



FCC CFR47 PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

BT + ZIGBEE and WLAN DTS/UNII a/b/g/n MIMO

MODEL NUMBER: ID:082

FCC ID: DKN1018

REPORT NUMBER: 15U20805-E4, Revision A

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Revision History

Rev.	Issue Date	Revisions	Revised By
--	08/18/15	Initial Issue	P. ZHANG
A	9/3/15	Updated Page 7 and Noted DC Factor statement in Page 30	P. ZHANG

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Echostar Technologies LLC

EUT DESCRIPTION: BT+ZIGBEE+WLAN DTS/UNII a/b/g/n MIMO

MODEL: 082

SERIAL NUMBER: 208117-02-095 (Conducted) ; 208117-02-117 (Radiated)

DATE TESTED: JULY 23 – AUG 18, 2015

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	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.

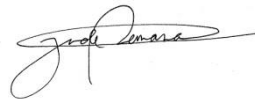
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. 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.

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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.

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(IC: 2324B-1)	☐ Chamber D(IC: 2324B-4)
☒ Chamber B(IC: 2324B-2)	☐ Chamber E(IC: 2324B-5)
☒ Chamber C(IC: 2324B-3)	☐ Chamber F(IC: 2324B-6)
	☐ Chamber G(IC: 2324B-7)
	☐ Chamber H(IC: 2324B-8)

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 18000 MHz	4.94 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a BLUETOOTH, ZIGBEE and DTS/UNII a/b/g/n MIMO Satellite setup box.

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)
2425 - 2475	ZIGBEE	1.10	1.29

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a rear panel detachable dipole antenna, with a maximum gain of 2 dBi.

5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

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 X orientation.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	Elitebook 8570W	N/A	N/A
Router	NETGEAR	N150	N/A	N/A

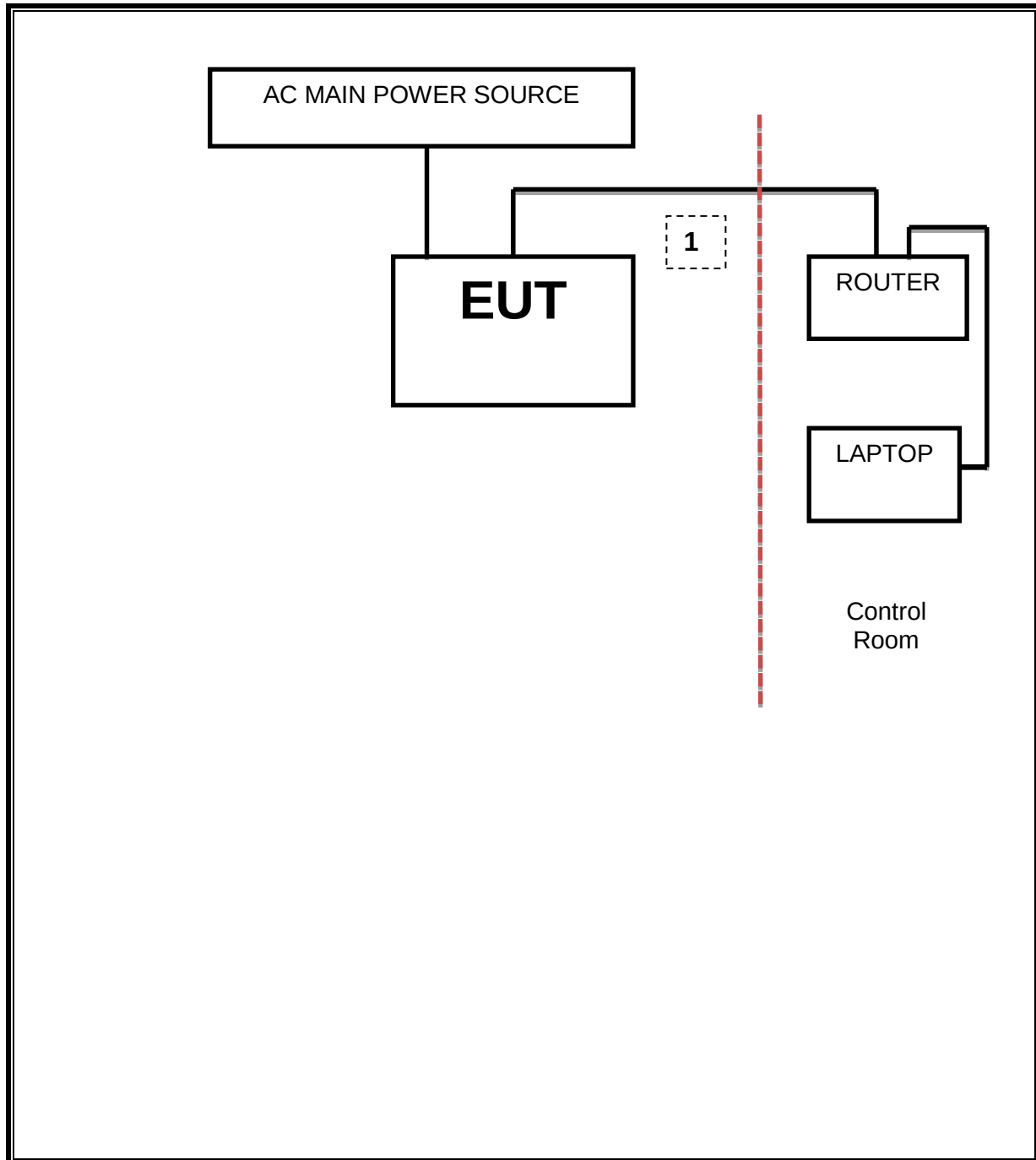
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	ethernet	1	RJ-45	un-shielded	5	N/A
2						N/A

TEST SETUP

EUT was set in the Hidden menu mode to enable ZIGBEE communications.

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	Asset	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/20/15
Spectrum Analyzer, 9KHz-40GHz	HP	8564E	C00986	04/01/16
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	08/13/15
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/18/15
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/15
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/15
Antenna, Horn, 1-18 GHz	ETS	3117	C01022	02/21/16
Antenna, Horn, 18- 26 GHz	ARA	MWH-1826/B	C00946	11/12/15
Antenna, Horn, 26-40 GHz	ARA	MWH-2640	C00891	06/28/16
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	T243	03/06/16
RF Preamplifier, 1GHz - 18GHz	Miteq	NSP4000-SP2	924343	03/23/16
RF Preamplifier, 1GHz - 26.5GHz	HP	8449B	T404	06/29/16
AC Power Supply, 2,500VA 45-500Hz	Elgar-Ametek	CW2501M	F00013	CNR
RF Preamplifier, 1GHz - 40GHz	Miteq	NSP4000-SP2	C00990	08/20/15
Attenuator / Switch driver	HP	11713A	F00204	CNR
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	F00219	05/23/16
High Pass Filter 6GHz	Micro-Tronics	HPS17542	F00222	05/22/16
High Pass Filter 3GHz	Micro-Tronics	HPM17543	F00224	05/22/16

7. SUMMARY

8.

FCC Part Section	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Worst Case
15.247 (a)(2)	RSS-210 A8.2(a)	Occupied Band width (6dB)	>500KHz	Conducted	Pass	1.59MHz
2.1051, 15.247 (d)	RSS-210 A8.5	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-52.4dBm
15.247	RSS-210 A8.4	TX conducted output power	<30dBm		Pass	1.1 dBm
15.247	RSS-210 A8.2	PSD	<8dBm		Pass	-12.12dBm
15.207 (a)	RSS-GEN 7.2.2	AC Power Line conducted emissions	Section 10	Radiated	Pass	51.98dBuV
15.205, 15.209	RSS-210 Clause 2.6, RSS-210 Clause 6	Radiated Spurious Emission	< 54dBuV/m		Pass	41.81dBuV/m

ANTENNA PORT TEST RESULTS

8.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

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

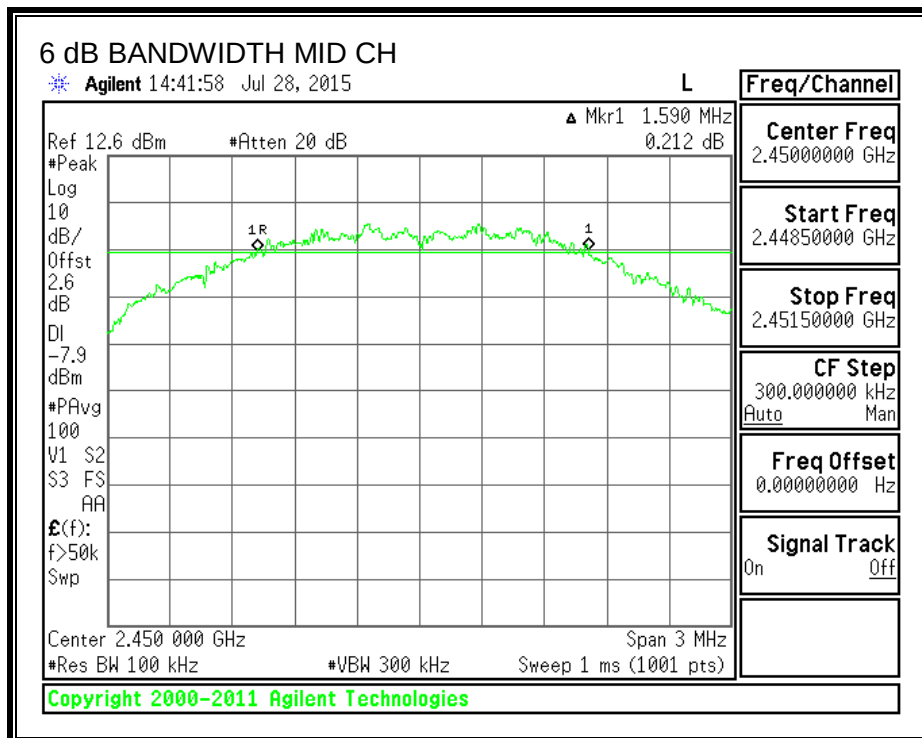
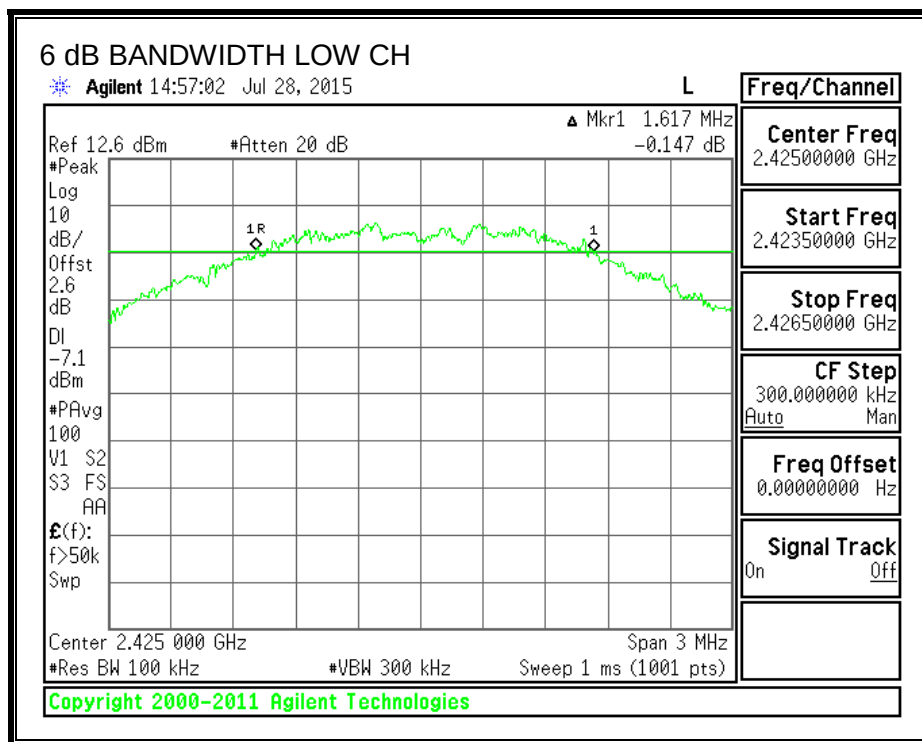
TEST PROCEDURE

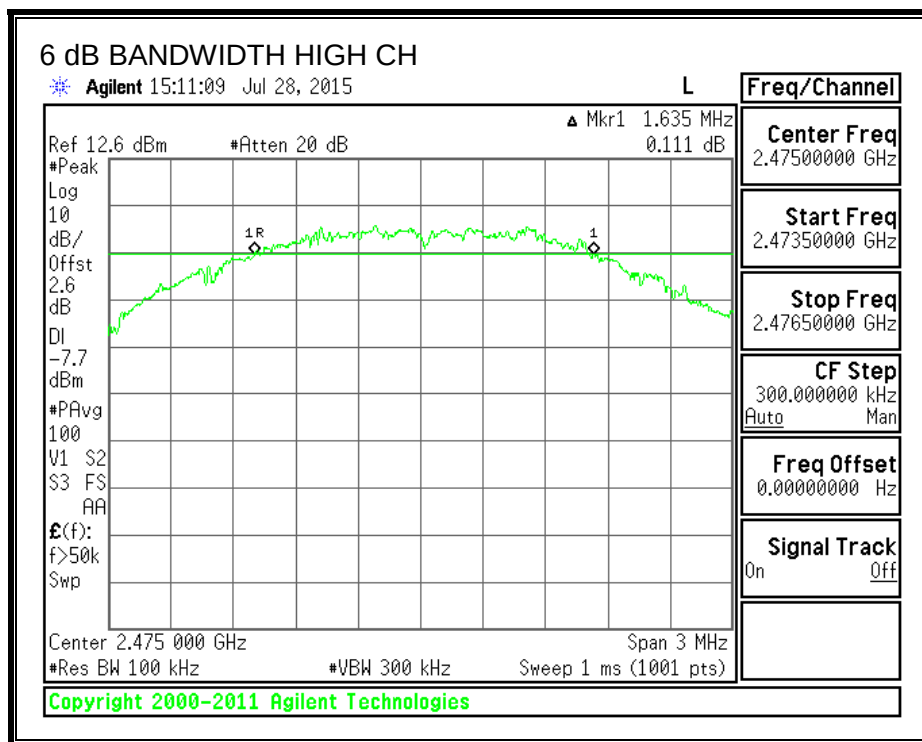
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2425	1.6170	0.5
Middle	2450	1.5900	0.5
High	2475	1.6350	0.5

6 dB BANDWIDTH





8.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

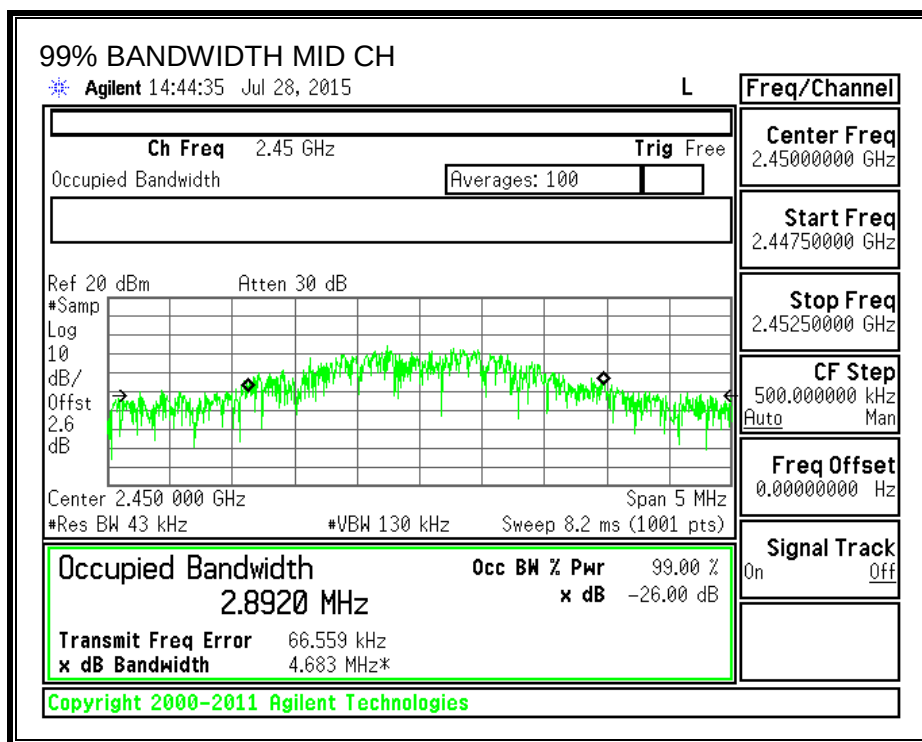
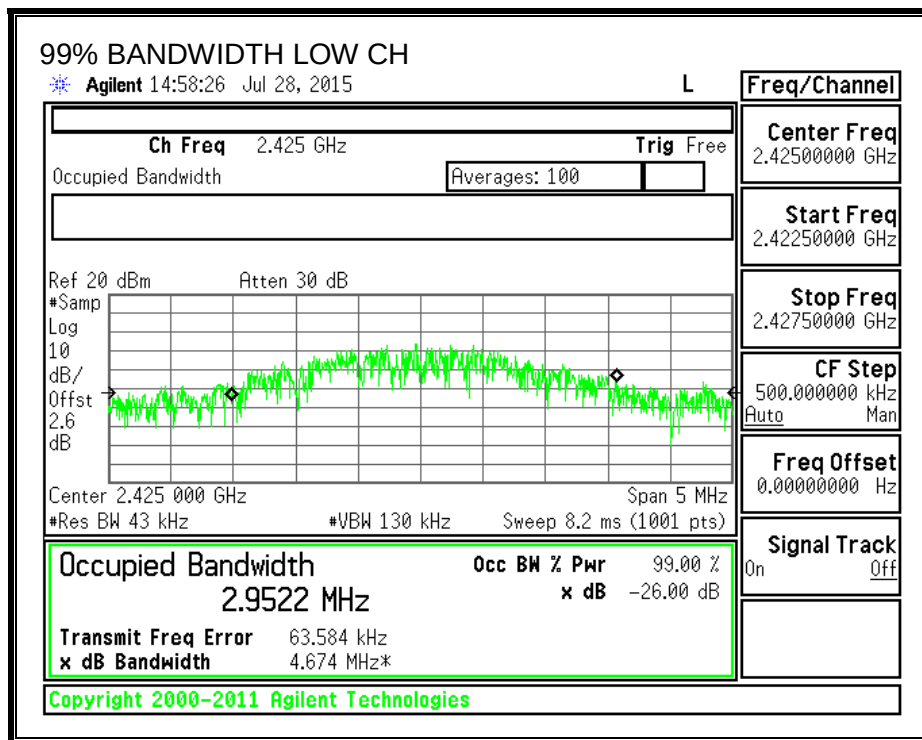
TEST PROCEDURE

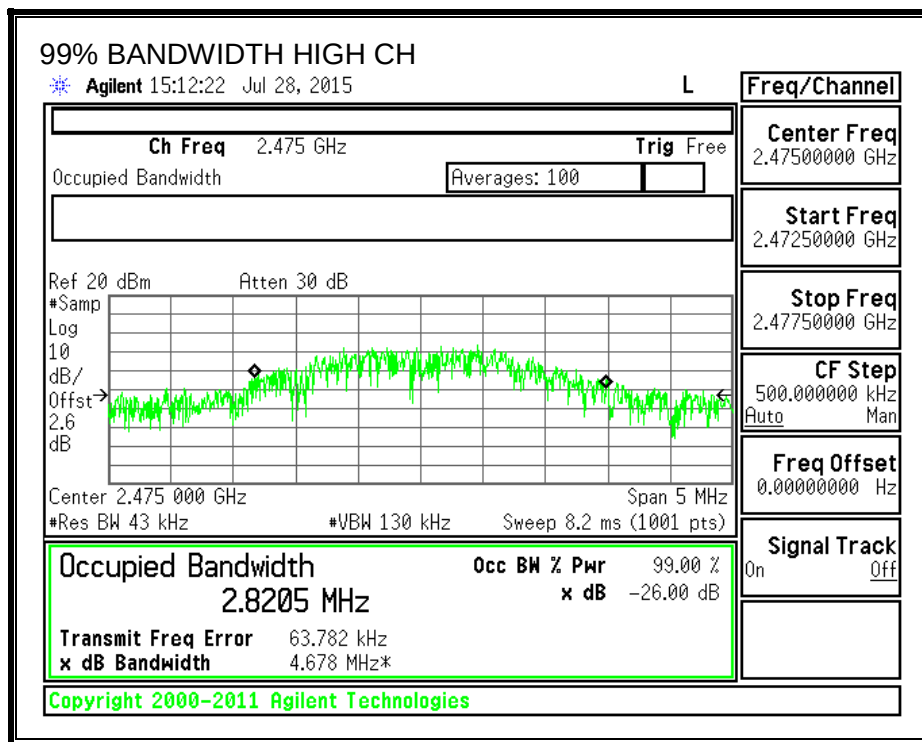
Reference to KDB558074 D01 DTS Meas Guidance v03r03: The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2425	2.9522
Middle	2450	2.8920
High	2475	2.8205

99% BANDWIDTH





8.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

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

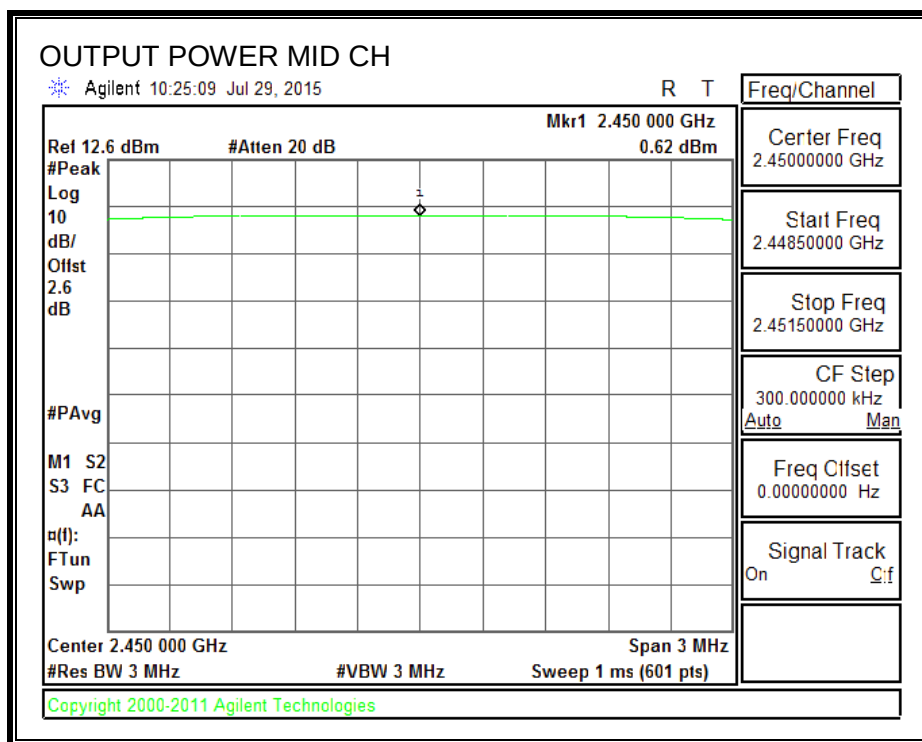
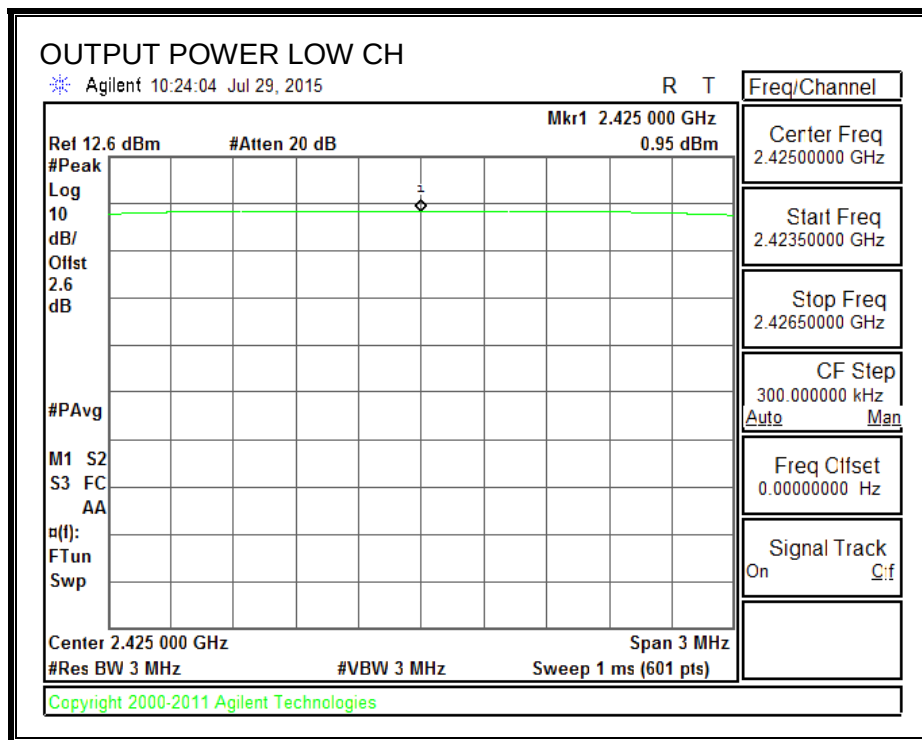
TEST PROCEDURE

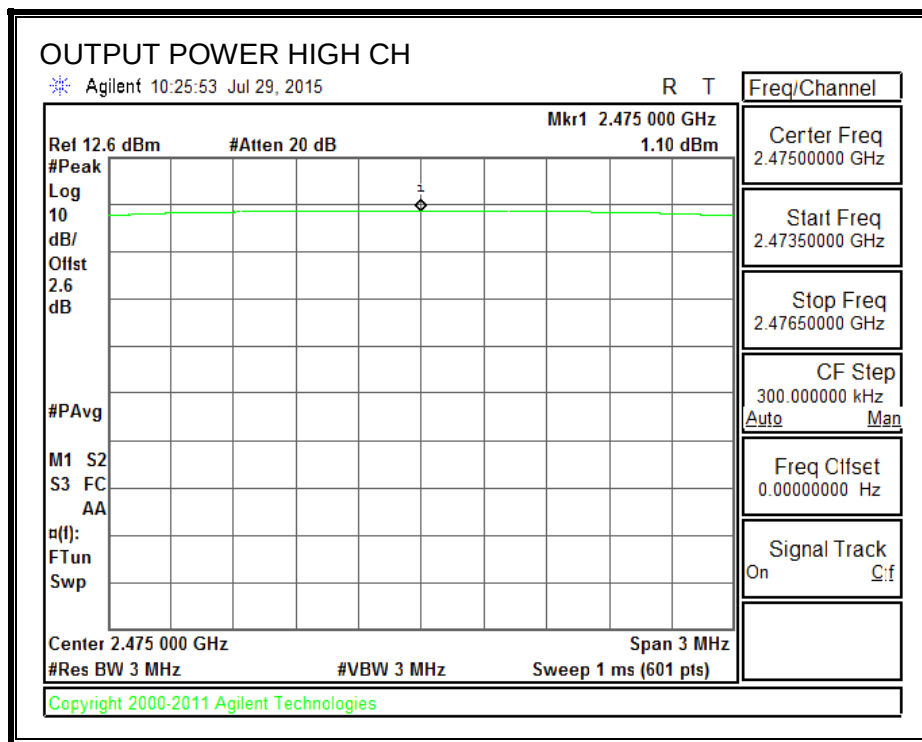
Peak power is measured using KDB558074 D01 DTS Meas Guidance v03r03 utilizing spectrum analyzer.

RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2425	0.950	30	-29.050
Middle	2450	0.620	30	-29.380
High	2475	1.100	30	-28.900

OUTPUT POWER





8.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 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	2425	0.4
Middle	2450	0.05
High	2475	0.07

8.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

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.

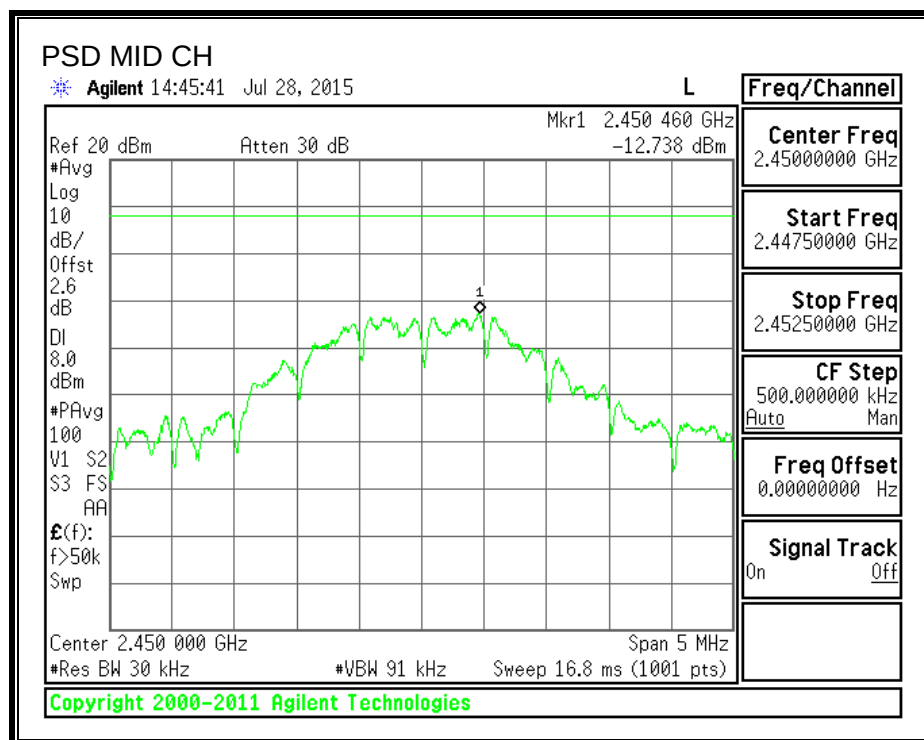
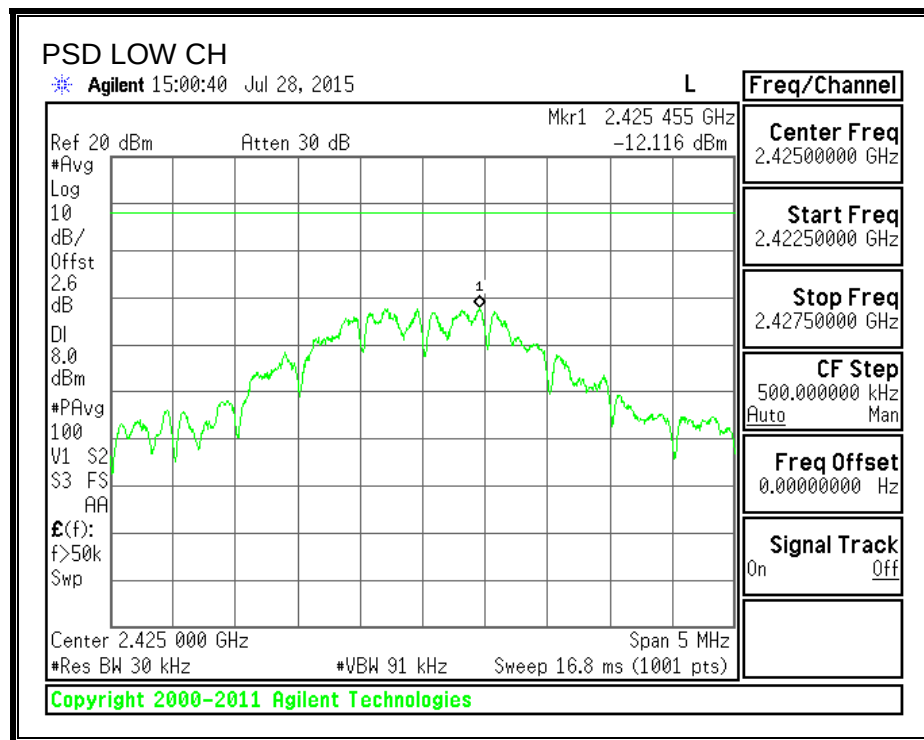
TEST PROCEDURE

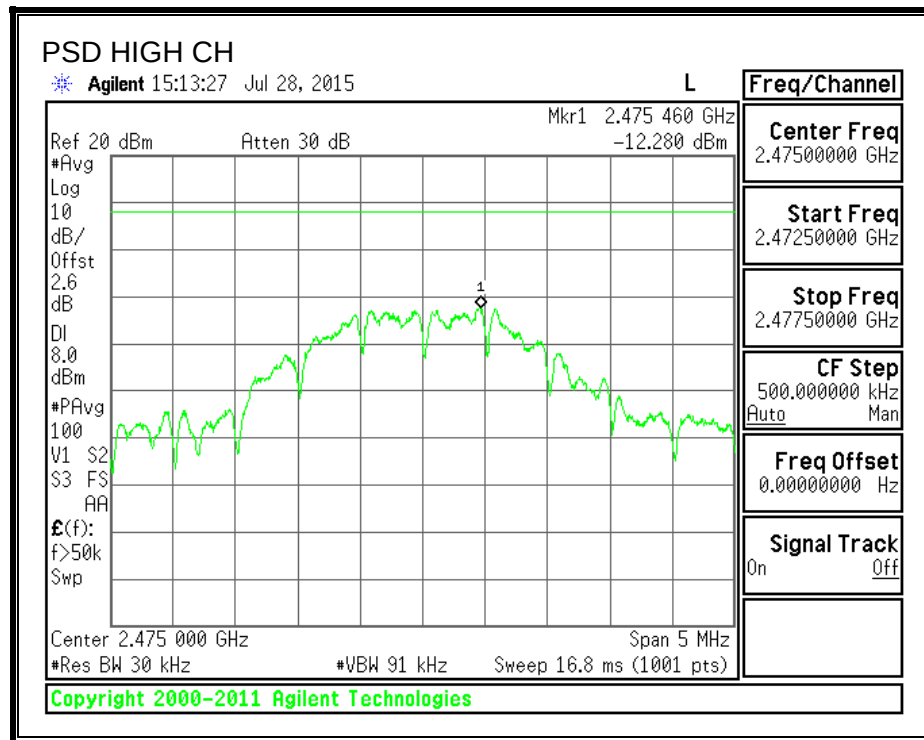
Power Spectral Density was performed utilizing the "Method PKPSD (Peak PSD)" under KDB558074 D01 DTS Meas Guidance v03r03.

RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2425	-12.12	8	-20.12
Middle	2450	-12.74	8	-20.74
High	2475	-12.28	8	-20.28

POWER SPECTRAL DENSITY





8.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

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

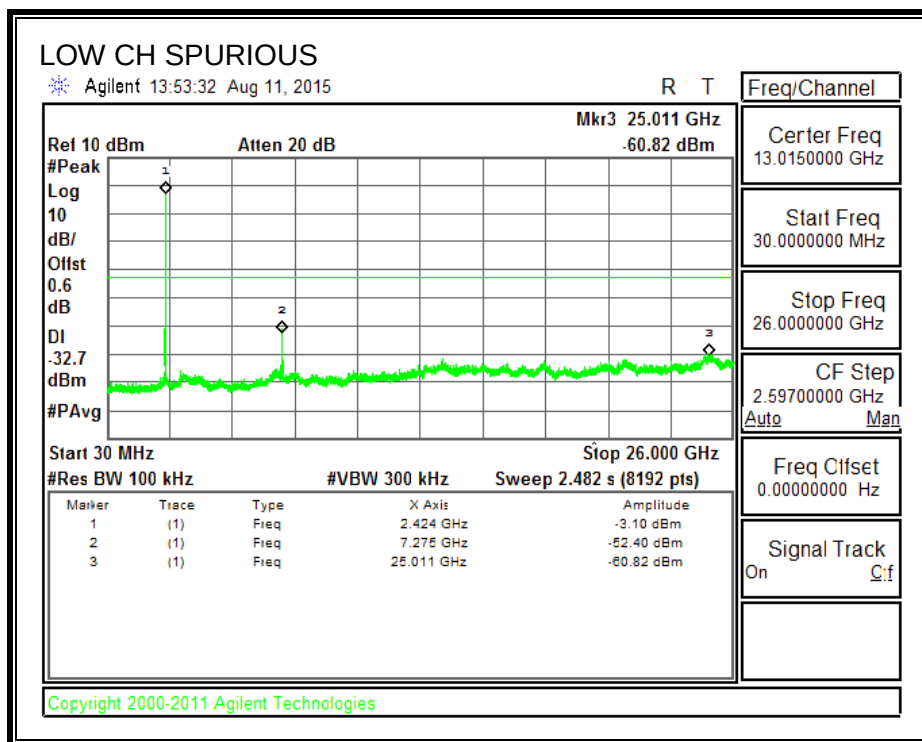
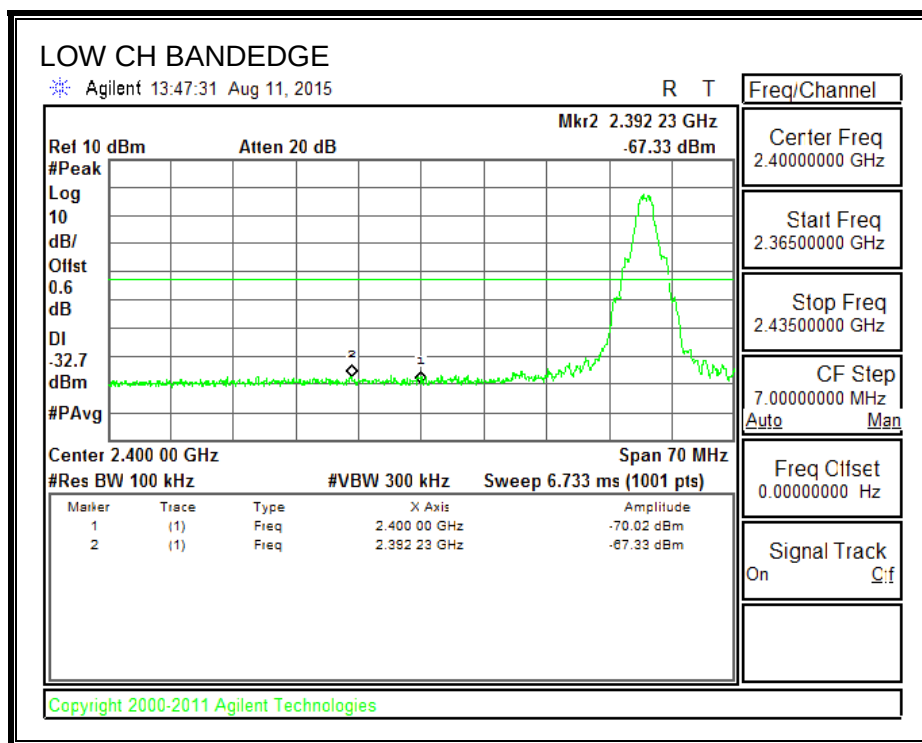
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

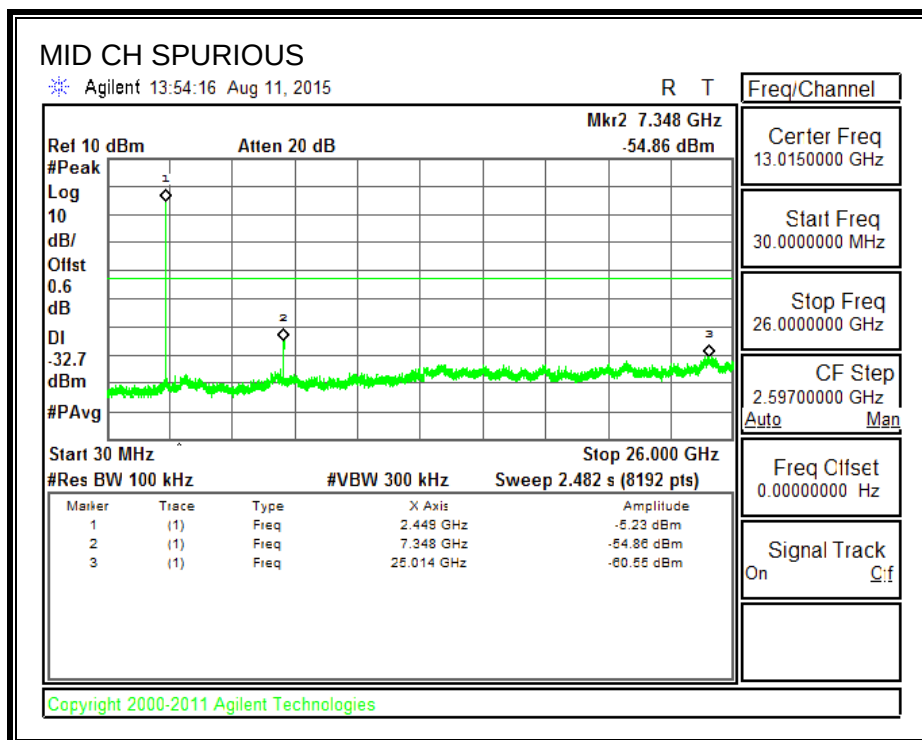
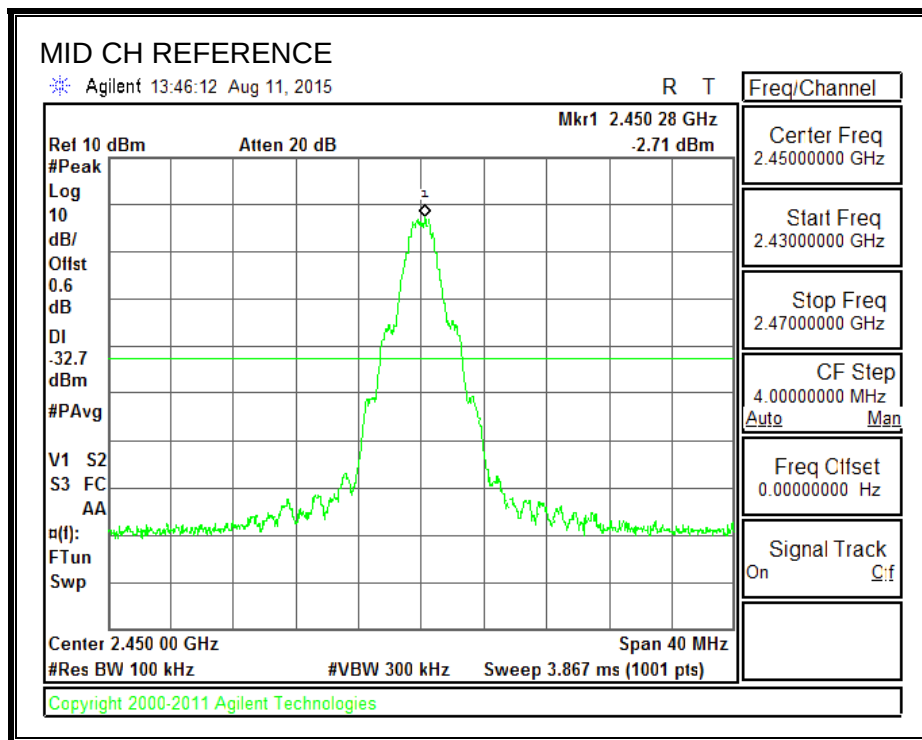
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

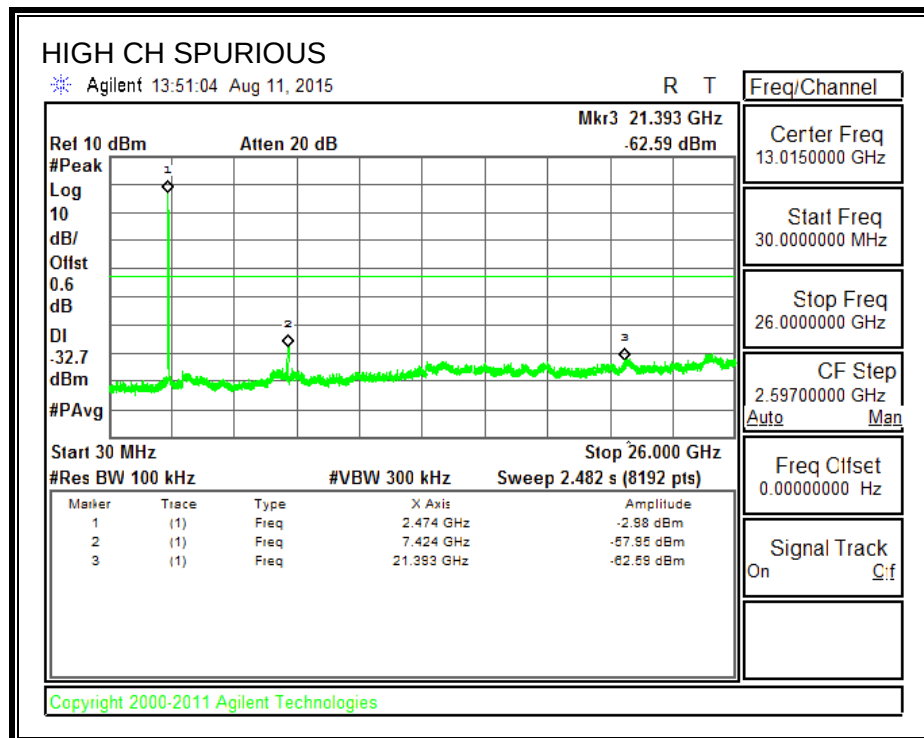
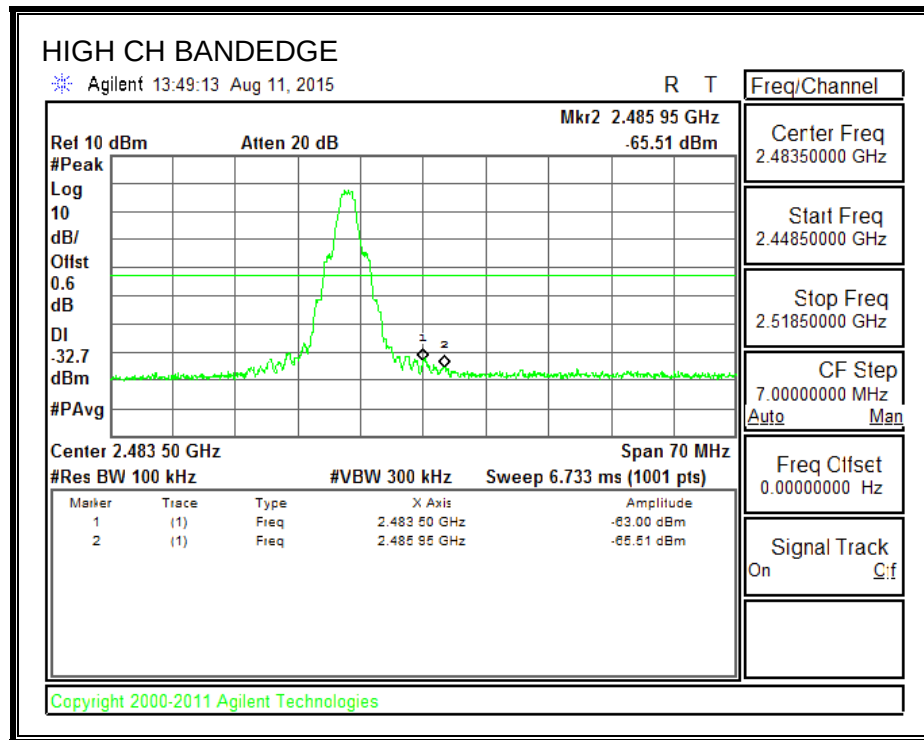
SPURIOUS EMISSIONS, LOW CHANNEL



SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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 C63.10 - 2009. 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.

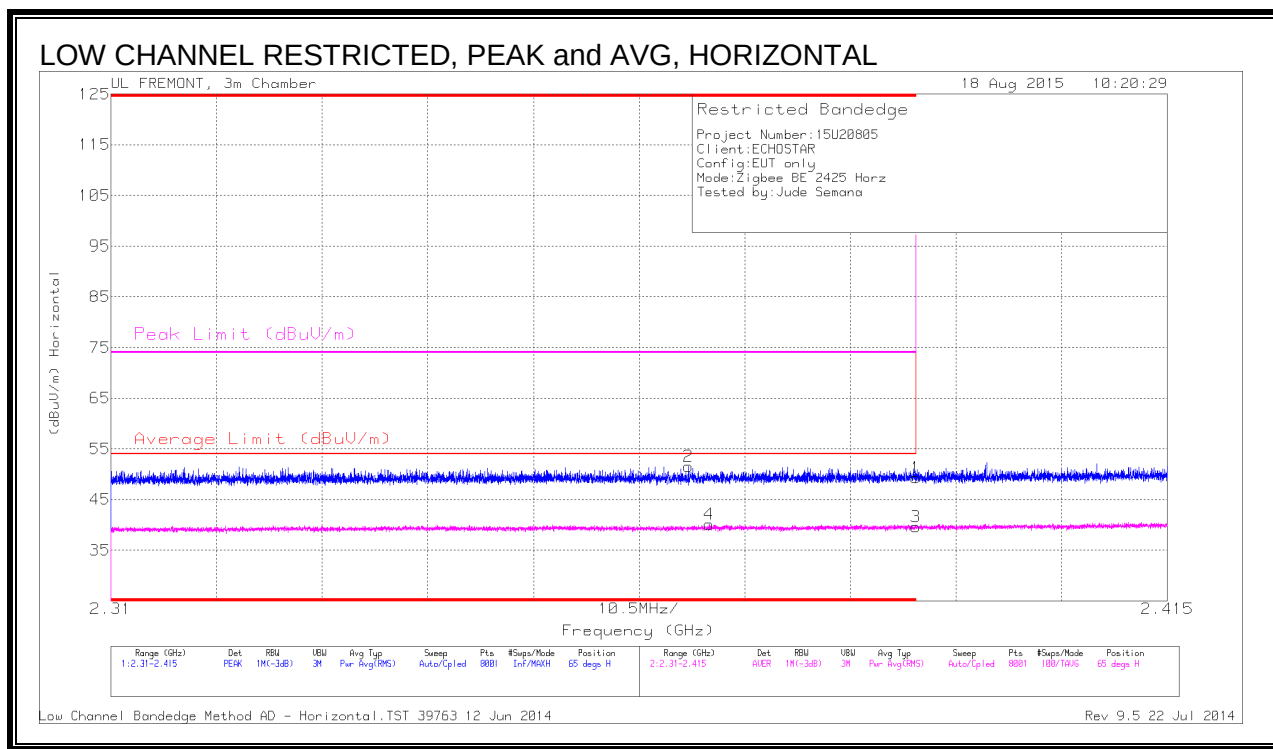
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and add duty cycle factor for average measurements. Duty cycle factor = $10 \log (1/x)$, For this sample, the unit is control by test software which is transmit continuous wave(duty cycle greater than 98%) .

The spectrum from 1GHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz 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.

9.2. TRANSMITTER ABOVE 1 GHz

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Trace Markers

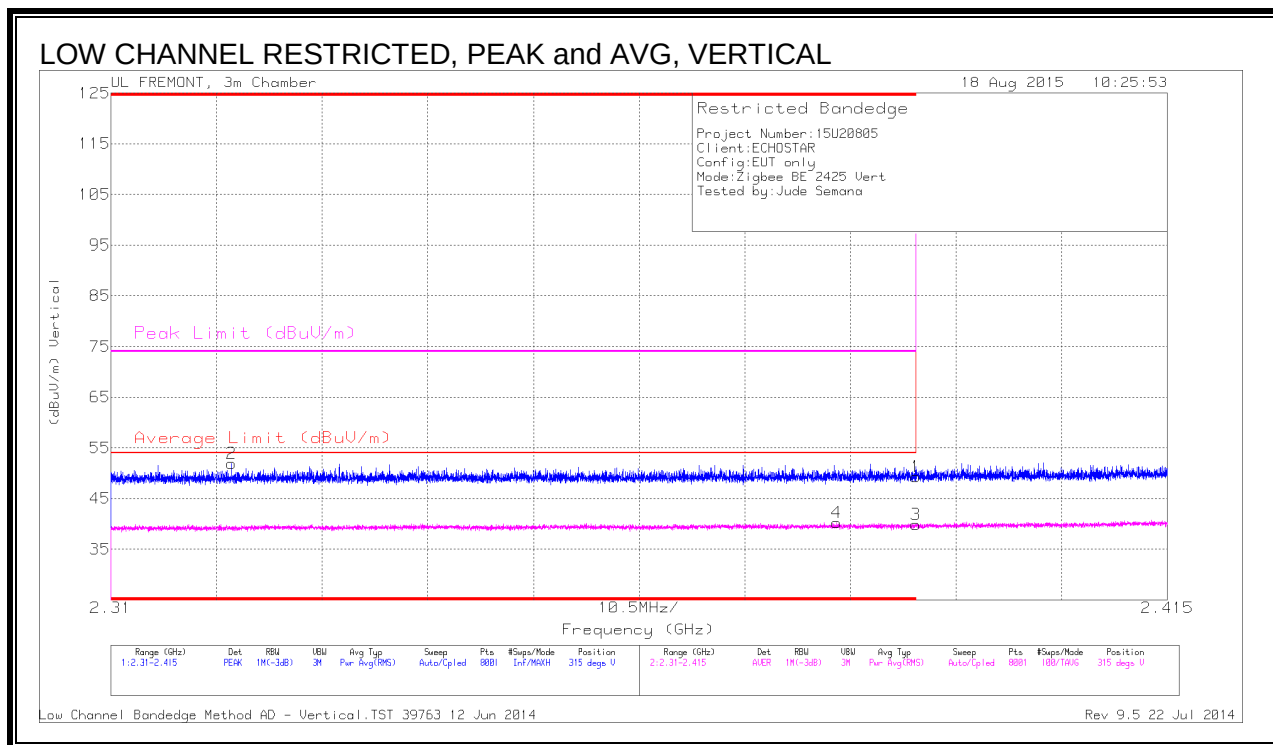
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/FI tr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.71	PK	32	-22.4	0	49.31	-	-	74	-24.69	65	275	H
2	* 2.367	42	PK	31.9	-22.4	0	51.5	-	-	74	-22.5	65	275	H
3	* 2.39	30	RMS	32	-22.4	0	39.6	54	-14.4	-	-	65	275	H
4	* 2.369	30.6	RMS	31.9	-22.4	0	40.1	54	-13.9	-	-	65	275	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

RMS - RMS detection

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



Trace Markers

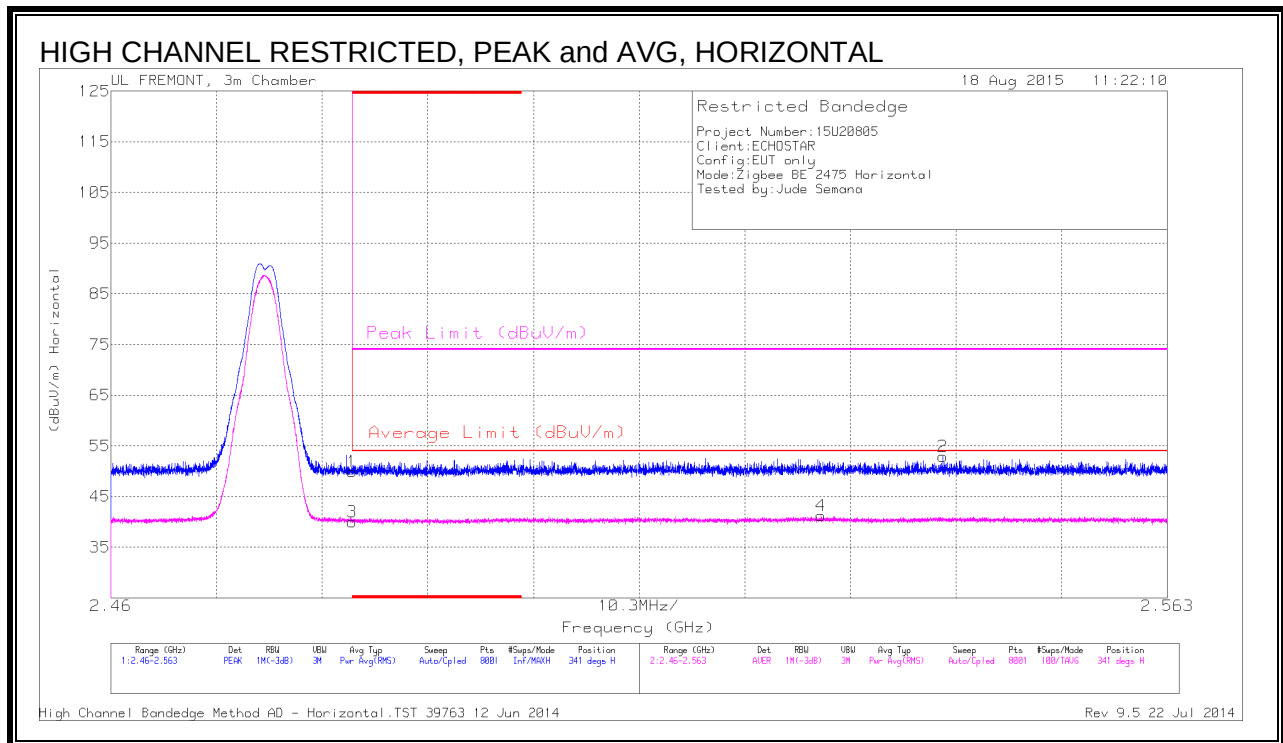
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/FI tr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.322	42.7	PK	31.7	-22.5	0	51.9	-	-	74	-22.1	315	244	V
4	* 2.382	30.63	RMS	32	-22.4	0	40.23	54	-13.77	-	-	315	244	V
1	* 2.39	39.71	PK	32	-22.4	0	49.31	-	-	74	-24.69	315	244	V
3	* 2.39	30.24	RMS	32	-22.4	0	39.84	54	-14.16	-	-	315	244	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

RMS - RMS detection

RESTRICTED BANDEGE (HIGH CHANNEL, HORIZONTAL)



Trace Markers

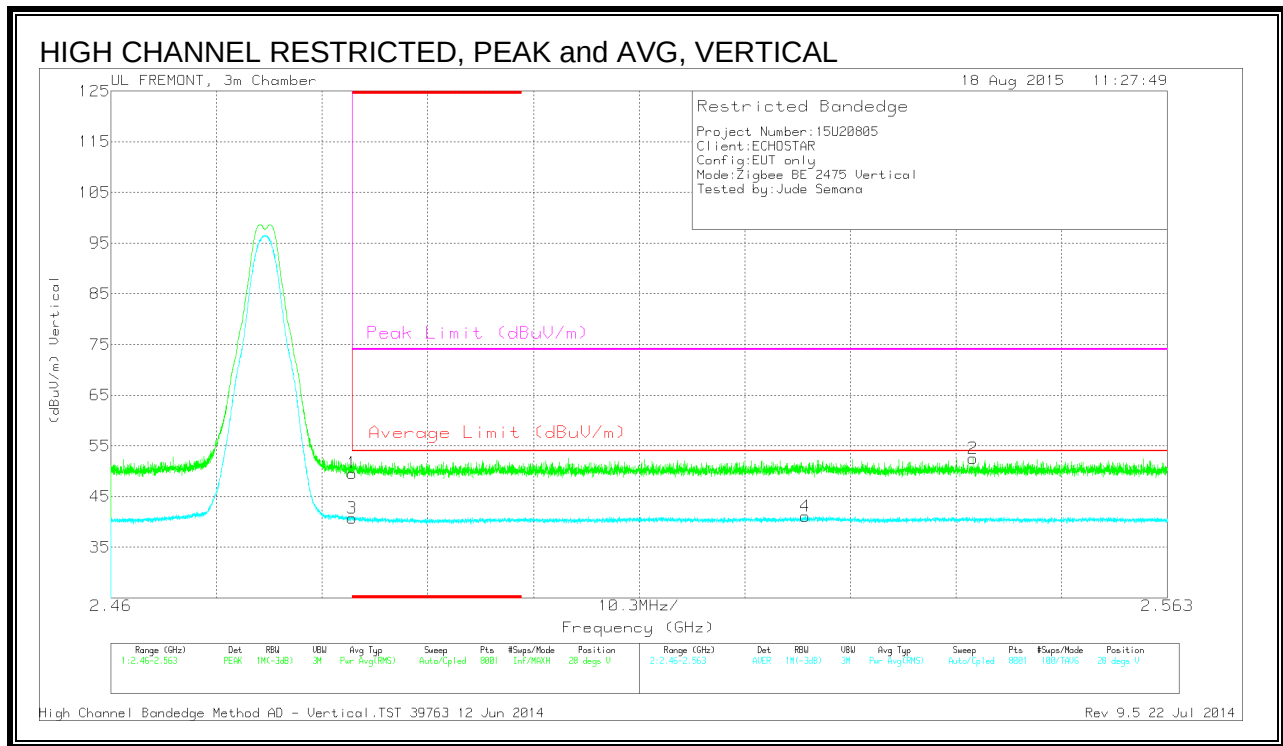
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/FI tr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	39.76	PK	32.3	-22.1	0	49.96	-	-	74	-24.04	341	216	H
3	* 2.484	29.84	RMS	32.3	-22.1	0	40.04	54	-13.96	-	-	341	216	H
4	2.529	30.81	RMS	32.4	-22	0	41.21	54	-12.79	-	-	341	216	H
2	2.541	42.44	PK	32.4	-21.9	0	52.94	-	-	74	-21.06	341	216	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

RMS - RMS detection

RESTRICTED BANDEGE (HIGH CHANNEL, VERTICAL)



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/FI tr/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	* 2.484	39.41	PK	32.3	-22.1	0	49.61	-	-	74	-24.39	28	214	V
3	* 2.484	30.54	RMS	32.3	-22.1	0	40.74	54	-13.26	-	-	28	214	V
4	2.528	30.73	RMS	32.4	-22	0	41.13	54	-12.87	-	-	28	214	V
2	2.544	42.13	PK	32.4	-22	0	52.53	-	-	74	-21.47	28	214	V

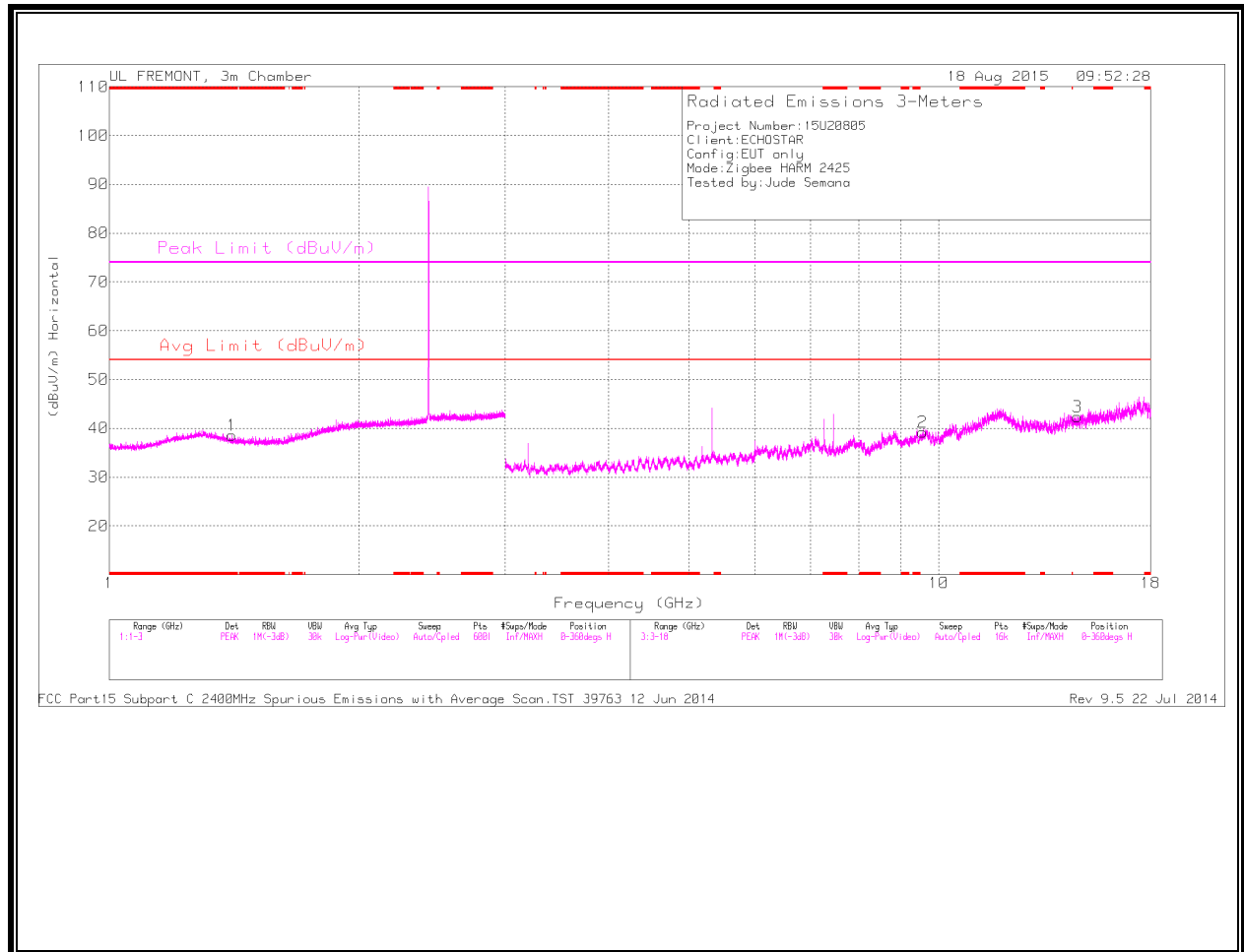
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

RMS - RMS detection

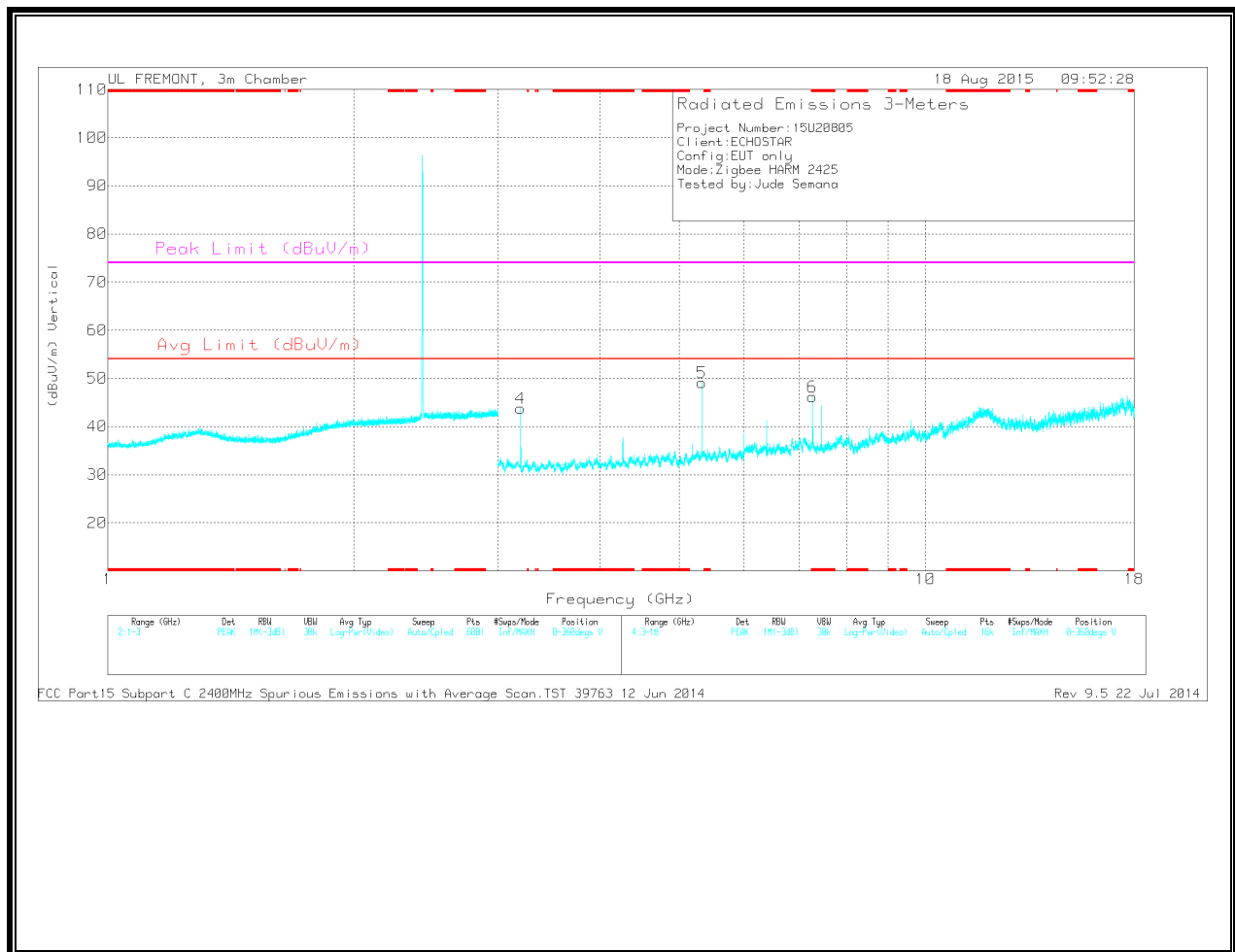
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



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

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 T119 (dB/m)	Amp/Cbl/Filtri/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	* 1.406	33.12	PK	28.6	-23.1	0	38.62	-	-	74	-35.38	0-360	100	H
6	* 7.277	38.88	PK	35.6	-28.3	0	46.18	-	-	74	-27.82	0-360	200	V
4	3.198	41.62	PK	32.6	-30.5	0	43.72	-	-	-	-	0-360	100	V
5	5.33	43.76	PK	34.5	-29.1	0	49.16	-	-	-	-	0-360	100	V
2	9.557	27.3	PK	36.6	-24.7	0	39.2	-	-	-	-	0-360	100	H
3	14.692	29.2	PK	39.8	-26.6	0	42.4	-	-	-	-	0-360	200	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK - Peak detector

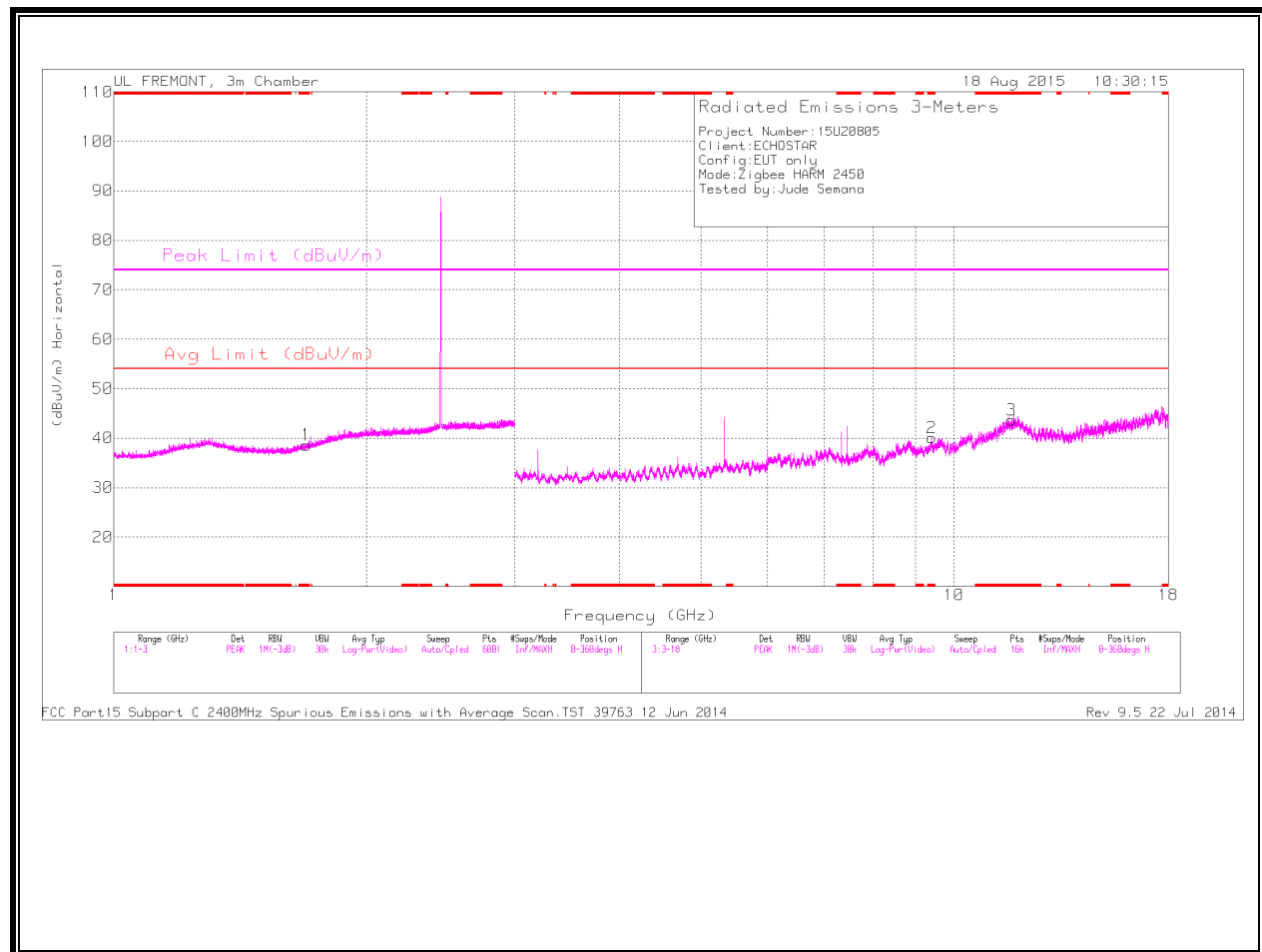
Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtri/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
* 1.407	41.85	PK2	28.6	-23.1	0	47.35	-	-	74	-26.65	0	100	H
* 1.407	30.65	MAV1	28.6	-23.1	0	36.15	54	-17.85	-	-	0	100	H
* 7.277	43.1	PK2	35.6	-28.3	0	50.4	-	-	74	-23.6	0	200	V
* 7.276	34.67	MAV1	35.6	-28.4	0	41.87	54	-12.13	-	-	0	200	V
3.198	41.12	PK2	32.6	-30.5	0	43.22	-	-	-	-	0	100	V
3.198	32.28	MAV1	32.6	-30.5	0	34.38	-	-	-	-	0	100	V
5.329	41.42	PK2	34.5	-29.1	0	46.82	-	-	-	-	0	100	V
5.33	33.42	MAV1	34.5	-29.1	0	38.82	-	-	-	-	0	100	V
9.558	36.24	PK2	36.6	-24.7	0	48.14	-	-	-	-	0	100	H
9.559	24.65	MAV1	36.6	-24.7	0	36.55	-	-	-	-	0	100	H
14.693	27.18	MAV1	39.8	-26.6	0	40.38	-	-	-	-	0	200	H
14.694	38.64	PK2	39.8	-26.6	0	51.84	-	-	-	-	0	200	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAV1 - KDB558074 Option 1 Maximum RMS Average

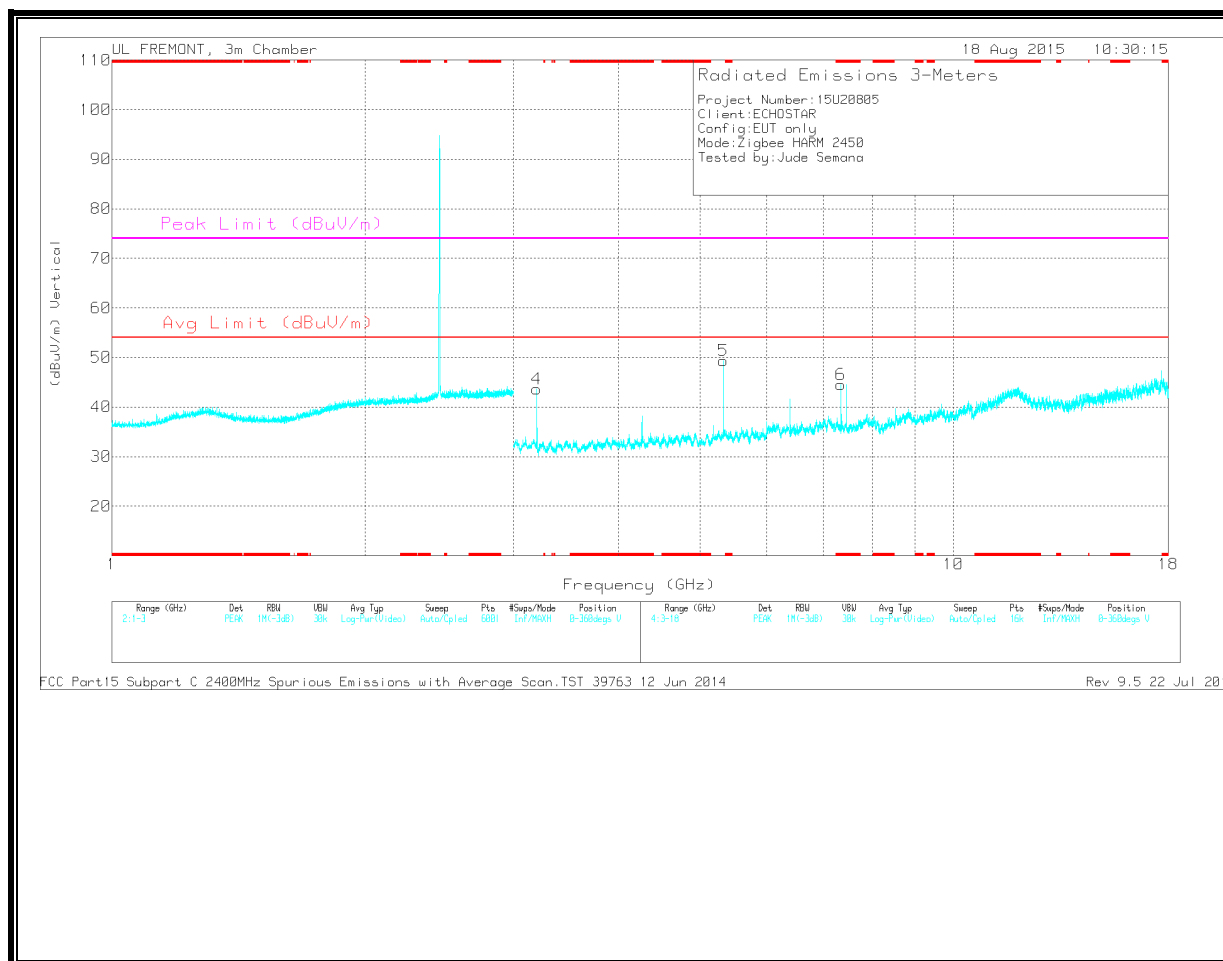
MID CHANNEL

HORIZONTAL



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

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 T119 (dB/m)	Amp/Cbl/Fil/Filt/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	* 1.694	32.43	PK	28.9	-22.7	0	38.63	-	-	74	-35.37	0-360	100	H
3	* 11.701	27.34	PK	38.8	-22.5	0	43.64	-	-	74	-30.36	0-360	100	H
6	* 7.349	36.58	PK	35.6	-27.7	0	44.48	-	-	74	-29.52	0-360	200	V
2	* 9.414	27.87	PK	36.4	-24.2	0	40.07	-	-	74	-33.93	0-360	200	H
4	3.198	41.55	PK	32.6	-30.5	0	43.65	-	-	-	-	0-360	100	V
5	5.33	43.91	PK	34.5	-29.1	0	49.31	-	-	-	-	0-360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK - Peak detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fil/Filt/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
* 1.695	42.16	PK2	28.9	-22.7	0	48.36	-	-	74	-25.64	360	100	H
* 1.695	30.63	MAV1	28.9	-22.7	0	36.83	54	-17.17	-	-	360	100	H
* 9.413	36.81	PK2	36.4	-24.2	0	49.01	-	-	74	-24.99	360	200	H
* 9.415	25.02	MAV1	36.4	-24.3	0	37.12	54	-16.88	-	-	360	200	H
* 11.703	37.43	PK2	38.8	-22.5	0	53.73	-	-	74	-20.27	360	100	H
* 11.701	25.51	MAV1	38.8	-22.5	0	41.81	54	-12.19	-	-	360	100	H
* 7.349	42.29	PK2	35.6	-27.7	0	50.19	-	-	74	-23.81	360	200	V
* 7.349	33.79	MAV1	35.6	-27.7	0	41.69	54	-12.31	-	-	360	200	V
3.197	41.17	PK2	32.6	-30.5	0	43.27	-	-	-	-	360	100	V
3.198	32.35	MAV1	32.6	-30.5	0	34.45	-	-	-	-	360	100	V
5.33	41.93	PK2	34.5	-29.1	0	47.33	-	-	-	-	360	100	V
5.33	33.81	MAV1	34.5	-29.1	0	39.21	-	-	-	-	360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAV1 - KDB558074 Option 1 Maximum RMS Average

FCC Part15 Subpart C 2400MHz Spurious Emissions with Average Scan.TST 39763 12 Jun 2014
Rev 9.5 22 Jul 2014

UL FREMONT, 3m Chamber

18 Aug 2015 10:52:20

Radiated Emissions 3-Meters

Project Number: 15U28805
Client: ECHOSTAR
Config: EUT only
Mode: Zigbee HARM 2475
Tested by: Jude Semano

Peak Limit (dBuV/m)

Avg Limit (dBuV/m)

(dBuV/m) Horizontal

Frequency (GHz)

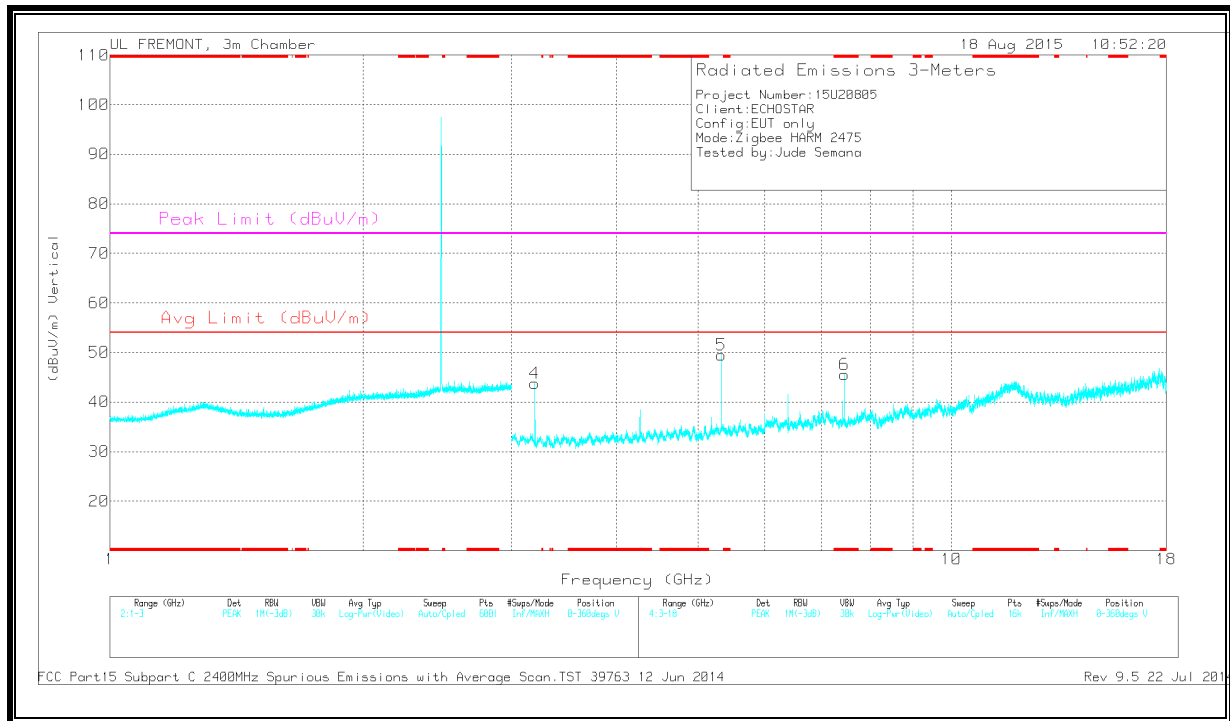
Range (GHz)	Det	RBW	VBW	Avg Typ	Sweep	Pls	#Samps/Mode	Position	Range (GHz)	Det	RBW	VBW	Avg Typ	Sweep	Pls	#Samps/Mode	Position
1-1.3	PEAK	1M(-3dB)	30K	Log-Fur(Video)	Auto/Spd	6001	Inf/7500M	0-350deg H	3-3-18	PEAK	1M(-3dB)	30K	Log-Fur(Video)	Auto/Spd	10K	Inf/7500M	0-350deg H

FCC Part15 Subpart C 2400MHz Spurious Emissions with Average Scan.TST 39763 12 Jun 2014

Rev 9.5 22 Jul 2014

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
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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 T119 (dB/m)	Amp/Cbl/Filtri/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	* 1.561	33.31	PK	28	-22.8	0	38.51	-	-	74	-35.49	0-360	200	H
2	* 11.112	27.33	PK	37.8	-23.4	0	41.73	-	-	74	-32.27	0-360	100	H
3	* 15.454	28.47	PK	40.1	-25.5	0	43.07	-	-	74	-30.93	0-360	100	H
6	* 7.461	37.94	PK	35.7	-28.1	0	45.54	-	-	74	-28.46	0-360	100	V
4	3.198	41.65	PK	32.6	-30.5	0	43.75	-	-	-	-	0-360	100	V
5	5.33	44.08	PK	34.5	-29.1	0	49.48	-	-	-	-	0-360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK - Peak detector

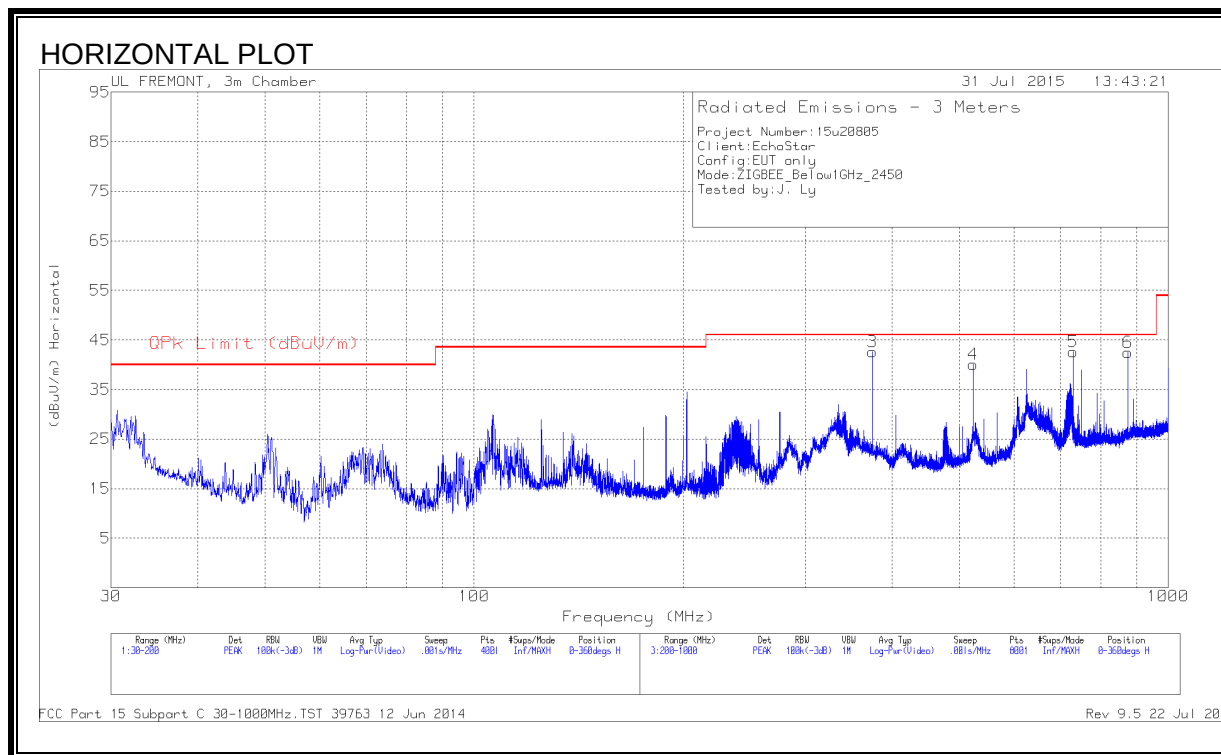
Radiated Emissions

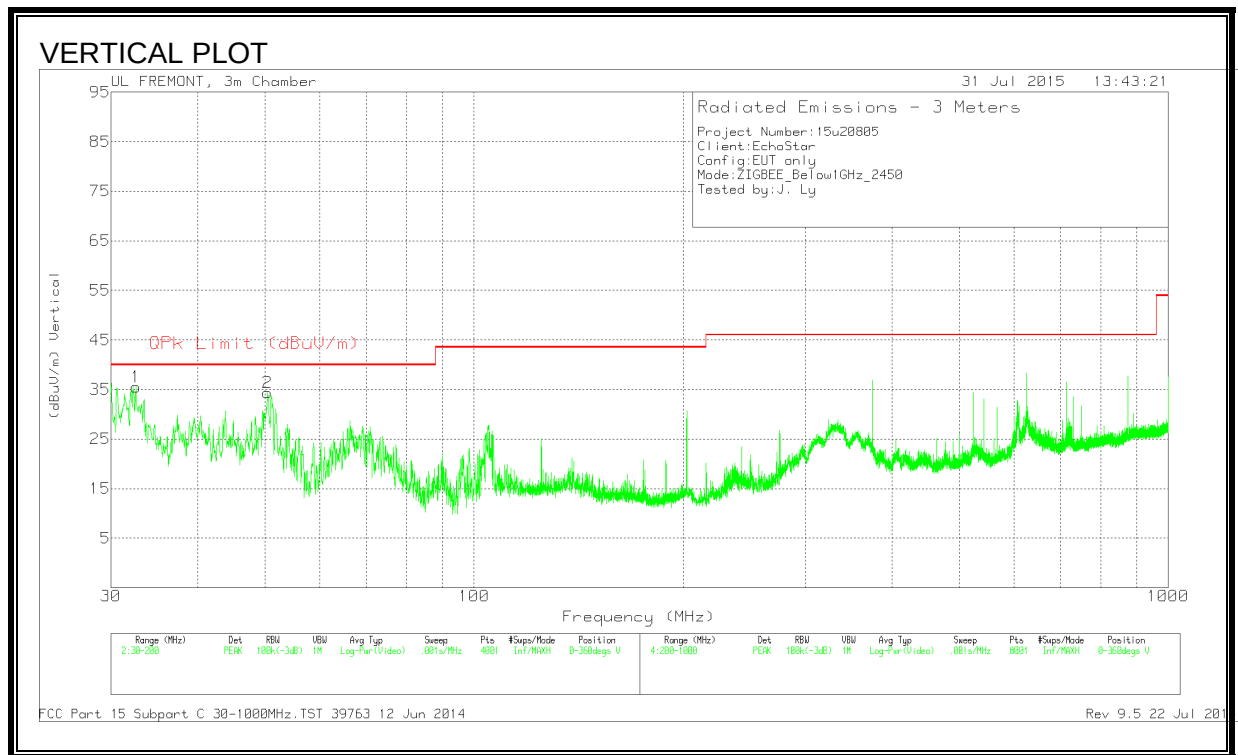
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtri/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.563	42.33	PK2	28	-22.7	0	47.63	-	-	74	-26.37	360	200	H
* 1.561	30.7	MAV1	28	-22.8	0	35.9	54	-18.1	-	-	360	200	H
* 11.112	36.69	PK2	37.8	-23.4	0	51.09	-	-	74	-22.91	360	100	H
* 11.114	25.04	MAV1	37.8	-23.4	0	39.44	54	-14.56	-	-	360	100	H
* 15.454	38.85	PK2	40.1	-25.5	0	53.45	-	-	74	-20.55	360	100	H
* 15.456	26.87	MAV1	40.1	-25.5	0	41.47	54	-12.53	-	-	360	100	H
* 7.461	40.47	PK2	35.7	-28.1	0	48.07	-	-	74	-25.93	360	100	V
* 7.461	31.62	MAV1	35.7	-28.1	0	39.22	54	-14.78	-	-	360	100	V
3.198	41.86	PK2	32.6	-30.5	0	43.96	-	-	-	-	360	100	V
3.198	32.58	MAV1	32.6	-30.5	0	34.68	-	-	-	-	360	100	V
5.33	41.69	PK2	34.5	-29.1	0	47.09	-	-	-	-	360	100	V
5.33	34.33	MAV1	34.5	-29.1	0	39.73	-	-	-	-	360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAV1 - KDB558074 Option 1 Maximum RMS Average

9.3. WORST-CASE BELOW 1 GHz

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





Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	32.5925	42.76	PK	19.9	-27.1	35.56	40	-4.44	0-360	100	V
2	50.4425	53.24	PK	8.1	-27	34.34	40	-5.66	0-360	100	V
3	375	52.22	PK	15.1	-24.7	42.62	46.02	-3.4	0-360	100	H
4	523.7	47.11	PK	18	-25	40.11	46.02	-5.91	0-360	200	H
5	729	46.63	PK	19.9	-23.9	42.63	46.02	-3.39	0-360	100	H
6	875	43.61	PK	21.8	-22.9	42.51	46.02	-3.51	0-360	100	H

PK - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
374.998	52.42	QP	15.1	-24.7	42.82	46.02	-3.2	142	100	H
729.0036	46.86	QP	19.9	-23.9	42.86	46.02	-3.16	133	101	H
875.0032	43.75	QP	21.8	-22.9	42.65	46.02	-3.37	136	100	H

QP - Quasi-Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

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.

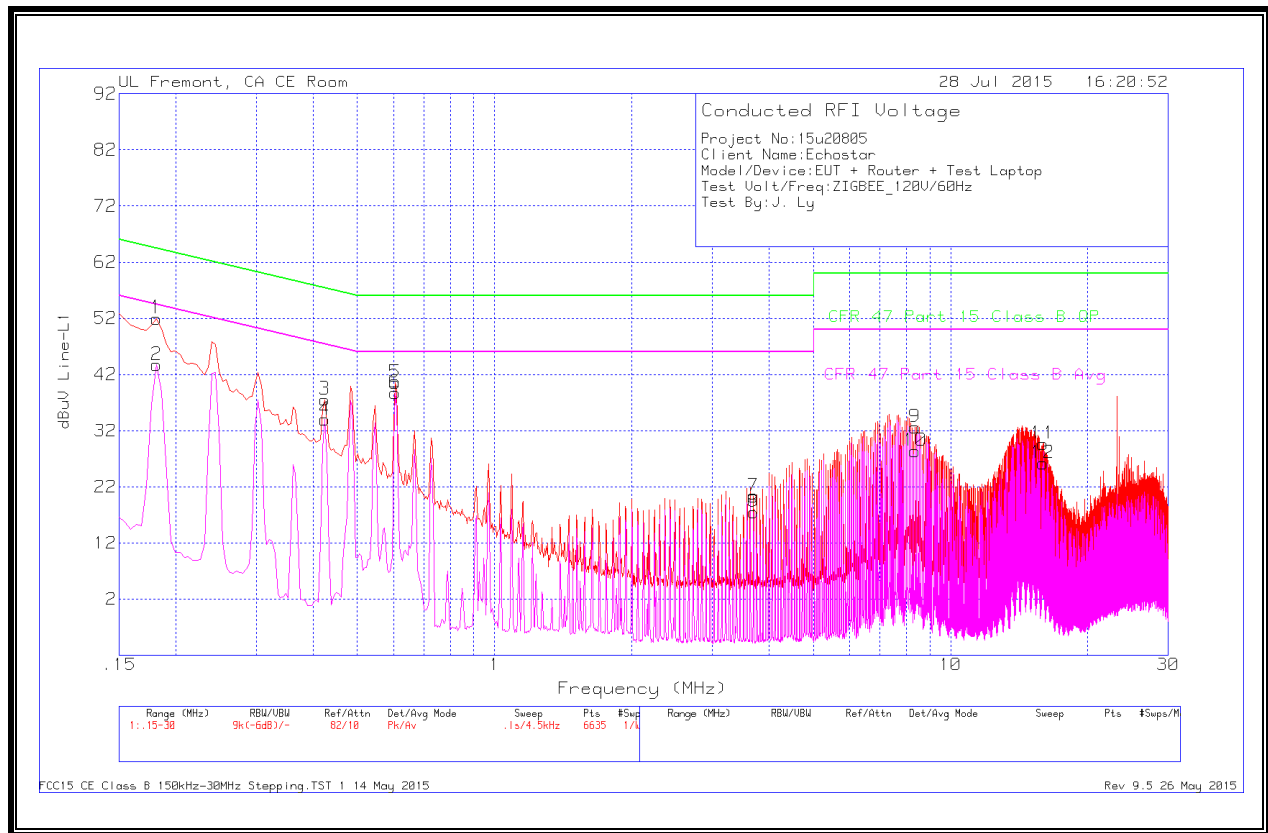
TEST PROCEDURE

ANSI C63.10 - 2009

RESULTS

6 WORST EMISSIONS

LINE 1 RESULTS



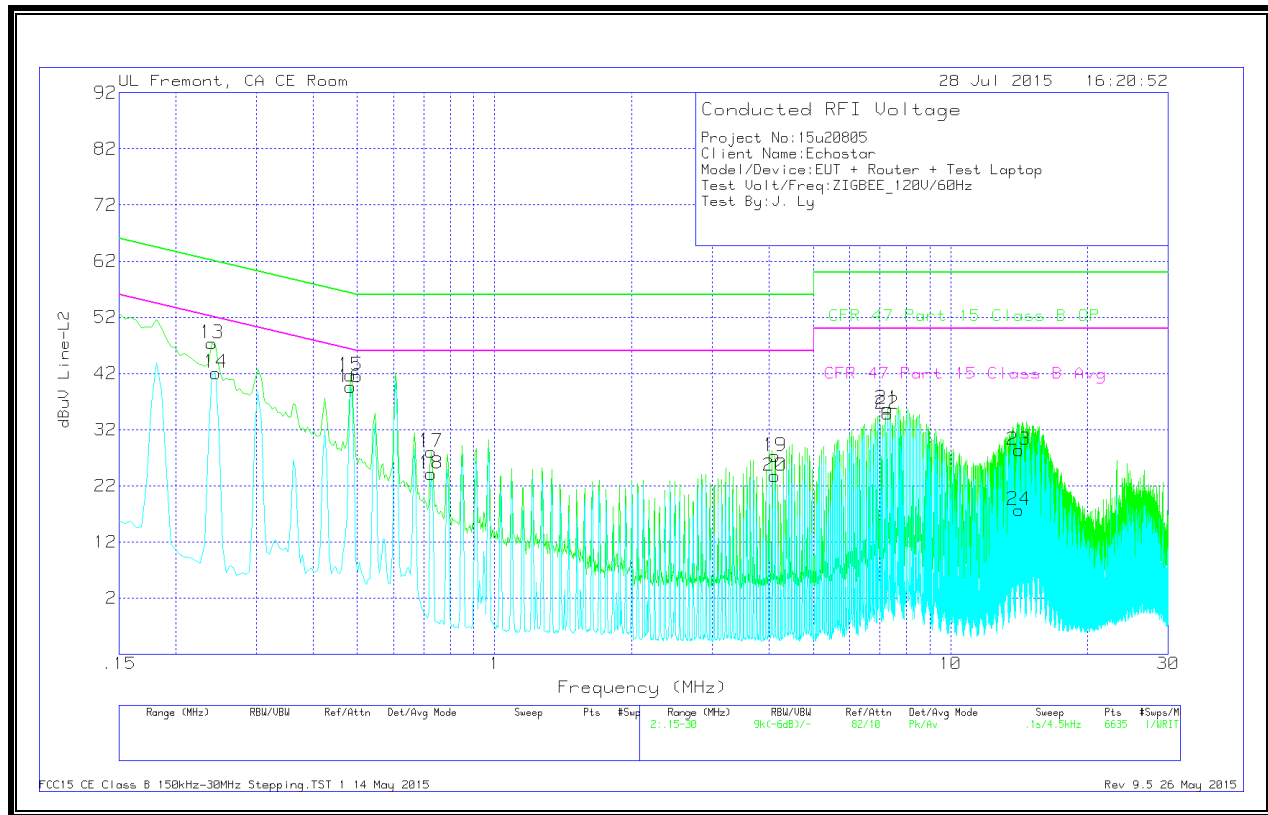
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin (dB)	CFR 47 Part 15 Class B Avg	Margin (dB)
1	.1815	50.88	Pk	1.1	0	51.98	64.42	-12.44		
2	.1815	42.6	Av	1.1	0	43.7	-	-	54.42	-10.72
3	.4245	37.14	Pk	.4	0	37.54	57.36	-19.82		
4	.4245	33.57	Av	.4	0	33.97	-	-	47.36	-13.39
5	.6045	40.24	Pk	.3	0	40.54	56	-15.46		
6	.6045	38.48	Av	.3	0	38.78	-	-	46	-7.22
7	3.696	19.99	Pk	.2	.1	20.29	56	-35.71		
8	3.696	17.22	Av	.2	.1	17.52	-	-	46	-28.48
9	8.3625	32.31	Pk	.2	.1	32.61	60	-27.39		
10	8.3625	28.06	Av	.2	.1	28.36	-	-	50	-21.64
11	15.9315	29.15	Pk	.3	.2	29.65	60	-30.35		
12	15.9315	25.68	Av	.3	.2	26.18	-	-	50	-23.82

Pk - Peak detector

Av - Average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin (dB)	CFR 47 Part 15 Class B Avg	Margin (dB)
13	.24	46.58	Pk	.8	0	47.38	62.1	-14.72		
14	.2445	41.32	Av	.8	0	42.12	-	-	51.94	-9.82
15	.483	41.26	Pk	.4	0	41.66	56.29	-14.63		
16	.483	39.2	Av	.4	0	39.6	-	-	46.29	-6.69
17	.726	27.75	Pk	.3	0	28.05	56	-27.95		
18	.726	23.85	Av	.3	0	24.15	-	-	46	-21.85
19	4.119	27.02	Pk	.2	.1	27.32	56	-28.68		
20	4.119	23.49	Av	.2	.1	23.79	-	-	46	-22.21
21	7.269	35.45	Pk	.2	.1	35.75	60	-24.25		
22	7.269	34.54	Av	.2	.1	34.84	-	-	50	-15.16
23	14.1225	27.98	Pk	.2	.2	28.38	60	-31.62		
24	14.1225	17.28	Av	.2	.2	17.68	-	-	50	-32.32

Pk - Peak detector

Av - Average detection

FCC15 CE Class B 150kHz-30MHz Stepping.TST 1 14 May 2015

Rev 9.5 26 May 2015