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TEST REPORT # 315142 A
LSR Job #: C-2217

Compliance Testing of:
USB1 FC WiFi-BLE Adapter

Test Date(s):
May 14th to July 23rd 2015

Prepared For:
Attention: Dave Epperson
Fluke Corporation
3550 Annapolis Lane N#70
Minneapolis, MN 55447

This Test Report is issued under the Authority of:
Tom Smith, VP of EMC Test Services

Signature: Date: 8/11/15

Test Report Reviewed by:	Project Engineer:
Tom Smith, VP of EMC Test Services	Khairul Aidi Zainal, Senior EMC Engineer.
Signature: Date: 8/11/15	Signature: Date: 8/7/15

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EXHIBIT 1. INTRODUCTION

1.1 - Scope

References:	FCC Part 15, Subpart C, Section 15.247 RSS GEN issue 4 and RSS 247 issue 1
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	FCC KDB 558074 D01 DTS Measurement Guidance v03r03 ANSI C63.10 2013

1.2 – Normative References

Publication	Year	Title
FCC CFR Parts 0-15	2015	Code of Federal Regulations – Telecommunications
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
RSS-247 Issue 1	2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
FCC KDB 558074 D01 DTS Measurement Guidance v03r03	2014	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.3 - LS Research, LLC Test Facility

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) as conforming to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.4 – Location of Testing

All testing was performed at the following location utilizing the facilities listed below, unless otherwise noted.

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA,

List of Facilities Located at LS Research, LLC:

Semi-Anechoic Chamber

1.5 – Test Equipment Utilized

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated by a calibration laboratory accredited to the requirements of ISO/IEC 17025, and traceable to the SI standard.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 – Client Information

Manufacturer Name:	Fluke Corporation
Address:	3550 Annapolis Lane N#70, Minneapolis, MN 55447
Contact Name:	Dave Epperson

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	USB1 FC WIFI-BLE ADAPTER
Model Number:	USB1 FC
Serial Number:	Eng. Sample

2.3 - Associated Antenna Description

The antenna used by the EUT is a TDK multilayer chip antenna, ANT016008LCD2442MA1 with a peak gain of 2.27 dBi.

2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2412MHz – 2462MHz (WLAN)
RF Power in Watts (Conducted measurement)	
Minimum:	2.4GHz WLAN 802.11 b: 0.0125watts 802.11 g: 0.0077watts 802.11 n (HT20): 0.0075watts 802.11 n (HT40): 0.0032watts 2.4 GHz BLE: 0.0010watts
Maximum:	2.4GHz WLAN 802.11 b: 0.0140watts 802.11 g: 0.0084watts 802.11 n (HT20): 0.0085watts 802.11 n (HT40): 0.0042watts 2.4 GHz BLE: 0.0013watts
Conducted Output Power, average (in dBm)	2.4GHz WLAN 802.11 b: Maximum = 11.3dBm Minimum = 11.1dBm 802.11 g: Maximum = 9.1dBm Minimum = 8.9dBm 802.11 n (HT20): Maximum = 9.3dBm Minimum = 8.8dBm 802.11 n (HT40): Maximum = 6.3dBm Minimum = 4.8dBm 2.4 GHz BLE : Maximum = 1.2dBm Minimum = 0.2dBm
Field Strength at 3 meters (Maximum)	Not Applicable
99% Bandwidth	2.4GHz WLAN: 802.11 b: 14.6MHz 802.11 g: 18.9MHz 802.11 n (HT20): 18.7MHz 802.11 n (HT40): 41.9MHz 2.4GHz BLE: 1.04MHz
Type of Modulation	OFDM (WLAN), DSSS(WLAN), GFSK (BLE)
Occupied Bandwidth (6dB BW)	2.4GHz WLAN: 802.11 b: 10.6MHz 802.11 g: 16.3MHz 802.11 n (HT20):15.7MHz 802.11 n (HT40): 35.4MHz

	2.4 GHz BLE: 712.7kHz
Transmitter Spurious (worst case) at 3 meters	42.9dBµV/m at 4824.0MHz
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor/Transceiver Model #	Transceiver: *WL1831MOD*
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	chip antenna
Gain	Peak Gain in 2.4GHz band = 2.27 dBi
EUT will be operated under FCC Rule Part(s)	Title 47 part 15.247
EUT will be operated under RSS Rule Part(s)	RSS 247
Modular Filing	☐ Yes ☒ No
Portable or Mobile?	

RF Technical Information:

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	X	RF Evaluation

The EUT was evaluated against the SAR test exclusion threshold listed in KDB 447498 D01 General RF Exposure Guidance v05r02, section 4.3 (1). The EUT was found to be compliant with the SAR exclusion threshold, 10-g extremity, for 100MHz to 6000MHz.

Frequency = 2.412GHz
ERP (dBm) = 11.5dBm + 2.0dB (manufacturing tolerance) = 13.5dBm
ERP (mW)= 22.4 milliwatt
Minimum separation distance = 5mm

[22.4mw/5mm]*[√2.412GHz] = 4.48*1.55 = 6.9 **≤ 7.5**

When evaluated against RSS 102 issue 5 section 2.5, table 1:

Frequency = 2.412GHz
EIRP (dBm) = 11.5dBm + 2.3dBi = 13.8dBm
ERP (mW)= 24.0 milliwatt

Note: Bluetooth and WLAN radios do not transmit at the same time. Please refer to Appendix D for BT and WLAN Coexistence information.

2.5 - Product Description

The USB1 FC is a Wi Fi and Bluetooth low energy wireless to USB adapter to be used in test and measurement instruments such as the 1735 Energy Logger to communicate readings wirelessly: http://en-us.fluke.com/products/power-and-energy-loggers/fluke-1735-power-quality.html

The Adapter is placed inside the instrument as shown in the photo and the instrument is left to record voltage and current over a period of time.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 - Climate Test Conditions

Temperature:	70 -71° F
Humidity:	32-42%
Pressure:	728-741mmHg

3.2 - Applicability & Summary Of EMC Emission Test Results

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
FCC : 15.207 IC : RSS GEN sect. 7.2.2	Power Line Conducted Emissions Measurements	N/A
FCC : 15.247 (a)(1) IC : RSS 210 A8.1 (a)	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 247 5.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(d) IC : RSS 247 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC:15.247 (a)(2) IC: RSS 247 5.2	6 dB Bandwidth of a Digital Modulation System	Yes
FCC:15.247 (d) IC: RSS 247 5.2	Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS GEN	Transmitter Radiated Emissions	Yes

3.3 - Modifications Incorporated In The EUT For Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 - Deviations & Exclusions From Test Specifications

☒ None ☐ Yes (explain below)

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-247, Issue 1.

Note: If some emissions are seen to be within 3 dB of their respective limits; as these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. UNWANTED EMISSIONS INTO THE RESTRICTED FREQUENCY BANDS.

5.1 - Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.10-2013. The EUT was placed on an 80cm high non-conductive pedestal below 1 GHz and 150cm high non-conductive pedestal above 1 GHz while centered on a flush mounted turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit mode for final testing. The unit has the capability to operate on 3 channels, controllable via proprietary software provided by the manufacturer.

The applicable limits apply at a 3 meter distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels to comply with FCC Part 15.31(m).

5.2 - Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz while a standard gain horn antenna was used in the 18 GHz to 25 GHz range. The maximum radiated RF emissions between 30MHz to 25 GHz were found by raising and lowering the sense antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

The EUT was positioned in 3 orthogonal orientations.

5.3 - Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a calibration laboratory accredited to ISO 17025, and are traceable to the SI standard. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz).

5.4 - Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-247, Issue 1, for a DTS transmitter. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 - Calculation of Radiated Emissions Limits and reported data.

Reported data:

For both fundamental and spurious emissions measurement, the data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBµV/m) + Antenna correction Factor + Cable factor (dB) + Miscellaneous factors when applicable (dB) – amplification factor when applicable (dB).

Generic example of reported data at 200 MHz:

Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor) = 35.45 (dBµV/m).

As specified in 15.247 (d), radiated emissions that fall within the restricted band described in 15.205(c), must comply with the general emissions limit.

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS GEN.

Frequency (MHz)	3 m Limit µV/m	3 m Limit (dBµV/m)	1 m Limit (dBµV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-40,000	500	54.0	63.5

Sample conversion of field strength (µV/m to dBµV/m):
dBµV/m = 20 log $_{10}$ (100)= 40 dBµV/m (from 30-88 MHz)

Per KDB 558074 section 10, an EIRP measurement can be converted to field strength using this relationship:

EIRP = E (electric field strength in dBµV/m) + 20log(d)-104.8
E = EIRP – 20log(d) + 104.8
Sample conversion:
For EIRP = -56.6 dBm,
E (dBµV/m) = -56.6 – 20log(3m) +104.8 = 38.7 dBµV/m
For EIRP = -60.9 dBm,
E (dBµV/m) = -60.9 – 20log(3m) + 104.8 = 34.4 dBµV/m

5.6 - Data:

Manufacturer:	Fluke					
Date(s) of Test:	5-14-15, 5-21-15, 7-29-15					
Project Engineer(s):	Khairul Aidi Zainal					
Test Engineer(s):	Shane Rismeyer, Coty Hammerer, Adam Alger, Khairul Aidi Zainal					
Voltage:	120VAC					
Operation Mode:	continuous transmit, modulated					
Environmental Conditions in the Lab:	Temperature: 70˚F Relative Humidity: 32%					
EUT Power:	X	Single Phase 120VAC		3 Phase ___VAC		
		Battery		Other: Bench DC Supply		
EUT Placement:	X	80cm non-conductive pedestal below 1 GHz	X	150cm non-conductive pedestal above 1 GHz		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

All necessary WLAN mode and bandwidth were investigated. The data presented in this section represents the worst case.

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation	Notes
238.6	1.40	288	41.1	46.0	4.9	H	V	1
238.0	1.00	181	42.8	46.0	3.2	V	V	1
238.0	1.00	175	41	46.0	5.0	V	S	1
238.0	1.00	100	37.9	46.0	8.1	H	S	1
239.3	1.20	274	39.1	46.0	6.9	H	F	1
238.7	1.00	175	38.4	46.0	7.6	V	F	1
999.9	1.00	320	36.3	54.0	17.7	H	V	1
999.9	1.00	30	40.3	54.0	13.7	V	V	1
500.0	1.00	265	36.1	46.0	9.9	V	V	1

Notes:

1. Investigations show that emission not a transceiver related emission.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Refer to exhibit 5.5 on explanation of how data is reported.

WLAN radiated harmonics

Frequency (MHz)	Ant	EUT	Height (cm)	Azimuth (°)	Peak (dBuV/m)	Q.Peak (dBuV/m)	Average (dBuV/m)	Peak limit (dBuV/m)	Q.Peak limit (dBuV/m)	Average limit (dBuV/m)	Peak margin (dB)	Q.Peak margin (dB)	Average margin (dB)	Notes
4824.0	H	V	111.0	100	52.6	N/A	42.9	74.0	N/A	54.0	21.4	N/A	11.1	
4874.0	H	V	131.5	97	45.3	N/A	36.0	74.0	N/A	54.0	28.7	N/A	18.0	
4924.0	H	V	110.8	95	46.8	N/A	38.2	74.0	N/A	54.0	27.2	N/A	15.8	
19296.0	V	V	162.3	77	55.9	N/A	48.4	83.5	N/A	63.5	27.6	N/A	15.1	3
19496.0	V	V	160.4	76	55.0	N/A	47.4	83.5	N/A	63.5	28.5	N/A	16.1	3
19696.0	V	V	162.7	74	55.1	N/A	46.5	83.5	N/A	63.5	28.4	N/A	17.0	3

Notes:

1. H: Horizontal, V: Vertical, S: Side, F: Flat.
2. Refer to exhibit 5.5 on explanation of how data is reported.
3. Measurement performed at 1m. Limit was adjusted to account for the measurement distance.

BLE radiated harmonics

Frequency MHz	Antenna	EUT	Height (m)	Azimuth (0° - 360°)	Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4804.0	H	Vert.	1.72	155	46.47	74.0	27.5	41.77	54.0	12.2
4880.0	H	Side	3.10	271	39.78	74.0	34.2	31.64	54.0	22.4
4960.0	H	Vertical	1.95	157	42.95	74.0	31.1	36.25	54.0	17.8

Notes:

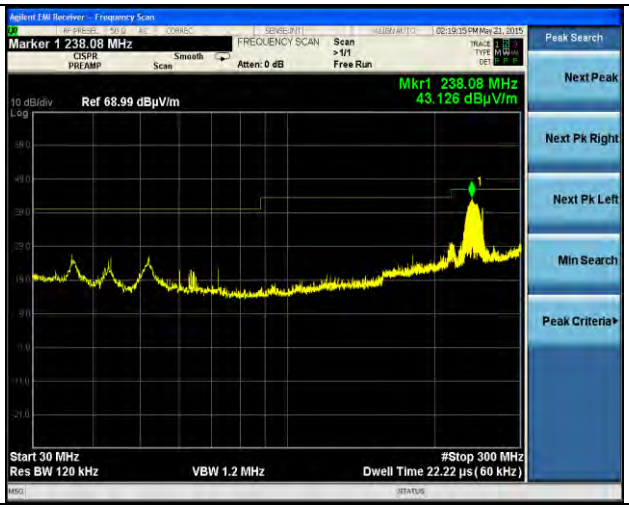
1. H: Horizontal, V: Vertical, S: Side, F: Flat.
2. Refer to exhibit 5.5 on explanation of how data is reported.

5.7 – Screen Captures.

The screen captures below are those using the Peak detector of the analyzer. In addition, the screen captures presented are those which were deemed to be an appropriate representation of the spectrum scan.

30 to 300 MHz, 3m distance.

Horizontal



Vertical

Note: The emissions levels in the plots above are not maximized.

300 to 1000 MHz, 3m distance.

Horizontal

Vertical

Note: The emissions levels in the plots above are not maximized.

1000 to 2400 MHz, 3m distance.

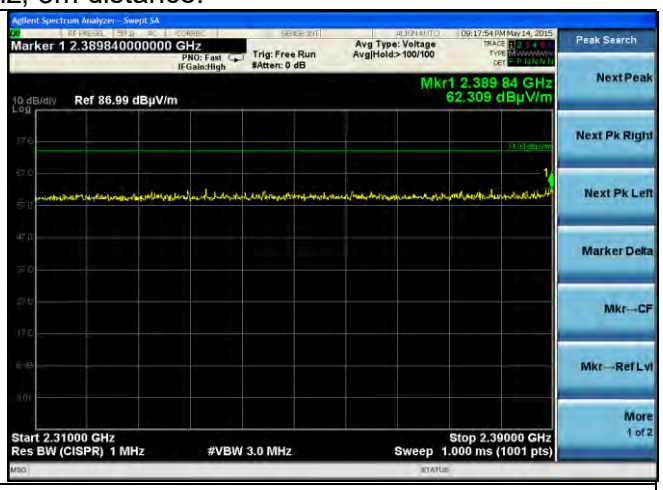
WLAN mode (Reduced bandwidth)

BLE mode (Reduced bandwidth)

Note: The emissions levels in the plots above are not maximized.

2310 to 2390 MHz, 3m distance.

Average



Peak

Notes:

1. The plot above taken when EUT was in IEEE 802.11n HT20 mode and represents worst case. IEEE 802.11b, IEEE 802.11n (HT20) and IEEE 802.11n (HT40) modes were tested and found to be lower in emission.

Note: The range 2483.5 to 2500 MHz is in section 8 of this report (Band-edges).

2500 to 4000 MHz, 3m distance.

WLAN mode (Reduced bandwidth)

BLE mode (Reduced bandwidth)

4000 to 25000 MHz, 3m distance.

4000 to 18000 MHz (reduced bandwidth)

18000 to 25000 MHz (reduced bandwidth)

Note: The emissions levels in the plots above are not maximized.

EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

6.1 Test Setup

The test area and setup are in accordance with ANSI C63.4 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The power supply was then plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to EMI receiver System. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

6.2 Test Procedure

The EUT was investigated in continuous modulated transmit mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

The EUT was installed into a Fluke power logger and set to operate as an access point (AP). The Fluke power logger was then plugged in to charge its battery. Testing was performed while the power logger was charging and the EUT acting as an access point (AP).

6.3 Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI System, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

6.4 Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15.207 and RSS GEN 7.2.4 for Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

6.5 FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBµV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

6.6 CONDUCTED EMISSIONS TEST DATA CHART

Frequency Range inspected: 150 KHz to 30 MHz

Manufacturer:	Fluke Thermography					
Date(s) of Test:	10/1/15					
Project Engineer:	Khairul Aidi Zainal					
Test Engineer:	Peter Feilen					
Voltage:	120 VAC					
Operation Mode:	EUT as access point and power logger charging.					
Environmental Conditions in the Lab:	Temperature: 71˚F Relative Humidity: 40%					
Test Location:	X	AC Mains Test area				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:		Peak	X	Quasi-Peak	X	Average

		Quasi-Peak			Average		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.231	1	52.9	62.4	9.5	45.1	52.4	7.3
0.384	1	35.2	58.2	23.0	27.4	48.2	20.8
4.000	1	43.5	56.0	12.5	39.2	46.0	6.8
12.000	1	38.1	60.0	21.9	34.4	50.0	15.6
28.000	1	40.0	60.0	20.0	37.0	50.0	13.0
0.231	2	53.0	62.4	9.4	46.1	52.4	6.3
0.267	2	50.1	61.2	11.1	42.7	51.2	8.5
4.000	2	37.3	56.0	18.7	32.5	46.0	13.5
12.000	2	36.1	60.0	23.9	29.5	50.0	20.5
28.000	2	44.4	60.0	15.6	40.3	50.0	9.7

Notes:

1) The emissions listed are characteristic of the power supply used and not that of the transmitter.

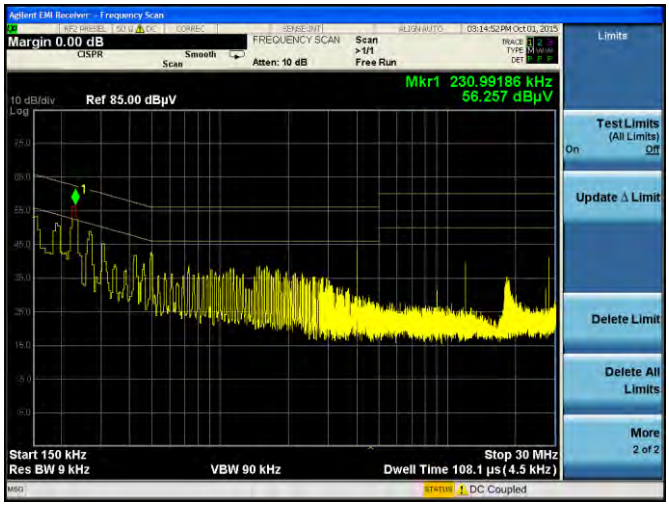
6.7 Test Setup Photo(s) – Conducted Emissions Test

6.8 Screen Captures – Conducted Emissions Test

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized.

120 VAC, 60Hz

Line 1



Line 2

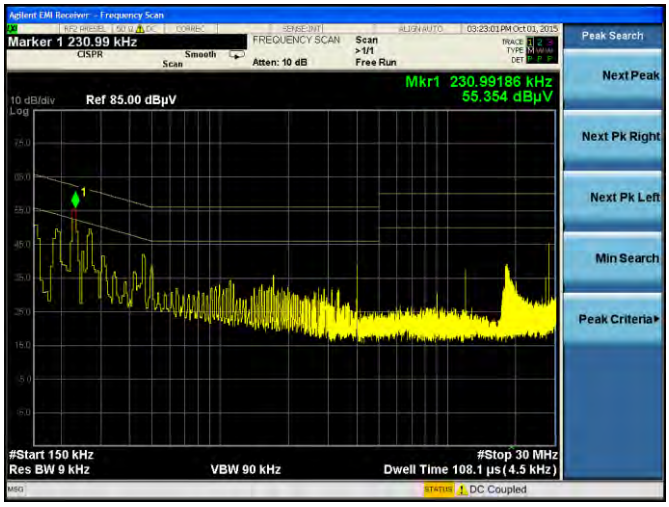


EXHIBIT 7. OCCUPIED BANDWIDTH

Test Engineer(s): Khairul Aidi Zainal

7.1 - Limits

For a DTS system operating in the 2400 to 2483.5 MHz band, the 6dB emission bandwidth limit is 500 kHz.

7.2 - Method of Measurements

For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. A bandwidth measurement function that is built into the spectrum analyzer was used to measure the 20dB/emission bandwidth while the 6dB bandwidth was measured using **FCC OET KDB 558074 section 8 option2.**

Note:
The 20dB bandwidth was measured for use with the measurement method prescribed in FCC OET KDB 558074 for maximum conducted power.

7.3 - Test Data

WLAN

802.11 Standard	Data Rate (MBPS)	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	20dB Bandwidth (MHz)	6dB Bandwidth minimum limit (MHz)
b	1 (DBPSK)	1	10.1	14.6	17.0	0.5
		6	10.1	14.5	16.4	0.5
		11	10.1	14.5	16.4	0.5
b	11 (8QPSK)	1	10.6	14.6	16.9	0.5
		6	10.5	14.6	16.9	0.5
		11	10.5	14.6	16.9	0.5
g	6 (BPSK)	1	15.1	16.6	18.7	0.5
		6	15.1	18.9	25.5	0.5
		11	15.1	16.5	18.5	0.5
g	54 (64QAM)	1	16.3	16.5	18.3	0.5
		6	15.7	16.6	18.7	0.5
		11	15.4	16.5	18.3	0.5
n (HT20)	MCS0 (BPSK)	1	15.2	17.8	20.3	0.5
		6	15.1	18.7	24.7	0.5
		11	15.1	17.6	19.9	0.5
n (HT20)	MCS7 (64QAM)	1	15.7	17.6	19.3	0.5
		6	15.1	17.7	19.7	0.5
		11	15.1	17.5	19.1	0.5
n (HT40)	MCS0 (BPSK)	3	35.1	36.2	39.1	0.5
		6	35.1	37.1	41.9	0.5
		9	35.1	36.5	40.7	0.5
n (HT40)	MCS7 (64QAM)	3	35.2	36.0	38.7	0.5
		6	35.2	36.2	39.9	0.5
		9	35.4	36.2	39.7	0.5

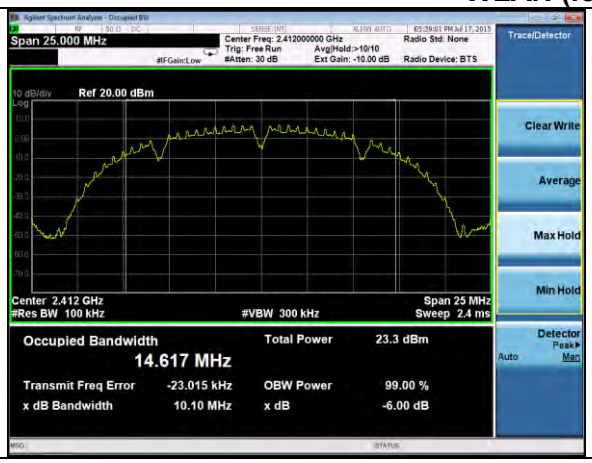
BLE

Channel (MHz)	6dB Bandwidth (kHz)	99% Bandwidth (MHz)	20dB Bandwidth (MHz)	6dB Bandwidth minimum limit (kHz)
2402	712.7	1.04	1.20	500.0
2440	705.3	1.04	1.20	500.0
2480	732.3	1.04	1.20	500.0

7.4 – Screen Captures

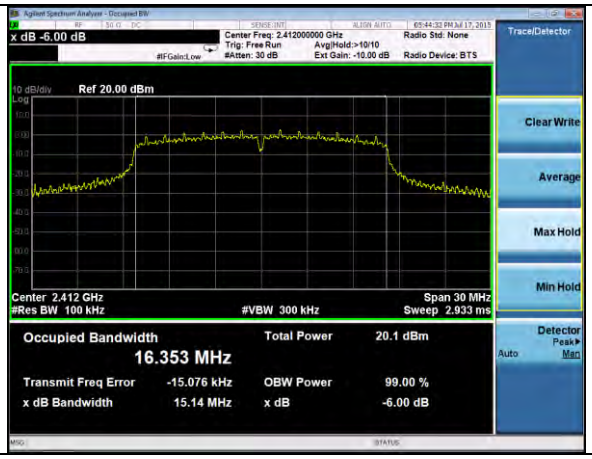
Examples of bandwidth measurements:

WLAN (lowest channel)

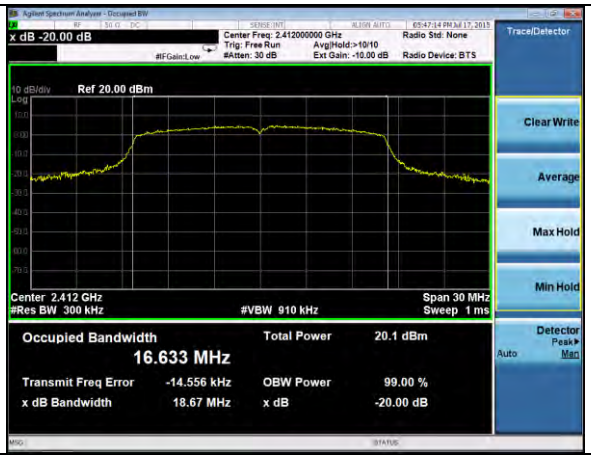


802.11b 6dB bandwidth

802.11b -20dB and 99% bandwidth



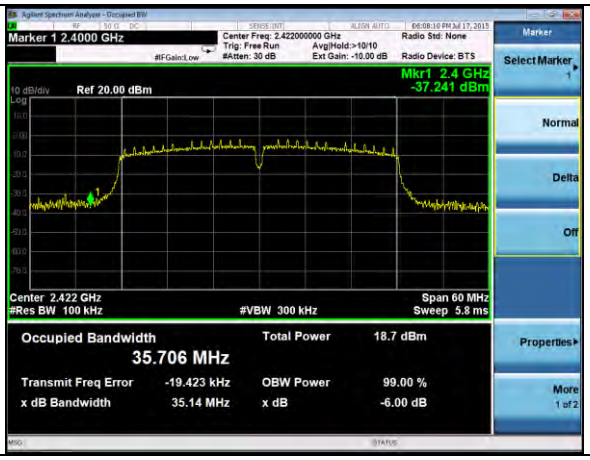
802.11g 6dB bandwidth



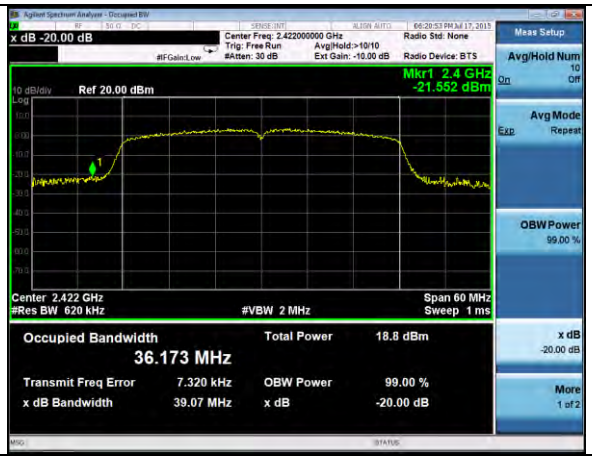
802.11g -20dB and 99% bandwidth

802.11n (HT20) 6dB bandwidth

802.11n (HT20) -20dB and 99% bandwidth



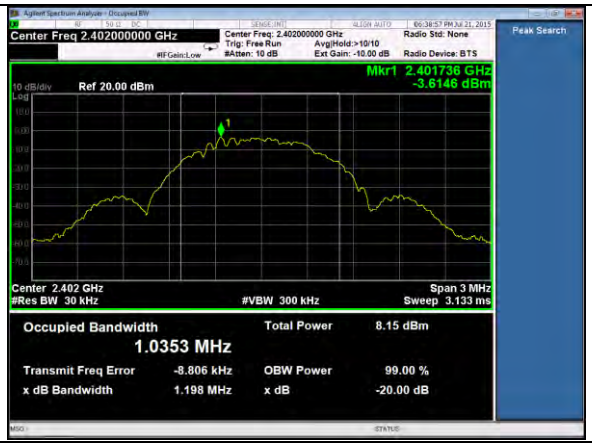
802.11n (HT40) 6dB bandwidth



802.11n (HT40) -20dB and 99% bandwidth

BLE

6dB bandwidth



-20dB and 99% bandwidth

EXHIBIT 8. BAND EDGE MEASUREMENTS

Test Engineer(s): Shane Rismeyer, Adam Alger, Khairul Aidi Zainal

8.1 - Method of Measurements

FCC 15.247 require a measurement of spurious emission levels at the restricted band to be compliant to the general emissions limit, in particular at the Band-Edges where the intentional radiator operates. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

The Band-edge measurements were performed conducted (100kHz bandwidth) and radiated. The measurement of band-edge was performed to satisfy FCC 15.247(d).

Per FCC KDB 558074 D01 Measurement Guidance v03r03 (section 11), conducted measurements were performed with 100 kHz bandwidth for all emissions outside of the band of operation. Emissions in the restricted band, a bandwidth of 120kHz (below 1000MHz) and 1MHz (above 1000MHz) were used in accordance with C63.10 and was performed radiated.

For both conducted and radiated measurements, correction factors and the cable loss factors were entered into the EMI Receiver database. **As a result, the plots taken from the EMI Receiver accounts for all applicable correction factor as well as cable loss, and can therefore be entered into the database as a corrected meter reading.**

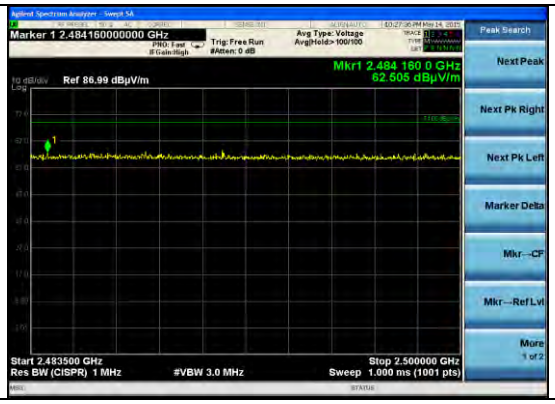
8.2. Band edge screen captures.

The data presented below are samples selected from the various data rates and channels tested.

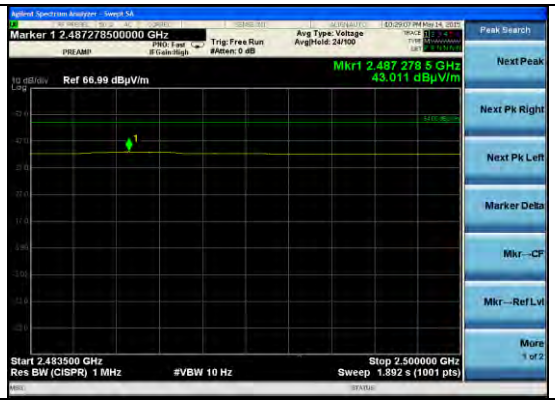
Band-edge in Restricted Band

WLAN Radiated Band-edge in Restricted Band:

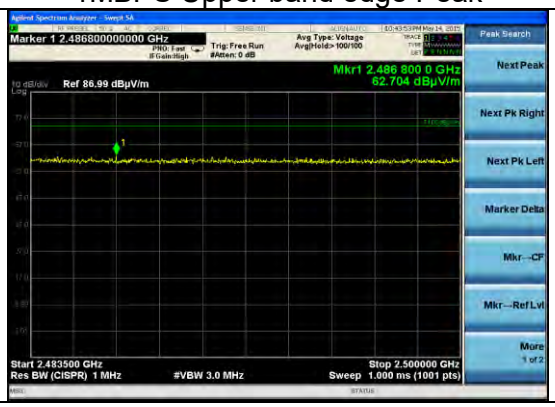
2483.5 to 2500 MHz Restricted band



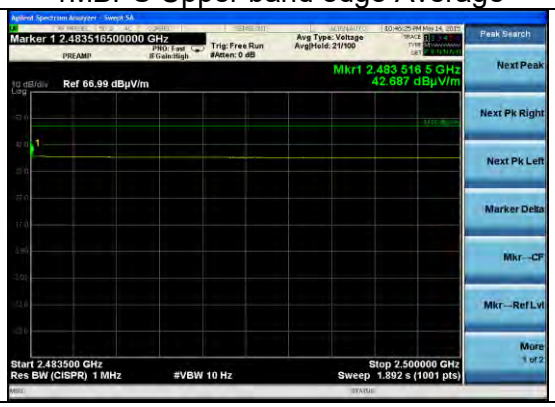
1MBPS Upper band edge Peak



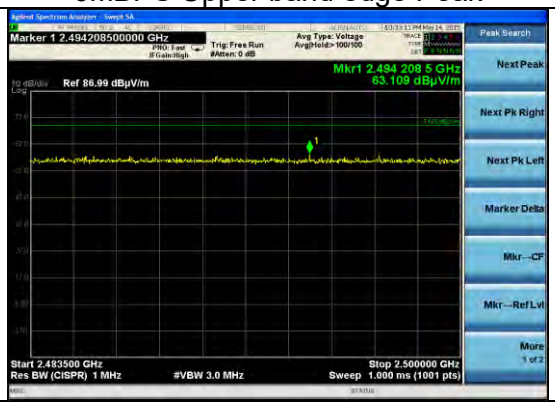
1MBPS Upper band edge Average



6MBPS Upper band edge Peak



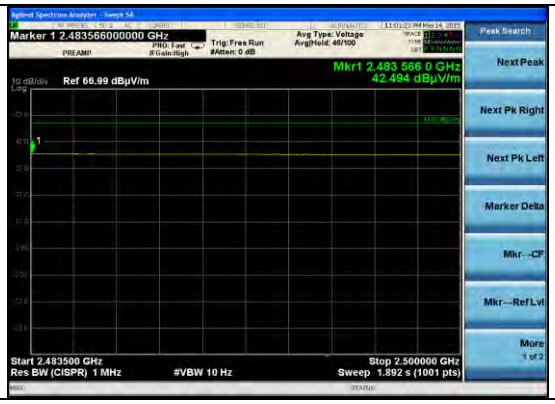
6MBPS Upper band edge Average



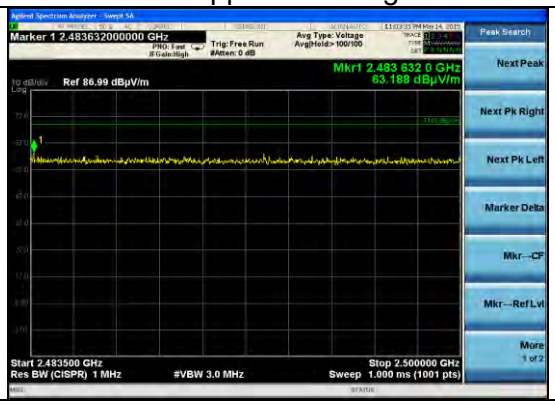
11MBPS Upper band edge Peak

11MBPS Upper band edge Average

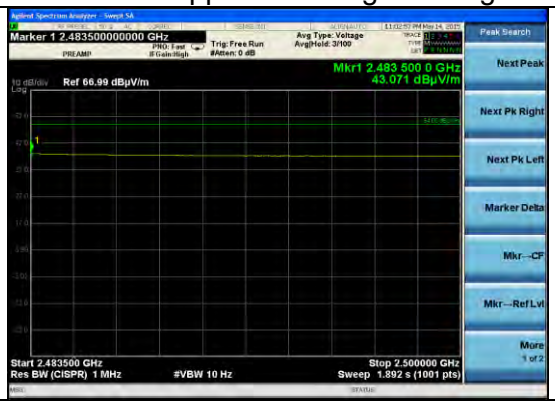
48MBPS Upper band edge Peak



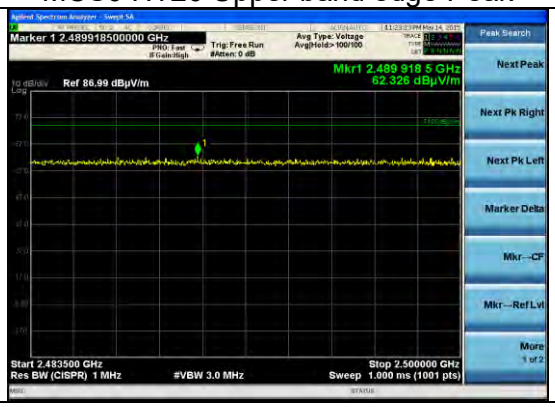
48MBPS Upper band edge Average



MCS0 HT20 Upper band edge Peak

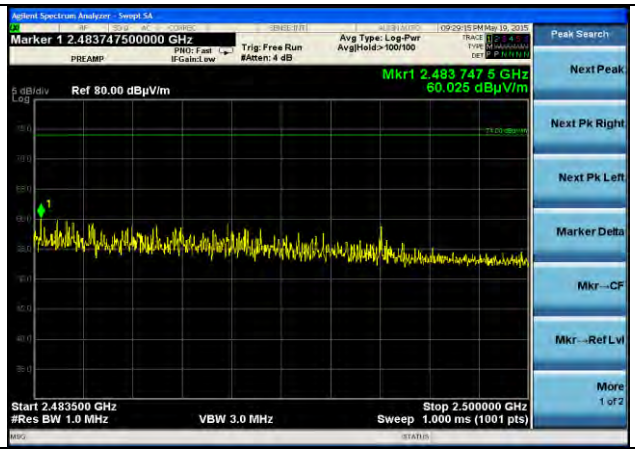


MCS0 HT20 Upper band edge Average



MCS7 HT20 Upper band edge Peak

MCS7 HT20 Upper band edge Average

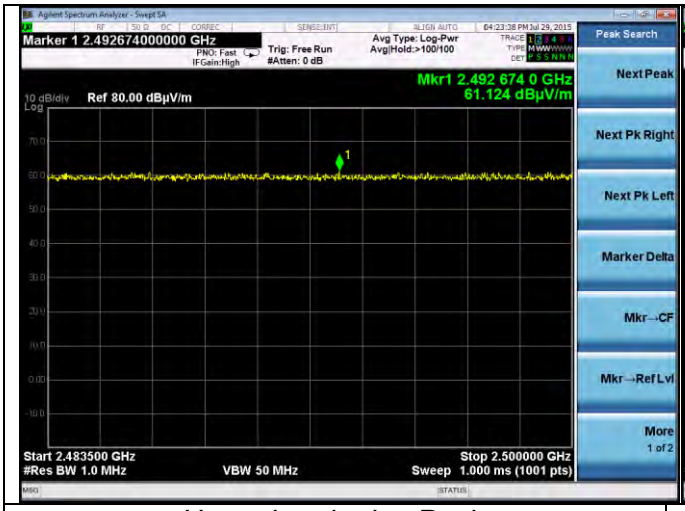


MCS0 HT40 Upper band edge Peak

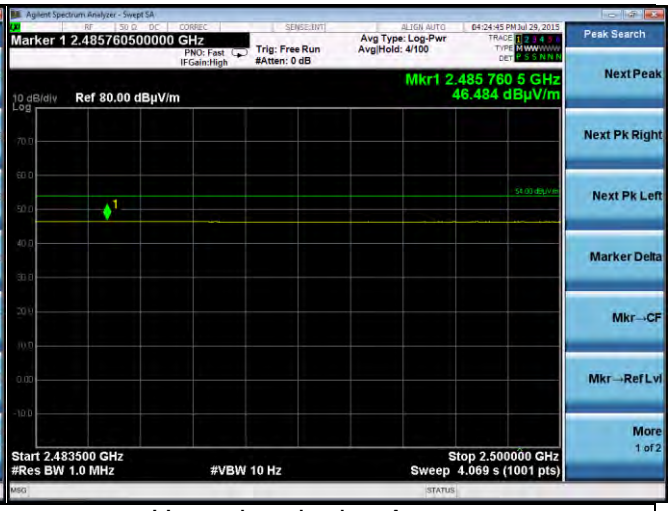
MCS0 HT40 Upper band edge Average

BLE Radiated Band-edge in Restricted Band:

2483.5 to 2500 MHz Restricted band



Upper band edge Peak

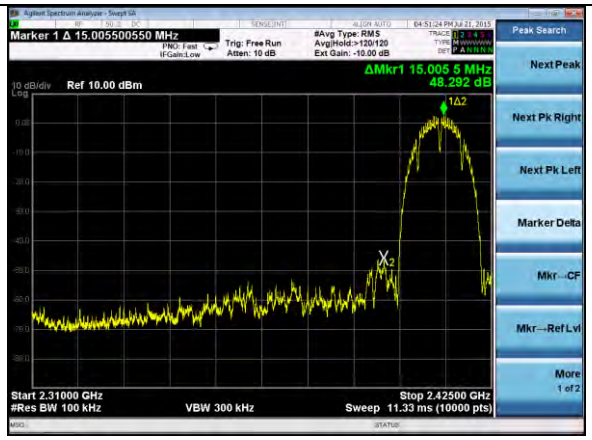


Upper band edge Average

Band-edge in 100kHz bandwidth.

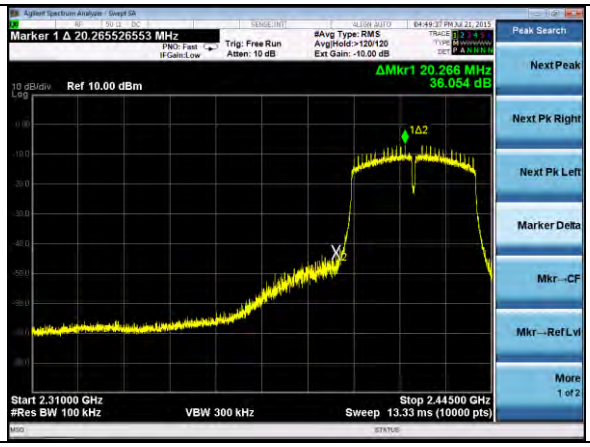
2.4GHz WLAN

1 MBPS upper band-edge



1 MBPS lower band-edge

HT40

	
MCS0 upper band-edge	MCS0 lower band-edge

2.4GHz BLE

	
upper band-edge	lower band-edge

EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

Test Engineer(s): Khairul Aidi Zainal

9.1 - Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

Measurement procedure used was FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 9.2.2.4 for WLAN and 9.1.1 for BLE

9.2 - Test Data

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

9.2.1. WLAN Maximum conducted average power:

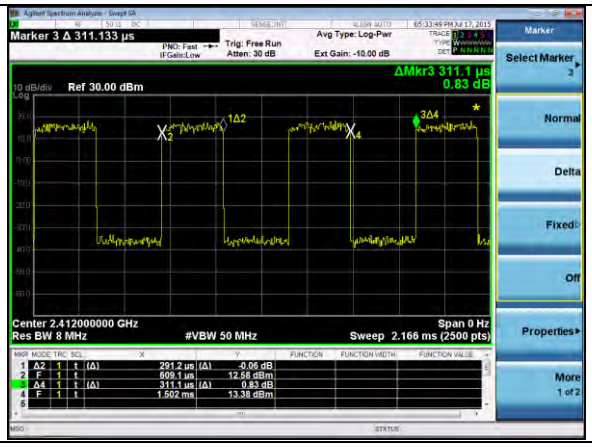
9.2.1.1 Duty cycle:

Measurement procedure: **FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 6**

Modulation	802.11 Standard	Data Rate (MBPS)	TX on time (ms)	TX off time (ms)	Duty Cycle	Duty cycle correction factor (dB)
DBPSK	b	1.0	16.430	0.290	0.98	0.0
BPSK	a,g	6.0	2.733	0.317	0.90	0.5
8-QPSK	b	11.0	1.667	0.313	0.84	0.7
64-QAM	a,g	54.0	0.329	0.310	0.51	2.9
BPSK	n	MCS0	2.542	0.313	0.89	0.5
64-QAM	n	MCS7	0.291	0.311	0.48	3.2

Example screen captures:

TX ON and OFF time 1MBPS



TX ON and OFF time MCS7

9.2.1.2 WLAN Maximum conducted (average) output power:

802.11 Standard	Data Rate (MBPS)	Channel	Maximum Conducted Power (dBm)	Duty Cycle correction for average measurement (dB)	Corrected Maximum Conducted Power (dBm)	Power Limit (dBm)	Power margin (dB)
b	1 (DBPSK)	1	11.3	0.0	11.3	30.0	18.7
		6	11.2	0.0	11.2	30.0	18.8
		11	11.0	0.0	11.0	30.0	19.0
b	11 (8QPSK)	1	10.8	0.7	11.5	30.0	18.5
		6	10.5	0.7	11.2	30.0	18.8
		11	10.4	0.7	11.1	30.0	18.9
g	6 (BPSK)	1	8.6	0.5	9.1	30.0	20.9
		6	8.7	0.5	9.2	30.0	20.8
		11	8.6	0.5	9.1	30.0	20.9
g	54 (64QAM)	1	6.2	2.9	9.1	30.0	20.9
		6	6.1	2.9	9.0	30.0	21.0
		11	6.0	2.9	8.9	30.0	21.1
n (HT20)	MCS0 (BPSK)	1	8.3	0.5	8.8	30.0	21.2
		6	8.7	0.5	9.2	30.0	20.8
		11	8.7	0.5	9.2	30.0	20.8
n (HT20)	MCS7 (64QAM)	1	6.1	3.2	9.3	30.0	20.7
		6	5.9	3.2	9.1	30.0	20.9
		11	6.0	3.2	9.2	30.0	20.8
n (HT40)	MCS0 (BPSK)	3	5.5	0.5	6.0	30.0	24.0
		6	5.8	0.5	6.3	30.0	23.7
		9	5.6	0.5	6.1	30.0	23.9
n (HT40)	MCS7 (64QAM)	3	1.6	3.2	4.8	30.0	25.2
		6	1.8	3.2	5.0	30.0	25.0
		9	1.9	3.2	5.1	30.0	24.9

9.2.2. BLE Maximum peak conducted power:

Data Rate (MBPS)	Channel (MHz)	Peak Conducted Power (dBm)	Power Limit (dBm)	Power margin (dB)
1	2402	1.2	30.0	28.8
	2440	1.0	30.0	29.0
	2480	0.2	30.0	29.8

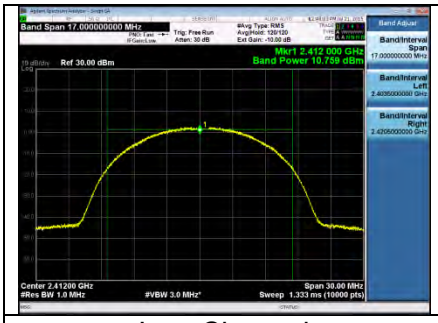
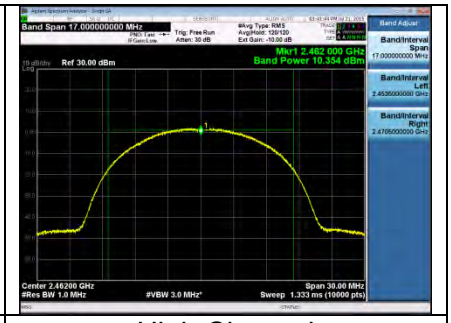
9.3 – Screen Captures.

9.3.1 WLAN:

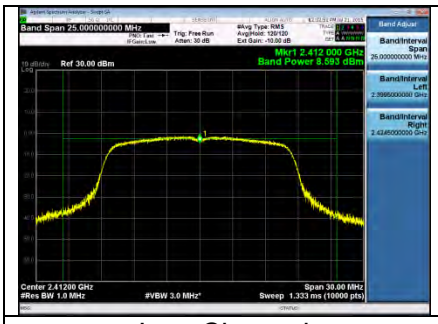
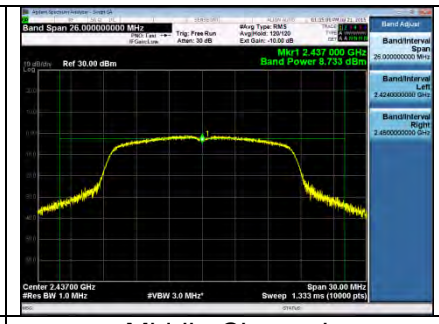
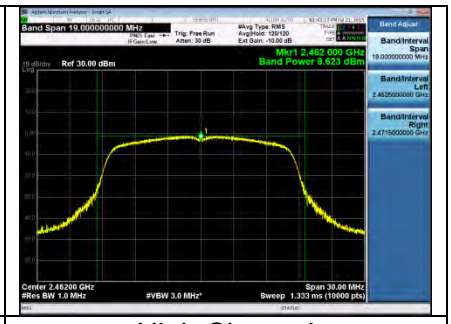
1MBPS

		
Low Channel	Middle Channel	High Channel

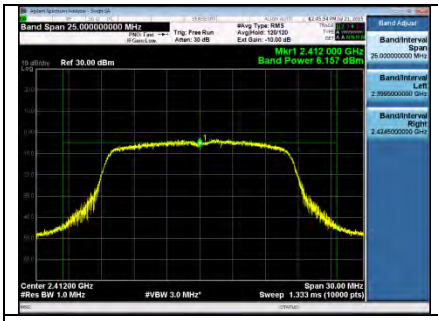
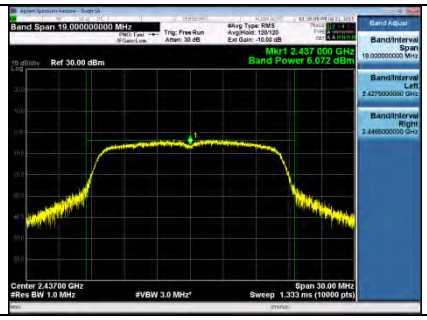
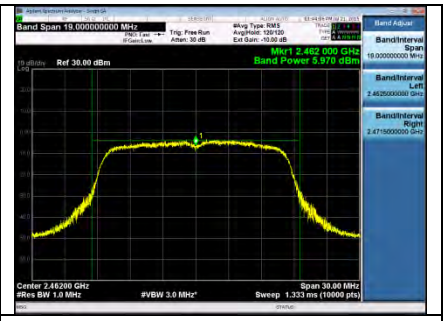
11MBPS

		
Low Channel	Middle Channel	High Channel

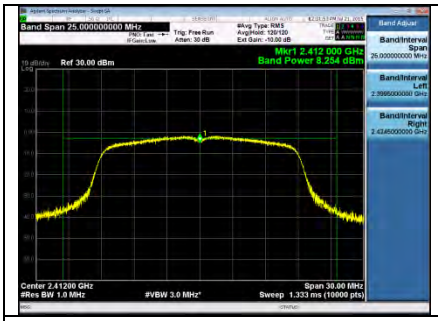
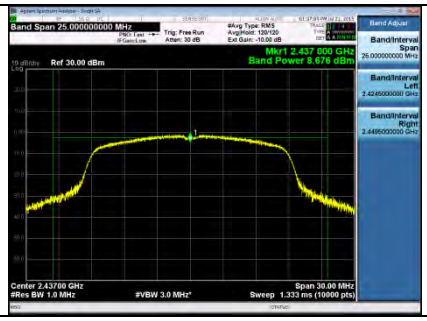
6MBPS

		
Low Channel	Middle Channel	High Channel

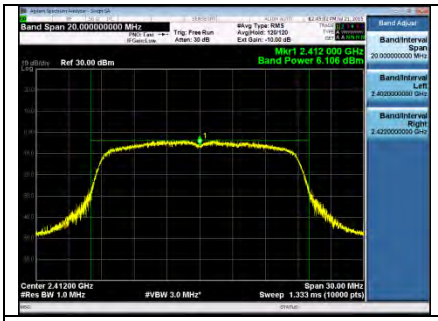
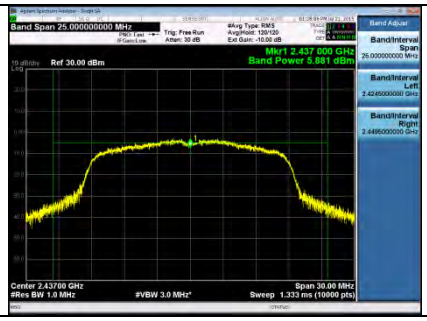
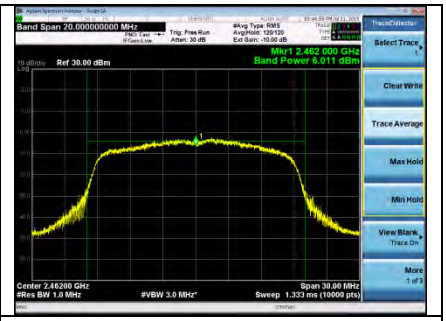
54MBPS

		
Low Channel	Middle Channel	High Channel

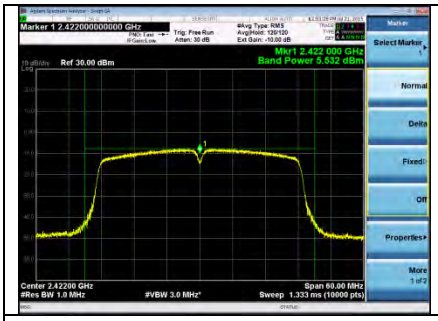
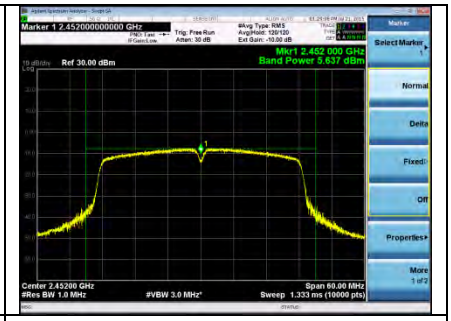
MCS0 HT20

		
Low Channel	Middle Channel	High Channel

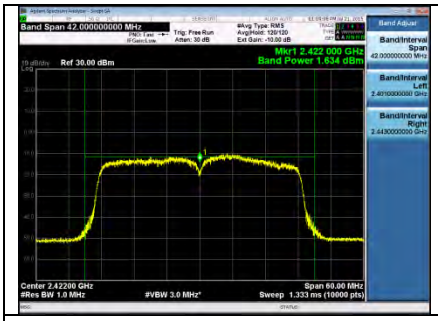
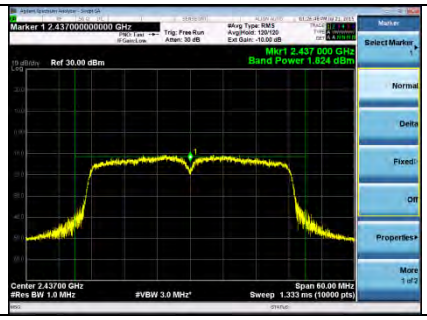
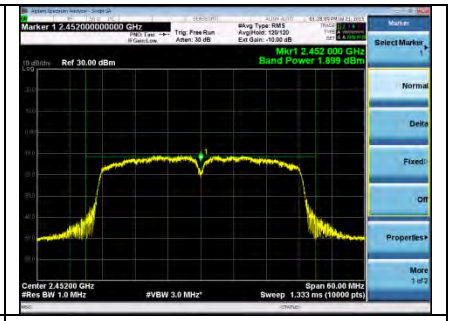
MCS7 HT20

		
Low Channel	Middle Channel	High Channel

MCS0 HT40

		
Low Channel	Middle Channel	High Channel

MCS7 HT40

		
Low Channel	Middle Channel	High Channel

9.3.2 BLE:

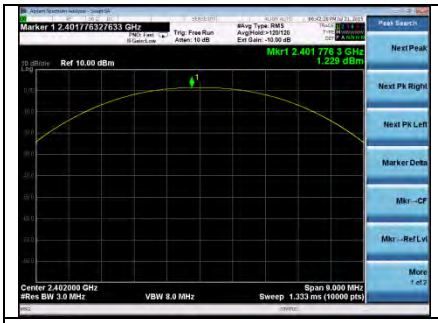
		
Low Channel	Middle Channel	High Channel

EXHIBIT 10. CONDUCTED SPURIOUS EMISSIONS: 15.247(d)

Test Engineer(s): Khairul Aidi Zainal

10.1 - Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

10.2 – Conducted Harmonic And Spurious RF Measurements

FCC Part 15.247(d) and IC RSS 210 A8.5 both require a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct readings of the measurements made without the need for any further corrections. A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

Measurement procedure used was FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 11.

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

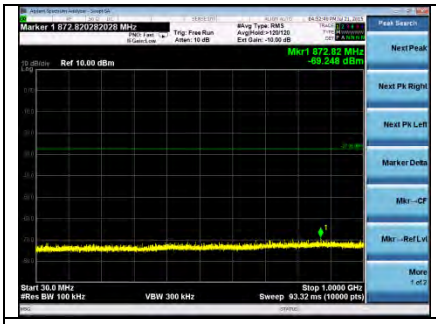
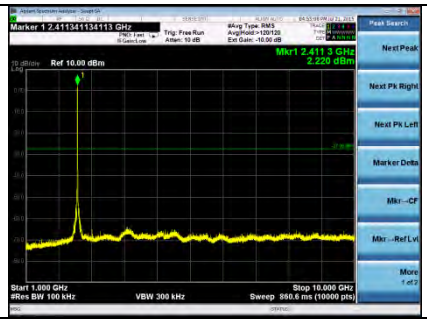
10.3 - Test Data

The data presented below are samples selected from the various data rates and channels tested.

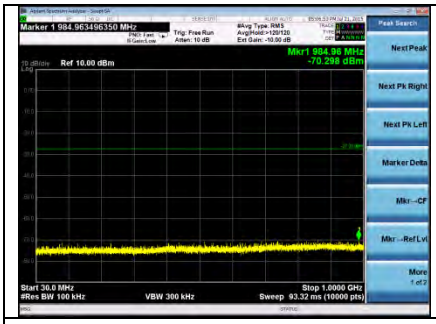
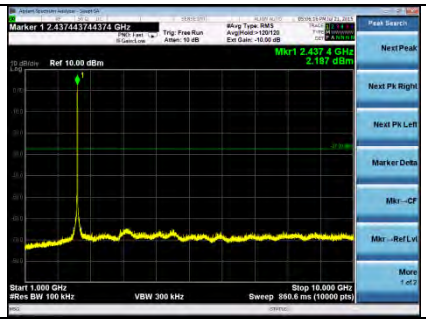
All necessary WLAN mode and bandwidth were investigated. The data presented in this section represents the worst case.

10.3.1 2.4GHz WLAN: 802.11b 1 MBPS

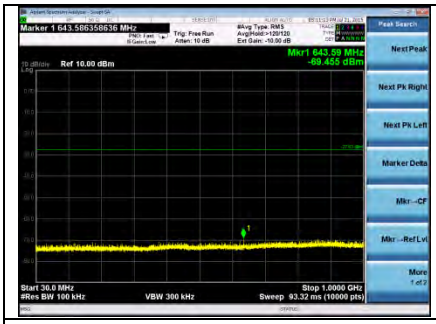
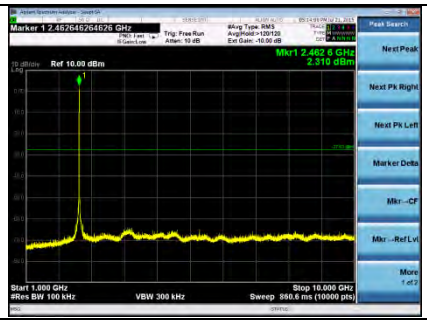
Low Channel fundamental in 100 kHz:

		
30 to 1000 MHz	1000 to 10000 MHz	10000 to 25000 MHz

Middle Channel fundamental in 100 kHz:

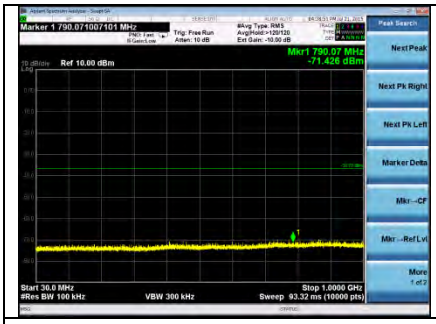
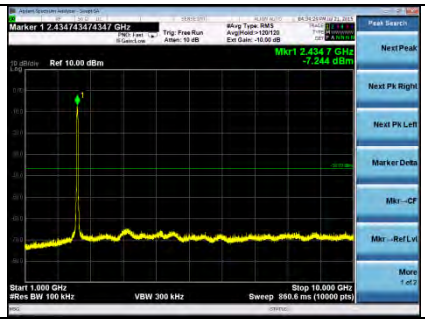
		
30 to 1000 MHz	1000 to 10000 MHz	10000 to 25000 MHz

High Channel fundamental in 100 kHz:

		
30 to 1000 MHz	1000 to 10000 MHz	10000 to 26000 MHz

HT40: 802.11n MCS0 (Only middle channel shown)

Middle Channel fundamental in 100 kHz:

		
30 to 1000 MHz	1000 to 10000 MHz	10000 to 26000 MHz

10.3.2 2.4GHz BLE
(Only middle channel shown)

Middle Channel fundamental in 100 kHz:

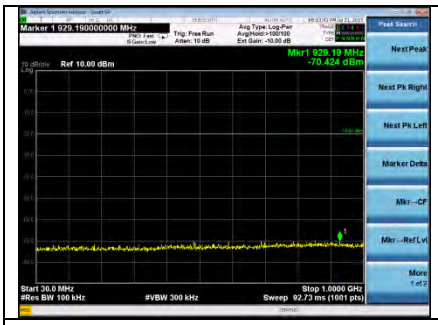
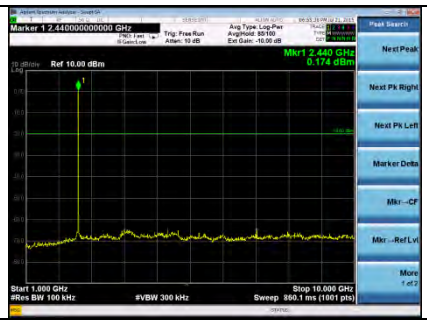
		
30 to 1000 MHz	1000 to 10000 MHz	10000 to 26000 MHz

EXHIBIT 11. POWER SPECTRAL DENSITIES: 15.247(e)

11.1 Limits

For digitally modulate systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e) and RSS 247 the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed.

Measurement procedure used was FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 10.2 for WLAN and for BLE.

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

11.2 Test Data

11.2.1 2.4GHz WLAN

Data Rate (MBPS)	Channel	PSD in 100kHz (dBm)	PSD in 3kHz limit(dBm)	PSD margin (dBm)
1 (DBPSK)	1	2.6	8.0	5.4
	6	2.7	8.0	5.3
	11	2.4	8.0	5.6
11 (8QPSK)	1	3.0	8.0	5.0
	6	2.8	8.0	5.2
	11	2.2	8.0	5.8
6 (BPSK)	1	-0.5	8.0	8.5
	6	-0.5	8.0	8.5
	11	-1.2	8.0	9.2
54 (64QAM)	1	-0.5	8.0	8.5
	6	-0.7	8.0	8.7
	11	-1.3	8.0	9.3
MCS0 (BPSK)	1	-0.8	8.0	8.8
	6	-0.3	8.0	8.3
	11	-0.7	8.0	8.7
MCS7 (64QAM)	1	-0.8	8.0	8.8
	6	-0.5	8.0	8.5
	11	-0.9	8.0	8.9
MCS0 (BPSK)	3	-6.9	8.0	14.9
	6	-6.7	8.0	14.7
	9	-6.8	8.0	14.8
MCS7 (64QAM)	3	-6.9	8.0	14.9
	6	-7.0	8.0	15.0
	9	-7.1	8.0	15.1

11.2.2 BLE

Data Rate (MBPS)	Channel (MHz)	Peak PSD in 100kHz (dBm)	PSD in 3kHz limit(dBm)	PSD margin (dBm)
1	2402	0.4	8.0	7.6
	2440	0.2	8.0	7.8
	2480	-0.7	8.0	8.7

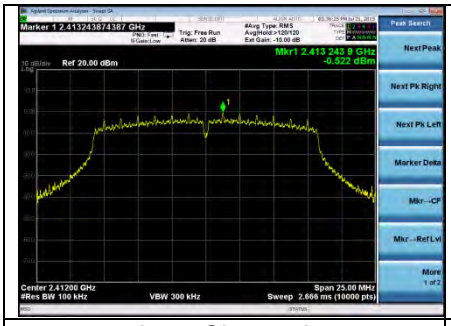
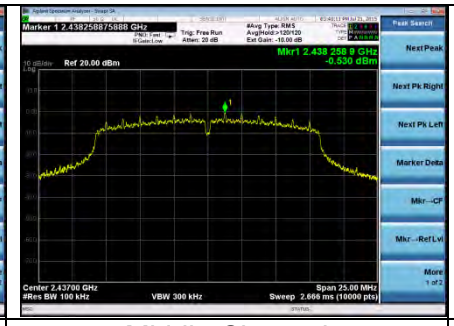
11.3 Screen Captures – Power Spectral Density

11.3.1 2.4GHz WLAN

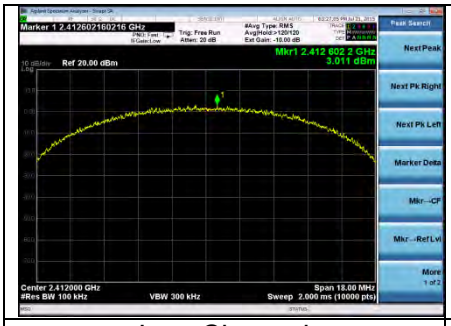
11.3.1.1 1MBPS

		
Low Channel	Middle Channel	High Channel

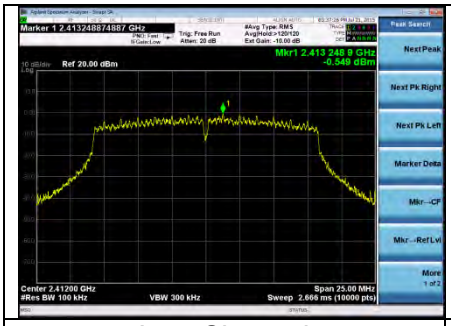
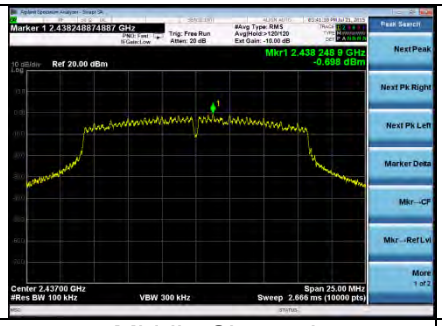
11.3.1.2 6MBPS

		
Low Channel	Middle Channel	High Channel

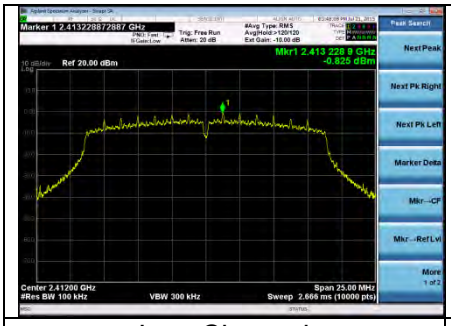
11.3.1.3 11MBPS

		
Low Channel	Middle Channel	High Channel

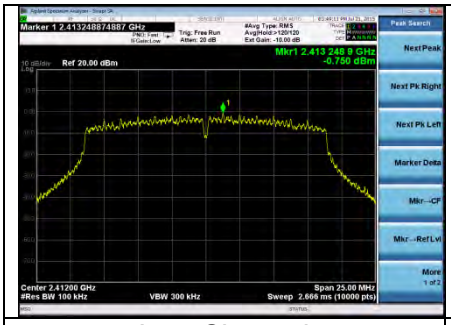
11.3.1.4 54MBPS

		
Low Channel	Middle Channel	High Channel

11.3.1.5 MCS0 HT20

		
Low Channel	Middle Channel	High Channel

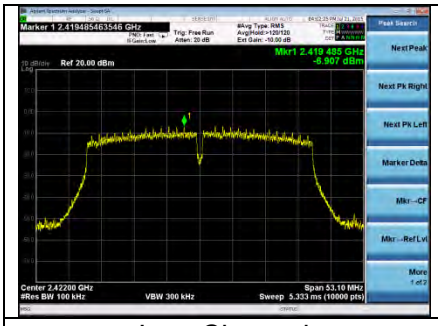
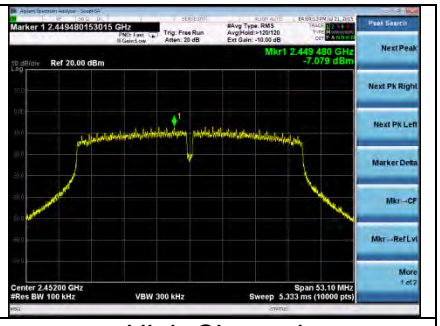
11.3.1.6 MCS7 HT20

		
Low Channel	Middle Channel	High Channel

11.3.1.5 MCS0 HT40

		
Low Channel	Middle Channel	High Channel

11.3.1.6 MCS7 HT40

		
Low Channel	Middle Channel	High Channel

11.3.2 BLE

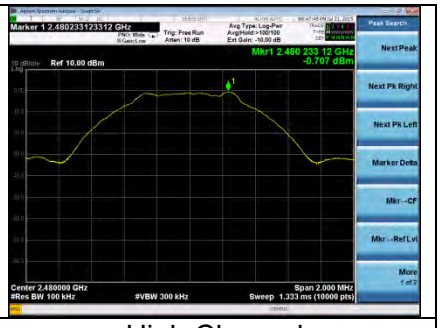
		
Low Channel	Middle Channel	High Channel

EXHIBIT 12. FREQUENCY STABILITY OVER VOLTAGE VARIATIONS

Test Engineer(s): Khairul Aidi Zainal

The frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied ±10% from the nominal.

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.

BLUETOOTH

	4.25VDC	5.0VDC	5.75VDC	
	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	2401995037	2401995053	2401995031	22
MID CHANNEL	2439994987	2439995007	2439994994	20
HIGH CHANNEL	2479994853	2479994851	2479994863	12

WLAN 2.4 GHZ

	4.25VDC	5.0VDC	5.75VDC	
	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	2411993790	2411993840	2411993896	106
MID CHANNEL	2436993620	2436993641	2436993704	84
HIGH CHANNEL	2461993910	2461993943	2461993994	84

APPENDIX A – Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 30-Jun-2015 Type Test : Radiated Emissions Job # : C-2217

Prepared By: Coty Hammerer Customer : Fluke Thermography Quote #: 315142

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/6/2015	5/6/2016	Active Calibration
2	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	7/28/2014	7/28/2015	Active Calibration
3	AA 960154	2.4GHz High Pass Filter	KWM	HPF-L-14186	7272-02	8/1/2014	8/1/2015	Active Calibration
4	EE 960125	SMA Cable	MegaPhase	NC19-S1S1-236	1GVT4 14032106 001	3/6/2015	3/6/2016	Active Verification
5	EE 960096	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	40201429	3/3/2015	3/3/2016	Active Calibration
6	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	12/11/2014	12/11/2015	Active Calibration
7	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	1/19/2015	1/19/2016	Active Calibration
8	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EMCO	WLA622-4 / 3160-09	123001	8/20/2014	8/20/2015	Active Calibration
9	AA 960150	Biconical Antenna	ETS	3110B	0003-3346	1/22/2015	1/22/2016	Active Calibration

Project Engineer: Quality Assurance:

APPENDIX B – Test Standards: CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2014		
ANSI C63.10	2013		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2015		
RSS GEN	2014		
RSS 247	2015		

APPENDIX C - Uncertainty Statement

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	*Particular Configuration*	*Uncertainty Values*
Radiated Emissions	*3 – Meter chamber, Biconical Antenna*	*4.82 dB*
Radiated Emissions	*3-Meter Chamber, Log Periodic Antenna*	*4.88 dB*
Radiated Emissions	*3-Meter Chamber, Horn Antenna*	*4.85 dB*
Radiated Emissions	*10-Meter OATS, Biconical Antenna*	*4.32 dB*
Radiated Emissions	*10-Meter OATS, Log Periodic Antenna*	*3.63 dB*
Absolute Conducted Emissions	*Agilent PSA/ESA Series*	*1.38 dB*
AC Line Conducted Emissions	*Shielded Room/EMCO LISN*	*3.20 dB*
Radiated Immunity	*3 Volts/Meter in 3-Meter Chamber*	*2.05 Volts/Meter*
Conducted Immunity	*3 Volts level*	*2.33 V*
EFT Burst, Surge, VDI	*230 VAC*	*54.4 V*
ESD Immunity	*Discharge at 15kV*	*3200 V*
Temperature/Humidity	*Thermo-hygrometer*	*0.64° / 2.88 %RH*

APPENDIX D –Bluetooth and WLAN Coexistence

(Information presented below was referenced from TI WILink 8 Software specification, document SWRU423 section 2.10)

Both WLAN and BT operate on a 2.4-GHz ISM band. Allowing the two technologies to work simultaneously, especially when located on the same device, is a challenging task that requires special treatment to keep performance quality on both sides. The advantage of having both Wi-Fi and BT/BLE on a single combo device such as WiLink8.0 provides better correlation between the different IPs to ensure good performance. WiLink8.0 uses a shared antenna for Wi-Fi and BT.

This operation is accomplished by managing a time-division multiplexing (TDM) scheme; transmitting and receiving independent signals over the shared antenna in an alternating pattern, using an external controlled switch.

The WLAN both switches the antenna to the BT IP and protects BT traffic from any WLAN traffic by other devices, using a number of different methods.

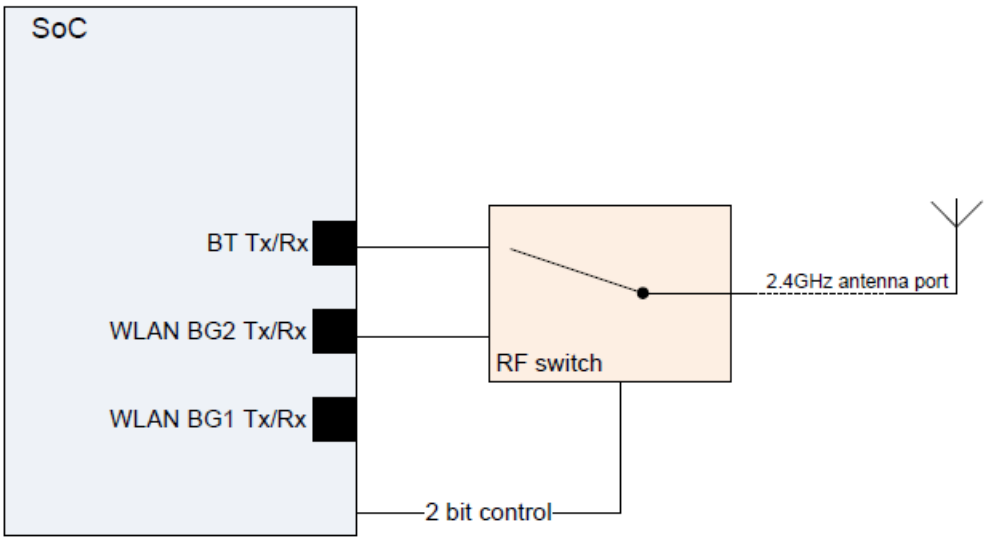


Figure 4. Wi-Fi – BT/BLE Coexistence – Shared Antenna