

TEST REPORT

Report Number: 101239952DEN-001

Project Number: G101239952

Report Issue Date: 8/29/2013

Product Designation: Model: ID:071

Standards: FCC 47 CFR Part 15.247

Tested by:
Intertek Testing Services NA, Inc.
1795 Dogwood St. Suite 200
Louisville, CO 80027

Client:
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Englewood, CO 80112

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 3.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded **the product tested complies with the requirements of the standard(s) indicated**. The results obtained in this test report pertain only to the item(s) tested.

1.1 Test Report Scope

The scope of this report was to qualify the Model: ID:071 Moca Thin Client configured with a Synkro RF4CE Remote. The remote operates in the following transmit band: 2.4GHz to 2.4835 GHz. This product is a Moca Thin Client.

1.2 General Test Methodology

Both RF conducted port and radiated emissions measurements were performed according to the procedures in the following documents:

- ANSI C63.10:2009 – ANSI Standard for Testing Unlicensed Wireless Devices
- FCC Publication 558074: 2013 – “Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247

Radiated emissions tests were performed at an antenna-to-product distance of 3-meters.

1.3 Test Facility

Intertek Denver’s testing facilities are located at 1795 Dogwood St. Suite 200 Louisville, CO 80027. The testing facility is ISO17025:2005 accredited by A2LA, our lab code is 2506.02, our VCCI registration numbers are. R-1643, C-1752 and T-1558, our FCC designation no. US1121 and our IC lab no. 2042N.

Testing contained in this test report may not be covered under the laboratories scope of accreditation. A note will be placed in the specific test section for testing not covered under the laboratories scope.

2 Test Summary

Section	Test full name	Test date	Result
5	Digital Modulation (DTS) Requirements – FCC 15.247(a)(2)	07/09/2013	Pass
6	6dB (DTS) Bandwidth – FCC 15.247(a)(2)	07/12/2013 08/26/2013	Pass
7	Transmitter Output Power – EIRP Requirements – FCC 15.247(b)(3)	07/10/2013 08/23/2013	Pass
8	Harmonics of the Fundamental - Out-of-Band Emissions (-20dBc) FCC 15.247(d)	07/12/2013 08/26/2013	Pass
9	Antenna Port Spurious Emissions – Non-Restricted Bands - 30MHz to 25GHz (-20dBc/ Band Edge) - FCC 15.247(d)	Note 2	N/A
10	Radiated Emissions – Spurious/ Restricted Band/ Band Edge FCC 15.209/15.247(d)/15.205	07/10/2013 08/27/2013	Pass
11	Power Spectral Density (PSD) – FCC 15.247(e)	07/12/2013 08/26/2013	Pass
12	Occupied Bandwidth – RSS-GEN, Section 4.6.1	Note 3	N/A
13	Receiver Unintentional Emissions – FCC 15.109	08/27/2013	Pass
14	AC Conducted Emissions – FCC 15.207	07/15/2013	Pass
15	Duty Cycle Correction Factor – FCC 15.35(c)	-----	N/A
16	Antenna Requirement – FCC 15.203	07/09/2013	Pass
17	RF Exposure Requirements – FCC 15.247(b)(5)	07/11/2013	Pass

Notes:

- 1) The product in (2) general product configurations. Specifically, the radio portion of the main board was configured with (2) specific shielding schemes.
- 2) The product has an integral antenna and was not configured with an RF Conducted port. All measurements were taken as radiated field strength.
- 3) Occupied Bandwidth testing is not required for the FCC.

General Radio Test Notes:

- ANSI C63.10, Section 6.3: Testing was performed in 3 different orthogonal axes to determine the worst-case emissions from the device. The worst-case axis and emissions are shown in this report.
- ANSI C63.10, Section 5.13/ FCC CFR Part 15.31(e): For battery-operated equipment, the equipment tests shall be performed using a new battery. For AC power equipment, the voltage was varied between 85% and 115% of nominal rated supply voltage.
- ANSI C63.10, Section 4.2.3.2/ FCC 15.35: Measurement detector functions and bandwidths utilized in this testing were per the preceding guidelines.
- ANSI C63.10, Section 4.2.3.2.2/ FCC 15.35(b): When an average limit is specified, the peak emission must also be measured to ensure the emissions is less than 20dB above the average limit and/or below the peak limit specified. This report includes both average and peak test data.
- ANSI C63.10, Section 4.2.3.2.4/ FCC 15.35(c): When the field strength (or envelope power) is not constant or when it pulses, and an average detector/limit is specified to be used, a duty cycle correction factor may be utilized to determine the pulsed “average” of the field strength or power. Duty cycle correction was not utilized in this report.
- ANSI C63.10, Section 5.3/ FCC 15.31: All measurements taken at an antenna-to-product test distance of 3-meters for the following frequency range: 30MHz to 18GHz. All measurements taken at an antenna-to-product test distance of 1-meter for the following frequency range: 18GHz to 40GHz. The measurements were then extrapolated to 3-meters using a factor of 20dB/decade.
- ANSI C63.10, Section 5.5, Table 2/ FCC 15.33(a): The frequency range of measurement per the requirements of the preceding standards. The product was tested from 30MHz to 25GHz.
- ANSI C63.10, Section 6.3.1/ FCC 15.35(b): Measurement bandwidths utilized for peak emissions were greater than the 6dB bandwidth of the emission.
- ANSI C63.10, Section 6.3/ FCC 15.31(m): Measurements were taken for at the lowest, middle and highest channels of the product tested. The product utilizes 3-channels.

Product-Specific Radio Notes:

1. The product is not a fixed, point-to-point operating system.
2. The product is an ac powered product - therefore ac port testing was required.
3. The product is configured with an integral antenna – not user accessible. Therefore, FCC 15.203 antenna requirements were satisfied.
4. Duty Cycle Correction Factors were not utilized in this testing for this report.

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3 Description of Equipment Under Test

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
MocA Thin Client	Echostar Technologies L.L.C	ID:071	R1886469654
MocA Thin Client	Echostar Technologies L.L.C	ID:071	R1886470001
AC to DC PSU	LiteOn	PB-1190-88ET	ETC15290042

Receive Date:	07/09/2013 08/23/2013
Received Condition:	Good
Type:	Production Samples

Description of Equipment Under Test (provided by client)

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 highdefinition 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 purpose of the 2.4GHz transceiver is to allow for a multi-channel (non-frequency hopping) communication between an Echostar designed set-top box and a remote (a.k.a the system) designed to meet Echostar requirements. The performance and protocols are fully compliant with the IEEE 802.15.4 with a reduced set of requirements.

The RF4CE specification defines a remote control (RC) network that defines a simple, robust and low-cost communication network allowing wireless connectivity in applications for consumer electronic (CE) devices.

The RF4CE specification enhances the IEEE 802.15.4 standard by providing a simple networking layer and standard application layer that can be used to create a multi-vendor interoperable solution for use within the home.

Some of the characteristics of RF4CE include:

- Operation in the 2.4GHz frequency band according to IEEE 802.15.4
- Frequency agile solution operating over three channels
- Incorporates power saving mechanisms for all device classes
- Specifies a simple RC control profile for CE products

Product Clocks: 1.8kHz, 100kHz, 20MHz, 25MHz

Product Radio: Synkro RF4CE Remote, 3 Channels of Operation 2425MHz, 2450MHz, and 2475MHz

The product will be marketed in the US.

Equipment Under Test Power Configuration

Rated Voltage	Rated Current	Rated Frequency	Number of Phases
120VAC	.5A	60Hz	1

Operating modes of the EUT: Intentional Tx Testing

No.	Descriptions of EUT Exercising
1	Model ID:071 with FCC Test Script to configure radio channels per below.
2	Product configured for continuous transmission, full power, CW signal.
3	Product configured for continuous transmission, full power with modulation/data transfer enabled.
4	Product configured in receive/ idle mode of operation.

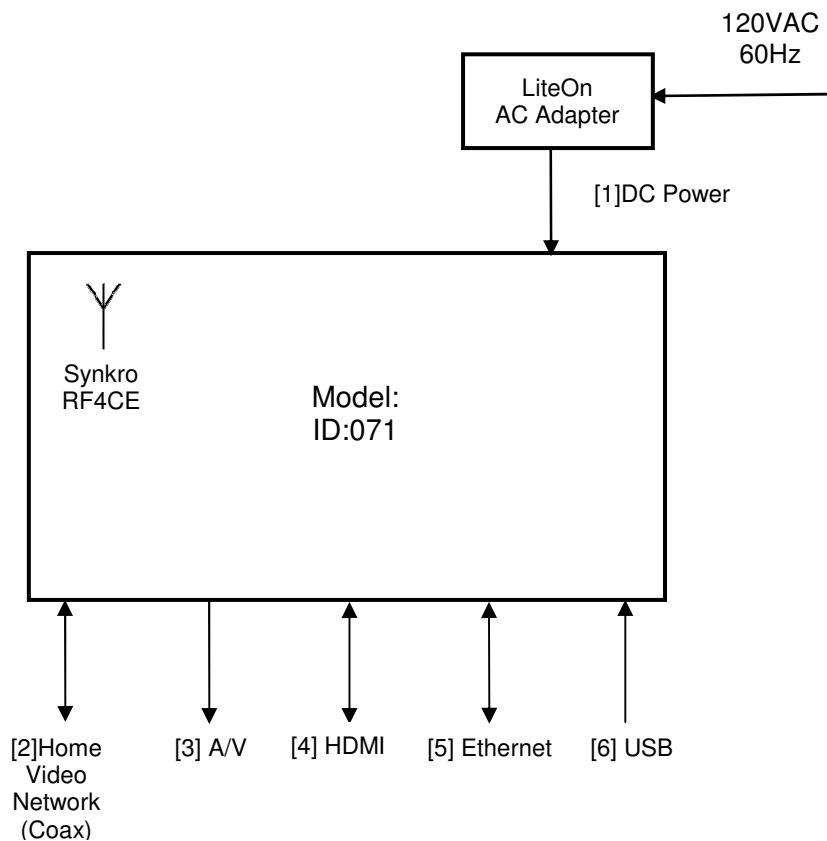
Note: The chosen mode of operation described above is dependent upon specific test to be performed.

4 System setup including cable interconnection details, support equipment and simplified block diagram

4.1 Method:

Record the details of EUT cabling, document the support equipment, and show the interconnections in a block diagram.

4.2 EUT Block Diagram:



Note: Dashed lines indicate auxiliary/support equipment – if applicable.

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4.3 Support Data - Cables:

ID	Description of cables	Length	Shielding	Ferrites	Connection
1	DC Power	6 feet	None	None	Lite-ON PSU
2	Coax-Home Video Network	6 feet	Braid	None	750 ohm Load
3	Composite A/V	6 feet	Foil	None	Resistive Load
4	HDMI	6 feet	Foil	None	Resistive Load
5	Ethernet	10 feet	None	None	Not terminated
6	USB	3 Feet	Foil	None	500 mA Load

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
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Notes:

- 1) None

4.4 Product Under Test: Model ID:071 with Synkro RF4CE Remote

Front View



Rear View

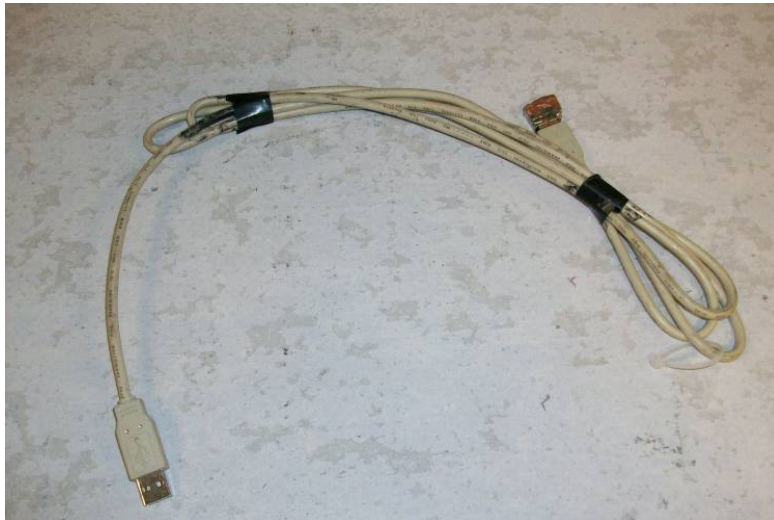


4.5 Product Under Test: Model ID:071 with Synkro RF4CE Remote

Home Video Network – Coax Cable



USB Cable



HDMI Cable



4.6 Product Under Test: Model ID:071 with Synkro RF4CE Remote

Ethernet Cable



Composite A/V Cables



5 Digital Modulation (DTS)**5.1****5.2 Method**

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC CFR47 15.247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

5.3 Test Requirement/Specification

Products operating under the provisions of the above standards are limited to frequency-hopping and digital transmissions systems (DTS) using digital modulation techniques operating in the 2400MHz to 2483.5MHz band.

- FCC 15.247(a)(2)

5.4 Results:

The sample tested was found to comply.

The product is a Synkro RF4CE Remote (3-channel) - Direct-Sequence Spread Spectrum (DSSS).

6 6dB Bandwidth (DTS Bandwidth)

6.1 Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247.

- Test Method: FCC 558074 D01 DTS Measurement Guidance: 2013, Section 8.0, Option 1

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

6.2 Test Requirement/Specification

The minimum 6dB Bandwidth (modulated) shall be at least 500 kHz.

- FCC 15.247(a)(2)

6.3

6.4 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18906	RF Pre-Amp (1-4GHz) with attenuator	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

6.5 Results:

The sample tested was found to comply.

6.6 Results Summary:

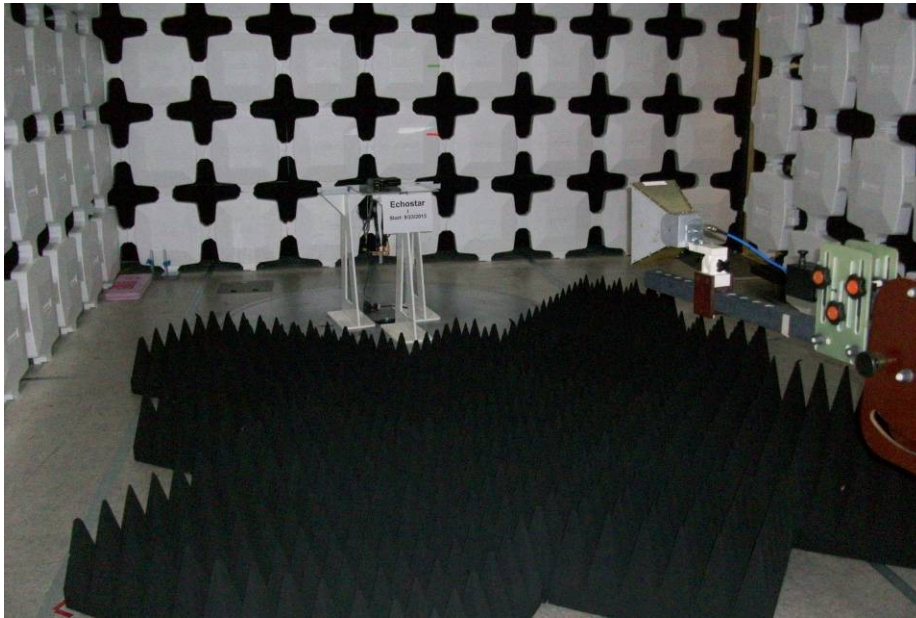
6dB Bandwidth (DTS Bandwidth) Summary – Unit 1	
Channel/ Mode	6dB Bandwidth
Low	2.051 MHz
Mid	1.987 MHz
High	1.667 MHz

6dB Bandwidth (DTS Bandwidth) Summary – Unit 2	
Channel/ Mode	6dB Bandwidth
Low	2.019 MHz
Mid	2.147 MHz
High	2.147 MHz

Specification: 6dB Bandwidth > 500 kHz

6.7 Setup Photographs

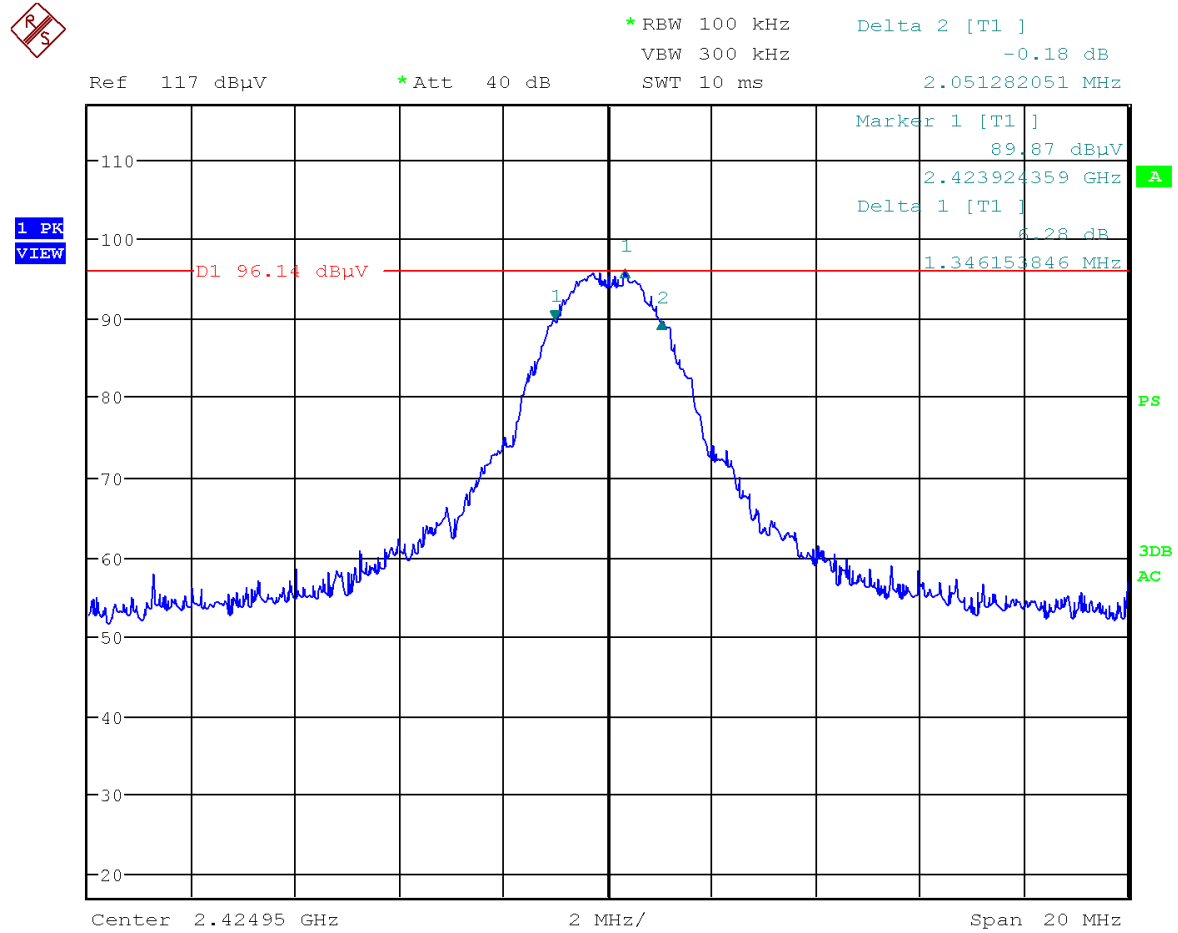
Test Setup



6.8 Test Data: DTS (6dB) Bandwidth – Unit 1

6 dB Bandwidth (DTS Bandwidth) – Model ID:071
FCC 15.247(a)(2)

Low Channel – 2425 MHz

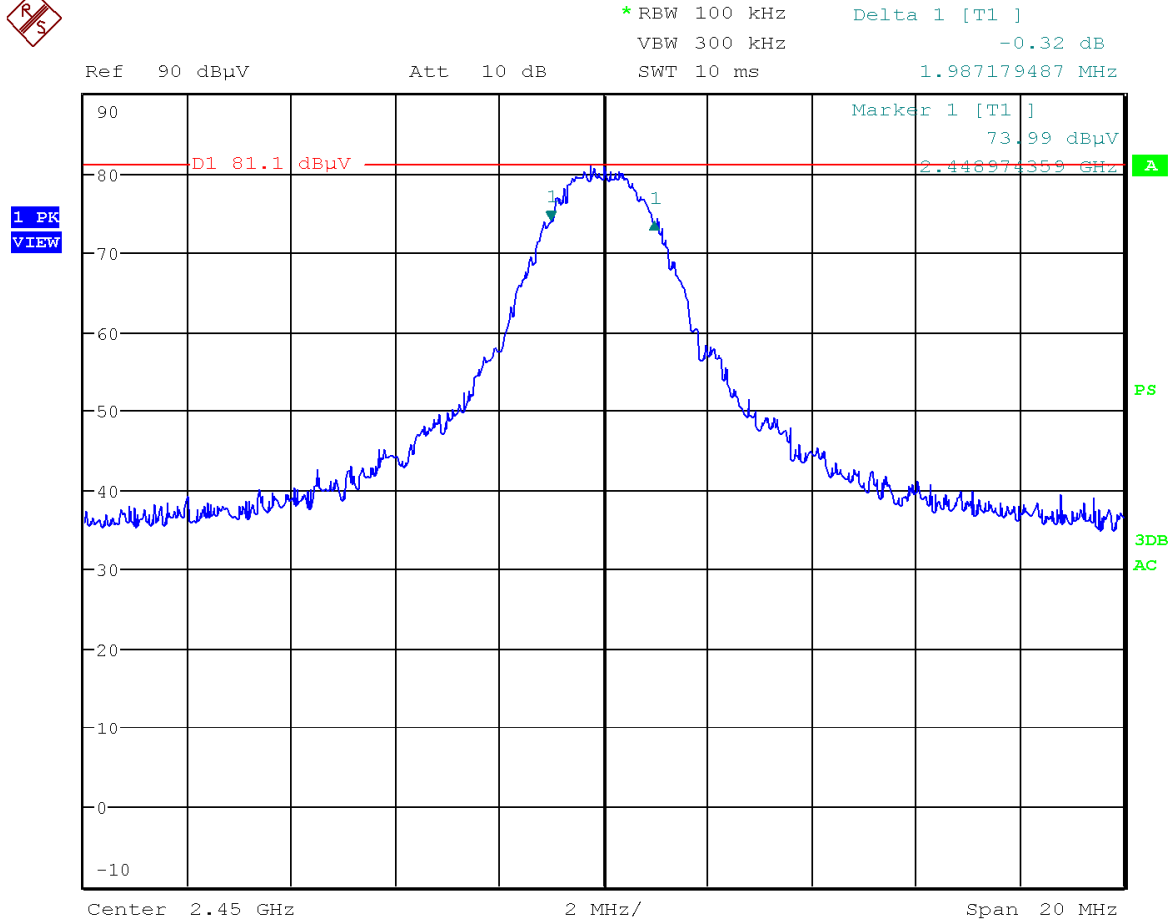


Date: 12.JUL.2013 10:26:39

Specification: 6dB Bandwidth > 500 kHz

6 dB Bandwidth (DTS Bandwidth)
FCC 15.247(a)(2)

Mid Channel – 2450 MHz



Date: 12.JUL.2013 10:43:54

Specification: 6dB Bandwidth > 500 kHz

6 dB Bandwidth (DTS Bandwidth)
FCC 15.247(a)(2)

High Channel – 2475 MHz

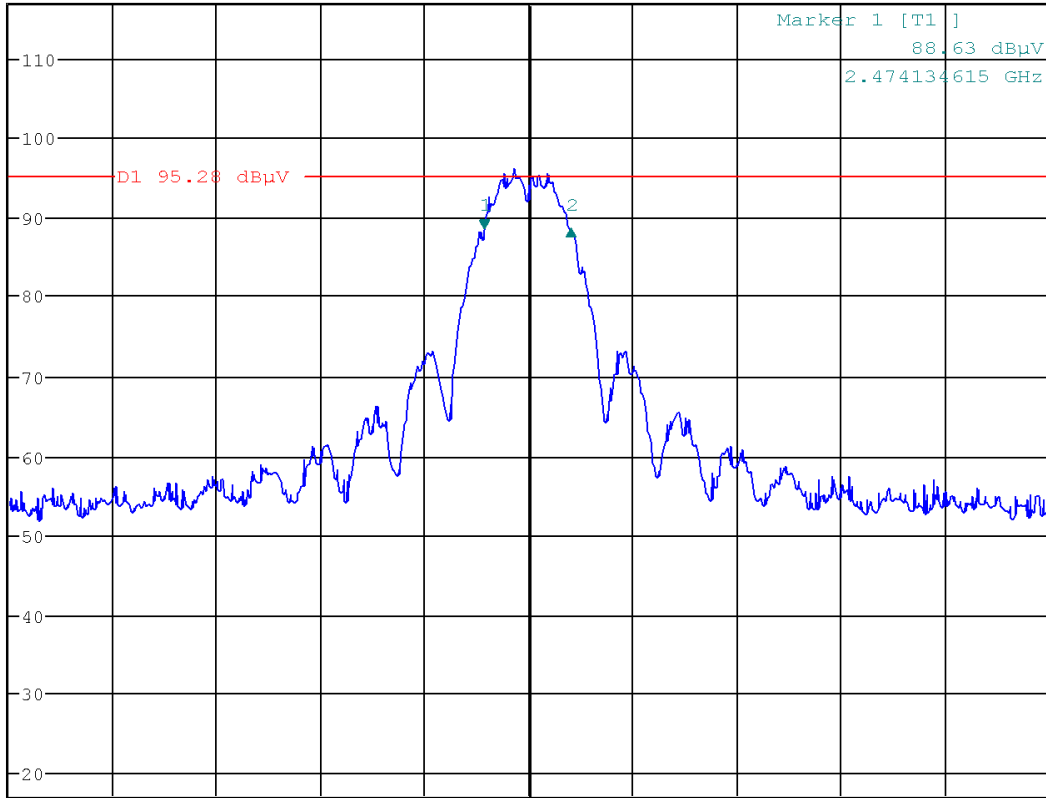


*RBW 100 kHz Delta 2 [T1]
VBW 300 kHz -0.03 dB
SWT 10 ms 1.666666667 MHz

Ref 117 dBμV

*Att 40 dB

1 PK
VIEW



Center 2.475 GHz

2 MHz/

Span 20 MHz

Date: 12.JUL.2013 10:33:30

Specification: 6dB Bandwidth > 500 kHz

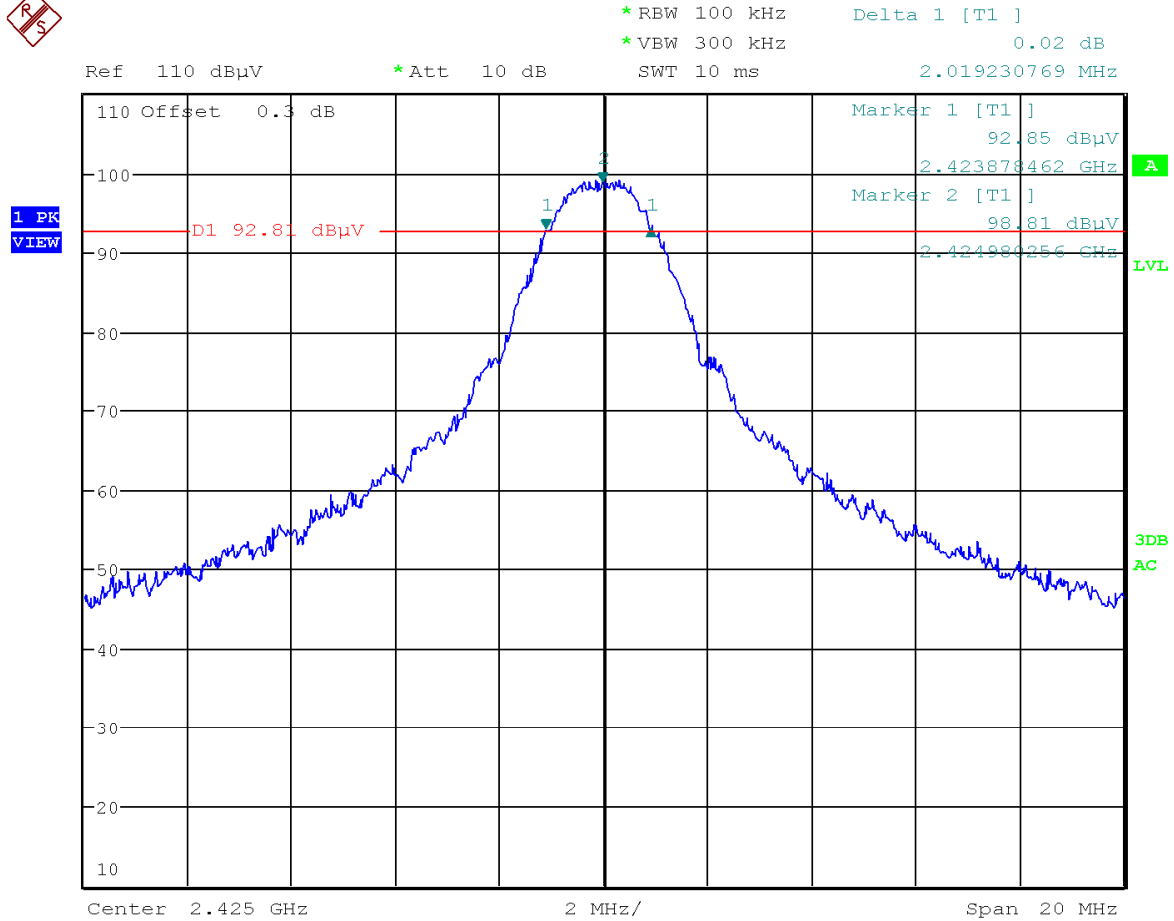
6.9 Test Notes:

- 1) Measurements were taken using worst-case modulated (minimum bandwidth) mode, using minimum data packet length.

6.10 Test Data: DTS (6dB) Bandwidth – Unit 2

6 dB Bandwidth (DTS Bandwidth) – Model ID:071
FCC 15.247(a)(2)

Low Channel – 2425 MHz

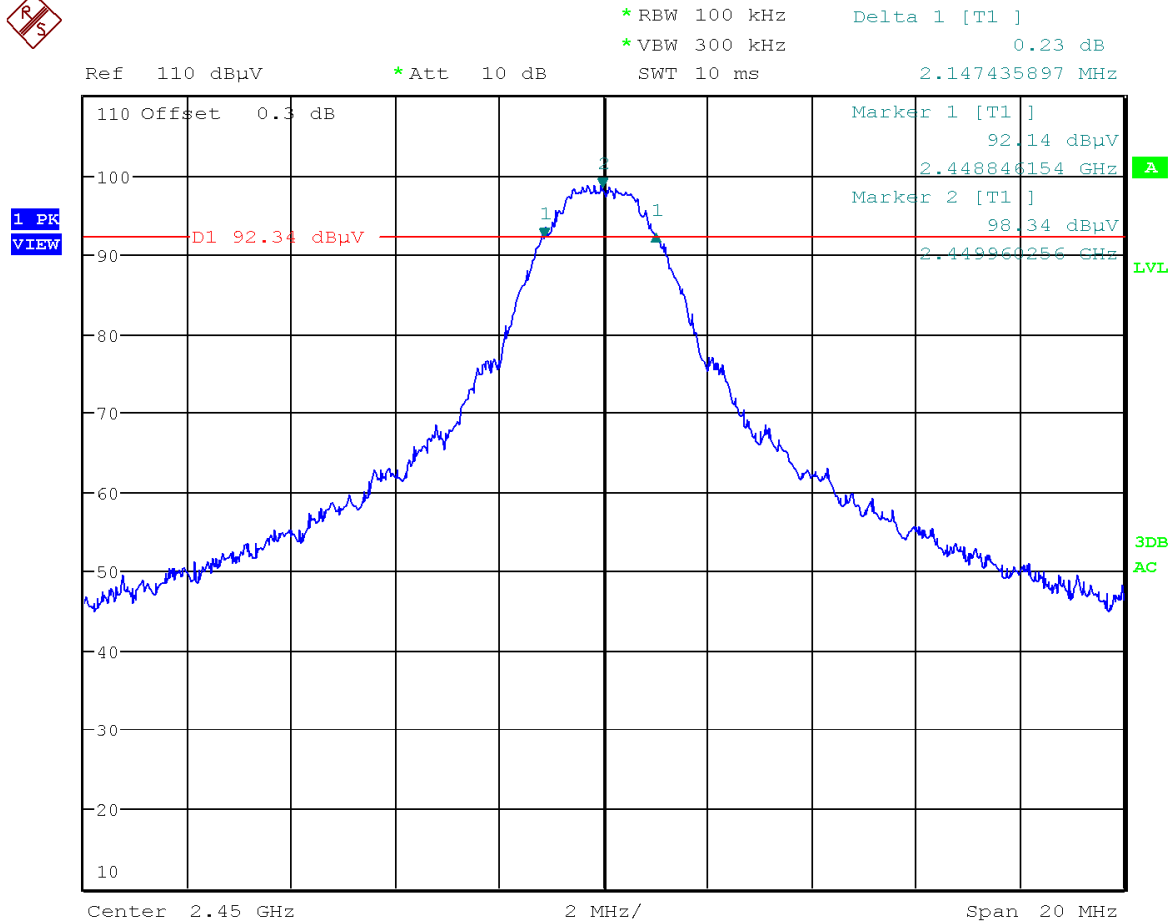


Date: 26.AUG.2013 12:02:26

Specification: 6dB Bandwidth > 500 kHz

6 dB Bandwidth (DTS Bandwidth)
FCC 15.247(a)(2)

Mid Channel – 2450 MHz

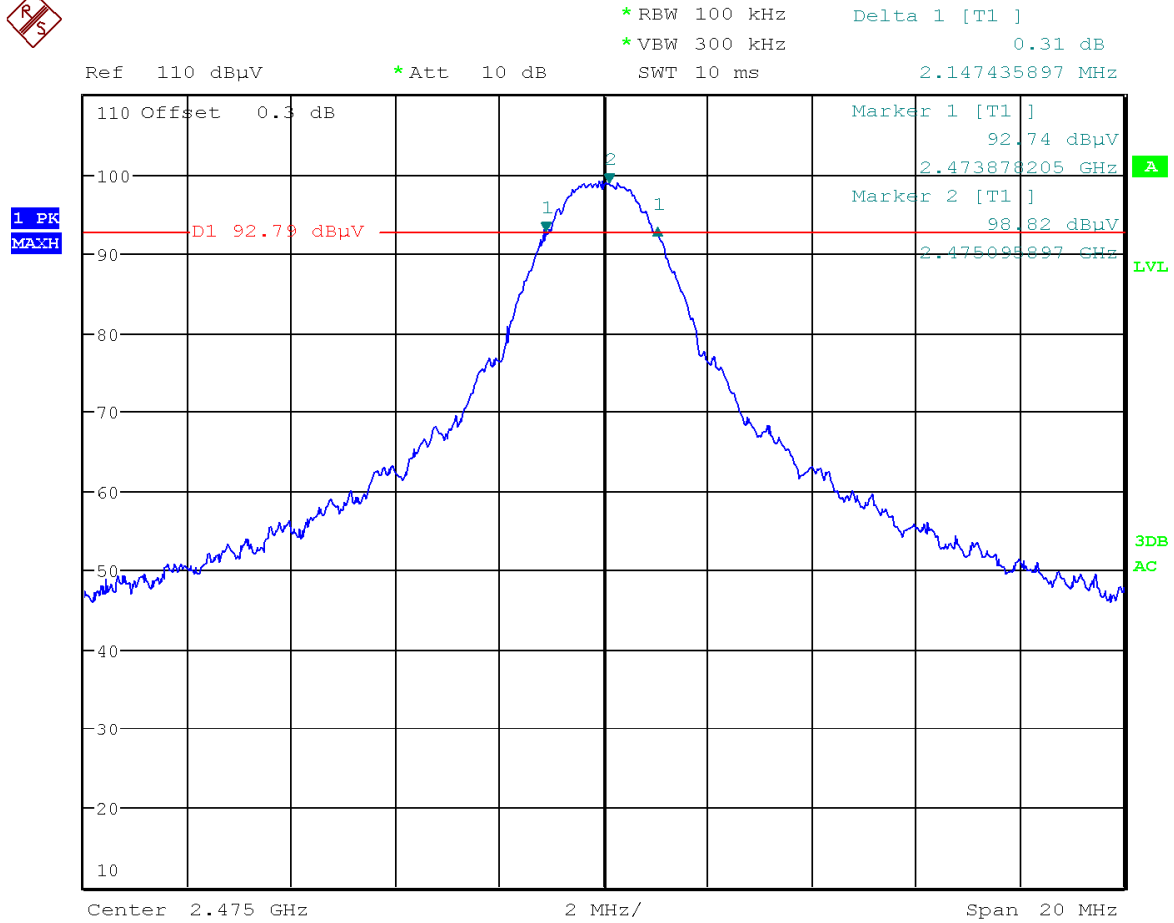


Date: 26.AUG.2013 12:06:13

Specification: 6dB Bandwidth > 500 kHz

**6 dB Bandwidth (DTS Bandwidth)
FCC 15.247(a)(2)**

High Channel – 2475 MHz



Date: 26.AUG.2013 12:16:03

Specification: 6dB Bandwidth > 500 kHz

6.11 Test Notes:

- 1) Measurements were taken using worst-case modulated (minimum bandwidth) mode, using minimum data packet length.

7 Transmitter Output Power – EIRP Requirements

7.1 Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247.

- FCC 558074 D01 DTS Measurement Guidance: 2013, Section 9.0, Option 9.1.1 (RBW ≥DTS Bandwidth - Peak)
- ANSI C63.10:2009, Section 6.10.2.1(a) (Peak detector)

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

7.2 Test Requirement/Specification

The maximum peak conducted output power shall not exceed 1 Watt (+30 dBm).
The EIRP shall not exceed 4 Watts.

The conducted output power limit specified above is based on the use of antennas with directional gains that do not exceed 6 dBi.

- FCC 15.247(b)(3)

7.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

7.4 Results:

The sample tested was found to comply.

7.5 Results Summary: Unit 1

Peak Conducted Output Power– Unit 1		
Channel/ Mode	Radiated Field Strength	Max Power
High	101.80 dBuV/m	4.54 mW

7.6 Results Summary: Unit 2

Peak Conducted Output Power– Unit 2		
Channel/ Mode	Radiated Field Strength	Max Power
Mid	101.66 dBuV/m	4.39 mW

Antenna Gain as declared by manufacturer: 0dBi

Specification: Maximum Peak Conducted Output Power 1W (+30dBm) = 125.2 dBuV/m

7.7 Setup Photographs

Test Setup – Axis 1 (Product Flat on Table – Horizontal)

Front View



Rear View



Setup Photographs

Test Setup – Axis 2 (Product Vertical on Table)

Front View



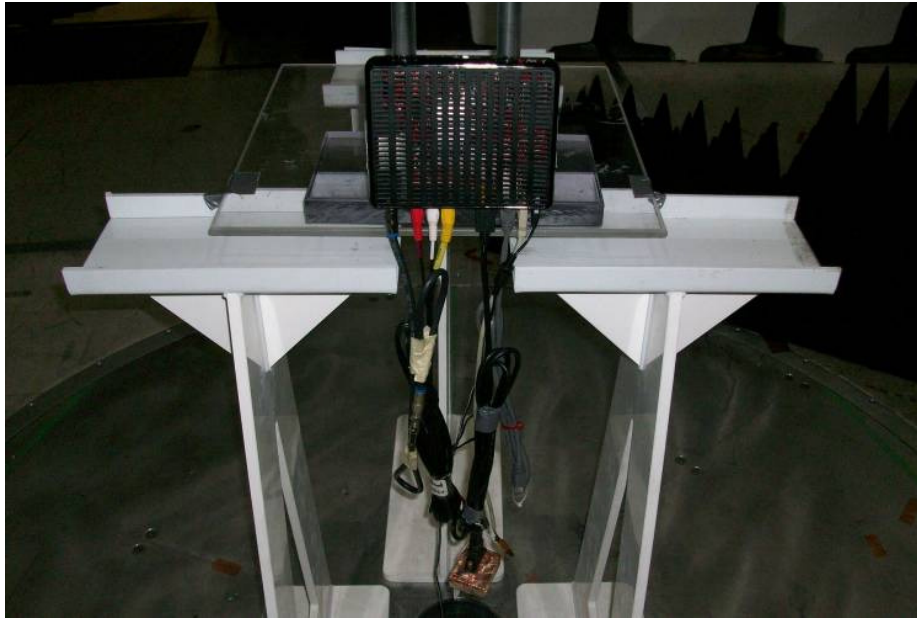
Rear View



Setup Photographs

Test Setup – Axis 3 (Product Wall-Mount Position)

Front View



Rear View



Setup Photographs

Test Setup – Axis 1 (Worst-Case)

Front View



Setup Photographs

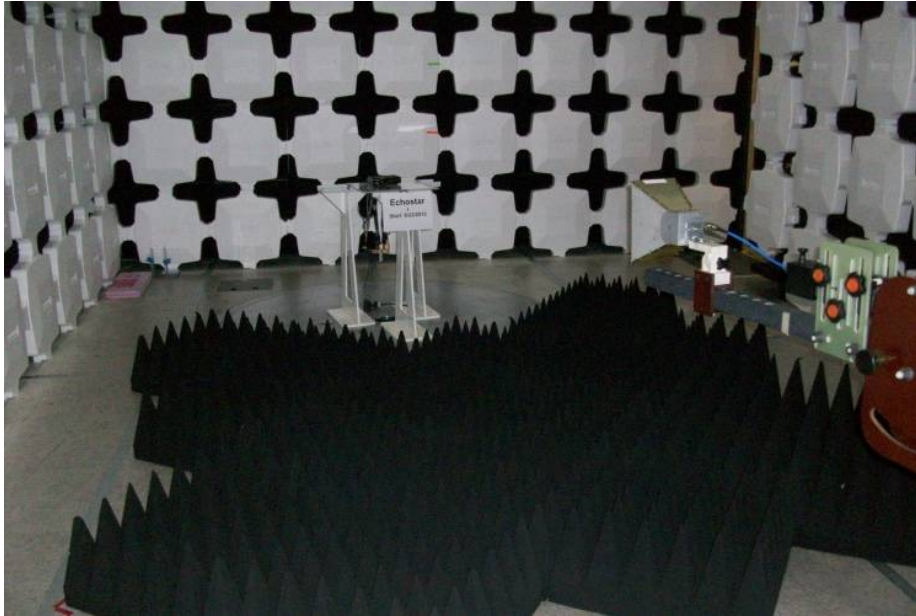
Test Setup – Axis 1 (Worst-Case)

Rear View



Setup Photographs

Antenna Setup – 1-18GHz



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7.8 Test Data: Unit 1

Fundamental Conducted Output Power of the Transmitter

Test Report #: G101239952	Test Area: CC1 Radiated	Temperature: 23.5 °C
Test Method: FCC 15.247 DTS	Test Date: 10-Jul-2013 11-Jul-2013	Relative Humidity: 25.2 %
EUT Model #: ID:071	EUT Power: 120VAC/60Hz	Air Pressure: 82.9 kPa
EUT Serial #: R1886469654		

Manufacturer: Echostar Technologies

EUT Description: MocA Thin Client

Notes: Product transmitting continuously – worst-case modulation (highest amplitude)

(3) Test Axes measured; Lowest, Middle and Highest Channels measured

Radiated Field Measurements, Peak detector – ~ 100% Duty Cycle

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

The following Duty Cycle was verified by Intertek: **No Duty Cycle Correction was utilized in this test data.**

Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.247 and delta limits were calculated as follows:
 Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission
 The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.247 and the emission/limit delta was calculated.
 DTCF is calculated as follows $20 \cdot \log_{10}$ (duty cycle in 100mS).

Part 15.247 DTS

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	[dB]	FINAL	(V/H)	(m)	(DEG)	FCC 15.247 (b)(3) [dBuV/m]	[dB]	(MHz)

Fundamental Measurements – Axis 1 – Product flat on table with base

Tx Lowest Channel

2425.0000	103.81	Pk	3.53	28.61	37.40	98.55	0.00	98.55	V	2.83	203.8	125.2	-26.65	3.000
2425.0000	106.40	Pk	3.53	28.61	37.40	101.14	0.00	101.14	H	1.86	102.4	125.2	-24.06	3.000

Tx Mid Channel

2450.0000	105.50	Pk	3.55	28.64	37.43	100.27	0.00	100.27	V	2.76	0.0	125.2	-24.93	3.000
2450.0000	107.03	Pk	3.55	28.64	37.43	101.80	0.00	101.80	H	1.83	98.9	125.2	-23.40	3.000

Tx Highest Channel

2475.0000	104.33	Pk	3.57	28.68	37.45	99.13	0.00	99.13	V	2.28	194.3	125.2	-26.07	3.000
2475.0000	106.80	Pk	3.57	28.68	37.45	101.60	0.00	101.60	H	1.79	102.2	125.2	-23.60	3.000

Fundamental Measurements – Axis 2 – Product Vertical on table with base

Tx Lowest Channel

2425.0000	99.86	Pk	3.53	28.61	37.40	94.60	0.00	94.60	V	2.31	157.4	125.2	-30.60	3.000
2425.0000	104.03	Pk	3.53	28.61	37.40	98.77	0.00	98.77	H	2.07	130.5	125.2	-26.43	3.000

Tx Mid Channel

2450.0000	98.21	Pk	3.55	28.64	37.43	92.98	0.00	92.98	V	2.28	162.1	125.2	-32.22	3.000
2450.0000	102.65	Pk	3.55	28.64	37.43	97.42	0.00	97.42	H	1.87	47.9	125.2	-27.78	3.000

Tx Highest Channel

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2475.0000	101.11	Pk	3.57	28.68	37.45	95.91	0.00	95.91	V	1.96	217.7	125.2	-29.29	3.000
2475.0000	104.03	Pk	3.57	28.68	37.45	98.83	0.00	98.83	H	1.92	77.4	125.2	-26.37	3.000
Fundamental Measurements – Axis 3 – Product Wall-Mount position with base														
Tx Lowest Channel														
2425.0000	104.30	Pk	3.53	28.61	37.40	99.04	0.00	99.04	V	2.45	199.8	125.2	-26.16	3.000
2425.0000	105.08	Pk	3.53	28.61	37.40	99.82	0.00	99.82	H	2.43	271.5	125.2	-25.38	3.000
Tx Mid Channel														
2450.0000	102.99	Pk	3.55	28.64	37.43	97.76	0.00	97.76	V	1.52	1.5	125.2	-27.44	3.000
2450.0000	102.12	Pk	3.55	28.64	37.43	96.89	0.00	96.89	H	1.78	198.2	125.2	-28.31	3.000
Tx Highest Channel														
2475.0000	104.90	Pk	3.57	28.68	37.45	99.70	0.00	99.70	V	2.39	68.9	125.2	-25.50	3.000
2475.0000	104.08	Pk	3.57	28.68	37.45	98.88	0.00	98.88	H	2.37	242.9	125.2	-26.32	3.000

Worst Case Fundamental Measurement: 2450 MHz, 101.80 dBuV/m (-23.40 dB under limit)

FREQ	LEVEL	DET	CABLE + Attenuator	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV]	[dB]	FINAL [dBuV]	(V/H)	(m)	(DEG)	FCC 15.247 (b)(3) [dBuV]	[dB]	(MHz)
2450.0000	107.03	Pk	3.55	28.64	37.43	101.80	0.00	101.80	H	1.83	98.9	125.2	-23.40	3.000

Specification: Maximum Peak Conducted Output Power 1W (+30dBm)

Calculation of Fundamental Output Power from Radiated Field Strength Measurement:

Worst-case measured Fundamental: 101.80 dBuV/m = 0.123027 V/m

Conversion to P (Watts): $P = (E \times D)^2 / (30 \times G) = 0.00454 \text{ W}$

Delta from 1 W Output Power Limit: $1.0 \text{ W} - 0.00454 \text{ W} = 0.99546 \text{ W}$ under the limit

Where:

E = Measured Field Strength in V/m (converted to dBuV/m in test data)

P = Watts

G = Numeric Gain of transmitting antenna over an ideal isotropic radiator = 1

D = EUT-to-Antenna Test Distance = 3-meters

Note: Manufacturer has declared the following antenna gain: 0dBi (used for calculation)

Calculation of Fundamental Output Power Limit – Conversion to Radiated Field Strength Limit

When antenna conducted port tests cannot be performed, radiated field strength tests to demonstrate compliance are acceptable per FCC 15.247 and IC RSS-210.

The following equation was used to convert power (watts) limits into field strength (V/m) limits:

$$P = (E \times D)^2 / (30 \times G), \text{ Therefore } E = \text{SQRT} (P (30 \times G)) / D$$

Power Limit Fundamental Frequency = 1 W = 1.82574 V/m = 125.23 dBuV/m

Where:

E = Measured Field Strength in V/m (converted to dBuV/m in test data)

P = 1 Watt Fundamental Limit

G = Numeric Gain of transmitting antenna over an ideal isotropic radiator = 1

D = EUT-to-Antenna Test Distance = 3-meters

7.9 Test Data: Unit 2

Fundamental Conducted Output Power of the Transmitter

Test Report #: G101239952 PCOR	Test Area: CC1 Radiated	Temperature: 23.2 °C
Test Method: FCC 15.247 DTS	Test Date: 26-Aug-2013	Relative Humidity: 22.9 %
EUT Model #: ID:071	EUT Power: 120VAC/60Hz	Air Pressure: 83.1 kPa
EUT Serial #: R1886470001 (Unit 2)		

Manufacturer: Echostar Technologies

EUT Description: MocA Thin Client with alternative shield

Notes: Product transmitting continuously – worst-case modulation (highest amplitude)

(3) Test Axes measured; Lowest, Middle and Highest Channels measured

Radiated Field Measurements, Peak detector – ~ 100% Duty Cycle

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

The following Duty Cycle was verified by Intertek: **No Duty Cycle Correction was utilized in this test data.**

Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.247 and delta limits were calculated as follows:

Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission

The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.247 and the emission/limit delta was calculated.

DTCF is calculated as follows $20 \cdot \log_{10}$ (duty cycle in 100mS).

Part 15.247 DTS

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	[dB]	FINAL	(V/H)	(m)	(DEG)	FCC 15.247 (b)(3) [dBuV/m]	[dB]	(MHz)

Fundamental Measurements – Axis 1 – Product flat on table with base

Tx Lowest Channel

2425.0304	99.17	Pk	9.28	28.61	37.63	99.43	0.00	99.43	V	2.39	112.0	125.2	-25.77	3.000
2425.0304	99.38	Pk	9.28	28.61	37.63	99.64	0.00	99.64	H	1.00	273.0	125.2	-25.56	3.000

Tx Mid Channel

2450.0000	99.28	Pk	9.28	28.64	37.66	99.57	0.00	99.57	H	1.00	271.0	125.2	-25.63	3.000
2450.0000	101.37	Pk	9.28	28.64	37.66	101.66	0.00	101.66	V	2.41	91.0	125.2	-23.54	3.000

Tx Highest Channel

2475.0000	101.02	Pk	9.28	28.68	37.67	101.36	0.00	101.36	V	2.37	96.0	125.2	-23.84	3.000
2474.8718	99.24	Pk	9.28	28.68	37.67	99.58	0.00	99.58	H	1.00	267.0	125.2	-25.62	3.000

Fundamental Measurements – Axis 2 – Product Vertical on table with base

Tx Lowest Channel

2474.8718	94.02	Pk	9.28	28.68	37.67	94.36	0.00	94.36	H	2.59	271.0	125.2	-30.84	3.000
2474.8718	100.03	Pk	9.28	28.68	37.67	100.37	0.00	100.37	V	1.39	287.0	125.2	-24.83	3.000

Tx Mid Channel

2450.0000	99.12	Pk	9.28	28.64	37.66	99.41	0.00	99.41	V	1.45	287.0	125.2	-25.79	3.000
2450.0000	92.00	Pk	9.28	28.64	37.66	92.29	0.00	92.29	H	2.66	271.0	125.2	-32.91	3.000

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Tx Highest Channel														
2424.8397	92.32	Pk	9.28	28.61	37.63	92.58	0.00	92.58	H	2.59	261.0	125.2	-32.62	3.000
2424.8397	99.68	Pk	9.28	28.61	37.63	99.94	0.00	99.94	V	1.41	287.0	125.2	-25.26	3.000
Fundamental Measurements – Axis 3 – Product Wall-Mount position with base														
Tx Lowest Channel														
2424.9199	97.55	Pk	9.28	28.61	37.63	97.81	0.00	97.81	V	2.45	90.0	125.2	-27.39	3.000
2424.9199	99.99	Pk	9.28	28.61	37.63	100.25	0.00	100.25	H	1.95	128.0	125.2	-24.95	3.000
Tx Mid Channel														
2450.0000	99.96	Pk	9.28	28.64	37.66	100.25	0.00	100.25	H	1.95	141.0	125.2	-24.95	3.000
2450.0000	97.59	Pk	9.28	28.64	37.66	97.88	0.00	97.88	V	2.37	87.0	125.2	-27.32	3.000
Tx Highest Channel														
2474.8397	97.54	Pk	9.28	28.68	37.67	97.88	0.00	97.88	V	2.37	72.0	125.2	-27.32	3.000
2474.8397	99.99	Pk	9.28	28.68	37.67	100.33	0.00	100.33	H	1.89	131.0	125.2	-24.87	3.000

Worst Case Fundamental Measurement: 2450 MHz, 101.66 dBuV/m (-23.54 dB under limit)															
FREQ	LEVEL	DET	CABLE + Attenuator	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW	
MHz	dBuV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV]	[dB]	FINAL [dBuV]	(V/H)	(m)	(DEG)	FCC 15.247 (b)(3) [dBuV]	[dB]	(MHz)	
2450.0000	101.37	Pk	9.28	28.64	37.66	101.66	0.00	101.66	V	2.41	91.0	125.2	-23.54	3.000	

Specification: Maximum Peak Conducted Output Power 1W (+30dBm)

Calculation of Fundamental Output Power from Radiated Field Strength Measurement:

Worst-case measured Fundamental: 101.66 dBuV/m = 0.12106 V/m

Conversion to P (Watts): $P = (E \times D)^2 / (30 \times G) = 0.00439 \text{ W}$

Delta from 1 W Output Power Limit: $1.0 \text{ W} - 0.00439 \text{ W} = 0.99561 \text{ W}$ under the limit

Where:

E = Measured Field Strength in V/m (converted to dBuV/m in test data)

P = Watts

G = Numeric Gain of transmitting antenna over an ideal isotropic radiator = 1

D = EUT-to-Antenna Test Distance = 3-meters

Note: Manufacturer has declared the following antenna gain: 0dBi (used for calculation).

Calculation of Fundamental Output Power Limit – Conversion to Radiated Field Strength Limit

When antenna conducted port tests cannot be performed, radiated field strength tests to demonstrate compliance are acceptable per FCC 15.247 and IC RSS-210.

The following equation was used to convert power (watts) limits into field strength (V/m) limits:

$P = (E \times D)^2 / (30 \times G)$, Therefore $E = \text{SQRT} (P (30 \times G)) / D$

Power Limit Fundamental Frequency = 1 W = 1.82574 V/m = 125.23 dBuV/m

Where:

E = Measured Field Strength in V/m (converted to dBuV/m in test data)

P = 1 Watt Fundamental Limit

G = Numeric Gain of transmitting antenna over an ideal isotropic radiator = 1

D = EUT-to-Antenna Test Distance = 3-meters

7.10 Test Notes:

1. All Fundamental and Harmonics measurements are Radiated Field – peak detector measurements, 3MHz RBW (> DTS bandwidth).
2. Measurements were not adjusted by the allowed duty cycle correction factor per FCC 15.35/ IC RSS-GEN, Section 4.5.
3. Product also measured without base attached – worst-case was with base attached. Therefore, all measurements above taken with the product base attached.

8 Harmonics of the Fundamental (Out-of-Band Emissions) -20dBc

8.1 Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247.

- FCC 558074 D01 DTS Measurement Guidance: 2013, Section 11.0
- ANSI C63.10:2009, Section 6.6

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

8.2 Test Requirement/Specification

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's harmonics 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.

Attenuation below the general limits specified in 15.209(a) is not required.

- FCC 15.247(d)

8.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	06/07/2013	06/07/2014
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
18900	RF Pre-Amplifier (4-8 GHz)	Avantek	AFT97-8434-10F	1007	06/10/2013	06/10/2014
18901	RF Pre-Amp (8-18GHz)	Avantek	AWT-18037	1002	06/10/2013	06/10/2014
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
18805	HF Active Antenna/Harmonic Mixer 18 GHz to 26.5 GHz	Hewlett-Packard	11970K	2332A01280	01/30/2013	01/30/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

8.4 Results:

The sample tested was found to comply.

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8.5 Results Summary:

Worst Case Harmonic Non-Restricted Band Measurement: 17325.00 MHz, 57.24 dBuV/m (-25.12 dB under limit)													
FREQ	LEVEL	DET	CABLE	ANT	PREAMP	Atten	FINAL	Pol	Hgt	Az	Limit	Delta Limit	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	[dB]	= [dBuV]	[V/H]	[m]	[Deg]	[dBuV/m]	[dB]	[MHz]
17325.0000	49.47	Pk	10.70	43.00	45.93	0.00	57.24	V	1.36	12.0	82.36	-25.12	1.000

8.6 Setup Photographs

Test Setup

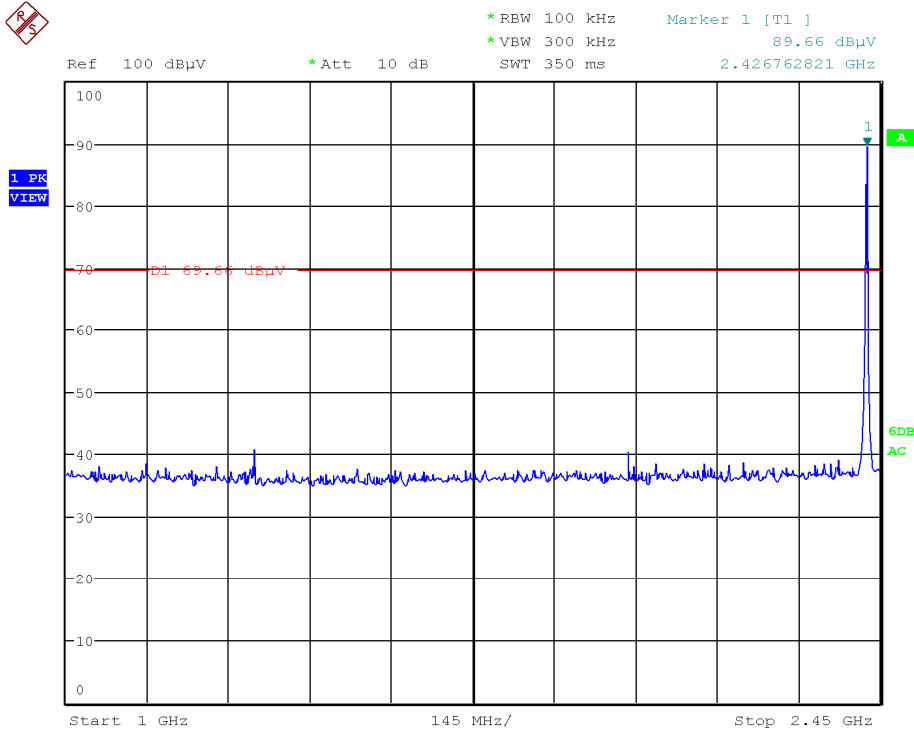
Antenna 1 GHz to 18GHz



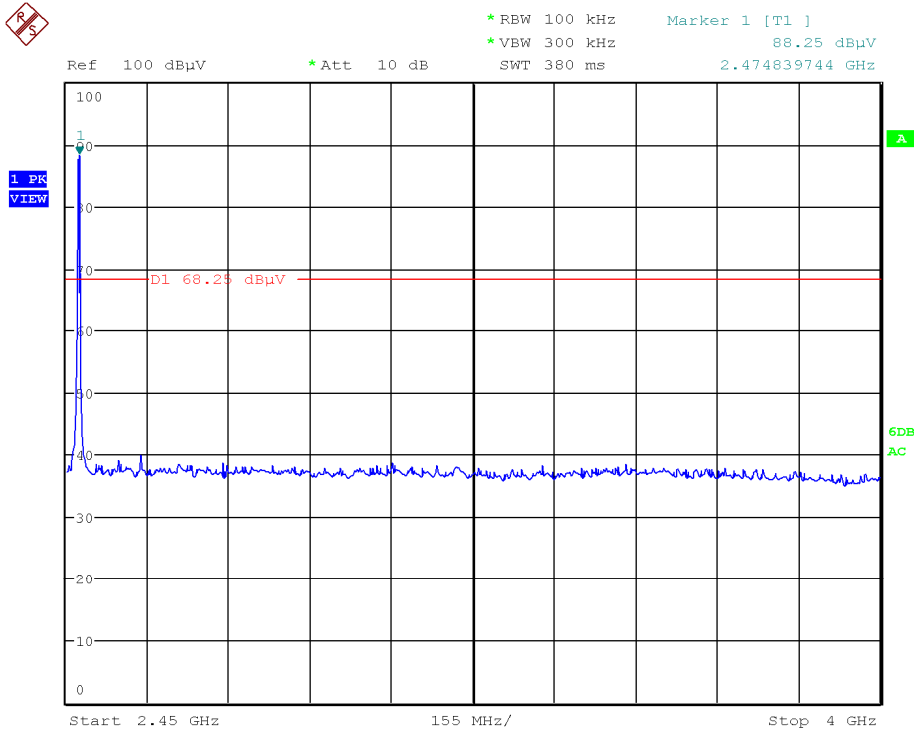
Antenna 18GHz to 25GHz



8.7 Plots: Vertical Antenna



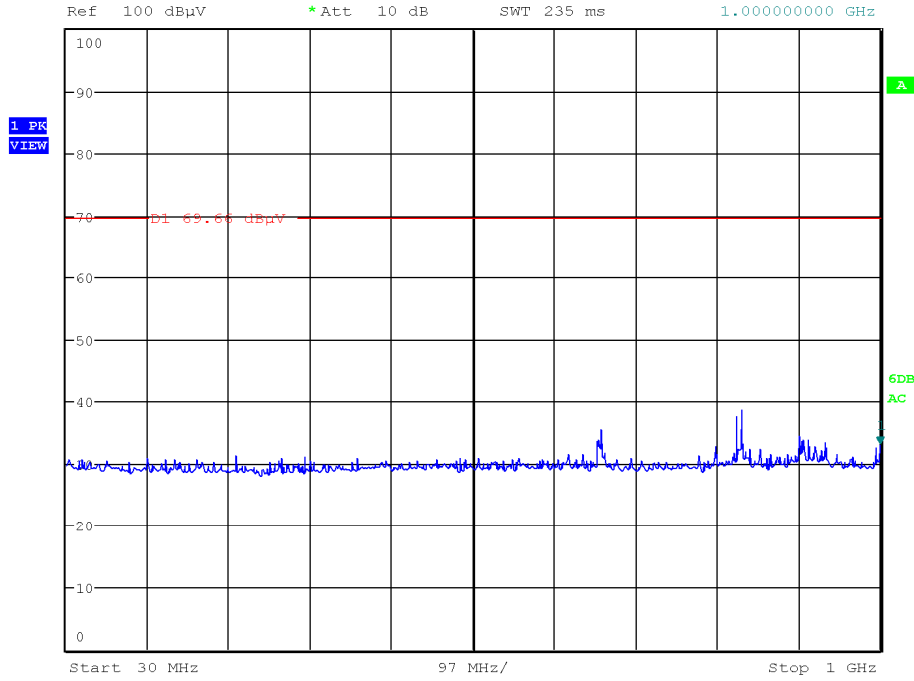
Date: 12.JUL.2013 16:06:55



Date: 12.JUL.2013 16:14:26



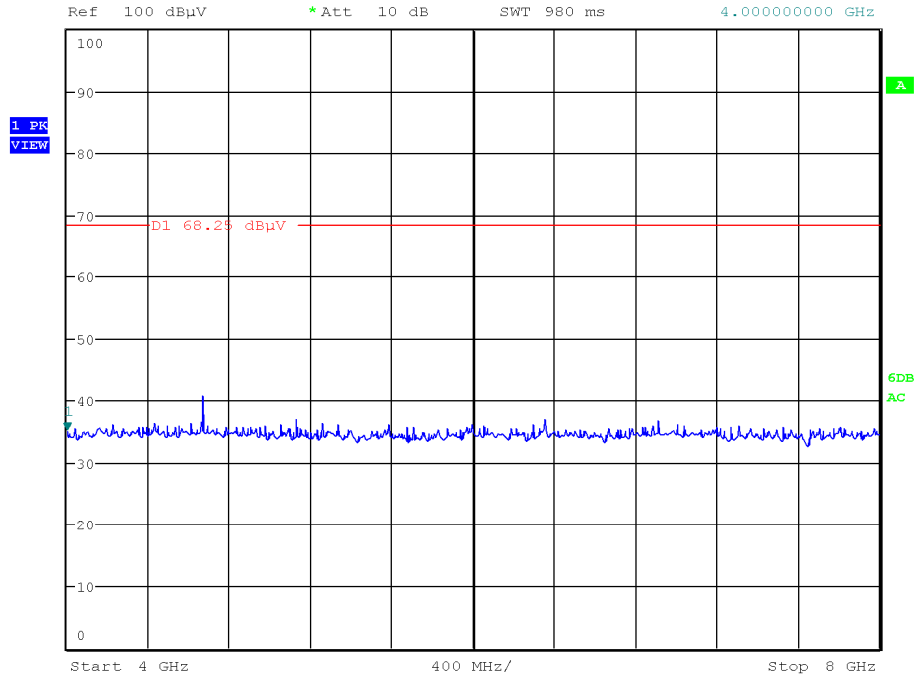
*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 33.00 dBuV
SWT 235 ms 1.000000000 GHz



Date: 12.JUL.2013 16:09:32



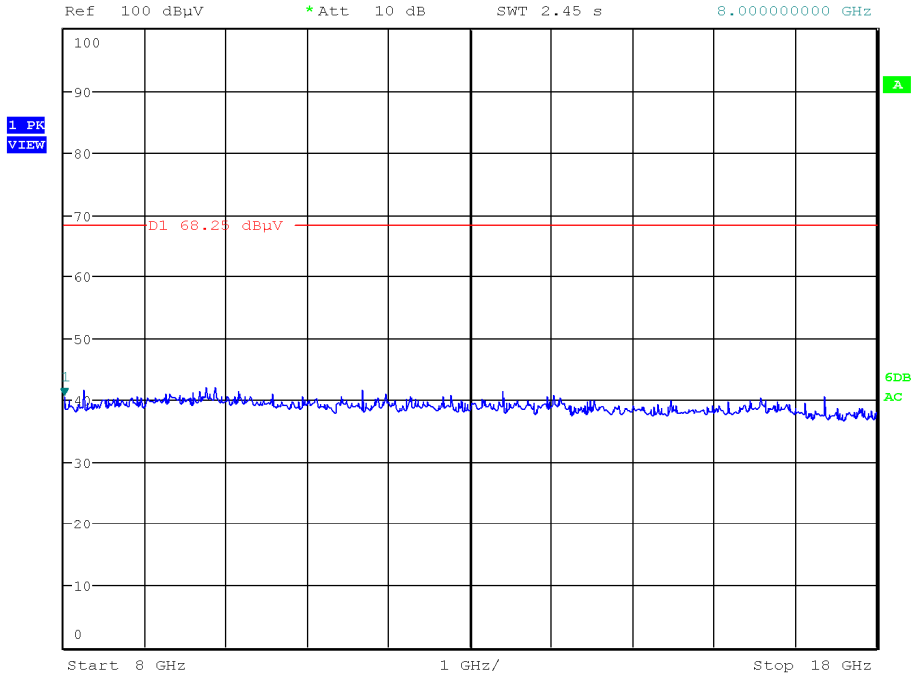
*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 35.20 dBuV
SWT 980 ms 4.000000000 GHz



Date: 12.JUL.2013 16:16:19

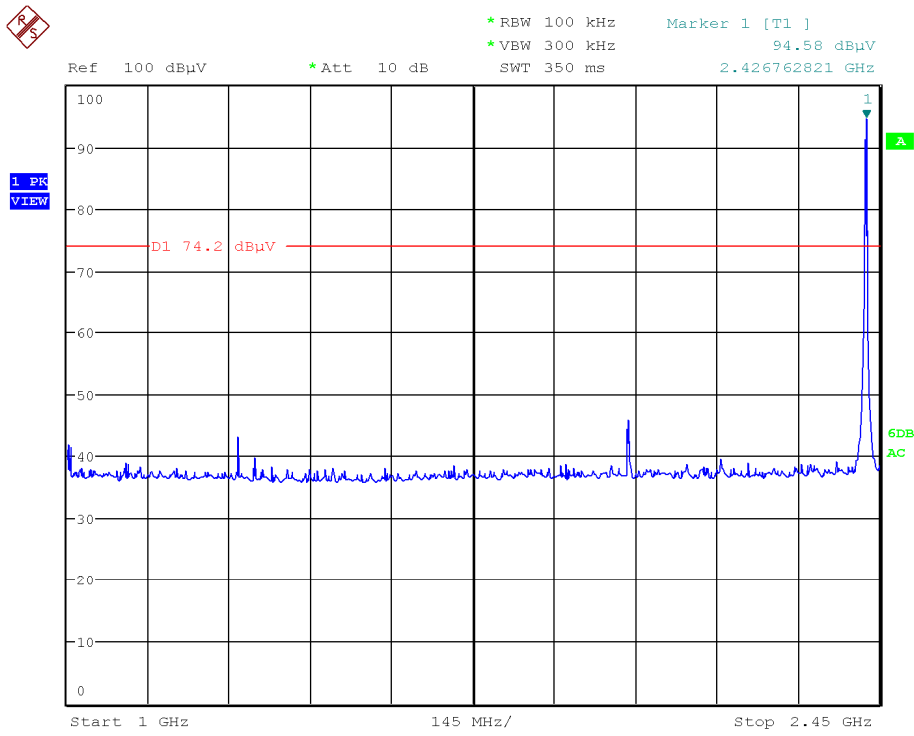


*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 40.68 dBuV
SWT 2.45 s 8.000000000 GHz

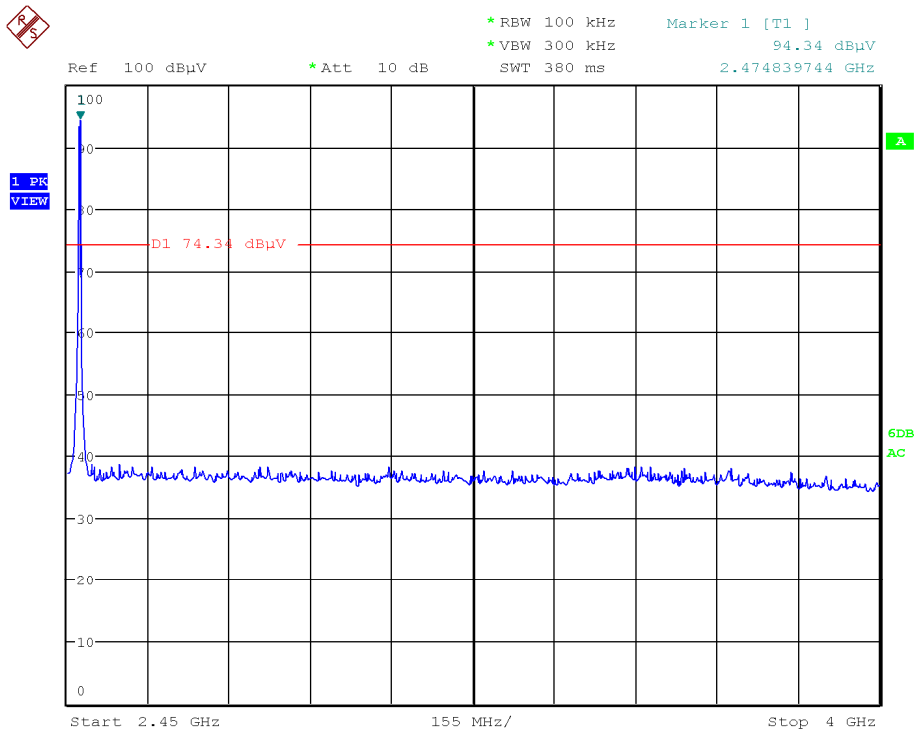


Date: 12.JUL.2013 16:18:09

8.8 Plots: Horizontal Antenna



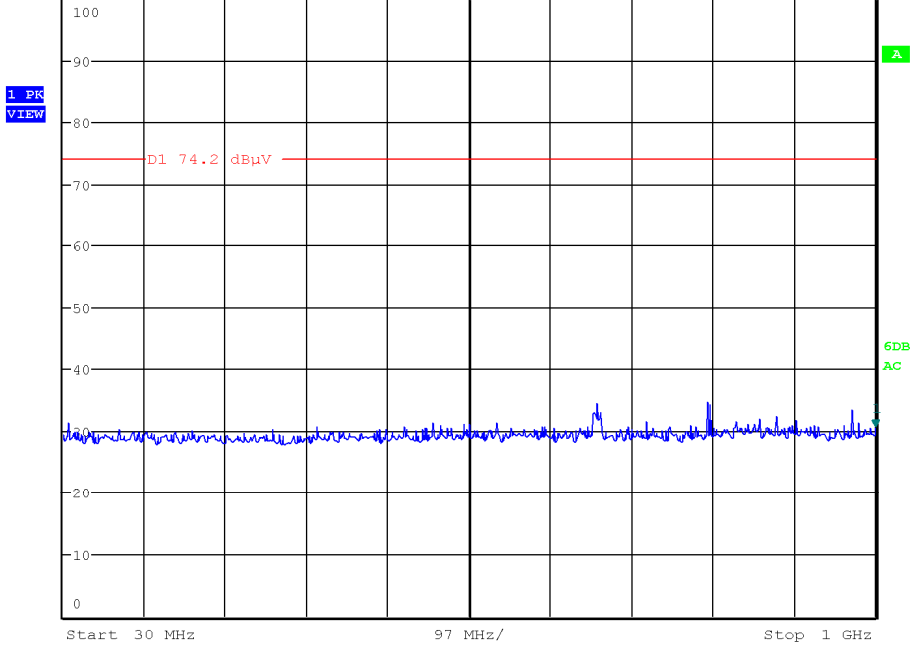
Date: 12.JUL.2013 15:44:20



Date: 12.JUL.2013 15:56:04



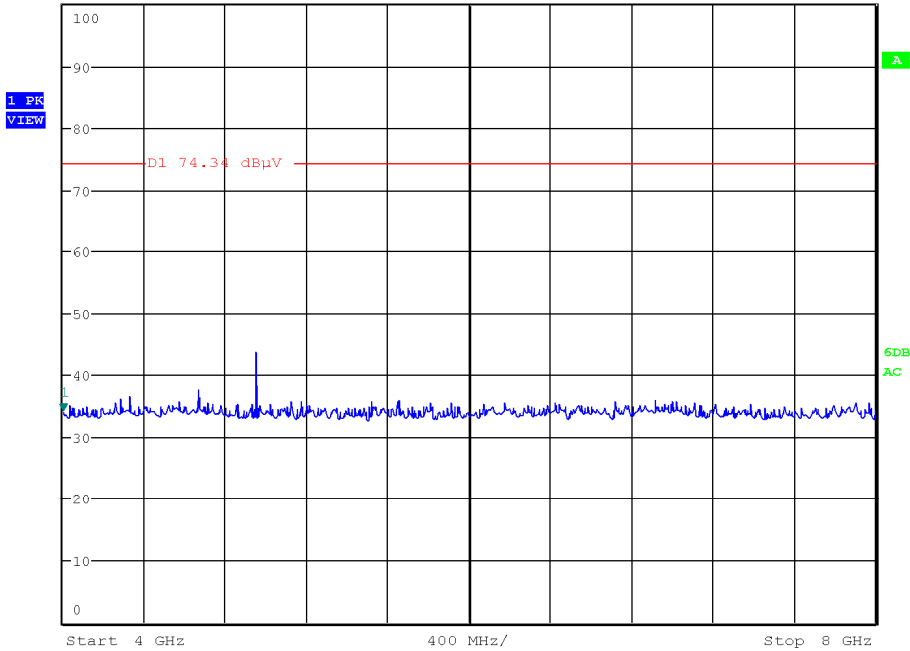
*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 30.55 dBuV
Ref 100 dBuV *Att 10 dB SWT 235 ms 1.000000000 GHz



Date: 12.JUL.2013 15:48:08



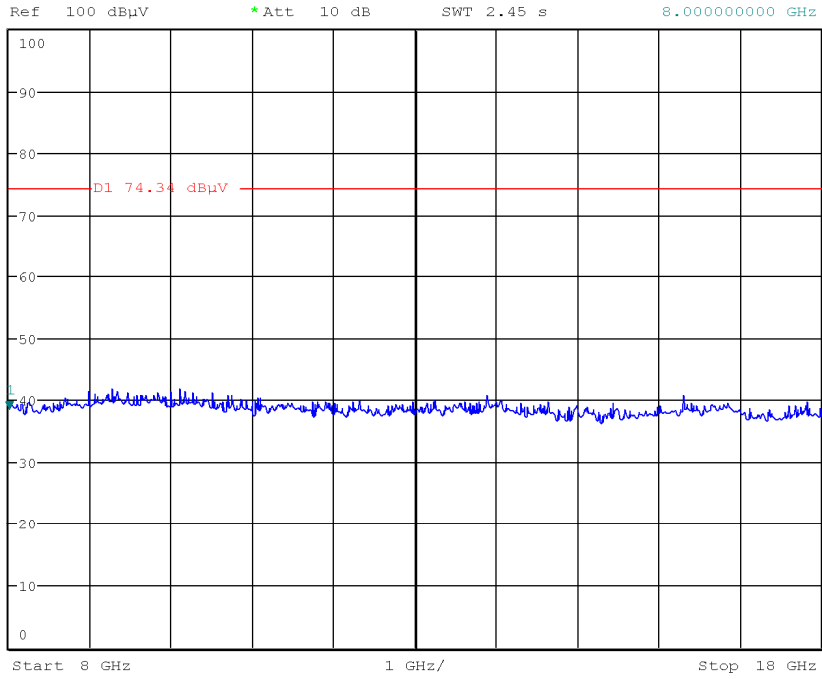
*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 34.09 dBuV
Ref 100 dBuV *Att 10 dB SWT 980 ms 4.000000000 GHz



Date: 12.JUL.2013 15:58:26



*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 38.53 dBuV
SWT 2.45 s 8.000000000 GHz



Date: 12.JUL.2013 16:00:53

8.9 Test Data:

Radiated Electromagnetic Emissions

Test Report #: 101239952	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC Part 15.209 FCC Part 15.205	Test Date: <u>07/10/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: ID:071	EUT Power: <u>120VAC/60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: R1886469654 (Unit 1)		

Manufacturer: Echostar Technologies, LLC

EUT Description: MocA Thin Client

Notes: Tx Spurious Measurements - Harmonics of the Fundamental
FCC Non- Restricted Band Harmonics of the Fundamental

Level Key
Pk – Peak
Qp – Quasi Peak
Av - Average

FREQ	LEVEL	DET	CABLE	ANT	PREAMP	Atten	FINAL	Pol	Hgt	Az	Limit	Delta Limit	RBW
<u>MHz</u>	<u>dBuV</u>	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	[dB]	= [dBuV]	[V/H]	[m]	[Deg]	[dBuV/m]	[dB]	[MHz]
Harmonics of the Fundamental - Low Channel													
9700.0000	39.59	Av	7.63	38.06	47.91	0.00	37.37	H	1.29	96.0	82.26	-44.89	1.000
9700.0000	52.00	Pk	7.63	38.06	47.91	0.00	49.78	H	1.29	96.0	82.26	-32.48	1.000
14550.0000	37.78	Av	9.46	42.70	47.50	0.00	42.45	H	1.23	45.0	82.26	-39.81	1.000
14550.0000	50.00	Pk	9.46	42.70	47.50	0.00	54.67	H	1.23	45.0	82.26	-27.59	1.000
16975.0000	36.96	Av	10.54	41.45	47.16	0.00	41.78	H	1.29	23.0	82.26	-40.48	1.000
16975.0000	49.78	Pk	10.54	41.45	47.16	0.00	54.60	H	1.29	23.0	82.26	-27.66	1.000
21825.0000	0.94	Av	0.00	21.40	0.00	0.00	22.34	H	1.00	0.0	82.26	-59.92	1.000
21825.0000	32.75	Pk	0.00	21.40	0.00	0.00	54.15	H	1.00	0.0	82.26	-28.11	1.000
24250.0000	0.63	Av	0.00	21.45	0.00	0.00	22.08	H	1.00	0.0	82.26	-60.18	1.000
24250.0000	32.09	Pk	0.00	21.45	0.00	0.00	53.54	H	1.00	0.0	82.26	-28.72	1.000
Harmonics of the Fundamental - Mid Channel													
9700.0000	39.49	Av	7.63	38.06	47.91	0.00	37.27	V	1.35	132.0	82.26	-44.99	1.000
9700.0000	51.59	Pk	7.63	38.06	47.91	0.00	49.37	V	1.35	132.0	82.26	-32.89	1.000
14550.0000	37.78	Av	9.46	42.70	47.50	0.00	42.45	V	1.33	31.0	82.26	-39.81	1.000
14550.0000	50.16	Pk	9.46	42.70	47.50	0.00	54.83	V	1.33	31.0	82.26	-27.43	1.000
16975.0000	36.94	Av	10.54	41.45	47.16	0.00	41.76	V	1.22	20.0	82.26	-40.50	1.000
16975.0000	49.19	Pk	10.54	41.45	47.16	0.00	54.01	V	1.22	20.0	82.26	-28.25	1.000
21825.0000	-0.24	Av	0.00	21.40	0.00	0.00	21.16	V	1.00	0.0	82.26	-61.10	1.000
21825.0000	31.60	Pk	0.00	21.40	0.00	0.00	53.00	V	1.00	0.0	82.26	-29.26	1.000
24250.0000	-0.69	Av	0.00	21.45	0.00	0.00	20.76	V	1.00	0.0	82.26	-61.50	1.000
24250.0000	29.67	Pk	0.00	21.45	0.00	0.00	51.12	V	1.00	0.0	82.26	-31.14	1.000
Harmonics of the Fundamental - Mid Channel													
9800.0000	39.62	Av	7.67	38.12	48.00	0.00	37.41	H	1.38	111.0	82.77	-45.36	1.000
9800.0000	52.86	Pk	7.67	38.12	48.00	0.00	50.65	H	1.38	111.0	82.77	-32.12	1.000
14700.0000	38.23	Av	9.53	42.32	47.42	0.00	42.66	H	1.20	72.0	82.77	-40.11	1.000
14700.0000	50.26	Pk	9.53	42.32	47.42	0.00	54.69	H	1.20	72.0	82.77	-28.08	1.000
17150.0000	36.72	Av	10.62	42.24	46.56	0.00	43.01	H	1.06	108.0	82.77	-39.76	1.000
17150.0000	49.67	Pk	10.62	42.24	46.56	0.00	55.96	H	1.06	108.0	82.77	-26.81	1.000

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24500.0000	1.35	Av	0.00	21.70	0.00	0.00	23.05	H	1.00	0.0	82.77	-59.72	1.000
24500.0000	31.01	Pk	0.00	21.70	0.00	0.00	52.71	H	1.00	0.0	82.77	-30.06	1.000
9800.0000	39.62	Av	7.67	38.12	48.00	0.00	37.41	V	1.32	28.0	82.77	-45.36	1.000
9800.0000	52.21	Pk	7.67	38.12	48.00	0.00	50.00	V	1.32	28.0	82.77	-32.77	1.000
14700.0000	38.25	Av	9.53	42.32	47.42	0.00	42.68	V	1.34	51.0	82.77	-40.09	1.000
14700.0000	51.08	Pk	9.53	42.32	47.42	0.00	55.51	V	1.34	51.0	82.77	-27.26	1.000
17150.0000	36.71	Av	10.62	42.24	46.56	0.00	43.00	V	1.34	95.0	82.77	-39.77	1.000
17150.0000	48.79	Pk	10.62	42.24	46.56	0.00	55.08	V	1.34	95.0	82.77	-27.69	1.000
24500.0000	-0.74	Av	0.00	21.70	0.00	0.00	20.96	V	1.00	0.0	82.77	-61.81	1.000
24500.0000	32.17	Pk	0.00	21.70	0.00	0.00	53.87	V	1.00	0.0	82.77	-28.90	1.000
												0.00	
Harmonics of the Fundamental - High Channel													
9900.0000	39.90	Av	7.73	38.23	48.09	0.00	37.77	H	1.38	66.0	82.36	-44.59	1.000
9900.0000	52.74	Pk	7.73	38.23	48.09	0.00	50.61	H	1.38	66.0	82.36	-31.75	1.000
14850.0000	37.03	Av	9.60	41.60	47.39	0.00	40.83	H	1.39	38.0	82.36	-41.53	1.000
14850.0000	49.51	Pk	9.60	41.60	47.39	0.00	53.31	H	1.39	38.0	82.36	-29.05	1.000
17325.0000	36.72	Av	10.70	43.00	45.93	0.00	44.49	H	1.29	56.0	82.36	-37.87	1.000
17325.0000	49.13	Pk	10.70	43.00	45.93	0.00	56.90	H	1.29	56.0	82.36	-25.46	1.000
24750.0000	1.90	Av	0.00	21.65	0.00	0.00	23.55	H	1.00	0.0	82.36	-58.81	1.000
24750.0000	29.57	Pk	0.00	21.65	0.00	0.00	51.22	H	1.00	0.0	82.36	-31.14	1.000
9900.0000	39.93	Av	7.73	38.23	48.09	0.00	37.80	V	1.32	104.0	82.36	-44.56	1.000
9900.0000	52.51	Pk	7.73	38.23	48.09	0.00	50.38	V	1.32	104.0	82.36	-31.98	1.000
14850.0000	37.03	Av	9.60	41.60	47.39	0.00	40.83	V	1.49	48.0	82.36	-41.53	1.000
14850.0000	49.84	Pk	9.60	41.60	47.39	0.00	53.64	V	1.49	48.0	82.36	-28.72	1.000
17325.0000	36.73	Av	10.70	43.00	45.93	0.00	44.50	V	1.36	12.0	82.36	-37.86	1.000
17325.0000	49.47	Pk	10.70	43.00	45.93	0.00	57.24	V	1.36	12.0	82.36	-25.12	1.000
24750.0000	-0.90	Av	0.00	21.65	0.00	0.00	20.75	V	1.00	0.0	82.36	-61.61	1.000
24750.0000	30.75	Pk	0.00	21.65	0.00	0.00	52.40	V	1.00	0.0	82.36	-29.96	1.000

Determination of Harmonic Limit – Outside FCC Restricted Bands (20dBc)

FREQ	DET	FINAL	Limit	RBW
<u>MHz</u>	Qp Av Pk	= [dBuV]	Harmonic Limit	(MHz)
Determination of Harmonic Limit - Outside Restricted Bands - RBW = 100kHz				
Low Channel				
2424.9600	Pk	102.26	82.26	0.100
Mid Channel				
2449.9600	Pk	102.77	82.77	0.100
High Channel				
2474.9600	Pk	102.36	82.36	0.100

8.10 Test Summary:

Worst Case Harmonic Outside Restricted Band Measurement: Low Channel: 17325 MHz, 57.24dBuV (-25.12dB under limit)														
FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	[dB]	FINAL	(V/H)	(m)	(DEG)	FCC 15.247 (b)(3) [dBuV]	[dB]	(MHz)
17325.0000	49.47	Pk	10.70	43.00	45.93	57.24	0.00	57.24	V	1.36	12.0	82.36	-25.12	1.000

Specification: All Harmonic Emissions < -20dBc

Notes:

1. All Harmonics of the Fundamental measurements are RF Conducted Port – peak detector, max hold measurements – 100kHz RBW.
2. Measurements were not adjusted by the allowed duty cycle correction factor per FCC 15.35/ IC RSS-GEN, Section 4.5.

9 Antenna RF Port Spurious Emissions 30MHz to 25GHz – Non-Restricted Bands (-20dBc & Band Edge)

9.1 Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247.

- FCC 558074 D01 DTS Measurement Guidance: 2013, Section 11.3
- ANSI C63.10:2009, Section 6.7

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

9.2 Test Requirement/Specification

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.

Attenuation below the general limits specified in 15.209(a) is not required.

- FCC 15.247(c)

9.3 Test Equipment Used:

<u>Asset ID:</u>	<u>Description:</u>	<u>Manufacturer:</u>	<u>Model:</u>	<u>Serial:</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014

9.4 Results:

Note applicable - the product has an integral antenna as was not configured with an RF Conducted port.

9.5 Setup Photographs

9.6 Test Data:

9.7 Test Summary:

Tx Spurious Antenna Port -20dBc Worst-Case	
Channel	Result

Specification: Tx Spurious emissions ≤ -20dBc in 100kHz bandwidth

9.8 Test Notes:

Deviations, Additions, or Exclusions: None

10 Radiated Spurious Emissions 30MHz to 25GHz – Includes Restricted Band & Band Edge

10.1 Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247.

- FCC 558074 D01 DTS Measurement Guidance: 2013, Section 12.1
- ANSI C63.10:2009, Section 6.6

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

10.2 Test Requirement/Specification

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.

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).

- FCC 15.247(d)/ 15.205/209

10.3

10.4 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
18900	RF Pre-Amplifier (4-8 GHz)	Avantek	AFT97-8434-10F	1007	06/07/2012	06/07/2013
18901	RF Pre-Amp (8-18GHz)	Avantek	AWT-18037	1002	06/07/2012	06/07/2013
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/07/2012	06/07/2013
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	6/6/2012	6/6/2013
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU
18805	HF Active Antenna/Harmonic Mixer 18 GHz to 26.5 GHz	Hewlett-Packard	11970K	2332A01280	01/30/2013	01/30/2014

10.5 Results:

The sample tested was found to comply.

Intertek

Report Number: 101239952DEN-001

Issued:8/29/2013

10.6 Results Summary: Harmonics in Restricted Band

Unit 1

Worst Case Radiated Spurious Restricted Band Harmonics Emission: 12375.00 MHz, 41.12dBuV (-12.88 dB under limit)													
Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Average Limit	Delta Limit	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 RSS-GEN 6.1	FCC 15.209 RSS-GEN 6.1	(MHz)
12375.0000	38.39	Av	8.92	38.86	45.04	0.00	41.12	V	1.38	69.0	54.00	-12.88	1.000

Unit 2

Worst Case Radiated Spurious Restricted Band Harmonics Emission: 12375.00 MHz, 41.14dBuV (-12.86 dB under limit)													
Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Average Limit	Delta Limit	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 RSS-GEN 6.1	FCC 15.209 RSS-GEN 6.1	(MHz)
12375.0000	38.41	Av	8.92	38.86	45.04	0.00	41.14	H	1.23	21.7	- 12.86	NA	1.000

Specification: FCC Part 15.209 Harmonics in Restricted Band

10.7 Results Summary: Band Edge

Unit 1

Worst Case Radiated Spurious Band Edge Emission: 2483.5 MHz, 46.16dBuV (-7.84dB under limit)													
Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Average Limit	Delta Limit	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 RSS-GEN 6.1	FCC 15.209 RSS-GEN 6.1	(MHz)
2483.5000	45..84	Av	3.58	28.69	37.67	5.75	46.16	V	2.38	85.0	- 7.84	NA	1.000

Unit 2

Worst Case Radiated Spurious Band Edge Emission: 2483.5 MHz, 45.29dBuV (-8.71dB under limit)													
Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Average Limit	Delta Limit	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 RSS-GEN 6.1	FCC 15.209 RSS-GEN 6.1	(MHz)
2483.5000	44.94	Av	3.58	28.69	37.67	5.75	45.29	V	2.38	85.0	- 8.71	NA	1.000

Specification: FCC Part 15.209 in Band Edge/Restricted Band

10.8 Setup Photographs

Test Setup – Radiated Emissions

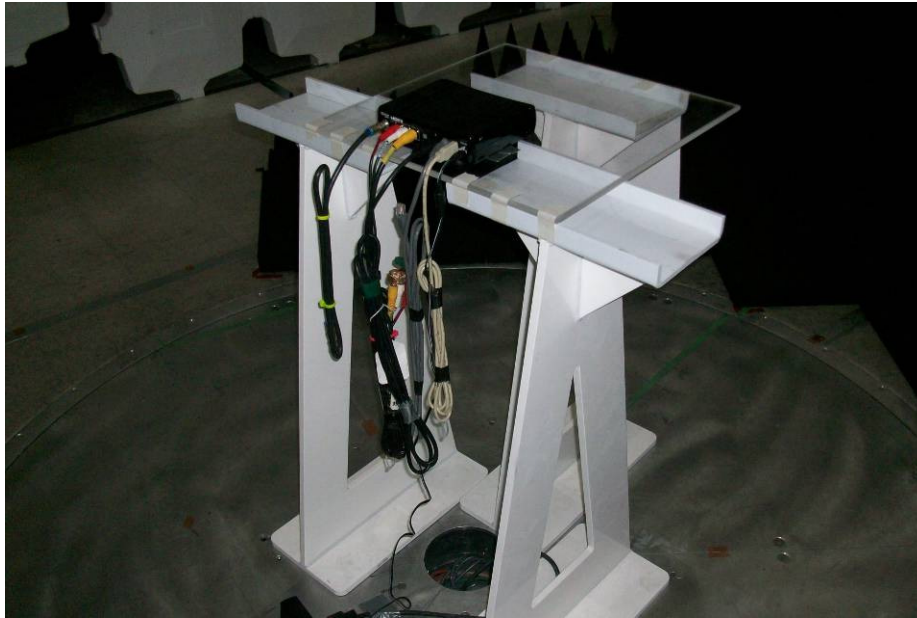
Front View



10.9 Setup Photographs

Test Setup – Radiated Emissions

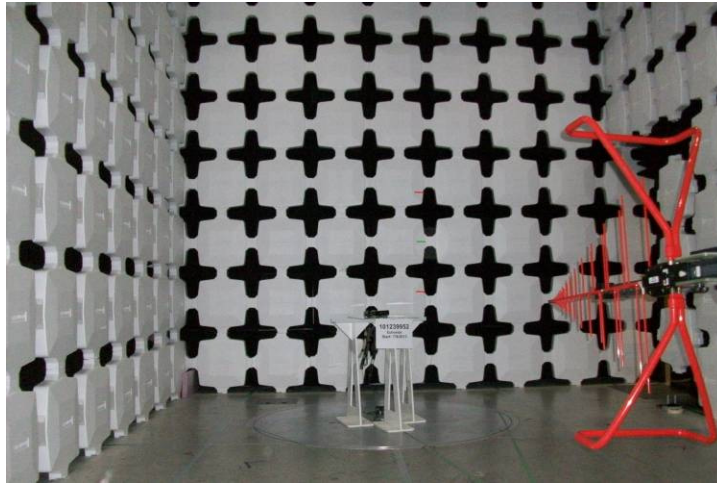
Rear View



10.10 Setup Photographs

Test Setup - Antenna

Antenna – 30 to 1000MHz



Antenna – 1 to 18GHz

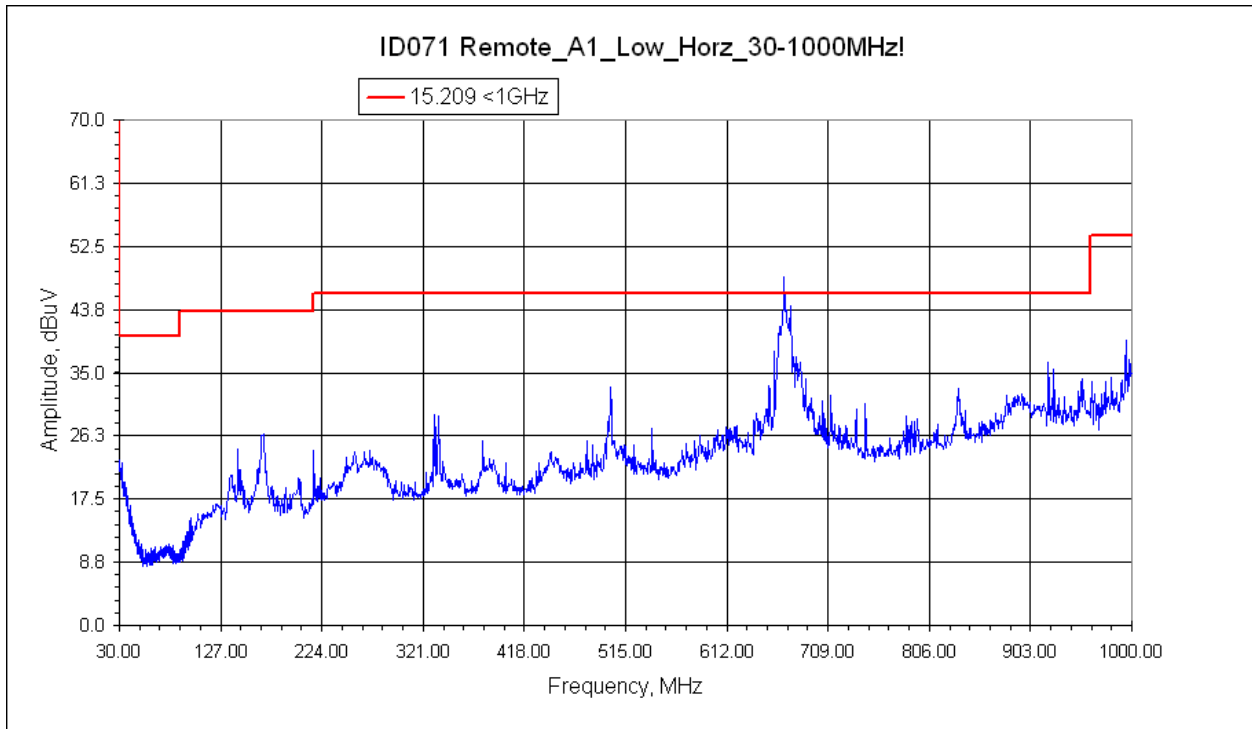
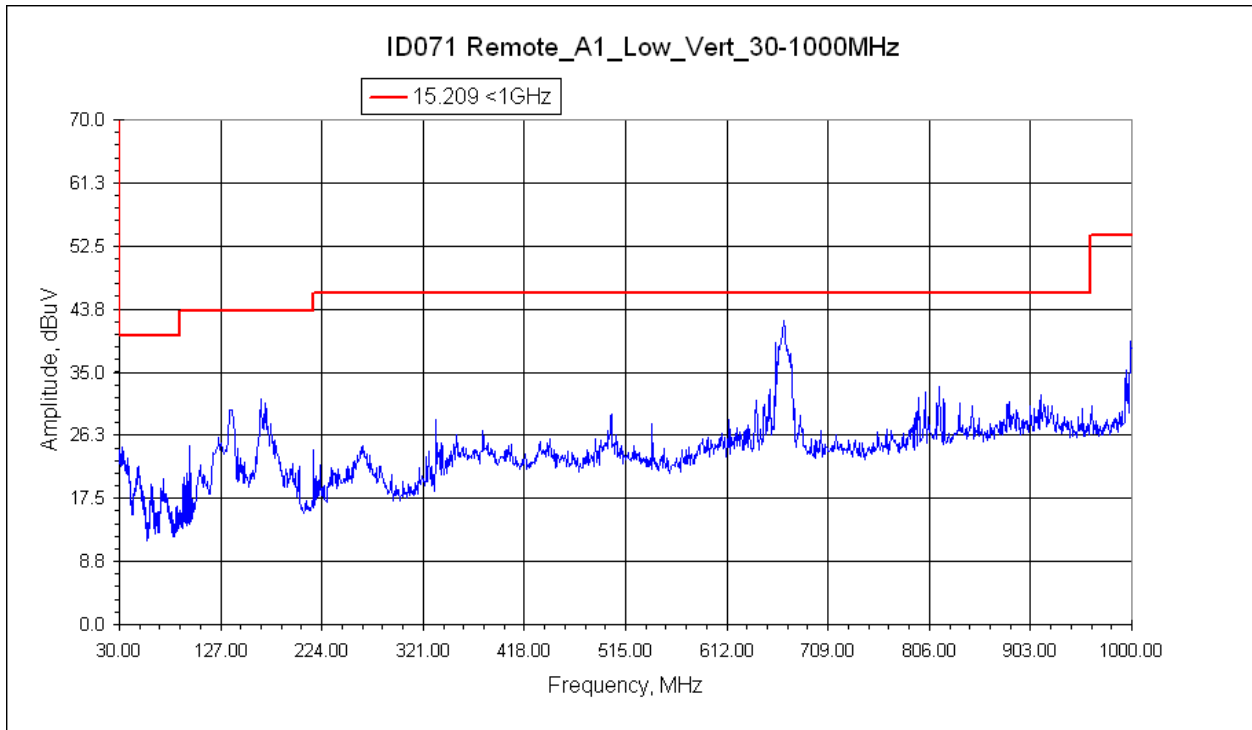


Harmonic Mixer (Pre-Amp & Horn)



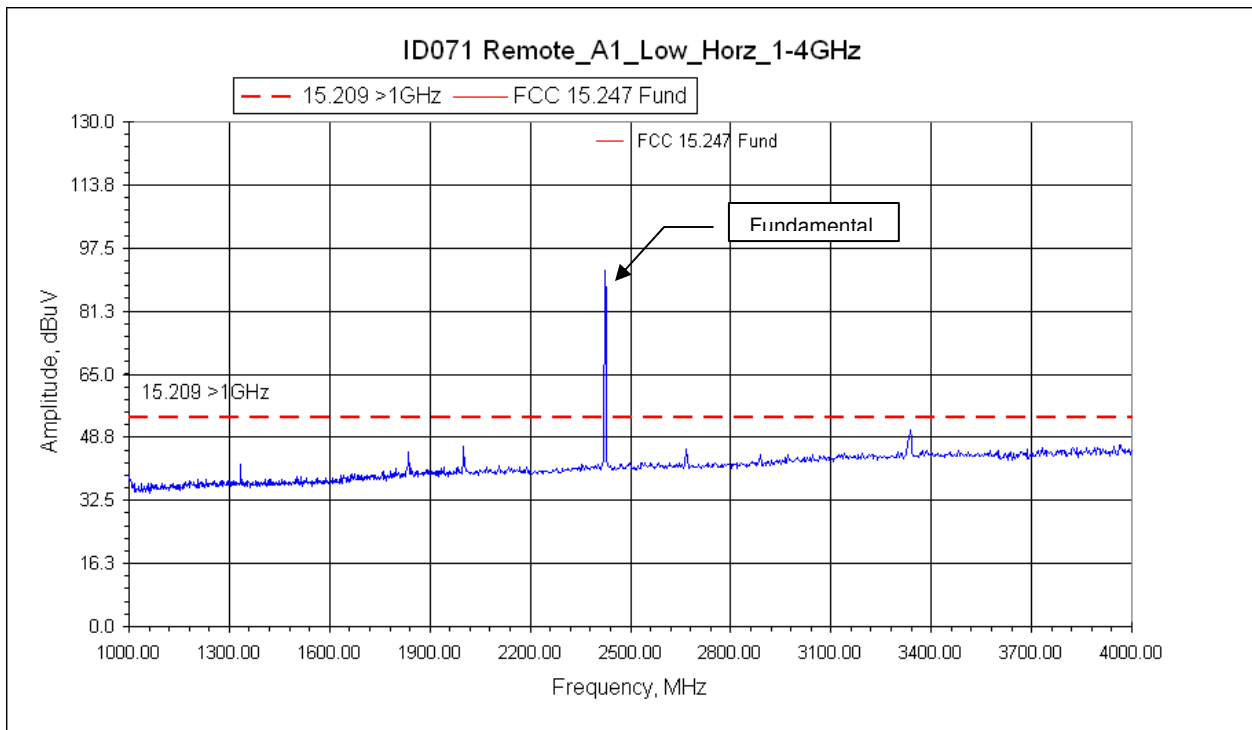
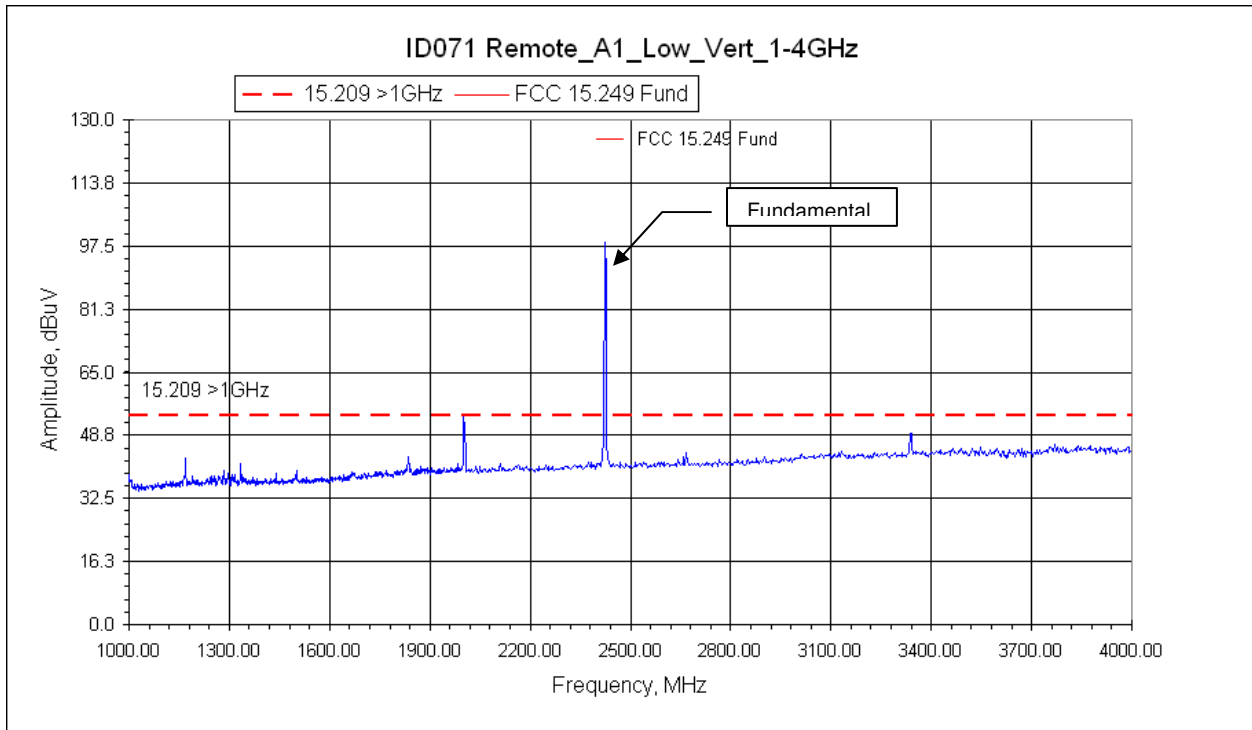
10.11 Pre-scan Plots: Unit 1 - Low Channel

30MHz to 1000MHz



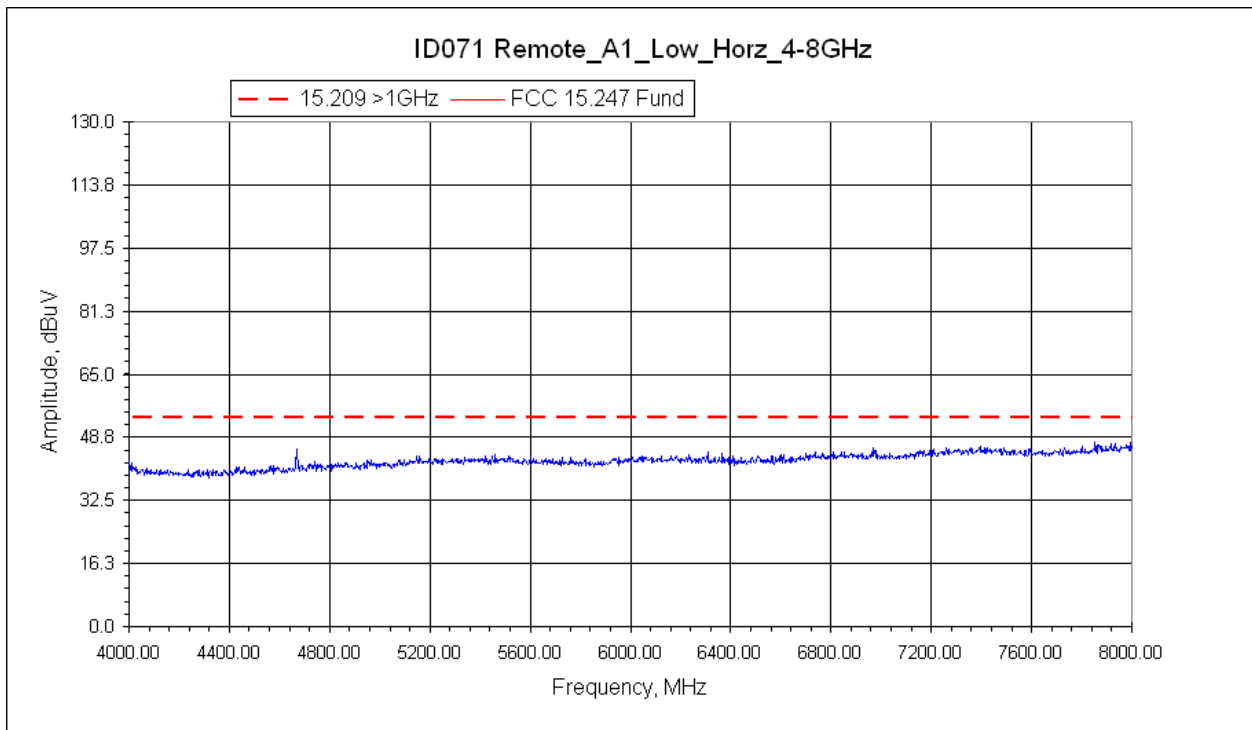
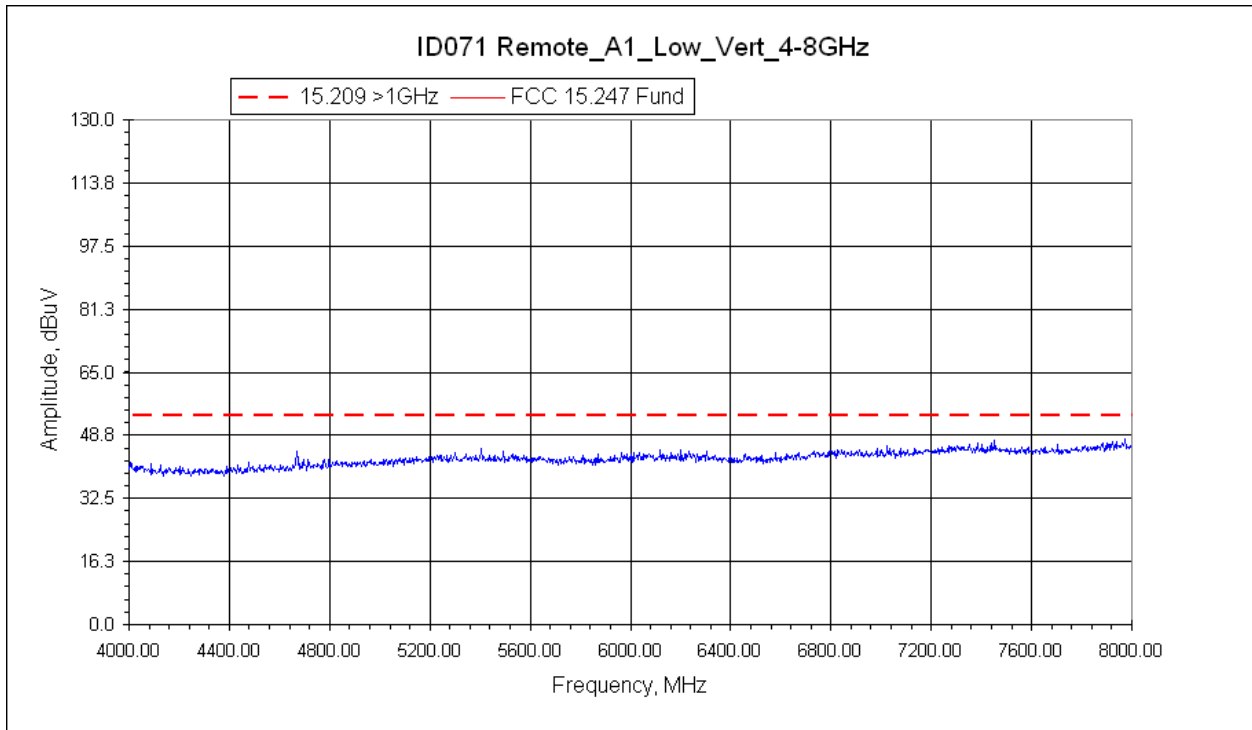
10.12 Pre-scan Plots: Unit 1- Low Channel

1GHz to 4GHz



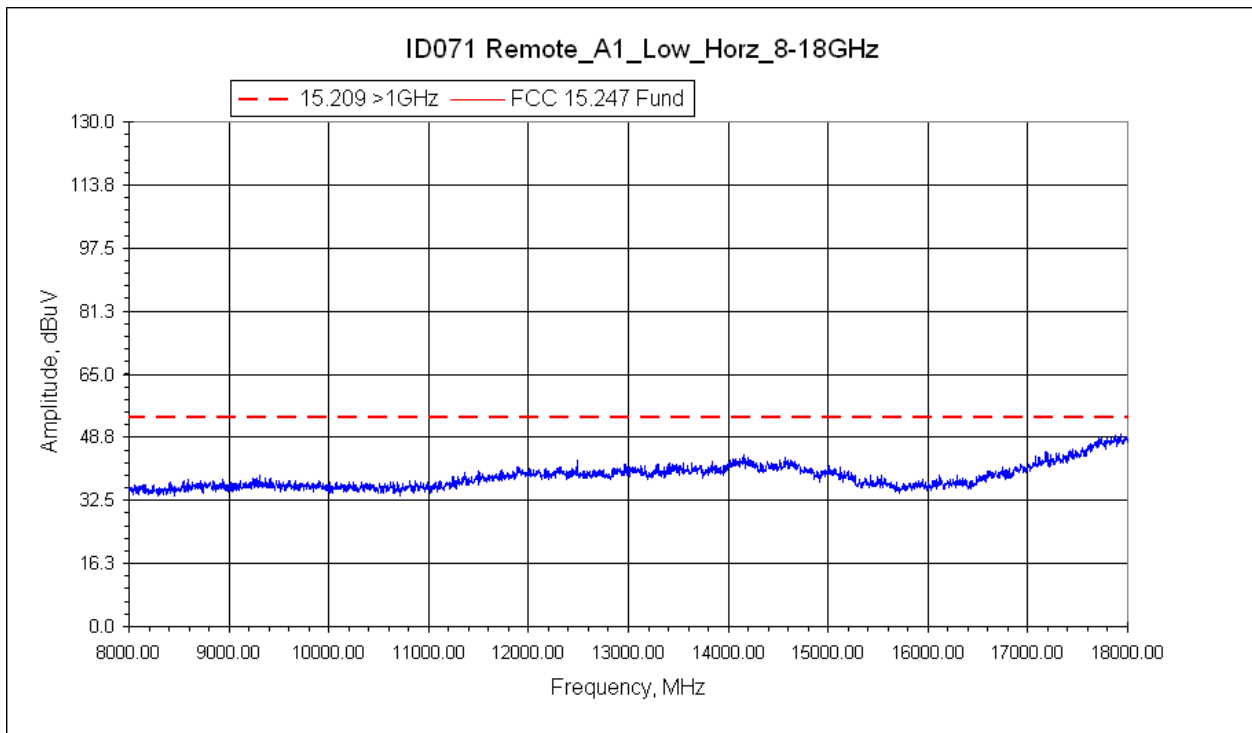
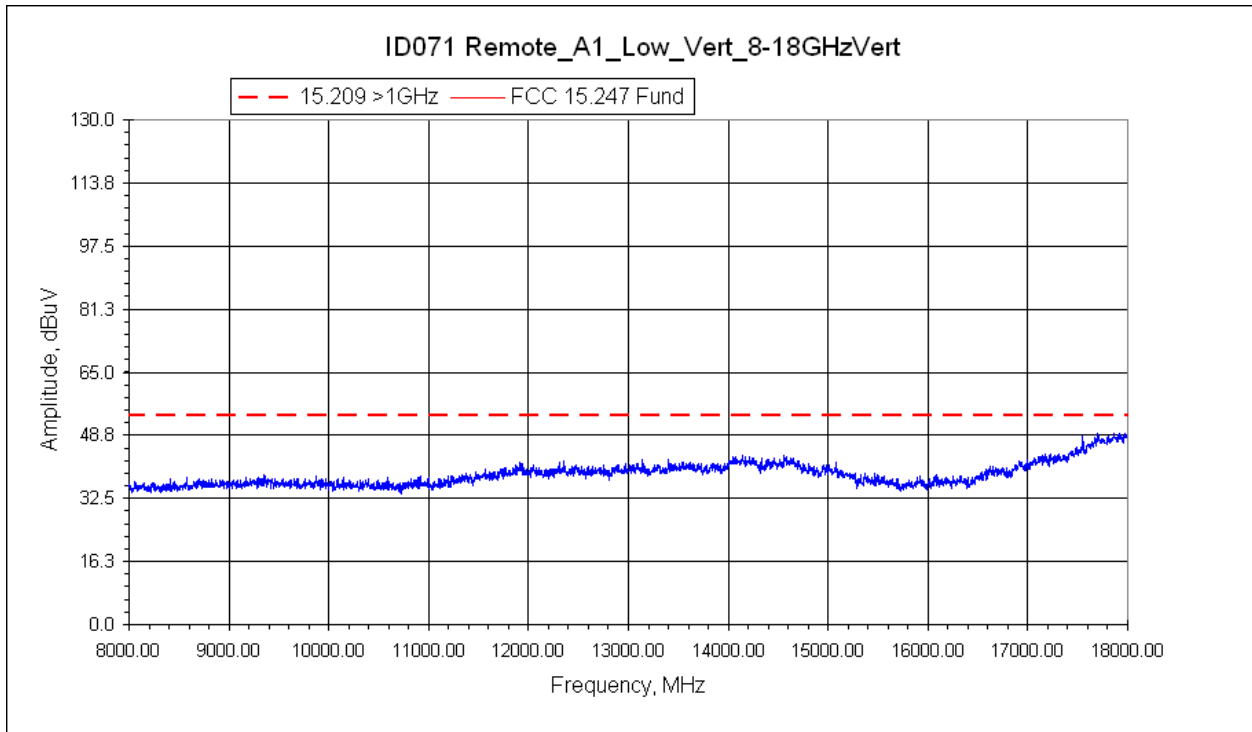
10.13 Pre-scan Plots: Unit 1 - Low Channel

4GHz to 8GHz



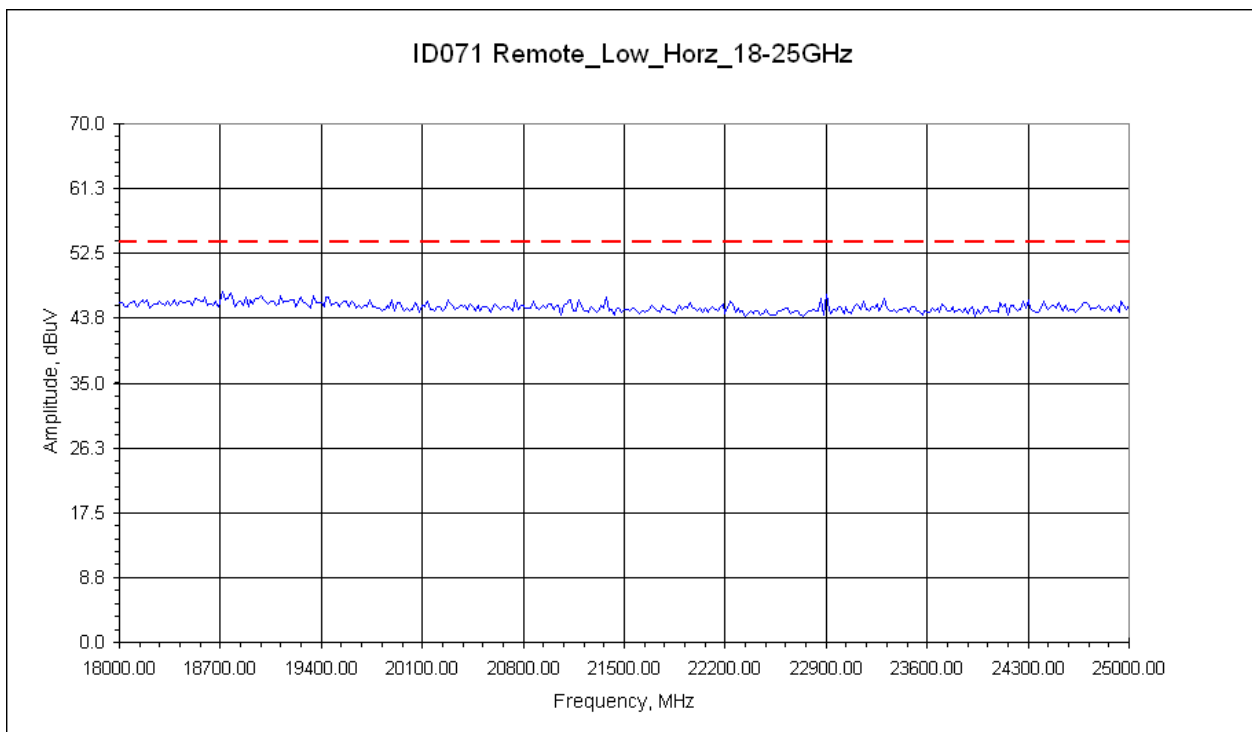
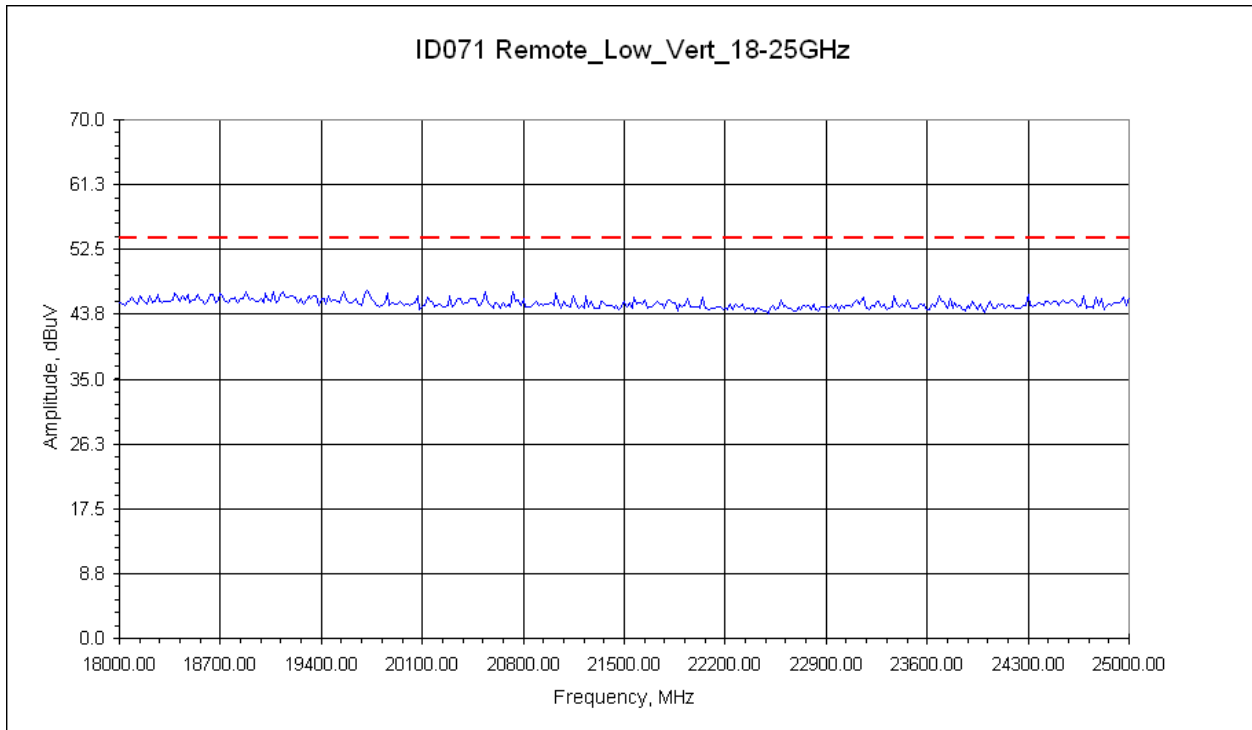
10.14 Pre-scan Plots: Unit 1 - Low Channel

8GHz to 18GHz



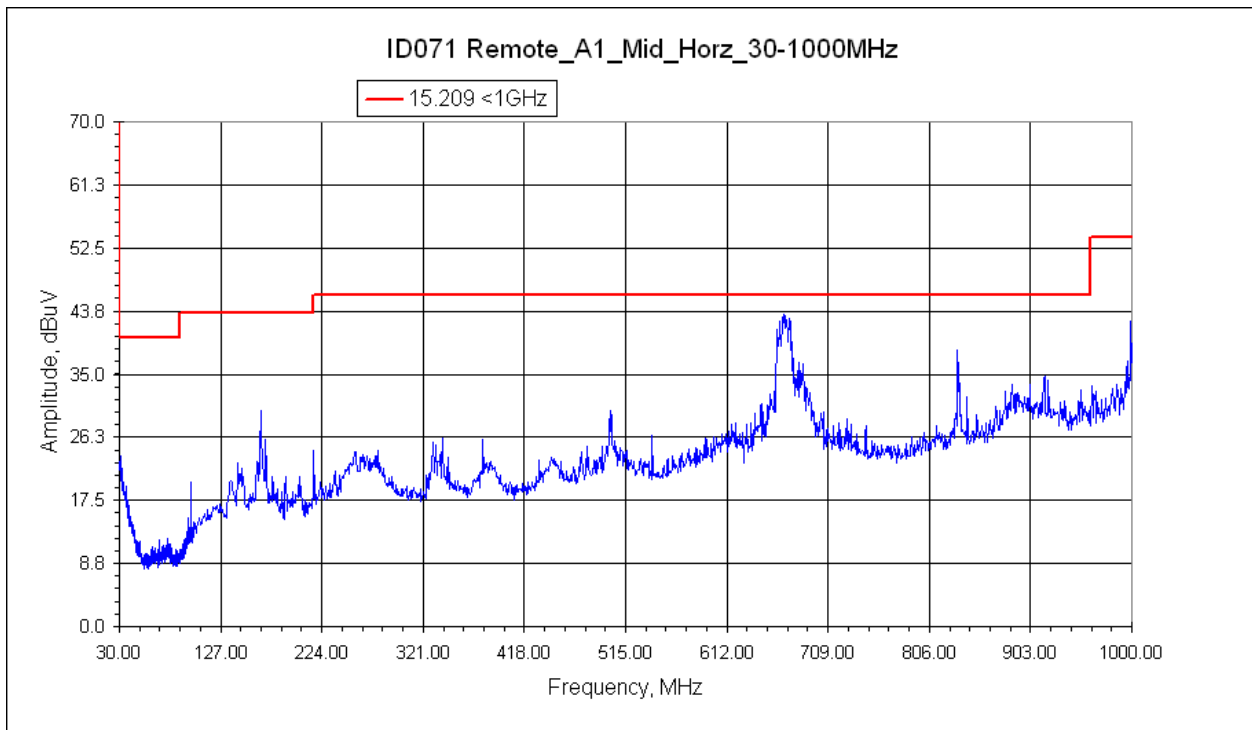
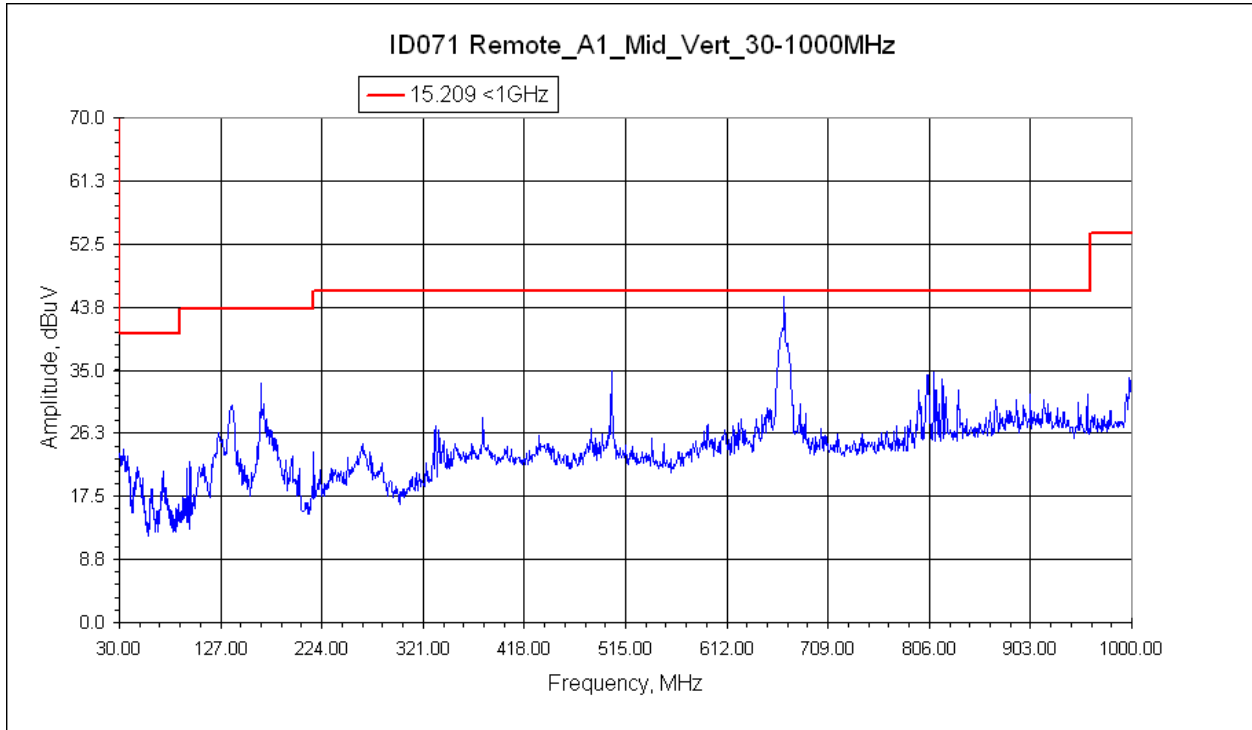
10.15 Pre-scan Plots: Unit 1 - Low Channel

18GHz to 25GHz



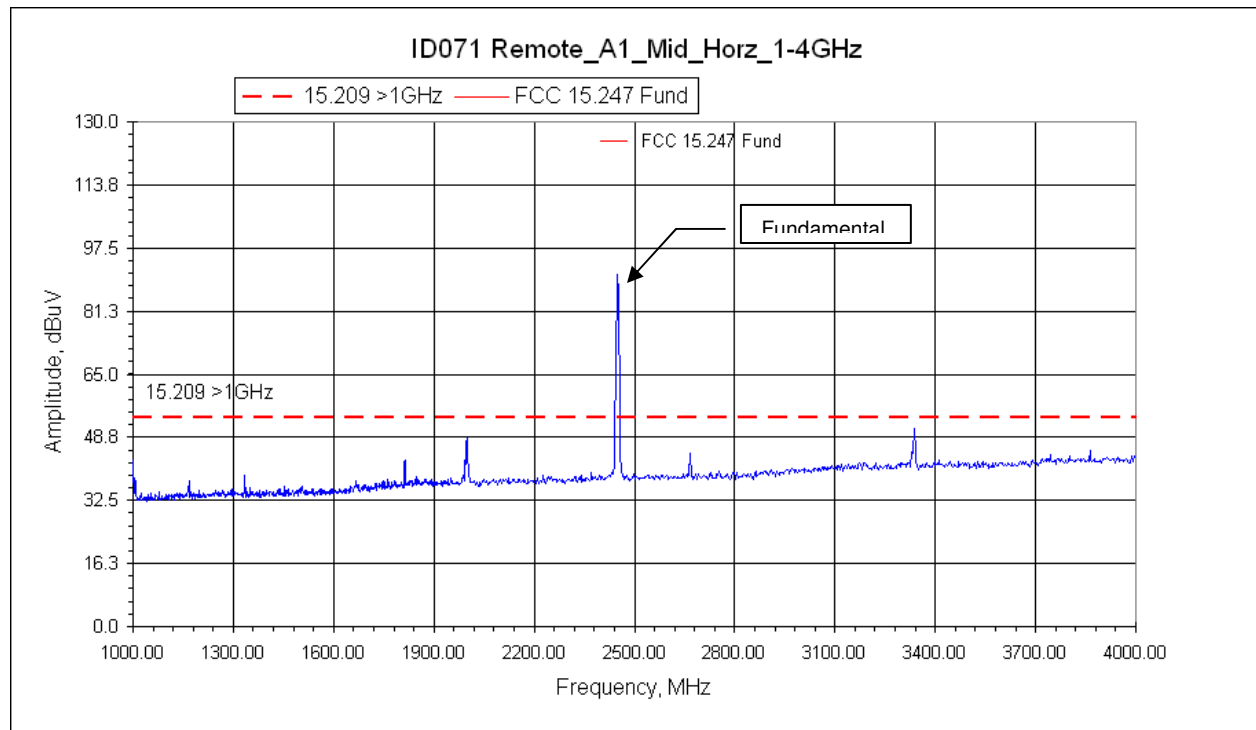
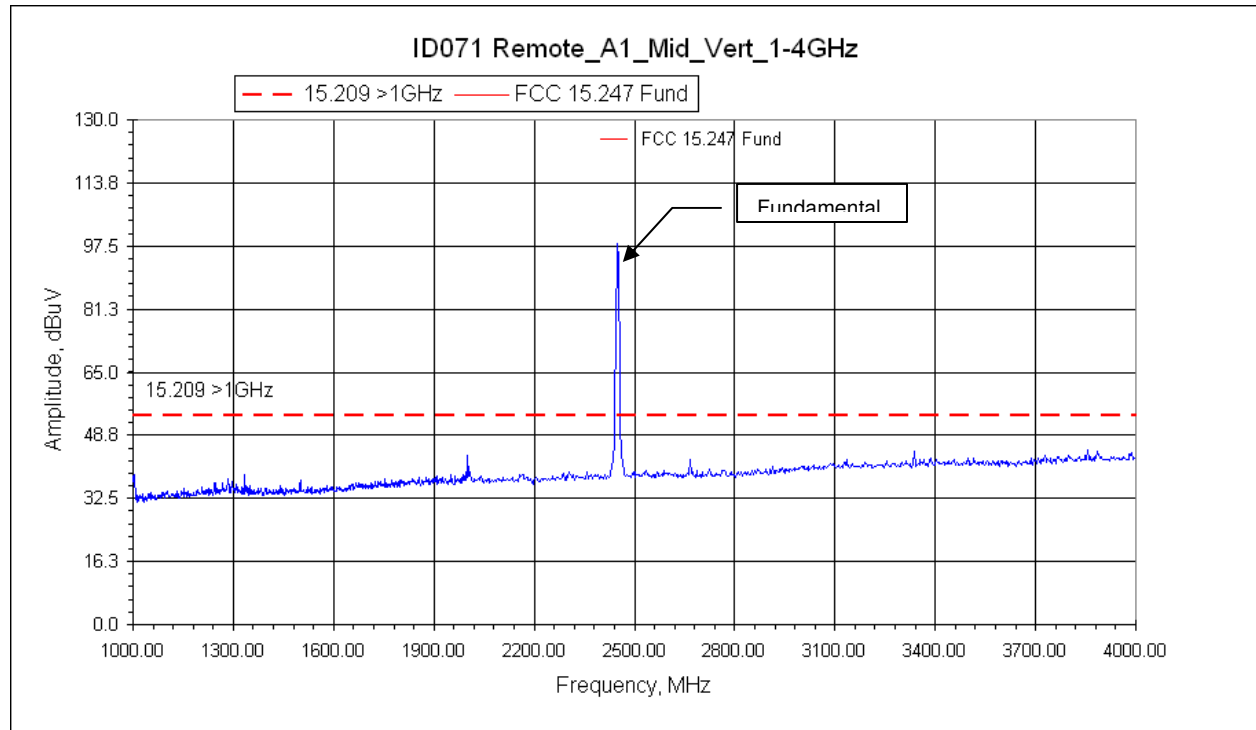
10.16 Pre-scan Plots: Unit 1 - Mid Channel

30MHz to 1000MHz



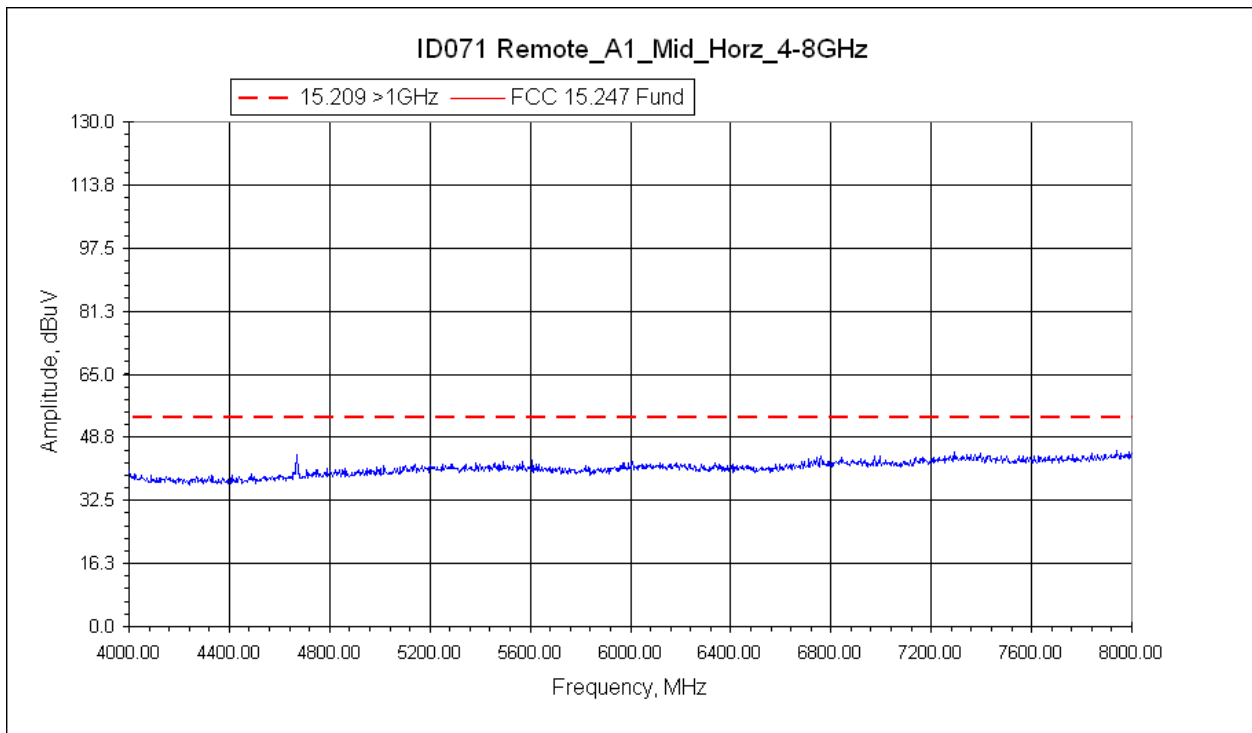
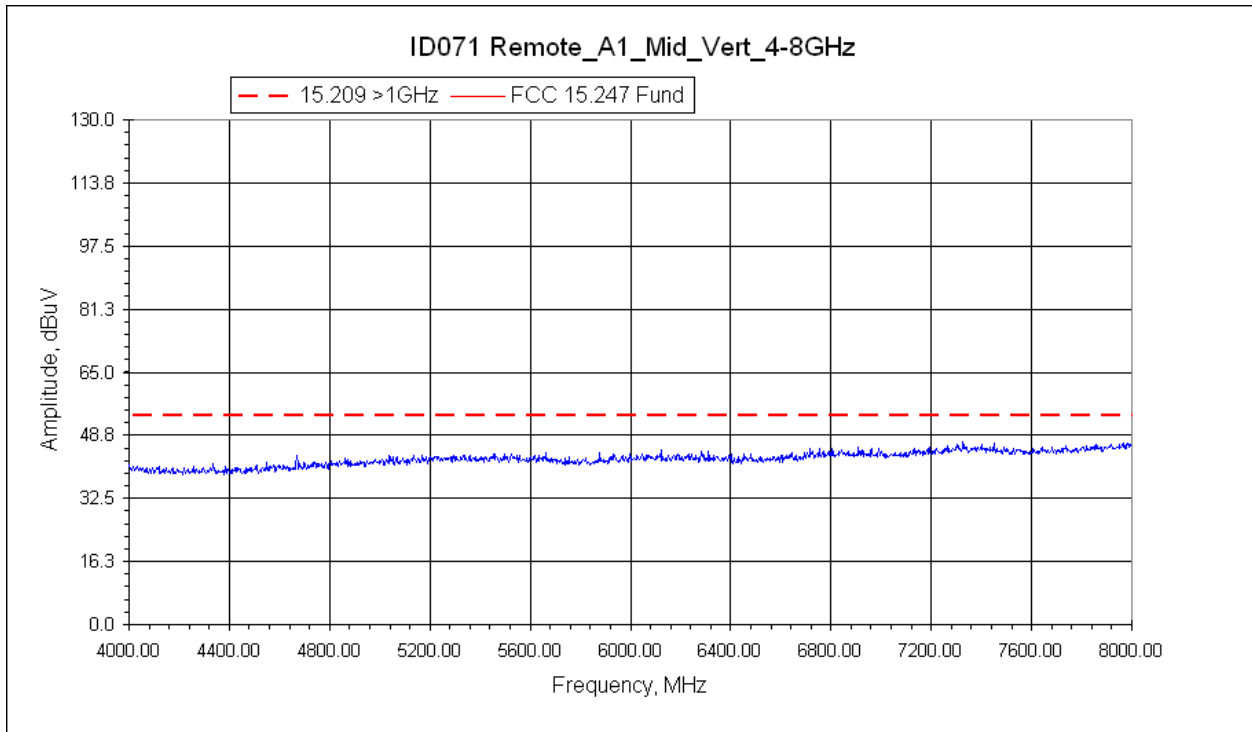
10.17 Pre-scan Plots: Unit 1 - Mid Channel

1GHz to 4GHz



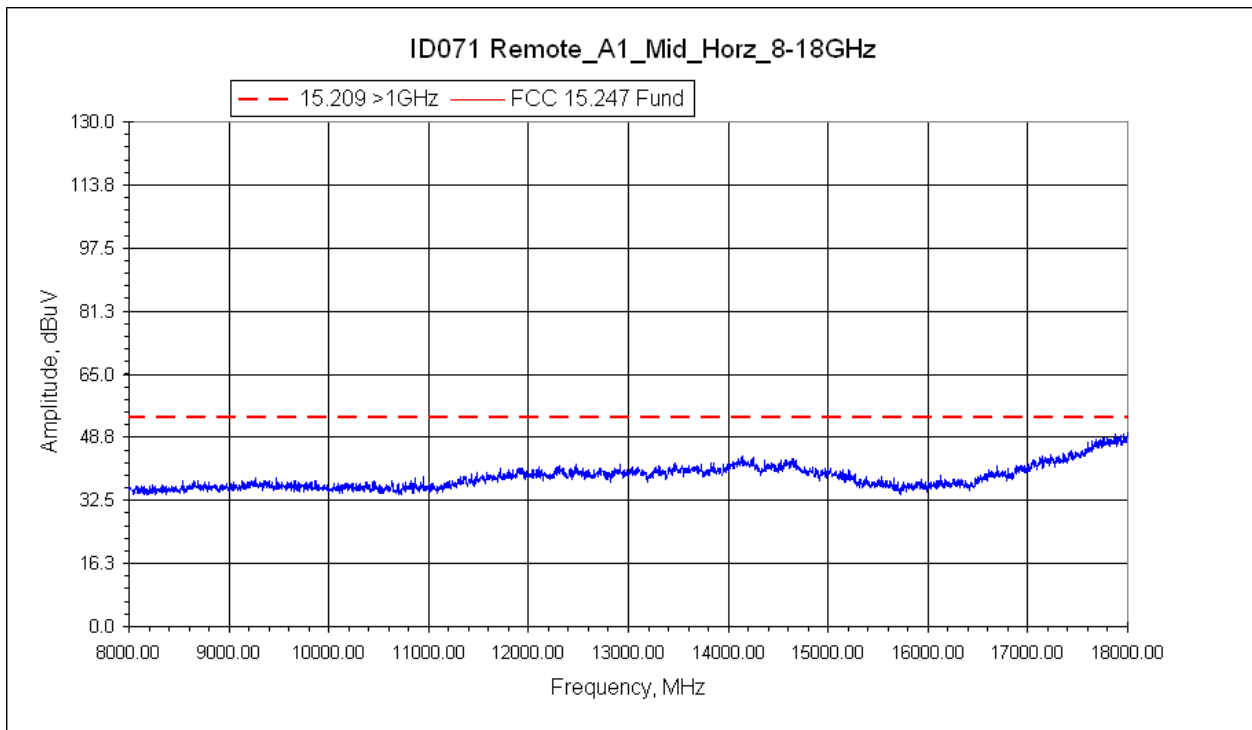
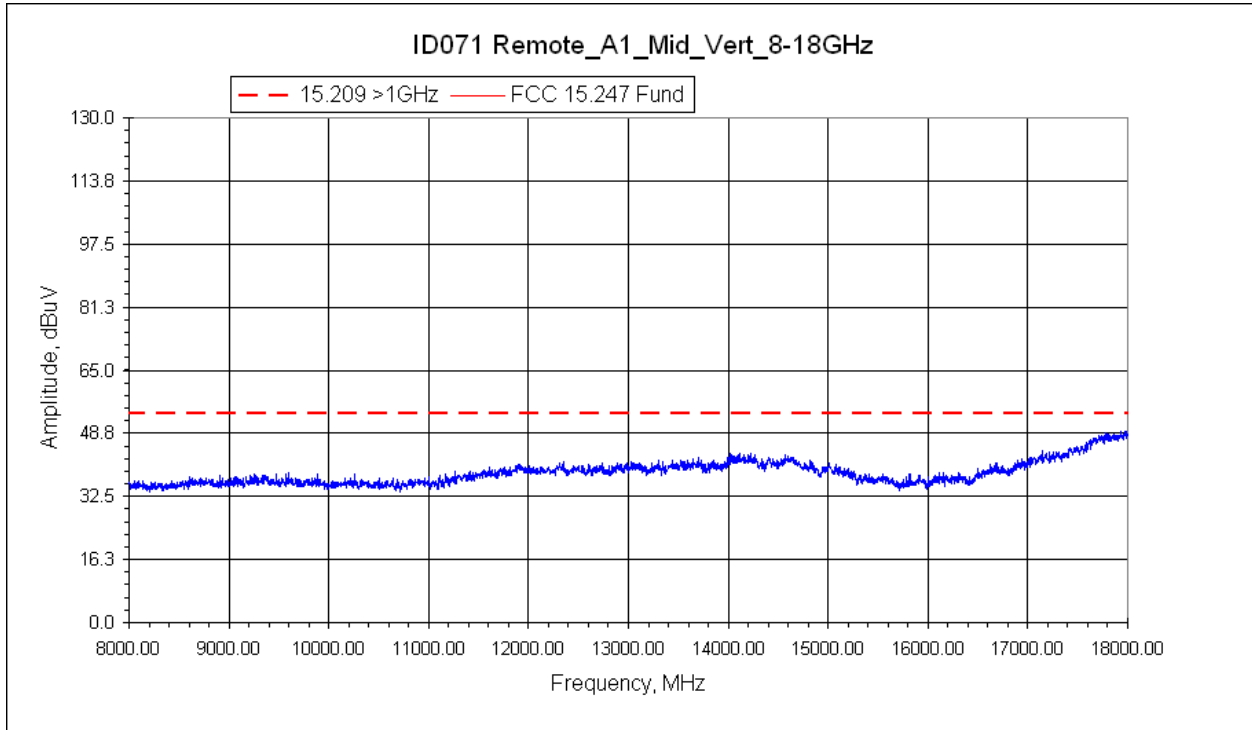
10.18 Pre-scan Plots: Unit 1 - Mid Channel

4GHz to 8GHz



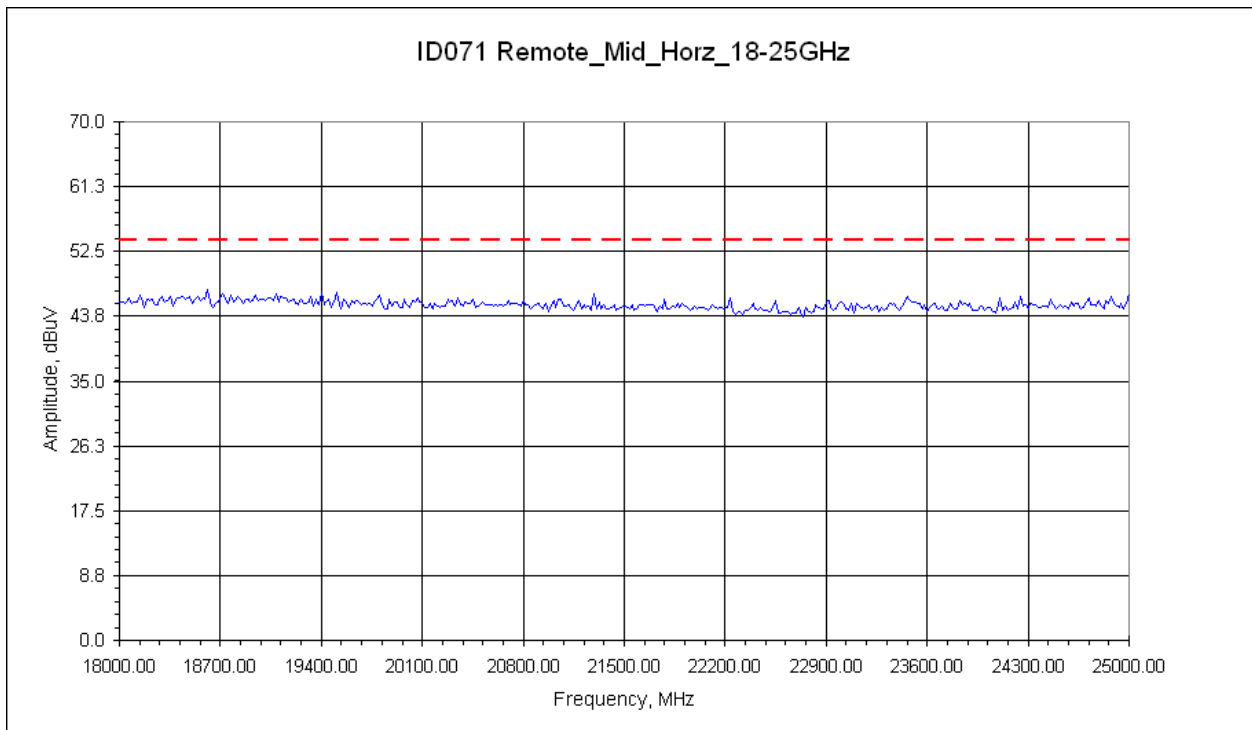
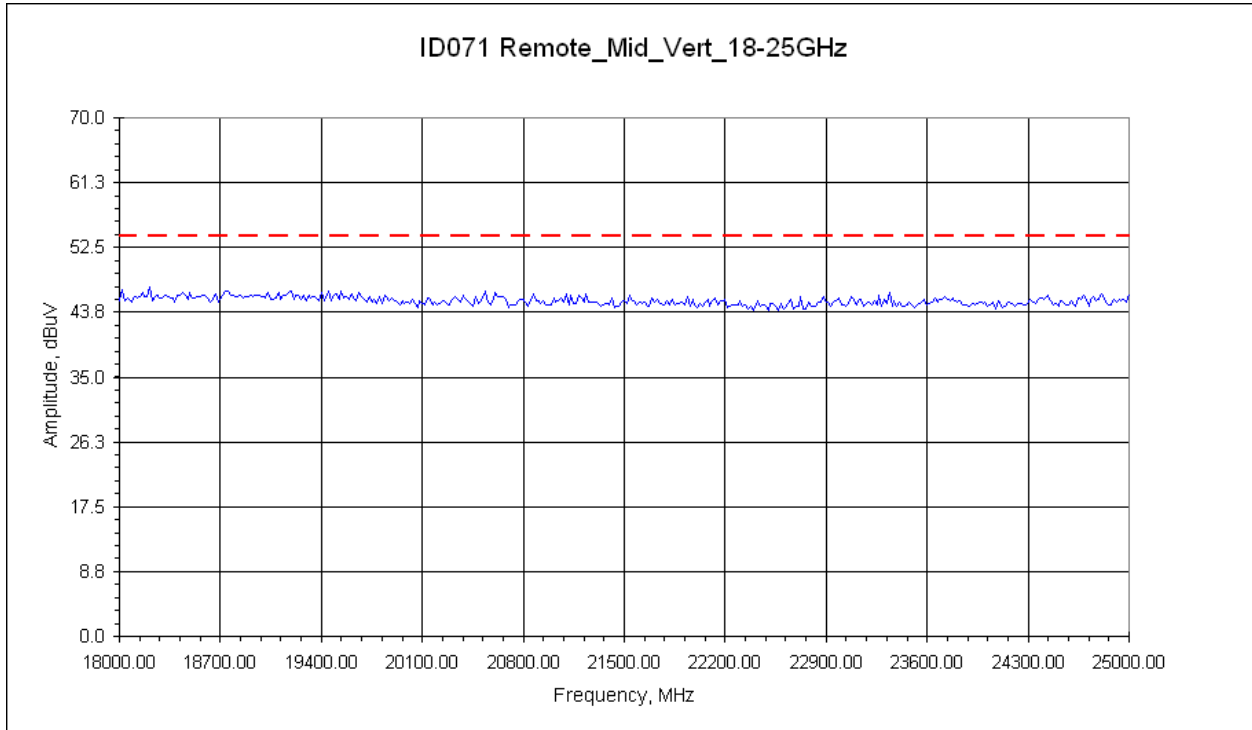
10.19 Pre-scan Plots: Unit 1 - Mid Channel

8GHz to 18GHz



10.20 Pre-scan Plots: Unit 1 - Mid Channel

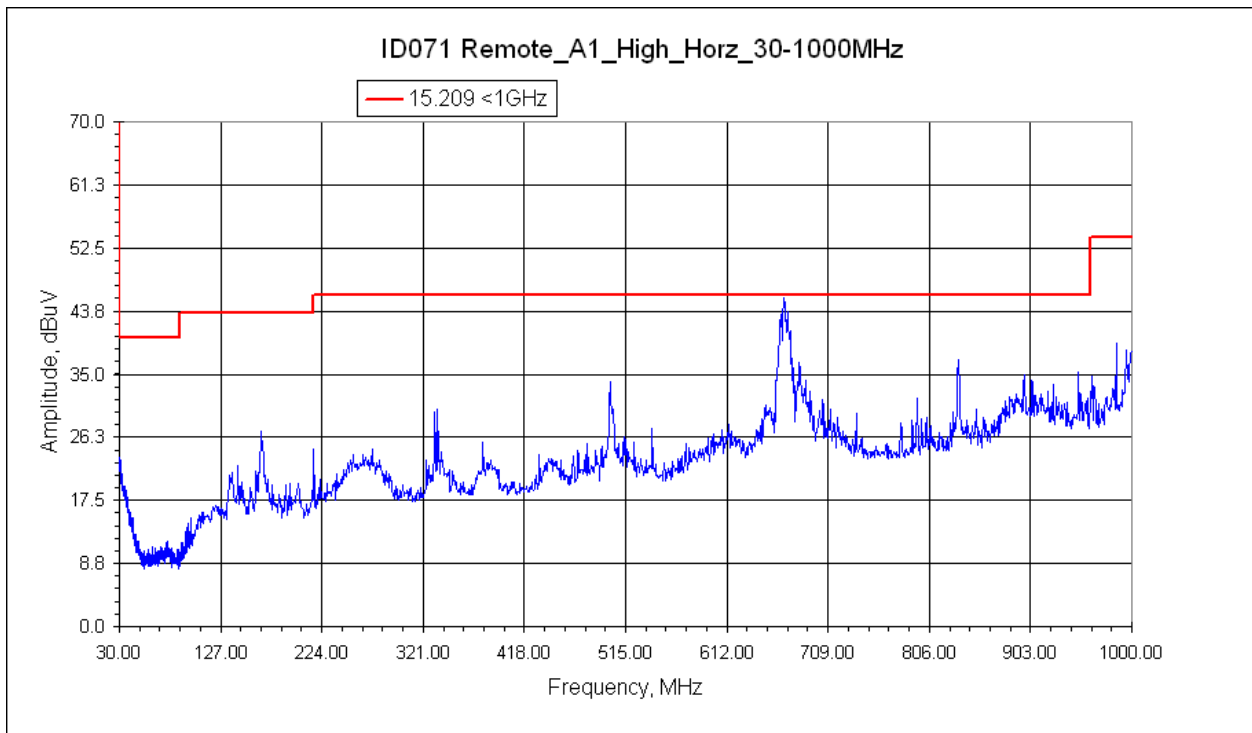
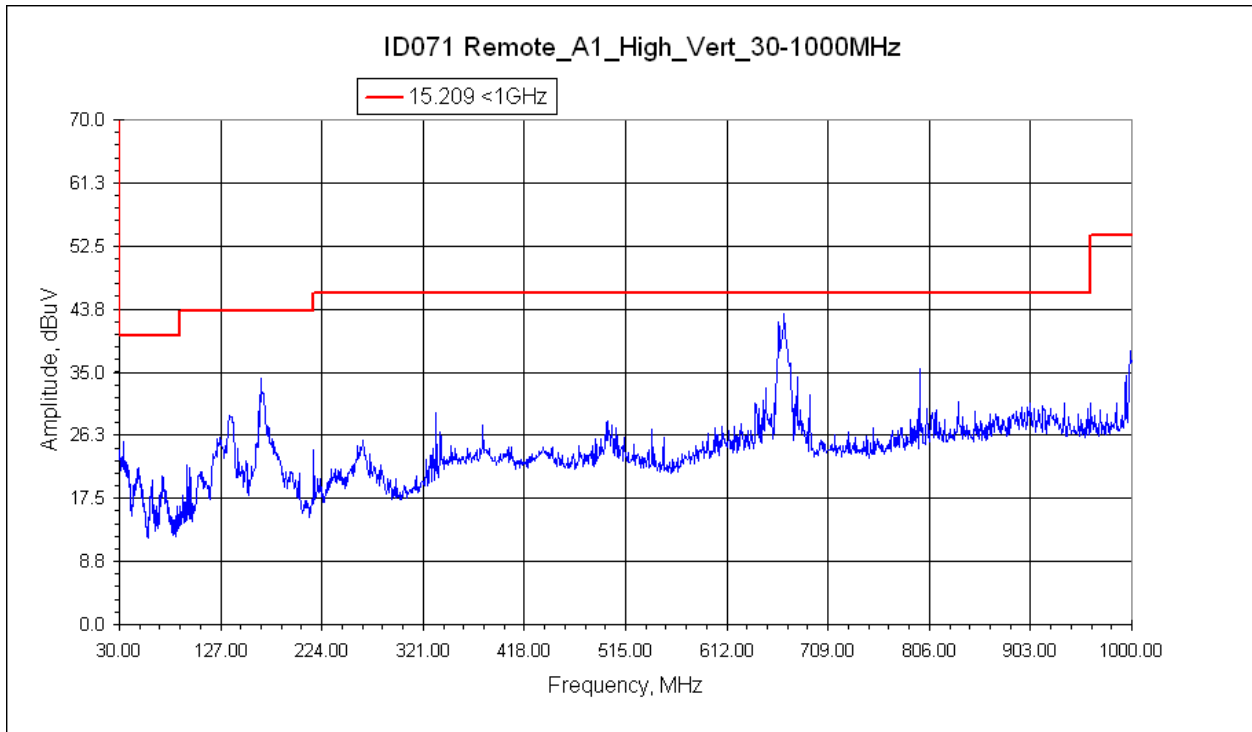
18GHz to 25GHz



10.21

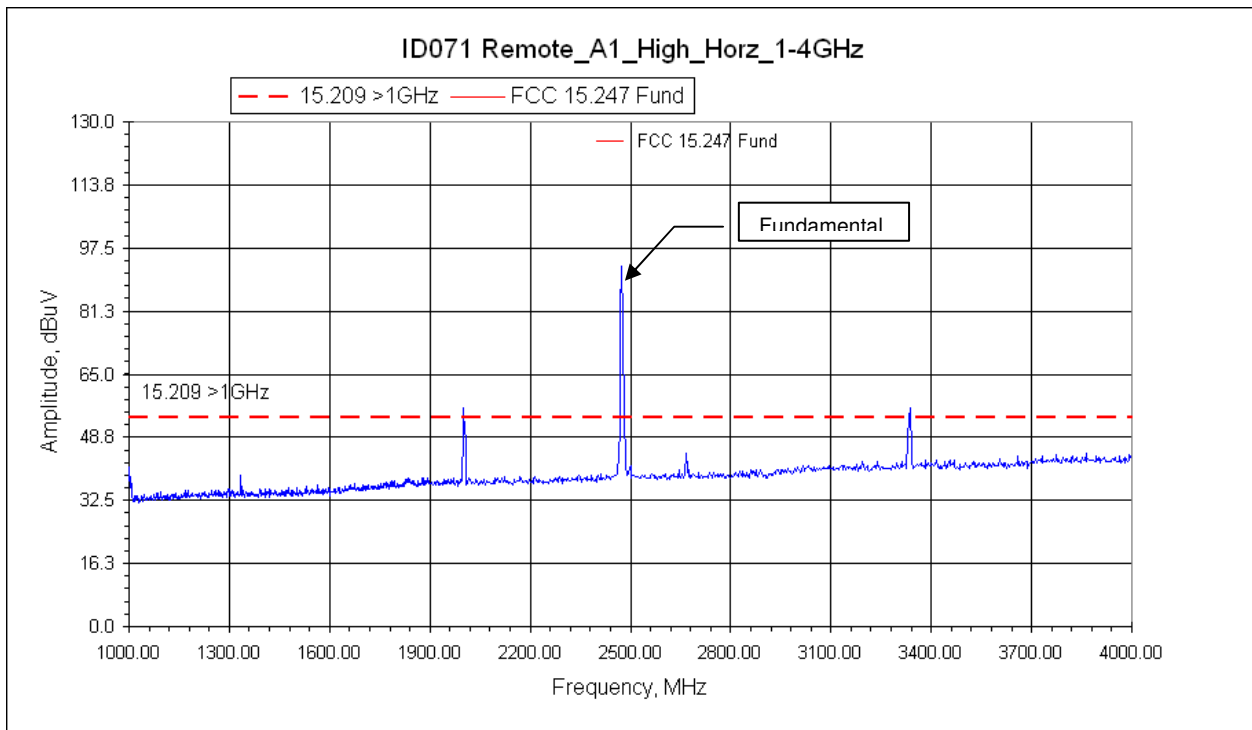
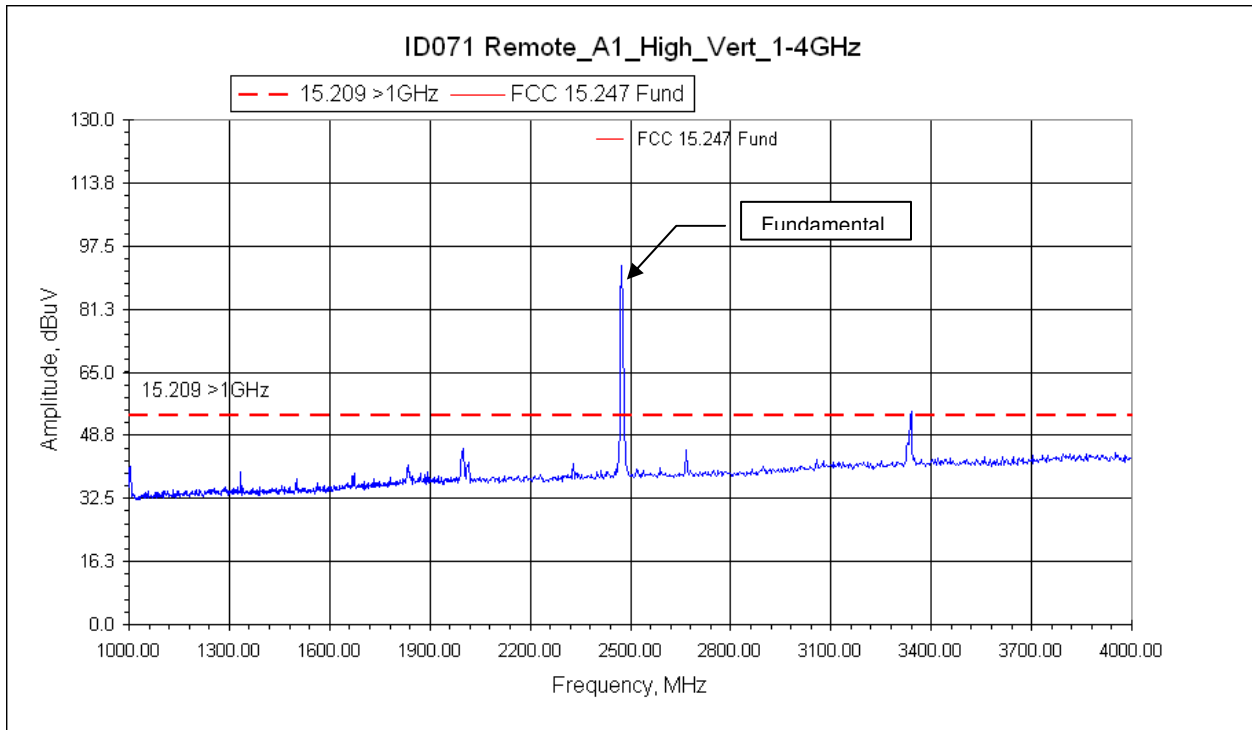
10.22 Pre-scan Plots: Unit 1 - High Channel

30MHz to 1000MHz



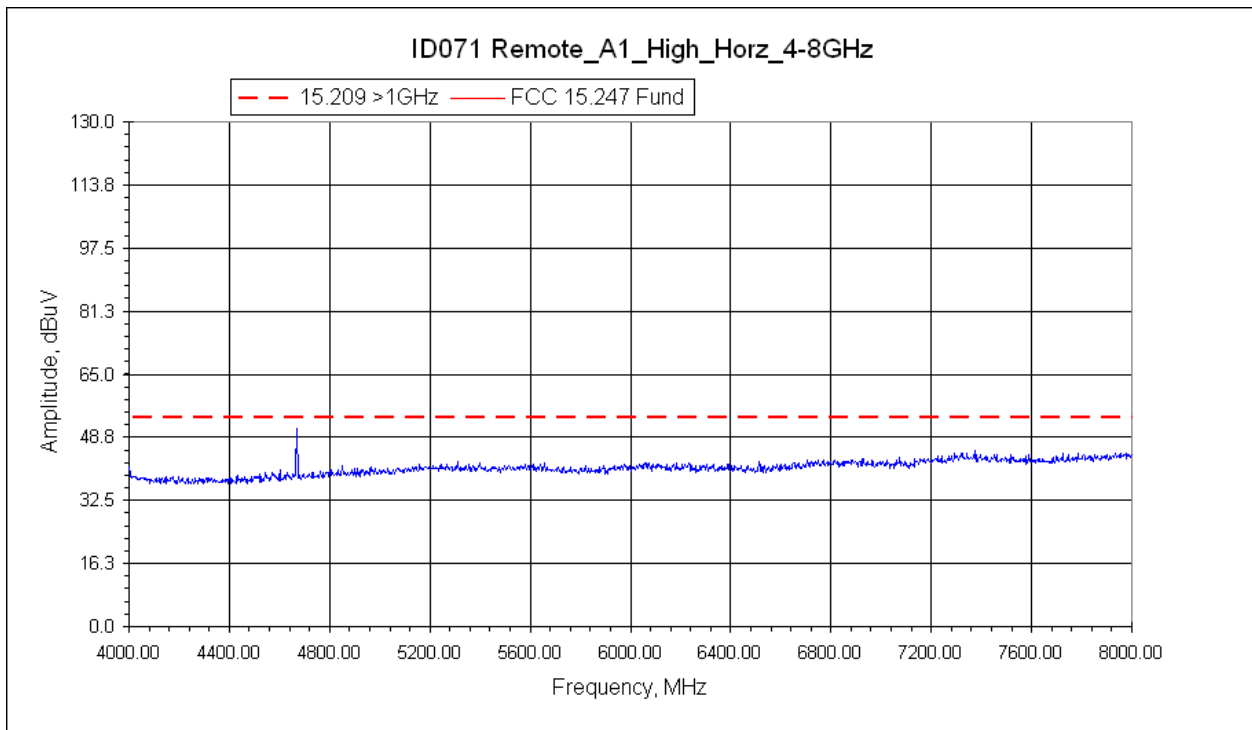
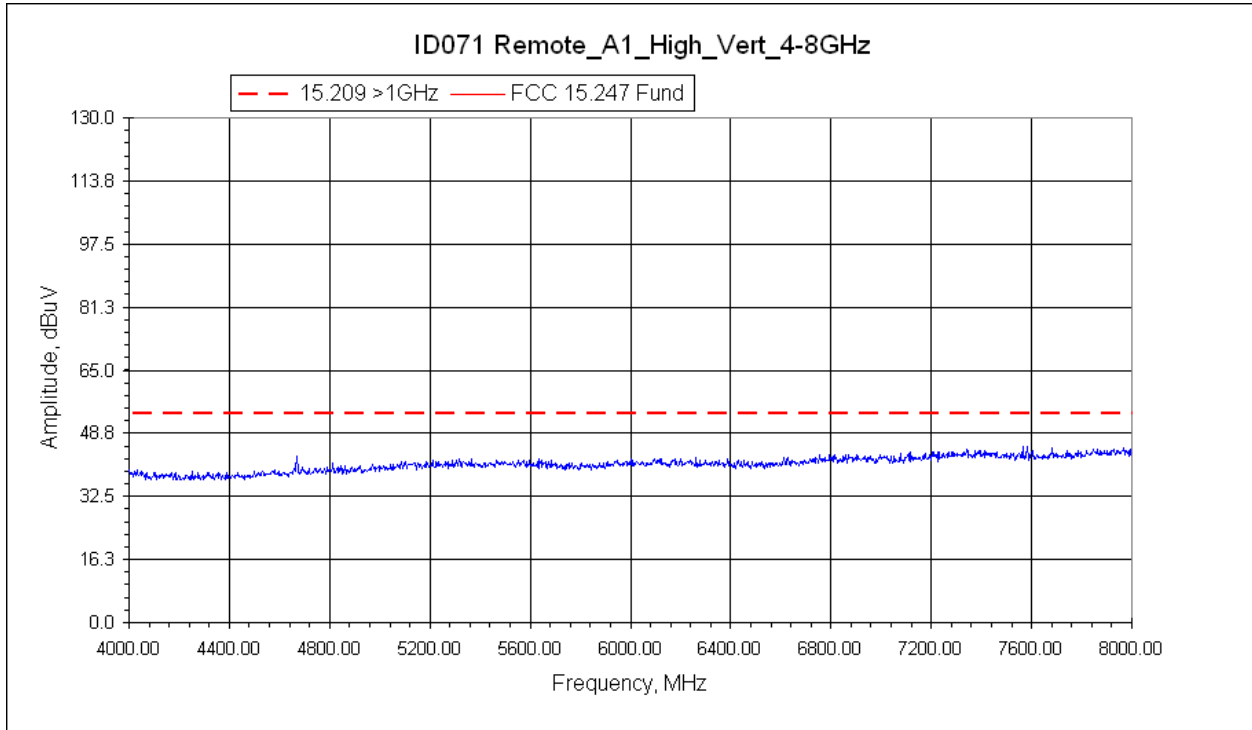
10.23 Pre-scan Plots: Unit 1 - High Channel

1GHz to 4GHz



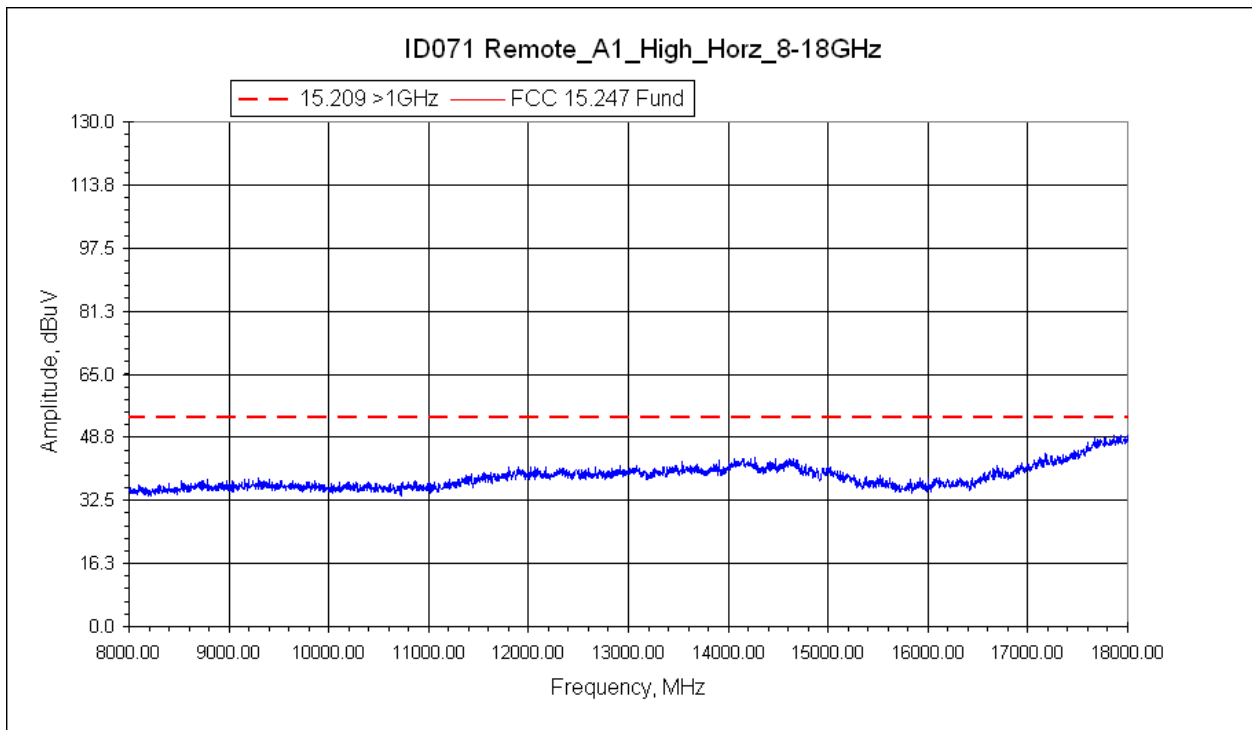
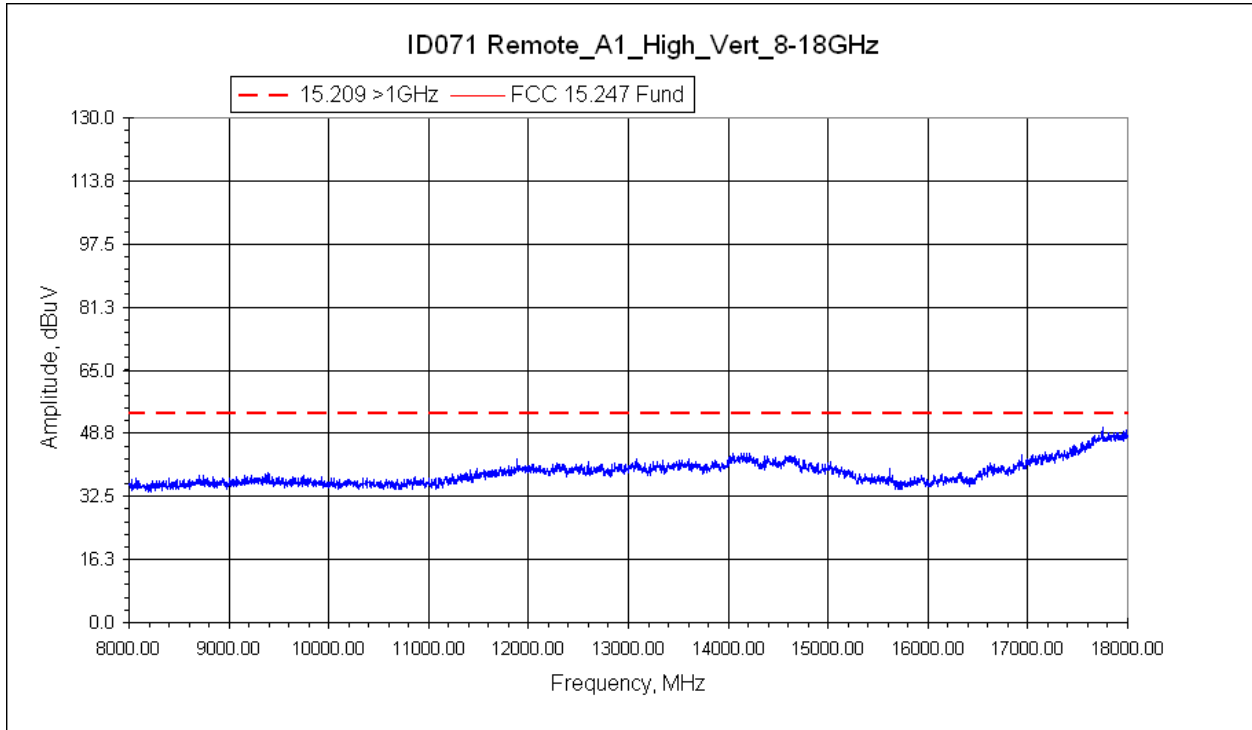
10.24 Pre-scan Plots: Unit 1 - High Channel

4GHz to 8GHz



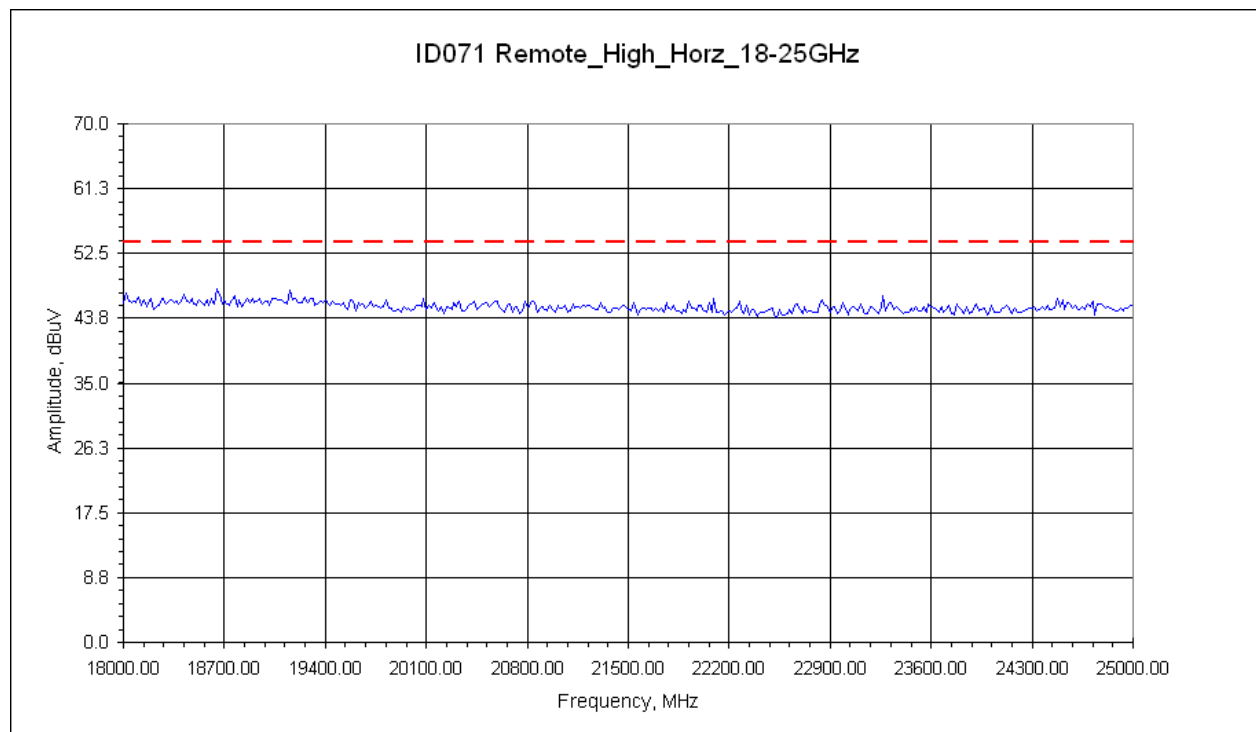
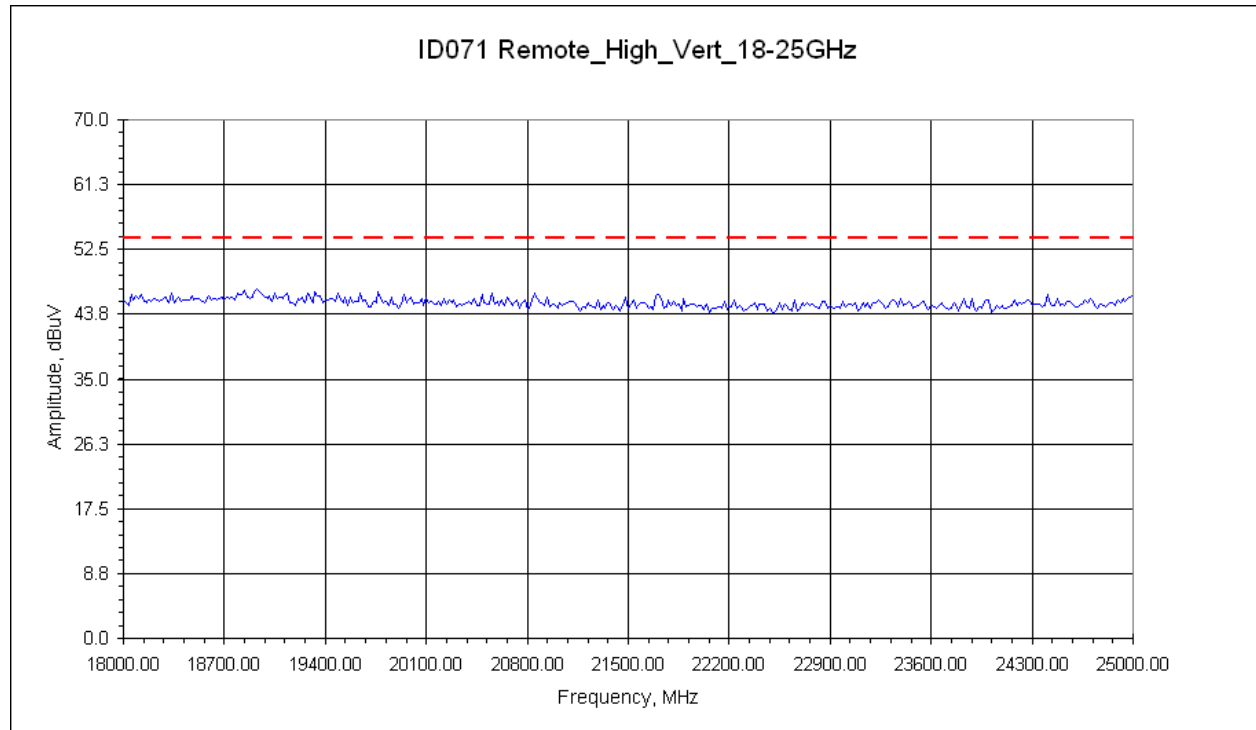
10.25 Pre-scan Plots: Unit 1 - High Channel

8GHz to 18GHz



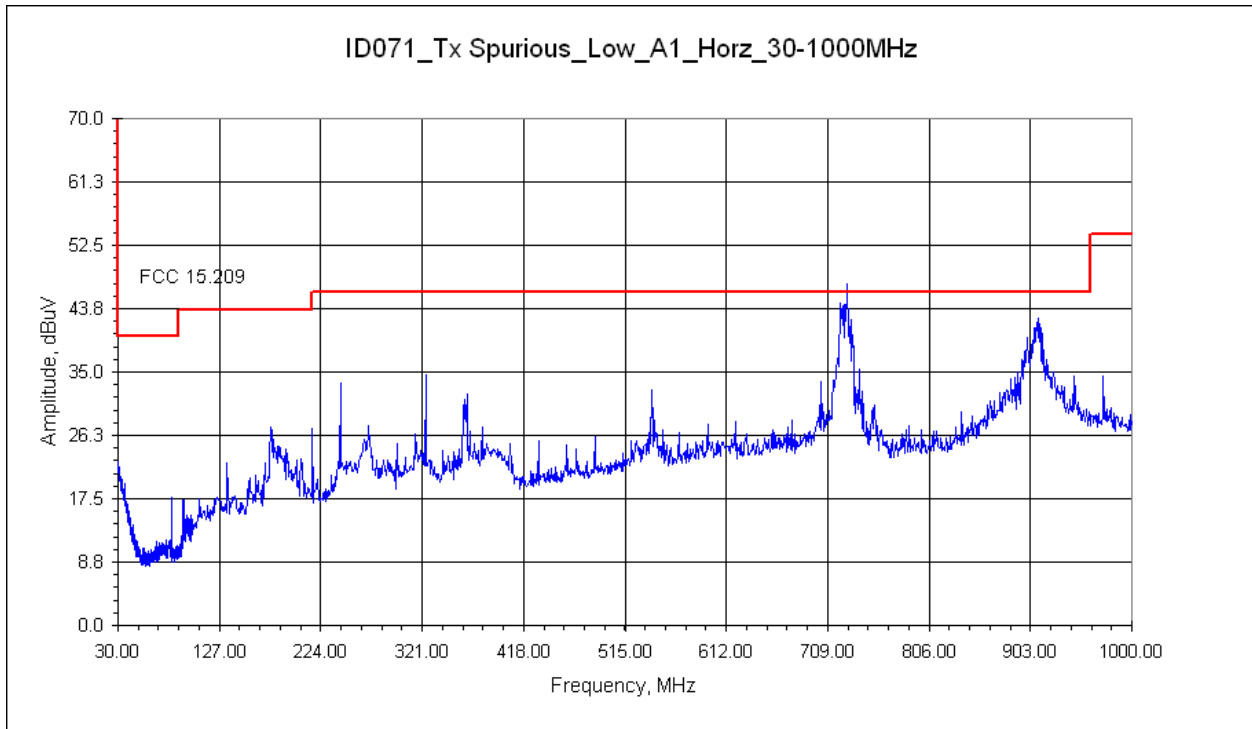
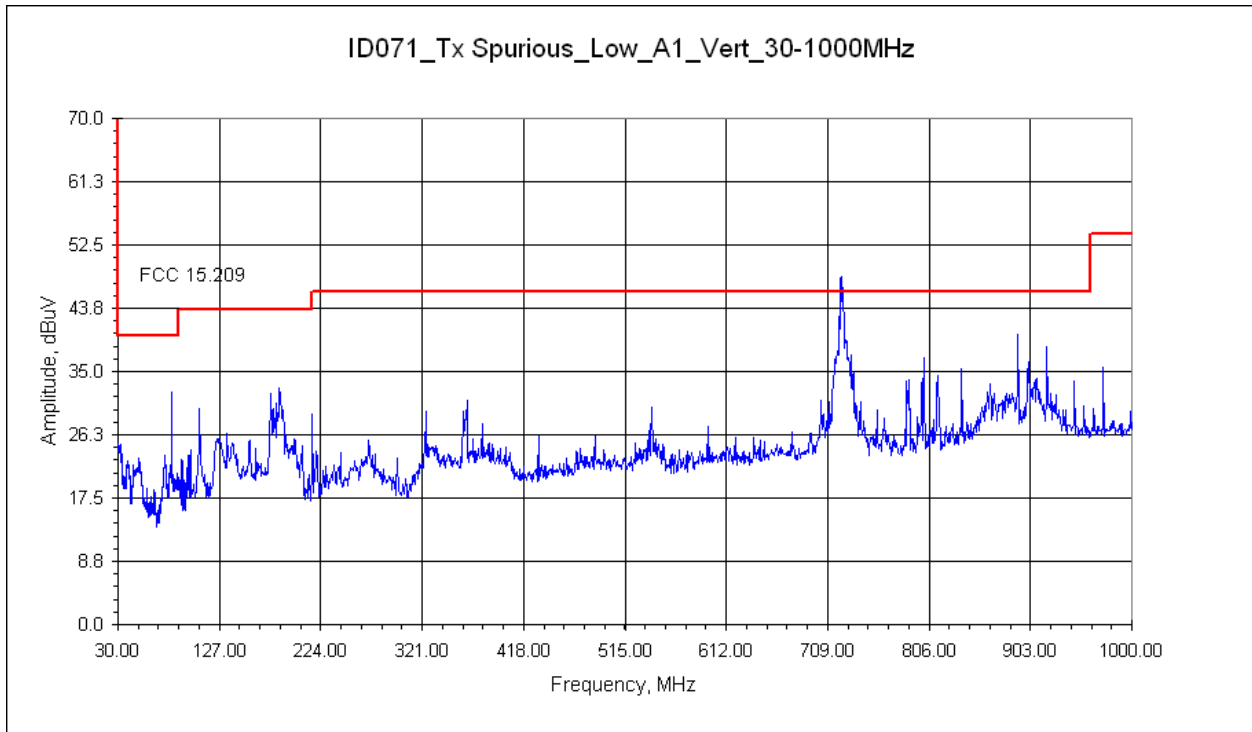
10.26 Pre-scan Plots: Unit 1 - High Channel

18GHz to 25GHz



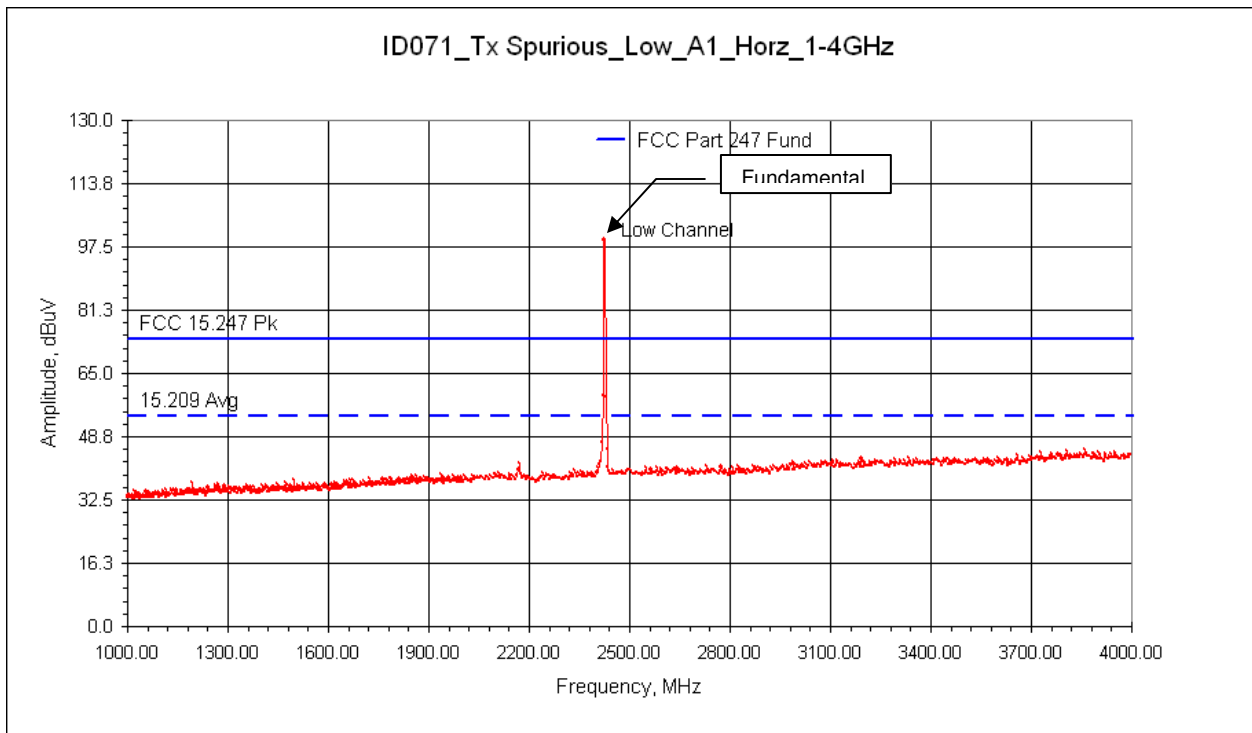
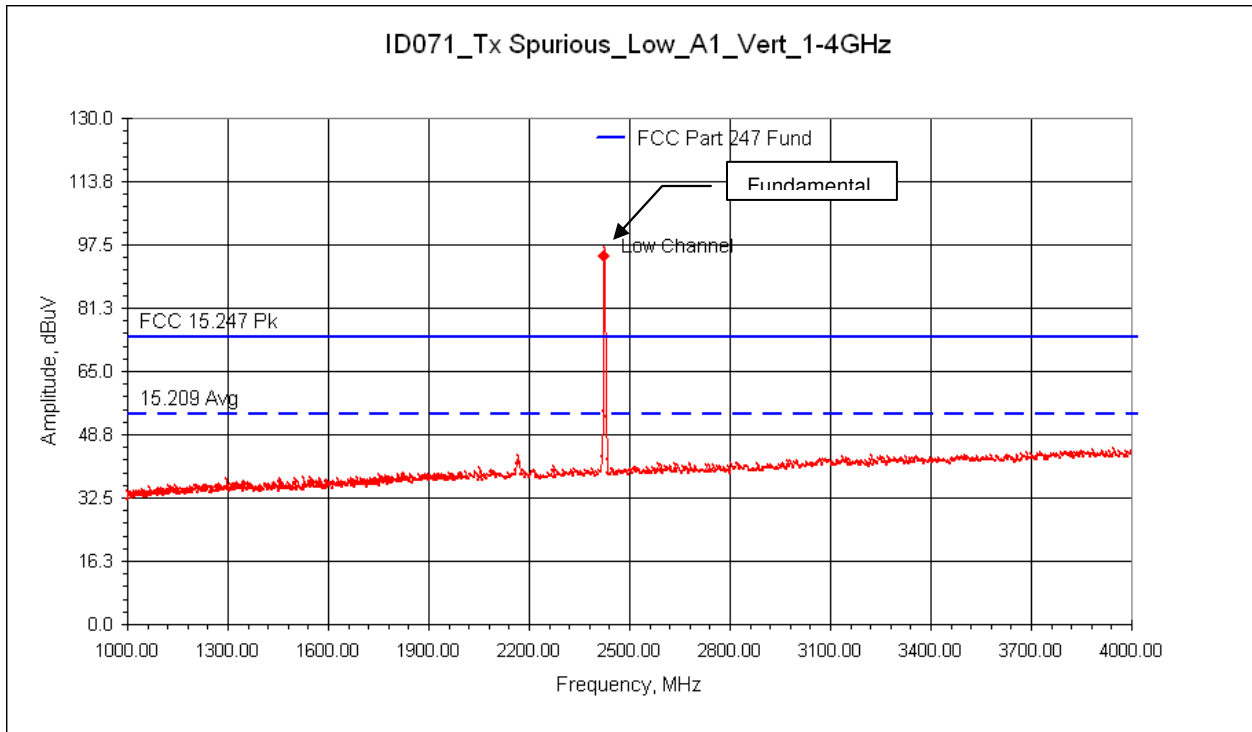
10.27 Pre-scan Plots: Unit 2 - Low Channel

30MHz to 1000MHz



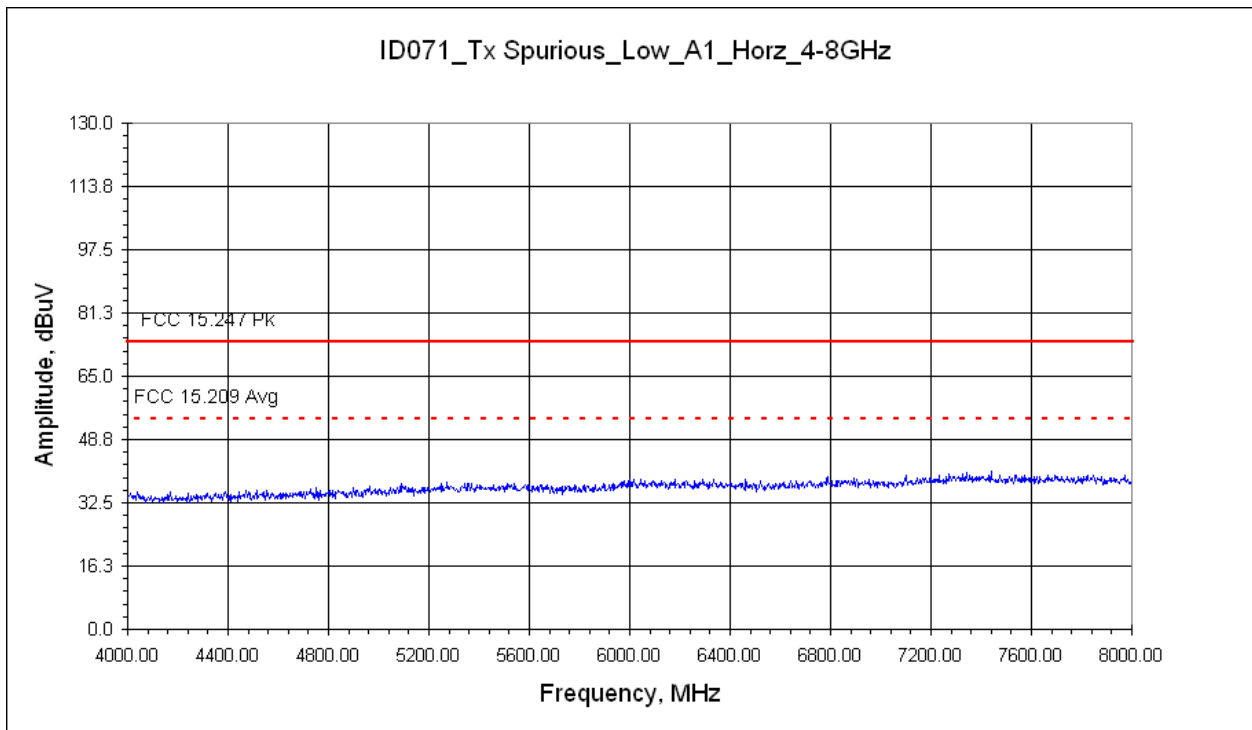
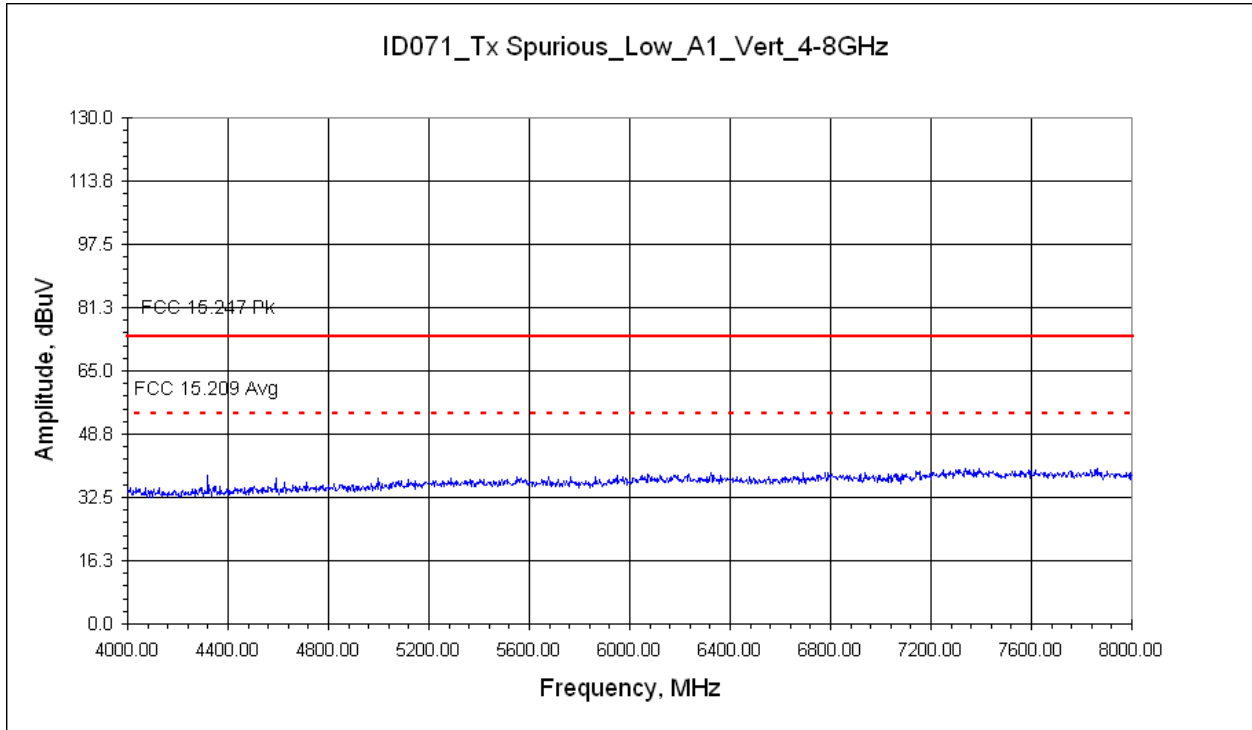
10.28 Pre-scan Plots: Unit 2- Low Channel

1GHz to 4GHz



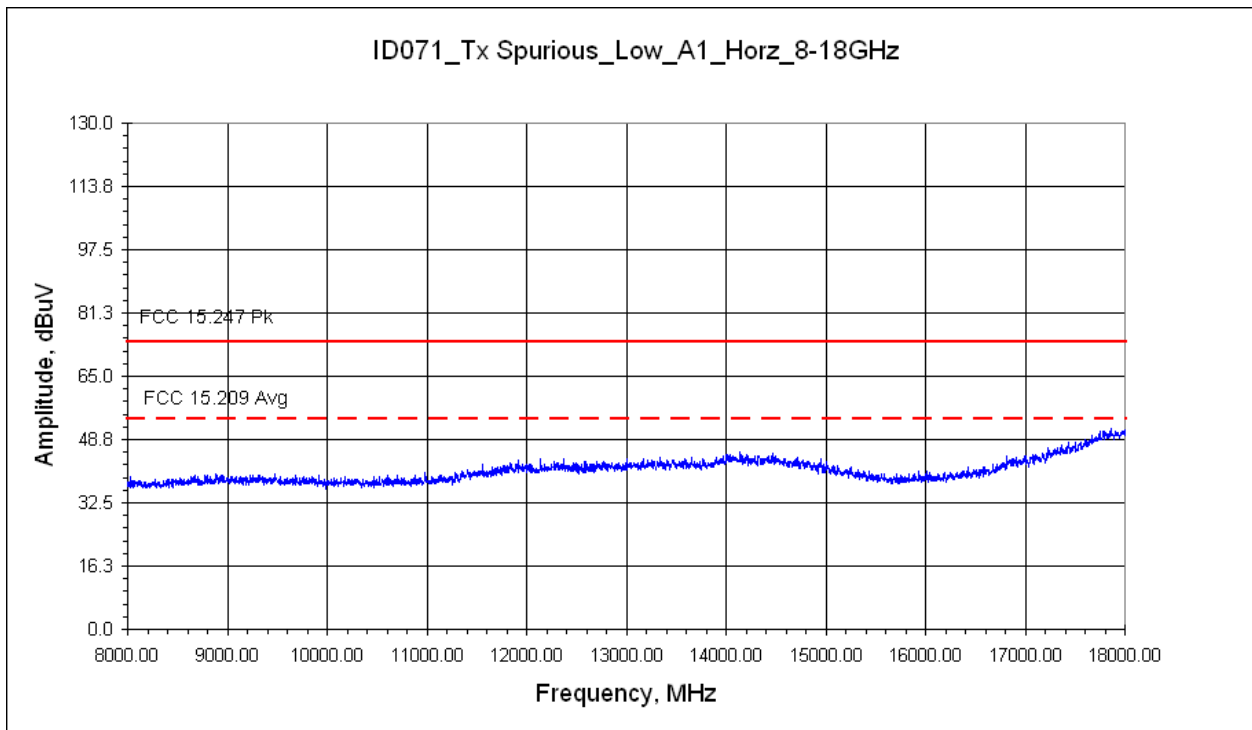
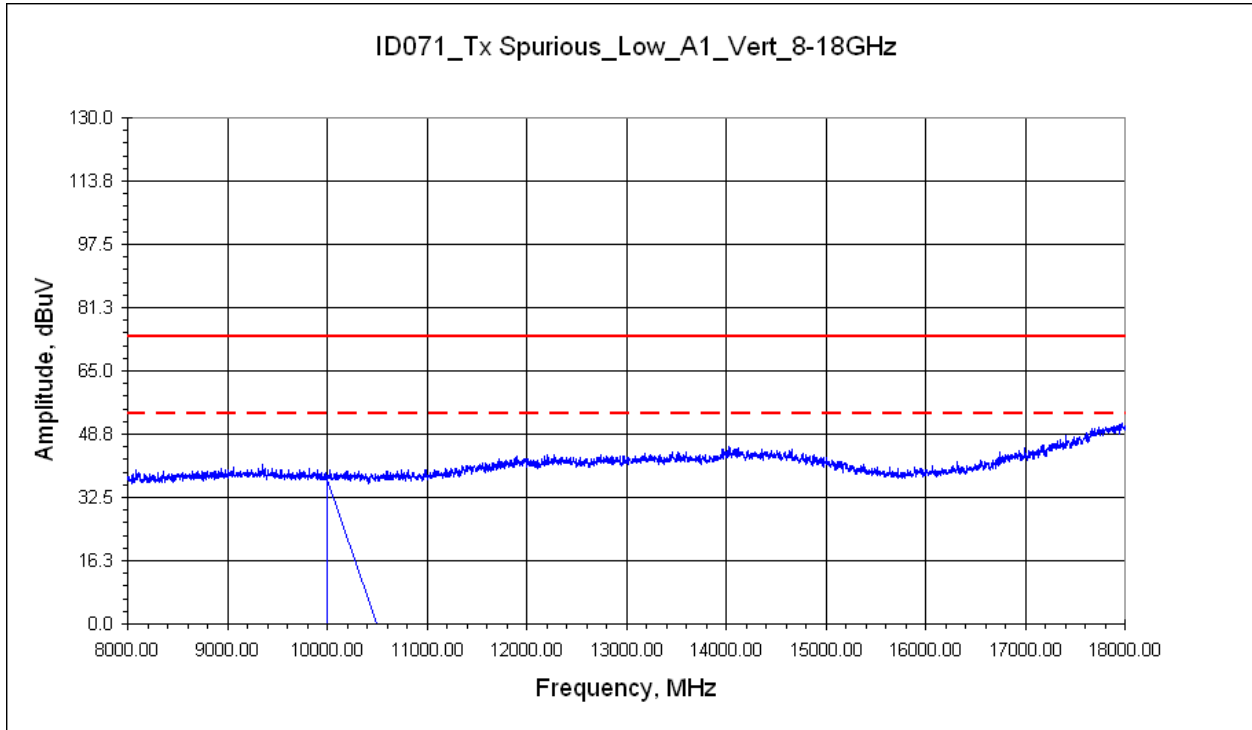
10.29 Pre-scan Plots: Unit 2 - Low Channel

4GHz to 8GHz



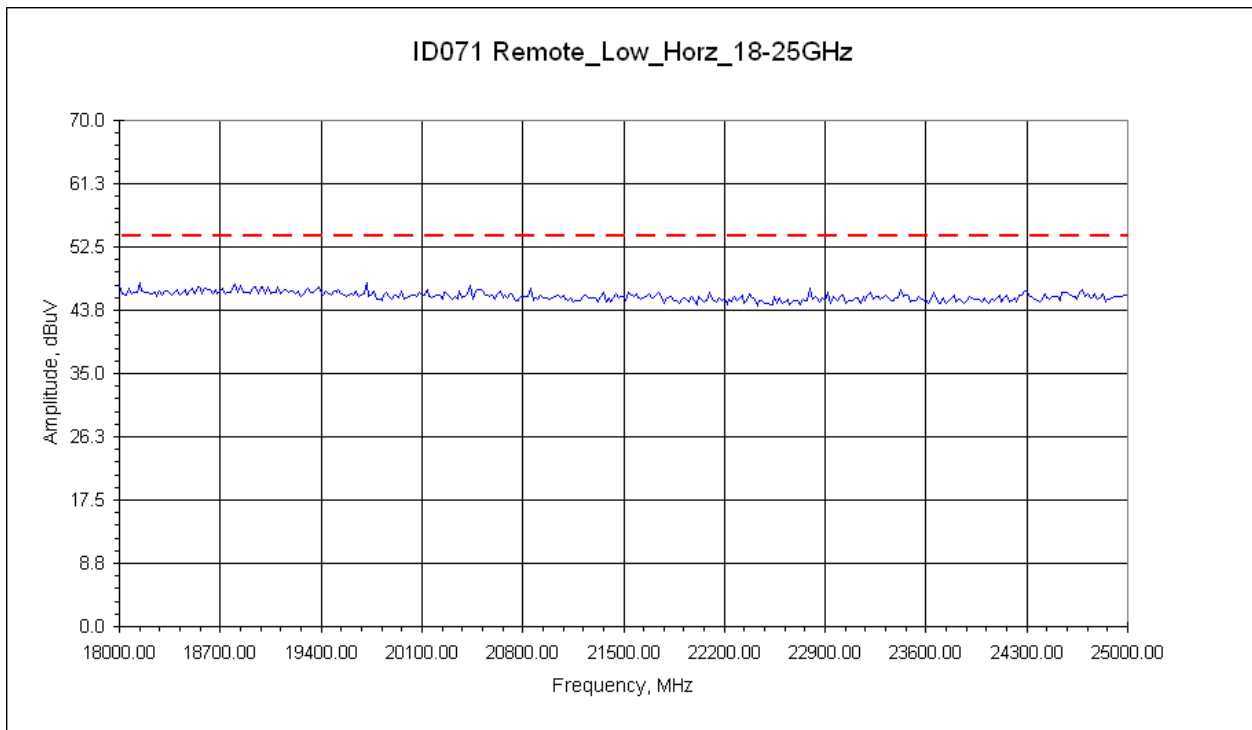
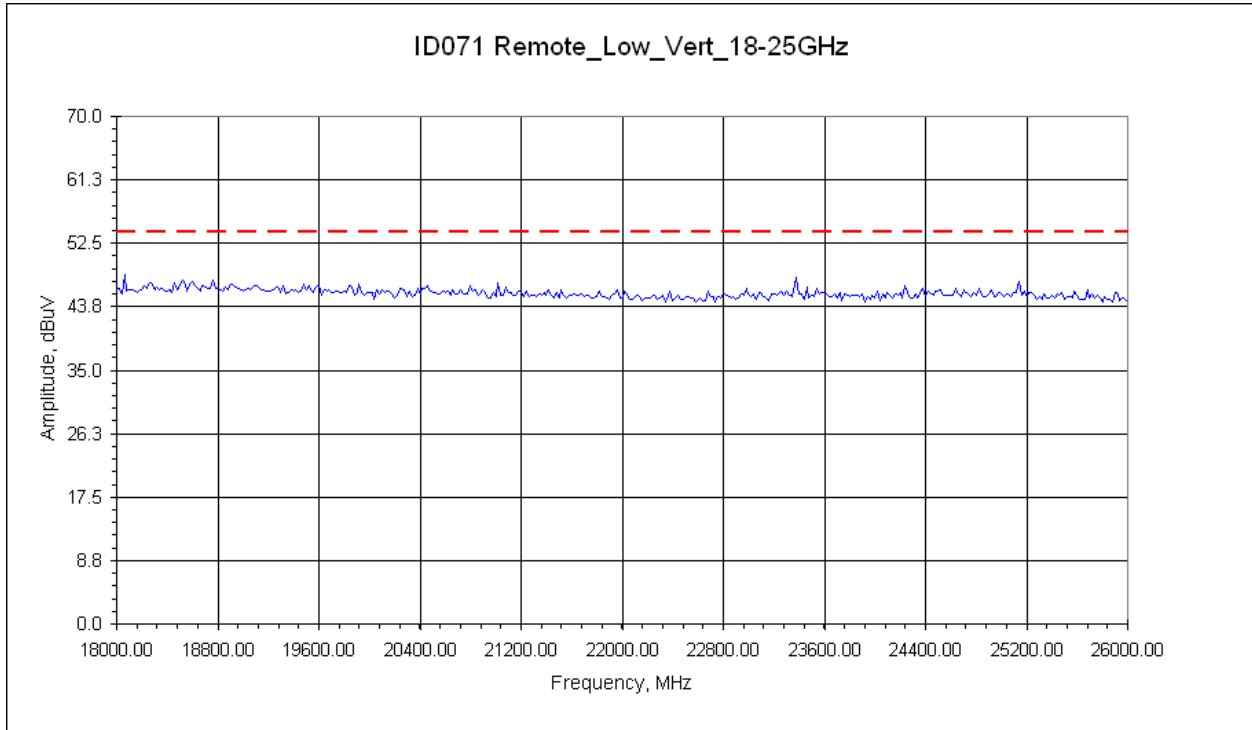
10.30 Pre-scan Plots: Unit 2 - Low Channel

8GHz to 18GHz



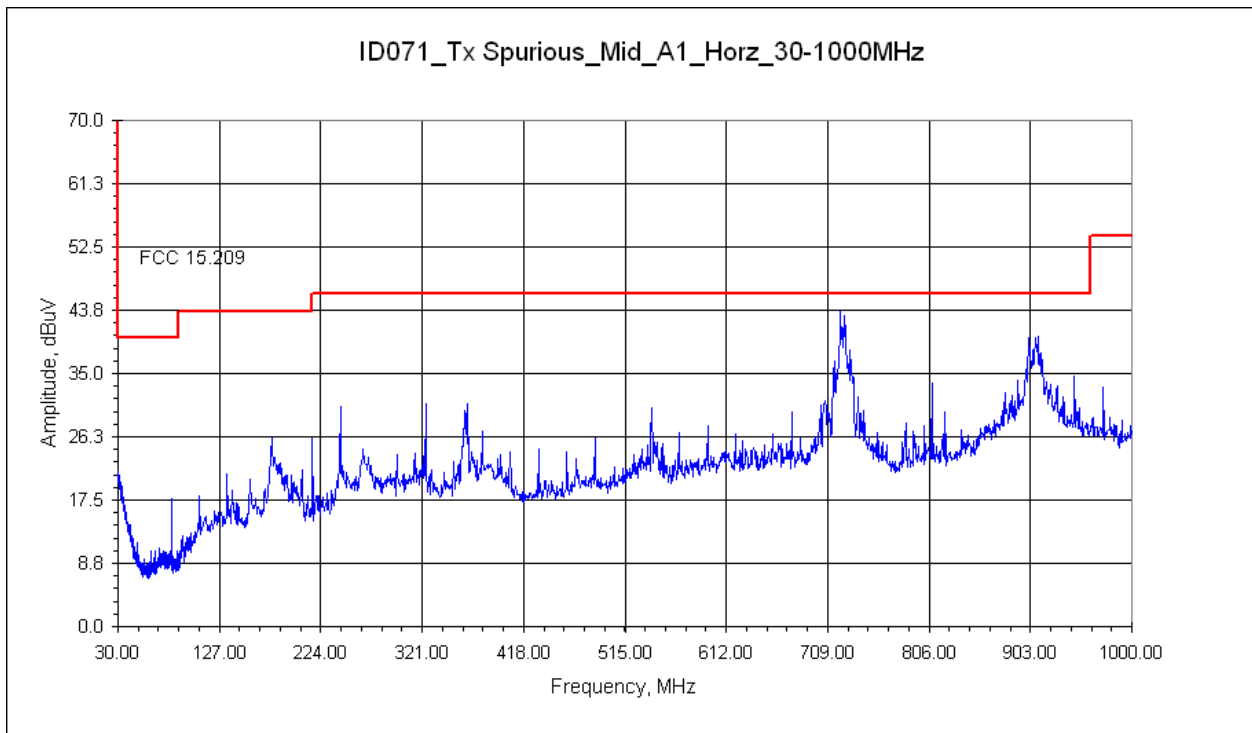
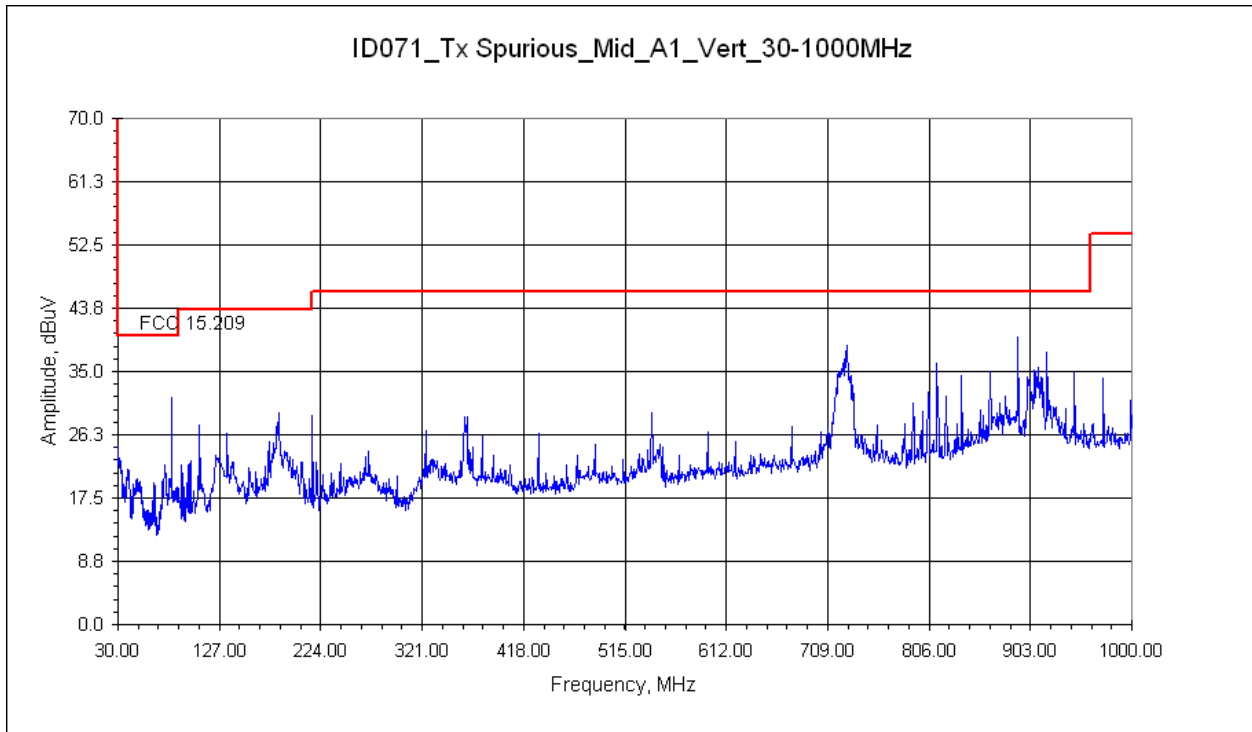
10.31 Pre-scan Plots: Unit 2 - Low Channel

18GHz to 25GHz



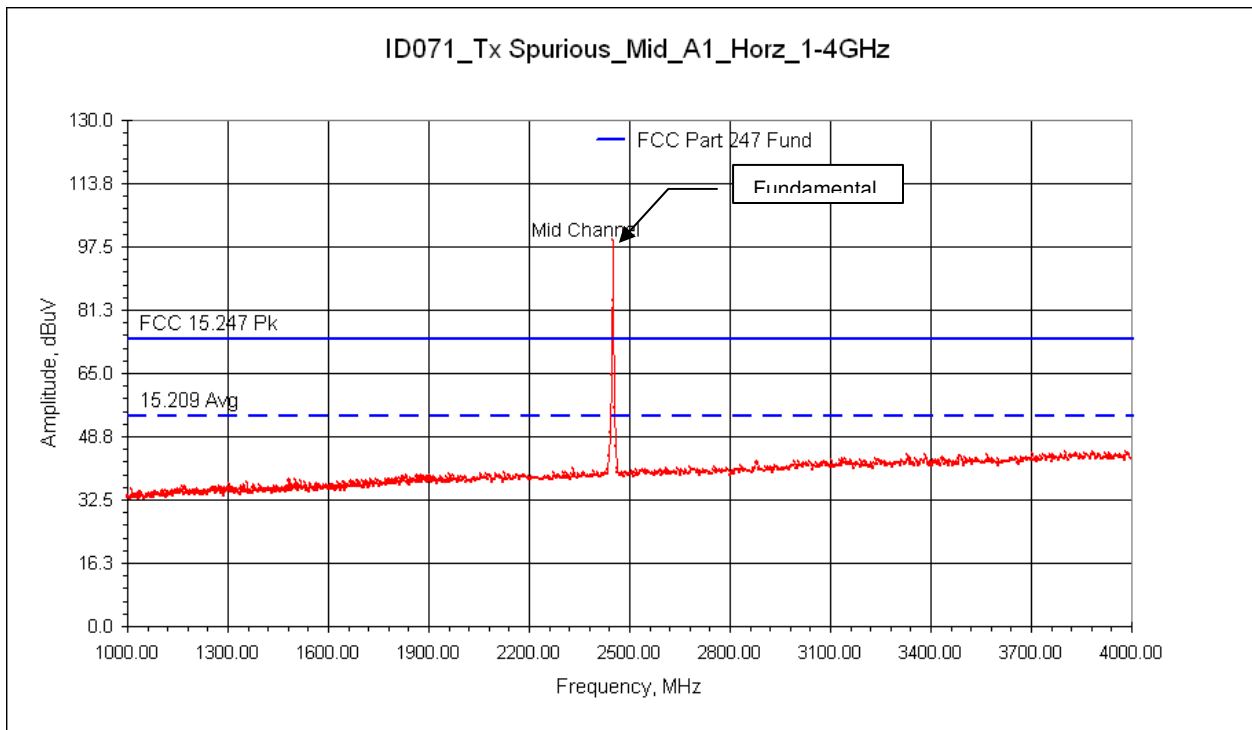
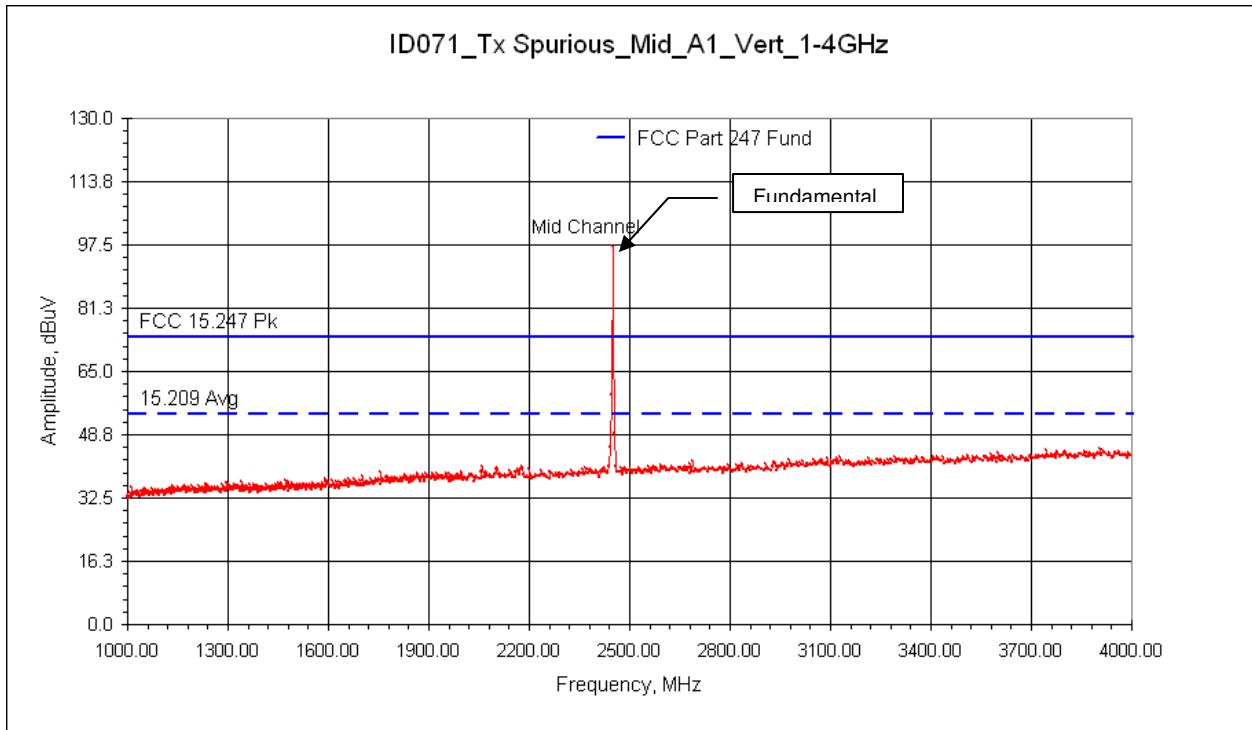
10.32 Pre-scan Plots: Unit 2 - Mid Channel

30MHz to 1000MHz



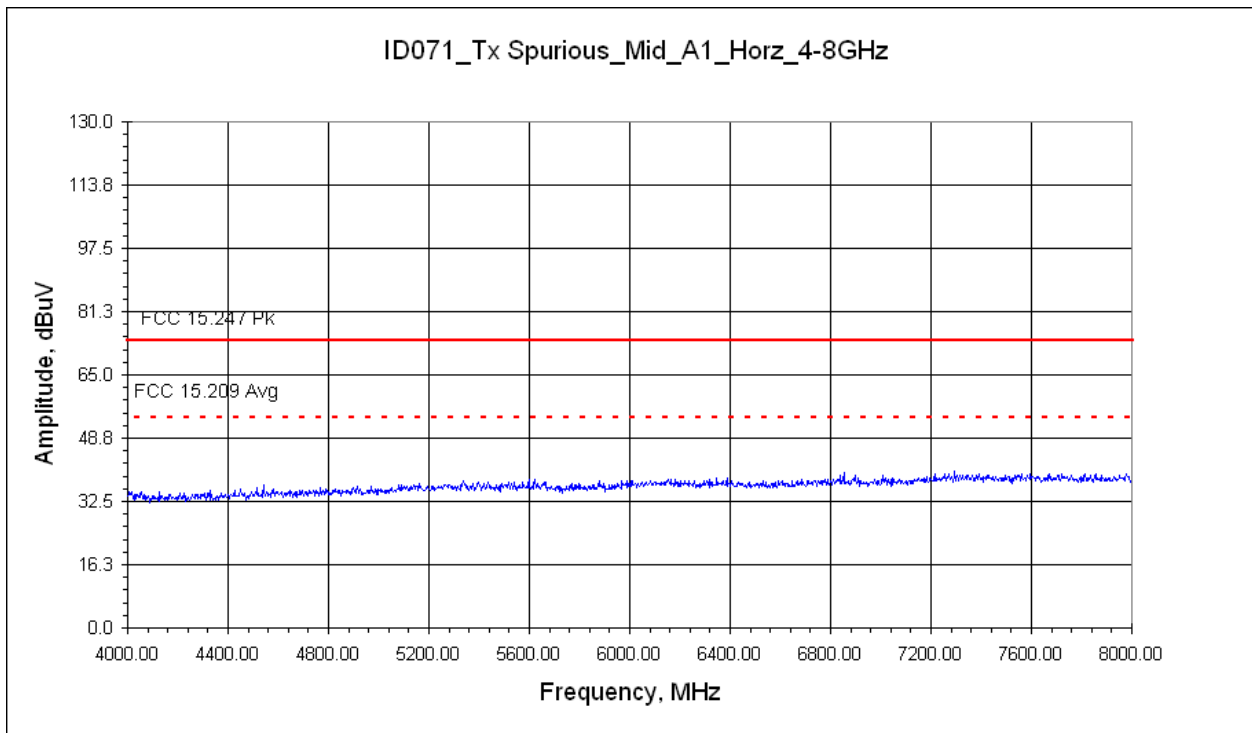
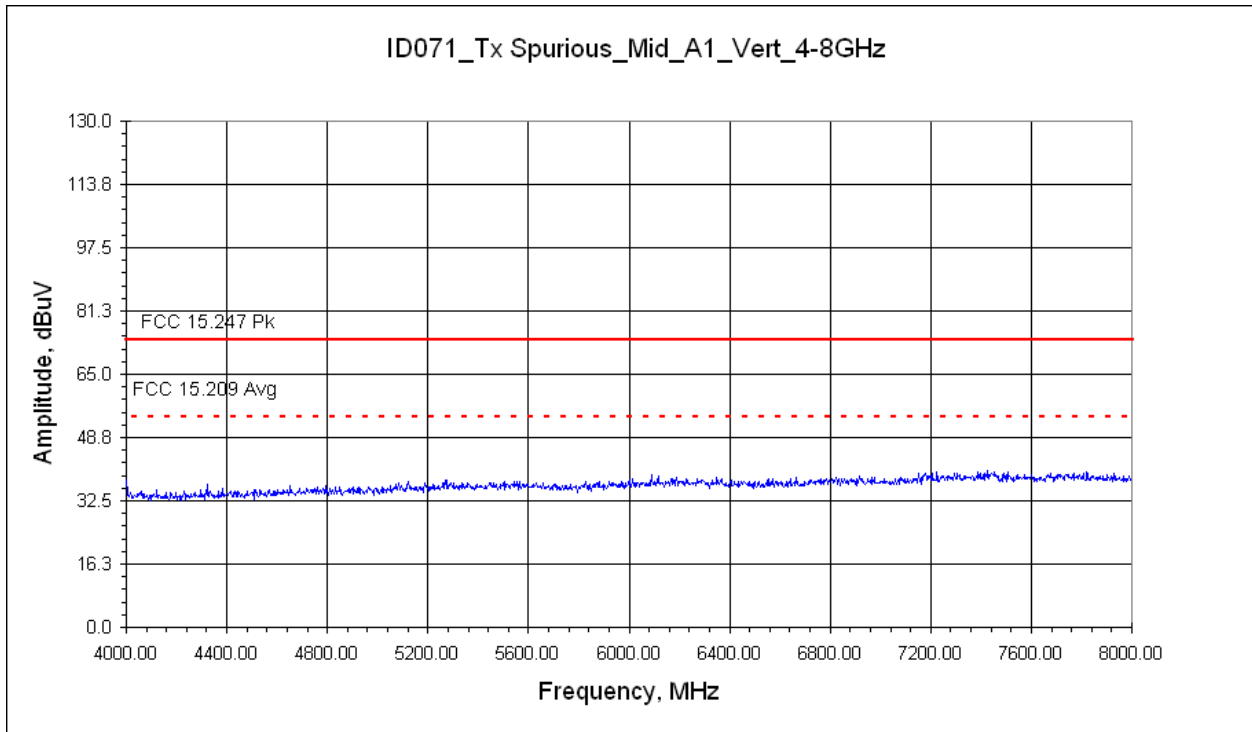
10.33 Pre-scan Plots: Unit 2 - Mid Channel

1GHz to 4GHz



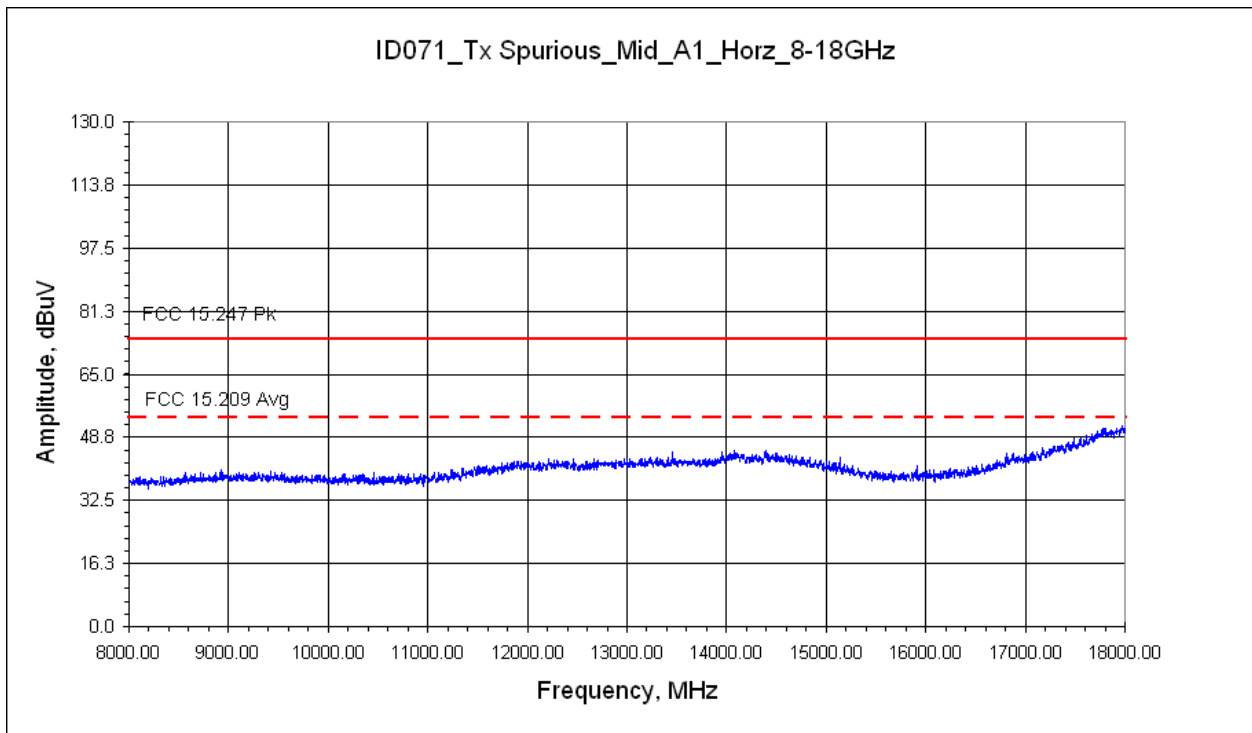
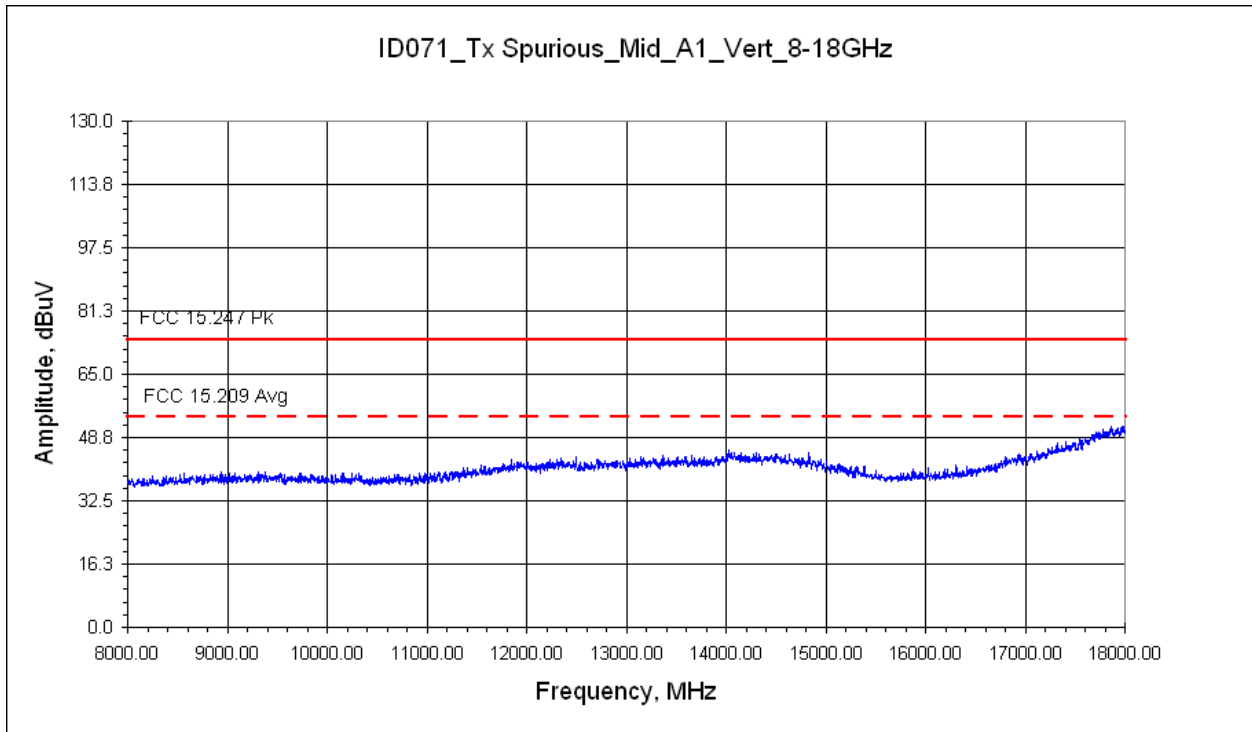
10.34 Pre-scan Plots: Unit 2 - Mid Channel

4GHz to 8GHz



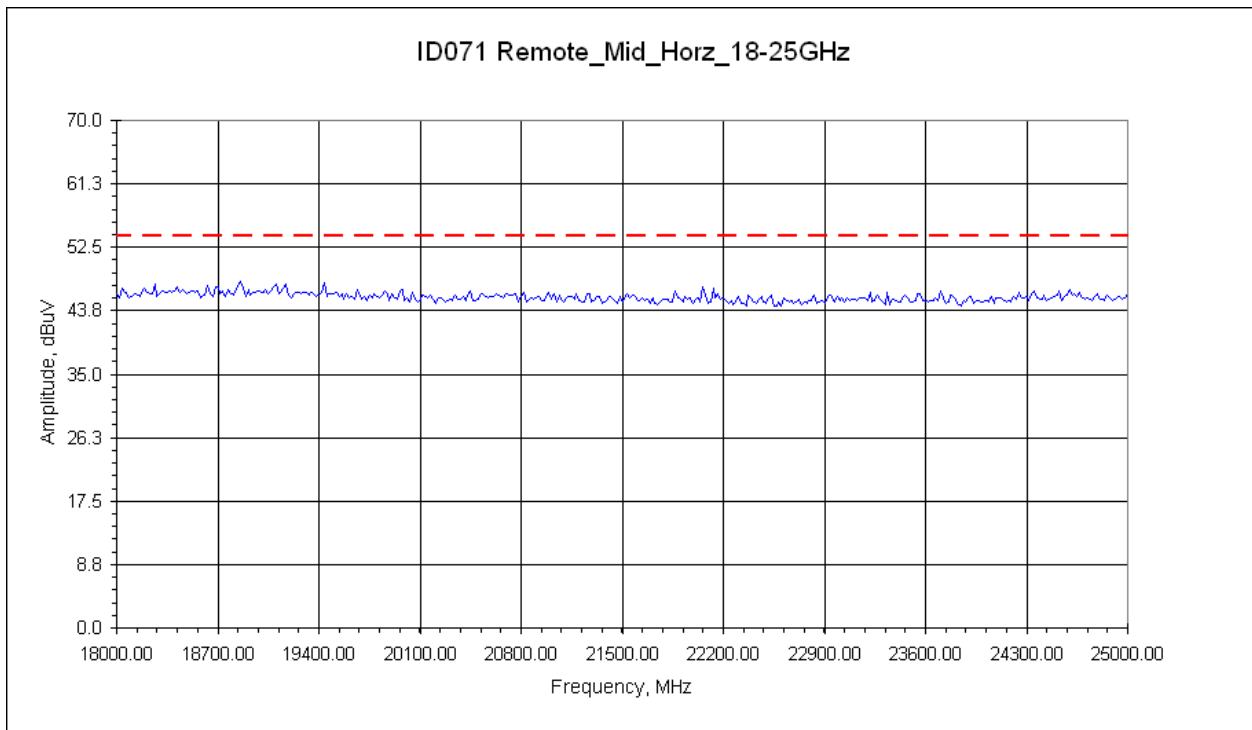
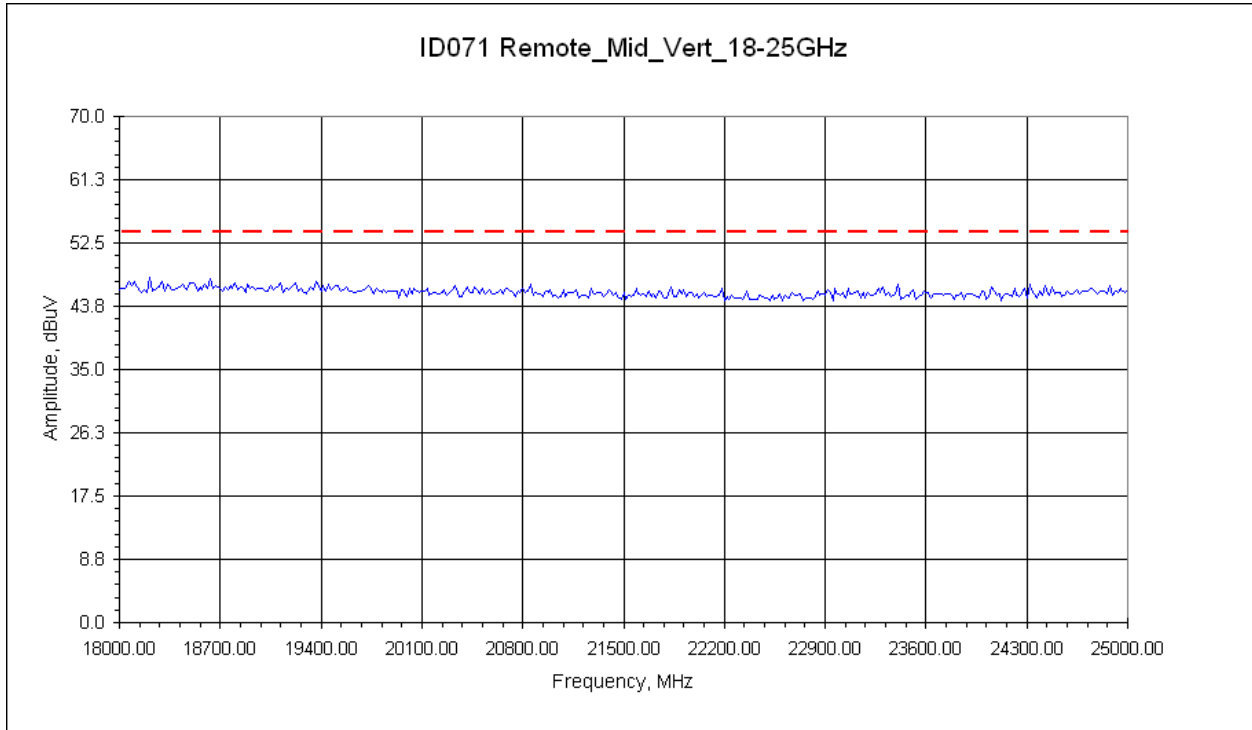
10.35 Pre-scan Plots: Unit 2 - Mid Channel

8GHz to 18GHz



10.36 Pre-scan Plots: Unit 2 - Mid Channel

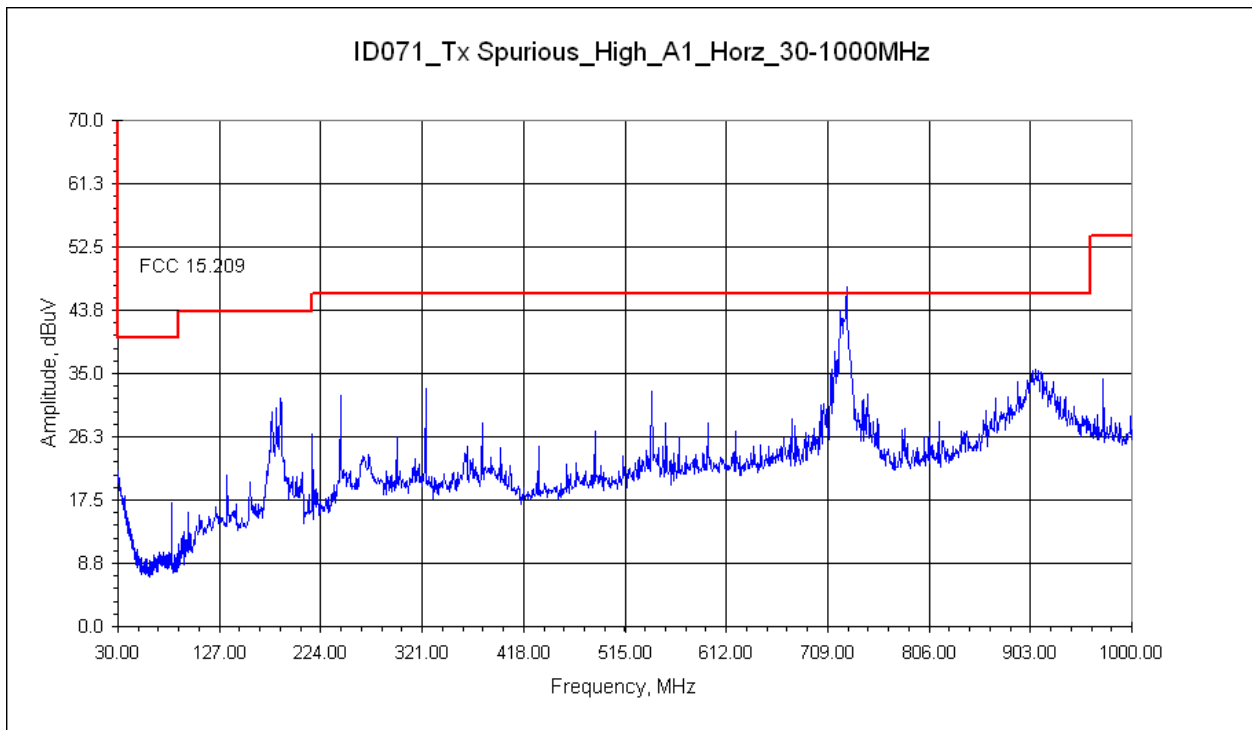
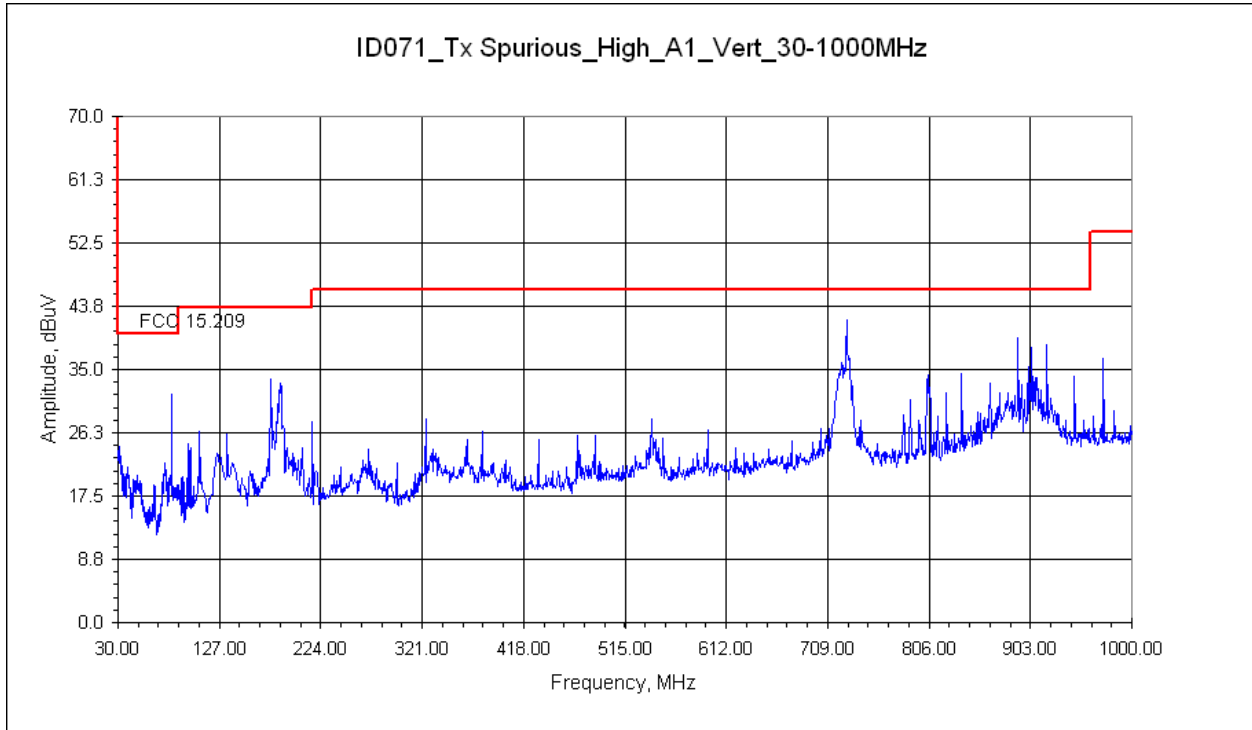
18GHz to 25GHz



10.37

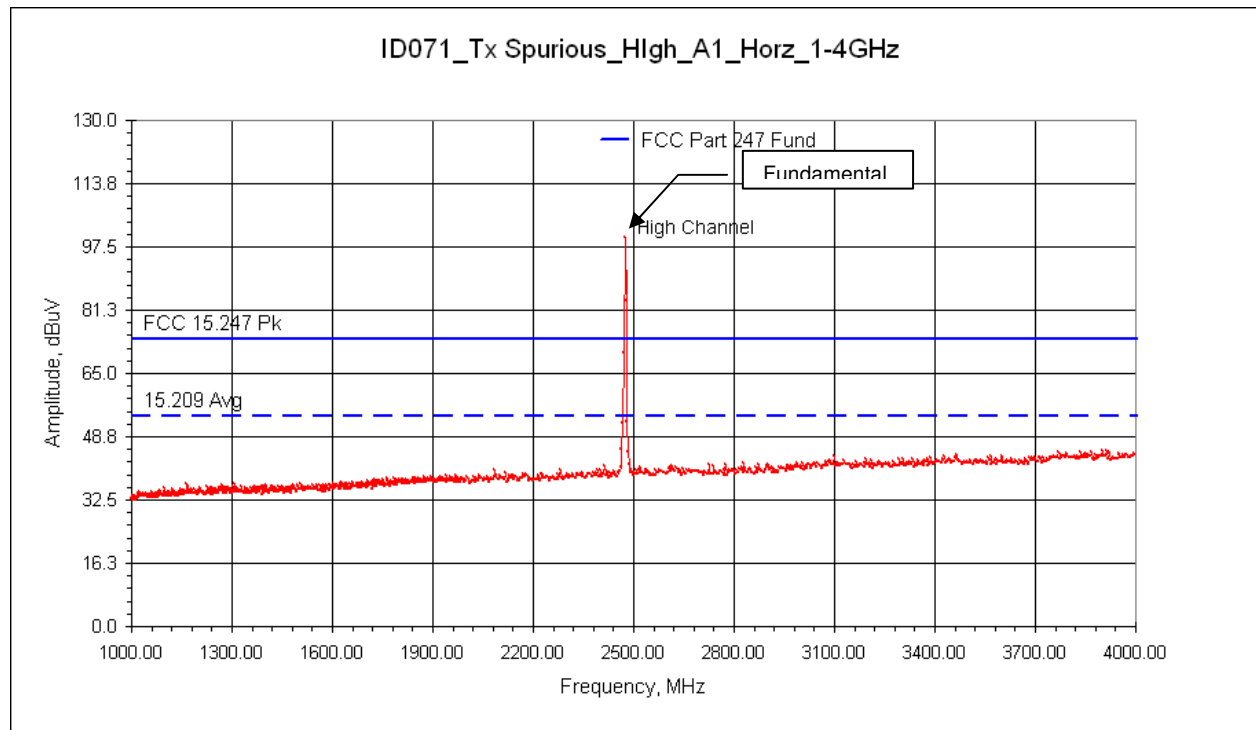
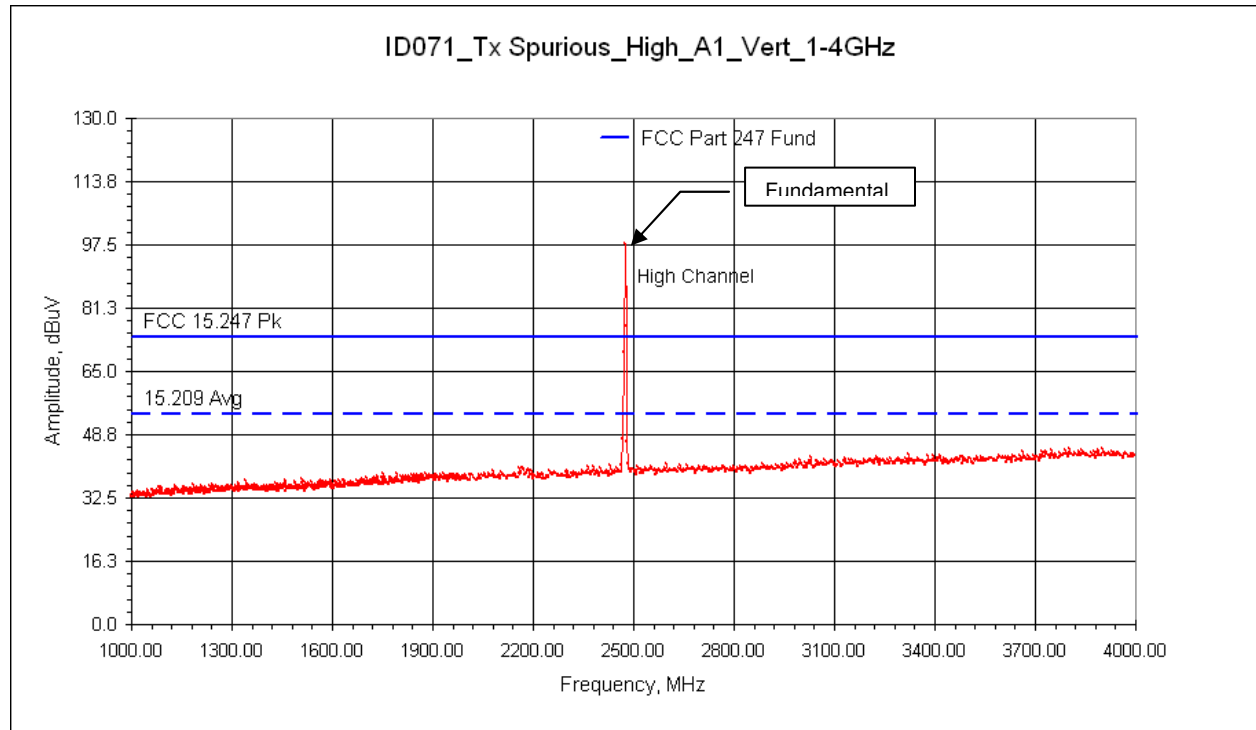
10.38 Pre-scan Plots: Unit 2 - High Channel

30MHz to 1000MHz



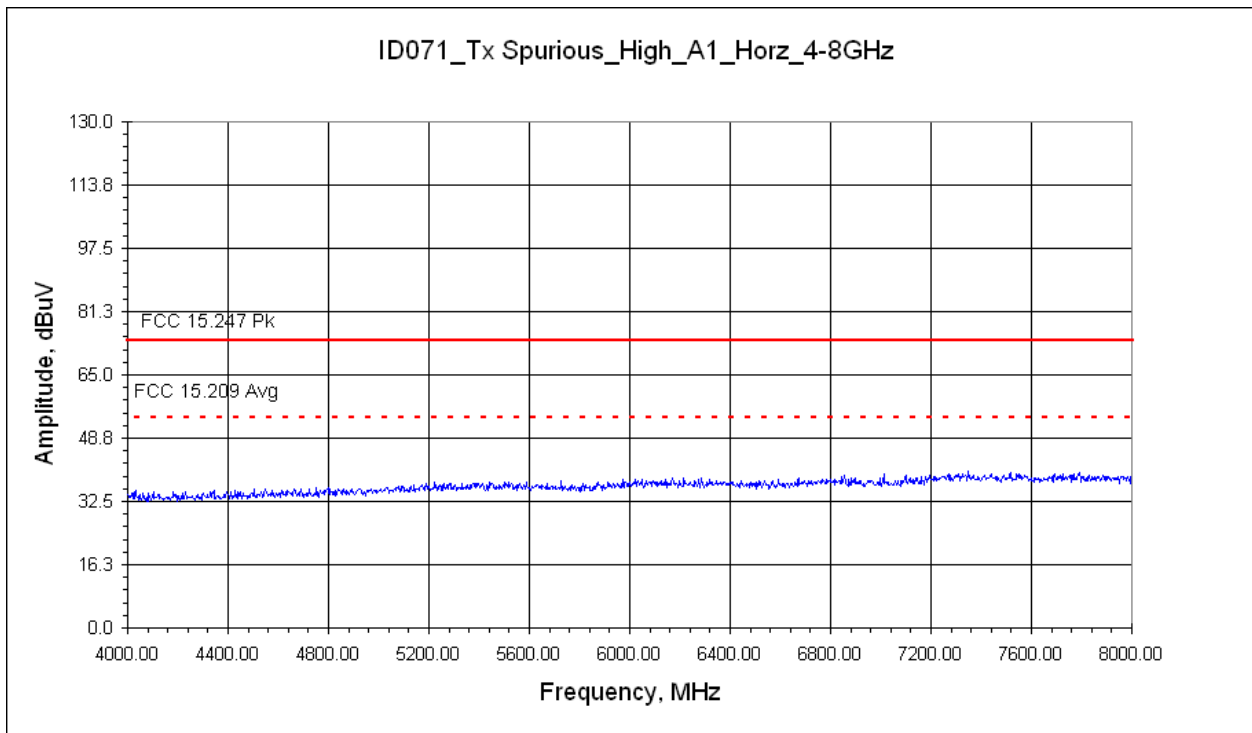
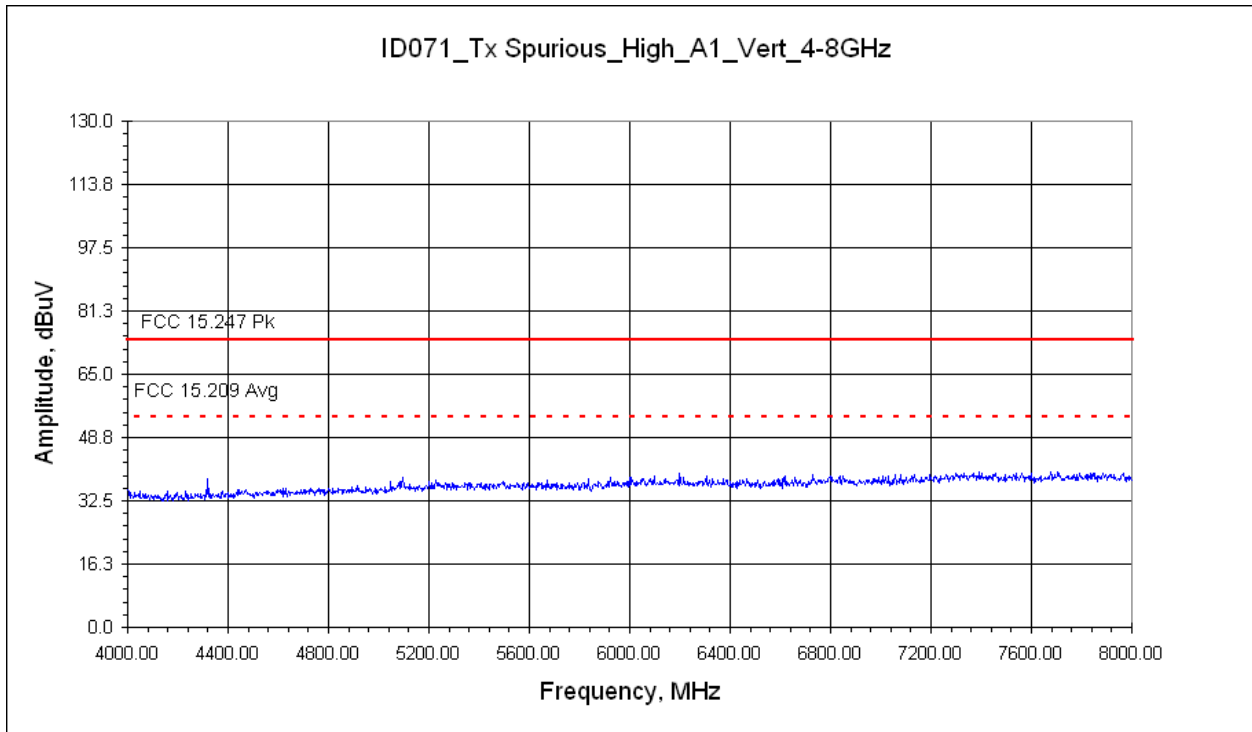
10.39 Pre-scan Plots: Unit 2 - High Channel

1GHz to 4GHz



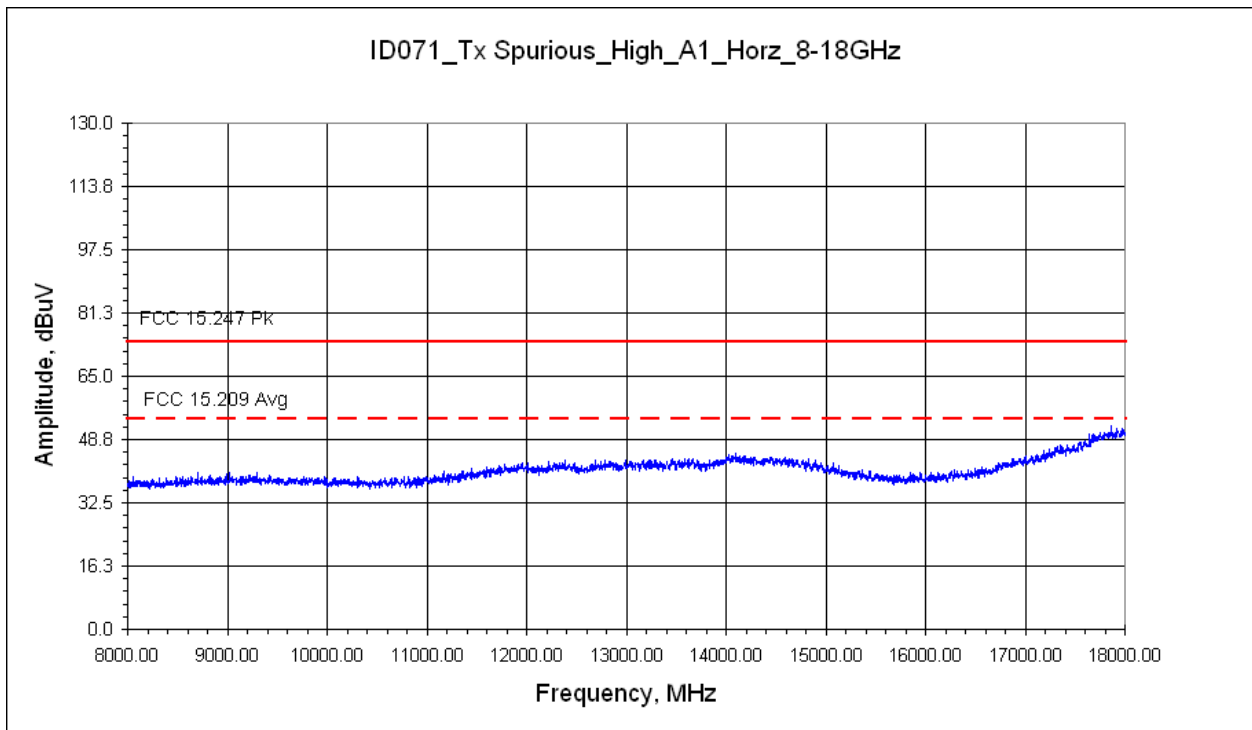
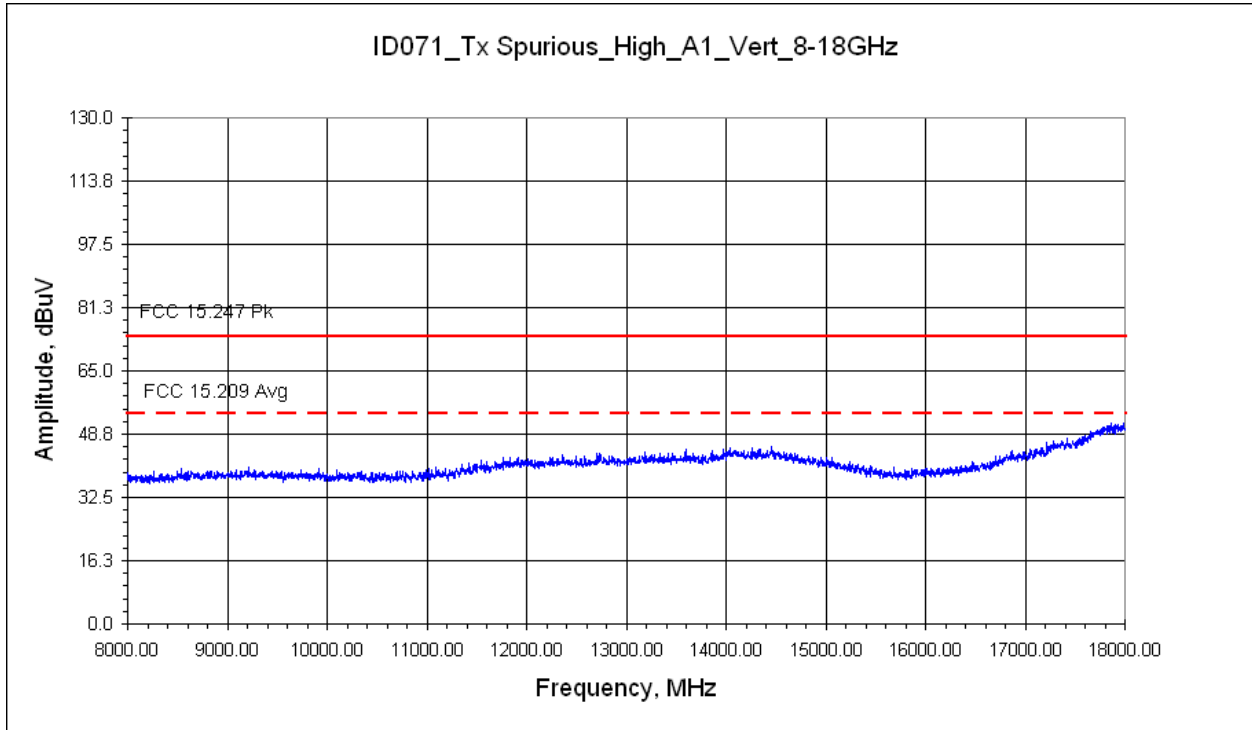
10.40 Pre-scan Plots: Unit 2 - High Channel

4GHz to 8GHz



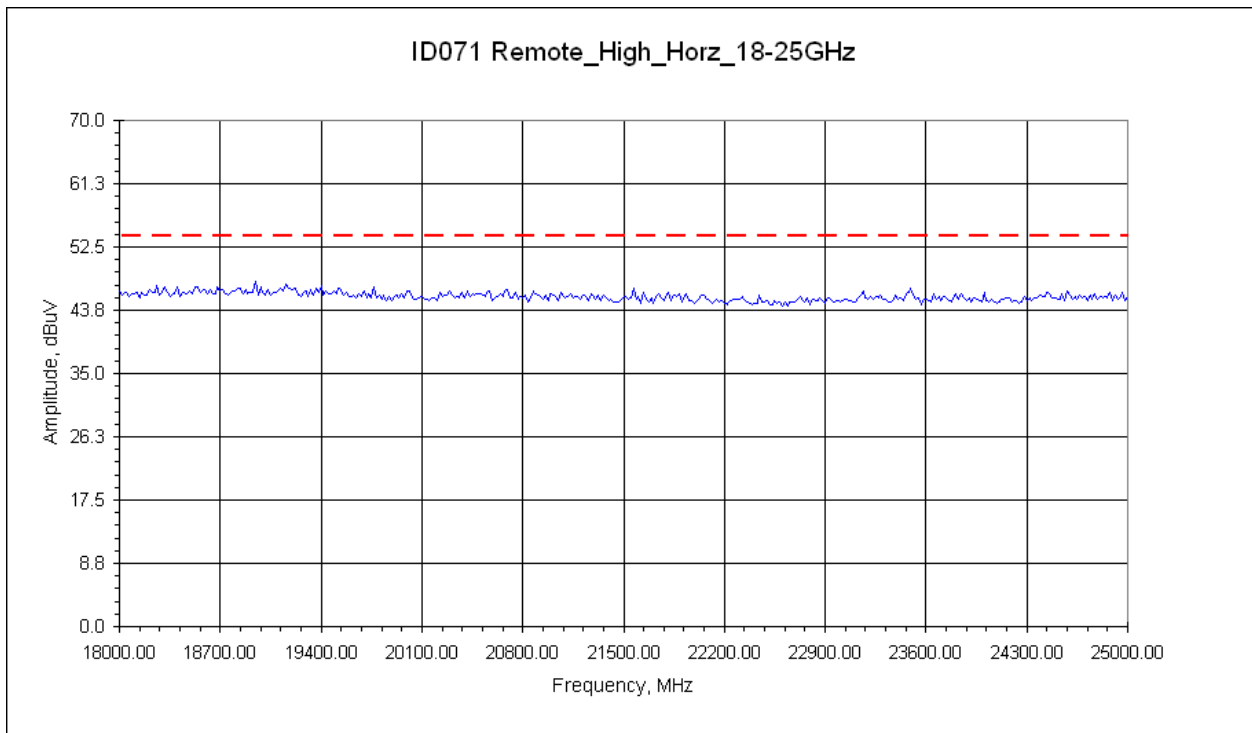
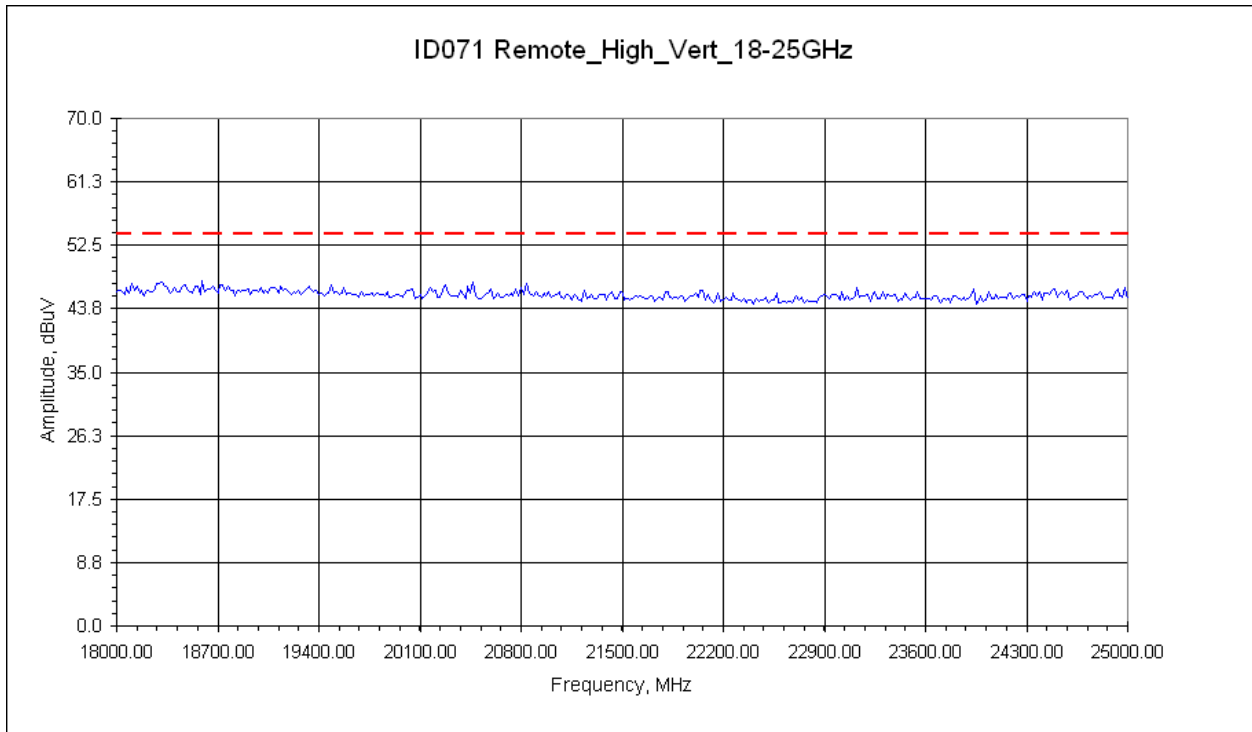
10.41 Pre-scan Plots: Unit 2 - High Channel

8GHz to 18GHz



10.42 Pre-scan Plots: Unit 2 - High Channel

18GHz to 25GHz



10.43 Test Data: Unit 1 Spurious Emissions – Harmonics in Restricted Bands

Radiated Electromagnetic Emissions

Test Report #: 101239952	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC Part 15.209 FCC Part 15.205	Test Date: <u>07/10/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: ID:071	EUT Power: <u>120VAC/60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: R1886469654 (Unit 1)		

Manufacturer: Echostar Technologies, LLC

EUT Description: MocA Thin Client

Notes: Tx Spurious Measurements - Harmonics of the Fundamental

FCC Restricted Band Harmonics

Level Key
Pk – Peak
Qp – Quasi Peak
Av - Average

FREQ	LEVEL	DET	CABLE	ANT	PREAMP	Atten	FINAL	Pol	Hgt	Az	Limit	Delta Limit	RBW
<u>MHz</u>	<u>dBuV</u>	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	[dB]	= [dBuV]	[V/H]	[m]	[Deg]	FCC 15.209 FCC 15.35(b) [dBuV/m]	[dB]	[MHz]
Harmonics of the Fundamental - Low Channel													
4850.0000	35.36	Av	5.18	32.95	38.88	0.43	35.04	H	1.59	265.0	54.00	-18.96	1.000
4850.0000	47.83	Pk	5.18	32.95	38.88	0.43	47.51	H	1.59	265.0	74.00	-26.49	1.000
7275.0000	33.74	Av	6.44	36.37	39.32	0.48	37.70	H	1.54	175.4	54.00	-16.30	1.000
7275.0000	45.93	Pk	6.44	36.37	39.32	0.48	49.89	H	1.54	175.4	74.00	-24.11	1.000
12125.0000	37.90	Av	8.77	39.09	45.43	0.00	40.33	H	1.36	28.0	54.00	-13.67	1.000
12125.0000	50.87	Pk	8.77	39.09	45.43	0.00	53.30	H	1.36	28.0	74.00	-20.70	1.000
19400.0000	1.95	Av	0.00	22.16	0.00	0.00	24.11	H	1.00	0.0	54.00	-29.89	1.000
19400.0000	30.09	Pk	0.00	22.16	0.00	0.00	52.25	H	1.00	0.0	74.00	-21.75	1.000
Harmonics of the Fundamental - Mid Channel													
4850.0000	34.30	Av	5.18	32.95	38.88	0.43	33.98	V	1.66	115.8	54.00	-20.02	1.000
4850.0000	46.96	Pk	5.18	32.95	38.88	0.43	46.64	V	1.66	115.8	74.00	-27.36	1.000
7275.0000	33.75	Av	6.44	36.37	39.32	0.48	37.71	V	1.71	0.0	54.00	-16.29	1.000
7275.0000	46.61	Pk	6.44	36.37	39.32	0.48	50.57	V	1.71	0.0	74.00	-23.43	1.000
12125.0000	37.90	Av	8.77	39.09	45.43	0.00	40.33	V	1.36	133.0	54.00	-13.67	1.000
12125.0000	51.94	Pk	8.77	39.09	45.43	0.00	54.37	V	1.36	133.0	74.00	-19.63	1.000
19600.0000	0.20	Av	0.00	22.16	0.00	0.00	22.36	V	1.00	0.0	54.00	-31.64	1.000
19600.0000	31.03	Pk	0.00	22.16	0.00	0.00	53.19	V	1.00	0.0	74.00	-20.81	1.000
4900.0000	34.58	Av	5.21	33.02	38.79	0.42	34.43	H	1.64	100.2	54.00	-19.57	1.000
4900.0000	46.66	Pk	5.21	33.02	38.79	0.42	46.51	H	1.64	100.2	74.00	-27.49	1.000
7350.0000	33.38	Av	6.48	36.60	39.16	0.48	37.79	H	1.42	133.6	54.00	-16.21	1.000
7350.0000	45.64	Pk	6.48	36.60	39.16	0.48	50.05	H	1.42	133.6	74.00	-23.95	1.000
12250.0000	38.05	Av	8.85	38.94	45.24	0.00	40.60	H	1.35	38.0	54.00	-13.40	1.000
12250.0000	50.04	Pk	8.85	38.94	45.24	0.00	52.59	H	1.35	38.0	74.00	-21.41	1.000
19600.0000	1.42	Av	0.00	22.00	0.00	0.00	23.42	H	1.00	0.0	54.00	-30.58	1.000
19600.0000	33.65	Pk	0.00	22.00	0.00	0.00	55.65	H	1.00	0.0	74.00	-18.35	1.000
22050.0000	0.87	Av	0.00	21.35	0.00	0.00	22.22	H	1.00	0.0	54.00	-31.78	1.000
22050.0000	30.45	Pk	0.00	21.35	0.00	0.00	51.80	H	1.00	0.0	74.00	-22.20	1.000

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4900.0000	34.09	Av	5.21	33.02	38.79	0.42	33.94	V	1.20	206.3	54.00	-20.06	1.000
4900.0000	46.26	Pk	5.21	33.02	38.79	0.42	46.11	V	1.20	206.3	74.00	-27.89	1.000
7350.0000	33.35	Av	6.48	36.60	39.16	0.48	37.76	V	1.66	170.2	54.00	-16.24	1.000
7350.0000	45.71	Pk	6.48	36.60	39.16	0.48	50.12	V	1.66	170.2	74.00	-23.88	1.000
12250.0000	37.98	Av	8.85	38.94	45.24	0.00	40.53	V	1.23	15.0	54.00	-13.47	1.000
12250.0000	50.28	Pk	8.85	38.94	45.24	0.00	52.83	V	1.23	15.0	74.00	-21.17	1.000
19600.0000	0.10	Av	0.00	22.00	0.00	0.00	22.10	V	1.00	0.0	54.00	-31.90	1.000
19600.0000	30.67	Pk	0.00	22.00	0.00	0.00	52.67	V	1.00	0.0	74.00	-21.33	1.000
22050.0000	-0.38	Av	0.00	21.35	0.00	0.00	20.97	V	1.00	0.0	54.00	-33.03	1.000
22050.0000	32.52	Pk	0.00	21.35	0.00	0.00	53.87	V	1.00	0.0	74.00	-20.13	1.000
Harmonics of the Fundamental - High Channel													
4950.0000	34.54	Av	5.24	33.14	38.71	0.40	34.61	H	1.79	89.9	54.00	-19.39	1.000
4950.0000	46.78	Pk	5.24	33.14	38.71	0.40	46.85	H	1.79	89.9	74.00	-27.15	1.000
7425.0000	33.49	Av	6.52	36.68	39.23	0.48	37.94	H	1.30	54.5	54.00	-16.06	1.000
7425.0000	45.51	Pk	6.52	36.68	39.23	0.48	49.96	H	1.30	54.5	74.00	-24.04	1.000
12375.0000	38.29	Av	8.92	38.86	45.04	0.00	41.02	H	1.45	114.0	54.00	-12.98	1.000
12375.0000	50.65	Pk	8.92	38.86	45.04	0.00	53.38	H	1.45	114.0	74.00	-20.62	1.000
19800.0000	1.98	Av	0.00	21.80	0.00	0.00	23.78	H	1.00	0.0	54.00	-30.22	1.000
19800.0000	29.63	Pk	0.00	21.80	0.00	0.00	51.43	H	1.00	0.0	74.00	-22.57	1.000
22275.0000	2.12	Av	0.00	21.12	0.00	0.00	23.24	H	1.00	0.0	54.00	-30.76	1.000
22275.0000	31.46	Pk	0.00	21.12	0.00	0.00	52.58	H	1.00	0.0	74.00	-21.42	1.000
4950.0000	34.34	Av	5.24	33.14	38.71	0.40	34.41	V	1.46	158.4	54.00	-19.59	1.000
4950.0000	46.62	Pk	5.24	33.14	38.71	0.40	46.69	V	1.46	158.4	74.00	-27.31	1.000
7425.0000	33.46	Av	6.52	36.68	39.23	0.48	37.91	V	1.16	78.2	54.00	-16.09	1.000
7425.0000	45.46	Pk	6.52	36.68	39.23	0.48	49.91	V	1.16	78.2	74.00	-24.09	1.000
12375.0000	38.39	Av	8.92	38.86	45.04	0.00	41.12	V	1.38	69.0	54.00	-12.88	1.000
12375.0000	50.83	Pk	8.92	38.86	45.04	0.00	53.56	V	1.38	69.0	74.00	-20.44	1.000
19800.0000	0.03	Av	0.00	21.80	0.00	0.00	21.83	V	1.00	0.0	54.00	-32.17	1.000
19800.0000	31.52	Pk	0.00	21.80	0.00	0.00	53.32	V	1.00	0.0	74.00	-20.68	1.000
22275.0000	-0.27	Av	0.00	21.12	0.00	0.00	20.85	V	1.00	0.0	54.00	-33.15	1.000
22275.0000	30.03	Pk	0.00	21.12	0.00	0.00	51.15	V	1.00	0.0	74.00	-22.85	1.000

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10.44 Test Data: Unit 2 Spurious Emissions – Harmonics in Restricted Bands

Radiated Electromagnetic Emissions

Test Report #: 101239952	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC Part 15.209 FCC Part 15.205	Test Date: <u>07/10/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: ID:071	EUT Power: <u>120VAC/60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: R1886470001 (Unit 2)		

Manufacturer: Echostar Technologies, LLC

EUT Description: MocA Thin Client

Notes: Tx Spurious Measurements - Harmonics of the Fundamental

FCC Restricted Band Harmonics

Level Key

Pk – Peak
Qp – Quasi Peak
Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Avg Limit 54dBuV	FCC 15.35(b) Pk Limit 74dBuV	(MHz)
Tx Spurious Measurements: Low Channel Harmonics 4-8GHz													
7425.0000	47.87	Pk	6.52	36.68	40.06	0.00	51.01	V	1.38	79.1	NA	- 22.99	1.000
7425.0000	33.48	Av	6.52	36.68	40.06	0.00	36.62	V	1.38	79.1	- 17.38	NA	1.000
4950.0000	47.76	Pk	5.24	33.14	39.18	0.00	46.95	V	1.25	100.8	NA	- 27.05	1.000
4950.0000	33.98	Av	5.24	33.14	39.18	0.00	33.17	V	1.25	100.8	- 20.83	NA	1.000
4950.0000	47.52	Pk	5.24	33.14	39.18	0.00	46.71	H	1.26	6.6	NA	- 27.29	1.000
4950.0000	34.15	Av	5.24	33.14	39.18	0.00	33.34	H	1.26	6.6	- 20.66	NA	1.000
7425.0000	47.00	Pk	6.52	36.68	40.06	0.00	50.14	H	1.33	119.0	NA	- 23.86	1.000
7425.0000	33.41	Av	6.52	36.68	40.06	0.00	36.55	H	1.33	119.0	- 17.45	NA	1.000
Tx Spurious Measurements: Low Channel Harmonics 8-18GHz													
12125.0000	51.31	Pk	8.77	39.09	45.43	0.00	53.74	V	1.24	15.9	NA	- 20.26	1.000
12125.0000	37.97	Av	8.77	39.09	45.43	0.00	40.40	V	1.24	15.9	- 13.60	NA	1.000
12125.0000	51.94	Pk	8.77	39.09	45.43	0.00	54.37	H	1.20	35.4	NA	- 19.63	1.000
12125.0000	37.98	Av	8.77	39.09	45.43	0.00	40.41	H	1.20	35.4	- 13.59	NA	1.000
Tx Spurious Measurements: Mid Channel Harmonics 4-8GHz													
4900.0000	41.41	Pk	5.21	33.02	39.22	0.00	40.42	V	1.38	324.2	NA	- 33.58	1.000
4900.0000	27.45	Av	5.21	33.02	39.22	0.00	26.46	V	1.38	324.2	- 27.54	NA	1.000
7350.0000	41.58	Pk	6.48	36.60	40.06	0.00	44.60	V	1.22	60.1	NA	- 29.40	1.000
7350.0000	27.53	Av	6.48	36.60	40.06	0.00	30.55	V	1.22	60.1	- 23.45	NA	1.000
7350.0000	41.05	Pk	6.48	36.60	40.06	0.00	44.07	H	1.30	109.8	NA	- 29.93	1.000
7350.0000	27.53	Av	6.48	36.60	40.06	0.00	30.55	H	1.30	109.8	- 23.45	NA	1.000
4900.0000	41.23	Pk	5.21	33.02	39.22	0.00	40.24	H	1.46	19.5	NA	- 33.76	1.000
4900.0000	27.44	Av	5.21	33.02	39.22	0.00	26.45	H	1.46	19.5	- 27.55	NA	1.000

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Tx Spurious Measurements: Mid Channel Harmonics 8-18GHz													
12250.0000	51.49	Pk	8.85	38.94	45.24	0.00	54.04	H	1.19	41.0	NA	- 19.96	1.000
12250.0000	38.16	Av	8.85	38.94	45.24	0.00	40.71	H	1.19	41.0	- 13.29	NA	1.000
12250.0000	51.63	Pk	8.85	38.94	45.24	0.00	54.18	V	1.09	25.1	NA	- 19.82	1.000
12250.0000	38.17	Av	8.85	38.94	45.24	0.00	40.72	V	1.09	25.1	- 13.28	NA	1.000
Tx Spurious Measurements: High Channel Harmonics 4-8GHz													
4950.0000	48.61	Pk	5.24	33.14	39.18	0.00	47.80	H	1.48	134.1	NA	- 26.20	1.000
4950.0000	34.31	Av	5.24	33.14	39.18	0.00	33.50	H	1.48	134.1	- 20.50	NA	1.000
7425.0000	47.09	Pk	6.52	36.68	40.06	0.00	50.23	H	1.42	50.5	NA	- 23.77	1.000
7425.0000	33.45	Av	6.52	36.68	40.06	0.00	36.59	H	1.42	50.5	- 17.41	NA	1.000
7425.0000	47.58	Pk	6.52	36.68	40.06	0.00	50.72	V	1.43	62.1	NA	- 23.28	1.000
7425.0000	33.48	Av	6.52	36.68	40.06	0.00	36.62	V	1.43	62.1	- 17.38	NA	1.000
4950.0000	47.66	Pk	5.24	33.14	39.18	0.00	46.85	V	1.43	105.3	NA	- 27.15	1.000
4950.0000	34.17	Av	5.24	33.14	39.18	0.00	33.36	V	1.43	105.3	- 20.64	NA	1.000
Tx Spurious Measurements: High Channel Harmonics 8-18GHz													
12375.0000	51.80	Pk	8.92	38.86	45.04	0.00	54.53	H	1.23	21.7	NA	- 19.47	1.000
12375.0000	38.41	Av	8.92	38.86	45.04	0.00	41.14	H	1.23	21.7	- 12.86	NA	1.000
12375.0000	52.06	Pk	8.92	38.86	45.04	0.00	54.79	V	1.22	22.5	NA	- 19.21	1.000
12375.0000	38.41	Av	8.92	38.86	45.04	0.00	41.14	V	1.22	22.5	- 12.86	NA	1.000

Reference Only – FCC Restricted Band Harmonics

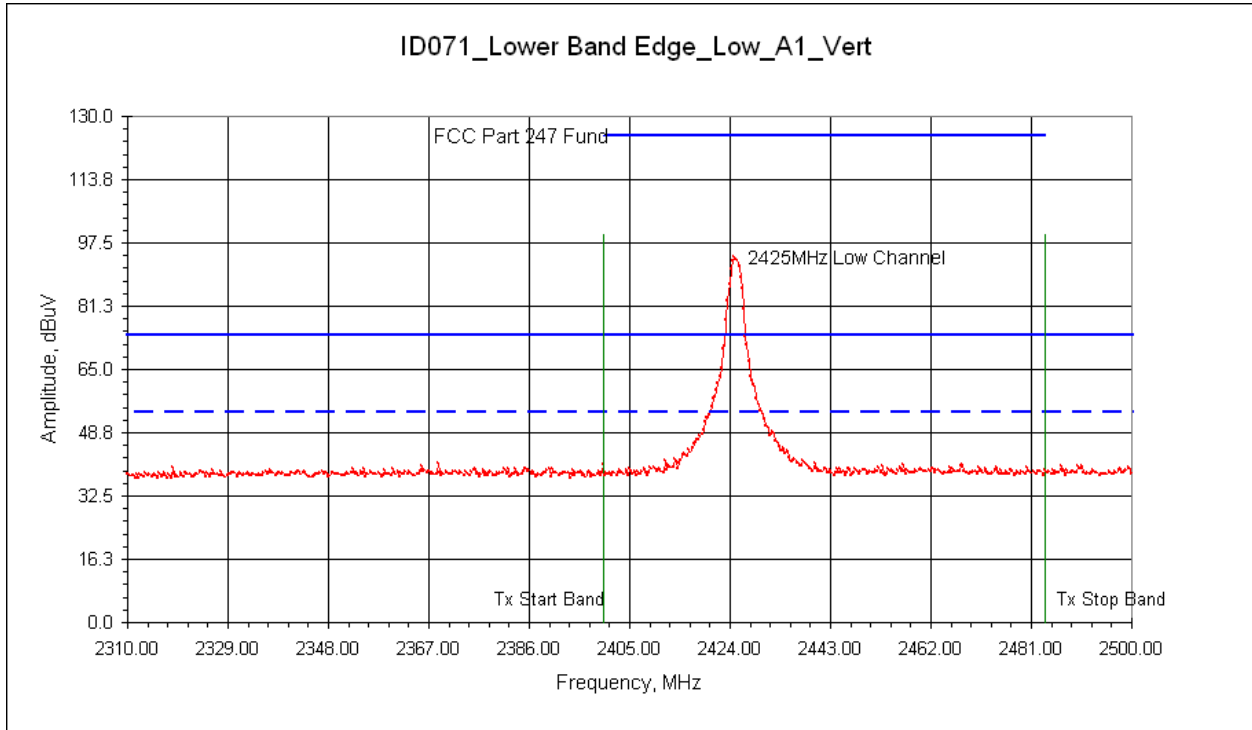
fundamental

Harmonics

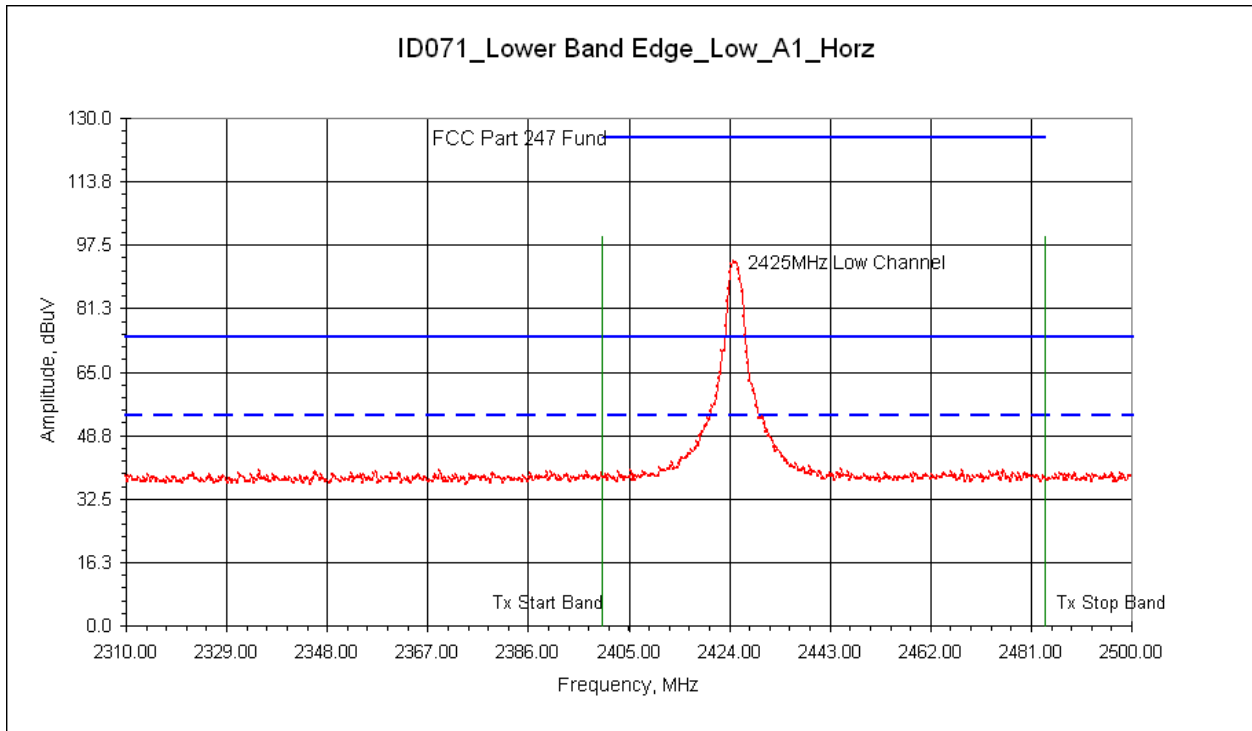
MHz0	MHz1	MHz2	MHz3	MHz4	MHz5	MHz6	MHz7	MHz8	MHz9	MHz10
2425	2425.00	4850.00	7275.00	9700.00	12125.00	14550.00	16975.00	19400.00	21825.00	24250.00
2450	2450.00	4900.00	7350.00	9800.00	12250.00	14700.00	17150.00	19600.00	22050.00	24500.00
2475	2475.00	4950.00	7425.00	9900.00	12375.00	14850.00	17325.00	19800.00	22275.00	24750.00

10.45 Plots: Unit 1 Low Band Edge

Vertical



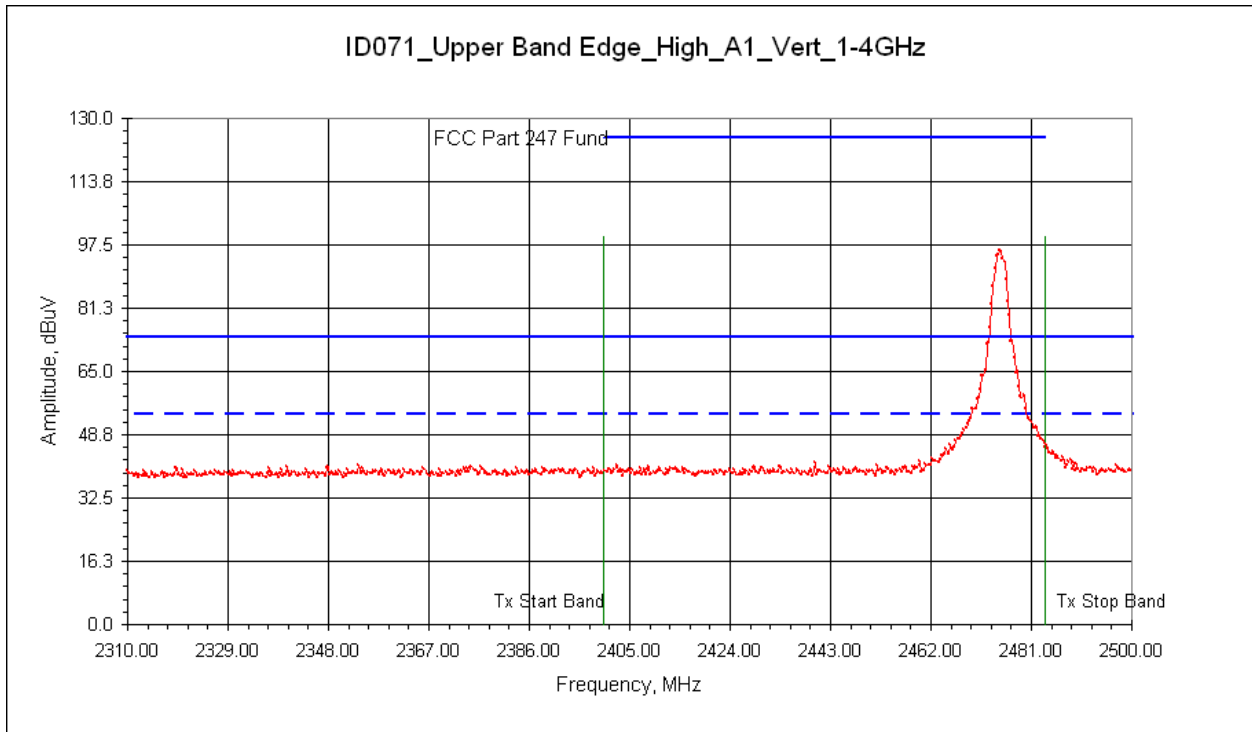
Horizontal



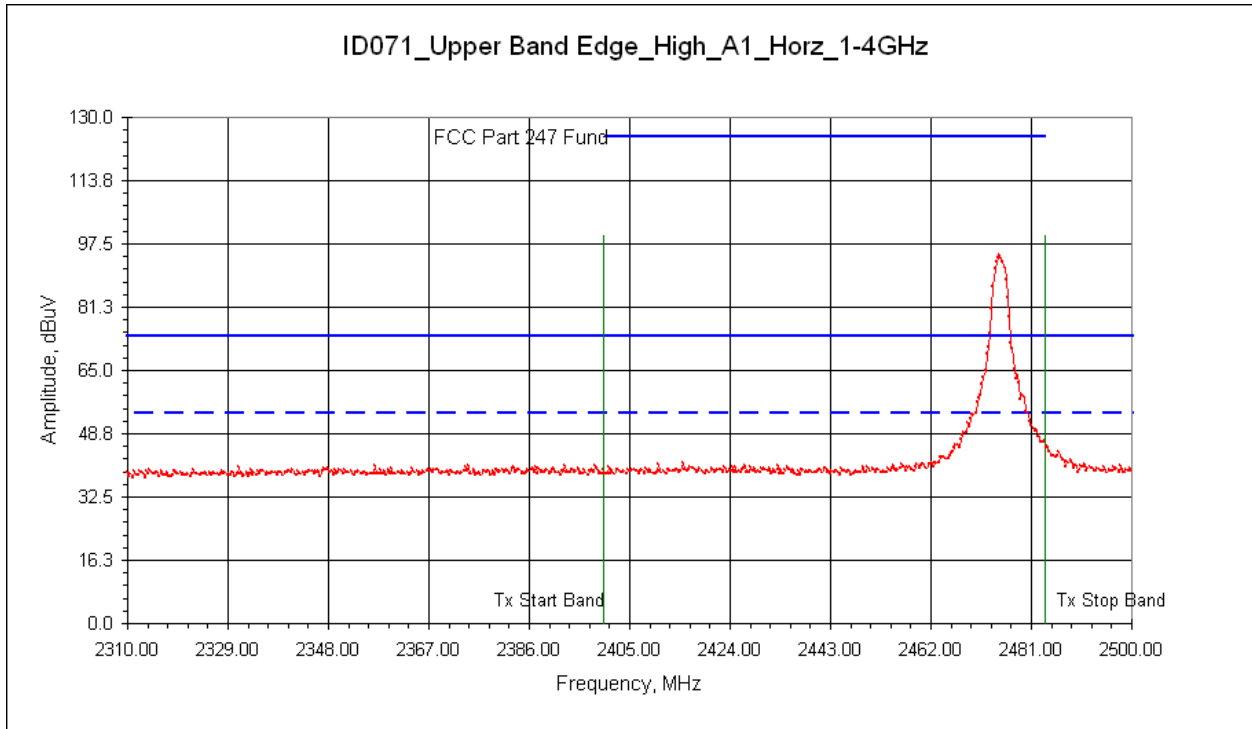
Note: Peak detector trace referenced to average & peak limits

Plots: Unit 1 Upper Band Edge

Vertical



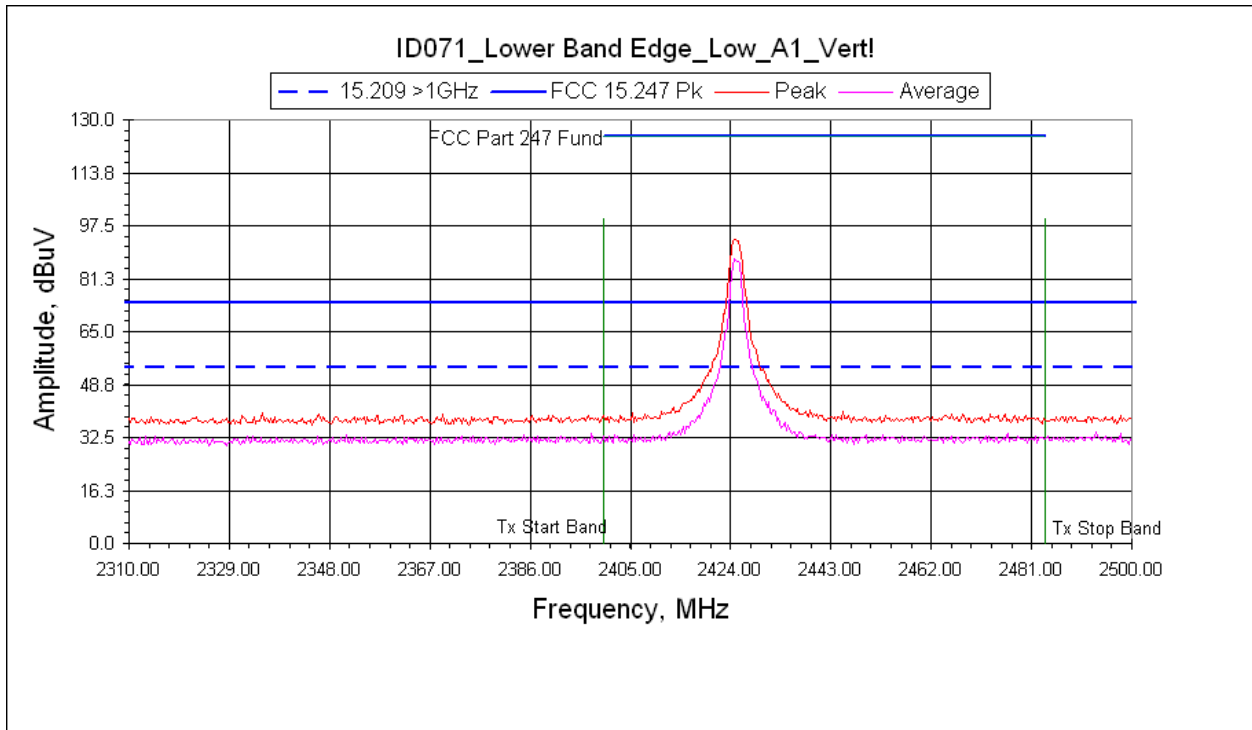
Horizontal



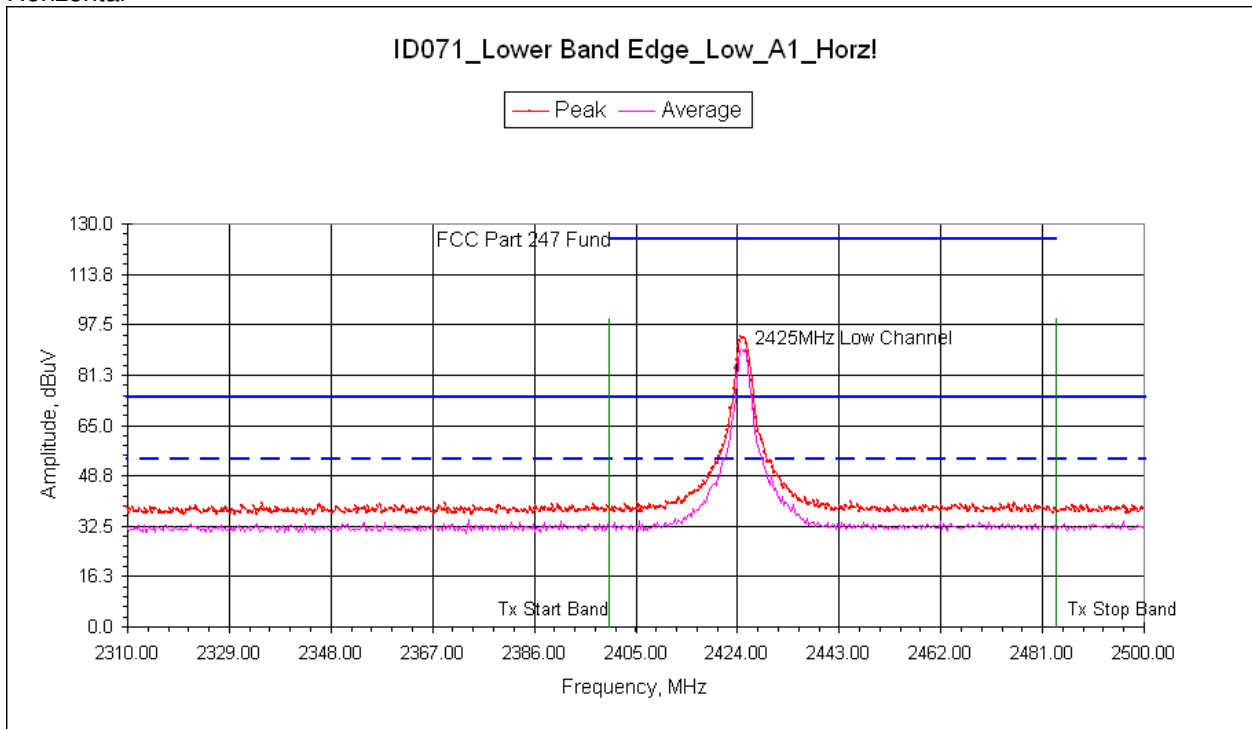
Note: Peak detector trace referenced to average & peak limits

10.46 Plots: Unit 2 Lower Band Edge

Vertical



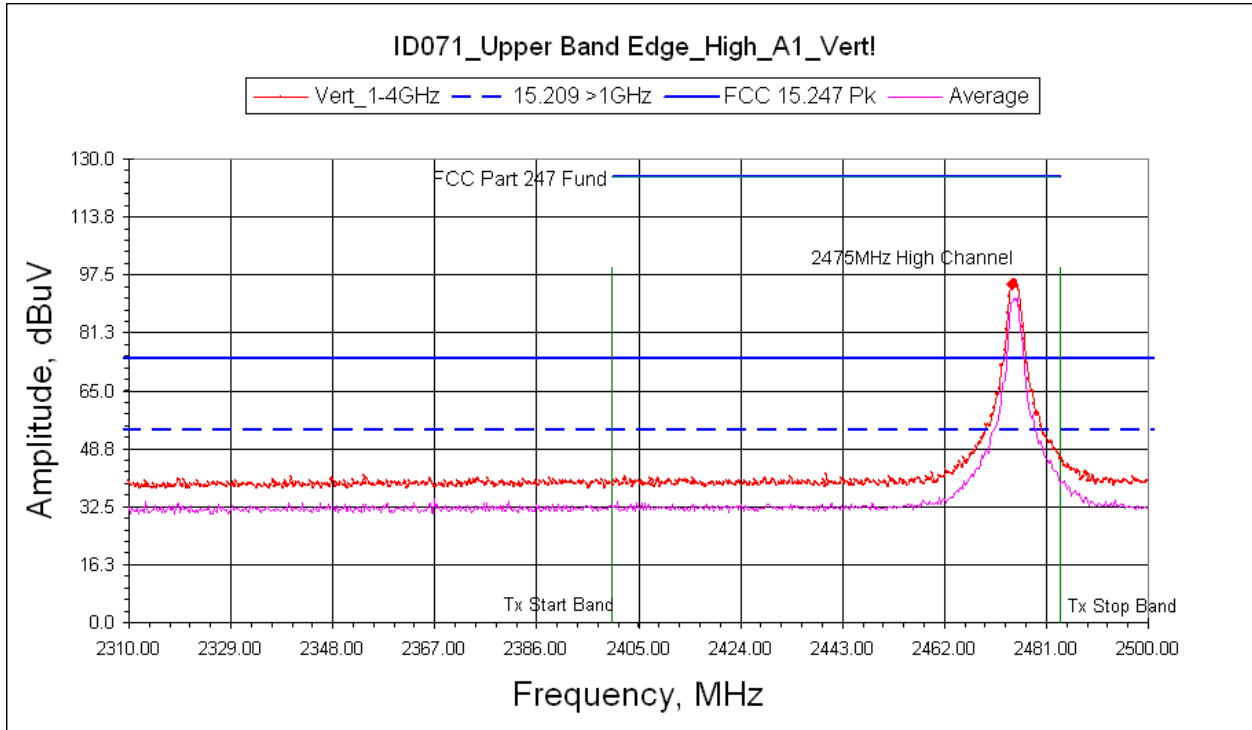
Horizontal



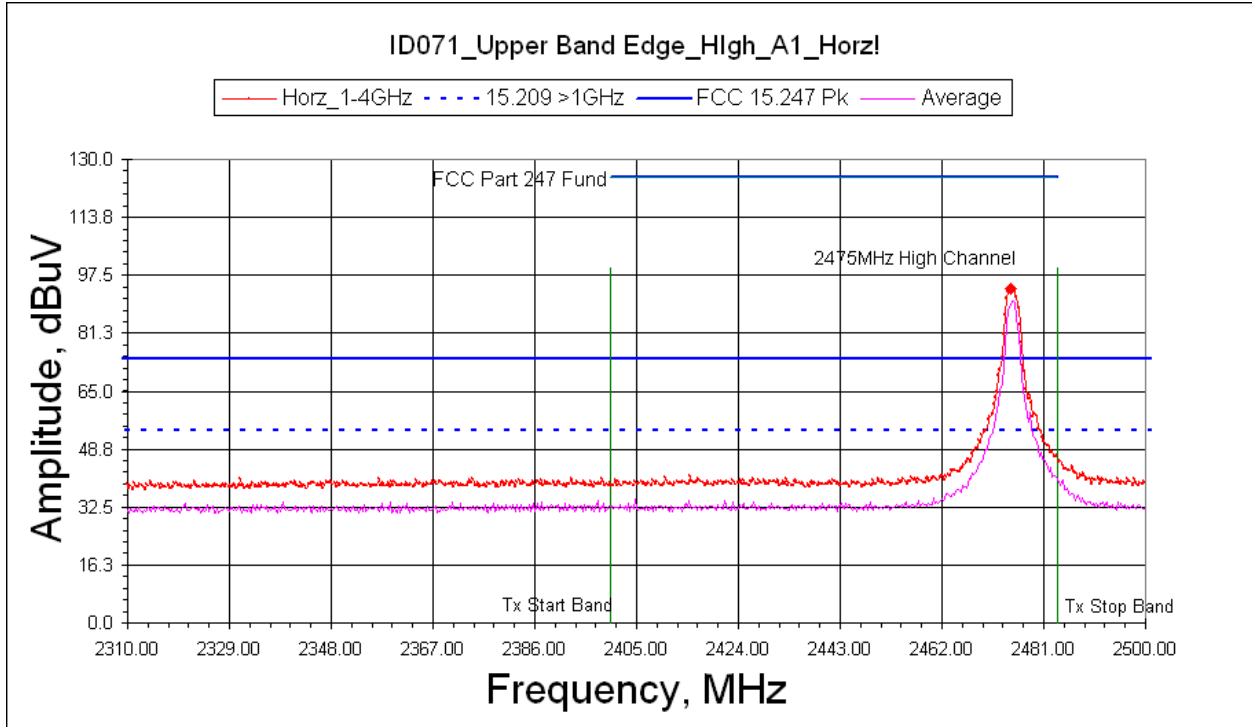
Note: Peak & Average detector traces referenced to average & peak limits

10.47 Plots: Unit 2 Upper Band Edge

Vertical



Horizontal



Note: Peak & Average detector traces referenced to average & peak limits

Intertek

Report Number: 101239952DEN-001

Issued:8/29/2013

10.48 Test Data: Unit 1 Radiated Tx Spurious - Band Edge

Radiated Electromagnetic Emissions

Test Report #: 101239952	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC Part 15.209 FCC Part 15.35(b)	Test Date: <u>07/10/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: ID:071	EUT Power: <u>120VAC/60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: R1886469654 (Unit 1)		

Manufacturer: Echostar Technologies, LLC	Level Key
EUT Description: MocA Thin Client	Pk – Peak
Notes: Tx Spurious Measurements - Non Harmonics of the Fundamental	Qp – Quasi Peak
Includes Restricted Band Edge Measurements	Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Avg Limit	FCC 15.35(b) Pk Limit 74dBuV	(MHz)
Tx Spurious Measurements: 30MHz to 1000MHz Vertical Antenna													
136.5000	40.45	Qp	0.79	13.05	27.79	0.00	26.51	V	1.00	275.0	- 17.01	NA	0.120
167.7186	44.96	Qp	0.87	12.33	27.64	0.00	30.52	V	1.00	286.0	- 13.00	NA	0.120
662.5545	44.05	Qp	1.80	19.65	28.30	0.00	37.19	V	1.00	267.0	- 8.83	NA	0.120
665.5545	32.70	Qp	1.80	19.59	28.30	0.00	25.79	V	1.34	320.0	- 20.23	NA	0.120
666.9968	51.23	Qp	1.80	19.56	28.30	0.00	44.30	V	1.40	221.0	- 1.72	NA	0.120
Tx Spurious Measurements: 30MHz to 1000MHz Horizontal Antenna													
499.6795	35.78	Qp	1.53	17.70	28.30	0.00	26.71	H	2.28	196.0	- 19.31	NA	0.120
666.0000	36.97	Qp	1.80	19.58	28.30	0.00	30.05	H	2.21	27.0	- 15.97	NA	0.120
667.0417	49.39	Qp	1.80	19.56	28.30	0.00	42.45	H	2.21	207.0	- 3.57	NA	0.120
670.0064	42.45	Qp	1.81	19.50	28.30	0.00	35.46	H	1.91	343.0	- 10.56	NA	0.120
821.7404	32.49	Qp	2.00	21.20	27.89	0.00	27.80	H	1.28	236.0	- 18.22	NA	0.120
997.3814	34.30	Qp	2.21	22.75	27.33	0.00	31.94	H	1.20	78.0	- 22.04	NA	0.120
Tx Spurious Measurements – Low Channel: Above 1GHz													
2000.0000	35.78	Av	3.19	27.34	37.06	0.00	29.26	V	1.73	205.7	- 24.74	NA	1.000
2000.0000	52.06	Pk	3.19	27.34	37.06	0.00	45.54	V	1.73	205.7	NA	- 28.46	1.000
3335.0000	42.04	Av	4.24	31.09	36.86	0.00	40.51	V	1.72	228.1	- 13.49	NA	1.000
3335.0000	57.89	Pk	4.24	31.09	36.86	0.00	56.36	V	1.72	228.1	NA	- 17.64	1.000
2001.0000	46.87	Av	3.19	27.35	37.06	0.00	40.35	H	1.71	120.7	- 13.65	NA	1.000
2001.0000	64.84	Pk	3.19	27.35	37.06	0.00	58.32	H	1.71	120.7	NA	- 15.68	1.000
3335.0000	45.26	Av	4.24	31.09	36.86	0.00	43.73	H	1.72	177.1	- 10.27	NA	1.000
3335.0000	62.54	Pk	4.24	31.09	36.86	0.00	61.01	H	1.72	177.1	NA	- 12.99	1.000
Tx Spurious Measurements – Mid Channel: Above 1GHz													
2001.0000	43.54	Av	3.19	27.35	37.06	0.00	37.02	V	1.73	0.0	- 16.98	NA	1.000
2001.0000	65.77	Pk	3.19	27.35	37.06	0.00	59.25	V	1.73	0.0	NA	- 14.75	1.000
3335.0000	41.18	Av	4.24	31.09	36.86	0.00	39.65	V	1.74	131.2	- 14.35	NA	1.000

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3335.0000	56.87	Pk	4.24	31.09	36.86	0.00	55.34	V	1.74	131.2	NA	- 18.66	1.000
2001.0000	46.51	Av	3.19	27.35	37.06	0.00	39.99	H	1.67	112.5	- 14.01	NA	1.000
2001.0000	66.92	Pk	3.19	27.35	37.06	0.00	60.40	H	1.67	112.5	NA	- 13.60	1.000
3335.0000	42.98	Av	4.24	31.09	36.86	0.00	41.45	H	1.74	131.2	- 12.55	NA	1.000
3335.0000	61.14	Pk	4.24	31.09	36.86	0.00	59.61	H	1.74	131.2	NA	- 14.39	1.000
Tx Spurious Measurements – High Channel: Above 1GHz													
3335.0000	44.29	Av	4.24	31.09	36.86	0.00	42.76	V	1.62	194.3	- 11.24	NA	1.000
3335.0000	56.36	Pk	4.24	31.09	36.86	0.00	54.83	V	1.62	194.3	NA	- 19.17	1.000
3335.0000	41.18	Av	4.24	31.09	36.86	0.00	39.65	V	1.74	131.2	- 14.35	NA	1.000
3335.0000	56.87	Pk	4.24	31.09	36.86	0.00	55.34	V	1.74	131.2	NA	- 18.66	1.000
2001.0000	47.61	Av	3.19	27.35	37.06	0.00	41.09	H	1.38	80.5	- 12.91	NA	1.000
2001.0000	66.97	Pk	3.19	27.35	37.06	0.00	60.45	H	1.38	80.5	NA	- 13.55	1.000
3335.0000	44.80	Av	4.24	31.09	36.86	0.00	43.27	H	1.34	169.4	- 10.73	NA	1.000
3335.0000	62.08	Pk	4.24	31.09	36.86	0.00	60.55	H	1.34	169.4	NA	- 13.45	1.000
Tx Spurious Measurements – Lower Band Edge													
2390.0000	47.82	Pk	3.50	28.51	37.57	5.75	48.02	H	1.06	267.0	NA	- 25.98	1.000
2390.0000	36.50	Av	3.50	28.51	37.57	5.75	35.70	H	1.06	267.0	- 18.30	NA	1.000
2400.0000	49.03	Pk	3.51	28.58	37.58	5.75	49.29	H	1.03	262.0	NA	- 24.71	1.000
2400.0000	35.13	Av	3.51	28.58	37.58	5.75	35.39	H	1.03	262.0	- 18.61	NA	1.000
Tx Spurious Measurements – Upper Band Edge													
2483.5000	53.13	Pk	3.58	28.69	37.67	5.75	53.48	H	1.00	276.0	NA	- 20.52	1.000
2483.5000	43.13	Av	3.58	28.69	37.67	5.75	43.29	H	1.00	276.0	- 10.72	NA	1.000
2483.5000	56.81	Pk	3.58	28.69	37.67	5.75	57.16	V	2.38	85.0	NA	- 16.84	1.000
2483.5000	45.84	Av	3.58	28.69	37.67	5.75	46.16	V	2.38	85.0	- 7.84	NA	1.000

Intertek

Report Number: 101239952DEN-001

Issued:8/29/2013

10.49 Test Data: Unit 2 Radiated Tx Spurious - Band Edge

Radiated Electromagnetic Emissions

Test Report #: 101239952	Test Area: CC1 Radiated	Temperature: <u>23.4</u> °C
Test Method: FCC Part 15.209 FCC Part 15.35(b)	Test Date: 08/26/2013 08/27/2013	Relative Humidity: <u>33.5</u> %
EUT Model #: ID:071	EUT Power: <u>120VAC/60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: R1886470001 (Unit 2)		

Manufacturer: Echostar Technologies, LLC	Level Key
EUT Description: Moca Thin Client	Pk – Peak
Notes: Tx Spurious Measurements - Non Harmonics of the Fundamental : Including Band Edge Measurements	Qp – Quasi Peak
	Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 Avg Limit	FCC 15.35(b) Pk Limit 74dBuV	(MHz)
Tx Spurious Measurements: 30MHz to 1000MHz Vertical Antenna													
81.0017	50.45	Qp	0.77	7.60	28.14	0.00	30.68	V	1.00	158.9	- 9.32	N/A	0.120
108.0027	42.21	Qp	0.77	12.50	28.04	0.00	27.44	V	1.00	19.6	- 16.08	N/A	0.120
184.0000	40.97	Qp	0.91	11.30	27.64	0.00	25.53	V	1.00	278.5	- 17.99	N/A	0.120
723.8000	43.41	Qp	1.88	20.40	28.37	0.00	37.32	V	1.00	195.2	- 8.70	N/A	0.120
803.3653	38.73	Qp	1.98	21.33	28.11	0.00	33.93	V	1.35	271.1	- 12.09	N/A	0.120
891.0058	44.80	Qp	2.08	22.04	27.84	0.00	41.08	V	1.33	22.0	- 4.94	N/A	0.120
972.0000	38.65	Qp	2.18	22.64	27.65	0.00	35.82	V	1.24	338.6	- 18.16	N/A	0.120
723.5000	48.23	Qp	1.88	20.40	28.37	0.00	42.14	V	1.00	274.4	- 3.88	N/A	0.120
Tx Spurious Measurements: 30MHz to 1000MHz Horizontal Antenna													
243.0085	44.90	Qp	1.05	11.90	27.40	0.00	30.45	H	2.20	200.6	- 15.57	N/A	0.120
324.0000	42.32	Qp	1.24	14.38	27.37	0.00	30.57	H	2.16	64.1	- 15.45	N/A	0.120
726.1250	44.34	Qp	1.88	20.40	28.36	0.00	38.26	H	2.35	183.8	- 7.76	N/A	0.120
912.0000	37.43	Qp	2.11	22.40	27.79	0.00	34.14	H	2.27	80.8	- 11.88	N/A	0.120
Tx Spurious Measurements - Lower Band Edge													
2390.0000	48.82	Pk	3.50	28.51	37.57	5.75	49.02	H	1.06	267.0	NA	- 24.98	1.000
2390.0000	35.00	Av	3.50	28.51	37.57	5.75	35.20	H	1.06	267.0	- 18.80	NA	1.000
2400.0000	49.03	Pk	3.51	28.58	37.58	5.75	49.29	H	1.03	262.0	NA	- 24.71	1.000
2400.0000	35.13	Av	3.51	28.58	37.58	5.75	35.39	H	1.03	262.0	- 18.61	NA	1.000
Tx Spurious Measurements - Upper Band Edge													
2483.5000	54.33	Pk	3.58	28.69	37.67	5.75	54.68	H	1.00	276.0	NA	- 19.32	1.000
2483.5000	42.63	Av	3.58	28.69	37.67	5.75	42.98	H	1.00	276.0	- 11.02	NA	1.000
2483.5000	55.81	Pk	3.58	28.69	37.67	5.75	56.16	V	2.38	85.0	NA	- 17.84	1.000
2483.5000	44.94	Av	3.58	28.69	37.67	5.75	45.29	V	2.38	85.0	- 8.71	NA	1.000
2483.5000	54.33	Pk	3.58	28.69	37.67	5.75	54.68	H	1.00	276.0	NA	- 19.32	1.000

Note: No significant signals found above 4GHz – refer to pre-scan plots.

10.50 Test Notes:

- 1) Measurements were taken using worst-case modulated (minimum bandwidth/maximum amplitude) mode, using worst-case data packet length.
- 2) All measurements Radiated Field Strength Emissions.

Deviations, Additions, or Exclusions: None

11 Power Spectral Density (PSD)

11.1 Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247.

- FCC 558074 D01 DTS Measurement Guidance: 2013, Section 10.0, Option 10.2 (Peak PSD)
- ANSI C63.10:2009, Section 6.11.2.3

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

11.2 Test Requirement/Specification:

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any $3\text{ kHz} \leq \text{RBW} \leq 100\text{kHz}$ band during any time interval of continuous transmission. The same method of determining the conducted output power shall be used to determine the power spectral density.

- FCC 15.247(e)

11.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18906	RF Pre-Amp (1-4GHz) with attenuator	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

11.4 Results:

The sample tested was found to comply.

11.5 Results Summary:

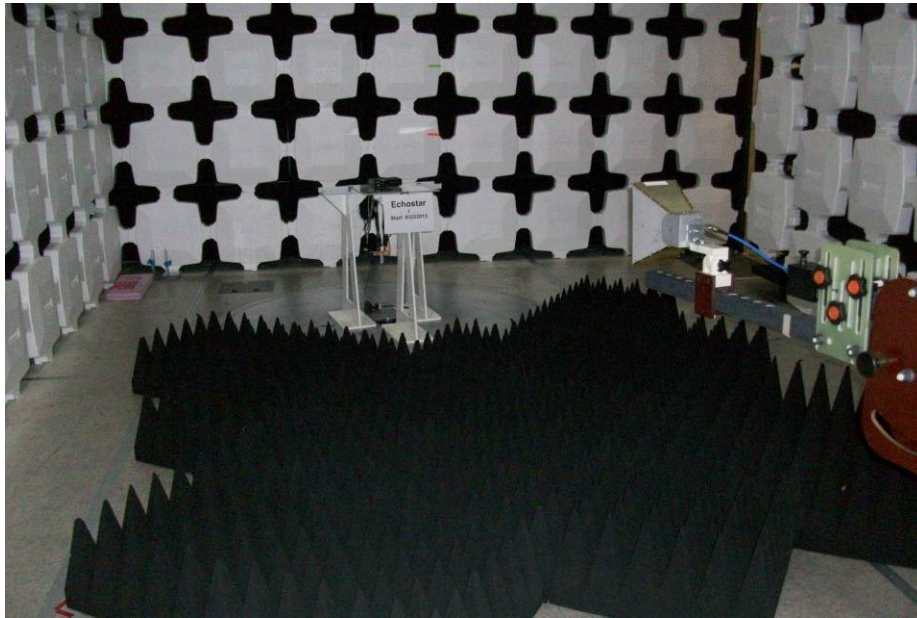
Power Spectral Density (PSD) Summary - Unit 1	
Channel/ Mode	PSD
Low	-15.00 dBm
Mid	-15.32 dBm
High	-15.68 dBm

Power Spectral Density (PSD) Summary – Unit 2	
Channel/ Mode	PSD
Low	-23.23 dBm
Mid	-22.65 dBm
High	-23.40 dBm

Specification: PSD per (3kHz ≤ RBW ≤ 100kHz) less than +8dBm

11.6 Test Setup Photographs:

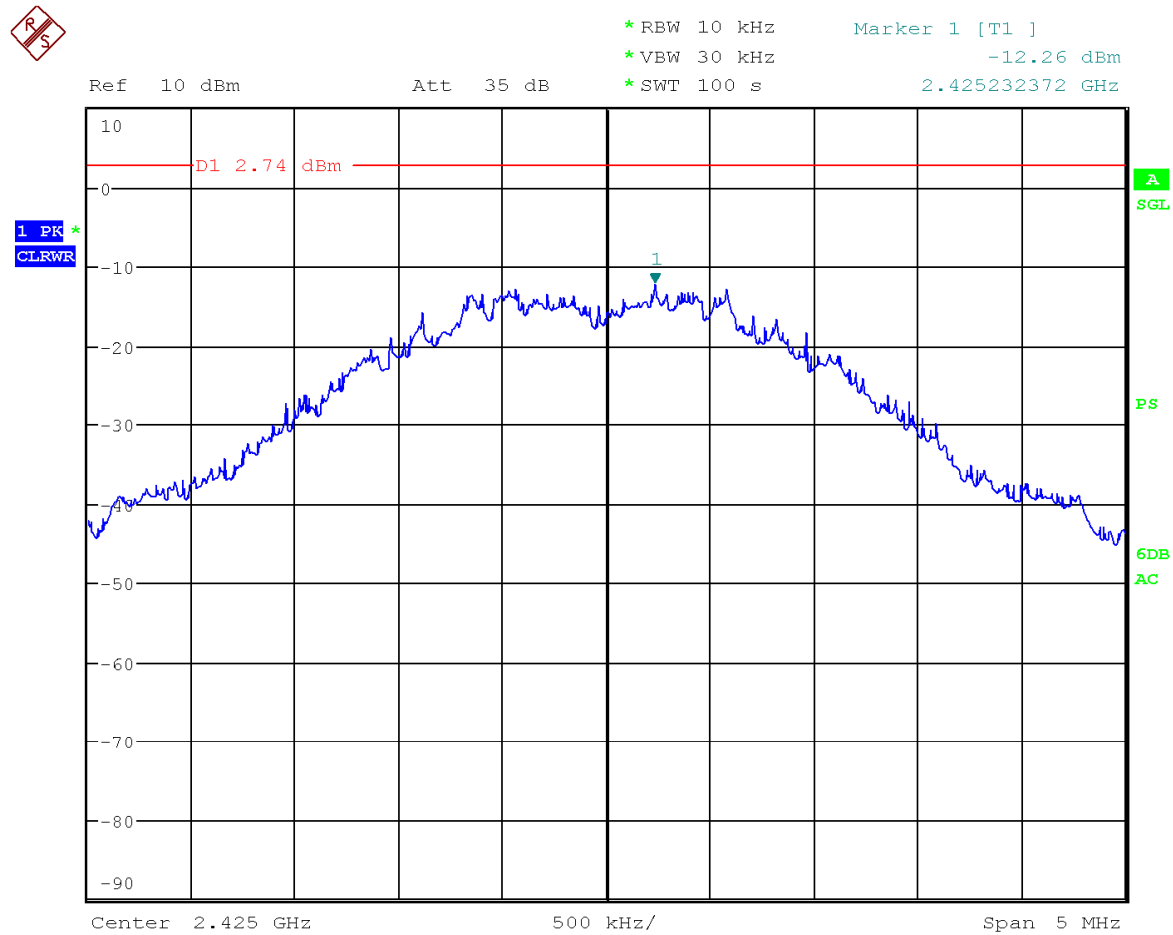
Test Setup - PSD



11.7 Test Data: PSD – Unit 1

**Power Spectral Density (PSD) – Model ID:071
FCC 15.247(e)**

Low Channel – 2425 MHz



Date: 12.JUL.2013 11:40:21

Specification: PSD < +8 dBm

Note: The above measurement is a “raw” spectrum analyzer reading - not corrected. The display line is corrected for all cable, antenna and pre-amp factors. Therefore, the delta between the raw analyzer reading and the adjusted display (limit) line is the actual delta from the +8 dBm PSD limit.

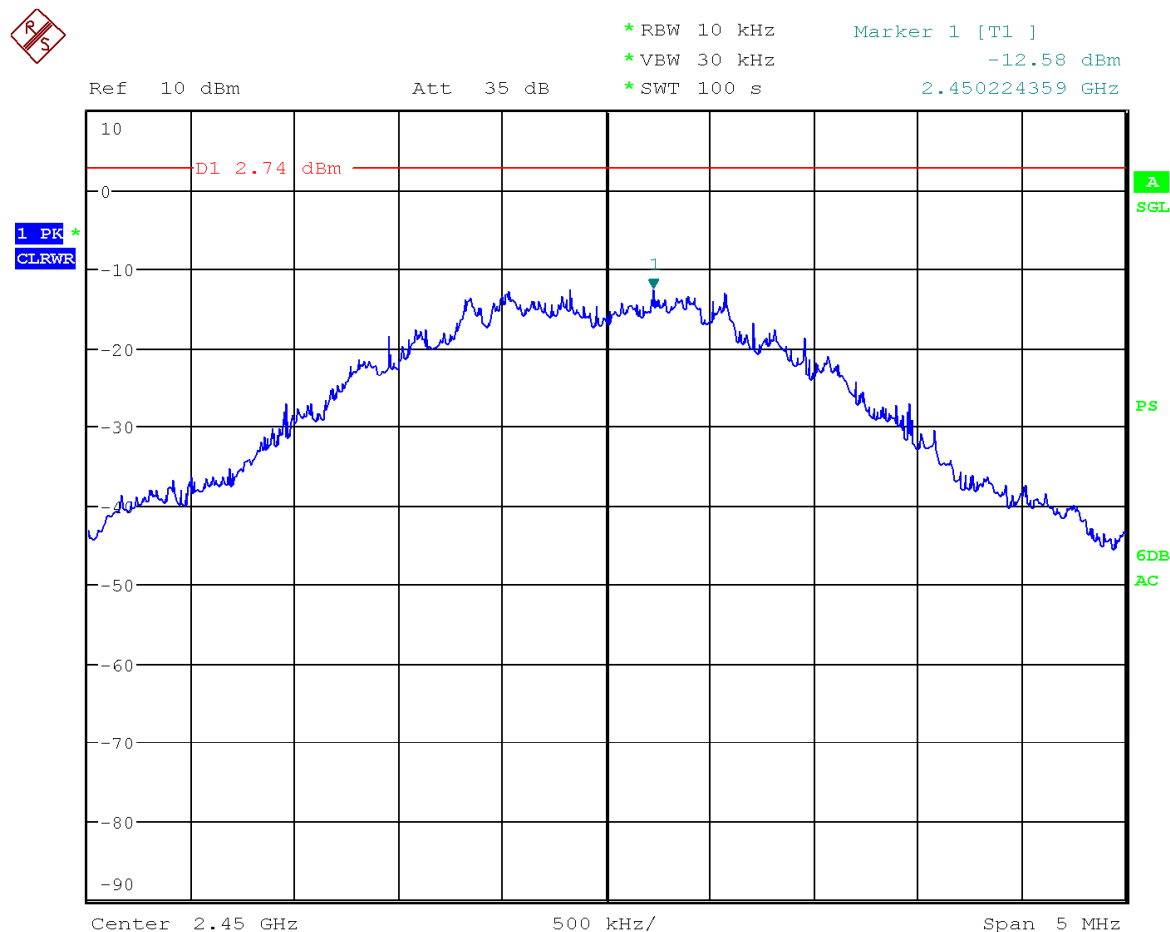
Cable Loss: 3.57dB + Antenna Factor: 28.68dB - Pre-Amp Gain: 37.45 dB = -5.26dB (Total Correction Factor).

PSD Limit of +8dBm -5.26dB (Total Correction Factor) = +2.74dBm

Delta PSD Limit: -15.00 dB

Power Spectral Density (PSD)

**FCC 15.247(e)
Mid Channel – 2450 MHz**



Date: 12.JUL.2013 11:46:54

Specification: PSD < +8 dBm

Note: The above measurement is a “raw” spectrum analyzer reading - not corrected. The display line is corrected for all cable, antenna and pre-amp factors. Therefore, the delta between the raw analyzer reading and the adjusted display (limit) line is the actual delta from the +8 dBm PSD limit.

Cable Loss: 3.57dB + Antenna Factor: 28.68dB - Pre-Amp Gain: 37.45 dB = -5.26dB (Total Correction Factor).

PSD Limit of +8dBm -5.26dB (Total Correction Factor) = +2.74dBm

Delta PSD Limit: -15.32 dB

**Power Spectral Density (PSD)
FCC 15.247(e)**

High Channel – 2475 MHz

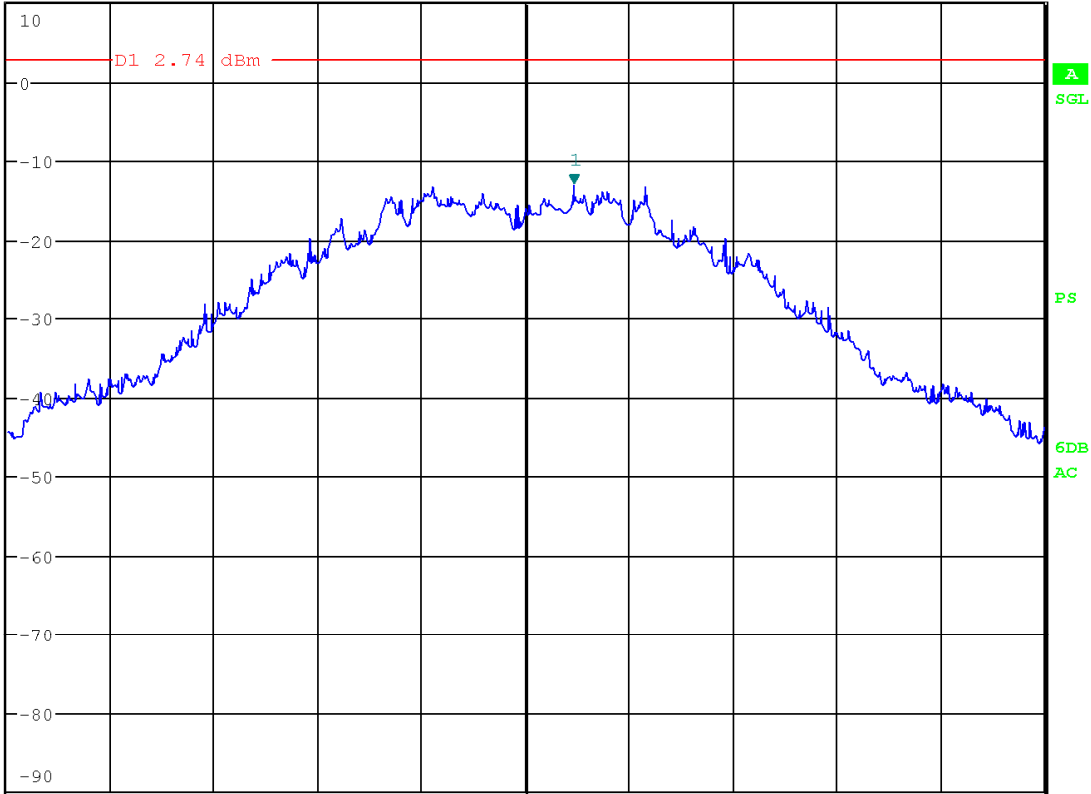


*RBW 10 kHz Marker 1 [T1]
 *VBW 30 kHz -12.94 dBm
 *SWT 100 s 2.475232372 GHz

Ref 10 dBm

Att 35 dB

1 PK *
CLRWR



Center 2.475 GHz

500 kHz/

Span 5 MHz

Date: 12.JUL.2013 11:49:52

Specification: PSD < +8 dBm

Note: The above measurement is a “raw” spectrum analyzer reading - not corrected. The display line is corrected for all cable, antenna and pre-amp factors. Therefore, the delta between the raw analyzer reading and the adjusted display (limit) line is the actual delta from the +8 dBm PSD limit.

Cable Loss: 3.57dB + Antenna Factor: 28.68dB - Pre-Amp Gain: 37.45 dB = -5.26dB (Total Correction Factor).

PSD Limit of +8dBm -5.26dB (Total Correction Factor) = +2.74 dBm

Delta PSD Limit: -15.68 dB

11.8 Test Notes:

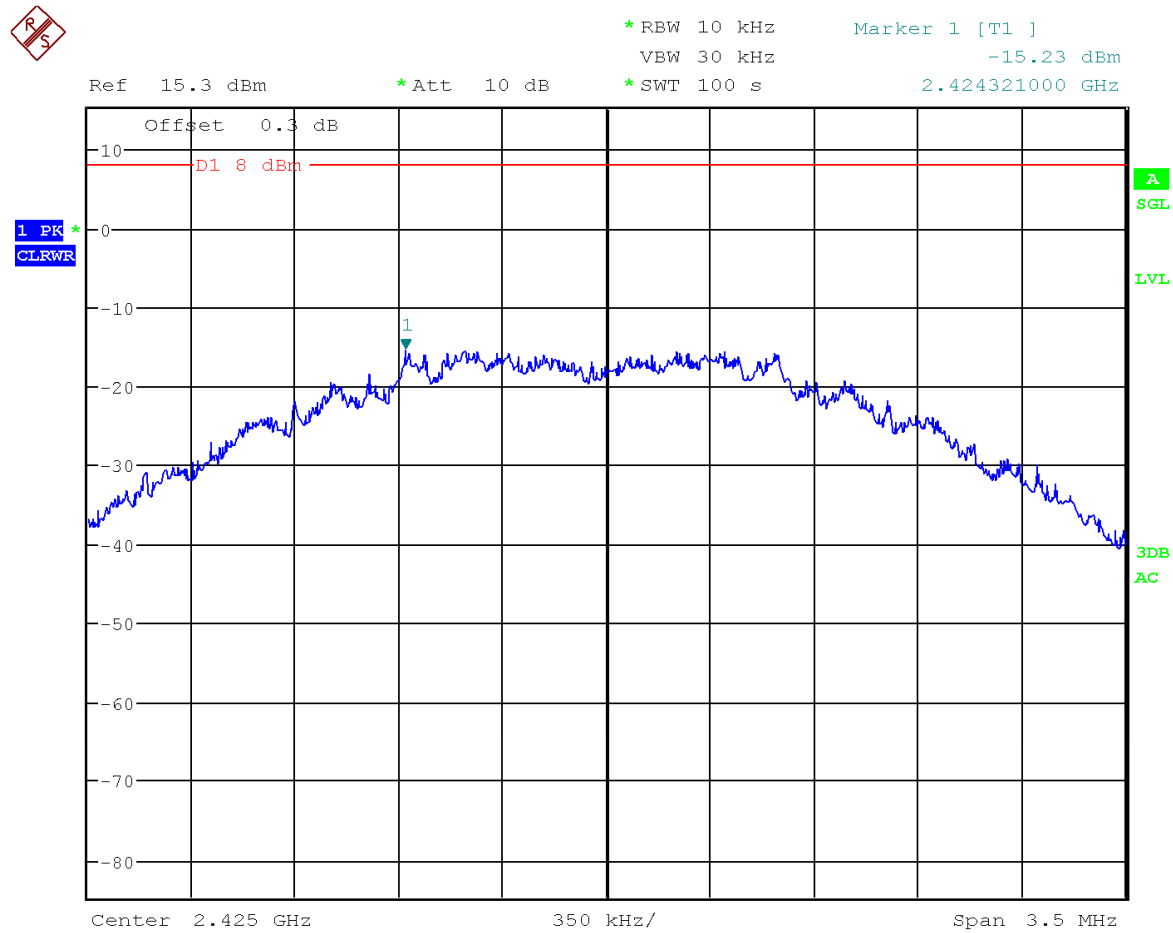
- (1) All measurements are radiated field - worst-case modulated (highest amplitude) data packet/payload.
- (2) Spectrum analyzer plot display line PSD Limit of +8dBm was adjusted for cable loss, antenna factor and pre-amp gain.

Deviations, Additions, or Exclusions: None

11.9 Test Data: PSD – Unit 2

**Power Spectral Density (PSD) – Model ID:071
FCC 15.247(e)**

Low Channel – 2425 MHz



Date: 26.AUG.2013 14:36:36

Specification: PSD < +8 dBm

Note: The above measurement includes an offset to compensate for cable loss, antenna factor, pre-amp and attenuator. Therefore, the spectrum analyzer reading is corrected for comparison to the limit.

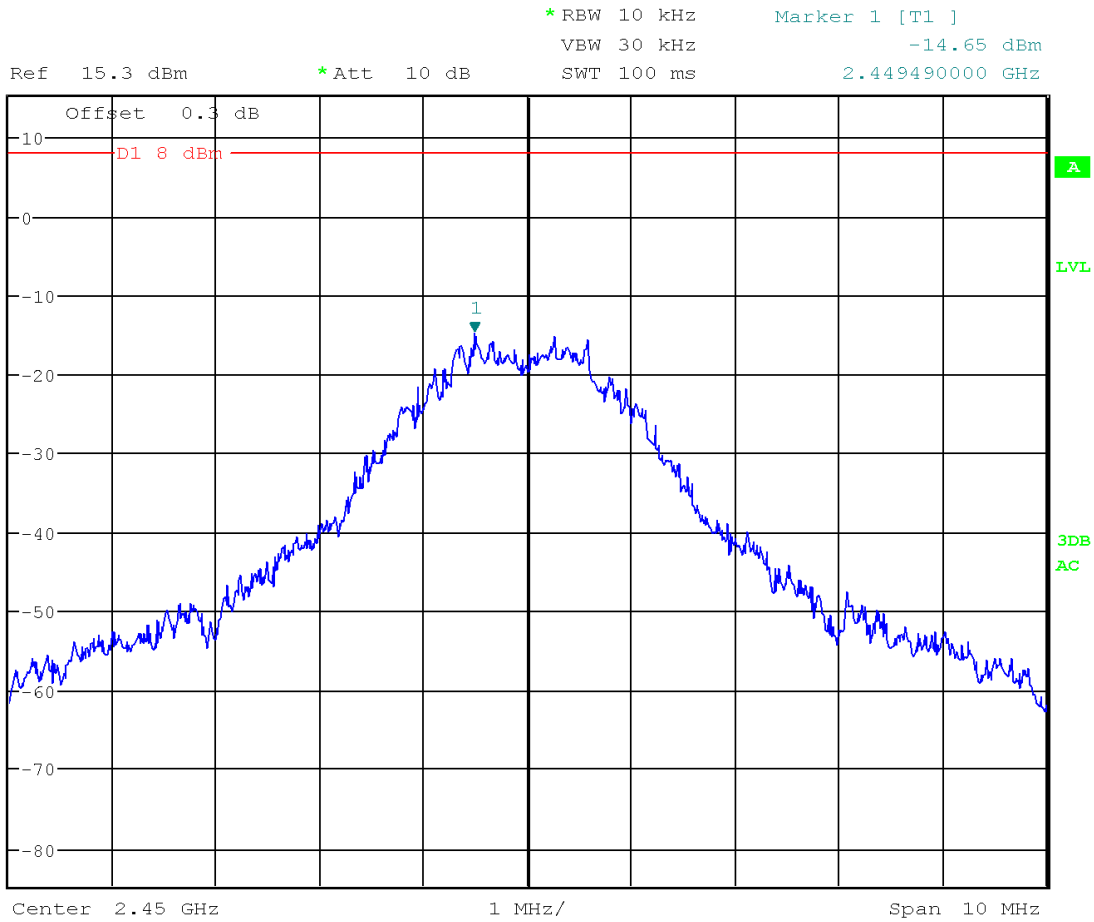
Cable Loss: 3.53dB + Antenna Factor: 28.61dB - Pre-Amp Gain: 37.63 dB + Attenuator 5.75dB: = + 0.26dB
 (Total Correction Factor).

PSD Limit: +8dBm (3kHz ≤ RBW ≤ 100kHz)

Delta PSD Limit: -23.23dB

Power Spectral Density (PSD)

**FCC 15.247(e)
Mid Channel – 2450 MHz**



Date: 26.AUG.2013 14:29:34

Specification: PSD < +8 dBm

Note: The above measurement includes an offset to compensate for cable loss, antenna factor, pre-amp and attenuator. Therefore, the spectrum analyzer reading is corrected for comparison to the limit.

Cable Loss: 3.53dB + Antenna Factor: 28.61dB - Pre-Amp Gain: 37.63 dB + Attenuator 5.75dB: = + 0.26dB
 (Total Correction Factor).

PSD Limit: +8dBm (3kHz ≤ RBW ≤ 100kHz)

Delta PSD Limit: -22.65 dB

**Power Spectral Density (PSD)
FCC 15.247(e)**

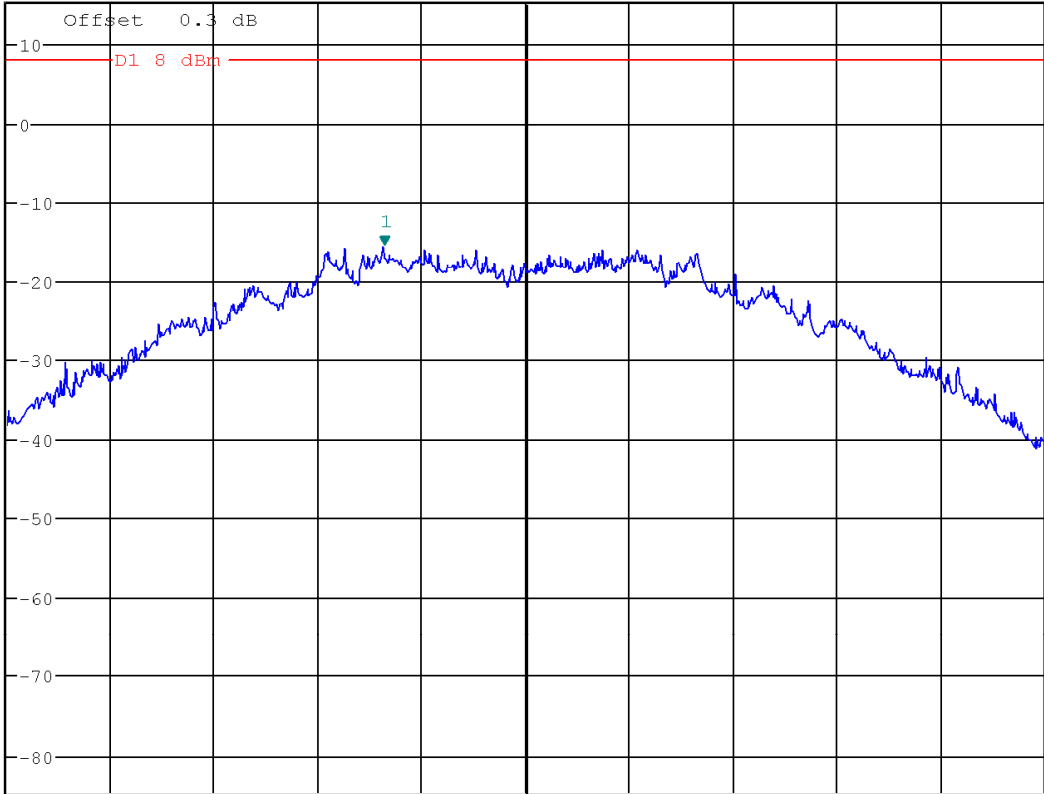
High Channel – 2475 MHz



*RBW 10 kHz Marker 1 [T1]
 VBW 30 kHz -15.40 dBm
 *SWT 100 s 2.474520500 GHz

Ref 15.3 dBm

*Att 10 dB



Center 2.475 GHz 350 kHz/ Span 3.5 MHz

Date: 26.AUG.2013 14:18:28

Specification: PSD < +8 dBm

Note: The above measurement includes an offset to compensate for cable loss, antenna factor, pre-amp and attenuator. Therefore, the spectrum analyzer reading is corrected for comparison to the limit.

Cable Loss: 3.53dB + Antenna Factor: 28.61dB - Pre-Amp Gain: 37.63 dB + Attenuator 5.75dB: = + 0.26dB
 (Total Correction Factor).

PSD Limit: +8dBm (3kHz ≤ RBW ≤ 100kHz)

Delta PSD Limit: -23.40 dB

11.10 Test Notes:

- 1) All measurements are radiated field - worst-case modulated (highest amplitude) data packet/payload.
- 2) Spectrum analyzer reading was adjusted for cable loss, antenna factor, pre-amp gain and attenuator.

Deviations, Additions, or Exclusions: None

12 Occupied Bandwidth (OBW)**12.1 Method**

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from IC RSS-GEN.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

12.2 Test Requirement/Specification:

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

- IC RSS-GEN, Clause 4.6.1

12.3 Test Equipment Used:

<u>Asset ID:</u>	<u>Description:</u>	<u>Manufacturer:</u>	<u>Model:</u>	<u>Serial:</u>	<u>Cal Date</u>	<u>Cal Due</u>
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12.4 Results:

Not applicable - test not required for FCC.

12.5 Test Setup Photographs:**12.6 Test Data: OBW**

13 Receiver Emissions**13.1 Method**

The test methods used comply with ANSI C63.4 and CISPR 16. Unless otherwise stated no deviations were made from FCC 15.109.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

13.2 Test Requirement/Specification:

- FCC 15.109 - Class B

13.3 Test Equipment Used:

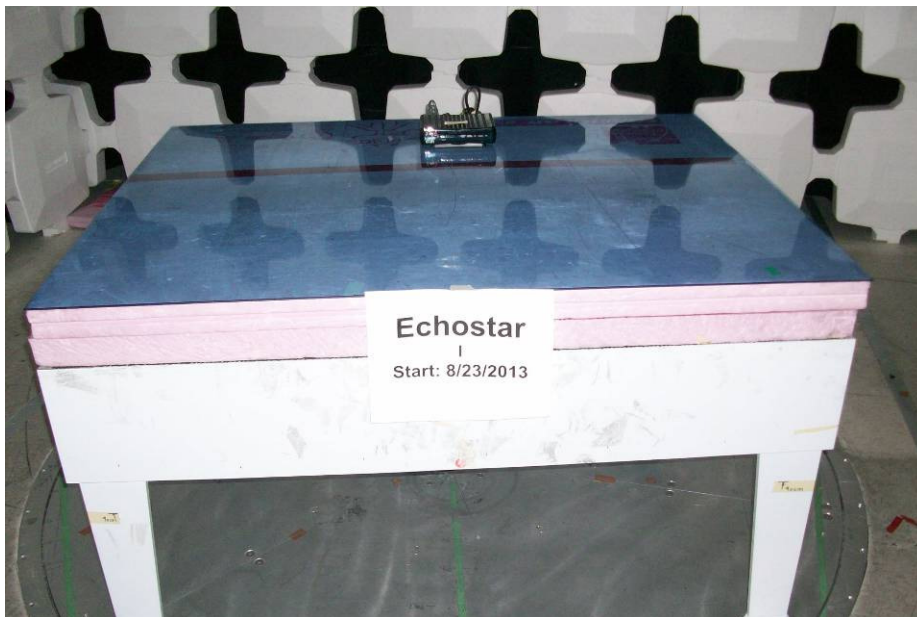
<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
18900	RF Pre-Amplifier (4-8 GHz)	Avantek	AFT97-8434- 10F	1007	06/07/2012	06/07/2013
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/07/2012	06/07/2013
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	6/6/2012	6/6/2013
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

13.4 Results:

The sample tested was found to comply.

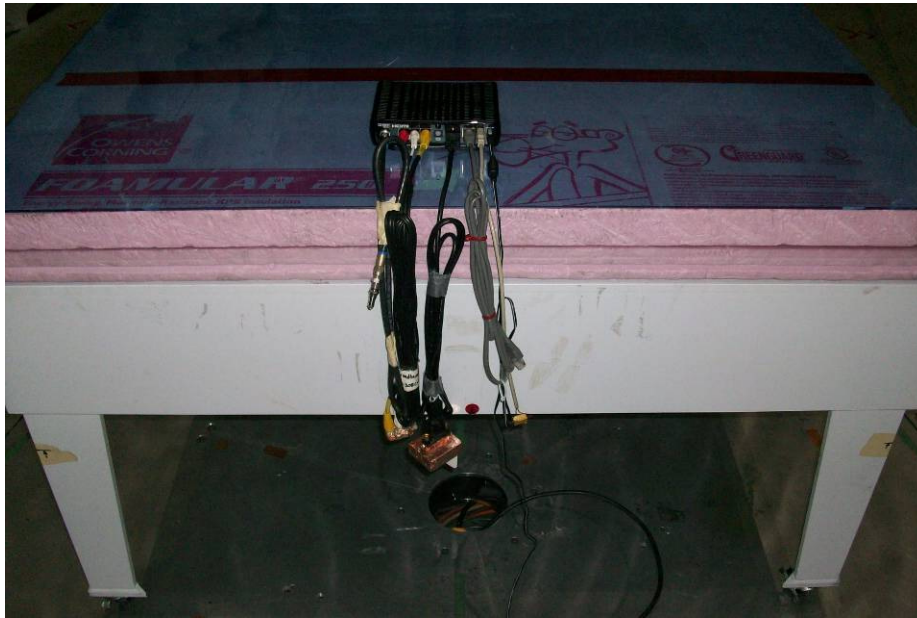
13.5 Setup Photographs:

Test Setup – Front View



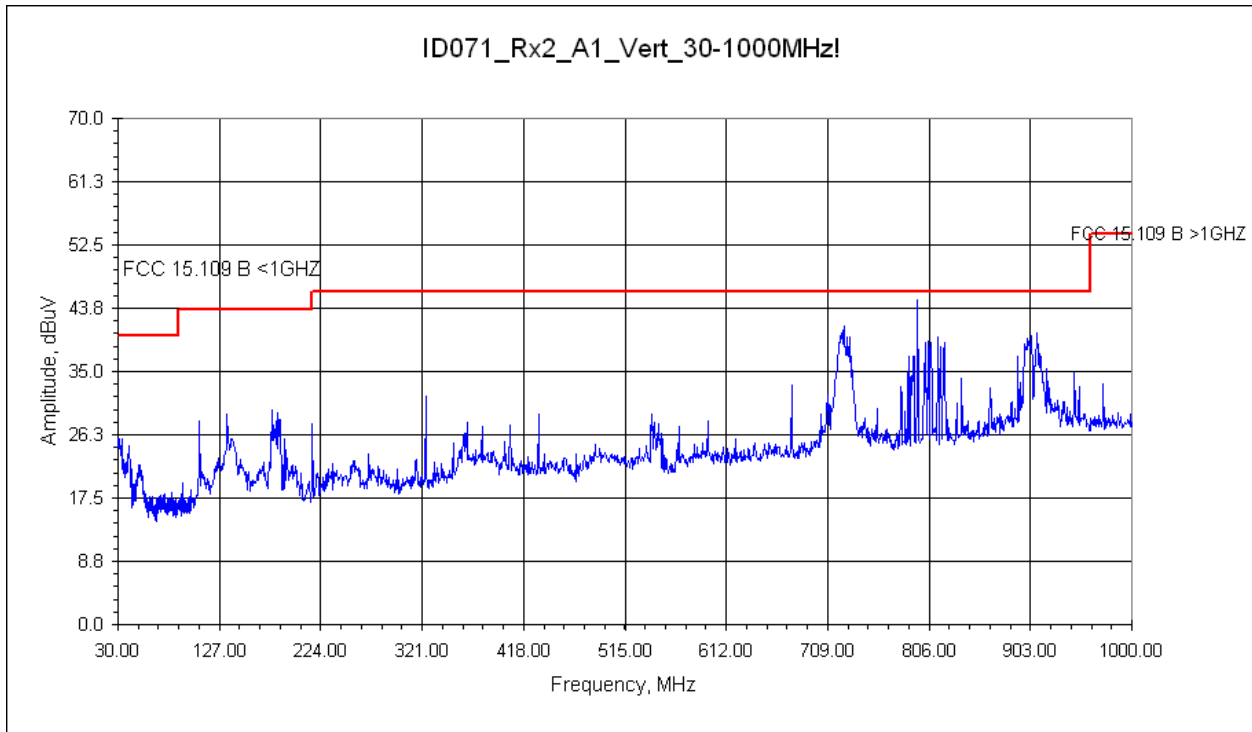
13.6 Setup Photographs:

Test Setup – Rear View

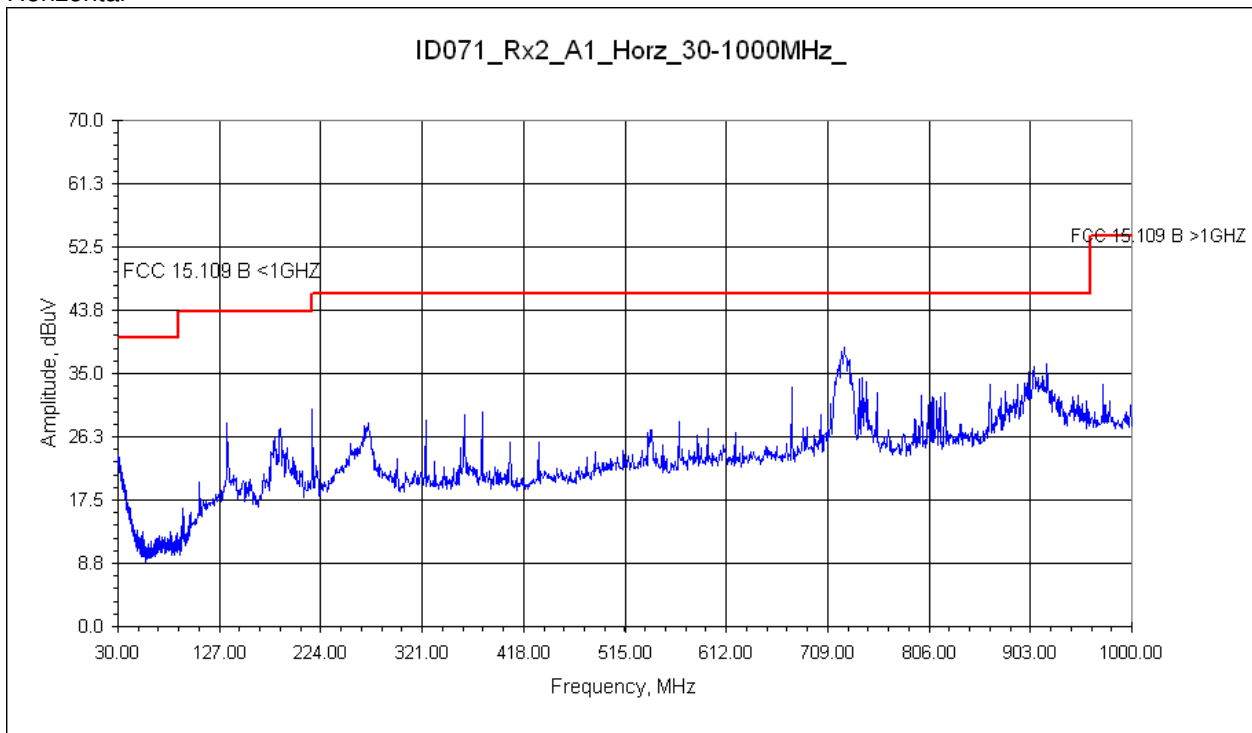


13.7 Pre-scan Plots:

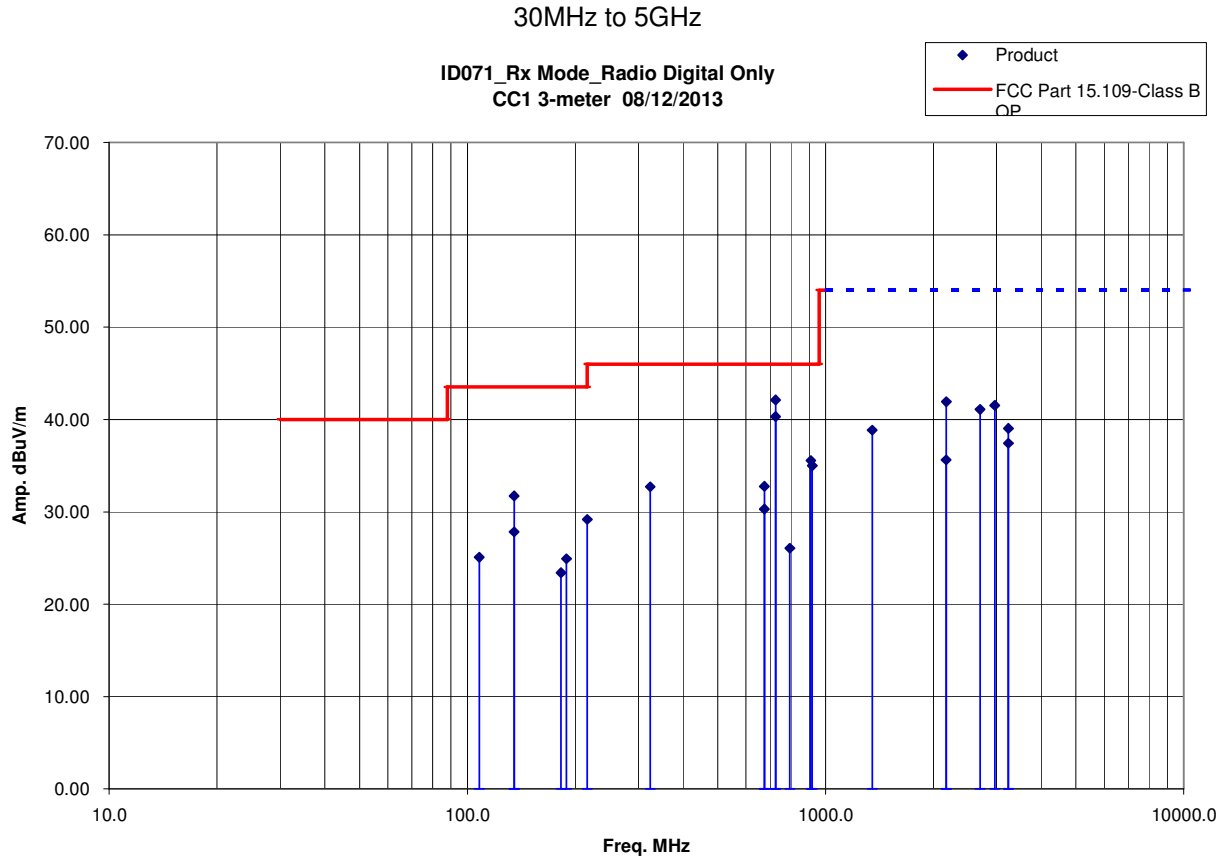
Vertical



Horizontal



13.8 Final Plots:



13.9 Test Data:

Radiated Electromagnetic Emissions

Test Report #: G101239952	Test Area: <u>CC1 Radiated</u>	Temperature: <u>23.4</u> °C
Test Method: <u>FCC Part 15.109</u>	Test Date: <u>08/27/2013</u>	Relative Humidity: <u>33.5</u> %
EUT Model #: <u>ID:071</u>	EUT Power: <u>120VAC/60Hz</u>	Air Pressure: <u>82.7</u> kPa
EUT Serial #: <u>R1886470001 (Unit 2)</u>		

Manufacturer: Echostar Technologies

EUT Description: MoCA Thin Client

Notes: Product tested in Idle/Standby mode of operation per IEC-60601-2-2 Medical Particular Standard for Electrosurgical Generators
Tested with alternative shield

Rx Mode of operation – radio electronics active only.

Level Key
Pk – Peak
Qp – Quasi Peak
Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.109 Class B	N/A	(MHz)
Measurements: 30MHz to 1000MHz Vertical Antenna													
107.9727	39.86	Qp	0.77	12.49	28.04	0.00	25.09	V	1.00	86.6	- 18.41	NA	0.120
135.0000	45.84	Qp	0.79	13.00	27.90	0.00	31.73	V	1.00	348.6	- 11.77	NA	0.120
189.0000	40.20	Qp	0.92	11.40	27.61	0.00	24.91	V	1.00	75.1	- 18.59	NA	0.120
182.5000	38.80	Qp	0.90	11.35	27.65	0.00	23.40	V	1.00	96.2	- 20.10	NA	0.120
323.9988	44.46	Qp	1.24	14.38	27.37	0.00	32.71	V	1.37	78.2	- 13.29	NA	0.120
675.0000	39.95	Qp	1.82	19.50	28.52	0.00	32.75	V	1.64	182.9	- 13.25	NA	0.120
725.0000	46.41	Qp	1.88	20.40	28.37	0.00	40.32	V	1.73	37.6	- 5.68	NA	0.120
795.0000	31.22	Qp	1.97	21.00	28.14	0.00	26.05	V	1.50	45.3	- 19.95	NA	0.120
910.0160	38.84	Qp	2.11	22.40	27.80	0.00	35.55	V	1.31	191.3	- 10.45	NA	0.120
Measurements: 30 to 1000MHz Horizontal Antenna													
135.0154	41.95	Qp	0.79	13.00	27.90	0.00	27.84	H	2.38	336.3	- 15.66	NA	0.120
216.0058	45.04	Qp	0.98	10.66	27.50	0.00	29.19	H	2.17	294.6	- 16.81	NA	0.120
674.9996	37.49	Qp	1.82	19.50	28.52	0.00	30.29	H	1.20	72.5	- 15.71	NA	0.120
725.0000	48.20	Qp	1.88	20.40	28.37	0.00	42.11	H	1.47	341.5	- 3.89	NA	0.120
917.9896	38.25	Qp	2.12	22.40	27.78	0.00	34.98	H	1.53	107.2	- 11.02	NA	0.120
Measurements: 1 to 5GHz													
1350.0200	47.92	Av	2.58	25.17	36.82	0.00	38.86	V	1.78	283.1	NA	- 15.14	1.000
2173.4870	48.14	Av	3.33	27.79	37.32	0.00	41.94	V	1.91	193.2	NA	- 12.06	1.000
2700.0180	45.85	Av	3.75	28.96	37.47	0.00	41.10	V	1.38	323.9	NA	- 12.90	1.000
2970.0322	44.92	Av	3.97	30.15	37.51	0.00	41.53	V	1.69	164.1	NA	- 12.47	1.000
3240.0645	41.39	Av	4.18	30.96	37.48	0.00	39.05	V	1.45	107.9	NA	- 14.95	1.000
2172.0000	41.82	Av	3.33	27.79	37.32	0.00	35.62	H	1.39	286.7	NA	- 18.38	1.000
3240.0350	39.76	Av	4.18	30.96	37.48	0.00	37.42	H	1.99	285.7	NA	- 16.58	1.000

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Example calculation:

Measured Level		Transducer, Cable Loss & Amplifier corrections		Corrected Reading	Specification Limit		Corrected Reading		Delta Specification
(dB μ V)	+	(dB)	=	(dB μ V/m)	(dB μ V/m)	-	(dB μ V/m)	=	
14.0		14.9		28.9	40.0		28.9		-11.1

Notes: Tested in Rx mode of operation – radio-associated electronics active only.

Deviations, Additions, or Exclusions: None

14 AC Mains Conducted Emissions**14.1 Method**

The test methods used comply with ANSI C63.10 and CISPR 16. Unless otherwise stated no deviations were made from FCC 15.207.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

14.2 Test Requirement/Specification:

- FCC 15.207

14.3 Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacture</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
18885	Transient Limiter	Hewlett-Packard	11947A	3107A00700	05/05/2013	05/05/2014
18914	Single Phase LISN	EMCO	3816/NM	9408-1003	04/11/2013	04/11/2014
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 1.0	VBU	VBU

14.4 Results:

The sample tested was found to Comply.

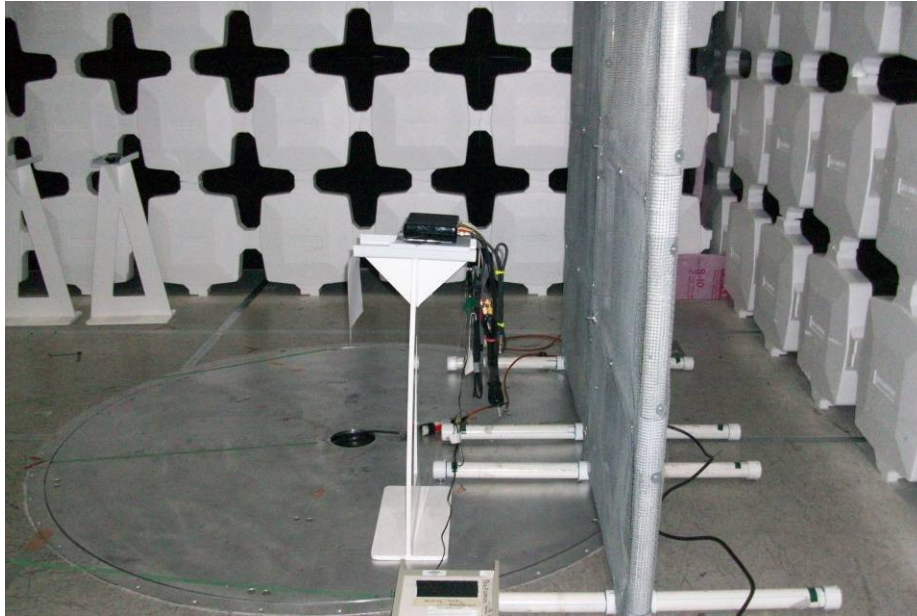
14.5 Setup Photographs:

Test Setup – AC Conducted Emissions (Front View)



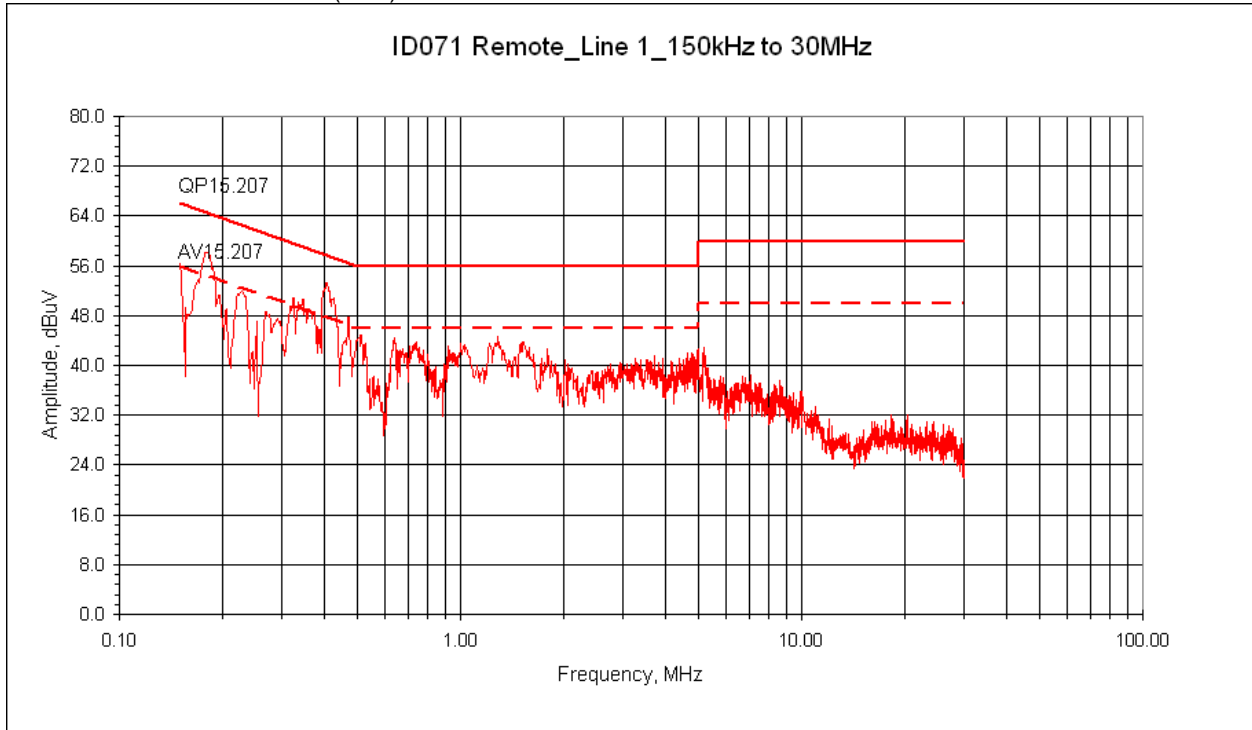
14.6 Setup Photographs:

Test Setup – AC Conducted Emissions (Side View)



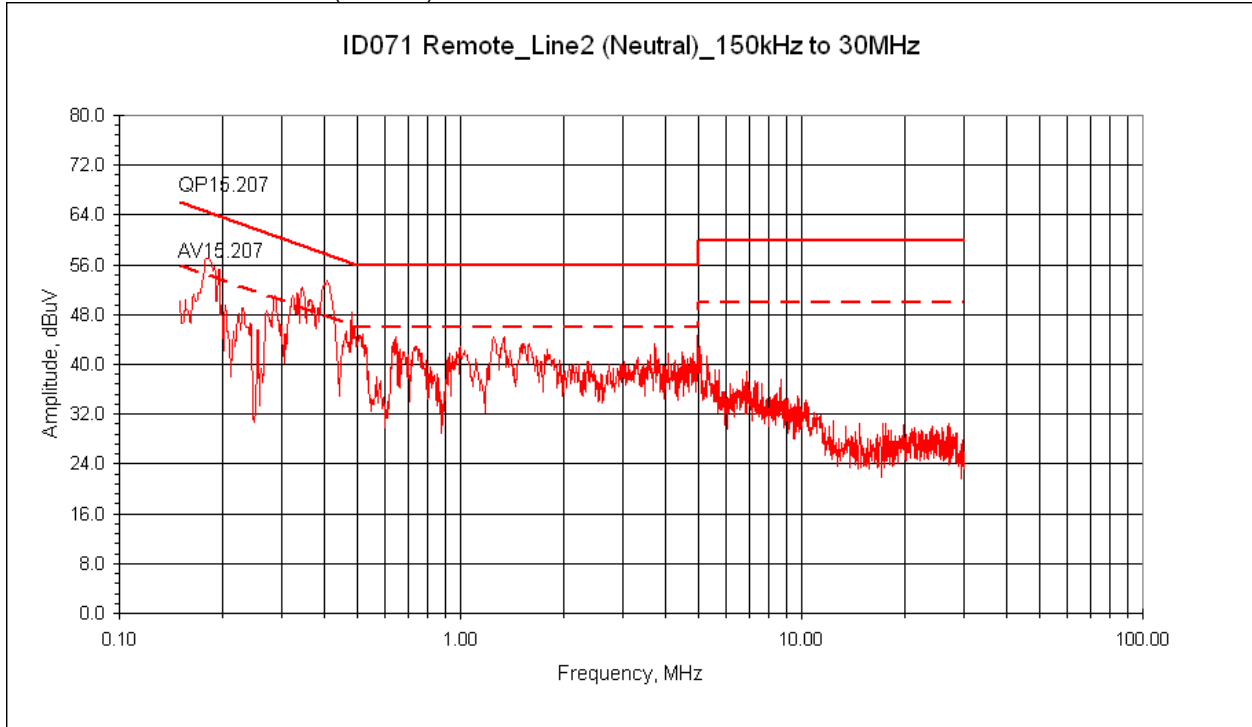
14.7 Pre-scan Plots: Reference only

FCC 15.207 120VAC/60Hz (Live)



Max hold. Reference only to determine frequencies to be maximized.

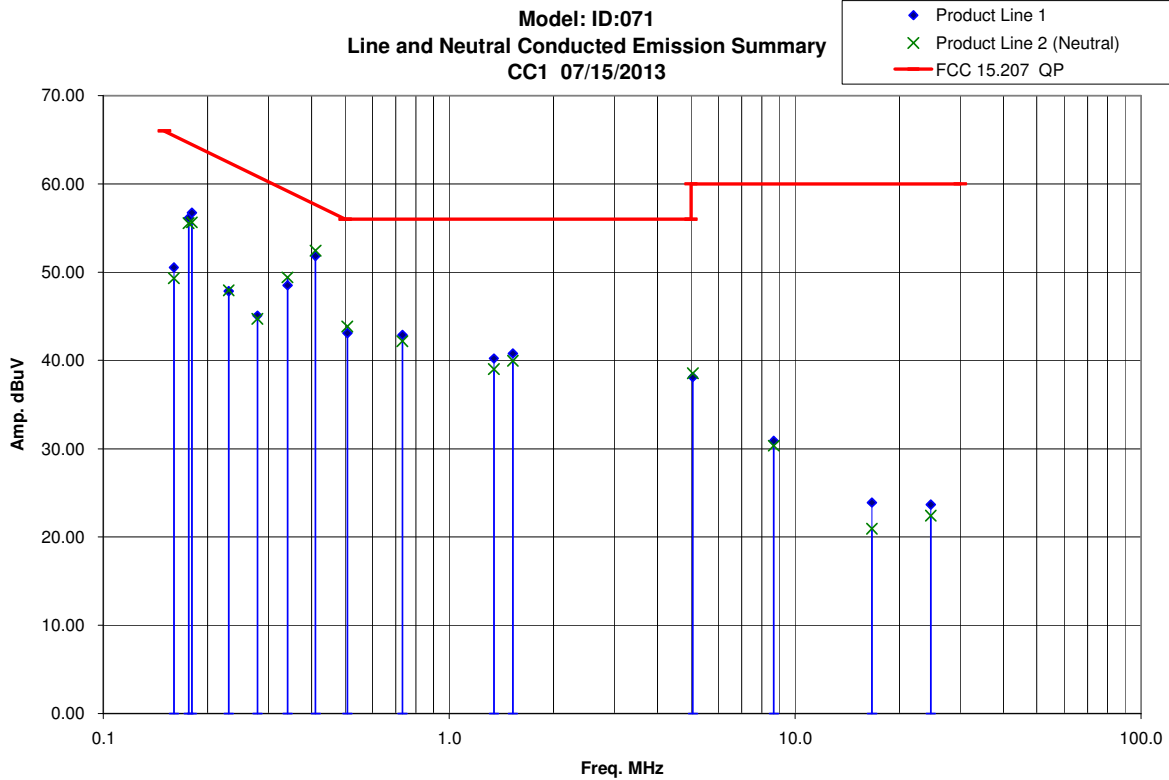
FCC 15.207 120VAC/60Hz (Neutral)



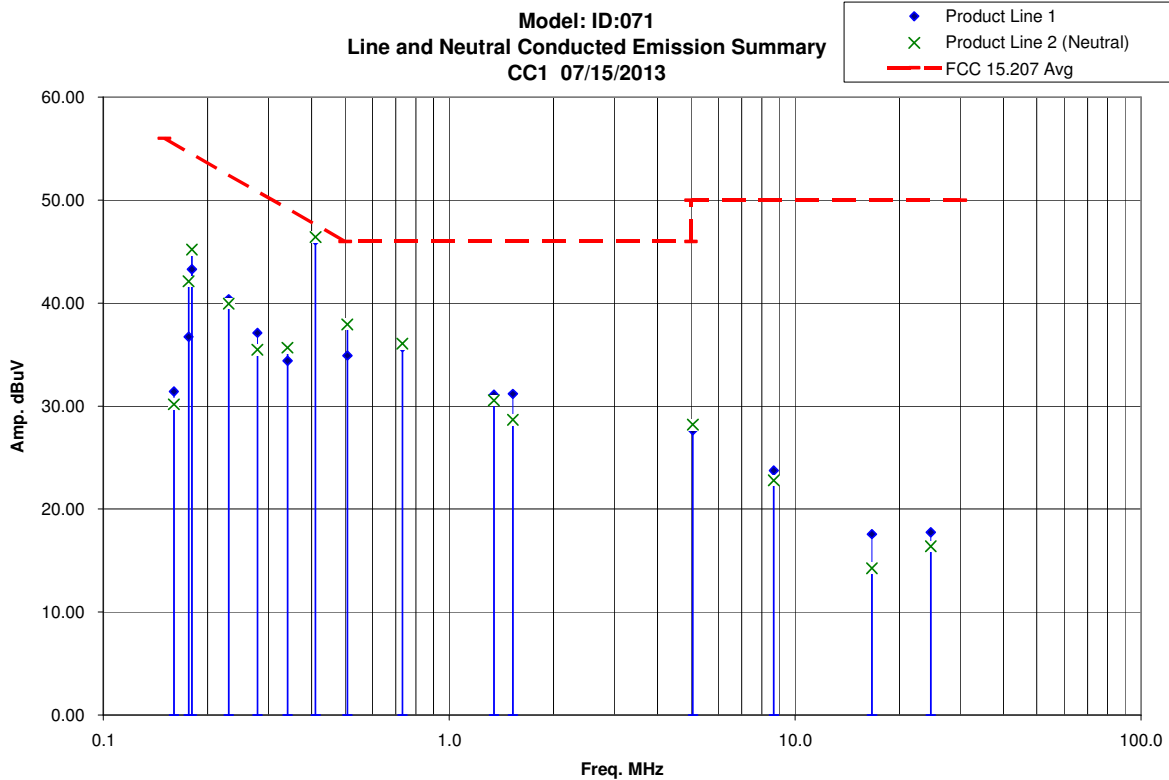
Max hold. Reference only to determine frequencies to be maximized.

14.8 Final Plots:

FCC 15.207 120VAC/60Hz (QP)



FCC 15.207 120VAC/60Hz (Average)



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14.9 Test Data:

AC Conducted Electromagnetic Emissions

Test Report #:	G101239952	Test Area:	CC1 Conducted	Temperature:	23.6	C
Test Method:	FCC 15.207	Test Date:	15-July-2013	Relative Humidity:	28.9	%
EUT Model #:	ID:071	EUT Power:	120VAC/60Hz	Air Pressure:	83.4	kPa
EUT Serial #:	R1886469654					
Manufacturer:	Echostar Technologies			Level Key		
EUT Description:	MocA Thin Client			Pk - Peak	Nb - Narrow Band	
Notes:	Product tested with Tx active, modulated – all channels.			Qp - QuasiPeak	Bb - Broad Band	
				Av - Average		

FREQ	LEVEL	DET	CABLE	LISN	PREAMP	ATTEN	FINAL	TEST POINT	DELTA1	DELTA2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]		FCC 15.207 Average	FCC 15.207 QP	(MHz)
Line 1 Data – 150kHz to 30MHz											
0.160	21.31	Av	0.10	0.04	0.00	9.97	31.41	Line 1	- 24.05	NA	0.009
0.160	40.43	Qp	0.10	0.04	0.00	9.97	50.53	Line 1	NA	- 14.93	0.009
0.176	26.63	Av	0.10	0.03	0.00	9.96	36.73	Line 1	- 17.93	NA	0.009
0.176	46.01	Qp	0.10	0.03	0.00	9.96	56.11	Line 1	NA	- 8.55	0.009
0.180	33.18	Av	0.10	0.03	0.00	9.96	43.28	Line 1	- 11.19	NA	0.009
0.180	46.64	Qp	0.10	0.03	0.00	9.96	56.74	Line 1	NA	- 7.73	0.009
0.230	30.30	Av	0.10	0.03	0.00	9.96	40.39	Line 1	- 12.05	NA	0.009
0.230	37.76	Qp	0.10	0.03	0.00	9.96	47.85	Line 1	NA	- 14.59	0.009
0.279	27.03	Av	0.10	0.03	0.00	9.97	37.12	Line 1	- 13.73	NA	0.009
0.279	34.98	Qp	0.10	0.03	0.00	9.97	45.07	Line 1	NA	- 15.78	0.009
0.341	24.29	Av	0.10	0.03	0.00	9.97	34.39	Line 1	- 14.80	NA	0.009
0.341	38.42	Qp	0.10	0.03	0.00	9.97	48.52	Line 1	NA	- 10.67	0.009
0.411	36.99	Av	0.10	0.03	0.00	9.97	47.09	Line 1	- 0.55	NA	0.009
0.411	41.72	Qp	0.10	0.03	0.00	9.97	51.82	Line 1	NA	- 5.82	0.009
0.508	24.81	Av	0.10	0.02	0.00	9.97	34.91	Line 1	- 11.09	NA	0.009
0.508	32.99	Qp	0.10	0.02	0.00	9.97	43.09	Line 1	NA	- 12.91	0.009
0.732	25.64	Av	0.10	0.03	0.00	9.98	35.74	Line 1	- 10.26	NA	0.009
0.732	32.80	Qp	0.10	0.03	0.00	9.98	42.90	Line 1	NA	- 13.10	0.009
1.345	20.90	Av	0.20	0.03	0.00	9.98	31.11	Line 1	- 14.89	NA	0.009
1.345	30.01	Qp	0.20	0.03	0.00	9.98	40.22	Line 1	NA	- 15.78	0.009
1.528	20.97	Av	0.20	0.03	0.00	9.98	31.18	Line 1	- 14.82	NA	0.009
1.528	30.59	Qp	0.20	0.03	0.00	9.98	40.80	Line 1	NA	- 15.20	0.009
5.060	17.30	Av	0.33	0.04	0.00	9.98	27.66	Line 1	- 22.34	NA	0.009
5.060	27.76	Qp	0.33	0.04	0.00	9.98	38.12	Line 1	NA	- 21.88	0.009
8.680	13.14	Av	0.50	0.10	0.00	10.00	23.74	Line 1	- 26.26	NA	0.009
8.680	20.28	Qp	0.50	0.10	0.00	10.00	30.88	Line 1	NA	- 29.12	0.009
16.670	6.30	Av	1.10	0.16	0.00	10.02	17.57	Line 1	- 32.43	NA	0.009
16.670	12.63	Qp	1.10	0.16	0.00	10.02	23.90	Line 1	NA	- 36.10	0.009
24.674	6.30	Av	1.20	0.21	0.00	10.03	17.74	Line 1	- 32.26	NA	0.009
24.674	12.23	Qp	1.20	0.21	0.00	10.03	23.67	Line 1	NA	- 36.33	0.009

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Line 2 (Neutral) Data – 150kHz to 30MHz											
0.160	20.07	Av	0.10	0.04	0.00	9.97	30.17	Line 2	- 25.29	NA	0.009
0.160	39.21	Qp	0.10	0.04	0.00	9.97	49.31	Line 2	NA	- 16.15	0.009
0.176	32.01	Av	0.10	0.03	0.00	9.96	42.11	Line 2	- 12.55	NA	0.009
0.176	45.44	Qp	0.10	0.03	0.00	9.96	55.54	Line 2	NA	- 9.12	0.009
0.180	35.10	Av	0.10	0.03	0.00	9.96	45.20	Line 2	- 9.27	NA	0.009
0.180	45.54	Qp	0.10	0.03	0.00	9.96	55.64	Line 2	NA	- 8.83	0.009
0.230	29.84	Av	0.10	0.03	0.00	9.96	39.93	Line 2	- 12.51	NA	0.009
0.230	37.85	Qp	0.10	0.03	0.00	9.96	47.94	Line 2	NA	- 14.50	0.009
0.279	25.39	Av	0.10	0.03	0.00	9.97	35.48	Line 2	- 15.37	NA	0.009
0.279	34.63	Qp	0.10	0.03	0.00	9.97	44.72	Line 2	NA	- 16.13	0.009
0.341	25.59	Av	0.10	0.02	0.00	9.97	35.68	Line 2	- 13.50	NA	0.009
0.341	39.33	Qp	0.10	0.02	0.00	9.97	49.42	Line 2	NA	- 9.76	0.009
0.411	37.33	Av	0.10	0.02	0.00	9.97	47.42	Line 2	- 0.21	NA	0.009
0.411	42.35	Qp	0.10	0.02	0.00	9.97	52.44	Line 2	NA	- 5.19	0.009
0.508	27.82	Av	0.10	0.02	0.00	9.97	37.92	Line 2	- 8.08	NA	0.009
0.508	33.74	Qp	0.10	0.02	0.00	9.97	43.84	Line 2	NA	- 12.16	0.009
0.732	25.97	Av	0.10	0.02	0.00	9.98	36.07	Line 2	- 9.93	NA	0.009
0.732	32.10	Qp	0.10	0.02	0.00	9.98	42.20	Line 2	NA	- 13.80	0.009
1.345	20.34	Av	0.20	0.03	0.00	9.98	30.55	Line 2	- 15.45	NA	0.009
1.345	28.80	Qp	0.20	0.03	0.00	9.98	39.01	Line 2	NA	- 16.99	0.009
1.528	18.45	Av	0.20	0.03	0.00	9.98	28.66	Line 2	- 17.34	NA	0.009
1.528	29.75	Qp	0.20	0.03	0.00	9.98	39.96	Line 2	NA	- 16.04	0.009
5.060	17.85	Av	0.33	0.04	0.00	9.98	28.20	Line 2	- 21.80	NA	0.009
5.060	28.18	Qp	0.33	0.04	0.00	9.98	38.53	Line 2	NA	- 21.47	0.009
8.680	12.18	Av	0.50	0.11	0.00	10.00	22.78	Line 2	- 27.22	NA	0.009
8.680	19.75	Qp	0.50	0.11	0.00	10.00	30.35	Line 2	NA	- 29.65	0.009
16.670	2.97	Av	1.10	0.17	0.00	10.02	14.25	Line 2	- 35.75	NA	0.009
16.670	9.66	Qp	1.10	0.17	0.00	10.02	20.94	Line 2	NA	- 39.06	0.009
24.674	4.82	Av	1.20	0.34	0.00	10.03	16.39	Line 2	- 33.61	NA	0.009
24.674	10.83	Qp	1.20	0.34	0.00	10.03	22.40	Line 2	NA	- 37.60	0.009

Example calculation:

Measured Level	+	Transducer, Cable Loss & Amplifier corrections	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dB μ V)		(dB)		(dB μ V/m)	(dB μ V/m)		(dB μ V/m)		
14.0		14.9		28.9	40.0		28.9		-11.1

14.10 Test Method:

- ANSI C63.10:2009, Section 6.2

14.11 Test Summary:

Worst Case AC Conducted Emission: 0.411 MHz, 47.42dBuV (-0.21 under average limit)											
FREQ	LEVEL	DET	CABLE	LISN	PREAMP	ATTEN	FINAL	TEST POINT	DELTA1	DELTA2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	Line 1 Line 2	FCC 15.207 Average	FCC 15.207 QP	(MHz)
0.411	37.33	Av	0.10	0.02	0.00	9.97	47.42	Line 2	- 0.21	NA	0.009

Notes:

- 1) Product tested in continuous Tx mode of operation – all channels active.

Deviations, Additions, or Exclusions: None

15 Duty Cycle Correction Factor – Not Used

No duty cycle correction factor was utilized during this testing – therefore, product duty cycle verification was not applicable.

15.1 Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC CFR47 15.247 & IC RSS-GEN.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

15.2 Test Requirement/Specification

- FCC 15.203

15.3 Results:

Not applicable

15.4 Test Method:

- ANSI C63.10: 2009, Clause 7.5

15.5 Test Summary:

Duty Cycle Measurements	

Notes: None

Deviations, Additions, or Exclusions: None

16 Antenna Requirement**16.1 Method**

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC CFR47 15.203.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

16.2 Test Requirement/Specification

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

- FCC 15.203

16.3 Results:

The product utilizes an integral antenna – not user accessible; therefore, the sample tested was found to comply.

17 RF Exposure Requirements - MPE**17.1 Method**

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC OET 65.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

17.2 Test Requirement/Specification

- FCC OET Bulletin 65

17.3 Results:

The sample tested was found to comply.

17.4 Test Data:

RF Exposure Requirements - MPE

Project #:	G101239952	Test Area:	Intertek Louisville
Test Method:	FCC CFR47 Part 1.1310	Test Date:	July 11, 2013
EUT Model #:	ID:071		
EUT Serial #:	R1886469654		
Manufacturer:	Echostar Technologies, LLC		
EUT Description:	Set-Top Box with 2.4 GHz Transceiver		
Notes:	Antenna gain = 0dBi as declared by the manufacturer		

The following limit is from table 1 (B) Limits for General Population/Uncontrolled Exposure in FCC part 1.1310:

1 mW/cm²

The following calculation was used to determine compliance to the above limit. The calculation is from FCC OET bulletin 65.

Power Density(S) =PG/4πR² or S=EIRP/4πR²

Where:

S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (mW).

G = numeric power gain of the antenna in the direction of interest relative to an isotropic radiator.

R = distance to the center of radiation of the antenna (cm)

In this case, 20cm will be used.

RF4CE Radio: 2.4GHz

Maximum measured radiated field strength at 3-meters = 101.80 dBuV/m

Maximum typical gain declared by the manufacture = 0 dBi = 1.0 (numeric gain)

Production Tolerance declared = +/- 5.0dB

Calculated power input to the antenna = Measured Field Strength – Antenna Gain + Production Tolerance

101.80 dBuV/m – (0dBi) + 5.0dB = 106.80 dBuV/m = **14.359 mW**

Power Density

Power (mW)	Gain (dbi)	Gain numeric	Distance (cm)	Power Density (mW/cm ²)
14.359	0	1.0	20	0.00286

Therefore: Power Density Margin (Δ Limit) = 0.00286 – 1.0 = -0.99714 mW/cm²

Result: The product complies with the requirements for Maximum Permissible Exposure

18 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of $k = 2$, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty \pm	Notes
Radiated emissions, 10kHz to 1000 MHz	4.4 dB	
Radiated emissions, 1 to 18 GHz	4.7 dB	
AC mains Conducted emissions, 9kHz to 30 MHz	3.14 dB	

19 Revision History

Revision Level	Date	Report Number	Notes
0	8/29/2013	101239952DEN-001	Original Issue
1	9/28/2013	101239952DEN-001	Revision 1 per TCB Review: 1. updated RF Exposure MPE (page124) 2. corrected output power of unit 1 in table: 101.80dBuV/m (4.54mW) (page 21) 3. revised antenna gain per manufacturer declaration of 0dBi (page 21, 29 & 33) Randy Thompson <i>R.T.</i> Reviewed by Mike Spataro