FCC RF Test Report

APPLICANT	:	**Elo Touch Solutions, Inc.**
EQUIPMENT	:	**POS**
BRAND NAME	:	**ELO or** elo
MODEL NAME	:	**PayPoint**
FCC ID	:	**RBWPAYPOINT**
STANDARD	:	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	:	**(DSS) Spread Spectrum Transmitter**

The product was received on Mar. 30, 2017 and testing was completed on May 19, 2017. We, SPORTON INTERNATIONAL INC. (KunShan) Mobile 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 test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. (KunShan) Mobile Communications Laboratory, the test report shall not be reproduced except in full.

James Huang

Prepared by: James Huang / Manager

Jones Tsai

Approved by: Jones Tsai / Manager

ilac-MRA TAF Testing Laboratory 2627

SPORTON INTERNATIONAL INC. (KunShan) Mobile Communications Laboratory

No.3-2, Pingxiang Road, Kunshan Development Zone, Jiangsu, China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR733048A	Rev. 01	Initial issue of report	Jun. 28, 2017
FR733048A	Rev. 02	Revise TAF code information on page 1. and section 1.4.	Jun. 27, 2019
FR733048A	Rev. 03	Revise Laboratory name and mentioning the CO01-SZ as the subcontract lab for conduction.	Jul. 04, 2019

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(1)	Number of Channels	≥ 15Chs	Pass	-
3.2	15.247(a)(1)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Pass	-
3.3	15.247(a)(1)	Dwell Time of Each Channel	≤ 0.4sec 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	≤ 125 mW	Pass	-
3.6	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	-
3.7	15.247(d)	Conducted Spurious Emission	≤ 20dBc	Pass	-
3.8	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 3.78 dB at 155.130 MHz
3.9	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 13.16 dB at 10.560 MHz
3.10	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

Elo Touch Solutions, Inc.
670 N. McCarthy Blvd., Suite 100, Milpitas, CA95035

1.2 Product Feature of Equipment Under Test

Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n, Wi-Fi 5GHz 802.11a/n/ac

Product Specification subjective to this standard	
Antenna Type	WLAN: PIFA Antenna Bluetooth: PIFA Antenna

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. (Shenzhen) Mobile Communications Laboratory
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan District, Shenzhen City, Guangdong Province, China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595
Test Site No.	**Sporton Site No.**
	CO01-SZ (TAF Code: 2353)
Remark	The conduction test item outsourcing to SPORTON INTERNATIONAL INC. (Shenzhen) Mobile Communications Laboratory

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

Test Site	SPORTON INTERNATIONAL INC. (KunShan) Mobile Communications Laboratory		
Test Site Location	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P.R.C. TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958		
Test Site No.	**Sporton Site No.**		**FCC Registration No.**
	TH01-KS	03CH03-KS	306251

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

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
- ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

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

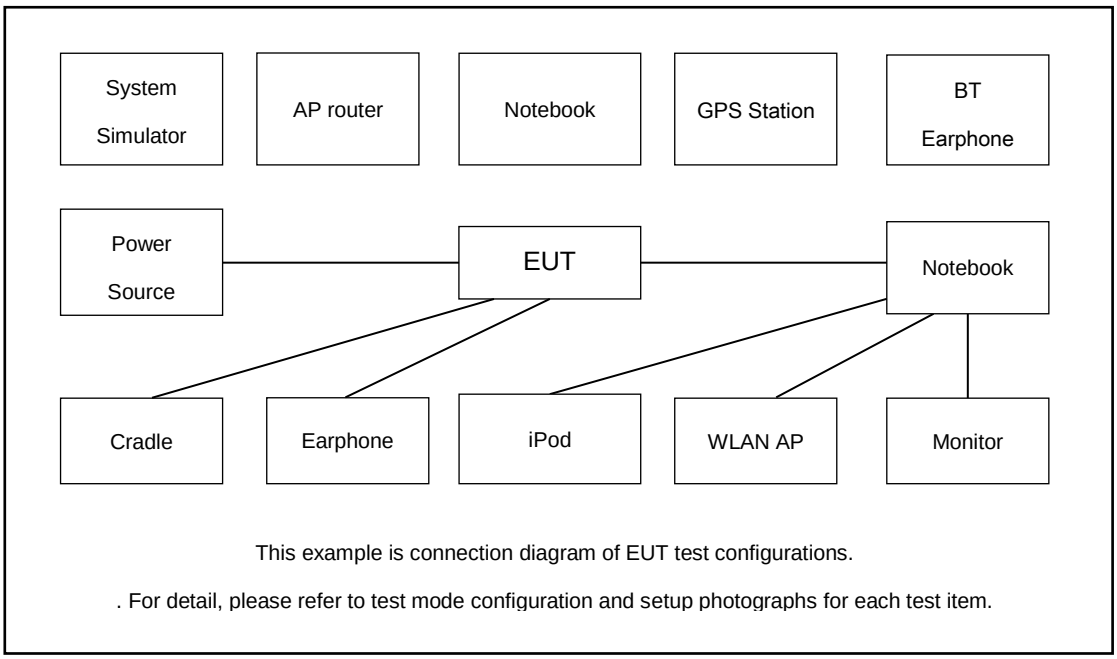
a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower), and the worst mode of radiated spurious emissions is Bluetooth 3Mbps 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 2: CH39_2441 MHz Mode 3: CH78_2480 MHz	Mode 4: CH00_2402 MHz Mode 5: CH39_2441 MHz Mode 6: CH78_2480 MHz	Mode 7: CH00_2402 MHz Mode 8: CH39_2441 MHz Mode 9: CH78_2480 MHz
Radiated Test Cases	**Bluetooth EDR 3Mbps 8-DPSK**		
	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz		
AC Conducted Emission	Mode 1 :Bluetooth Link + WLAN Link (2.4GHz) + Adapter + Earphone		
Remark: For radiated test cases, the worst mode data rate 3Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and the conducted spurious emissions and conducted band edge measurement for each data rate are no worse than 3Mbps, and no other significantly frequencies found in conducted spurious emission.			

2.3 Connection Diagram of Test System



This example is connection diagram of EUT test configurations.

. For detail, please refer to test mode configuration and setup photographs for each test item.

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Base Station	R&S	CBT32	N/A	N/A	Unshielded, 1.8 m
2.	WLAN AP	D-Link	DIR-820L	KA2IR820LA1	N/A	Unshielded, 1.8 m
3.	LCD Monitor	Dell	92715Qt	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
4.	NOTE BOOK	Lenovo	E540	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
5.	Bluetooth Earphone	Nokia	BH-108	PYAHS-107W	N/A	N/A
6.	iPod	Apple	MC690ZP/A	FCC DoC	Shielded, 1.2 m	N/A
7.	USB flash drive	Kingston	DT101	N/A	N/A	N/A
8.	SD Card	SanDisk	4G class 4	N/A	N/A	N/A

2.5 UT Operation Test Setup

The RF test items, programmed RF utility, “QRCT” installed in the notebook make the EUT provide functions like channel selection and power level for continuous transmitting and receiving 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.

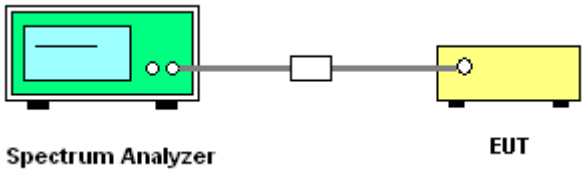
3.1.2 Measuring Instruments

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 ≥ 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

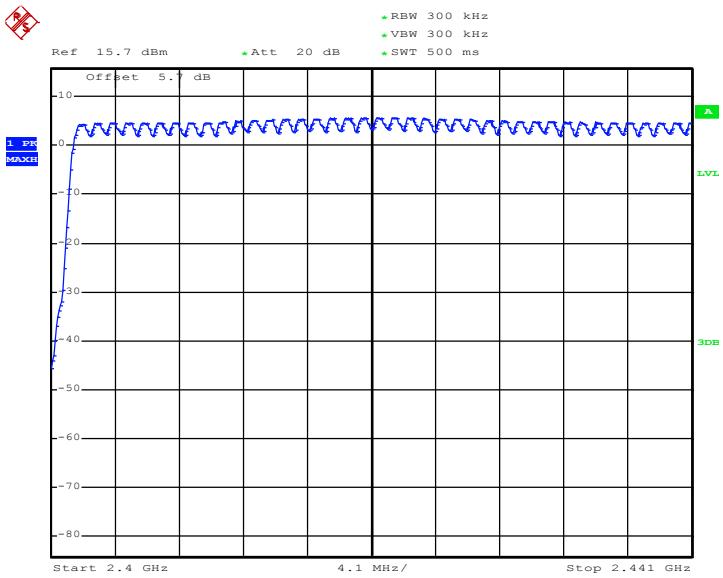


3.1.5 Test Result of Number of Hopping Frequency

Test Mode :	3Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

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



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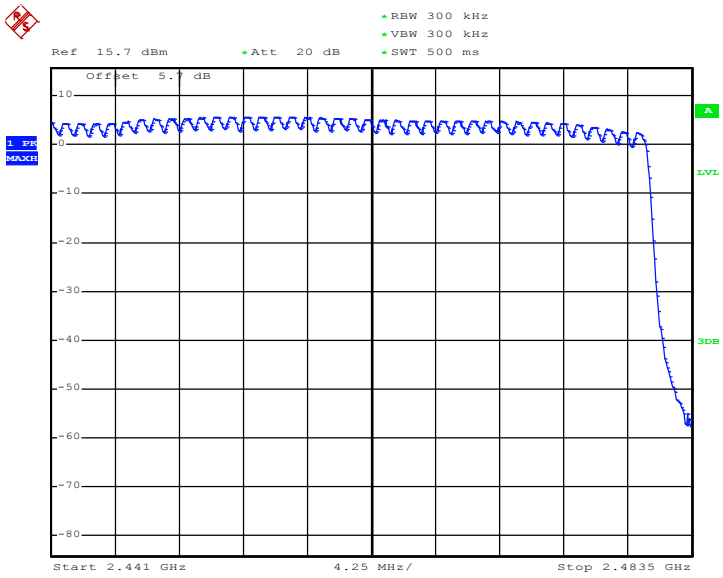


Date: 4.MAY.2017 01:31:02

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.

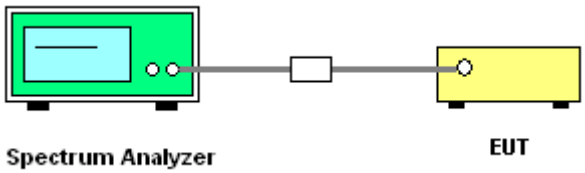
3.2.2 Measuring Instruments

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

3.2.4 Test Setup

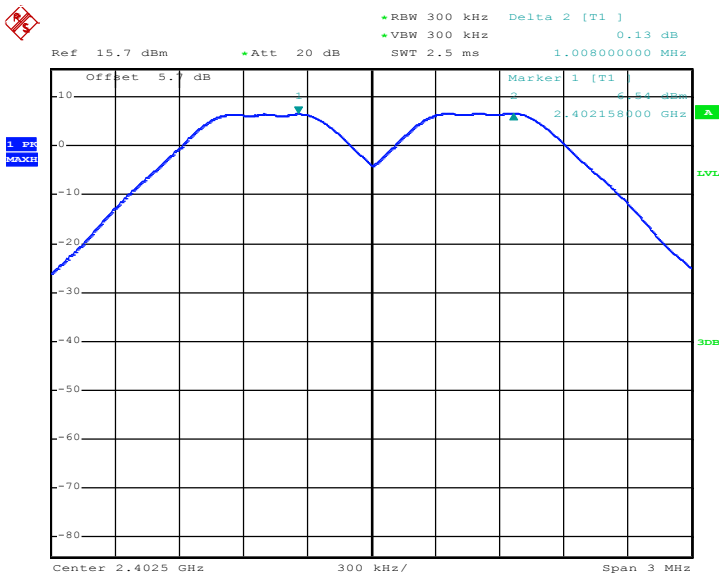


3.2.5 Test Result of Hopping Channel Separation

Test Mode :	1Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

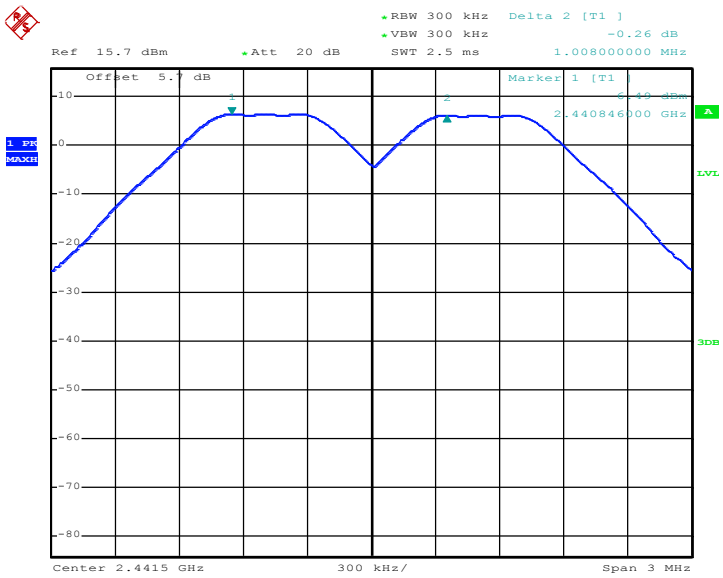
Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1008.000	0.6427	Pass
39	2441	1008.000	0.6427	Pass
78	2480	1002.000	0.6293	Pass

Channel Separation Plot on Channel 00 - 01



Date: 3.MAY.2017 23:17:02

Channel Separation Plot on Channel 39 - 40



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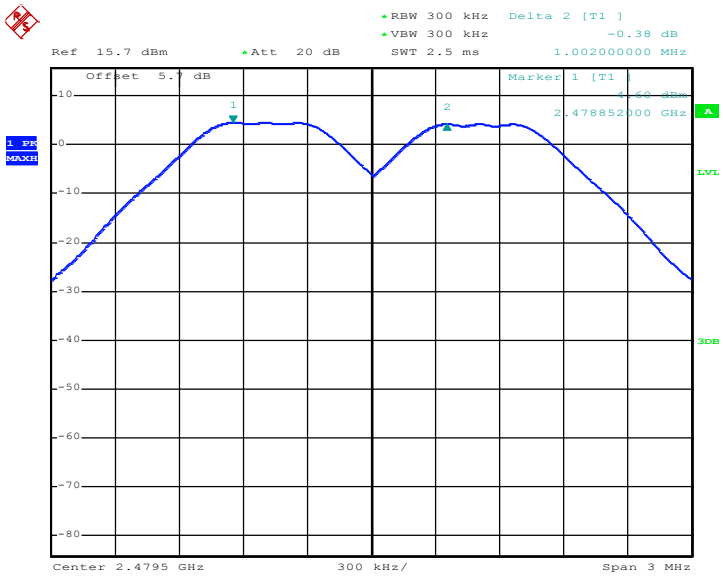
Channel Separation Plot on Channel 77 - 78

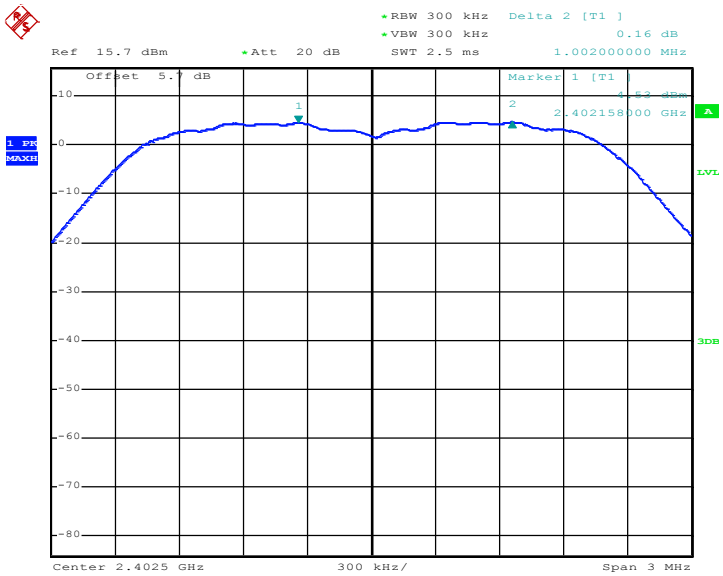


Date: 3.MAY.2017 23:27:09

Test Mode :	2Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1002.000	0.8440	Pass
39	2441	1008.000	0.8440	Pass
78	2480	1008.000	0.8440	Pass

Channel Separation Plot on Channel 00 - 01



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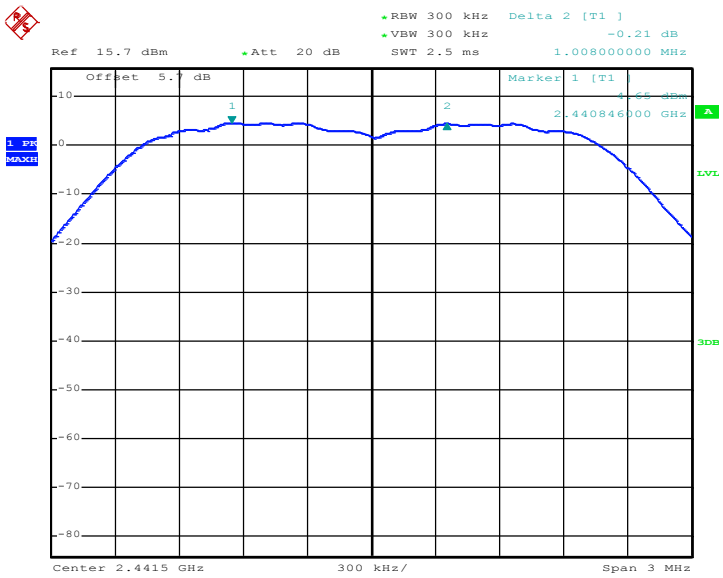
Channel Separation Plot on Channel 39 - 40



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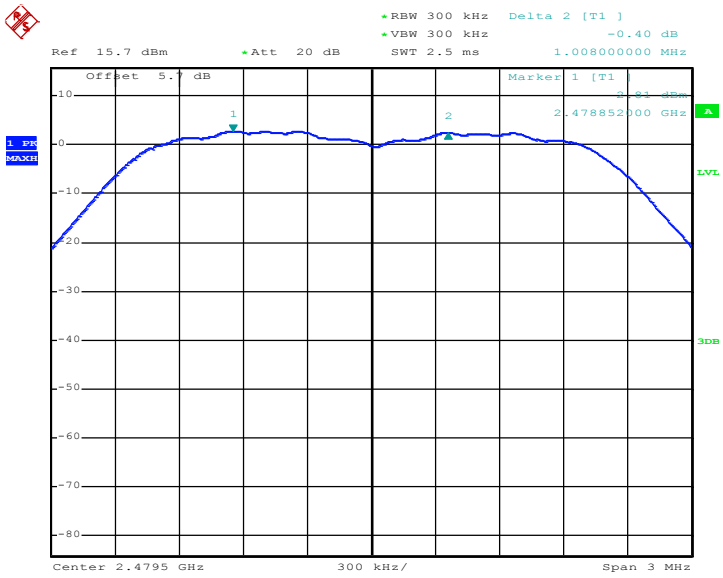
Channel Separation Plot on Channel 77 - 78

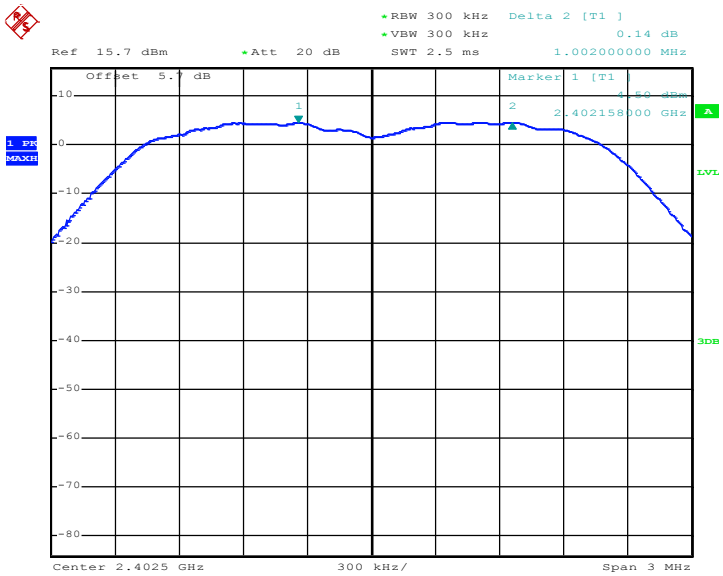


Date: 3.MAY.2017 23:29:17

Test Mode :	3Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1002.000	0.8240	Pass
39	2441	1008.000	0.8240	Pass
78	2480	1008.000	0.8240	Pass

Channel Separation Plot on Channel 00 - 01



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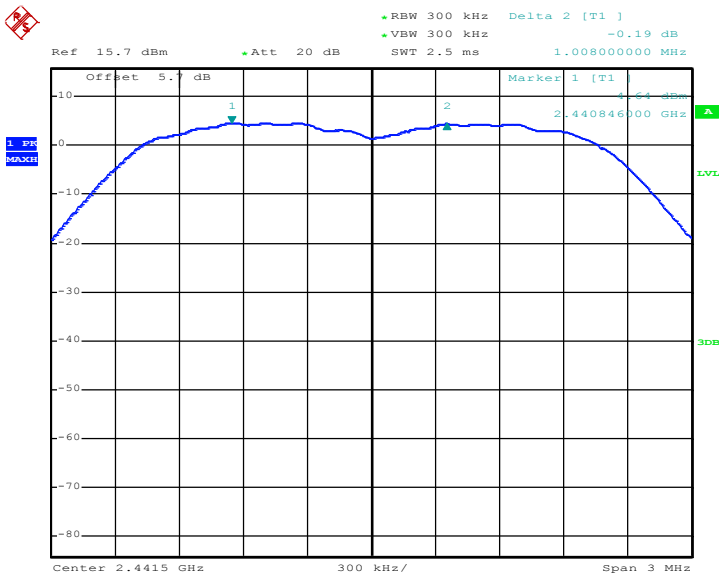
Channel Separation Plot on Channel 39 - 40



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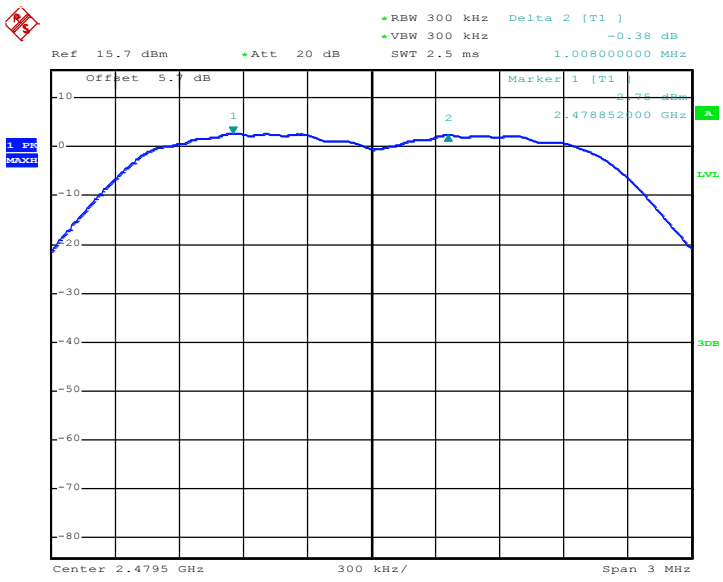
Channel Separation Plot on Channel 77 - 78



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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.

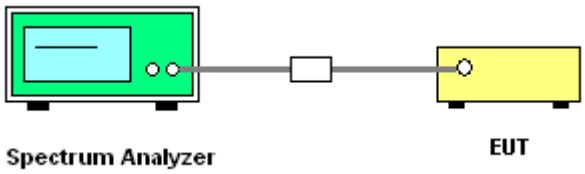
3.3.2 Measuring Instruments

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 ≥ 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 :	Hirem Shen	Relative Humidity :	51~55%

Mode	Hopping Channel Number	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Normal	79	106.67	2.8841	0.31	0.4	Pass
AFH	20	53.33	2.8841	0.15	0.4	Pass

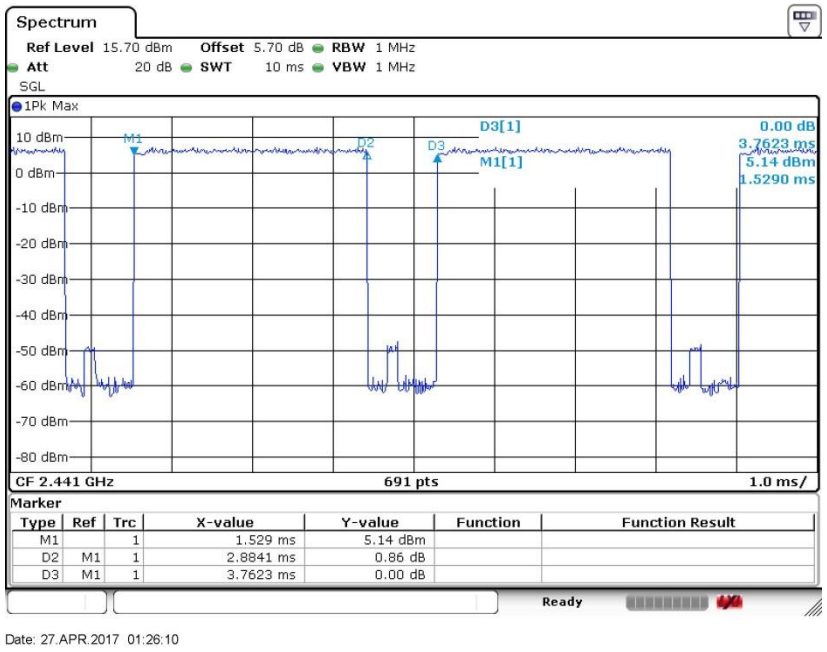
Remark:

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

Package Transfer Time Plot



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 ≥ 1% of the 20 dB bandwidth; 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% of the 99% bandwidth; VBW ≥ RBW; Sweep = auto; Detector function = peak;
   Trace = max hold.
6. Measure and record the results in the test report.

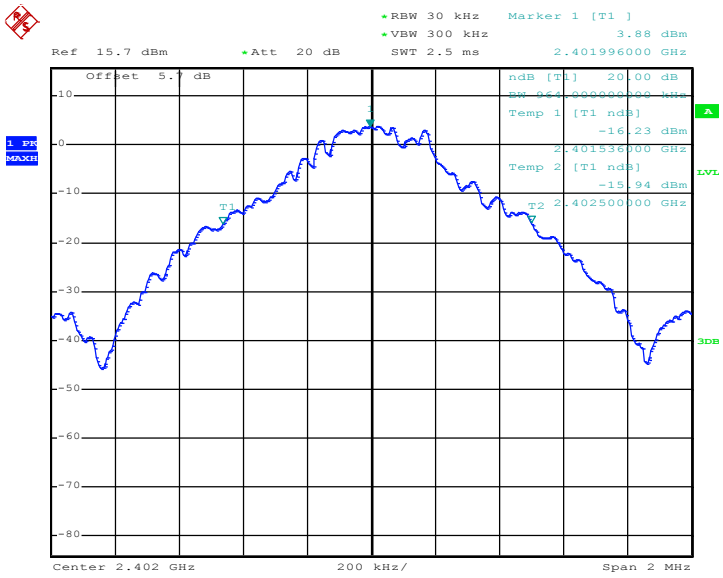
3.4.4 Test Setup

3.4.5 Test Result of 20dB Bandwidth

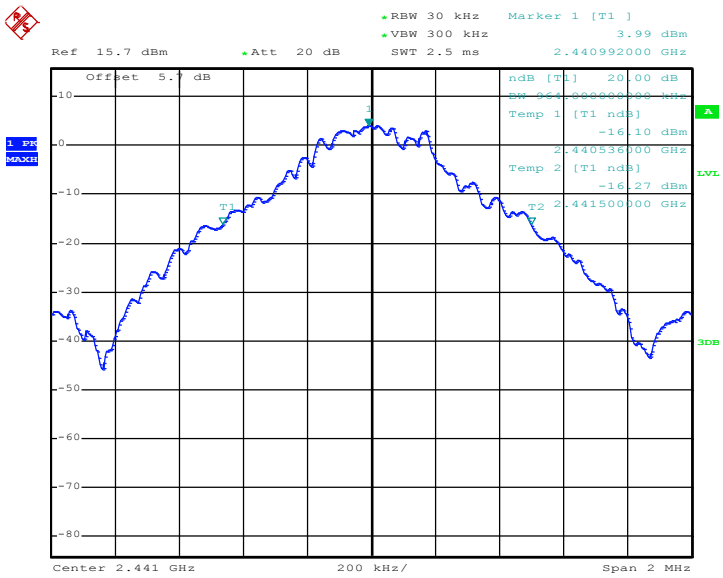
Test Mode :	1Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	0.964
39	2441	0.964
78	2480	0.944

20 dB Bandwidth Plot on Channel 00



20 dB Bandwidth Plot on Channel 39



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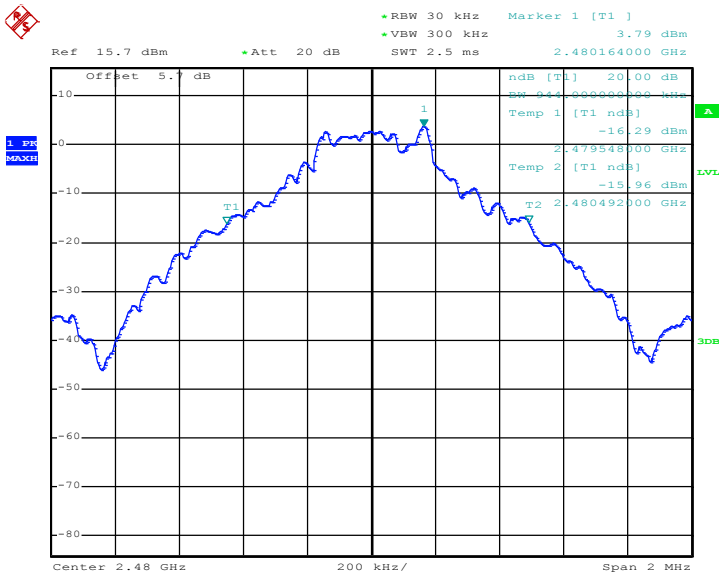
20 dB Bandwidth Plot on Channel 78

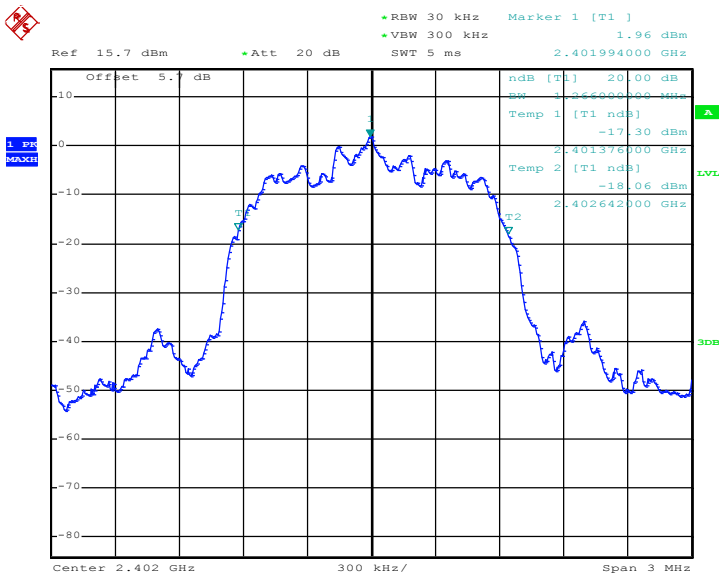


Date: 10.MAY.2017 01:51:30

Test Mode :	2Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.266
39	2441	1.266
78	2480	1.266

20 dB Bandwidth Plot on Channel 00



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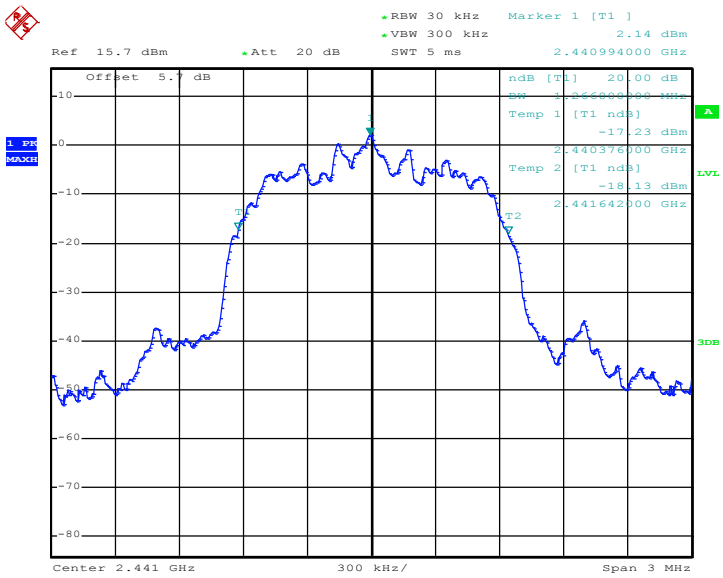
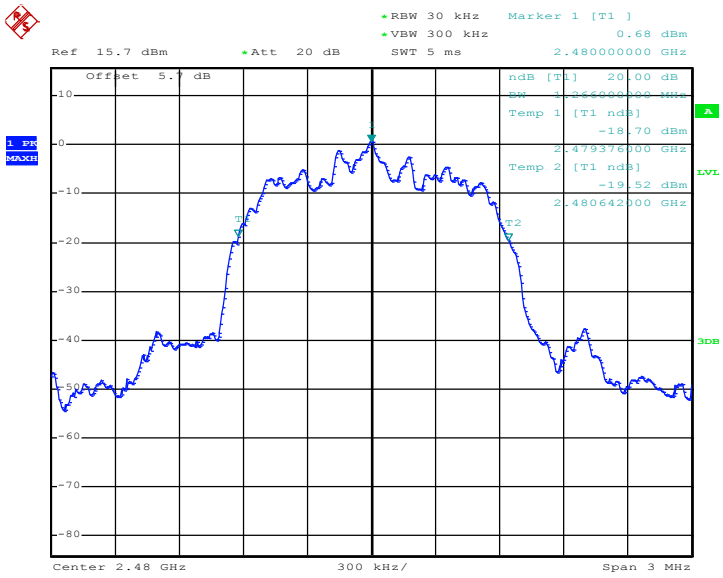
20 dB Bandwidth Plot on Channel 39



Date: 4.MAY.2017 01:07:16

20 dB Bandwidth Plot on Channel 78

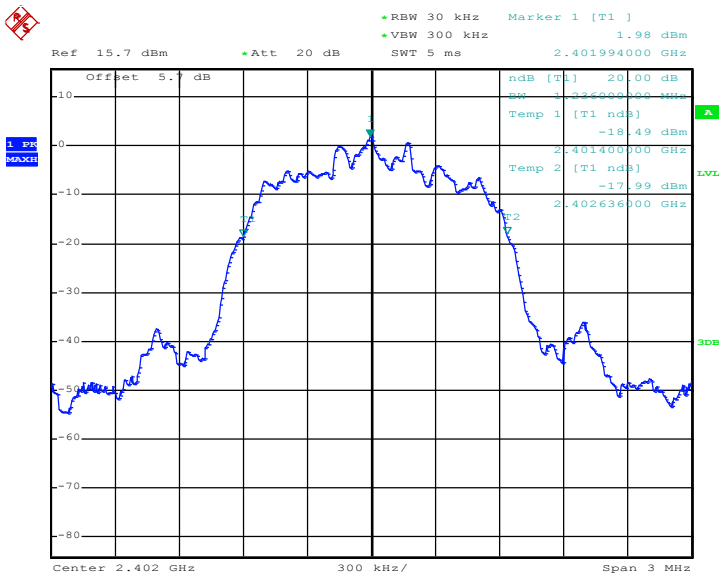


Date: 10.MAY.2017 01:57:18

Test Mode :	3Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

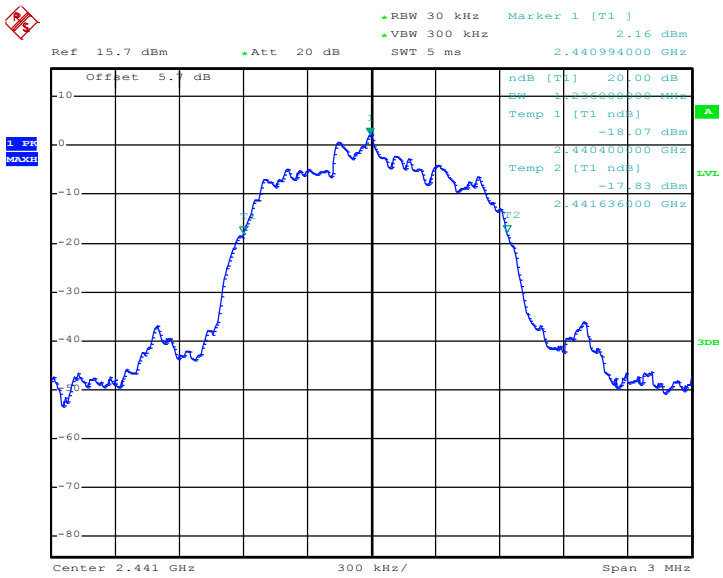
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.236
39	2441	1.236
78	2480	1.236

20 dB Bandwidth Plot on Channel 00



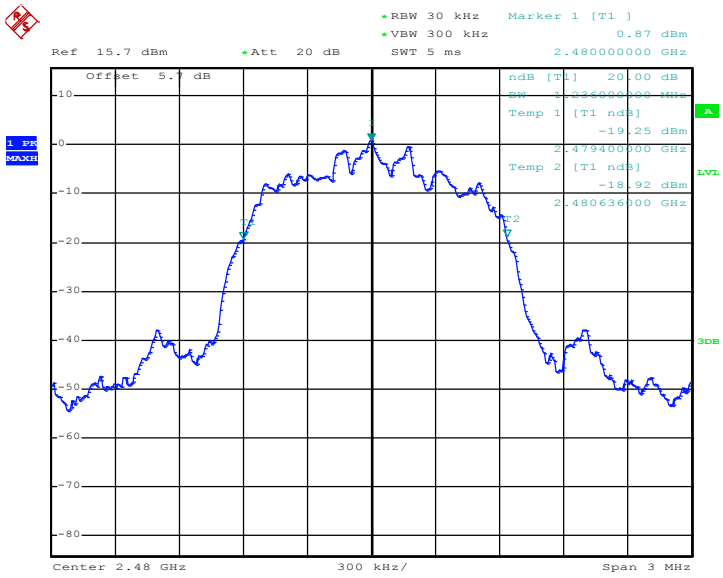
Date: 4.MAY.2017 01:07:39

20 dB Bandwidth Plot on Channel 39



Date: 4.MAY.2017 01:08:04

20 dB Bandwidth Plot on Channel 78



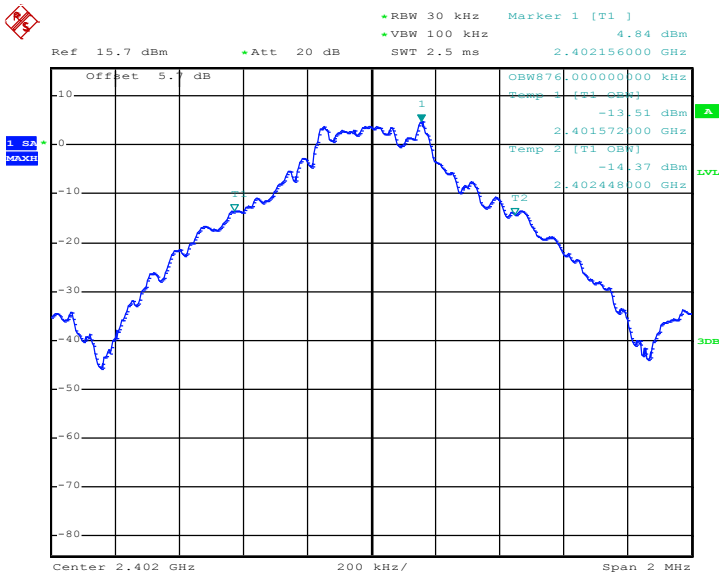
Date: 10.MAY.2017 01:54:22

3.4.6 Test Result of 99% Occupied Bandwidth

Test Mode :	1Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

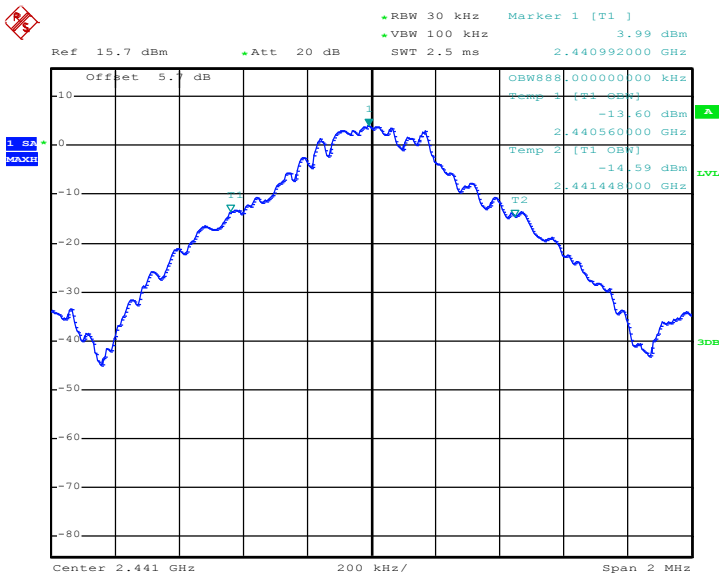
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	0.876
39	2441	0.888
78	2480	0.892

99% Occupied Bandwidth Plot on Channel 00



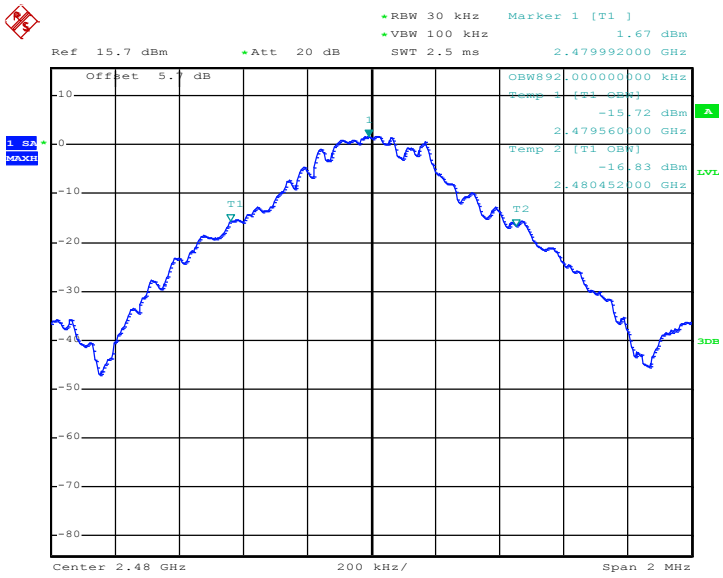
Date: 4.MAY.2017 01:14:02

99% Occupied Bandwidth Plot on Channel 39



Date: 4.MAY.2017 01:14:38

99% Occupied Bandwidth Plot on Channel 78

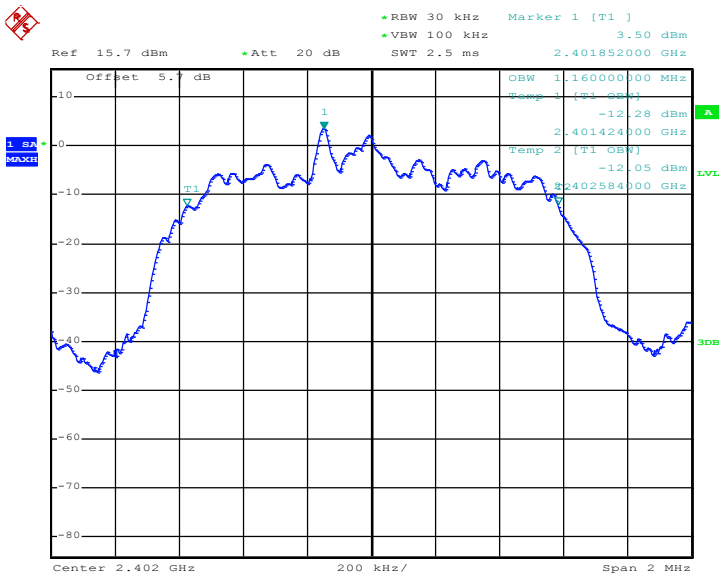


Date: 4.MAY.2017 01:15:15

Test Mode :	2Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

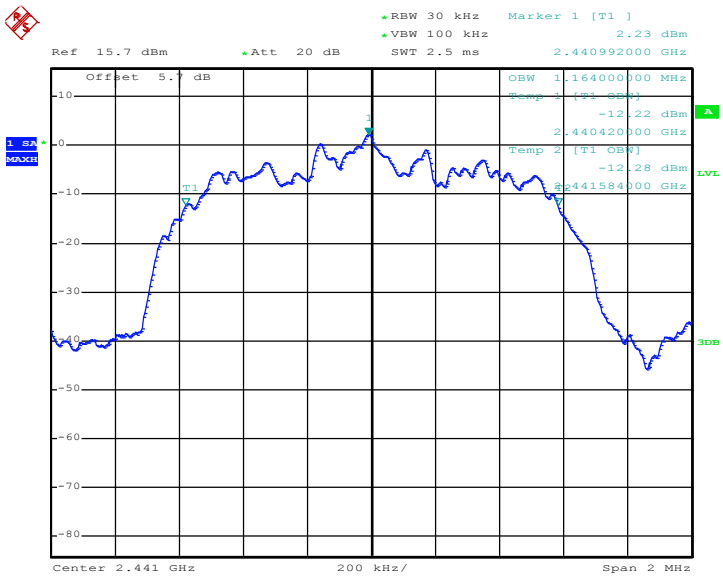
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	1.160
39	2441	1.164
78	2480	1.168

99% Occupied Bandwidth Plot on Channel 00



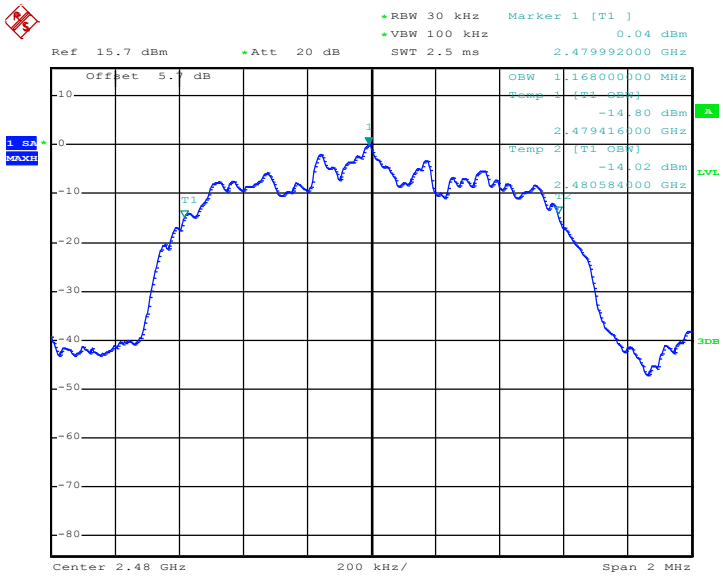
Date: 4.MAY.2017 01:15:51

99% Occupied Bandwidth Plot on Channel 39



Date: 4.MAY.2017 01:16:27

99% Occupied Bandwidth Plot on Channel 78

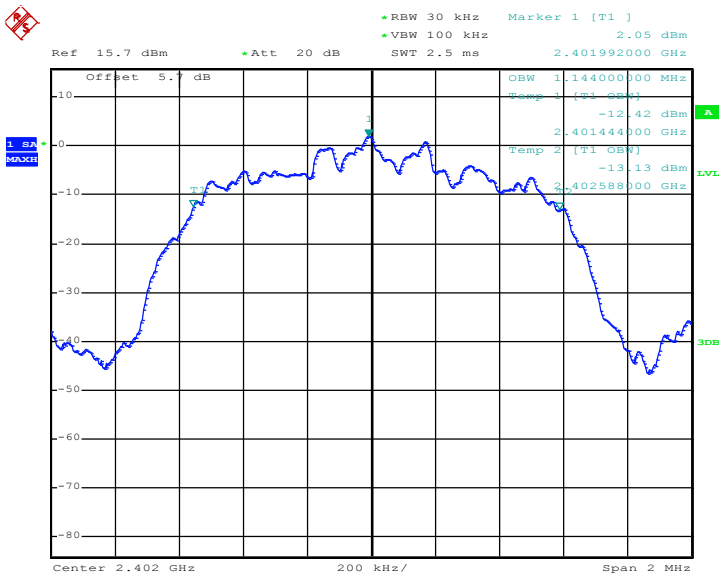


Date: 4.MAY.2017 01:17:03

Test Mode :	3Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

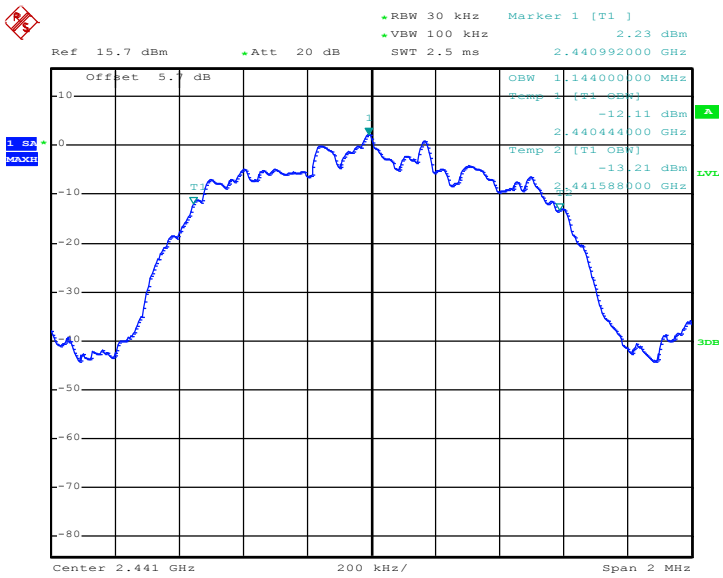
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	1.144
39	2441	1.144
78	2480	1.144

99% Occupied Bandwidth Plot on Channel 00



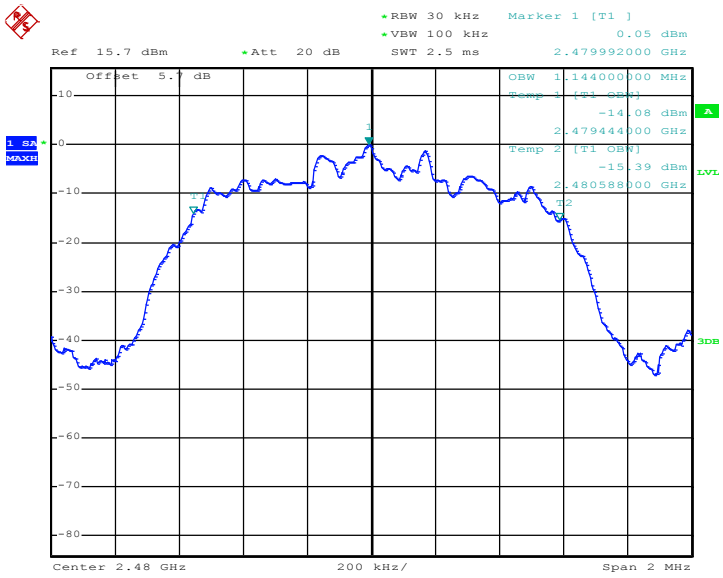
Date: 4.MAY.2017 01:17:39

99% Occupied Bandwidth Plot on Channel 39



Date: 4.MAY.2017 01:18:15

99% Occupied Bandwidth Plot on Channel 78



Date: 4.MAY.2017 01:18:52

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

3.5 Peak Output Power Measurement

3.5.1 Limit of Peak Output Power

Section 15.247 (b) 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.

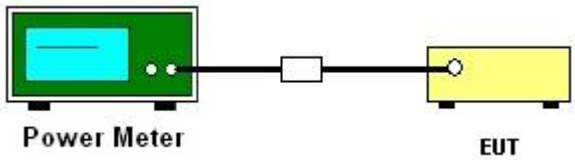
3.5.2 Measuring Instruments

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℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	6.73	20.97	Pass
39	2441	7.06	20.97	Pass
78	2480	5.64	20.97	Pass

Note: For AFH mode using 20 hopping channels, the maximum output power limit is 20.97dBm.

Test Mode :	2Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

Channel	Frequency (MHz)	RF Power (dBm)		
		π /4-DQPSK	Max. Limits (dBm)	Pass/Fail
		2 Mbps		
00	2402	6.76	20.97	Pass
39	2441	7.04	20.97	Pass
78	2480	5.63	20.97	Pass

Test Mode :	3Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

Channel	Frequency (MHz)	RF Power (dBm)		
		8-DPSK	Max. Limits (dBm)	Pass/Fail
		3 Mbps		
00	2402	7.14	20.97	Pass
39	2441	7.47	20.97	Pass
78	2480	6.05	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.

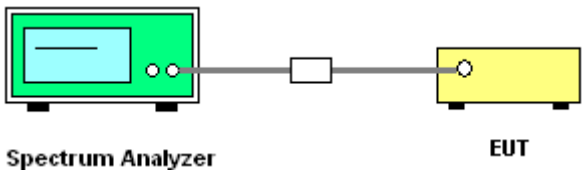
3.6.2 Measuring Instruments

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.

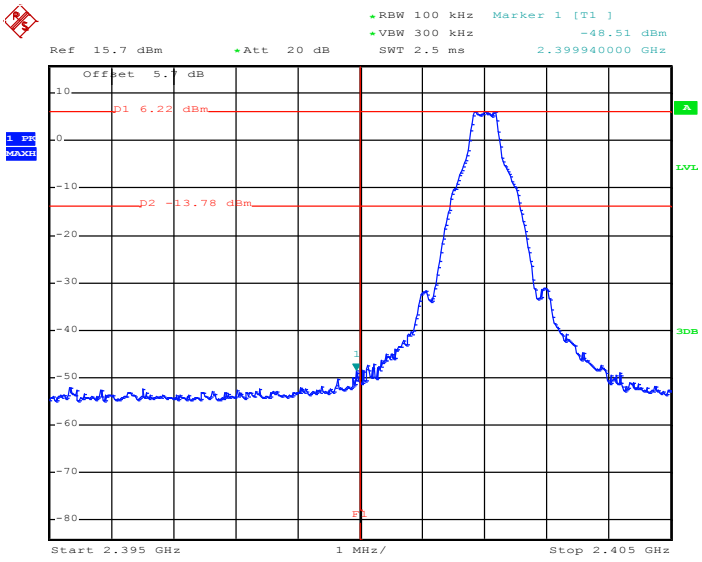
3.6.4 Test Setup



3.6.5 Test Result of Conducted Band Edges

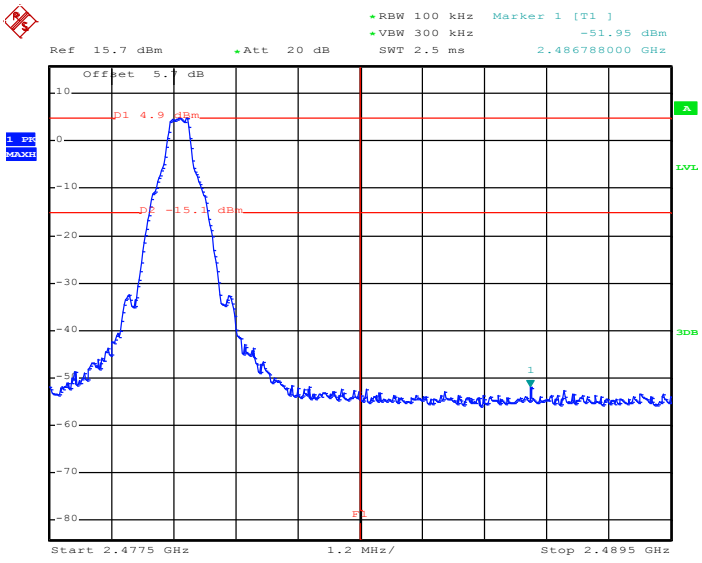
Test Mode :	1Mbps	**Temperature :**	21~25℃
Test Channel :	00 and 78	**Relative Humidity :**	51~55%
		Test Engineer :	Hirem Shen

Low Band Edge Plot on Channel 00



Date: 4.MAY.2017 01:09:07

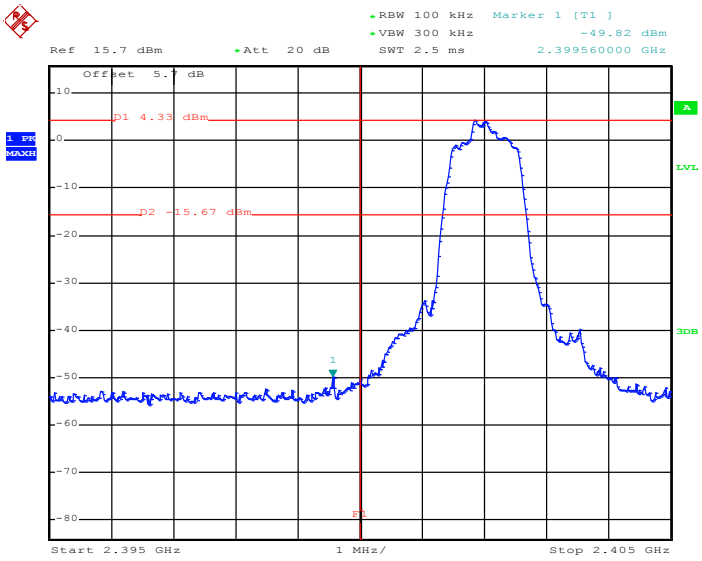
High Band Edge Plot on Channel 78



Date: 10.MAY.2017 01:35:27

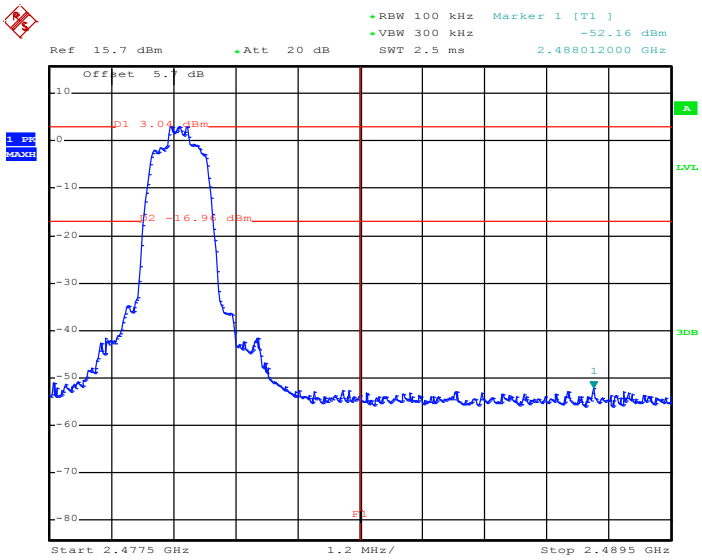
Test Mode :	2Mbps	**Temperature :**	21~25℃
Test Channel :	00 and 78	**Relative Humidity :**	51~55%
		Test Engineer :	Hirem Shen

Low Band Edge Plot on Channel 00



Date: 4.MAY.2017 01:10:50

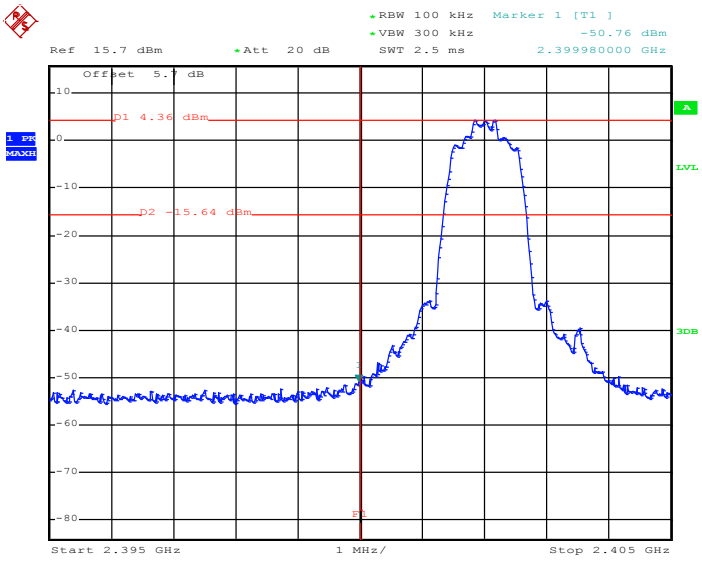
High Band Edge Plot on Channel 78



Date: 10.MAY.2017 01:36:06

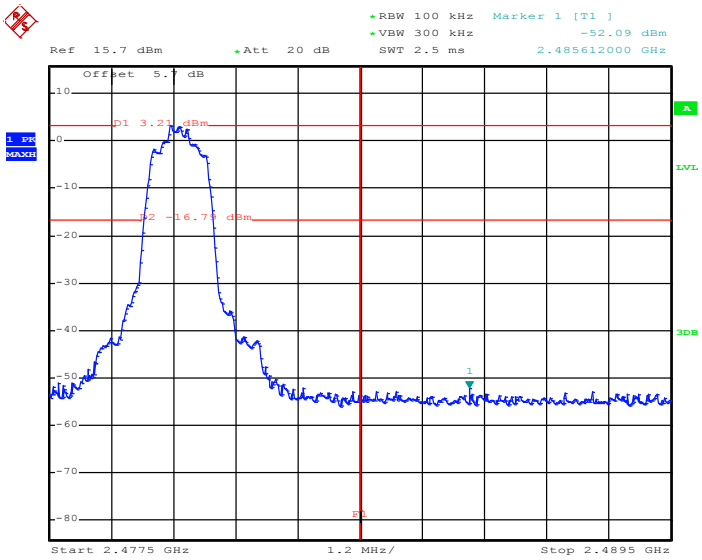
Test Mode :	3Mbps	**Temperature :**	21~25℃
Test Channel :	00 and 78	**Relative Humidity :**	51~55%
		Test Engineer :	Hirem Shen

Low Band Edge Plot on Channel 00



Date: 4.MAY.2017 01:12:33

High Band Edge Plot on Channel 78

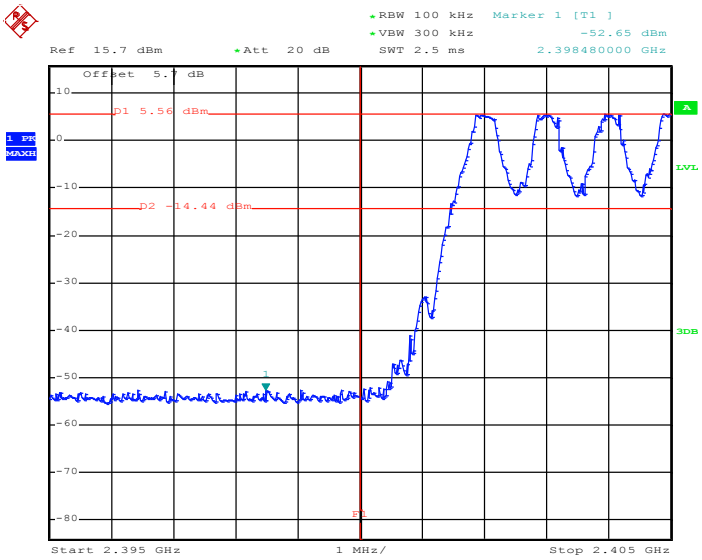


Date: 10.MAY.2017 01:37:09

3.6.6 Test Result of Conducted Hopping Mode Band Edges

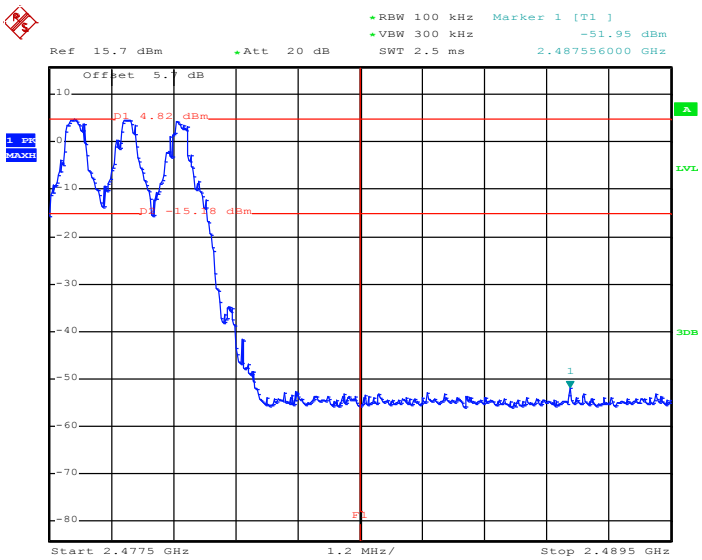
Test Mode :	1Mbps	Temperature :	21~25℃
Test Engineer :	Hirem Shen	Relative Humidity :	51~55%

1Mbps Hopping Mode Low Band Edge Plot



Date: 4.MAY.2017 02:24:51

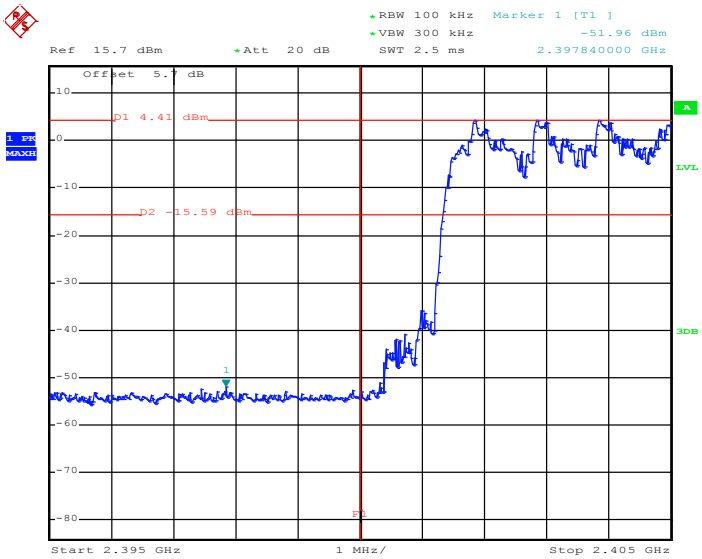
1Mbps Hopping Mode High Band Edge Plot



Date: 10.MAY.2017 01:34:39

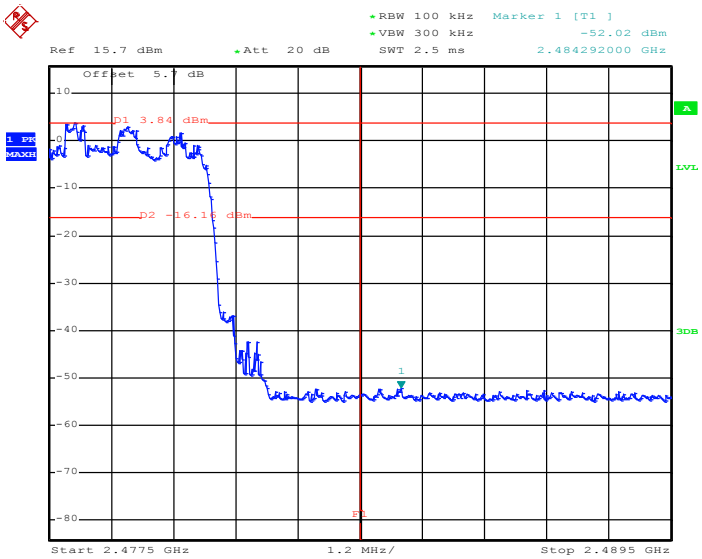
Test Mode :	2Mbps	**Temperature :**	21~25℃
Test Engineer :	Hirem Shen	**Relative Humidity :**	51~55%

2Mbps Hopping Mode Low Band Edge Plot



Date: 4.MAY.2017 02:24:00

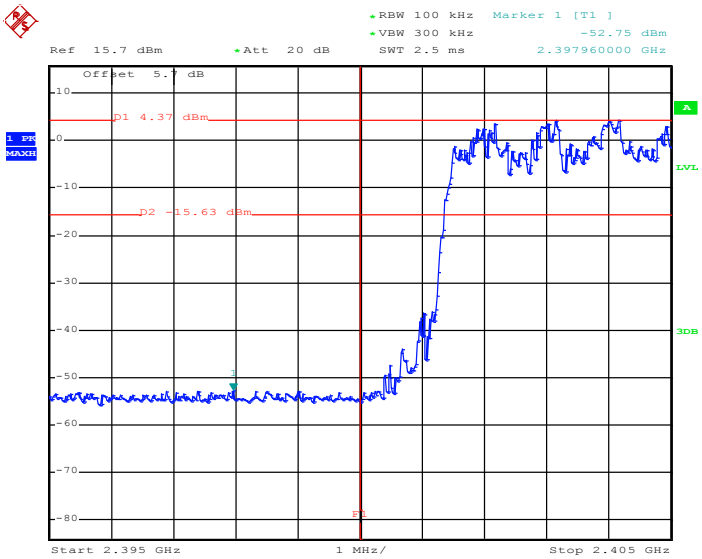
2Mbps Hopping Mode High Band Edge Plot



Date: 10.MAY.2017 01:32:00

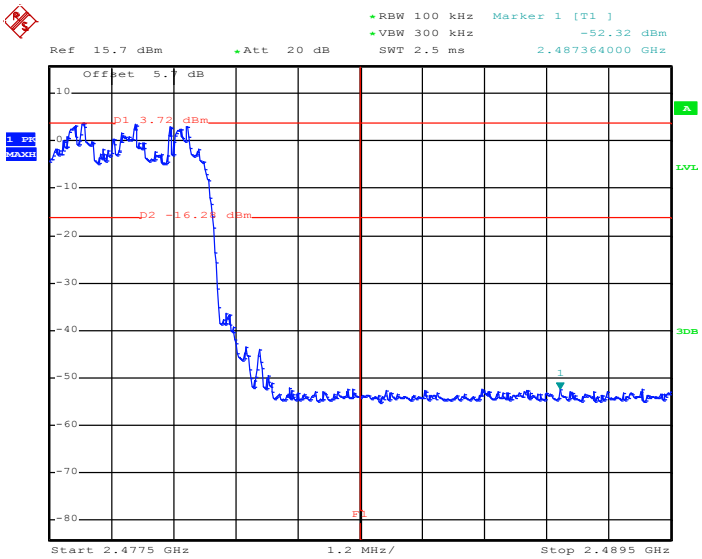
Test Mode :	3Mbps	**Temperature :**	21~25℃
Test Engineer :	Hirem Shen	**Relative Humidity :**	51~55%

3Mbps Hopping Mode Low Band Edge Plot



Date: 4.MAY.2017 02:20:52

3Mbps Hopping Mode High Band Edge Plot



Date: 10.MAY.2017 01:33:24

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

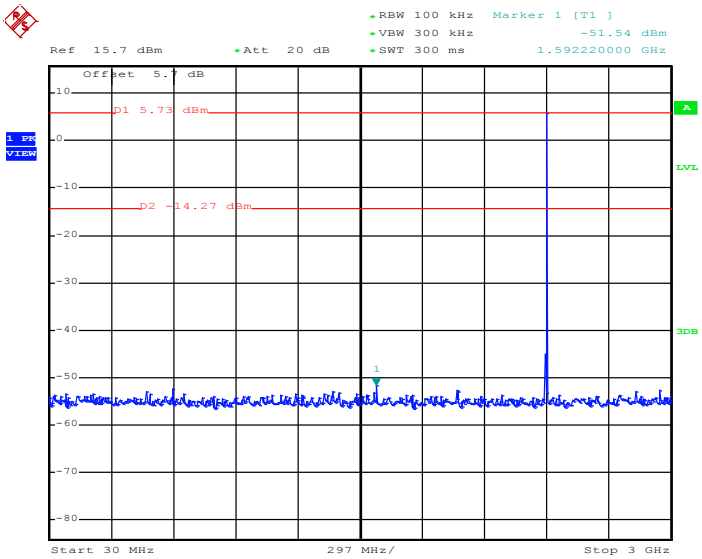
1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 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

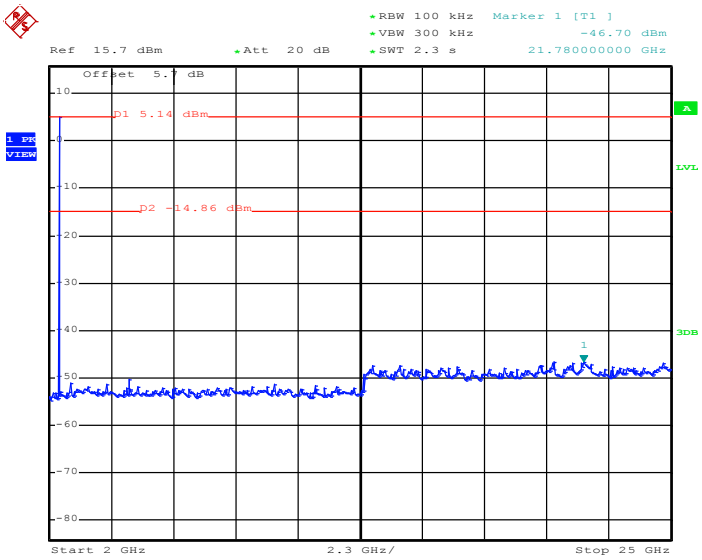
Test Mode :	1Mbps	Temperature :	21~25℃
Test Channel :	00	Relative Humidity :	51~55%
		Test Engineer :	Hirem Shen

1Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 10.MAY.2017 00:52:10

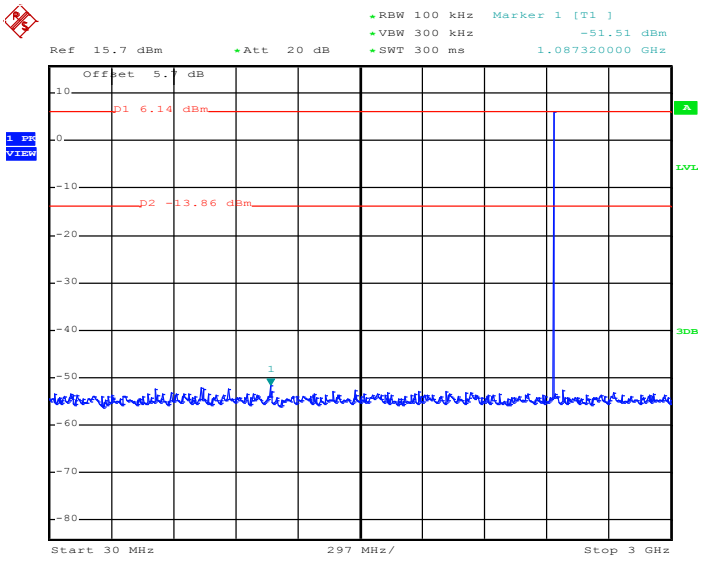
1Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 10.MAY.2017 00:54:28

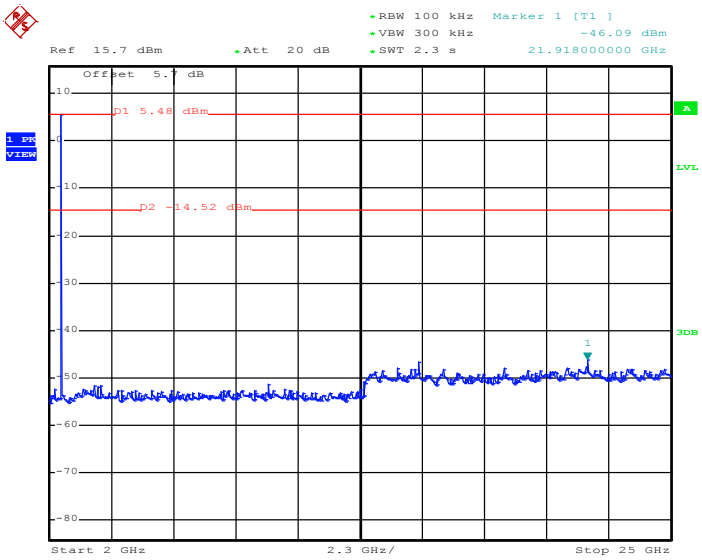
Test Mode :	1Mbps	Temperature :	21~25℃
Test Channel :	39	Relative Humidity :	51~55%
		Test Engineer :	Hirem Shen

1Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 10.MAY.2017 01:02:59

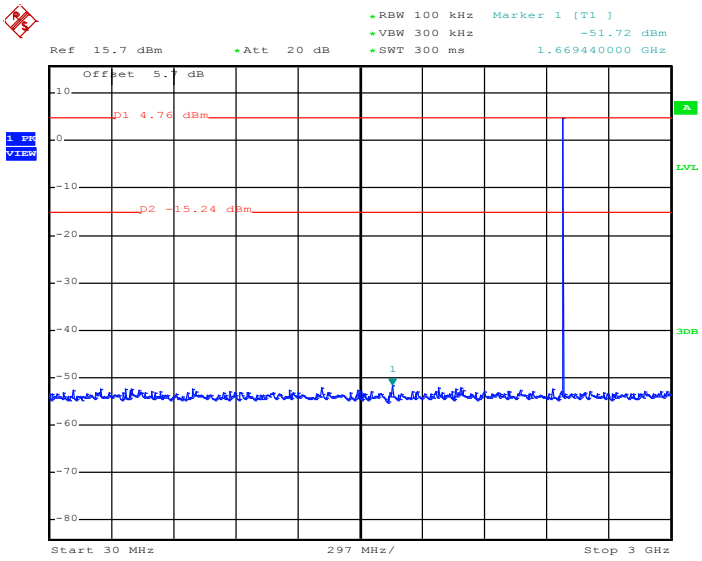
1Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 10.MAY.2017 01:01:12

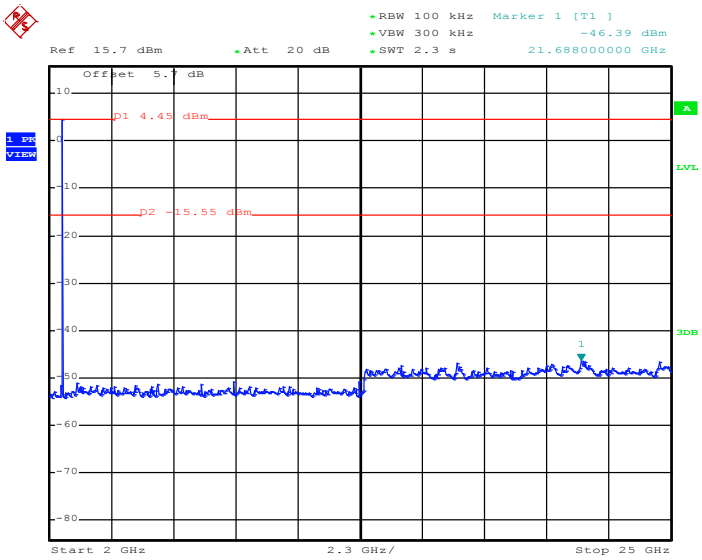
Test Mode :	1Mbps	Temperature :	21~25℃
Test Channel :	78	Relative Humidity :	51~55%
		Test Engineer :	Hirem Shen

1Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 10.MAY.2017 01:05:33

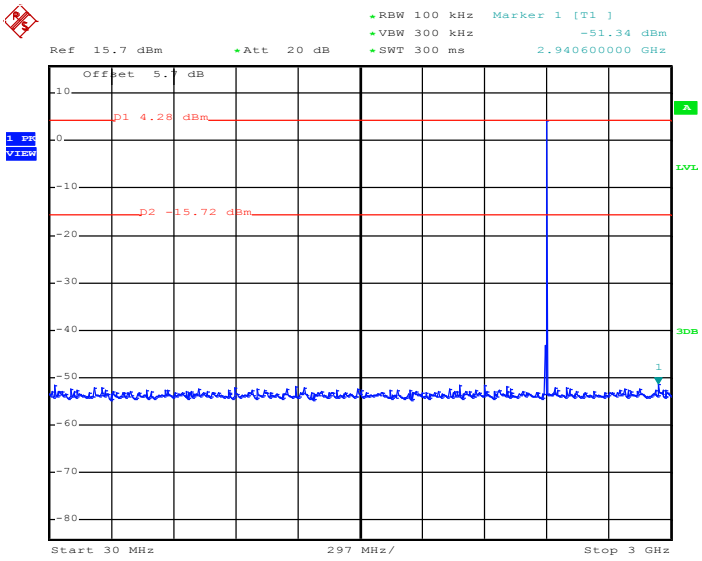
1Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz



Date: 10.MAY.2017 01:07:40

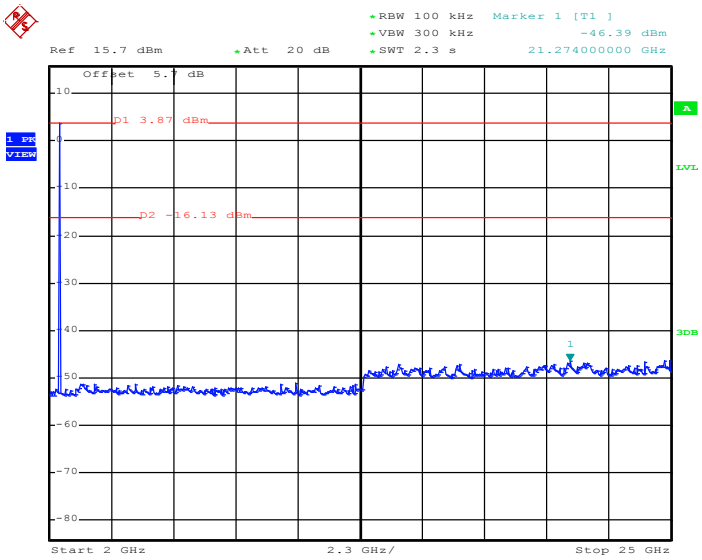
Test Mode :	2Mbps	Temperature :	21~25℃
Test Channel :	00	Relative Humidity :	51~55%
		Test Engineer :	Hirem Shen

2Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 10.MAY.2017 00:40:30

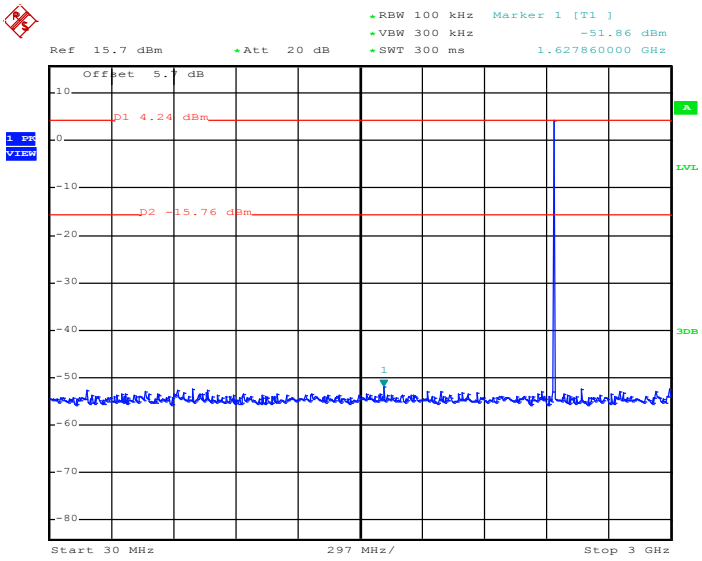
2Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 10.MAY.2017 00:43:07

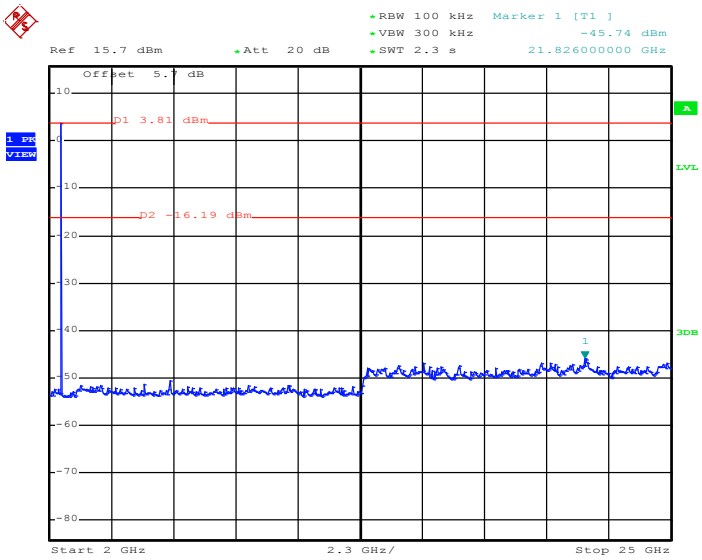
Test Mode :	2Mbps	**Temperature :**	21~25℃
Test Channel :	39	**Relative Humidity :**	51~55%
		Test Engineer :	Hirem Shen

2Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 10.MAY.2017 00:49:15

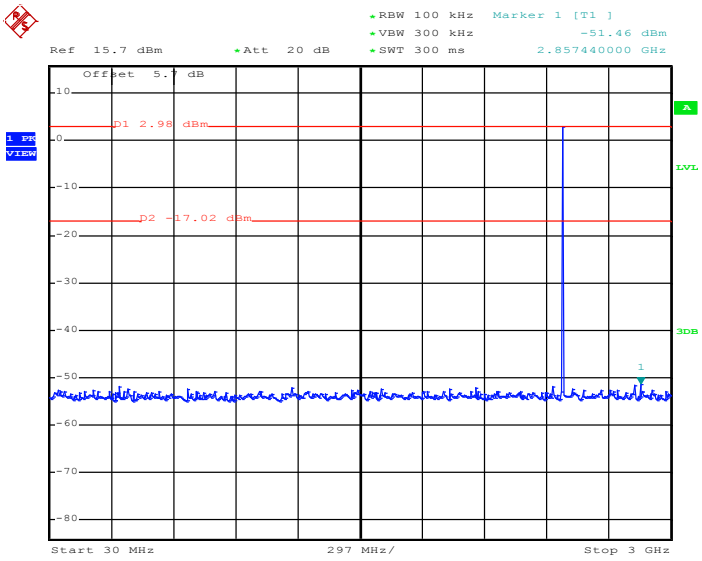
2Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 10.MAY.2017 00:47:36

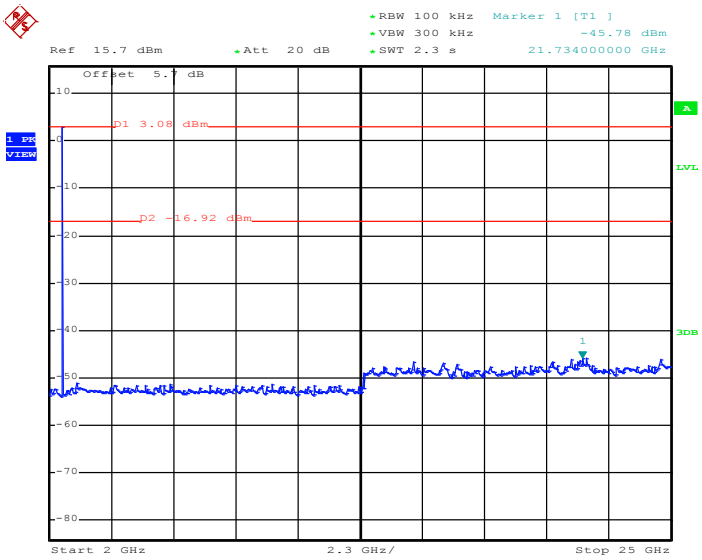
Test Mode :	2Mbps	**Temperature :**	21~25℃
Test Channel :	78	**Relative Humidity :**	51~55%
		Test Engineer :	Hirem Shen

2Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 10.MAY.2017 00:21:51

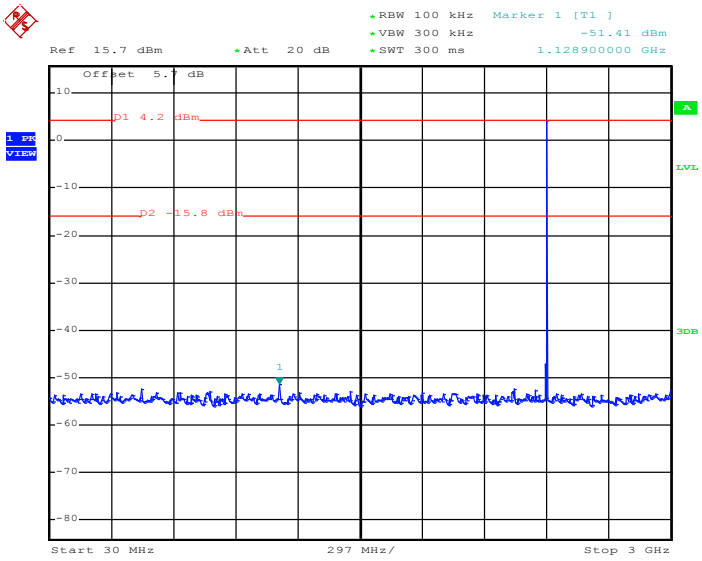
2Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz



Date: 10.MAY.2017 00:19:57

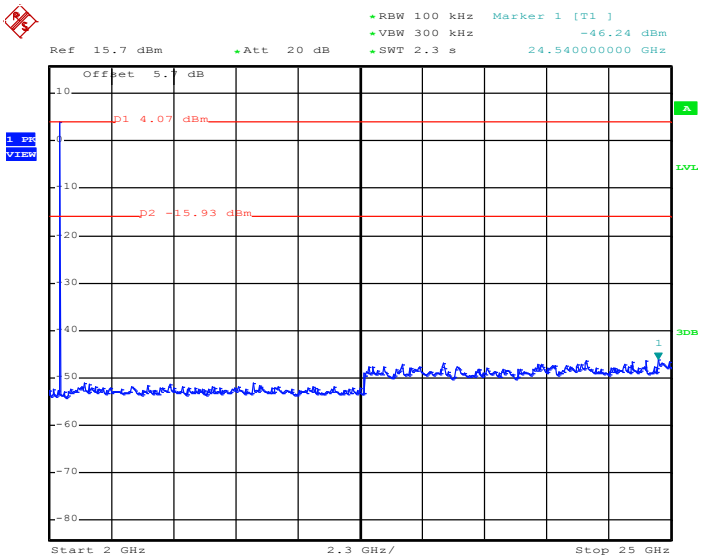
Test Mode :	3Mbps	Temperature :	21~25℃
Test Channel :	00	Relative Humidity :	51~55%
		Test Engineer :	Hirem Shen

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



Date: 9.MAY.2017 23:24:50

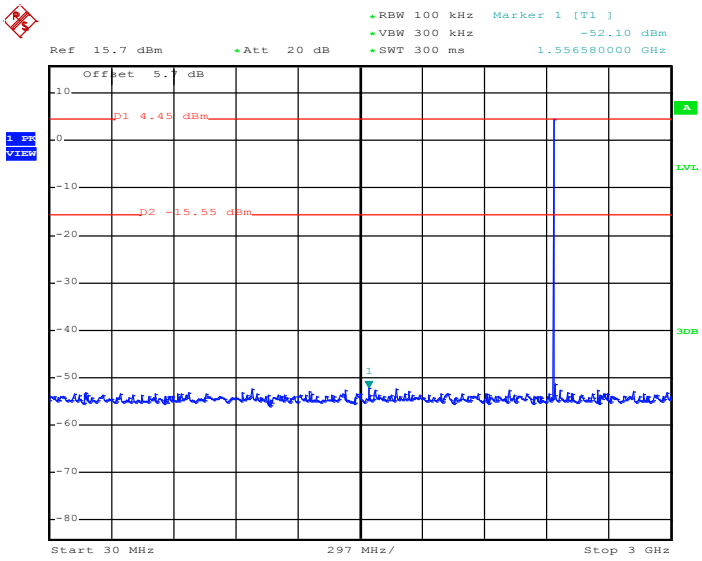
3Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 9.MAY.2017 23:28:26

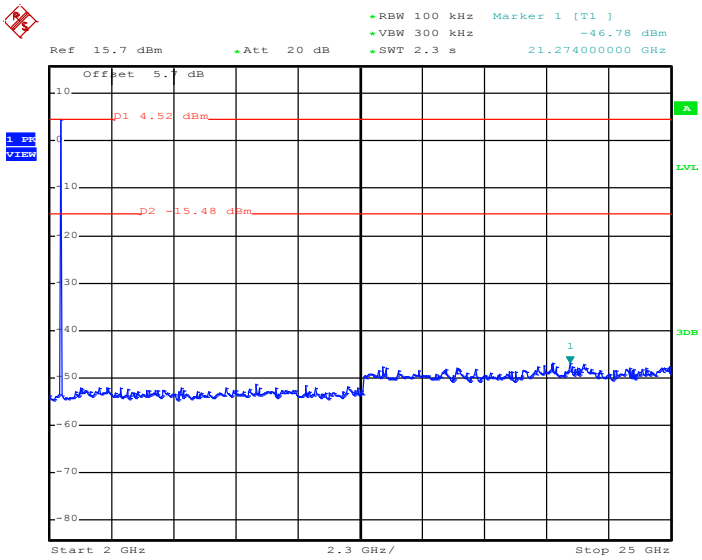
Test Mode :	3Mbps	**Temperature :**	21~25℃
Test Channel :	39	**Relative Humidity :**	51~55%
		Test Engineer :	Hirem Shen

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



Date: 10.MAY.2017 00:10:07

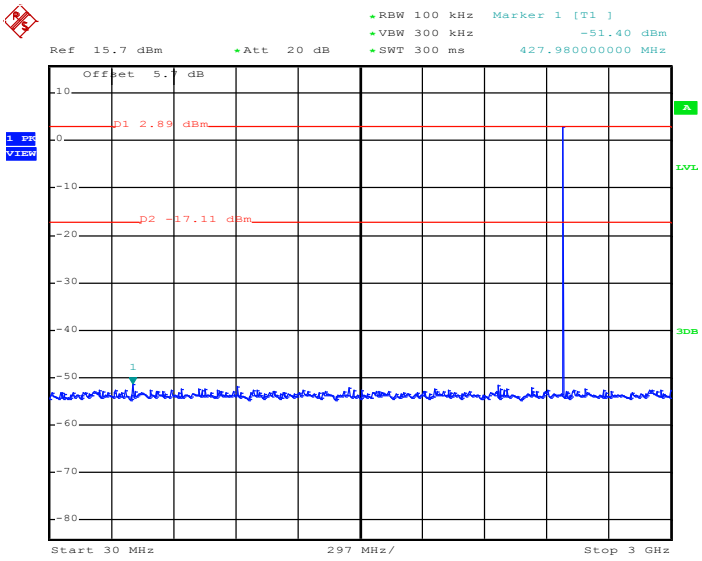
3Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 9.MAY.2017 23:31:44

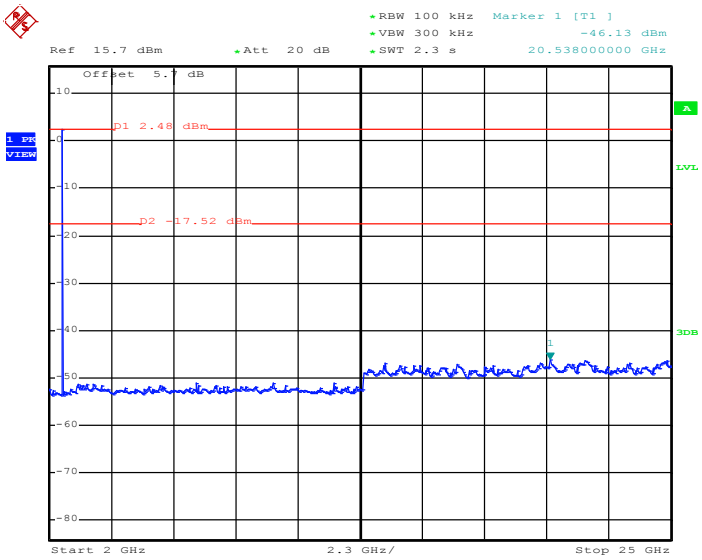
Test Mode :	3Mbps	**Temperature :**	21~25℃
Test Channel :	78	**Relative Humidity :**	51~55%
		Test Engineer :	Hirem Shen

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



Date: 9.MAY.2017 23:59:56

3Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz



Date: 10.MAY.2017 00:16:18

3.8 Radiated Band Edges and Spurious Emission Measurement

3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

3.8.2 Measuring Instruments

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

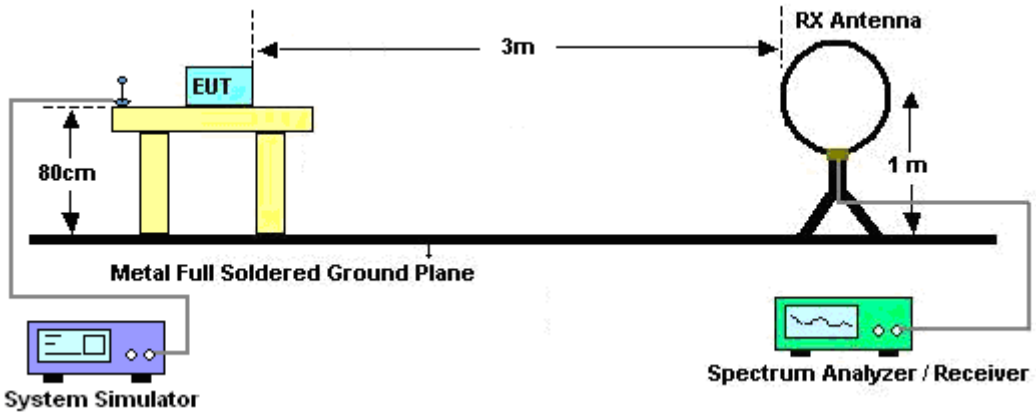
3.8.3 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

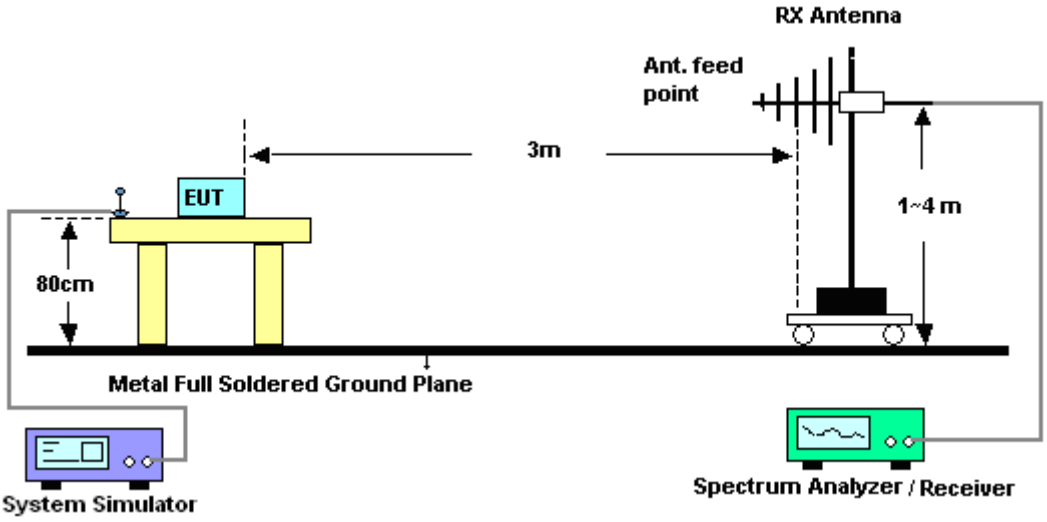
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.76dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.8.4 Test Setup

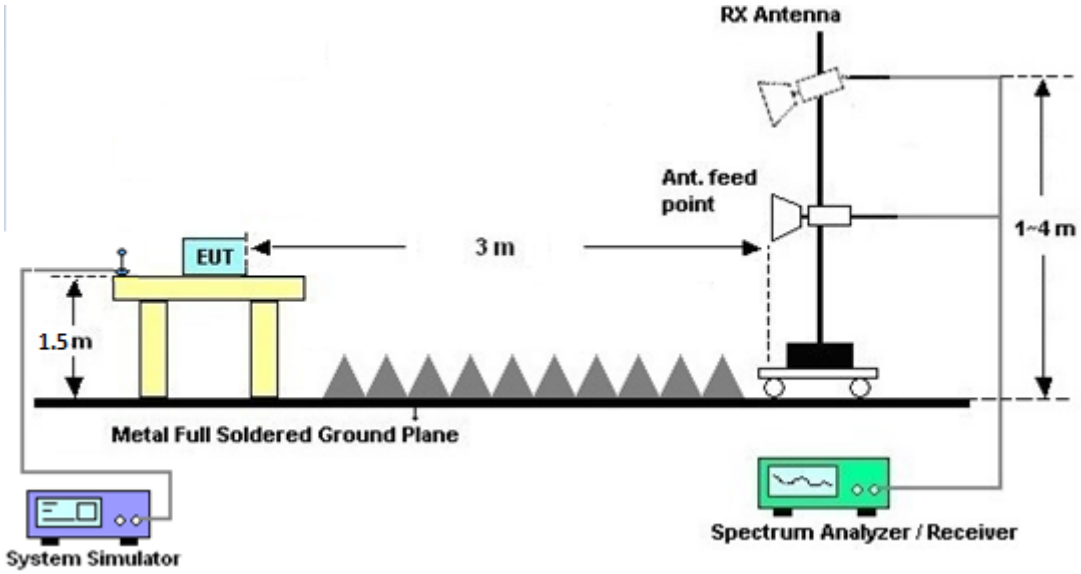
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.8.7 Duty Cycle

Please refer to Appendix D.

3.8.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix B and C.

3.9 AC Conducted Emission Measurement

3.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

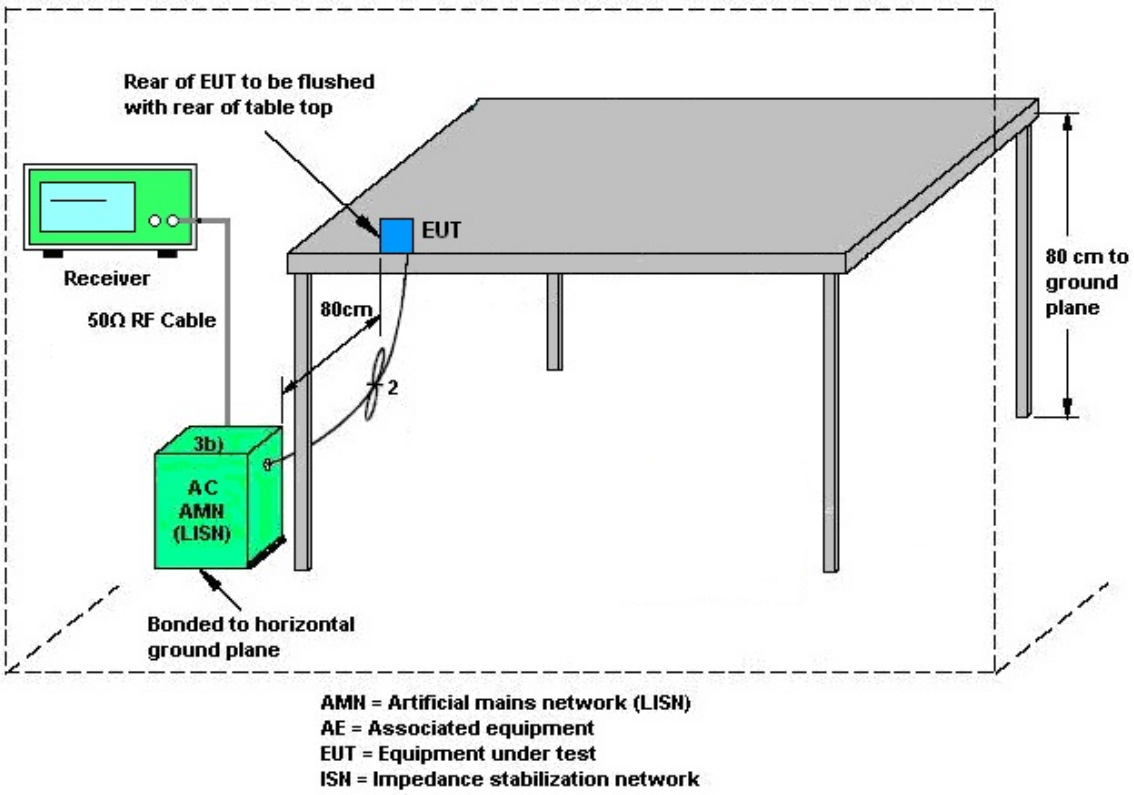
3.9.2 Measuring Instruments

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

3.9.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.9.4 Test Setup



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.10 Antenna Requirements

3.10.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSP40	100319	9kHz~40GHz	Oct.13, 2016	May 03, 2017 ~ May 10, 2017	Oct.13, 2017	Conducted (TH01-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Aug. 09, 2016	May 03, 2017 ~ May 10, 2017	Aug. 08, 2017	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 19, 2017	May 03, 2017 ~ May 10, 2017	Jan. 19, 2018	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 19, 2017	May 03, 2017 ~ May 10, 2017	Jan. 19, 2018	Conducted (TH01-KS)
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Jan. 06, 2017	May 19, 2017	Jan. 05, 2018	Conduction (CO01-SZ)
AC LISN	EMCO	3816/2SH	00103912	9kHz~30MHz	Jan. 05, 2017	May 19, 2017	Jan. 04, 2018	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	MessTec	3816/2SH	00103892	9kHz~30MHz	Jan. 05, 2017	May 19, 2017	Jan. 04, 2018	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000891	100Vac~250Vac	Jul. 16, 2016	May 19, 2017	Jul. 15, 2017	Conduction (CO01-SZ)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct..22.2016	May 09, 2017 ~ May 10, 2017	Oct. 21, 2017	Radiation (03CH03-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz-44GHz	Apr. 18, 2017	May 09, 2017 ~ May 10, 2017	Apr.17, 2018	Radiation (03CH03-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 23, 2016	May 09, 2017 ~ May 10, 2017	Nov.22, 2017	Radiation (03CH03-KS)
Bilog Antenna	TeseQ	CBL6112D	35406	25MHz-2GHz	Apr. 22, 2017	May 09, 2017 ~ May 10, 2017	Apr 21, 2018	Radiation (03CH03-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1356	1GHz~18GHz	Apr. 22, 2017	May 09, 2017 ~ May 10, 2017	Apr 21, 2018	Radiation (03CH03-KS)
SHF-EHF Horn	com-power	AH-840	101070	18GHz ~40GHz	Oct. 19, 2016	May 09, 2017 ~ May 10, 2017	Oct. 18, 2017	Radiation (03CH03-KS)
Amplifier	com-power	PA-103A	161069	1MHz ~1000MHz / 32 dB	Apr 18, 2017	May 09, 2017 ~ May 10, 2017	Apr 17, 2018	Radiation (03CH03-KS)
Amplifier	MITEQ	TTA1840-35-HG	1887435	18~40GHz	Oct. 13, 2016	May 09, 2017 ~ May 10, 2017	Oct. 12, 2017	Radiation (03CH03-KS)
Amplifier	Agilent	8449B	3008A02370	1GHz~26.5GHz	Oct. 13, 2016	May 09, 2017 ~ May 10, 2017	Oct. 12, 2017	Radiation (03CH03-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	May 09, 2017 ~ May 10, 2017	NCR	Radiation (03CH03-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	May 09, 2017 ~ May 10, 2017	NCR	Radiation (03CH03-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	May 09, 2017 ~ May 10, 2017	NCR	Radiation (03CH03-KS)

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.50**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.6**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

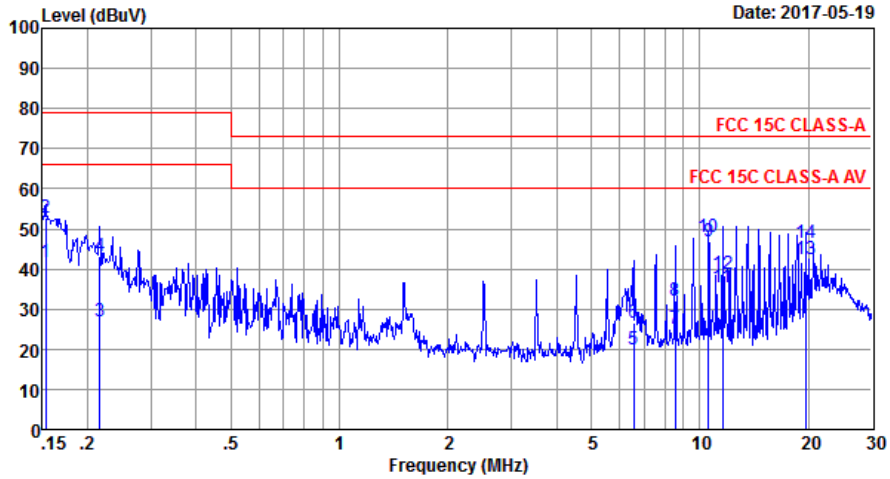
Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.5**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.5**

Appendix A. AC Conducted Emission Test Results

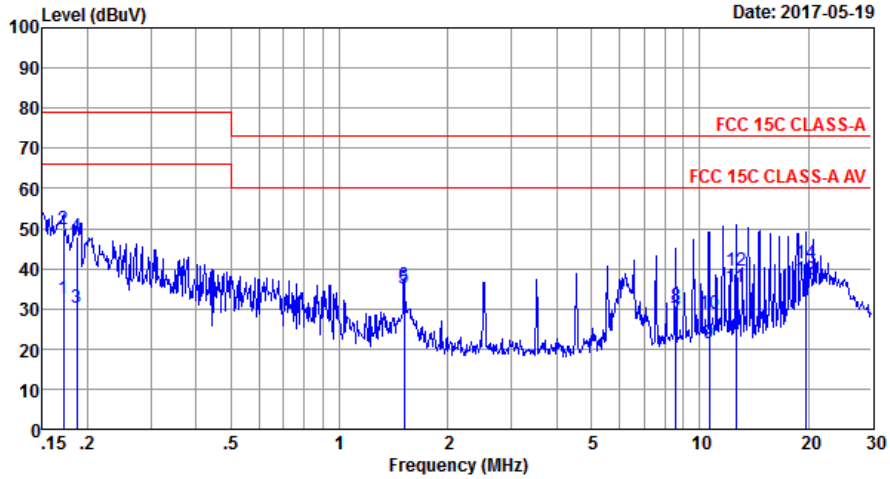
Test Engineer :	Tao Cheng	**Temperature :**	21~23℃
		Relative Humidity :	41~42%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line



Site : CO01-SZ
Condition: FCC 15C CLASS-A LISN_20170301_L LINE
Project : (FR)733008
Mode : Mode 1
IMEI :

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.15	41.73	-24.27	66.00	31.30	0.03	10.40	Average
2		0.15	52.93	-26.07	79.00	42.50	0.03	10.40	QP
3		0.22	26.85	-39.15	66.00	16.60	0.03	10.22	Average
4		0.22	43.35	-35.65	79.00	33.10	0.03	10.22	QP
5		6.56	19.94	-40.06	60.00	9.41	0.22	10.31	Average
6		6.56	26.74	-46.26	73.00	16.21	0.22	10.31	QP
7		8.55	25.05	-34.95	60.00	14.40	0.30	10.35	Average
8		8.55	32.25	-40.75	73.00	21.60	0.30	10.35	QP
9	*	10.56	46.84	-13.16	60.00	36.10	0.38	10.36	Average
10		10.56	48.14	-24.86	73.00	37.40	0.38	10.36	QP
11		11.56	35.46	-24.54	60.00	24.70	0.41	10.35	Average
12		11.56	38.86	-34.14	73.00	28.10	0.41	10.35	QP
13		19.64	42.40	-17.60	60.00	30.51	1.26	10.63	Average
14		19.64	46.60	-26.40	73.00	34.71	1.26	10.63	QP

Test Engineer :	Tao Cheng	**Temperature :**	21~23℃
		Relative Humidity :	41~42%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral



Site : CO01-SZ
Condition: FCC 15C CLASS-A LISN_20170301_N NEUTRAL
Project : (FR)733008
Mode : Mode 1
IMEI :

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.17	32.65	-33.35	66.00	22.30	0.03	10.32	Average
2		0.17	49.65	-29.35	79.00	39.30	0.03	10.32	QP
3		0.19	30.30	-35.70	66.00	20.00	0.03	10.27	Average
4		0.19	47.80	-31.20	79.00	37.50	0.03	10.27	QP
5		1.51	34.91	-25.09	60.00	24.70	0.05	10.16	Average
6		1.51	35.91	-37.09	73.00	25.70	0.05	10.16	QP
7		8.59	27.37	-32.63	60.00	16.90	0.12	10.35	Average
8		8.59	30.47	-42.53	73.00	20.00	0.12	10.35	QP
9		10.62	21.35	-38.65	60.00	10.81	0.18	10.36	Average
10		10.62	28.65	-44.35	73.00	18.11	0.18	10.36	QP
11		12.58	35.49	-24.51	60.00	24.89	0.26	10.34	Average
12		12.58	39.49	-33.51	73.00	28.89	0.26	10.34	QP
13	*	19.64	37.10	-22.90	60.00	25.90	0.57	10.63	Average
14		19.64	41.30	-31.70	73.00	30.10	0.57	10.63	QP

Appendix B. Radiated Spurious Emission

Test Engineer :	Rich Sun	Temperature :	21~22°C
		Relative Humidity :	41~42%

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BT CH00 2402MHz		2354.59	49.43	-24.57	74	54.48	26.03	5.43	36.51	299	14	P	H
		2354.59	24.67	-29.33	54	-	-	-	-	-	-	A	H
	*	2402	101.06	-	-	105.71	26.3	5.47	36.42	299	14	P	H
		2402	76.3	-	-	-	-	-	-	-	-	A	H
													H
													H
		2341.72	50.24	-23.76	74	55.49	25.89	5.41	36.55	331	261	P	V
		2341.72	25.48	-28.52	54	-	-	-	-	-	-	A	V
	*	2402	98.9	-	-	103.55	26.3	5.47	36.42	331	261	P	V
		2402	74.14	-	-	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		2389.95	49.81	-24.19	74	54.46	26.3	5.47	36.42	296	11	P	H
		2389.95	25.05	-28.95	54	-	-	-	-	-	-	A	H
	*	2442	100.94	-	-	105.73	26.17	5.49	36.45	296	11	P	H
		2442	76.18	-	-	-	-	-	-	-	-	A	H
		2484.95	48.75	-25.25	74	53.62	26.09	5.51	36.47	296	11	P	H
		2484.95	23.99	-30.01	54	-	-	-	-	-	-	A	H
		2383.58	49.43	-24.57	74	54.28	26.16	5.45	36.46	309	256	P	V
		2383.58	24.67	-29.33	54	-	-	-	-	-	-	A	V
	*	2442	98.63	-	-	103.42	26.17	5.49	36.45	309	256	P	V
		2442	73.87	-	-	-	-	-	-	-	-	A	V
		2485.65	49.19	-24.81	74	54.06	26.09	5.51	36.47	309	256	P	V
		2485.65	24.43	-29.57	54	-	-	-	-	-	-	A	V

BT CH 78 2480MHz	*	2480	100.41	-	-	105.28	26.09	5.51	36.47	334	356	P	H
		2480	75.65	-	-	-	-	-	-	-	-	A	H
		2491.95	49.45	-24.55	74	54.37	26.04	5.52	36.48	334	356	P	H
		2491.95	24.69	-29.31	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	97.5	-	-	102.37	26.09	5.51	36.47	306	261	P	V
		2480	72.74	-	-	-	-	-	-	-	-	A	V
		2484.6	48.84	-25.16	74	53.71	26.09	5.51	36.47	306	261	P	V
		2484.6	24.08	-29.92	54	-	-	-	-	-	-	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4806	41.1	-32.9	74	39.13	30.76	7.71	36.5	100	360	P	H
													H
													H
													H
		4806	40.83	-33.17	74	38.86	30.76	7.71	36.5	100	0	P	V
													V
													V
													V
BT CH 39 2441MHz		4884	42.31	-31.69	74	40.11	30.97	7.76	36.53	300	360	P	H
		7323	47.18	-26.82	74	38.57	35.08	9.78	36.25	300	360	P	H
													H
													H
		4882	41.24	-32.76	74	39.04	30.97	7.76	36.53	300	360	P	V
		7323	47.49	-26.51	74	38.88	35.08	9.78	36.25	300	360	P	V
													V
													V
BT CH 78 2480MHz		4962	41.52	-32.48	74	39.03	31.24	7.82	36.57	100	0	P	H
		7440	45.93	-28.07	74	36.91	35.44	9.87	36.29	100	0	P	H
													H
													H
		4962	41.43	-32.57	74	38.94	31.24	7.82	36.57	100	360	P	V
		7440	46.57	-27.43	74	37.55	35.44	9.87	36.29	100	360	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BT LF		128.94	35.92	-7.58	43.5	47.85	18.31	1.26	31.5	-	-	P	H
		155.13	39.49	-4.01	43.5	51.92	17.69	1.43	31.55	100	78	P	H
		210.42	36.78	-6.72	43.5	50.42	16.08	1.76	31.48	-	-	P	H
		312.27	41.47	-4.53	46	51.31	19.59	1.9	31.33	-	-	P	H
		367.56	38.85	-7.15	46	46.14	21.96	1.98	31.23	-	-	P	H
		676.02	40.07	-5.93	46	41.98	26.18	2.99	31.08	-	-	P	H
													H
													H
													H
													H
													H
													H
		55.22	36.12	-3.88	40	51.33	14.9	1.29	31.4	-	-	P	V
		120.21	38.37	-5.13	43.5	50.19	18.49	1.17	31.48	-	-	P	V
		155.13	39.72	-3.78	43.5	52.15	17.69	1.43	31.55	100	156	P	V
		367.56	40.4	-5.6	46	47.69	21.96	1.98	31.23	-	-	P	V
		486.87	39.81	-6.19	46	44.71	23.86	2.49	31.25	-	-	P	V
		682.81	35.94	-10.06	46	37.71	26.3	3	31.07	-	-	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

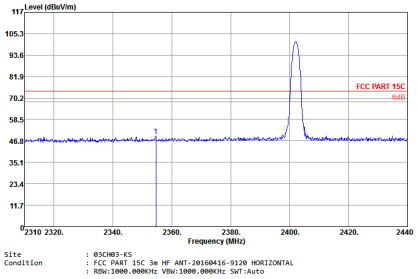
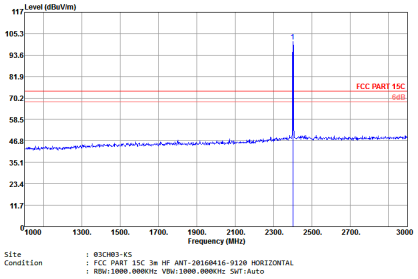
Both peak and average measured complies with the limit line, so test result is "PASS".

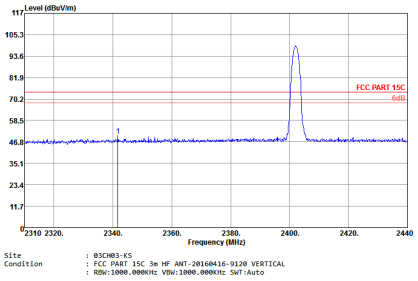
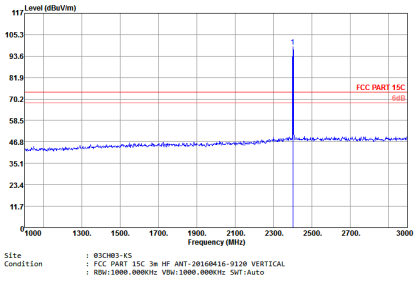
Appendix C. Radiated Spurious Emission Plots

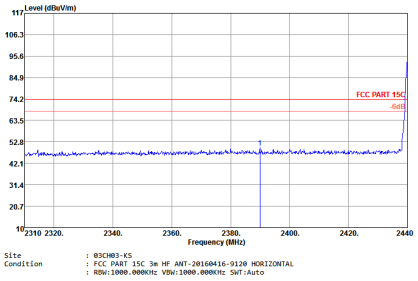
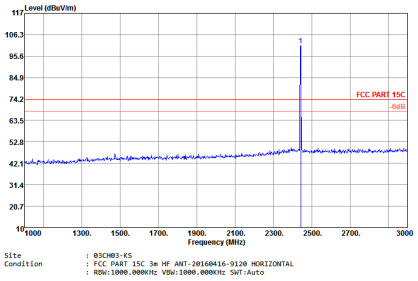
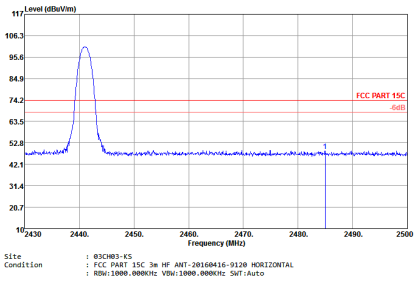
Test Engineer :	Rich Sun	Temperature :	21~22°C
		Relative Humidity :	41~42%

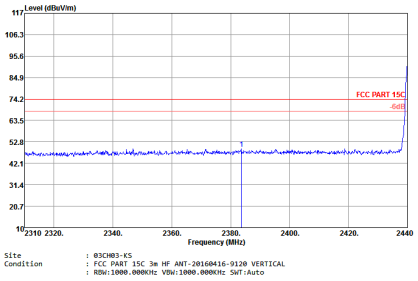
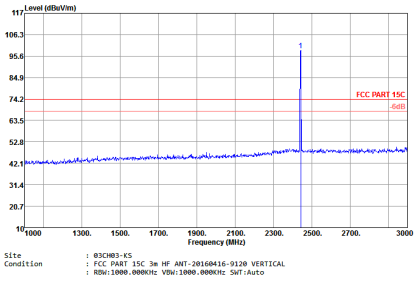
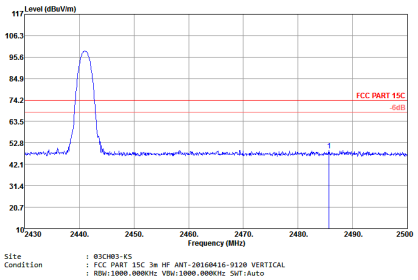
2.4GHz 2400~2483.5MHz

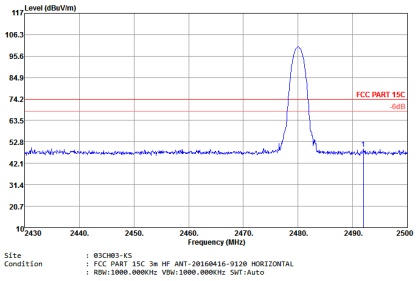
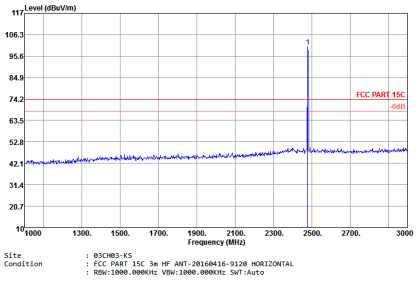
BT (Band Edge @ 3m)

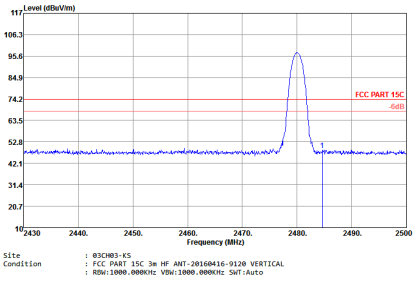
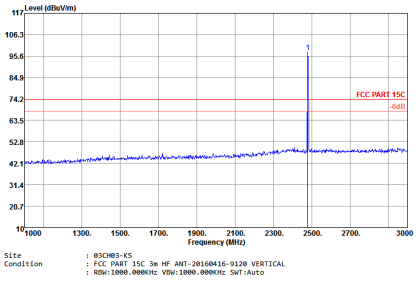
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH00 2402MHz	
1	Horizontal	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH00 2402MHz	
1	Vertical	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH39 2441MHz	
1	Horizontal	Fundamental
Peak		
Peak		Left blank

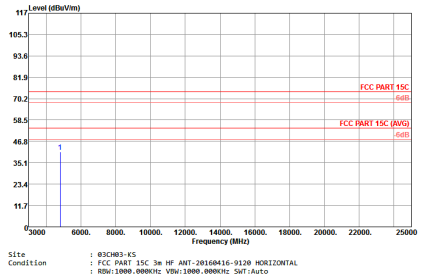
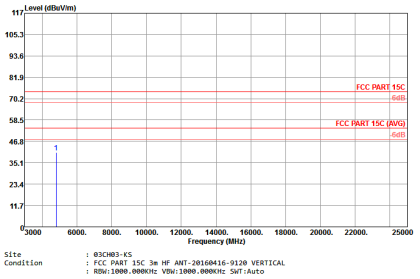
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH39 2441MHz	
1	Vertical	Fundamental
Peak		
Peak		Left blank

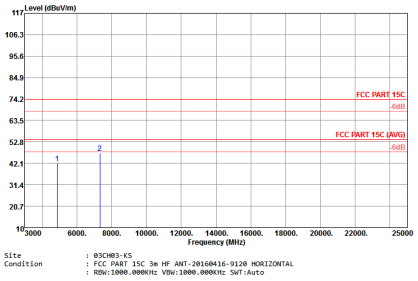
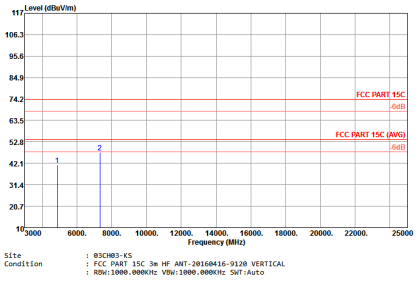
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
1	Horizontal	Fundamental
Peak		

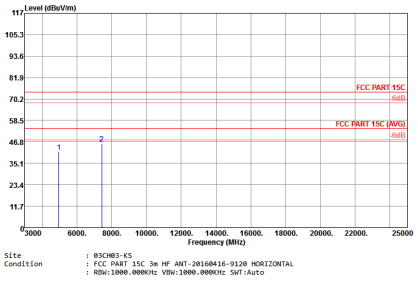
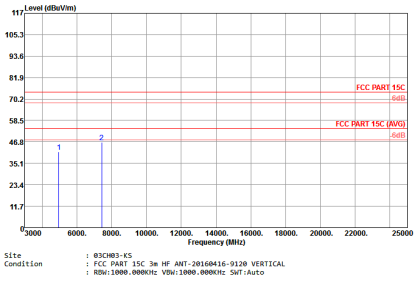
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
1	Vertical	Fundamental
Peak		

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

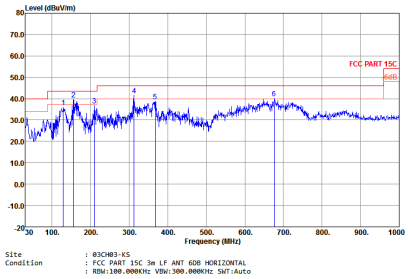
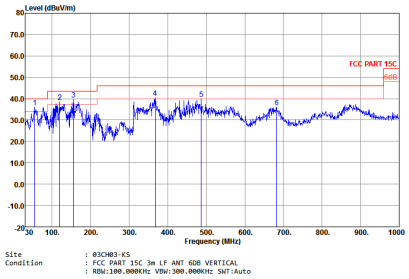
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH00 2402MHz	
1	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH39 2441MHz	
1	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH78 2480MHz	
1	Horizontal	Vertical
Peak Avg.		

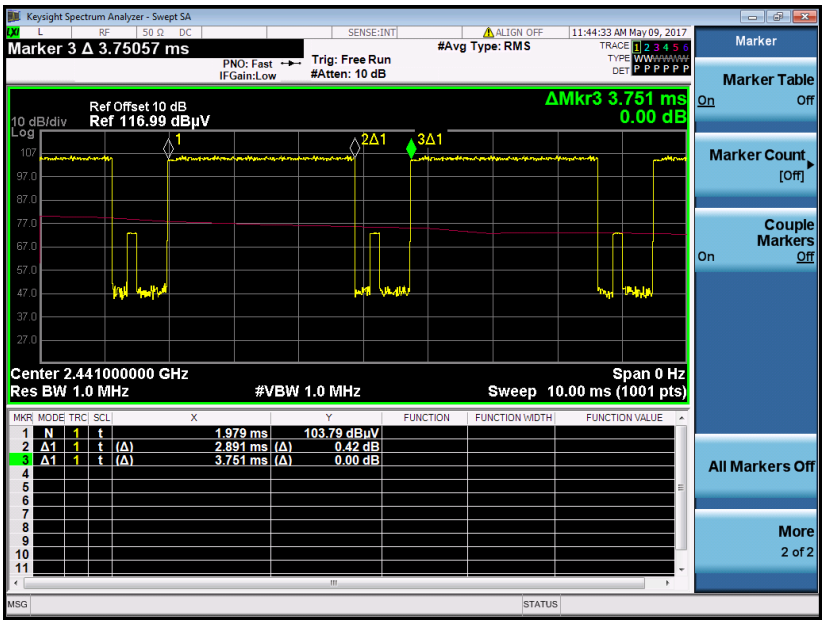
Emission below 1GHz

2.4GHz BT (LF)

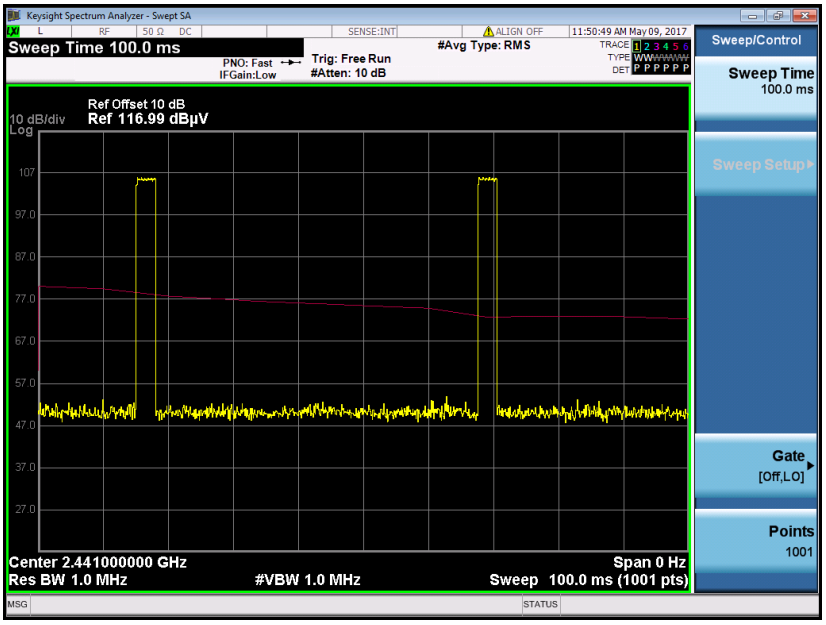
BT	2.4GHz 2400~2483.5MHz	
ANT	BT LF	
1	Horizontal	Vertical
QP / Peak		

Appendix D. Duty Cycle Plots

3DH5 on time (One Pulse) Plot on Channel 39



on time (Count Pulses) Plot on Channel 39



Note:

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.891 / 100 = 5.782 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.76 dB
3. **3DH5** has the highest duty cycle worst case and is reported.

Duty Cycle Correction Factor Consideration for AFH mode:

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

2.891 ms x 20 channels = 57.82 ms

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100ms / 57.6ms] = 2 hops

Thus, the maximum possible ON time:

2.891 ms x 2 = 5.782 ms

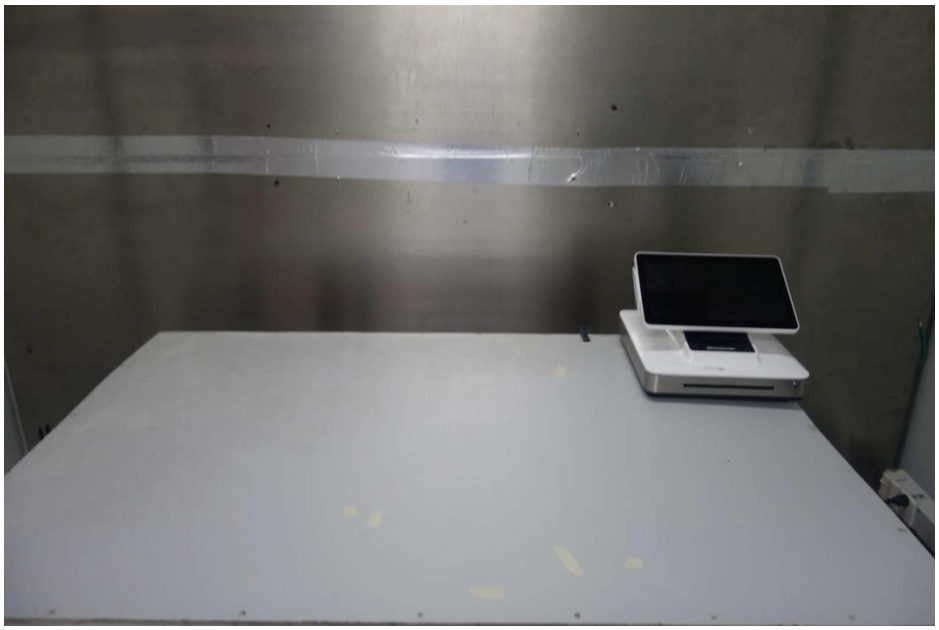
Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

20 x log(5.782 ms/100ms) = -24.76 dB

Appendix E. Setup Photographs

<Conducted Emission>

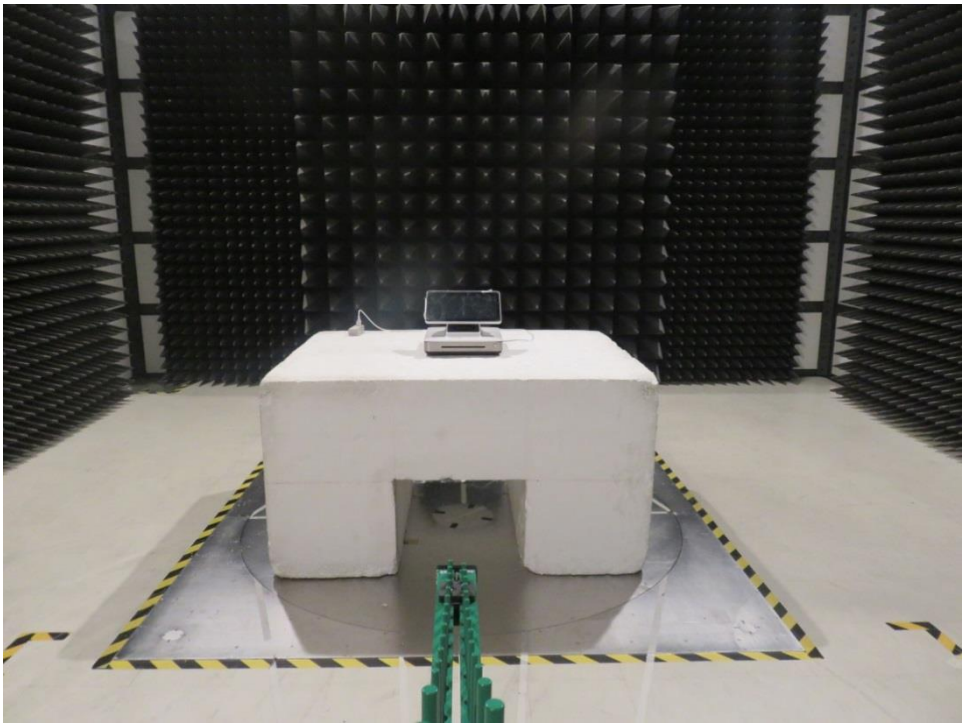
Remote View



Rear View

<Radiated Emission>

LF



HF