dB, 30MHz to 1GHz         |
| Uniformity of field strength | Between 0 and 6 dB, from 80MHz to 3000 MHz |

## ANNEX A. Detailed Test Results

### ANNEX A.1. Peak Output Power-Conducted

#### A.1.1 Measurement Limit

| Standard              | Limit (dBm) |
|-----------------------|-------------|
| FCC Part 15.247(b)(1) | < 21        |

#### A.1.2 Test Condition:

| Hopping Mode | RBW  | VBW   | Span | Sweeptime |
|--------------|------|-------|------|-----------|
| Hopping OFF  | 3MHz | 10MHz | 9MHz | Auto      |

#### A.1.3 Test procedure

The measurement is according to ANSI C63.10 clause 7.8.5.

1. The output power of EUT was connected to the spectrum analyzer and CBT32 by cable and divide. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Measure the conducted output power and record the results it.

#### Measurement Results:

##### For GFSK

| Channel                           | Ch0 2402 MHz | Ch39 2441 MHz | CH78 2480 MHz | Conclusion |
|-----------------------------------|--------------|---------------|---------------|------------|
| Peak Conducted Output Power (dBm) | 8.42         | 7.97          | 7.23          | P          |
|                                   | Fig.1        | Fig.2         | Fig.3         |            |

##### For $\pi/4$ DQPSK

| Channel                           | Ch0 2402 MHz | Ch39 2441 MHz | CH78 2480 MHz | Conclusion |
|-----------------------------------|--------------|---------------|---------------|------------|
| Peak Conducted Output Power (dBm) | 4.23         | 4.46          | 3.52          | P          |
|                                   | Fig.4        | Fig.5         | Fig.6         |            |

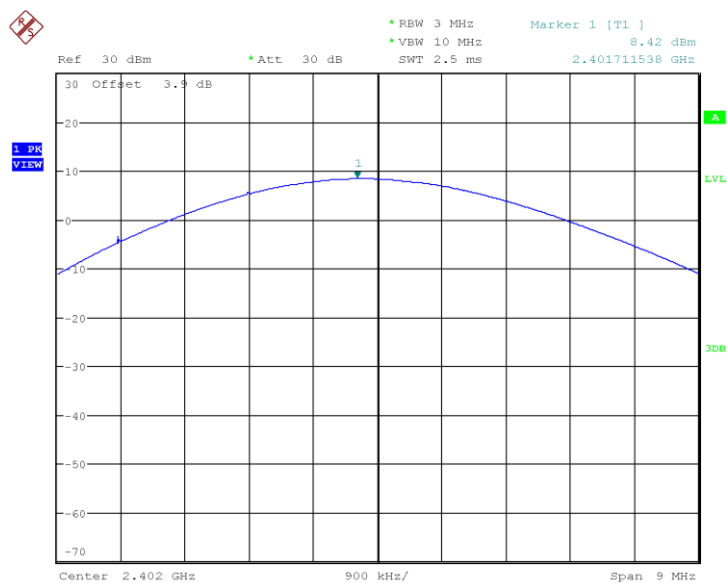
##### For 8DPSK

| Channel        | Ch0 2402 MHz | Ch39 2441 MHz | CH78 2480 MHz | Conclusion |
|----------------|--------------|---------------|---------------|------------|
| Peak Conducted | 4.81         | 5.05          | 4.07          | P          |

| Output Power<br>(dBm) | Fig.7 | Fig.8 | Fig.9 |  |
|-----------------------|-------|-------|-------|--|
|-----------------------|-------|-------|-------|--|

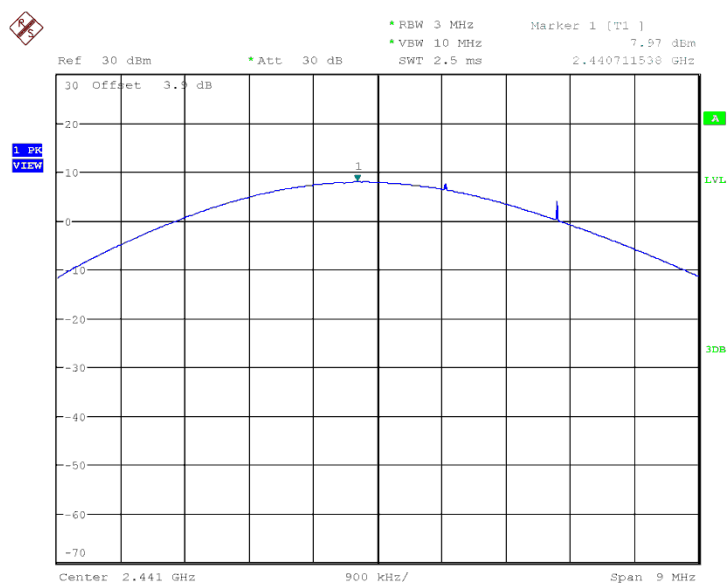
**Conclusion: PASS**

Test graphs an below



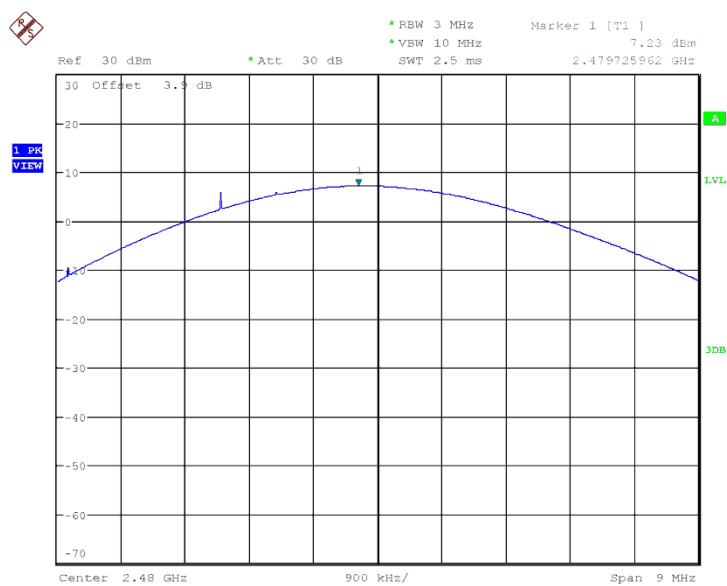
Date: 27.MAY.2019 02:10:52

**Fig.1 Peak Conducted Output Power CH0, DH1**



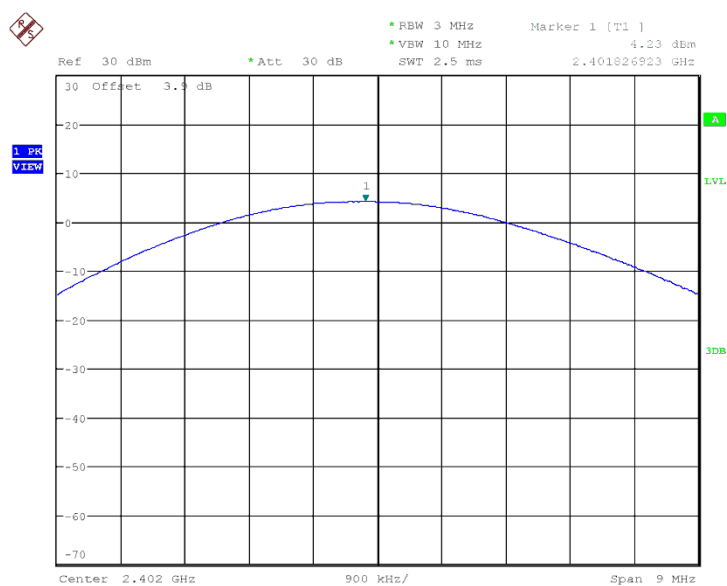
Date: 27.MAY.2019 01:59:20

**Fig.2 Peak Conducted Output Power CH39, DH1**



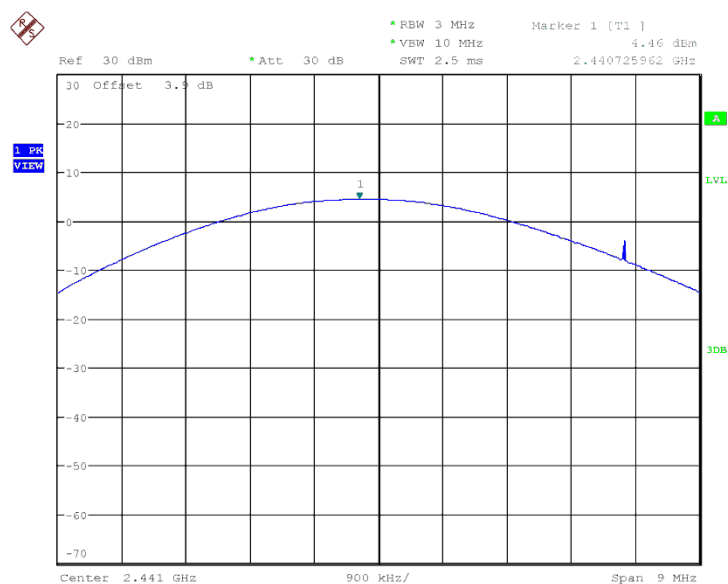
Date: 27.MAY.2019 02:00:19

Fig.3 Peak Conducted Output Power CH78, DH1



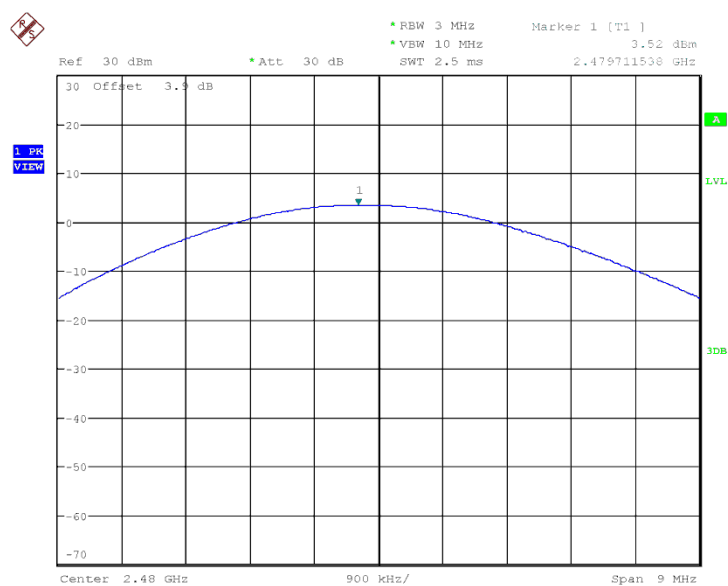
Date: 27.MAY.2019 02:01:30

Fig.4 Peak Conducted Output Power CH0, 2DH1



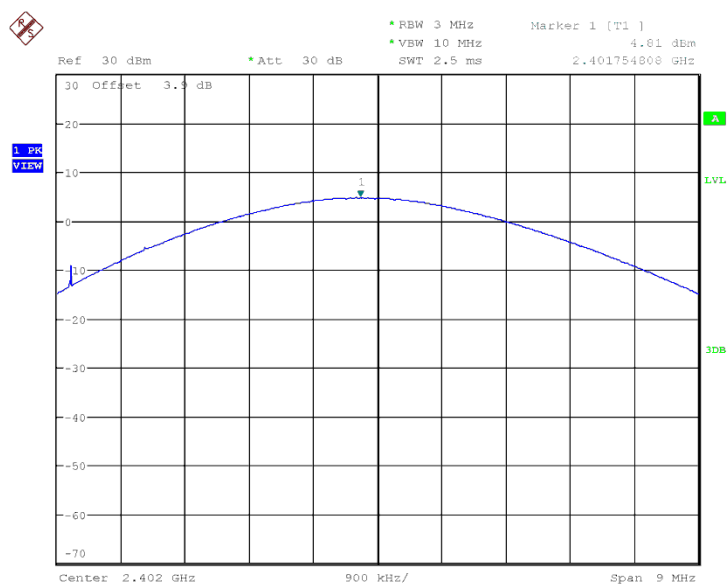
Date: 27.MAY.2019 02:02:30

Fig.5 Peak Conducted Output Power CH39, 2DH1



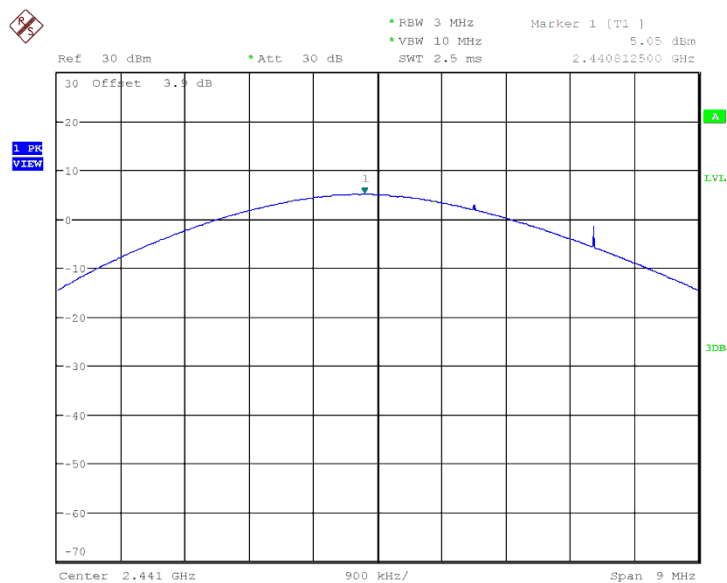
Date: 27.MAY.2019 02:04:03

Fig.6 Peak Conducted Output Power CH78, 2DH1



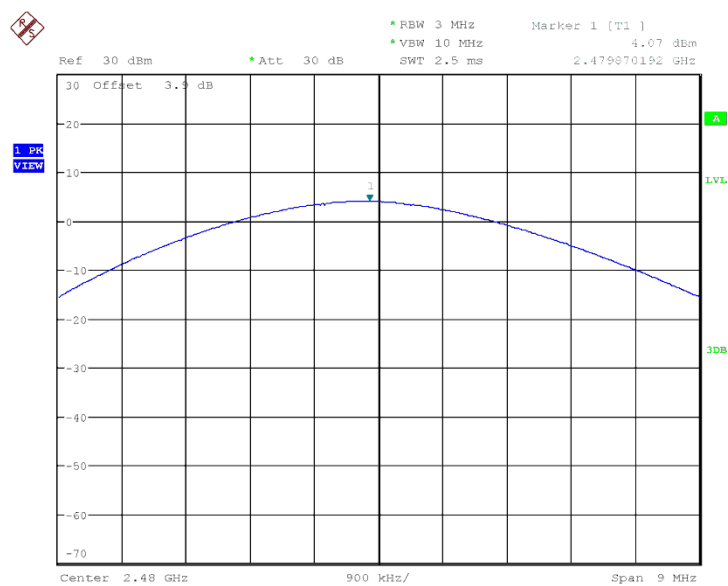
Date: 27.MAY.2019 02:05:11

Fig.7 Peak Conducted Output Power CH0, 3DH1



Date: 27.MAY.2019 02:06:17

Fig.8 Peak Conducted Output Power CH39, 3DH1



Date: 27.MAY.2019 02:07:57

Fig.9 Peak Conducted Output Power CH78, 3DH1

## ANNEX A.2. Frequency Band Edges-Conducted

### A.2.1 Measurement Limit:

| Standard                  | Limited(dBc) |
|---------------------------|--------------|
| FCC 47 CFR Part 15.247(d) | >20          |

### A.2.2 Test procedure

The measurement is according to ANSI C63.10 clause 7.8.6.

1. Connect the EUT to spectrum analyzer.
2. Set RBW=100KHz, VBW=300KHz, span more than 1.5 times channel bandwidth (2MHz).
3. Detector =peak, sweep time=auto couple, trace mode=max hold.
4. Allow sweep to continue until the trace stabilizes.

### Measurement results

#### For GFSK

| Channel | Hopping     | Band Edge Power (dBc) | Conclusion |
|---------|-------------|-----------------------|------------|
| 0       | Hopping OFF | Fig.10                | P          |
|         | Hopping ON  | Fig.11                | P          |
| 78      | Hopping OFF | Fig.12                | P          |
|         | Hopping ON  | Fig.13                | P          |

#### For $\pi/4$ DQPSK

| Channel | Hopping     | Band Edge Power (dBc) | Conclusion |
|---------|-------------|-----------------------|------------|
| 0       | Hopping OFF | Fig.14                | P          |
|         | Hopping ON  | Fig.15                | P          |
| 78      | Hopping OFF | Fig.16                | P          |
|         | Hopping ON  | Fig.17                | P          |

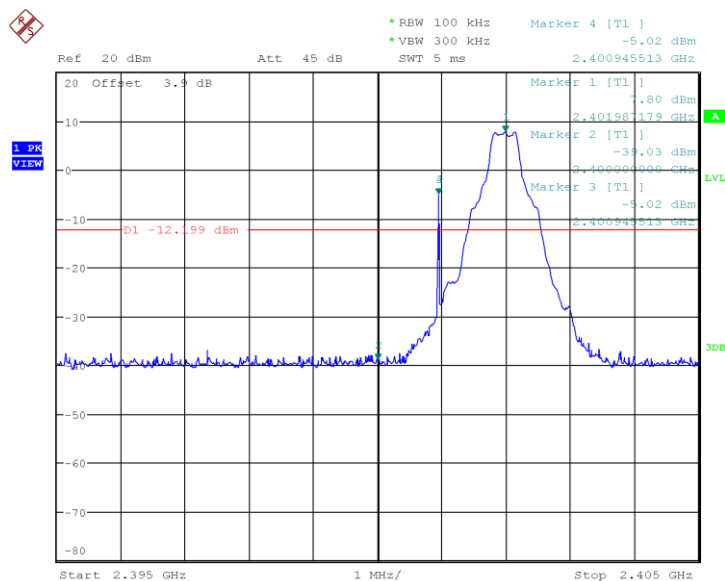
#### For 8DPSK

| Channel | Hopping     | Band Edge Power (dBc) | Conclusion |
|---------|-------------|-----------------------|------------|
| 0       | Hopping OFF | Fig.18                | P          |
|         | Hopping ON  | Fig.19                | P          |
| 78      | Hopping OFF | Fig.20                | P          |

|  |            |        |   |
|--|------------|--------|---|
|  | Hopping ON | Fig.21 | P |
|--|------------|--------|---|

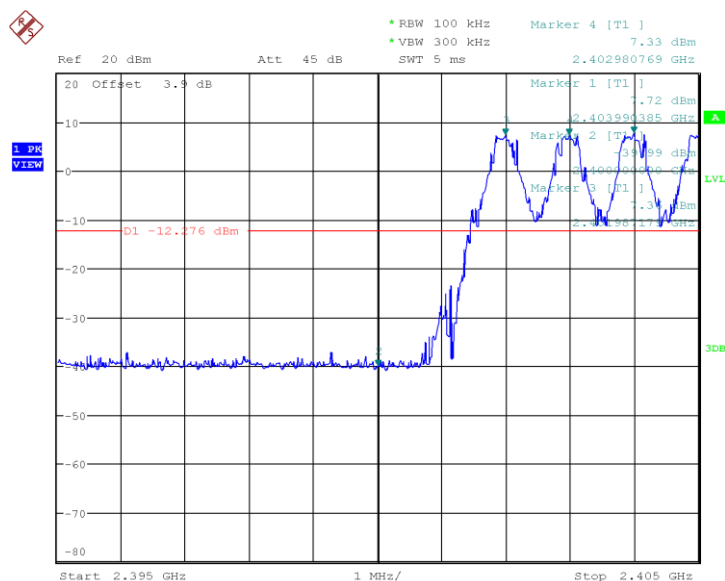
Conclusion: PASS

Test graphs an below



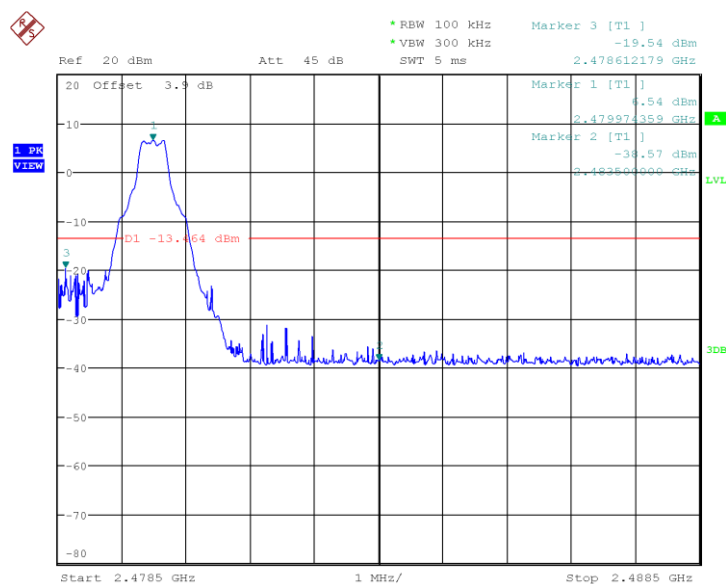
Date: 27.MAY.2019 04:23:24

Fig.10 Frequency Band Edge: GFSK, Ch0, Hopping OFF



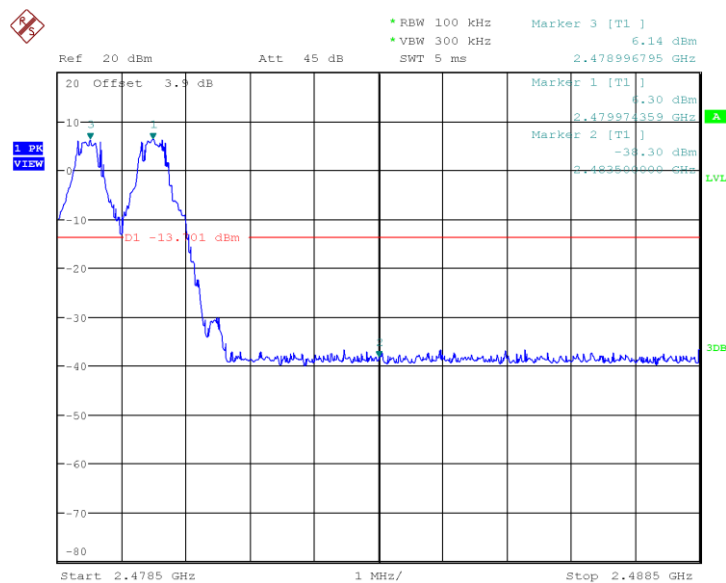
Date: 27.MAY.2019 04:56:14

Fig.11 Frequency Band Edge: GFSK, Ch0, Hopping ON



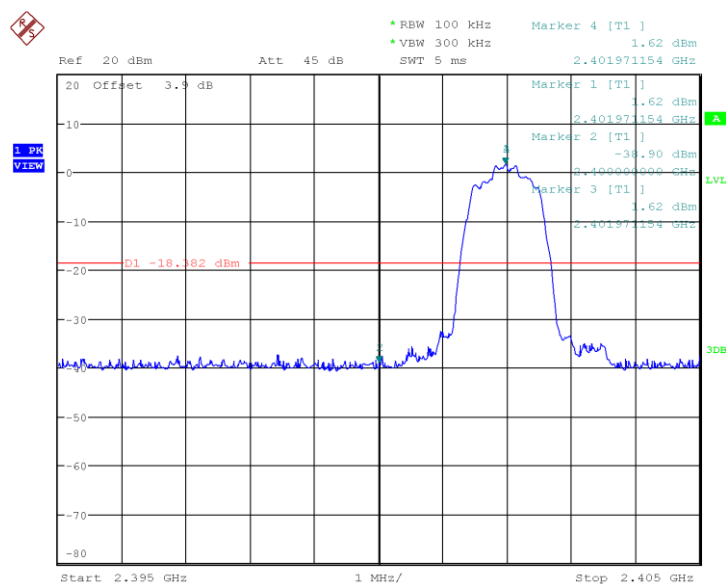
Date: 27.MAY.2019 04:28:30

Fig.12 Frequency Band Edge: GFSK, Ch78, Hopping OFF

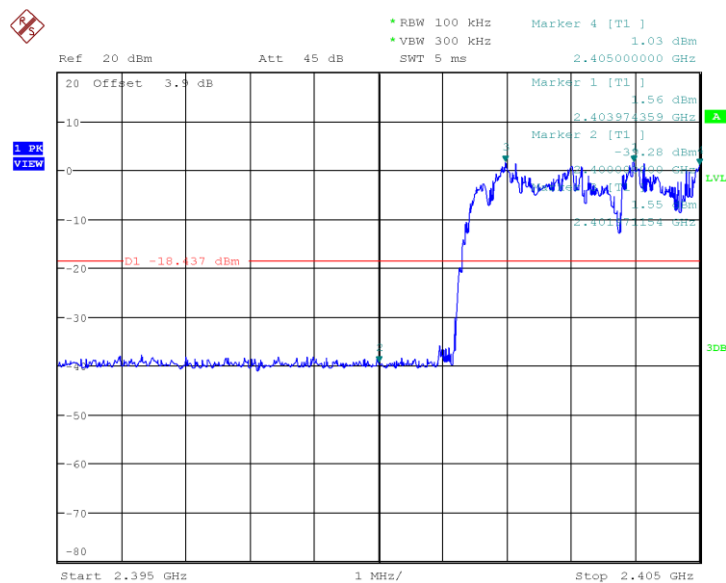


Date: 27.MAY.2019 05:22:00

Fig.13 Frequency Band Edge: GFSK, Ch78, Hopping ON

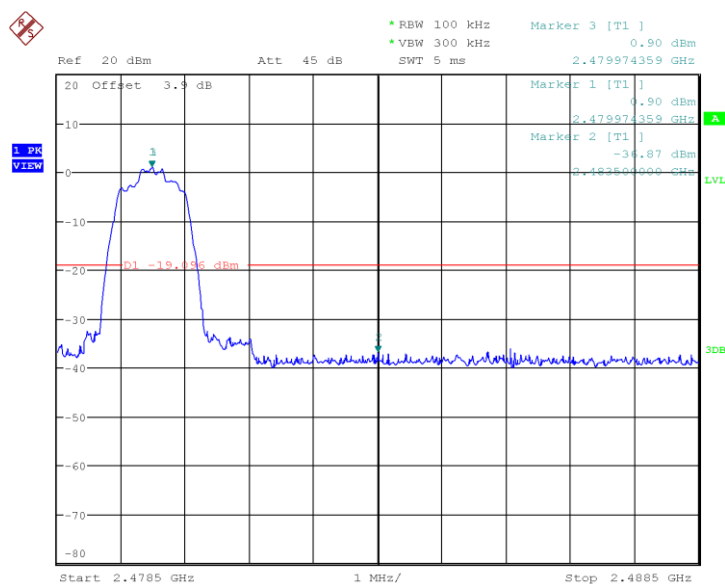


Date: 27.MAY.2019 04:31:42

Fig.14 Frequency Band Edge:  $\pi/4$  DQPSK, Ch0, Hopping OFF


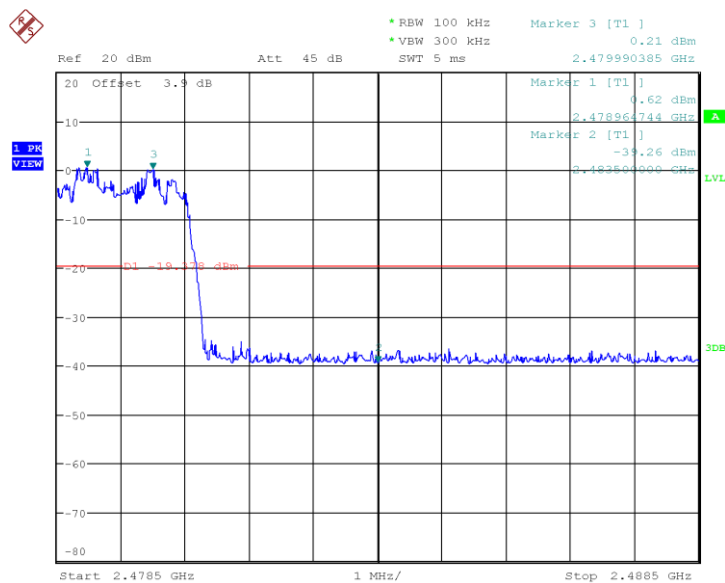
Date: 27.MAY.2019 05:00:51

Fig.15 Frequency Band Edge:  $\pi/4$  DQPSK, Ch0, Hopping ON



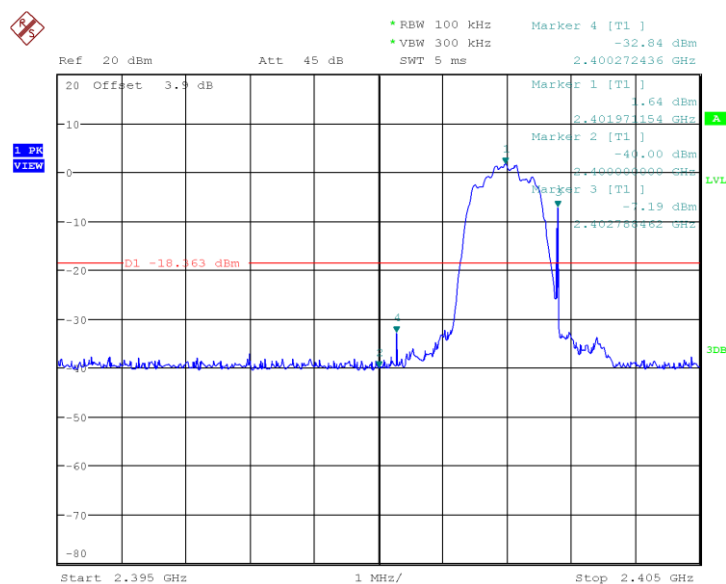
Date: 27.MAY.2019 04:39:03

Fig.16 Frequency Band Edge:  $\pi/4$  DQPSK, Ch78, Hopping OFF



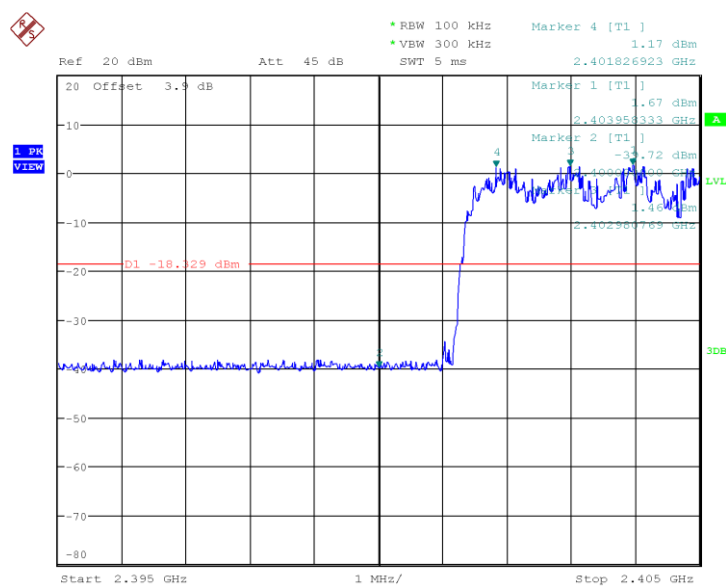
Date: 27.MAY.2019 05:35:32

Fig.17 Frequency Band Edge:  $\pi/4$  DQPSK, Ch78, Hopping ON



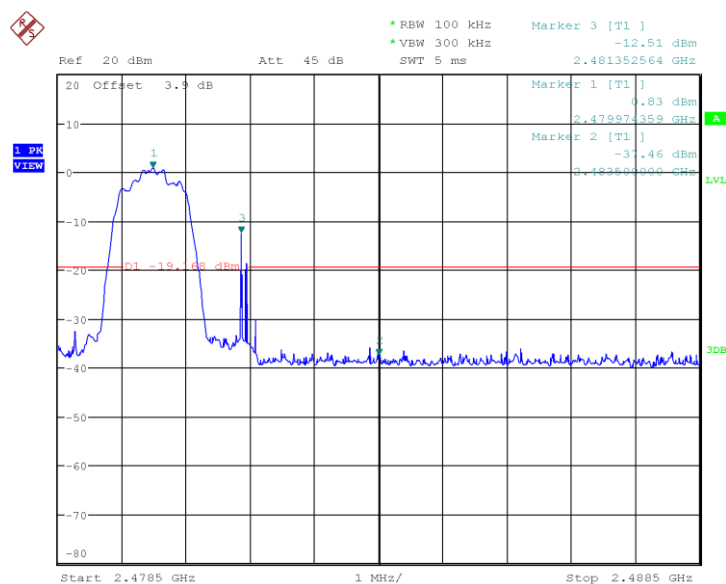
Date: 27.MAY.2019 04:47:04

Fig.18 Frequency Band Edge: 8DPSK, Ch0, Hopping OFF



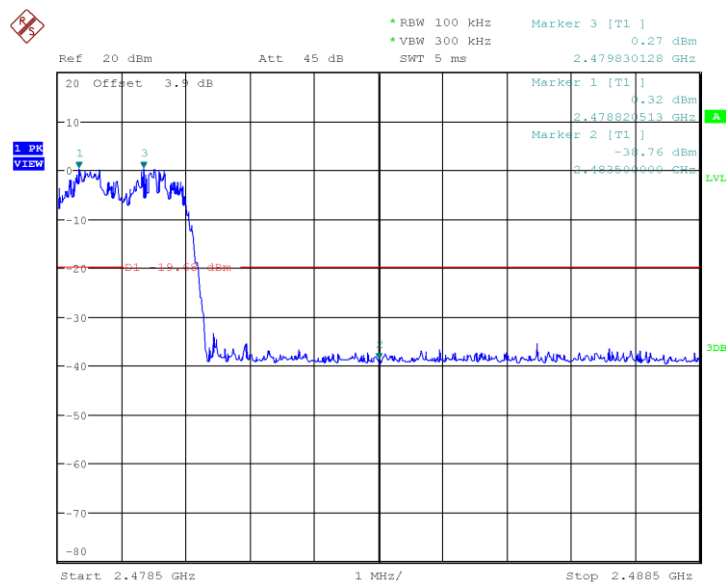
Date: 27.MAY.2019 05:03:45

Fig.19 Frequency Band Edge: 8DPSK, Ch0, Hopping ON



Date: 27.MAY.2019 04:52:03

Fig.20 Frequency Band Edge: 8DPSK, Ch78, Hopping OFF



Date: 27.MAY.2019 05:47:23

Fig.21 Frequency Band Edge: 8DPSK, Ch78, Hopping ON

**ANNEX A.3. Conducted Emission****A.3.1 Measurement Limit:**

| Standard                  | Limit                                            |
|---------------------------|--------------------------------------------------|
| FCC 47 CFR Part15.247 (d) | 20dB below peak output power in 100KHz bandwidth |

**A.3.2 Test procedures**

The measurement is according to ANSI C63.10 clause 7.8.8.

1. Connect the EUT to spectrum analyzer.
2. Set RBW=100KHz, VBW=300KHz.
3. Detector =peak, sweep time=auto couple, trace mode=max hold.

**Measurement Results:****For GFSK**

| Channel      | Frequency Range | Test Results | Conclusion |
|--------------|-----------------|--------------|------------|
| Ch0 2402MHz  | 30MHz~26GHz     | Fig.22       | P          |
| Ch39 2441MHz | 30MHz~26GHz     | Fig.23       | P          |
| Ch78 2480MHz | 30MHz~26GHz     | Fig.24       | P          |

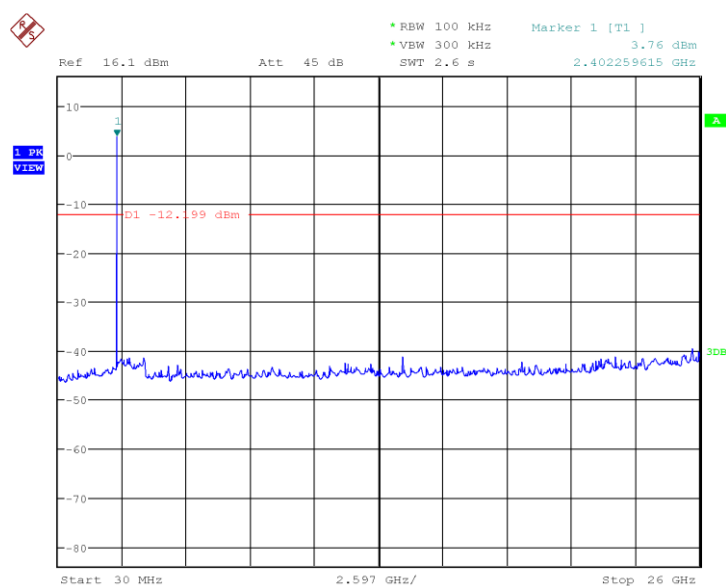
**For  $\pi/4$  DQPSK**

| Channel      | Frequency Range | Test Results | Conclusion |
|--------------|-----------------|--------------|------------|
| Ch0 2402MHz  | 30MHz~26GHz     | Fig.25       | P          |
| Ch39 2441MHz | 30MHz~26GHz     | Fig.26       | P          |
| Ch78 2480MHz | 30MHz~26GHz     | Fig.27       | P          |

**For 8DPSK**

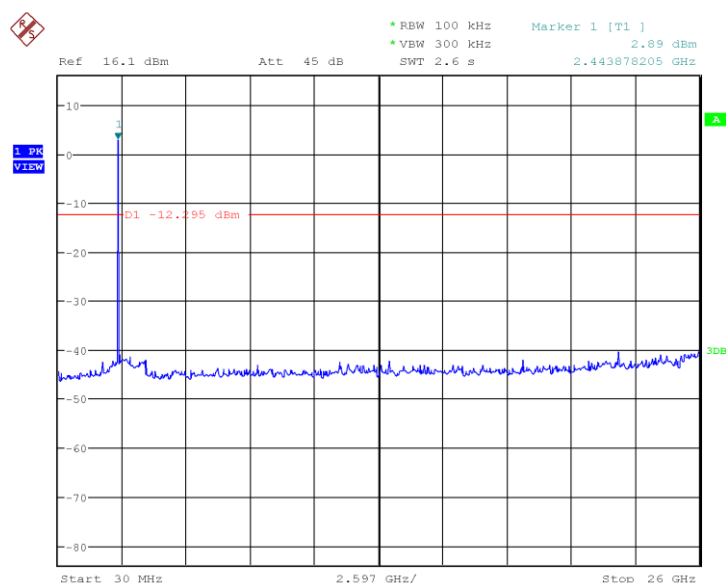
| Channel      | Frequency Range | Test Results | Conclusion |
|--------------|-----------------|--------------|------------|
| Ch0 2402MHz  | 30MHz~26GHz     | Fig.28       | P          |
| Ch39 2441MHz | 30MHz~26GHz     | Fig.29       | P          |
| Ch78 2480MHz | 30MHz~26GHz     | Fig.30       | P          |

**Conclusion: PASS**



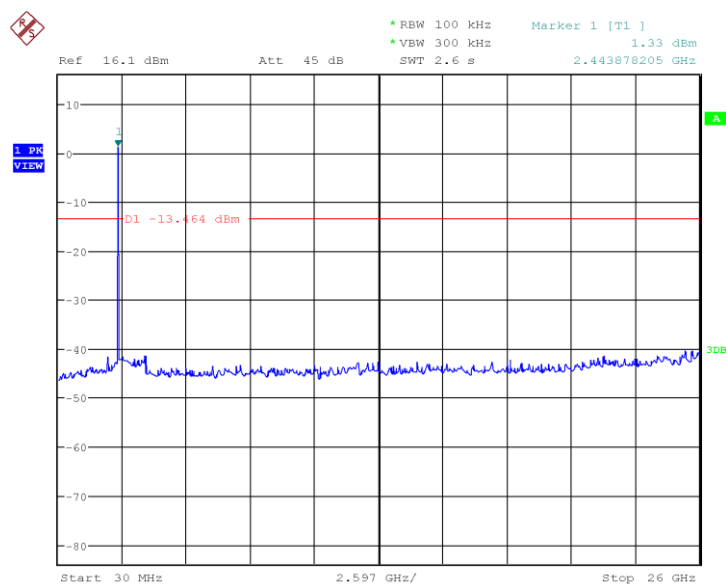
Date: 27.MAY.2019 04:24:18

Fig.22 Conducted spurious emission: GFSK, Ch0, 30MHz~26GHz



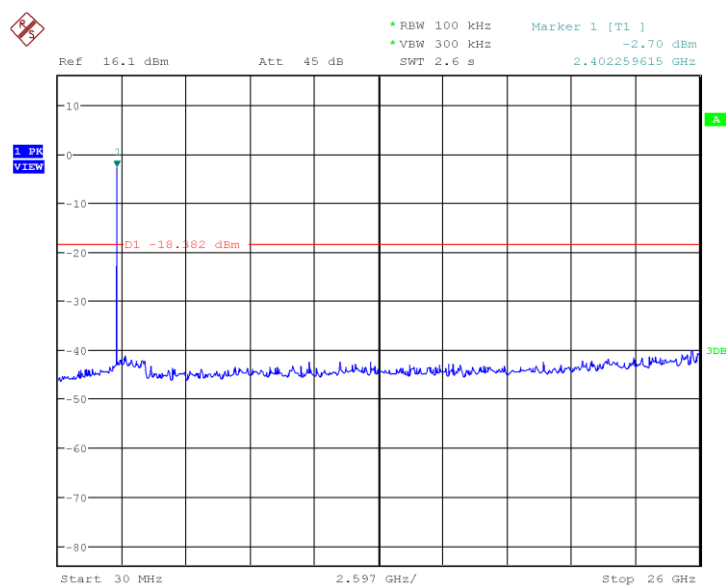
Date: 27.MAY.2019 04:26:50

Fig.23 Conducted spurious emission: GFSK, Ch39, 30MHz~26GHz



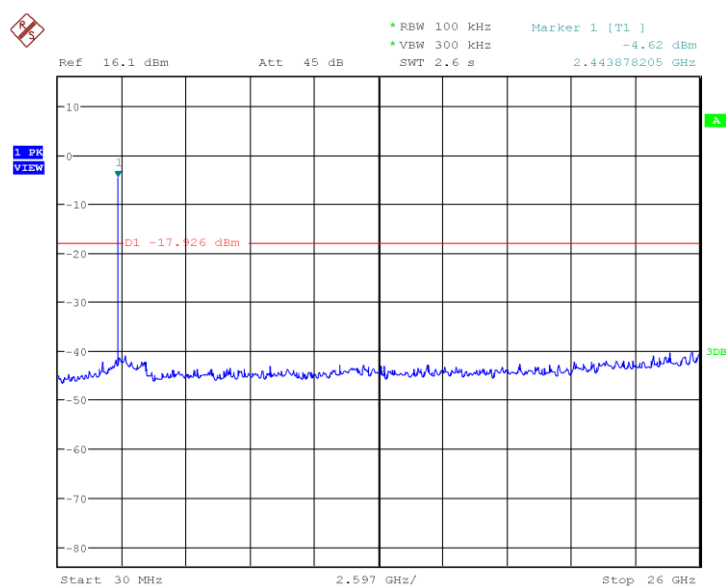
Date: 27.MAY.2019 04:29:24

Fig.24 Conducted spurious emission: GFSK, Ch78, 30MHz~26GHz



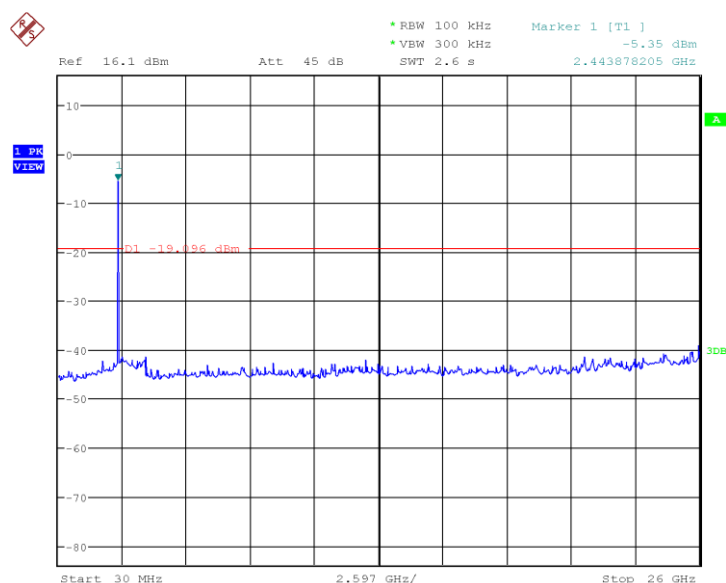
Date: 27.MAY.2019 04:32:37

Fig.25 Conducted spurious emission:  $\pi/4$  DQPSK, Ch0, 30MHz~26GHz



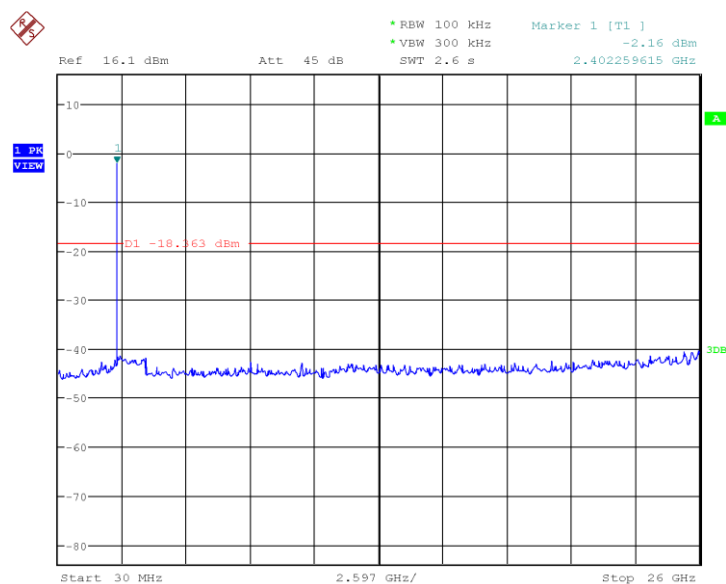
Date: 27.MAY.2019 04:36:17

Fig.26 Conducted spurious emission:  $\pi/4$  DQPSK, Ch39, 30MHz~26GHz



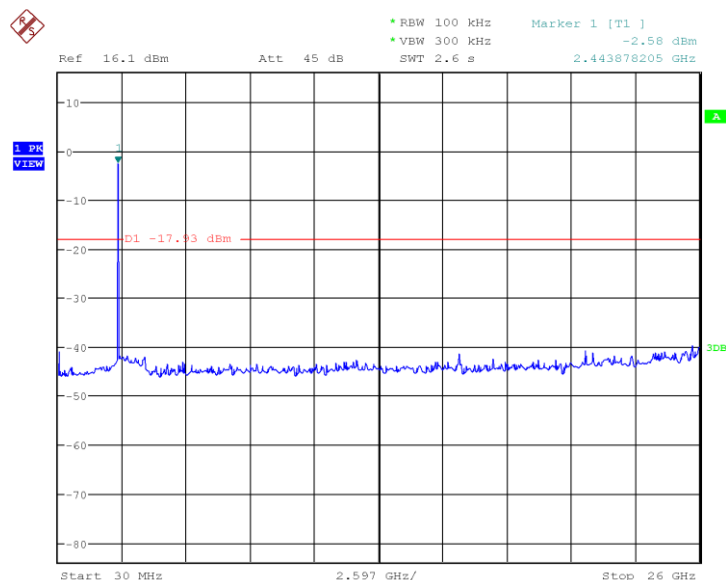
Date: 27.MAY.2019 04:39:58

Fig.27 Conducted spurious emission:  $\pi/4$  DQPSK, Ch78, 30MHz~26GHz



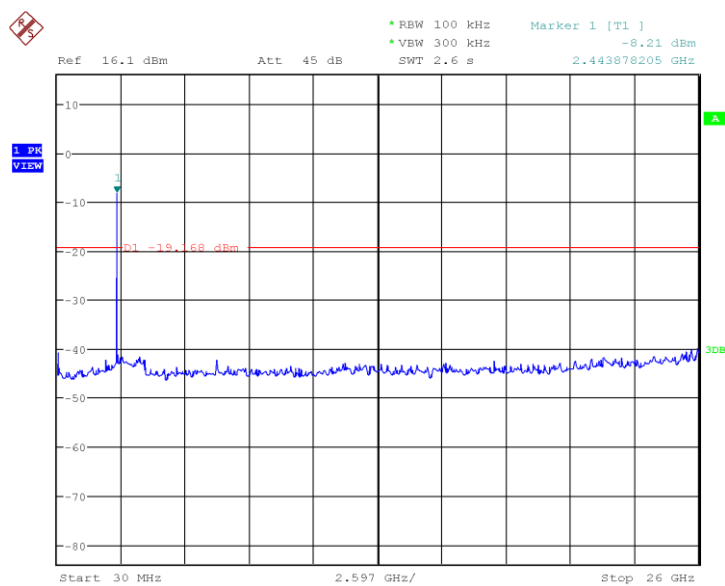
Date: 27.MAY.2019 04:47:58

Fig.28 Conducted spurious emission: 8DPSK, Ch0, 30MHz~26GHz



Date: 27.MAY.2019 04:50:28

Fig.29 Conducted spurious emission: 8DPSK, Ch39, 30MHz~26GHz



Date: 27.MAY.2019 04:52:57

Fig.30 Conducted spurious emission: 8DPSK, Ch78, 30MHz~26GHz

## ANNEX A.4. Radiated Emission

### A.4.1 Measurement Limit:

| Standard                               | Limit                        |
|----------------------------------------|------------------------------|
| FCC 47 CFR Part 15.247, 15.205, 15.209 | 20dB below peak output power |

In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see 15.205(c)).

### Limit in restricted band:

| Frequency of emission (MHz) | Field strength (uV/m) | Field strength (dBuV/m) |
|-----------------------------|-----------------------|-------------------------|
| 30~88                       | 100                   | 40                      |
| 88~216                      | 150                   | 43.5                    |
| 216~960                     | 200                   | 46                      |
| Above 960                   | 500                   | 54                      |

### A.4.2 Test Method

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. but it may be larger or smaller to accommodate various sized EUTs. For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also ANSI C63.10-2013 section 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

| Frequency of emission (MHz) | RBW/VBW       | Sweep Time (s) |
|-----------------------------|---------------|----------------|
| 30~1000                     | 100KHz/300KHz | 5              |
| 1000~4000                   | 1MHz/3MHz     | 15             |
| 4000~18000                  | 1MHz/3MHz     | 40             |
| 18000~26500                 | 1MHz/3MHz     | 20             |

#### A.4.3 Measurement Results:

A “reference path loss” is established and  $A_{Rpi}$  is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.

The measurement results are obtained as described below:

$A_{Rpi}$  = Cable loss + Antenna Gain-Preamplifier gain

Result= $P_{Mea} + A_{Rpi}$

##### For GFSK

| Channel         | Frequency Range | Test Results | Conclusion |
|-----------------|-----------------|--------------|------------|
| Ch0 2402MHz     | 30MH~1GHz       | Fig.31       | P          |
|                 | 1GHz~3GHz       | Fig.32       | P          |
|                 | 3GHz~18GHz      | Fig.33       | P          |
| Bandedge (low ) | 2.31GHz~2.5GHz  | Fig.34       | P          |
| Bandedge (high) | 2.31GHz~2.5GHz  | Fig.35       | P          |

##### For $\pi/4$ DQPSK

| Channel         | Frequency Range | Test Results | Conclusion |
|-----------------|-----------------|--------------|------------|
| Ch0 2402MHz     | 30MH~1GHz       | Fig.36       | P          |
|                 | 1GHz~3GHz       | Fig.37       | P          |
|                 | 3GHz~18GHz      | Fig.38       | P          |
| Bandedge (low ) | 2.31GHz~2.5GHz  | Fig.39       | P          |
| Bandedge (high) | 2.31GHz~2.5GHz  | Fig.40       | P          |

##### For 8DPSK

| Channel         | Frequency Range | Test Results | Conclusion |
|-----------------|-----------------|--------------|------------|
| Ch0 2402MHz     | 30MH~1GHz       | Fig.41       | P          |
|                 | 1GHz~3GHz       | Fig.42       | P          |
|                 | 3GHz~18GHz      | Fig.43       | P          |
| Bandedge (low ) | 2.31GHz~2.5GHz  | Fig.44       | P          |
| Bandedge (high) | 2.31GHz~2.5GHz  | Fig.45       | P          |

**GFSK Ch0 30MHz-1GHz**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 39.8           | 22.24          | -26.2     | 48.44        | V        |
| 44.2           | 27.75          | -25.7     | 53.45        | V        |
| 61.1           | 26.55          | -27.3     | 53.85        | V        |
| 375.0          | 33.07          | -24.1     | 57.17        | V        |
| 500.0          | 41.46          | -21.7     | 63.16        | V        |
| 805.7          | 42.12          | -15.7     | 57.82        | V        |

**GFSK Ch0 1GHz-3GHz (Peak)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 2719.9         | 53.84          | 4.5       | 49.34        | V        |
| 2747.5         | 54.27          | 4.3       | 49.97        | H        |
| 2776.3         | 54.53          | 4.3       | 50.23        | H        |
| 2822.8         | 54.51          | 4.7       | 49.81        | H        |
| 2886.0         | 55.07          | 5.6       | 49.47        | V        |
| 2939.0         | 54.93          | 5.4       | 49.53        | V        |

**GFSK Ch0 1GHz-3GHz (Average)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 2747.5         | 41.97          | 4.3       | 37.67        | H        |
| 2776.3         | 41.93          | 4.3       | 37.63        | H        |
| 2822.8         | 42.25          | 4.7       | 37.55        | H        |
| 2886.0         | 42.94          | 5.6       | 37.34        | V        |
| 2939.0         | 43.01          | 5.4       | 37.61        | V        |

**GFSK Ch0 3GHz-18GHz (Peak)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 4279.7         | 47.72          | -1.2      | 48.92        | H        |
| 5400.1         | 49.67          | 1         | 48.67        | H        |

|         |       |      |       |   |
|---------|-------|------|-------|---|
| 10014.9 | 48.35 | 9.8  | 38.55 | V |
| 15993.4 | 59.49 | 25.3 | 34.19 | V |
| 16843.6 | 60.28 | 27.3 | 32.98 | H |
| 17818.1 | 59.63 | 28.2 | 31.43 | H |

**GFSK Ch0 3GHz-18GHz (Average)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 15993.4        | 46.79          | 25.3      | 21.49        | V        |
| 16843.6        | 47.72          | 27.3      | 20.42        | H        |
| 17818.1        | 48.23          | 28.2      | 20.03        | H        |

 **$\pi/4$  DQPSK Ch0 30MHz-1GHz**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 40.1           | 28.44          | -26.1     | 54.54        | V        |
| 44.0           | 28.36          | -25.7     | 54.06        | V        |
| 60.5           | 26.23          | -27.1     | 53.33        | V        |
| 375.0          | 30.83          | -24.1     | 54.93        | V        |
| 500.0          | 42.22          | -21.7     | 63.92        | V        |
| 805.7          | 39.61          | -15.7     | 55.31        | V        |

 **$\pi/4$  DQPSK Ch0 1GHz-3GHz (Peak)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 2546.5         | 53.35          | 3.5       | 49.85        | V        |
| 2668.6         | 54.11          | 4.5       | 49.61        | V        |
| 2734.2         | 54.51          | 4.4       | 50.11        | V        |
| 2869.7         | 54.43          | 5.4       | 49.03        | H        |
| 2912.6         | 55.64          | 5.7       | 49.94        | H        |
| 2936.6         | 54.59          | 5.5       | 49.09        | H        |

**$\pi/4$  DQPSK Ch0 1GHz-3GHz (Average)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 2668.6         | 42             | 4.5       | 37.5         | V        |
| 2734.2         | 41.94          | 4.4       | 37.54        | V        |
| 2869.7         | 42.82          | 5.4       | 37.42        | H        |
| 2912.6         | 43.27          | 5.7       | 37.57        | H        |
| 2936.6         | 43.02          | 5.5       | 37.52        | H        |

 **$\pi/4$  DQPSK Ch0 3GHz-18GHz (Peak)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 4279.7         | 51.68          | -1.2      | 52.88        | H        |
| 5400.1         | 52.13          | 1         | 51.13        | V        |
| 6210.2         | 49.64          | 3.2       | 46.44        | V        |
| 10806.0        | 49.96          | 12.7      | 37.26        | V        |
| 16276.1        | 58.2           | 25.6      | 32.6         | V        |
| 16811.0        | 59.96          | 27.2      | 32.76        | H        |

 **$\pi/4$  DQPSK Ch0 3GHz-18GHz (Average)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 16276.1        | 46.06          | 25.6      | 20.46        | V        |
| 16811.0        | 47.53          | 27.2      | 20.33        | H        |

**8DPSK Ch0 30MHz-1GHz**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 43.9           | 29.56          | -25.7     | 55.26        | V        |
| 61.4           | 24.02          | -27.4     | 51.42        | V        |
| 171.3          | 23.2           | -29.3     | 52.5         | H        |
| 375.0          | 33.88          | -24.1     | 57.98        | V        |
| 500.0          | 41.08          | -21.7     | 62.78        | V        |
| 875.0          | 34.28          | -14.7     | 48.98        | H        |

**8DPSK Ch0 1GHz-3GHz (Peak)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 2699.6         | 54.64          | 4.7       | 49.94        | H        |
| 2760.2         | 54.49          | 4.3       | 50.19        | H        |
| 2794.4         | 54.35          | 4.4       | 49.95        | H        |
| 2849.8         | 54.86          | 5.1       | 49.76        | H        |
| 2896.5         | 55.83          | 5.8       | 50.03        | H        |
| 2963.4         | 54.78          | 5.4       | 49.38        | V        |

**8DPSK Ch0 1GHz-3GHz (Average)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 2699.6         | 42.6           | 4.7       | 37.9         | H        |
| 2760.2         | 41.79          | 4.3       | 37.49        | H        |
| 2794.4         | 42.06          | 4.4       | 37.66        | H        |
| 2849.8         | 42.33          | 5.1       | 37.23        | H        |
| 2896.5         | 43.17          | 5.8       | 37.37        | H        |
| 2963.4         | 42.98          | 5.4       | 37.58        | V        |

**8DPSK Ch0 3GHz-18GHz (Peak)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 13198.5        | 51.71          | 16.8      | 34.91        | H        |
| 14273.2        | 54.27          | 20.4      | 33.87        | H        |
| 15422.4        | 55.79          | 22.7      | 33.09        | V        |
| 16295.6        | 57.89          | 25.7      | 32.19        | H        |
| 17199.0        | 60.17          | 27.3      | 32.87        | H        |
| 17577.9        | 60.48          | 27.7      | 32.78        | H        |

**8DPSK Ch0 3GHz-18GHz (Average)**

| Frequency(MHz) | Result(dBuV/m) | ARpl (dB) | PMea(dBuV/m) | Polarity |
|----------------|----------------|-----------|--------------|----------|
| 14273.2        | 42.47          | 20.4      | 22.07        | H        |

|         |       |      |       |   |
|---------|-------|------|-------|---|
| 15422.4 | 43.62 | 22.7 | 20.92 | V |
| 16295.6 | 46.19 | 25.7 | 20.49 | H |
| 17199.0 | 47.76 | 27.3 | 20.46 | H |
| 17577.9 | 47.66 | 27.7 | 19.96 | H |

Note: Only the worst case is written in the report.

Conclusion: PASS

Test graphs as below:

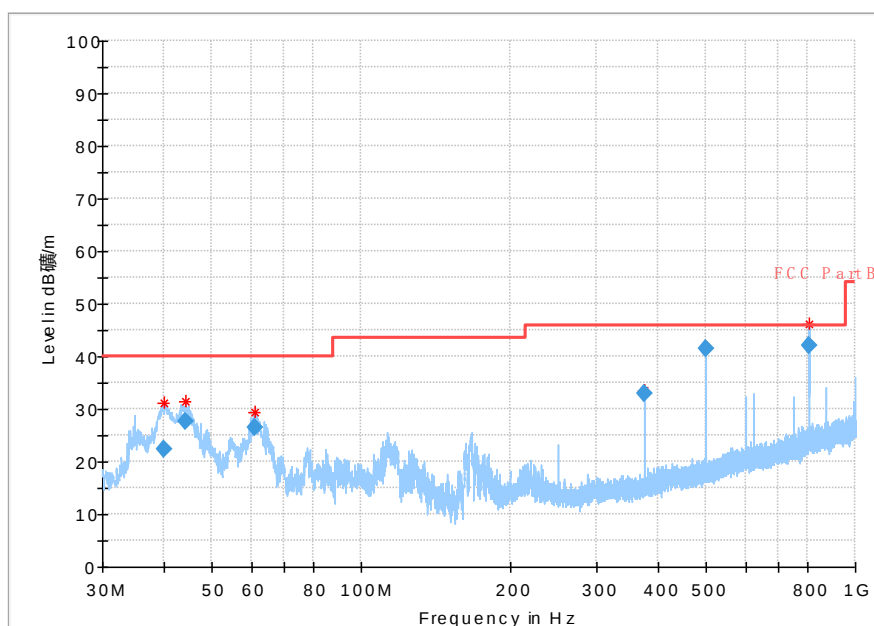


Fig.31 Radiated emission: GFSK, Ch0, 30MHz~1GHz

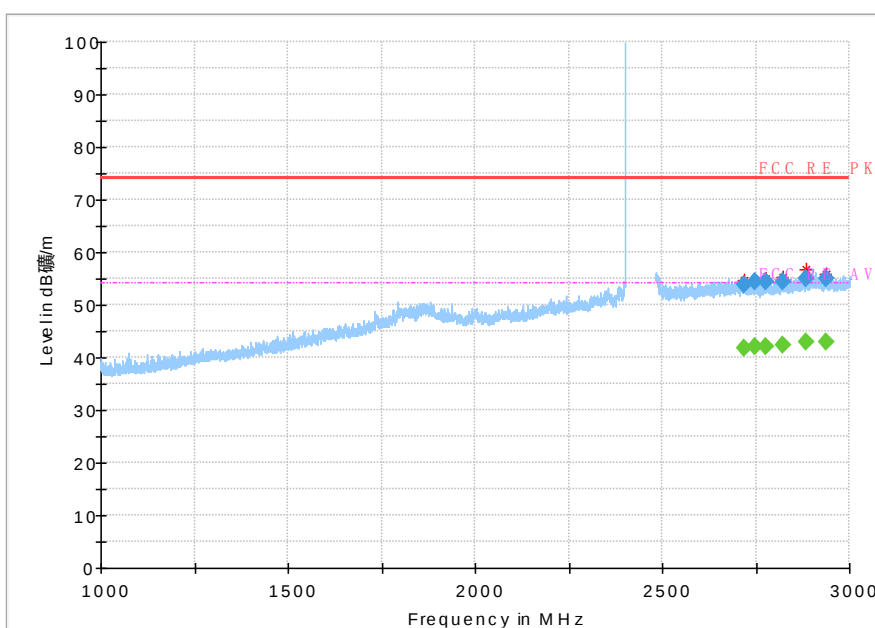


Fig.32 Radiated emission: GFSK, Ch0, 1GHz~3GHz

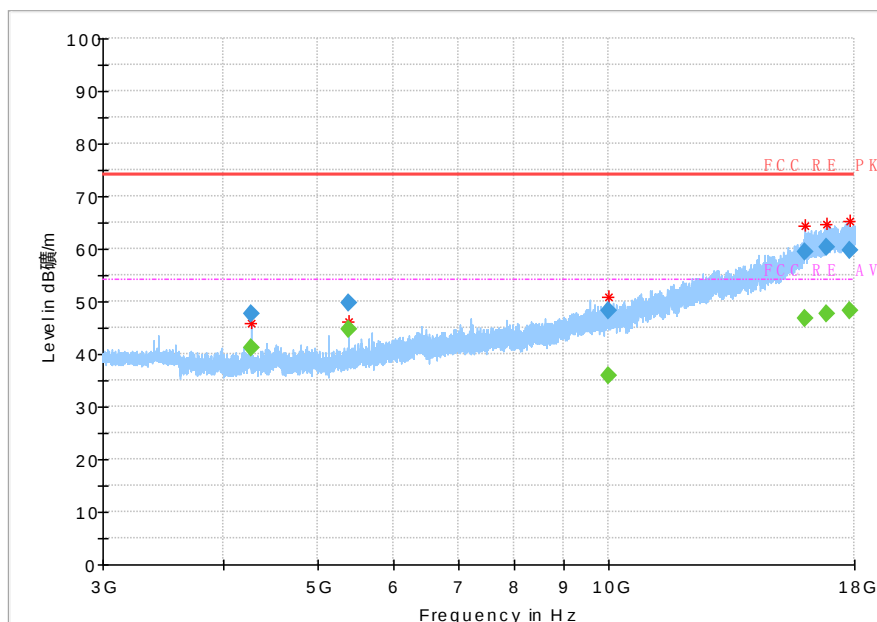


Fig.33 Radiated emission: GFSK, Ch0, 3GHz~18GHz

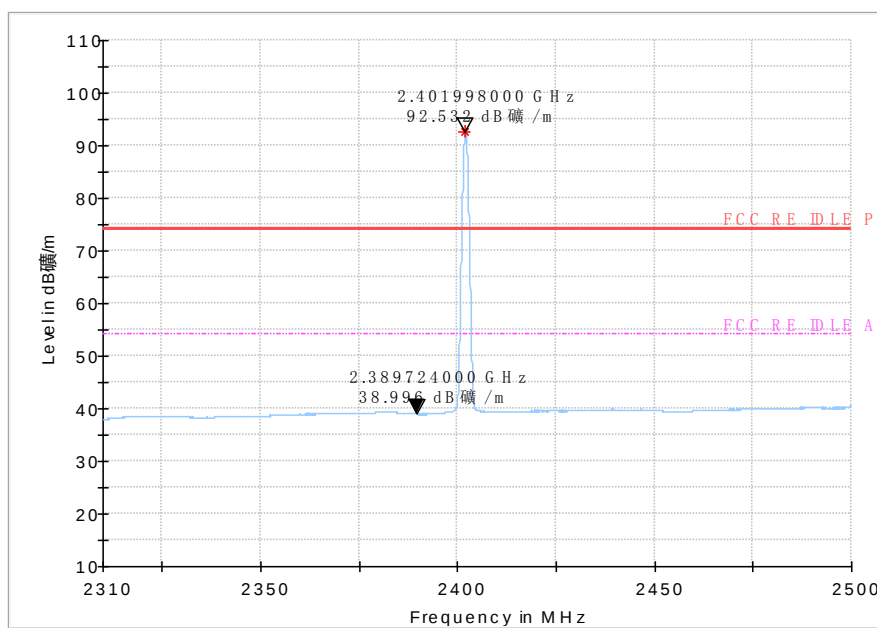


Fig.34 Bandedge (Low): GFSK, low channel

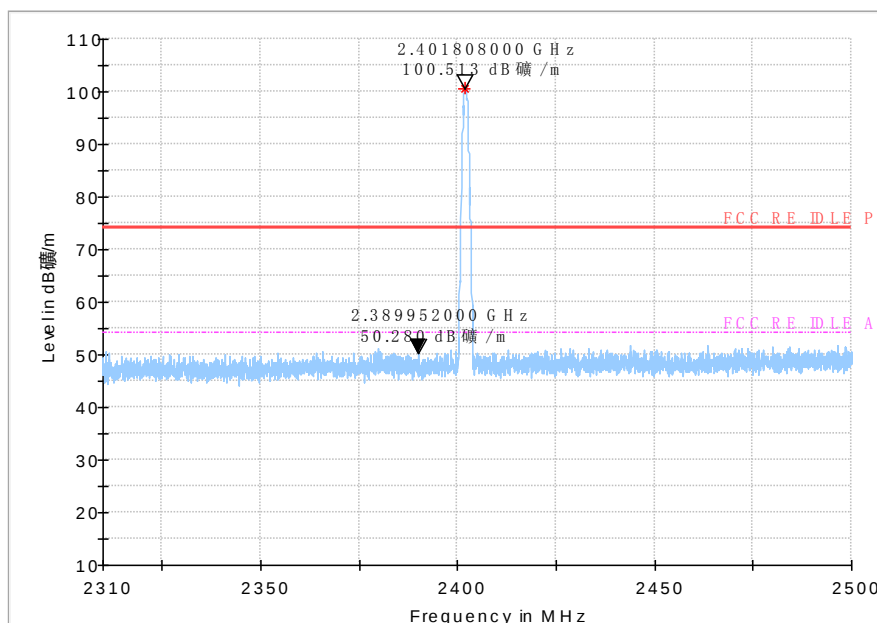


Fig.35 Bandedge (High): GFSK, high channel

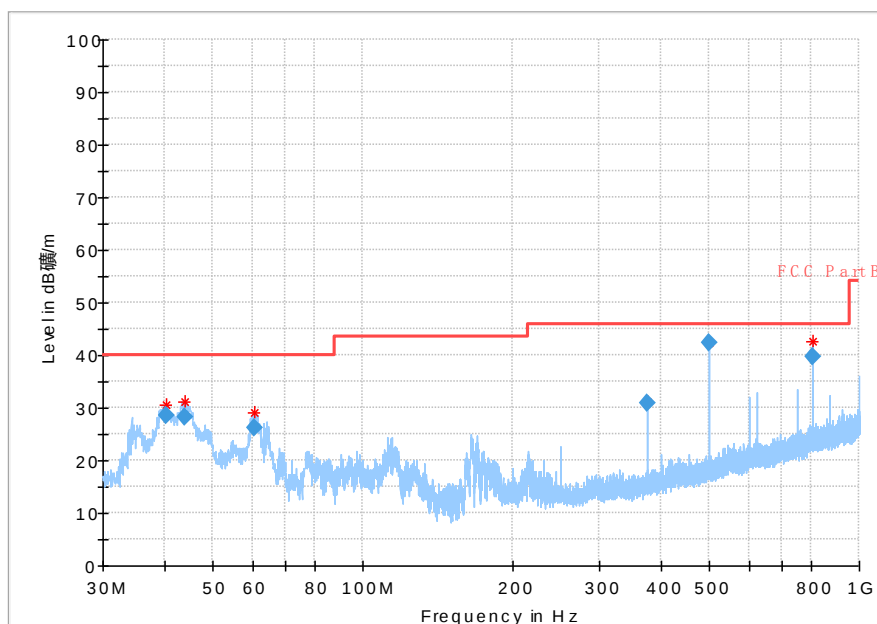


Fig.36 Radiated emission:  $\pi/4$  DQPSK, Ch0, 30MHz~1GHz

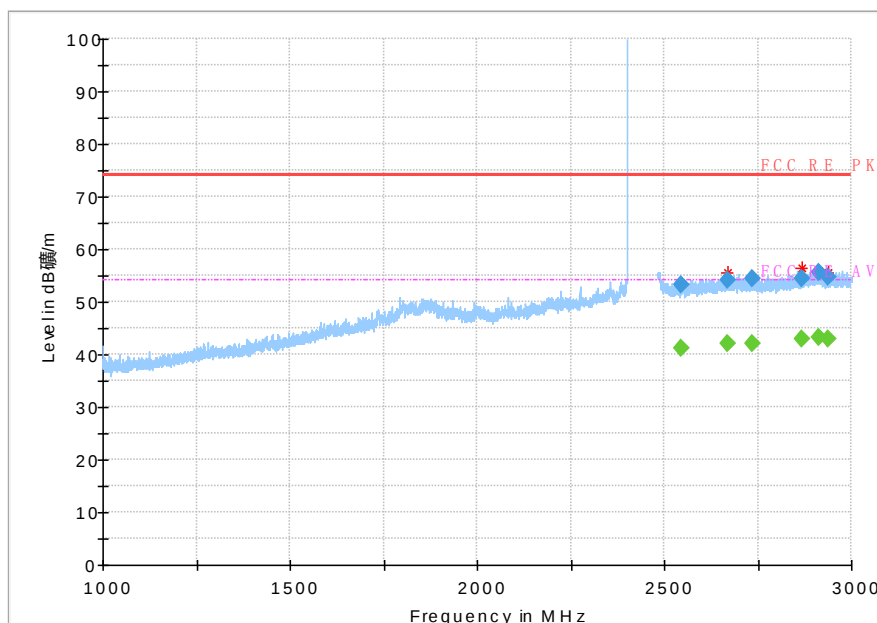


Fig.37 Radiated emission:  $\pi/4$  DQPSK, Ch0, 1GHz~3GHz

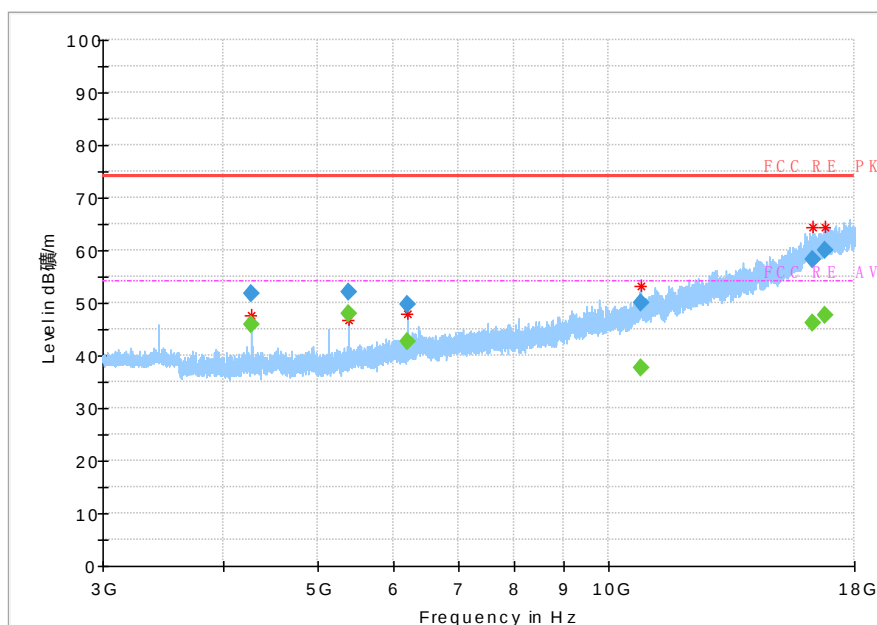


Fig.38 Radiated emission:  $\pi/4$  DQPSK, Ch0, 3GHz~18GHz

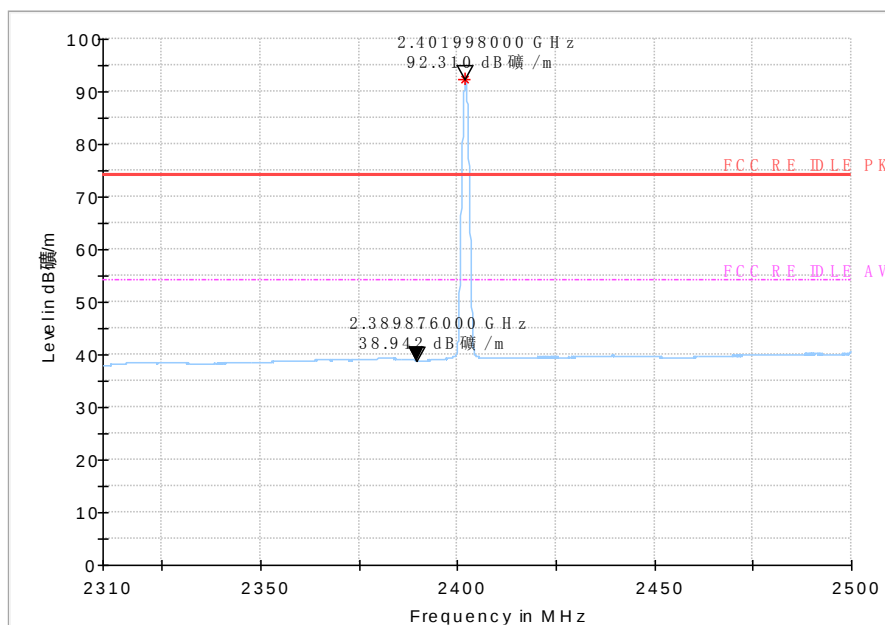


Fig.39 Bandedge (Low):  $\pi/4$  DQPSK, low channel

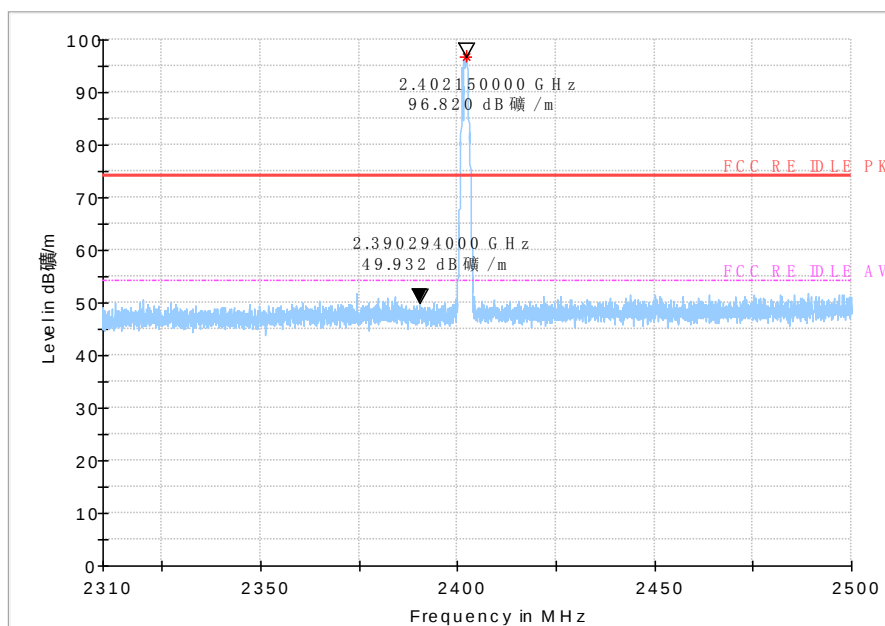


Fig.40 Bandedge (High):  $\pi/4$  DQPSK, high channel

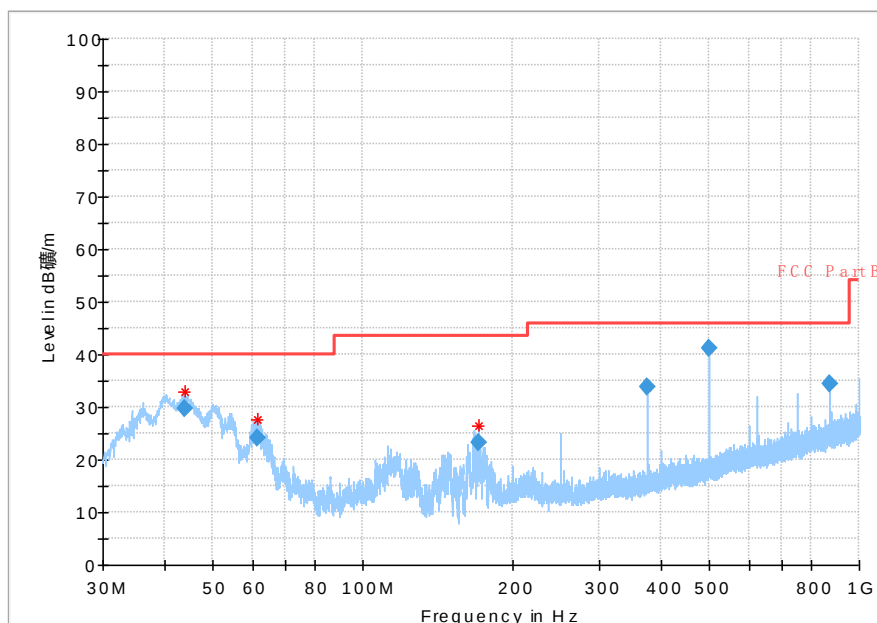


Fig.41 Radiated emission: 8DPSK, Ch0, 30MHz~1GHz

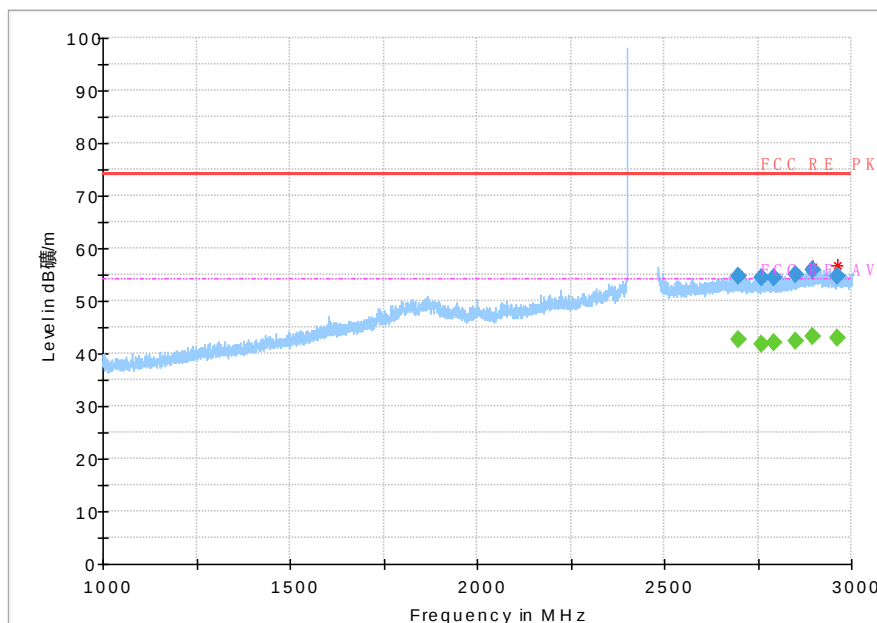


Fig.42 Radiated emission: 8DPSK, Ch0, 1GHz~3GHz

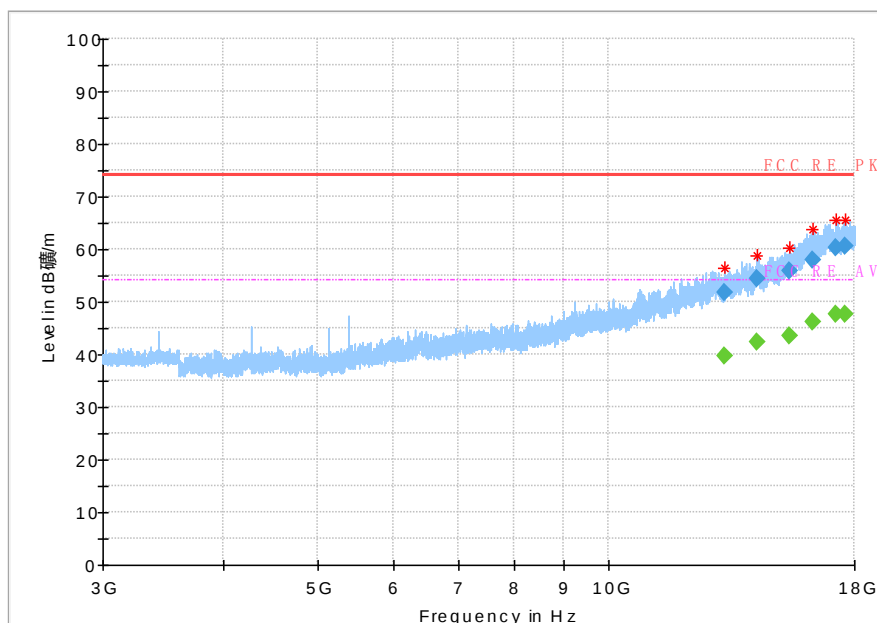


Fig.43 Radiated emission: 8DPSK, Ch0, 3GHz~18GHz

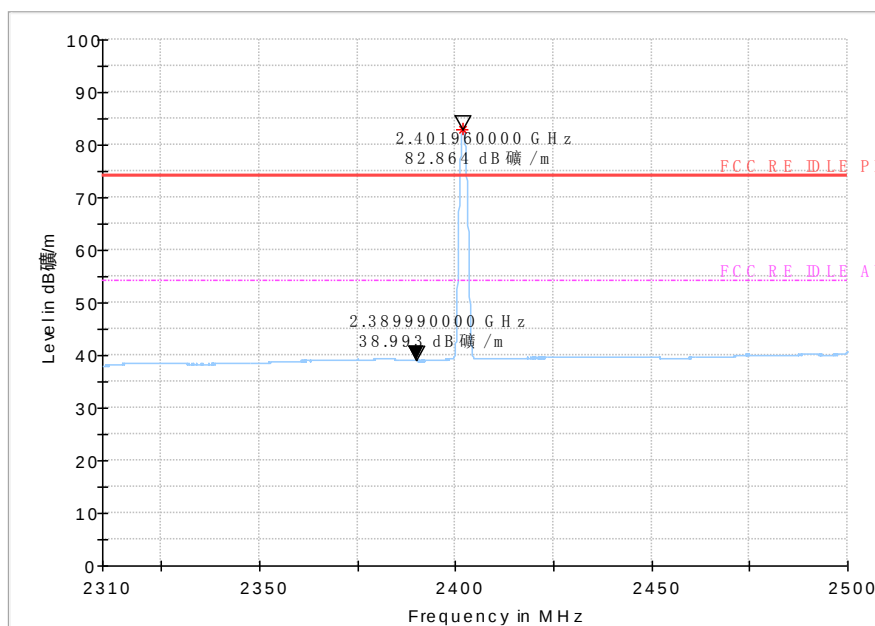


Fig.44 Bandedge (Low): 8DPSK, low channel

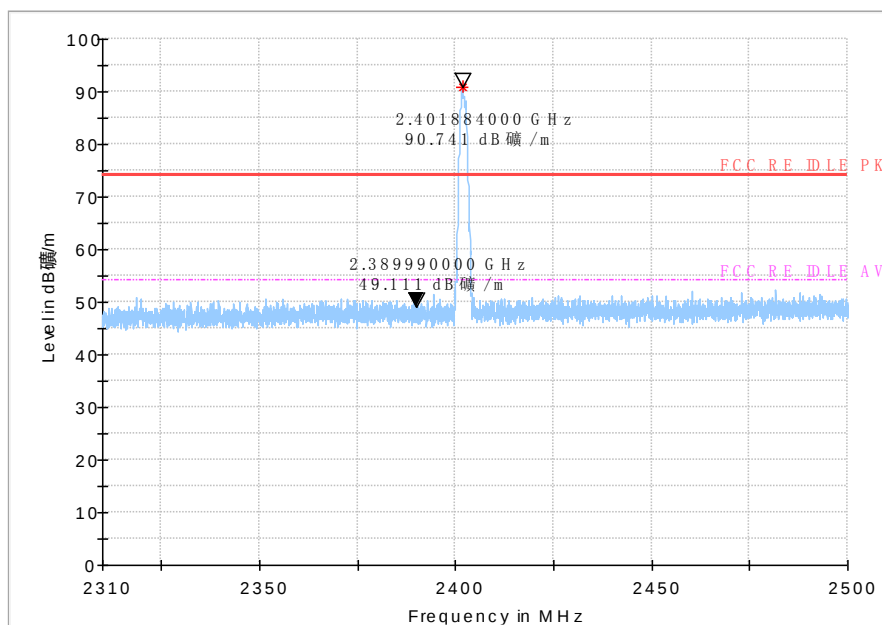
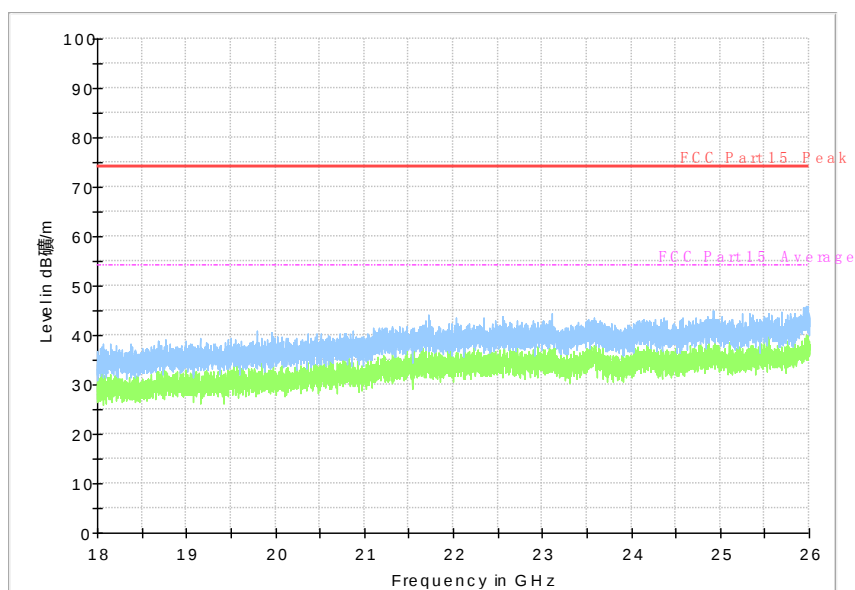


Fig.45 Bandedge (High): 8DPSK, high channel



ALL Channel 18GHz~26GHz

## ANNEX A.5. Time Of Occupancy (Dwell Time)

### A.5.1 Measurement Limit:

| Standard                            | Limit (ms) |
|-------------------------------------|------------|
| FCC 47CFR Part 15.247 (a) (1) (iii) | < 400      |

### A.5.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.4

1. Connect the EUT through cable and divide with CBT32 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 8.
4. Span: Zero span, centered on a hopping channel.
5. RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where T is the expected dwell time per channel.
6. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
7. Detector function: Peak.
8. Trace: Max hold.
9. Use the marker-delta function, and record it.

**Note:** For AFH mode, Test Period = 0.4 (second/ channel) x 20 Channel = 8 sec,

For FHSS mode, Test Period = 0.4 (second/ channel) x 79 Channel = 31.6 sec,

So the Time of Occupancy (Dwell Time) of AFH mode = Time of Occupancy (Dwell Time) of FHSS mode / 79 Channel x 20 Channel

| Modulation type         | Frequency(MHz) | Dwell Time (ms) | Limit(ms) | Conclusion |
|-------------------------|----------------|-----------------|-----------|------------|
| AFH(GFSK DH5)           | 2402-2421MHz   | 70.38           | 400       | P          |
| AFH( $\pi/4$ DQPSK DH5) | 2402-2421MHz   | 63.04           | 400       | P          |
| AFH(8DPSK DH5)          | 2402-2421MHz   | 68.92           | 400       | P          |

## Measurement Result

### For GFSK

| Channel | Packet | Dwell Time (ms) |        | Conclusion |
|---------|--------|-----------------|--------|------------|
| 39      | DH1    | Fig.46          | 64.13  | P          |
|         |        | Fig.47          |        |            |
|         | DH3    | Fig.48          | 186.05 | P          |
|         |        | Fig.49          |        |            |
|         | DH5    | Fig.50          | 278.02 | P          |
|         |        | Fig.51          |        |            |

### For $\pi/4$ DQPSK

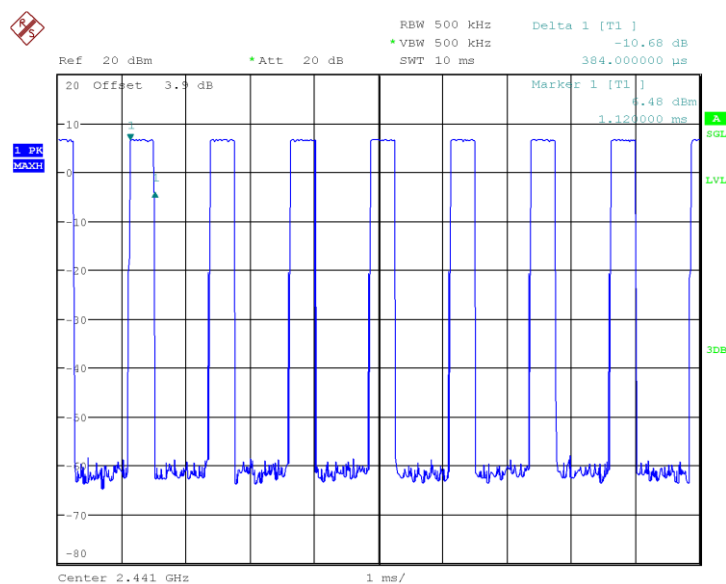
| Channel | Packet | Dwell Time (ms) |        | Conclusion |
|---------|--------|-----------------|--------|------------|
| 39      | 2DH1   | Fig.52          | 64.13  | P          |
|         |        | Fig.53          |        |            |
|         | 2DH3   | Fig.54          | 197.76 | P          |
|         |        | Fig.55          |        |            |
|         | 2DH5   | Fig.56          | 249.06 | P          |
|         |        | Fig.57          |        |            |

### For 8DPSK

| Channel | Packet | Dwell Time (ms) |        | Conclusion |
|---------|--------|-----------------|--------|------------|
| 39      | 3DH1   | Fig.58          | 63.36  | P          |
|         |        | Fig.59          |        |            |
|         | 3DH3   | Fig.60          | 199.1  | P          |
|         |        | Fig.61          |        |            |
|         | 3DH5   | Fig.62          | 272.22 | P          |
|         |        | Fig.63          |        |            |

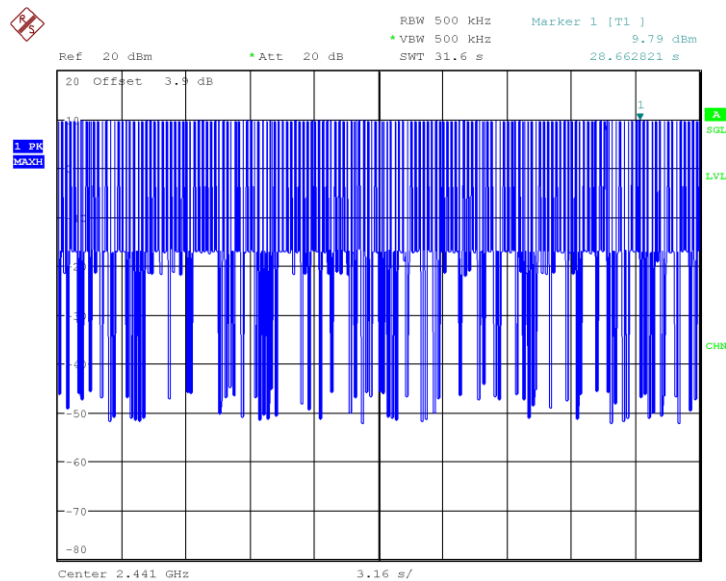
**Conclusion: PASS**

**Test graphs as below:**



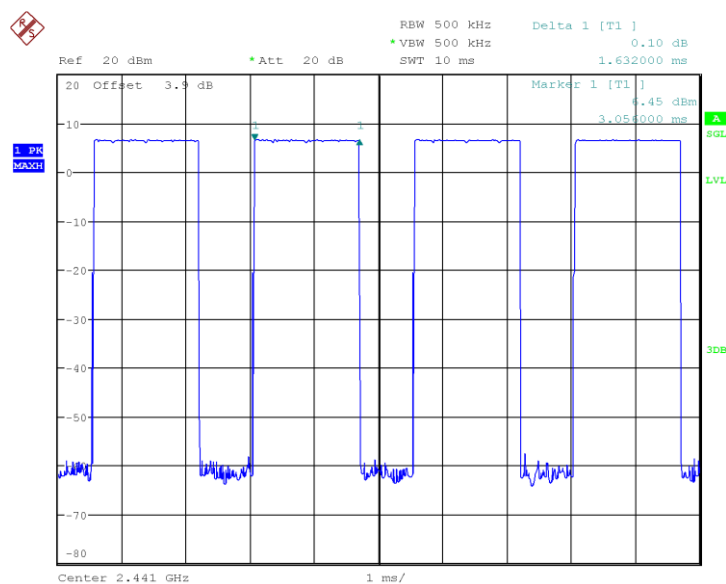
Date: 27.MAY.2019 06:24:12

Fig.46 Time of occupancy (Dwell Time): Ch39, Packet DH1



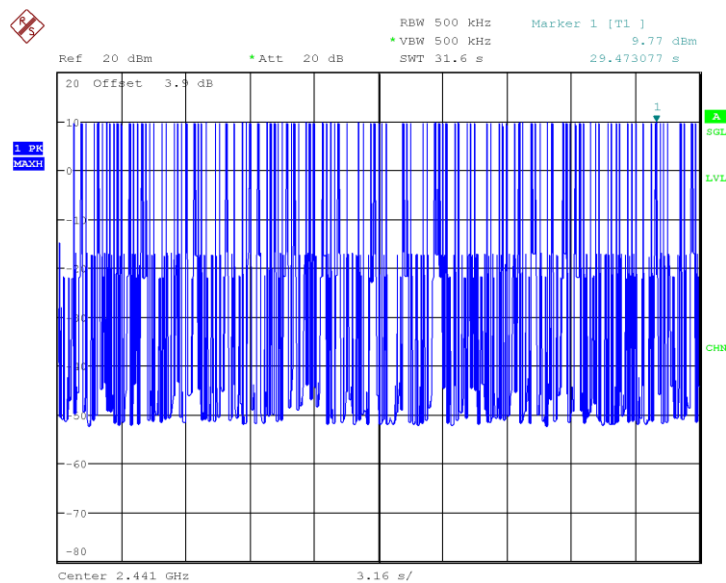
Date: 27.MAY.2019 06:29:15

Fig.47 Number of Transmissions Measurement: Ch39, Packet DH1



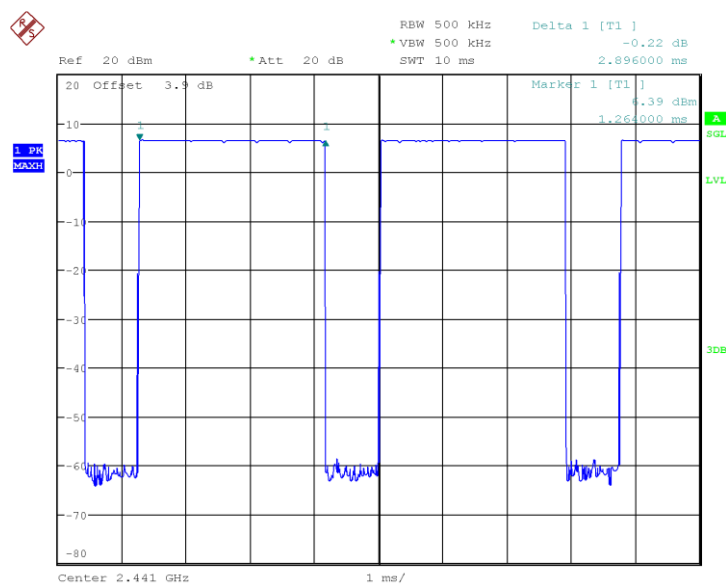
Date: 27.MAY.2019 06:30:41

Fig.48 Time of occupancy (Dwell Time): Ch39, Packet DH3



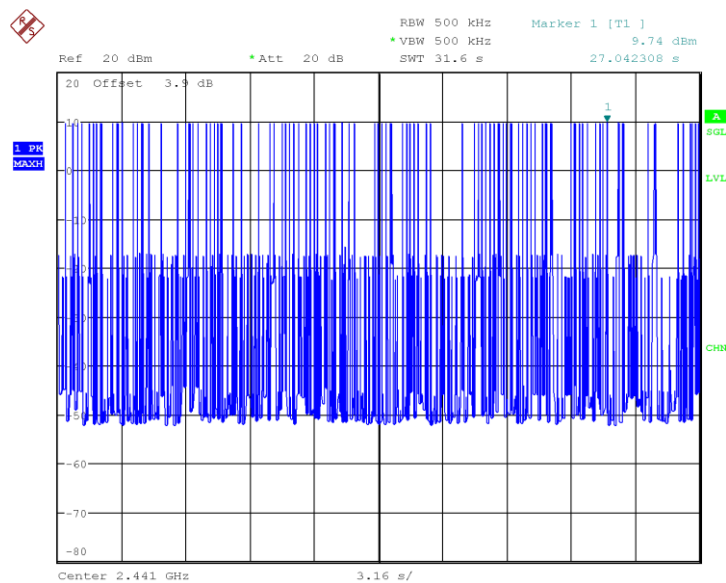
Date: 27.MAY.2019 06:32:19

Fig.49 Number of Transmissions Measurement: Ch39, Packet DH3



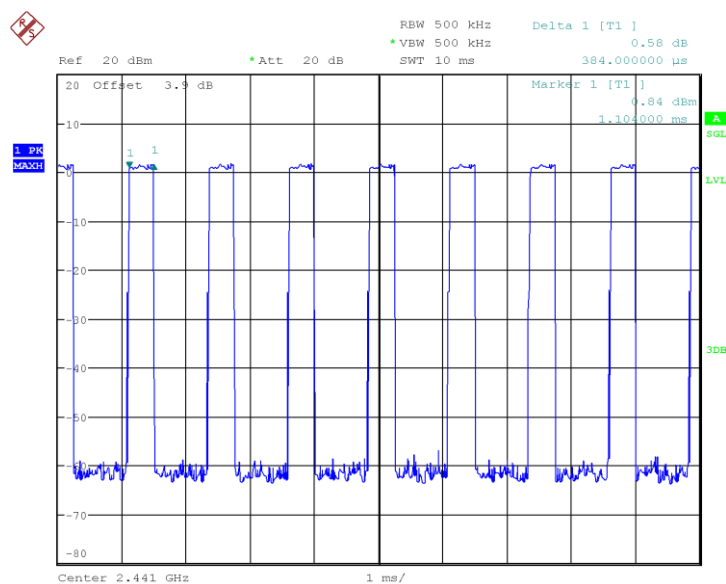
Date: 27.MAY.2019 06:33:06

Fig.50 Time of occupancy (Dwell Time): Ch39,Packet DH5



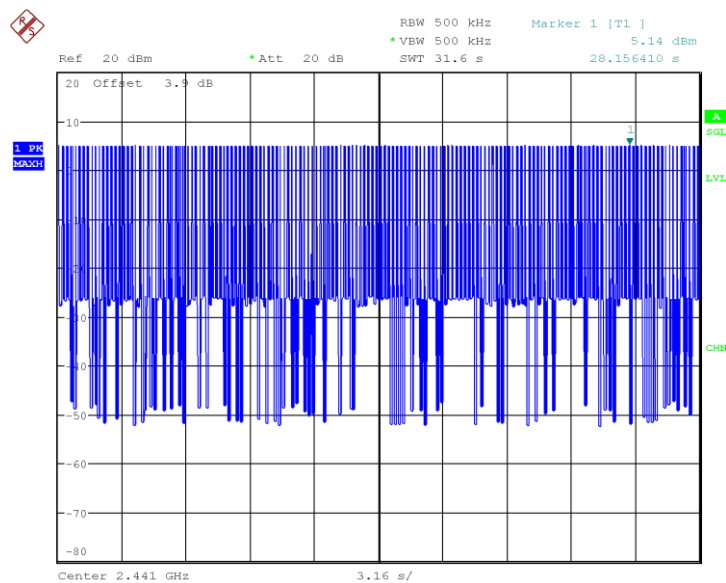
Date: 27.MAY.2019 06:34:17

Fig.51 Number of Transmissions Measurement: Ch39, Packet DH5



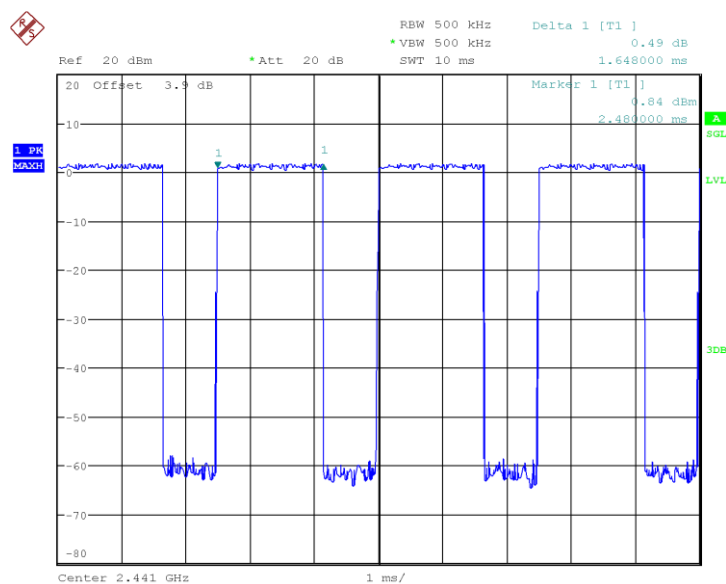
Date: 27.MAY.2019 06:36:53

Fig.52 Time of occupancy (Dwell Time): Ch39, Packet 2-DH1



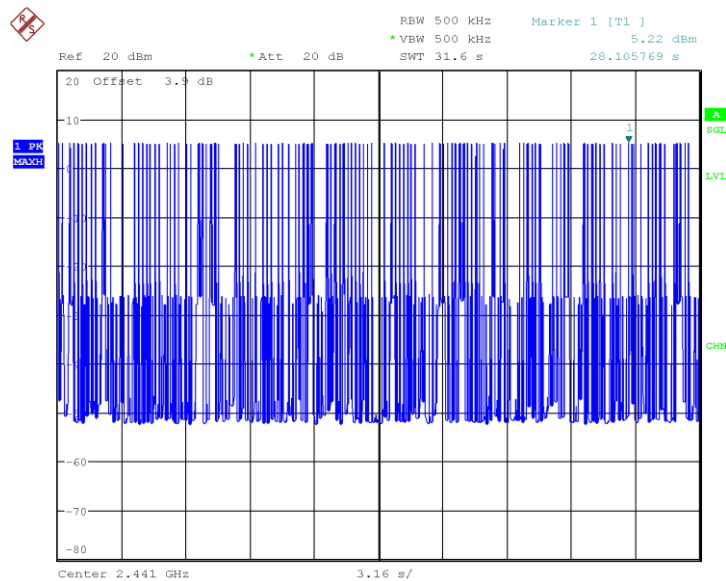
Date: 27.MAY.2019 06:38:30

Fig.53 Number of Transmissions Measurement: Ch39, Packet 2-DH1



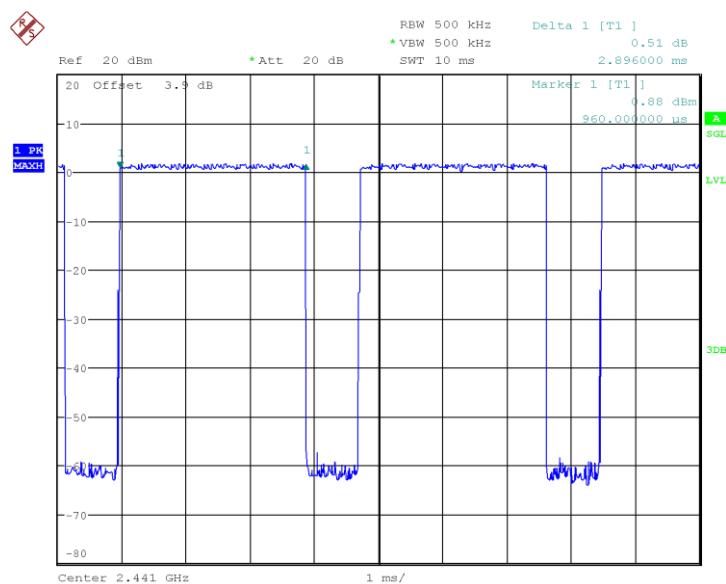
Date: 27.MAY.2019 06:39:42

Fig.54 Time of occupancy (Dwell Time): Ch39,Packet 2-DH3



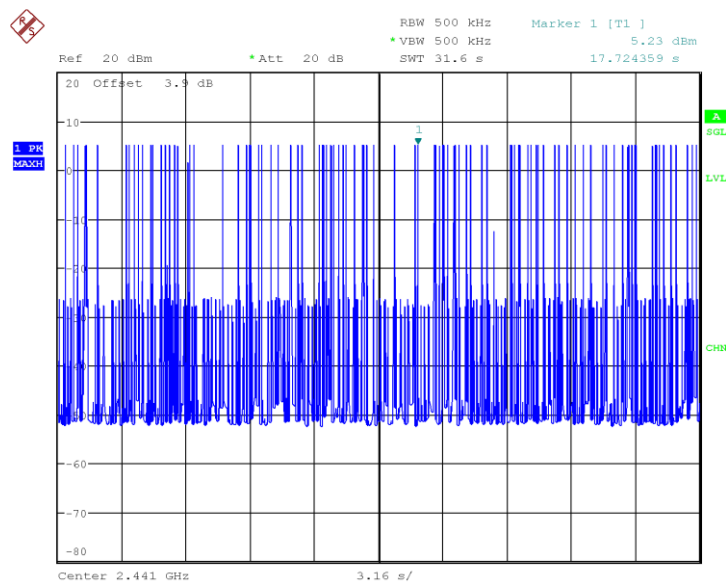
Date: 27.MAY.2019 06:41:02

Fig.55 Number of Transmissions Measurement: Ch39, Packet 2-DH3



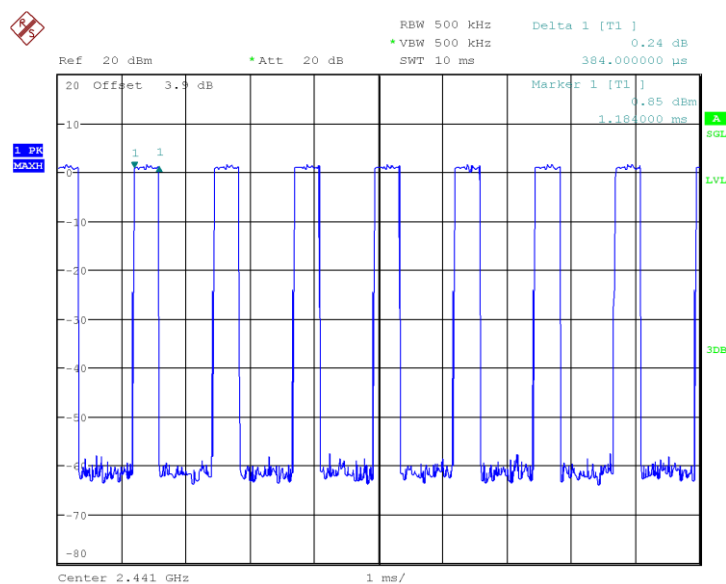
Date: 27.MAY.2019 06:41:42

Fig.56 Time of occupancy (Dwell Time): Ch39, Packet 2-DH5



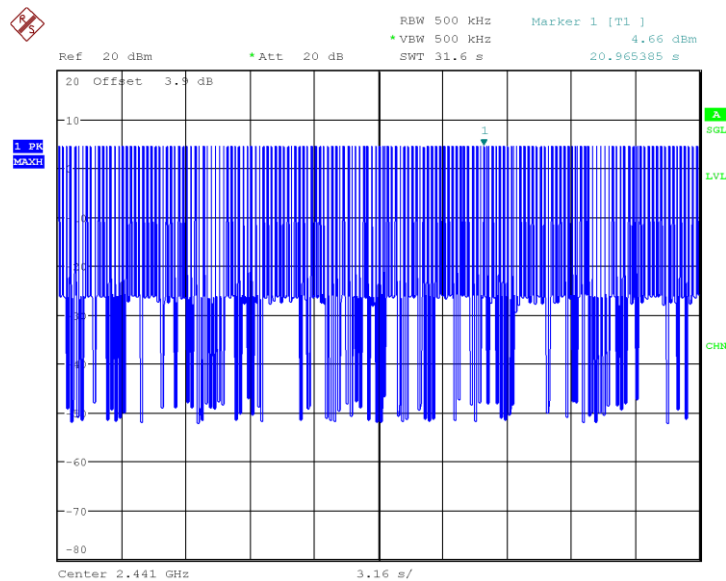
Date: 27.MAY.2019 06:43:21

Fig.57 Number of Transmissions Measurement: Ch39, Packet 2-DH5



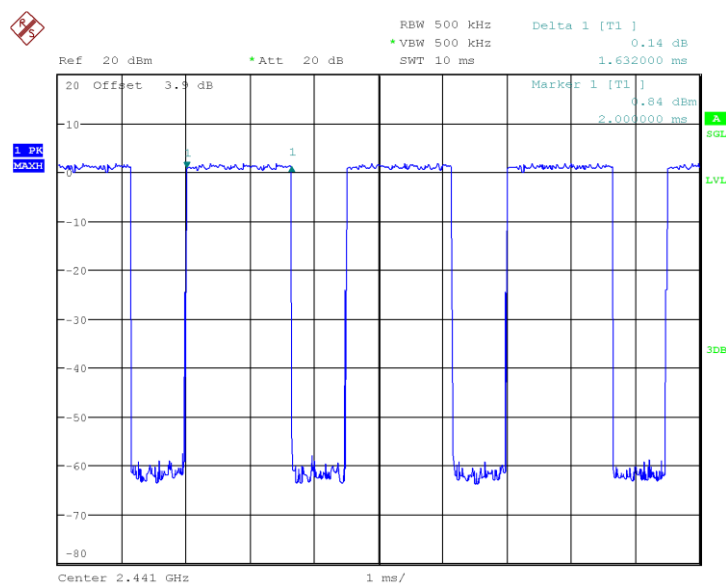
Date: 27.MAY.2019 06:45:46

Fig.58 Time of occupancy (Dwell Time): Ch39,Packet 3-DH1



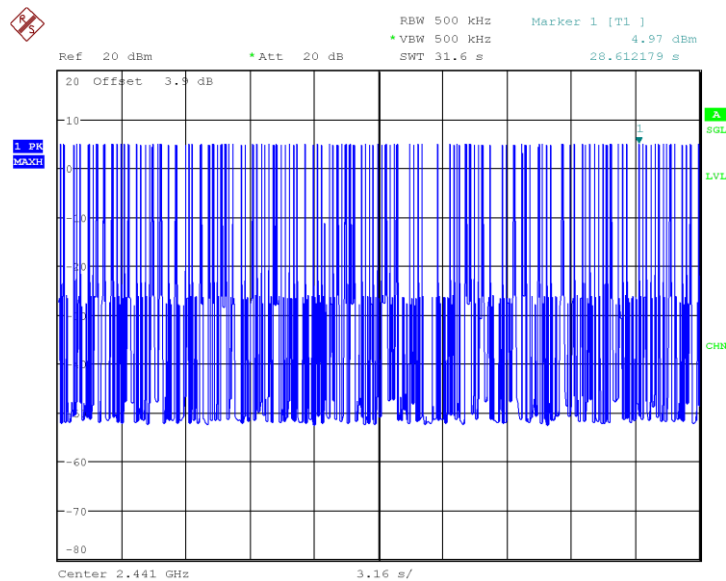
Date: 27.MAY.2019 06:47:01

Fig.59 Number of Transmissions Measurement: Ch39, Packet 3-DH1



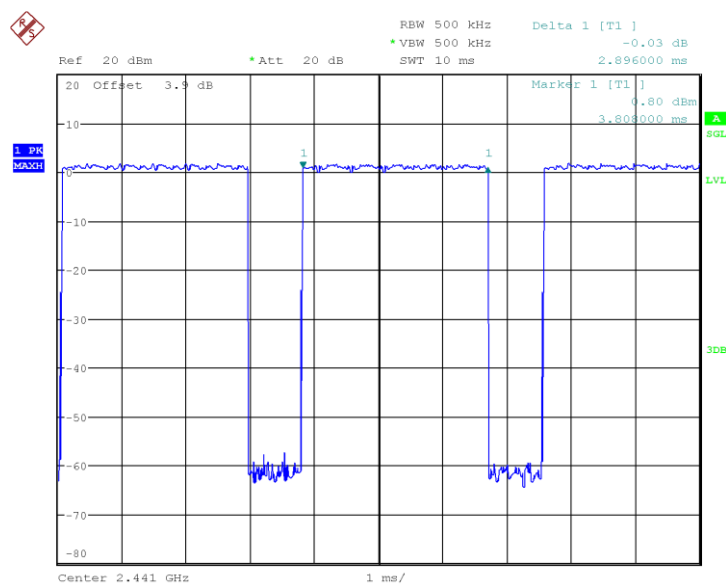
Date: 27.MAY.2019 06:49:53

Fig.60 Time of occupancy (Dwell Time): Ch39,Packet 3-DH3



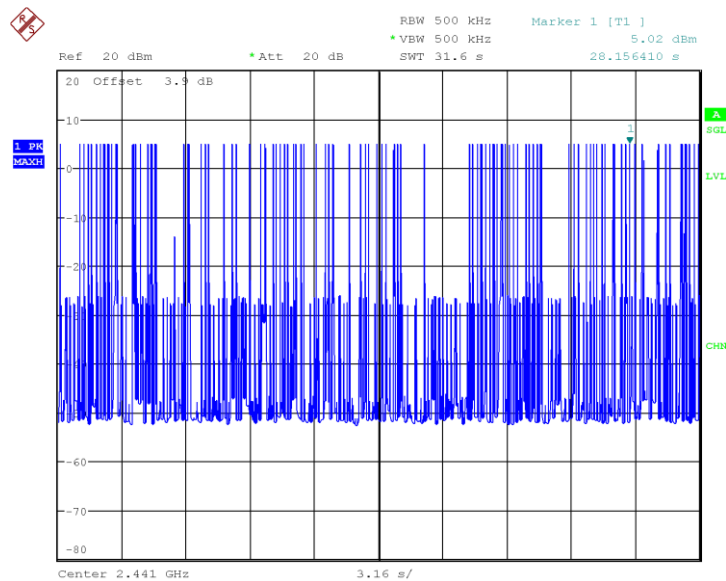
Date: 27.MAY.2019 06:51:24

Fig.61 Number of Transmissions Measurement: Ch39, Packet 3-DH3



Date: 27.MAY.2019 06:52:28

Fig.62 Time of occupancy (Dwell Time): Ch39,Packet 3-DH5



Date: 27.MAY.2019 06:53:59

Fig.63 Number of Transmissions Measurement: Ch39, Packet 3-DH5

## ANNEX A.6. 20dB Bandwidth

### A.6.1 Measurement Limit:

| Standard                       | Limit |
|--------------------------------|-------|
| FCC 47 CFR Part 15.247 (a) (1) | N/A   |

### A.6.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.7

1. Connect the EUT through cable and divide with CBT32 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 7.
4. Span: two or five times of OBW
5. RBW= 1% to 5% of the OBW; VBW is approximately three times of RBW; Max Hold.
6. Select the max peak, and N DB DOWN=20dB.
7. Record the results.

### Measurement Result:

#### For GFSK

| Channel | 20dB Bandwidth (MHz) |       | Conclusion |
|---------|----------------------|-------|------------|
| 0       | Fig.64               | 0.850 | P          |
| 39      | Fig.65               | 0.903 | P          |
| 78      | Fig.66               | 0.899 | P          |

#### For $\pi/4$ DQPSK

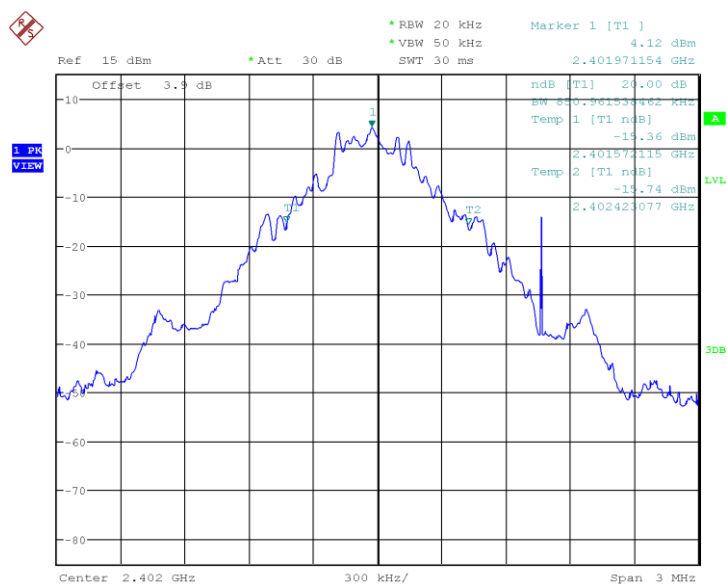
| Channel | 20dB Bandwidth (MHz) |       | Conclusion |
|---------|----------------------|-------|------------|
| 0       | Fig.67               | 1.332 | P          |
| 39      | Fig.68               | 1.332 | P          |
| 78      | Fig.69               | 1.337 | P          |

#### For 8DPSK

| Channel | 20dB Bandwidth (MHz) |       | Conclusion |
|---------|----------------------|-------|------------|
| 0       | Fig.70               | 1.284 | P          |
| 39      | Fig.71               | 1.269 | P          |
| 78      | Fig.72               | 1.284 | P          |

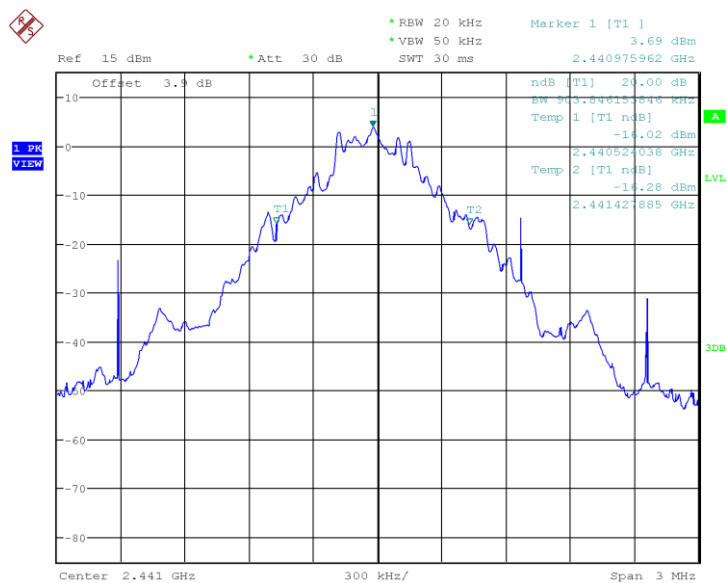
**Conclusion: PASS**

**Test graphs as below:**



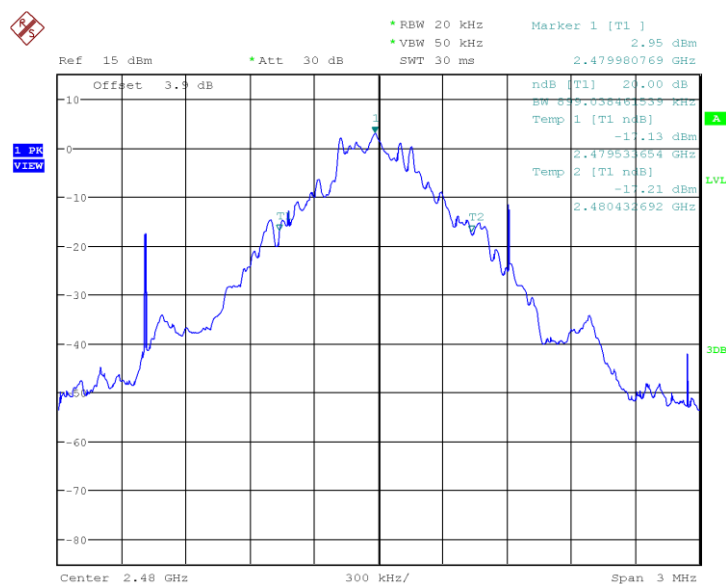
Date: 27.MAY.2019 01:38:49

Fig.64 20dB Bandwidth: GFSK, Ch0



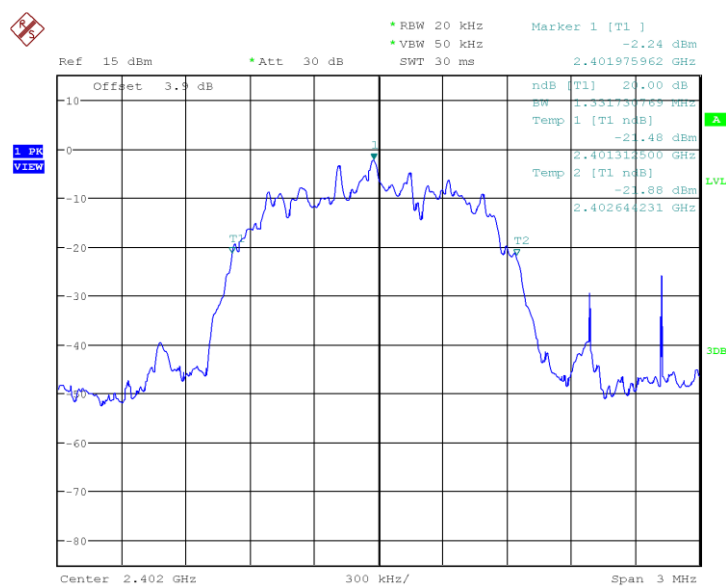
Date: 27.MAY.2019 01:42:17

Fig.65 20dB Bandwidth: GFSK, Ch39



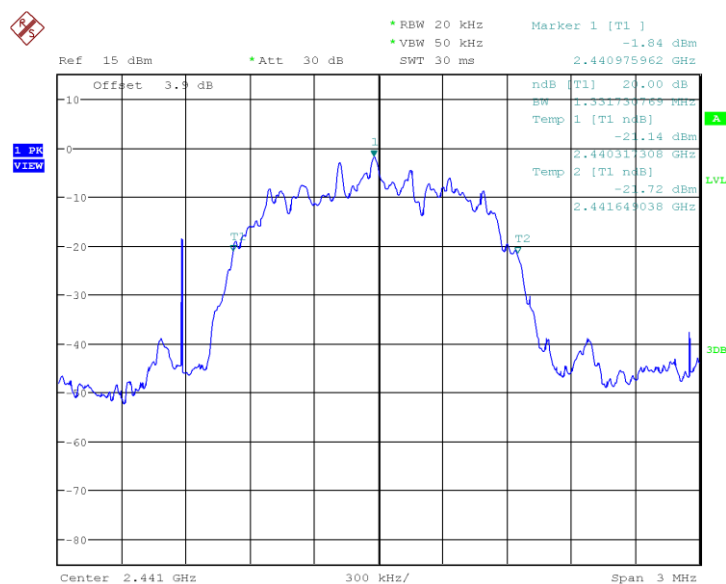
Date: 27.MAY.2019 01:43:47

Fig.66 20dB Bandwidth: GFSK, Ch78



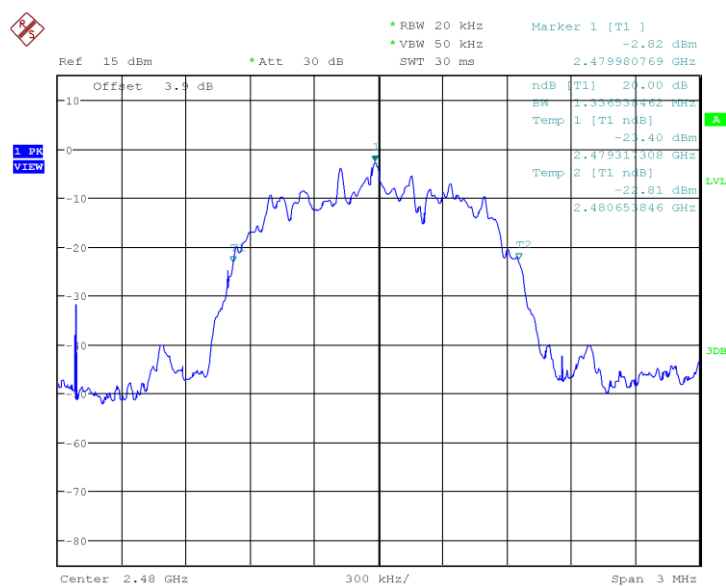
Date: 27.MAY.2019 01:47:12

Fig.67 20dB Bandwidth:  $\pi/4$  DQPSK, Ch0



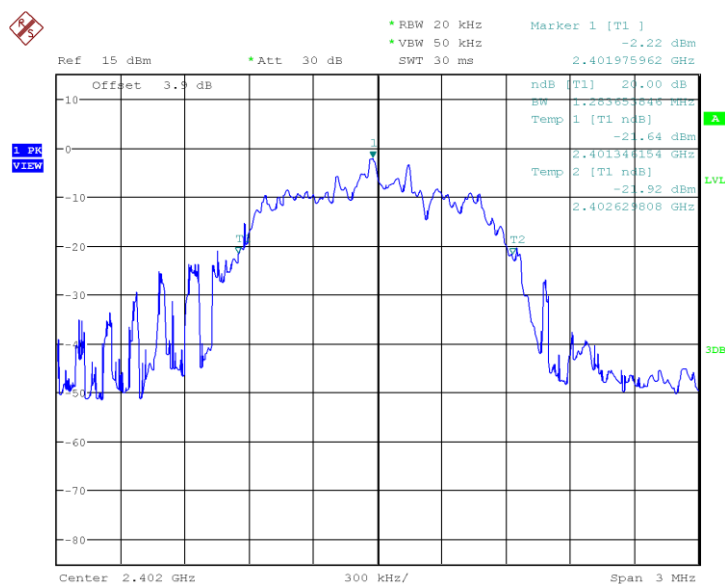
Date: 27.MAY.2019 01:48:58

Fig.68 20dB Bandwidth:  $\pi/4$  DQPSK, Ch39



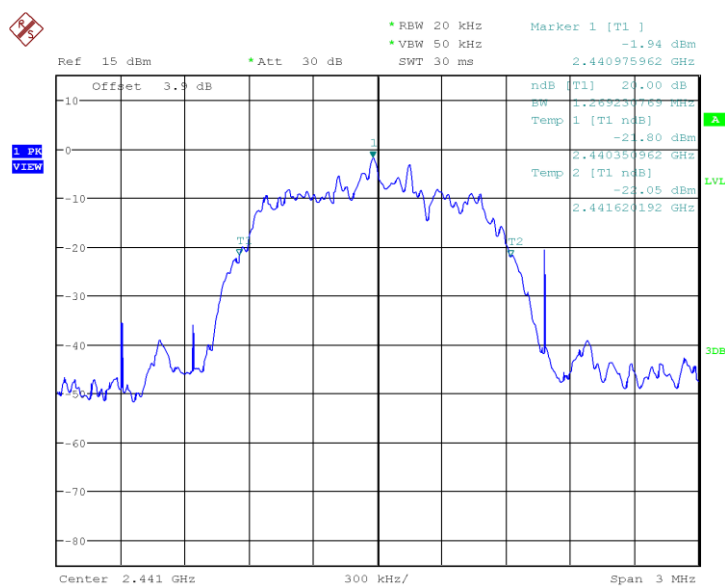
Date: 27.MAY.2019 01:50:32

Fig.69 20dB Bandwidth:  $\pi/4$  DQPSK, Ch78



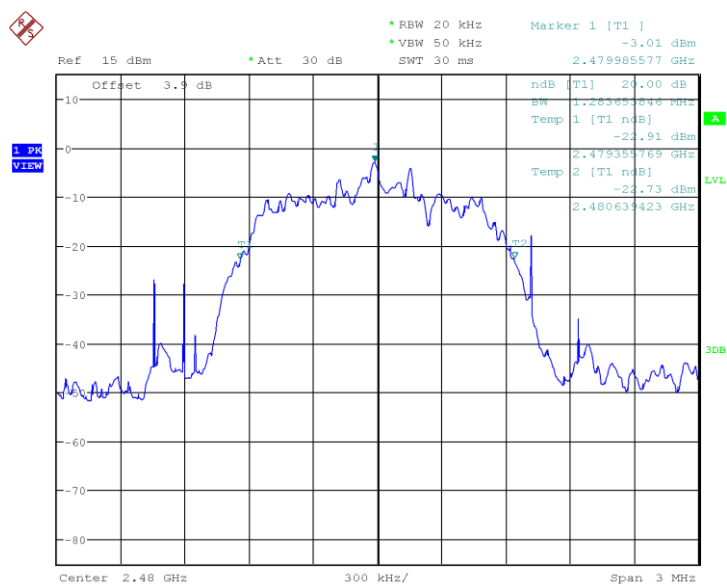
Date: 27.MAY.2019 01:51:45

Fig.70 20dB Bandwidth: 8DPSK, Ch0



Date: 27.MAY.2019 01:53:04

Fig.71 20dB Bandwidth: 8DPSK, Ch39



Date: 27.MAY.2019 01:54:29

Fig.72 20dB Bandwidth: 8DPSK, Ch78

**ANNEX A.7. Carrier Frequency Separation****A.7.1 Measurement Limit:**

| Standard                       | Limit (KHz)                                 |
|--------------------------------|---------------------------------------------|
| FCC 47 CFR Part 15.247 (a) (1) | Over 25KHz or $(2/3)*20\text{dB}$ bandwidth |

**A.7.2 Test procedures**

The measurement is according to ANSI C63.10 clause 7.8.2.

1. Connect the EUT through cable and divide with CBT32 and spectrum analyzer.
2. Enable the EUT transmit in hopping mode.
3. Span: Wide enough to capture the peaks of two adjacent channels.
4. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
5. Video (or average) bandwidth (VBW)  $\geq$  RBW.
6. Sweep: Auto.
7. Detector function: Peak.
8. Trace: Max hold.
9. Allow the trace to stabilize.

**Measurement Result:****For GFSK**

| Channel | Carrier separation (KHz) |      | Conclusion |
|---------|--------------------------|------|------------|
| 39      | Fig.73                   | 1315 | P          |

**For  $\pi/4$  DQPSK**

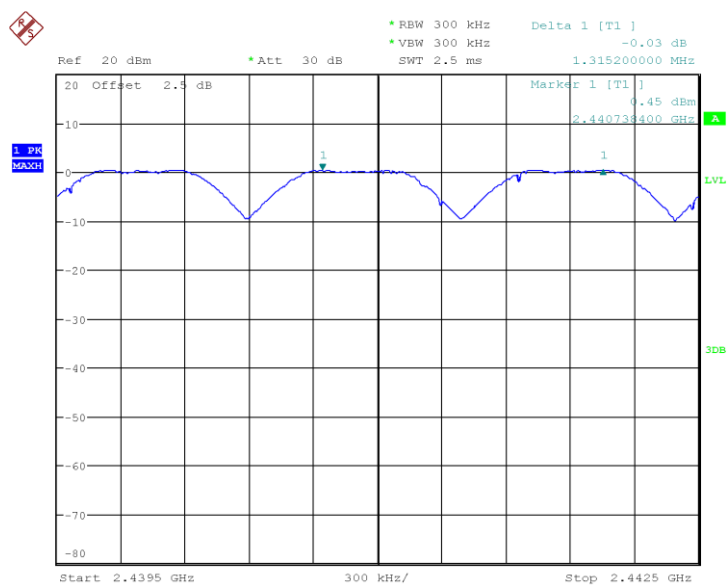
| Channel | Carrier separation (KHz) |     | Conclusion |
|---------|--------------------------|-----|------------|
| 39      | Fig.74                   | 993 | P          |

**For 8DPSK**

| Channel | Carrier separation (KHz) |     | Conclusion |
|---------|--------------------------|-----|------------|
| 39      | Fig.75                   | 993 | P          |

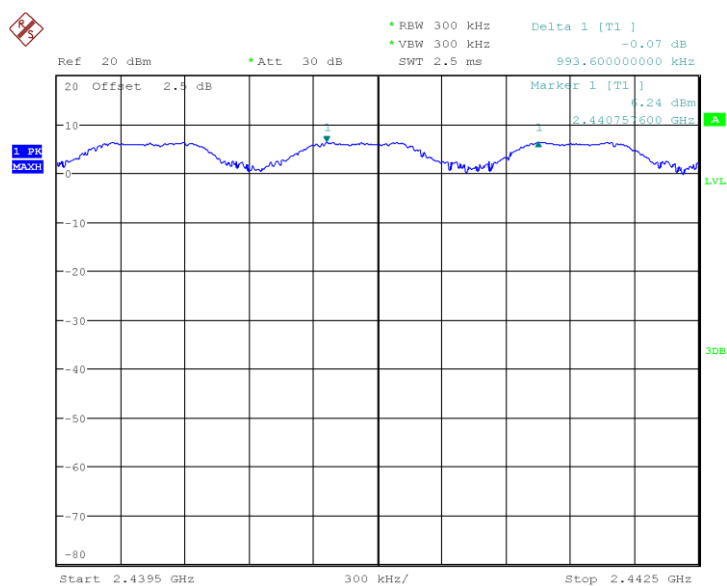
**Conclusion: PASS**

**Test graphs as below:**



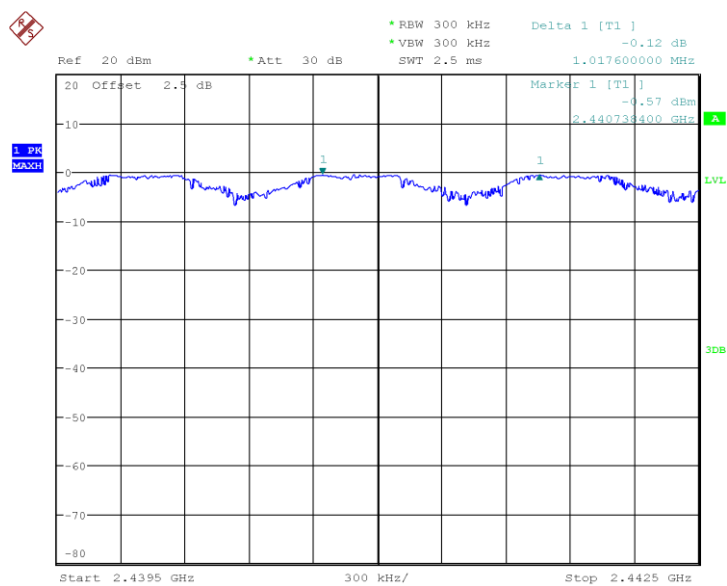
Date: 24.MAY.2019 02:10:49

Fig.73 Carrier separation measurement: GFSK, Ch39



Date: 21.MAY.2019 06:36:00

Fig.74 Carrier separation measurement:  $\pi/4$  DQPSK, Ch39



Date: 24.MAY.2019 02:15:01

Fig.75 Carrier separation measurement: 8DPSK, Ch39

## ANNEX A.8. Number Of Hopping Channels

### A.8.1 Measurement Limit:

| Standard                           | Limit                                |
|------------------------------------|--------------------------------------|
| FCC 47 CFR Part 15.247 (a)(1)(iii) | At least 15 non-overlapping channels |

### A.8.2 Test procedure

The measurement is according to ANSI C63.10 clause 7.8.3.

1. Connect the EUT through cable and divide with CBT32 and spectrum analyzer.
2. Enable the EUT transmit in hopping mode.
3. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
4. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
5. VBW  $\geq$  RBW.
6. Sweep: Auto.
7. Detector function: Peak.
8. Trace: Max hold.
9. Allow the trace to stabilize.
10. Record the test results.

### Measurement Result:

#### For GFSK

| Channel | Number of hopping channels |    | Conclusion |
|---------|----------------------------|----|------------|
| 0~39    | Fig.76                     | 79 | P          |
| 40~78   | Fig.77                     |    | P          |

#### For $\pi/4$ DQPSK

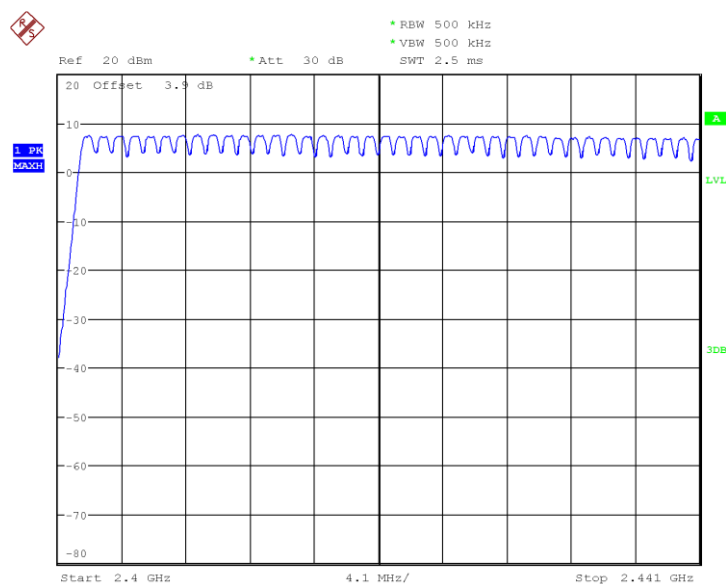
| Channel | Number of hopping channels |    | Conclusion |
|---------|----------------------------|----|------------|
| 0~39    | Fig.78                     | 79 | P          |
| 40~78   | Fig.79                     |    | P          |

#### For 8DPSK

| Channel | Number of hopping channels |    | Conclusion |
|---------|----------------------------|----|------------|
| 0~39    | Fig.80                     | 79 | P          |
| 40~78   | Fig.81                     |    | P          |

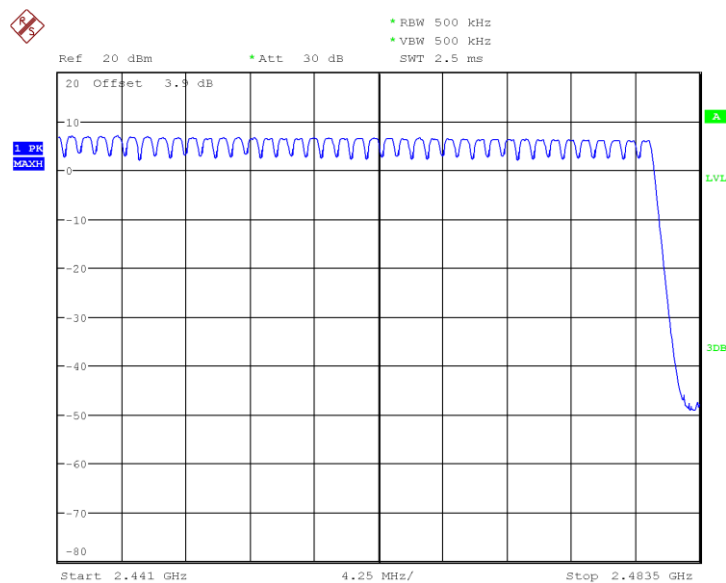
**Conclusion: PASS**

**Test graphs as below:**



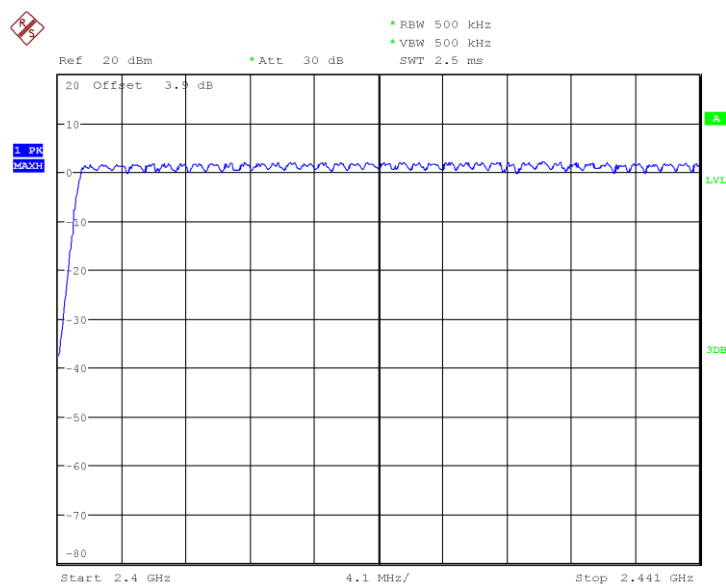
Date: 27.MAY.2019 07:03:39

Fig.76 Number of hopping frequency: GFSK, Ch0~39



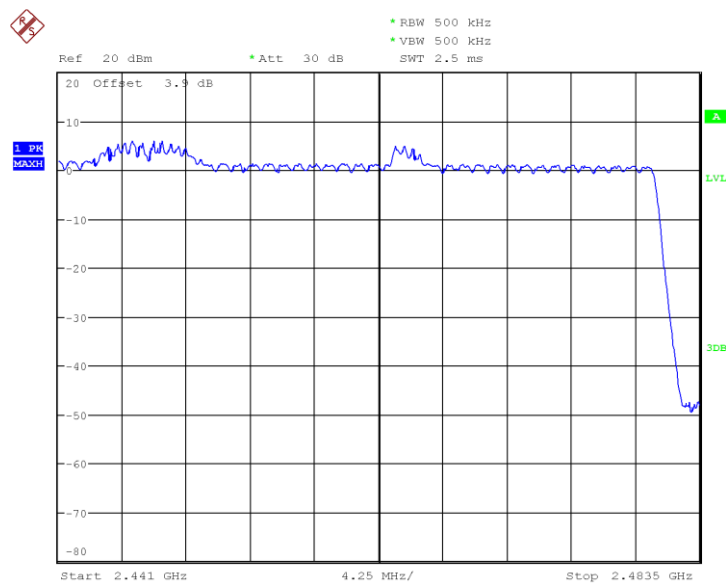
Date: 27.MAY.2019 07:04:49

Fig.77 Number of hopping frequency: GFSK, Ch40~78



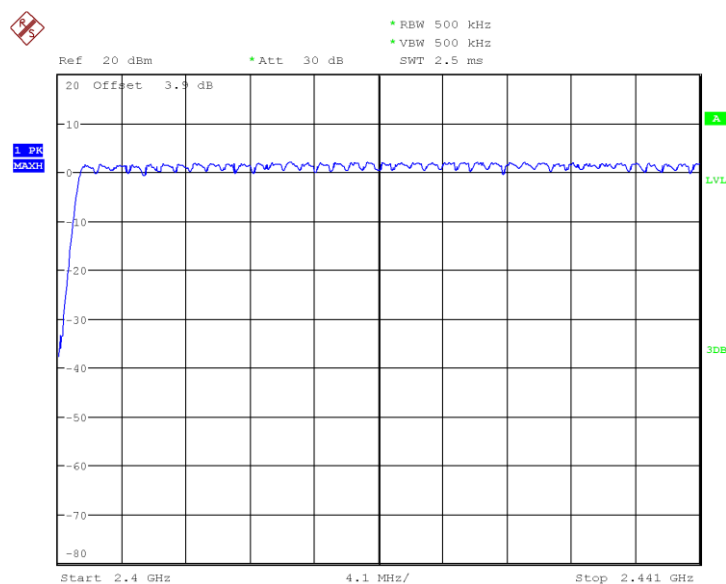
Date: 27.MAY.2019 07:06:38

Fig.78 Number of hopping frequency:  $\pi/4$  DQPSK, Ch0~39



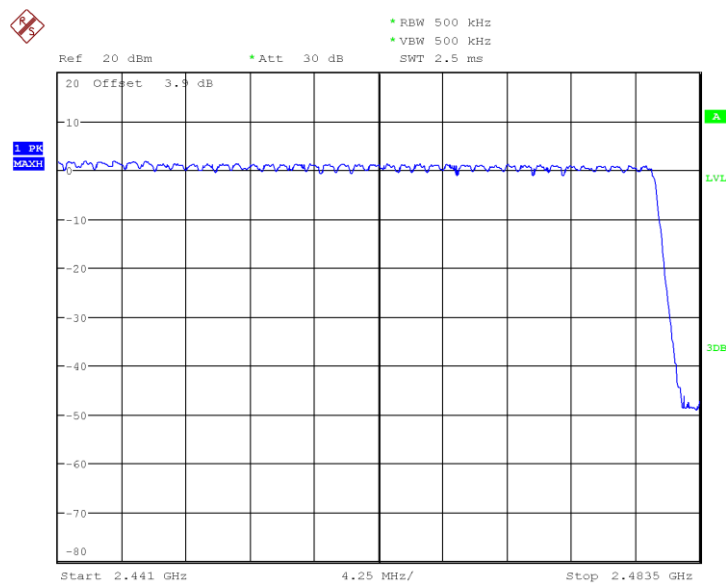
Date: 27.MAY.2019 07:07:48

Fig.79 Number of hopping frequency:  $\pi/4$  DQPSK, Ch40~78



Date: 27.MAY.2019 07:09:49

Fig.80 Number of hopping frequency: 8DPSK, Ch0~39



Date: 27.MAY.2019 07:11:00

Fig.81 Number of hopping frequency: 8DPSK, Ch40~78

## ANNEX A.9. AC Powerline Conducted Emission

### Method of Measurement: See ANSI C63.10-2013-clause 6.2

- 1 The one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT.
- 2 If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed.
- 3 The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation.
- 4 If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.
- 5 If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.<sup>36</sup> Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

### Test Condition:

| Voltage (V) | Frequency (Hz) |
|-------------|----------------|
| 120         | 60             |

### Measurement Result and limit:

(Quasi-peak-average Limit)

| Frequency range<br>(MHz)                                                                                 | Quasi-peak<br>Limit (dBμV) | Average Limit<br>(dBμV) | Result (dBμV) | Conclusion |
|----------------------------------------------------------------------------------------------------------|----------------------------|-------------------------|---------------|------------|
|                                                                                                          |                            |                         | With charger  |            |
|                                                                                                          |                            |                         | BT            |            |
| 0.15 to 0.5                                                                                              | 66 to 56                   | 56 to 46                | Fig.82        | P          |
| 0.5 to 5                                                                                                 | 56                         | 46                      |               |            |
| 5 to 30                                                                                                  | 60                         | 50                      |               |            |
| NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz. |                            |                         |               |            |

Conclusion: Pass

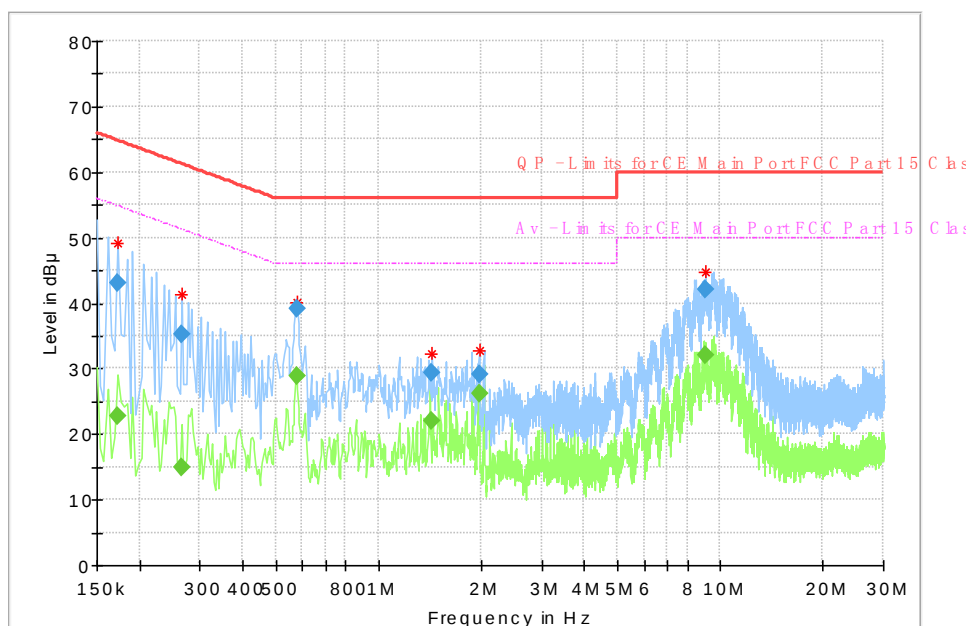


Fig.82 AC Powerline Conducted Emission

| Frequency (MHz) | QuasiPeak (dB $\mu$ V) | Average (dB $\mu$ V) | Limit (dB $\mu$ V) | Margin (dB) | Meas. Time | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|-----------------|------------------------|----------------------|--------------------|-------------|------------|-----------------|------|--------|------------|
| 0.172388        | 43.06                  | ---                  | 64.85              | 21.79       | 15000.     | 9.000           | L1   | ON     | 9.7        |
| 0.172388        | ---                    | 22.63                | 54.85              | 32.22       | 15000.     | 9.000           | L1   | ON     | 9.7        |
| 0.265669        | 35.21                  | ---                  | 61.25              | 26.04       | 15000.     | 9.000           | L1   | ON     | 9.8        |
| 0.265669        | ---                    | 14.83                | 51.25              | 36.42       | 15000.     | 9.000           | L1   | ON     | 9.8        |
| 0.575363        | 39.09                  | ---                  | 56.00              | 16.91       | 15000.     | 9.000           | L1   | ON     | 9.8        |
| 0.575363        | ---                    | 28.85                | 46.00              | 17.15       | 15000.     | 9.000           | L1   | ON     | 9.8        |
| 1.437281        | 29.40                  | ---                  | 56.00              | 26.60       | 15000.     | 9.000           | L1   | ON     | 9.9        |
| 1.437281        | ---                    | 22.07                | 46.00              | 23.93       | 15000.     | 9.000           | L1   | ON     | 9.9        |
| 1.967119        | ---                    | 26.09                | 46.00              | 19.91       | 15000.     | 9.000           | N    | ON     | 10.0       |
| 1.967119        | 29.10                  | ---                  | 56.00              | 26.90       | 15000.     | 9.000           | N    | ON     | 10.0       |
| 9.063956        | ---                    | 32.11                | 50.00              | 17.89       | 15000.     | 9.000           | L1   | ON     | 11.1       |
| 9.063956        | 42.20                  | ---                  | 60.00              | 17.80       | 15000.     | 9.000           | L1   | ON     | 11.1       |

**ANNEX B. Accreditation Certificate**

\*\*\*\*\*End of the Report\*\*\*\*\*