# FCC RADIO TEST REPORT

| | | |
|---|---|---|
| **FCC ID** | : | **UZ7MC930P** |
| **Equipment** | : | **Mobile computer** |
| **Brand Name** | : | **Zebra** |
| **Model Name** | : | **MC930P** |
| **Applicant** | : | **Zebra Technologies Corporation**<br>**1 Zebra Plaza, Holtsville, NY 11742** |
| **Manufacturer** | : | **Zebra Technologies Corporation**<br>**1 Zebra Plaza, Holtsville, NY 11742** |
| **Standard** | : | **FCC Part 15 Subpart C §15.247** |

**The product was received on Nov. 26, 2018 and testing was started from Dec. 25, 2018 and completed on Mar. 08, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.**

Jones Tsai

**Reviewed by: Jones Tsai**

***SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory***
*No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)*

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# History of this test report

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| FR8N2626A | 01 | Initial issue of report | Mar. 13, 2019 |
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# Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---|---|---|---|---|
| 3.1 | 15.247(a)(1) | Number of Channels | Pass | - |
| 3.2 | 15.247(a)(1) | Hopping Channel Separation | Pass | - |
| 3.3 | 15.247(a)(1) | Dwell Time of Each Channel | Pass | - |
| 3.4 | 15.247(a)(1) | 20dB Bandwidth | Pass | - |
| 3.4 | 2.1049 | 99% Occupied Bandwidth | Reporting only | - |
| 3.5 | 15.247(b)(1) | Peak Output Power | Pass | - |
| 3.6 | 15.247(d) | Conducted Band Edges | Pass | - |
| 3.7 | 15.247(d) | Conducted Spurious Emission | Pass | - |
| 3.8 | 15.247(d) | Radiated Band Edges and Radiated Spurious Emission | Pass | Under limit 3.20 dB at 947.500 MHz |
| 3.9 | 15.207 | AC Conducted Emission | Pass | Under limit 12.59 dB at 0.175 MHz |
| 3.10 | 15.203 & 15.247(b) | Antenna Requirement | Pass | - |

| **Declaration of Conformity:** |
|---|
| The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. |
| **Comments and Explanations:** |
| The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. |

**Reviewed by: Wii Chang**

**Report Producer: Yimin Ho**

# 1 General Description

## 1.1 Product Feature of Equipment Under Test

| Product Feature | |
|---|---|
| **Equipment** | Mobile computer |
| **Brand Name** | Zebra |
| **Model Name** | MC930P |
| **FCC ID** | UZ7MC930P |
| **Sample 1** | EUT with SKU 3 |
| **Sample 2** | EUT with SKU 4 |
| **Sample 3** | EUT with SKU 5 |
| **Sample 4** | EUT with SKU 6 |
| **Sample 5** | EUT with SKU 7 |
| **EUT supports Radios application** | NFC<br>WLAN 11a/b/g/n HT20/HT40<br>WLAN 11ac VHT20/VHT40/VHT80<br>Bluetooth BR/EDR/LE |
| **HW Version** | EV1 |
| **SW Version** | 01-14-11.00-OG |
| **MFD** | 13NOV18 |
| **EUT Stage** | Engineering Sample |

**Remark:** The above EUT's information was declared by manufacturer.

| Specification of Accessories | | | | |
|---|---|---|---|---|
| **Adapter (5V/2.5A)** | **Brand Name** | Zebra | **Part Number** | PWR-WUA5V12W0US |
| **USB-C Adapter** | **Brand Name** | Zebra | **Part Number** | CBL-MC93-USBCHG-01 |
| **USB-C cable** | **Brand Name** | Zebra | **Part Number** | CBL-TC2X-USBC-01 |
| **Std Battery** | **Brand Name** | Zebra | **Part Number** | BT-000370-00 |
| **Fzr Battery** | **Brand Name** | Zebra | **Part Number** | BT-000371-00 |
| **Holster** | **Brand Name** | Zebra | **Part Number** | 051607-79N1-18 |

**<Sample Information>**

| Model Name | MC930P | | | | |
|---|---|---|---|---|---|
| | **SKU3** | **SKU4** | **SKU5** | **SKU6** | **SKU7** |
| **Organization / Function / Group** | EV1a-G21 | EV1a-G22 | EV1a-G23 | EV1a-F11 | EV1a-F13 |
| **nm** | G-2S-1D-53k | G-2S-2D-53k | G-2S-LRI-53k | G-1F-1D-53k | G-1F-LRI-53k |
| **Product Number** | MC930P-GSBDG4NA | MC930P-GSDDG4NA | MC930P-GSFDG4NA | MC930P-GFADG4NA | MC930P-GFEDG4NA |
| **Form factor** | Gun | Gun | Gun | Gun | Gun |
| **Package/ Component Category** | Pkg2 | Pkg2 | Pkg2 | Pkg1 CS | Pkg 1 CS |
| **NFC** | YES | YES | YES | YES | YES |
| **Vib** | YES | YES | YES | YES | YES |
| **Camera** | YES | YES | YES | NO | NO |
| **NI** | NO | NO | NO | NO | NO |
| **Side Trigger** | NO | NO | NO | NO | NO |
| **Display + TP Stackup** | Option2 | Option2 | Option2 | Option5 | Option5 |
| **Scanner** | SE965 | SE4750SR | SE4850 | SE965 | SE4850 |
| **Battery** | Std | Std | Std | Fzr | Fzr |
| **Keyboard** | 53 Key | 53 Key | 53 Key | 53 Key | 53 Key |
| **Build Date** | Oct 2018 | Oct 2018 | Oct 2018 | Nov 2018 | Nov 2018 |

## 1.2 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) : 3.69 dBm (0.0023 W)<br>Bluetooth EDR (2Mbps) : 2.64 dBm (0.0018 W)<br>Bluetooth EDR (3Mbps) : 2.98 dBm (0.0020 W) |
| **99% Occupied Bandwidth** | Bluetooth BR(1Mbps) : 0.834MHz<br>Bluetooth EDR (2Mbps) : 1.166MHz<br>Bluetooth EDR (3Mbps) : 1.149MHz |
| **Antenna Type / Gain** | Patch Antenna with gain 3.85 dBi |
| **Type of Modulation** | Bluetooth BR (1Mbps) : GFSK<br>Bluetooth EDR (2Mbps) : $\pi$ /4-DQPSK<br>Bluetooth EDR (3Mbps) : 8-DPSK |

## 1.3 Modification of EUT

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

## 1.4 Testing Location

| | | | |
|---|---|---|---|
| **Test Site** | SPORTON INTERNATIONAL INC. | | |
| **Test Site Location** | No.52, Huaya 1st Rd., Guishan Dist.,<br>Taoyuan City, Taiwan (R.O.C.)<br>TEL: +886-3-327-3456<br>FAX: +886-3-328-4978 | | |
| **Test Site No.** | **Sporton Site No.** | | |
| | TH05-HY | CO05-HY | 03CH07-HY |

**Note:** The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No. TW1190

## 1.5 Applicable Standards

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

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- 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. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (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

| Channel | Frequency | Bluetooth Average Output Power | | |
|---|---|---|---|---|
| | | GFSK / 1Mbps | | |
| | | DH1 | DH3 | DH5 |
| Ch00 | 2402MHz | 1.57 dBm | 1.54 dBm | 1.55 dBm |
| Ch39 | 2441MHz | **3.17 dBm** | 3.13 dBm | 3.13 dBm |
| Ch78 | 2480MHz | 2.89 dBm | 2.85 dBm | 2.85 dBm |

| Channel | Frequency | Bluetooth Average Output Power | | |
|---|---|---|---|---|
| | | π/4-DQPSK / 2Mbps | | |
| | | 2DH1 | 2DH3 | 2DH5 |
| Ch00 | 2402MHz | -1.75 dBm | -1.90 dBm | -1.92 dBm |
| Ch39 | 2441MHz | **-0.26 dBm** | -0.40 dBm | -0.45 dBm |
| Ch78 | 2480MHz | -0.29 dBm | -0.44 dBm | -0.50 dBm |

| Channel | Frequency | Bluetooth Average Output Power | | |
|---|---|---|---|---|
| | | 8-DPSK / 3Mbps | | |
| | | 3DH1 | 3DH3 | 3DH5 |
| Ch00 | 2402MHz | -1.75 dBm | -1.93 dBm | -1.96 dBm |
| Ch39 | 2441MHz | **-0.24 dBm** | -0.42 dBm | -0.47 dBm |
| Ch78 | 2480MHz | -0.27 dBm | -0.45 dBm | -0.51 dBm |

| Channel | Frequency | Bluetooth Peak Output Power | | |
|---|---|---|---|---|
| | | GFSK / 1Mbps | | |
| | | DH1 | DH3 | DH5 |
| Ch00 | 2402MHz | 2.27 dBm | 2.25 dBm | 2.22 dBm |
| Ch39 | 2441MHz | **3.69 dBm** | 3.64 dBm | 3.62 dBm |
| Ch78 | 2480MHz | 3.42 dBm | 3.40 dBm | 3.38 dBm |

| Channel | Frequency | Bluetooth Peak Output Power | | |
|---|---|---|---|---|
| | | π/4-DQPSK / 2Mbps | | |
| | | 2DH1 | 2DH3 | 2DH5 |
| Ch00 | 2402MHz | 1.13 dBm | 1.10 dBm | 1.09 dBm |
| Ch39 | 2441MHz | **2.64 dBm** | 2.62 dBm | 2.60 dBm |
| Ch78 | 2480MHz | 2.59 dBm | 2.57 dBm | 2.56 dBm |

| Channel | Frequency | Bluetooth Peak Output Power | | |
|---|---|---|---|---|
| | | 8-DPSK / 3Mbps | | |
| | | 3DH1 | 3DH3 | 3DH5 |
| Ch00 | 2402MHz | 1.59 dBm | 1.54 dBm | 1.52 dBm |
| Ch39 | 2441MHz | **2.98 dBm** | 2.97 dBm | 2.90 dBm |
| Ch78 | 2480MHz | 2.91 dBm | 2.87 dBm | 2.85 dBm |

**Remark:**The data rate was set in 1Mbps for all the test items due to the highest RF output power.

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 (Y 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.

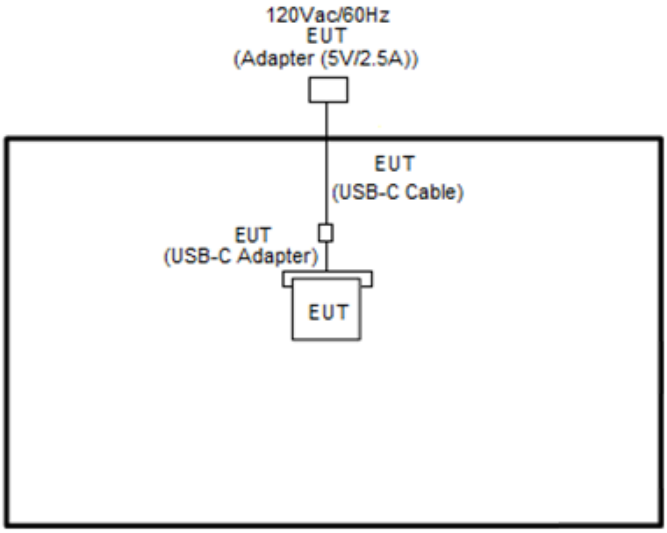
| Summary table of Test Cases | | | |
|---|---|---|---|
| **Test Item** | **Data Rate / Modulation** | | |
| | **Bluetooth BR 1Mbps GFSK** | **Bluetooth EDR 2Mbps π/4-DQPSK** | **Bluetooth EDR 3Mbps 8-DPSK** |
| **Conducted Test Cases** | Mode 1: CH00_2402 MHz<br>Mode 2: CH39_2441 MHz<br>Mode 3: CH78_2480 MHz | Mode 4: CH00_2402 MHz<br>Mode 5: CH39_2441 MHz<br>Mode 6: CH78_2480 MHz | Mode 7: CH00_2402 MHz<br>Mode 8: CH39_2441 MHz<br>Mode 9: CH78_2480 MHz |
| **Radiated Test Cases Radiated Test Cases** | **Bluetooth BR 1Mbps GFSK** | | |
| | Mode 1: CH00_2402 MHz<br>Mode 2: CH39_2441 MHz<br>Mode 3: CH78_2480 MHz | | |
| | **Bluetooth BR 3Mbps 8-DPSK** | | |
| | Mode 1: CH00_2402 MHz<br>Mode 2: CH39_2441 MHz<br>Mode 3: CH78_2480 MHz | | |
| **AC Conducted Emission** | Mode 1: Bluetooth Link + WLAN (2.4GHz) Link + Scan + MP3 Play + Keypad (53) + Std Battery + USB-C Adapter + USB-C Cable + Data Link with Notebook (Notebook to SD Card) for Sample 2 | | |

**Remark:**

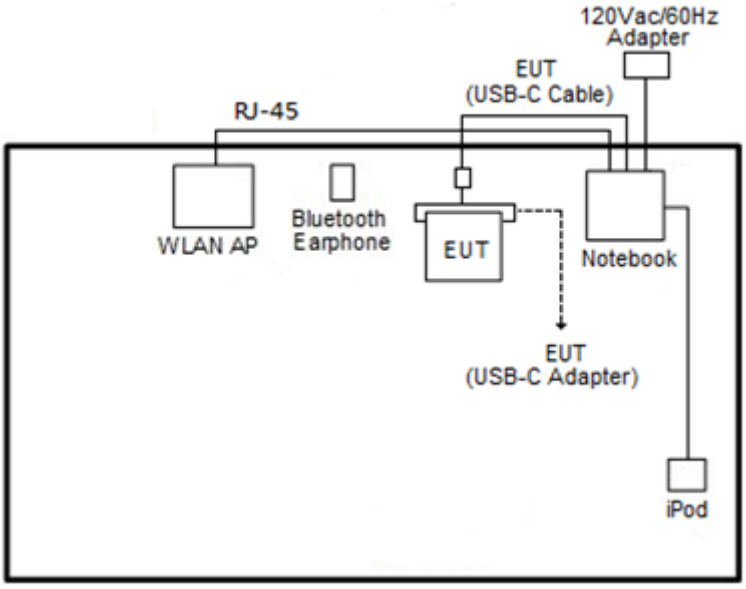
1. The conducted spurious emissions and conducted band edge measurement for other data rates were not worse than 1Mbps, and no other significantly frequencies found in conducted spurious emission.
2. For Radiated Test Cases, the tests were performed with Std Battery and Sample 1.

## 2.3 Connection Diagram of Test System

**<Bluetooth Tx Mode>**




**<AC Conducted Emission Mode>**



## 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 | ASUS | RT-AC66U | MSQ-RTAC66U | N/A | Unshielded, 1.8 m |
| 2. | Bluetooth Earphone | Sony Ericsson | MW600 | PY7DDA-2029 | N/A | N/A |
| 3. | Notebook | DELL | Latitude E6320 | FCC DoC/ Contains FCC ID: QDS-BRCM1054 | N/A | AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m |
| 4. | iPod | Apple | A1285 | FCC DoC | Shielded, 1.0 m | N/A |
| 5. | SD Card | SanDisk | MicroSD HC | FCC DoC | N/A | N/A |

## 2.5 EUT Operation Test Setup

The RF test items, utility “QRCT” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

## 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 and attenuator factor 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 and attenuator factor.
*Offset = RF cable loss + attenuator factor.*
Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

*Offset(dB) = RF cable loss(dB) + attenuator factor(dB).*
= 4.2 + 10 = 14.2 (dB)

# 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.

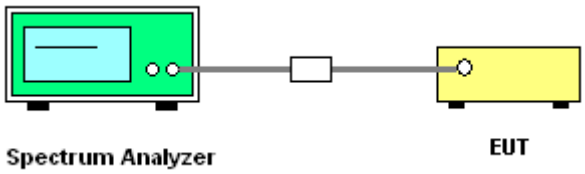
### 3.1.2 Measuring Instruments

See list of measuring equipment 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 ≥ 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

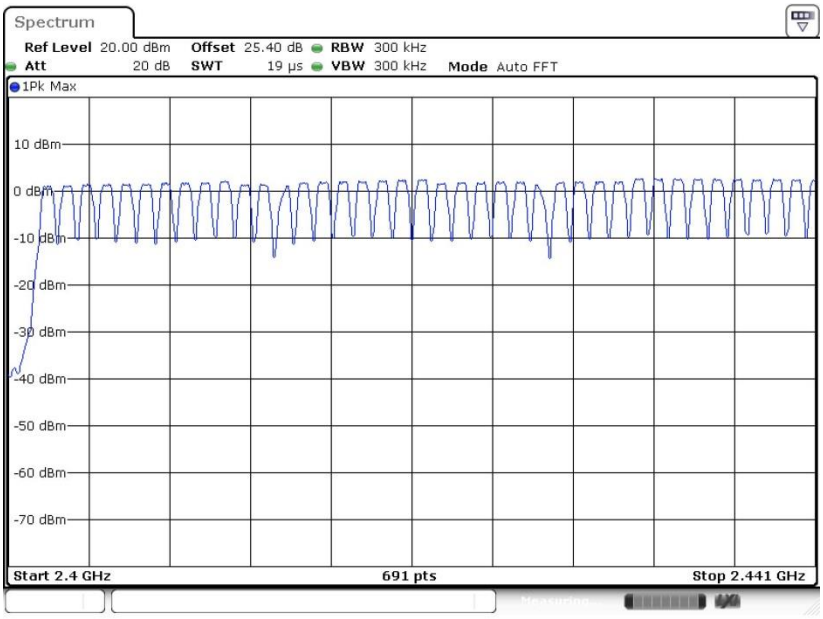


## 3.1.5 Test Result of Number of Hopping Frequency

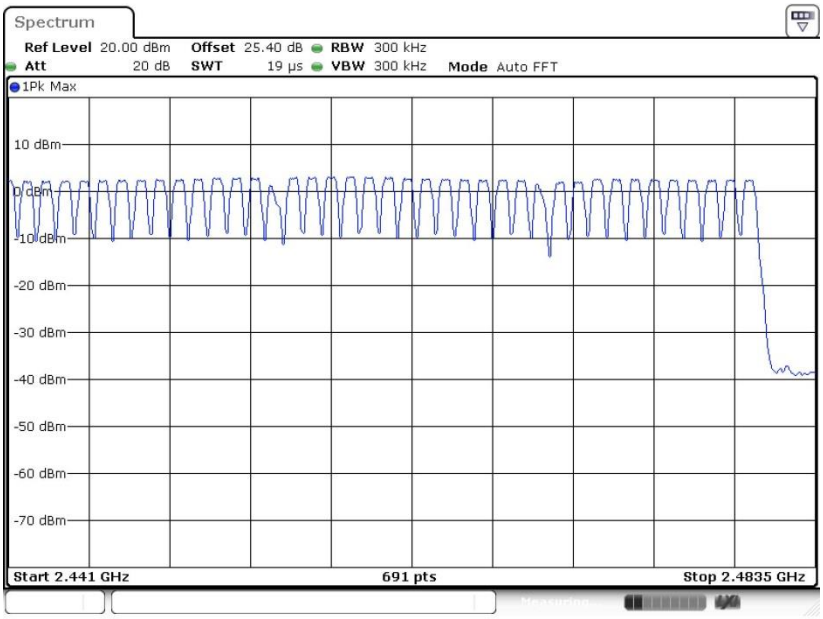
| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

| Number of Hopping (Channel) | Adaptive Frequency Hopping (Channel) | Limits (Channel) | Pass/Fail |
|---|---|---|---|
| 79 | 20 | > 15 | Pass |

**Number of Hopping Channel Plot on Channel 00 - 78**




Date: 7.MAR.2019 10:39:43

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# 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

See list of measuring equipment 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 ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

## 3.2.4 Test Setup

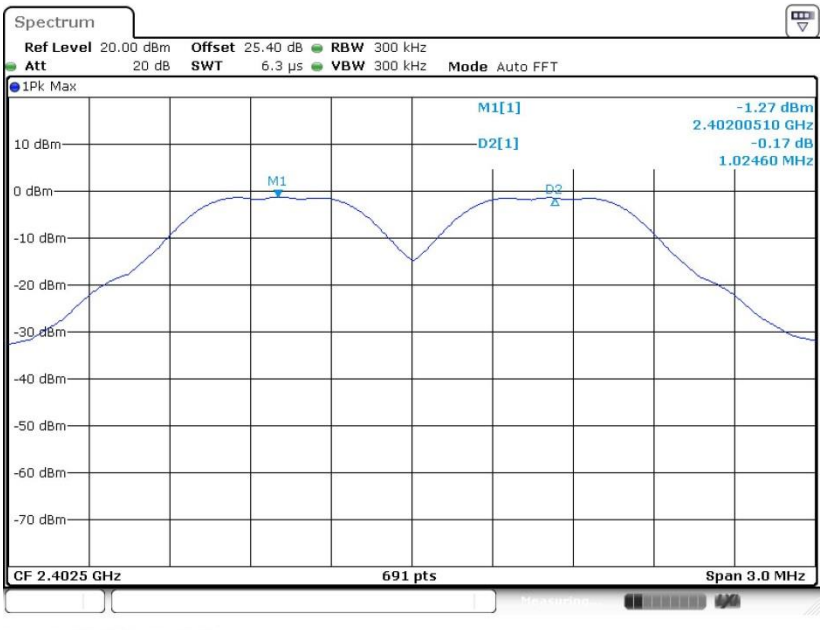
## 3.2.5 Test Result of Hopping Channel Separation

| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

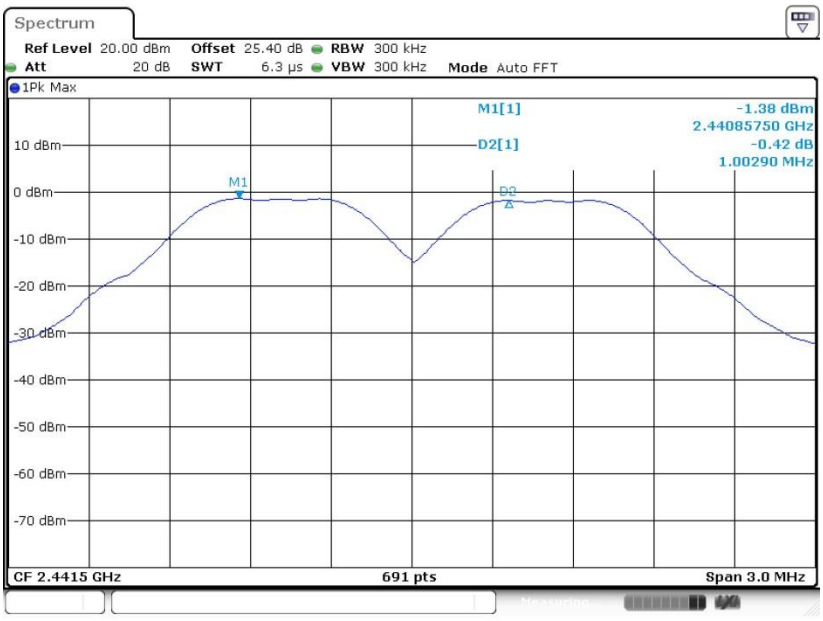
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Hopping Channel Separation Measurement (MHz) | Hopping Channel Separation Measurement Limit (MHz) | Pass/Fail |
|---|---|---|---|---|---|---|---|
| DH | 1Mbps | 1 | 0 | 2402 | 1.025 | 0.5827 | Pass |
| DH | 1Mbps | 1 | 39 | 2441 | 1.003 | 0.5827 | Pass |
| DH | 1Mbps | 1 | 78 | 2480 | 1.003 | 0.5827 | Pass |
| 2DH | 2Mbps | 1 | 0 | 2402 | 1.003 | 0.8365 | Pass |
| 2DH | 2Mbps | 1 | 39 | 2441 | 1.003 | 0.8336 | Pass |
| 2DH | 2Mbps | 1 | 78 | 2480 | 1.012 | 0.8365 | Pass |
| 3DH | 3Mbps | 1 | 0 | 2402 | 1.007 | 0.8278 | Pass |
| 3DH | 3Mbps | 1 | 39 | 2441 | 1.003 | 0.8278 | Pass |
| 3DH | 3Mbps | 1 | 78 | 2480 | 1.003 | 0.8278 | Pass |

**<1Mbps>**

**Channel Separation Plot on Channel 00 - 01**

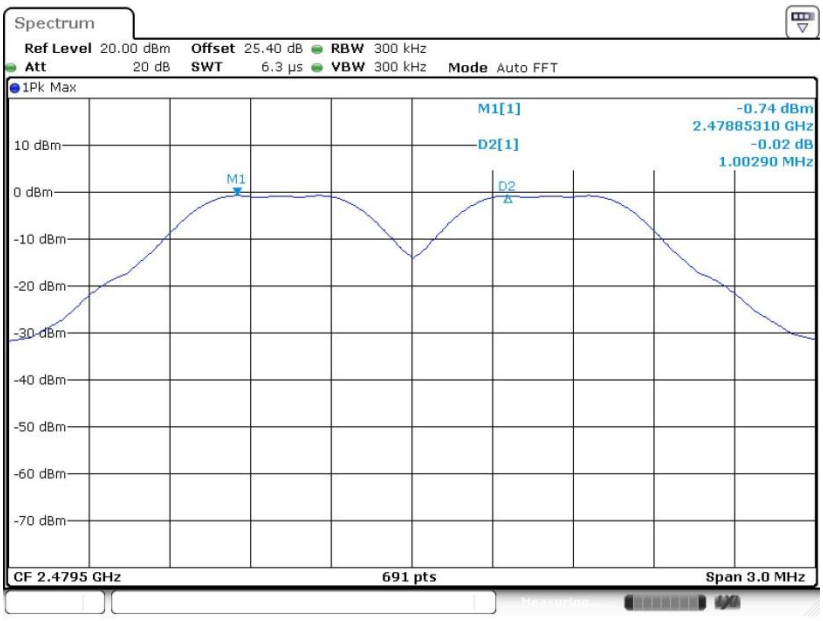


### Channel Separation Plot on Channel 39 - 40




Date: 7.MAR.2019 09:20:57

### Channel Separation Plot on Channel 77 - 78

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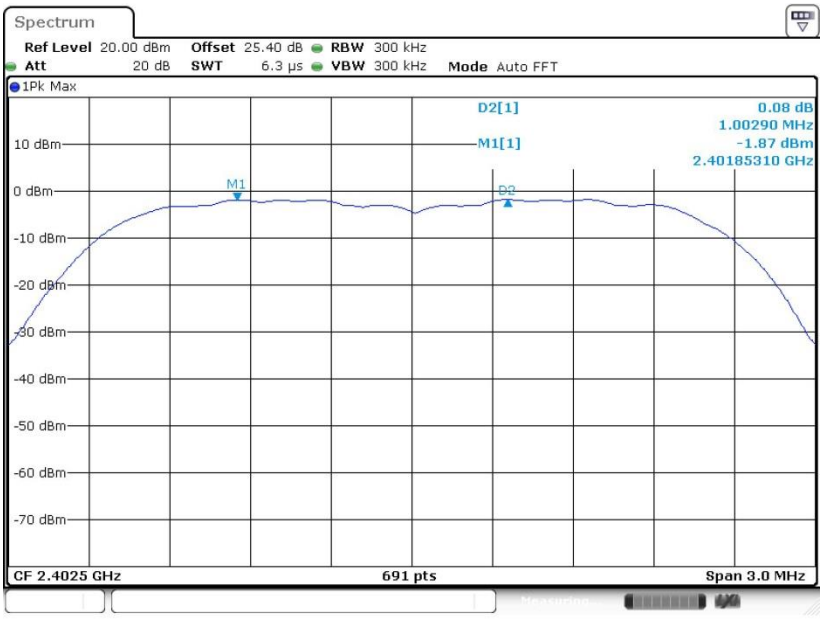
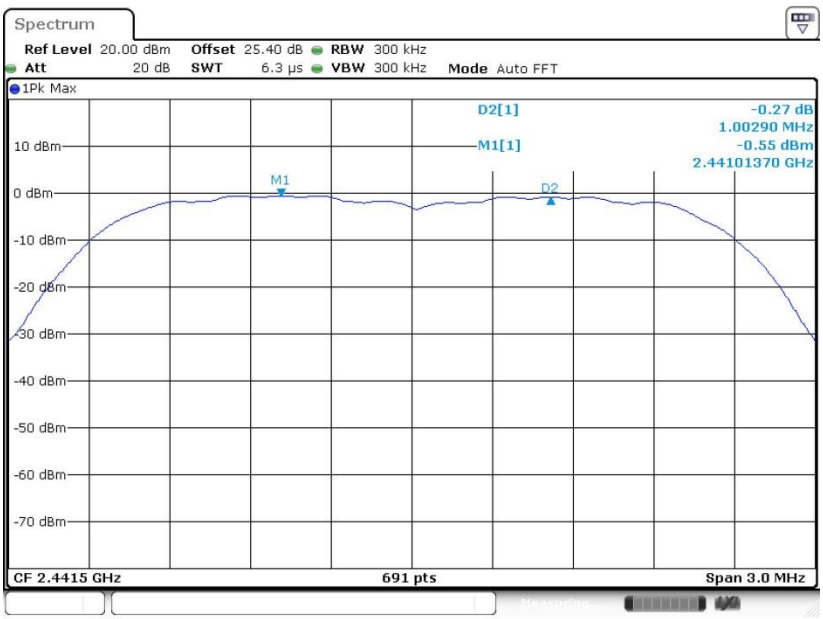
**<2Mbps>**

**Channel Separation Plot on Channel 00 - 01**



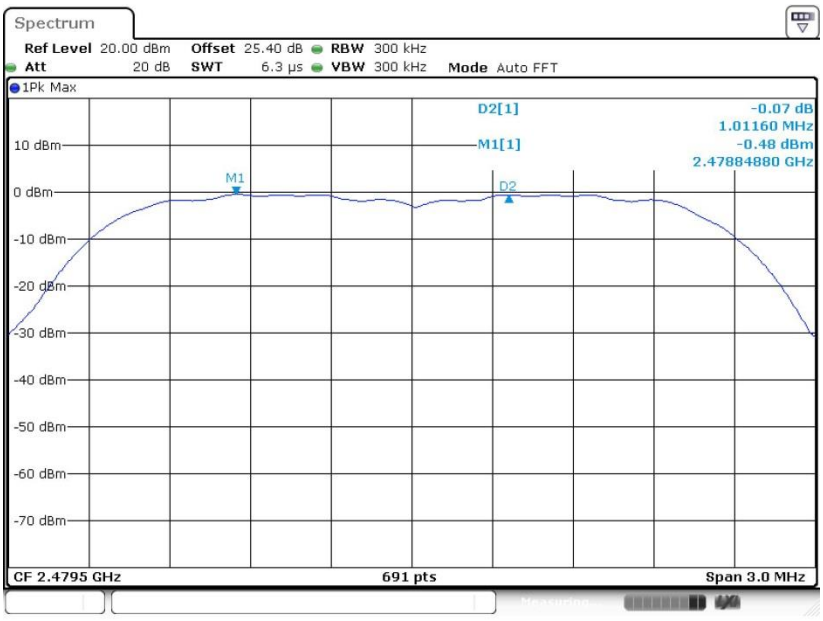

Date: 7.MAR.2019 10:55:27

**Channel Separation Plot on Channel 39 - 40**




Date: 7.MAR.2019 11:13:39

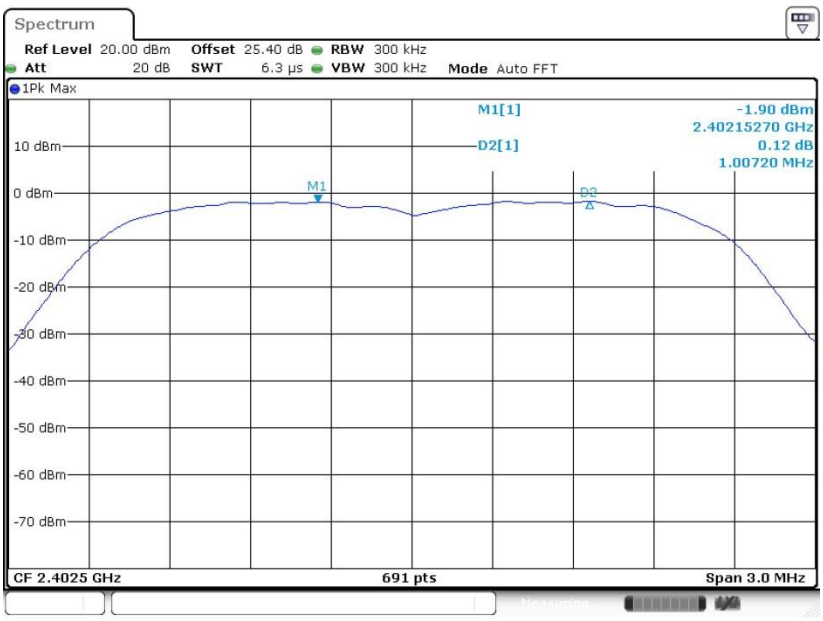
### Channel Separation Plot on Channel 77 - 78




Date: 7.MAR.2019 11:36:25

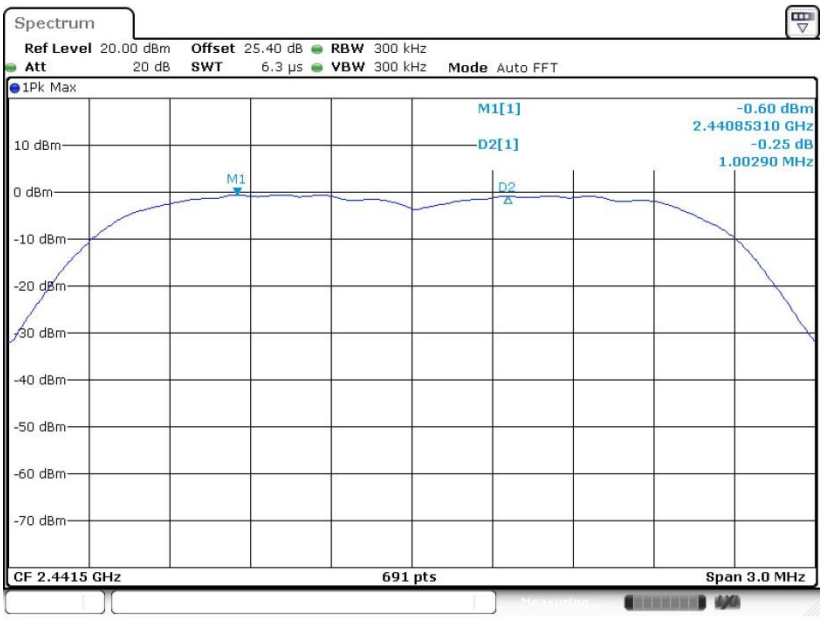
### <3Mbps>

### Channel Separation Plot on Channel 00 - 01



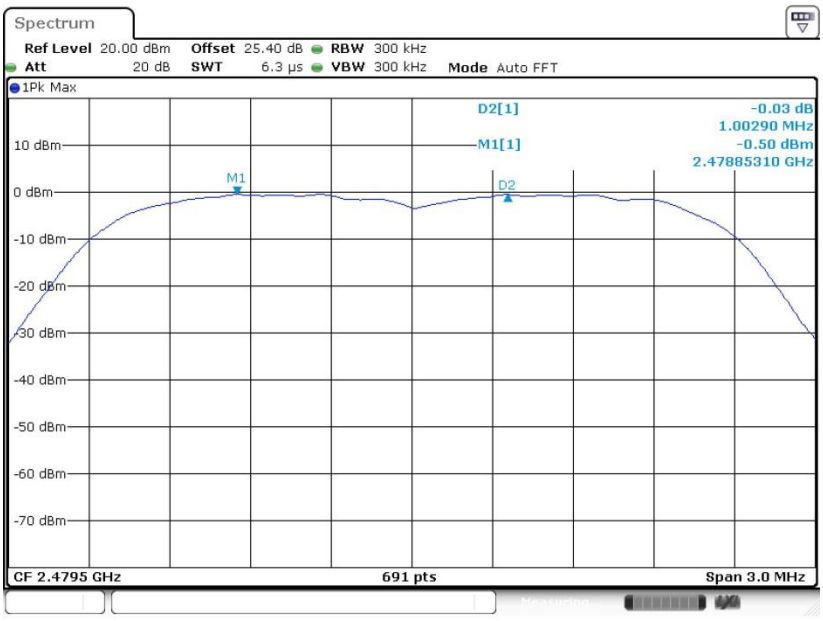

Date: 7.MAR.2019 12:24:29

### Channel Separation Plot on Channel 39 - 40




Date: 7.MAR.2019 12:22:15

### Channel Separation Plot on Channel 77 - 78




Date: 7.MAR.2019 12:00:32

# 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.

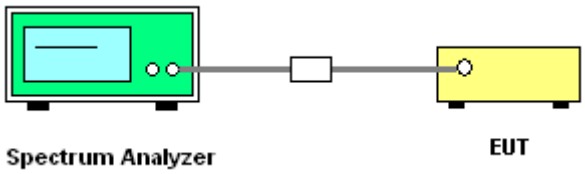
## 3.3.2 Measuring Instruments

See list of measuring equipment 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 ≥ 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

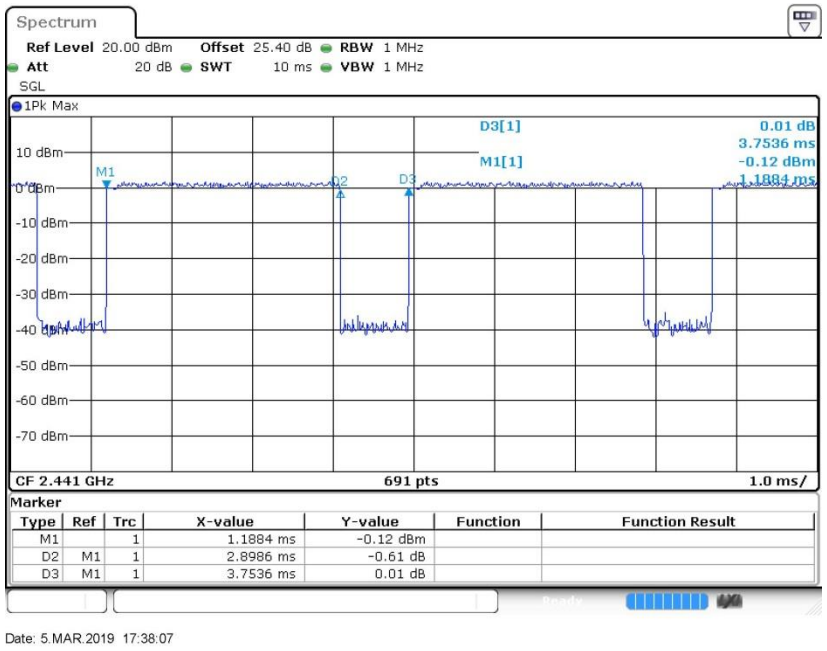


### 3.3.5 Test Result of Dwell Time

| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

| Mod. | Hopping Channel Number Rate | Hops Over Occupancy Time(hops) | Package Transfer Time (msec) (MHz) | Dwell Time (sec) | Limits (sec) | Pass/Fail |
|---|---|---|---|---|---|---|
| **Nomal** | 79 | 106.67 | 2.90 | 0.31 | 0.4 | Pass |
| **AFH** | 20 | 53.33 | 2.90 | 0.15 | 0.4 | Pass |

**Package Transfer Time Plot**




**Remark:**

**1.** 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.

**2.** 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.

**3.** 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

See list of measuring equipment 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 ≥ 1-5% of the OBW; VBW ≥ 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 ≥ 1-5% of the 99% bandwidth; VBW ≥ 3 * RBW; Sweep = auto; Detector function = peak;
   Trace = max hold.
6. Measure and record the results in the test report.

## 3.4.4 Test Setup

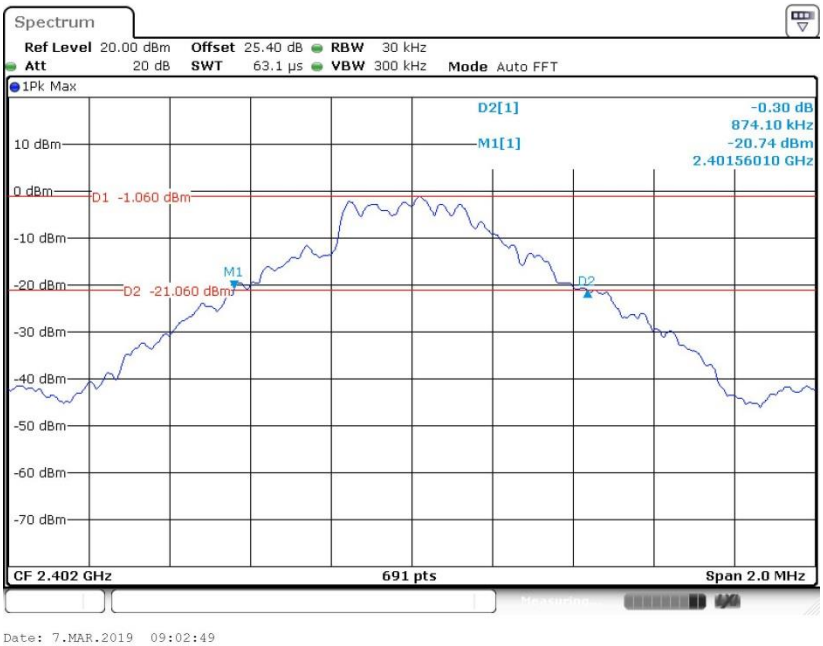
## 3.4.5 Test Result of 20dB Bandwidth

| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

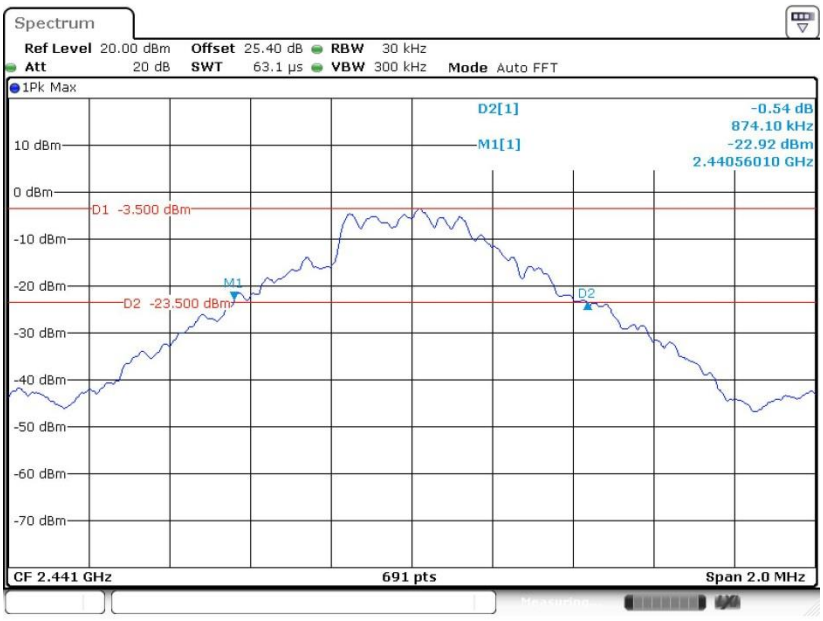
| Mod. | Data Rate | $N_{TX}$ | CH. | Freq. (MHz) | 20db BW (MHz) | Pass/Fail |
|---|---|---|---|---|---|---|
| DH | 1Mbps | 1 | 0 | 2402 | 0.874 | Pass |
| DH | 1Mbps | 1 | 39 | 2441 | 0.874 | Pass |
| DH | 1Mbps | 1 | 78 | 2480 | 0.874 | Pass |
| 2DH | 2Mbps | 1 | 0 | 2402 | 1.255 | Pass |
| 2DH | 2Mbps | 1 | 39 | 2441 | 1.250 | Pass |
| 2DH | 2Mbps | 1 | 78 | 2480 | 1.255 | Pass |
| 3DH | 3Mbps | 1 | 0 | 2402 | 1.242 | Pass |
| 3DH | 3Mbps | 1 | 39 | 2441 | 1.242 | Pass |
| 3DH | 3Mbps | 1 | 78 | 2480 | 1.242 | Pass |

**<1Mbps>**

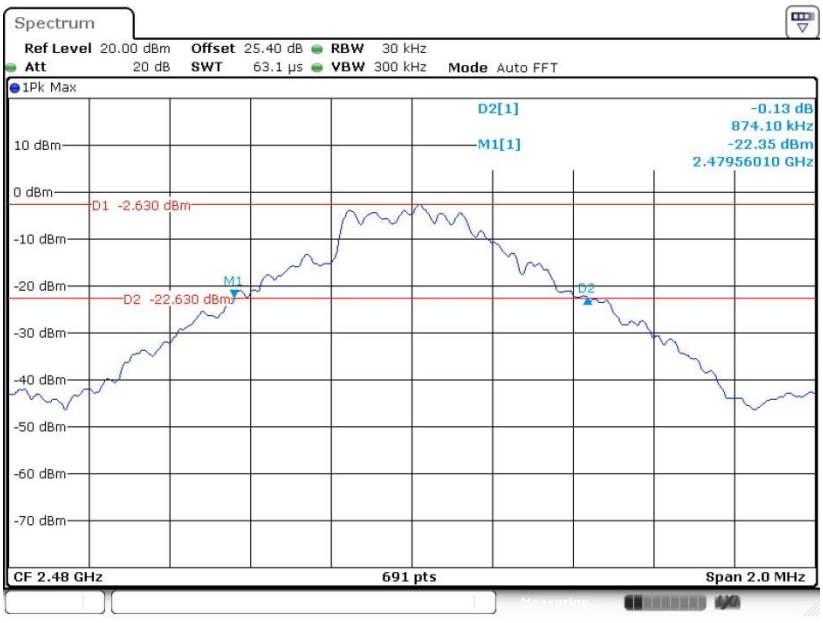
**20 dB Bandwidth Plot on Channel 00**



### 20 dB Bandwidth Plot on Channel 39

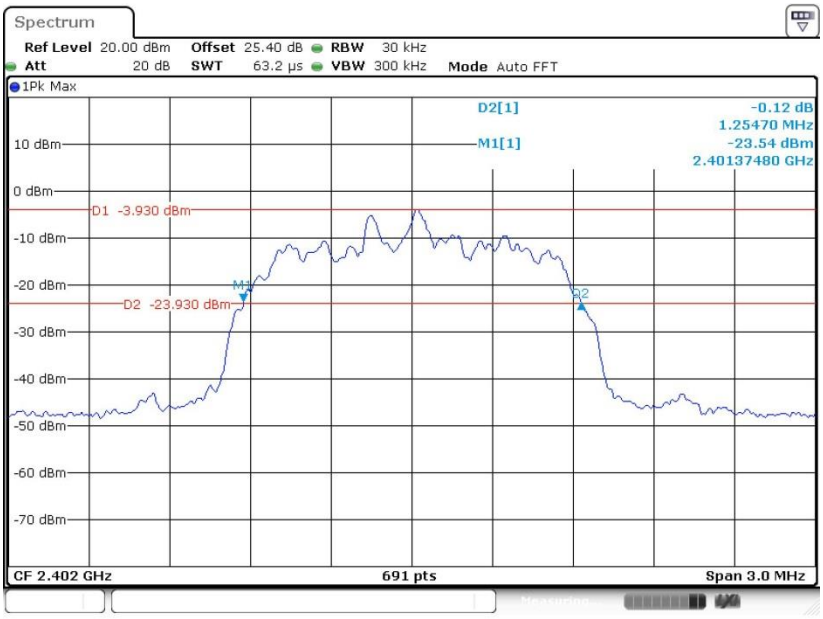



### 20 dB Bandwidth Plot on Channel 78



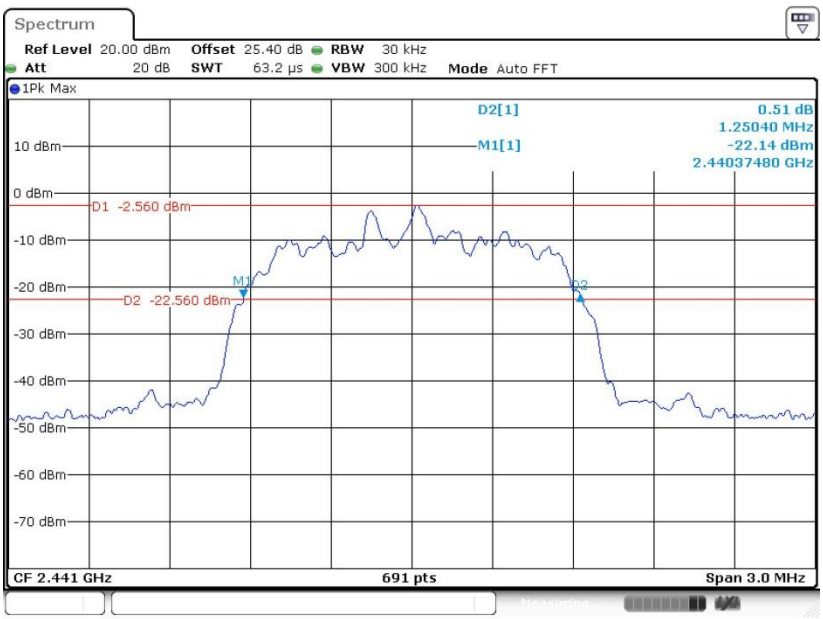
**<2Mbps>**

**20 dB Bandwidth Plot on Channel 00**



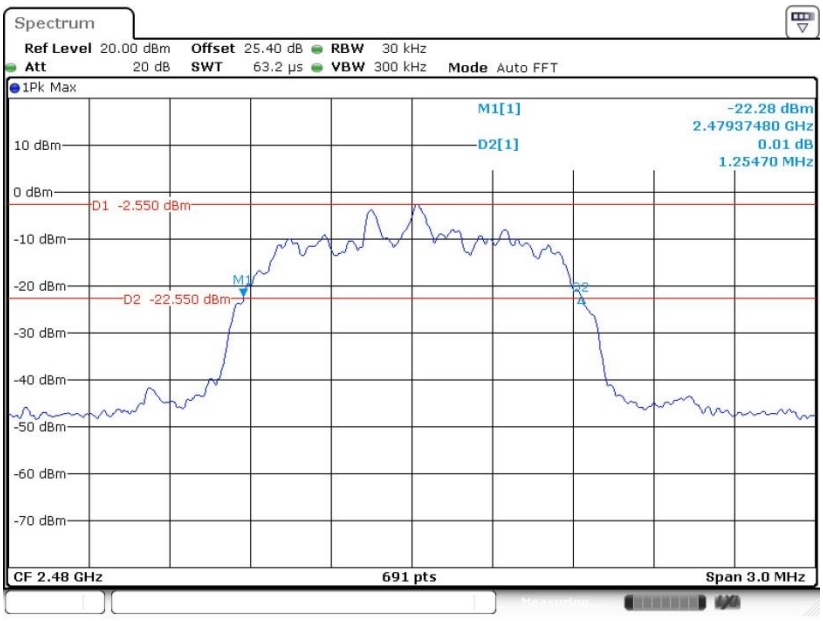

Date: 7.MAR.2019 10:58:42

**20 dB Bandwidth Plot on Channel 39**




Date: 7.MAR.2019 11:18:40

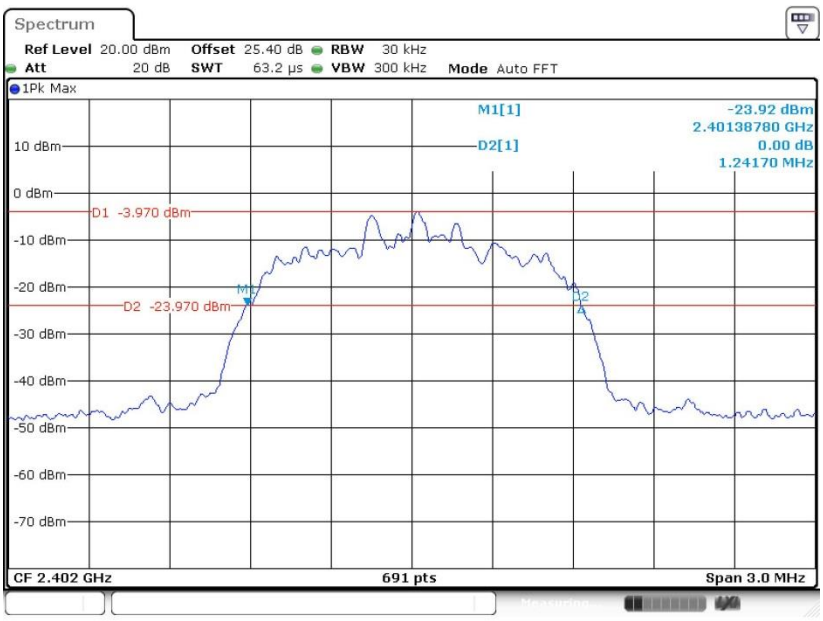
### 20 dB Bandwidth Plot on Channel 78




Date: 7.MAR.2019 11:47:28

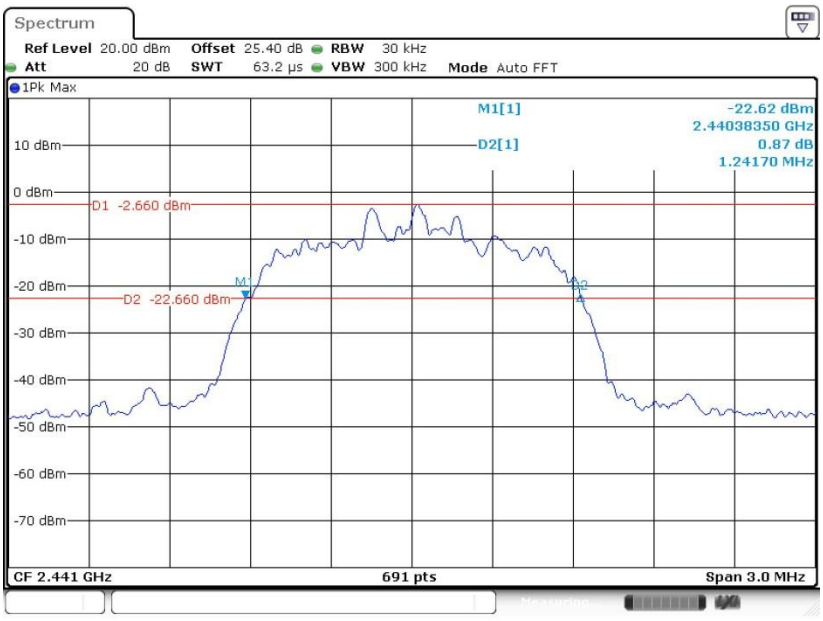
### <3Mbps>

### 20 dB Bandwidth Plot on Channel 00



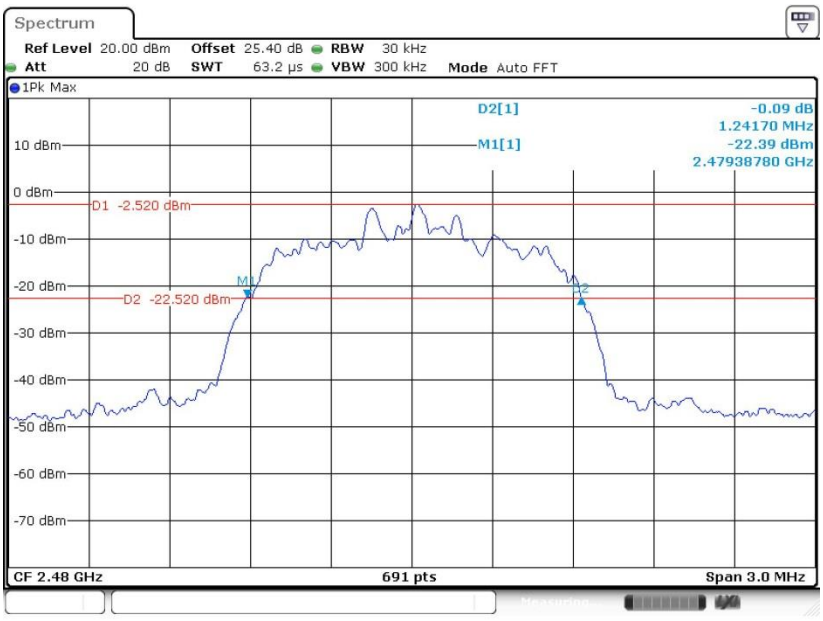

Date: 7.MAR.2019 12:27:26

### 20 dB Bandwidth Plot on Channel 39




Date: 7.MAR.2019 12:21:05

### 20 dB Bandwidth Plot on Channel 78




Date: 7.MAR.2019 12:10:38

## 3.4.6 Test Result of 99% Occupied Bandwidth

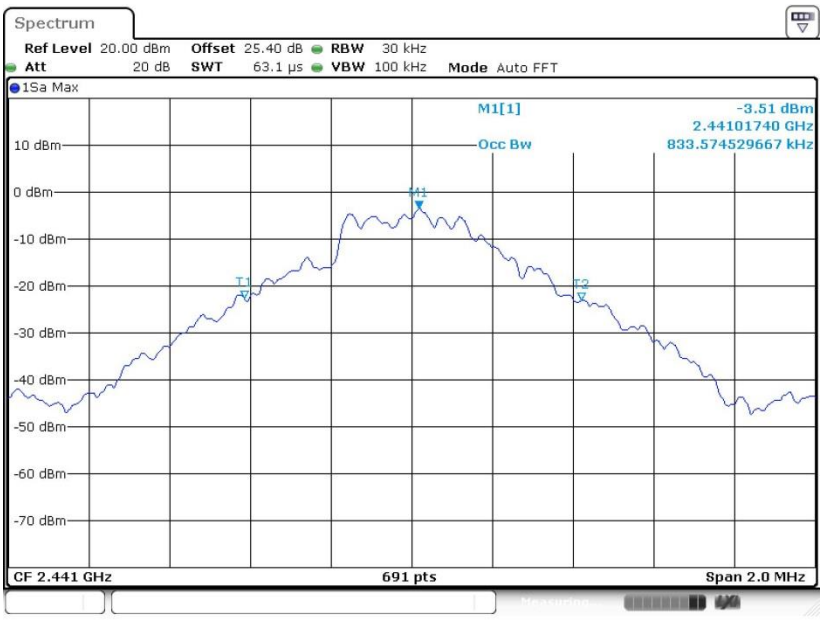
| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

| Mod. | Data Rate | $N_{TX}$ | CH. | Freq. (MHz) | 99% Bandwidth (MHz) | Pass/Fail |
|---|---|---|---|---|---|---|
| DH | 1Mbps | 1 | 0 | 2402 | 0.828 | Pass |
| DH | 1Mbps | 1 | 39 | 2441 | 0.834 | Pass |
| DH | 1Mbps | 1 | 78 | 2480 | 0.834 | Pass |
| 2DH | 2Mbps | 1 | 0 | 2402 | 1.166 | Pass |
| 2DH | 2Mbps | 1 | 39 | 2441 | 1.166 | Pass |
| 2DH | 2Mbps | 1 | 78 | 2480 | 1.166 | Pass |
| 3DH | 3Mbps | 1 | 0 | 2402 | 1.149 | Pass |
| 3DH | 3Mbps | 1 | 39 | 2441 | 1.149 | Pass |
| 3DH | 3Mbps | 1 | 78 | 2480 | 1.149 | Pass |

**<1Mbps>**

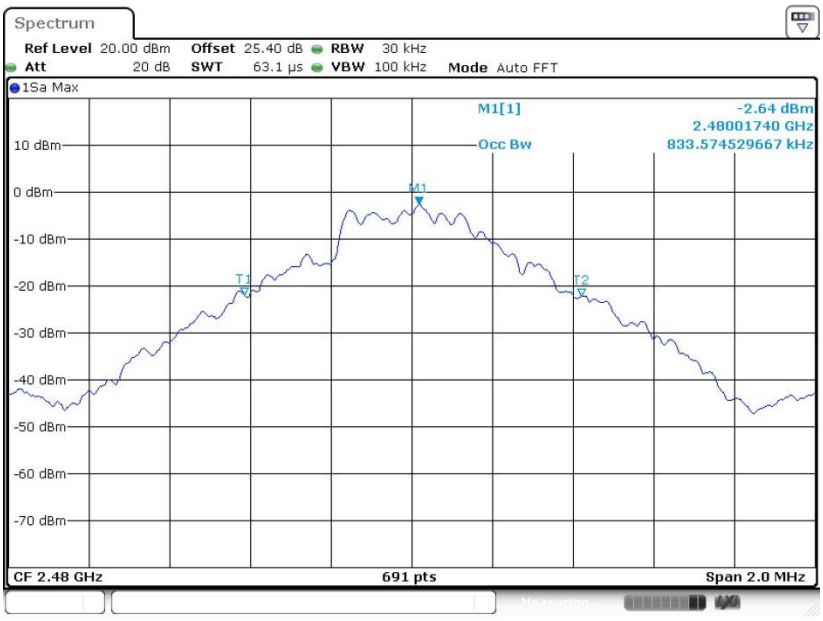
**99% Occupied Bandwidth Plot on Channel 00**

### 99% Occupied Bandwidth Plot on Channel 39




Date: 7.MAR.2019 09:13:40

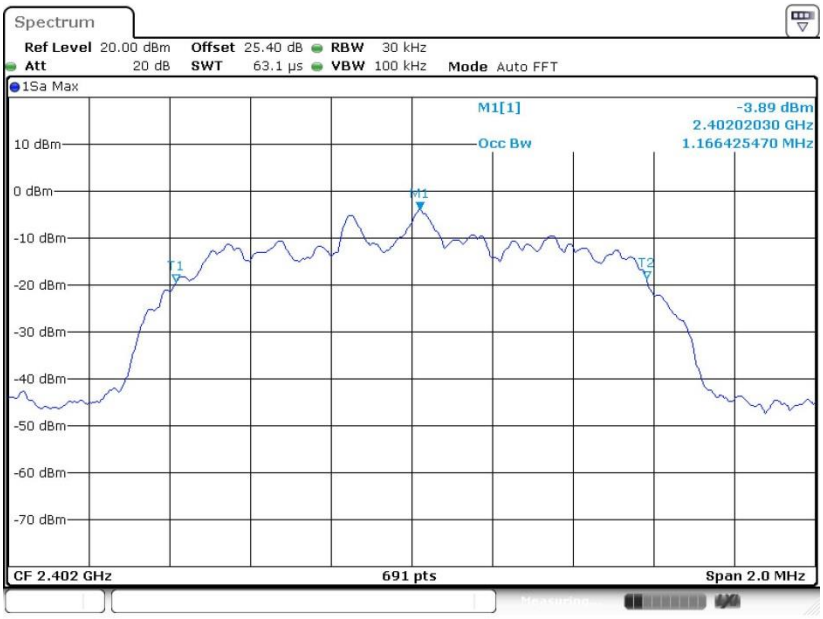
### 99% Occupied Bandwidth Plot on Channel 78




Date: 7.MAR.2019 09:23:05

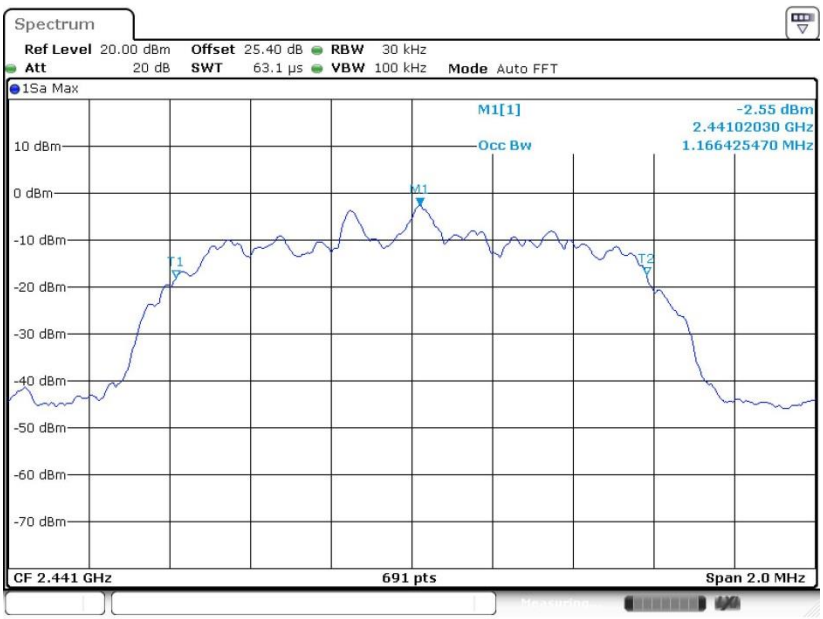
**<2Mbps>**

**99% Occupied Bandwidth Plot on Channel 00**



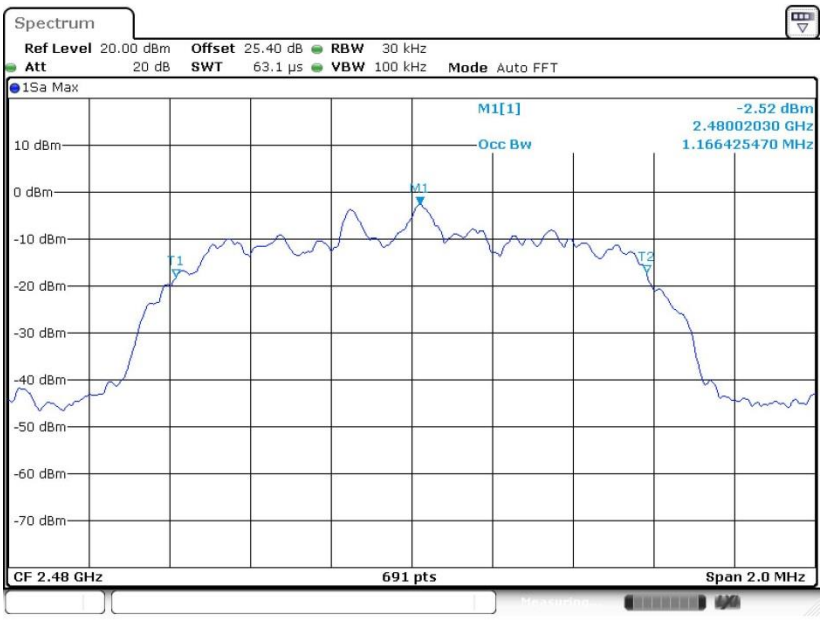

Date: 7.MAR.2019 11:00:16

**99% Occupied Bandwidth Plot on Channel 39**




Date: 7.MAR.2019 11:19:20

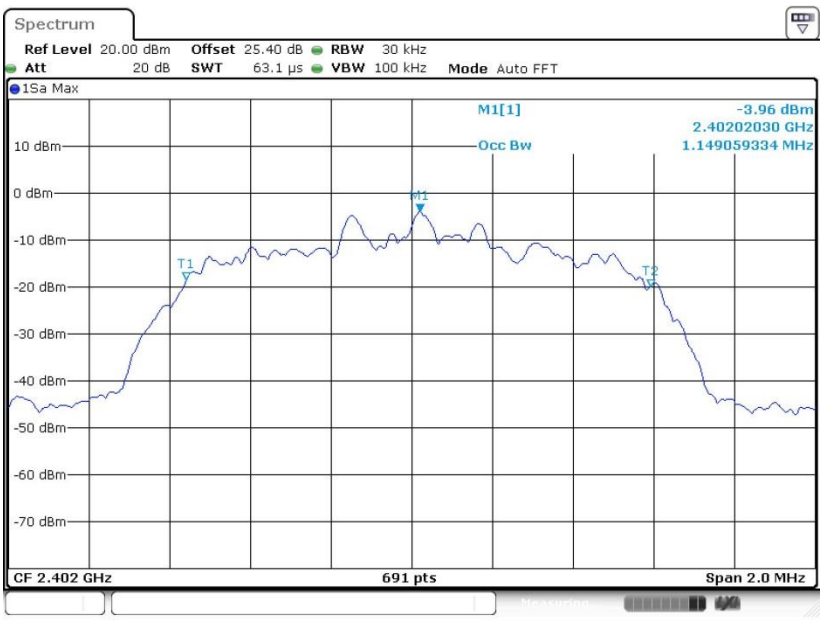
**99% Occupied Bandwidth Plot on Channel 78**




Date: 7.MAR.2019 11:49:50

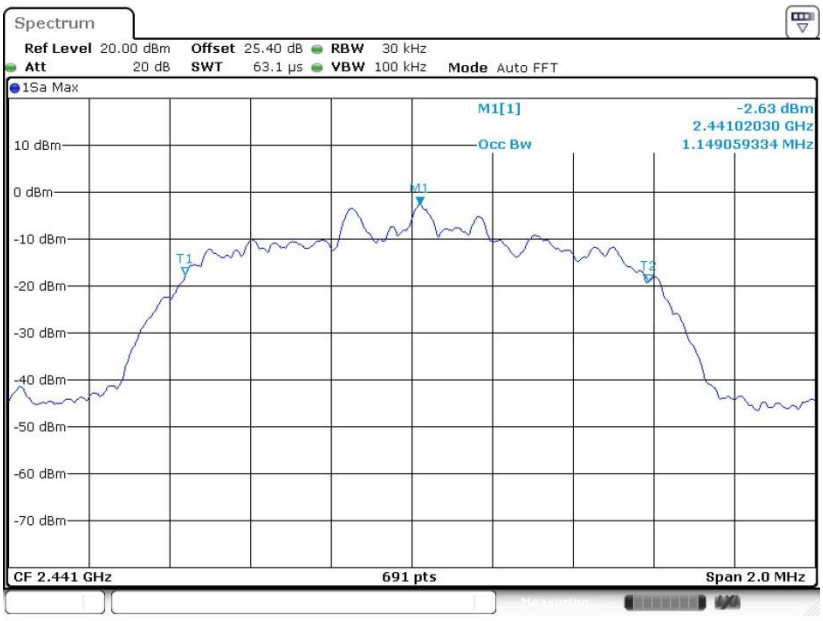
**<3Mbps>**

**99% Occupied Bandwidth Plot on Channel 00**

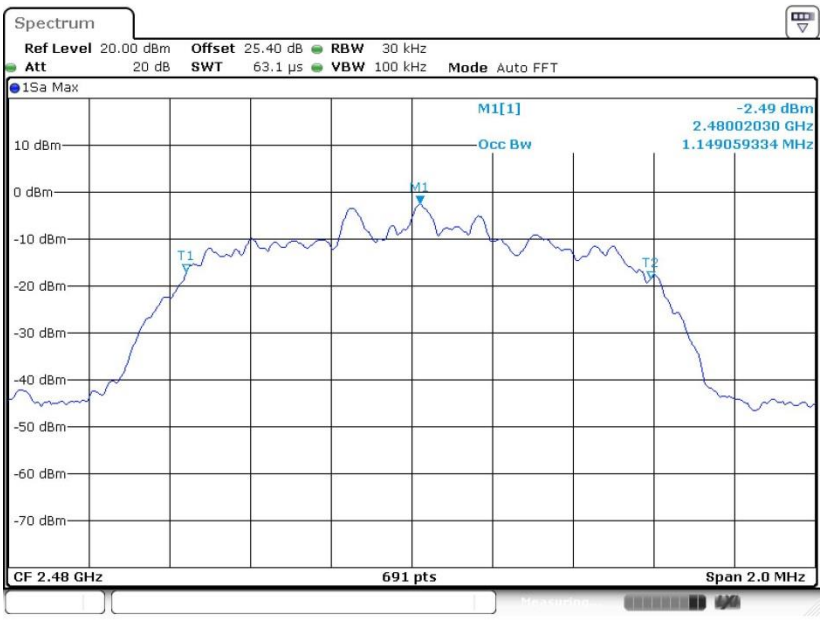



Date: 7.MAR.2019 12:28:28

**99% Occupied Bandwidth Plot on Channel 39**




**99% Occupied Bandwidth Plot on Channel 78**




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. The power limit for 1Mbps, 2Mbps, 3Mbps and AFH modes are 0.125 watts.

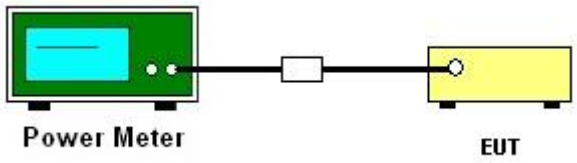
## 3.5.2 Measuring Instruments

See list of measuring equipment 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 Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

| DH | CH. | NTX | Peak Power (dBm) | Power Limit (dBm) | Test Result |
|---|---|---|---|---|---|
| DH1 | 0 | 1 | 2.27 | 20.97 | Pass |
| | 39 | 1 | **3.69** | 20.97 | Pass |
| | 78 | 1 | 3.42 | 20.97 | Pass |

| 2DH | CH. | NTX | Peak Power (dBm) | Power Limit (dBm) | Test Result |
|---|---|---|---|---|---|
| 2DH1 | 0 | 1 | 1.13 | 20.97 | Pass |
| | 39 | 1 | **2.64** | 20.97 | Pass |
| | 78 | 1 | 2.59 | 20.97 | Pass |

| 3DH | CH. | NTX | Peak Power (dBm) | Power Limit (dBm) | Test Result |
|---|---|---|---|---|---|
| 3DH1 | 0 | 1 | 1.59 | 20.97 | Pass |
| | 39 | 1 | **2.98** | 20.97 | Pass |
| | 78 | 1 | 2.91 | 20.97 | Pass |

### 3.5.6 Test Result of Average Output Power (Reporting Only)

| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

| DH | CH. | NTX | Average Power (dBm) | Duty Factor (dB) |
|---|---|---|---|---|
| DH1 | 0 | 1 | 1.57 | 5.19 |
| | 39 | 1 | **3.17** | 5.19 |
| | 78 | 1 | 2.89 | 5.19 |

| 2DH | CH. | NTX | Average Power (dBm) | Duty Factor (dB) |
|---|---|---|---|---|
| 2DH1 | 0 | 1 | -1.75 | 5.11 |
| | 39 | 1 | **-0.26** | 5.11 |
| | 78 | 1 | -0.29 | 5.11 |

| 3DH | CH. | NTX | Average Power (dBm) | Duty Factor (dB) |
|---|---|---|---|---|
| 3DH1 | 0 | 1 | -1.75 | 5.11 |
| | 39 | 1 | **-0.24** | 5.11 |
| | 78 | 1 | -0.27 | 5.11 |

# 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.

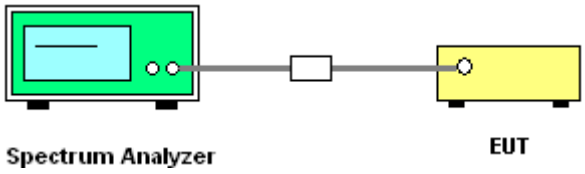
## 3.6.2 Measuring Instruments

See list of measuring equipment 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

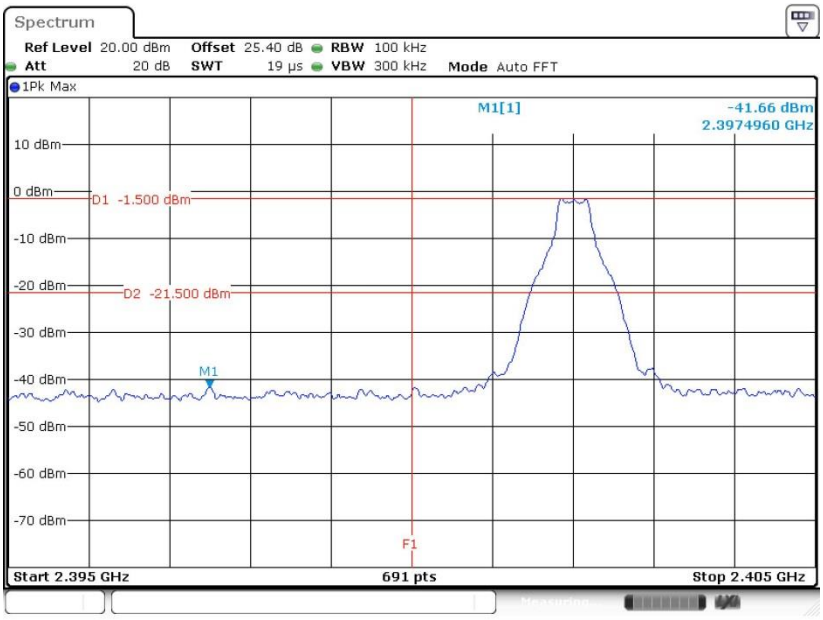


## 3.6.5 Test Result of Conducted Band Edges

| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

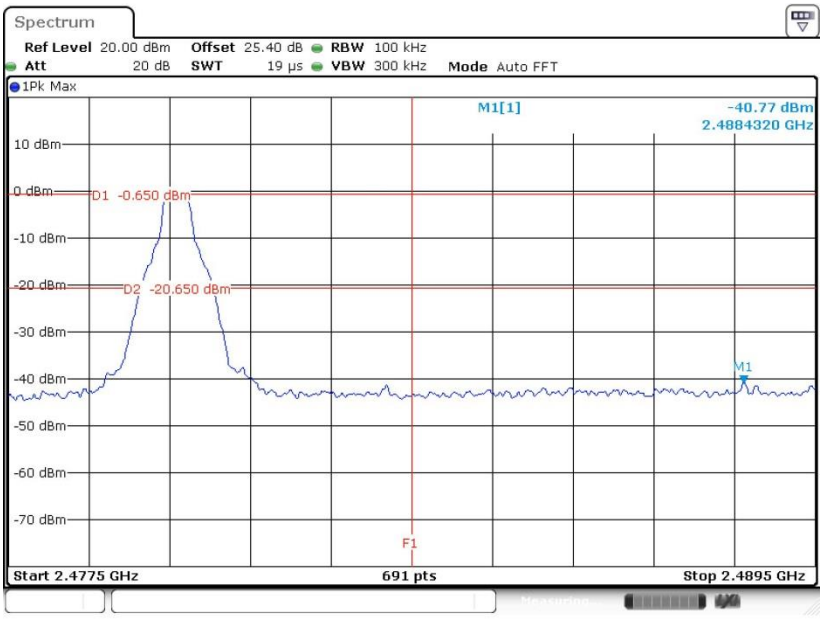
**<1Mbps>**

**Low Band Edge Plot on Channel 00**




Date: 7.MAR.2019 09:07:27

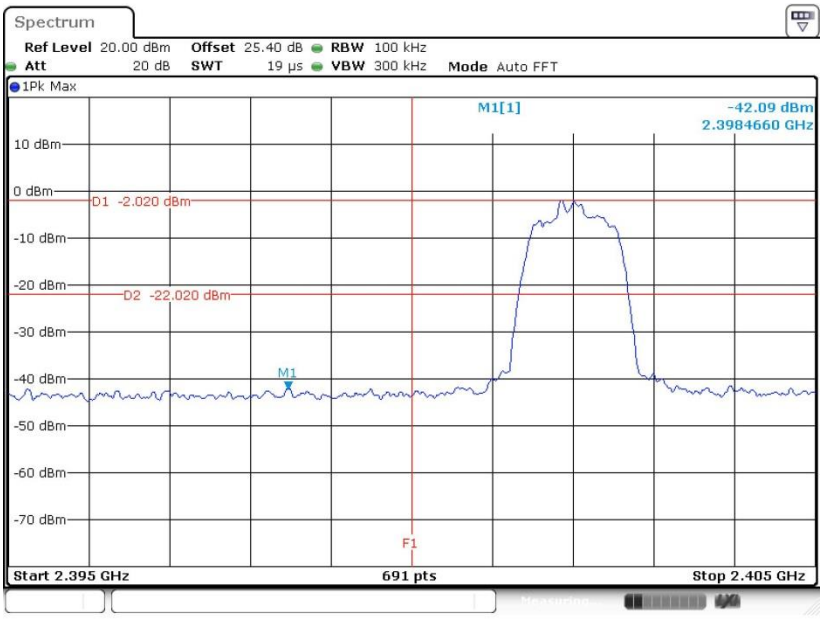
**High Band Edge Plot on Channel 78**




Date: 7.MAR.2019 09:29:53

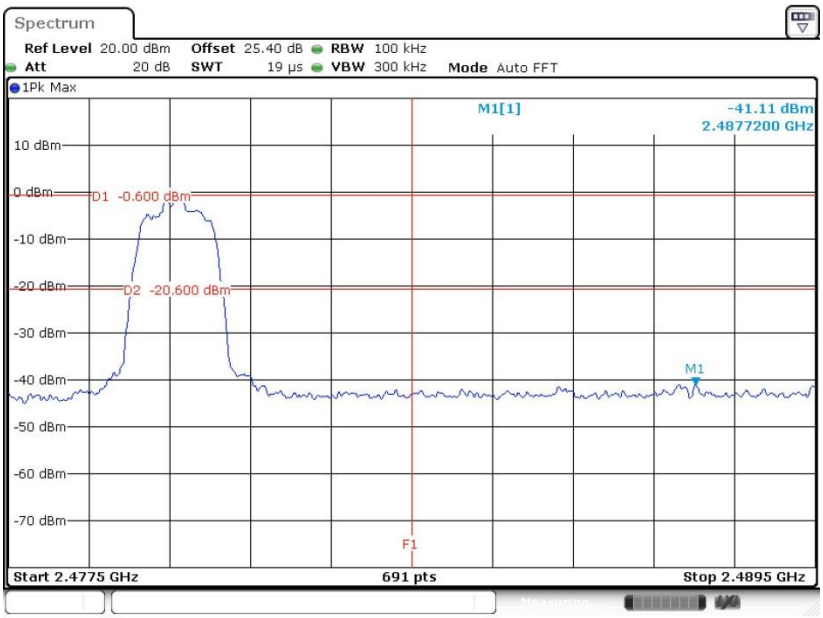
**<2Mbps>**

**Low Band Edge Plot on Channel 00**




Date: 7.MAR.2019 10:59:10

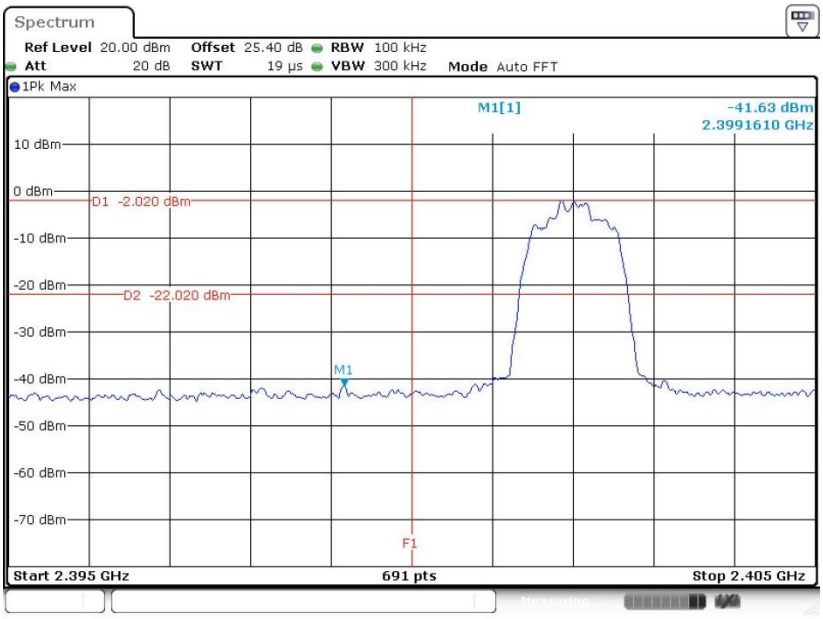
**High Band Edge Plot on Channel 78**




Date: 7.MAR.2019 11:49:06

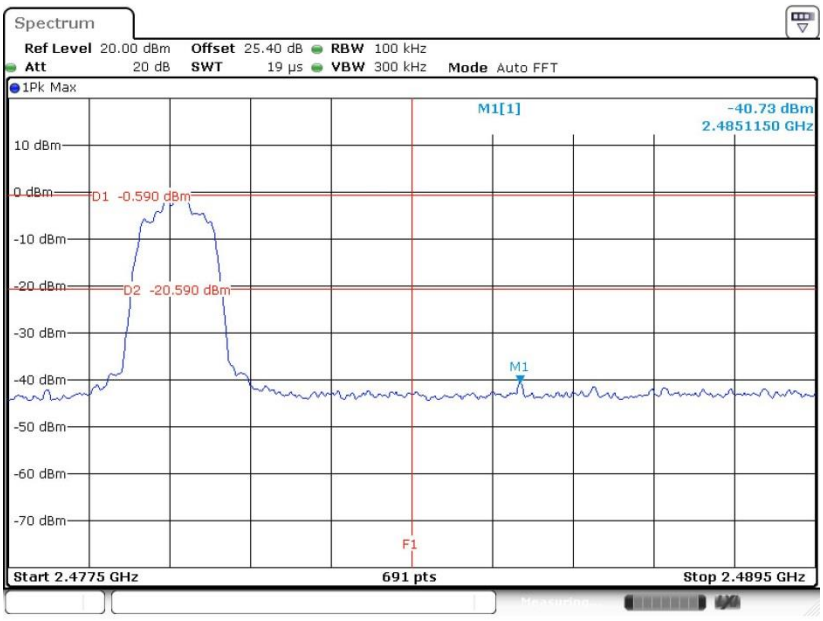
**<3Mbps>**

**Low Band Edge Plot on Channel 00**




Date: 7.MAR.2019 12:27:47

**High Band Edge Plot on Channel 78**

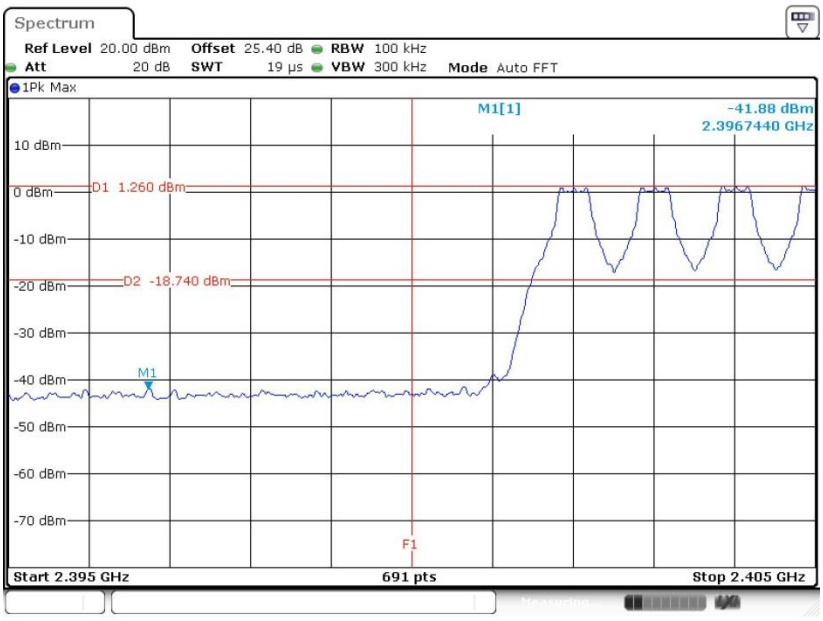



Date: 7.MAR.2019 12:11:06

## 3.6.6 Test Result of Conducted Hopping Mode Band Edges

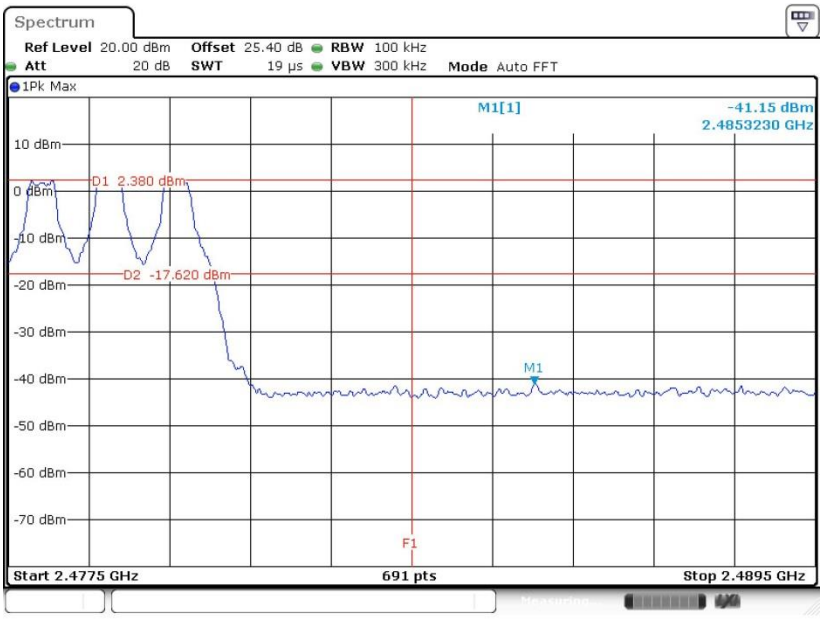
**<1Mbps>**

**Hopping Mode Low Band Edge Plot**




Date: 7.MAR.2019 10:34:43

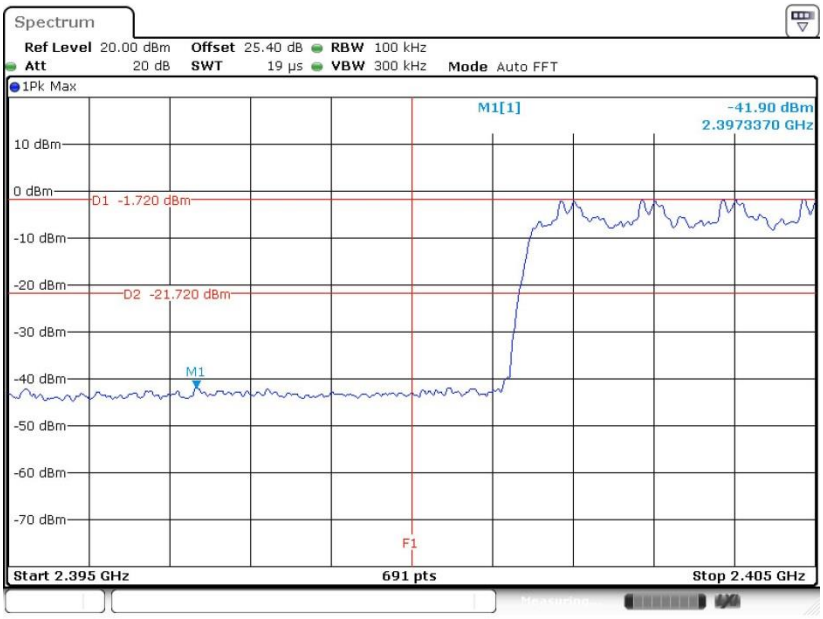
**Hopping Mode High Band Edge Plot**




Date: 7.MAR.2019 10:35:40

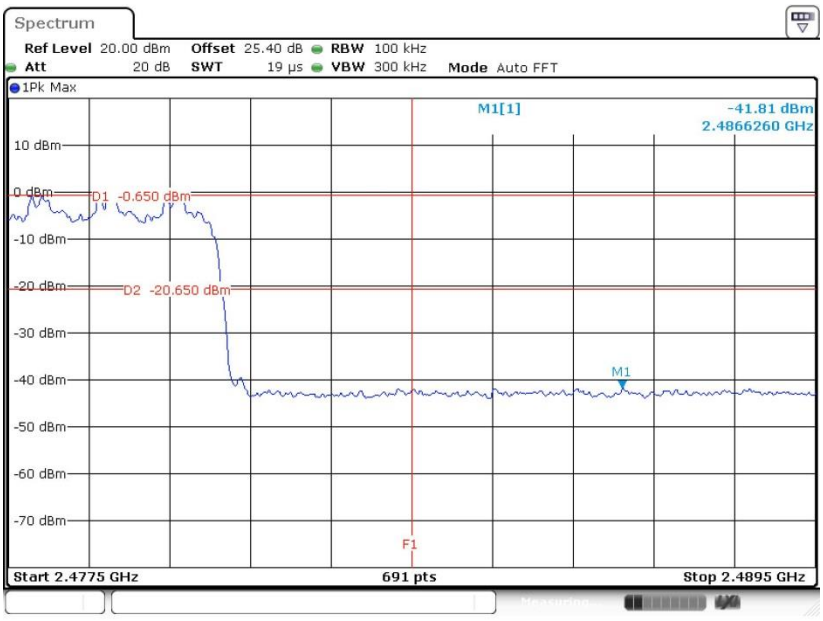
**<2Mbps>**

**Hopping Mode Low Band Edge Plot**




Date: 7.MAR.2019 11:55:24

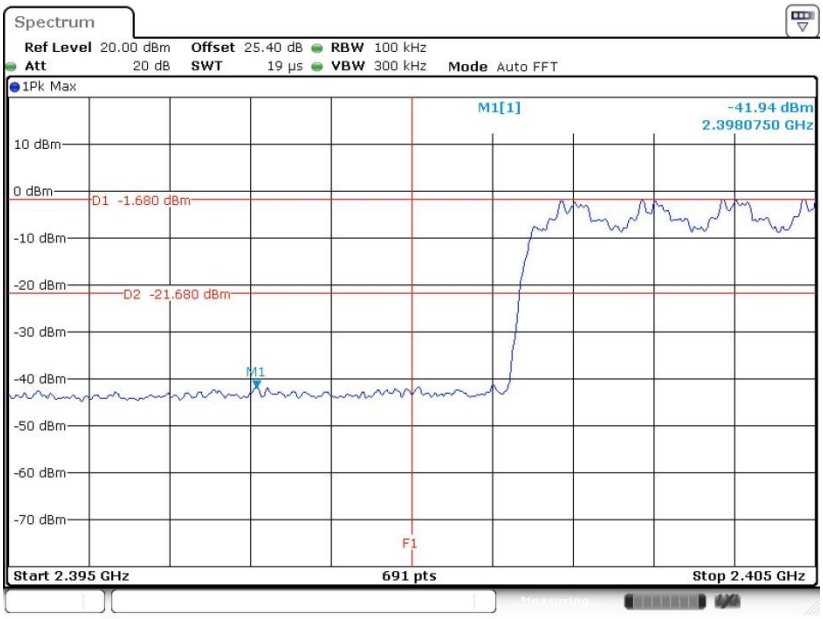
**Hopping Mode High Band Edge Plot**




Date: 7.MAR.2019 11:54:40

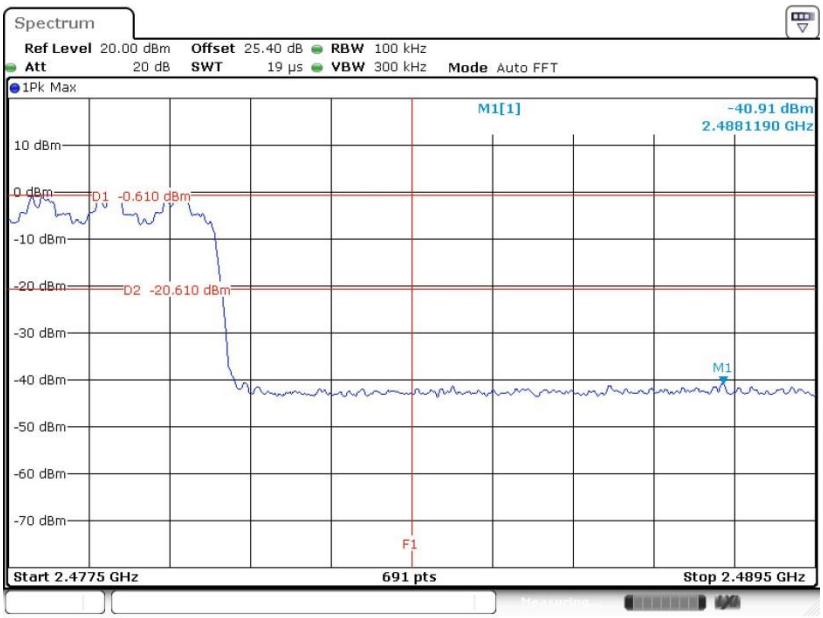
**<3Mbps>**

**Hopping Mode Low Band Edge Plot**




Date: 7.MAR.2019 11:56:46

**Hopping Mode High Band Edge Plot**




Date: 7.MAR.2019 11:57:52

# 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.

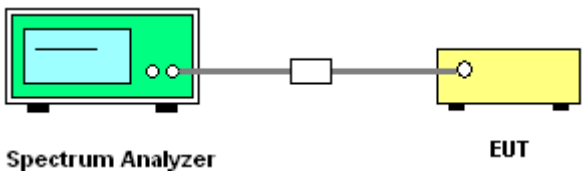
## 3.7.2 Measuring Instruments

See list of measuring equipment 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

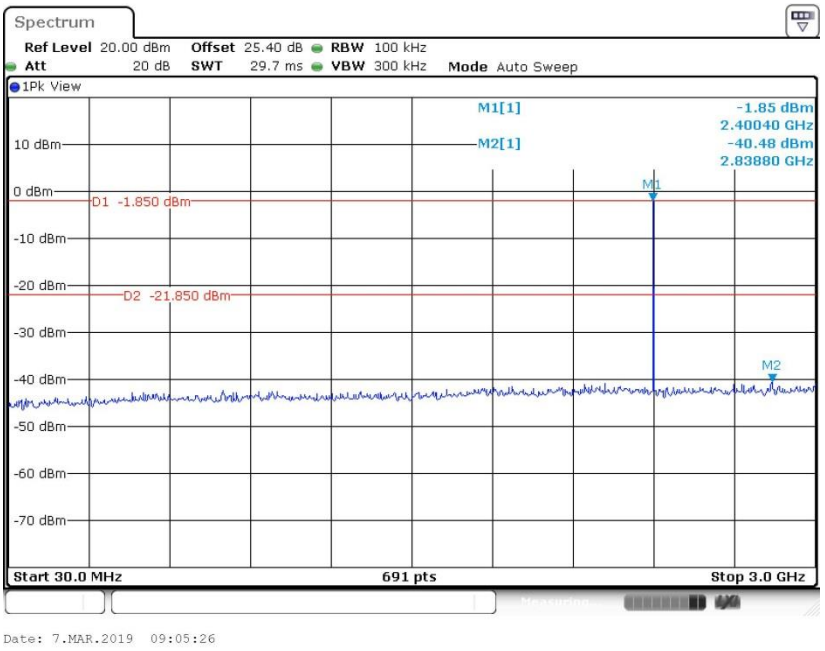


## 3.7.5 Test Result of Conducted Spurious Emission

| Test Engineer : | Howard Lin, Tommy Lee and Kai Liao | Temperature : | 21~25℃ |
|---|---|---|---|
| | | Relative Humidity : | 51~54% |

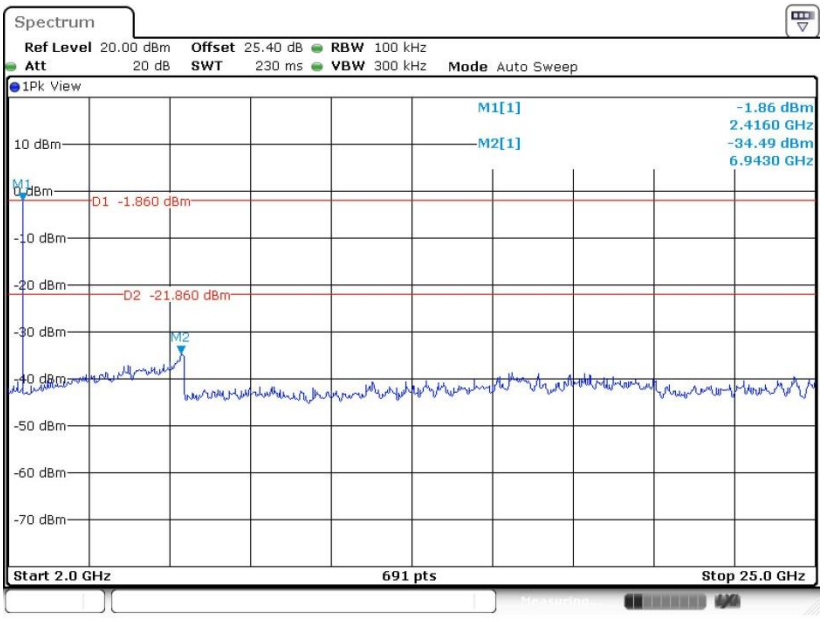
**<1Mbps>**

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



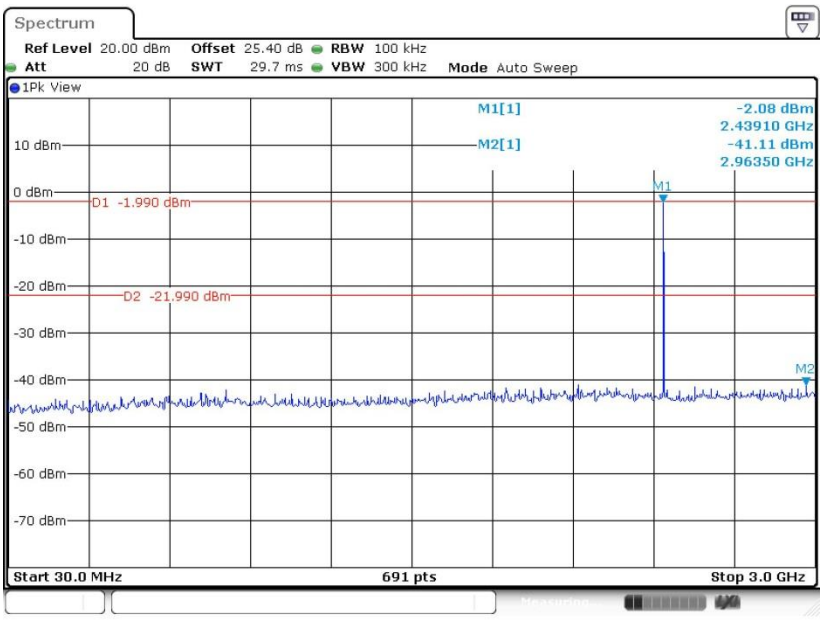

Date: 7.MAR.2019 09:05:26

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



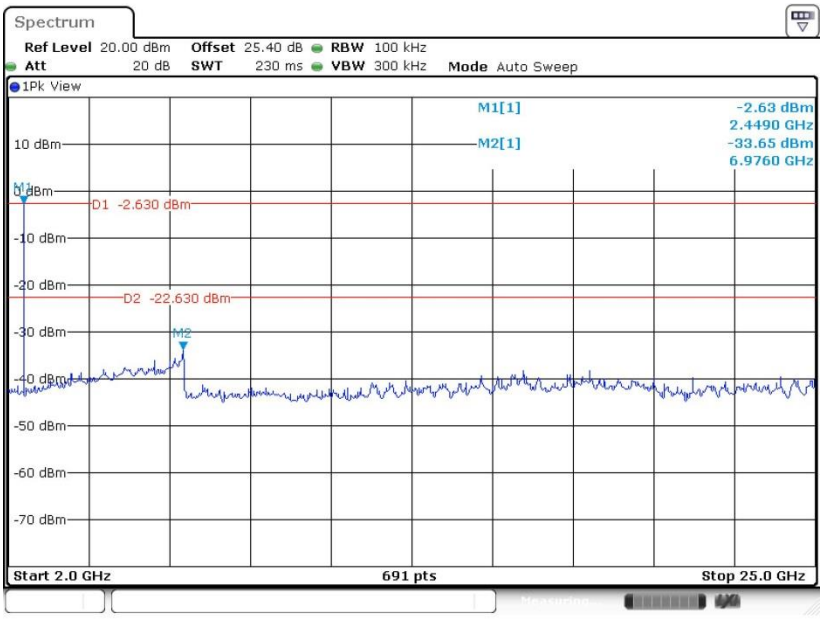

Date: 7.MAR.2019 09:06:01

**CSE Plot on Ch 39 between 30MHz ~ 3 GHz**



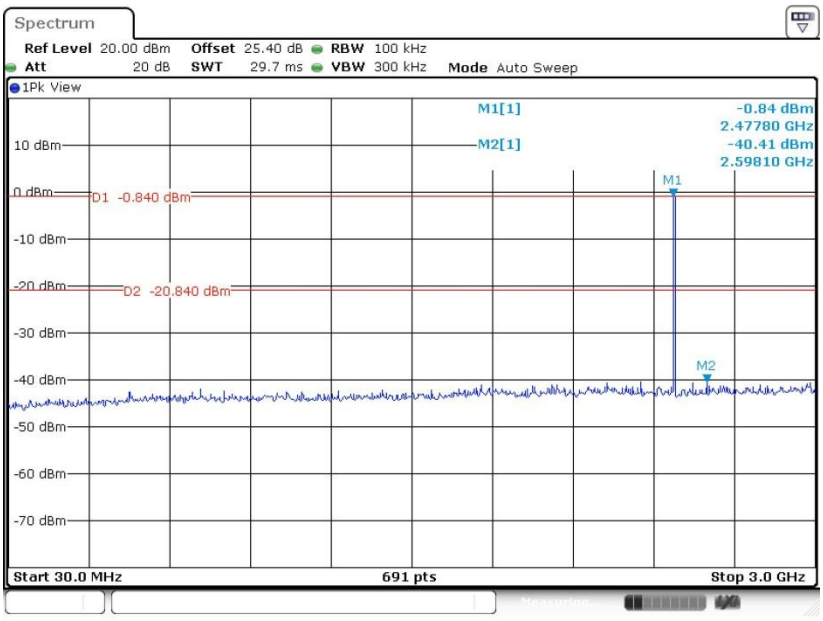

Date: 7.MAR.2019 09:18:15

**CSE Plot on Ch 39 between 2 GHz ~ 25 GHz**



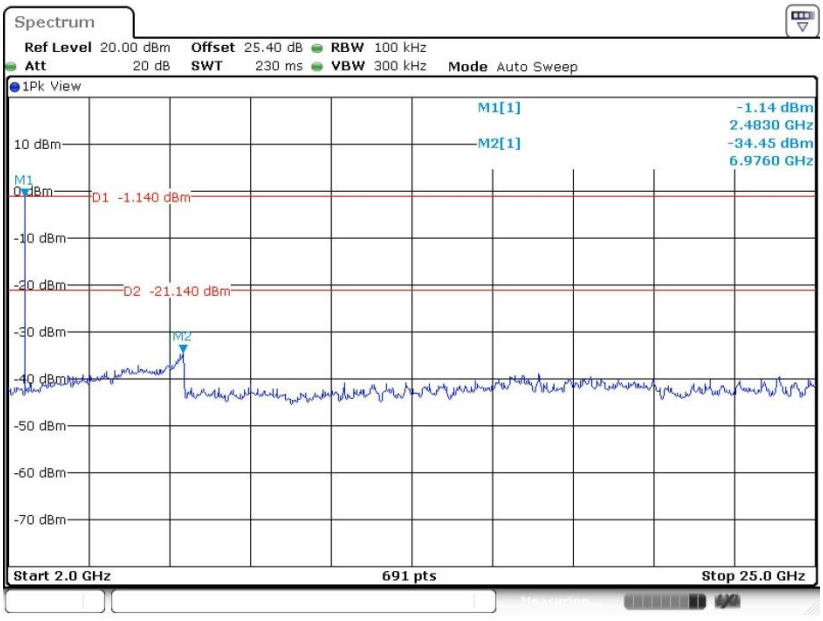

Date: 7.MAR.2019 09:18:49

**CSE Plot on Ch 78 between 30MHz ~ 3 GHz**




Date: 7.MAR.2019 09:33:47

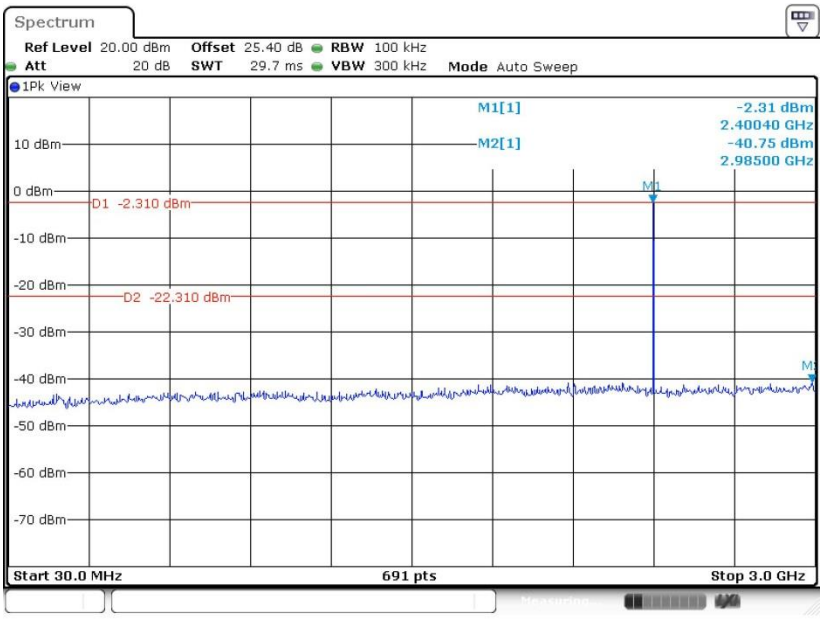
**CSE Plot on Ch 78 between 2 GHz ~ 25 GHz**




Date: 7.MAR.2019 09:34:31

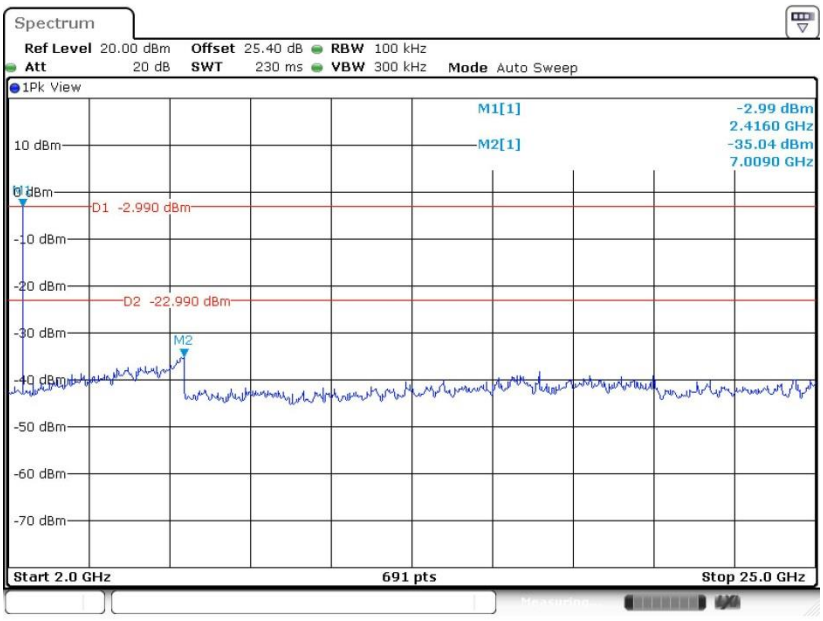
**<2Mbps>**

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



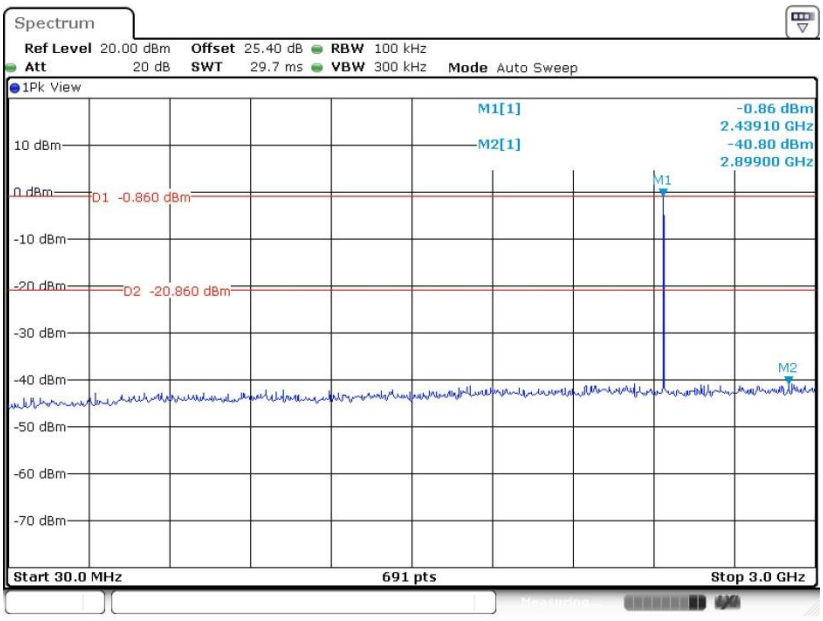

Date: 7.MAR.2019 11:02:04

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



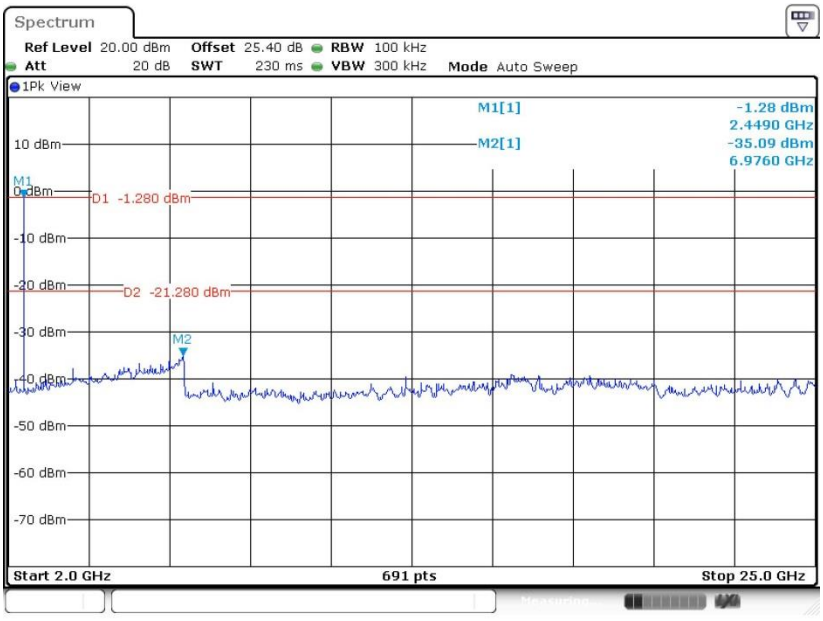

Date: 7.MAR.2019 11:09:36

**CSE Plot on Ch 39 between 30MHz ~ 3 GHz**



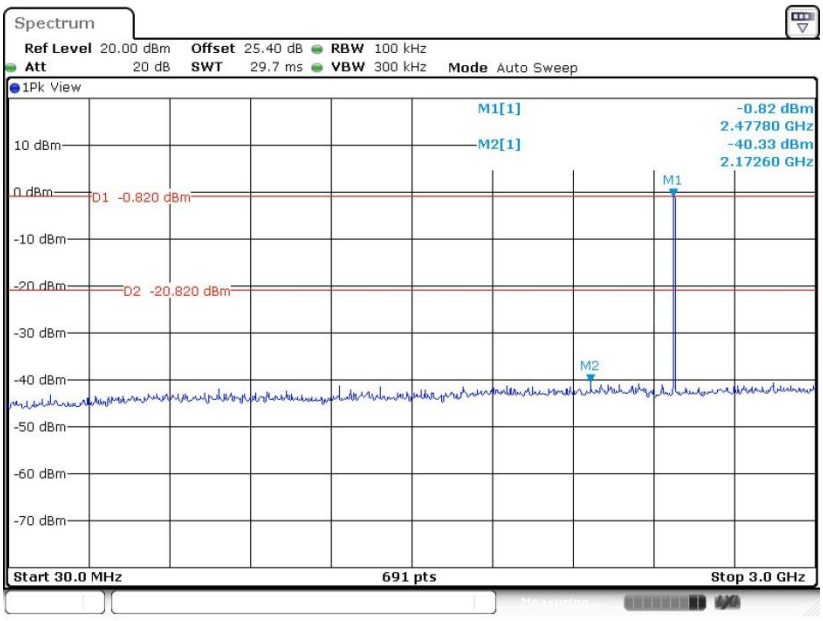

Date: 7.MAR.2019 11:20:39

**CSE Plot on Ch 39 between 2 GHz ~ 25 GHz**



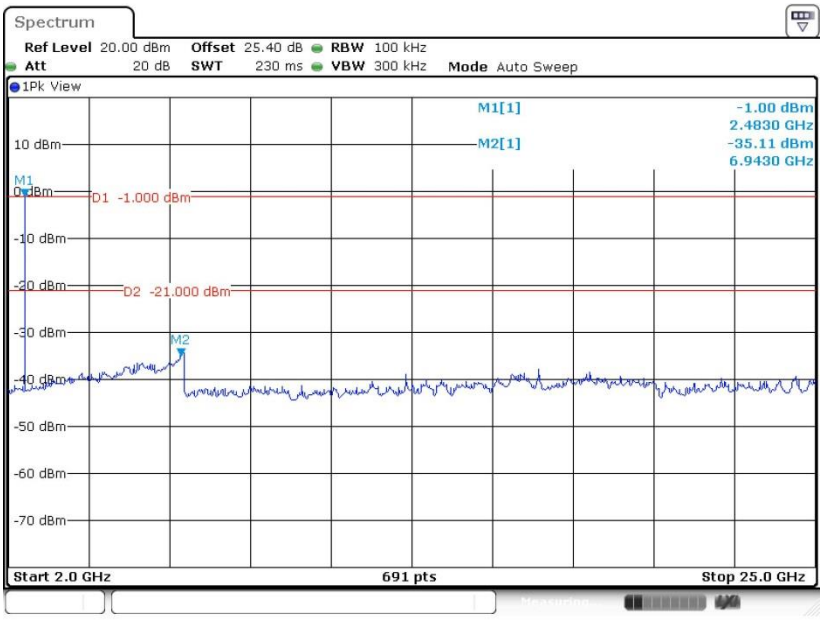

Date: 7.MAR.2019 11:21:18

**CSE Plot on Ch 78 between 30MHz ~ 3 GHz**




Date: 7.MAR.2019 11:51:13

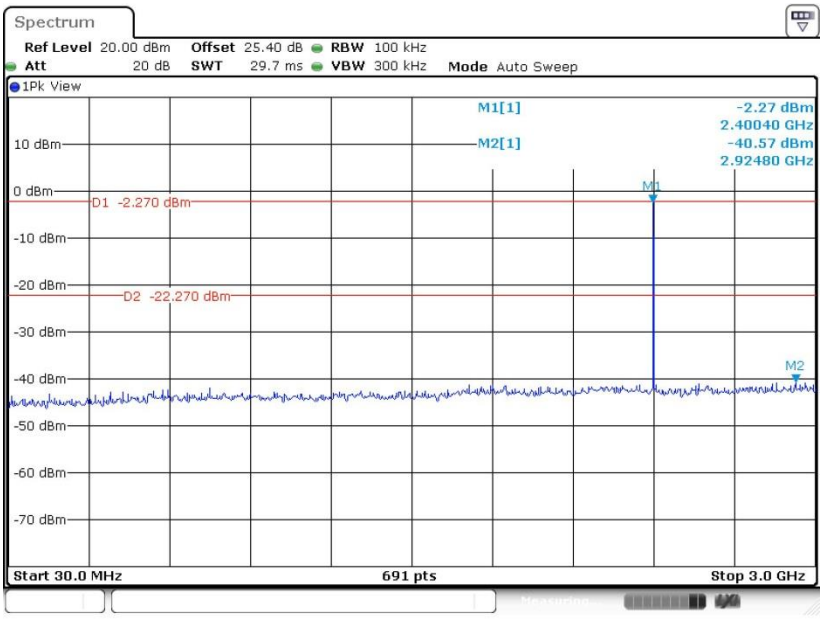
**CSE Plot on Ch 78 between 2 GHz ~ 25 GHz**




Date: 7.MAR.2019 11:53:48

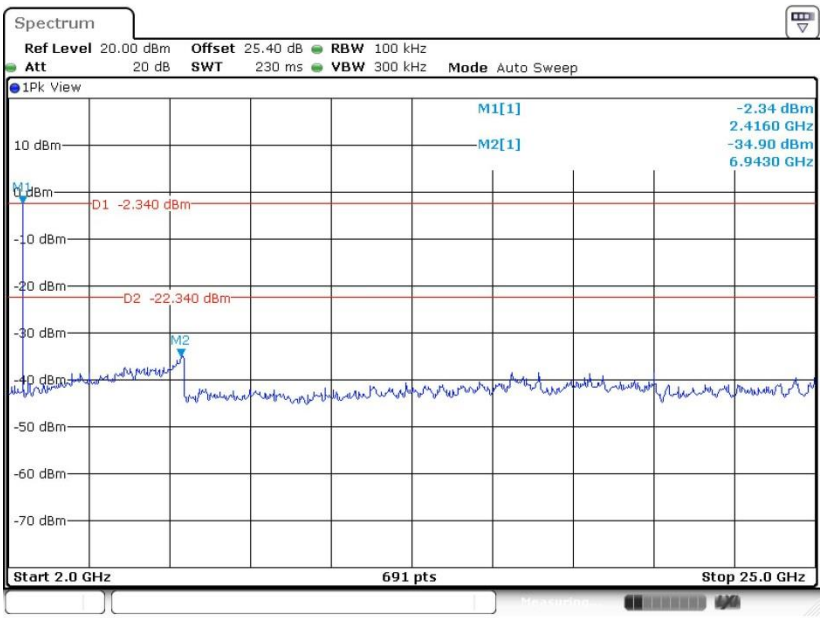
**<3Mbps>**

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




Date: 7.MAR.2019 12:29:04

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

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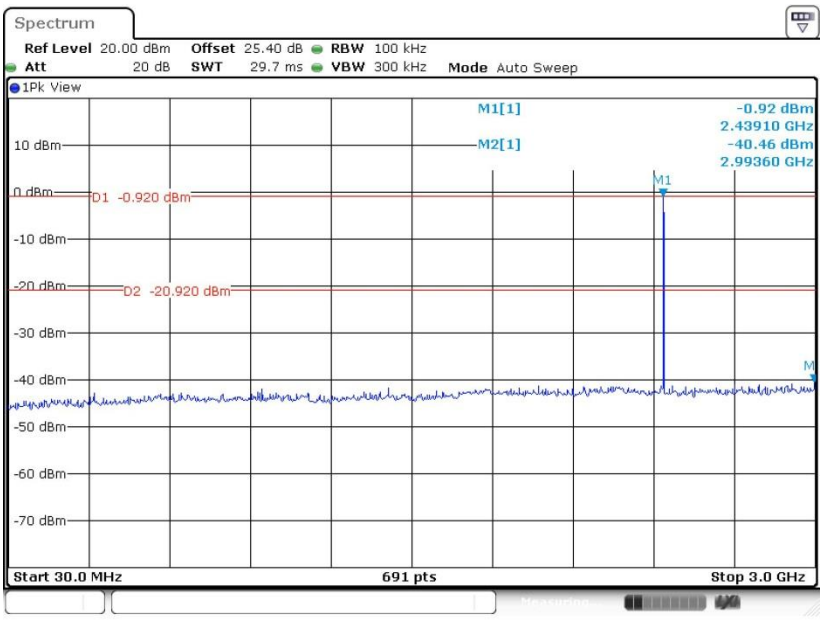
**CSE Plot on Ch 39 between 30MHz ~ 3 GHz**

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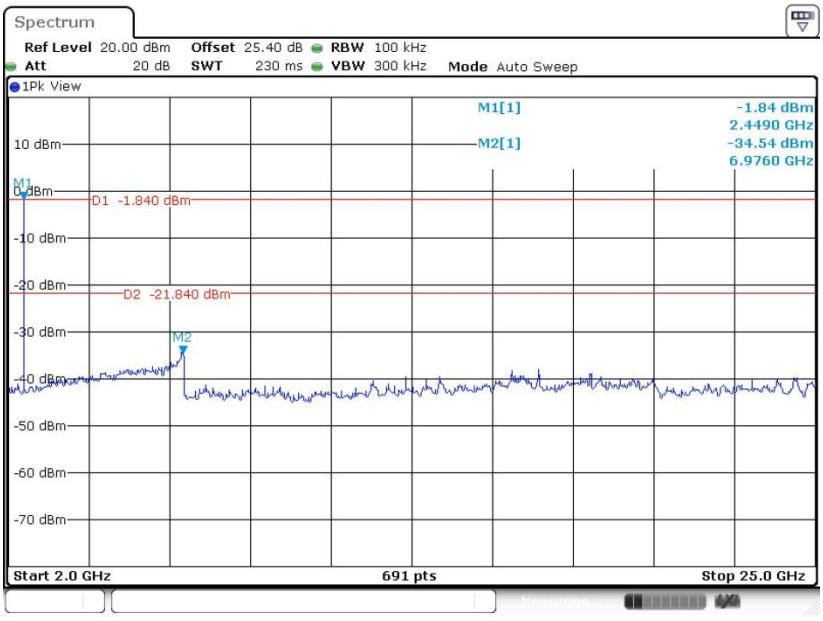
**CSE Plot on Ch 39 between 2 GHz ~ 25 GHz**

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