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TEST REPORT # 314218 B
LSR Job #: C-2142

Compliance Testing of:
Tix560/Tix520

Test Date(s):
January 9th to March 4th 2015

Prepared For:
Attention: Reed Nelson
Fluke Thermology
3550 Annapolis Lane N#70
Minneapolis, MN 55447

This Test Report is issued under the Authority of:
Khairul Aidi Zainal, Senior EMC Engineer

Signature: Date: 2/13/15

Test Report Reviewed by:	Project Engineer:
Tom Smith, VP of EMC Test Services	Khairul Aidi Zainal, Senior EMC Engineer.
Signature: Date: 2/2/15	Signature: Date: 1/24/15

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EXHIBIT 1. INTRODUCTION

1.1 - Scope

References:	FCC Part 15, Subpart C, Section 15.247 RSS GEN issue 3 and RSS 210 issue 8 Annex 8
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
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 v03r02
Environmental Classification:	Industrial

1.2 – Normative References

Publication	Year	Title
FCC CFR Parts 0-15	2015	Code of Federal Regulations – Telecommunications
ANSI C63.4	2009	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-210 Annex 8	2010	Low-power License-exempt Radio communication Devices (All Frequency Bands): Category I Equipment
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
FCC KDB 558074 D01 DTS Measurement Guidance v03r02	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:

Compact Chamber
Semi-Anechoic Chamber
Open Area Test Site (OATS)

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 Thermology
Address:	3550 Annapolis Lane N#70, Minneapolis, MN 55447
Contact Name:	Reed Nelson

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	Thermal Imager
Model Number:	TiX560/Tix520
Serial Number:	TiX56014120035: Radiated measurements TiX56014120042: Conducted measurements

2.3 - Associated Antenna Description

The antenna associated with the EUT is a Johanson Technology high frequency ceramic chip antenna, part number 2450AT18D0100. The chip antenna has a peak gain of 1.5dBi.

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: 0.0117 watts 802.11 g: 0.0138 watts 802.11 n (HT20): 0.0091 watts 2.4 GHz BLE: 0.0009 watts
Maximum:	2.4GHz WLAN 802.11 b: 0.0145 watts 802.11 g: 0.0191 watts 802.11 n (HT20): 0.0155 watts 2.4 GHz BLE: 0.0014 watts
Conducted Output Power, average (in dBm)	2.4GHz WLAN 802.11 b: Maximum = 11.6 dBm Minimum = 10.7 dBm 802.11 g: Maximum = 12.8 dBm Minimum = 11.4 dBm 802.11 n (HT20): Maximum = 11.9 dBm Minimum = 9.6 dBm 2.4 GHz BLE : Maximum = 1.43 dBm Minimum = -0.34 dBm
Field Strength at 3 meters (Maximum)	Not Applicable
99% Bandwidth	2.4GHz WLAN: 802.11 b: 14.4 MHz 802.11 g: 16.6 MHz 802.11 n (HT20): 17.8 MHz 2.4GHz BLE:1.047 MHz
Type of Modulation	OFDM (WLAN), DSSS(WLAN), GFSK (BLE)
Occupied Bandwidth (6dB BW)	2.4GHz WLAN: MHz 802.11 b: 9.8 MHz 802.11 g: 16.4 MHz 802.11 n (HT20): 17.3 MHz 2.4 GHz BLE: 720kHz
Transmitter Spurious (worst case) at 3 meters	34.6dBµV/m at 1399.5MHz (not a function of transmitter)
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor Model # (if applicable)	Microprocessor: DM3730
Antenna Information	

Detachable/non-detachable	Non-detachable
Type	Ceramic chip antenna
Gain	Peak Gain in 2.4GHz band = 1.5 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 210
Modular Filing	☐ Yes ☒ No
Portable or Mobile?	portable

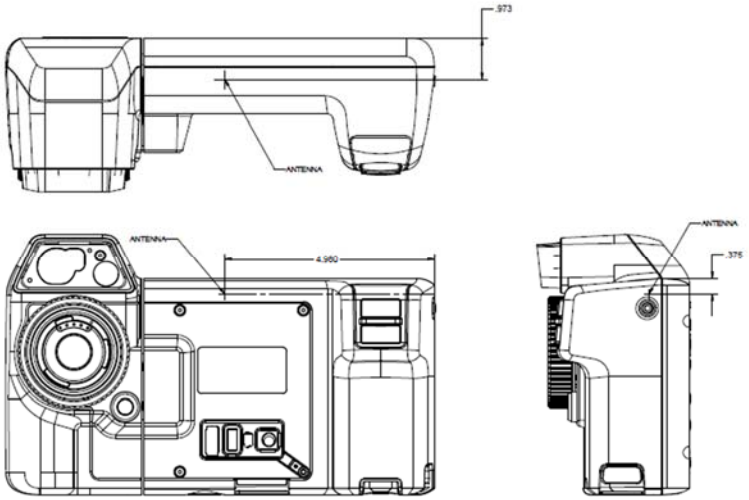
RF Technical Information:

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 for 100MHz to 6000MHz.

Frequency = 2.480 GHz
ERP (dBm) = 12.8 dBm
ERP (mW)= 19.1 milliwatt
Minimum separation distance = 0.973 inches =24.7mm

[19.1mw/24.7mm]*[√2.48GHz] = 0.77*1.57 = **<u>1.2</u> ≤ 3.0**



The dimensions in the figures above have units of inches.

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 thermal Imager is a WLAN and Bluetooth enabled handheld imaging product that can detect infrared radiation (IR). The primary use is for preventive maintenance and diagnosing problems in industrial environments. These products are not intended for sale to consumers. The series has two versions labeled TiX520 and TiX560.

The versions use the same common IR camera body assembly (Fluke part number 4596742). Other than the model numbers, the electronics, mechanical components, layout, bill of materials, assembly procedures, and test processes are the exactly same for the three versions. The versions are configured through software flags in the flash memory at the end of the production line to match the customer's order.

The differences between the versions are the following:

Thermal Sensitivity:
The thermal sensitivity is the minimal temperature difference that the thermal camera can detect. TiX520 can detect down to 0.05 °C temperature difference. TiX560 can detect down to 0.045 °C temperature difference. The native thermal sensitivity of the IR Camera is 0.045 °C. Embedded software within the IR Camera reduces the thermal sensitivity for the Ti200 version.

Temperature Measurement rage:
The TiX520 and TiX560 are Calibrated to -10°C. The TiX520's measurement range is -20 to 850°C and the TiX560's measurement range is -20 to 1200°C

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	Yes
FCC : 15.247 (a)(1) IC : RSS 210 A8.1 (a)	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	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 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC:15.247 (a)(2) IC: RSS 210 A8.2 (a)	6 dB Bandwidth of a Digital Modulation System	Yes
FCC:15.247 (d) IC: RSS 210 A8.2 (b)	Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	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-210, Issue 8 (2010), Annex 8.

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 C63.4-2009. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit mode for final testing using power as provided by an AC to DC power supply that comes with the EUT. 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-210, Issue 8 (2010), Annex 8 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) and RSS 210 A8.5, radiated emissions that fall within the restricted band described in 15.205(c) for FCC and section 2.2 of RSS 210 for IC, 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 Thermology						
Date(s) of Test:	January 9th , 16th , 20th and 21st 2015						
Project Engineer(s):	Khairul Aidi Zainal						
Test Engineer(s):	Khairul Aidi Zainal, Mike Hintzke						
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		10cm Spacers			
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	

Emissions that are present but not a function of the transmitter:

Frequency (MHz)	Antenna	EUT	Height (cm)	Azimuth (°)	Peak (dBµV/m)	Q. Peak (dBµV/m)	Average (dBµV/m)	Note
5000.00	H	V	100.0	0	41.0	N/A	30.7	1
14000.00	V	V	100.0	0	48.6	N/A	36.5	1
10000.00	H	V	100.0	0	46.8	N/A	34.6	1
177.93	V	V	100.0	134	N/A	37.9	N/A	
45.56	V	V	100.0	0	N/A	33.1	N/A	
153.58	H	V	226.3	180	N/A	45.3	N/A	
177.87	H	V	100.0	96	N/A	44.2	N/A	
381.12	H	V	100.0	0	N/A	39.7	N/A	
420.00	H	V	100.0	0	N/A	42.5	N/A	
228.72	V	V	100.0	20	N/A	42.7	N/A	
1399.46	H	V	100.00	110	53.3	N/A	34.6	
1100.00	H	V	100.00	93	48.7	N/A	30.8	

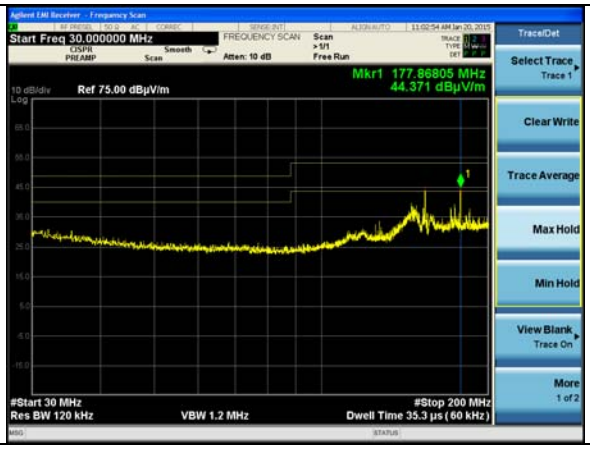
Notes:

1. Measurement of system noise floor.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Since the emissions listed above are not a function of the transmitter, these are not compared to a specific limit.
4. 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 200 MHz, 3m distance.



Horizontal Transmitter enabled

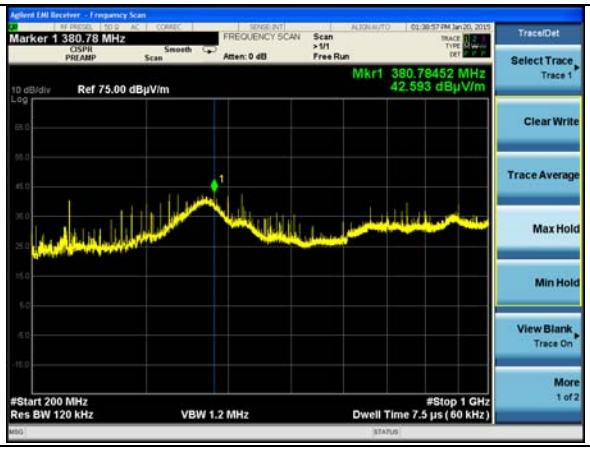
Horizontal Transmitter disabled

Vertical Transmitter enabled

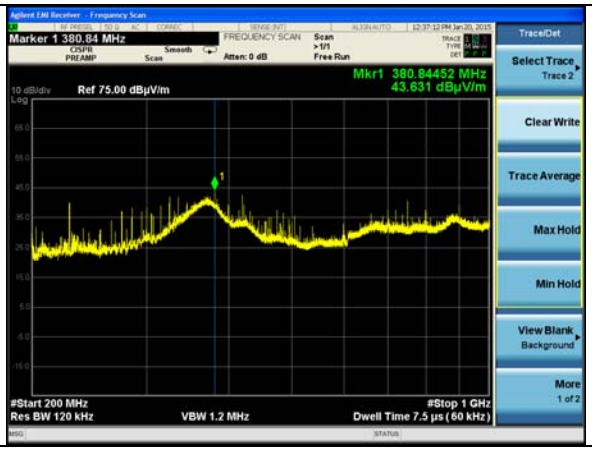
Vertical Transmitter disabled

Note: In addition to investigation with the radio disabled, the radio module was tested stand-alone and confirms that emissions seen are not those of the radio module.

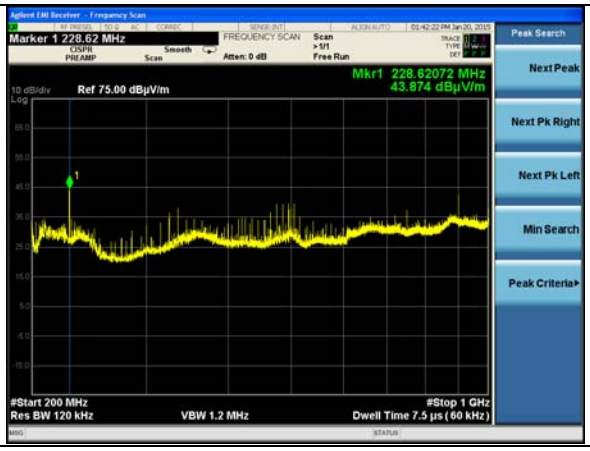
200 to 1000 MHz, 3m distance.



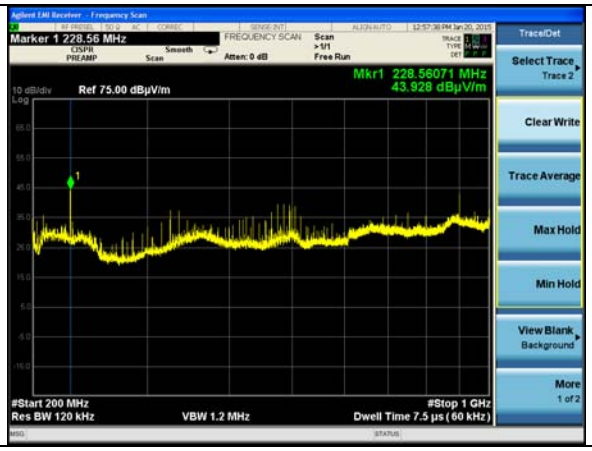
Horizontal Transmitter enabled



Horizontal Transmitter disabled



Vertical Transmitter enabled



Vertical Transmitter disabled

Note: In addition to investigation with the radio disabled, the radio module was tested stand-alone and confirms that emissions seen are not those of the radio module.

1000 to 2310 MHz, 3m distance.

Peak

Reduced bandwidth

Note: In addition to investigation with the radio disabled, the radio module was tested stand-alone and confirms that emissions seen are not those of the radio module.

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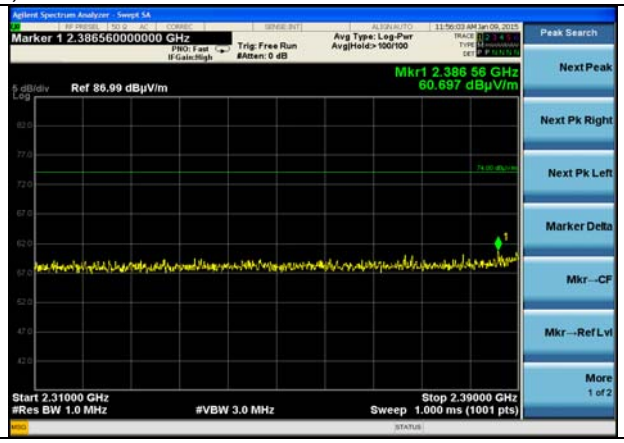
2310 to 2390 MHz, 3m distance.

Average

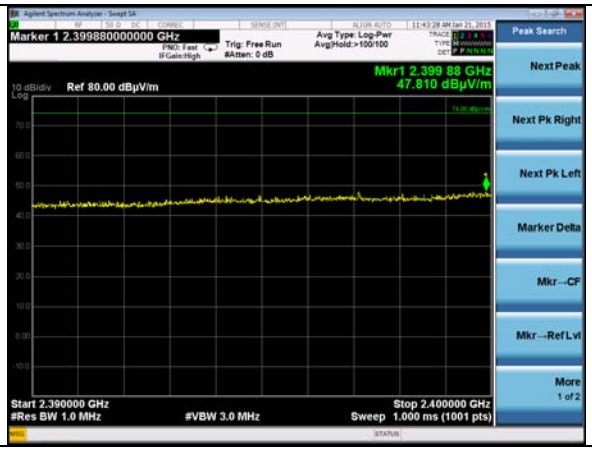


Peak

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

2390 to 2400 MHz, 3m distance.

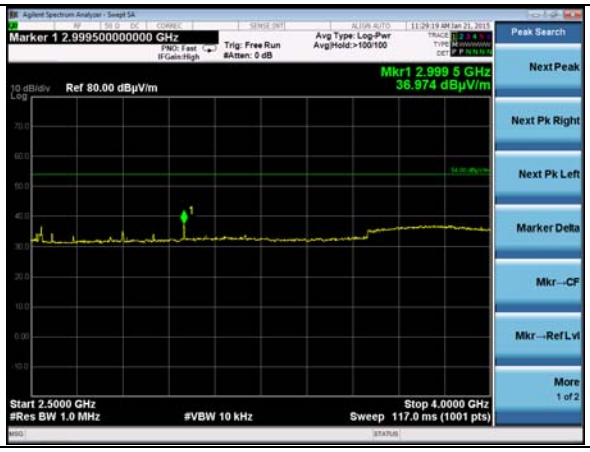
Average



Peak

Note: The display lines depicted in the plots above do not represent limit lines

2500 to 4000 MHz, 3m distance.



Average

Peak

4000 to 25000 MHz, 3m distance.

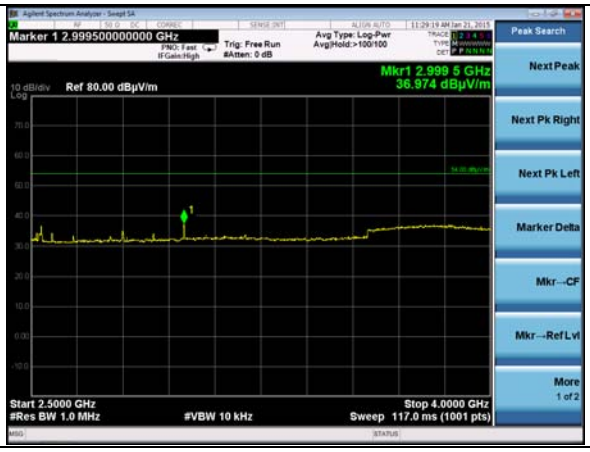
	
4000 to 18000 MHz (reduced bandwidth)	18000 to 25000 MHz (reduced bandwidth)

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.

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

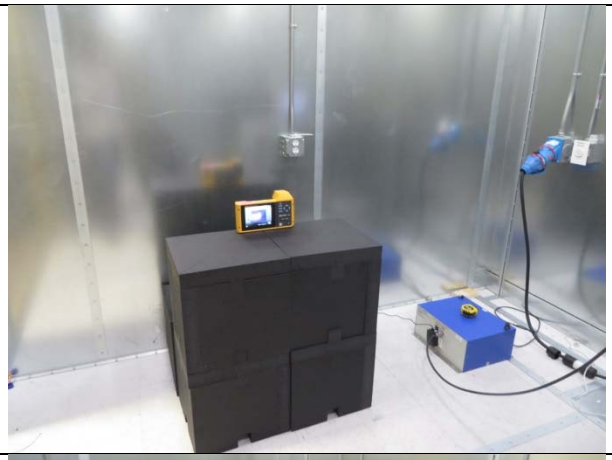
Manufacturer:	Fluke Thermography					
Date(s) of Test:	January 15th 2015					
Project Engineer:	Khairul Aidi Zainal					
Test Engineer:	Peter Feilen					
Voltage:	120 VAC and 240VAC					
Operation Mode:	Continuous transmit, modulated					
Environmental Conditions in the Lab:	Temperature: 71° F Relative 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

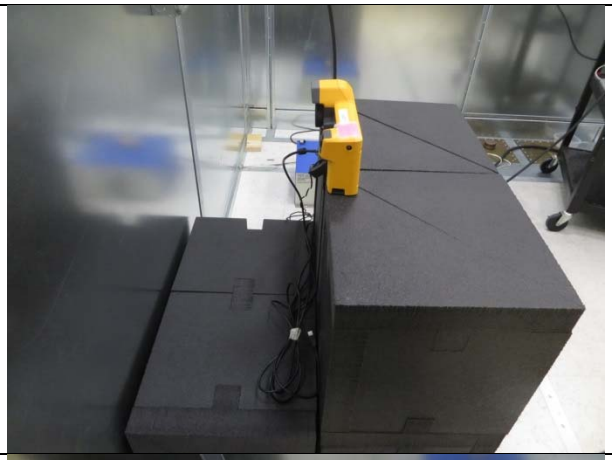
			Quasi-Peak			Average		
Voltage / Frequency	Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
120V/60Hz	0.177	1	41.2	64.6	23.4	31.2	54.6	23.4
120V/60Hz	0.332	1	44.0	59.4	15.4	31.4	49.4	18.0
120V/60Hz	0.415	1	25.2	57.5	32.3	15.7	47.5	31.8
120V/60Hz	4.070	1	42.5	56.0	13.5	33.3	46.0	12.7
120V/60Hz	0.330	2	47.0	59.5	12.5	37.5	49.5	12.0
120V/60Hz	0.461	2	45.4	56.7	11.3	35.2	46.7	11.5
120V/60Hz	0.505	2	45.6	56.0	10.4	32.1	46.0	13.9
240V/50Hz	0.173	2	51.2	64.8	13.6	42.8	54.8	12.0
240V/50Hz	0.357	2	43.6	58.8	15.2	32.7	48.8	16.1
240V/50Hz	0.469	2	47.8	56.5	8.7	39.5	46.5	7.0
240V/50Hz	0.173	1	50.6	64.8	14.2	40.7	54.8	14.1
240V/50Hz	0.208	1	46.4	63.3	16.9	36.1	53.3	17.2
240V/50Hz	0.312	1	46.5	59.9	13.4	34.8	49.9	15.1
240V/50Hz	1.918	1	45.6	56.0	10.4	35.4	46.0	10.6

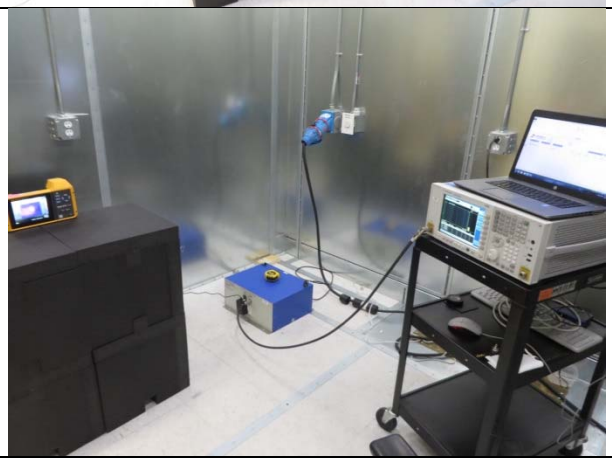
Notes:

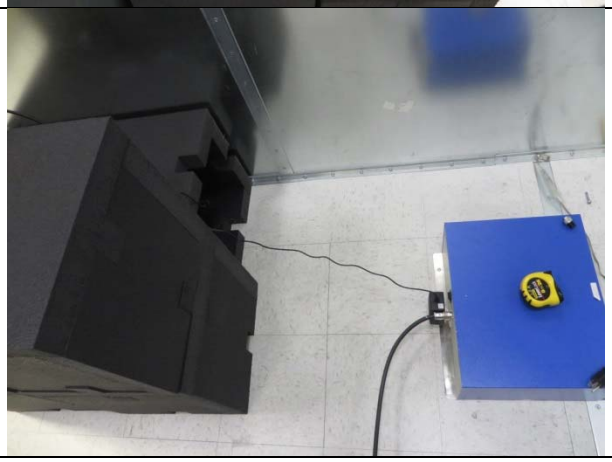
1) The emissions listed are characteristic of the power supply used and not that of the transmitter. Changing transmit channels did not change the emissions.

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

Note: The display lines in the plot above do not represent the limit lines.

240 VAC, 50Hz

Line 1

Line 2

Note: The display lines in the plot above do not represent the limit lines.

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)	-20dB Bandwidth (MHz)	99% Bandwidth MHz)
b	1 (DBPSK)	1	9.1	16.1	13.9
		6	9.1	16.1	13.9
		11	9.1	16.1	13.9
g	6 (BPSK)	1	15.3	18.6	16.4
		6	15.6	18.7	16.5
		11	15.4	18.9	16.6
n	MCS0 (BPSK)	1	15.7	20.1	17.7
		6	15.3	20.4	17.7
		11	15.2	20.5	17.8
b	11 (8QPSK)	1	9.8	16.6	14.3
		6	9.8	16.7	14.4
		11	9.8	16.7	14.4
g	54 (64QAM)	1	16.4	18.1	16.4
		6	16.4	18.3	16.5
		11	16.4	18.1	16.5
n	MCS7 (64QAM)	1	17.3	19.7	17.7
		6	17.3	19.7	17.7
		11	17.0	19.5	17.7

BLE

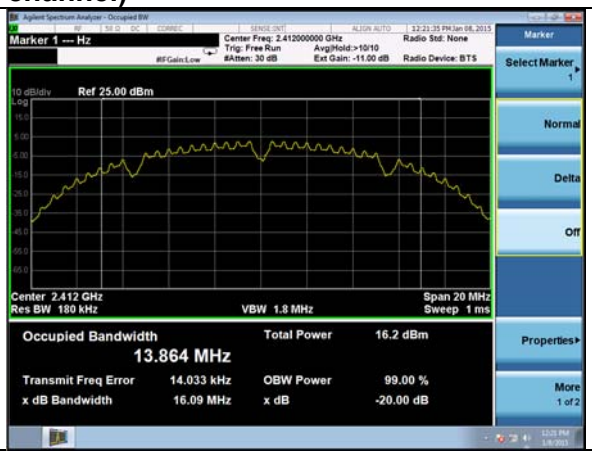
Frequency (MHz)	6 dB BW (MHz)	Emission BW (MHz)
2402.0	0.720	1.047
2440.0	0.715	1.045
2480.0	0.720	1.042

7.4 – Screen Captures

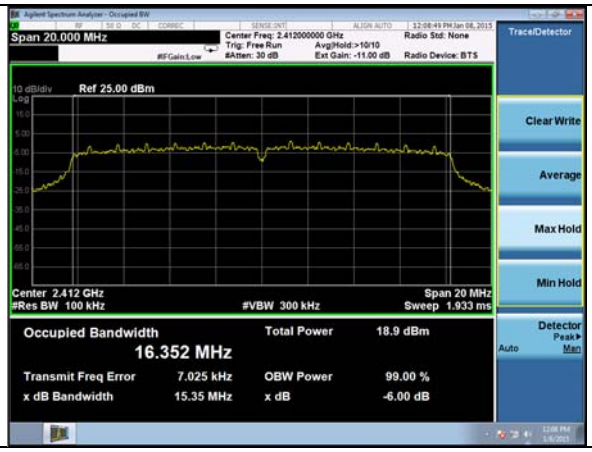
Examples of bandwidth measurements:

WLAN (lowest channel)

802.11b 6dB bandwidth

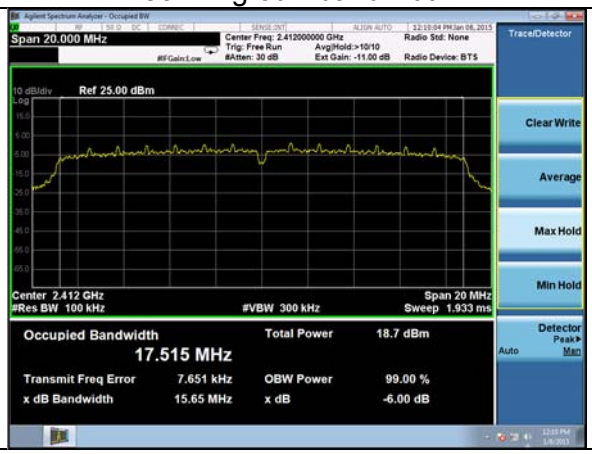


802.11b -20dB and 99% bandwidth



802.11g 6dB bandwidth

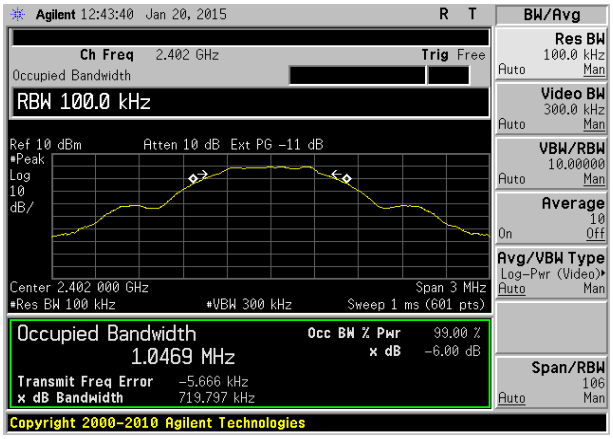
802.11g -20dB and 99% bandwidth

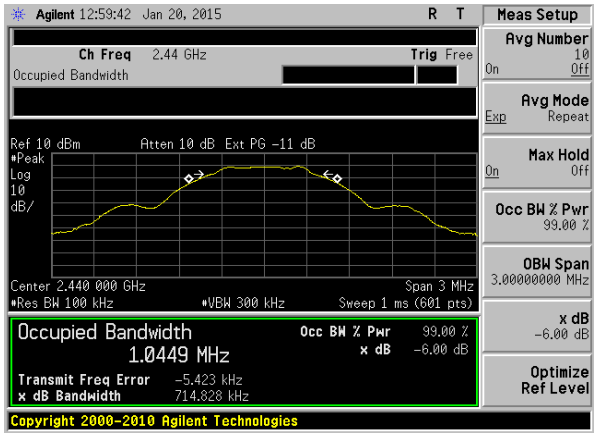


802.11n 6dB bandwidth

802.11n -20dB and 99% bandwidth

BLE


Agilent 12:43:40 Jan 20, 2015
R T
BW/Avg
Ch Freq 2.402 GHz
Trig Free
Occupied Bandwidth
RBW 100.0 kHz
Ref 10 dBm
Atten 10 dB Ext PG -11 dB
#Peak
Log
10
dB/
Center 2.402 000 GHz
Span 3 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 1 ms (601 pts)
Occupied Bandwidth
1.0469 MHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error -5.666 kHz
x dB Bandwidth 719.797 kHz
Res BW 100.0 kHz Auto Man
Video BW 300.0 kHz Auto Man
VBW/RBW 10.00000 Auto Man
Average 10 On Off
Avg/VBW Type Log-Pwr (Video) Auto Man
Span/RBW 106 Auto Man
Copyright 2000-2010 Agilent Technologies


Agilent 12:59:42 Jan 20, 2015
R T
Meas Setup
Ch Freq 2.44 GHz
Trig Free
Occupied Bandwidth
Ref 10 dBm
Atten 10 dB Ext PG -11 dB
#Peak
Log
10
dB/
Center 2.440 000 GHz
Span 3 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 1 ms (601 pts)
Occupied Bandwidth
1.0449 MHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error -5.423 kHz
x dB Bandwidth 714.828 kHz
Avg Number 10 On Off
Avg Mode Exp Repeat
Max Hold On Off
Occ BW % Pwr 99.00 %
OBW Span 3.00000000 MHz
x dB -6.00 dB
Optimize Ref Level
Copyright 2000-2010 Agilent Technologies

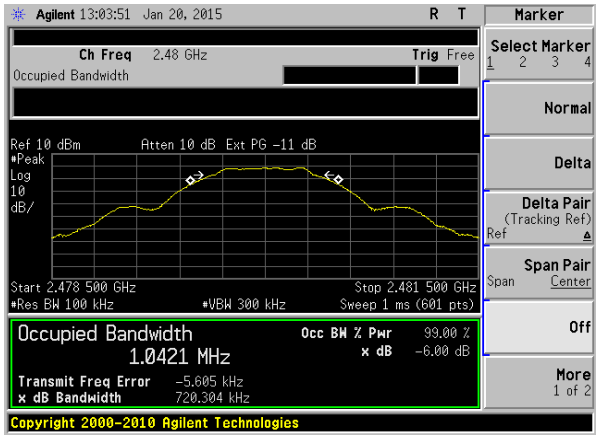

Agilent 13:03:51 Jan 20, 2015
R T
Marker
Ch Freq 2.48 GHz
Trig Free
Occupied Bandwidth
Ref 10 dBm
Atten 10 dB Ext PG -11 dB
#Peak
Log
10
dB/
Start 2.478 500 GHz
Stop 2.481 500 GHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 1 ms (601 pts)
Occupied Bandwidth
1.0421 MHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error -5.605 kHz
x dB Bandwidth 720.304 kHz
Select Marker 1 2 3 4
Normal
Delta
Delta Pair (Tracking Ref) Ref
Span Pair Span Center
Off
More 1 of 2
Copyright 2000-2010 Agilent Technologies

EXHIBIT 8. BAND EDGE MEASUREMENTS

Test Engineer(s): Mike Hintzke

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. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in RSS GEN and also to the limits in the applicable annex. 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 v03r02 (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 C63.4 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.**

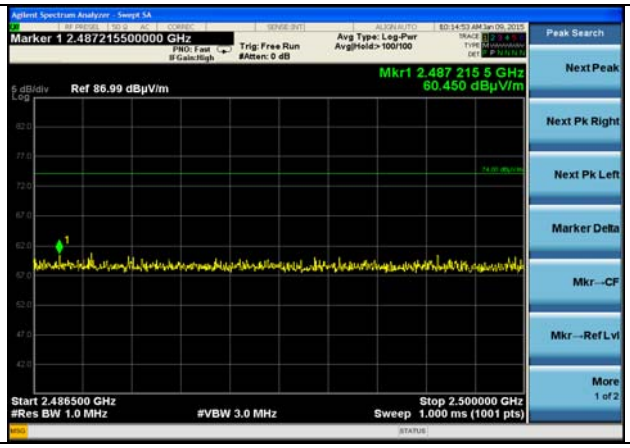
8.2. Band edge screen captures.

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

Band-edge in Restricted Band

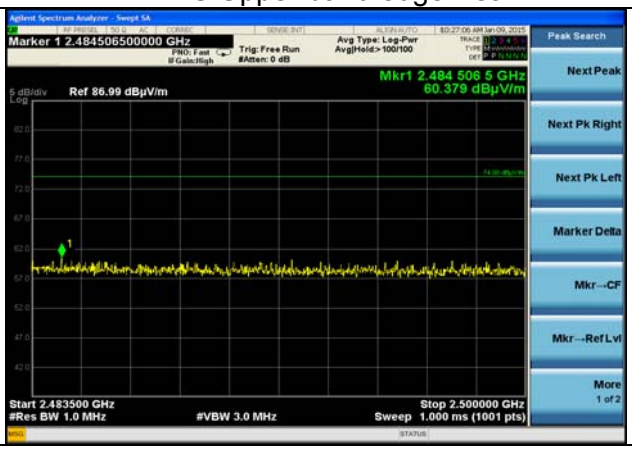
WLAN Radiated Band-edge in Restricted Band:

2483.5 to 2500 MHz Restricted band



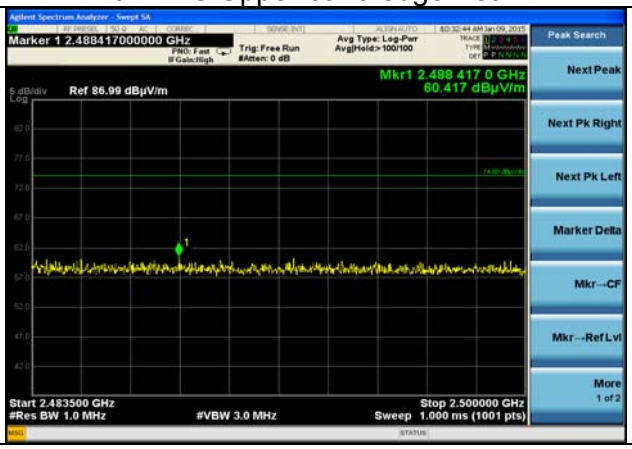
1MBPS Upper band edge Peak

1MBPS Upper band edge Average



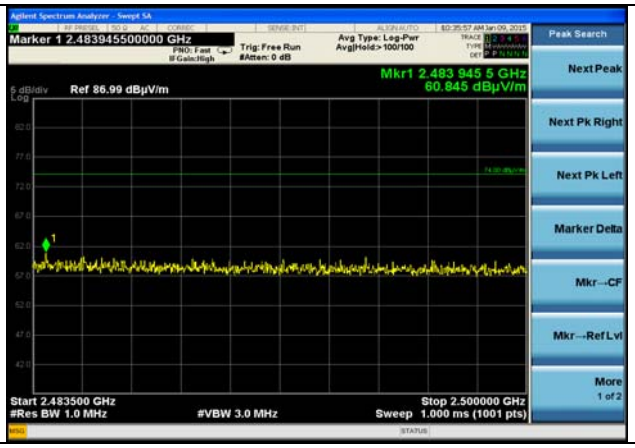
6MBPS Upper band edge Peak

6MBPS Upper band edge Average



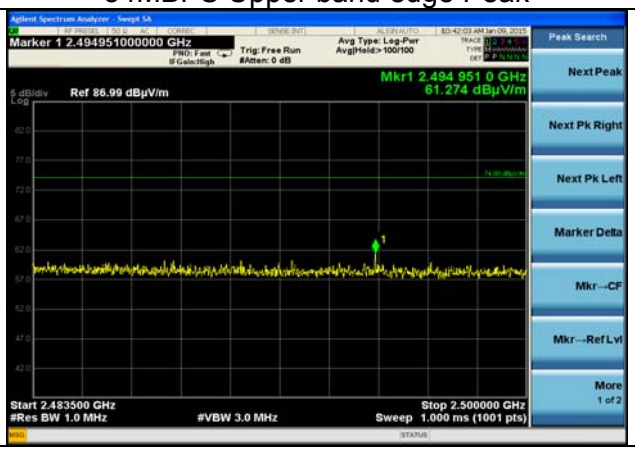
11MBPS Upper band edge Peak

11MBPS Upper band edge Average

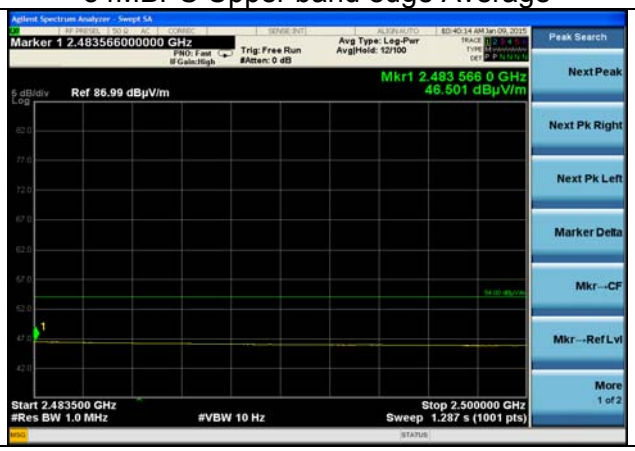


54MBPS Upper band edge Peak

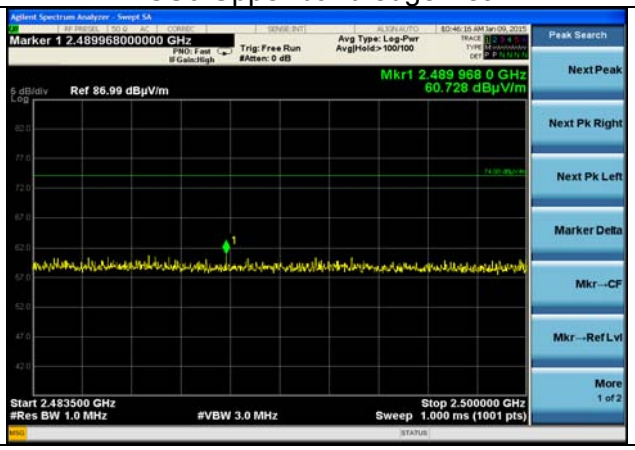
54MBPS Upper band edge Average



MCS0 Upper band edge Peak



MCS0 Upper band edge Average

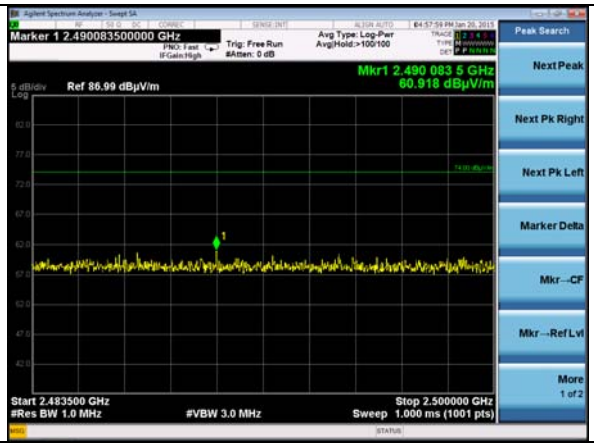


MCS7 Upper band edge Peak

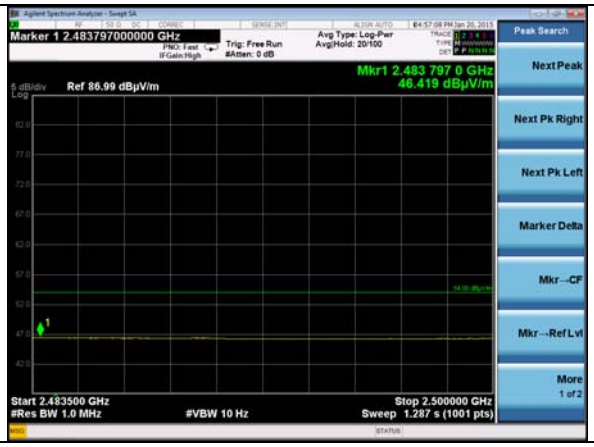
MCS7 Upper band edge Average

BLE Radiated Band-edge in Restricted Band:

2483.5 to 2500 MHz Restricted band



Upper band edge Peak

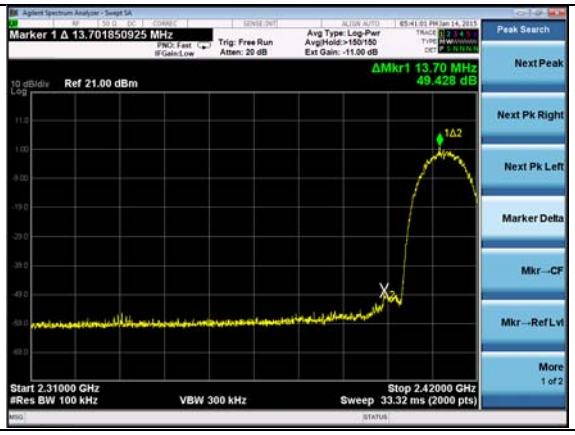


Upper band edge Average

Band-edge in 100kHz bandwidth.

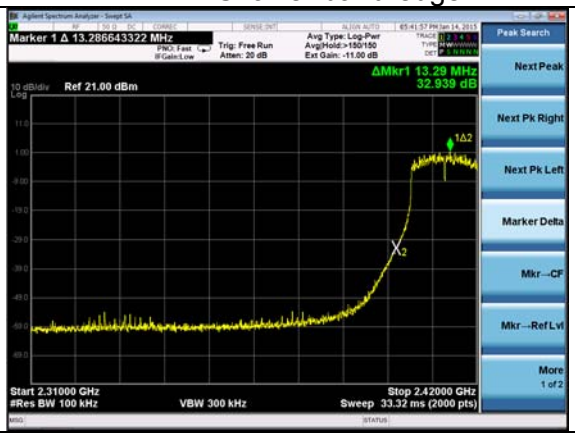
2.4GHz WLAN

11 MBPS upper band-edge

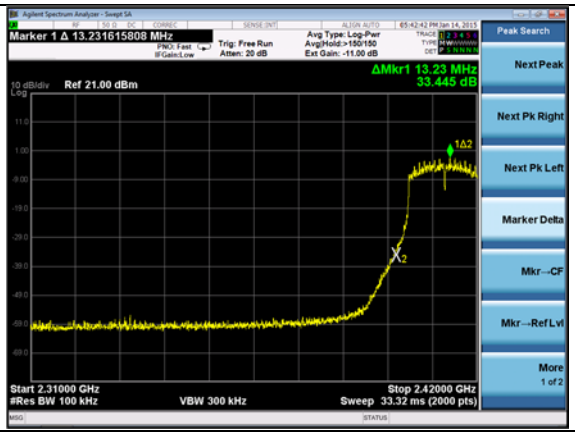


11 MBPS lower band-edge

54 MBPS upper band-edge



54 MBPS lower band-edge

	
MCS0 upper band-edge	MCS0 lower band-edge

2.4GHz BLE

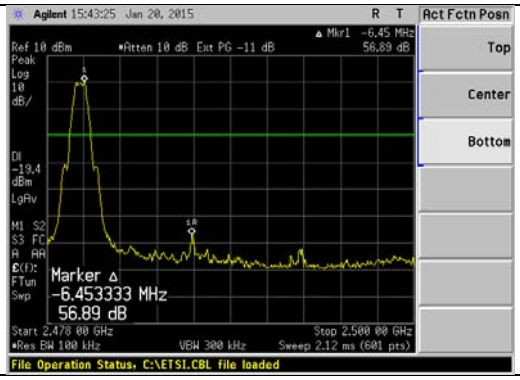
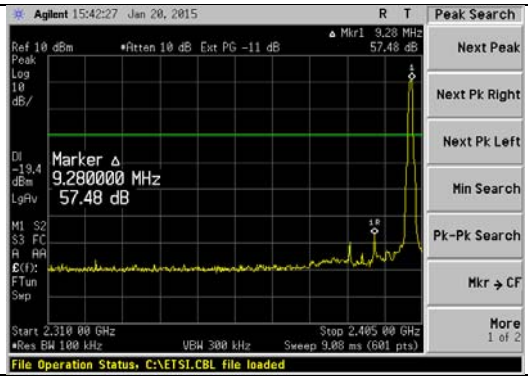
	
upper band-edge	lower band-edge

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

Test Engineer(s): Khairul Aidi Zainal, Peter Feilen

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 v03r02 section 9.2.2.4 for WLAN and 9.1.1 for BLE

Note: Per FCC requirement, output power measurements of WLAN channels 12, 13 and 14 were measured to show that these channels are not meant for use hence set at the lowest available power setting. The data is presented in this section.

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).

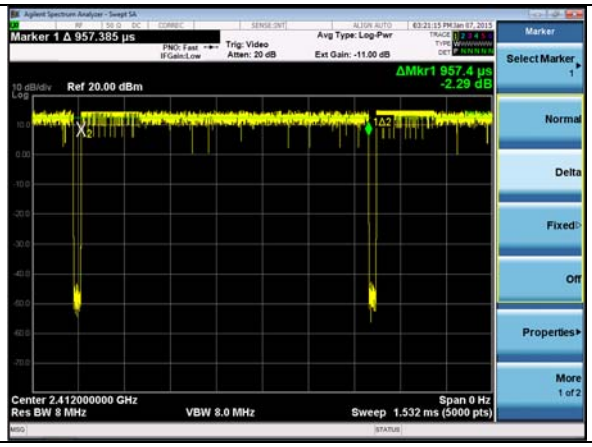
9.2.1. WLAN Maximum conducted average power:

9.2.1.1 Duty cycle:

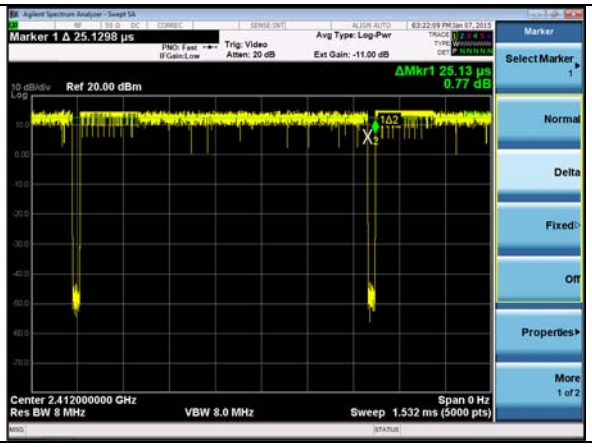
Measurement procedure: **FCC OET KDB 558074 D01 Measurement Guidance v03r02 section 6**

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	8.609	0.026	1.00	0.0
DQPSK	b	2.0	4.400	0.026	0.99	0.0
BPSK	a,g	6.0	1.428	0.031	0.98	0.1
8-QPSK	b	11.0	0.957	0.025	0.97	0.1
QPSK	a,g	12.0	0.724	0.031	0.96	0.2
16-QAM	a,g	24.0	0.372	0.031	0.92	0.3
64-QAM	a,g	54.0	0.180	0.031	0.85	0.7
BPSK	n	MCS0	1.336	0.031	0.98	0.1
64-QAM	n	MCS7	0.169	0.030	0.85	0.7
QPSK	n	MCS1	0.623	0.031	0.95	0.2
64-QAM	n	MCS5	0.184	0.030	0.86	0.7
64-QAM	a,g	48.0	0.196	0.031	0.86	0.6
16-QAM	n	MCS3	0.332	0.031	0.92	0.4

Example screen captures:



TX ON time



TX OFF time

9.2.1.2 WLAN Maximum conducted (average) output power:

802.11 Standard	Data Rate (MBPS)	Channel	Maximum Conducted (average) Power (dBm)	Duty Cycle correction for average measurement (dB)	Corrected Maximum Conducted Power (dBm)	Power Limit (dBm)	Power margin (dB)
b	1 (DBPSK)	1	11.0	0.0	11.0	30.0	19.0
		6	10.7	0.0	10.7	30.0	19.3
		11	10.7	0.0	10.7	30.0	19.3
g	6 (BPSK)	1	11.9	0.1	12.0	30.0	18.0
		6	11.3	0.1	11.4	30.0	18.6
		11	11.6	0.1	11.7	30.0	18.3
n	MCS0 (BPSK)	1	11.8	0.1	11.9	30.0	18.1
		6	11.3	0.1	11.4	30.0	18.6
		11	11.5	0.1	11.6	30.0	18.4
b	11 (8QPSK)	1	11.5	0.1	11.6	30.0	18.4
		6	10.9	0.1	11.0	30.0	19.0
		11	11.1	0.1	11.2	30.0	18.8
g	54 (64QAM)	1	11.9	0.7	12.6	30.0	17.4
		6	11.9	0.7	12.6	30.0	17.4
		11	12.1	0.7	12.8	30.0	17.2
n	MCS7 (64QAM)	1	8.7	0.7	9.4	30.0	20.6
		6	8.7	0.7	9.4	30.0	20.6
		11	8.9	0.7	9.6	30.0	20.4

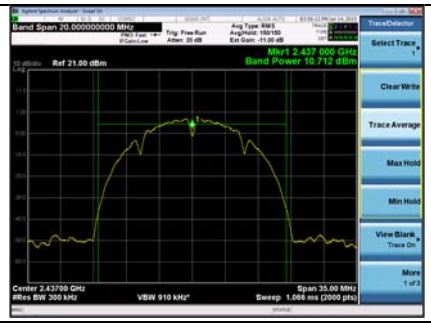
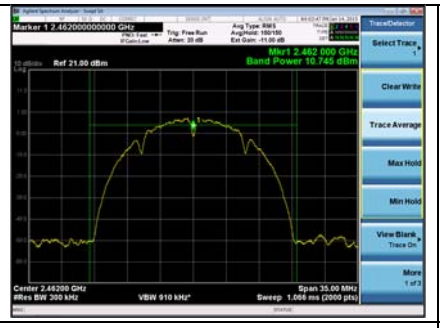
9.2.2. BLE Maximum peak conducted power:

Frequency (MHz)	Conducted Output Power (dBm)	Conducted Power Limit (dBm)	Conducted Power Margin (dB)
2402	1.4	30.0	28.6
2440	0.9	30.0	29.1
2480	-0.3	30.0	30.3

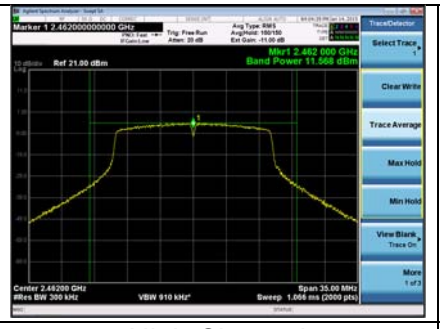
9.3 – Screen Captures.

9.3.1 WLAN:

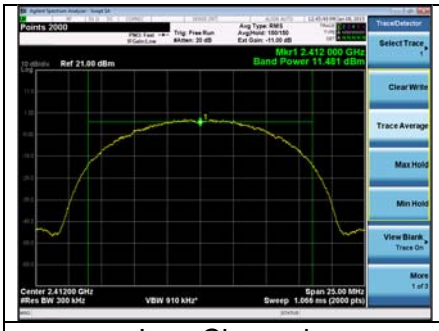
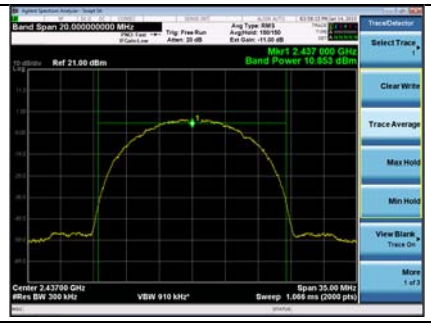
1MBPS

		
Low Channel	Middle Channel	High Channel

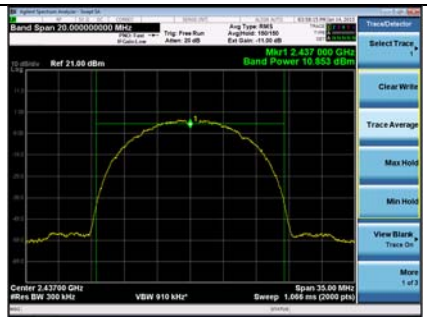
6MBPS

		
Low Channel	Middle Channel	High Channel

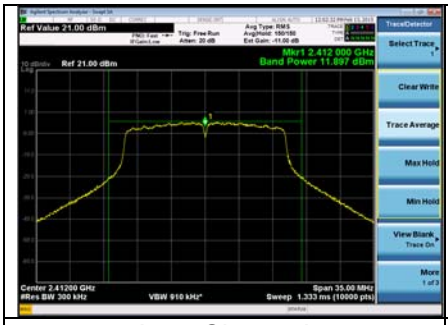
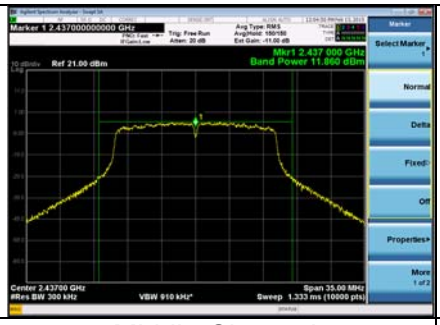
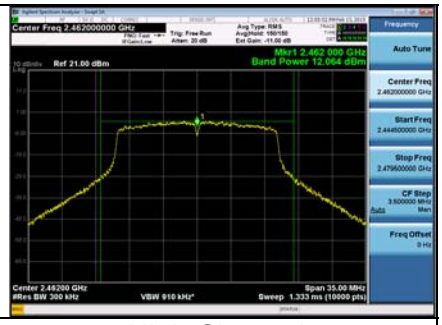
MCS0

		
Low Channel	Middle Channel	High Channel

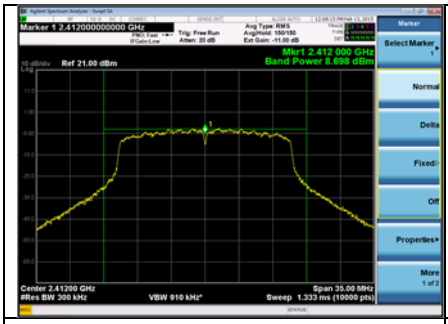
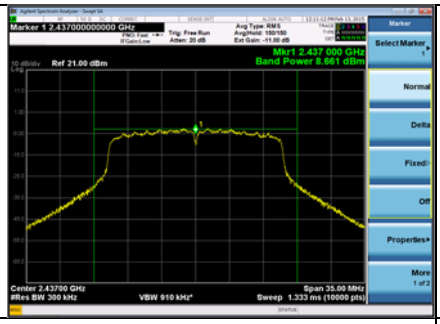
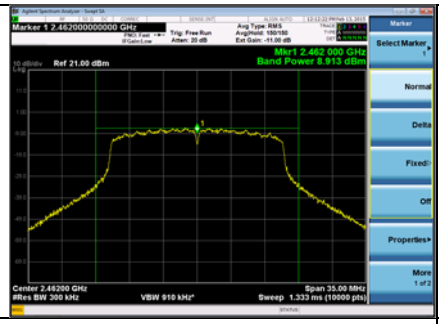
11 MBPS

		
Low Channel	Middle Channel	High Channel

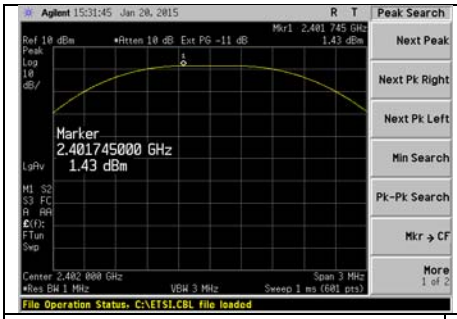
54 MBPS

		
Low Channel	Middle Channel	High Channel

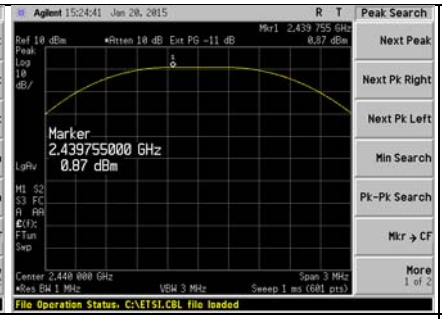
MCS7

		
Low Channel	Middle Channel	High Channel

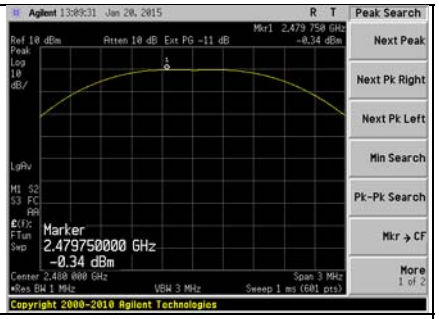
9.3.2 BLE:



Low Channel



Middle Channel



High Channel

EXHIBIT 10. CONDUCTED SPURIOUS EMISSIONS: 15.247(d)

Test Engineer(s): Khairul Aidi Zainal, Peter Feilen

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 v03r02 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:

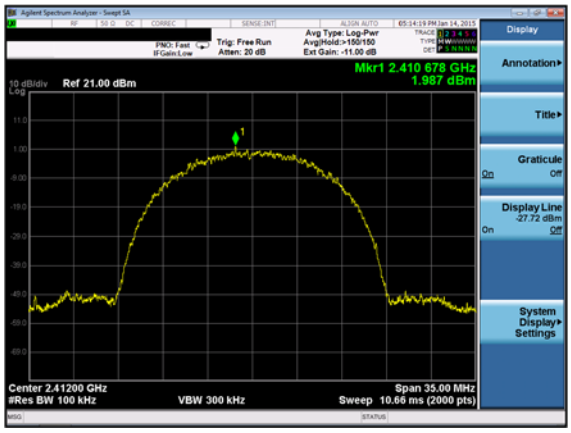
Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

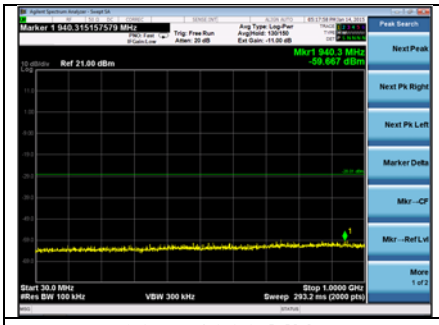
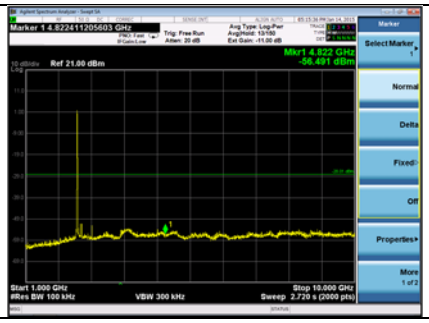
10.3 - Test Data

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

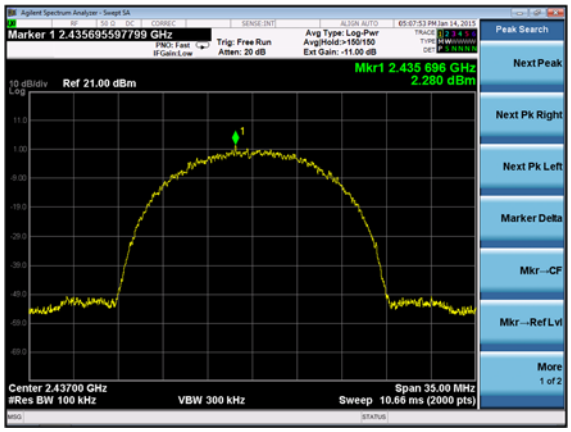
10.3.1 2.4GHz WLAN

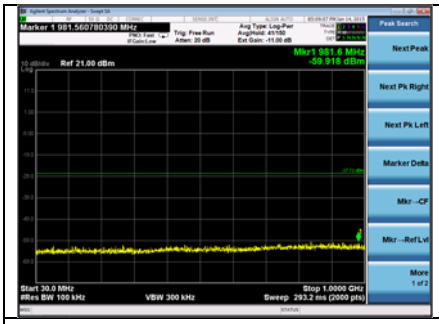
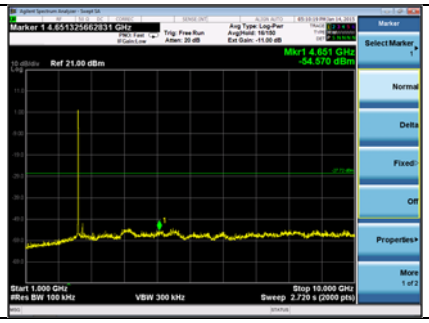
Low Channel fundamental in 100 kHz:



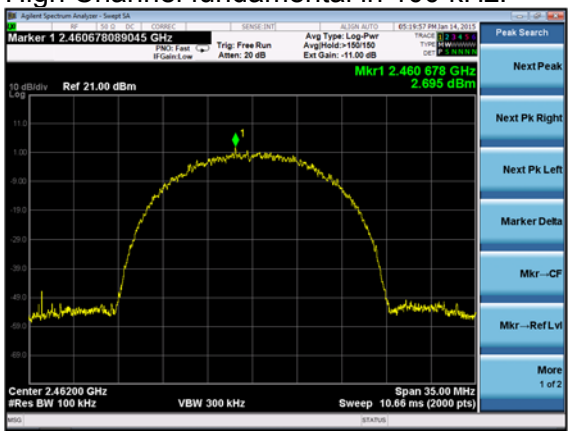
		
30 to 1000 MHz	1000 to 10000 MHz	10000 to 26000 MHz

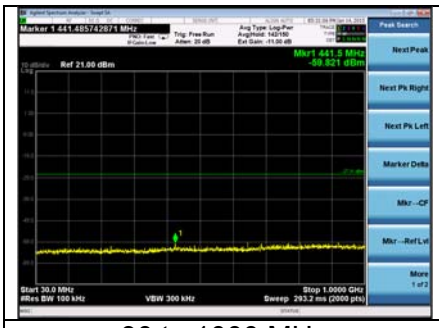
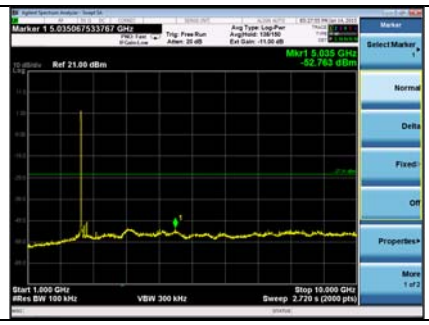
Middle Channel fundamental in 100 kHz:



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

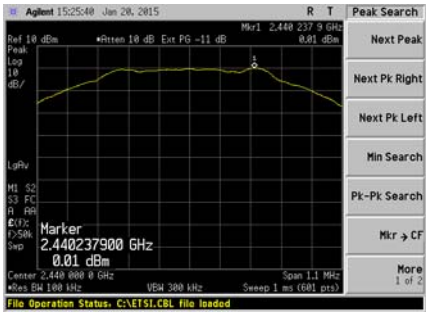
High Channel fundamental in 100 kHz:



		
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:



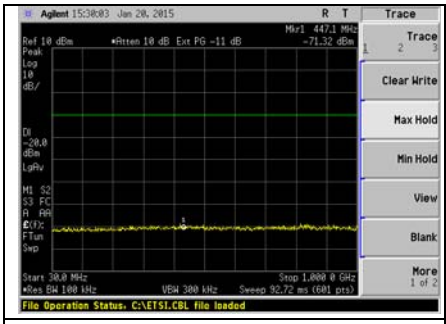
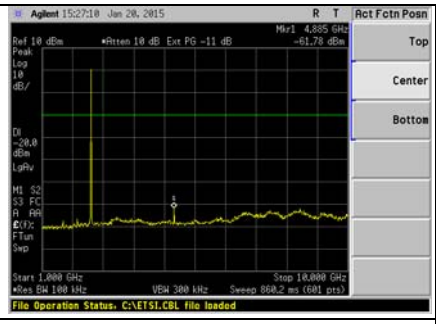
		
30 to 1000 MHz	1000 to 10000 MHz	10000 to 26000 MHz

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 210 A8.2(b), 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 v03r02 section 10.1 for WLAN and 10.2 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

802.11 Standard	Data Rate (MBPS)	Channel	PSD (dBm)	Duty Cycle correction for average measurement (dB)	Corrected PSD (dBm)	PSD in 3kHz limit(dBm)	PSD margin (dBm)
b	1 (DBPSK)	1	-11.1	0.0	-11.1	8.0	19.1
		6	-11.0	0.0	-11.0	8.0	19.0
		11	-11.6	0.0	-11.6	8.0	19.6
g	6 (BPSK)	1	-12.3	0.1	-12.2	8.0	20.2
		6	-12.6	0.1	-12.5	8.0	20.5
		11	-12.4	0.1	-12.3	8.0	20.3
n (HT20)	MCS0 (BPSK)	1	-12.5	0.1	-12.4	8.0	20.4
		6	-13.1	0.1	-13.0	8.0	21.0
		11	-13.0	0.1	-12.9	8.0	20.9
b	11 (8QPSK)	1	-11.0	0.1	-10.9	8.0	18.9
		6	-11.4	0.1	-11.3	8.0	19.3
		11	-11.4	0.1	-11.3	8.0	19.3
g	54 (64QAM)	1	-10.4	0.7	-9.7	8.0	17.7
		6	-10.5	0.7	-9.8	8.0	17.8
		11	-10.9	0.7	-10.2	8.0	18.2
n (HT20)	MCS7 (64QAM)	1	-14.4	0.7	-13.7	8.0	21.7
		6	-13.4	0.7	-12.7	8.0	20.7
		11	-12.8	0.7	-12.1	8.0	20.1

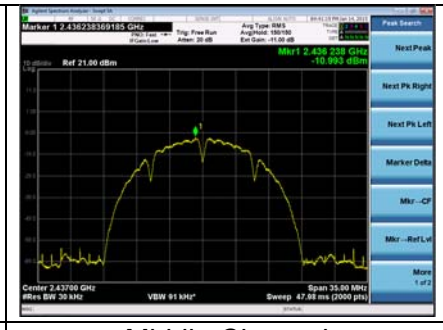
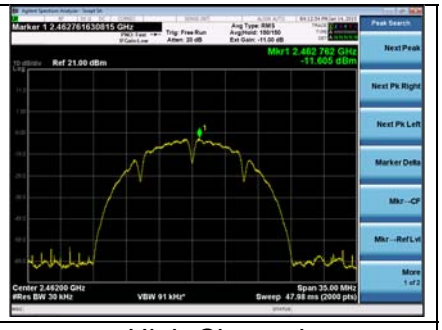
11.2.2 BLE

Frequency (MHz)	Power Spectral Density (dBm)	Power Spectral Desity Limit (dBm)	Power Spectral Desity Margin (dB)
2402.0	-14.8	8.0	22.8
2440.0	-15.4	8.0	23.4
2480.0	-15.6	8.0	23.6

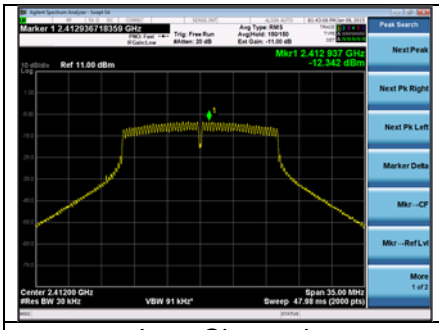
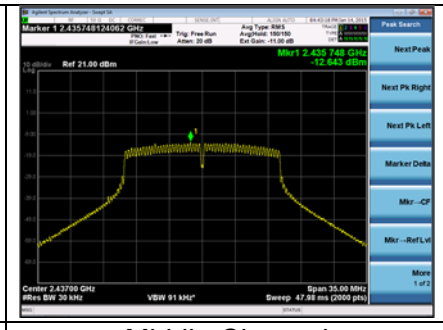
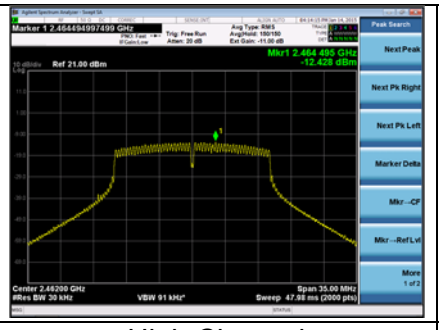
11.3 Screen Captures – Power Spectral Density

11.3.1 2.4GHz WLAN

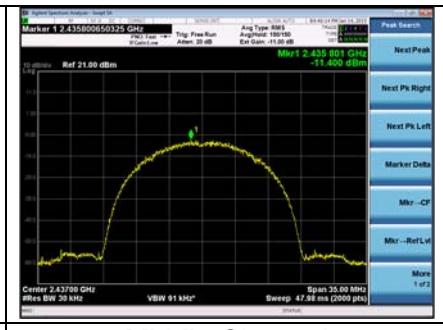
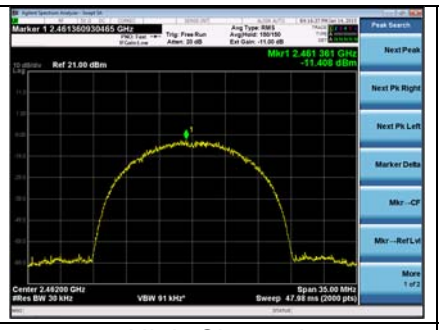
11.3.1.1 1MBPS

		
Low Channel	Middle Channel	High Channel

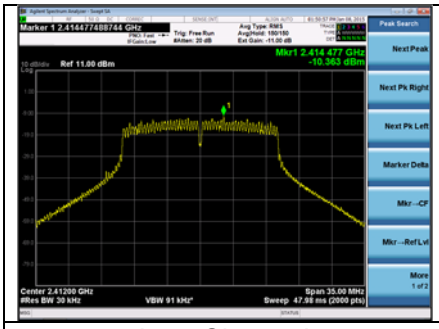
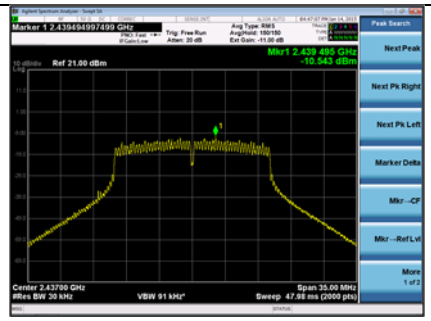
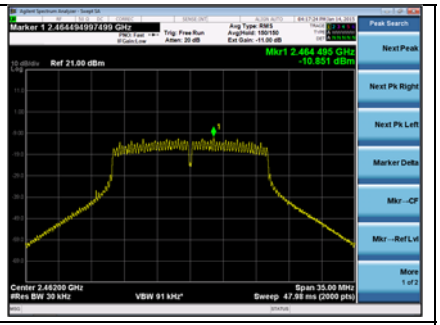
11.3.1.2 6MBPS

		
Low Channel	Middle Channel	High Channel

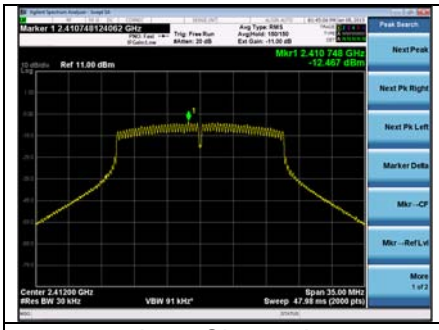
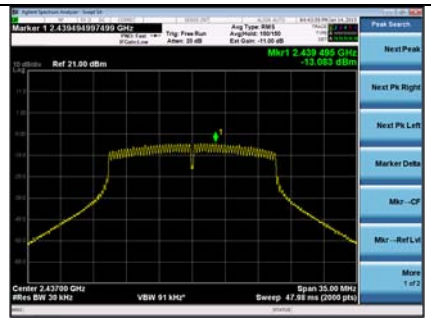
11.3.1.3 11MBPS

		
Low Channel	Middle Channel	High Channel

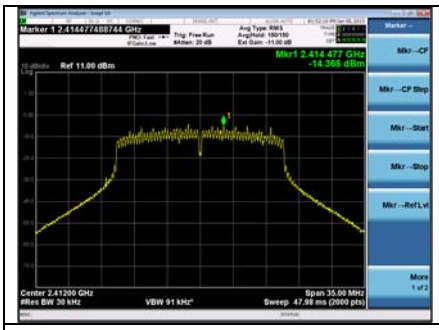
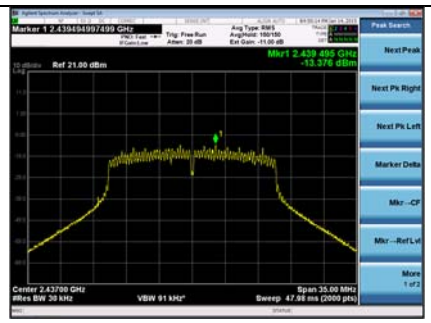
11.3.1.4 54MBPS

		
Low Channel	Middle Channel	High Channel

11.3.1.5 MCS0

		
Low Channel	Middle Channel	High Channel

11.3.1.6 MCS7

		
Low Channel	Middle Channel	High Channel

11.3.2 BLE

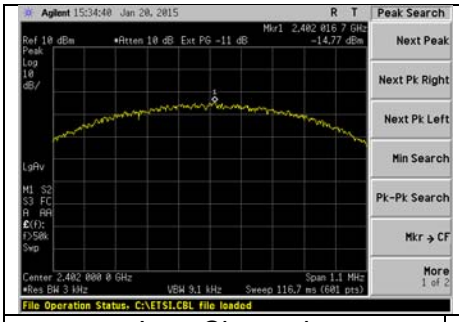
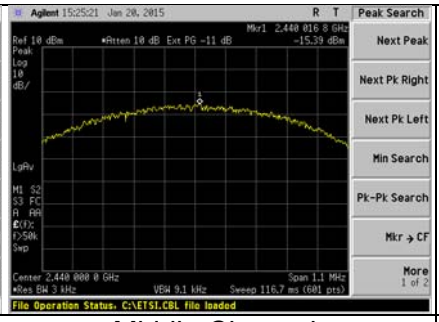
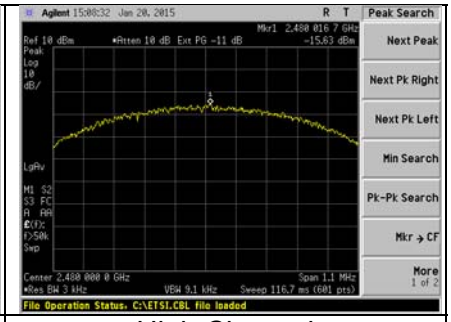
		
Low Channel	Middle Channel	High Channel

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.

WLAN 2.4 GHZ

	13.5VDC	15.0VDC	16.5VDC	
	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	2412000969	2412000990	2412000990	21
MID CHANNEL	2437000920	2437000940	2437000960	40
HIGH CHANNEL	2462000939	2462000960	2462000960	21

BLUETOOTH

	13.5VDC	15.0VDC	16.5VDC	
	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	2402000459	2402000479	2402000479	20
MID CHANNEL	2440000560	2440000560	2440000539	21
HIGH CHANNEL	2480000580	2480000560	2480000539	41

EXHIBIT 13. COMPLIANCE TO KDB 594280 D01

In this exhibit, data is presented showing WLAN channel 12 and 13 compliance to the technical requirements for DTS operations in the band 2400 to 2483.5MHz.

Measurements were performed conducted at the antenna port using measurement methods presented in KDB 558074

A. Bandwidths
(FCC OET KDB 558074 v03r02 section 8 option2 and C63.10)

802.11 Standard	Data Rate (MBPS)	Channel	6dB Bandwidth (MHz)	-20dB Bandwidth (MHz)	99% Bandwidth (MHz)
b	1 (DBPSK)	12	6.0	15.1	14.2
		13	6.0	15.2	14.2
g	24 (16-QAM)	12	11.3	17.4	16.5
		13	11.3	17.3	16.5
n	MCS3 (16-QAM)	12	11.3	18.6	17.6
		13	11.3	18.6	17.7

Sample Screen Captures

Channel 12 6dB BW

Channel 12 99% BW

B. Maximum Conducted Power
(FCC OET KDB 558074 v03r02 section 9.2.2.4)

802.11 Standard	Data Rate (MBPS)	Channel	Maximum Conducted (average) Power (dBm)	Duty Cycle correction for average measurement (dB)	Corrected Maximum Conducted Power (dBm)	Power Limit (dBm)	Power margin (dB)
b	1 (DBPSK)	12	-25.2	0.0	-25.2	30.0	55.2
		13	-24.9	0.0	-24.9	30.0	54.9
g	24 (16-QAM)	12	-23.8	0.3	-23.5	30.0	53.5
		13	-23.8	0.3	-23.5	30.0	53.5
n	MCS3 (16-QAM)	12	-24.0	0.4	-23.6	30.0	53.6
		13	-23.9	0.4	-23.5	30.0	53.5

Sample Screen Captures

	
Channel 12 (1MBPS)	Channel 13 (1MBPS)

C. Restricted band Band-edge
(FCC OET KDB 558074 v03r02 section 12)

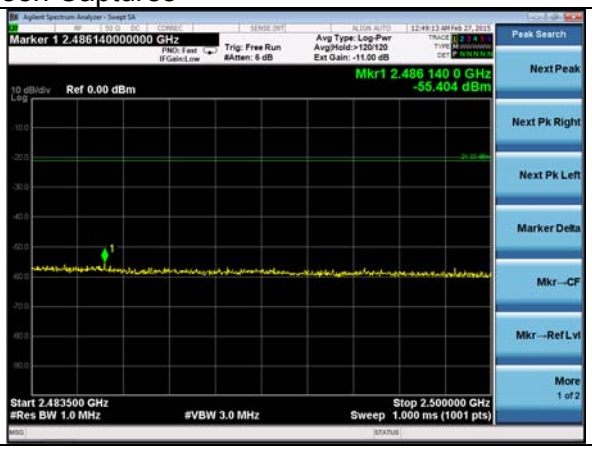
1. Channel 12

802.11 Standard	Data Rate (MBPS)	Peak data Frequency (MHz)	Restricted band Band-edge: Peak (dBm)	Average data Frequency (MHz)	Restricted band Band-edge: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak Band-edge (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average Band-edge (dBm)	Average Limit (dBm)	Average Margin (dB)
b	1	2486.1	-55.4	2484.2	-66.8	0.0	2.0	-53.4	-21.2	32.2	-64.8	-41.2	23.6
a,g	24	2485.7	-56.3	2483.8	-67.3	0.3	2.0	-54.3	-21.2	33.1	-65.0	-41.2	23.7
n	MCS3	2486.5	-55.5	2483.6	-67.1	0.4	2.0	-53.5	-21.2	32.2	-64.7	-41.2	23.5

Note:
a. Final Peak band-edge = Peak data + antenna gain
b. Final Average band-edge = Average data + DC correction + antenna gain
c. Peak data and average data includes all applicable equipment factors (i.e. cable factor)
d. Peak and average limit was converted from field strength to dBm using equation from C63.10

Sample Screen Captures

Average (802.11b)



Peak (802.11b)

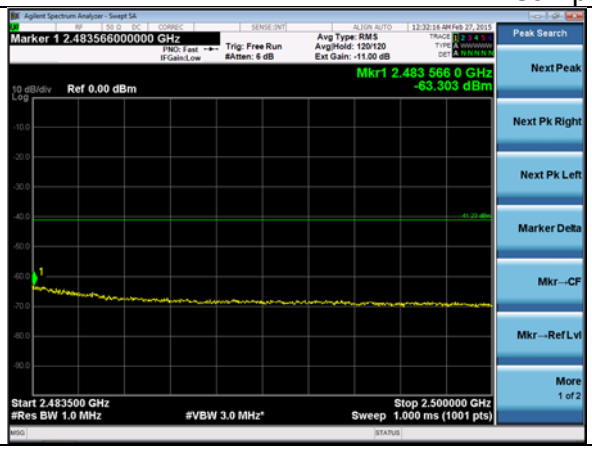
2. Channel 13

802.11 Standard	Data Rate (MBPS)	Peak data Frequency (MHz)	Restricted band Band-edge: Peak (dBm)	Average data Frequency (MHz)	Restricted band Band-edge: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak Band-edge (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average Band-edge (dBm)	Average Limit (dBm)	Average Margin (dB)
b	1	2484.6	-55.5	2483.5	-66.0	0.0	2.0	-53.5	-21.2	32.2	-64.0	-41.2	22.8
a,g	24	2483.6	-47.3	2483.7	-62.7	0.3	2.0	-45.3	-21.2	24.1	-60.4	-41.2	19.1
n	MCS3	2483.7	-45.2	2483.5	-61.8	0.4	2.0	-43.2	-21.2	22.0	-59.4	-41.2	18.2

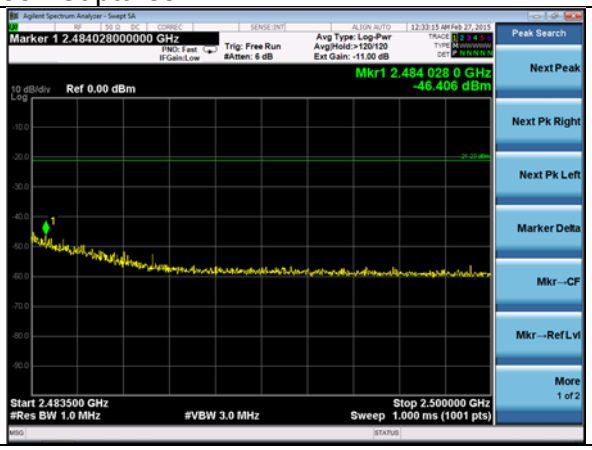
Note:

a. Final Peak band-edge = Peak data + antenna gain
b. Final Average band-edge = Average data + DC correction + antenna gain
c. Peak data and average data includes all applicable equipment factors (i.e. cable factor)
d. Peak and average limit was converted from field strength to dBm using equation from C63.10

Sample Screen Captures



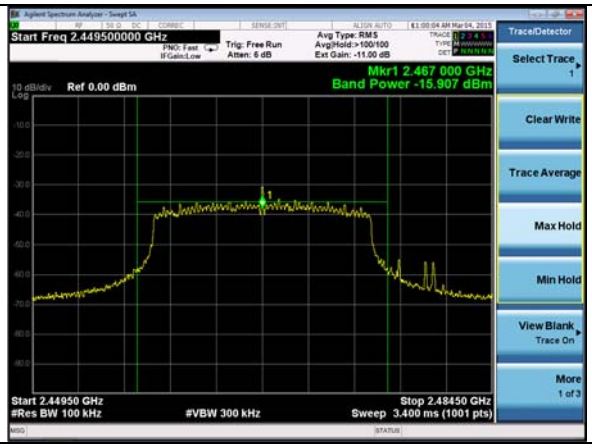
Average (802.11n)



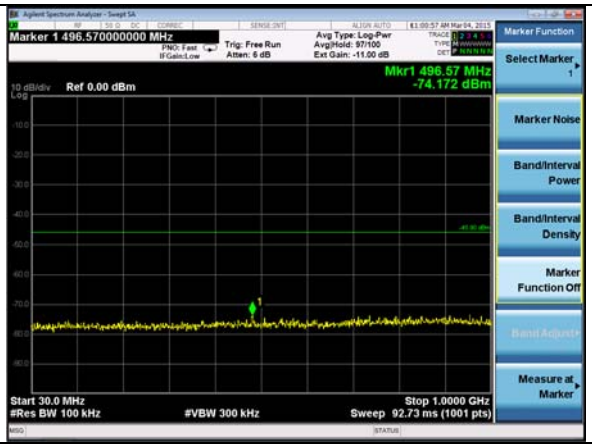
Peak (802.11n)

D. Transmitter spurious emissions (100 kHz bandwidth)
(FCC OET KDB 558074 v03r02 section 11)

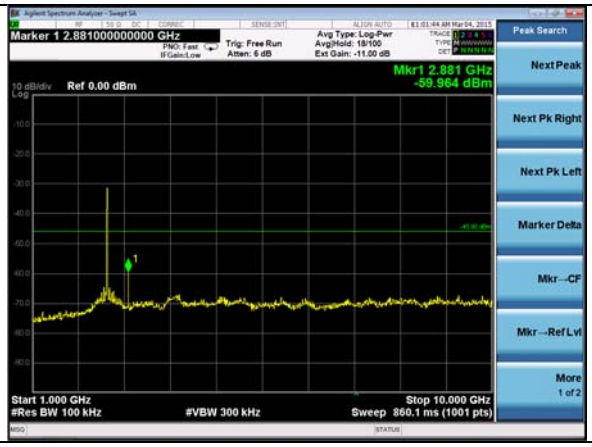
Channel 12



Fundamental



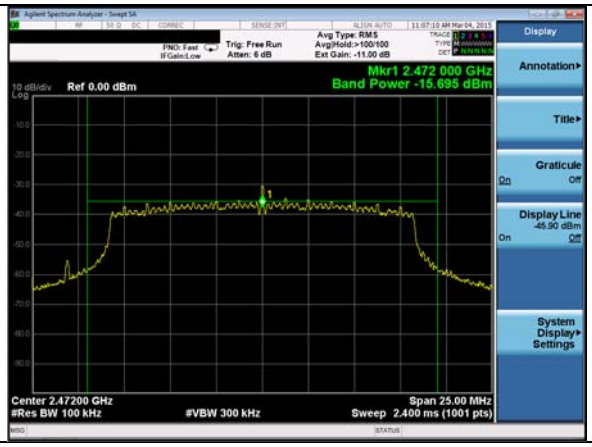
30 to 1000 MHz



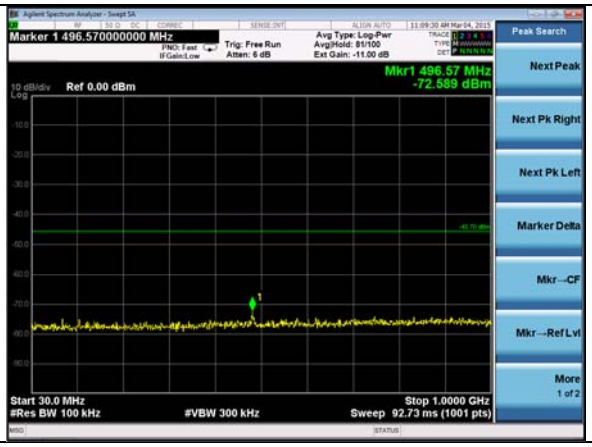
1000 to 10000 MHz

10000 to 25000 MHz

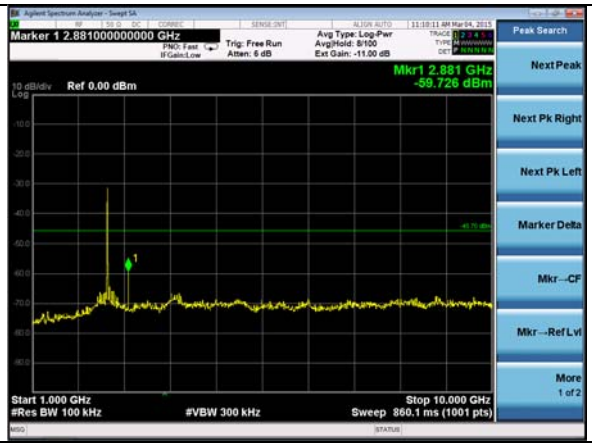
Channel 13



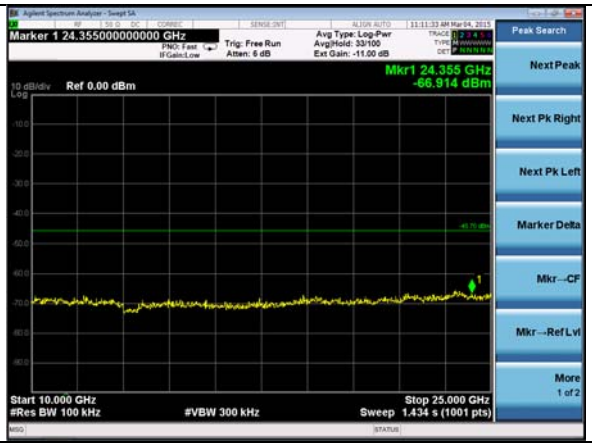
Fundamental



30 to 1000 MHz



1000 to 10000 MHz



10000 to 25000 MHz

The EUT does NOT have the ability to operate at different power levels. The power levels are set via firmware. This firmware is installed onto the radio module at the factory. The user has no access to any power level control.

In addition, the module EEPROM will be programmed at the factory to only operate and actively scan on these specific channels:

Channels 1 – 11, 2412-2462 MHz 802.11b mode
Channels 1 – 11, 2412-2462 MHz 802.11g mode
Channels 1 – 11, 2412-2462 MHz 802.11n mode (20 MHz channel)

The following channels will be programmed at the factory to passively scan and will only listen and cannot send a probe request to initiate communication on these specific channels. Ad-hoc mode is always disabled on these passive channels.

Channels 12 & 13, 2467 & 2472 MHz 802.11b mode
Channels 12 & 13, 2467 & 2472 MHz 802.11g mode
Channels 12 & 13, 2467 & 2472 MHz 802.11n mode (20MHz channel)

APPENDIX A – Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 8-Jan-2015 Type Test : Cond measurements Job # : C-2142

Prepared By: Aidi Customer : Fluke Thermography Quote #: 314218

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	12/11/2014	12/11/2015	Active Calibration
2	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	Verification	Verification	System
3	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/14/2013	6/14/2015	Active Calibration
4	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	10/19/2014	10/19/2015	Active Calibration

Project Engineer: Quality Assurance: Peter Fielen

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Jan-2015 Type Test : TX and RX AC mains Job # : C-2142

Prepared By: Peter Customer : Fluke Thermography Quote #: 314218

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960084	LISN - 15A	COM-POWER	LI-215A	191920	5/2/2014	5/2/2015	Active Calibration
2	EE 960088	8GHz MXE Spectrum Analyzer	Agilent	N9038A	MY51210138	1/9/2015	1/9/2016	Active Calibration

Project Engineer: Peter Fielen Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 15-Jan-2015 Type Test : Radiated Emissions Job # : C-2142

Prepared By: Peter Customer : Fluke Thermography Quote #: 314218

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960088	8GHz MXE Spectrum Analyzer	Agilent	N9038A	MY51210138	1/9/2015	1/9/2016	Active Calibration
2	AA 960004	Log Periodic Antenna	EMCO	93146	9512-4276	8/22/2014	8/22/2015	Active Calibration
3	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	8/7/2014	8/7/2015	Active Calibration
4	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	6/20/2014	6/20/2015	Active Calibration
5	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	740411007	6/20/2014	6/20/2015	Active Calibration
6	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EMCO	WLA622-4 / 3160-09	123001	8/20/2014	8/20/2015	Active Calibration

Project Engineer: Peter Fielen Quality Assurance:

APPENDIX B – Test Standards: CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2009		
ANSI C63.10	2009		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2015		
RSS GEN	2014		
RSS 210	2010		

APPENDIX C - Uncertainty Statement

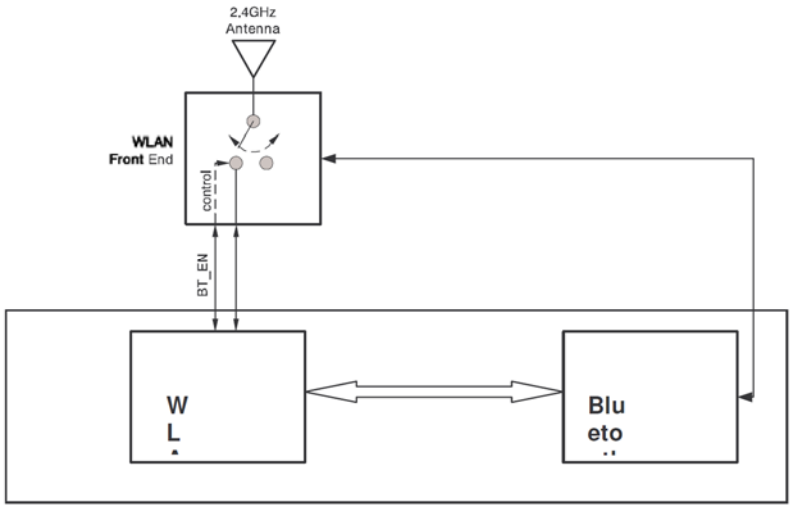
Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

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 application note: WL1271 WLAN Bluetooth Coexistence Application note. Literature Number: SPRAB96)

The radio chipset implemented is a TI WL1271. On these chipset, the SoftGemini (SG 3.0) algorithm enables WLAN and Bluetooth technology to co-exist in a single product. SoftGemini (SG 3.0) handles cases that involve BT Voice /Data and WLAN voice/Data applications using a single antenna.
In the single antenna configuration, the WLAN subsystem uses and internal radio frequency switch that enables the Bluetooth and WLAN operations to be multiplexed through a single antenna. This function allows either WLAN or Bluetooth to transmit and not both at the same time.



In the single antenna configuration, the following rules apply in the shared antenna configuration:

- Bluetooth TX is not allowed, if the switch is in WLAN state.
- WLAN TX is not allowed, if the switch is in Bluetooth state.
- Simultaneous RX is not possible because of a very high-power input signal
- Switch receive isolation for the BT in the WL1273FE is at least 30dB