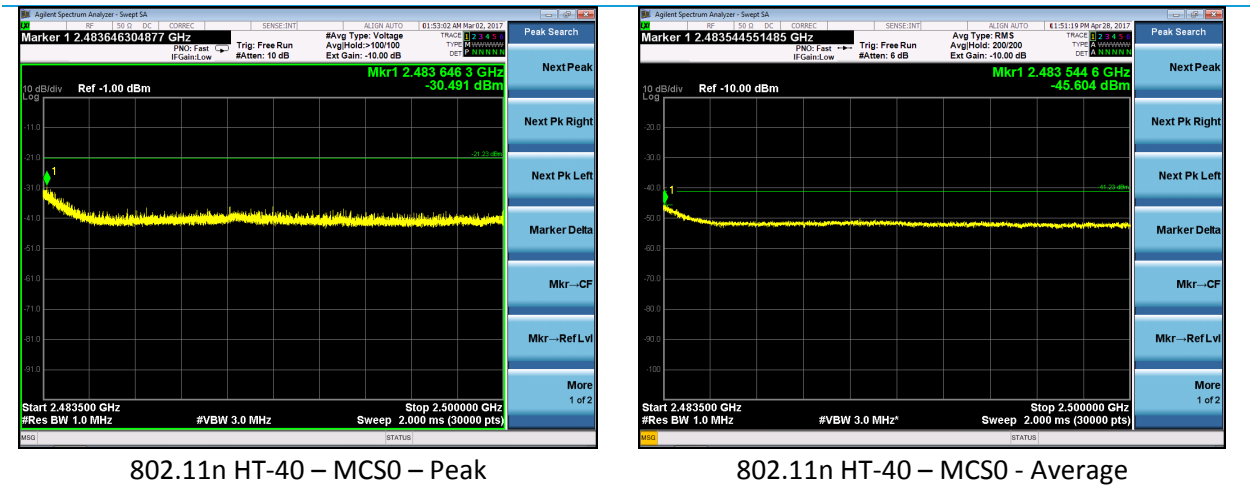


Plots – Upper Band Edge, continued



5.1.7 Antenna Port Conducted Emissions – 100 kHz Spurious Emissions

Operator	Kimberly Bay / Shane Dock
QA	Shane Dock / Kimberly Bay
Test Date	March 1, 2017 / March 29, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21-22°C / 34-35% R.H.
Requirement	FCC 15.247 (d) / RSS-247 Section 5.5
Method	ANSI C63.10 2013 Section 11.12.2

Limits:

Frequency (MHz)	Limit
All	-20 dBc

Test Parameters

Frequency	30 MHz to 25 GHz
Setting	RBW = 100 kHz, VBW = 300 kHz
EUT	802.11b HT-20, 1 Mbps: 2412, 2437, 2462 MHz
EUT	<u>BLE:</u> 2402, 2440, 2480 MHz
Note	WLAN 802.11b, 1 Mbps represents worse case
Note	No emissions found within 30 dB of the limit

Instrumentation



Date : 6-Feb-2017

Type Test : DTS Conducted RF Measurements

Job # : C-2602

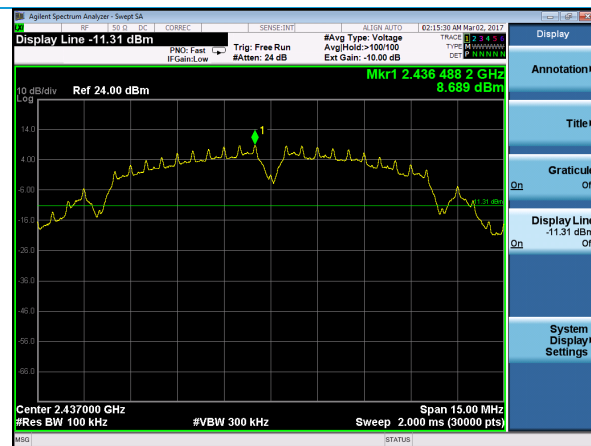
Prepared By: Kim/Shane

Customer : Laird Technologies, Inc.

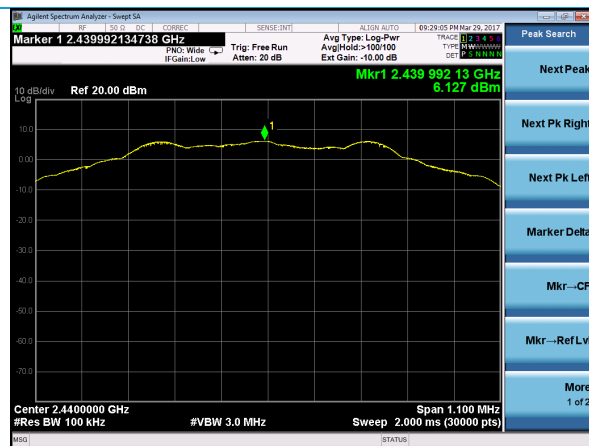
Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification
4	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration

Reference Levels for Measurement

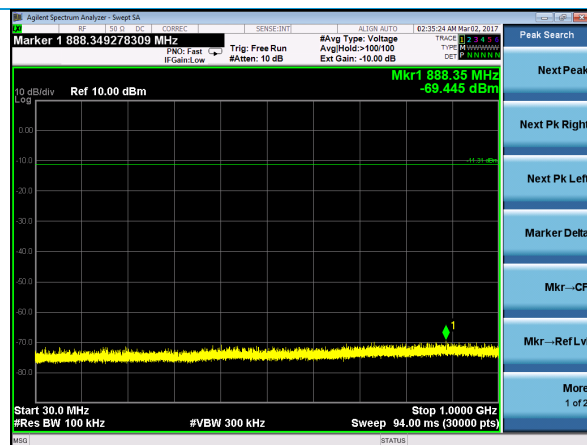


WLAN -802.11b – 1 Mbps – Mid Channel

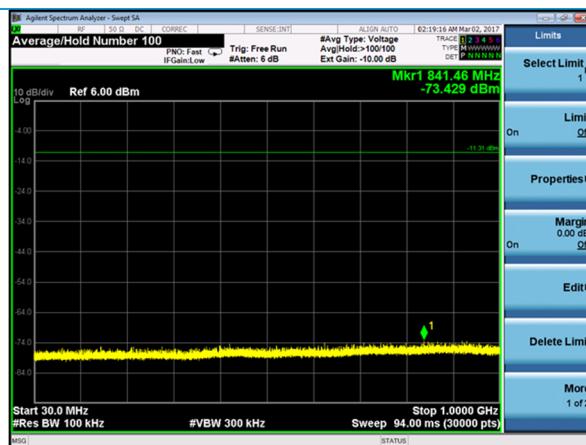


BLE – Mid Channel

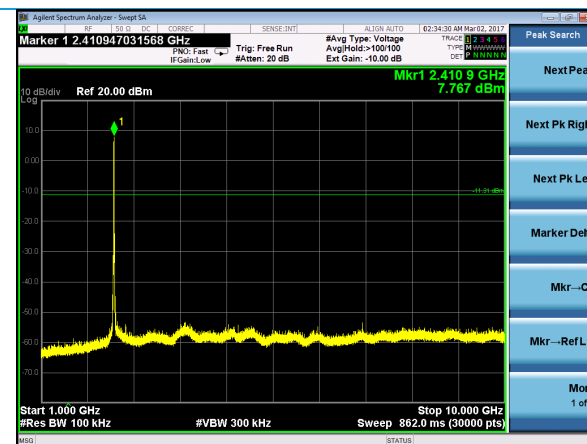
Plots – WLAN Spurious Emissions



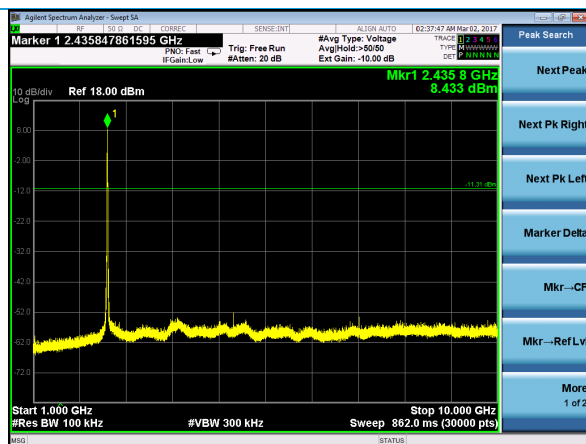
Low Channel – 30-1000 MHz



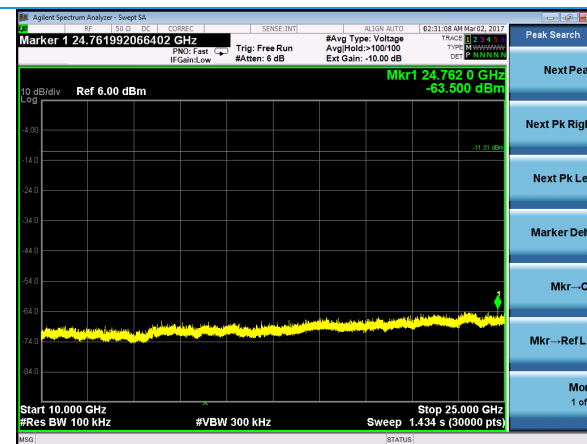
Mid Channel – 30-1000 MHz



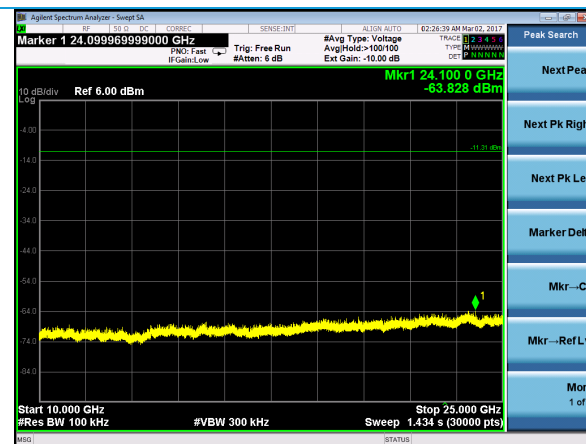
Low Channel – 1-10 GHz



Mid Channel – 1-10 GHz

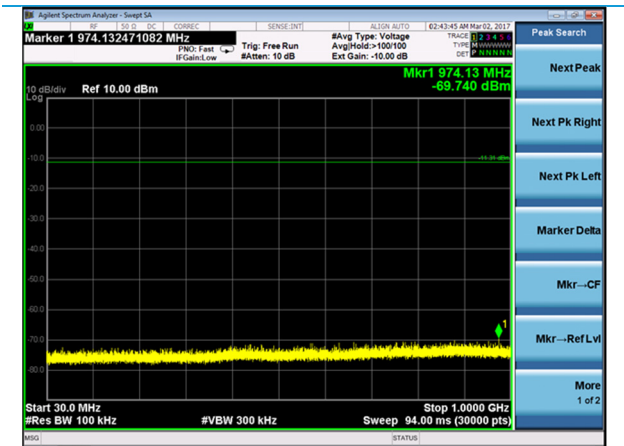


Low Channel – 10-25 GHz

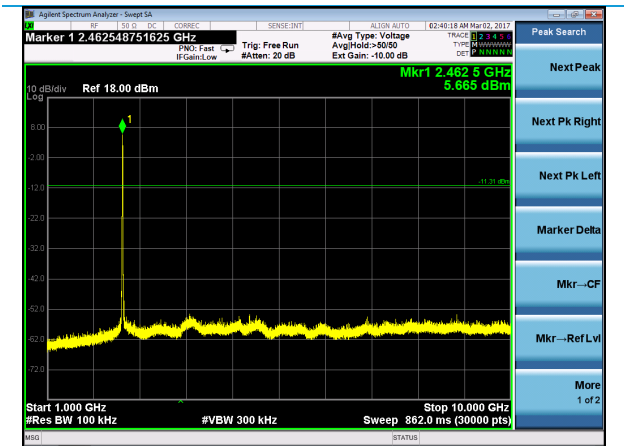


Mid Channel – 10-25 GHz

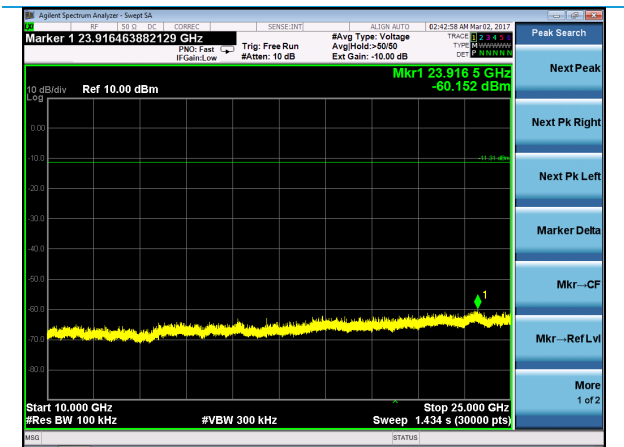
Plots – WLAN Spurious Emissions, continued



High Channel – 30-1000 MHz



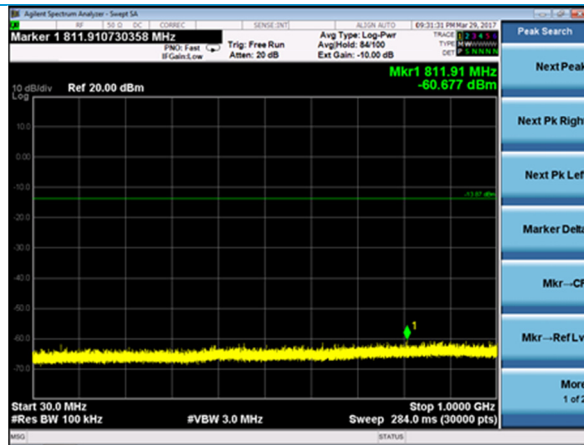
High Channel – 1-10 GHz



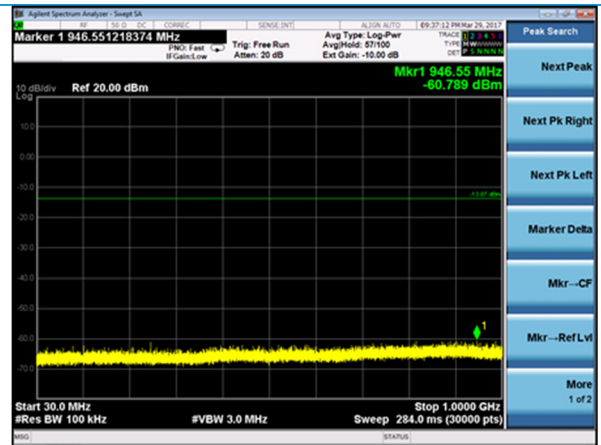
High Channel – 10-25 GHz

Company: Laird Technologies, Inc.	Page 43 of 73	Name: Sterling – LWB5
Report: TR 315356 A (DTS)		Model: Sterling – LWB5
Job: C-2602		Serial: WLAN – 00008, 00035 BLE – 00009, 00015, 00019, 00032

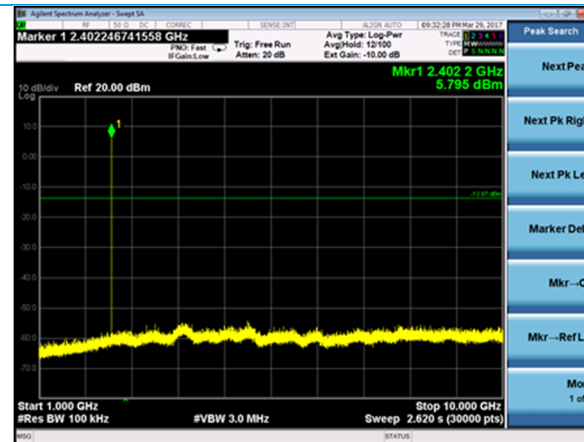
Plots – BLE Spurious Emissions



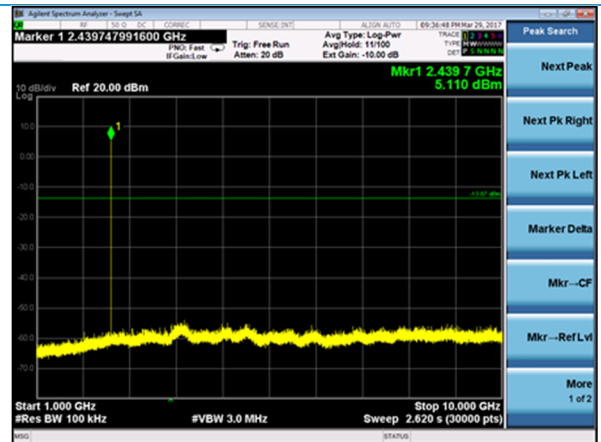
Low Channel – 30-1000 MHz



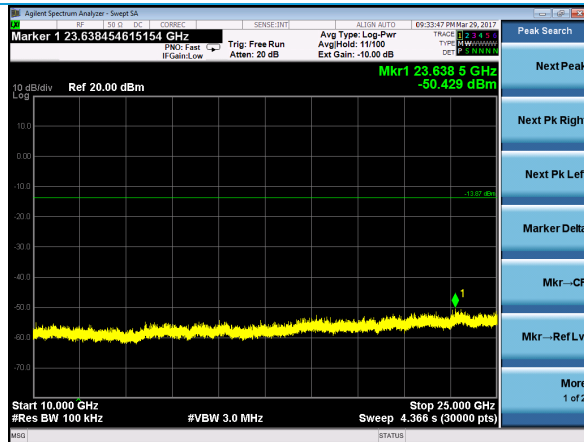
Mid Channel – 30-1000 MHz



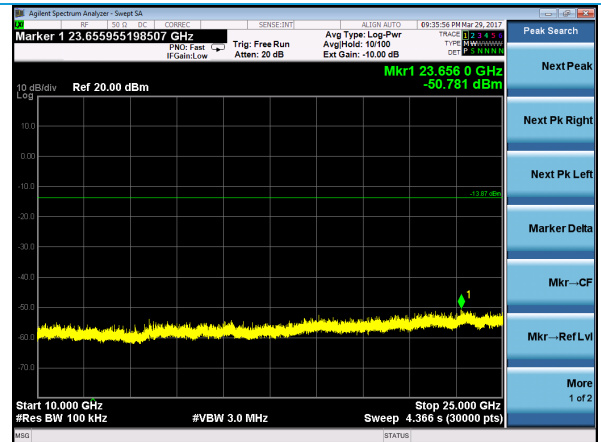
Low Channel – 1-10 GHz



Mid Channel – 1-10 GHz

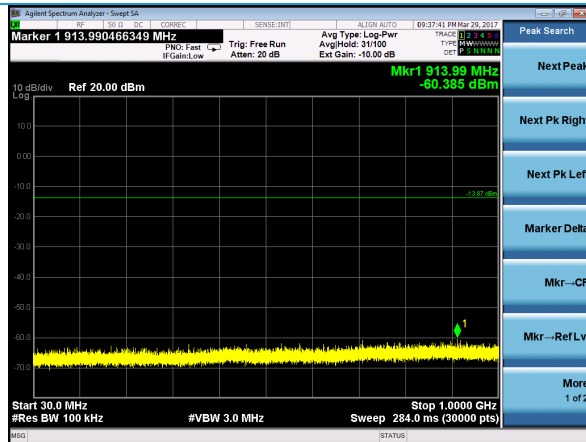


Low Channel – 10-25 GHz

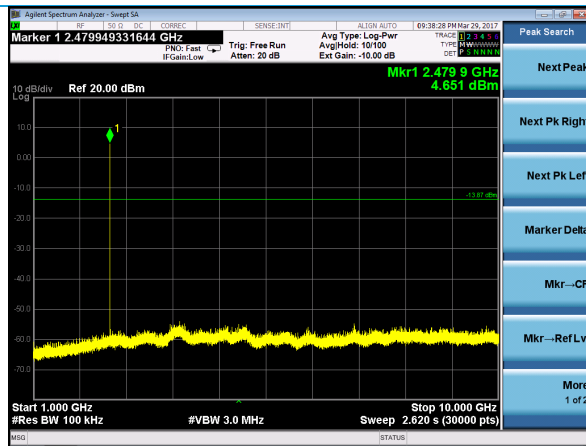


Mid Channel – 10-25 GHz

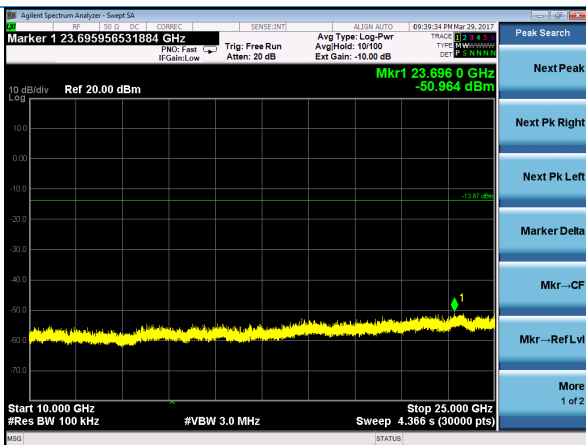
Plots – BLE Spurious Emissions, continued



High Channel – 30-1000 MHz



High Channel – 1-10 GHz



High Channel – 10-25 GHz

Company: Laird Technologies, Inc.	Page 45 of 73	Name: Sterling – LWB5
Report: TR 315356 A (DTS)		Model: Sterling – LWB5
Job: C-2602		Serial: WLAN – 00008, 00035 BLE – 00009, 00015, 00019, 00032

5.1.8 Antenna Port Conducted Emissions – Spurious Emissions

Operator	Kimberly Bay / Shane Dock
QA	Shane Dock / Kimberly Bay
Test Date	March 1, 2017 / March 29, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21-22°C / 34-35% R.H.
Requirement	FCC 15.247 (d) / RSS-247 Section 5.5
Method	ANSI C63.10 2013 Section 11.12.2

Limits:

Frequency (MHz)	Quasi-Peak Limit (dBm)	Average Limit (dBm)	Peak Limit (dBm)
30-88	-55.23	N/A	N/A
88-216	-51.73	N/A	N/A
216-960	-49.23	N/A	N/A
960-1000	-41.23	N/A	N/A
Above 1000	N/A	-41.23	-21.23

Test Parameters

Frequency	30 MHz – 25 GHz
Settings	RBW = 1 MHz, VBW = 3 MHz, unless otherwise noted
EUT	<u>802.11b HT-20, 1 Mbps:</u> 2412, 2437, 2462 MHz
EUT	<u>802.11g HT-20, 6 Mbps:</u> 2412, 2437, 2462 MHz
EUT	<u>802.11n HT-20, MCS0:</u> 2412, 2437, 2462 MHz
EUT	<u>802.11n HT-40, MCS0:</u> 2422, 2442, 2462 MHz
Note	Frequency ranges 2310-2390 MHz and 2438.5-2500 MHz are in section 5.1.6 Restricted-Band Band-Edge measurements

Instrumentation Sheet



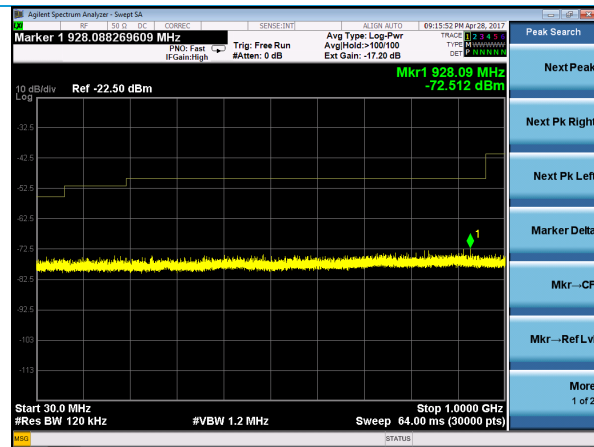
Date : 6-Feb-2017 Type Test : DTS Conducted RF Measurements Job # : C-2602
 Prepared By: Kim/Shane Customer : Laird Technologies, Inc. Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification
4	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration

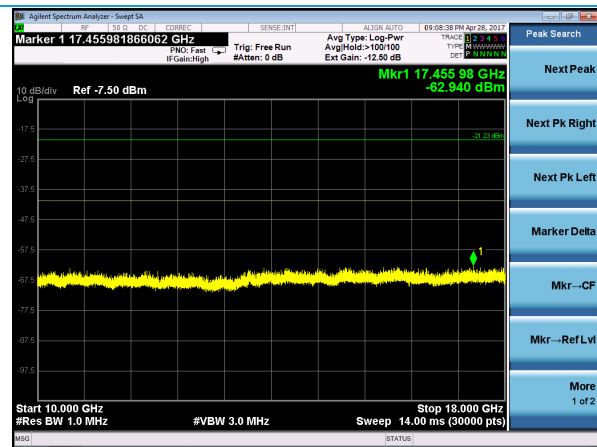
Table – Spurious Emissions

Mode	Frequency (MHz)	Peak Measurement (dBm)	Average Measurement (dBm)	Correction Factor	Peak Limit (dBm)	Average Limit (dBm)	Peak Margin (dB)	Average Margin (dB)
802.11b	4824	-45.89	-49.10	0	-21.23	-41.23	24.66	7.87
802.11b	4874	-46.94	-49.81	0	-21.23	-41.23	25.71	8.58
802.11b	7311	-47.38	-51.35	0	-21.23	-41.23	26.15	10.12
802.11b	4924	-50.56	-54.26	0	-21.23	-41.23	29.33	13.03
802.11b	7386	-52.94	-58.94	0	-21.23	-41.23	31.71	17.71
802.11b	2694	-48.06	-55.09	0	-21.23	-41.23	26.83	13.86
802.11g	7311	-49.76	-63.40	0.18	-21.23	-41.23	28.35	21.99
802.11g	2694	-48.42	-58.54	0.18	-21.23	-41.23	27.01	17.13
802.11n	7311	-56.87	-68.24	0.19	-21.23	-41.23	35.45	26.82

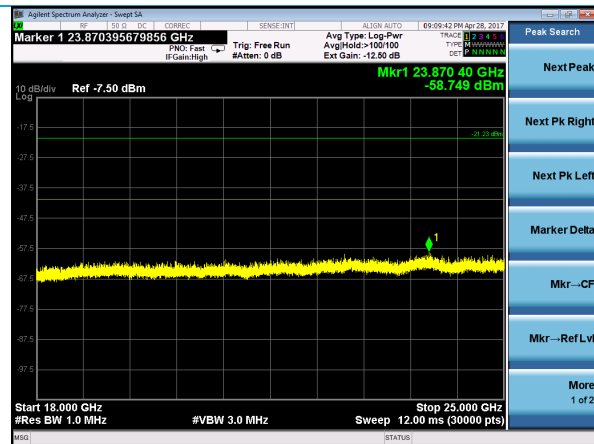
Plots – WLAN Conducted Spurious Emissions



30-1000 MHz *



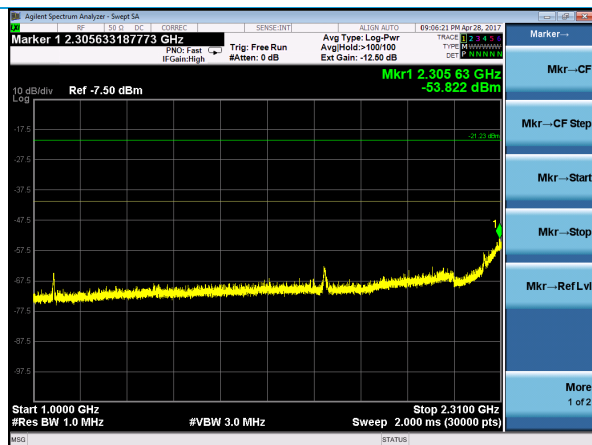
10 – 18 GHz *



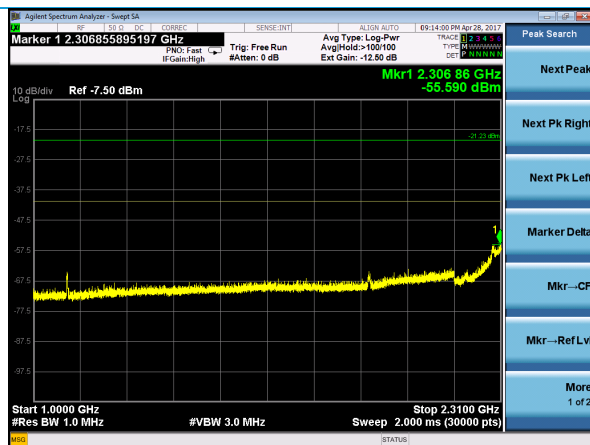
18-25 GHz *

* There were no emissions in the above frequency ranges for any channel or data rate.

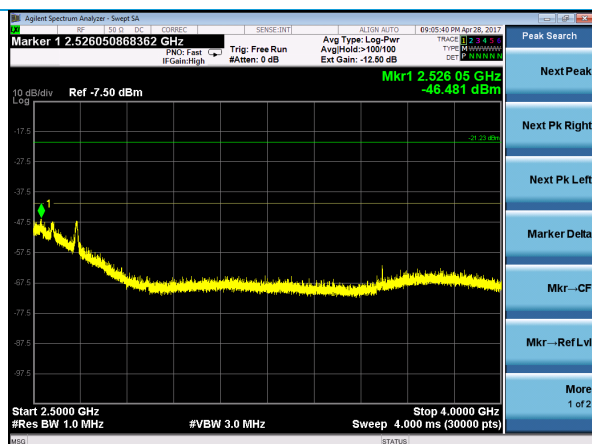
Plots – WLAN Conducted Spurious Emissions, continued



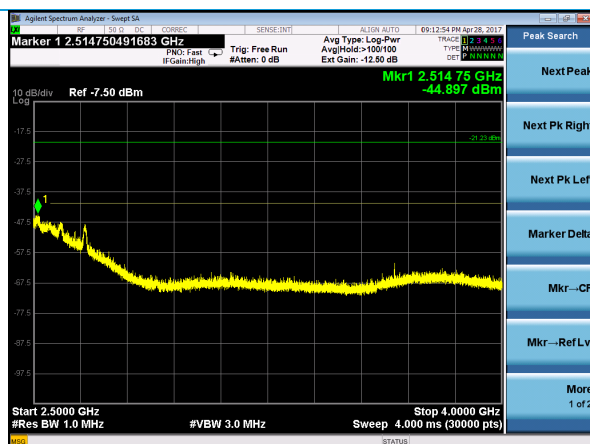
802.11b – 1-2.31 GHz – Low Channel



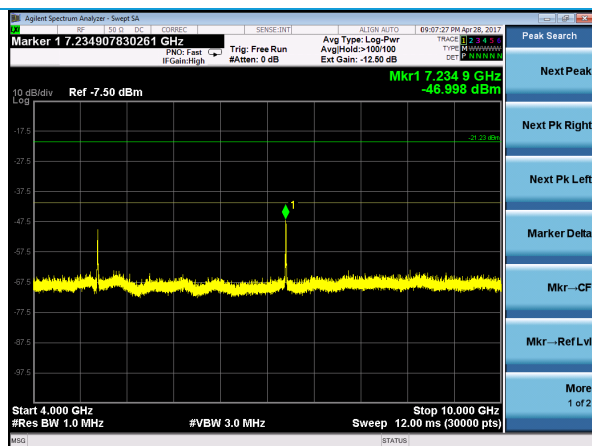
802.11b – 1-2.31 GHz – Mid Channel



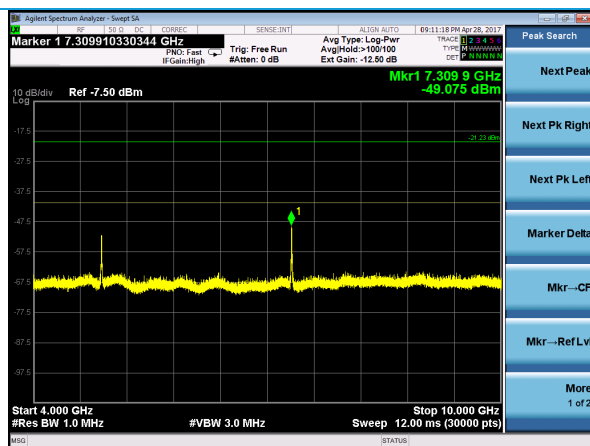
802.11b – 2.5-4 GHz – Low Channel



802.11b – 2.5-4 GHz – Mid Channel

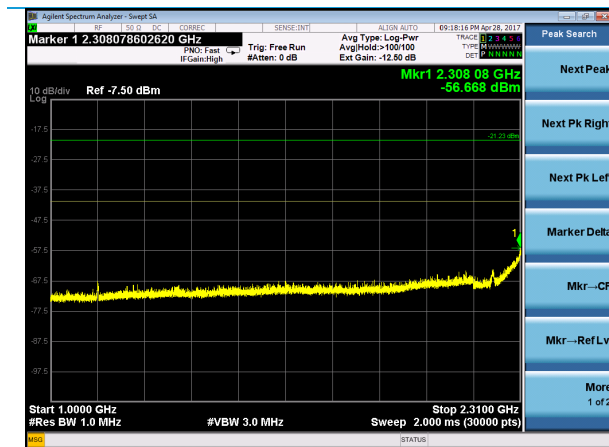


802.11b – 4-10 GHz – Low Channel

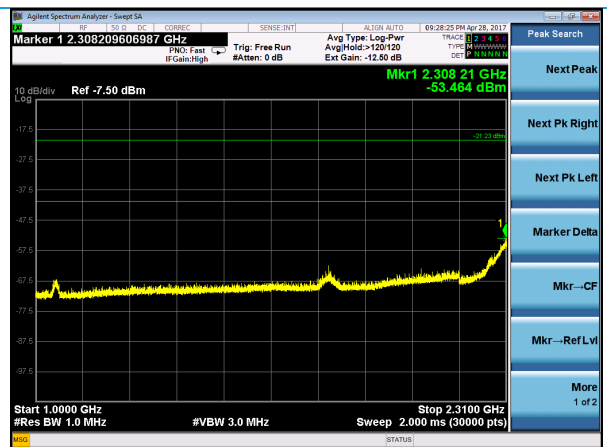


802.11b – 4-10 GHz – Mid Channel

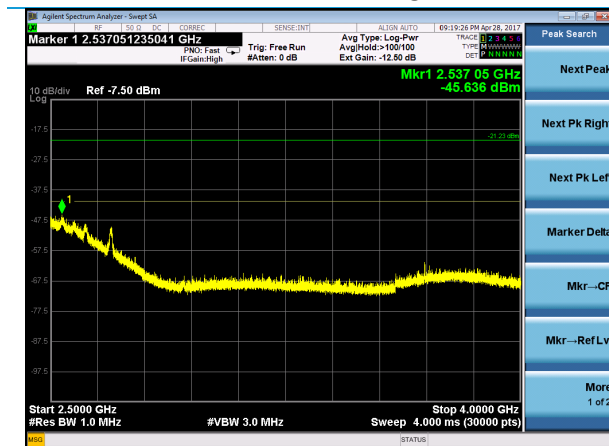
Plots – WLAN Conducted Spurious Emissions, continued



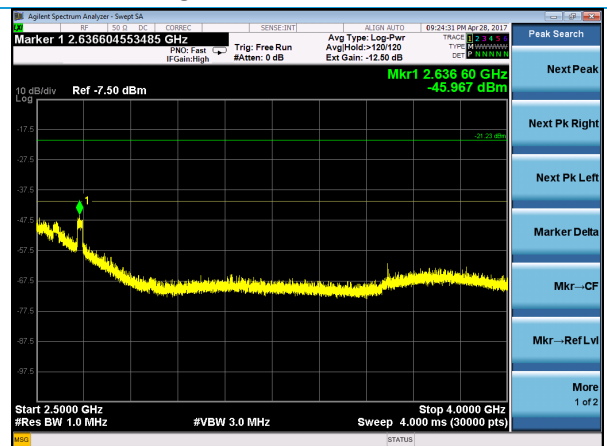
802.11b – 1-2.31 GHz – High Channel



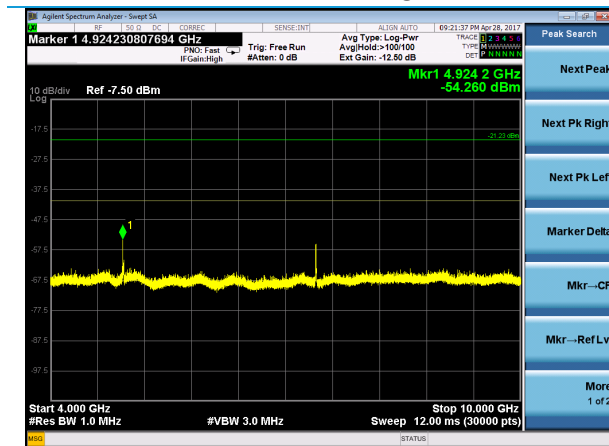
802.11g - 1-2.31 GHz – Low Channel



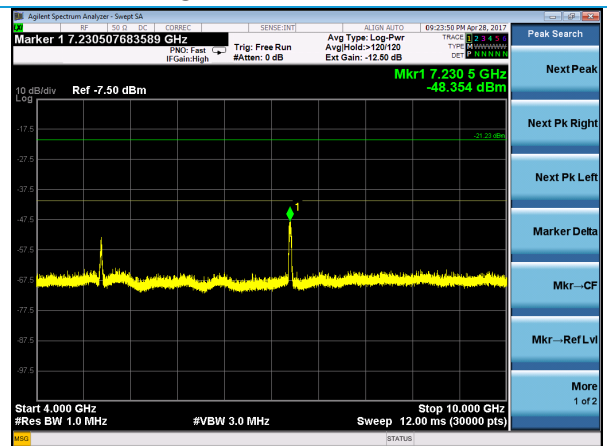
802.11b – 2.5-4 GHz – High Channel



802.11g – 2.5-4 GHz – Low Channel

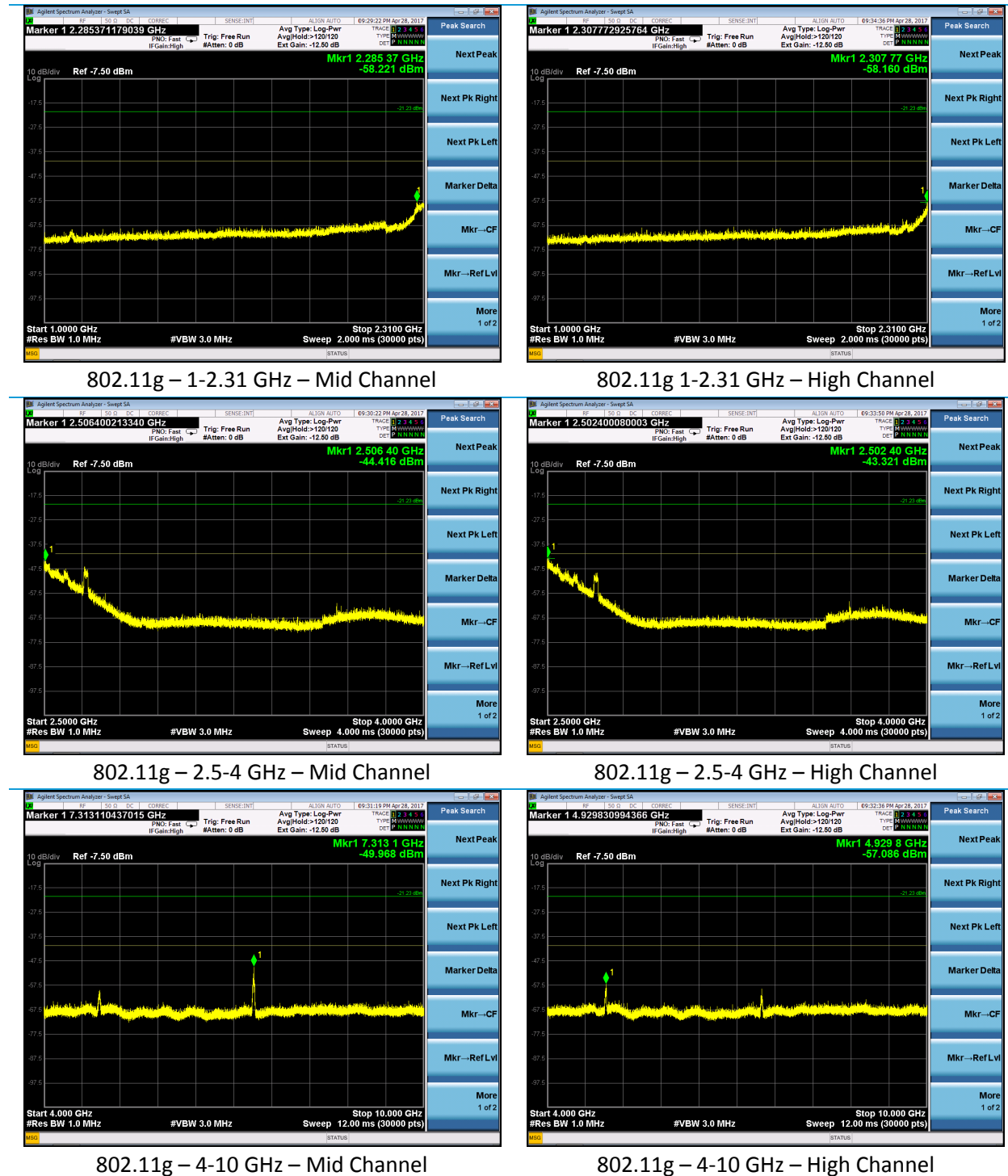


802.11b – 4-10 GHz – High Channel

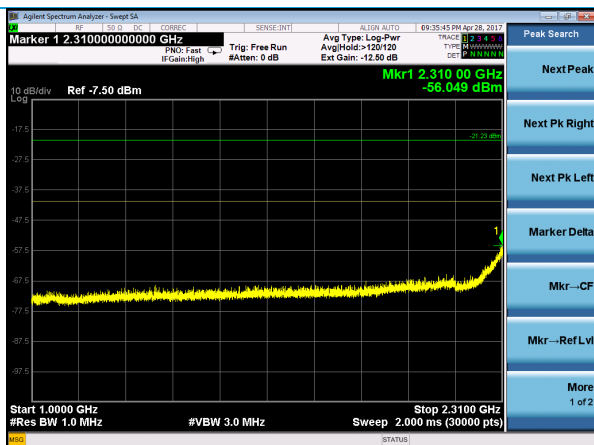


802.11g – 4-10 GHz – Low Channel

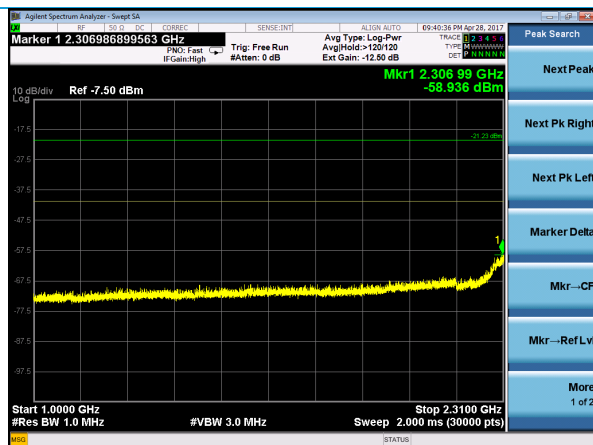
Plots – WLAN Conducted Spurious Emissions, continued



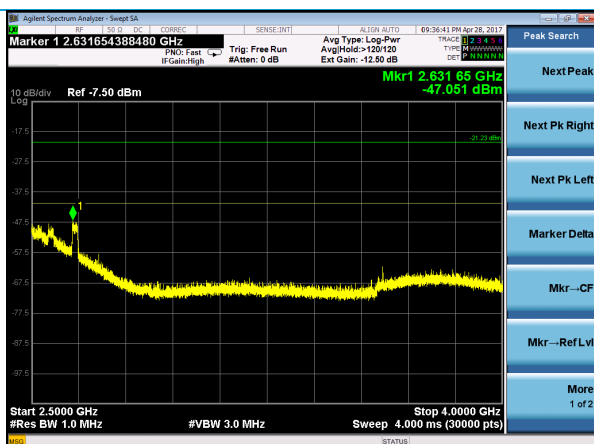
Plots – WLAN Conducted Spurious Emissions, continued



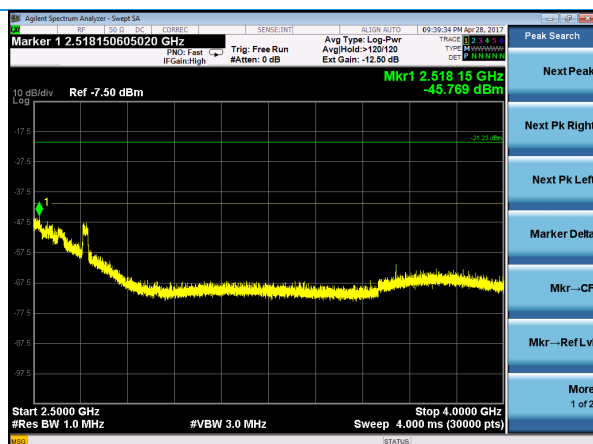
802.11n – 1-2.31 GHz – Low Channel



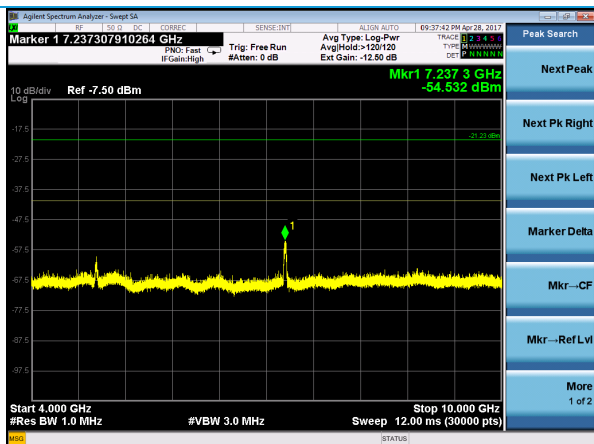
802.11n – 1-2.31 GHz – Mid Channel



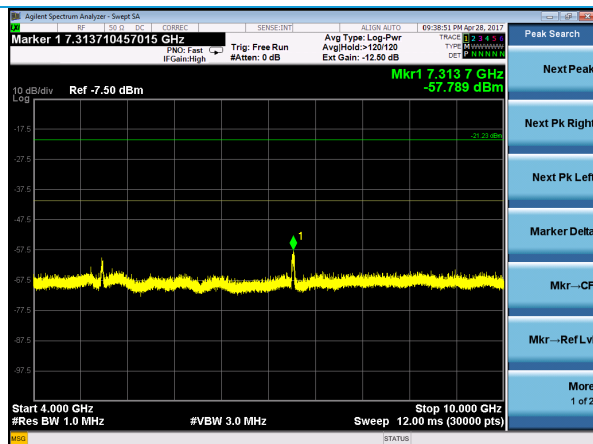
802.11n – 2.5-4 GHz – Low Channel



802.11n – 2.5-4 GHz – Mid Channel

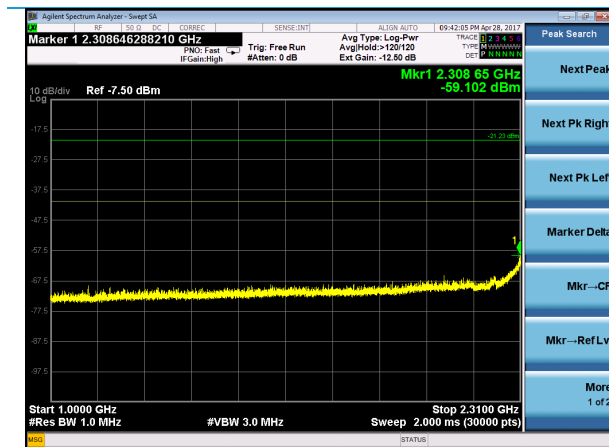


802.11n – 4-10 GHz – Low Channel

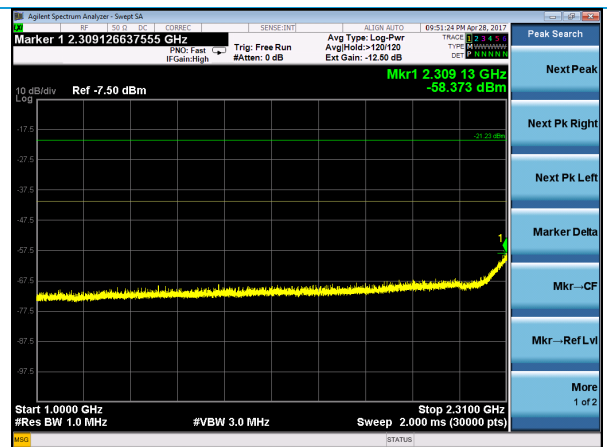


802.11n – 4-10 GHz – Mid Channel

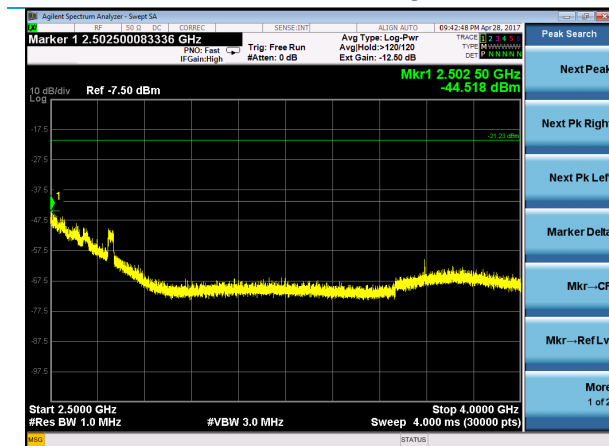
Plots – WLAN Conducted Spurious Emissions, continued



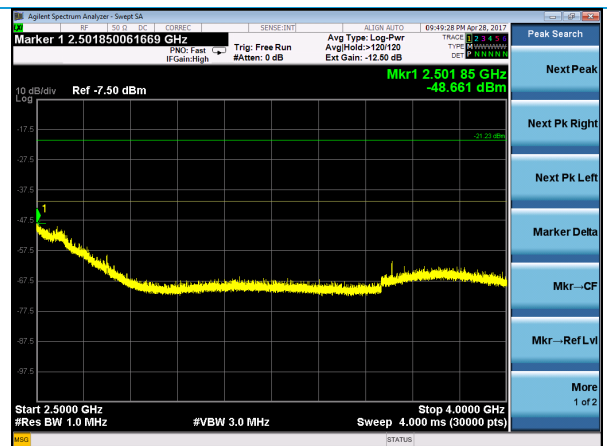
802.11n – 1-2.31 GHz – High Channel



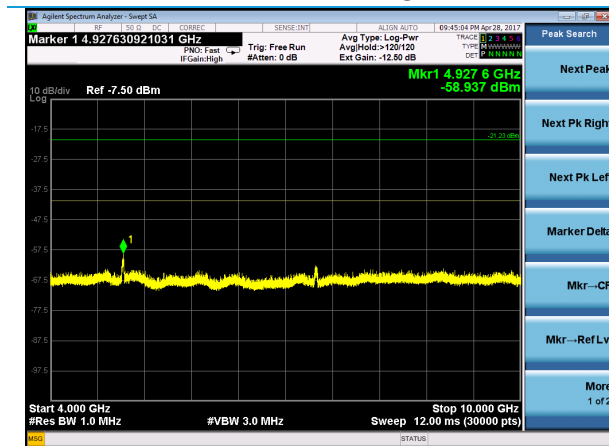
802.11n HT-40 – 1-2.31 GHz – Low Channel



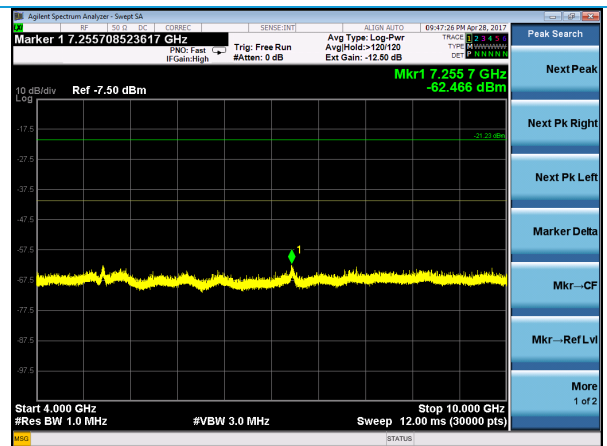
802.11n – 2.5-4 GHz – High Channel



802.11n HT-40 – 2.5-4 GHz – Low Channel

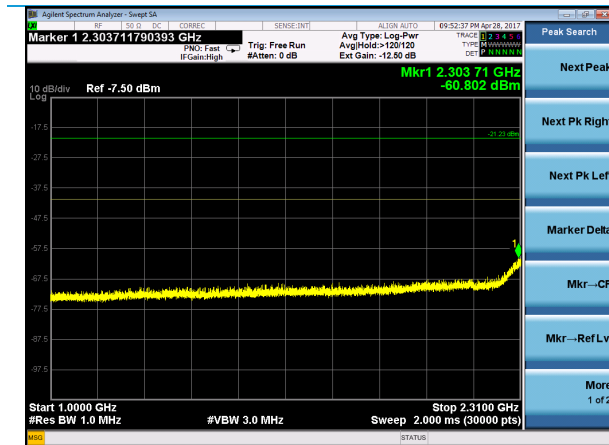


802.11n – 4-10 GHz – High Channel

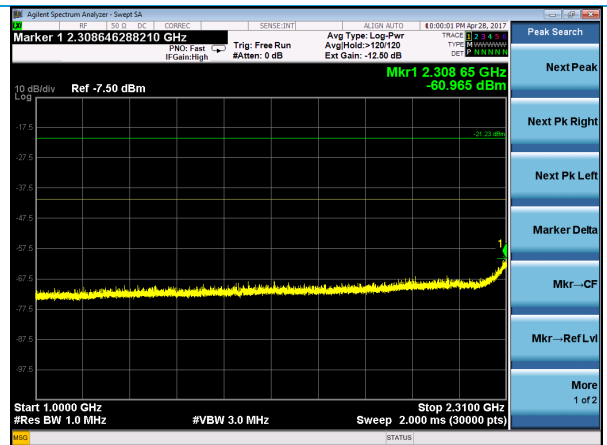


802.11n HT-40 – 4-10 GHz – Low Channel

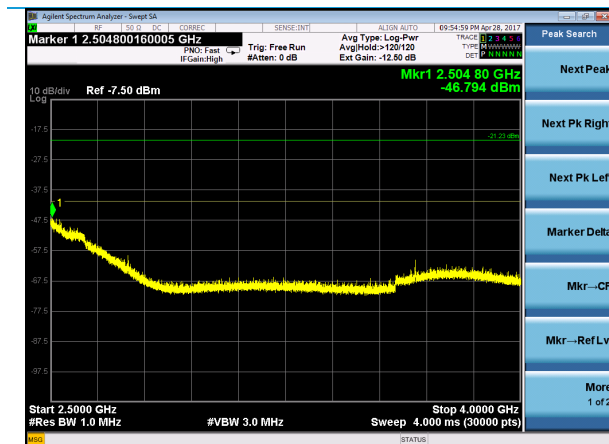
Plots – WLAN Conducted Spurious Emissions, continued



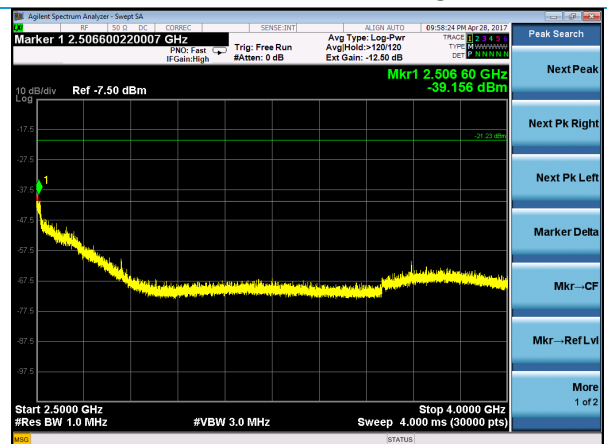
802.11n HT-40 – 1-2.31 GHz – Mid Channel



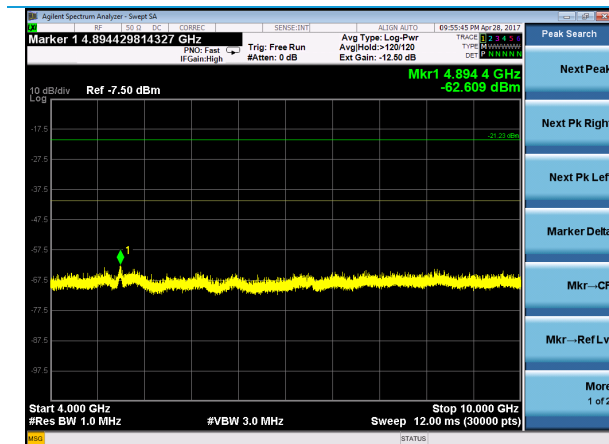
802.11n HT-40 – 1-2.31 GHz – High Channel



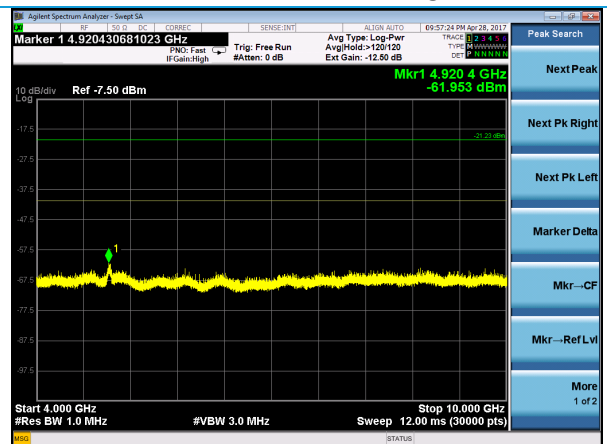
802.11n HT-40 – 2.5-4 GHz – Mid Channel



802.11n HT-40 – 2.5-4 GHz – High Channel



802.11n HT-40 – 4-10 GHz – Mid Channel



802.11n HT-40 – 4-10 GHz – High Channel

5.2 Radiated Emissions

Description of Measurement	The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBμV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBμV/m) Margin (dB) = Limit (dBμV/m) - Corrected Reading (dBμV/m) Example at 4000 MHz: Reading = 40 dBμV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBμV/m Average Limit = 20 log (500) = 54 dBμV/m Margin = 54 dBμV/m - 50.8 dBμV/m = 3.2 dB

Block Diagram



5.2.1 Radiated Emissions – Restricted-Band Band-Edges

Operator	Kimberly Bay
QA	John Johnston / Shane Dock
Test Date	February 7, 2017 / February 15, 2017 / February 22, 2017
Location	3-meter Semi-Anechoic Chamber
Temp. / R.H.	20°C / 31% R.H.
Requirement	FCC 15.247 (d) / RSS-247 Section 5.5
Method	ANSI C63.10 2013 Sections 6.3, 6.6, 6.10

Limits:

Frequency (MHz)	Average Limit (dBμV/m)	Peak Limit (dBμV/m)
2310-2390	54	74
2483.5-2500	54	74

Test Parameters

Settings	RBW = 1 MHz; VBW = 3 MHz for peak and at least 1/duty cycle for average
Test Chamber	Absorbers on floor, tilt-gear added to antenna to maintain cone of radiation
EUT	<u>802.11b HT-20, 1 Mbps:</u> 2412, 2462 MHz
EUT	<u>802.11g HT-20, 6 Mbps:</u> 2412, 2462 MHz
EUT	<u>802.11n HT-20, MCS0:</u> 2412, 2462 MHz
EUT	<u>802.11n HT-40, MCS0:</u> 2422, 2462 MHz
EUT	<u>BLE:</u> 2402, 2480 MHz
Notes	<u>WLAN:</u> Tested antenna port terminated
Notes	<u>BLE:</u> Tested with FlexPIFA (highest gain) antenna

Instrumentation



Date : 6-Feb-2017

Type Test : DTS Radiated Band Edged Emissions

Job # : C-2602

Prepared By: Kim

Customer : LSR

Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	10/13/2016	10/13/2017	Active Calibration
3	EE 960159	Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	40201429	10/13/2016	10/13/2017	Active Calibration
4	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	7/22/2016	7/22/2017	Active Calibration
5	EE 960160	Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	977711030	7/22/2016	7/22/2017	Active Calibration

Table – Lower Band-Edge Measurements (2310-2390 MHz)

Mode	Peak Freq. (MHz)	Peak Reading (dBμV/m)	Average Freq. (MHz)	Average Reading (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Peak Margin (dB)	Average Margin (dB)
802.11b	2385	42.2	2386	30.6	74	54	31.8	23.4
802.11g	2389	41.7	2389	29.9	74	54	32.3	24.1
802.11n	2386	41.0	2390	29.4	74	54	33.0	24.6
802.11n (HT-40)	2389	38.3	2386	27.2	74	54	35.7	26.8

Table – Upper Band-Edge Measurements (2483.5-2500 MHz)

Mode	Peak Freq. (MHz)	Peak Reading (dBμV/m)	Average Freq. (MHz)	Average Reading (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Peak Margin (dB)	Average Margin (dB)
802.11b	2488	43.1	2484	29.4	74	54	30.9	24.6
802.11g	2484	43.1	2484	30.5	74	54	30.9	23.5
802.11n	2497	41.8	2490	29.1	74	54	32.2	24.9
802.11n (HT-40)	2485	47.8	2484	35.3	74	54	26.2	18.7

Plots – WLAN Lower Band Edge

