FCC RF TEST REPORT

47 CFR FCC Part 15 Subpart C § 15.249

EQUIPMENT	**:**	**Electronic Drive Train**
BRAND NAME	**:**	**FSA**
MODEL NAME	**:**	**SF-ED-8400**
FCC ID	**:**	**2ALMLSFED8400**

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.
The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Joseph Lin / Supervisor

Approved by: Jones Tsai / Manager

Testing Laboratory
1190

SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR760823B	Rev. 01	Initial issue of report	May 18, 2018

1. SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C § 15.249				
Part	**FCC Rule**	**Description of Test**	**Result**	**Remark**
3.1	15.207	AC Power Line Conducted Emissions	Not Required	-
3.2	2.1049	20dB & 99% Occupied Bandwidth	Complies	-
3.3	15.249(a)	Field Strength of Fundamental Emissions	Complies	Max level 81.09 dBμV/m at 2402.000 MHz
3.3	15.249(a)(d)	Radiated Spurious Emissions	Complies	Under limit 1.43 dB at 4884.000MHz
3.4	15.203	Antenna Requirements	Complies	-
Remark: Not required means after assessing, test items are not necessary to carry out.				

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

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

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**

2. GENERAL INFORMATION

2.1 Applicant

Tien Hsin industries Co., LTD

No.6, Wugong 8th Rd., Wufeng Dist., Taichung City 41353, Taiwan (R.O.C.)

2.2 Manufacturer

Tien Hsin industries Co., LTD

No.6, Wugong 8th Rd., Wufeng Dist., Taichung City 41353, Taiwan (R.O.C.)

2.3 Product Feature of Equipment Under Test

Bluetooth and ANT+

Product Specification subjective to this standard	
Antenna Type	Bluetooth: Chip Antenna ANT+: Chip Antenna

2.4 Modification of EUT

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

2.5 Table for Test Modes

Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode
AC Power Line Conducted Emissions	CTX
Field Strength of Fundamental Emissions	CTX
Bandwidth	CTX
Radiated Emissions	CTX

Note:

1. CTX=continuously transmitting.
2. The programmed RF utility, “QRCT Tool” installed in the notebook to make the EUT get into the engineering modes to continuously transmit.

2.6 Table for Testing Locations

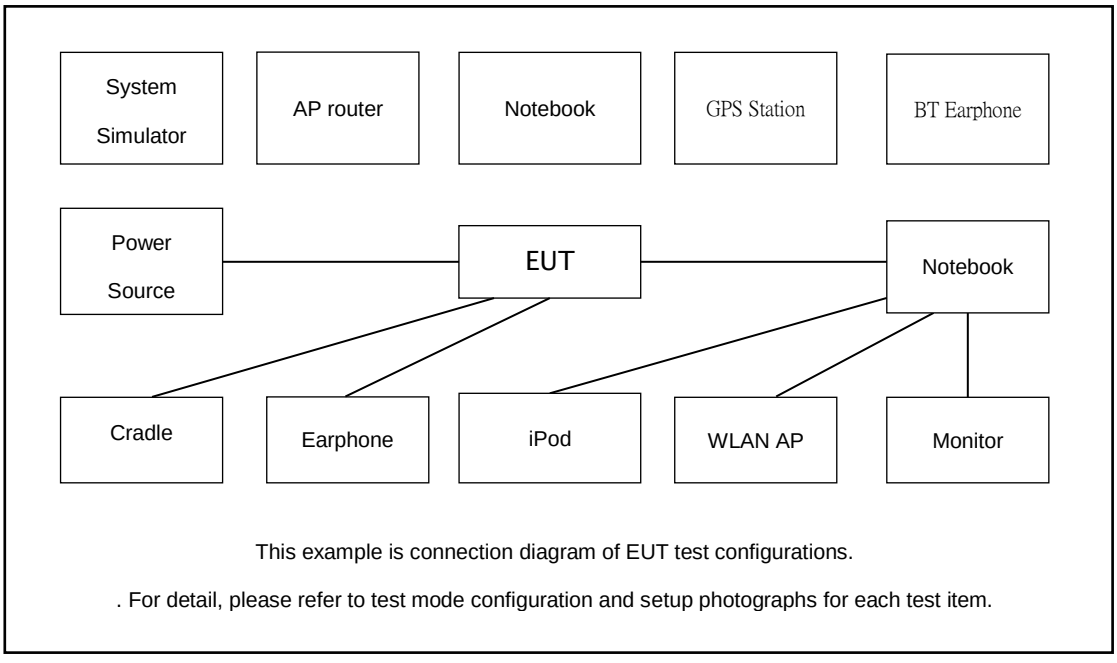
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	**Sporton Site No.**
	TH05-HY

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

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd. Guishan Dist, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH11-HY

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

2.7 Connection Diagram of Test System



This example is connection diagram of EUT test configurations.

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

3. TEST RESULT

3.1 20dB and & 99% Occupied Bandwidth

3.1.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band.

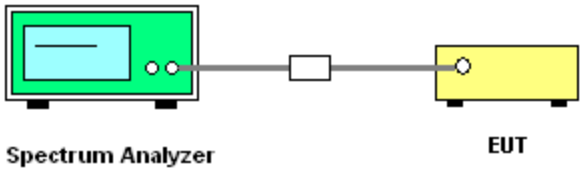
3.1.2 Measuring Instruments

Please refer to section 4 of equipment list in this report.

3.1.3 Test Procedures

1. The transmitter output port was connected to the spectrum analyzer.
2. Measured the spectrum width with highest power setting.

3.1.4 Test Setup Layout



3.1.5 Test Deviation

There is no deviation with the original standard.

3.1.6 EUT Operation during Test

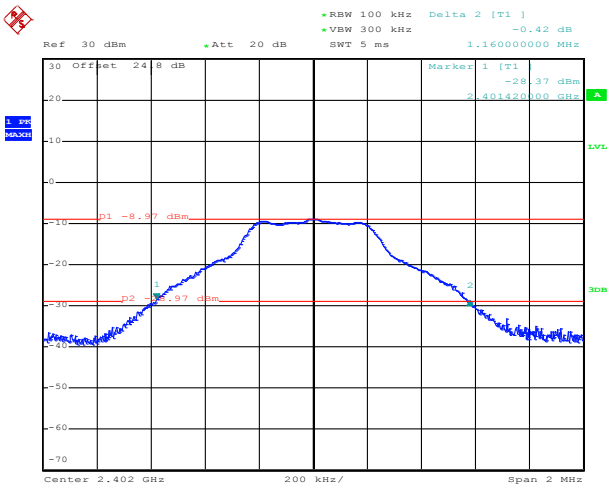
The EUT was programmed to be in continuously transmitting mode.

3.1.7 Test Result of 20dB Spectrum Bandwidth

Final Test Date	Apr. 07. 2018	Test Site No.	TH05-HY
Temperature	21~25°C	Humidity	51~54 %
Test Engineer	Shiming Liu and Rebecca Li		

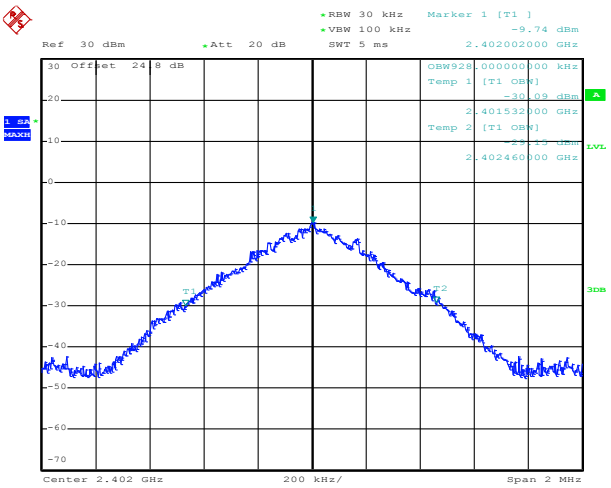
Frequency	20dB BW (MHz)	99% OBW (MHz)
2402MHz	1.160	0.928
2442MHz	1.156	0.928
2480MHz	1.176	0.932

20 dB Bandwidth Plot on 2402MHz



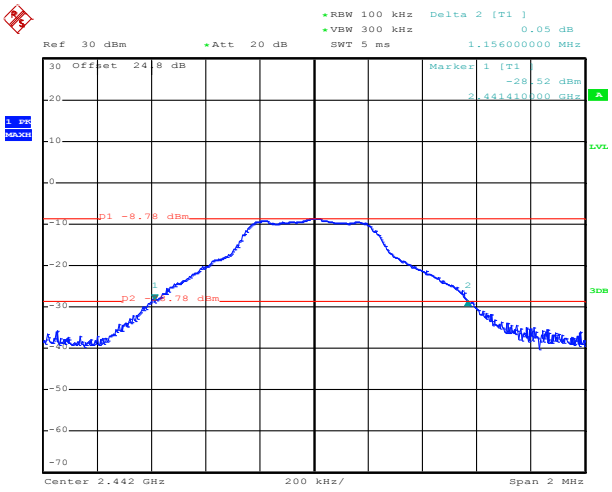
Date: 6.APR.2018 09:39:18

99% Bandwidth Plot on 2402MHz



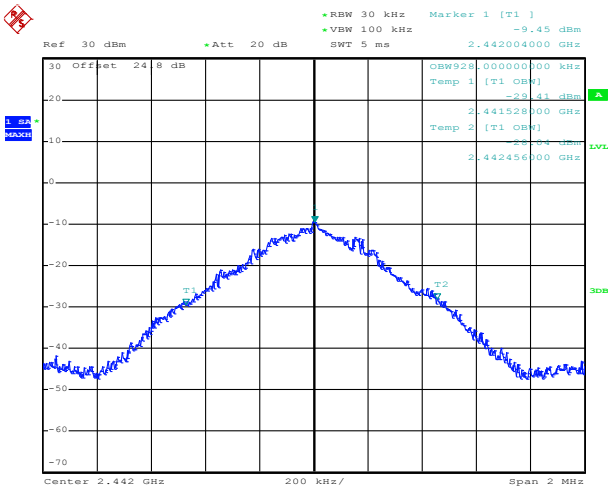
Date: 7.APR.2018 07:20:46

20 dB Bandwidth Plot on 2442MHz



Date: 6.APR.2018 09:48:07

99% Bandwidth Plot on 2442MHz



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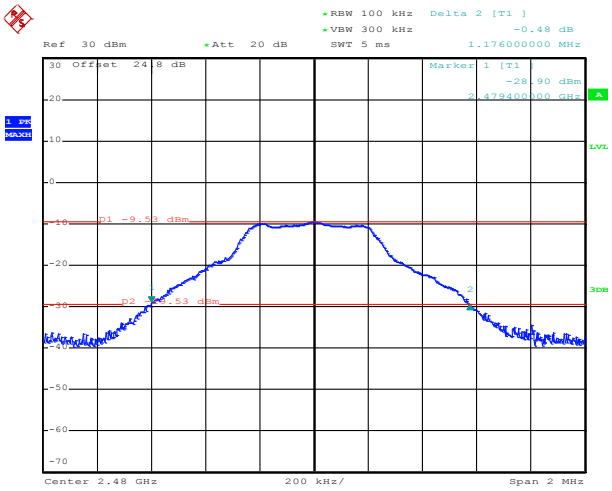
20 dB Bandwidth Plot on 2480MHz



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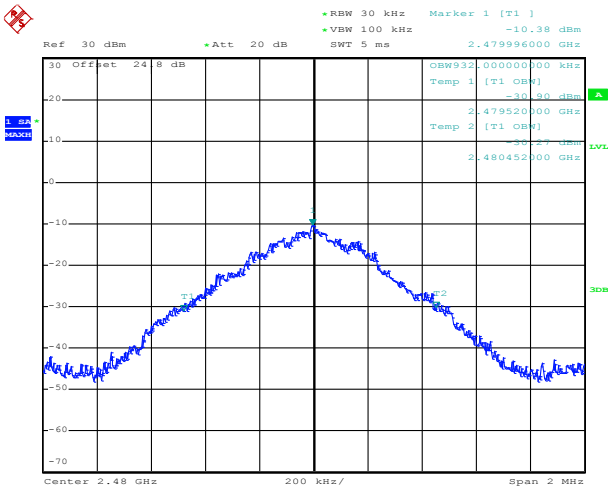
99% Bandwidth Plot on 2480MHz



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3.2 Field Strength of Fundamental Emissions and Radiated Spurious Emissions

3.2.1 Limit

The field strength measured at 3 meters shall not exceed the limits in the following table:

Fundamental Frequencies(MHz)	Field Strength(millivolts/m)	
	Fundamental	Harmonics
902~928	50	0.5
2400~2483.5	50	0.5
5725~5875	50	0.5

Note: The limits shown in the above table are based on measurements using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using a CISPR quasi-peak detector.

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in 15.209 as below, whichever is less stringent.

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

3.2.2 Measuring Instruments

Please refer to section 4 of equipment list in this report.

3.2.3 Test Procedures

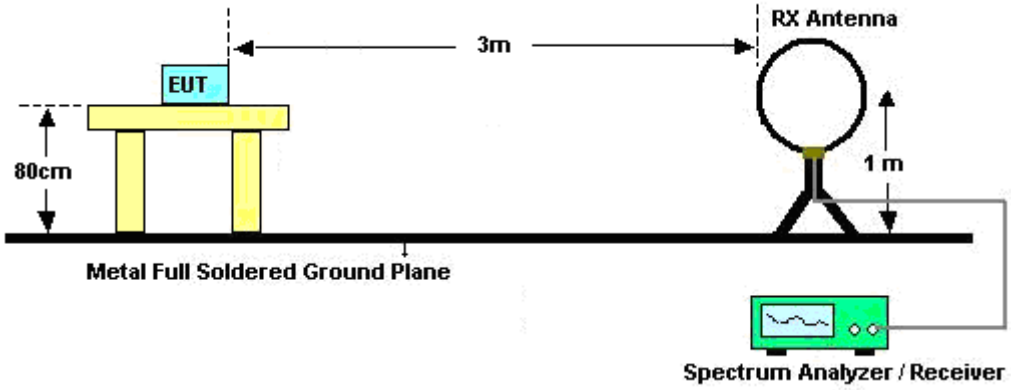
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.

Remark:

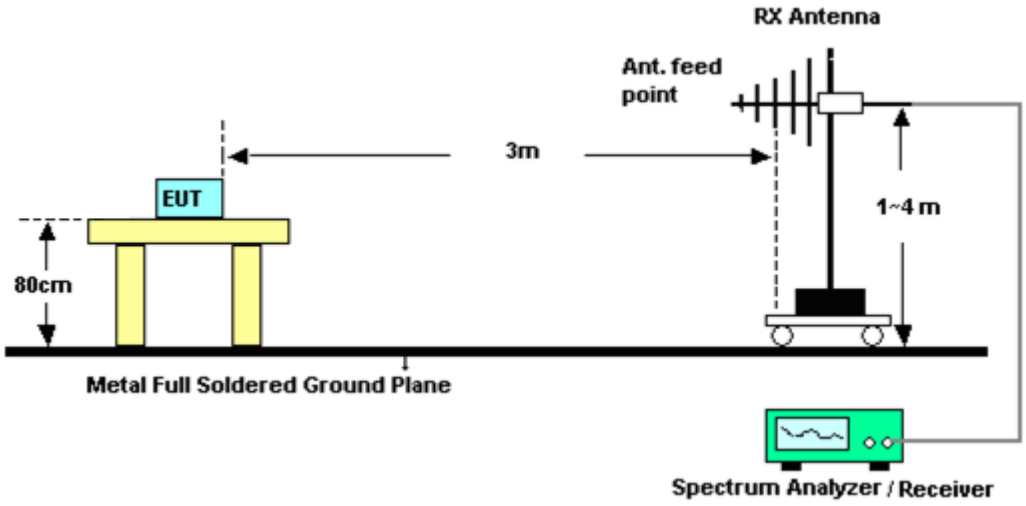
1. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
2. For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln
   Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)

3.2.4 Test Setup Layout

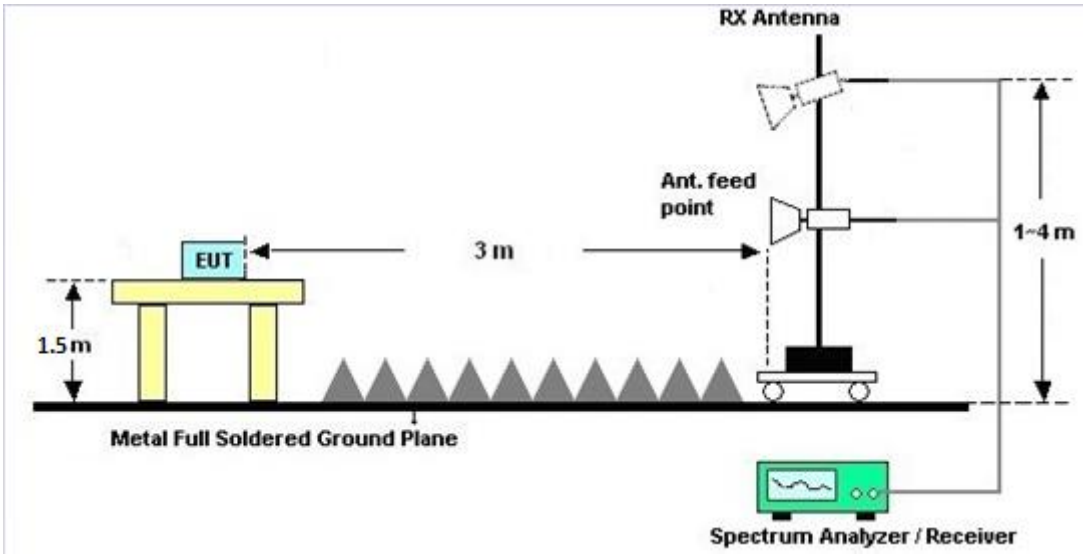
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.2.5 Test Deviation

There is no deviation with the original standard.

3.2.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

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

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

3.2.8 Duty cycle correction factor for average measurement

Please refer to Appendix C.

3.2.9 Test Result of Field Strength of Fundamental Emissions and Spurious Emissions

Please refer to Appendix A and B.

3.3 Antenna Requirements

3.3.1 Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

3.3.2 Antenna Connector Construction

Enbedded in Antenna.

4. LIST OF MEASURING EQUIPMENT

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Agilent	E4416A	GB41292344	N/A	Dec. 20, 2017	Mar. 27, 2018~ Apr. 07, 2018	Dec. 19, 2018	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	50MHz~18GHz	Dec. 20, 2017	Mar. 27, 2018~ Apr. 07, 2018	Dec. 19, 2018	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz~40GHz	Jun. 20, 2017	Mar. 27, 2018~ Apr. 07, 2018	Jun. 19, 2018	Conducted (TH05-HY)
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 18, 2017	Jan. 22, 2018~ Mar. 14, 2018	Jul. 17, 2018	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Nov. 10, 2016	Jan. 22, 2018~ Mar. 14, 2018	Nov. 09, 2018	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D&N-6-06	35414&AT-N0602	30MHz~1GHz	Oct. 14, 2017	Jan. 22, 2018~ Mar. 14, 2018	Oct. 13, 2018	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1326	1GHz ~ 18GHz	Oct. 16, 2017	Jan. 22, 2018~ Mar. 14, 2018	Oct. 15, 2018	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Nov. 23, 2017	Jan. 22, 2018~ Mar. 14, 2018	Nov. 22, 2019	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 10, 2016	Jan. 22, 2018~ Mar. 14, 2018	Nov. 09, 2018	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz ~ 44GHz	Oct. 19, 2017	Jan. 22, 2018~ Mar. 14, 2018	Oct. 18, 2018	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Jan. 22, 2018~ Mar. 14, 2018	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Jan. 22, 2018~ Mar. 14, 2018	N/A	Radiation (03CH11-HY)
EMI Test Receiver	Agilent	N9038A(MXE)	MY53290053	20Hz to 26.5GHz	Jan. 16, 2018	Jan. 22, 2018~ Mar. 14, 2018	Jan. 15, 2019	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 27, 2017	Jan. 22, 2018~ Mar. 14, 2018	Nov. 26, 2018	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-001042	NA	N/A	Jan. 22, 2018~ Mar. 14, 2018	N/A	Radiation (03CH11-HY)
RF Cable	HUBER+SUHNER/MTJCooperation	MT18A-600/SUCOFLEX 104	D1124, MY249694, MY286544	25MHz~1GHz	Oct. 12, 2017	Jan. 22, 2018~ Mar. 14, 2018	Oct. 11, 2018	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY249684,MY249694	1GHz~26GHz	Oct. 12, 2017	Jan. 22, 2018~ Mar. 14, 2018	Oct. 11, 2018	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-2700-3000-18000-60ST	SN2	3 GHz High pass	Jul. 17, 2017	Jan. 22, 2018~ Mar. 14, 2018	Jul. 16, 2018	Radiation (03CH11-HY)
Filter	Wainwright	WLKS1200-12SS	SN2	1.2G Low Pass	Mar. 24, 2017	Jan. 22, 2018~ Mar. 14, 2018	Mar. 23, 2018	Radiation (03CH11-HY)

Appendix A. Radiated Spurious Emission

Test Engineer :	Hao Hsu and Ken Wu	Temperature :	23~26°C
		Relative Humidity :	53~58%

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2.4GHz 2400~2483.5MHz

ANT+ (Band Edge @ 3m)

ANT+	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ANT+ CH 42 2442MHz		2388.04	51.89	-22.11	74	42.07	27.13	16.29	33.6	150	31	P	H
	*	2442.04	77.61	-36.39	114	67.61	27.27	16.31	33.58	150	31	P	H
		2486.44	52.97	-21.03	74	42.87	27.36	16.32	33.58	150	31	P	H
		2382.52	41.76	-12.24	54	31.98	27.09	16.29	33.6	150	31	A	H
	*	2442.04	77.07	-16.93	94	67.07	27.27	16.31	33.58	150	31	A	H
		2487.64	42.07	-11.93	54	31.93	27.4	16.32	33.58	150	31	A	H
		2381.32	51.44	-22.56	74	41.66	27.09	16.29	33.6	104	111	P	V
	*	2442.16	77.69	-36.31	114	67.69	27.27	16.31	33.58	104	111	P	V
		2483.8	51.74	-22.26	74	41.65	27.36	16.31	33.58	104	111	P	V
		2396.44	41.96	-12.04	54	32.13	27.13	16.29	33.59	104	111	A	V
	*	2442.04	77.18	-16.82	94	67.18	27.27	16.31	33.58	104	111	A	V
		2490.4	42.15	-11.85	54	32.01	27.4	16.32	33.58	104	111	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

ANT+ (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ANT+ CH 42 2442MHz		4884	46.01	-27.99	74	69.34	31.38	9.99	64.7	100	0	P	H
		7326	43.4	-30.6	74	60.16	36.32	11.75	64.83	100	0	P	H
													H
													H
		4884	54.36	-19.64	74	77.69	31.38	9.99	64.7	100	23	P	V
		4884	52.57	-1.43	54	75.9	31.38	9.99	64.7	100	23	A	V
		7326	42.42	-31.58	74	59.18	36.32	11.75	64.83	100	0	P	V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz ANT+ (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz ANT+ LF		48.09	24.92	-15.08	40	41.48	14.9	1.03	32.49	-	-	P	H
		130.98	18.34	-25.16	43.5	31.91	17.32	1.56	32.45	-	-	P	H
		254.64	19.9	-26.1	46	31	19.12	2.16	32.38	-	-	P	H
		467.3	25.67	-20.33	46	31.96	23.26	2.81	32.36	-	-	P	H
		720	40.66	-5.34	46	42.68	26.86	3.53	32.41	100	0	P	H
		832	36.62	-9.38	46	36.64	28.24	3.75	32.01	-	-	P	H
													H
													H
													H
													H
													H
													H
		30.81	36.69	-3.31	40	44.64	23.7	0.84	32.49	100	0	P	V
		48.9	33.86	-6.14	40	50.42	14.9	1.03	32.49	-	-	P	V
		98.31	22.37	-21.13	43.5	37.89	15.55	1.41	32.48	-	-	P	V
		456.1	24.52	-21.48	46	31.06	23.08	2.74	32.36	-	-	P	V
		736.1	32.65	-13.35	46	33.93	27.56	3.53	32.37	-	-	P	V
		939.8	32.79	-13.21	46	30.04	30.05	3.99	31.29	-	-	P	V
													V
													V
													V
													V
													V
													V

Remark

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

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2.4GHz 2400~2483.5MHz

ANT+ (Band Edge @ 3m)

ANT+	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
ANT+ CH 02 2402MHz		2399.08	51.57	-22.43	74	41.74	27.13	6.36	33.59	100	91	P	H
	*	2402	81.09	-32.91	114	71.26	27.13	6.36	33.59	100	91	P	H
		2399.32	41.83	-12.17	54	32	27.13	6.36	33.59	100	91	A	H
	*	2402	80.73	-13.27	94	70.9	27.13	6.36	33.59	100	91	A	H
													H
													H
		2399.56	53.69	-20.31	74	43.86	27.13	6.36	33.59	206	301	P	V
	*	2402	80.48	-33.52	114	70.65	27.13	6.36	33.59	206	301	P	V
		2391.52	41.83	-12.17	54	32	27.13	6.36	33.59	206	301	A	V
	*	2402	80.05	-13.95	94	70.22	27.13	6.36	33.59	206	301	A	V
													V
													V
ANT+ CH 42 2442MHz		2385.52	51.65	-22.35	74	41.83	27.13	6.36	33.6	111	92	P	H
	*	2442	76.7	-37.3	114	66.7	27.27	6.38	33.58	111	92	P	H
		2485	51.61	-22.39	74	41.51	27.36	6.39	33.58	111	92	P	H
		2399.8	41.84	-12.16	54	32.01	27.13	6.36	33.59	111	92	A	H
	*	2442	76.05	-17.95	94	66.05	27.27	6.38	33.58	111	92	A	H
		2485.48	42.07	-11.93	54	31.97	27.36	6.39	33.58	111	92	A	H
		2384.56	52.1	-21.9	74	42.32	27.09	6.36	33.6	135	300	P	V
	*	2442	77.13	-36.87	114	67.13	27.27	6.38	33.58	135	300	P	V
		2498.8	52.06	-21.94	74	41.91	27.4	6.39	33.57	135	300	P	V
		2398.48	41.76	-12.24	54	31.93	27.13	6.36	33.59	135	300	A	V
	*	2442	76.68	-17.32	94	66.68	27.27	6.38	33.58	135	300	A	V
		2491.12	42.2	-11.8	54	32.06	27.4	6.39	33.58	135	300	A	V

ANT+ CH 80 2480MHz	*	2480	76.6	-37.4	114	66.51	27.36	6.38	33.58	112	92	P	H
		2489.68	52.37	-21.63	74	42.23	27.4	6.39	33.58	112	92	P	H
	*	2480	76.14	-17.86	94	66.05	27.36	6.38	33.58	112	92	A	H
		2490.4	42.15	-11.85	54	32.01	27.4	6.39	33.58	112	92	A	H
													H
													H
	*	2480	77.57	-36.43	114	67.48	27.36	6.38	33.58	133	299	P	V
		2487.04	52.49	-21.51	74	42.39	27.36	6.39	33.58	133	299	P	V
	*	2480	77.1	-16.9	94	67.01	27.36	6.38	33.58	133	299	A	V
		2496.16	42.16	-11.84	54	32.01	27.4	6.39	33.57	133	299	A	V
													V
													V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

ANT+ (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ANT+ CH 02 2402MHz		4804	45.62	-28.38	74	69.08	31.26	9.6	64.75	100	0	P	H
													H
													H
													H
		4804	53.65	-20.35	74	77.11	31.26	9.6	64.75	108	15	P	V
		4804	51.46	-2.54	54	74.92	31.26	9.6	64.75	108	15	A	V
													V
													V
ANT+ CH 42 2442MHz		4884	45.95	-28.05	74	69.28	31.38	9.56	64.7	100	0	P	H
		7326	42.32	-31.68	74	59.08	36.32	11.31	64.83	100	0	P	H
													H
													H
		4884	54.54	-19.46	74	77.87	31.38	9.56	64.7	110	15	P	V
		4884	52.37	-1.63	54	75.7	31.38	9.56	64.7	110	15	A	V
		7326	42.79	-31.21	74	59.55	36.32	11.31	64.83	100	0	P	V
													V
ANT+ CH 80 2480MHz		4960	46.4	-27.6	74	69.52	31.54	9.53	64.63	100	0	P	H
		7440	42.4	-31.6	74	58.97	36.59	11.34	64.88	100	0	P	H
													H
													H
		4960	54.13	-19.87	74	77.25	31.54	9.53	64.63	104	13	P	V
		4960	51.73	-2.27	54	74.85	31.54	9.53	64.63	104	13	A	V
		7440	41.61	-32.39	74	58.18	36.59	11.34	64.88	100	0	P	V
													V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz ANT+ (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz ANT+ LF		48.9	24.42	-15.58	40	40.98	14.9	1.02	32.49	-	-	P	H
		119.91	17.99	-25.51	43.5	31.69	17.33	1.39	32.46	-	-	P	H
		224.13	17.95	-28.05	46	33.09	15.47	1.72	32.39	-	-	P	H
		458.2	23.71	-22.29	46	30.22	23.11	2.7	32.36	-	-	P	H
		703.9	34.98	-11.02	46	37.46	26.5	3.35	32.46	100	0	P	H
		880.3	34.79	-11.21	46	33.56	29.1	3.73	31.76	-	-	P	H
													H
													H
													H
													H
													H
													H
		48.09	36.85	-3.15	40	53.41	14.9	1.02	32.49	100	0	P	V
		122.88	21.46	-22.04	43.5	35.11	17.26	1.51	32.46	-	-	P	V
		262.74	19.15	-26.85	46	29.73	19.63	2.09	32.38	-	-	P	V
		395.9	21.44	-24.56	46	29.63	21.52	2.56	32.33	-	-	P	V
		561.8	26.9	-19.1	46	30.25	26.01	2.98	32.43	-	-	P	V
		868.4	32.21	-13.79	46	31.15	29.07	3.67	31.83	-	-	P	V
													V
													V
													V
													V
													V
													V
Remark	3. No other spurious found. 4. All results are PASS against limit line.												

Note symbol

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

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

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

1. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

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

Appendix B. Radiated Spurious Emission Plots

Test Engineer :	Hao Hsu and Ken Wu	**Temperature :**	23~26°C
		Relative Humidity :	53~58%

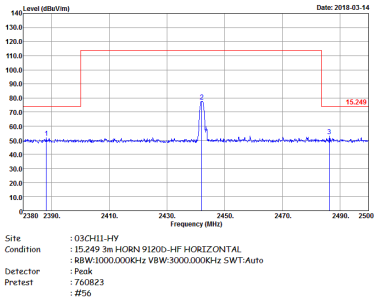
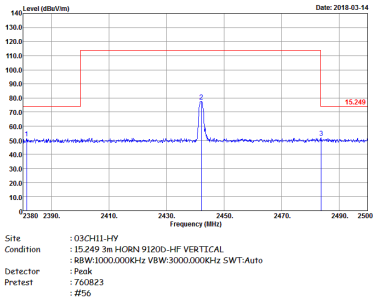
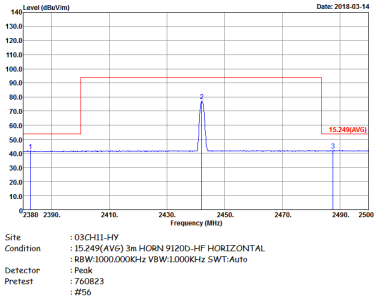
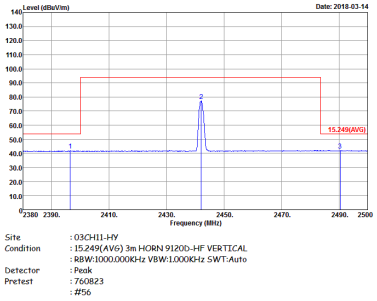
Note symbol

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

<For Right>

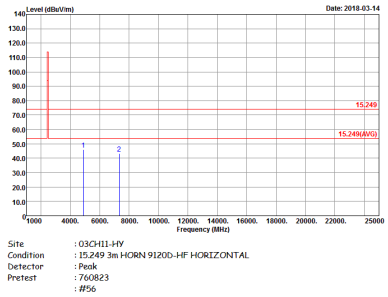
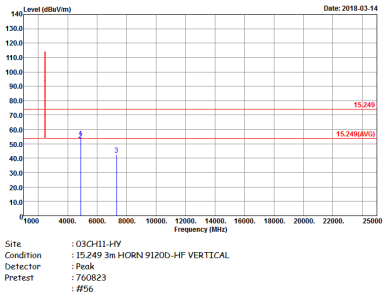
2.4GHz 2400~2483.5MHz

ANT+ (Band Edge @ 3m)

ANT+	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	ANT+ CH42 2442MHz	
1	Horizontal	Vertical
Peak		
Avg.		

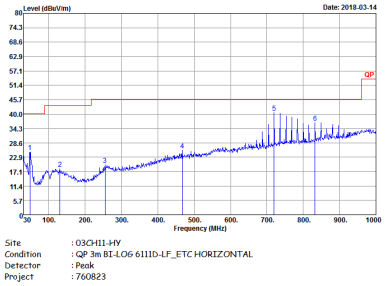
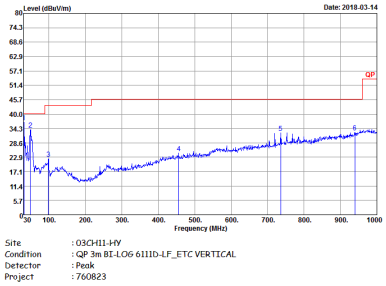
2.4GHz 2400~2483.5MHz

ANT+ (Harmonic @ 3m)

ANT+	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	ANT+ CH42 2442MHz	
1	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

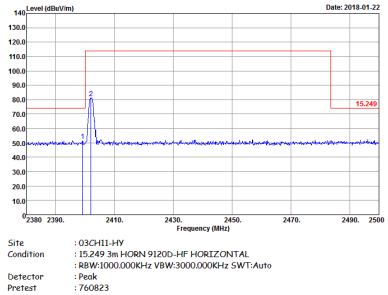
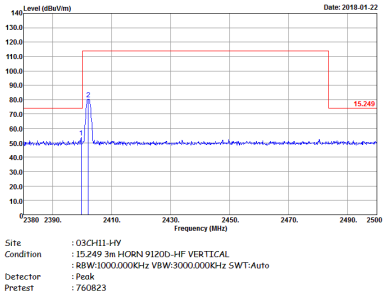
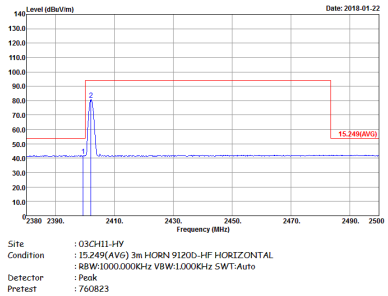
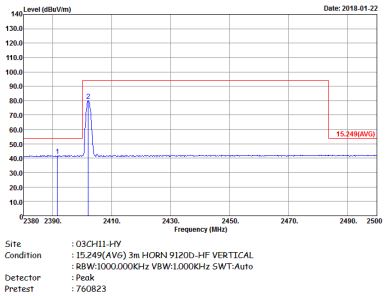
2.4GHz ANT+ (LF)

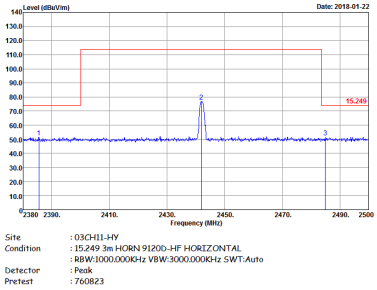
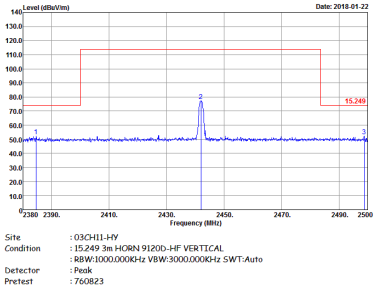
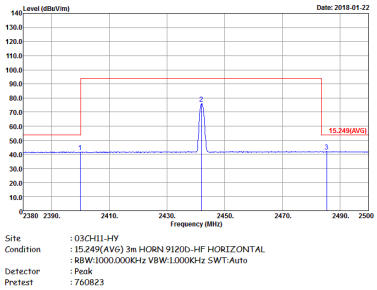
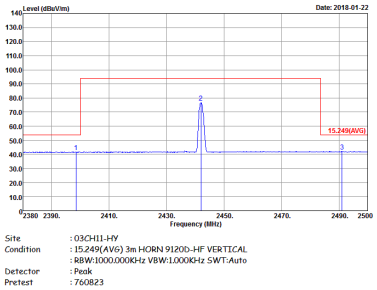
ANT+	2.4GHz 2400~2483.5MHz	
ANT	ANT+_LF	
1	Horizontal	Vertical
QP / Peak		

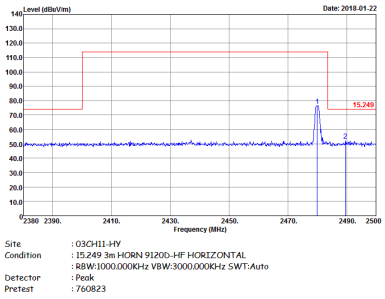
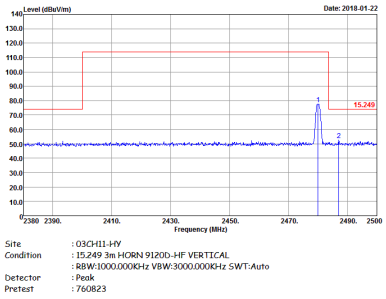
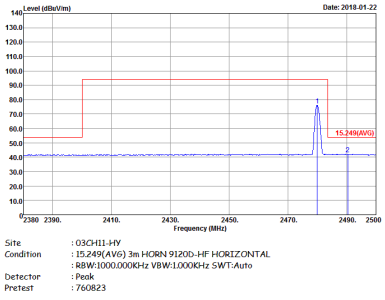
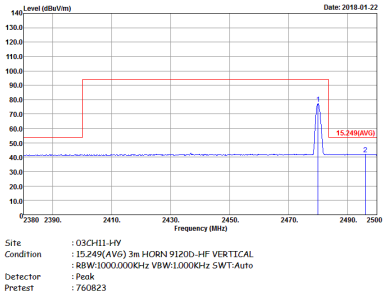
<For Left>

2.4GHz 2400~2483.5MHz

ANT+ (Band Edge @ 3m)

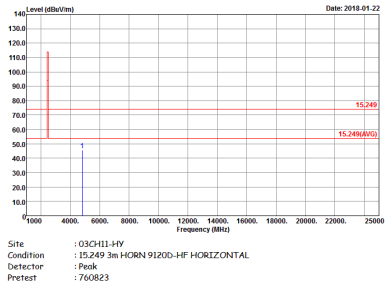
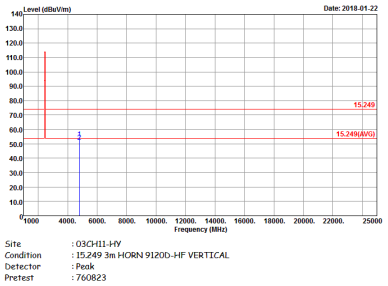
ANT+	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	ANT+ CH02 2402MHz	
1	Horizontal	Vertical
Peak		
Avg.		

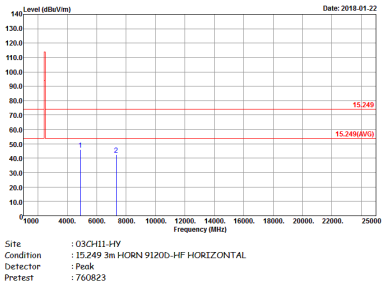
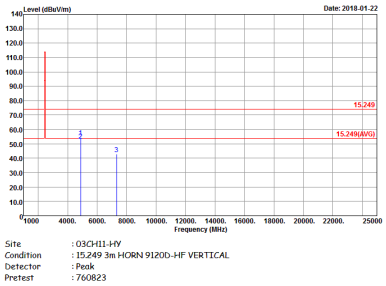
ANT+	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	ANT+ CH42 2442MHz	
1	Horizontal	Vertical
Peak	 Site : 03CH11-HY Condition : 15.249 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 760823	 Site : 03CH11-HY Condition : 15.249 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 760823
Avg.	 Site : 03CH11-HY Condition : 15.249(AV6) 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Pretest : 760823	 Site : 03CH11-HY Condition : 15.249(AV6) 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Pretest : 760823

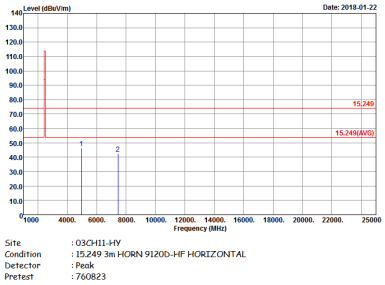
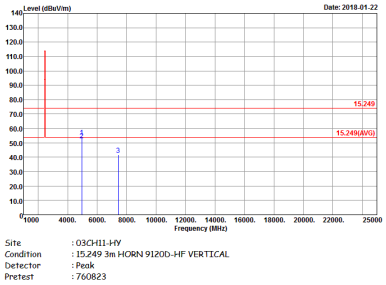
ANT+	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	ANT+ CH80 2480MHz	
1	Horizontal	Vertical
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

ANT+ (Harmonic @ 3m)

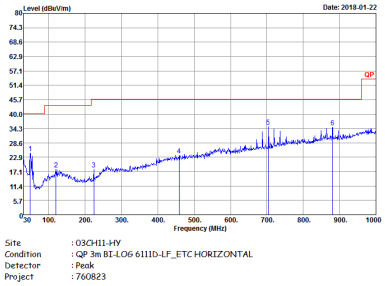
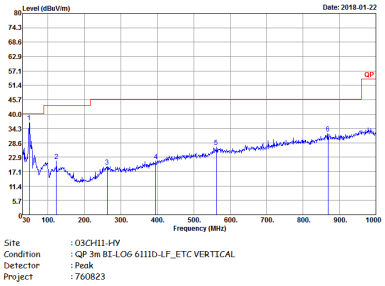
ANT+	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	ANT+ CH02 2402MHz	
1	Horizontal	Vertical
Peak Avg.		

ANT+	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	ANT+ CH42 2442MHz	
1	Horizontal	Vertical
Peak Avg.		

ANT+	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	ANT+ CH80 2480MHz	
1	Horizontal	Vertical
Peak		

Emission below 1GHz

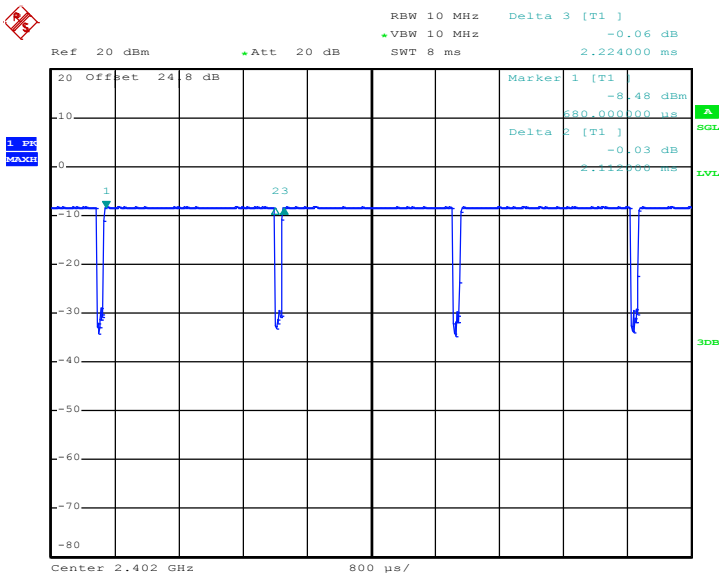
2.4GHz ANT+ (LF)

ANT+	2.4GHz 2400~2483.5MHz	
ANT	ANT+_LF	
1	Horizontal	Vertical
QP / Peak		

Appendix C. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
Bluetooth -LE	94.96	2112	0.47	1kHz	0.22

ANT+



Date: 19.MAR.2018 05:12:43