

### FCC 47 CFR PART 15 SUBPART C

### **CERTIFICATION TEST REPORT**

FOR

### SET TOP BOX 071 WITH 2.4 GHz TRANSCEIVER

MODEL NUMBER: ID:071 (XiP110CR)

FCC ID: DKN74Z

REPORT NUMBER: R10475492-RF

**ISSUE DATE: 2014-11-24** 

Prepared for ECHOSTAR TECHNOLOGIES LLC 90 INVERNESS CIRCLE EAST ENGLEWOOD CO, 80112, USA

Prepared by UL LLC 12 LABORATORY DR. RESEARCH TRIANGLE PARK, NC 27709 USA TEL: (919) 549-1400



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### **Revision History**

Rev.	Issue Date	Revisions	Revised By
	2014-11-24	Initial Issue	Jeff Moser

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## **1. ATTESTATION OF TEST RESULTS**

COMPANY NAME: ECHOSTAR TECHNOLOGIES LLC 90 INVERNESS CIRCLE EAST ENGLEWOOD CO, 80112, USA				
<b>EUT DESCRIPTION:</b> SET TOP BOX 071 WITH 2.4 GHz TRANSCEIVER				
MODEL:	ID:071 (XiP110CR)			
SERIAL NUMBER:	SERIAL NUMBER: SN – E4EXFZ02421K, E4EXFZ02422K			
<b>DATE TESTED:</b> 2014-11-06 through 2014-11-22				
APPLICABLE STANDARDS				
ST	ANDARD TI	EST RESULTS		
CFR 47 Pa	art 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:

Michal /

Michael Antola EMC Project Lead UL – Consumer Technology Division

Prepared By:

Jeff Moser EMC Program Manager UL – Consumer Technology Division

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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, 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 12 Laboratory Dr., Research Triangle Park, NC 27709, USA.

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

# 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	± 2.37 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.84 dB (10m)
Radiated Disturbance, 1 to 6 GHz	± 5.96 dB
Radiated Disturbance, 6 to 18 GHz	± 6.10 dB
Radiated Disturbance, 18 to 26 GHz	± 6.81 dB
Radiated Disturbance, 26 to 40 GHz	± 6.81 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 ID:071 is a set-top box that is intended to be connected to any secondary television in a consumer's home. Using a Home Network (MoCA) it will decode and output high definition TV2 programming from an Echostar client STB. The ID:071 uses an on board 802.15.4 2.4GHz RF4CE solution to interface to a remote. The EUT operates at 2425 MHz, 2450 MHz and 2475 MHz, only.

The radio is an onboard device, designed by EchoStar. The radio circuit contains a radio chip, RF4CE silicon solution from Texas Instruments and is TI's CC2533 IEEE 802.15.4 Transceiver BGA.

## 5.2. MAXIMUM OUTPUT POWER

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

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
2425 - 2475	RF4CE (O-QPSK)	3.29	2.13

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

## 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was TI\_Agency\_Build\_2010\_2014.

The test utility software used during testing was D471\_Agency.

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## 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 fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, with and without the mounting stand plate (Note - with and without mounting plate stand is X, Y only. Z requires the mounting stand) and it was determined that the X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Note – The mounting stand made no significant difference in the measurements. Therefore, all measurements were made without the mounting stand. Additionally, different configurations were evaluated during the fundamental investigation to determine if populating the host's ports would yield more severe emissions (e.g. RCA ports, HDMI, etc). The worst-case configuration was determined to be no ports populated.

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## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List						
Description	Manufacturer	Model	Serial Number	FCC ID		
Power Supply - Used to	Delta Electronics	ADP-18DW BA	DZZD2AU732851	NA		
power the ID: 071		(EchoStar P/N				
device		191202)				
Remote Control - Used	EchoStar Technolo	180552	NA	Not available		
to change the radio						
channel on the EUT						

### I/O CABLES

	I/O Cable List							
Cable         Port         # of identical         Connector         Cable Type         Cable         Remarks					Remarks			
No		ports	Туре		Length (m)			
1	AC	1	AC Inlet	Unshielded	-	Direct plug in power supply for EUT.		
2	DC	1	DC	Unshielded	NA	Output of Direct plug- in power supply to EUT		

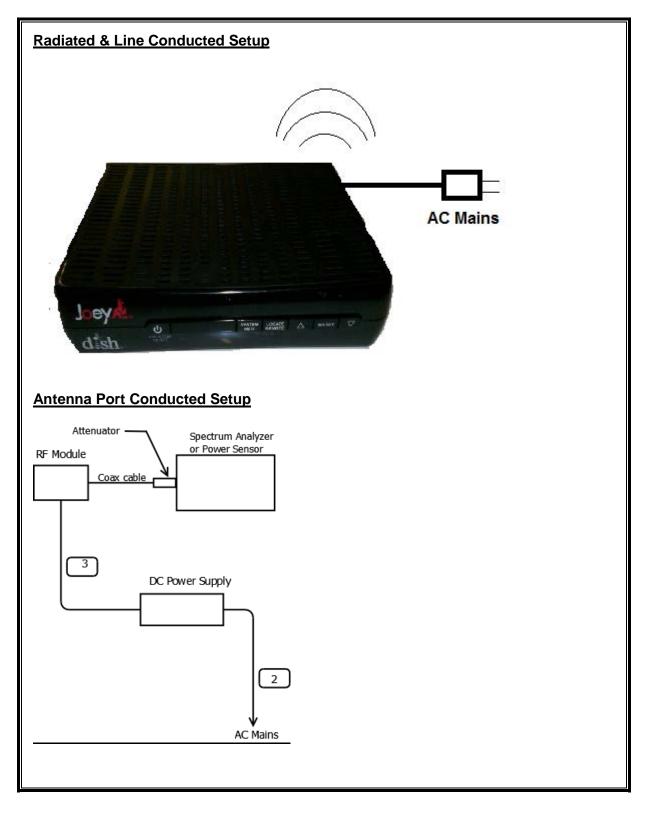
Note – Different configurations were evaluated during the fundamental testing to determine if populating the host's ports would yield more severe emissions (e.g. RCA ports, HDMI, USB, etc.). The worst-case configuration was determined to be no ports populated.

### TEST SETUP

The EUT was setup as a table top device in the worst-case orientation. One unit was provided for Radiated Emissions and one unit was provided for Conducted Emissions.

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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:

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
SA0016	Spectrum Analyzer	Agilent Technologies	N9030A	2014-09-03	2015-09-30
PAR005	Power Meter, DC to 40GHz	Rohde & Schwarz	NRVD	2014-09-03	2015-09-30
PAR006	Power Sensor, DC to 18GHz	Rohde & Schwarz	NRV-Z51	2014-09-03	2015-09-30
PSENSOR001	RF Power Meter Sensor Head	Rohde & Schwartz	NRP-Z81 (w/ NRP- Z3 USB adapter)	2014-09-03	2015-09-30
MM0150	Digital Multimeter, 4½ Digit (True RMS AC, AC+DC measurement)	Agilent	U1252A	2014-09-04	2016-09-30
MM0151	Digital Multimeter, 4½ Digit (True RMS AC, AC+DC measurement)	Agilent	U1252A	2014-09-04	2016-09-30
EC0214	Environmental Chamber	Thermotron	SE1200	2014-02-06	2015-02-28
HI0041	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-02-19	2015-02-28

Wireless Conducted Measurement Equipment

### Radiated Disturbance Emissions (E-field) - 1 to 26 GHz, Chamber A

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0062	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2014-07-22	2015-07-31
	18-40 GHz				
AT0063	Horn Antenna, 18- 26.5GHz	ARA	MWH-1826/B	2014-07-23	2015-07-31
	Gain-Loss Chains				
SAC_E_ HORN	Gain-Loss string for horn antenna at 3m	Various	Various	2014-07-17	2015-07-31
	Receiver & Software				
SAR003	Spectrum Analyzer / Receiver	Rohde & Schwarz	ESIB40 (1088.7490.40)	2014-07-14	2015-07-31
SA0016	Spectrum Analyzer	Agilent	N9030A	2014-09-03	2015-09-30
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	RF Amp (>1GHz)				
AMP011	RF Amp, 1-20GHz	Miteq	AMF-6D- 01002000-22-10P	2014-07-18	2015-07-31
AMP012	RF Amp, 18-40GHz	Miteq	JS44-18004000- 33-8P	2014-07-18	2015-07-31
AMP013	RF Amp, 18-40GHz	Miteq	JS44-18004000- 33-8P	2014-07-18	2015-07-31
BRF003	2.4GHz Band-reject Fileter	Microtronics	BRM50702	2014-09-03	2015-09-30
	Additional Equipment used				
HI0034	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-02-19	2015-02-28

### Radiated Disturbance Emissions (E-field) – 30 to 1000 MHz, Chamber C

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	30-1000 MHz Range				
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2014-07-10	2015-07-31
	Gain-Loss Chains				
SAC_G (Hybrid)	Gain-Loss string for Hyrbid antenna at 3m	Various	Various	2014-11-10	2015-11-30
	Receiver & Software				
SA0018	Spectrum Analyzer	Agilent	N9030A	2014-06-24	2015-06-30
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
HI0034	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-02-19	2015-02-28

### Conducted Disturbance Emissions - Voltage

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Equipment – Ground Plane E				
SA0015	EMI Test Receiver 9kHz- 7GHz	Rohde & Schwarz	ESCI 7	2014-09-03	2015-09-30
ATA509	Coaxial cable, 20 ft., BNC -male to BNC-male	UL	RG-223	2014-09-15	2015-07-31
HI0069	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-06-27	2015-06-30
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Transient Limiter				
ATA508	Transient Limiter, 0.009 to 100 MHz	Electro- Metrics	EM 7600	2014-09-03	2015-09-30
	LISN				
LISN002	LISN, 50-ohm/50-uH, 2- conductor, 50A	Fischer Custom Com.	FCC-LISN-50- 50-2-02-550V	2014-09-04	2015-09-30

## 7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

### **LIMITS**

None; for reporting purposes only.

### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

## 7.1. 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						
802.15.4 (RF4CE) MODE	100.000	100.000	1.000	100.00%	0.00	0.010

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# 7.1. DUTY CYCLE PLOTS

### 2.4 GHz BAND

ilent Spectrum Analyzer - Swept SA R T RF 50 2 DC weep Time 10.00 ms	PNO: Fast	SENSE:INT Trig: Free Run Atten: 30 dB	ALIGNAUTO Avg Type: Log-Pwr	11:51:34 AMNov 06, 201 TRACE 12:3:4:5 TYPE WARMAN DET N N N N N
Ref Offset 10 dB				Mkr1 2.425 Ge dBm
0.0				
0.0				
1.00				
0.0				
0.0				
0.0				
0.0				
0.0				
0.0				

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## 7.2. MEASUREMENT METHODS

<u>6 dB BW</u>: 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 12.1.

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## 8. ANTENNA PORT TEST RESULTS

### 8.1. 802.15.4 (RF4CE) MODE IN THE 2.4 GHz BAND

### 8.1.1.6 dB BANDWIDTH

### **LIMITS**

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

### TEST PROCEDURE

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	6 dB Bandwidth	Minimum Limit
	(MHz)	(MHz)	(MHz)
Low	2425	1.61	0.5
Middle	2450	1.62	0.5
High	2475	1.61	0.5

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### 6 dB BANDWIDTH

RT RF larker 2Δ1.6	50 Ω DC 510400000 MHz	PNO: W IFGain:L		g:FreeRun en:30 dB	ALIGN AUTO Avg Typ	e: Log-Pwr	TRA Th C	PMNov 06, 201 CE 1 2 3 4 5 PE MUUUUUU PF P N N N N
	offset 10 dB 30.00 dBm					Δ	Mkr2 1.61	0 4 MH -0.10 dE
20.0			<u>1</u>					
0.00	X						2Δ3	-6.32 dB
20.0	(0)							~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
30.0								
0.0								
50.0								
enter 2.42500 Res BW 100 k			#VBW 30	0 kHz	FUNCTION WIDTH		Span 2 ep 1.20 ms i	2.400 MH (1001 pts
1 N 1 f 2 Δ3 1 f 3 F 1 f 4	2.424 760 0	MHz ( $\Delta$ )	-0.32 dBm -0.10 dB -6.04 dBm					
6 7 8 9 10								

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RT		RF	alyzer - S 50 17600	Ω DC	I	'NO: W Gain:I	] /ide 🕞	SENSE:I D Tri; Att	ा। g:Free en:30 (	Run dB	AL	IGNAUTO Avg T	'ype: L	og-Pwr			TRAC TYP DE	MNov 06, 20 E 1 2 3 4 5 E MUUUUU T P N N N N
0 dB/d	lv		Offset 1 f 30.00												ΔΝ	/kr2 1		6 MH 0.06 d
20.0																		
0.00							~~~~		~~~		~	Q		-	~	~ <sup>2</sup>	Δ3	-6.39 di
20.0																		
30.0 — 40.0 —																	-	
50.0 — 60.0 —																		
ente Res I			00 GH kHz	z		<u> </u>	#VB	W 30	0 kHz					:	Swee			.400 MH 1001 pt:
1 Ν 2 Δ3 3 F 4	1	f f f	(Δ)		0 283 2 GHz 1.617 6 MHz 9 215 2 GHz	(Δ)		dBm 06 dB dBm	FUN	CTION	FUNCT	IION WIDTH			FUN	ICTION VAL	UE	
5 6 7 8 9 10																		

R	Т		RF	yzer - S   S0 \$056(	ΩD	X	MHz		NO: W Gain:I		SENSE	EINT rig: Fre Atten: 30	e Run ) dB	/	ALIGN AU AN		: Log-P			TR	2 PMNov 06, 2 ACE 1 2 3 4 TYPE MUMUU DET P N N N
	3/div			)ffset 30.00														Δ	Mkı	2 1.60	05 6 MH 0.03 d
.og 20.0																					
10.0	-					+		-							01				-	24.2	
0.00					-))(	-		~~				~~~~		~~	14		******	~~~~	n	2∆3 _	-6.49
10.0 20.0		~~~			-//\\	5															
30.0													_								
40.0						+		_			_				-				-		
50.0						+		_					_		-				-		
60.0						+									-		-				
	ter : s B\			0 GH Hz	z					#V	BW 3	100 KH	z					Swe	ep 1		2.400 Mi (1001 pt
	MODE	_				×	278 <b>4</b> G			Y 0.40	4 dBn		NCTION	FUN	CTION W	DTH		F	UNCTIO	N VALUE	
	Ν Δ3	1		Δ)		1.	605 6 M	Hz	(Δ)	(	0.03 dl	3									
34	F	1	f		2.4	4/4	215 2 G	ΗŻ		-6.4	19 dBn	n									
6																					
6 7 8 9																					
10																					
11 12																					

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### 8.1.2. 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 3% 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**

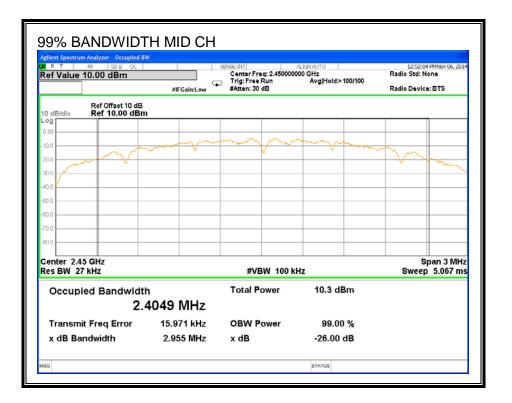
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Low	2425	2.398
Middle	2450	2.405
High	2475	2.408

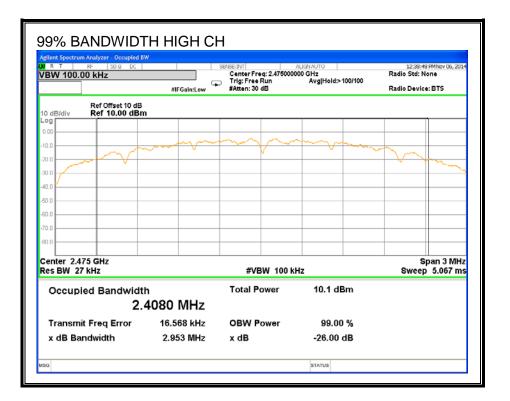
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#### 99% BANDWIDTH

nter Freq 2.425000000		SENSE:INT Center Freq: 2.4250000 Trig: Free Run #Atten: 30 dB	ALIGNAUTO 000 GHz Avg Hold:>100/100	12:53:50 PMNov 06, 201 Radio Std: None Radio Device: BTS
Ref Offset 10 dB	n			
9				
0.0	- Andrew - A			$\neg \neg$
1.0				V James
0.0				
.0				
0.0				
enter 2.425 GHz es BW 27 kHz		#VBW 100 k	Hz	Span 3 MHz Sweep 5.067 ms
Occupied Bandwidt 2.	հ 3981 MHz	Total Power	10.1 dBm	
Transmit Freq Error	14.909 kHz	OBW Power	99.00 %	
x dB Bandwidth	2.953 MHz	x dB	-26.00 dB	

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### 8.1.3. OUTPUT POWER

#### **LIMITS**

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi (0 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 99% bandwidth of the EUT.

#### **RESULTS**

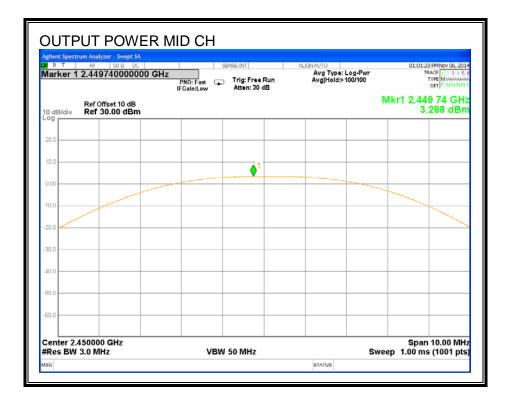
Channel	Frequency	Output	Limit	Margin
		Power		
	(MHz)	(dBm)	(dBm)	(dB)
Low	2425	3.20	30	-26.80
Middle	2450	3.29	30	-26.71
High	2475	3.18	30	-26.83

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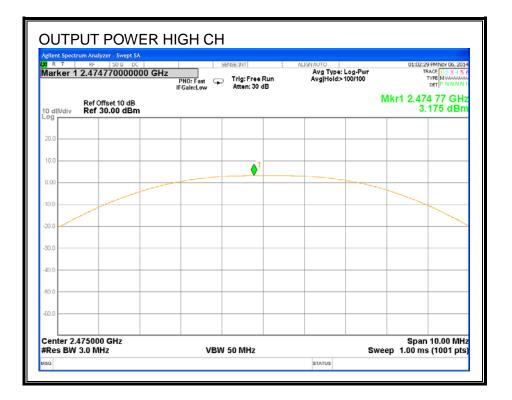
### OUTPUT POWER

arker 1	rum Analyzer - Swept S/ RF 50 Q DC 2.4254600000	00 GHz	PNO: Fast G	SENSE:INT Trig: Free Atten: 30	Run	ALIGNAUTO Avg Type: I Avg Hold:>1	00/100	١	IO PMNov 06, 2014 RACE 1 2 3 4 5 TYPE MULLING DET P NNNN
0 dB/div	Ref Offset 10 dB Ref 30.00 dBm	1						Mkr1 2.42 3	.203 dBm
20.0									
10.0					1				
0.00									
10.0									
20.0									
30.0									
40.0									
50.0									
60.0									

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### 8.1.4. 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 10.68 dB (including 10 dB pad and 0.68 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Power
	(MHz)	(dBm)
Low	2425	3.25
Middle	2450	3.29
High	2475	3.24

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### 8.1.5. POWER SPECTRAL DENSITY

#### LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

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", June 2014.

#### **RESULTS**

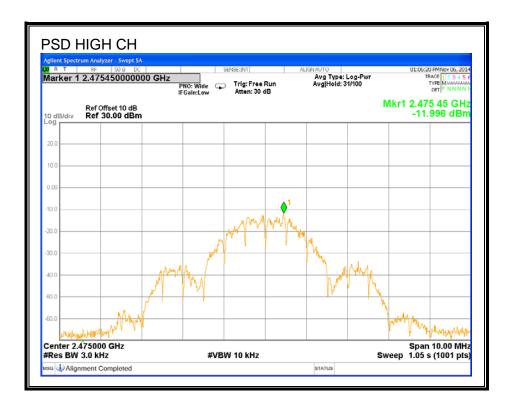
Channel	Frequency	PPSD	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2425	-11.98	8	-19.98
Middle	2450	-12.37	8	-20.37
High	2475	-12.00	8	-20.00

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### POWER SPECTRAL DENSITY







### 8.1.6. CONDUCTED SPURIOUS EMISSIONS

### LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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.

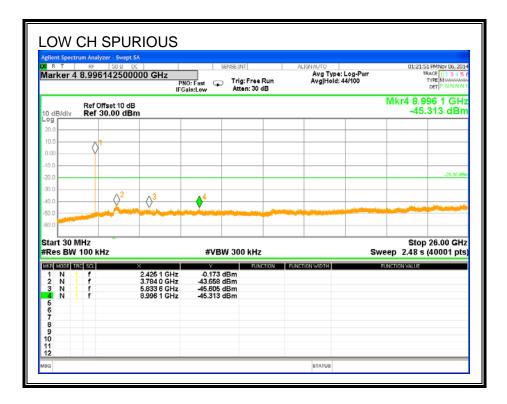
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### **RESULTS**

#### SPURIOUS EMISSIONS, LOW CHANNEL

V R T RF SC Marker 4 2.400000	Swept SA	SENSE:INT	ALIGNAUTO Avg Type: Log-Pwr	01:17:38 PMNov 06, 201 TRACE 1 2 3 4 5
Marker 4 2.40000	PNO	:Wide 😱 Trig: Free Ru in:Low Atten: 30 dB	n	
Ref Offset Ref 30.00			1	/kr4 2.400 000 GH -52.58 dBn
20.0				
10.0				
0.00				min
10.0				A3/2
-20.0				-20.30 dB
30.0				
-40.0	<b>▲</b> 4			
50.0 monthing - month	Man mar and an and all and	whether whether a strand water and the strand water and the strand water and the strand water and the strand w	an a	
-60.0				
Start 2.39500 GHz #Res BW 100 kHz		#VBW 300 kHz	Sw	Stop 2.42700 GH reep 3.07 ms (1001 pts
MKB MODE TRC SCL	X		IN FUNCTION WIDTH	FUNCTION VALUE
1 N 1 f 2 N 1 f	2.425 272 GHz 2.423 576 GHz	-0.03 dBm -20.94 dBm		
3 N 1 f 4 N 1 f	2.422 744 GHz 2.400 000 GHz	-22.72 dBm -52.58 dBm		
6				
7				
9				

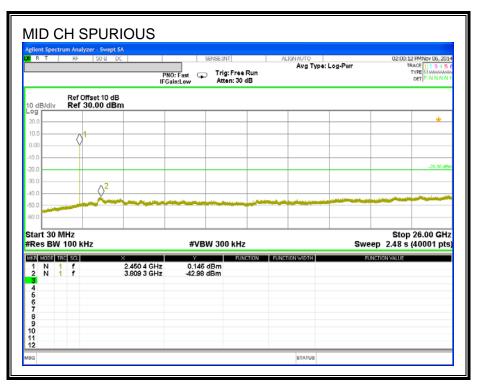
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#### SPURIOUS EMISSIONS, MID CHANNEL

R	т		RF	alyzer - Swept SA 50 Ω DC 0273240000 GHz	PNO: Wid	de 🖵	Trig	T Free Run m: 30 dB		ALIGN AUTO Avg Type	: Log-Pwr		SS PMNov 06, 201 TRACE 1 2 3 4 5 TYPE MWWWWW DET P N N N N
0 dB	/div			Offset 10 dB 30.00 dBm	Ir Gain:Lu						Mkr1		73 24 GH: 0.38 dBn
20.0										1			
0.00				-				~					
10.0			~										-20 30 dBr
20.0 30.0 -													-10.00 04
40.0													
50.0													-
60.0											_		-
cent Res				00 GHz kHz		#VB	W 300	kHz			Swee		n 2.400 MH: ; (40001 pts
	DDE N	TRC 1	SCL f	× 2.450 273 24 G 2.483 500 000 G		¥ -0.38	dBm dBm	FUNCTION	1	FUNCTION WIDTH		FUNCTION VALUE	
3		-		2.400 000 000 0	12		ubiii						
4 6 7													
7 8 9 10													
10 11													

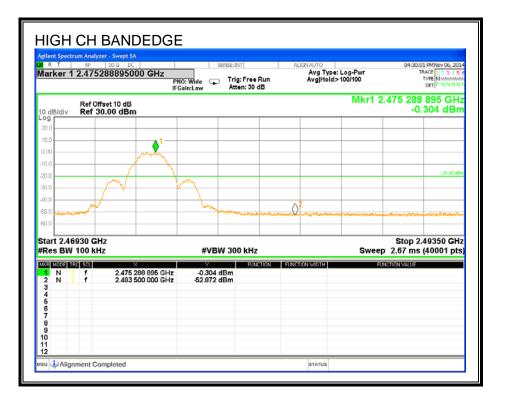
Page 37 of 68
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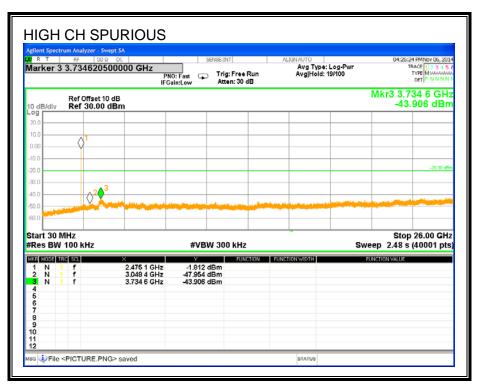
Note – No other measurable emissions other than what was reported above.

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#### SPURIOUS EMISSIONS, HIGH CHANNEL



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Note – No other measurable emissions other than what was reported above.

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# 9. RADIATED TEST RESULTS

# 9.1. LIMITS AND PROCEDURE

## **LIMITS**

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

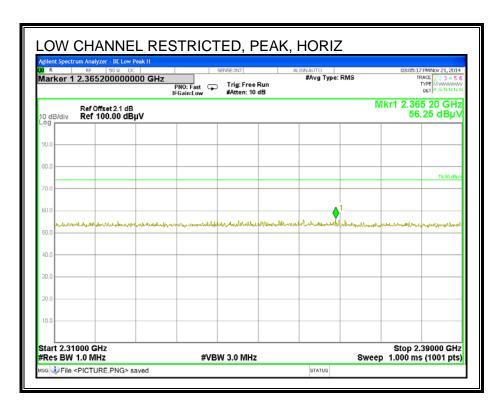
Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

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# 9.2. TRANSMITTER ABOVE 1 GHz

# 9.2.1. TX ABOVE 1 GHz FOR 802.15.4 ((RF4CE) MODE IN THE 2.4 GHz BAND

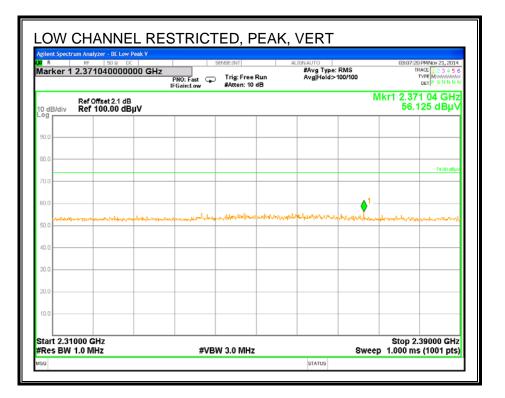
#### **RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



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gilent Spectrum Analyzer - BE Low Avg I R RF 50 Ω DC Jisplay Line 54.00 dBµV	PNO: Fast C Trig: Free	ALIGNAUTO #Avg Type: RMS Run Avg Hold>100/100	03:10:59 PMNov 21, 2014 TRACE 1 2 3 4 5 6 TYPE A WWWWW
Ref Offset 2.1 dB 0 dB/div Ref 100.00 dBµV	IFGain:Low #Atten: 10	dB	Mkr1 2.371 04 GHz 42.278 dBµV
90.0			
60.0			
70.0			
50.0			54.00 dByV
50.0			▲ <sup>1</sup>
40.0	de francés de francés de la constante de la const La constante de la constante de	and and a set of the s	
30.0			
20.0			
10.0			
itart 2.31000 GHz Res BW 1.0 MHz	#VBW 3.0 MHz		Stop 2.39000 GHz Sweep 1.000 ms (1001 pts)

## **RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

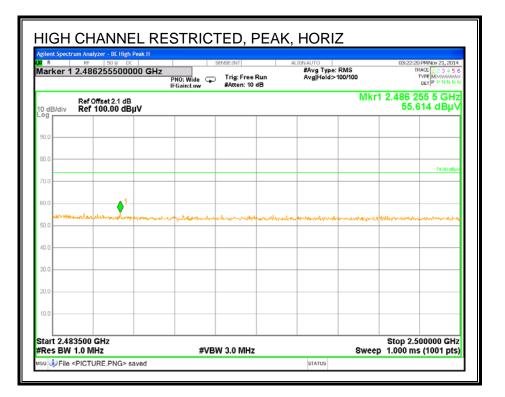


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gilent Spectrum Analyzer R RF Isplay Line 54.0	50 R DC	PNO: Fast G	SENSE:INT Trig: Free Run #Atten: 10 dB	ALIGNAUTO #Avg Type: RMS Avg Held:>100/1	00	03:10:17 PMNov 21, 2014 TRACE 1 2 3 4 5 0 TYPE A WANNAM DET A S N N N
Ref Offse 0 dB/div Ref 100	et2.1 dΒ 0.00 dΒμV				Mkr1	2.371 04 GHz 42.203 dBµ\
0.0						
30.0						
70.0						
50.0						54.00 dBu/
50.0					▲ <sup>1</sup>	
10.0		**************************************		10	******	******
30.0						
20.0						
10.0						
tart 2.31000 GHz Res BW 1.0 MHz		#\/P	W 3.0 MHz*		Sumar d d	top 2.39000 GHz 100 ms (1001 pts)

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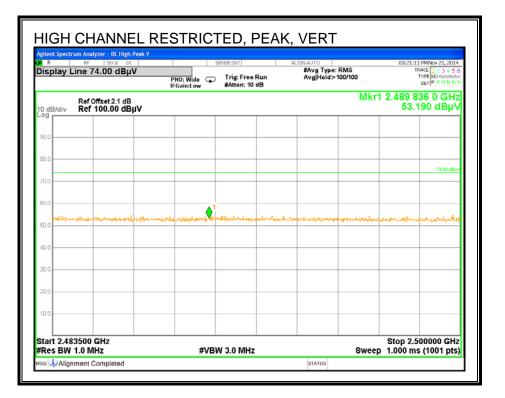
## **RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



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gilent Spectrum Analyzer - BE Low A R RF 50 Q DC tart Freq 2.483500000	GHz		Free Run n: 10 dB	ALIGNAUTO #Avg Type: RMS Avg Hold:>100/100	03:17	20 PMNov 21, 2014 TRACE 1 2 3 4 5 6 TYPE A WAWAAA DET A S N N N
Ref Offset 2.1 dB 0 dB/div Ref 100.00 dB				r	/kr1 2.489 42	836 0 GHz .090 dBµ∖
30.0						
30.0						
70.0						
60.0						54.00 dBu/
50.0		▲1				
10.0	******	·····				******
30.0						
20.0						
0.0						
tart 2.483500 GHz Res BW 1.0 MHz		#VBW 3.01			Stop 2 weep 1.000 n	500000 GHz

## **RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**

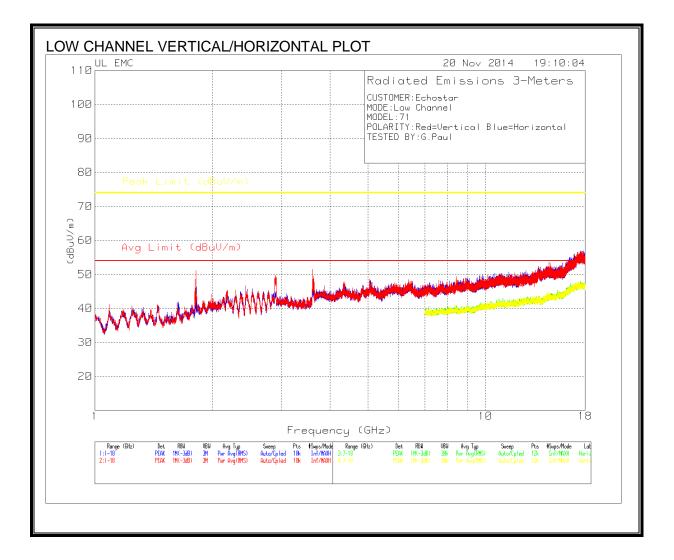


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gilent Spectrum Analyzer - BE High J R RF 50 R OC Start Freq 2.483500000		SENSE:INT Trig: Free Run #Atten: 10 dB	ALIGNAUTO #Avg Type: RMS Avg Hold:>100/100	03:19:43 PMNov 21, 2014 TRACE 1 2 3 4 5 6 TYPE A MWWWW DET A P N N N
Ref Offset 2.1 dB	μV		Mk	r1 2.489 836 0 GHz 42.292 dBµ∨
90.0				
60.0				
70.0				
60.0				54.00 dBu/
50.0		1		
40.0	*****		arran araa aadaa ahaa ahaa ahaa ahaa ahaa aha	***********
30.0				
20.0				
10.0				
start 2.483500 GHz Res BW 1.0 MHz		BW 3.0 MHz*		Stop 2.500000 GHz

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## HARMONICS AND SPURIOUS EMISSIONS: 1-18 GHz



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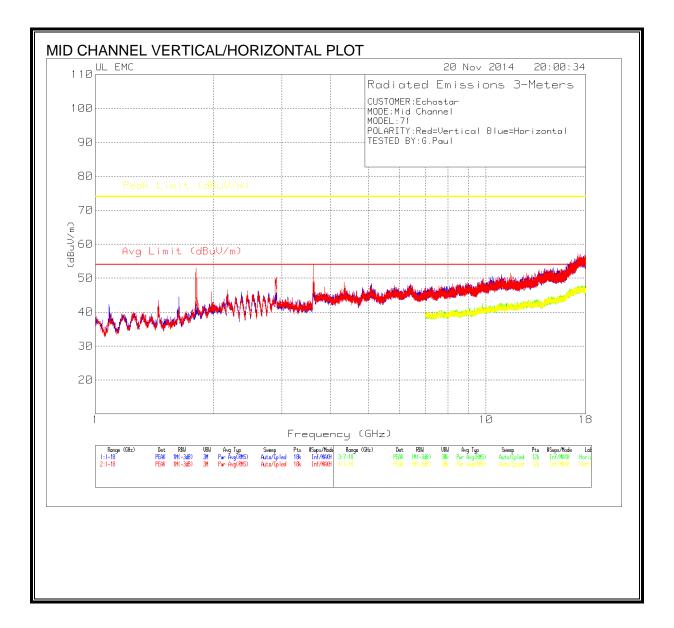
### LOW CHANNEL VERTICAL/HORIZONTAL DATA

CUSTOMER:Echostar MODE:Low Channel MODEL:71 POLARITY:Red=Vertical, Blue=Horizontal TESTED BY:G.Paul

Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/ Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?		
2.898	53.6	PK2	32.5	-35.5	50.6	-	-	74.0	-23.3	V	Y		
2.894	39.2	MAv1	32.5	-35.5	36.2	54.0	-17.8	-	-	V	Y		
3.637	57.2	PK2	33.2	-36.1	54.3	-	-	74.0	-19.7	V	Y		
3.629	38.8	MAv1	33.2	-36.1	35.9	54.0	-18.0	-	-	V	Y		
PK2 - KDB5	PK2 - KDB558074 Method: Maximum Peak												

MAv1 - KDB558074 Option 1 Maximum RMS Average

Note - No additional emissions detected above the system noise floor within the restricted bands.



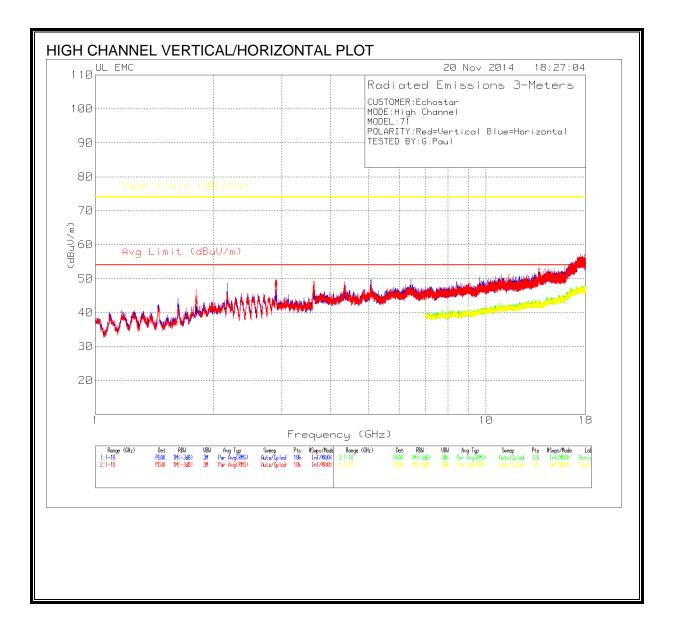
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#### MID CHANNEL VERTICAL/HORIZONTAL DATA

CUSTOMER:Echostar MODE:Mid Channel MODEL:71 POLARITY:Red=Vertical, Blue=Horizontal TESTED BY:G.Paul

Reading [dBuV]	Detector	Factor [dB/m]	Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
54.4	PK2	32.5	-35.6	51.3	-	-	74.0	-22.7	V	Y
39.7	MAv1	32.5	-35.6	36.6	54.0	-17.4	-	-	V	Y
59.4	PK2	33.2	-36.1	56.5	-	-	74.0	-17.5	V	Y
38.1	MAv1	33.2	-36.1	35.2	54.0	-18.8	-	-	V	Y
52.3	PK2	33.6	-36.0	49.9	-	-	74.0	-24.1	V	Y
38.7	MAv1	33.6	-36.0	36.3	54.0	-17.7	-	-	V	Y
074 Method	d: Maximum	n Peak								
8074 Optio	n 1 Maximu	m RMS Ave	rage							
	54.4 39.7 59.4 38.1 52.3 38.7 074 Metho 8074 Optio	54.4         PK2           39.7         MAv1           59.4         PK2           38.1         MAv1           52.3         PK2           38.7         MAv1           074 Method: Maximum         Maximum           8074 Option 1 Maximum         Maximum	54.4         PK2         32.5           39.7         MAv1         32.5           59.4         PK2         33.2           38.1         MAv1         33.2           52.3         PK2         33.6           38.7         MAv1         33.6           074 Method:         Maximum Peak           8074 Option 1         Maximum RMS Ave	54.4         PK2         32.5         -35.6           39.7         MAv1         32.5         -35.6           59.4         PK2         33.2         -36.1           38.1         MAv1         33.2         -36.1           52.3         PK2         33.6         -36.0           38.7         MAv1         33.6         -36.0           074 Method: Maximum Peak         8074 Option 1 Maximum RMS Average         -36.0	54.4         PK2         32.5         -35.6         51.3           39.7         MAv1         32.5         -35.6         36.6           59.4         PK2         33.2         -36.1         56.5           38.1         MAv1         33.2         -36.1         35.2           52.3         PK2         33.6         -36.0         49.9           38.7         MAv1         33.6         -36.0         36.3           074 Method: Maximum Peak         8074 Option 1 Maximum RMS Average         -36.0         36.3	54.4         PK2         32.5         -35.6         51.3         -           39.7         MAvt         32.5         -35.6         36.6         54.0           59.4         PK2         33.2         -36.1         56.5         -           38.1         MAvt         33.2         -36.1         35.2         54.0           52.3         PK2         33.6         -36.0         49.9         -           38.7         MAvt         33.6         -36.0         36.3         54.0           074 Method:         Maximum Peak         8074 Option 1 Maximum RMS Average         -         -	54.4         PK2         32.5         -35.6         51.3         -         -           39.7         MAv1         32.5         -35.6         36.6         54.0         -17.4           59.4         PK2         33.2         -36.1         56.5         -         -           38.1         MAv1         33.2         -36.1         35.2         54.0         -18.8           52.3         PK2         33.6         -36.0         49.9         -         -           38.7         MAv1         33.6         -36.0         36.3         54.0         -17.7           074 Method:         Maximum Peak         8074 Option 1         Maximum RMS Average         -         -	54.4         PK2         32.5         -35.6         51.3         -         -         74.0           39.7         MAvt         32.5         -35.6         36.6         54.0         -17.4         -           59.4         PK2         33.2         -36.1         56.5         -         -         74.0           38.1         MAvt         33.2         -36.1         35.2         54.0         -18.8         -           52.3         PK2         33.6         -36.0         49.9         -         -         74.0           38.7         MAvt         33.6         -36.0         36.3         54.0         -17.7         -           074 Method:         Maximum Peak         8074 Option 1 Maximum RMS Average         -         -         -         -	54.4         PK2         32.5         -35.6         51.3         -         74.0         -22.7           39.7         MAvt         32.5         -35.6         36.6         54.0         -17.4         -         -           59.4         PK2         33.2         -36.1         56.5         -         -         74.0         -17.5           38.1         MAvt         33.2         -36.1         35.2         54.0         -18.8         -         -           52.3         PK2         33.6         -36.0         49.9         -         -         74.0         -24.1           38.7         MAvt         33.6         -36.0         36.3         54.0         -17.7         -         -           074 Method:         Maximum Peak         -         -         -         -         -	54.4         PK2         32.5         -35.6         51.3         -         74.0         -22.7         V           39.7         MAvt         32.5         -35.6         36.6         54.0         -17.4         -         -         V           59.4         PK2         33.2         -36.1         56.5         -         -         74.0         -17.5         V           58.1         MAvt         33.2         -36.1         35.2         54.0         -18.8         -         -         V           38.1         MAvt         33.2         -36.1         35.2         54.0         -18.8         -         -         V           52.3         PK2         33.6         -36.0         49.9         -         -         74.0         -24.1         V           38.7         MAvt         33.6         -36.0         36.3         54.0         -17.7         -         -         V           074 Method: Maximum Peak         -         -         V         -         V         -         -         V

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## HIGH CHANNEL VERTICAL/HORIZONTAL DATA

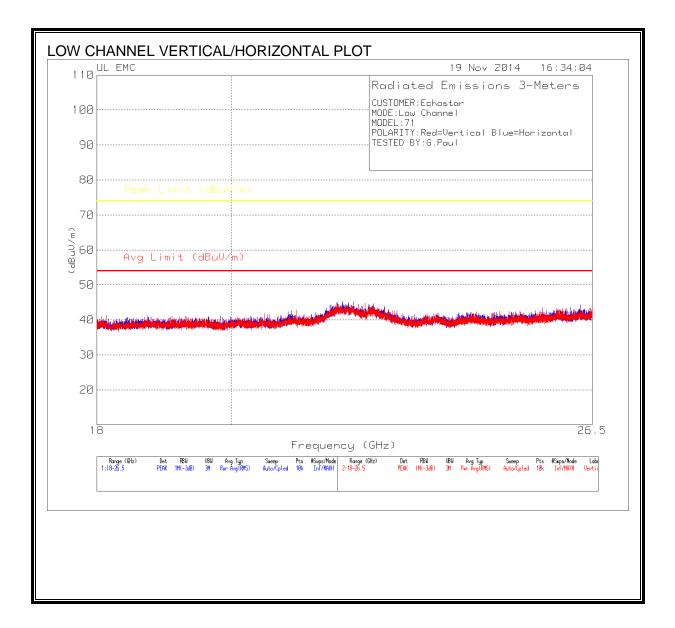
CUSTOMER:Echostar MODE:High Channel MODEL:71 POLARITY:Red=Vertical, Blue=Horizontal TESTED BY:G.Paul

Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/ Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
3.623	57.0	PK2	33.1	-36.1	54.0	-	-	74.0	-19.9	V	Y
3.636	40.4	MAv1	33.2	-36.1	37.5	54.0	-16.5	-	-	V	Y
4.329	52.8	PK2	33.6	-36.0	50.4	-	-	74.0	-23.6	V	Y
4.320	39.6	MAv1	33.6	-36.0	37.2	54.0	-16.8	-	-	V	Y
5.090	49.8	PK2	34.2	-34.9	49.1	-	-	74.0	-24.9	н	Y
5.048	37.2	MAv1	34.1	-34.9	36.4	54.0	-17.5	-	-	Н	Y
PK2 - KDB5	58074 Metho	d: Maximum	n Peak							·	
MAv1 - KDB	558074 Optic	on 1 Maximu	im RMS Ave	rage							

Note - No additional emissions detected above the system noise floor within the restricted bands.

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#### HARMONICS AND SPURIOUS EMISSIONS: 18-26GHz



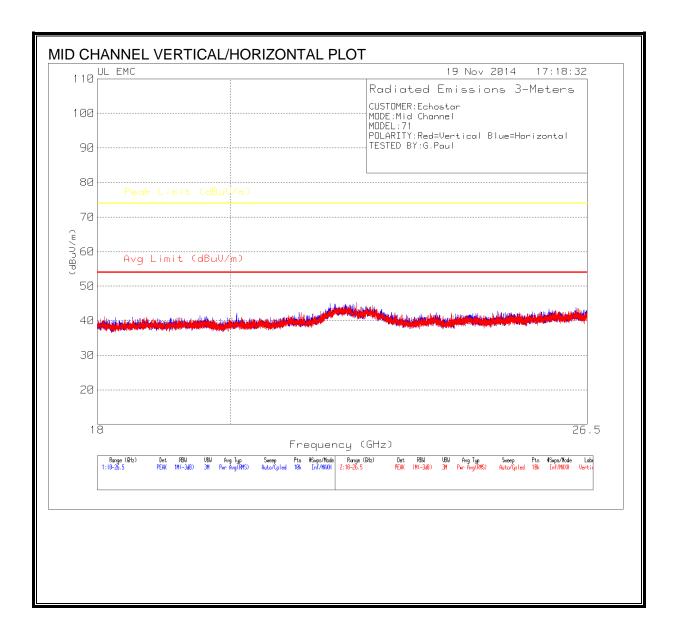
# LOW CHANNEL VERTICAL/HORIZONTAL DATA

CUSTOMER:Echostar MODE:Lov Channel MODEL:71 POLARITY Blue=Horizontal TESTED BY:G.Paul

Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/ Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
18.703	46.4	PK	32.2	-38.8	39.8	54.0	-14.1	74.0	-34.1	Н	Y
21.875	46.0	PK	36.7	-38.3	44.4	54.0	-9.6	74.0	-29.6	Н	N
25.813	44.5	PK	34.1	-35.7	42.9	54.0	-11.1	74.0	-31.1	Н	N
PK - Poak											

PK - Peak

Note - No emissions detected above the system noise floor within the restricted bands. The above is for reporting purposes, only.



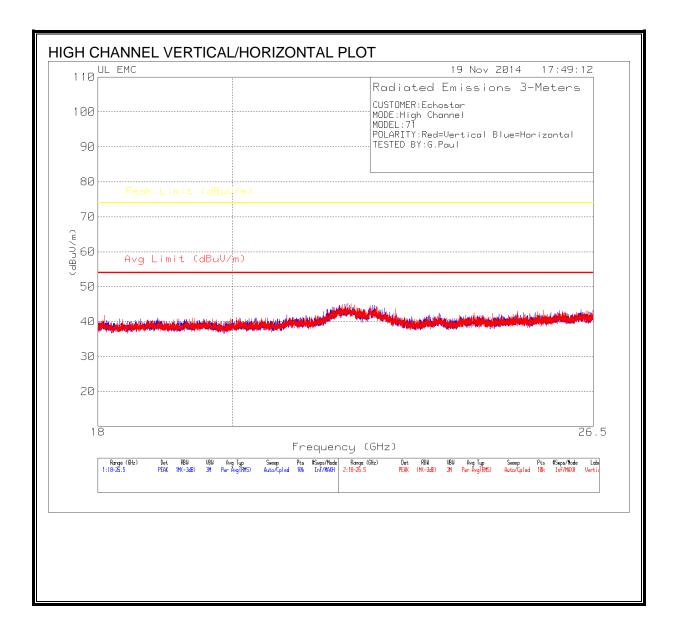
#### MID CHANNEL VERTICAL/HORIZONTAL DATA

CUSTOMER:Echostar MODE:Mid Channel MODEL:71 POLARITY:Red=Vertical, Blue=Horizontal TESTED BY:G.Paul

Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/ Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
18.871	47.0	PK	32.5	-38.8	40.7	54.0	-13.3	74.0	-33.3	Н	Y
22.106	44.2	PK	36.8	-38.2	42.8	54.0	-11.2	74.0	-31.2	Н	Y
26.215	43.7	PK	34.2	-35.5	42.4	54.0	-11.6	74.0	-31.6	Н	Ν
PK - Peak											

Note - No emissions detected above the system noise floor within the restricted bands. The above is for reporting purposes, only.

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# HIGH CHANNEL VERTICAL/HORIZONTAL DATA

CUSTOMER:Echostar MODE:Hig Channel MODEL:71 POLARITY Blue=Horizontal TESTED BY:G.Paul

	req Hz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/ Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
18.	.085	46.8	PK	32.3	-38.9	40.2	54.0	-13.8	74.0	-33.8	Н	Y
21.	.851	46.7	PK	36.6	-38.3	45.0	54.0	-9.0	74.0	-29.0	Н	Ν
24.	.981	43.8	PK	33.9	-36.4	41.3	54.0	-12.7	74.0	-32.7	Н	Ν
PK -	Peak											

PK - Pea

Note - No emissions detected above the system noise floor within the restricted bands. The above is for reporting purposes, only.

# 9.3. WORST-CASE BELOW 1 GHz

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



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DATA										
CUSTOMER Echostar										
MODE: Tx, worst-case channel										
MODEL: 71										
POLARITY:Red=Vertical, Green=Horizontal										
TESTED	BY: G. Paul									
	Meter		Antenna	Gain/	Field	15.209 QP		<b>.</b> .	In	
	Reading	_	Factor	Loss	Strength	Limit		Antenna	Restricted	
Freq (MHz)	[dBuV]	Detector	[dB/m]	[dB]	[dBuV/m]	[dBuV/m]	Margin [dB]		Band?	
360.444	43.2	PK	14.6	-19.0	38.8	-	-	Н	N	
361.004	32.9	QP	14.6	-19.0	28.5	-	-	Н	N	
727.773	35.2	QP	20.5	-17.9	37.8	-	-	H	N	
50.004										
50.681	41.1	QP	7.6	-21.0	27.7	-	-	V	N	
51.820	46.6	PK	7.3	-21.0	32.9	-	-	V	N	
724.830 41.9 PK 20.5 -17.9 44.5 V N										
PK - Peak de										
QP - Quasi-p	eak detector									

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# **10. AC POWER LINE CONDUCTED EMISSIONS**

### LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

Decreases with the logarithm of the frequency.

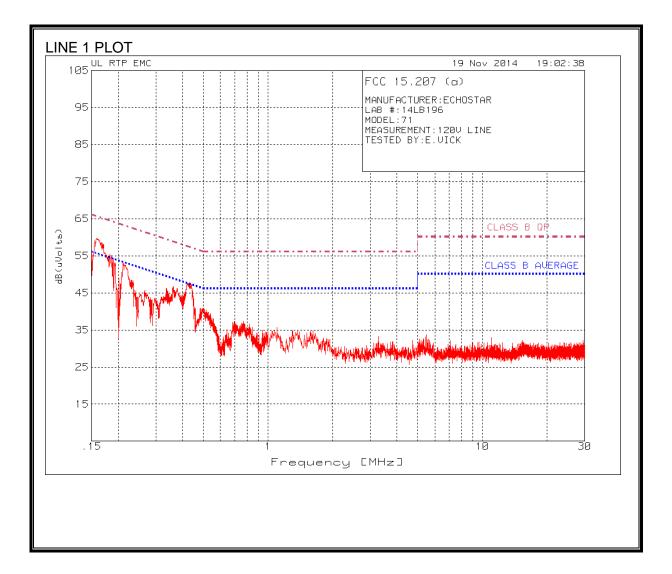
#### TEST PROCEDURE

ANSI C63.4

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#### **<u>6 WORST EMISSIONS</u>**

#### LINE 1 RESULTS



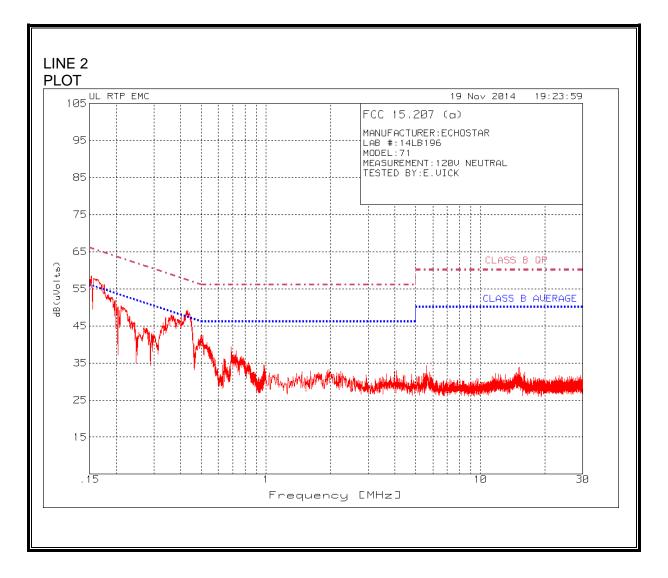
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LINE 1 DATA MANUFACTURER:ECHOSTAR LAB #:14LB196 MODEL:71 MEASUREMENT:120V LINE TESTED BY:E.VICK

						FCC		FCC	
Test	Meter				<b>RF</b> Line	15.207		15.207	
Frequency	Reading			Cable	Voltage	(QP)	Margin	(AV)	Margin
[MHz]	[dBuV]	Detector*	LISN [dB]	Loss [dB]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dB]
0.159	43.2	QP	0.3	9.8	53.3	65.5	-12.3	-	-
0.170	42.4	QP	0.3	9.8	52.5	65.0	-12.5	-	-
0.159	19.1	CAV	0.3	9.8	29.2	-	-	55.5	-26.3
0.169	27.4	CAV	0.3	9.8	37.5	-	-	55.0	-17.5
0.184	19.0	CAV	0.3	9.8	29.1	-	-	54.3	-25.2
0.211	23.0	CAV	0.2	9.8	33.0	-	-	53.2	-20.1
0.233	13.6	CAV	0.2	9.8	23.6	-	-	52.4	-28.8
0.266	13.6	CAV	0.2	9.8	23.6	-	-	51.2	-27.7
0.335	17.5	CAV	0.1	9.8	27.4	-	-	49.3	-21.9
0.362	17.6	CAV	0.1	9.8	27.5	-	-	48.7	-21.2
0.418	14.2	CAV	0.1	9.8	24.1	-	-	47.5	-23.4
0.495	15.2	CAV	0.1	9.8	25.1	-	-	46.1	-21.0
*PK = Peak, 0	*PK = Peak, QP = Quasi-Peak, CAV = CISPR Average								

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#### LINE 2 RESULTS



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LINE 2 DATA MANUFACTURER:ECHOSTAR LAB #:14LB196 MODEL:71 MEASUREMENT:120V NEUTRAL TESTED BY:E.VICK

						FCC		FCC	
Test	Meter				<b>RF</b> Line	15.207		15.207	
Frequency	Reading			Cable	Voltage	(QP)	Margin	(AV)	Margin
[MHz]	[dBuV]	Detector*	LISN [dB]	Loss [dB]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dB]
0.153	34.4	QP	0.4	9.8	44.6	65.8	-21.3	-	-
0.160	43.6	QP	0.3	9.8	53.7	65.4	-11.7	-	-
0.153	14.1	CAV	0.4	9.8	24.3	-	-	55.9	-31.5
0.160	16.2	CAV	0.3	9.8	26.3	-	-	55.5	-29.2
0.176	28.9	CAV	0.3	9.8	39.0	-	-	54.7	-15.7
0.198	10.2	CAV	0.2	9.8	20.2	-	-	53.7	-33.5
0.212	21.1	CAV	0.2	9.8	31.1	-	-	53.1	-22.1
0.241	7.6	CAV	0.2	9.8	17.6	-	-	52.1	-34.5
0.340	17.6	CAV	0.1	9.8	27.5	-	-	49.2	-21.7
0.364	15.7	CAV	0.1	9.8	25.6	-	-	48.6	-23.1
0.430	26.3	CAV	0.1	9.8	36.2	-	-	47.3	-11.0
0.497	12.1	CAV	0.1	9.8	22.0	-	-	46.1	-24.1
*PK = Peak, QP = Quasi-Peak, CAV = CISPR Average									

# **END OF REPORT**

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