BEC INCORPORATED

CERTIFICATION APPLICATION TEST REPORT

TEST STANDARDS:
FCC Part 15 Subpart C, Section 15.247 Intentional Radiator

ARRIS Model VMS4100 Set Top Box
FCC ID: ACQ-VMS4100

REPORT BEC-1792-02

TEST DATES: 03/13/2017 – 04/12/2017

CUSTOMER:
ARRIS Group Incorporated
101 Tournament Drive
Horsham, PA 19044

PREPARED BY: _____
Paul Banker, Test Engineer

REVIEWED and APPROVED BY: _____
Steve Fanella, Quality Manager

ACCREDITED
Testing Cert #2957.01

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Revision History

Revision #	Description of Changes	Date of Changes	Date Released
0	Test Report Initial Release	N/A	05/29/2017
1	Replaced Analyzer Screen Captures with Correct Band Edge Measurements for all three Modulation Schemes at Low and High Frequency. See Section 4.12 for edits.	11/01/2017	11/01/2017

1.0 Administrative Information

1.1 Project Details

Project Number	BEC-1792	
Set Top Box Manufacturer	ARRIS Group Incorporated	
Set Top Box Model Number	VMS4100	
Set Top Box Serial Number	M11707TCP172	M11707TCP165
Set Top Box Sample Number	1792-02	1792-03 (Modified with SMA to transmitter output)
Power Supply Manufacturer Model and Serial Number	Delta Model ADP-36KR SN# IEAD66B002L	
Power Supply Sample Number	1792-04	
Power Supply Manufacturer Model and Serial Number	LITEON Model PB-1360-05R4 SN#524475079041603300238010005000	
Power Supply Sample Number	1792-05	
FCC ID	ACQ-VMS4100	
Bluetooth Chip Manufacturer	Broadcom Corporation	
Bluetooth Chip Model Number	BCM20705 Single Chip Blue Tooth Transceiver	
Frequency of Operation	2402.0 - 2480.0 MHz	
Equipment Class	DSS for Frequency Hopper	
EUT Description	Cable Set Top Box with wireless capability supporting Bluetooth	
Applicable FCC Rules Part	47 CFR Part 15.247: Operation within the band 2400-2483.5 MHz, FCC Public Bulletin DA 00-705	
Test Laboratory Location	BEC Incorporated 970 East High Street Pottstown, PA 19464	
Test Personnel	Paul Banker / Steve Fanella	
Test Performed For	ARRIS Group Incorporated 101 Tournament Drive Horsham, PA 19044	
Customer Contact(s)	Robert Sicilia / Mark Haegali	
Date Received	03/10/2017	

1.2 Preface

This report documents product testing conducted to verify compliance of the specified EUT with applicable standards and requirements as identified herein. EUT, test instrument configurations, test procedures, and recorded data are generally described in this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

1.3 Test Result Summary Table

The ARRIS Model VMS4100 Set Top Box was tested to the following standards:

FCC Part 15, Subpart C Intentional Radiators	Test Description	Result
15.31(m)	Number of Operating Frequencies	**PASS**
15.203	Antenna Restrictions	**PASS**
15.204	Antenna Identification	**PASS**
15.205	Restricted Bands of Operation	**PASS**
15.207(b)	Conducted Emissions Power Leads 150 kHz to 30 MHz	**PASS**
15.209(a)	Spurious Radiated Emissions, 30 MHz to 25 GHz	**PASS**
15.247(a)(1)	Carrier Frequency Separation	**PASS**
15.247(a)(1)(iii)	Number of Hopping Frequencies	**PASS**
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	**PASS**
FCC DA 009705, ANSI C63.10 (6.9.2)	20 dB Bandwidth	**PASS**
15.247(b)(1)	Maximum Peak Power Output	**PASS**
15.247(d)	Band Edge Measurement	**PASS**
15.247(f)	Antenna Port, Power Spectral Density	**PASS**

Interpretation of Test Results: Where required, the EUT was tested in three modulation schemes; GFSK, QPSK and 8PSK. Also, each modulation scheme was tested at low, middle and high channel frequencies. The resultant data is presented by showing the worst case levels for each modulation type and/or frequency. All recorded results are maintained at BEC Inc.

1.4 Measurement Uncertainty

Measurement	Measurement Distance	Frequency Range	Measurement Limit	Expanded Uncertainty
Conducted Disturbance	N/A	150 kHz – 30 MHz	FCC Section 15.207	3.58
Radiated Disturbance	3 Meters	30 MHz – 1 GHz	FCC Section 15.209	4.61

No adjustments to measured data presented in this report are required because all values of uncertainty are less that the CISPR 16-4-2:2011 recommendations. These uncertainties have a coverage factor of $k = 2$, which yields approximately a 95% level of confidence for the near-normal distribution typical of most measurement results.

FCC Registered Test Site Number: US1118

1.5 Condition of Received Sample

An evaluation of the EUT was conducted in order to verify test subject identity and condition and to ensure suitability for testing. No evidence of physical damage was noted. The test item condition was deemed acceptable for the performance of the requested test services.

1.6 Climatic Environment

Unless noted elsewhere in this report, the following were the ambient conditions in the laboratory during testing:

Temperature: 22 ° ± 5 °
Humidity: 50% ± 20%
Barometric Pressure: 1000mb ± 20%

1.7 Test Equipment

All test equipment is checked to manufacturer's specifications and, when applicable, have current N.I.S.T. traceable, ISO 9002 conforming certificates of calibration. Test equipment used for the tests described herein is listed in Appendix A.

2.0 Equipment Under Test

Unless otherwise noted in the individual test results sections, testing was performed on the EUT as follows.

2.1 EUT Description

The ARRIS VMS4100 HD Video Media Server is an advanced whole home solution for viewing entertainment in the home. It is a media server that includes multiple QAM tuners up to 860MHz, a high-end processor, expanded memory, and enhanced graphics to support delivery of digital, on-demand, and interactive services, including 4K video, throughout the entire home. The ARRIS VMS4100 provides a full complement of interconnection options including Bluetooth for Remote control and audio streaming. This device not only allows for streaming media content, but also uses smaller, more energy-efficient IP client set-top boxes (STBs). The ARRIS VMS4100 communicates with the client set-top boxes (STBs) each connected to a TV.

2.2 Product Category

FCC Part 15, Subpart C (Section 15.247)

2.3 Product Classification

Intentional Radiator Testing Requirements DSS for Frequency Hopper
Operation within the band of 2400 - 2483.5 MHz.

2.4 Test Configuration

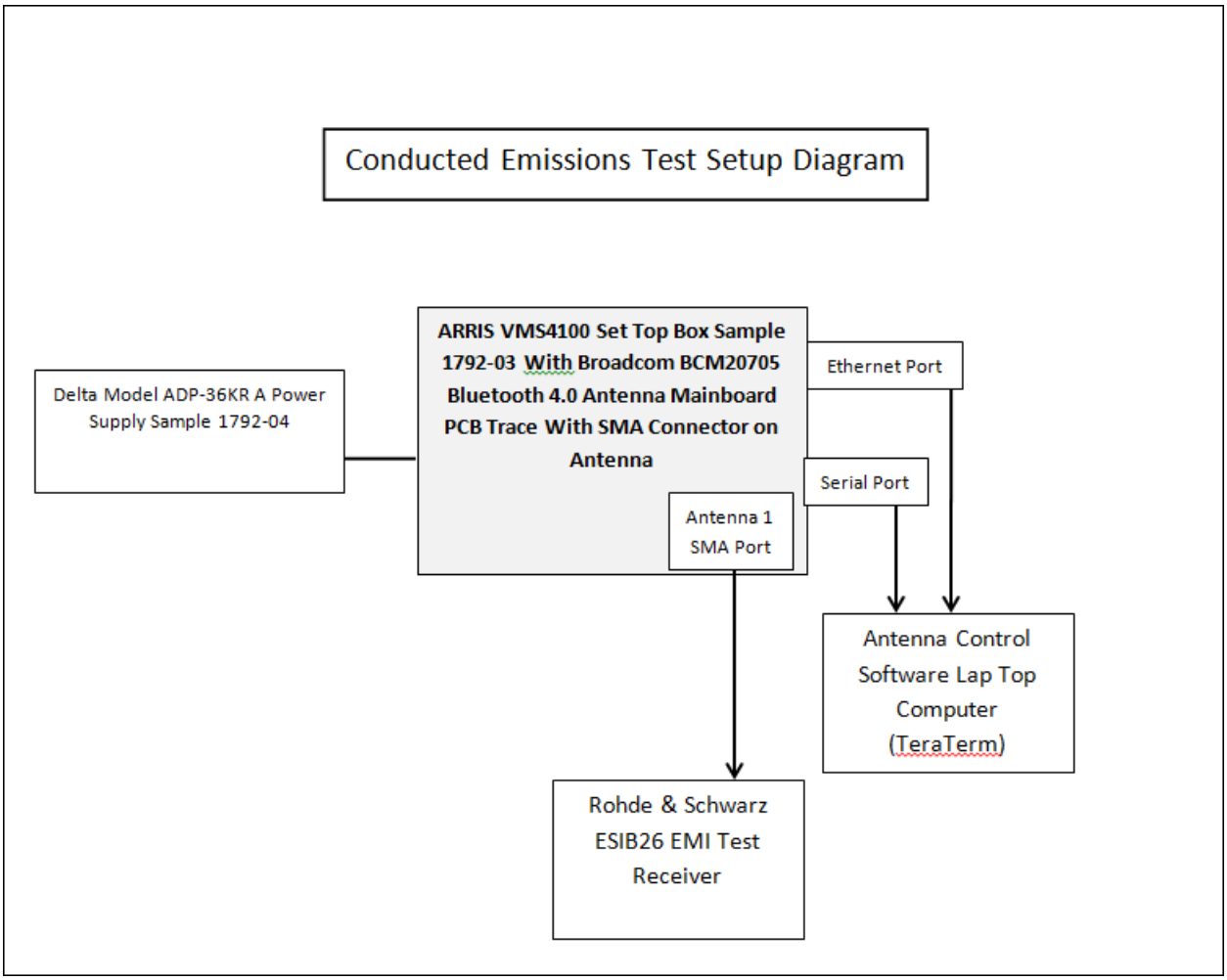
The antenna within the ARRIS VMS4100 set top box was controlled by software which allowed selection of frequency hopping (BR-Basic Rata of 1Mbps or EDR-Enhanced Data Rate of 2Mbps). When selecting specific transmission frequencies the software would allow the technician to select Modulated or Un-modulated signals with choices of QPSK, GFSK or 8PSK Modulation Signatures. Output power was controlled as 1-Low, 2-Medium or 3-Maximum Output Power.

2.5 Test Configuration Rationale

The tested configuration of the EUT was required so that the test technician could view the characteristics of the antenna at specific frequencies and allow the technician to record the required measurements.

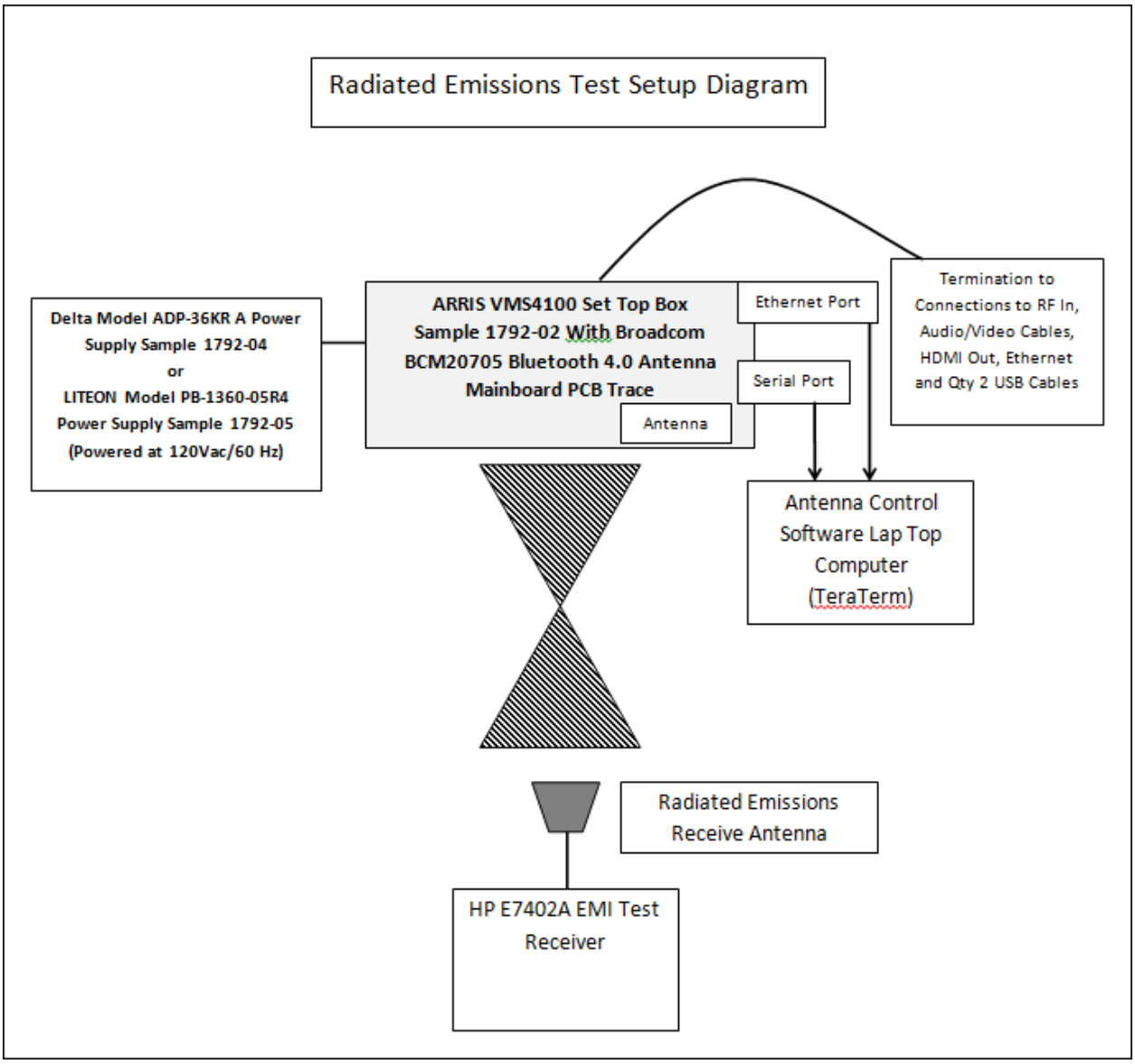
2.6 Test Configuration Diagram (Transmitter Conducted Measurements)

A block diagram of the EUT configuration showing interconnection cables is illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution.



2.7 Test Configuration Diagram (Radiated/Conducted Measurements)

A block diagram of the EUT configuration showing interconnection cables is illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution.



2.8 EUT Information, Interconnection Cabling and Support Equipment

EUT Hardware

Description	Manufacturer	Model	Serial Number	Sample Number
Set Top Box (Unmodified Antennas)	ARRIS	VMS4100	M11707TCP172	1792-02
Set Top Box (Modified Antennas with SMA Connectors)	ARRIS	VMS4100	M11707TCP165	1792-03
AC Adapter	Delta	ADP-36KR A	IEAD66B002L	1792-04
AC Adapter	LITEON	PB-1360-05R4	5244750790416 0330023801000 5000	1792-05

Interconnection Cable List (Conducted Test Setup)

Manufacturer	Model	Type	Shielding	Length	Description
Workhorse	WHU18-3636-036	High Frequency RF Cable 1 to 40 GHz	Double Braid	1 Meter	Measurement Cable from the Antenna SMA Connector to the Rohde and Schwarz ESIB26 Receiver. Asset # BEC-814

Interconnection Cable List (Radiated Test Setup)

Type	Mfr/Part#	Shielding	Length	Description
Audio Video	Acoustic Research/PR161	95% braid w/100% aluminum Mylar foil	6 Ft	Audio & Video Out Ports
HDMI	Rocketfish	Braid over foil	1.3 m	HDMI Port
75-Ohm Coax	Belden-T 9114 Duobond	Double Braid	1 m	RF In and RF Out
Ethernet CAT5	Siemon Co. / MC5-8-T-07-20	Mylar foil	7 Ft	Ethernet Port
USB	Hannstar/E52534-D	Braid over foil	2 m	USB Port

Support Equipment

Description	Manufacturer	Model	Serial Number
Ethernet Broadband Router	D-Link	DI-604	B25I16B000726
Lap Top Computer	Dell	Latitude C640	HB00X21

2.9 Test Signals and Test Modulation

The following table lists the individual hopping frequencies for the transmitter. The EUT can provide GFSK, QPSK or 8PSK modulation. The frequency hopping could be enabled and modulated by selection. The transmitter also could be programmed to control the output at Low, Medium and Maximum Output levels.

Channel	Frequency GHz	Channel	Frequency GHz	Channel	Frequency GHz	Channel	Frequency GHz
1	2.402	21	2.422	41	2.442	61	2.462
2	2.403	22	2.423	42	2.443	62	2.463
3	2.404	23	2.424	43	2.444	63	2.464
4	2.405	24	2.425	44	2.445	64	2.465
5	2.406	25	2.426	45	2.446	65	2.466
6	2.407	26	2.427	46	2.447	66	2.467
7	2.408	27	2.428	47	2.448	67	2.468
8	2.409	28	2.429	48	2.449	68	2.469
9	2.410	29	2.430	49	2.450	69	2.470
10	2.411	30	2.431	50	2.451	70	2.471
11	2.412	31	2.432	51	2.452	71	2.472
12	2.413	32	2.433	52	2.453	72	2.473
13	2.414	33	2.434	53	2.454	73	2.474
14	2.415	34	2.435	54	2.455	74	2.475
15	2.416	35	2.436	55	2.456	75	2.476
16	2.417	36	2.437	56	2.457	76	2.477
17	2.418	37	2.438	57	2.458	77	2.478
18	2.419	38	2.439	58	2.459	78	2.479
19	2.420	39	2.440	59	2.460	79	2.480
20	2.421	40	2.441	60	2.461		

2.10 Grounding

Direct grounding of the test sample was accomplished through the coaxial cable connected to the RF input port of the EUT.

2.11 EUT Modifications

Except for the attachment of a SMA connector directly to the antenna output on the main board of the ARRIS VMS4100 Sample 1972-03 for conducted testing, no modifications were made to the units under test.

2.12 EUT Pictures

ARRIS Model VMS4100 Set Top Box Sample #1792-02 (Front View)

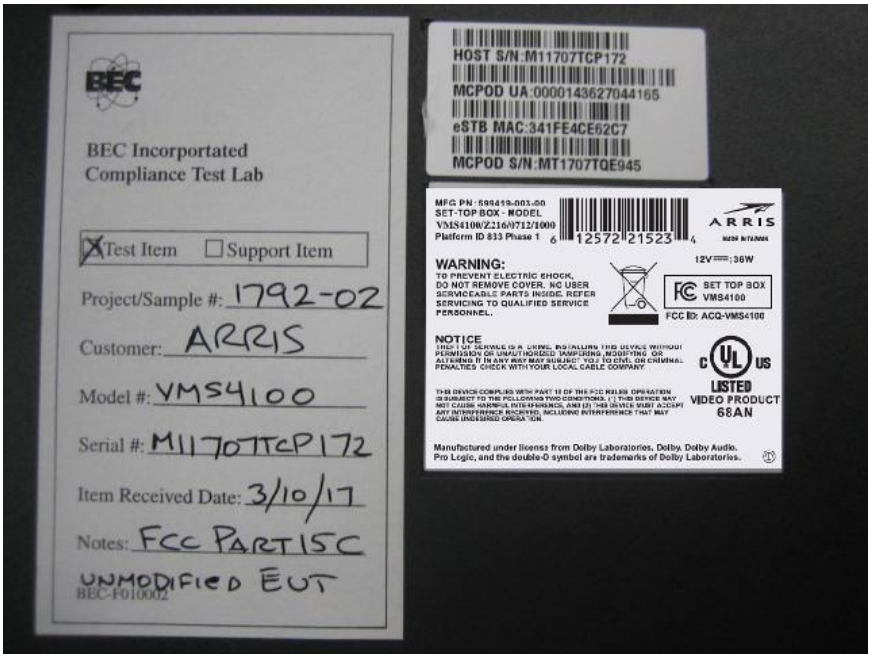
ARRIS Model VMS4100 Set Top Box Sample #1792-02 (Rear View)

ARRIS Model VMS4100 Set Top Box Sample #1792-02 (Build Tag)

ARRIS Model VMS4100 Set Top Box Sample #1792-02 (Bottom View)

ARRIS Model VMS4100 Set Top Box Sample #1792-02 (Top View)

ARRIS Model VMS4100 Set Top Box Sample #1792-02 (Sample Tag, Serial Number View)



ARRIS Model VMS4100 Set Top Box Sample #1792-03 (Front View)

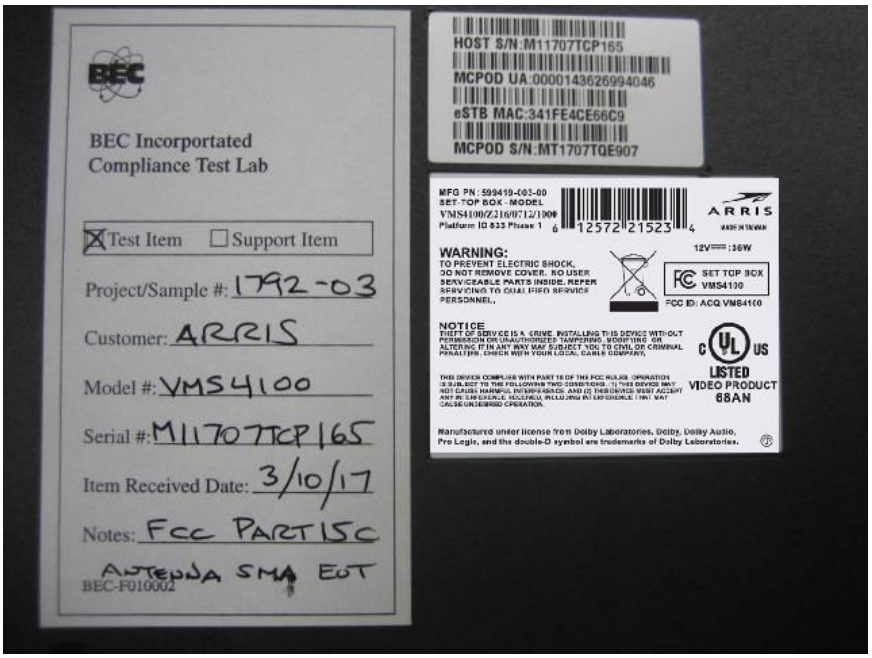
ARRIS Model VMS4100 Set Top Box Sample #1792-03 (Rear View)

ARRIS Model VMS4100 Set Top Box Sample #1792-03 (Build Tag)

ARRIS Model VMS4100 Set Top Box Sample #1792-03 (Bottom View)

ARRIS Model VMS4100 Set Top Box Sample #1792-03 (Top View)

ARRIS Model VMS4100 Set Top Box Sample #1792-03 (Sample Tag, Serial Number View)



ARRIS Model VMS4100 Set Top Box Sample #1792-03 (SMA to Antenna View)

ARRIS Model VMS4100 Set Top Box Sample #1792-03 (SMA to Antenna View) Close-up

Delta AC Adapter Sample # 1792-04

LITEON AC Adapter Sample # 1792-05

3.0 Applicable Requirements, Methods, and Procedures

3.1 Applicable Requirements

The results of the measurement of the radio disturbance characteristics of the EUT described herein may be applied and where appropriate, provide a presumption of compliance to one or more of the following requirements or to other requirements at the discretion of the customer, regulatory agencies, or other entities.

3.1.1 FCC Requirements

USA

Code of Federal Regulations:

Title 47 – Telecommunication

Chapter I - Federal Communications Commission

Sub-chapter A – General

Part 15 – Radio Frequency Devices

Subpart C - Intentional Radiators

3.1.2 Basic Test Methods and Test Procedures

ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

FCC Public Notice FCC DA 00-705, Released March 30, 2000, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems."

3.2 Deviations or Exclusions from the Requirements

No deviations or exclusions were made.

4.0 Test Results

4.1 Number of Operating Frequencies (47 CFR 15.31(m))

4.1.1 Hopping Frequency List

The table below details the 79 hopping frequencies contained in the 2.402 – 2.480 GHz band.

Channel	Frequency GHz	Channel	Frequency GHz	Channel	Frequency GHz	Channel	Frequency GHz
1	2.402	21	2.422	41	2.442	61	2.462
2	2.403	22	2.423	42	2.443	62	2.463
3	2.404	23	2.424	43	2.444	63	2.464
4	2.405	24	2.425	44	2.445	64	2.465
5	2.406	25	2.426	45	2.446	65	2.466
6	2.407	26	2.427	46	2.447	66	2.467
7	2.408	27	2.428	47	2.448	67	2.468
8	2.409	28	2.429	48	2.449	68	2.469
9	2.410	29	2.430	49	2.450	69	2.470
10	2.411	30	2.431	50	2.451	70	2.471
11	2.412	31	2.432	51	2.452	71	2.472
12	2.413	32	2.433	52	2.453	72	2.473
13	2.414	33	2.434	53	2.454	73	2.474
14	2.415	34	2.435	54	2.455	74	2.475
15	2.416	35	2.436	55	2.456	75	2.476
16	2.417	36	2.437	56	2.457	76	2.477
17	2.418	37	2.438	57	2.458	77	2.478
18	2.419	38	2.439	58	2.459	78	2.479
19	2.420	39	2.440	59	2.460	79	2.480
20	2.421	40	2.441	60	2.461		

Demonstration of compliance of intentional radiators that operate in a frequency range greater than 10 MHz shall test three frequencies, 1 near top, 1 near middle and 1 near bottom of range. The frequencies of 2.402, 2.441 and 2.480 GHz were selected for testing of the ARRIS VMS4100.

4.2 Antenna Requirement (47 CFR 15.203)

The antenna used by the ARRIS VMS4100, is a short trace on the main PCB of the EUT. There are no detachable parts of the antenna. The antenna is not replaceable, nor changeable, and therefore complies with the requirements of this section.

4.3 External RF power amplifiers and antenna modifications (47 CFR 15.204)

There are no RF power amplifier kits available to be used with the ARRIS VMS4100. There are no detachable parts of the antenna. The antenna is not replaceable, nor changeable, and therefore complies with the requirements of this section.

4.4 Restricted Bands of Operation (47 CFR 15.205) 30 MHz - 25 GHz

The emissions, from the ARRIS VMS4100, which fall in the restricted bands of operation, detailed in this section, comply with the limits of 15.209. The combinations of frequency and modulation that produced the highest emissions are shown. The EUT operated at maximum RF output at Low Frequency (LF) 2.402 MHz, Middle Frequency (MF) 2.441 GHz and High Frequency (HF) 2.480 GHz. GFSK (Gaussian Frequency Shift Keying), QPSK (Quadrture Phase Shift Keying) and 8PSK (Eight Phase Shift Keying) modulation methods were examined at each frequency.

Measurement of the signals was performed with the EUT on a turntable and a variable height antenna mast at 3 meters distance. The signals residing in restricted bands of operation were the second harmonic of the carrier. The table below shows the highest emission measured among the nine combinations of frequency and modulation.

4.4.1 Restricted Bands of Operation (47 CFR 15.205) and Spurious Emissions, 30 MHz – 1000 MHz

The tables below show the radiated emissions between 30 MHz and 1 GHz and transmitter harmonics of the VMS4100 EPR4, measured at a distance of 3 meters. The emissions were measured for each of the high, middle and low transmitter frequencies and with each of the three modulation types. From the total of the nine possible tables, the transmitter frequency of 2.408 GHz, with GFSK modulation, showed the highest emissions.

GFSK Channel 1 (2.408 GHz)								
Frequency	Peak	QP	Polarity	TT angle	Ant Height	CF	FCCB Limit	Margin
MHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB
32.958	20.32	19.18	H	187	200	-7.87	40.00	-20.82
60.215	32.72	33.40	V	124	114	-19.29	40.00	-6.60
64.786	35.76	33.87	V	156	120	-18.76	40.00	-6.13
66.295	37.32	36.30	V	153	134	-18.64	40.00	-3.70
86.057	34.09	32.56	V	019	108	-18.79	40.00	-7.44
87.639	35.31	33.63	V	009	125	-18.62	40.00	-6.37
88.871	34.35	33.54	V	009	120	-18.49	43.52	-9.98
89.672	33.77	31.98	V	004	149	-18.41	43.52	-11.54
90.348	33.56	32.13	V	355	110	-18.31	43.52	-11.39
94.350	33.48	31.99	V	020	111	-17.41	43.52	-11.53
98.404	34.23	32.56	V	131	119	-16.40	43.52	-10.96
101.899	36.22	34.74	V	121	128	-15.51	43.52	-8.78
104.743	37.22	35.83	V	163	116	-14.80	43.52	-7.69
106.669	36.37	34.90	V	160	150	-14.40	43.52	-8.62
107.989	35.45	34.95	V	343	116	-14.13	43.52	-8.57
108.022	23.65	23.80	H	107	110	-14.12	43.52	-19.72
128.902	18.11	15.41	H	264	160	-12.64	43.52	-28.11
131.510	23.74	24.27	H	272	144	-12.71	43.52	-19.25
132.888	32.74	30.35	V	351	190	-12.71	43.52	-13.17
188.990	27.51	24.84	H	256	190	-14.25	43.52	-18.68
201.222	19.83	18.27	H	239	127	-13.51	43.52	-25.25
324.031	28.87	29.01	H	272	107	-10.86	46.02	-17.01
350.993	39.95	39.69	H	306	111	-10.28	46.02	-6.33
377.997	37.39	36.68	H	347	154	-10.03	46.02	-9.34
405.002	39.50	38.60	H	347	106	-9.30	46.02	-7.42
432.001	36.78	36.14	H	347	118	-8.88	46.02	-9.88
458.993	30.63	29.04	H	054	106	-8.56	46.02	-16.98
485.992	28.63	28.27	H	335	107	-7.98	46.02	-17.75
960.043	22.11	21.89	H	307	108	-1.31	53.98	-32.09
971.985	28.63	22.69	H	046	113	-1.05	53.98	-31.29

4.4.2 Restricted Bands of Operation (47 CFR 15.205) 1 – 25 GHz

GFSK Channel 1 (2.402 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2026	45.04	43.59	V	215	121	-1.67	73.98	-28.94	53.98	-10.39
3.5190	42.43	28.89	V	340	101	-0.54	73.98	-31.55	53.98	-25.09
4.4946	47.73	31.90	V	323	100	1.10	73.98	-26.25	53.98	-22.08
4.4997	49.72	33.87	H	277	101.9	1.10	73.98	-24.26	53.98	-20.11
4.8037	56.18	51.47	V	233	124	2.25	73.98	-17.80	53.98	-2.51
4.8042	63.80	61.34	H	143	201.5	2.26	73.98	-10.18	53.98	7.36
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8037	43.7		V	215.6	142.3	2.25			53.98	-8.03
4.8040	34.9		H	145	197.2	2.26			53.98	-16.82

QPSK Channel 1 (2.402 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2027	44.83	42.76	V	279	195	-1.67	73.98	-29.15	53.98	-11.22
3.4548	39.63	27.75	V	101	101	-0.76	73.98	-34.35	53.98	-26.23
4.4972	43.98	31.40	H	044	100	1.10	73.98	-30.00	53.98	-22.58
4.4997	50.36	32.35	V	060	114	1.10	73.98	-23.62	53.98	-21.63
4.8000	68.40	61.50	V	215	130	2.24	73.98	-5.58	53.98	9.76
4.80E+09	67.10	60.10	H	143	186	2.26	73.98	-6.88	53.98	8.38
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8000	26.00		V	215	130	2.24			53.98	-25.74
4.80E+09	26.40		H	143	186	2.26			53.98	-25.32

8PSK Channel 1 (2.402 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.4792	37.80	27.89	H	187	209.9	-0.67	73.98	-36.18	53.98	-26.09
3.2027	44.84	42.51	V	223	101	-1.67	73.98	-29.14	53.98	-11.47
3.4851	40.41	28.31	V	093	101	-0.65	73.98	-33.57	53.98	-25.67
4.4794	50.35	33.13	V	312	102	1.10	73.98	-23.63	53.98	-20.85
4.8040	61.10	53.30	H	204	101	2.26	73.98	-12.88	53.98	1.58
4.8040	67.00	59.40	V	213.6	133.3	2.31	73.98	-6.98	53.98	7.73
4.8173	38.48	30.23	V	004	123	2.31	73.98	-35.50	53.98	-23.75
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8040	27.2		V	213.6	133.3	2.31			53.98	-24.47
4.8040	22.3		H	204	101	2.26			53.98	-29.42

GFSK Channel 40 (2.441 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2547	46.35	43.90	H	192	122	-1.48	73.98	-70.73	53.98	-10.08
3.2547	48.04	44.84	V	185	103	-1.48	73.98	-25.94	53.98	-9.14
4.4916	50.71	33.27	V	051	102	1.10	73.98	-23.27	53.98	-20.71
4.4963	47.78	31.60	H	059	101	1.10	73.98	-69.48	53.98	-22.38
4.8820	64.10	60.60	V	215	136	2.56	73.98	-9.88	53.98	9.18
4.8823	50.67	46.66	H	118	100	2.55	73.98	-69.10	53.98	-7.32
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8820	39.20		V	215	136	2.56			53.98	-12.22

QPSK Channel 40 (2.441 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2547	46.30	40.60	H	151	140	-1.48	73.98	-27.68	53.98	-13.38
3.2573	34.70	26.66	V	267	099	-1.47	73.98	-39.28	53.98	-27.32
4.4996	51.96	33.15	V	060	101	1.10	73.98	-22.02	53.98	-20.83
4.5002	42.85	30.75	H	315	180	1.10	73.98	-31.13	53.98	-23.23
4.8817	66.70	59.60	V	219	145	2.55	73.98	-7.28	53.98	8.17
4.8822	67.20	60.50	H	144	179	2.55	73.98	-6.78	53.98	9.07
7.3233	55.71	47.08	V	154	101	5.33	73.98	-18.27	53.98	-6.90
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8817	41.30		V	219	145	2.55			53.98	-10.13
4.8822	40.60		H	144	179	2.55			53.98	-10.83

8PSK Channel 40 (2.441 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2546	44.78	42.87	V	215	100	-1.48	73.98	-29.20	53.98	-11.11
3.2547	44.90	43.15	H	192	121	-1.48	73.98	-29.08	53.98	-10.83
4.4964	50.49	33.30	V	313	106	1.10	73.98	-23.49	53.98	-20.68
4.8819	68.30	60.90	V	227	112	2.55	73.98	-5.68	53.98	9.47
4.8820	65.00	58.17	H	149	207	2.55	73.98	-8.98	53.98	4.19
7.3232	56.56	48.67	V	222	113	5.33	73.98	-17.42	53.98	-5.31
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8819	27.25		V	227	112	2.55			53.98	-53.98
4.8820	25.90	25.08	H	149	207	2.55			53.98	-28.90

GFSK Channel 79 (2.480 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.3067	47.79	44.37	H	166	124	-1.30	73.98	-26.19	53.98	-9.61
3.5960	41.46	30.56	V	315	100	-0.29	73.98	-32.52	53.98	-23.42
4.4980	49.06	32.18	H	060	101	1.10	73.98	-24.92	53.98	-21.80
4.4997	53.07	33.71	V	060	102	1.10	73.98	-20.91	53.98	-20.27
4.9603	63.30	60.50	V	193	103	2.85	73.98	-10.68	53.98	9.37
4.9603	62.90	60.00	H	146	182	2.85	73.98	-11.08	53.98	8.87
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.9603	34.30		V	149	100	2.85			53.98	-16.83
4.9603	34.40		H	146	182	2.85			53.98	-16.73

QPSK Channel 79 (2.480 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.3066	45.34	41.44	V	181	100	-1.30	73.98	-28.64	53.98	-12.54
3.3066	46.39	44.80	H	164	173	-1.30	73.98	-27.59	53.98	-9.18
4.4927	51.10	33.97	V	312	101	1.10	73.98	-22.88	53.98	-20.01
4.4958	46.57	31.38	H	303	100	1.10	73.98	-27.41	53.98	-22.60
4.9596	65.90	59.20	V	228	102	2.85	73.98	-8.08	53.98	8.07
4.9601	64.60	57.30	H	144	131	2.85	73.98	-9.38	53.98	6.17
7.4403	53.99	46.18	V	225	103	5.71	73.98	-19.99	53.98	-7.80
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.9596	25.00		V	228	102	2.85			53.98	-26.13
4.9601	27.20		H	144	131	2.85			53.98	-23.93

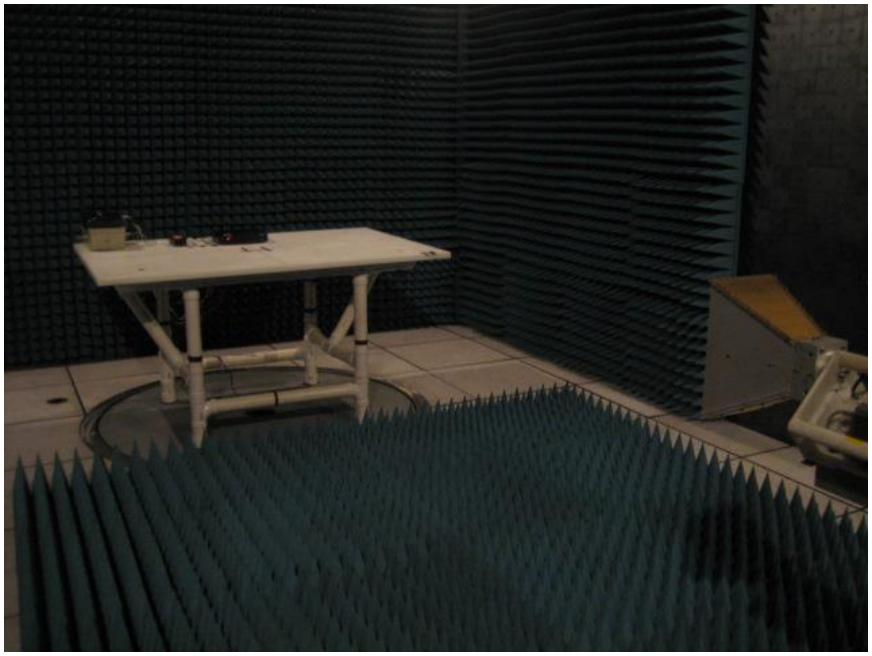
8PSK Channel 79 (2.480 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.3066	46.46	44.36	H	168	177	-1.30	73.98	-27.52	53.98	-9.62
3.3095	35.95	27.23	V	339	148	-1.29	73.98	-38.03	53.98	-26.75
4.4783	44.78	29.19	H	047	100	1.10	73.98	-29.20	53.98	-24.79
4.4834	48.85	33.18	V	312	100	1.10	73.98	-25.13	53.98	-20.80
4.9599	63.70	56.10	H	127	155	2.85	73.98	-10.28	53.98	4.97
4.9600	65.40	57.90	V	194	144	2.85	73.98	-8.58	53.98	6.77
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.9599	24.10	24.50	H	127	155	2.85			53.98	-27.03
4.9600	24.50	24.70	V	194	144	2.85			53.98	-26.63

Test Results: The ARRIS VMS4100 EPR4 complies with the requirements of 47 CFR Part 15.205. Spurious emissions, from 30 – 1000 MHz and the second and third harmonics of the transmitter frequency, were measured. The second harmonic of the transmitter, using average detected signals levels exceeded the limits of 15.209, were re-measured with reduced bandwidth of 10 Hz as permitted by DA-00-705.

4.4.1 Restricted Bands of Operation (47 CFR 15.205) Test Setup Pictures

30 – 1000 MHz

1 – 18 GHz



4.5 Conducted Emissions AC power leads (47 CFR 15.207(b))

AC Power Line

Conducted emissions at the power line input of the EUT were measured with an EMI receiver set to the appropriate detector and CISPR bandwidth, which was connected to the RF output of a 50 Ω, 50 µH Line Impedance Stabilization Network (LISN) installed in each power line. Measurements were made over the frequency range of 150 kHz to 30 MHz while the EUT was operating as described in the EUT section of this report. The significant amplitudes of emissions measured on the AC power lines of the EUT were recorded as follows:

Emission (dBµV) = Meter Reading (dBµv) + Cable Loss (dB) + LISN Factor (dB) + Limiter Loss (dB)

4.5.1 Conducted Emissions AC power leads (47 CFR 15.207(b)) EUT Test Configuration Description

The ARRIS Model VMS4100 Set Top Box Sample 1792-02 was tested with both the Delta Model ADP-36KR A Power Supply Sample 1792-04 with the 3 Different Modulation Schemes testing each at a Low (2402 MHz), Medium (2441 MHz) and High (2480 MHz) Frequency. The testing was then repeated using the LITEON Model PB-1360-05R4 Power Supply Sample 1792-05.

4.5.2 Conducted Emissions AC power leads (47 CFR 15.207(b)) EUT Test Results Summary For Delta Model ADP-36KR A Power Supply Sample 1792-04 (03/20/2017)

The summary table below shows the highest average and quasi-peak detected signals for each of nine configurations tested. Detailed tabular results for the worst case levels follow.

Summary Table of Conducted Emission measurements of the AC power leads (Delta PS)

Modulation Scheme	Frequency (MHz)	L1 Avg Margin	L1 QP Margin	L2 Avg Margin	L2 QP Margin
GFSK	2402	-25.15	-22.36	-24.1	-20.7
GFSK	2441	-21.4	-20.9	-24.1	-20.9
GFSK	2480	-25.16	-22.05	-24	-21.08
QPSK	2402	-25.46	-21.42	-23.82	-20.54
QPSK	2441	-24.81	-21.48	-23.92	-21.99
QPSK	2480	-24.67	-21.7	-24.1	-20.59
8-DPSK	2402	-25.26	-22.77	-24.07	-21.06
8-DPSK	2441	-25.28	-21.44	-24.32	-20.65
8-DPSK	2480	-25.31	-21.78	-24.15	-22

4.5.3 Conducted Emissions, AC power line, 47 CFR 15.207(b)

BEC INC.
Line 1 Conducted Emissions
11:30:21 AM, Monday, March 20, 2017

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.467 KHz	28.02	55.99	-27.96	44.57	65.99	-21.42	0.130
381.415 KHz	16.32	49.39	-33.07	26.29	59.39	-33.10	0.130
1.933 MHz	20.04	46.00	-25.96	26.51	56.00	-29.49	0.217
2.279 MHz	19.84	46.00	-26.16	26.77	56.00	-29.23	0.231
2.407 MHz	20.54	46.00	-25.46	27.67	56.00	-28.33	0.236
2.573 MHz	20.20	46.00	-25.80	27.70	56.00	-28.30	0.244
2.825 MHz	18.51	46.00	-27.49	26.65	56.00	-29.35	0.259
4.221 MHz	19.23	46.00	-26.77	29.17	56.00	-26.83	0.315
13.301 MHz	19.85	50.00	-30.15	26.12	60.00	-33.88	0.713
15.450 MHz	23.75	50.00	-26.25	29.40	60.00	-30.60	0.762
Project# - BEC-1792							
Configuration - ARRIS VMS4100 (QPSK at 2402)							
EUT - Delta Model ADP-36KR A							
Volt/Freq - 120Vac/60Hz							
Test Spec - FCC Class B Limits FCC Part 15.207							

BEC INC.
Line 2 Conducted Emissions
11:37:26 AM, Monday, March 20, 2017

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.429 KHz	29.010	55.988	-26.978	45.440	65.988	-20.548	0.130
199.039 KHz	21.477	54.599	-33.121	38.770	64.599	-25.829	0.130
1.994 MHz	22.177	46.000	-23.823	28.080	56.000	-27.920	0.210
2.263 MHz	21.696	46.000	-24.304	28.566	56.000	-27.434	0.226
2.434 MHz	21.776	46.000	-24.224	28.896	56.000	-27.104	0.236
2.669 MHz	20.473	46.000	-25.527	28.770	56.000	-27.230	0.250
2.729 MHz	19.279	46.000	-26.721	28.734	56.000	-27.266	0.254
3.993 MHz	19.975	46.000	-26.025	29.025	56.000	-26.975	0.305
4.671 MHz	19.525	46.000	-26.475	28.325	56.000	-27.675	0.335
15.728 MHz	25.939	50.000	-24.061	31.749	60.000	-28.251	0.849
Project# - BEC-1792							
Configuration - ARRIS VMS4100 (QPSK at 2402)							
EUT - Delta Model ADP-36KR A							
Volt/Freq - 120Vac/60Hz							
Test Spec - FCC Class B Limits FCC Part 15.207							

4.5.4 Conducted Emissions AC power leads (47 CFR 15.207(b)) EUT Test Results Summary For LITEON Model PB-1360-05R4 Power Supply Sample 1792-05 (03/17/2017)

The table below shows the results for all Conducted Emissions testing for the ARRIS Model VMS4100 Set Top Box Sample 1792-02 when tested with the LITEON Model PB-1360-05R4 Sample 1792-05 with the 3 Different Modulation Schemes Testing each at a Low (2402 MHz), Medium (2441 MHz) and High (2480 MHz) Frequency.

Summary Table of Conducted Emission measurements of the AC power leads (Liteon PS)

Modulation Scheme	Frequency (MHz)	L1 Avg Margin	L1 QP Margin	L2 Avg Margin	L2 QP Margin
GFSK	2402	-16.1	-12.89	-16.53	-13.27
GFSK	2441	-18.11	-14.73	-27.33	-13.16
GFSK	2480	-24.57	-14.29	-18.27	-14.8
QPSK	2402	-19.86	-16.17	-20.85	-16.55
QPSK	2441	-18.38	-15.6	-21.92	-16.94
QPSK	2480	-19.28	-15.74	-26.05	-20.75
8-DPSK	2402	-24.09	-20.15	-21.49	-17.55
8-DPSK	2441	-19.59	-17.04	-25.19	-21.75
8-DPSK	2480	-20.68	-16.9	-18.75	-17.55

4.5.5 Conducted Emissions AC power leads (47 CFR 15.207(b)) EUT Test Results Table and Graph For LITEON Model PB-1360-05R4 Power Supply Sample 1792-05 (GFSK @ 2402 MHz Worst Case)

BEC INC.
Line 1 Conducted Emissions
12:41:23 PM, Friday, March 17, 2017

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.545 KHz	28.12	55.98	-27.87	49.39	65.98	-16.59	0.130
153.445 KHz	25.59	55.90	-30.31	45.97	65.90	-19.93	0.130
164.653 KHz	39.48	55.58	-16.10	52.69	65.58	-12.89	0.130
181.294 KHz	34.18	55.11	-20.93	48.88	65.11	-16.23	0.126
205.823 KHz	30.25	54.41	-24.15	44.80	64.41	-19.61	0.120
245.691 KHz	24.05	53.27	-29.22	33.43	63.27	-29.84	0.120
269.494 KHz	23.43	52.59	-29.16	35.83	62.59	-26.76	0.120
294.763 KHz	23.60	51.86	-28.27	34.92	61.86	-26.94	0.120
324.250 KHz	16.12	51.02	-34.90	29.72	61.02	-31.30	0.125
398.564 KHz	21.12	48.90	-27.78	29.08	58.90	-29.82	0.130
Project# - BEC-1792							
Configuration - ARRIS VMS4100 (GFSK at 2402)							
EUT - LITEON Model PB-1360-05R4							
Volt/Freq - 120Vac/60Hz							
Test Spec - FCC Class B Limits FCC Part 15.207							

BEC INC.
Line 2 Conducted Emissions
12:48:31 PM, Friday, March 17, 2017

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.055 KHz	28.290	55.998	-27.708	45.160	65.998	-20.838	0.130
164.775 KHz	39.045	55.578	-16.533	52.300	65.578	-13.278	0.130
178.175 KHz	34.615	55.195	-20.580	49.540	65.195	-15.655	0.130
188.423 KHz	30.002	54.902	-24.900	44.750	64.902	-20.152	0.130
207.507 KHz	30.400	54.357	-23.957	44.790	64.357	-19.567	0.130
253.120 KHz	22.792	53.054	-30.261	37.660	63.054	-25.394	0.130
288.820 KHz	22.920	52.034	-29.114	35.610	62.034	-26.424	0.130
309.468 KHz	19.269	51.444	-32.174	31.842	61.444	-29.602	0.132
333.945 KHz	18.462	50.744	-32.283	28.747	60.744	-31.998	0.137
447.117 KHz	20.014	47.511	-27.497	28.889	57.511	-28.622	0.149
Project# - BEC-1792							
Configuration - ARRIS VMS4100 (GFSK at 2402)							
EUT - LITEON Model PB-1360-05R4							
Volt/Freq - 120Vac/60Hz							
Test Spec - FCC Class B Limits FCC Part 15.207							

4.5.6 Conducted Emissions AC power leads (47 CFR 15.207(b)) Test Setup Picture

4.6 Spurious Radiated Emissions 1 – 25 GHz (47 CFR 15.209(a) & DA 00-705)

SR#1

The Semi-Anechoic Shielded Room (SR#1) is an ferrite and absorber lined chamber which houses a 5-foot diameter turntable capable of rotating equipment 360 degrees and antenna mast for Horizontal and Vertical polarity measurements. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This 3 meter shielded enclosure has a raised computer floor with metal tile bottoms providing a continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel outside the chamber. The EUT and support peripherals required for EUT operation were placed on a table 80 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment.

The test site complies with the attenuation measurements specified in ANSI C63.4:2014

Radiated Emissions 1 – 40 GHz

The EMI receiver was set to quasi-peak mode for frequencies from 30MHz to 1GHz and the appropriate CISPR bandwidths were employed. The receiver was set to average mode for frequencies above 1GHz with the appropriate CISPR bandwidths were employed. Significant emissions found during the preliminary scans were maximized by rotating the turntable and varying the antenna height. Both horizontal and vertical antenna polarities were also investigated for suspect emissions. The signals are maximized and measured using the in house generated RADE or off the shelf TILE software. The support equipment and test item(s) were powered off in turn to determine the source of the emissions where appropriate.

Field strengths were calculated as follows:

Field Strength (dBµV/m) = Meter Reading (dBµV) + Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)

4.6.1 Spurious Radiated Emissions 1 – 25 GHz Measurement

The spurious signal measurements made above 1 GHz are the same measurements made for 47 CFR Part 15.205. The detected signals were the second and third harmonics of the radio transmitter frequency. The levels were measured at low, middle and high frequencies utilizing GFSK, QPSK and 8PSK modulation. The test result tables show the second harmonic exceeds the Class B limit at several combinations of frequency and modulation. FCC DA 00-705 provides guidance in measuring signals with low duty cycles. Measurements are made with the Spectrum Analyzer RBW = 1 MHz and VBW = 3 MHz. A re-measurement is then made with the VBW reduced to 10 Hz. The peak level is then measured and compared to the FCC Class B limit at 3 meters.

GFSK Channel 1 (2.402 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2026	45.04	43.59	V	215	121	-1.67	73.98	-28.94	53.98	-10.39
3.5190	42.43	28.89	V	340	101	-0.54	73.98	-31.55	53.98	-25.09
4.4946	47.73	31.90	V	323	100	1.10	73.98	-26.25	53.98	-22.08
4.4997	49.72	33.87	H	277	101.9	1.10	73.98	-24.26	53.98	-20.11
4.8037	56.18	51.47	V	233	124	2.25	73.98	-17.80	53.98	-2.51
4.8042	63.80	61.34	H	143	201.5	2.26	73.98	-10.18	53.98	7.36
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8037	43.7		V	215.6	142.3	2.25			53.98	-8.03
4.8040	34.9		H	145	197.2	2.26			53.98	-16.82

QPSK Channel 1 (2.402 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2027	44.83	42.76	V	279	195	-1.67	73.98	-29.15	53.98	-11.22
3.4548	39.63	27.75	V	101	101	-0.76	73.98	-34.35	53.98	-26.23
4.4972	43.98	31.40	H	044	100	1.10	73.98	-30.00	53.98	-22.58
4.4997	50.36	32.35	V	060	114	1.10	73.98	-23.62	53.98	-21.63
4.8000	68.40	61.50	V	215	130	2.24	73.98	-5.58	53.98	9.76
4.80E+09	67.10	60.10	H	143	186	2.26	73.98	-6.88	53.98	8.38
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8000	26.00		V	215	130	2.24			53.98	-25.74
4.80E+09	26.40		H	143	186	2.26			53.98	-25.32

8PSK Channel 1 (2.402 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.4792	37.80	27.89	H	187	209.9	-0.67	73.98	-36.18	53.98	-26.09
3.2027	44.84	42.51	V	223	101	-1.67	73.98	-29.14	53.98	-11.47
3.4851	40.41	28.31	V	093	101	-0.65	73.98	-33.57	53.98	-25.67
4.4794	50.35	33.13	V	312	102	1.10	73.98	-23.63	53.98	-20.85
4.8040	61.10	53.30	H	204	101	2.26	73.98	-12.88	53.98	1.58
4.8040	67.00	59.40	V	213.6	133.3	2.31	73.98	-6.98	53.98	7.73
4.8173	38.48	30.23	V	004	123	2.31	73.98	-35.50	53.98	-23.75
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8040	27.2		V	213.6	133.3	2.31			53.98	-24.47
4.8040	22.3		H	204	101	2.26			53.98	-29.42

GFSK Channel 40 (2.441 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2547	46.35	43.90	H	192	122	-1.48	73.98	-70.73	53.98	-10.08
3.2547	48.04	44.84	V	185	103	-1.48	73.98	-25.94	53.98	-9.14
4.4916	50.71	33.27	V	051	102	1.10	73.98	-23.27	53.98	-20.71
4.4963	47.78	31.60	H	059	101	1.10	73.98	-69.48	53.98	-22.38
4.8820	64.10	60.60	V	215	136	2.56	73.98	-9.88	53.98	9.18
4.8823	50.67	46.66	H	118	100	2.55	73.98	-69.10	53.98	-7.32
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8820	39.20		V	215	136	2.56			53.98	-12.22

QPSK Channel 40 (2.441 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2547	46.30	40.60	H	151	140	-1.48	73.98	-27.68	53.98	-13.38
3.2573	34.70	26.66	V	267	099	-1.47	73.98	-39.28	53.98	-27.32
4.4996	51.96	33.15	V	060	101	1.10	73.98	-22.02	53.98	-20.83
4.5002	42.85	30.75	H	315	180	1.10	73.98	-31.13	53.98	-23.23
4.8817	66.70	59.60	V	219	145	2.55	73.98	-7.28	53.98	8.17
4.8822	67.20	60.50	H	144	179	2.55	73.98	-6.78	53.98	9.07
7.3233	55.71	47.08	V	154	101	5.33	73.98	-18.27	53.98	-6.90
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8817	41.30		V	219	145	2.55			53.98	-10.13
4.8822	40.60		H	144	179	2.55			53.98	-10.83

8PSK Channel 40 (2.441 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.2546	44.78	42.87	V	215	100	-1.48	73.98	-29.20	53.98	-11.11
3.2547	44.90	43.15	H	192	121	-1.48	73.98	-29.08	53.98	-10.83
4.4964	50.49	33.30	V	313	106	1.10	73.98	-23.49	53.98	-20.68
4.8819	68.30	60.90	V	227	112	2.55	73.98	-5.68	53.98	9.47
4.8820	65.00	58.17	H	149	207	2.55	73.98	-8.98	53.98	4.19
7.3232	56.56	48.67	V	222	113	5.33	73.98	-17.42	53.98	-5.31
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.8819	27.25		V	227	112	2.55			53.98	-53.98
4.8820	25.90	25.08	H	149	207	2.55			53.98	-28.90

GFSK Channel 79 (2.480 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.3067	47.79	44.37	H	166	124	-1.30	73.98	-26.19	53.98	-9.61
3.5960	41.46	30.56	V	315	100	-0.29	73.98	-32.52	53.98	-23.42
4.4980	49.06	32.18	H	060	101	1.10	73.98	-24.92	53.98	-21.80
4.4997	53.07	33.71	V	060	102	1.10	73.98	-20.91	53.98	-20.27
4.9603	63.30	60.50	V	193	103	2.85	73.98	-10.68	53.98	9.37
4.9603	62.90	60.00	H	146	182	2.85	73.98	-11.08	53.98	8.87
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.9603	34.30		V	149	100	2.85			53.98	-16.83
4.9603	34.40		H	146	182	2.85			53.98	-16.73

QPSK Channel 79 (2.480 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.3066	45.34	41.44	V	181	100	-1.30	73.98	-28.64	53.98	-12.54
3.3066	46.39	44.80	H	164	173	-1.30	73.98	-27.59	53.98	-9.18
4.4927	51.10	33.97	V	312	101	1.10	73.98	-22.88	53.98	-20.01
4.4958	46.57	31.38	H	303	100	1.10	73.98	-27.41	53.98	-22.60
4.9596	65.90	59.20	V	228	102	2.85	73.98	-8.08	53.98	8.07
4.9601	64.60	57.30	H	144	131	2.85	73.98	-9.38	53.98	6.17
7.4403	53.99	46.18	V	225	103	5.71	73.98	-19.99	53.98	-7.80
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.9596	25.00		V	228	102	2.85			53.98	-26.13
4.9601	27.20		H	144	131	2.85			53.98	-23.93

8PSK Channel 79 (2.480 GHz)										
Frequency	Peak Level	Avg Level	Ant Pol	Azimuth	Ant Hght	C/F	Peak Limit	Peak Margin	Avg Limit	Avg Margin
GHz	dBuV/m	dBuV/m	H/V	degrees	cm	dB	dBuV/m	dB	dBuV/m	dB
measured peak and average with 1MHz RBW, 3 MHz VBW (47 CFR Part 15.205, 15.209)										
3.3066	46.46	44.36	H	168	177	-1.30	73.98	-27.52	53.98	-9.62
3.3095	35.95	27.23	V	339	148	-1.29	73.98	-38.03	53.98	-26.75
4.4783	44.78	29.19	H	047	100	1.10	73.98	-29.20	53.98	-24.79
4.4834	48.85	33.18	V	312	100	1.10	73.98	-25.13	53.98	-20.80
4.9599	63.70	56.10	H	127	155	2.85	73.98	-10.28	53.98	4.97
4.9600	65.40	57.90	V	194	144	2.85	73.98	-8.58	53.98	6.77
Re-measured peak with 1MHz RBW, 10 Hz VBW (FCC DA 00-705)										
4.9599	24.10	24.50	H	127	155	2.85			53.98	-27.03
4.9600	24.50	24.70	V	194	144	2.85			53.98	-26.63

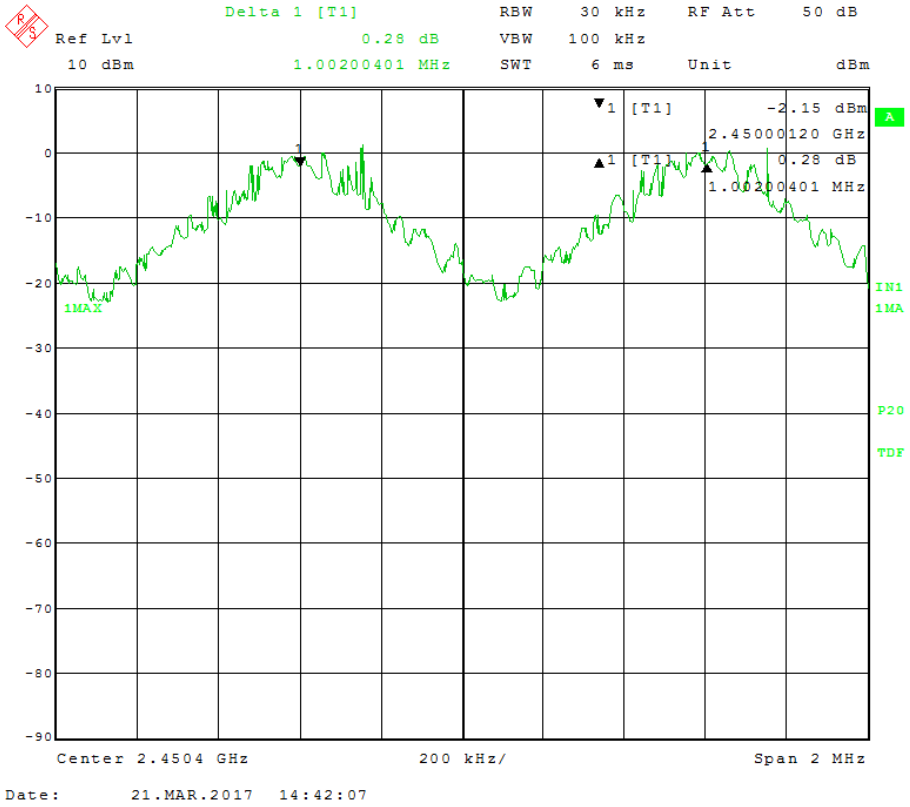
Test Results: The ARRIS VMS4100 EPR4 complies with the requirements of 47 CFR Part 15.209. Spurious emissions, namely the second and third harmonics of the transmitter frequency, were measured. Those average detected signals levels that exceeded the limits of 15.209, were re-measured with reduced bandwidth of 10 Hz as permitted by DA-00-705.

4.7 Carrier Frequency Separation (47 CFR 15.247(a)(1)) (03/21/2017)

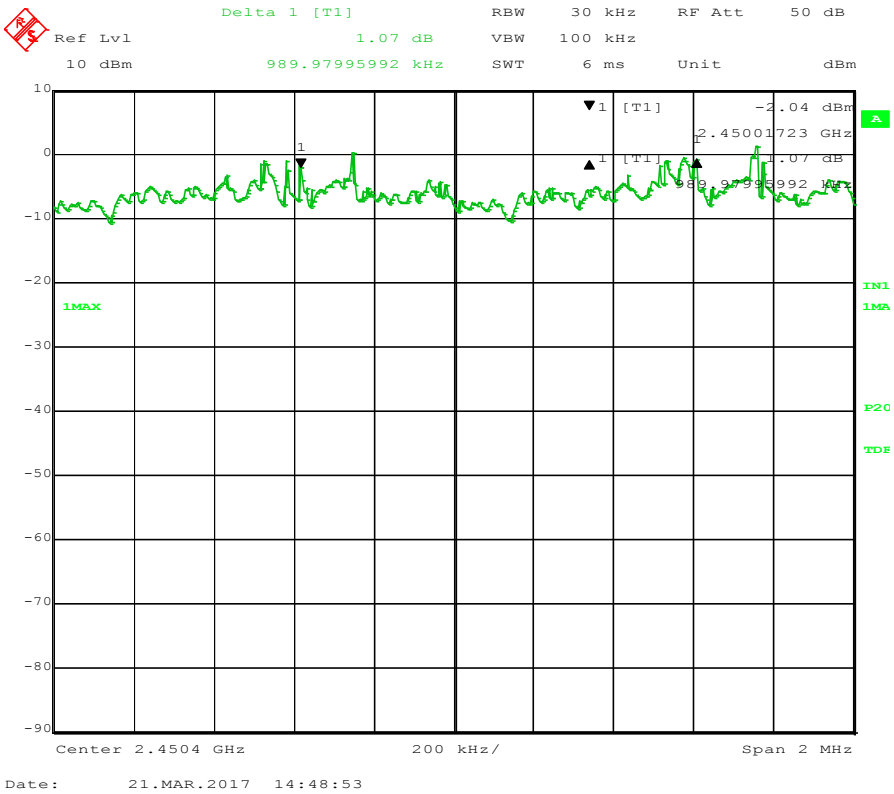
Hopping Channels must be separated by a minimum of 25 kHz or 2/3 of the 20 dB bandwidth whichever is greater. The first table shows the 2/3 value of the 20 dB bandwidths of each low, middle and high frequencies with the three types of modulation from Section 4.10. Basic Data Rate (BDR) speed is 1 Mbps (Megabits per second) and uses GFSK modulation. Enhanced Data Rate (EDR) is 2 Mbps. The measured channel separation is shown on the screen graph and table depicted below.

2/3 of 20 dB Bandwidth			
Frequency	GFSK Modulation	QPSK Modulation	8-DPSK Modulation
GHz	MHz	MHz	MHz
2.408	0.581	0.907	0.900
2.441	0.577	0.907	0.893
2.480	0.581	0.907	0.900

BDR (Basic Data Rate) 1 Mbps



EDR (Enhanced Data Rate) 2 Mbps



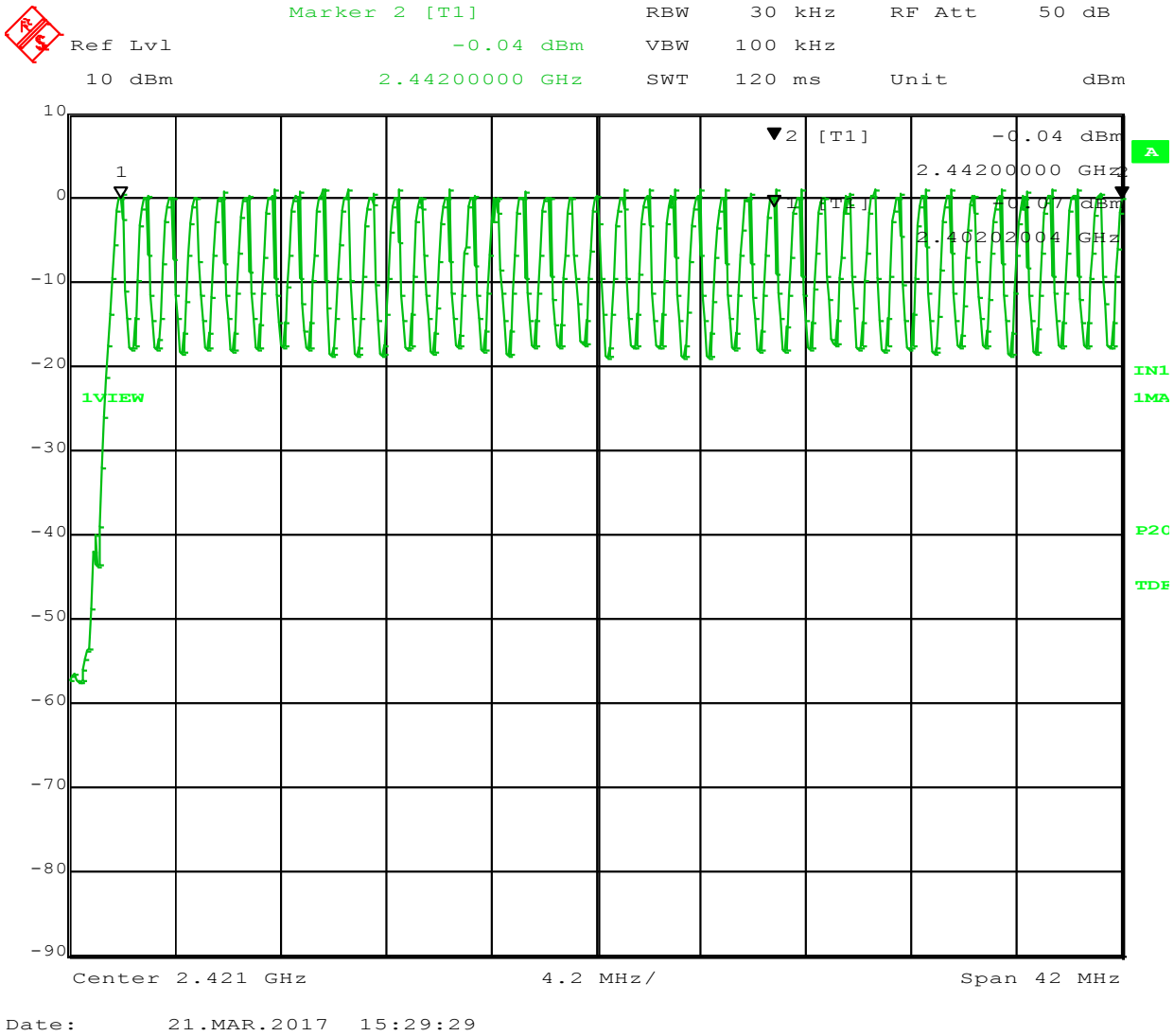
Minimum Bandwidth (GFSK @ 2.48 GHz)	Measured Hopping Channel Separation	
	BDS	EDS
(MHz)	(MHz)	(MHz)
0.581	**1.0020**	**0.9900**

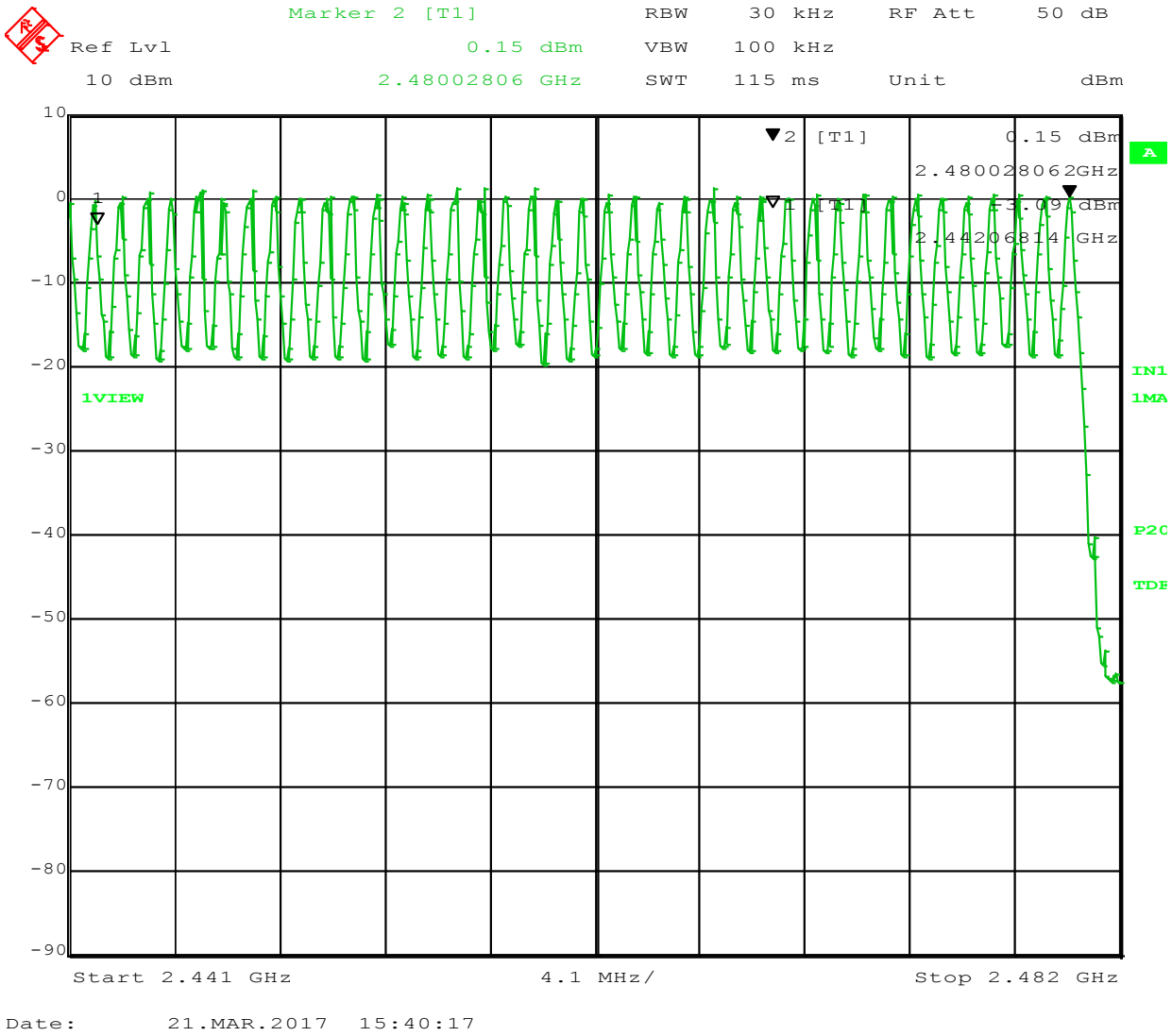
Test Results: The Channel spacing for BDR and EDR Modes are 1.002 and .99 MHz respectively. These values are greater than the minimum 2/3 value of the 20 dB bandwidth required by 47 CFR Part 15.246 (a)(1).

4.8 Number of Hopping Frequencies (47 CFR 15.247(a)(1)(iii)) (03/21/2017)

The hopping frequencies utilized by the VMS4100 were measured directly from the transmitter output of the EUT for BDR and EDR. The displays captured from the Spectrum Analyzer show the range of 2.402 to 2.480 using two separate scans for each transmission rate.

BDR (Basic Data Rate) 1 Mbps





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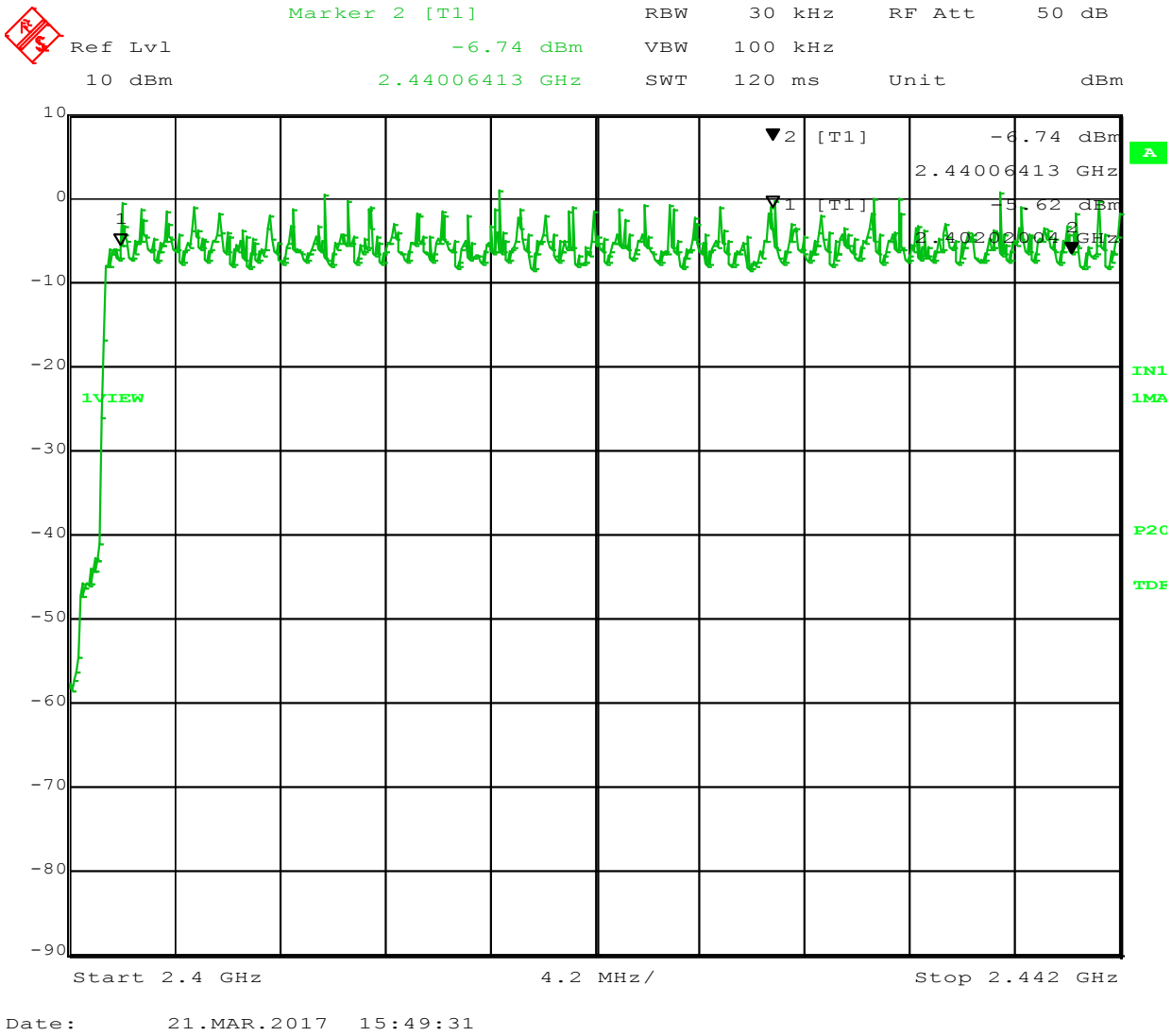
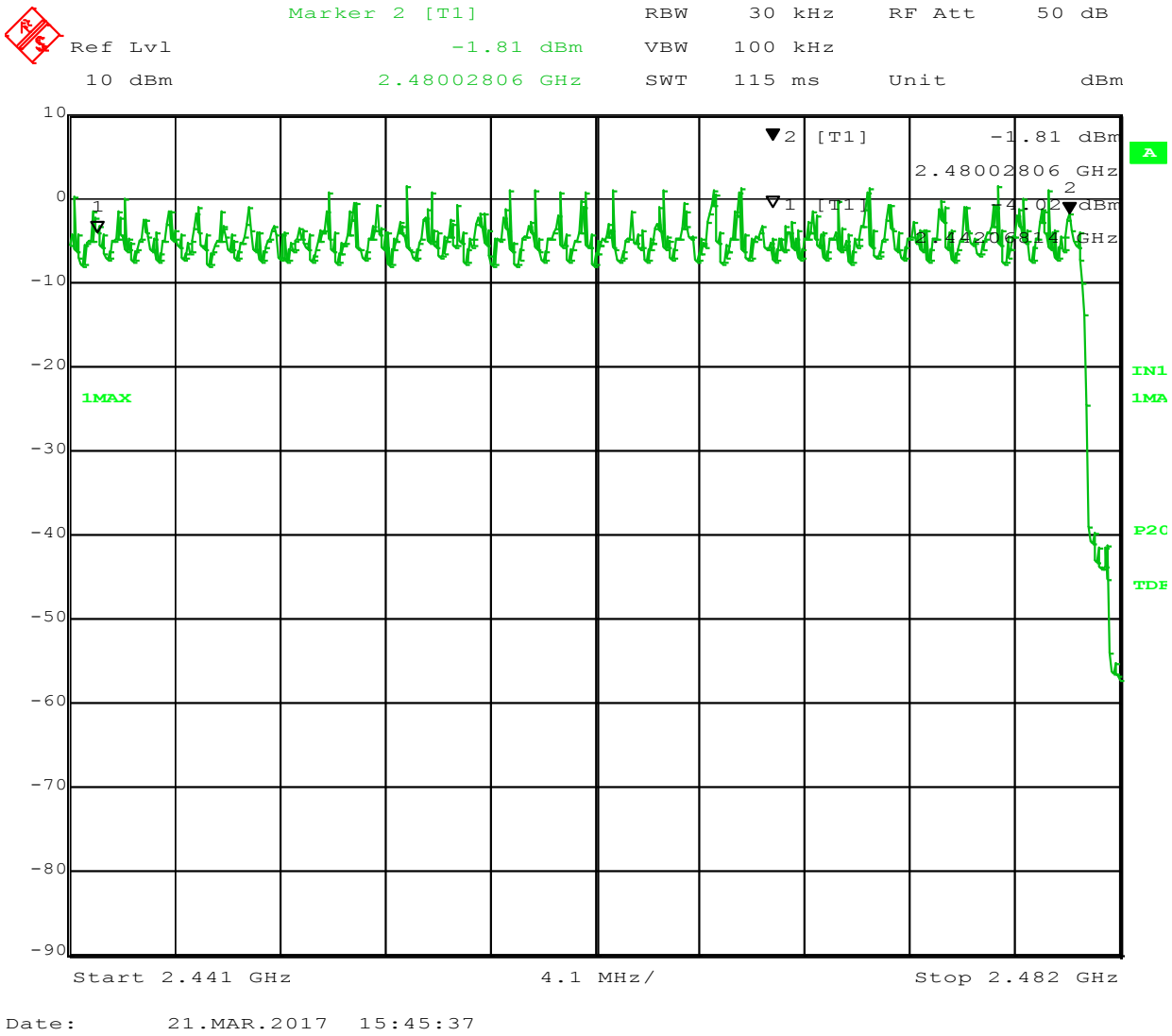
(EDR) Enhanced Data Rate 1 Mbps



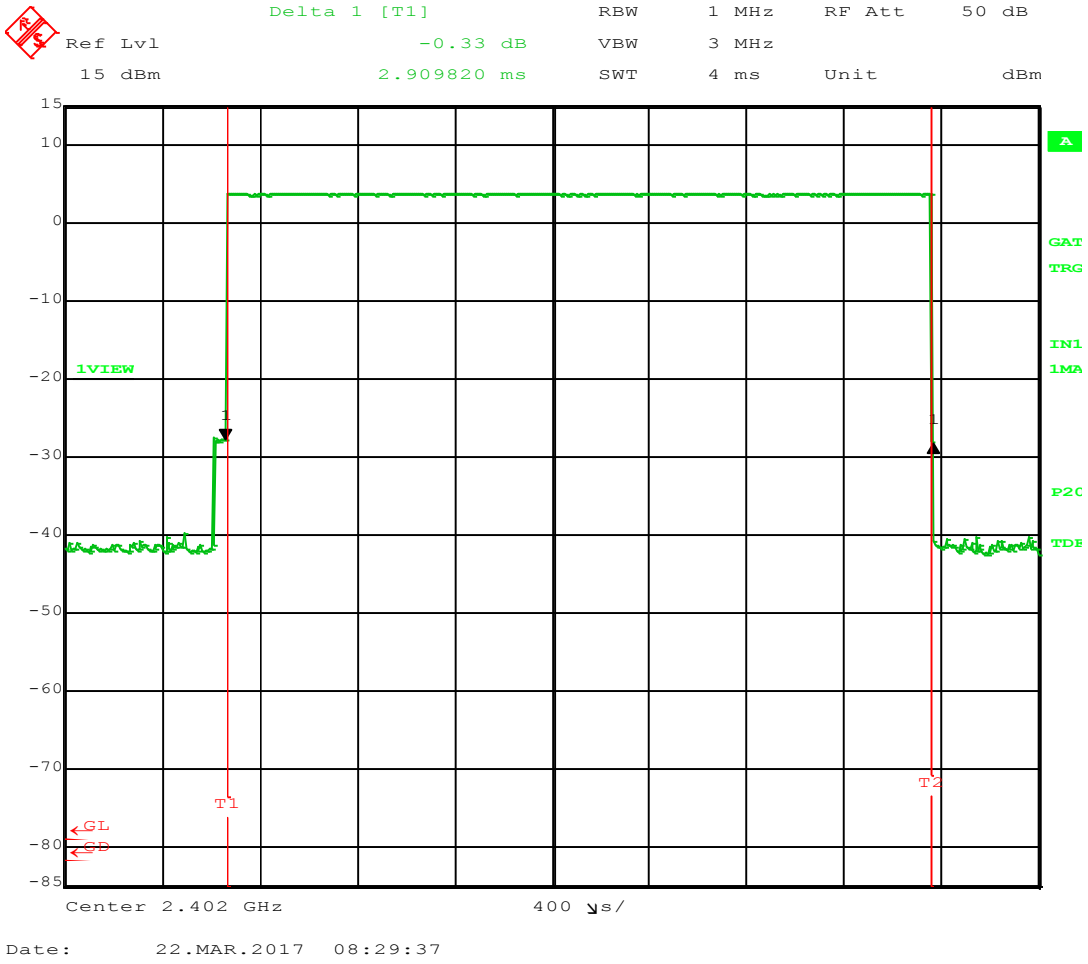


Test Results: The number of hopping frequencies is 79 for both BDR and EDR modes. This complies with the requirements of 47 CFR 15.247(a)(1)(iii).

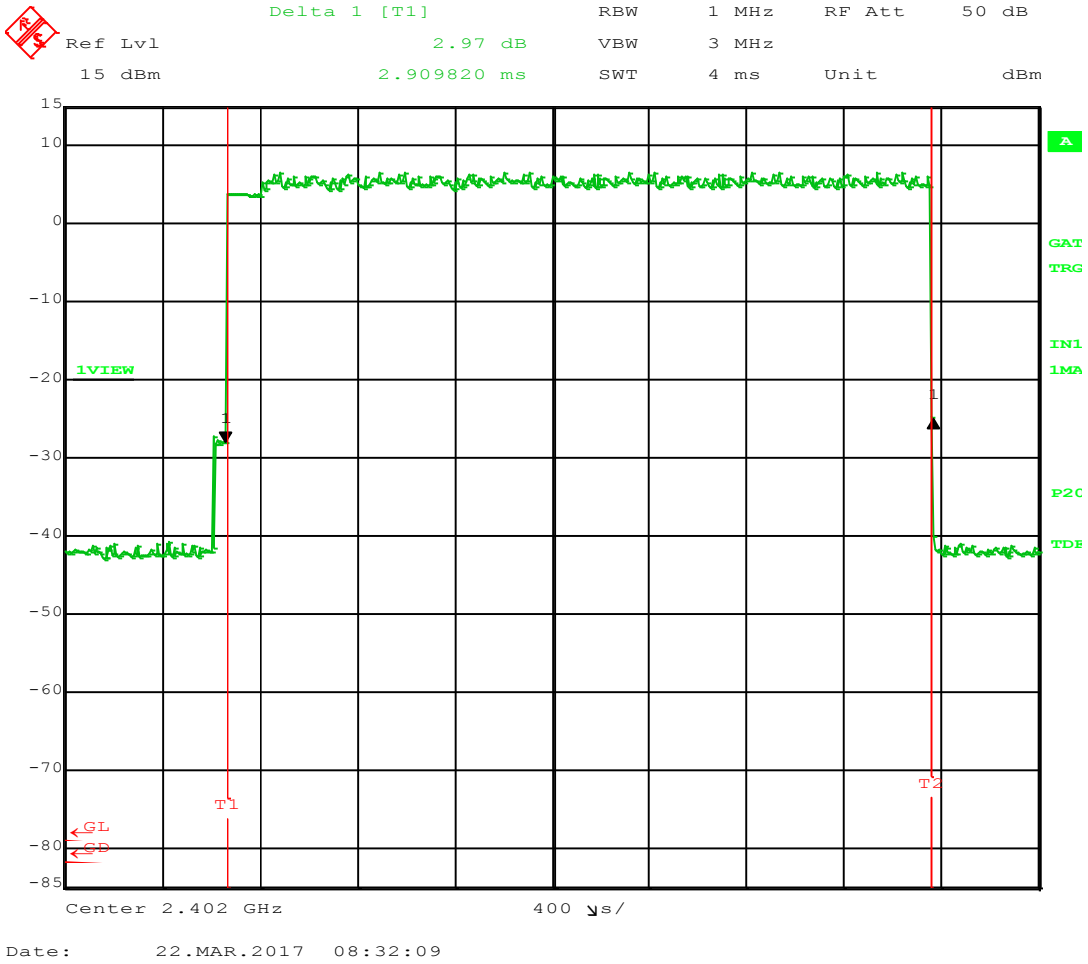
4.9 Time of Occupancy (Dwell Time) (47 CFR 15.247(a)(1)(iii)) (03/22/2017)

Section (a)(1)(iii) of 15.247 requires the average occupancy time of the hopping frequency system shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed (79 channels). The following displays show the measured occupancy time for both data rates.

BDR (Basic Data Rate) 1 Mbps (2.9098 ms)



EDR (Enhanced Data Rate) 2 Mbps (2.9098 ms)



4.9.1 Time of Occupancy (Dwell Time) (47 CFR 15.247(a)(1)(iii)) Summary Table

The calculation to determine occupancy time:

79 Hopping Channels X .4 seconds = 31.6 maximum transmission time. DH5 packet utilizes 5 time slots. The hopping rate is 1600 hops/second. Maximum dwell is 5/1600 = 3.125 ms. DH5 maximum hops per second is 1600 hops/second, 79 channels, 6 time slots (5Tx, 1Rx); 1600/79/6 = 3.37 hops/second in each channel. Dwell time: hops/sec each channel (3.37 ms) X maximum transmission time (31.6) = 106.6.

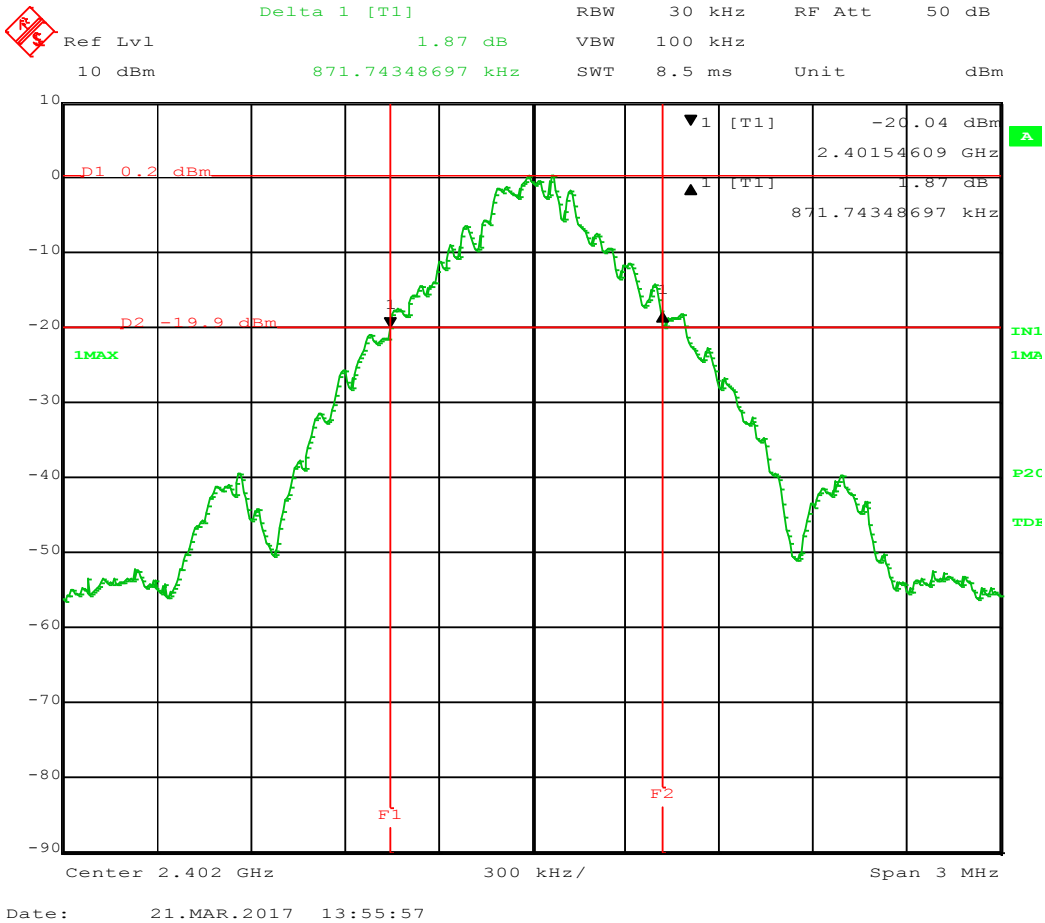
Modulation	Frequency	Measured Transmission Time	# of transmissions in band	Dwell Time	Limit	Result
	(MHz)	msec		seconds	seconds	
BDR	2.402 GHz	2.91	106.6	0.31	0.40	PASS
EDR	2.402 GHz	2.91	106.6	0.31	0.40	PASS

4.10 20 dB Bandwidth, 47 CFR 15.247(a)(1)(i), FCC DA 00-705, ANSI C63.10, (6.9.2).

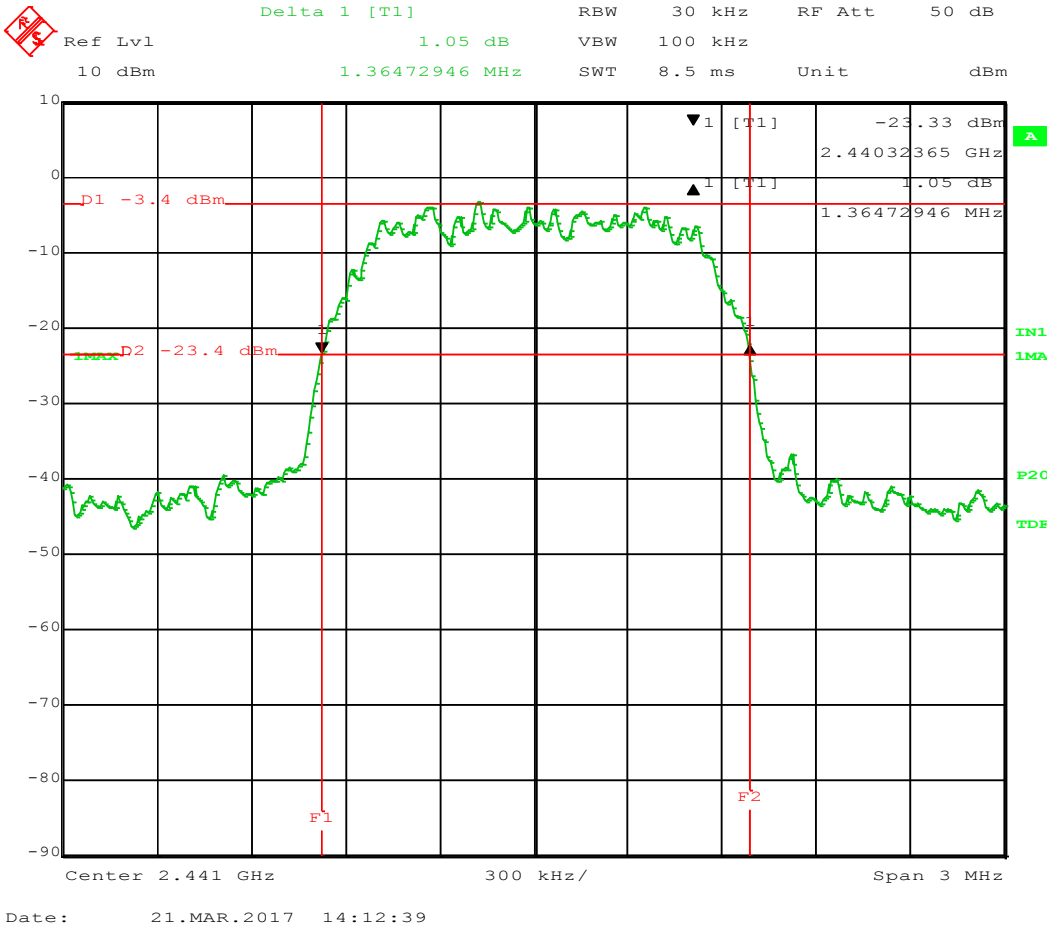
The following table contains the 20 dB bandwidth measured for each of the modulation schemes and low, middle and high frequency channels. The displays show the highest of each of the modulation schemes.

	20 dB Bandwidth		
Frequency	GFSK Modulation	QPSK Modulation	8-DPSK Modulation
GHz	kHz	MHz	MHz
2.402	**871.74**	**1.36**	**1.35**
2.441	**865.71**	**1.36**	**1.34**
2.480	**871.74**	**1.36**	**1.35**

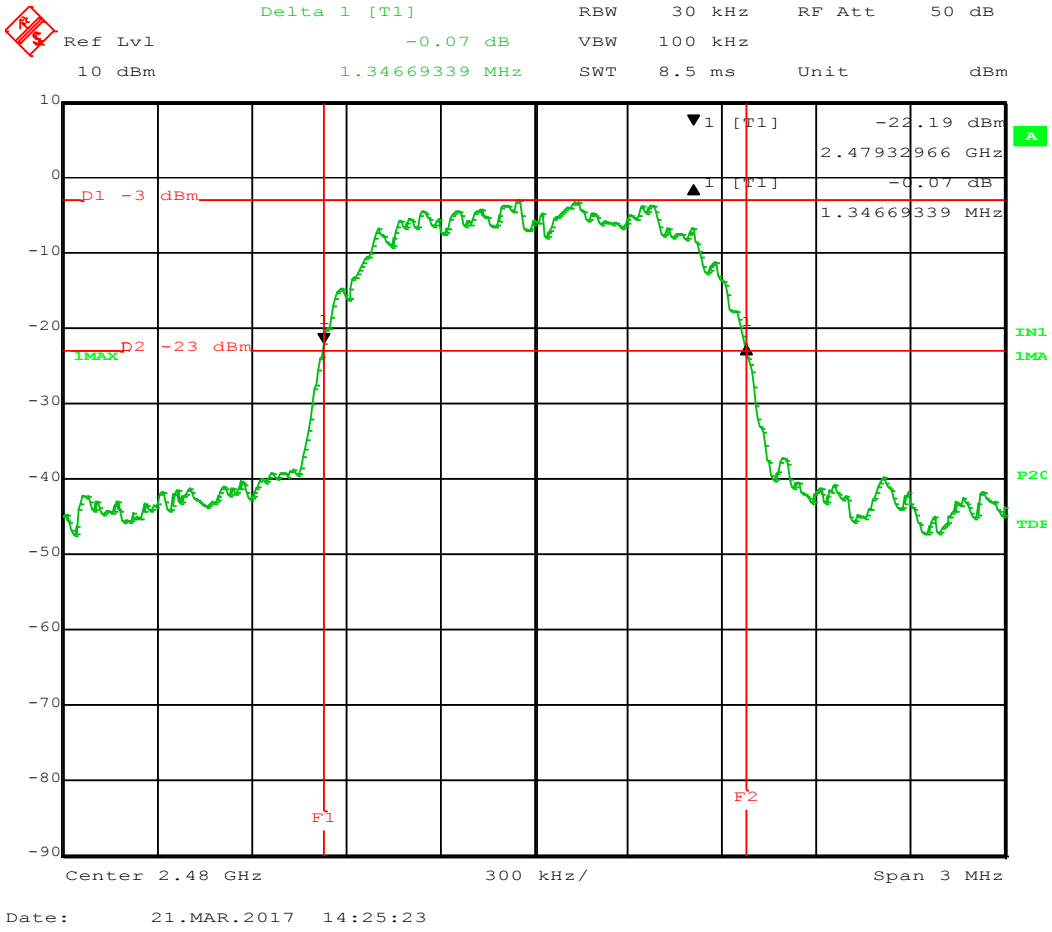
GFSK Modulation



QPSK Modulation



8-DPSK Modulation



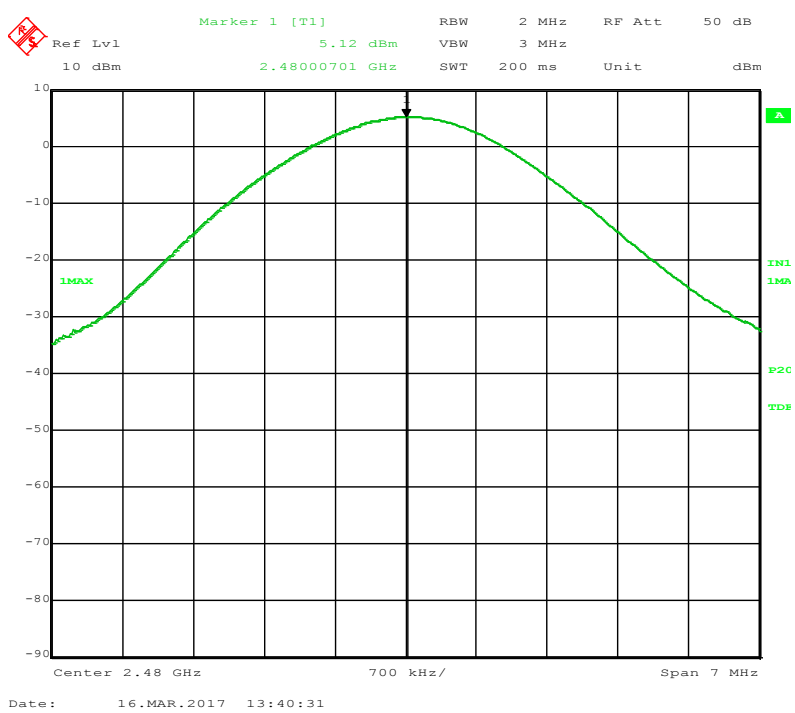
Test Results: The VMS4100, 20 dB bandwidth, for each of the modulation methods is used to determine the channel separation in section 4.7.

4.11 Maximum Peak Power Output, 47 CFR 15.247(b)(1) (03/16/2017)

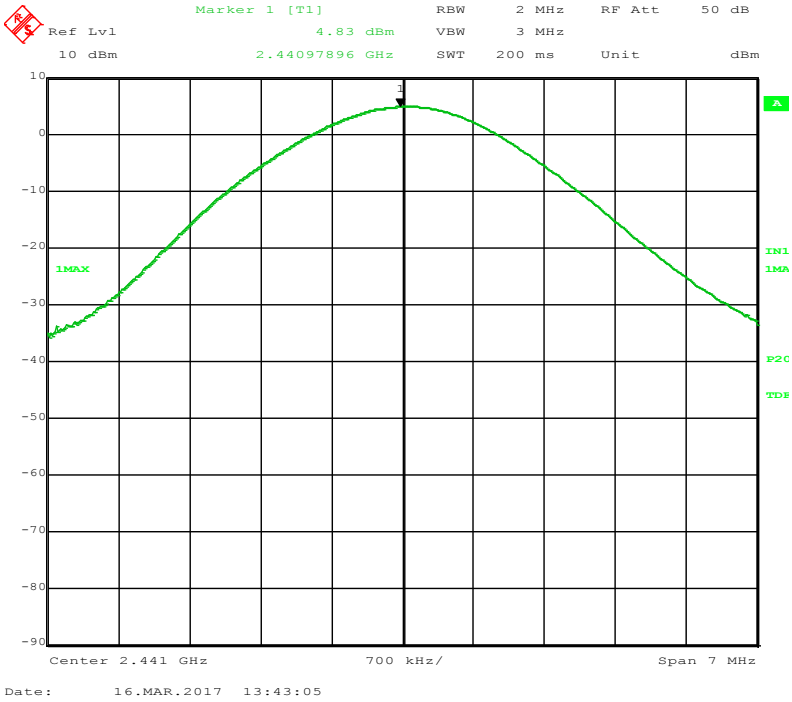
Measurement of the Maximum Peak Power Output of the VMS4100 was made with the spectrum analyzer connected directly to the transmitter output in place of the antenna. The table contains the power levels of each of the modulation schemes at low, middle and high frequency channels in constant transmit mode, non-hopping.

	Frequency (GHz)	Measured Level (dBm)	Cable # 814 Loss (dB)	Total		Limit		Margin	
				dBm	Watts	dBm	Watts	dBm	Watts
Unmodulated Carrier	2.402	4.76	0.50	5.26	0.003	30.00	1.000	-24.74	-0.997
	2.441	4.83	0.51	5.34	0.003	30.00	1.000	-24.66	-0.997
	2.480	5.12	0.57	5.69	0.004	30.00	1.000	-24.31	-0.996
GFSK	2.402	3.75	0.50	4.25	0.003	30.00	1.000	-25.75	-0.997
	2.441	3.89	0.51	4.40	0.003	30.00	1.000	-25.60	-0.997
	2.480	4.30	0.57	4.87	0.003	30.00	1.000	-25.13	-0.997
QPSK	2.402	6.27	0.50	6.77	0.005	30.00	1.000	-23.23	-0.995
	2.441	6.40	0.51	6.91	0.005	30.00	1.000	-23.09	-0.995
	2.480	6.82	0.57	7.39	0.005	30.00	1.000	-22.61	-0.995
8-DPSK	2.402	6.76	0.50	7.26	0.005	30.00	1.000	-22.74	-0.995
	2.441	6.81	0.51	7.32	0.005	30.00	1.000	-22.68	-0.995
	2.480	7.19	0.57	7.76	0.006	30.00	1.000	-22.24	-0.994

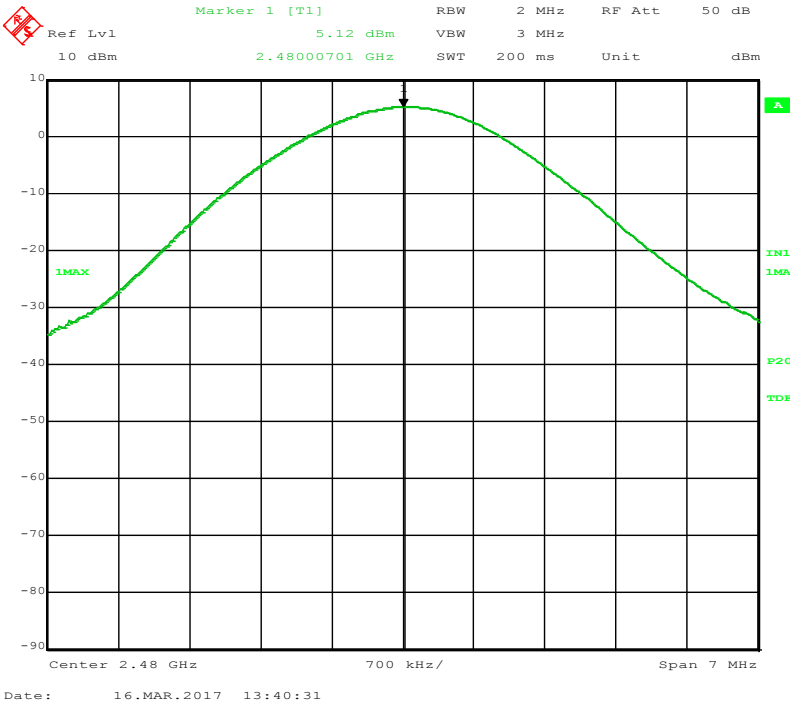
No Modulation, Channel 1



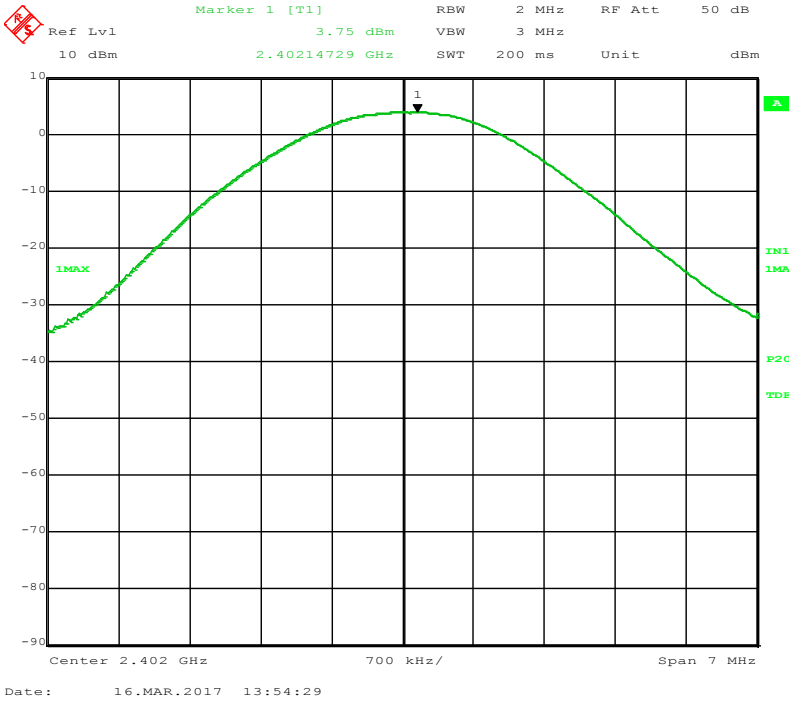
No Modulation, Channel 40



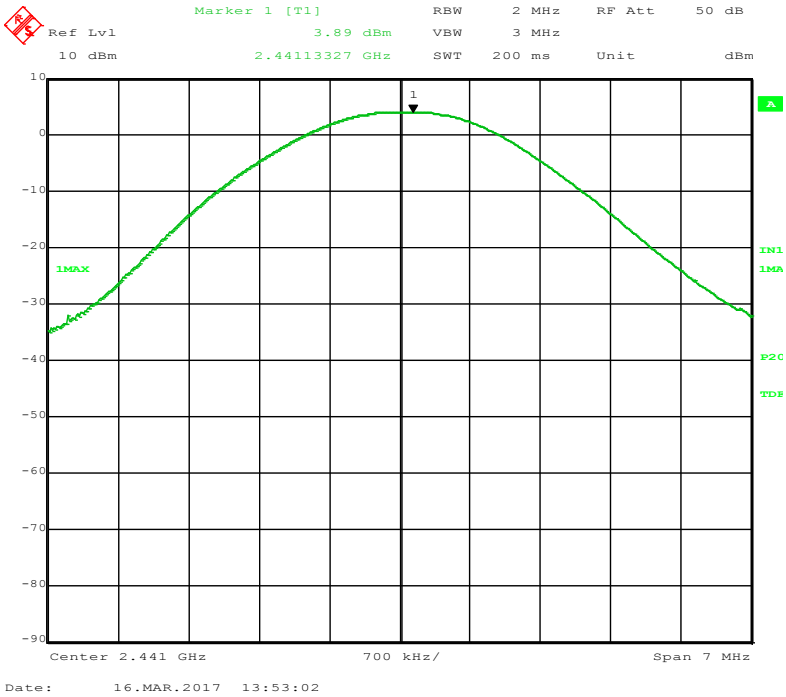
No Modulation, Channel 79



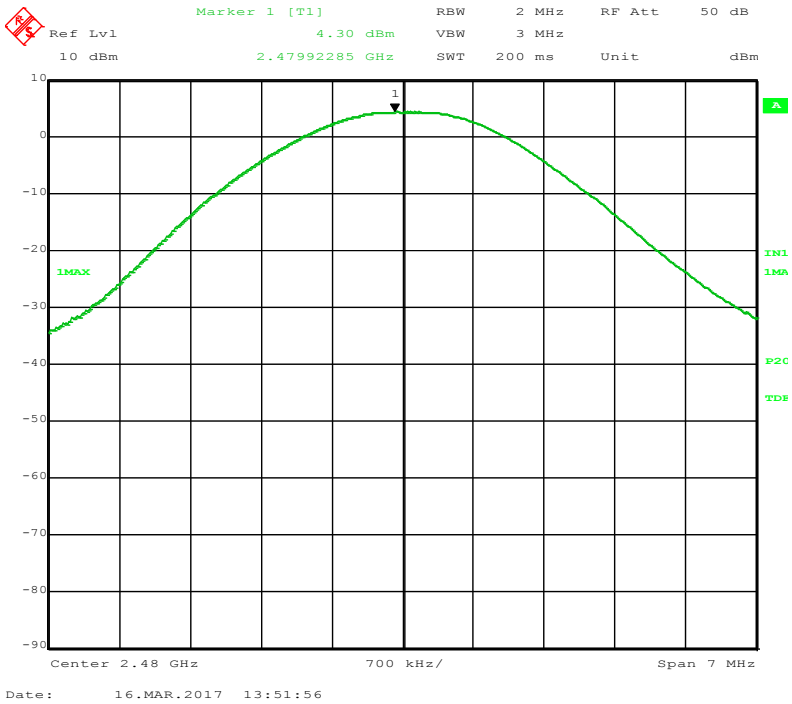
GFSK Modulation, Channel 1



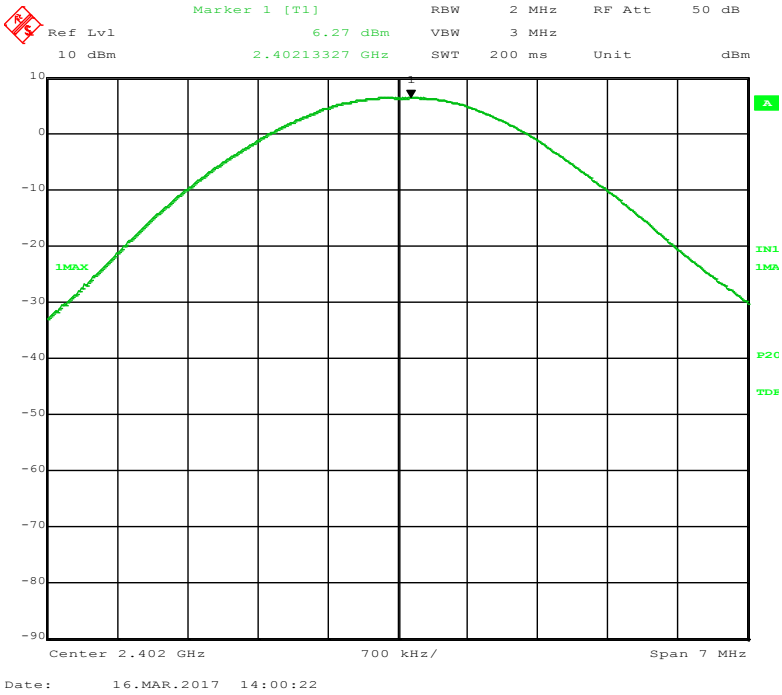
GFSK Modulation, Channel 40



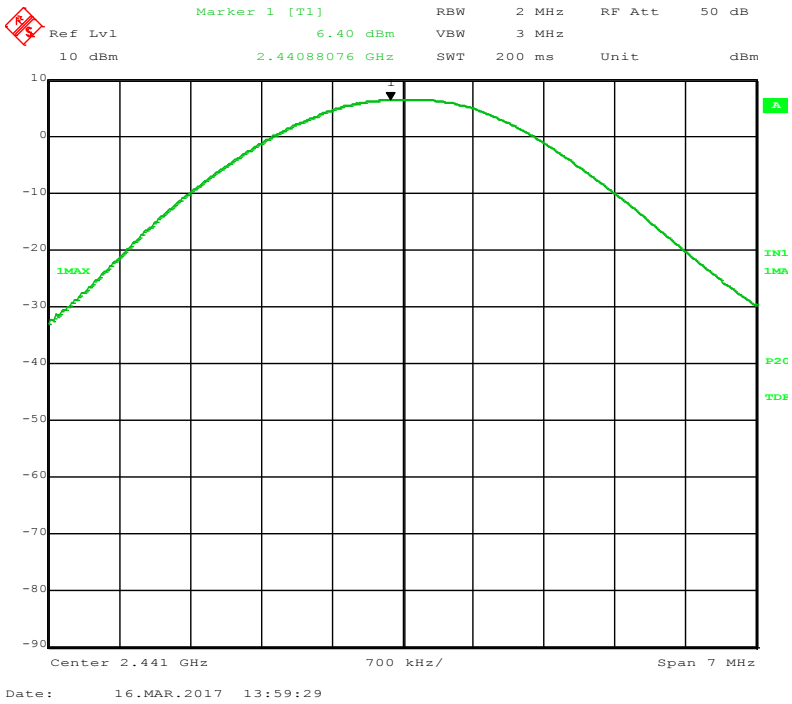
GFSK Modulation, Channel 79



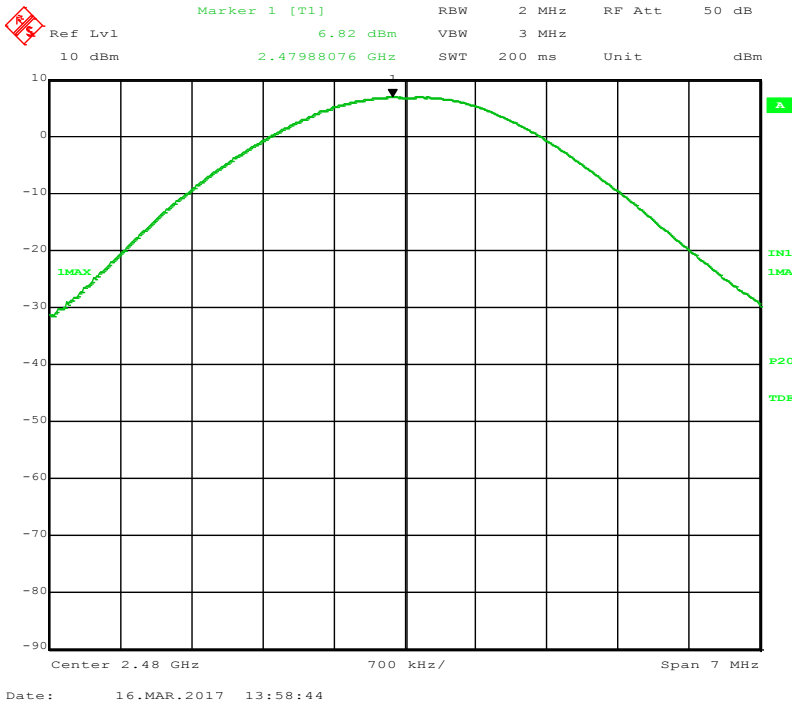
QPSK Modulation, Channel 1



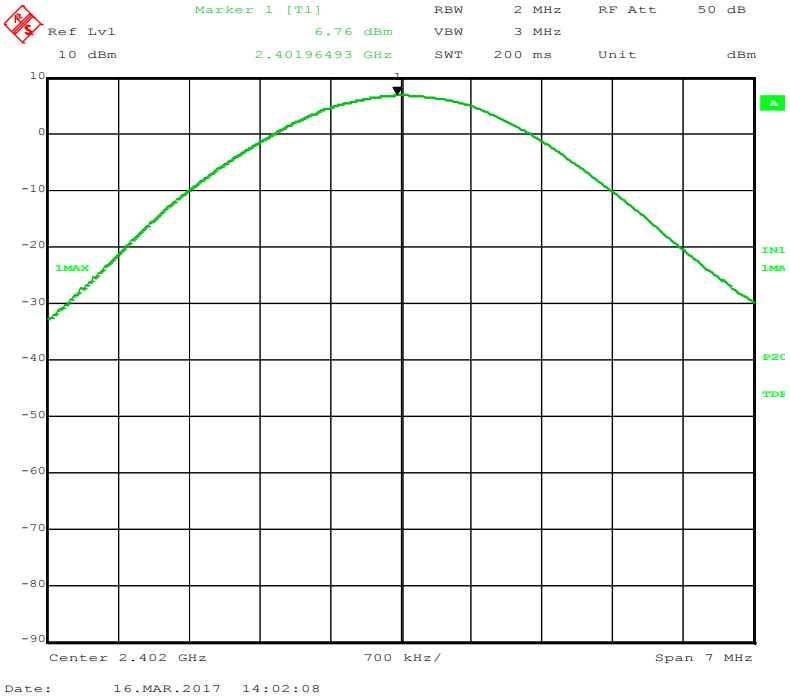
QPSK Modulation, Channel 40



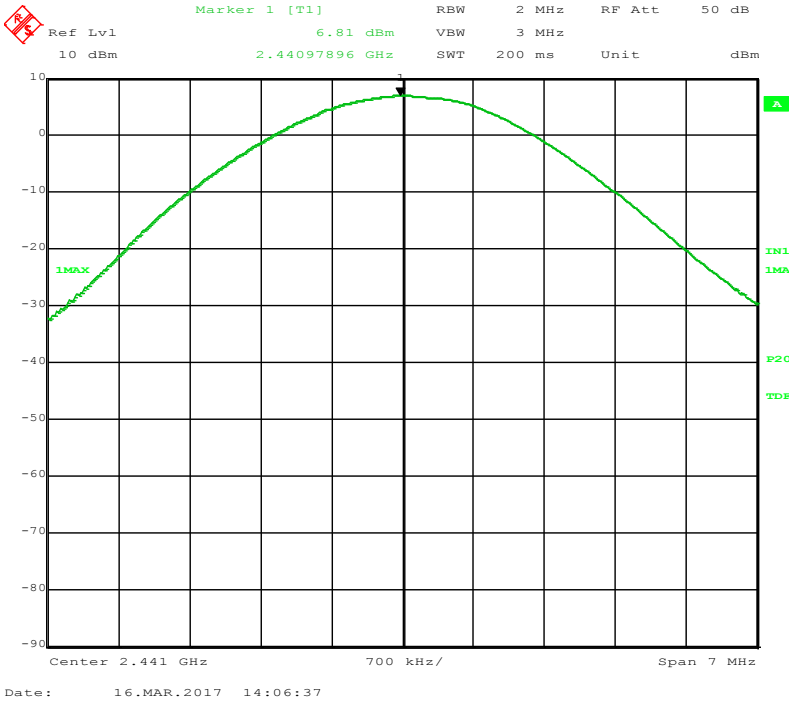
QPSK Modulation, Channel 79



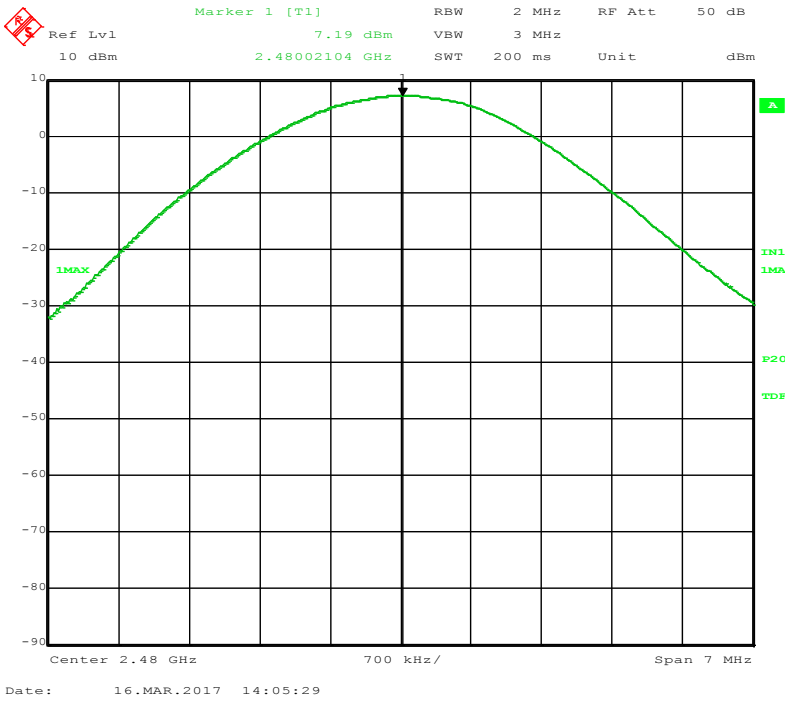
8-DPSK Modulation, Channel 1



8-DPSK Modulation, Channel 40



8-DPSK Modulation, Channel 79



Test Results: The peak output power of the VMS4100 varied slightly with modulation type. The highest levels consistently occurred at the highest channel frequency (2.480 GHz). The maximum peak power output level was compliant to the 1 Watt limit imposed by 47 CFR Part 15.247 (b)(1).

4.12 Band Edge Measurement (47 CFR 15.247(d)) (11/01/2017)

Band edge measurements were recorded on the EUT while operating with a modulated carrier at three frequencies (low middle and high) in the operating band of 2.4 GHz to 2.48 GHz. The measurement procedure used was the conducted output power method, where the antenna output port of the EUT was connected to the receiver input port for direct measurement.

The frequencies and associated channel numbers chosen for measurement were as follows:

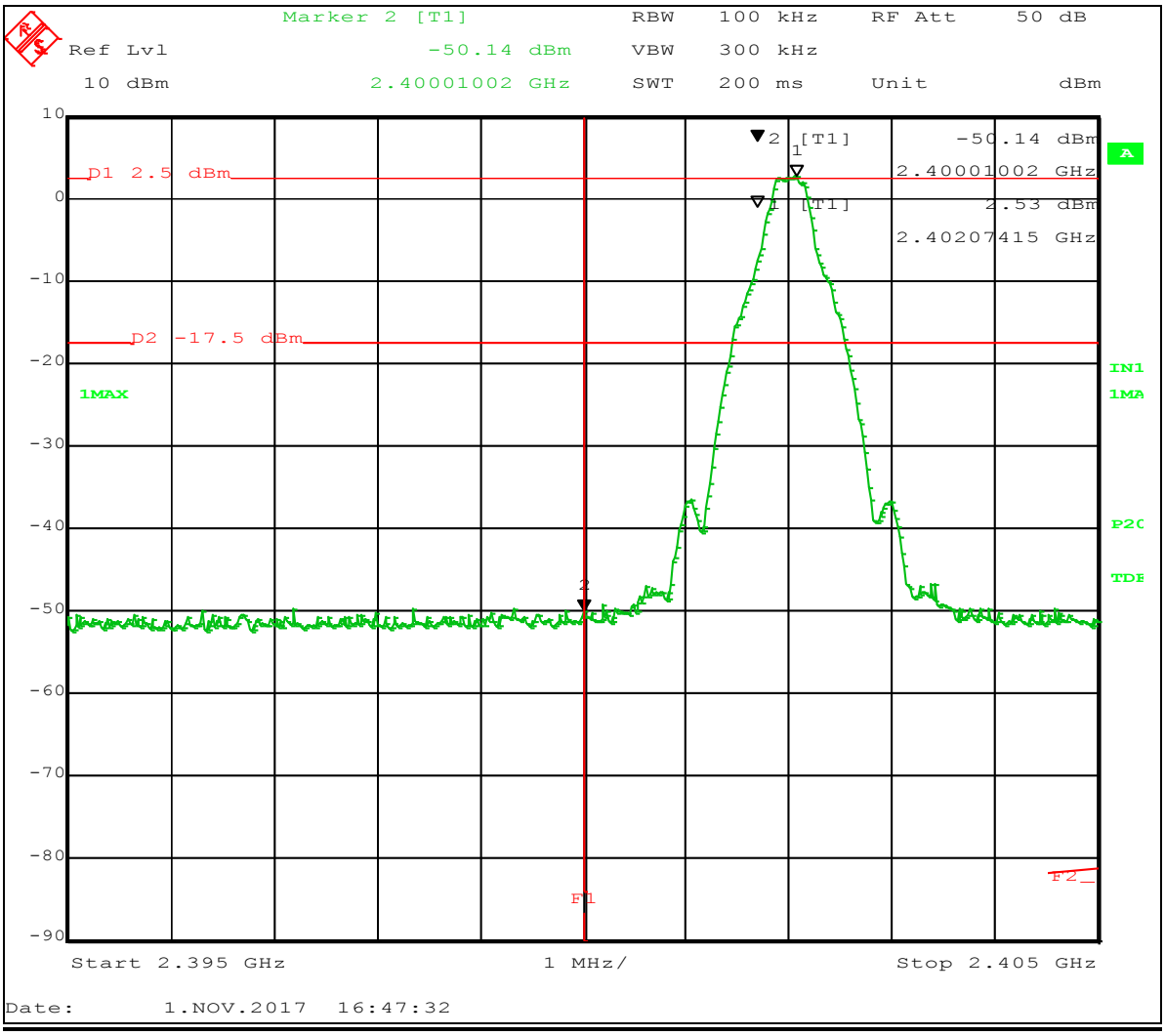
Channel	Frequency (GHz)
1	2.402
39	2.440
79	2.480

The data was recorded in three screen captures from the Spectrum Analyzer. Parameters particular to each measurement are as follows:

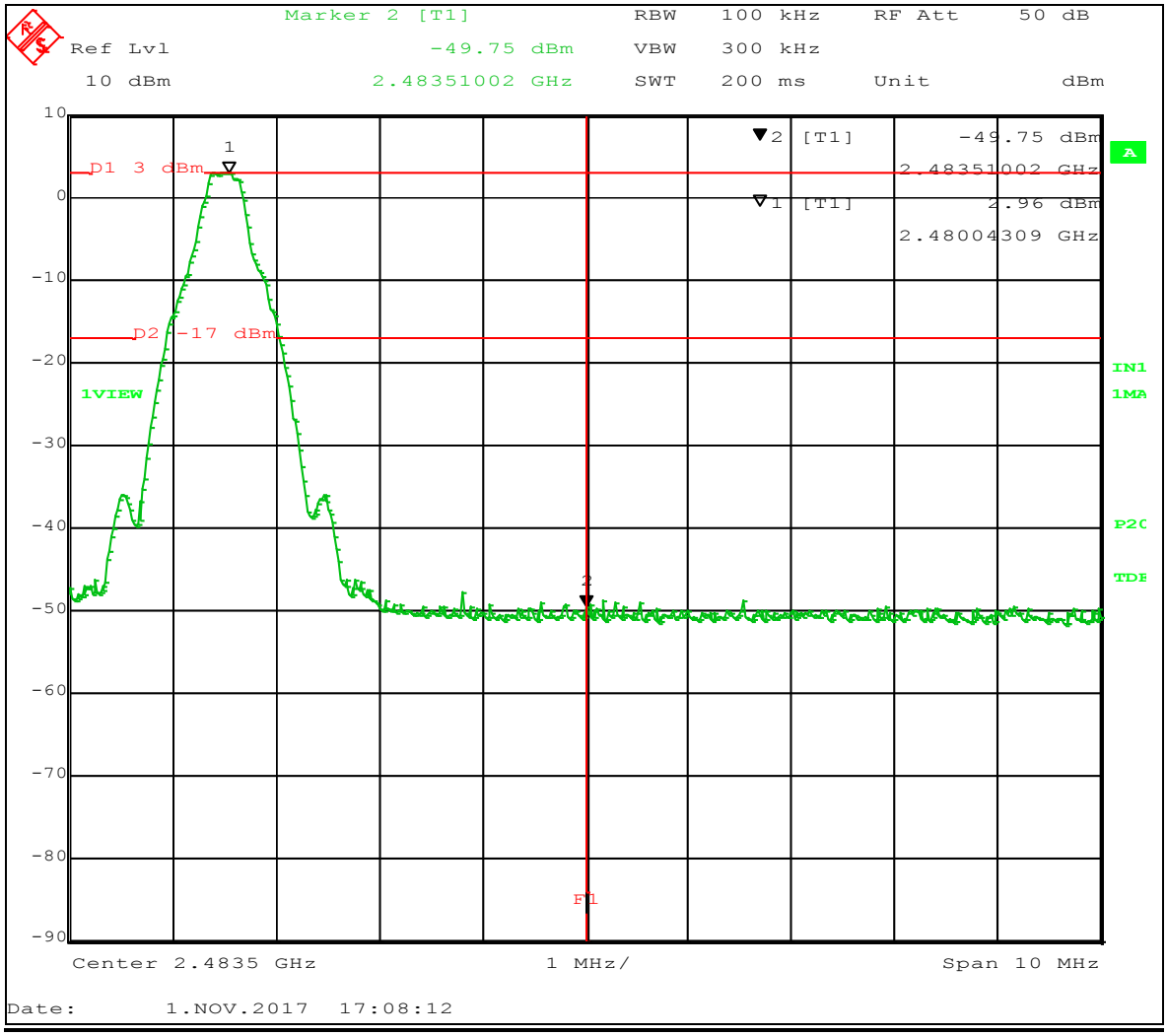
Center Frequency	
Resolution Bandwidth	100 kHz
Video Bandwidth	300 kHz
Span	10 MHz
Scale:	dBm
Reference Level:	10 dBm

4.12.1 Band Edge Measurement Analyzer Screen Captures

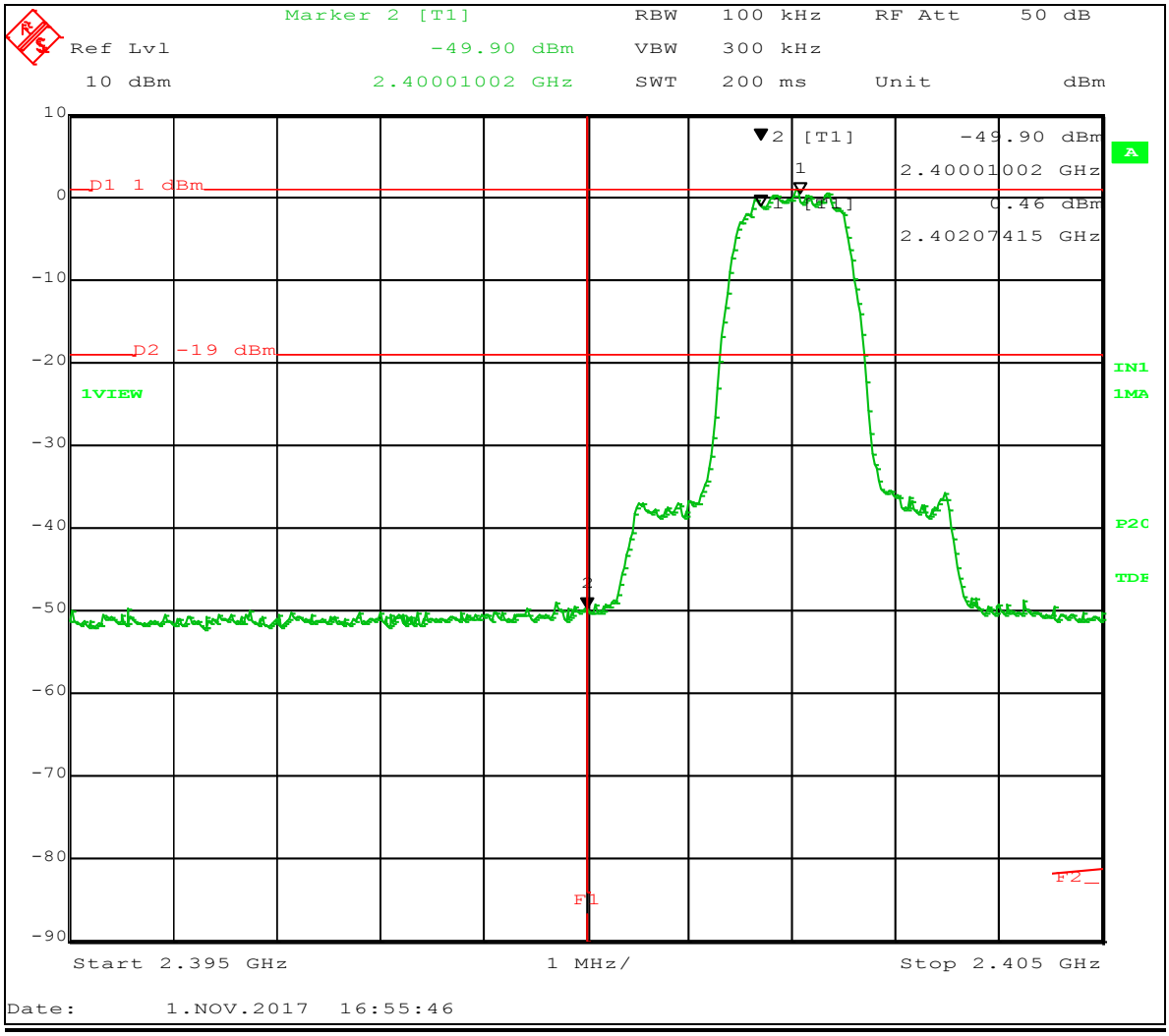
GFSK CHANNEL 1: 2402 MHZ BAND EDGE MEASUREMENT



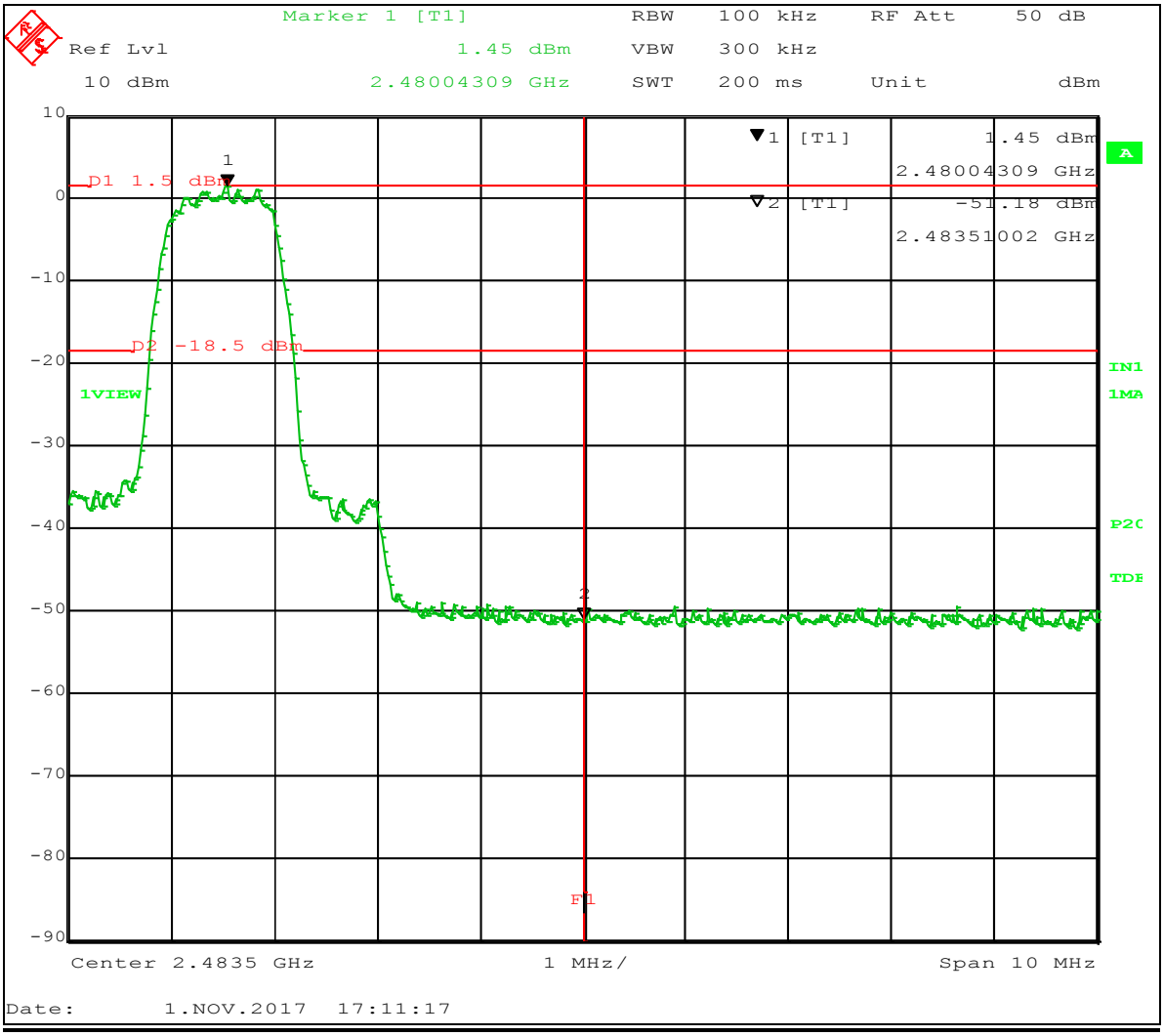
GFSK CHANNEL 79: 2480 MHZ BAND EDGE MEASUREMENT



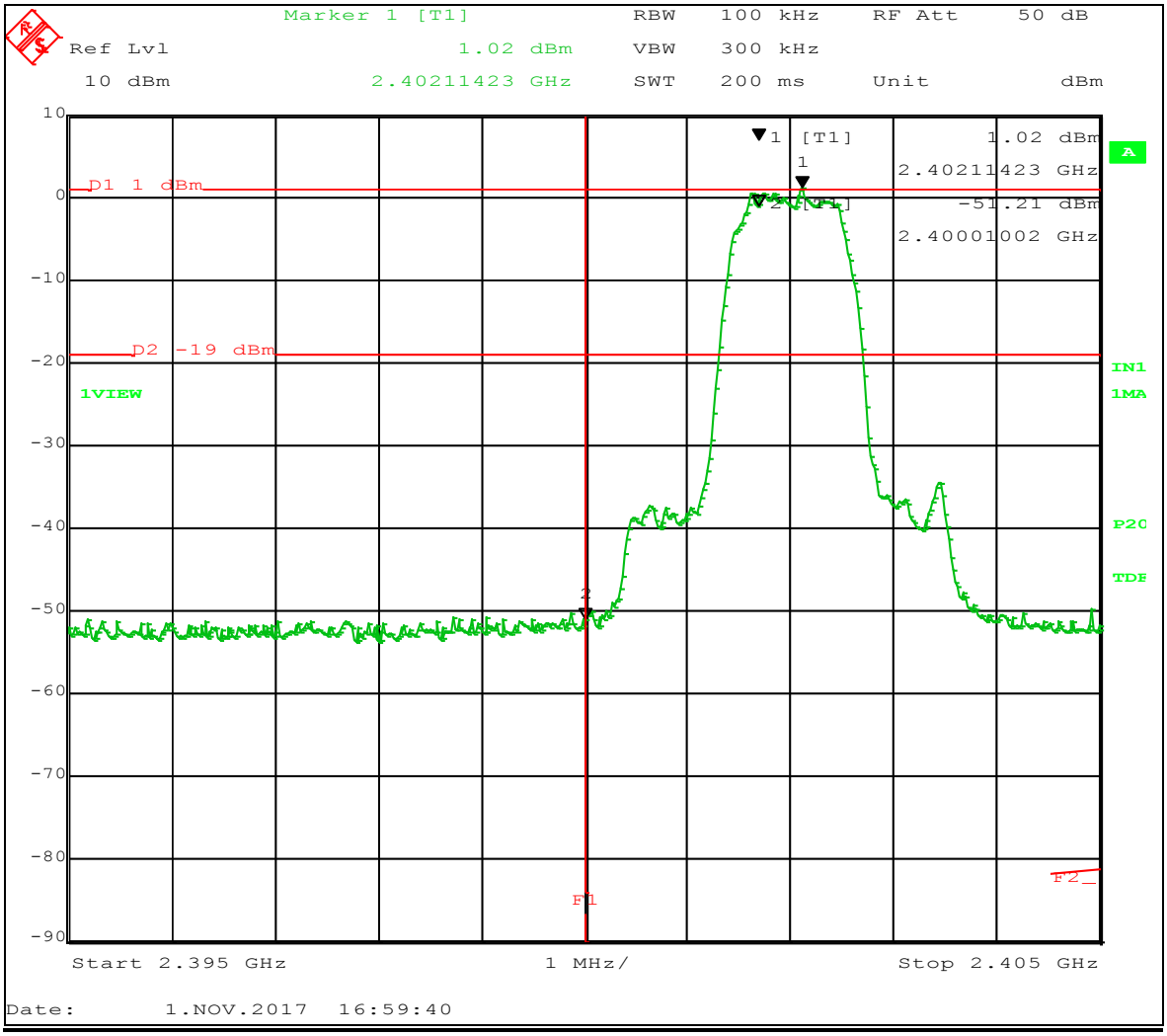
QPSK CHANNEL 1: 2402 MHZ BAND EDGE MEASUREMENT



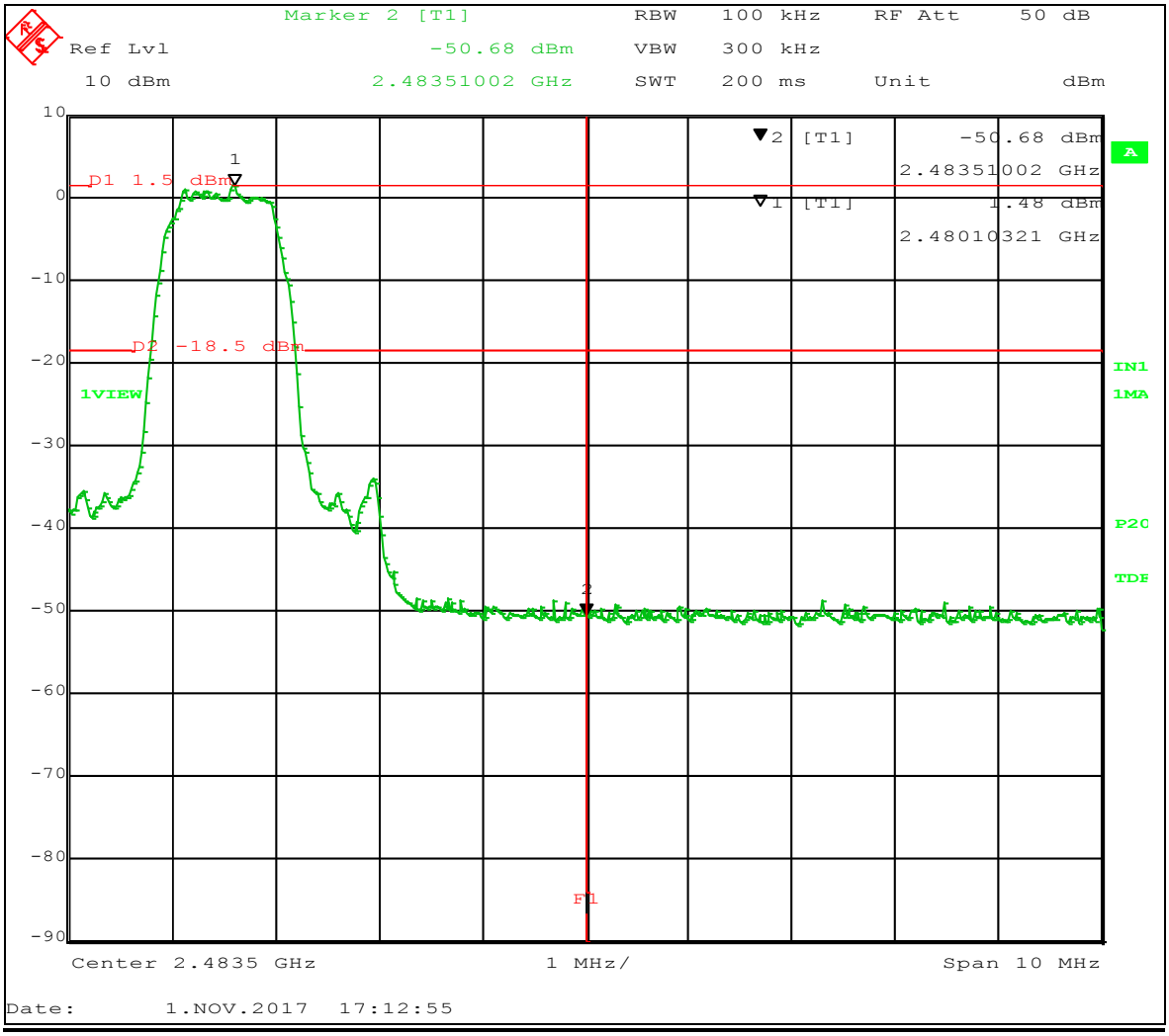
QPSK CHANNEL 79: 2480 MHZ BAND EDGE MEASUREMENT



8PSK CHANNEL 1: 2402 MHZ BAND EDGE MEASUREMENT



8PSK CHANNEL 79: 2480 MHZ BAND EDGE MEASUREMENT



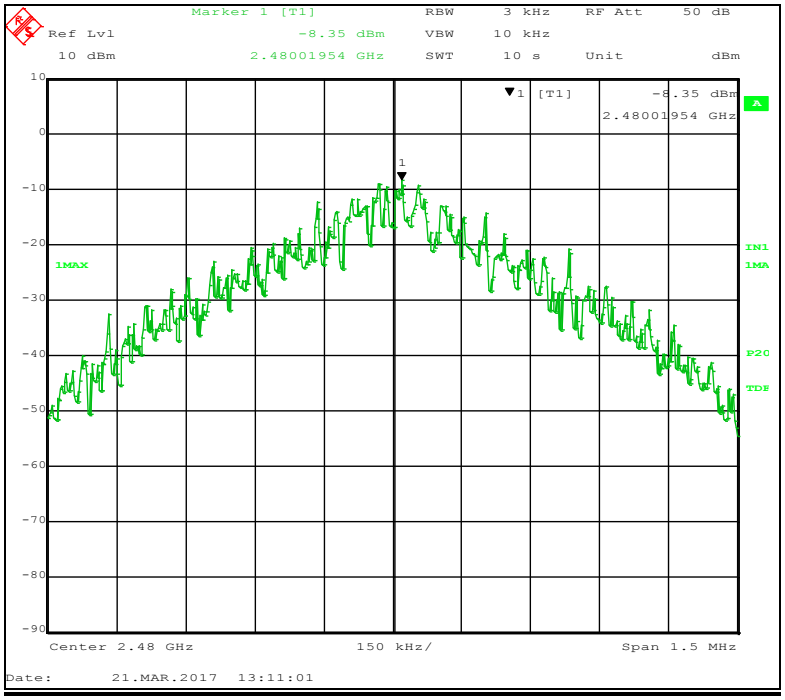
Test Results: The Band Edge measurements for Bluetooth Frequencies of the ARRIS Model VMS4100 Set Top Box are compliant with the limits specified in FCC Section 15.247(d).

4.13 Antenna Port, Power Spectral Density (47 CFR 15.247(f)) (03/21/2017)

The VMS4100 employs a combination of both frequency hopping and digital modulation techniques. Therefore, the power spectral density, conducted from the transmitter to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off shall not be greater than 8 dBm in any 3 kHz band during continuous transmission.

Modulation	Channel	Freq (GHz)	Measured Power Spectral Density (dBm)	Cable Loss (dB)	Total Power Spectral Density (dBm)	Power Spectral Density Limit (dBm)	Pass/Fail
GFSK	CH.1	2.402	-8.77	0.50	-8.27	8.00	PASS
	CH.40	2.441	-8.90	0.51	-8.39	8.00	PASS
	CH.79	2.480	-8.35	0.57	-7.78	8.00	PASS
QPSK	CH.1	2.402	-12.69	0.50	-12.19	8.00	PASS
	CH.40	2.441	-12.38	0.51	-11.87	8.00	PASS
	CH.79	2.480	-12.12	0.57	-11.55	8.00	PASS
8PSK	CH.1	2.402	-13.62	0.50	-13.12	8.00	PASS
	CH.40	2.441	-13.50	0.51	-12.99	8.00	PASS
	CH.79	2.480	-12.32	0.57	-11.75	8.00	PASS

GFSK Modulation @ 2.480 GHz

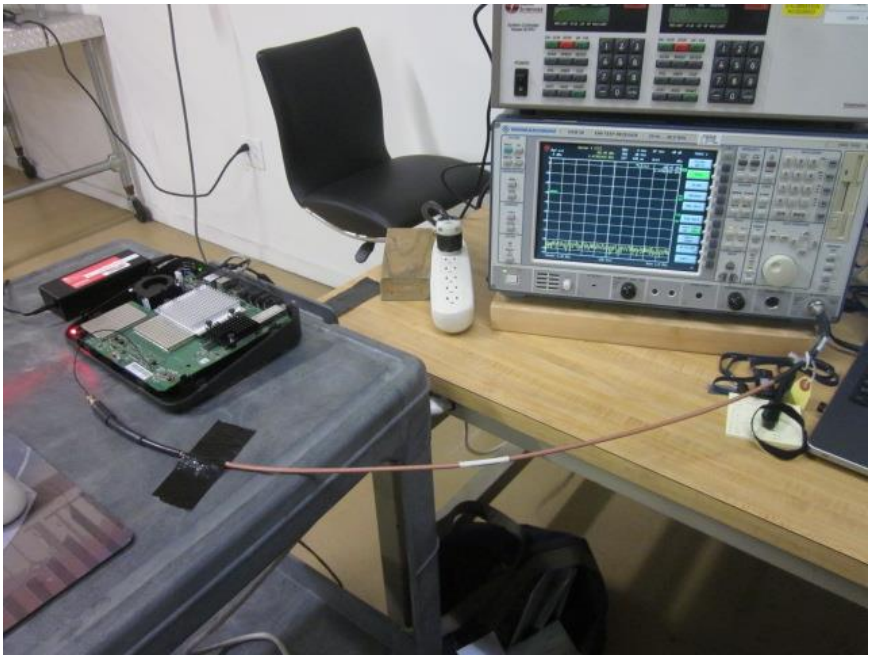


Test Results: Power Spectral Density of the VMS4100 complied with the requirements of CFR Part 15.247(f) with a margin of 15.78 dB.

5.0 Test Setup Pictures

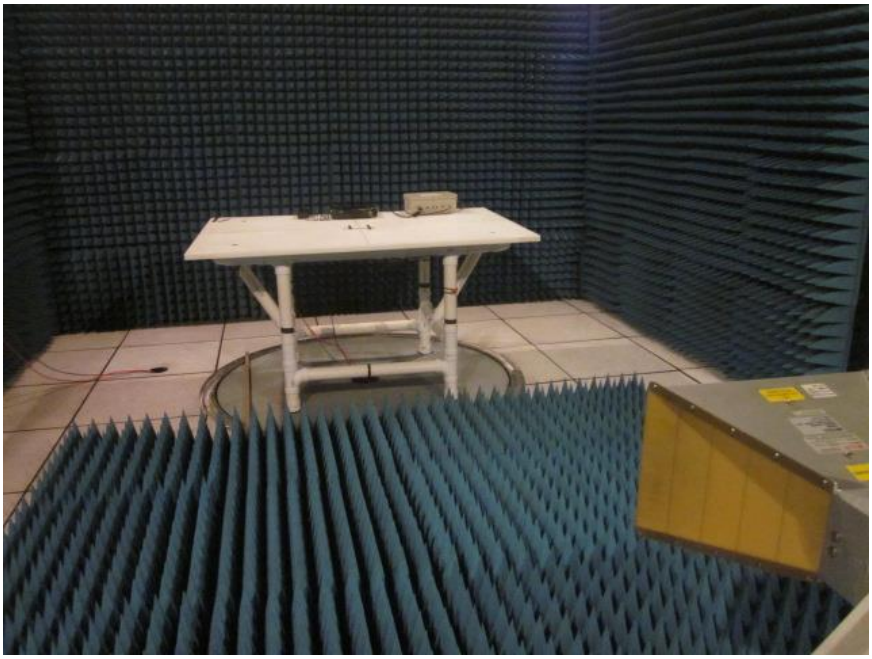
5.1 Conducted Emissions Power Line Test Setup Picture

5.2 Conducted Emissions Antenna Test Setup Picture



5.3 Radiated Emissions 30 – 1000 MHz Test Setup Picture

5.4 Radiated Emissions 1 – 25 GHz Test Setup Picture



Appendix A – Test Equipment

Equipment	Manufacturer	Model #	Serial #	BEC #	Calibration Date	Calibration Cycle	Calibration Due Date
EMI Receiver (20 Hz – 26.5 GHz)	Rohde & Schwarz	ESIB 26	836119/006	1010	07/01/16	2 Years	07/01/18
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A020714	882	04/01/16	2 Years	04/01/18
9kHz-3GHz EMC Analyzer	Agilent	E7402A	US39440162	883	02/16/16	2 Years	02/16/18
Amplifier (.1 – 1300 MHz)	Hewlett Packard	8447F	2805A02896	1003	No Cal. Required	No Cal. Required	No Cal. Required
EMC Analyzer (9 kHz - 1.8 GHz)	Hewlett Packard	8591EM	3536A00746	821	10/14/14	3 Years	10/14/17
GTEM (30 MHz – 1 GHz)	ETS Lindgren	5317	1014	1001	No Cal. Required	No Cal. Required	No Cal. Required
Spectrum Analyzer (9 kHz - 40 GHz)	Hewlett Packard	8564E	3410A00129	769	12/29/15	3 Years	12/29/18
EMC Analyzer (9 kHz - 26.5 GHz)	Hewlett Packard	8593EM	3710A00214	1026	03/02/17	2 Years	03/02/19
Amplifier System (0.5 – 50 GHz)	Hewlett Packard	83015A 83017A	3123A00360 & 3332A00219	1027	10/03/16	2 Year	10/03/18
Double Ridged Horn Antenna (1 - 18 GHz)	EMCO	3115	9705-5225	1028	10/19/16	2 Years	10/19/18

Antenna (18 - 26.5 GHz)	Hewlett Packard	84125-80008	N/A	1056	10/19/16	2 Years	10/19/18
EMI Receiver (9 kHz - 6.5 GHz)	Hewlett Packard	8546A	3325A00158	761	12/13/16	3 Years	12/13/19
LISN (9 kHz – 30 MHz)	EMCO	4825/2	9803-1047	750	04/21/15	2 Years	04/21/17
Shielded Room #1	ETS Lindgren	12-2/2-0	4078	859	12/16/15	2 Years	12/16/17
Intentional Radiator Testing High Frequency RF Test Cable	Workhorse	WHU18-3636-036	N/A	814	12/04/16	2 Years	12/04/18
OATS Site (30 MHz – 1 GHz)	BEC	N/A	N/A	705	05/09/16	1 Year	05/09/17
Temp/Humidity Meter	Control Company	4096	151872672	780	11/19/15	2 Years	11/19/17
Software (Tile Instrument Control System)	Quantum Change/EMC Systems	Version 3	N/A	N/A	No Cal. Required	No Cal. Required	No Cal. Required
Radiated Emissions Test Software	BEC	RADE	2.2	N/A	No Cal. Required	No Cal. Required	No Cal. Required