FCC RADIO TEST REPORT

FCC ID	:	**NM82Q6M200**
Equipment	:	**Controller**
Model Name	:	**2Q6M200**
Applicant	:	**HTC Corporation** **No. 88, Sec. 3, Zhongxing Rd., Xindian Dist., New Taipei City 231, Taiwan (R.O.C.)**
Manufacturer	:	**HTC Corporation** **No. 23, Xinghua Rd., Taoyuan District, Taoyuan City, Taiwan 330**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on Jan. 22, 2019 and testing was started from Feb. 11, 2019 and completed on Mar. 05, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

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

Approved by: Jones Tsai

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR912262	01	Initial issue of report	Mar. 26, 2019
FR912262	02	Revising Average Conducted Power	Mar. 29, 2019

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)	Output Power	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 6.68 dB at 2312.660 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.6	15.203 & 15.247(b)	Antenna Requirement	Pass	-
Remark: Not required means after assessing, test items are not necessary to carry out.				

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

Reviewed by: Wii Chang

Report Producer: Fish Liu

1 General Description

1.1 Product Feature of Equipment Under Test

2.4GHz Proprietary Radio

Product Specification subjective to this standard	
Antenna Type	2.4GHz Proprietary Radio: PCB Antenna

1.2 Modification of EUT

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

1.3 Testing Location

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

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

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH15-HY

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

FCC Designation No. TW1190 and TW0007

1.4 Applicable Standards

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

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r01
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- ANSI C63.10-2013

Remark:

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

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2.4GHz Proprietary Radio	3	2403	31	2431	59	2459
	5	2405	33	2433	61	2461
	7	2407	35	2435	63	2463
	9	2409	37	2437	65	2465
	11	2411	39	2439	67	2467
	13	2413	41	2441	69	2469
	15	2415	43	2443	71	2471
	17	2417	45	2445	73	2473
	19	2419	47	2447	75	2475
	21	2421	49	2449	77	2477
	23	2423	51	2451	79	2479
	25	2425	53	2453	-	-
	27	2427	55	2455	-	-
	29	2429	57	2457	-	-

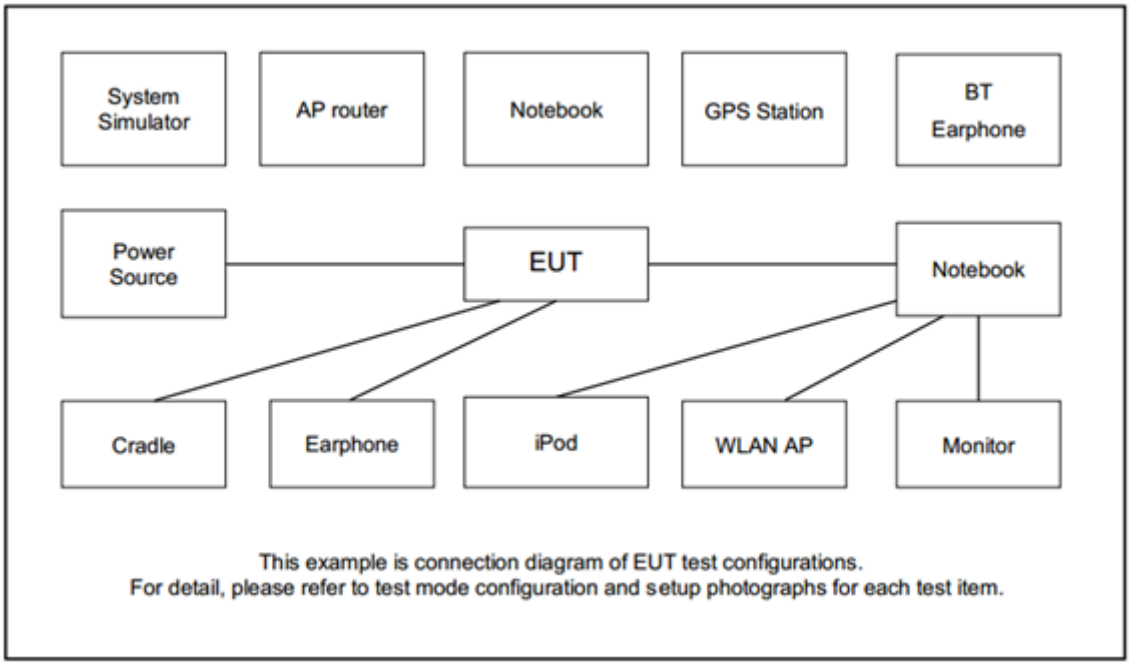
2.2 Test Mode

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: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report.

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

Summary table of Test Cases	
Test Item	**2.4GHz Proprietary Radio**
Conducted Test Cases	Mode 1: 2.4GHz Proprietary Radio Tx CH03_2403 MHz Mode 2: 2.4GHz Proprietary Radio Tx CH41_2441 MHz Mode 3: 2.4GHz Proprietary Radio Tx CH79_2479 MHz
Radiated Test Cases	Mode 1: 2.4GHz Proprietary Radio Tx CH03_2403 MHz Mode 2: 2.4GHz Proprietary Radio Tx CH41_2441 MHz Mode 3: 2.4GHz Proprietary Radio Tx CH79_2479 MHz

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.	DC Power Supply	Topward	3303D	N/A	N/A	Unshielded, 1.8 m

2.5 EUT Operation Test Setup

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

2.6 Measurement Results Explanation Example

For all conducted test items:

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

Example:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.
Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

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

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
6. Measure and record the results in the test report.

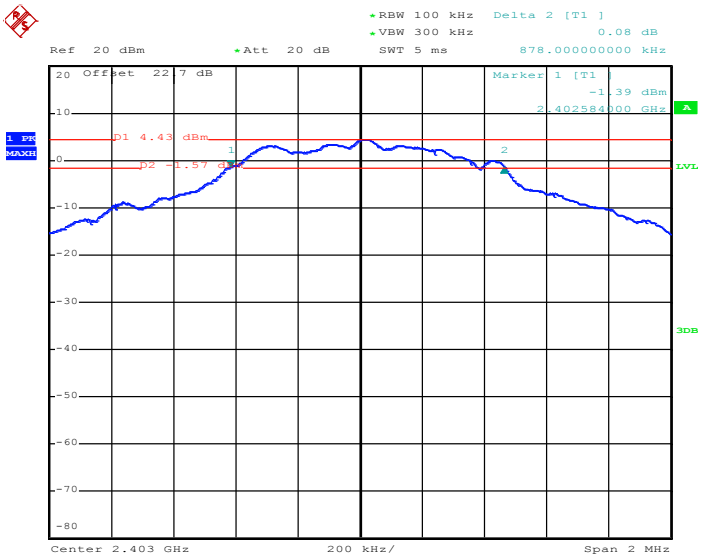
3.1.4 Test Setup

3.1.5 Test Result of 6dB Bandwidth

Test Engineer :	Kai Liao, Howard Lin, and Allen Lin	Temperature :	21~25°C
		Relative Humidity :	51~54%

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
2.4GHz	2Mbps	1	03	2403	0.878	0.50	Pass
2.4GHz	2Mbps	1	41	2441	0.864	0.50	Pass
2.4GHz	2Mbps	1	79	2479	0.882	0.50	Pass

6 dB Bandwidth Plot on Channel 03



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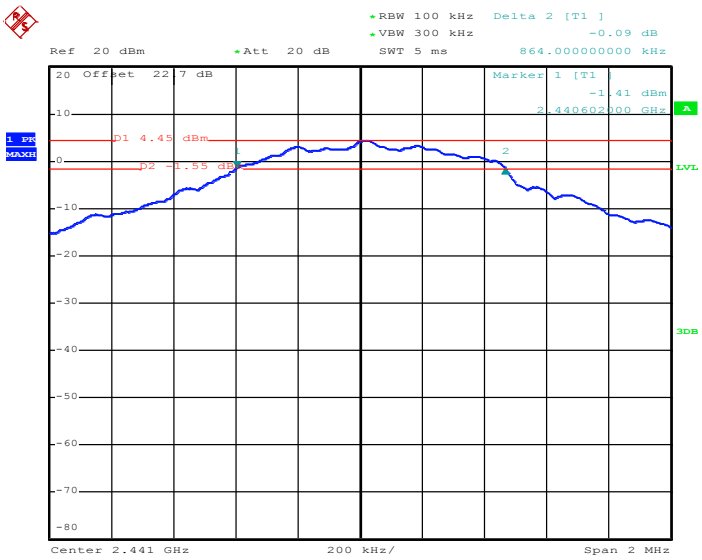
6 dB Bandwidth Plot on Channel 41



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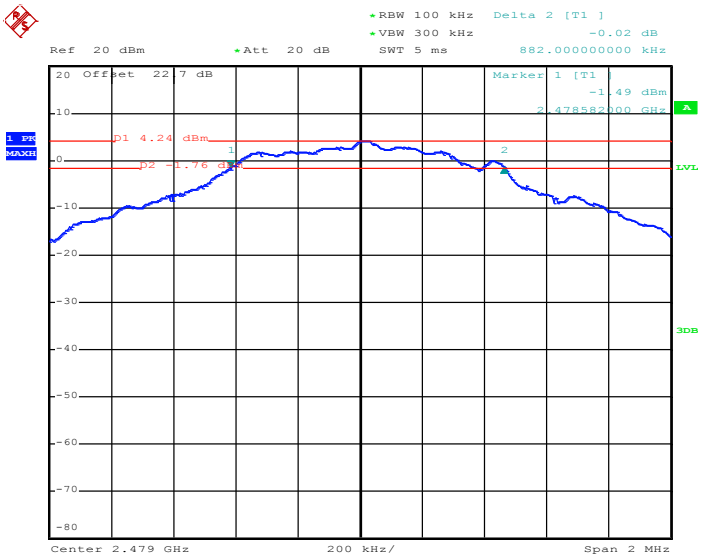
6 dB Bandwidth Plot on Channel 79



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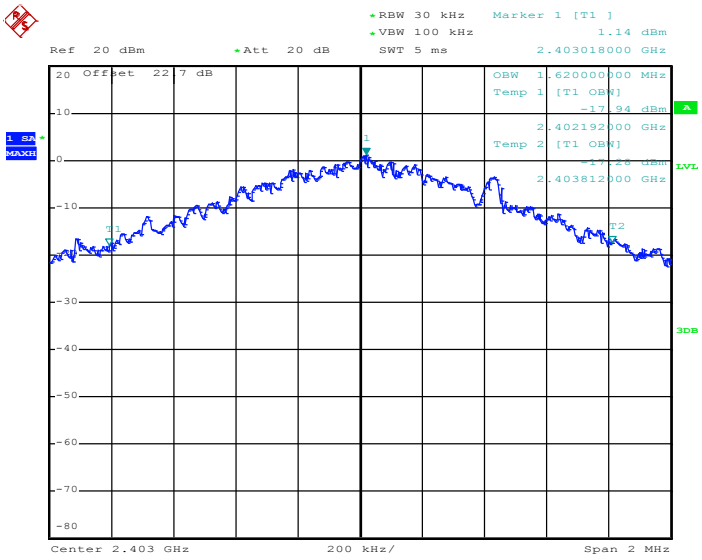
3.1.6 Test Result of 99% Occupied Bandwidth

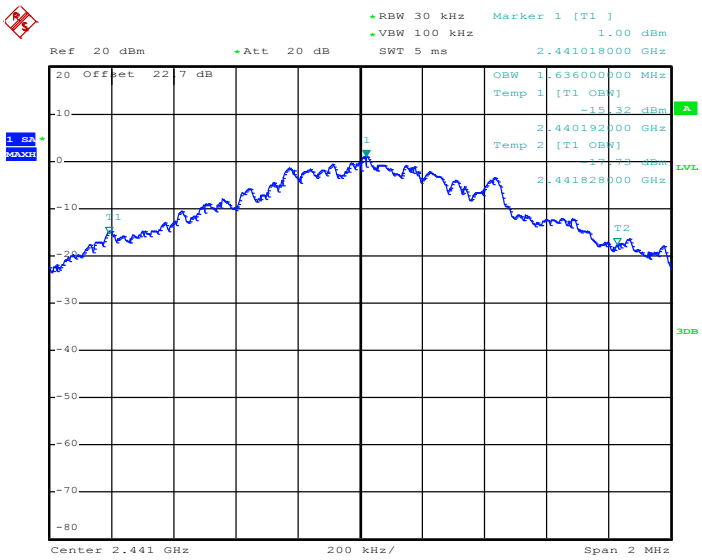
Test Engineer :	Kai Liao, Howard Lin, and Allen Lin	Temperature :	21~25°C
		Relative Humidity :	51~54%

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	Pass/Fail
2.4GHz	2Mbps	1	03	2403	1.620	Pass
2.4GHz	2Mbps	1	41	2441	1.636	Pass
2.4GHz	2Mbps	1	79	2479	1.634	Pass

99% Bandwidth Plot on Channel 03



99% Occupied Bandwidth Plot on Channel 41



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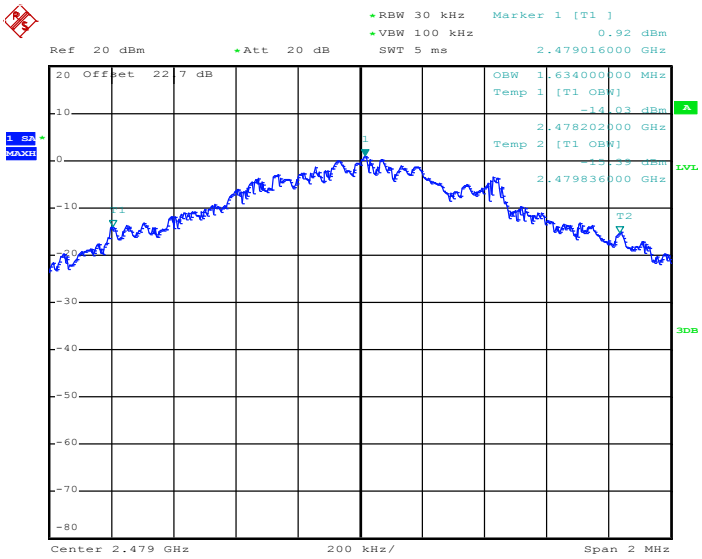
99% Occupied Bandwidth Plot on Channel 79



Date: 4.MAR.2019 15:01:59

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

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

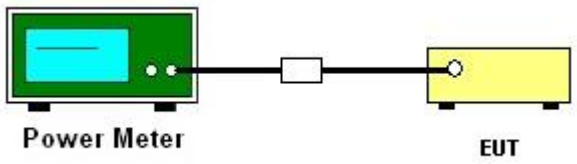
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average output Power

Test Engineer :	Kai Liao, Howard Lin, and Allen Lin	Temperature :	21~25°C
		Relative Humidity :	51~54%

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)
2.4GHz	2Mbps	1	3	2403	0.47	3.80
2.4GHz	2Mbps	1	41	2441	0.47	3.90
2.4GHz	2Mbps	1	79	2479	0.47	3.70

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

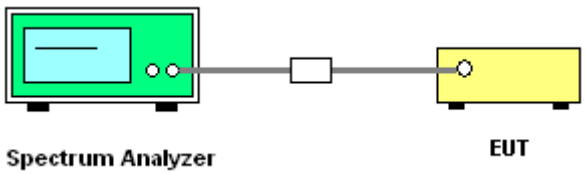
3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



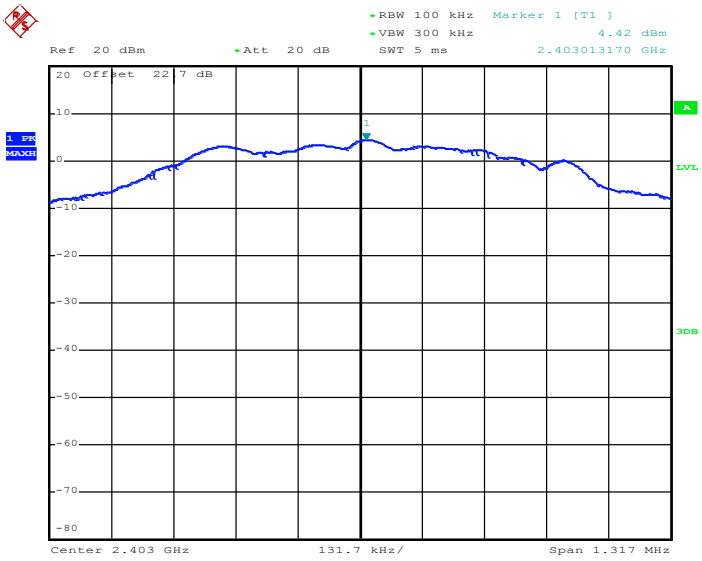
3.3.5 Test Result of Power Spectral Density

Test Engineer :	Kai Liao, Howard Lin, and Allen Lin	Temperature :	21~25°C
		Relative Humidity :	51~54%

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm/100kHz)	Peak PSD (dBm/3kHz)	DG (dBi)	Peak PSD Limit (dBm/3kHz)	Pass/Fail
2.4GHz	2Mbps	1	3	2403	4.42	**-9.02**	-2.00	8.00	Pass
2.4GHz	2Mbps	1	41	2441	**4.44**	-9.97	-2.00	8.00	Pass
2.4GHz	2Mbps	1	79	2479	4.24	-9.72	-2.00	8.00	Pass

3.3.6 Test Result of Power Spectral Density Plots (100kHz)

PSD 100kHz Plot on Channel 03



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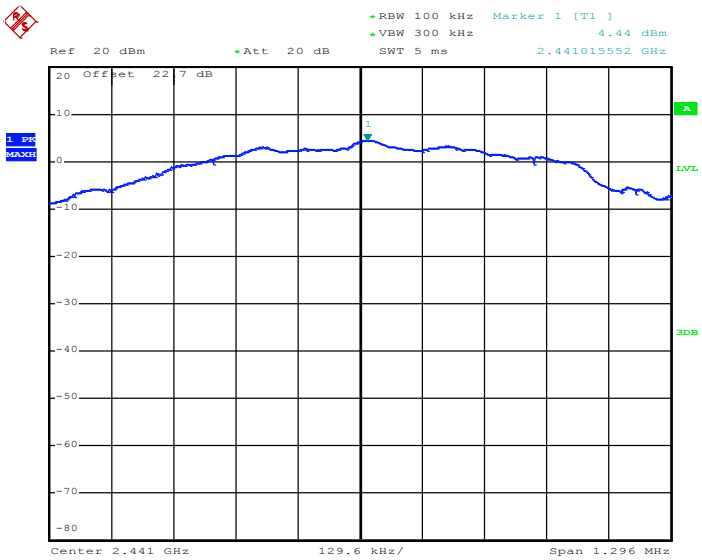
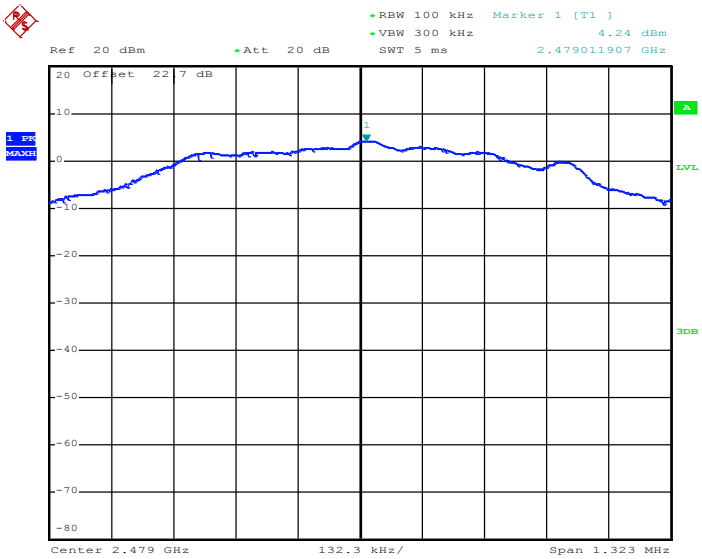
PSD 100kHz Plot on Channel 41



Date: 5.MAR.2019 11:04:39

PSD 100kHz Plot on Channel 79



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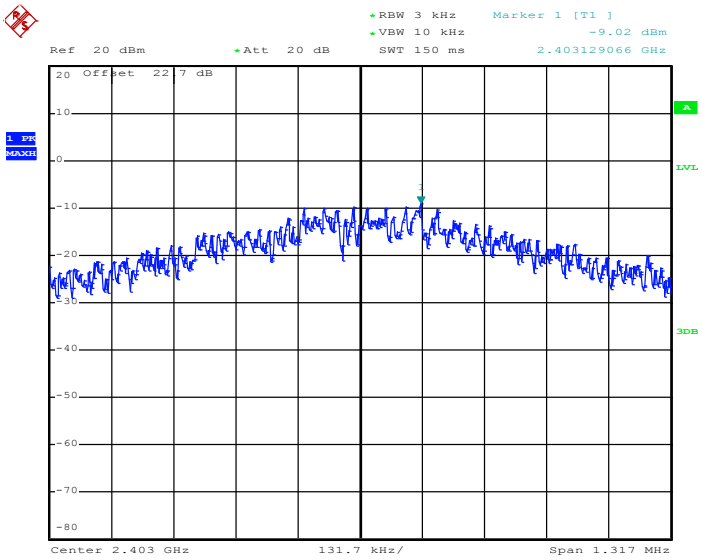
3.3.7 Test Result of Power Spectral Density Plots (3kHz)

PSD 3kHz Plot on Channel 03



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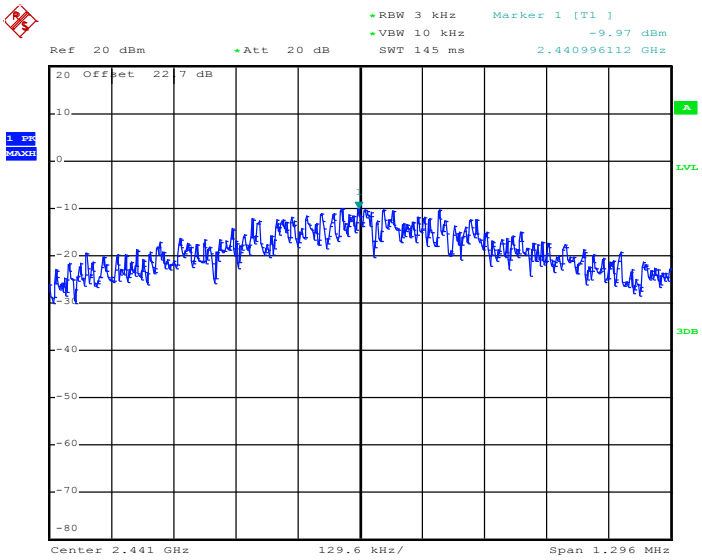
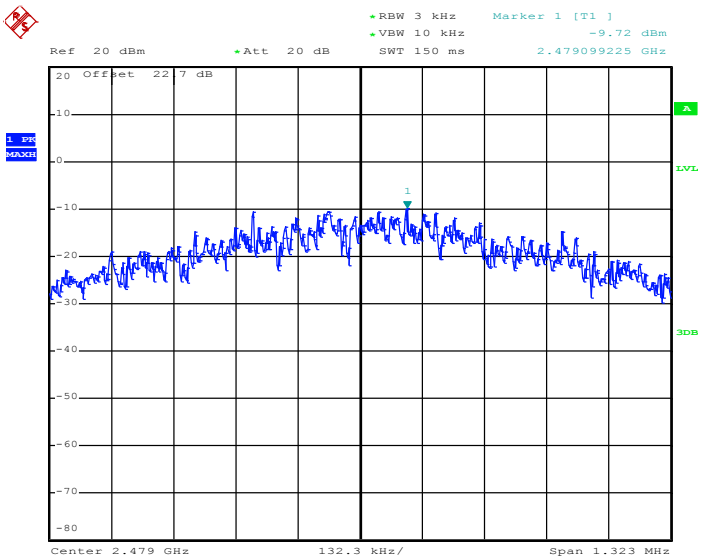
PSD 3kHz Plot on Channel 41



Date: 5.MAR.2019 11:04:15

PSD 3kHz Plot on Channel 79



Date: 4.MAR.2019 15:00:13

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

All harmonics/spurious must be at least 30 dB down from the highest emission level within the authorized band.

3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

3.4.3 Test Procedures

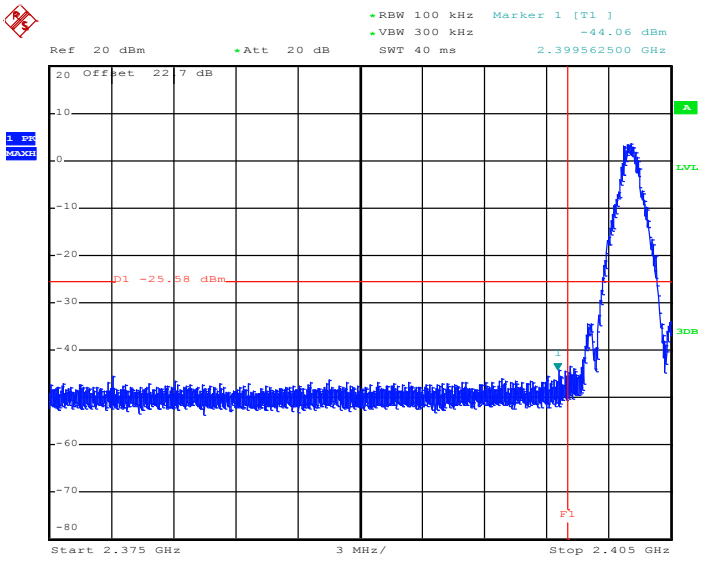
1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
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.

3.4.4 Test Setup

3.4.5 Test Result of Conducted Band Edges Plots

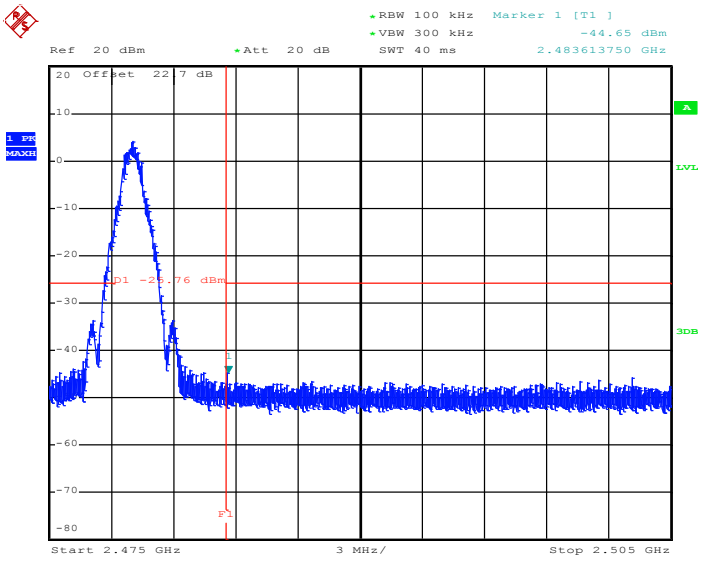
Test Engineer :	Kai Liao, Howard Lin, and Allen Lin	Temperature :	21~25°C
		Relative Humidity :	51~54%

Low Band Edge Plot on Channel 03



Date: 4.MAR.2019 14:55:17

High Band Edge Plot on Channel 79

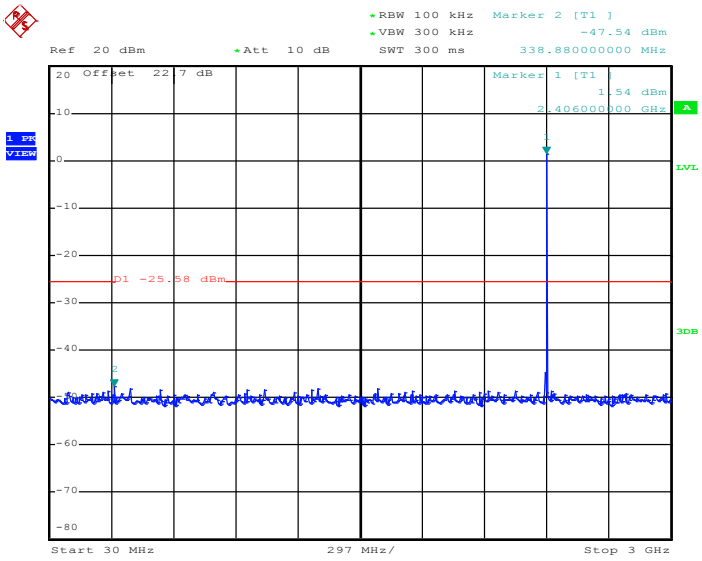


Date: 4.MAR.2019 15:00:57

3.4.6 Test Result of Conducted Spurious Emission Plots

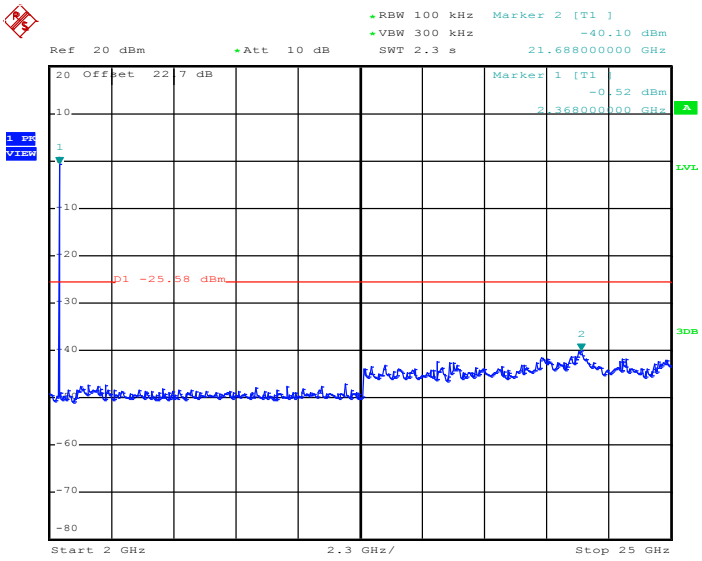
Test Engineer :	Kai Liao, Howard Lin, and Allen Lin	Temperature :	21~25°C
		Relative Humidity :	51~54%

Conducted Spurious Emission Plot on 2.4GHz Channel 03



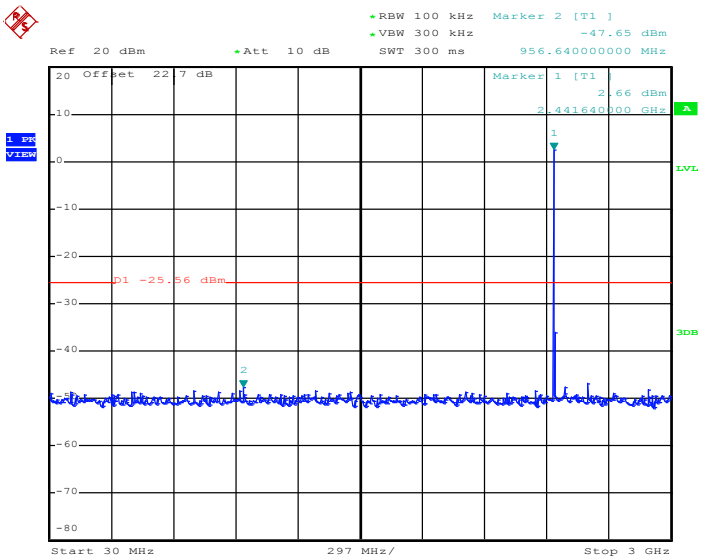
Date: 4.MAR.2019 14:56:09

Conducted Spurious Emission Plot on 2.4GHz Channel 03



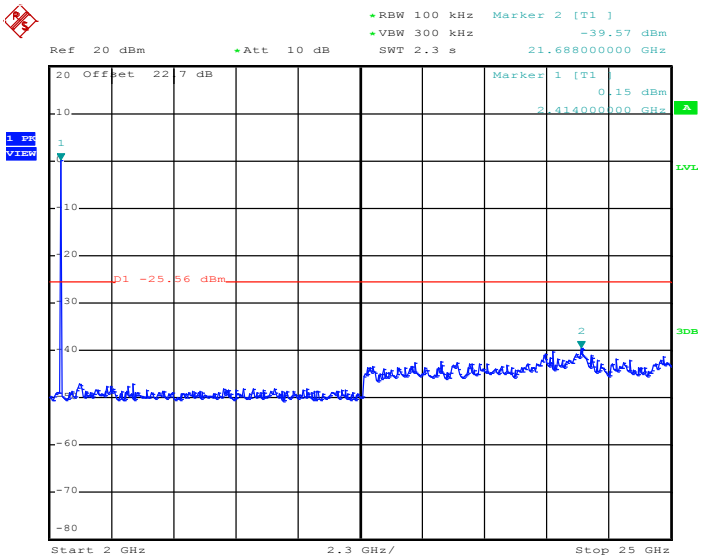
Date: 4.MAR.2019 14:56:23

Conducted Spurious Emission Plot on 2.4GHz Channel 41



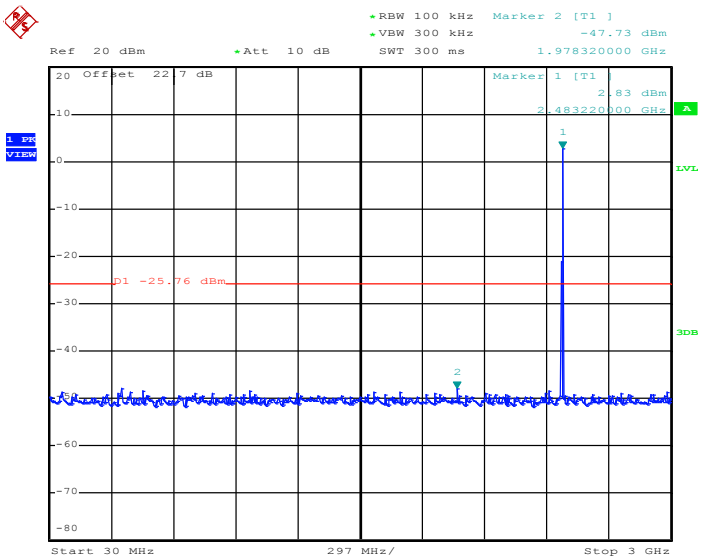
Date: 5.MAR.2019 11:05:16

Conducted Spurious Emission Plot on 2.4GHz Channel 41



Date: 5.MAR.2019 11:05:53

Conducted Spurious Emission Plot on 2.4GHz Channel 79



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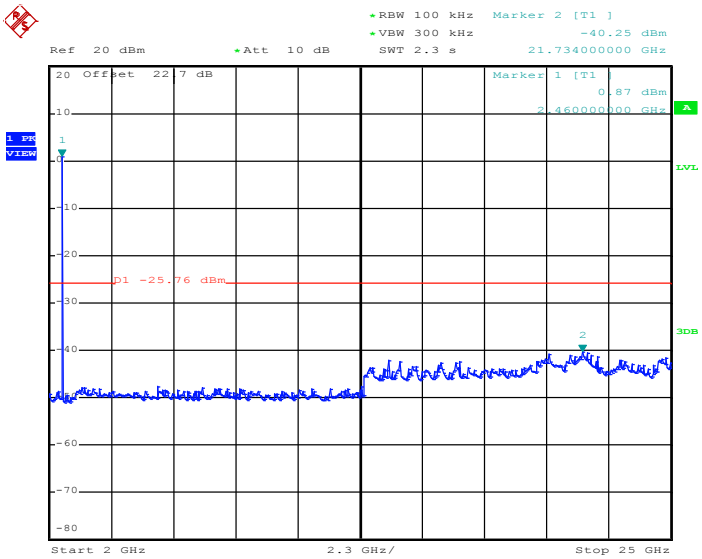
Conducted Spurious Emission Plot on 2.4GHz Channel 79



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3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

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. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. 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

3.5.2 Measuring Instruments

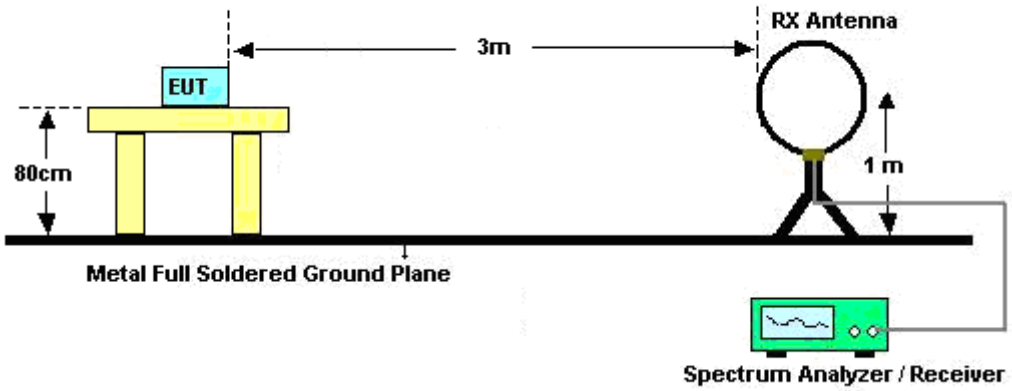
See list of measuring equipment of this test report.

3.5.3 Test Procedures

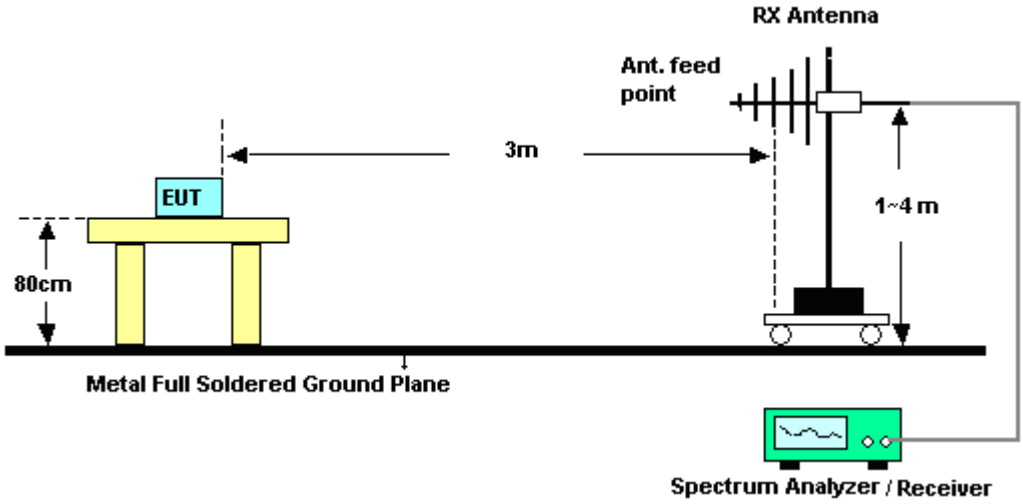
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. 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.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. 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; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

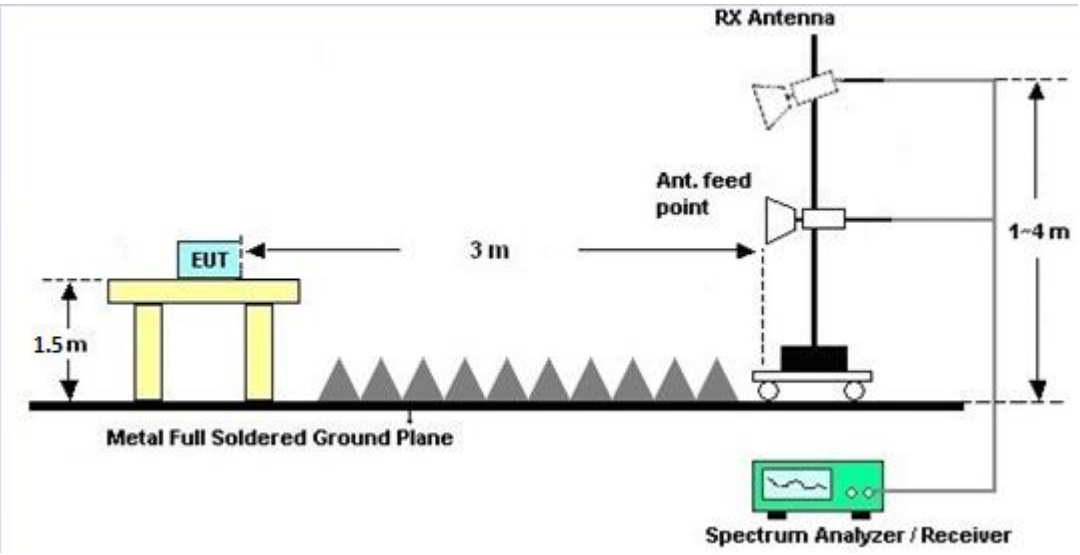
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.5.7 Duty Cycle

Please refer to Appendix C.

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

Please refer to Appendix A and B.

3.6 Antenna Requirements

3.6.1 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.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.6.3 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
Power Sensor	DARE	RadiPower	15I00041SNO09	10MHz~6GHz	May 07, 2018	Feb. 11, 2019 ~ Mar. 05, 2019	May 06, 2019	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP 40	100057	9kHz~40GHz	Nov. 21, 2018	Feb. 11, 2019 ~ Mar. 05, 2019	Nov. 20, 2019	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV 30	100895	9kHz~30GHz	Apr. 20, 2018	Feb. 11, 2019 ~ Mar. 05, 2019	Apr. 19, 2019	Conducted (TH05-HY)
Loop Antenna	TESEQ	HLA 6120	31244	9 kHz~30 MHz	Mar. 29, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Mar. 28, 2019	Radiation (03CH15-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 06, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Dec. 05, 2019	Radiation (03CH15-HY)
Bilog Antenna	TESEQ	CBL6111D&00800N1D01N-06	41912&05	30MHz to 1GHz	Feb. 12, 2019	Feb. 26, 2019 ~ Mar. 05, 2019	Feb. 11, 2020	Radiation (03CH15-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1620	1G~18GHz	Oct. 17, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Oct. 16, 2019	Radiation (03CH15-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170576	18GHz ~ 40GHz	May 08, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	May 07, 2019	Radiation (03CH15-HY)
Amplifier	SONOMA	310N	363440	9kHz~1GHz	Dec. 28, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Dec. 27, 2019	Radiation (03CH15-HY)
Preamplifier	Jet-Power	JPA0118-55-303	171000180 00550006	1GHz~18GHz	Jul. 10, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Jul. 09, 2019	Radiation (03CH15-HY)
Preamplifier	Keysight	83017A	MY53270195	1GHz~26.5GHz	Aug. 23, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Aug. 22, 2019	Radiation (03CH15-HY)
EMI Test Receiver	Keysight	N9038A (MXE)	MY54130085	20Hz ~ 8.4GHz	Nov. 01, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Oct. 31, 2019	Radiation (03CH15-HY)
Spectrum Analyzer	Agilent	E4446A	MY50180136	3Hz~44GHz	Apr. 25, 2018	Feb. 26, 2019 ~ Mar. 05, 2019	Apr. 24, 2019	Radiation (03CH15-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Feb. 26, 2019 ~ Mar. 05, 2019	N/A	Radiation (03CH15-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Feb. 26, 2019 ~ Mar. 05, 2019	N/A	Radiation (03CH15-HY)
Software	Audix	E3 6.2009-8-24	RK-000451	N/A	N/A	Feb. 26, 2019 ~ Mar. 05, 2019	N/A	Radiation (03CH15-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.5**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2**

Appendix A. Radiated Spurious Emission

Test Engineer :	Karl Hou	Temperature :	24~26°C
		Relative Humidity :	49~53%

2.4G Tx (Band Edge @ 3m)

Wifi	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2.4G Tx CH 03 2403MHz		2389.59	56.68	-17.32	74	44.17	27.6	5.85	30.86	342	223	P	H
		2388.33	44.36	-9.64	54	31.85	27.6	5.85	30.86	342	223	A	H
	*	2403	100.73	-	-	88.19	27.6	5.87	30.85	342	223	P	H
	*	2403	99.98	-	-	87.44	27.6	5.87	30.85	342	223	A	H
													H
													H
		2333.94	53.98	-20.02	74	41.41	27.77	5.77	30.89	297	282	P	V
		2332.365	44.33	-9.67	54	31.76	27.77	5.77	30.89	297	282	A	V
	*	2403	99.4	-	-	86.86	27.6	5.87	30.85	297	282	P	V
	*	2403	98.57	-	-	86.03	27.6	5.87	30.85	297	282	A	V
													V
													V
2.4G Tx CH 41 2441MHz		2328.62	56	-18	74	43.44	27.77	5.76	30.89	100	241	P	H
		2312.66	47.32	-6.68	54	34.73	27.83	5.74	30.9	100	241	A	H
	*	2441	103.67	-	-	91.05	27.6	5.93	30.83	100	241	P	H
	*	2441	102.8	-	-	90.18	27.6	5.93	30.83	100	241	A	H
		2499.93	53.15	-20.85	74	40.63	27.4	6.01	30.81	100	241	P	H
		2489.29	43.52	-10.48	54	31.02	27.4	6	30.82	100	241	A	H
		2312.94	54.78	-19.22	74	42.19	27.83	15.66	30.9	354	206	P	V
		2312.8	44.71	-9.29	54	32.12	27.83	15.66	30.9	354	206	A	V
	*	2441	99.78	-	-	87.16	27.6	15.85	30.83	354	206	P	V
	*	2441	98.91	-	-	86.29	27.6	15.85	30.83	354	206	A	V
		2495.87	53.26	-20.74	74	40.75	27.4	15.92	30.81	354	206	P	V
		2493.56	43.41	-10.59	54	30.9	27.4	15.92	30.81	354	206	A	V

2.4G Tx CH 79 2479MHz	*	2479	102.52	-	-	89.97	27.47	5.98	30.82	251	227	P	H
	*	2479	101.68	-	-	89.13	27.47	5.98	30.82	251	227	A	H
		2483.64	63.85	-10.15	74	51.29	27.47	5.99	30.82	251	227	P	H
		2483.56	47.23	-6.77	54	34.67	27.47	5.99	30.82	251	227	A	H
													H
													H
	*	2479	99.41	-	-	86.86	27.47	5.98	30.82	316	289	P	V
	*	2479	98.62	-	-	86.07	27.47	5.98	30.82	316	289	A	V
		2483.6	61.32	-12.68	74	48.76	27.47	5.99	30.82	316	289	P	V
		2483.6	45.59	-8.41	54	33.03	27.47	5.99	30.82	316	289	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4G Tx (Harmonic @ 3m)

Wifi Ant 1	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2.4G Tx CH 03 2403MHz		4806	52.68	-21.32	74	70.97	31.3	7.99	58.04	397	63	P	H
		4806	43.48	-10.52	54	61.77	31.3	7.99	58.04	397	63	A	H
													H
													H
		4806	55.78	-18.22	74	74.07	31.3	7.99	58.04	228	94	P	V
		4806	46.59	-7.41	54	64.88	31.3	7.99	58.04	228	94	A	V
													V
													V
2.4G Tx CH 41 2441MHz		4882	45.99	-28.01	74	64.13	31.3	8.21	58.11	100	0	P	H
		7323	44.45	-29.55	74	55.29	36.23	10.79	58.34	100	0	P	H
													H
													H
		4882	55.78	-18.22	74	73.92	31.3	8.21	58.11	270	106	P	V
		4882	40.25	-13.75	54	58.39	31.3	8.21	58.11	270	106	A	V
		7323	44.92	-29.08	74	55.76	36.23	10.79	58.34	100	0	P	V
													V
2.4G Tx CH 79 2479MHz		4958	44.37	-29.63	74	62.17	31.47	8.44	58.17	100	0	P	H
		7437	44.93	-29.07	74	55.31	36.6	10.88	58.31	100	0	P	H
													H
													H
		4958	55.77	-18.23	74	73.57	31.47	8.44	58.17	224	131	P	V
		4958	39.69	-14.31	54	57.49	31.47	8.44	58.17	224	131	A	V
		7437	45.44	-28.56	74	55.82	36.6	10.88	58.31	100	0	P	V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz Tx (LF)

Wifi	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
2.4G Tx LF		95.96	22.62	-20.88	43.5	38.45	15.4	1.2	32.52	-	-	P	H
		191.99	31.8	-11.7	43.5	47.62	14.8	1.67	32.49	100	0	P	H
		288.02	22.75	-23.25	46	34.01	19.06	2.03	32.53	-	-	P	H
		384.05	24.52	-21.48	46	33.38	21.26	2.35	32.55	-	-	P	H
		563.5	27.83	-18.17	46	31.07	26.37	2.8	32.59	-	-	P	H
		721.61	32.97	-13.03	46	34.79	27.26	3.16	32.36	-	-	P	H
													H
													H
													H
													H
													H
													H
		95.96	18.51	-24.99	43.5	34.34	15.4	1.2	32.52	-	-	P	V
		191.99	21.96	-21.54	43.5	37.78	14.8	1.67	32.49	-	-	P	V
		355.92	21.13	-24.87	46	30.75	20.62	2.23	32.55	-	-	P	V
		466.5	25.92	-20.08	46	32.4	23.43	2.55	32.56	-	-	P	V
		560.59	28.39	-17.61	46	31.7	26.31	2.79	32.59	-	-	P	V
		649.83	29.32	-16.68	46	32.08	26.6	2.98	32.5	100	0	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:

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 00 2402MHz		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. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path 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) + Path 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".

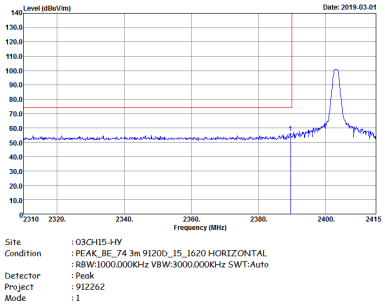
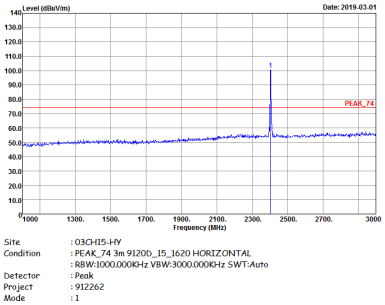
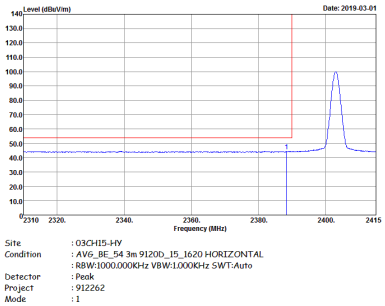
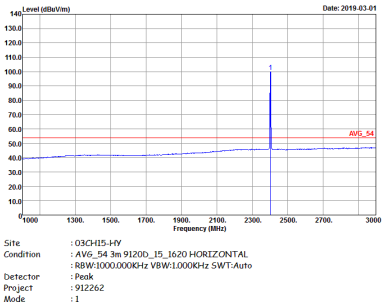
Appendix B. Radiated Spurious Emission Plots

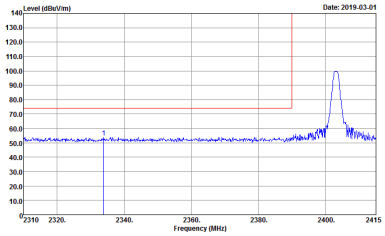
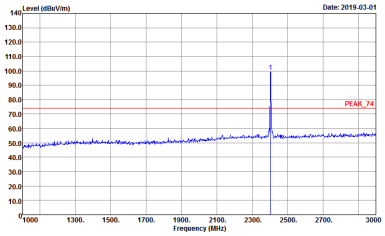
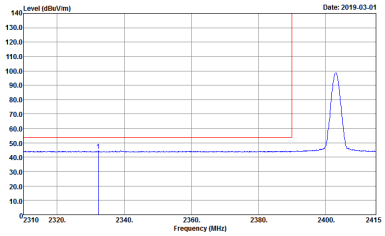
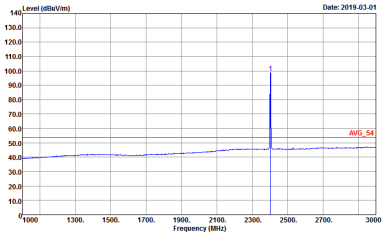
Test Engineer :	Karl Hou	**Temperature :**	24~26°C
		Relative Humidity :	49~53%

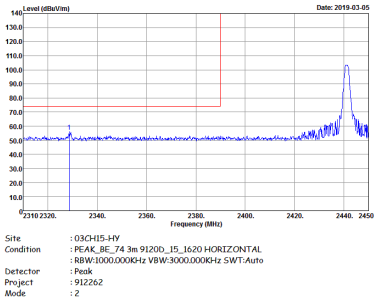
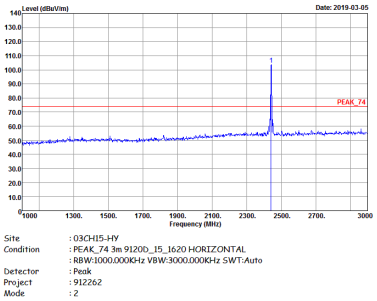
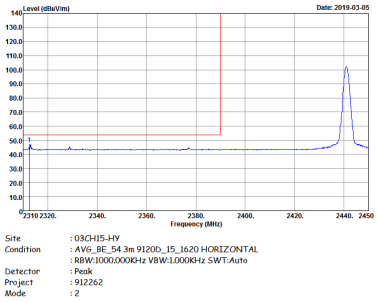
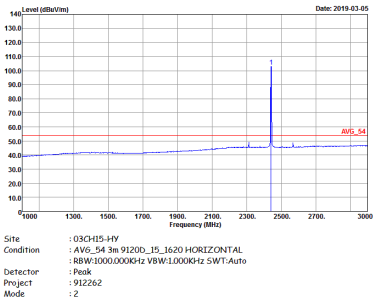
Note symbol

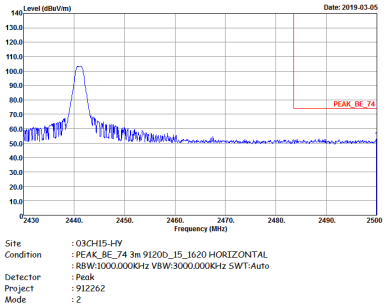
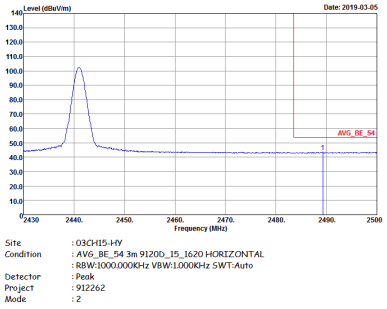
-L	**Low channel location**
-R	**High channel location**

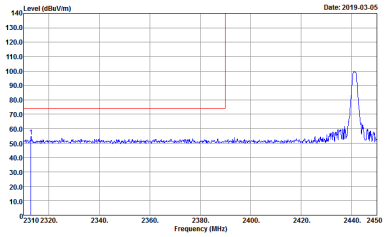
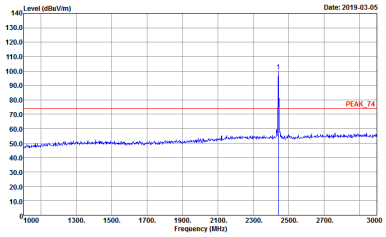
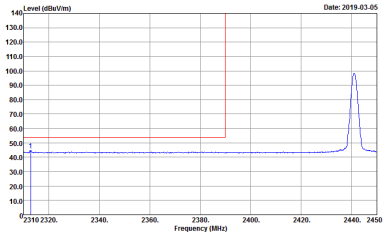
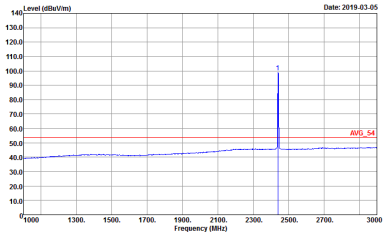
2.4GHz Tx (Band Edge @ 3m)

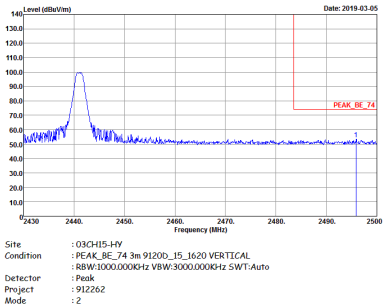
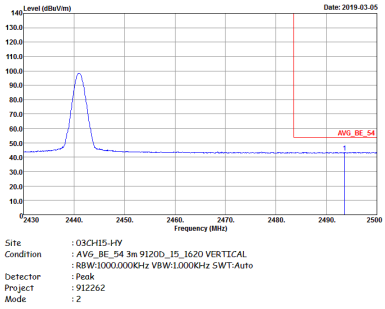
2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH03 2403MHz	
	Horizontal	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1	 Site : 03CH15-HY Condition : PEAK_74 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1
Avg.	 Site : 03CH15-HY Condition : AVG_BE_54 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1	 Site : 03CH15-HY Condition : AVG_54 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1

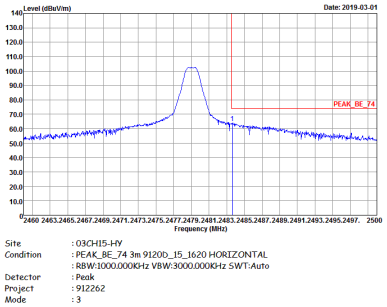
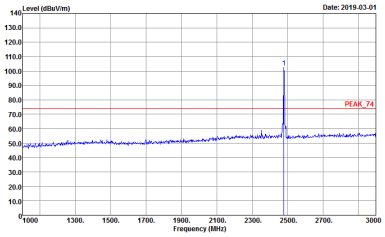
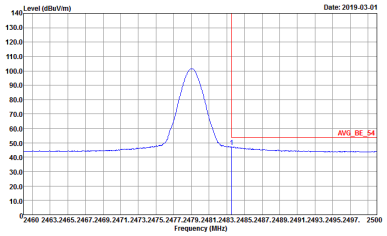
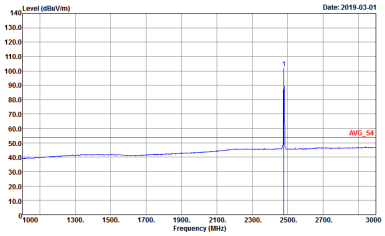
2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH03 2403MHz	
	Vertical	Fundamental
Peak	 Site : 03CH15-HV Condition : PEAK_BE_74 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1	 Site : 03CH15-HV Condition : PEAK_74 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1
Avg	 Site : 03CH15-HV Condition : AVG_BE_54 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1	 Site : 03CH15-HV Condition : AVG_54 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 1

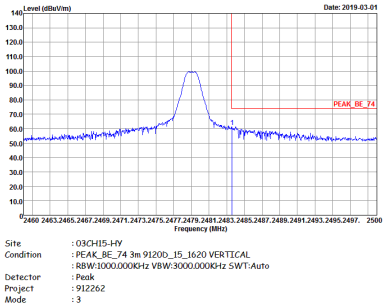
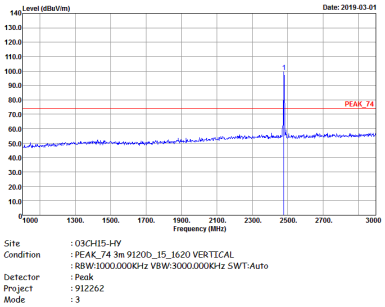
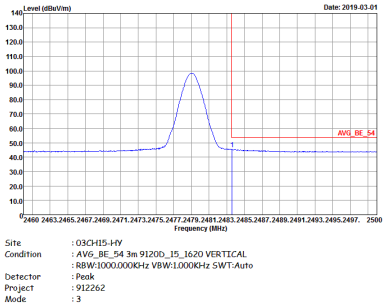
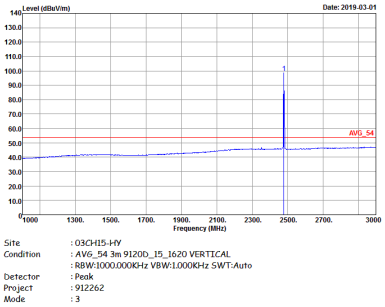
2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH41 2441MHz - L	
	Horizontal	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 2	 Site : 03CH15-HY Condition : PEAK_74 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 2
Avg.	 Site : 03CH15-HY Condition : AVG_BE_54 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 2	 Site : 03CH15-HY Condition : AVG_54 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 2

2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH41 2441MHz - R	
	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

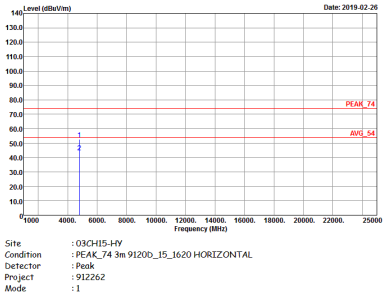
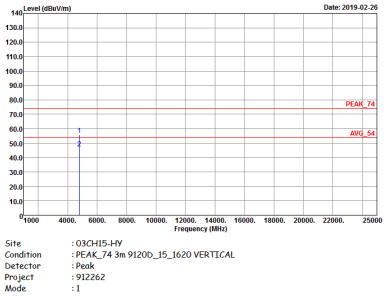
2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH41 2441MHz - L	
	Vertical	Fundamental
Peak		
Avg.		

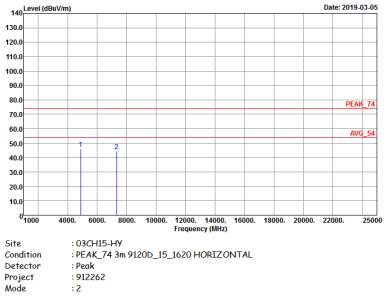
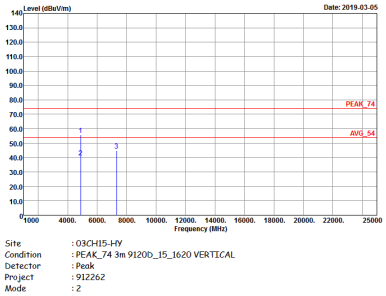
2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH41 2441MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

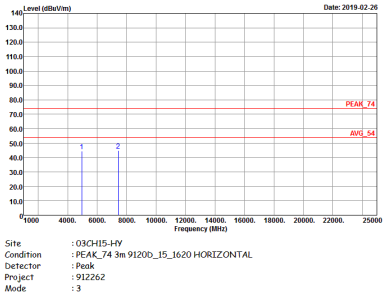
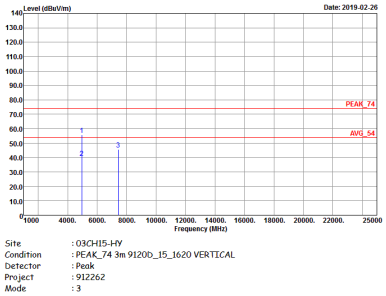
2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH79 2479MHz	
	Horizontal	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3	 Site : 03CH15-HY Condition : PEAK_74 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3
Avg.	 Site : 03CH15-HY Condition : AVG_BE_54 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3	 Site : 03CH15-HY Condition : AVG_54 3m 9120D_15_1620 HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3

2.4G	2.4GHz Band Edge @ 3m	
	2.4G Tx CH79 2479MHz	
	Vertical	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3	 Site : 03CH15-HY Condition : PEAK_74 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3
Avg.	 Site : 03CH15-HY Condition : AVG_BE_54 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3	 Site : 03CH15-HY Condition : AVG_54 3m 9120D_15_1620 VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 912262 Mode : 3

2.4GHz Tx (Harmonic @ 3m)

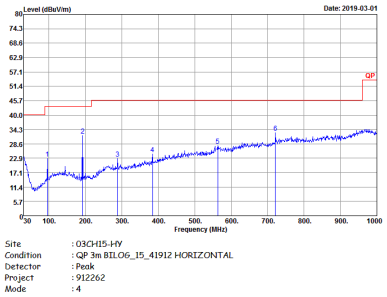
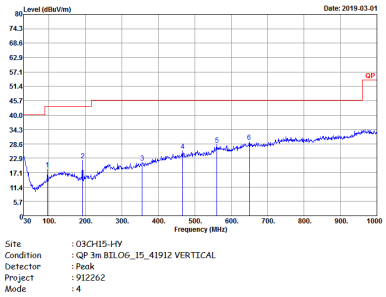
2.4G	2.4GHz Harmonic @ 3m	
	2.4G Tx CH03 2403MHz	
	Horizontal	Vertical
Peak Avg.		

2.4G	2.4GHz Harmonic @ 3m	
	2.4G Tx CH41 2441MHz	
	Horizontal	Vertical
Peak Avg.		

2.4G	2.4GHz Harmonic @ 3m	
	2.4G Tx CH79 2479MHz	
	Horizontal	Vertical
Peak		

Emission below 1GHz

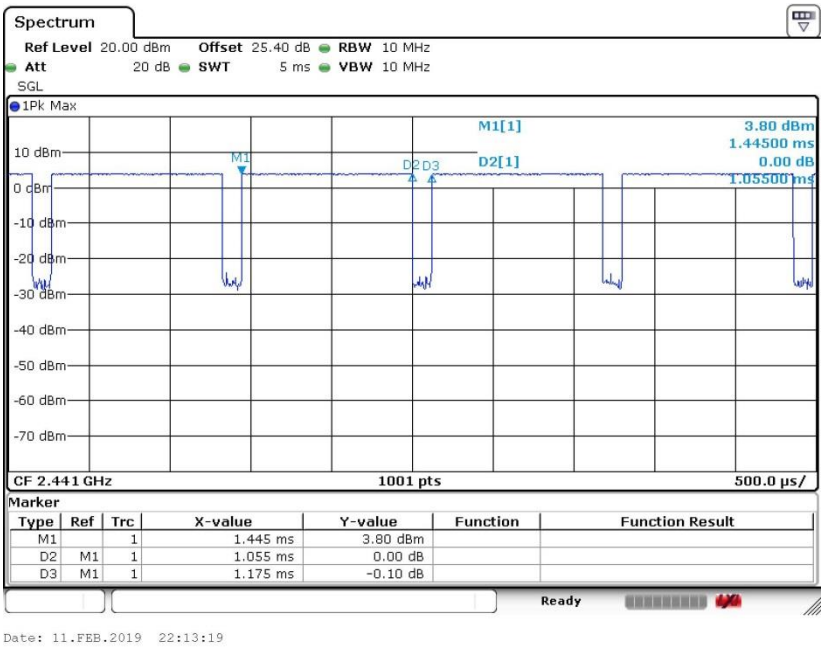
2.4GHz Tx (LF)

2.4G	2.4G Tx LF	
	Horizontal	Vertical
QP / Peak		

Appendix C. Duty Cycle Plots

Band	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor (dB)
2.4GHz Proprietary Radio	89.79	1055.00	0.95	1kHz	0.47

2.4GHz Proprietary Radio



————THE END————