FCC CO-LOCATION RADIO TEST REPORT

FCC ID	**:**	**2AGOZ-D87L**
Equipment	**:**	**Media receiver**
Brand Name	**:**	**facebook**
Model Name	**:**	**DT90GB**
Applicant	**:**	**Facebook Technologies, LLC 1 Hacker Way, Menlo Park, CA 94025, USA**
Standard	**:**	**FCC Part 15 Subpart E §15.407**

The product was received on May 24, 2019 and testing was started from Jun. 13, 2019 and completed on Jul. 04, 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
FR952407F	01	Initial issue of report	Jul. 11, 2019
FR952407F	02	Revise the connection diagram of test system in section 2.3	Jul. 18, 2019
FR952407F	03	Revise the Radiated Spurious Emission Plots data in appendix B	Jul. 30, 2019

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	Under limit 4.90 dB at 5351.040 MHz
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: Aileen Huang

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	
Antenna Type	WLAN: FPC Antenna Bluetooth: FPC 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.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.**
	03CH16-HY

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

FCC Designation No.: 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 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.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- 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

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 for Bluetooth - LE + WLAN2.4GHz with Ant. 2, Bluetooth - LE + WLAN5GHz with Ant. 1 and Ant. 2, and Y plane for WLAN2.4GHz with Ant. 2 + WLAN5GHz with Ant. 2) were recorded in this report.

2.1 Carrier Frequency and Channel

2400-2483.5 MHz Bluetooth LE		2400-2483.5 MHz 802.11g	
Channel	**Freq. (MHz)**	**Channel**	**Freq. (MHz)**
39	2480	11	2462

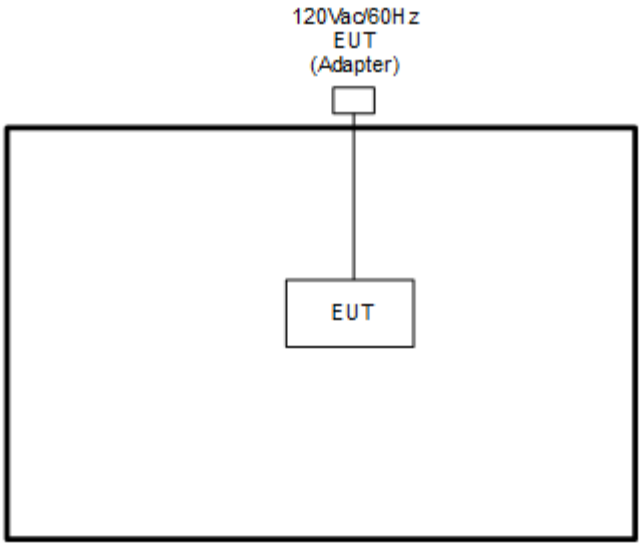
5250-5350 MHz 802.11ac VHT40		5725-5850 MHz 802.11ac VHT80	
Channel	**Freq. (MHz)**	**Channel**	**Freq. (MHz)**
62	5310	155	5775

2.2 Test Mode

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

Modulation	Data Rate
Bluetooth – LE + 2.4 GHz 11g	**1 Mbps + 6 Mbps**
Bluetooth - LE + 5GHz 802.11ac VHT80	**1 Mbps + MCS0**
Bluetooth - LE + 5GHz 802.11ac VHT40	**1 Mbps + MCS0**

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.	Notebook	Lenovo	LAPTOP-J4S01QMP	N/A	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “QRCT Version3.0.271.0” was installed in 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

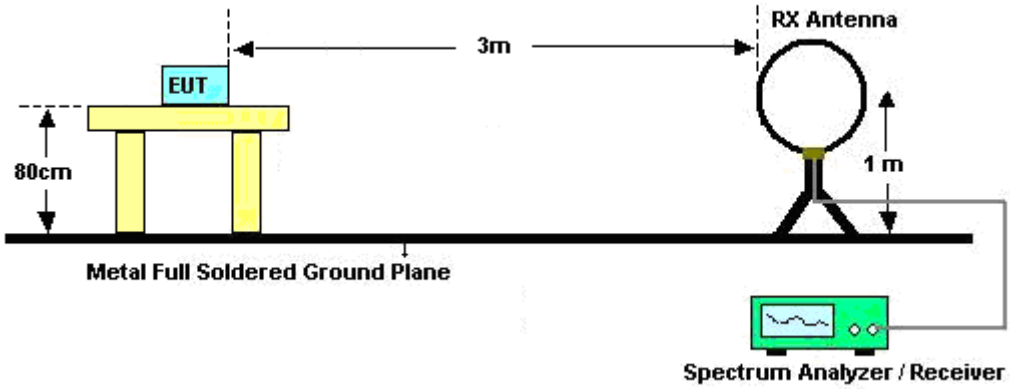
   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

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.

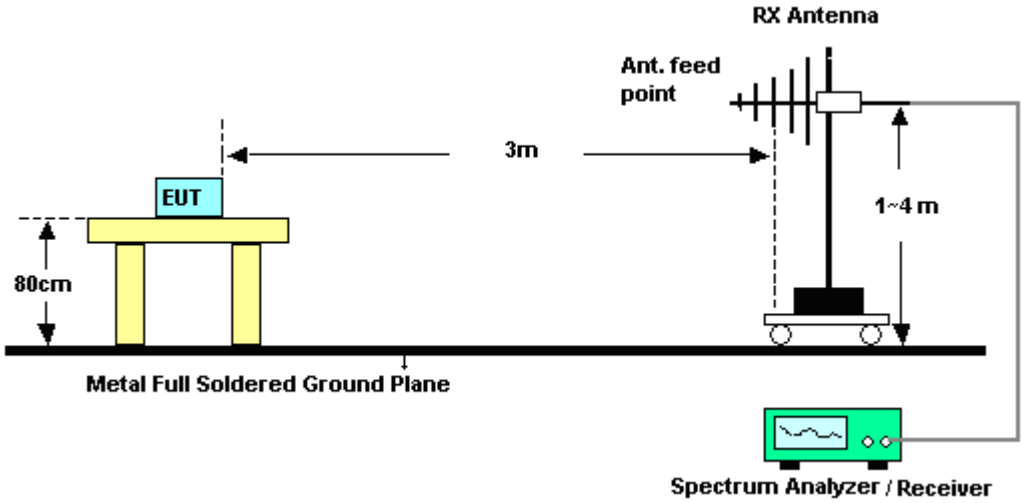
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level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

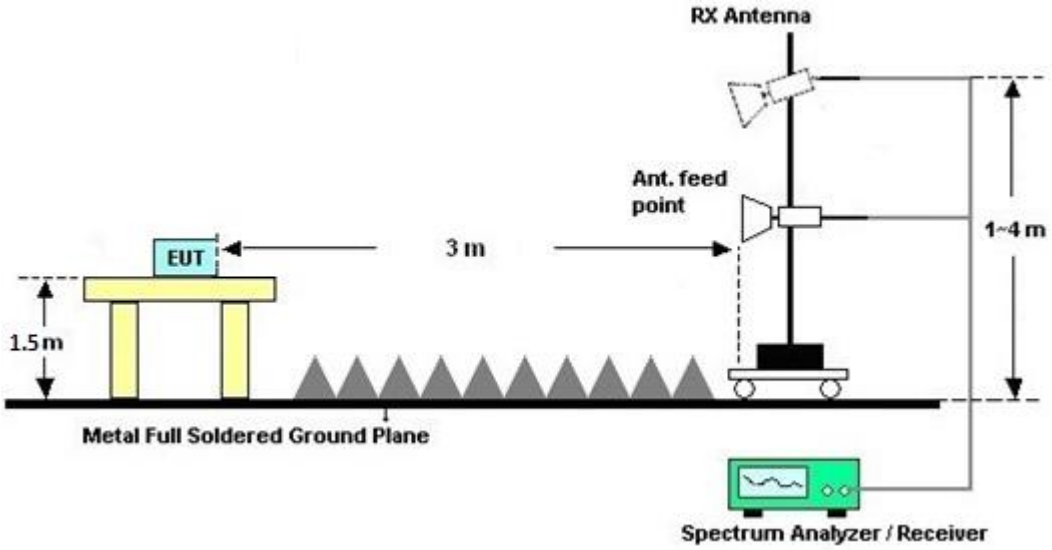
For radiated emissions below 30MHz



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
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jan. 11, 2019	Jun. 13, 2019~ Jul. 04, 2019	Jan. 10, 2020	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL6111D&00802N1D01N-06	47020&06	30MHz to 1GHz	Oct. 13, 2018	Jun. 13, 2019~ Jul. 04, 2019	Oct. 12, 2019	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1G~18GHz	Sep. 07, 2018	Jun. 13, 2019~ Jul. 04, 2019	Sep. 06, 2019	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz ~ 40GHz	Nov. 20, 2018	Jun. 13, 2019~ Jul. 04, 2019	Nov. 19, 2019	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1000MHz	Oct. 02. 2018	Jun. 13, 2019~ Jul. 04, 2019	Oct. 01. 2019	Radiation (03CH16-HY)
Preamplifier	Jet-Power	JPA0118-55-303	1710001800055007	1GHz~18GHz	Apr. 01, 2019	Jun. 13, 2019~ Jul. 04, 2019	Mar. 31, 2020	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 12, 2018	Jun. 13, 2019~ Jul. 04, 2019	Dec.11, 2019	Radiation (03CH16-HY)
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 16, 2018	Jun. 13, 2019~ Jul. 04, 2019	Jul. 15, 2019	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A (MXE)	MY57290111	3Hz~26.5GHz	Nov. 29, 2018	Jun. 13, 2019~ Jul. 04, 2019	Nov. 28, 2019	Radiation (03CH16-HY)
Spectrum Analyzer	Agilent	N9010A	MY54200486	10Hz~44GHz	Oct. 19, 2018	Jun. 13, 2019~ Jul. 04, 2019	Oct. 18, 2019	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	MY1082/26EA	30M-18G	Oct. 15, 2018	Jun. 13, 2019~ Jul. 04, 2019	Oct. 14, 2019	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY15539/4	30M-18G	Feb. 26, 2019	Jun. 13, 2019~ Jul. 04, 2019	Feb. 25, 2020	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY36980/4	30M~18GHz	Apr. 15, 2019	Jun. 13, 2019~ Jul. 04, 2019	Apr. 14, 2020	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jun. 13, 2019~ Jul. 04, 2019	N/A	Radiation (03CH16-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))	**4.9**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.8**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.9**

Appendix A. Radiated Spurious Emission

Test Engineer :	Jacky Hung, Austin Li and CR Liao	Temperature :	20~25°C
		Relative Humidity :	50~60%

BLE + WIFI 802.11g (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
	*	2480	101.61	-	-	85.84	27.65	18.38	30.26	209	342	P	H
	*	2480	101.06	-	-	85.29	27.65	18.38	30.26	209	342	A	H
		2497.16	56.38	-17.62	74	40.55	27.69	18.38	30.25	209	342	P	H
		2483.52	46.88	-7.12	54	31.09	27.66	18.38	30.25	209	342	A	H
BLE													H
CH 39													H
2480MHz	*	2480	102.48	-	-	86.71	27.65	18.38	30.26	182	85	P	V
Ant 1	*	2480	101.94	-	-	86.17	27.65	18.38	30.26	182	85	A	V
		2498.12	56.18	-17.82	74	40.34	27.7	18.38	30.25	182	85	P	V
		2497	46.42	-7.58	54	30.59	27.69	18.38	30.25	182	85	A	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.

BLE + WIFI 802.11g (Band Edge @ 3m)

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)
	*	2462	104.01	-	-	88.3	27.6	18.37	30.26	230	206	P	H
	*	2462	96.07	-	-	80.36	27.6	18.37	30.26	230	206	A	H
		2497.04	57.51	-16.49	74	41.68	27.69	18.39	30.25	230	206	P	H
		2485.4	47.31	-6.69	54	31.52	27.66	18.38	30.25	230	206	A	H
802.11g													H
CH 11													H
2462MHz	*	2462	103.34	-	-	87.63	27.6	18.37	30.26	108	85	P	V
Ant 2	*	2462	95.16	-	-	79.45	27.6	18.37	30.26	108	85	A	V
		2498.64	57.16	-16.84	74	41.32	27.7	18.39	30.25	108	85	P	V
		2483.84	46.85	-7.15	54	31.06	27.66	18.38	30.25	108	85	A	V
													V
													V

BLE + WIFI 802.11g (Harmonic @ 3m)

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 39 2480MHz Ant 1 + 802.11g CH 11 2462MHz Ant 2		4924	39.56	-34.44	74	51.03	32.65	13.42	58.13	100	0	P	H
		4960	39.52	-34.48	74	50.88	32.72	13.48	58.14	100	0	P	H
		7386	43.29	-30.71	74	48.18	37.34	14.86	57.4	100	0	P	H
		7440	44.7	-29.3	74	49.32	37.42	14.96	57.33	100	0	P	H
													H
		4924	39.72	-34.28	74	51.19	32.65	13.42	58.13	100	0	P	V
		4960	39.18	-34.82	74	50.54	32.72	13.48	58.14	100	0	P	V
		7386	45.3	-28.7	74	50.19	37.34	14.86	57.4	100	0	P	V
		7440	43.65	-30.35	74	48.27	37.42	14.96	57.33	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

BLE + WIFI 802.11g (LF)

	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 39 2480MHz Ant 1 + 802.11g CH 11 2462MHz Ant 2		105.66	21.76	-21.74	43.5	36.32	16.71	1.1	32.37	-	-	P	H
		171.62	24.16	-19.34	43.5	39.47	15.46	1.59	32.36	-	-	P	H
		463.59	24.42	-21.58	46	30.41	23.36	3.2	32.55	-	-	P	H
		660.5	27.93	-18.07	46	30.1	26.34	4.08	32.59	-	-	P	H
		901.06	31.81	-14.19	46	29.87	29.07	4.65	31.78	-	-	P	H
		954.41	33.29	-12.71	46	29.05	30.86	4.69	31.31	100	0	P	H
													H
													H
													H
													H
													H
													H
		31.94	21.8	-18.2	40	30.43	23.53	0.29	32.45	-	-	P	V
		108.57	24.16	-19.34	43.5	38.48	16.93	1.12	32.37	-	-	P	V
		179.38	21.9	-21.6	43.5	37.56	15.06	1.63	32.35	-	-	P	V
		713.85	28.79	-17.21	46	30.17	26.92	4.21	32.51	-	-	P	V
		918.52	33.22	-12.78	46	30.67	29.55	4.63	31.63	-	-	P	V
		950.53	33.64	-12.36	46	29.62	30.75	4.62	31.35	100	0	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

BLE + WIFI 802.11ac VHT80 (Band Edge @ 3m)

BLE	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)
	*	2480	101.93	-	-	86.16	27.65	18.38	30.26	140	339	P	H
	*	2480	101.32	-	-	85.55	27.65	18.38	30.26	140	339	A	H
		2495.64	56.59	-17.41	74	40.76	27.69	18.39	30.25	140	339	P	H
		2493.52	46.77	-7.23	54	30.95	27.68	18.39	30.25	140	339	A	H
BLE													H
CH 39													H
2480MHz	*	2480	103	-	-	87.23	27.65	18.38	30.26	154	104	P	V
Ant 1	*	2480	102.41	-	-	86.64	27.65	18.38	30.26	154	104	A	V
		2484	58.15	-15.85	74	42.36	27.66	18.38	30.25	154	104	P	V
		2486.56	46.98	-7.02	54	31.18	27.67	18.38	30.25	154	104	A	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.

BLE + WIFI 802.11ac VHT80 (Band Edge @ 3m)

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)
802.11ac VHT80 CH 155 5775MHz Ant 1		5636.2	55.09	-13.11	68.2	38.64	32.5	13.76	29.81	214	245	P	H
		5690	59.74	-38.09	97.83	43.05	32.62	13.9	29.83	214	245	P	H
		5708.6	62.62	-44.99	107.61	45.85	32.66	13.95	29.84	214	245	P	H
		5724.4	61.61	-59.22	120.83	44.77	32.69	14	29.85	214	245	P	H
	*	5775	107.17	-	-	90.1	32.81	14.13	29.87	214	245	P	H
	*	5775	99.95	-	-	82.88	32.81	14.13	29.87	214	245	A	H
		5850.2	58.76	-62.98	121.74	41.67	32.97	14.03	29.91	214	245	P	H
		5855.6	57.87	-52.76	110.63	40.79	32.98	14.01	29.91	214	245	P	H
		5880.2	56.86	-44.48	101.34	39.81	33.04	13.93	29.92	214	245	P	H
		5930.8	56.85	-11.35	68.2	39.89	33.15	13.76	29.95	214	245	P	H
													H
													H
		5606.6	55.99	-12.21	68.2	39.67	32.43	13.68	29.79	216	104	P	V
		5691.8	60.67	-38.48	99.15	43.97	32.62	13.91	29.83	216	104	P	V
		5708.2	62.19	-45.31	107.5	45.42	32.66	13.95	29.84	216	104	P	V
		5725	63.62	-58.58	122.2	46.78	32.69	14	29.85	216	104	P	V
	*	5775	108.96	-	-	91.89	32.81	14.13	29.87	216	104	P	V
	*	5775	101.3	-	-	84.23	32.81	14.13	29.87	216	104	A	V
		5851.8	60.64	-57.46	118.1	43.55	32.97	14.03	29.91	216	104	P	V
		5855.8	59.48	-51.1	110.58	42.4	32.98	14.01	29.91	216	104	P	V
		5875	57.26	-47.94	105.2	40.2	33.03	13.95	29.92	216	104	P	V
		5925.4	55.12	-13.08	68.2	38.14	33.14	13.78	29.94	216	104	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

BLE + WIFI 802.11ac VHT80 (Harmonic @ 3m)

	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 39 2480MHz Ant 1 + 802.11ac VHT80 CH 155 5775MHz Ant 1		4960	45.59	-28.41	74	27.41	32.72	15.17	29.71	100	0	P	H
		7440	45.93	-28.07	74	50.06	37.42	15.78	57.33	100	0	P	H
		11550	45.9	-28.1	74	48.61	39.63	18.42	60.76	100	0	P	H
		17325	52.1	-16.1	68.2	41.71	43.59	23.39	56.59	100	0	P	H
													H
		4960	45.15	-28.85	74	26.97	32.72	15.17	29.71	100	0	P	V
		7440	44.94	-29.06	74	49.07	37.42	15.78	57.33	100	0	P	V
		11550	45.56	-28.44	74	48.27	39.63	18.42	60.76	100	0	P	V
		17325	52.41	-15.79	68.2	42.02	43.59	23.39	56.59	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

BLE + WIFI 802.11ac VHT80 (LF)

	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)
		107.6	21.56	-21.94	43.5	35.96	16.86	1.08	32.37	-	-	P	H
		162.89	24.73	-18.77	43.5	39.29	16.24	1.46	32.36	-	-	P	H
		491.72	26.17	-19.83	46	31.67	23.8	3.22	32.57	-	-	P	H
		719.67	29.45	-16.55	46	30.6	27.09	4.13	32.5	-	-	P	H
		897.18	32.1	-13.9	46	30.23	29.03	4.49	31.81	-	-	P	H
		949.56	34.14	-11.86	46	30.15	30.73	4.44	31.35	100	0	P	H
													H
													H
BLE													H
CH 39													H
2480MHz													H
Ant 1													H
+													H
802.11ac		31.94	22.82	-17.18	40	31.45	23.53	0.27	32.45	-	-	P	V
VHT80		108.57	24.24	-19.26	43.5	38.56	16.93	1.09	32.37	-	-	P	V
CH 155		177.44	22.05	-21.45	43.5	37.62	15.16	1.53	32.35	-	-	P	V
5775MHz		666.32	28.57	-17.43	46	30.68	26.38	3.97	32.58	-	-	P	V
Ant 1		846.74	32.1	-13.9	46	30.54	29.01	4.49	32.09	-	-	P	V
		950.53	32.91	-13.09	46	28.89	30.75	4.45	31.35	100	0	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

BLE + WIFI 802.11ac VHT40 (Band Edge @ 3m)

BLE	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)
	*	2480	102.7	-	-	86.93	27.65	18.38	30.26	138	344	P	H
	*	2480	102.15	-	-	86.38	27.65	18.38	30.26	138	344	A	H
		2488.92	57.03	-16.97	74	41.23	27.67	18.38	30.25	138	344	P	H
		2494.04	46.78	-7.22	54	30.96	27.68	18.39	30.25	138	344	A	H
BLE													H
CH 39													H
2480MHz	*	2480	101.21	-	-	85.44	27.65	18.38	30.26	269	122	P	V
Ant 1	*	2480	100.67	-	-	84.9	27.65	18.38	30.26	269	122	A	V
		2495.56	57.18	-16.82	74	41.35	27.69	18.39	30.25	269	122	P	V
		2490.28	46.88	-7.12	54	31.08	27.67	18.38	30.25	269	122	A	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.

BLE + WIFI 802.11ac VHT40 (Band Edge @ 3m)

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)
802.11ac VHT40 CH 62 5310MHz Ant 2		5106.08	56.38	-17.62	74	40.12	32.67	13.31	29.72	213	245	P	H
		5050.32	45.55	-8.45	54	29.08	32.74	13.44	29.71	213	245	A	H
	*	5310	103.53	-	-	87.82	32.43	13.01	29.73	213	245	P	H
	*	5310	95.81	-	-	80.1	32.43	13.01	29.73	213	245	A	H
		5358.24	56.39	-17.61	74	40.77	32.37	12.98	29.73	213	245	P	H
		5350.8	47.53	-6.47	54	31.9	32.38	12.98	29.73	213	245	A	H
		5039.1	55.47	-18.53	74	38.96	32.75	13.47	29.71	260	279	P	V
		5040.46	45.44	-8.56	54	28.94	32.75	13.46	29.71	260	279	A	V
	*	5310	105.78	-	-	90.07	32.43	13.01	29.73	260	279	P	V
	*	5310	98.08	-	-	82.37	32.43	13.01	29.73	260	279	A	V
		5352.96	56.71	-17.29	74	41.08	32.38	12.98	29.73	260	279	P	V
		5351.04	49.1	-4.9	54	33.47	32.38	12.98	29.73	260	279	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

BLE + WIFI 802.11ac VHT40 (Harmonic @ 3m)

	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 39 2480MHz Ant 1 + 802.11ac VHT40 CH 62 5310MHz Ant 2		4960	57.71	-16.29	74	39.4	32.72	15.3	29.71	100	0	P	H
		4960	47.98	-6.02	54	29.67	32.72	15.3	29.71	100	0	A	H
		7440	44.6	-29.4	74	48.73	37.42	15.78	57.33	100	0	P	H
		10620	46.48	-27.52	74	48.32	40.1	17.69	59.63	100	0	P	H
		15930	43.83	-30.17	74	44.04	37.9	21.59	59.7	100	0	P	H
													H
		4960	57.86	-16.14	74	39.55	32.72	15.3	29.71	100	0	P	V
		4960	47.87	-6.13	54	29.56	32.72	15.3	29.71	100	0	A	V
		7440	44.64	-29.36	74	48.77	37.42	15.78	57.33	100	0	P	V
		10620	45.67	-28.33	74	47.51	40.1	17.69	59.63	100	0	P	V
		15930	43.56	-30.44	74	43.77	37.9	21.59	59.7	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

BLE + WIFI 802.11ac VHT40 (LF)

	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)
		105.66	21.82	-21.68	43.5	36.38	16.71	1.1	32.37	-	-	P	H
		164.83	24.3	-19.2	43.5	39.1	15.99	1.57	32.36	-	-	P	H
		569.32	26.86	-19.14	46	29.95	25.87	3.69	32.65	-	-	P	H
		748.77	30.76	-15.24	46	30.54	28.15	4.52	32.45	-	-	P	H
		840.92	31.5	-14.5	46	30.07	28.96	4.6	32.13	-	-	P	H
		952.47	33.24	-12.76	46	29.1	30.81	4.66	31.33	100	0	P	H
													H
													H
BLE													H
CH 39													H
2480MHz													H
Ant 1													H
+													H
802.11ac		34.85	23.05	-16.95	40	33.17	22.1	0.23	32.45	-	-	P	V
VHT40		109.54	24.27	-19.23	43.5	38.51	17.01	1.12	32.37	-	-	P	V
CH 62		179.38	21.75	-21.75	43.5	37.41	15.06	1.63	32.35	-	-	P	V
5310MHz		751.68	30.13	-15.87	46	29.88	28.17	4.52	32.44	-	-	P	V
Ant 2		838.01	31.11	-14.89	46	29.8	28.87	4.58	32.14	-	-	P	V
		951.5	33.36	-12.64	46	29.28	30.78	4.64	31.34	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".

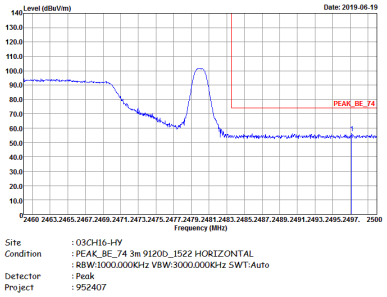
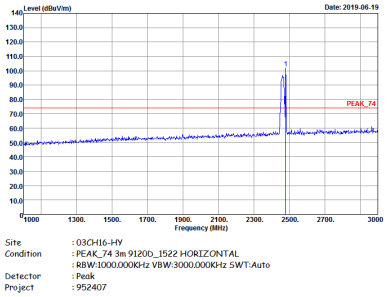
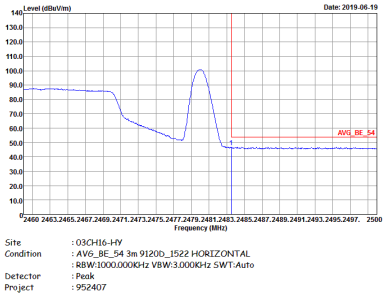
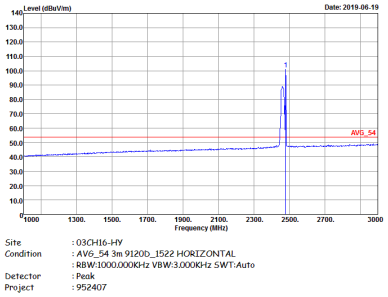
Appendix B. Radiated Spurious Emission Plots

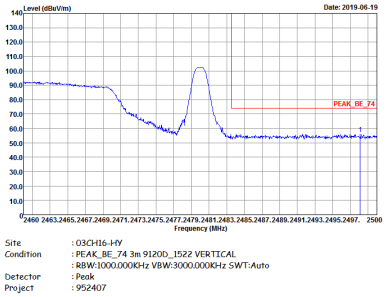
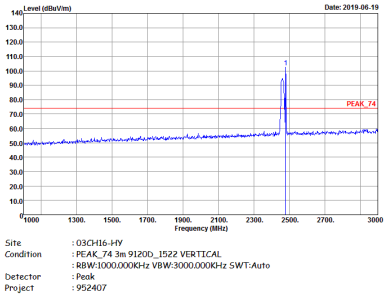
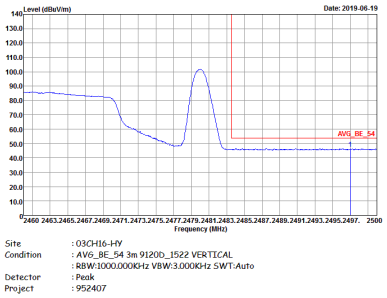
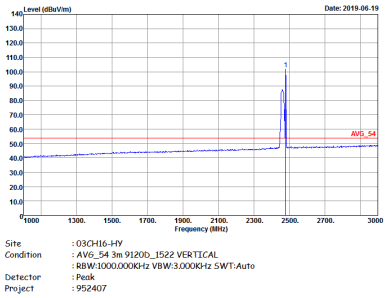
Test Engineer :	Jacky Hung, Austin Li and CR Liao	**Temperature :**	20~25°C
		Relative Humidity :	50~60%

Note symbol

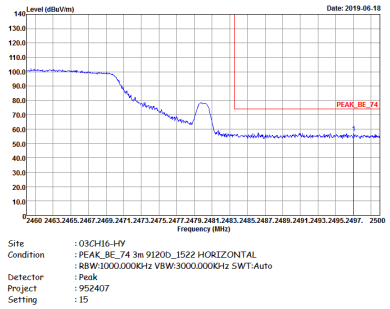
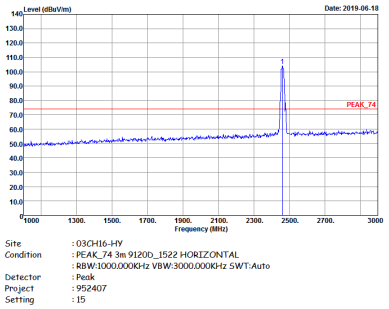
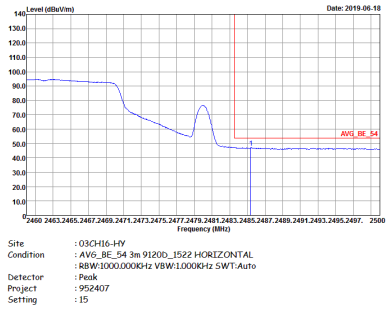
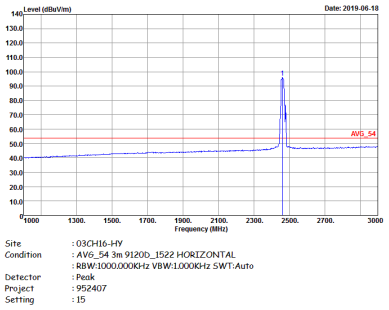
-L	**Low channel location**
-R	**High channel location**

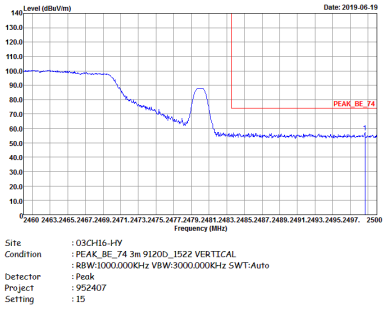
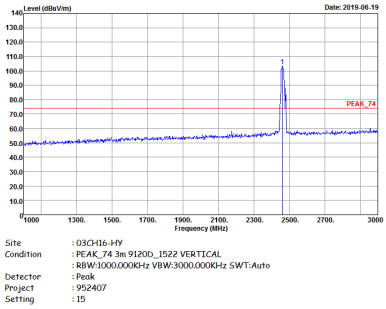
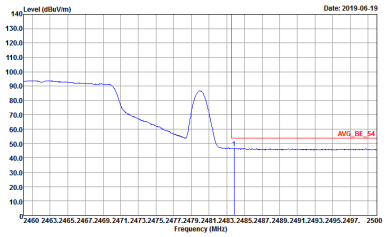
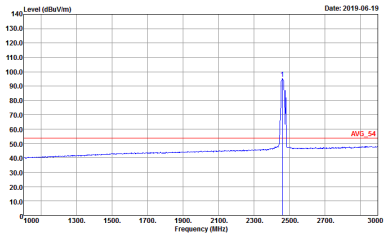
BLE + WIFI 802.11g (Band Edge @ 3m)

BLE	BLE + WIFI 802.11g Band Edge @ 3m	
ANT	BLE CH39	
1	Horizontal	Fundamental
Peak		
Avg.		

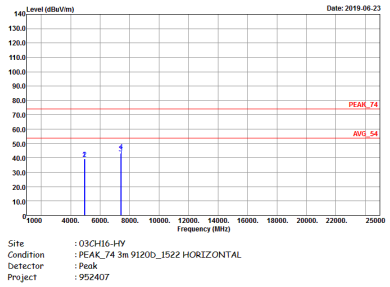
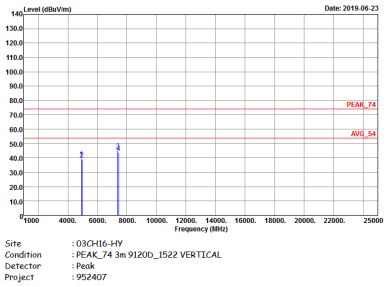
BLE	BLE + WIFI 802.11g Band Edge @ 3m	
ANT	BLE CH39	
1	Vertical	Fundamental
Peak		
Avg.		

BLE + WIFI 802.11g (Band Edge @ 3m)

WIFI	BLE + WIFI 802.11g Band Edge @ 3m	
ANT	WIFI 802.11g Ch11	
2	Horizontal	Fundamental
Peak		
Avg.		

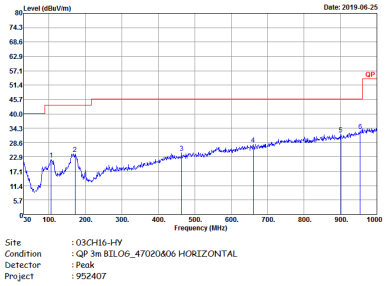
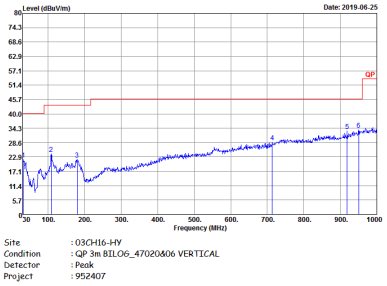
WIFI	BLE + WIFI 802.11g Band Edge @ 3m	
ANT	WIFI 802.11g Ch11	
2	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 15	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 15
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 15	 Site : 03CH16-HY Condition : AVG_54 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 15

BLE + WIFI 802.11g (Harmonic @ 3m)

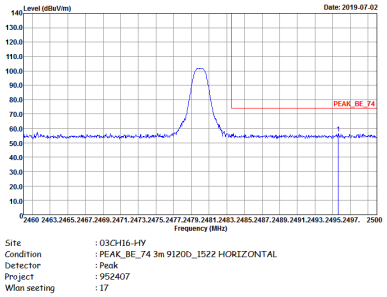
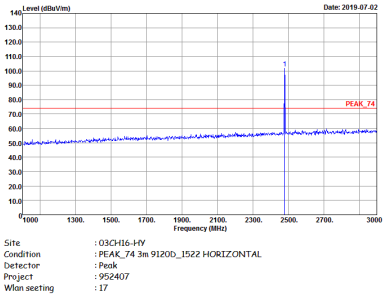
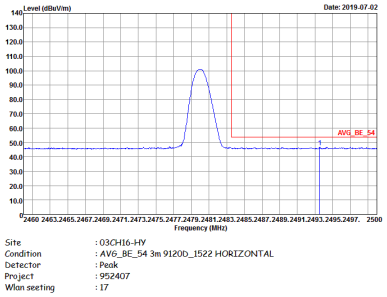
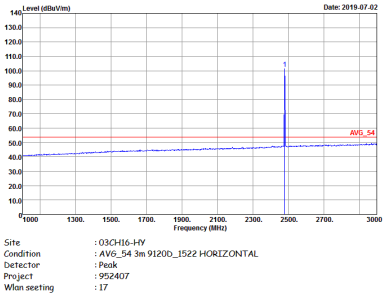
	BLE + WIFI 802.11g Harmonic @ 3m	
	BLE CH39 Ant 1 + WIFI 802.11g Ch11 Ant 2	
	Horizontal	Vertical
Peak Avg.		

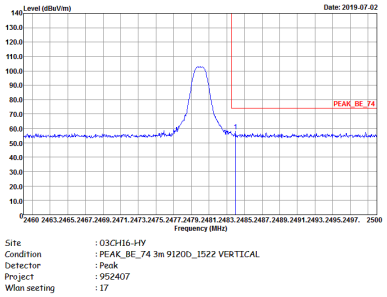
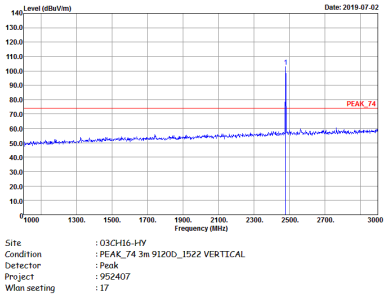
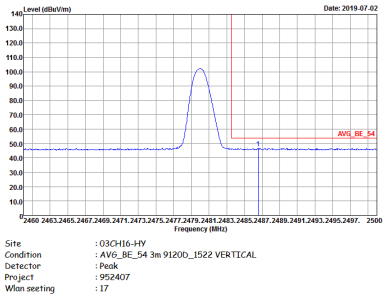
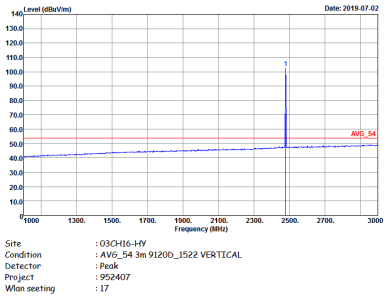
Emission below 1GHz

BLE + WIFI 802.11g (LF)

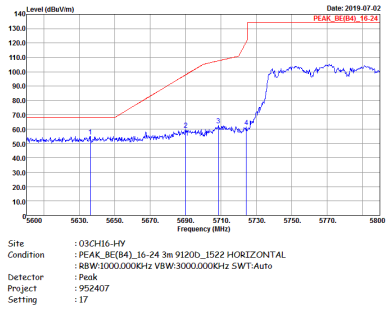
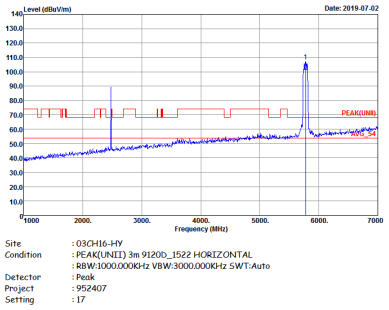
	BLE + WIFI 802.11g LF	
	BLE CH39 Ant 1 + WIFI 11g Ch11 Ant 2	
	Horizontal	Vertical
QP / Peak		

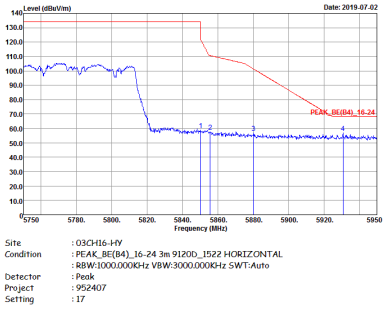
BLE + WIFI 802.11ac VHT80 (Band Edge @ 3m)

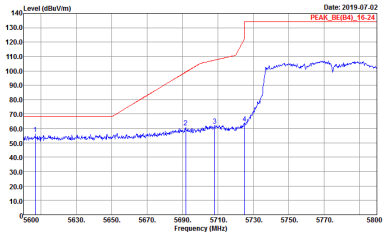
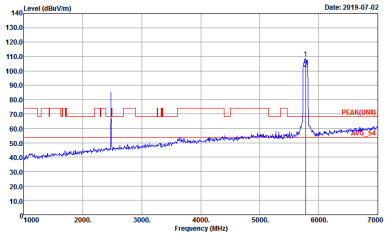
BLE	BLE + WIFI 802.11ac VHT80 Band Edge @ 3m	
ANT	BLE CH39	
1	Horizontal	Fundamental
Peak		
Avg.		

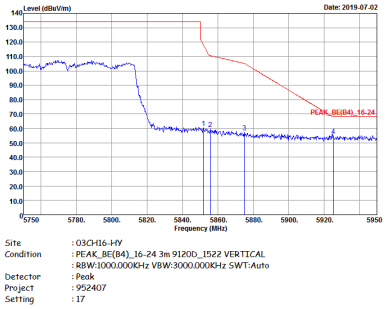
BLE	BLE + WIFI 802.11ac VHT80 Band Edge @ 3m	
ANT	BLE CH39	
1	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522 VERTICAL Detector : Peak Project : 952407 Wlan seeting : 17	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522 VERTICAL Detector : Peak Project : 952407 Wlan seeting : 17
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522 VERTICAL Detector : Peak Project : 952407 Wlan seeting : 17	 Site : 03CH16-HY Condition : AVG_54 3m 9120D_1522 VERTICAL Detector : Peak Project : 952407 Wlan seeting : 17

BLE + WIFI 802.11ac VHT80 (Band Edge @ 3m)

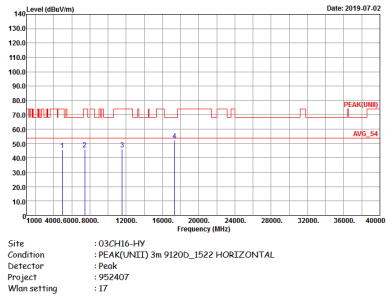
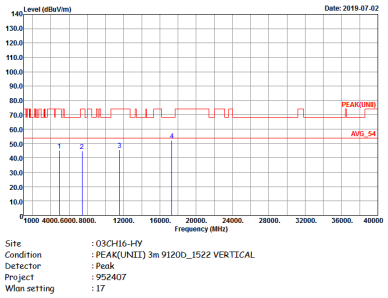
WIFI	BLE + WIFI 802.11ac VHT80 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT80 Ch155	
1	Horizontal	Fundamental
Peak		

WIFI	BLE + WIFI 802.11ac VHT80 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT80 Ch155	
1	Horizontal	Fundamental
Peak		

WIFI	BLE + WIFI 802.11ac VHT80 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT80 Ch155	
1	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE(B4)_16-24 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 17	 Site : 03CH16-HY Condition : PEAK(UNII) 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 17

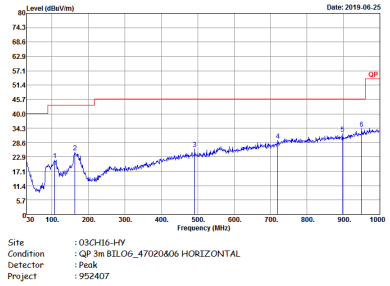
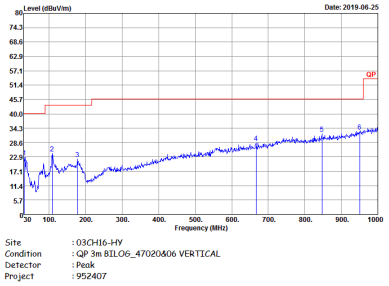
WIFI	BLE + WIFI 802.11ac VHT80 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT80 Ch155	
1	Vertical	Fundamental
Peak		

BLE + WIFI 802.11ac VHT80 (Harmonic @ 3m)

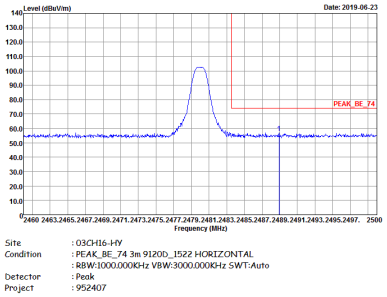
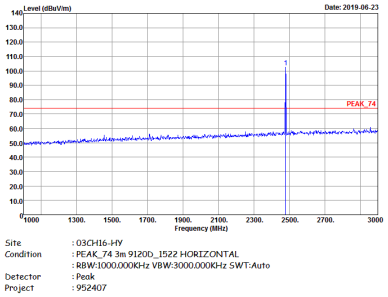
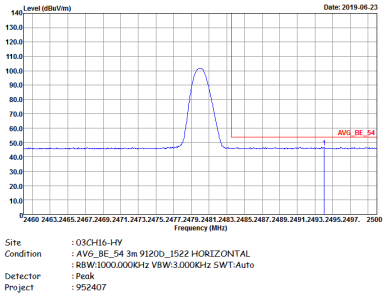
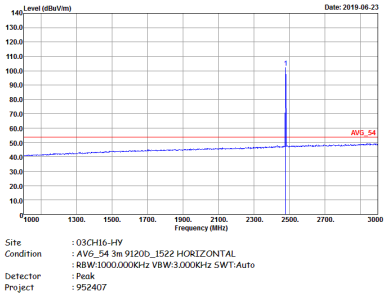
	BLE + WIFI 802.11ac VHT80 Harmonic @ 3m	
	BLE CH39 Ant 1 + WIFI 802.11ac VHT80 Ch155 Ant 1	
	Horizontal	Vertical
Peak Avg.		

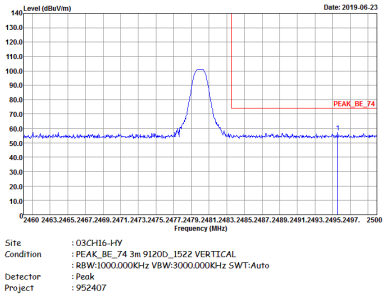
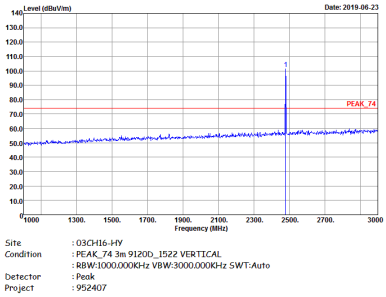
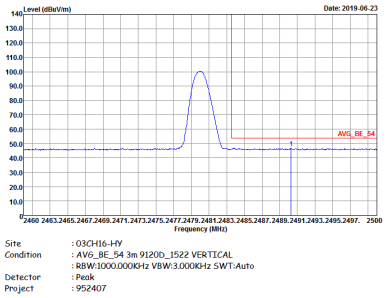
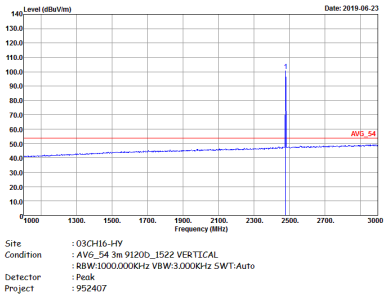
Emission below 1GHz

BLE + WIFI 802.11ac VHT80 (LF)

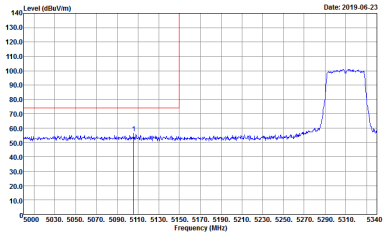
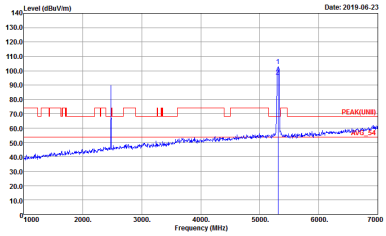
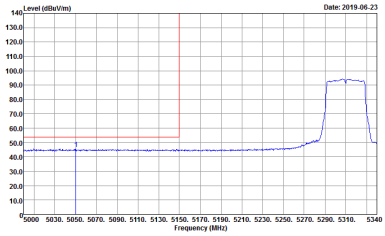
	BLE + WIFI 802.11ac VHT80 LF	
	BLE CH39 Ant 1 + WIFI 802.11ac VHT80 Ch155 Ant 1	
	Horizontal	Vertical
QP / Peak		

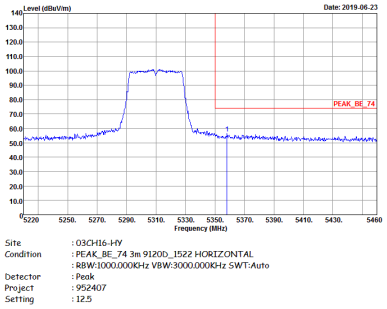
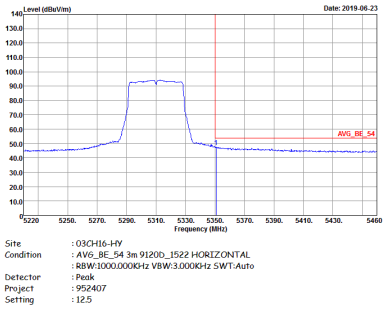
BLE + WIFI 802.11ac VHT40 (Band Edge @ 3m)

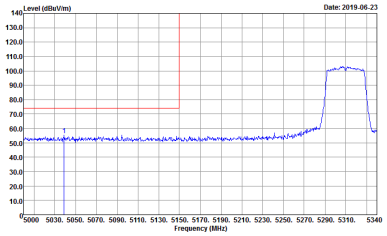
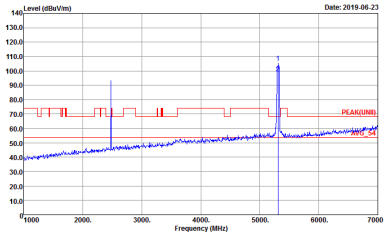
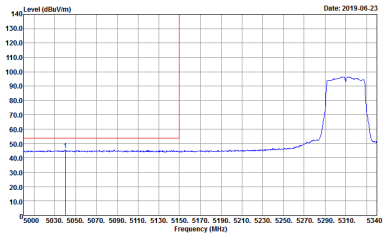
BLE	BLE + WIFI 802.11ac VHT40 Band Edge @ 3m	
ANT	BLE CH39	
1	Horizontal	Fundamental
Peak		
Avg.		

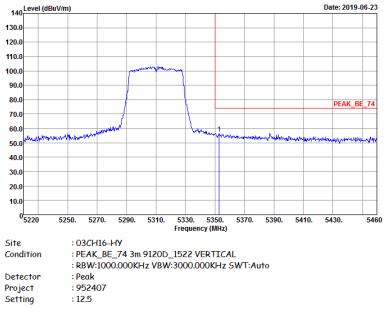
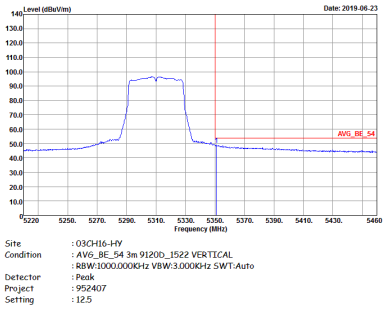
BLE	BLE + WIFI 802.11ac VHT40 Band Edge @ 3m	
ANT	BLE CH39	
1	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 952407	 Site : 03CH16-HY Condition : AVG_54 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 952407

BLE + WIFI 802.11ac VHT40 (Band Edge @ 3m)

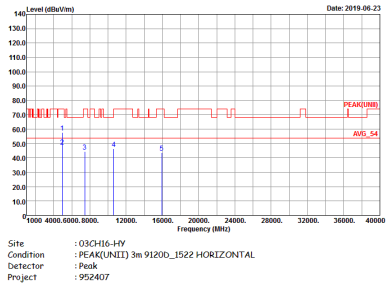
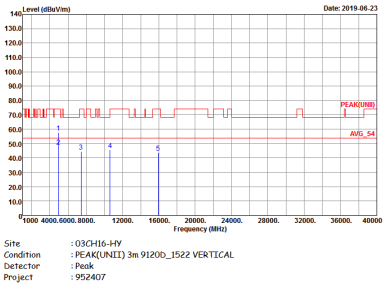
WIFI	BLE + WIFI 802.11ac VHT40 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT40 Ch62	
2	Horizontal	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 12.5	 Site : 03CH16-HY Condition : PEAK(UNID) 3m 9120D_1522 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 12.5
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 12.5	

WIFI	BLE + WIFI 802.11ac VHT40 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT40 Ch62	
2	Horizontal	Fundamental
Peak		
Avg.		

WIFI	BLE + WIFI 802.11ac VHT40 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT40 Ch62	
2	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 12.5	 Site : 03CH16-HY Condition : PEAK(UNII) 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 12.5
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Detector : Peak Project : 952407 Setting : 12.5	

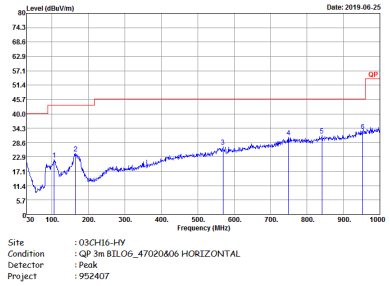
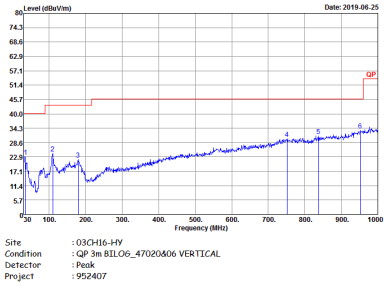
WIFI	BLE + WIFI 802.11ac VHT40 Band Edge @ 3m	
ANT	WIFI 802.11ac VHT40 Ch62	
2	Vertical	Fundamental
Peak		
Avg.		

BLE + WIFI 802.11ac VHT40 (Harmonic @ 3m)

	BLE + WIFI 802.11ac VHT40 Harmonic @ 3m	
	BLE CH39 Ant 1 + WIFI 802.11ac VHT40 Ch62 Ant 2	
	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

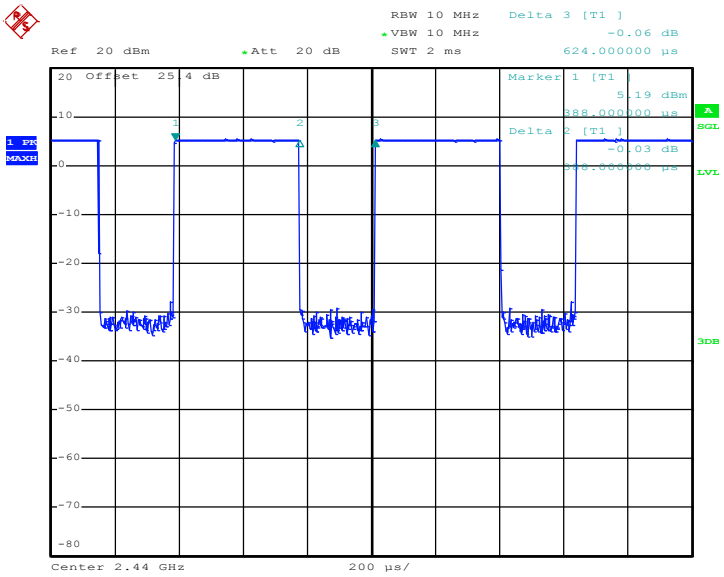
BLE + WIFI 802.11ac VHT40 (LF)

	BLE + WIFI 802.11ac VHT40 Harmonic @ 3m	
	BLE CH39 Ant 1 + WIFI 802.11ac VHT40 Ch62 Ant 2	
	Horizontal	Vertical
QP / Peak		

Appendix C. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
-	Bluetooth –LE for 1Mbps	62.18	388	2.58	3kHz	2.06
2	802.11g	97.31	2024	0.49	1kHz	0.12
2	5GHz 802.11ac VHT40	95.90	935	1.07	3kHz	0.18
1	5GHz 802.11ac VHT80	92.06	452	2.21	3kHz	0.36

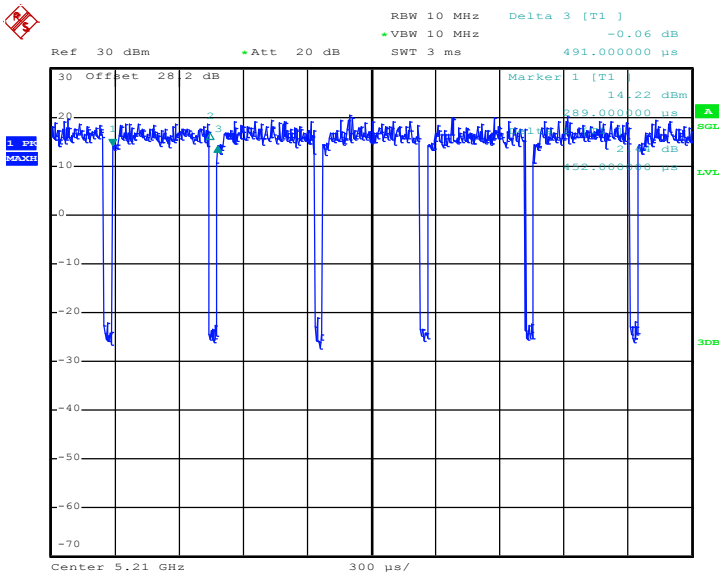
Bluetooth - LE



Date: 18.JUN.2019 03:23:44

<Ant. 1>

802.11ac VHT80



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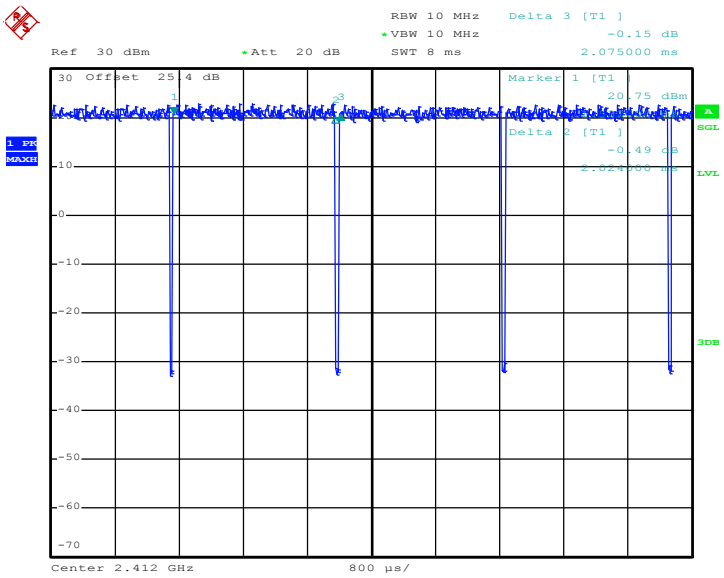
<Ant. 2>

802.11g



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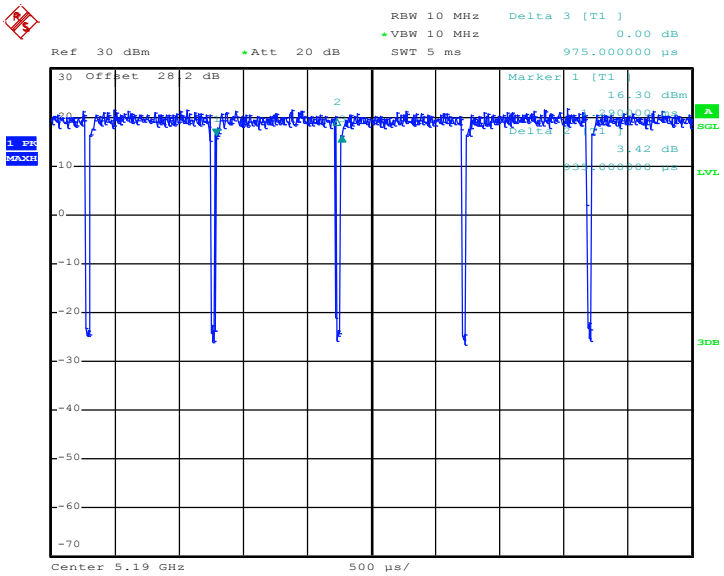
802.11ac VHT40



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