



FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

STB

MODEL NUMBER: 4K JOEY

FCC ID: DKN4KJT

REPORT NUMBER: 10566895B

ISSUE DATE: April 7, 2015

Prepared for

Echostar

**90 Inverness Circle East
Englewood, CO 80112**

Prepared by

UL LLC

**333 Pfingsten Rd.
Northbrook, IL 60062
TEL: (847) 272-8800**



NVLAP Lab code: 100414-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	4/7/15	Initial Issue	M.Ferrer

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: STB

MODEL: 4K JOEY

SERIAL NUMBER: Prototype

DATE TESTED: April 2, 2015 – April 8, 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:



Bart Mucha
Staff Engineer
UL LLC

Tested By:



MICHAEL FERRER
Program Manager
UL LLC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, DA 00-705.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 333 Pfingsten Road, Northbrook, IL 60062 USA.

UL NBK is accredited by NVLAP, Laboratory Code 100414-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/Standards/scopes/1004140.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

Sample Calculations

Radiated Field Strength and Conducted Emissions data contained within this report is calculated on the following basis:

Field Strength (dBuV/m) = Meter Reading (dBuV) + AF (dB/m) - Gain (dB) + Cable Loss (dB)

Conducted Voltage (dBuV) = Meter Reading (dBuV) + Cable Loss (dB) + LISN IL (dB)

Conducted Current (dBuA) = Meter Reading (dBuV) + Cable Loss (dB) - Transducer Factor (dBohms)

4.3. MEASUREMENT UNCERTAINTY

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

Test	Range	Equipment	Uncertainty k=2
Radiated Emissions	30-200MHz	Bicon 10m Horz	4.27dB
Radiated Emissions	30-200MHz	Bicon 10m Vert	4.28dB
Radiated Emissions	200-1000MHz	LogP 10m Horz	3.33dB
Radiated Emissions	200-1000MHz	LogP 10m Vert	3.39dB
Radiated Emissions	30-200MHz	Bicon 3m Horz	3.30dB
Radiated Emissions	30-130MHz	Bicon 3m Vert	4.84dB
Radiated Emissions	130-200MHz	Bicon 3m Vert	4.94dB
Radiated Emissions	200-1000MHz	LogP 3m Horz	3.46dB
Radiated Emissions	200-1000MHz	LogP 3m Vert	4.98dB
Radiated Emissions	1-6GHz	Horn	5.02dB
Radiated Emissions	6-18GHz	Horn	5.34dB
Radiated Emissions	18-26GHz	Horn	6.60dB
Conducted Ant Port	30MHz-26GHz	Spectrum Analyzer	2.94

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a STB that contains a Bluetooth transceiver. EUT also contains a Zigbee transceiver which is not covered in this report.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	-1.87	0.65
2402 - 2480	DQPSK	0.85	1.22
2402 - 2480	Enhanced 8PSK	1.30	1.35

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an inverted F style antenna, with a maximum gain of 0 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 2 orthogonal orientations Vertical and Horizontal, it was determined that Horizontal orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Horizontal orientation.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List		
Description	Manufacturer	Model
STB	DISH	88
Power Supply	LiteON	PB-1300-1ES1
Laptop	HP	8470P

I/O CABLES

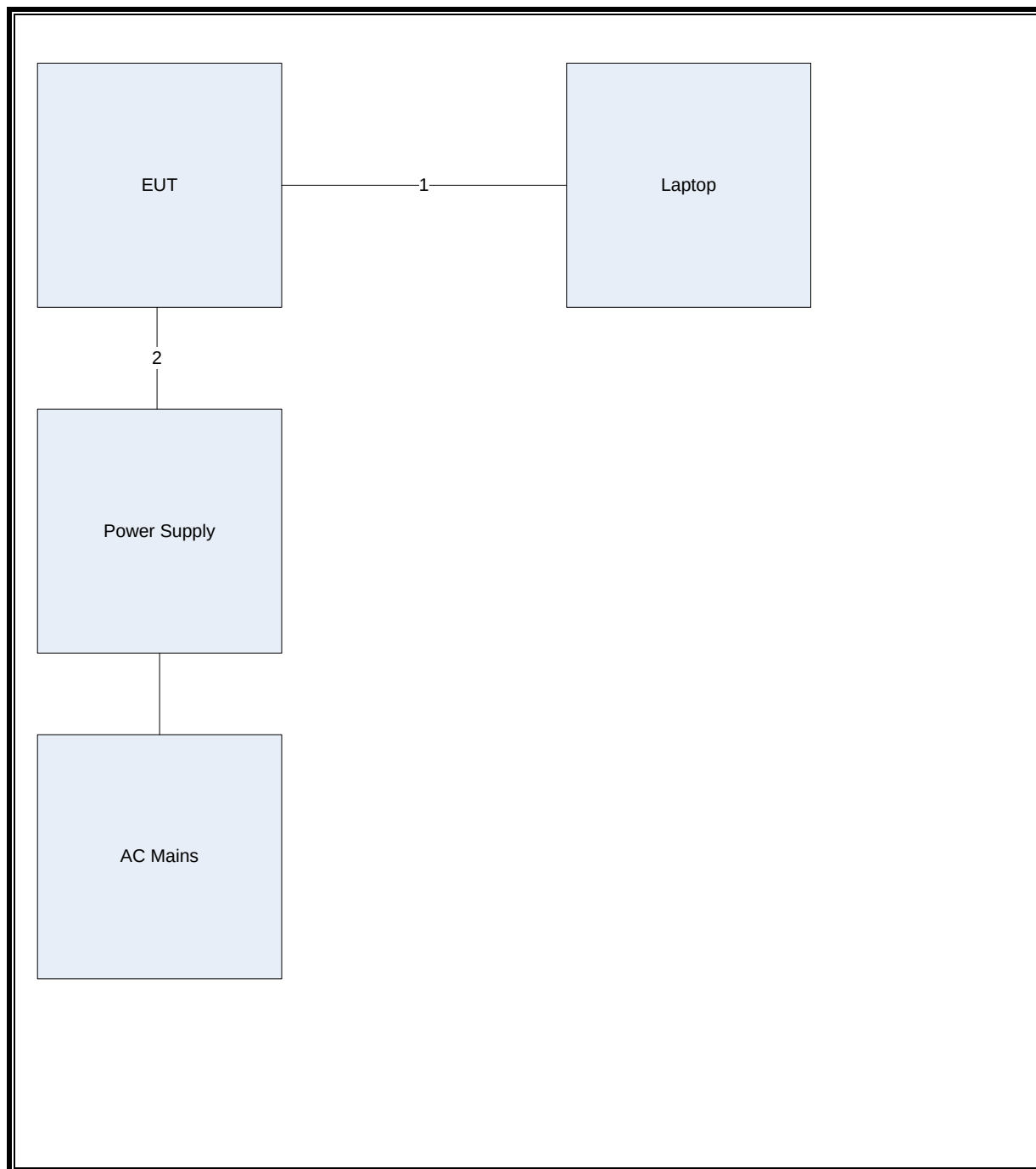
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	1	USB	4 wire	1	None
2	DC	1	DC	2wire	2	None

TEST SETUP

The EUT is a standalone device. The EUT was programed with a laptop via USB to internal port. The Laptop was removed during Radiated Emissions testing

EUT programmed for 100% duty cycle.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment List					
Description	Manufacturer	Model	T No.	Cal Date	Cal Due
Radiated Software	UL	UL EMC	Ver 9.5, Jan 30, 2015		
Conducted Software	UL	UL EMC	Ver 9.5, Oct 24, 2014		
Receiver	R&S	ESCI	EMC4328	12/18/14	12/31/15
Antenna	Chase	VBA6106A	EMC4078	04/01/14	04/30/15
Antenna	Schaffner	UPA6109	EMC4313	11/16/14	11/30/15
Receiver	R&S	ESU	EMC4323	12/16/14	12/31/15
Antenna	UL	BOMS	EMC4276	12/01/14	12/31/15
Spectrum Analyzer	Agilent	N903A	EMC4360	12/16/14	12/31/15
Power Meter	Agilent	N1912A	EMC4362	12/18/14	12/31/15
Power Sensor	Agilent	N8781A	EMC4363	12/16/14	12/31/15
Receiver	R&S	ESR	EMC4377	04/15/14	04/15/15
LISN	Solar	8602-50-TS-50-N	EMC4052	01/09/15	01/10/16
LISN	Solar	8602-50-TS-50-N	EMC4064	01/09/15	01/10/16

7. ANTENNA PORT TEST RESULTS

7.1. BASIC DATA RATE GFSK MODULATION

7.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

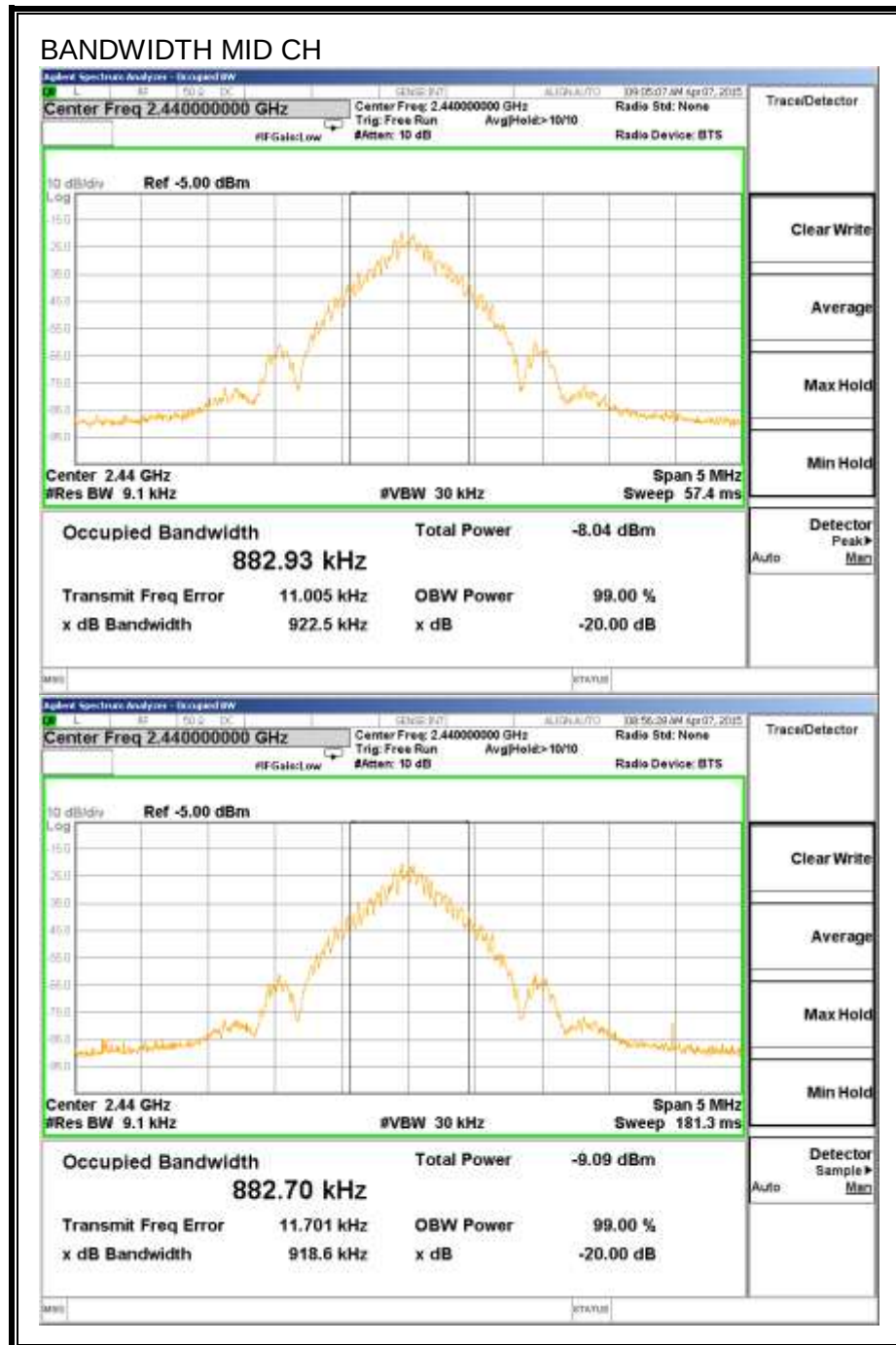
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	922.6	878.32
Middle	2441	922.5	882.7
High	2480	923.5	877.23

20 dB AND 99% BANDWIDTH







7.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

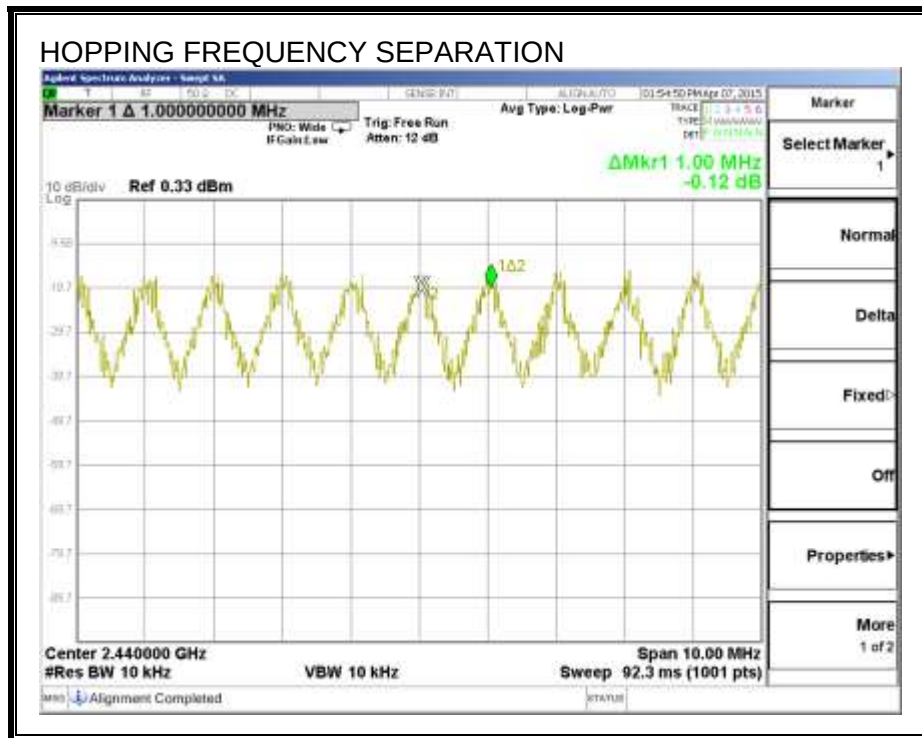
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 10 kHz and the VBW is set to 10 kHz. The sweep time is coupled.

RESULTS

Seperation 1MHz

HOPPING FREQUENCY SEPARATION



7.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

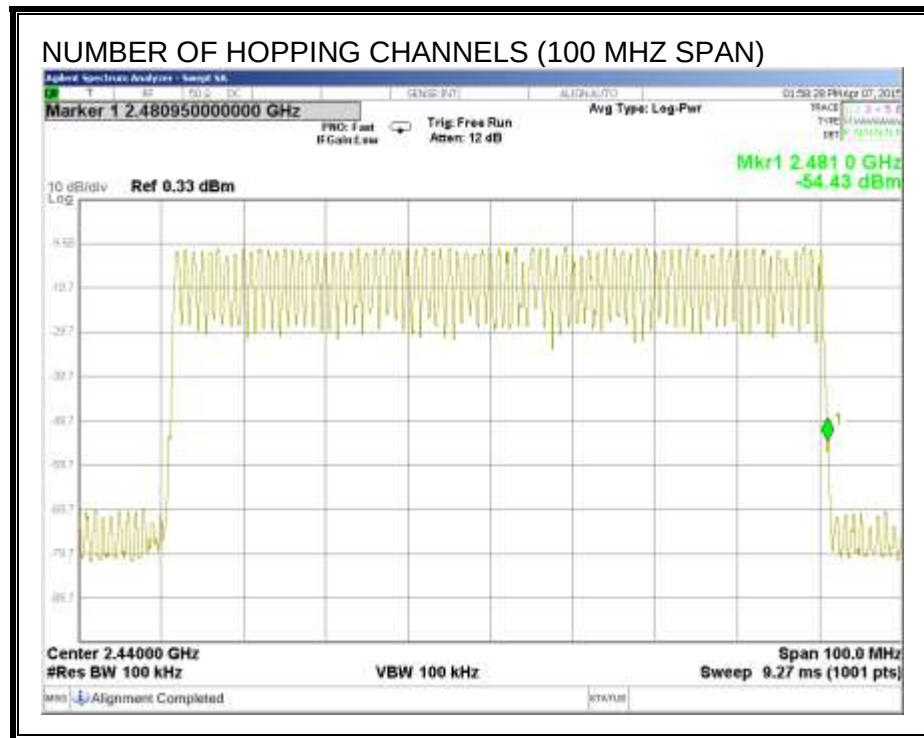
TEST PROCEDURE

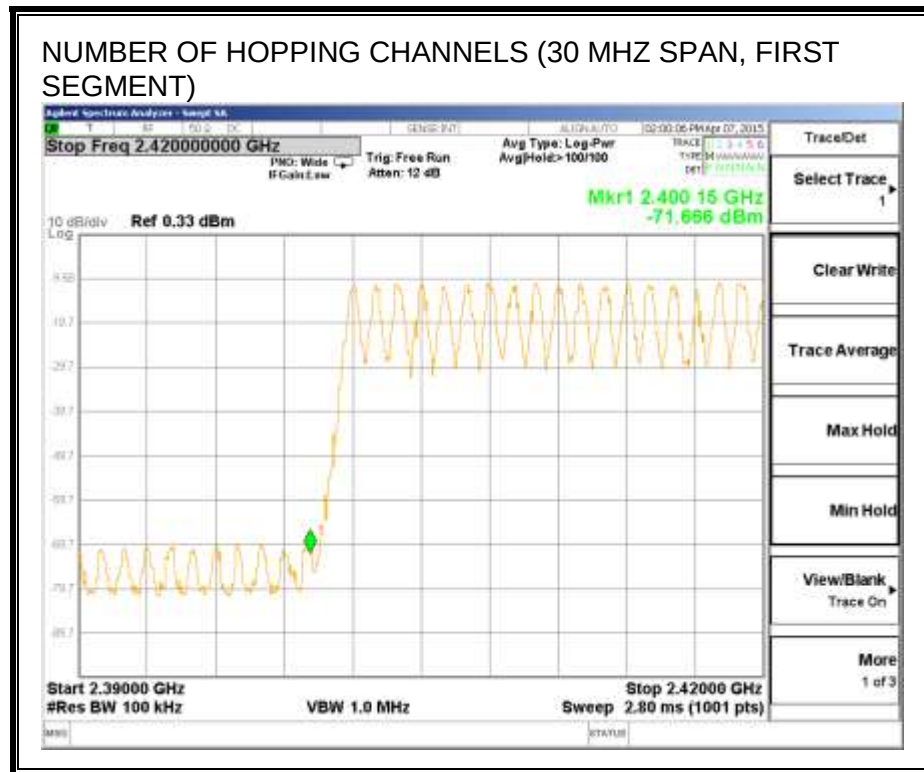
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

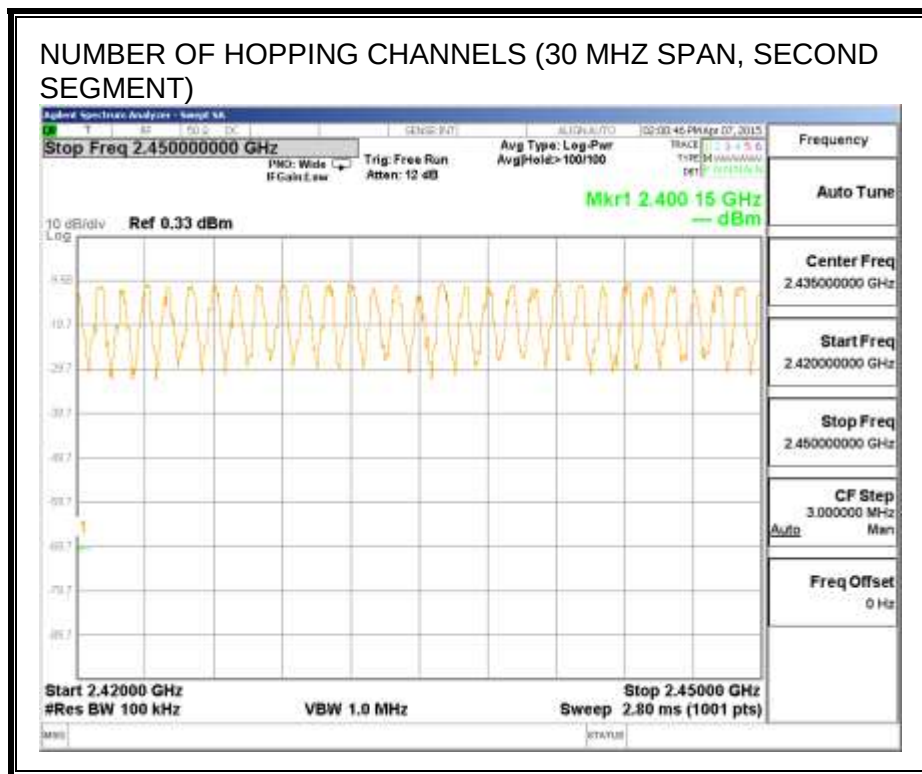
RESULTS

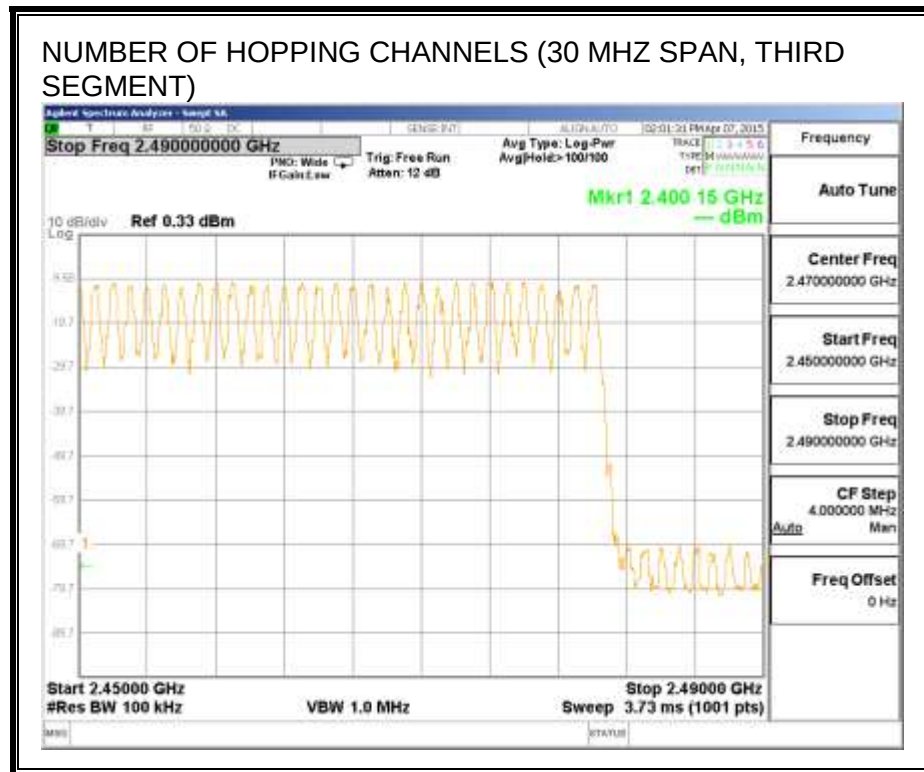
Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS









7.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

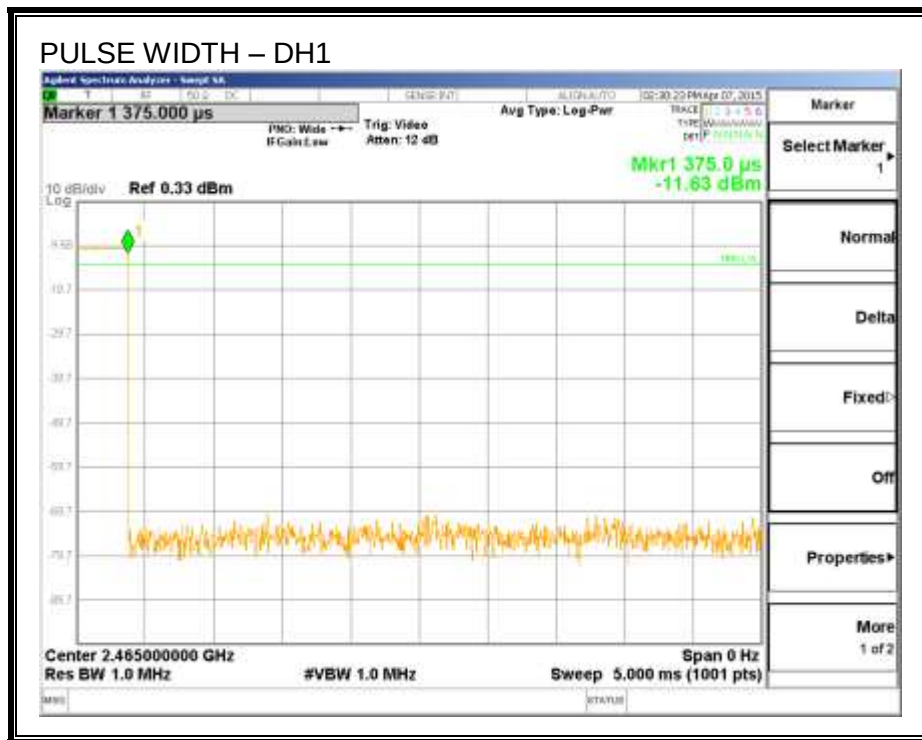
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 7.9 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $4 * (\# \text{ of pulses in } 7.9 \text{ s}) * \text{pulse width}$.

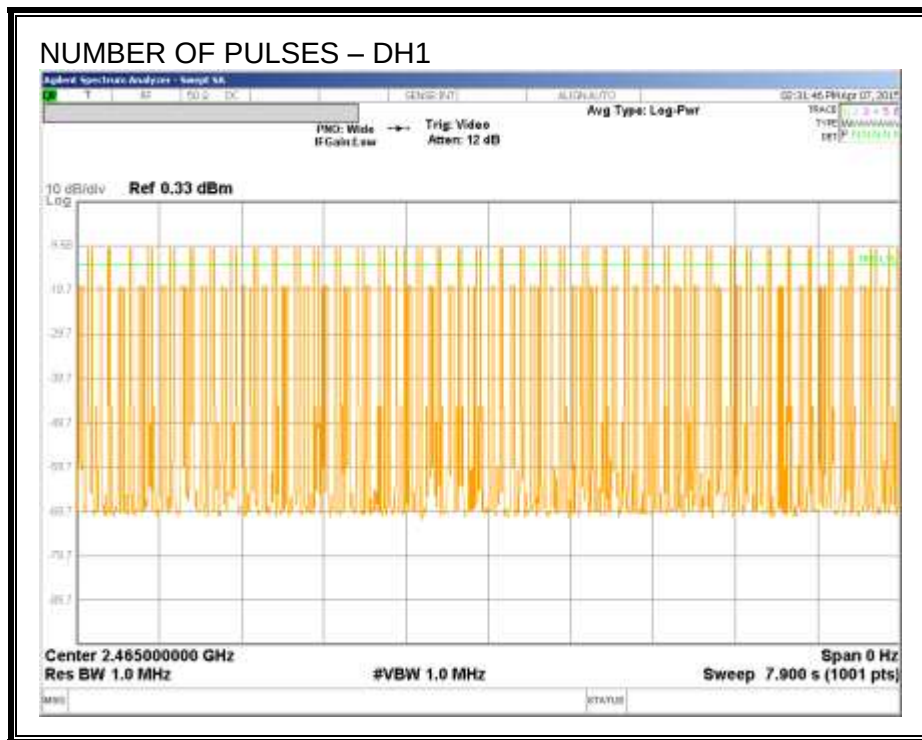
RESULTS

DH Packet	Pulse Width (msec)	Number of Pulses in 7.9 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.375	81	0.304	0.4	-0.096
DH3	1.65	40	0.264	0.4	-0.136
DH5	2.875	30	0.345	0.4	-0.055

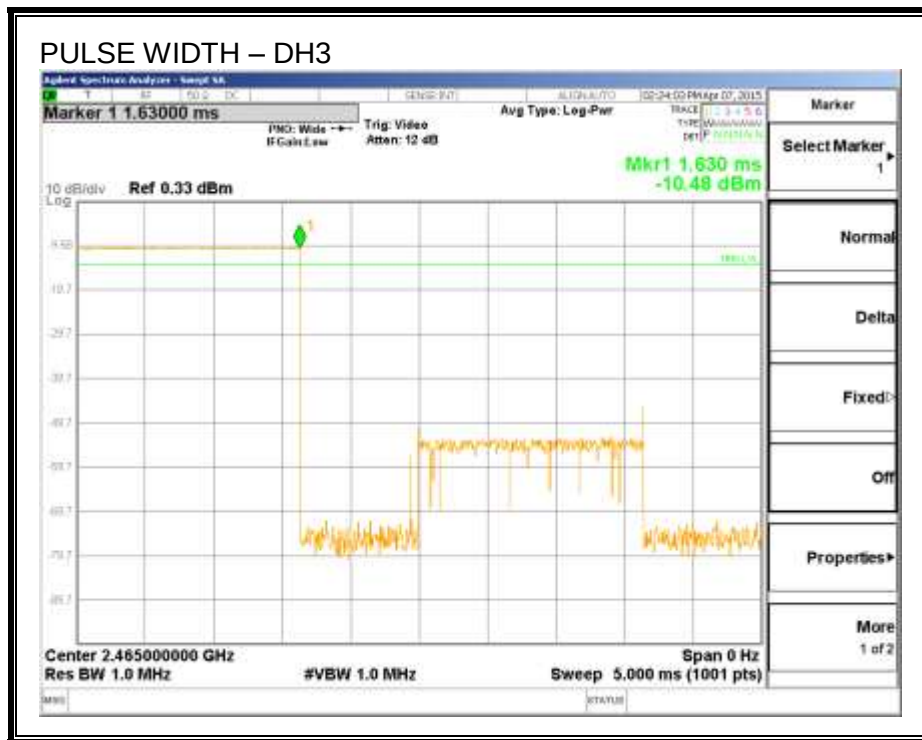
PULSE WIDTH - DH1



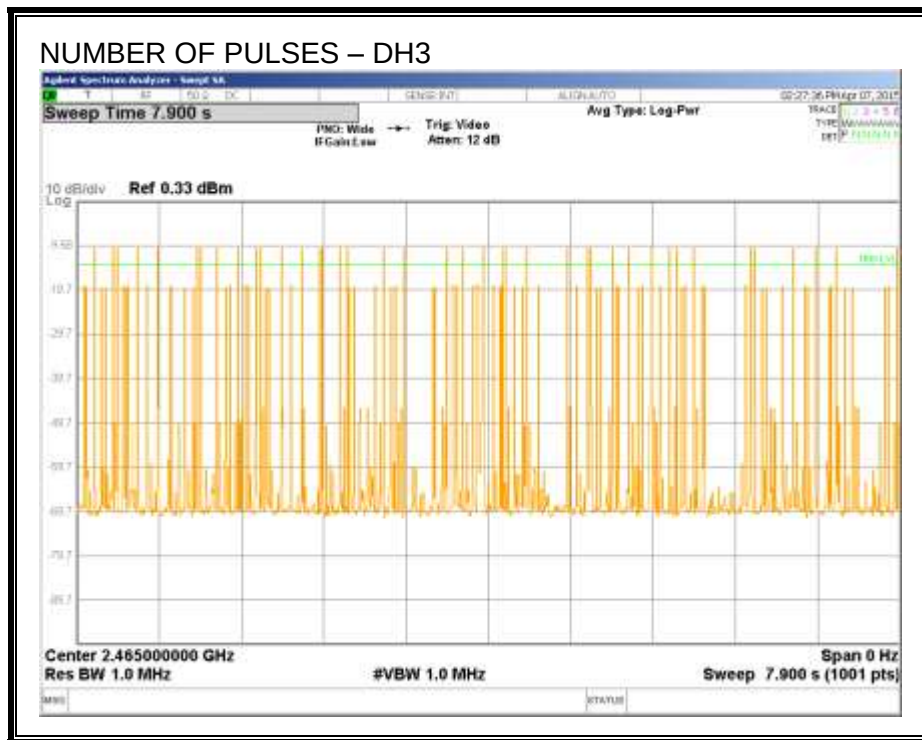
NUMBER OF PULSES IN 7.9 SECOND OBSERVATION PERIOD – DH1



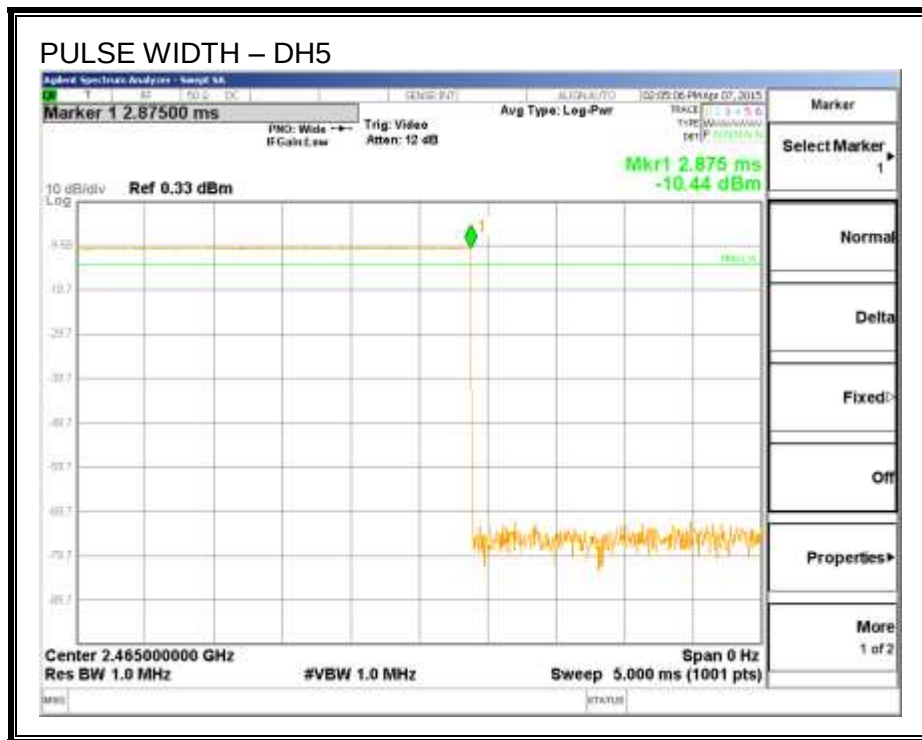
PULSE WIDTH – DH3



NUMBER OF PULSES IN 7.9 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



7.1.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-210 Clause A8.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

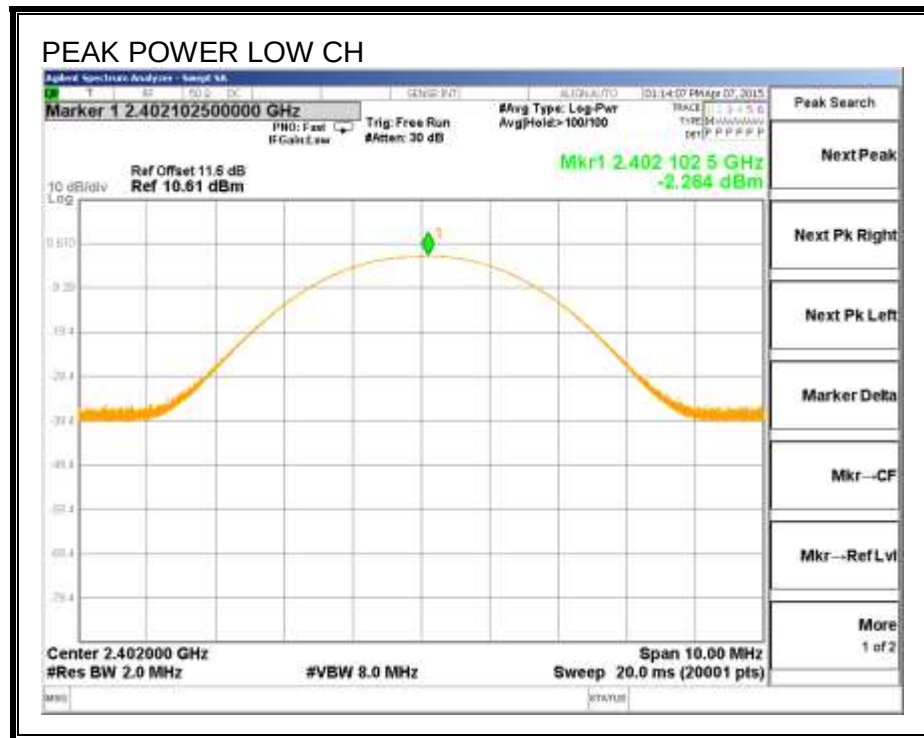
TEST PROCEDURE

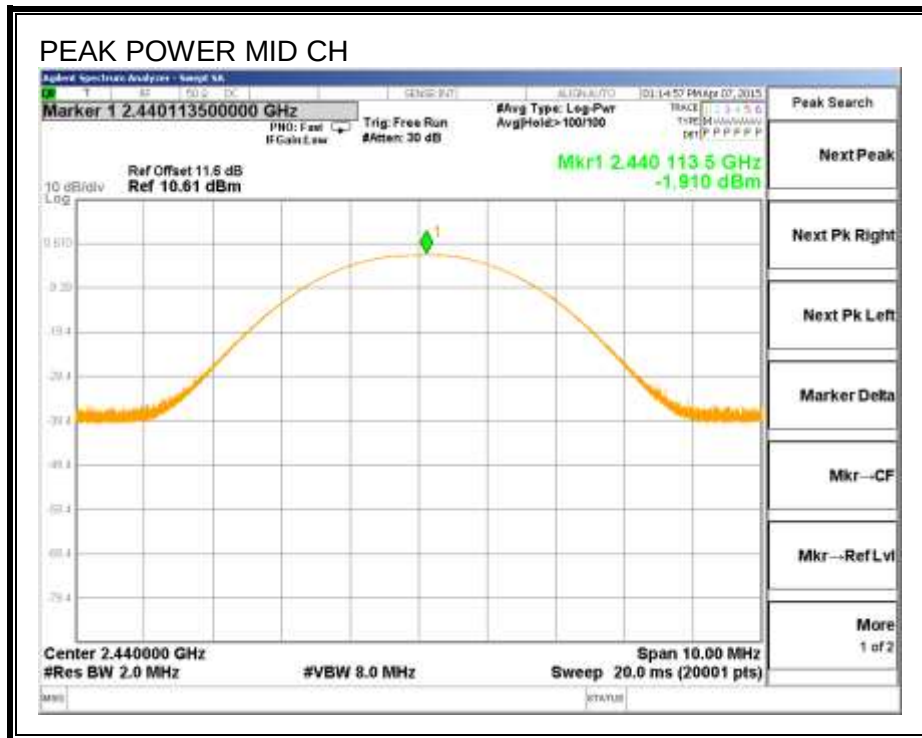
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

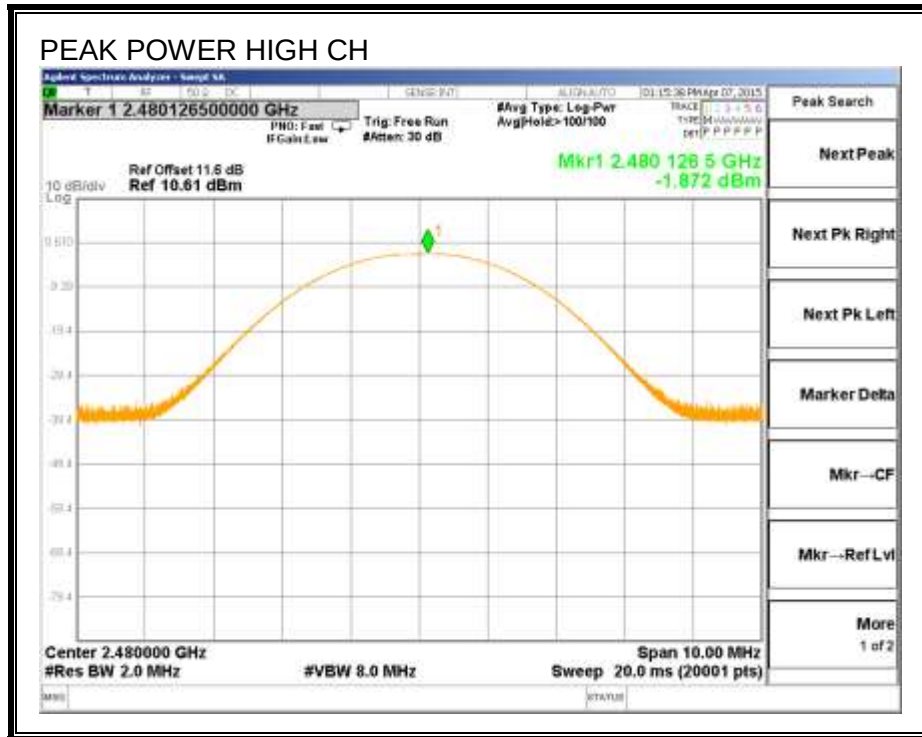
RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	-2.26	0.00	30	-32.26
Middle	2440	-1.91	0.00	30	-31.91
High	2480	-1.87	0.00	30	-31.87

OUTPUT POWER







7.1.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.6 dB (including 10 dB pad and 1.6 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	-3.40
Middle	2441	-3.01
High	2480	-2.91

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-210 A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

TEST PROCEDURE

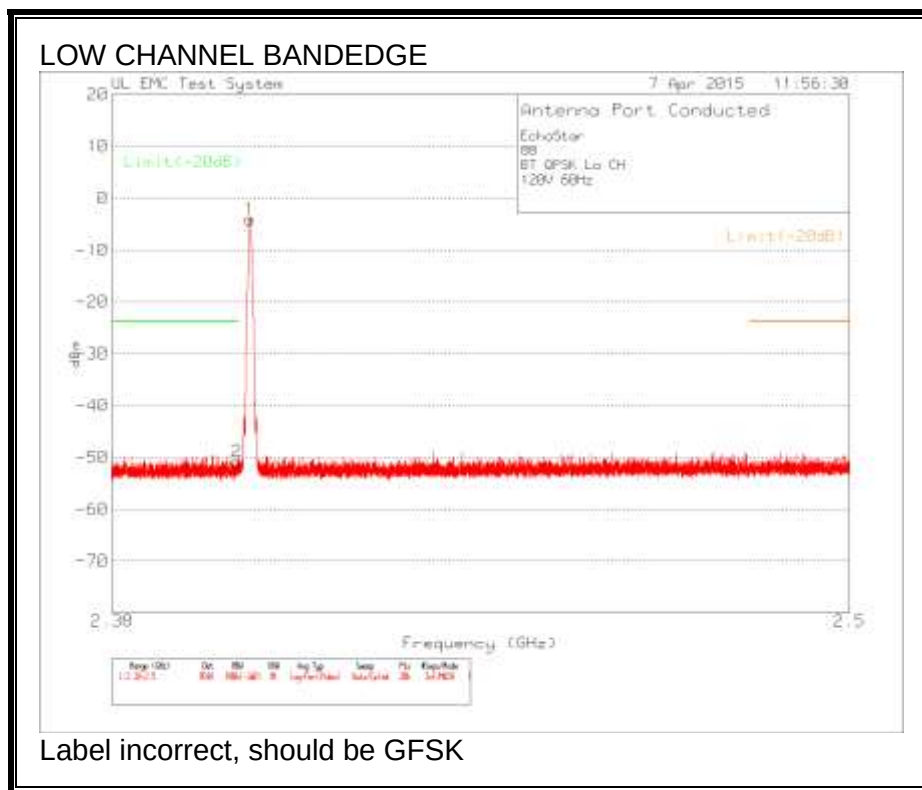
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

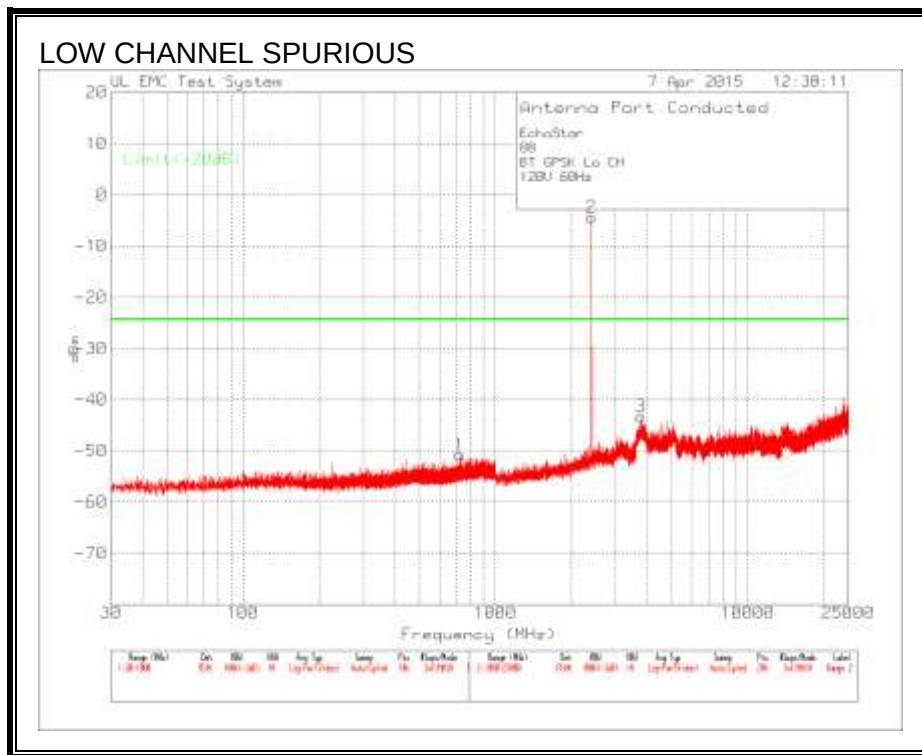


EchoStar
88
BT GFSK Lo CH
120V 60Hz

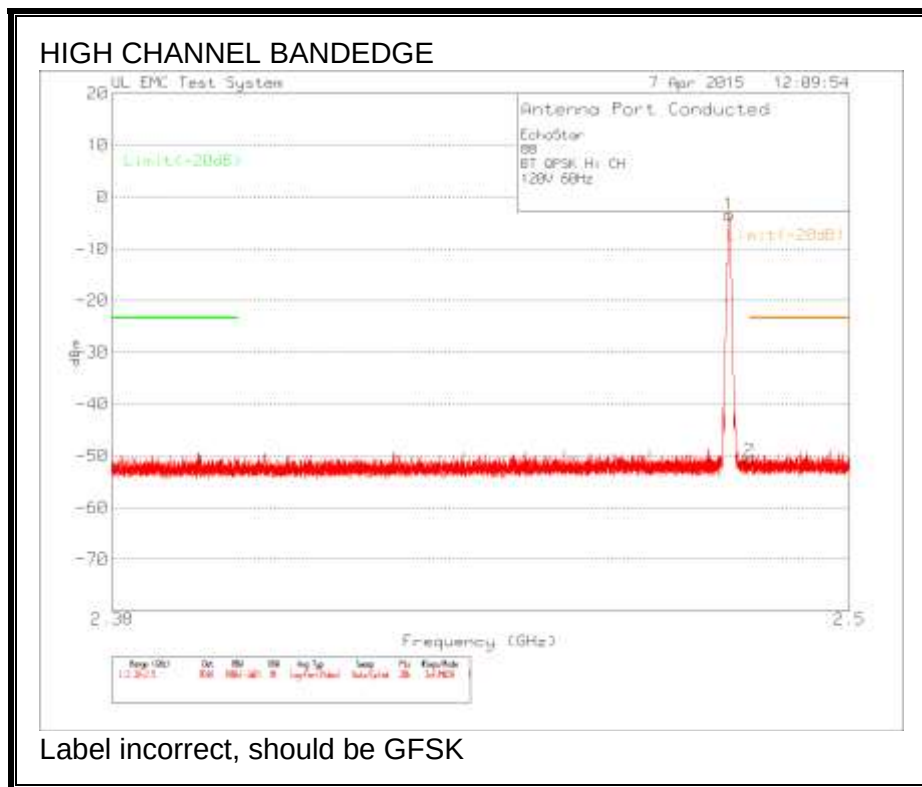
Trace Markers										
Test	Meter	Transducer	Gain/Loss	Corrected	Limit:1	2	3	4	5	6
No. Frequency (GHz)	Reading	Factor (dB)	Factor (dB)	Reading dBm						
Range 2 2.38 - 2.5GHz										
1 2.401981	91.84dBuV PK	-107	11.1	-4.06	-	-	-	-	-	-
				Margin (dB)	-	-	-	-	-	-
2 2.399914	45.05dBuV PK	-107	11.1	-50.85	-23.81	-	-	-	-	-
				Margin (dB)	-27.04	-	-	-	-	-

LIMIT 1: Limit
LIMIT 2: Limit

PK - Peak detector



SPURIOUS EMISSIONS, HIGH CHANNEL

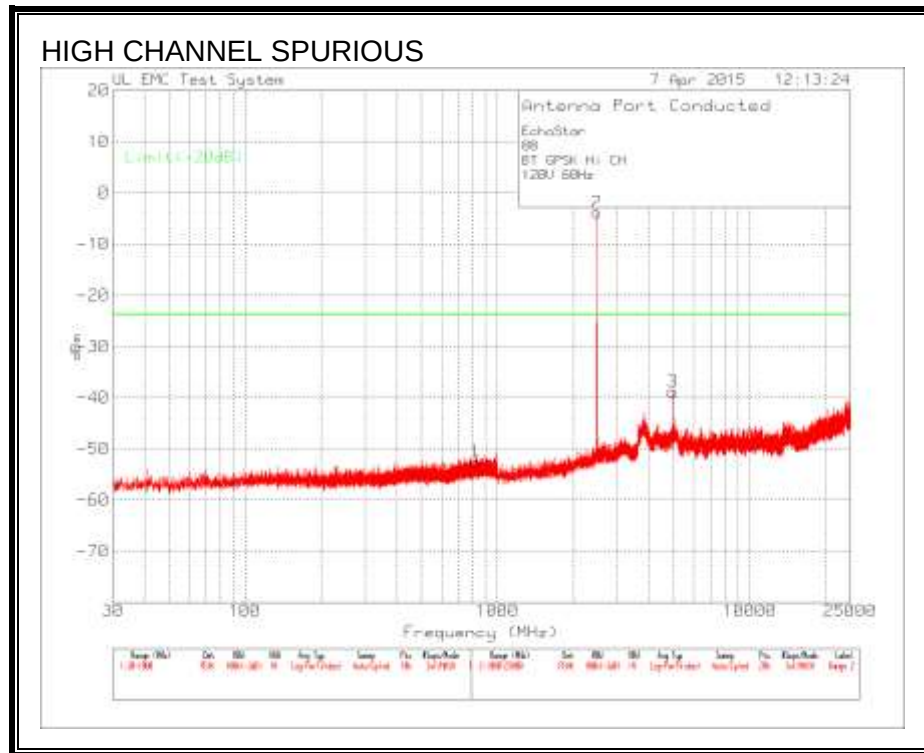


EchoStar
88
BT GFSK Hi CH
120V 60Hz

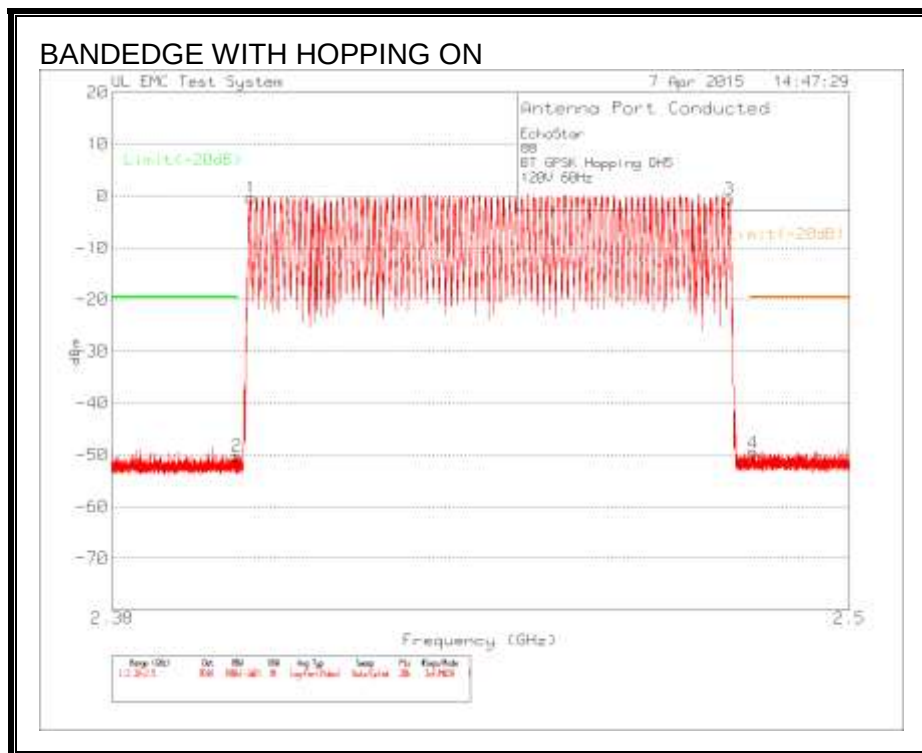
Trace Markers											
Test	Meter	Transducer	Gain/Loss	Corrected	Limit:1	2	3	4	5	6	
No. Frequency	Reading	Factor	Factor	Reading dBm							
(GHz)		(dB)	(dB)								
=====											
Range 2 2.38 - 2.5GHz	-----										
1 2.480008	92.53dBuV PK	-107	11.1	-3.37	-	-	-	-	-	-	-
				Margin (dB)	-	-	-	-	-	-	-
2 2.48347	45.02dBuV PK	-107	11.1	-50.88	-	-	-	-	-	-	-
				Margin (dB)	-	-	-	-	-	-	-

LIMIT 1: Limit
LIMIT 2: Limit

PK - Peak detector



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



EchoStar
88
BT GPSK Hopping DHS
120V 60Hz

Trace Markers						1	2	3	4	5	6
No.	Test Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dBm	Limit:1 (dB)	2	3	4	5	6
1	2.402176	95.49dBuV PK	-107	11.1	-41	-	-	-	-	-	-
					Margin (dB)	-	-	-	-	-	-
2	2.399896	45.67dBuV PK	-107	11.1	-50.23	-19.54	-	-	-	-	-
					Margin (dB)	-30.69	-	-	-	-	-
3	2.480068	95.36dBuV PK	-107	11.1	-54	-	-	-	-	-	-
					Margin (dB)	-	-	-	-	-	-
4	* 2.484022	46.22dBuV PK	-107	11.1	-49.68	-	-19.54	-	-	-	-
					Margin (dB)	-	-30.14	-	-	-	-

LIMIT 1: Limit
LIMIT 2: Limit

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

PK - Peak detector

7.2. ENHANCED DATA RATE QPSK MODULATION

7.2.1. OUTPUT POWER

LIMIT

§15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-210 Clause A8.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

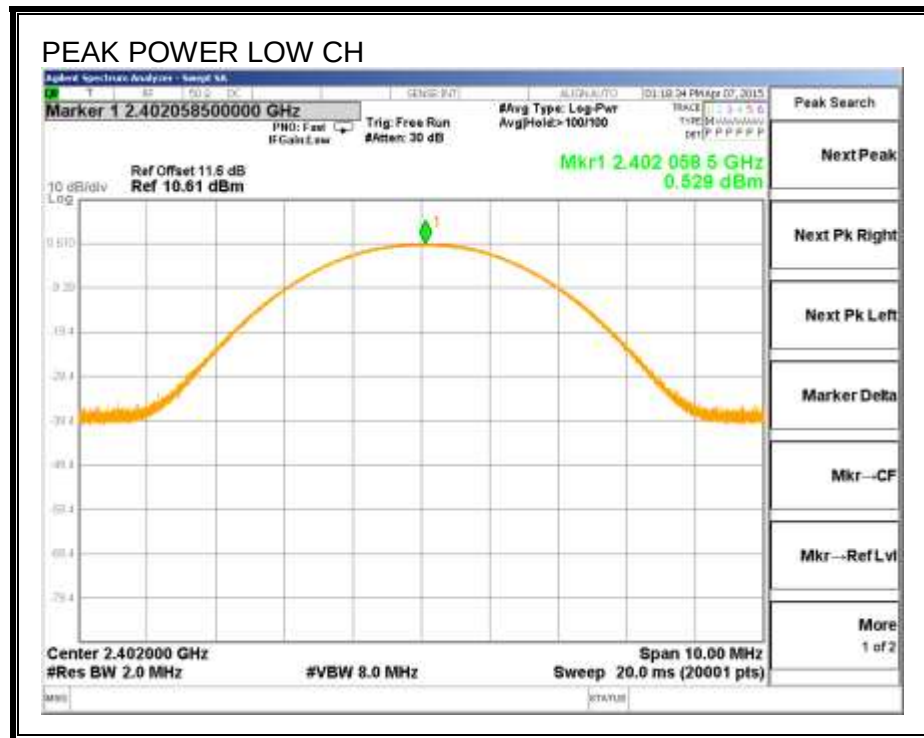
TEST PROCEDURE

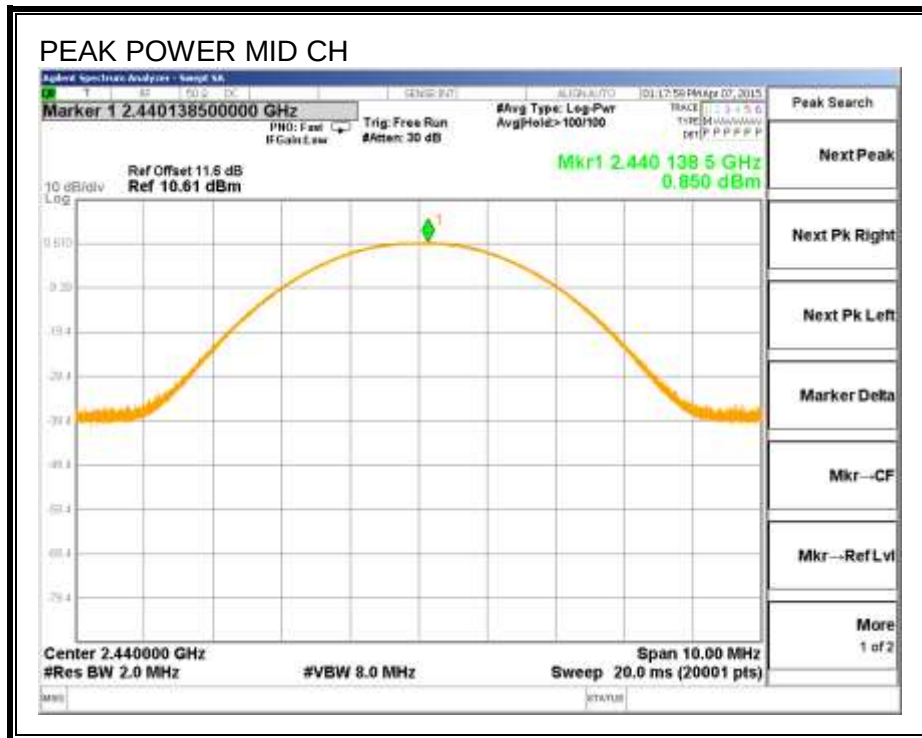
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

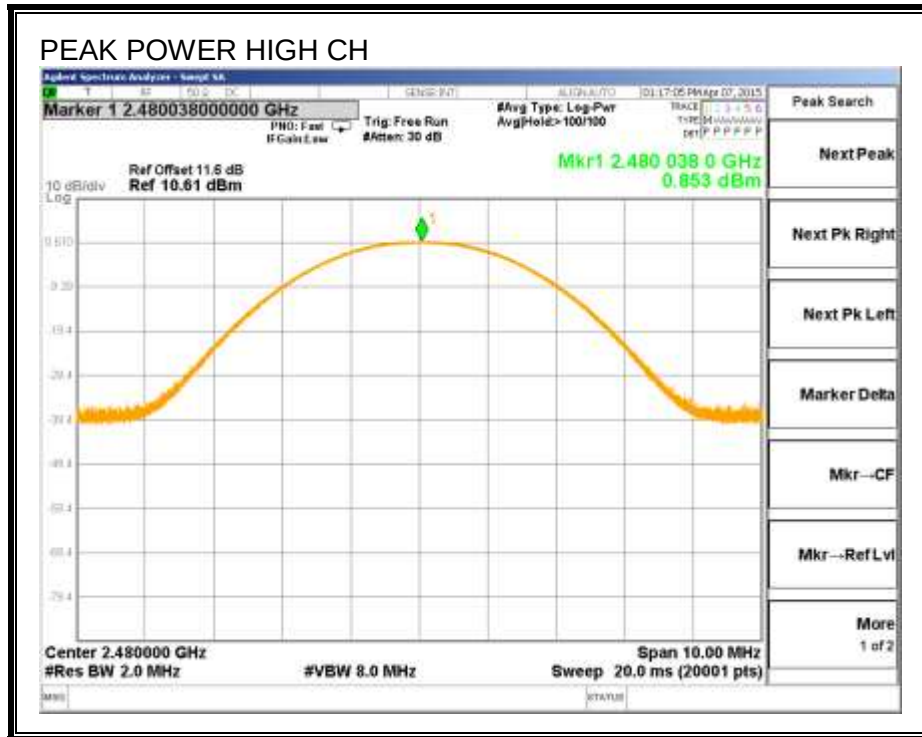
RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	0.53	0.00	30	-29.47
Middle	2441	0.85	0.00	30	-29.15
High	2480	0.85	0.00	30	-29.15

OUTPUT POWER







7.3. ENHANCED DATA RATE 8PSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1.346	1.2
Middle	2441	1.348	1.1998
High	2480	1.348	1.2017

20 dB AND 99% BANDWIDTH







7.3.2. OUTPUT POWER

LIMIT

§15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-210 Clause A8.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

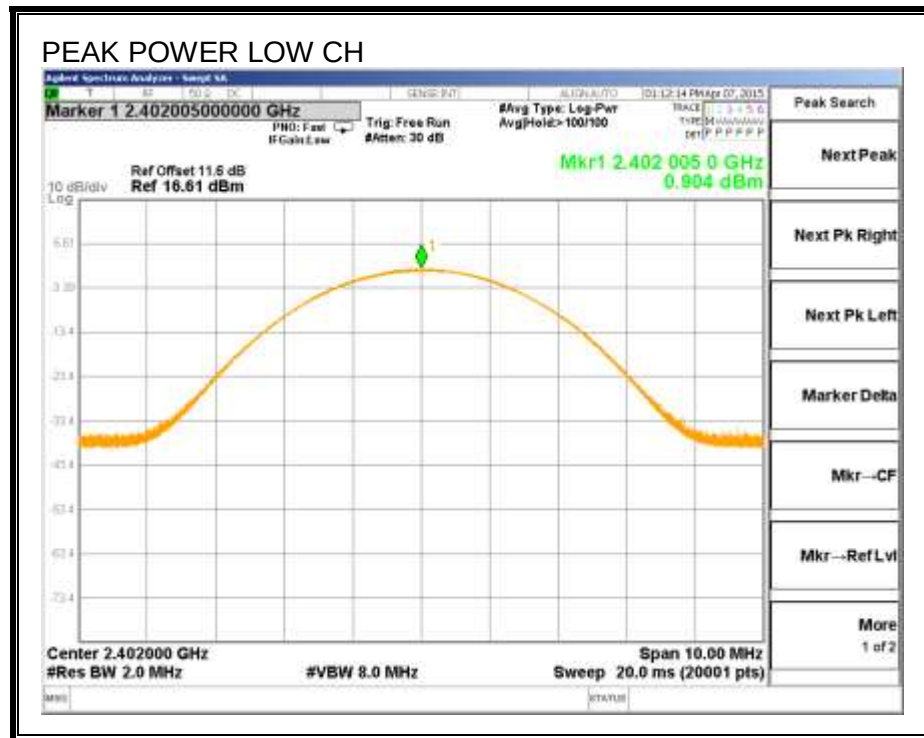
TEST PROCEDURE

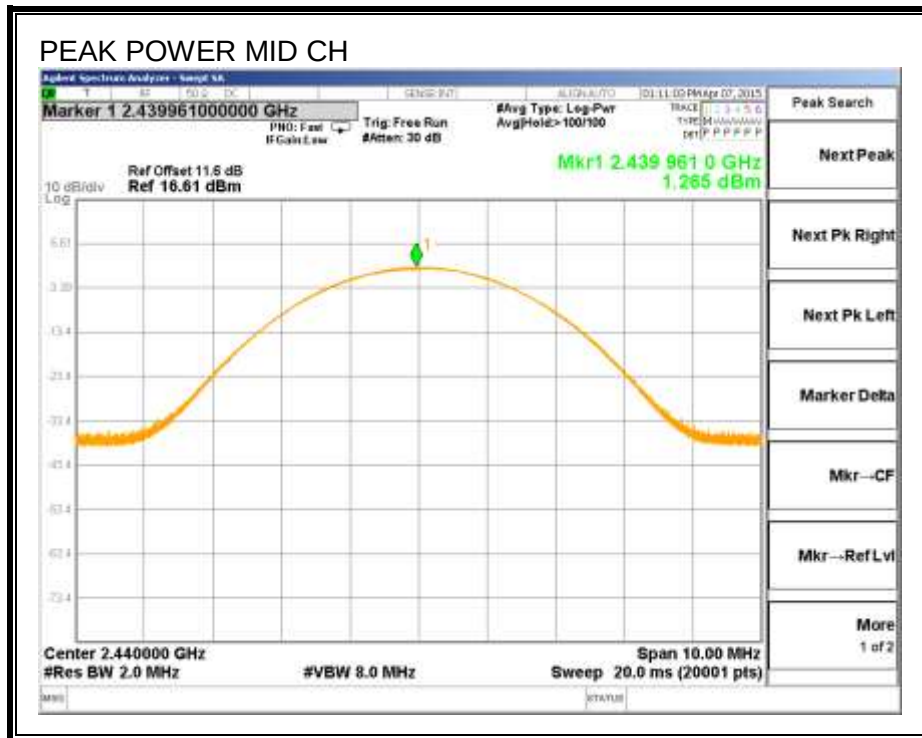
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

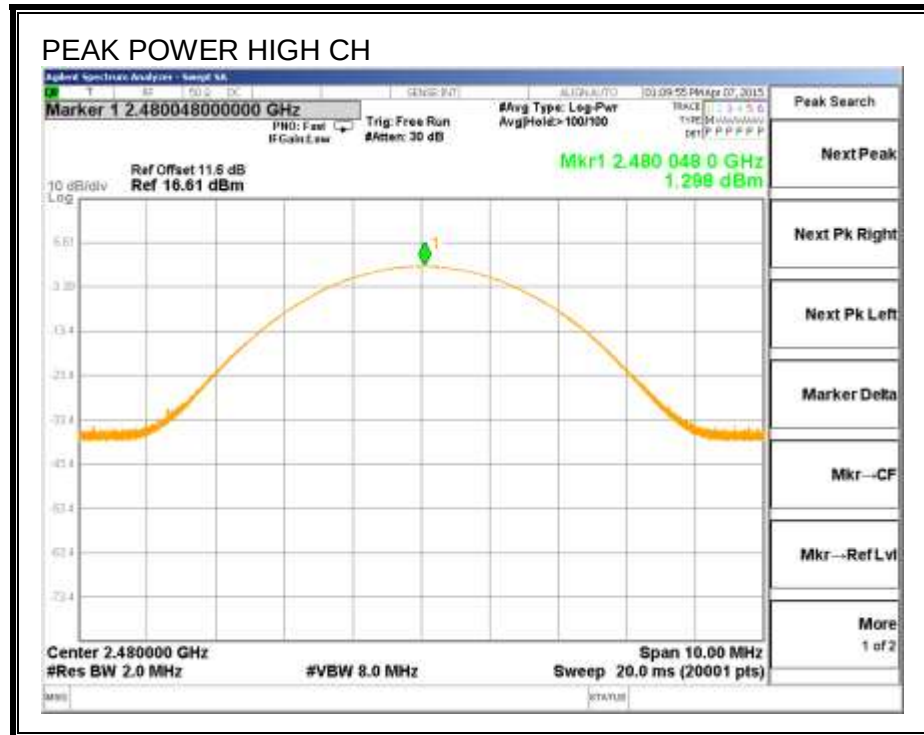
RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	0.90	0.00	30	-29.10
Middle	2440	1.27	0.00	30	-28.74
High	2480	1.30	0.00	30	-28.70

OUTPUT POWER







7.3.3. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.6dB (including 10 dB pad and 1.6 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	-2.94
Middle	2441	-2.55
High	2480	-2.45

7.3.4. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-210 A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

TEST PROCEDURE

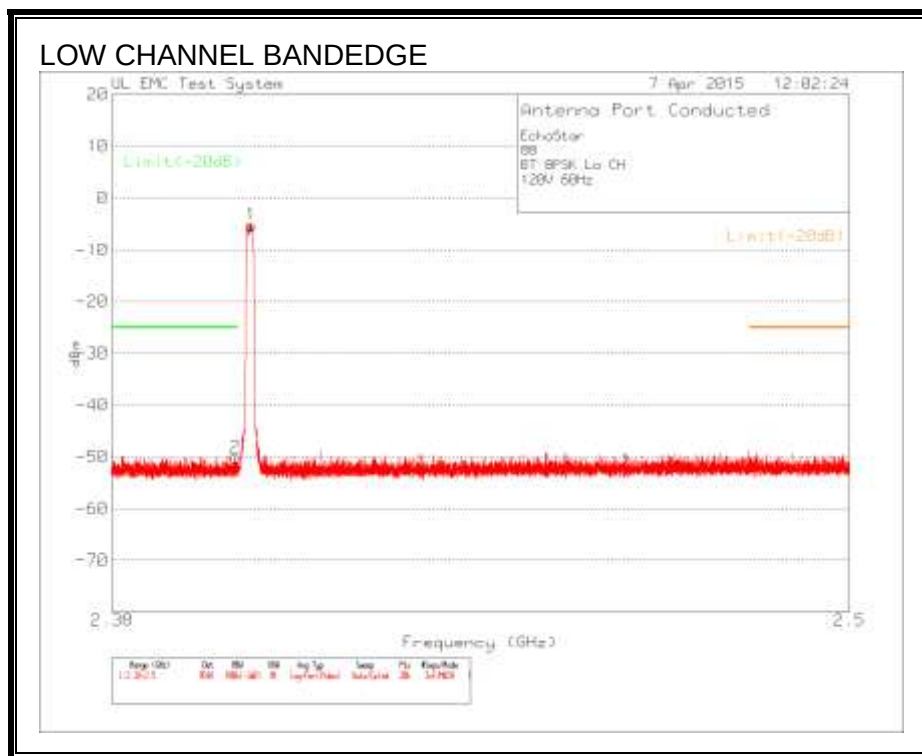
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

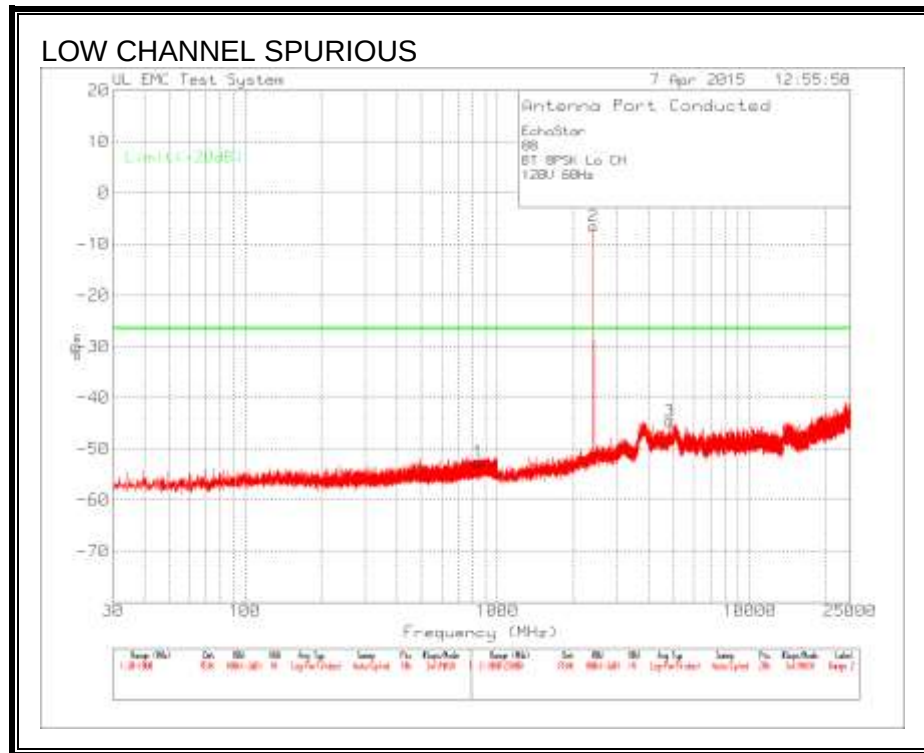


EchoStar
88
BT 8PSK Lo CH
120V 60Hz

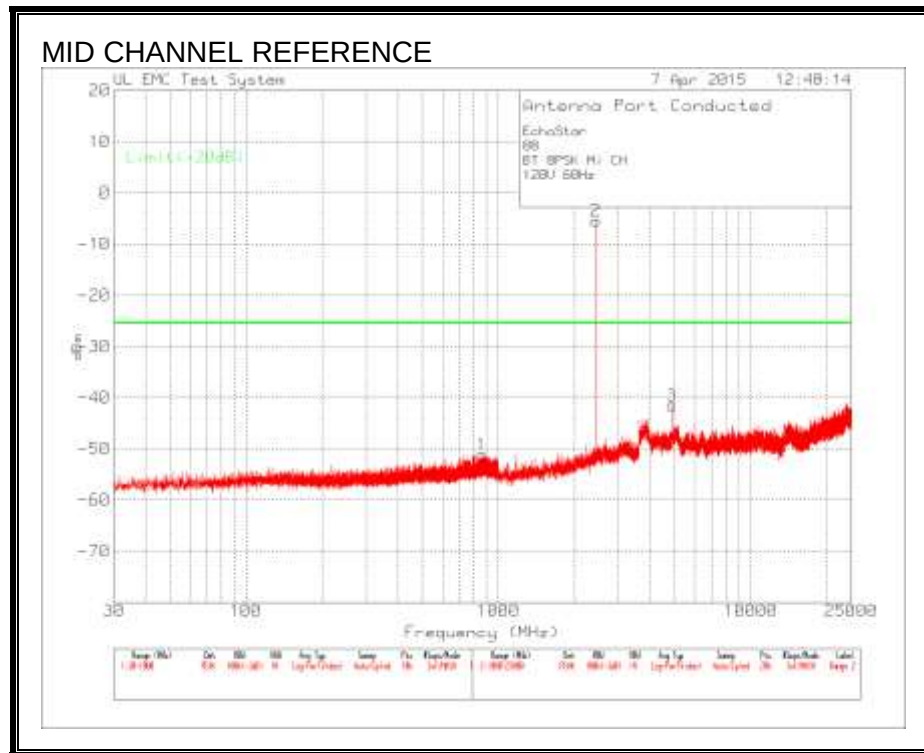
Trace Markers										
Test	Meter	Transducer	Gain/Loss	Corrected	Limit:1	2	3	4	5	6
No. Frequency (GHz)	Reading	Factor (dB)	Factor (dB)	Reading dBm						
=====										
Range 2 2.38 - 2.5GHz	-----									
1 2.4022	90.69dBuV PK	-107	11.1	-5.21	-	-	-	-	-	-
				Margin (dB)	-	-	-	-	-	-
2 2.39971	45.81dBuV PK	-107	11.1	-50.09	-25.09	-	-	-	-	-
				Margin (dB)	-25	-	-	-	-	-

LIMIT 1: Limit
LIMIT 2: Limit

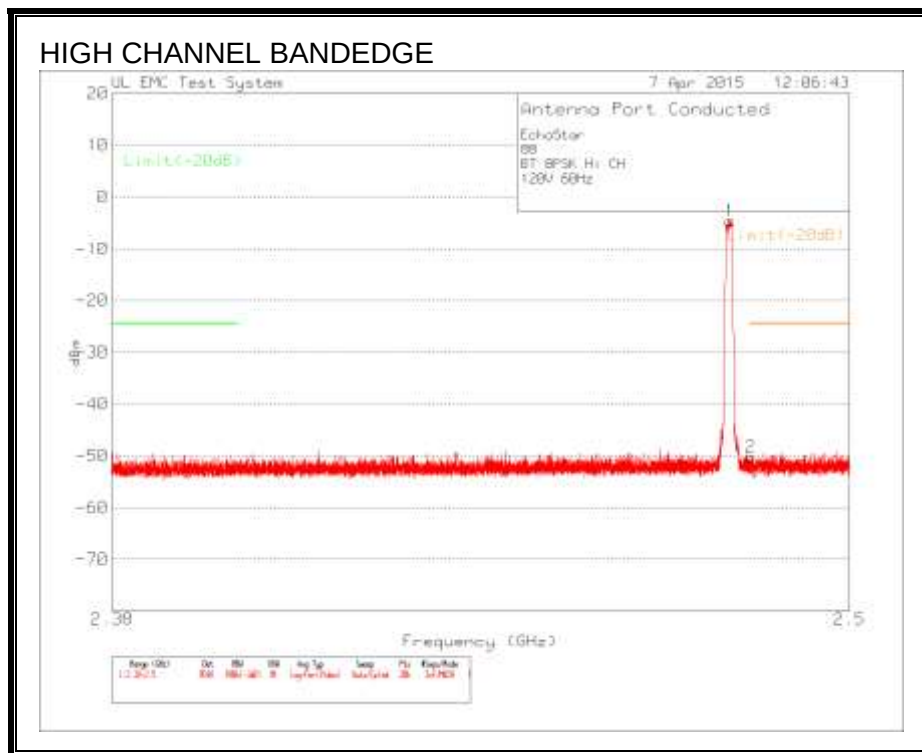
PK - Peak detector



SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



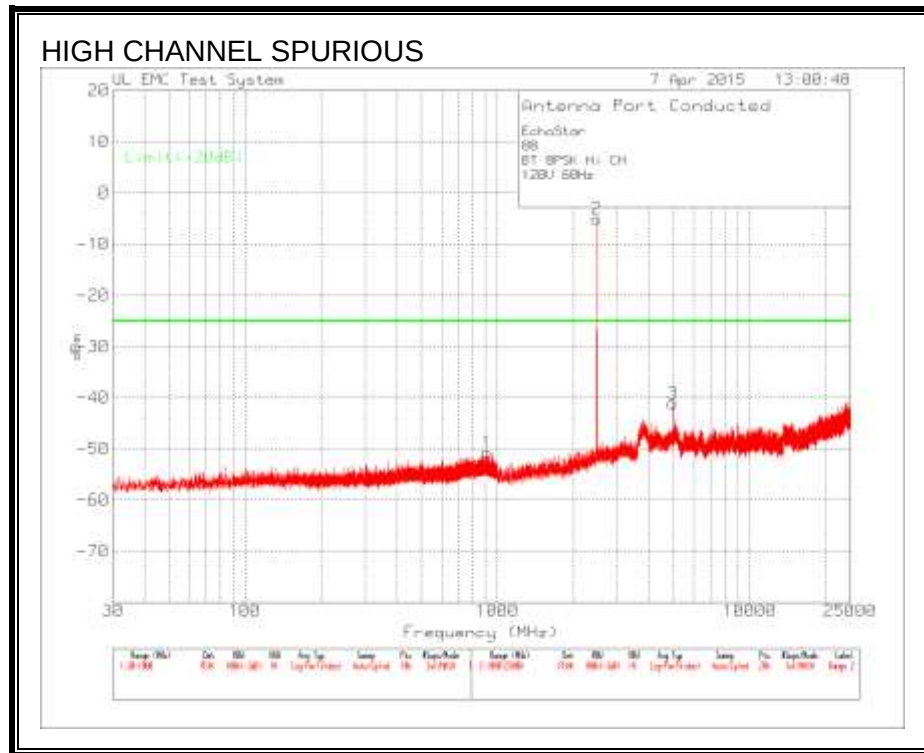
EchoStar
88
BT 8PSK Hi CH
120V 60Hz

Trace Markers										
Test	Meter	Transducer	Gain/Loss	Corrected	Limit:1	2	3	4	5	6
No. Frequency (GHz)	Reading	Factor (dB)	Factor (dB)	Reading dBm						
Range 2 2.38 - 2.5GHz										
1 2.4802	91.27dBuV PK	-107	11.1	-4.63	-	-	-	-	-	-
				Margin (dB)	-	-	-	-	-	-
2 * 2.483629	45.69dBuV PK	-107	11.1	-50.21	-	-24.5	-	-	-	-
				Margin (dB)	-	-25.71	-	-	-	-

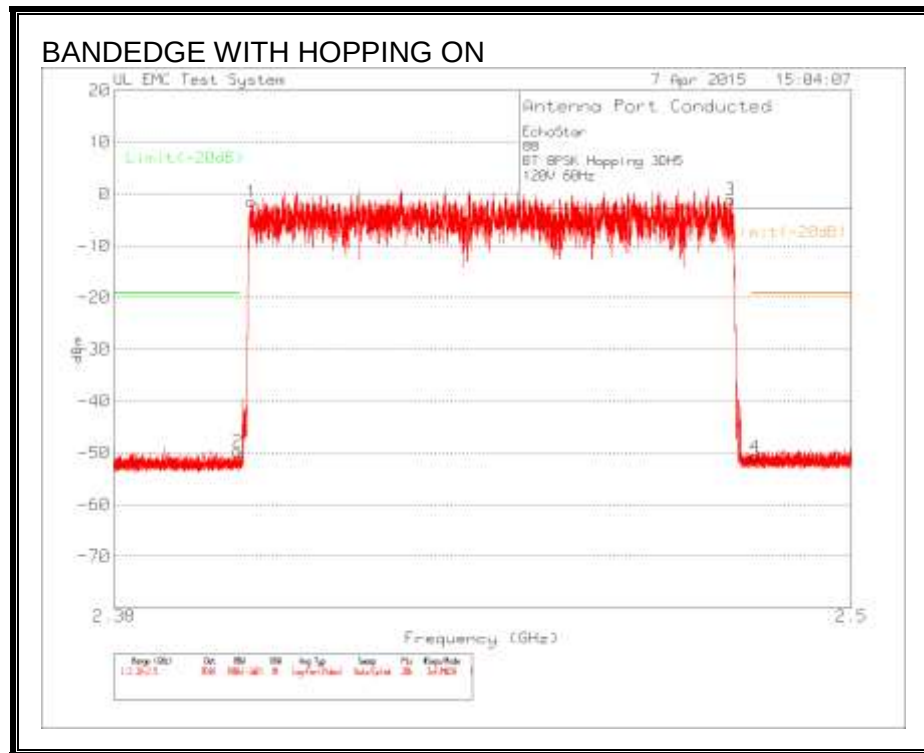
LIMIT 1: Limit
LIMIT 2: Limit

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

PK - Peak detector



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



EchoStar
88
BT 8PSK Hopping 3DH5
120V 60Hz

Trace Markers						1	2	3	4	5	6
No.	Test Frequency (GHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dBm	Limit:1 (dB)					
Range 2 2.38 - 2.5GHz											
1	2.40199	94.38dBuV PK	-107	11.1	-1.52	-	-	-	-	-	-
					Margin (dB)	-	-	-	-	-	-
2	2.399758	46.18dBuV PK	-107	11.1	-49.72	-19.23	-	-	-	-	-
					Margin (dB)	-30.49	-	-	-	-	-
3	2.479972	94.82dBuV PK	-107	11.1	-1.08	-	-	-	-	-	-
					Margin (dB)	-	-	-	-	-	-
4	* 2.483998	45.16dBuV PK	-107	11.1	-50.74	-	-19.23	-	-	-	-
					Margin (dB)	-	-31.51	-	-	-	-

LIMIT 1: Limit
LIMIT 2: Limit

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

PK - Peak detector

8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-GEN Clause 8.9 (Transmitter)

IC RSS-GEN Clause 7.1.2 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

Test setup

80cm below 1GHz

1.5m above 1GHz

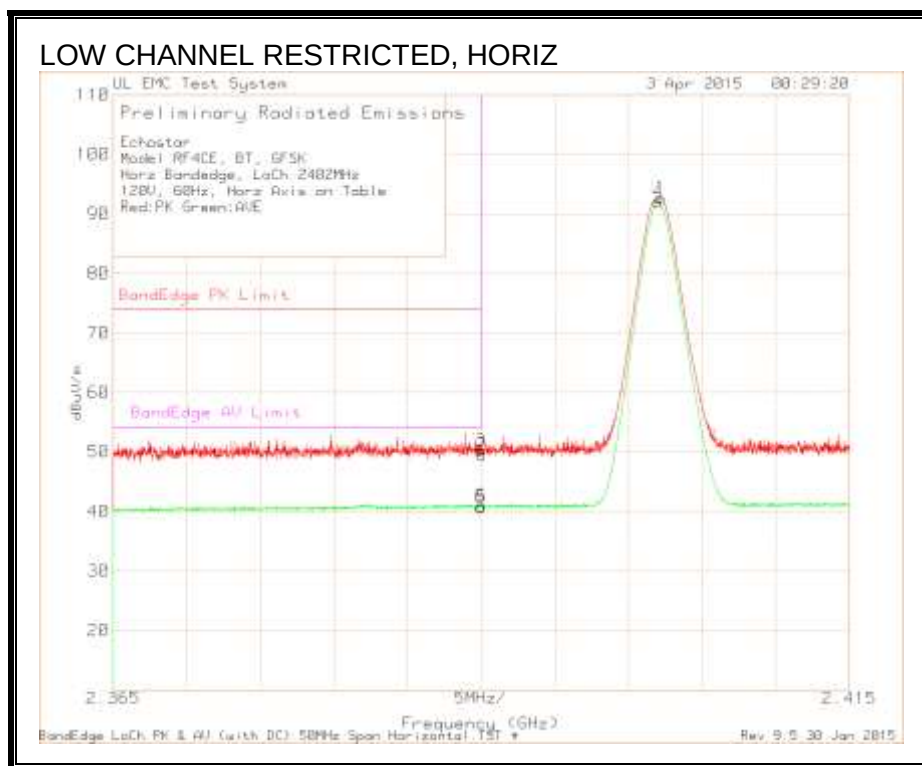
Peak 1MHz/1MHz – Peak detector

AV 1MHz/1MHz – AV dectector

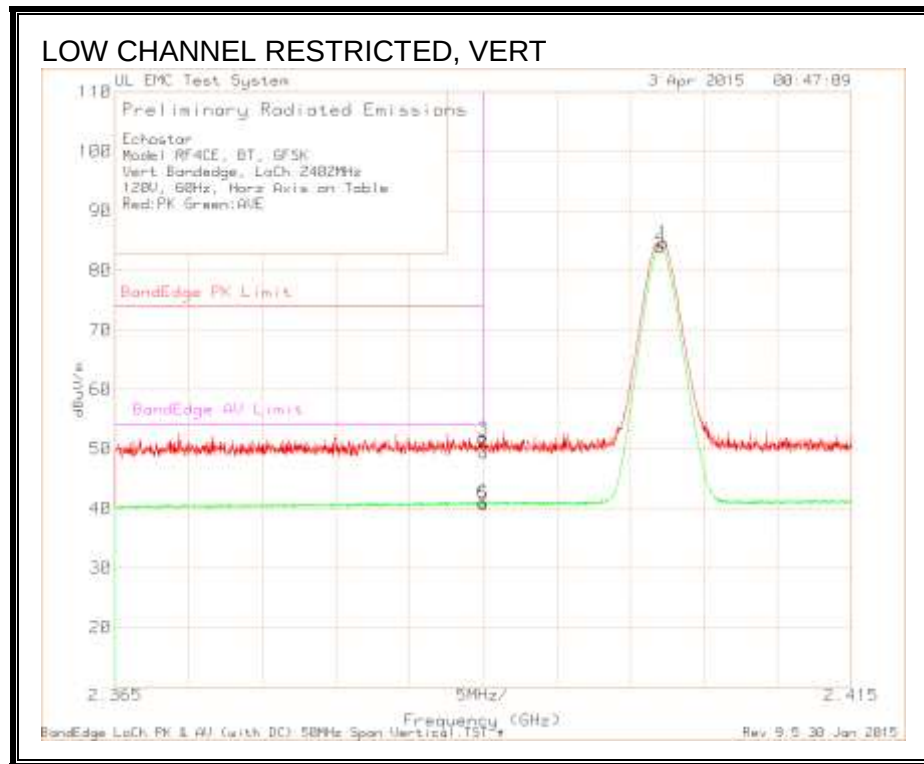
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION

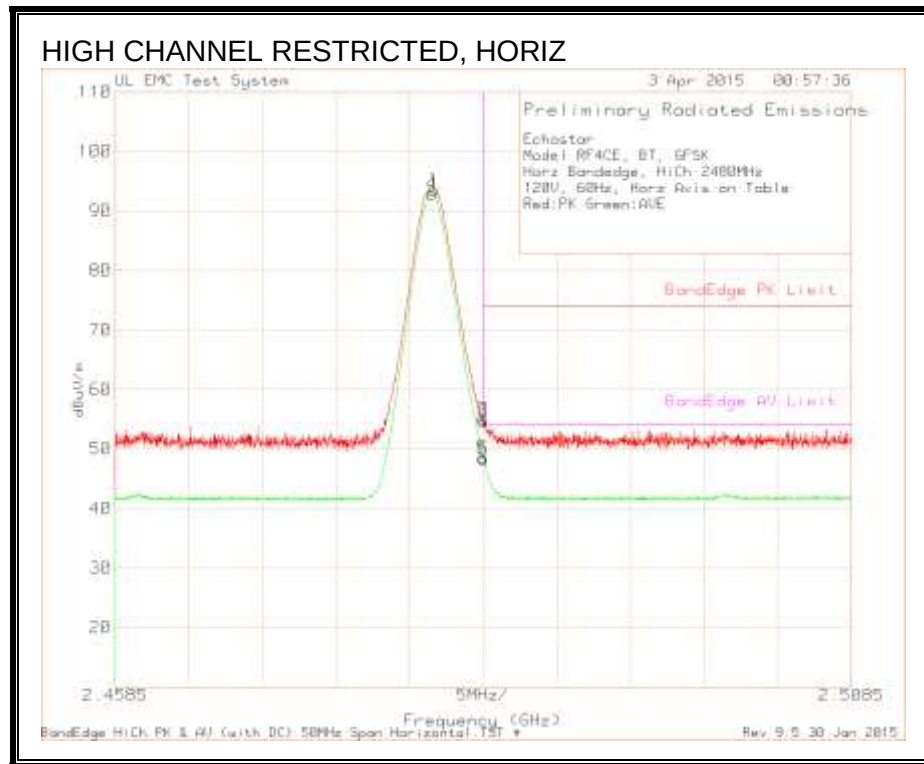
RESTRICTED BANDEDGE (LOW CHANNEL, Horizontal)



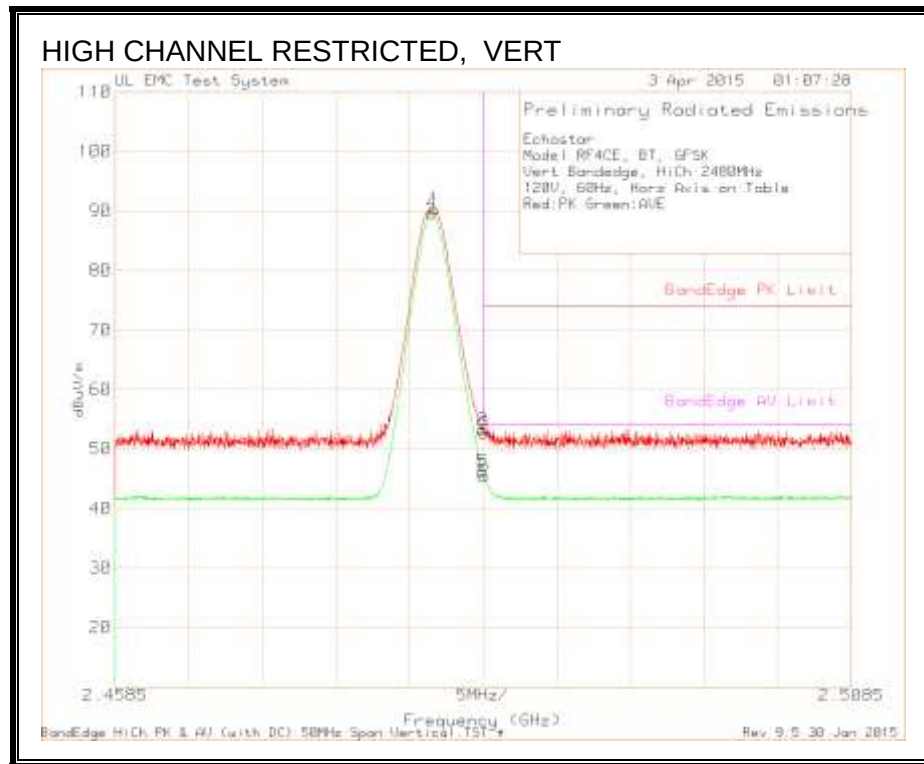
RESTRICTED BANDEDGE (LOW CHANNEL, Vertical)

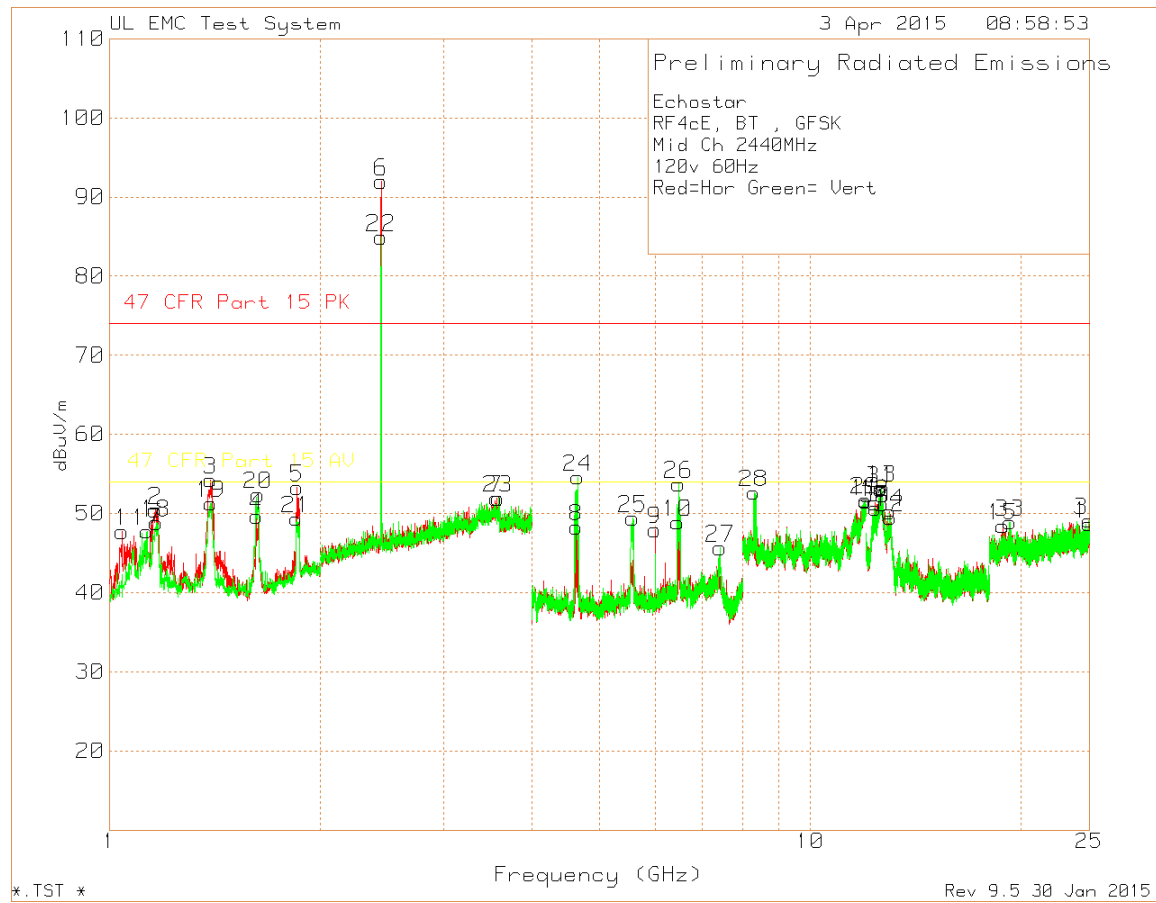


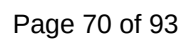
RESTRICTED BANEDGE (HIGH CHANNEL, Horizontal)



RESTRICTED BANEDGE (HIGH CHANNEL, Vertical)







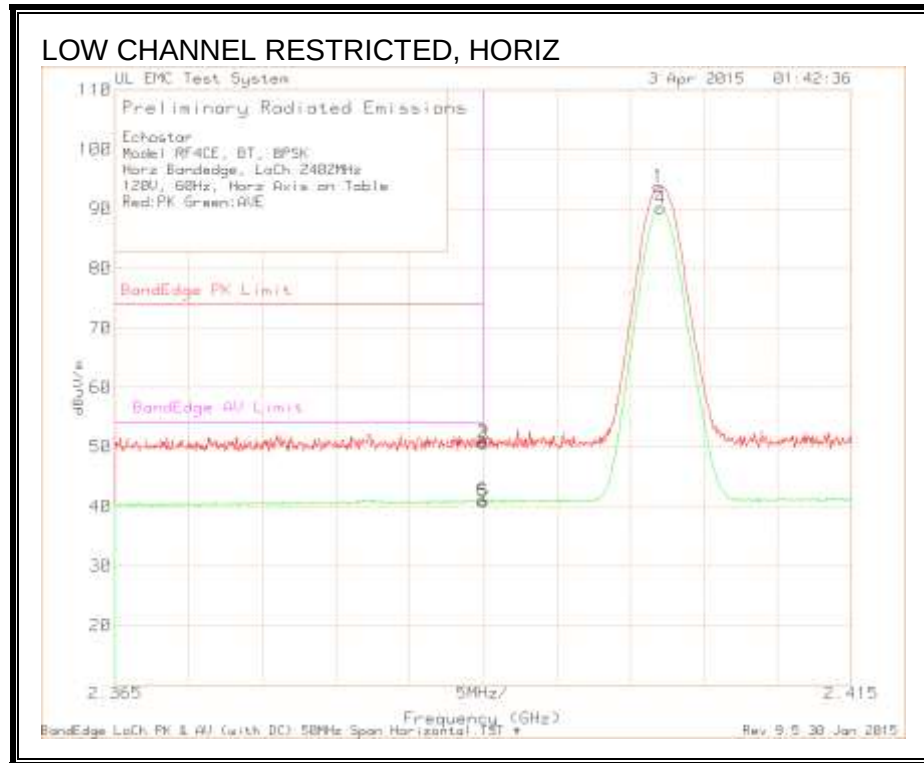
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Echostar												
Model 088												
120V, 60Hz												
Test	Meter		Antenna		Corrected	47 CFR		47 CFR				
Frequency	Reading		factor	Gain/Loss	Reading	Part 15	Margin	Part 15	Margin	Azimuth	Height	
(GHz)	(dBuV)	Detector	dB/m	(dB)	dBuV/m	PK	(dB)	AV	(dB)	[Degs]	[cm]	Polarity
1.3921	82.43	Pk	29	-55.74	55.69	74	-18.31	-	-	10	193	H
1.3897	65.76	Av	29	-55.75	39.01	74	-34.99	54	-14.99	10	193	H
1.389	65.8	Av	29	-55.75	39.05	74	-34.95	54	-14.95	10	193	H
1.384	80.22	Pk	29	-55.78	53.44	74	-20.56	-	-	256	100	V
1.3891	63.87	Av	29	-55.75	37.12	74	-36.88	54	-16.88	256	100	V
1.1558	78.89	Pk	28	-56.43	50.46	74	-23.54	-	-	245	100	V
1.1562	63.36	Av	28	-56.43	34.93	74	-39.07	54	-19.07	245	100	V
1.1623	82.74	Pk	28.1	-56.42	54.42	74	-19.58	-	-	76	132	H
1.1619	65.64	Av	28.1	-56.42	37.32	74	-36.68	54	-16.68	76	132	H
1.6212	75.31	Pk	28.4	-54.33	49.38	74	-24.62	-	-	78	100	H
1.6219	57.79	Av	28.4	-54.34	31.85	74	-42.15	54	-22.15	78	100	H
1.6287	78.7	Pk	28.5	-54.36	52.84	74	-21.16	-	-	360	144	V
1.8551	78.18	Pk	30.9	-53.87	55.21	74	-18.79	-	-	325	169	H
1.8492	59.43	Av	30.8	-53.94	36.29	74	-37.71	54	-17.71	325	169	H
1.8529	72.21	Pk	30.8	-53.9	49.11	74	-24.89	-	-	151	140	V
1.8556	54.57	Av	30.9	-53.86	31.61	74	-42.39	54	-22.39	151	140	V
2.6812	29.86	Pk	22.1	4.56	56.52	74	-17.48	-	-	257	100	V
2.6812	16.35	Avg	22.1	4.56	43.01	74	-30.99	54	-10.99	257	100	V
6.4881	75.25	Pk	29.1	-47.71	56.64	74	-17.36	-	-	324	100	V
6.4803	50.86	Av	29.1	-47.74	32.22	74	-41.78	54	-21.78	324	100	V
6.5131	72.16	Pk	29	-47.59	53.57	74	-20.43	-	-	20	100	H
6.4833	49.08	Av	29.1	-47.74	30.44	74	-43.56	54	-23.56	20	100	H
4.6223	75.53	Pk	27.7	-51.9	51.33	74	-22.67	-	-	11	100	H
4.6323	53.88	Av	27.7	-51.83	29.75	74	-44.25	54	-24.25	11	100	H
4.6169	81.31	Pk	27.7	-51.87	57.14	74	-16.86	-	-	158	100	V
4.6344	57.01	Av	27.7	-51.78	32.93	74	-41.07	54	-21.07	158	100	V
5.5661	68.76	Pk	28.3	-49.8	47.26	74	-26.74	-	-	74	161	H
5.5448	51.86	Av	28.3	-49.75	30.41	74	-43.59	54	-23.59	74	161	H
5.5662	73.03	Pk	28.3	-49.8	51.53	74	-22.47	-	-	169	100	V
5.5448	53.4	Av	28.3	-49.75	31.95	74	-42.05	54	-22.05	169	100	V
6.0001	69.56	Pk	28.7	-48.75	49.51	74	-24.49	-	-	270	143	H
6.0001	66.43	Av	28.7	-48.75	46.38	74	-27.62	54	-7.62	270	143	H
6.0001	66.47	Pk	28.7	-48.75	46.42	74	-27.58	-	-	61	100	V
6.0001	60.65	Av	28.7	-48.75	40.6	74	-33.4	54	-13.4	61	100	V
8.3454	71.96	Pk	36.5	-48.77	59.69	74	-14.31	-	-	308	100	V
8.3654	50.7	Av	36.5	-49.07	38.13	74	-35.87	54	-15.87	308	100	V
12.6054	59.23	Pk	39.5	-34.53	64.2	74	-9.8	-	-	201	100	H
12.6059	46.59	Av	39.5	-34.52	51.57	74	-22.43	54	-2.43	201	100	H
12.6044	59.84	Pk	39.5	-34.56	64.78	74	-9.22	-	-	179	100	V
12.6062	45.01	Avg	39.5	-34.51	50	74	-24	54	-4	179	100	V

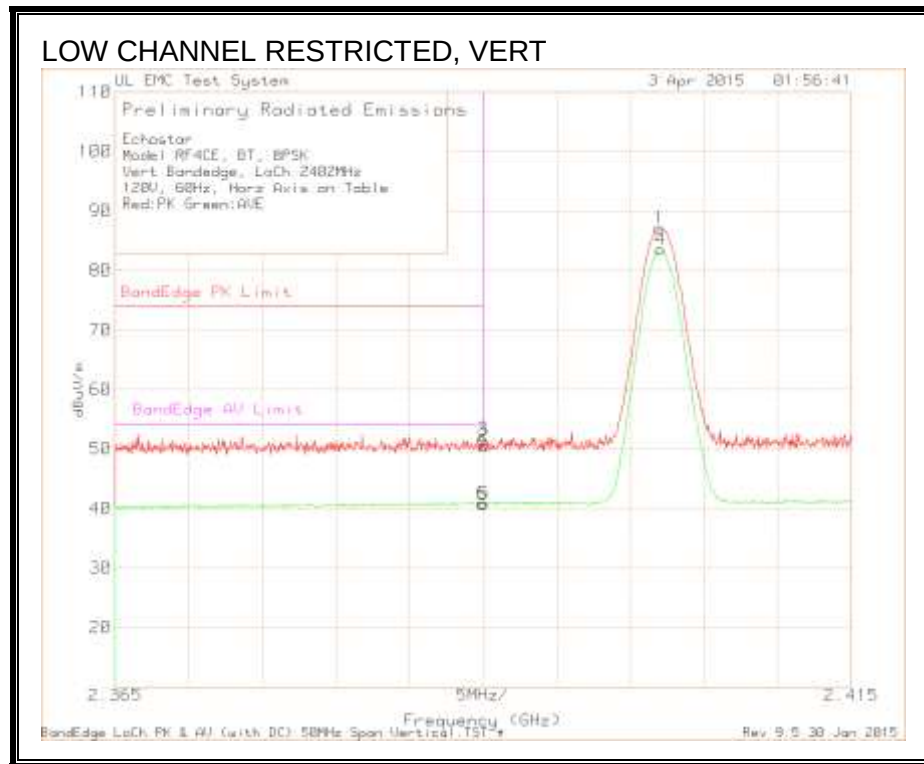
Emissions found within 6dB of the limit were not harmonics of the transmitter.

8.2.2. ENHANCED DATA RATE 8PSK MODULATION

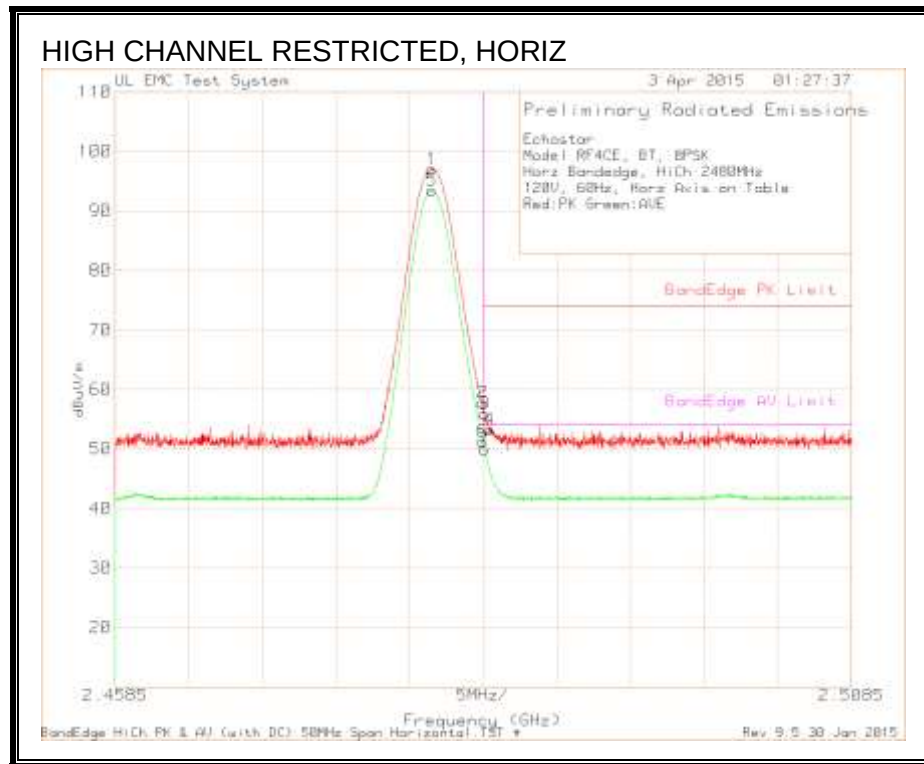
RESTRICTED BANDEDGE (LOW CHANNEL)



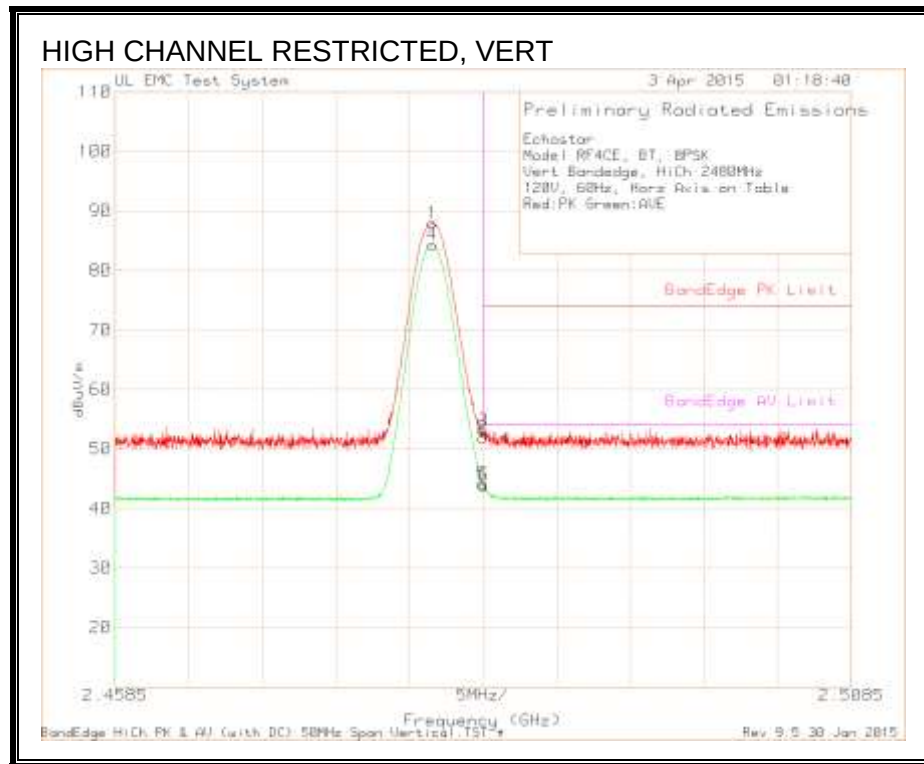
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



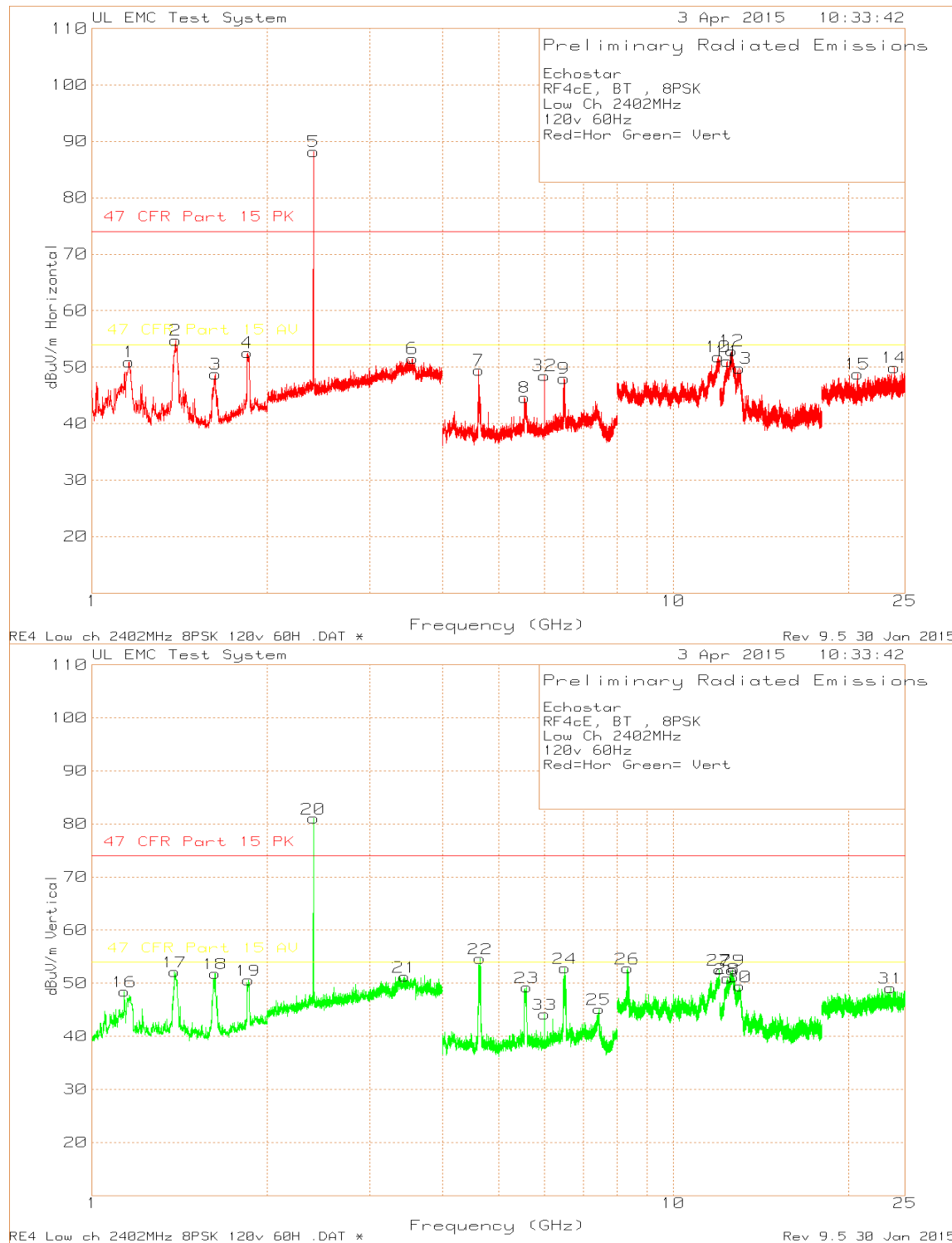
RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)

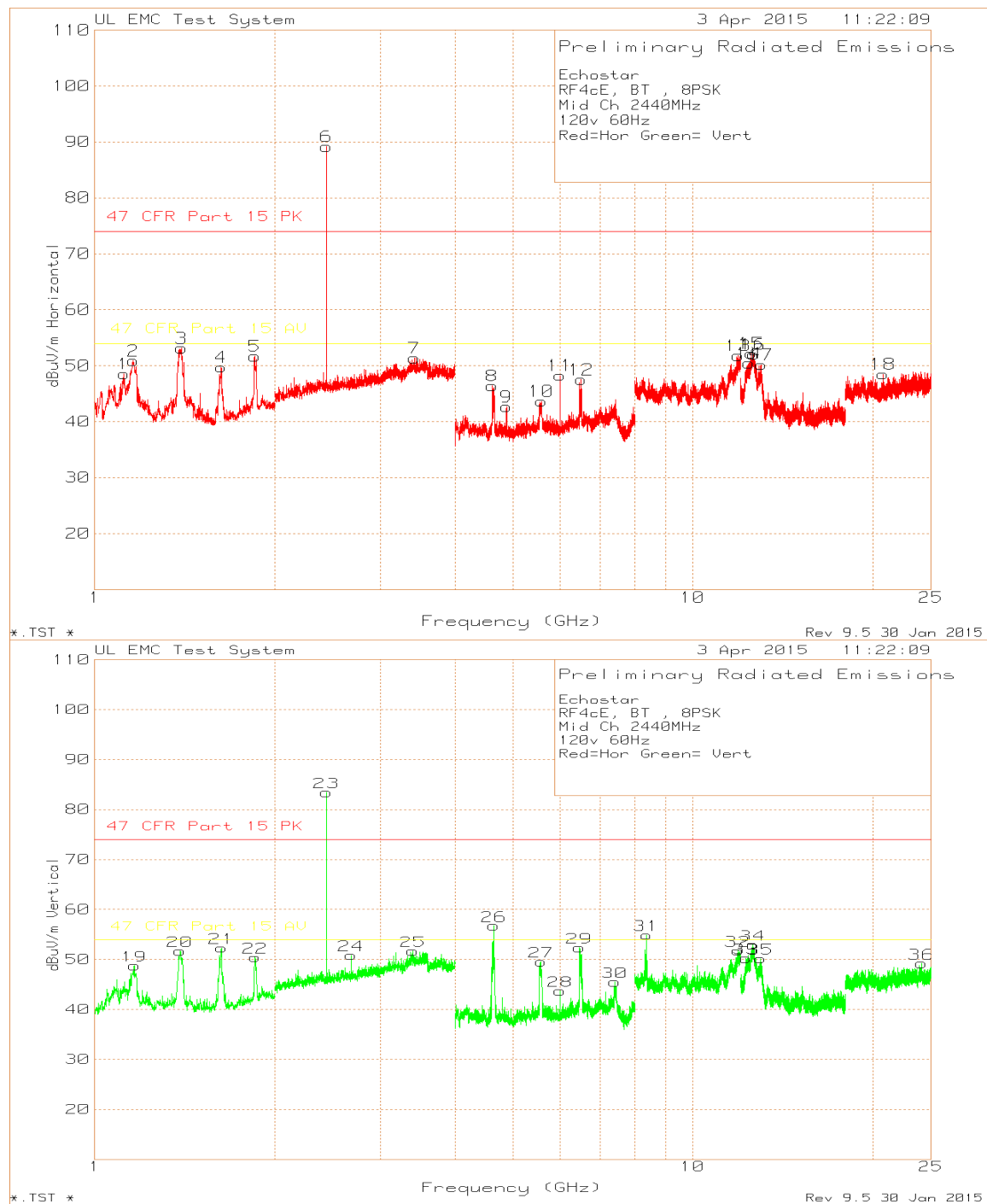


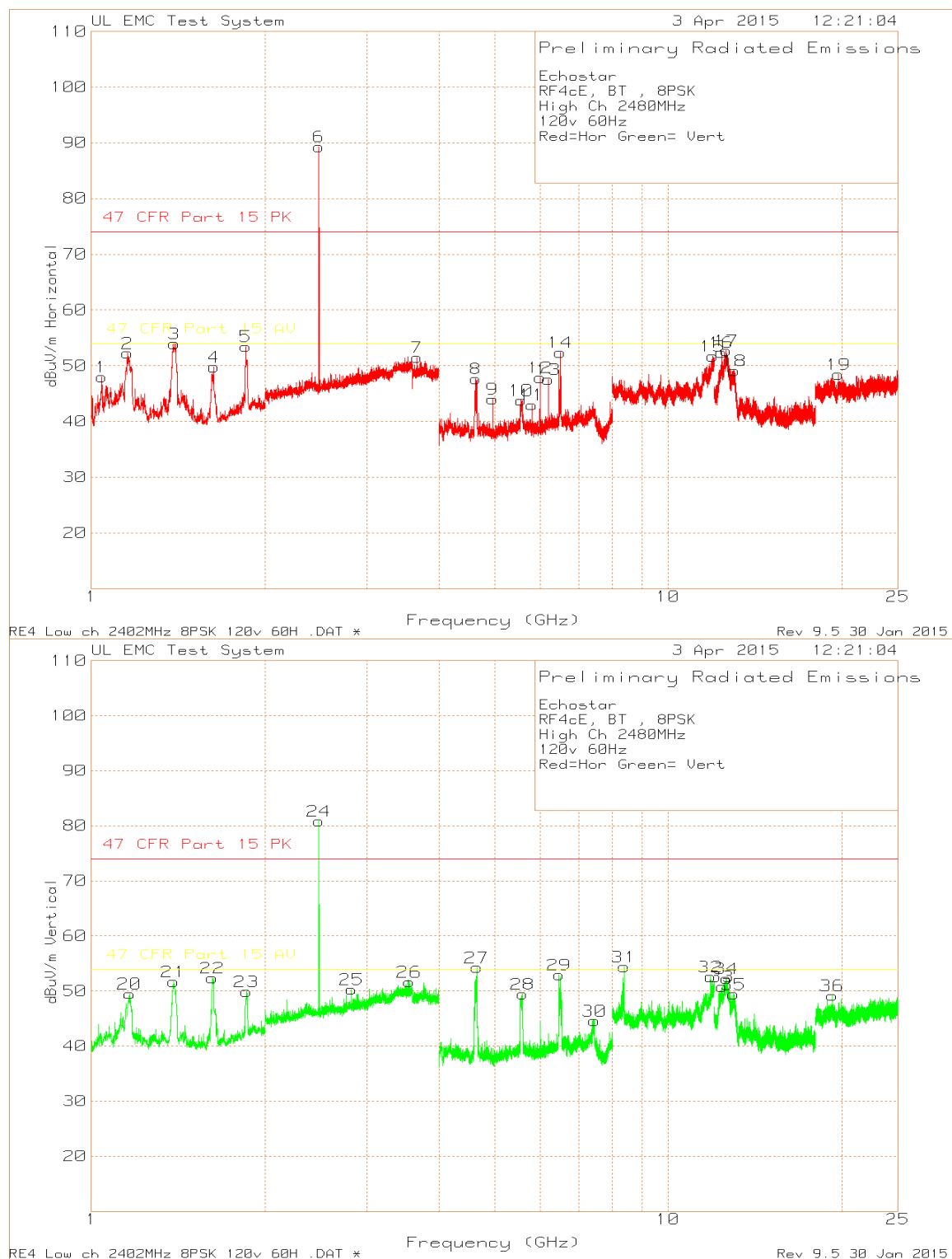
RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS





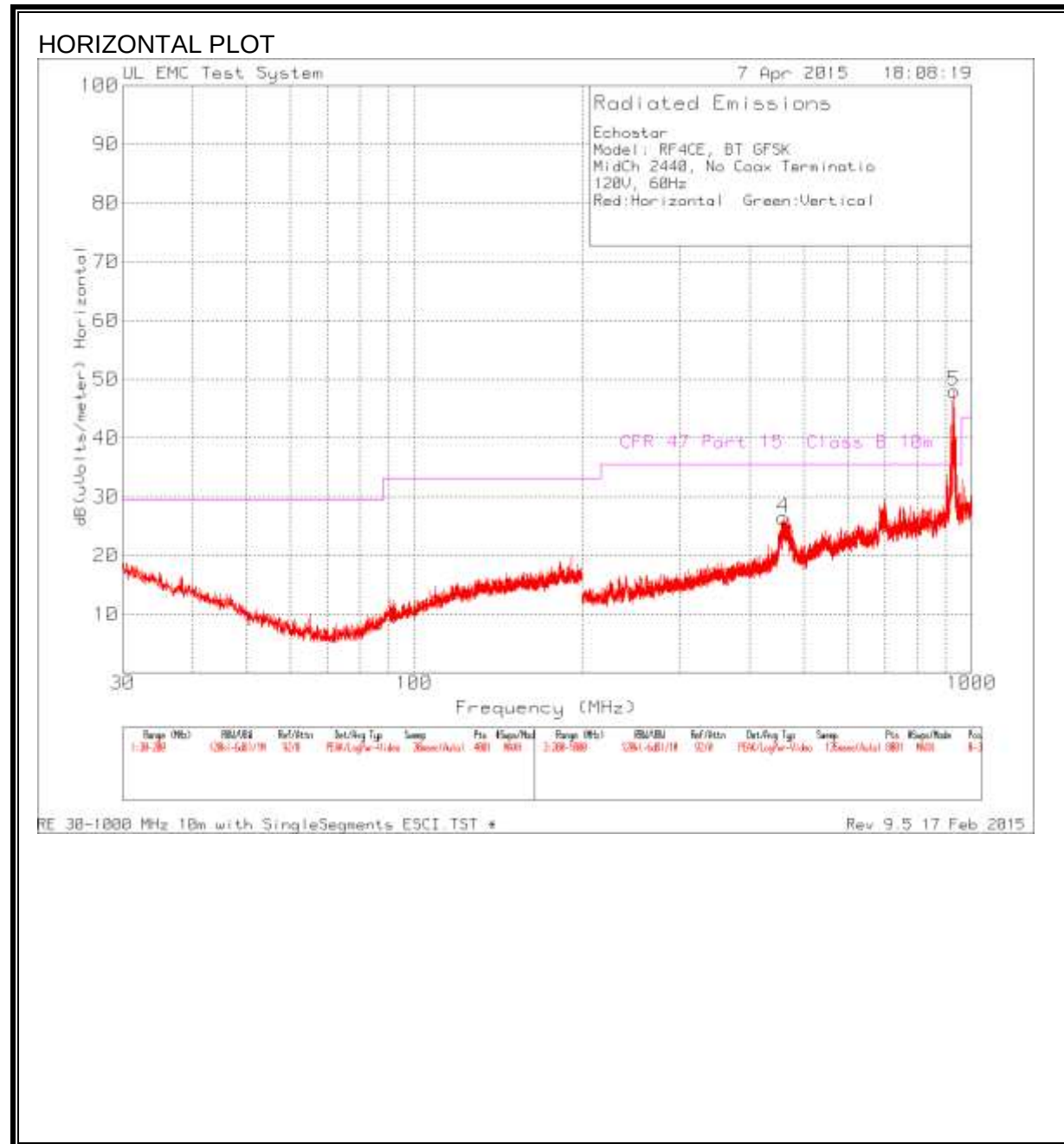


Echostar												
Model 088												
120V, 60Hz												
Test	Meter		Antenna		Corrected	47 CFR		47 CFR				
Frequency	Reading		factor	Gain/Loss	Reading	Part 15	Margin	Part 15	Margin	Azimuth	Height	
(GHz)	(dBuV)	Detector	dB/m	(dB)	dBuV/m	PK	(dB)	AV	(dB)	[Degs]	[cm]	Polarity
1.3921	82.43	Pk	29	-55.74	55.69	74	-18.31	-	-	10	193	H
1.3897	65.76	Av	29	-55.75	39.01	74	-34.99	54	-14.99	10	193	H
1.389	65.8	Av	29	-55.75	39.05	74	-34.95	54	-14.95	10	193	H
1.384	80.22	Pk	29	-55.78	53.44	74	-20.56	-	-	256	100	V
1.3891	63.87	Av	29	-55.75	37.12	74	-36.88	54	-16.88	256	100	V
1.1558	78.89	Pk	28	-56.43	50.46	74	-23.54	-	-	245	100	V
1.1562	63.36	Av	28	-56.43	34.93	74	-39.07	54	-19.07	245	100	V
1.1623	82.74	Pk	28.1	-56.42	54.42	74	-19.58	-	-	76	132	H
1.1619	65.64	Av	28.1	-56.42	37.32	74	-36.68	54	-16.68	76	132	H
1.6212	75.31	Pk	28.4	-54.33	49.38	74	-24.62	-	-	78	100	H
1.6219	57.79	Av	28.4	-54.34	31.85	74	-42.15	54	-22.15	78	100	H
1.6287	78.7	Pk	28.5	-54.36	52.84	74	-21.16	-	-	360	144	V
1.8551	78.18	Pk	30.9	-53.87	55.21	74	-18.79	-	-	325	169	H
1.8492	59.43	Av	30.8	-53.94	36.29	74	-37.71	54	-17.71	325	169	H
1.8529	72.21	Pk	30.8	-53.9	49.11	74	-24.89	-	-	151	140	V
1.8556	54.57	Av	30.9	-53.86	31.61	74	-42.39	54	-22.39	151	140	V
2.6812	29.86	Pk	22.1	4.56	56.52	74	-17.48	-	-	257	100	V
2.6812	16.35	Avg	22.1	4.56	43.01	74	-30.99	54	-10.99	257	100	V
6.4881	75.25	Pk	29.1	-47.71	56.64	74	-17.36	-	-	324	100	V
6.4803	50.86	Av	29.1	-47.74	32.22	74	-41.78	54	-21.78	324	100	V
6.5131	72.16	Pk	29	-47.59	53.57	74	-20.43	-	-	20	100	H
6.4833	49.08	Av	29.1	-47.74	30.44	74	-43.56	54	-23.56	20	100	H
4.6223	75.53	Pk	27.7	-51.9	51.33	74	-22.67	-	-	11	100	H
4.6323	53.88	Av	27.7	-51.83	29.75	74	-44.25	54	-24.25	11	100	H
4.6169	81.31	Pk	27.7	-51.87	57.14	74	-16.86	-	-	158	100	V
4.6344	57.01	Av	27.7	-51.78	32.93	74	-41.07	54	-21.07	158	100	V
5.5661	68.76	Pk	28.3	-49.8	47.26	74	-26.74	-	-	74	161	H
5.5448	51.86	Av	28.3	-49.75	30.41	74	-43.59	54	-23.59	74	161	H
5.5662	73.03	Pk	28.3	-49.8	51.53	74	-22.47	-	-	169	100	V
5.5448	53.4	Av	28.3	-49.75	31.95	74	-42.05	54	-22.05	169	100	V
6.0001	69.56	Pk	28.7	-48.75	49.51	74	-24.49	-	-	270	143	H
6.0001	66.43	Av	28.7	-48.75	46.38	74	-27.62	54	-7.62	270	143	H
6.0001	66.47	Pk	28.7	-48.75	46.42	74	-27.58	-	-	61	100	V
6.0001	60.65	Av	28.7	-48.75	40.6	74	-33.4	54	-13.4	61	100	V
8.3454	71.96	Pk	36.5	-48.77	59.69	74	-14.31	-	-	308	100	V
8.3654	50.7	Av	36.5	-49.07	38.13	74	-35.87	54	-15.87	308	100	V
12.6054	59.23	Pk	39.5	-34.53	64.2	74	-9.8	-	-	201	100	H
12.6059	46.59	Av	39.5	-34.52	51.57	74	-22.43	54	-2.43	201	100	H
12.6044	59.84	Pk	39.5	-34.56	64.78	74	-9.22	-	-	179	100	V
12.6062	45.01	Avg	39.5	-34.51	50	74	-24	54	-4	179	100	V

There were no harmonics found within 6dB of the limit. Emissions found were product of the digital portion of the device. Measurements were made with one mode to represent all modes.

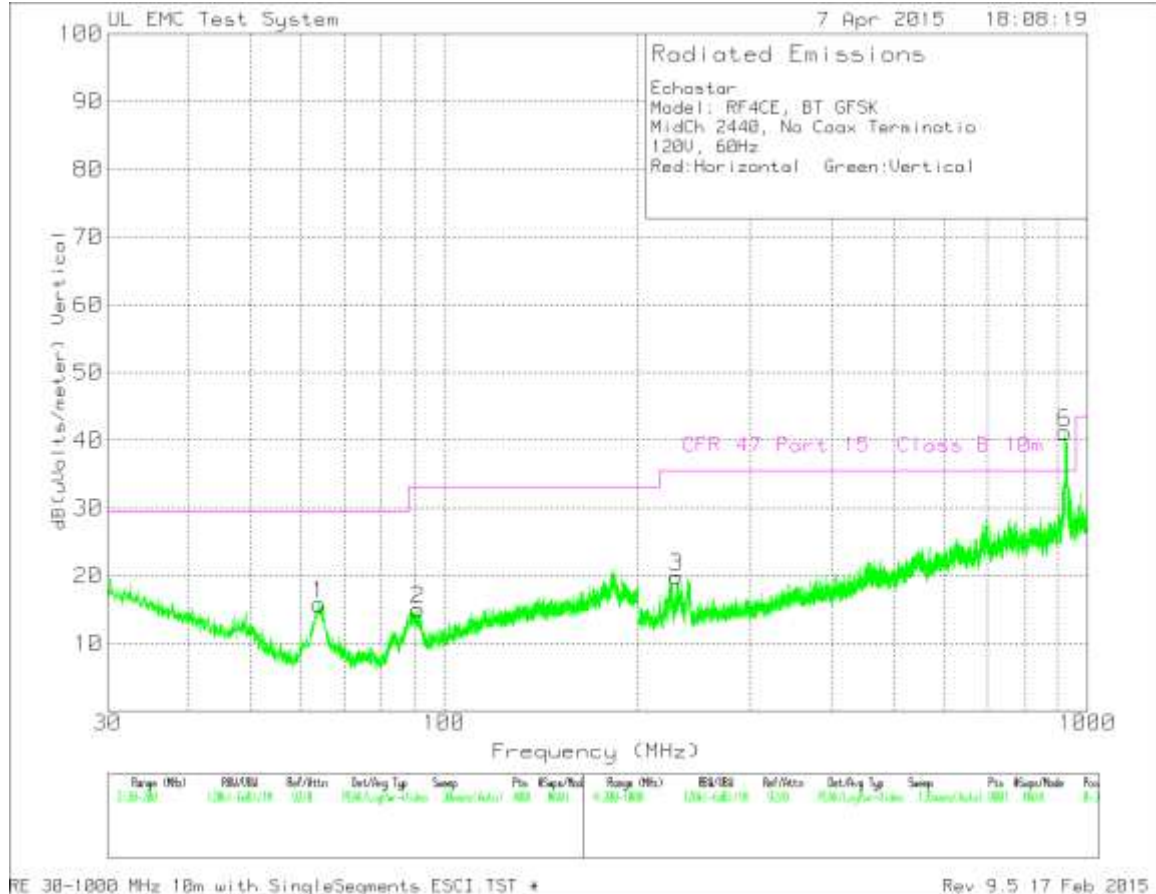
8.3. WORST-CASE BELOW 1 GHz

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



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

VERTICAL PLOT



DATA

Echostar
Model: RF4CE, BT GFSK
MidCh 2440, No Coax Terminatio
120V, 60Hz
Red:Horizontal Green:Vertical

Trace Markers										
No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit:1	2	3	4	5
=====										
Range 2: Bicon Vertical 30 - 200MHz -----										
1	63.9575	39.66dBuV Pk	6.3	-30.1	15.86	29.55	-	-	-	-
		Azimuth:0-360	Height:249	Vert	Margin (dB)	-13.69	-	-	-	-
2	91.1575	35.85dBuV Pk	9.2	-30	15.05	33.07	-	-	-	-
		Azimuth:0-360	Height:249	Vert	Margin (dB)	-18.02	-	-	-	-
Range 3: LogP Horizontal 200 - 1000MHz -----										
4	459.7	36.83dBuV Pk	17.2	-27.6	26.43	35.57	-	-	-	-
		Azimuth:0-360	Height:200	Horz	Margin (dB)	-9.14	-	-	-	-
5	930.1	51.13dBuV Pk	22.8	-25.9	48.03	-	-	-	-	-
		Azimuth:0-360	Height:100	Horz	Margin (dB)	-	-	-	-	-
Range 4: LogP Vertical 200 - 1000MHz -----										
3	229.9	37.88dBuV Pk	11	-29	19.88	35.57	-	-	-	-
		Azimuth:0-360	Height:99	Vert	Margin (dB)	-15.69	-	-	-	-
6	923.2	45.18dBuV Pk	22.8	-26.8	41.18	-	-	-	-	-
		Azimuth:0-360	Height:199	Vert	Margin (dB)	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 10m

Pk - Peak detector

923MHz is not in the restricted band.

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

^{*} Decreases with the logarithm of the frequency.

TEST PROCEDURE

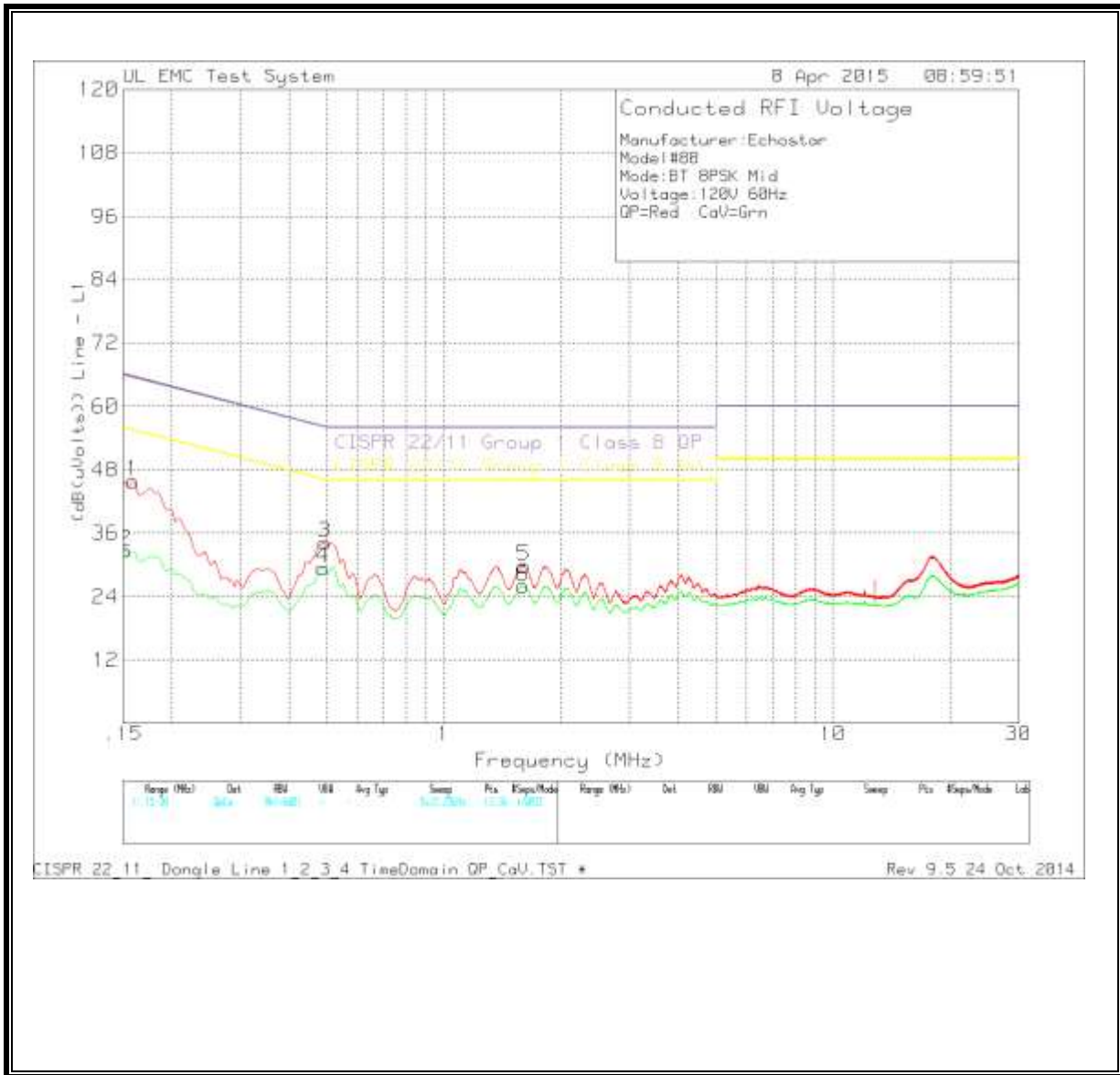
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

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

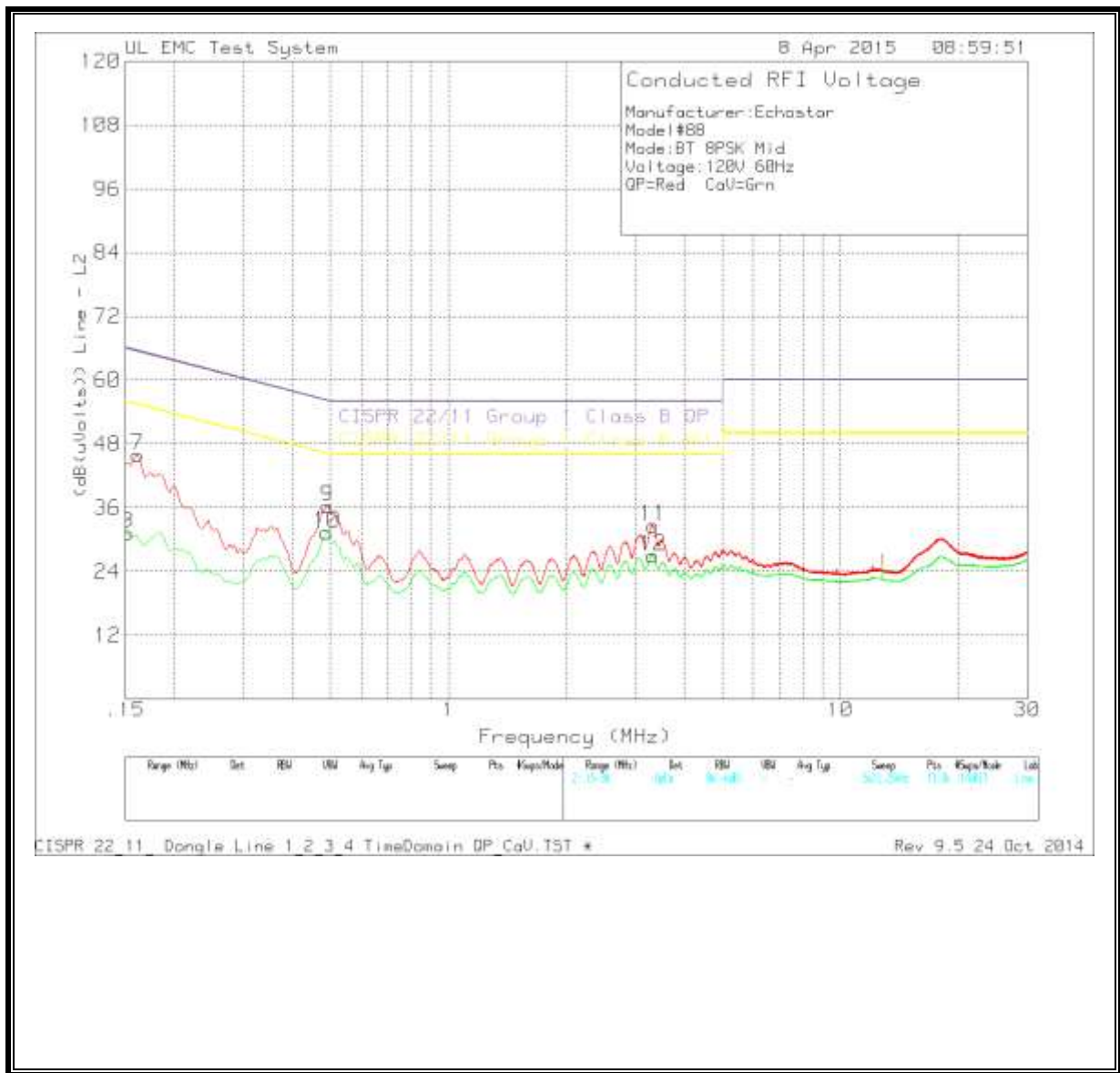
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

LINE 1 RESULTS



LINE 2 RESULTS



Manufacturer:Echostar
Model#88
Mode:BT 8PSK Mid
Voltage:120V 60Hz
QP=Red CaV=Grn

Trace Markers											
No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading (dB(uVolts))	Limit:1	2	3	4	5	
=====											
Line - L1	.15	- 30MHz	-----								
1	.159	33.25dBuV Qp	.1	12.5	45.85	-	-	65.52	-	-	-
					Margin (dB)	-	-	-19.67	-	-	-
2	.15225	19.91dBuV Ca	.1	12.7	32.71	-	-	-	55.88	-	-
					Margin (dB)	-	-	-	-23.17	-	-
3	.49425	23.53dBuV Qp	.1	10.6	34.23	-	-	56.1	-	-	-
					Margin (dB)	-	-	-21.87	-	-	-
4	.48975	18.74dBuV Ca	.1	10.6	29.44	-	-	-	46.17	-	-
					Margin (dB)	-	-	-	-16.73	-	-
5	1.608	19.17dBuV Qp	.1	10.5	29.77	-	-	56	-	-	-
					Margin (dB)	-	-	-26.23	-	-	-
6	1.59675	15.42dBuV Ca	.1	10.5	26.02	-	-	-	46	-	-
					Margin (dB)	-	-	-	-19.98	-	-
=====											
Line - L2	.15	- 30MHz	-----								
7	.16125	33.24dBuV Qp	.1	12.6	45.94	-	-	65.4	-	-	-
					Margin (dB)	-	-	-19.46	-	-	-
8	.15225	18.32dBuV Ca	.1	12.8	31.22	-	-	-	55.88	-	-
					Margin (dB)	-	-	-	-24.66	-	-
9	.49087	25.37dBuV Qp	.1	10.8	36.27	-	-	56.15	-	-	-
					Margin (dB)	-	-	-19.88	-	-	-
10	.48975	20.45dBuV Ca	.1	10.8	31.35	-	-	-	46.17	-	-
					Margin (dB)	-	-	-	-14.82	-	-
11	3.32475	21.68dBuV Qp	.1	10.8	32.58	-	-	56	-	-	-
					Margin (dB)	-	-	-23.42	-	-	-
12	3.32363	16.07dBuV Ca	.1	10.8	26.97	-	-	-	46	-	-
					Margin (dB)	-	-	-	-19.03	-	-

LIMIT 3: CISPR 22/11 Group 1 Class B QP
LIMIT 4: CISPR 22/11 Group 1 Class B AV

Qp - Quasi-Peak detector
Ca - CISPR Average detection