FCC CFR47 PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

EUT
RF4CE 2.4GHz radio

MODEL NUMBER: ID: 072

FCC ID: DKNCR90

REPORT NUMBER: 13U16571-4

REVISED ISSUE DATE: 2014-01-29

Prepared for
Echostar
90 Inverness Circle East
Englewood, CO 80112

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NVLAP LAB CODE 100255-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	2014-01-09	Initial Issue	Joseph Danisi
1	2014-01-29	Add data with modifications to include an inductor	Joseph Danisi

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: **Echostar**
90 Inverness Circle East
Englewood, CO 80112

EUT DESCRIPTION: **RF4CE 2.4GHz radio**

MODEL: **ID: 072**

SERIAL NUMBER: **Prototype**

REVISED DATE TESTED: **2013-12-11 to 2014-01-16**

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, using test results reported in the test report documents referenced below and/or documentation furnished by the applicant. All indications of Pass/Fail in this report are opinions expressed by UL LLC. based on interpretations of these calculations. The results show that the equipment 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 by the referenced documents. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Inc. 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 By:

Bob DeLisi
WiSE Principal Engineer
UL

Tested By:

Joseph Danisi
WiSE Project Lead
UL

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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 1285 Walt Whitman Rd. Melville, NY 11747, USA.

UL Melville is accredited by NVLAP, Laboratory Code 100255-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/1002550.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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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	± 3.3 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.00 dB

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.15.4 Zigbee transceiver.

The radio module is manufactured by Echostar 90 Inverness Circle East Englewood, CO 80112

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	802.15.4	5.19	3.30

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PCB antenna, with a maximum gain of 0 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was SWP3, rev. rev01.1.

The EUT driver software installed during testing was RF4CE Dev01.7.

The test utility software used during testing was not applicable

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated Emission below 1GHz and power line Conducted Emission was performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

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5.6 DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	IBM	2687	L3-BB983	E-A012-03-0857(B)
DVD Player	Toshiba	SD4300KU	A48S 9604 5U5300	N/A

I/O CABLES

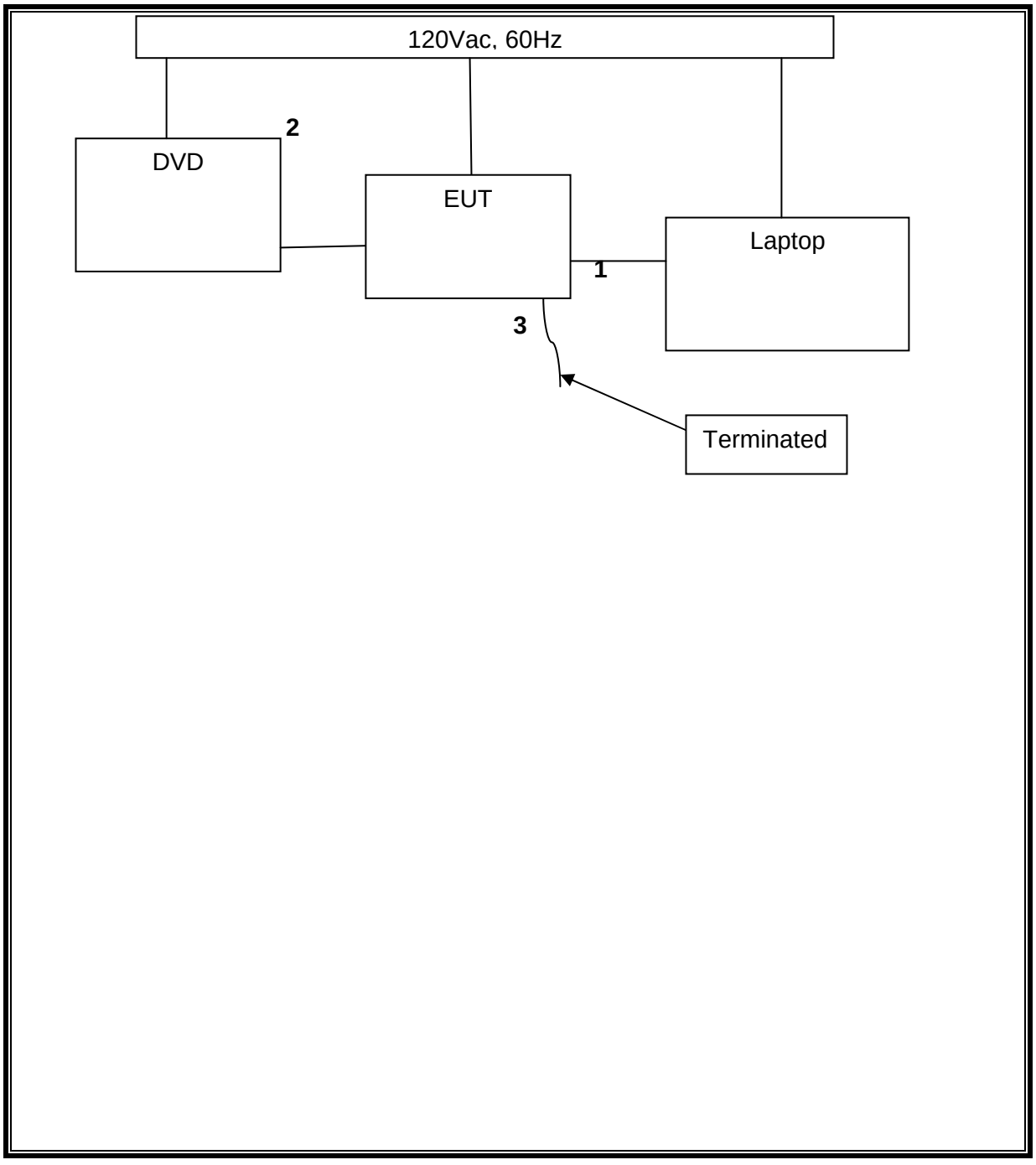
I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	Network	1	RJ45	Ethernet	1M	None
2	External	1	Composite	Composite	1.5M	None
3	HDMI	1	HDMI	HDMI	5M	None

TEST SETUP

For antenna port testing the EUT was set up in stand-alone device software exercised the radio card. For Radiated testing all ports were terminated with support equipment connected to all ports a computer connecting the Ethernet cable the Composite cable connected to DVD player and the HDMI terminated.

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SETUP DIAGRAM FOR TESTS



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6. TEST AND MEASUREMENT EQUIPMENT

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

Radiated Emissions					
Description	Manufacturer	Model	Identifier	Cal Date	Cal Due Date
30-1000MHz					
EMI Receiver	Rohde & Schwarz	ESIB40	34968	2013-01-30	2014-01-31
Bicon Antenna	Schaffner	VBA6106A	43441	2012-11-12	2013-11-13
Log-P Antenna	Schaffner	UPA6109	44068	2012-11-12	2013-11-13
Switch Driver	HP	11713A	ME7A-627	N/A	
System Controller	Sunol Sciences	SC99V	44396	N/A	
Camera Controller	Panasonic	WV-CU254	44395	N/A	
RF Switch Box	UL	1	44398	N/A	
Measurement Software	UL	Version 9.5	44740	N/A	
Multimeter	Fluke	83III	ME5B-305	2013-01-29	2014-01-31
Above 1GHz (Band Optimized System)					
Spectrum Analyzer	Agilent	E4446A	72823	2013-01-29	2014-01-31
Horn Antenna (1-2 GHz)	ETS	3161-01 (26°)**	51442	2008-03-28	See * below
Horn Antenna (2-4 GHz)	ETS	3161-02 (22°)**	48107	2007-09-27	See * below
Horn Antenna (4-8 GHz)	ETS	3161-03 (22°)**	48106	2007-09-27	See * below
Horn Antenna (8-12 GHz)	ETS	3160-07 (26°)**	8933	2008-11-24	See * below
Horn Antenna (12-18 GHz)	ETS	3160-08 (26°)**	8932	2007-09-27	See * below
Horn Antenna (18-26.5 GHz)	ETS	3160-09 (27°)**	8947	2007-09-26	See * below
Signal Path Controller	HP	11713A	50250	N/A	
Gain Controller	HP	11713A	50251	N/A	
RF Switch / Preamp Fixture	UL	BOMS1	50249	N/A	
System Controller	UL	BOMS2	50252	N/A	
Measurement Software	UL	Version 9.5	44740	N/A	
Temp/Humidity/Pressure Meter	Cole Parmer	99760-00	4268	2012-12-22	2014-12-22
Multimeter	Fluke	83III	ME5B-305	2013-01-29	2014-01-31

* - Note: As allowed by the calibration standard ANSI C63.4 Section 4.4.2, standard gain horns need only a one-time calibration. Only if physical damage occurs will the horn antenna require re-calibration.

Gain standard horn antennas (sometimes called standard gain horn antennas) need not be calibrated beyond that which is provided by the manufacturer unless they are damaged or deterioration is suspected, or they are used at a distance closer than $2D^2/\lambda$. Gain standard horn antennas have gains that are fixed by their dimensions and dimensional tolerances.

** - Number in parentheses denotes antenna beam width.

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Conducted Emissions					
Description	Manufacturer	Model	Identifier	Cal Date	Cal Due Date
Conducted Emissions – GP 1					
EMI Receiver	Rohde & Schwarz	ESIB26	ME5B-081	2013-01-27	2014-01-31
LISN	Solar	9252-50-R-24-BNC	ME5A-636	2013-01-02	2014-01-28
LISN	EMCO	3825/2	ME5A-629	2013-02-01	2014-02-28
Switch Driver	HP	11713A	44397	N/A	
RF Switch Box	UL	4	44404	N/A	
Measurement Software	UL	Version 9.5	44736	N/A	
Temp/Humidity/Pressure Meter	Cole Parmer	99760-00	43734	12-03-03	14-03-13
Multimeter	Fluke	83V	43443	13-01-28	14-31-01

Bench Tests					
Description	Manufacturer	Model	Identifier	Cal Date	Cal Due Date
RF Room 1					
Spectrum Analyzer	Agilent	E4446A	72823	2013-01-24	2014-01-31
Horn Antenna	EMCO	RGA-180	ME5-565	2013-09-05	2014-09-05
Temp/Humidity/Pressure Meter	Cole Parmer	99760-00	4268	2012-03-13	2014-03-13
Multimeter	Fluke	83V	43443	2013-01-28	2014-31-01

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7. ANTENNA PORT TEST RESULTS

7.1.1. 802.15.4 MODE IN THE 2.4 GHz BAND

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7.1.2. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

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

TEST PROCEDURE

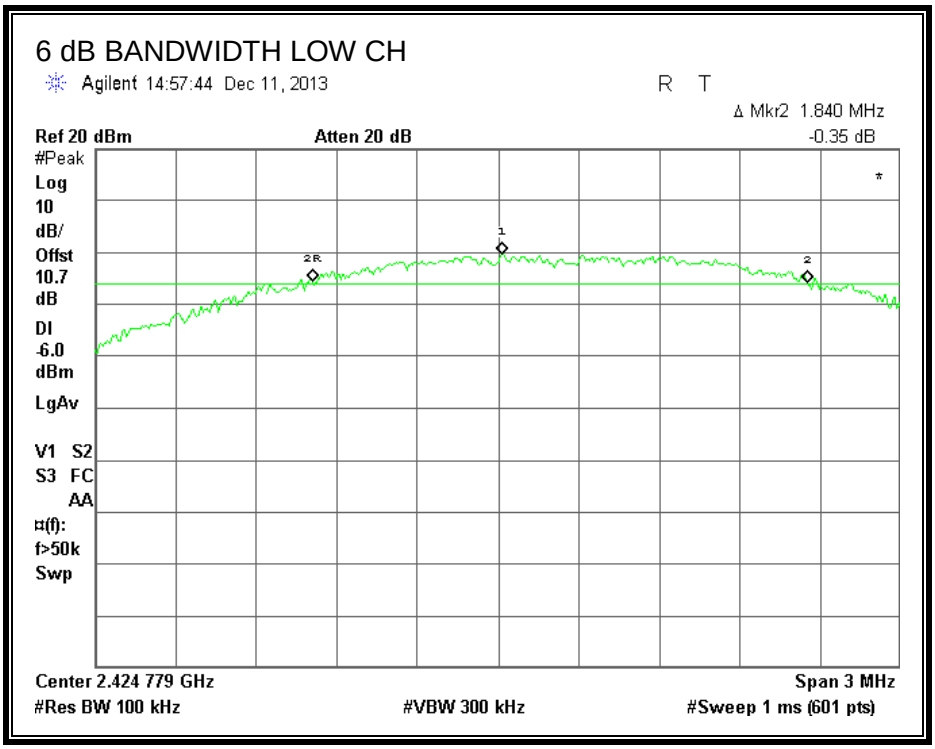
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

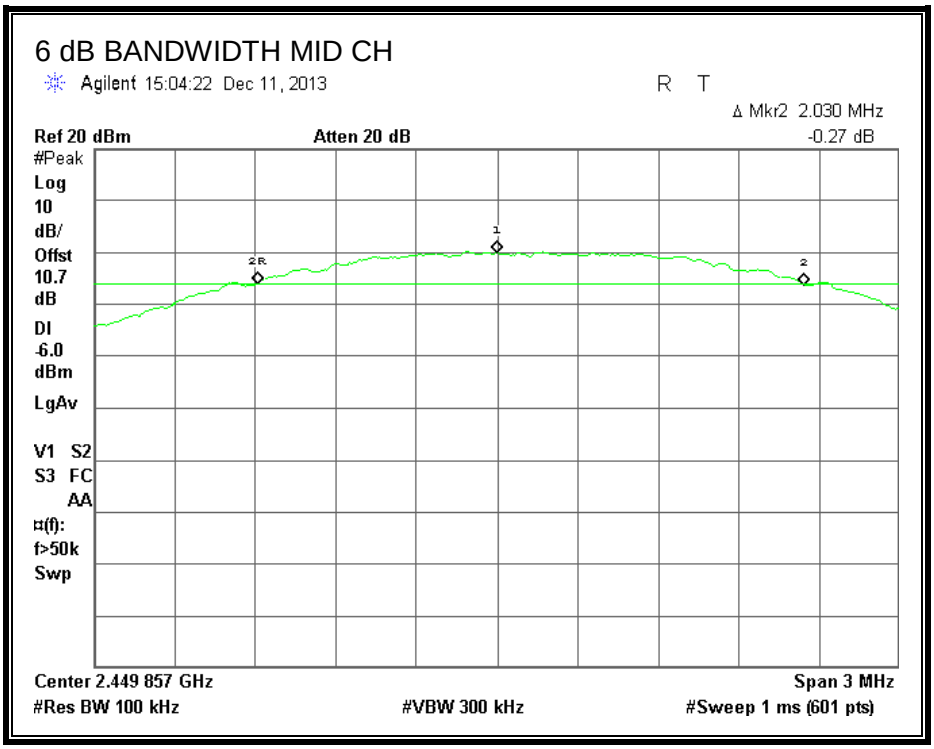
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2425	1.840	0.5
Middle	2450	2.030	0.5
High	2475	1.975	0.5

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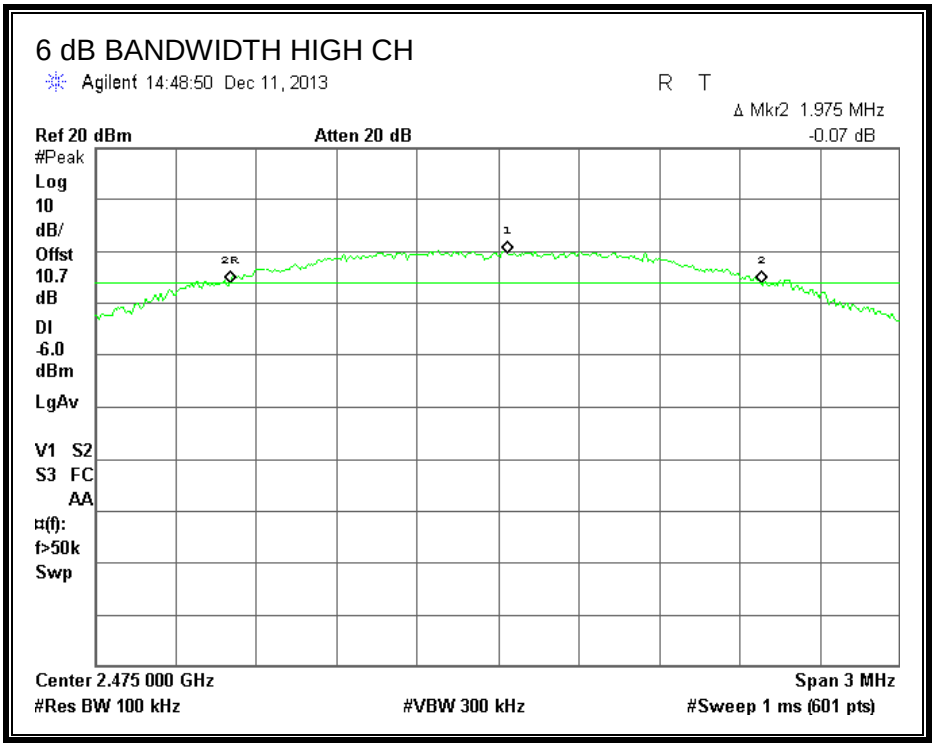
6 dB BANDWIDTH



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7.1.3. 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

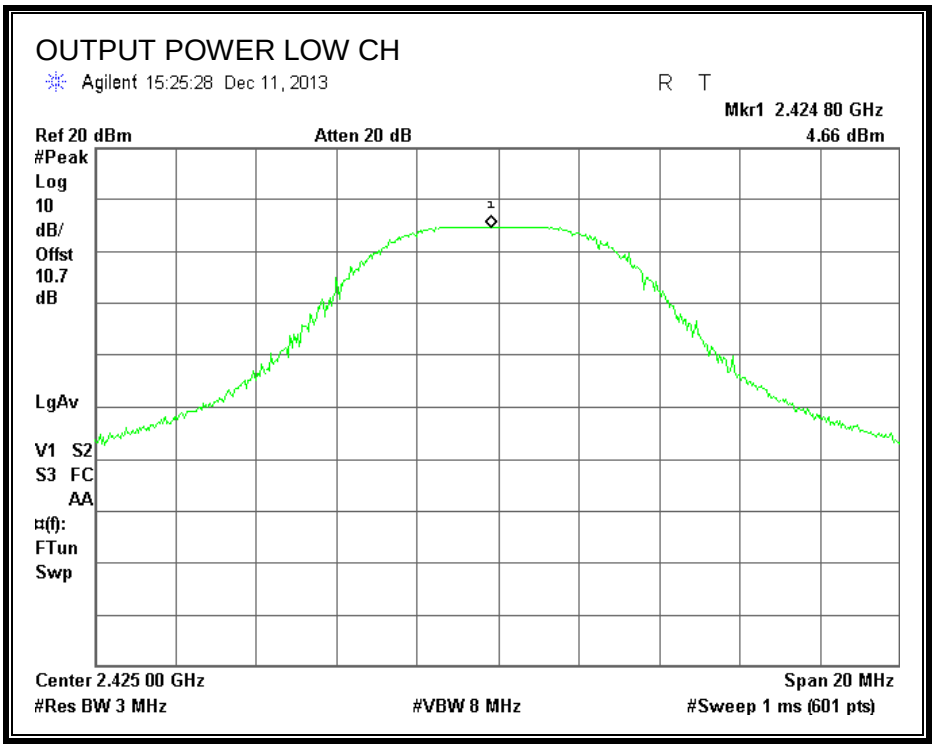
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the DTS bandwidth of the EUT.

RESULTS

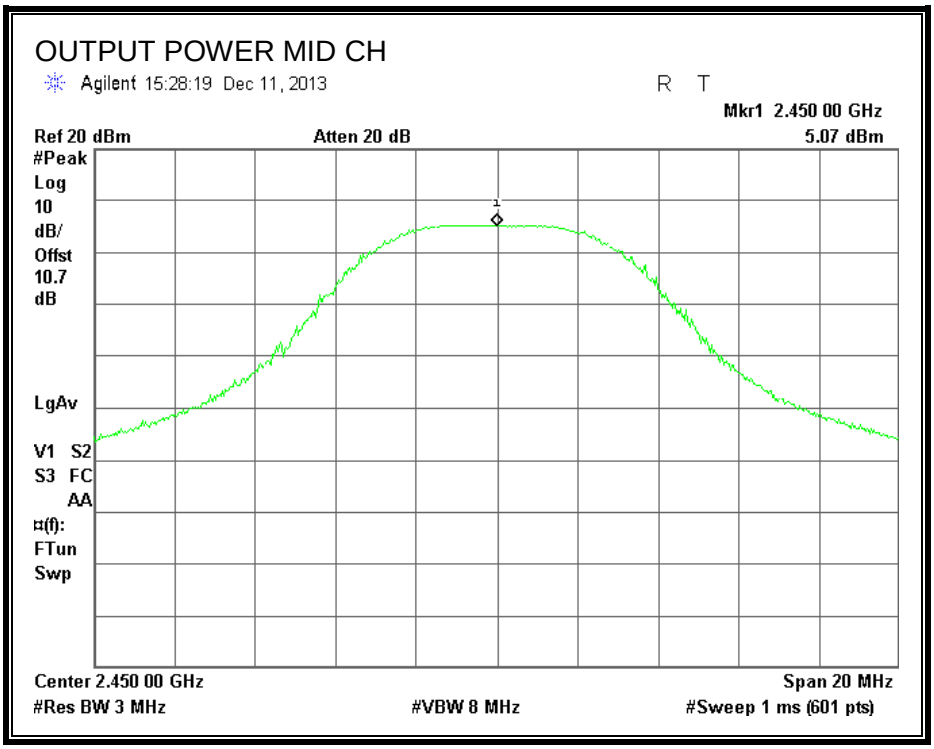
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2425	4.66	30	-25.34
Middle	2450	5.07	30	-24.93
High	2475	5.19	30	-24.81

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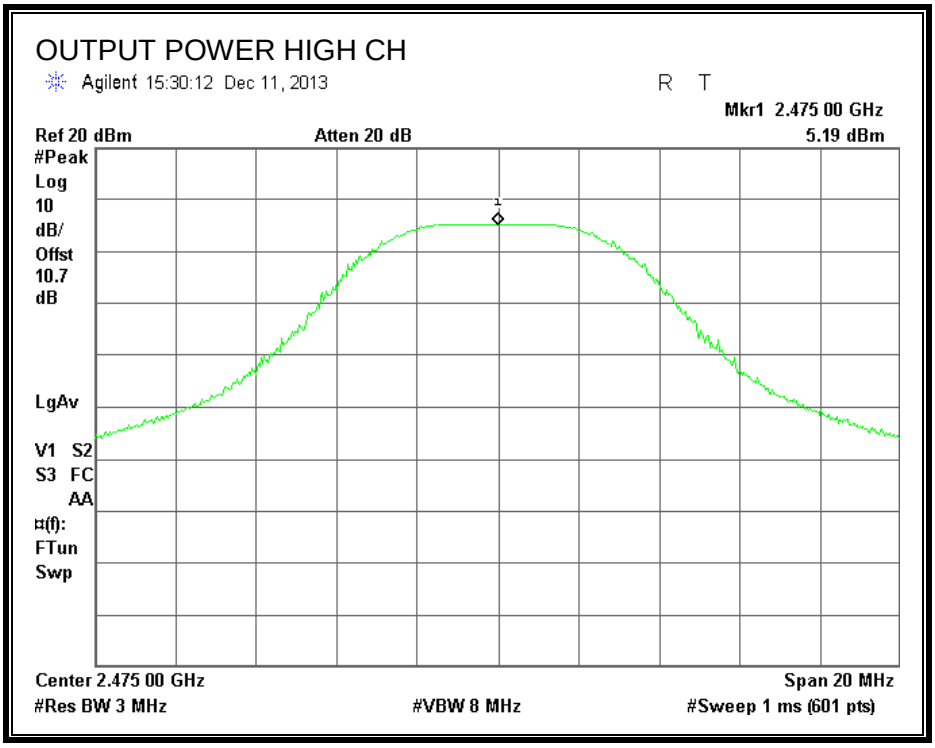
OUTPUT POWER



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7.1.4. 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 10.7 dB (including 10 dB pad and 0.7dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2425	4.27
Middle	2450	4.63
High	2475	4.80

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7.1.5. 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

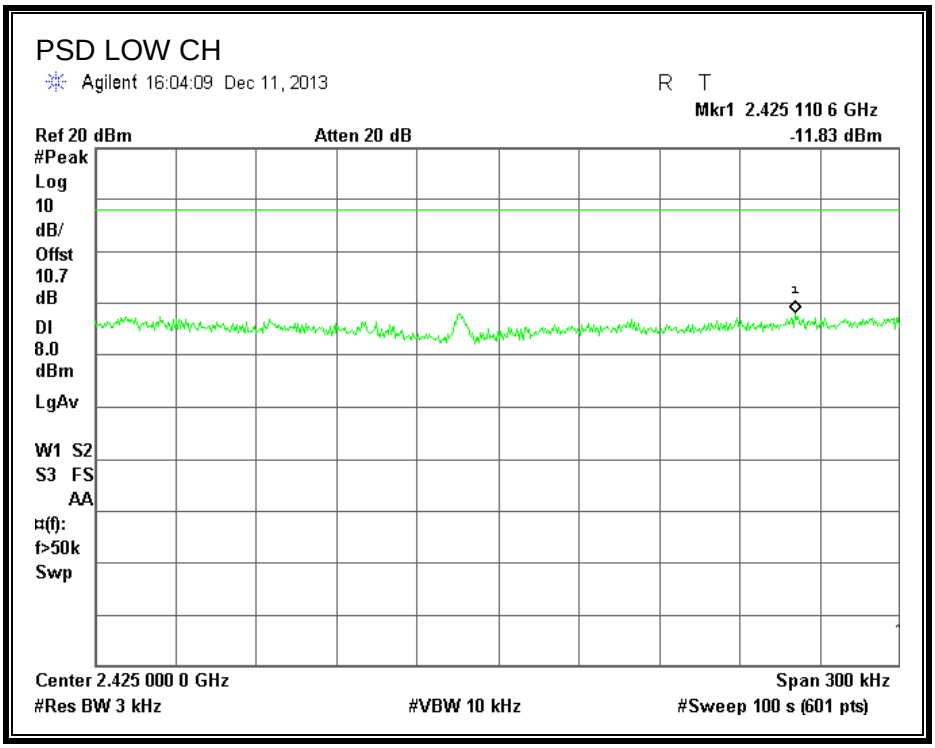
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

RESULTS

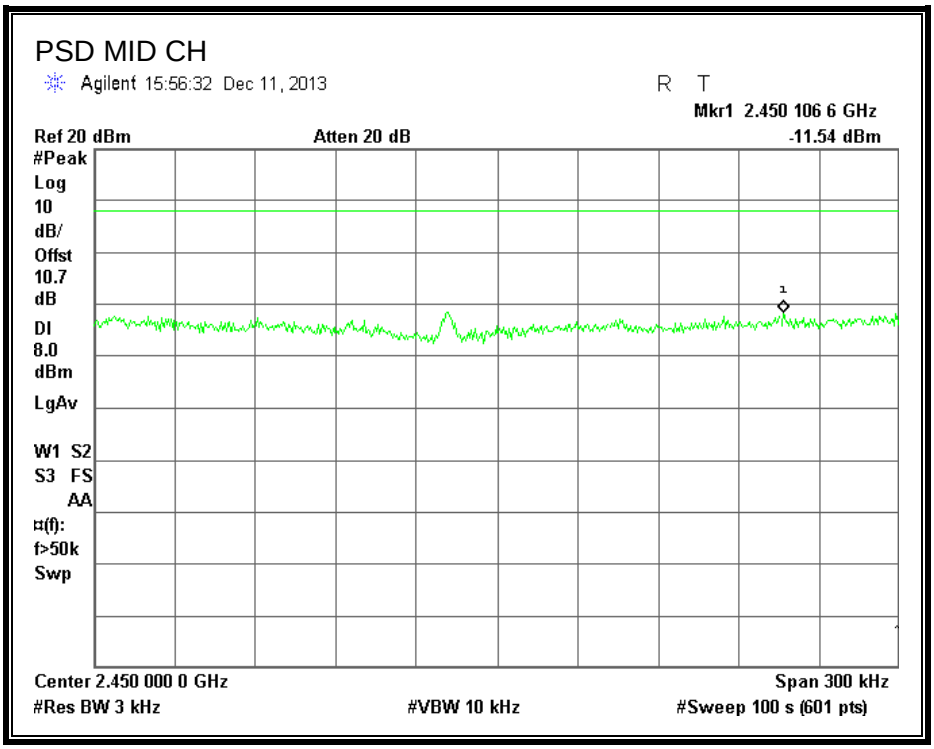
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2425	-11.83	8	-19.83
Middle	2450	-11.54	8	-19.54
High	2475	-11.28	8	-19.28

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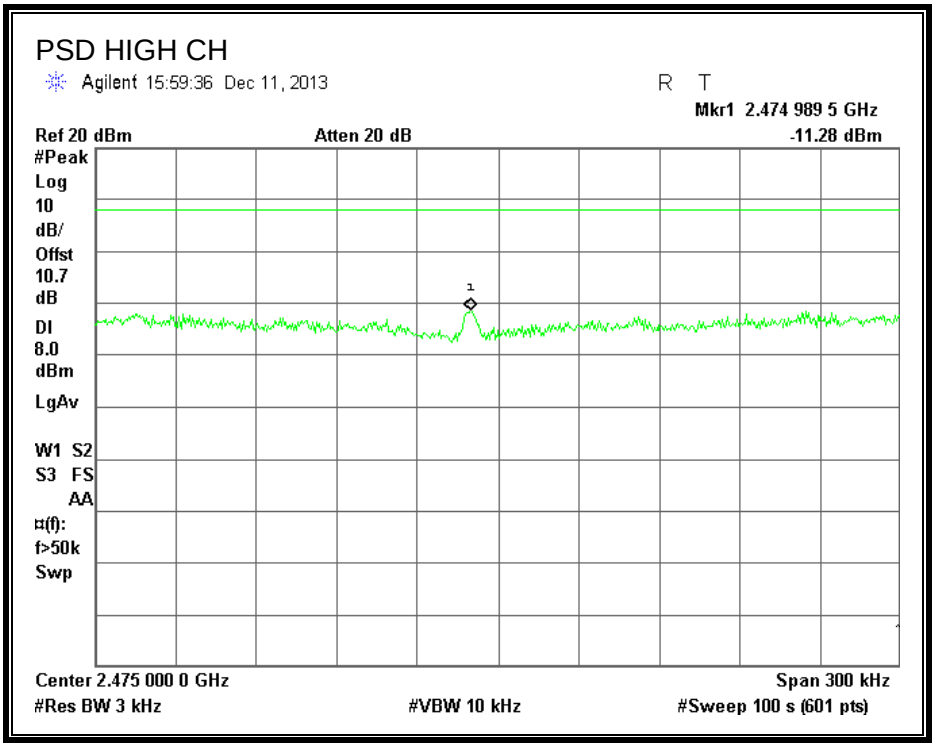
POWER SPECTRAL DENSITY



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7.2. 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

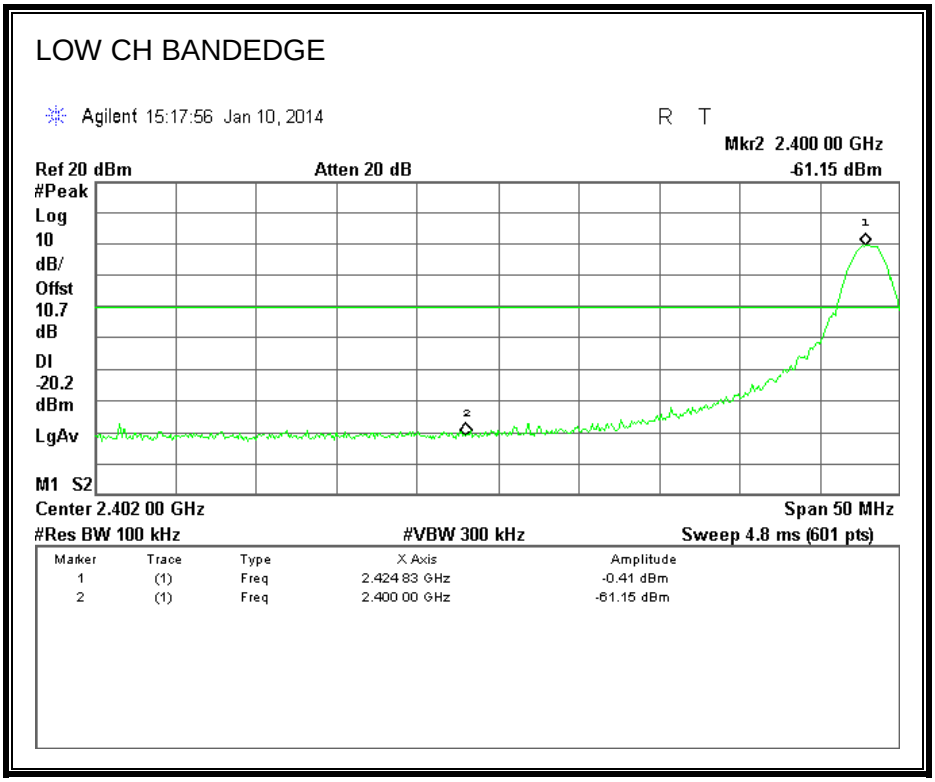
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

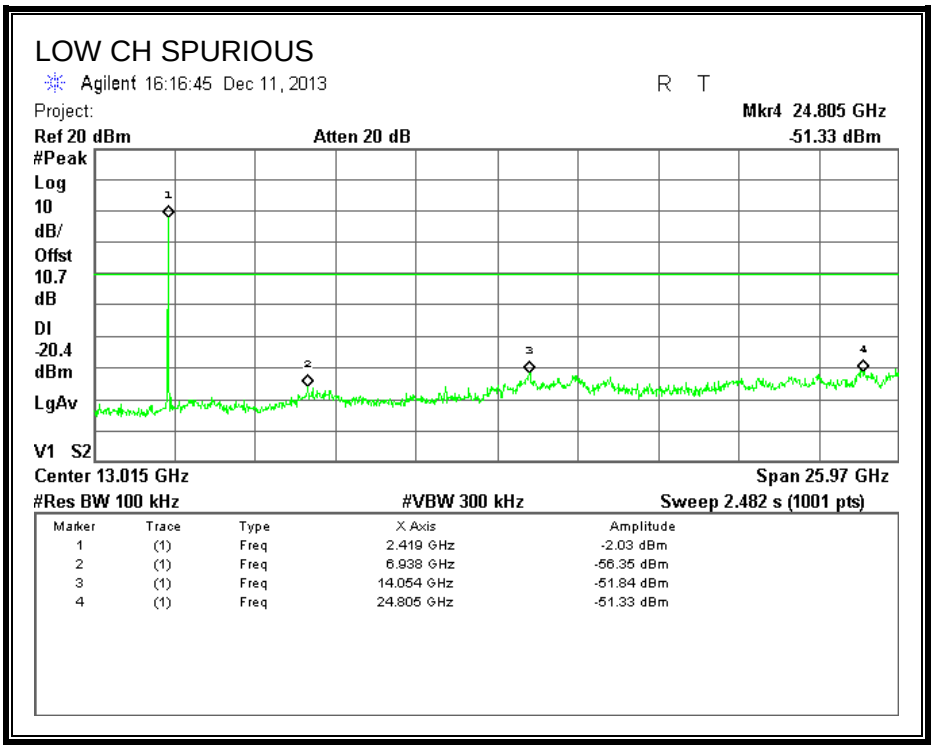
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RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

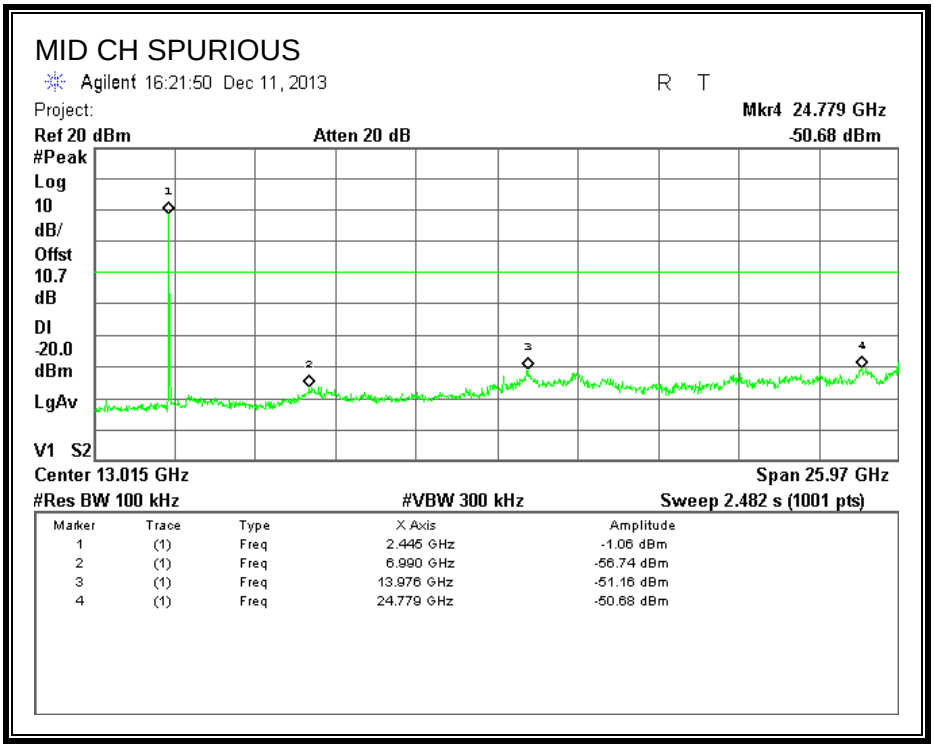


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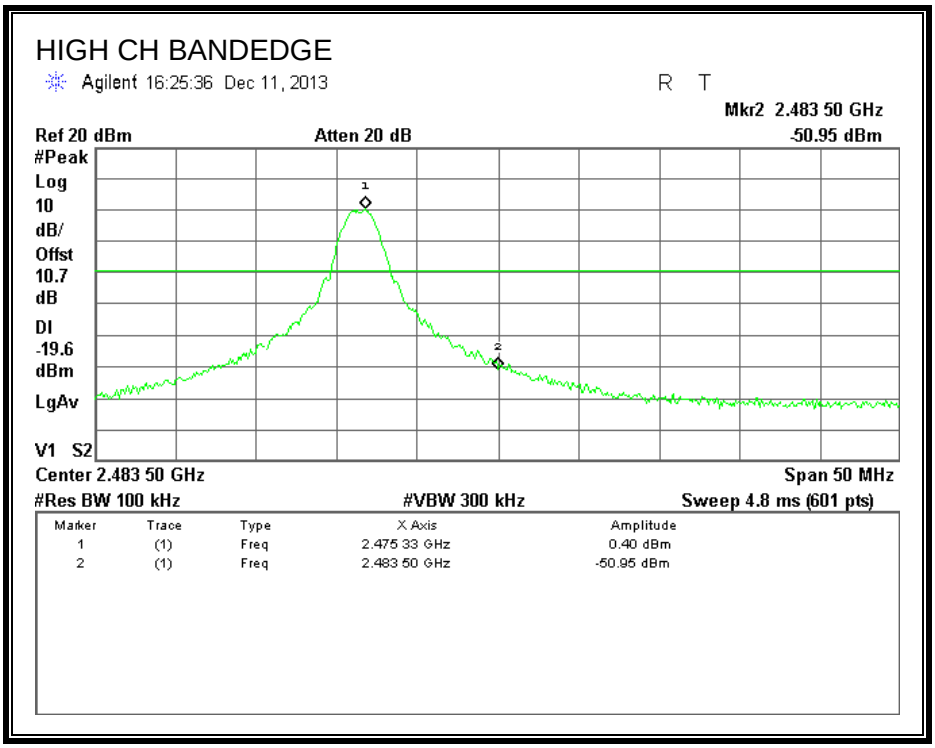
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SPURIOUS EMISSIONS, MID CHANNEL

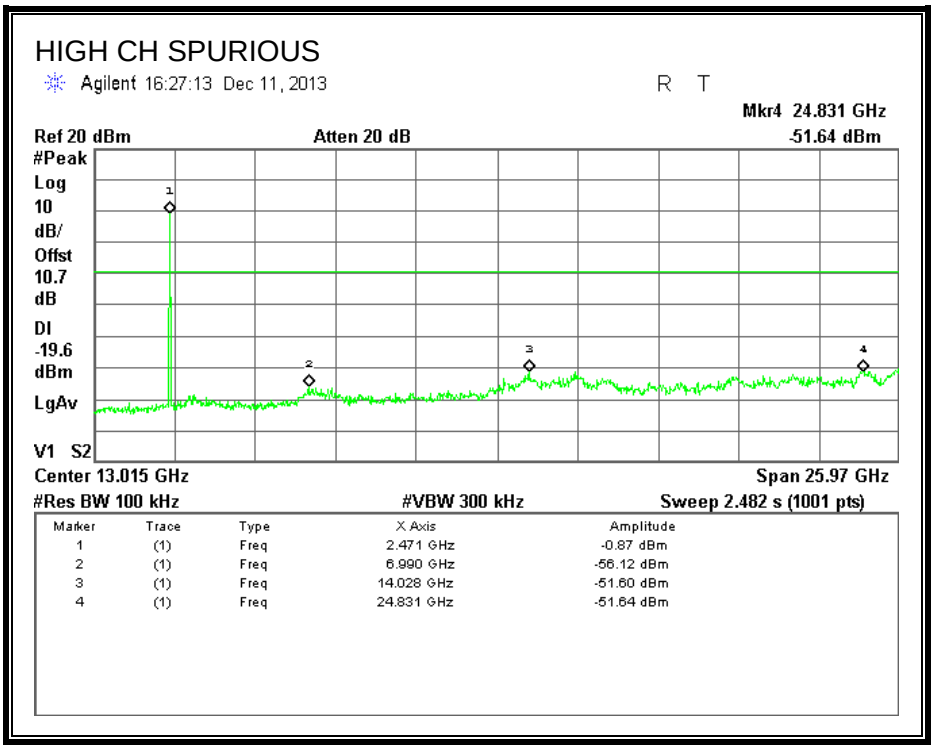


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SPURIOUS EMISSIONS, HIGH CHANNEL



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8. RADIATED TEST RESULTS

8.1. 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 RMS average detection 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 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.

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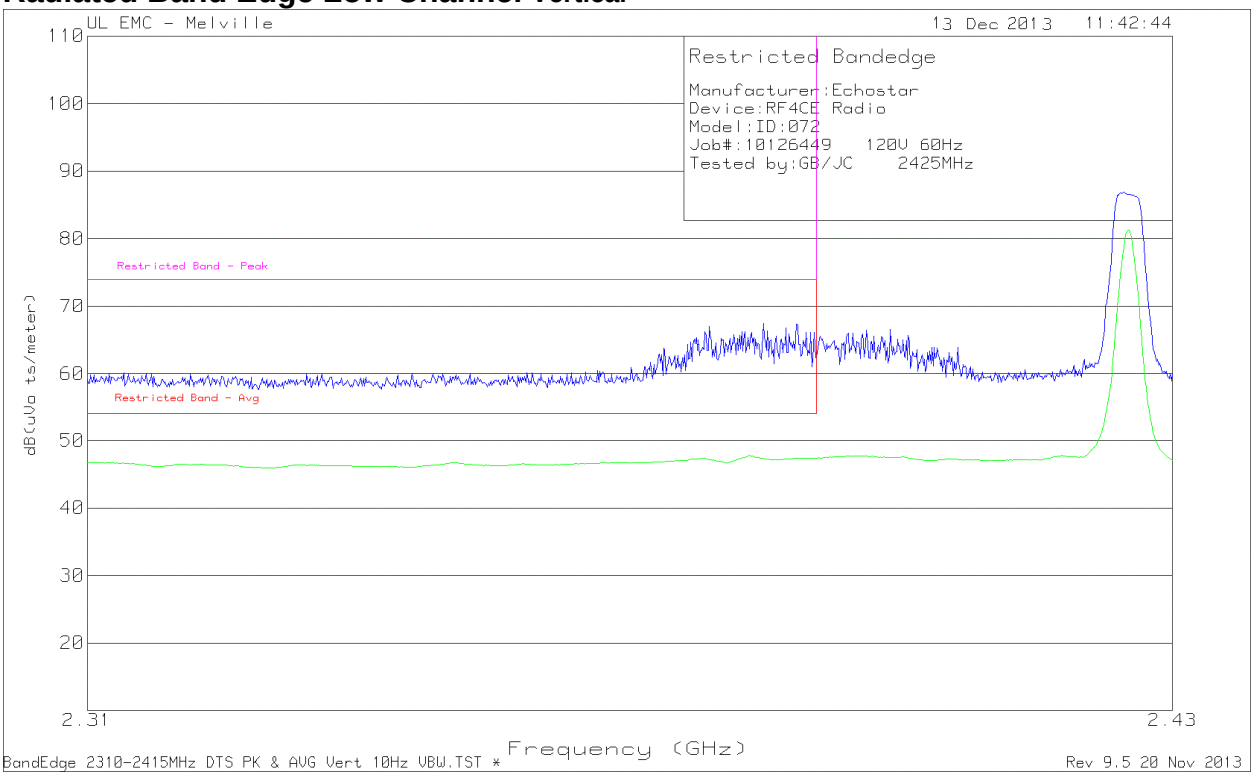
8.2. TRANSMITTER ABOVE 1 GHz

Radiated Band Edge Low Channel Horizontal



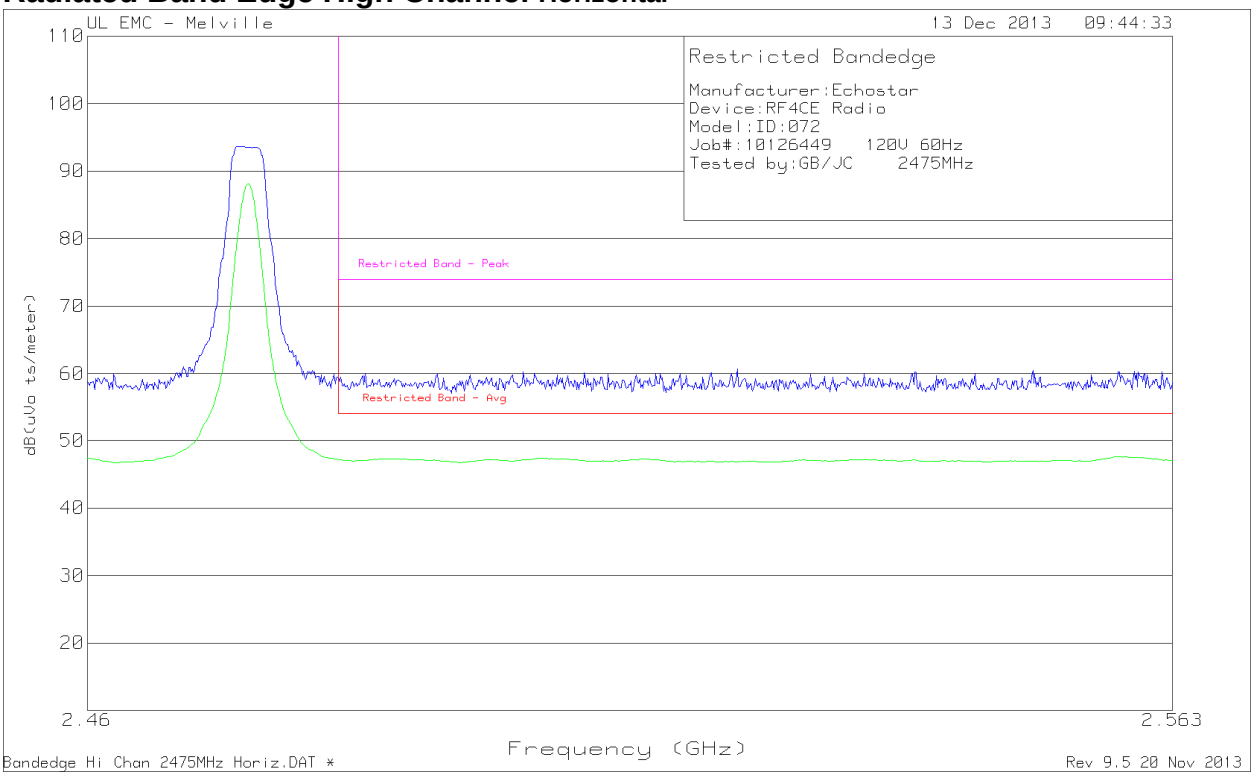
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Radiated Band Edge Low Channel Vertical



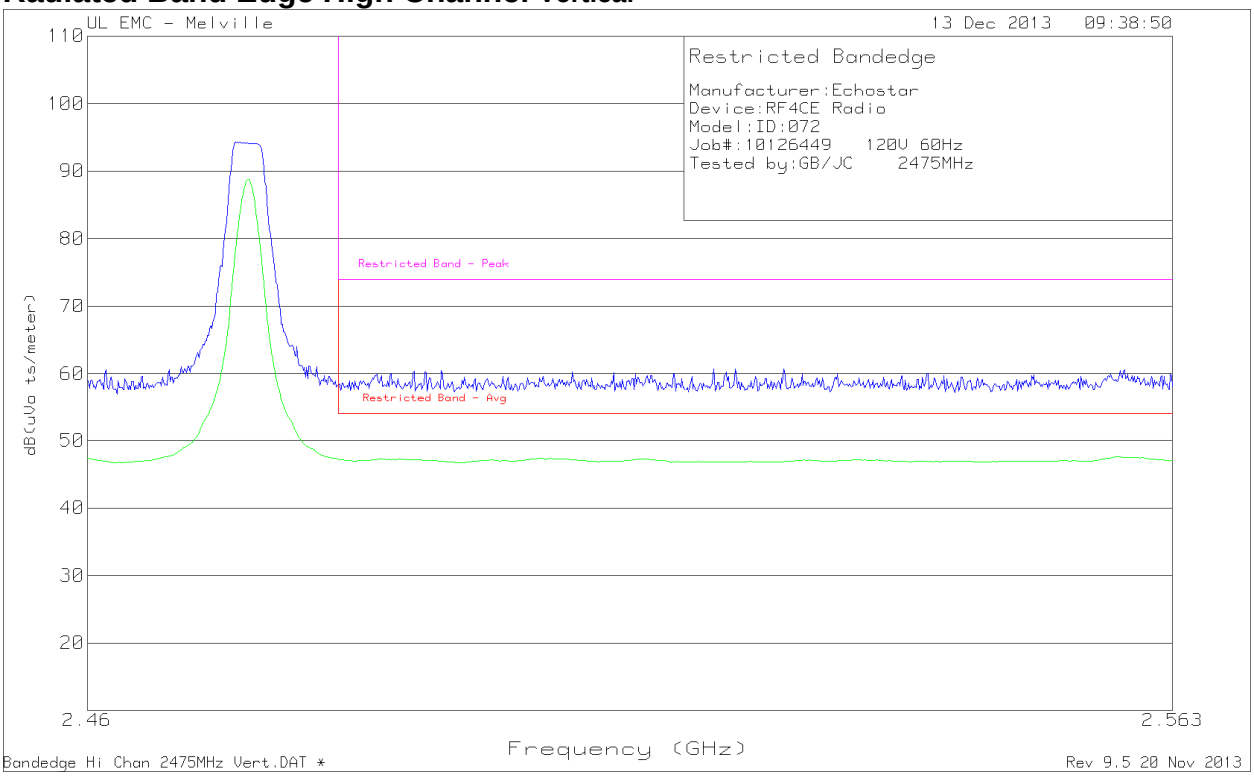
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Radiated Band Edge High Channel Horizontal



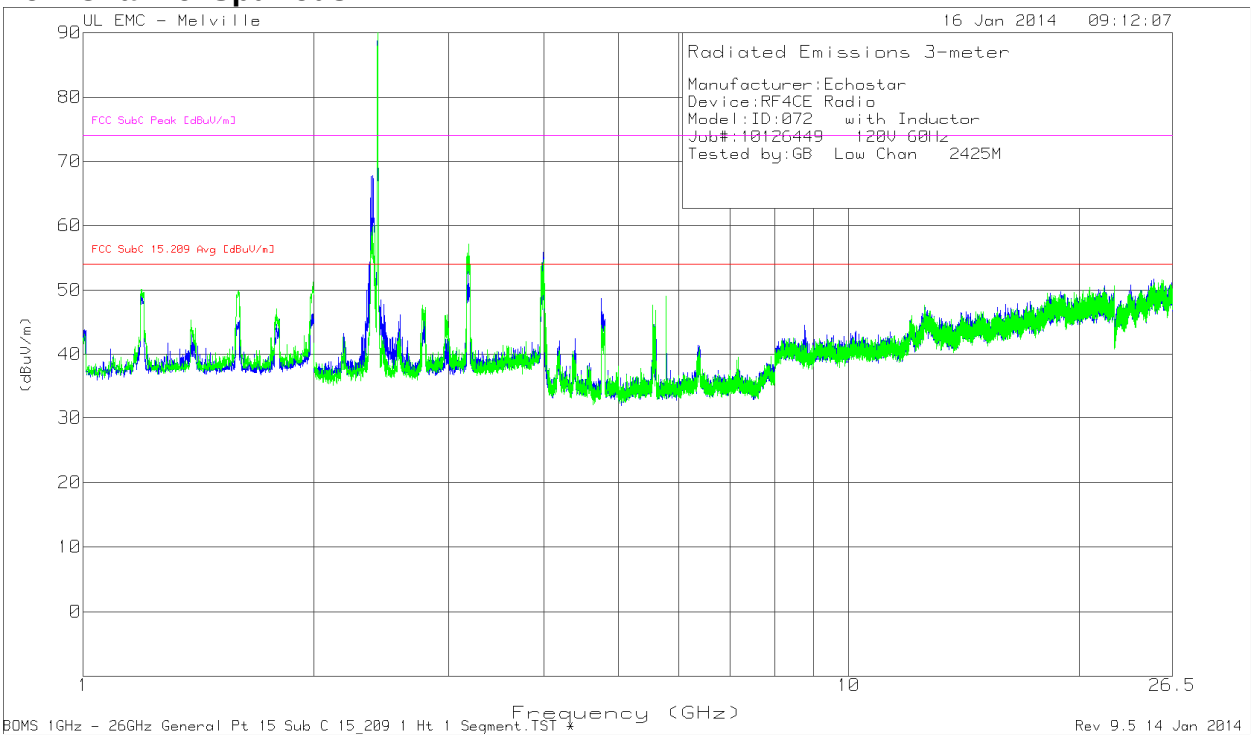
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Radiated Band Edge High Channel Vertical



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Low Channel Spurious



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HORIZONTAL/VERTICAL DATA

Manufacturer: Echostar												
Device:RF4CE Radio												
Model:ID:072												
Job#:10126449 120V 60Hz												
Tested by: GB/JC Low Chan 2425M												
Horizontal 1 - 2GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-51442 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1.1965	73.9	PK2	19.8	-44.35	49.35	-	-	74	-24.65	297	288	H
1.1942	61.23	MAv1	19.8	-44.28	36.75	54	-17.25	-	-	297	288	H
1.1947	76.3	PK2	19.8	-44.31	51.79	-	-	74	-22.21	291	175	V
1.1937	63.9	MAv1	19.8	-44.26	39.44	54	-14.56	-	-	291	175	V
1.5877	75.07	PK2	21.2	-44.06	52.21	-	-	74	-21.79	244	147	V
1.5902	62.55	MAv1	21.2	-43.89	39.86	54	-14.14	-	-	244	147	V
2	71.17	PK2	22.2	-43.48	49.89	-	-	74	-24.11	303	267	V
1.9981	58.54	MAv1	22.2	-43.35	37.39	54	-16.61	-	-	303	267	V
Horizontal 2 - 4GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-48107 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2.392	93.45	PK2	21.1	-42.66	71.89	-	-	74	-2.11	295	280	H
2.3874	74.23	MAv1	21.1	-42.62	52.71	54	-1.29	-	-	295	280	H
2.4701	73.15	PK2	21.3	-42.51	51.94	-	-	74	-22.06	220	270	H
2.4685	54.97	MAv1	21.3	-42.5	33.77	54	-20.23	-	-	220	270	H
3.1682	75.14	PK2	21.9	-41.71	55.33	-	-	74	-18.67	183	318	H
3.1701	57.96	MAv1	21.9	-41.89	37.97	54	-16.03	-	-	183	318	H
3.9767	74.62	PK2	22.8	-41.21	56.21	-	-	74	-17.79	271	289	V
3.9768	58.18	MAv1	22.8	-41.2	39.78	54	-14.22	-	-	271	289	V
3.1871	79.83	PK2	22	-41.94	59.89	-	-	74	-14.11	292	162	V
3.1873	63.71	MAv1	22	-41.96	43.75	54	-10.25	-	-	292	162	V
2.7959	72.63	PK2	21.8	-42.3	52.13	-	-	74	-21.87	258	271	V
2.799	58.19	MAv1	21.8	-42.19	37.8	54	-16.2	-	-	258	271	V
2.4146	81.28	PK2	21.1	-42.61	59.77	-	-	74	-14.23	267	328	H
2.4162	62.71	MAv1	21.1	-42.56	41.25	54	-12.75	-	-	267	328	H
2.4277	74.51	PK2	21.2	-42.81	52.9	-	-	74	-21.1	249	352	H
2.4299	58.86	MAv1	21.2	-42.73	37.33	54	-16.67	-	-	249	352	H
PK2 - KDB558074 Method: Maximum Peak												
MAv1 - KDB558074 Option 1 Maximum RMS Average												

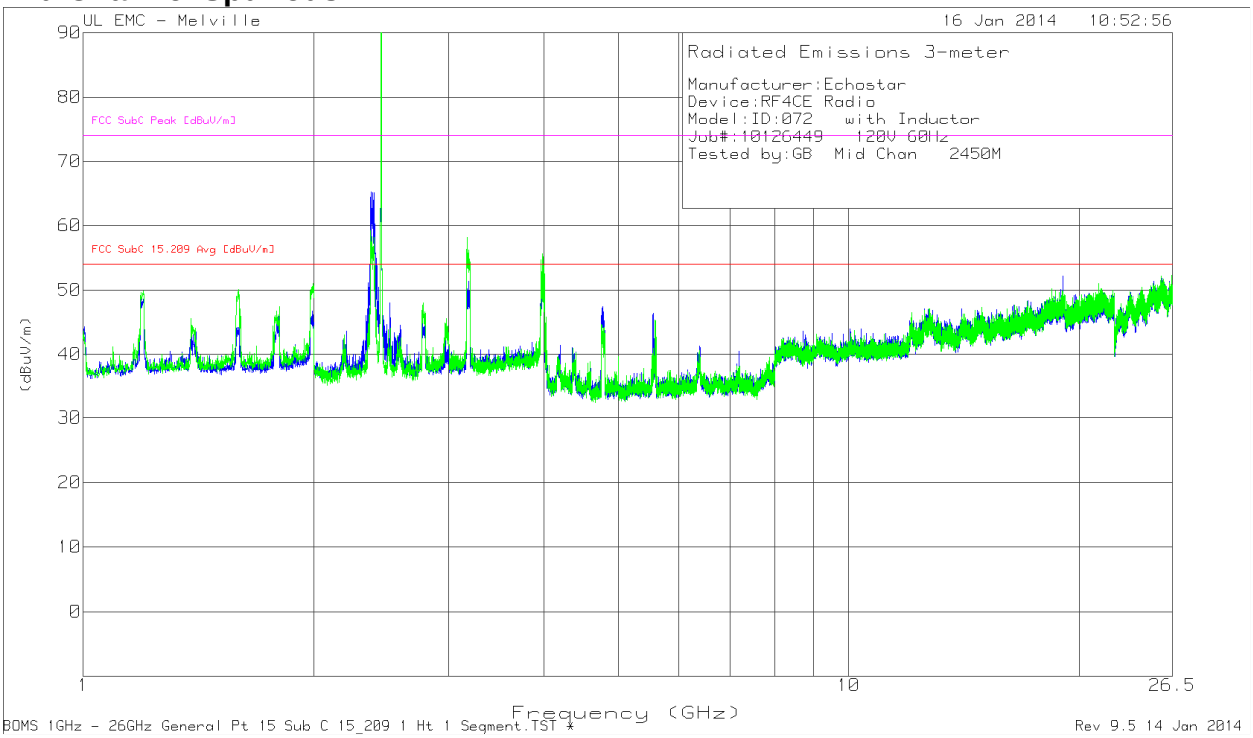
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Manufacturer: Echostar											
Device:RF4CE Radio											
Model:ID:072											
Job#:10126449 120V 60Hz											
Tested by: GB/JC Low Chan 2425M											

Horizontal 4 - 8GHz											
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-48106 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
4.7732	74.3	PK2	27.1	-52.06	49.34	-	-	74	-24.66	305	260	H
4.7789	61.33	MAv1	27.1	-52.29	36.14	54	-17.86	-	-	305	260	H
4.7691	74.83	PK2	27.1	-52.01	49.92	-	-	74	-24.08	305	260	H
4.7594	61.52	MAv1	27.1	-52.22	36.4	54	-17.6	-	-	305	260	H
4.7527	68.4	PK2	27.1	-52.13	43.37	-	-	74	-30.63	178	319	V
4.7538	56.22	MAv1	27.1	-52.2	31.12	54	-22.88	-	-	178	319	V
5.5691	74.53	PK2	27.5	-51.95	50.08	-	-	74	-23.92	296	368	V
5.5627	57.42	MAv1	27.5	-51.83	33.09	54	-20.91	-	-	296	368	V
Horizontal 18 - 26.5GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-8947 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
25.6205	63.74	PK2	40.8	-50.75	53.79	-	-	74	-20.21	356	389	H
25.6228	52.8	MAv1	40.8	-50.56	43.04	54	-10.96	-	-	356	389	H
25.6208	62.6	PK2	40.8	-50.72	52.68	-	-	74	-21.32	251	221	V
25.6169	52.98	MAv1	40.8	-50.77	43.01	54	-10.99	-	-	251	221	V
25.7665	62.72	PK2	40.9	-50.7	52.92	-	-	74	-21.08	274	165	V
25.7607	52.7	MAv1	40.9	-50.36	43.24	54	-10.76	-	-	274	165	V
25.9556	60.97	PK2	41	-51.04	50.93	-	-	74	-23.07	120	313	H
25.947	52.2	MAv1	41	-50.65	42.55	54	-11.45	-	-	120	313	H
26.0293	62.05	PK2	41	-51.24	51.81	-	-	74	-22.19	209	102	V
26.0333	52.21	MAv1	41	-51.29	41.92	54	-12.08	-	-	209	102	V
25.5968	62.78	PK2	40.8	-50.65	52.93	-	-	74	-21.07	65	369	H
25.6054	53.02	MAv1	40.8	-50.54	43.28	54	-10.72	-	-	65	369	H
PK - Peak detector												
PK2 - KDB558074 Method: Maximum Peak												
MAv1 - KDB558074 Option 1 Maximum RMS Average												

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Mid Channel Spurious



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HORIZONTAL/VERTICAL DATA

Manufacturer: Echostar
Device:RF4CE Radio
Model:ID:072
Job#:10126449 120V 60Hz
Tested by: GB/JC Mid Chan 2450M

Horizontal 1 - 2GHz

Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-51442 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1.196	76.05	PK2	19.8	-44.38	51.47	-	-	74	-22.53	66	279	H
1.1915	62.97	MAv1	19.8	-44.32	38.45	54	-15.55	-	-	66	279	H
1.9956	69.96	PK2	22.2	-43.18	48.98	-	-	74	-25.02	338	337	V
1.998	55.57	MAv1	22.2	-43.36	34.41	54	-19.59	-	-	338	337	V
1.1904	76	PK2	19.8	-44.21	51.59	-	-	74	-22.41	298	205	V
1.1901	63.41	MAv1	19.8	-44.18	39.03	54	-14.97	-	-	298	205	V
1.5896	74.82	PK2	21.2	-43.89	52.13	-	-	74	-21.87	274	110	V
1.5875	63.46	MAv1	21.1	-44.09	40.47	54	-13.53	-	-	274	110	V
1.7818	73.41	PK2	20.9	-43.74	50.57	-	-	74	-23.43	302	188	V
1.784	58.87	MAv1	21	-43.8	36.07	54	-17.93	-	-	302	188	V
1.9981	70.31	PK2	22.2	-43.35	49.16	-	-	74	-24.84	76	356	V
1.9964	56.68	MAv1	22.2	-43.29	35.59	54	-18.41	-	-	76	356	V

Horizontal 2 - 4GHz

Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-48107 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2.3772	89.99	PK2	21.1	-42.54	68.55	-	-	74	-5.45	318	232	H
2.381	71.24	MAv1	21.1	-42.62	49.72	54	-4.28	-	-	318	232	H
2.3989	88.61	PK2	21.1	-42.62	67.09	-	-	74	-6.91	232	108	H
2.3971	69.16	MAv1	21.1	-42.64	47.62	54	-6.38	-	-	232	108	H
3.1735	67.01	PK2	21.9	-41.88	47.03	-	-	74	-26.97	265	198	H
3.182	53.62	MAv1	21.9	-41.82	33.7	54	-20.3	-	-	265	198	H
3.1753	80.7	PK2	21.9	-41.86	60.74	-	-	74	-13.26	262	148	V
3.1803	64.71	MAv1	21.9	-41.81	44.8	54	-9.2	-	-	262	148	V
2.4006	85.38	PK2	21.1	-42.62	63.86	-	-	74	-10.14	262	148	V
2.3975	67.9	MAv1	21.1	-42.63	46.37	54	-7.63	-	-	262	148	V

PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

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Manufacturer: Echostar											
Device:RF4CE Radio											
Model:ID:072											
Job#:10126449 120V 60Hz											
Tested by: GB/JC Mid Chan 2450M											

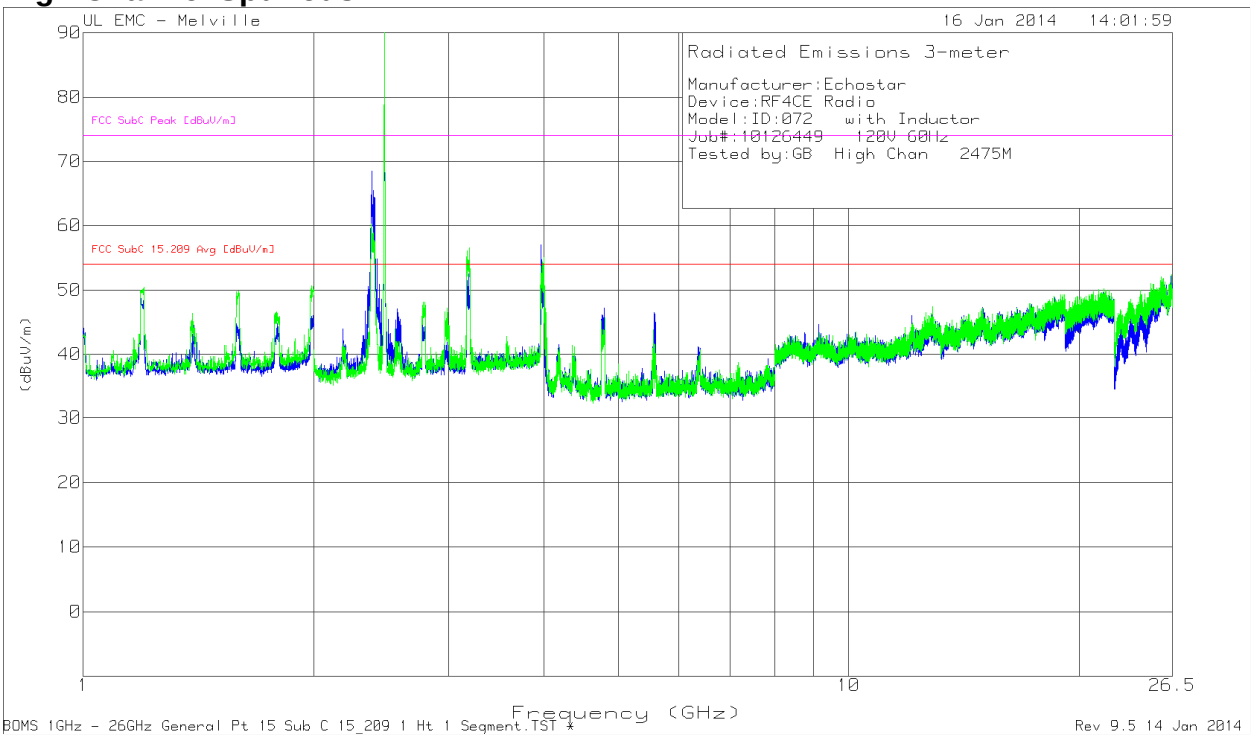
Horizontal 2 - 4GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-48107 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2.7878	69.52	PK2	21.8	-42.35	48.97	-	-	74	-25.03	229	124	V
2.7884	56.28	MAv1	21.8	-42.35	35.73	54	-18.27	-	-	229	124	V
3.9683	77.44	PK2	22.8	-41.55	58.69	-	-	74	-15.31	296	229	V
3.9678	60.4	MAv1	22.8	-41.62	41.58	54	-12.42	-	-	296	229	V
3.9702	76.79	PK2	22.8	-41.34	58.25	-	-	74	-15.75	340	200	H
3.9686	59.53	MAv1	22.8	-41.52	40.81	54	-13.19	-	-	340	200	H
2.4146	81.28	PK2	21.1	-42.61	59.77	-	-	74	-14.23	267	328	H
2.4162	62.71	MAv1	21.1	-42.56	41.25	54	-12.75	-	-	267	328	H
2.4277	74.51	PK2	21.2	-42.81	52.9	-	-	74	-21.1	249	352	H
2.4299	58.86	MAv1	21.2	-42.73	37.33	54	-16.67	-	-	249	352	H
Horizontal 4 - 8GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-48106 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
4.7732	74.3	PK2	27.1	-52.06	49.34	-	-	74	-24.66	305	260	H
4.7789	61.33	MAv1	27.1	-52.29	36.14	54	-17.86	-	-	305	260	H
4.7691	74.83	PK2	27.1	-52.01	49.92	-	-	74	-24.08	305	260	H
4.7594	61.52	MAv1	27.1	-52.22	36.4	54	-17.6	-	-	305	260	H
4.7527	68.4	PK2	27.1	-52.13	43.37	-	-	74	-30.63	178	319	V
4.7538	56.22	MAv1	27.1	-52.2	31.12	54	-22.88	-	-	178	319	V
5.5691	74.53	PK2	27.5	-51.95	50.08	-	-	74	-23.92	296	368	V
5.5627	57.42	MAv1	27.5	-51.83	33.09	54	-20.91	-	-	296	368	V
PK2 - KDB558074 Method: Maximum Peak												
MAv1 - KDB558074 Option 1 Maximum RMS Average												

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Manufacturer: Echostar												
Device:RF4CE Radio												
Model:ID:072												
Job#:10126449 120V 60Hz												
Tested by: GB/JC Mid Chan 2450M												
Horizontal 18 - 26.5GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-8947 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
26.0293	62.05	PK2	41	-51.24	51.81	-	-	74	-22.19	209	102	V
26.0333	52.21	MAv1	41	-51.29	41.92	54	-12.08	-	-	209	102	V
25.5968	62.78	PK2	40.8	-50.65	52.93	-	-	74	-21.07	65	369	H
25.6054	53.02	MAv1	40.8	-50.54	43.28	54	-10.72	-	-	65	369	H
PK2 - KDB558074 Method: Maximum Peak												
MAv1 - KDB558074 Option 1 Maximum RMS Average												

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High Channel Spurious



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HORIZONTAL/VERTICAL DATA

Manufacturer: Echostar												
Device:RF4CE Radio												
Model:ID:072												
Job#:10126449 120V 60Hz												
Tested by: GB/JC High Chan 2475M												
Horizontal 1 - 2GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-51442 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
1.1922	75.09	PK2	19.8	-44.4	50.49	-	-	74	-23.51	80	160	H
1.1917	62.55	MAv1	19.8	-44.35	38	54	-16	-	-	80	160	H
1.1943	75.45	PK2	19.8	-44.29	50.96	-	-	74	-23.04	240	144	V
1.1944	62.53	MAv1	19.8	-44.29	38.04	54	-15.96	-	-	240	144	V
1.5996	75.22	PK2	21.2	-43.98	52.44	-	-	74	-21.56	259	130	V
1.5949	62.84	MAv1	21.2	-43.86	40.18	54	-13.82	-	-	259	130	V
1.9849	73.78	PK2	22.1	-43.34	52.54	-	-	74	-21.46	269	138	V
1.9867	60.23	MAv1	22.1	-43.39	38.94	54	-15.06	-	-	269	138	V
Horizontal 2 - 4GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-48107 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2.3903	92.76	PK2	21.1	-42.61	71.25	-	-	74	-2.75	253	240	H
2.3873	72.44	MAv1	21.1	-42.62	50.92	54	-3.08	-	-	253	240	H
2.3877	85.17	PK2	21.1	-42.61	63.66	-	-	74	-10.34	248	170	V
2.3857	67.63	MAv1	21.1	-42.67	46.06	54	-7.94	-	-	248	170	V
3.1758	79.85	PK2	21.9	-41.82	59.93	-	-	74	-14.07	261	364	V
3.1702	63.72	MAv1	21.9	-41.89	43.73	54	-10.27	-	-	261	364	V
3.1852	76.44	PK2	22	-41.83	56.61	-	-	74	-17.39	289	203	H
3.1912	59.57	MAv1	22	-41.95	39.62	54	-14.38	-	-	289	203	H
3.9917	81.7	PK2	22.9	-41.48	63.12	-	-	74	-10.88	292	236	H
3.9872	63.27	MAv1	22.9	-41.29	44.88	54	-9.12	-	-	292	236	H
3.9705	77.28	PK2	22.8	-41.36	58.72	-	-	74	-15.28	304	190	V
3.9649	59.58	MAv1	22.8	-41.48	40.9	54	-13.1	-	-	304	190	V
2.7949	71.95	PK2	21.8	-42.27	51.48	-	-	74	-22.52	280	250	V
2.7896	57.57	MAv1	21.8	-42.36	37.01	54	-16.99	-	-	280	250	V
2.4277	74.51	PK2	21.2	-42.81	52.9	-	-	74	-21.1	249	352	H
2.4299	58.86	MAv1	21.2	-42.73	37.33	54	-16.67	-	-	249	352	H
PK2 - KDB558074 Method: Maximum Peak												
MAv1 - KDB558074 Option 1 Maximum RMS Average												

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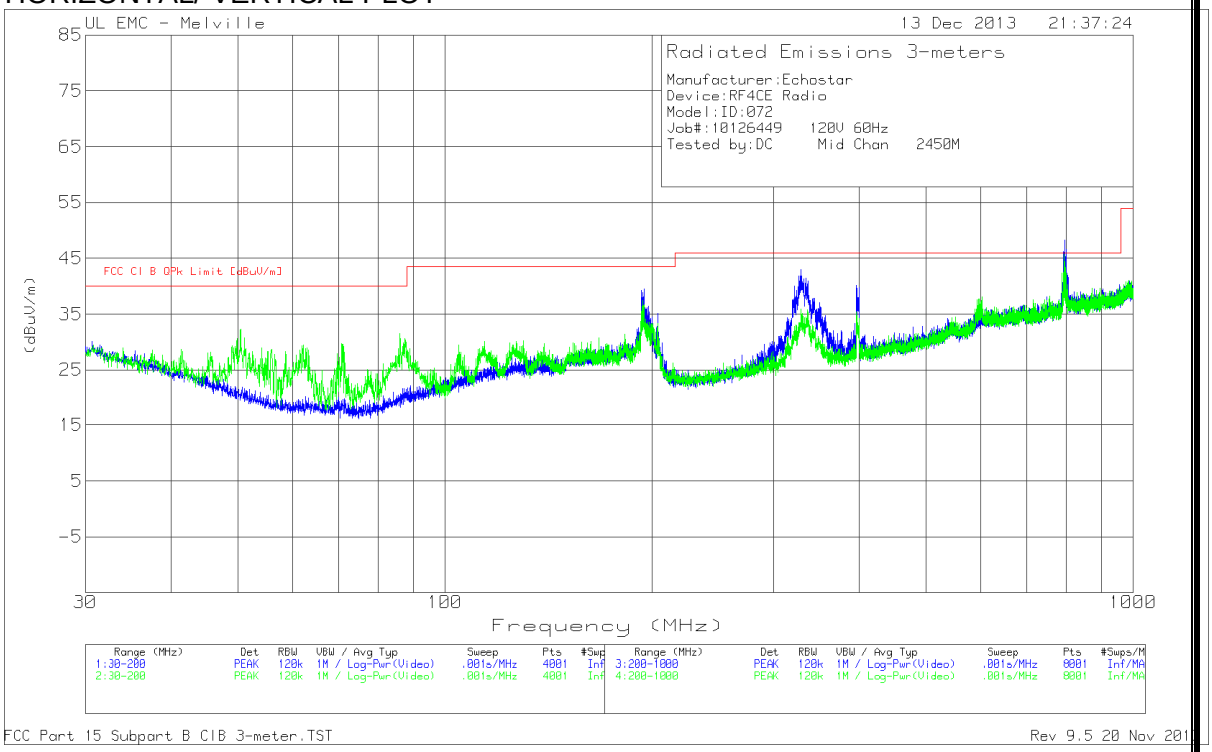
Manufacturer: Echostar												
Device:RF4CE Radio												
Model:ID:072												
Job#:10126449 120V 60Hz												
Tested by: GB/JC High Chan 2475M												
Horizontal 4 - 8GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-48106 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
4.7732	74.3	PK2	27.1	-52.06	49.34	-	-	74	-24.66	305	260	H
4.7789	61.33	MAv1	27.1	-52.29	36.14	54	-17.86	-	-	305	260	H
4.7691	74.83	PK2	27.1	-52.01	49.92	-	-	74	-24.08	305	260	H
4.7594	61.52	MAv1	27.1	-52.22	36.4	54	-17.6	-	-	305	260	H
4.7527	68.4	PK2	27.1	-52.13	43.37	-	-	74	-30.63	178	319	V
4.7538	56.22	MAv1	27.1	-52.2	31.12	54	-22.88	-	-	178	319	V
5.5691	74.53	PK2	27.5	-51.95	50.08	-	-	74	-23.92	296	368	V
5.5627	57.42	MAv1	27.5	-51.83	33.09	54	-20.91	-	-	296	368	V
Horizontal 18 - 26.5GHz												
Test Frequency (GHz)	Meter Reading (dBuV)	Detector	AF-8947 [dB/m]	BOMS Factor (dB)	Corrected Reading (dBuV/m)	FCC SubC 15.209 Avg [dBuV/m]	Margin (dB)	FCC SubC Peak [dBuV/m]	PK Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
25.7644	62.27	PK2	40.9	-50.5	52.67	-	-	74	-21.33	319	194	H
25.7671	53.16	MAv1	40.9	-50.75	43.31	54	-10.69	-	-	319	194	H
26.2605	62.02	PK2	41.1	-50.19	52.93	-	-	74	-21.07	38	196	H
26.2603	51.13	MAv1	41.1	-50.21	42.02	54	-11.98	-	-	38	196	H
24.1296	61.76	PK2	40.9	-51.29	51.37	-	-	74	-22.63	38	374	V
24.1304	52.52	MAv1	40.9	-51.29	42.13	54	-11.87	-	-	38	374	V
25.8457	62.15	PK2	40.9	-50.81	52.24	-	-	74	-21.76	194	380	V
25.8408	51.79	MAv1	40.9	-50.44	42.25	54	-11.75	-	-	194	380	V
26.0293	62.05	PK2	41	-51.24	51.81	-	-	74	-22.19	209	102	V
26.0333	52.21	MAv1	41	-51.29	41.92	54	-12.08	-	-	209	102	V
25.5968	62.78	PK2	40.8	-50.65	52.93	-	-	74	-21.07	65	369	H
25.6054	53.02	MAv1	40.8	-50.54	43.28	54	-10.72	-	-	65	369	H
PK2 - KDB558074 Method: Maximum Peak												
MAv1 - KDB558074 Option 1 Maximum RMS Average												

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WORST-CASE BELOW 1 GHz

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

HORIZONTAL/ VERTICAL PLOT



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HORIZONTAL/VERTICAL DATA

Frequency (MHz)	Meter Reading (dBuV)	Det	AF-54 [dB/m]	GL-3M [dB]	Corrected Reading (dBuV/m)	FCC Cl B QPk Limit [dBuV/m]	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
194.5252	13.05	QP	15.6	.8	29.45	43.5	-14.05	32	126	H
192.8	6.87	QP	15.6	.7	23.17	43.5	-20.33	32	172	V

QP - Quasi-Peak detector

Frequency (MHz)	Meter Reading (dBuV)	Det	AF-67 [dB/m]	GL-3M [dB]	Corrected Reading (dBuV/m)	FCC Cl B QPk Limit [dBuV/m]	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
329.1	23.47	QP	13.8	1.3	38.57	46	-7.43	109	116	H
396.1726	20.71	QP	15.4	1.4	37.51	46	-8.49	78	102	H
795.3	9.58	QP	21.2	2	32.78	46	-13.22	354	250	H
793.4	14.2	QP	21.1	2	37.3	46	-8.7	293	163	V

QP - Quasi-Peak detector

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9. 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

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RESULTS

6 WORST EMISSIONS

Manufacturer:Echostar							
Device:RF4CE Radio							
Model:ID:072							
Job#:10126449 120V 60Hz							
Tested by:GB/JC 2425MHz							

Frequency (MHz)	Meter Reading (dBuV)	Det	Line 1 G/L (dB)	Corrected Reading (dBuV)	Subpart C QPK Limit (dBuV)	Margin (dB)	Subpart C Avg Limit (dBuV)	Margin (dB)
.15511	47.48	PK	10	57.48	65.72	-8.24	-	-
.18748	44.97	PK	10	54.97	64.15	-9.18	-	-
.22836	41.18	PK	10	51.18	62.51	-11.33	-	-
.61333	42.79	PK	10	52.79	56	-3.21	-	-
.60375	34.94	Av	10	44.94	-	-	46	-1.06
3.53351	34.58	PK	10.1	44.68	56	-11.32	-	-
18.19306	31.05	PK	11	42.05	60	-17.95	-	-
3.56908	24.38	Av	10.1	34.48	-	-	46	-11.52
.16533	47.02	PK	10	57.02	65.19	-8.17	-	-
.19088	42.41	PK	10	52.41	64	-11.59	-	-
.21473	43.21	PK	10	53.21	63.02	-9.81	-	-
.61162	40.82	PK	10	50.82	56	-5.18	-	-
.17404	35.67	Av	10	45.67	-	-	54.77	-9.1
.20554	32.26	Av	10	42.26	-	-	53.38	-11.12
.17179	36.52	Av	10	46.52	-	-	54.87	-8.35
.20554	32.26	Av	10	42.26	-	-	53.38	-11.12
.6018	33.37	Av	10	43.37	-	-	46	-2.63

PK - Peak detector
Av - average detection

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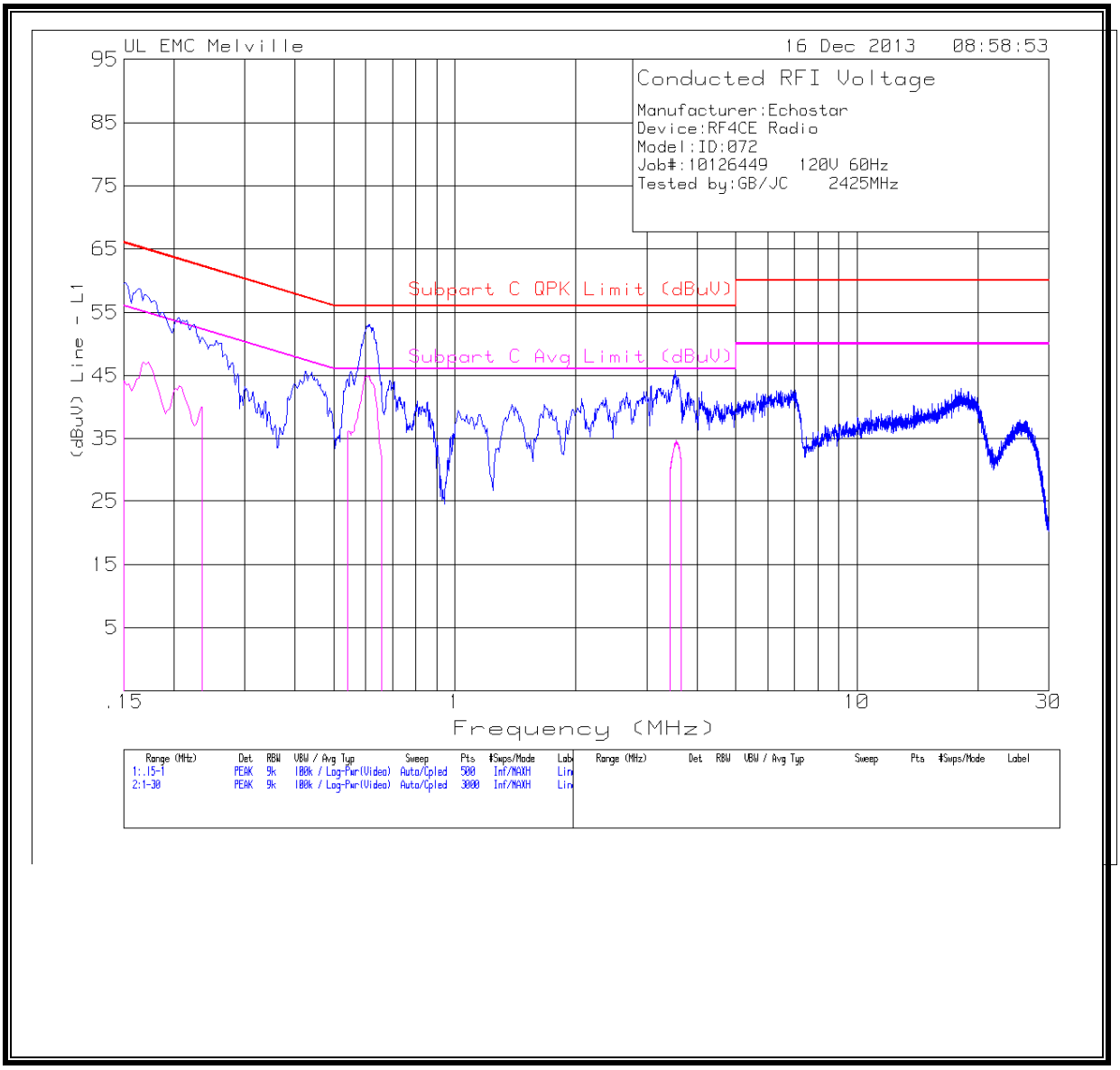
Manufacturer:Echostar							
Device:RF4CE Radio							
Model:ID:072							
Job#:10126449 120V 60Hz							
Tested by:GB/JC 2425MHz							

Line - L2 .15 - 1MHz								
Test Frequency (MHz)	Meter Reading(dBuV)	Detector	Line 2 G/L (dB)	Corrected Reading (dBuV)	Subpart C QPK Limit (dBuV)	Margin (dB)	Subpart C Avg Limit (dBuV)	Margin (dB)
0.16533	47.02	PK	10	57.02	65.19	-8.17	-	-
0.19088	42.41	PK	10	52.41	64	-11.59	-	-
0.21473	43.21	PK	10	53.21	63.02	-9.81	-	-
0.61162	40.82	PK	10	50.82	56	-5.18	-	-
0.17404	35.67	Av	10	45.67	-	-	54.77	-9.1
0.20554	32.26	Av	10	42.26	-	-	53.38	-11.12
0.17179	36.52	Av	10	46.52	-	-	54.87	-8.35
0.20554	32.26	Av	10	42.26	-	-	53.38	-11.12
0.6018	33.37	Av	10	43.37	-	-	46	-2.63
Line - L2 1 - 30MHz								
Test Frequency (MHz)	Meter Reading(dBuV)	Detector	Line 2 G/L (dB)	Corrected Reading (dBuV)	Subpart C QPK Limit (dBuV)	Margin (dB)	Subpart C Avg Limit (dBuV)	Margin (dB)
3.53351	33.42	PK	10.2	43.62	56	-12.38	-	-
18.95699	30.55	PK	11.2	41.75	60	-18.25	-	-
3.58358	23.98	Av	10.2	34.18	-	-	46	-11.82
PK - Peak detector								
Av - Average detector								

PK - Peak detector
Av - average detection

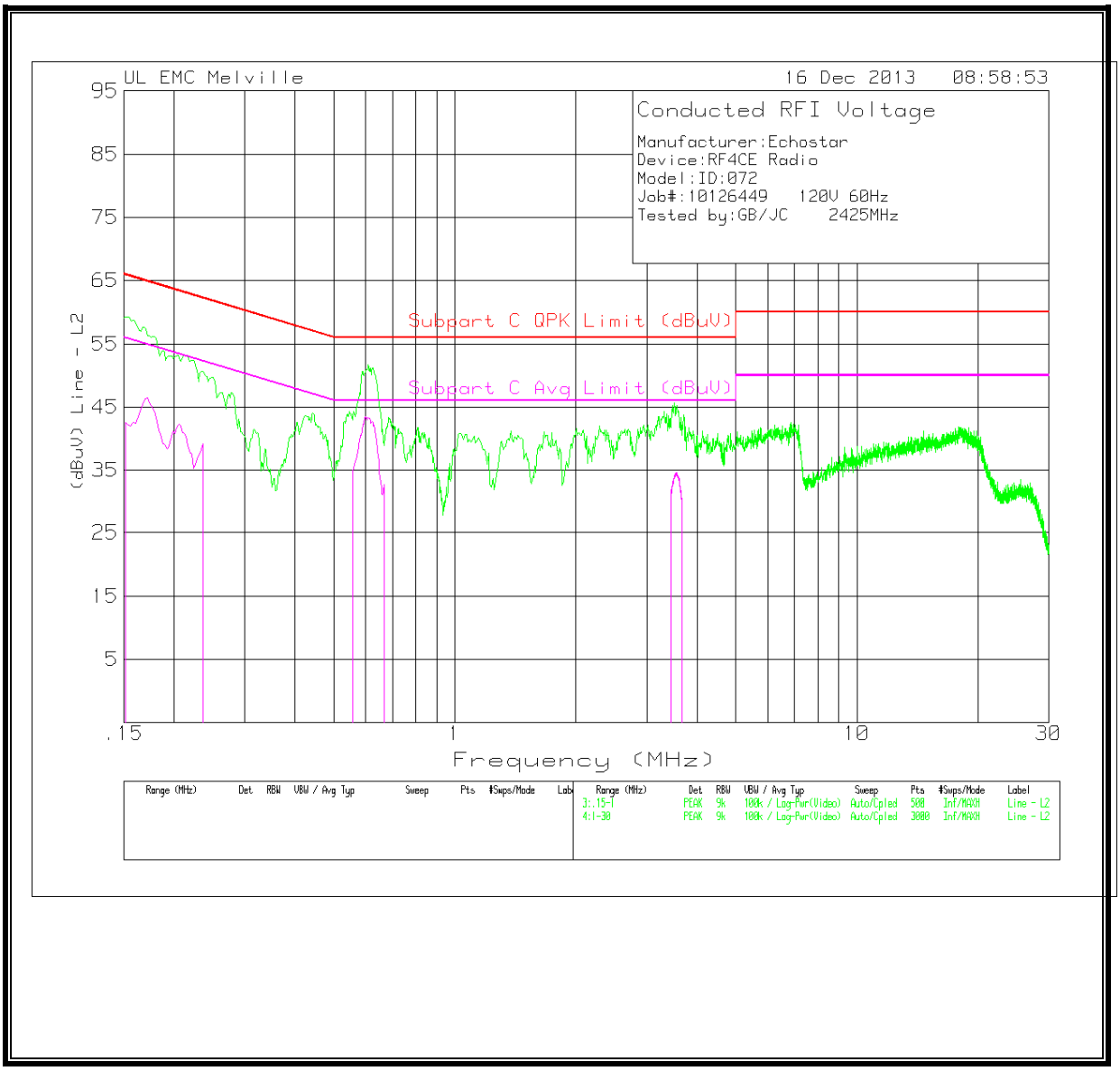
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LINE 1 RESULTS



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LINE 2 RESULTS



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10. SETUP PHOTOS

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ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

ANTENNA PORT CONDUCTED PHOTO
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POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

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RADIATED RF MEASUREMENT SETUP (BELOW 1 GHz)

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RADIATED RF MEASUREMENT SETUP (ABOVE 1 GHz)

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