



**FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-247 ISSUE 1**

**BLUETOOTH LOW ENERGY
CERTIFICATION TEST REPORT**

FOR

WLAN 2.4GHz b/g/n, Bluetooth and BLE Module

MODEL NUMBER: SWOC-T

**FCC ID: J9CSWOC-T
IC ID: 2723A-SWOCT**

REPORT NUMBER: 16U23207-E2V2

ISSUE DATE: 11/8/2016

Prepared for
**QUALCOMM TECHNOLOGIES INC
5775 MOREHOUSE Drive
SAN DIEGO, CA 92121, U.S.A**

Prepared by
**UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888**



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	09/16/16	Initial Issue	C. Vergonio
V2	11/8/16	Updated Section 5.5 and Section 10.1	C. Vergonio

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS.....	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION.....	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. MEASURING INSTRUMENT CALIBRATION	6
4.2. SAMPLE CALCULATION.....	6
4.3. MEASUREMENT UNCERTAINTY	7
5. EQUIPMENT UNDER TEST	8
5.1. DESCRIPTION OF EUT.....	8
5.2. MAXIMUM OUTPUT POWER.....	8
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	8
5.4. SOFTWARE AND FIRMWARE	8
5.5. WORST-CASE CONFIGURATION AND MODE.....	9
5.6. DESCRIPTION OF TEST SETUP.....	10
6. TEST AND MEASUREMENT EQUIPMENT	12
7. SUMMARY TABLE	13
8. MEASUREMENT METHOD	14
9. ANTENNA PORT TEST RESULTS	15
9.1. ON TIME AND DUTY CYCLE RESULTS.....	15
9.2. DUTY CYCLE PLOTS.....	15
9.3. 6 dB BANDWIDTH	16
9.4. 99% BANDWIDTH.....	19
9.5. OUTPUT POWER	22
9.6. AVERAGE POWER.....	25
9.7. POWER SPECTRAL DENSITY	26
9.8. CONDUCTED SPURIOUS EMISSIONS.....	29
9.9. CONDUCTED BANDEDGE and HARMONICS/SPURIOUS IN RESTRICTED BANDS 33	
10. RADIATED TEST RESULTS.....	39
10.1. LIMITS AND PROCEDURE.....	39
10.2. TRANSMITTER ABOVE 1 GHz FOR BLE MODE IN THE 2.4 GHz.....	40

10.3.	WORST-CASE BELOW 1 GHz – With 50 ohm terminator	50
10.4.	WORST-CASE BELOW 1 GHz – With 50 ohm terminator	52
11.	AC POWER LINE CONDUCTED EMISSIONS	54
12.	SETUP PHOTOS	57

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: QUALCOMM TECHNOLOGIES INC.
5775 MOREHOUSE Drive
SAN DIEGO, CA 92121, U.S.A

EUT DESCRIPTION: WLAN 2.4GHz b/g/n, Bluetooth and BLE Module

MODEL: SWOC-T

SERIAL NUMBER: Conducted Sample: N10ML3B1C
Radiated Sample: N10ML37L3

DATE TESTED: August 18 to September 07, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-247 Issue 1	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:



CHARLES VERGONIO
CONSUMER TECHNOLOGY DIVISION
WISE ENGINEER
UL Verification Services Inc.

Prepared By:



THANH PHAM
CONSUMER TECHNOLOGY DIVISION
EMC LAB ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 1.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☒ Chamber A	☐ Chamber D
☐ Chamber B	☐ Chamber E
☒ Chamber C	☐ Chamber F

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.84 dB
Radiated Disturbance, 9KHz to 30 MHz	2.14 dB
Radiated Disturbance, 30 to 1000 MHz	4.98 dB
Radiated Disturbance, 1000 to 6000 MHz	3.86 dB
Radiated Disturbance, 6000 to 18000 MHz	4.23 dB
Radiated Disturbance, 18000 to 26000 MHz	5.30 dB
Radiated Disturbance, 26000 to 40000 MHz	5.23 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a WLAN 2.4GHz b/g/n, Bluetooth and BLE Module.

The radio module is manufactured by Qualcomm.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE	1.32	1.36

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna to be used with the device are integral antennas with maximum gain of 0dBi (including gain and path loss).

5.4. SOFTWARE AND FIRMWARE

The product SW version is: MSM8909W.LAW.1.0-00095-512M.PM8916.APQ.INT-1

The EUT driver software installed in the host support equipment during testing was Qualcomm Incorporated, rev. 2.1.2.2.

The test utility software used during testing was QC BluetoothLE direct mode, rev. 1.2.1.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated bandedge, harmonics, and spurious emissions from 1 GHz to 18GHz were performed with 50 ohm load, terminator method (cabinet). The EUT was set to transmit at the Low/Middle/High channels with designed (target) output powers.

Radiated emission below 1GHz, above 18GHz, and power line conducted emission were also performed with 50 ohm load, terminator method (cabinet). The EUT was set to transmit at the channel with highest output power as worst-case scenario.

Conducted band edge, harmonics, and spurious below, above 1GHz in restricted band were performed to comply with radiated limits.

All final tests in the BLE mode were made at GFSK / 1Mbps

The fundamental of the EUT was investigated in three orthogonal orientations X, Y, & Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z (stand-up) orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	Elitebook 8460p	CNU1340PXF	-
Laptop	HP	Elitebook 8460p	CNU2020MMC	-
AC Adapter	HP	PP012L	2112645106	-
AC Adapter	HP	PP012H	F12941129022008	-
DC Power Supply	AMETEK	XT 15-4	1319A00221	-
DC Power Supply	AMETEK	XT 15-4	1319A02778	-

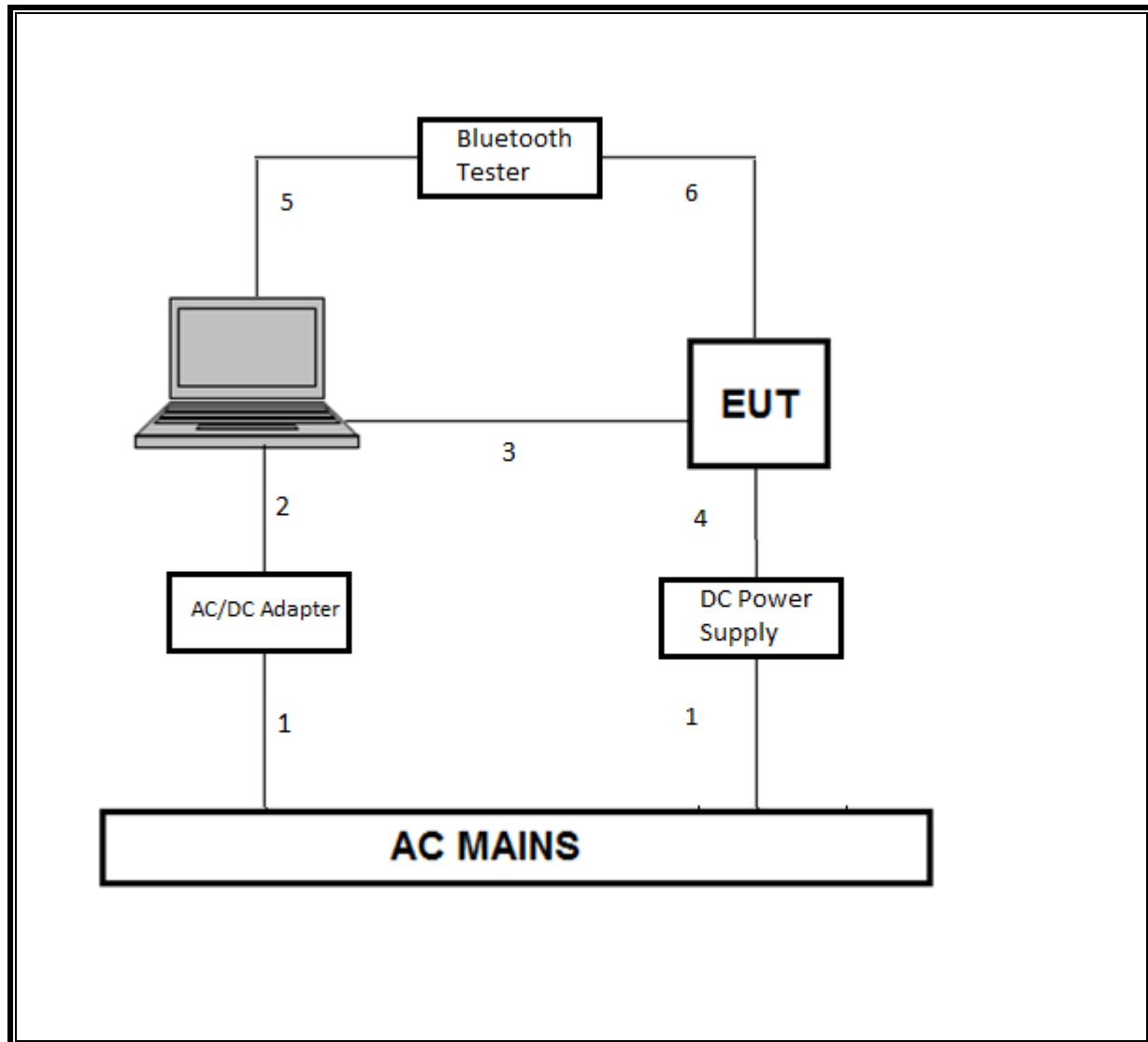
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC Power	2	AC	Unsheilded	1	-
2	DC Power	1	DC	Sheilded	1.2	AC/DC Adapter to Laptop
3	MicroUSB	1	USB	Unsheilded	1.5	Laptop to EUT
4	DC Power	1	Barrel	Unsheilded	0.3	DC Power to EUT
5	USB-Serial	1	USB	Unsheilded	1.2	-
6	SMA	1	SMA	Unsheilded	0.3	-

TEST SETUP

The EUT is connected to a host laptop computer thru USB cable during the tests and laptop handshaking with callbox by USB-serial cable. Once callbox is configured and connected in test mode then callbox is ready to exercise the radio card.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	Manufacturer	Model	T No.	Cal Date	Cal Due
Amplifier, 1 - 18GHz	Miteq	AFS42	T493	03/09/16	03/09/17
Amplifier, 1 - 8GHz	Amplicial	AMP1G7-10-27	T1370	11/25/15	11/25/16
Amplifier, 10KHz to 1GHz, 32dB	HP	8447D	T10	02/01/16	02/01/17
Antenna, Broadband Hybrid 30MHz to 2000MHz	Sunol Science	JB3	T477	06/22/16	06/22/17
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T345	03/07/16	03/07/17
Bluetooth Tester	ROHDE SCHWARZ	CBT	T258	07/11/16	07/11/17
EMI Test Receiver 9KHz-7GHz	R&S	ESR7	T1436	12/08/15	12/08/16
High Pass Filter 3GHz	Micro-Tronics	HPS17543	T1013	12/11/15	12/11/16
LISN for Conducted Emissions	Fischer	50/250-25-2	T1310	06/08/16	06/08/17
Loop Antenna, 10KHz-30MHz	EMCO	6502	35	03/24/16	03/24/17
Power Cable, Line Conducted Emissions	UL	PG1	N/A	07/28/16	07/28/17
Power Meter, P-series single channel	Keysight	N1911A	T1262	07/08/16	07/08/17
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	T751	08/23/16	08/23/17
PSA Spectrum Analyzer 40GHz	Agilent	E4446A	T146	07/13/16	07/13/17
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	T907	01/06/16	01/06/17

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Ver 9.5, Apr 26, 2016
Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015
Antenna Port Software	UL	UL RF	Ver 5.1.1, July 15, 2016

7. SUMMARY TABLE

FCC Part Section	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result
15.247 (a)(2)	RSS-247 5.2.1	Occupied Band width (6dB)	>500KHz	Conducted	Pass
2.1051, 15.247 (d)	RSS-247 5.5	Band Edge / Conducted Spurious Emission	-20dBc		Pass
15.247	RSS-247 5.4.4	TX conducted output power	<30dBm		Pass
15.247	RSS-247 5.2.2	PSD	<8dBm		Pass
15.207 (a)	RSS-GEN 8.8	AC Power Line conducted emissions	Section 10		Pass
15.205, 15.209	RSS-GEN 8.9/7	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass

8. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 558074 D01 v03r05, Section 6.

6 dB Emission BW: KDB 558074 D01 v03r05, Section 8.1.

Conducted Output Power: KDB 558074 D01 v03r05, Section 9.1.1.

Power Spectral Density: KDB 558074 D01 v03r05, Section 10.2 (Method PKPSD).

Unwanted emissions in restricted bands: KDB 558074 D01 v03r05, Section 12.1, 12.2.2, 12.2.7.

Unwanted emissions in non-restricted bands: KDB 558074 D01 v03r05, Section 11.0.

Band-edge: KDB 558074 D01 v03r05, Section 13.2.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE RESULTS

LIMITS

None; for reporting purposes only.

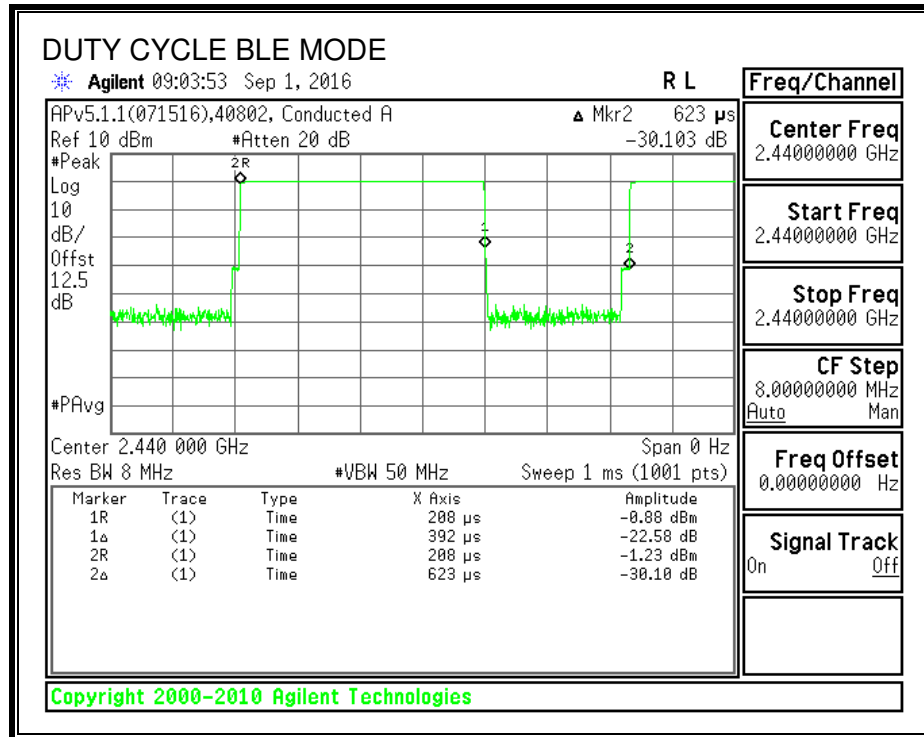
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
BLE	0.392	0.623	0.629	62.92%	2.01	2.551

9.2. DUTY CYCLE PLOTS



9.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

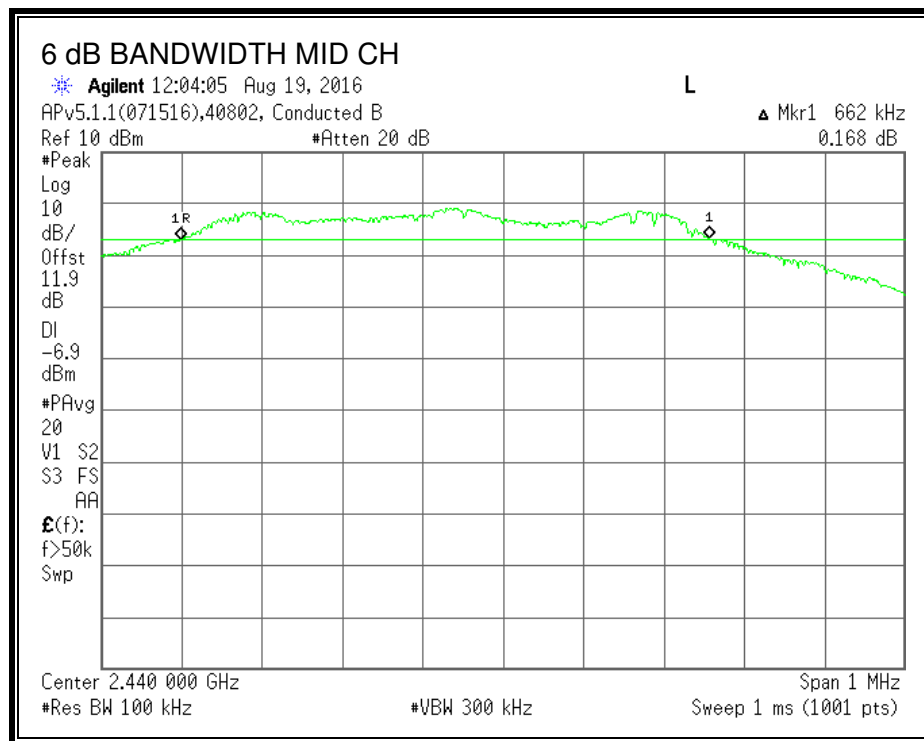
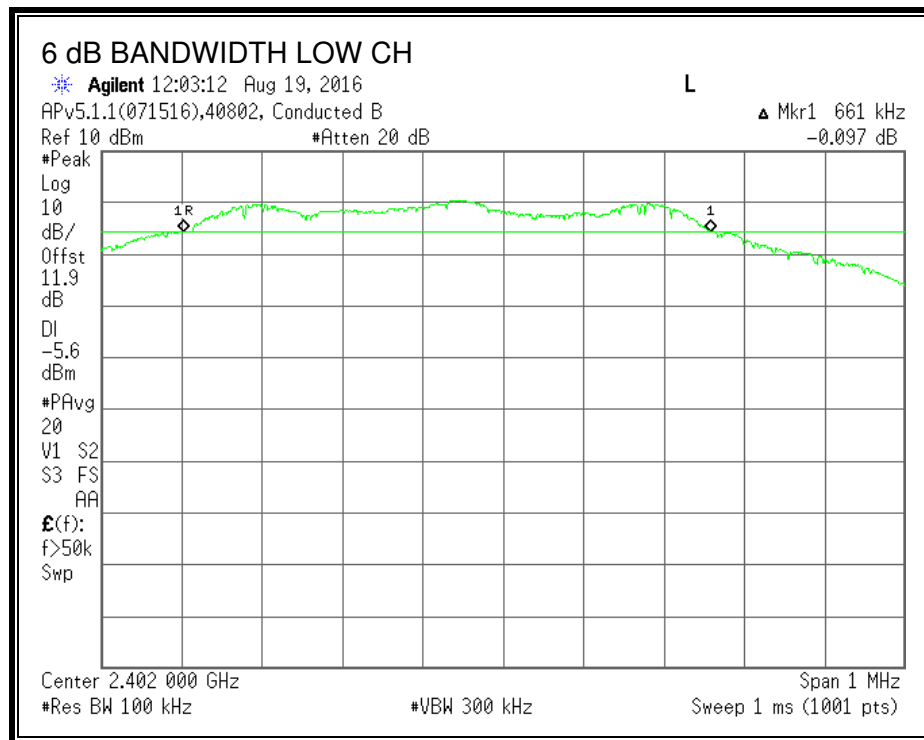
IC RSS-247 5.2 (1)

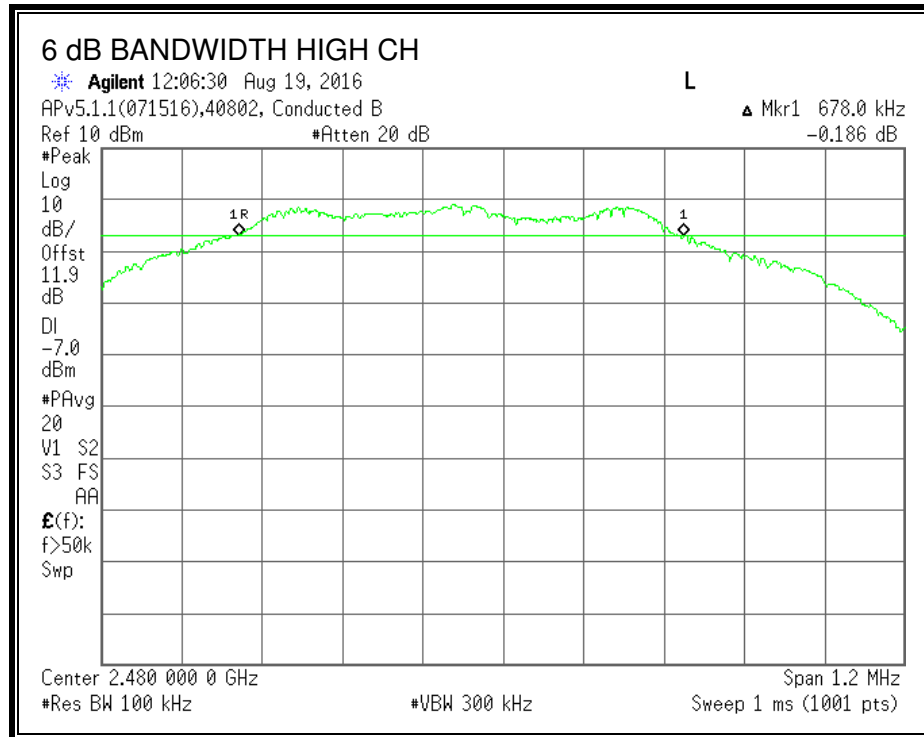
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6610	0.5
Middle	2440	0.6620	0.5
High	2480	0.6780	0.5

6 dB BANDWIDTH





9.4. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

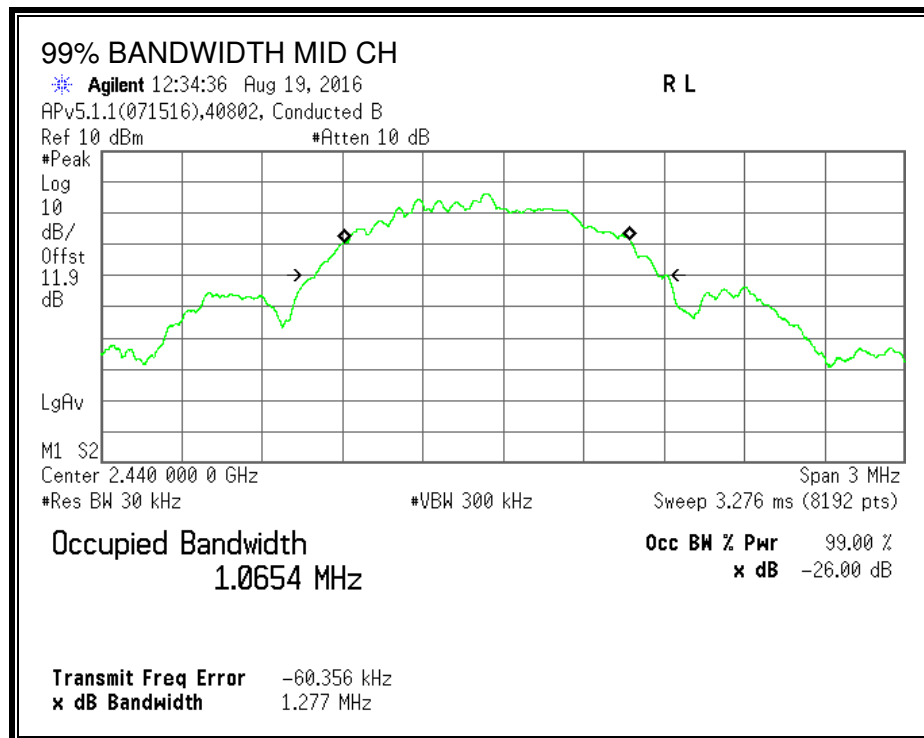
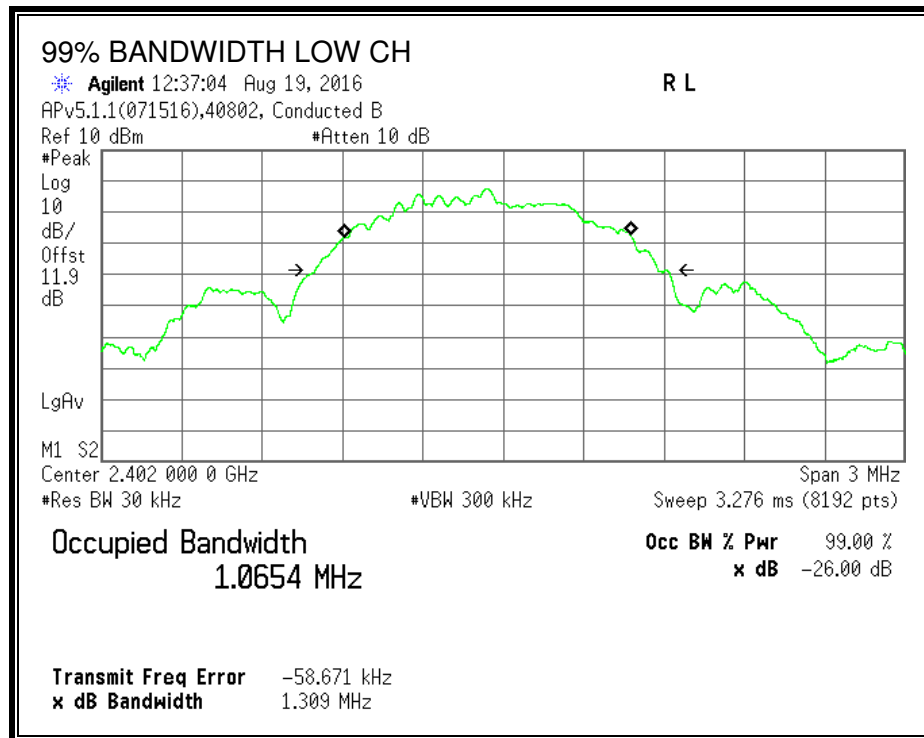
TEST PROCEDURE

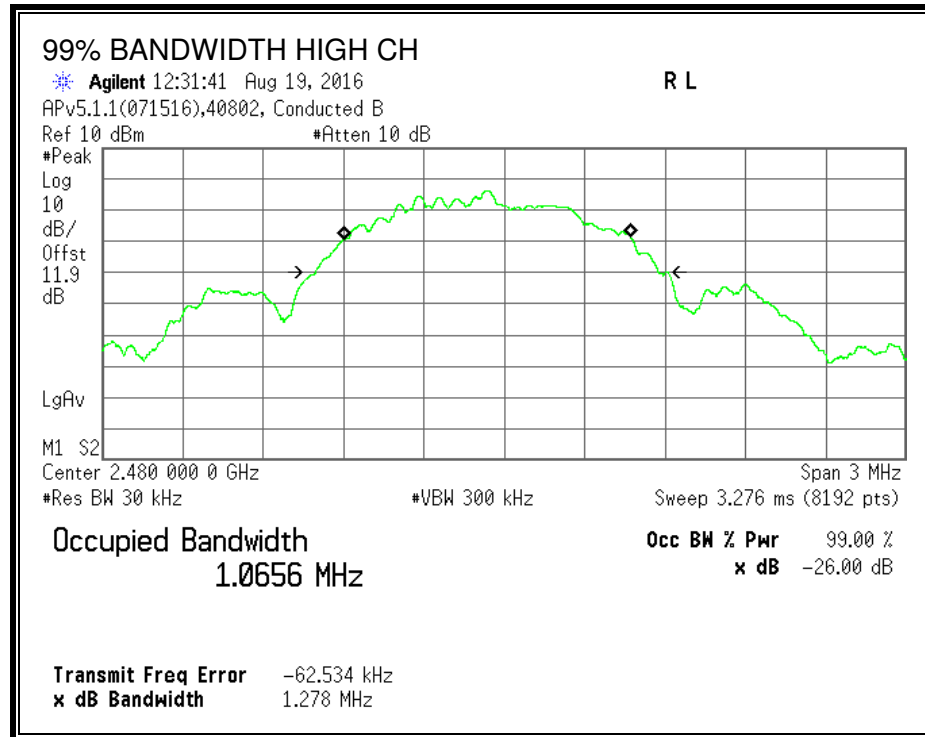
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0654
Middle	2440	1.0654
High	2480	1.0656

99% BANDWIDTH





9.5. OUTPUT POWER

LIMITS

FCC §15.247 (b)

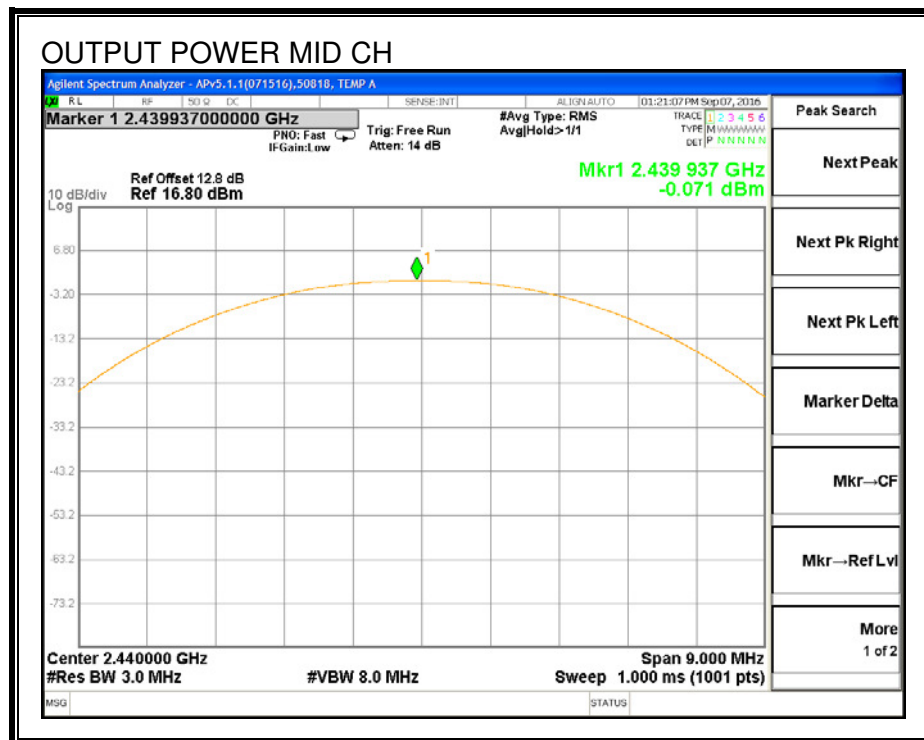
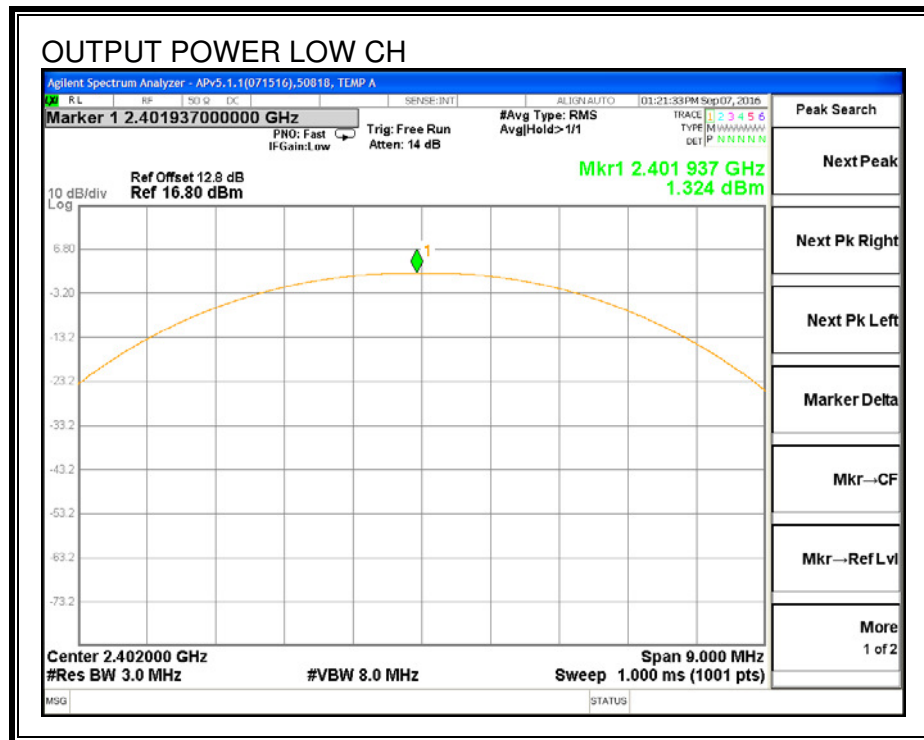
IC RSS-247 5.4 (4)

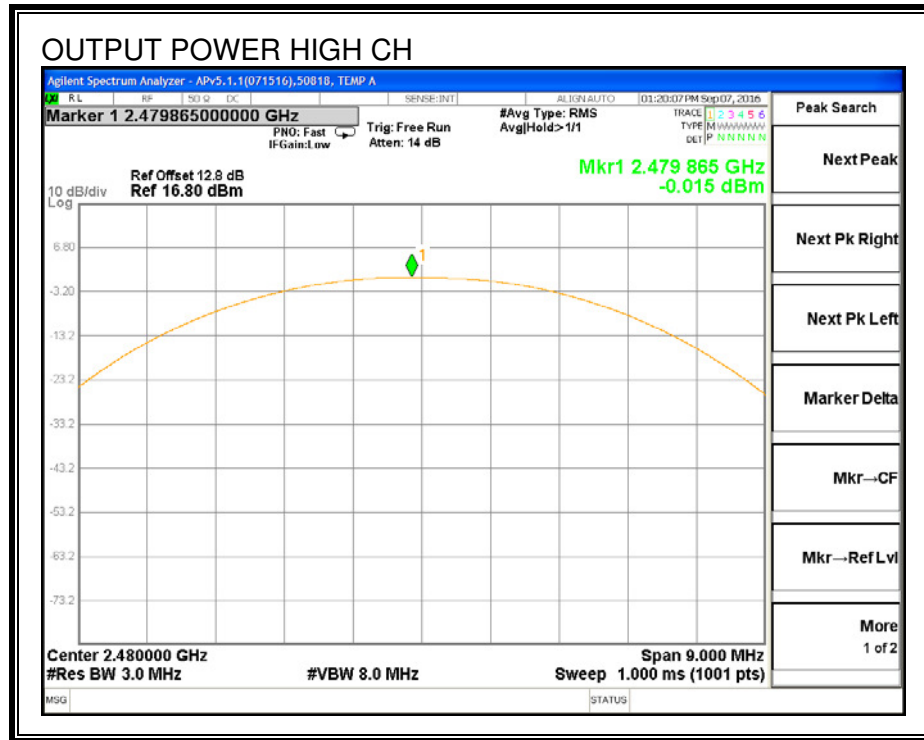
The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.324	30	-28.676
Middle	2440	-0.071	30	-30.071
High	2480	-0.015	30	-30.015

OUTPUT POWER





9.6. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

ID:	40802	Date:	08/18/16
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The cable assembly insertion loss of 12.5 dB (including 11 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	0.76
Middle	2440	-0.41
High	2480	-0.28

9.7. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

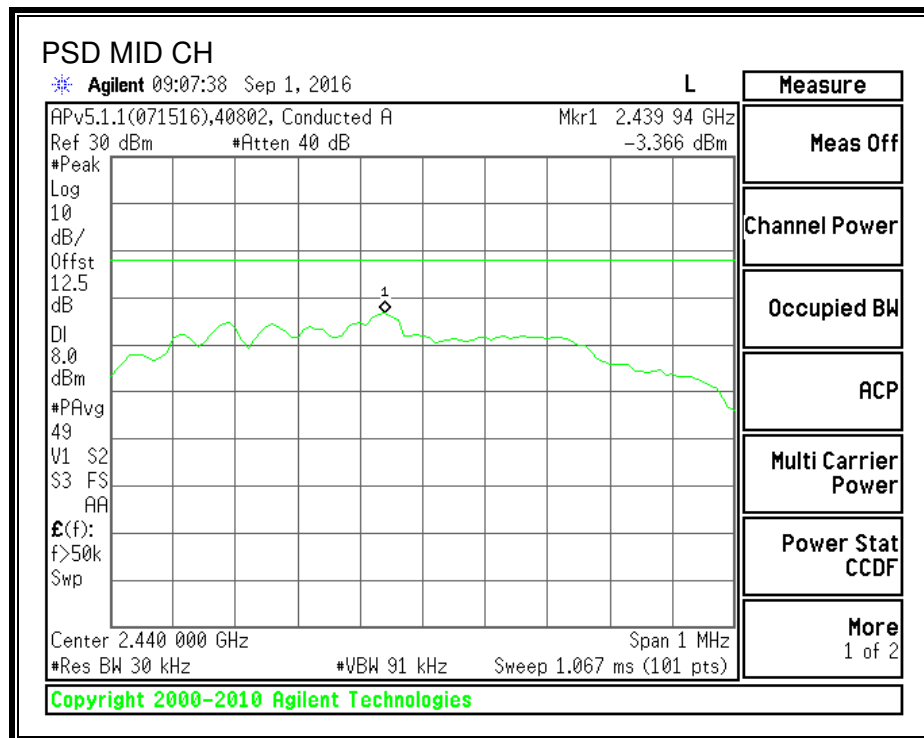
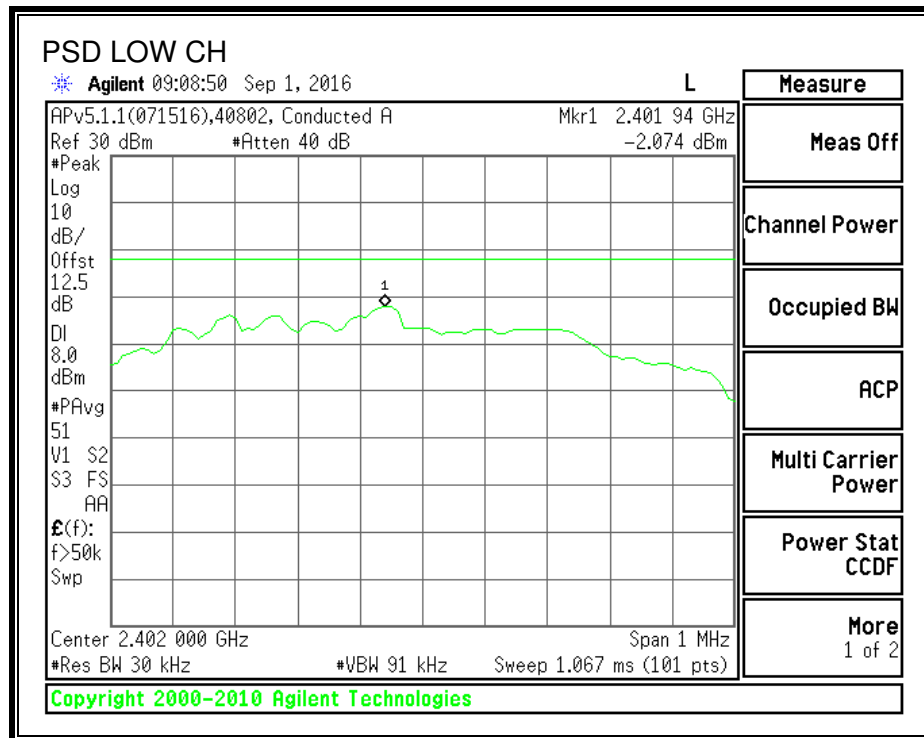
IC RSS-247 5.2 (2)

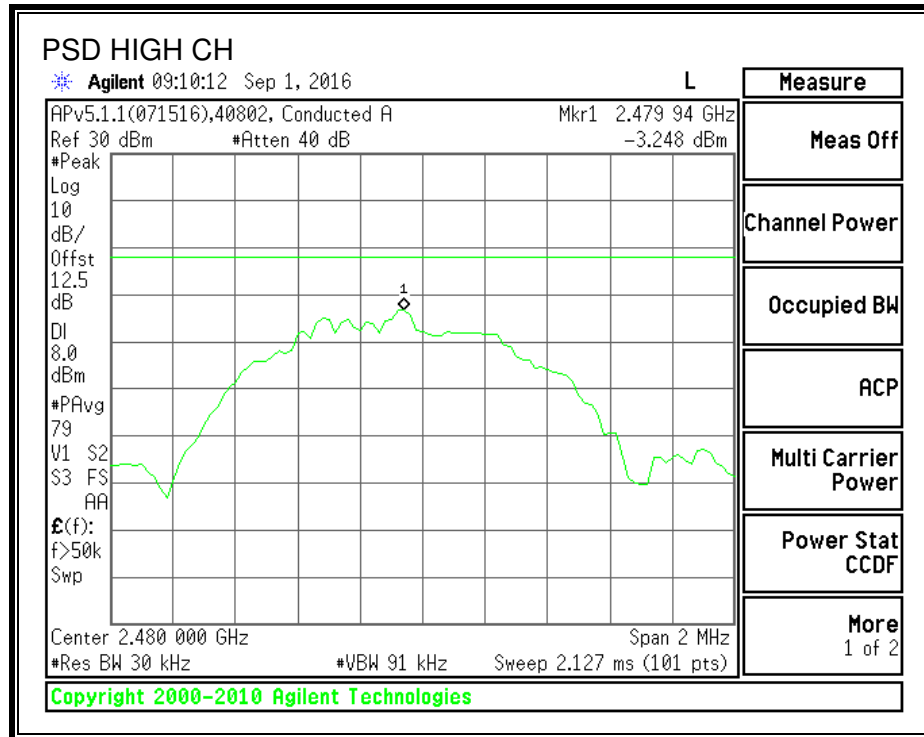
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-2.074	8	-10.07
Middle	2440	-3.366	8	-11.37
High	2480	-3.248	8	-11.25

POWER SPECTRAL DENSITY





9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

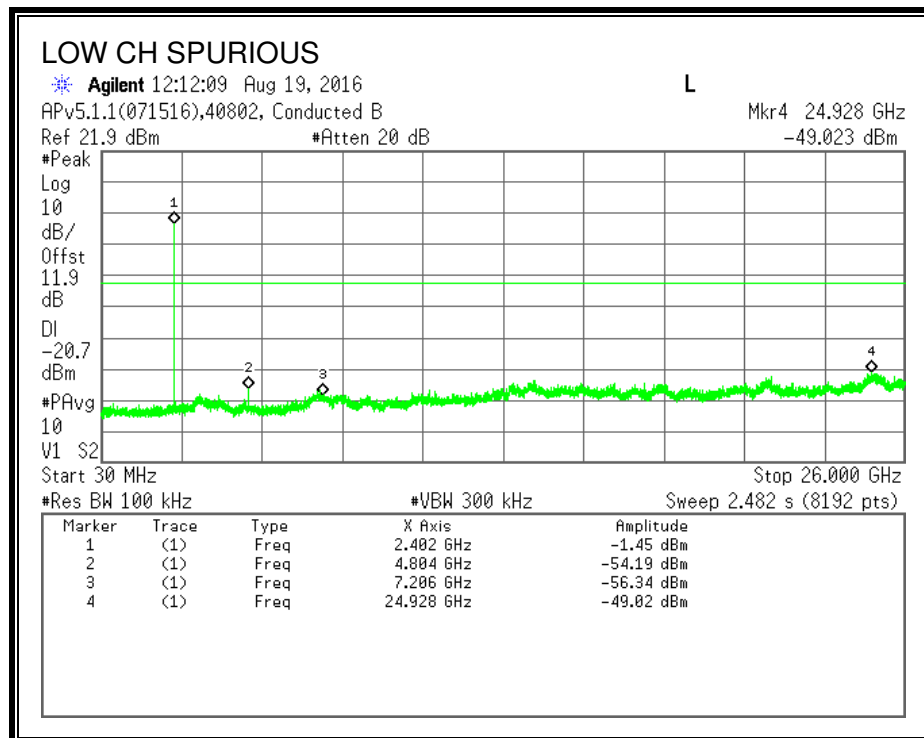
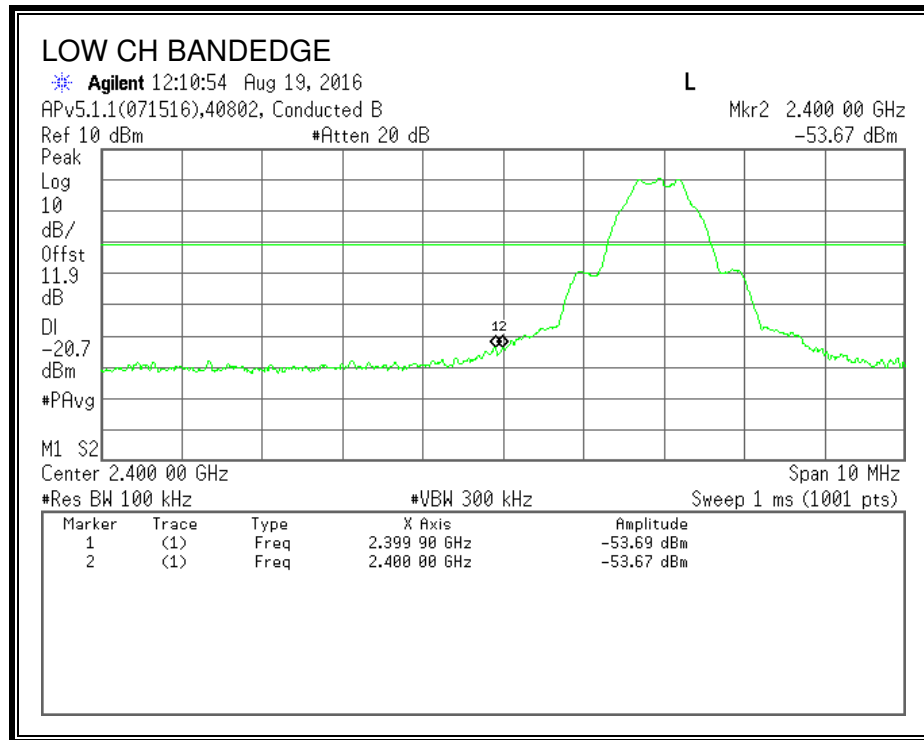
FCC §15.247 (d)

IC RSS-247 5.5

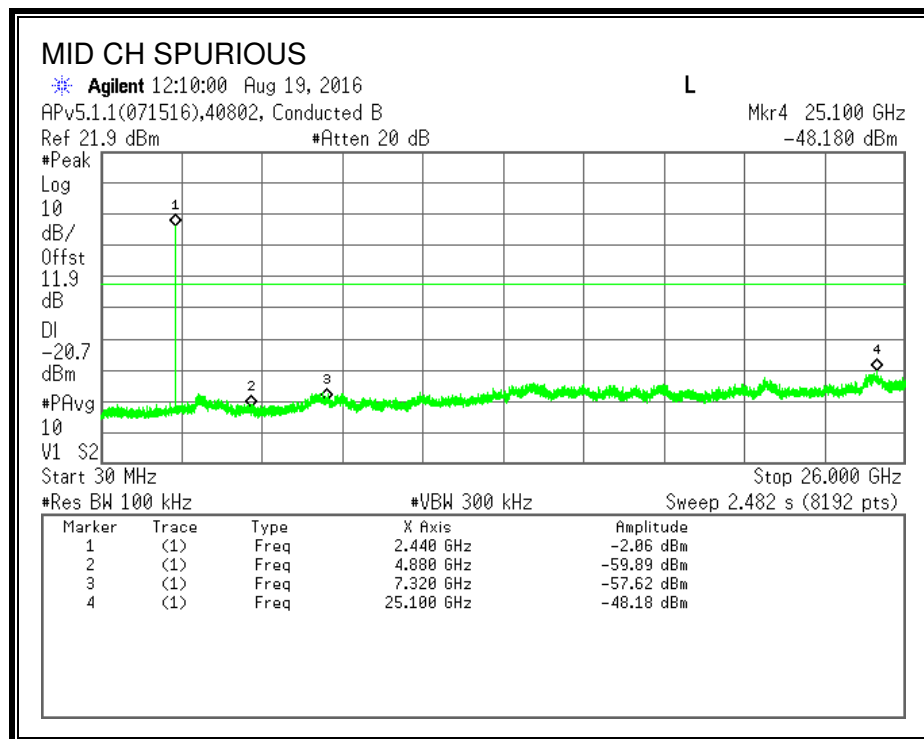
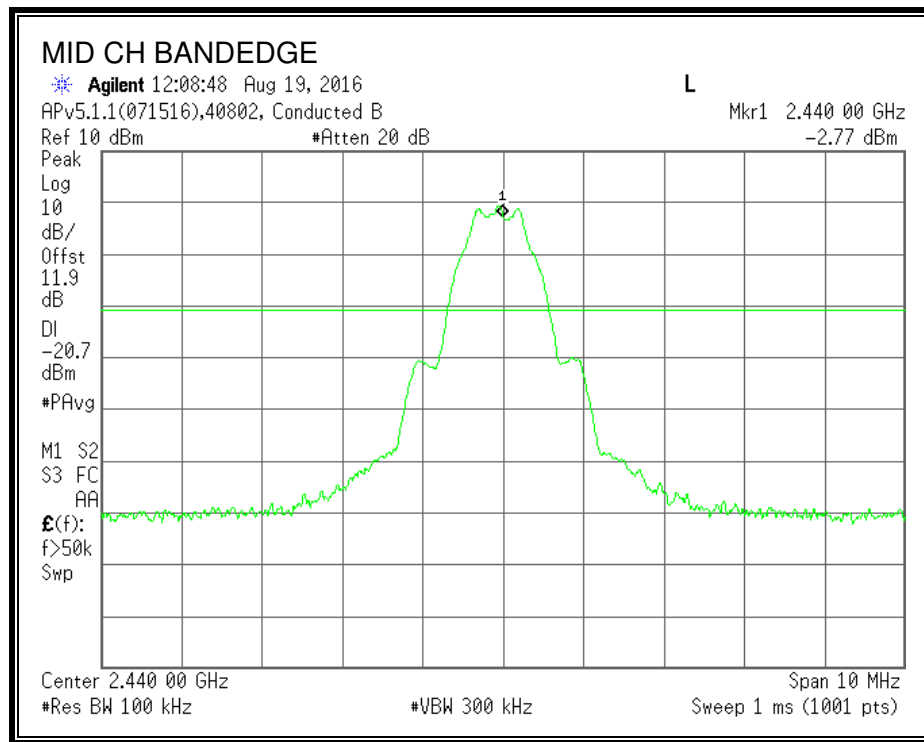
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS

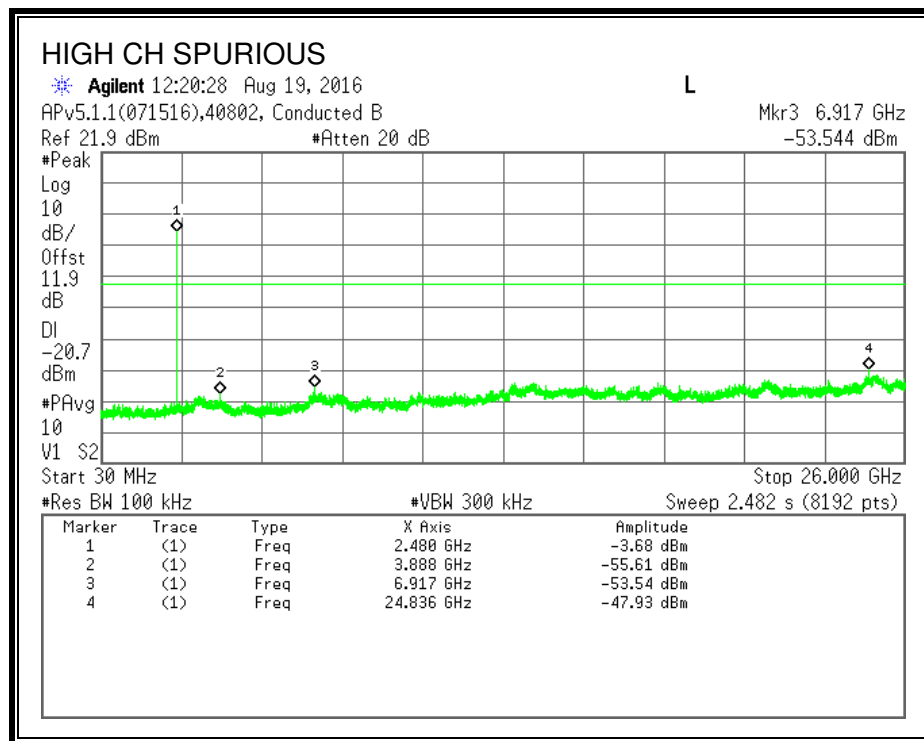
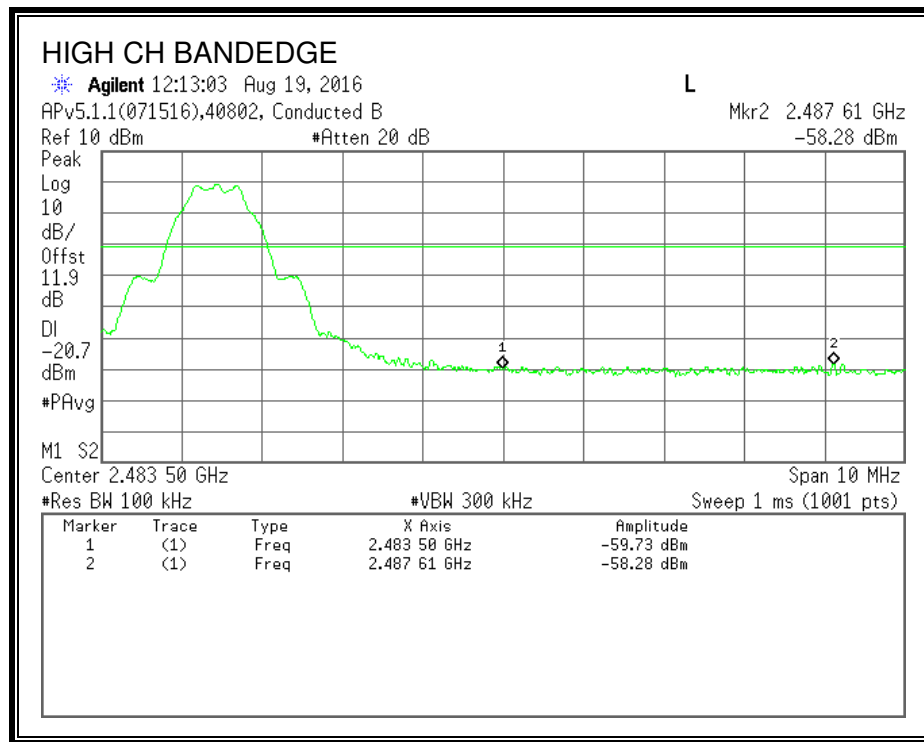
SPURIOUS EMISSIONS, LOW CHANNEL



SPURIOUS EMISSIONS, MID CHANNEL

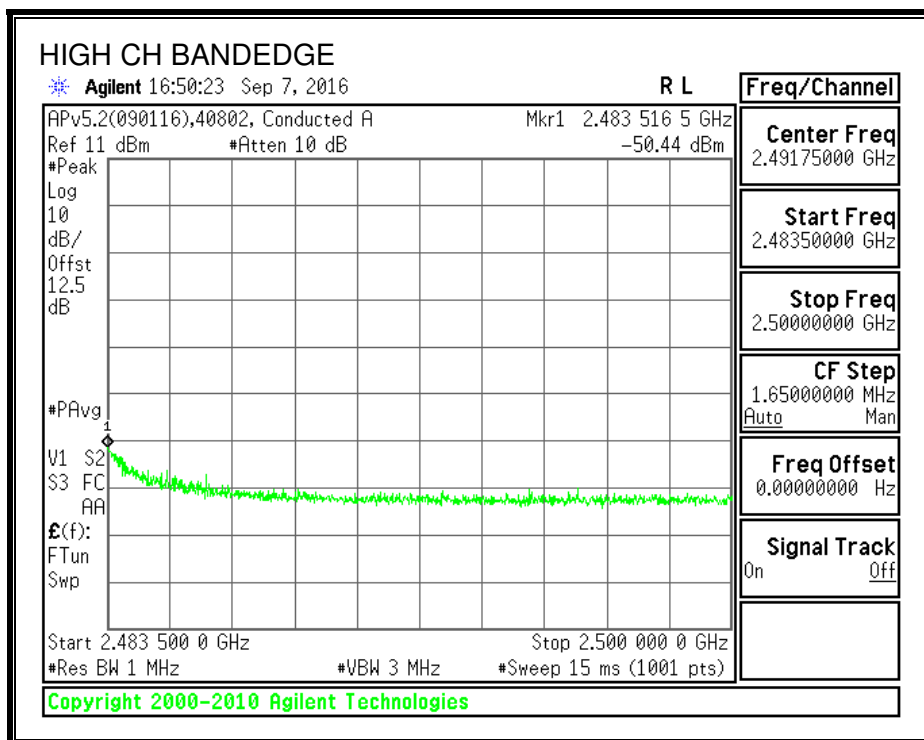
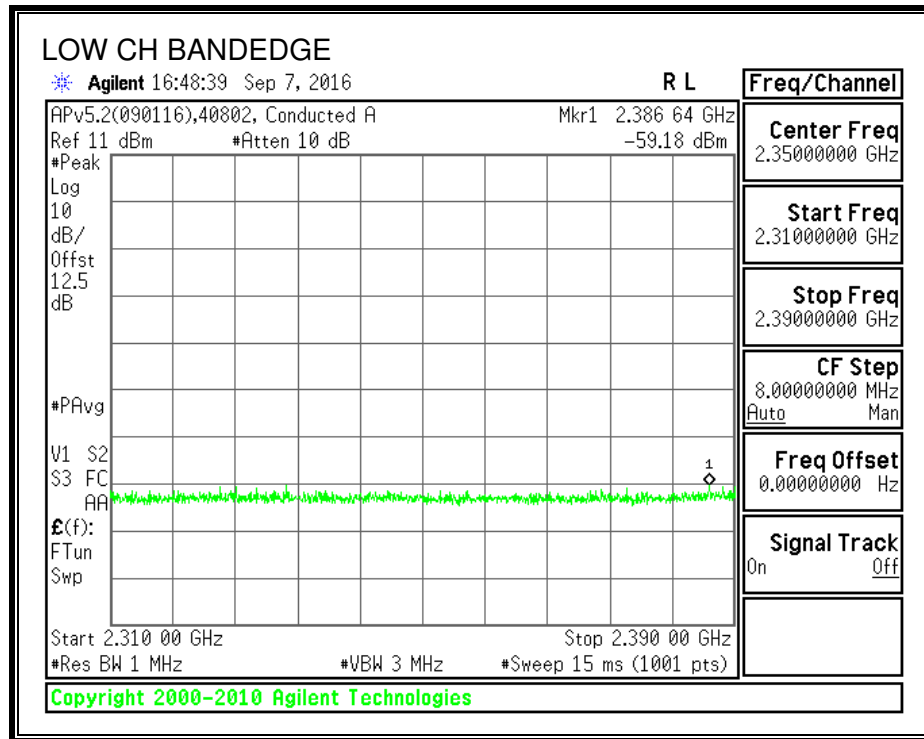


SPURIOUS EMISSIONS, HIGH CHANNEL



9.9. CONDUCTED BANDEGE and HARMONICS/SPURIOUS IN RESTRICTED BANDS

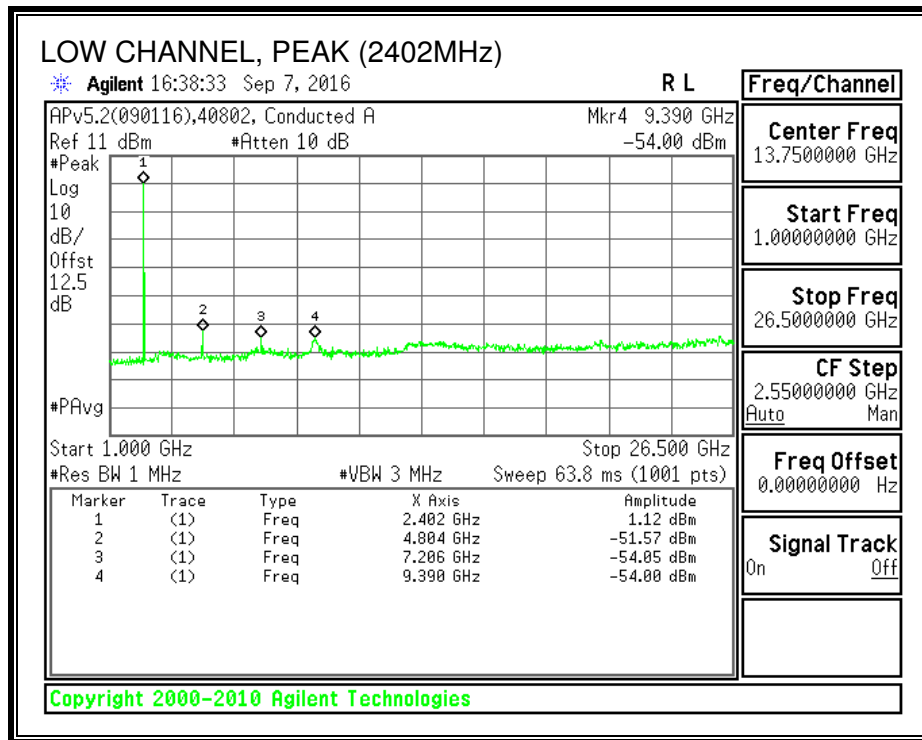
BANDEGE EMISSIONS IN RESTRICTED BANDS PLOT

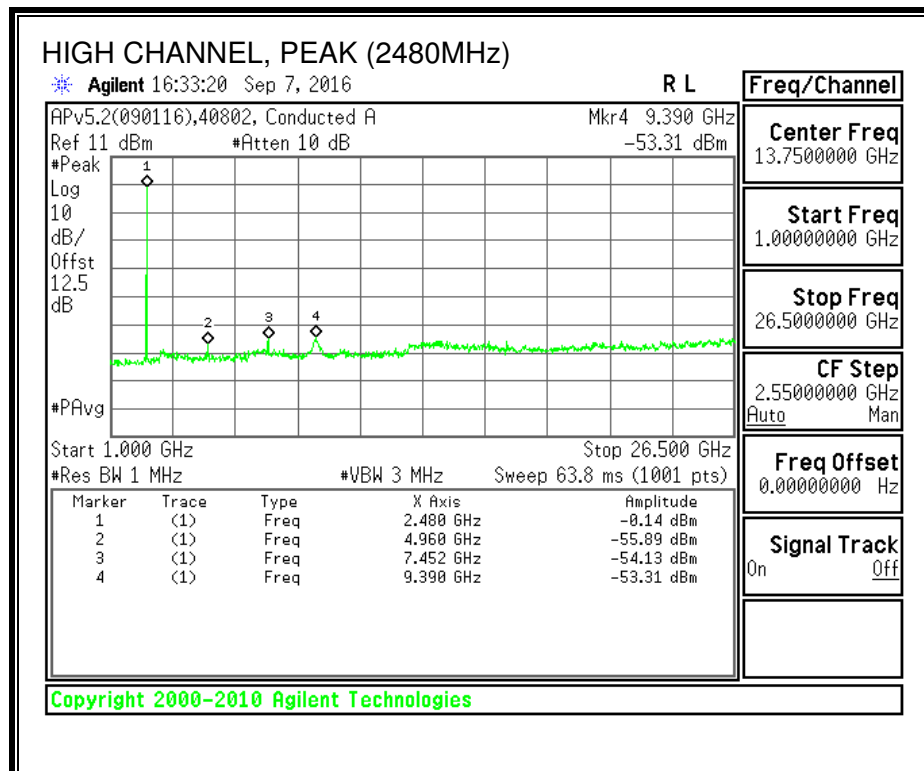
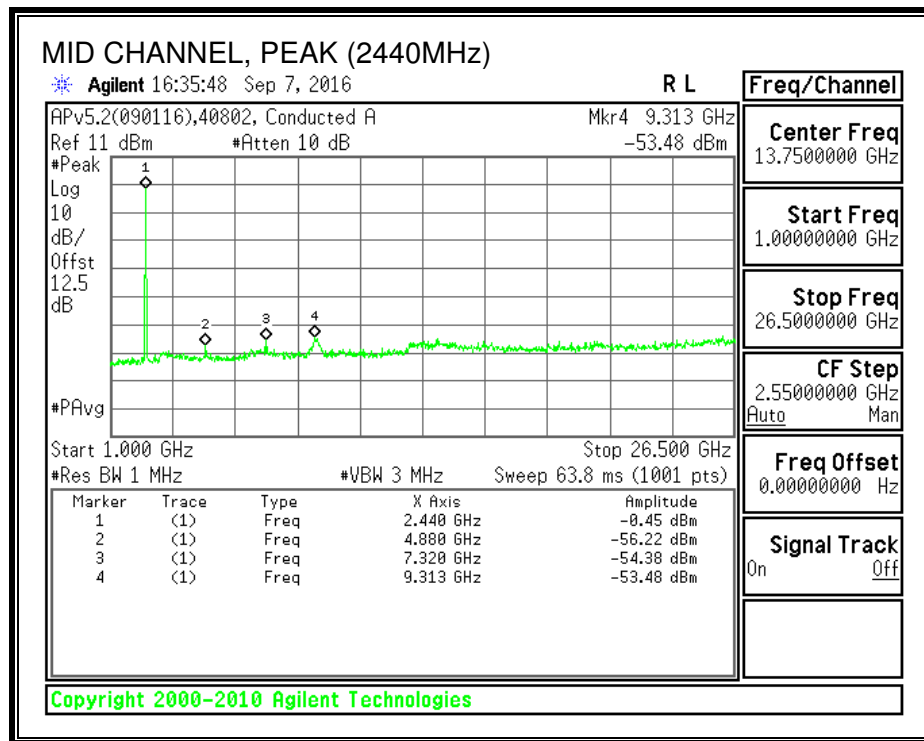


BANDEDGE SPURIOUS EMISSIONS IN RESTRICTED BANDS DATA

Date:	9/7/2016				
Test Engineer:	40802_TP				
Client:	QUALCOMM				
Project Number:	16U23207				
Configuration:	EUT with Support Equipments				
Mode of operation:	BLE mode				
Note: if the PK margin is greater than 20 dB, there is no need to get AVG reading					
Frequency (MHz)	Meter PK Reading Chain 0 (dBm)	AG Chain 0 (dBi)	PK EIRP (dBm)	PK E-field Limit (dBm)	PK E-field Margin (dB)
CH0, 2402MHz					
2386.64	-59.18	0	-59.18	-21.2	-37.98
CH39, 2480MHz					
2483.5165	-50.44	0	-50.44	-21.2	-29.24

HARMONICS SPURIOUS EMISSIONS IN RESTRICTED BANDS PLOT

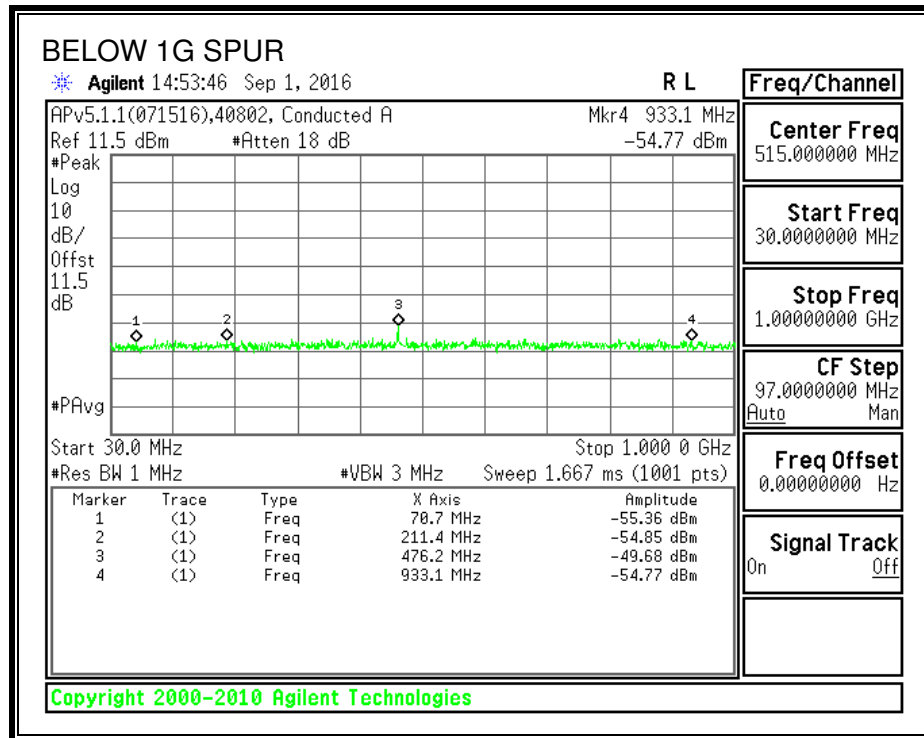




CONDUCTED SPURIOUS EMISSIONS IN RESTRICTED BANDS DATA

Date:	9/7/2016				
Test Engineer:	40802_TP				
Client:	QUALCOMM				
Project Number:	16U23207				
Configuration:	EUT with Support Equipments				
Mode of operation:	BLE				
Note : if the PK margin is greater than 20 dB, there is no need to get AVG reading.					
Frequency (MHz)	Meter PK Reading Chain 0 (dBm)	AG Chain 0 (dBi)	PK EIRP (dBm)	PK E-field Limit (dBm)	PK E-field Margin (dB)
2402, CH0					
4804	-51.57	0	-51.57	-21.2	-30.37
7206	-54.05	0	-54.05	-21.2	-32.85
9390	-54	0	-54.00	-21.2	-32.80
2440, CH19					
4880	-56.22	0	-56.22	-21.2	-35.02
7320	-54.38	0	-54.38	-21.2	-33.18
9313	-53.48	0	-53.48	-21.2	-32.28
2480, CH39					
4960	-55.89	0	-55.89	-21.2	-34.69
7452	-54.13	0	-54.13	-21.2	-32.93
9390	-53.31	0	-53.31	-21.2	-32.11

BELOW 1G SPURIOUS EMISSIONS IN RESTRICTED BANDS PLOT



BELOW 1G SPURIOUS EMISSIONS IN RESTRICTED BANDS DATA

BELOW 1G SPUR

Date: 9/1/2016
 Test Engineer: 40802_TP
 Client: Qualcomm Tech
 Project Number: 16U23207
 Configuration: EUT with Support Equipment
 Mode of operation: BLE

Note: if the QP margin is passing there is no need to get QP measurement.

Frequency (MHz)	Meter PK Reading Chain 0 (dBm)	AG Chain 0 (dBi)	PK EIRP (dBm)	QP E-field Limit (dBm)	QP E-field Margin (dB)
60.1	-65.22	0	-65.22	-55.2	-10.02
122.2	-64.31	0	-64.31	-51.68	-12.63
476.2	-53.59	0	-53.59	-49.18	-4.41
980.6	-63.8	0	-63.80	-41.22	-22.58

10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-GEN Clause 8.9 (Transmitter)

IC RSS-GEN Clause 7.1.2 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009 – 0.490	2400/F (kHz)	2400/F (kHz)
0.490 – 1.705	24000/F (kHz)	24000/F (kHz)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150 cm for above 1GHz. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

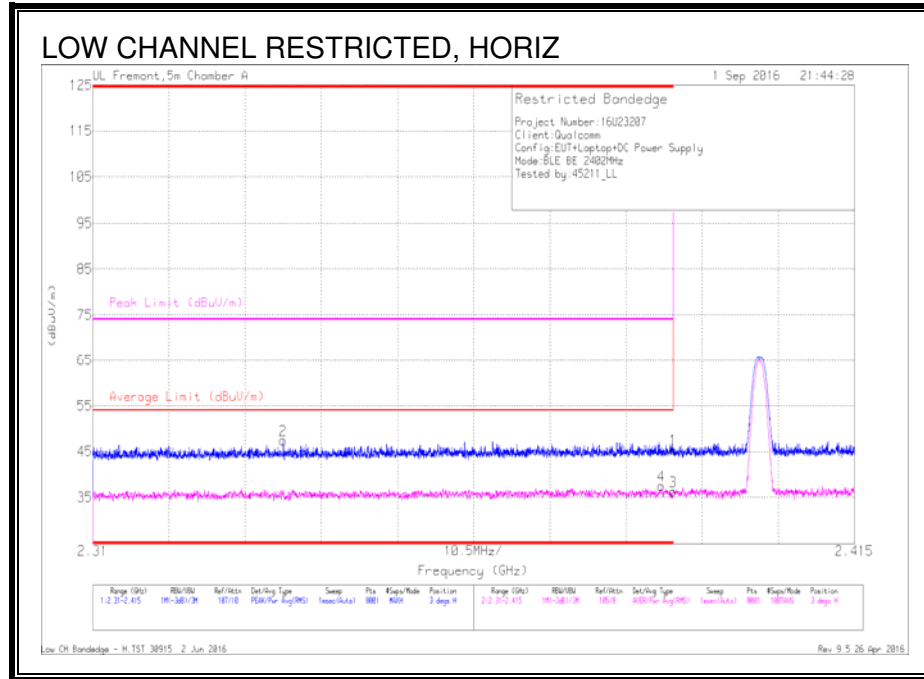
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average measurements. Please refer to test report section 9.1 for duty cycle factor information. Note: The pre-scan measurements above 1GHz the VBW is set to 30 kHz.

The spectrum from 30 MHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

10.2. TRANSMITTER ABOVE 1 GHz FOR BLE MODE IN THE 2.4 GHz

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL) – With 50 ohm terminator



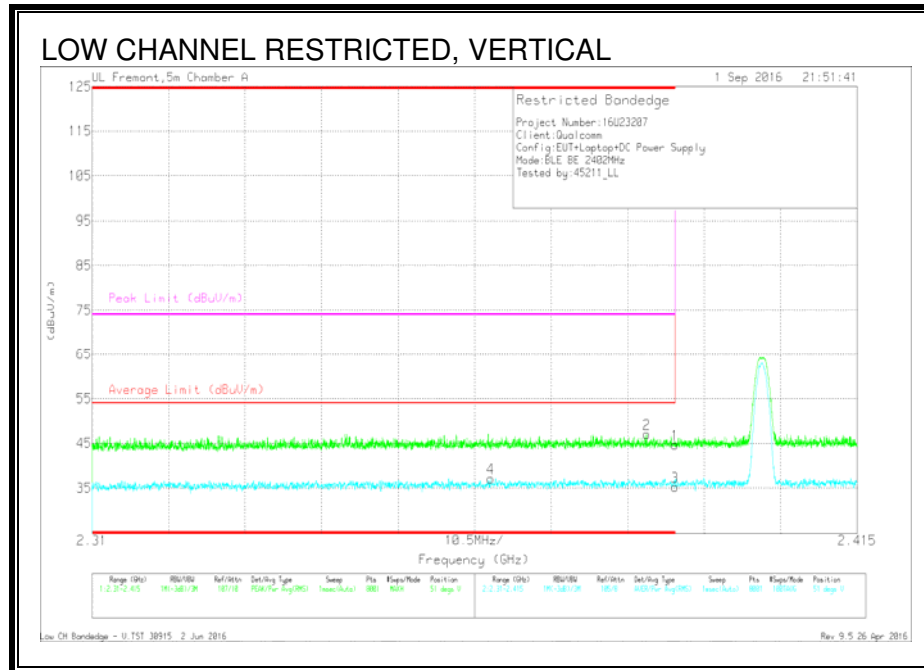
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Ftr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Altitude (Degs)	Height (cm)	Polarity
1	* 2.39	36.83	Pk	32.3	-23.7	0	45.43	-	-	74	-28.57	3	149	H
2	* 2.336	39.09	Pk	32	-23.7	0	47.39	-	-	74	-26.61	3	149	H
3	* 2.39	25.65	RMS	32.3	-23.7	2.01	36.26	54	-17.74	-	-	3	149	H
4	* 2.388	26.85	RMS	32.3	-23.7	2.01	37.46	54	-16.54	-	-	3	149	H

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection



Trace Markers

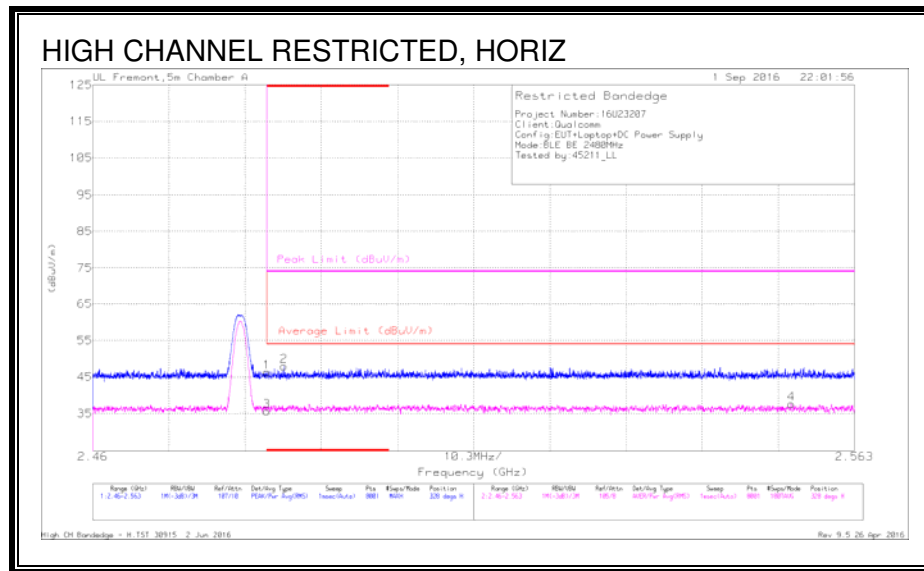
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Ch/Flo/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	36.11	Pk	32.3	-23.7	0	44.71	-	-	74	-29.29	51	120	V
2	* 2.386	38.45	Pk	32.3	-23.7	0	47.05	-	-	74	-26.95	51	120	V
3	* 2.39	24.7	RMS	32.3	-23.7	2.01	35.31	54	-18.69	-	-	51	120	V
4	* 2.365	26.88	RMS	32.1	-23.8	2.01	37.19	54	-16.81	-	-	51	120	V

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL) – With 50 ohm terminator



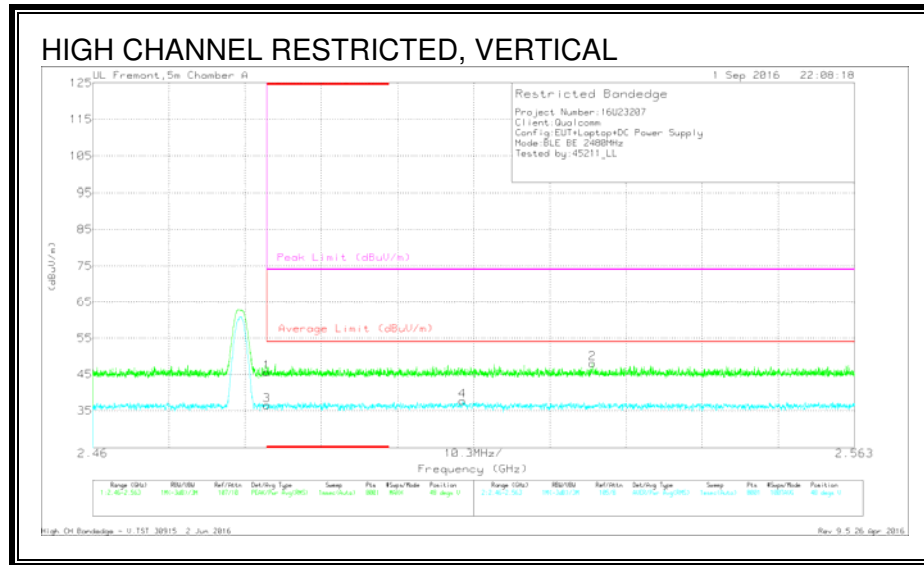
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Ch/Filt/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Altitude (Degs)	Height (cm)	Polarity
1	* 2.484	37.52	Pk	32.4	-23.6	0	46.32	-	-	74	-27.68	328	226	H
2	* 2.486	39.15	Pk	32.5	-23.7	0	47.95	-	-	74	-26.05	328	226	H
3	* 2.484	24.85	RMS	32.4	-23.6	2.01	35.66	54	-18.34	-	-	328	226	H
4	2.554	26.76	RMS	32.4	-23.5	2.01	37.67	54	-16.33	-	-	328	226	H

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Ch/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Asimuth (Degs)	Height (cm)	Polarity
1	* 2.484	36.76	Pk	32.4	-23.6	0	45.56	-	-	74	-28.44	48	147	V
3	* 2.484	25.71	RMS	32.4	-23.6	2.01	36.52	54	-17.48	-	-	48	147	V
4	2.51	26.73	RMS	32.5	-23.5	2.01	37.74	54	-16.26	-	-	48	147	V
2	2.528	39.3	Pk	32.4	-23.6	0	48.1	-	-	74	-25.9	48	147	V

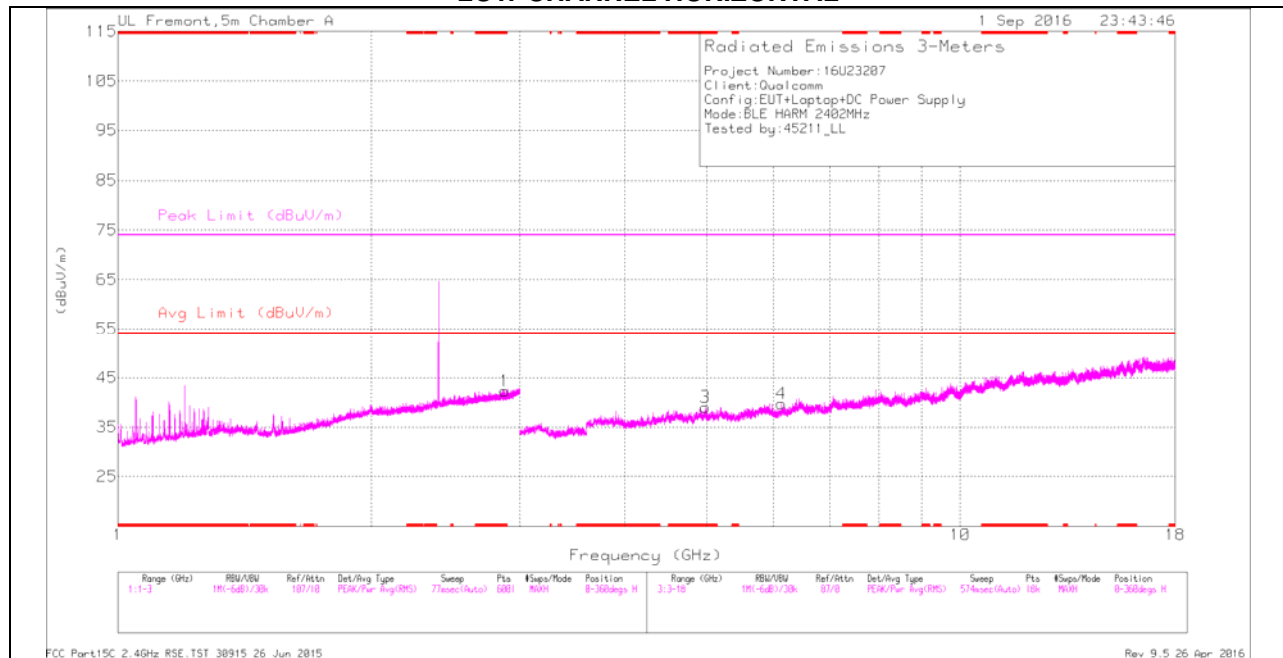
* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band

Pk - Peak detector

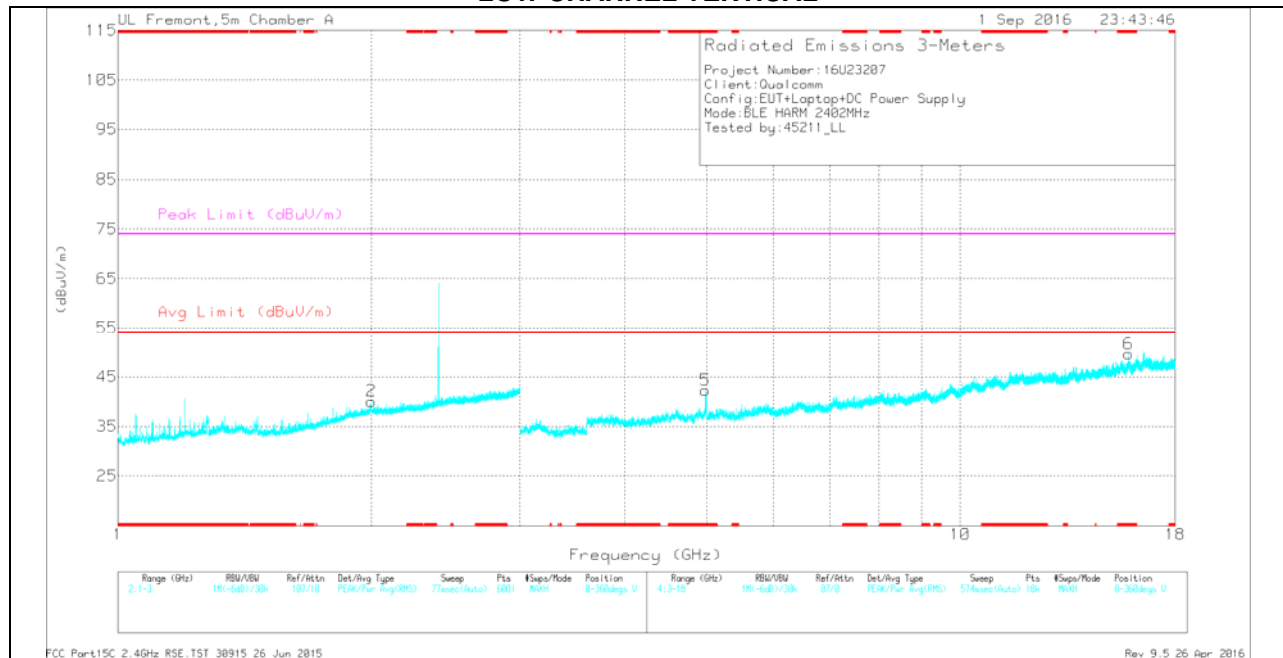
RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS – With 50 ohm terminator

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

LOW CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cb/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.879	32.17	Pk	32.6	-22.5	0	42.27	-	-	74	-31.73	0-360	199	H
3	* 4.979	33.46	Pk	34.3	-28.7	0	39.06	-	-	74	-34.94	0-360	199	H
5	* 4.978	36.75	Pk	34.3	-28.7	0	42.35	-	-	74	-31.65	0-360	101	V
6	* 15.839	28.31	Pk	40.4	-19	0	49.71	-	-	74	-24.29	0-360	101	V
2	1.999	31.98	Pk	31.7	-23.6	0	40.08	-	-	-	-	0-360	101	V
4	6.13	30.23	Pk	35.5	-26	0	39.73	-	-	-	-	0-360	199	H

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band

Pk - Peak detector

Radiated Emissions

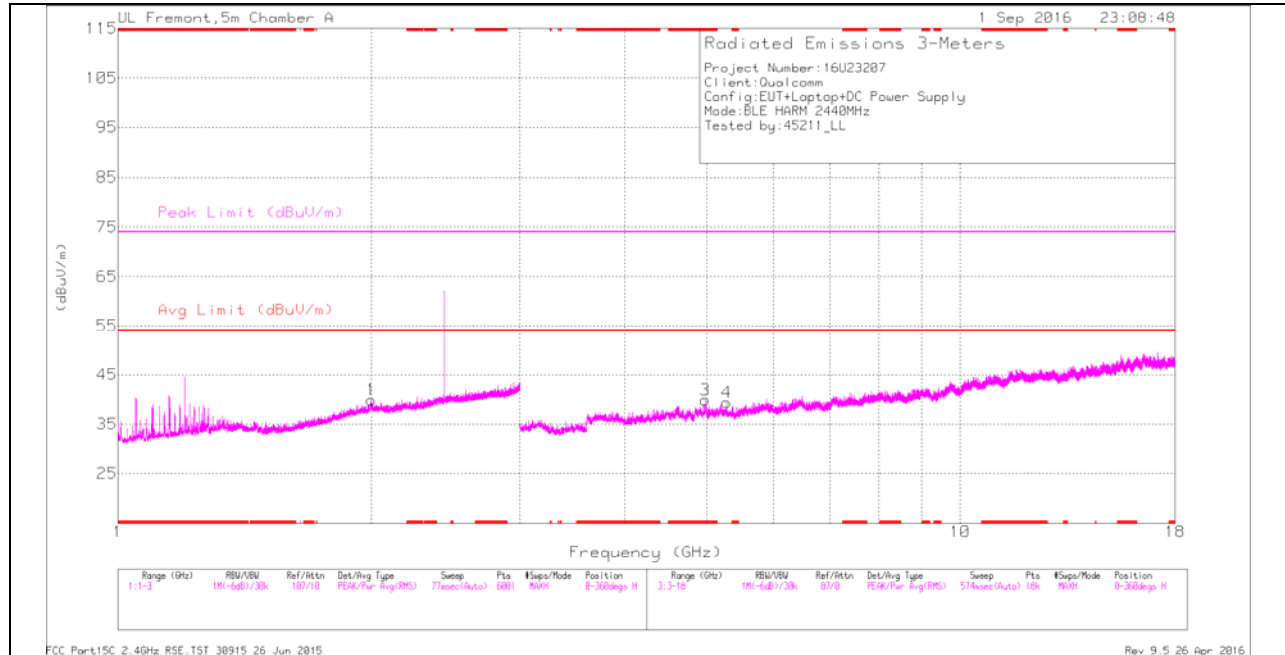
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cb/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.88	36.86	PK2	32.6	-22.4	0	47.06	-	-	74	-26.94	261	206	H
* 2.879	26.25	MAv1	32.6	-22.5	2.01	38.36	54	-15.64	-	-	261	206	H
* 4.979	38.07	PK2	34.3	-28.7	0	43.67	-	-	74	-30.33	225	182	H
* 4.981	28.22	MAv1	34.3	-28.7	2.01	35.83	54	-18.17	-	-	225	182	H
* 4.979	44.99	PK2	34.3	-28.7	0	50.59	-	-	74	-23.41	199	125	V
* 15.837	32.06	PK2	40.4	-19	0	53.46	-	-	74	-20.54	161	217	V
* 15.842	21.71	MAv1	40.4	-19	2.01	45.12	54	-8.88	-	-	161	217	V
* 4.979	33.46	MAv1	34.3	-28.7	2.01	41.07	54	-12.93	-	-	199	125	V
1.999	38.57	PK2	31.7	-23.6	0	46.67	-	-	74	-27.33	217	121	V
6.13	35.2	PK2	35.5	-26	0	44.7	-	-	74	-29.3	50	282	H

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band

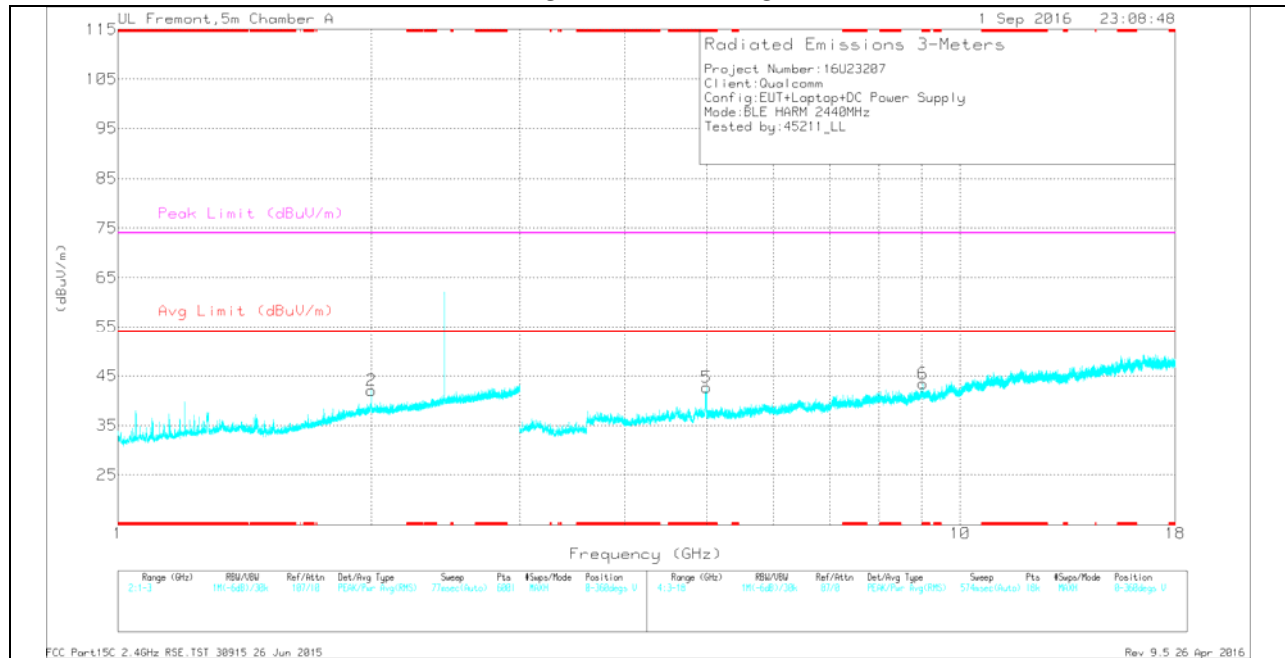
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

MID CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 4.979	34.31	Pk	34.3	-28.7	0	39.91	-	-	74	-34.09	0-360	199	H
5	* 4.998	37.48	Pk	34.3	-29.1	0	42.68	-	-	74	-31.32	0-360	101	V
6	* 9.035	29.6	Pk	36.1	-22.3	0	43.4	-	-	74	-30.6	0-360	101	V
1	1.999	31.78	Pk	31.7	-23.6	0	39.88	-	-	-	-	0-360	199	H
2	2	33.98	Pk	31.7	-23.6	0	42.08	-	-	-	-	0-360	101	V
4	5.281	32.57	Pk	34.7	-27.9	0	39.37	-	-	-	-	0-360	199	H

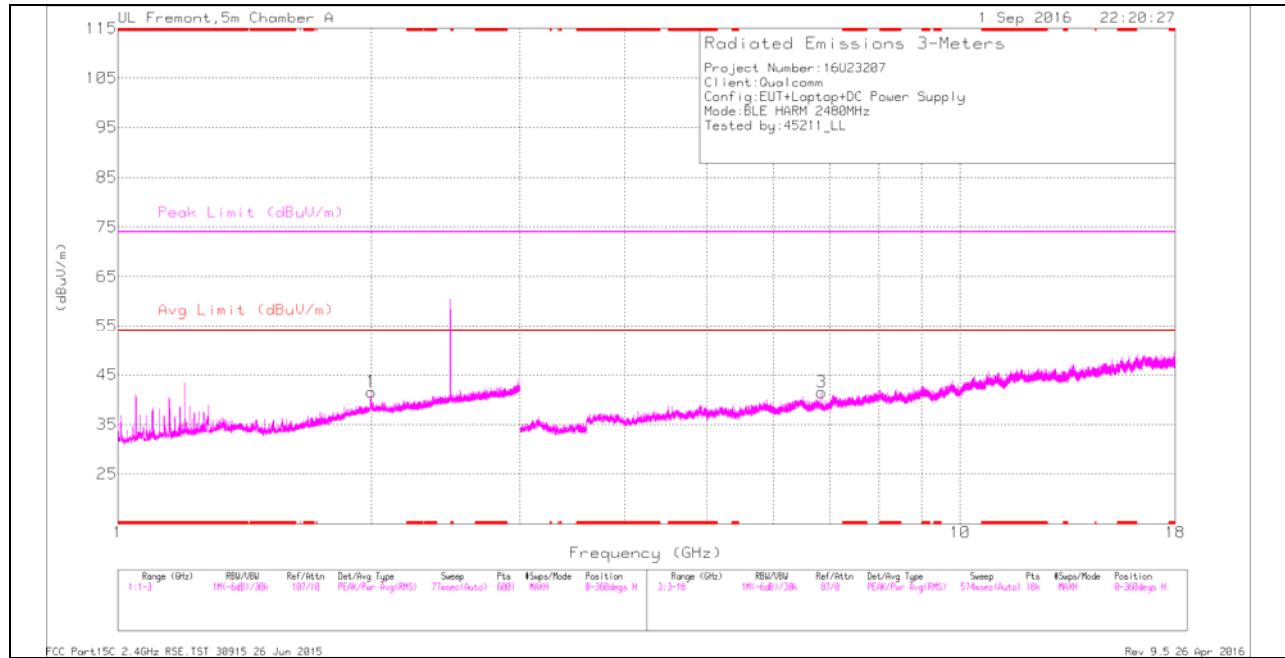
* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band
Pk - Peak detector

Radiated Emissions

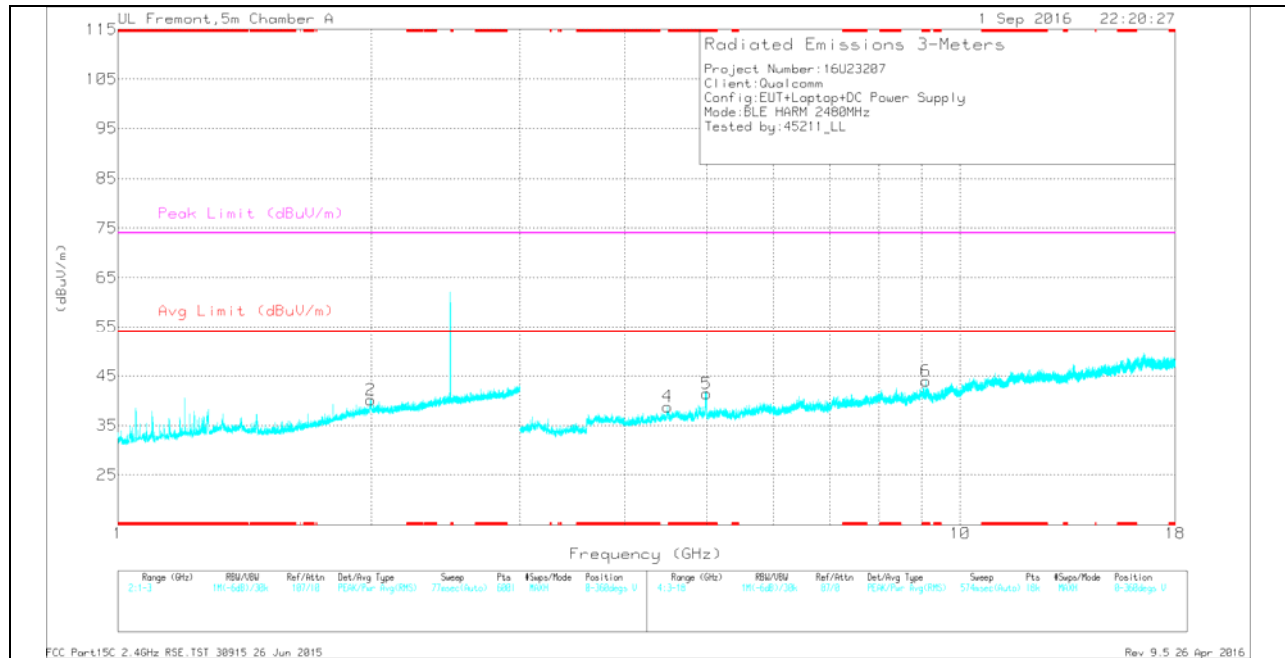
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.979	39.01	PK2	34.3	-28.7	0	44.61	-	-	74	-29.39	178	216	H
* 4.979	28.36	MAv1	34.3	-28.7	2.01	35.97	54	-18.03	-	-	178	216	H
* 4.998	43.92	PK2	34.3	-29.1	0	49.12	-	-	74	-24.88	200	163	V
* 4.998	31.59	MAv1	34.3	-29.1	2.01	38.8	54	-15.2	-	-	200	163	V
* 9.038	34.14	PK2	36.1	-22.3	0	47.94	-	-	74	-26.06	279	317	V
* 9.032	23.18	MAv1	36.1	-22.3	2.01	38.99	54	-15.01	-	-	279	317	V
2	37.37	PK2	31.7	-23.6	0	45.47	-	-	74	-26.53	55	193	H
2	39.48	PK2	31.7	-23.6	0	47.58	-	-	74	-26.42	180	110	V
5.282	37.29	PK2	34.7	-28	0	43.99	-	-	74	-30.01	275	237	H

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

HIGH CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	* 4.995	36.06	Pk	34.3	-29	0	41.36	-	-	74	-32.64	0-360	101	V
6	* 9.112	29.91	Pk	36.2	-22.2	0	43.91	-	-	74	-30.09	0-360	199	V
2	1.997	32.02	Pk	31.7	-23.6	0	40.12	-	-	-	-	0-360	101	V
1	2	33.5	Pk	31.7	-23.6	0	41.6	-	-	-	-	0-360	101	H
4	4.492	33.31	Pk	34.3	-28.8	0	38.81	-	-	-	-	0-360	101	V
3	6.851	30.78	Pk	35.6	-24.9	0	41.48	-	-	-	-	0-360	199	H

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band
Pk - Peak detector

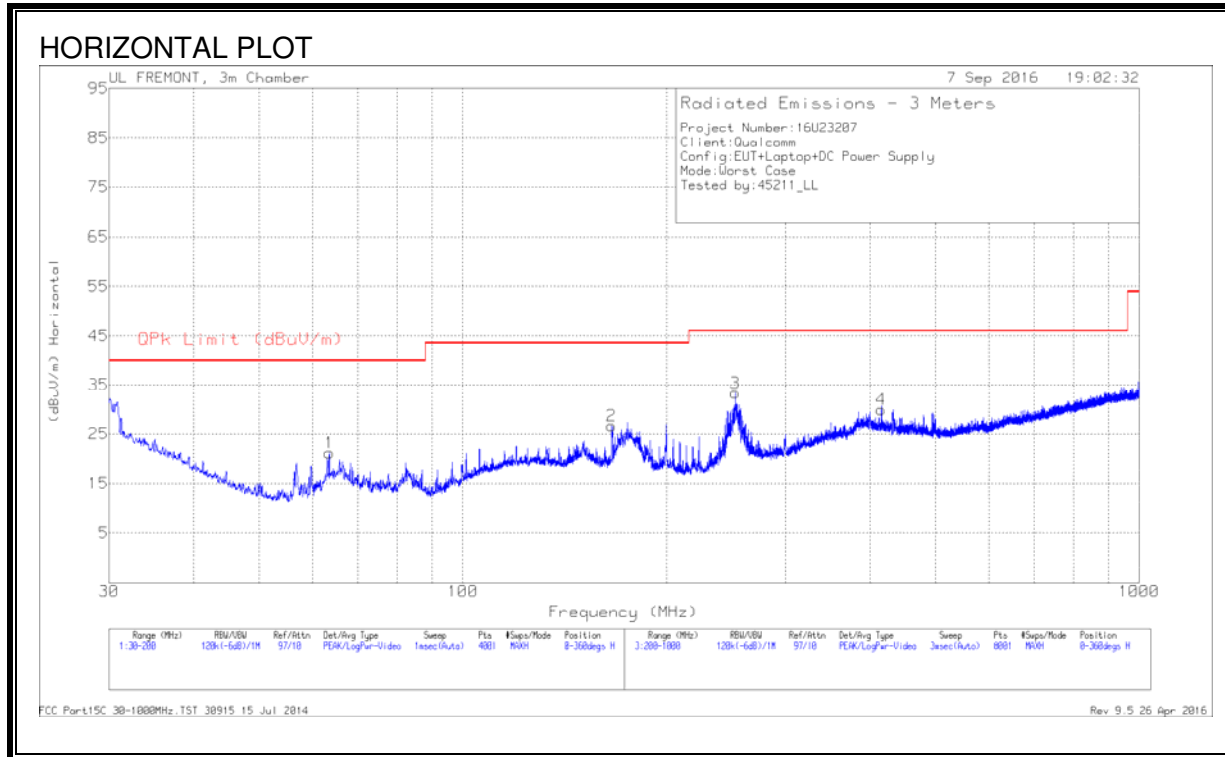
Radiated Emissions

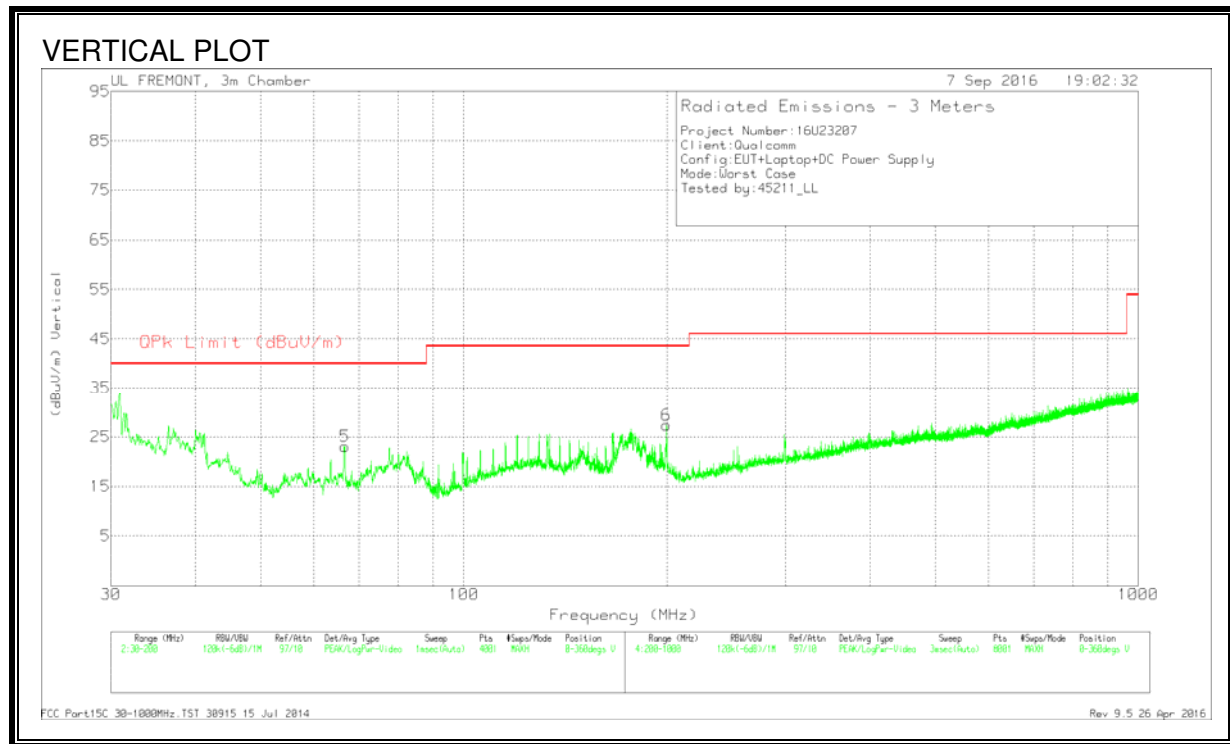
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.995	44.25	PK2	34.3	-29	0	49.55	-	-	74	-24.45	202	101	V
* 4.998	31.86	MAv1	34.3	-29.1	2.01	39.07	54	-14.93	-	-	202	101	V
* 9.108	33.5	PK2	36.2	-22.2	0	47.5	-	-	74	-26.5	166	287	V
* 9.109	22.83	MAv1	36.2	-22.2	2.01	38.84	54	-15.16	-	-	166	287	V
1.996	40.05	PK2	31.7	-23.6	0	48.15	-	-	74	-25.85	103	105	V
1.998	39.43	PK2	31.7	-23.6	0	47.53	-	-	74	-26.47	188	182	H
4.489	40.46	PK2	34.2	-28.8	0	45.86	-	-	74	-28.14	66	207	V
6.848	34.85	PK2	35.6	-24.8	0	45.65	-	-	74	-28.35	318	247	H

* - indicates frequency in CFR15.205/IC 8.10 RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

10.3. WORST-CASE BELOW 1 GHz – With 50 ohm terminator

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)





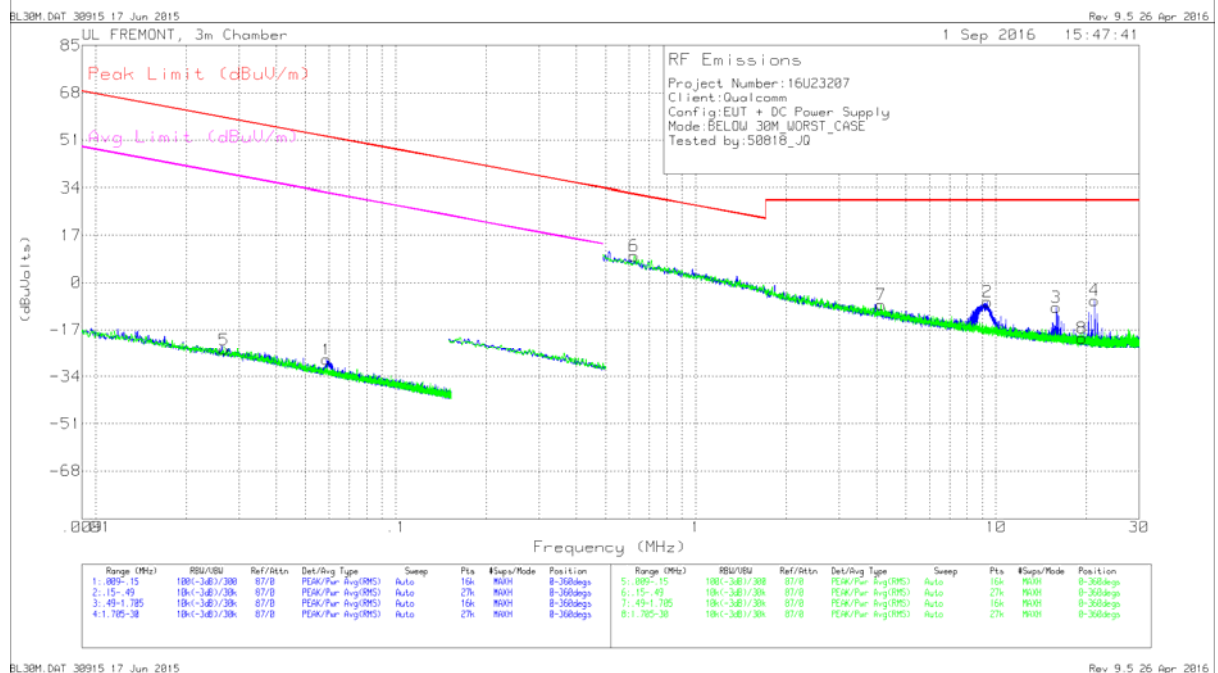
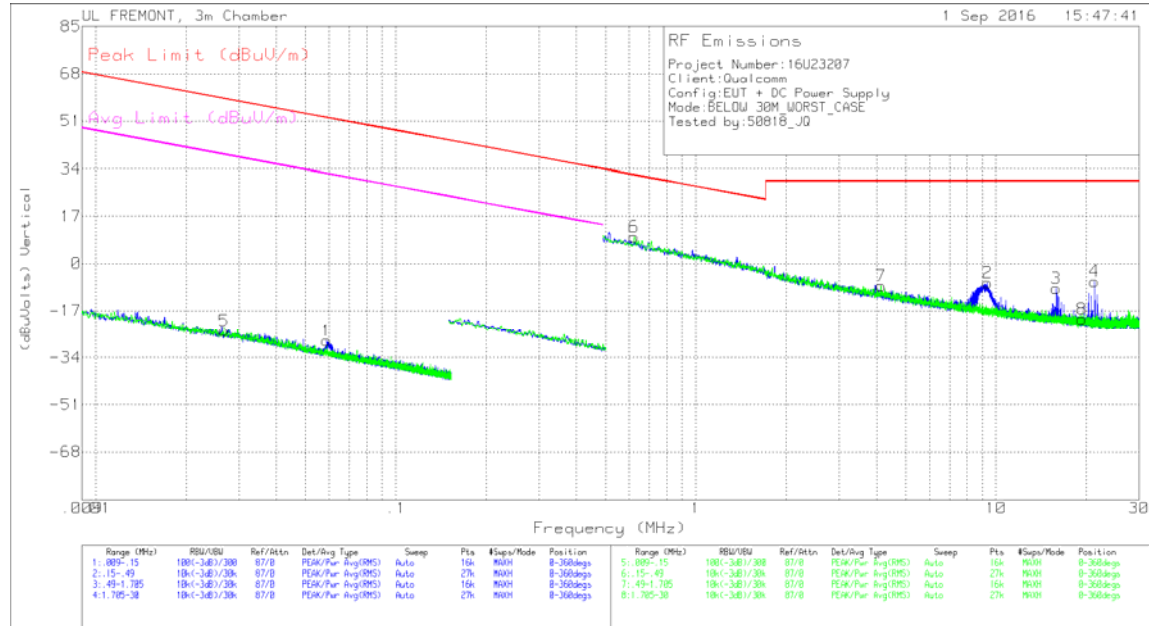
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	63.49	36.31	Pk	11.6	-26.7	21.21	40	-18.79	0-360	300	H
5	66.635	37.89	Pk	11.9	-26.7	23.09	40	-16.91	0-360	100	V
2	166	36.11	Pk	16	-25.5	26.61	43.52	-16.91	0-360	200	H
6	199.9363	35.87	Pk	16.5	-25	27.37	43.52	-16.15	0-360	100	V
3	253.1	42.47	Pk	15.4	-24.5	33.37	46.02	-12.65	0-360	100	H
4	415.6	34.38	Pk	20.1	-24.6	29.88	46.02	-16.14	0-360	100	H

Pk - Peak detector

10.4. WORST-CASE BELOW 1 GHz – With 50 ohm terminator

PLOT



Note: The anechoic chamber has been properly calibrated so that the measurement results correspond to what would be obtained from an open field sites.

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
5	.02679	41.03	Pk	13.2	1.4	-80	-24.37	59.04	-83.41	39.04	-63.41	0-360
1	.05883	39.43	Pk	11.2	1.4	-80	-27.97	52.21	-80.18	32.21	-60.18	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
6	.62365	37.53	Pk	10.6	1.5	-40	9.63	31.71	-22.08	-	-	0-360
7	4.13636	19.56	Pk	10.9	1.5	-40	-8.04	29.54	-37.58	-	-	0-360
2	9.35121	20.89	Pk	10.8	1.5	-40	-6.81	29.54	-36.35	-	-	0-360
3	15.87868	18.94	Pk	10.5	1.6	-40	-8.96	29.54	-38.5	-	-	0-360
8	19.31716	8.18	Pk	10.2	1.6	-40	-20.02	29.54	-49.56	-	-	0-360
4	21.30208	22.08	Pk	9.9	1.7	-40	-6.32	29.54	-35.86	-	-	0-360

Pk - Peak detector

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

ANSI C63.10

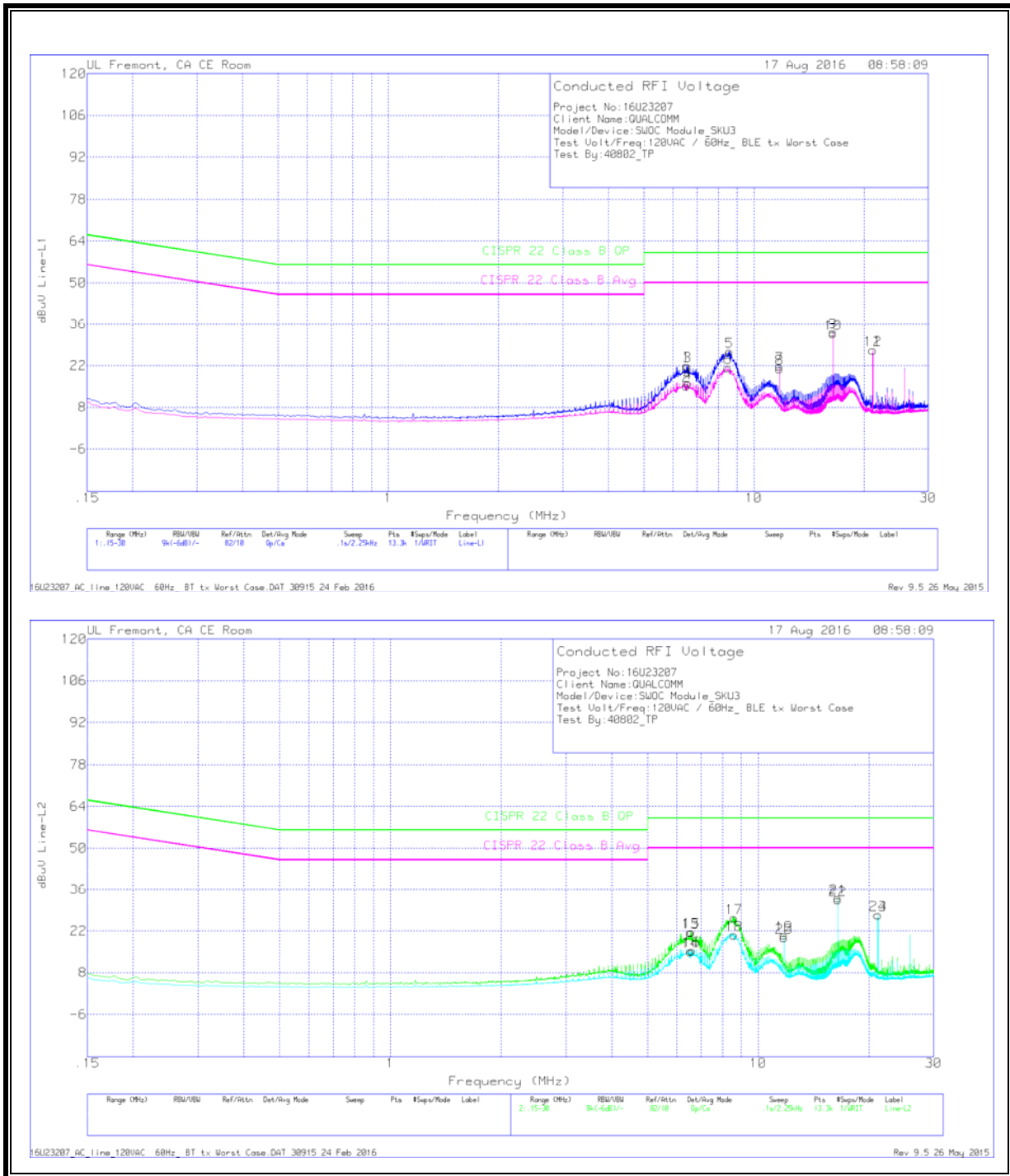
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

LINE 1 AND LINE 2 RESULTS – With 50 ohm terminator



LINE 1 & LINE 2 DATA RESULTS – With 50 ohm terminator

Trace Markers

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables 1&3	Limiter (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
1	6.54225	11.5	Qp	0	.1	10.2	21.8	60	-38.2	-	-
2	6.54675	4.98	Ca	0	.1	10.2	15.28	-	-	50	-34.72
3	6.57825	11.62	Qp	0	.1	10.2	21.92	60	-38.08	-	-
4	6.60075	5.73	Ca	0	.1	10.2	16.03	-	-	50	-33.97
5	8.56725	16.41	Qp	0	.1	10.2	26.71	60	-33.29	-	-
6	8.502	11	Ca	0	.1	10.2	21.3	-	-	50	-28.7
7	11.76	11.39	Qp	.1	.2	10.2	21.89	60	-38.11	-	-
8	11.76	10.44	Ca	.1	.2	10.2	20.94	-	-	50	-29.06
9	16.46475	22.88	Qp	0	.2	10.3	33.38	60	-26.62	-	-
10	16.46475	22.25	Ca	0	.2	10.3	32.75	-	-	50	-17.25
11	21.16725	16.7	Qp	0	.2	10.4	27.3	60	-32.7	-	-
12	21.16725	16.69	Ca	0	.2	10.4	27.29	-	-	50	-22.71

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables 2&3	Limiter (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
13	6.54338	11.14	Qp	0	.1	10.2	21.44	60	-38.56	-	-
14	6.5445	4.83	Ca	0	.1	10.2	15.13	-	-	50	-34.87
15	6.576	11.33	Qp	0	.1	10.2	21.63	60	-38.37	-	-
16	6.5985	5.03	Ca	0	.1	10.2	15.33	-	-	50	-34.67
17	8.6055	16.12	Qp	0	.1	10.2	26.42	60	-33.58	-	-
18	8.61225	10.38	Ca	0	.1	10.2	20.68	-	-	50	-29.32
19	11.76	10.3	Qp	0	.2	10.2	20.7	60	-39.3	-	-
20	11.76	9.35	Ca	0	.2	10.2	19.75	-	-	50	-30.25
21	16.46475	22.57	Qp	0	.2	10.3	33.07	60	-26.93	-	-
22	16.46475	21.92	Ca	0	.2	10.3	32.42	-	-	50	-17.58
23	21.16725	16.74	Qp	0	.2	10.4	27.34	60	-32.66	-	-
24	21.16725	16.74	Ca	0	.2	10.4	27.34	-	-	50	-22.66

Qp - Quasi-Peak detector

Ca - CISPR average detection