



FCC RF Test Report

APPLICANT : HMD global Oy
EQUIPMENT : Mobile Phone
BRAND NAME : Nokia
MODEL NAME : TA-1184
FCC ID : 2AJOTTA-1184
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DSS) Spread Spectrum Transmitter

The product was received on Mar. 05, 2019 and testing was completed on Apr. 02, 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.



Approved by: James Huang / Manager

Sporton International (Kunshan) Inc.
No. 1098, Pengxi North Road, Kunshan Economic Development Zone,
Jiangsu Province 215335, China



TABLE OF CONTENTS

REVISION HISTORY.....	3
SUMMARY OF TEST RESULT	4
1 GENERAL DESCRIPTION.....	5
1.1 Applicant.....	5
1.2 Manufacturer.....	5
1.3 Product Feature of Equipment Under Test.....	5
1.4 Product Specification of Equipment Under Test.....	6
1.5 Modification of EUT	6
1.6 Testing Location	7
1.7 Applicable Standards.....	7
2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST.....	8
2.1 Carrier Frequency Channel	8
2.2 Test Mode.....	9
2.3 Connection Diagram of Test System.....	10
2.4 Support Unit used in test configuration and system	10
2.5 EUT Operation Test Setup	11
2.6 Measurement Results Explanation Example.....	11
3 TEST RESULT	12
3.1 Number of Channel Measurement	12
3.2 Hopping Channel Separation Measurement	14
3.3 Dwell Time Measurement.....	21
3.4 20dB and 99% Bandwidth Measurement	23
3.5 Output Power Measurement.....	36
3.6 Conducted Band Edges Measurement.....	38
3.7 Conducted Spurious Emission Measurement	45
3.8 Radiated Band Edges and Spurious Emission Measurement	55
3.9 AC Conducted Emission Measurement.....	59
3.10 Antenna Requirements.....	61
4 LIST OF MEASURING EQUIPMENT.....	62
5 UNCERTAINTY OF EVALUATION.....	63
APPENDIX A. AC CONDUCTED EMISSION TEST RESULT	
APPENDIX B. RADIATED SPURIOUS EMISSION	
APPENDIX C. DUTY CYCLE PLOTS	
APPENDIX D. SETUP PHOTOGRAPHS	



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR930509-01A	Rev. 01	Initial issue of report	Apr. 16, 2019

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 18.65 dB at 2483.550 MHz
3.9	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 4.52 dB at 0.747 MHz
3.10	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

HMD global Oy

Bertel Jungin aukio 9, 02600 Espoo, Finland

1.2 Manufacturer

HMD global Oy

Bertel Jungin aukio 9, 02600 Espoo, Finland

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Mobile Phone
Brand Name	Nokia
Model Name	TA-1184
FCC ID	2AJOTTA-1184
EUT supports Radios application	GSM/GPS/EGPRS/WCDMA/HSPA/DC-HSDPA/HSPA+/LTE WLAN 11b/g/n HT20 Bluetooth BR/EDR/LE FM Receiver/GNSS
IMEI Code	Conducted: N/A Conduction: 352916100002667/352916100002675 Radiation: 352916100002923/352916100002931
HW Version	DVT_0.2
SW Version	00WW_0_095
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 two types of EUT. According to the difference, choose sample 1 to perform full test.

Object	Sample 1 with Dual SIMs(TA-1184)		Sample 2 with Dual SIMs(TA-1184)	
	Specifications	Supplier	Specifications	Supplier
Memory	3+32G	Kingston	3+32G	Foresee
TP+LCD	HQ23201454000	K&D	HQ23201454000	Holitech
Battery Cover	HQ20704757000	Goodmark-new	HQ20746201000	Zhiyin
Front Camera	HQ20207233000	Jinkang	HQ20207233000	Tianshi
Rear Camera	HQ20207234000	Tianshi	HQ20207234000	Guangzhen
Speaker	HQ20312058000	Xichun	HQ20312058000	Xinrongda
Receiver	HQ20321087000	Dongsheng	HQ20321087000	Xinrongda
MIC	HQ12030105000	Knowles	HQ12030105000	Minxinwei



Motor	HQ20400123000	Kunwang	HQ20400123000	Jinlangda
--------------	---------------	---------	---------------	-----------

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) : 9.13 dBm (0.0082 W) Bluetooth EDR (2Mbps) : 8.29 dBm (0.0067 W) Bluetooth EDR (3Mbps) : 8.45 dBm (0.0070 W)
99% Occupied Bandwidth	Bluetooth BR(1Mbps) : 0.764MHz Bluetooth EDR (2Mbps) : 1.140MHz Bluetooth EDR (3Mbps) : 1.120MHz
Antenna Type / Gain	IFA Antenna with gain -0.18 dBi
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK 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 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0).

Test Site	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone, Jiangsu Province 215335, China TEL : 86-512-57900158 FAX : 86-512-57900958		
Test Site No.	Sporton Site No.	FCC designation No.	FCC Test Firm Registration No.
	TH01-KS CO01-KS 03CH06-KS	CN5013	630927

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 v05r01
- ♦ 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

- 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 (X 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	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 Test Cases	Bluetooth BR 1Mbps GFSK		
	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz		
AC Conducted Emission	Mode 1 : GSM 850 Idle + Bluetooth Link + WLAN Link (2.4G) + USB Cable (Charging from Adapter) + Earphone + Battery 1		
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 , Earphone and USB Cable .			

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	R&S	CMU 200	N/A	N/A	Unshielded, 1.8 m
2.	WLAN AP	D-link	DIR-855	KA2DIR855A2	N/A	Unshielded, 1.8m
3.	Notebook	Lenovo	G480	PRC4	N/A	shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m
4.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A
5.	SD Card	Kingston	8GB	N/A	N/A	N/A

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 5.1 dB.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} . \\ &= 5.1 \text{ (dB)}\end{aligned}$$

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.

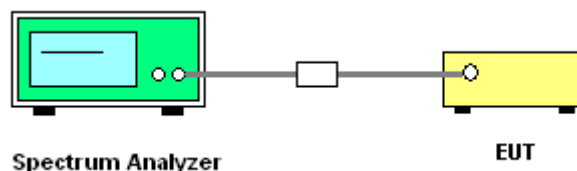
3.1.2 Measuring Instruments

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



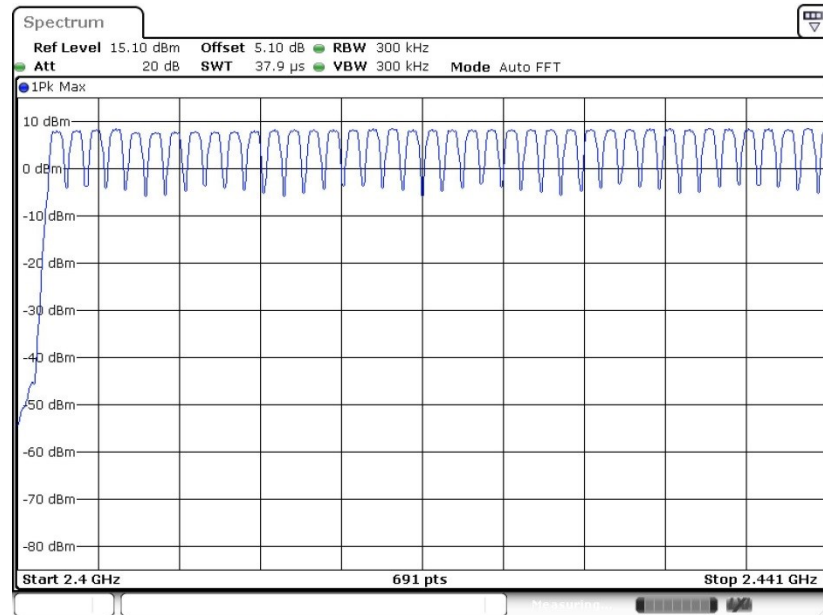
3.1.5 Test Result of Number of Hopping Frequency

Test Mode :	1Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

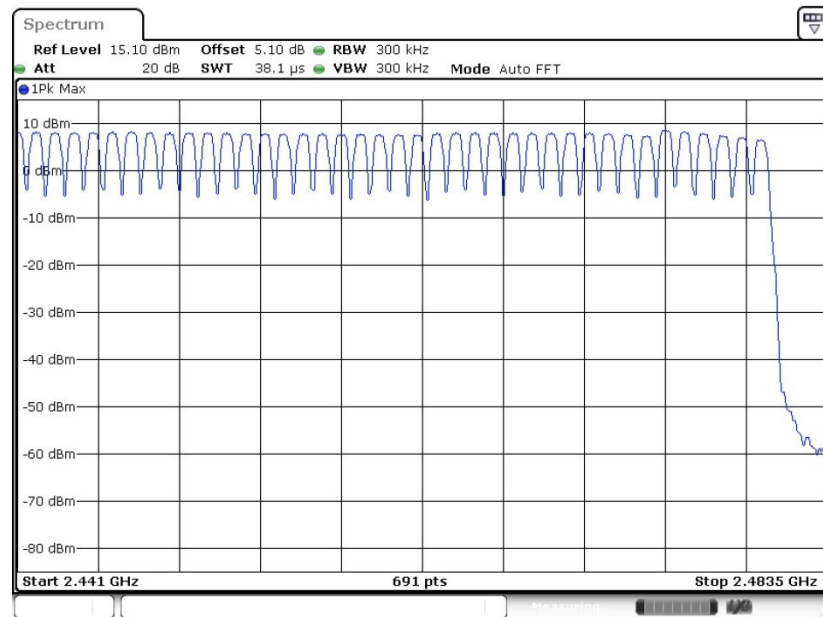
Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail
79	20	> 15	Pass



Number of Hopping Channel Plot on Channel 00 - 78



Date: 23.MAR.2019 00:55:09



Date: 23.MAR.2019 00:58:11

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



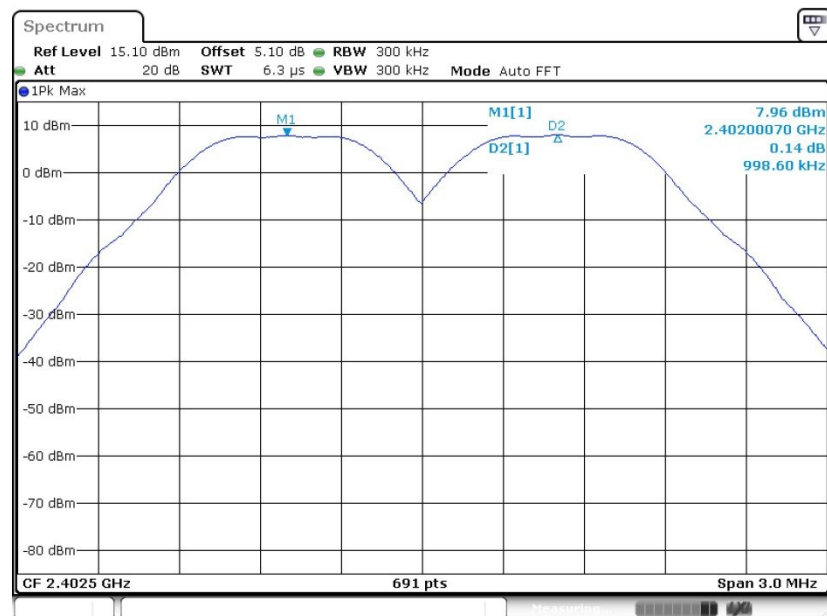
**3.2.5 Test Result of Hopping Channel Separation**

Test Mode :	1Mbps	Temperature :	21~25℃
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	0.9986	0.5711	Pass
39	2441	1.0029	0.5711	Pass
78	2480	1.0029	0.5750	Pass

<1Mbps>

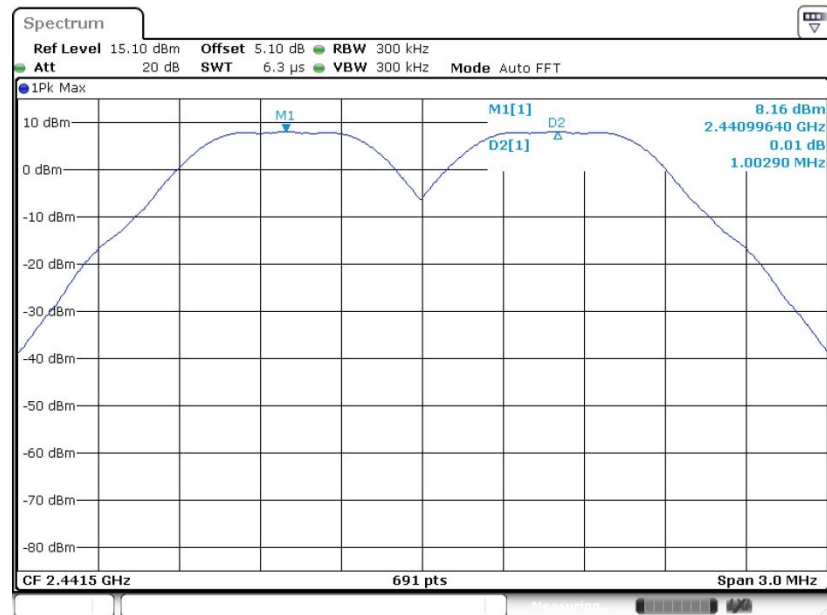
Channel Separation Plot on Channel 00 - 01



Date: 16.MAR.2019 22:25:49

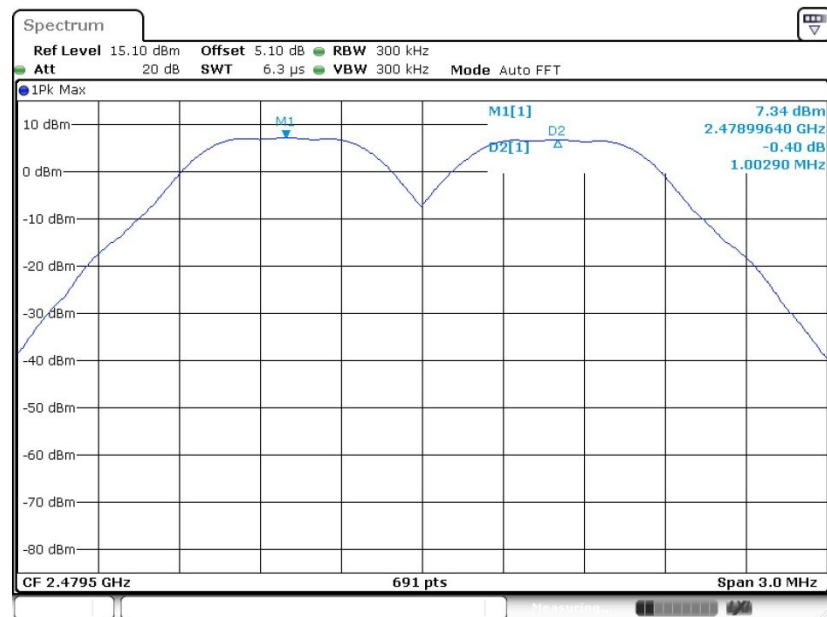


Channel Separation Plot on Channel 39 - 40



Date: 16.MAR.2019 22:34:08

Channel Separation Plot on Channel 77 - 78



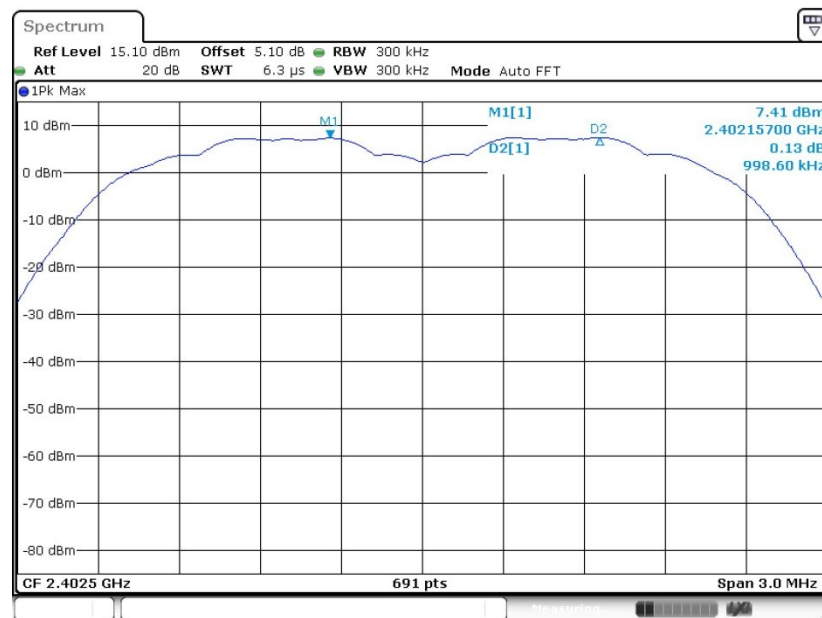
Date: 16.MAR.2019 22:39:00

Test Mode :	1Mbps	Temperature :	21~25℃
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	0.9986	0.8278	Pass
39	2441	0.9986	0.8249	Pass
78	2480	1.0029	0.8249	Pass

<2Mbps>

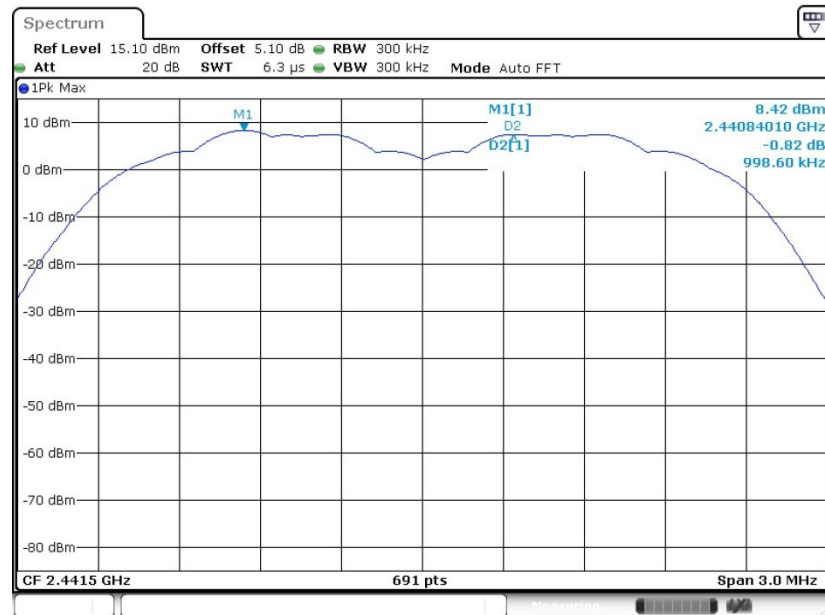
Channel Separation Plot on Channel 00 - 01



Date: 16.MAR.2019 22:44:08

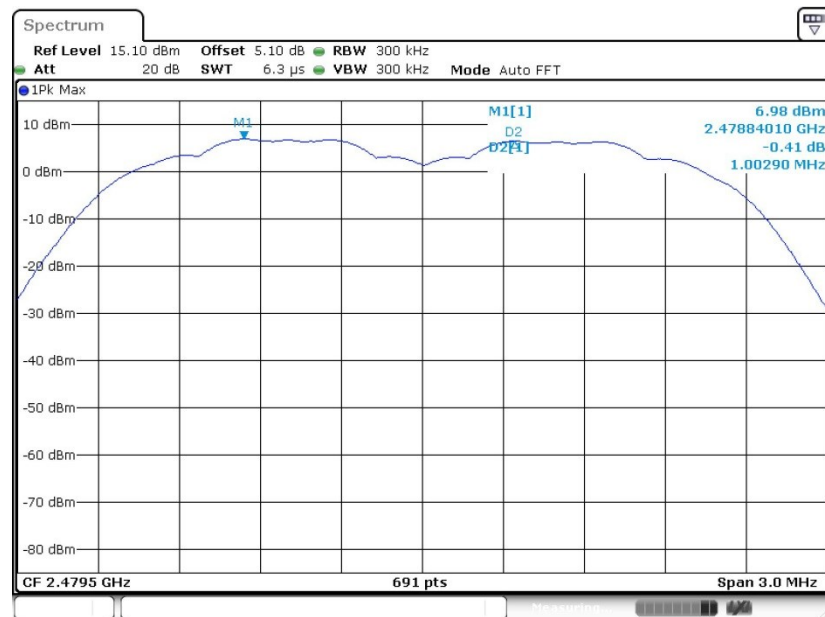


Channel Separation Plot on Channel 39 - 40



Date: 16.MAR.2019 22:47:06

Channel Separation Plot on Channel 77 - 78



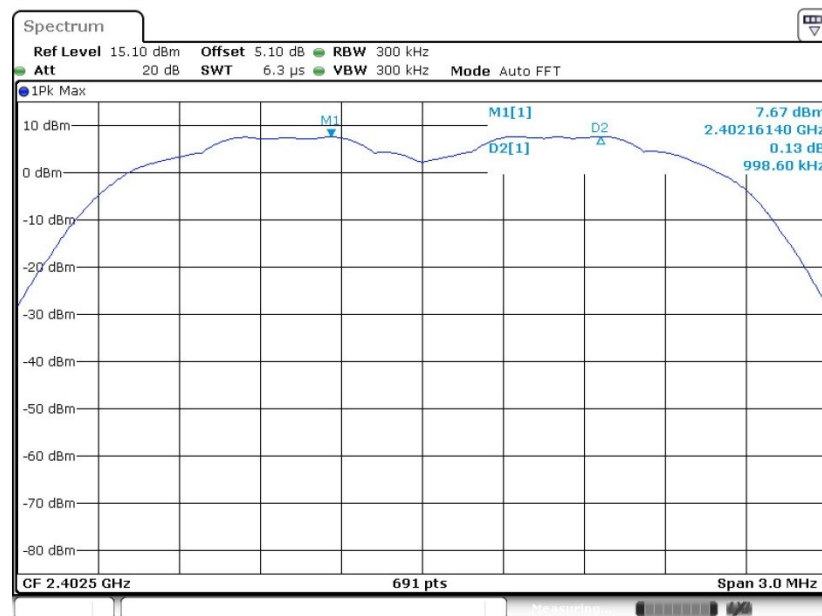
Date: 16.MAR.2019 22:52:15

Test Mode :	1Mbps	Temperature :	21~25℃
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	0.9986	0.8075	Pass
39	2441	0.8683	0.8075	Pass
78	2480	1.3025	0.8046	Pass

<3Mbps>

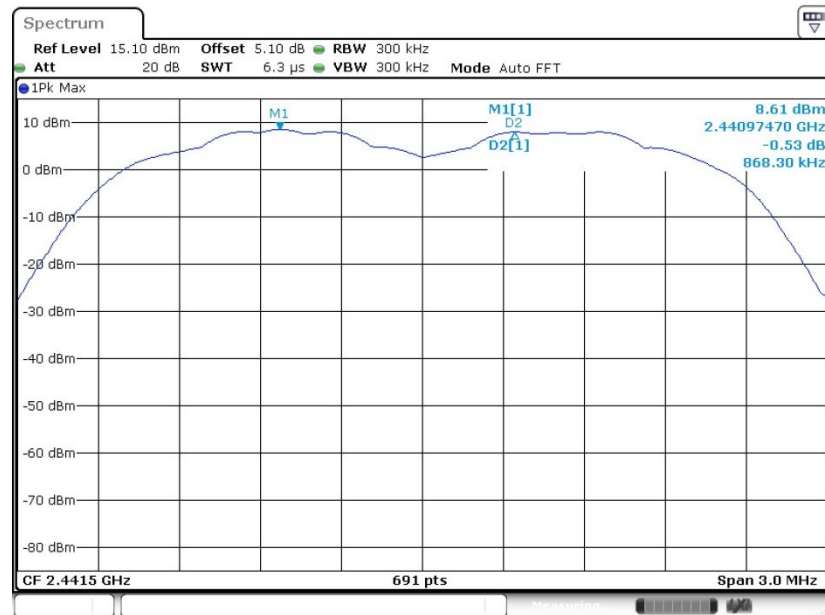
Channel Separation Plot on Channel 00 - 01



Date: 17.MAR.2019 03:30:07

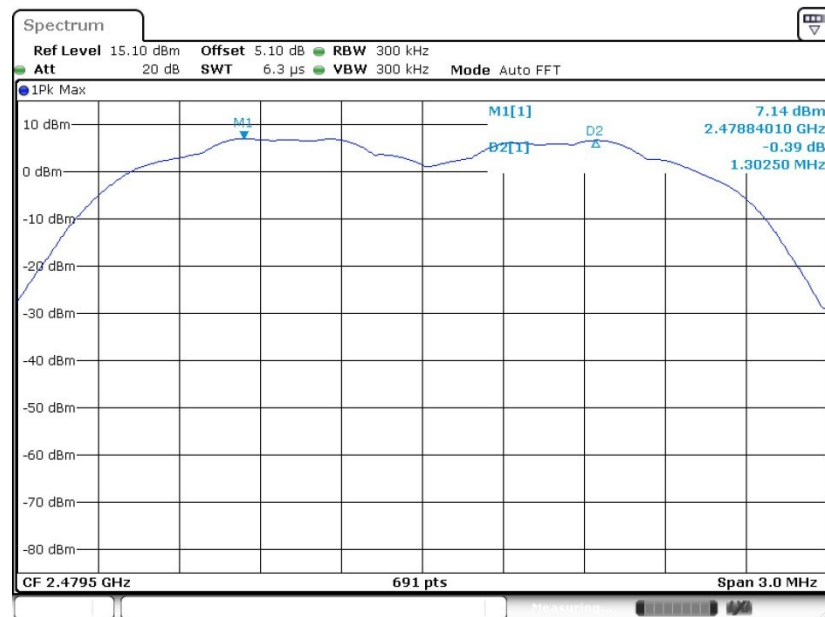


Channel Separation Plot on Channel 39 - 40



Date: 2 APR.2019 09:24:19

Channel Separation Plot on Channel 77 - 78



Date: 16.MAR.2019 23:05:45

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

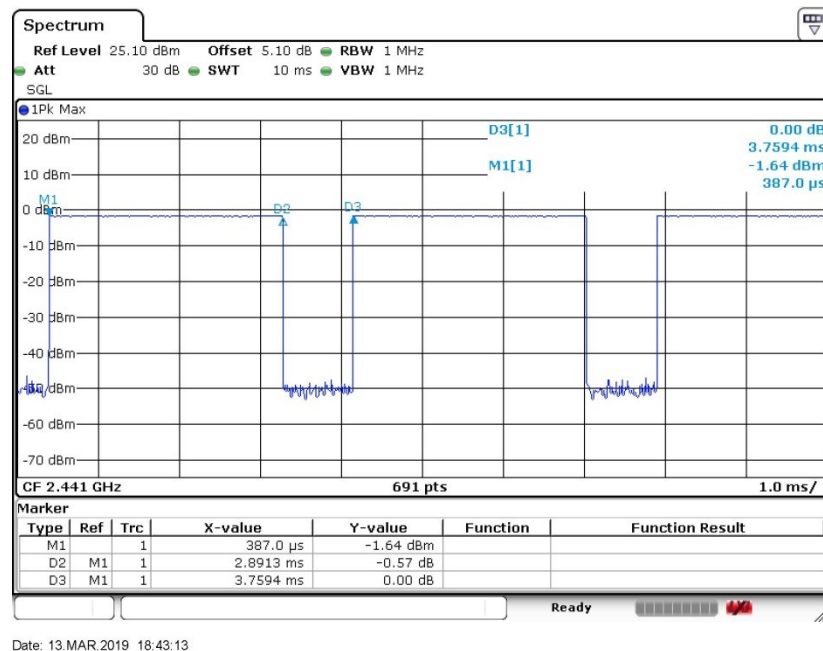


3.3.5 Test Result of Dwell Time

Test Mode :	DH5	Temperature :	21~25℃
Test Engineer :	Aly Cao	Relative Humidity :	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	2.8913	0.31	0.4	Pass
AFH	20	53.34	2.8913	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 (0.4×79) (s),
Hops Over Occupancy Time comes to $(1600 / 6 / 79) \times (0.4 \times 79) = 106.67$ 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 (0.4×20) (s),
Hops Over Occupancy Time comes to $(800 / 6 / 20) \times (0.4 \times 20) = 53.33$ 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

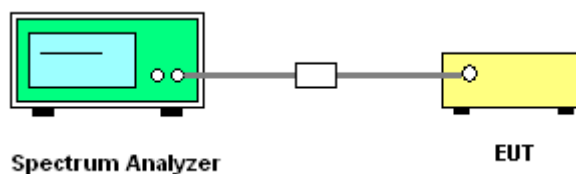
3.4.2 Measuring Instruments

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 = peak;
Trace = max hold.
6. Measure and record the results in the test report.

3.4.4 Test Setup



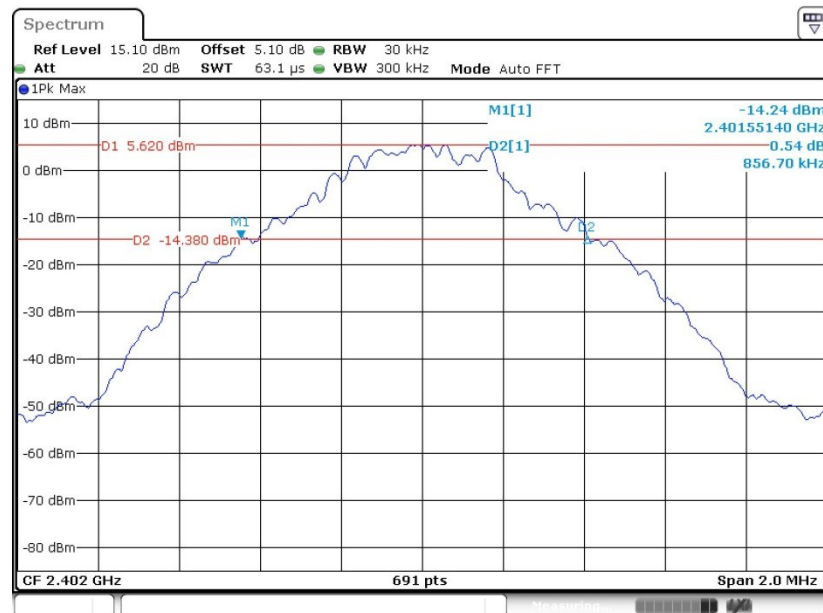
3.4.5 Test Result of 20dB Bandwidth

Test Mode :	1Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	0.857
39	2441	0.857
78	2480	0.863

<1Mbps>

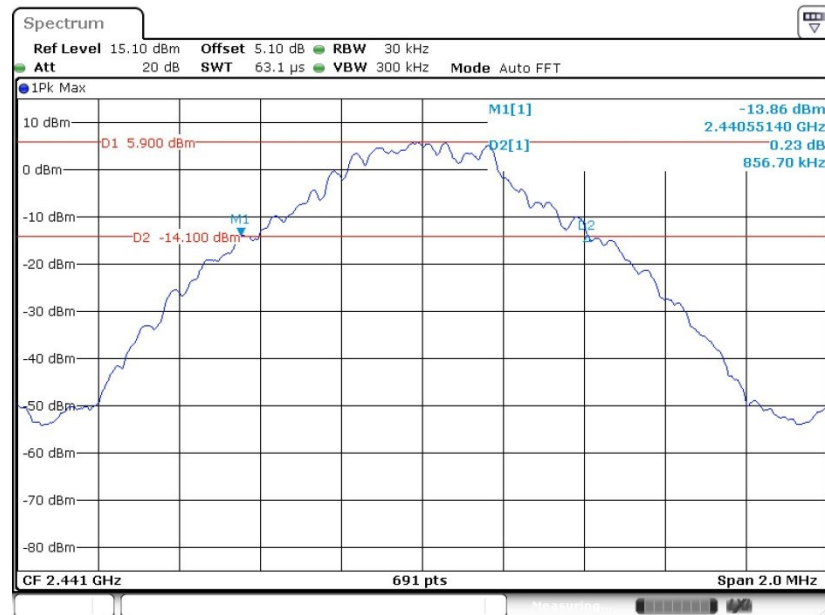
20 dB Bandwidth Plot on Channel 00



Date: 22.MAR.2019 05:18:21

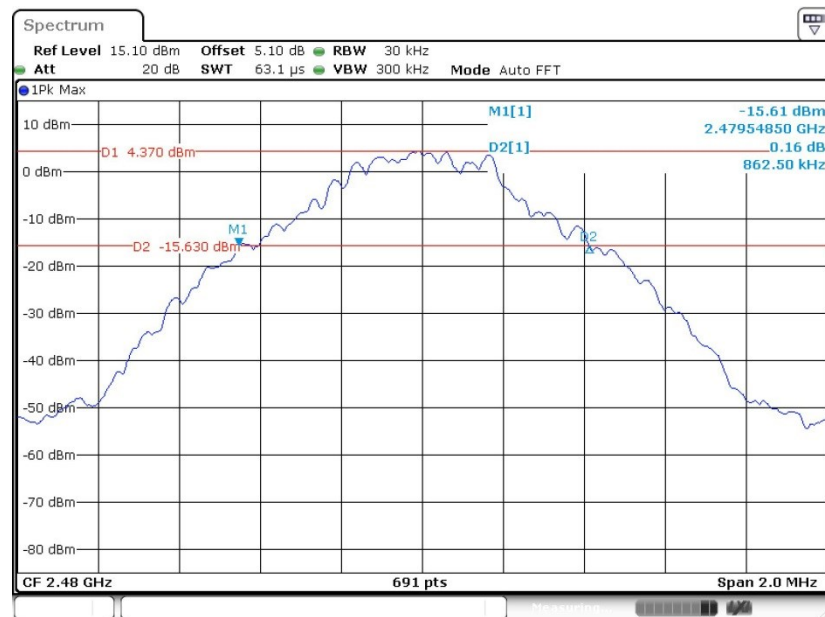


20 dB Bandwidth Plot on Channel 39



Date: 22.MAR.2019 05:16:42

20 dB Bandwidth Plot on Channel 78



Date: 22.MAR.2019 05:45:34

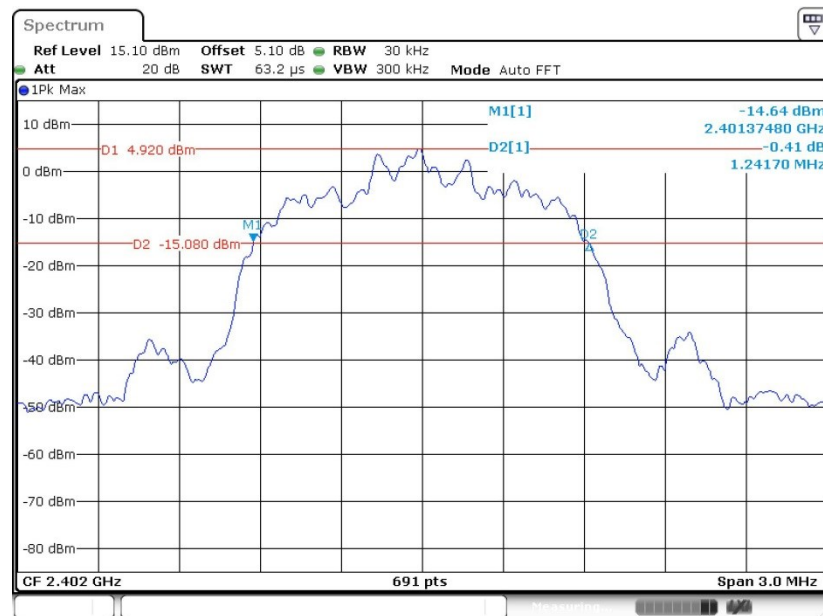


Test Mode :	2Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.242
39	2441	1.237
78	2480	1.237

<2Mbps>

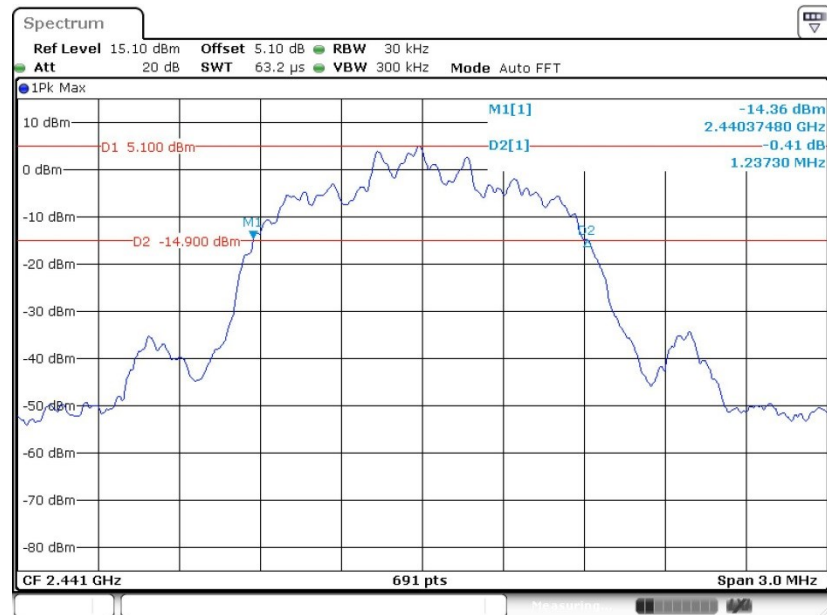
20 dB Bandwidth Plot on Channel 00



Date: 22 MAR 2019 05:19:40

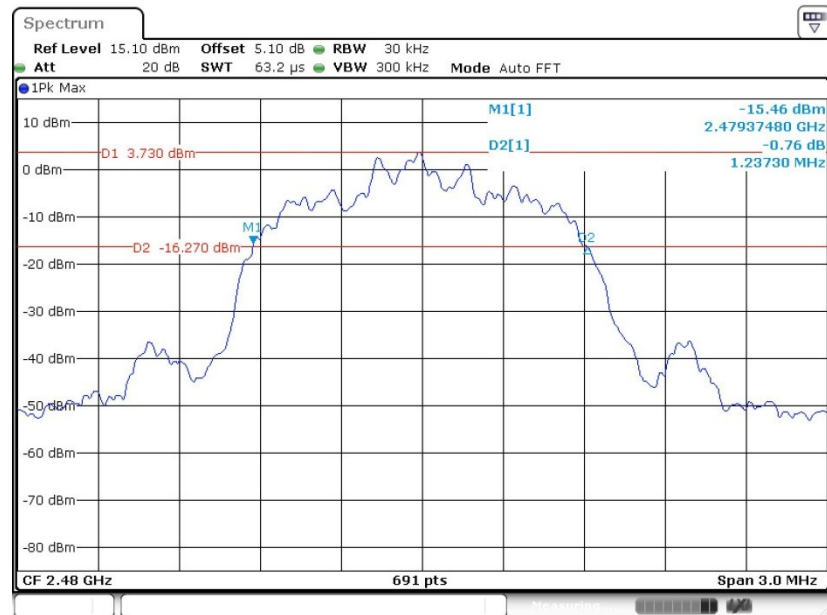


20 dB Bandwidth Plot on Channel 39



Date: 22.MAR.2019 05:20:57

20 dB Bandwidth Plot on Channel 78

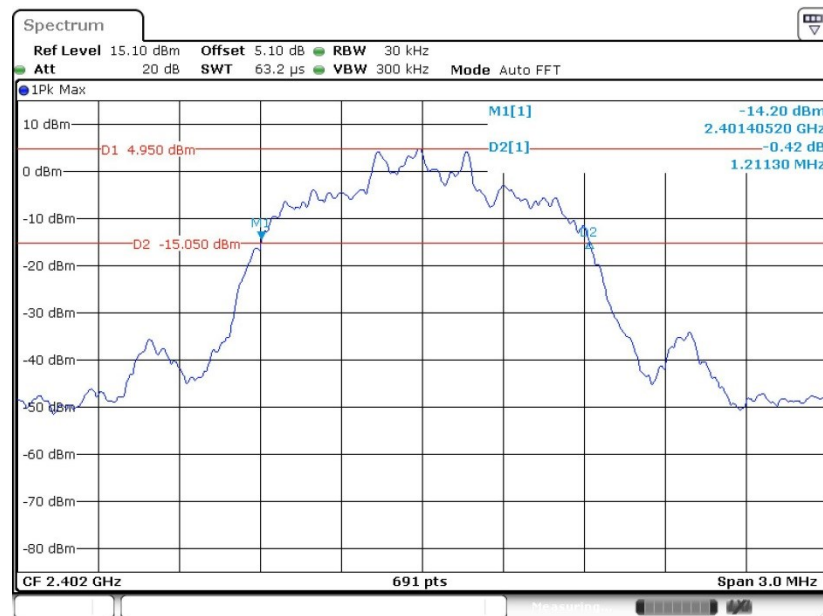


Date: 22.MAR.2019 05:22:08



Test Mode :	3Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

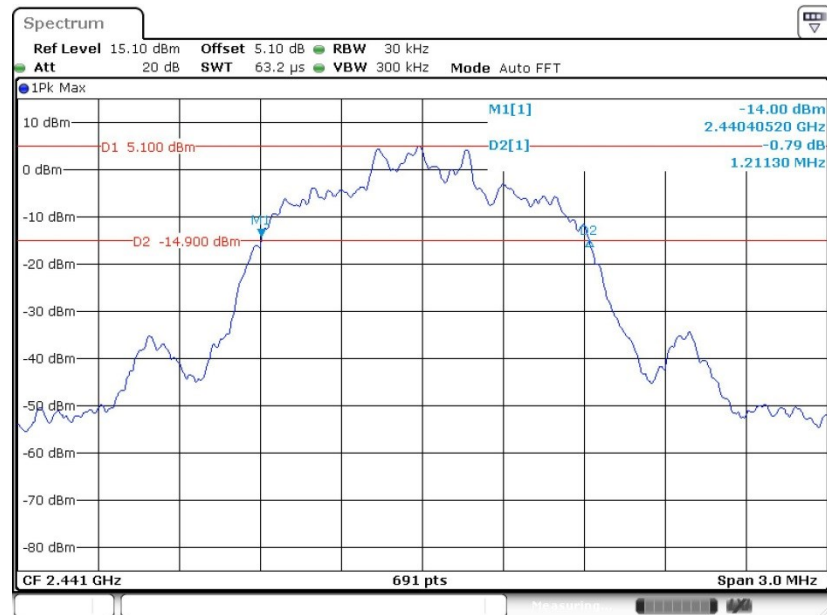
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.211
39	2441	1.211
78	2480	1.207

<3Mbps>**20 dB Bandwidth Plot on Channel 00**

Date: 22.MAR.2019 05:27:11

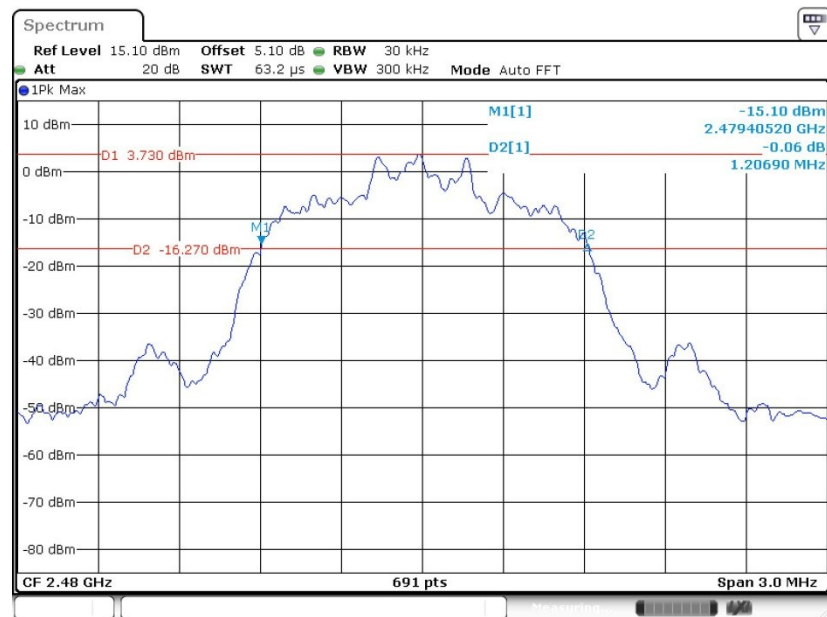


20 dB Bandwidth Plot on Channel 39



Date: 22.MAR.2019 05:25:52

20 dB Bandwidth Plot on Channel 78



Date: 22.MAR.2019 05:24:29

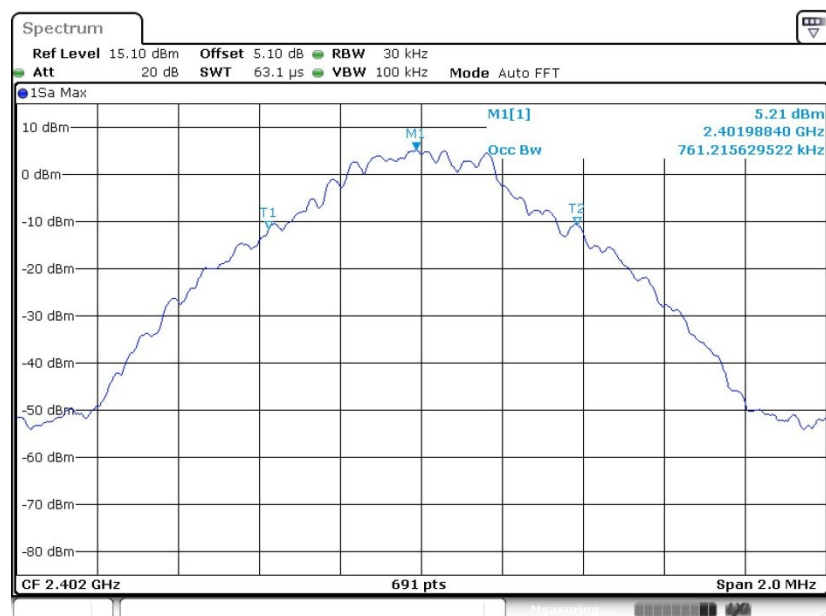
3.4.6 Test Result of 99% Occupied Bandwidth

Test Mode :	1Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	99% Bandwidth (MHz)
00	2402	0.761
39	2441	0.758
78	2480	0.764

<1Mbps>

99% Occupied Bandwidth Plot on Channel 00



Date: 16.MAR.2019 22:27:58

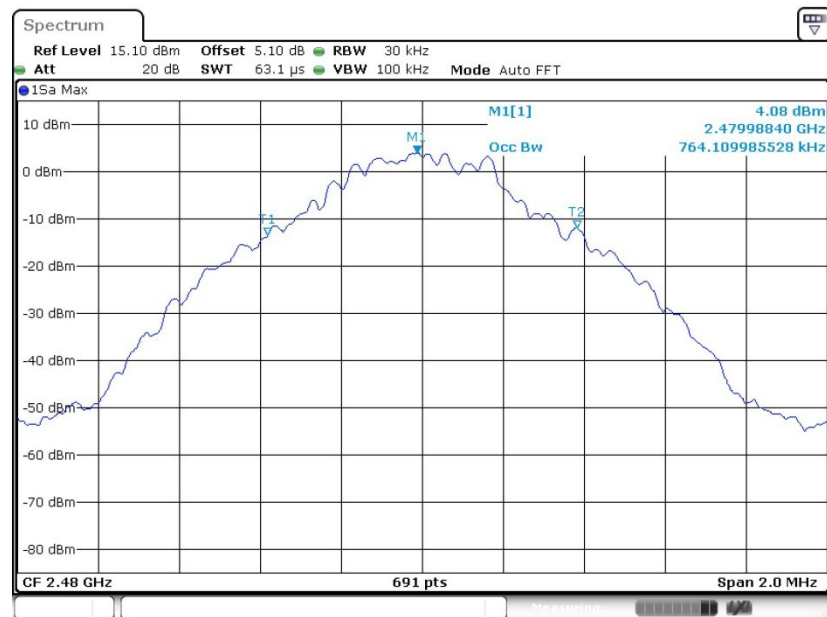


99% Occupied Bandwidth Plot on Channel 39



Date: 16.MAR.2019 22:34:47

99% Occupied Bandwidth Plot on Channel 78



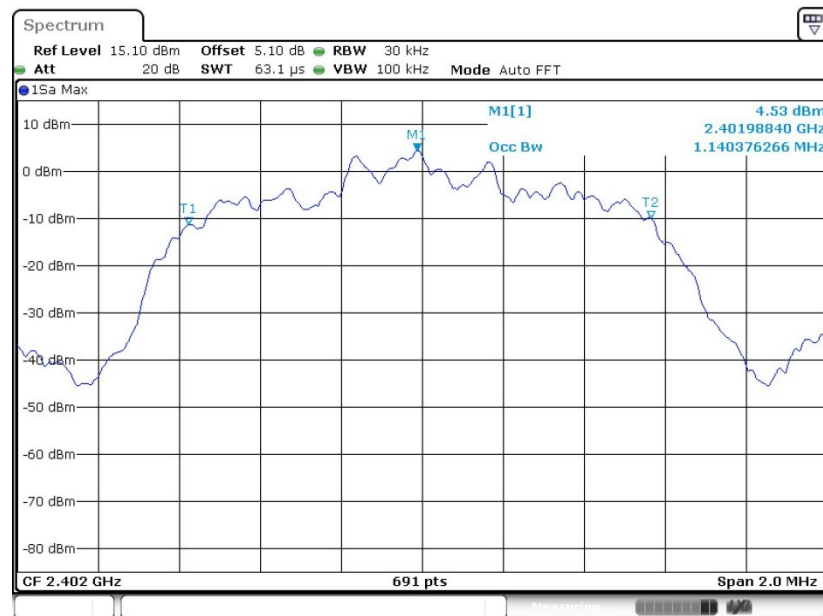
Date: 16.MAR.2019 22:39:48



Test Mode :	2Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	99% Bandwidth (MHz)
00	2402	1.140
39	2441	1.137
78	2480	1.140

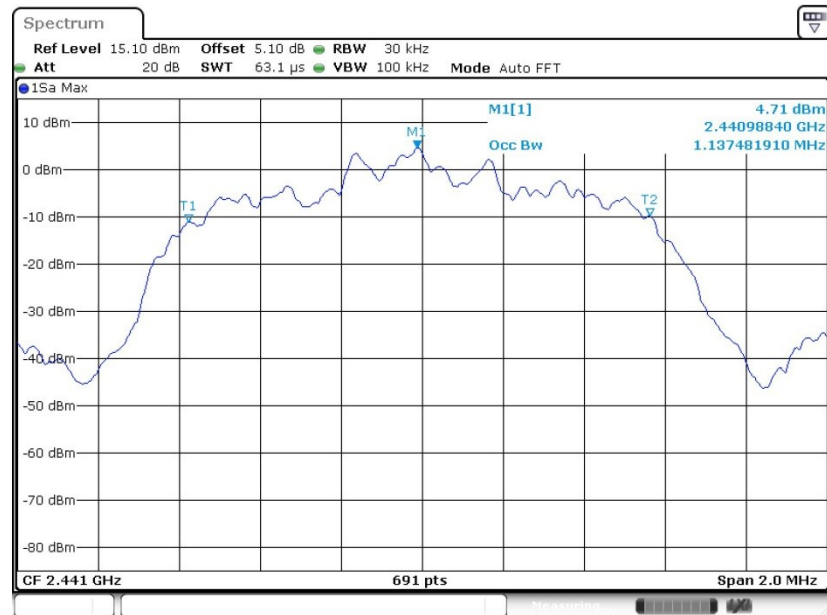
<2Mbps>

99% Occupied Bandwidth Plot on Channel 00

Date: 16 MAR 2019 22:44:43

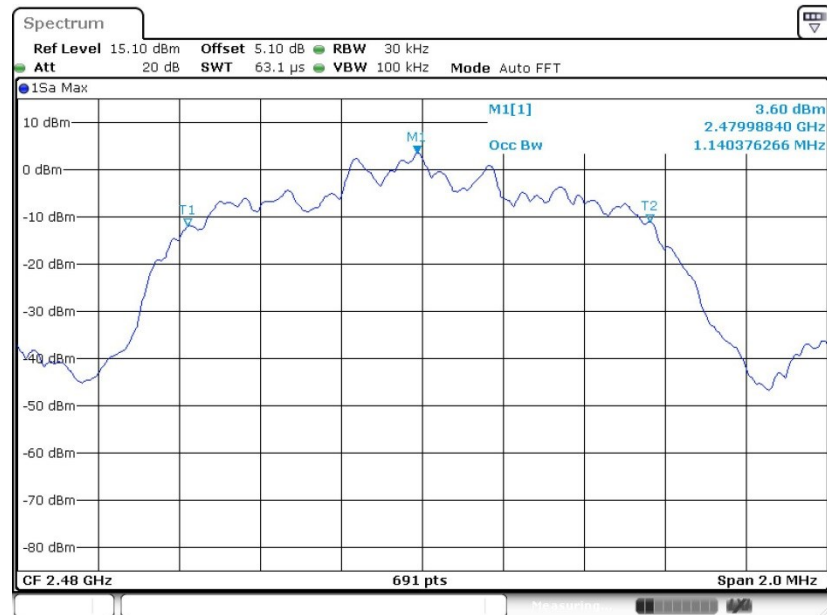


99% Occupied Bandwidth Plot on Channel 39



Date: 16.MAR.2019 22:47:41

99% Occupied Bandwidth Plot on Channel 78



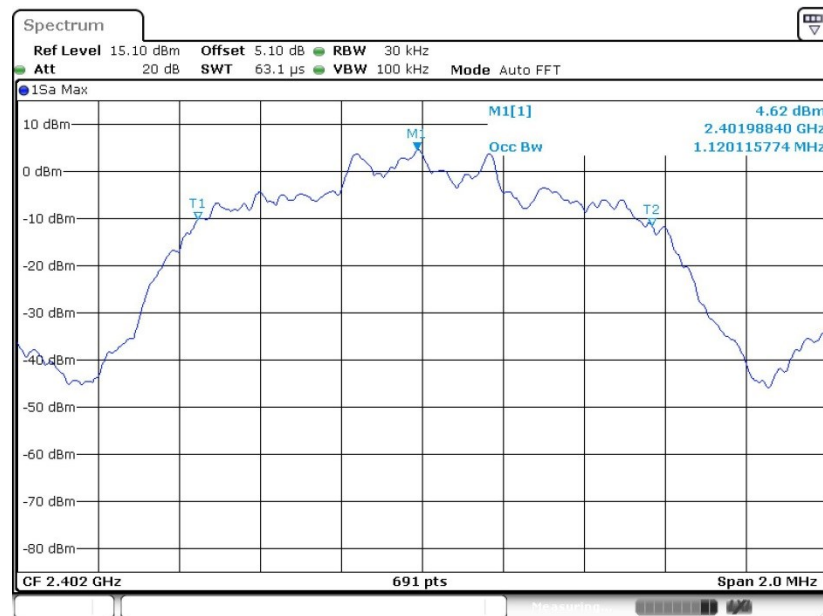
Date: 16.MAR.2019 22:53:01



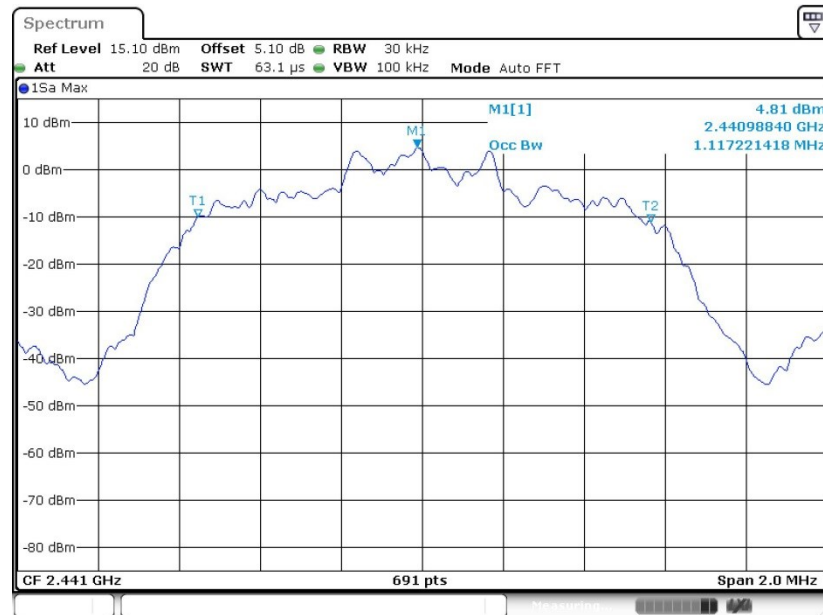
Test Mode :	3Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	99% Bandwidth (MHz)
00	2402	1.120
39	2441	1.117
78	2480	1.117

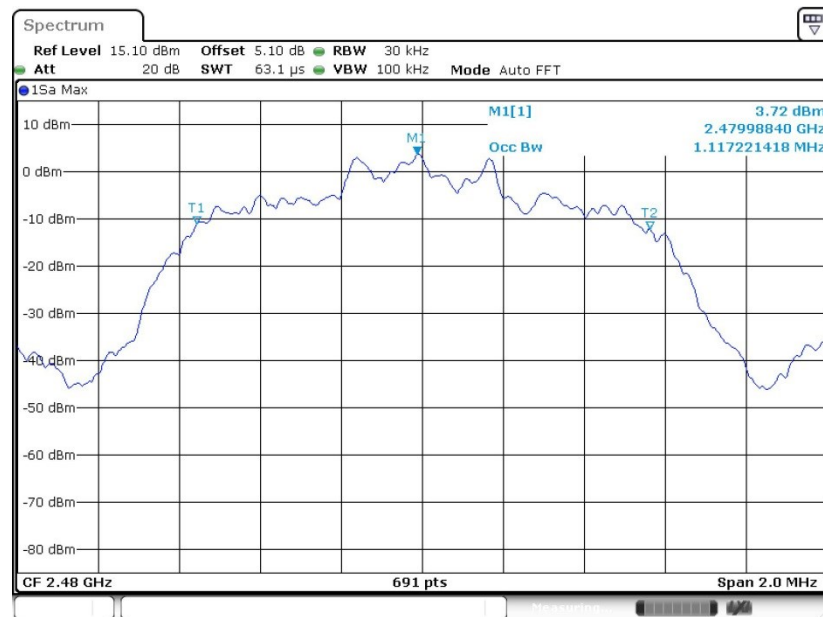
<3Mbps>

99% Occupied Bandwidth Plot on Channel 00

Date: 16 MAR 2019 22:58:46

99% Occupied Bandwidth Plot on Channel 39


Date: 16.MAR.2019 23:02:18

99% Occupied Bandwidth Plot on Channel 78


Date: 16.MAR.2019 23:08:03

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.

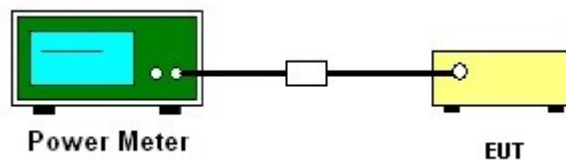
3.5.2 Measuring Instruments

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 :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	9.03	20.97	Pass
39	2441	9.05	20.97	Pass
78	2480	9.13	20.97	Pass

Test Mode :	2Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	RF Power (dBm)		
		$\pi/4$ -DQPSK	Max. Limits (dBm)	Pass/Fail
		2 Mbps		
00	2402	8.29	20.97	Pass
39	2441	8.26	20.97	Pass
78	2480	8.23	20.97	Pass

Test Mode :	3Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

Channel	Frequency (MHz)	RF Power (dBm)		
		8-DPSK	Max. Limits (dBm)	Pass/Fail
		3 Mbps		
00	2402	8.45	20.97	Pass
39	2441	8.33	20.97	Pass
78	2480	8.28	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.

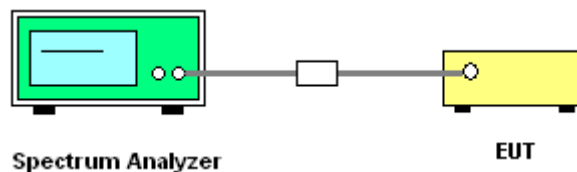
3.6.2 Measuring Instruments

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



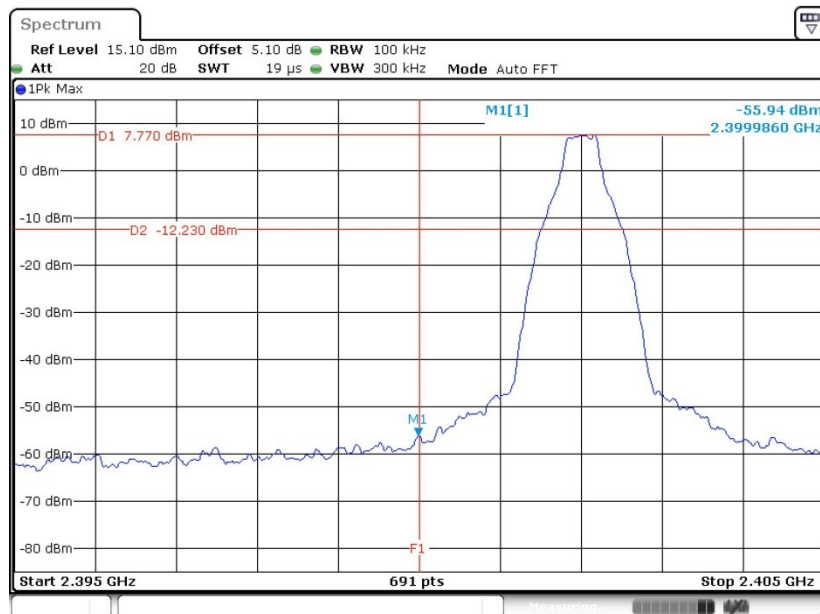


3.6.5 Test Result of Conducted Band Edges

Test Mode :	1Mbps	Temperature :	21~25°C
Test Channel :	00 and 78	Relative Humidity :	51~54%
		Test Engineer :	Aly Cao

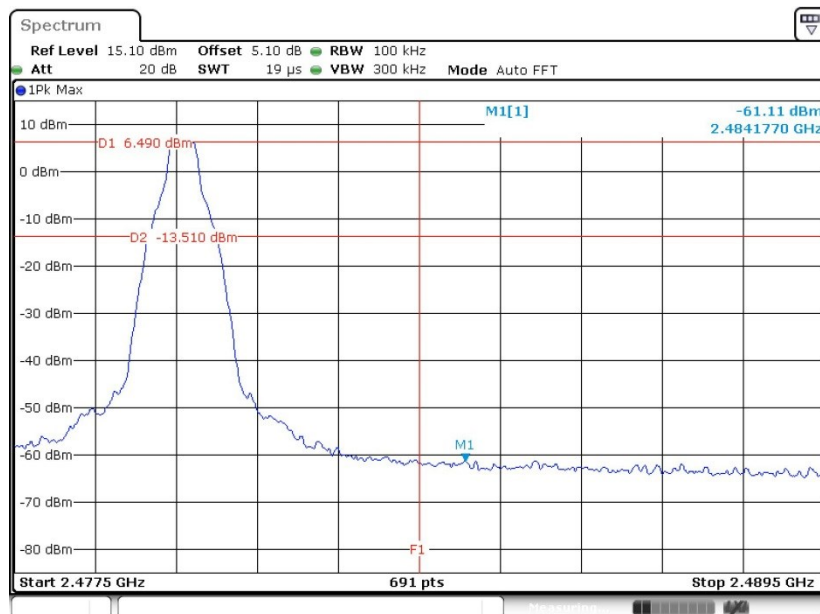
<1Mbps>

Low Band Edge Plot on Channel 00



Date: 16 MAR 2019 22:23:30

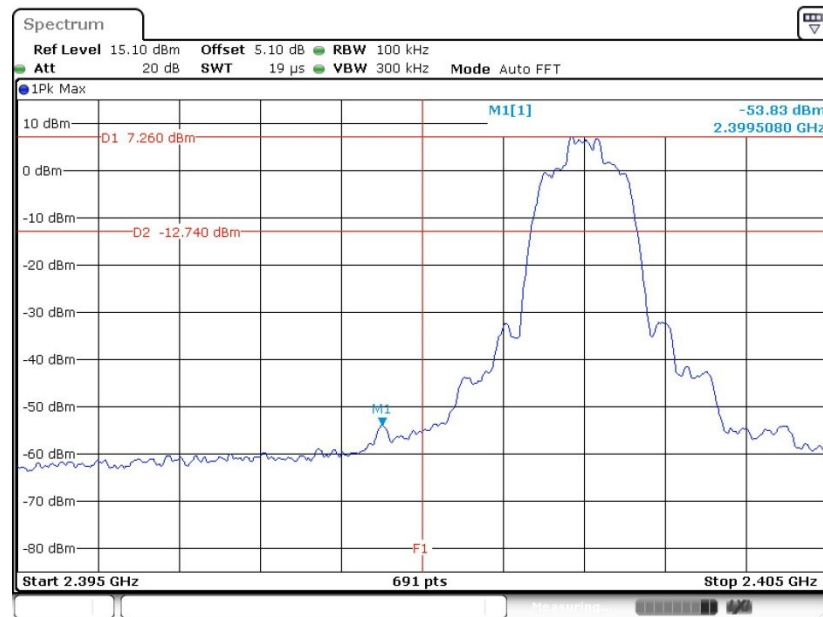
High Band Edge Plot on Channel 78



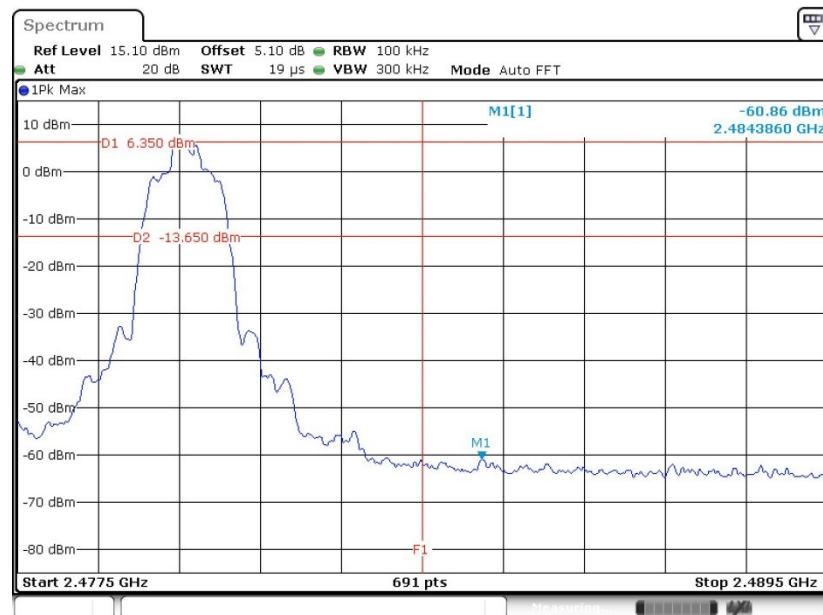
Date: 16 MAR 2019 22:37:50



Test Mode :	2Mbps	Temperature :	21~25°C
Test Channel :	00 and 78	Relative Humidity :	51~54%
		Test Engineer :	Aly Cao

<2Mbps>**Low Band Edge Plot on Channel 00**

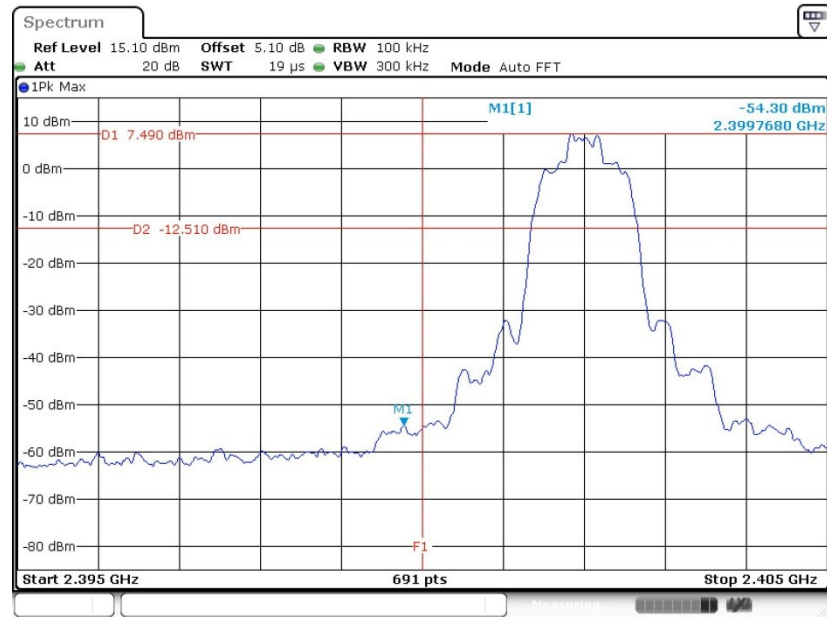
Date: 16.MAR.2019 22:42:40

High Band Edge Plot on Channel 78

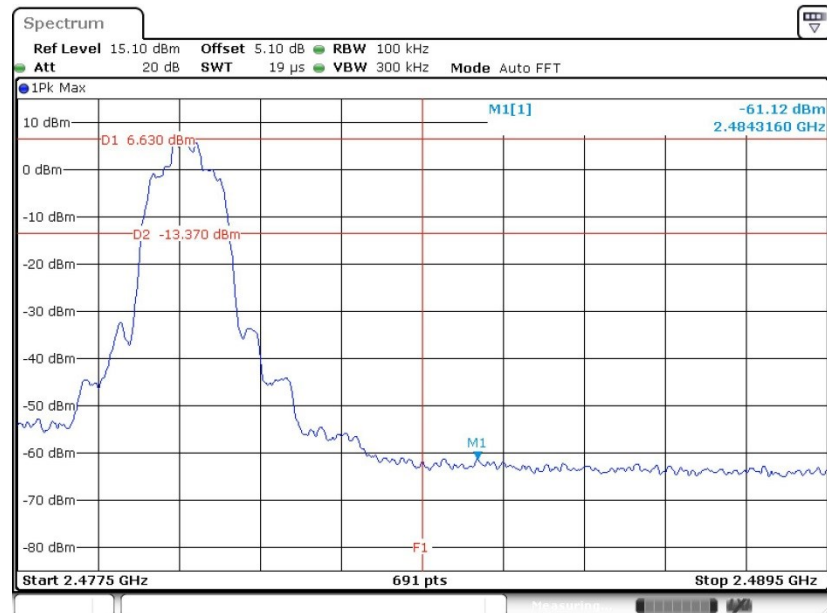
Date: 16.MAR.2019 22:50:05



Test Mode :	3Mbps	Temperature :	21~25°C
Test Channel :	00 and 78	Relative Humidity :	51~54%
		Test Engineer :	Aly Cao

<3Mbps>**Low Band Edge Plot on Channel 00**

Date: 16.MAR.2019 22:55:09

High Band Edge Plot on Channel 78

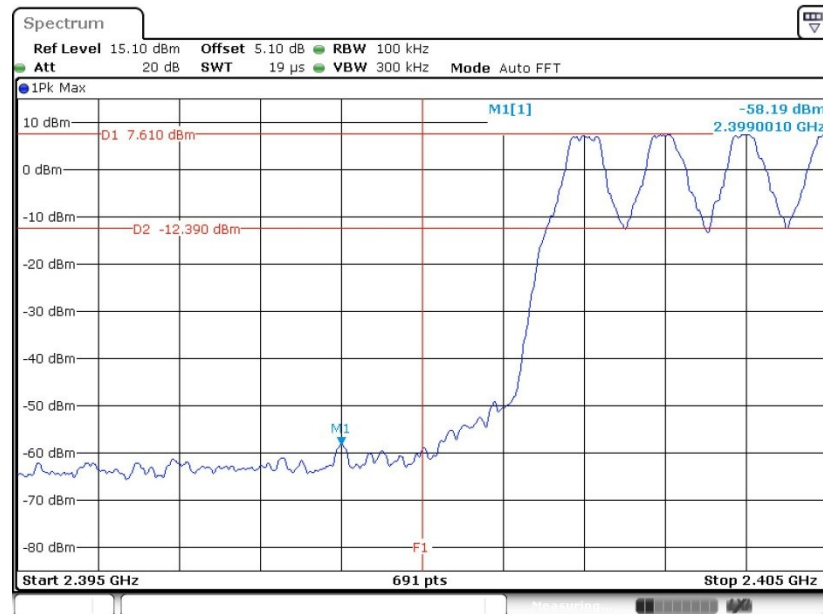
Date: 16.MAR.2019 23:04:39

3.6.6 Test Result of Conducted Hopping Mode Band Edges

Test Mode :	1Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

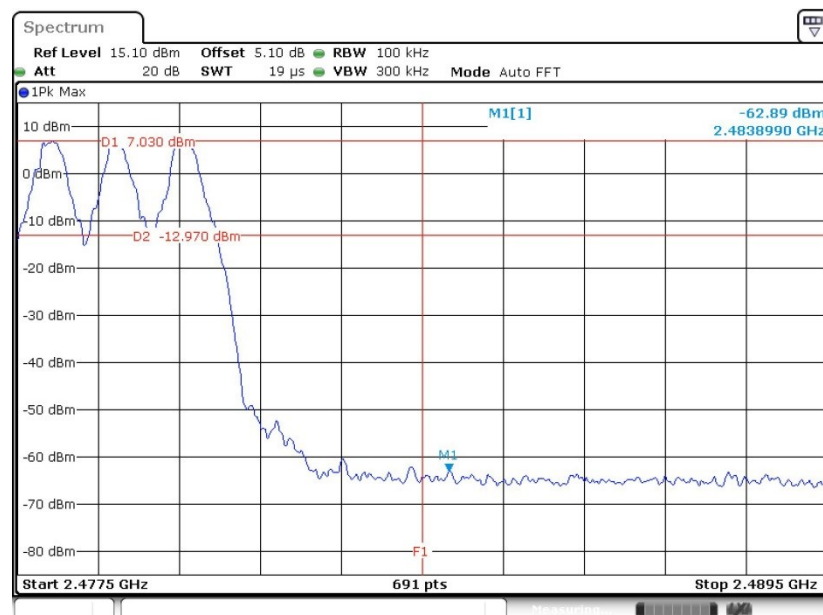
<1Mbps>

Hopping Mode Low Band Edge Plot



Date: 16.MAR.2019 22:23:52

Hopping Mode High Band Edge Plot



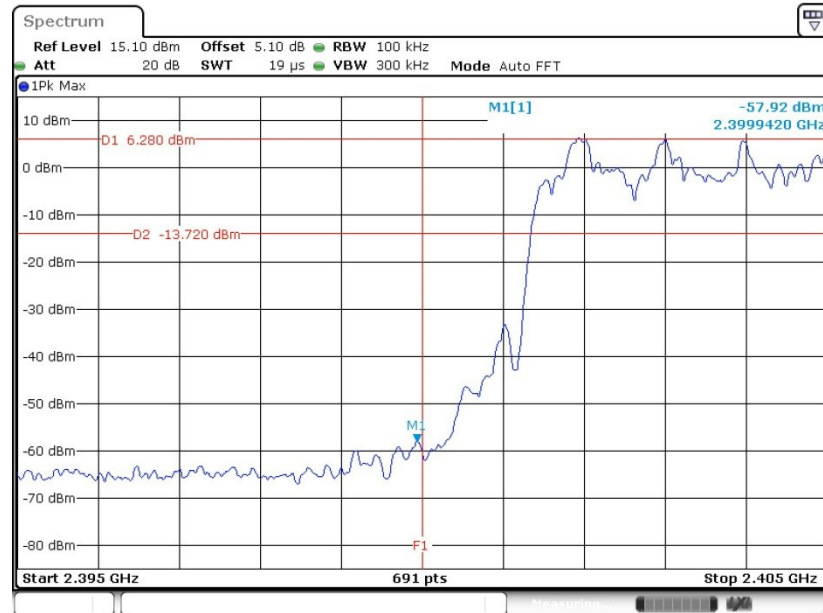
Date: 16.MAR.2019 22:38:03



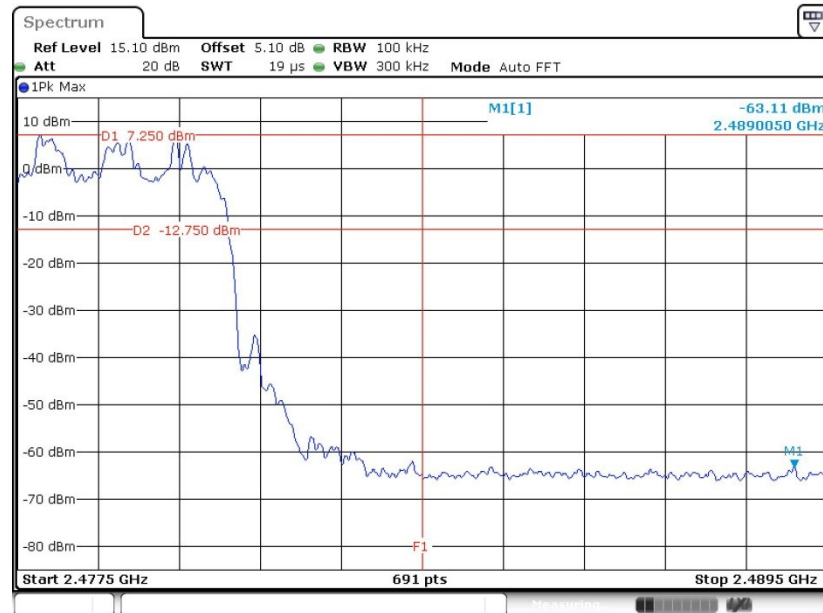
Test Mode :	2Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

720510

<2Mbps>

Hopping Mode Low Band Edge Plot

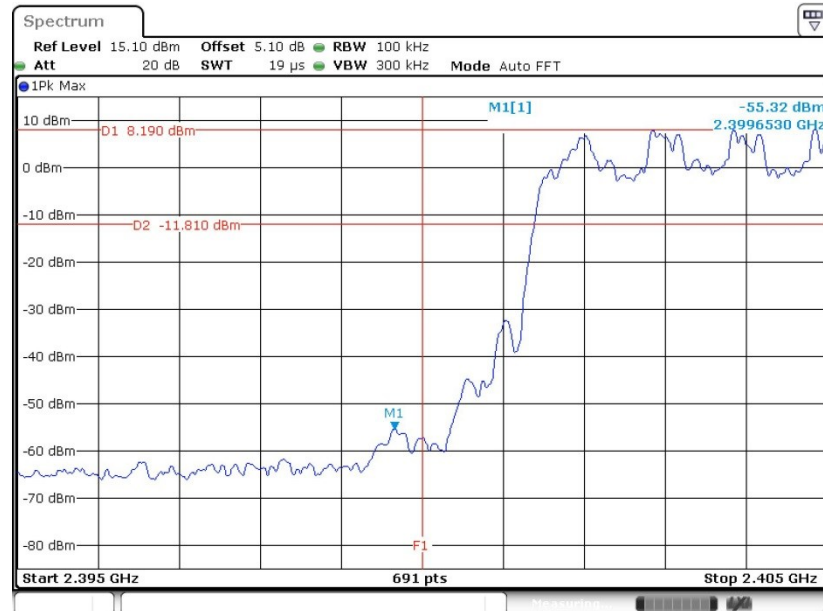
Date: 16.MAR.2019 22:43:17

Hopping Mode High Band Edge Plot

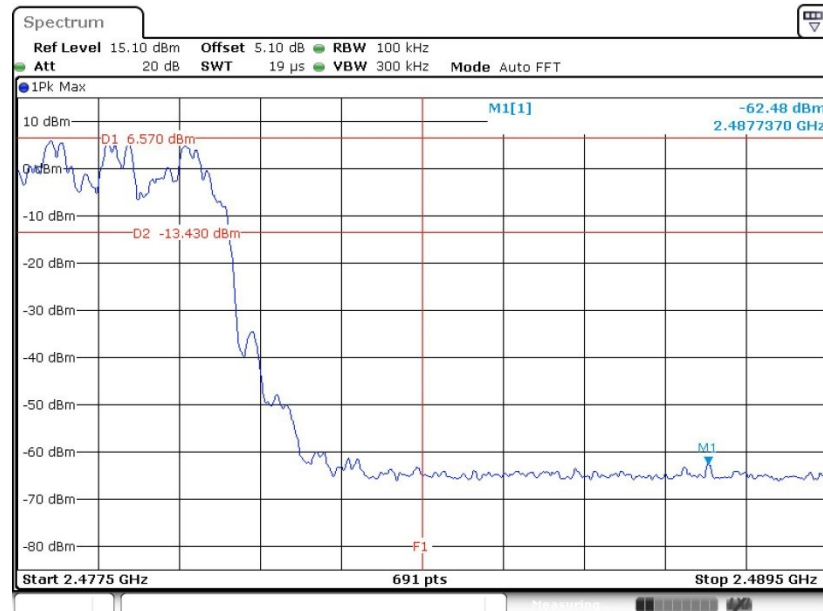
Date: 16.MAR.2019 22:50:21



Test Mode :	3Mbps	Temperature :	21~25°C
Test Engineer :	Aly Cao	Relative Humidity :	51~54%

<3Mbps>**Hopping Mode Low Band Edge Plot**

Date: 2.APR.2019 09:22:49

Hopping Mode High Band Edge Plot

Date: 16.MAR.2019 23:04:57

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.

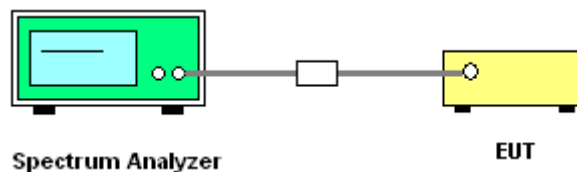
3.7.2 Measuring Instruments

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

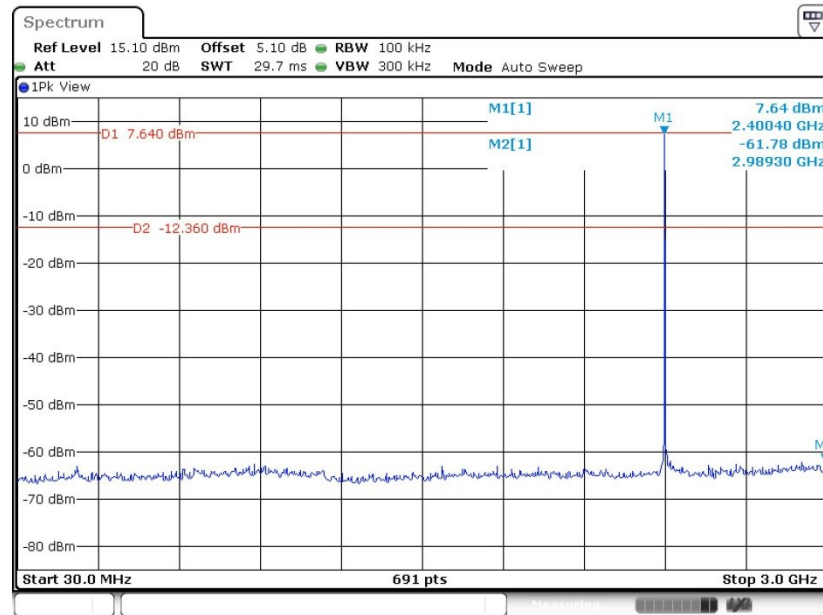


3.7.5 Test Result of Conducted Spurious Emission

Test Mode :	1Mbps	Temperature :	21~25°C
Test Channel :	00	Relative Humidity :	51~54%
		Test Engineer :	Aly Cao

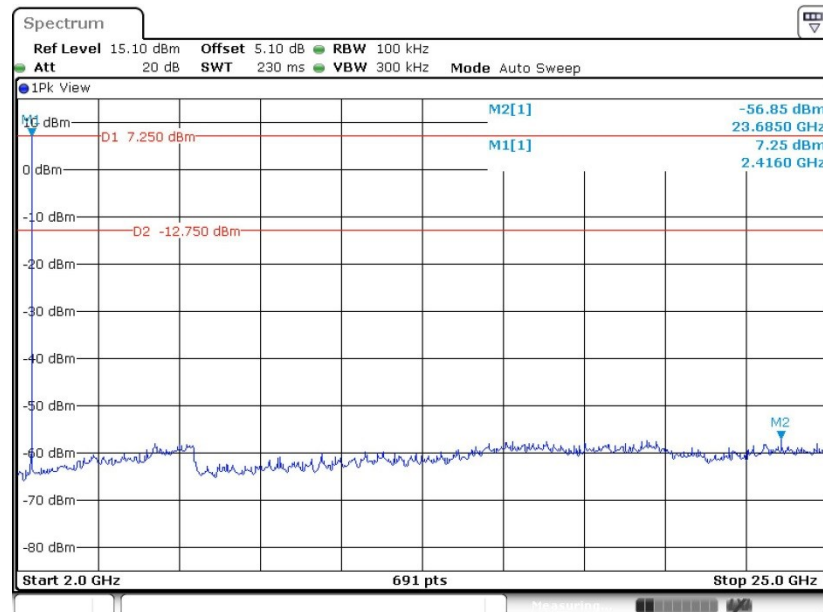
<1Mbps>

CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 16.MAR.2019 22:30:56

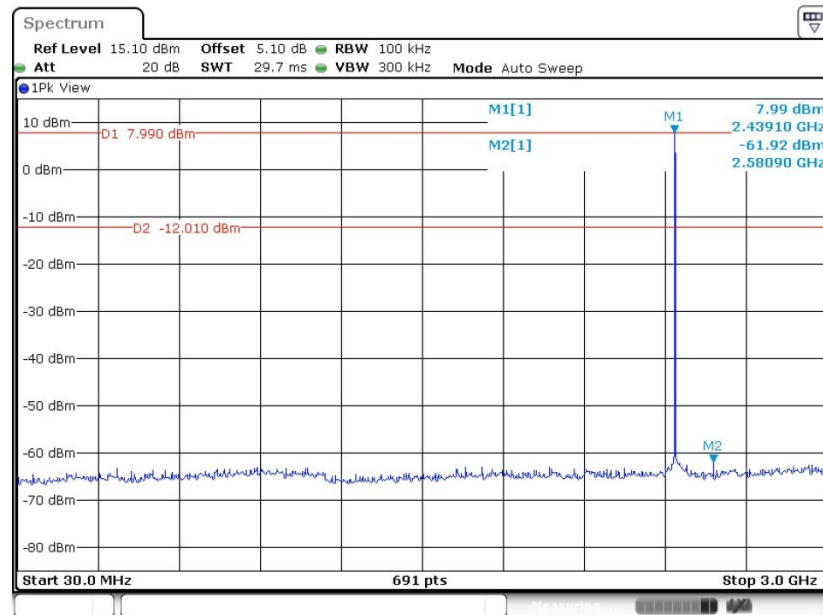
1Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 16.MAR.2019 22:32:26

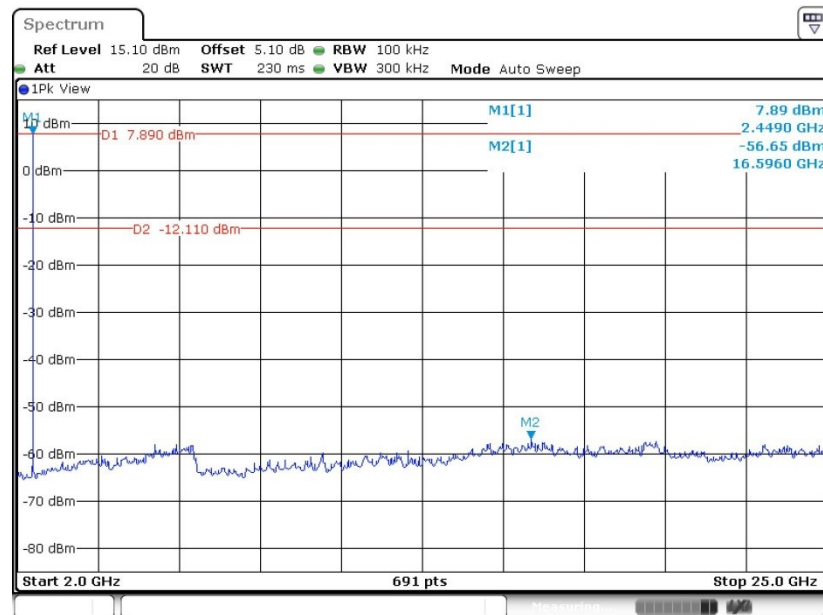


CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 16.MAR.2019 22:35:31

CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 16.MAR.2019 22:36:01