H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Microchip Technology Inc.

IEEE 802.15.4 Transceiver Module

Tested under

The FCC Rules contained in Title 47 of the CFR, Part 15.247 for

Digitally Transmitting Sequence

Prepared for:

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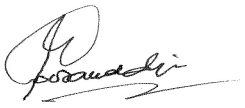

Hoosamuddin Bandukwala

Cert # ATL-0062-E

Engineering Statement: The measurements shown in this report were made in accordance with the procedure indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurement made, the equipment tested is capable of operation in accordance with the requirements of Part 15 of the FCC Rules under normal use and maintenance.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	November 12, 2010	Initial Issue
1	January 21, 2011	Added Section for Unintentional Radiated Emissions and updated Section 7
2	February 01,2011	Updated Section 1 & 2
3	February 04, 2011	Added Duty Cycle Plot and Calculation

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EXECUTIVE SUMMARY

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15.247. All tests were conducted using measurement procedure from ANSI C63.4-2003 and FCC Public Notice 558074 DTS Guide March 23, 2005 as appropriate.

Test Name	Test Method/Standard	Result	Comments
Unintentional Radiated Emissions	15.109	Pass	
A/C Power Line Conducted Emissions	15.207	Pass	
Occupied Bandwidth	15.247(a)(2)	Pass	
Peak Output Power	15.247(b)	Pass	
Conducted Spurious Emissions	15.247(d)	Pass	
Radiated Spurious Emissions	15.247(d), 15.209(a), 15.205	Pass	
Emissions At Band Edges & Restricted Band	15.247(d), 15.209(a), 15.205	Pass	
Power Spectral Density	15.247(e)	Pass	

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Microchip Technology Inc. to perform testing on the IEEE Std. 802.15.4 Transceiver modules under the purchase order number 207702.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Microchip, IEEE Std. 802.15.4 Transceiver module.

The tests were based on FCC Part 15 Rules. The tests described in this document were formal tests as described with the objective of the testing was to evaluate compliance of the Equipment Under Test (EUT) to the requirements of the aforementioned specifications. Microchip should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been permanently discontinued. The results obtained relate only to the item(s) tested.

Product Name:	IEEE Std. 802.15.4 RF Transceiver Module
Model(s) Tested:	MRF24J40MC
FCC ID:	OA3MRF24J40MC
Supply Voltage Input:	Primary Power : 3.3 Vdc
Frequency Range:	2.405-2.475 GHz
No. of Channels:	Single Chanel
Type(s) of Modulation:	OQPSK
Range of Operation Power:	0.077W (conducted)
Emission Designator:	N/A
Channel Spacing(s)	None
Test Item:	Pre-Production
Type of Equipment :	Fixed
Antenna Requirement (§15.203) :	Type of Antenna: Ultra miniature coaxial (U.FL) Gain of Antenna: 2dBi & 5dBi
Environmental Test Conditions:	Temperature: 15-35°C Humidity: 30-60% Barometric Pressure: 860-1060 mbar
Modification to the EUT:	None
Evaluated By:	Staff at Emerson Network
Test Date(s):	10/07/10 till 11/02/10

2. Test Facility

All testing was performed at Emerson Network Power. This facility is located at 2900 S. Diablo Way, Suite 190, Tempe, AZ 85282. All equipment used in making physical determination is accurate and bears recent traceability to the National Institute of Standards and Technology.

Test facility at Emerson Network power is an A2LA accredited test site. The A2LA certificate number is 2716.01. The scope of accreditation covers the FCC Method - 47 CFR Part 15, ICES-003, CISPR 22, AS/NZS 3548 and VCCI

Radiated Emissions measurements were performed in a semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at Emerson Network Power.

3. Description of Test Sample

The Microchip, MRF24J40MC is a 2.4GHz IEEE Std. 802.15.4 compliant surface mount module with an external antenna connector. This module interfaces to many Microchip PIC microcontrollers through a 4-wire serial SPI interface. The components are contained in a metal shielded enclosure. It runs off 3.3 volt DC power.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	Zigbee Transceiver Module	MRF24J40MC	N/A
# 2	5dBi Antenna (Aristotle Enterprises Inc.)	RFA-02-L2H1-70B-150	N/A

Table 1. Equipment Configuration

5. Support Equipment

All support equipment supplied is listed in the following Support Equipment List.

Ref ID	Name / Description	Manufacturer	Model #	Serial #
#3	DC Power Supply	Hewlett Packard	E3610A	KR83021468
#4	Laptop Computer	IBM	Thinkpad T 41	99-K3967
#5	Microcontroller Board	Microchip	PICDEM Z	BUR062000003

Table 2. Support Equipment

6. Ports and Cabling Information

Ref ID	Port name on the EUT	Cable Description	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
#5	Power	2 wire	1	1	N	DC Power Supply
#6	Serial	DB-9	1	2	N	Laptop

Table 3. Ports and Cabling Information

7. Method of Monitoring EUT Operation

A test receiver will be used to monitor the data transmission from the EUT.

8. Mode of Operation

The EUT will be configured to transmit at maximum power level. Test mode was provided to select the lower, middle and upper band of the transmitter by test software which was operated through a laptop computer. This software allowed the transmitter to switch between each channel and its mode from modulated to CW mode. These settings were created for testing purpose only.

9. Modifications

9.1 Modifications to EUT

No modifications were made to the EUT

9.2 Modifications to Test Standard

No Modifications were made to the test standard.

10. Disposition of EUT

The test sample including all support equipment submitted to H.B Compliance Solutions for testing will be returned to Microchip Technology Inc. upon completion of testing & certification

Criteria for Un-Intentional Radiators

1. Radiated Emissions

Test Requirement(s):	§15.109	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	10/26/10

Test Procedures:

The final radiated emissions test was performed using the parameters described above as worst case. That final test was conducted at a facility that meets the ANSI C63.4 NSA requirements. The frequency range noted in the data sheets was scanned/tested at that facility. Emissions were maximized as specified, by varying table azimuth, antenna height, and manipulating cables.

Using the mode of operation and configuration noted within this report, a final radiated emissions test was performed. The frequency range investigated (scanned), is also noted in this report. Radiated emissions measurements were made at the EUT azimuth and antenna height such that the maximum radiated emissions level will be detected. This requires the use of a turntable and an antenna positioner. The preferred method of a continuous azimuth search is utilized for frequency scans of the EUT field strength with both polarities of the measuring antenna. A calibrated, linearly polarized antenna was positioned at the specified distance from the periphery of the EUT.

> *Note: The specified distance is the horizontal separation between the closest periphery of the EUT and the center of the axis of the elements of the receiving antenna. However, if the receiving antenna is a log-periodic array, the specified distance shall be the distance between the closest periphery of the EUT and the front-to-back center of the array of elements.*

Tests were made with the antenna positioned in both the horizontal and vertical polarization planes. The measurement was varied in height above the conducting ground plane to obtain the maximum signal strength. Though specified in the report, the measurement distance shall be 3 meters. At any measurement distance, the antenna height was varied from 1 meter to 4 meters. These height scans apply for both horizontal and vertical polarization, except that for vertical polarization the minimum height of the center of the antenna shall be increased so that the lowest point of the bottom of the antenna clears the ground surface by at least 25 cm.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
30 MHz to 1 GHz	120 kHz	120 kHz	N/A
1 GHz to 11 GHz	1MHz	N/A	1MHz
Measurements were made using the bandwidths and detectors specified. The video filter was at least as wide as the IF bandwidth of the measuring receiver.			

Table 4. Radiated Emissions – Measurement Bandwidth

Emissions Tests Calculations

In the case of indoor measurements, radiated emissions measurements are made by the manipulation of correction factors using Rohde and Schwarz ES-K1 software. This is done automatically by the software during the final measurement process.

In both cases, the level of the Field Strength of the interfering signal is calculated by adding the Antenna Factor, Cable Factor and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + (CF –AG)

Where: FS = Field Strength

RA = Receiver (indicated) Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

This laboratory uses an approach of combining the CF and AG using an end-to-end measurement of the entire cabling system, including the test cable, any in-line amplifiers, attenuators, or transient protection networks, all measured in-situ.

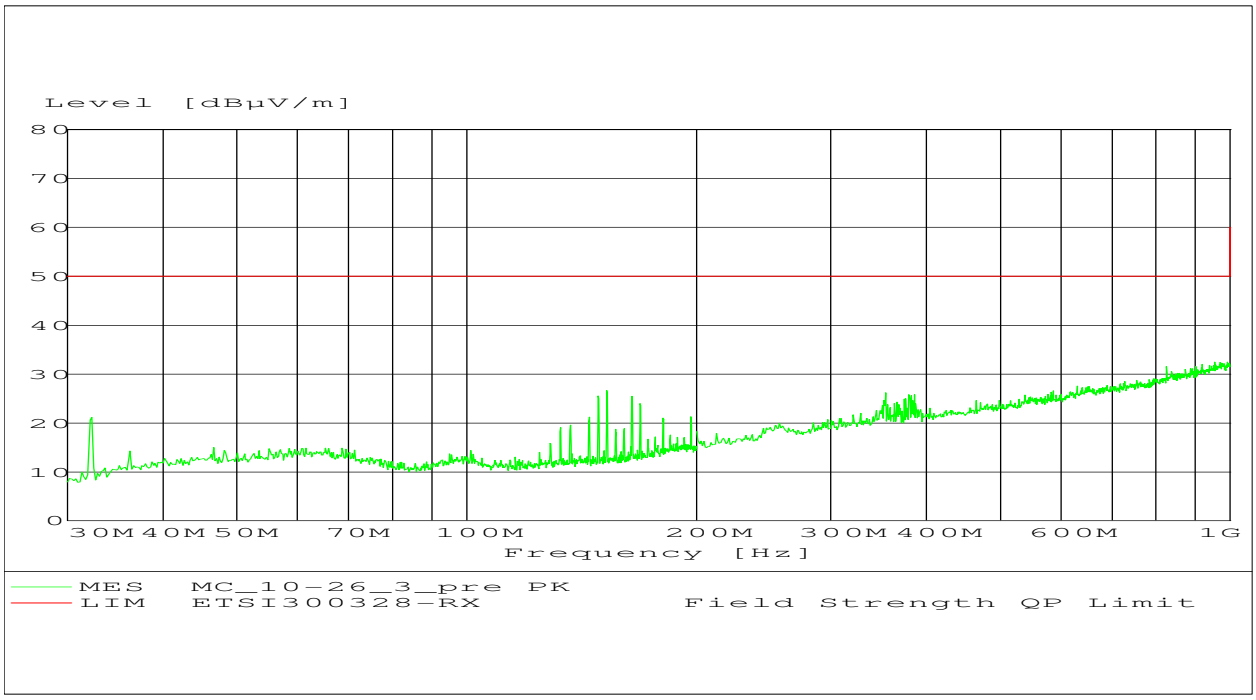
For a sample calculation, assume a receiver reading of 52.5 dBuV is obtained. With an antenna factor of 7.4 and a combined cable factor (CF + AG) of -27.9:

FS = 52.5 + 7.4 + (-27.9) = 32 dBuV/m

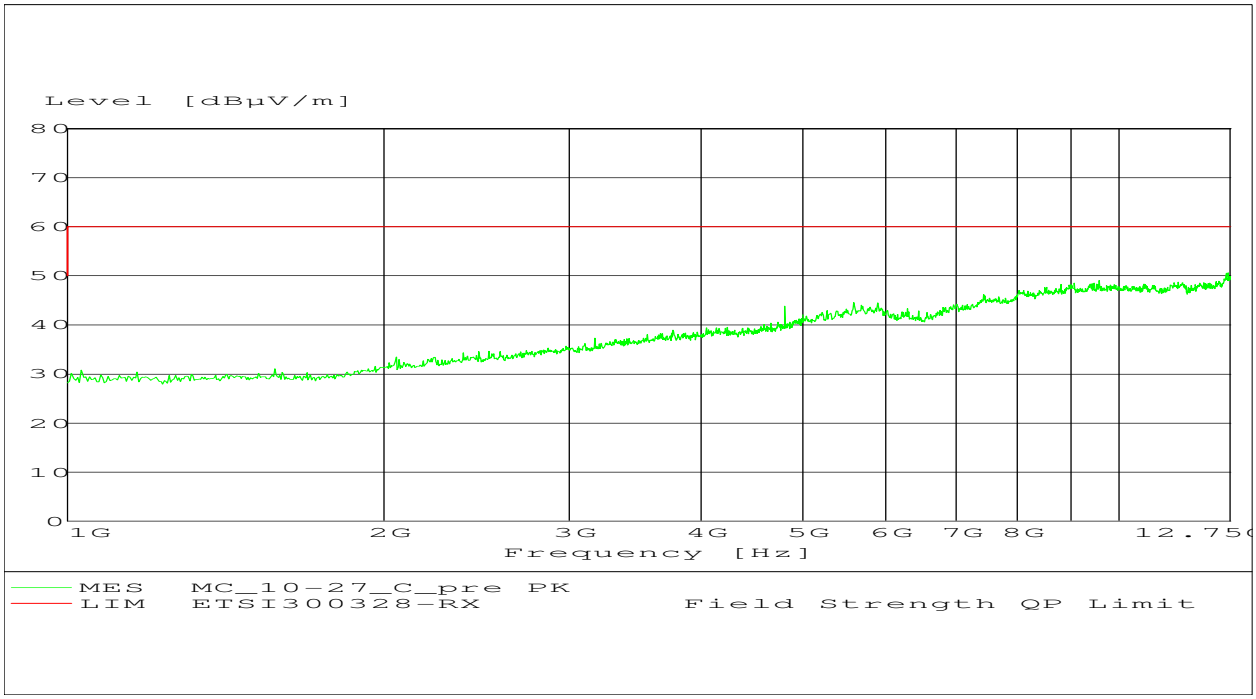
FS = 32 dBuV/m

If desired, this can be converted into its corresponding level in uV/m:

FS = 10^((32 dBuV/m)/20) = 39.8 uV/m



Plot 1 – Radiated Emissions – 30MHz to 1GHz



Plot 2 – Radiated Emissions – 1GHz to 12.75GHz

Frequency (MHz)	Measured Level	Height(cm)	Azimuth (deg)	Polarization
32.07	20.33	100	0	Vertical
32.26	21.80	100	270	Vertical
152.39	19.29	300	270	Horizontal
152.96	23.08	200	90	Horizontal
152.58	25.83	200	225	Horizontal
2000	30.0	100	0	Vertical
7200	43.0	100	0	Vertical

Table 5. Final Measurement Results for Radiated Emissions

2. Conducted Emissions

Test Requirement(s):	§15.207	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	10/29/2010

Test Procedures: The EUT was placed on a non-metallic table, 80cm above the ground plane inside a shielded enclosure. The EUT was powered through a 50Ω/50µH LISN. The conducted emissions tests were performed using the mode of operation and configuration noted within this report. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with power cords that are the same as those cords normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network). All 50 Ohm measuring ports of the LISN are terminated by 50 Ohms, either by the 50 Ohm EMI receiver or a 50 Ohm resistive load.

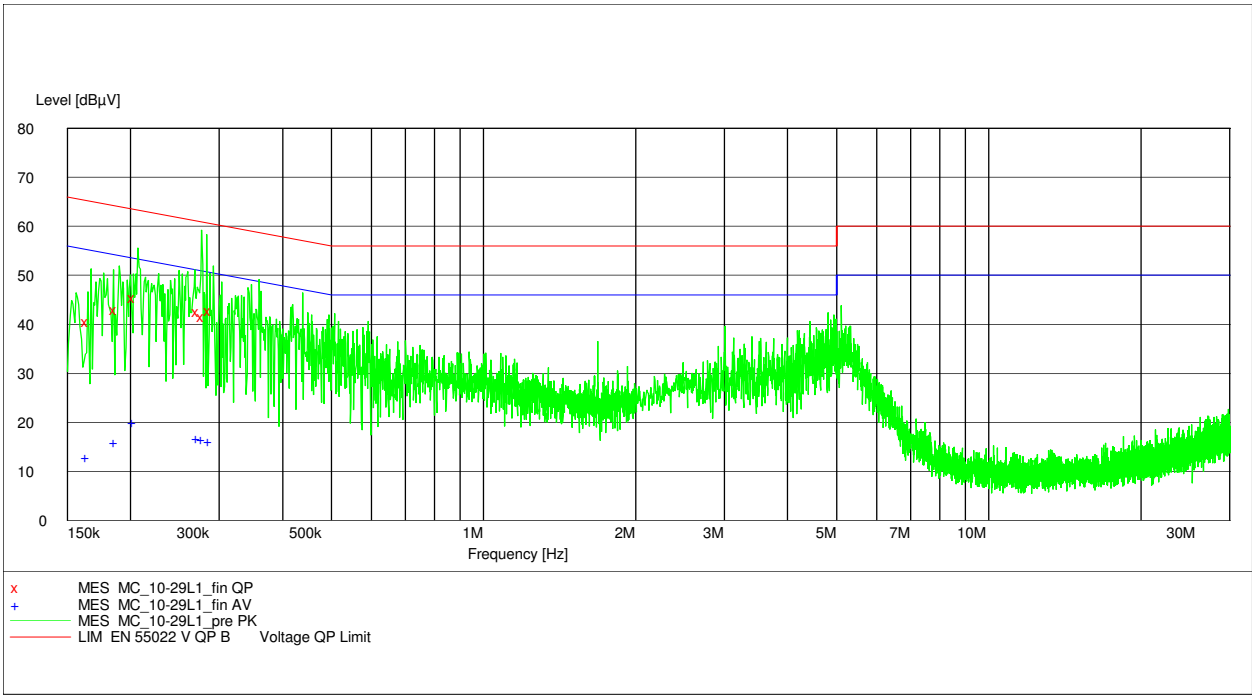
Refer to the Emissions Tests Calculations section in the Radiated Emissions section for sample calculations. For the purposes of the conducted emissions test, the Antenna Factor (AF) is replaced by the LISN correction factor.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.150 - 30	9.0	9.0	9.0
Measurements were made using the bandwidths and detectors specified. No video filter was used.			

Table 6.Conducted Emissions – Measurement Bandwidth

Frequency Range (MHz)	15.107(b), Class A Limits (dBuV)		15.107(a), Class B Limits (dBuV)	
	Quasi-Peak	Average	Quasi Peak	Average
0.15 – 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 – 30	73	60	60	50
Note 1 – The lower limit shall apply at the transition frequencies.				

Table 7. Conducted Emissions Limits – FCC Limits from Section 15.107(a)(b)



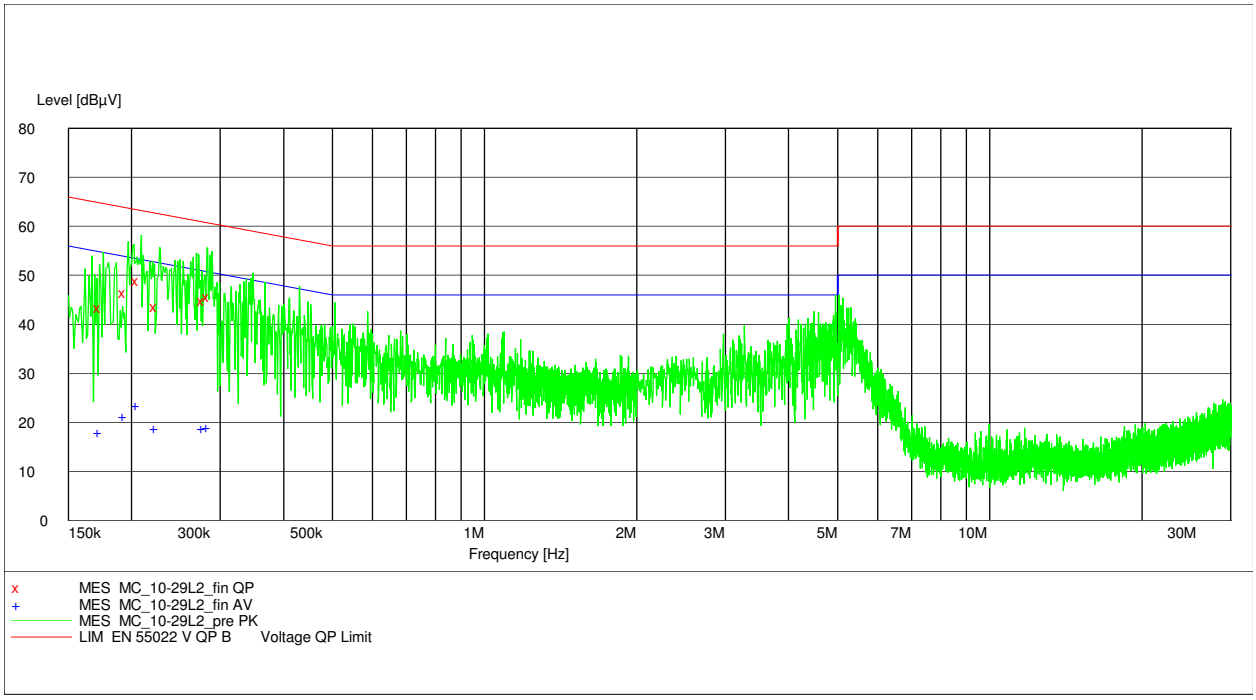
Plot 3 – Conducted Emission Plot – Positive Side

Frequency (MHz)	Measured Level (dBuV)	Transducer (dB)	Limit(dBuV)	Margin(dB)
0.167	40.60	10.0	66	28.4
0.190	42.90	10.0	66	26.1
0.207	45.50	10.0	64	23.5
0.277	42.60	10.0	64	26.4

Table 8. Measurement Results for QP

Frequency (MHz)	Measured Level (dBuV)	Transducer (dB)	Limit(dBuV)	Margin(dB)
0.167	13.10	10.0	56	42.9
0.190	16.0	10.0	56	40.0
0.207	20.10	10.0	52	35.9
0.277	16.80	10.0	52	39.2
0.283	16.70	10.0	52	39.3

Table 9. Measurement Results for Average



Plot 4 – Conducted Emissions – Ground Side

Frequency (MHz)	Measured Level (dBuV)	Transducer (dB)	Limit(dBuV)	Margin(dB)
0.176	43.30	10.0	66	25.6
0.197	46.50	10.0	66	22.5
0.209	48.90	10.0	64	20.1
0.227	43.70	10.0	64	25.3

Table 10. Measurement Results for Quasi Peak

Frequency (MHz)	Measured Level (dBuV)	Transducer (dB)	Limit	Margin
0.176	18.20	10.0	56	37.8
0.197	21.40	10.0	56	34.6
0.209	23.70	10.0	52	32.3
0.227	19.0	10.0	52	37.0
0.282	18.90	10.0	52	37.1

Table 11. Measurement Results for Average

3. Occupied Bandwidth

Test Requirement(s):	15.247(a)(2)	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	10/07/10

Test Procedure: As required by 47 CFR 15.247(a): System using digital modulation techniques may operate in the 902-928MHz, 2400 – 2483.5MHz, and 5725 – 5850MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer. The measured highest peak power was set relative to zero dB reference. The RBW of the Spectrum Analyzer was set to 100kHz and VBW>RBW. Measurements were carried out at the low, mid and high channels of the TX band at the output terminals of the EUT.

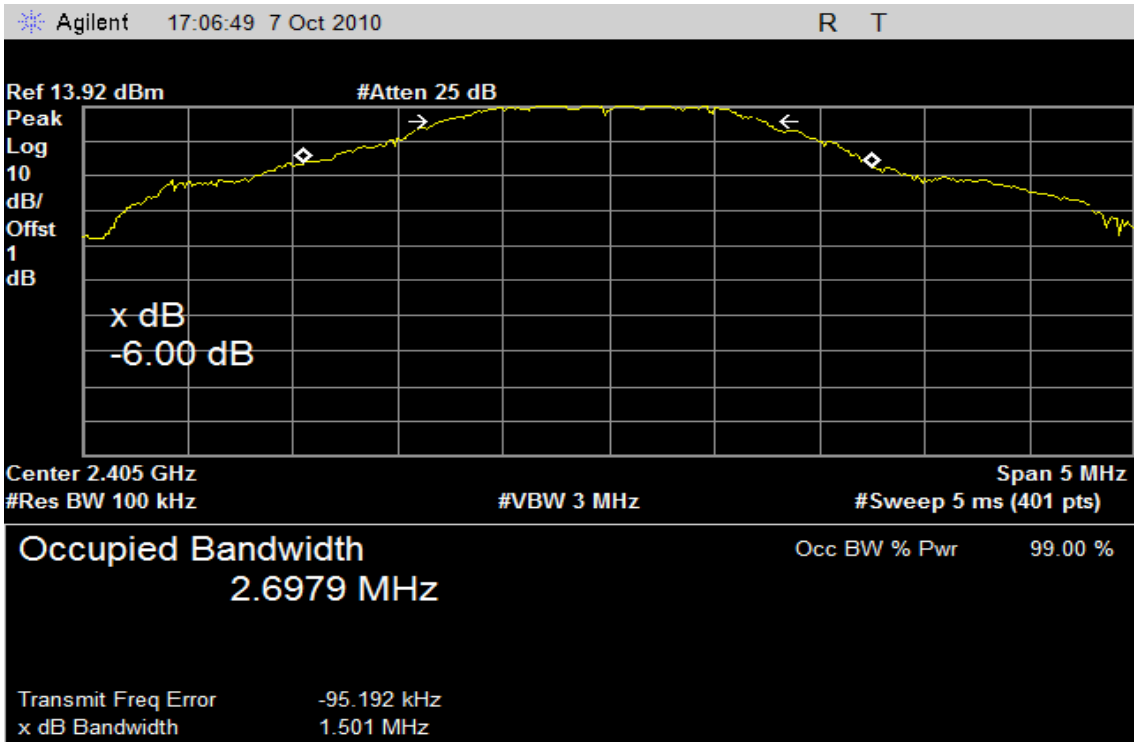
Frequency (MHz)	Recorded Measurement	Specification Limit
2405	1.501 MHz	≥ 500 KHz
2440	1.581 MHz	≥ 500 KHz
2475	1.561 MHz	≥ 500 KHz

Table 12. Occupied Bandwidth Summary, Test Results

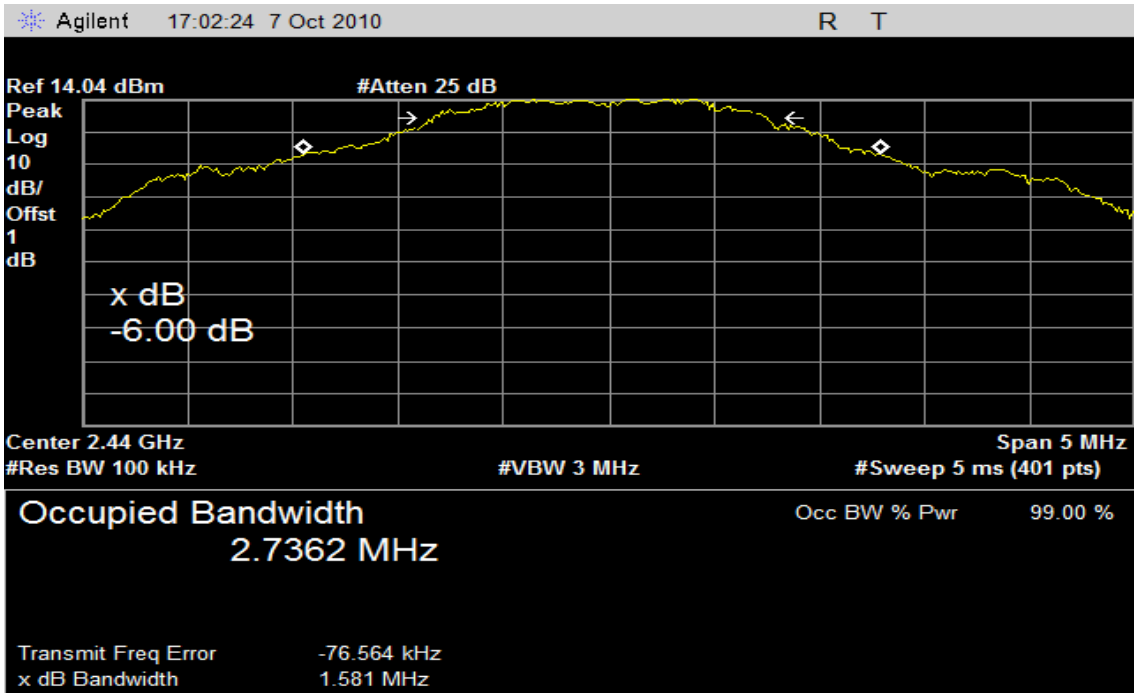
Frequency (MHz)	Recorded Measurement
2405	2.6184 MHz
2440	2.7506 MHz
2475	2.7121 MHz

Table 13. 99% Bandwidth, Test Results

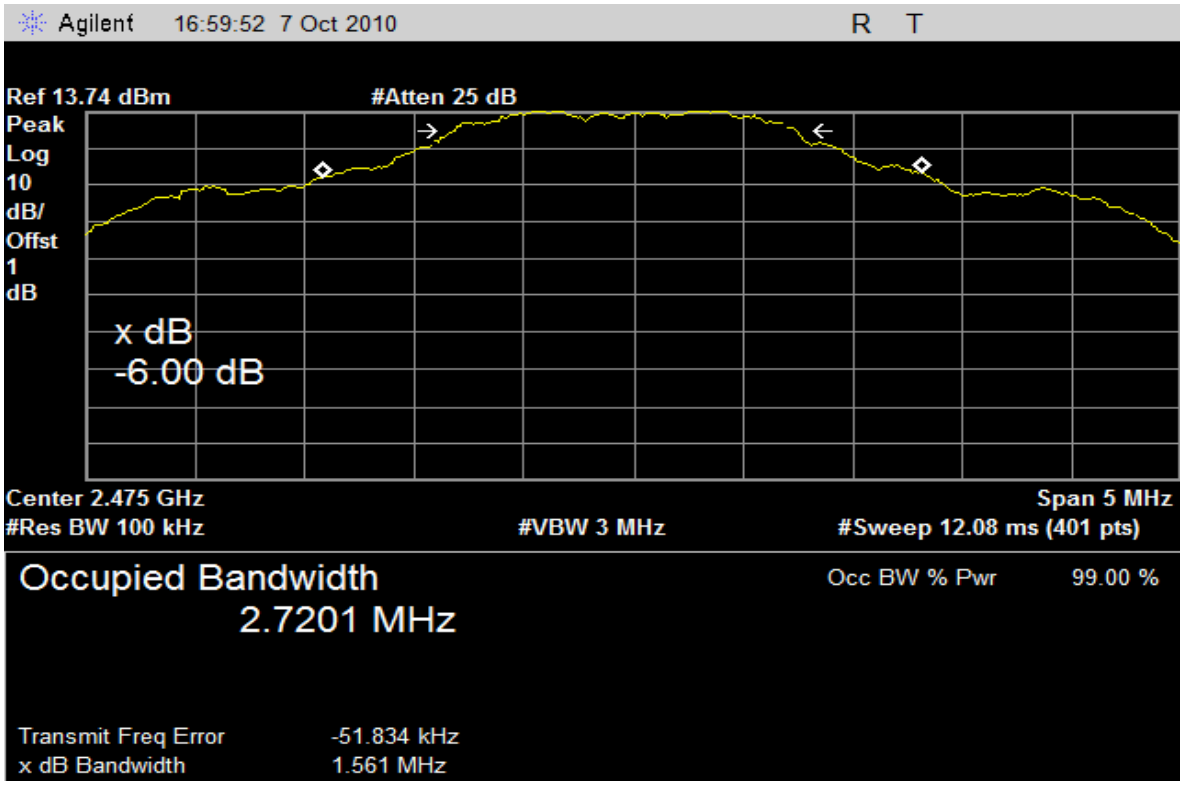
The following pages show measurements of Occupied Bandwidth plots:



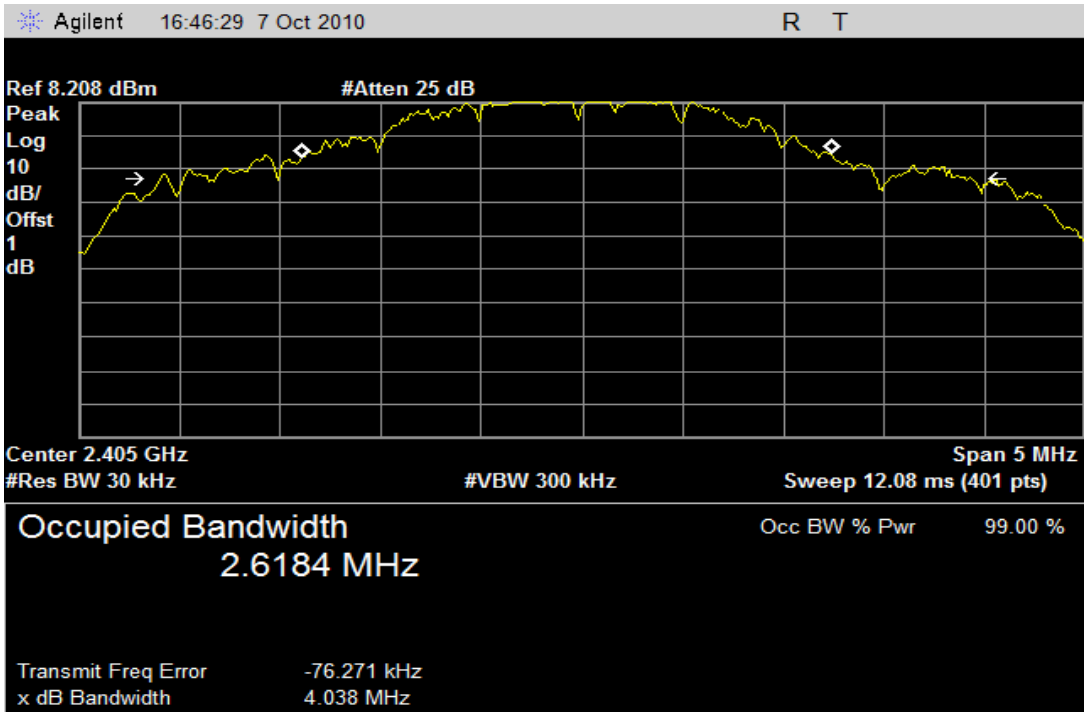
Plot 5 – Lowest Channel – 6dB BW



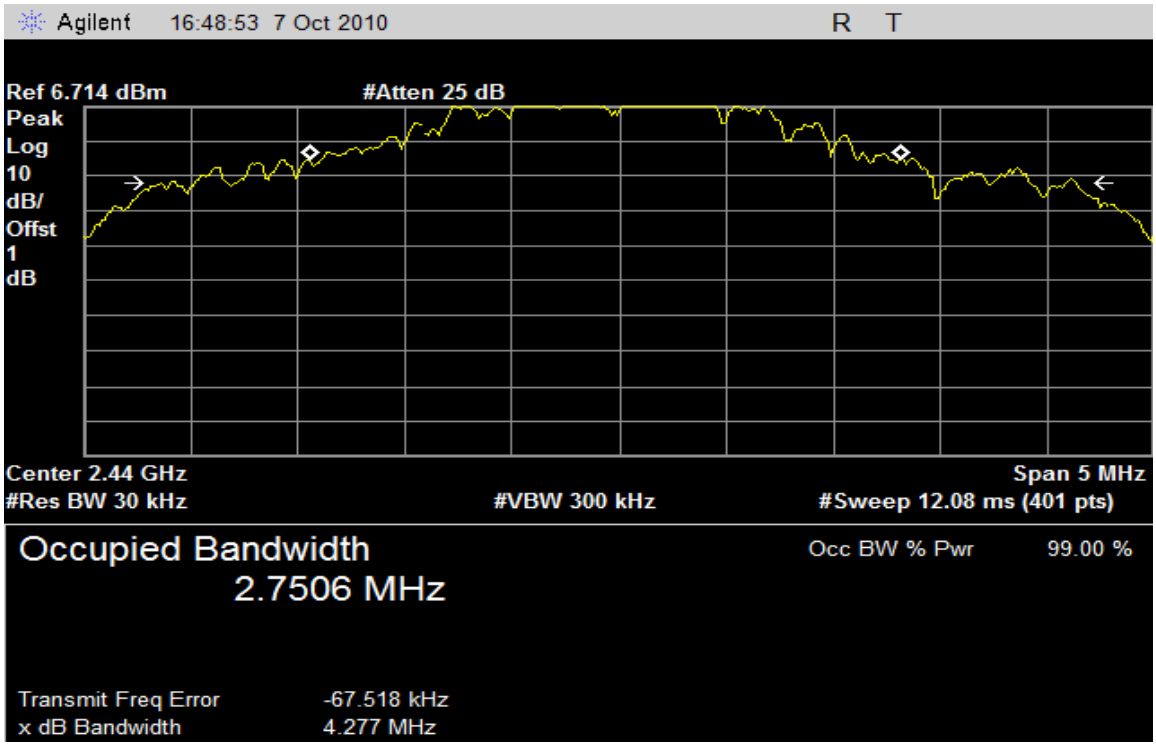
Plot 6 – Middle Channel – 6dB BW



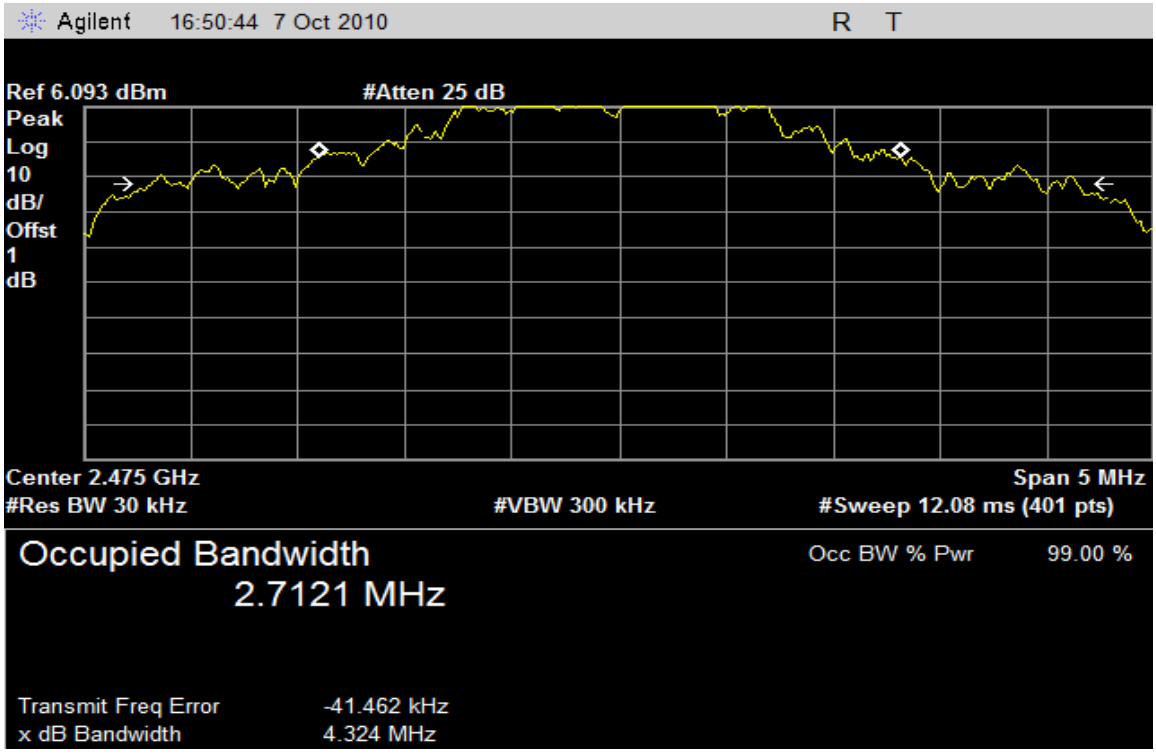
Plot 7 – Highest Channel – 6dB BW



Plot 8 – Lowest Channel – 99% - For IC



Plot 9 – Middle Channel – 99% - For IC



Plot 10 – Highest Channel – 99% - For IC

4. RF Power Output

Test Requirement(s):	§15.247(b)(3)	Test Engineer(s):	Hoosam B.
Test Results:	Pass	Test Date(s):	10/08/10

Test Procedures: As required by 47 CFR 15.247(b)(3), RF Power output measurements were made at the RF output terminals of the EUT.

Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer capable of making power measurements. Measurements were made at the low, mid, and high channels of the entire frequency band.

Frequency (MHz)	Conducted Power (dBm)	Conducted Power (W)	Specification Limit
2405	18.89	0.077	1W
2440	18.42	0.069	1W
2475	17.89	0.061	1W

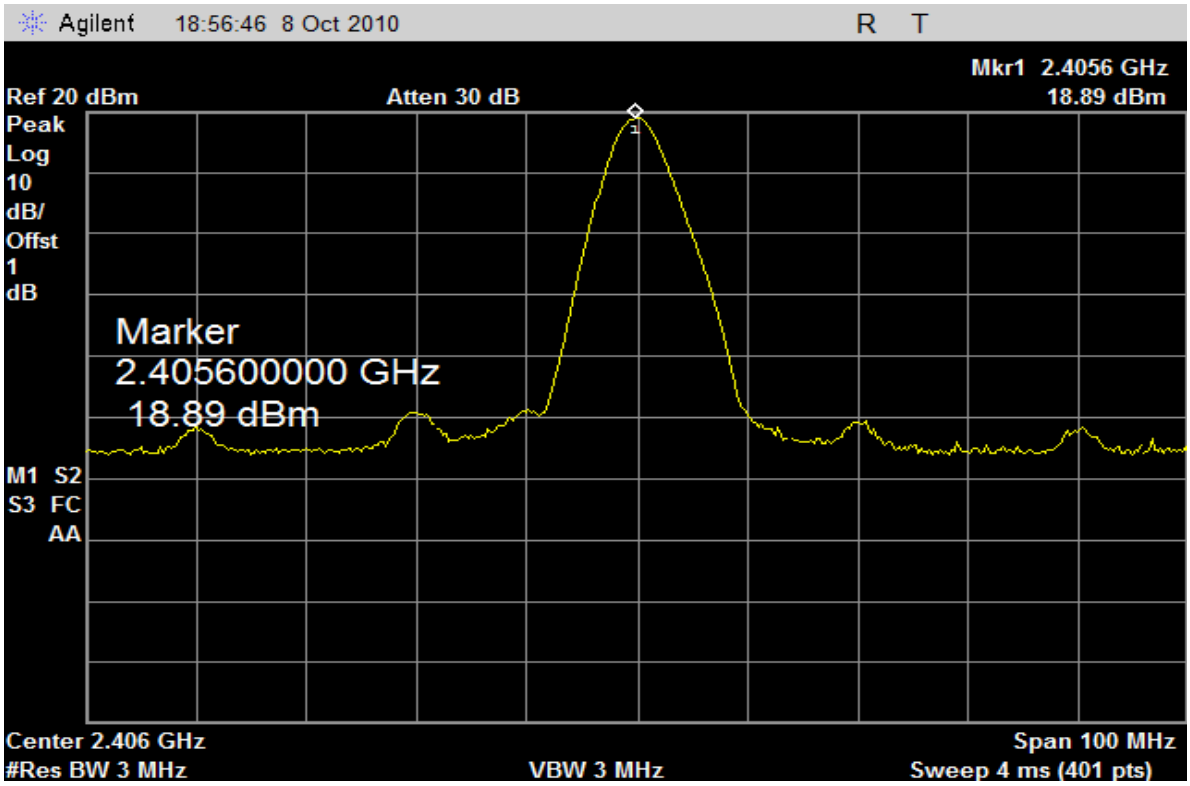
Table 14. RF Power Output, Conducted Test Results

Frequency (MHz)	EIRP Power (dBm)	Specification Limit (dBm)	Margin (dB)
2405	23.89	36	12.11
2440	23.42	36	12.58
2475	22.89	36	13.11

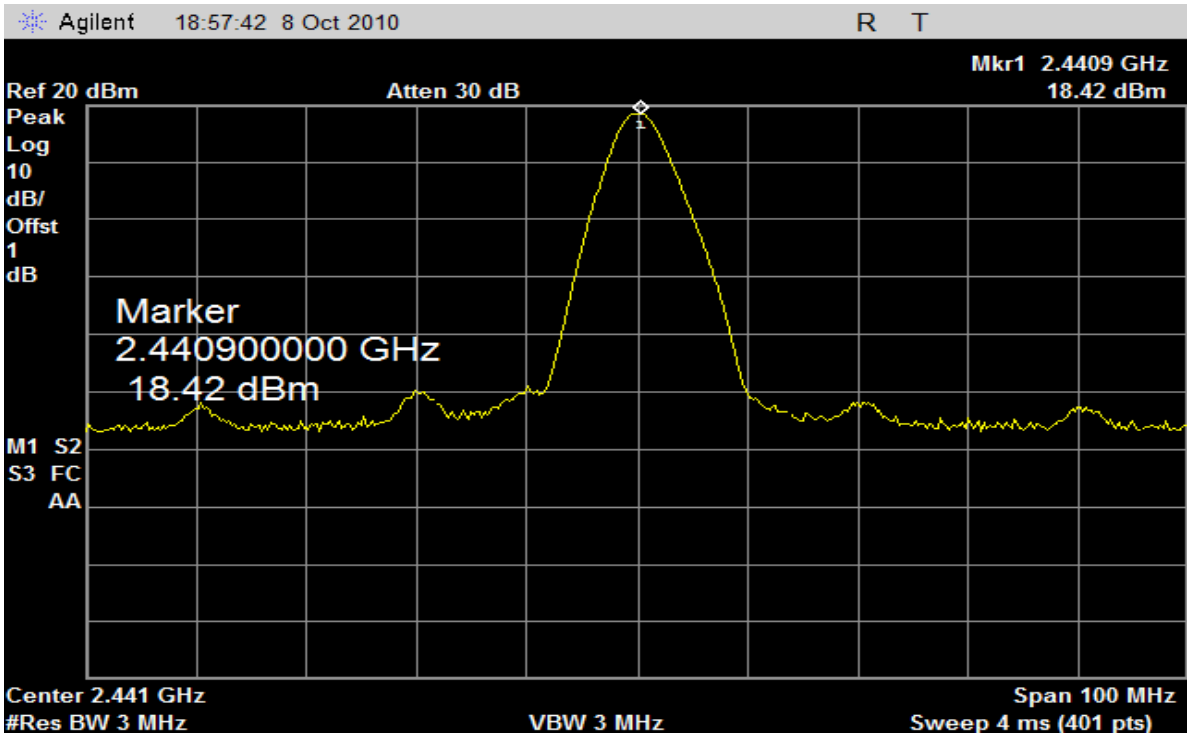
Table 15. RF Power Output, EIRP Calculation Test Results

EIRP = Conducted output power [dBm] + antenna gain [dBi]

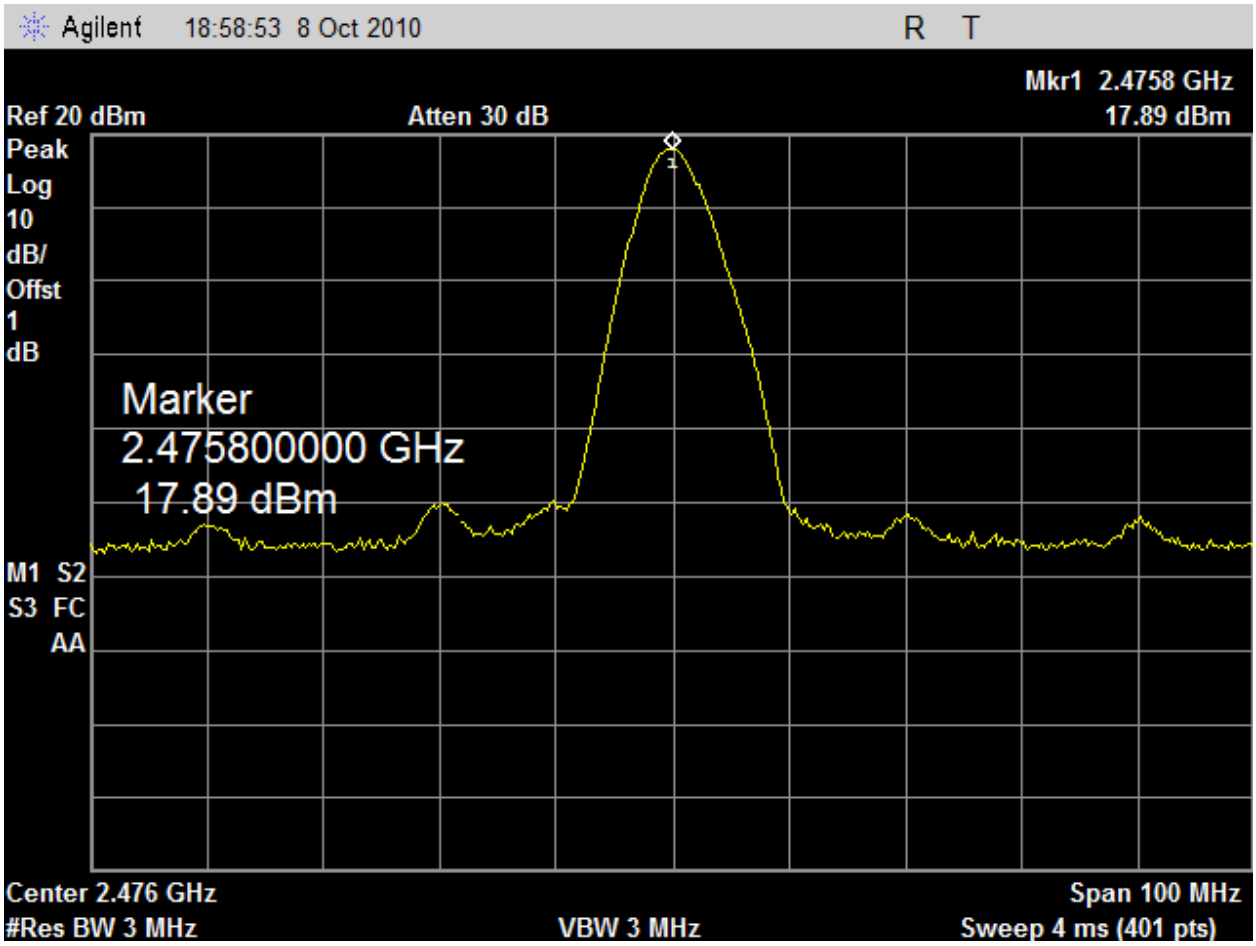
Maximum Antenna Gain = 5dBi



Plot 11 – Lowest Channel - Output Power



Plot 12 – Middle Channel -Output Power



Plot 13 – Highest Channel – Output Power

5. Conducted Spurious Emissions

Test Requirement(s):	§15.247(c)	**Test Engineer(s):**	Tom Karas
Test Results:	Pass	**Test Date(s):**	10/19/10

Test Procedures:

As required by 47 CFR 15.247(c): In any 100kHz bandwidth the frequency band in which the spread spectrum or digitally modulation intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either and RF conducted or a radiated measurement. Conducted spurious emissions at antenna terminal measurements were made at the RF output antenna terminal of the EUT.

Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer with RBW set to 100KHz and VBW ≥ RBW. The Spectrum Analyzer was set to sweep from 30MHz up to 10th harmonic of the fundamental or 40GHz whichever is the lesser. Measurements were made at the low, mid and high frequency of the transmit band.

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)
4813.33	-60.0	-1.0
7222.22	-53.49	-1.0
9622.22	-48.16	-1.0
12026.66	-61.8	-1.0
14437.77	-63.76	-1.0
16848.88	-73.08	-1.0

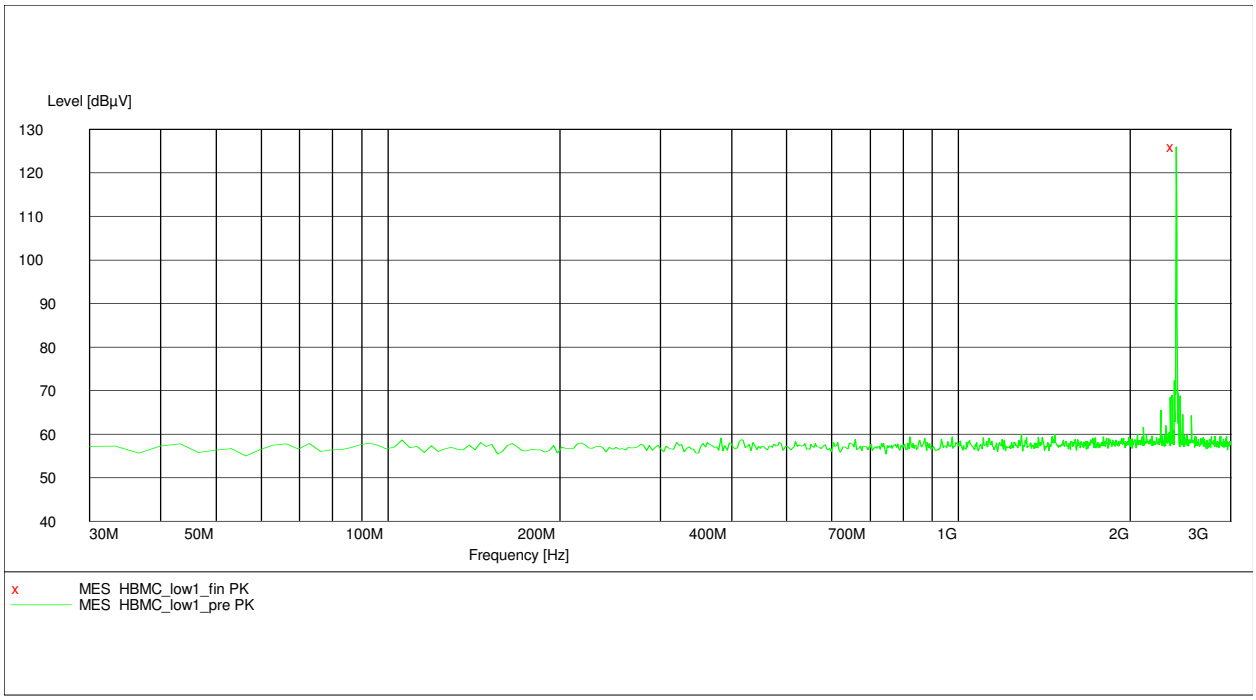
Table 16. Lowest Channel – Conducted Spurious Emissions, Test Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)
3035.55	-73.66	-1.0
7328.88	-61.07	-1.0
9764.44	-51.07	-1.0
12197.77	-60.04	-1.0
14655.55	-66.12	-1.0
19524.44	-66.17	-1.0

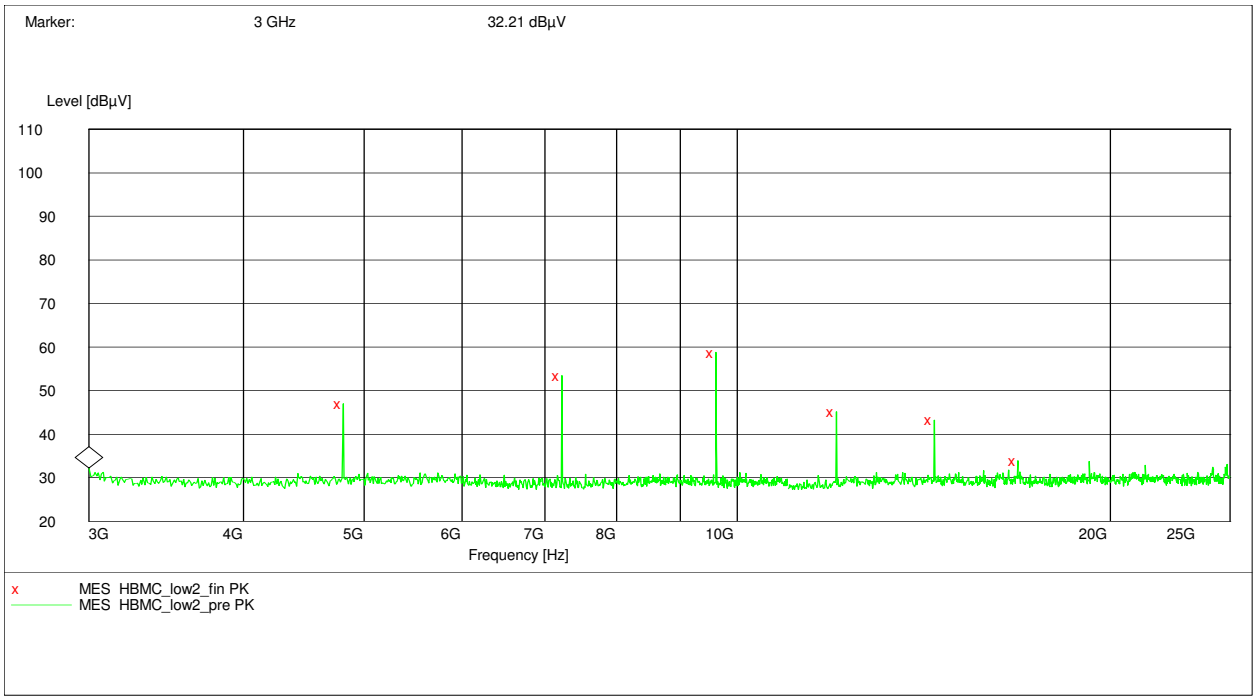
Table 17. Middle Channel – Conducted Spurious Emissions, Test Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)
4955.55	-71.57	-1.0
7426.66	-69.4	-1.0
9906.66	-51.62	-1.0
12368.88	-61.33	-1.0
14857.77	-63.47	-1.0
19820.00	-71.08	-1.0

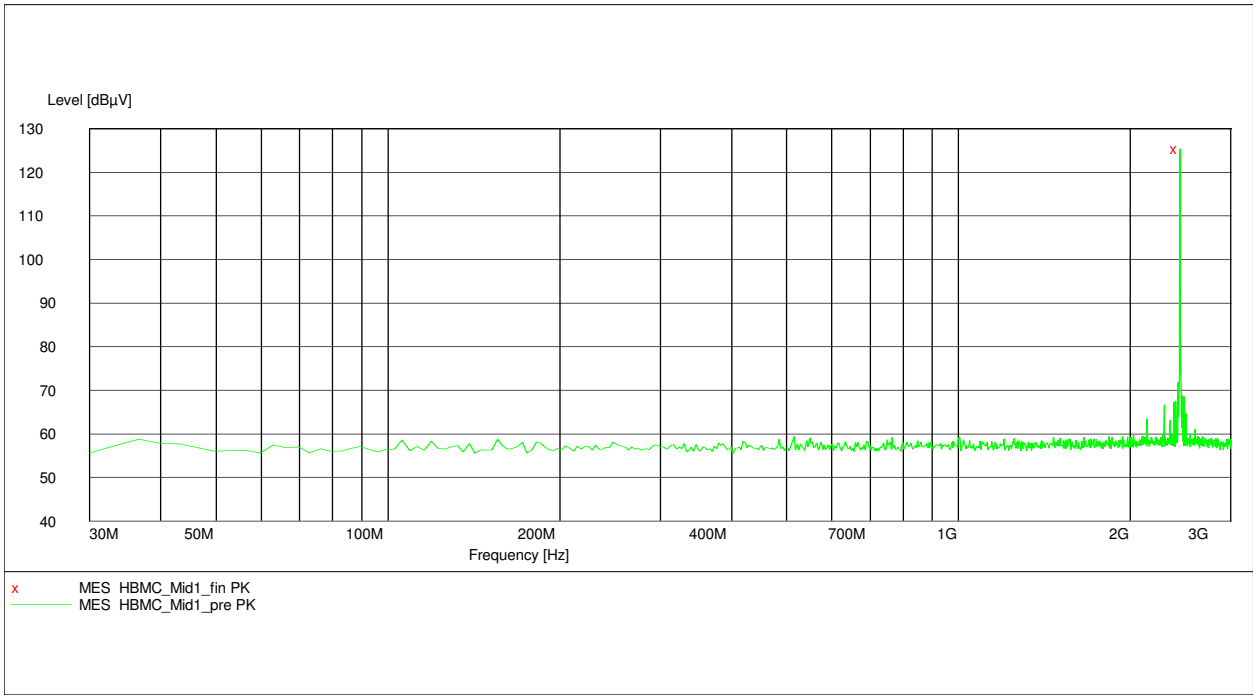
Table 18. Highest Channel – Conducted Spurious Emissions, Test Results



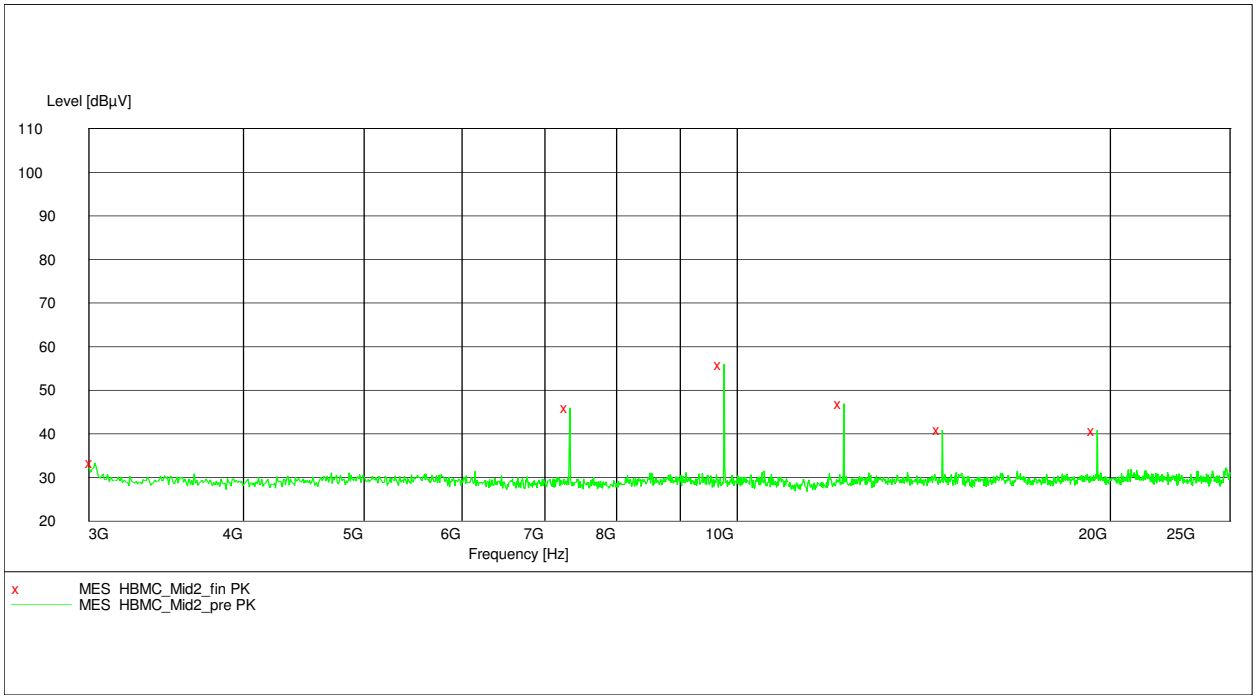
Plot 14 – Lowest Channel (30MHz to 3GHz)



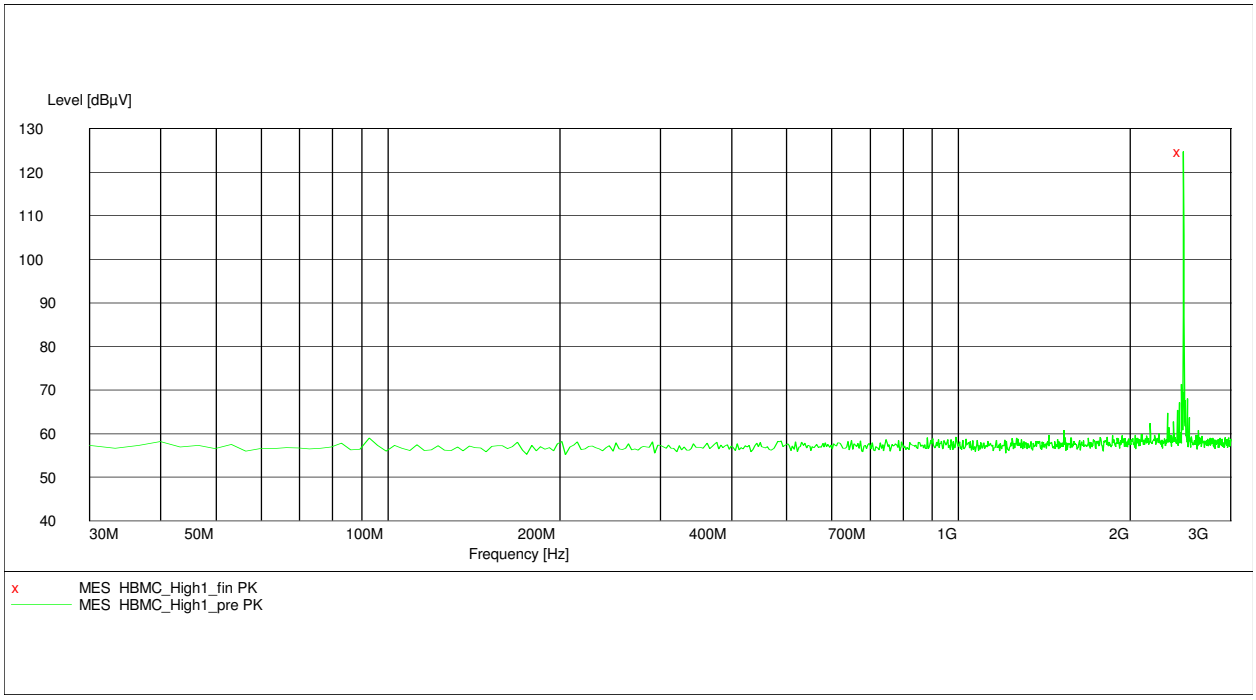
Plot 15 – Lowest Channel (3GHz to 25GHz)



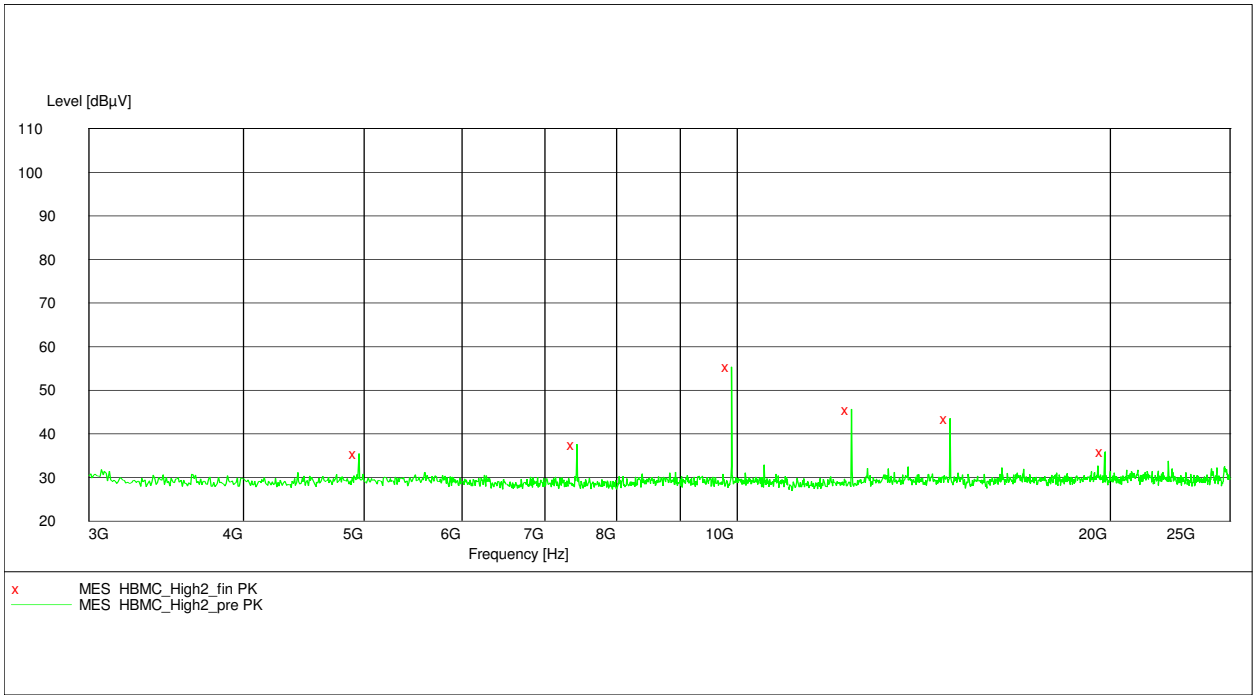
Plot 16 – Middle Channel (30MHz to 3GHz)



Plot 17 – Middle Channel (3GHz to 25GHz)



Plot 18 – Highest Channel (30MHz to 3GHz)



Plot 19 – Highest Channel (3GHz to 25GHz)

6. Radiated Spurious Emissions

Test Requirement(s):	§15.247(d), 15.209(a), 15.205	**Test Engineer(s):**	Tom Karas
Test Results:	Pass	**Test Date(s):**	10/27/10

Test Procedures: As required by 47 CFR 15.247, Radiated spurious measurements were made in accordance with the procedures of the ANSI C63.4-2003.

The EUT was placed on a wooden table inside a 3 meter semi-anechoic chamber. The EUT was set on continuous transmit.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The frequency range up to the 10th harmonic was investigated.

Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
Peak	1MHz	1MHz	As necessary
Average	1MHz	10Hz	0 Hz

Table 19 - Analyzer Settings

Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m))	Average Limit (dBuV/m)
4817.77	62.19	74.0	42.19	54.0
7220.84	59.72	74.0	40.22	54.0
12031.0	53.86	74.0	33.86	54.0
14435.73	53.43	74.0	33.93	54.0
17943.33	56.07	74.0	36.07	54.0

Table 20 - Spurious Radiated Emission Data – Low Band

Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m)	Average Limit (dBuV/m)
4884.44	63.75	74.0	43.75	54.0
7326.18	56.65	74.0	37.15	54.0
9766.37	57.14	74.0	37.14	54.0
14362.07	53.20	74.0	33.70	54.0
17869.66	56.65	74.0	36.65	54.0

Table 11– Spurious Radiated Emission Data – Mid Band

Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m)	Average Limit (dBuV/m)
4950.96	66.5	74.0	45.9	54.0
7426.44	60.2	74.0	40.7	54.0
9901.81	54.7	74.0	34.7	54.0
17966.00	56.26	74.0	36.76	54.0

Table 22– Spurious Radiated Emission Data – High Band

NOTE: There were no detectable emissions above the 5th harmonic.

7. Emissions at Band Edges and Restricted Band

Test Requirement(s):	§15.247(d), 15.209(a), 15.205	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	11/02/10

Test Procedures: As required by 47 CFR 15.247, Band edge radiated emissions measurements were made at the RF antenna output terminals of the EUT.

The EUT was placed on a wooden table inside a 3 meter semi-anechoic chamber. The EUT was set on continuous transmit.

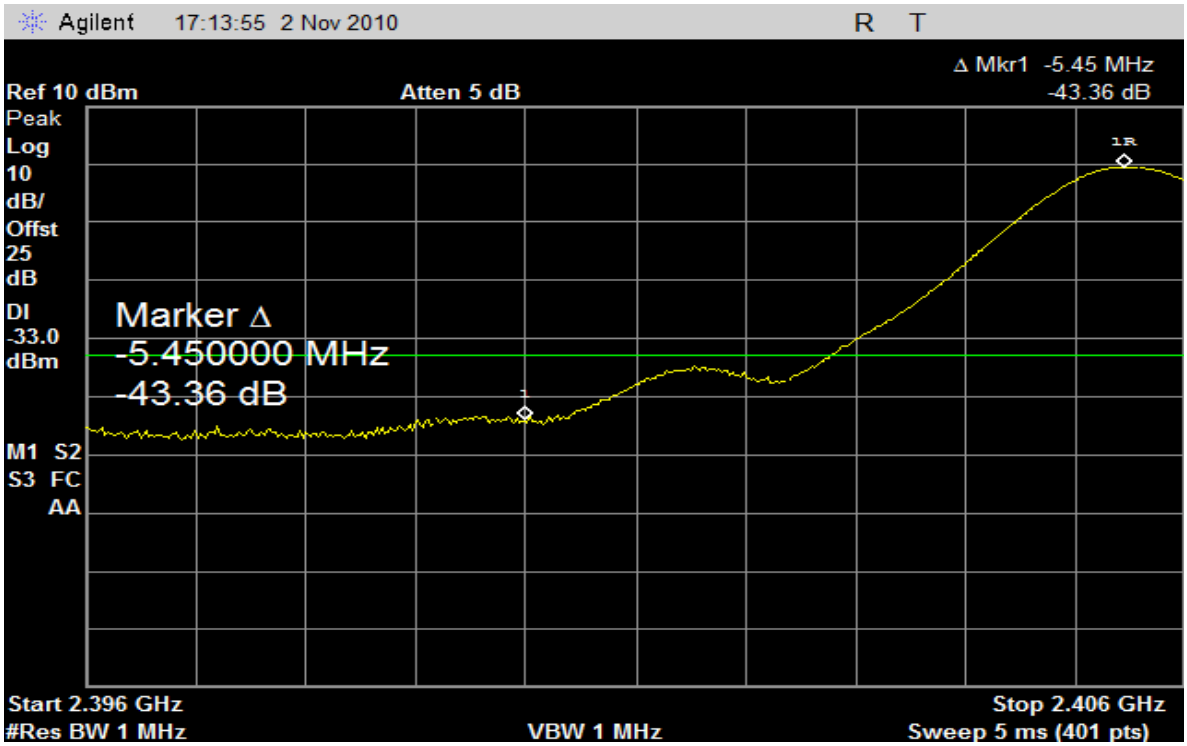
The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The EUT was set up at maximum power, first on the lowest operating channel, then on the highest operating channel of the transmit band. A plot of each channel is taken with a marker showing the nearest bordering Restricted Band.

Frequency (MHz)	Measured Level (dB)	Detector	Limit
2400.0	-43.36	Peak	-20dBc
2483.5	-48.67	Peak	-20dBc

Table 23 – Band Edge Emissions Summary

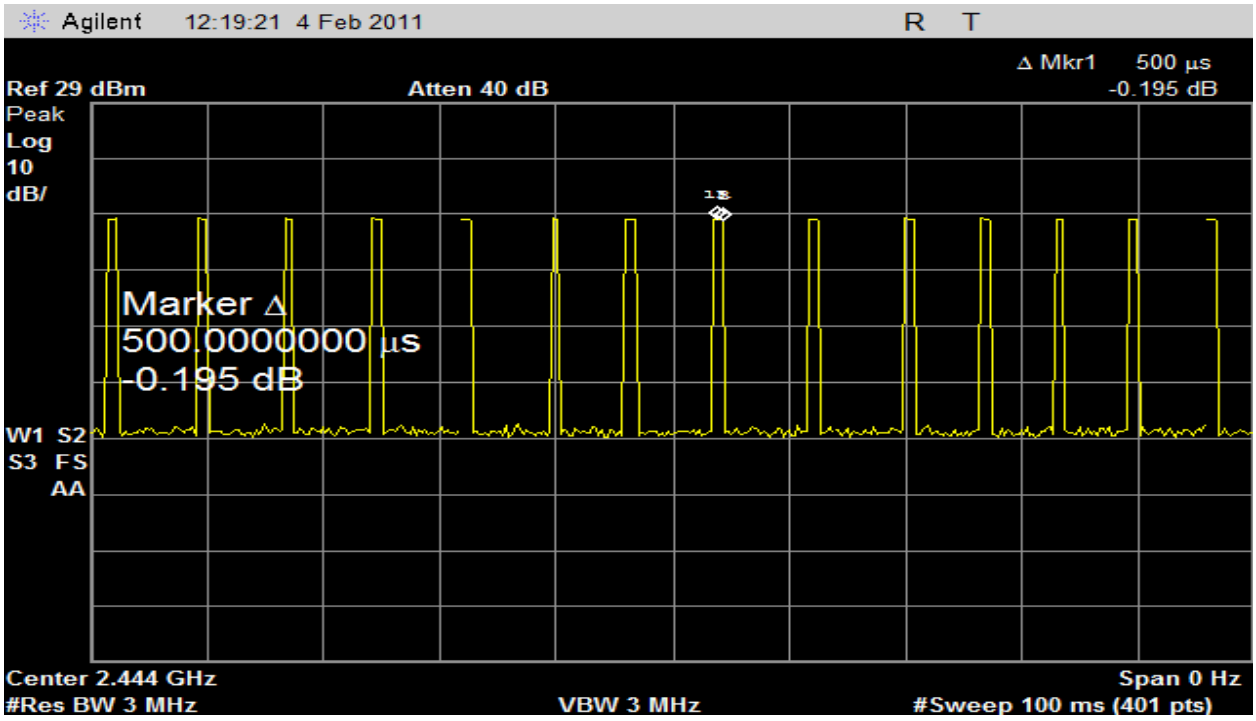
Frequency (MHz)	Measured Peak Level (dBuV)	Peak Limit (dBuV/m)	Duty Cycle Correction Factor (dB)	Measured Average Level (dBuV)	Average Limit (dBuV/m)
2390.0	64.86	74	20.49	44.37	54
2483.5	66.42	74	20.49	45.93	54

Table 24 – Restricted Band Emissions Summary

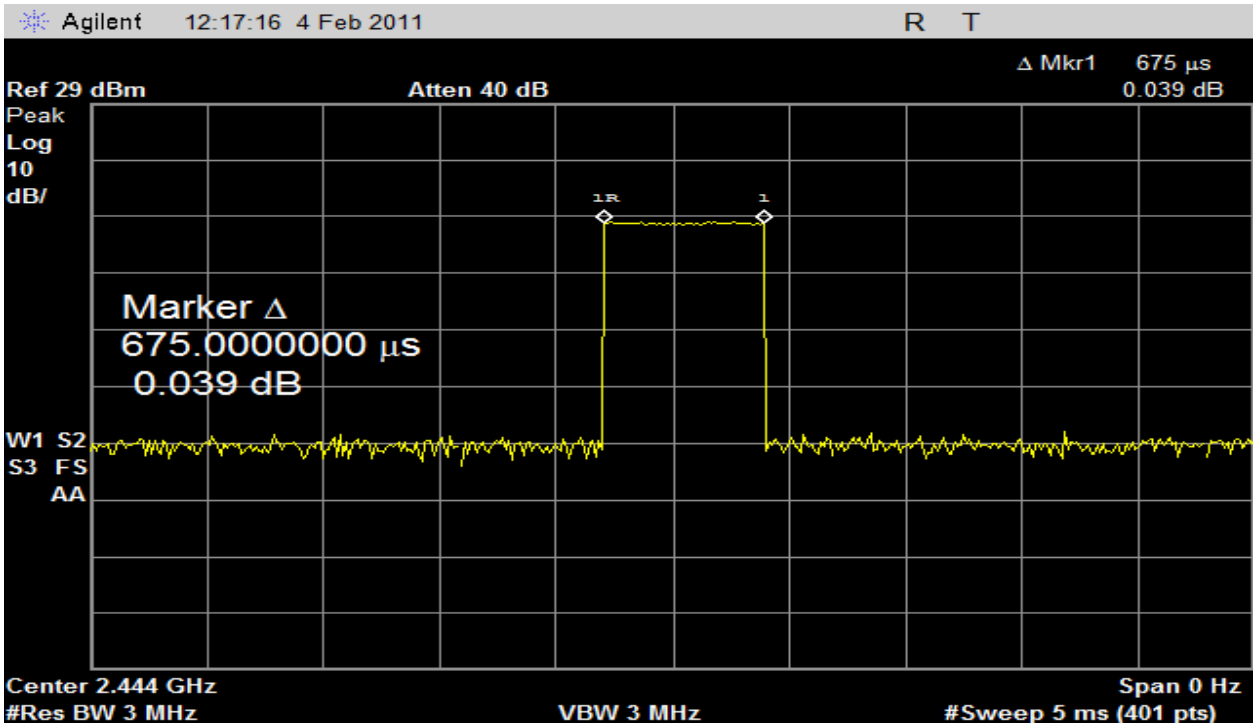


Plot 20 – Lowest Channel (Band Edge)

Plot 21 – Highest Channel (Band Edge)



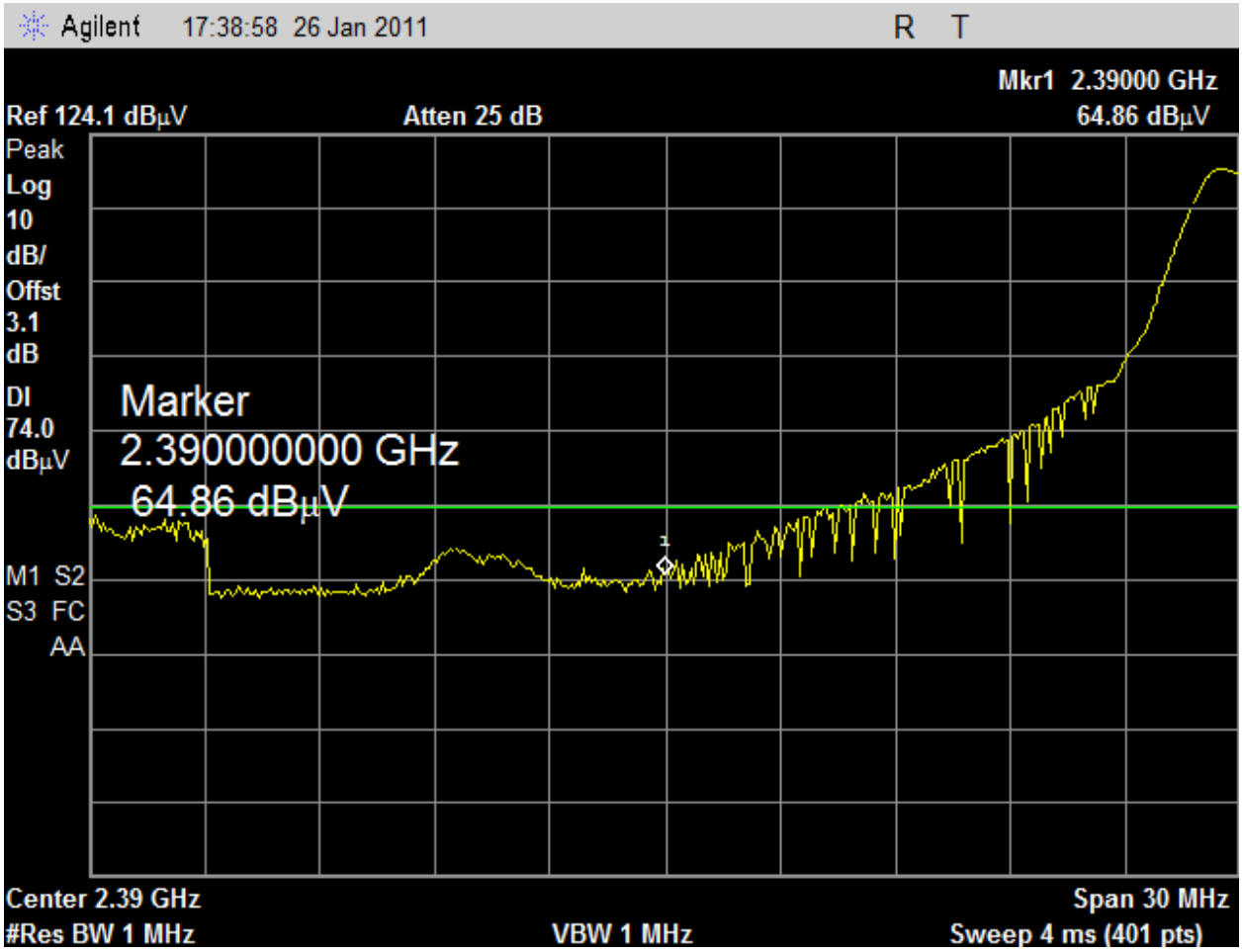
Plot 22 –Duty Cycle (# of Pulses)



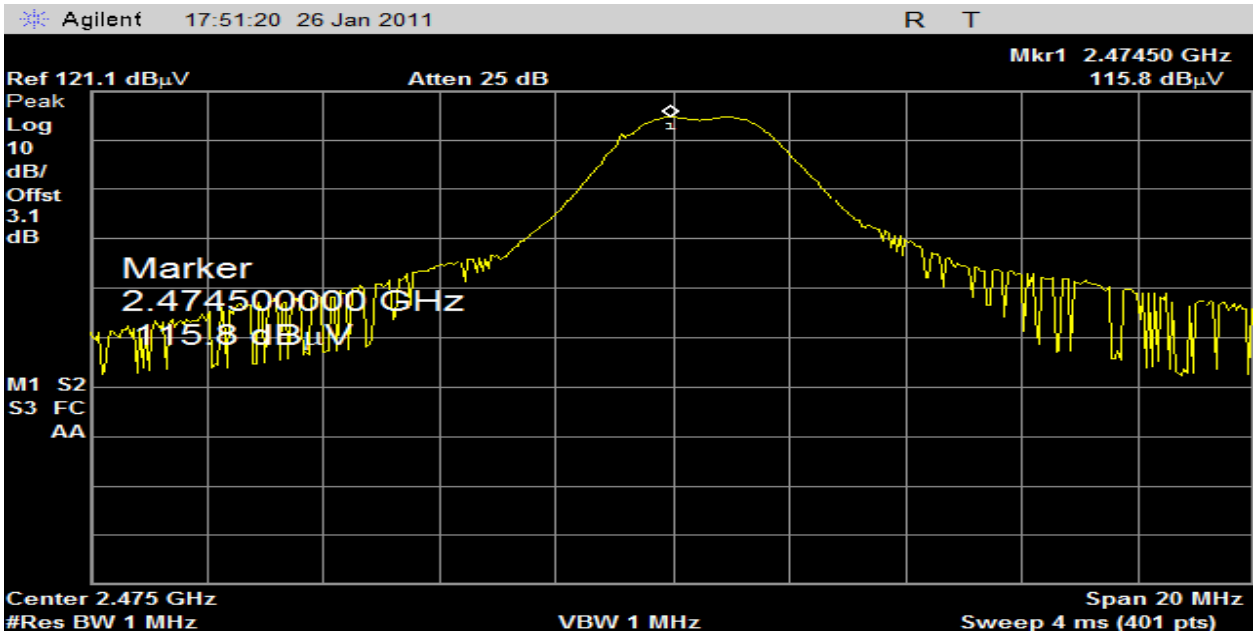
Plot 22 – Duty Cycle

Duty Cycle Calculation

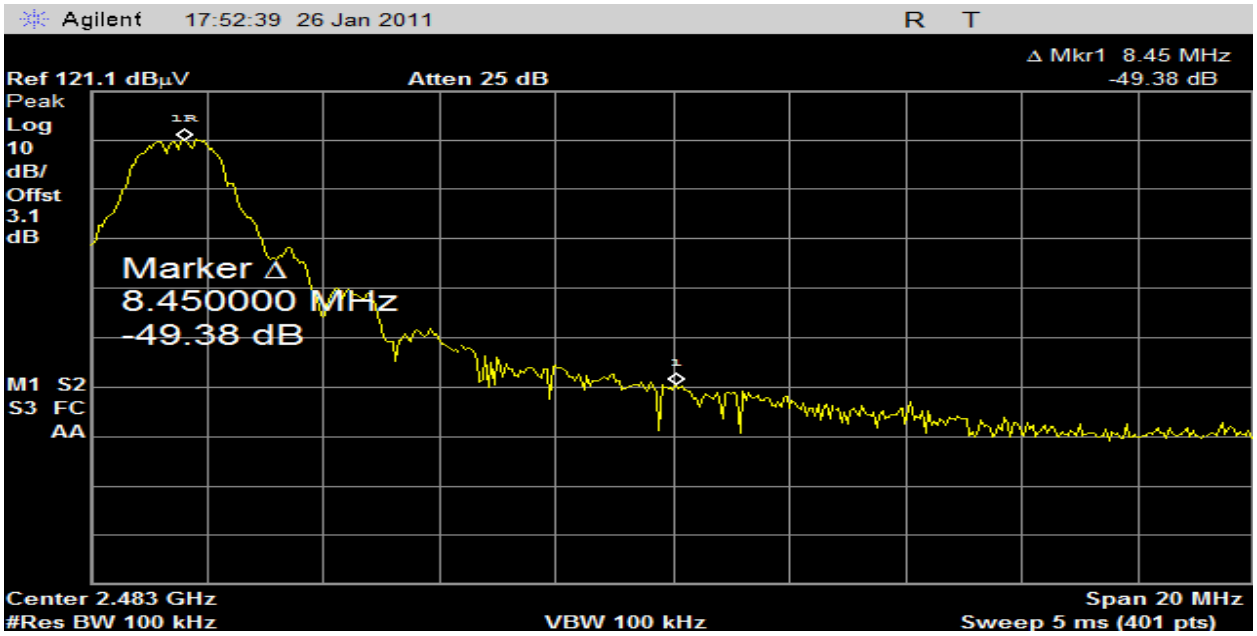
Plot # 22 shows data transmission over a 100 ms period. There are total of 14 data packets. Each packet represents transmission on time and if we measure the packet or on time of a single pulse (See Plot # 23), we see it is 675us (0.675ms). The total on time over a 100 ms period then equals
Transmission On time per burst = 0.675ms
Period = 100 ms
Total on time over 100 ms = 0.675 x 14 = 9.45 ms
Duty Cycle Correction Factor = 20 log 9.45ms / 100 ms
Duty cycle Correction Factor = -20.49 dB



Plot 23 – Lowest Channel (Restricted Band)



Plot 24 – Highest Channel (Restricted Band) – Delta Marker Method



Plot 25 – Highest Channel (Restricted Band) – Delta Marker Method

Delta Marker =49.38

Therefore,

Peak Field Strength = 115.8dBuV/m - 49.38 (Delta Marker) = 66.42dBuV/m

Limit = 74dBuV/m

Average Field Strength = 66.42 dBuV/m – 20.49db (Duty cycle correction factor) = 45.93dBuV/m

Limit = 54dBuV/m

8. Power Spectral Density

Test Requirement(s):	§15.247(d)	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	10/07/10

Test Procedures: As required by 47 CFR 15.247(d), For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3kHz band during any time interval of continuous transmission. Power spectral density measurements were made at the RF antenna output terminals of the EUT.

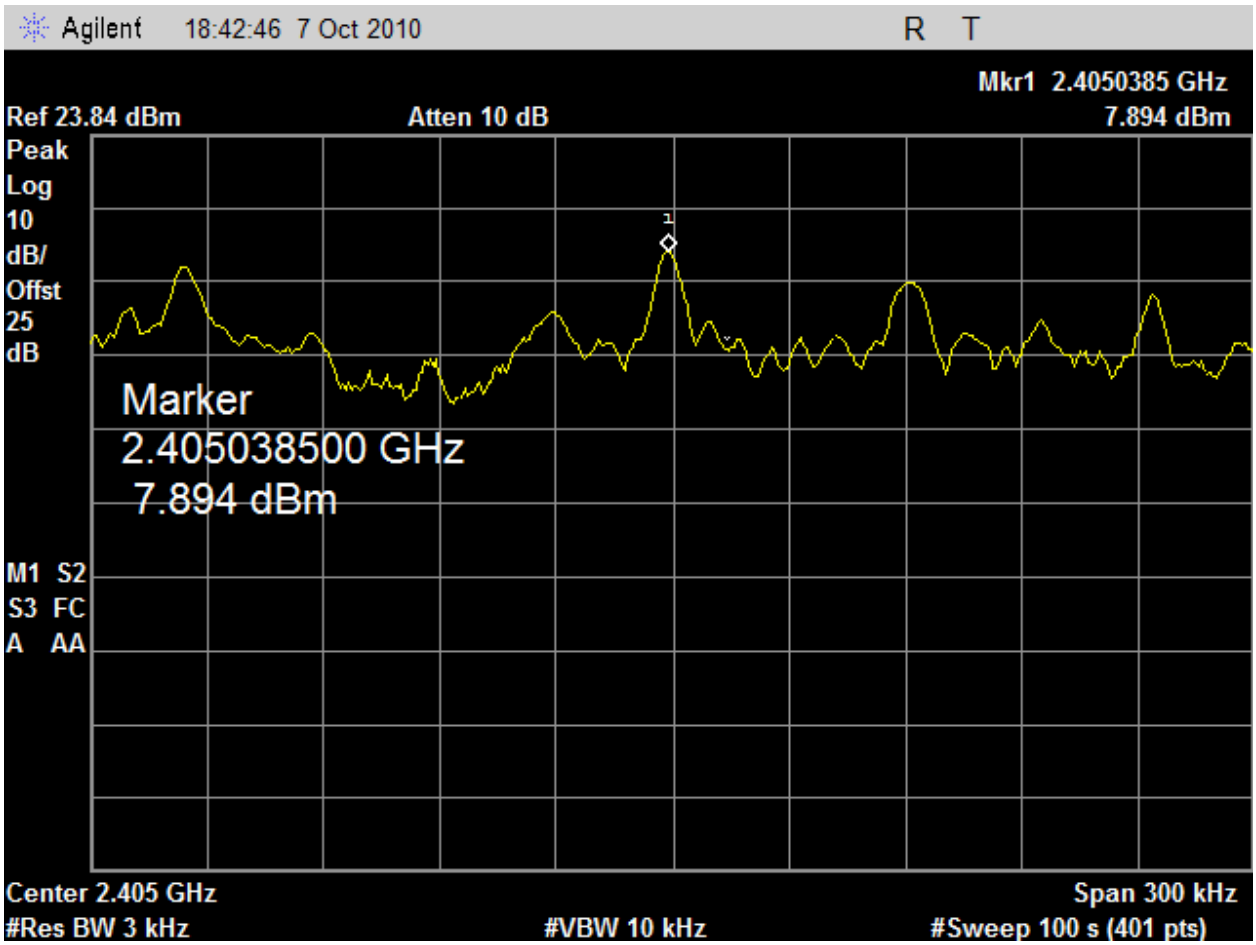
The EUT output was connected directly to the spectrum analyzer through an attenuator. The measurements were made at the RF antenna output terminals of the EUT.

Detector Setting	Resolution Bandwidth	Sweep Time	Span
Peak	3KHz	100 seconds	300 kHz

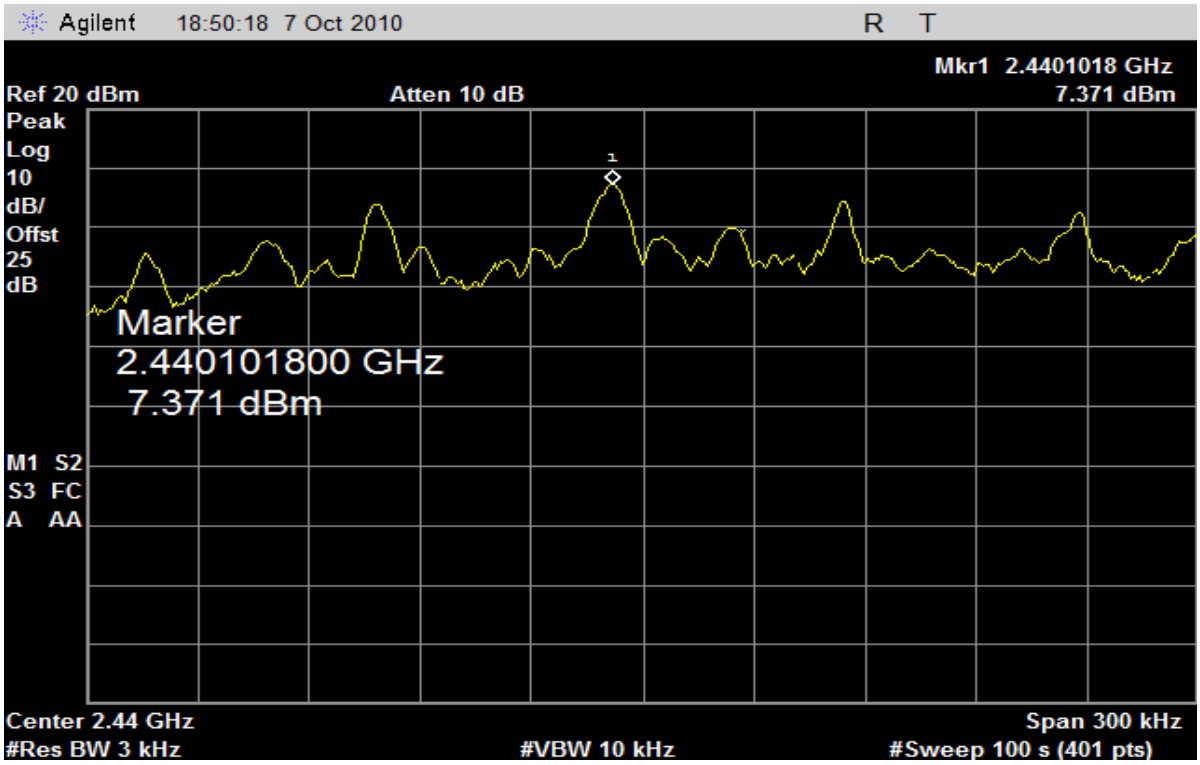
Table 15 – Analyzer settings

Frequency (MHz)	Measured Level	Limit
2405	7.894	8 dBm
2440	7.371	8 dBm
2475	7.461	8 dBm

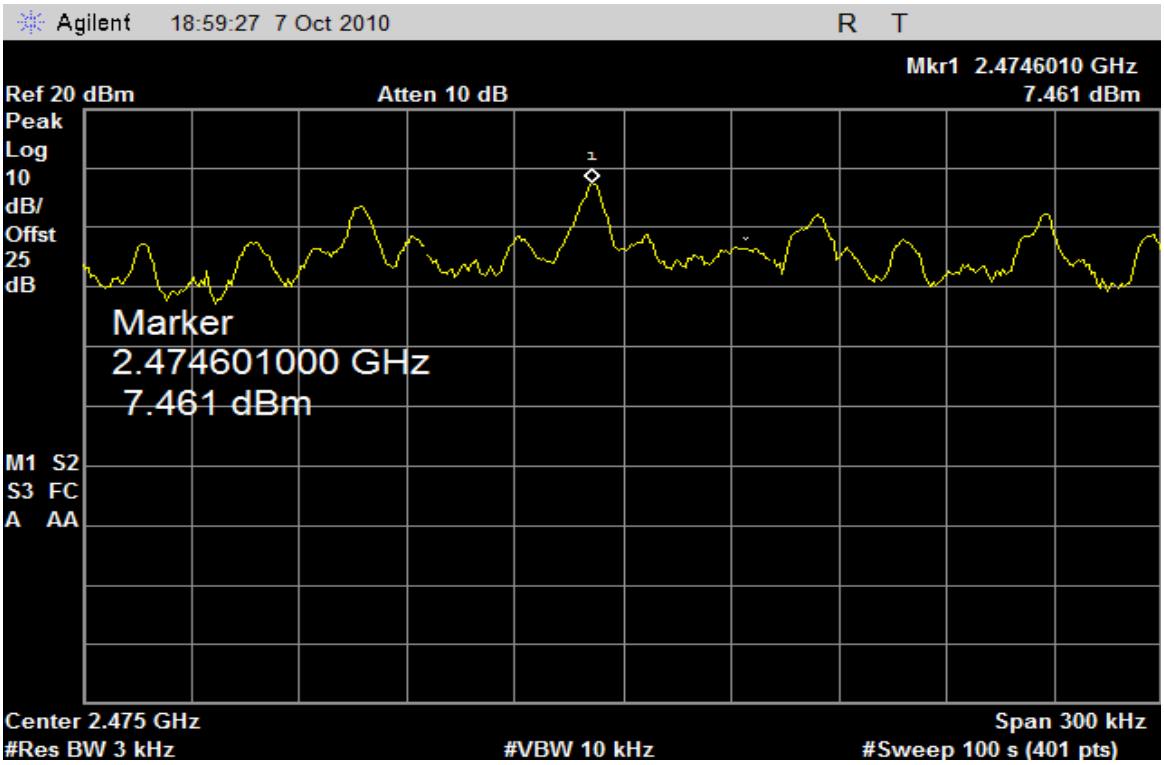
Table 16. PSD Summary Test Result



Plot 26 – Lowest Channel (PSD)



Plot 27 – Middle Channel (PSD)



Plot 28 – Highest Channel (PSD)

I. Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Power Supply	H.P	E3610A	KR83021468	NCR	None
Spectrum Analyzer	Agilent	E4402B	USA1192757	Sep/24/10	Sep/24/11
DMM	H.P	34401A	US36054008	Nov/11/09	Nov/11/10
Spectrum Analyzer	H.P.	8595E	3543A01606	Apr/08/10	Apr/08/11
Combiner/Splitter	Mini-Circuits	ZFSC-2-2	None	NCR	None
High Pass Filter	Mini-Circuits	VHF-3100+	15542	NCR	None
Temperature Meter	Fluke	52	6767008	10/30/09	10/30/10
Attenuator 30dB	Bird	10-A-MFN-30	0031039	11/03/09	11/03/10
Directional Coupler	Werlatone	C1795-13	18722	Oct/01/10	Oct/01/11
Variable Attenuator	H.P.	None	None	NCR	None
EMI Receiver	R&S	ESCS-30	828985/007	Sep/03/10	Sep/03/11
Signal Generator	R&S	SMY02	1062.5502.12	NCR	None
Attenuator 20dB	Mini Circuits	CAT-20	10012	NCR	None
Horn Antenna	EMCO	3115	9505-4428	Nov/04/09	Nov/04/10
Bilog Antena	Chase	CBL6140	1040	Nov/09/09	Nov/09/10

Table 17 – Test Equipment List

END OF TEST REPORT