



## CTC Laboratories, Inc.

1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China  
Tel: +86-755- 27521059 Fax: +86-755- 27521011 Http://www.sz-ctc.com.cn

# TEST REPORT

**Report No.** ..... GTI20190532F  
**FCC ID** ..... 2AB75-BT581  
**Applicant** ..... Wintop Electronics Co., Ltd  
**Address** ..... Unit 04 7/F, Bright Way Tower 33, Mong Kok RD, KL, Hong Kong  
**Manufacturer** ..... Shenzhen Wintop Electronics Co.,Ltd  
**Address** ..... No.46 Xinhe Road Shangmugu Pinghu Town Longgang District  
Shenzhen China  
**Product Name** ..... Bluetooth Earphone  
**Trade Mark** ..... /  
**Model/Type reference** ..... BT-581  
BT-582 、 BT-575 、 BT-596 、 BT-536 、 BT-517 、 BT-519 、 BT-512 、  
**Listed Model(s)** ..... BT-559 、 BT-558 、 BT-535 、 BT-535B 、 BT-535C  
BT-535D 、 BT-535E 、 BT-562  
BT-530 、 BT-563 、 BT-568 、 BT-576 、 BT-576S  
**Standard** ..... FCC CFR Title 47 Part 15 Subpart C Section 15.247  
RSS-GEN Issue 5  
RSS-247 Issue 2  
ANSI C63.10-2013  
**Date of receipt of test sample**...: 2019-03-22  
**Date of testing**.....: 2019-03-22 to 2019-04-03  
**Date of issue**.....: 2019-04-03  
**Result**.....: PASS

Compiled by:

(Printed name+signature) Torny Fang

Torny Fang

Supervised by:

( Printed name+signature) Eric Zhang

Eric Zhang

Approved by:

( Printed name+signature) Walter Chen

Walter Chen

**Testing Laboratory Name**..... CTC Laboratories, Inc.

**Address**..... 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park,  
Shenzhen, Guangdong, China

This test report may be duplicated completely for legal use with the approval of the applicant. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product endorsement by CTC. The test results in the report only apply to the tested sample. The test report shall be invalid without all the signatures of testing engineers, reviewer and approver. Any objections must be raised to CTC within 15 days since the date when the report is received. It will not be taken into consideration beyond this limit. The test report merely correspond to the test sample.



## Table of Contents

## Page

|                                                   |           |
|---------------------------------------------------|-----------|
| <b>1. TEST SUMMARY .....</b>                      | <b>3</b>  |
| 1.1. TEST STANDARDS.....                          | 3         |
| 1.2. REPORT VERSION.....                          | 3         |
| 1.3. TEST DESCRIPTION.....                        | 4         |
| 1.4. TEST FACILITY .....                          | 5         |
| 1.5. MEASUREMENT UNCERTAINTY .....                | 5         |
| 1.6. ENVIRONMENTAL CONDITIONS .....               | 6         |
| <b>2. GENERAL INFORMATION .....</b>               | <b>7</b>  |
| 2.1. CLIENT INFORMATION .....                     | 7         |
| 2.2. GENERAL DESCRIPTION OF EUT .....             | 7         |
| 2.3. OPERATION STATE.....                         | 8         |
| 2.4. MEASUREMENT INSTRUMENTS LIST .....           | 9         |
| <b>3. TEST ITEM AND RESULTS .....</b>             | <b>11</b> |
| 3.1. CONDUCTED EMISSION.....                      | 11        |
| 3.2. RADIATED EMISSION .....                      | 14        |
| 3.3. BAND EDGE EMISSIONS .....                    | 20        |
| 3.4. CHANNEL SEPARATION AND BANDWIDTH .....       | 28        |
| 3.5. NUMBER OF HOPPING CHANNEL.....               | 41        |
| 3.6. DWELL TIME .....                             | 44        |
| 3.7. PEAK OUTPUT POWER .....                      | 47        |
| 3.8. ANTENNA REQUIREMENT .....                    | 54        |
| <b>4. EUT TEST PHOTOS .....</b>                   | <b>55</b> |
| <b>5. PHOTOGRAPHS OF EUT CONSTRUCTIONAL .....</b> | <b>56</b> |



## 1. TEST SUMMARY

### 1.1. Test Standards

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

[RSS 247 Issue 2](#): Standard Specifications for Frequency Hopping Systems (FHSs) and Digital Transmission Systems (DTSs) Operating in the Bands 902-928MHz, 2400-2483.5MHz and 5725-5850MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices.

### 1.2. Report version

| Revised No. | Date of issue | Description |
|-------------|---------------|-------------|
| 01          | 2019-04-03    | Original    |
|             |               |             |
|             |               |             |
|             |               |             |



### 1.3. Test Description

| FCC Part 15 Subpart C(15.247)/ RSS 247 Issue 5 |                  |                 |        |               |
|------------------------------------------------|------------------|-----------------|--------|---------------|
| Test Item                                      | Standard Section |                 | Result | Test Engineer |
|                                                | FCC              | IC              |        |               |
| Antenna Requirement                            | 15.203           | /               | Pass   | Terry Su      |
| Conducted Emission                             | 15.207           | RSS-GEN 7.2.2   | Pass   | Terry Su      |
| Restricted Bands                               | 15.205           | RSS-Gen 7.2.3   | Pass   | Terry Su      |
| Hopping Channel Separation                     | 15.247(a)(1)     | RSS 247 5.1 (2) | Pass   | Terry Su      |
| Dwell Time                                     | 15.247(a)(1)     | RSS 247 5.1 (4) | Pass   | Terry Su      |
| Peak Output Power                              | 15.247(b)(1)     | RSS 247 5.4 (2) | Pass   | Terry Su      |
| Number of Hopping Frequency                    | 15.247(b)(1)     | RSS 247 5.1 (4) | Pass   | Terry Su      |
| Band Edge Emissions                            | 15.247(d)        | RSS 247 5.5     | Pass   | Terry Su      |
| Radiated Spurious Emission                     | 15.247(c)&15.209 | RSS 247 5.5     | Pass   | Terry Su      |
| 99% Occupied Bandwidth & 20dB Bandwidth        | 15.247(a)        | RSS 247 5.1 (1) | Pass   | Terry Su      |

Note: The measurement uncertainty is not included in the test result.



## 1.4. Test Facility

### Address of the report laboratory

#### CTC Laboratories, Inc.

Add: 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China

### Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

#### CNAS-Lab Code: L5365

CTC Laboratories, Inc. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

#### A2LA-Lab Cert. No.: 4340.01

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

#### IC Registration No.: 9783A

The 3m alternate test site of CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

#### FCC-Registration No.: 951311

CTC Laboratories, Inc. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 951311, Aug 26, 2017

## 1.5. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the CTC Laboratories, Inc. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Below is the best measurement capability for CTC Laboratories, Inc.



| Test Items                              | Measurement Uncertainty | Notes |
|-----------------------------------------|-------------------------|-------|
| Transmitter power conducted             | 0.42 dB                 | (1)   |
| Transmitter power Radiated              | 2.14 dB                 | (1)   |
| Conducted spurious emissions 9kHz~40GHz | 1.60 dB                 | (1)   |
| Radiated spurious emissions 9kHz~40GHz  | 2.20 dB                 | (1)   |
| Conducted Emissions 9kHz~30MHz          | 3.20 dB                 | (1)   |
| Radiated Emissions 30~1000MHz           | 4.70 dB                 | (1)   |
| Radiated Emissions 1~18GHz              | 5.00 dB                 | (1)   |
| Radiated Emissions 18~40GHz             | 5.54 dB                 | (1)   |
| Occupied Bandwidth                      | -----                   | (1)   |

**Note (1):** This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=1.96$ .

## 1.6. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

|                    |             |
|--------------------|-------------|
| Temperature:       | 15~35°C     |
| Relative Humidity: | 30~60 %     |
| Air Pressure:      | 950~1050mba |



## 2. GENERAL INFORMATION

### 2.1. Client Information

|               |                                                                         |
|---------------|-------------------------------------------------------------------------|
| Applicant:    | Wintop Electronics Co., Ltd                                             |
| Address:      | Unit 04 7/F, Bright Way Tower 33, Mong Kok RD, KL, Hong Kong            |
| Manufacturer: | Shenzhen Wintop Electronics Co.,Ltd                                     |
| Address:      | No.46 Xinhe Road Shangmugu Pinghu Town Longgang District Shenzhen China |
| Factory       | Shenzhen Wintop Electronics Co.,Ltd                                     |
| Address:      | No.46 Xinhe Road Shangmugu Pinghu Town Longgang District Shenzhen China |

### 2.2. General Description of EUT

|                          |                                                                                                                                                            |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Name:            | Bluetooth Earphone                                                                                                                                         |
| Model/Type reference:    | BT-581                                                                                                                                                     |
| Marketing Name:          | N/A                                                                                                                                                        |
| Listed Model(s):         | BT-582、BT-575、BT-596、BT-536、BT-517、BT-519、<br>BT-512、BT-559、BT-558、BT-535、BT-535B、BT-535C<br>BT-535D、BT-535E、BT-562<br>BT-530、BT-563、BT-568、BT-576、BT-576S |
| Power supply:            | DC 3.7V 75mAh                                                                                                                                              |
| Hardware version:        | N/A                                                                                                                                                        |
| Software version:        | N/A                                                                                                                                                        |
| <b>Bluetooth 2.1+EDR</b> |                                                                                                                                                            |
| Modulation:              | GFSK, $\pi/4$ -DQPSK, 8-DPSK                                                                                                                               |
| Operation frequency:     | 2402MHz~2480MHz                                                                                                                                            |
| Max Peak Output Power:   | 1.28dBm(GFSK)                                                                                                                                              |
| Channel number:          | 79                                                                                                                                                         |
| Channel separation:      | 1MHz                                                                                                                                                       |
| Antenna type:            | PCB Antenna                                                                                                                                                |
| Antenna gain:            | 2.5dBi                                                                                                                                                     |



## 2.3. Operation state

Operation Frequency List: The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. BT EDR, 79 channels are provided to the EUT. Channels 00/39/78 were selected for testing.

Operation Frequency List:

| Channel   | Frequency (MHz) |
|-----------|-----------------|
| <b>00</b> | <b>2402</b>     |
| 01        | 2403            |
| ⋮         | ⋮               |
| 38        | 2440            |
| <b>39</b> | <b>2441</b>     |
| 40        | 2442            |
| ⋮         | ⋮               |
| 77        | 2479            |
| <b>78</b> | <b>2480</b>     |

Note: The display in grey were the channel selected for testing.

Test mode

|                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| For RF test items:                                                                                                                                                                                                       |
| The engineering test program was provided and enabled to make EUT continuous transmit                                                                                                                                    |
| For AC power line conducted emissions:                                                                                                                                                                                   |
| The EUT was set to connect with the Bluetooth instrument under large package sizes transmission.                                                                                                                         |
| For Radiated spurious emissions test item:                                                                                                                                                                               |
| The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report. |



## 2.4. Measurement Instruments List

| Item | Test Equipment    | Manufacturer | Model No. | Serial No. | Calibrated until |
|------|-------------------|--------------|-----------|------------|------------------|
| 1    | LISN              | R&S          | ENV216    | 101112     | Dec. 28, 2019    |
| 2    | LISN              | R&S          | ENV216    | 101113     | Dec. 28, 2019    |
| 3    | EMI Test Receiver | R&S          | ESCI      | 100920     | Dec. 28, 2019    |
| 4    | ISN CAT6          | Schwarzbeck  | NTFM 8158 | 8158-0046  | Dec. 28, 2019    |

| Item | Test Equipment                      | Manufacturer    | Model No. | Serial No. | Calibrated until |
|------|-------------------------------------|-----------------|-----------|------------|------------------|
| 1    | Spectrum Analyzer                   | Rohde & Schwarz | FSU26     | 100105     | Dec. 28 2019     |
| 2    | Spectrum Analyzer                   | Rohde & Schwarz | FUV40-N   | 101331     | Dec. 28 2019     |
| 3    | MXG Vector Signal Generator         | Agilent         | N5182A    | MY47420864 | Dec. 28 2019     |
| 4    | Signal Generator                    | Agilent         | E8257D    | MY46521908 | Dec. 28 2019     |
| 5    | Power Sensor                        | Agilent         | U2021XA   | MY5365004  | Dec. 28 2019     |
| 6    | Power Sensor                        | Agilent         | U2021XA   | MY5365006  | Dec. 28 2019     |
| 7    | Simultaneous Sampling DAQ           | Agilent         | U2531A    | TW54493510 | Dec. 28 2019     |
| 8    | Climate Chamber                     | TABAI           | PR-4G     | A8708055   | Dec. 28 2019     |
| 9    | Wideband Radio Communication Tester | Rohde & Schwarz | CMW500    | 116410     | Dec. 28 2019     |
| 10   | Climate Chamber                     | ESPEC           | MT3065    | /          | Dec. 28 2019     |
| 11   | 300328 v2.1.1 test system           | TONSCEND        | v2.6      | /          | /                |

| Item | Test Equipment          | Manufacturer    | Model No.   | Serial No. | Calibrated until |
|------|-------------------------|-----------------|-------------|------------|------------------|
| 1    | EMI Test Receiver       | Rohde & Schwarz | ESCI        | 100658     | Dec. 28 2019     |
| 2    | High pass filter        | micro-tranics   | HPM50111    | 142        | Dec. 28 2019     |
| 3    | Log-Bicon Antenna       | Schwarzbeck     | CBL6141A    | 4180       | Dec. 28 2019     |
| 4    | Ultra-Broadband Antenna | ShwarzBeck      | BBHA9170    | 25841      | Dec. 28 2019     |
| 5    | Loop Antenna            | LAPLAC          | RF300       | 9138       | Dec. 28 2019     |
| 6    | Spectrum Analyzer       | Rohde & Schwarz | FSU26       | 100105     | Dec. 28 2019     |
| 7    | Horn Antenna            | Schwarzbeck     | BBHA 9120D  | 647        | Dec. 28 2019     |
|      | Horn Antenna            | Rohde & Schwarz | Sep-60      | 69483      | Dec. 28 2019     |
| 8    | Pre-Amplifier           | HP              | 8447D       | 1937A03050 | Dec. 28 2019     |
| 9    | Pre-Amplifier           | EMCI            | EMC051835   | 980075     | Dec. 28 2019     |
| 10   | Antenna Mast            | UC              | UC3000      | N/A        | N/A              |
| 11   | Turn Table              | UC              | UC3000      | N/A        | N/A              |
| 12   | Cable Below 1GHz        | Schwarzbeck     | AK9515E     | 33155      | Dec. 28 2019     |
| 13   | Cable Above 1GHz        | Hubersuhner     | SUCOFLEX102 | DA1580     | Dec. 28 2019     |

CTC Laboratories, Inc

1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China

Tel.: (86)755-27521059

Fax: (86)755-27521011

Http://www.sz-ctc.org.cn

中国国家认证认可监督管理委员会  
Certification and Accreditation Administration of the People's Republic of ChinaFor anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China: [yz.cncaic.cn](http://yz.cncaic.cn)



|    |                     |                                 |                    |        |              |
|----|---------------------|---------------------------------|--------------------|--------|--------------|
| 14 | Splitter            | Mini-Circuit                    | ZAPD-4             | 400059 | Dec. 28 2019 |
| 15 | RF Connection Cable | HUBER+SUHNER                    | RE-7-FL            | N/A    | Dec. 28 2019 |
| 16 | RF Connection Cable | Chengdu<br>E-Microwave          | ---                | ---    | Dec. 28 2019 |
| 17 | High pass filter    | Compliance<br>Direction systems | BSU-6              | 34202  | Dec. 28 2019 |
| 18 | Attenuator          | Chengdu<br>E-Microwave          | EMCAXX-10R<br>NZ-3 | ---    | Dec. 28 2019 |

Note: 1. The Cal. Interval was one year.

2. The cable loss has calculated in test result which connection between each test instruments.

### 3. TEST ITEM AND RESULTS

#### 3.1. Conducted Emission

##### Limit

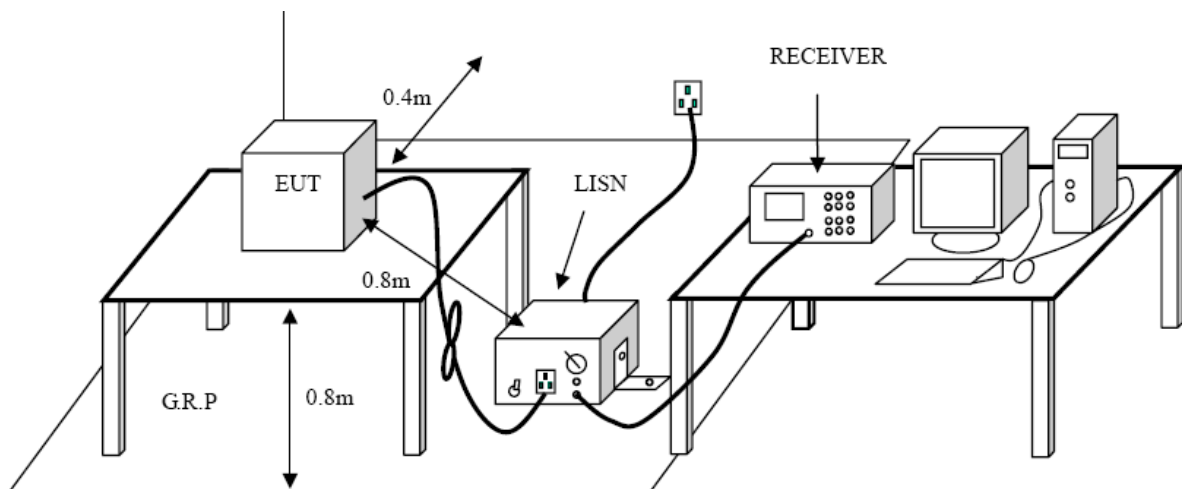
Conducted Emission Test Limit

| Frequency     | Maximum RF Line Voltage (dB $\mu$ V) |               |
|---------------|--------------------------------------|---------------|
|               | Quasi-peak Level                     | Average Level |
| 150kHz~500kHz | 66 ~ 56 *                            | 56 ~ 46 *     |
| 500kHz~5MHz   | 56                                   | 46            |
| 5MHz~30MHz    | 60                                   | 50            |

Notes:

- (1) \*Decreasing linearly with logarithm of the frequency.
- (2) The lower limit shall apply at the transition frequencies.
- (3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

##### Test Configuration



##### Test Procedure

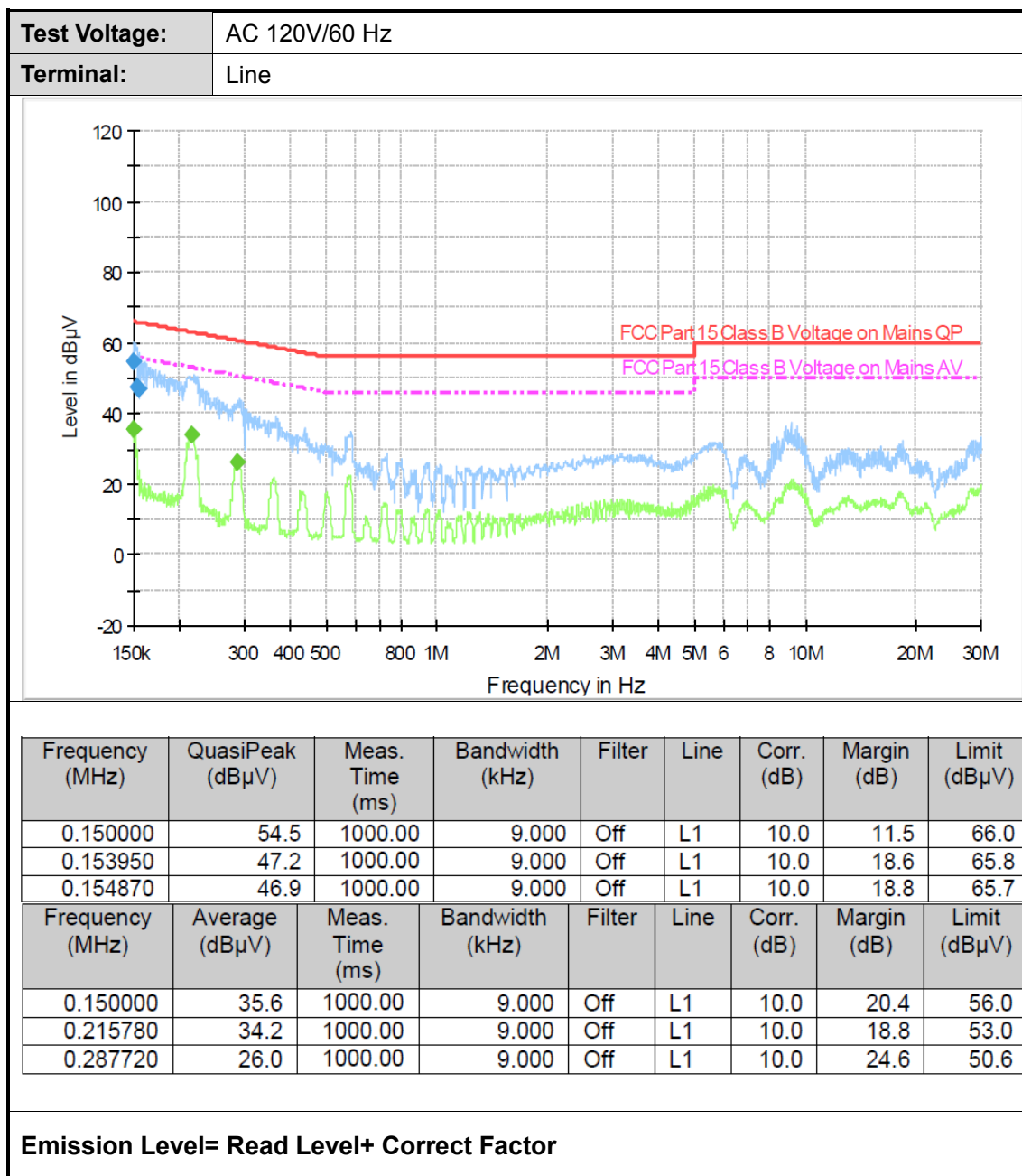
1. The EUT was setup according to ANSI C63.10:2013 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50ohm /50uH coupling impedance for the measuring equipment.  
The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
4. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
5. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
6. Conducted Emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
7. During the above scans, the emissions were maximized by cable manipulation.

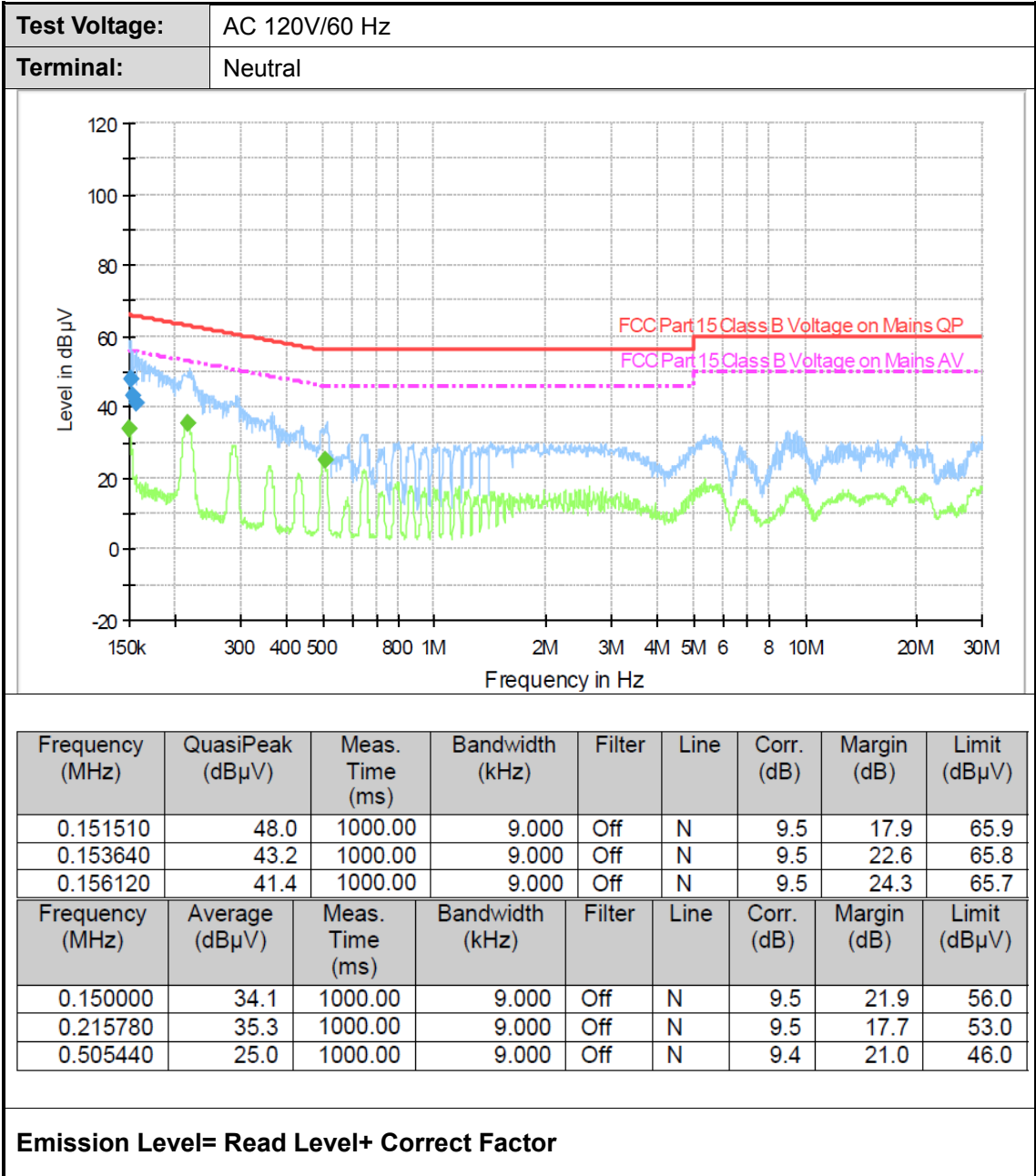
**Test Mode:**

Please refer to the clause 2.2.

**Test Results**

Only show worst adapter data.





### 3.2. Radiated Emission

#### Limit

**Radiated Emission Limits (9 kHz~1000 MHz)**

| Frequency (MHz) | Field Strength (microvolt/meter) | Measurement Distance (meters) |
|-----------------|----------------------------------|-------------------------------|
| 0.009~0.490     | 2400/F(KHz)                      | 300                           |
| 0.490~1.705     | 24000/F(KHz)                     | 30                            |
| 1.705~30.0      | 30                               | 30                            |
| 30~88           | 100                              | 3                             |
| 88~216          | 150                              | 3                             |
| 216~960         | 200                              | 3                             |
| Above 960       | 500                              | 3                             |

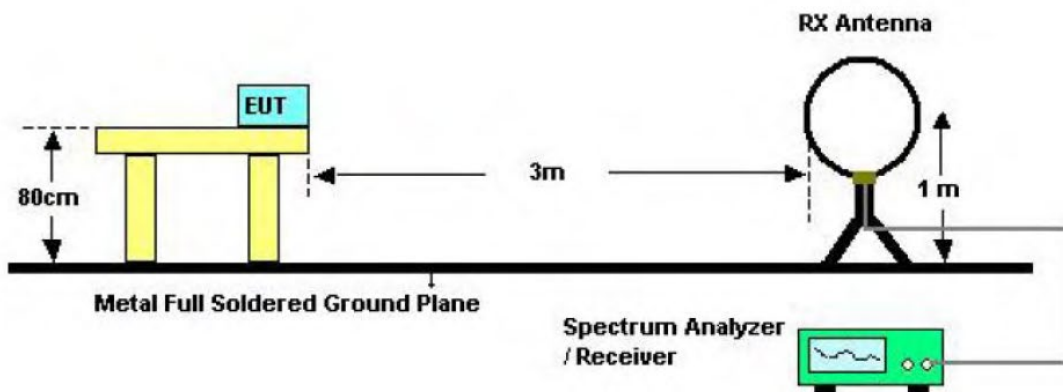
**Radiated Emission Limit (Above 1000MHz)**

| Frequency (MHz) | Distance Meters(at 3m) |         |
|-----------------|------------------------|---------|
|                 | Peak                   | Average |
| Above 1000      | 74                     | 54      |

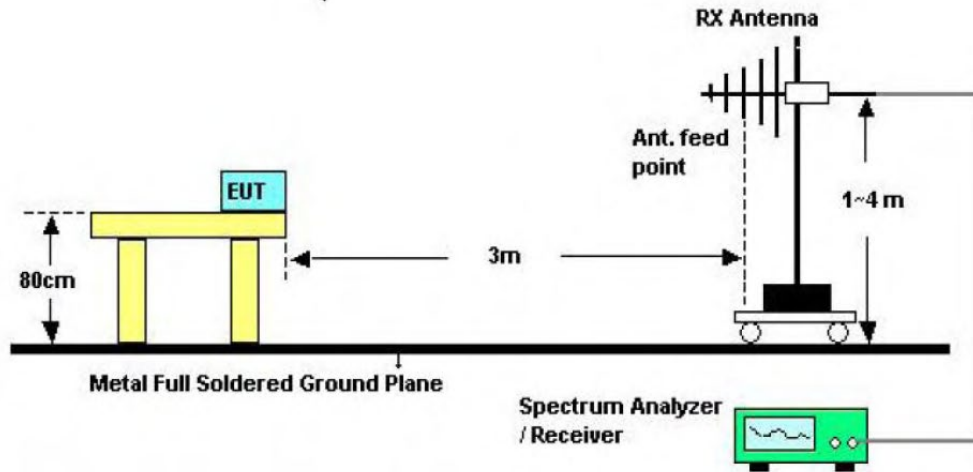
#### Note:

- (1) The tighter limit applies at the band edges.
- (2) Emission Level (dBuV/m)=20log Emission Level (uV/m).

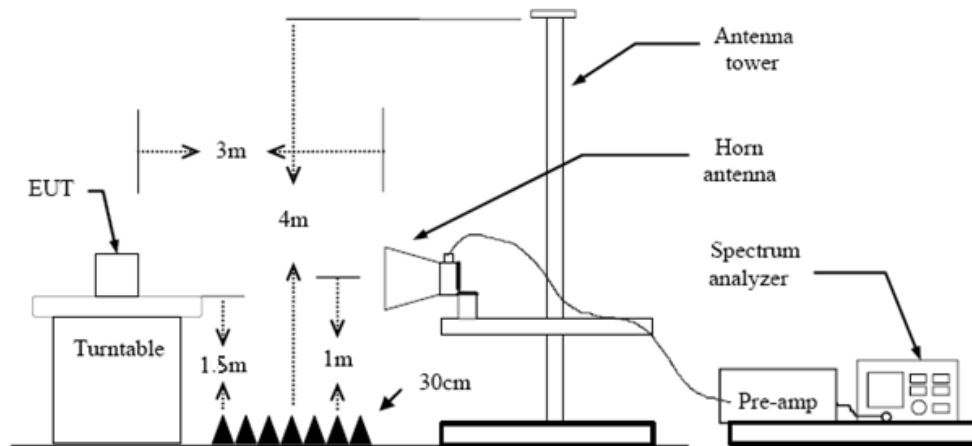
#### Test Configuration



Below 30MHz Test Setup



Below Above 1GHz Test Setup



Above 1GHz Test Setup

**Test Procedure**

1. The EUT was setup and tested according to ANSI C63.10:2013
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Below 1 GHz:  
RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;  
If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
  - (3) From 1 GHz to 10<sup>th</sup> harmonic:  
RBW=1MHz, VBW=3MHz Peak detector for Peak value.  
RBW=1MHz, VBW=3MHz RMS detector for Average value.

**Test Mode**

Please refer to the clause 2.2.

**Test Result****9 KHz~30 MHz**

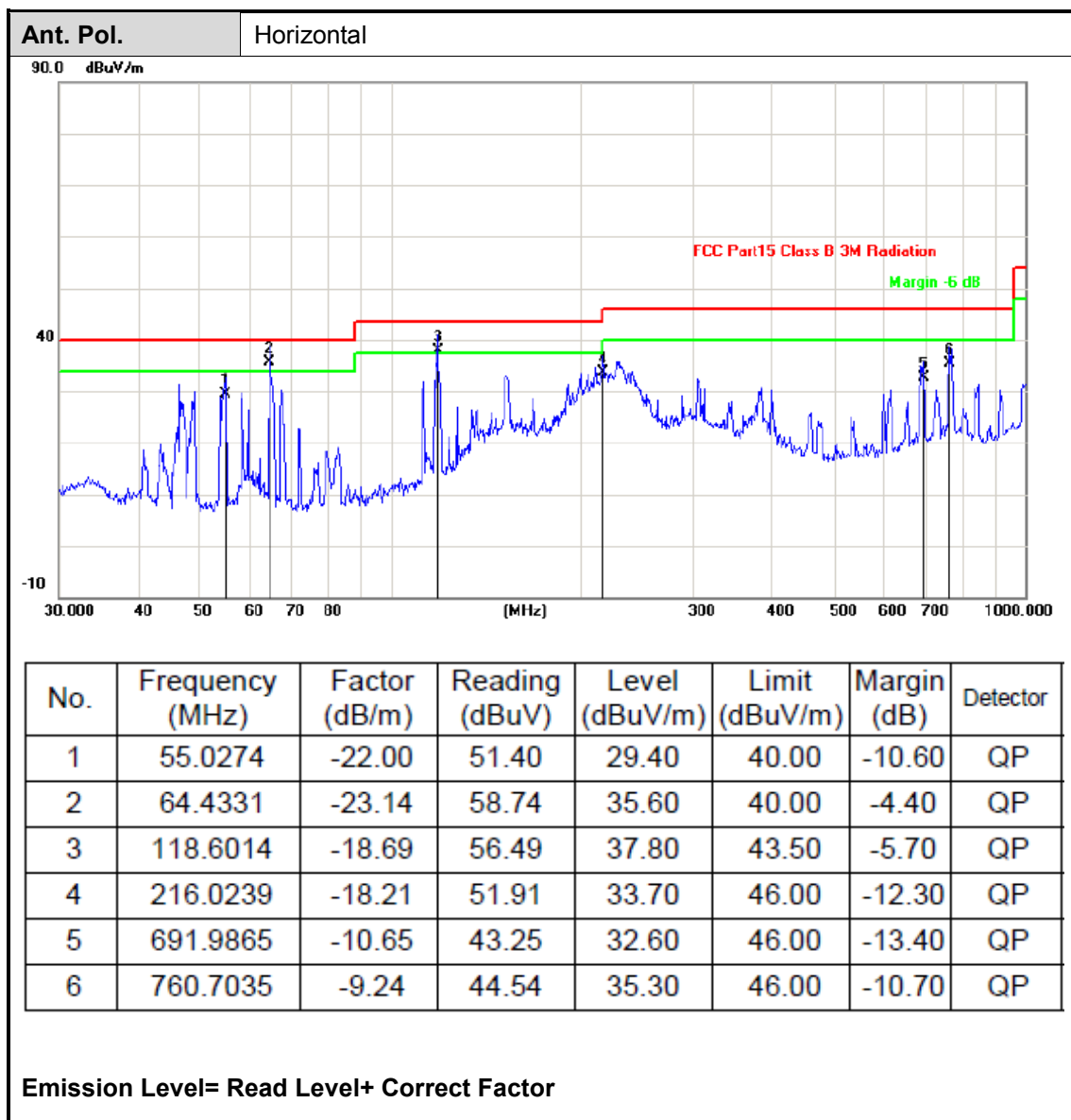
From 9 KHz to 30 MHz: Conclusion: PASS

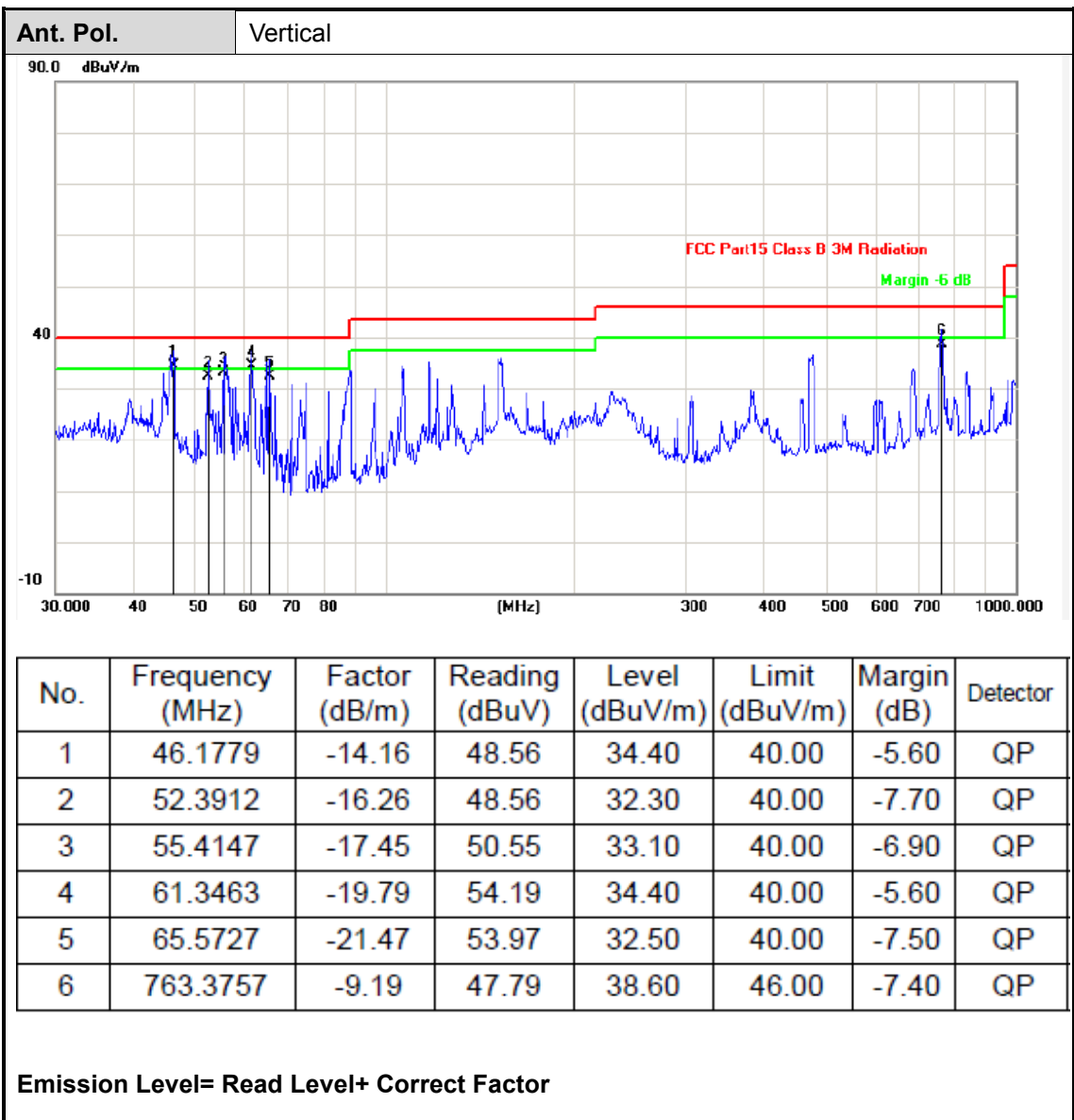
Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.



30MHz-1GHz

Only show worse case:GFSK





**Adobe 1GHz****Only show worse case:GFSK****No report for the emission which more than 10 dB below the prescribed limit.**

| Test Mode: GFSK - 2402MHz |                |                       |                |                |             |                    |        |
|---------------------------|----------------|-----------------------|----------------|----------------|-------------|--------------------|--------|
| Frequency (MHz)           | Reading (dBuV) | Antenna Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Pole (V/H) | Remark |
| 4804                      | 46.12          | 3.09                  | 49.21          | 74             | -24.79      | V                  | peak   |
| 7206                      | 43.69          | 5.21                  | 48.9           | 74             | -25.1       | V                  | peak   |
| 4804                      | 45.34          | 3.09                  | 48.43          | 74             | -25.57      | H                  | peak   |
| 7206                      | 44.28          | 5.21                  | 49.49          | 74             | -24.51      | H                  | peak   |

Remark:

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

| Test Mode: GFSK - 2441MHz |                |                       |                |                |             |                    |        |
|---------------------------|----------------|-----------------------|----------------|----------------|-------------|--------------------|--------|
| Frequency (MHz)           | Reading (dBuV) | Antenna Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Pole (V/H) | Remark |
| 4882                      | 43.66          | 3.37                  | 47.03          | 74             | -26.97      | V                  | peak   |
| 7323                      | 44.89          | 5.56                  | 50.45          | 74             | -23.55      | V                  | peak   |
| 4882                      | 45.68          | 3.37                  | 49.05          | 74             | -24.95      | H                  | peak   |
| 4882                      | 46.31          | 3.37                  | 49.68          | 74             | -24.32      | V                  | peak   |

Remark:

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

| Test Mode: GFSK - 2480MHz |                |                       |                |                |             |                    |        |
|---------------------------|----------------|-----------------------|----------------|----------------|-------------|--------------------|--------|
| Frequency (MHz)           | Reading (dBuV) | Antenna Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Pole (V/H) | Remark |
| 4960                      | 44.97          | 3.44                  | 48.41          | 74             | -25.59      | V                  | peak   |
| 7440                      | 46.23          | 5.64                  | 51.87          | 74             | -22.13      | V                  | peak   |
| 4960                      | 46.51          | 3.44                  | 49.95          | 74             | -24.05      | H                  | peak   |
| 7440                      | 44.28          | 5.64                  | 49.92          | 74             | -24.08      | H                  | peak   |

Remark:

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

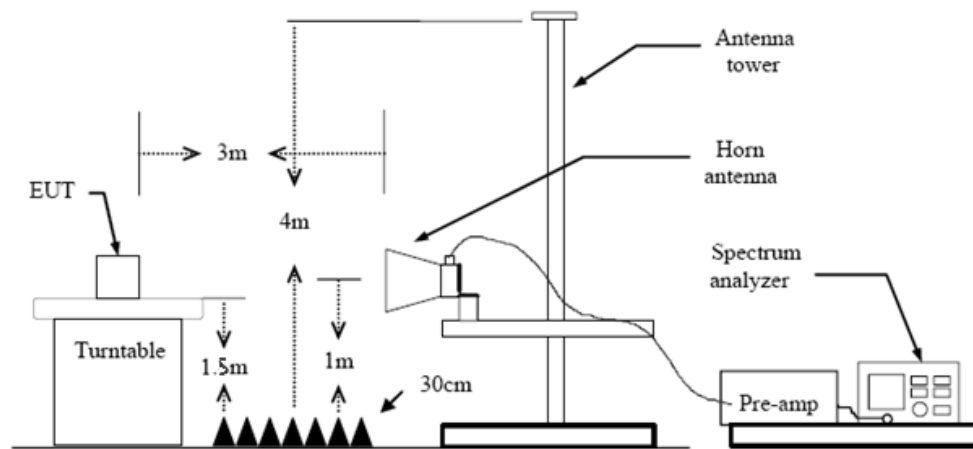
2.Margin value = Level -Limit value

### 3.3. Band Edge Emissions

#### Limit

| Restricted Frequency Band (MHz)                                                       | (dBuV/m)(at 3m) |         |
|---------------------------------------------------------------------------------------|-----------------|---------|
|                                                                                       | Peak            | Average |
| 2310 ~2390                                                                            | 74              | 54      |
| 2483.5 ~2500                                                                          | 74              | 54      |
| <b>Note: All restriction bands have been tested, only the worst case is reported.</b> |                 |         |

#### Test Configuration



#### Test Procedure

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:  
RBW=1MHz, VBW=3MHz PEAK detector for Peak value.  
RBW=1MHz, VBW=10Hz with PEAK Detector for Average Value.

#### Test Mode

Please refer to the clause 2.2.

#### Test Results



## (1) Radiation Test

Only show worse case:GFSK

| EDR             |                   |               |                | 2402MHz             |             |              |            |
|-----------------|-------------------|---------------|----------------|---------------------|-------------|--------------|------------|
| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Margin (dB) | Polarization | Test value |
| 2390            | 53.78             | 3.28          | 57.06          | 74                  | -16.94      | Vertical     | Peak       |
| 2400            | 51.28             | 3.85          | 55.13          | 74                  | -18.87      | Vertical     | Peak       |
| 2390            | 54.99             | 3.02          | 58.01          | 74                  | -15.99      | Horizontal   | Peak       |
| 2400            | 50.41             | 3.67          | 54.08          | 74                  | -19.92      | Horizontal   | Peak       |
| 2390            | 43.2              | 3.28          | 46.48          | 54                  | -7.52       | Vertical     | Average    |
| 2400            | 44.6              | 3.85          | 48.45          | 54                  | -5.55       | Vertical     | Average    |
| 2390            | 42.1              | 3.02          | 45.12          | 54                  | -8.88       | Horizontal   | Average    |
| 2400            | 43.82             | 3.67          | 47.49          | 54                  | -6.51       | Horizontal   | Average    |

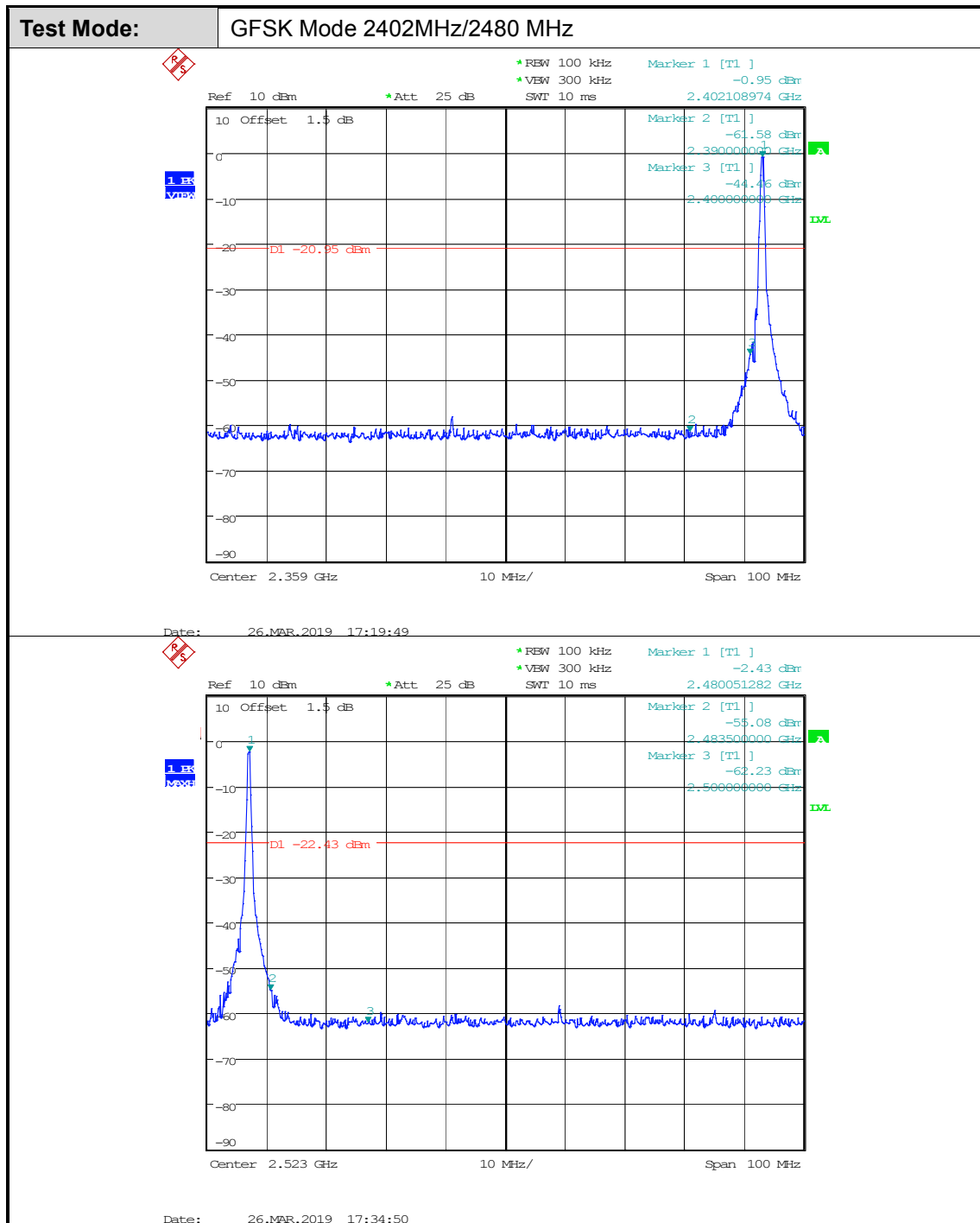
| EDR             |                   |               |                | 2480MHz             |             |              |            |
|-----------------|-------------------|---------------|----------------|---------------------|-------------|--------------|------------|
| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Margin (dB) | Polarization | Test value |
| 2483.5          | 52.82             | 3.79          | 56.61          | 74                  | -17.39      | Vertical     | Peak       |
| 2500            | 51.39             | 4.09          | 55.48          | 74                  | -18.52      | Vertical     | Peak       |
| 2483.5          | 51.77             | 3.65          | 55.42          | 74                  | -18.58      | Horizontal   | Peak       |
| 2500            | 52.29             | 3.95          | 56.24          | 74                  | -17.76      | Horizontal   | Peak       |
| 2483.5          | 40.32             | 3.79          | 44.11          | 54                  | -9.89       | Vertical     | Average    |
| 2500            | 39.71             | 4.09          | 43.8           | 54                  | -10.2       | Vertical     | Average    |
| 2483.5          | 39.79             | 3.65          | 43.44          | 54                  | -10.56      | Horizontal   | Average    |
| 2500            | 40.38             | 3.95          | 44.33          | 54                  | -9.67       | Horizontal   | Average    |

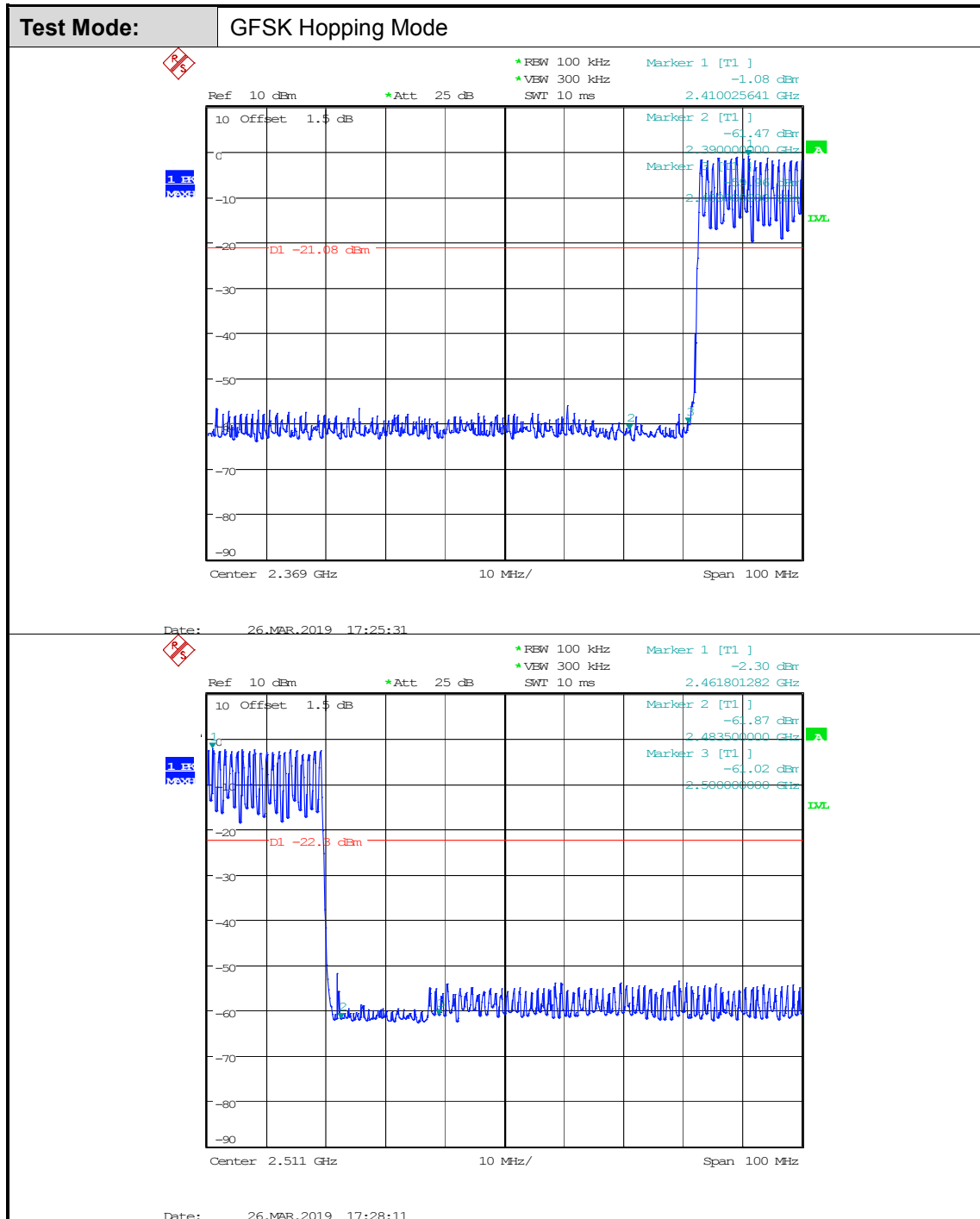
Remark:

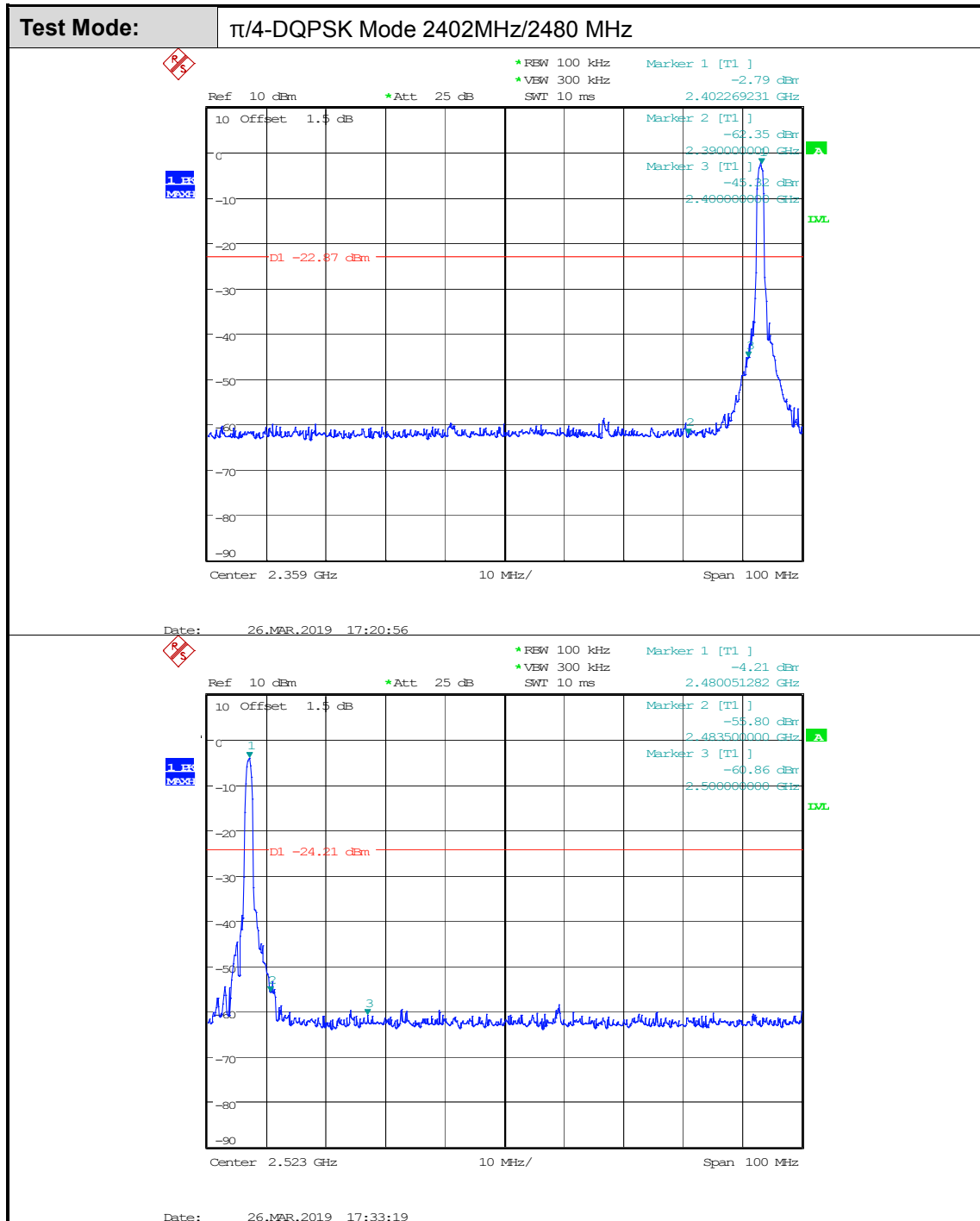
- 1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2.Margin value = Level -Limit value

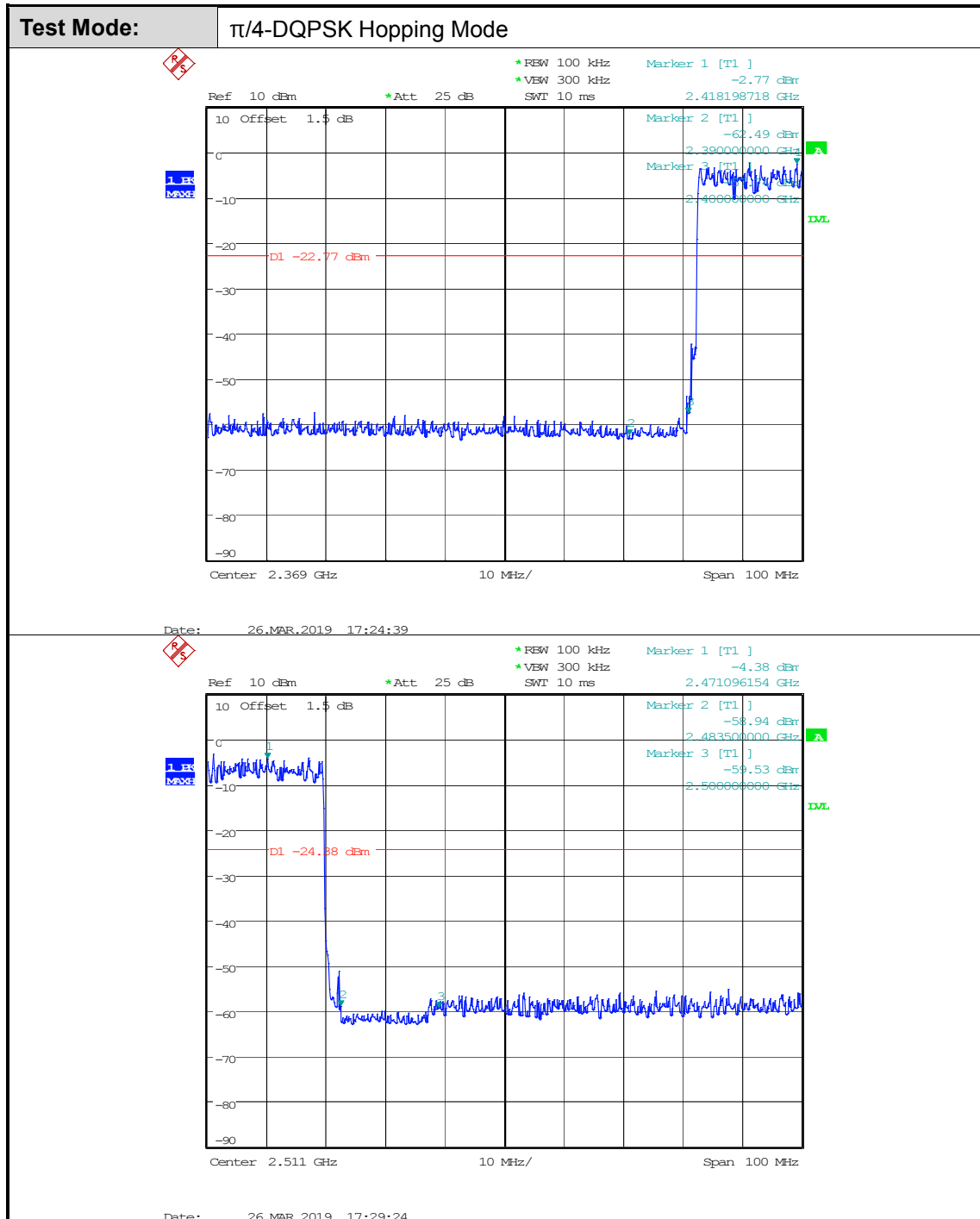


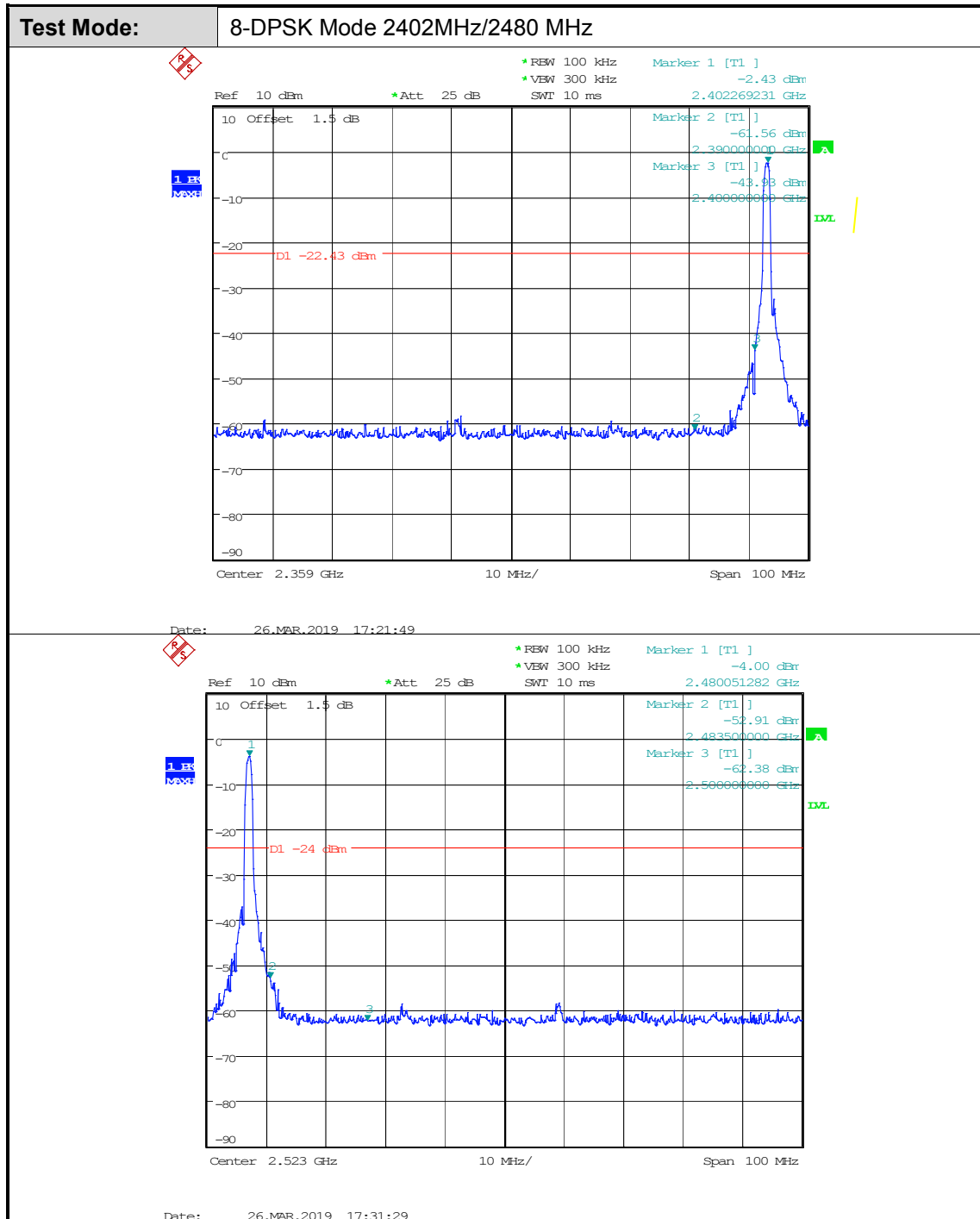
## (2) Conducted Test

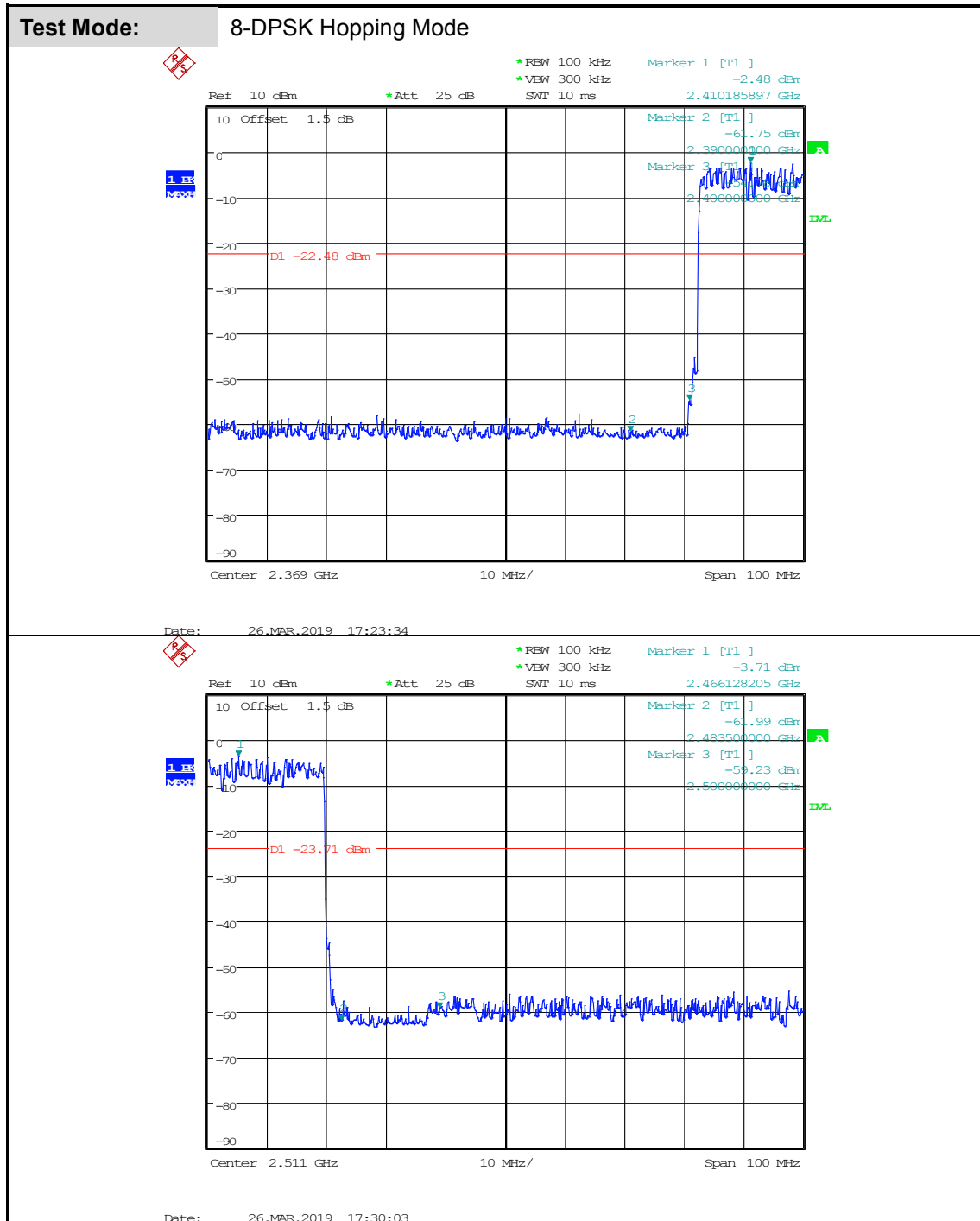












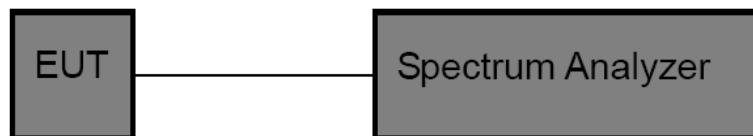


### 3.4. Channel Separation and Bandwidth

#### Limit

| Test Item          | Limit                                                                      | Frequency Range(MHz) |
|--------------------|----------------------------------------------------------------------------|----------------------|
| Bandwidth          | $\leq 1$ MHz<br>(20dB bandwidth)                                           | 2400~2483.5          |
| Channel Separation | $> 25$ KHz or $>$ two-thirds of the<br>20 dB bandwidth<br>Which is greater | 2400~2483.5          |

#### Test Configuration



#### Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
  - (1) Set RBW = 100 kHz.
  - (2) Set the video bandwidth (VBW)  $\geq 3$  RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.

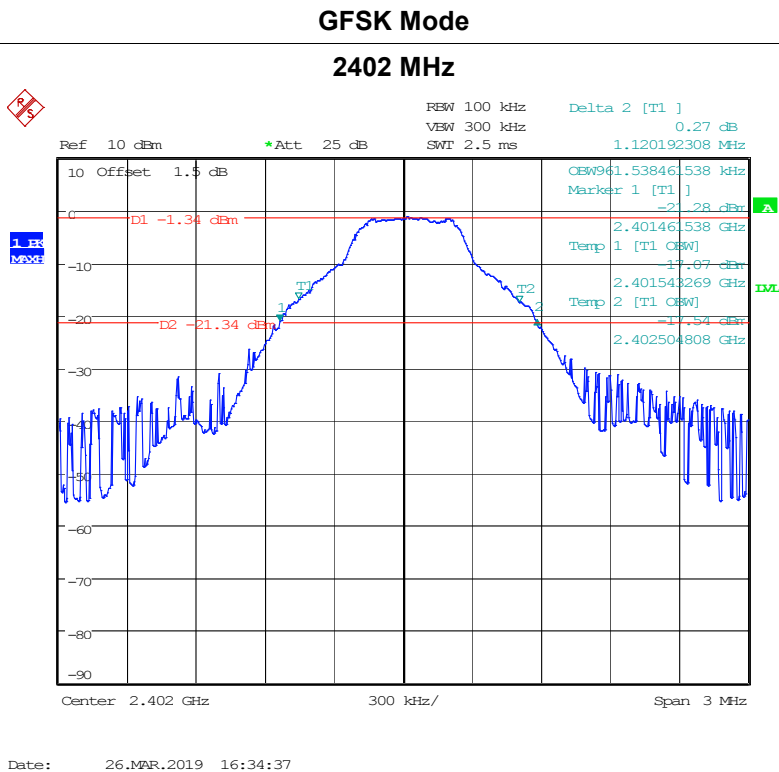
NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

#### Test Mode

Please refer to the clause 2.2.

#### Test Results

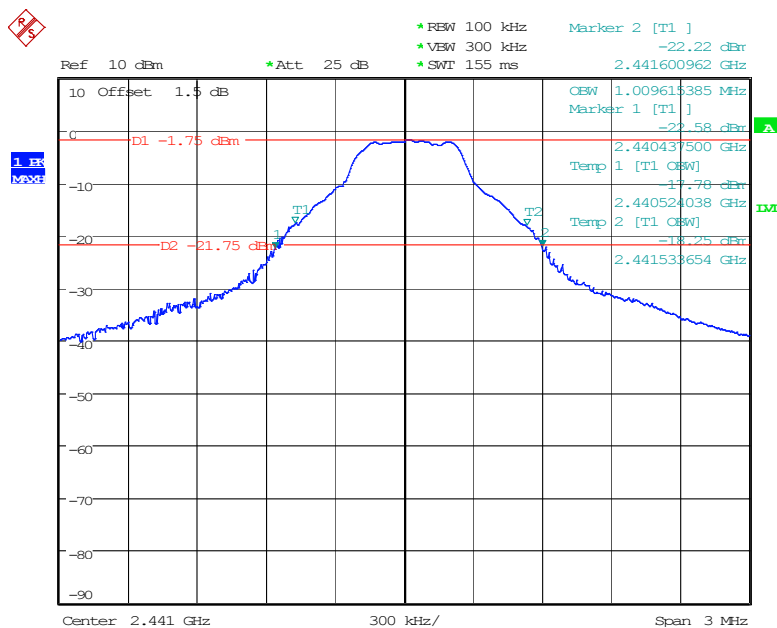
|                                |                      |                             |                                  |  |
|--------------------------------|----------------------|-----------------------------|----------------------------------|--|
| <b>Test Mode:</b>              | GFSK Mode            |                             |                                  |  |
| <b>Channel frequency (MHz)</b> | <b>99% OBW (kHz)</b> | <b>20dB Bandwidth (kHz)</b> | <b>20dB Bandwidth *2/3 (kHz)</b> |  |
| 2402                           | 961.538              | 1120.192                    | 746.795                          |  |
| 2441                           | 1009.615             | 1163.462                    | 775.641                          |  |
| 2480                           | 1014.423             | 1158.653                    | 772.435                          |  |





## GFSK Mode

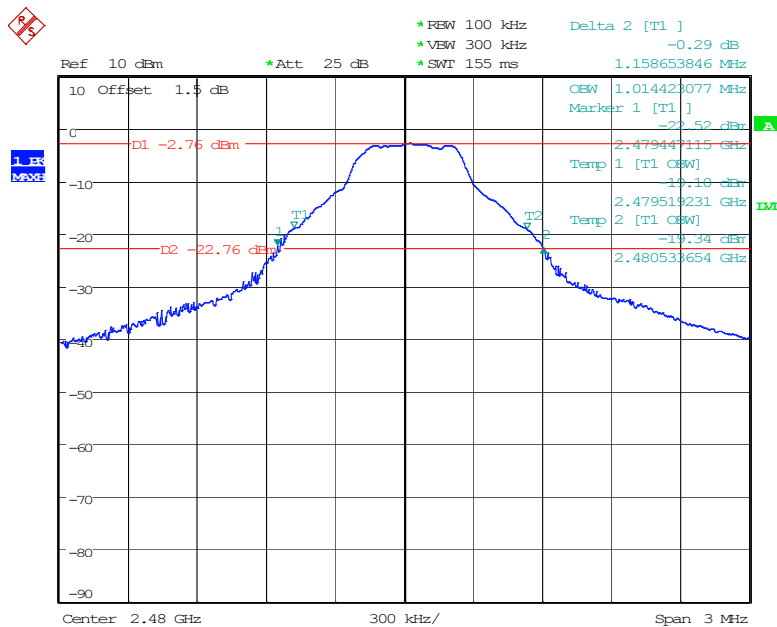
2441 MHz



Date: 26.MAR.2019 16:31:29

## GFSK Mode

2480 MHz



Date: 26.MAR.2019 16:29:40

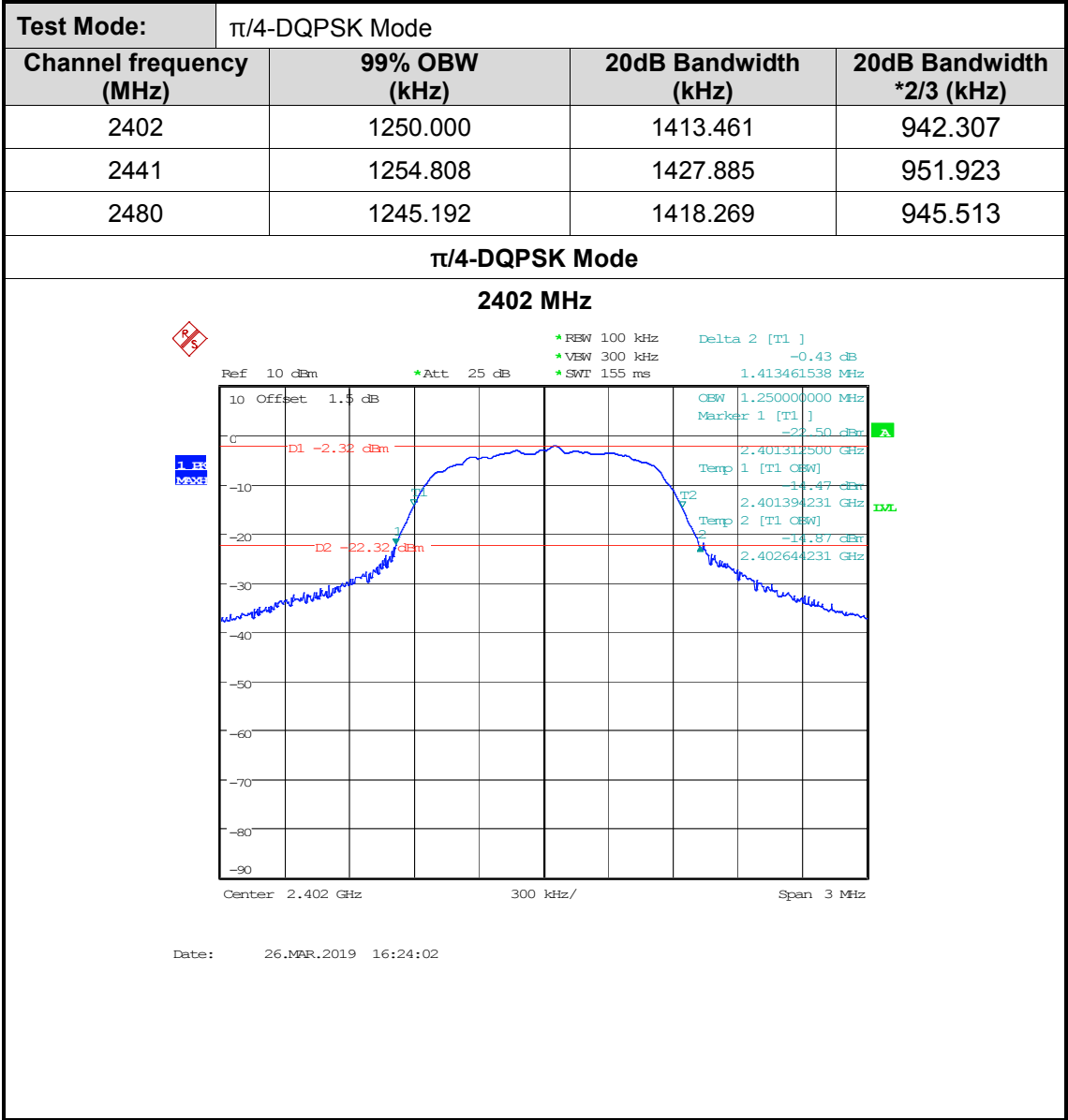
CTC Laboratories, Inc

1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China  
Tel.: (86)755-27521059 Fax: (86)755-27521011 Http://www.sz-ctc.org.cn



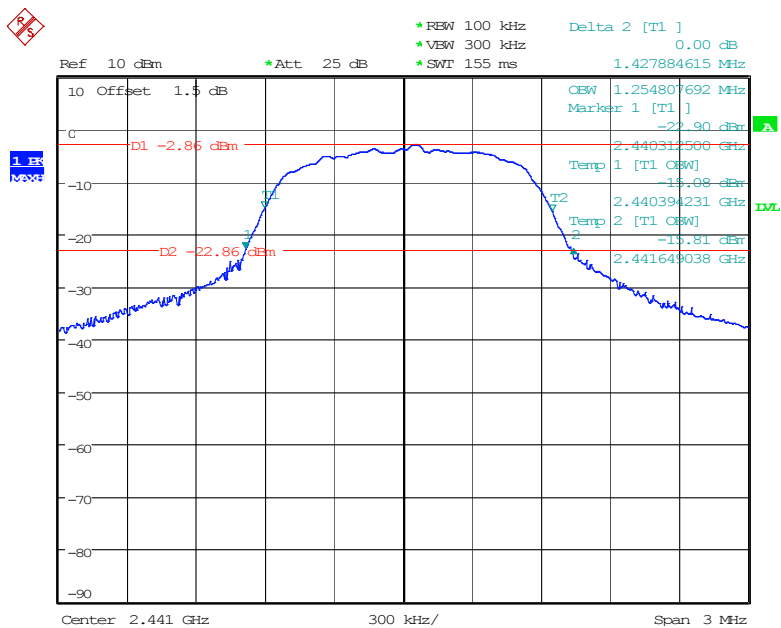
中国国家认证认可监督管理委员会  
Certification and Accreditation Administration of the People's Republic of China

For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China: [yz.cncaic.cn](http://yz.cncaic.cn)

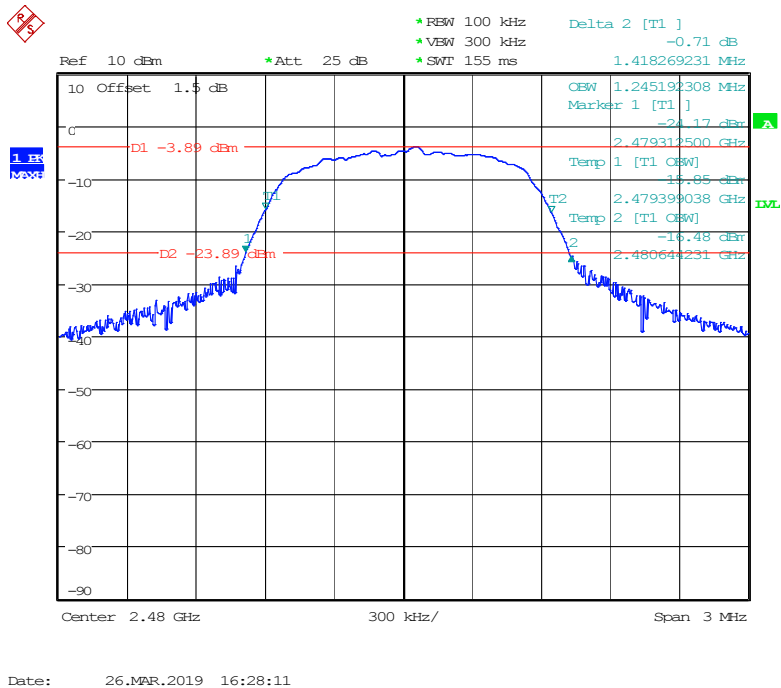


 $\pi/4$ -DQPSK Mode

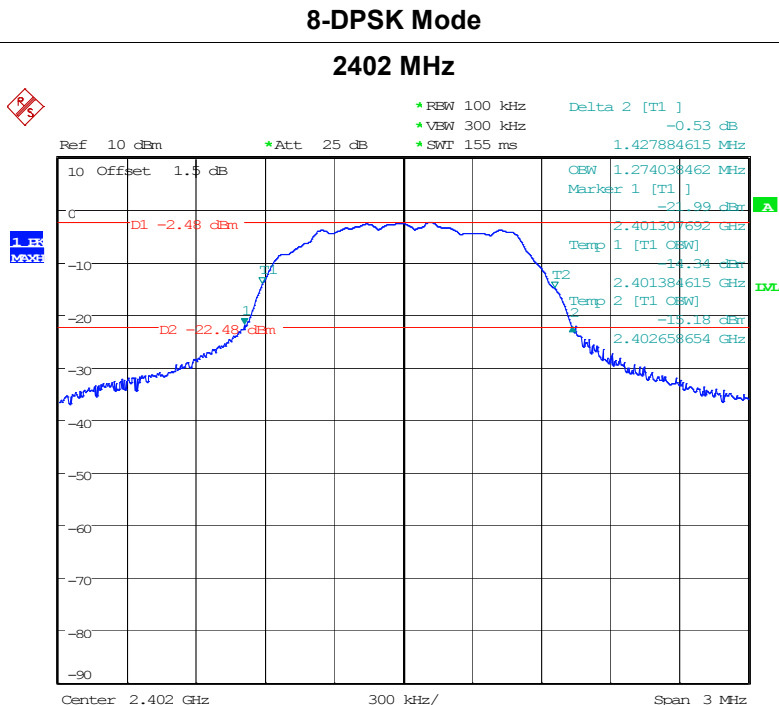
2441 MHz

 $\pi/4$ -DQPSK Mode

2480 MHz



|                                |                      |                             |                                  |
|--------------------------------|----------------------|-----------------------------|----------------------------------|
| <b>Test Mode:</b>              | 8-DPSK Mode          |                             |                                  |
| <b>Channel frequency (MHz)</b> | <b>99% OBW (kHz)</b> | <b>20dB Bandwidth (kHz)</b> | <b>20dB Bandwidth *2/3 (kHz)</b> |
| 2402                           | 1274.038             | 1427.885                    | 951.923                          |
| 2441                           | 1274.038             | 1447.115                    | 964.743                          |
| 2480                           | 1264.423             | 1411.538                    | 941.025                          |

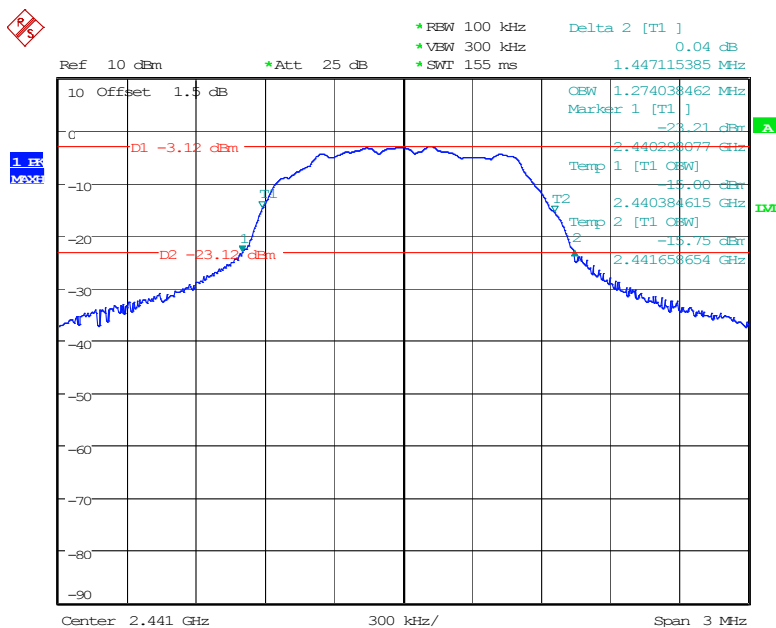


Date: 26.MAR.2019 16:22:23



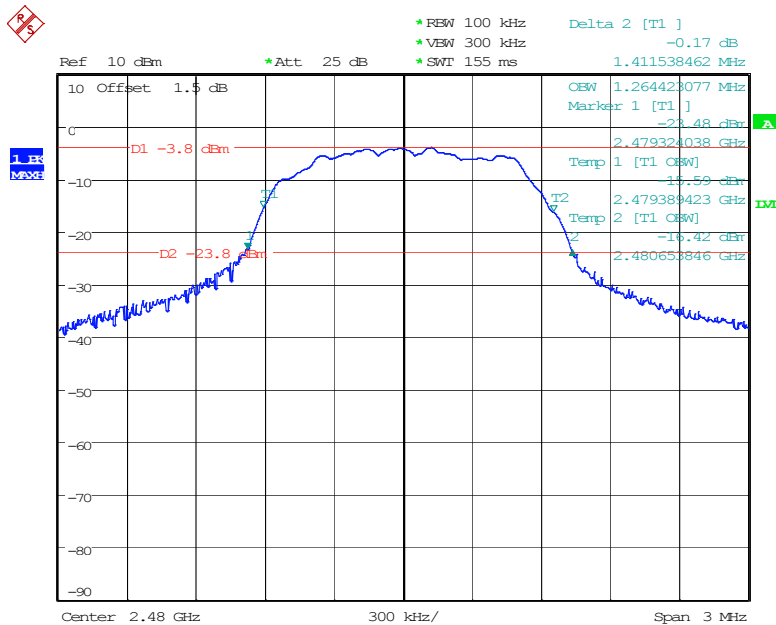
## 8-DPSK Mode

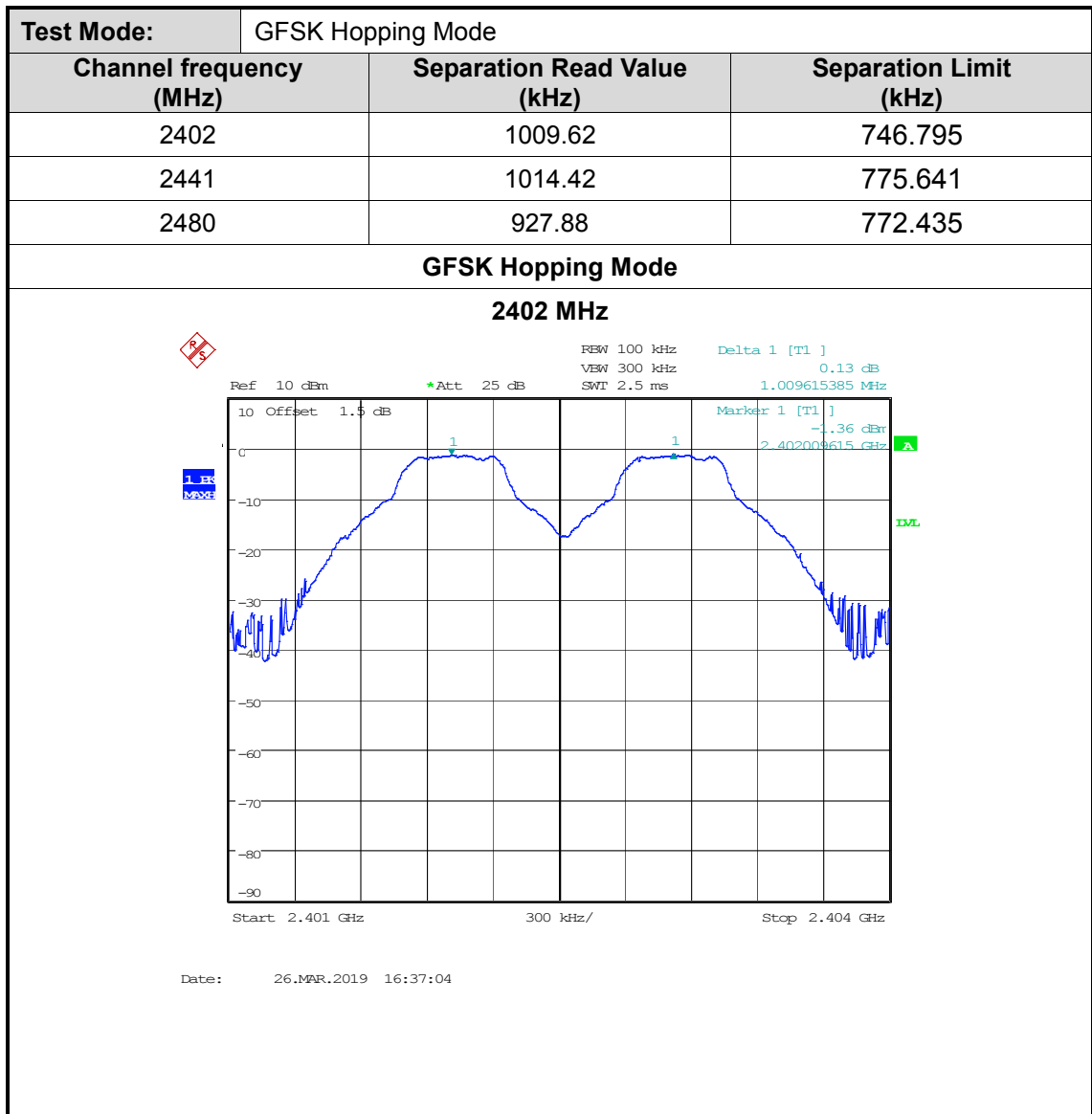
2441 MHz

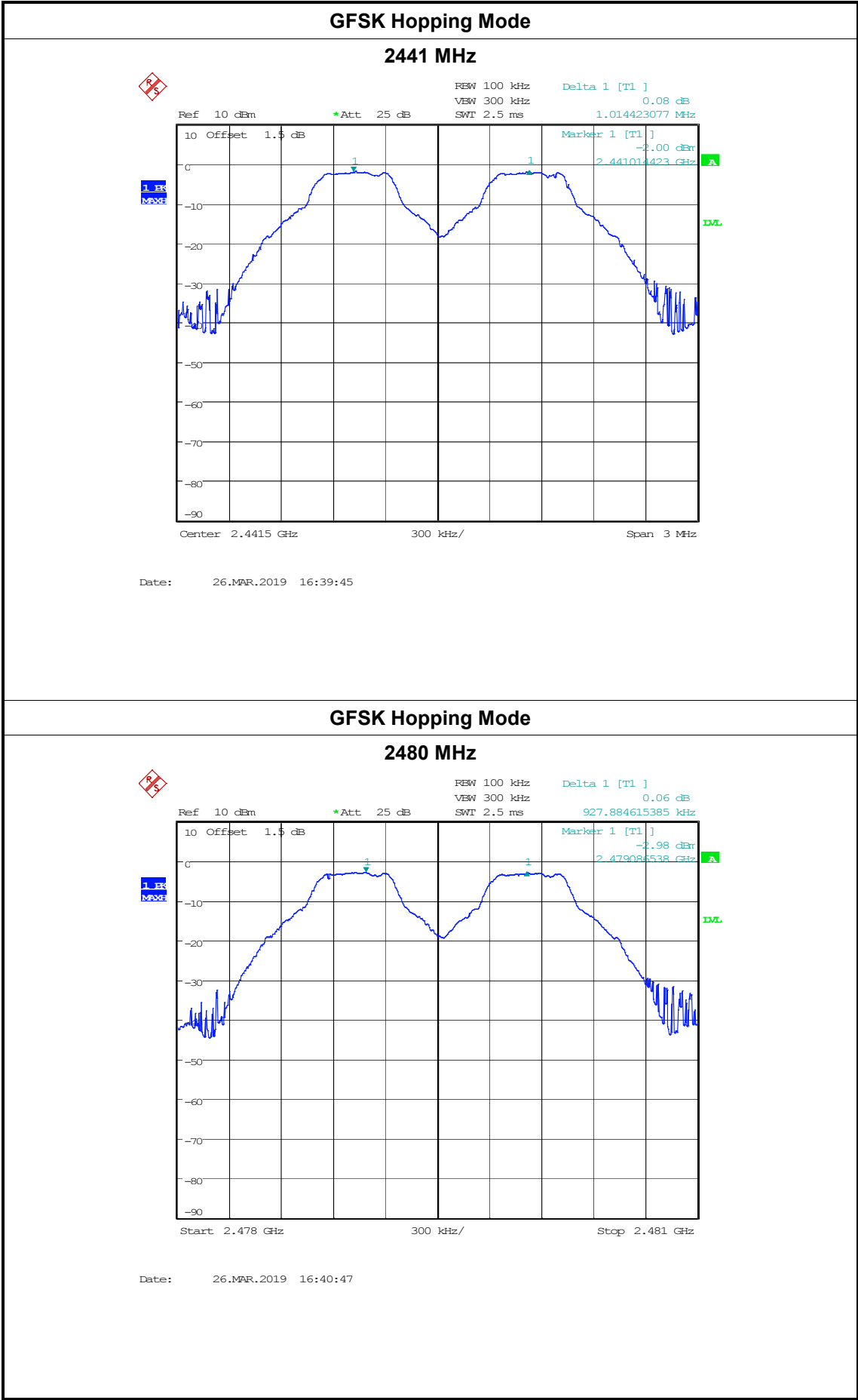


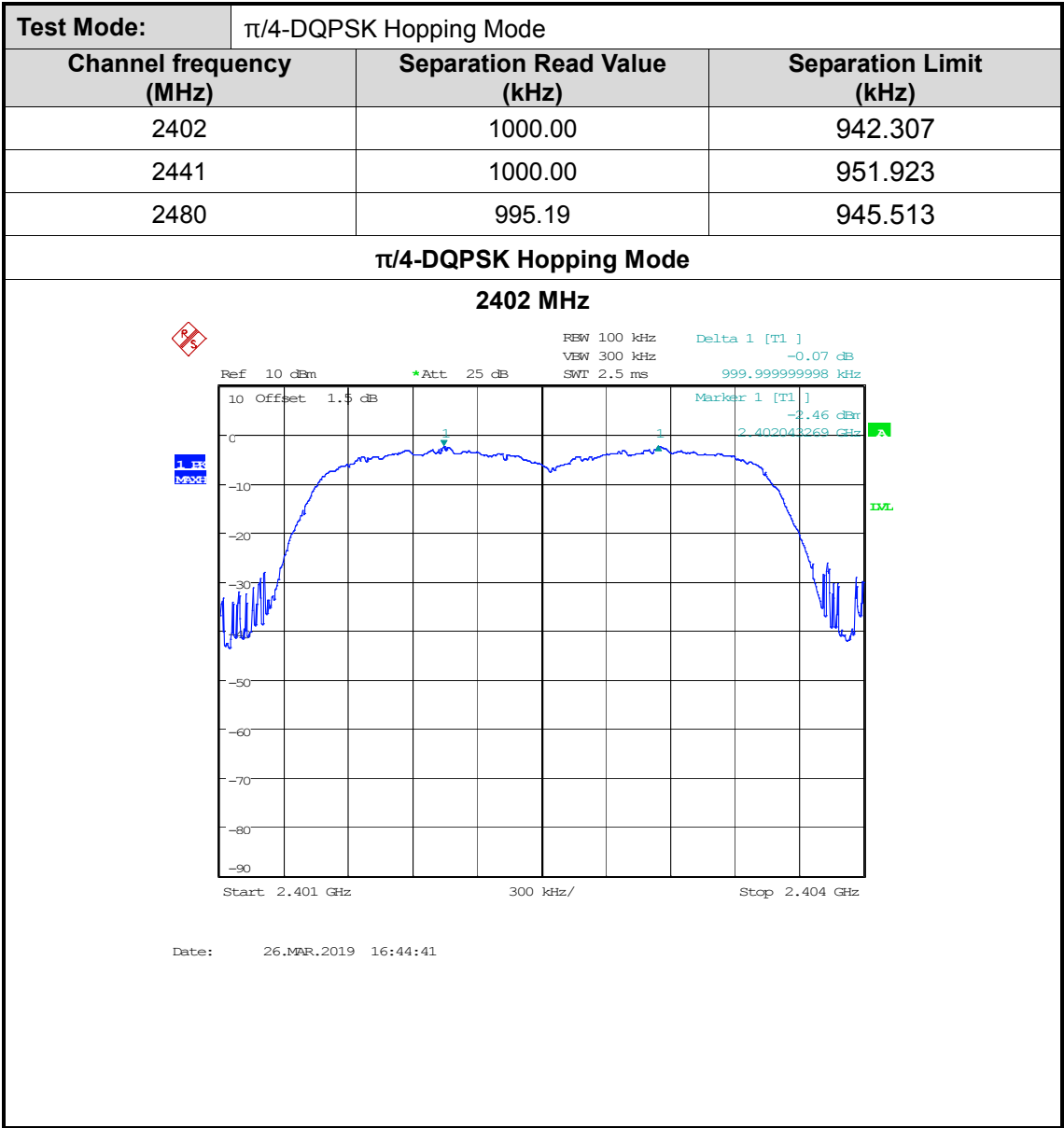
## 8-DPSK Mode

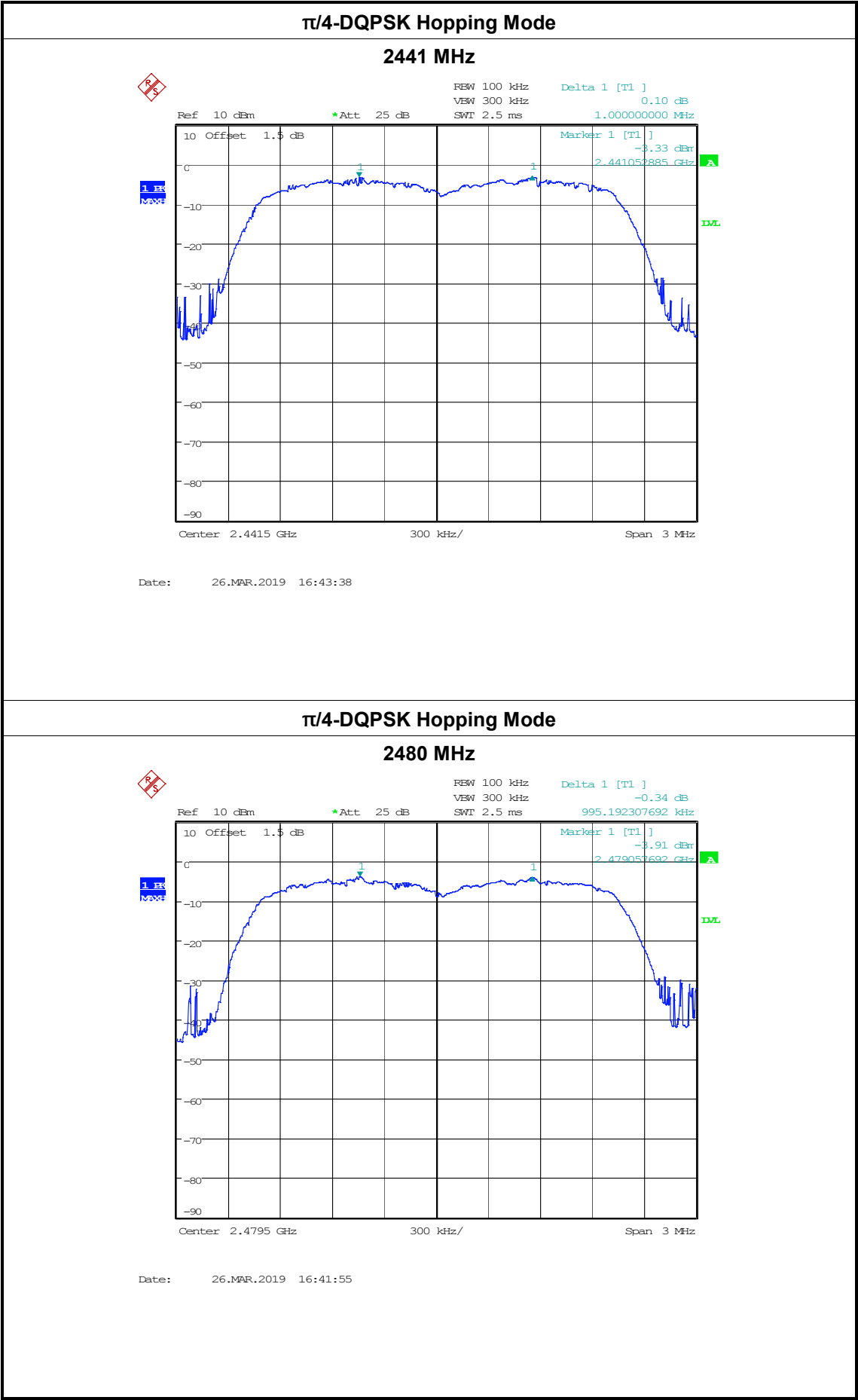
2480 MHz

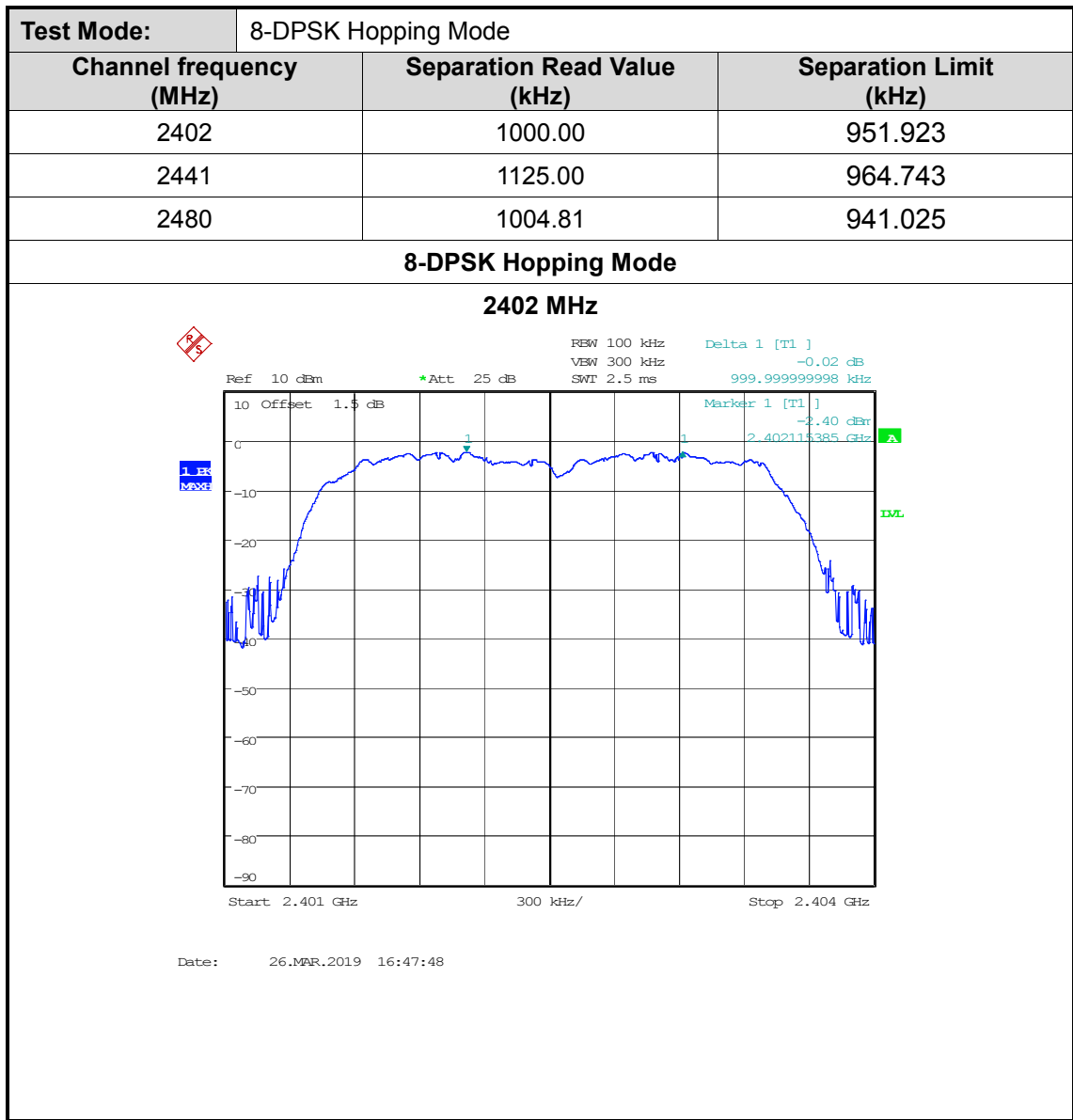








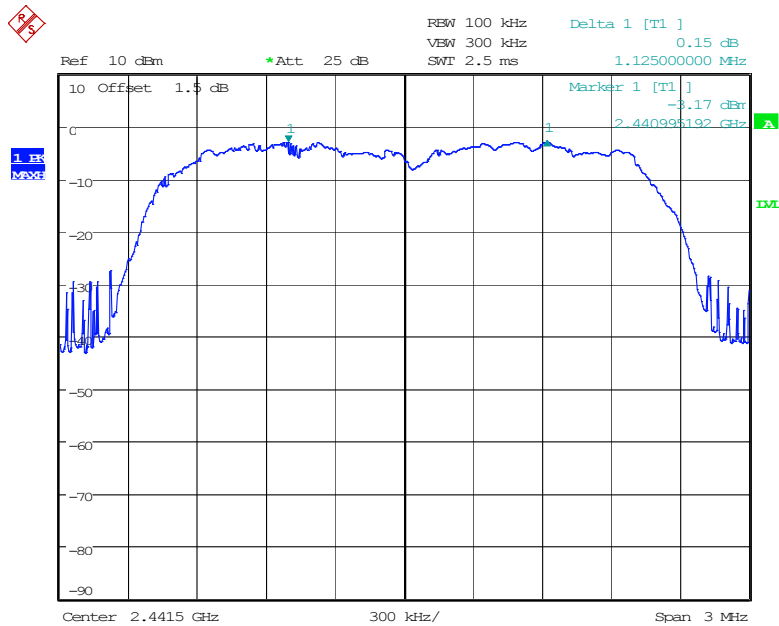






## 8-DPSK Hopping Mode

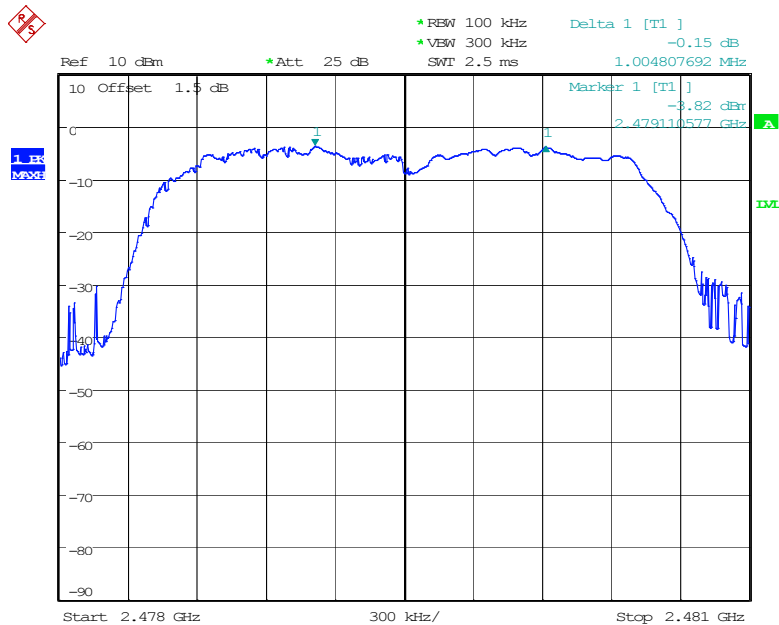
2441 MHz



Date: 26.MAR.2019 16:52:15

## 8-DPSK Hopping Mode

2480 MHz



Date: 26.MAR.2019 18:02:00

CTC Laboratories, Inc

1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China  
Tel.: (86)755-27521059 Fax: (86)755-27521011 Http://www.sz-ctc.org.cn



For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : [yz.cncaic.cn](http://yz.cncaic.cn)

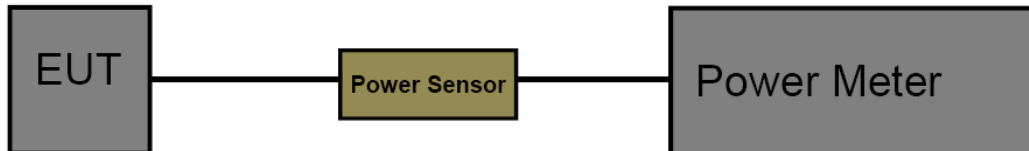


### 3.5. Number of Hopping Channel

#### Limit

| Section | Test Item                 | Limit |
|---------|---------------------------|-------|
| 15.247  | Number of Hopping Channel | >15   |

#### Test Configuration



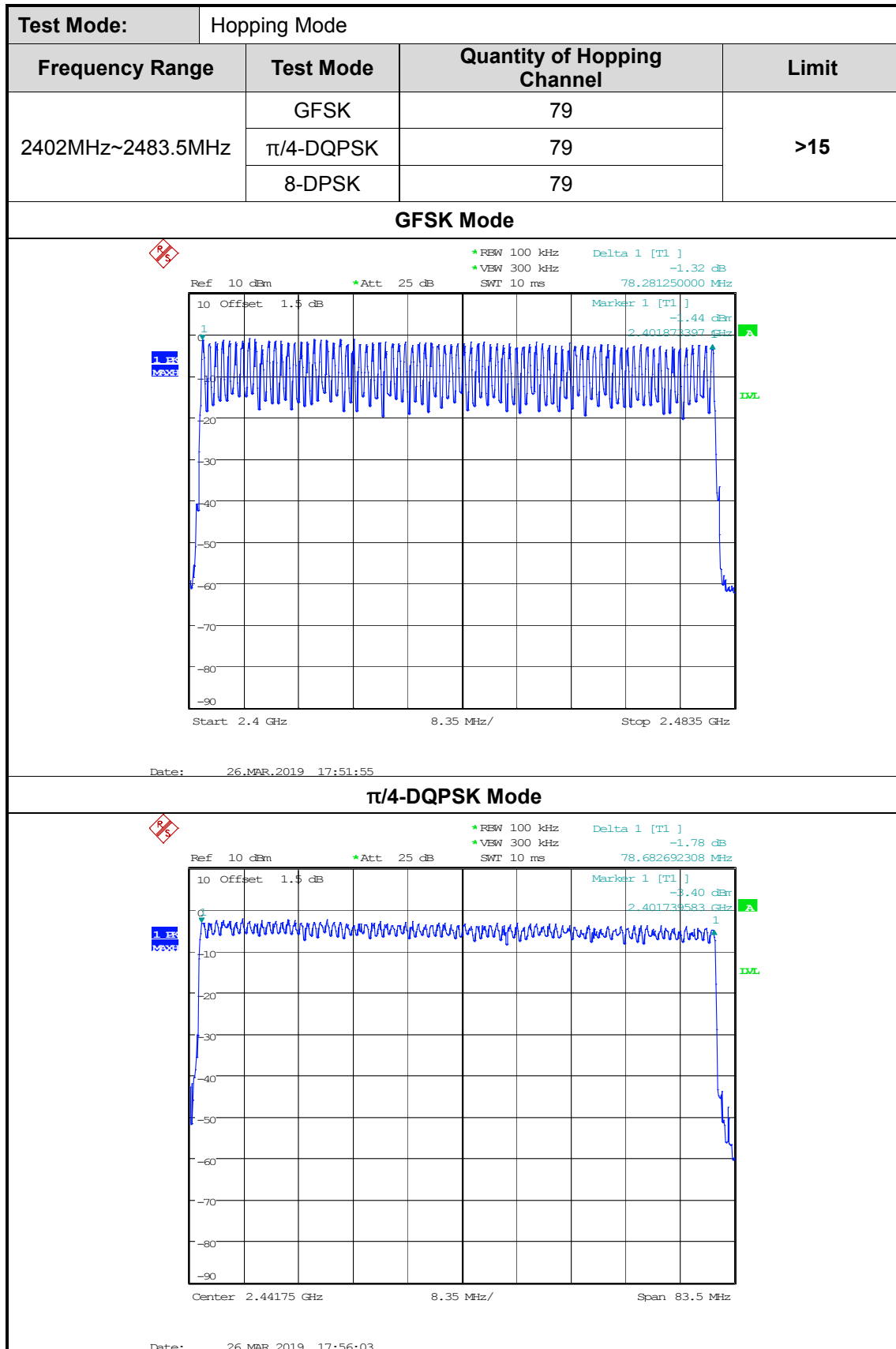
#### Test Procedure

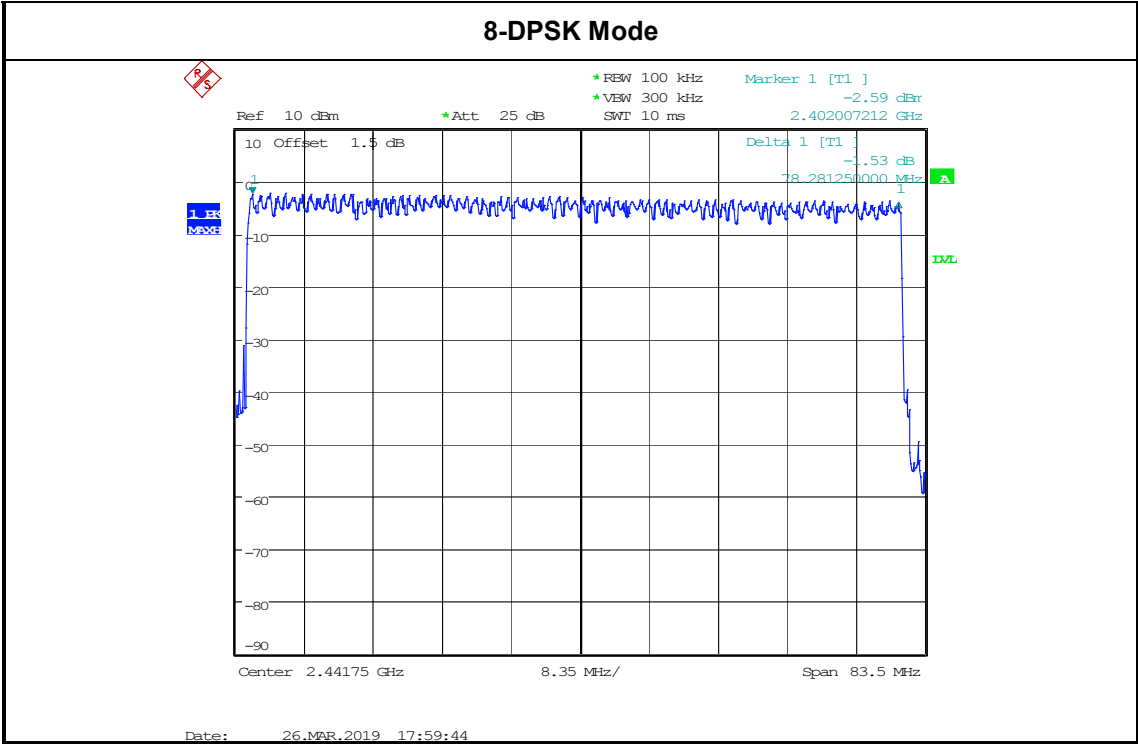
1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
  - (1) Peak Detector: RBW=100 kHz, VBW□RBW, Sweep time= Auto.

#### Test Mode

Please refer to the clause 2.2.

#### Test Result





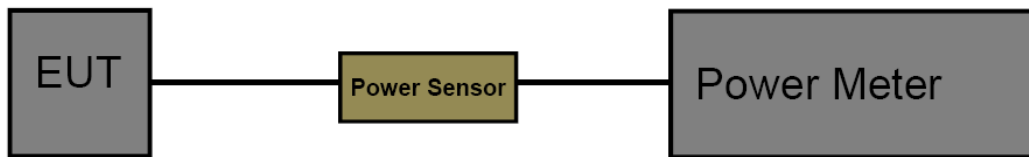


### 3.6. Dwell Time

#### Limit

| Section                              | Test Item                 | Limit   |
|--------------------------------------|---------------------------|---------|
| 15.247(a)(1)/ RSS-210 Annex 8(A8.1d) | Average Time of Occupancy | 0.4 sec |

#### Test Configuration



#### Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
  - (1) Spectrum Setting: RBW=1MHz, VBW□RBW.
  - (2) Use video trigger with the trigger level set to enable triggering only on full pulses.
  - (3) Sweep Time is more than once pulse time.
  - (4) Set the center frequency on any frequency would be measure and set the frequency span to zero.
  - (5) Measure the maximum time duration of one single pulse.
  - (6) Set the EUT for packet transmitting.

#### Test Mode

Please refer to the clause 2.2

#### Test Result

| Modulation | Packet | Dwell time (second) | Limit (second) | Result |
|------------|--------|---------------------|----------------|--------|
| GFSK       | DH5    | 0.322               | 0.40           | Pass   |
| π/4DQPSK   | 2DH5   | 0.318               | 0.40           | Pass   |
| 8DPSK      | 3DH5   | 0.318               | 0.40           | Pass   |

Note:

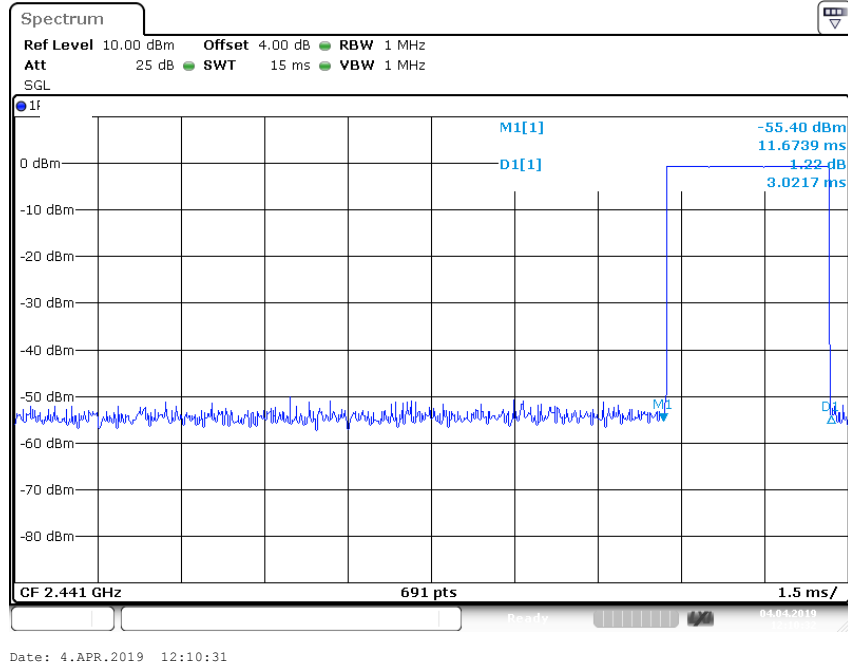
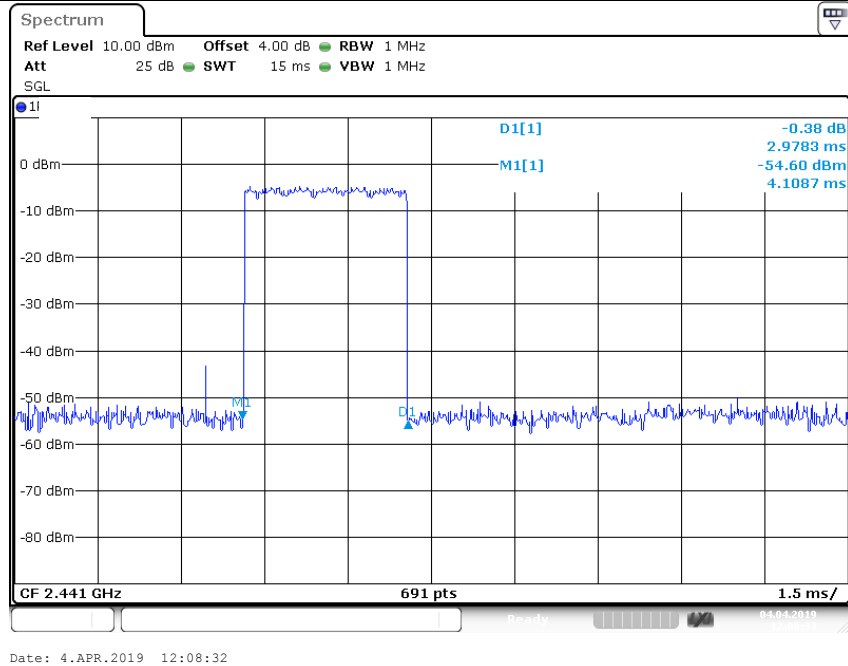
1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1  
Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3, 3-DH3  
Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5, 3-DH5

CTC Laboratories, Inc

1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China  
Tel.: (86)755-27521059 Fax: (86)755-27521011 Http://www.sz-ctc.org.cn



For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : [yz.cncaic.cn](http://yz.cncaic.cn)

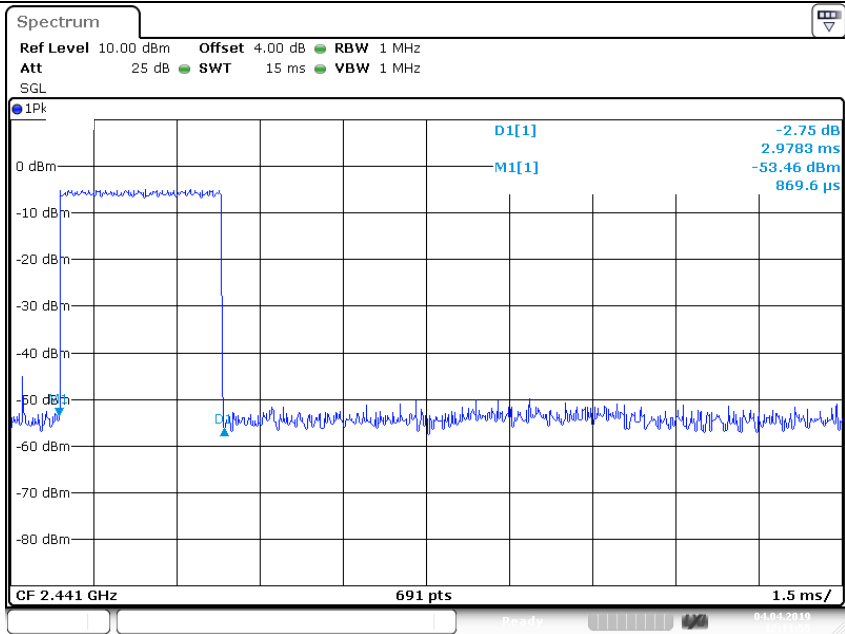
**Test plot as follows:****GFSK Modulation** **$\pi/4$ DQPSK Modulation****8DPSK Modulation**

CTC Laboratories, Inc

1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China  
Tel.: (86)755-27521059 Fax: (86)755-27521011 Http://www.sz-ctc.org.cn



For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : [yz.cncaic.cn](http://yz.cncaic.cn)



Date: 4.APR.2019 12:11:55

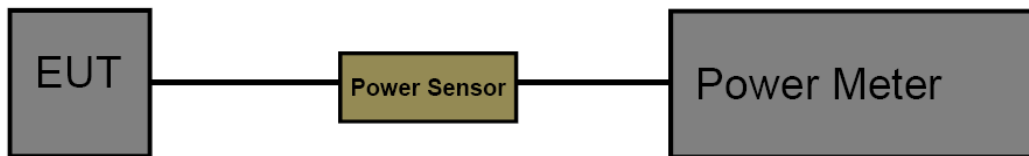


### 3.7. Peak Output Power

#### Limit

| Test Item         | Limit                                                         | Frequency Range(MHz) |
|-------------------|---------------------------------------------------------------|----------------------|
| Peak Output Power | Hopping Channels>75<br>Power<1W(30dBm)<br>Other <125mW(21dBm) | 2400~2483.5          |

#### Test Configuration



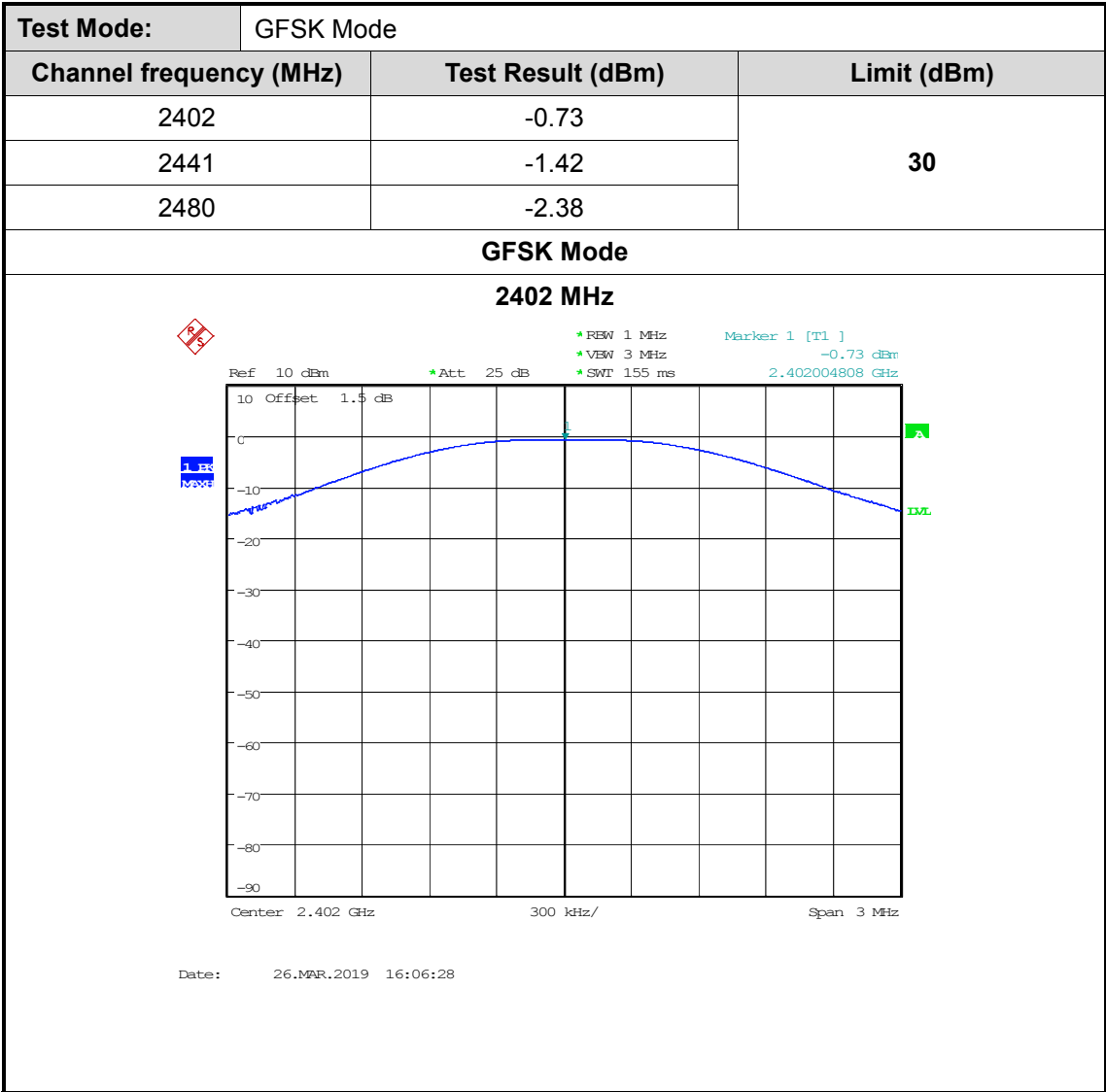
#### Test Procedure

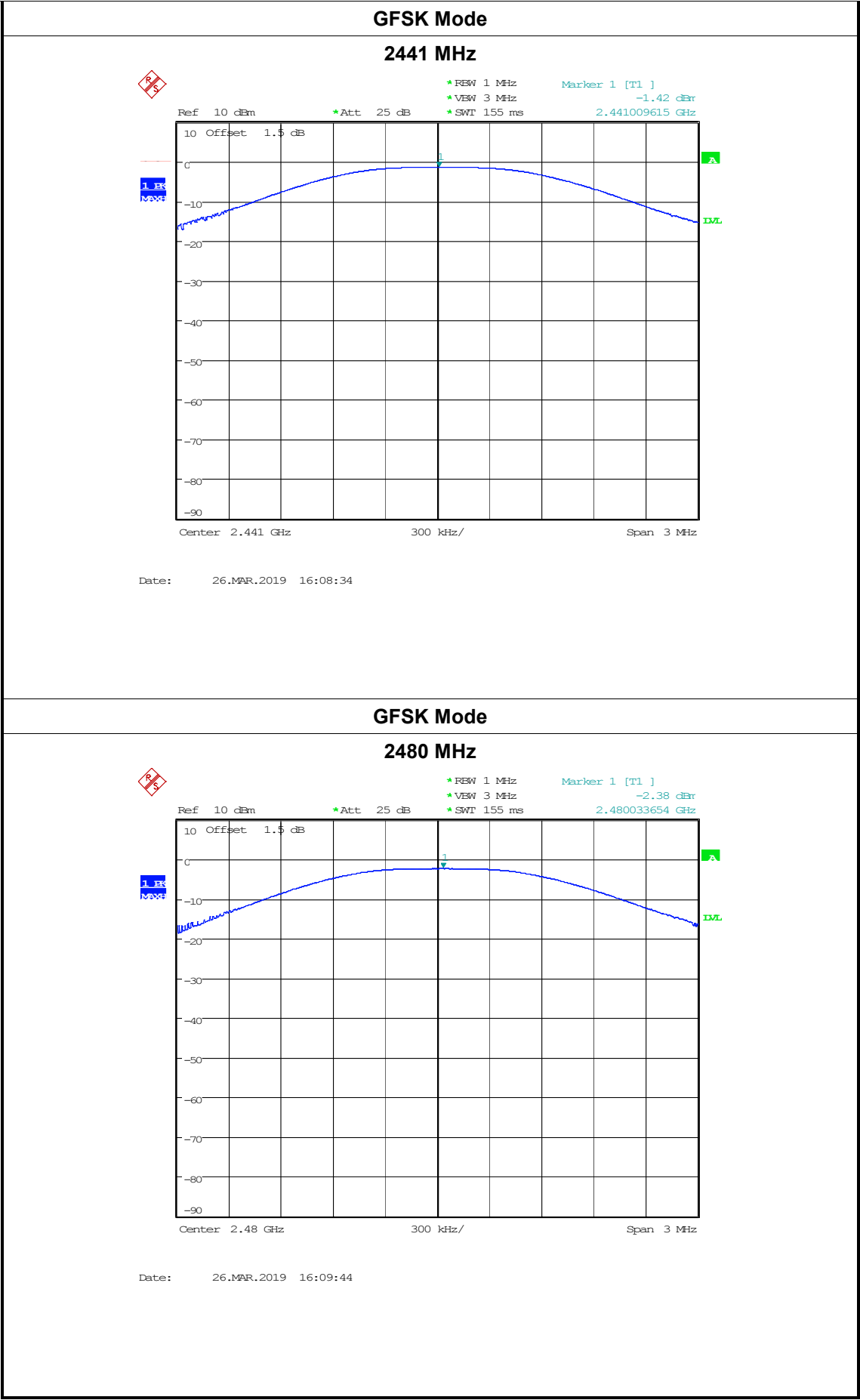
1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:  
Peak Detector: RBW=1 MHz, VBW=3 MHz for bandwidth less than 1MHz.  
RBW=3 MHz, VBW=3 MHz for bandwidth more than 1MHz.

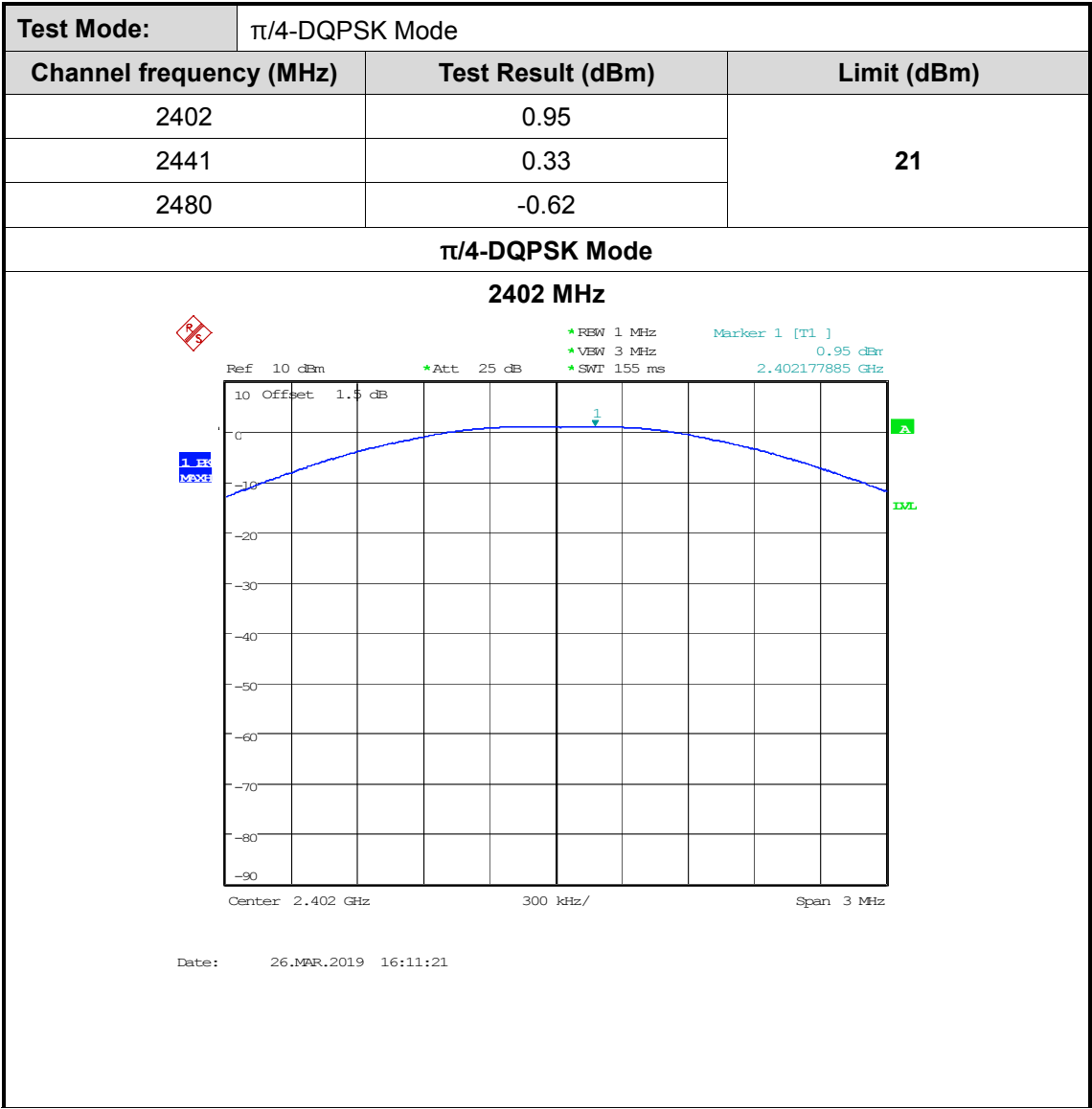
#### Test Mode

Please refer to the clause 2.2

#### Test Result

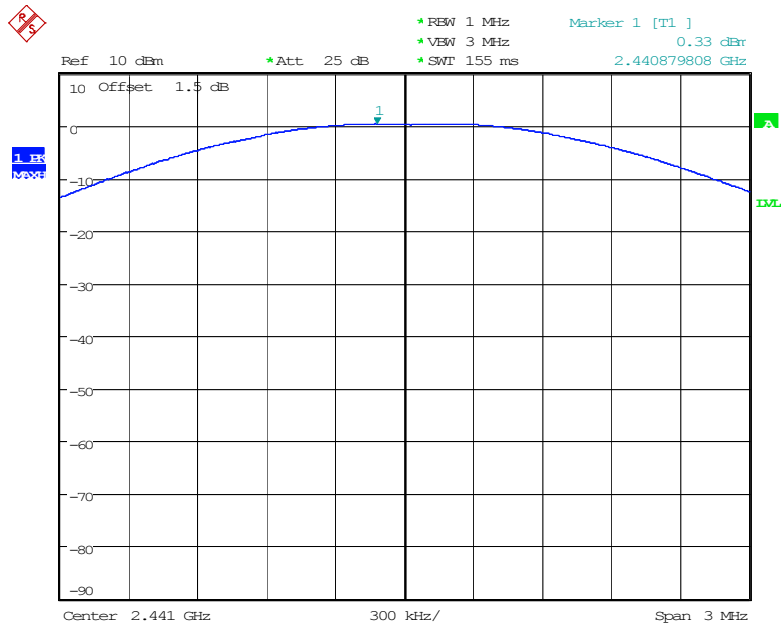






 $\pi/4$ -DQPSK Mode

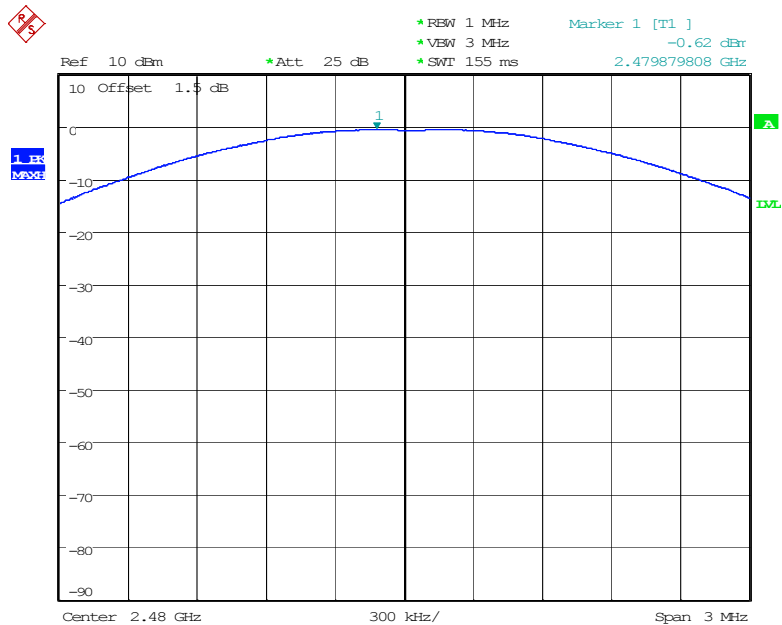
2441 MHz



Date: 26.MAR.2019 16:10:51

 $\pi/4$ -DQPSK Mode

2480 MHz



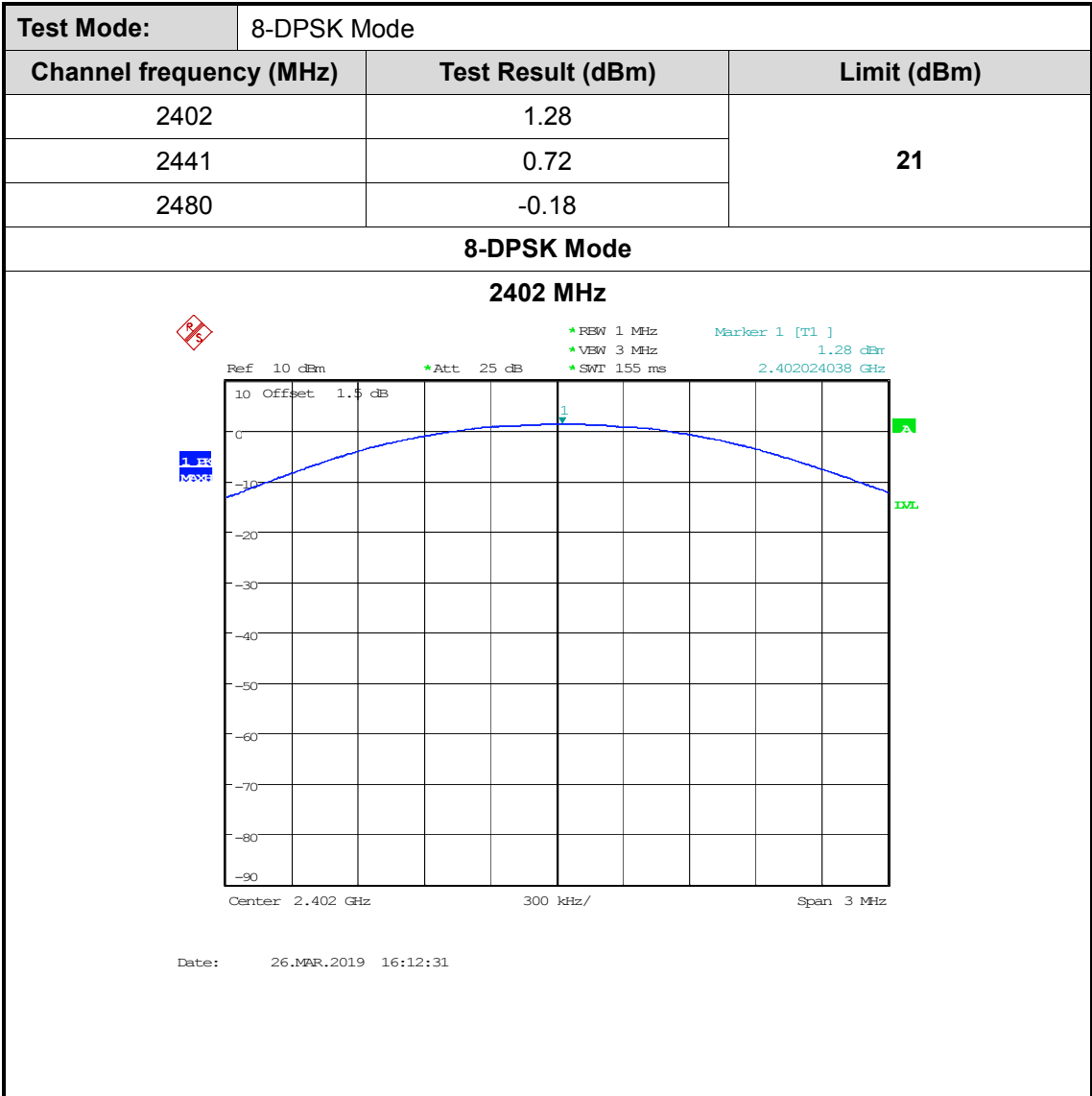
Date: 26.MAR.2019 16:10:21

CTC Laboratories, Inc

1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China  
Tel.: (86)755-27521059    Fax: (86)755-27521011    Http://www.sz-ctc.org.cn



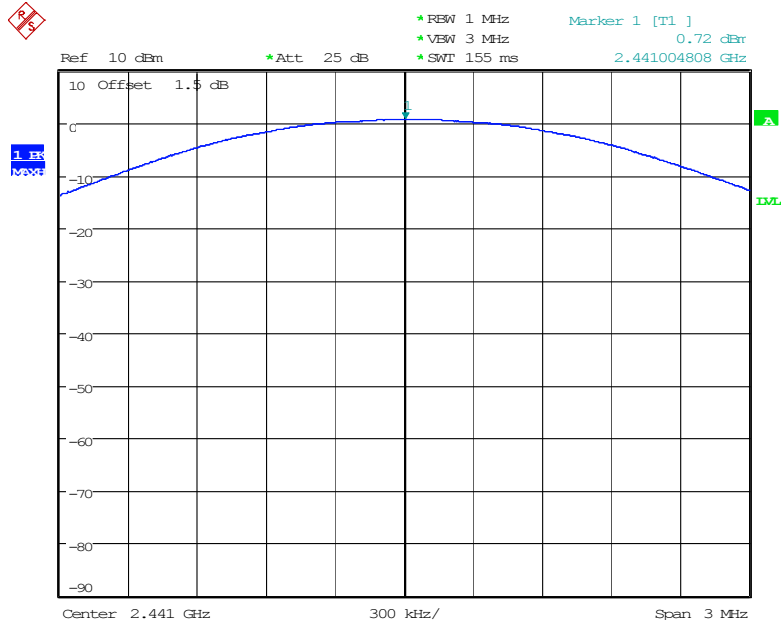
For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : [yz.cncaic.cn](http://yz.cncaic.cn)





## 8-DPSK Mode

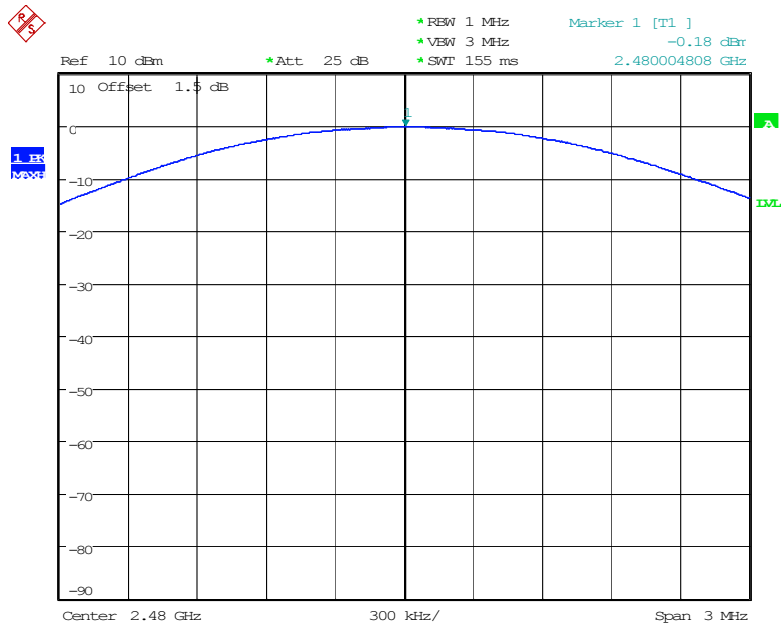
2441 MHz



Date: 26.MAR.2019 16:13:44

## 8-DPSK Mode

2480 MHz



Date: 26.MAR.2019 16:14:22



### 3.8. Antenna requirement

#### Requirement

##### **FCC CFR Title 47 Part 15 Subpart C Section 15.203:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

##### **FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):**

(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

#### Test Result

The EUT's antenna is soldered to the PCB. The gain of the antenna is 2.5dBi. Meet the standards.

Please reference to the annex: Internal Photographs



## 4.EUT TEST PHOTOS

Please reference to the annex: Test Photo



## 5. PHOTOGRAPHS OF EUT CONSTRUCTIONAL

Please reference to the annex: External Photographs and Internal Photographs

\*\*\*\*\*THE END\*\*\*\*\*