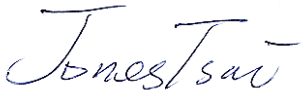
FCC RF TEST REPORT

47 CFR FCC Part 15 Subpart C § 15.249

EQUIPMENT	**:**	**Electronic Drive Train**
BRAND NAME	**:**	**FSA**
MODEL NAME	**:**	**FD-ED-8400**
FCC ID	**:**	**2ALMLFDED8400**

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
FR760902B	Rev. 01	Initial issue of report	Apr, 24, 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	Complies	Under limit 13.00 dB at 0.630MHz
3.2	2.1049	20dB & 99% Occupied Bandwidth	Complies	-
3.3	15.249(a)	Field Strength of Fundamental Emissions	Complies	Max level 80.74 dBμV/m at 2480.000 MHz
3.3	15.249(a)(d)	Radiated Spurious Emissions	Complies	Under limit 0.14 dB at 4804.000MHz
3.4	15.203	Antenna Requirements	Complies	-

Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.7**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.6**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.9**

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

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

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 RF test items, power on the EUT 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.

AC Conducted Emission	Mode 1: ANT+ Link + Shifter + Battery (With Notebook Charge) Mode 2: Bluetooth LE Link + Phone + Battery (With Adapter Charge)
Remark: The worst case of conducted emission is mode 2; only the test data of it was reported.	

2.6 Table for Testing Locations

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1190 and TW0007 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

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	CO05-HY

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

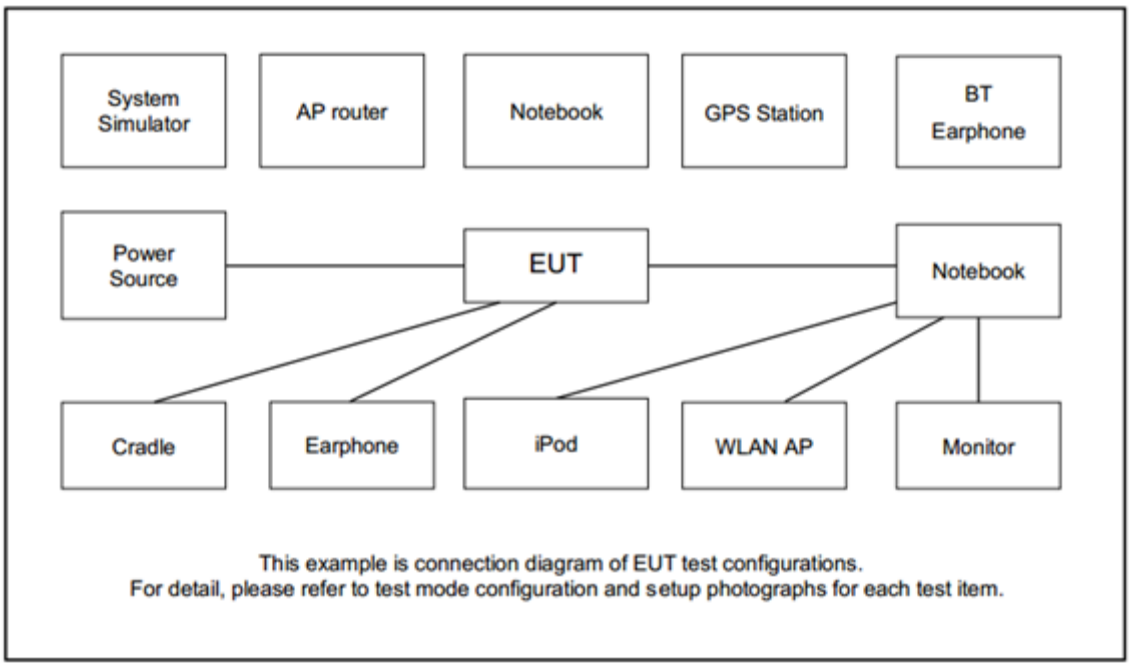
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd. Guishan Dist, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH10-HY

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

2.7 Table for Supporting Units

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded,1.8m
2.	iPod	Apple	A1285	FCC DoC	Shielded, 1.0 m	N/A
3.	Notebook	DELL	Latitude E6320	FCC DoC/ Contains FCC ID: QDS-BRCM1054	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Mobile Phone	Acer	T012	HLZDMZ320	N/A	N/A
5.	Adapter	NA	NA	NA	N/A	N/A

2.8 Connection Diagram of Test System



3. TEST RESULT

3.1 AC Power Line Conducted Emissions Measurement

3.1.1 Limit

For a Low-power Radio-frequency device which is designed to be connected to the AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed below limits table.

Frequency (MHz)	QP Limit (dBμV)	AV Limit (dBμV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

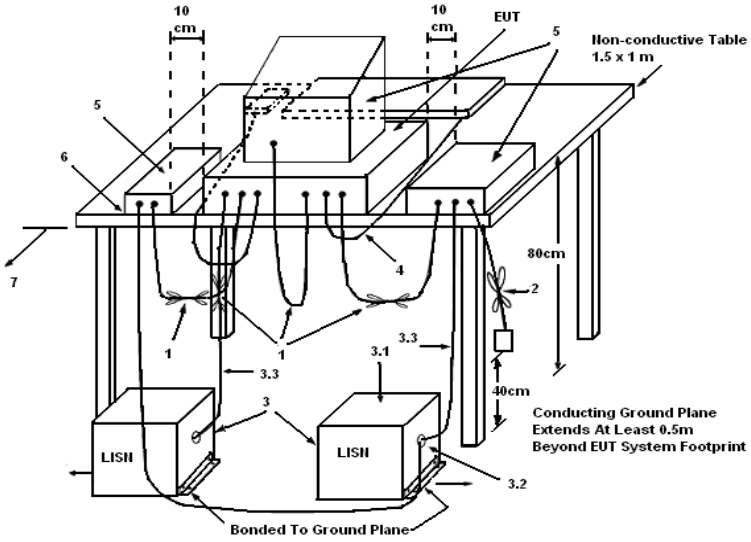
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

1. Configure the EUT according to ANSI C63.4. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 kHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

3.1.4 Test Setup Layout



LEGEND:

(1) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

(2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

(3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference ground plane.

(3.1) All other equipment powered from additional LISN(s).

(3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

(3.3) LISN at least 80 cm from nearest part of EUT chassis.

(4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

(5) Non-EUT components of EUT system being tested.

(6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

(7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.

3.1.5 Test Deviation

There is no deviation with the original standard.

3.1.6 EUT Operation during Test

The EUT was placed on the test table and programmed in transmitting function.

3.1.7 Results of AC Power Line Conducted Emissions Measurement

Please refer to Appendix A

3.2 20dB and & 99% Occupied Bandwidth

3.2.1 Limit

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

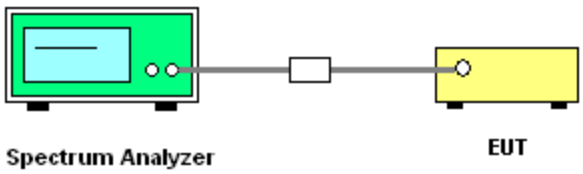
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

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

3.2.4 Test Setup Layout



3.2.5 Test Deviation

There is no deviation with the original standard.

3.2.6 EUT Operation during Test

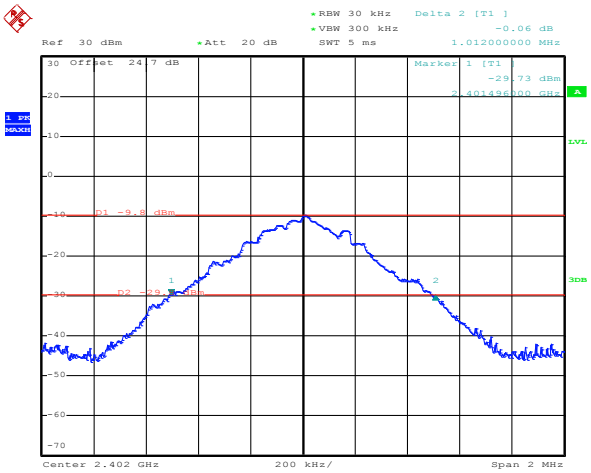
The EUT was programmed to be in continuously transmitting mode.

3.2.7 Test Result of 20dB Spectrum Bandwidth

Final Test Date	Feb. 05, 2018 ~ Feb. 23, 2018	Test Site No.	TH05-HY
Temperature	21~25°C	Humidity	51~54%
Test Engineer	Lena Lo		

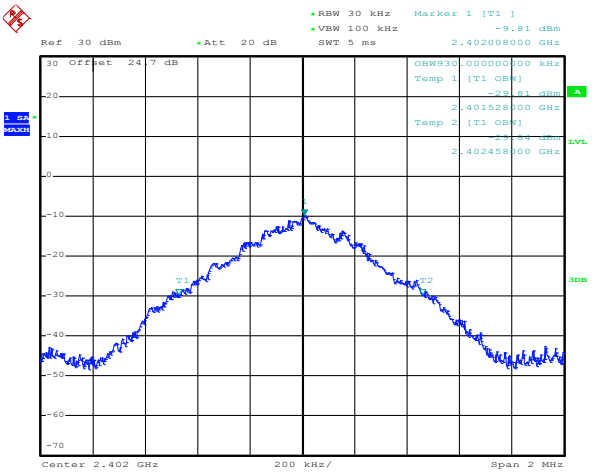
Frequency	20dB BW (MHz)	99% OBW (MHz)
2402MHz	1.012	0.930
2442MHz	0.982	0.926
2480MHz	0.996	0.932

20 dB Bandwidth Plot on 2402MHz



Date: 23.FEB.2018 09:35:36

99% Bandwidth Plot on 2402MHz



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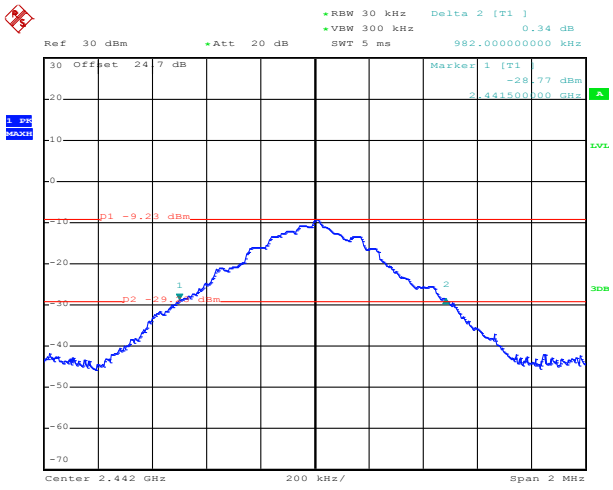
20 dB Bandwidth Plot on 2442MHz



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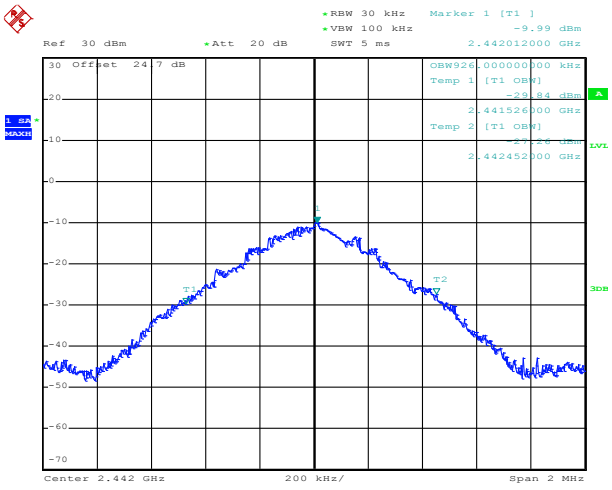
99% Bandwidth Plot on 2442MHz



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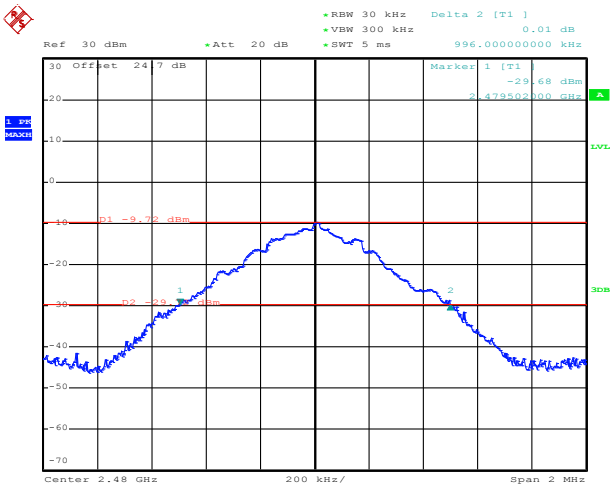
20 dB Bandwidth Plot on 2480MHz



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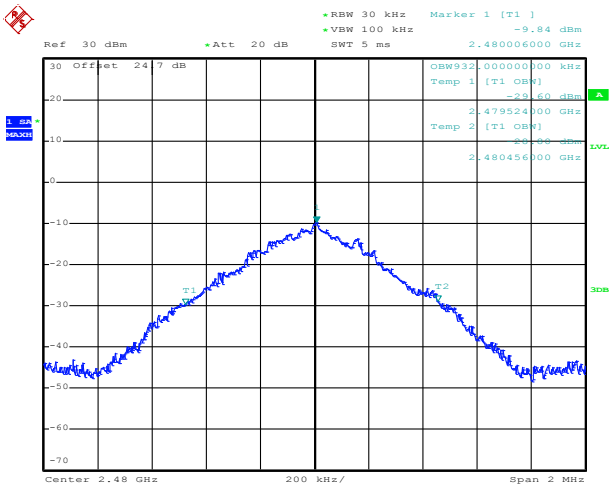
99% Bandwidth Plot on 2480MHz



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3.3 Field Strength of Fundamental Emissions and Radiated Spurious Emissions

3.3.1 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

3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

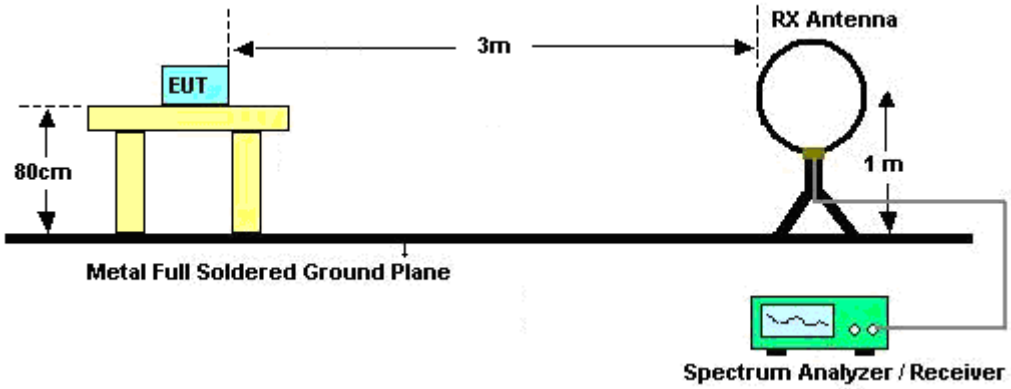
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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:

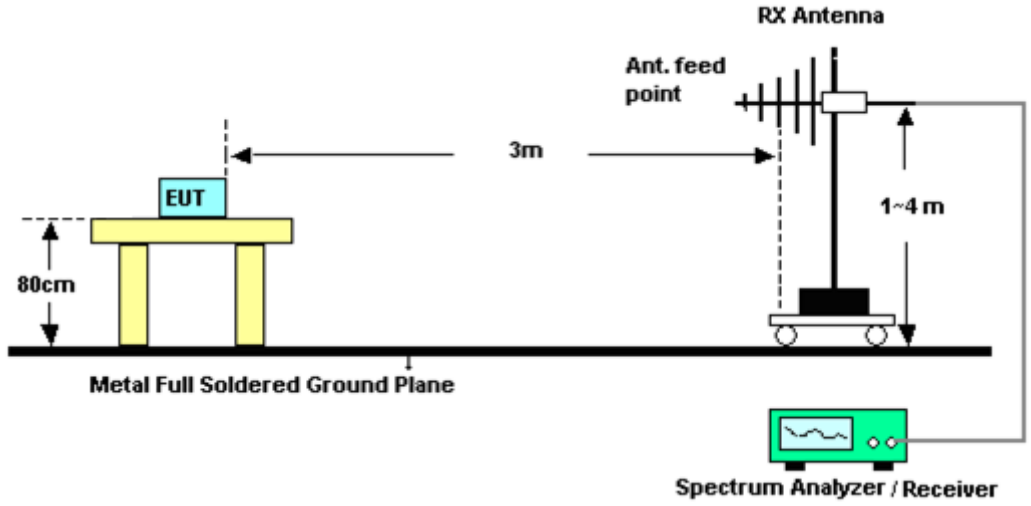
1. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
2. For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln
   Where N1 is number of type 1 pulses, L1 is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

3.3.4 Test Setup Layout

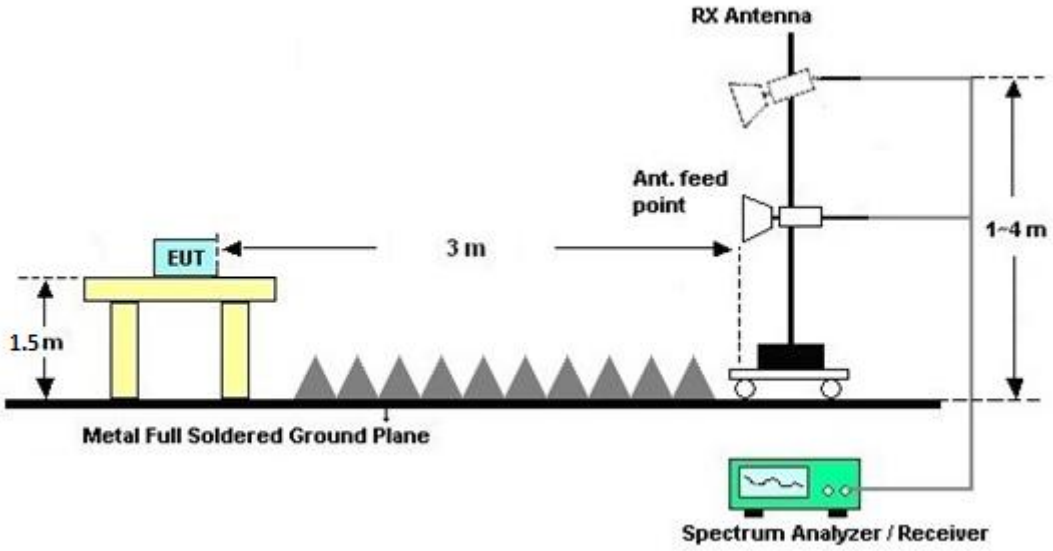
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.3.5 Test Deviation

There is no deviation with the original standard.

3.3.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

3.3.7 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 was not reported.

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

3.3.8 Duty cycle correction factor for average measurement

Please refer to Appendix D.

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

Please refer to Appendix B and C

3.4 Antenna Requirements

3.4.1 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.

3.4.2 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	Feb. 05, 2018~ Feb. 23. 2018	Dec. 19, 2018	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	50MHz~18GHz	Dec. 20, 2017	Feb. 05, 2018~ Feb. 23. 2018	Dec. 19, 2018	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz~40GHz	Jun. 20, 2017	Feb. 05, 2018~ Feb. 23. 2018	Jun. 19, 2018	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Dec. 20, 2017~ Dec. 21, 2017	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9kHz~7GHz	Sep. 20, 2017	Dec. 20, 2017~ Dec. 21, 2017	Sep. 19, 2018	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 30, 2017	Dec. 20, 2017~ Dec. 21, 2017	Nov. 29, 2018	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Dec. 08, 2017	Dec. 20, 2017~ Dec. 21, 2017	Dec. 07, 2018	Conduction (CO05-HY)
Test Software	Rohde & Schwarz	EMC32 V8.4	N/A	N/A	N/A	Dec. 20, 2017~ Dec. 21, 2017	N/A	Conduction (CO05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Nov. 10, 2017	Dec.19, 2017~ Jan.05 2018	Nov. 09, 2019	Radiation (03CH10-HY)
Amplifier	SONOMA	310N	187311	9kHz~1GHz	Oct. 19, 2017	Dec. 19, 2017~ Jan. 05, 2018	Oct. 18, 2018	Radiation (03CH10-HY)
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 18, 2017	Dec. 19, 2017~ Jan. 05, 2018	Jul. 17, 2018	Radiation (03CH10-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	35413&02	30MHz~1GHz	Jan. 07, 2017	Dec. 19, 2017~ Jan. 05, 2018	Jan. 06, 2018	Radiation (03CH10-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1325	1GHz ~ 18GHz	Sep. 27, 2017	Dec. 19, 2017~ Jan. 05, 2018	Sep. 26, 2018	Radiation (03CH10-HY)
Preamplifier	Keysight	83017A	MY53270078	1GHz~26.5GHz	Oct. 25, 2017	Dec. 19, 2017~ Jan. 05, 2018	Oct. 24, 2018	Radiation (03CH10-HY)
Preamplifier	MITEQ	AMF-7D-00101800	2025787	1GHz~18GHz	Feb. 13, 2017	Dec. 19, 2017~ Jan. 05, 2018	Feb 12, 2018	Radiation (03CH10-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz ~ 44GHz	Oct. 31, 2017	Dec. 19, 2017~ Jan. 05, 2018	Oct. 30, 2018	Radiation (03CH10-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Dec. 19, 2017~ Jan. 05, 2018	N/A	Radiation (03CH10-HY)
Turn Table	EMEC	TT 2200	N/A	0~360 Degree	N/A	Dec. 19, 2017~ Jan. 05, 2018	N/A	Radiation (03CH10-HY)
EMI Test Receiver	Agilent	N9038A(MXE)	MY53290053	20Hz to 26.5GHz	Jan. 12, 2017	Dec. 19, 2017~ Jan. 05, 2018	Jan. 11, 2018	Radiation (03CH10-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 27, 2017	Dec. 19, 2017~ Jan. 05, 2018	Nov. 26, 2018	Radiation (03CH10-HY)
Filter	Wainwright	WHKX12-2700-3000-18000-60ST	SN2	3 GHz High pass	Jul. 17, 2017	Dec. 19, 2017~ Jan. 05, 2018	Jul. 16, 2018	Radiation (03CH10-HY)
Filter	Wainwright	WLKS1200-12SS	SN2	1.2G Low Pass	Mar. 24, 2017	Dec. 19, 2017~ Jan. 05, 2018	Mar. 23, 2018	Radiation (03CH10-HY)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Test Software	Audix	E3 6.2009-8-24	RK-001042	N/A	N/A	Dec. 19, 2017 ~ Jan. 05, 2018	N/A	Radiation (03CH10-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY335041/4 MY9840/4 MY9838/4	30MHz~1GHz	Jan. 26, 2017	Dec. 19, 2017 ~ Jan. 05, 2018	Jan. 25, 2018	Radiation (03CH10-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY335041/4 MY9840/4 MY9838/4	1GHz~26GHz	Jan. 26, 2017	Dec. 19, 2017 ~ Jan. 05, 2018	Jan. 25, 2018	Radiation (03CH10-HY)

Note: Test equipment calibration is traceable to the procedure of ISO17025.

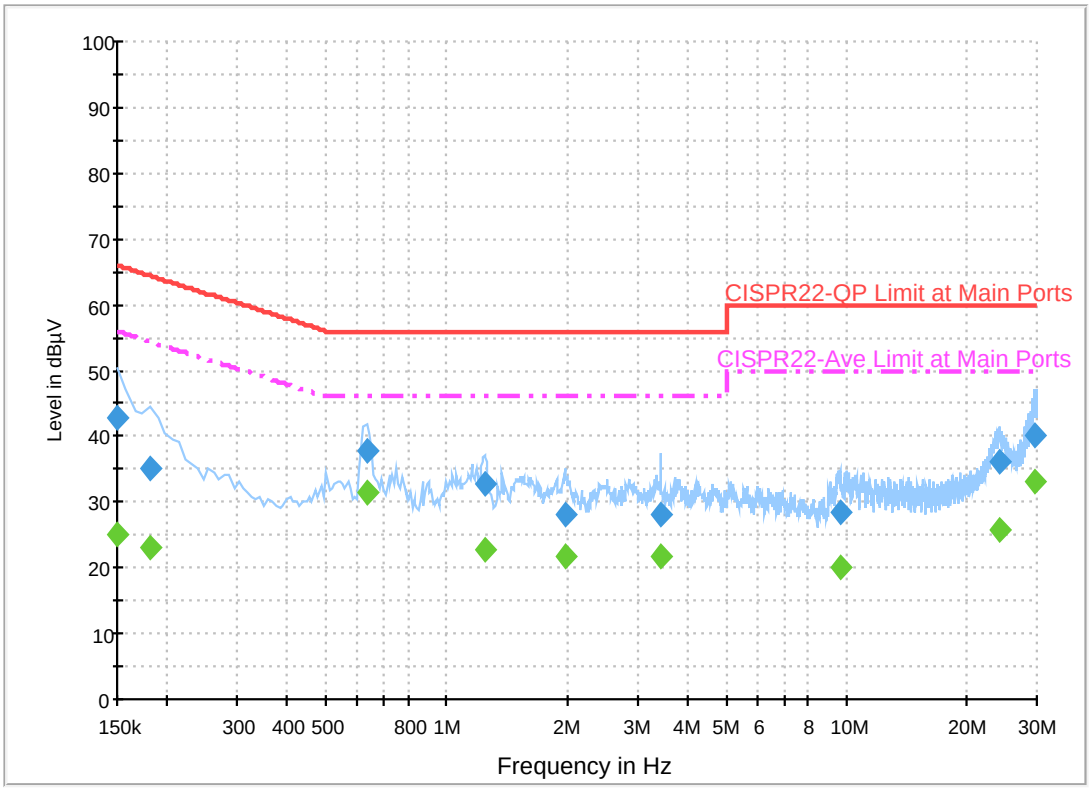
Appendix A. AC Conducted Emission Test Results

Test Engineer :	Shareef Yu	**Temperature :**	26~27℃
		Relative Humidity :	43~44%

EUT Information

Report NO :	760902
Test Mode :	Mode 2
Test Voltage :	120Vac/60Hz
Phase :	Line

ENV216 Auto Test FCC Power Bar - L



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	42.8	Off	L1	19.5	23.2	66.0
0.182000	35.2	Off	L1	19.5	29.2	64.4
0.630000	37.9	Off	L1	19.5	18.1	56.0
1.246000	32.9	Off	L1	19.5	23.1	56.0
1.982000	28.1	Off	L1	19.5	27.9	56.0
3.446000	28.2	Off	L1	19.5	27.8	56.0
9.630000	28.4	Off	L1	19.7	31.6	60.0
24.254000	36.1	Off	L1	19.8	23.9	60.0
29.774000	40.0	Off	L1	19.8	20.0	60.0

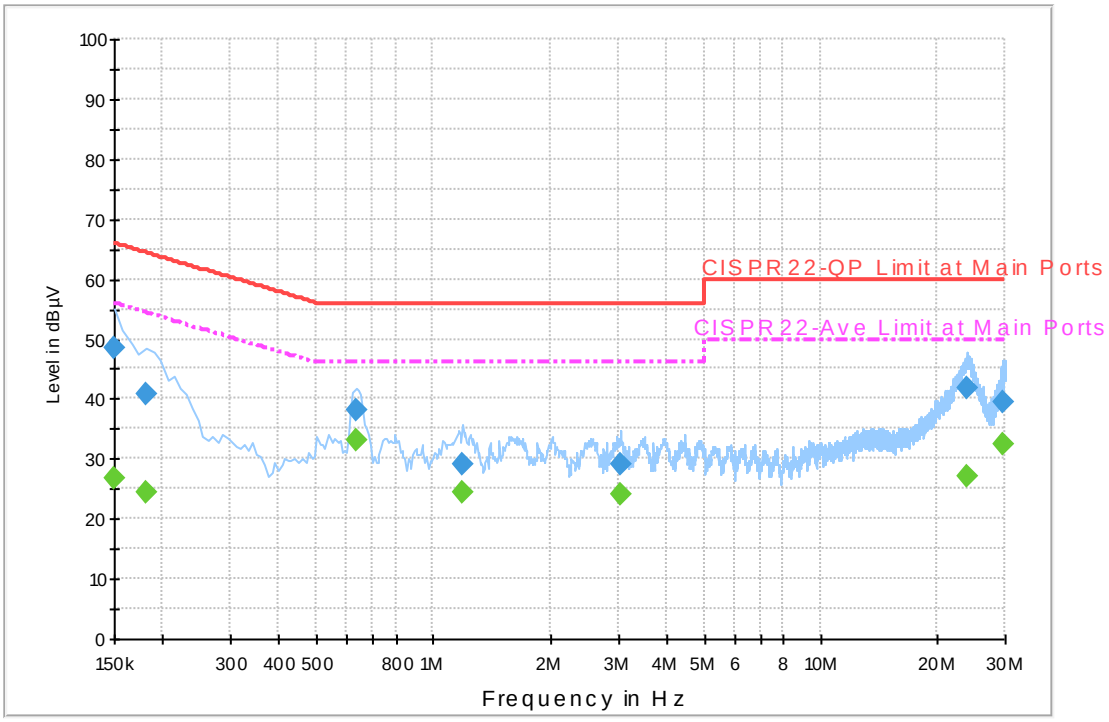
Final Result 2

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	24.9	Off	L1	19.5	31.1	56.0
0.182000	23.0	Off	L1	19.5	31.4	54.4
0.630000	31.5	Off	L1	19.5	14.5	46.0
1.246000	22.8	Off	L1	19.5	23.2	46.0
1.982000	21.9	Off	L1	19.5	24.2	46.0
3.446000	21.9	Off	L1	19.5	24.1	46.0
9.630000	19.9	Off	L1	19.7	30.1	50.0
24.254000	25.8	Off	L1	19.8	24.2	50.0
29.774000	33.1	Off	L1	19.8	16.9	50.0

EUT Information

Report NO :	760902
Test Mode :	Mode 2
Test Voltage :	120Vac/60Hz
Phase :	Neutral

ENV216 Auto Test FCC Power Bar - N



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	48.7	Off	N	19.5	17.3	66.0
0.182000	40.8	Off	N	19.5	23.6	64.4
0.630000	38.1	Off	N	19.5	17.9	56.0
1.190000	29.1	Off	N	19.5	26.9	56.0
3.046000	29.1	Off	N	19.5	26.9	56.0
23.838000	42.0	Off	N	19.9	18.0	60.0
29.726000	39.3	Off	N	20.1	20.7	60.0

Final Result 2

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	26.9	Off	N	19.5	29.1	56.0
0.182000	24.5	Off	N	19.5	29.9	54.4
0.630000	33.0	Off	N	19.5	13.0	46.0
1.190000	24.5	Off	N	19.5	21.5	46.0
3.046000	24.1	Off	N	19.5	21.9	46.0
23.838000	27.0	Off	N	19.9	23.0	50.0
29.726000	32.5	Off	N	20.1	17.5	50.0

Appendix B. Radiated Spurious Emission

Test Engineer :	Ken Wu	Temperature :	22~23°C
		Relative Humidity :	45~47%

2.4GHz 2400~2483.5MHz

ANT+ (Band Edge @ 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)
		2381.68	46.17	-27.83	74	46.88	27.06	5.39	33.16	342	240	P	H
	*	2402	77.05	-36.95	114	77.68	27.11	5.41	33.15	342	240	P	H
		2381.68	32.94	-21.06	54	33.65	27.06	5.39	33.16	342	240	A	H
	*	2402	76.8	-17.2	94	77.43	27.11	5.41	33.15	342	240	A	H
													H
ANT+													H
2402MHz		2381.68	50.36	-23.64	74	51.07	27.06	5.39	33.16	100	248	P	V
	*	2402.2	79.84	-34.16	114	80.47	27.11	5.41	33.15	100	248	P	V
		2381.68	35.22	-18.78	54	35.93	27.06	5.39	33.16	100	248	A	V
	*	2402	79.28	-14.72	94	79.91	27.11	5.41	33.15	100	248	A	V
													V
													V
		2395.36	42.2	-31.8	74	42.83	27.11	5.41	33.15	179	139	P	H
	*	2442	75.83	-38.17	114	76.24	27.26	5.45	33.12	179	139	P	H
		2488.96	42.48	-31.52	74	42.69	27.4	5.5	33.11	179	139	P	H
		2394.28	31.8	-22.2	54	32.43	27.11	5.41	33.15	179	139	A	H
	*	2442	75.34	-18.66	94	75.75	27.26	5.45	33.12	179	139	A	H
ANT+		2485.48	32.35	-21.65	54	32.61	27.35	5.5	33.11	179	139	A	H
2442MHz		2398.24	41.63	-32.37	74	42.26	27.11	5.41	33.15	100	238	P	V
	*	2442	79.9	-34.1	114	80.31	27.26	5.45	33.12	100	238	P	V
		2491.6	42.63	-31.37	74	42.84	27.4	5.5	33.11	100	238	P	V
		2383.72	31.8	-22.2	54	32.51	27.06	5.39	33.16	100	238	A	V
	*	2442	79.5	-14.5	94	79.91	27.26	5.45	33.12	100	238	A	V
		2495.92	32.31	-21.69	54	32.51	27.4	5.5	33.1	100	238	A	V

ANT+ 2480MHz	*	2480	76.84	-37.16	114	77.12	27.35	5.48	33.11	173	161	P	H
		2498.2	44.38	-29.62	74	44.58	27.4	5.5	33.1	173	161	P	H
	*	2480	76.52	-17.48	94	76.8	27.35	5.48	33.11	173	161	A	H
		2484.04	32.38	-21.62	54	32.64	27.35	5.5	33.11	173	161	A	H
													H
													H
	*	2480	80.74	-33.26	114	81.02	27.35	5.48	33.11	100	257	P	V
		2498.32	49.74	-24.26	74	49.94	27.4	5.5	33.1	100	257	P	V
	*	2480	80.48	-13.52	94	80.76	27.35	5.48	33.11	100	257	A	V
		2498.44	32.89	-21.11	54	33.09	27.4	5.5	33.1	100	257	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

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)
		4804	55.7	-18.3	74	72.89	31.16	8.42	57.27	100	218	P	H
		4804	53.86	-0.14	54	71.05	31.16	8.42	57.27	100	218	A	H
													H
ANT+													H
2402MHz		4804	53.91	-20.09	74	71.1	31.16	8.42	57.27	100	41	P	V
		4804	51.97	-2.03	54	69.16	31.16	8.42	57.27	100	41	A	V
													V
													V
		4884	55.12	-18.88	74	72.15	31.28	8.38	57.17	100	237	P	H
		4884	52.89	-1.11	54	69.92	31.28	8.38	57.17	100	237	A	H
		7326	42.98	-31.02	74	53.55	36.22	10.11	57.29	100	0	P	H
ANT+													H
2442MHz		4884	52.47	-21.53	74	69.5	31.28	8.38	57.17	100	42	P	V
		4884	50.39	-3.61	54	67.42	31.28	8.38	57.17	100	42	A	V
		7326	43.06	-30.94	74	53.63	36.22	10.11	57.29	100	0	P	V
													V
		4960	53.59	-20.41	74	70.39	31.44	8.35	57.05	100	225	P	H
		4960	51.35	-2.65	54	68.15	31.44	8.35	57.05	100	225	A	H
		7440	44.09	-29.91	74	54.65	36.49	10.04	57.44	100	0	P	H
ANT+													H
2480MHz		4960	52.2	-21.8	74	69	31.44	8.35	57.05	102	48	P	V
		4960	49.75	-4.25	54	66.55	31.44	8.35	57.05	102	48	A	V
		7440	43.39	-30.61	74	53.95	36.49	10.04	57.44	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)
		31.08	22.19	-17.81	40	30.21	24.07	0.6	32.77	-	-	P	H
		271.92	34.32	-11.68	46	45.63	19.16	1.72	32.6	-	-	P	H
		288.12	38.46	-7.54	46	49.99	18.9	1.77	32.6	-	-	P	H
		304.2	38.4	-7.6	46	49.56	19.21	1.83	32.59	-	-	P	H
		320.3	43.82	-2.18	46	54.66	19.47	1.88	32.59	100	257	QP	H
		335.7	37.77	-8.23	46	48.14	19.9	1.92	32.59	-	-	P	H
													H
													H
													H
													H
2.4GHz													H
ANT+		39.18	30.19	-9.81	40	42.08	19.99	0.78	32.77	-	-	P	V
LF		271.92	34.41	-11.59	46	45.72	19.16	1.72	32.6	-	-	P	V
		288.12	38.62	-7.38	46	50.15	18.9	1.77	32.6	100	196	P	V
		320.3	30.5	-15.5	46	41.34	19.47	1.88	32.59	-	-	P	V
		671.7	32.84	-13.16	46	35.76	26.52	2.76	32.79	-	-	P	V
		953.8	34.24	-11.76	46	30.81	30.81	3.29	31.48	-	-	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:

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)

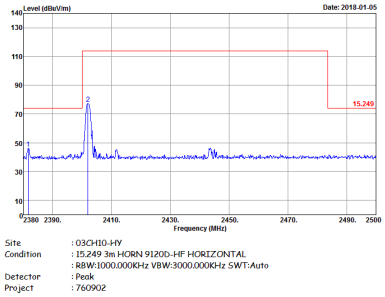
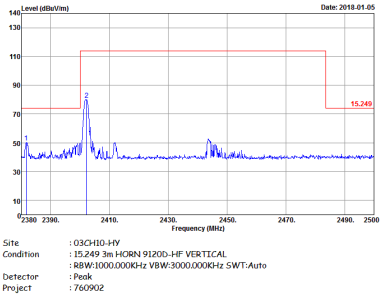
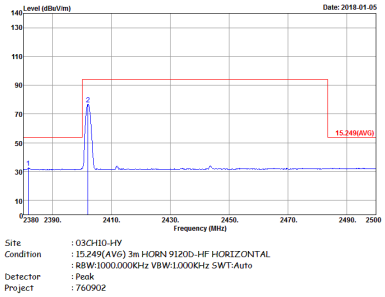
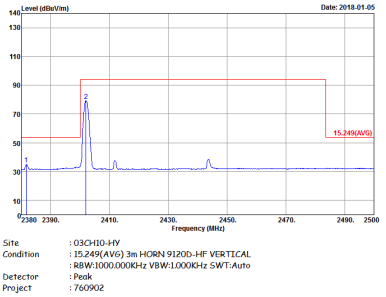
Both peak and average measured complies with the limit line, so test result is “PASS”.

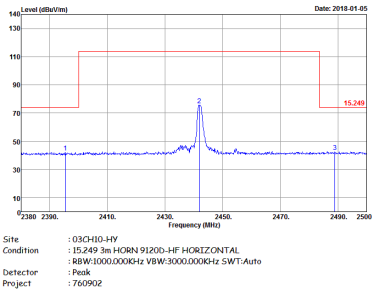
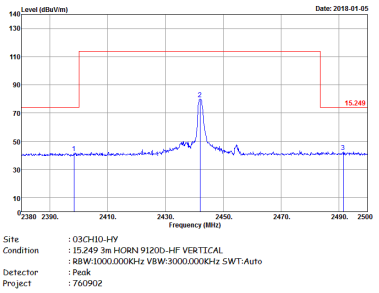
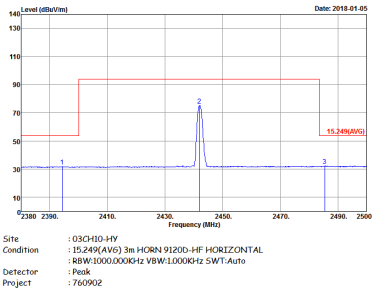
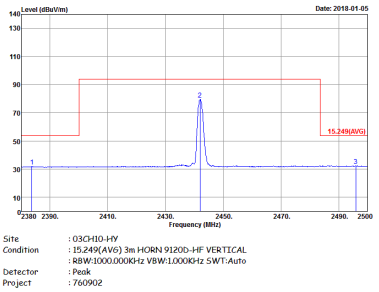
Appendix C. Radiated Spurious Emission Plots

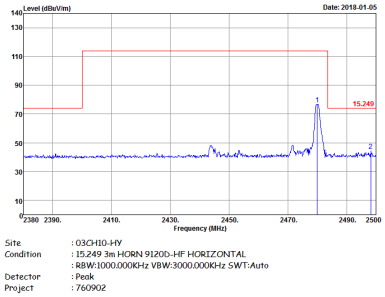
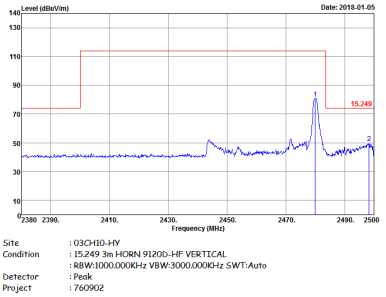
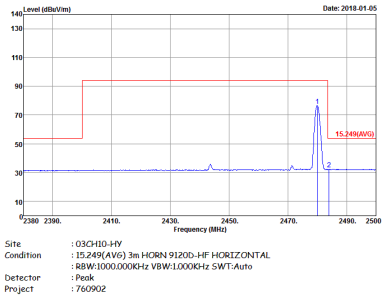
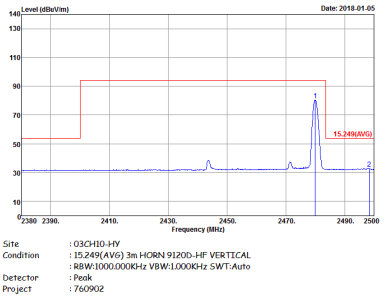
Test Engineer :	Ken Wu	**Temperature :**	22~23℃
		Relative Humidity :	45~47%

2.4GHz 2400~2483.5MHz

ANT+ (Band Edge @ 3m)

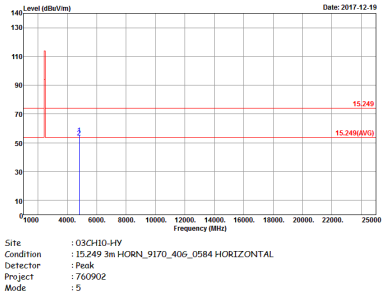
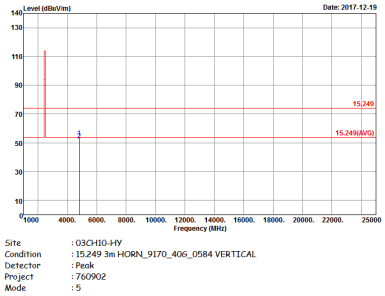
ANT+	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	ANT+ 2402MHz	
1	Horizontal	Vertical
Peak		
Avg.		

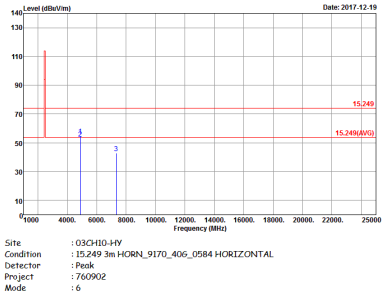
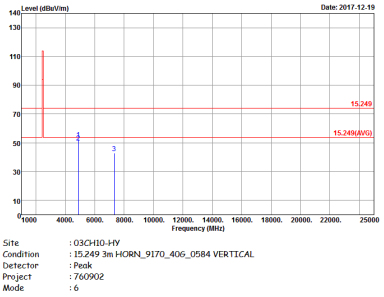
ANT+	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	ANT+ 2442MHz	
1	Horizontal	Vertical
Peak	 Site : 03CH10-HY Condition : 15.249 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 760902	 Site : 03CH10-HY Condition : 15.249 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 760902
Avg.	 Site : 03CH10-HY Condition : 15.249(AVG) 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 760902	 Site : 03CH10-HY Condition : 15.249(AVG) 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 760902

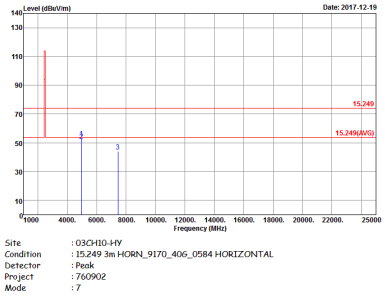
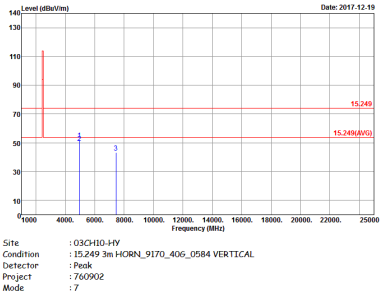
ANT+	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	ANT+ 2480MHz	
1	Horizontal	Vertical
Peak	 Site : 03CH10-HY Condition : 15.249 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 760902	 Site : 03CH10-HY Condition : 15.249 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 760902
Avg.	 Site : 03CH10-HY Condition : 15.249(AVG) 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 760902	 Site : 03CH10-HY Condition : 15.249(AVG) 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:1.000KHz SWT:Auto Detector : Peak Project : 760902

2.4GHz 2400~2483.5MHz

ANT+ (Harmonic @ 3m)

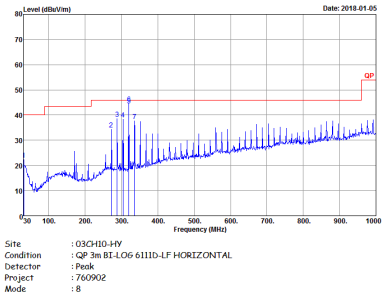
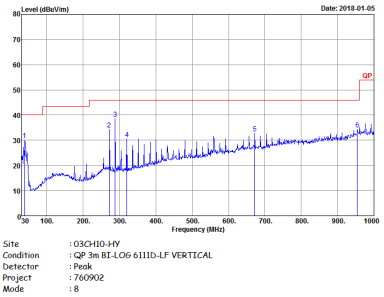
ANT+	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	ANT+ 2402MHz	
1	Horizontal	Vertical
Peak Avg.		

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

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

Emission below 1GHz

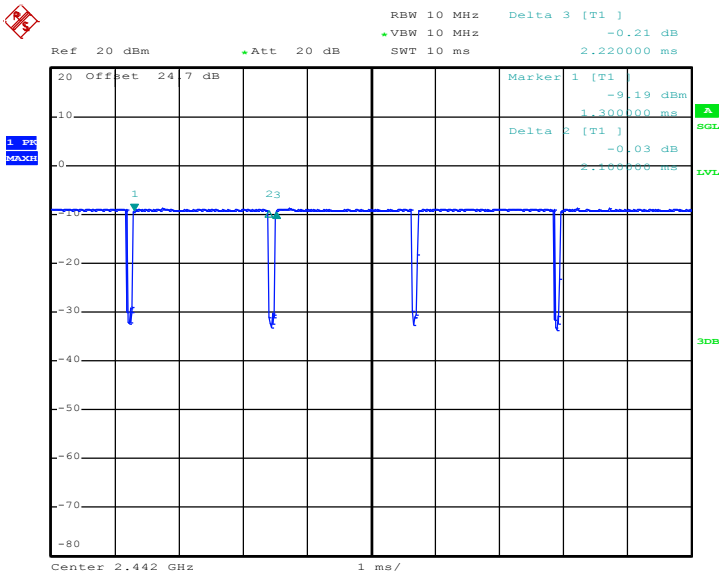
2.4GHz ANT+ (LF)

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

Appendix D. Duty Cycle Plots

Band	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor (dB)
ANT	94.59	2100.00	0.48	1kHz	0.24

ANT+



Date: 23.FEB.2018 14:42:11