



FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

**HOME AUTOMATION GATEWAY PRODUCT: 802.11a/b/g/n 2x2 MIMO,
BLUETOOTH, BLUETOOTH LOW ENERGY, ZigBee and Z-WAVE**

MODEL NUMBER: ID:087

FCC ID: DKNCS08

REPORT NUMBER: R10526502-RF5A

ISSUE DATE: 2015-05-27

Prepared for
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Revision History

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TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>6</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>6</i>
4.3. <i>MEASUREMENT UNCERTAINTY.....</i>	<i>7</i>
5. EQUIPMENT UNDER TEST	8
5.1. <i>DESCRIPTION OF EUT</i>	<i>8</i>
5.2. <i>MAXIMUM OUTPUT POWER.....</i>	<i>8</i>
5.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	<i>9</i>
5.4. <i>SOFTWARE AND FIRMWARE.....</i>	<i>9</i>
5.5. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>9</i>
5.6. <i>DESCRIPTION OF TEST SETUP.....</i>	<i>10</i>
6. TEST AND MEASUREMENT EQUIPMENT	12
7. MEASUREMENT METHODS	15
8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS	16
8.1. <i>ON TIME AND DUTY CYCLE RESULTS.....</i>	<i>16</i>
8.1. <i>DUTY CYCLE PLOTS</i>	<i>17</i>
9. ANTENNA PORT TEST RESULTS	18
9.1. <i>802.15.4 MODE IN THE 2.4 GHz BAND.....</i>	<i>18</i>
9.1.1. <i>6 dB BANDWIDTH.....</i>	<i>18</i>
9.1.2. <i>99% BANDWIDTH.....</i>	<i>22</i>
9.1.3. <i>OUTPUT POWER</i>	<i>26</i>
9.1.4. <i>AVERAGE POWER.....</i>	<i>35</i>
9.1.5. <i>POWER SPECTRAL DENSITY</i>	<i>36</i>
9.1.6. <i>CONDUCTED SPURIOUS EMISSIONS.....</i>	<i>40</i>
10. RADIATED TEST RESULTS	47
10.1. <i>LIMITS AND PROCEDURE.....</i>	<i>47</i>
10.2. <i>TRANSMITTER ABOVE 1 GHz.....</i>	<i>48</i>
10.2.1. <i>TX ABOVE 1 GHz FOR 802.15.4 MODE IN THE 2.4 GHz BAND</i>	<i>48</i>
10.3. <i>WORST-CASE BELOW 1 GHz</i>	<i>68</i>
10.4. <i>WORST-CASE 18-26GHz.....</i>	<i>69</i>

11. AC POWER LINE CONDUCTED EMISSIONS70

12. SETUP PHOTOS73

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ECHOSTAR TECHNOLOGIES LLC
90 INVERNESS CIRCLE EAST
ENGLEWOOD CO, 80112, USA

EUT DESCRIPTION: HOME AUTOMATION GATEWAY PRODUCT

MODEL: ID: 087

SERIAL NUMBER: FCC1, FCC2 (RE06039Z00457L)

DATE TESTED: March 06, 2015 – May 14, 2015

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

UL LLC 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 LLC 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 LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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 LLC By:

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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 and KDB 558074 D01 v03r02.

Note – Radiated testing above 1GHz was performed on a 1.5m table height, per ANSI C63.10: 2013. All other testing was performed per ANSI C63.10: 2009.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA.

12 Laboratory Dr., RTP, NC 27709	
<input type="checkbox"/>	Chamber A
<input checked="" type="checkbox"/>	Chamber C

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2002460.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

Test	Uncertainty
Conducted Emissions (0.150-30MHz)	+/- 2.37 dB
Total RF power, conducted	+/- 0.45 dB
RF power density, conducted	+/- 1.5 dB
Spurious emissions, conducted	+/- 1.46 dB
Radiated Emissions (30-1000 MHz)	+/- 6.04 dB (3m)
Radiated Emissions (1-6 GHz)	+/- 5.96 dB
Radiated Emissions (6-18 GHz)	+/- 6.10 dB
Radiated Emissions (18-26 GHz)	+/- 6.81 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT, EchoStar's ID:087 Home Automation Gateway Product, is a controller with a portfolio of connected devices offered as part of connected home services which allows the user to manage their home automation connected devices on the TV and their connected mobile hand held devices.

The EUT contains an 802.11a/b/g/n (n - 20MHz/40MHz) 2x2 MIMO transceiver, along with Bluetooth, Bluetooth Low Energy, ZigBee and Z-Wave (908 MHz and 916 MHz) transceivers.

The Zigbee 2.4GHz radio in the ID:087 is derived from the RFMD RF6525 chipset. The radio utilizes O-QPSK modulation at 256kbps.

This report covers the ZigBee radio. Other reports were issued to cover the other radio technologies:

- R10526502-RF1: 802.11 b/g/n 2.4 GHz
- R10526502-RF2: 802.11 a/n 5 GHz
- R10526502-RF3: Bluetooth
- R10526502-RF4: Bluetooth Low Energy
- R10526502-RF6: Z-Wave

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)
2405 - 2480	802.15.4 ZigBee	18.4	69.18

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The Zigbee antenna is a trace antenna on the PCB. The trace antenna has a gain of 3dBi.

The 802.11a/b/g/n 2.4/5GHz radio uses two Airgain, model N2420DS series antennas.

WLAN Antenna 0 has a gain of 3.1dBi in the 2.4GHz band and 2.5dBi in the 5GHz band.

WLAN Antenna 1 has a gain of 3.1dBi in the 2.4GHz band and 2.5dBi in the 5GHz band.

Antenna 0 is J21 u.fl on the PCB and has a short cable, Antenna 1 is J20 u.fl on the PCB and has a longer cable.

The Bluetooth antenna is a trace antenna on the PCB. The trace antenna has a gain of 3dBi.

The Z-wave antenna is a trace antenna on the PCB. The trace antenna has a gain of 1.6dBi.

5.4. SOFTWARE AND FIRMWARE

The driver SW for Zigbee: Nodetest version 1.0

The firmware in all units was: Linux kernel version 3.1.10

The driver for Bluetooth: HCI Control 1.0

The driver for Z-wave: ZWave test ZM5304

The driver for Wi-Fi: Linux MT7662 0.0.00

The test utility SW: Python Test Scripts rev. 1.0

5.5. 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 device is a table-top device and was positioned as such during radiated and line-conducted testing.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
EUT AC adapter	LITEON	PB-1180-2ES1	ETC1444046079	-
Laptop PC	HP	EliteBook 8470p	CNU342CL9Z	-
Laptop PC AC adapter	HP	677774-001	WCNXA0C3U5IA7F	

I/O CABLES

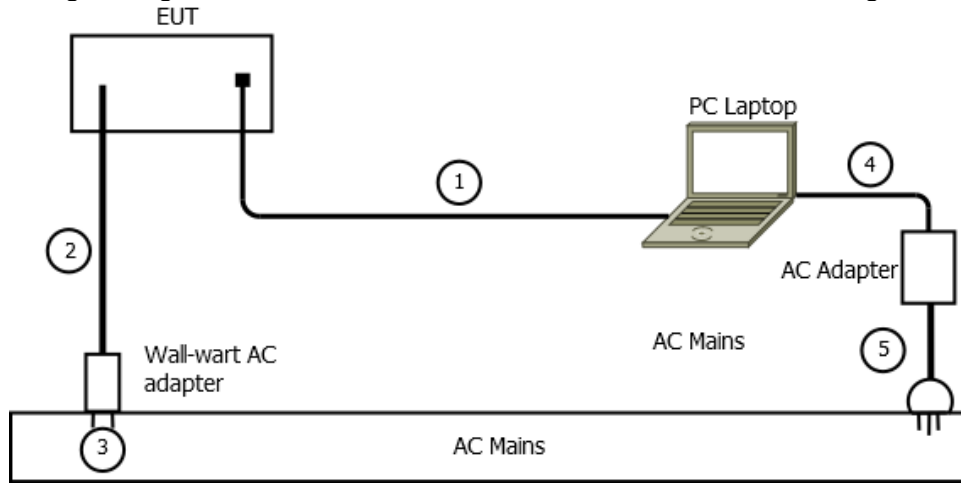
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Ethernet	1	RJ45	CAT5UTP	15	Connection between laptop PC and EUT used to control the transmitter function of the EUT.
2	DC (12V)	1	2C DC	Unshielded	1.8	Wall-wart AC adapter DC output to EUT. Non-detachable.
3	AC	1	2C AC	N/A	0	Wall-wart AC adapter's AC input.
4	DC	1	2C DC	Unshielded	1.8	Laptop AC adapter output to laptop PC. Non-detachable
5	AC	1	3C AC	Unshielded	1.8	Laptop PC power adapter AC input. Detachable.

TEST SETUP

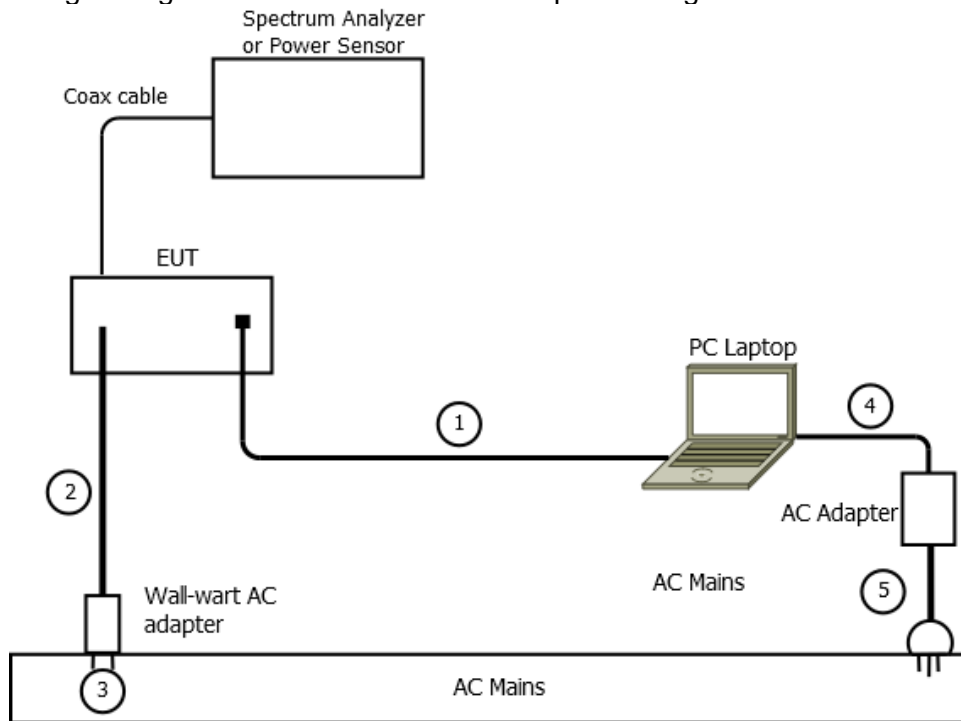
The EUT was configured as a table-top device connected to a located laptop PC over an Ethernet cable. This Ethernet connection was used to control the transmitter function of the EUT.

SETUP DIAGRAM FOR TESTS

The following arrangement was used for radiated and line-conducted testing.



The following arrangement was used for antenna-port testing.



6. TEST AND MEASUREMENT EQUIPMENT

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

Radiated Disturbance Emissions (E-field) – Chamber C

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2014-07-10	2015-07-31
AT0062 (Testing after 02/28/2015)	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2014-07-22	2015-07-31
AT0067 (Testing before 03/01/2015)	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2014-02-19	2015-02-28
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2014-07-23	2015-07-31
SAC_G (Hybrid)	Gain-Loss string for Hybrid antenna at 3m	Various	Various	2015-02-01	2016-02-29
SAC_G (3117)	Gain-Loss string for 3117 antenna at 3m	Various	Various	2015-02-01	2016-02-29
SAC_G (MWH-1826/B)	Gain-Loss string for MWH-1826/B antenna at 3m	Various	Various	2015-01-26	2016-01-31
SA0018	Spectrum Analyzer	Agilent	N9030A	2014-06-26	2015-06-30
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
HPF009	1GHz High-pass Filter	Micro-Tronics	HPM17672	2015-01-28	2016-01-31
HI0069	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-06-27	2015-06-27

Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
SA0020	Spectrum Analyzer, 3Hz-44GHz	Agilent Technologies	E4446	2015-02-26	2016-02-29
PAR0037	Power Meter, 100kHz to 110 GHz	HP	437B	2015-01-19	2016-01-31
MM0143	Digital Multimeter	Fluke	175	2014-09-04	2016-09-30
HI0069	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-06-27	2015-06-27

Power-line Conducted Disturbance Emissions - Voltage

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0021	EMI Test Receiver 9kHz-3.6GHz	Rohde & Schwarz	ESR3	2014-05-26	2015-05-31
ATA509	Coaxial cable, 20 ft., BNC - male to BNC-male	UL	RG-223	2014-09-15	2015-07-31
HI0041	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2015-03-23	2016-03-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
ATA508	Transient Limiter, 0.009 to 100 MHz	Electro-Metrics	EM 7600	2014-09-03	2015-09-30
LISN002 (EUT)	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2014-09-04	2015-09-30
LISN003 (AUX)	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2014-09-04	2015-09-30

7. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v03r02, Section 8.1.

Output Power: KDB 558074 D01 v03r02, Section 9.1.1.

Power Spectral Density: KDB 558074 D01 v03r02, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r02, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r02, Section 12.0.

8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

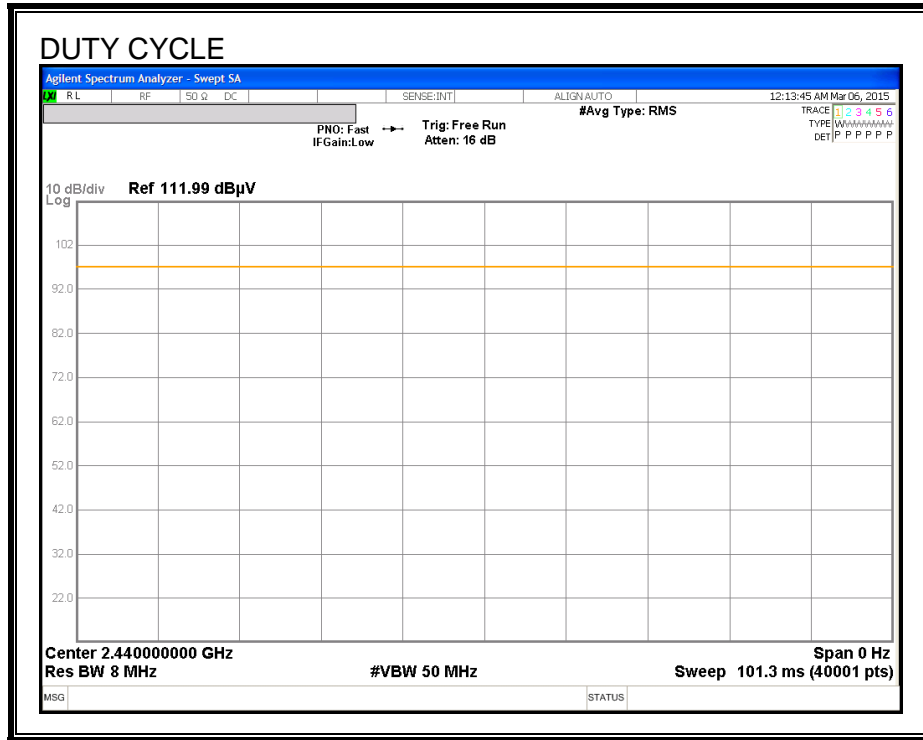
KDB 558074 Zero-Span Spectrum Analyzer Method.

8.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
O-QPSK Mode	100.000	100.000	1.000	100.00%	0.00	0.010

8.1. DUTY CYCLE PLOTS

2.4 GHz BAND



9. ANTENNA PORT TEST RESULTS

9.1. 802.15.4 MODE IN THE 2.4 GHz BAND

9.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

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

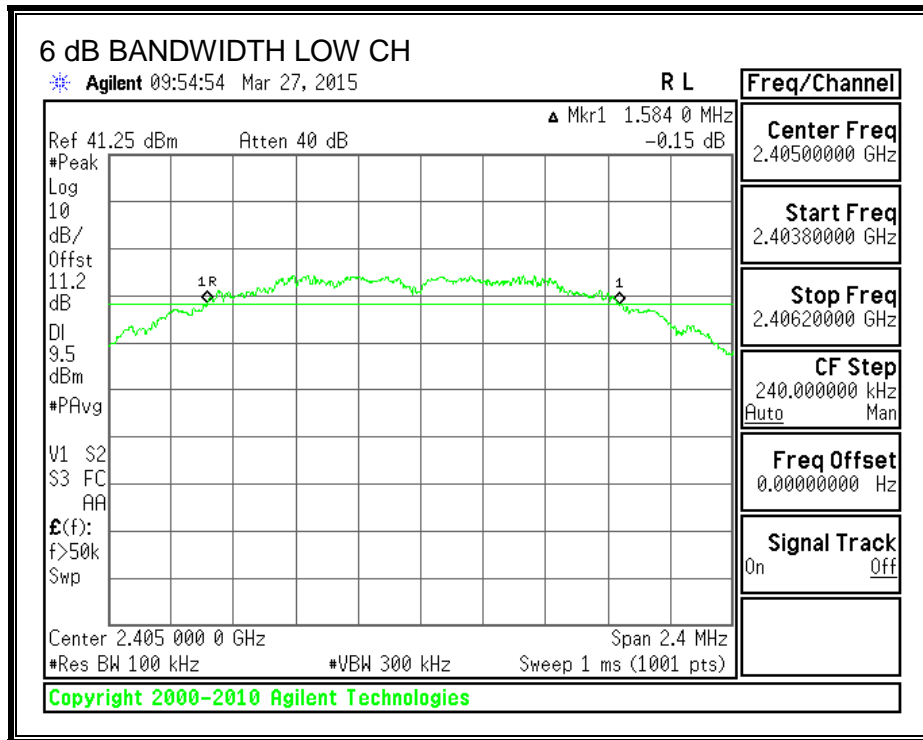
TEST PROCEDURE

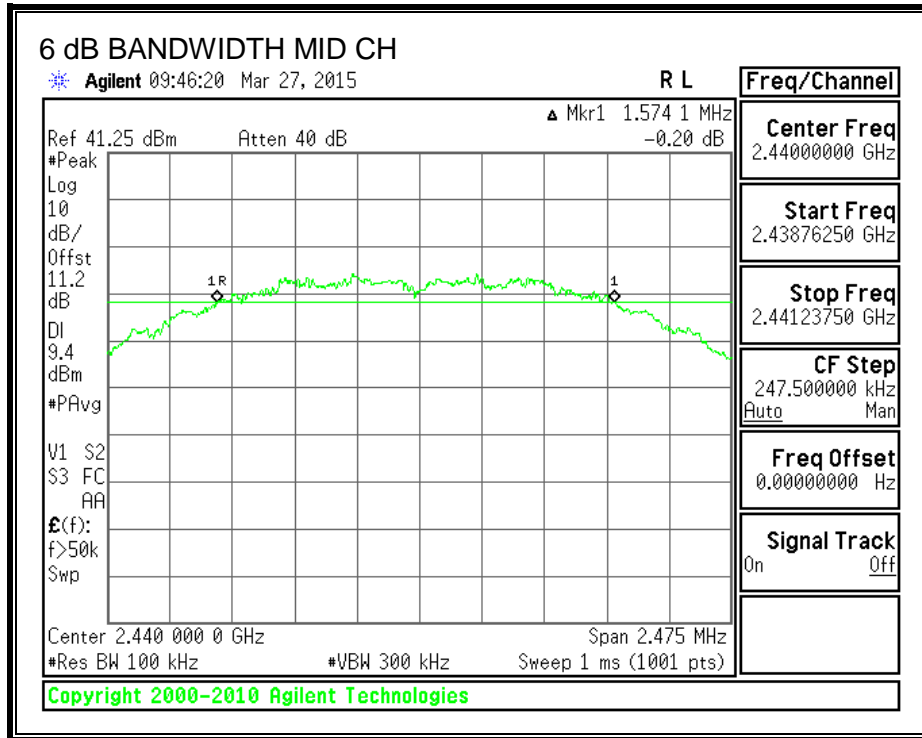
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

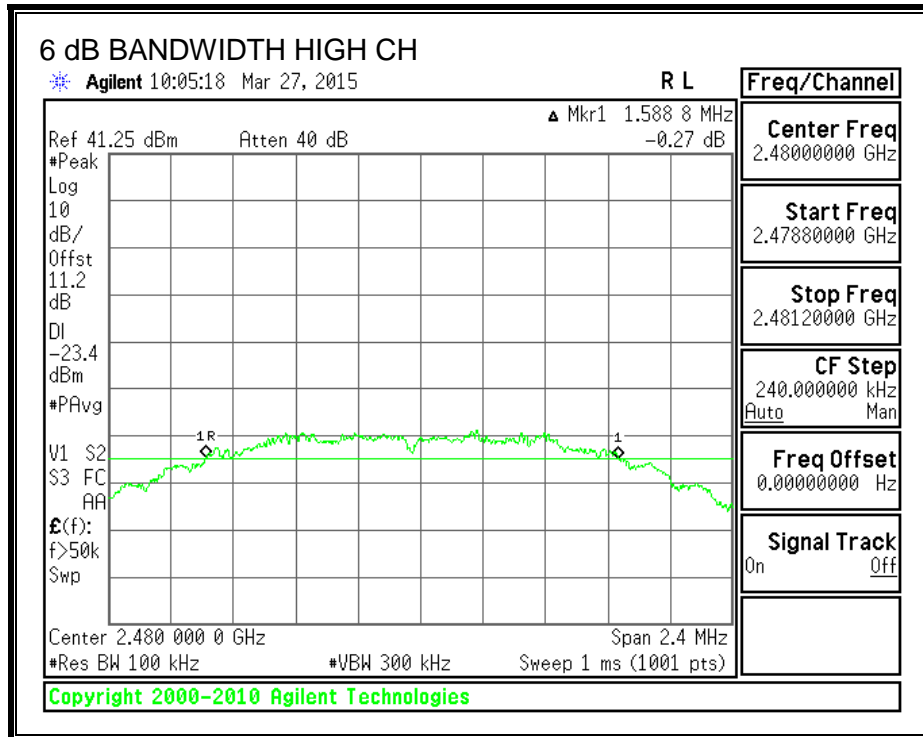
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2405	1.5840	0.5
Middle	2440	1.5741	0.5
High	2480	1.5888	0.5

6 dB BANDWIDTH







9.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

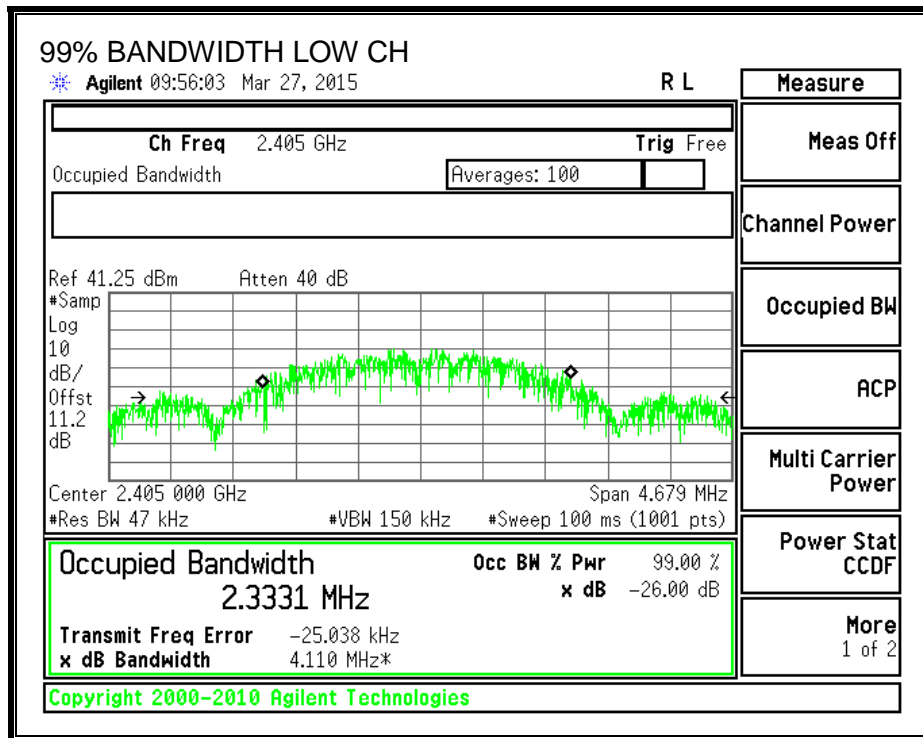
TEST PROCEDURE

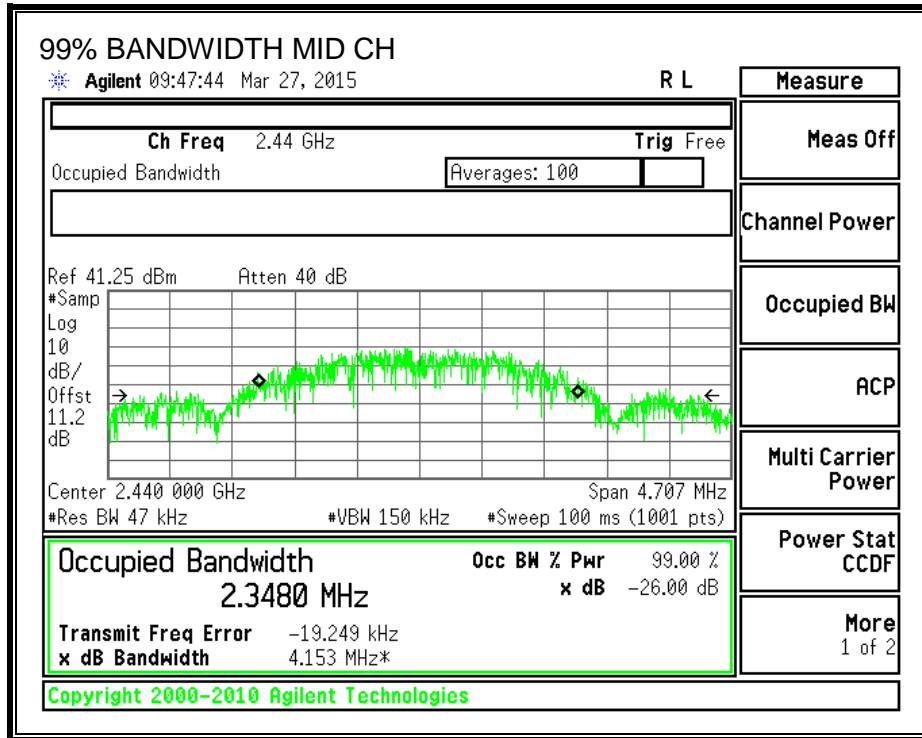
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 5% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

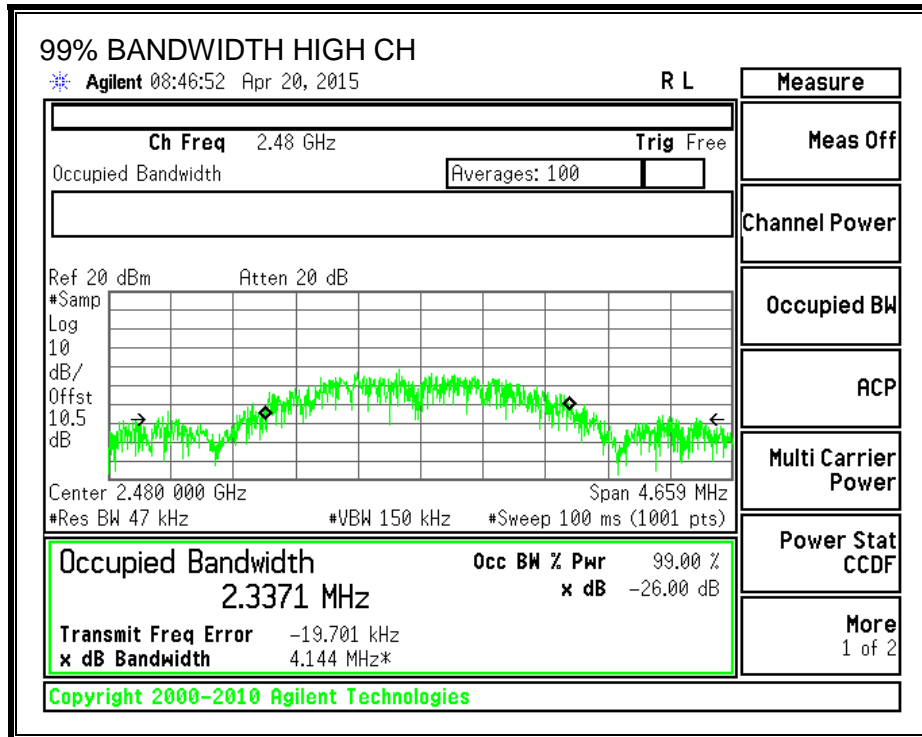
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2405	2.3331
Middle	2440	2.3480
High	2480	2.3371

99% BANDWIDTH







9.1.3. 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.

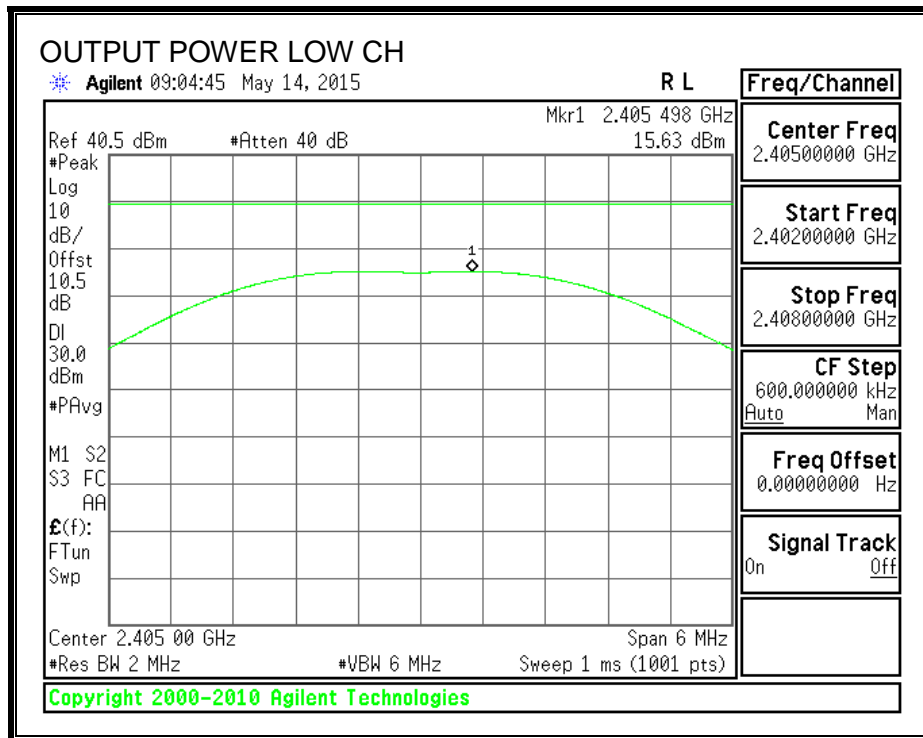
TEST PROCEDURE

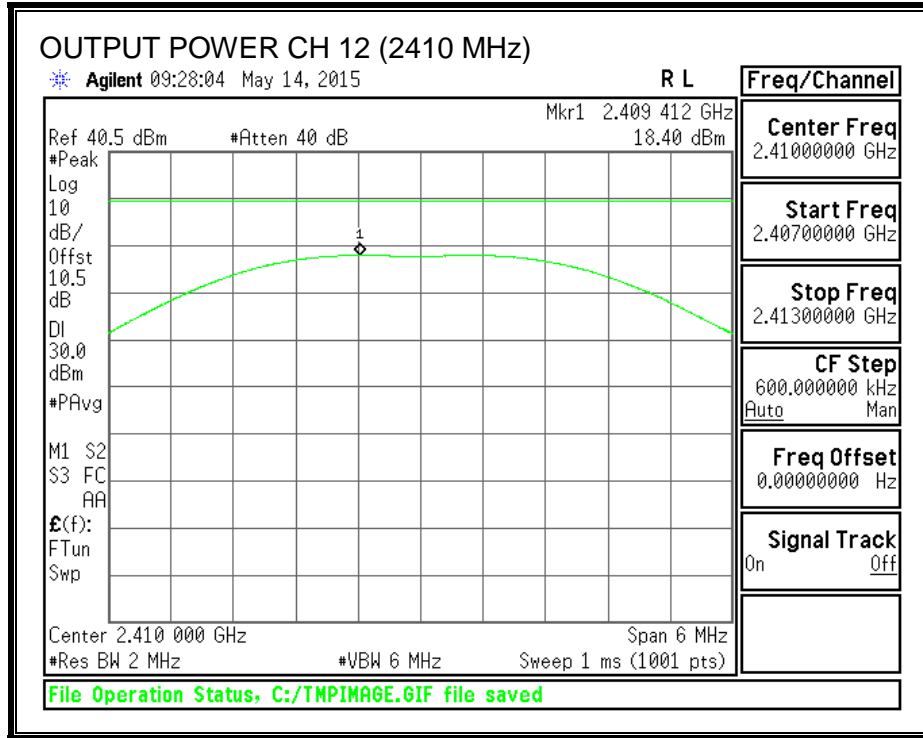
The transmitter output is connected to a spectrum analyzer whose bandwidth is set to a value greater than or equal to the DTS bandwidth (6dB bandwidth) of the EUT (KDB 558074 D01 v03r02, Section 9.1.1).

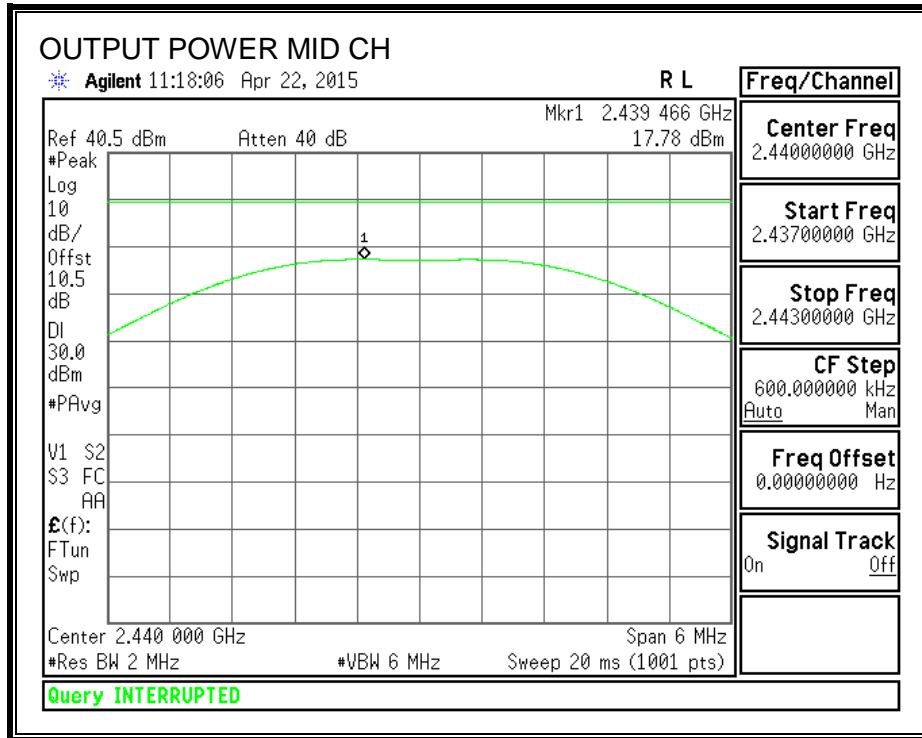
RESULTS

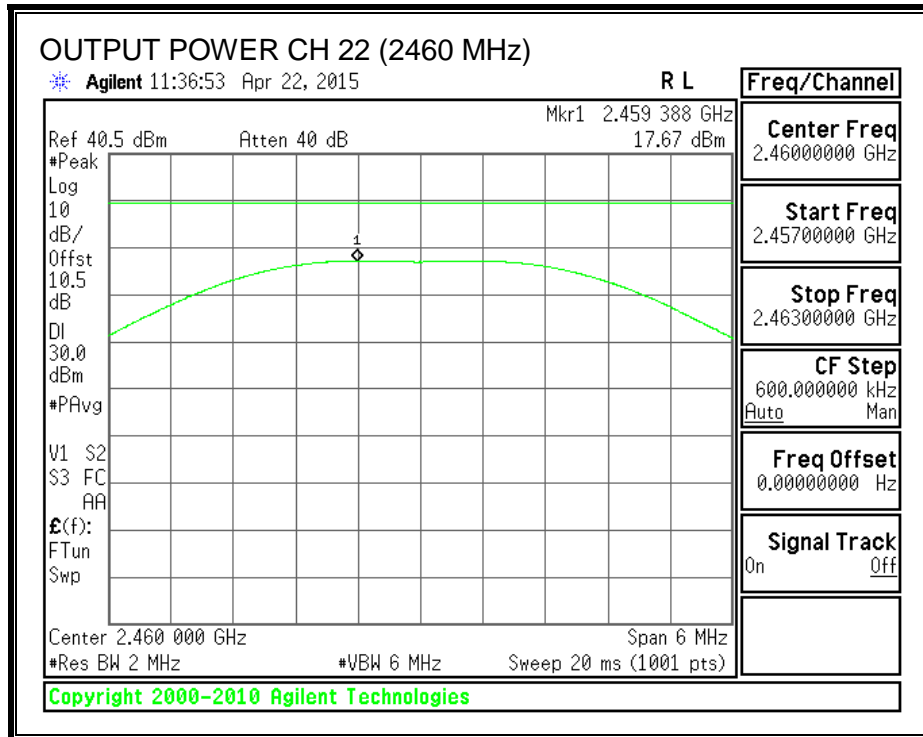
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low (11)	2405	15.63	30	-14.37
12	2410	18.40	30	-11.60
Middle (18)	2440	17.78	30	-12.22
22	2460	17.67	30	-12.33
23	2465	13.81	30	-16.19
24	2470	8.65	30	-21.35
25	2475	2.26	30	-27.74
High (26)	2480	-12.98	30	-42.98

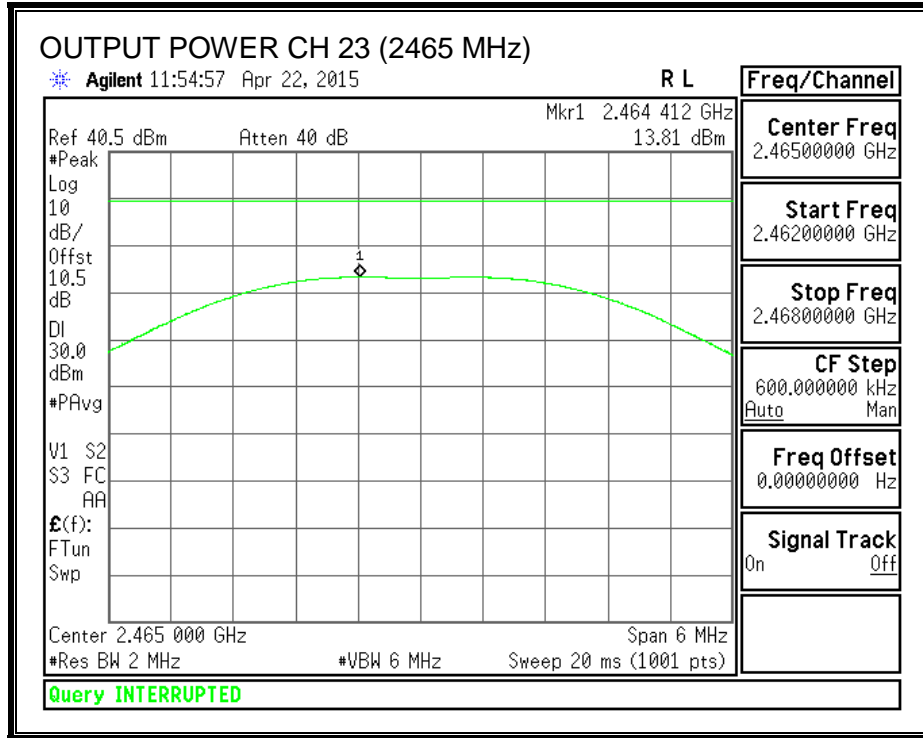
OUTPUT POWER

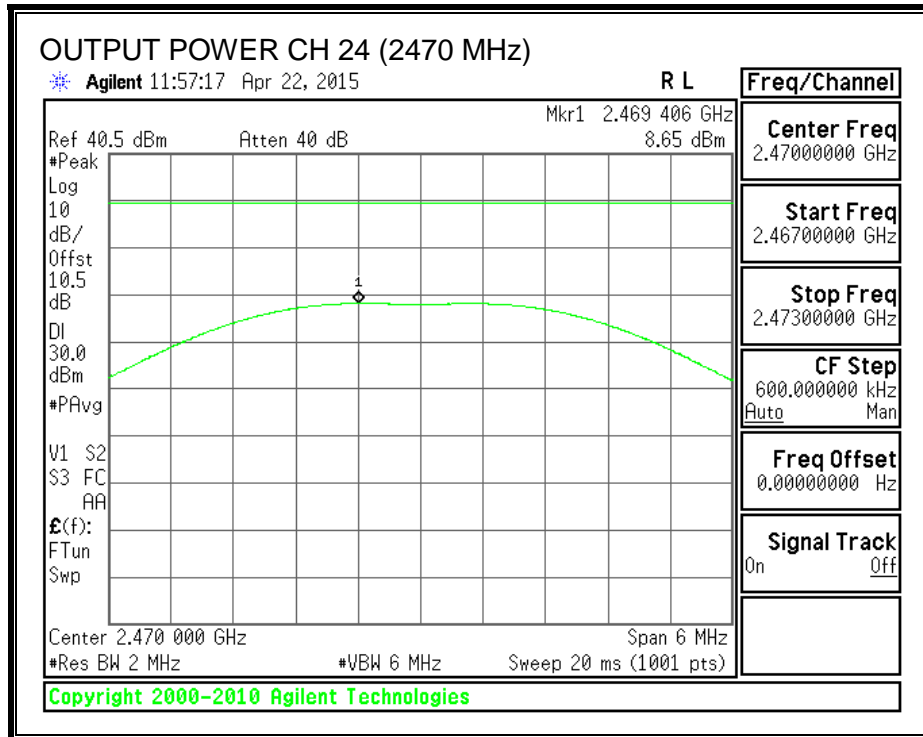


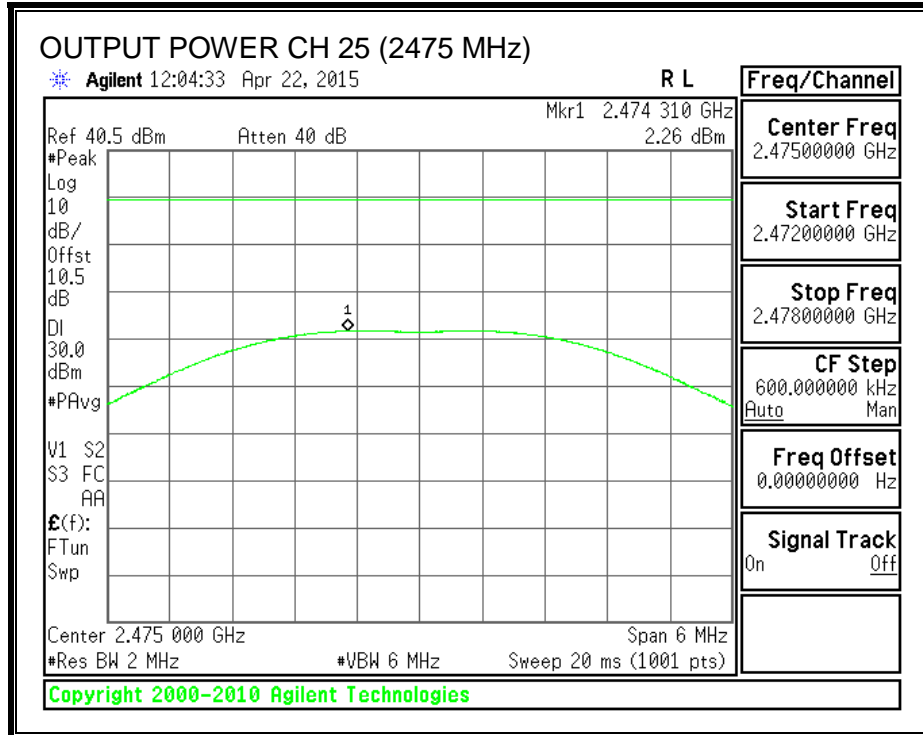


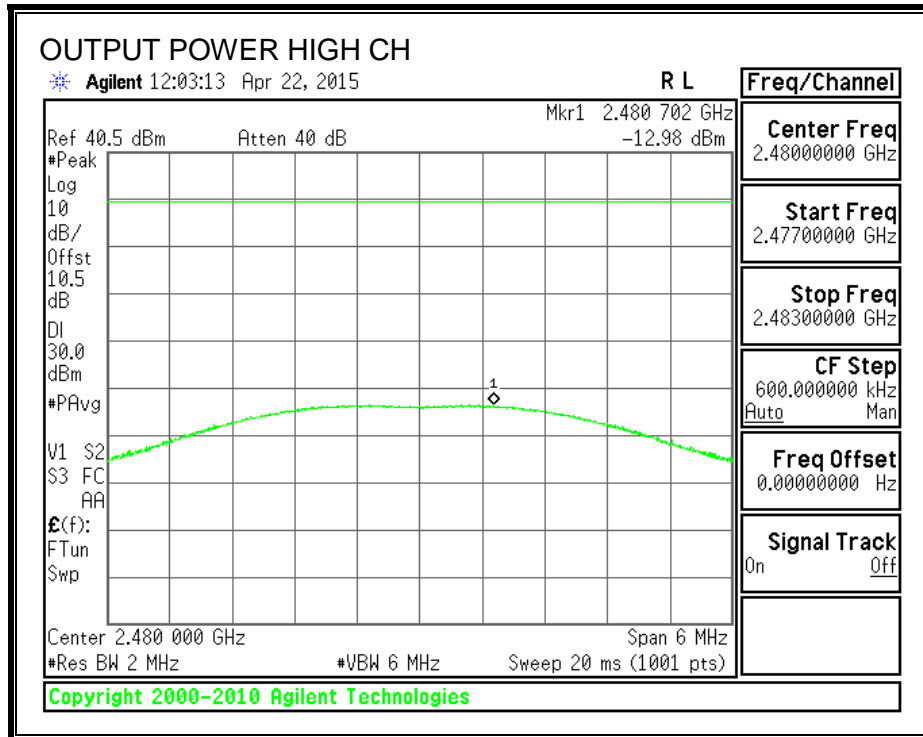












9.1.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.25 dB (including 10 dB pad and 1.25 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low (11)	2405	14.88
12	2410	18.20
Middle (18)	2440	17.68
22	2460	17.62
23	2465	13.78
24	2470	8.61
25	2475	2.16
High (26)	2480	-13.57

9.1.5. 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

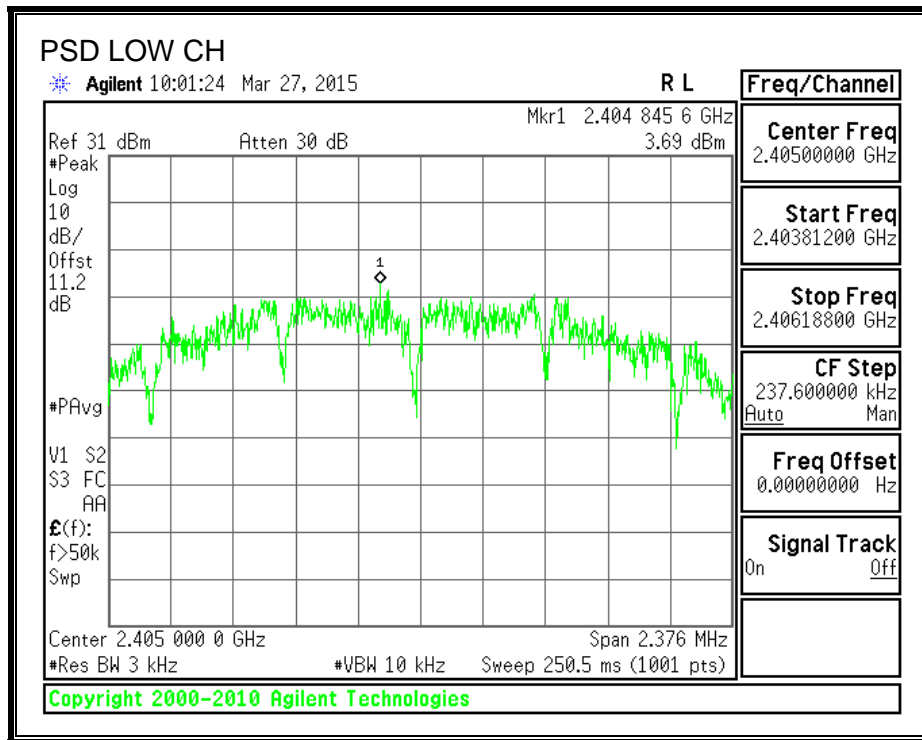
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC KDB 558074 D01 v03r02, Section 10.2.

RESULTS

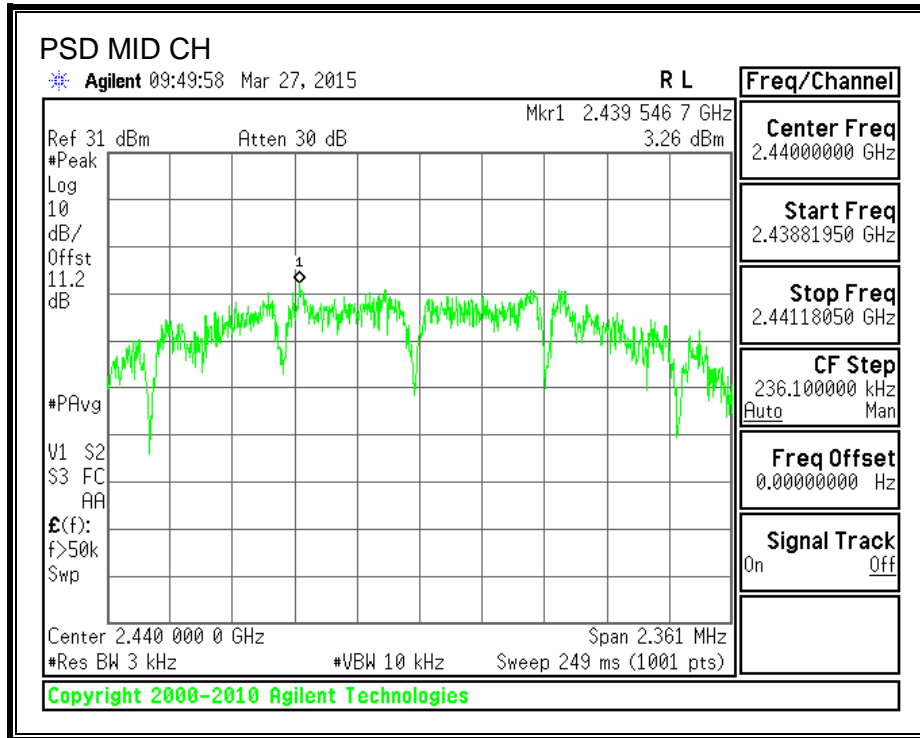
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2405	3.69	8	-4.31
Middle	2440	3.26	8	-4.74
High	2480	-30.76	8	-38.76

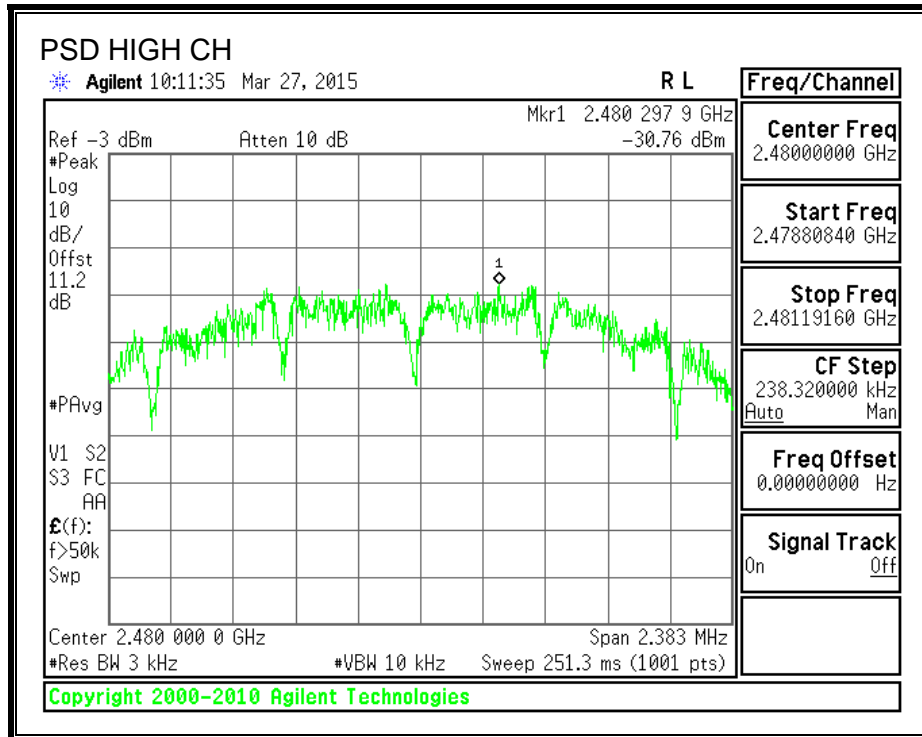
Note – CH11 was tested at the Mid Channel Power setting to achieve worst-case results.

POWER SPECTRAL DENSITY



Note – CH11 was tested at the Mid Channel Power setting to achieve worst-case results.





9.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

Output power was measured based on the use of a peak measurement, which specifies an attenuation of spurious emissions by at least 20dBc. However, a worst-case 30dBc attenuation was used in this instance.

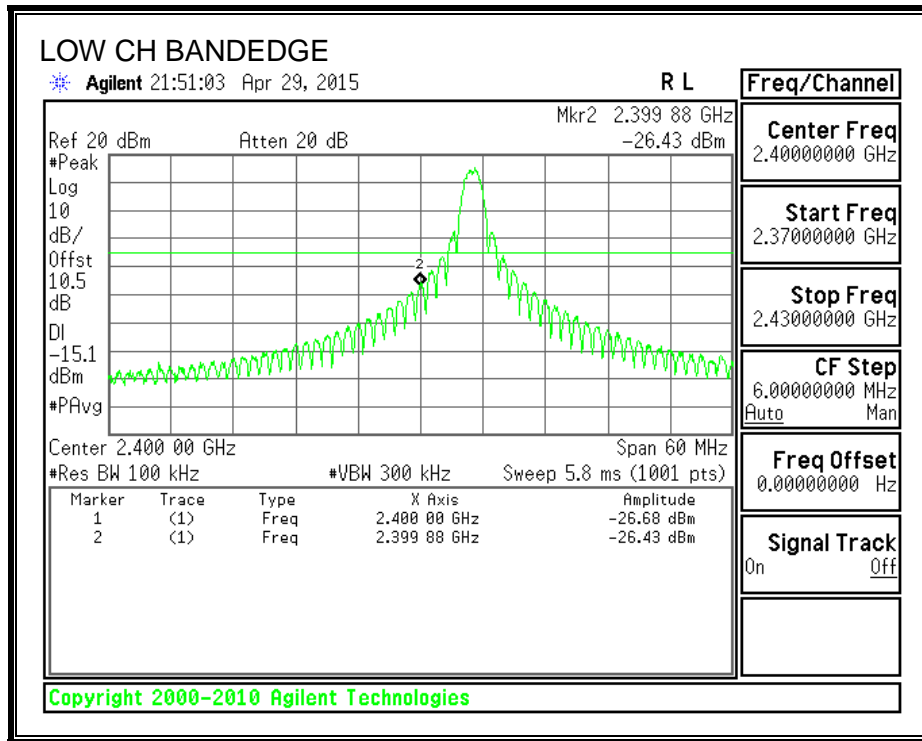
TEST PROCEDURE

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.

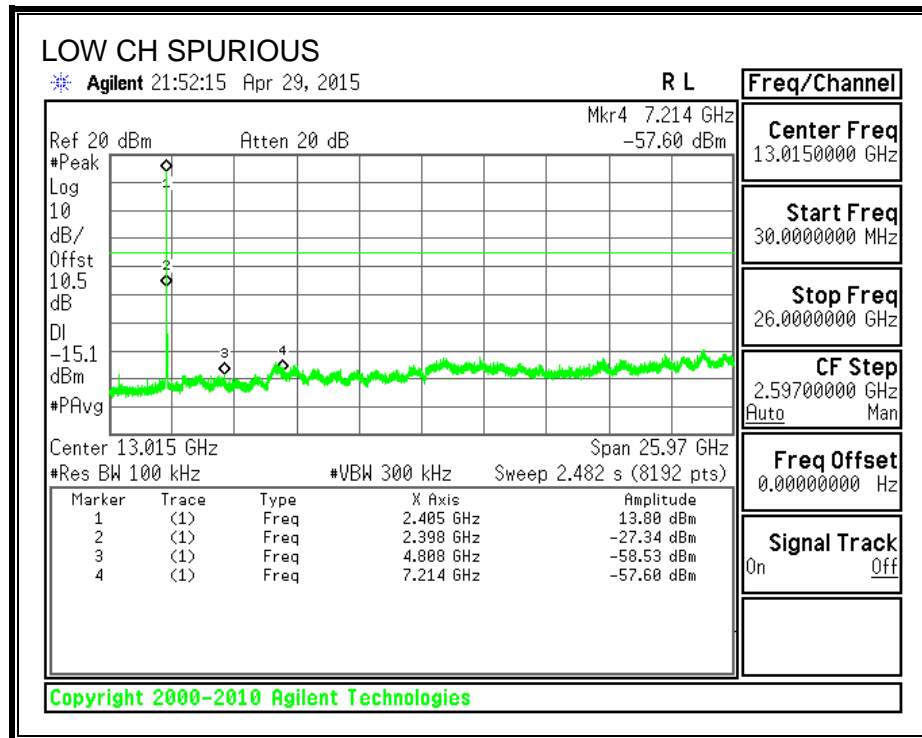
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels. This test was performed per FCC KDB 558074 D01 v03r02, Section 11.0.

RESULTS

BANDEDGE AND SPURIOUS EMISSIONS, LOW CHANNEL

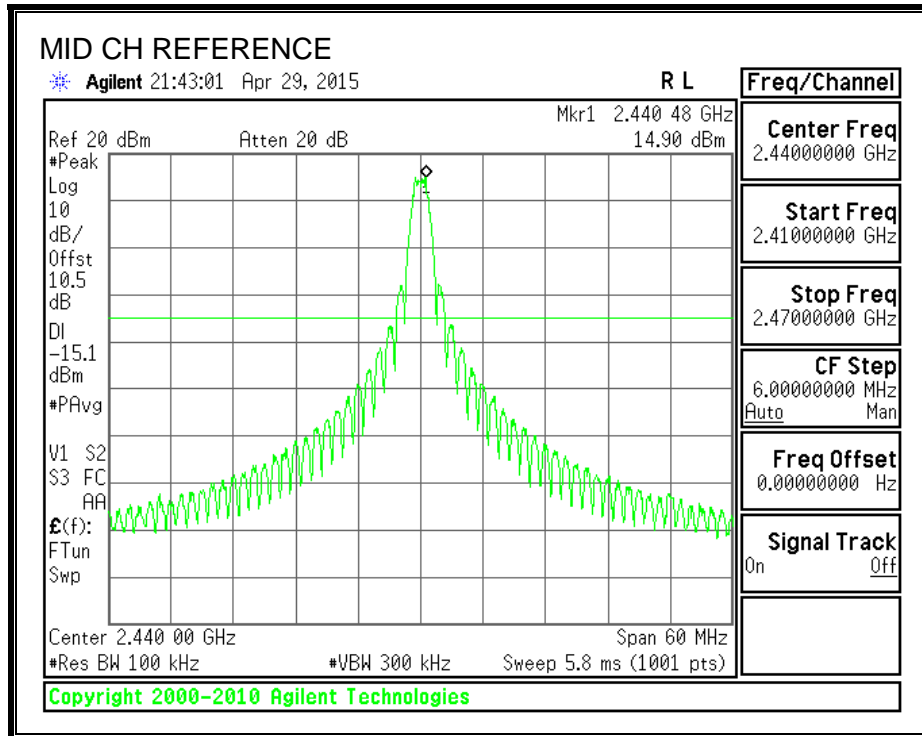


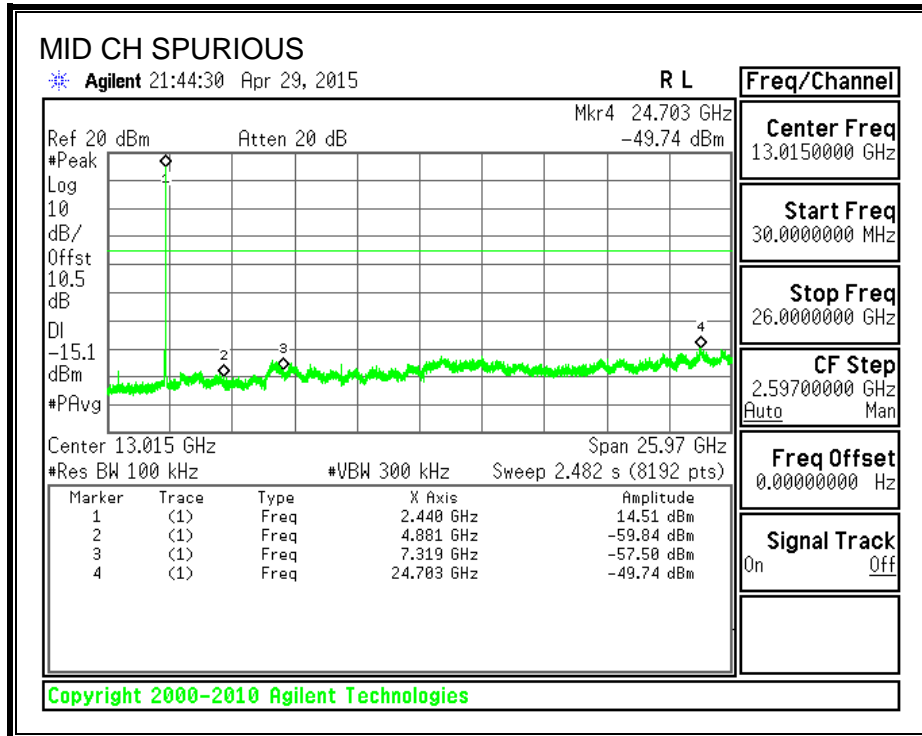
Note – CH11 was tested at the Mid Channel Power setting to achieve worst-case results.



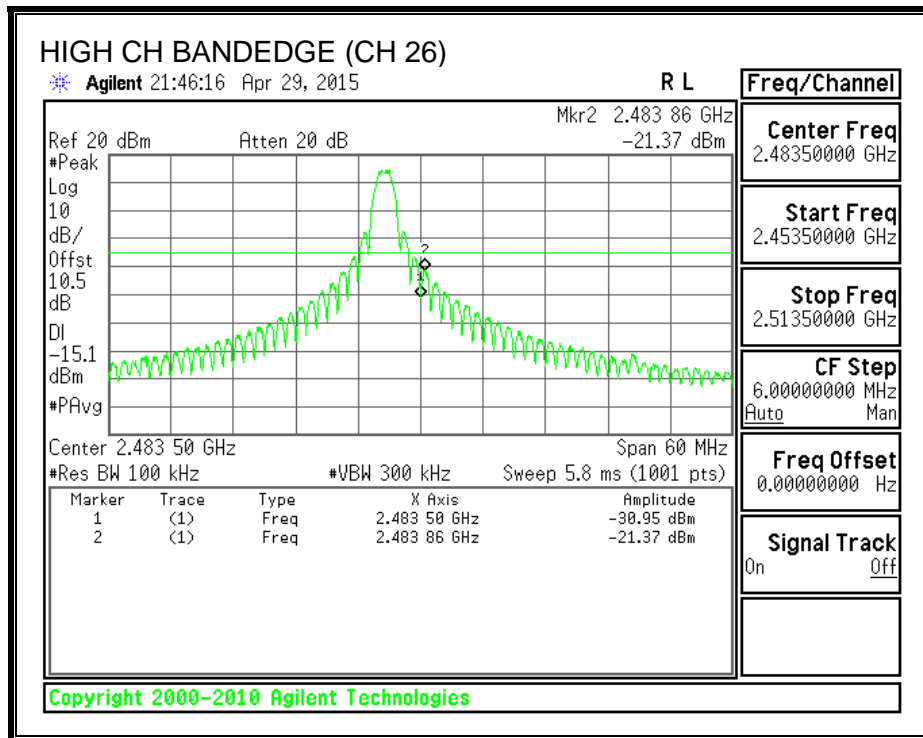
Note – CH11 was tested at the Mid Channel Power setting to achieve worst-case results.

SPURIOUS EMISSIONS, MID CHANNEL

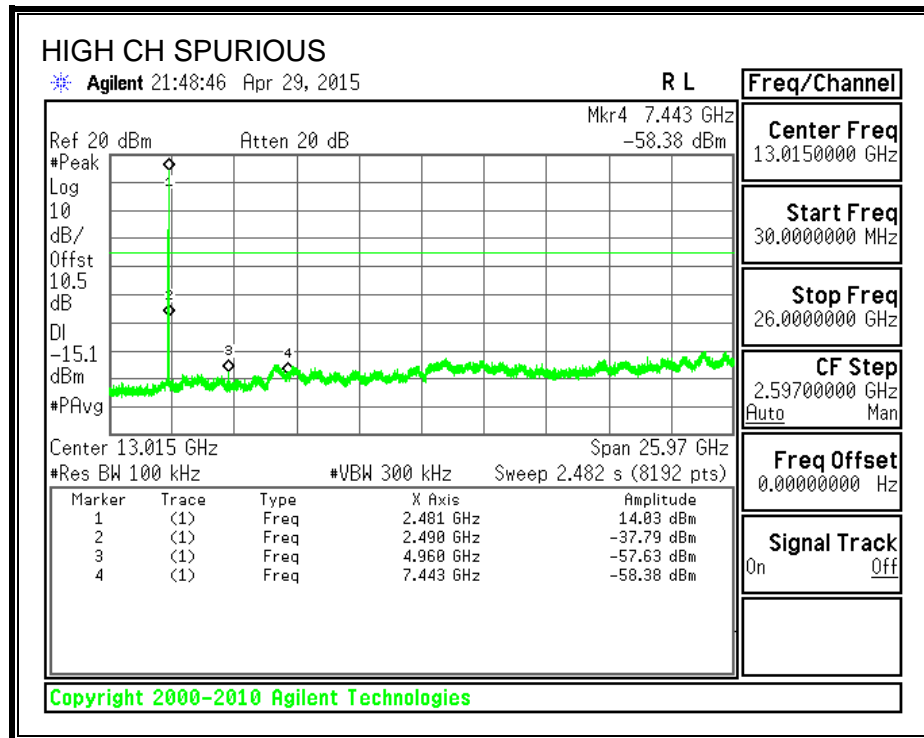




BANDEGDE AND SPURIOUS EMISSIONS, HIGH CHANNEL



Note – CH26 was tested at the Mid Channel Power setting to achieve worst-case results.



Note – For Conducted Spurious, the High Channel was tested at the same power setting as Mid channel to achieve worst-case results.

10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

KDB 558074 D01 v03r02, Section 12.0

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 for below 1GHz measurements and 1.5 m above the ground plane for above 1GHz measurements. The antenna to EUT distance is 3 meters.

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

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

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.

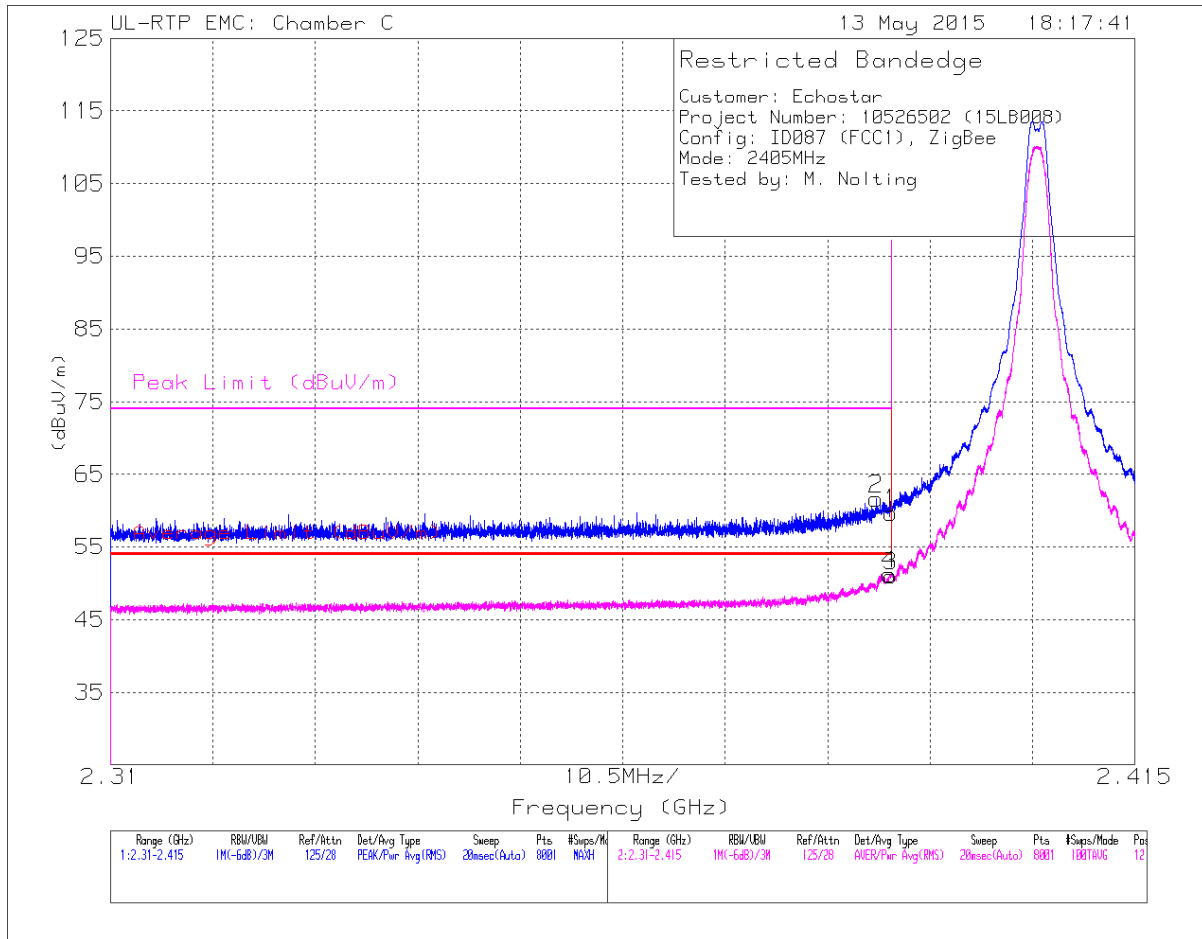
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. TX ABOVE 1 GHz FOR 802.15.4 MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL- CH 11)

HORIZONTAL



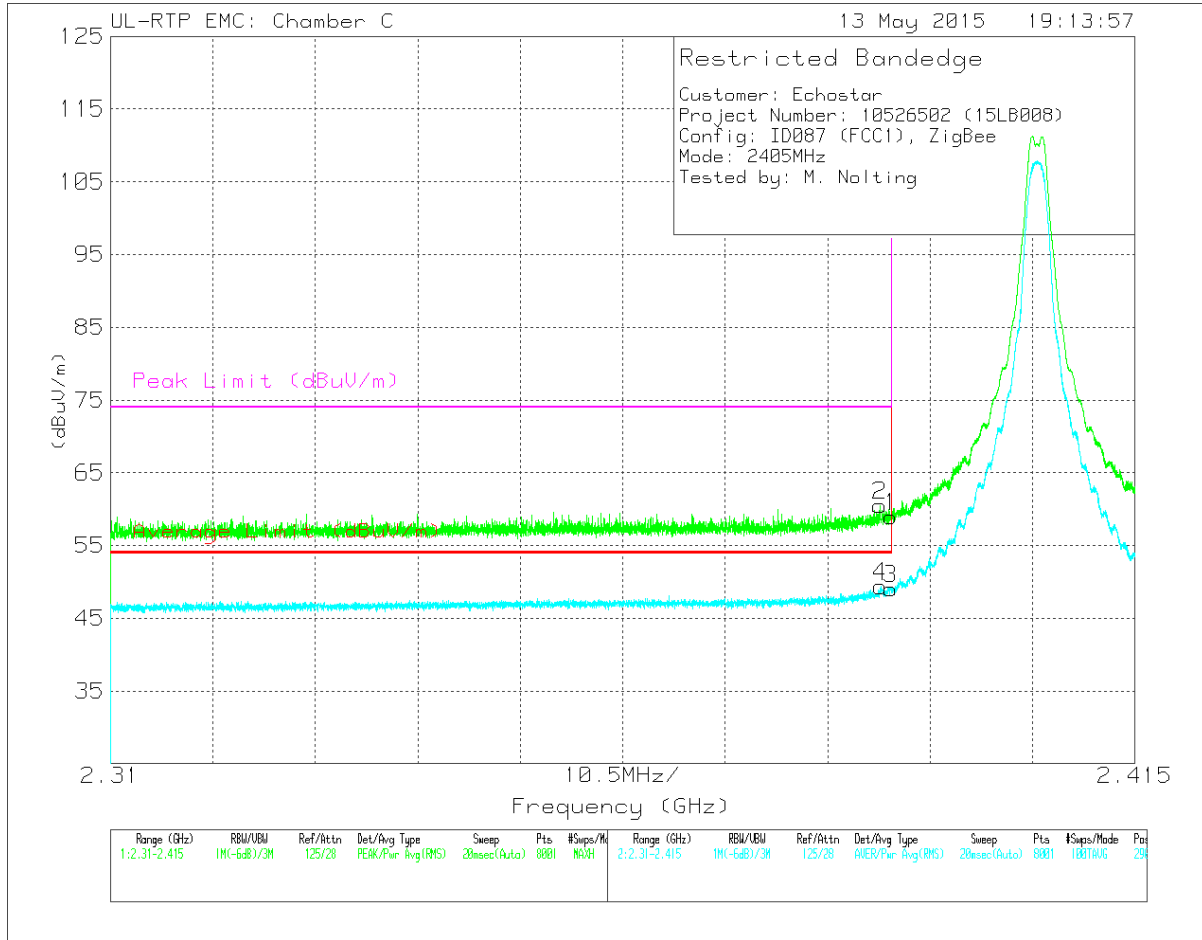
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	54.31	Pk	32.1	-26.7	59.71	-	-	74	-14.29	12	149	H
2	* 2.388	56.24	Pk	32.1	-26.7	61.64	-	-	74	-12.36	12	149	H
3	* 2.39	45.63	RMS	32.1	-26.7	51.03	54	-2.97	-	-	12	149	H
4	* 2.39	45.86	RMS	32.1	-26.7	51.26	54	-2.74	-	-	12	149	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Ftr/Pad	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	53.59	Pk	32.1	-26.7	58.99	-	-	74	-15.01	290	365	V
2	* 2.389	55.12	Pk	32.1	-26.7	60.52	-	-	74	-13.48	290	365	V
3	* 2.39	43.65	RMS	32.1	-26.7	49.05	54	-4.95	-	-	290	365	V
4	* 2.389	43.98	RMS	32.1	-26.7	49.38	54	-4.62	-	-	290	365	V

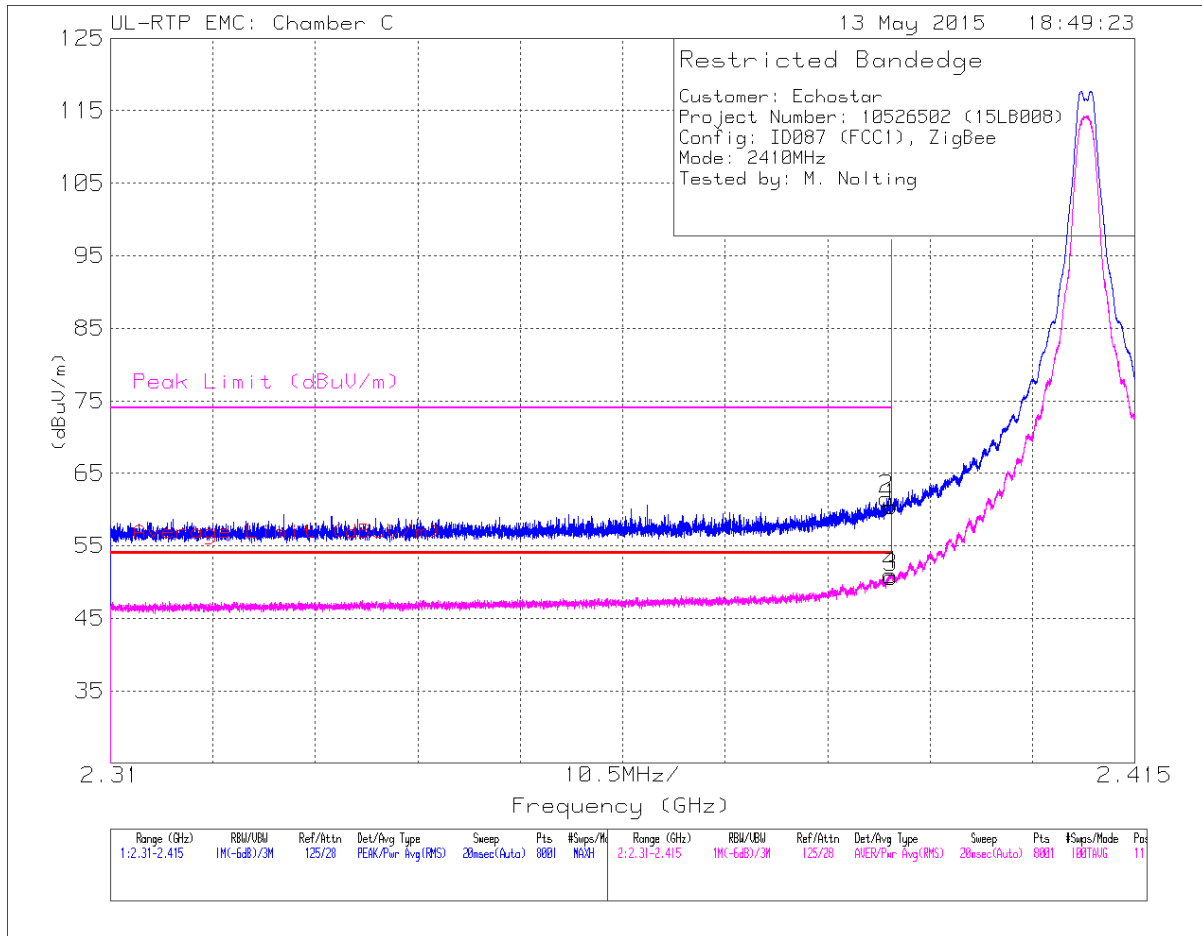
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEGE (CH 12)

HORIZONTAL



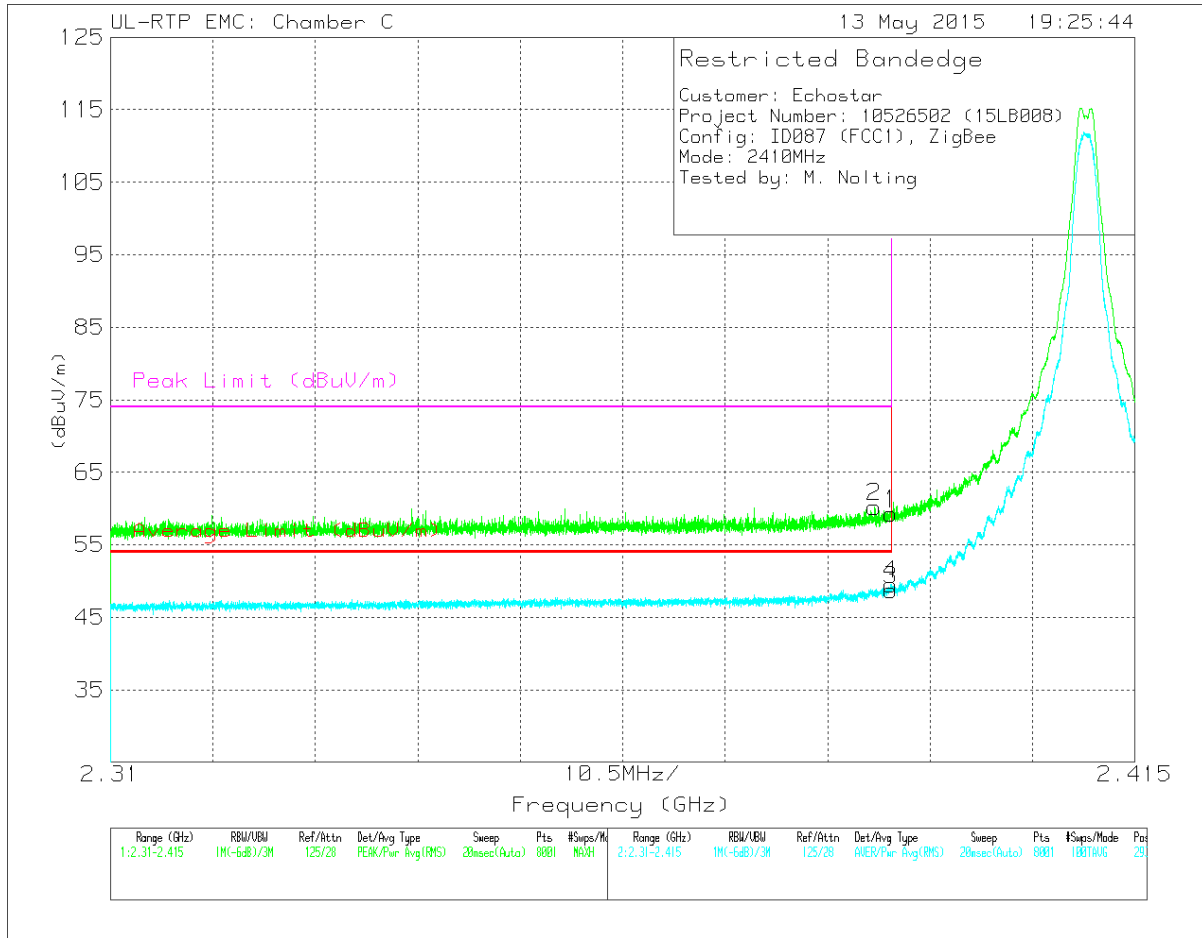
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Ftr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	55.03	Pk	32.1	-26.7	60.43	-	-	74	-13.57	11	150	H
2	* 2.39	56.11	Pk	32.1	-26.7	61.51	-	-	74	-12.49	11	150	H
3	* 2.39	45.29	RMS	32.1	-26.7	50.69	54	-3.31	-	-	11	150	H
4	* 2.39	45.6	RMS	32.1	-26.7	51	54	-3	-	-	11	150	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.388	54.81	Pk	32.1	-26.7	60.21	-	-	74	-13.79	293	363	V
1	* 2.39	53.87	Pk	32.1	-26.7	59.27	-	-	74	-14.73	293	363	V
3	* 2.39	43.36	RMS	32.1	-26.7	48.76	54	-5.24	-	-	293	363	V
4	* 2.39	44.15	RMS	32.1	-26.7	49.55	54	-4.45	-	-	293	363	V

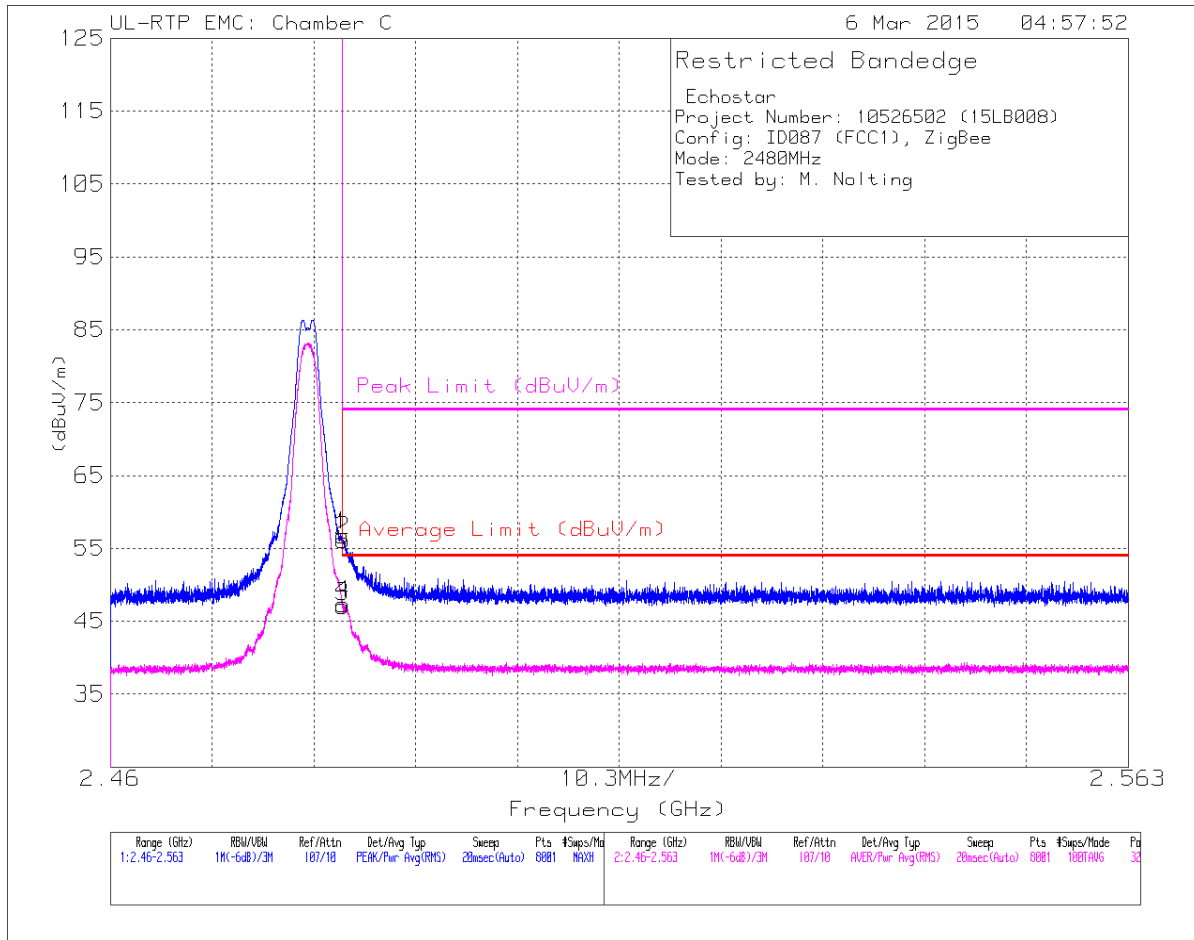
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEGE (HIGH CHANNEL – CH 26)

HORIZONTAL



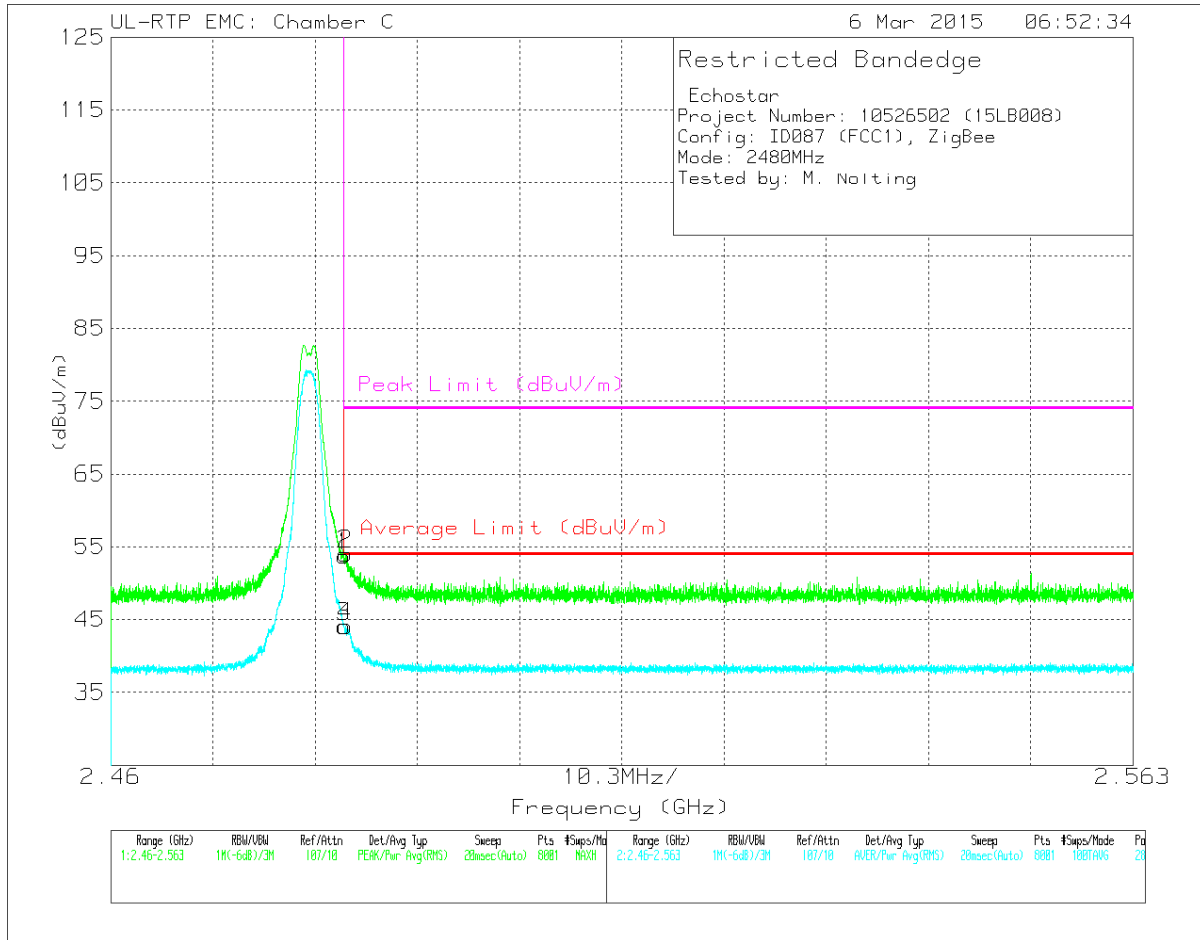
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	50.97	Pk	32.3	-26.5	56.77	-	-	74	-17.23	323	111	H
2	* 2.484	50.29	Pk	32.3	-26.5	56.09	-	-	74	-17.91	323	111	H
3	* 2.484	41.24	RMS	32.3	-26.5	47.04	54	-6.96	-	-	323	111	H
4	* 2.484	41.56	RMS	32.3	-26.5	47.36	54	-6.64	-	-	323	111	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Fltr/Pad	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	47.94	Pk	32.3	-26.5	53.74	-	-	74	-20.26	289	345	V
2	* 2.484	48.21	Pk	32.3	-26.5	54.01	-	-	74	-19.99	289	345	V
3	* 2.484	38.26	RMS	32.3	-26.5	44.06	54	-9.94	-	-	289	345	V
4	* 2.484	38.3	RMS	32.3	-26.5	44.1	54	-9.9	-	-	289	345	V

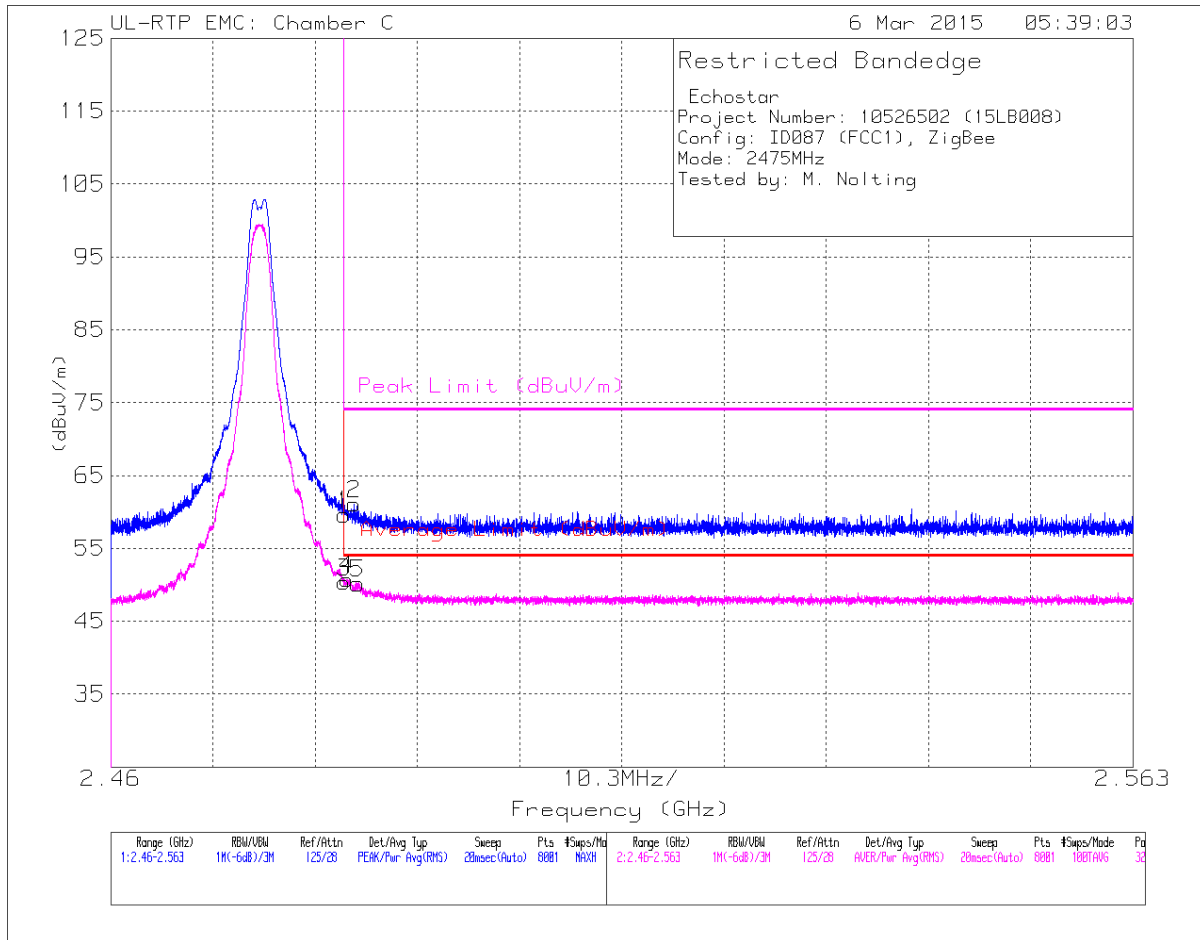
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEGE (CHANNEL 25)

HORIZONTAL



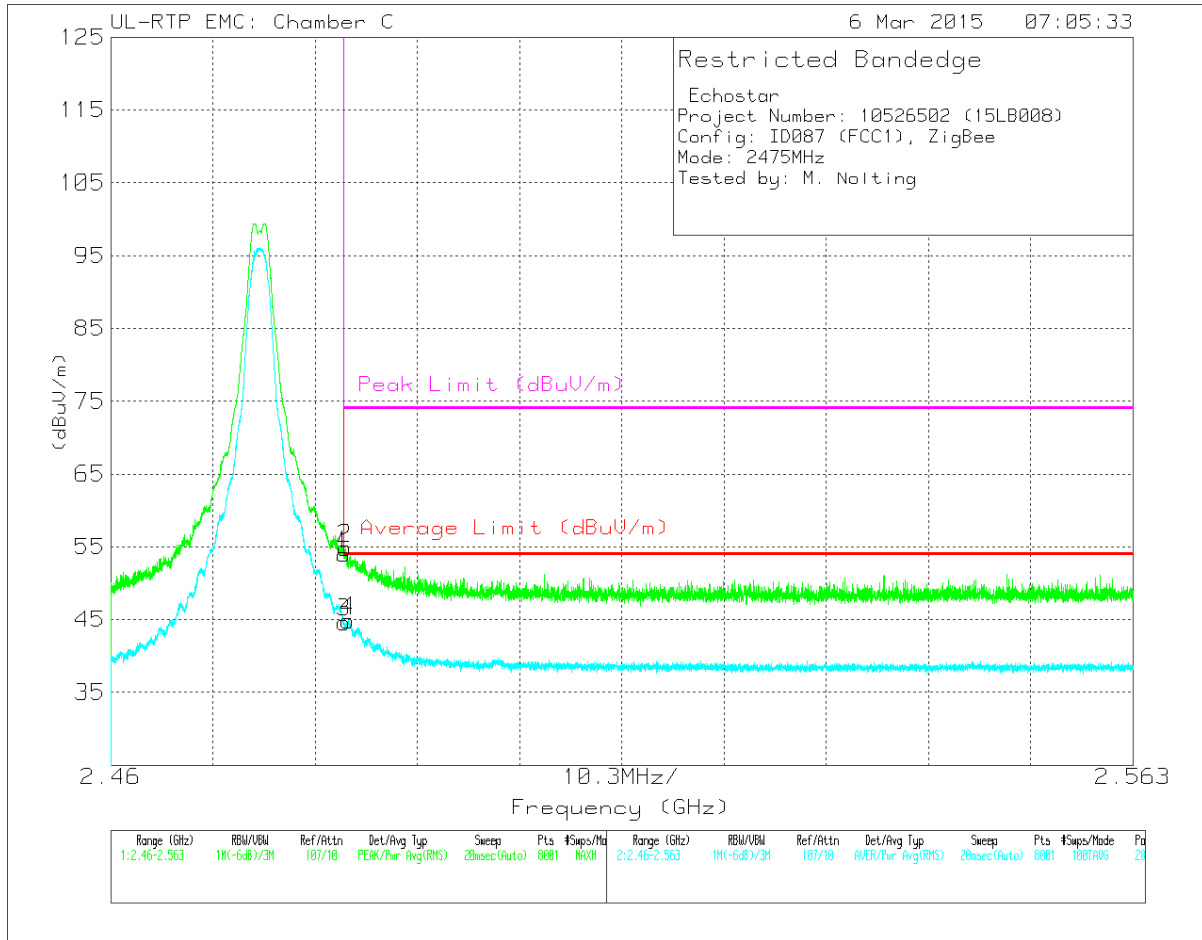
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	53.83	Pk	32.3	-26.5	59.63	-	-	74	-14.37	324	111	H
3	* 2.484	44.57	RMS	32.3	-26.5	50.37	54	-3.63	-	-	324	111	H
4	* 2.484	44.95	RMS	32.3	-26.5	50.75	54	-3.25	-	-	324	111	H
2	* 2.485	55.29	Pk	32.3	-26.5	61.09	-	-	74	-12.91	324	111	H
5	* 2.485	44.39	RMS	32.3	-26.5	50.19	54	-3.81	-	-	324	111	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Fltr/Pad	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	48.17	Pk	32.3	-26.5	53.97	-	-	74	-20.03	284	345	V
2	* 2.484	49.01	Pk	32.3	-26.5	54.81	-	-	74	-19.19	284	345	V
3	* 2.484	38.84	RMS	32.3	-26.5	44.64	54	-9.36	-	-	284	345	V
4	* 2.484	39.03	RMS	32.3	-26.5	44.83	54	-9.17	-	-	284	345	V

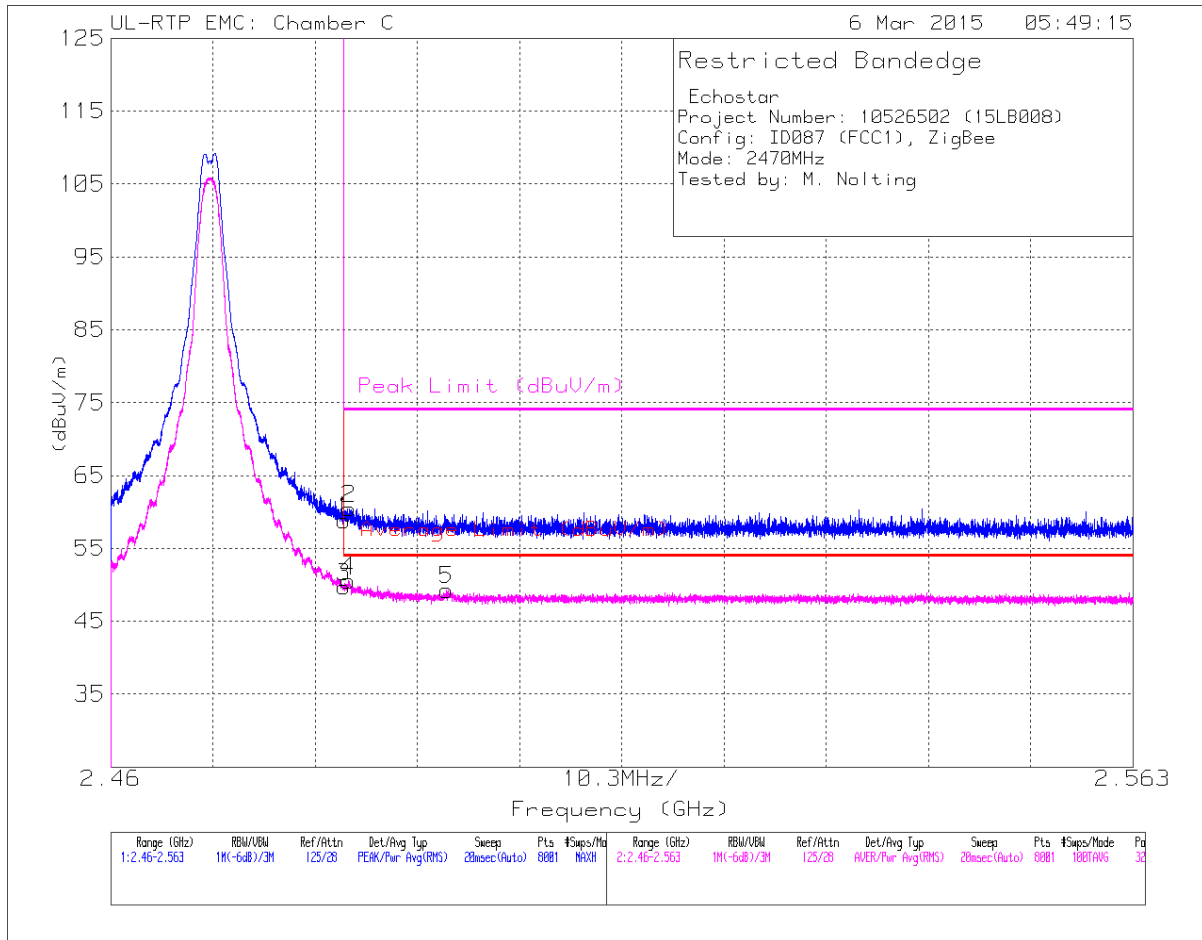
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEGE (CHANNEL 24)

HORIZONTAL



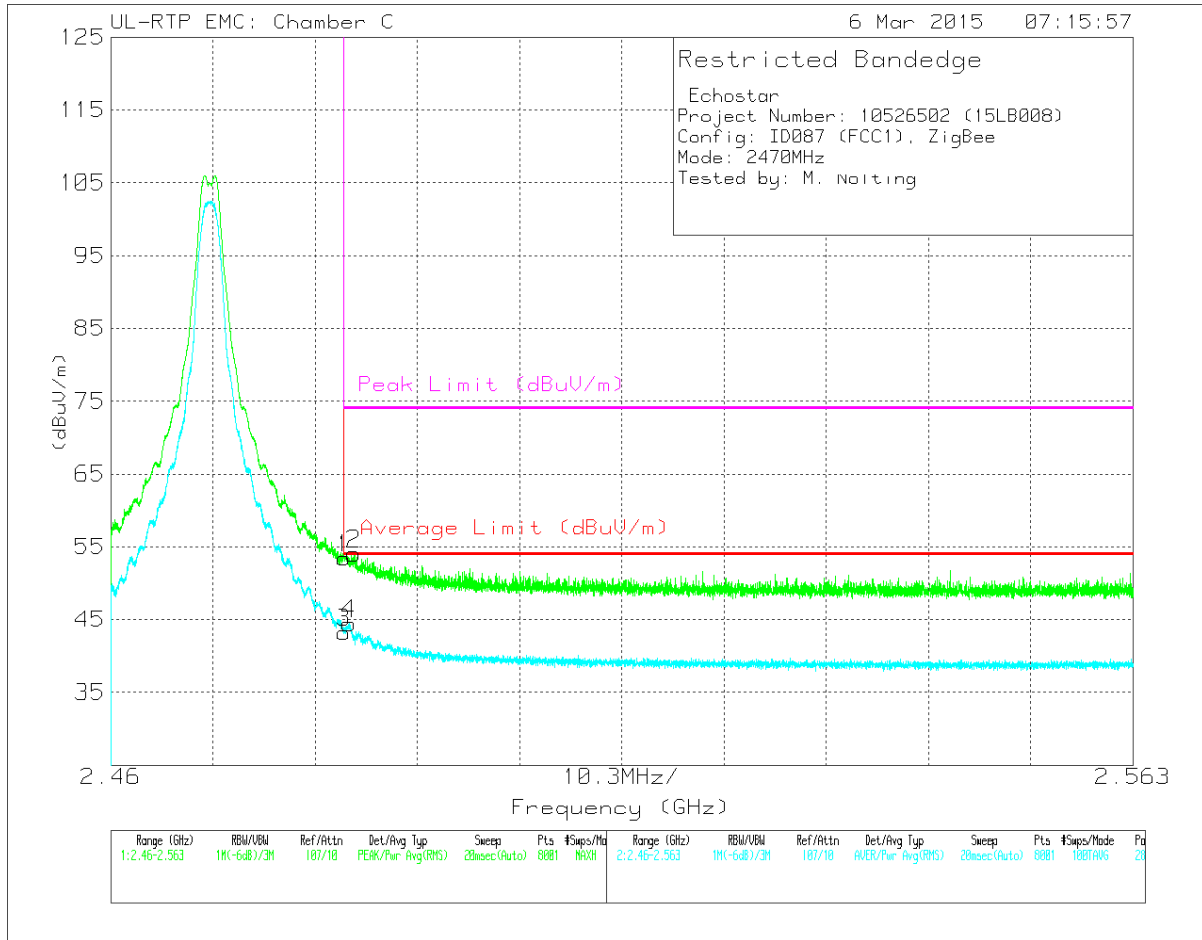
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	53.01	Pk	32.3	-26.5	58.81	-	-	74	-15.19	324	111	H
2	* 2.484	54.65	Pk	32.3	-26.5	60.45	-	-	74	-13.55	324	111	H
3	* 2.484	43.91	RMS	32.3	-26.5	49.71	54	-4.29	-	-	324	111	H
4	* 2.484	44.74	RMS	32.3	-26.5	50.54	54	-3.46	-	-	324	111	H
5	* 2.494	43.39	RMS	32.4	-26.5	49.29	54	-4.71	-	-	324	111	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL



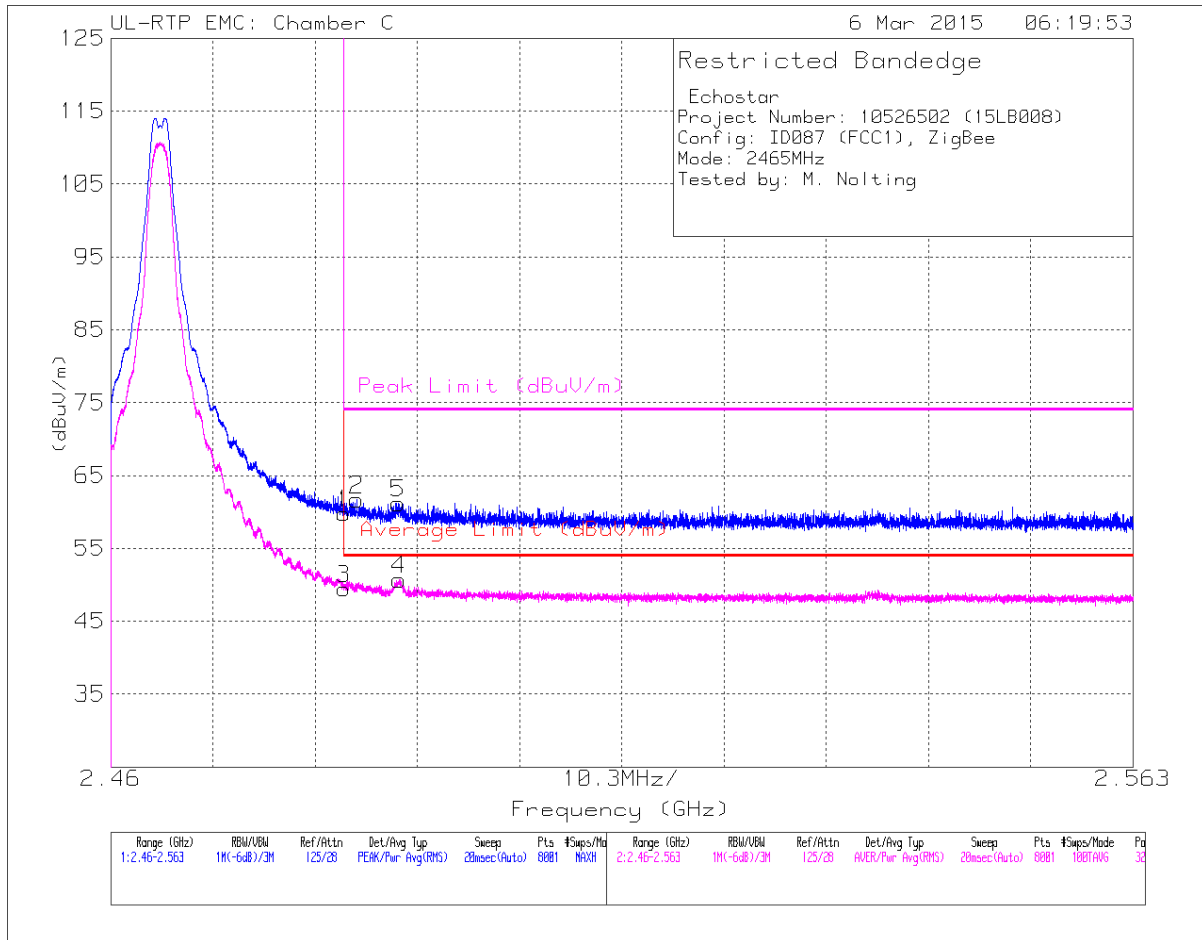
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	47.65	Pk	32.3	-26.5	53.45	-	-	74	-20.55	284	347	V
3	* 2.484	37.43	RMS	32.3	-26.5	43.23	54	-10.77	-	-	284	347	V
4	* 2.484	38.63	RMS	32.3	-26.5	44.43	54	-9.57	-	-	284	347	V
2	* 2.485	48.23	Pk	32.3	-26.5	54.03	-	-	74	-19.97	284	347	V

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

Pk - Peak detector
 RMS - RMS detection

RESTRICTED BANDEGE (CHANNEL 23)

HORIZONTAL

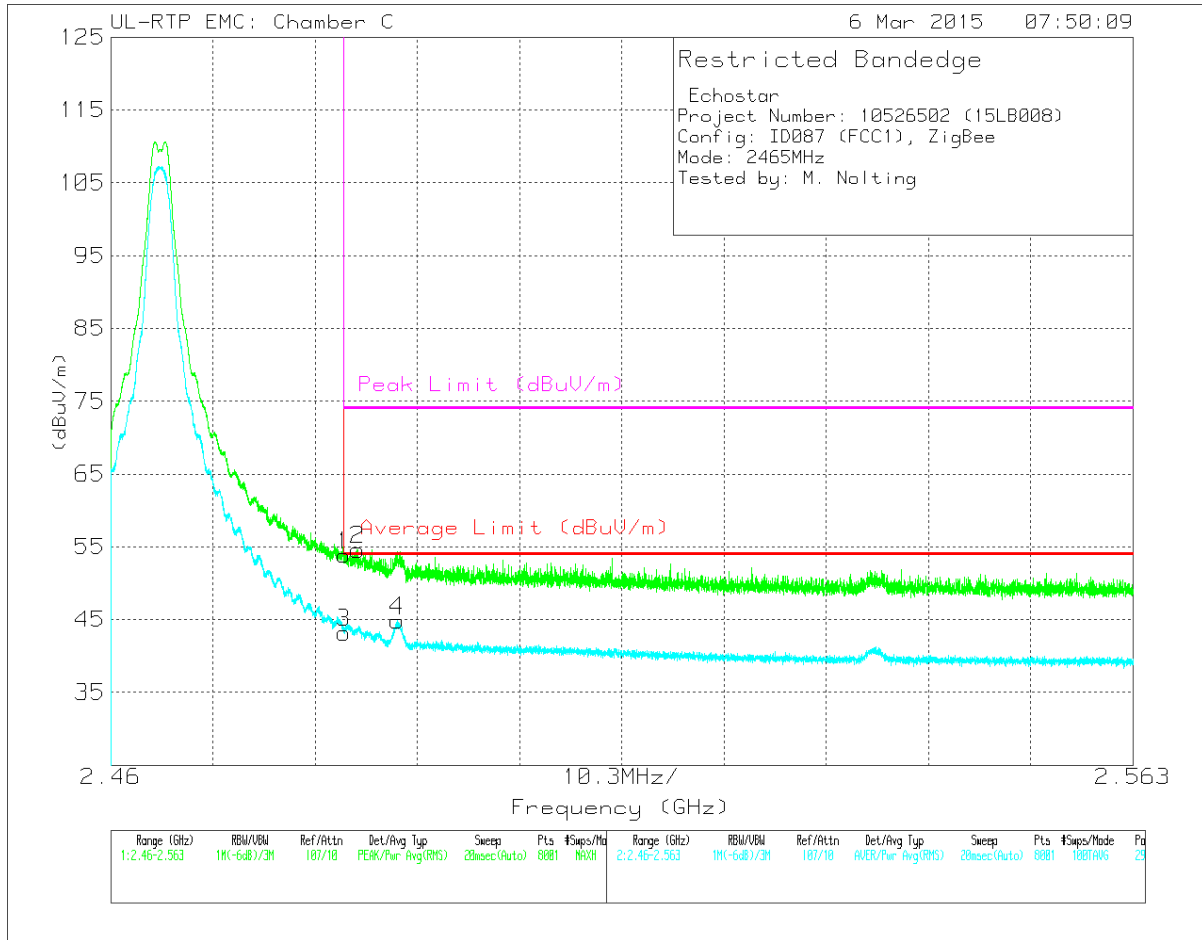


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	53.99	Pk	32.3	-26.5	59.79	-	-	74	-14.21	322	128	H
3	* 2.484	43.65	RMS	32.3	-26.5	49.45	54	-4.55	-	-	322	128	H
2	* 2.485	55.86	PK	32.3	-26.5	61.66	-	-	74	-12.34	322	128	H
5	* 2.489	55.36	Pk	32.3	-26.5	61.16	-	-	74	-12.84	322	128	H
4	* 2.489	44.89	RMS	32.3	-26.5	50.69	54	-3.31	-	-	322	128	H

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

Pk - Peak detector
 RMS - RMS detection

VERTICAL



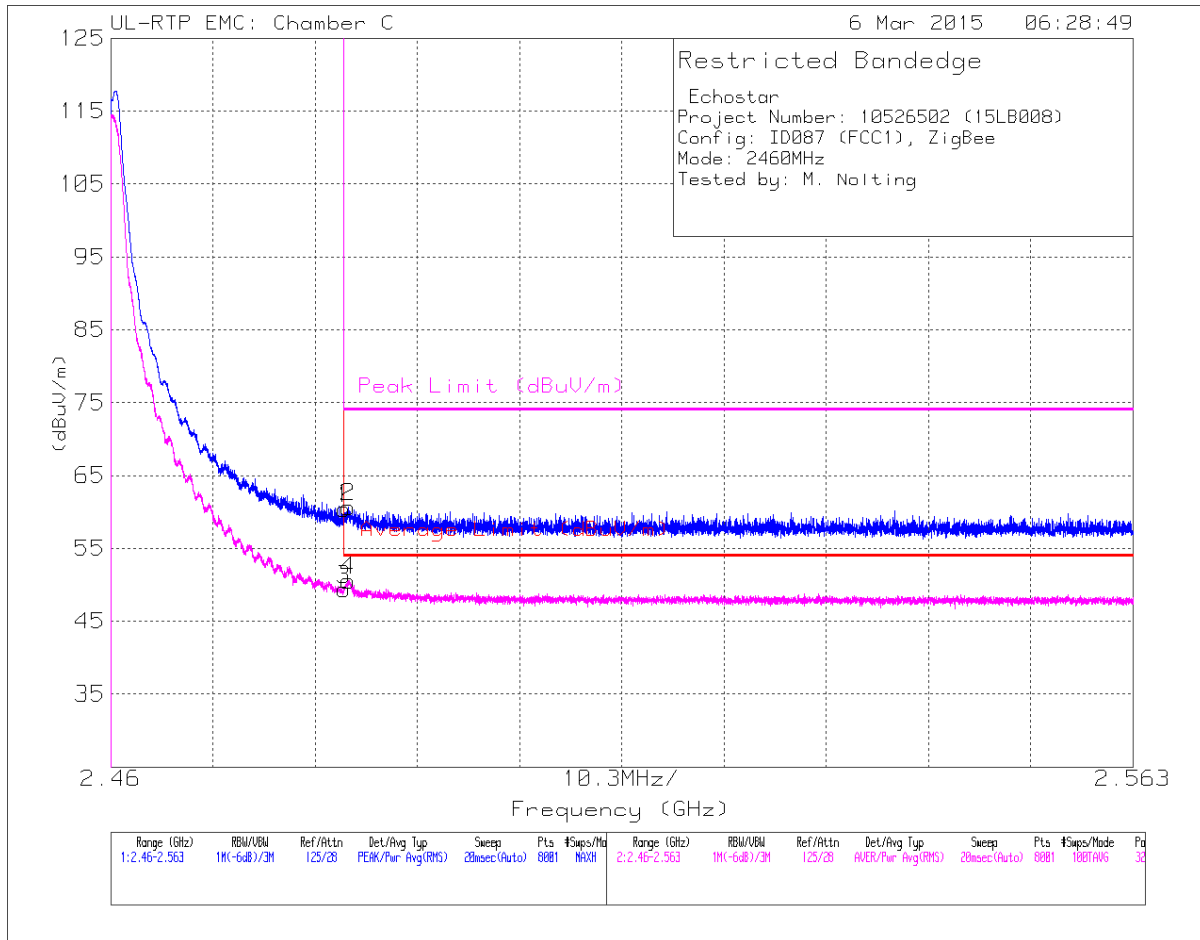
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Fltr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	48.06	Pk	32.3	-26.5	53.86	-	-	74	-20.14	290	337	V
3	* 2.484	37.4	RMS	32.3	-26.5	43.2	54	-10.8	-	-	290	337	V
2	* 2.485	48.81	Pk	32.3	-26.5	54.61	-	-	74	-19.39	290	337	V
4	* 2.489	39.02	RMS	32.3	-26.5	44.82	54	-9.18	-	-	290	337	V

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

Pk - Peak detector
 RMS - RMS detection

RESTRICTED BANDEGE (CHANNEL 22)

HORIZONTAL



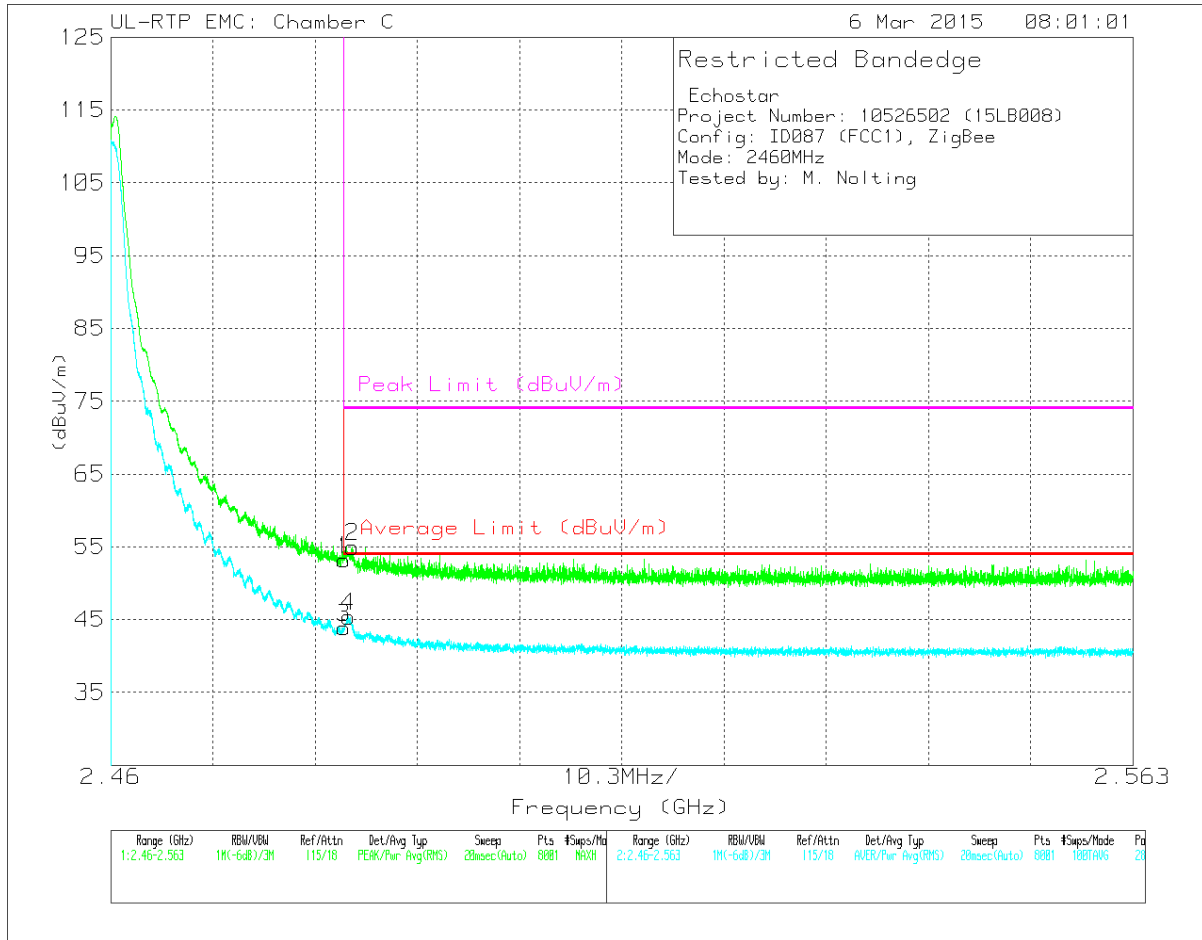
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	54.62	Pk	32.3	-26.5	60.42	-	-	74	-13.58	322	111	H
2	* 2.484	54.89	Pk	32.3	-26.5	60.69	-	-	74	-13.31	322	111	H
3	* 2.484	43.58	RMS	32.3	-26.5	49.38	54	-4.62	-	-	322	111	H
4	* 2.484	44.77	RMS	32.3	-26.5	50.57	54	-3.43	-	-	322	111	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL



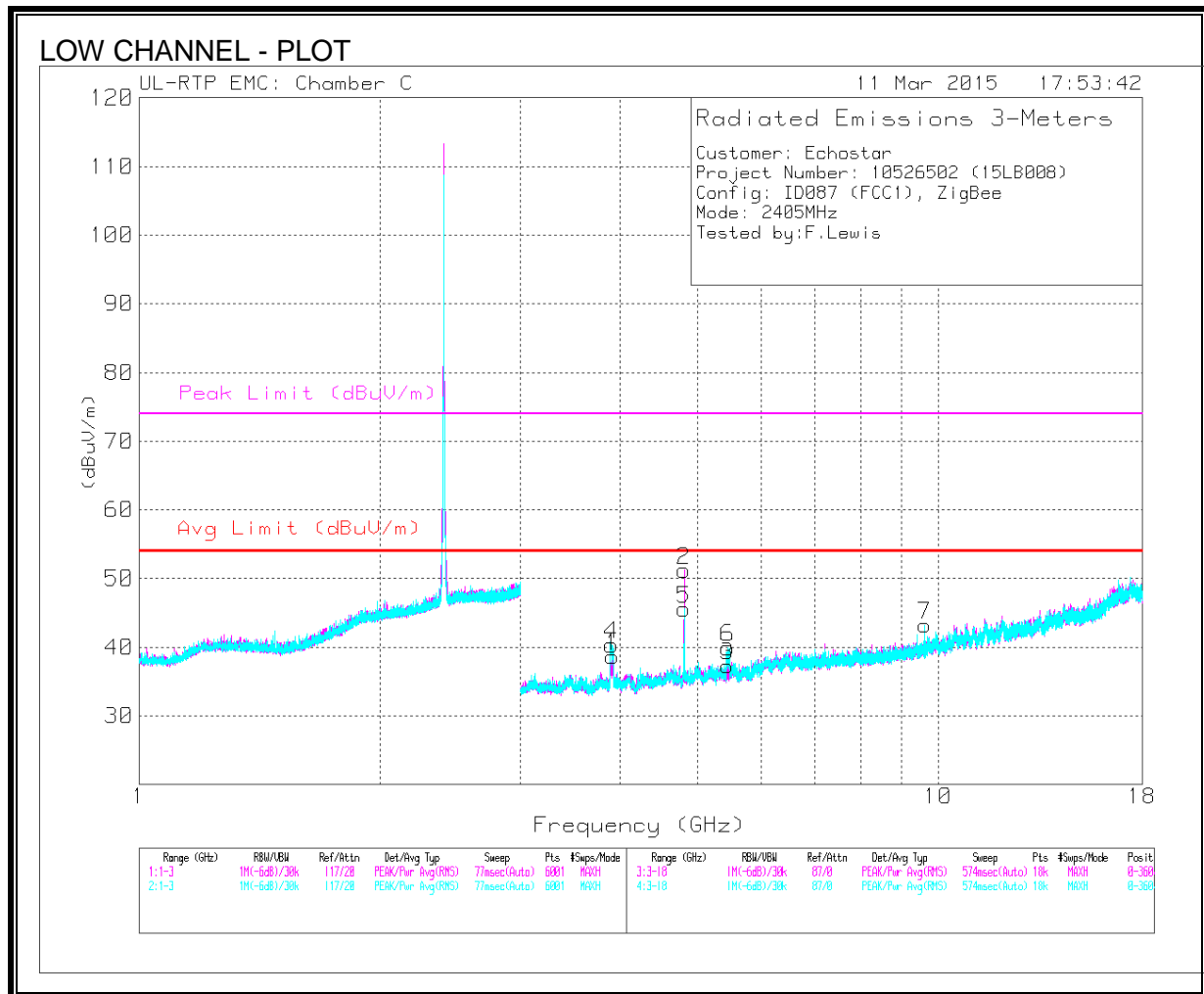
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/Fltr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	47.39	Pk	32.3	-26.5	53.19	-	-	74	-20.81	289	338	V
2	* 2.484	49.15	Pk	32.3	-26.5	54.95	-	-	74	-19.05	289	338	V
3	* 2.484	38.08	RMS	32.3	-26.5	43.88	54	-10.12	-	-	289	338	V
4	* 2.484	39.58	RMS	32.3	-26.5	45.38	54	-8.62	-	-	289	338	V

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

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS



Note – For Radiated Spurious, the Low Channel was tested at the same power setting as Mid channel to achieve worst-case results.

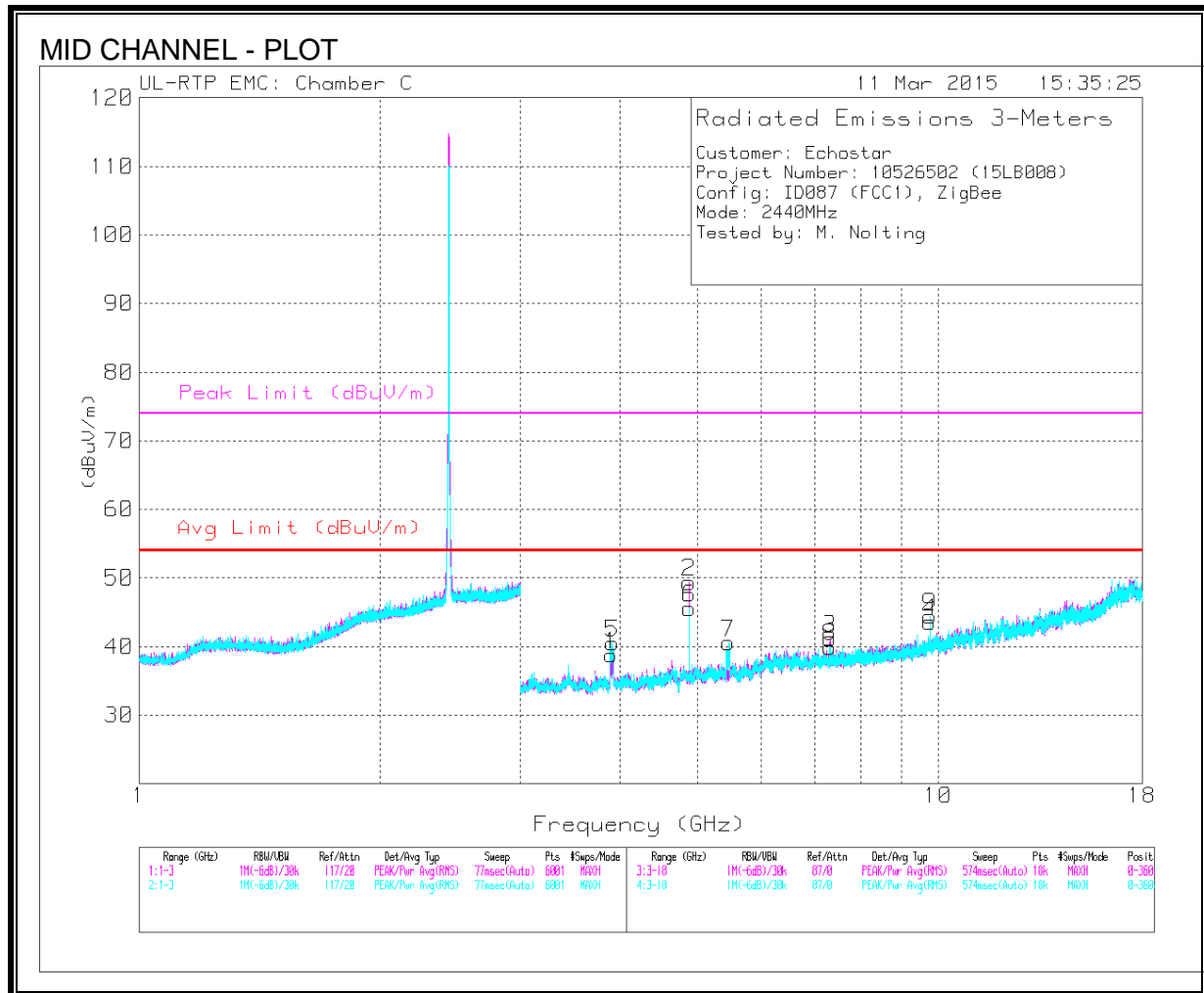
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/ Ftr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.889	50.89	PK2	33.6	-34.5	49.99	-	-	74	-24.01	130	383	H
	* 3.889	35.59	MAv1	33.6	-34.5	34.69	54	-19.31	-	-	130	383	H
2	* 4.809	55.22	PK2	34.1	-32.8	56.52	-	-	74	-17.48	306	101	H
	* 4.809	49.66	MAv1	34.1	-32.8	50.96	54	-3.04	-	-	306	101	H
3	* 5.453	45.04	PK2	34.5	-32	47.54	-	-	74	-26.46	134	305	H
	* 5.45	31.04	MAv1	34.5	-32	33.54	54	-20.46	-	-	134	305	H
4	* 4.811	51.12	PK2	34.1	-32.8	52.42	-	-	74	-21.58	305	306	V
	* 4.811	43.91	MAv1	34.1	-32.8	45.21	54	-8.79	-	-	305	306	V
5	* 3.889	50.81	PK2	33.6	-34.5	49.91	-	-	74	-24.09	70	293	V
	* 3.888	35.6	MAv1	33.6	-34.5	34.7	54	-19.3	-	-	70	293	V
6	* 5.434	45.79	PK2	34.5	-31.9	48.39	-	-	74	-25.61	316	283	V
	* 5.459	31.5	MAv1	34.5	-31.9	34.1	54	-19.9	-	-	316	283	V
7	9.621	34.23	Pk	36.8	-27.8	43.23	-	-	74	-30.77	0-360	250	V

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

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average



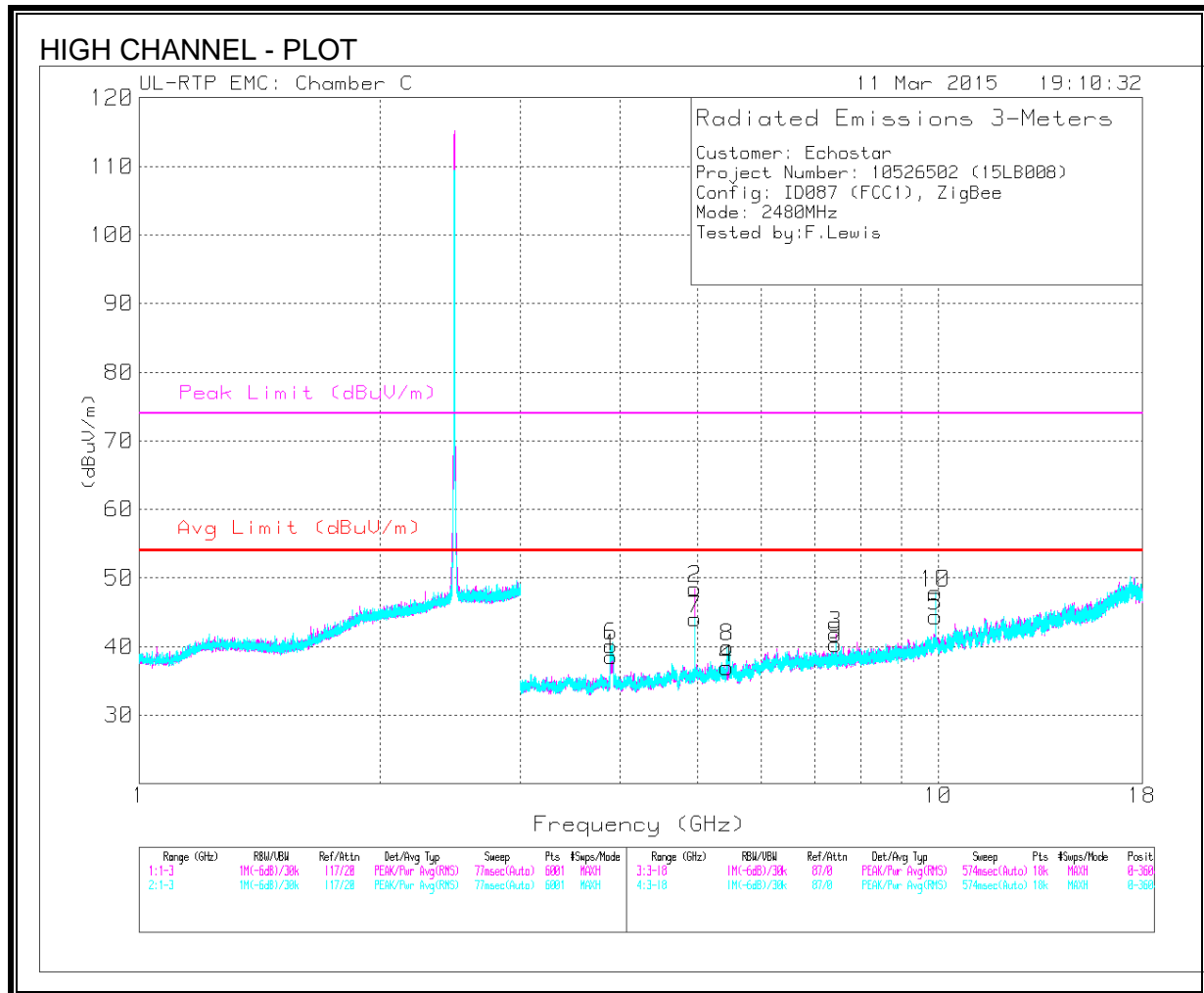
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.89	50.76	PK2	33.6	-34.5	49.86	-	-	74	-24.14	129	356	H
	* 3.889	35.57	MAv1	33.6	-34.5	34.67	54	-19.33	-	-	129	356	H
2	* 4.879	54.95	PK2	34.1	-32.9	56.15	-	-	74	-17.85	283	101	H
	* 4.879	49.17	MAv1	34.1	-32.9	50.37	54	-3.63	-	-	283	101	H
3	* 7.318	44.03	PK2	35.7	-29.1	50.63	-	-	74	-23.37	296	102	H
	* 7.321	34.7	MAv1	35.7	-29.1	41.3	54	-12.7	-	-	296	102	H
5	* 3.889	51.23	PK2	33.6	-34.5	50.33	-	-	74	-23.67	69	292	V
	* 3.884	35.73	MAv1	33.6	-34.5	34.83	54	-19.17	-	-	69	292	V
6	* 4.879	51.07	PK2	34.1	-32.9	52.27	-	-	74	-21.73	300	273	V
	* 4.879	43.62	MAv1	34.1	-32.9	44.82	54	-9.18	-	-	300	273	V
8	* 7.318	43.09	PK2	35.7	-29.1	49.69	-	-	74	-24.31	12	396	V
	* 7.318	32.96	MAv1	35.7	-29.1	39.56	54	-14.44	-	-	12	396	V
7	5.463	37.98	Pk	34.5	-31.9	40.58	-	-	74	-33.42	0-360	250	V
4	9.757	33.29	Pk	37	-26.7	43.59	-	-	74	-30.41	0-360	250	H
9	9.761	34.24	Pk	37	-26.8	44.44	-	-	74	-29.56	0-360	250	V

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

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average



Note – For Radiated Spurious, the High Channel was tested at the same power setting as Mid channel to achieve worst-case results.

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0062 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.961	53.69	PK2	34.1	-32.5	55.29	-	-	74	-18.71	298	102	H
	* 4.959	47.63	MAv1	34.1	-32.6	49.13	54	-4.87	-	-	298	102	H
2	* 3.889	50.89	PK2	33.6	-34.5	49.99	-	-	74	-24.01	135	387	H
	* 3.889	35.75	MAv1	33.6	-34.5	34.85	54	-19.15	-	-	135	387	H
3	* 7.441	43.68	PK2	35.7	-28.7	50.68	-	-	74	-23.32	289	286	H
	* 7.441	34.28	MAv1	35.7	-28.7	41.28	54	-12.72	-	-	289	286	H
4	* 5.455	45.17	PK2	34.5	-32	47.67	-	-	74	-26.33	127	318	H
	* 5.455	31.37	MAv1	34.5	-32	33.87	54	-20.13	-	-	127	318	H
6	* 4.959	49.99	PK2	34.1	-32.6	51.49	-	-	74	-22.51	299	249	V
	* 4.959	42.22	MAv1	34.1	-32.6	43.72	54	-10.28	-	-	299	249	V
7	* 3.911	50.33	PK2	33.6	-34.2	49.73	-	-	74	-24.27	53	262	V
	* 3.888	35.11	MAv1	33.6	-34.5	34.21	54	-19.79	-	-	53	262	V
8	* 5.444	46.85	PK2	34.5	-31.9	49.45	-	-	74	-24.55	360	287	V
	* 5.453	31.7	MAv1	34.5	-32	34.2	54	-19.8	-	-	360	287	V
9	* 7.442	42.11	PK2	35.7	-28.7	49.11	-	-	74	-24.89	360	279	V
	* 7.441	32.02	MAv1	35.7	-28.7	39.02	54	-14.98	-	-	360	279	V
5	9.917	33.6	Pk	37.1	-26.3	44.4	-	-	74	-29.6	0-360	250	H
10	9.918	36.97	Pk	37.1	-26.2	47.87	-	-	74	-26.13	0-360	250	V

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

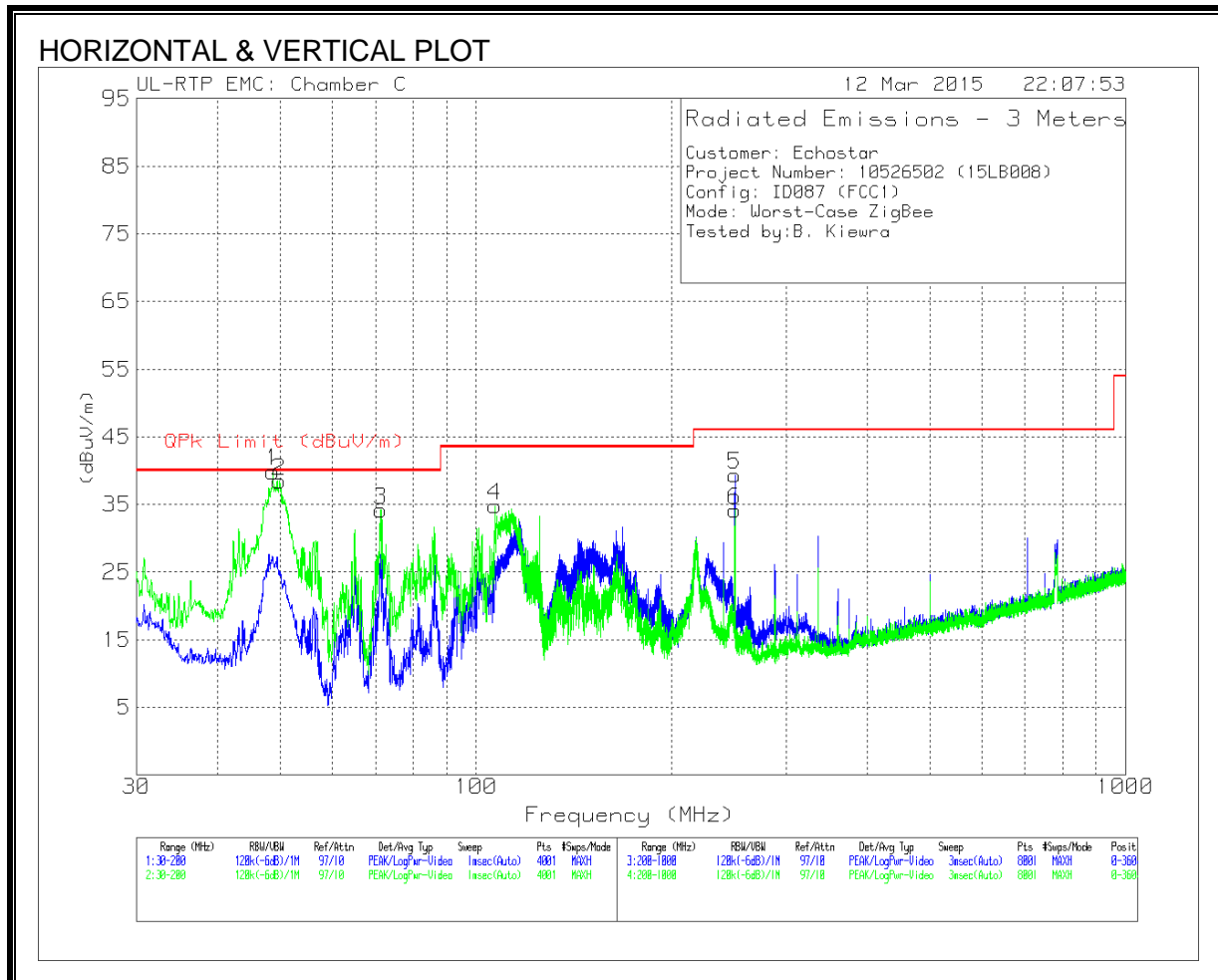
Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

10.3. WORST-CASE BELOW 1 GHz

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



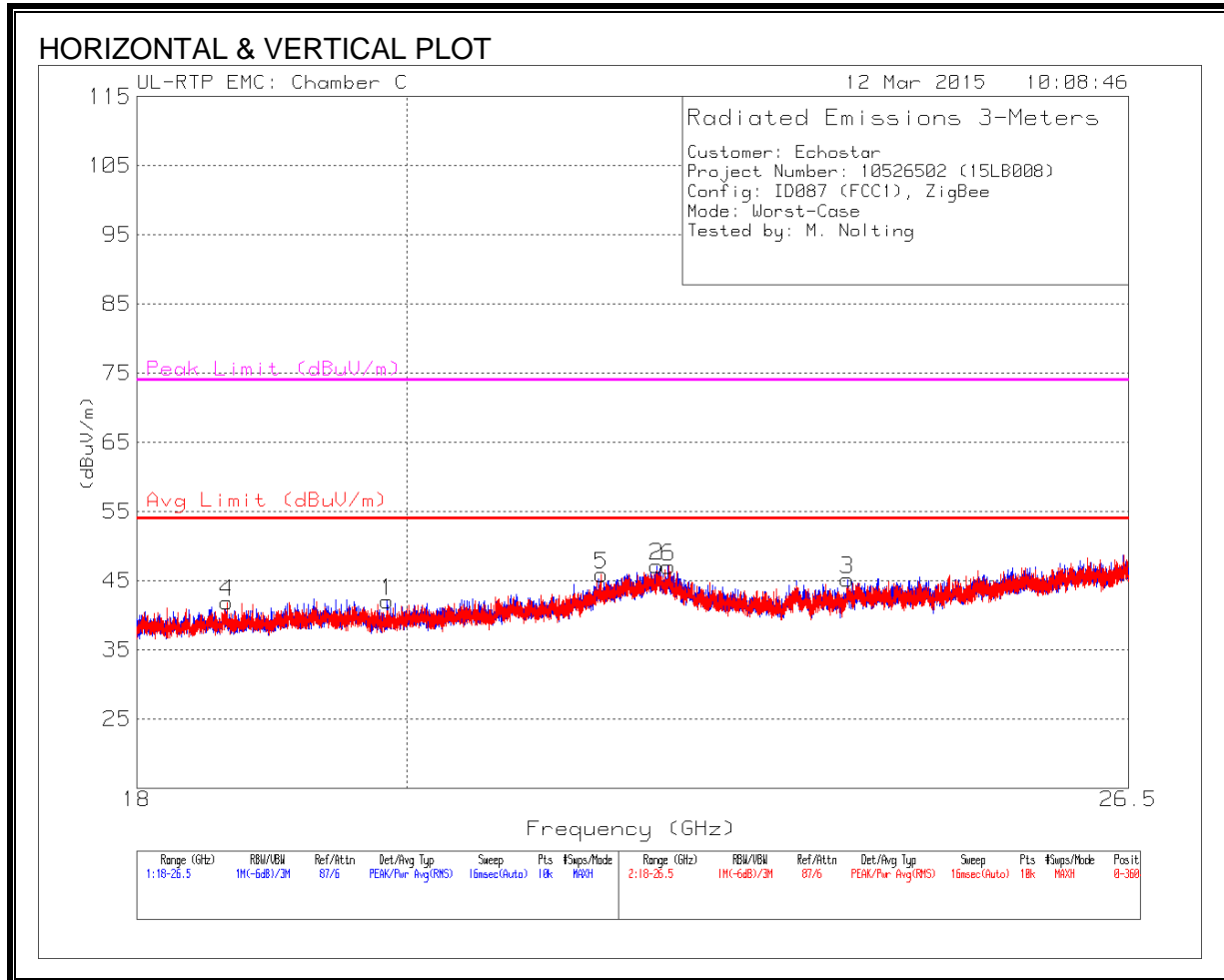
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0066 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	* 250.3	57.84	Pk	11.5	-30	39.34	46.02	-6.68	0-360	100	H
6	* 250.3	52.64	Pk	11.5	-30	34.14	46.02	-11.88	0-360	200	V
1	48.4679	58.51	Qp	8.5	-31.4	35.61	40	-4.39	0	105	V
2	49.6048	58.09	Qp	8	-31.4	34.69	40	-5.31	5	116	V
3	71.4351	54.82	Qp	8.3	-31.1	32.02	40	-7.98	232	127	V
4	106.925	53.49	Pk	12.1	-30.8	34.79	43.52	-8.73	0-360	100	V

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

Pk - Peak detector

10.4. WORST-CASE 18-26GHz

SPURIOUS EMISSIONS 18 TO 26GHz (WORST-CASE CONFIGURATION)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Horn AT0063 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 19.847	42.05	Pk	32.6	-32.6	42.05	54	-11.95	74	-31.95	0-360	200	H
2	* 22.047	44.89	PK2	36.9	-31.7	50.09	-	-	74	-23.91	163	149	H
	* 22.048	32.44	MAv1	36.9	-31.7	37.64	54	-16.36	-	-	163	149	H
3	* 23.748	42.18	Pk	33.5	-30.5	45.18	54	-8.82	74	-28.82	0-360	175	H
4	* 18.643	42.8	Pk	32.3	-33.2	41.9	54	-12.1	74	-32.1	0-360	175	V
6	* 22.146	45.58	PK2	36.5	-31.9	50.18	-	-	74	-23.82	345	160	V
	* 22.147	33	MAv1	36.5	-31.9	37.6	54	-16.4	-	-	345	160	V
5	21.576	42.3	Pk	35.5	-31.9	45.9	-	-	74	-28.1	0-360	200	V

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

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

11. 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

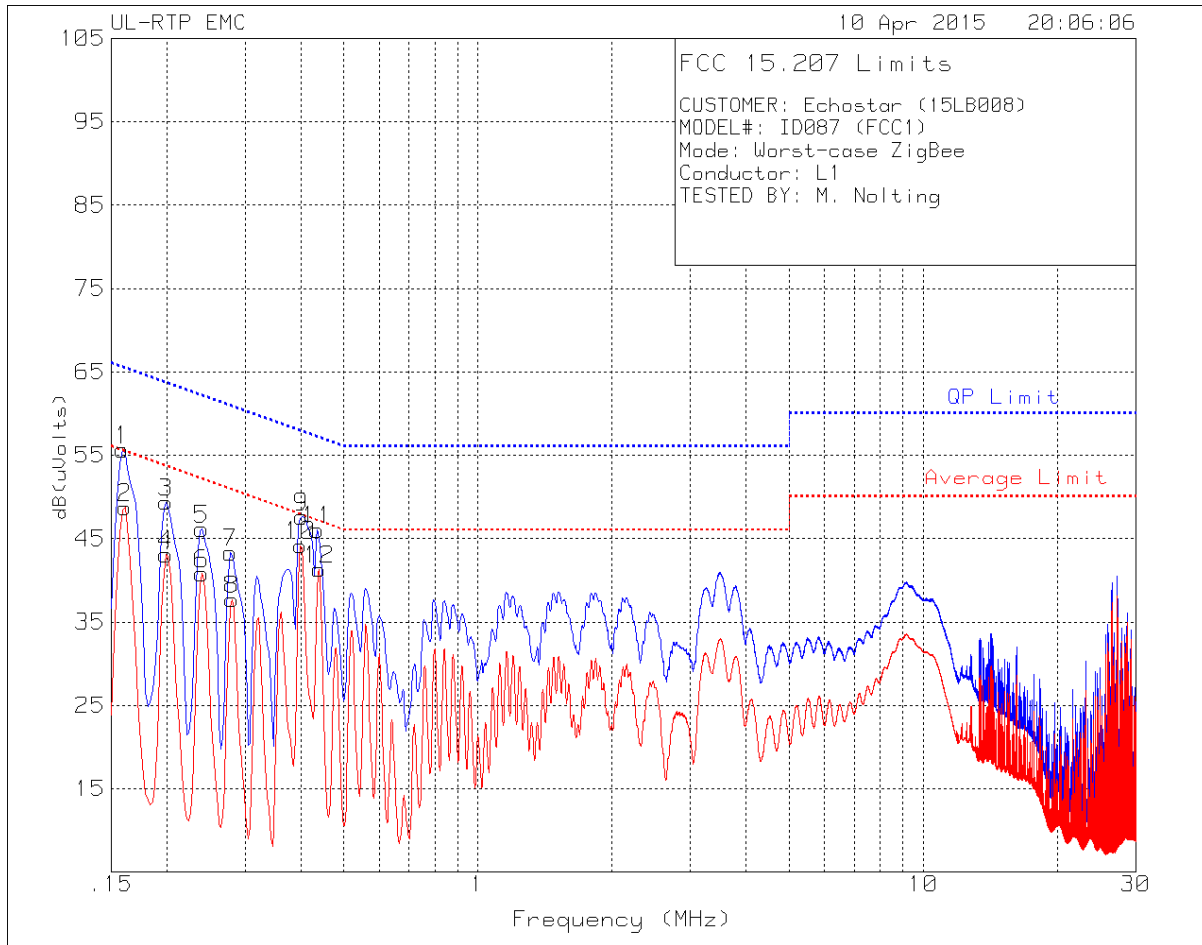
*Decreases with the logarithm of the frequency.

TEST PROCEDURE

Consistent with ANSI C63.4 and ANSI C63.10.

RESULTS

LINE 1 RESULTS

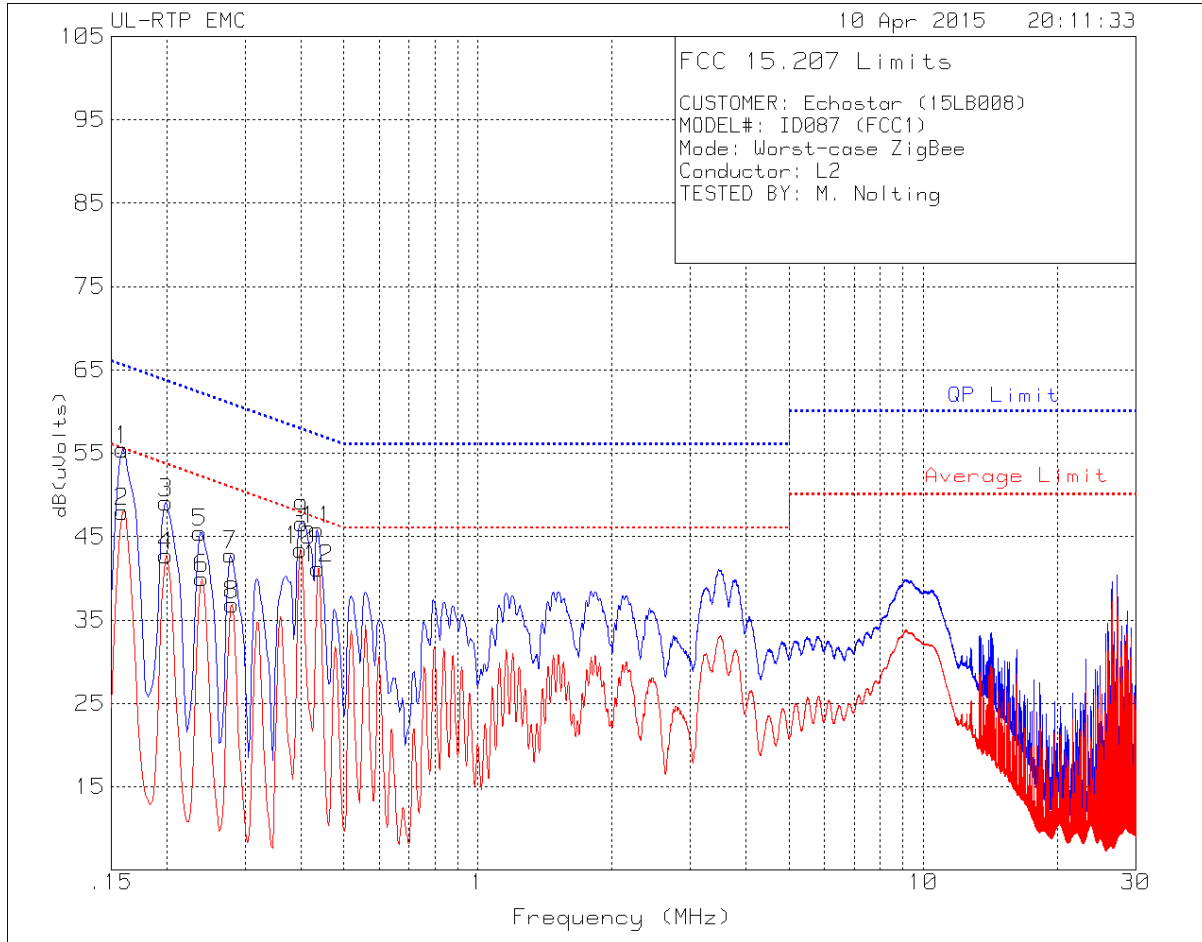


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN (dB)	Limiter & Cable (dB)	Corrected Reading (dBuV)	QP Limit	QP Margin (dB)	Average Limit	Average Margin (dB)
1	.159	45.95	Qp	.3	9.4	55.65	65.52	-9.87	-	-
2	.16125	39.02	Ca	.3	9.4	48.72	-	-	55.4	-6.68
3	.1995	39.78	Qp	.2	9.4	49.38	63.63	-14.25	-	-
4	.1995	33.5	Ca	.2	9.4	43.1	-	-	53.63	-10.53
5	.24	36.53	Qp	.2	9.4	46.13	62.1	-15.97	-	-
6	.24	31.21	Ca	.2	9.4	40.81	-	-	52.1	-11.29
7	.27825	33.85	Qp	.1	9.4	43.35	60.87	-17.52	-	-
8	.2805	28.21	Ca	.1	9.4	37.71	-	-	50.8	-13.09
10	.39975	34.68	Ca	.1	9.4	44.18	-	-	47.86	-3.68
9	.402	38.1	Qp	.1	9.4	47.6	57.81	-10.21	-	-
11	.43575	36.54	Qp	.1	9.4	46.04	57.14	-11.1	-	-
12	.44025	31.82	Ca	.1	9.4	41.32	-	-	47.06	-5.74

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN (dB)	Limiter & Cable (dB)	Corrected Reading (dBuV)	QP Limit	QP Margin (dB)	Average Limit	Average Margin (dB)
1	.159	45.73	Qp	.3	9.4	55.43	65.52	-10.09	-	-
2	.159	38.28	Ca	.3	9.4	47.98	-	-	55.52	-7.54
3	.1995	39.47	Qp	.2	9.4	49.07	63.63	-14.56	-	-
4	.1995	33.12	Ca	.2	9.4	42.72	-	-	53.63	-10.91
5	.23775	35.91	Qp	.2	9.4	45.51	62.17	-16.66	-	-
6	.24	30.39	Ca	.2	9.4	39.99	-	-	52.1	-12.11
7	.27825	33.32	Qp	.1	9.4	42.82	60.87	-18.05	-	-
8	.2805	27.34	Ca	.1	9.4	36.84	-	-	50.8	-13.96
10	.39975	33.9	Ca	.1	9.4	43.4	-	-	47.86	-4.46
9	.402	37.1	Qp	.1	9.4	46.6	57.81	-11.21	-	-
11	.43575	36.37	Qp	.1	9.4	45.87	57.14	-11.27	-	-
12	.438	31.68	Ca	.1	9.4	41.18	-	-	47.1	-5.92

Qp - Quasi-Peak detector
 Ca - CISPR average detection