



FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

QUAD-BAND RADIO WITH WLAN AND BT RADIO

MODEL NUMBER: A1456, A1532

FCC ID: BCG-E2644A
IC: 579C-E2644A, 579C-E2644B

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Prepared for
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1 INFINITE LOOP
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: QUAD-BAND RADIO WITH WLAN AND BT RADIO

MODEL: A1456, A1532

SERIAL NUMBER: 39KD007FHYY (Conducted), C39KP005FL57 (Radiated)

DATE TESTED: APRIL 26 - JUNE 12, 2013

APPLICABLE STANDARDS		TEST RESULTS
STANDARD		
CFR 47 Part 15 Subpart C		Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8		Pass
INDUSTRY CANADA RSS-GEN Issue 3		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:



Thu Chan
WiSE Operations Manager
UL Verification Services Inc.

Tested By:



Francisco Guarnero
WiSE Lab Technician
UL Verification Services

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

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:

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

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	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

Model A1456/A1532 is a mobile phone with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/CDMA/EVDO/LTE radio, IEEE 802.11a/b/g/n, Bluetooth and GPS radio. The rechargeable battery is not user accessible.

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)
2412 - 2462	802.11b	18.810	76.03
2412 - 2462	802.11g	23.760	237.68
2412 - 2462	802.11n HT20	23.490	223.36
5745 - 5825	802.11a	20.816	120.67
5746 - 5825	802.11n HT20	20.529	112.95
5747 - 5825	802.11n HT40	20.741	118.60

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PiFA antenna, with a maximum gain as below table.

FREQUENCY (MHZ)	ANTENNA GAIN (dBi)
2400 – 2483.5	0.21
5150 -- 5250	-0.73
5250 -- 5350	-0.37
5500 -- 5700	1.31
5725 -- 5850	1.59

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was WL Tool FW 6.10.56.166

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel for RF radiated emissions below 1GHz tests is channel with highest RF output power.

Based on the investigation results, the highest peak power and enhanced data rate is the worst-case scenario for all measurements.

For the fundamental investigation, the EUT is investigated for vertical and horizontal antenna orientations and the worst case was determined to be at Y-position for 2.4GHz and 5GHz bands.

Based on the manufacturer's attestation that the nominal output power is reduced as the data rate increases, the data rates tested represent the highest power and worst-case with respect to EMC performance.

Worst-case data rates were used:

802.11b mode: 1 Mbps
802.11g mode: 6 Mbps
802.11a mode: 6 Mbps
802.11n HT20mode: MCS0
802.11n HT40mode: MCS0

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	Manufacturer	Model	Serial Number
AC adapter	Apple	A1385	NA
Earphone	Apple	NA	NA

I/O CABLES (Conducted Setup)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Shielded	0.1m	To Spectrum Analyzer

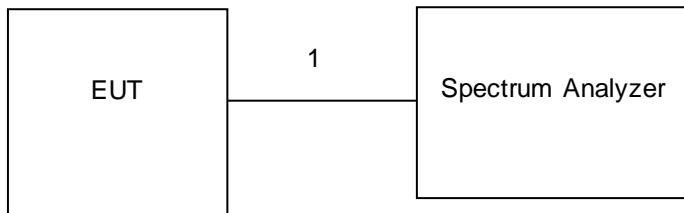
I/O CABLES (Radiated Setup)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Jack	1	Earphone	Unshielded	0.5m	N/A

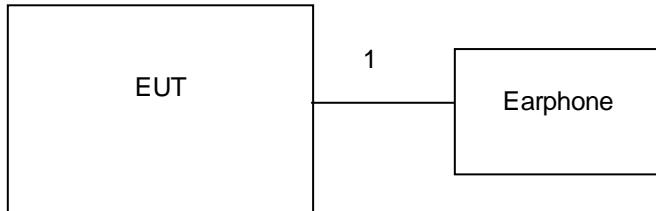
TEST SETUP

The EUT is a stand-alone device.

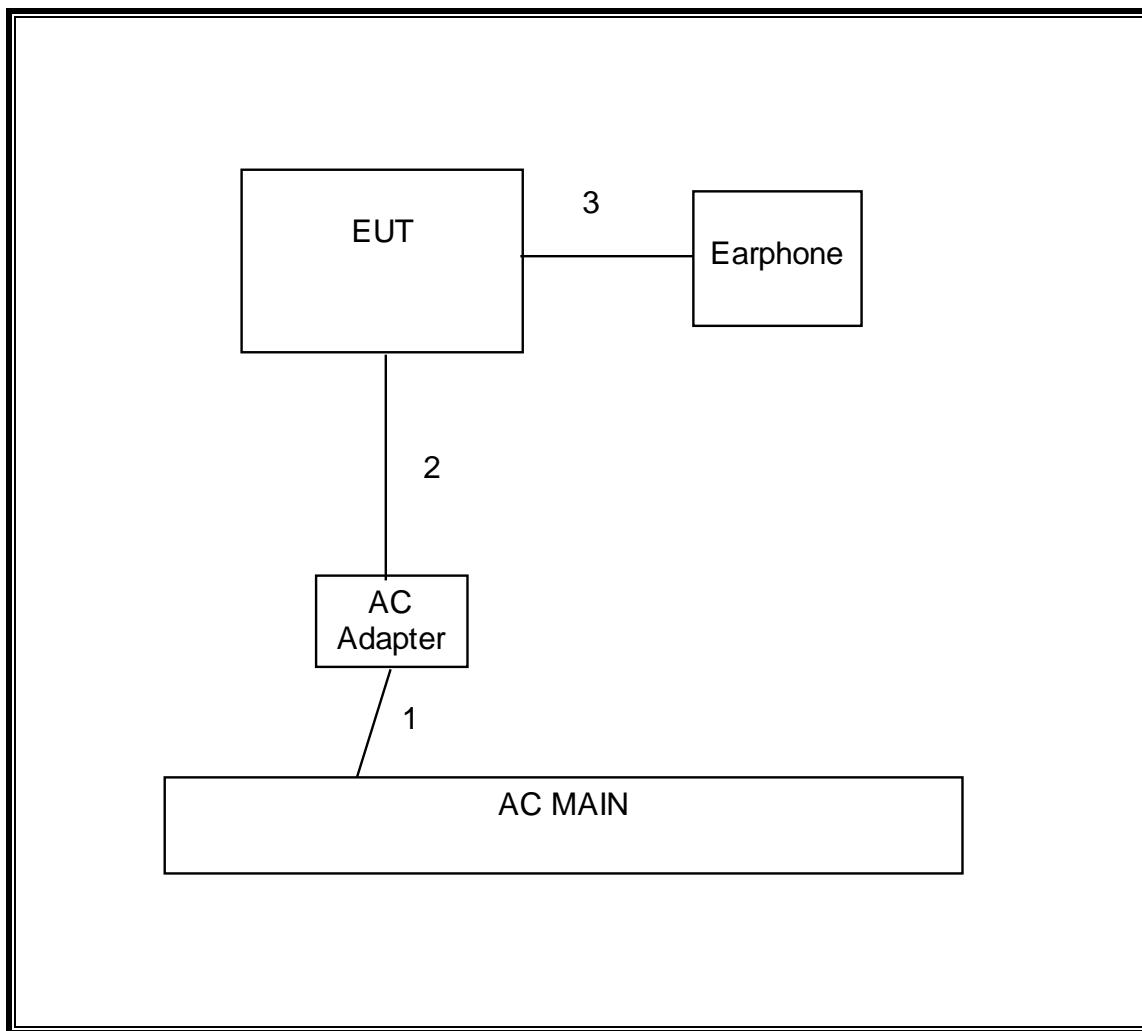
SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS



SETUP DIAGRAM FOR AC POWER CONDUCTED 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	Asset	Cal Due
Horn Antenna 1-18GHz	ETS Lindgren	3117	F00133	02/19/14
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01/28/14
Antenna, Horn, 26.5 GHz	ARA	SWH-28	C01015	05/06/14
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	F00215	03/07/14
Peak / Average Power Sensor	Agilent / HP	E9323A	F00026	07/27/14
P-Series single channel Power Meter	Agilent / HP	N1911A	F00153	07/26/14
Spectrum Analyzer, 3Hz-44GHz	Agilent	N9030A	F00127	02/22/14
PreApmplifier, 1-26.5GHz	Agilent	8449B	C01052	10/22/13
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	04/17/14
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06/14/14
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/08/13
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/02/13

7. ANTENNA PORT TEST RESULTS

7.1. 2.4GHz BAND

7.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

TEST PROCEDURE

KDB 558074 D01 v01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

B MODE

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	8.052	0.5
Mid	2437	8.052	0.5
High	2462	8.064	0.5

G MODE

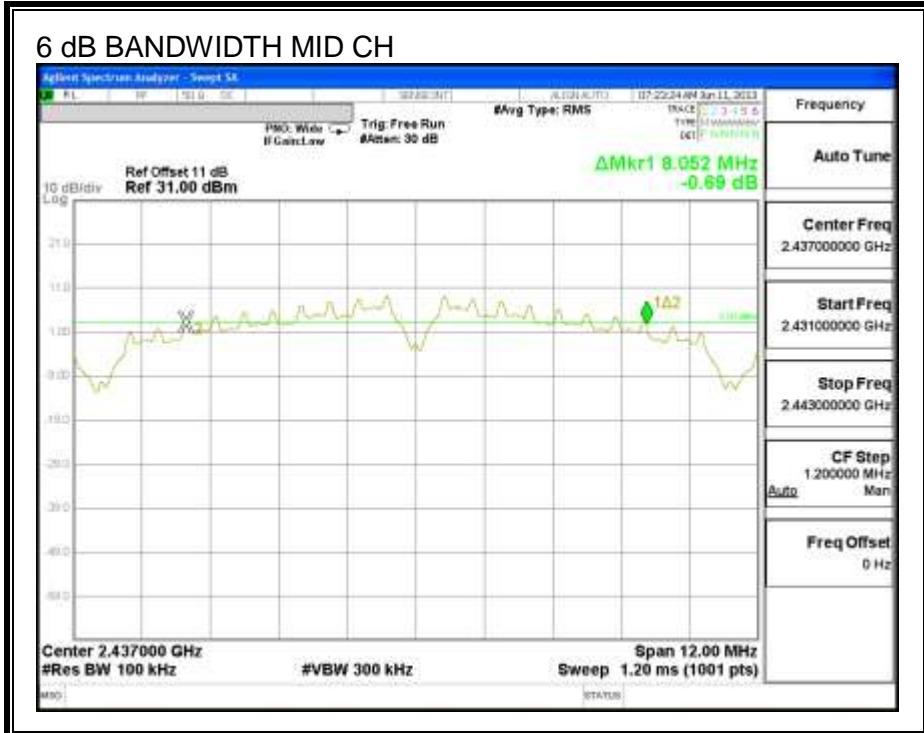
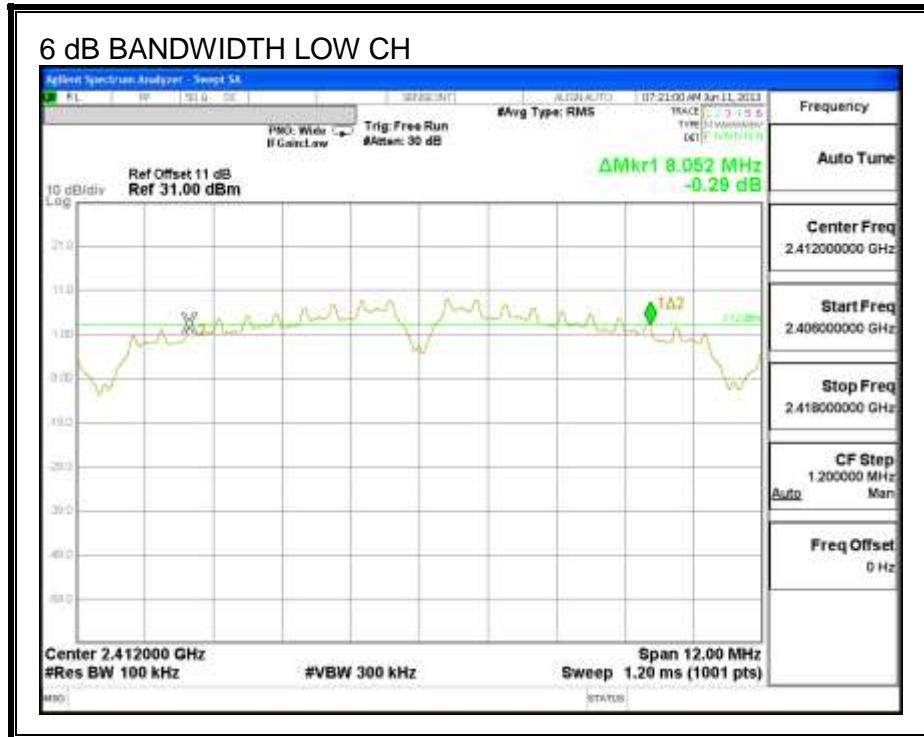
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	15.134	0.5
Mid	2437	15.123	0.5
High	2462	15.134	0.5

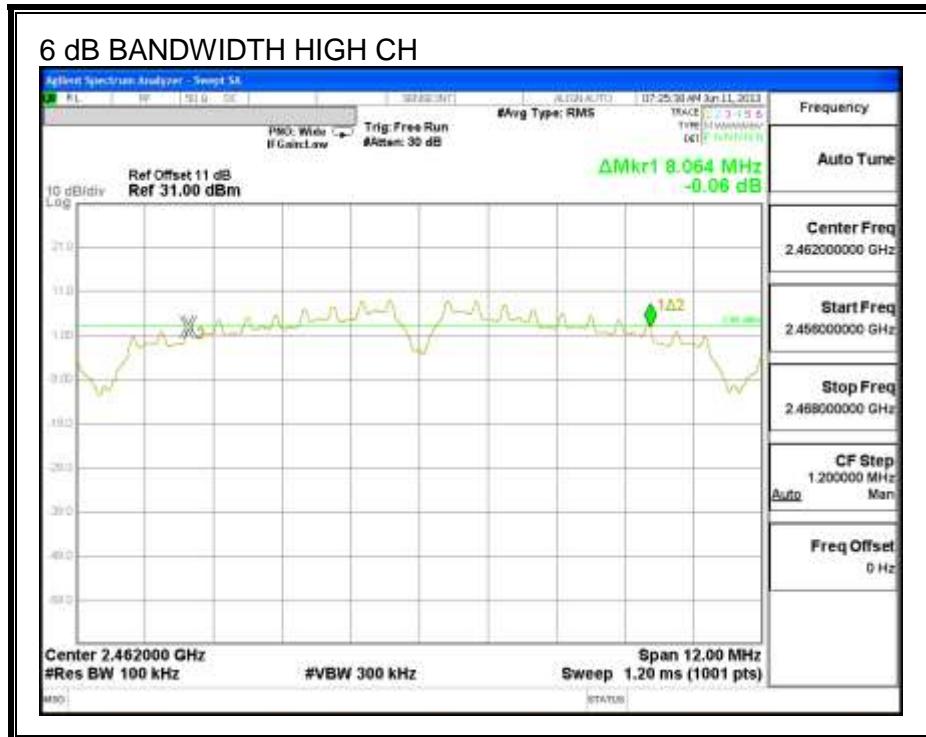
HT20

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	15.134	0.5
Mid	2437	15.157	0.5
High	2462	15.134	0.5

b mode

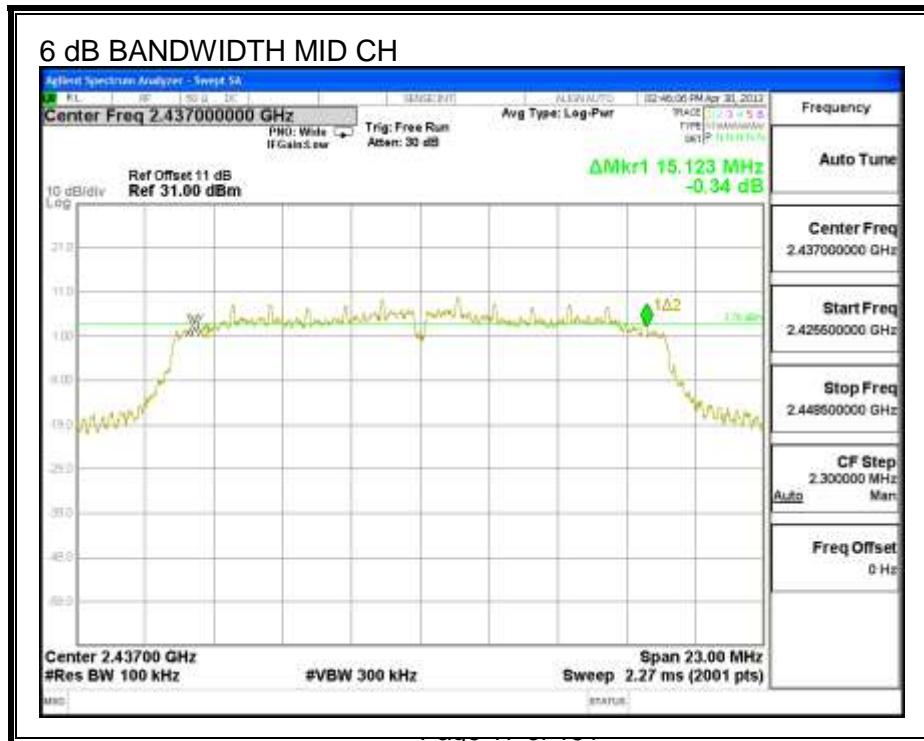
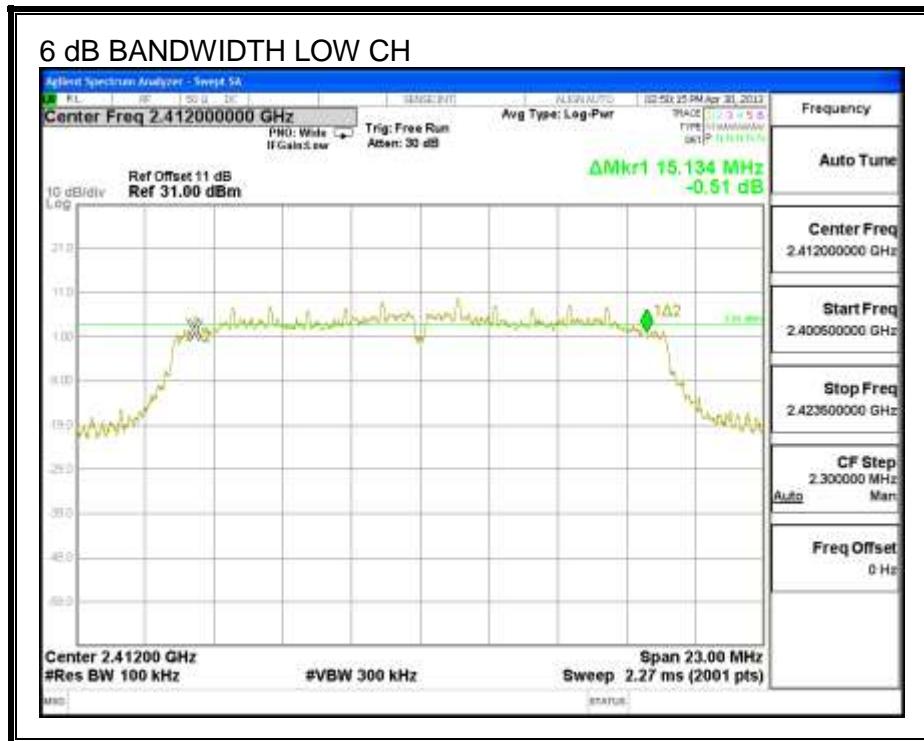
6 dB BANDWIDTH

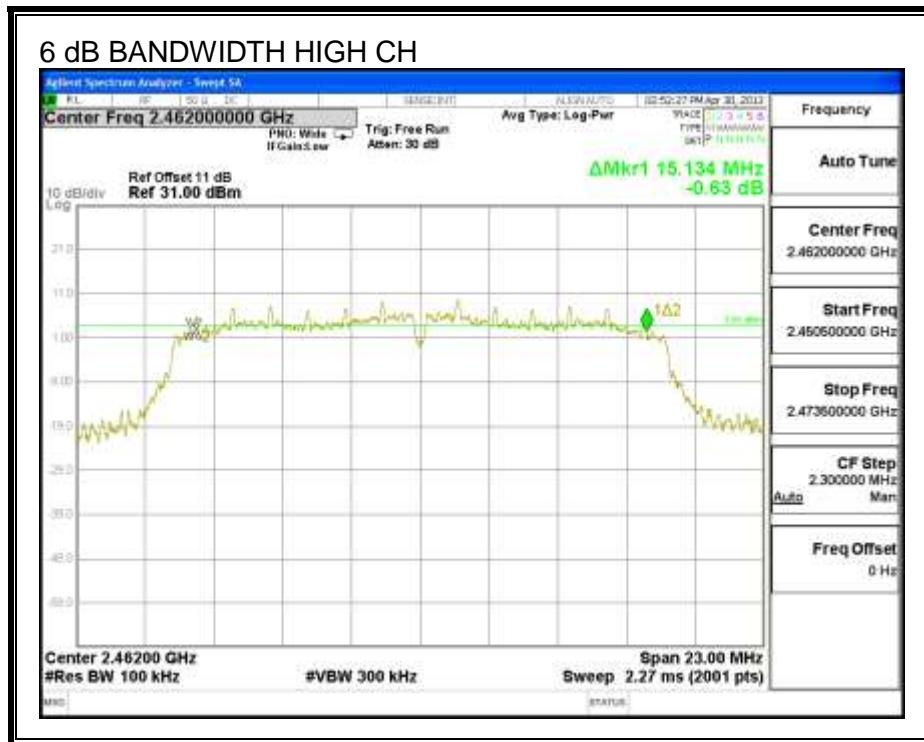




G mode

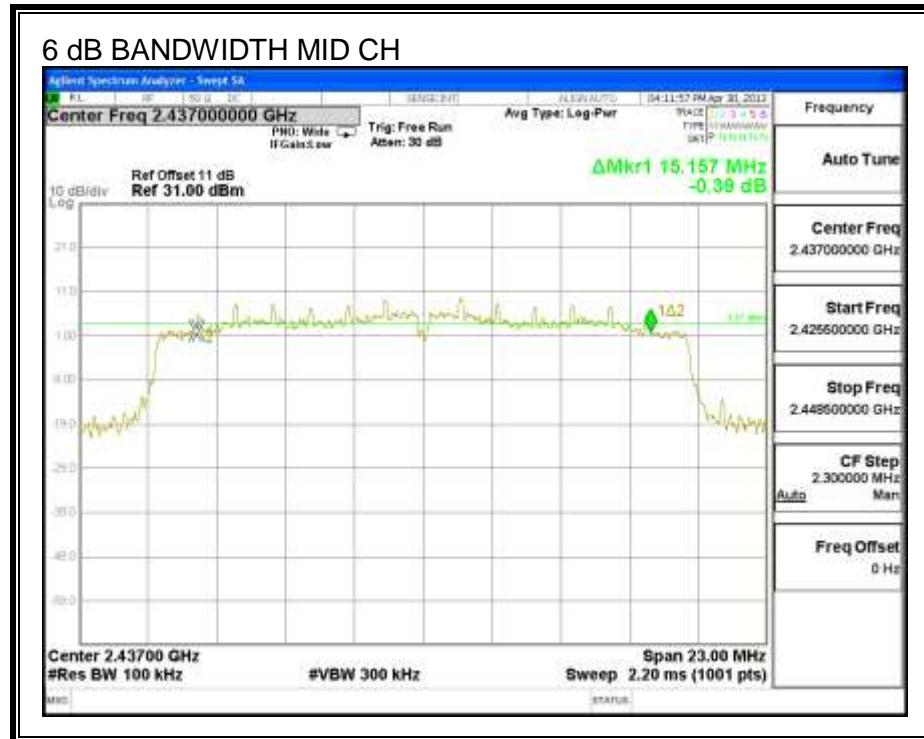
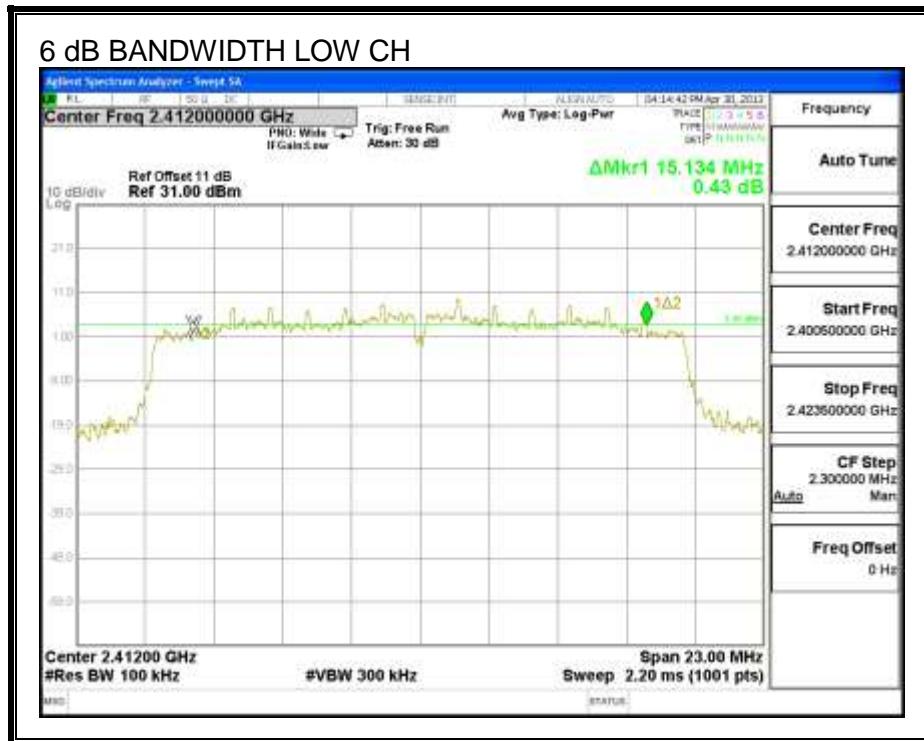
6 dB BANDWIDTH

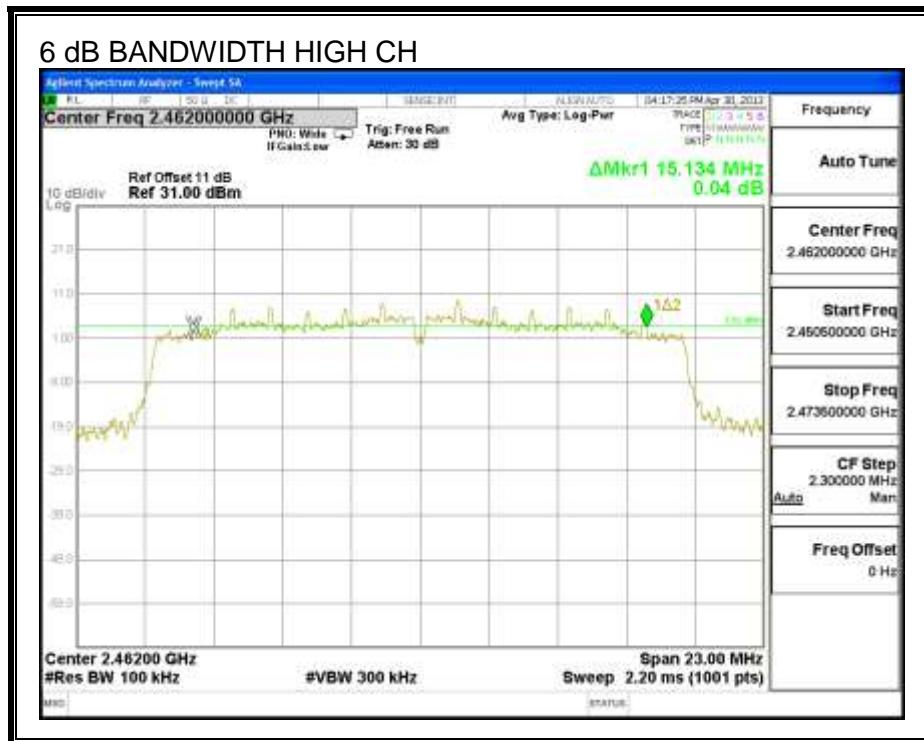




HT20

6 dB BANDWIDTH





7.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

B mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	12.4980
Mid	2437	12.6040
High	2462	12.3370

G mode

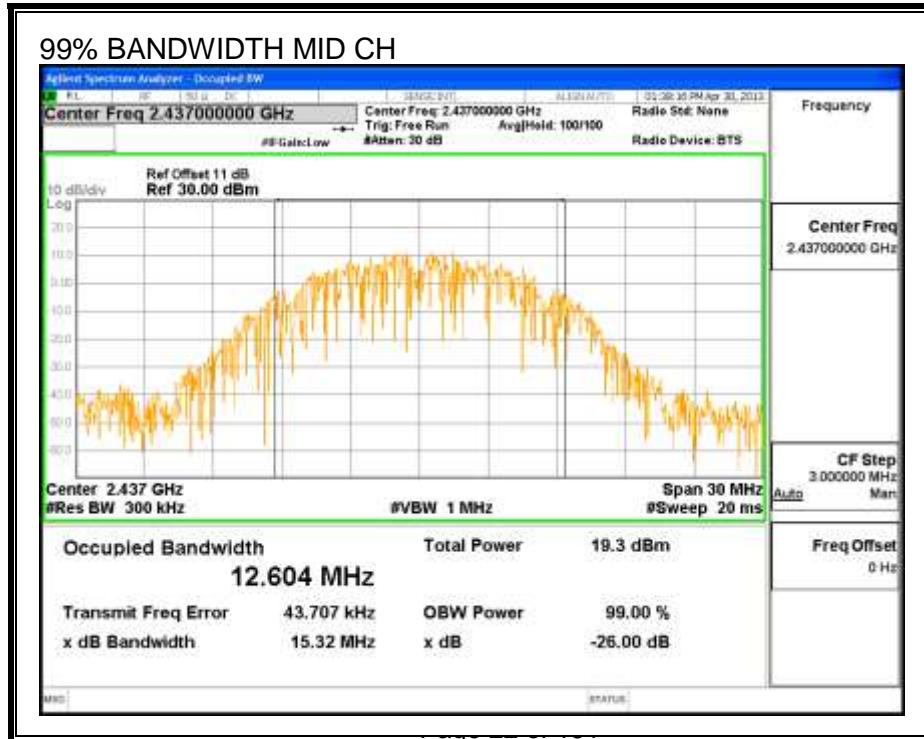
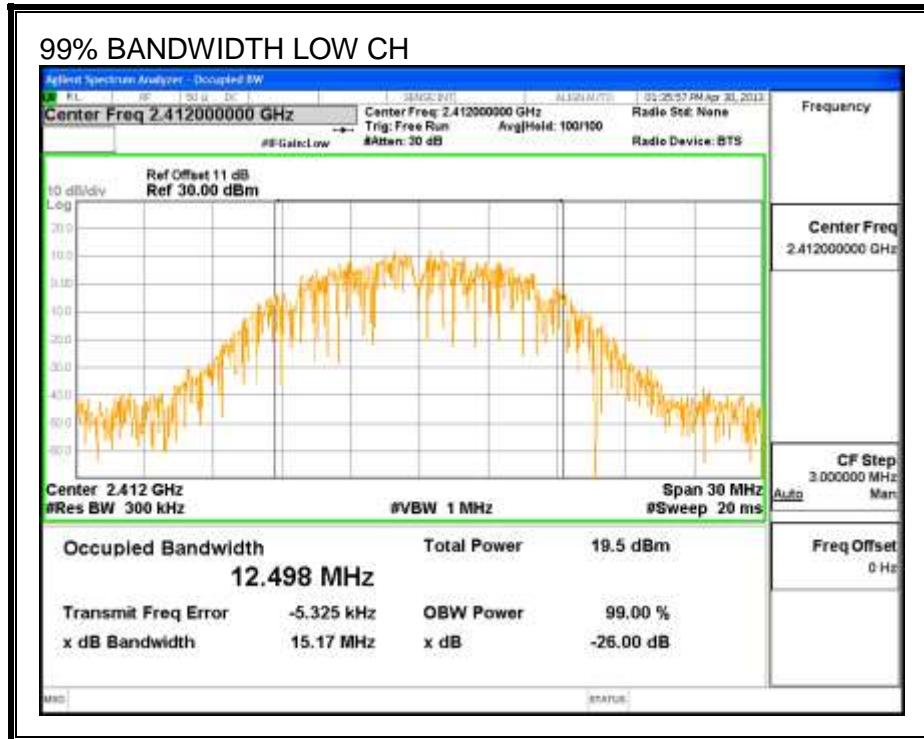
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	16.4620
Mid	2437	16.4110
High	2462	16.5380

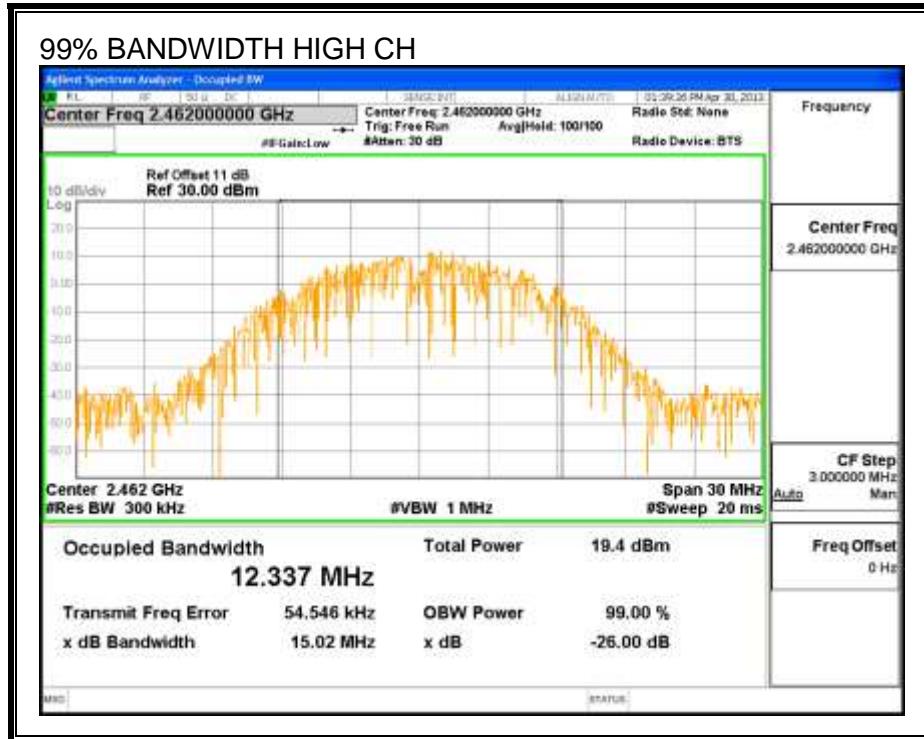
HT20

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	17.6280
Mid	2437	17.0680
High	2462	17.6200

B mode

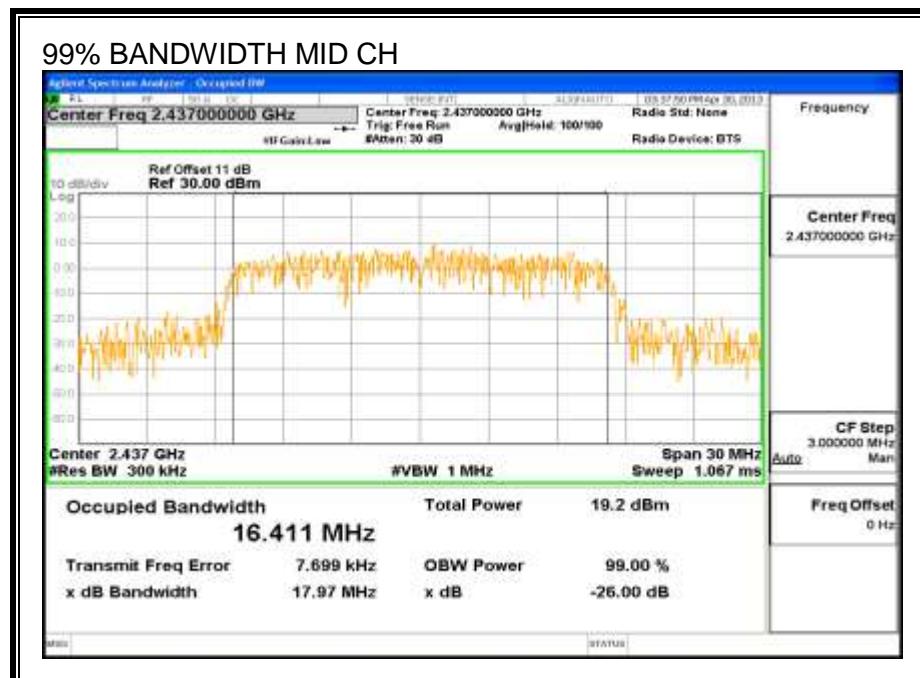
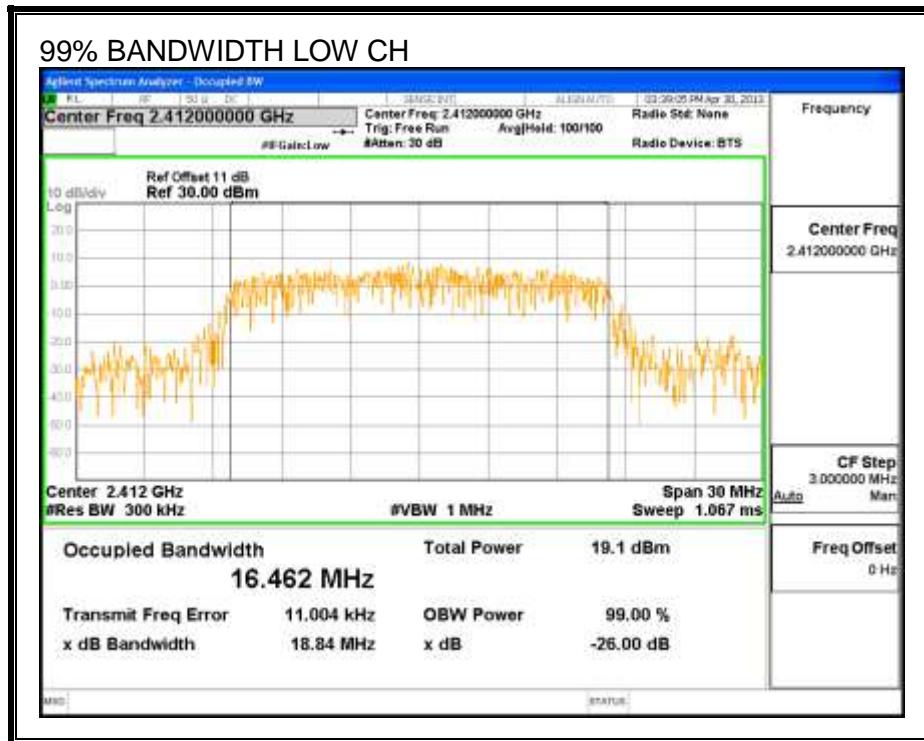
99% BANDWIDTH

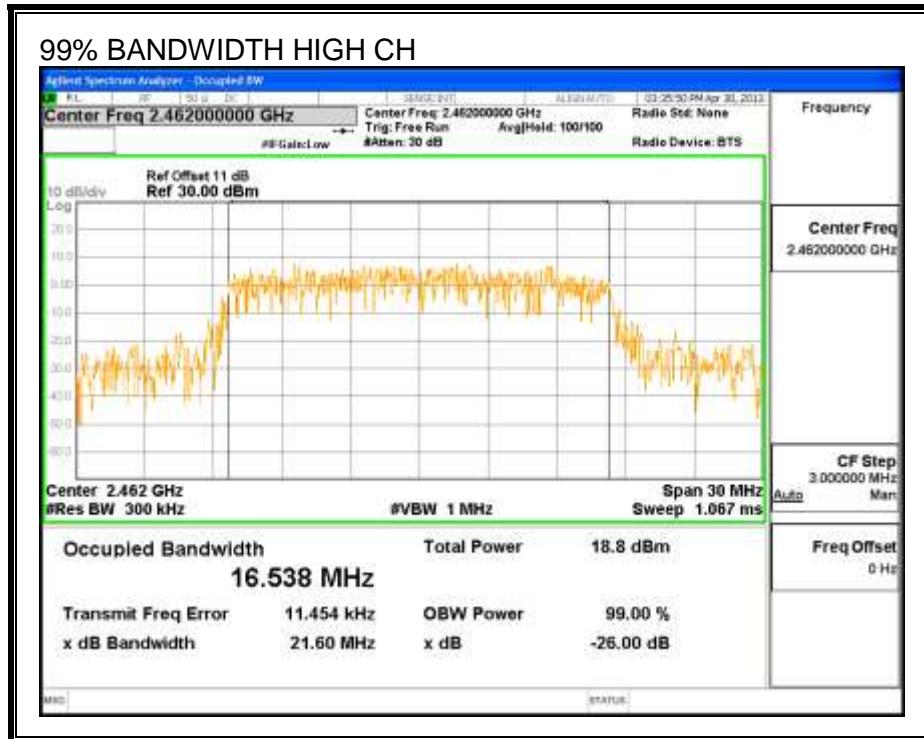




G mode

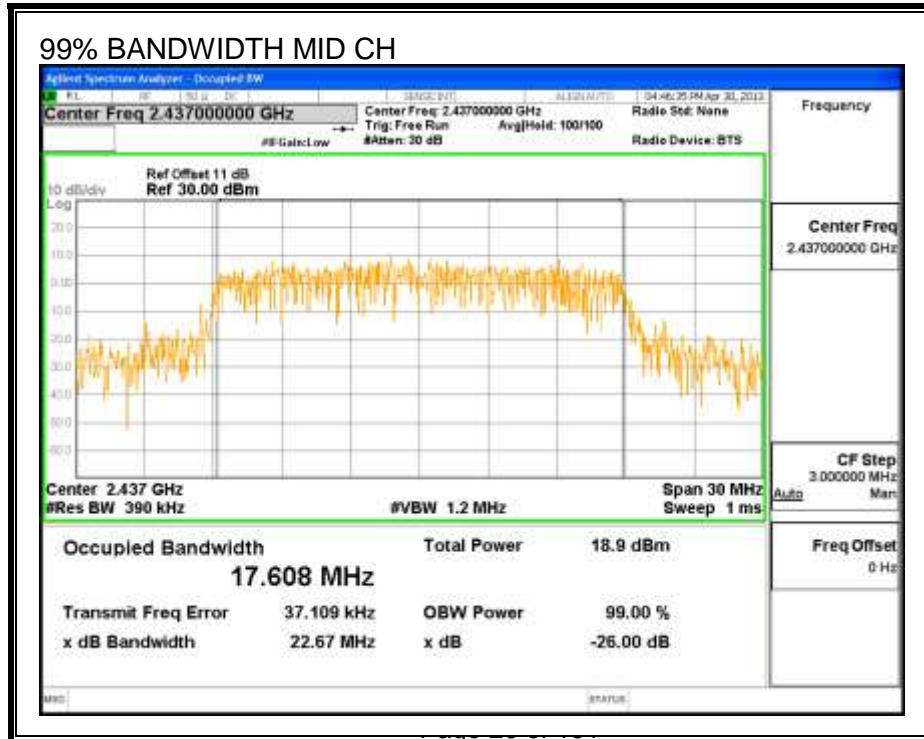
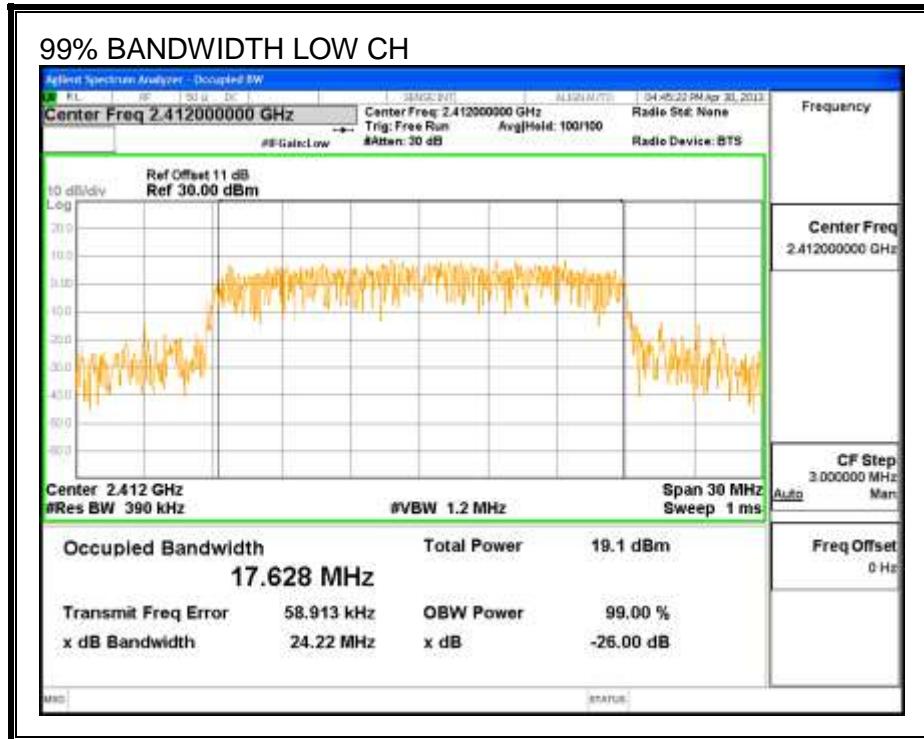
99% BANDWIDTH

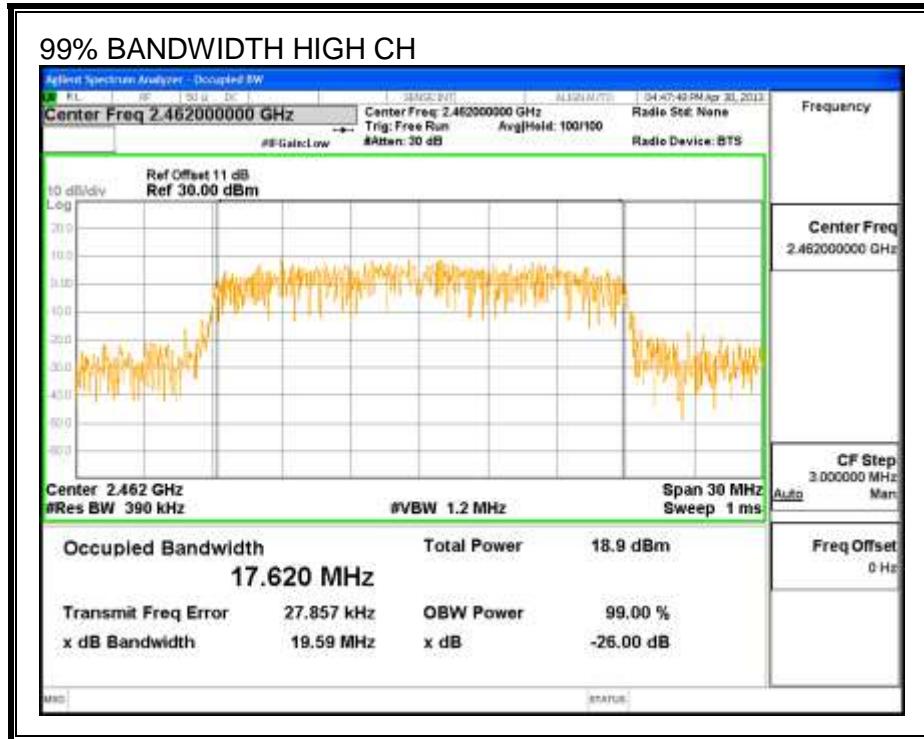




HT20

99% BANDWIDTH





7.1.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

B mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.0
Mid	2437	16.0
High	2462	16.0

G mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	15.9
Mid	2437	16.0
High	2462	15.9

HT20

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.0
Mid	2437	15.9
High	2462	16.0

7.1.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-210 A8.4

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

B mode

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	1.00	30.00	30	36	30.00
Mid	2437	1.00	30.00	30	36	30.00
High	2462	1.00	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	18.812	18.81	30.00	-11.19
Mid	2437	18.760	18.76	30.00	-11.24
High	2462	18.707	18.71	30.00	-11.29

G mode

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	1.00	30.00	30	36	30.00
Mid	2437	1.00	30.00	30	36	30.00
High	2462	1.00	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	23.65	23.65	30.00	-6.35
Mid	2437	23.72	23.72	30.00	-6.28
High	2462	23.76	23.76	30.00	-6.24

HT20

Limits

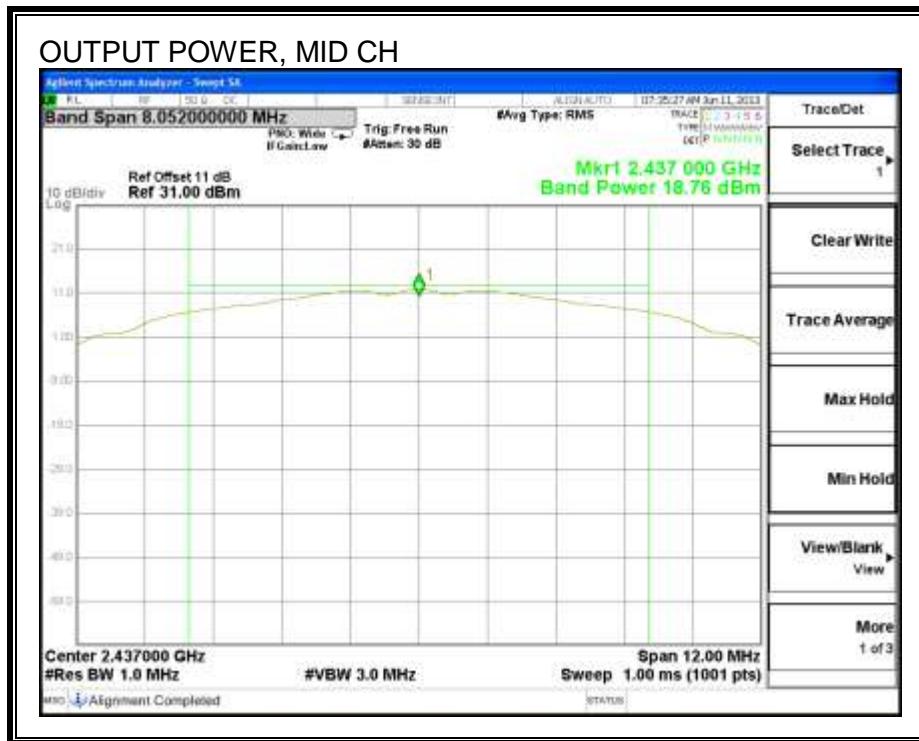
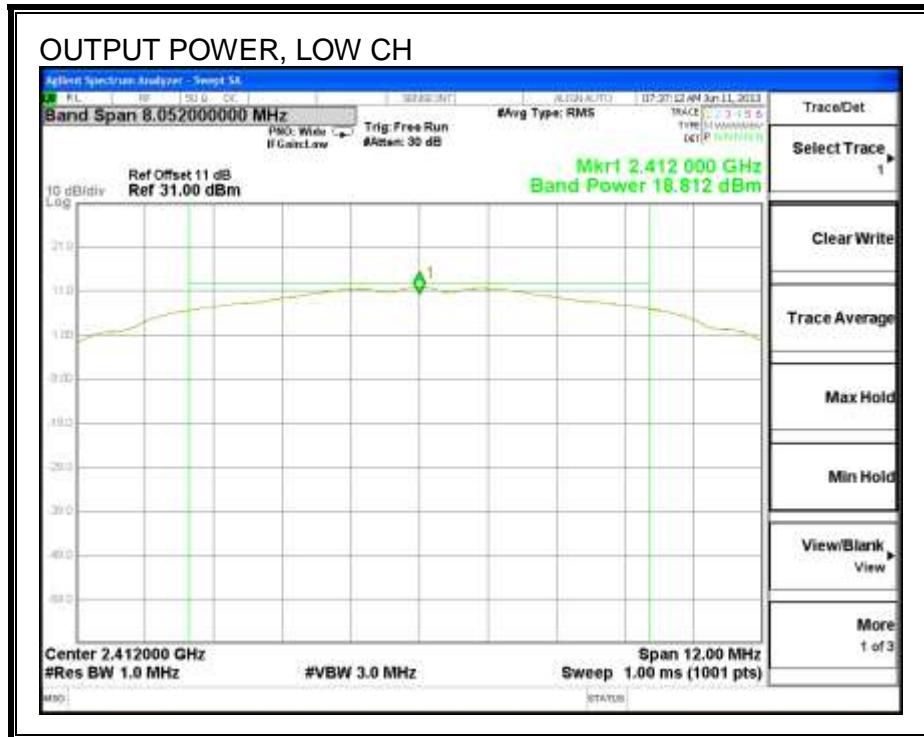
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	1.00	30.00	30	36	30.00
Mid	2437	1.00	30.00	30	36	30.00
High	2462	1.00	30.00	30	36	30.00

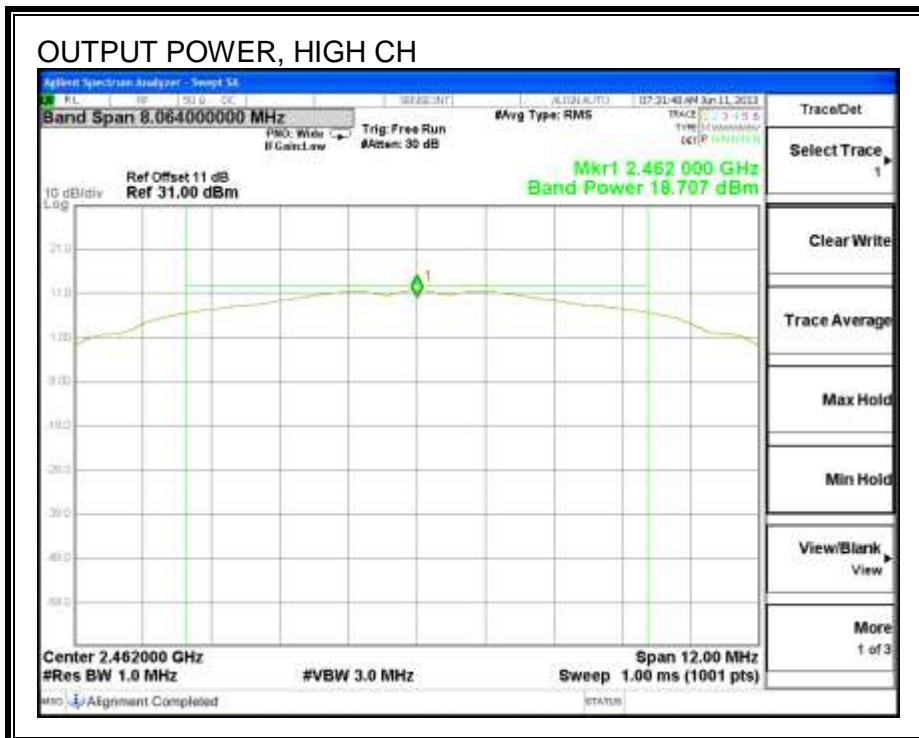
Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	23.32	23.32	30.00	-6.68
Mid	2437	23.49	23.49	30.00	-6.51
High	2462	23.42	23.42	30.00	-6.58

b mode

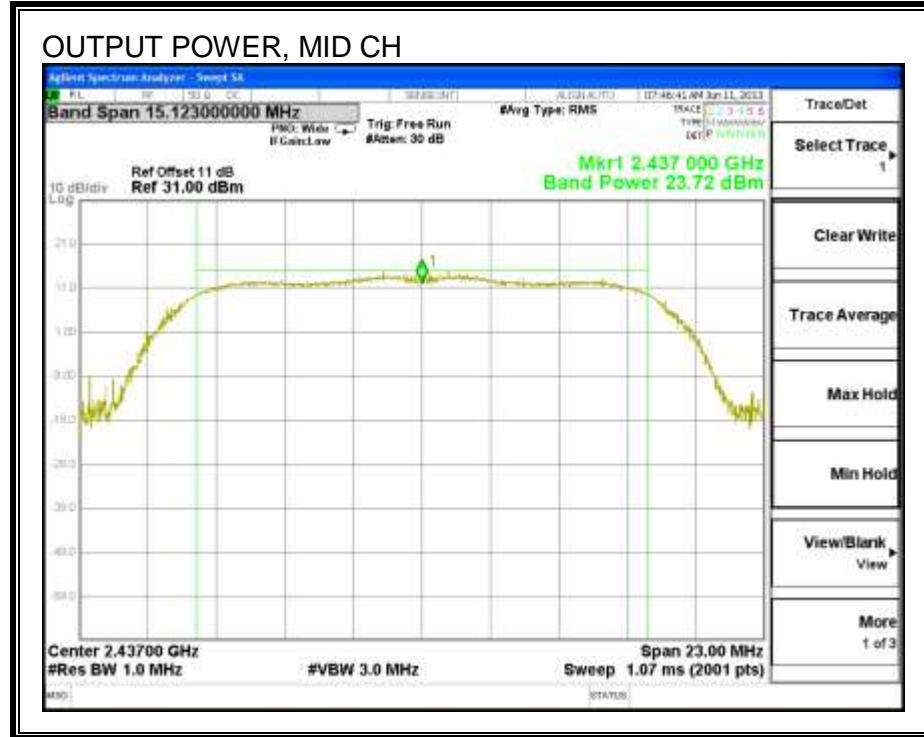
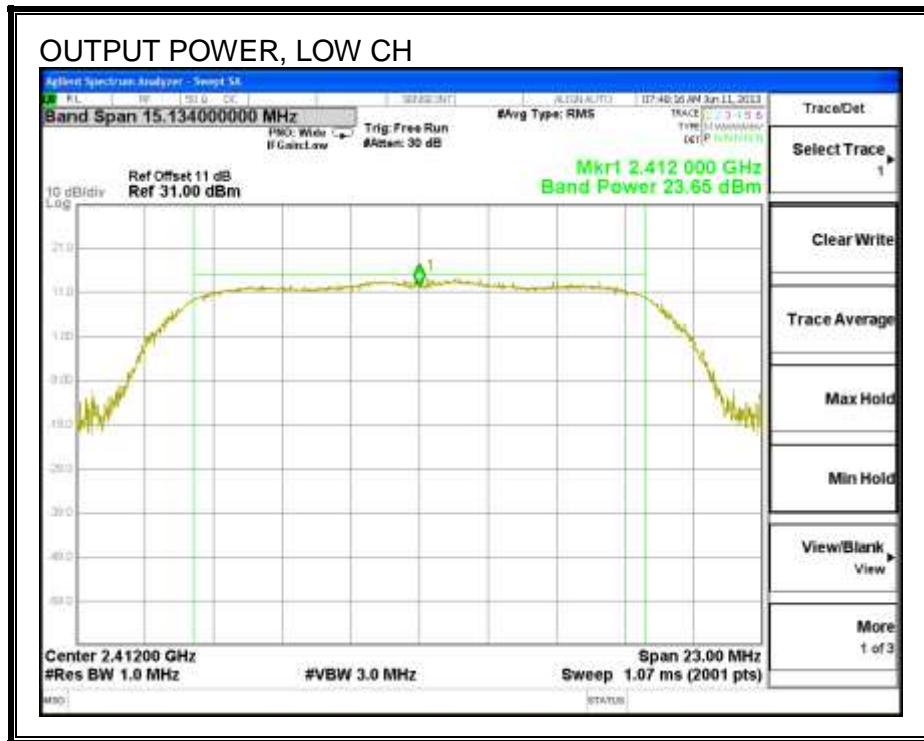
OUTPUT POWER

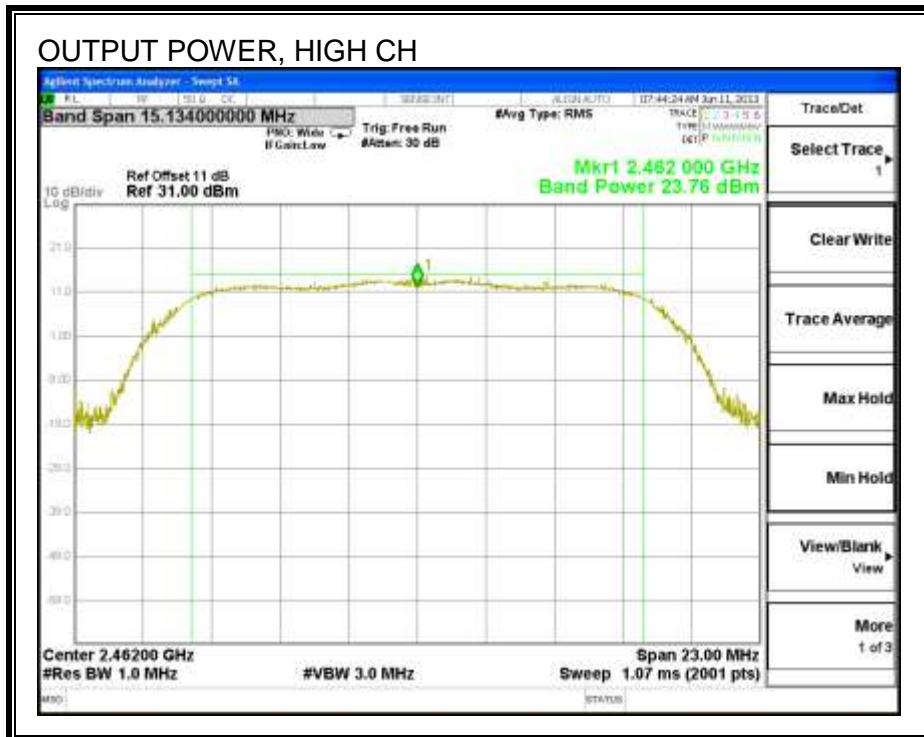




G mode

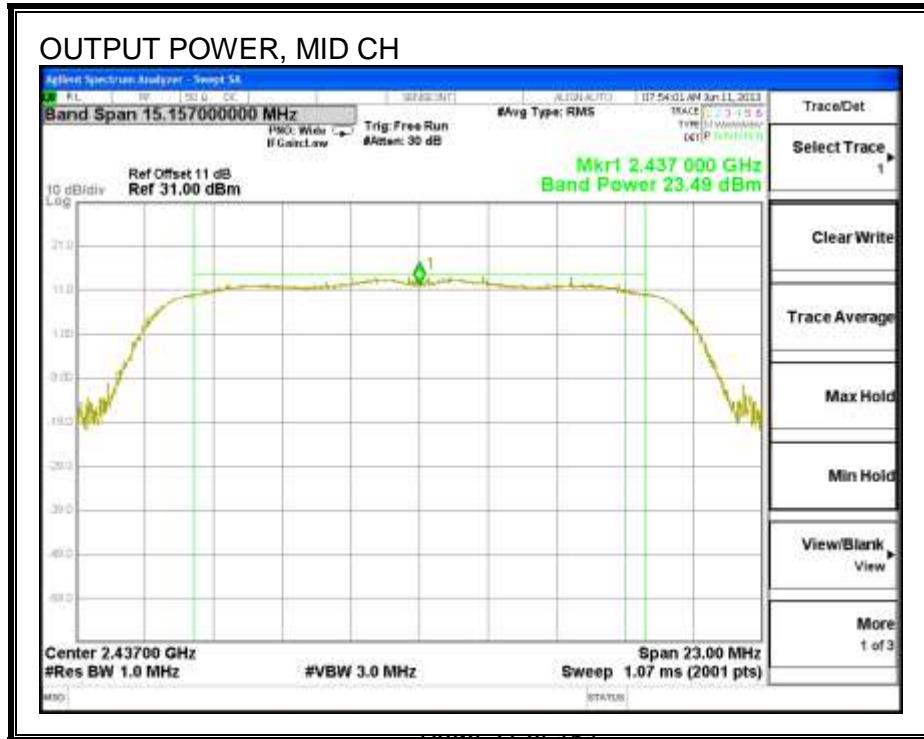
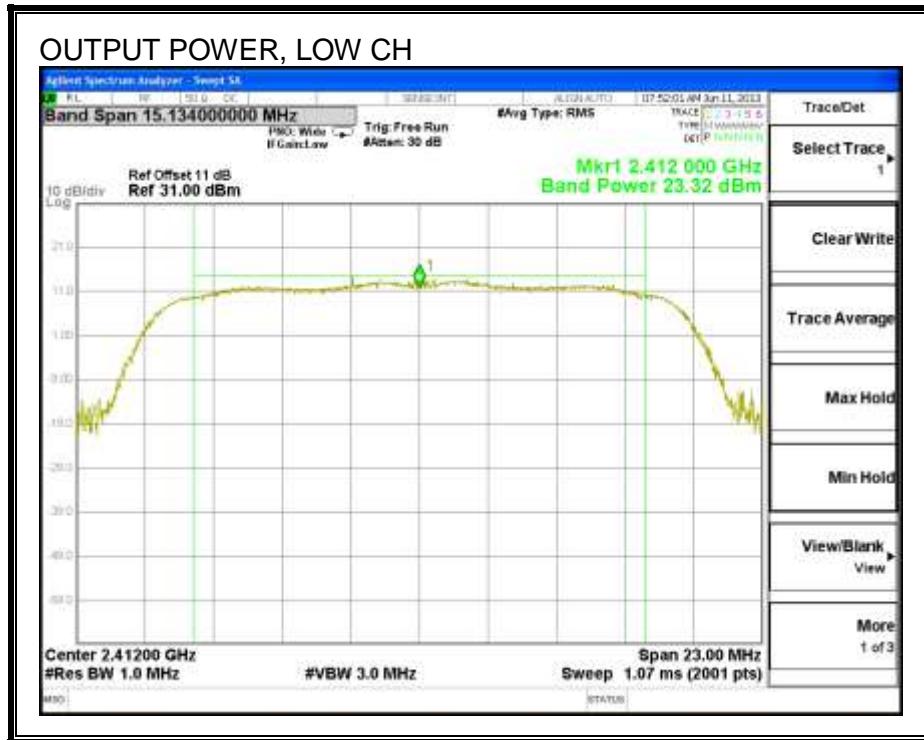
OUTPUT POWER

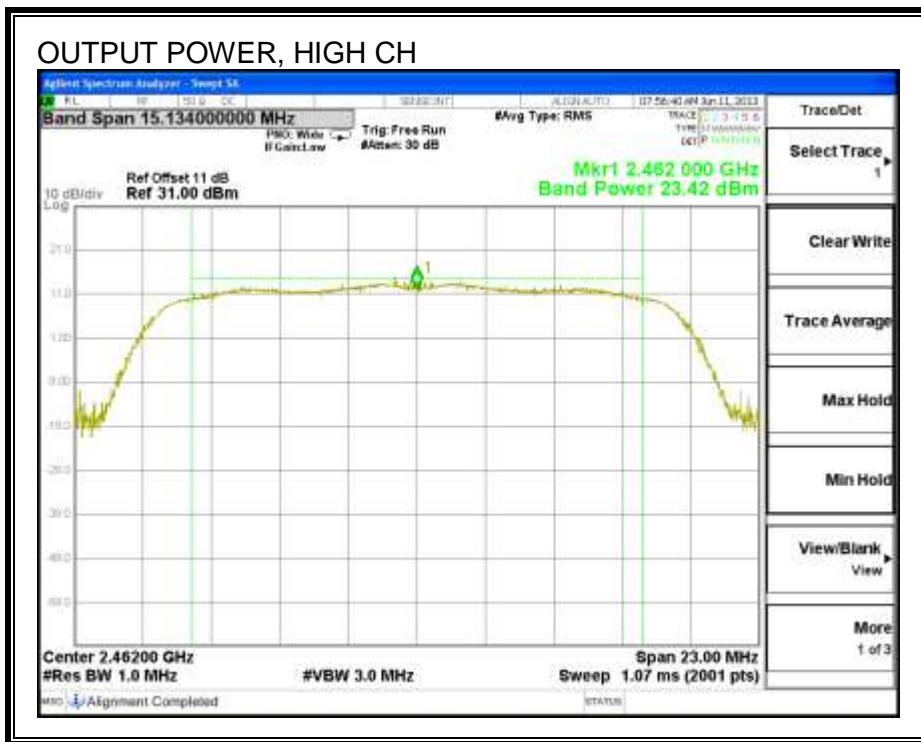




HT20

OUTPUT POWER





7.1.5. PSD

LIMITS

FCC §15.247

IC RSS-210 A8.2

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.

B mode

PSD Results

Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-2.12	8.0	-10.12
Mid	2437	-1.98	8.0	-9.98
High	2462	-2.33	8.0	-10.33

G mode

PSD Results

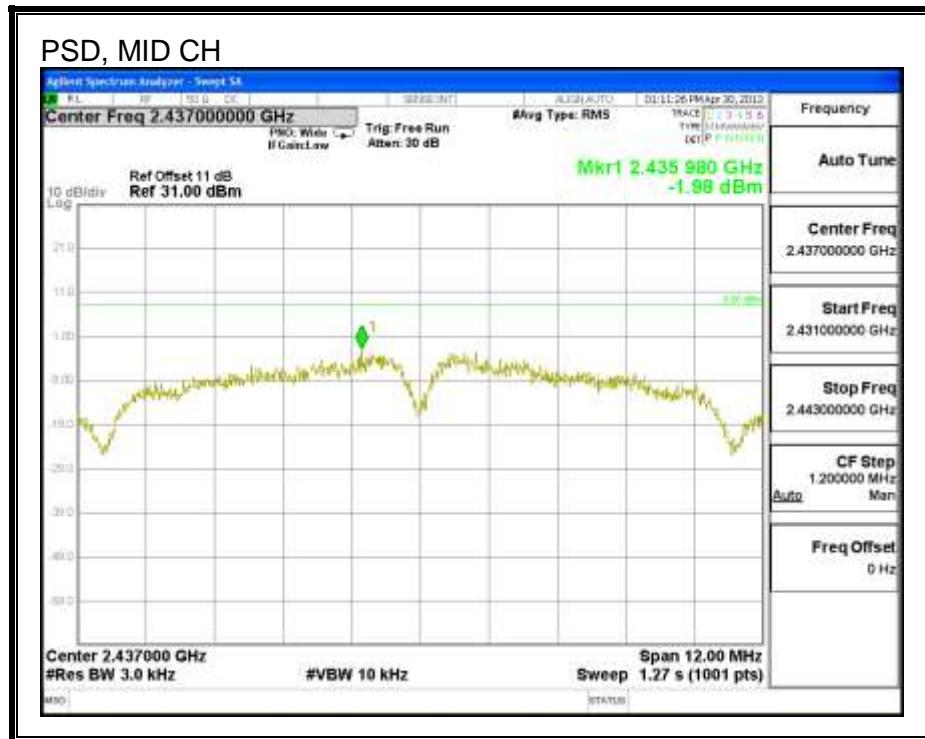
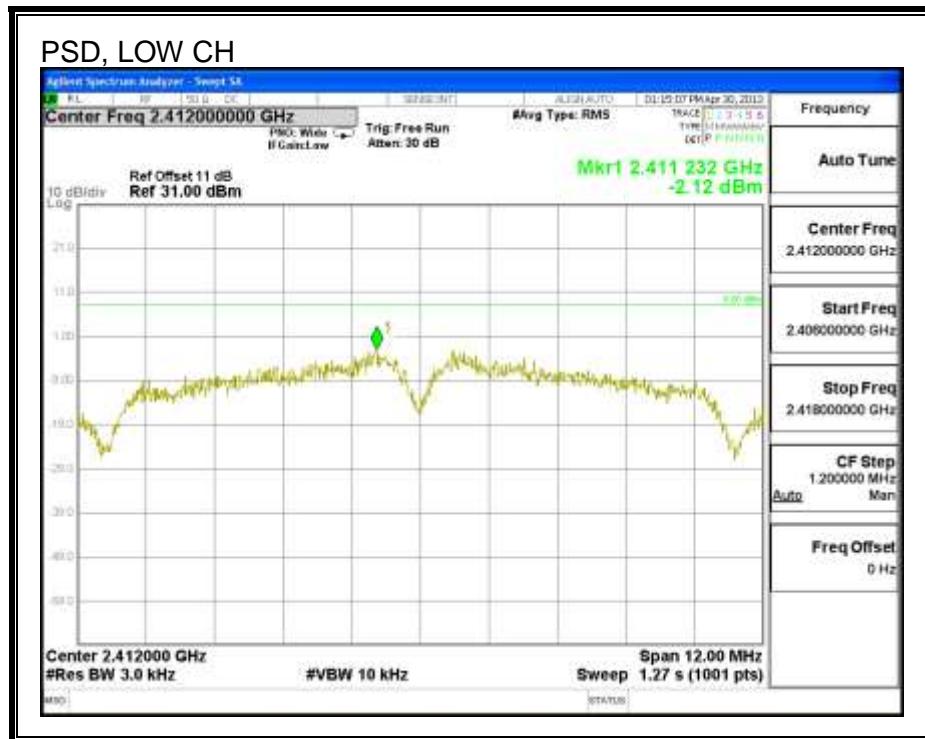
Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.29	8.0	-13.29
Mid	2437	-5.25	8.0	-13.25
High	2462	-5.02	8.0	-13.02

HT20

PSD Results

Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.50	8.0	-13.50
Mid	2437	-5.62	8.0	-13.62
High	2462	-5.17	8.0	-13.17

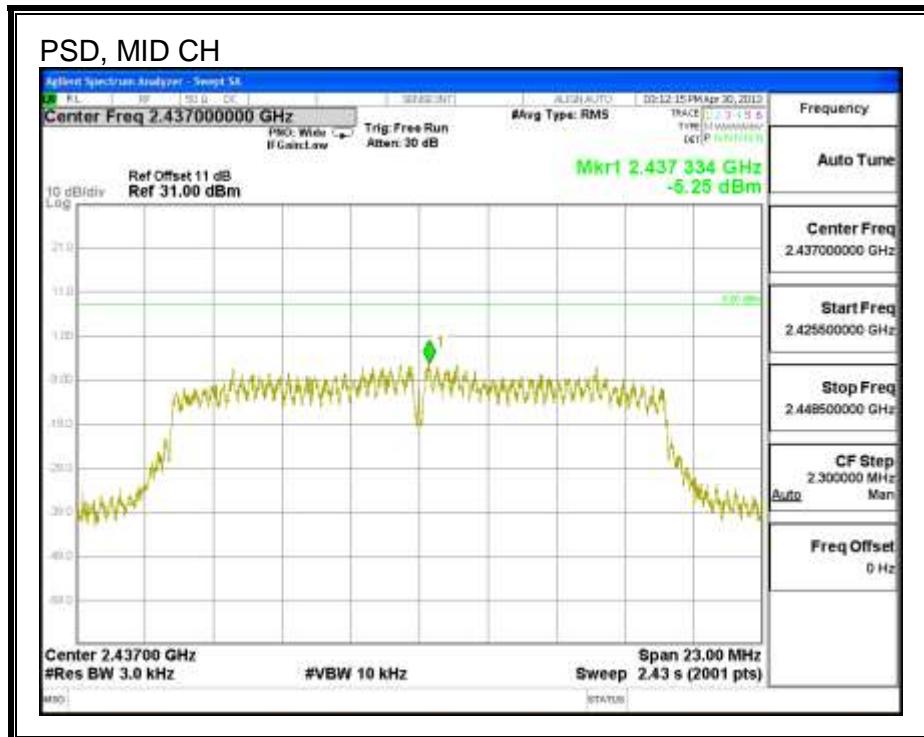
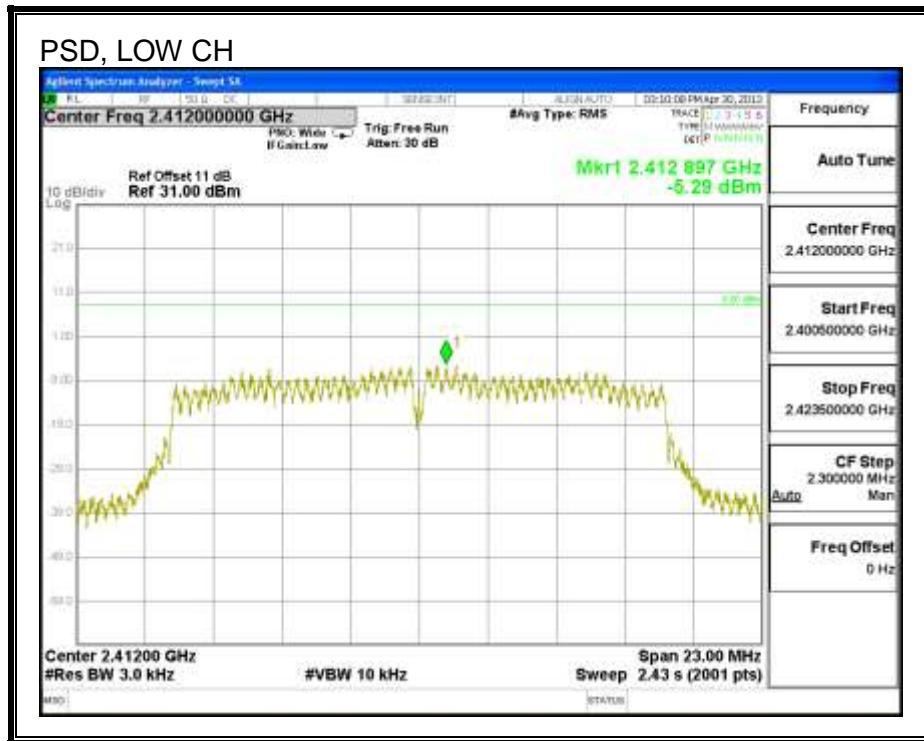
B mode, PSD

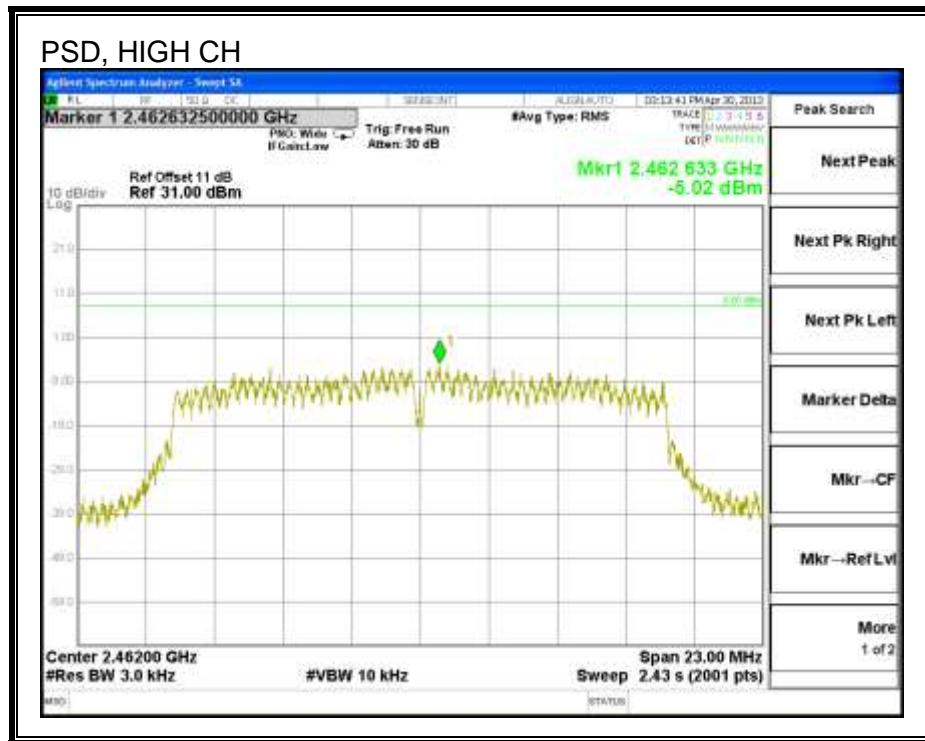




G mode

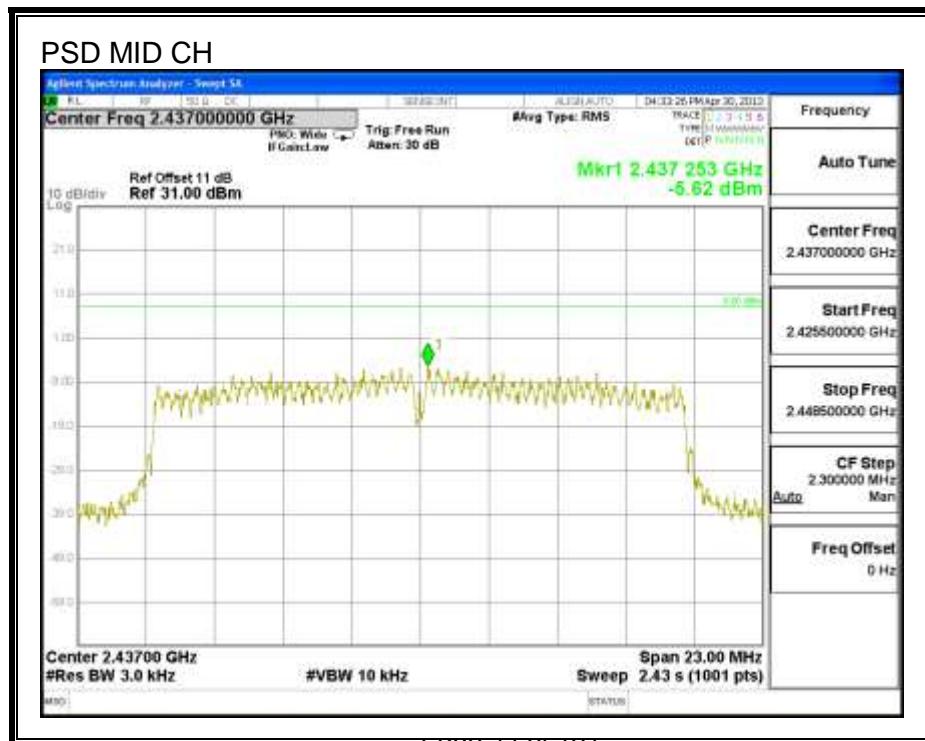
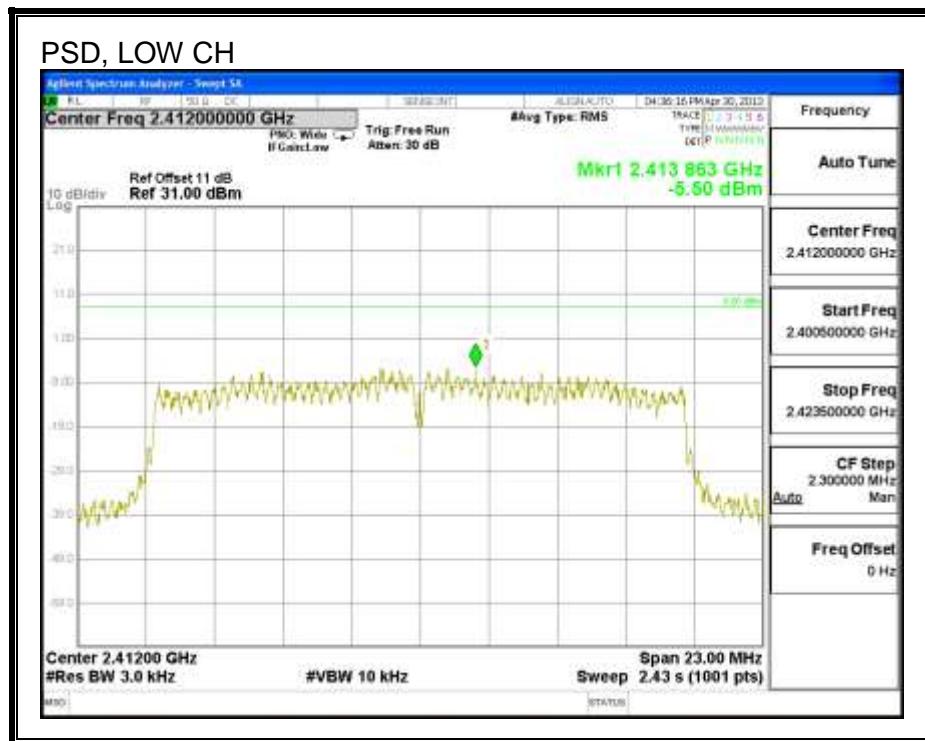
PSD

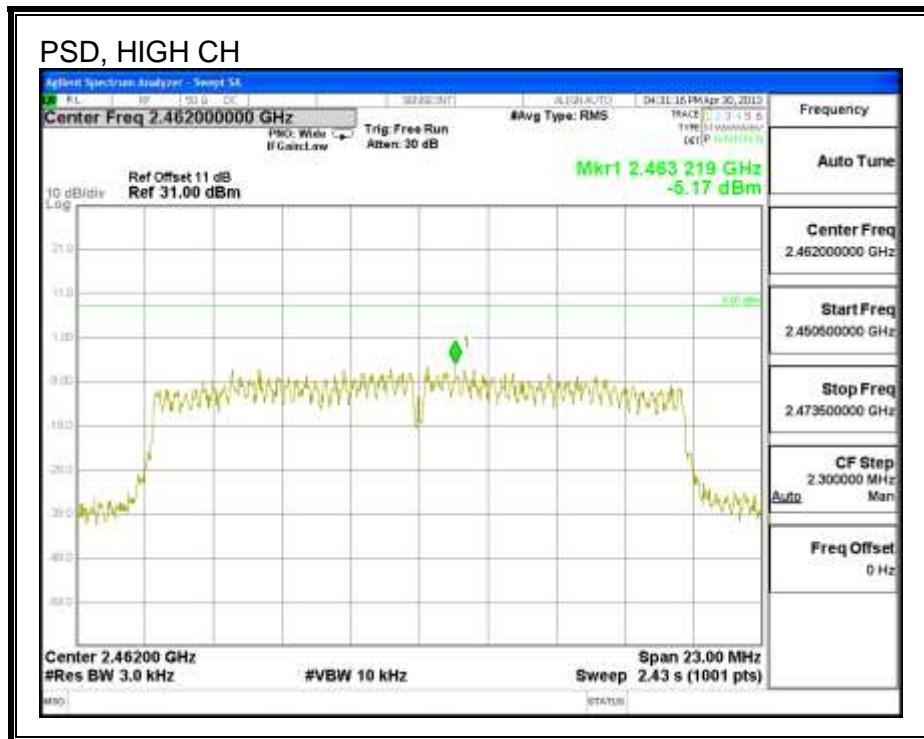




HT20

PSD





7.1.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

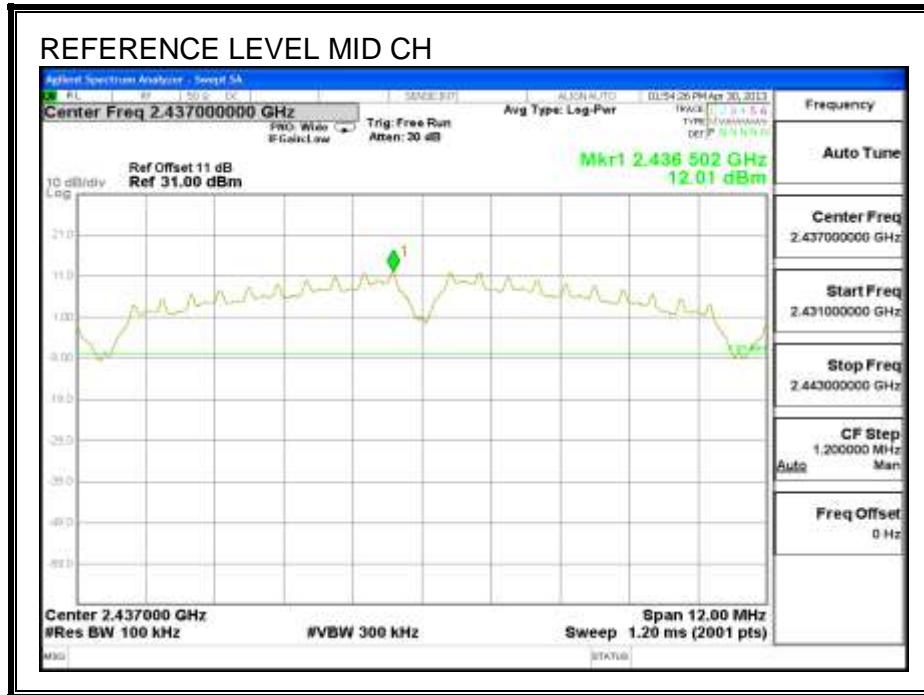
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

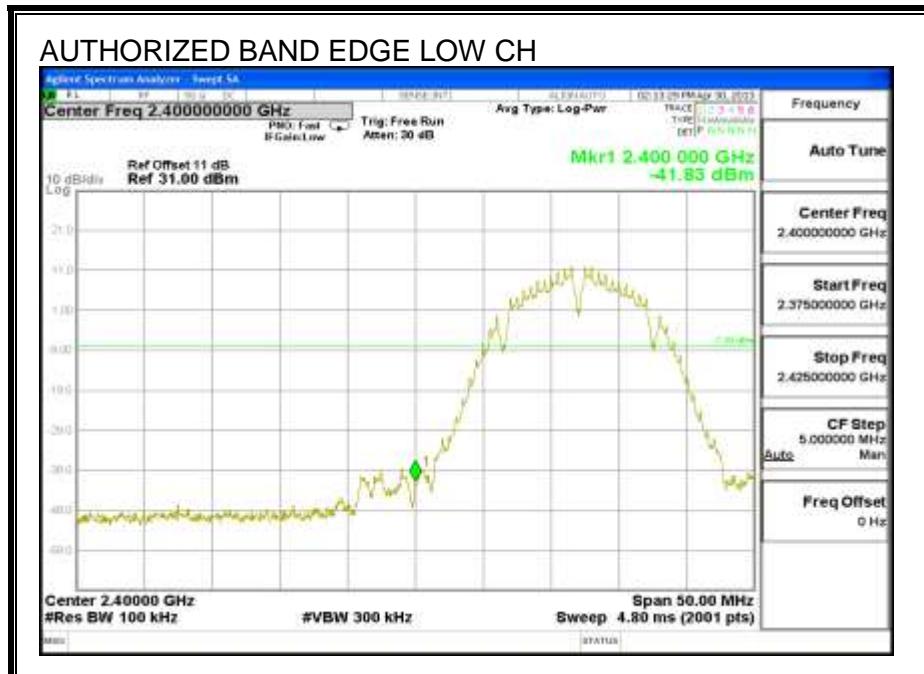
RESULTS

B mode,

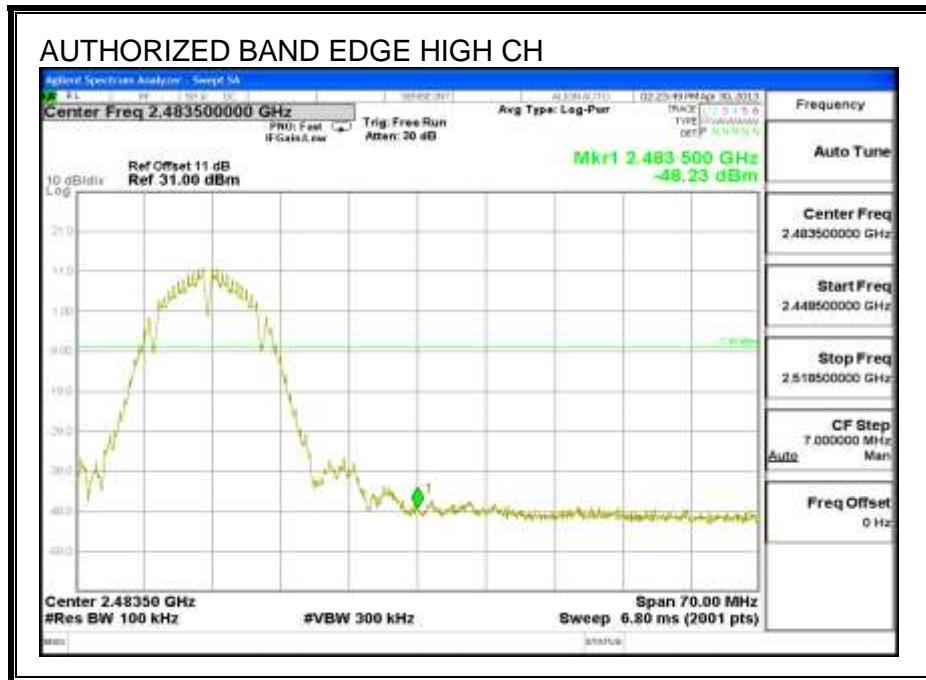
IN-BAND REFERENCE LEVEL



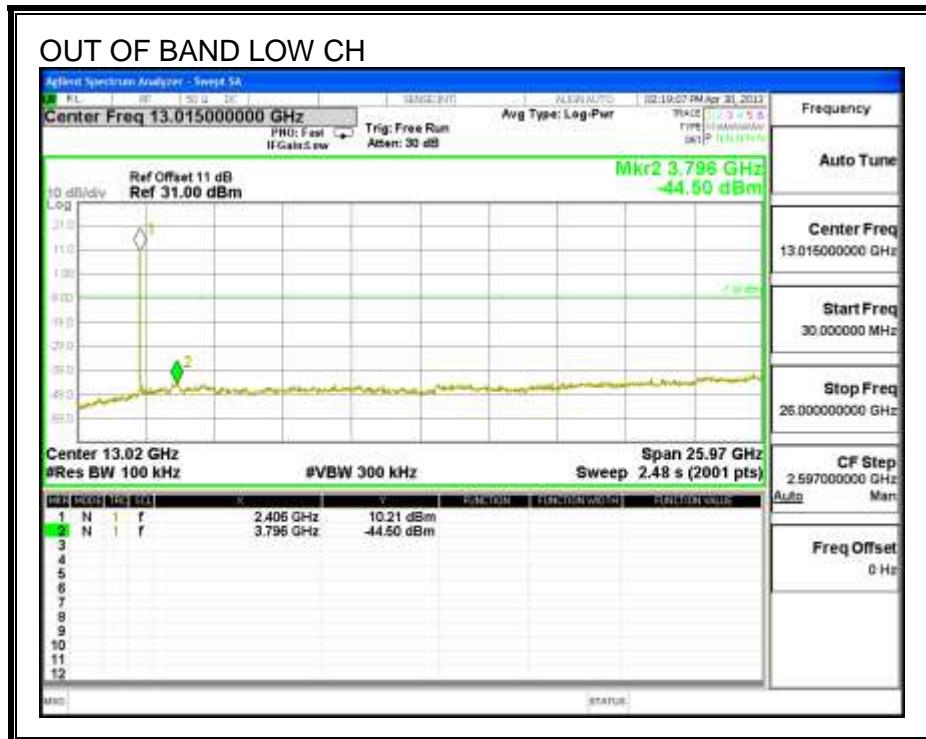
LOW CHANNEL BANDEDGE

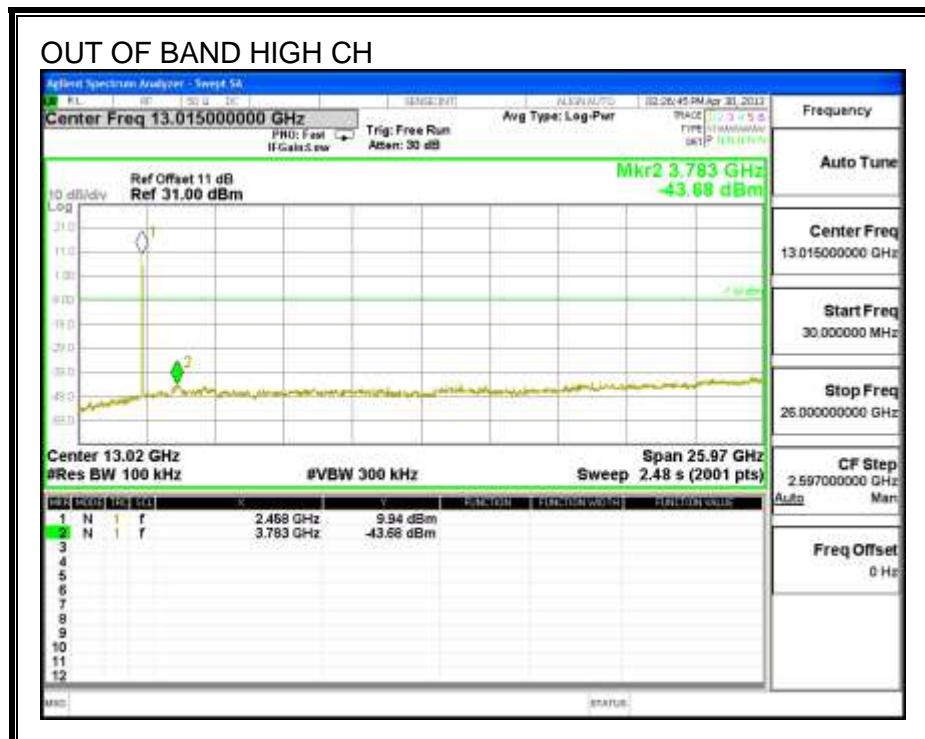
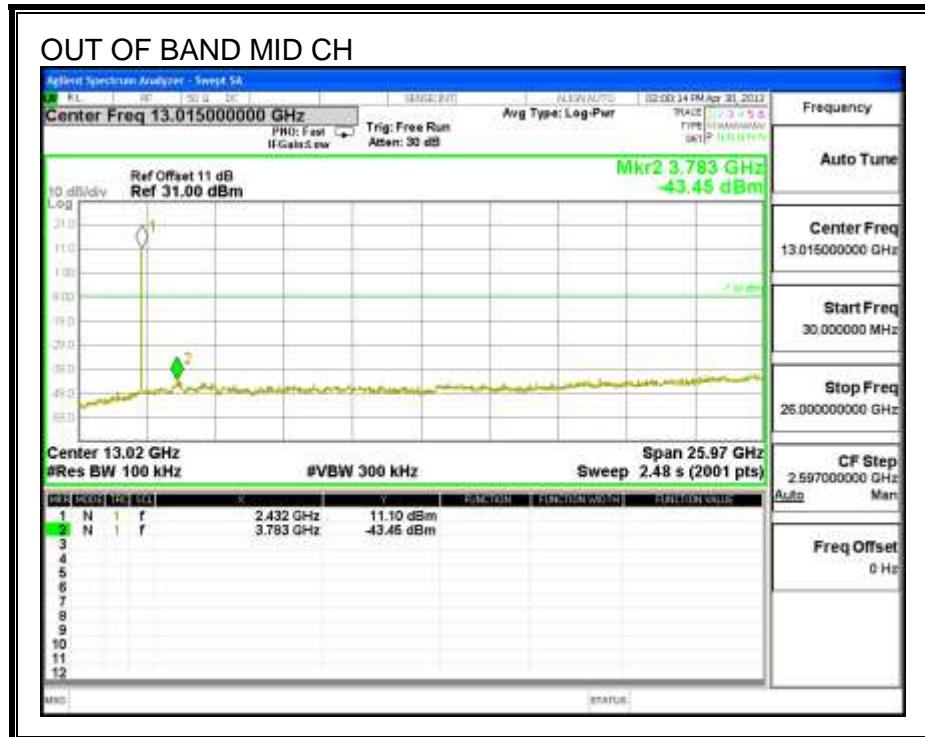


HIGH CHANNEL BANDEDGE



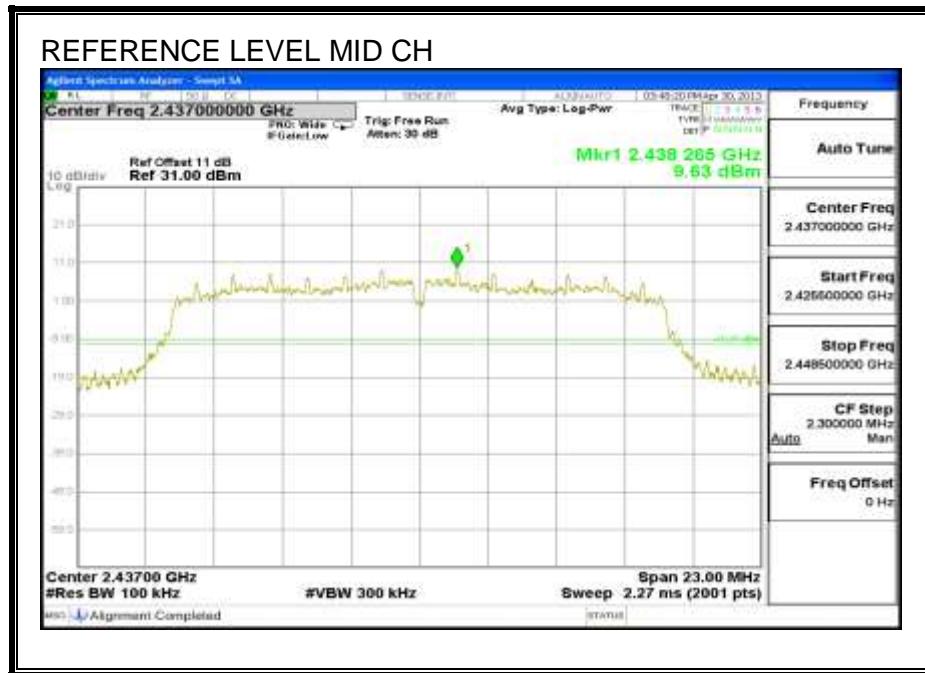
OUT-OF-BAND EMISSIONS



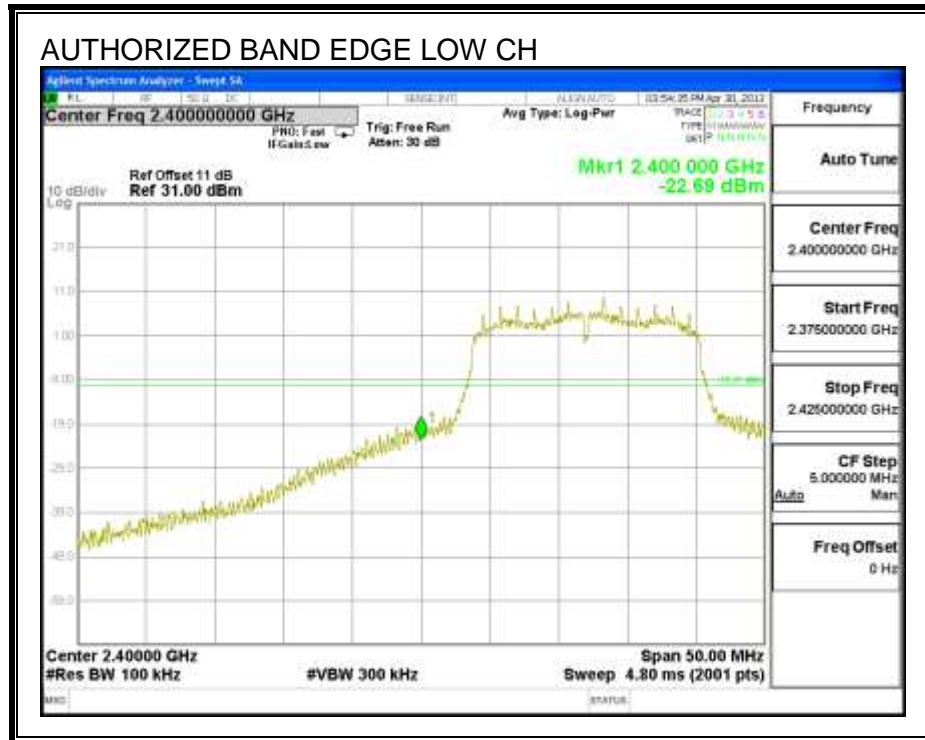


G mode

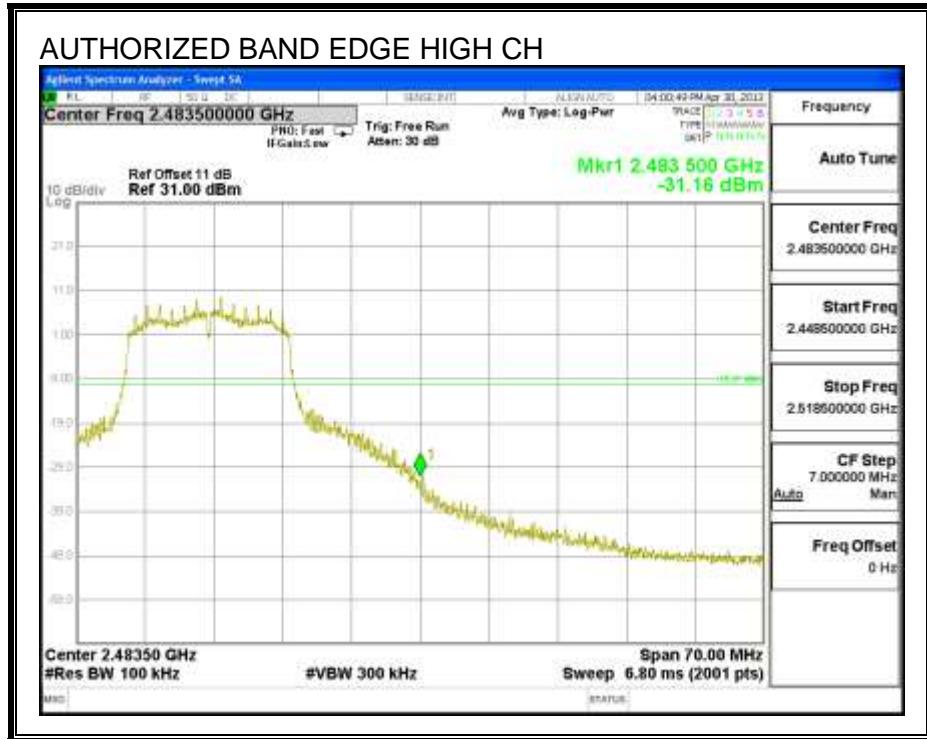
IN-BAND REFERENCE LEVEL



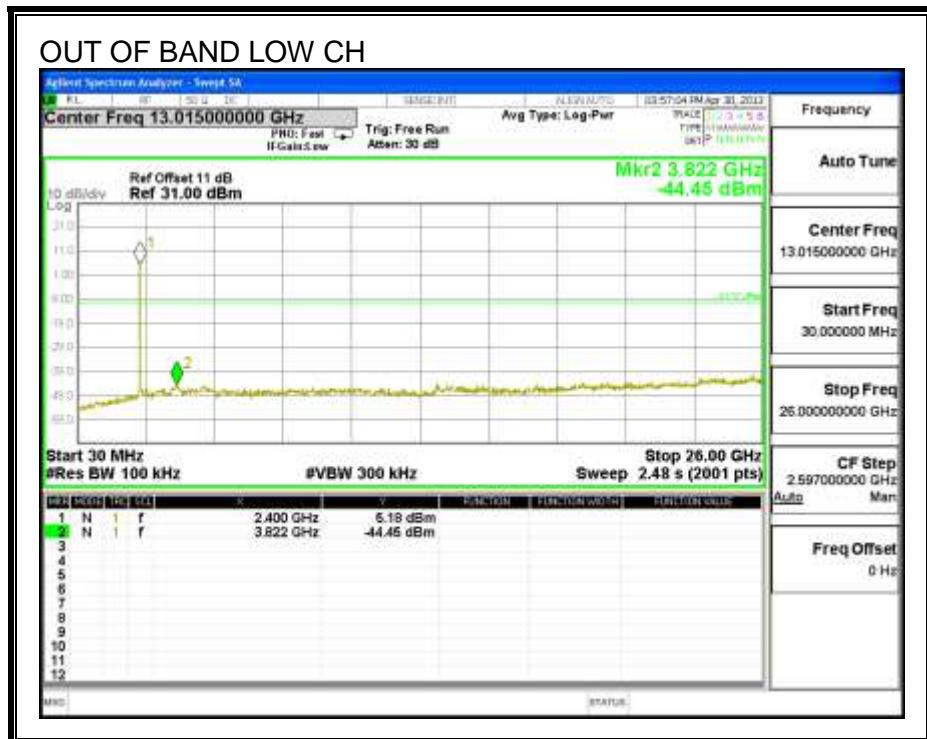
LOW CHANNEL BANDEDGE

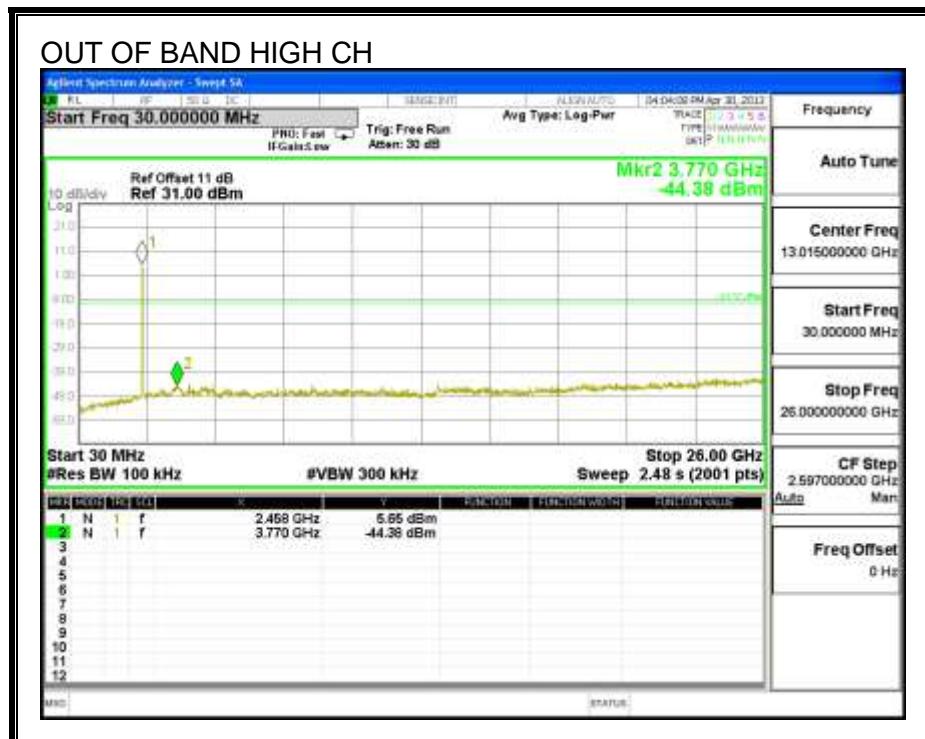
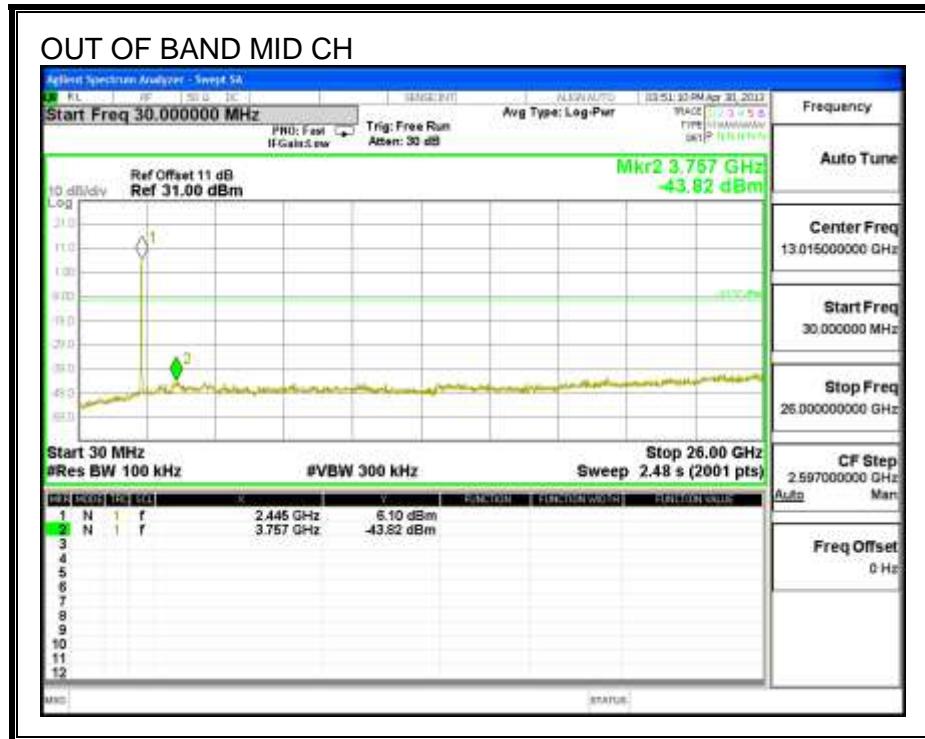


HIGH CHANNEL BANDEDGE



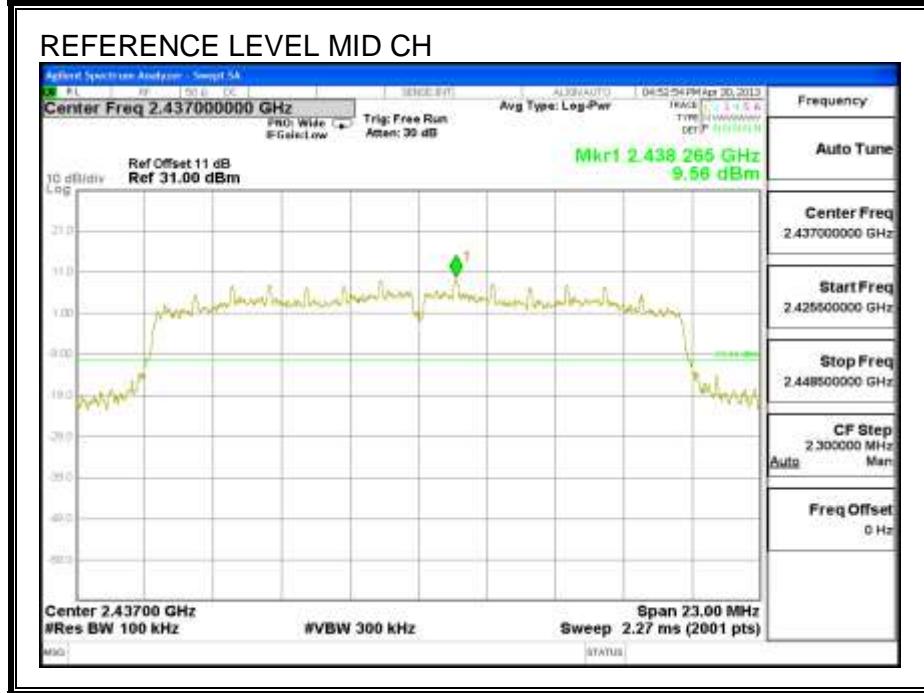
OUT-OF-BAND EMISSIONS



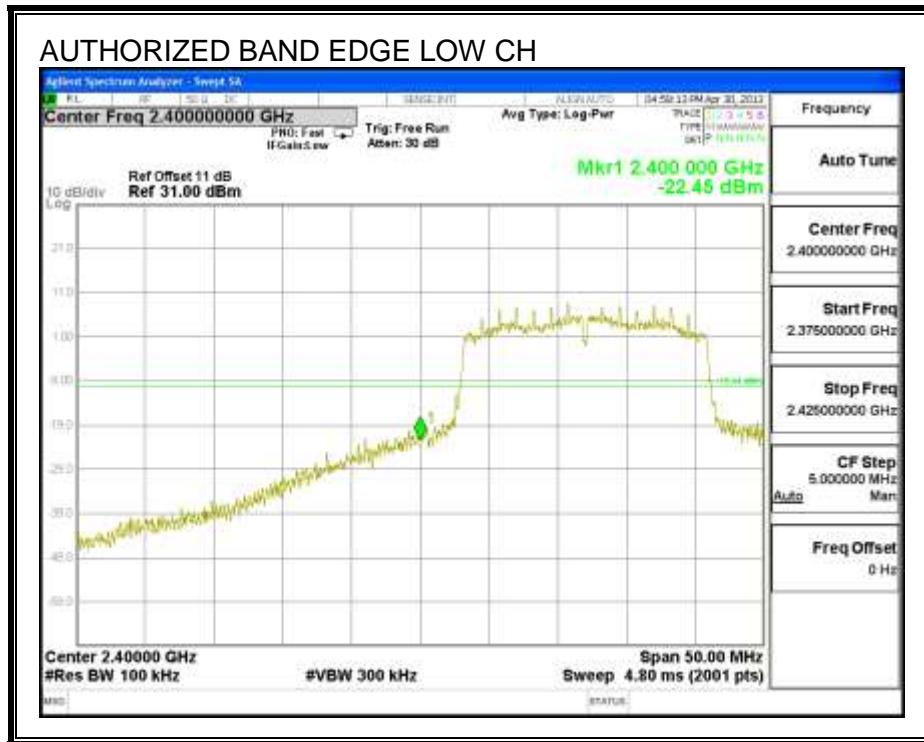


HT20

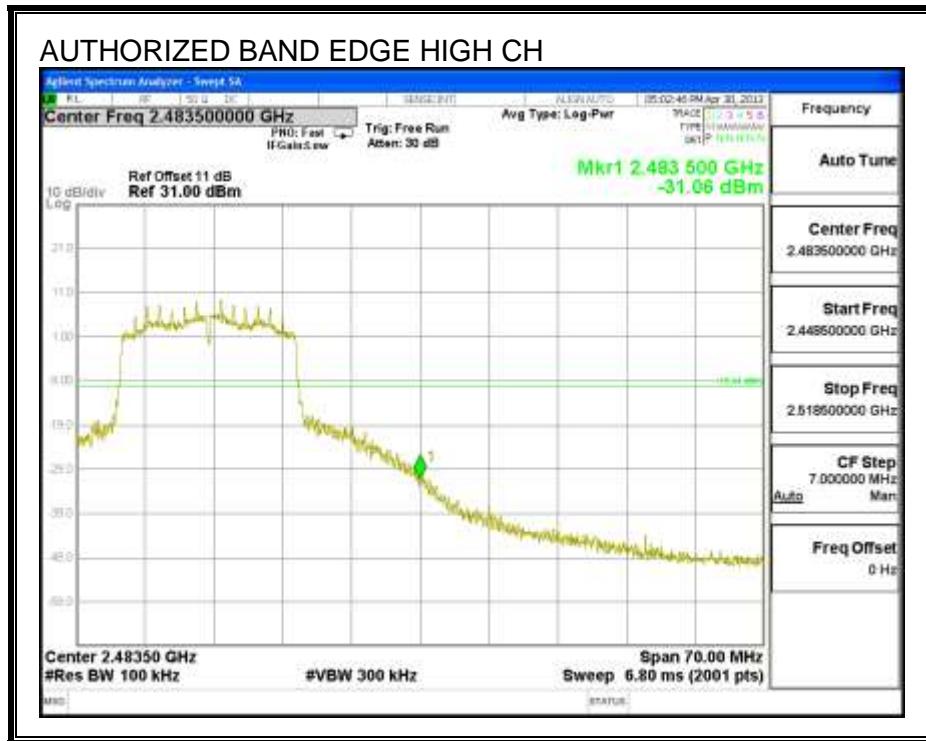
IN-BAND REFERENCE LEVEL



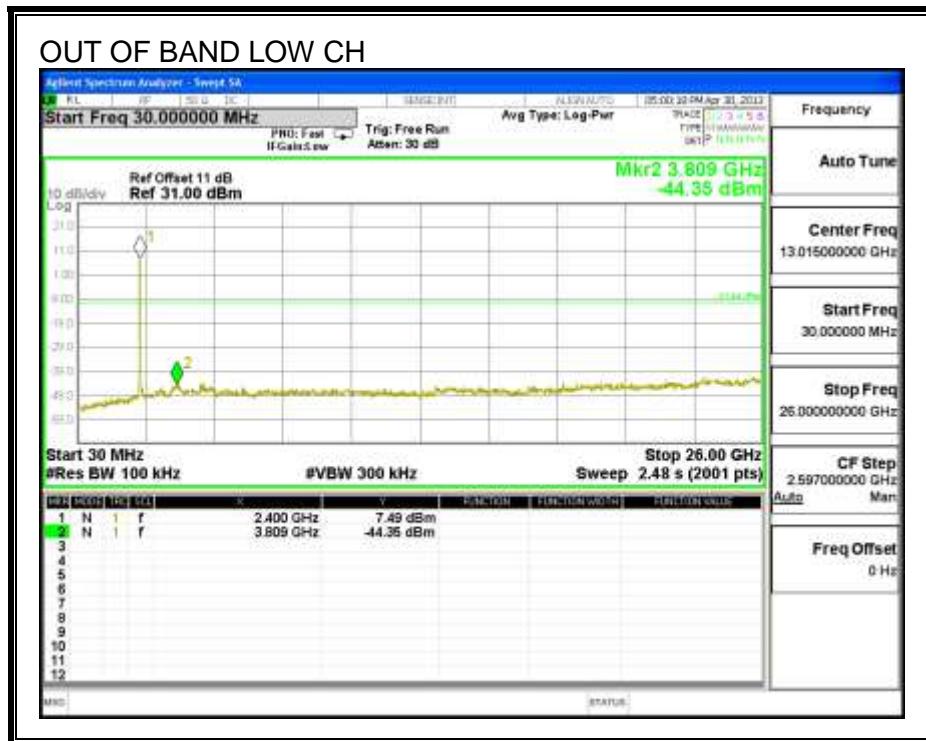
LOW CHANNEL BANEDGE

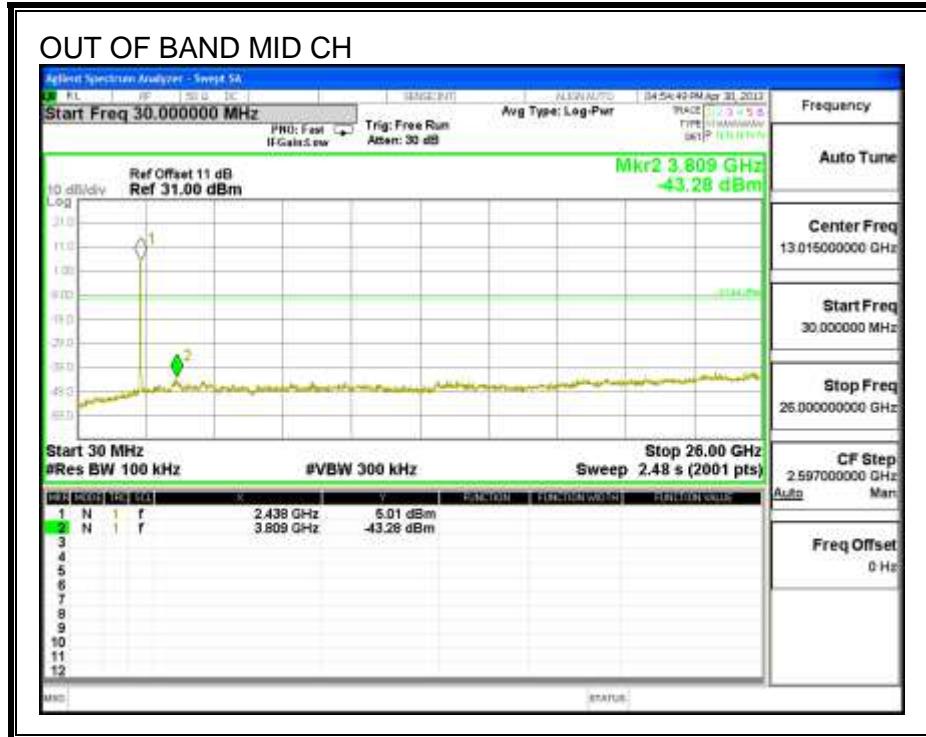


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS





7.2. 5.8GHz BAND

7.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

TEST PROCEDURE

KDB 558074 D01 v01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

a mode

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5745	15.144	0.5
Mid	5785	15.120	0.5
High	5825	15.144	0.5

HT20 Mode

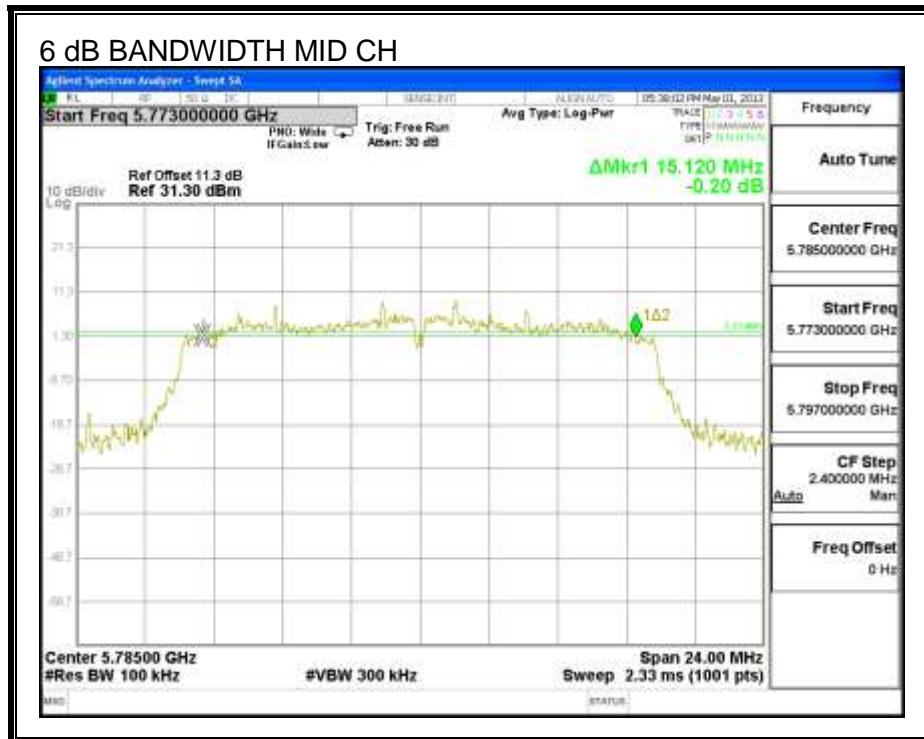
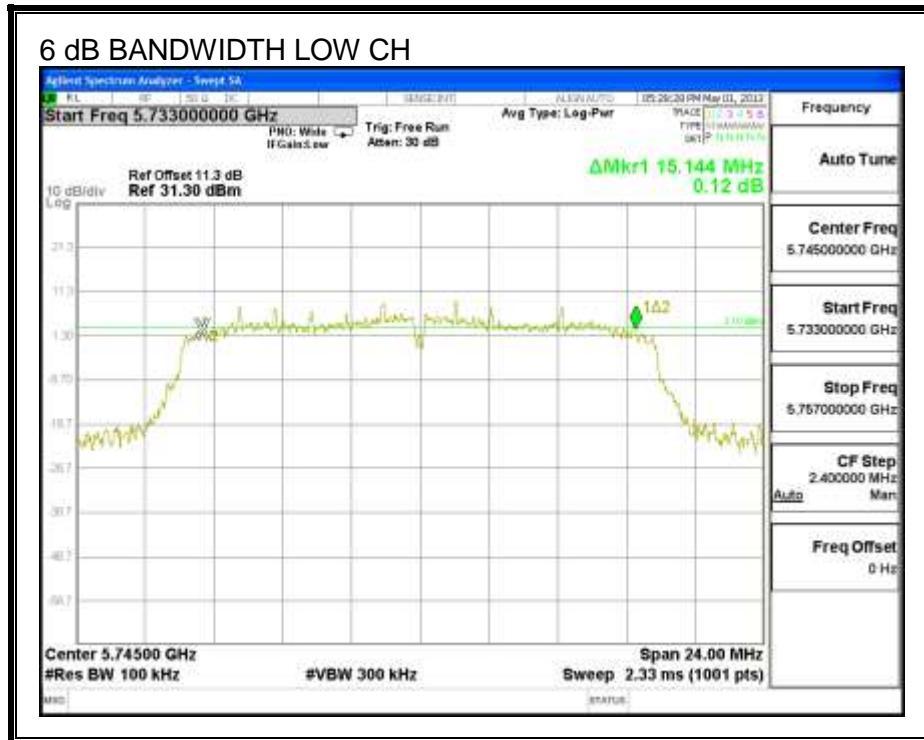
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5745	15.168	0.5
Mid	5785	15.096	0.5
High	5825	15.096	0.5

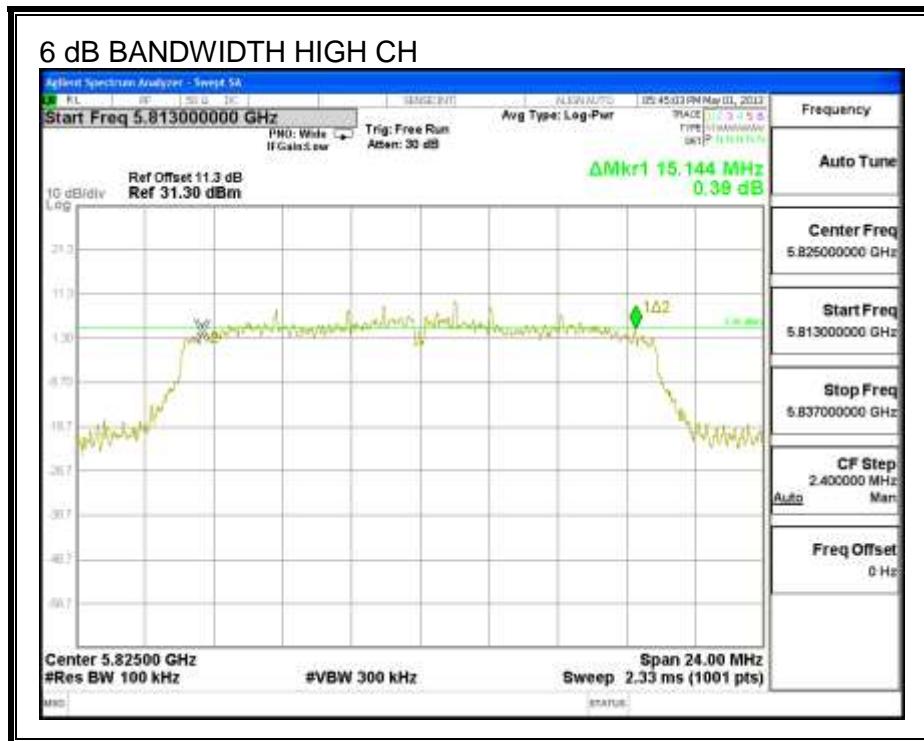
HT40

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5755	35.112	0.5
High	5795	35.112	0.5

a mode

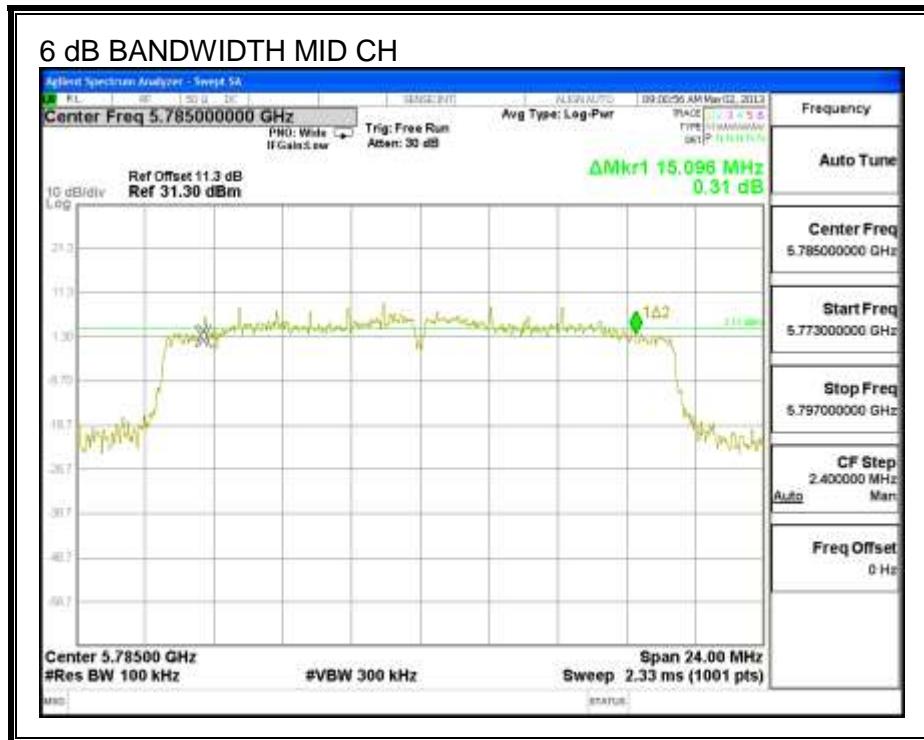
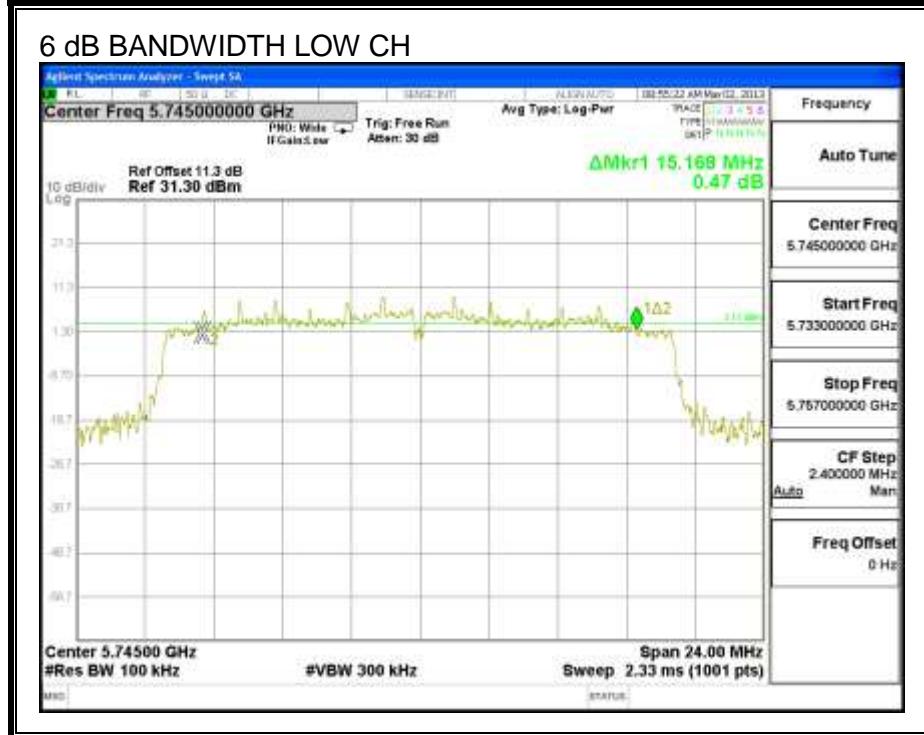
6 dB BANDWIDTH

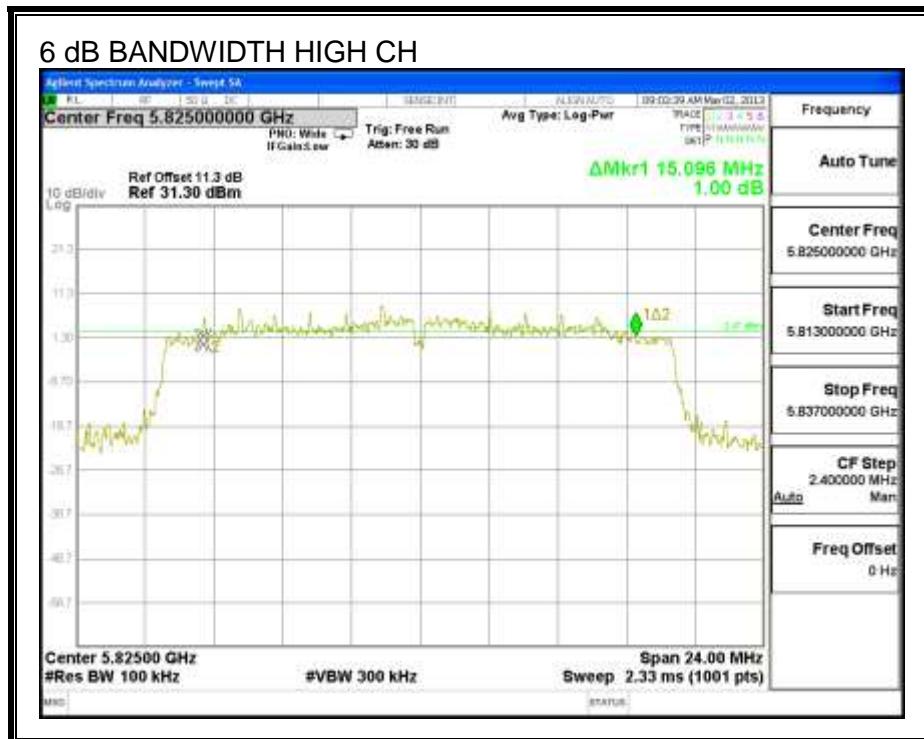




HT20

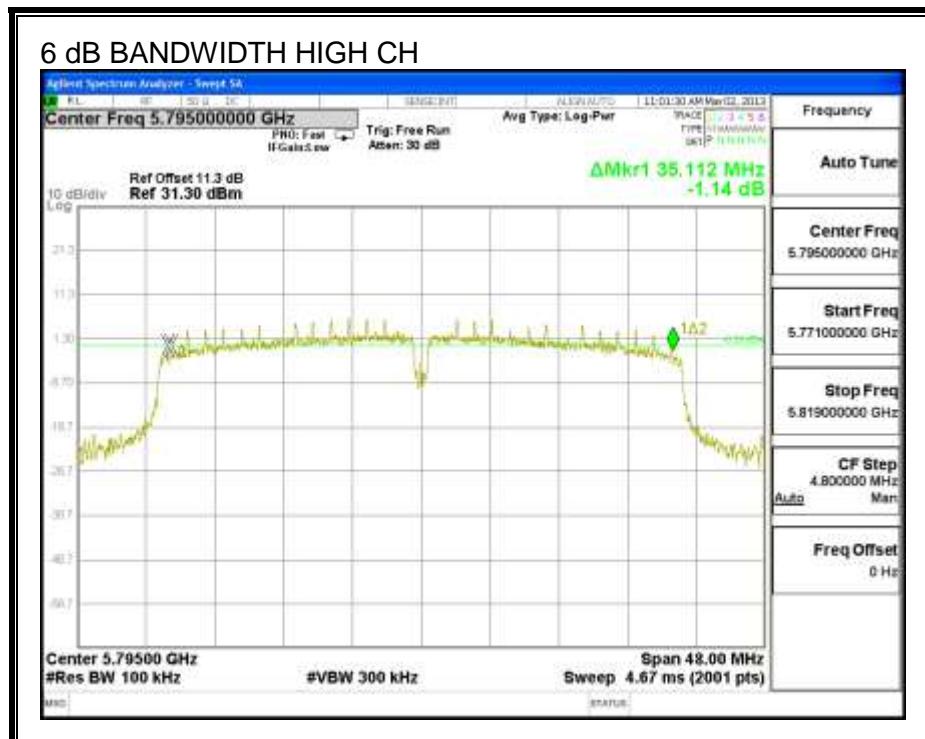
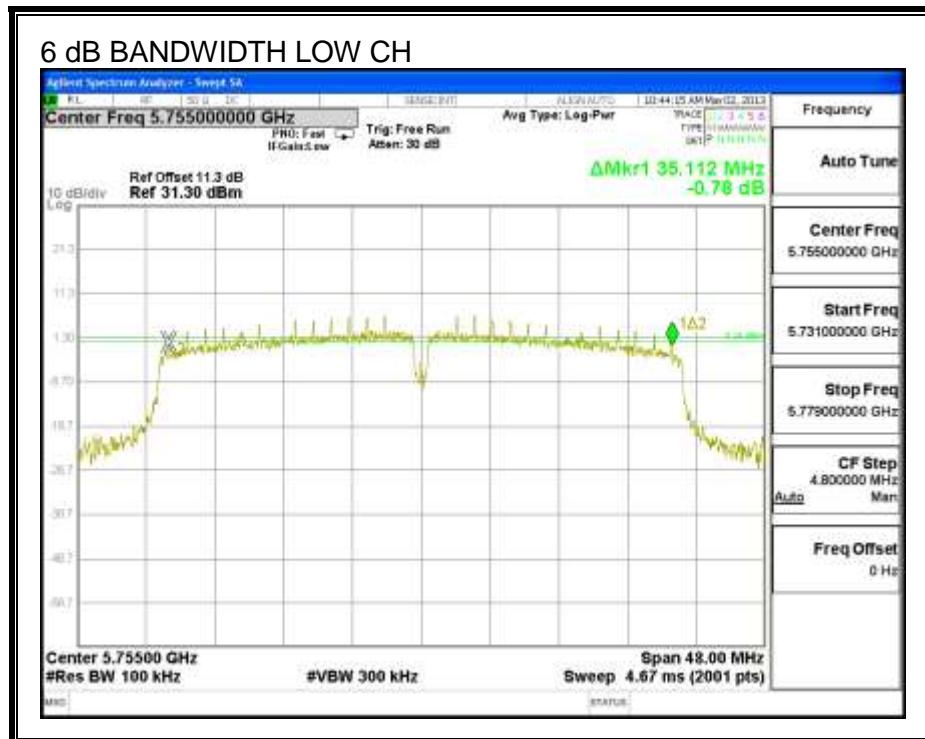
6 dB BANDWIDTH





HT40

6 dB BANDWIDTH



7.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

a mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	16.3380
Mid	5785	16.4100
High	5825	16.4550

HT20

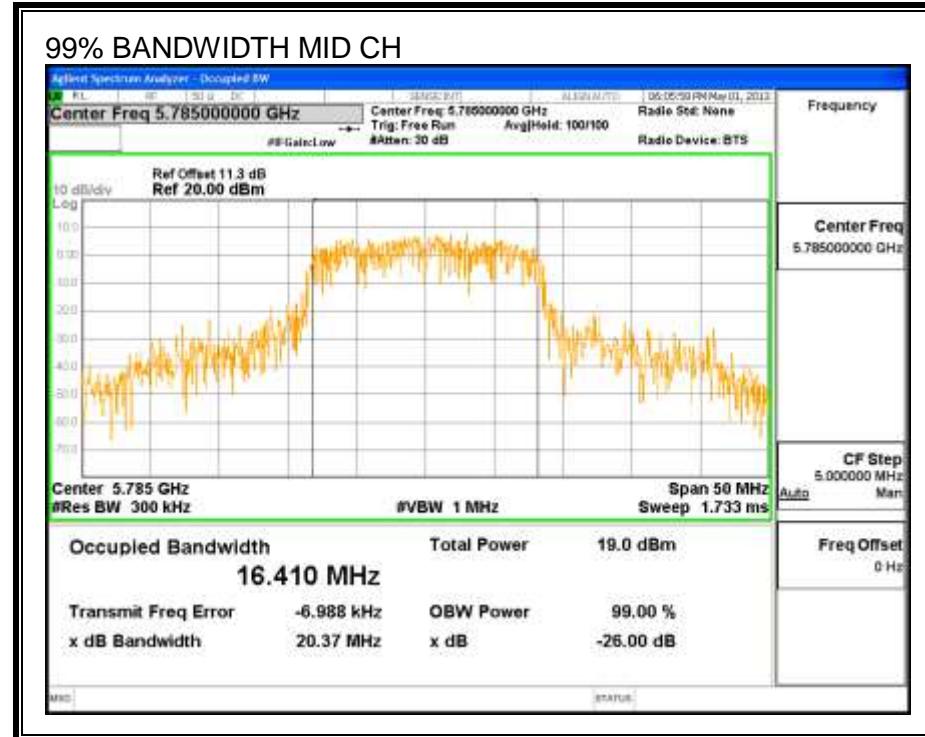
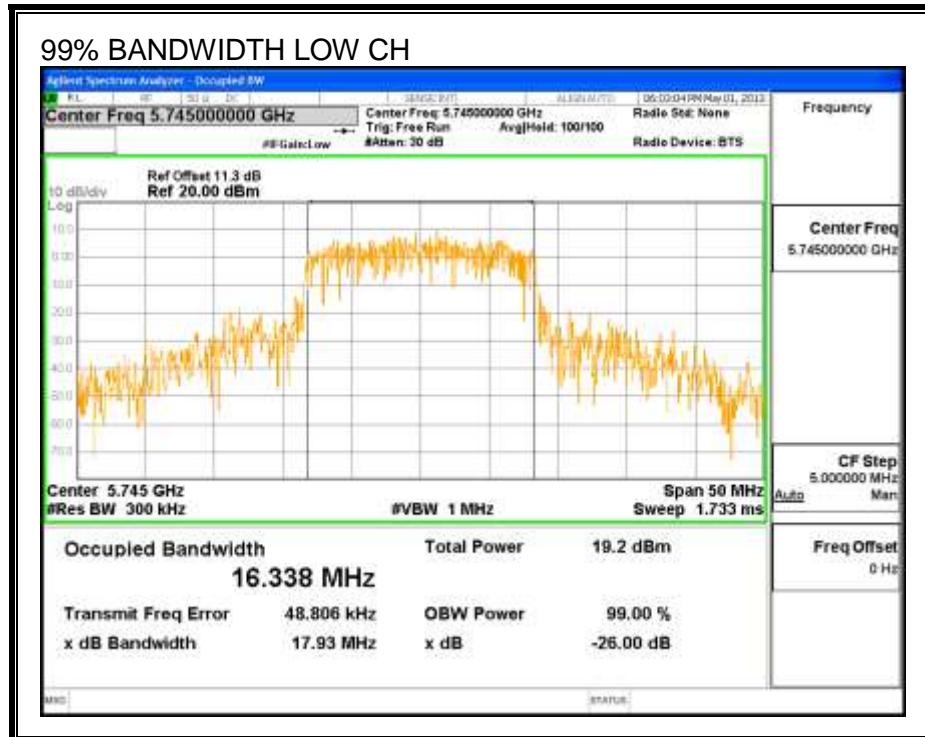
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	17.6220
Mid	5785	17.6570
High	5825	17.6440

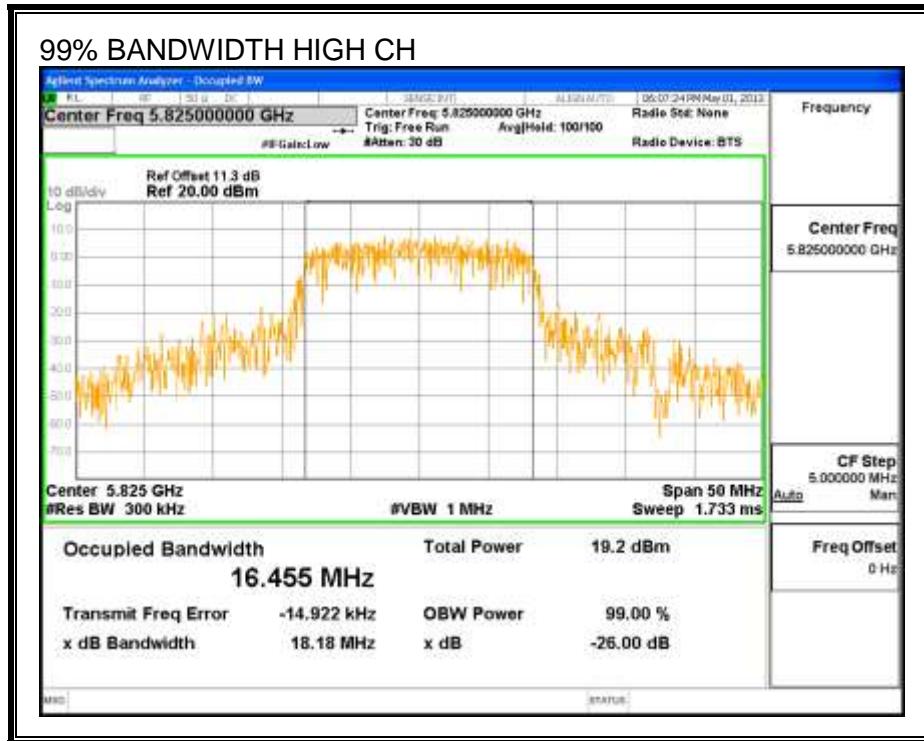
HT40

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5755	36.1210
High	5795	36.1840

a mode

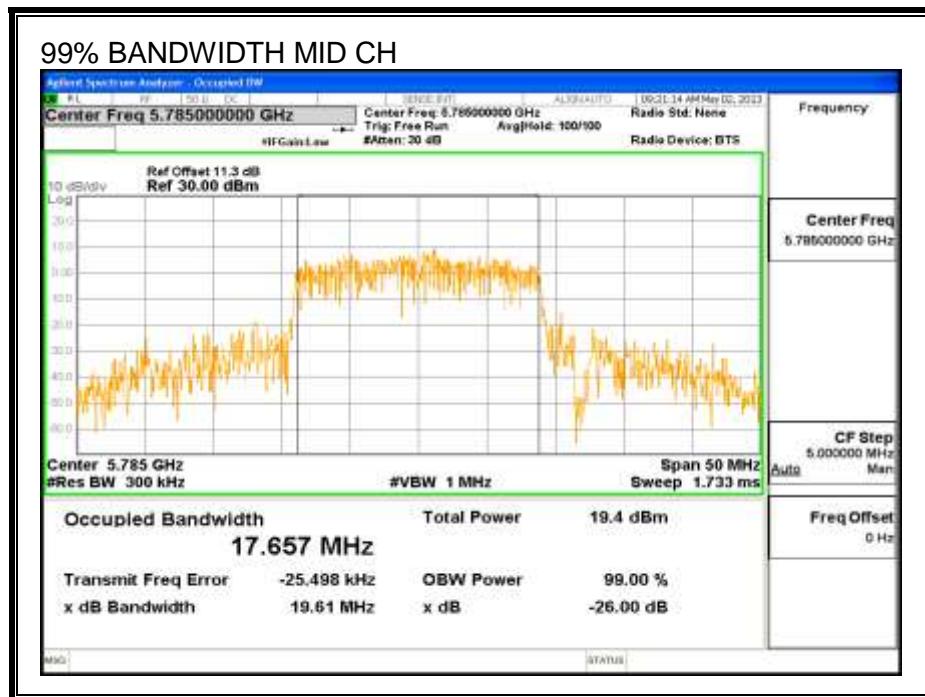
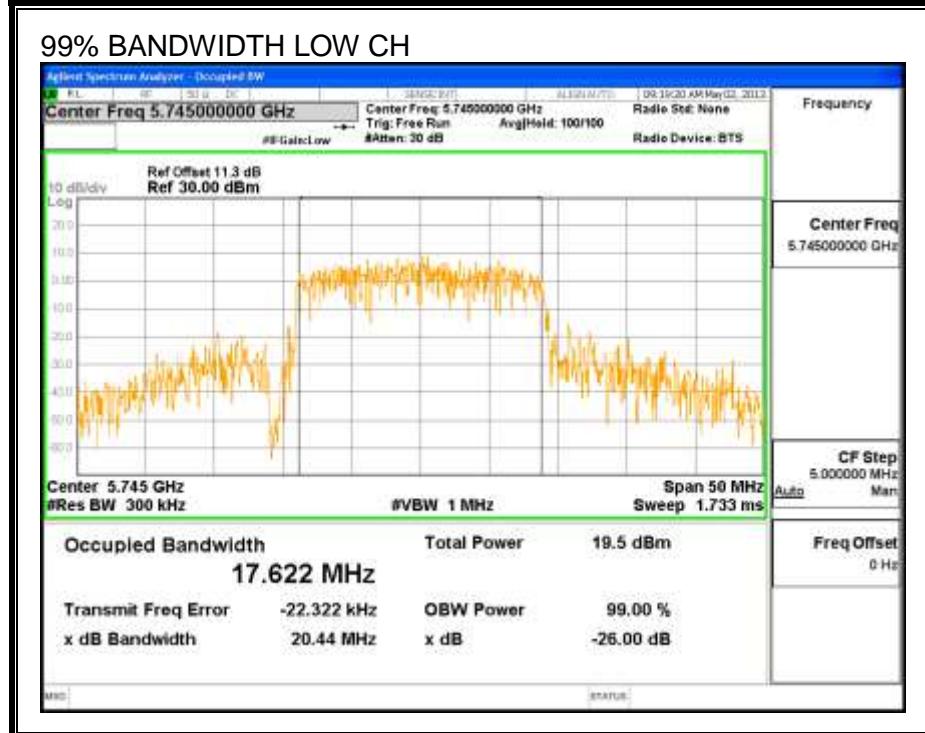
99% BANDWIDTH

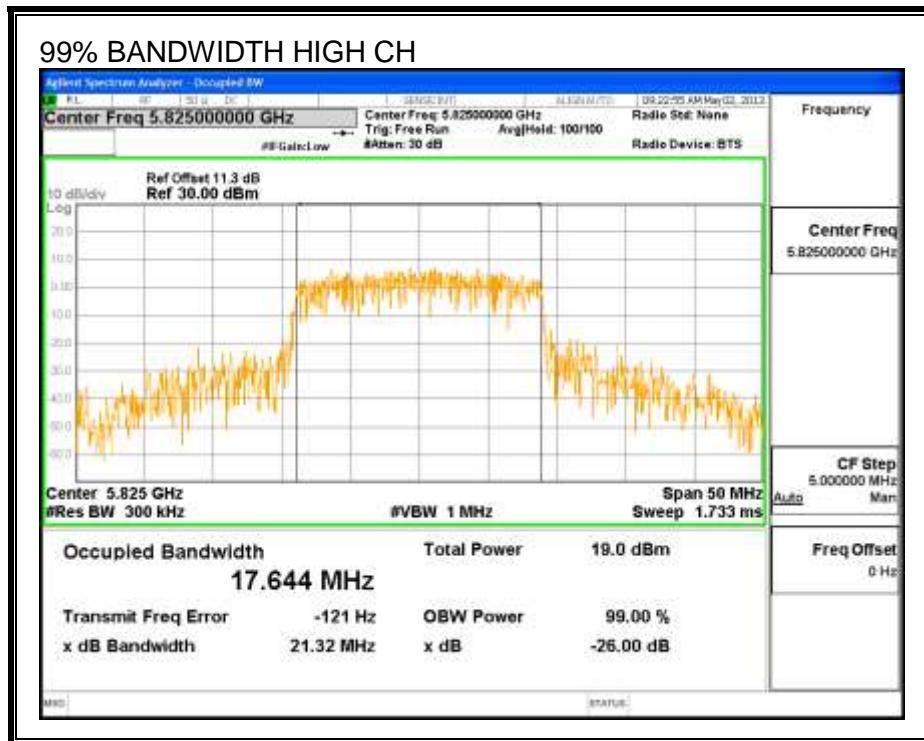




HT20

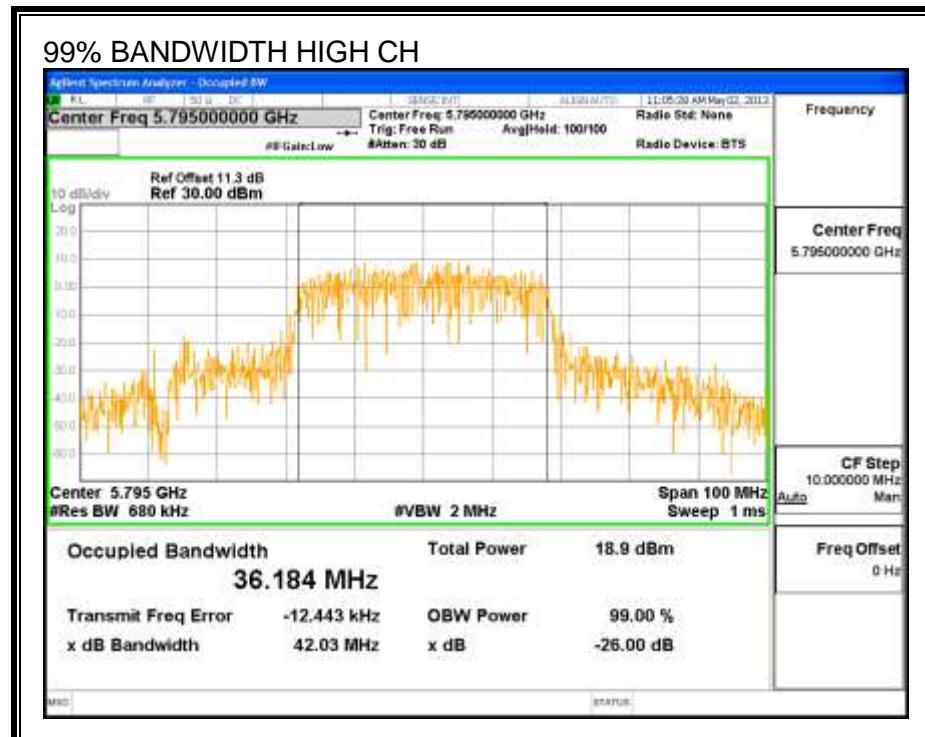
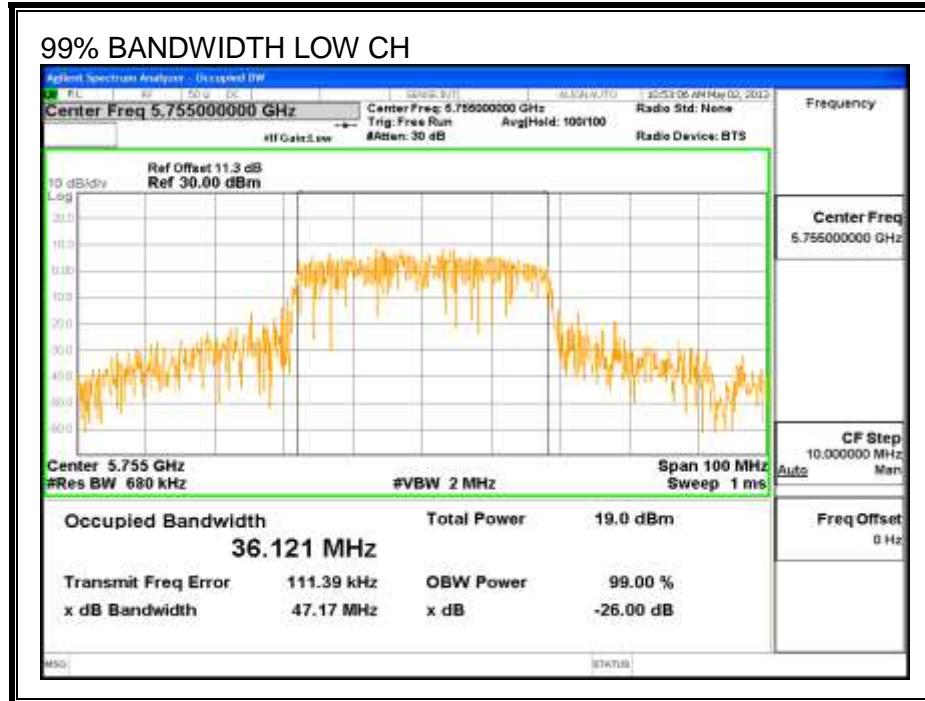
99% BANDWIDTH





HT40

99% BANDWIDTH



7.2.3. AVERAGE POWER

LIMITS

Note; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

a mode

Channel	Frequency (MHz)	Power (dBm)
Low	5745	13.5
Mid	5785	13.5
High	5825	13.5

HT20

Channel	Frequency (MHz)	Power (dBm)
Low	5745	13.5
Mid	5785	13.5
High	5825	13.5

HT40

Channel	Frequency (MHz)	Power (dBm)
Low	5755	13.5
High	5795	13.4

7.2.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-210 A8.4

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

a mode

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5745	-4.50	30.00	30	36	30.00
Mid	5785	-4.50	30.00	30	36	30.00
High	5825	-4.50	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5745	20.816	20.82	30.00	-9.18
Mid	5785	20.541	20.54	30.00	-9.46
High	5825	20.640	20.64	30.00	-9.36

HT20

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5745	-4.50	30.00	30	36	30.00
Mid	5785	-4.50	30.00	30	36	30.00
High	5825	-4.50	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5745	20.529	20.53	30.00	-9.47
Mid	5785	20.528	20.53	30.00	-9.47
High	5825	20.436	20.44	30.00	-9.56

HT40

Limits

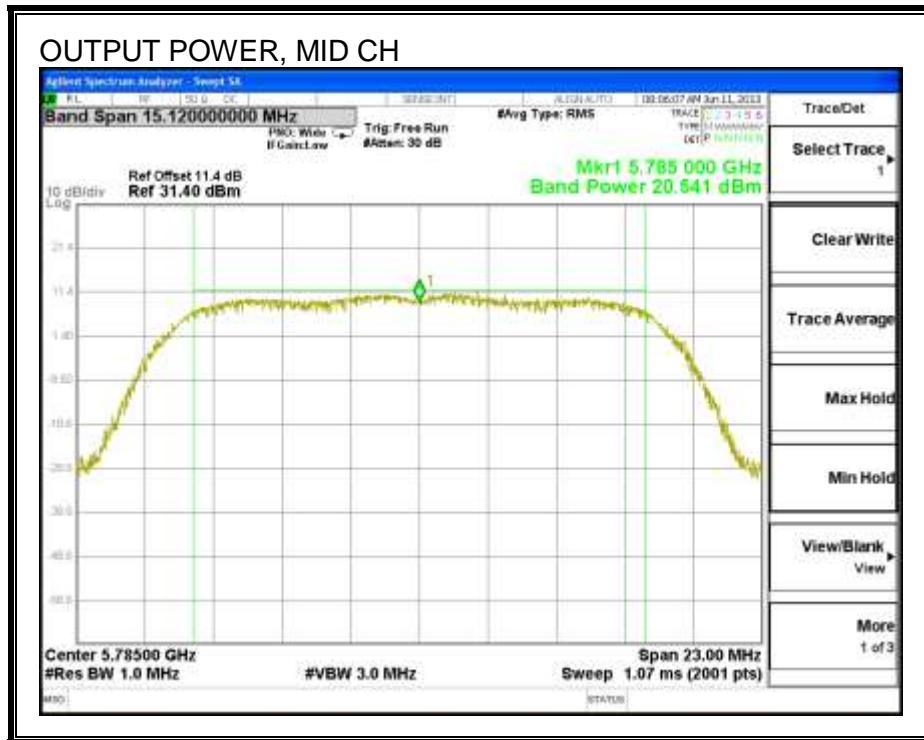
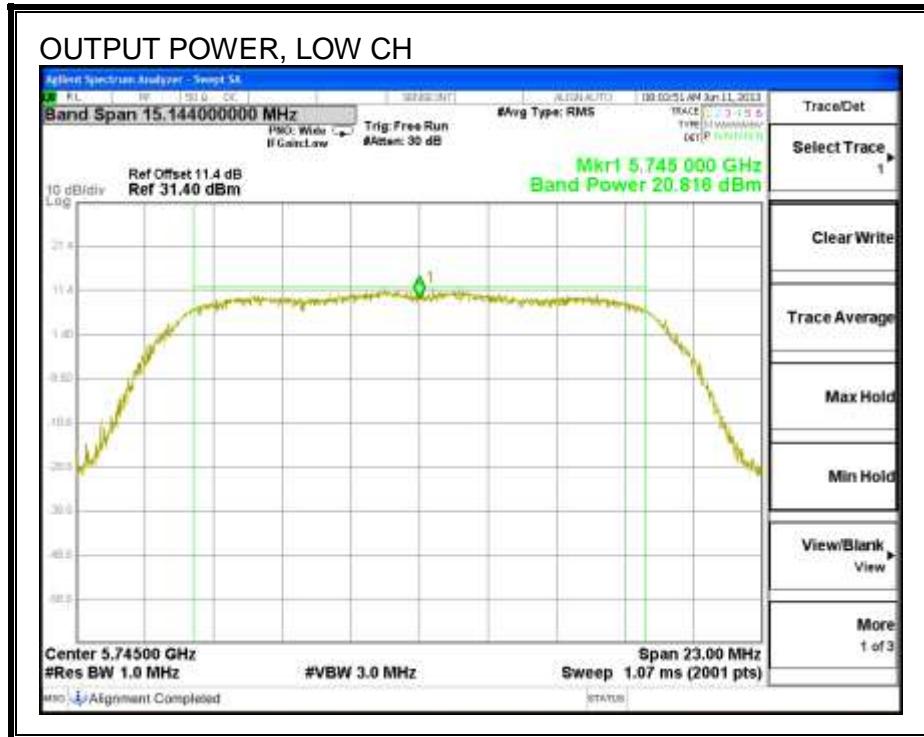
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5755	-4.50	30.00	30	36	30.00
High	5795	-4.50	30.00	30	36	30.00

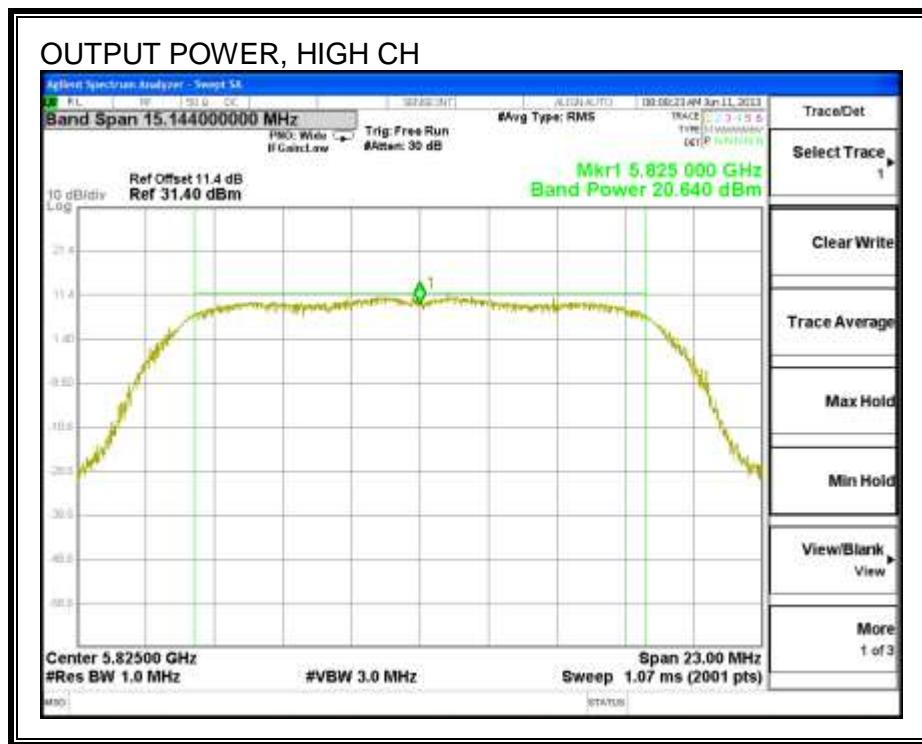
Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5755	20.710	20.710	30.00	-9.29
High	5795	20.741	20.741	30.00	-9.26

a mode

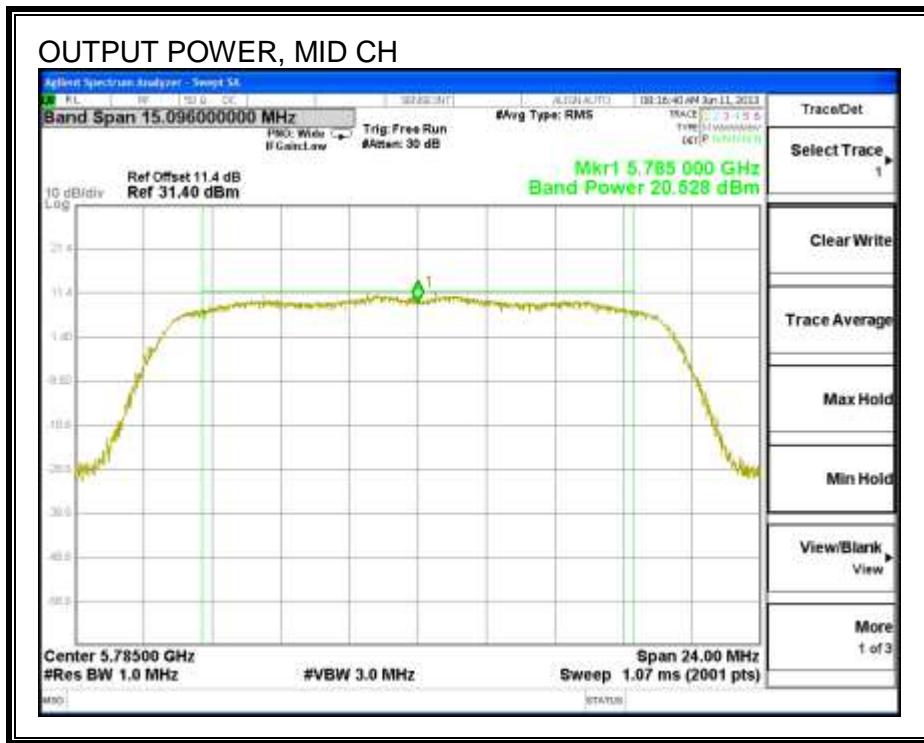
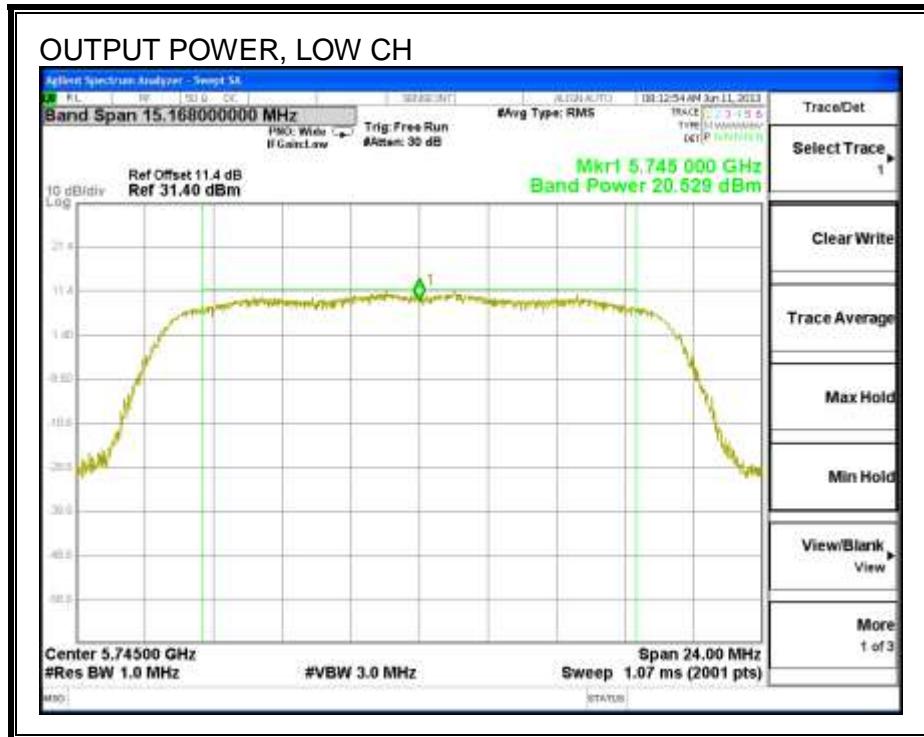
OUTPUT POWER

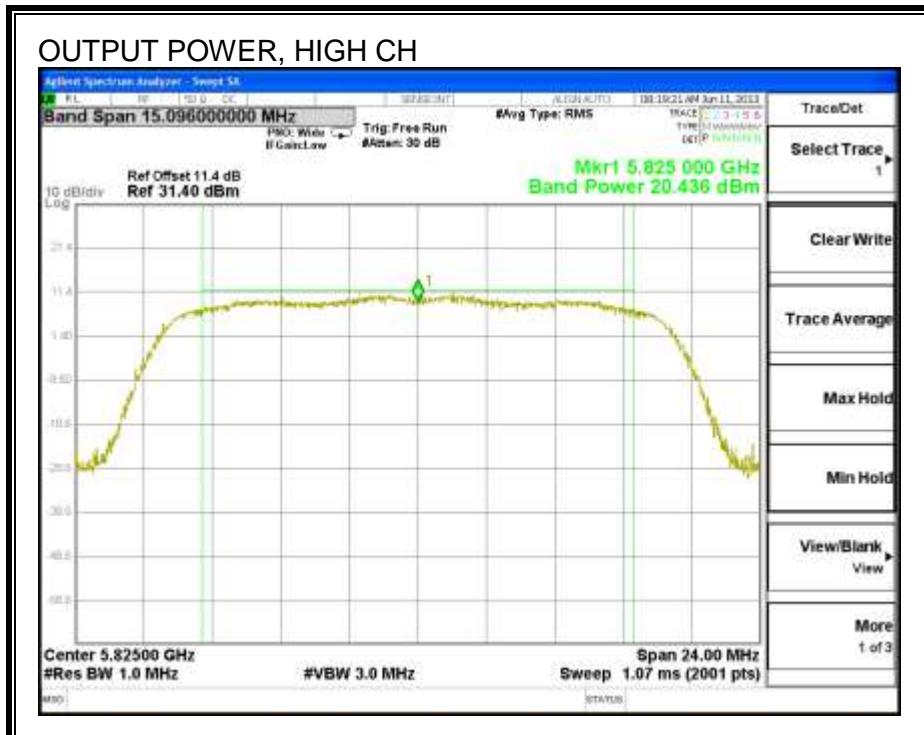




HT20

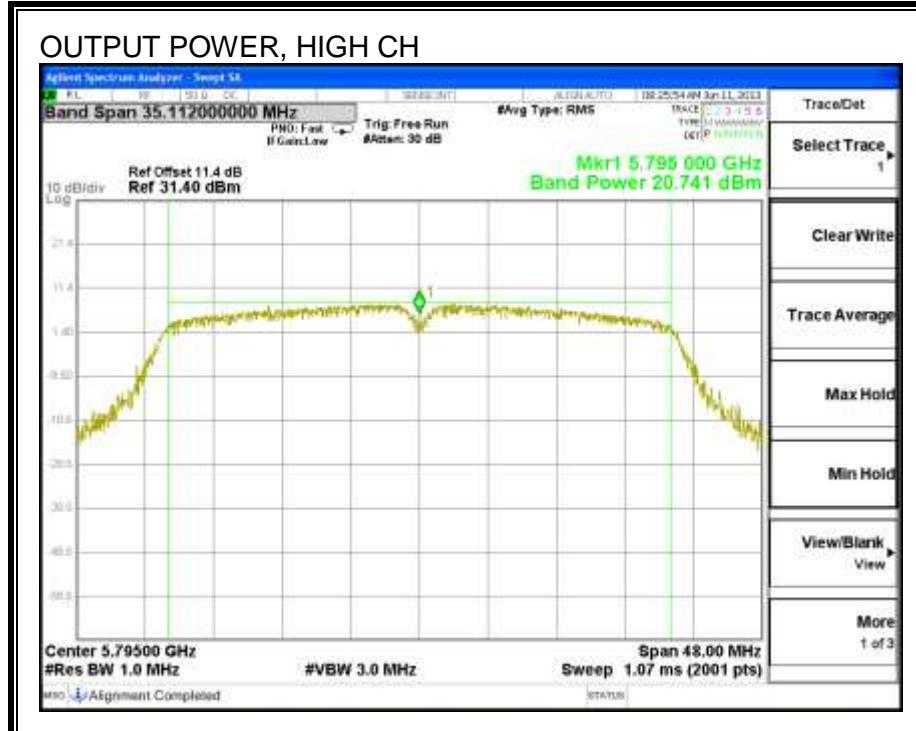
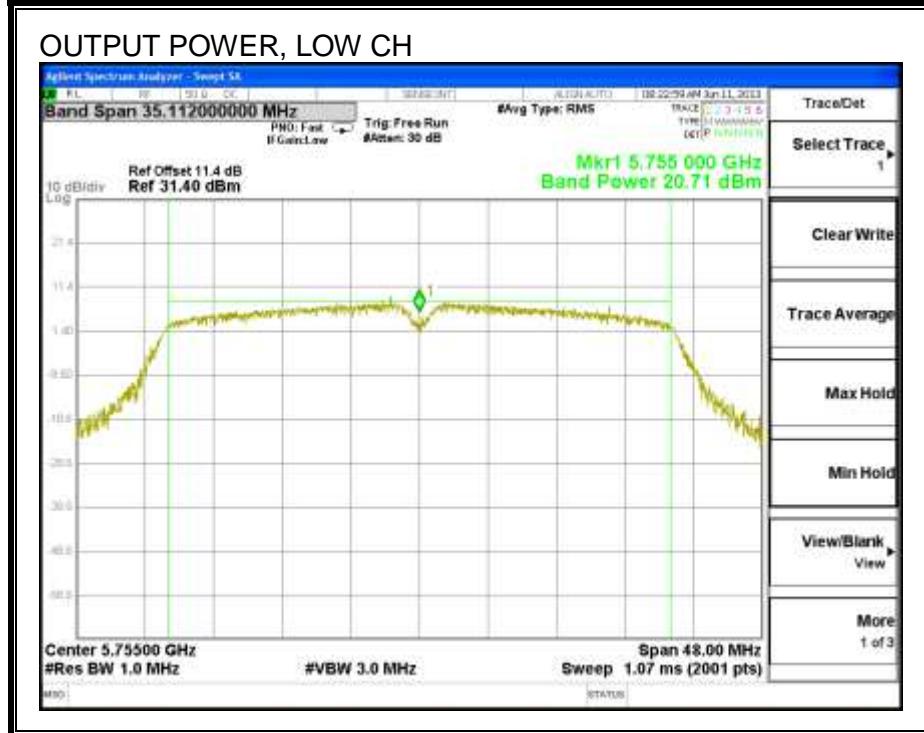
OUTPUT POWER





HT40

OUTPUT POWER



7.2.5. PSD

LIMITS

FCC §15.247

IC RSS-210 A8.2

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

a mode

PSD Results

Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-5.60	8.0	-13.6
Mid	5785	-5.46	8.0	-13.5
High	5825	-4.93	8.0	-12.9

HT20

PSD Results

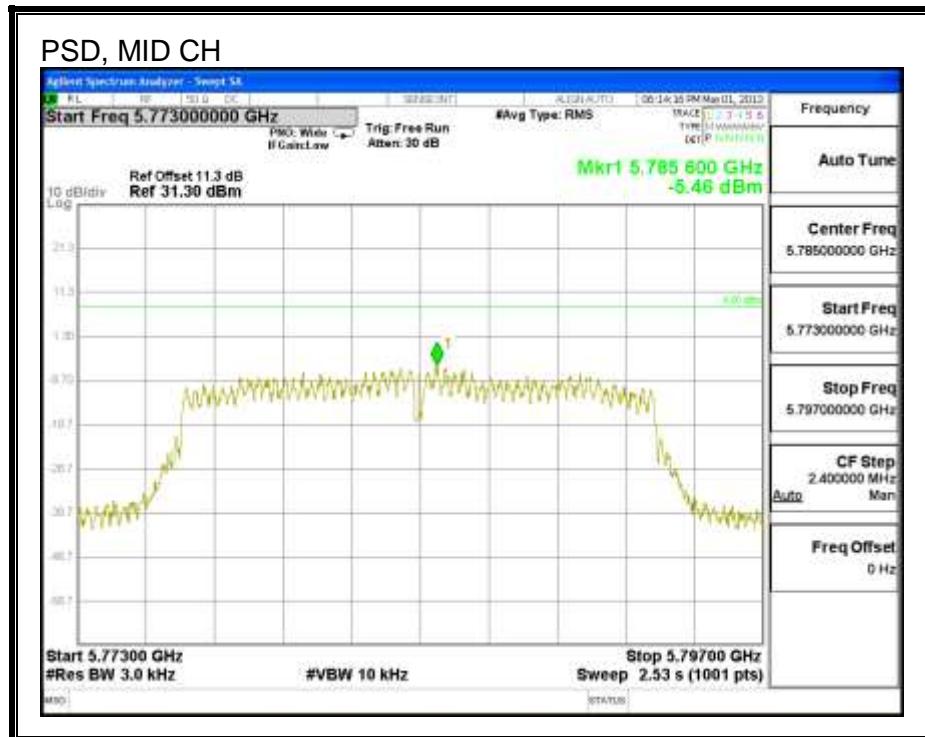
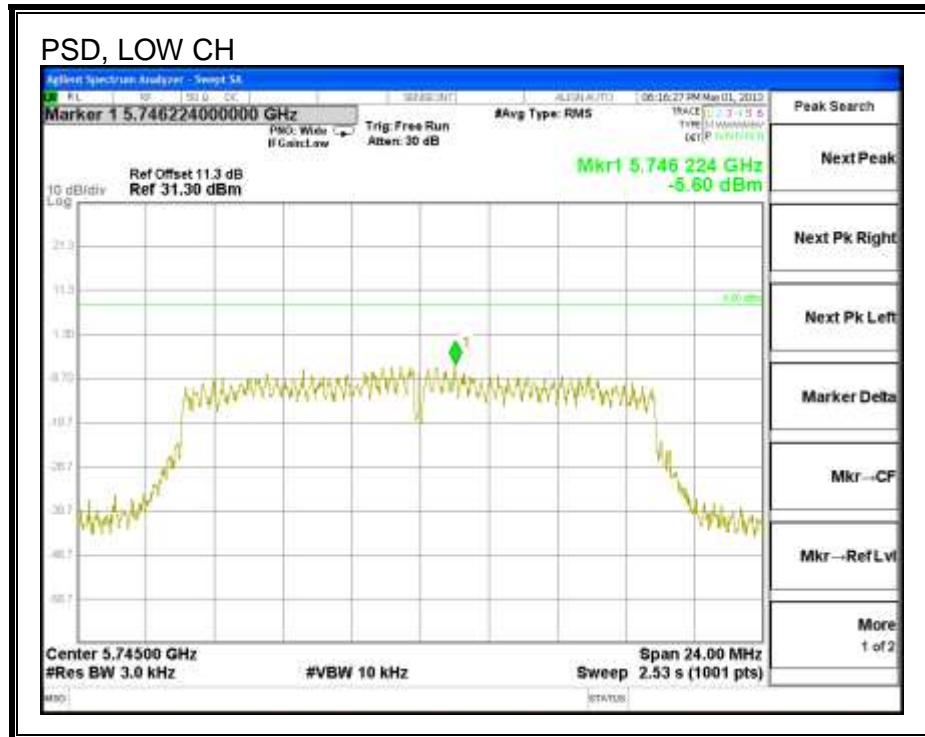
Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-5.39	8.0	-13.4
Mid	5785	-5.76	8.0	-13.8
High	5825	-5.59	8.0	-13.6

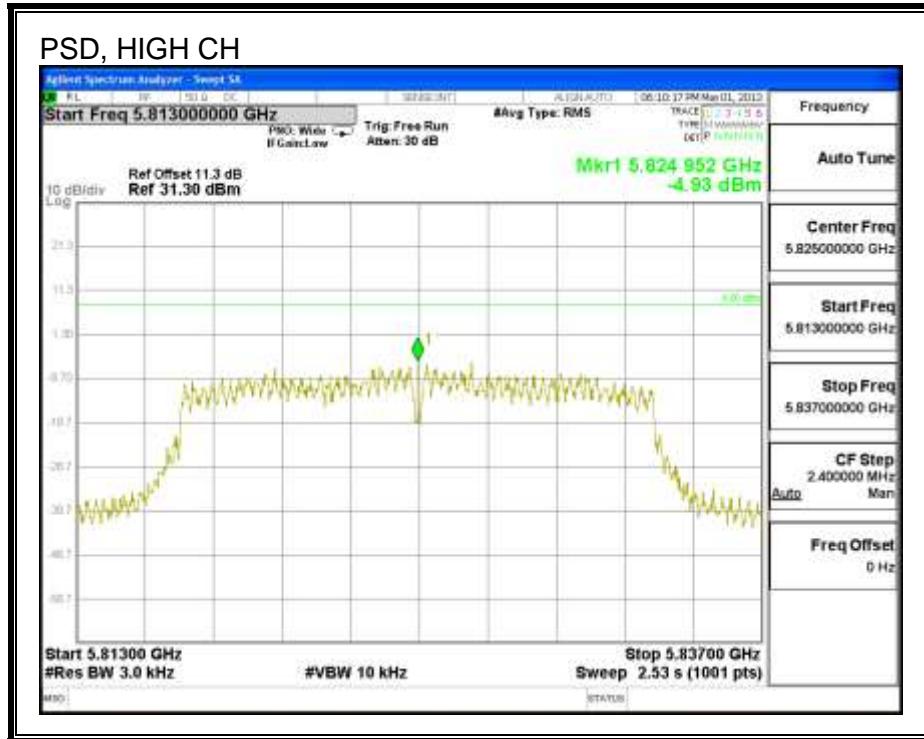
HT40

PSD Results

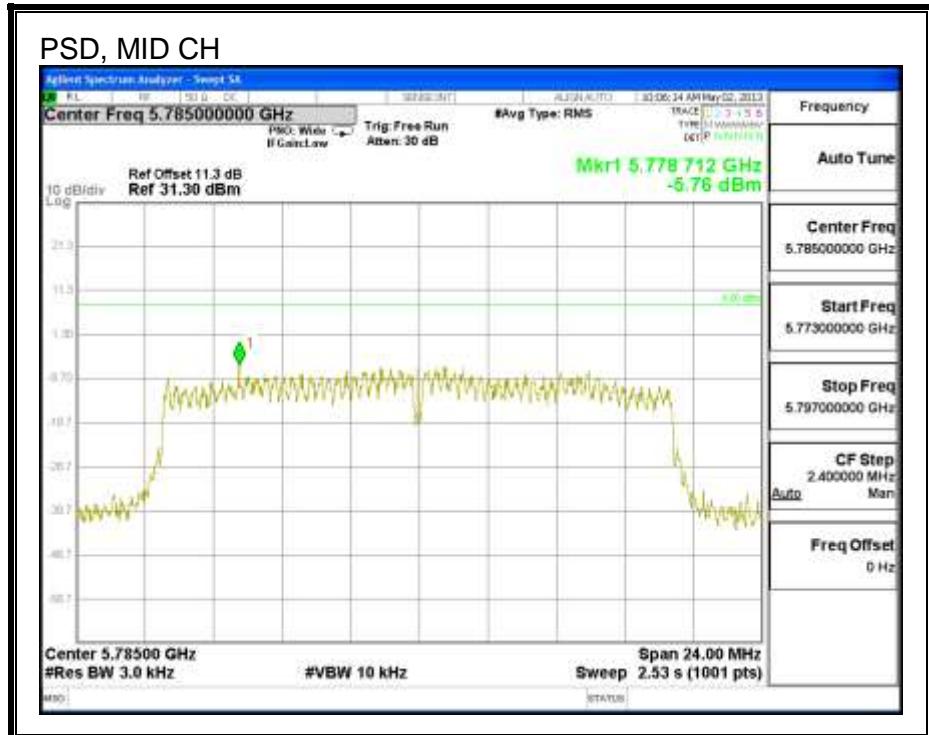
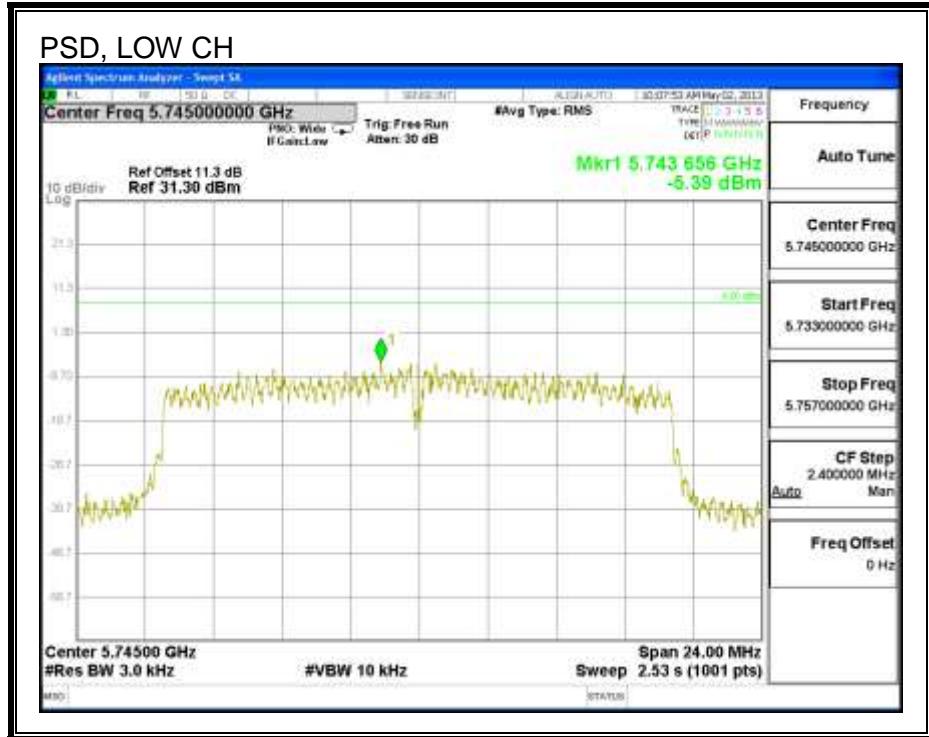
Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	5755	-8.64	8.0	-16.6
High	5795	-9.04	8.0	-17.0

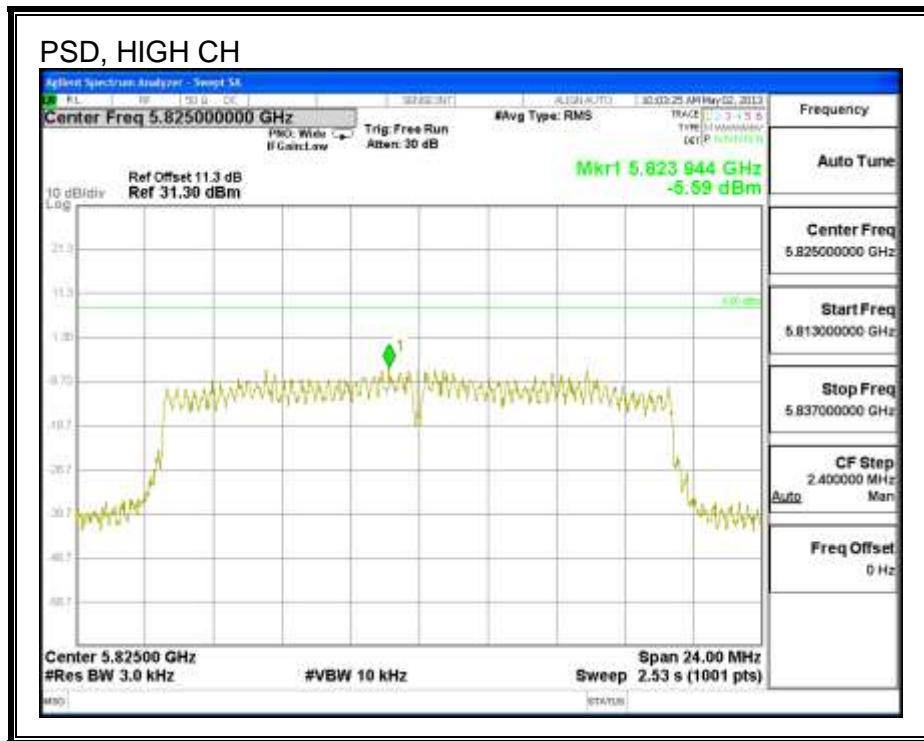
a mode, PSD



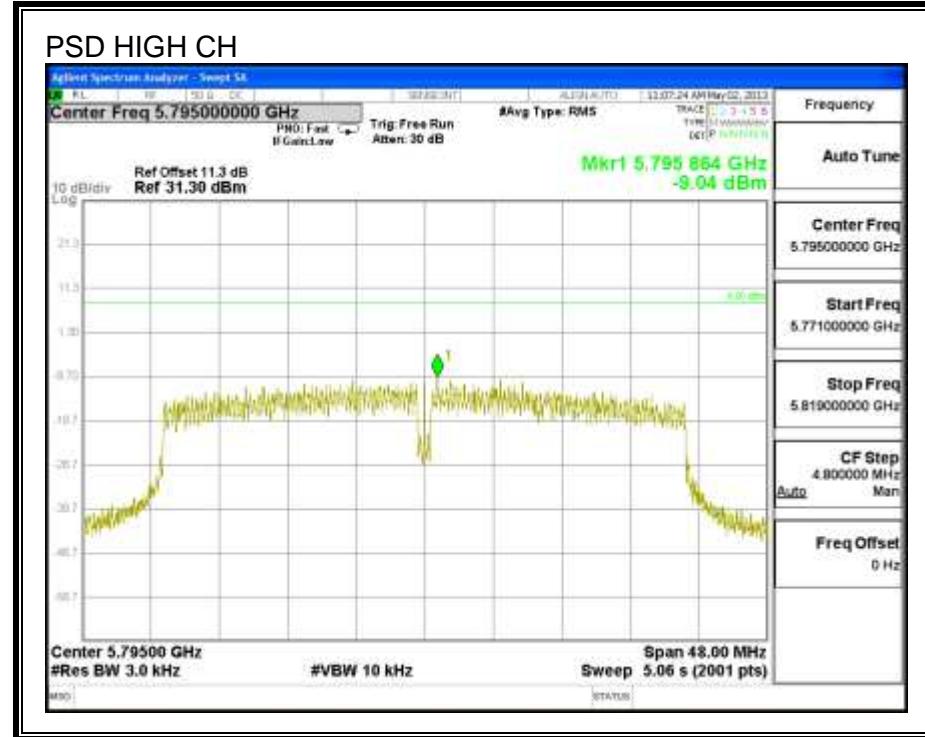
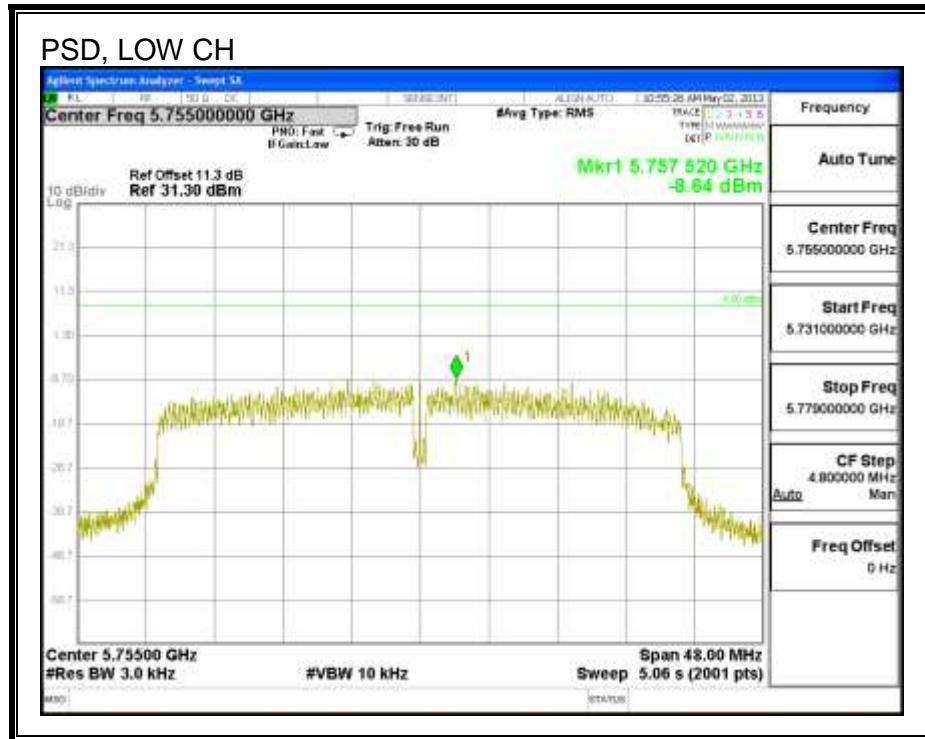


HT20, PSD





HT40,PSD



7.2.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

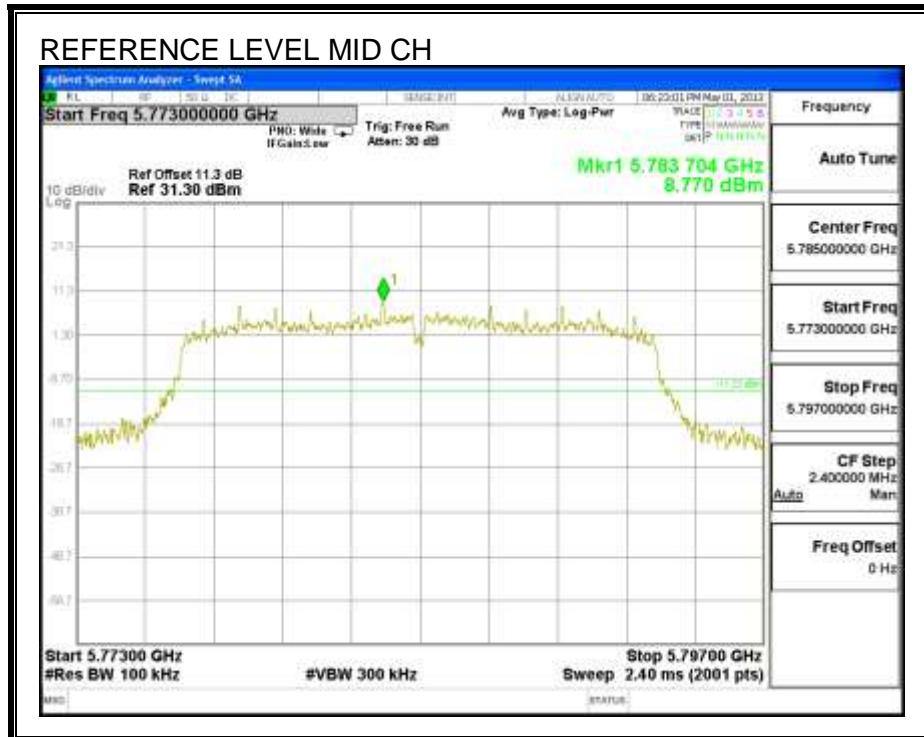
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

TEST PROCEDURE

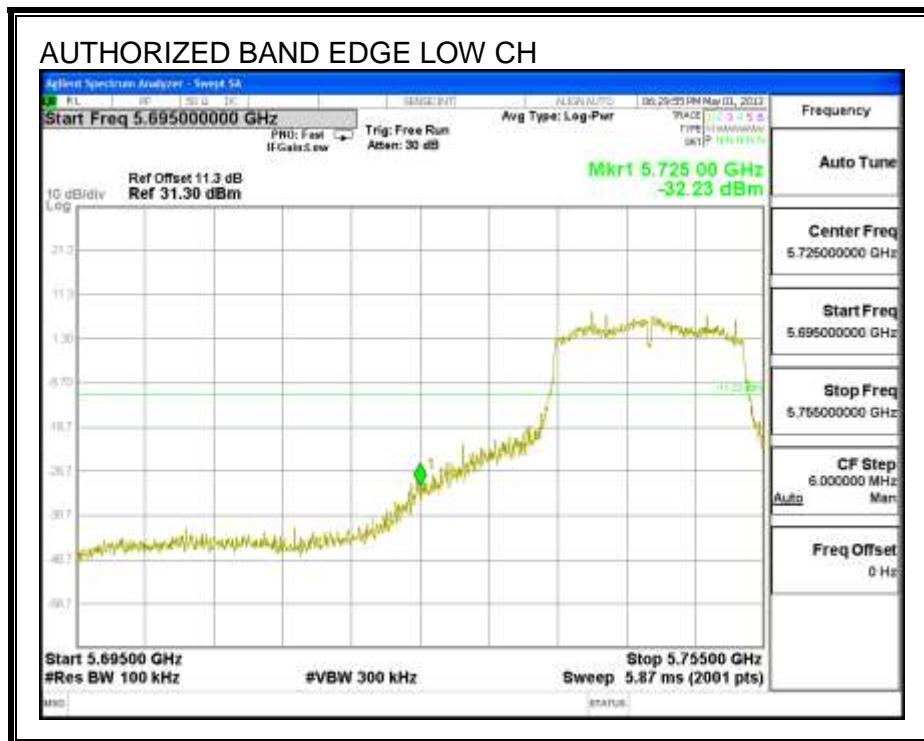
The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

RESULTS

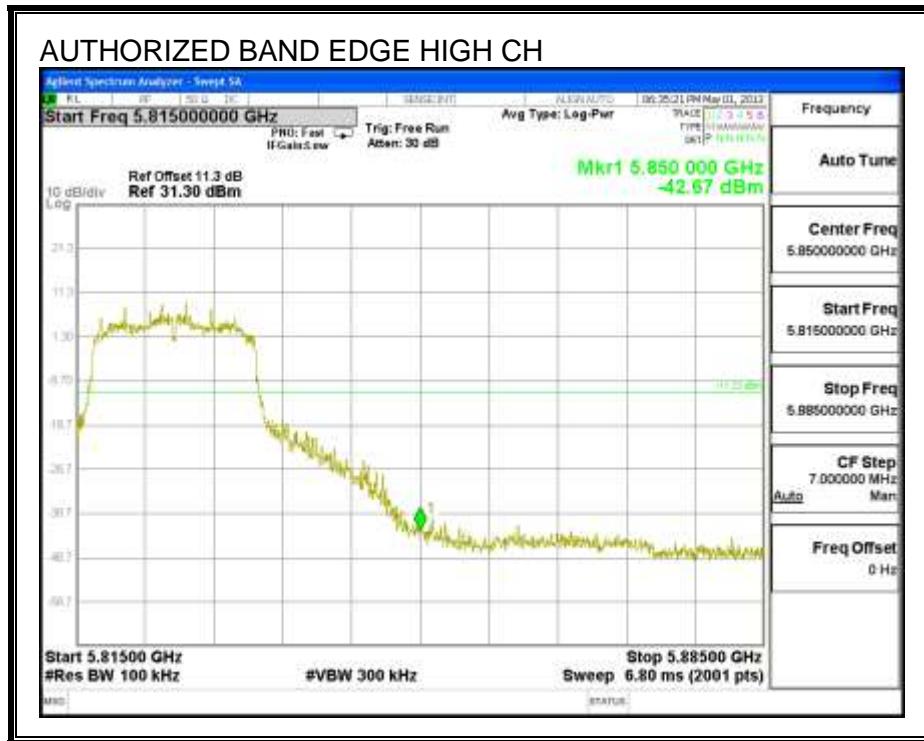
a mode, IN-BAND REFERENCE LEVEL



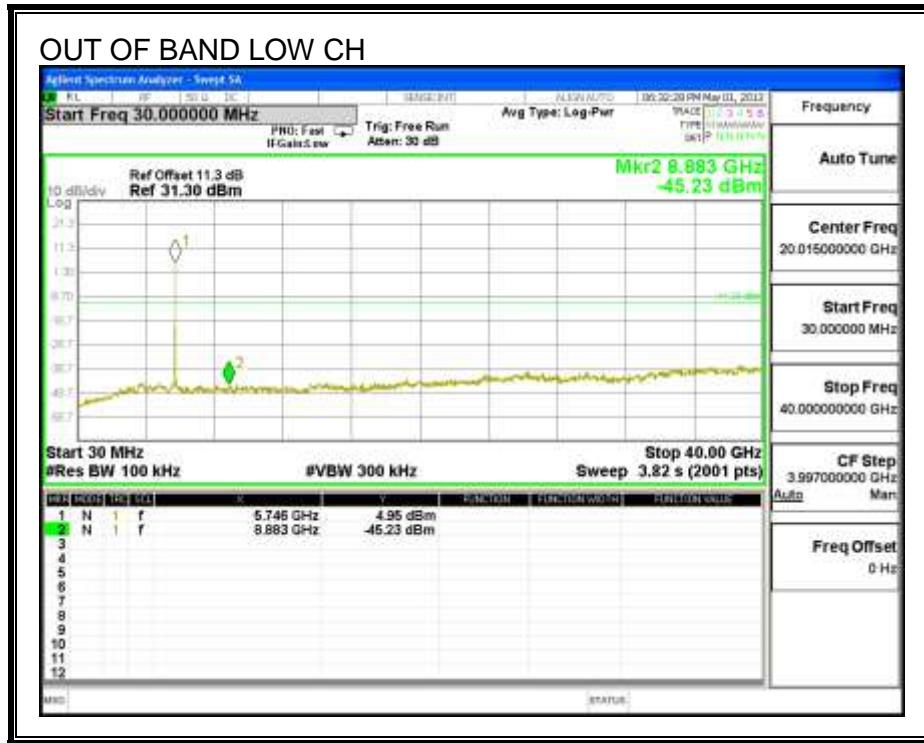
LOW CHANNEL BANDEDGE

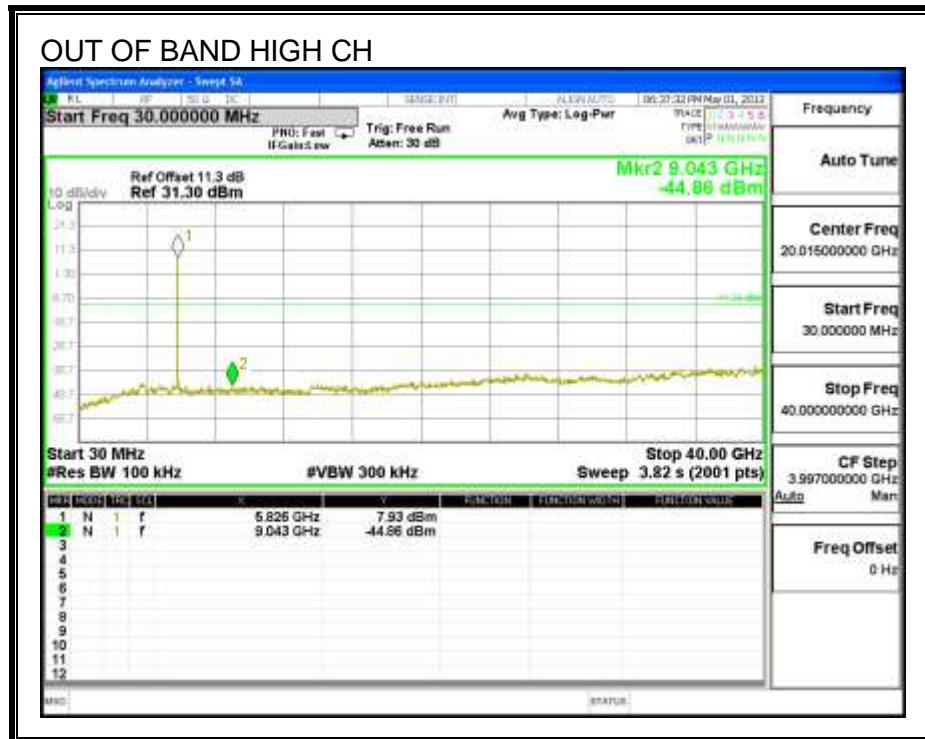
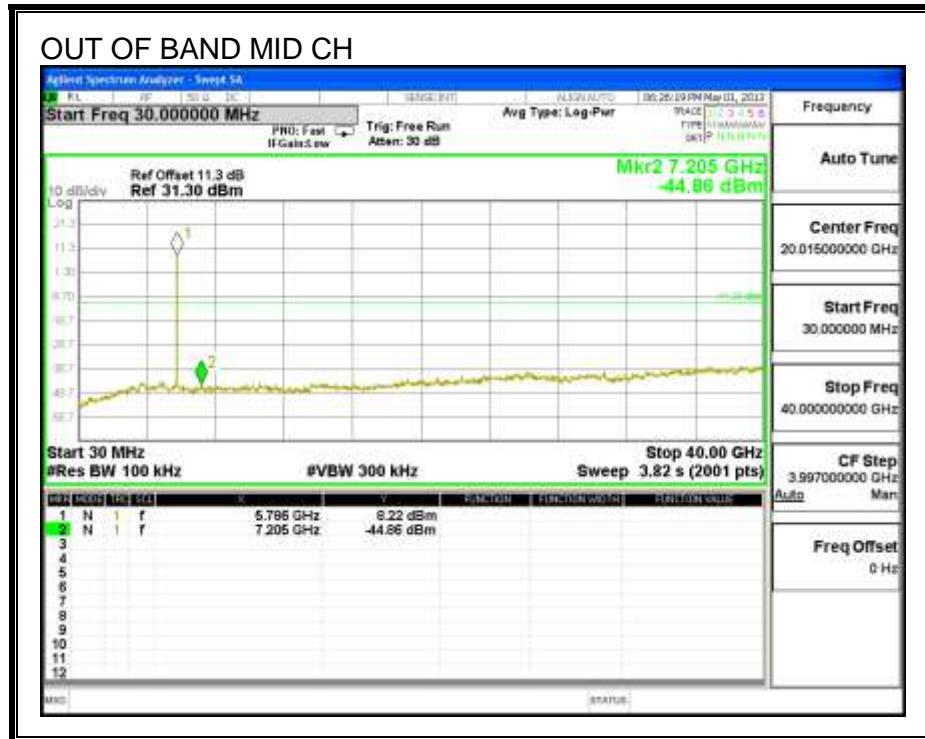


HIGH CHANNEL BANDEDGE



a mode, OUT-OF-BAND EMISSIONS

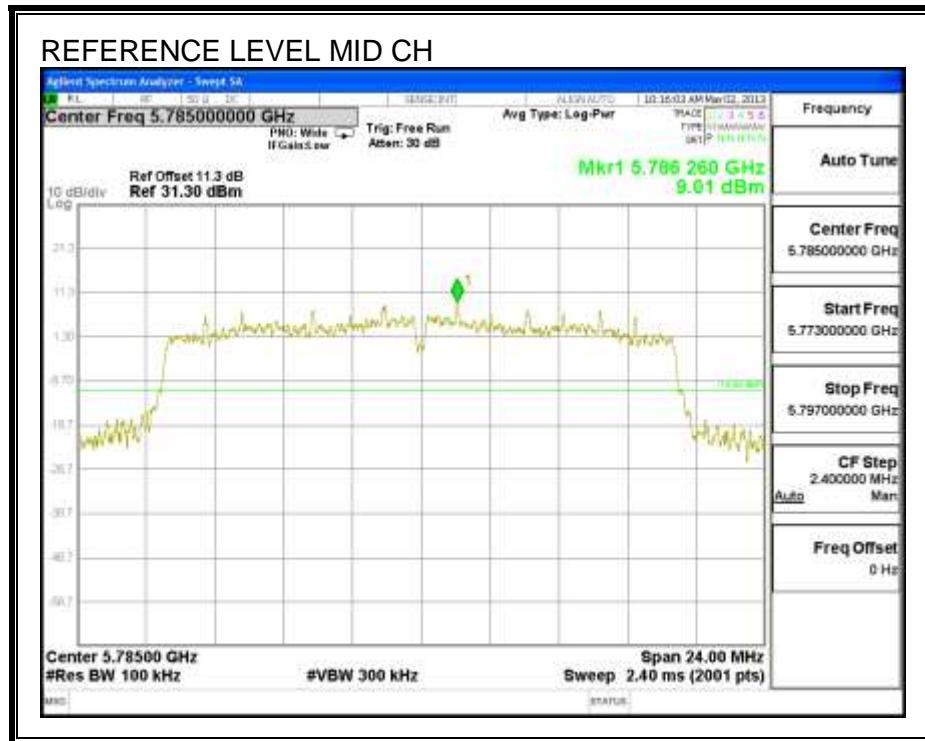




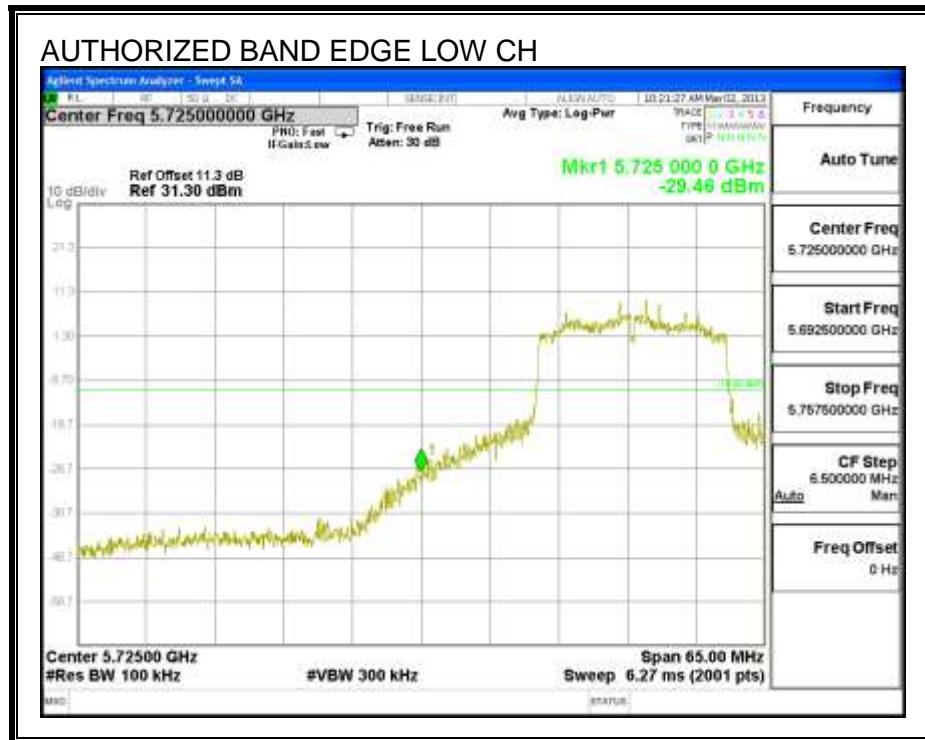
HT20

RESULTS

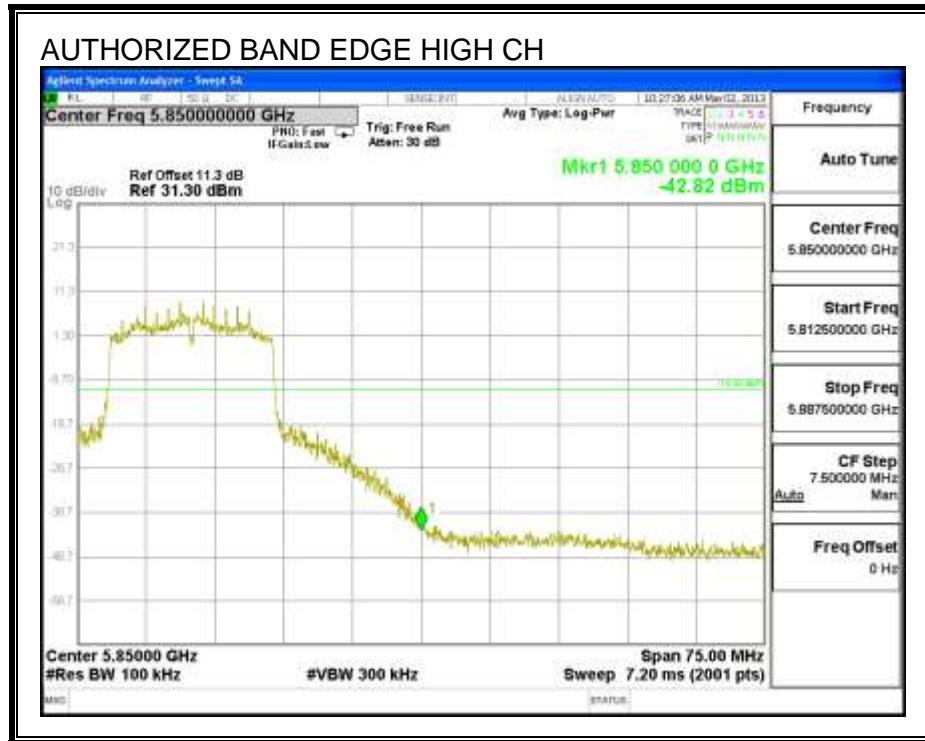
IN-BAND REFERENCE LEVEL



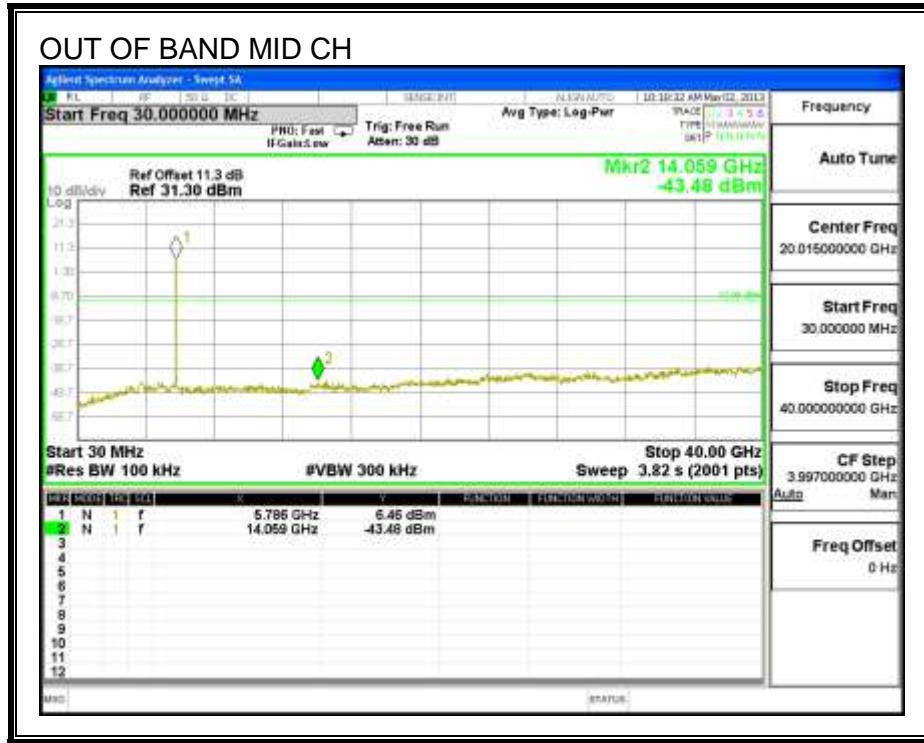
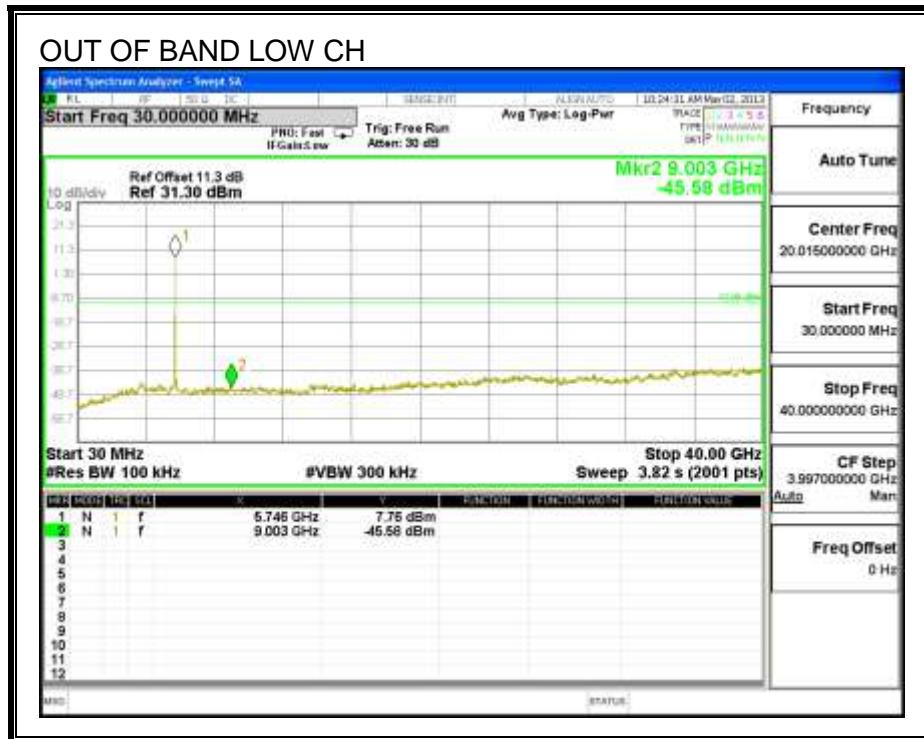
LOW CHANNEL BANDEDGE

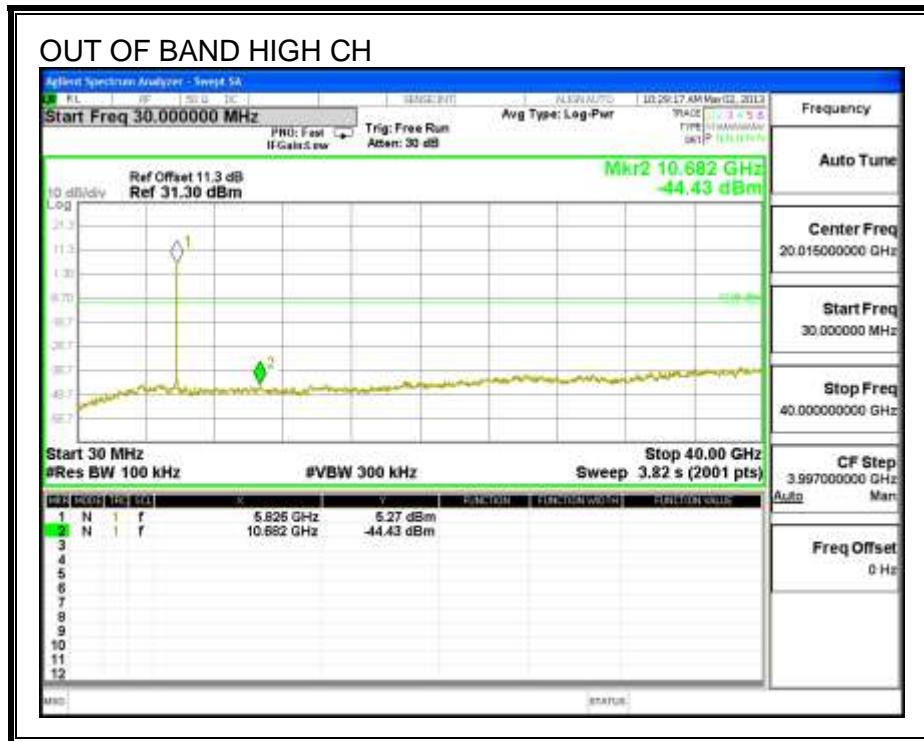


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS

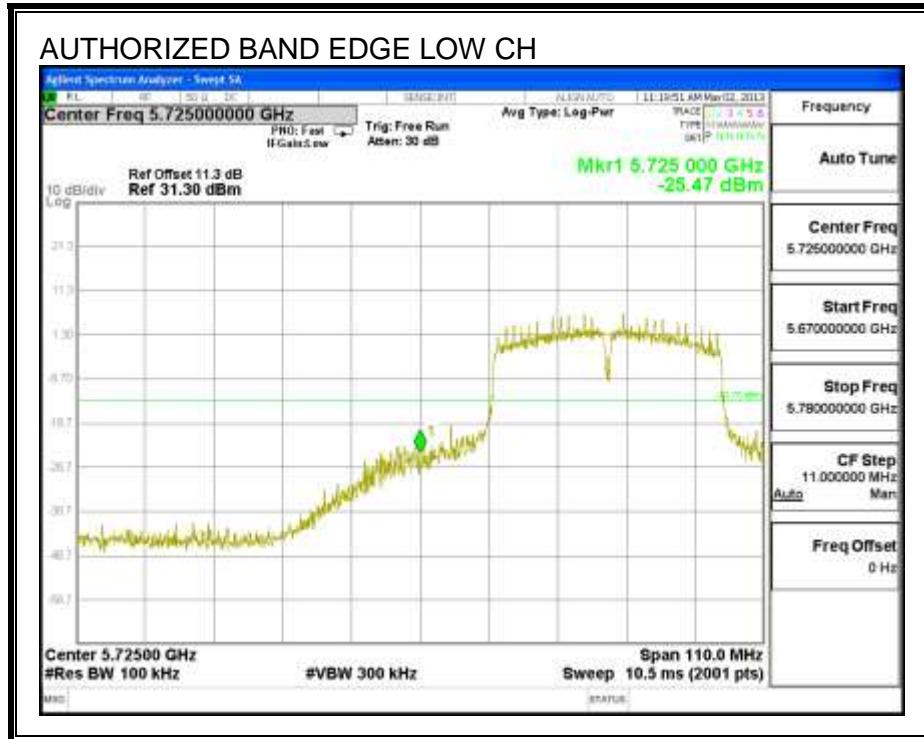




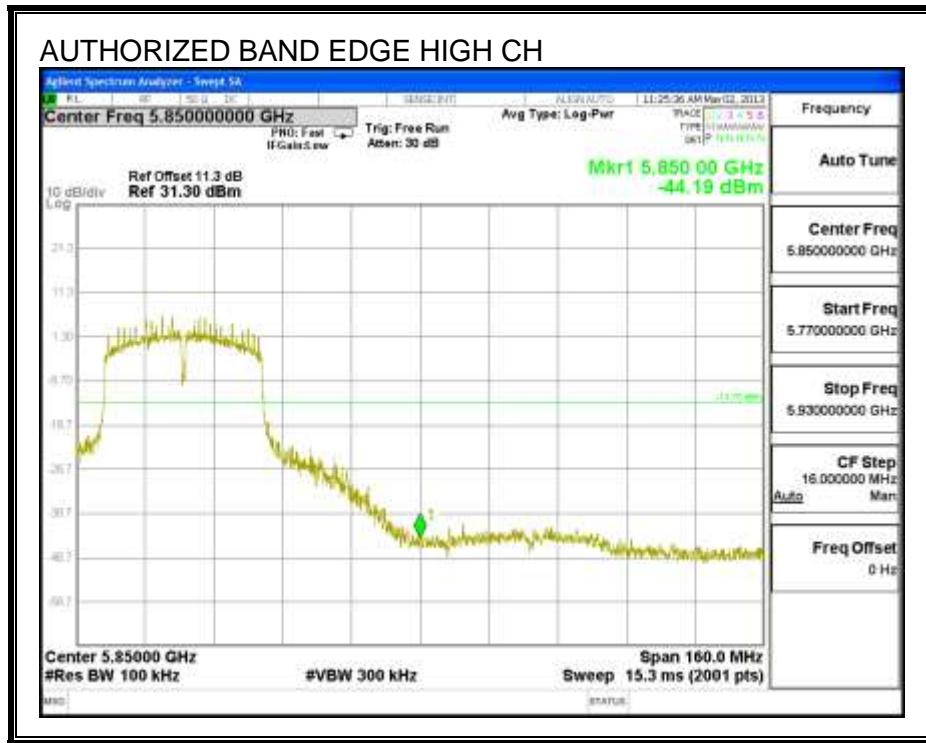
HT40

RESULTS

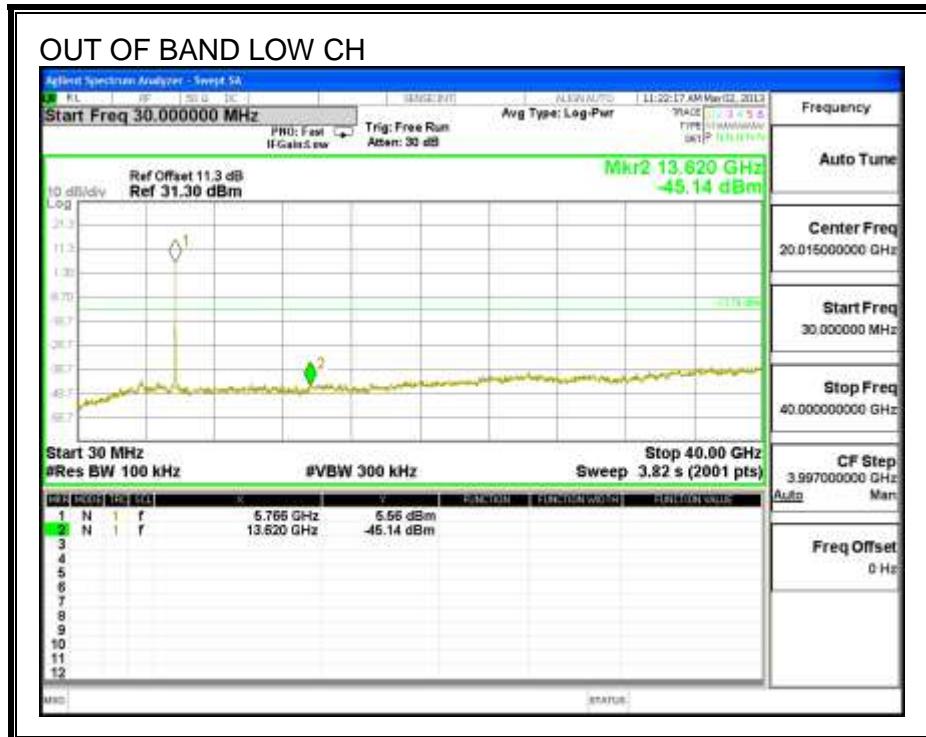
LOW CHANNEL BANDEDGE

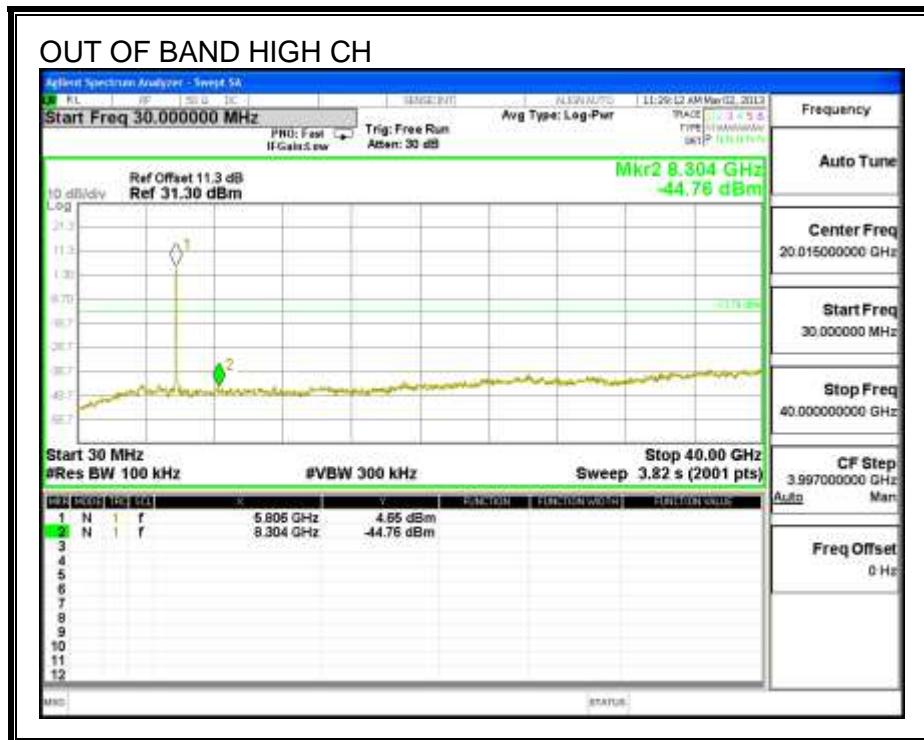


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS





8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
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. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

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, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

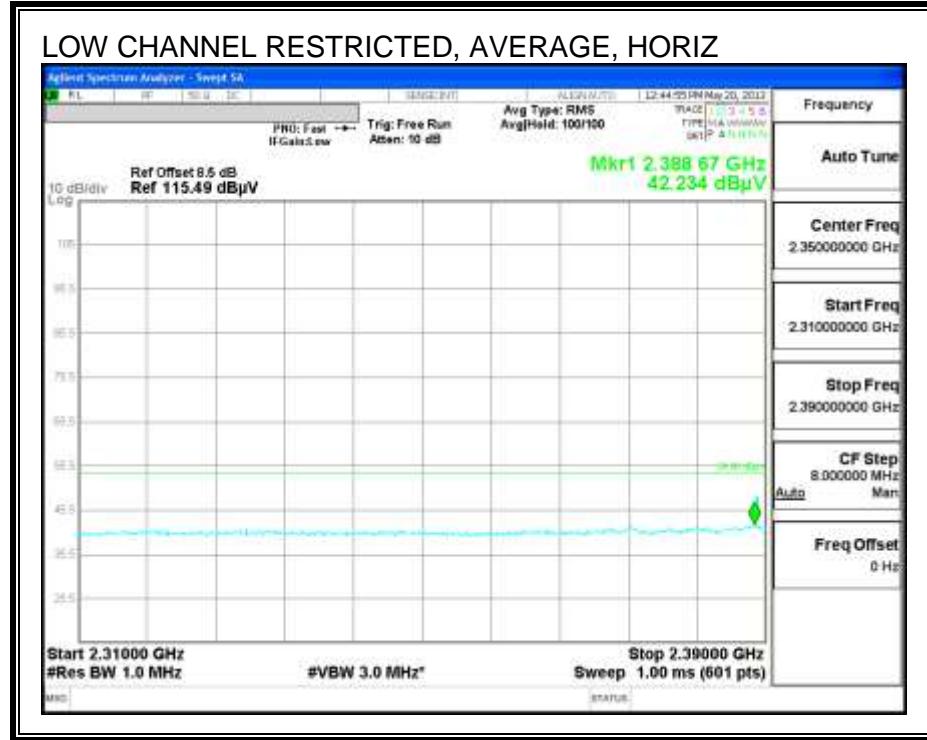
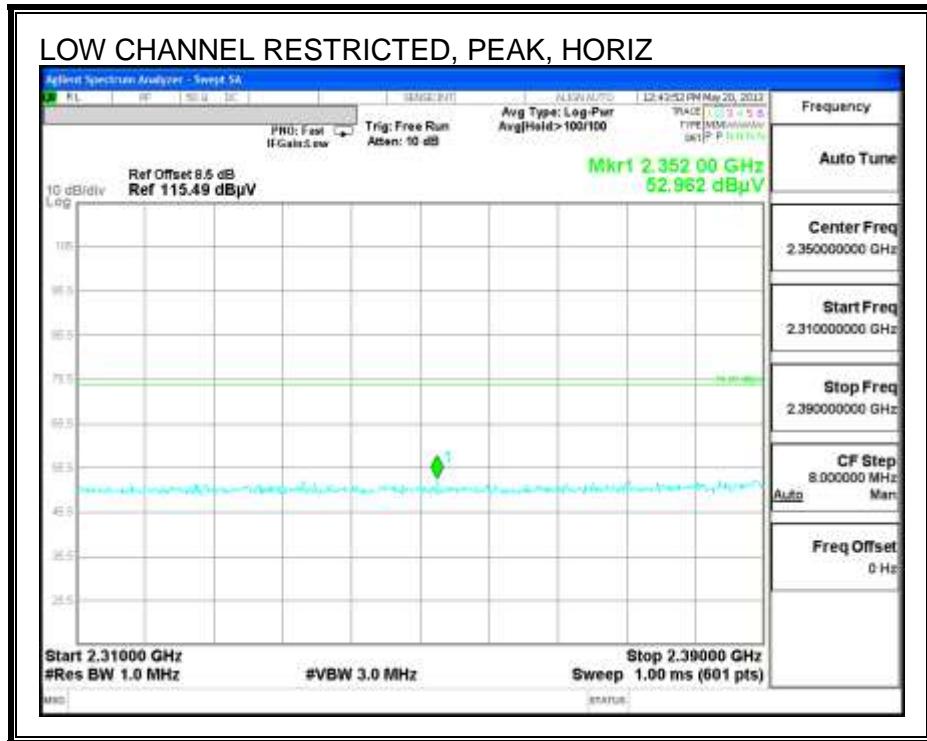
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

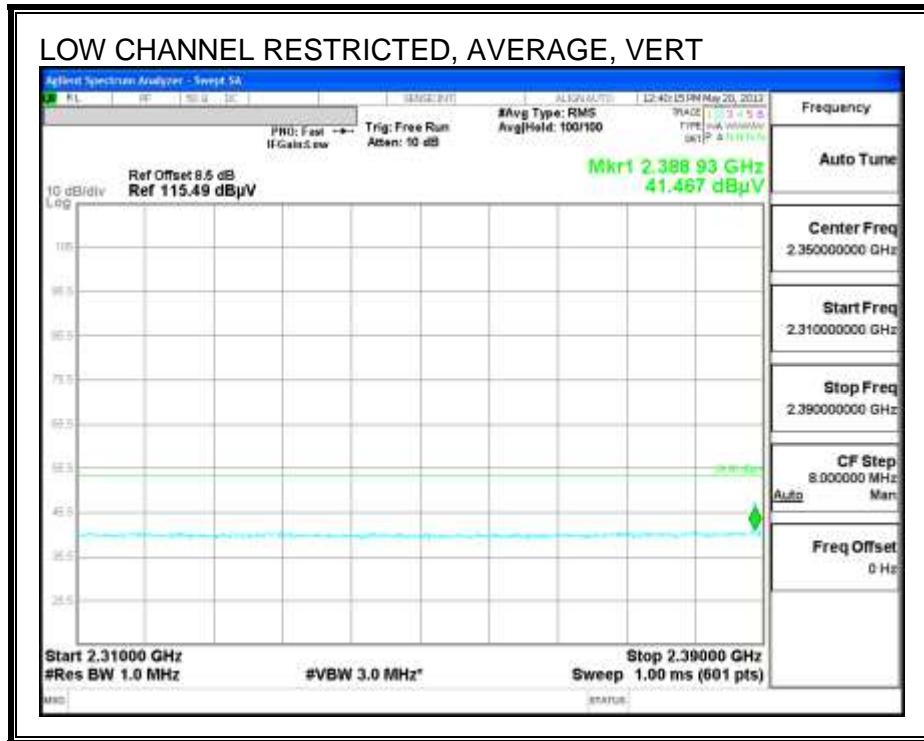
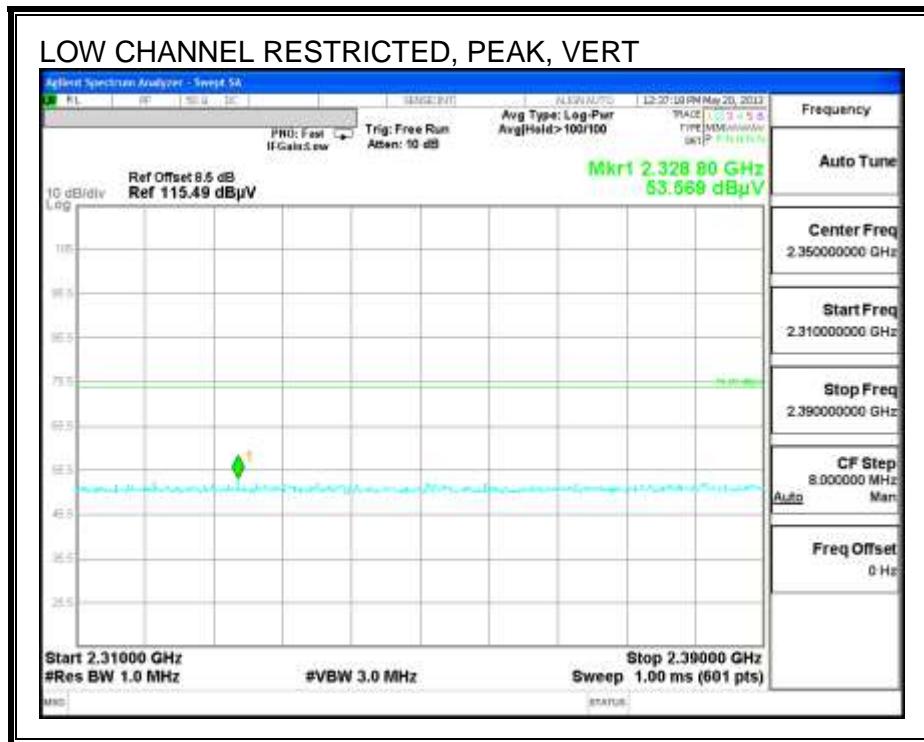
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

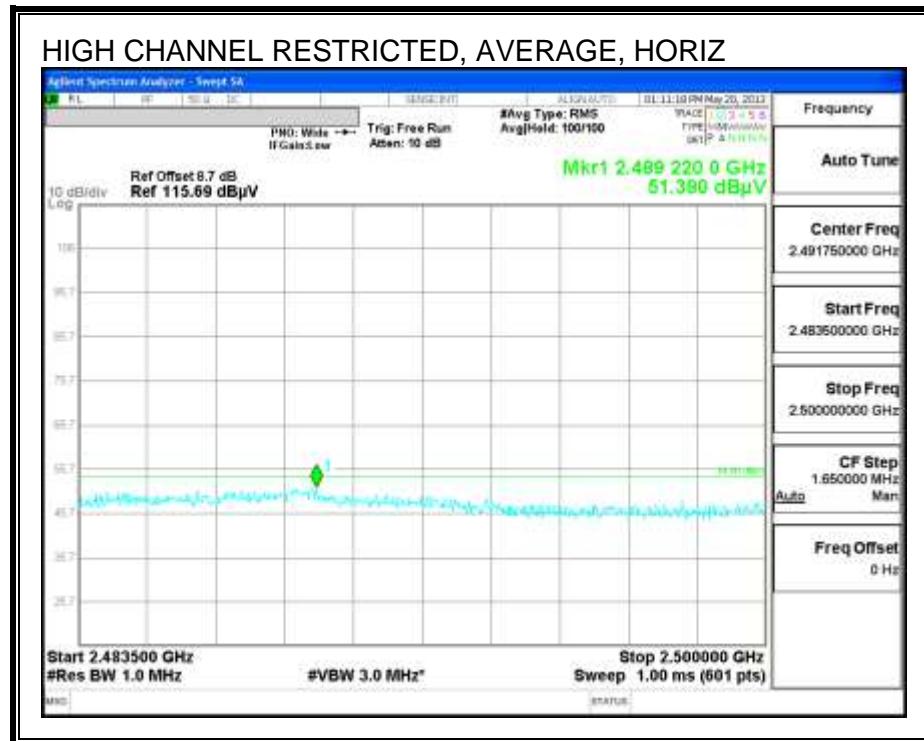
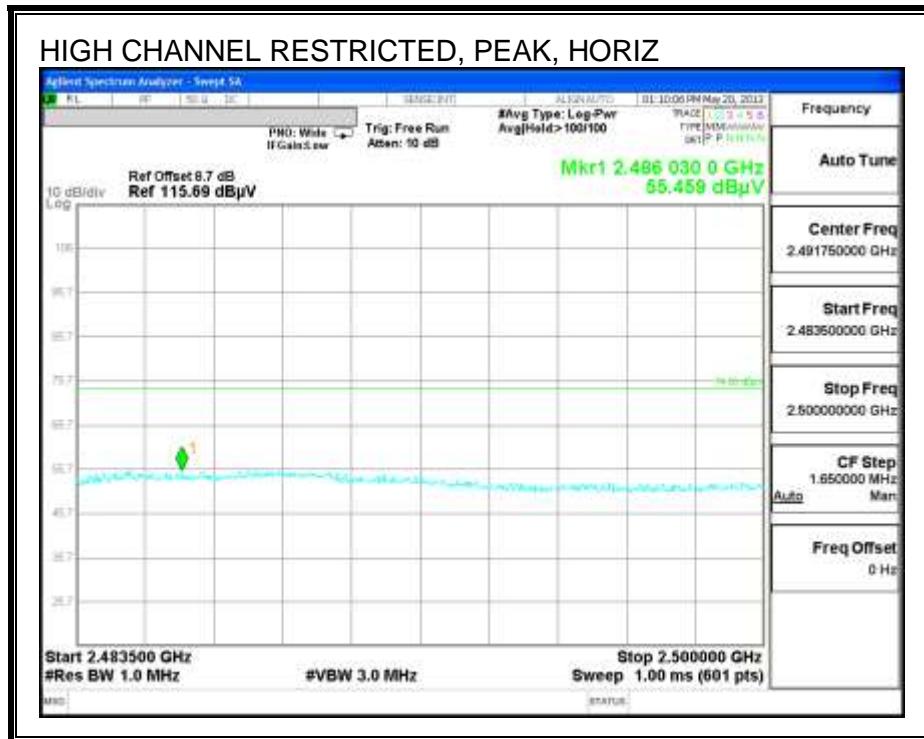
8.2. TX ABOVE 1 GHz 802.11b MODE IN THE 2.4 GHz BAND

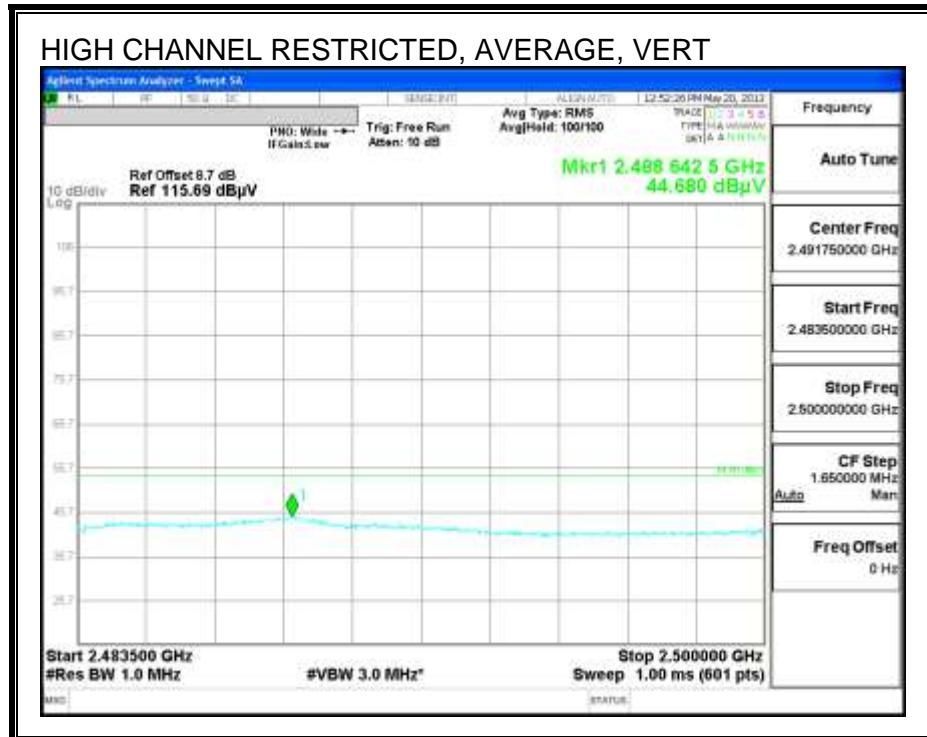
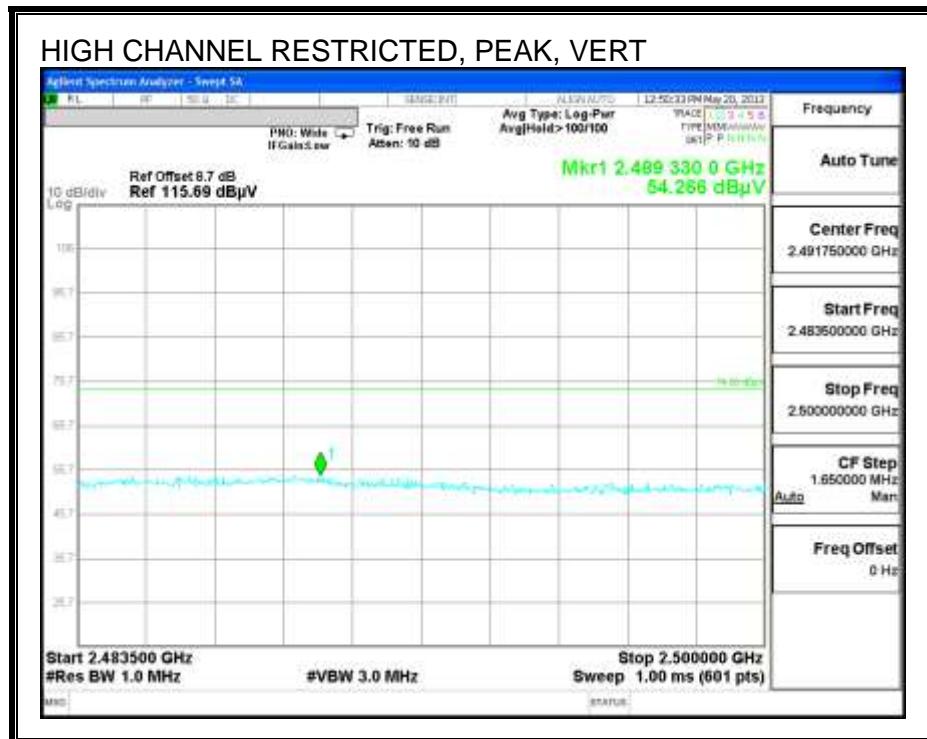
RESTRICTED BANDEDGE (LOW CHANNEL)



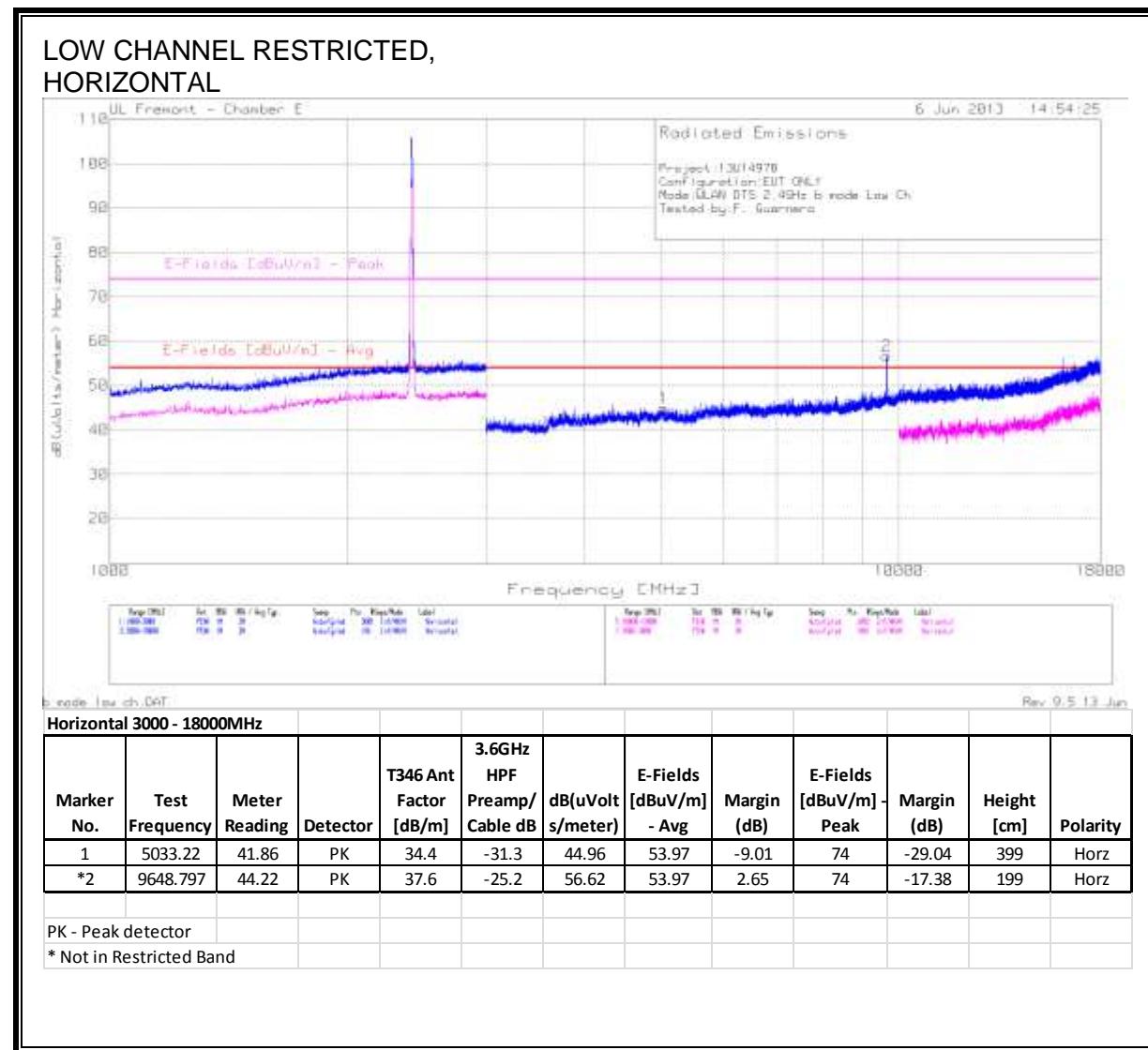


RESTRICTED BANDEDGE (HIGH CHANNEL)

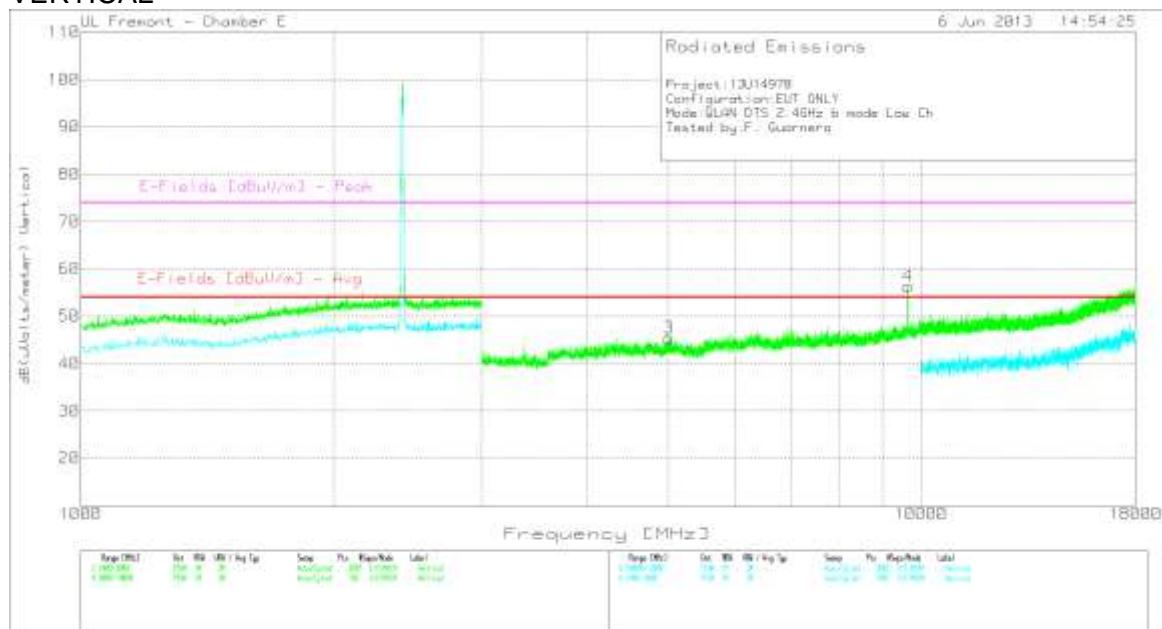




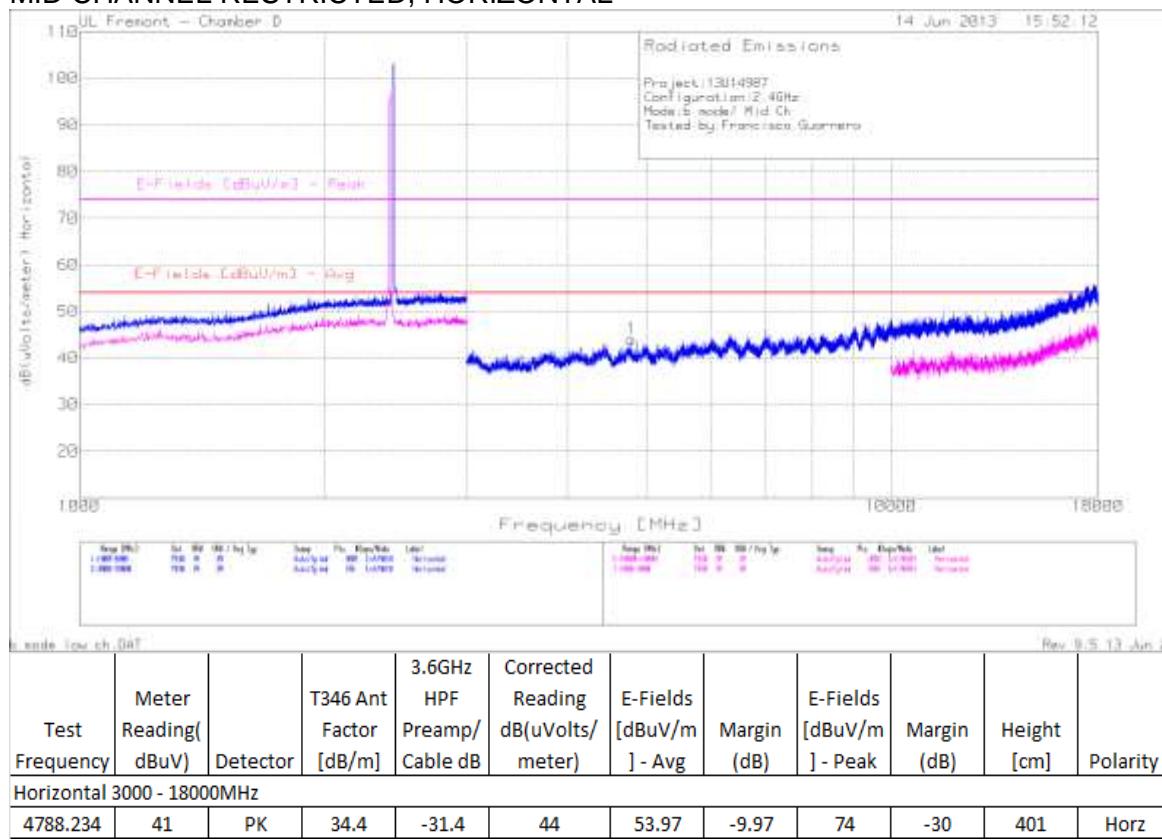
HARMONICS AND SPURIOUS EMISSIONS



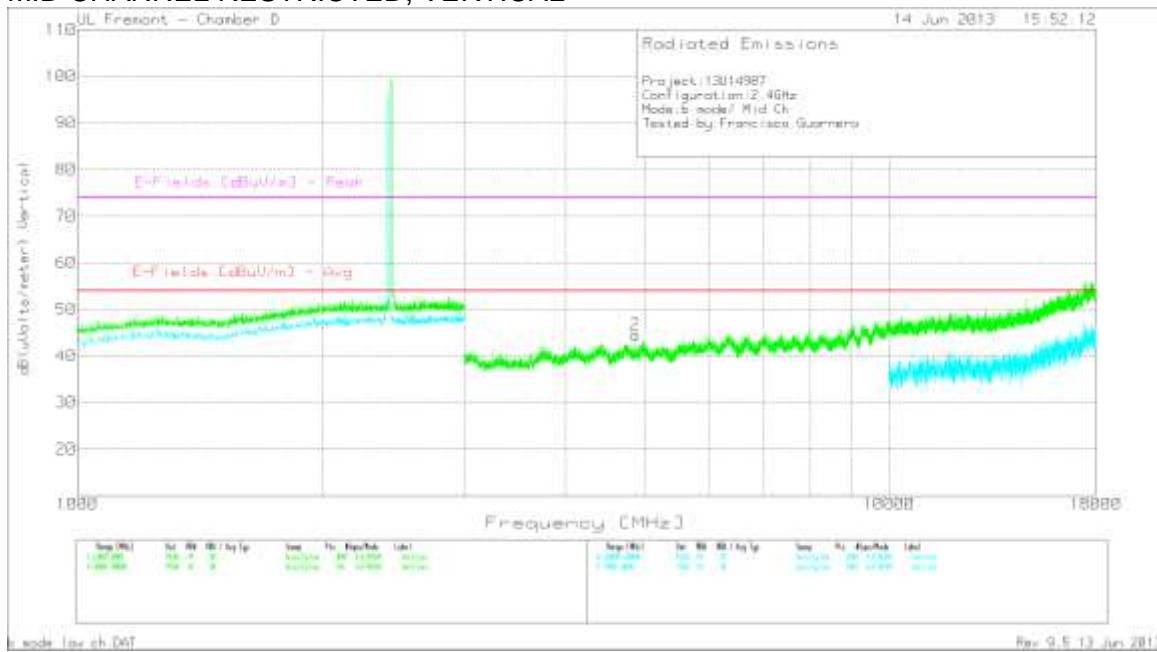
LOW CHANNEL RESTRICTED, VERTICAL



MID CHANNEL RESTRICTED, HORIZONTAL

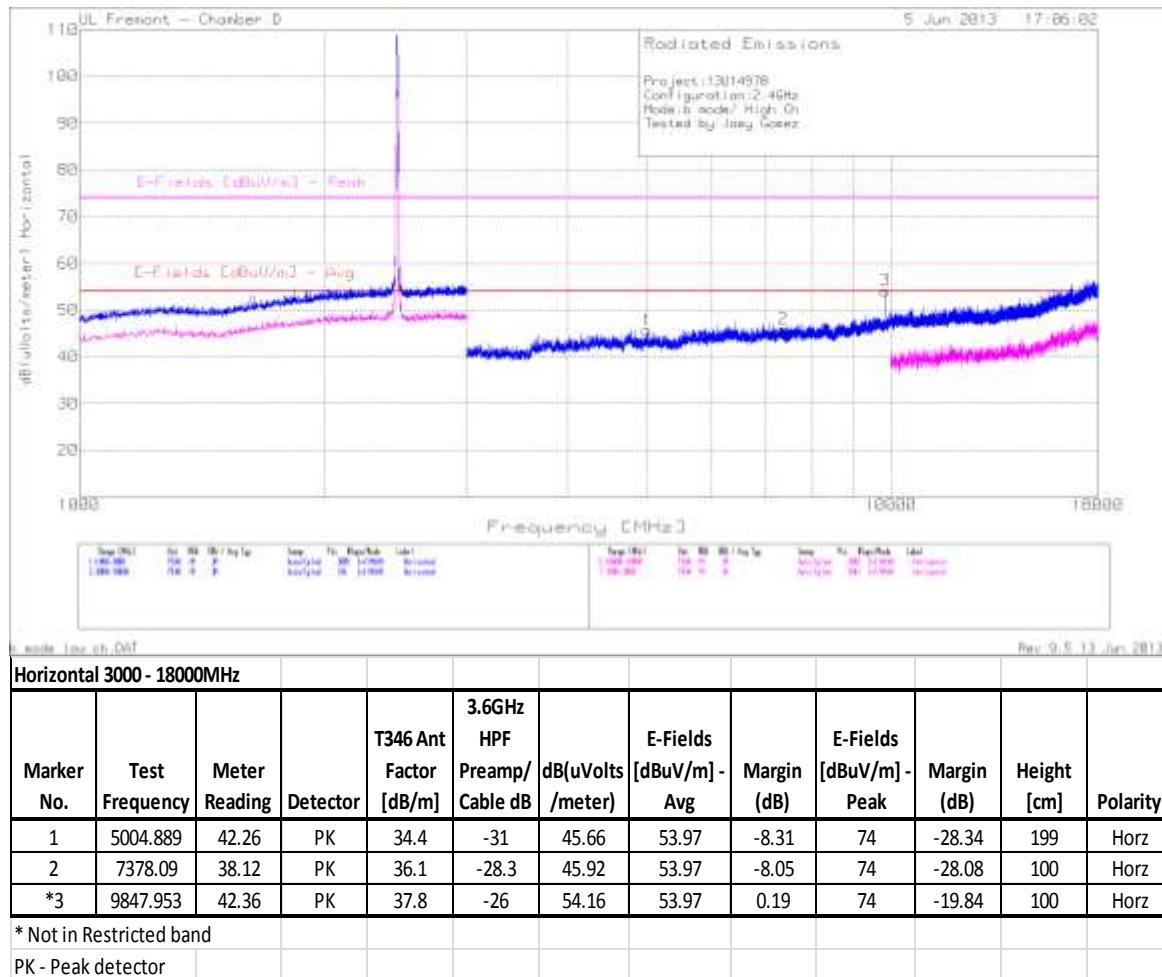


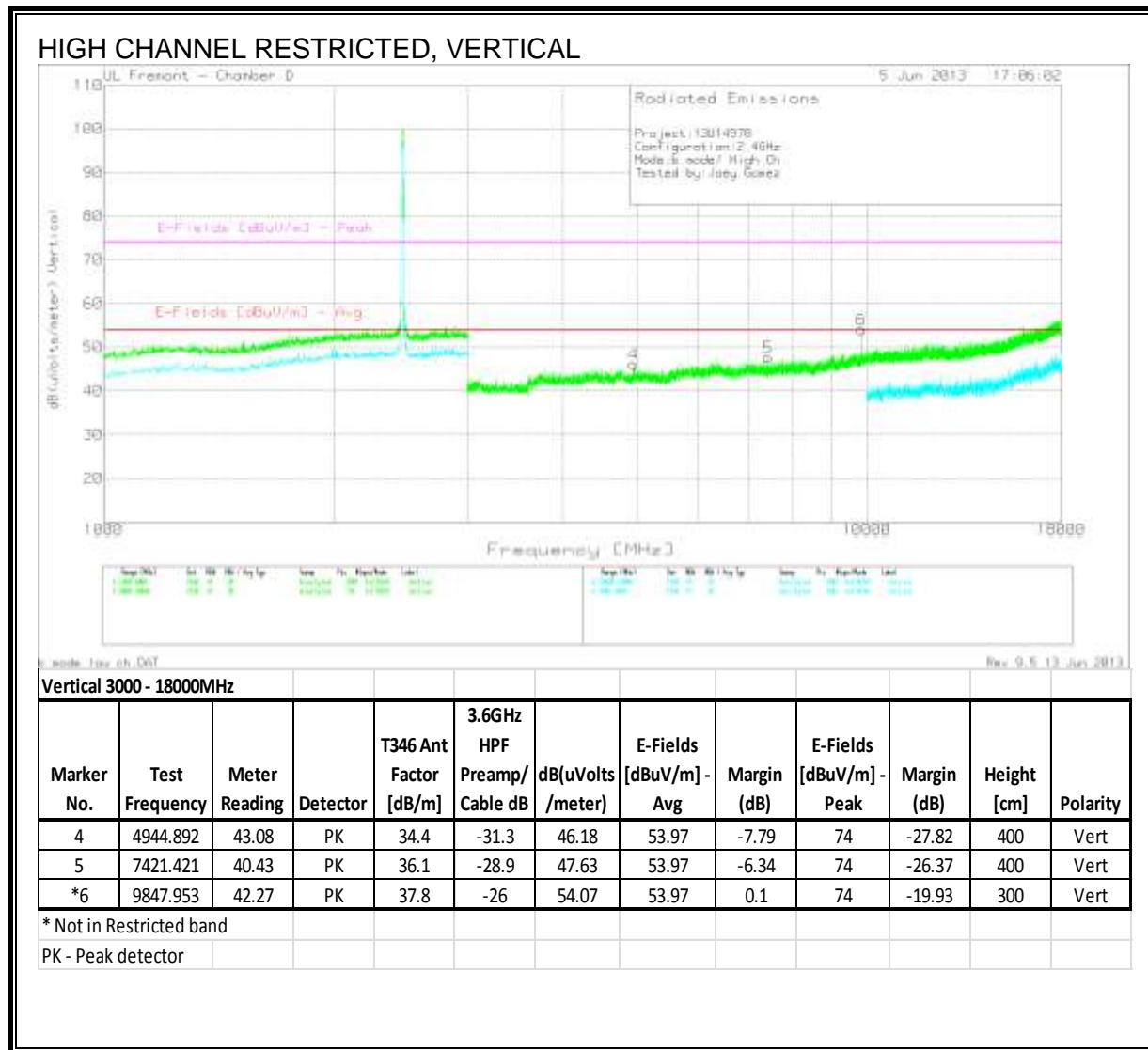
MID CHANNEL RESTRICTED, VERTICAL



Test Frequency	Meter Reading(dBuV)	Detector	T346 Ant Factor [dB/m]	3.6GHz HPF Preamp/ Cable dB	Corrected Reading dB(uVolts/ meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
Vertical 3000 - 18000MHz											
4874.063	41.74	PK	34.4	-31.6	44.54	53.97	-9.43	74	-29.46	300	Vert

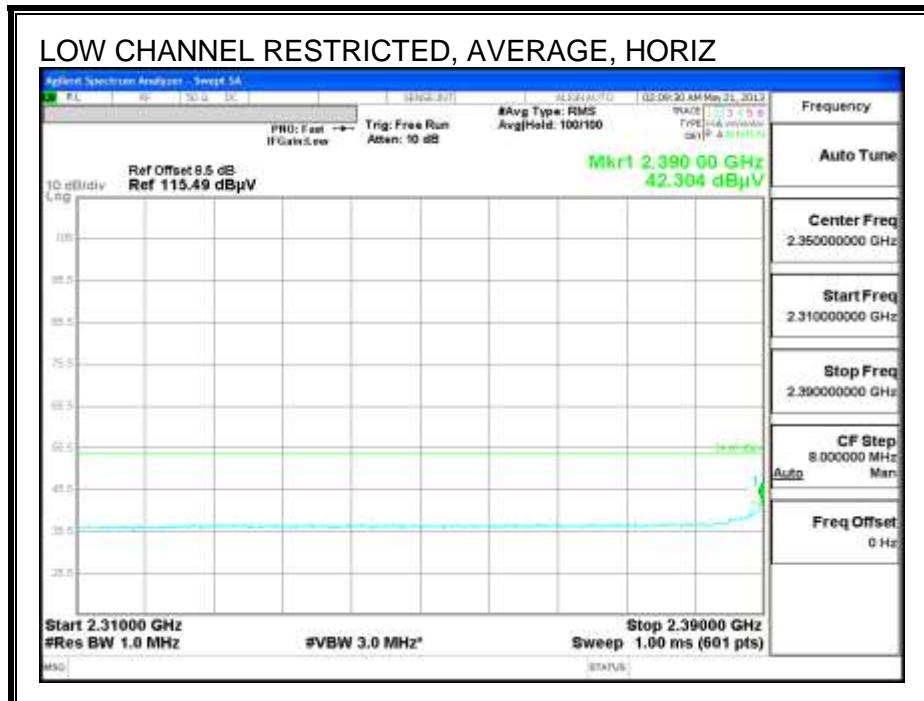
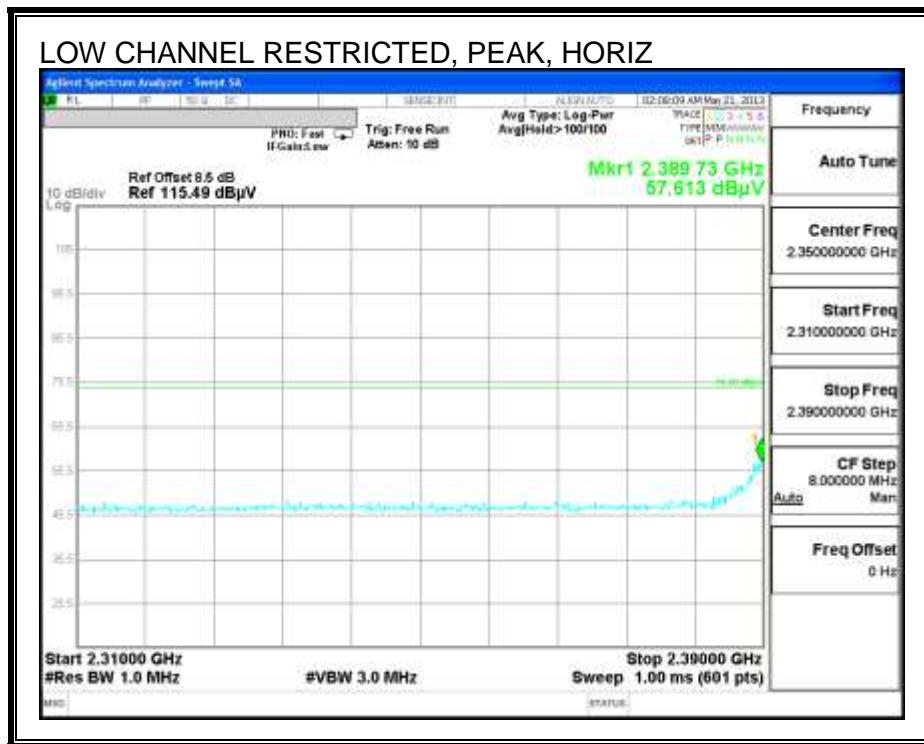
HIGH CHANNEL RESTRICTED, HORIZONTAL

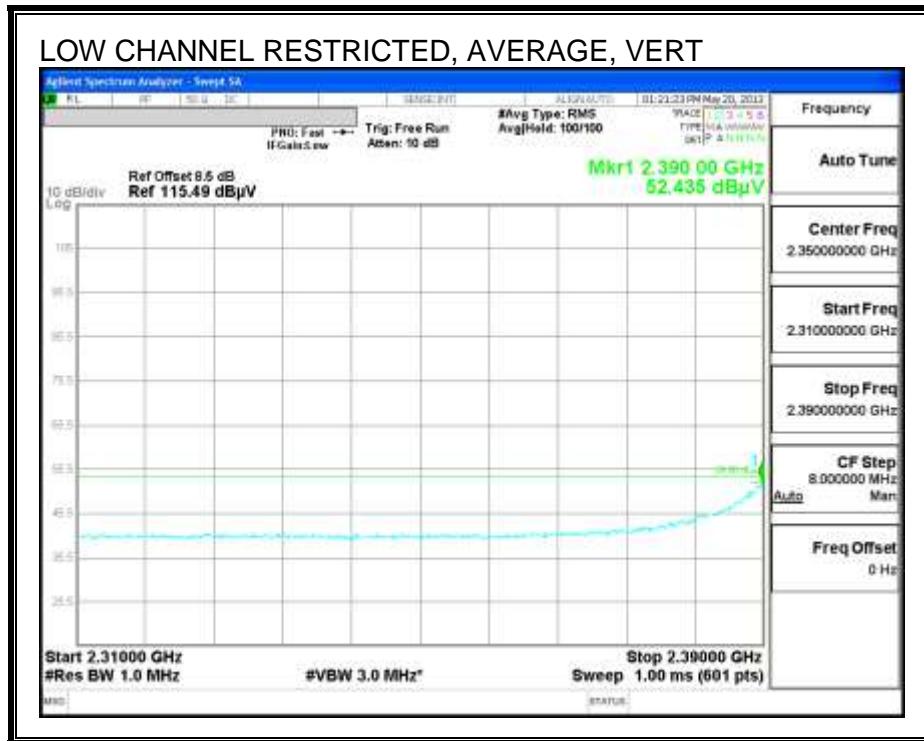
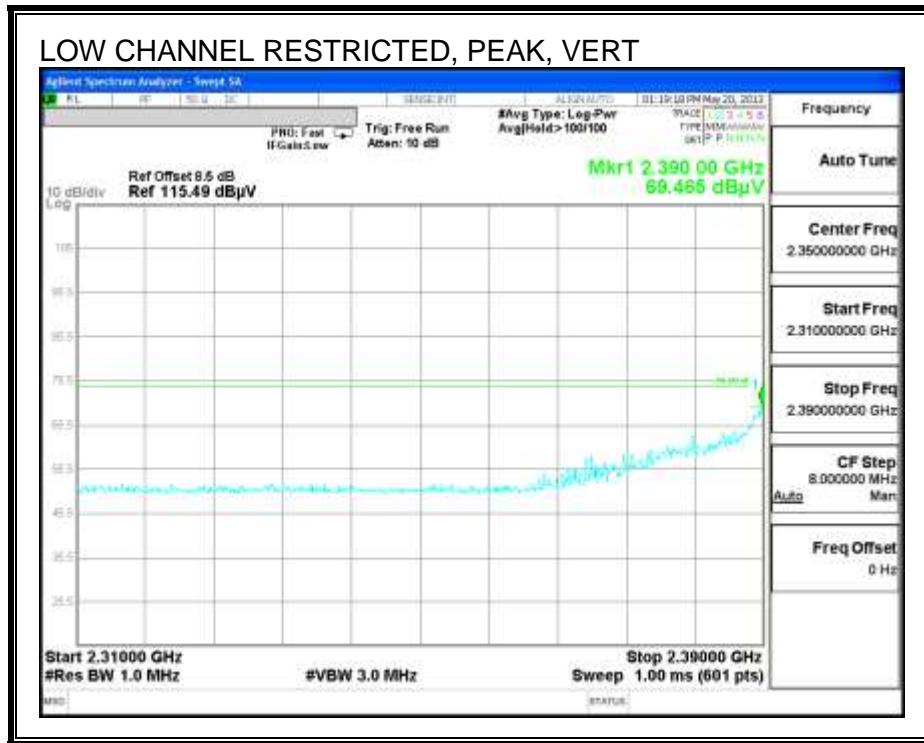




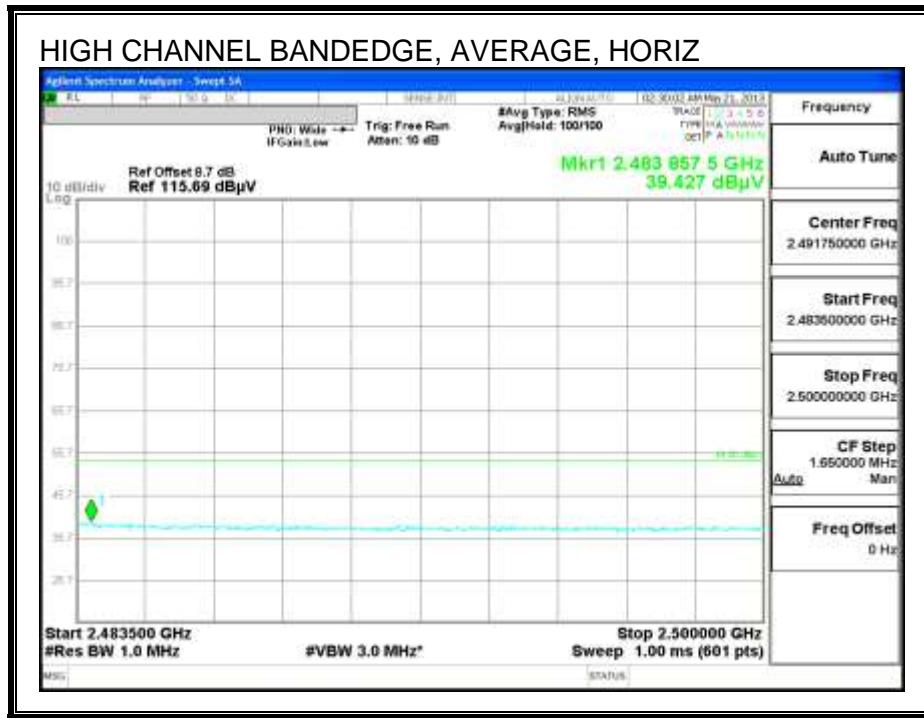
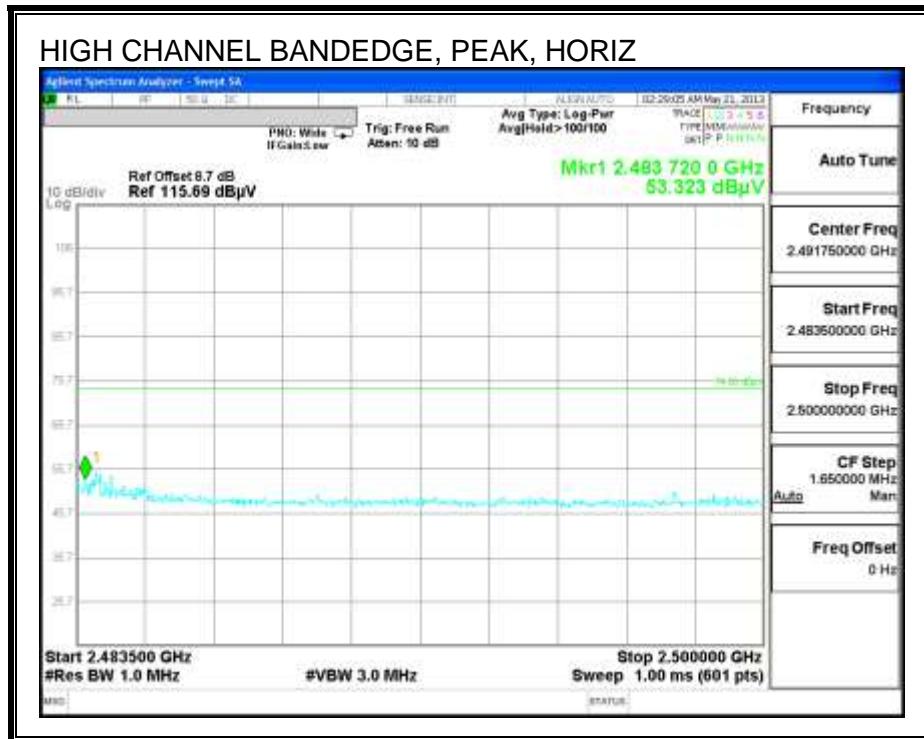
8.3. TX ABOVE 1 GHz 802.11g MODE IN THE 2.4 GHz BAND

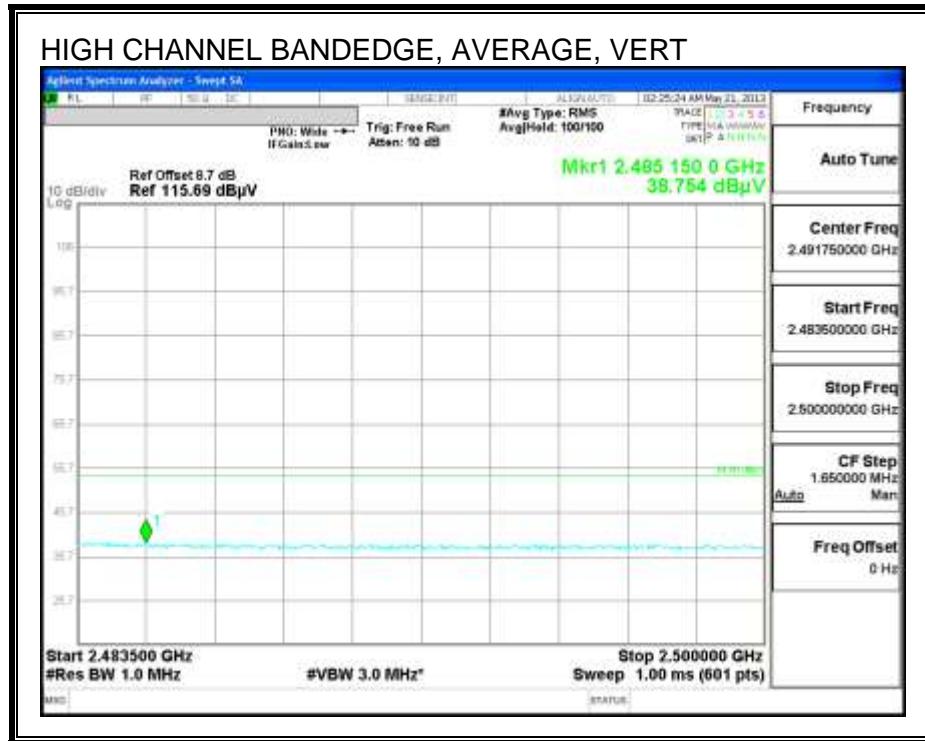
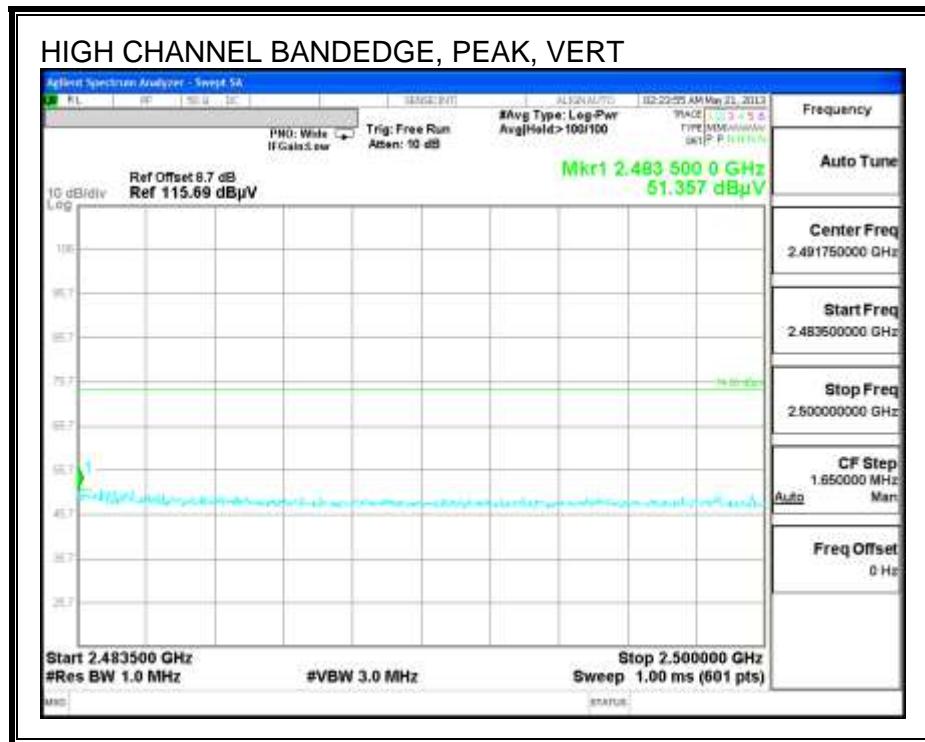
RESTRICTED BANDEDGE (LOW CHANNEL)



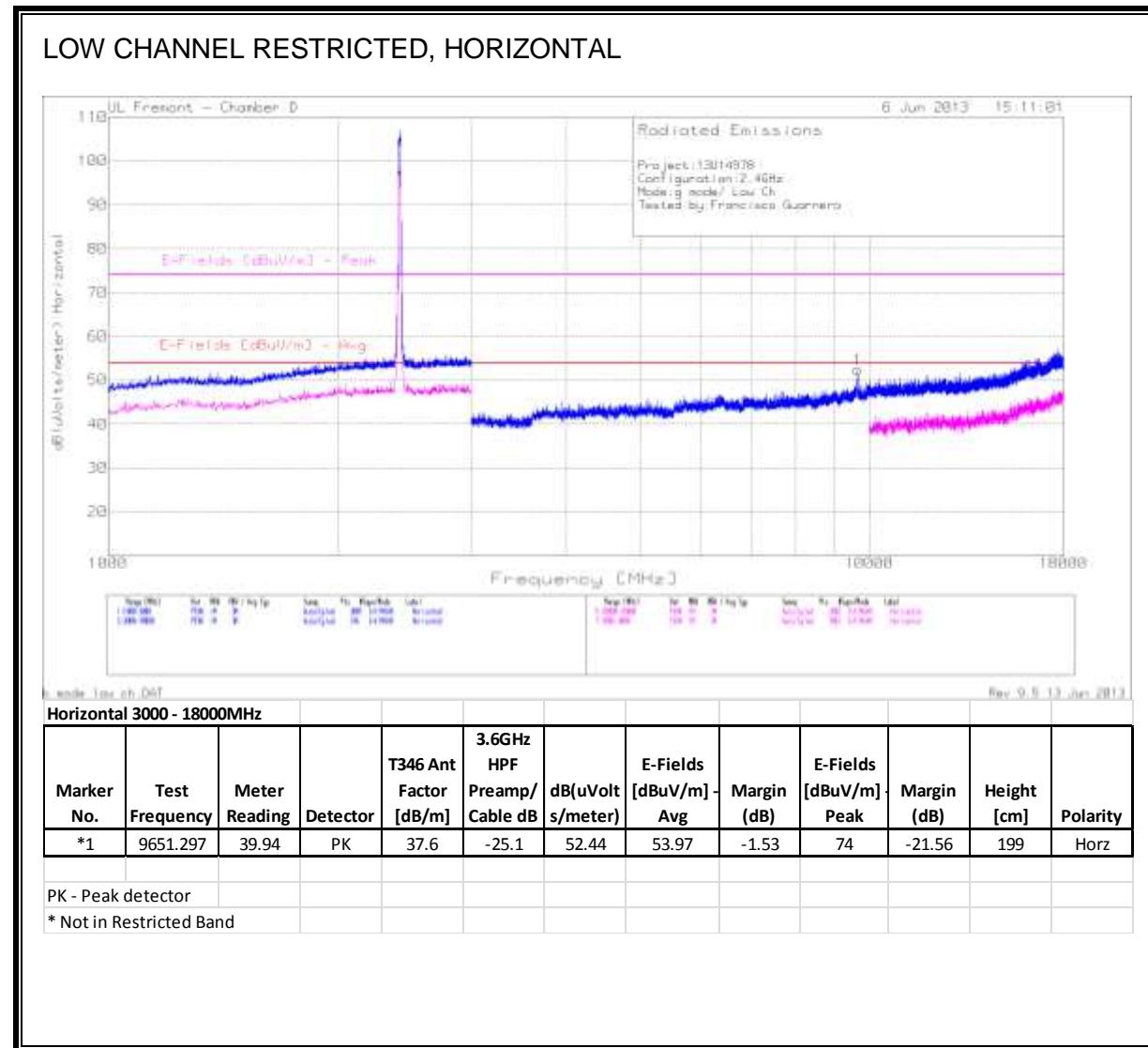


RESTRICTED BANDEDGE (HIGH CHANNEL)

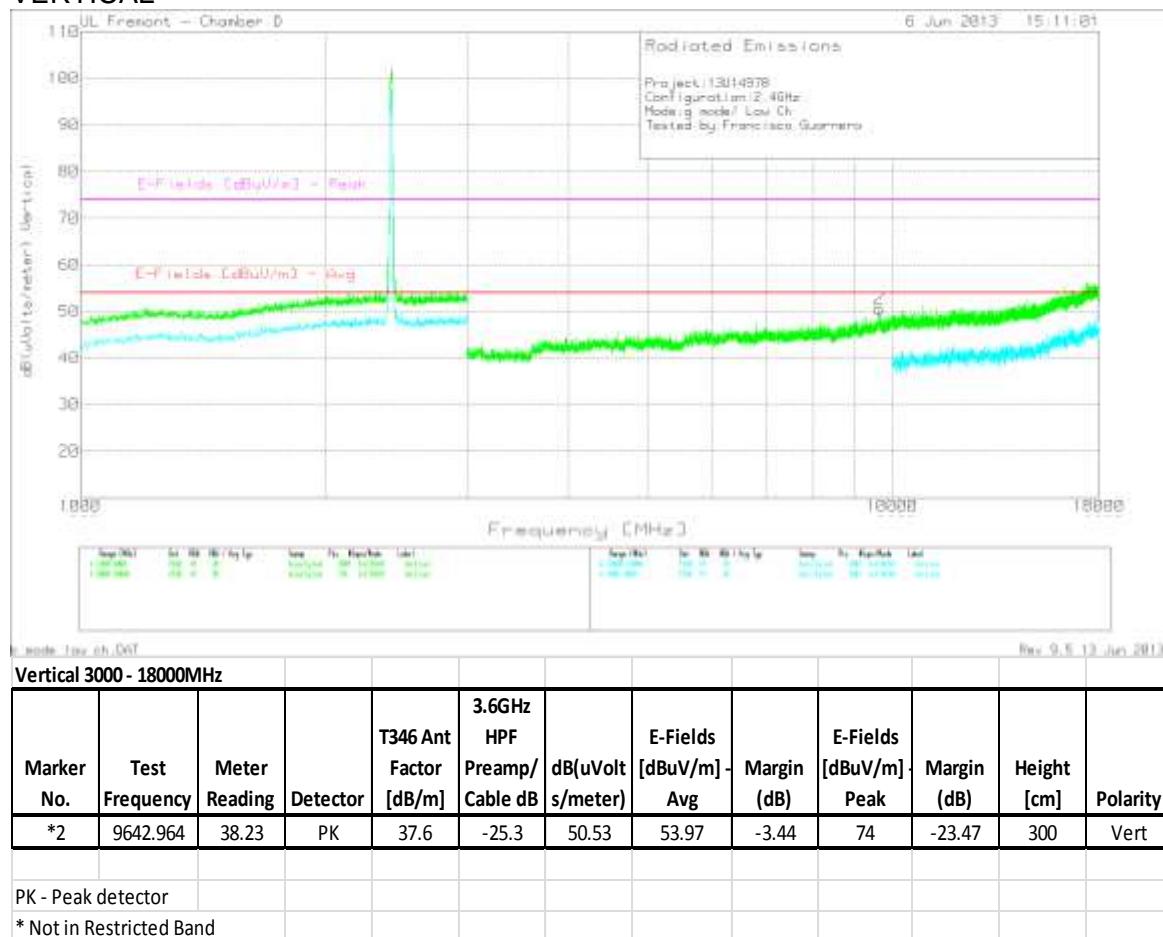




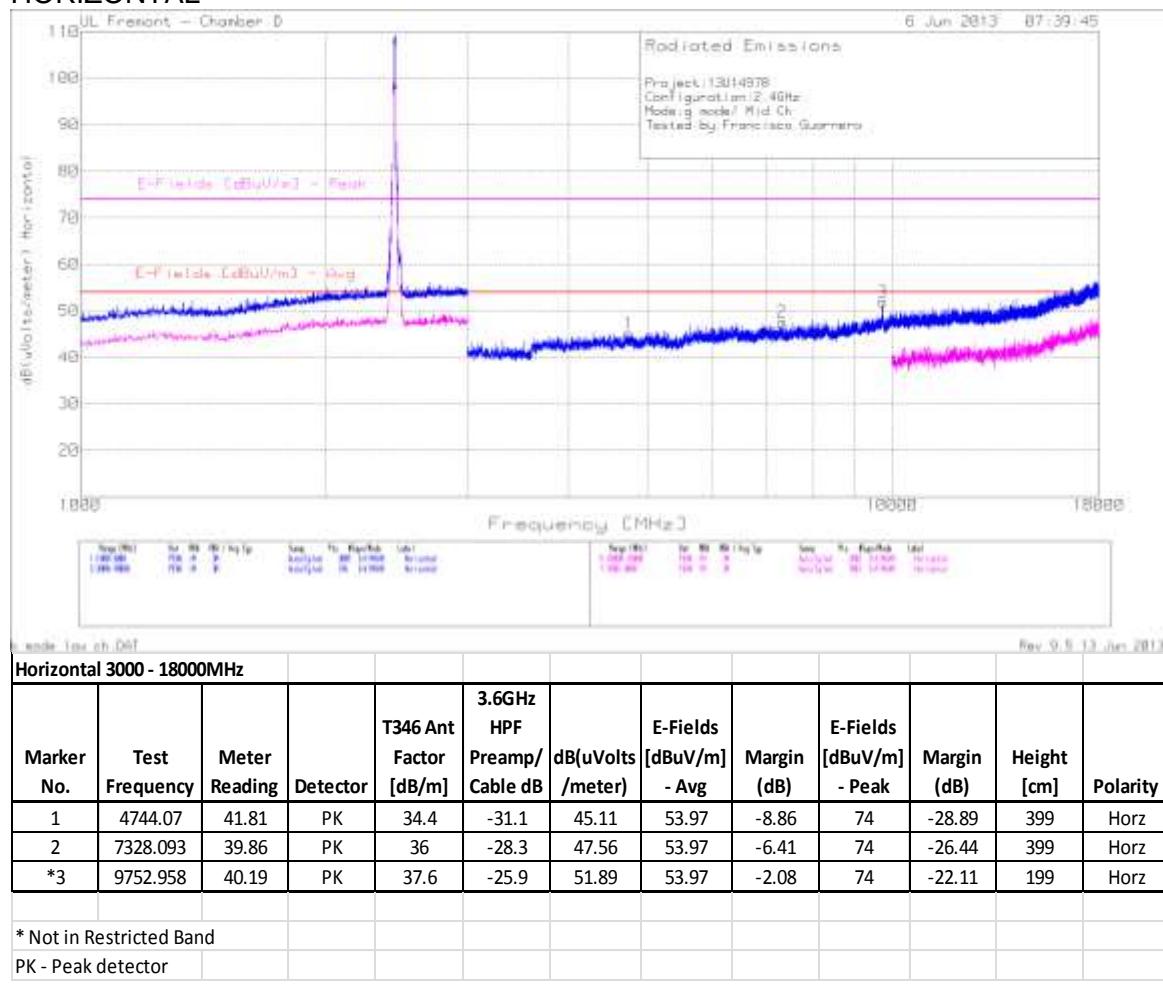
HARMONICS AND SPURIOUS EMISSIONS



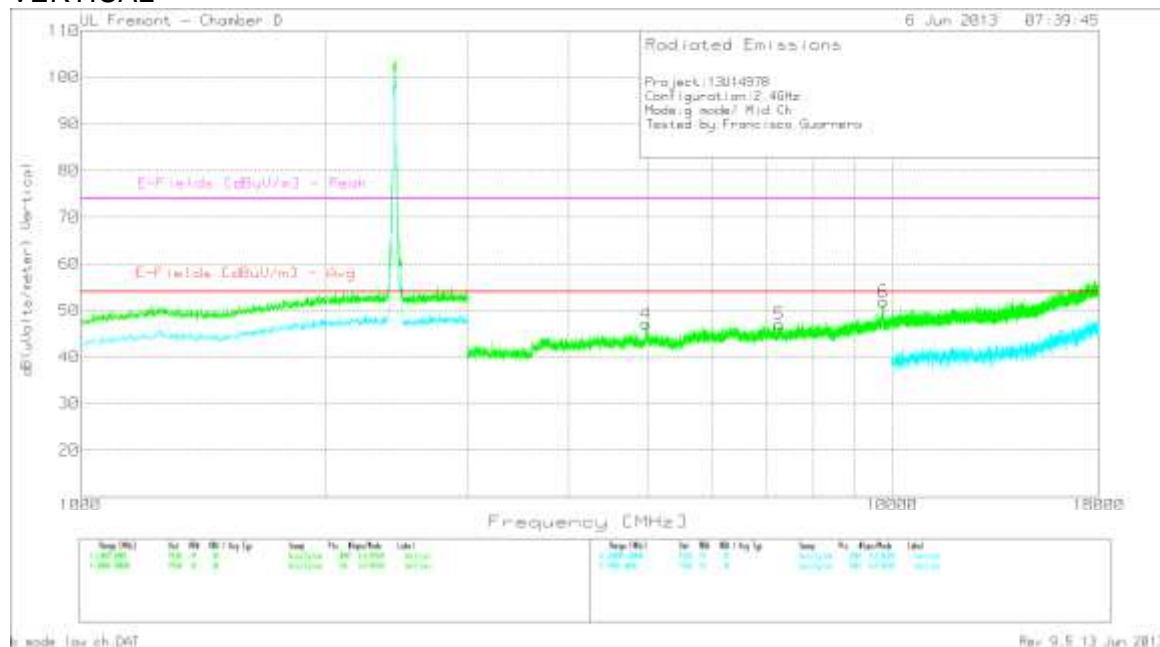
LOW CHANNEL RESTRICTED,
VERTICAL



MID CHANNEL RESTRICTED,
HORIZONTAL



MID CHANNEL RESTRICTED,
VERTICAL

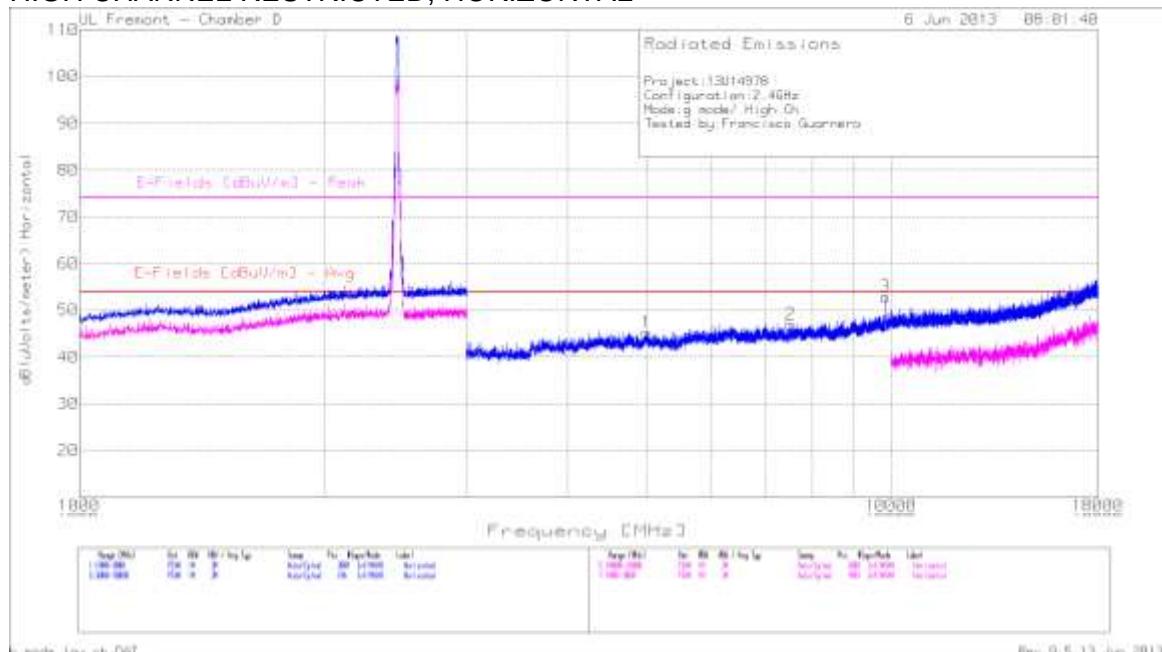


Vertical 3000 - 18000MHz												
Marker No.	Test Frequency	Meter Reading	Detector	T346 Ant Factor [dB/m]	3.6GHz HPF Preamp/ Cable dB	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
4	4978.223	44.07	PK	34.4	-31.3	47.17	53.97	-6.8	74	-26.83	300	Vert
5	7271.429	39.89	PK	36	-28.9	46.99	53.97	-6.98	74	-27.01	200	Vert
*6	9759.624	40.19	PK	37.6	-25.9	51.89	53.97	-2.08	74	-22.11	200	Vert

* Not in Restricted Band

PK - Peak detector

HIGH CHANNEL RESTRICTED, HORIZONTAL

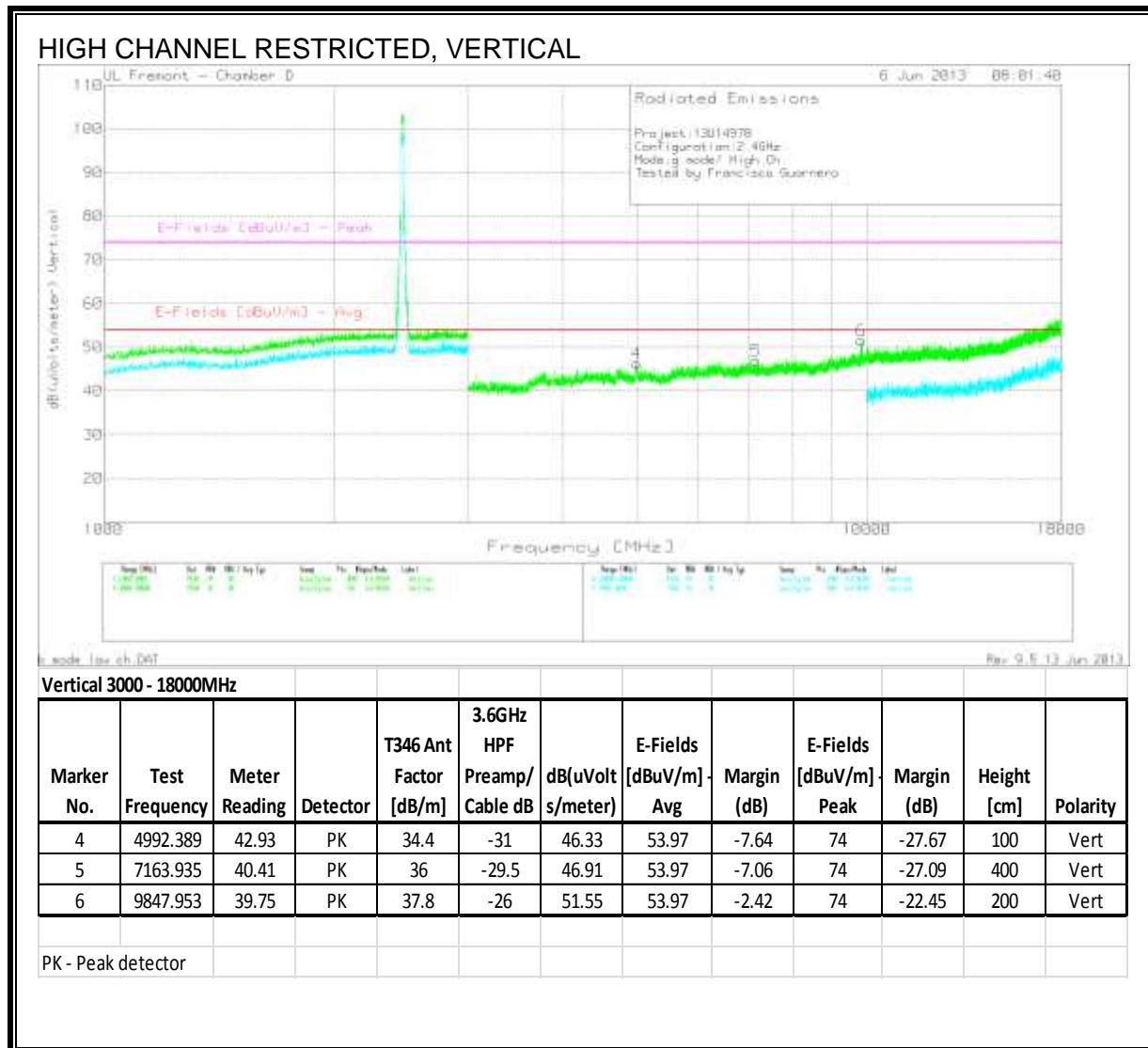


Rev. 0.5 13 Jun 2013

Horizontal 3000 - 18000MHz

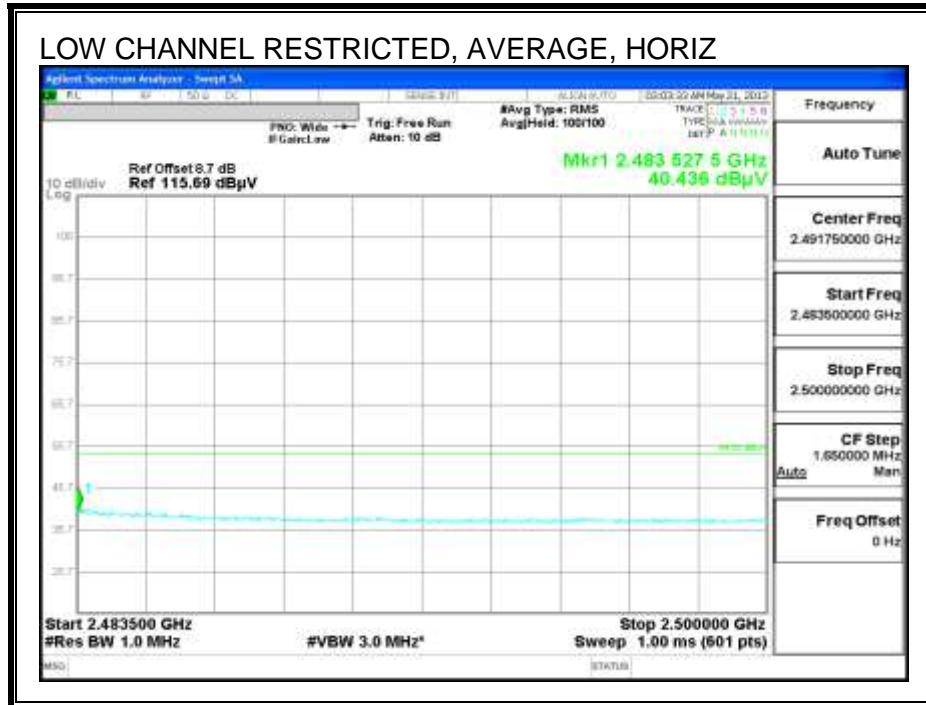
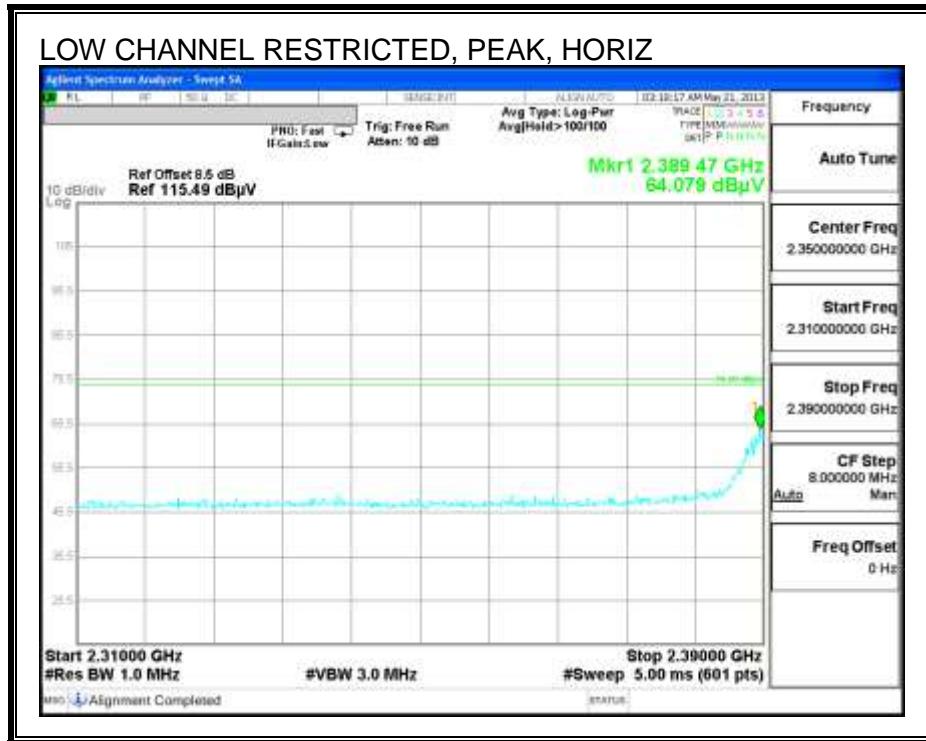
Marker No.	Test Frequency	Meter Reading	Detector	T346 Ant Factor [dB/m]	3.6GHz HPF Preamp/ Cable dB	dB(uVolt s/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	4997.389	41.78	PK	34.4	-31	45.18	53.97	-8.79	74	-28.82	199	Horz
2	7525.582	39.7	PK	36.1	-28.9	46.9	53.97	-7.07	74	-27.1	299	Horz
3	9852.953	41.09	PK	37.8	-26	52.89	53.97	-1.08	74	-21.11	199	Horz

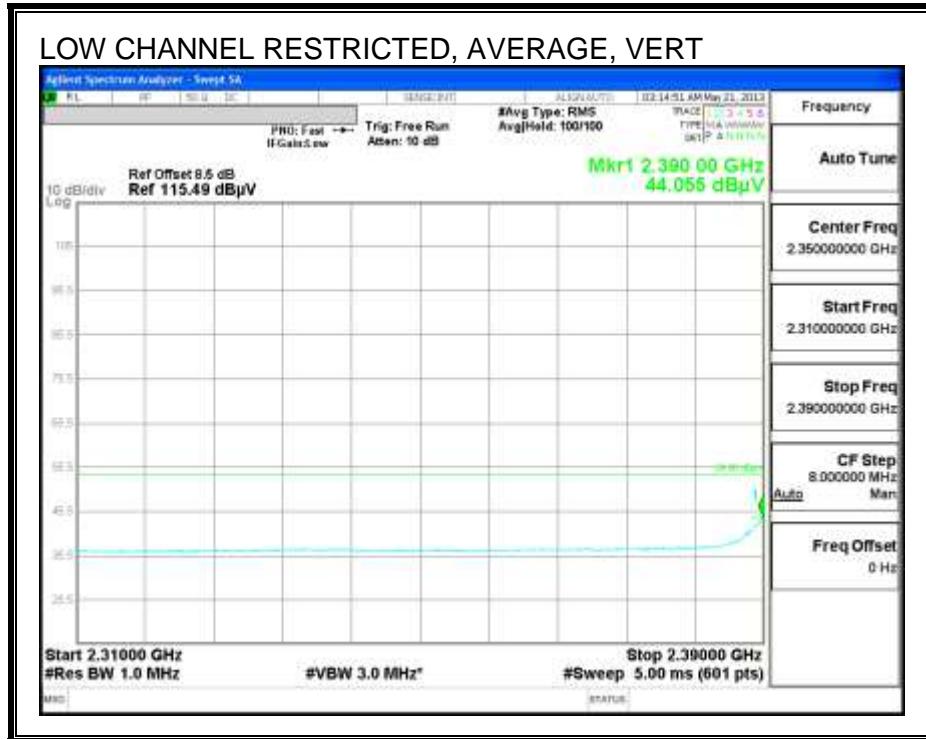
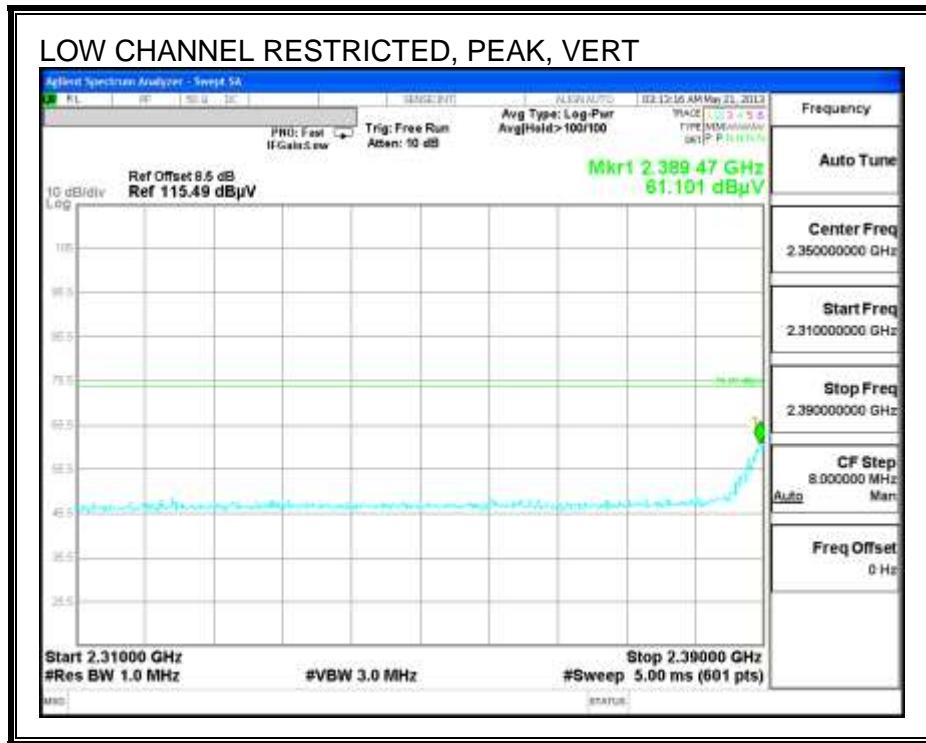
PK - Peak detector



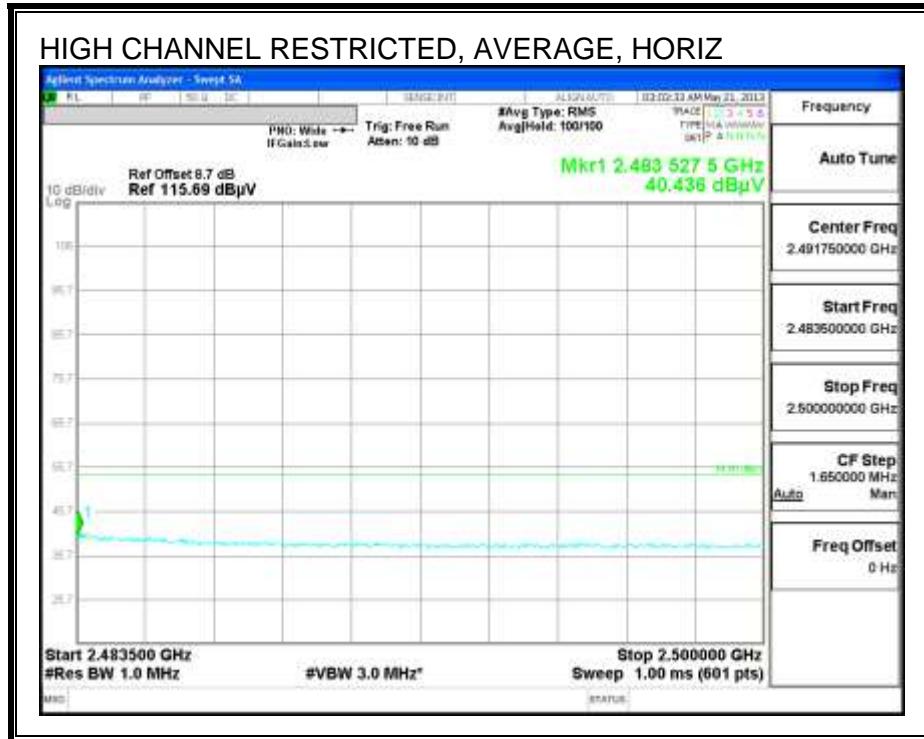
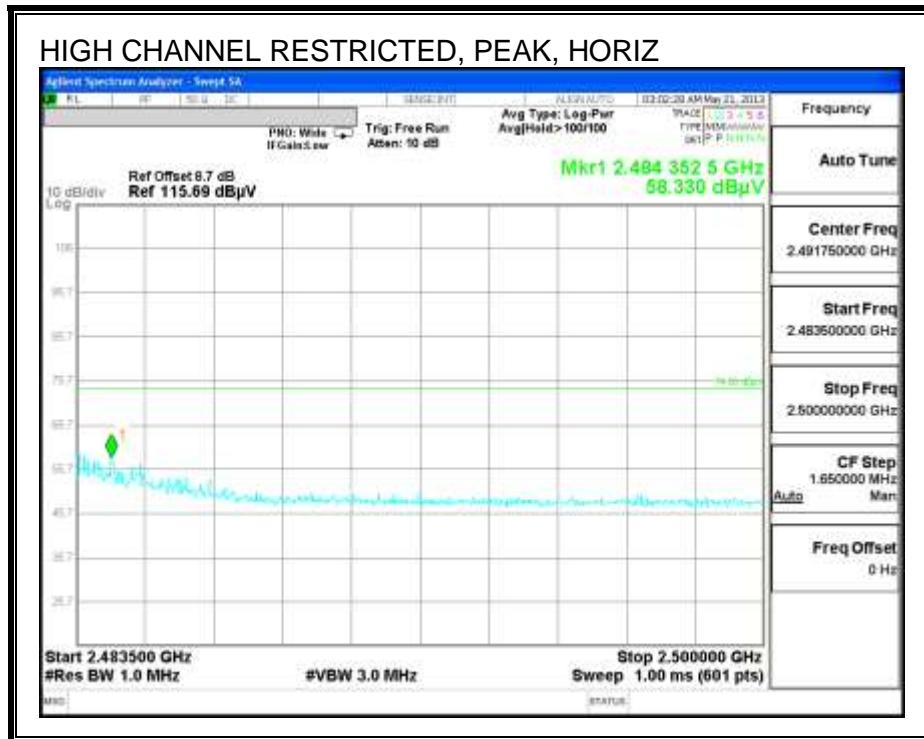
8.4. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 2.4 GHz BAND

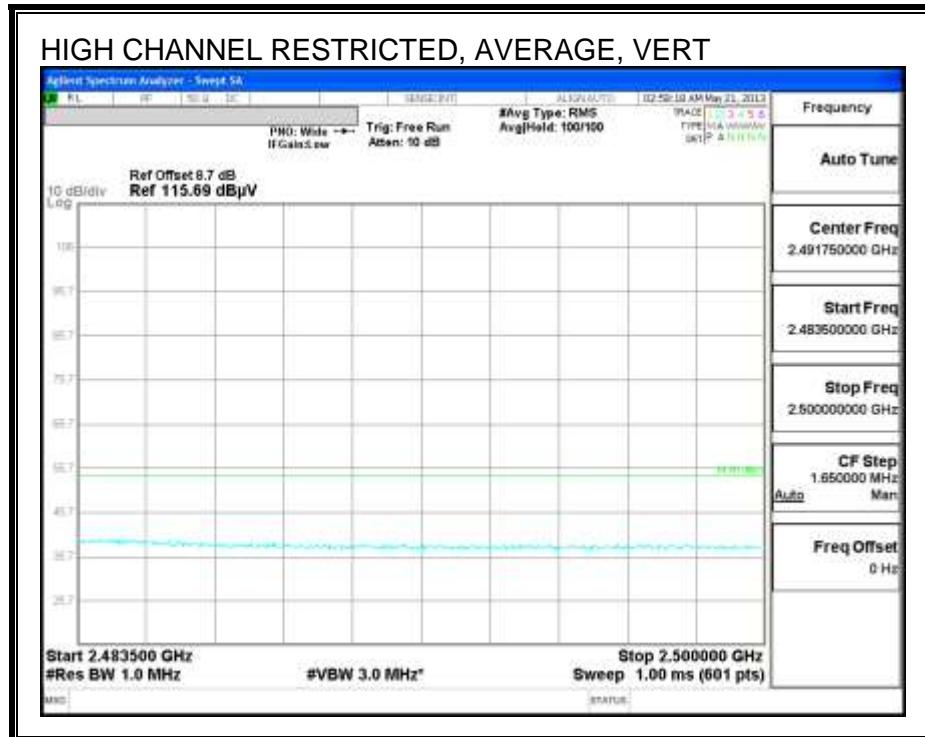
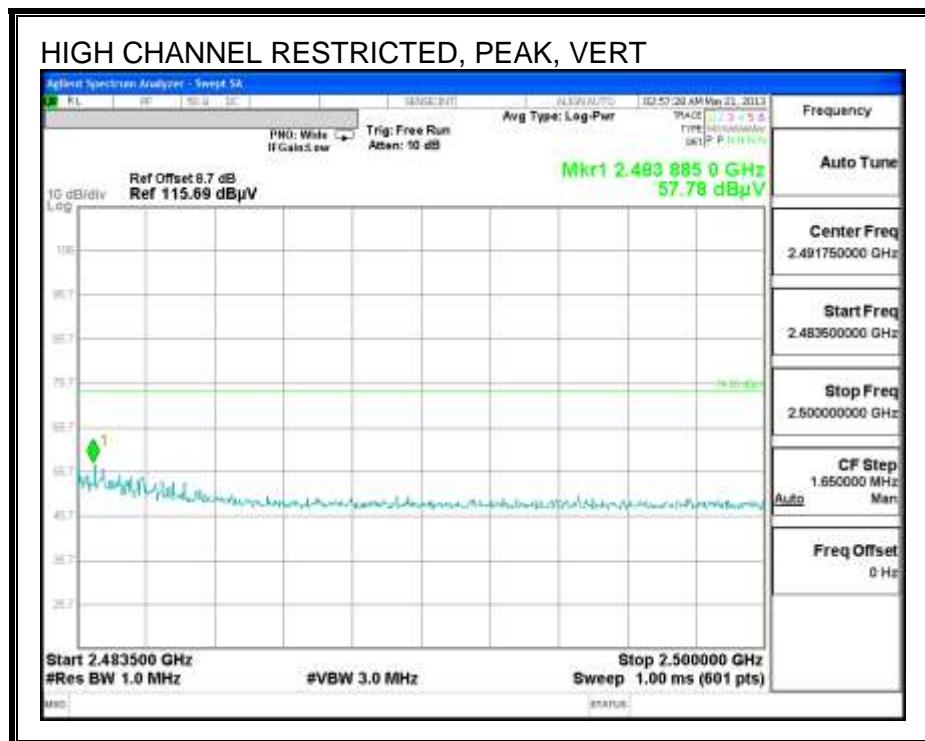
RESTRICTED BANDEDGE (LOW CHANNEL)



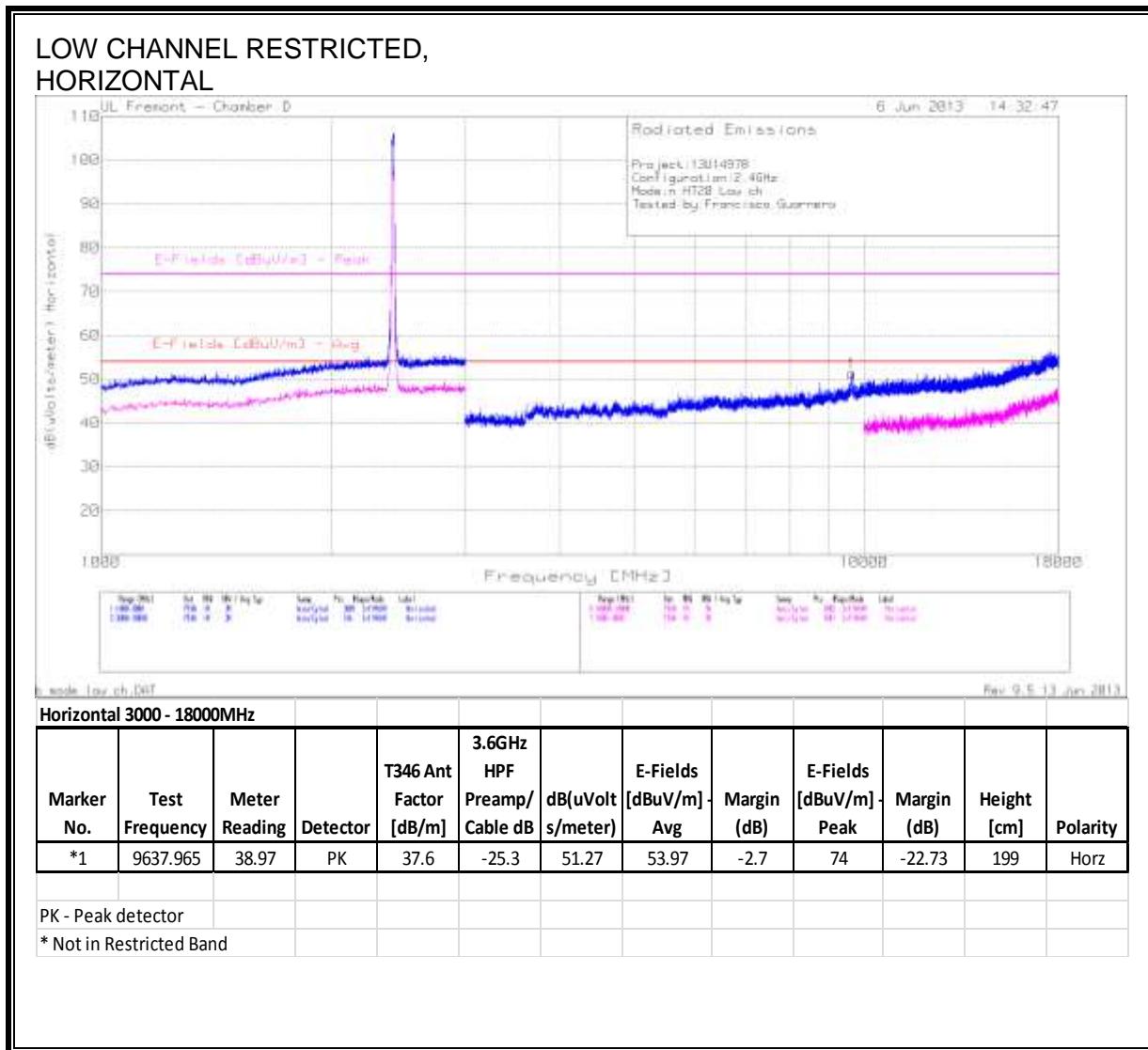


RESTRICTED BANDEDGE (HIGH CHANNEL)

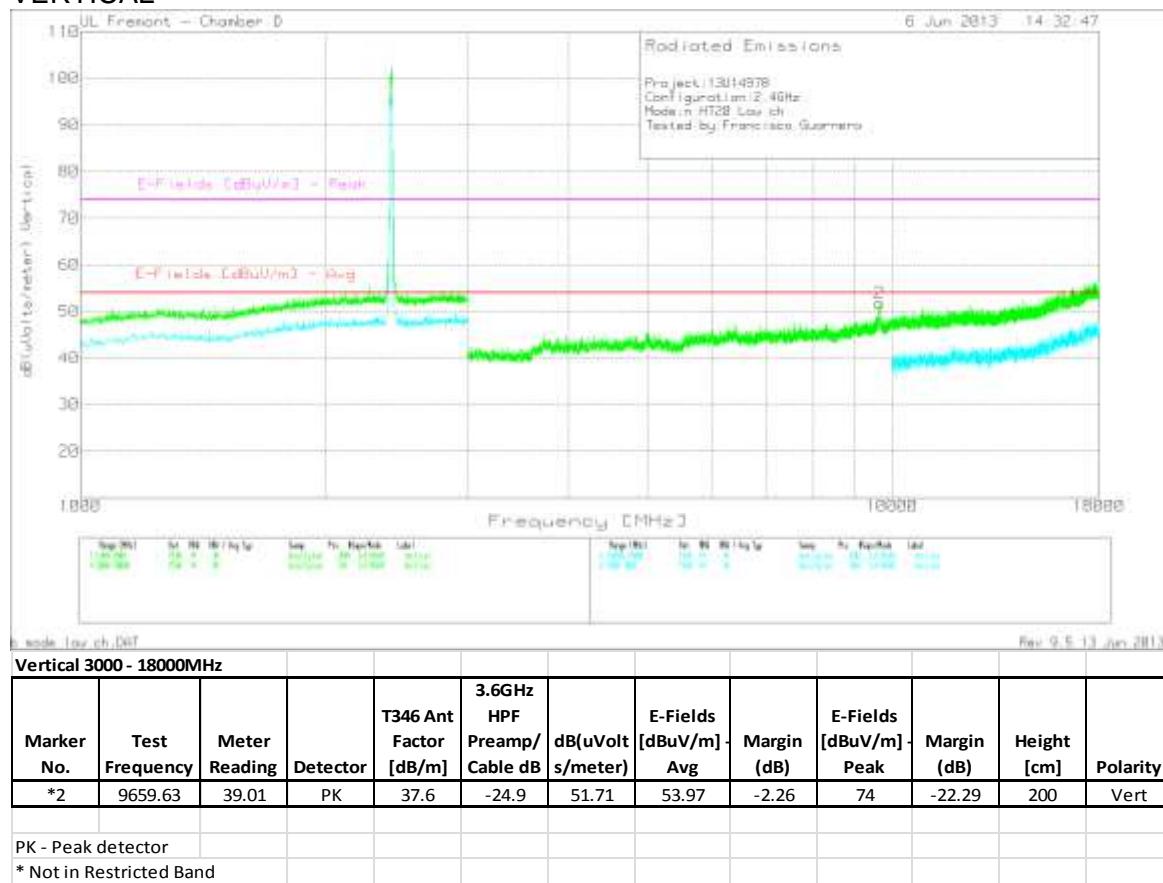




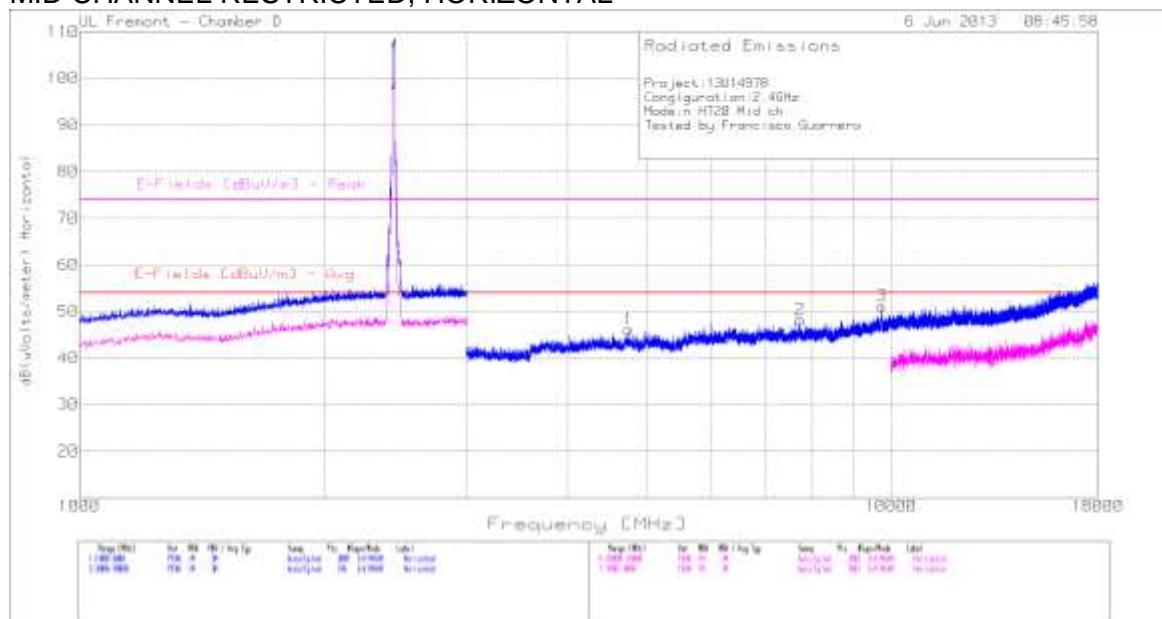
HARMONICS AND SPURIOUS EMISSIONS



LOW CHANNEL RESTRICTED,
VERTICAL

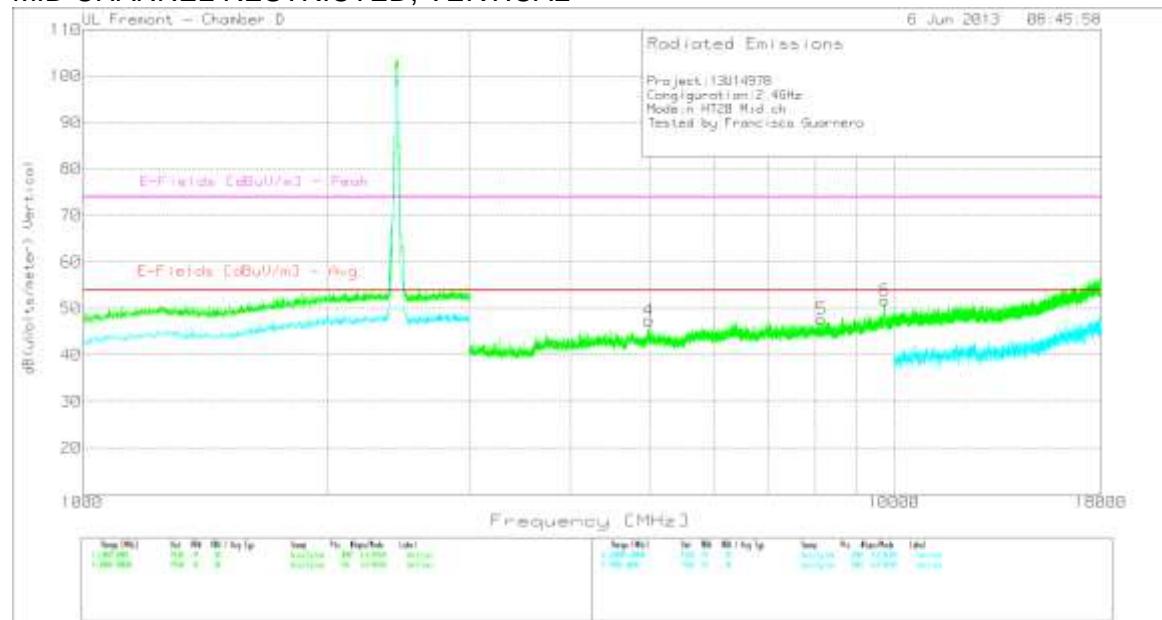


MID CHANNEL RESTRICTED, HORIZONTAL



Horizontal 3000 - 18000MHz											Rev. 9.5 13 Jun 2013	
Marker No.	Test Frequency	Meter Reading	Detector	T346 Ant Factor [dB/m]	3.6GHz HPF Preamp/ Cable dB	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] Peak	Margin (dB)	Height [cm]	Polarity
1	4751.569	42.86	PK	34.4	-31.2	46.06	53.97	-7.91	74	-27.94	399	Horz
2	7733.904	40.3	PK	36.2	-28.3	48.2	53.97	-5.77	74	-25.8	399	Horz
3	9742.959	39.35	PK	37.6	-25.8	51.15	53.97	-2.82	74	-22.85	101	Horz

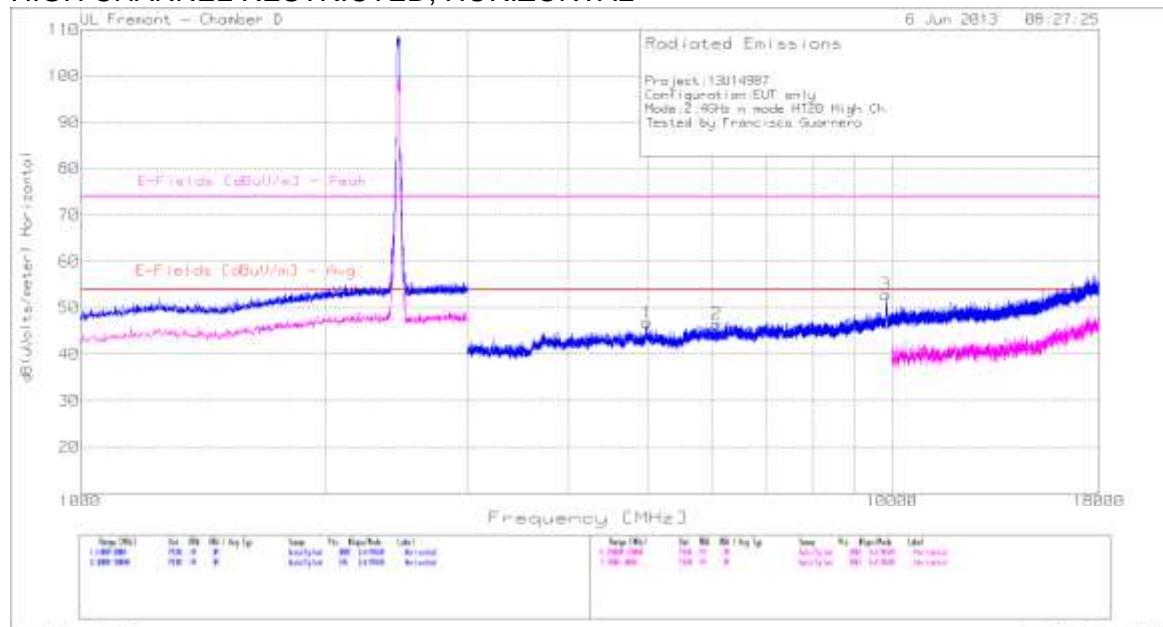
MID CHANNEL RESTRICTED, VERTICAL



Vertical 3000 - 18000MHz

Marker No.	Test Frequency	Meter Reading	Detector	T346 Ant Factor [dB/m]	3.6GHz HPF Preamp/ Cable dB	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
4	4989.056	44.16	PK	34.4	-31.1	47.46	53.97	-6.51	74	-26.54	200	Vert
5	8148.047	39.92	PK	36.2	-28.5	47.62	53.97	-6.35	74	-26.38	100	Vert
6	9748.792	40.06	PK	37.6	-25.9	51.76	53.97	-2.21	74	-22.24	300	Vert
PK - Peak detector												

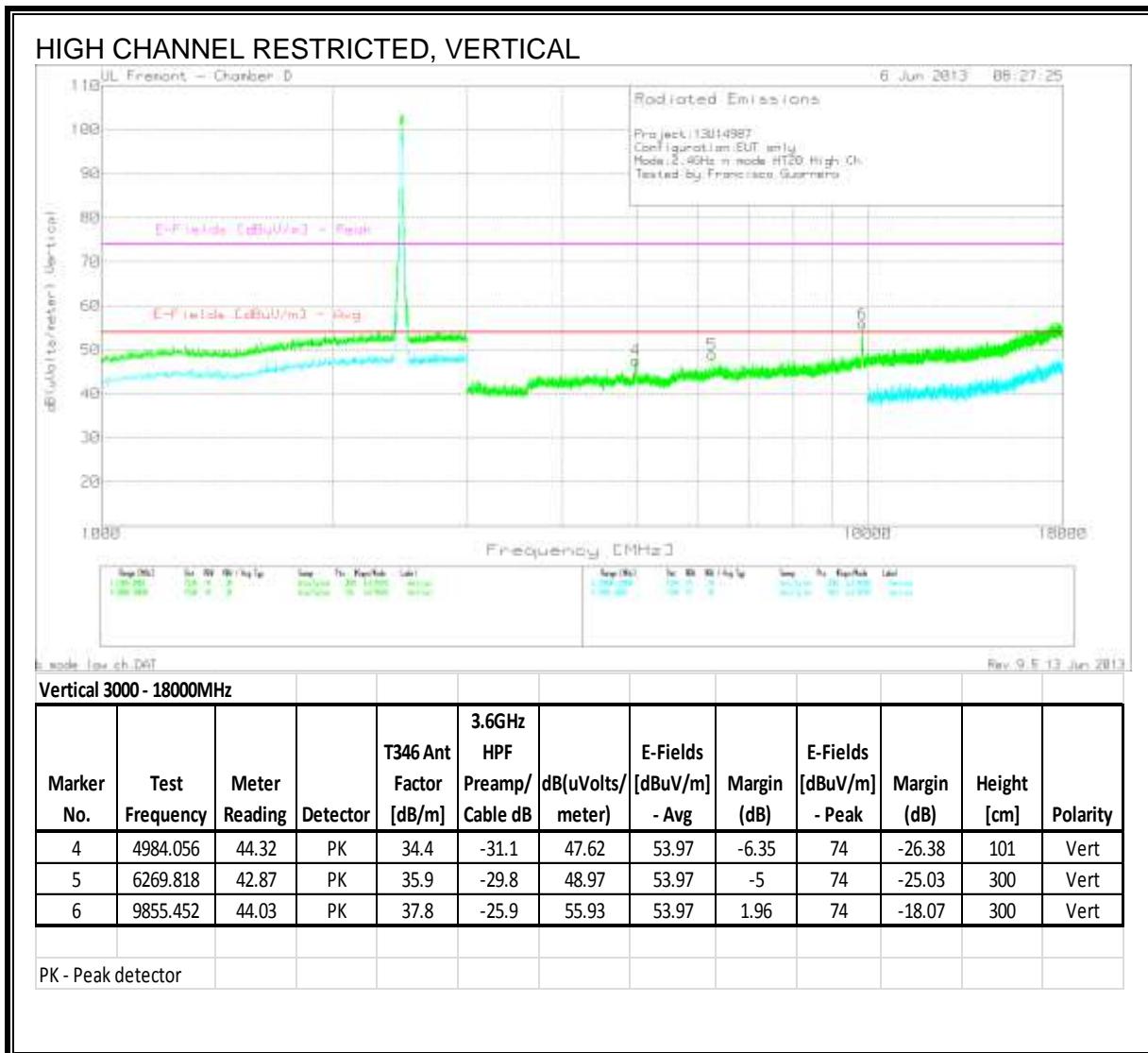
HIGH CHANNEL RESTRICTED, HORIZONTAL



Horizontal 3000 - 18000MHz

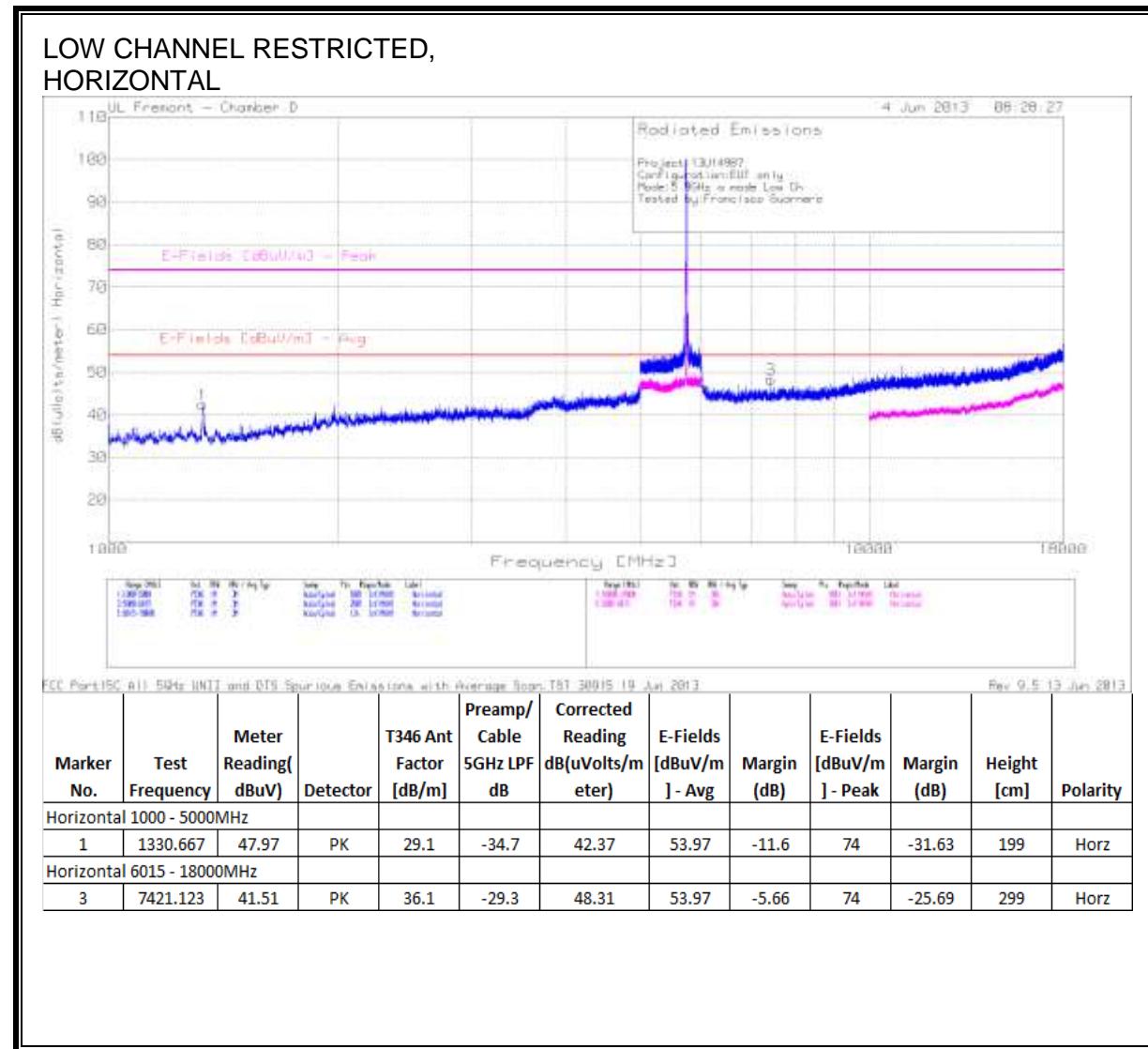
Marker No.	Test Frequency	Meter Reading	Detector	T346 Ant Factor [dB/m]	3.6GHz HPF Preamp/ Cable dB	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	4989.056	43.5	PK	34.4	-31.1	46.8	53.97	-7.17	74	-27.2	299	Horz
2	6085.662	40.71	PK	35.8	-29.9	46.61	53.97	-7.36	74	-27.39	100	Horz
3	9834.62	41.06	PK	37.8	-26	52.86	53.97	-1.11	74	-21.14	199	Horz

PK - Peak detector

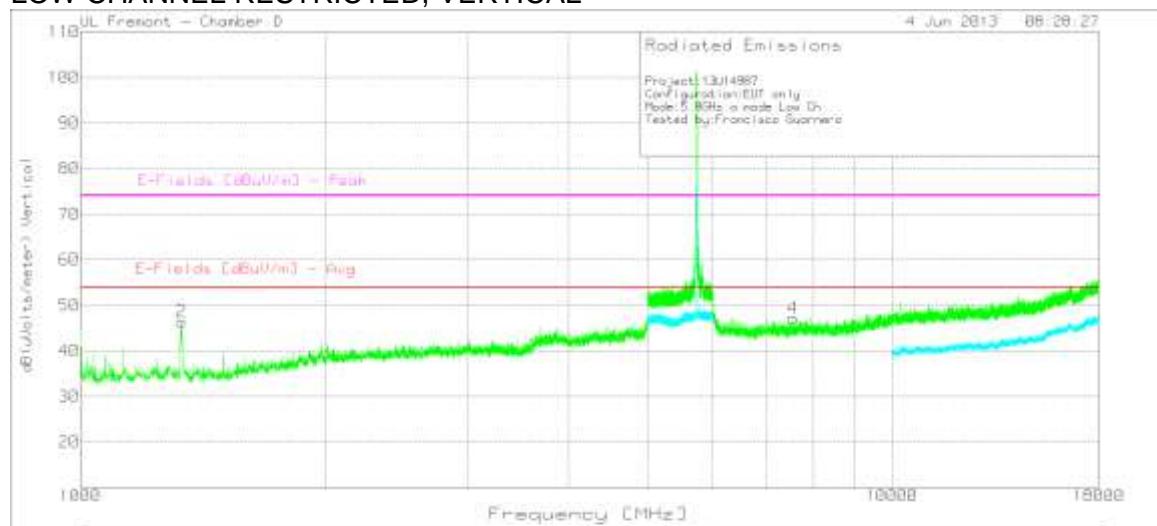


8.5. TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND

HARMONICS AND SPURIOUS EMISSIONS



LOW CHANNEL RESTRICTED, VERTICAL

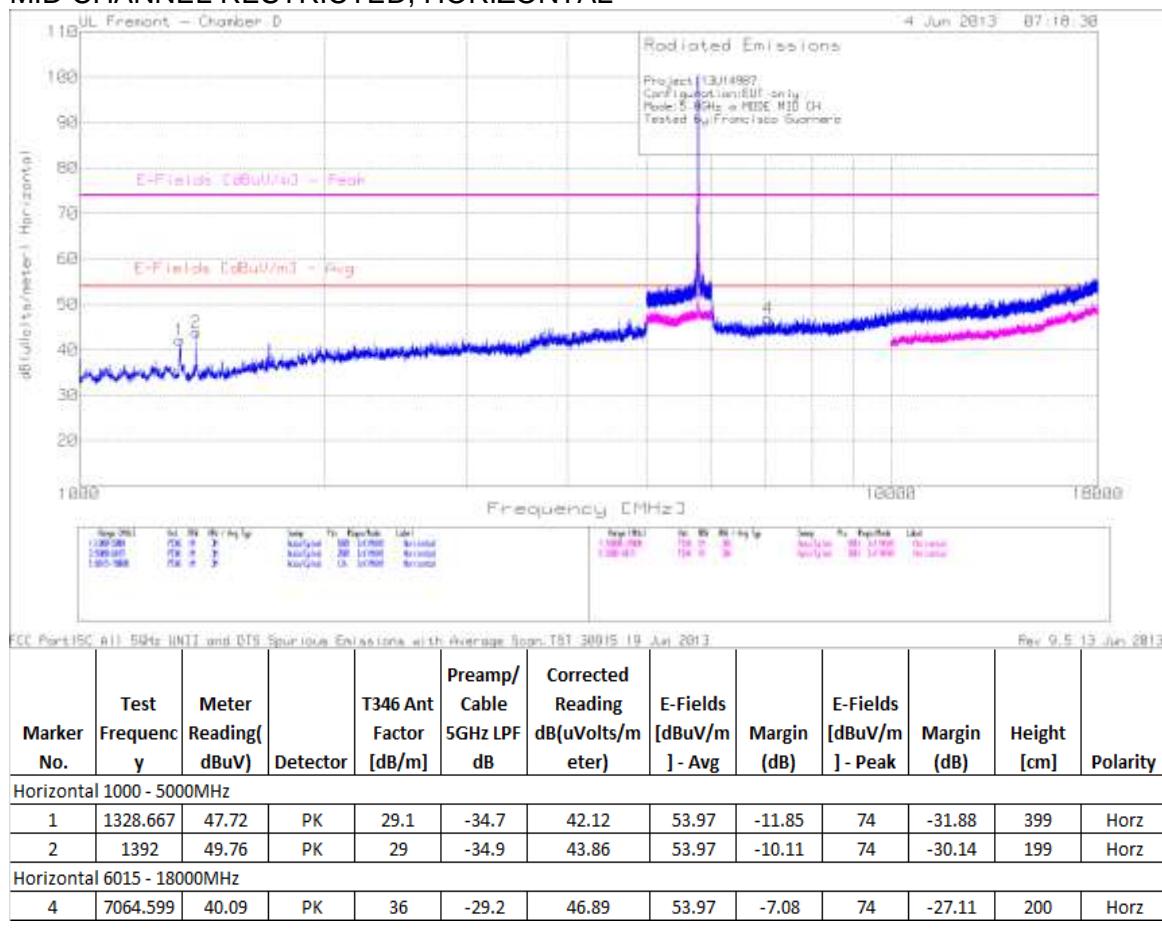


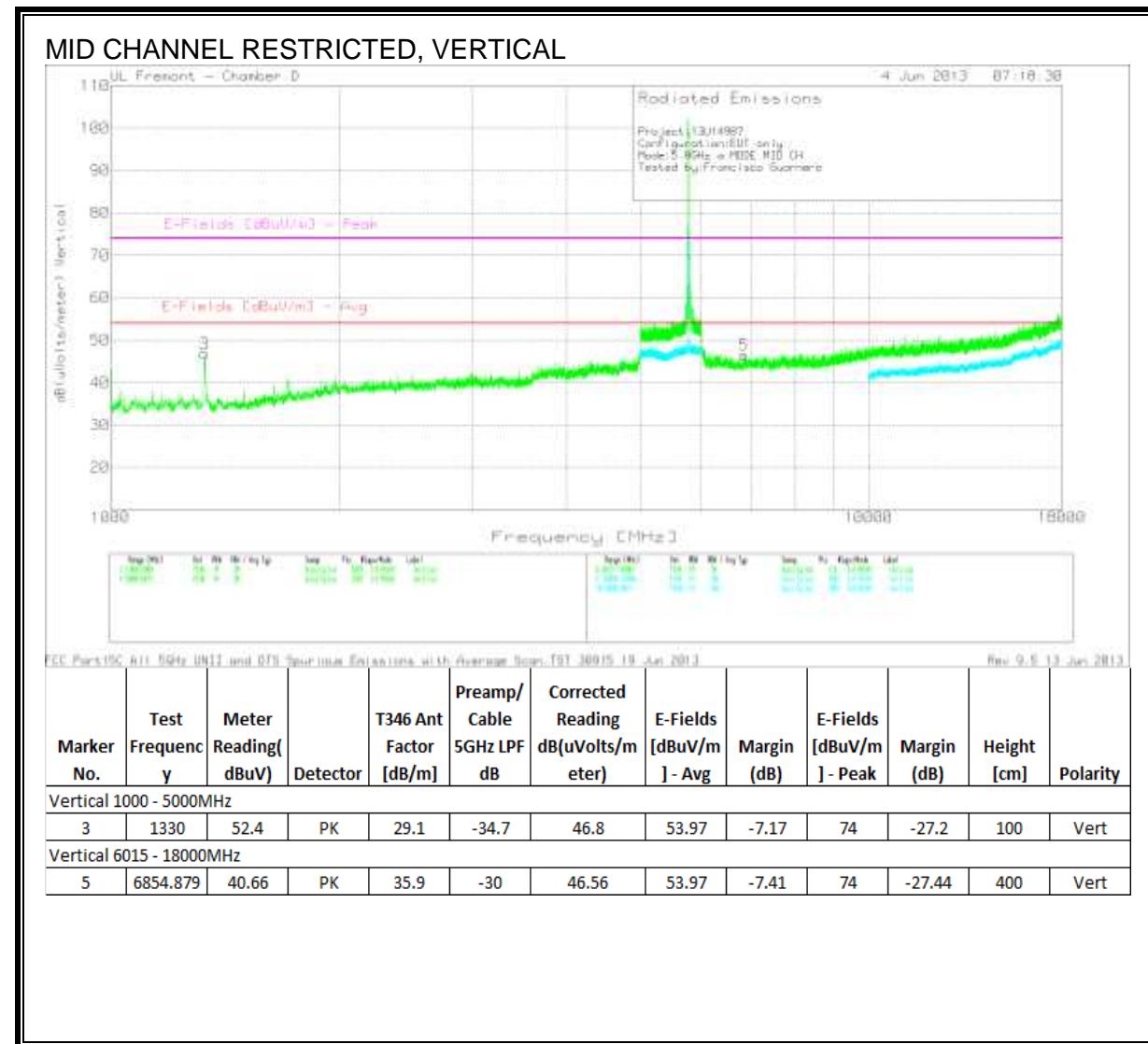
FCC Part 15C, B11, 5GHz UNII and B15 Spurious Emissions with Average Scan, TST 30015, 18 Jun 2013

Rev. 9, E 13 Jun 2013

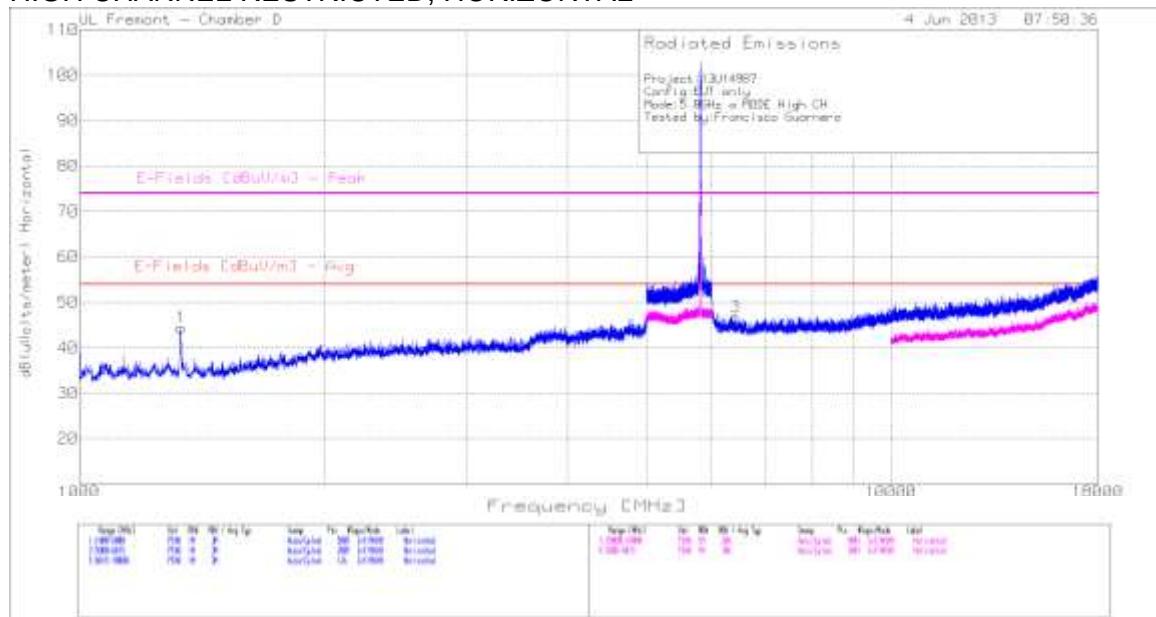
Marker No.	Test Frequency	Meter Reading(dBuV)	Meter Detector	T346 Ant Factor [dB/m]	Preamplifier/Cable 5GHz LPF dB	Corrected Reading dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
Vertical 1000 - 5000MHz												
2	1332.667	52.02	PK	29.1	-34.7	46.42	53.97	-7.55	74	-27.58	200	Vert
Vertical 6015 - 18000MHz												
4	7554.944	40.02	PK	36.1	-29	47.12	53.97	-6.85	74	-26.88	399	Vert

MID CHANNEL RESTRICTED, HORIZONTAL





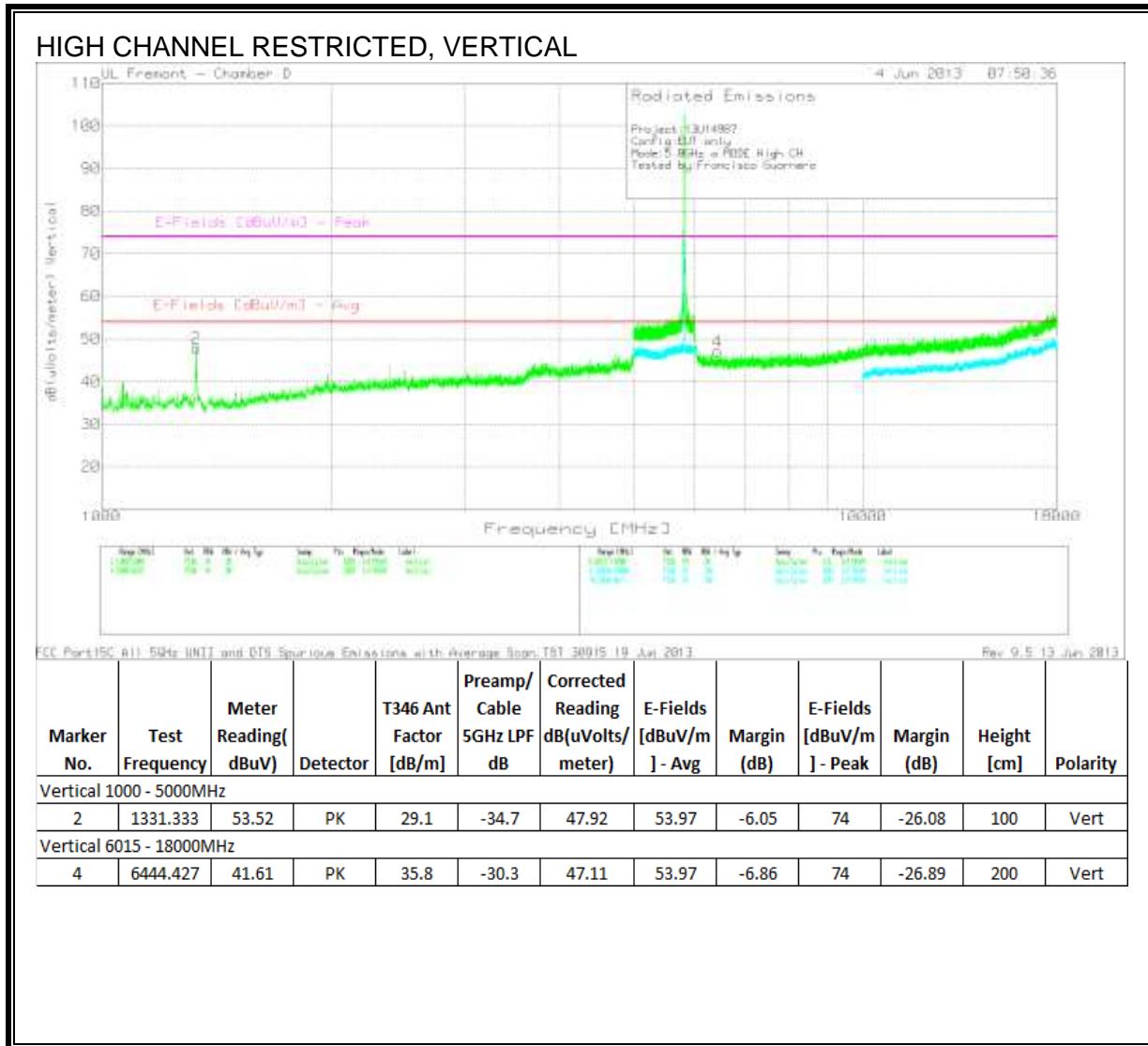
HIGH CHANNEL RESTRICTED, HORIZONTAL



FCC Part 15C, B11, 5GHz, B111, and GTR, Spurious Emissions, with Frequency from TBT 30015, 10 Jun 2013

Rev. 9.5 13 Jun 2013

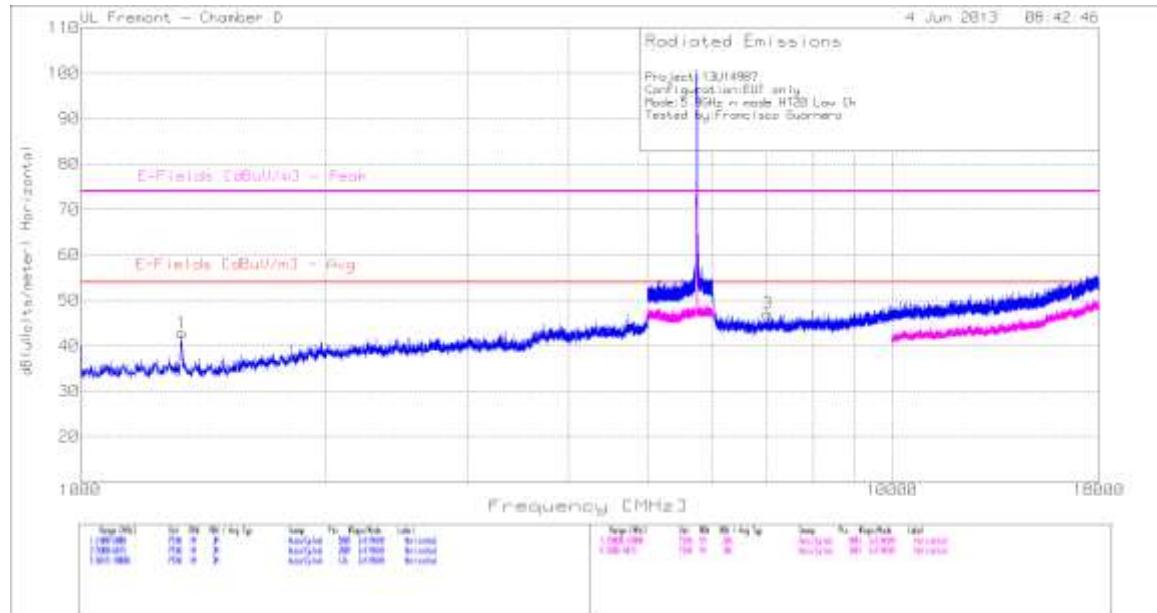
Marker No.	Test Frequency	Meter Reading(dBuV)	Detector	T346 Ant Factor [dB/m]	Preamp/ Cable 5GHz LPF dB	Corrected Reading dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
Horizontal 1000 - 5000MHz												
1	1334	49.99	PK	29.1	-34.7	44.39	53.97	-9.58	74	-29.61	399	Horz
Horizontal 6015 - 18000MHz												
3	6439.433	41.3	PK	35.8	-30.4	46.7	53.97	-7.27	74	-27.3	299	Horz



8.6. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.8 GHz BAND

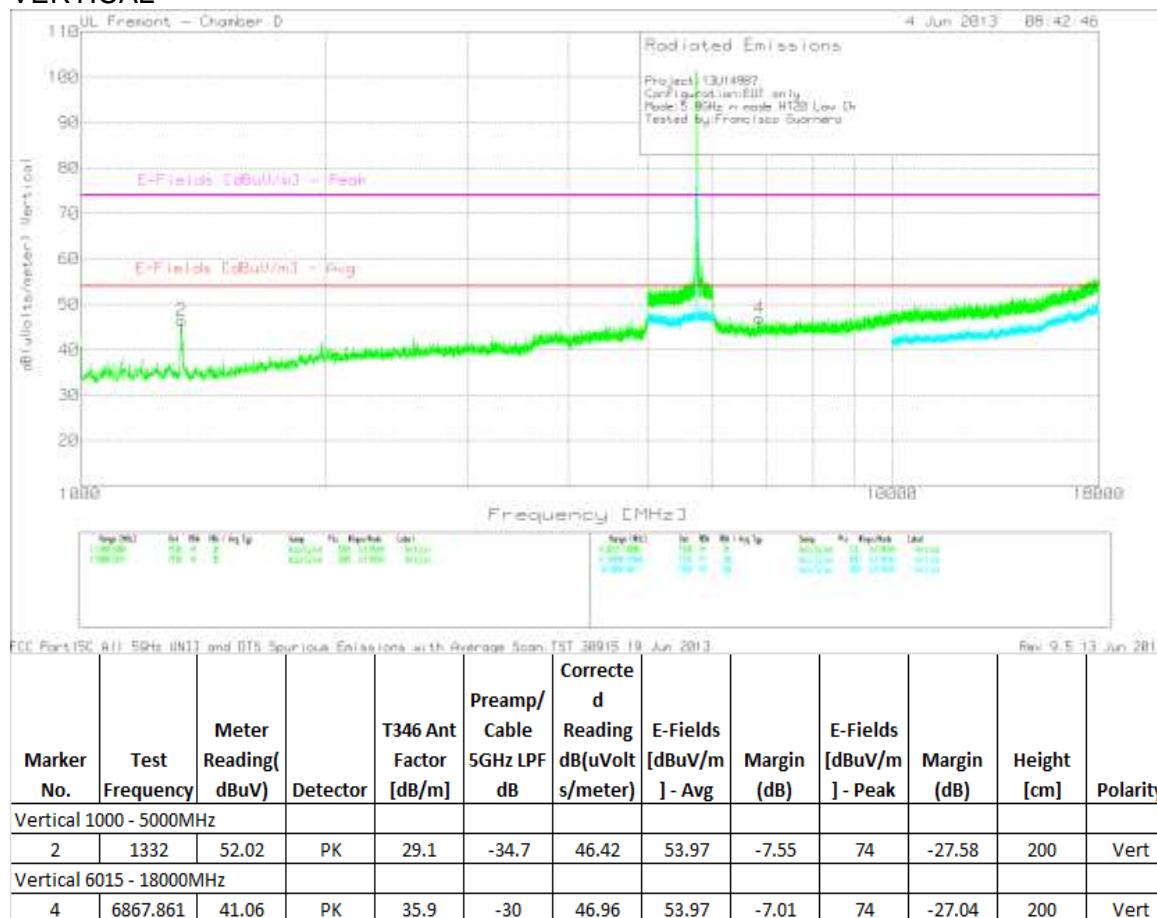
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESTRICTED, HORIZONTAL

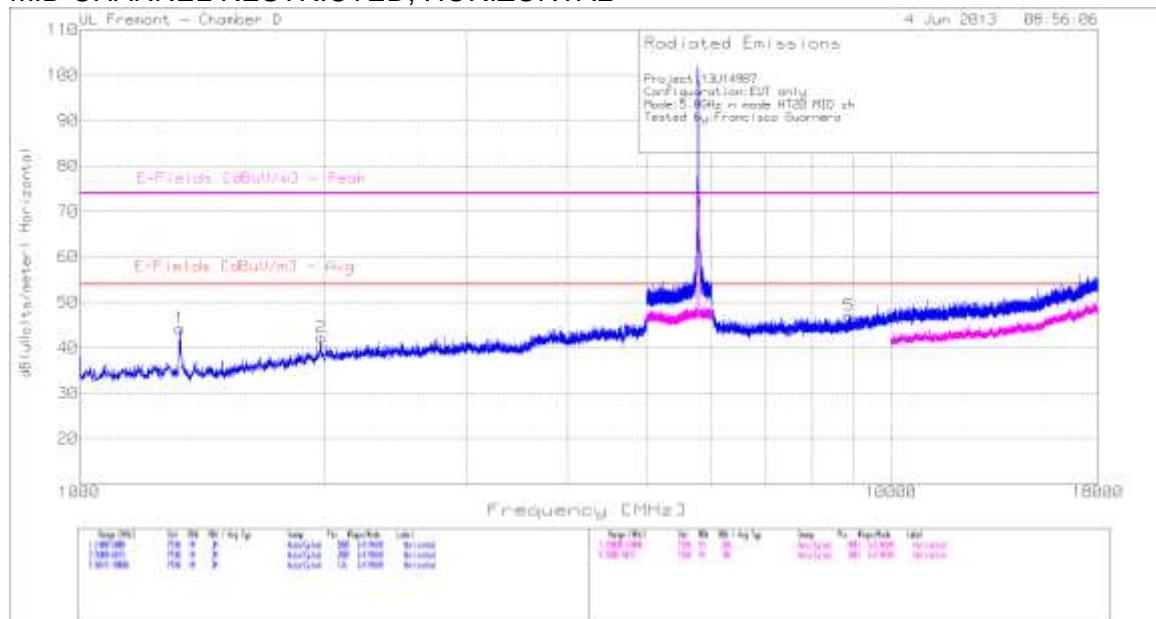


FCC Part 15C Rule 101 Emissions with Average from TLT 30015, 10 Jun 2013										Rev. 9.5.13 Jun 2013		
Marker No.	Test Frequency	Meter Reading(dBuV)	Detector	T346 Ant Factor [dB/m]	Preamp/ Cable 5GHz LPF dB	Corrected Reading dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
Horizontal 1000 - 5000MHz												
1	1334	48.37	PK	29.1	-34.7	42.77	53.97	-11.2	74	-31.23	199	Horz
Horizontal 6015 - 18000MHz												
3	7029.645	39.99	PK	36	-28.9	47.09	53.97	-6.88	74	-26.91	399	Horz

LOW CHANNEL RESTRICTED,
VERTICAL



MID CHANNEL RESTRICTED, HORIZONTAL

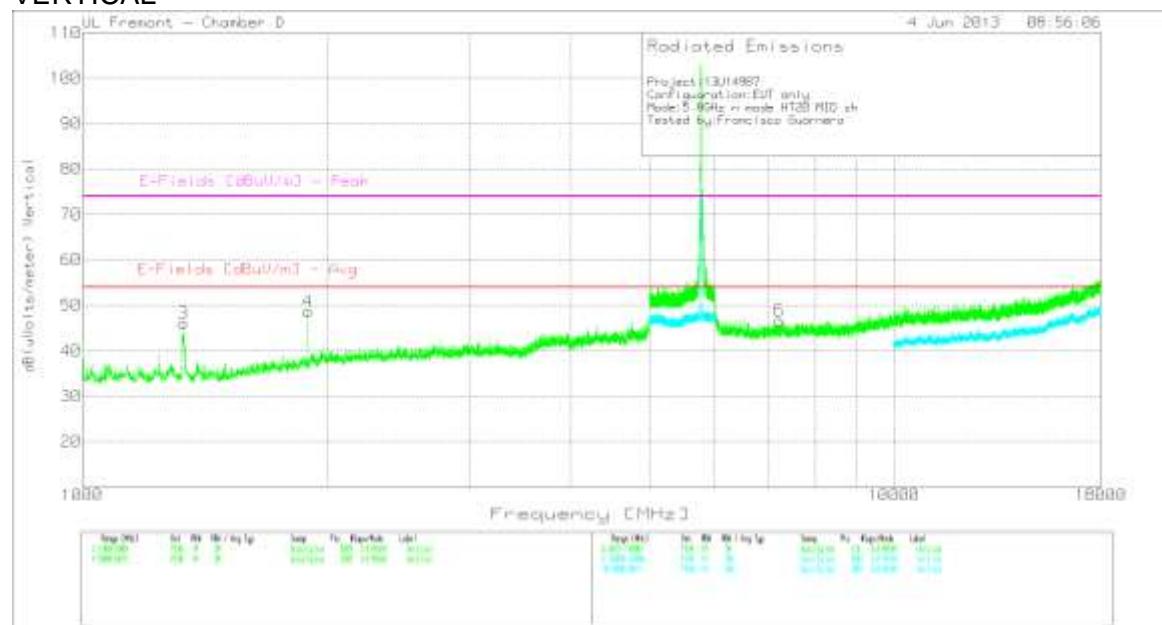


FCC Part 15C, B11, B20, B21, and D20, Unintentional Emissions with Average Test, TRT 30015, 10 Jun 2013

Rev. 9.5, 13 Jun 2013

Marker No.	Test Frequency	Meter Reading(dBuV)	Detector	T346 Ant Factor	Preamp/ Cable 5GHz LPF	Corrected Reading dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
Horizontal 1000 - 5000MHz												
1	1330	49.87	PK	29.1	-34.7	44.27	53.97	-9.7	74	-29.73	199	Horz
2	1985.333	43.79	PK	32	-33.5	42.29	53.97	-11.68	74	-31.71	199	Horz
Horizontal 6015 - 18000MHz												
5	8879.176	37.86	PK	36.7	-27.5	47.06	53.97	-6.91	74	-26.94	299	Horz

MID CHANNEL RESTRICTED,
VERTICAL

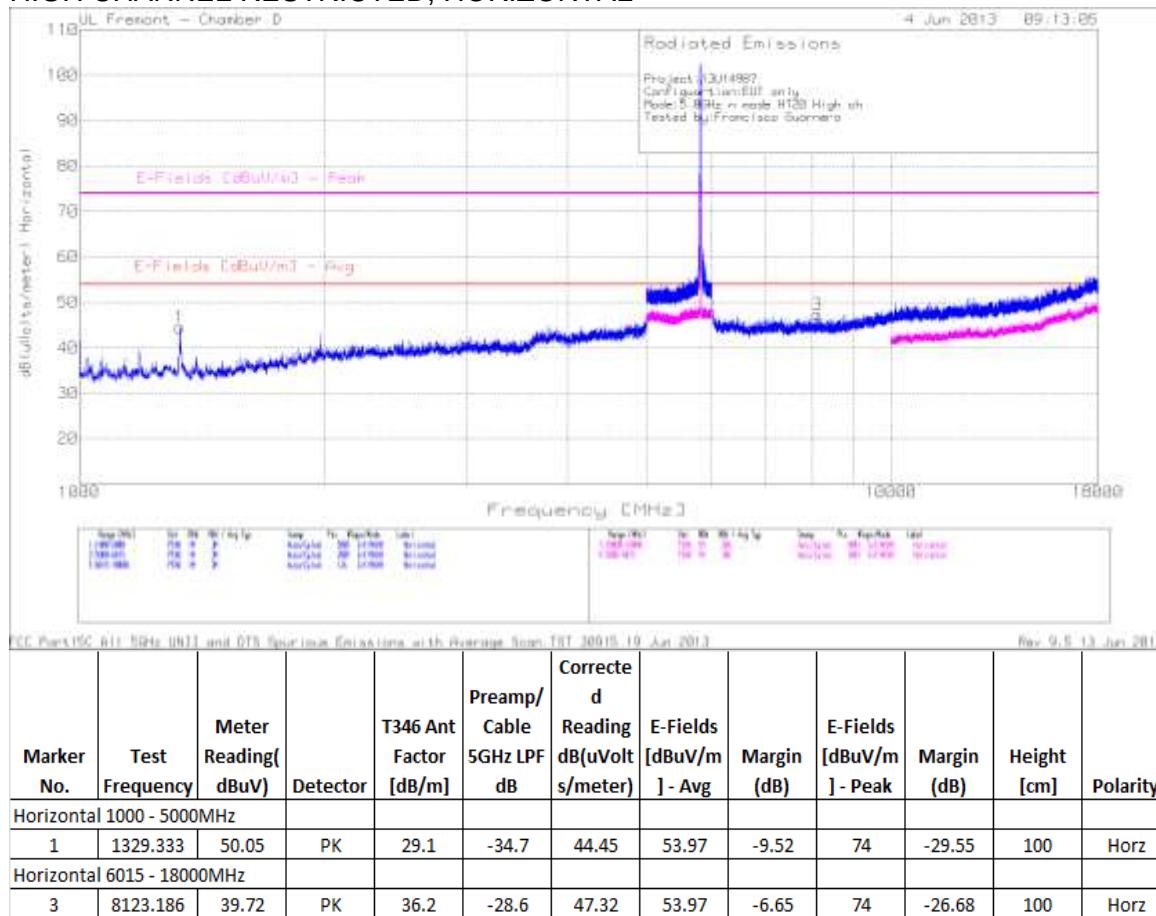


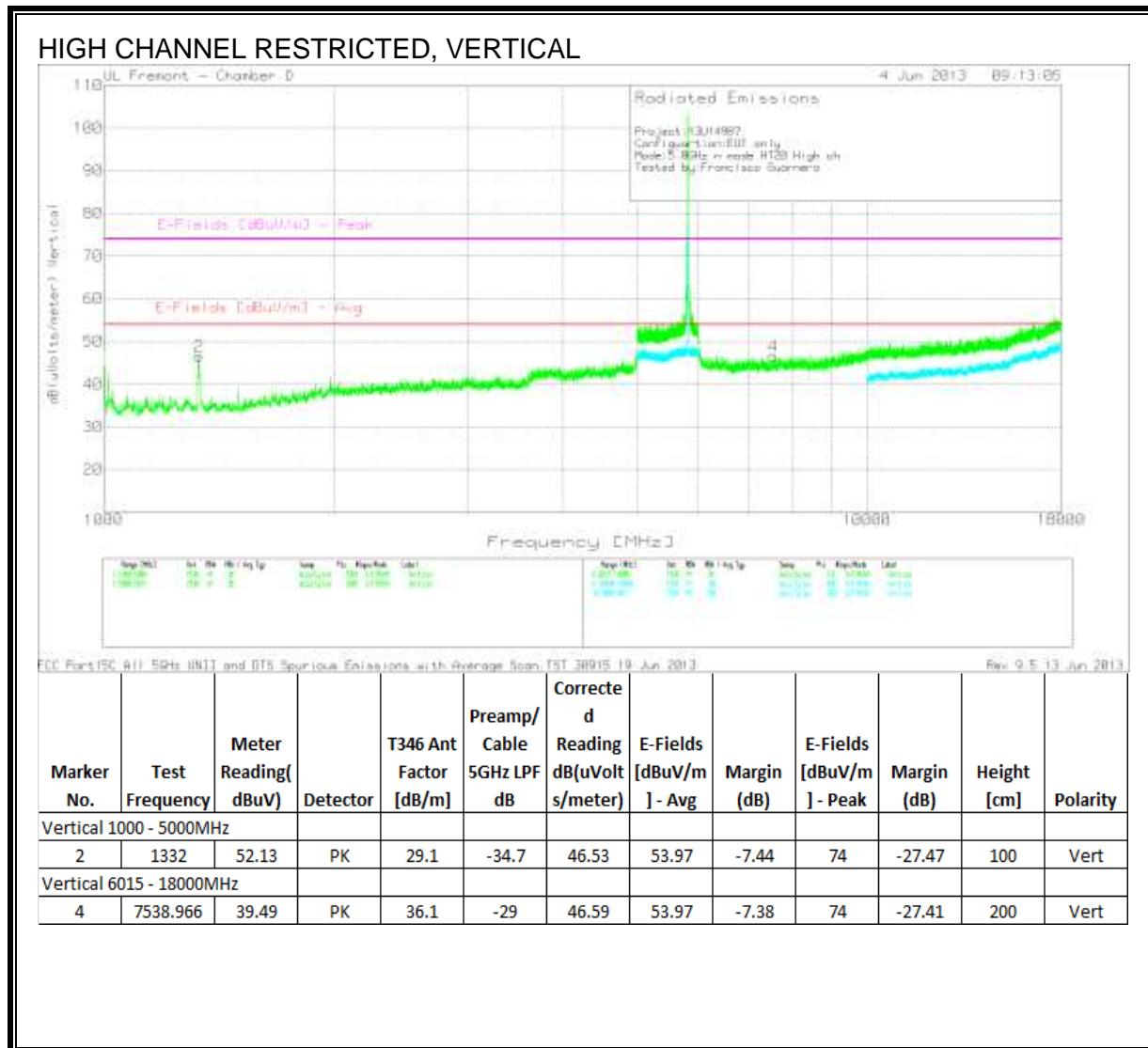
FCC Part 15C All Rights Reserved - Emissions with Average Noise TOT 30915 19 Jun 2013

Rev. 9.5 13 Jun 2013

Marker No.	Test Frequency	Meter Reading(dBuV)	Detector	T346 Ant Factor [dB/m]	Preamp/ Cable 5GHz LPF dB	Corrected Reading dB(uV/s/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
Vertical 1000 - 5000MHz												
3	1332	51.62	PK	29.1	-34.7	46.02	53.97	-7.95	74	-27.98	100	Vert
4	1897.333	51.01	PK	31.4	-33.8	48.61	53.97	-5.36	74	-25.39	200	Vert
Vertical 6015 - 18000MHz												
6	7221.389	39.81	PK	36	-29.2	46.61	53.97	-7.36	74	-27.39	100	Vert

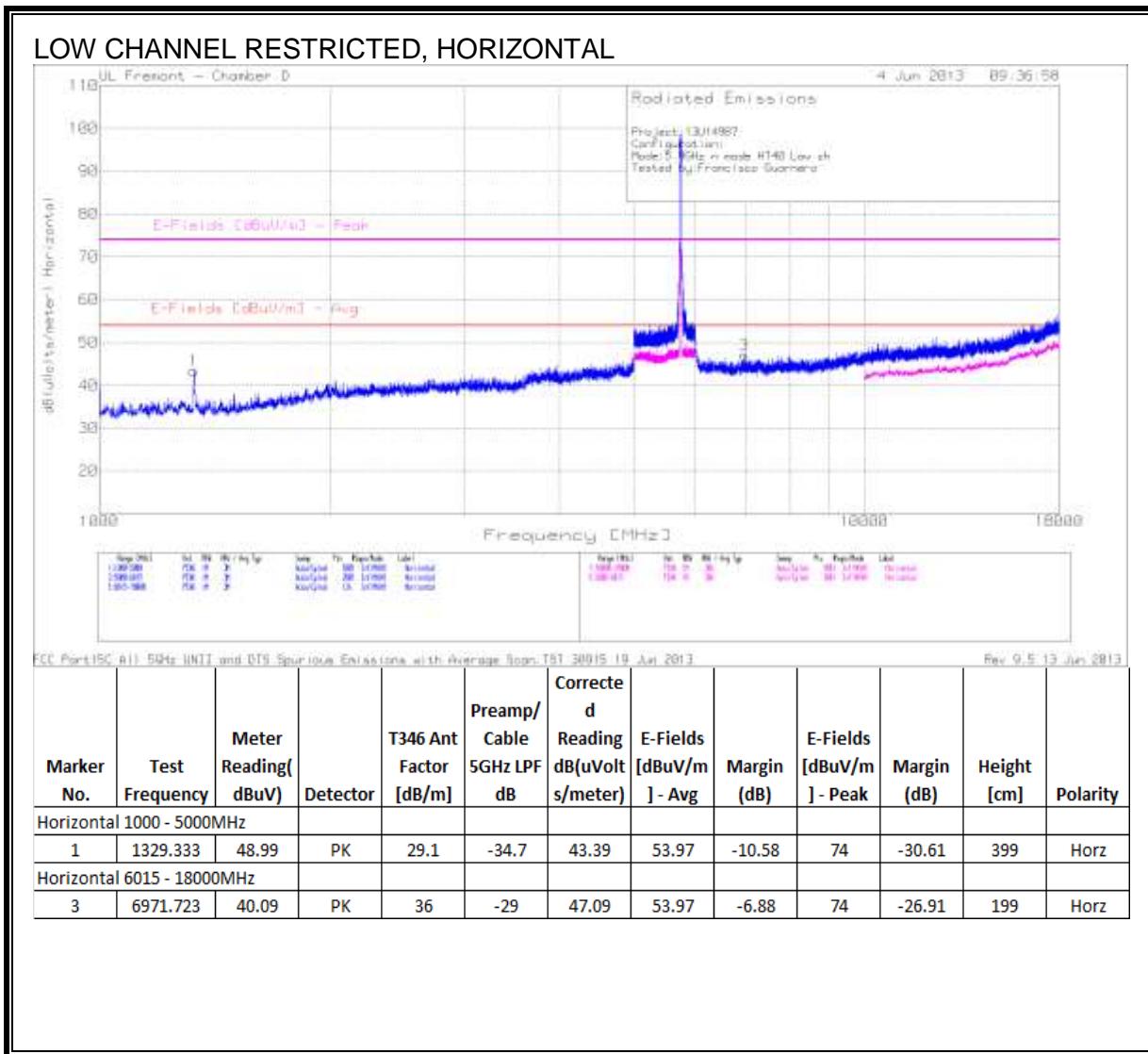
HIGH CHANNEL RESTRICTED, HORIZONTAL



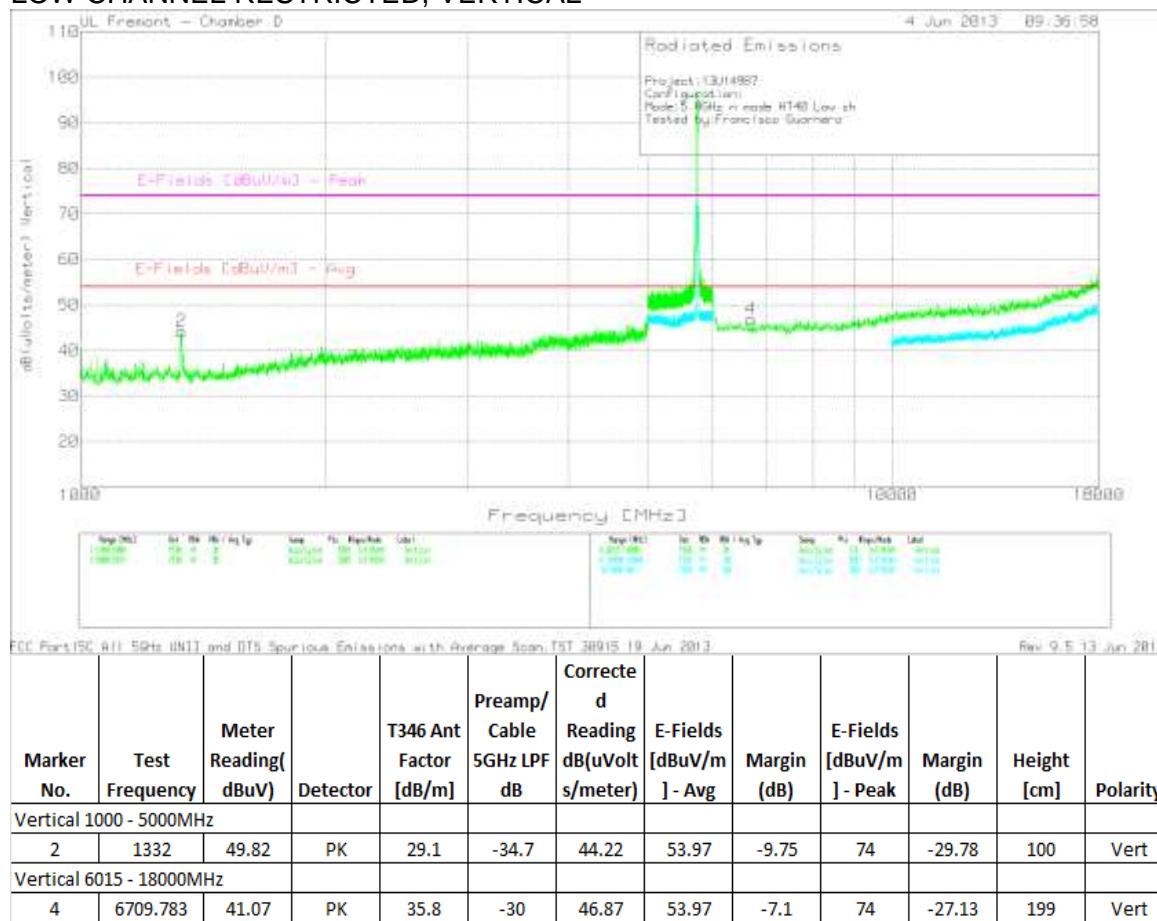


8.7. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.8 GHz BAND

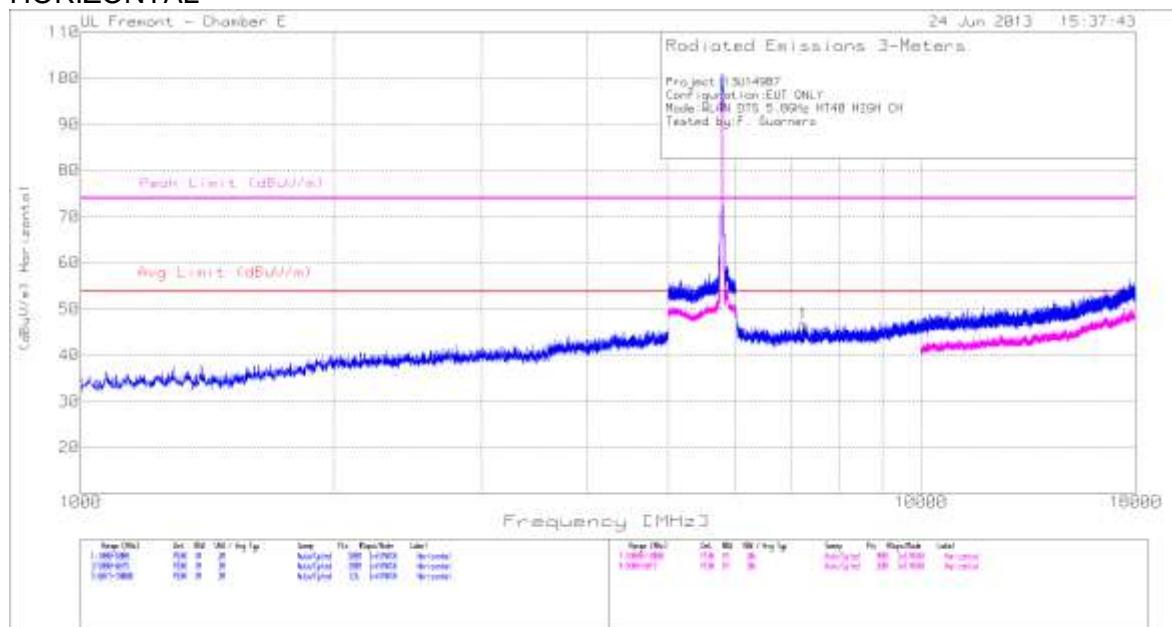
HARMONICS AND SPURIOUS EMISSIONS



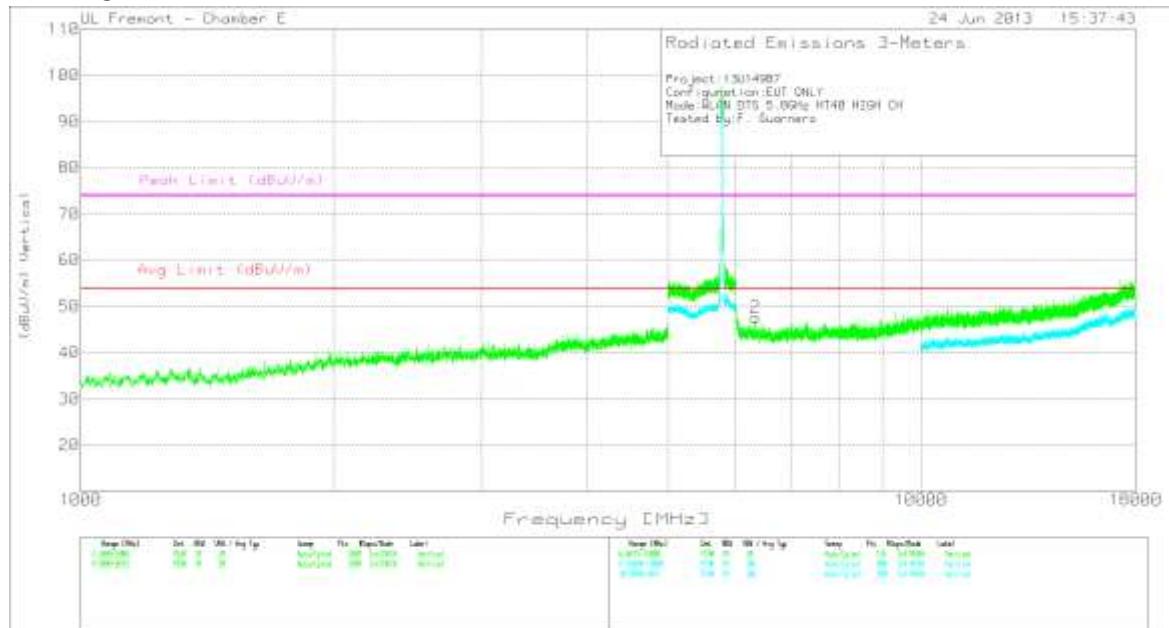
LOW CHANNEL RESTRICTED, VERTICAL



HIGH CHANNEL RESTRICTED, HORIZONTAL



HIGH CHANNEL RESTRICTED, VERTICAL

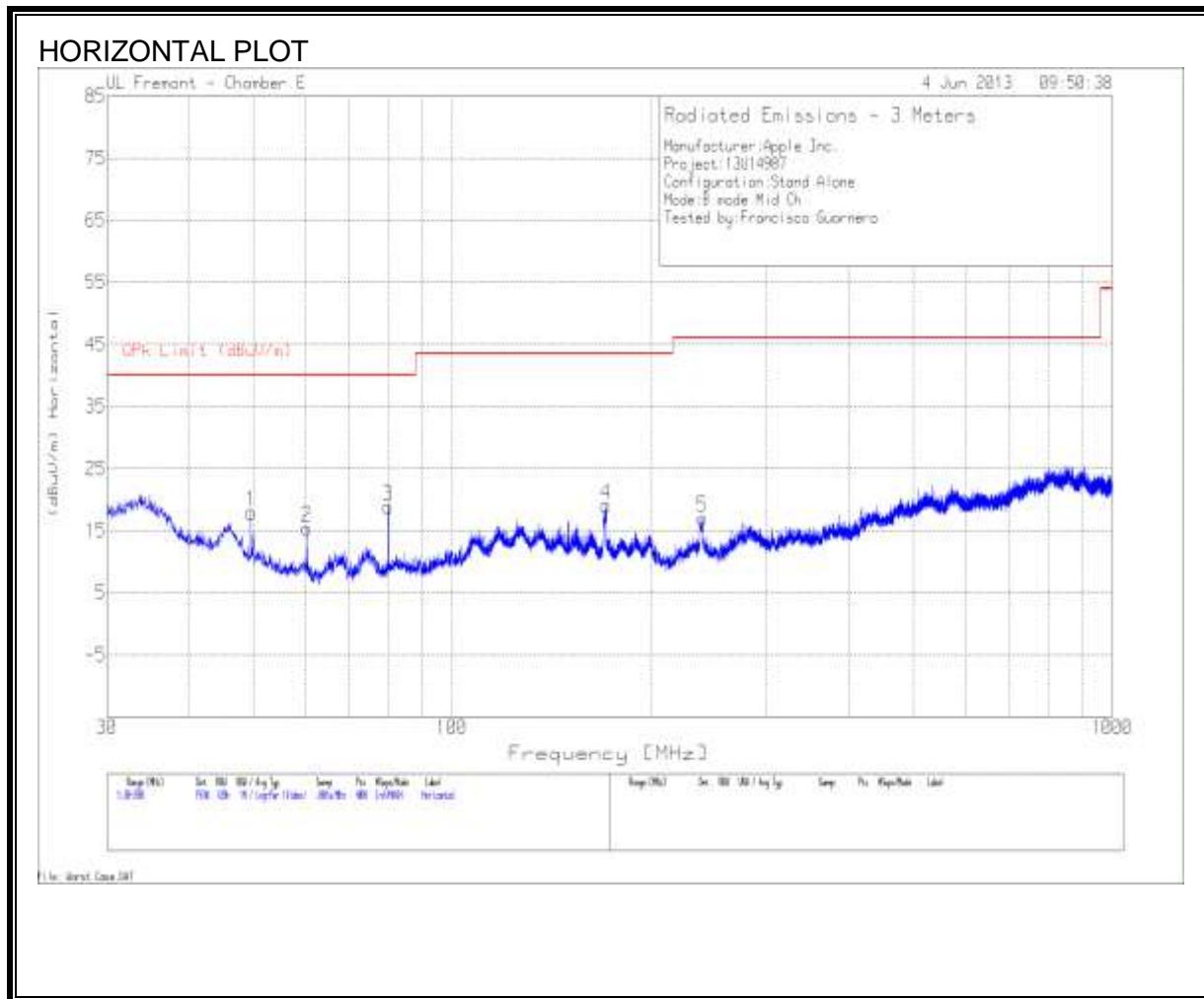


FCC Part 15C All EGm3 UNII and BT5 Spurious Emissions with Average S-est 38915 19 Jun 2013

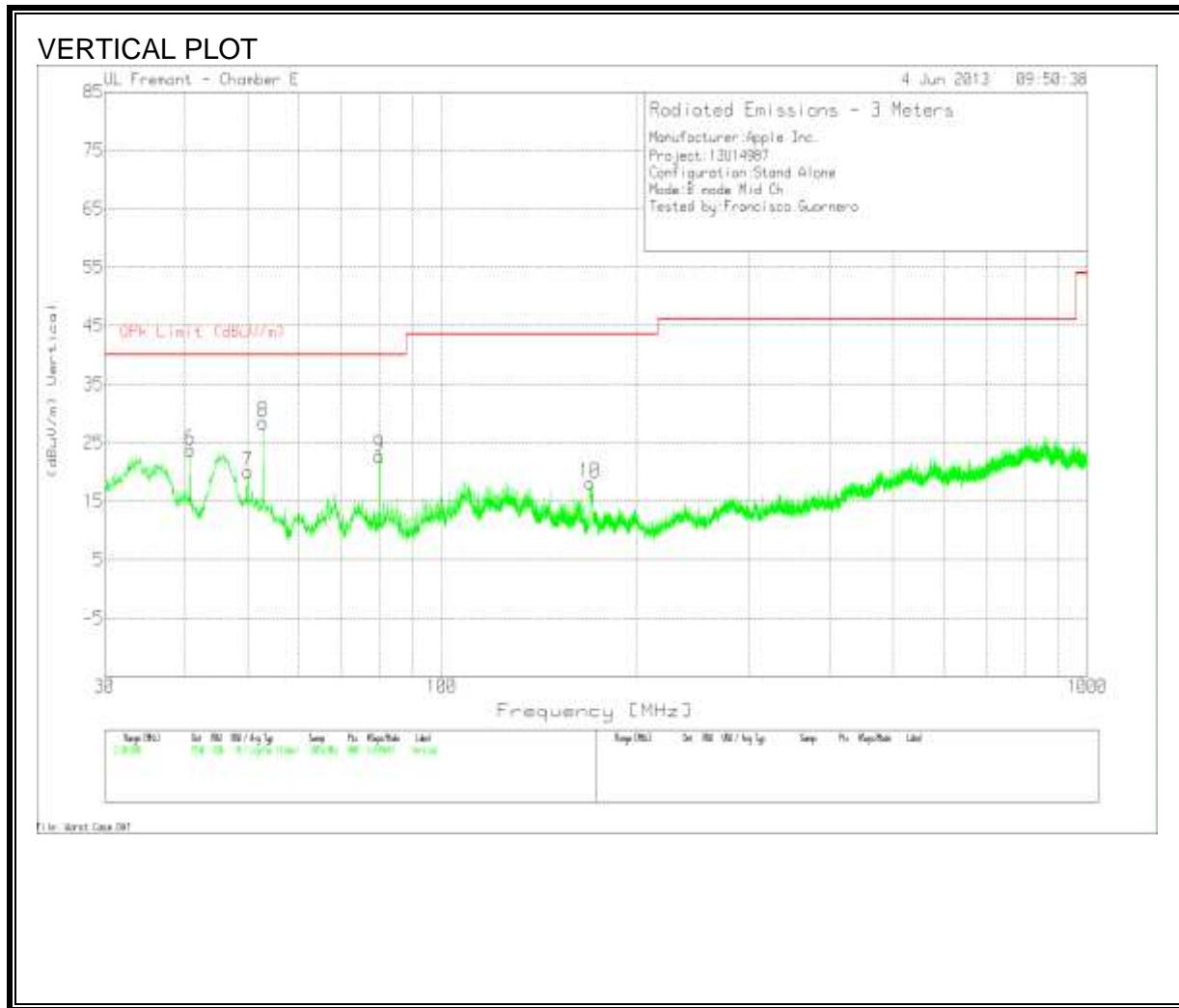
Rev. 9.5.13 Jun

8.8. WORST-CASE BELOW 1 GHz

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



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



HORIZONTAL AND VERTICAL DATA

Manufacturer: Apple Inc

Project:13U14987

Configuration:Stand Alone

Mode:B mode Mid Ch

Tested by:Francisco Guarnero

Marker No.	Test Frequency	Meter Reading	Detector	AF T408 (dB/m)	Amp/Cbl (dB)	(dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Height [cm]	Polarity
Horizontal 30 - 200MHz										
1	49.5925	37.5	PK	8.1	-27.6	18	40	-22	200	Horz
2	60.26	35.91	PK	7.4	-27.9	15.41	40	-24.59	200	Horz
3	80.0225	38.87	PK	7.7	-27.7	18.87	40	-21.13	400	Horz
4	171.0575	34.72	PK	11.7	-27.3	19.12	43.52	-24.4	98	Horz
Horizontal 200 - 1000MHz										
5	239.5	31.85	PK	11.5	-26.3	17.05	46.02	-28.97	99	Horz
Vertical 30 - 200MHz										
6	40.7525	37.77	PK	13.3	-27.3	23.77	40	-16.23	100	Vert
7	50.0175	39.84	PK	7.9	-27.7	20.04	40	-19.96	100	Vert
8	52.8225	48.77	PK	7.3	-27.6	28.47	40	-11.53	100	Vert
9	80.0225	42.72	PK	7.7	-27.7	22.72	40	-17.28	100	Vert
10	169.57	33.85	PK	11.7	-27.4	18.15	43.52	-25.37	100	Vert

PK - Peak detector

9. 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 C63.4

RESULTS

6 WORST EMISSIONS

Line-L1 .15 - 30MHz

Test Frequency	Meter Reading	Detector	T24 IL L1.TXT (dB)	LC Cables 1&3.TXT (dB)	dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.159	54.38	QP	0.1	0	54.48	65.52	-11.04	-	-
0.159	48.7	Av	0.1	0	48.8	-	-	55.5	-6.7
0.8295	48.8	PK	0.1	0	48.9	56	-7.1	-	-
0.8295	30.76	Av	0.1	0	30.86	-	-	46	-15.14
7.278	39.71	PK	0.1	0.1	39.91	60	-20.09	-	-
7.278	25.72	Av	0.1	0.1	25.92	-	-	50	-24.08
16.854	45.42	PK	0.2	0.2	45.82	60	-14.18	-	-
16.854	28.85	Av	0.2	0.2	29.25	-	-	50	-20.75

Line-L2 .15 - 30MHz

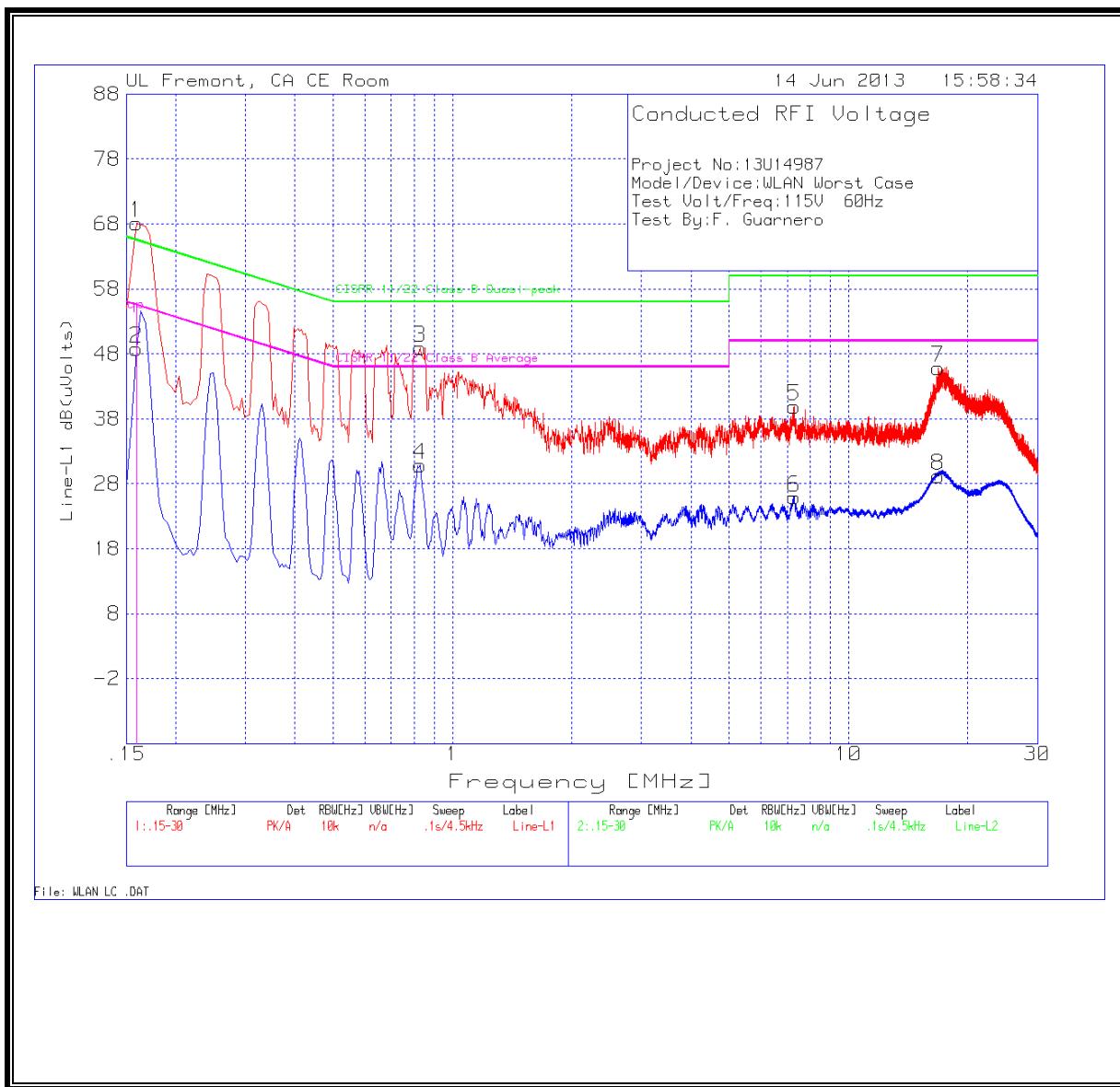
Test Frequency	Meter Reading	Detector	T24 IL L2.TXT (dB)	LC Cables 2&3.TXT (dB)	dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.1545	54.75	PK	0.1	0	54.85	65.8	-10.95	-	-
0.1545	40.25	Av	0.1	0	40.35	-	-	55.8	-15.45
0.78	42.3	PK	0.1	0	42.4	56	-13.6	-	-
0.78	24.89	Av	0.1	0	24.99	-	-	46	-21.01
2.4585	35.55	PK	0.1	0.1	35.75	56	-20.25	-	-
2.4585	22.07	Av	0.1	0.1	22.27	-	-	46	-23.73
17.5425	42	PK	0.2	0.2	42.4	60	-17.6	-	-
17.5425	29.72	Av	0.2	0.2	30.12	-	-	50	-19.88

PK - Peak detector

QP - Quasi-Peak detector

Av - Average detector

LINE 1 RESULTS



LINE 2 RESULTS

