



BEC INCORPORATED

CERTIFICATION APPLICATION TEST REPORT

**TEST STANDARDS:
FCC Part 15 Subpart C Intentional Radiator**

ARRIS Model IP810 Set Top Box

REPORT BEC-1585-01

TEST DATES: 12/15/2014 – 01/14/2015

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

PREPARED BY: 
Steve Fanella, Test Engineer

REVIEWED and APPROVED BY: 
Al Fanella, Test Director

The results described in this report relate only to the item(s) tested. This document shall not be reproduced except in full without prior written permission of BEC Incorporated





TABLE OF CONTENTS

Notice To Customer	4
Revision History	4
1.0 Administrative Information.....	5
1.1 Project Details	5
1.2 Preface	6
1.3 Test Result Summary Table	6
1.4 Measurement Uncertainty	7
1.5 Condition of Received Sample	7
1.6 Test Equipment	7
2.0 Equipment Under Test	8
2.1 EUT Description	8
2.2 Receiver Classification	8
2.3 Product Category	8
2.4 Product Classification	8
2.5 Test Configuration	8
2.6 Test Configuration Rationale	8
2.7 Test Configuration Diagram (Conducted Measurements)	9
2.8 Test Configuration Diagram (Radiated Measurements)	10
2.9 EUT Information, Interconnection Cabling and Support Equipment	11
2.10 Test Signals and Test Modulation	12
2.11 Grounding	12
2.12 EUT Modifications	12
2.13 EUT Pictures	13
3.0 Applicable Requirements, Methods, and Procedures	22
3.1 Applicable Requirements	22
3.1.1 FCC Requirements	22
3.1.2 Basic Test Methods and Test Procedures	23
3.2 Deviations or Exclusions from the Requirements	23
4.0 Test Results	24
4.1 Conducted Emissions Power Leads, 150 kHz to 30 MHz. FCC Section 15.207(b)	24
4.1.1 Conducted Emissions Test Procedure	24
4.1.2 Conducted Emissions Test Results Delta Model ADP-18DRA Power Supply (01/14/2015)	25
4.1.3 Conducted Emissions Test Results LITEON Model PA-1180-2AR1 Power Supply (01/14/2015)	27
4.2 Spurious Radiated Emissions, 1 GHz to 25 GHz. FCC Section 15.209	29
4.2.1 Test Facility	29
4.2.2 Spurious Radiated Emissions Test Procedure	30
4.2.3 Spurious Radiated Emissions 1GHz to 25 GHz Test Results (12/18/2014)	31
4.3 6 dB Occupied Bandwidth. FCC Section 15.247(a)(2)	34
4.3.1 6 dB Occupied Bandwidth – Test Procedure	34
4.3.2 6 dB Occupied Bandwidth Analyzer Display Captures Antenna 0	34
4.3.3 6 dB Occupied Bandwidth Analyzer Display Captures Antenna 1	37



4.3.4	6 dB Occupied Bandwidth Test Results (12/15/2014)	40
4.4	Maximum Peak Power Output FCC Section 15.247(b)(3)	41
4.4.1	Maximum Peak Power Output Test Procedure	41
4.4.2	Maximum Peak Power Output Analyzer Display Captures Antenna 0	41
4.4.3	Maximum Peak Power Output Analyzer Display Captures Antenna 1	44
4.4.4	Maximum Peak Power Output Test Results (12/15/2014)	47
4.5	Antenna Conducted Spurious Emissions FCC Section 15.247(d)	48
4.5.1	Antenna Conducted Spurious Emissions Test Procedure	48
4.5.2	Antenna Conducted Spurious Emissions Test Results (12/15/2014)	48
4.6	Power Spectral Density FCC Section 15.247(e)	50
4.6.1	Power Spectral Density Test Procedure	50
4.6.2	Power Spectral Density Analyzer Display Captures Antenna 0	50
4.6.3	Power Spectral Density Analyzer Display Captures Antenna 1	53
4.6.4	Power Spectral Density Test Results (12/15/2014)	56
4.7	Band Edge Measurement FCC Section 15.247(d)	57
4.7.1	Band Edge Measurement Test Procedure	57
4.7.2	Band Edge Measurement Analyzer Display Captures Antenna 0	58
4.7.3	Band Edge Measurement Analyzer Display Captures Antenna 1	61
4.7.4	Band Edge Measurement Test Data Results (01/06/2015)	64
5.0	Test Setup Pictures	65
5.1	Conducted Emissions Power Line Test Setup Picture	65
5.2	Conducted Emissions Antenna Test Setup Picture	65
5.3	Harmonic Radiated Emissions Test Setup Picture	66
Appendix A – Test Equipment		67



Notice To Customer

This report and any recommendations it contains represent the result of BEC's testing and assessment on behalf of your company. Testing has been conducted according to accepted engineering standards and practices. This report reflects testing and assessment of product samples provided by your company and may not reflect the characteristics of other samples, especially those produced at different times. Therefore this report and its findings and recommendations, if implemented, should not be construed as an assurance or implied warranty for the continuing electromagnetic compatibility (EMC) of the product. **BEC shall not be liable for incidental or consequential damages, even if advised of the possibility thereof.**

BEC will not disseminate this report to other parties without your express permission. You may reproduce this report in its entirety including this notice and the entireties of any supplemental test reports on the same product (e.g. reports on additional testing following modification). However 'you may not reproduce portions of the report (except for the entirety of the summary section) or quote from it for any purpose without specific prior written permission from BEC'.

Revision History

Revision #	Description of Changes	Date of Changes	Date Released
0	Test Report Initial Release	N/A	01/22/2015
1	Added Details for Duty Cycle Correction Factor into section 4.2.2	03/30/2015	03/30/2015



1.0 Administrative Information

1.1 Project Details

Project Number	BEC-1585
Set Top Box Manufacturer	ARRIS Group Incorporated
Set Top Box Model Number	IP810
Set Top Box Serial Number	M11417THK354
Set Top Box Sample Number	1585-01 (Modified With SMA Ports to the Antennas)
Set Top Box Serial Number	M11444THC006
Set Top Box Sample Number	1585-02 (Unmodified Antennas)
FCC ID	ACQ-IP810
Frequency of Operation	2400 - 2483.5 MHz
Test Laboratory Location	BEC Incorporated 970 East High Street Pottstown, PA 19464
Test Performed For	ARRIS Group Incorporated 101 Tournament Drive Horsham, PA 19044
Test Personnel	Paul Banker / Steve Fanella
Technical Contact	Mike Welty
Date Received	12/01/2014
Condition Received	Suitable for test
Sample Type	Production unit
EUT Classification	Unlicensed Unintentional Radiator
FCC Classification	DTS- Part 15 Digital Transmission System
Applicable FCC Rule Part	FCC Rules Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System



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 IP810 Set Top Box was tested and found to be compliant to the sections of the FCC Part 15 Subpart C standard listed below:

FCC Part 15, Subpart C Intentional Radiators	Test Description	Result
15.207(b)	Conducted Emissions, Power Leads, 150 kHz to 30 MHz	PASS
15.209(a)	Spurious Radiated Emissions, 30 MHz to 1 GHz	PASS
15.209, 15.205	Spurious Radiated Emissions, 1 GHz to 25 GHz	PASS
15.247(a)(2)	6 dB Occupied Bandwidth	PASS
15.247(b)(3)	Maximum Peak Power Output	PASS
15.247(d)	Antenna Port, Conducted Spurious Emissions	PASS
15.247(e)	Antenna Port, Power Spectral Density	PASS
15.247(d)	Band Edge Measurement	PASS



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 m	30 MHz – 1 GHz	FCC Section 15.209	4.02

No adjustments to measured data presented in this report are required because all values of uncertainty are less than the CISPR 16-4-2:2003 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.

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 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 Model IP810 is an Advanced IP Client Video Set-Top Box with the following features and interfaces:

MoCA 2.0

Ethernet

USB 2.0

HDMI output

Composite video output

Baseband audio output

Internal IR receiver and support for external IR receiver

2.2 Receiver Classification

N/A

2.3 Product Category

FCC Part 15, Subpart C (Section 15.247)

2.4 Product Classification

RF4CE Intentional Radiator Testing Requirements for IR Signal Operation within the bands of 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz-Direct Sequence System

2.5 Test Configuration

The antennas within the ARRIS IP810 set top box were controlled by software which allowed the test technician to select the specific antenna within the EUT, designate the specific Channel Frequency, control the antenna power and control the antenna modulation (on/off).

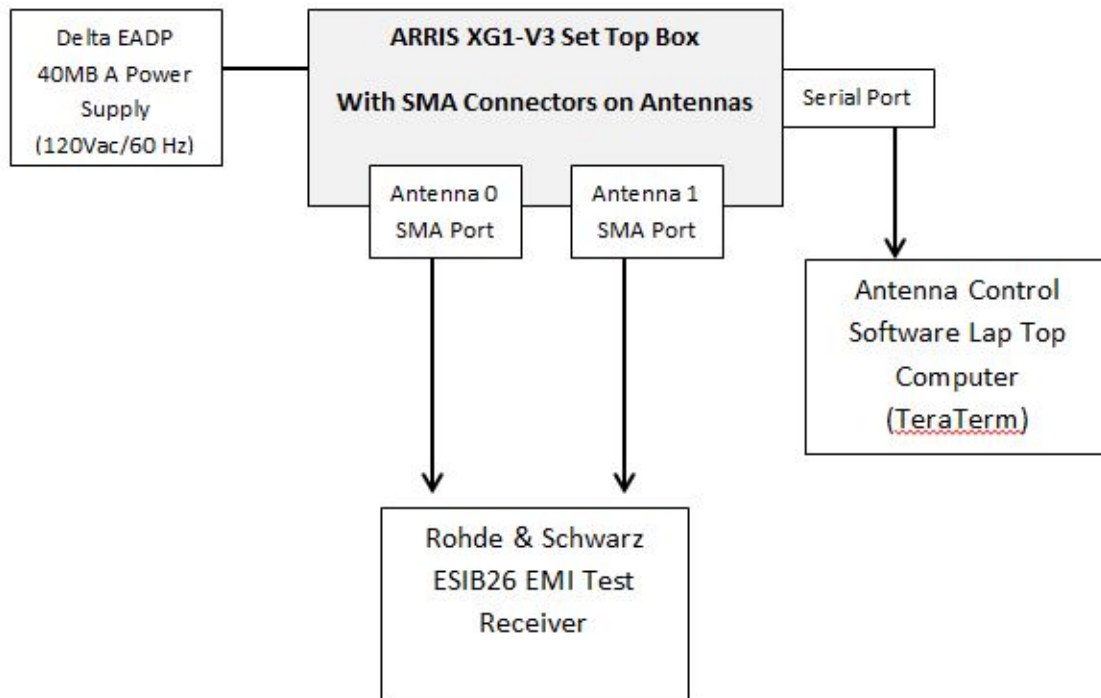
2.6 Test Configuration Rationale

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.



2.7 Test Configuration Diagram (Conducted Measurements)

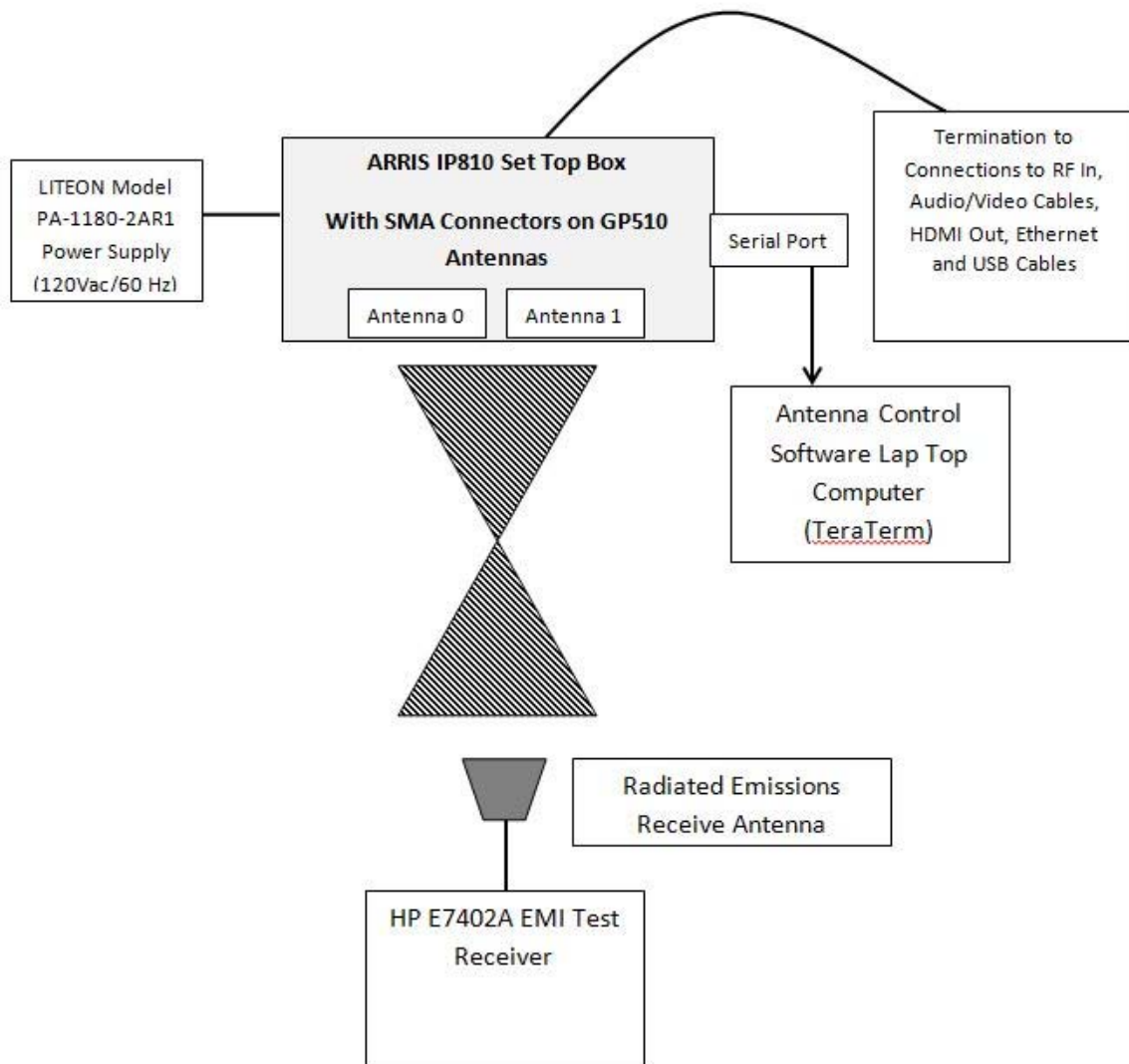
A block diagram of the EUT configuration showing interconnection cables is illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution.





2.8 Test Configuration Diagram (Radiated 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.





2.9 EUT Information, Interconnection Cabling and Support Equipment

EUT Hardware

Description	Manufacturer	Model	Serial Number	Sample Number
Set Top Box (Modified Antennas with SMA Connectors)	ARRIS	IP810	M11417THK354	1585-01
Set Top Box (Unmodified Antennas)	ARRIS	IP810	M11444THC006	1585-02

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
AC/DC Power Convertor for IP810 Set Top Box	LITEON	PA-1180-2AR1	5581240051425000106
Antenna Control Software Lap Top Computer	Dell	Latitude D830	CH-0HN338-48643-84F-0307



2.10 Test Signals and Test Modulation

By design this product does not have an external Modulation input connector, therefore, normal operating modulation was used for all testing reported herein. The only test where modulation was not active was during testing of the Maximum Peak Power Output FCC Section 15.247(b)(3) (Section 4.4 of this report) because the signal amplitude was higher without modulation applied when measuring.

The control unit in this product is a digital frequency transmitter. The EUT transmits to a discrete frequency on a specific channel. The RF4CE Device has 16 Channels available. The 16 Channels and frequencies that can be transmitted by the EUT are as follows:

Channel 11	2.405 GHz	Channel 19	2.445 GHz
Channel 12	2.410 GHz	Channel 20	2.450 GHz
Channel 13	2.415 GHz	Channel 21	2.455 GHz
Channel 14	2.420 GHz	Channel 22	2.460 GHz
Channel 15	2.425 GHz	Channel 23	2.465 GHz
Channel 16	2.430 GHz	Channel 24	2.470 GHz
Channel 17	2.435 GHz	Channel 25	2.475 GHz
Channel 18	2.440 GHz	Channel 26	2.480 GHz

For some of the required testing, the EUT was configured to transmit individually at low Channel 11 (2.405 GHz), middle Channel 19 (2.445 GHz) or high Channel 26 (2.480 GHz) during the measurement of the signal.

2.11 Grounding

During all testing presented in this report, earth grounding of the test sample was accomplished through the AC mains input power cord to the EUT and through the return of the DC line to the Controller.

2.12 EUT Modifications

No modifications were made to the ARRIS IP810 set top box.



2.13 EUT Pictures

ARRIS IP810









ARRIS IP810 SAMPLE TAG 1585-01 MODIFIED ANTENNA EUT

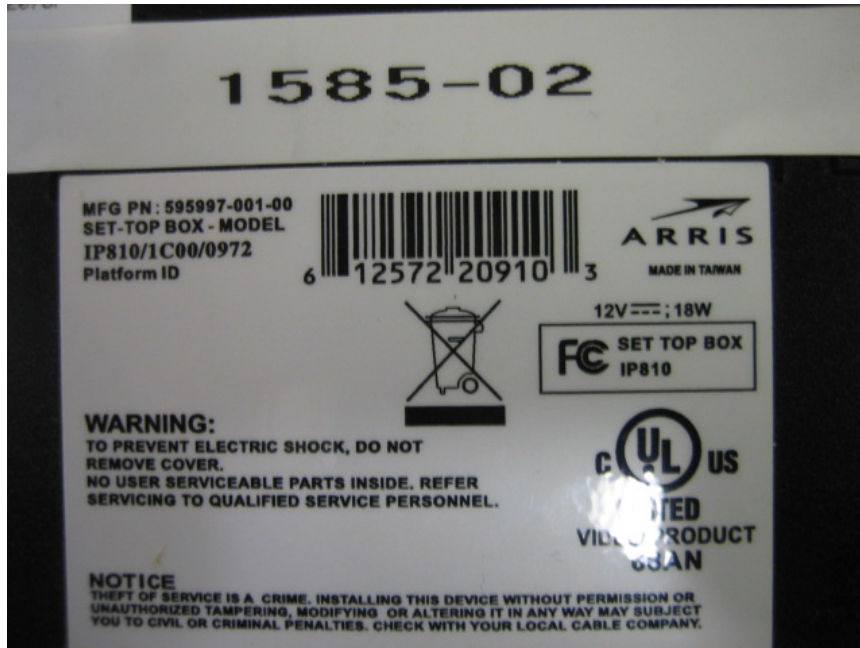


ARRIS IP810 SERIAL NUMBER MODIFIED ANTENNA EUT





ARRIS IP810 SAMPLE TAG 1585-02 UNMODIFIED ANTENNA EUT

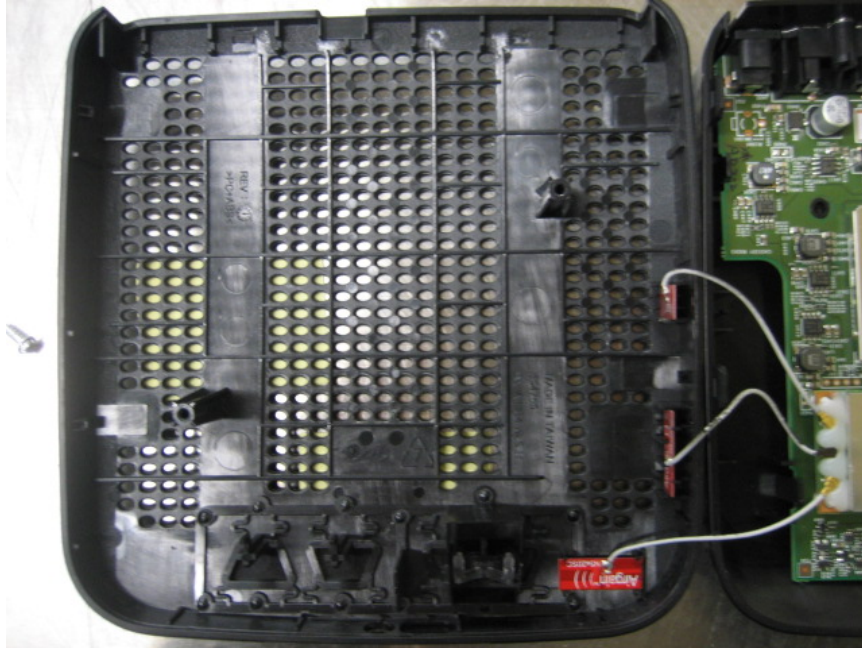


ARRIS IP810 SERIAL NUMBER UNMODIFIED ANTENNA EUT

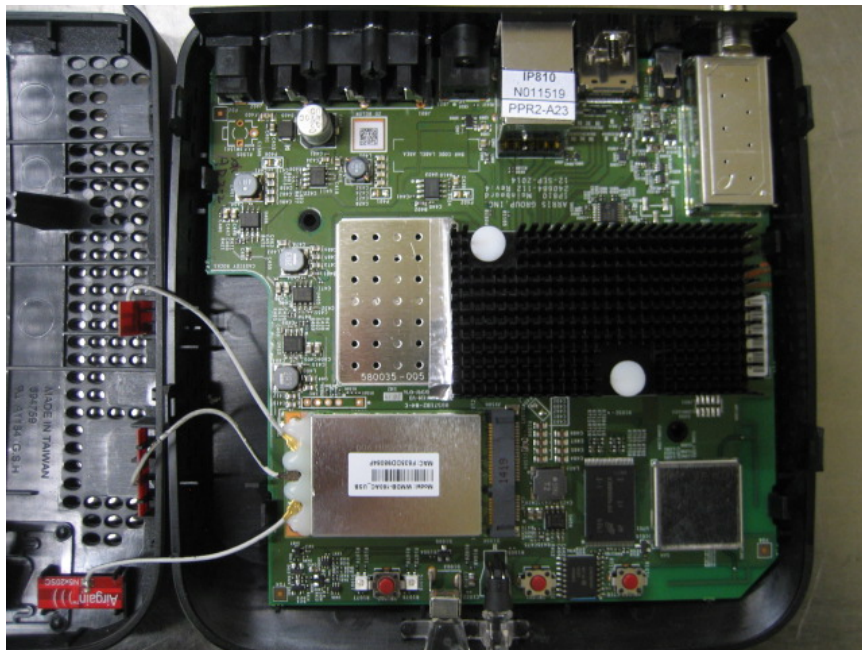




ARRIS IP810 INSIDE TOP COVER

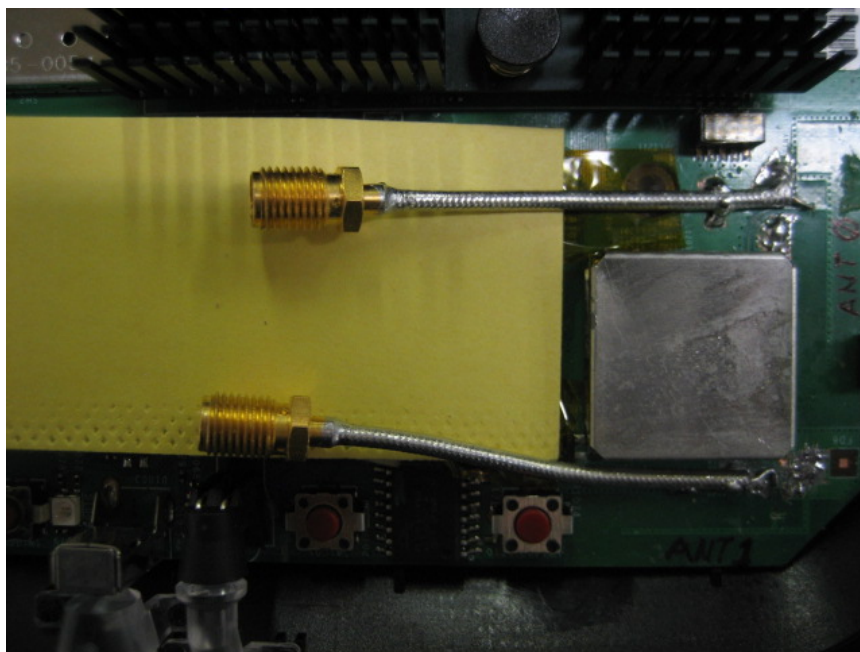
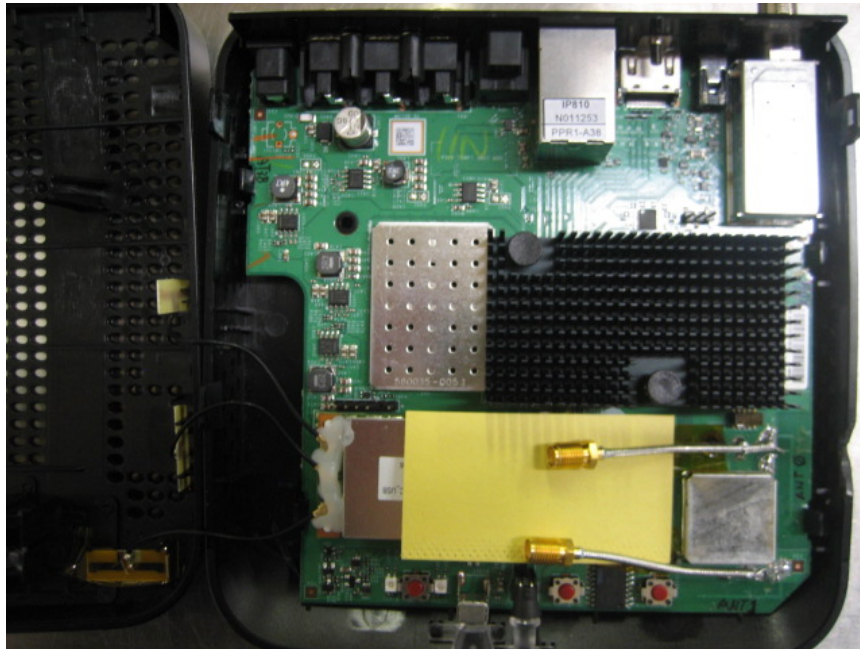


ARRIS IP810 (UNMODIFIED ANTENNAS)



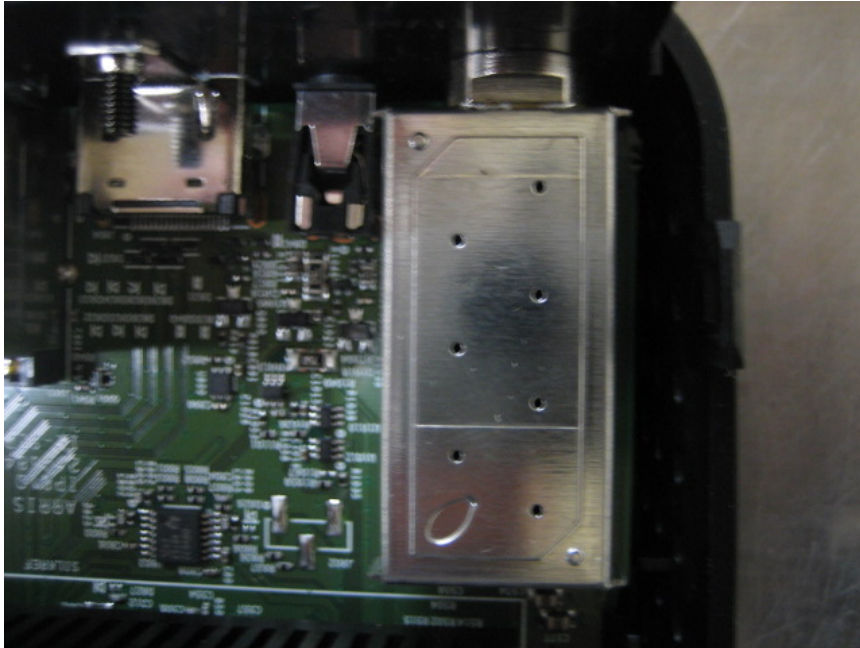


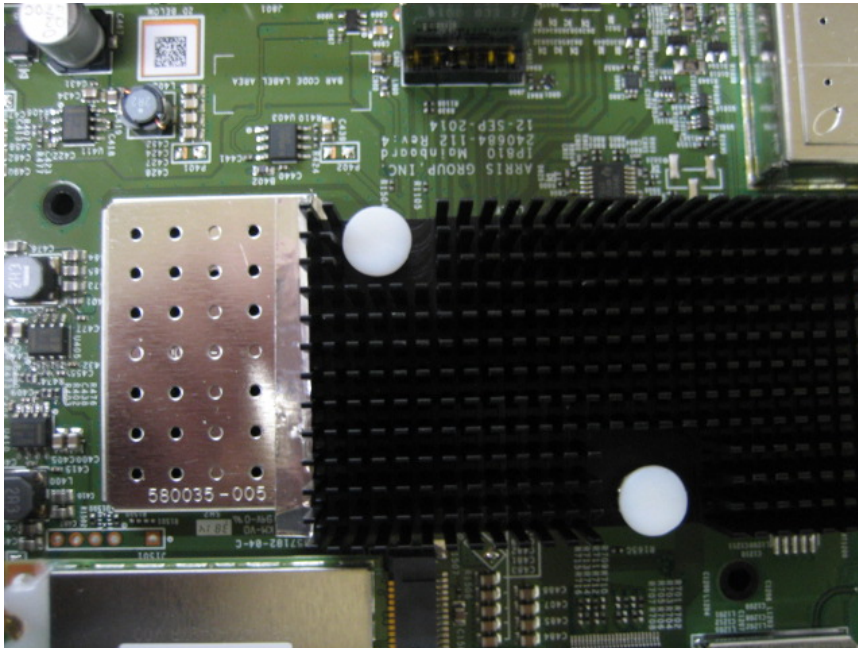
ARRIS IP810 (MODIFIED ANTENNAS)





ARRIS IP810 (SHIELDED AREAS)







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

Subpart D - Unlicensed Personal Communications Service Devices

Subpart E - Unlicensed National Information Infrastructure Devices



3.1.2 Basic Test Methods and Test Procedures

ANSI C63.4, 2009, 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

3.2 Deviations or Exclusions from the Requirements

No deviations or exclusions were made.



4.0 Test Results

4.1 Conducted Emissions Power Leads, 150 kHz to 30 MHz. FCC Section 15.207(b)

4.1.1 Conducted Emissions Test Procedure

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 μ H 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 (dB μ V) = Meter Reading (dB μ v) + Cable Loss (dB) + LISN Factor (dB) + Limiter Loss (dB)



4.1.2 Conducted Emissions Test Results Delta Model ADP-18DRA Power Supply (01/14/2015)

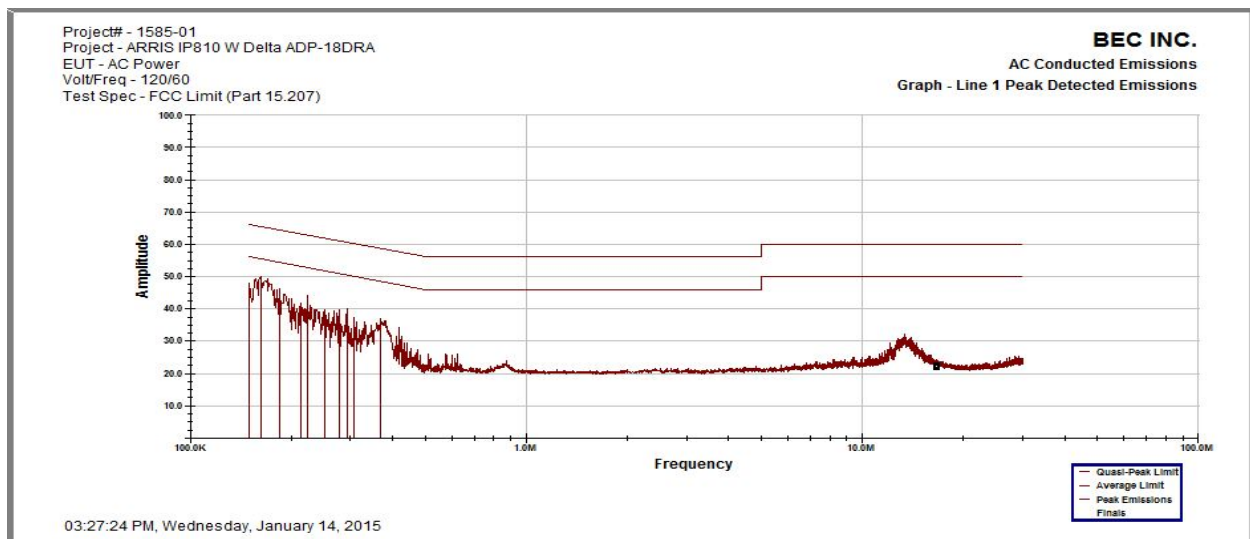
The following graphs and tables show the conducted emissions recorded on the AC power line of the EUT displayed against the FCC limits as outlined in Section 15.207(b). The Delta Model ADP-18DRA supply was powered at 120Vac/60 Hz.

BEC INC.

Line 1 Conducted Emissions

03:27:21 PM, Wednesday, January 14, 2015

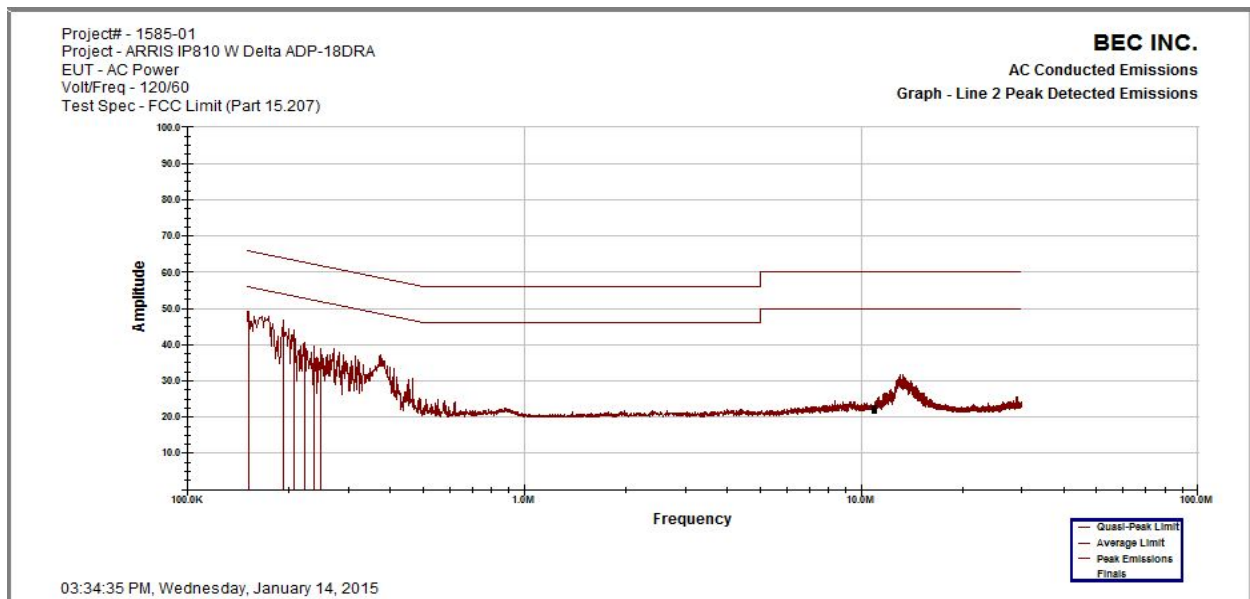
	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.780 KHz	30.79	55.98	-25.19	44.42	65.98	-21.56	0.130
163.668 KHz	30.43	55.61	-25.18	46.03	65.61	-19.58	0.133
187.053 KHz	25.98	54.94	-28.96	39.76	64.94	-25.18	0.132
212.019 KHz	22.03	54.23	-32.20	37.12	64.23	-27.11	0.130
224.496 KHz	20.14	53.87	-33.73	35.35	63.87	-28.52	0.130
251.312 KHz	19.30	53.11	-33.81	32.66	63.11	-30.45	0.130
276.779 KHz	21.32	52.38	-31.06	31.39	62.38	-30.99	0.130
291.479 KHz	22.03	51.96	-29.93	30.60	61.96	-31.36	0.130
309.699 KHz	23.13	51.44	-28.31	29.06	61.44	-32.38	0.132
372.113 KHz	27.62	49.65	-22.03	33.36	59.65	-26.29	0.140
Project# - 1585-01							
Project - ARRIS IP810 W Delta ADP-18DRA							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Limit (Part 15.207)							





BEC INC.
Line 2 Conducted Emissions
03:34:33 PM, Wednesday, January 14, 2015

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.967 KHz	30.845	55.972	-25.127	43.690	65.972	-22.282	0.130
192.932 KHz	30.146	54.773	-24.627	39.709	64.773	-25.065	0.139
207.015 KHz	25.855	54.371	-28.516	37.950	64.371	-26.421	0.140
220.608 KHz	19.375	53.983	-34.608	34.110	63.983	-29.873	0.140
237.612 KHz	22.712	53.497	-30.784	34.460	63.497	-29.037	0.140
249.623 KHz	19.557	53.154	-33.596	30.750	63.154	-32.404	0.140
Project# - 1585-01							
Project - ARRIS IP810 W Delta ADP-18DRA							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Limit (Part 15.207)							



Results: All conducted emissions measured on the telecommunications port(s) of the Delta Model ADP-18DRA supply are below the limits specified in FCC Section 15.207 by a margin of at least 19.5 dB.



4.1.3 Conducted Emissions Test Results LITEON Model PA-1180-2AR1 Power Supply (01/14/2015)

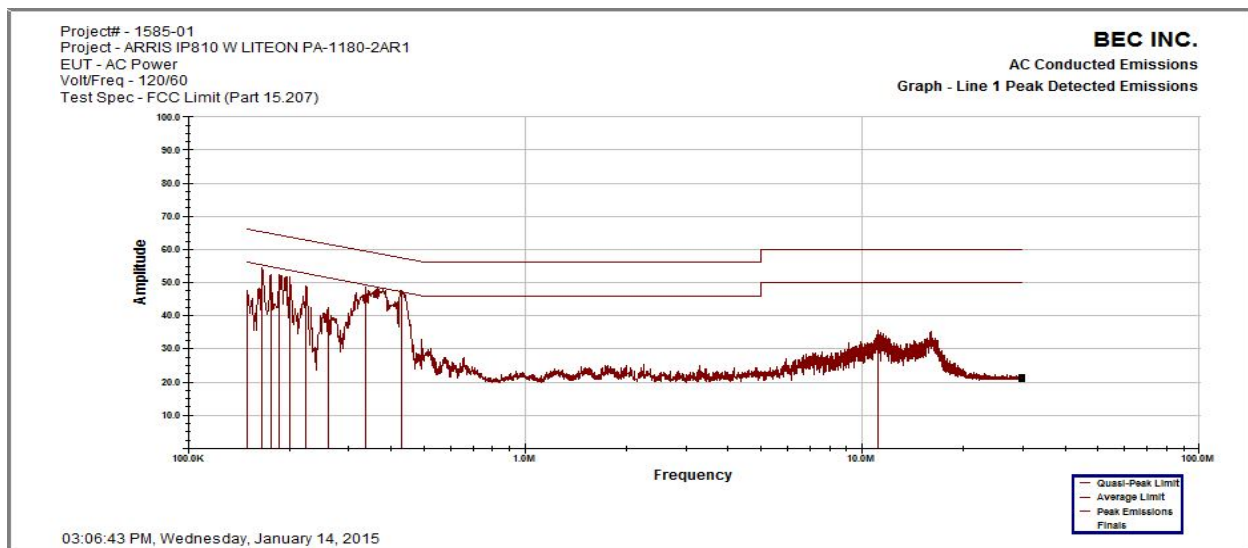
The following graphs and tables show the conducted emissions recorded on the AC power line of the EUT displayed against the FCC limits as outlined in Section 15.207(b). The LITEON Model PA-1180-2AR1 supply was powered at 120Vac/60 Hz.

BEC INC.

Line 1 Conducted Emissions

03:06:40 PM, Wednesday, January 14, 2015

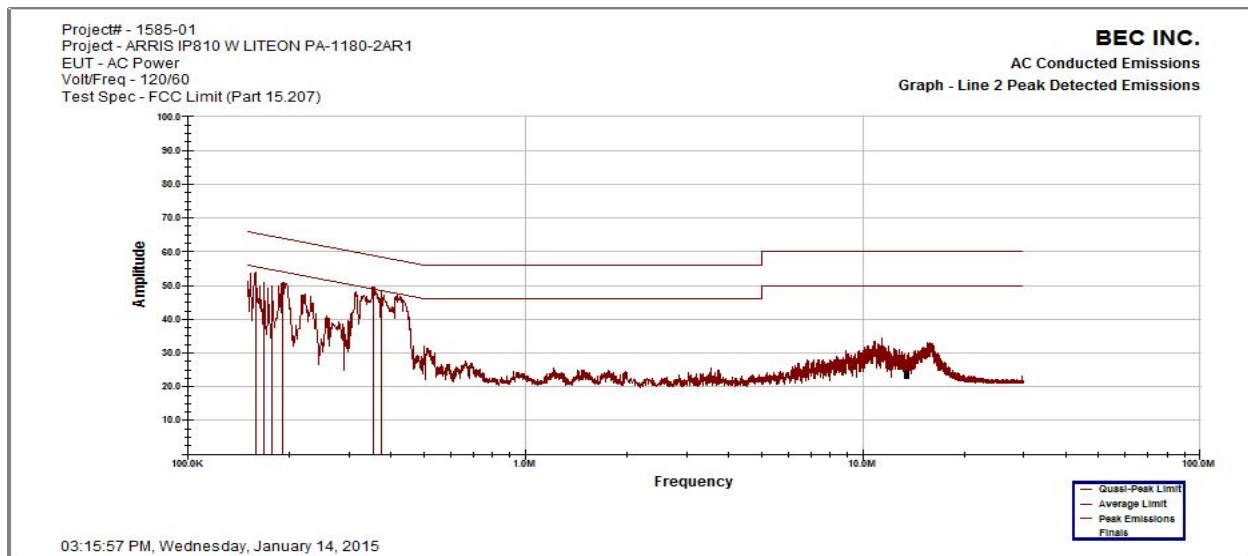
	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.384 KHz	38.29	55.99	-17.70	52.92	65.99	-13.07	0.130
165.120 KHz	28.07	55.57	-27.50	43.48	65.57	-22.08	0.133
177.045 KHz	36.38	55.23	-18.85	49.15	65.23	-16.07	0.133
186.370 KHz	34.98	54.96	-19.98	48.44	64.96	-16.52	0.132
197.502 KHz	35.51	54.64	-19.14	48.11	64.64	-16.53	0.130
222.882 KHz	33.24	53.92	-20.68	44.28	63.92	-19.64	0.130
258.743 KHz	25.41	52.89	-27.48	36.51	62.89	-26.38	0.130
341.408 KHz	37.90	50.53	-12.63	45.14	60.53	-15.39	0.138
425.313 KHz	40.20	48.13	-7.93	46.10	58.13	-12.03	0.140
11.184 MHz	23.56	50.00	-26.44	30.44	60.00	-29.56	0.666
Project# - 1585-01							
Project - ARRIS IP810 W LITEON PA-1180-2AR1							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Limit (Part 15.207)							





BEC INC.
Line 2 Conducted Emissions
03:15:54 PM, Wednesday, January 14, 2015

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
157.275 KHz	38.986	55.792	-16.806	50.951	65.792	-14.841	0.131
166.722 KHz	28.058	55.522	-27.464	44.953	65.522	-20.569	0.133
176.594 KHz	34.280	55.240	-20.960	46.685	65.240	-18.555	0.135
188.800 KHz	34.683	54.891	-20.209	45.768	64.891	-19.124	0.138
355.051 KHz	41.000	50.141	-9.141	46.430	60.141	-13.711	0.150
370.726 KHz	39.198	49.694	-10.496	45.570	59.694	-14.124	0.150
Project# - 1585-01							
Project - ARRIS IP810 W LITEON PA-1180-2AR1							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Limit (Part 15.207)							



Results: All conducted emissions measured on the telecommunications port(s) of the LITEON Model PA-1180-2AR1 supply are below the limits specified in FCC Section 15.207 by a margin of at least 7.9 dB.



4.2 Spurious Radiated Emissions, 1 GHz to 25 GHz. FCC Section 15.209

4.2.1 Test Facility

OATS

The Open Area Test Site (OATS) is an all-weather facility with a wooden enclosure that contains a ground level 4-foot diameter turntable capable of rotating equipment 360 degrees. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This non-metallic enclosure and the 3 and 10 meter test range existing outside the enclosure rest upon a protective insulating material, which in turn covers a flat, metal, continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel indoors. 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 and CISPR 22.

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 and CISPR 22.



4.2.2 Spurious Radiated Emissions Test Procedure

Radiated Emissions 30 MHz – 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 (dB μ V/m) = Meter Reading (dB μ V) + Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)

Because the intentional radiator has a pulse modulated amplitude signal, a “duty cycle correction factor” must be taken against the Peak Measurement of the harmonic spurious emissions when calculating the final field strengths against the required limits. The duty cycle correction factor for the GreenPeak GP711 is 20 dB (maximum allowed by the FCC).

Section 15.35 (c) mentions: “Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.”

The maximum duty cycle of the RF4CE set top box is gated by the remote control. The maximum repeat rate of a RF4CE remote control, while continuously pressing a key, is 1 packet per 100 ms, so the set top box can confirm every 100 ms a packet with an ACK. The duration of an ACK is ~0.5 ms.

The duration of a ACK is 0.5 ms, the interval time is 100 ms. This means that the correction factor for the average spurious emission field strength is:

$20 * \log_{10}(0.5 / 100) = -46$ dB. FCC limits the max duty cycle correction factor to 20 dB.



4.2.3 Spurious Radiated Emissions 1GHz to 25 GHz Test Results (12/18/2014)

The following table shows the highest amplitude average detected field strengths as recorded from the EUT. These measurements were performed over the frequency range of 1.0 GHz to 25 GHz at a distance of 3 meters to satisfy FCC Section 15.209 requirements. Spurious emissions from the Antenna 0 and Antenna 1 were measured when individually set to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized with modulation.

Settings: Antenna 0, Channel 11 (2.405 GHz Fundamental) Maximum Output with Modulation

Freq [MHz]	Peak [dBμV/m]	Calculated Average w Duty Cycle Correction Factor [dBμV/m]	Pol	Angle [deg]	Height [cm]	CF [dB]	Limit [dBμV/m]	Margin [dB]	Comment
4.8110	56.87	36.87	H	310	100	2.28	53.98	-17.11	PASS
12.0240	47.35	27.35	H	000	100	7.92	53.98	-26.63	PASS
14.4213	52.62	32.62	H	325	100	10.99	53.98	-21.36	PASS
16.8371	56.36	36.36	H	360	100	14.64	53.98	-17.62	PASS
4.8110	51.36	31.36	V	208	100	2.28	53.98	-22.62	PASS
12.0142	49.50	29.50	V	133	100	7.91	53.98	-24.48	PASS
14.4356	53.12	33.12	V	157	100	10.95	53.98	-20.86	PASS
16.8368	57.05	37.05	V	050	100	14.64	53.98	-16.93	PASS

Settings: Antenna 0, Channel 19 (2.445 GHz Fundamental) Maximum Output with Modulation

Freq [MHz]	Peak [dBμV/m]	Calculated Average w Duty Cycle Correction Factor [dBμV/m]	Pol	Angle [deg]	Height [cm]	CF [dB]	Limit [dBμV/m]	Margin [dB]	Comment
4.8890	57.05	37.05	H	162	100	2.58	53.98	-16.93	PASS
12.2303	49.51	29.51	H	022	100	8.08	53.98	-24.47	PASS
14.6604	53.34	33.34	H	162	100	10.22	53.98	-20.64	PASS
17.1085	60.57	40.57	H	182	100	16.68	53.98	-13.41	PASS
4.8889	52.77	32.77	V	197	100	2.58	53.98	-21.21	PASS
12.2134	48.24	28.24	V	200	100	8.07	53.98	-25.74	PASS
14.6632	52.91	32.91	V	100	100	10.21	53.98	-21.07	PASS
17.1145	58.67	38.67	V	182	100	16.70	53.98	-15.31	PASS



Settings: Antenna 0, Channel 26 (2.480 GHz Fundamental) Maximum Output with Modulation

Freq [MHz]	Peak [dBμV/m]	Calculated Average w Duty Cycle Correction Factor [dBμV/m]	Pol	Angle [deg]	Height [cm]	CF [dB]	Limit [dBμV/m]	Margin [dB]	Comment
4.9611	55.29	35.29	H	186	100	2.85	53.98	-18.69	PASS
12.4017	47.74	27.74	H	332	100	8.22	53.98	-26.24	PASS
14.8901	50.46	30.46	H	329	100	9.40	53.98	-23.52	PASS
17.3554	58.79	38.79	H	031	100	17.32	53.98	-15.19	PASS
4.9590	50.03	30.03	V	150	100	2.84	53.98	-23.95	PASS
12.3988	48.75	28.75	V	302	100	8.22	53.98	-25.23	PASS
14.8807	53.32	33.32	V	361	100	9.43	53.98	-20.66	PASS
17.3590	58.41	38.41	V	010	100	17.33	53.98	-15.57	PASS

Settings: Antenna 1, Channel 11 (2.405 GHz Fundamental) Maximum Output with Modulation

Freq [MHz]	Peak [dBμV/m]	Calculated Average w Duty Cycle Correction Factor [dBμV/m]	Pol	Angle [deg]	Height [cm]	CF [dB]	Limit [dBμV/m]	Margin [dB]	Comment
4.8110	66.57	46.57	H	313	100	2.28	53.98	-7.41	PASS
12.0106	47.93	27.93	H	332	100	7.91	53.98	-26.05	PASS
14.4326	52.05	32.05	H	289	100	10.96	53.98	-21.93	PASS
16.8330	57.46	37.46	H	051	100	14.60	53.98	-16.52	PASS
4.8109	56.12	36.12	V	229	100	2.28	53.98	-17.86	PASS
12.0160	49.31	29.31	V	263	100	7.91	53.98	-24.67	PASS
14.4242	53.34	33.34	V	010	100	10.98	53.98	-20.64	PASS
16.8392	56.34	36.34	V	346	100	14.66	53.98	-17.64	PASS



Settings: Antenna 1, Channel 19 (2.445 GHz Fundamental) Maximum Output with Modulation

Freq [MHz]	Peak [dBμV/m]	Calculated Average w Duty Cycle Correction Factor [dBμV/m]	Pol	Angle [deg]	Height [cm]	CF [dB]	Limit [dBμV/m]	Margin [dB]	Comment
4.8890	64.85	44.85	H	312	100	2.58	53.98	-9.13	PASS
12.2206	47.53	27.53	H	101	100	8.08	53.98	-26.45	PASS
14.6759	51.64	31.64	H	143	100	10.17	53.98	-22.34	PASS
17.1215	56.89	36.89	H	106	100	16.72	53.98	-17.09	PASS
4.8890	56.95	36.95	V	231	100	2.58	53.98	-17.03	PASS
12.2161	49.38	29.38	V	308	100	8.07	53.98	-24.60	PASS
14.6568	55.46	35.46	V	260	100	10.24	53.98	-18.52	PASS
17.1130	58.24	38.24	V	098	100	16.69	53.98	-15.74	PASS

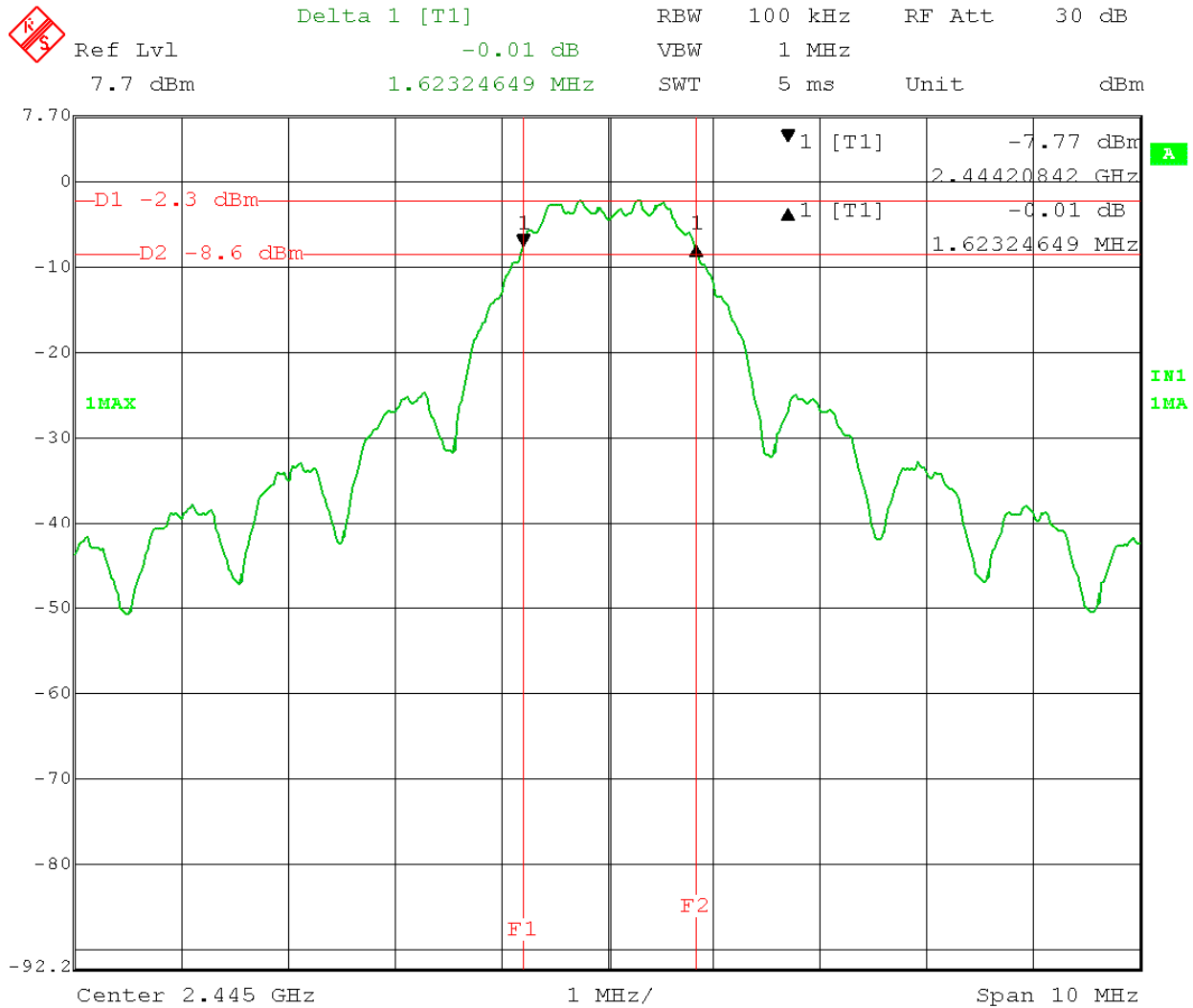
Settings: Antenna 1, Channel 26 (2.480 GHz Fundamental) Maximum Output with Modulation

Freq [MHz]	Peak [dBμV/m]	Calculated Average w Duty Cycle Correction Factor [dBμV/m]	Pol	Angle [deg]	Height [cm]	CF [dB]	Limit [dBμV/m]	Margin [dB]	Comment
4.9609	61.69	41.69	H	313	100	2.85	53.98	-12.29	PASS
12.4055	48.55	28.55	H	332	100	8.22	53.98	-25.43	PASS
14.8829	51.23	31.23	H	49	100	9.42	53.98	-22.75	PASS
17.3555	59.55	39.55	H	99	100	17.32	53.98	-14.43	PASS
4.9590	53	33.00	V	232	100	2.84	53.98	-20.98	PASS
12.3917	48.4	28.40	V	275	100	8.21	53.98	-25.58	PASS
14.8885	51.93	31.93	V	89	100	9.4	53.98	-22.05	PASS
17.3681	60.55	40.55	V	226	100	17.36	53.98	-13.43	PASS

Results: All harmonic spurious radiated emissions as recorded at a distance of 3 meters from the ARRIS Model IP810 Set Top Box are below the 3 meter limit specified by FCC Section 15.209 requirements by a margin of at least 7.4 dB.



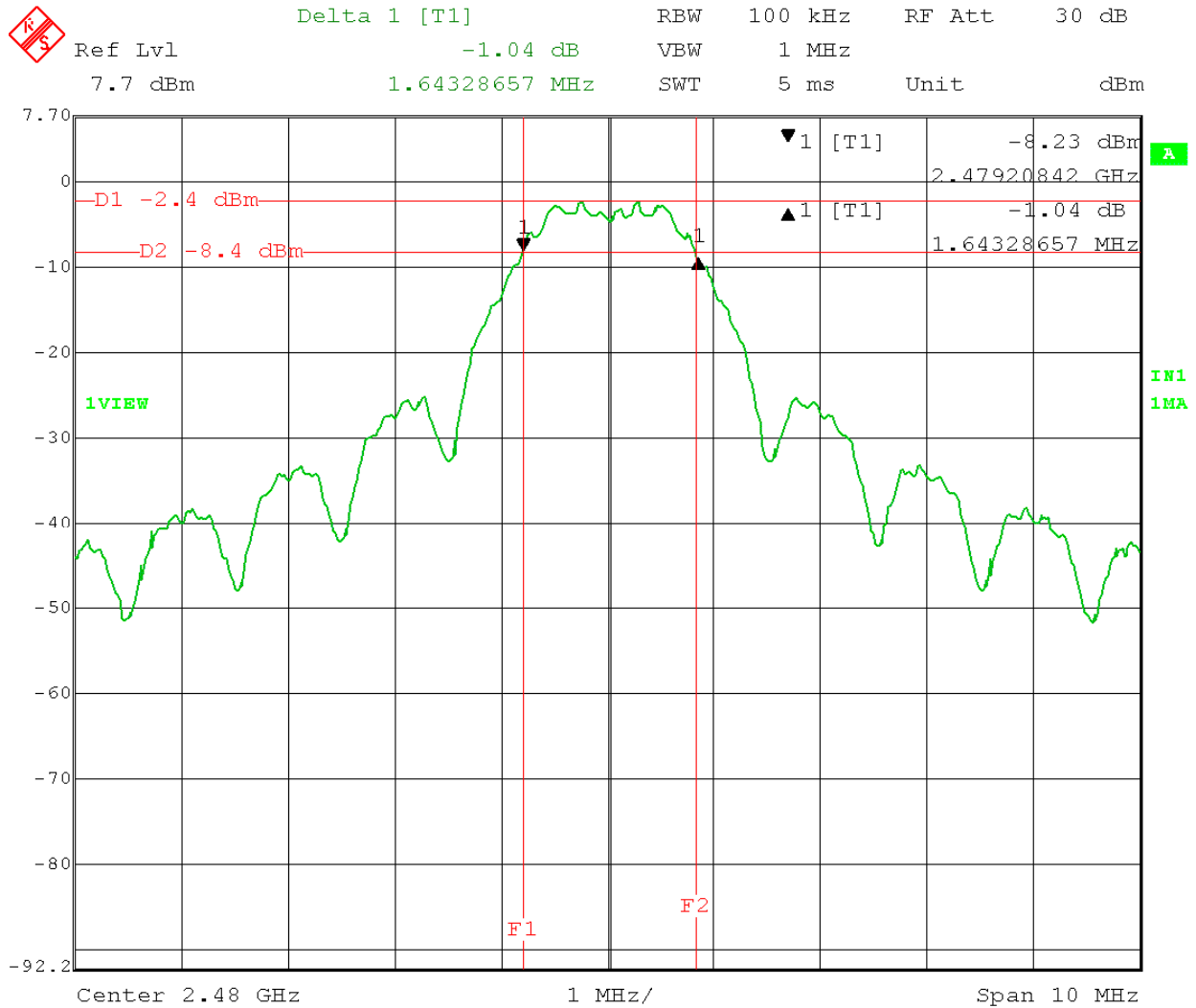
Antenna 0, Channel 19 (2.445 GHz)



Date: 15.DEC.2014 11:35:57



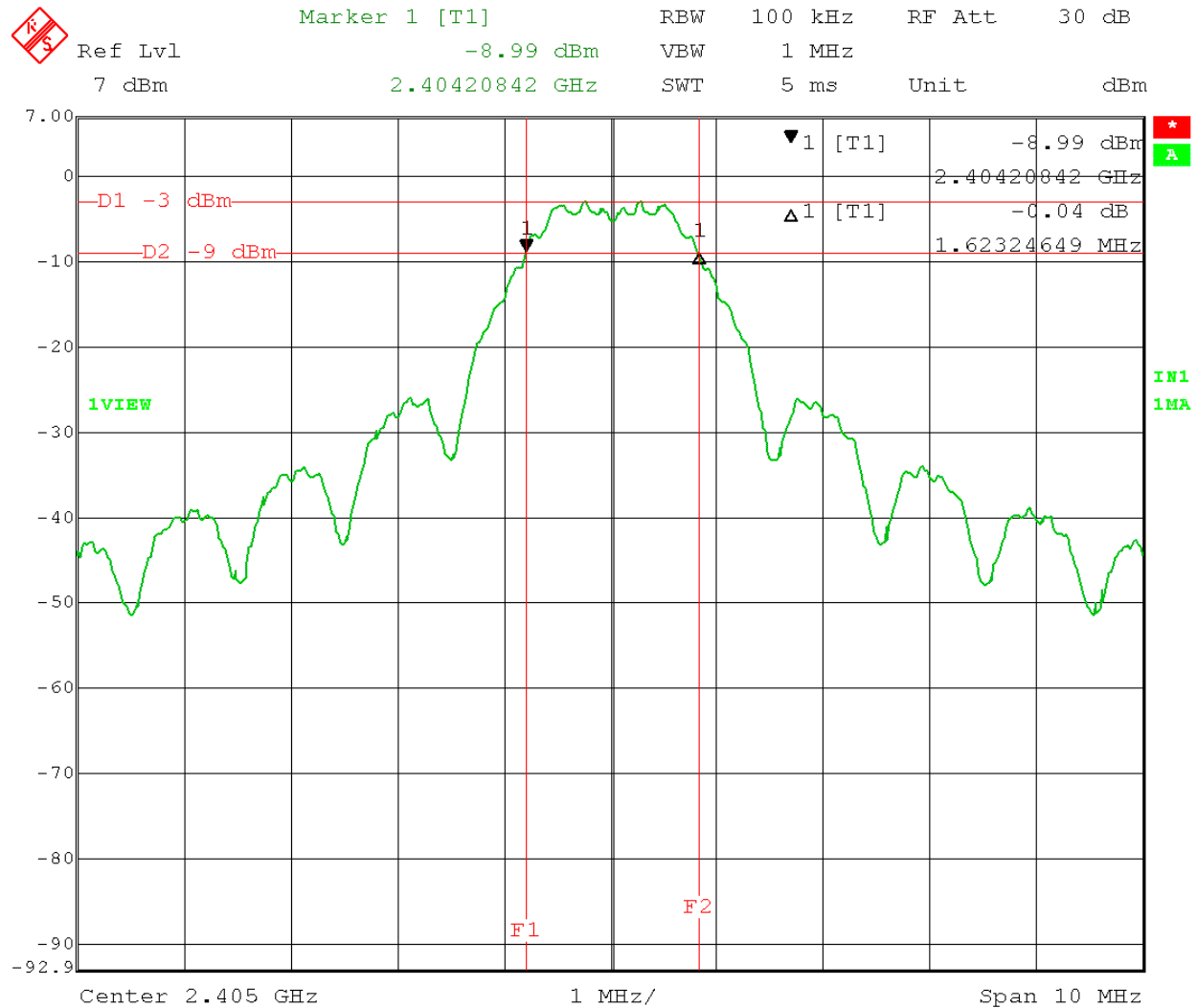
Antenna 0, Channel 26 (2.480 GHz)



Date: 15.DEC.2014 11:44:36

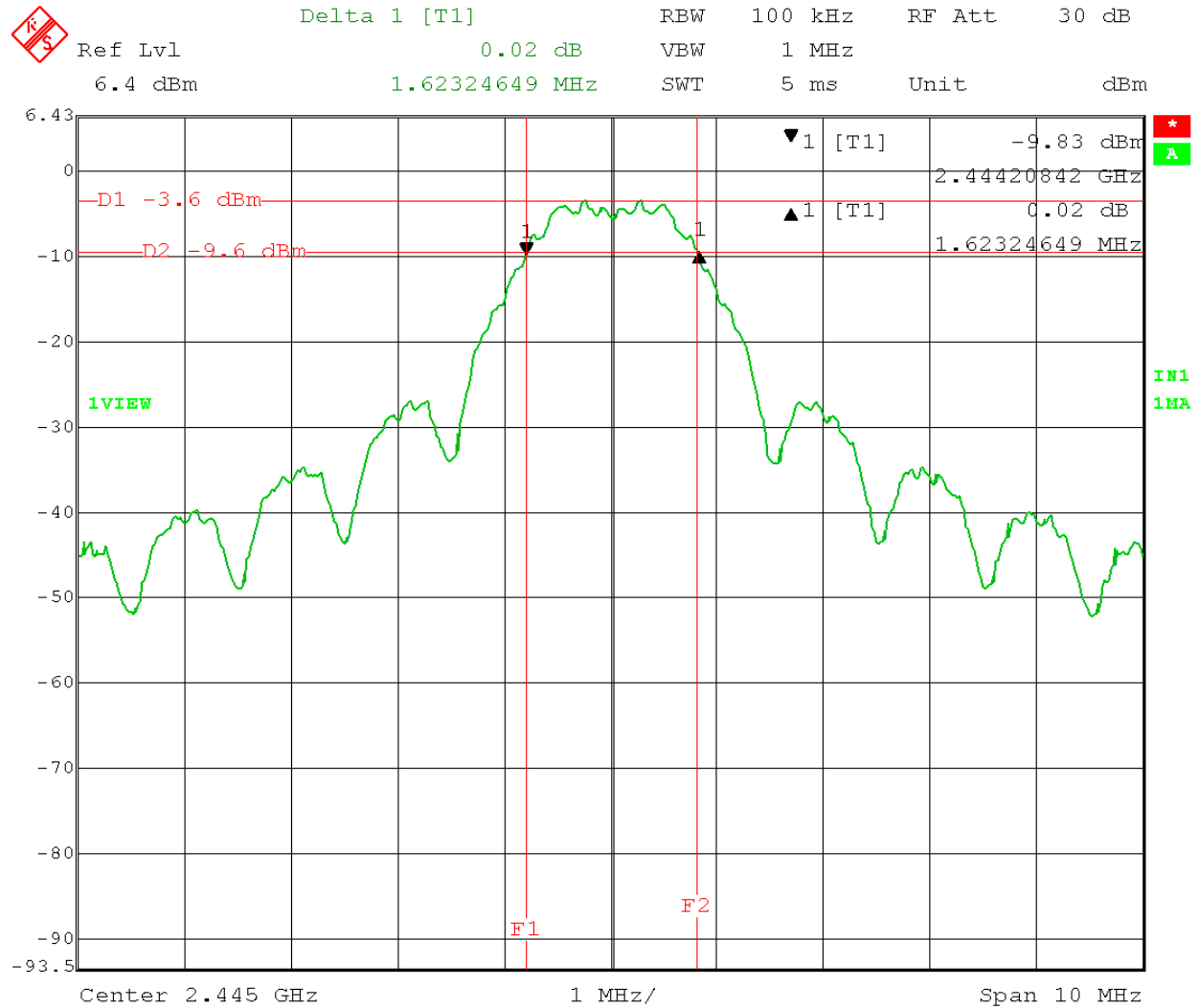
4.3.3 6 dB Occupied Bandwidth Analyzer Display Captures Antenna 1

Antenna 1, Channel 11 (2.405 GHz)



Date: 15.DEC.2014 12:16:58

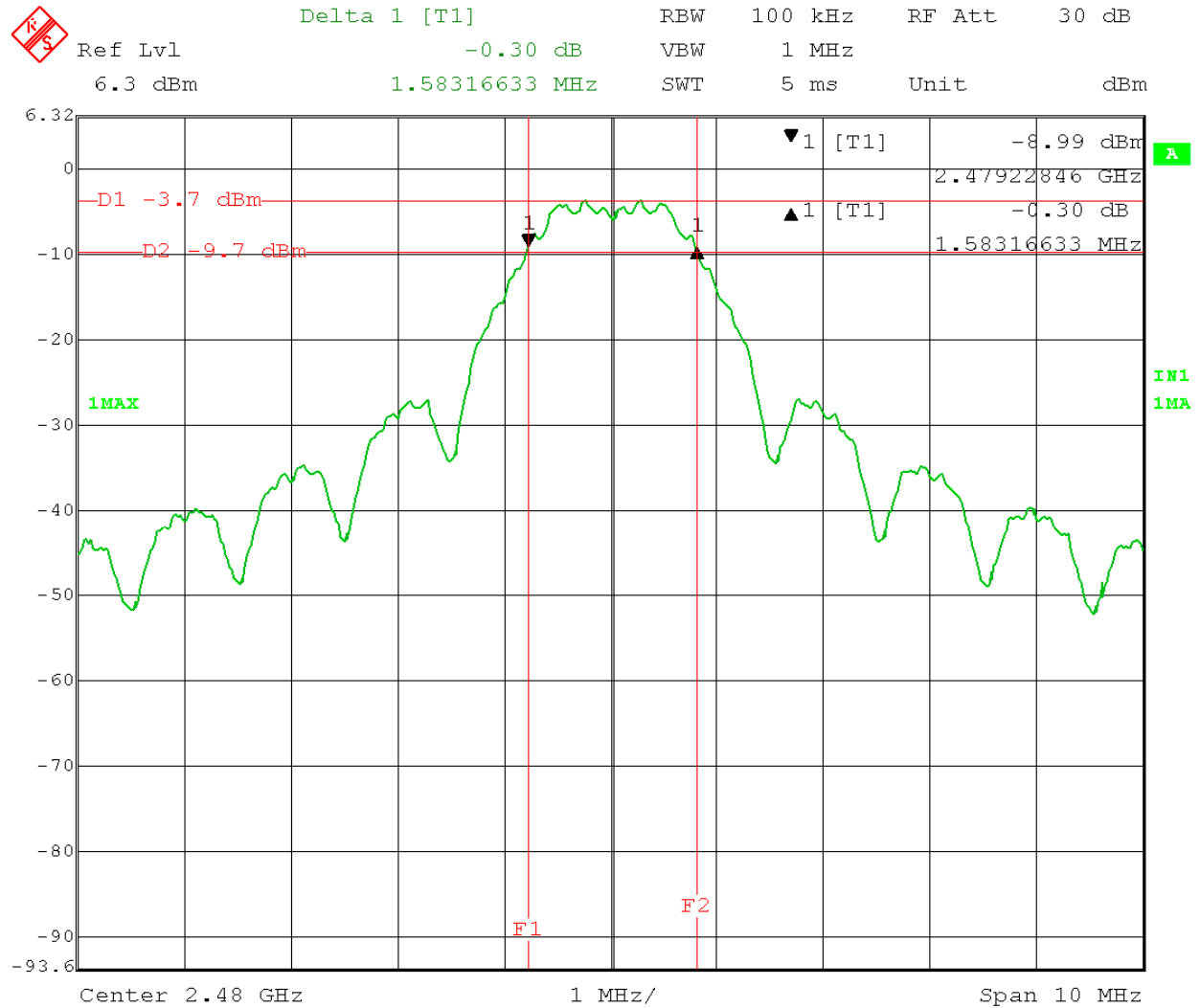
Antenna 1, Channel 19 (2.445 GHz)



Date: 15.DEC.2014 12:20:55



Antenna 1, Channel 26 (2.480 GHz)



Date: 15.DEC.2014 13:03:09



4.3.4 6 dB Occupied Bandwidth Test Results (12/15/2014)

Antenna 0

Antenna Number	Freq (GHz)	6 - dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass/Fail
0	2.405	1.6633	0.5	PASS
0	2.445	1.6232	0.5	PASS
0	2.480	1.6433	0.5	PASS

Antenna 1

Antenna Number	Freq (GHz)	6 - dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass/Fail
1	2.405	1.6232	0.5	PASS
1	2.445	1.6232	0.5	PASS
1	2.480	1.5832	0.5	PASS

Results: The 6 dB Occupied Bandwidth measurements for antenna 0 and antenna 1 of the ARRIS Model IP810 Set Top Box are compliant with the limits specified in FCC Section 15.247(a)(2).



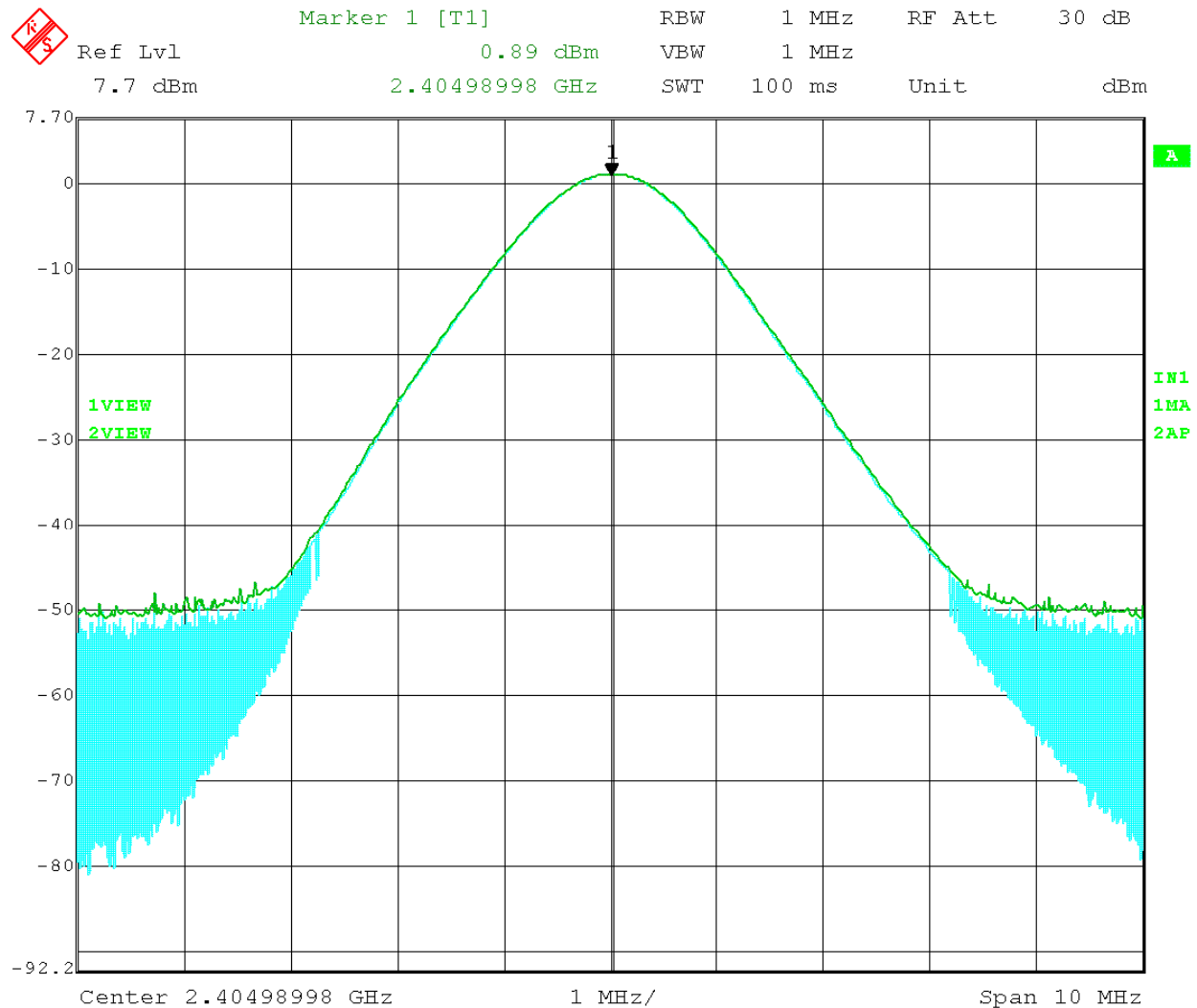
4.4 Maximum Peak Power Output FCC Section 15.247(b)(3)

4.4.1 Maximum Peak Power Output Test Procedure

A conducted power measurement of the output frequency was measured for both Antenna 0 and Antenna 1. The Antenna 0 and Antenna 1 were set individually to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized without modulation. Signal was measured with no modulation since the peak of the signal was higher when modulation was turned off.

4.4.2 Maximum Peak Power Output Analyzer Display Captures Antenna 0

Antenna 0, Channel 11 (2.405 GHz)



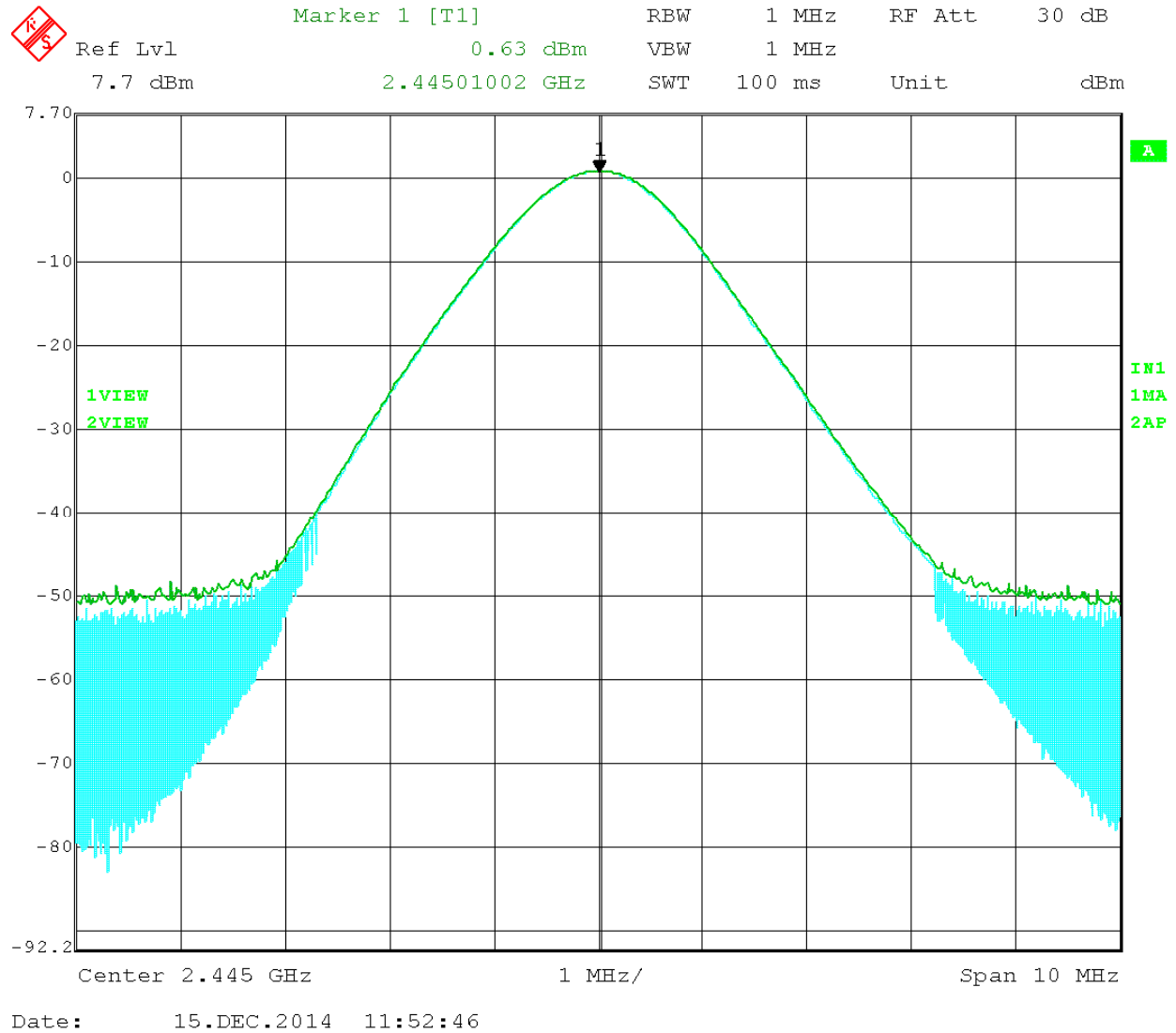
Date: 15.DEC.2014 11:54:22

Report # BEC- 1585-01 REV1 ARRIS IP810 FCC Part 15.247 Test Report

Release Date: 01/22/2015

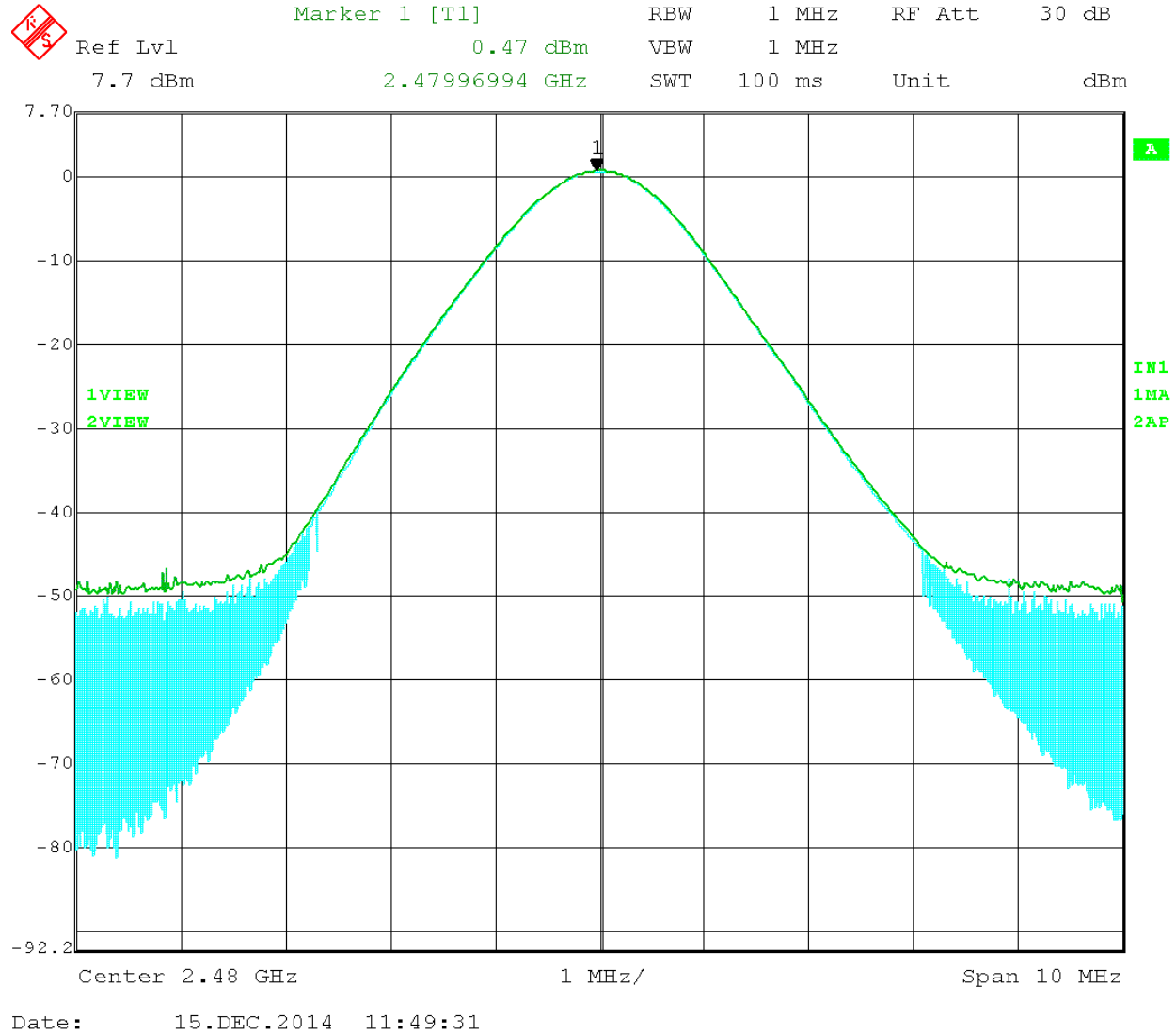


Antenna 0, Channel 19 (2.445 GHz)





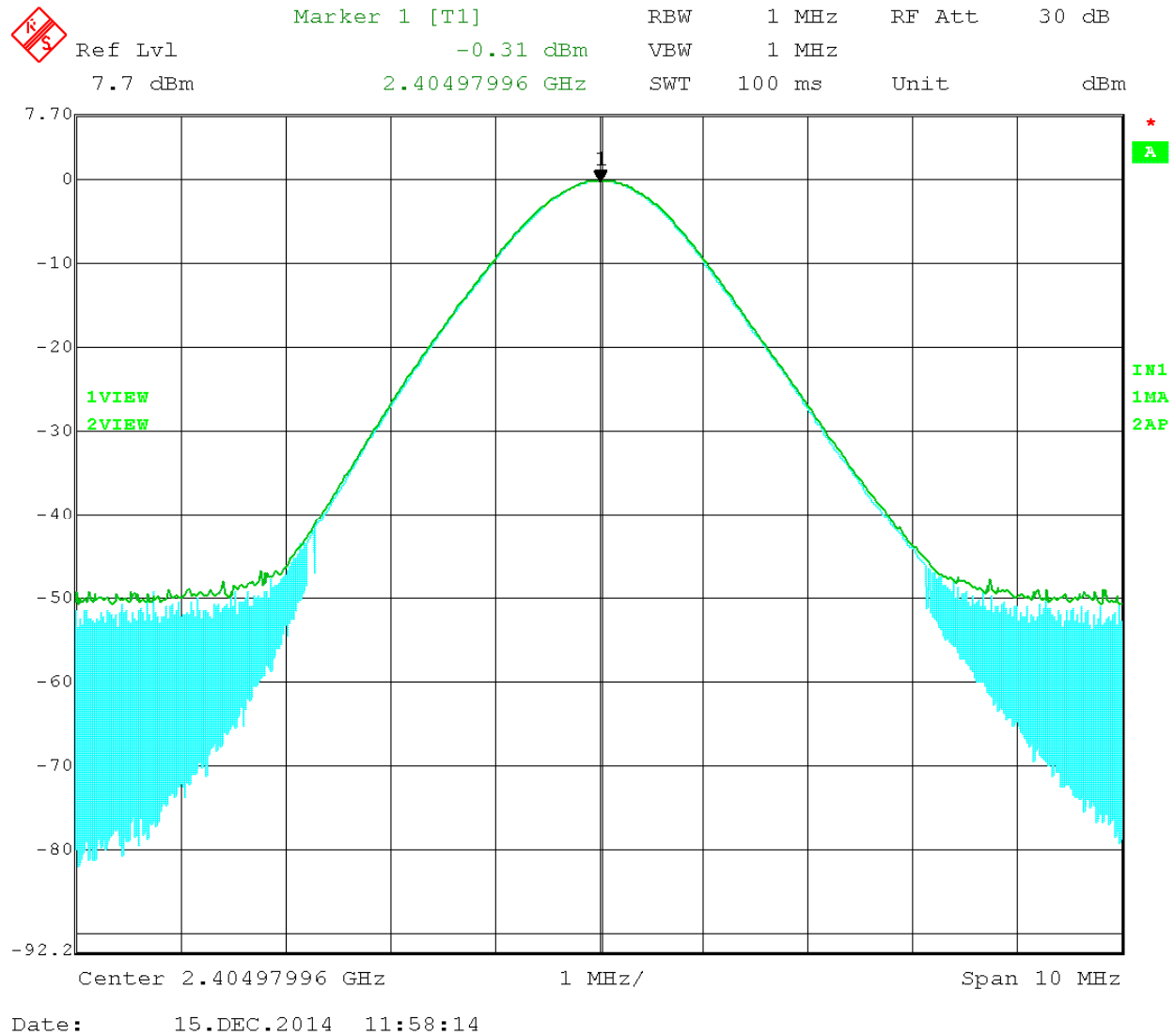
Antenna 0, Channel 26 (2.480 GHz)





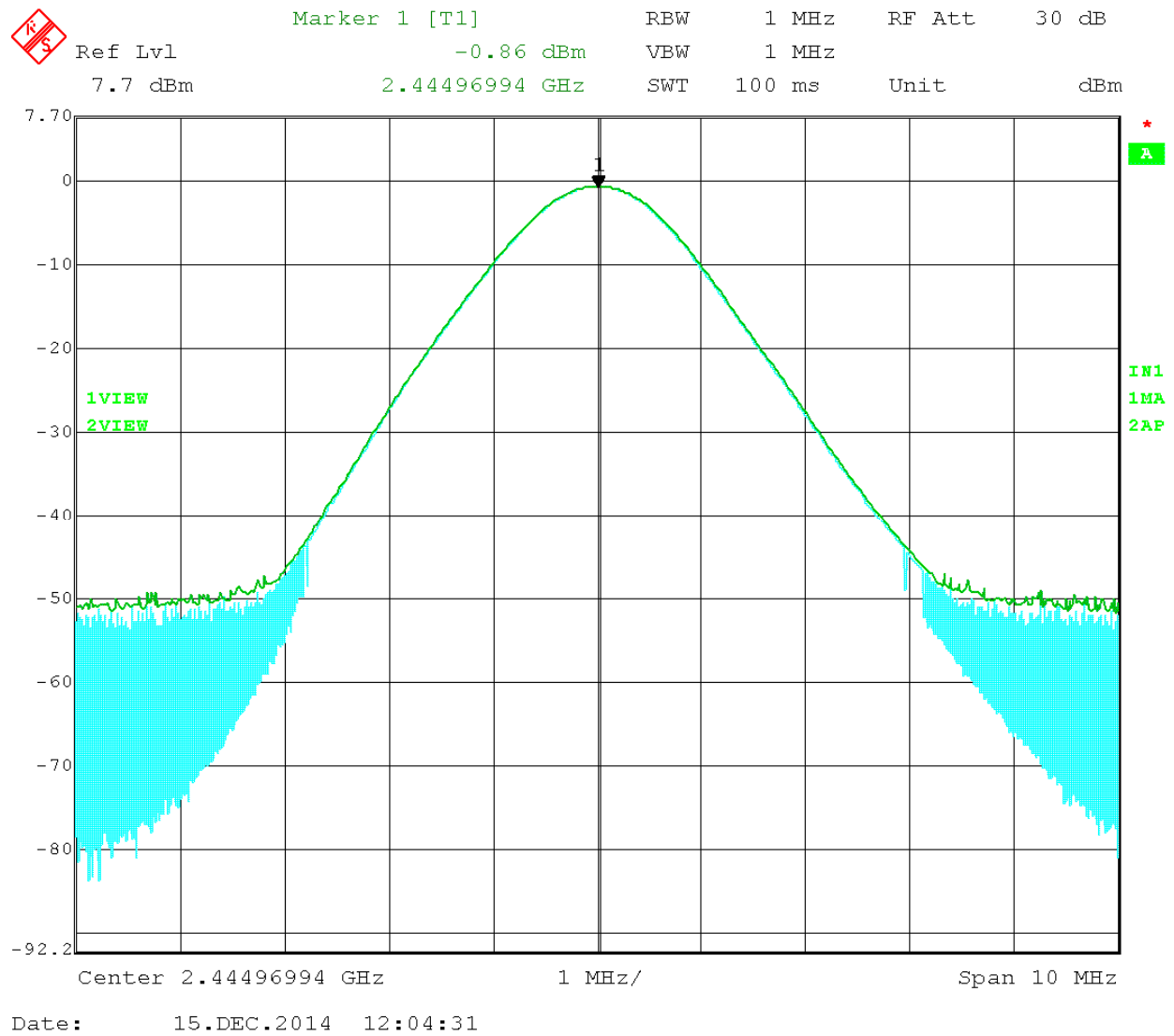
4.4.3 Maximum Peak Power Output Analyzer Display Captures Antenna 1

Antenna 1, Channel 11 (2.405 GHz)



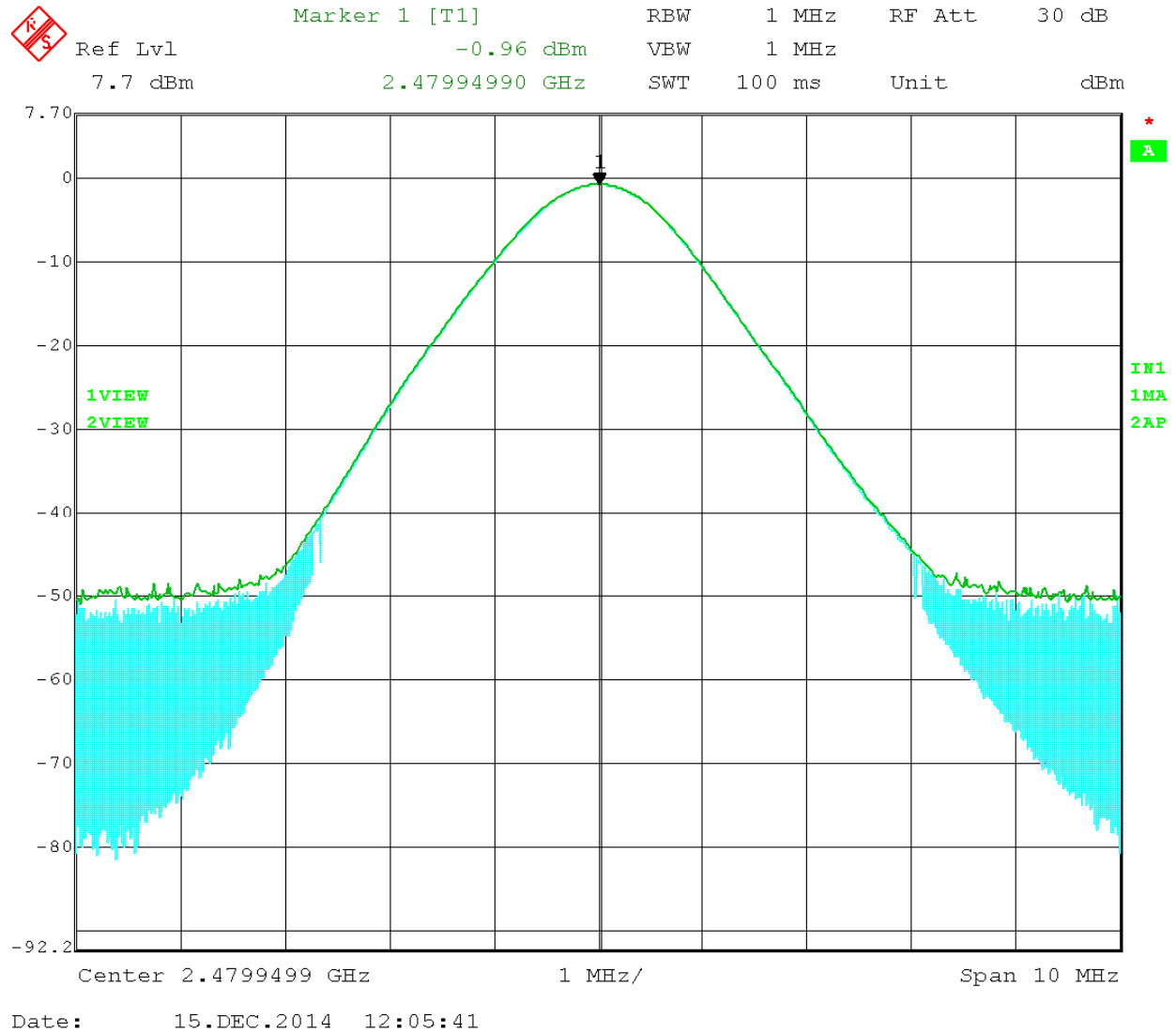


Antenna 1, Channel 19 (2.445 GHz)





Antenna 1, Channel 26 (2.480 GHz)





4.4.4 Maximum Peak Power Output Test Results (12/15/2014)

Antenna 0

Frequency GHz	Measured Level dBm	Cable Loss dB	Total		Limit		Margin	
			dBm	Watts	dBm	Watts	dBm	Watts
2.405	0.89	0.63	1.52	0.00142	30	1	-28.48	-0.99858
2.445	0.63	0.63	1.26	0.00134	30	1	-28.74	-0.99866
2.480	0.47	0.63	1.1	0.00129	30	1	-28.9	-0.99871

Antenna 1

Frequency GHz	Measured Level dBm	Cable Loss dB	Total		Limit		Margin	
			dBm	Watts	dBm	Watts	dBm	Watts
2.405	-0.31	0.63	0.32	0.00108	30	1	-29.68	-0.99892
2.445	-0.86	0.63	-0.23	0.00095	30	1	-30.23	-0.99905
2.480	-0.96	0.63	-0.33	0.00093	30	1	-30.33	-0.99907

Results: The Peak Power Output measurements for antenna 0 and antenna 1 of the ARRIS Model IP810 Set Top Box are compliant with the limits specified in FCC Section 15.247(b)(3).



4.5 Antenna Conducted Spurious Emissions FCC Section 15.247(d)

4.5.1 Antenna Conducted Spurious Emissions Test Procedure

A conducted power measurement of the output frequency was measured for both Antenna 0 and Antenna 1. The Antenna 0 and Antenna 1 were set individually to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized with modulation.

4.5.2 Antenna Conducted Spurious Emissions Test Results (12/15/2014)

Antenna 0

Channel	Fundamental Channel Frequency (GHz)	Measured Antenna Conducted Frequency (GHz)	Measured Antenna Conducted Frequency Level (dBm)	BEC#814 Cable Loss (dB)	Total Corrected Level (dBm)	Output Spurious Limit (dBm)	Pass/Fail
11	2.405	4.7650	-61.44	0.92	-60.52	-21.84	PASS
11	2.405	7.2084	-69.88	1.06	-68.82	-21.84	PASS
11	2.405	No other harmonics to 24 GHz					
19	2.445	4.9038	-62.68	0.95	-61.73	-21.99	PASS
19	2.445	12.2320	-65.64	2.27	-63.37	-21.84	PASS
19	2.445	No other harmonics to 24 GHz					
26	2.480	4.9499	-62.96	0.95	-62.01	-23.23	PASS
26	2.480	12.3707	-63.35	2.27	-61.08	-21.84	PASS
26	2.480	No other harmonics to 24 GHz					



Antenna 1

Channel	Fundamental Channel Frequency (GHz)	Measured Antenna Conducted Frequency (GHz)	Measured Antenna Conducted Frequency Level (dBm)	BEC#814 Cable Loss (dB)	Total Corrected Level (dBm)	Output Spurious Limit (dBm)	Pass/Fail
11	2.405	4.7655	-64.07	0.92	-63.15	-21.7	PASS
11	2.405	7.2084	-69.41	1.06	-68.35	-21.7	PASS
11	2.405	No other harmonics to 24 GHz					
19	2.445	4.8577	-65.77	0.95	-64.82	-22.07	PASS
19	2.445	7.2084	-69.31	1.06	-68.25	-21.7	PASS
19	2.445	No other harmonics to 24 GHz					
26	2.480	4.9499	-65.22	0.95	-64.27	-23.59	PASS
26	2.480	7.2084	-68.94	1.06	-67.88	-21.7	PASS
26	2.480	No other harmonics to 24 GHz					

Results: The Antenna Conducted Spurious Emissions measurements for antenna 0 and antenna 1 of the ARRIS Model IP810 Set Top Box are compliant with the limits specified in FCC Section 15.247(d).



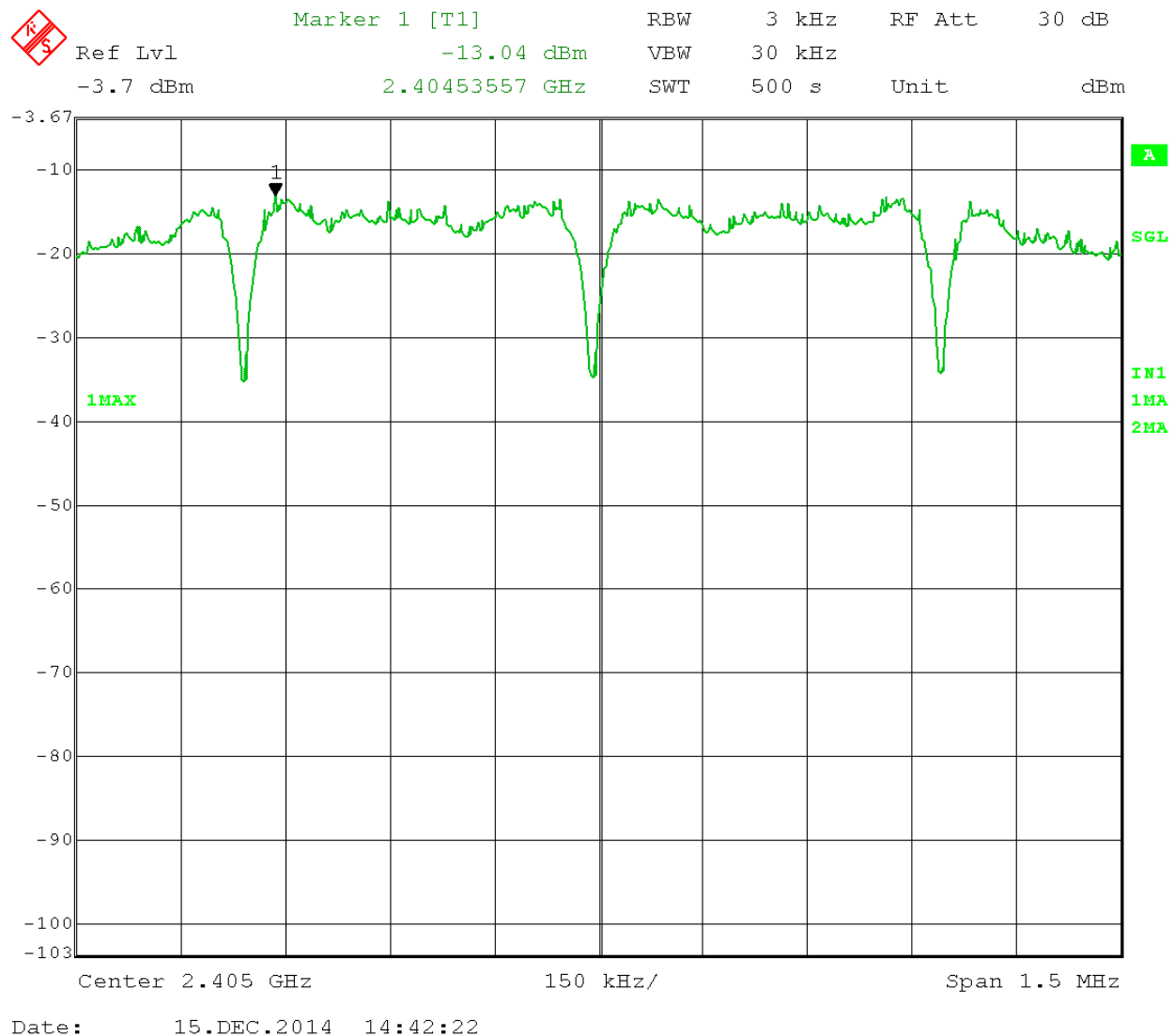
4.6 Power Spectral Density FCC Section 15.247(e)

4.6.1 Power Spectral Density Test Procedure

A conducted power measurement of the output frequency was measured for both Antenna 0 and Antenna 1. The Antenna 0 and Antenna 1 were set individually to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized with modulation.

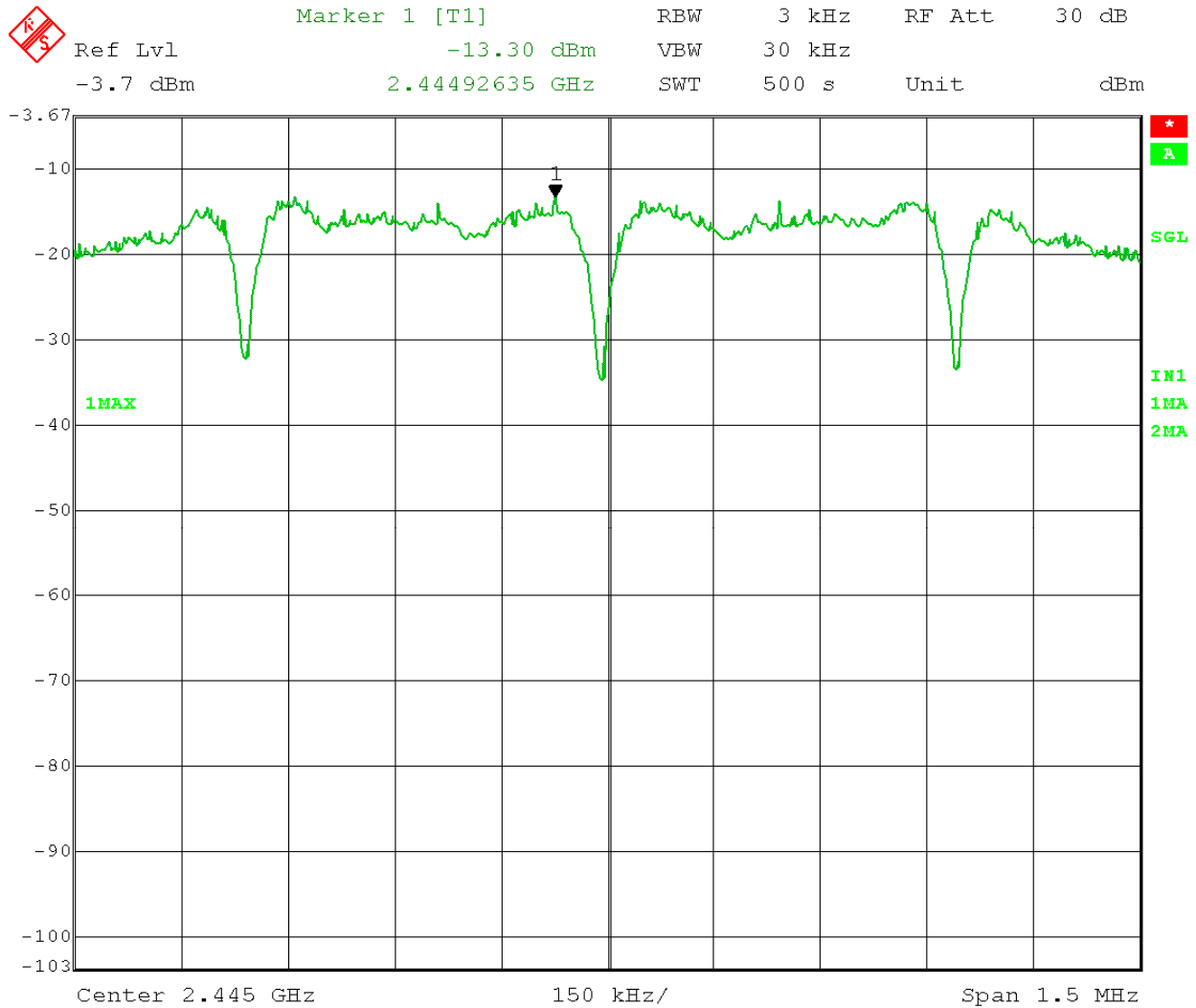
4.6.2 Power Spectral Density Analyzer Display Captures Antenna 0

Antenna 0, Channel 11 (2.405 GHz)





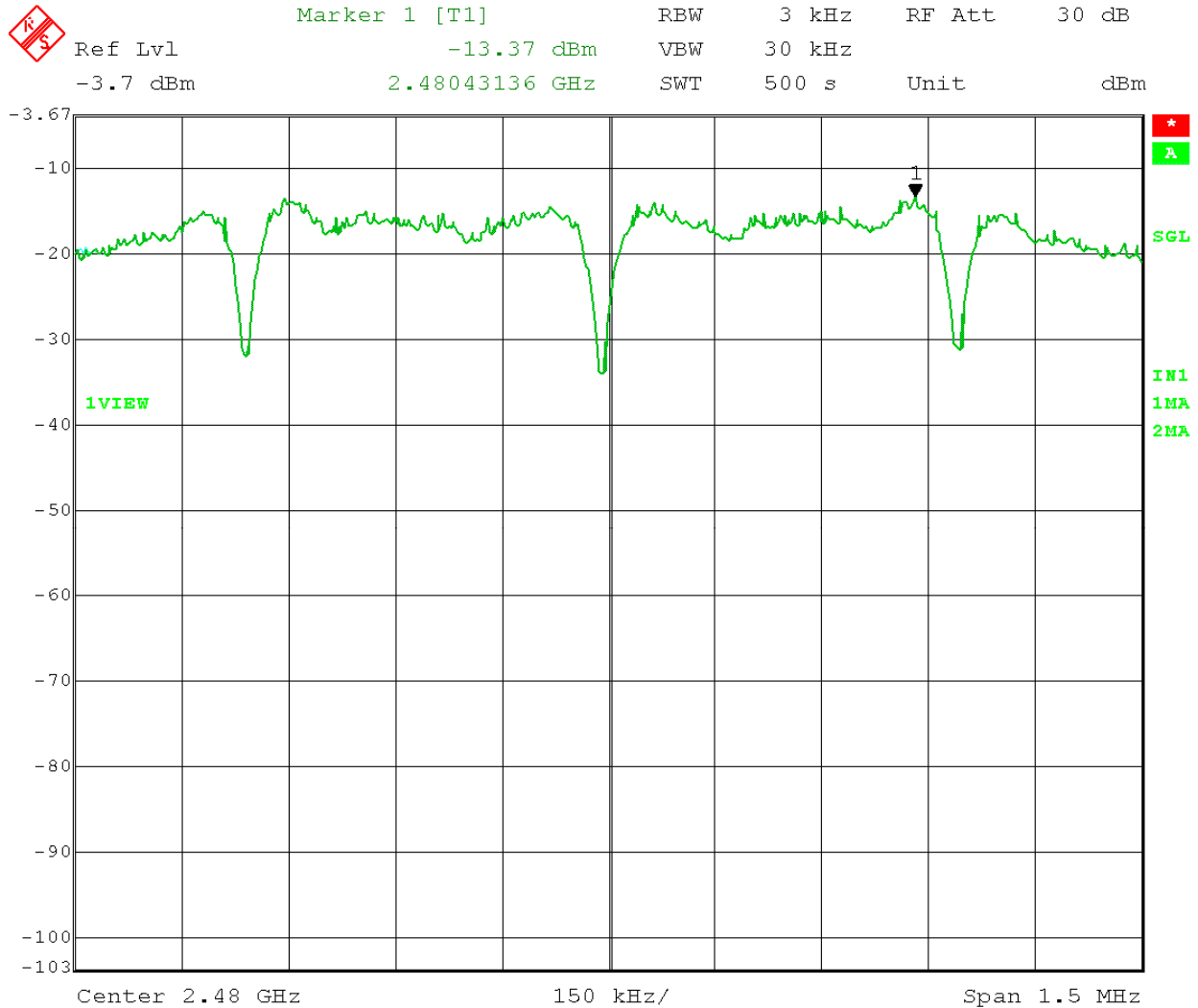
Antenna 0, Channel 19 (2.445 GHz)



Date: 15.DEC.2014 15:06:22



Antenna 0, Channel 26 (2.480 GHz)

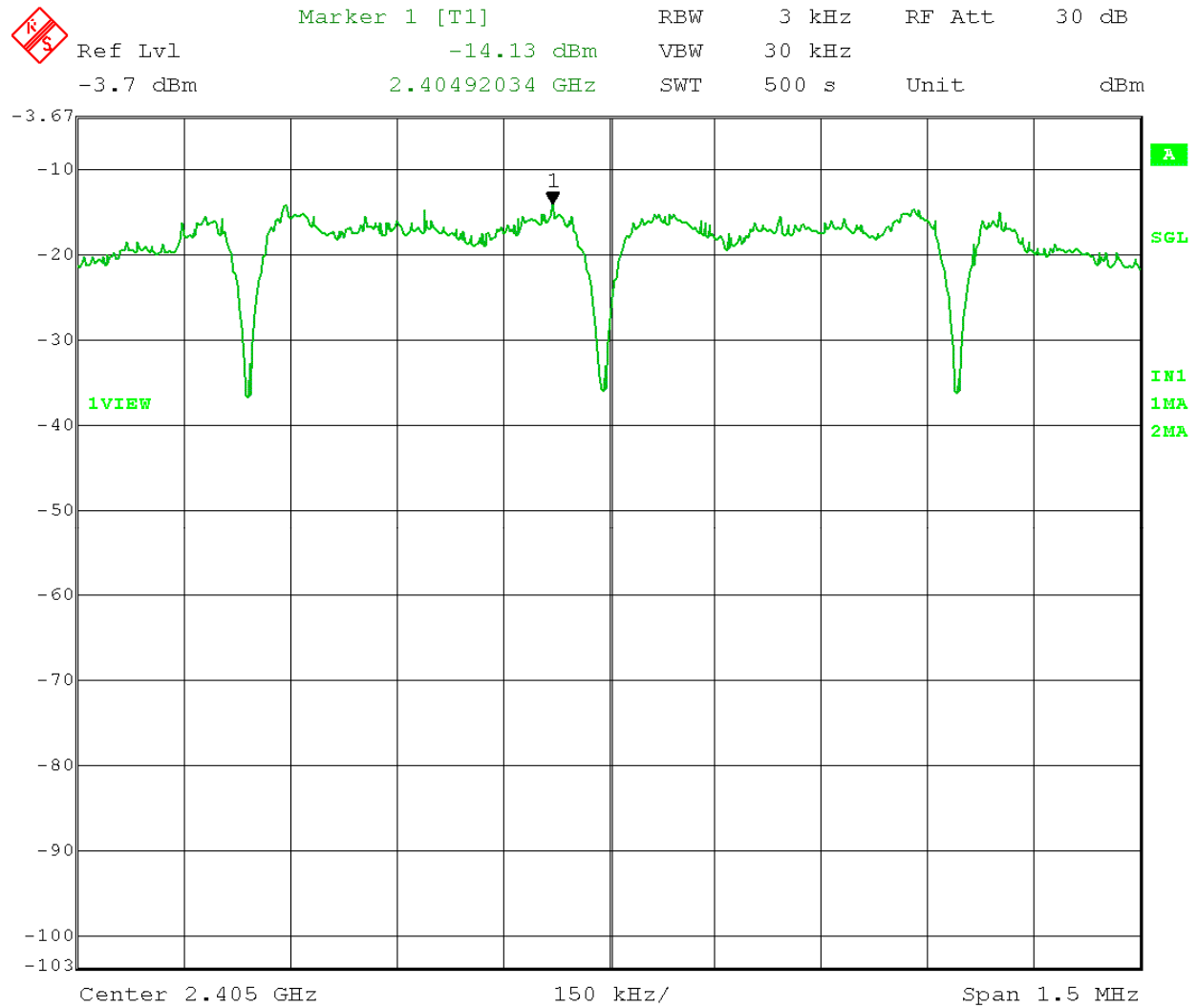


Date: 15.DEC.2014 15:24:36



4.6.3 Power Spectral Density Analyzer Display Captures Antenna 1

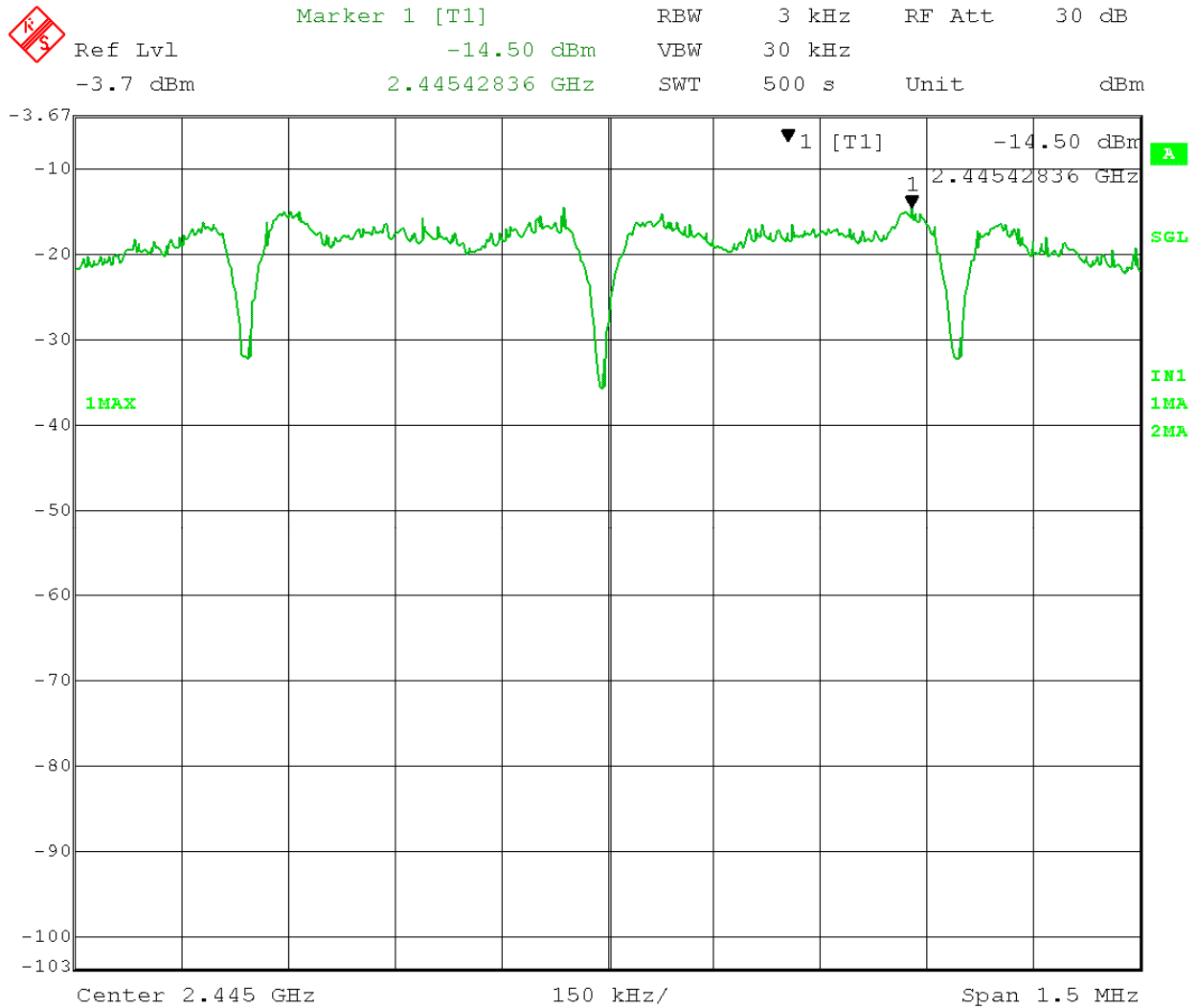
Antenna 1, Channel 11 (2.405 GHz)



Date: 15.DEC.2014 14:24:14



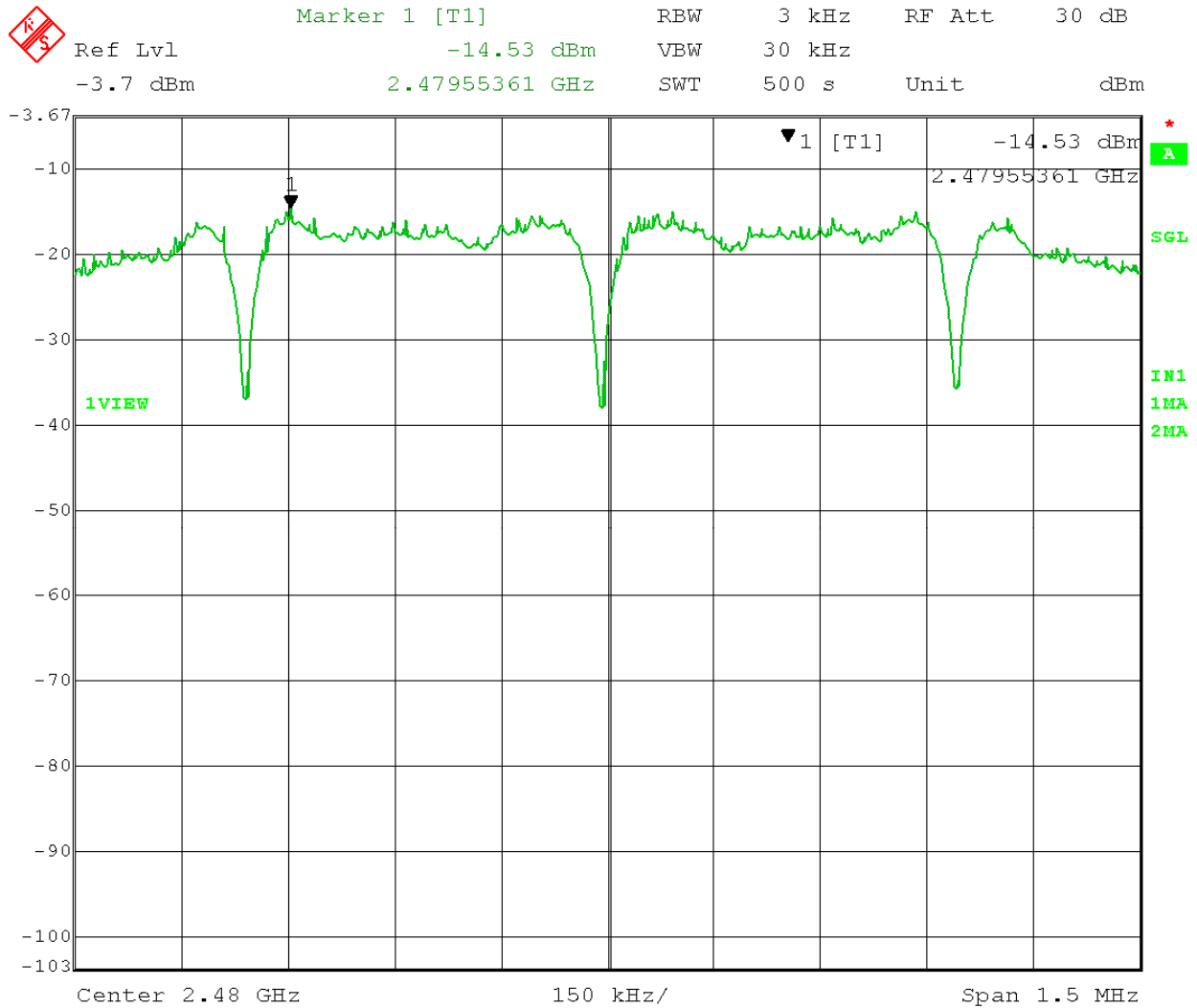
Antenna 1, Channel 19 (2.445 GHz)



Date: 15.DEC.2014 13:42:07



Antenna 1, Channel 26 (2.480 GHz)



Date: 15.DEC.2014 13:26:33



4.6.4 Power Spectral Density Test Results (12/15/2014)

Antenna 0

Antenna	Channel	Freq (GHz)	Measured Power Spectral Density (dBm)	Cable Loss (dB)	Total Power Spectral Density (dBm)	Power Spectral Density Limit (dBm)	Pass/Fail
0	CH.11	2.4045	-13.04	0.63	-12.41	8	PASS
0	CH.19	2.4449	-13.3	0.63	-12.67	8	PASS
0	CH.26	2.4804	-13.37	0.63	-12.74	8	PASS

Antenna 1

Antenna	Channel	Freq (GHz)	Measured Power Spectral Density (dBm)	Cable Loss (dB)	Total Power Spectral Density (dBm)	Power Spectral Density Limit (dBm)	Pass/Fail
1	CH.11	2.4049	-14.13	0.63	-13.5	8	PASS
1	CH.19	2.4454	-14.5	0.63	-13.87	8	PASS
1	CH.26	2.4796	-14.53	0.63	-13.9	8	PASS

Results: The Power Spectral Density measurements for antenna 0 and antenna 1 of the ARRIS Model IP810 Set Top Box are compliant with the limits specified in FCC Section 15.247(e).



4.7 Band Edge Measurement FCC Section 15.247(d)

4.7.1 Band Edge Measurement Test Procedure

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)
11	2.405
19	2.445
26	2.480

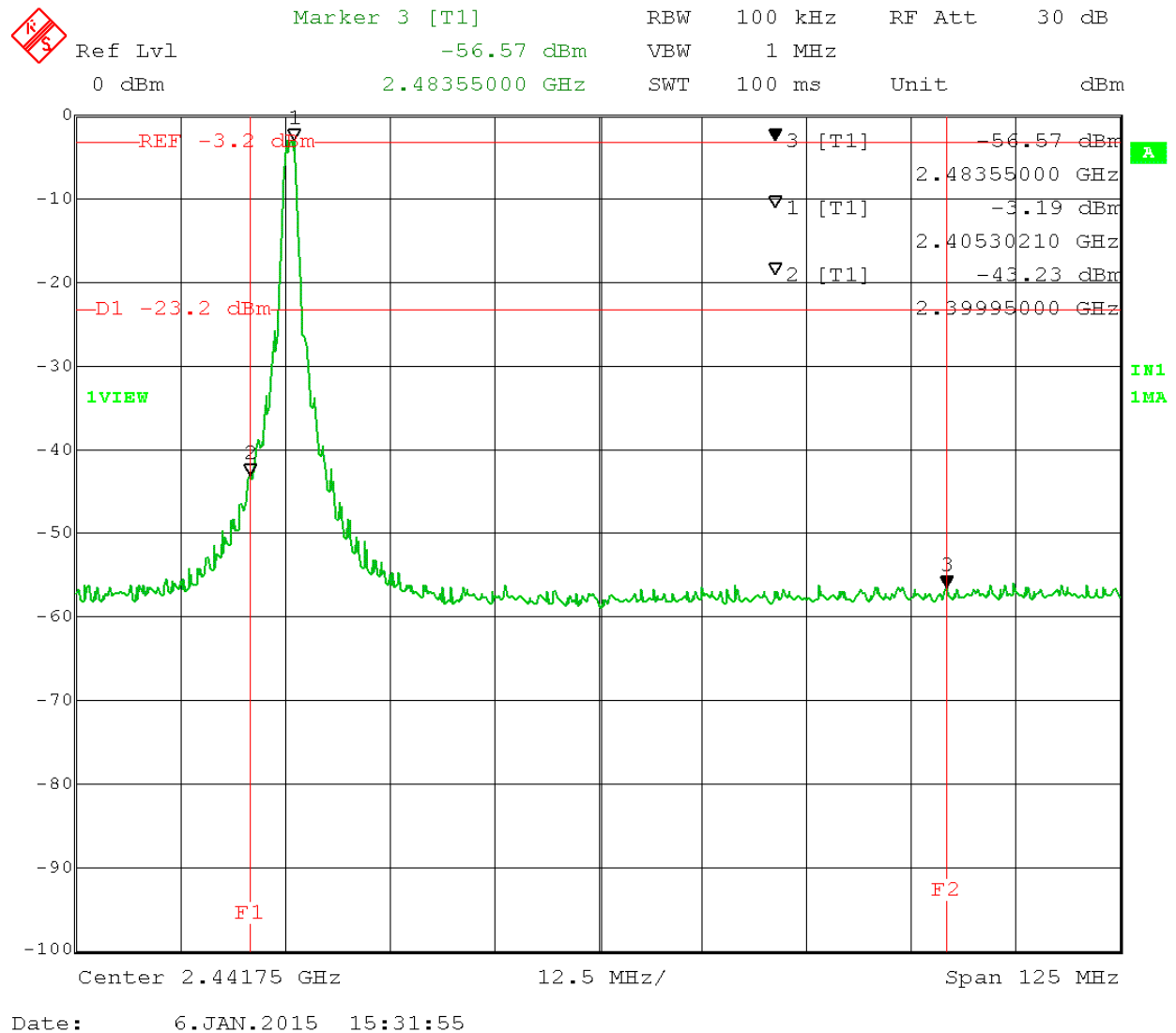
The data was recorded in three screen captures from the Spectrum Analyzer. Parameters particular to each measurement are as follows:

Center Frequency	
Resolution Bandwidth	100 kHz
Video Bandwidth	1 MHz
Span	125 MHz
Scale:	dBm
Reference Level:	0 dBm



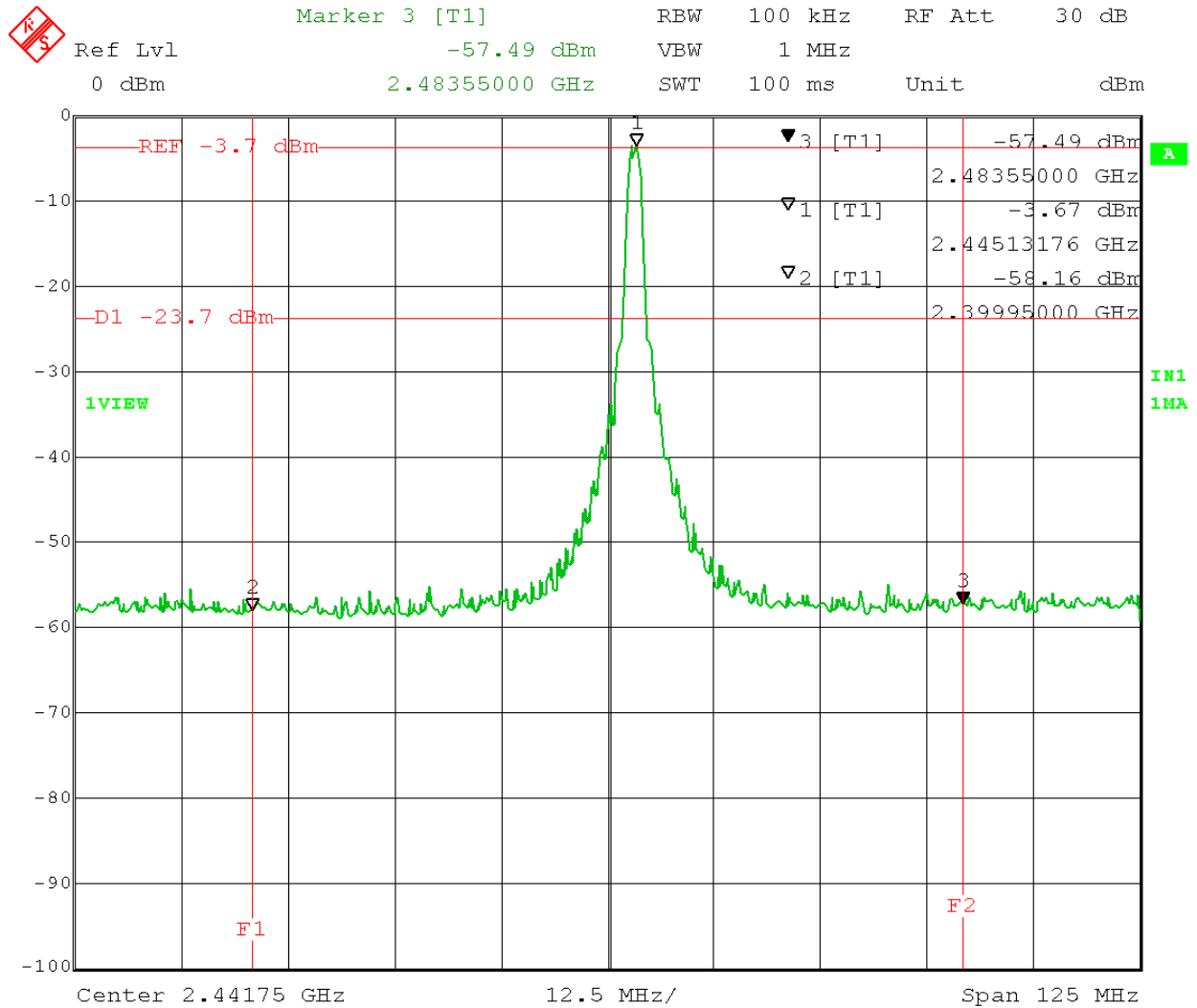
4.7.2 Band Edge Measurement Analyzer Display Captures Antenna 0

Antenna 0, Channel 11 (2.405 GHz)



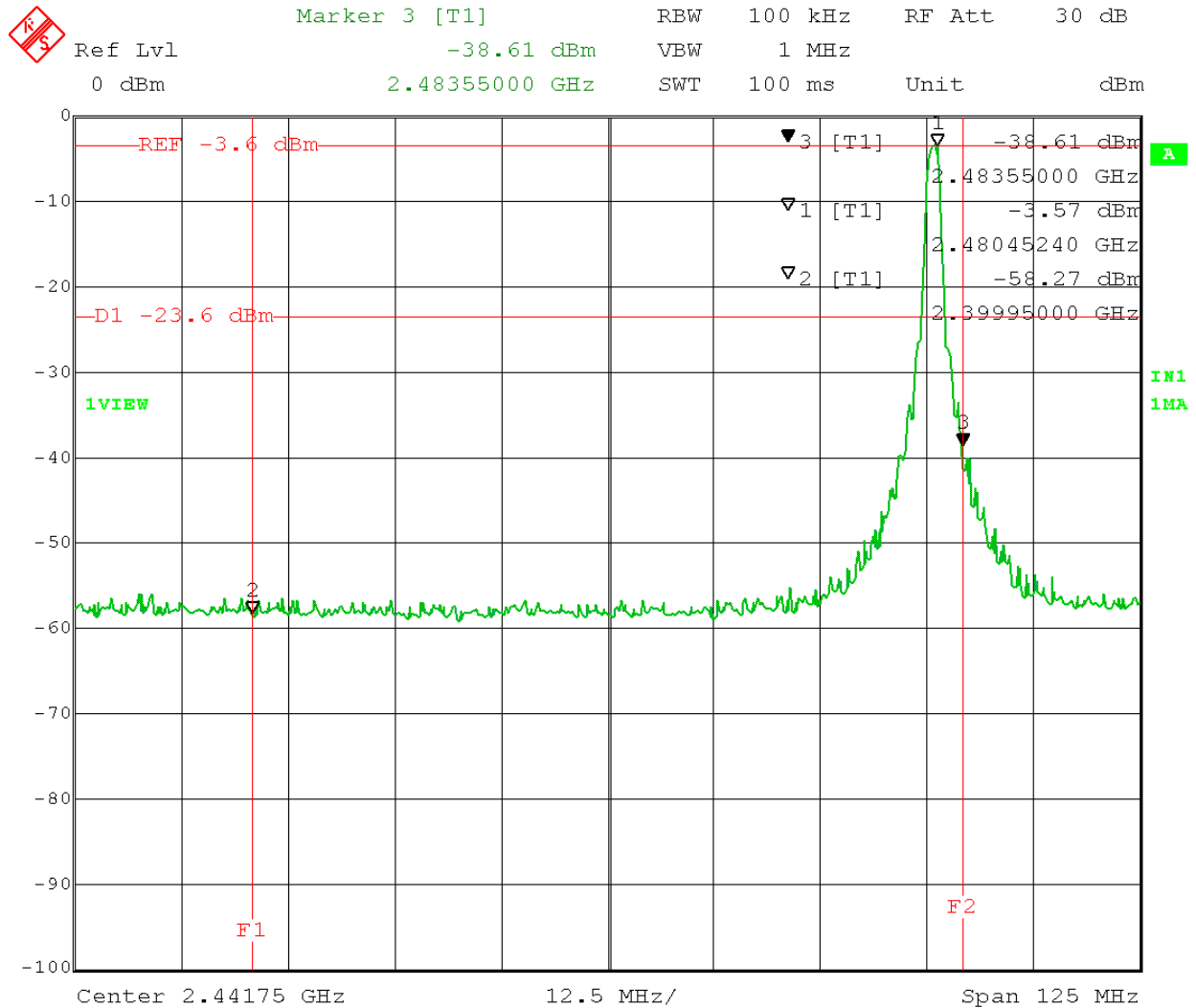


Antenna 0, Channel 19 (2.445 GHz)



Date: 6.JAN.2015 15:38:27

Antenna 0, Channel 26 (2.480 GHz)

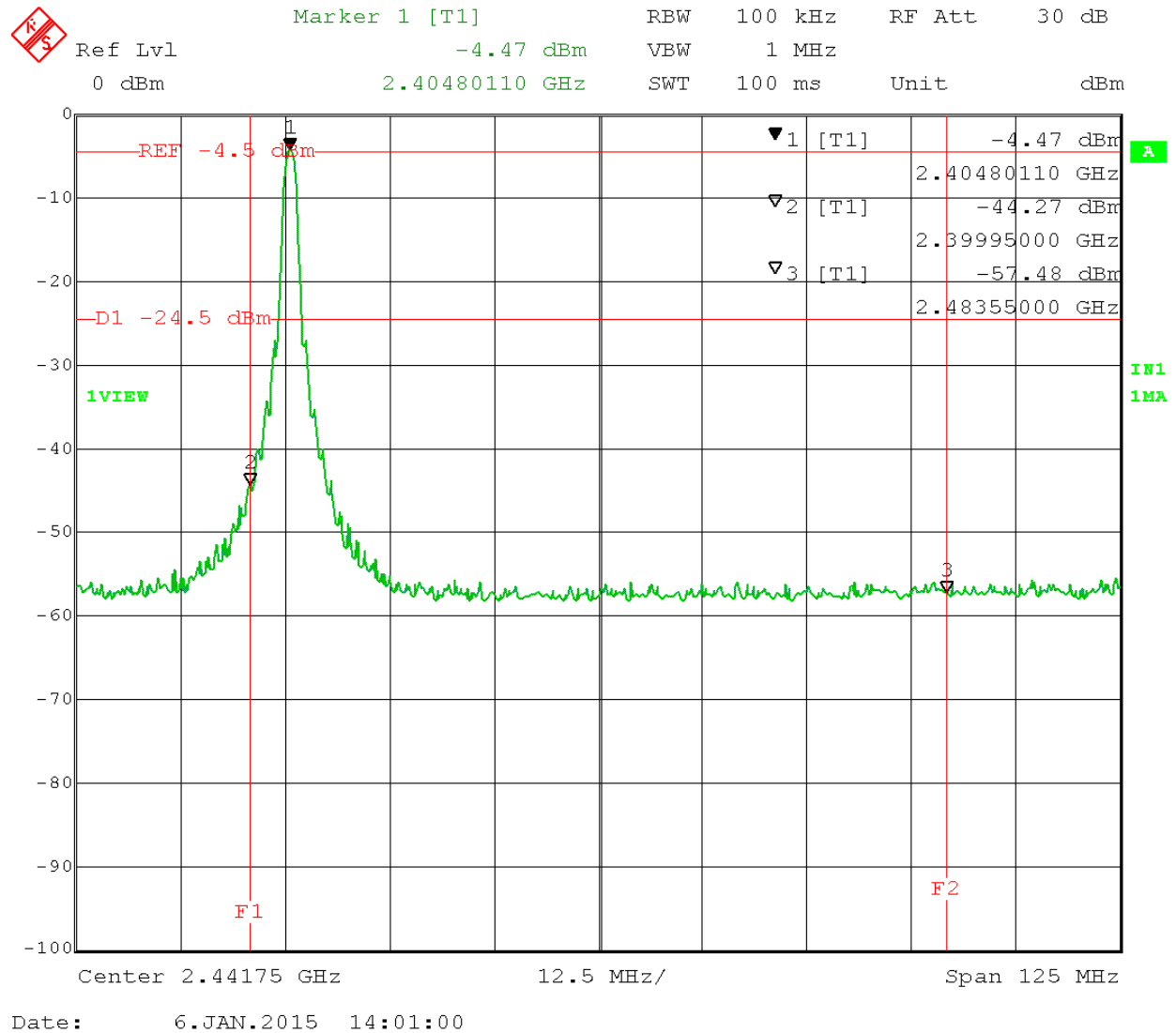


Date: 6.JAN.2015 15:42:48



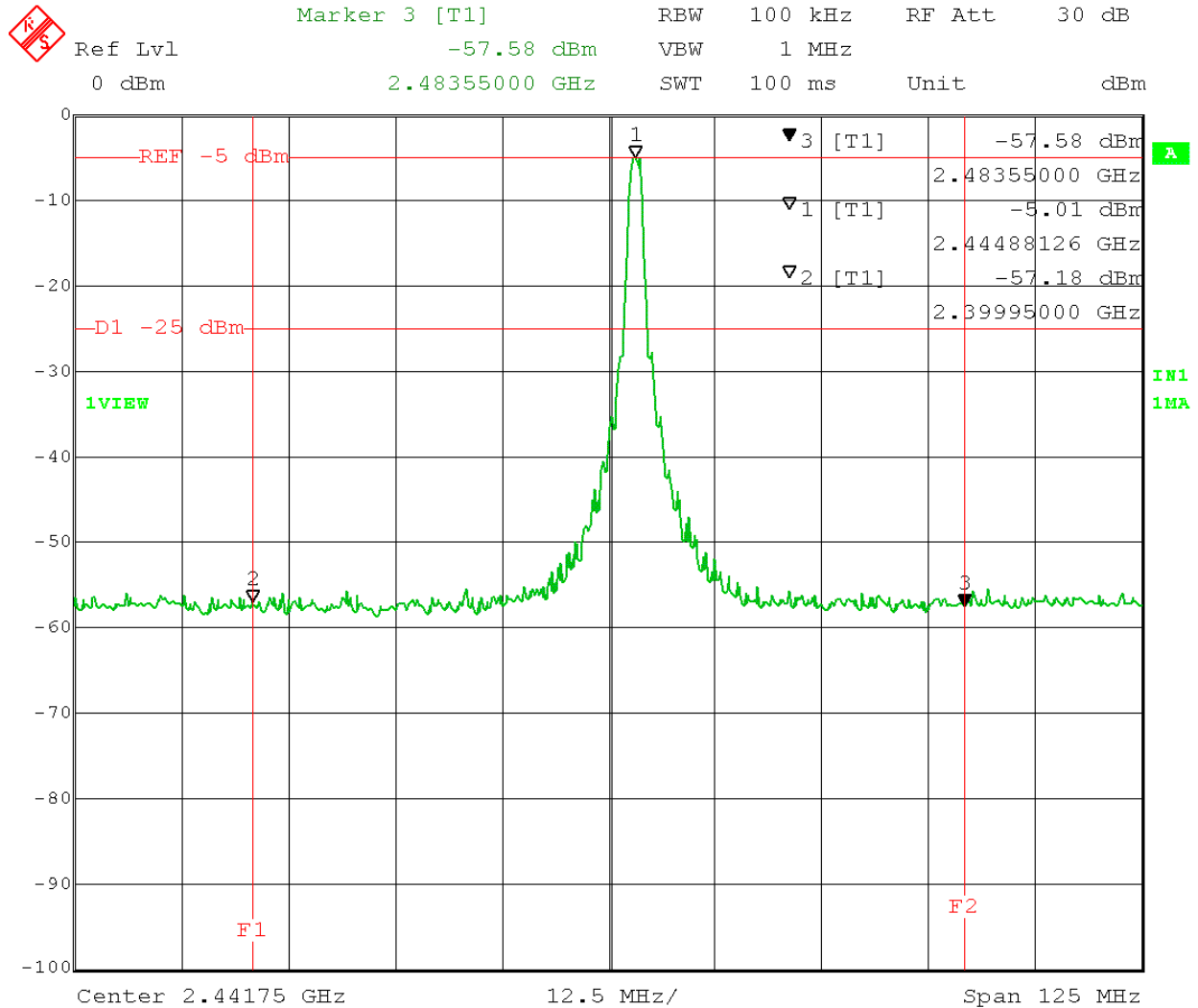
4.7.3 Band Edge Measurement Analyzer Display Captures Antenna 1

Antenna 1, Channel 11 (2.405 GHz)





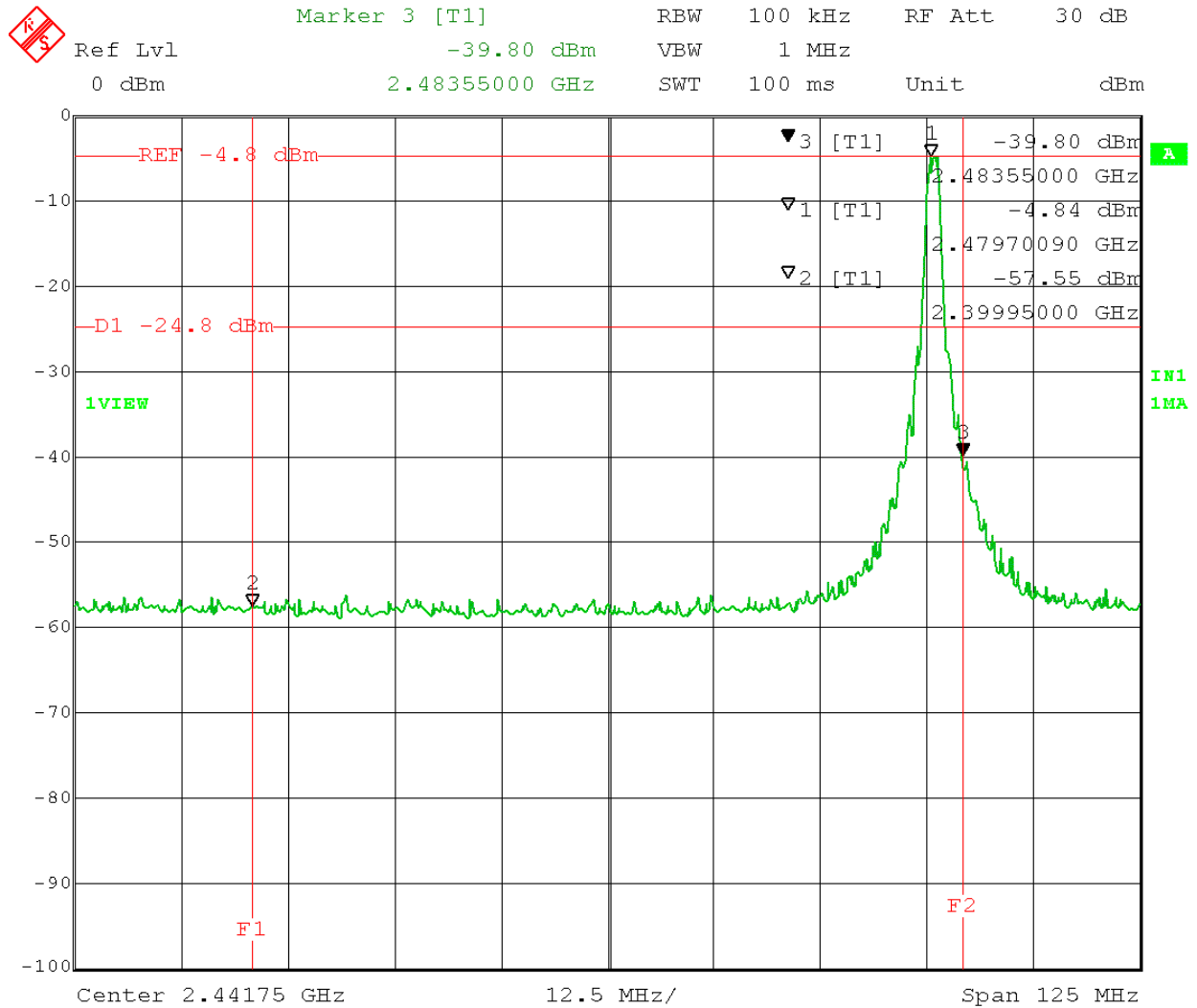
Antenna 1, Channel 19 (2.445 GHz)



Date: 6.JAN.2015 14:54:51



Antenna 0, Channel 26 (2.480 GHz)



Date: 6.JAN.2015 15:53:42



4.7.4 Band Edge Measurement Test Data Results (01/06/2015)

Antenna 0

Channel	Measurement Frequency (GHz)	Peak Amplitude (dBm)	20 dB Limit	Lower Edge of Freq Band (GHz)	Upper Edge of Freq Band (GHz)	Lower Measured Freq (GHz)	Lower Measured Amplitude (dBm)	Upper Measured Frequency (GHz)	Upper Measured Amplitude (dBm)
11	2.4053	-3.19	-23.2	2.4	2.4835	2.39995	-43.23	2.48355	-56.57
19	2.4451	-3.67	-23.7	2.4	2.4835	2.39995	-58.16	2.48355	-57.49
26	2.4804	-3.57	-23.6	2.4	2.4835	2.39995	-58.27	2.48355	-38.61

Antenna 1

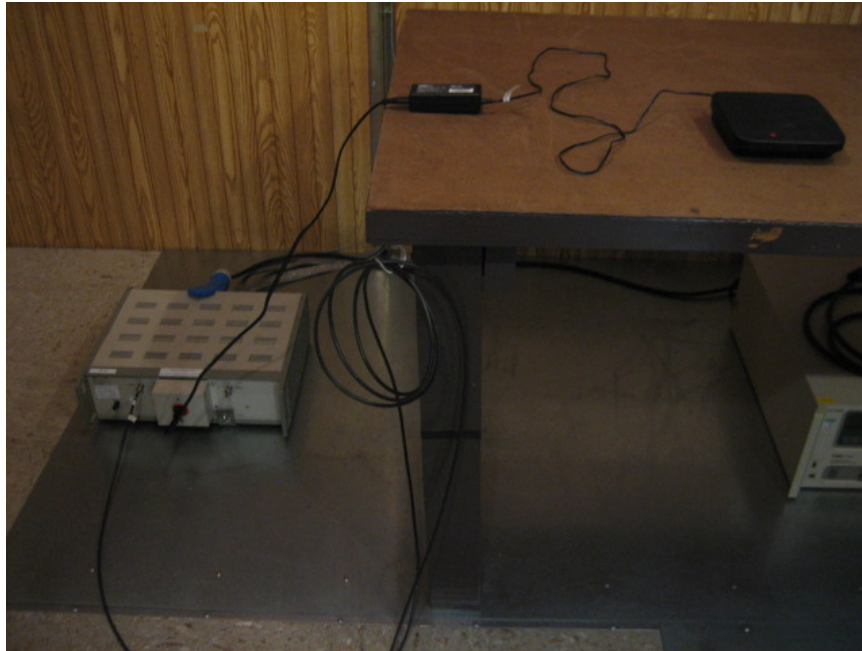
Channel	Measurement Frequency (GHz)	Peak Amplitude (dBm)	20 dB Limit	Lower Edge of Freq Band (GHz)	Upper Edge of Freq Band (GHz)	Lower Measured Freq (GHz)	Lower Measured Amplitude (dBm)	Upper Measured Frequency (GHz)	Upper Measured Amplitude (dBm)
11	2.4048	-4.47	-24.5	2.4	2.4835	2.39995	-44.27	2.48355	-57.48
19	2.4448	-5.01	-25	2.4	2.4835	2.39995	-57.18	2.48355	-57.58
26	2.4797	-4.84	-24.8	2.4	2.4835	2.39995	-57.55	2.48355	-39.8

Results: The Band Edge measurements for antenna 0 and antenna 1 of the ARRIS Model IP810 Set Top Box are compliant with the limits specified in FCC Section 15.247(d).

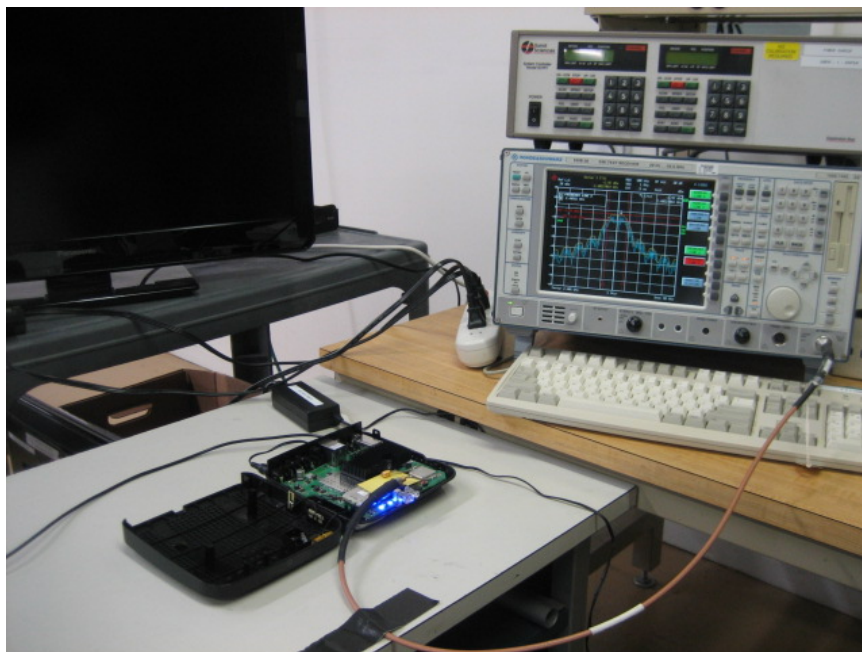


5.0 Test Setup Pictures

5.1 Conducted Emissions Power Line Test Setup Picture

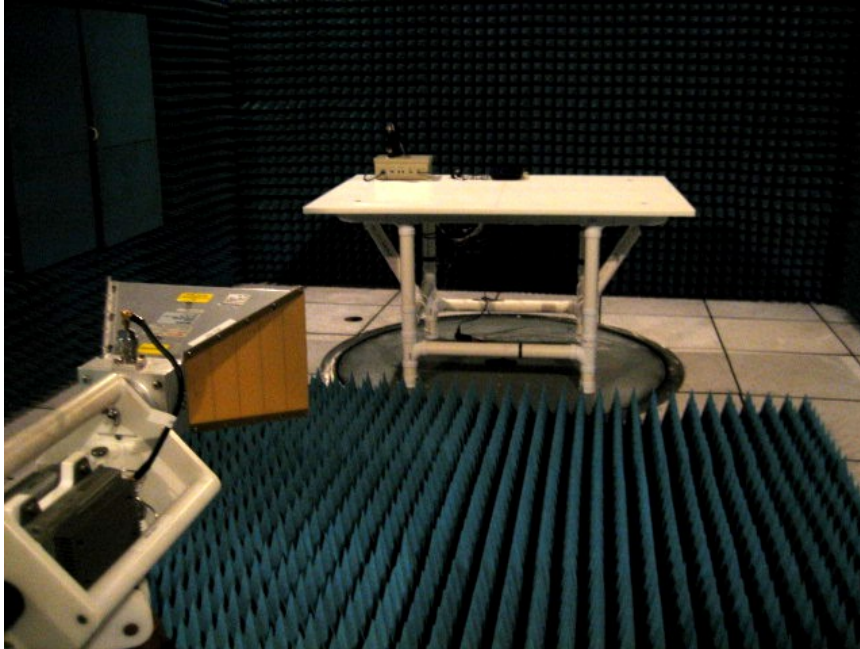


5.2 Conducted Emissions Antenna Test Setup Picture





5.3 Harmonic Radiated Emissions Test Setup Picture





Appendix A – Test Equipment

Equipment	Manufacturer	Model #	Serial #	BEC #	Calibration Date	Calibration Cycle	Calibration Due Date
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A022108	712	04/25/14	2 Years	04/25/16
EMI Receiver (20 Hz – 26.5 GHz)	Rohde & Schwarz	ESIB 26	836119/006	1010	06/18/14	1 Year	06/18/15
9kHz-3GHz EMC Analyzer	Agilent	E7402A	US39440162	883	12/22/14	1 Year	12/22/15
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	2 Years	10/14/16
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	08/07/12	3 Years	08/07/15
Amplifier System (0.5 – 50 GHz)	Hewlett Packard	83015A 83017A	3123A00360 & 3332A00219	1027	09/09/14	2 Year	09/09/16
Double Ridged Horn Antenna (1 - 18 GHz)	EMCO	3115	9705-5225	1028	10/08/14	2 Years	10/06/16
Antenna (18 - 26.5 GHz)	Hewlett Packard	84125-80008	N/A	1056	10/08/14	2 Years	10/08/16



EMI Receiver (9 kHz - 6.5 GHz)	Hewlett Packard	8546A	3325A00158	761	05/11/13	2 Years	05/11/15
Amplifier (.1 – 1300 MHz)	Hewlett Packard	8447F	3313A06658	807	No Cal. Required	No Cal. Required	No Cal. Required
Limiter	Hewlett Packard	11867A	01423	802	04/23/13	2 Years	04/23/15
LISN (9 kHz – 30 MHz)	EMCO	4825/2	9803-1047	750	04/12/13	2 Years	04/12/15
Shielded Room #1	ETS Lindgren	12-2/2-0	4078	859	05/14/13	1 Year	05/14/15
Intentional Radiator Testing High Frequency RF Test Cable	Workhorse	WHU18-3636-036	N/A	814	12/04/14	2 Years	12/04/16
OATS Site (30 MHz – 1 GHz)	BEC	N/A	N/A	705	05/07/14	1 Year	05/07/15
Temp/Humidity Meter	Control Company	4096	140055652	780	01/21/14	2 Years	01/21/16
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