FCC CO-LOCATION RADIO TEST REPORT

FCC ID	:	**2AP7R-6245**
Equipment	:	**Tablet**
Model Name	:	**M2V3R5**
Applicant	:	**No Dark Matter LLC** **1350 Scenic Hwy, Ste. 266 Snellville, GA 30078**
Standard	:	**FCC Part 15 Subpart E §15.407**

The product was completed on May 27, 2019 . We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

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

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

Jones Tsai

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
FR8N2215-02F	01	Initial issue of report	Jun. 06, 2019

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)
3.1	15.407(b)	Unwanted Emissions	Pass
3.2	15.203 15.407(a)	Antenna Requirement	Pass

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

Reviewed by: Wii Chang

Report Producer: Yimin Ho

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Tablet
Model Name	M2V3R5
FCC ID	2AP7R-6245
EUT supports Radios application	WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2400 MHz ~ 2483.5 MHz 5180 MHz ~ 5240 MHz
Antenna Type / Gain	**<Bluetooth LE>** Ant. 1 : Fixed Internal Antenna with gain 2.10 dBi Ant. 2 : Fixed Internal Antenna with gain 1.10 dBi **<5180 MHz ~ 5240 MHz>** Ant. 1 : Fixed Internal Antenna with gain 2.40 dBi Ant. 2 : Fixed Internal Antenna with gain 1.50 dBi
Type of Modulation	Bluetooth LE : GFSK 802.11a : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)

1.3 Modification of EUT

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

1.4 Testing Location

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

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

FCC Designation No.: TW1190

1.5 Applicable Standards

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

- FCC Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- 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

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 with Notebook for Ant. 1 and X plane with Notebook for Ant. 2) were recorded in this report.

2.1 Carrier Frequency and Channel

2400-2483.5 MHz Bluetooth-LE		5150-5250MHz 802.11a		5150-5250MHz 802.11ac VHT80	
Channel	**Freq. (MHz)**	**Channel**	**Freq. (MHz)**	**Freq. (MHz)**	
39	2480	44	5220	42	5210

2.2 Test Mode

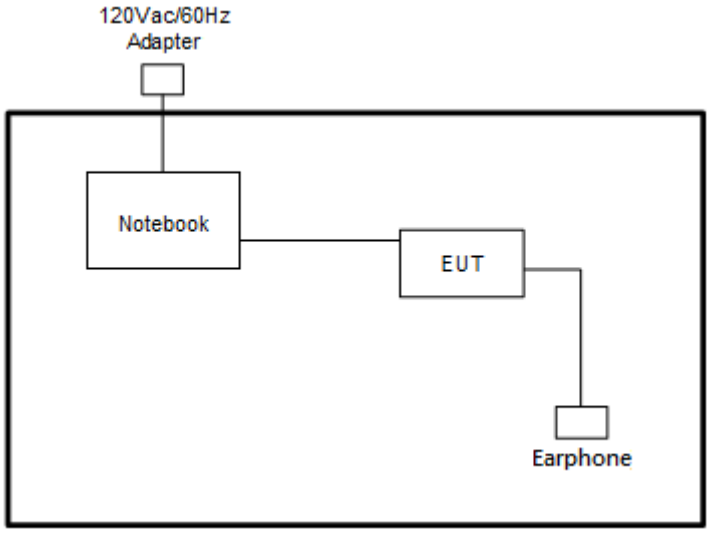
Final test modes are considering the modulation and worse data rates as below table.

<Co-Location>

Modulation	Data Rate
Bluetooth LE for Ant. 1+ 5GHz 802.11a for Ant. 1	**1 Mbps + 6Mbps**
Bluetooth LE for Ant. 2+ 5GHz 802.11ac VHT80 for Ant. 2	**1 Mbps + MCS0**

2.3 Connection Diagram of Test System

< Co-Location Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	DELL	Latitude E3340	FCC DoC/ Contains FCC ID: PD97260NGU	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
2.	Earphone	N/A	N/A	Verification	Unshielded, 1.15 m	N/A

2.5 EUT Operation Test Setup

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

3 Test Result

3.1 Unwanted Emissions Measurement

This section is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

3.1.1 Limit of Unwanted Emissions

(1) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

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

Note: The following formula is used to convert the EIRP to field strength.

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.3

(2) KDB789033 D02 v02r01 G)2)c)

(i) Section 15.407(b)(1) to (b)(3) specify the unwanted emission limits for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of -27 dBm/MHz.[3]

(ii) Section 15.407(b)(4) specifies the unwanted emission limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are in terms of a Peak detector. An alternative to the band emissions mask is specified in Section 15.407(b)(4)(ii). The alternative limits are based on the highest antenna gain specified in the filing. There are also marketing and importation restrictions for the devices using the alternative limit.[4]

Note 3: An out-of-band emission that complies with both the average and peak limits of Section 15.209 is not required to satisfy the -27 dBm/MHz peak emission limit.

Note 4: Only devices with antenna gains of 10 dBi or less may be approved using the emission limits specified in Section 15.247(d) till March 2, 2018; all other devices operating in this band must use the mask specified in Section 15.407(b)(4)(i).

3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.

   (1) Procedure for Unwanted Emissions Measurements Below 1000MHz

   - RBW = 120 kHz
   - VBW = 300 kHz
   - Detector = Peak
   - Trace mode = max hold

   (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

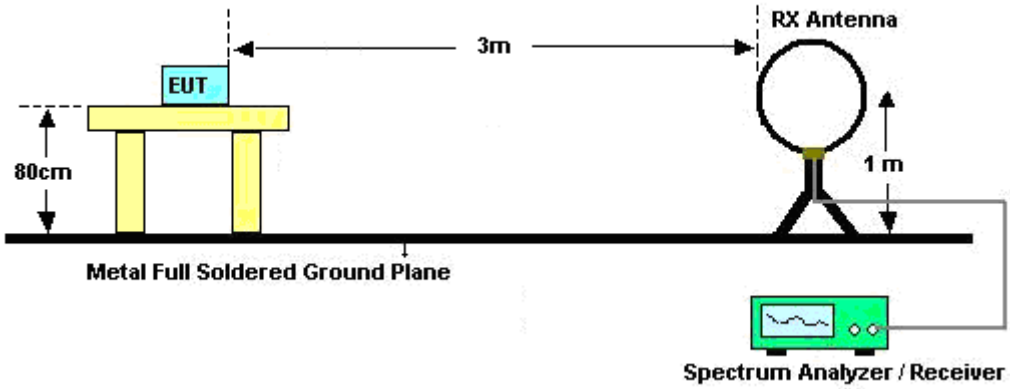
   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

2. 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.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.

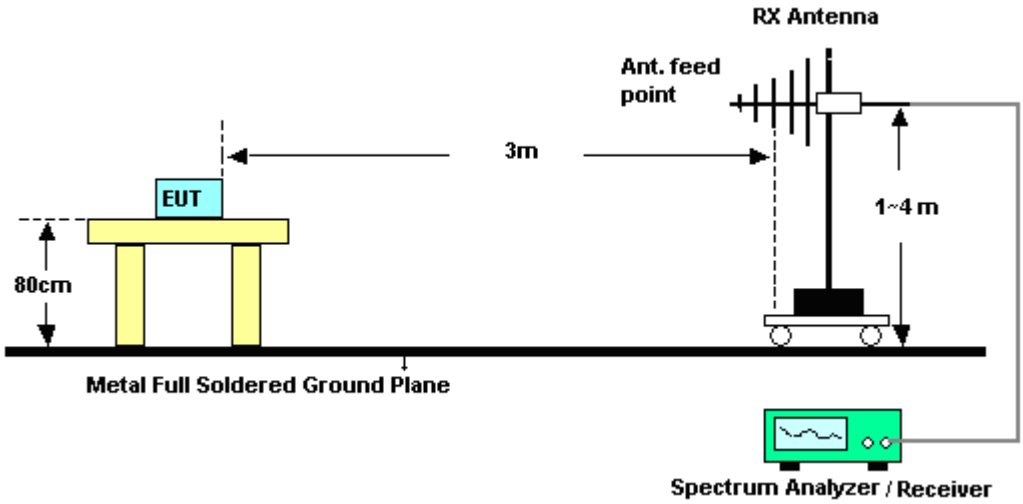
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level 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.

3.1.4 Test Setup

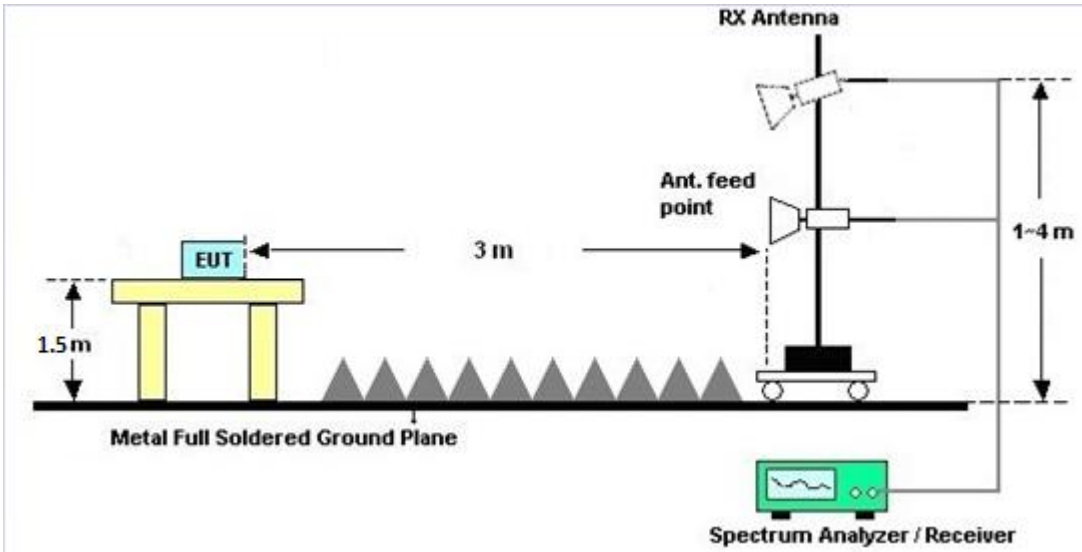
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.1.5 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 alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.1.7 Duty Cycle

Please refer to Appendix C.

3.1.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix A and B.

3.2 Antenna Requirements

3.2.1 Standard Applicable

If transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.2.3 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
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	35419&03	30MHz to 1GHz	Apr. 30, 2019	May 11, 2019 ~ May 27, 2019	Apr. 29, 2020	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Dec. 02, 2018	May 11, 2019 ~ May 27, 2019	Dec. 03, 2019	Radiation (03CH07-HY)
EMI Test Receiver	Agilent	N9038A(MXE)	MY53290053	20Hz to 26.5GHz	Jan. 23, 2019	May 11, 2019 ~ May 27, 2019	Jan. 22, 2020	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jan. 11, 2019	May 11, 2019 ~ May 27, 2019	Jan. 10, 2020	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	1GHz ~ 18GHz	Apr. 24, 2019	May 11, 2019 ~ May 27, 2019	Apr. 23, 2020	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz-1GHz	May 20, 2019	May 26, 2019	May 19, 2020	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1GHz~ 26.5GHz	Nov. 02, 2018	May 11, 2019 ~ May 27, 2019	Nov. 01, 2019	Radiation (03CH07-HY)
Filter	Wainwright	WLKS1200-8S S	SN3	1.2G Low Pass	Nov. 02, 2018	May 11, 2019 ~ May 27, 2019	Nov. 01, 2019	Radiation (03CH07-HY)
Filter	Microwave	H3G018G1	SN477220	3.0G High Pass	Nov. 02, 2018	May 11, 2019 ~ May 27, 2019	Nov. 01, 2019	Radiation (03CH07-HY)
Filter	Microwave	WHKX7.0/26.5 G-6SS	SN4	7G High Pass	Nov. 02, 2018	May 11, 2019 ~ May 27, 2019	Nov. 01, 2019	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971/4,M Y28655/4	9KHz~30MHz	Feb. 26, 2019	May 11, 2019 ~ May 27, 2019	Feb. 25, 2020	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	30MHz~1GHz	Feb. 26, 2019	May 11, 2019 ~ May 27, 2019	Feb. 25, 2020	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	1GHz~18GHz	Feb. 26, 2019	May 11, 2019 ~ May 27, 2019	Feb. 25, 2020	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2858/2	18GHz~40GHz	Feb. 26, 2019	May 11, 2019 ~ May 27, 2019	Feb. 25, 2020	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	May 11, 2019 ~ May 27, 2019	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	May 11, 2019 ~ May 27, 2019	N/A	Radiation (03CH07-HY)
Amplifier	MITEQ	TTA1840-35-H G	1871923	18GHz~40GHz,V SWR : 2.5:1 max	Jul. 16, 2018	May 11, 2019 ~ May 27, 2019	Jul. 15, 2019	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170251	18GHz- 40GHz	Nov. 20, 2018	May 11, 2019 ~ May 27, 2019	Nov. 19, 2019	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9010A	MY53470118	10Hz~44GHz	Apr. 18, 2019	May 11, 2019 ~ May 27, 2019	Apr. 17, 2020	Radiation (03CH07-HY)
Software	Audix	E3 6.2009-8-24	80504004656 H	N/A	N/A	May 11, 2019 ~ May 27, 2019	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 = 2Uc(y))	5.70

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.50

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.20

Appendix A. Radiated Spurious Emission

Test Engineer :	Jesse Wang, Stan Hsieh, and Troye Hsieh	Temperature :	20~26°C
		Relative Humidity :	50~56%

Co-location Mode

Band 1 5150~5250MHz (Band edge @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 1 + 802.11a CH44 5220 MHz Ant 1		5138.84	50.99	-23.01	74	40.6	34.2	11.24	35.05	100	231	P	H
		5149.5	42.45	-11.55	54	31.91	34.3	11.29	35.05	100	231	A	H
	*	5220	105.74	-	-	95.12	34.33	11.34	35.05	100	231	P	H
	*	5220	98.42	-	-	87.8	34.33	11.34	35.05	100	231	A	H
		5442.64	50.58	-23.42	74	39.41	34.67	11.56	35.06	100	231	P	H
		5357.52	40.83	-13.17	54	29.99	34.4	11.49	35.05	100	231	A	H
		5133.12	53.99	-20.01	74	43.6	34.2	11.24	35.05	112	120	P	V
		5135.72	44.96	-9.04	54	34.57	34.2	11.24	35.05	112	120	A	V
	*	5220	110.95	-	-	100.33	34.33	11.34	35.05	112	120	P	V
	*	5220	103.58	-	-	92.96	34.33	11.34	35.05	112	120	A	V
		5373.2	51.76	-22.24	74	40.85	34.47	11.49	35.05	112	120	P	V
		5353.6	43.12	-10.88	54	32.28	34.4	11.49	35.05	112	120	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz (Band edge @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 1 + 802.11a CH44 5220 MHz Ant 1	*	2322.75	54.56	-19.44	74	40.1	31.8	7.84	34.97	100	242	P	H
	*	2357.43	45.38	-8.62	54	30.78	31.87	7.84	34.97	100	242	A	H
		2480	106.15	-	-	91.08	32.2	7.84	34.97	100	242	P	H
		2480	105.57	-	-	90.5	32.2	7.84	34.97	100	242	A	H
		2491.08	55.32	-18.68	74	40.25	32.2	7.84	34.97	100	242	P	H
		2490.12	46.93	-7.07	54	31.86	32.2	7.84	34.97	100	242	A	H
	*	2362.02	54.19	-19.81	74	39.59	31.87	7.84	34.97	304	280	P	V
	*	2311.53	45.32	-8.68	54	30.85	31.8	7.84	34.97	304	280	A	V
		2480	103.05	-	-	87.98	32.2	7.84	34.97	304	280	P	V
		2480	102.66	-	-	87.59	32.2	7.84	34.97	304	280	A	V
		2487.44	56.11	-17.89	74	41.04	32.2	7.84	34.97	304	280	P	V
		2492.32	46.1	-7.9	54	31.04	32.2	7.84	34.98	304	280	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz (Harmonic @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 1 + 802.11a CH44 5220 MHz Ant 1		4960	43.11	-30.89	74	56.24	34.13	11.05	58.74	100	0	P	H
		7440	43.73	-30.27	74	52.27	35.5	13.62	58.38	100	0	P	H
		10440	49.1	-19.1	68.2	53.79	37.4	16.66	59.54	100	0	P	H
		15660	63.62	-10.38	74	59.63	40.3	19.49	56.7	194	336	P	H
		15660	53.42	-0.58	54	49.43	40.3	19.49	56.7	194	336	A	H
		4960	43.53	-30.47	74	56.66	34.13	11.05	58.74	100	0	P	V
		7440	44.34	-29.66	74	52.88	35.5	13.62	58.38	100	0	P	V
		10440	49.43	-18.77	68.2	54.12	37.4	16.66	59.54	100	0	P	V
		15660	55.55	-18.45	74	51.56	40.3	19.49	56.7	316	32	P	V
		15660	45.85	-8.15	54	41.86	40.3	19.49	56.7	316	32	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz (LF @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 1 + 802.11a CH44 5220 MHz Ant 1		60.78	23.9	-16.1	40	40.31	11.88	1.55	29.99	-	-	P	H
		91.83	32.38	-11.12	43.5	45.76	14.88	1.55	29.99	-	-	P	H
		126.66	33.68	-9.82	43.5	44.03	17.59	1.83	29.95	100	0	P	H
		745.2	35.36	-10.64	46	32.63	27.72	4.18	29.45	-	-	P	H
		951.7	33.91	-12.09	46	26.94	30.44	4.74	28.55	-	-	P	H
		974.1	34.59	-19.41	54	27.05	30.84	4.74	28.39	-	-	P	H
		30.27	32.5	-7.5	40	36.56	24.6	1.19	29.98	-	-	P	V
		58.89	33.43	-6.57	40	50.11	11.97	1.19	29.99	100	0	P	V
		89.67	28.01	-15.49	43.5	41.62	14.66	1.55	29.99	-	-	P	V
		745.2	32.47	-13.53	46	29.74	27.72	4.18	29.45	-	-	P	V
		957.3	33.5	-12.5	46	26.18	30.75	4.74	28.51	-	-	P	V
		979	34.48	-19.52	54	26.92	30.82	4.74	28.35	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Band 1 5150~5250MHz (Band edge @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 2 + 802.11ac VHT80 CH42 5210 MHz Ant 2		5138.84	66.49	-7.51	74	56.1	34.2	11.24	35.05	102	270	P	H
		5135.46	53.09	-0.91	54	42.7	34.2	11.24	35.05	102	270	A	H
	*	5210	95.94	-	-	85.32	34.33	11.34	35.05	102	270	P	H
	*	5210	88.41	-	-	77.79	34.33	11.34	35.05	102	270	A	H
		5374.04	57.59	-16.41	74	46.69	34.47	11.49	35.06	102	270	P	H
		5359.76	50.67	-3.33	54	39.83	34.4	11.49	35.05	102	270	A	H
		5139.88	54.22	-19.78	74	43.73	34.3	11.24	35.05	400	168	P	V
		5076.44	44.65	-9.35	54	34.48	34.03	11.18	35.04	400	168	A	V
	*	5210	89.18	-	-	78.56	34.33	11.34	35.05	400	168	P	V
	*	5210	82.52	-	-	71.9	34.33	11.34	35.05	400	168	A	V
		5352.76	50.67	-23.33	74	39.83	34.4	11.49	35.05	400	168	P	V
		5353.6	44.65	-9.35	54	33.81	34.4	11.49	35.05	400	168	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz (Band edge @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 2 + 802.11ac VHT80 CH42 5210 MHz Ant 2		2388.88	54.74	-19.26	74	39.94	32	7.74	34.94	400	276	P	H
		2388.37	45.46	-8.54	54	30.66	32	7.74	34.94	400	276	A	H
	*	2480	104	-	-	88.93	32.2	7.84	34.97	400	276	P	H
	*	2480	103.48	-	-	88.41	32.2	7.84	34.97	400	276	A	H
		2487.328	54.51	-19.49	74	39.44	32.2	7.84	34.97	400	276	P	H
		2484.424	45.97	-8.03	54	30.9	32.2	7.84	34.97	400	276	A	H
		2386.5	54.92	-19.08	74	40.12	32	7.74	34.94	100	303	P	V
		2373.92	45.51	-8.49	54	30.85	31.93	7.67	34.94	100	303	A	V
	*	2480	96.31	-	-	81.24	32.2	7.84	34.97	100	303	P	V
	*	2480	95.26	-	-	80.19	32.2	7.84	34.97	100	303	A	V
		2491.2	54.3	-19.7	74	39.23	32.2	7.84	34.97	100	303	P	V
		2493.576	45.76	-8.24	54	30.7	32.2	7.84	34.98	100	303	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz and Band 1 5150~5250MHz (Harmonic @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 2 + 802.11ac VHT80 CH42 5210 MHz Ant 2		4960	42.11	-31.89	74	55.24	34.13	11.05	58.74	100	0	P	H
		7440	44.55	-29.45	74	53.09	35.5	13.62	58.38	100	0	P	H
		10420	46.47	-21.73	68.2	51.19	37.4	16.64	59.55	100	0	P	H
		15630	49.83	-24.17	74	45.85	40.27	19.49	56.68	100	0	P	H
		4960	43.53	-30.47	74	56.66	34.13	11.05	58.74	100	0	P	V
		7440	43.69	-30.31	74	52.23	35.5	13.62	58.38	100	0	P	V
		10420	46.73	-21.47	68.2	51.45	37.4	16.64	59.55	100	0	P	V
		15630	49.82	-24.18	74	45.84	40.27	19.49	56.68	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz 2400~2483.5MHz and Band 1 5150~5250MHz (LF @ 3m)

WIFI Ant. Simultaneously	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)
BLE CH39 2480 MHz Ant 2 + 802.11ac VHT80 CH42 5210 MHz Ant 2		60.51	24.77	-15.23	40	41.17	11.89	1.55	29.99	-	-	P	H
		127.2	34.17	-9.33	43.5	44.52	17.59	1.83	29.95	100	0	P	H
		194.7	29.98	-13.52	43.5	42.63	14.83	2.18	29.86	-	-	P	H
		745.2	34.45	-11.55	46	31.72	27.72	4.18	29.45	-	-	P	H
		918.8	32.58	-13.42	46	27.23	29.13	4.68	28.79	-	-	P	H
		984.6	35	-19	54	27.39	30.69	4.89	28.32	-	-	P	H
		44.85	33.88	-6.12	40	45.83	16.71	1.19	29.99	100	0	P	V
		60.51	33.66	-6.34	40	50.06	11.89	1.55	29.99	-	-	P	V
		117.75	30.6	-12.9	43.5	41.23	17.33	1.83	29.97	-	-	P	V
		745.9	33.3	-12.7	46	30.56	27.73	4.18	29.45	-	-	P	V
		977.6	34.25	-19.75	54	26.7	30.83	4.74	28.37	-	-	P	V
		990.2	34.39	-19.61	54	26.88	30.53	4.89	28.27	-	-	P	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.
-	The signal is **Unintentional Radiators**.
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 Ant. Simultaneously	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)
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. 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”.

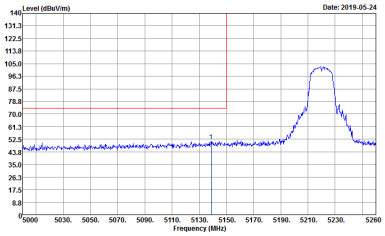
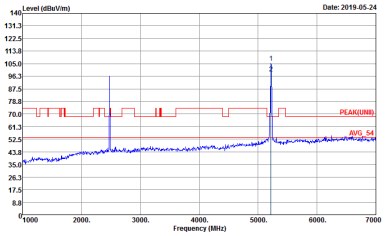
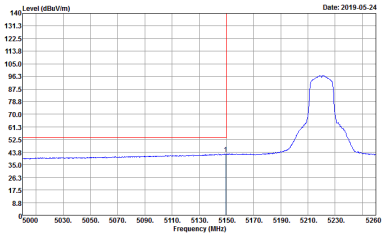
Appendix B. Radiated Spurious Emission Plots

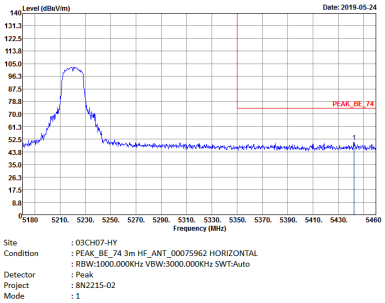
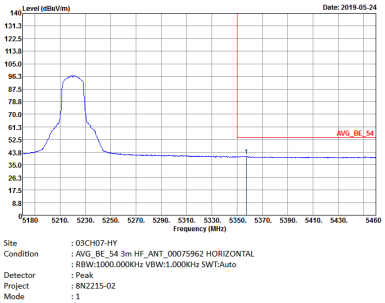
Test Engineer :	Jesse Wang, Stan Hsieh, and Troye Hsieh	**Temperature :**	20~26°C
		Relative Humidity :	50~56%

Note symbol

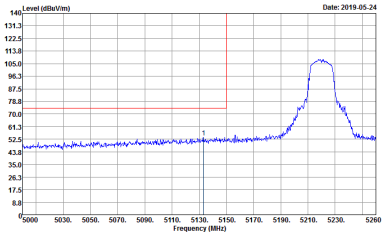
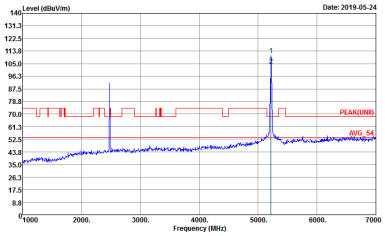
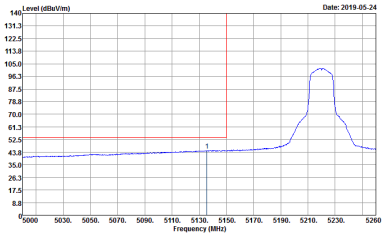
-L	**Low channel location**
-R	**High channel location**

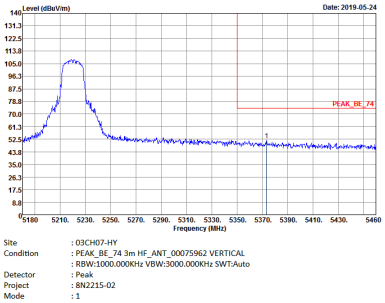
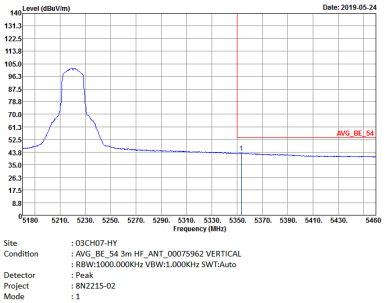
Band 1 5150~5250MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - L	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	 Site : 03CH07-HY Condition : PEAK(UNII) 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	Left blank

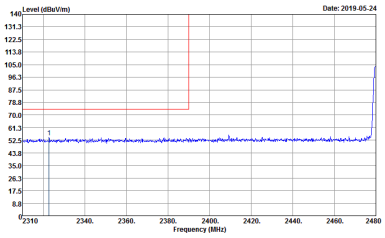
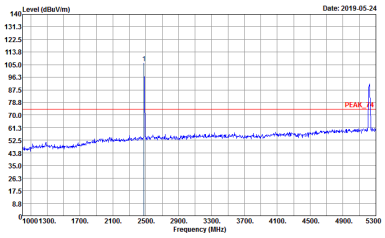
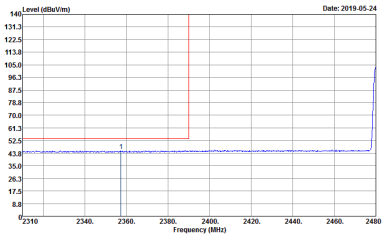
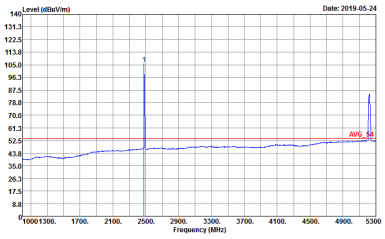
ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - R	
Simultaneously	**Horizontal**	**Fundamental**
Peak		Left blank
Avg.		Left blank

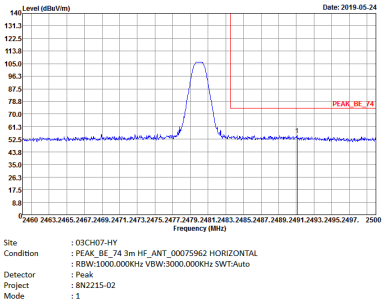
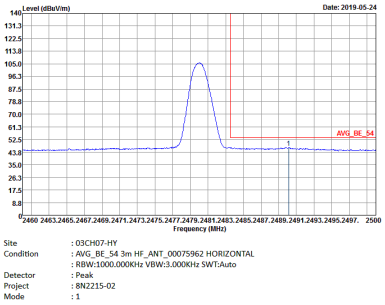
Band 1 5150~5250MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - L	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	 Site : 03CH07-HY Condition : PEAK(UNII) 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	Left blank

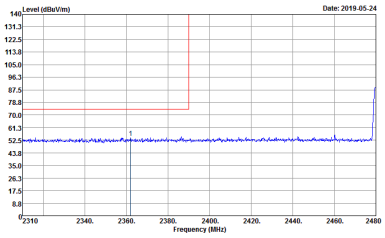
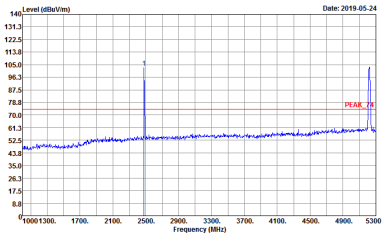
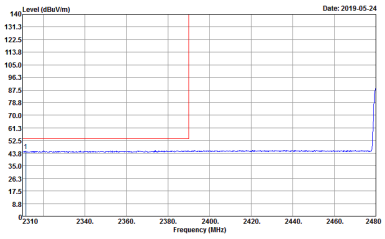
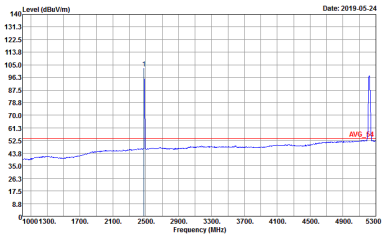
ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - R	
Simultaneously	**Vertical**	**Fundamental**
Peak		Left blank
Avg.		Left blank

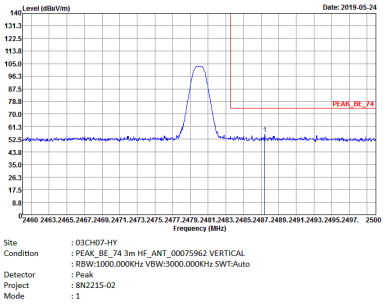
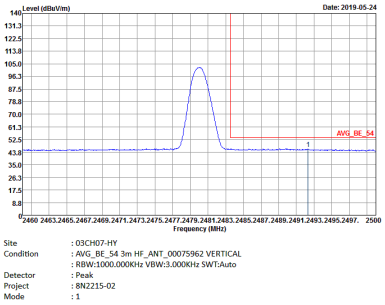
2.4GHz 2400~2483.5MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - L	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	 Site : 03CH07-HY Condition : AVG_54 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1

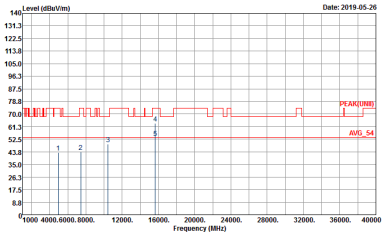
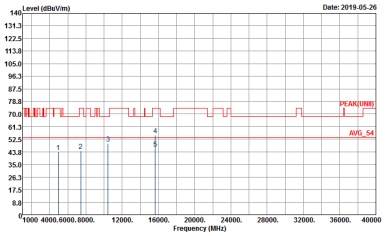
ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - R	
Simultaneously	**Vertical**	**Fundamental**
Peak		Left blank
Avg.		Left blank

2.4GHz 2400~2483.5MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - L	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1	 Site : 03CH07-HY Condition : AVG_54 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 1

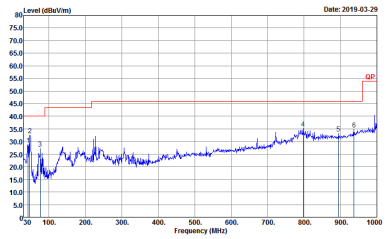
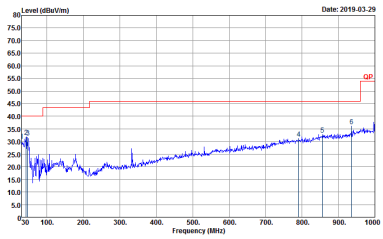
ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1 - R	
Simultaneously	**Vertical**	**Fundamental**
Peak		Left blank
Avg.		Left blank

2.4GHz 2400~2483.5MHz and Band 1 5150~5250MHz (Harmonic @ 3m)

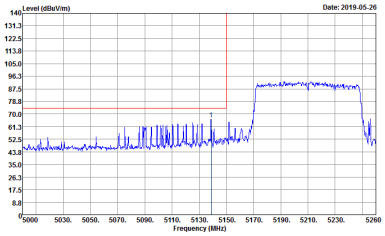
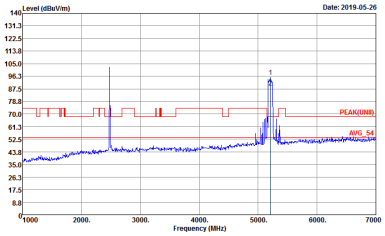
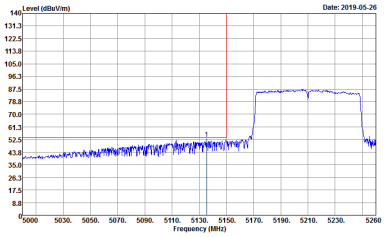
ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH07-HY Condition : PEAK(UNII) 3m SHF-EHF_131029 HORIZONTAL Detector : Peak Project : 8N2215-02 Mode : 1	 Site : 03CH07-HY Condition : PEAK(UNII) 3m SHF-EHF_131029 VERTICAL Detector : Peak Project : 8N2215-02 Mode : 1

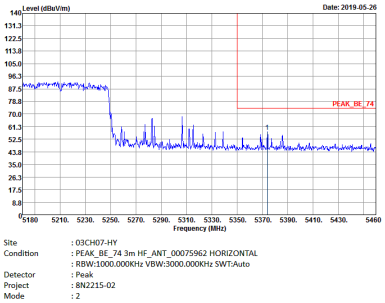
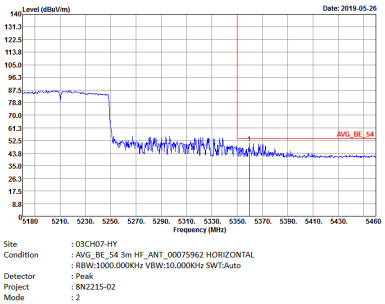
Emission below 1GHz

2.4GHz 2400~2483.5MHz and Band 1 5150~5250MHz (LF)

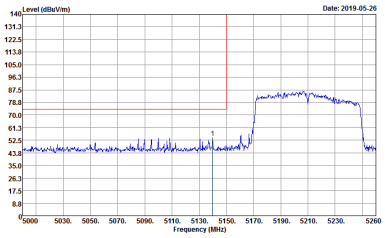
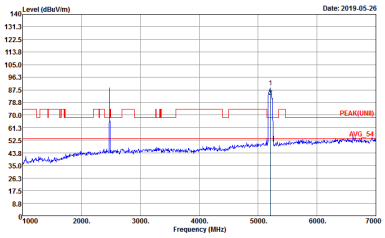
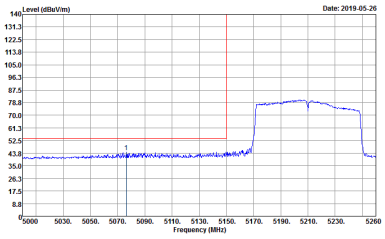
ANT	BLE_Ch39_Ant 1 + WIFI 802.11a_Ch44_Ant 1	
Simultaneously	Horizontal	Vertical
QP / Peak	 Site : 03CH07-HY Condition : QP 3m LF-ANT-35419(6) HORIZONTAL Detector : Peak Project : 8N2215-01 Mode : 1	 Site : 03CH07-HY Condition : QP 3m LF-ANT-35419(6) VERTICAL Detector : Peak Project : 8N2215-01 Mode : 1

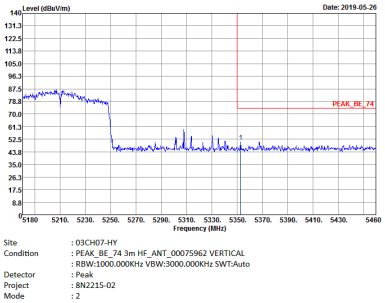
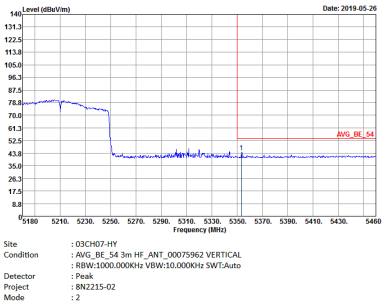
Band 1 5150~5250MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - L	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : PEAK(UNII) 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	Left blank

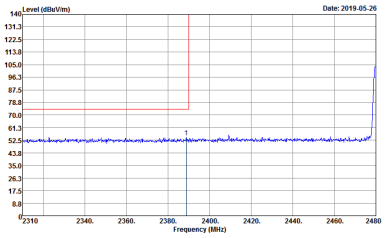
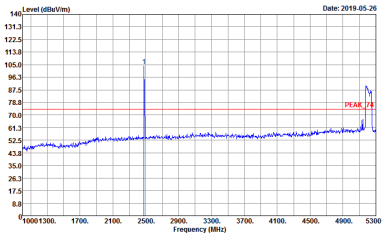
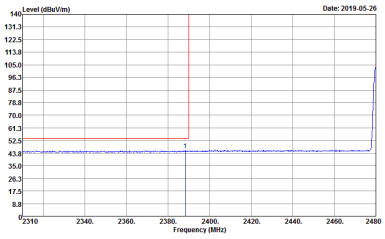
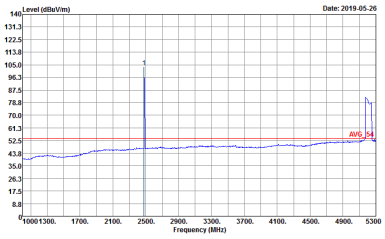
ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - R	
Simultaneously	**Horizontal**	**Fundamental**
Peak		Left blank
Avg.		Left blank

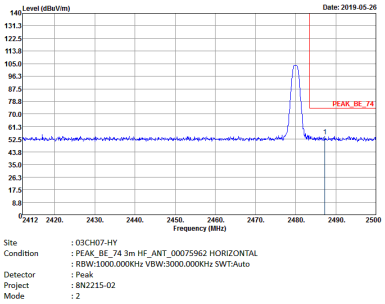
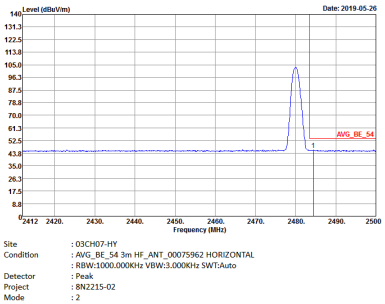
Band 1 5150~5250MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - L	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : PEAK(UNII) 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	Left blank

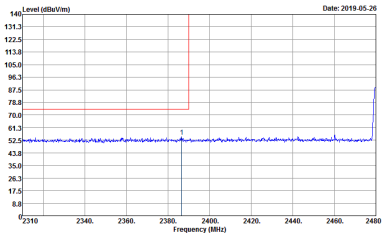
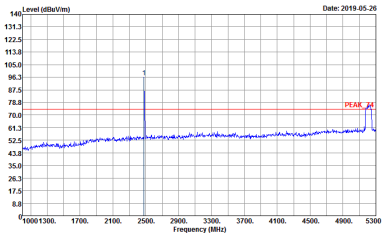
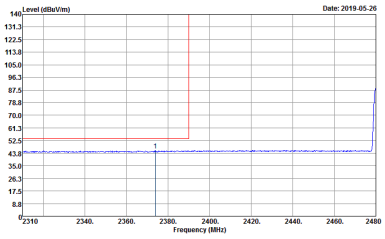
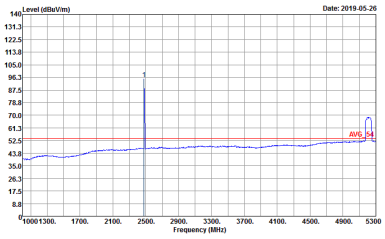
ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - R	
Simultaneously	**Vertical**	**Fundamental**
Peak		Left blank
Avg.		Left blank

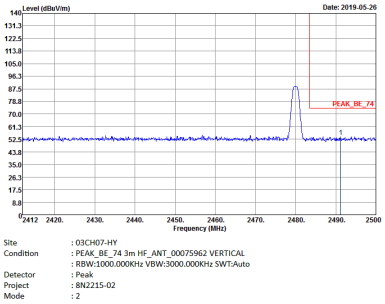
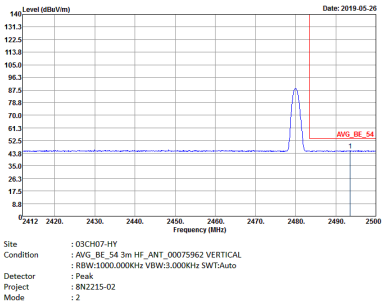
2.4GHz 2400~2483.5MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - L	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : AVG_54 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2

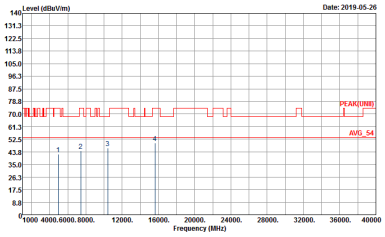
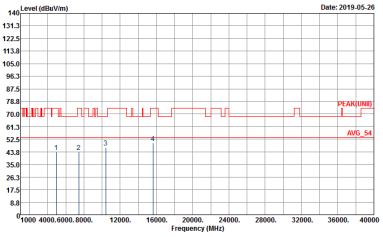
ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - R	
Simultaneously	**Horizontal**	**Fundamental**
Peak		Left blank
Avg.		Left blank

2.4GHz 2400~2483.5MHz (Band Edge @ 3m)

ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - L	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2
Avg.	 Site : 03CH07-HY Condition : AVG_BE_54 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : AVG_54 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 8N2215-02 Mode : 2

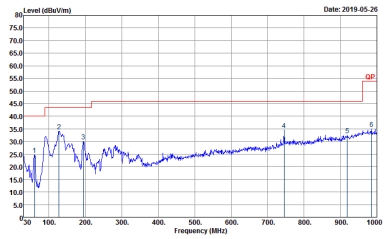
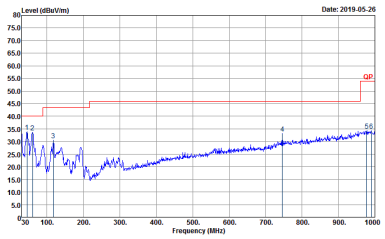
ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2 - R	
Simultaneously	**Vertical**	**Fundamental**
Peak		Left blank
Avg.		Left blank

2.4GHz 2400~2483.5MHz and Band 1 5150~5250MHz (Harmonic @ 3m)

ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH07-HY Condition : PEAK(UNII) 3m SHF-EHF_131029 HORIZONTAL Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : PEAK(UNII) 3m SHF-EHF_131029 VERTICAL Detector : Peak Project : 8N2215-02 Mode : 2

Emission below 1GHz

2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz (LF)

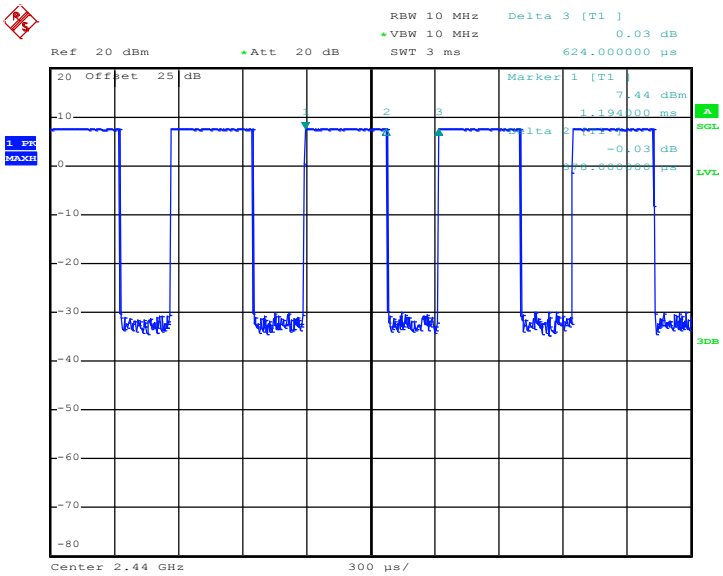
ANT	BLE_Ch39_Ant 2 + WIFI 802.11ac VHT80_Ch42_Ant 2	
Simultaneously	Horizontal	Vertical
QP / Peak	 Site : 03CH07-HY Condition : QP 3m LF-ANT-35419(6) HORIZONTAL Detector : Peak Project : 8N2215-02 Mode : 2	 Site : 03CH07-HY Condition : QP 3m LF-ANT-35419(6) VERTICAL Detector : Peak Project : 8N2215-02 Mode : 2

Appendix C. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
1	Bluetooth – LE	60.58	378	2.65	3kHz	2.18
2	Bluetooth – LE	60.74	379	2.64	3kHz	2.17
1	5GHz 802.11ac VHT80	74.07	320	3.13	10kHz	1.30
2	5GHz 802.11ac VHT80	74.07	320	3.13	10kHz	1.30

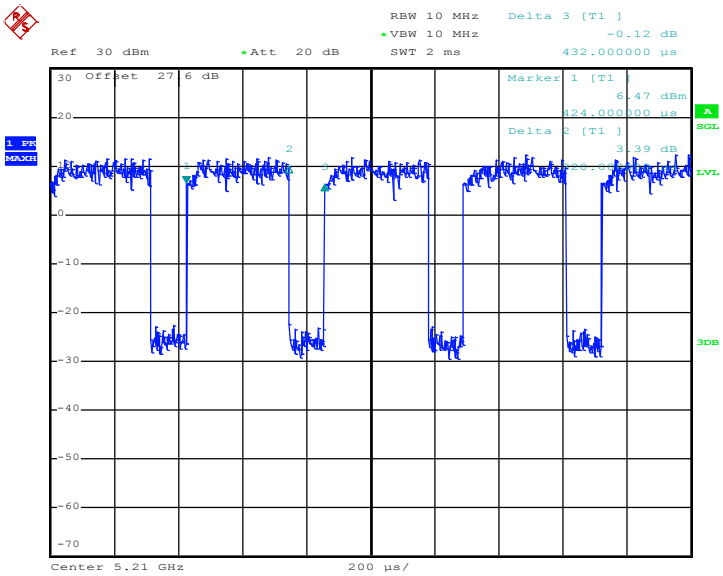
<Ant. 1>

Bluetooth – LE



Date: 8.MAY.2019 00:56:30

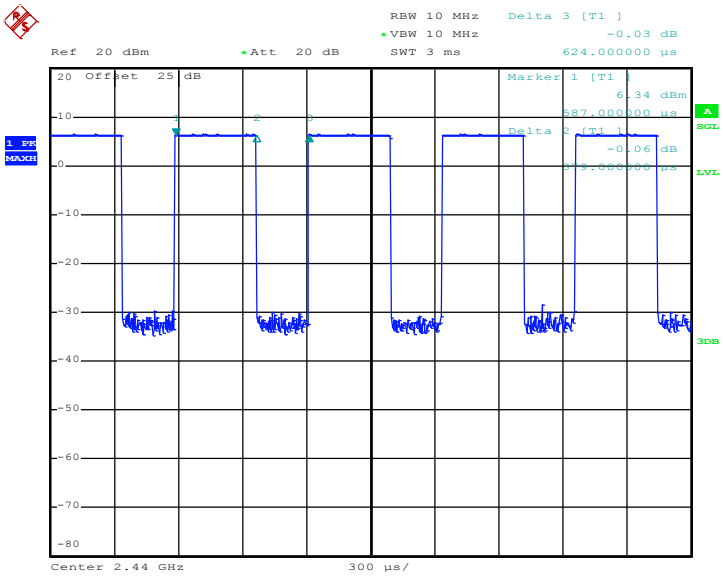
5GHz 802.11ac VHT80



Date: 8.MAY.2019 22:13:49

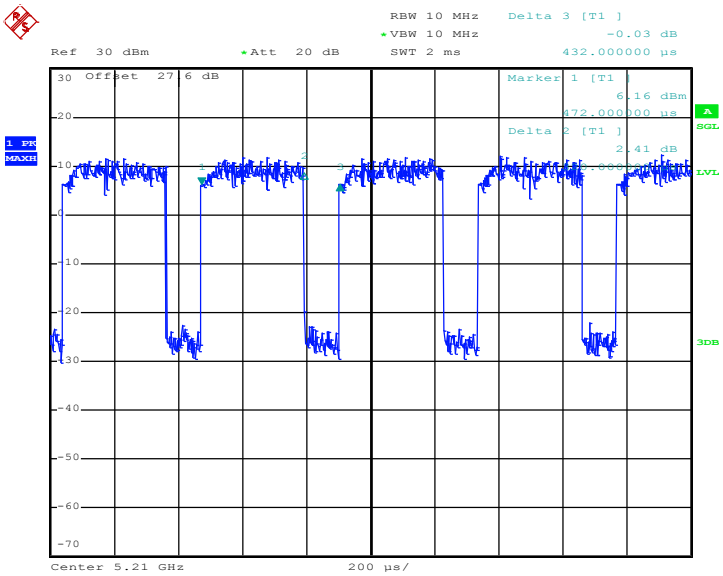
<Ant. 2>

Bluetooth – LE



Date: 8.MAY.2019 01:00:40

5GHz 802.11ac VHT80



Date: 8.MAY.2019 22:19:06

———THE END———