

# FCC RF Test Report

APPLICANT : Lenovo(Shanghai) Electronics Technology Co., Ltd.  
EQUIPMENT : Portable Tablet Computer  
BRAND NAME : Lenovo  
MODEL NAME : Lenovo TB-7305F  
FCC ID : O57TB7305F  
STANDARD : FCC Part 15 Subpart C §15.247  
CLASSIFICATION : (DSS) Spread Spectrum Transmitter

The product was received on Jun. 15, 2019 and testing was completed on Jul. 10, 2019. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

Jason Jia

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Reviewed by: Jason Jia / Supervisor

James Huang

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Approved by: James Huang / Manager



**Sporton International (Kunshan) Inc.**

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300  
People's Republic of China**



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## REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION             | ISSUED DATE   |
|------------|---------|-------------------------|---------------|
| FR961501A  | Rev. 01 | Initial issue of report | Aug. 01, 2019 |
|            |         |                         |               |
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## SUMMARY OF TEST RESULT

| Report Section | FCC Rule           | Description                                        | Limit                                  | Result | Remark                                  |
|----------------|--------------------|----------------------------------------------------|----------------------------------------|--------|-----------------------------------------|
| 3.1            | 15.247(a)(1)       | Number of Channels                                 | $\geq 15\text{Chs}$                    | Pass   | -                                       |
| 3.2            | 15.247(a)(1)       | Hopping Channel Separation                         | $\geq 2/3$ of 20dB BW                  | Pass   | -                                       |
| 3.3            | 15.247(a)(1)       | Dwell Time of Each Channel                         | $\leq 0.4\text{sec}$ in 31.6sec period | Pass   | -                                       |
| 3.4            | 15.247(a)(1)       | 20dB Bandwidth                                     | NA                                     | Pass   | -                                       |
| 3.4            | -                  | 99% Bandwidth                                      | -                                      | Pass   | -                                       |
| 3.5            | 15.247(b)(1)       | Peak Output Power                                  | $\leq 125\text{ mW}$                   | Pass   | -                                       |
| 3.6            | 15.247(d)          | Conducted Band Edges                               | $\leq 20\text{dBc}$                    | Pass   | -                                       |
| 3.7            | 15.247(d)          | Conducted Spurious Emission                        | $\leq 20\text{dBc}$                    | Pass   | -                                       |
| 3.8            | 15.247(d)          | Radiated Band Edges and Radiated Spurious Emission | 15.209(a) & 15.247(d)                  | Pass   | Under limit<br>6.61 dB at<br>43.580 MHz |
| 3.9            | 15.207             | AC Conducted Emission                              | 15.207(a)                              | Pass   | Under limit<br>10.47 dB at<br>0.479 MHz |
| 3.10           | 15.203 & 15.247(b) | Antenna Requirement                                | N/A                                    | Pass   | -                                       |



# 1 General Description

## 1.1 Applicant

Lenovo(Shanghai) Electronics Technology Co., Ltd.

Section 304-305, Building No. 4, # 222, Meiyue Road,China (Shanghai) Pilot Free Trade Zone

## 1.2 Manufacturer

Lenovo PC HK Limited

23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong

## 1.3 Product Feature of Equipment Under Test

| Product Feature                 |                                                             |
|---------------------------------|-------------------------------------------------------------|
| Equipment                       | Portable Tablet Computer                                    |
| Brand Name                      | Lenovo                                                      |
| Model Name                      | Lenovo TB-7305F                                             |
| FCC ID                          | O57TB7305F                                                  |
| EUT supports Radios application | WLAN 2.4GHz 802.11b/g/n HT20<br>Bluetooth BR/EDR/LE<br>GNSS |
| HW Version                      | Lenovo Tablet TB-7305F                                      |
| SW Version                      | TB-7305F_RF01_190604                                        |
| EUT Stage                       | Identical Prototype                                         |

### Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. There are five types of EUT, the difference could be referred to the product equality declaration which is exhibit separately. According to the difference, we choose the sample 1 to full test.

## 1.4 Product Specification of Equipment Under Test

| Standards-related Product Specification |                                                                                                                                         |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Tx/Rx Frequency Range                   | 2402 MHz ~ 2480 MHz                                                                                                                     |
| Number of Channels                      | 79                                                                                                                                      |
| Carrier Frequency of Each Channel       | 2402+n*1 MHz; n=0~78                                                                                                                    |
| Maximum Output Power to Antenna         | Bluetooth BR(1Mbps) : 4.05 dBm (0.0025 W)<br>Bluetooth EDR (2Mbps) : 3.95 dBm (0.0025 W)<br>Bluetooth EDR (3Mbps) : 3.98 dBm (0.0025 W) |
| 99% Occupied Bandwidth                  | Bluetooth BR(1Mbps) : 0.915MHz<br>Bluetooth EDR (2Mbps) : 1.155MHz<br>Bluetooth EDR (3Mbps) : 1.146MHz                                  |
| Antenna Type / Gain                     | PIFA Antenna type with gain 0.02 dBi                                                                                                    |
| Type of Modulation                      | Bluetooth BR (1Mbps) : GFSK<br>Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK<br>Bluetooth EDR (3Mbps) : 8-DPSK                                 |

## 1.5 Modification of EUT

No modifications are made to the EUT during all test items.

## 1.6 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

|                           |                                                                                                                                                                          |                            |                                       |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------------|
| <b>Test Firm</b>          | Sporton International (Kunshan) Inc.                                                                                                                                     |                            |                                       |
| <b>Test Site Location</b> | No. 1098, Pengxi North Road, Kunshan Economic Development Zone<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158<br>FAX : +86-512-57900958 |                            |                                       |
| <b>Test Site No.</b>      | <b>Sporton Site No.</b>                                                                                                                                                  | <b>FCC Designation No.</b> | <b>FCC Test Firm Registration No.</b> |
|                           | CO01-KS<br>03CH06-KS<br>TH01-KS                                                                                                                                          | CN1257                     | 314309                                |

## 1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR Part 15 Subpart C §15.247
- ♦ FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ♦ ANSI C63.10-2013

### Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



## 2 Test Configuration of Equipment Under Test

### 2.1 Carrier Frequency Channel

| Frequency Band  | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) |
|-----------------|---------|----------------|---------|----------------|---------|----------------|
| 2400-2483.5 MHz | 0       | 2402           | 27      | 2429           | 54      | 2456           |
|                 | 1       | 2403           | 28      | 2430           | 55      | 2457           |
|                 | 2       | 2404           | 29      | 2431           | 56      | 2458           |
|                 | 3       | 2405           | 30      | 2432           | 57      | 2459           |
|                 | 4       | 2406           | 31      | 2433           | 58      | 2460           |
|                 | 5       | 2407           | 32      | 2434           | 59      | 2461           |
|                 | 6       | 2408           | 33      | 2435           | 60      | 2462           |
|                 | 7       | 2409           | 34      | 2436           | 61      | 2463           |
|                 | 8       | 2410           | 35      | 2437           | 62      | 2464           |
|                 | 9       | 2411           | 36      | 2438           | 63      | 2465           |
|                 | 10      | 2412           | 37      | 2439           | 64      | 2466           |
|                 | 11      | 2413           | 38      | 2440           | 65      | 2467           |
|                 | 12      | 2414           | 39      | 2441           | 66      | 2468           |
|                 | 13      | 2415           | 40      | 2442           | 67      | 2469           |
|                 | 14      | 2416           | 41      | 2443           | 68      | 2470           |
|                 | 15      | 2417           | 42      | 2444           | 69      | 2471           |
|                 | 16      | 2418           | 43      | 2445           | 70      | 2472           |
|                 | 17      | 2419           | 44      | 2446           | 71      | 2473           |
|                 | 18      | 2420           | 45      | 2447           | 72      | 2474           |
|                 | 19      | 2421           | 46      | 2448           | 73      | 2475           |
|                 | 20      | 2422           | 47      | 2449           | 74      | 2476           |
|                 | 21      | 2423           | 48      | 2450           | 75      | 2477           |
|                 | 22      | 2424           | 49      | 2451           | 76      | 2478           |
|                 | 23      | 2425           | 50      | 2452           | 77      | 2479           |
|                 | 24      | 2426           | 51      | 2453           | 78      | 2480           |
|                 | 25      | 2427           | 52      | 2454           | -       | -              |
|                 | 26      | 2428           | 53      | 2455           | -       | -              |

## 2.2 Test Mode

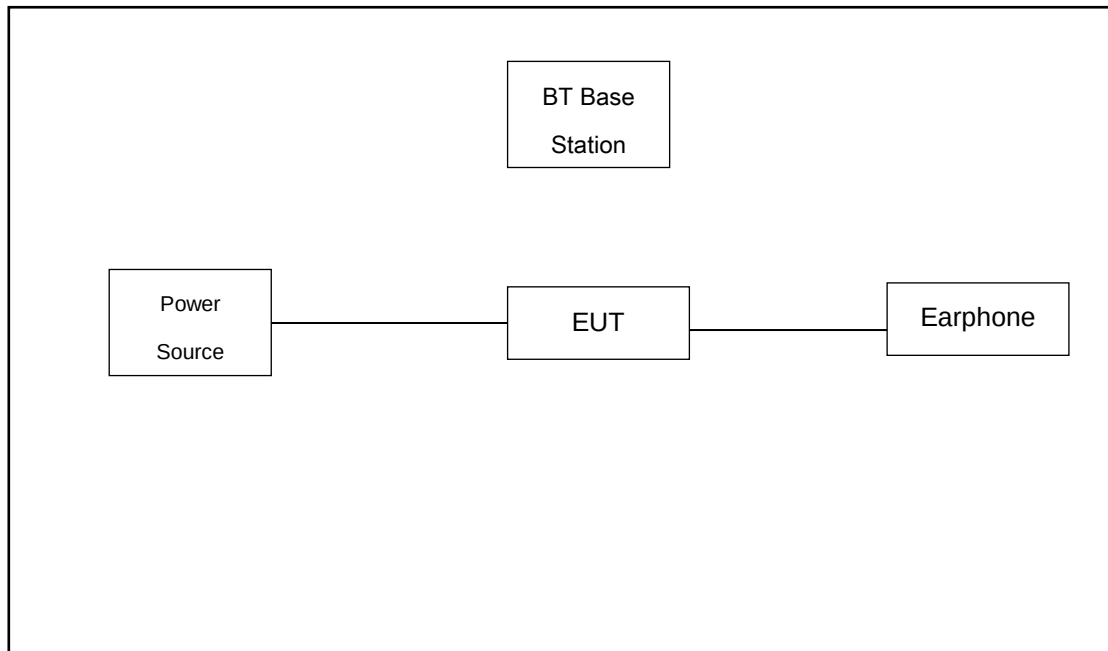
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report, and the worst mode of radiated spurious emissions is Bluetooth 1Mbps mode, and recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

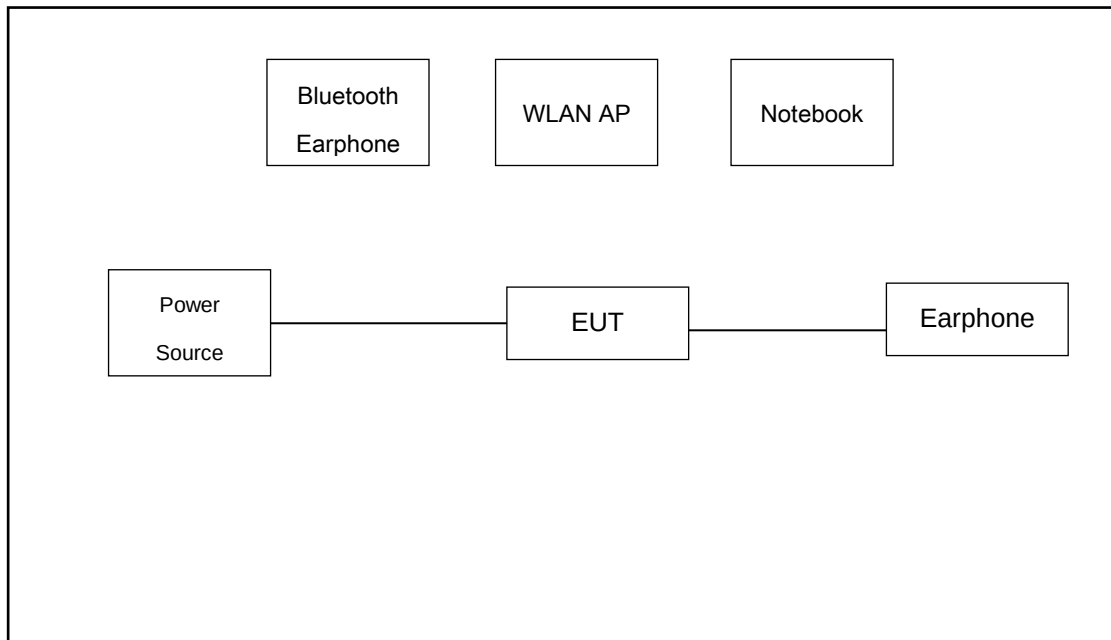
| Summary table of Test Cases                                                                                                                                                                                                             |                                                                                                 |                                       |                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------|
| Test Item                                                                                                                                                                                                                               | Data Rate / Modulation                                                                          |                                       |                               |
|                                                                                                                                                                                                                                         | Bluetooth BR 1Mbps<br>GFSK                                                                      | Bluetooth EDR 2Mbps<br>$\pi/4$ -DQPSK | Bluetooth EDR 3Mbps<br>8-DPSK |
| Conducted<br>Test Cases                                                                                                                                                                                                                 | Mode 1: CH00_2402 MHz                                                                           | Mode 4: CH00_2402 MHz                 | Mode 7: CH00_2402 MHz         |
|                                                                                                                                                                                                                                         | Mode 2: CH39_2441 MHz                                                                           | Mode 5: CH39_2441 MHz                 | Mode 8: CH39_2441 MHz         |
|                                                                                                                                                                                                                                         | Mode 3: CH78_2480 MHz                                                                           | Mode 6: CH78_2480 MHz                 | Mode 9: CH78_2480 MHz         |
| Radiated<br>Test Cases                                                                                                                                                                                                                  | Bluetooth BR 1Mbps GFSK                                                                         |                                       |                               |
|                                                                                                                                                                                                                                         | Mode 1: CH00_2402 MHz<br>Mode 2: CH39_2441 MHz<br>Mode 3: CH78_2480 MHz                         |                                       |                               |
| AC<br>Conducted<br>Emission                                                                                                                                                                                                             | Mode 1 : Bluetooth Link + WLAN Link (2.4G) + USB Cable 2(Charging from Adapter 2)<br>+ Earphone |                                       |                               |
| Remark:                                                                                                                                                                                                                                 |                                                                                                 |                                       |                               |
| 1. For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and no other significantly frequencies found in conducted spurious emission. |                                                                                                 |                                       |                               |
| 2. For Radiated Test Cases, The tests were performed with Adapter 1, Earphone and USB Cable 1 .                                                                                                                                         |                                                                                                 |                                       |                               |

## 2.3 Connection Diagram of Test System

For Radiation



For Conducted Emission



## 2.4 Support Unit used in test configuration and system

| Item | Equipment          | Trade Name | Model Name | FCC ID      | Data Cable      | Power Cord                                                 |
|------|--------------------|------------|------------|-------------|-----------------|------------------------------------------------------------|
| 1.   | WLAN AP            | D-link     | DIR-855    | KA2DIR855A2 | N/A             | Unshielded,1.8m                                            |
| 2.   | Notebook           | Lenovo     | G480       | N/A         | N/A             | AC I/P:<br>Unshielded, 1.8 m<br>DC O/P:<br>Shielded, 1.8 m |
| 3.   | Earphone           | Lenovo     | P121       | N/A         | Unshielded,1.2m | N/A                                                        |
| 4.   | Bluetooth Earphone | Lenovo     | LBH308     | N/A         | N/A             | N/A                                                        |
| 5.   | BT Base Station    | R&S        | CBT        | N/A         | N/A             | Unshielded,1.8m                                            |

## 2.5 EUT Operation Test Setup

For Bluetooth function, the engineering test program was provided and enabled to make EUT connect with Bluetooth base station to continuous transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

## 2.6 Measurement Results Explanation Example

**For all conducted test items:**

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss.

*Offset = RF cable loss.*

Following shows an offset computation example with cable loss 6.0 dB.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} . \\ &= 6.0 \text{ (dB)}\end{aligned}$$

### 3 Test Result

#### 3.1 Number of Channel Measurement

##### 3.1.1 Limits of Number of Hopping Frequency

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

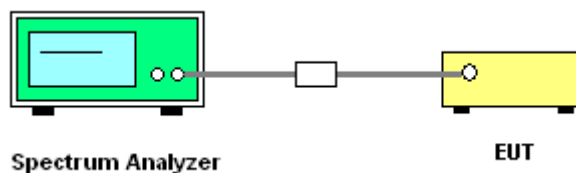
##### 3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

##### 3.1.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation;  
RBW = 300kHz; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

##### 3.1.4 Test Setup

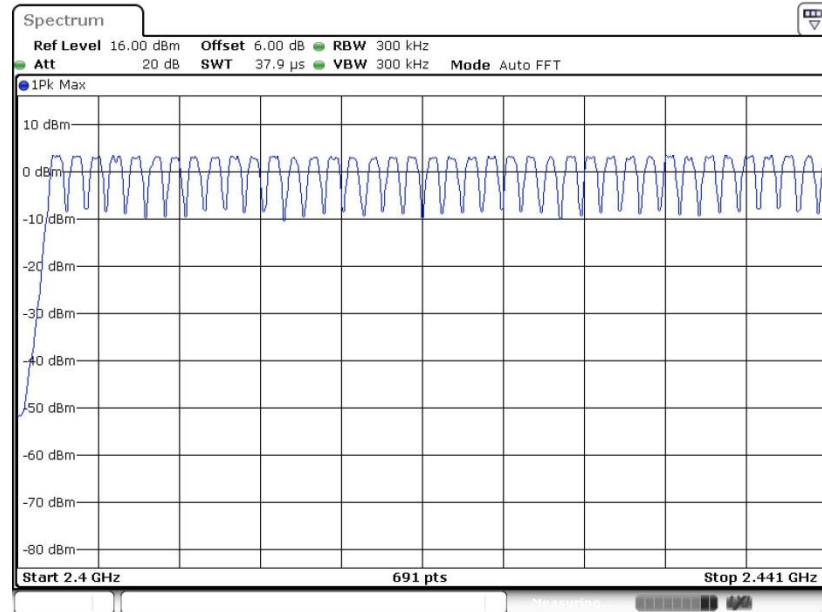


##### 3.1.5 Test Result of Number of Hopping Frequency

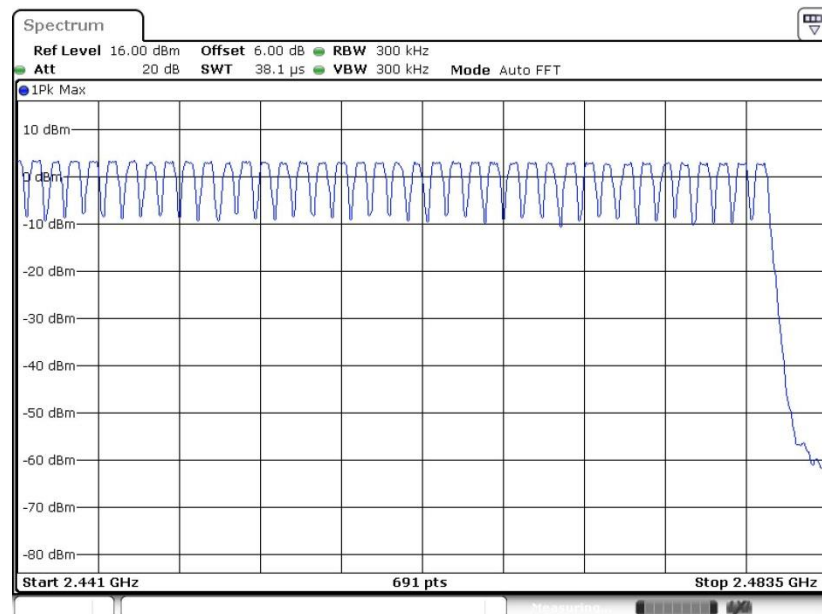
| <b>Test Mode :</b>             | 1Mbps                                   | <b>Temperature :</b>       | 21~25°C   |
|--------------------------------|-----------------------------------------|----------------------------|-----------|
| <b>Test Engineer :</b>         | Lion Ran                                | <b>Relative Humidity :</b> | 51~54%    |
| Number of Hopping<br>(Channel) | Adaptive Frequency<br>Hopping (Channel) | Limits<br>(Channel)        | Pass/Fail |
| 79                             | 20                                      | > 15                       | Pass      |



Number of Hopping Channel Plot on Channel 00 - 78



Date: 10.JUL.2019 20:25:25



Date: 10.JUL.2019 20:25:43

## 3.2 Hopping Channel Separation Measurement

### 3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

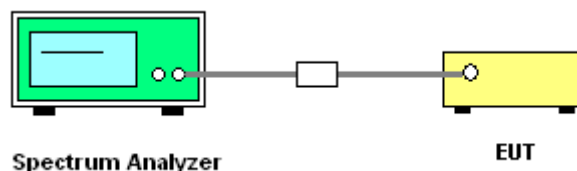
### 3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.2.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels;  
RBW = 300kHz; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

### 3.2.4 Test Setup



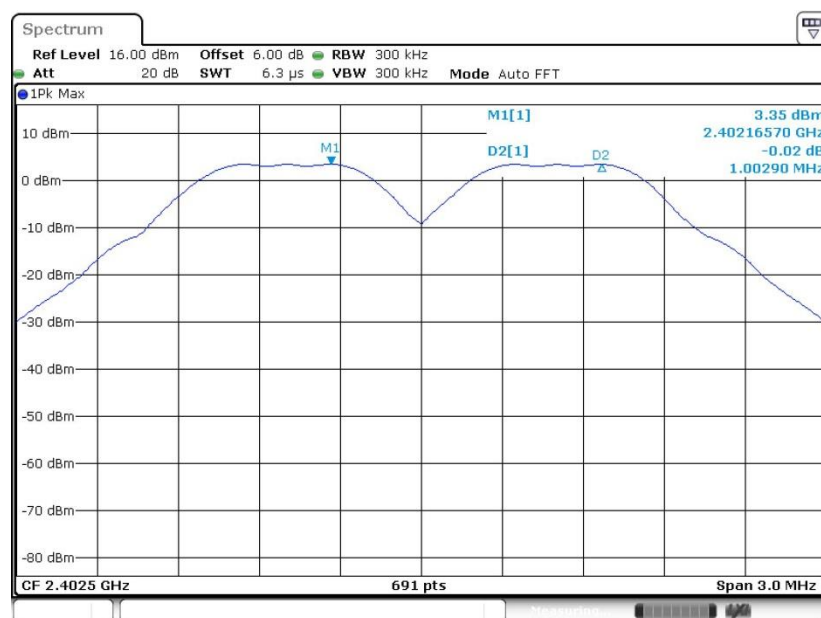


## 3.2.5 Test Result of Hopping Channel Separation

|                 |          |                     |        |
|-----------------|----------|---------------------|--------|
| Test Mode :     | 1Mbps    | Temperature :       | 21~25℃ |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54% |

| Channel | Frequency (MHz) | Frequency Separation (MHz) | (2/3 of 20dB BW) Limits (MHz) | Pass/Fail |
|---------|-----------------|----------------------------|-------------------------------|-----------|
| 00      | 2402            | 1.0029                     | 0.6947                        | Pass      |
| 39      | 2441            | 1.0029                     | 0.6927                        | Pass      |
| 78      | 2480            | 1.0029                     | 0.6908                        | Pass      |

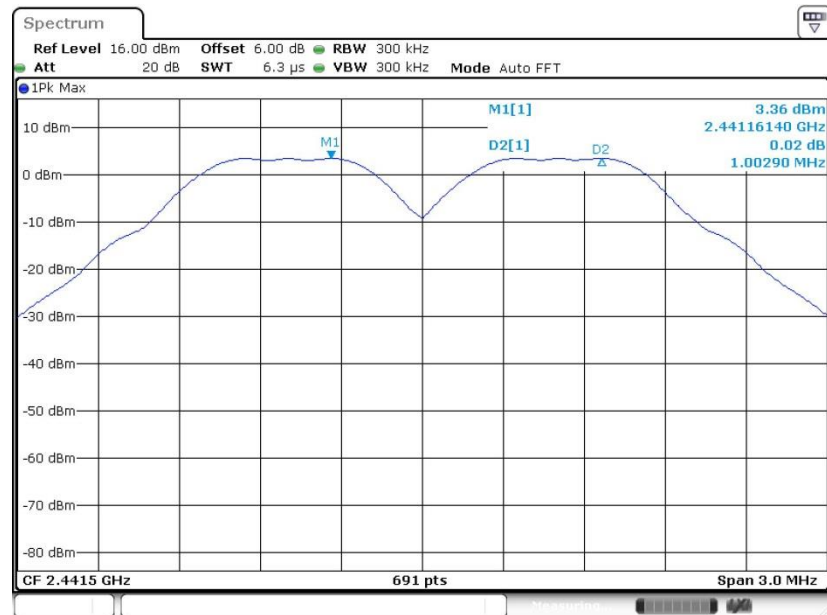
Channel Separation Plot on Channel 00 - 01



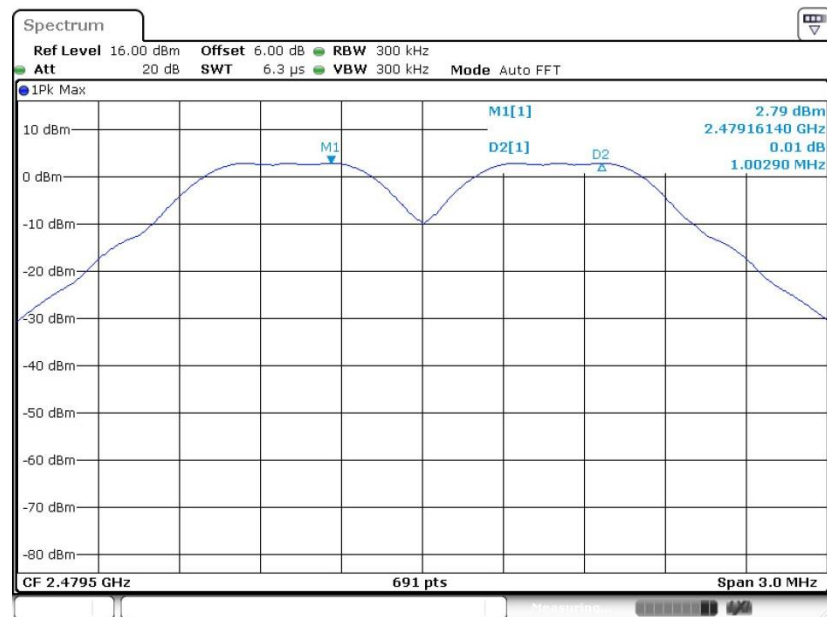
Date: 10 JUL 2019 20:25:05



Channel Separation Plot on Channel 39 - 40



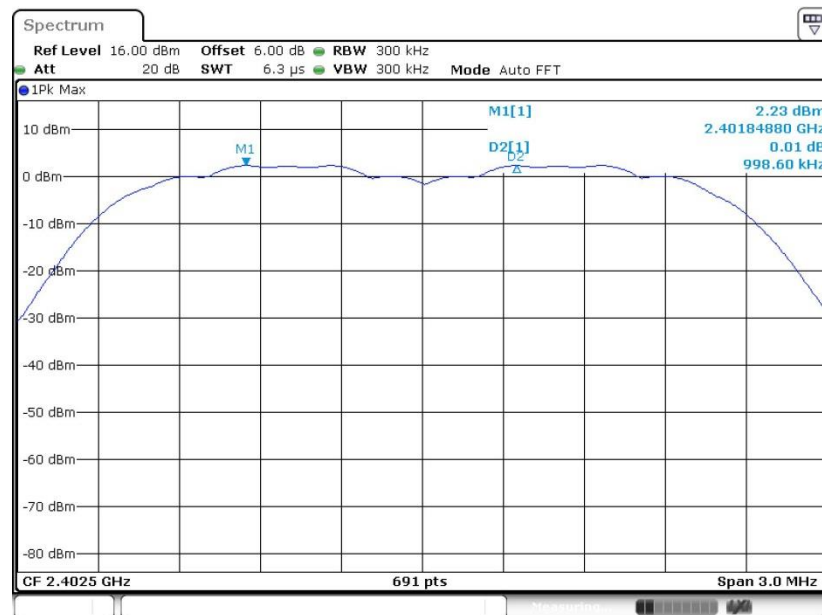
Channel Separation Plot on Channel 77 - 78



|                        |          |                            |        |
|------------------------|----------|----------------------------|--------|
| <b>Test Mode :</b>     | 2Mbps    | <b>Temperature :</b>       | 21~25℃ |
| <b>Test Engineer :</b> | Lion Ran | <b>Relative Humidity :</b> | 51~54% |

| Channel | Frequency (MHz) | Frequency Separation (MHz) | (2/3 of 20dB BW) Limits (MHz) | Pass/Fail |
|---------|-----------------|----------------------------|-------------------------------|-----------|
| 00      | 2402            | 0.9986                     | 0.8336                        | Pass      |
| 39      | 2441            | 1.0203                     | 0.8336                        | Pass      |
| 78      | 2480            | 0.9465                     | 0.8336                        | Pass      |

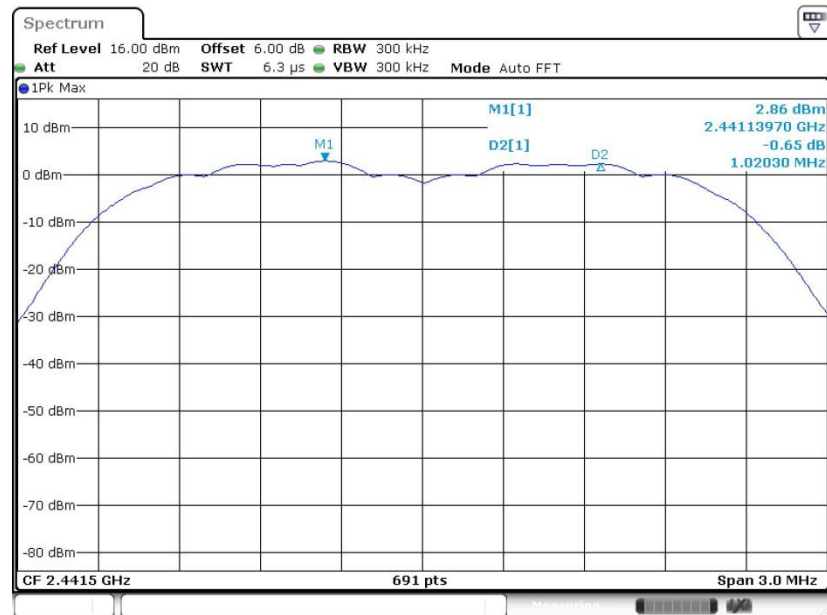
### Channel Separation Plot on Channel 00 - 01



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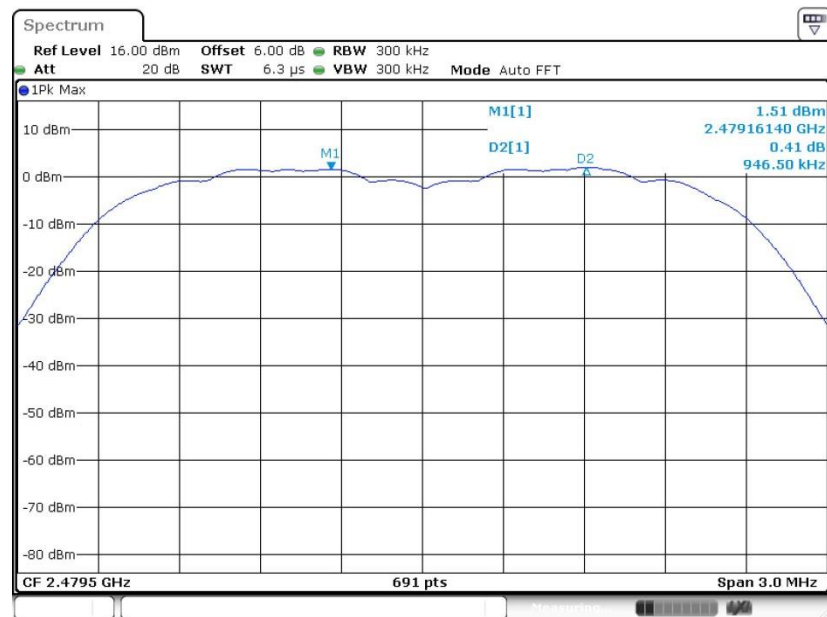


### Channel Separation Plot on Channel 39 - 40



Date: 10 JUL 2019 20:40:38

### Channel Separation Plot on Channel 77 - 78



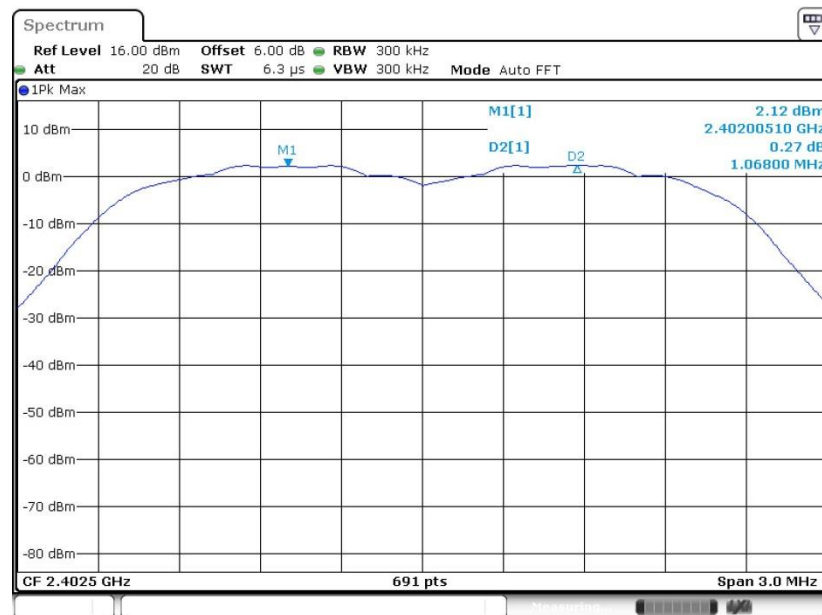
Date: 10 JUL 2019 20:44:26



|                 |          |                     |        |
|-----------------|----------|---------------------|--------|
| Test Mode :     | 3Mbps    | Temperature :       | 21~25℃ |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54% |

| Channel | Frequency (MHz) | Frequency Separation (MHz) | (2/3 of 20dB BW) Limits (MHz) | Pass/Fail |
|---------|-----------------|----------------------------|-------------------------------|-----------|
| 00      | 2402            | 1.0680                     | 0.8133                        | Pass      |
| 39      | 2441            | 0.9986                     | 0.8133                        | Pass      |
| 78      | 2480            | 1.3198                     | 0.8133                        | Pass      |

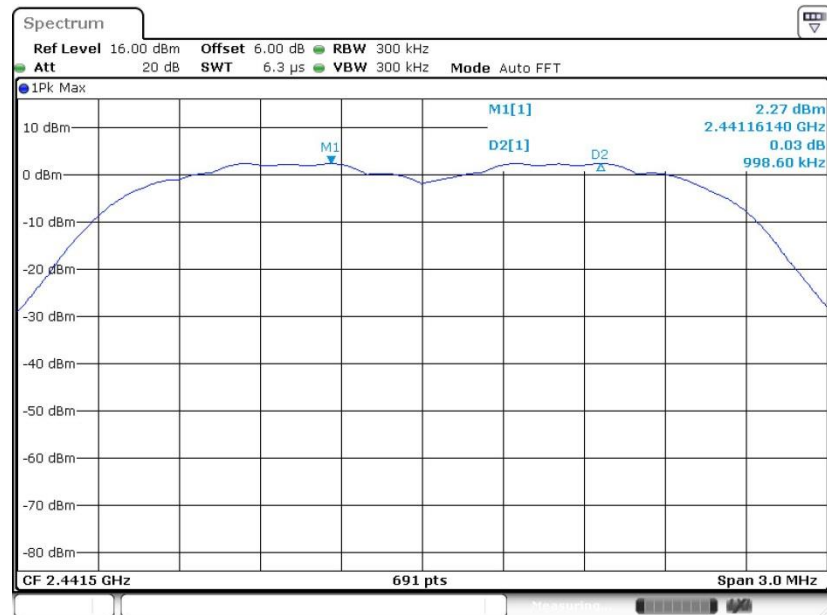
Channel Separation Plot on Channel 00 - 01



Date: 10 JUL 2019 20:48:39

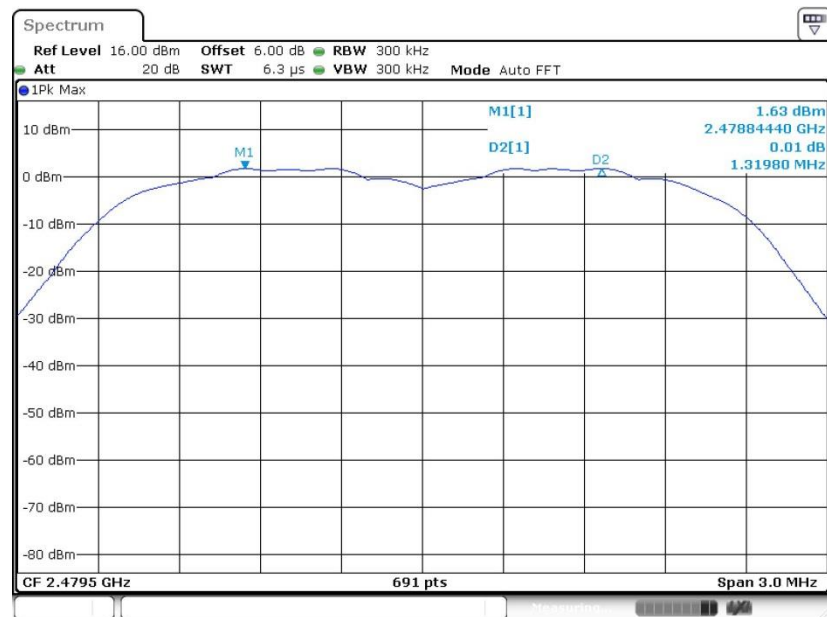


### Channel Separation Plot on Channel 39 - 40



Date: 10 JUL 2019 20:51:47

### Channel Separation Plot on Channel 77 - 78



Date: 10 JUL 2019 20:55:30

### 3.3 Dwell Time Measurement

#### 3.3.1 Limit of Dwell Time

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

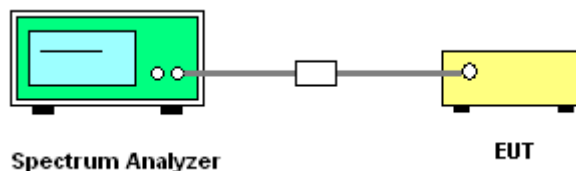
#### 3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.3.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.4.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW  $\geq$  RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

#### 3.3.4 Test Setup

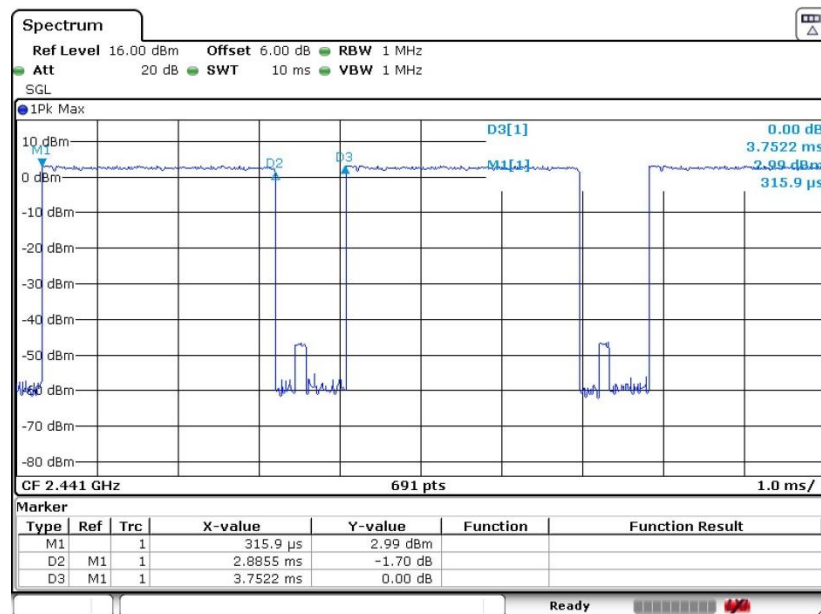


### 3.3.5 Test Result of Dwell Time

|                        |          |                            |        |
|------------------------|----------|----------------------------|--------|
| <b>Test Mode :</b>     | 2DH5     | <b>Temperature :</b>       | 21~25℃ |
| <b>Test Engineer :</b> | Lion Ran | <b>Relative Humidity :</b> | 51~54% |

| Mode   | Hopping Channel Number | Hops Over Occupancy Time(hops) | Package Transfer Time (msec) | Dwell Time (sec) | Limits (sec) | Pass/Fail |
|--------|------------------------|--------------------------------|------------------------------|------------------|--------------|-----------|
| Normal | 79                     | 106.67                         | 2.8855                       | 0.31             | 0.4          | Pass      |
| AFH    | 20                     | 53.34                          | 2.8855                       | 0.15             | 0.4          | Pass      |

**Package Transfer Time Plot**



**Remark:**

- In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hopping channels.  
With channel hopping rate (1600 / 6 / 79) in Occupancy Time Limit (0.4 x 79) (s),  
Hops Over Occupancy Time comes to (1600 / 6 / 79) x (0.4 x 79) = 106.67 hops.
- In AFH mode, hopping rate is 800 hops/s with 6 slots in 20 hopping channels.  
With channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 x 20) (s),  
Hops Over Occupancy Time comes to (800 / 6 / 20) x (0.4 x 20) = 53.33 hops.
- Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

### 3.4 20dB and 99% Bandwidth Measurement

#### 3.4.1 Limit of 20dB and 99% Bandwidth

Reporting only

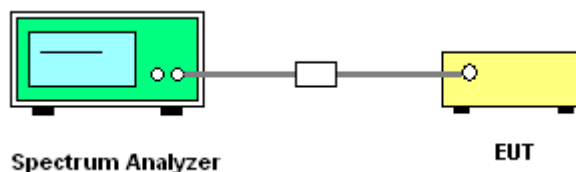
#### 3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.  
Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;  
RBW  $\geq$  1% of the 20 dB bandwidth; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak;  
Trace = max hold.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.  
Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel;  
RBW  $\geq$  1% of the 99% bandwidth; VBW  $\geq$  RBW; Sweep = auto; Detector function = sample;  
Trace = max hold.
6. Measure and record the results in the test report.

#### 3.4.4 Test Setup



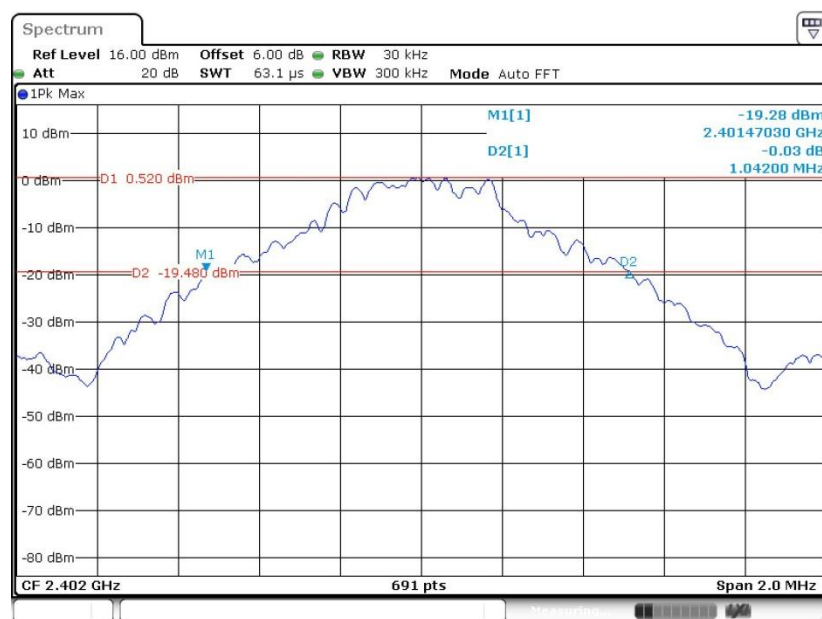


## 3.4.5 Test Result of 20dB Bandwidth

|                 |          |                     |        |
|-----------------|----------|---------------------|--------|
| Test Mode :     | 1Mbps    | Temperature :       | 21~25℃ |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54% |

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---------|-----------------|----------------------|
| 00      | 2402            | 1.042                |
| 39      | 2441            | 1.039                |
| 78      | 2480            | 1.036                |

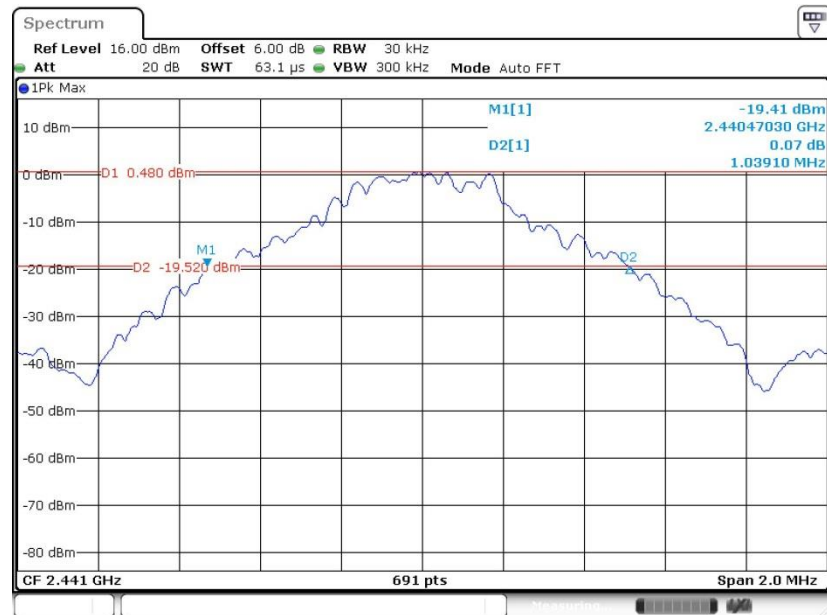
20 dB Bandwidth Plot on Channel 00



Date: 10 JUL 2019 20:20:54

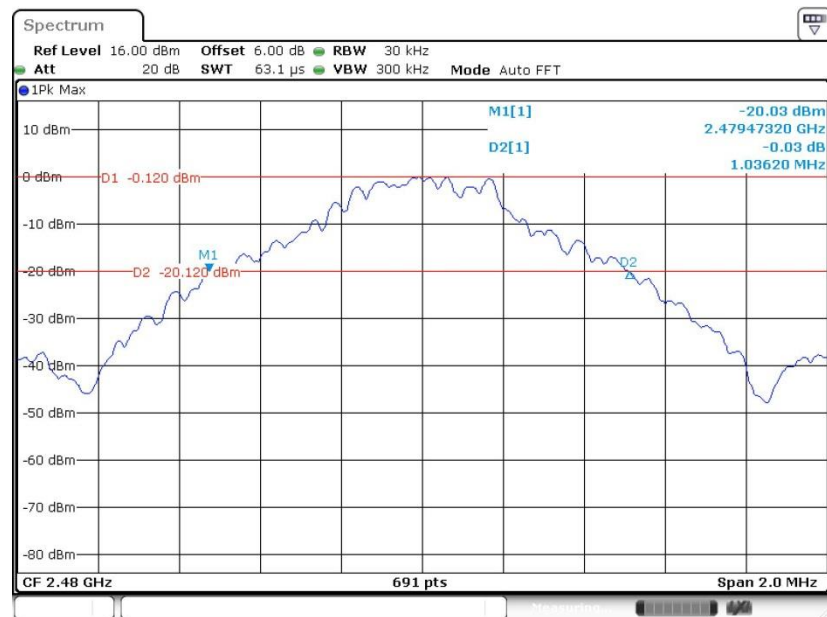


### 20 dB Bandwidth Plot on Channel 39



Date: 10 JUL 2019 20:26:57

### 20 dB Bandwidth Plot on Channel 78

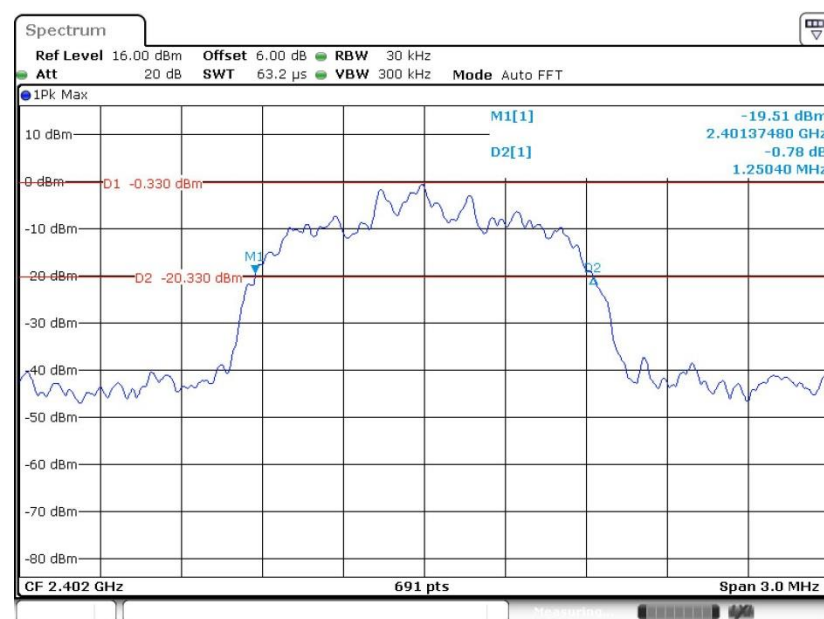


Date: 10 JUL 2019 20:30:24

|                        |          |                            |        |
|------------------------|----------|----------------------------|--------|
| <b>Test Mode :</b>     | 2Mbps    | <b>Temperature :</b>       | 21~25℃ |
| <b>Test Engineer :</b> | Lion Ran | <b>Relative Humidity :</b> | 51~54% |

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---------|-----------------|----------------------|
| 00      | 2402            | 1.250                |
| 39      | 2441            | 1.250                |
| 78      | 2480            | 1.250                |

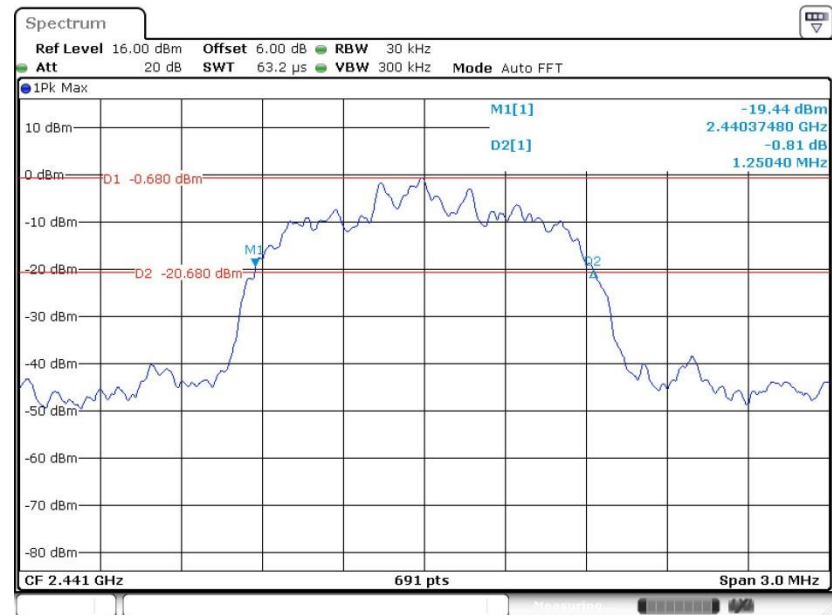
### 20 dB Bandwidth Plot on Channel 00



Date: 10.JUL.2019 20:34:27

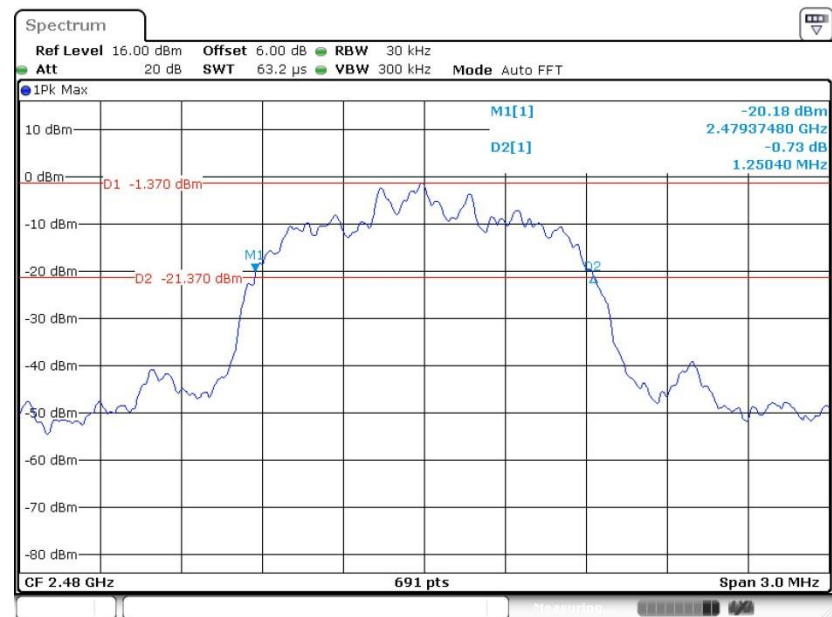


### 20 dB Bandwidth Plot on Channel 39



Date: 10 JUL 2019 20:38:23

### 20 dB Bandwidth Plot on Channel 78



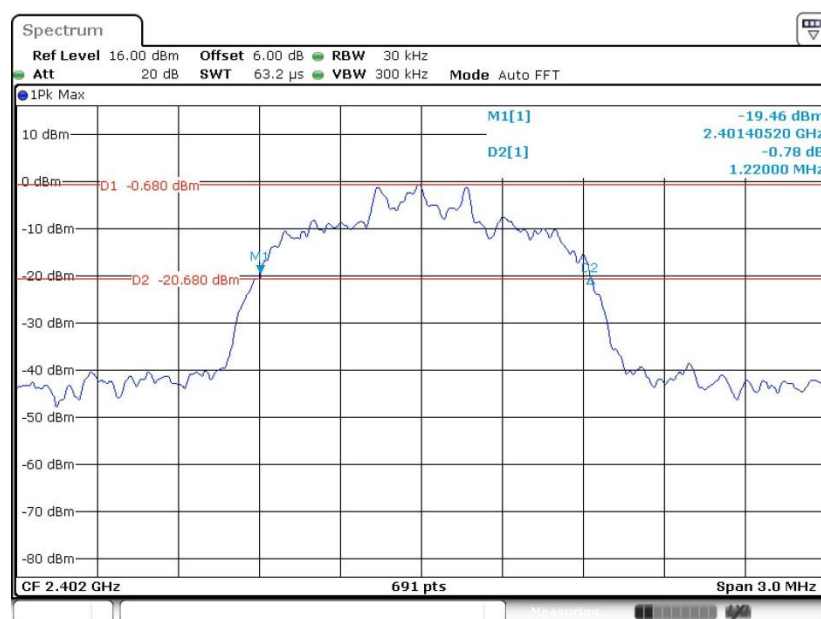
Date: 10 JUL 2019 20:41:27



|                 |          |                     |         |
|-----------------|----------|---------------------|---------|
| Test Mode :     | 3Mbps    | Temperature :       | 21~25°C |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54%  |

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---------|-----------------|----------------------|
| 00      | 2402            | 1.220                |
| 39      | 2441            | 1.220                |
| 78      | 2480            | 1.220                |

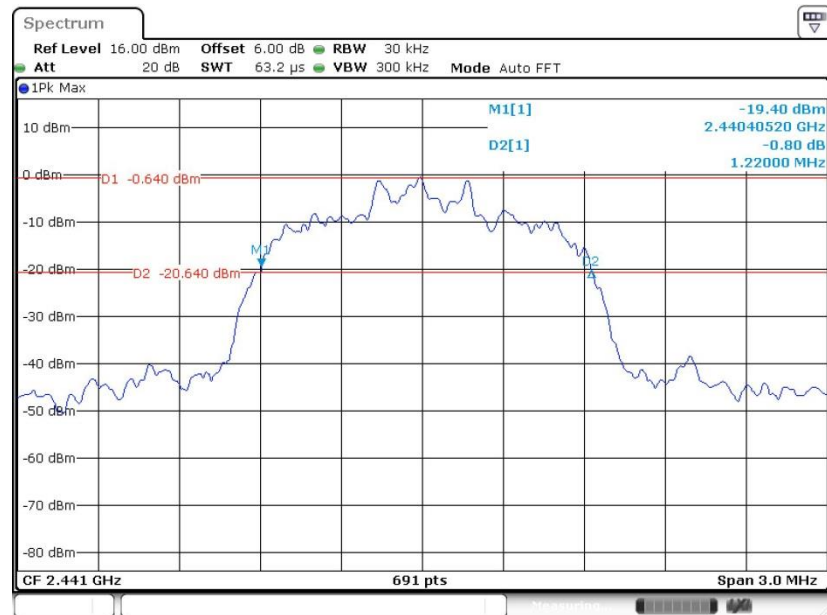
20 dB Bandwidth Plot on Channel 00



Date: 10 JUL 2019 20:45:29

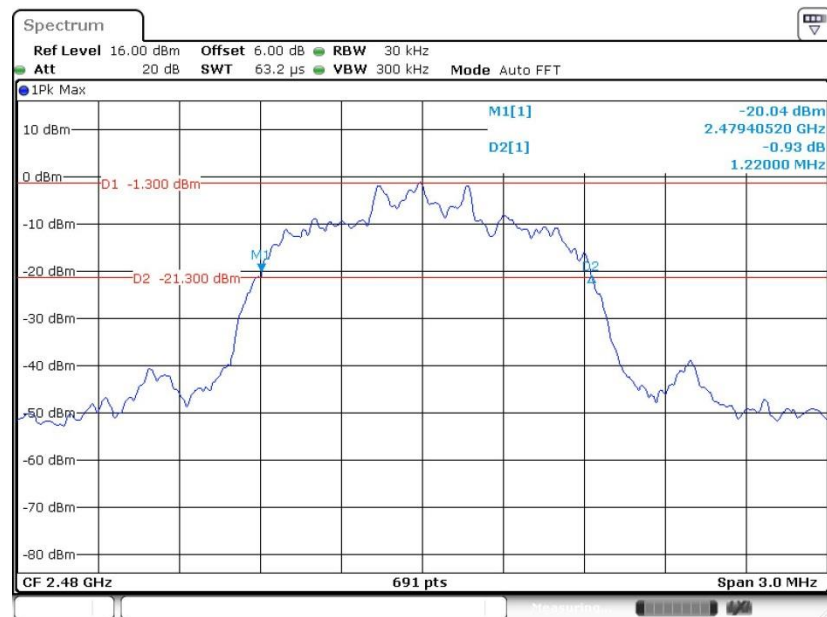


### 20 dB Bandwidth Plot on Channel 39



Date: 10 JUL 2019 20:49:33

### 20 dB Bandwidth Plot on Channel 78



Date: 10 JUL 2019 20:52:37



## 3.4.6 Test Result of 99% Occupied Bandwidth

|                 |          |                     |        |
|-----------------|----------|---------------------|--------|
| Test Mode :     | 1Mbps    | Temperature :       | 21~25℃ |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54% |

| Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) |
|---------|-----------------|------------------------------|
| 00      | 2402            | 0.915                        |
| 39      | 2441            | 0.912                        |
| 78      | 2480            | 0.909                        |

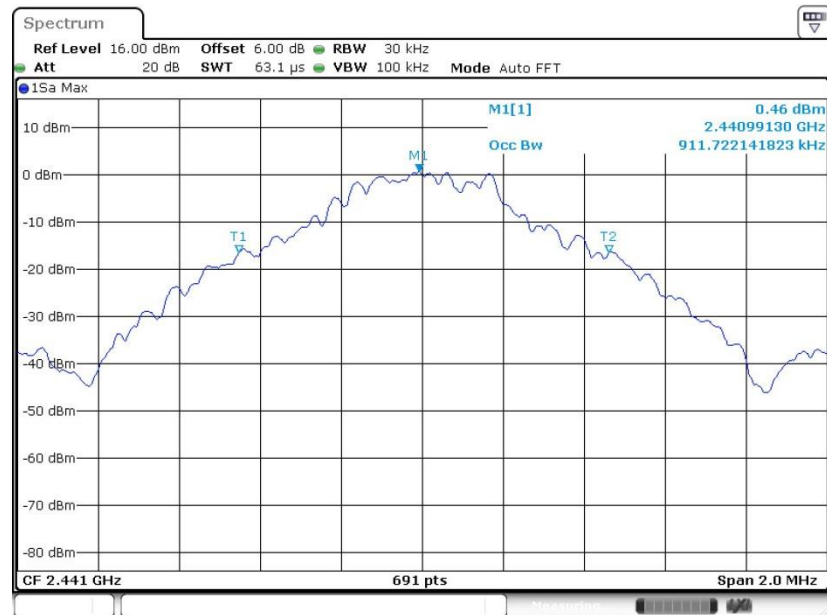
99% Occupied Bandwidth Plot on Channel 00



Date: 10 JUL 2019 20:23:02

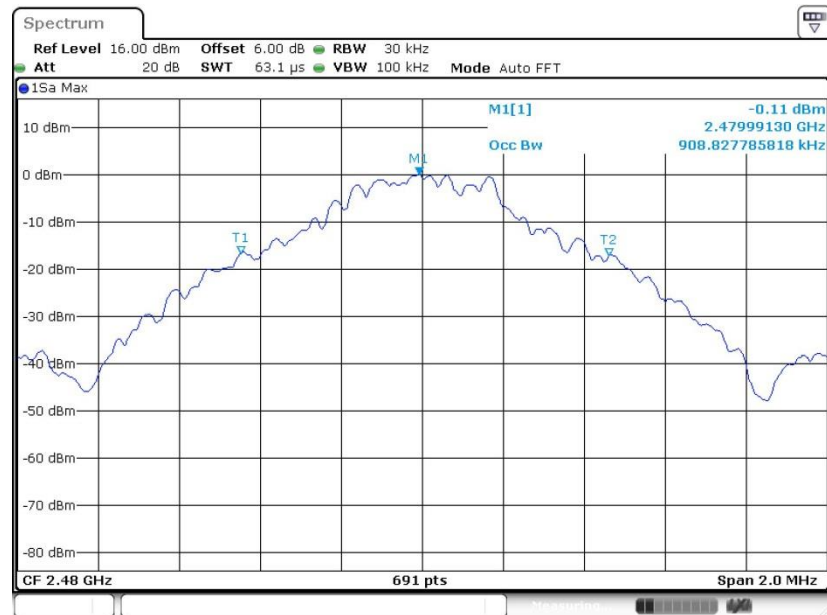


### 99% Occupied Bandwidth Plot on Channel 39



Date: 10 JUL 2019 20:27:29

### 99% Occupied Bandwidth Plot on Channel 78



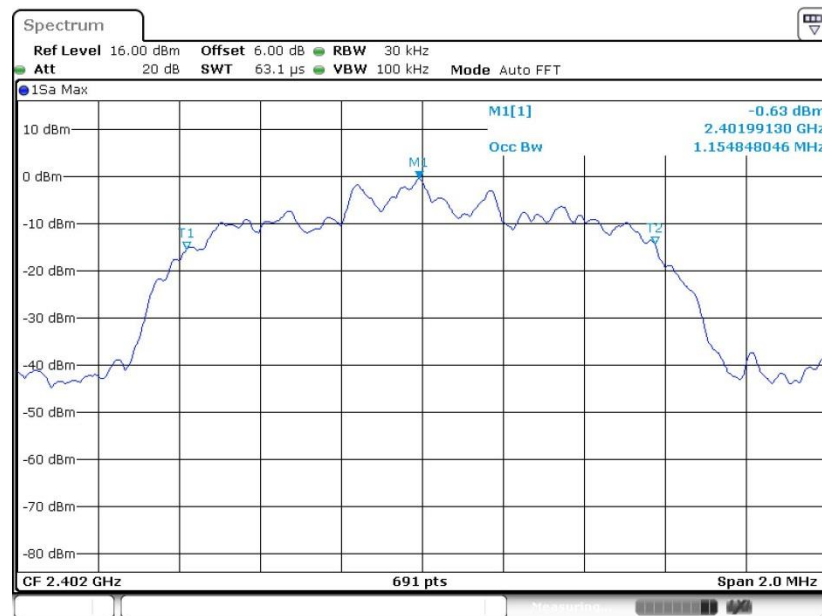
Date: 10 JUL 2019 20:31:41



|                 |          |                     |        |
|-----------------|----------|---------------------|--------|
| Test Mode :     | 2Mbps    | Temperature :       | 21~25℃ |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54% |

| Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) |
|---------|-----------------|------------------------------|
| 00      | 2402            | 1.155                        |
| 39      | 2441            | 1.155                        |
| 78      | 2480            | 1.155                        |

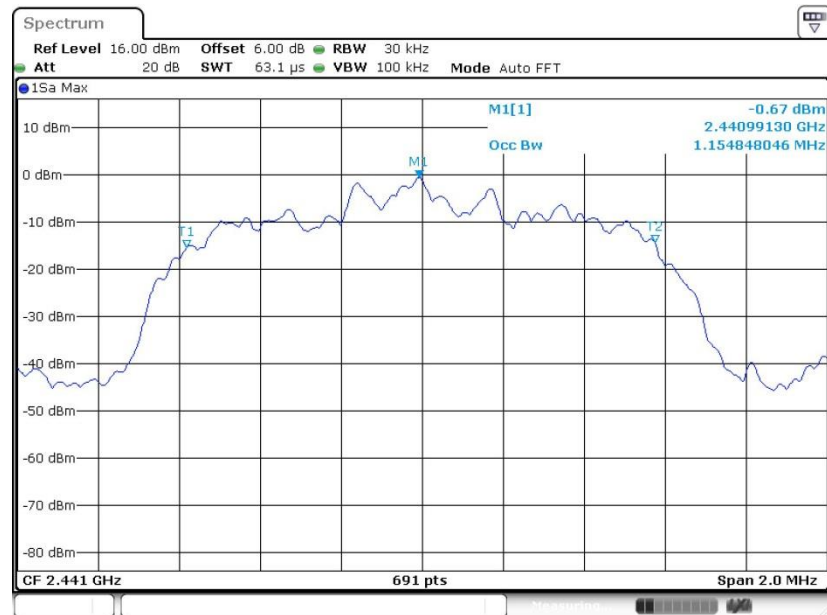
99% Occupied Bandwidth Plot on Channel 00



Date: 10 JUL 2019 20:35:50

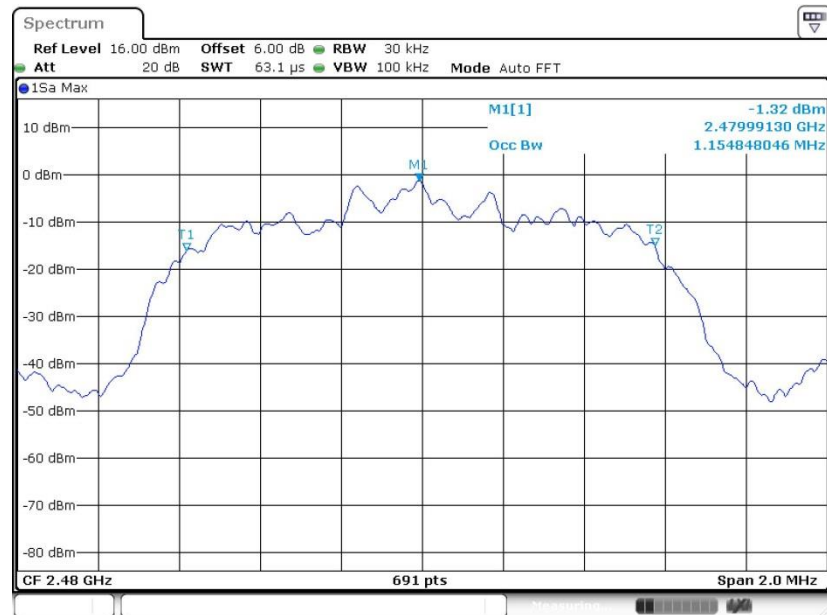


### 99% Occupied Bandwidth Plot on Channel 39



Date: 10 JUL 2019 20:38:55

### 99% Occupied Bandwidth Plot on Channel 78



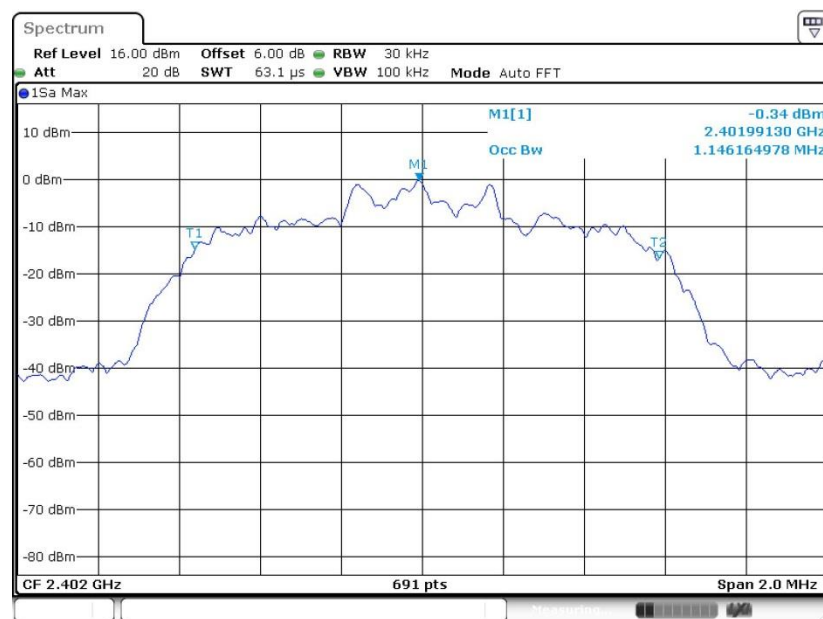
Date: 10 JUL 2019 20:42:43



|                 |          |                     |        |
|-----------------|----------|---------------------|--------|
| Test Mode :     | 3Mbps    | Temperature :       | 21~25℃ |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54% |

| Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) |
|---------|-----------------|------------------------------|
| 00      | 2402            | 1.146                        |
| 39      | 2441            | 1.146                        |
| 78      | 2480            | 1.143                        |

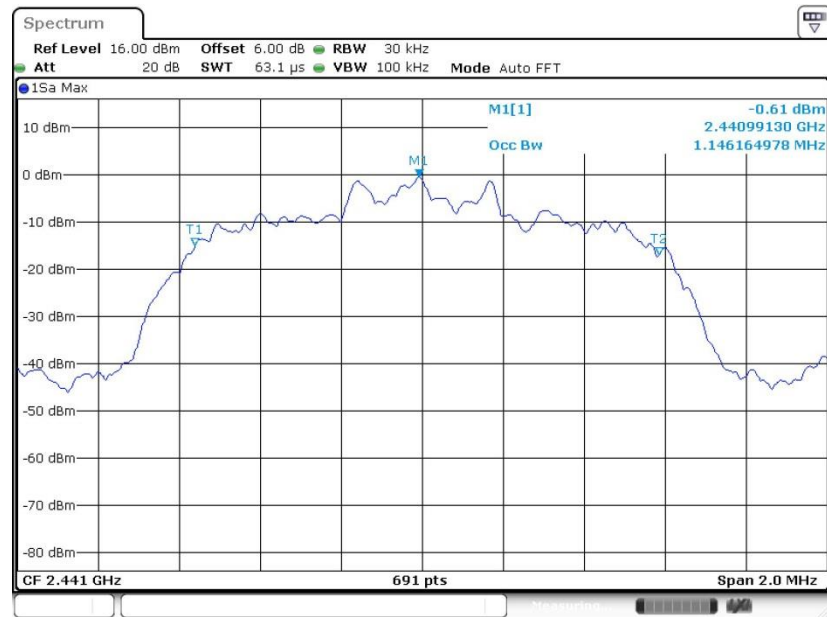
99% Occupied Bandwidth Plot on Channel 00



Date: 10 JUL 2019 20:46:47

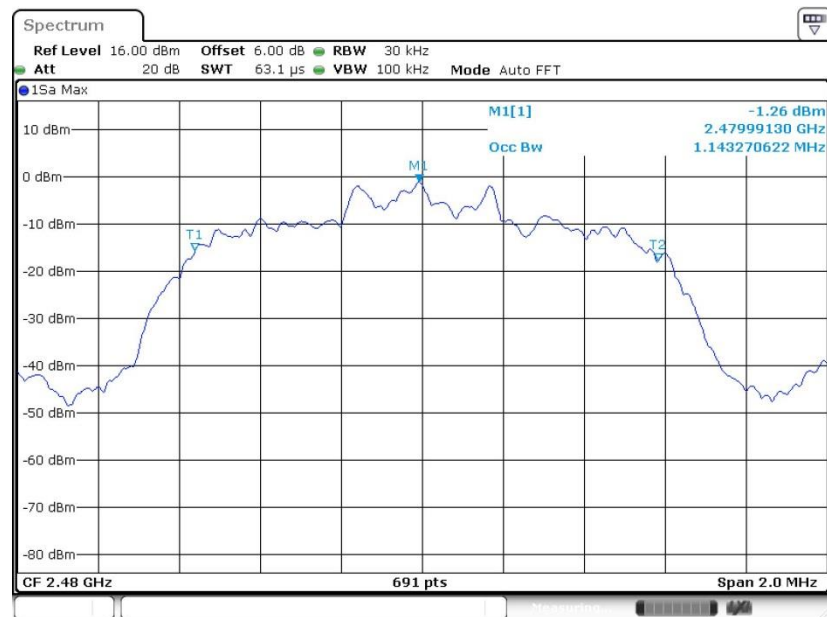


### 99% Occupied Bandwidth Plot on Channel 39



Date: 10 JUL 2019 20:50:09

### 99% Occupied Bandwidth Plot on Channel 78



Date: 10 JUL 2019 20:53:51

Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

## 3.5 Output Power Measurement

### 3.5.1 Limit of Output Power

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

- (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

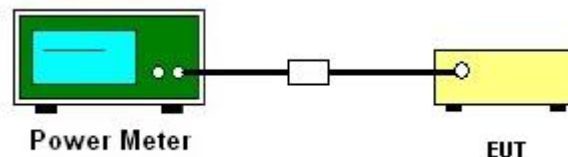
### 3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.5.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

### 3.5.4 Test Setup





## 3.5.5 Test Result of Peak Output Power

|                 |          |                     |         |
|-----------------|----------|---------------------|---------|
| Test Mode :     | 1Mbps    | Temperature :       | 21~25°C |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54%  |

| Channel | Frequency (MHz) | RF Power (dBm) |                   |           |
|---------|-----------------|----------------|-------------------|-----------|
|         |                 | GFSK           | Max. Limits (dBm) | Pass/Fail |
|         |                 | 1 Mbps         |                   |           |
| 00      | 2402            | 4.05           | 20.97             | Pass      |
| 39      | 2441            | 3.91           | 20.97             | Pass      |
| 78      | 2480            | 3.32           | 20.97             | Pass      |

|                 |          |                     |         |
|-----------------|----------|---------------------|---------|
| Test Mode :     | 2Mbps    | Temperature :       | 21~25°C |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54%  |

| Channel | Frequency (MHz) | RF Power (dBm) |                   |           |
|---------|-----------------|----------------|-------------------|-----------|
|         |                 | $\pi/4$ -DQPSK | Max. Limits (dBm) | Pass/Fail |
|         |                 | 2 Mbps         |                   |           |
| 00      | 2402            | 3.95           | 20.97             | Pass      |
| 39      | 2441            | 3.77           | 20.97             | Pass      |
| 78      | 2480            | 3.12           | 20.97             | Pass      |

|                 |          |                     |         |
|-----------------|----------|---------------------|---------|
| Test Mode :     | 3Mbps    | Temperature :       | 21~25°C |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54%  |

| Channel | Frequency (MHz) | RF Power (dBm) |                   |           |
|---------|-----------------|----------------|-------------------|-----------|
|         |                 | 8-DPSK         | Max. Limits (dBm) | Pass/Fail |
|         |                 | 3 Mbps         |                   |           |
| 00      | 2402            | 3.98           | 20.97             | Pass      |
| 39      | 2441            | 3.88           | 20.97             | Pass      |
| 78      | 2480            | 3.16           | 20.97             | Pass      |

## 3.6 Conducted Band Edges Measurement

### 3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

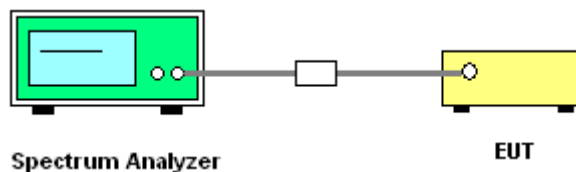
### 3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.6.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.6.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

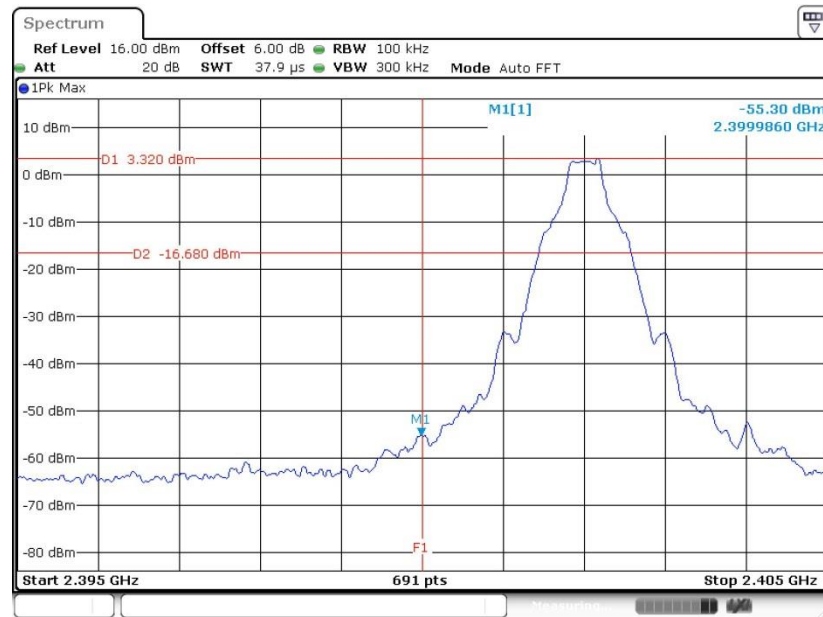
### 3.6.4 Test Setup



### 3.6.5 Test Result of Conducted Band Edges

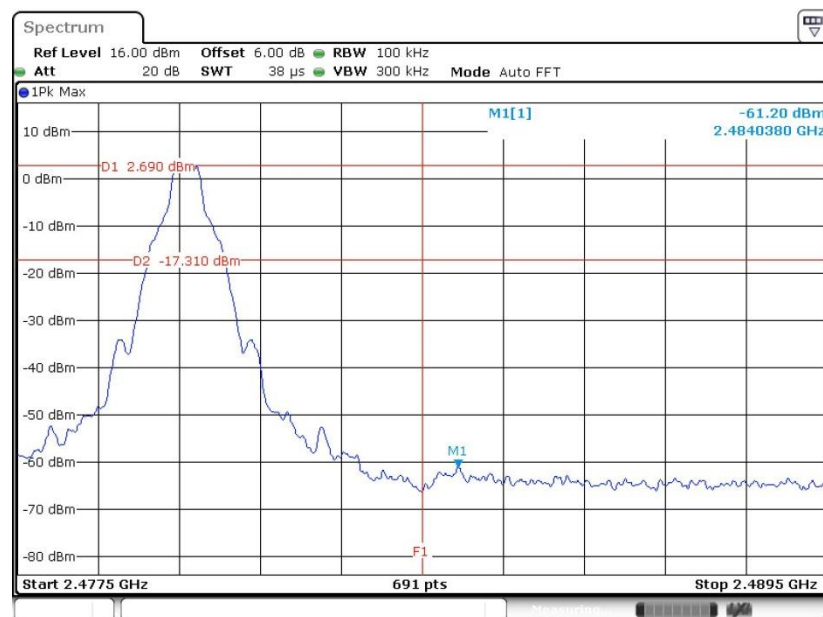
|                |           |                     |          |
|----------------|-----------|---------------------|----------|
| Test Mode :    | 1Mbps     | Temperature :       | 21~25℃   |
| Test Channel : | 00 and 78 | Relative Humidity : | 51~54%   |
|                |           | Test Engineer :     | Lion Ran |

**Low Band Edge Plot on Channel 00**



Date: 10 JUL 2019 20:21:33

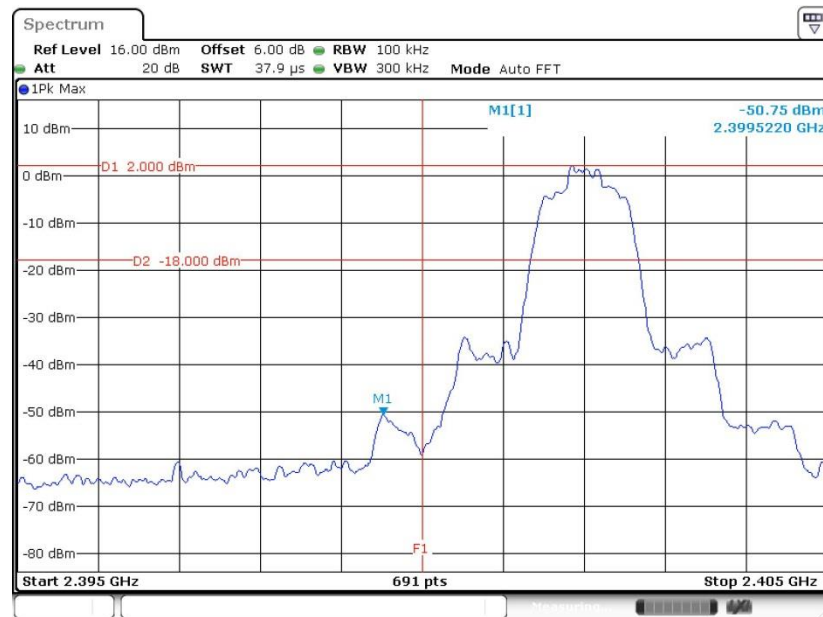
**High Band Edge Plot on Channel 78**



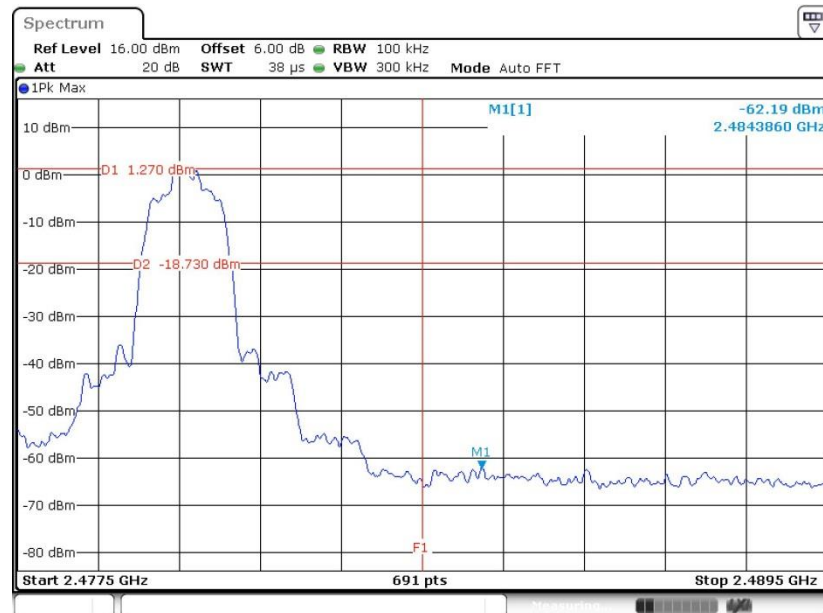
Date: 10 JUL 2019 20:30:41



|                |           |                     |          |
|----------------|-----------|---------------------|----------|
| Test Mode :    | 2Mbps     | Temperature :       | 21~25°C  |
| Test Channel : | 00 and 78 | Relative Humidity : | 51~54%   |
|                |           | Test Engineer :     | Lion Ran |

**Low Band Edge Plot on Channel 00**

Date: 10 JUL 2019 20:34:45

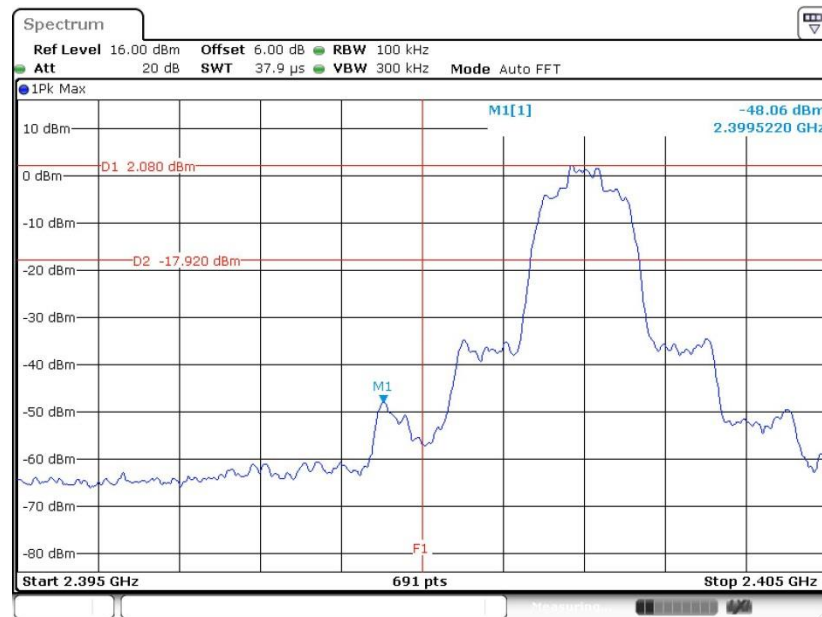
**High Band Edge Plot on Channel 78**

Date: 10 JUL 2019 20:41:46



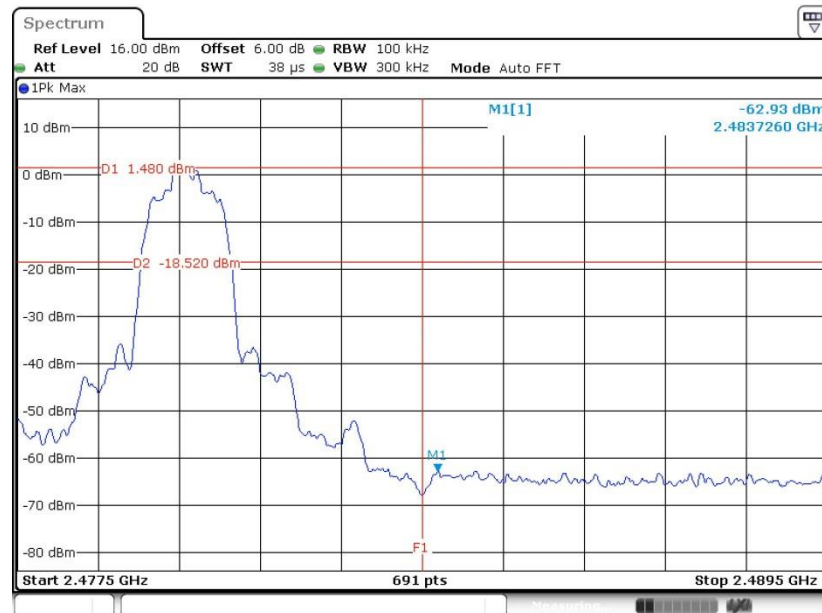
|                |           |                     |          |
|----------------|-----------|---------------------|----------|
| Test Mode :    | 3Mbps     | Temperature :       | 21~25°C  |
| Test Channel : | 00 and 78 | Relative Humidity : | 51~54%   |
|                |           | Test Engineer :     | Lion Ran |

### Low Band Edge Plot on Channel 00



Date: 10 JUL 2019 20:45:52

### High Band Edge Plot on Channel 78



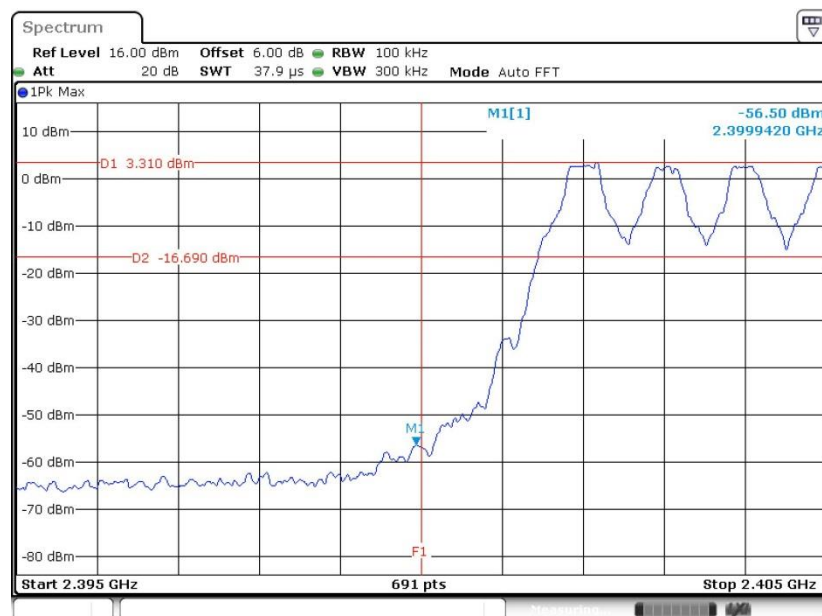
Date: 10 JUL 2019 20:52:53



## 3.6.6 Test Result of Conducted Hopping Mode Band Edges

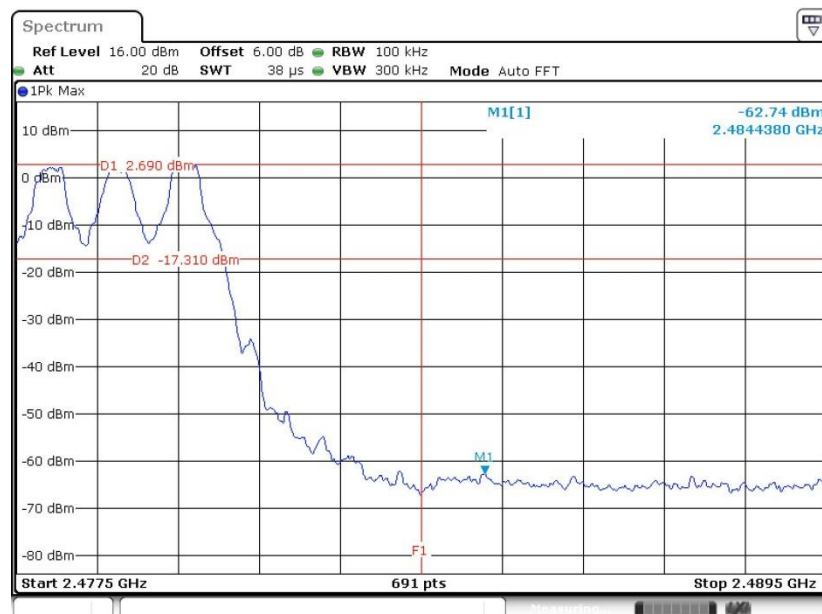
|                 |          |                     |        |
|-----------------|----------|---------------------|--------|
| Test Mode :     | 1Mbps    | Temperature :       | 21~25℃ |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54% |

Hopping Mode Low Band Edge Plot



Date: 10 JUL 2019 20:21:54

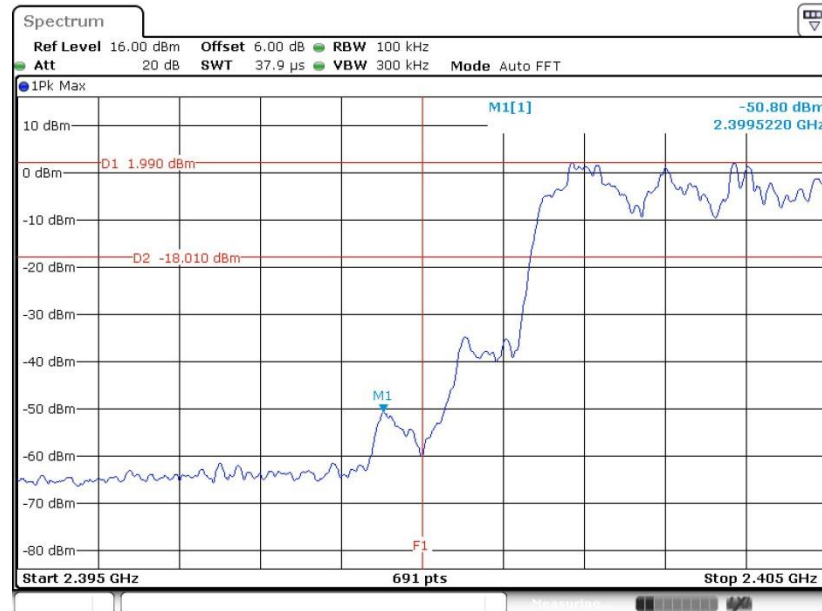
Hopping Mode High Band Edge Plot



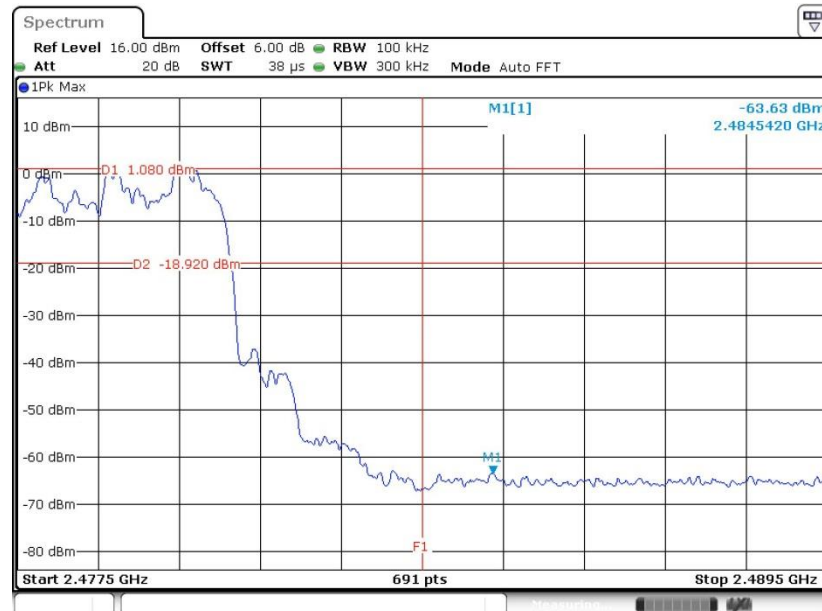
Date: 10 JUL 2019 20:31:03



|                 |          |                     |         |
|-----------------|----------|---------------------|---------|
| Test Mode :     | 2Mbps    | Temperature :       | 21~25°C |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54%  |

**Hopping Mode Low Band Edge Plot**

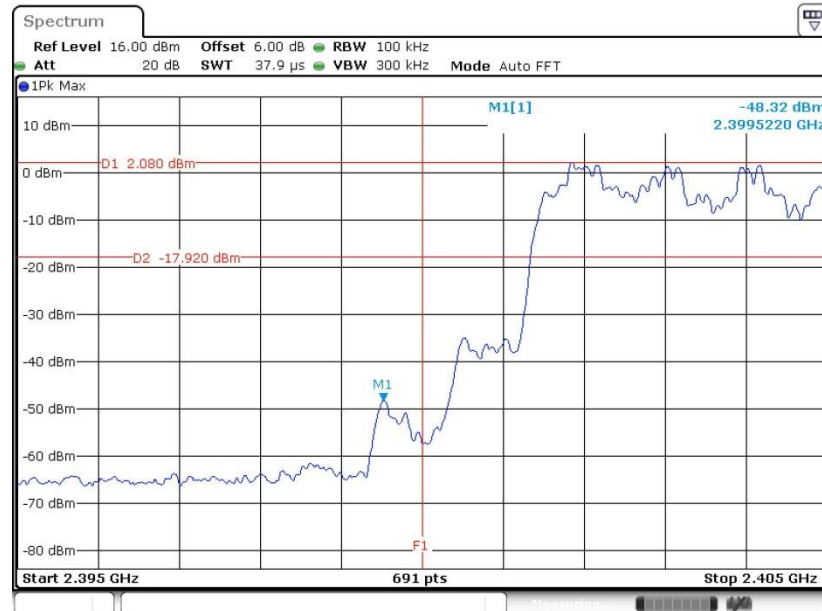
Date: 10 JUL 2019 20:35:14

**Hopping Mode High Band Edge Plot**

Date: 10 JUL 2019 20:42:07



|                 |          |                     |         |
|-----------------|----------|---------------------|---------|
| Test Mode :     | 3Mbps    | Temperature :       | 21~25°C |
| Test Engineer : | Lion Ran | Relative Humidity : | 51~54%  |

**Hopping Mode Low Band Edge Plot**

Date: 10 JUL 2019 20:46:09

**Hopping Mode High Band Edge Plot**

Date: 10 JUL 2019 20:53:15

## 3.7 Conducted Spurious Emission Measurement

### 3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

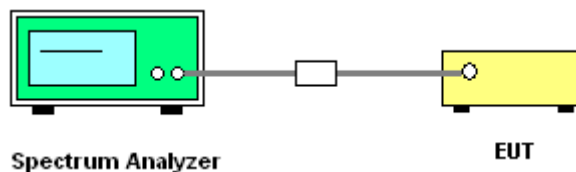
### 3.7.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.7.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

### 3.7.4 Test Setup

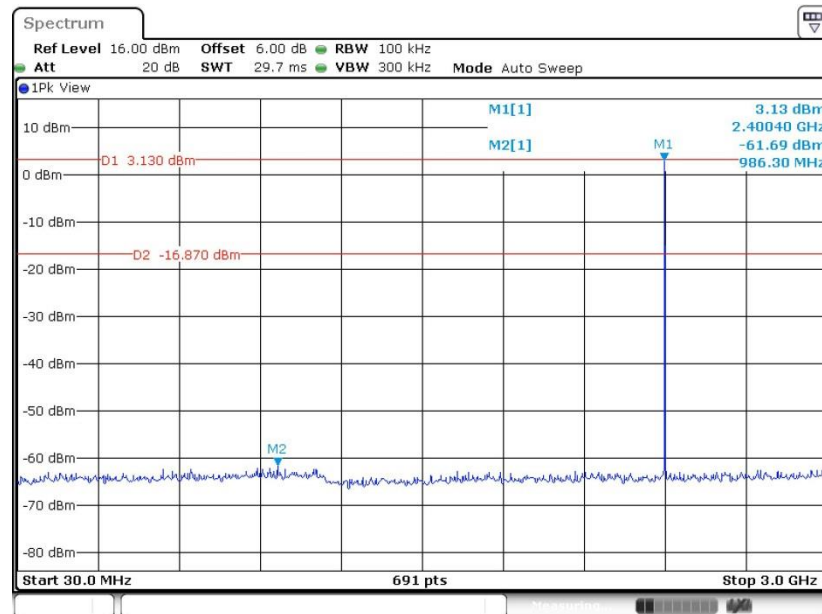




## 3.7.5 Test Result of Conducted Spurious Emission

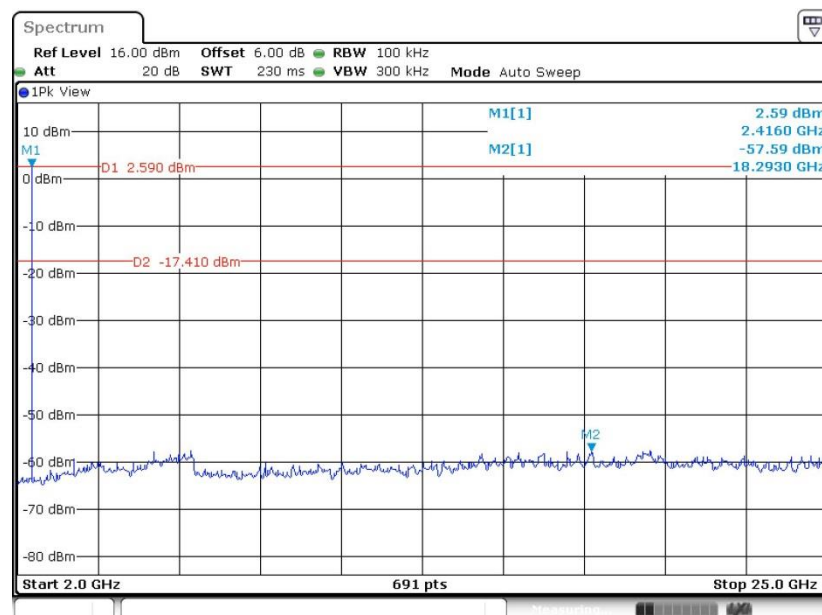
|                |          |                     |          |
|----------------|----------|---------------------|----------|
| Test Mode :    | 1Mbps    | Temperature :       | 21~25°C  |
| Test Channel : | 00,39,78 | Relative Humidity : | 51~54%   |
|                |          | Test Engineer :     | Lion Ran |

CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 10 JUL 2019 20:23:37

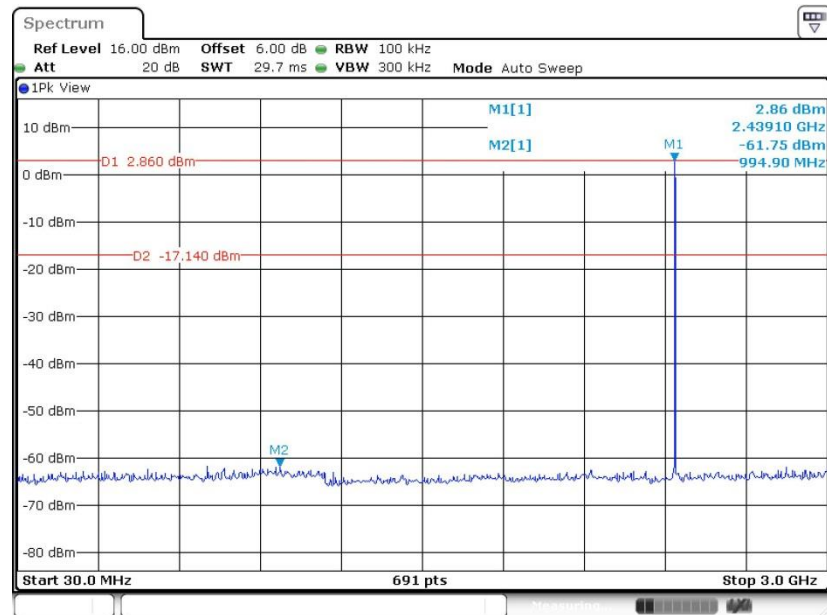
1Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 10 JUL 2019 20:24:07

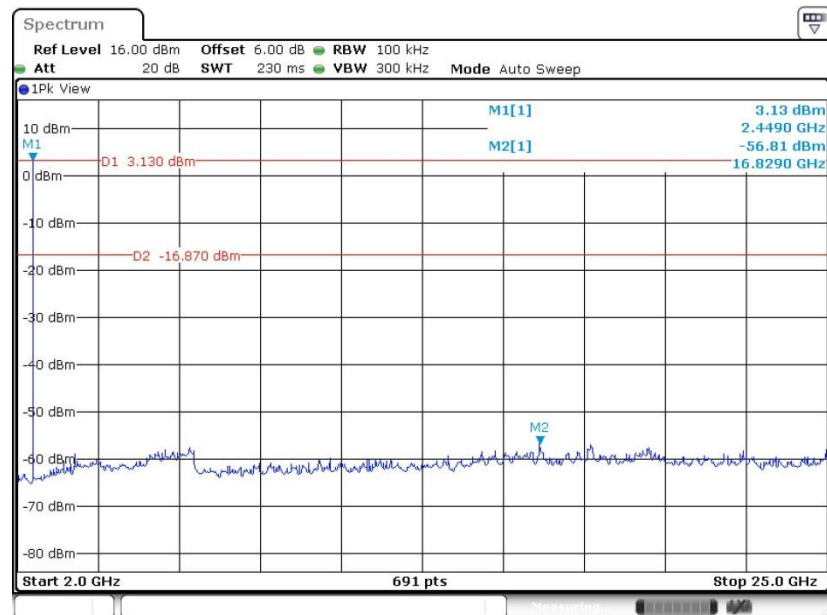


CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 10.JUL.2019 20:28:07

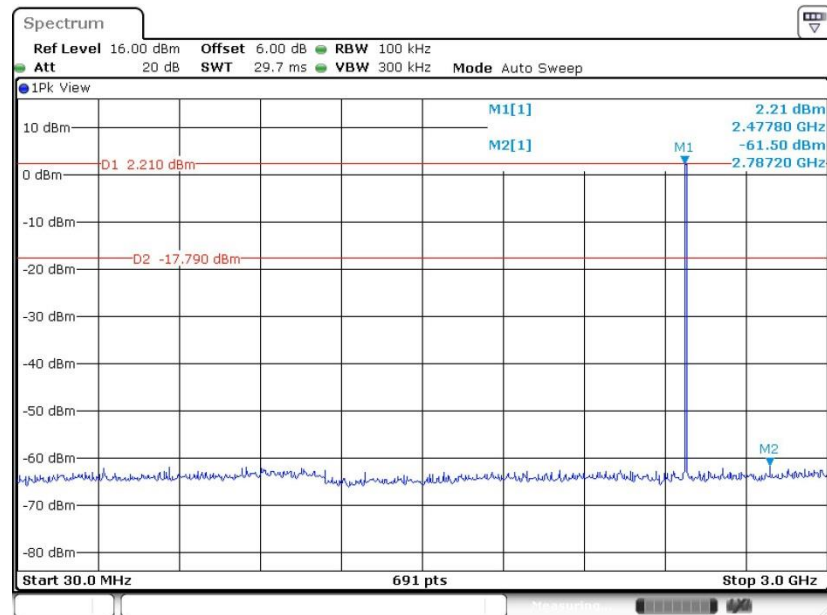
CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 10.JUL.2019 20:28:36

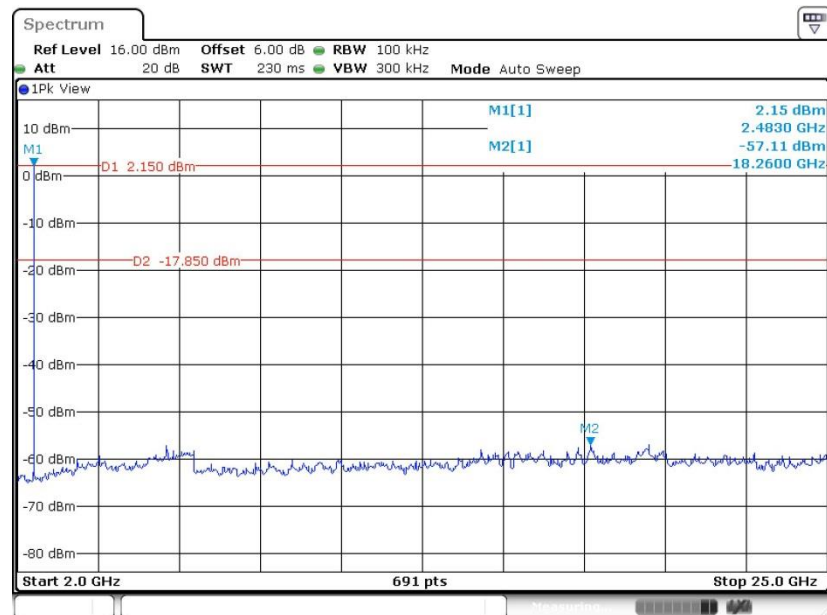


CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 10 JUL 2019 20:32:13

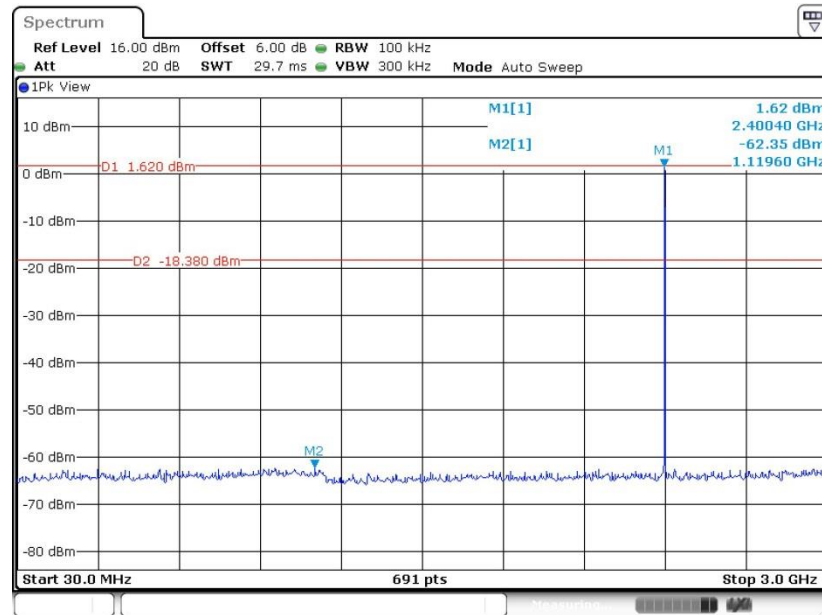
CSE Plot on Ch 78 between 2 GHz ~ 25 GHz



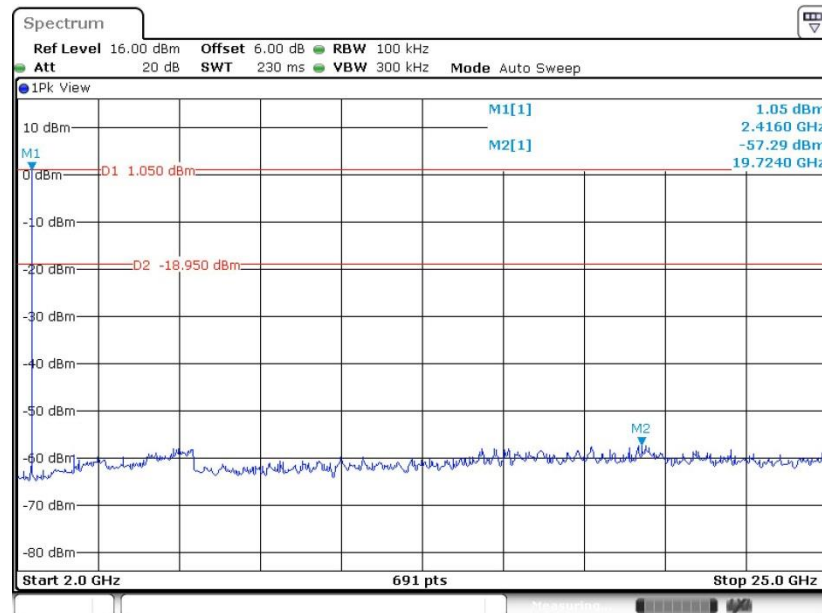
Date: 10 JUL 2019 20:32:43



|                |          |                     |          |
|----------------|----------|---------------------|----------|
| Test Mode :    | 2Mbps    | Temperature :       | 21~25°C  |
| Test Channel : | 00,39,78 | Relative Humidity : | 51~54%   |
|                |          | Test Engineer :     | Lion Ran |

**CSE Plot on Ch 00 between 30MHz ~ 3 GHz**

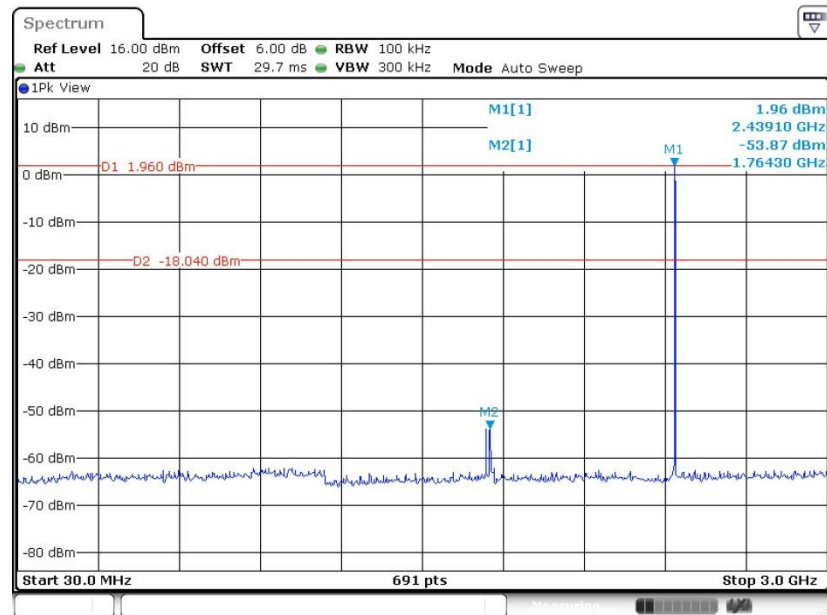
Date: 10.JUL.2019 20:36:20

**CSE Plot on Ch 00 between 2 GHz ~ 25 GHz**

Date: 10.JUL.2019 20:36:48

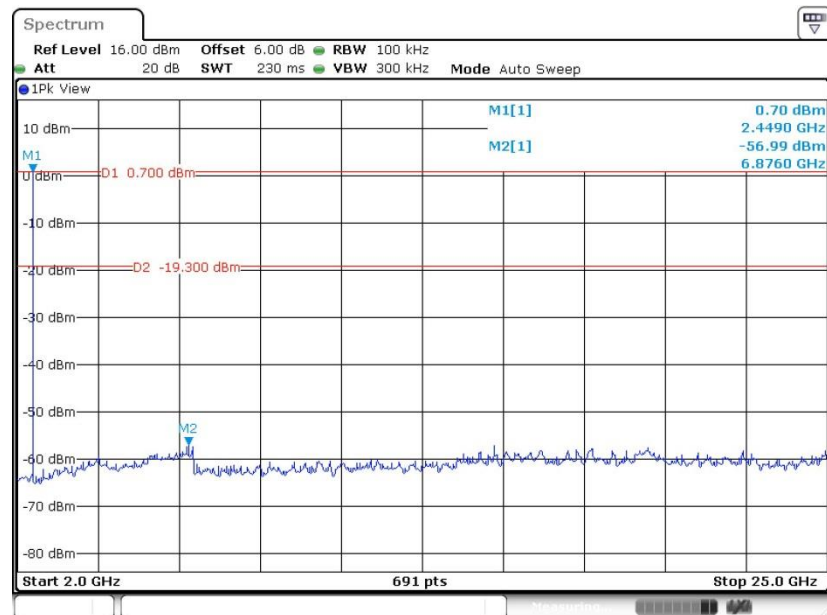


CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 10 JUL 2019 20:39:26

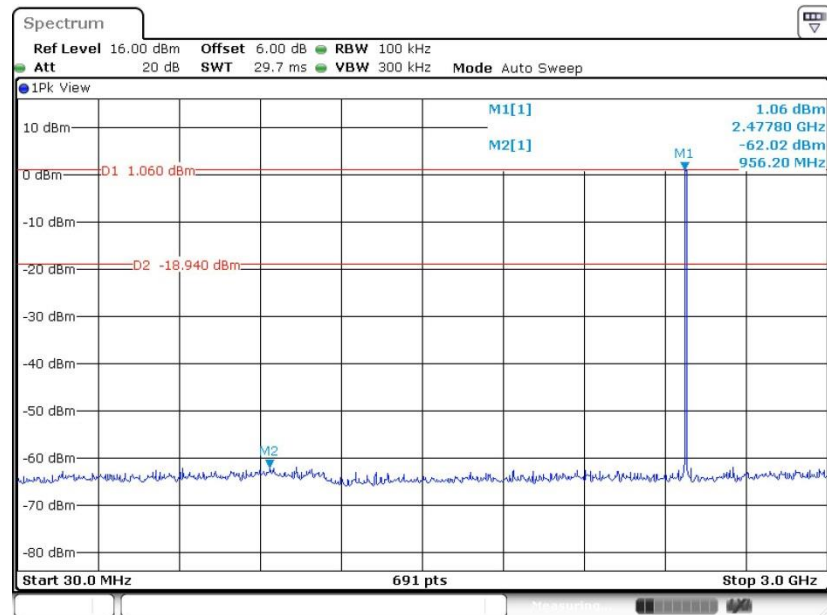
CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 10 JUL 2019 20:39:54

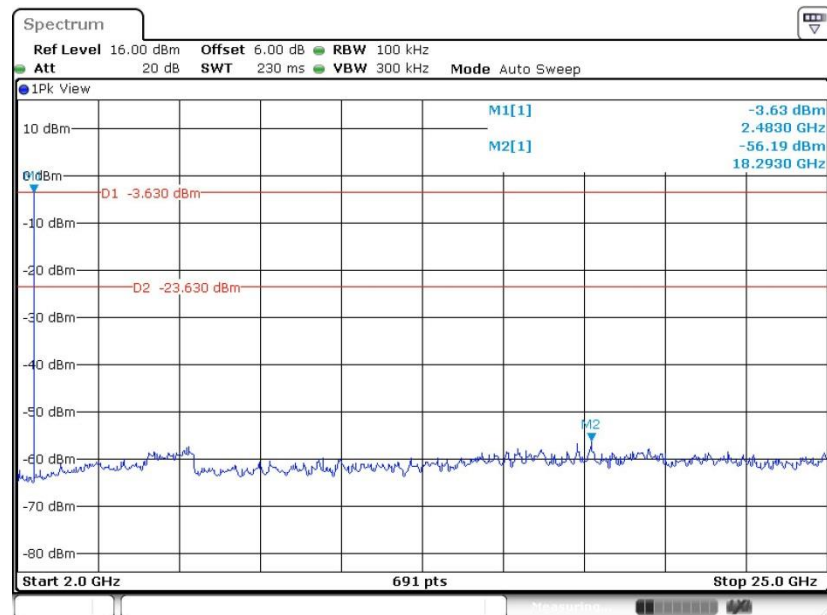


CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 10 JUL 2019 20:43:17

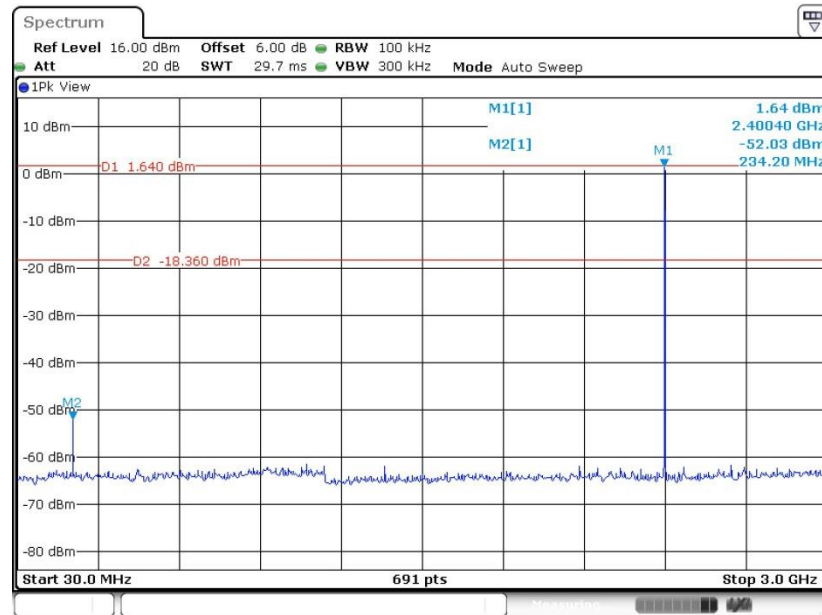
CSE Plot on Ch 78 between 2 GHz ~ 25 GHz



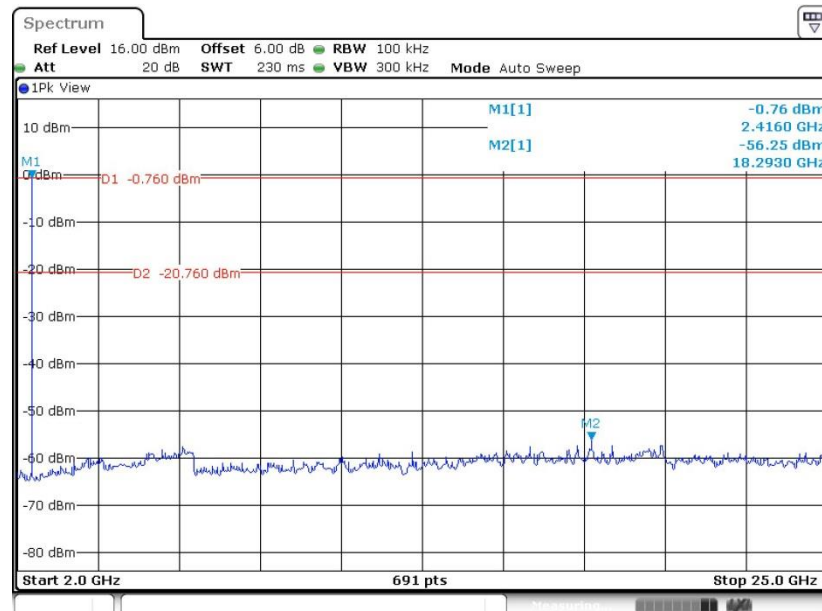
Date: 10 JUL 2019 20:43:43



|                |          |                     |          |
|----------------|----------|---------------------|----------|
| Test Mode :    | 3Mbps    | Temperature :       | 21~25°C  |
| Test Channel : | 00,39,78 | Relative Humidity : | 51~54%   |
|                |          | Test Engineer :     | Lion Ran |

**CSE Plot on Ch 00 between 30MHz ~ 3 GHz**

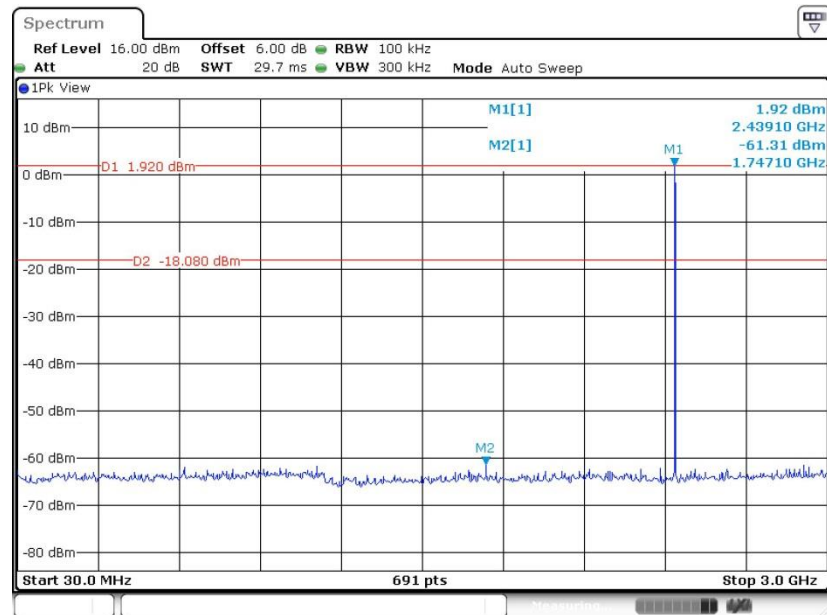
Date: 10.JUL.2019 20:47:16

**CSE Plot on Ch 00 between 2 GHz ~ 25 GHz**

Date: 10.JUL.2019 20:47:45

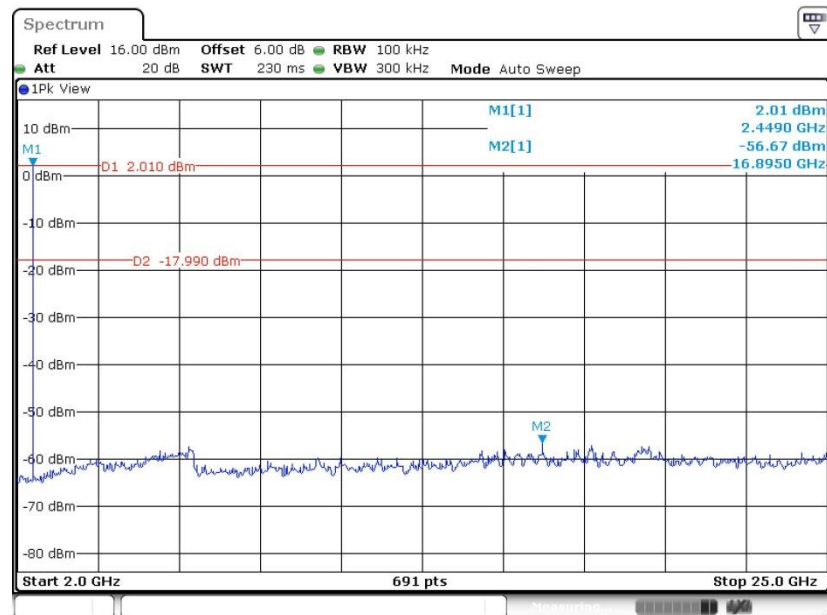


CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 10 JUL 2019 20:50:38

CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 10 JUL 2019 20:51:05