

FCC RF Test Report

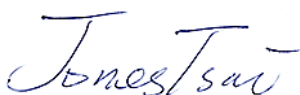
APPLICANT : HMD Global Oy
EQUIPMENT : Smart Phone
BRAND NAME : NOKIA
MODEL NAME : TA-1053
FCC ID : 2AJOTTA-1053
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was received on Jan. 26, 2017 and testing was completed on Mar. 11, 2017. 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



SPORTON INTERNATIONAL INC.

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



TABLE OF CONTENTS

SUMMARY OF TEST RESULT	4
1 GENERAL DESCRIPTION.....	5
1.1 Applicant.....	5
1.2 Manufacturer.....	5
1.3 Product Feature of Equipment Under Test.....	5
1.4 Re-use of Measured Data	5
1.5 Modification of EUT	9
1.6 Testing Location	9
1.7 Applicable Standards.....	10
2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST.....	11
2.1 Carrier Frequency Channel	11
2.2 Descriptions of Test Mode	12
2.3 Test Mode.....	12
2.4 Connection Diagram of Test System.....	13
2.5 Support Unit used in test configuration and system	13
2.6 EUT Operation Test Setup	13
3 TEST RESULT	14
3.1 Radiated Band Edges and Spurious Emission Measurement	14
3.2 AC Conducted Emission Measurement.....	18
3.3 Antenna Requirements.....	20
4 LIST OF MEASURING EQUIPMENT.....	21
5 UNCERTAINTY OF EVALUATION.....	22
APPENDIX A. AC CONDUCTED EMISSION TEST RESULT	
APPENDIX B. RADIATED SPURIOUS EMISSION	
APPENDIX C. RADIATED SPURIOUS EMISSION PLOTS	
APPENDIX D. DUTY CYCLE PLOTS	
APPENDIX E. SETUP PHOTOGRAPHS	



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR712016-02B	Rev. 01	Initial issue of report	Apr. 06, 2017



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 4.58 dB at 38.370 MHz
3.2	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 13.80 dB at 13.558 MHz
3.3	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

HMD Global Oy

Karaportti 2, 02610 Espoo, Finland

1.2 Manufacturer

HMD Global Oy

Karaportti 2, 02610 Espoo, Finland

1.3 Product Feature of Equipment Under Test

GSM/WCDMA/LTE, Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n, Wi-Fi 5GHz 802.11a/n, ANT+, FM Receiver, NFC, and GPS.

Product Specification subjective to this standard	
Antenna Type	WWAN: PIFA Antenna WLAN: PIFA Antenna Bluetooth: PIFA Antenna ANT+: PIFA Antenna GPS/Glonass/Beidou : Monopole Antenna NFC : Loop Antenna

1.4 Re-use of Measured Data

1.4.1 Introduction Section

The original model (FCC ID: 2AJOTTA-1044) and the variant model (FCC ID: 2AJOTTA-1053) has identical PCB layout, antenna, SW implementation for Bluetooth/Wi-Fi/GPS. Based on their similarity, the FCC Part 15C & 15E(equipment class: DTS, DSS,DXX, NII) test data issued for original model also apply for the variant model.

The applicant takes full responsibility that the test data as referenced in section 4 below represent compliance for this FCC ID (FCC ID: 2AJOTTA-1053).



1.4.2 Difference Section

The original model (FCC ID: 2AJOTTA-1044) and the variant model (FCC ID: 2AJOTTA-1053) has identical PCB layout, antenna, SW implementation for Bluetooth/Wi-Fi/GPS. The details of similarity and difference can be found in the Operating Description.

The product specification is outlined in the following table:

FCC ID			2AJOTTA-1044	2AJOTTA-1053
Wireless Tech	Mode		Frequency (MHz)	
GSM	GSM Voice GPRS (GMSK) EDGE (8PSK)	Multi-Slot Class 11 DTM: Yes	850/1900	850/1900
UMTS	AMR/RCM12.2Kbps HSDPA/HSUPA/DC-HSDPA		B2/B4/B5	B2/B5
LTE	QPSK/16QAM VoLTE		B2/B4/B7/B12/B17/B38	B5/B7/B38
Wi-Fi	11b/11g/11n(HT20)		2412-2462 MHz/	
	11a/11n(HT20)/11n(HT40)		5180-5240 MHz 5260-5320 MHz 5500-5700 MHz 5745-5825 MHz	
Bluetooth	BR/EDR/LE		2402-2480 MHz	
ANT+	ANT+		2402-2480 MHz	



1.4.3 Spot Check Verification Data Section

Summary of the spot check:

Test Item	Mode	2AJOTTA-1044 Worst Result	2AJOTTA-1053 Worst Result	Difference (dB)
Average Conducted Power (dBm)	802.11b	13.99	13.89	0.10
	802.11g	11.64	11.65	0.01
	11n HT20	10.90	10.92	-0.02
	20MHz BW 5150-5250MHz	14.42	14.48	-0.06
	20MHz BW 5250-5350MHz	14.41	14.47	-0.06
	20MHz BW 5470-5725MHz	14.37	14.34	0.03
	20MHz BW 5725-5850MHz	14.43	14.40	0.03
	40MHz BW 5150-5250MHz	14.23	14.19	0.04
	40MHz BW 5250-5350MHz	14.21	14.26	-0.05
	40MHz BW 5470-5725MHz	14.17	14.04	0.13
	40MHz BW 5725-5850MHz	14.34	14.40	-0.06
	BT (1Mbps)	7.53	7.62	-0.09
	BT (2Mbps)	5.23	5.17	0.06
	BT (3Mbps)	5.20	5.13	0.07
	BT-LE	0.63	0.72	-0.09
	ANT+	0.47	0.48	-0.01
	Test date	2017/02/11 – 2017/02/24	2017/03/14 – 2017/03/14	
Peak Radiated Spurious Emission (Band Edge) (dBuV/m)	802.11b	54.48	54.95	-0.47
	11n HT20	56.36	57.04	-0.68
	BT (1Mbps)	44.35	43.75	0.60
	BT-LE	55.17	54.61	0.56
	ANT+	65.94	63.66	2.28
	Test date	2017/02/11 – 2017/02/24	2017/03/03 – 2017/03/11	
Average Radiated Spurious Emission (Band Edge) (dBuV/m)	802.11b	45.51	44.25	1.26
	11n HT20	45.77	46.96	-1.19
	BT (1Mbps)	19.59	18.99	0.60
	BT-LE	45.28	45.24	0.04
	ANT+	38.85	38.59	0.26
	Test date	2017/02/11 – 2017/02/24	2017/03/03 – 2017/03/11	
Peak Radiated Spurious Emission (Harmonic) (dBuV/m)	802.11b	45.27	46.25	-0.98
	11n HT20	41.37	43.54	-2.17
	BT (1Mbps)	40.93	41.49	-0.56
	BT-LE	40.63	42.23	-1.60
	ANT+	37.66	39.64	-1.98
	Test date	2017/02/11 – 2017/02/24	2017/03/03 – 2017/03/11	

**Conclusion:**

WLAN Radiated spurious emission test against the variant model for non-cellular part based on the worst-case condition from the original model was performed in this filing to demonstrate the test data from original model remains representative for the variant model.

Based on the spot check test result (power levels measured are within 0.5dB, and the worst case of RSE spot check verification based on the worst condition from the original model is within 3dB, and are compliance with the limits), the test data from the original model is representative for the variant model.

The unwanted, harmonics, radiated spurious emission is reported peak measurement only due to spurious lower than 20dB than the limit.

The detail test results can be found in this document, Appendix A, hereafter.

1.4.4 Reference detail Section

Equipment Class	Reference FCC ID	Type Grant/Permissive Change	Reference Application	Folder Test/RF Exposure	Report Title
DTS	2AJOTTA-1044	Original Grant	FR712016B	Part 15C	All sections applicable
			FR712016C	Part 15C	All sections applicable
			FA712016	RF Exposure	All sections applicable
DSS	2AJOTTA-1044	Original Grant	FR712016A	Part 15C	All sections applicable
			FA712016	RF Exposure	All sections applicable
DXX	2AJOTTA-1044	Original Grant	FR712016D	Part 15C	All sections applicable
			FA712016	RF Exposure	All sections applicable
NII	2AJOTTA-1044	Original Grant	FR712016F FR712016G FZ712016	Part 15E	Conducted sections applicable
			FA712016	RF Exposure	All sections applicable



1.5 Modification of EUT

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

1.6 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. 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 1 st 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.	
	03CH11-HY	

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



1.7 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05
- ♦ 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

2.1 Carrier Frequency Channel

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

2.2 Descriptions of Test Mode

The RF output power was recorded in the following table:

Channel	Frequency	Bluetooth – LE RF Output Power
		Data Rate / Modulation
		GFSK
		1Mbps
Ch00	2402MHz	0.75 dBm
Ch19	2440MHz	-0.23 dBm
Ch39	2480MHz	0.32 dBm

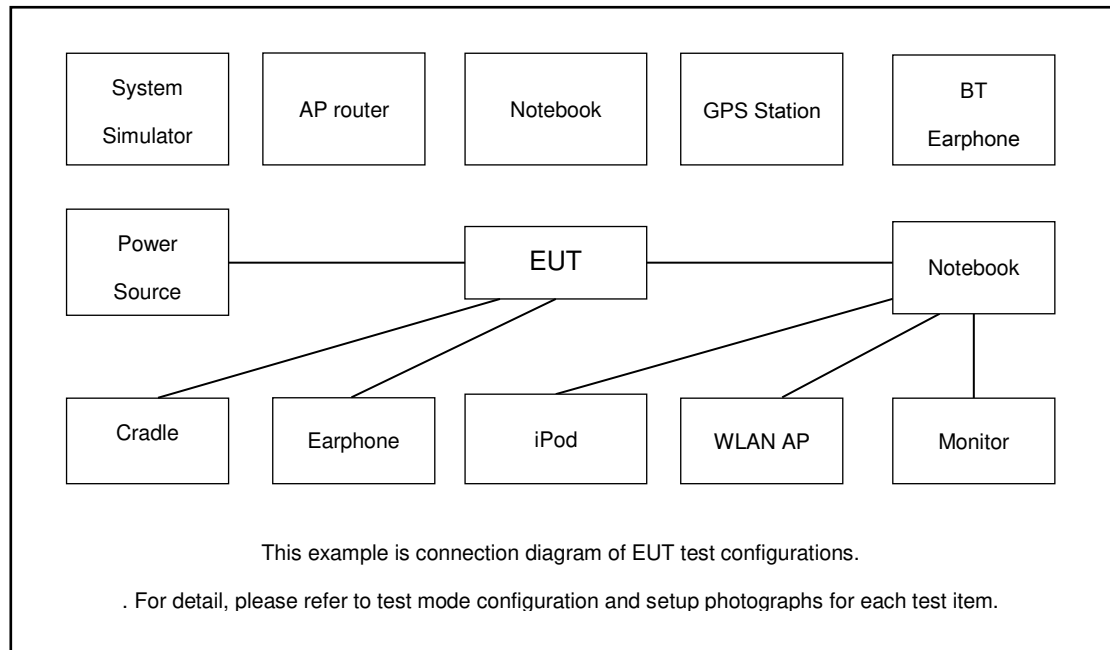
- The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental 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) were recorded in this report.
- AC power line Conducted Emission was tested under maximum output power.

2.3 Test Mode

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH19_2440 MHz_1Mbps
AC Conducted Emission	Mode 1: GSM850 Idle + Bluetooth Link + WLAN (2.4GHz) Link + NFC On + Earphone + USB Cable (Charging from Adapter) + SIM 1

2.4 Connection Diagram of Test System



2.5 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 1.8m
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.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
5.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

2.6 EUT Operation Test Setup

The RF test items, programmed RF utility, "QRCT.exe" installed in the notebook make the EUT provide functions like channel selection and power level for continuous transmitting and receiving signals.



3 Test Result

3.1 Radiated Band Edges and Spurious Emission Measurement

3.1.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

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

3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.



3.1.3 Test Procedures

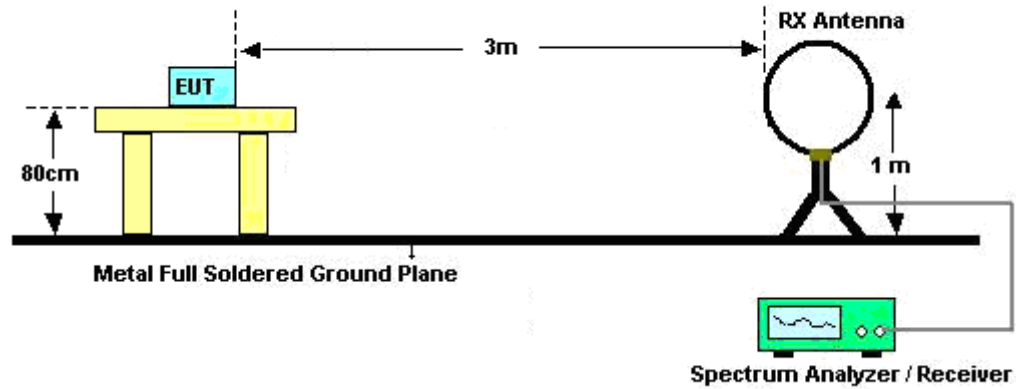
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.

For average measurement:

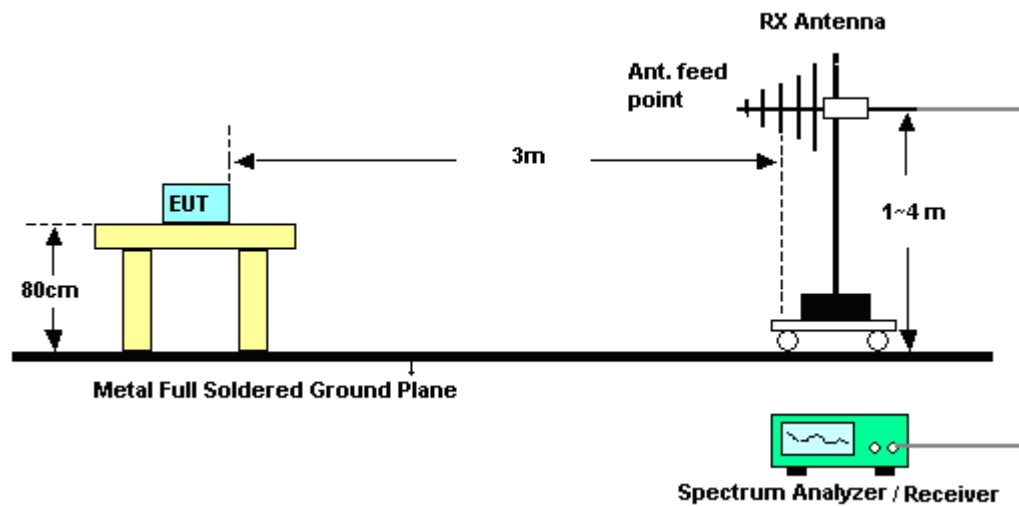
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.1.4 Test Setup

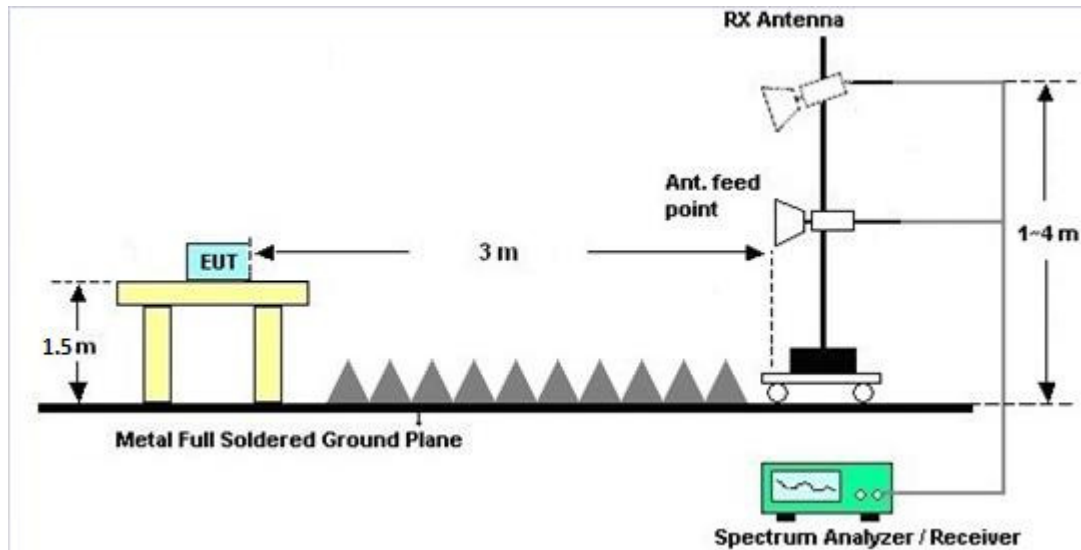
For radiated emissions below 30MHz



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 per 15.31(o) was not reported.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

3.1.7 Duty Cycle

Please refer to Appendix E.

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

Please refer to Appendix C and D.

3.2 AC Conducted Emission Measurement

3.2.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (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 the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

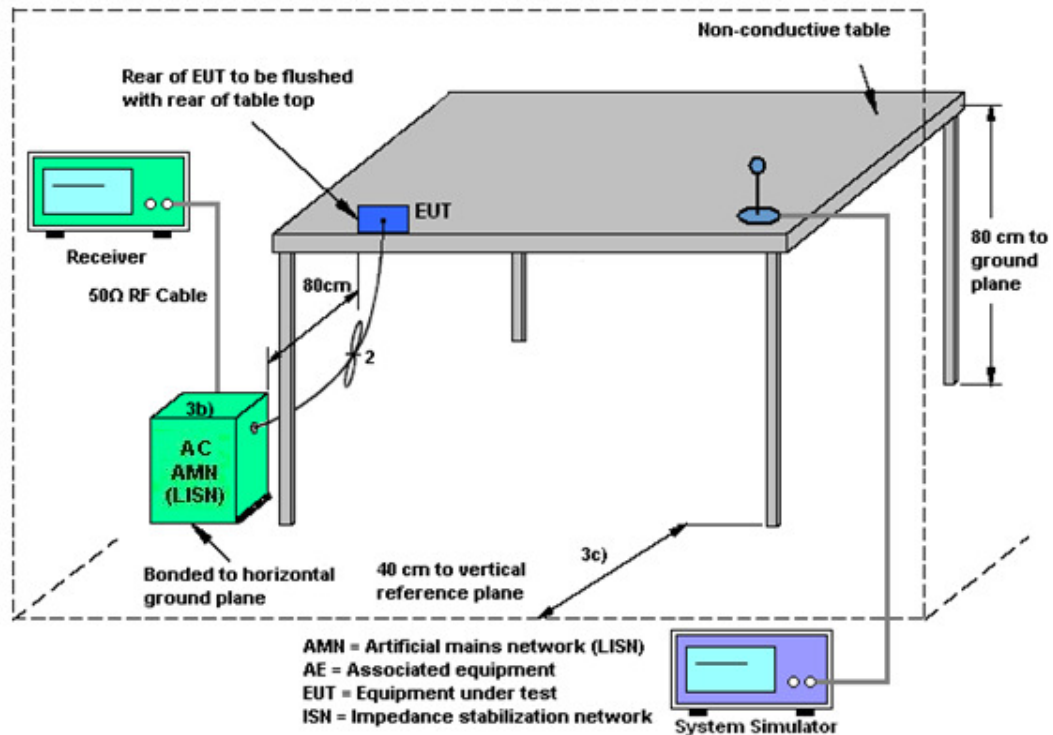
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.2.4 Test Setup



3.2.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.3 Antenna Requirements

3.3.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Agilent	E4416A	GB41292344	300MHz~40GHz	Dec. 26, 2016	Feb. 09, 2017 ~ Feb. 24, 2017	Dec. 25, 2017	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Dec. 26, 2016	Feb. 09, 2017 ~ Feb. 24, 2017	Dec. 25, 2017	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz-40GHz	Jul. 17, 2016	Feb. 09, 2017 ~ Feb. 24, 2017	Jul. 16, 2017	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Feb. 11, 2017	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9kHz~7GHz	Aug. 30, 2016	Feb. 11, 2017	Aug. 29, 2017	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 29, 2016	Feb. 11, 2017	Nov. 28, 2017	Conduction (CO05-HY)
LF Cable	HUBER + SUHNER	RG-214/U	LF01	N/A	Jan. 05, 2017	Feb. 11, 2017	Jan. 04, 2018	Conduction (CO05-HY)
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100851	N/A	Jan. 05, 2017	Feb. 11, 2017	Jan. 04, 2018	Conduction (CO05-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Nov. 10, 2016	Mar. 03, 2017 ~ Mar. 11, 2017	Nov. 09, 2017	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Sep. 02, 2015	Mar. 03, 2017 ~ Mar. 11, 2017	Sep. 01, 2017	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D	35414	30MHz~1GHz	Oct. 15, 2016	Mar. 03, 2017 ~ Mar. 11, 2017	Oct. 14, 2017	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1GHz ~ 18GHz	Mar. 30, 2016	Mar. 03, 2017 ~ Mar. 11, 2017	Mar. 31, 2017	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 10, 2016	Mar. 03, 2017 ~ Mar. 11, 2017	Nov. 09, 2017	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY52350276	10Hz ~ 44GHZ	Mar. 21, 2016	Mar. 03, 2017 ~ Mar. 11, 2017	Mar. 20, 2017	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Mar. 03, 2017 ~ Mar. 11, 2017	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Mar. 03, 2017 ~ Mar. 11, 2017	N/A	Radiation (03CH11-HY)
Preamplifier	MITEQ	AMF-7D-00101800	2025787	1GHz~18GHz	Feb. 13, 2017	Mar. 03, 2017 ~ Mar. 11, 2017	Feb. 12, 2018	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 08, 2016	Mar. 03, 2017 ~ Mar. 11, 2017	Nov. 07, 2017	Radiation (03CH11-HY)

5 Uncertainty of Evaluation

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% ($U = 2Uc(y)$)	5.2
---	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.5
---	-----

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

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



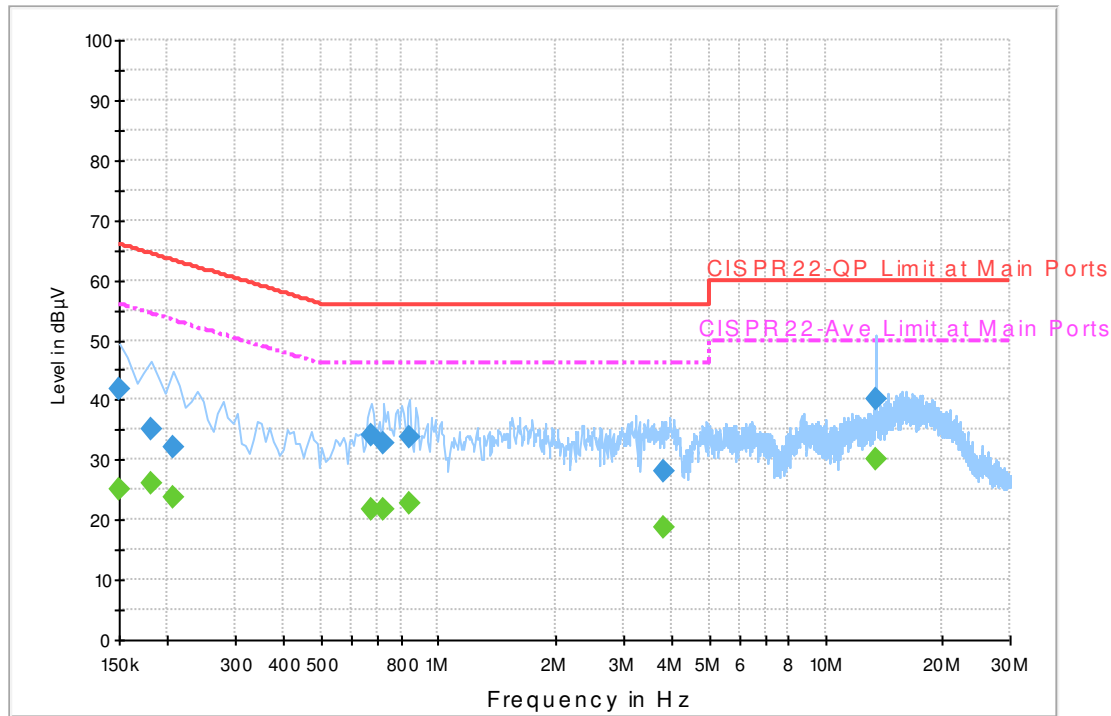
Appendix A. AC Conducted Emission Test Results

Test Engineer :	Arthur Hsieh	Temperature :	21~22°C
		Relative Humidity :	54~56%

EUT Information

Report NO : 712016-02
Test Mode : Mode 1
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	41.8	Off	L1	19.6	24.2	66.0
0.182000	35.2	Off	L1	19.6	29.2	64.4
0.206000	32.1	Off	L1	19.6	31.3	63.4
0.670000	34.3	Off	L1	19.6	21.7	56.0
0.726000	32.6	Off	L1	19.6	23.4	56.0
0.846000	33.9	Off	L1	19.6	22.1	56.0
3.846000	28.1	Off	L1	19.7	27.9	56.0
13.558000	40.2	Off	L1	20.2	19.8	60.0

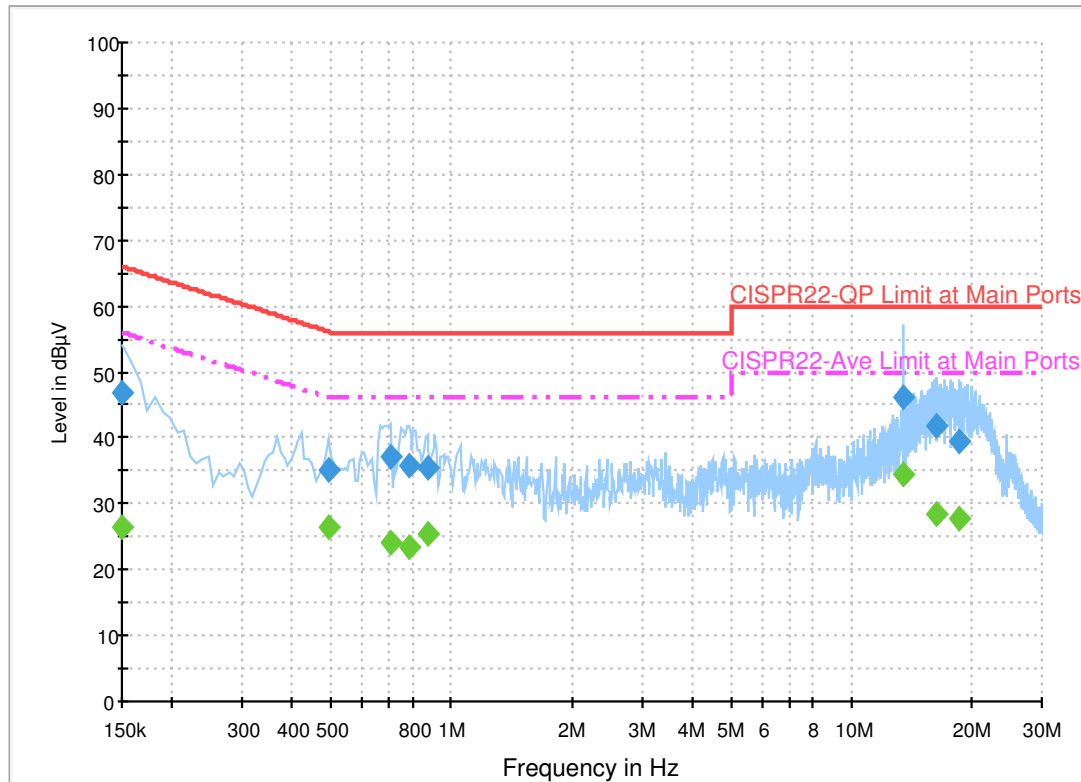
Final Result 2

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	25.2	Off	L1	19.6	30.8	56.0
0.182000	25.9	Off	L1	19.6	28.5	54.4
0.206000	23.8	Off	L1	19.6	29.6	53.4
0.670000	21.6	Off	L1	19.6	24.4	46.0
0.726000	21.7	Off	L1	19.6	24.3	46.0
0.846000	22.8	Off	L1	19.6	23.2	46.0
3.846000	18.6	Off	L1	19.7	27.4	46.0
13.558000	30.2	Off	L1	20.2	19.8	50.0

EUT Information

Report NO : 712016-02
Test Mode : Mode 1
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	46.8	Off	N	19.5	19.2	66.0
0.494000	35.0	Off	N	19.5	21.1	56.1
0.702000	37.2	Off	N	19.5	18.8	56.0
0.782000	35.9	Off	N	19.5	20.1	56.0
0.870000	35.4	Off	N	19.6	20.6	56.0
13.558000	46.2	Off	N	20.3	13.8	60.0
16.374000	41.8	Off	N	20.5	18.2	60.0
18.566000	39.3	Off	N	20.6	20.7	60.0

Final Result 2

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	26.5	Off	N	19.5	29.5	56.0
0.494000	26.4	Off	N	19.5	19.7	46.1
0.702000	24.1	Off	N	19.5	21.9	46.0
0.782000	23.3	Off	N	19.5	22.7	46.0
0.870000	25.4	Off	N	19.6	20.6	46.0
13.558000	34.5	Off	N	20.3	15.5	50.0
16.374000	28.4	Off	N	20.5	21.6	50.0
18.566000	27.9	Off	N	20.6	22.1	50.0



Appendix B. Radiated Spurious Emission

Test Engineer :	J.C. Liang, Jacky Hung, and Ken Wu	Temperature :	20~24°C
		Relative Humidity :	50~54%

2.4GHz 2400~2483.5MHz

BLE (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)
BLE CH 19 2440MHz		2385.88	53.57	-20.43	74	51.09	27.19	8.89	33.6	347	335	P	H
		2365.44	44.76	-9.24	54	42.45	27.09	8.82	33.6	347	335	A	H
	*	2440	90.12	-	-	87.43	27.34	8.94	33.59	347	335	P	H
	*	2440	89.2	-	-	86.51	27.34	8.94	33.59	347	335	A	H
		2483.9	54.44	-19.56	74	51.59	27.45	8.98	33.58	347	335	P	H
		2489.5	45.1	-8.9	54	42.2	27.5	8.98	33.58	347	335	A	H
		2377.34	53.35	-20.65	74	50.99	27.14	8.82	33.6	276	65	P	V
		2379.58	44.7	-9.3	54	42.34	27.14	8.82	33.6	276	65	A	V
	*	2440	92.17	-	-	89.48	27.34	8.94	33.59	276	65	P	V
	*	2440	91.36	-	-	88.67	27.34	8.94	33.59	276	65	A	V
		2492.79	54.61	-19.39	74	51.7	27.5	8.98	33.57	276	65	P	V
		2490.2	45.24	-8.76	54	42.34	27.5	8.98	33.58	276	65	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

**2.4GHz 2400~2483.5MHz****BLE (Harmonic @ 3m)**

BLE	Note	Frequency (MHz)	Level (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)
BLE CH 19 2440MHz		4880	37.97	-36.03	74	60.06	31.78	10.83	64.7	100	0	P	H
		7320	41.69	-32.31	74	55.71	37.29	13.52	64.83	100	0	P	H
													H
													H
		4880	37.93	-36.07	74	60.02	31.78	10.83	64.7	100	0	P	V
		7320	42.23	-31.77	74	56.25	37.29	13.52	64.83	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BLE (LF)

[illegible]



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		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		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 :	J.C. Liang, Jacky Hung, and Ken Wu	Temperature :	20~24°C
		Relative Humidity :	50~54%

Note symbol

-L	Low channel location
-R	High channel location

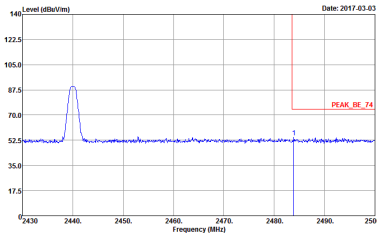
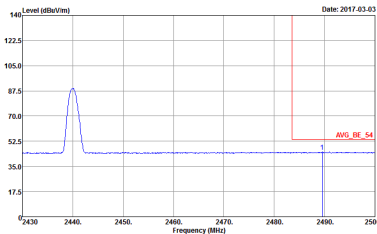


2.4GHz 2400~2483.5MHz

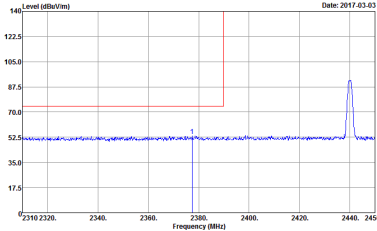
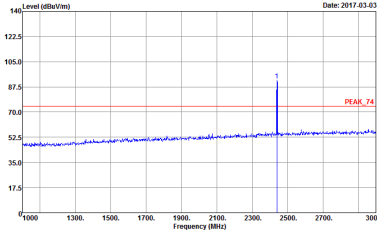
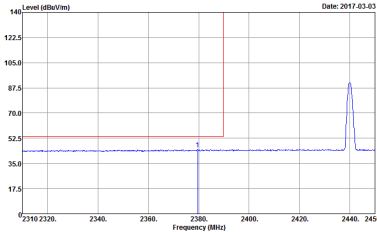
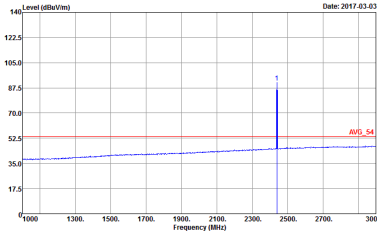
BLE (Band Edge @ 3m)

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - L	
1	Horizontal	Fundamental
Peak	Level (dBuV/m) Frequency (MHz) Date: 2017-03-03 Site : 03CH11-HY Condition : PEAK_BE_74 3m HORN 91200-HF HORIZONTAL Detector : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02	Level (dBuV/m) Frequency (MHz) Date: 2017-03-03 Site : 03CH11-HY Condition : PEAK_74 3m HORN 91200-HF HORIZONTAL Detector : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02
Avg.	Level (dBuV/m) Frequency (MHz) Date: 2017-03-03 Site : 03CH11-HY Condition : AVG_BE_54 3m HORN 91200-HF HORIZONTAL Detector : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02	Level (dBuV/m) Frequency (MHz) Date: 2017-03-03 Site : 03CH11-HY Condition : AVG_54 3m HORN 91200-HF HORIZONTAL Detector : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02

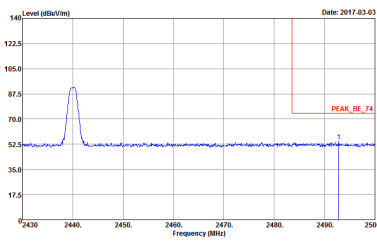
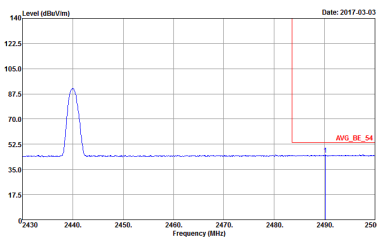


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
1	Horizontal	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_BE_74 3m HORN 91200-HF HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02	Left blank
Avg.	 Site : 03CH11-HY Condition : AVG_BE_54 3m HORN 91200-HF HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02	Left blank



BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - L	
1	Vertical	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_BE_74 3m HORN 9120D-HF VERTICAL Detector : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Project : Peak Project : 712016-02	 Site : 03CH11-HY Condition : PEAK_74 3m HORN 9120D-HF VERTICAL Detector : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Project : Peak Project : 712016-02
Avg.	 Site : 03CH11-HY Condition : AVG_BE_54 3m HORN 9120D-HF VERTICAL Detector : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Project : Peak Project : 712016-02	 Site : 03CH11-HY Condition : AVG_54 3m HORN 9120D-HF VERTICAL Detector : RBW:1000.000KHz VBW:3.000KHz SWT:Auto Project : Peak Project : 712016-02

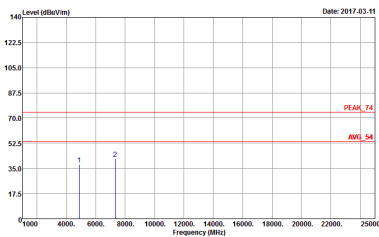
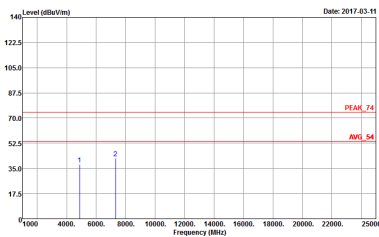


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
1	Vertical	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_BE_74 3m HORN 91200-HF VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02	Left blank
Avg.	 Site : 03CH11-HY Condition : AVG_BE_54 3m HORN 91200-HF VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 712016-02	Left blank

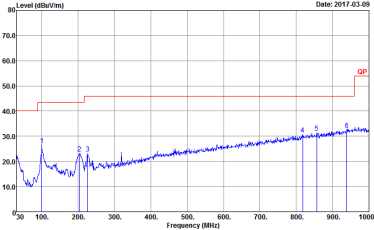
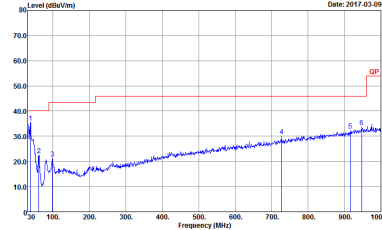


2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH19 2440MHz	
1	Horizontal	Vertical
Peak Avg.	 Site : 03CH11-HY Condition : PEAK_74 3m 9170 SHF HORM_150809 HORIZONTAL Detector : Peak Project : 712016-02	 Site : 03CH11-HY Condition : PEAK_74 3m 9170 SHF HORM_150809 VERTICAL Detector : Peak Project : 712016-02

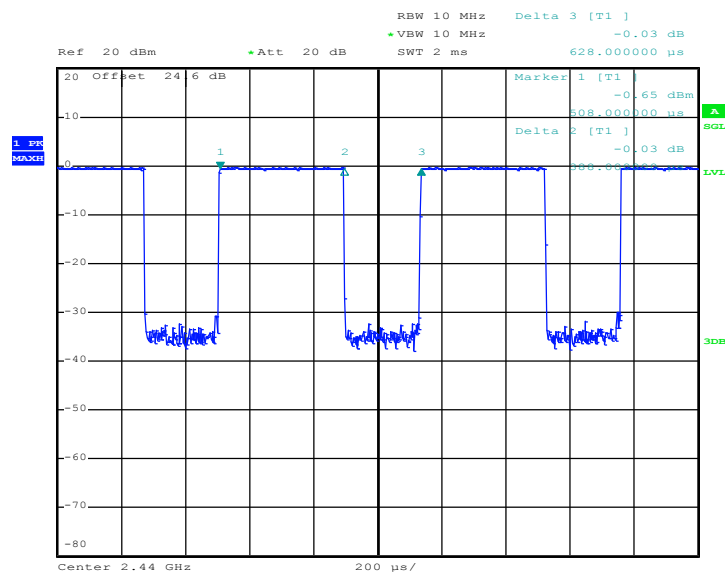
Emission below 1GHz
2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz	
ANT	BLE LF	
1	Horizontal	Vertical
QP / Peak	 Site : 03CH11-HY Condition : QP 3m BE-LOG 6111D-LF_ETC HORIZONTAL Detector : Peak Project : 712016-02	 Site : 03CH11-HY Condition : QP 3m BE-LOG 6111D-LF_ETC VERTICAL Detector : Peak Project : 712016-02

Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
Bluetooth -LE	61.78	388.00	2.58	3kHz

Bluetooth - LE



Date: 16.FEB.2017 19:55:17