



FCC RADIO TEST REPORT

FCC ID : PPD-QCNFA435
Equipment : Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2
Type Card
Brand Name : Qualcomm Atheros
Model Name : QCNFA435
Applicant : Qualcomm Atheros, Inc
1700 Technology Drive, San Jose, CA 95110
Manufacturer : Qualcomm Atheros, Inc
1700 Technology Drive, San Jose, CA 95110
Standard : FCC Part 15 Subpart C §15.247

The product was received on Jun. 27, 2018 and testing was started from Jul. 24, 2018 and completed on Aug. 04, 2018. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The 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 partial 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.)



Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
1 General Description.....	5
1.1 Product Feature of Equipment Under Test.....	5
1.2 Modification of EUT	5
1.3 Testing Location	6
1.4 Applicable Standards.....	6
2 Test Configuration of Equipment Under Test.....	7
2.1 Carrier Frequency Channel	7
2.2 Test Mode.....	8
2.3 Connection Diagram of Test System.....	8
2.4 Support Unit used in test configuration and system	9
2.5 EUT Operation Test Setup	9
3 Test Result.....	10
3.1 Output Power Measurement.....	10
3.2 Radiated Band Edges and Spurious Emission Measurement	11
3.3 Antenna Requirements	15
4 List of Measuring Equipment	16
5 Uncertainty of Evaluation.....	17
Appendix A. Conducted Test Results	
Appendix B. Radiated Spurious Emission	
Appendix C. Radiated Spurious Emission Plots	
Appendix D. Duty Cycle Plots	
Appendix E. Setup Photographs	



History of this test report



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(b)(3)	Peak Output Power	Pass	-
3.2	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	Under limit 4.93 dB at 69.420 MHz
3.3	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Reviewed by: Joseph Lin

Report Producer: Polly Tsai



1 General Description

1.1 Product Feature of Equipment Under Test

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

Product Specification subjective to this standard	
Sample 1	EUT with Host 1
Sample 2	EUT with Host 2

The product was installed into Portable Computer (Brand Name: DELL, Model Name: P77F) during test, and the host information was recorded in the following table.

Host Information	
Host 1	Host with WNC Antenna
Host 2	Host with HB Antenna

Antenna Information									
Mode	Manufacturer	Antenna type	Antenna	2.4G	5G B1	5G B2	5G B3	5G B4	
Notebook	HB	PIFA	1(main)	0.72	-2.24	-3.79	-0.4	0.84	
			2(aux)	-2.07	-4.02	-2.29	0.98	0.98	
	WNC	PIFA	1(main)	-3.86	-1.92	-0.86	-3.04	-2.23	
			2(aux)	-3.88	-3.41	-3.03	-0.97	-0.97	

1.2 Modification of EUT

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



1.3 Testing Location

Sportun Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

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.	Sportun Site No.	
	TH05-HY	03CH07-HY

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

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 v04
- 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)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
	20	2442	-	-

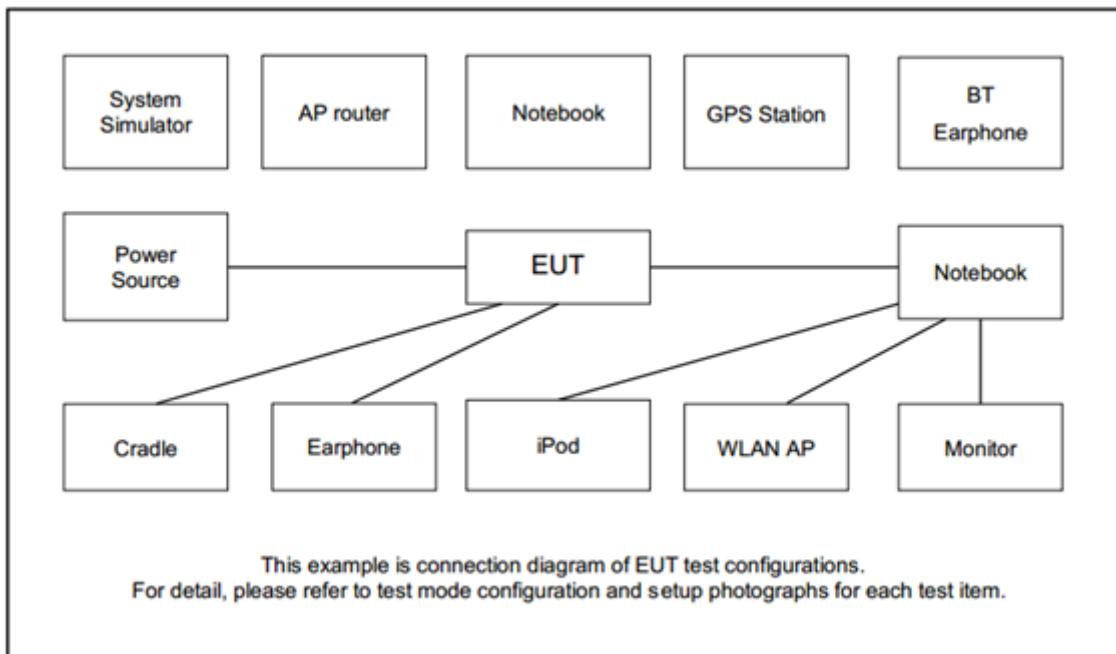
2.2 Test Mode

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 notebook mode and three orthogonal panels, X, Y, Z. The worst cases (notebook mode) 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	Data Rate / Modulation
	Bluetooth – LE / GFSK
Radiated Test Cases	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps for Sample 1 Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps for Sample 1 Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps for Sample 1 Mode 4: Bluetooth Tx CH39_2480 MHz_1Mbps for Sample 2
Remark:	
1. For Radiated Test Cases, the tests were performed with Adapter 1. 2. The test configuration was designated by manufacturer.	

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.	iPod Earphone	Apple	N/A	Verification	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “QRCT” was installed in Portable Computer 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.

3 Test Result

3.1 Output Power Measurement

3.1.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm.

If transmitting antenna of directional gain greater than 6dBi is used, the peak 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.

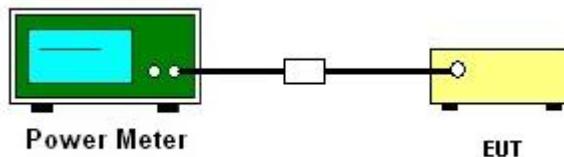
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

1. For Peak Power, the testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v04 section 9.1.3 PKPM1 Peak power meter method.
2. For Average Power, the testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v04 section 9.2.3.1 Method AVGPM.
3. The RF output of EUT was connected to the power meter by RF cable and attenuator.
4. The path loss was compensated to the results for each measurement.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Measure the conducted output power and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.1.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.



3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 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. 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

3.2.2 Measuring Instruments

See list of measuring equipment of this test report.



3.2.3 Test Procedures

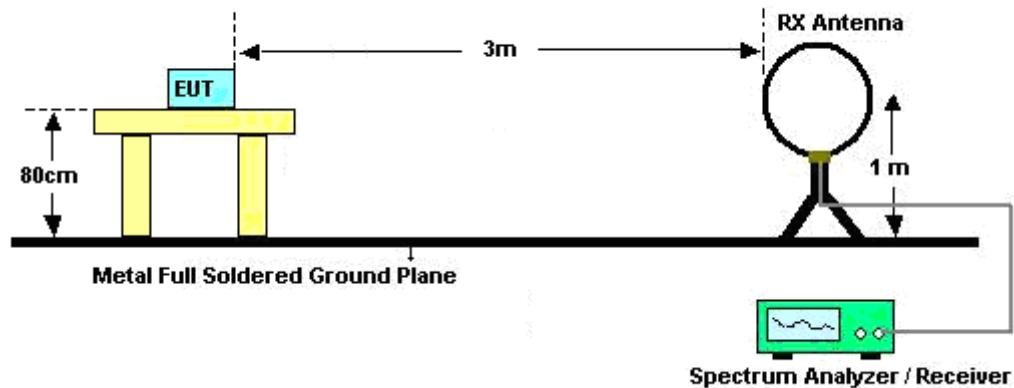
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test 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 \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.

For average measurement:

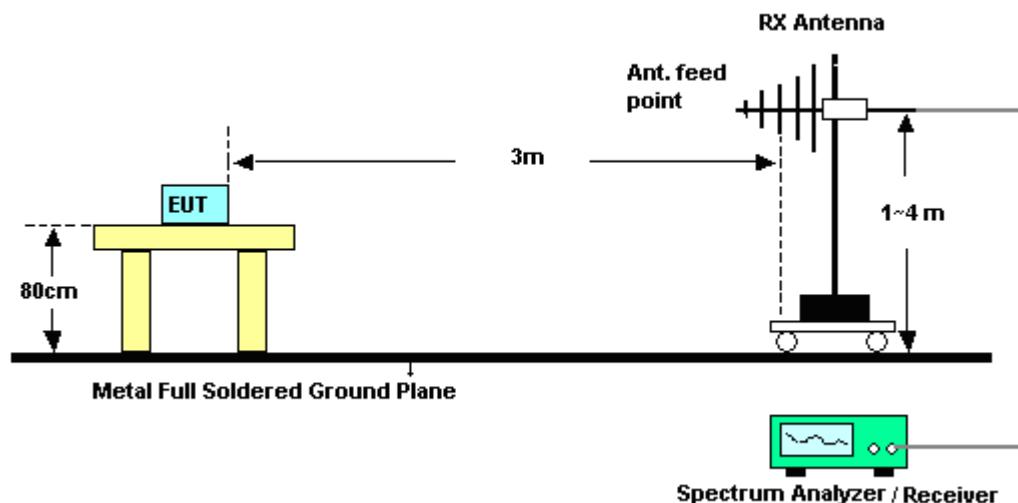
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.2.4 Test Setup

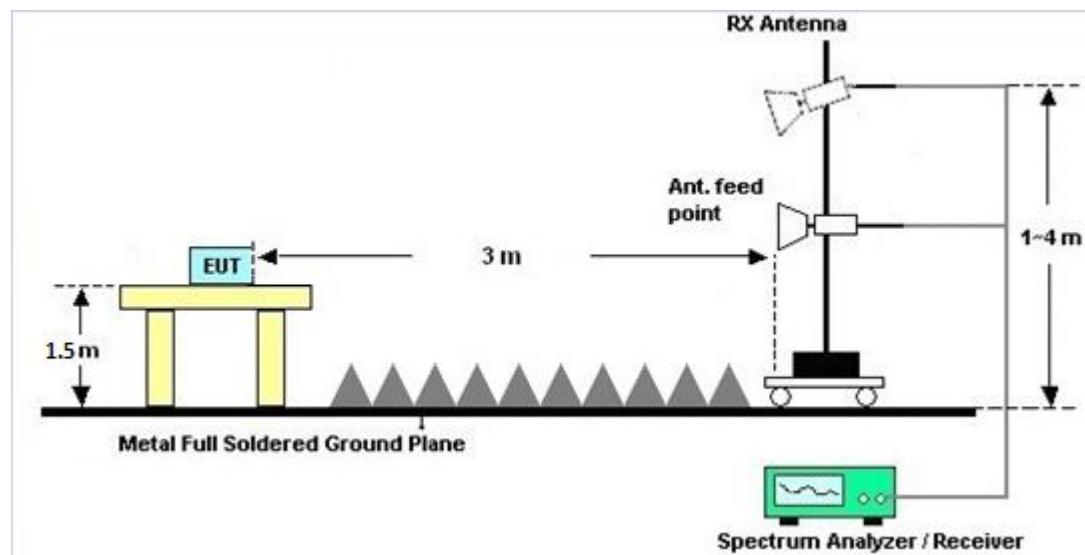
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.2.5 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 was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.2.7 Duty Cycle

Please refer to Appendix D.

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

Please refer to Appendix B and C.



3.3 Antenna Requirements

3.3.1 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.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 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 Meter	Agilent	E4416A	GB41292344	N/A	Dec. 20, 2017	Jul. 24, 2018	Dec. 19, 2018	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	50MHz~18GHz	Dec. 20, 2017	Jul. 24, 2018	Dec. 19, 2018	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP30	101067	9kHz ~ 30GHz	Nov. 13, 2017	Jul. 24, 2018	Nov. 12, 2018	Conducted (TH05-HY)
Switch Box & RF Cable	Burgeon	ETF-058	EC1300484	N/A	Mar. 01, 2018	Jul. 24, 2018	Feb. 28, 2019	Conducted (TH05-HY)
Bilog Antenna	TESEQ	CBL 6111D̠N1 D01N-06	35419&03	30MHz to 1GHz	Dec. 18, 2017	Jul. 24, 2018~ Aug. 04, 2018	Dec. 17, 2018	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Aug. 23, 2017	Jul. 24, 2018~ Aug. 04, 2018	Aug. 22, 2018	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Nov. 10, 2017	Jul. 24, 2018~ Aug. 04, 2018	Nov. 09, 2018	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-001018 00-30-10P	1590075	1GHz ~ 18GHz	Apr. 25, 2018	Jul. 24, 2018~ Aug. 04, 2018	Apr. 24, 2019	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz-1GHz	May 21, 2018	Jul. 24, 2018~ Aug. 04, 2018	May 20, 2019	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1GHz~ 26.5GHz	Oct. 30, 2017	Jul. 24, 2018~ Aug. 04, 2018	Oct. 29, 2018	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9010A	MY53470118	10Hz~44GHz	Apr. 17, 2018	Jul. 24, 2018~ Aug. 04, 2018	Apr. 16, 2019	Radiation (03CH07-HY)
Filter	Wainwright	WLKS1200-8SS	SN3	1.2G Low Pass	Nov. 21, 2017	Jul. 24, 2018~ Aug. 04, 2018	Nov. 20, 2018	Radiation (03CH07-HY)
Filter	Microwave	H3G018G1	SN477220	3.0G High Pass	Nov. 21, 2017	Jul. 24, 2018~ Aug. 04, 2018	Nov. 20, 2018	Radiation (03CH07-HY)
Filter	Microwave	WHKX7.0/26.5G -6SS	SN4	7G High Pass	Nov. 21, 2017	Jul. 24, 2018~ Aug. 04, 2018	Nov. 20, 2018	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971/4, MY 28655/4	9KHz~30MHz	Jan. 02, 2018	Jul. 24, 2018~ Aug. 04, 2018	Jan. 01, 2019	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	30MHz~1GHz	Feb. 27, 2018	Jul. 24, 2018~ Aug. 04, 2018	Feb. 26, 2019	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	1GHz~18GHz	Feb. 27, 2018	Jul. 24, 2018~ Aug. 04, 2018	Feb. 26, 2019	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2858/2	18GHz~40GHz	Feb. 27, 2018	Jul. 24, 2018~ Aug. 04, 2018	Feb. 26, 2019	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	Jul. 24, 2018~ Aug. 04, 2018	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Jul. 24, 2018~ Aug. 04, 2018	N/A	Radiation (03CH07-HY)
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 16, 2018	Jul. 24, 2018~ Aug. 04, 2018	Jul. 15, 2019	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz- 40GHz	Nov. 10, 2017	Jul. 24, 2018~ Aug. 04, 2018	Nov. 09, 2018	Radiation (03CH07-HY)
EMI Test Receiver	Agilent	N9038A(MXE)	MY53290053	20Hz to 26.5GHz	Jan. 16, 2018	Jul. 24, 2018~ Aug. 04, 2018	Jan. 15, 2019	Radiation (03CH07-HY)
Software	Audix	E3 6.2009-8-24	8050400465 6H	N/A	N/A	Jul. 24, 2018~ Aug. 04, 2018	N/A	Radiation (03CH07-HY)



5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$)	5.7
---	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$)	5.5
---	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$)	5.2
---	-----

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Luffy Lin	Temperature:	21~25	°C
Test Date:	2018/7/24	Relative Humidity:	51~54	%

<u>TEST RESULTS DATA</u>						
<u>Peak Power Table</u>						
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)
BLE	1Mbps	1	0	2402	3.23	30.00
BLE	1Mbps	1	19	2440	3.46	30.00
BLE	1Mbps	1	39	2480	3.64	30.00

<u>TEST RESULTS DATA</u>						
<u>Average Power Table</u>						
<u>(Reporting Only)</u>						
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)
BLE	1Mbps	1	0	2402	1.92	-1.14
BLE	1Mbps	1	19	2440	1.92	-0.91
BLE	1Mbps	1	39	2480	1.92	-0.85



Appendix B. Radiated Spurious Emission

Test Engineer :	Jesse Wang, Stan Hsieh, and Ken Wu	Temperature :		22~24°C	
		Relative Humidity :		52~54%	

<For Sample 1>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Over Limit (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol.
BLE CH 00 2402MHz		2350.95	54.33	-19.67	74	40.16	31.83	17.37	35.03	258	112	P	H
		2329.845	45.42	-8.58	54	31.34	31.79	17.31	35.02	258	112	A	H
	*	2402	96.36	-	-	82.03	31.95	17.43	35.05	258	112	P	H
	*	2402	95.74	-	-	81.41	31.95	17.43	35.05	258	112	A	H
													H
													H
		2381.19	54.04	-19.96	74	39.74	31.91	17.43	35.04	268	222	P	V
		2331.945	45.4	-8.6	54	31.32	31.79	17.31	35.02	268	222	A	V
	*	2402	95.45	-	-	81.12	31.95	17.43	35.05	268	222	P	V
	*	2402	94.79	-	-	80.46	31.95	17.43	35.05	268	222	A	V
BLE CH 19 2440MHz													V
		2341.22	55.13	-18.87	74	40.96	31.83	17.37	35.03	357	115	P	H
		2378.46	45.28	-8.72	54	31.04	31.91	17.37	35.04	357	115	A	H
	*	2440	96.88	-	-	82.37	32.08	17.49	35.06	357	115	P	H
	*	2440	96.17	-	-	81.66	32.08	17.49	35.06	357	115	A	H
		2486.35	55.1	-18.9	74	40.46	32.16	17.55	35.07	357	115	P	H
		2498.74	45.74	-8.26	54	31.07	32.2	17.55	35.08	357	115	A	H
		2376.64	54.66	-19.34	74	40.42	31.91	17.37	35.04	271	219	P	V
		2386.3	45.19	-8.81	54	30.85	31.95	17.43	35.04	271	219	A	V
	*	2440	95.42	-	-	80.91	32.08	17.49	35.06	271	219	P	V
	*	2440	94.81	-	-	80.3	32.08	17.49	35.06	271	219	A	V
		2496.92	54.36	-19.64	74	39.69	32.2	17.55	35.08	271	219	P	V
		2490.06	45.58	-8.42	54	30.9	32.2	17.55	35.07	271	219	A	V



BLE CH 39 2480MHz	*	2480	95.26	-	-	80.62	32.16	17.55	35.07	379	116	P	H
	*	2480	94.6	-	-	79.96	32.16	17.55	35.07	379	116	A	H
		2483.72	55.64	-18.36	74	41	32.16	17.55	35.07	379	116	P	H
		2484.24	45.75	-8.25	54	31.11	32.16	17.55	35.07	379	116	A	H
													H
													H
	*	2480	93.97	-	-	79.33	32.16	17.55	35.07	347	216	P	V
	*	2480	93.12	-	-	78.48	32.16	17.55	35.07	347	216	A	V
		2494.16	54.52	-19.48	74	39.85	32.2	17.55	35.08	347	216	P	V
		2483.72	45.73	-8.27	54	31.09	32.16	17.55	35.07	347	216	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

BLE (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Over Limit (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4804	42.78	-31.22	74	56.99	34.24	10.93	59.38	100	0	P	H
													H
													H
													H
		4804	43.23	-30.77	74	57.44	34.24	10.93	59.38	100	0	P	V
													V
													V
													V
BLE CH 19 2440MHz		4880	47.28	-26.72	74	61.27	34.22	11.03	59.24	100	0	P	H
		7320	42.74	-31.26	74	51.54	35.7	13.66	58.16	100	0	P	H
													H
													H
		4880	43.84	-30.16	74	57.83	34.22	11.03	59.24	100	0	P	V
		7320	42.59	-31.41	74	51.39	35.7	13.66	58.16	100	0	P	V
													V
													V
BLE CH 39 2480MHz		4960	45.99	-28.01	74	59.71	34.21	11.14	59.07	100	0	P	H
		7440	44.43	-29.57	74	53.34	35.63	13.79	58.33	100	0	P	H
													H
													H
		4960	44.94	-29.06	74	58.66	34.21	11.14	59.07	100	0	P	V
		7440	45.29	-28.71	74	54.2	35.63	13.79	58.33	100	0	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 BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
												Limit	Line
												Level	Factor
2.4GHz BLE LF		69.42	35.07	-4.93	40	52.62	12.34	1.7	31.59	100	0	P	H
		98.31	35.35	-8.15	43.5	49.58	15.58	1.75	31.56	-	-	P	H
		256.26	29.3	-16.7	46	38.96	19.08	2.63	31.37	-	-	P	H
		783	30.49	-15.51	46	28.52	27.98	4.6	30.61	-	-	P	H
		857.9	31.56	-14.44	46	28.39	28.98	4.74	30.55	-	-	P	H
		960.1	32.8	-21.2	54	27.36	30.9	5.05	30.51	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													V
		30	32.9	-7.1	40	38.32	24.6	1.33	31.35	100	0	P	V
		151.5	31.05	-12.45	43.5	43.32	16.98	2.25	31.5	-	-	P	V
		250.05	24.59	-21.41	46	34.96	18.38	2.63	31.38	-	-	P	V
		664	31.66	-14.34	46	31.95	26.19	4.25	30.73	-	-	P	V
		934.2	31.68	-14.32	46	27.61	29.62	4.97	30.52	-	-	P	V
		954.5	31.83	-14.17	46	26.7	30.59	5.05	30.51	-	-	P	V
													V
													V
													V
													V
													V
	Remark	1. No other spurious found. 2. All results are PASS against limit line.											



<For Sample 2>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Over Limit (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 39 2480MHz	*	2480	92.59	-	-	77.95	32.16	17.55	35.07	378	111	P	H
	*	2480	91.74	-	-	77.1	32.16	17.55	35.07	378	111	A	H
		2496.56	54.15	-19.85	74	39.48	32.2	17.55	35.08	378	111	P	H
		2488.72	45.28	-8.72	54	30.6	32.2	17.55	35.07	378	111	A	H
													H
													H
	*	2480	90.76	-	-	76.12	32.16	17.55	35.07	130	313	P	V
	*	2480	89.85	-	-	75.21	32.16	17.55	35.07	130	313	A	V
		2492.04	54.21	-19.79	74	39.54	32.2	17.55	35.08	130	313	P	V
		2498.8	45.28	-8.72	54	30.61	32.2	17.55	35.08	130	313	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

BLE (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Over Limit (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 39 2480MHz		4960	41.41	-32.59	74	55.13	34.21	11.14	59.07	100	0	P	H
		7440	43.41	-30.59	74	52.32	35.63	13.79	58.33	100	0	P	H
													H
													H
		4960	44.5	-29.5	74	58.22	34.21	11.14	59.07	100	0	P	V
		7440	41.99	-32.01	74	50.9	35.63	13.79	58.33	100	0	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 BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
												Limit	Line
												Level	Factor
2.4GHz BLE LF		71.04	22.28	-17.72	40	39.75	12.42	1.7	31.59	-	-	P	H
		154.2	29.8	-13.7	43.5	42.2	16.85	2.25	31.5	100	0	P	H
		257.34	31.52	-14.48	46	41.06	19.19	2.63	31.36	-	-	P	H
		871.2	31.48	-14.52	46	28.18	28.96	4.88	30.54	-	-	P	H
		918.1	32.08	-13.92	46	28.5	29.13	4.97	30.52	-	-	P	H
		957.3	31.71	-14.29	46	26.42	30.75	5.05	30.51	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													V
		30	31.66	-8.34	40	37.08	24.6	1.33	31.35	100	0	P	V
		153.12	31.15	-12.35	43.5	43.51	16.89	2.25	31.5	-	-	P	V
		260.31	31.42	-14.58	46	40.37	19.54	2.87	31.36	-	-	P	V
		886.6	30.6	-15.4	46	27.4	28.84	4.89	30.53	-	-	P	V
		923	31.05	-14.95	46	27.33	29.27	4.97	30.52	-	-	P	V
		954.5	31.86	-14.14	46	26.73	30.59	5.05	30.51	-	-	P	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	Peak or Average
H/V	Horizontal or Vertical



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)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V)	(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(dB μ V/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dB μ V/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB μ V) - Preamp Factor(dB)

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

= 55.45 (dB μ V/m)

2. Over Limit(dB)

= Level(dB μ V/m) – Limit Line(dB μ V/m)

= 55.45(dB μ V/m) – 74(dB μ V/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dB μ V/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB μ V) - Preamp Factor(dB)

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

= 43.54 (dB μ V/m)

2. Over Limit(dB)

= Level(dB μ V/m) – Limit Line(dB μ V/m)

= 43.54(dB μ V/m) – 54(dB μ V/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 :	Jesse Wang, Stan Hsieh, and Ken Wu	Temperature :	22~24°C
		Relative Humidity :	52~54%

Note symbol

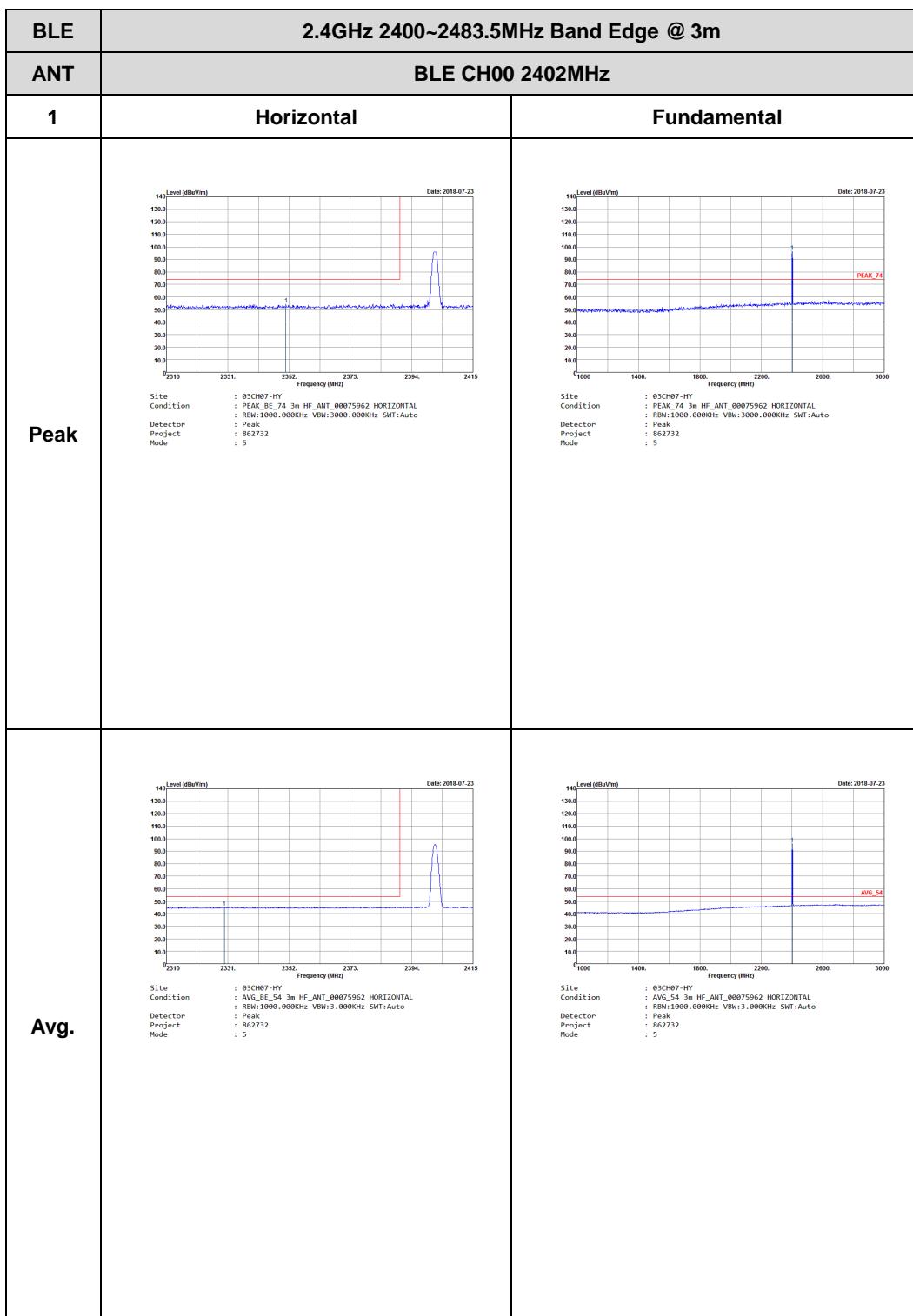
-L	Low channel location
-R	High channel location

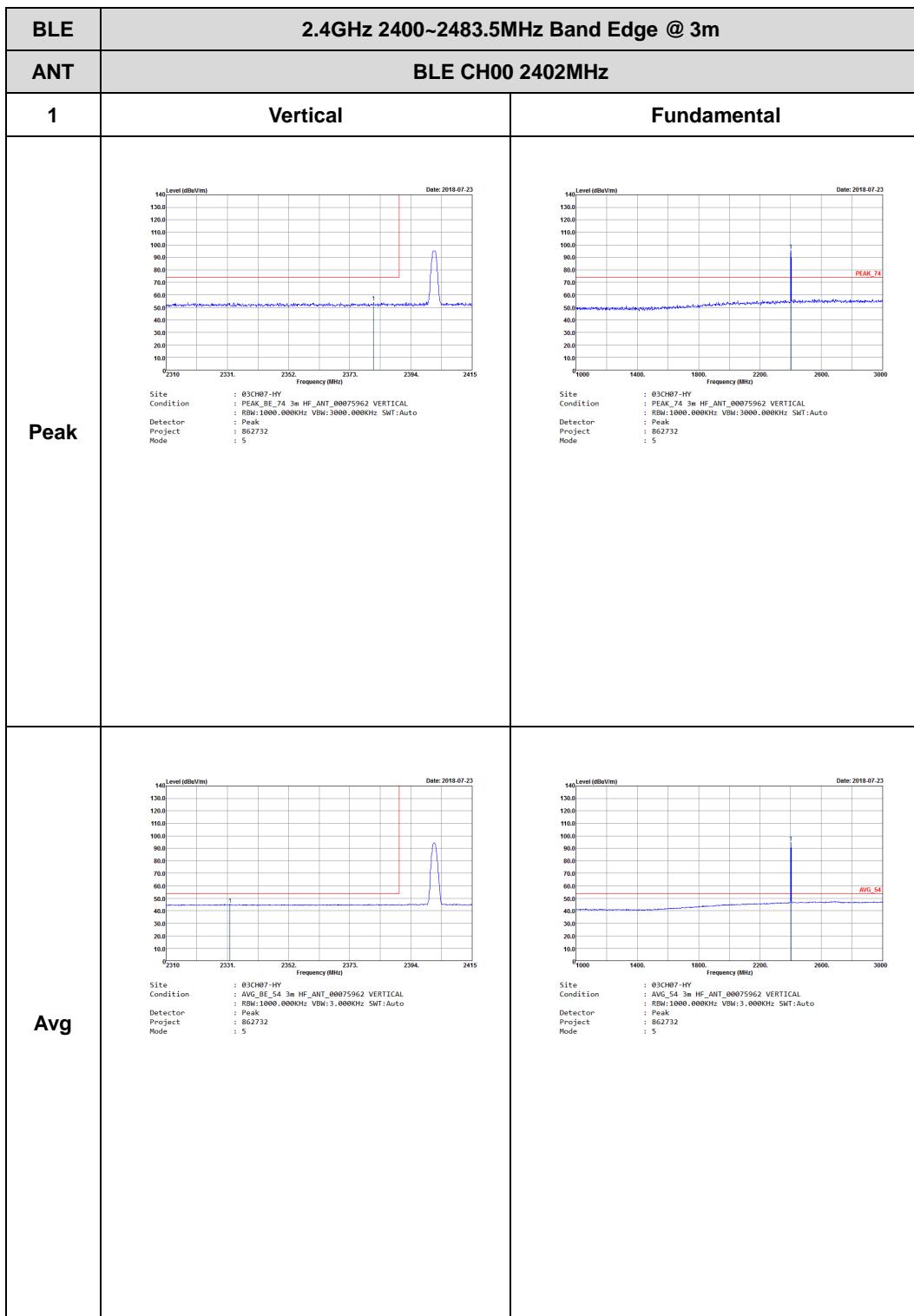


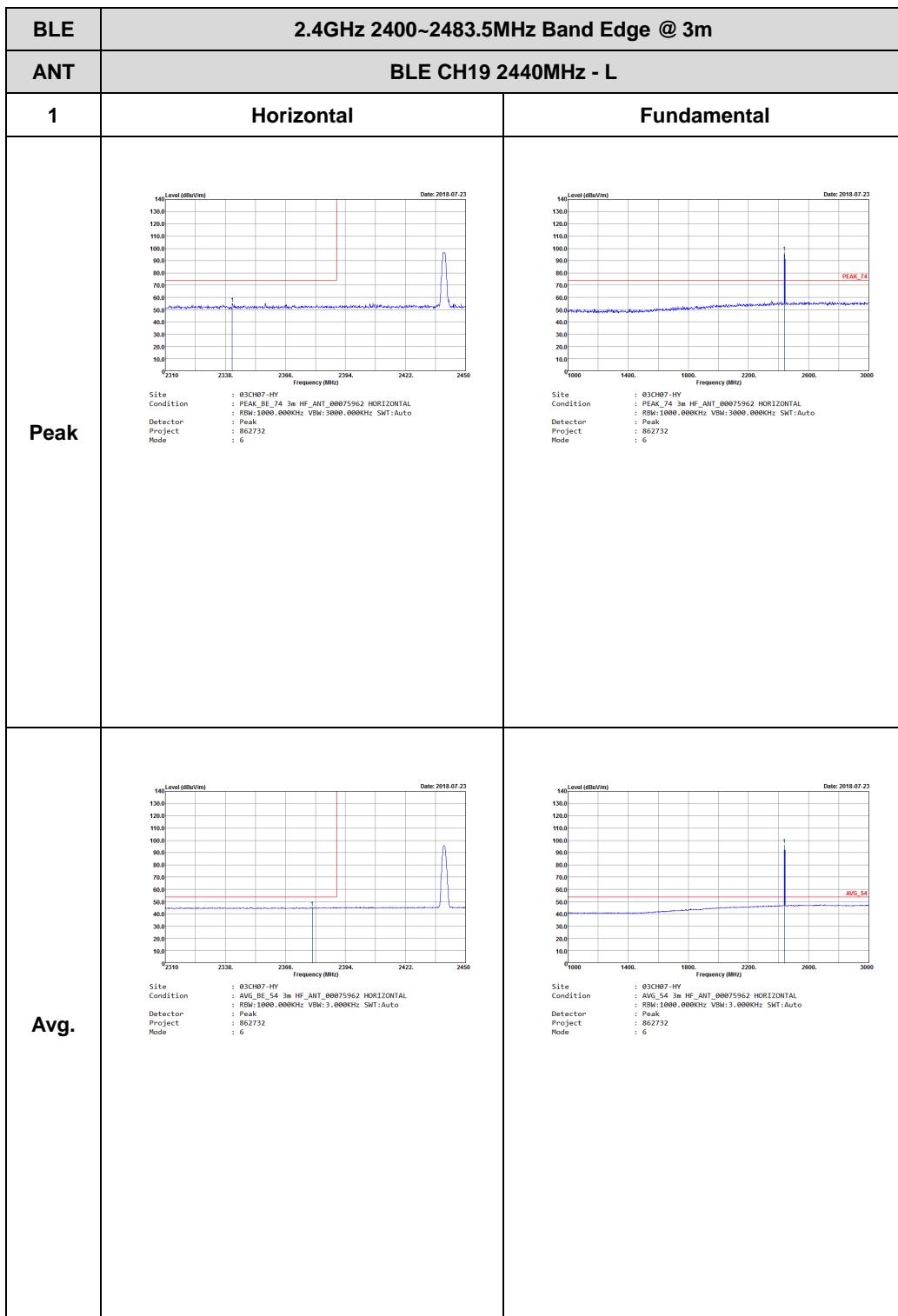
<For Sample 1>

2.4GHz 2400~2483.5MHz

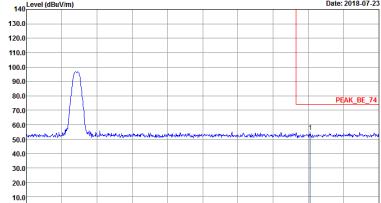
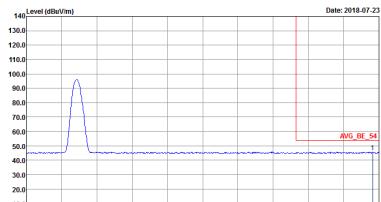
BLE (Band Edge @ 3m)

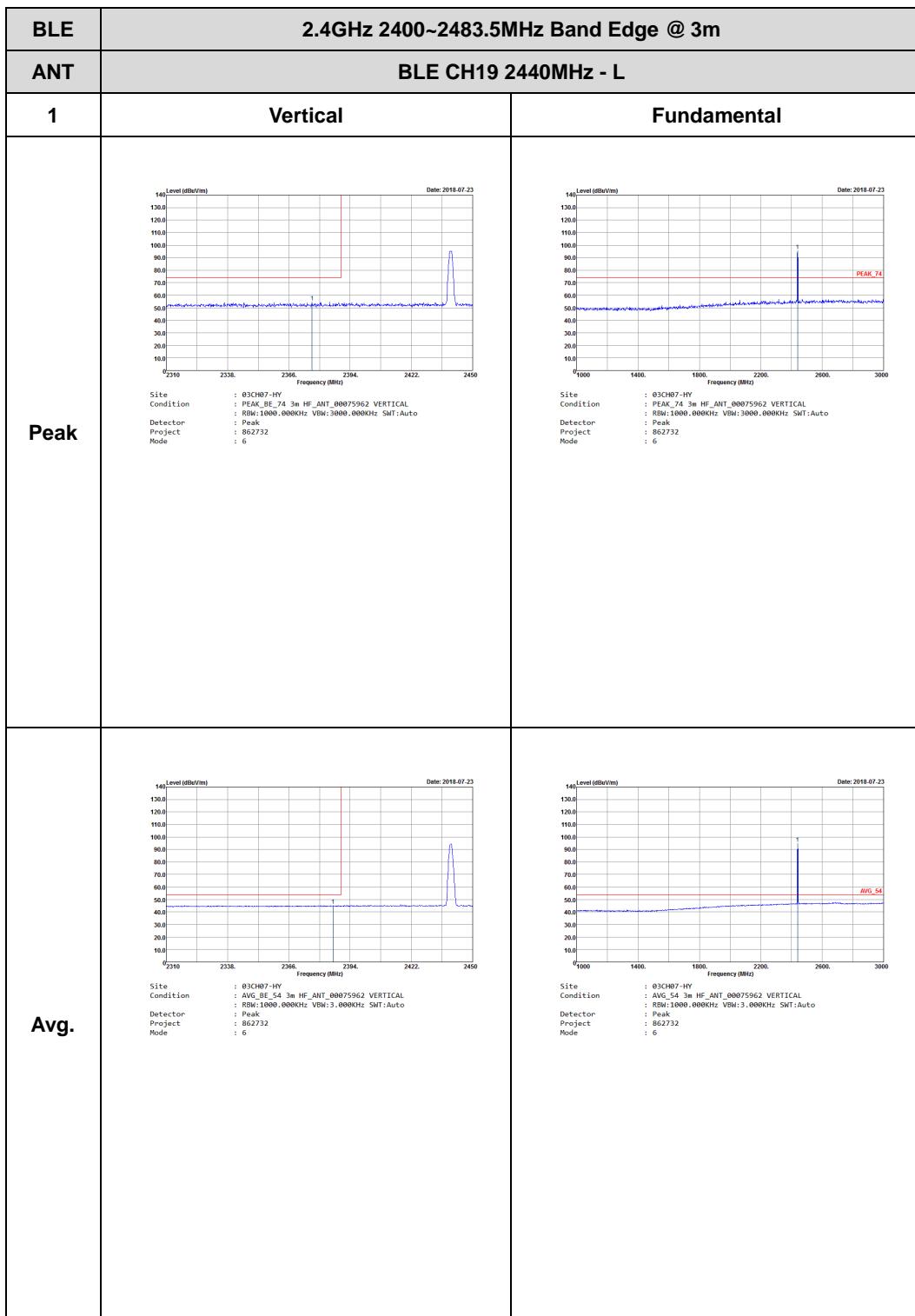




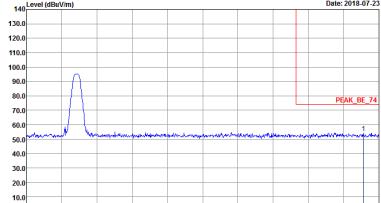
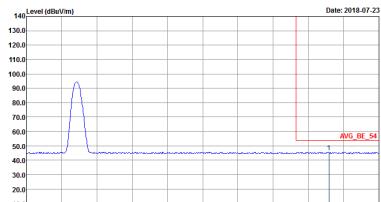




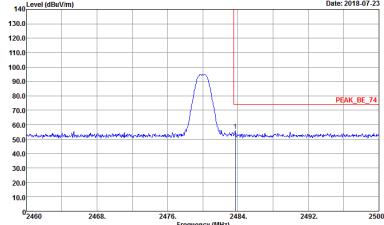
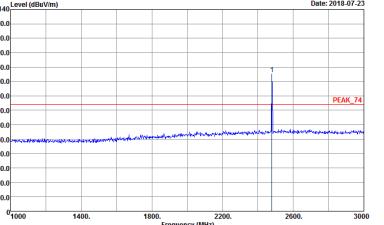
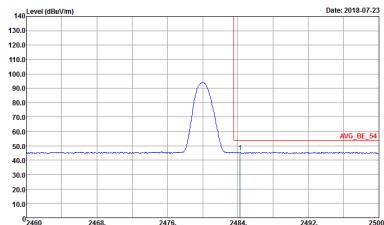
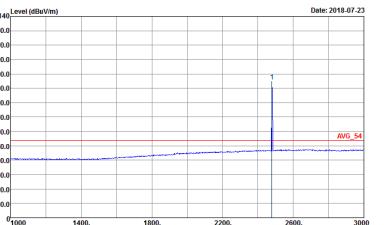
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
1	Horizontal	Fundamental
Peak	 <p>Level (dBmV/m)</p> <p>Date: 2018-07-23</p> <p>Site : 03CH07-HY Condition : PEAK_BE_74 3m HF ANT_000075962 HORIZONTAL Detector : RBW:1000.000KHz VBW:3.000KHz SMT:Auto Project : 862732 Mode : 6</p> <p>Frequency (MHz)</p>	Left blank
Avg.	 <p>Level (dBmV/m)</p> <p>Date: 2018-07-23</p> <p>Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_000075962 HORIZONTAL Detector : RBW:1000.000KHz VBW:3.000KHz SMT:Auto Project : 862732 Mode : 6</p> <p>Frequency (MHz)</p>	Left blank

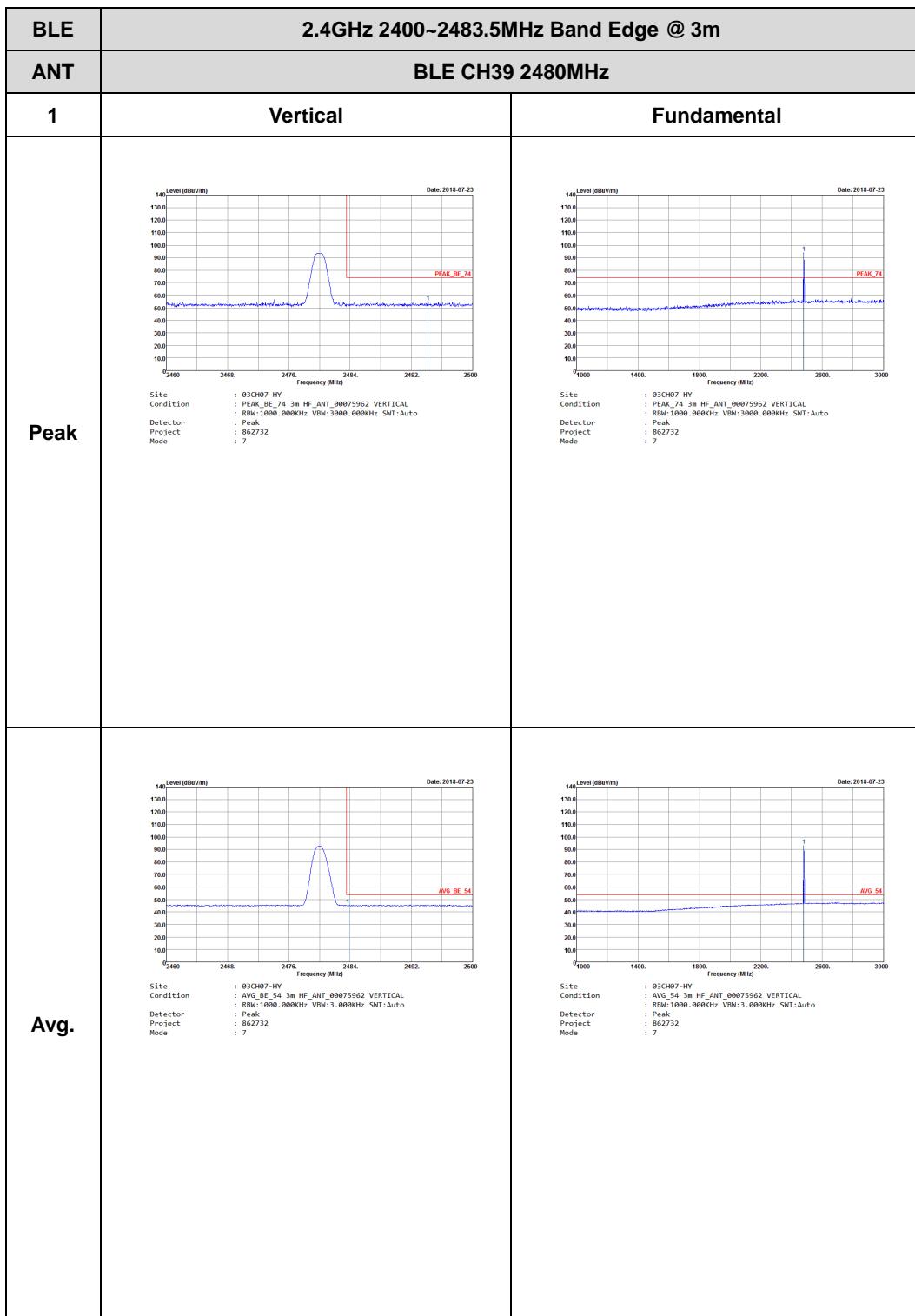




BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
1	Vertical	Fundamental
Peak	 <p>Level (dBmV/m)</p> <p>Date: 2018-07-23</p> <p>Site : 03CH07-HY Condition : PEAK_BE_74 3m HF ANT_000075962 VERTICAL Detector : RBW:1000.000KHz VBW:3.000KHz SMT:Auto Project : 862732 Mode : 6</p> <p>Frequency (MHz)</p>	Left blank
Avg.	 <p>Level (dBmV/m)</p> <p>Date: 2018-07-23</p> <p>Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_000075962 VERTICAL Detector : RBW:1000.000KHz VBW:3.000KHz SMT:Auto Project : 862732 Mode : 6</p> <p>Frequency (MHz)</p>	Left blank



BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
1	Horizontal	Fundamental
Peak	 <p>Site : 03CH07-HY Condition : PEAK_BE_74 3m HF ANT_000075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SMT:Auto Detector : Peak Project : 862732 Mode : 7</p>	 <p>Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_000075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SMT:Auto Detector : Peak Project : 862732 Mode : 7</p>
Avg.	 <p>Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_000075962 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SMT:Auto Detector : Peak Project : 862732 Mode : 7</p>	 <p>Site : 03CH07-HY Condition : AVG_54 3m HF_ANT_000075962 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SMT:Auto Detector : Peak Project : 862732 Mode : 7</p>

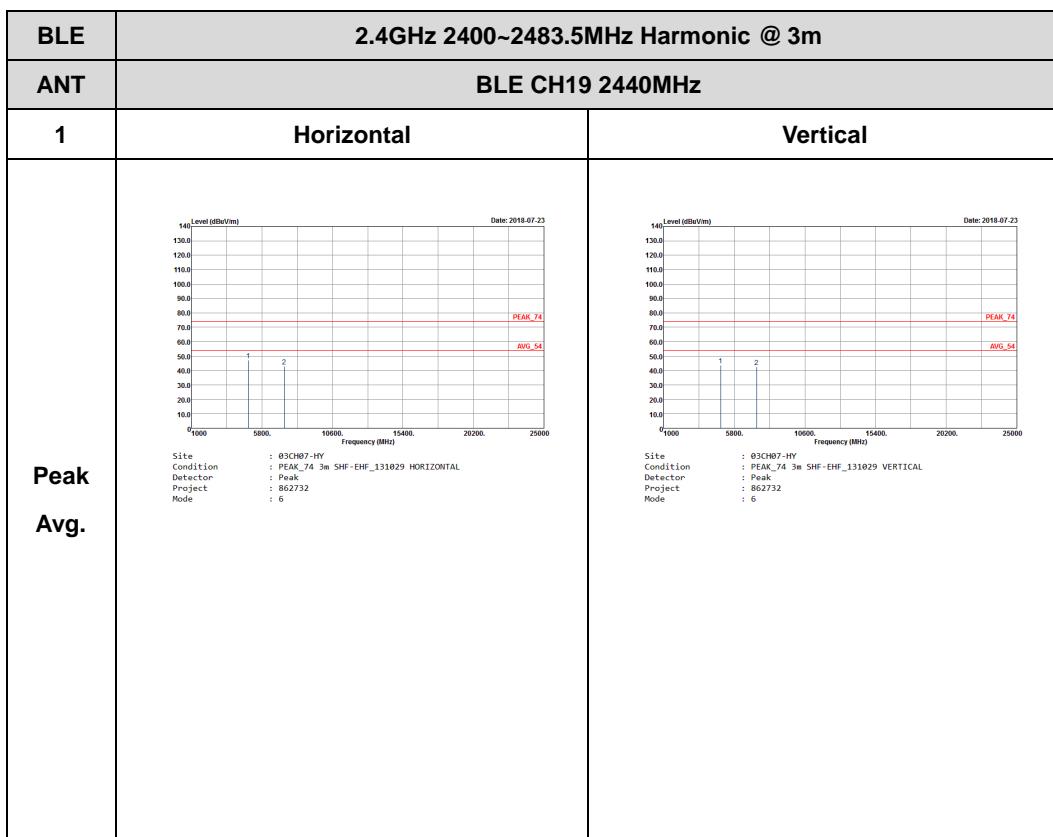


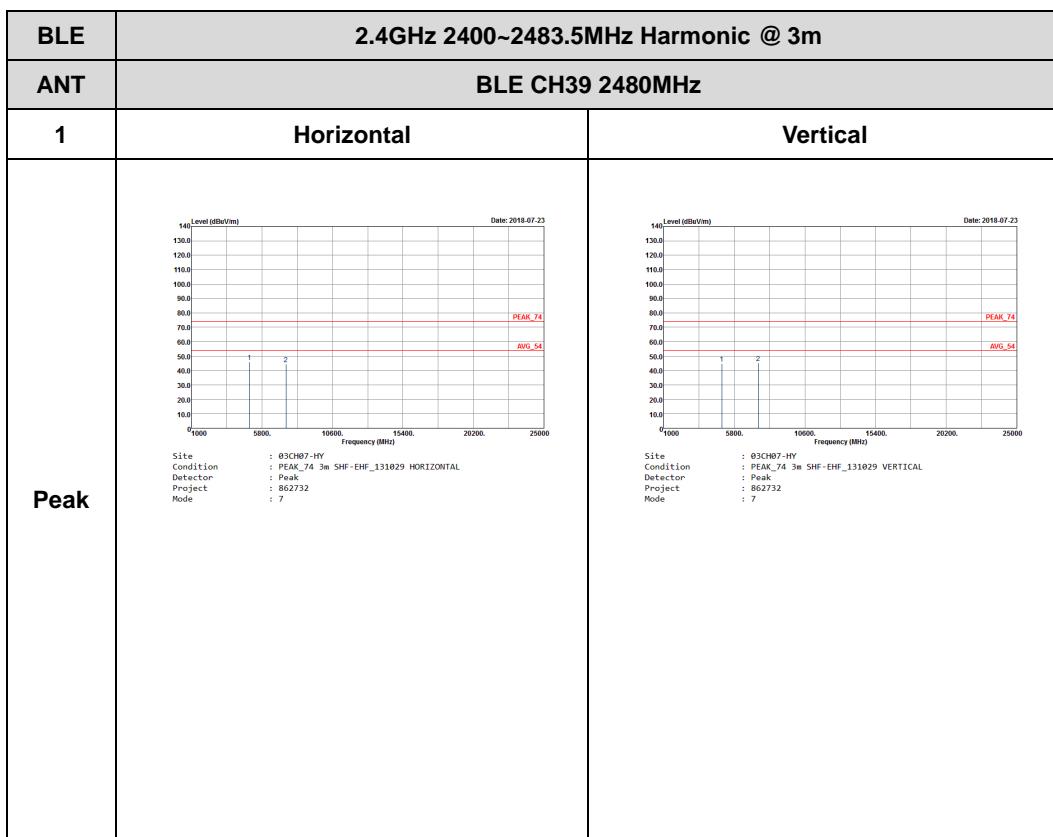


2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH00 2402MHz	
1	Horizontal	Vertical
Peak	 <p>Site : 03CH07-HY Condition : PEAK_74 3m SHF-EHF_131829 HORIZONTAL Detector : Peak Project : 862732 Mode : 5</p>	 <p>Site : 03CH07-HY Condition : PEAK_74 3m SHF-EHF_131829 VERTICAL Detector : Peak Project : 862732 Mode : 5</p>
Avg.		

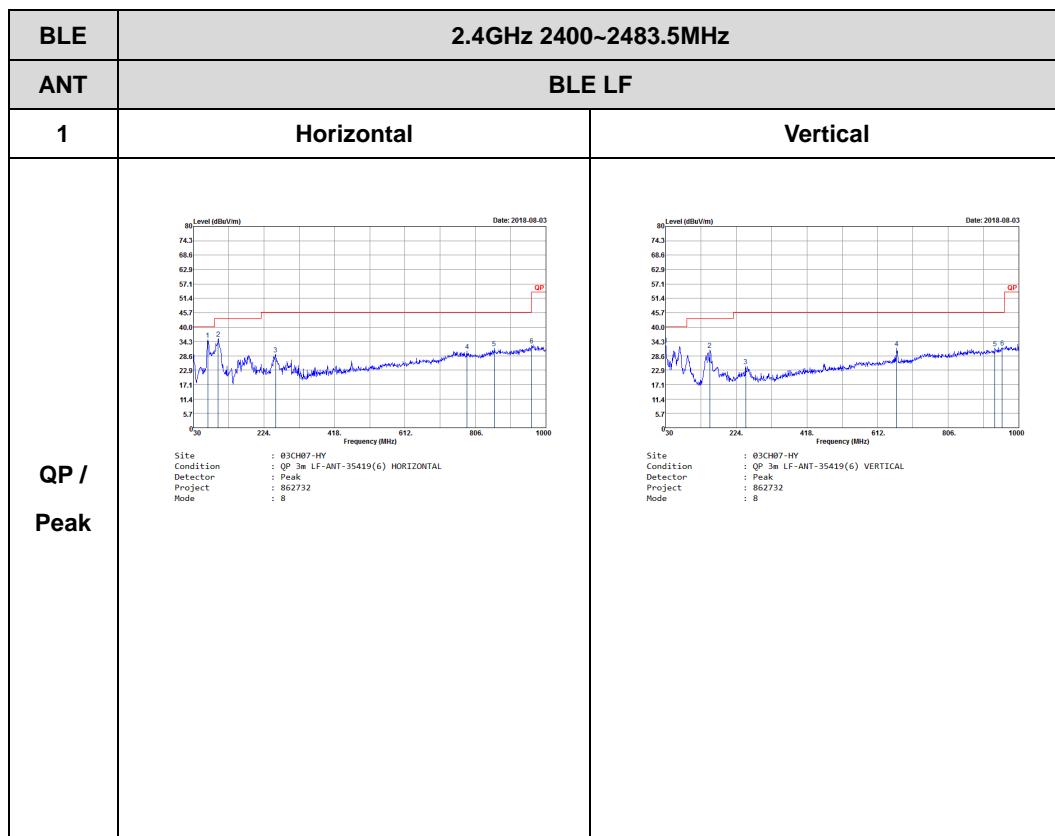






Emission below 1GHz

2.4GHz BLE (LF)

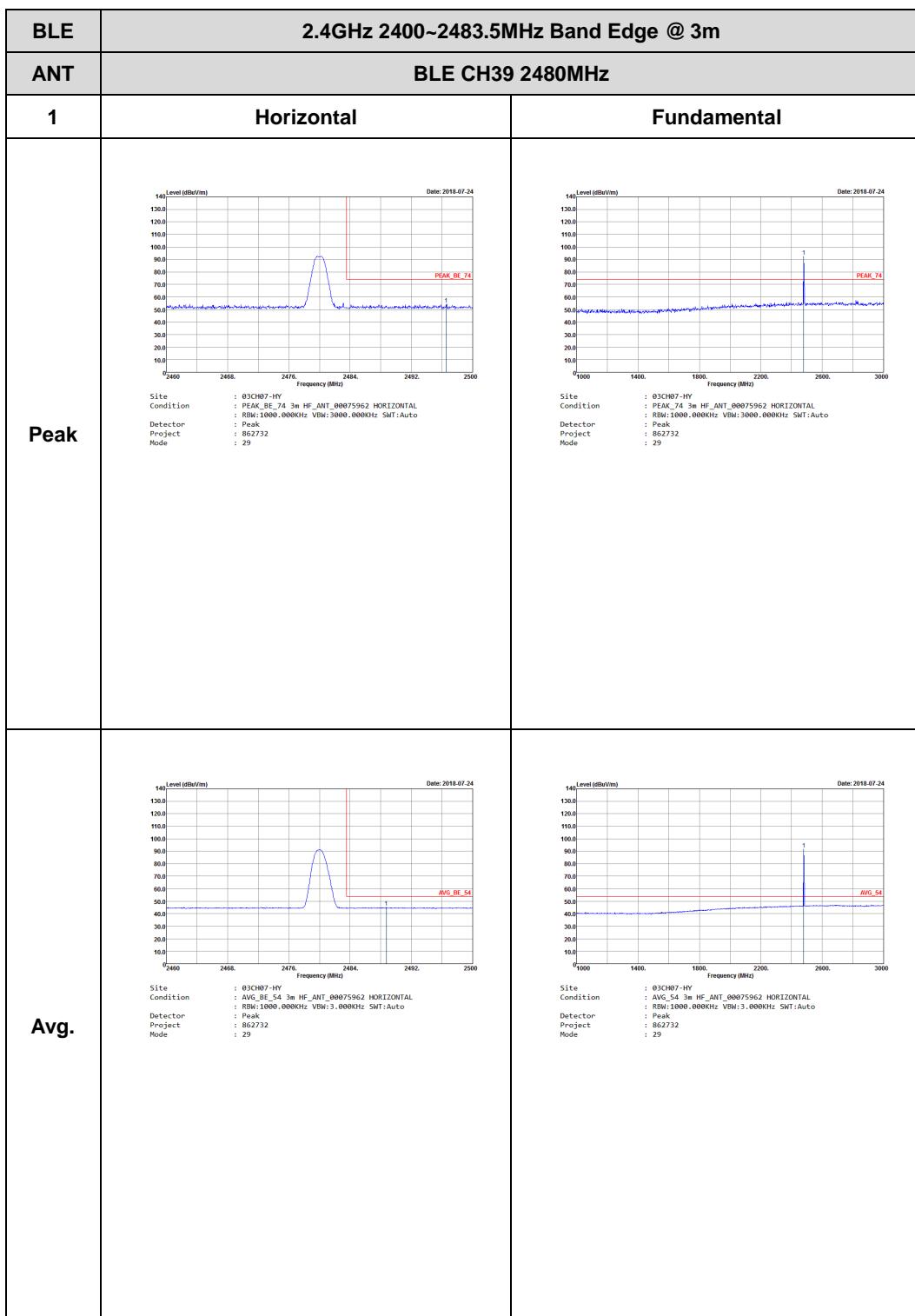


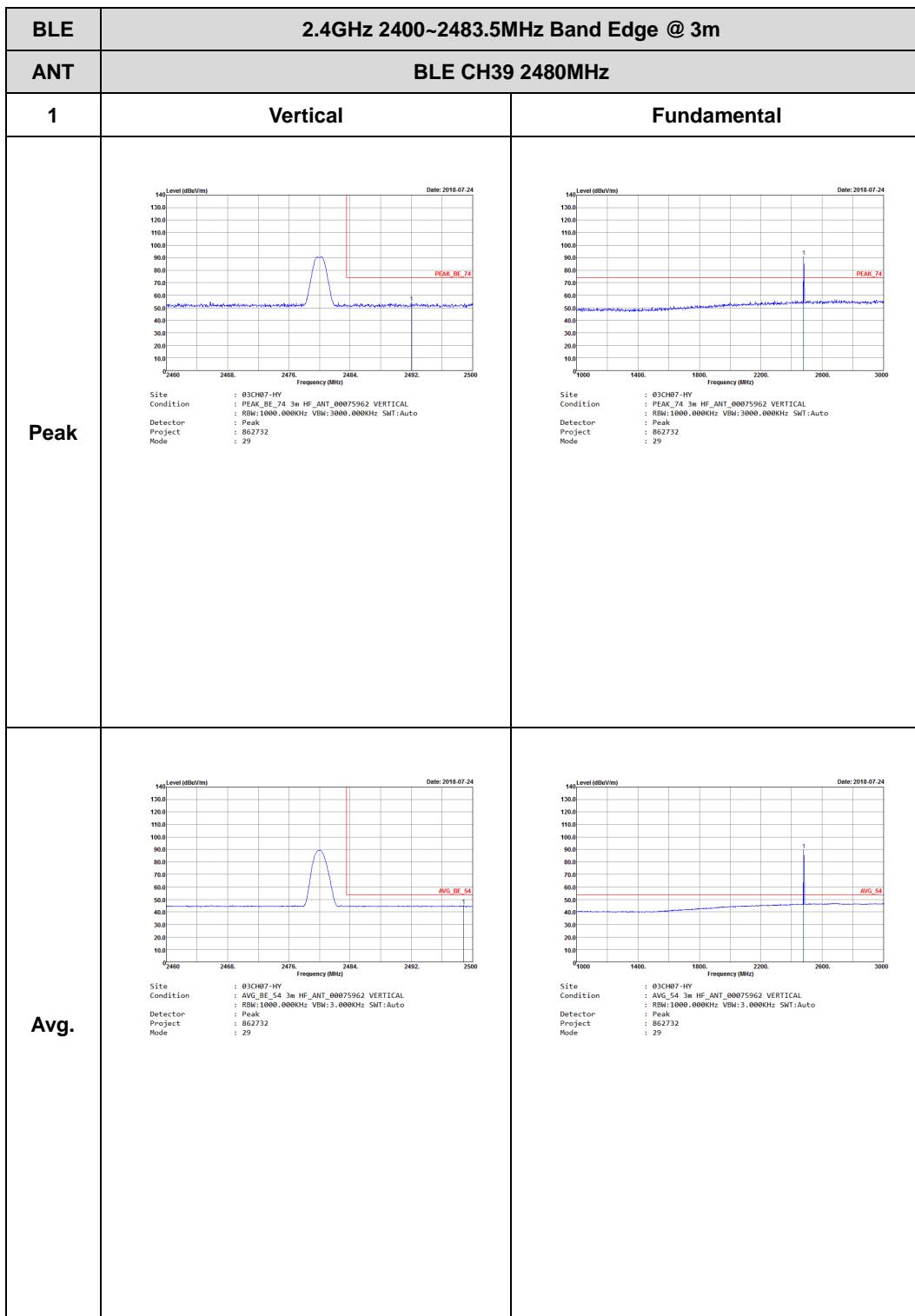


<For Sample 2>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

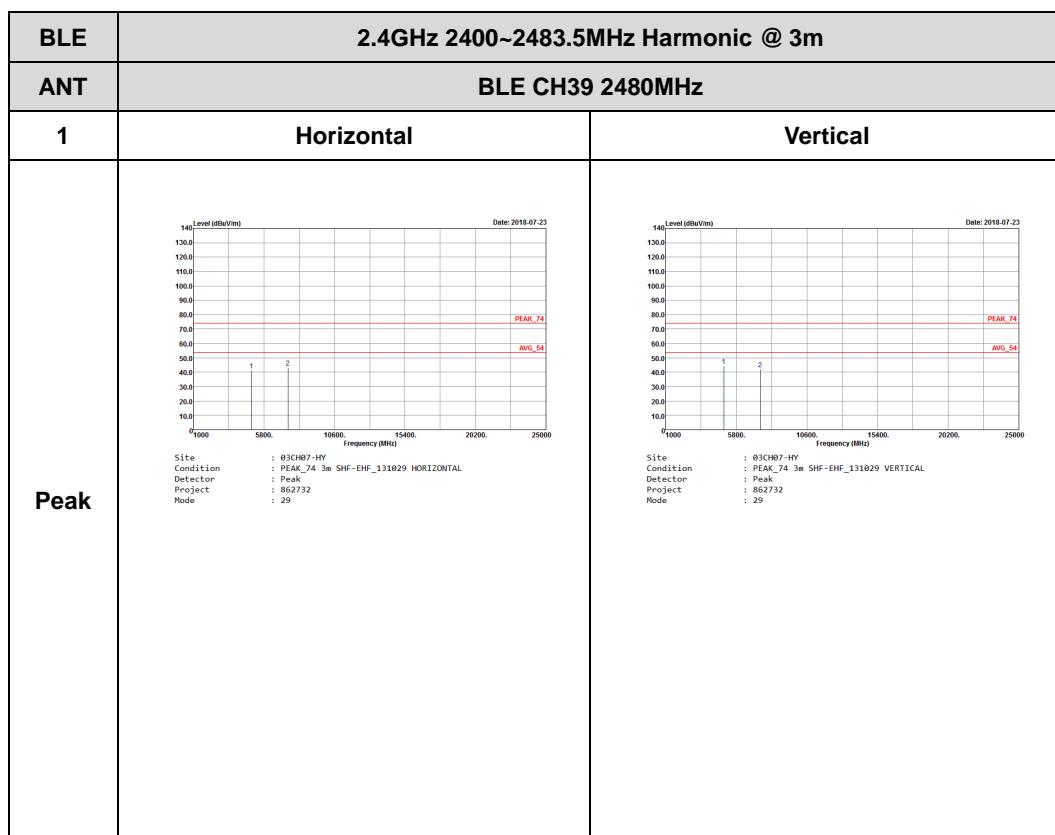






2.4GHz 2400~2483.5MHz

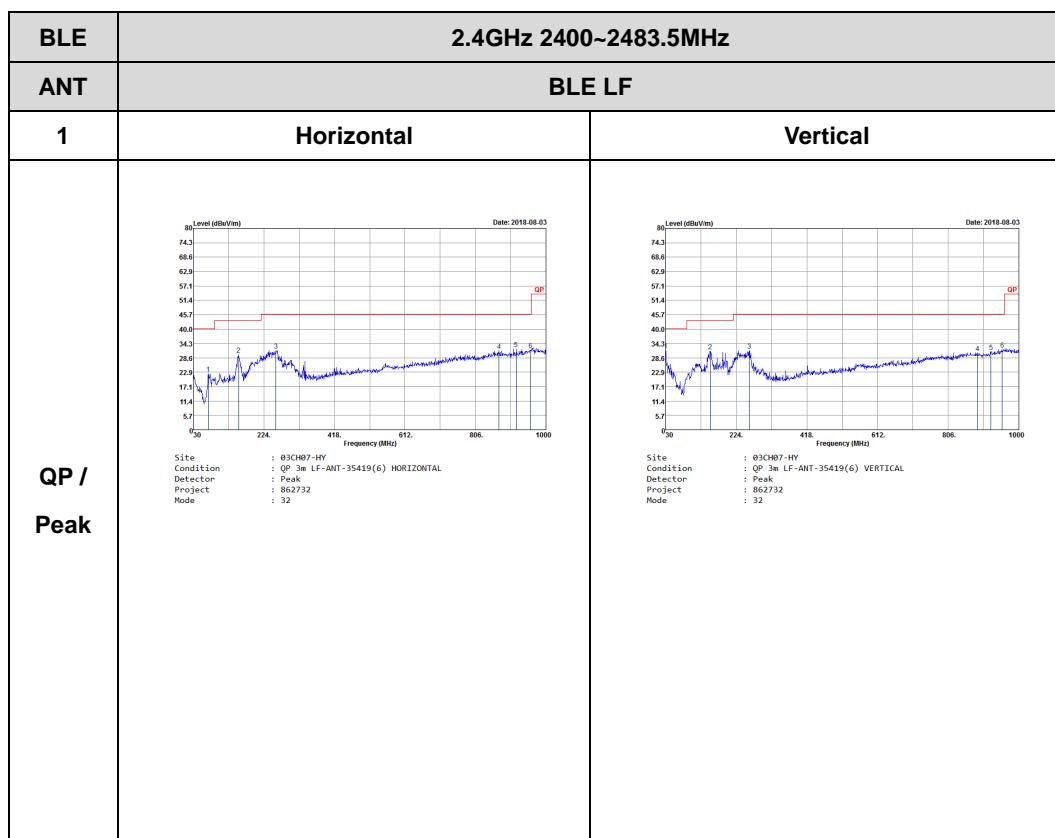
BLE (Harmonic @ 3m)





Emission below 1GHz

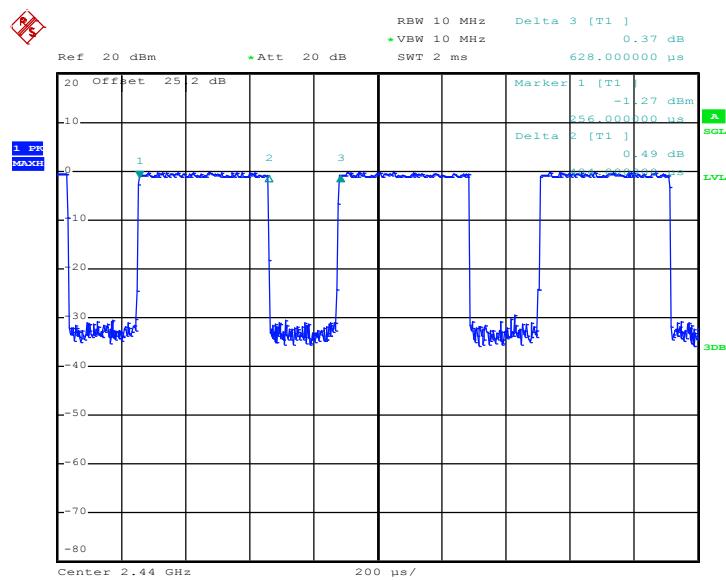
2.4GHz BLE (LF)



Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
Bluetooth - LE	64.33	404.00	2.48	3kHz	1.92

Bluetooth - LE



Date: 24.JUL.2018 06:23:07