LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
Testing Cert. 1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

TEST REPORT #: 310025
LSR Job #: C-828

Compliance Testing of:
2.4 GHz Radio

Test Date(s):
January 26-28, February 1-5, 15-16, March 3, 2010

Prepared For:
Saflok
31750 Sherman Ave
Madison Heights, MI 48071

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 210 Annex 8
Digital Modulation Transmitters (DTS) Operating in the
Frequency Band 2400 MHz – 2483.5 MHz

This Test Report is issued under the Authority of:

Signature: Thomas T. Smith Date: 06.08.10

Test Report Reviewed by:	**Tested by:**
Signature: Date: 06.08.10	Peter Feilen, EMC Engineer Signature: Peter Feilen Date: 04.03.10

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EXHIBIT 1. INTRODUCTION

1.1 SCOPE

References:	FCC Part 15, Subpart C, Section 15.247 and 15.209 RSS GEN and RSS 210 Annex 8
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15.
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 – 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.
Environmental Classification:	• Commercial, Industrial or Business • Residential

1.2 NORMATIVE REFERENCES

Publication	Year	Title
47 CFR, Parts 0-15 (FCC)	2008-10	Code of Federal Regulations - Telecommunications
RSS 210 Annex 8	2007 June	Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
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.
CISPR 16-1-1	2006-03 A1: 2006-09 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003 A1: 2004-04 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	2007	Measurement of Digital Transmission Systems operating under Section 15.247.

1.3 LS Research, LLC TEST FACILITY

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at LS Research, LLC:

- Compact Chamber
- Semi-Anechoic Chamber
- Open Area Test Site (OATS)

1.5 TEST EQUIPMENT UTILIZED

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated by an ISO 17025 accredited calibration laboratory, traceable to the SI standard.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	**Saflok**
Address:	**31750 Sherman Ave, Madison Heights, MI 48071**
Contact Name:	**Jim Mills**

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	Messenger EM
Model Number:	A28900
Serial Number:	NA

2.3 ASSOCIATED ANTENNA DESCRIPTION

A chip SMT antenna is used. It has a maximum gain of 1.3dBi, and an average gain of -0.5dBi. Please see Appendix E for further information within the manufacturer's specification sheet.

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

EUT Frequency Range (in MHz)	2405-2480 MHz
RF Power in Watts	
Minimum:	.000659 W (@ 2405 MHz)
Maximum:	.000714 W (@ 2480 MHz)
Conducted Output Power (in dBm)	-1.461 (Maximum @ 2480 MHz)
Field Strength at 3 meters	99.03 dBuV (@ 2405 MHZ)
Occupied Bandwidth (99% BW)	4.45 MHz
Type of Modulation	QPSK
Emission Designator	4M45G1D
EIRP (in mW)	.632 mW
Transmitter Spurious (worst case) at 3 meters	24.9 dBuV/m (@ 298 MHz)
Receiver Spurious (worst case) at 3 meters	33.2 dBuV/m (@ system noise floor)
Frequency Tolerance %, Hz, ppm	Greater than 100 ppm
Microprocessor Model # (if applicable)	CC2430F32
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	Chip
Gain (in dBi)	+1.3 pk, -0.5 Avg
EUT will be operated under FCC Rule Part(s)	15.247
Modular Filing	☒ Yes ☐ No
Portable or Mobile	Portable

RF Technical Information:

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	X	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100 %
- Standard used for evaluation: OET 65
- Measurement Distance: 20 cm
- RF Value: 0.00192 ☐ V/m ☐ A/m ☒ W/m^2
  ☒ Measured ☐ Computed ☐ Calculated

2.5 PRODUCT DESCRIPTION

This product is a door lock activated wireless transmitter for system controls in the hospitality industry. The radio turns on once the door lock is activated via a key card, and then the devices in the room are activated, such as lighting or temperature control units. The transceiver can operate between 2405 and 2480 MHz and uses a chip antenna. The unit is to be supplied by 6 VDC.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	15-35 ˚C
Humidity:	30-60 %
Pressure:	86-106 kPa

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC and IC Paragraph	Test Requirements	Compliance (yes/no)
FCC : 15.247(a)(2) IC : RSS 210 A8.2(a)	6 dB Bandwidth of a Digital Modulation System	Yes
IC : RSS GEN section 4.6.1	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(c) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC : 15.247(d) IC : RSS 210 A8.2(b)	Transmitted Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers (RSS GEN and RSS 210 of IC). The Receiver Test Report is available upon request.		

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☒ **None** ☐ **Yes (explain below)**

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☒ **None** ☐ **Yes (explain below)**

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 7 (2007), Section Annex 8 (section 8.2) for a Digital Spread Spectrum (DTS) Transmitter.

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in transmit and receive modes, and final testing was performed using each mode, using power as provided by AA batteries to create 6 VDC. The unit has the capability to operate on 15 channels, controllable for test purposes via a button on the radio board.

The applicable limits apply at a 3 meter distance. Measurements above 4 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2405 MHz), middle (2445 MHz) and high (2480 MHz) to comply with FCC Part 15.31. The channels were changed using a button on the radio board. The test mode was programmed with a development board.

5.2 Test Procedure

The frequency range from 30-25000 MHz was scanned and investigated for radiated RF measurements. From 30-4000MHz radiated RF measurements were performed in a on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. From 30-300 MHz a Biconical antenna was used. From 300-1000 MHz a Log Periodic antenna was used. From 1000-5000 MHz a Double-Ridged Waveguide Horn Antenna was used. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT.
From 4000-25000 MHz the EUT was measured at a 1.0 meter separation in a compact semi-anechoic chamber. From 4-18GHz a Double-Ridged Waveguide Horn Antenna and pre-amplifier was used and from 18-25 GHz a standard gain Horn antenna and pre-amplifier was used. The antenna was raised from 1.0-1.8 m. The EUT was placed on a non-conductive pedestal. The turntable was rotated and the radiated RF emission levels were noted at various fixed degree and antenna height settings.

The battery voltage was checked frequently, and the batteries were replaced as necessary.

The EUT was rotated along three orthogonal axis during the investigations to find the highest emission levels.

5.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a ISO/IEC 17025 accredited Calibration laboratory, and traceable to the SI standard. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an Agilent E4445A/N9039A EMI System. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 3 MHz for measurements above 1 GHz (video bandwidth of 50 MHz). From 4 GHz to 18 GHz, an Agilent E4446A Spectrum Analyzer and an EMCO Double-Ridge Horn Antenna were used. From 18 GHz to 25 GHz, the Agilent E4446A Spectrum Analyzer with a standard gain horn, and preamp were used.

Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
EMI Receiver	Agilent	E4445A	MY48250225
EMI Receiver Pre-Select.	Agilent	N5181A	MY49060062
Spectrum Analyzer	Agilent	E4446A	US45300564
Log Periodic Antenna	EMCO	93146	9701-4855
Horn Antenna	EMCO	3115	6907
Bicon Antenna	EMCO	93110B	9702-2918
Pre-Amp	Adv. Microwave	WLA612	1145A04094
Horn Antenna – Std. Gain	EMCO	3160-09	9809-1120

5.4 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-210, Issue 7 (2007), Annex 8 for a DTS transmitter. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 CALCULATION OF RADIATED EMISSIONS LIMITS

The maximum peak output power of an intentional radiator in the 2400-2483.5 MHz band, as specified in Title 47 CFR 15.247 (b)(3) and RSS 210 A8.4 is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d) and RSS 210 A8.2(b), shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c) for FCC and section 2.2,2.6 and 2.7 of RSS 210 for IC.

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS 210 section 2.7.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
>960	500	54.0	63.5

Sample conversion from field strength μV/m to dBμV/m:

$dB\mu V/m = 20 \log_{10} (100)$

= 40 dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

960 MHz to 10,000 MHz

500μV/m or 54.0 dB/μV/m at 3 meters

54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

5.6 RADIATED EMISSIONS TEST DATA CHART

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.205 and 15.247(DTS)
RSS 210 A8, sections 2.2,2.6 and 2.7
Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	Saflok					
Date(s) of Test:	February 2, 4, 5, 9, March 3, 2010					
Test Engineer(s):	Peter Feilen					
Voltage:	6.0 VDC					
Operation Mode:	Modulated Continuous Transmit Mode					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
	X	Battery		Other:		
EUT Placement:	X	80cm non-conductive table		10cm Spacers		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

The following table depicts the level of significant spurious radiated RF emissions found:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
49.8	V/H	1.00	0	10.8	40.0	29.2
72.2	V/H	1.00	0	8.8	40.0	31.2
99.9	V/H	1.31	0	10.2	43.5	33.3
116.2	V/H	1.52	0	11.9	43.5	31.6
180.3	V/H	1.00	0	24.3	43.5	19.2
185.7	V/H	1.00	0	16.9	43.5	26.6
216.0	V/H	1.00	254	16.8	46.0	29.2
247.10	V/H	1.00	0	22.5	46.0	23.5
298.26	V/H	1.00	0	24.9	46.0	31.1
968.0	V/H	1.00	0	22.2	54.0	31.8
999.2	V/H	1.00	0	20.9	54.0	33.1

RADIATED EMISSIONS DATA CHART *(continued)*

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 11:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4811.00	H/H	1.18	119.9	63.6 NOTE 4	63.5	-0.1
7214.40	H/H	1.03	331.7	68.6	79.0	10.4
9619.53	H/H	1.15	164.8	52.8	79.0	26.2
12020.63	H/H	1.06	159.8	43.2	63.5	20.3
14424.73	H/H	1.13	32.5	43.5	79.0	35.5
16841.23	H/H	1.11	166.5	41.0	79.0	38.0
4810.83	V/F	1.49	149.1	54.7	63.5	8.8
7216.47	V/F	1.33	185.0	62.3	79.0	16.7
9619.70	V/F	1.06	6.9	47.5	79.0	31.5
12021.63	V/F	1.21	322.6	40.3	63.5	23.2
14428.93	V/F	1.11	136.6	41.3	79.0	37.7
16837.30	V/F	1.03	6.0	41.0	79.0	38.0

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 18:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4889.23	H/H	1.16	52	55.4	63.5	8.1
7333.97	H/H	1.10	325	51.0	63.5	12.5
9782.53	H/H	1.00	288	49.9	79.0	29.1
12228.63	H/H	1.10	158	41.8	63.5	21.7
14674.63	H/H	1.03	9	39.9	79.0	39.1
17119.47	H/H	1.06	18	42.9	79.0	36.1
4890.27	V/F	1.30	126	47.4	63.5	16.1
7333.83	V/F	1.22	200	47.3	63.5	16.2
9782.17	V/F	1.03	223	43.2	79.0	35.8
12228.00	V/F	1.24	189	40.8	63.5	22.7
14670.53	V/F	1.04	51	40.0	79.0	39.0
17122.07	V/F	1.05	5	43.0	79.0	36.0

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 26:

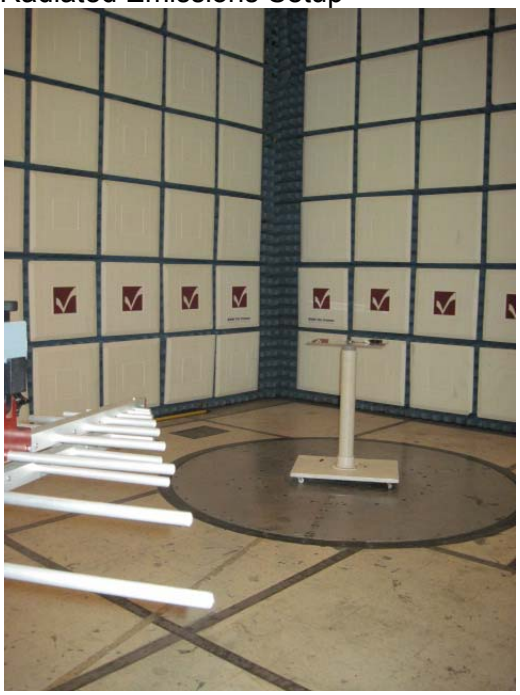
Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4960.27	H/H	1.11	51	50.7	63.5	12.8
7439.77	H/H	1.03	326	39.1	63.5	24.4
9918.40	H/H	1.04	299	40.9	79.0	38.1
12408.50	H/H	1.03	7	38.1	63.5	25.4
14886.17	H/H	1.03	7	39.8	79.0	39.2
17368.67	H/H	1.03	5	43.8	79.0	35.2
4960.43	V/F	1.03	58	43.6	63.5	19.9
7441.67	V/F	1.19	201	37.1	63.5	26.4
9924.53	V/F	1.13	203	38.5	79.0	40.5
12407.43	V/F	1.25	7	37.9	63.5	25.6
14880.97	V/F	1.03	7	40.0	79.0	39.0
17355.17	V/F	1.04	9	44.2	79.0	34.8

Notes:

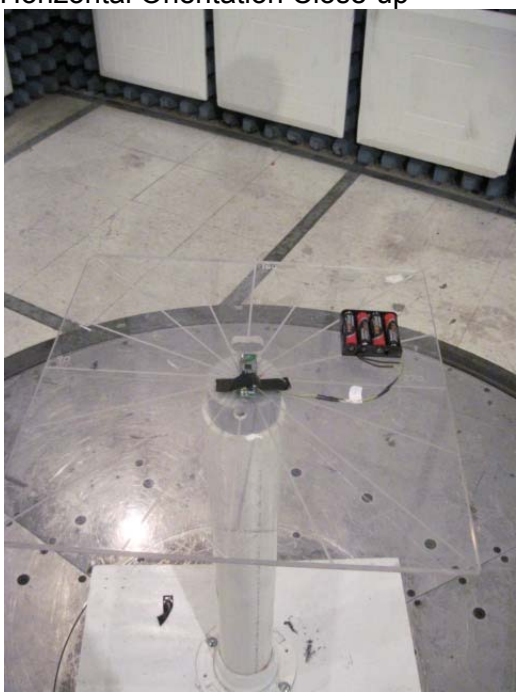
1) A Quasi-Peak Detector was used for all measurements below 1 GHz, and a Peak Detector was used for measurements above 1 GHz. Measurements documented in the data charts with a frequency greater than 1 GHz were taken using a 10 Hz video averaged peak detector in compliance with the spurious radiated emissions procedure outlined in OET KDB Publication Number 550874 . Additionally, measurements were verified using the peak detector with VBW>RBW to ensure the peak emissions did not exceed 20 dB above the stated average limits.
2) Measurements above 4 GHz were made at 1 meters of separation from the EUT
3) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=3MHz, VBW=50MHz.
4) Duty cycle relaxation was invoked. 26 dB of relaxation can be applied. Please reference Appendix D for justification.

5.7 Test Setup Photo(s) – Radiated Emissions Test

Radiated Emissions Setup



Horizontal Orientation Close-up



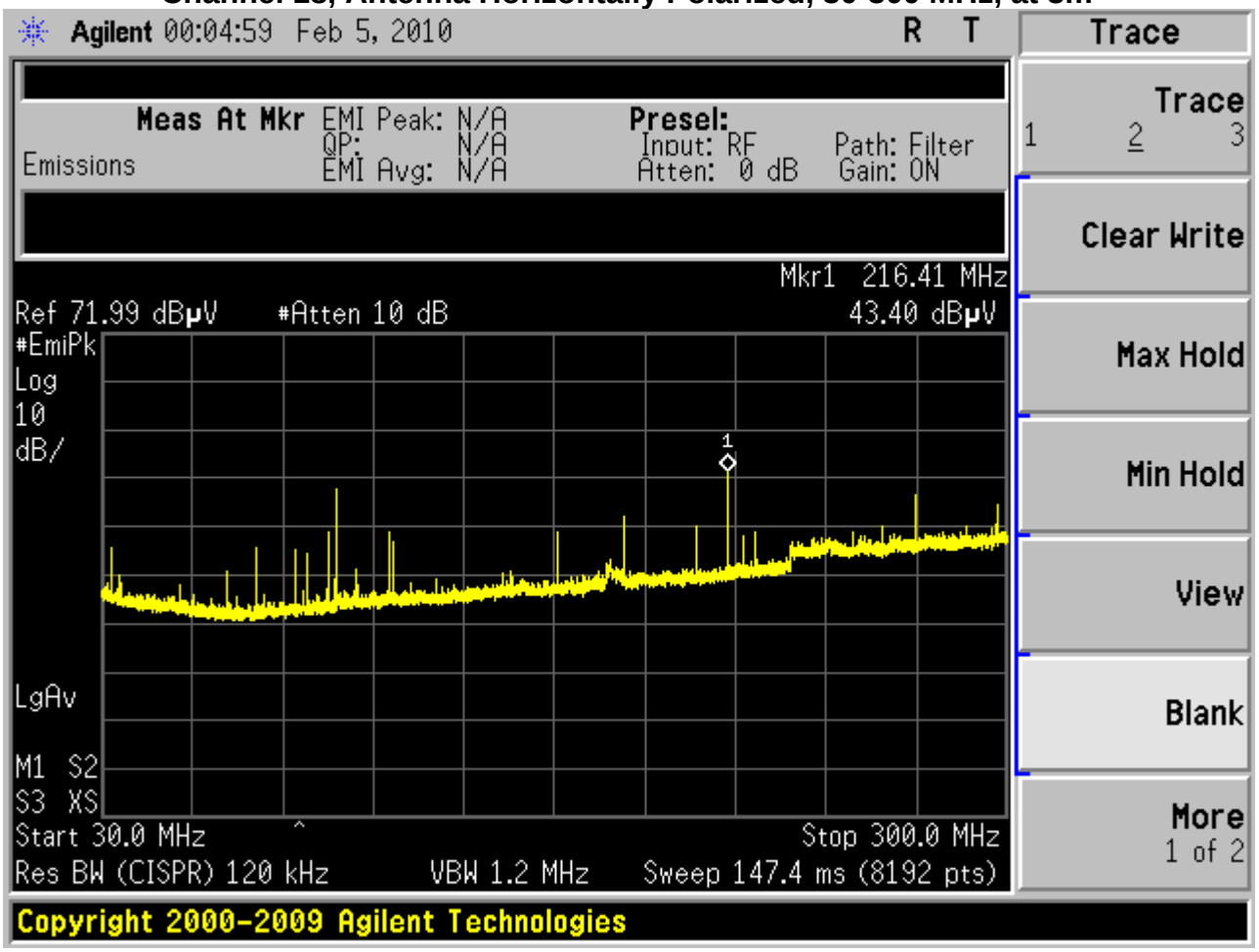
NOTE: All orientations were investigated, and the above orientation demonstrated worst case orientation. Data provided is reflective of this testing orientation.

5.8 Screen Captures - Radiated Emissions Test

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and a 10 Hz video averaged peak detector function is utilized when measuring frequencies above 1 GHz.

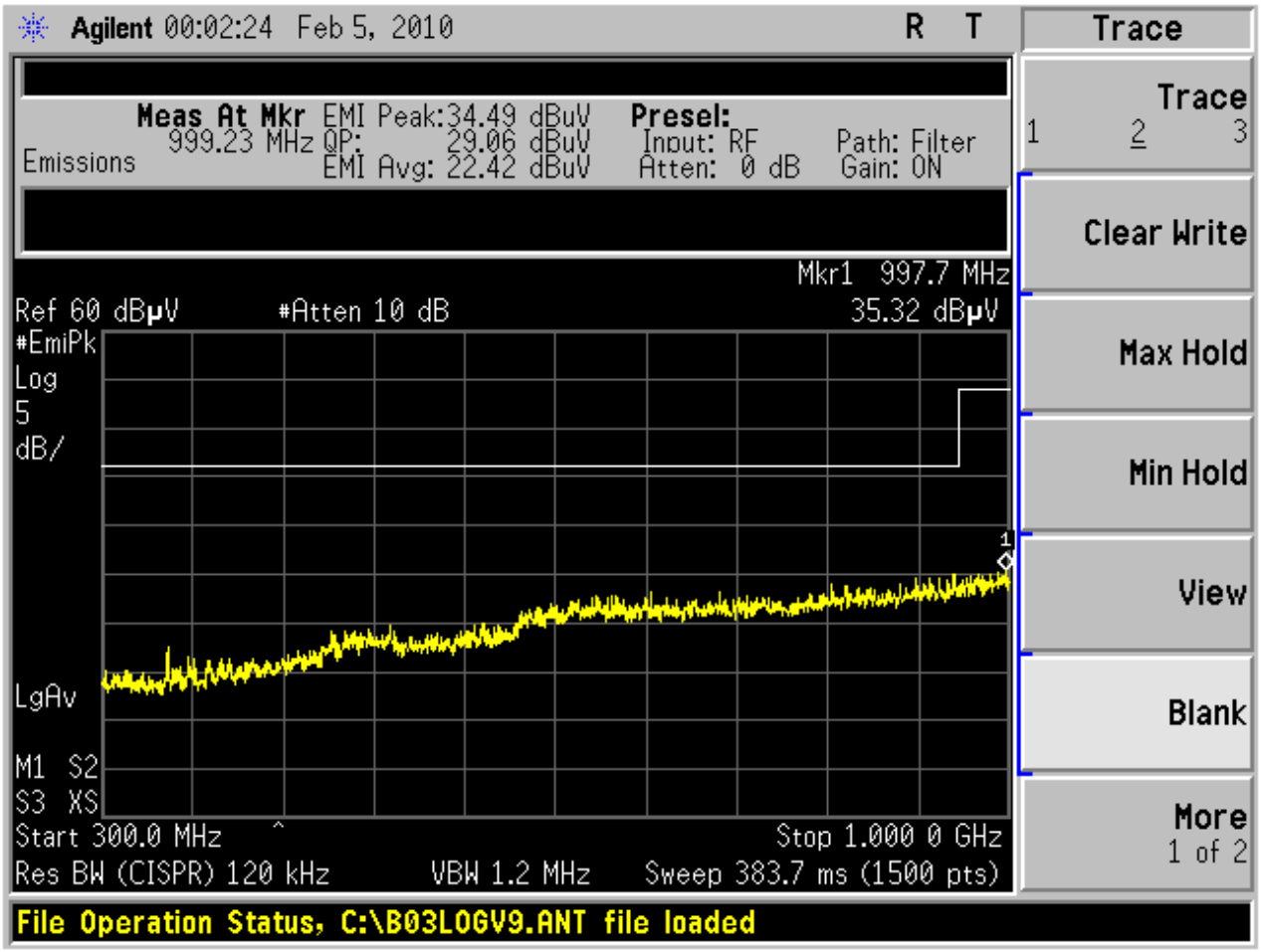
The signature scans shown here are from worst-case emissions, as measured on channels 11, 18, or 26, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 18, Antenna Horizontally Polarized, 30-300 MHz, at 3m

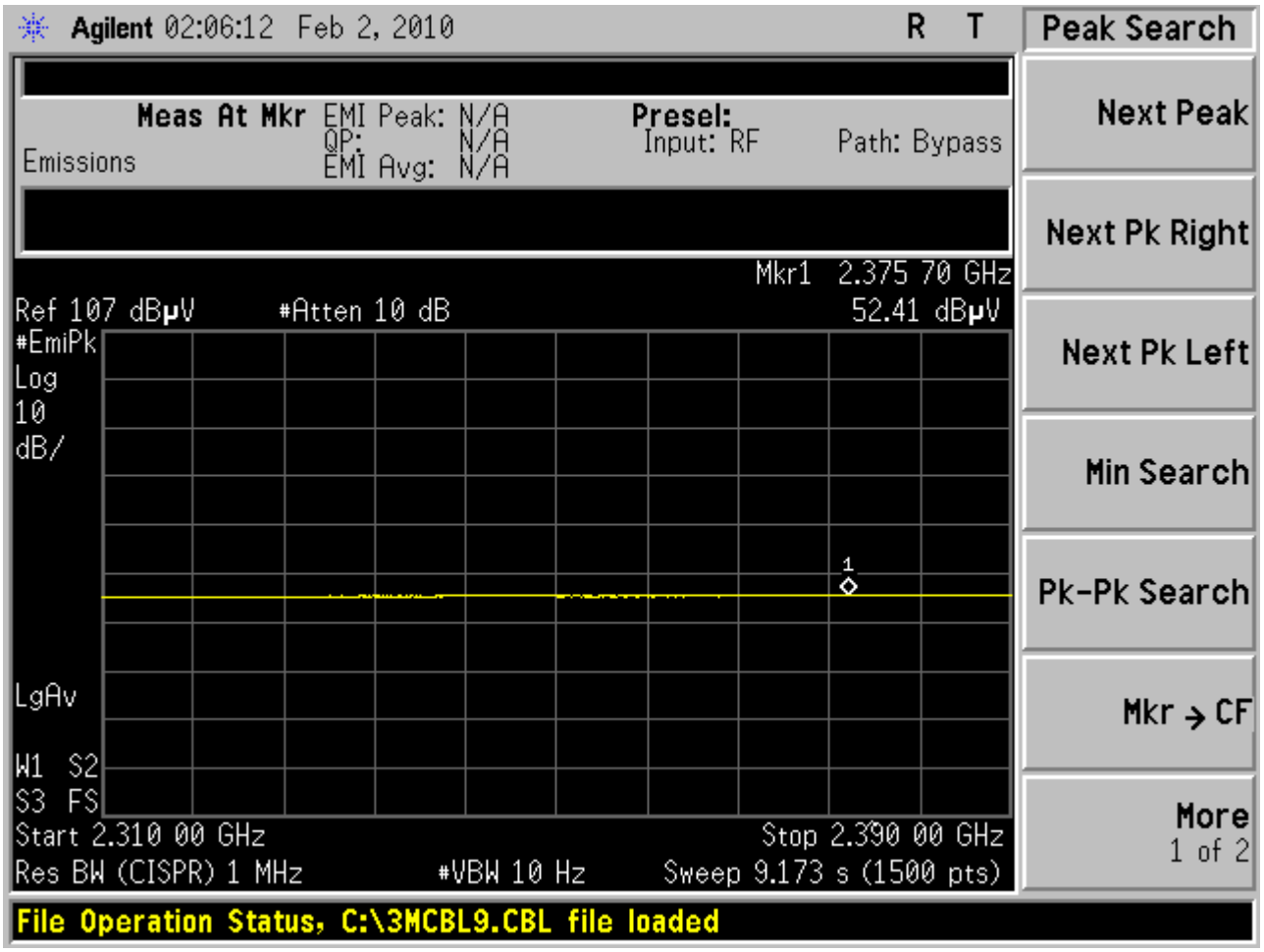


Screen Captures - Radiated Emissions Testing **(continued)**

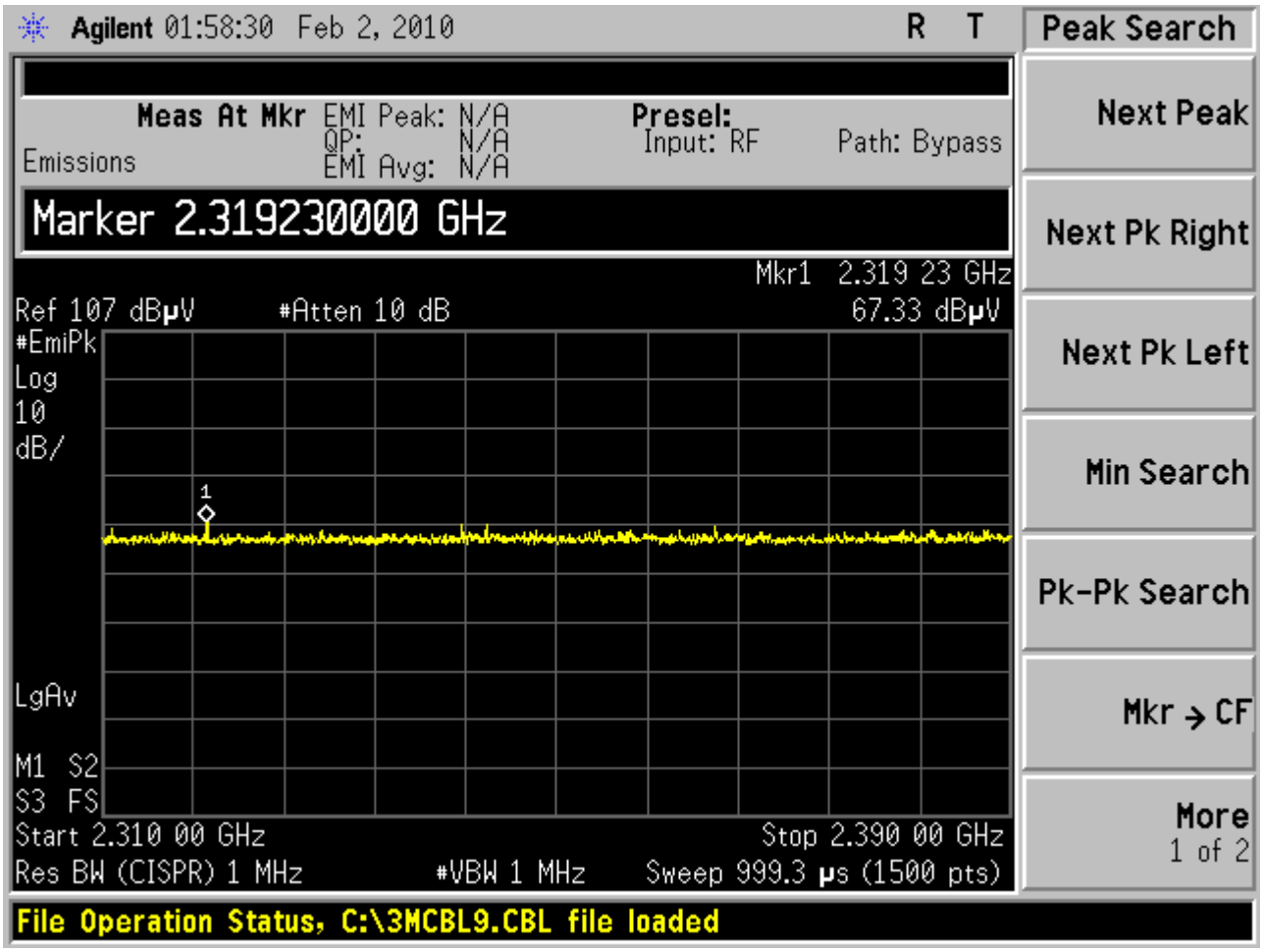
Channel 18, Antenna Horizontally Polarized, 300-1000 MHz, at 3m



Channel 11, Antenna Horizontally Polarized, 1000-2310 MHz, at 3m

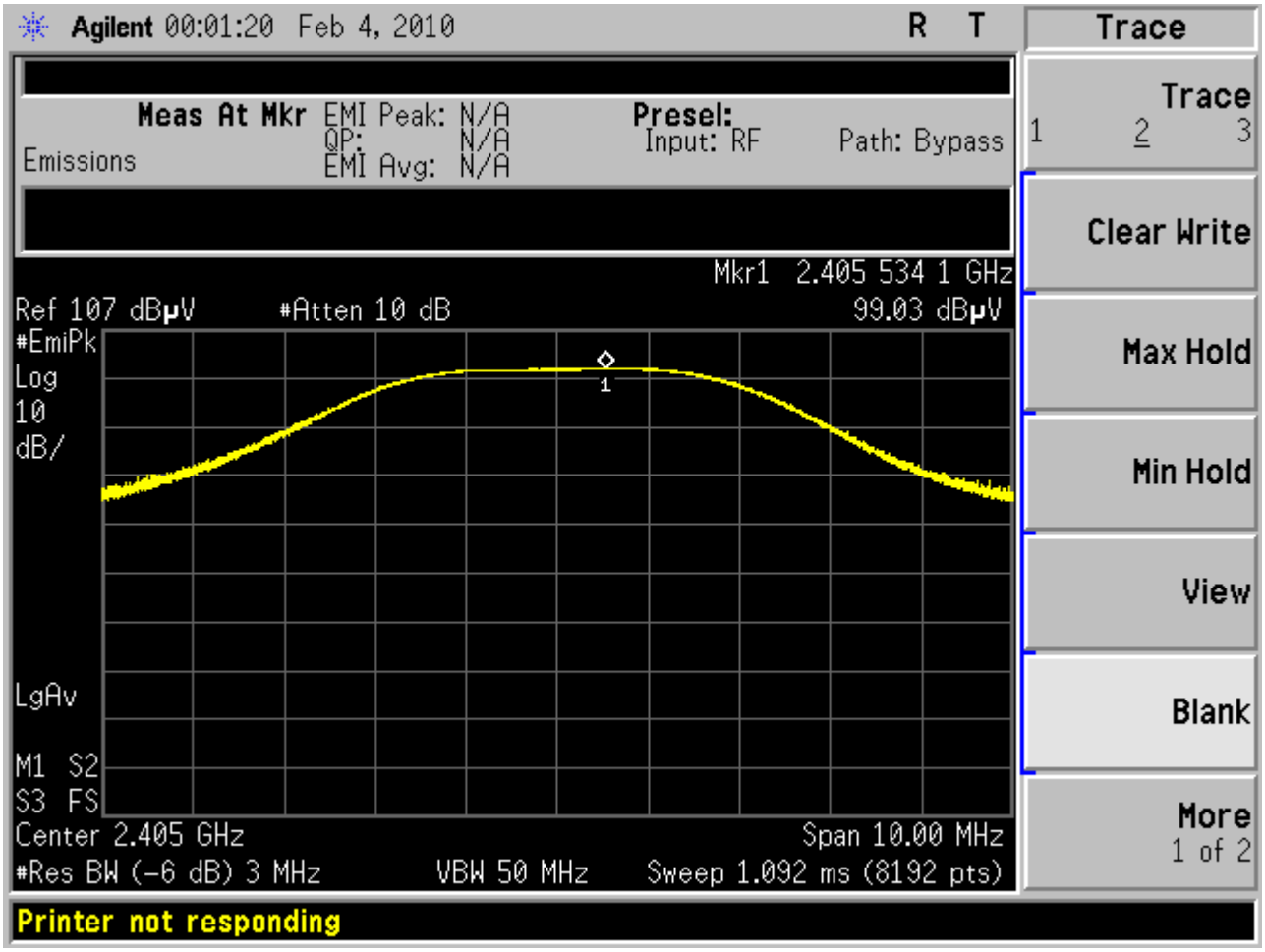


Channel 11, Antenna Horizontally Polarized, 2310-2390 MHz, at 3m

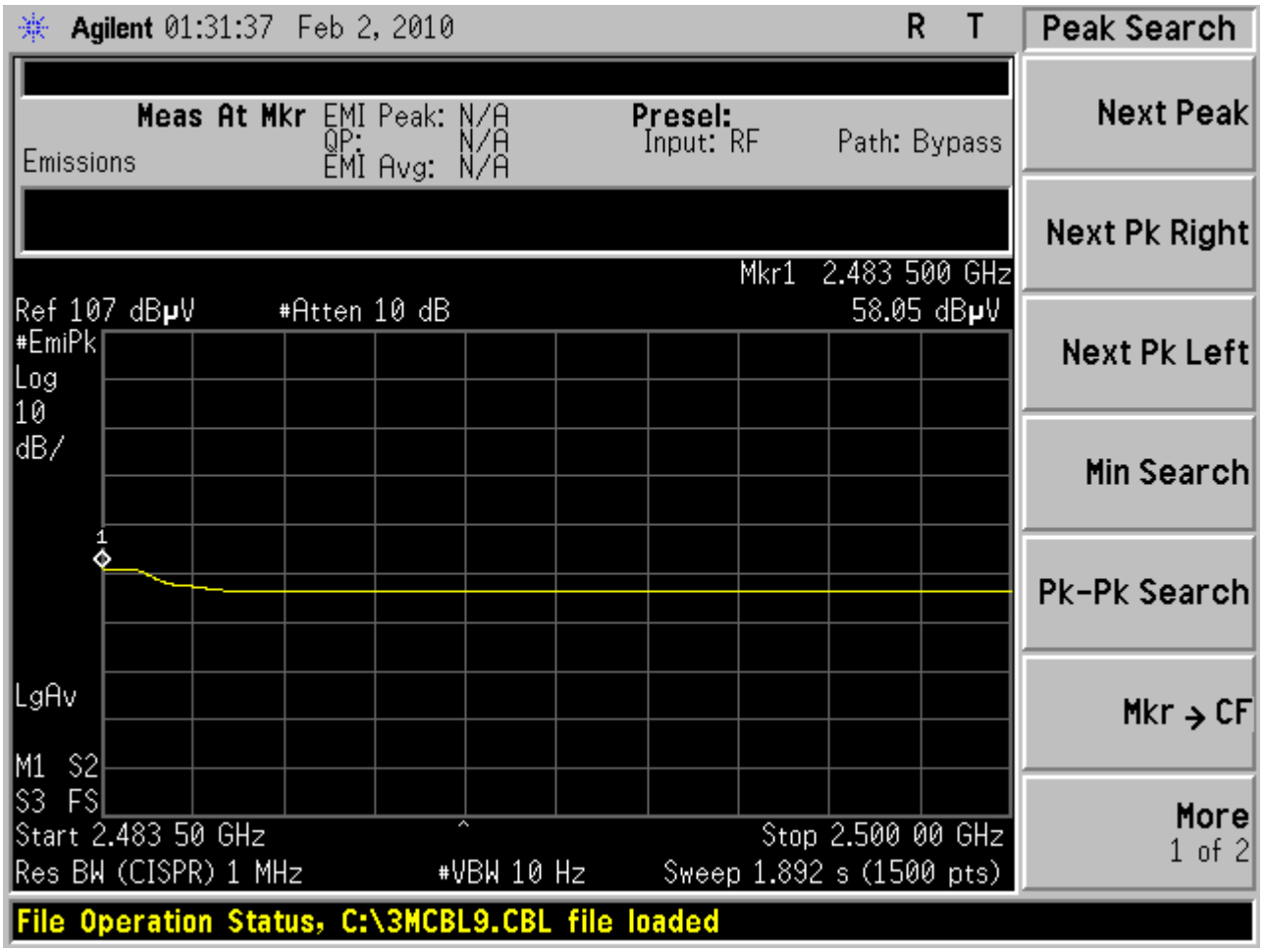


Screen Captures - Radiated Emissions Testing **(continued)**

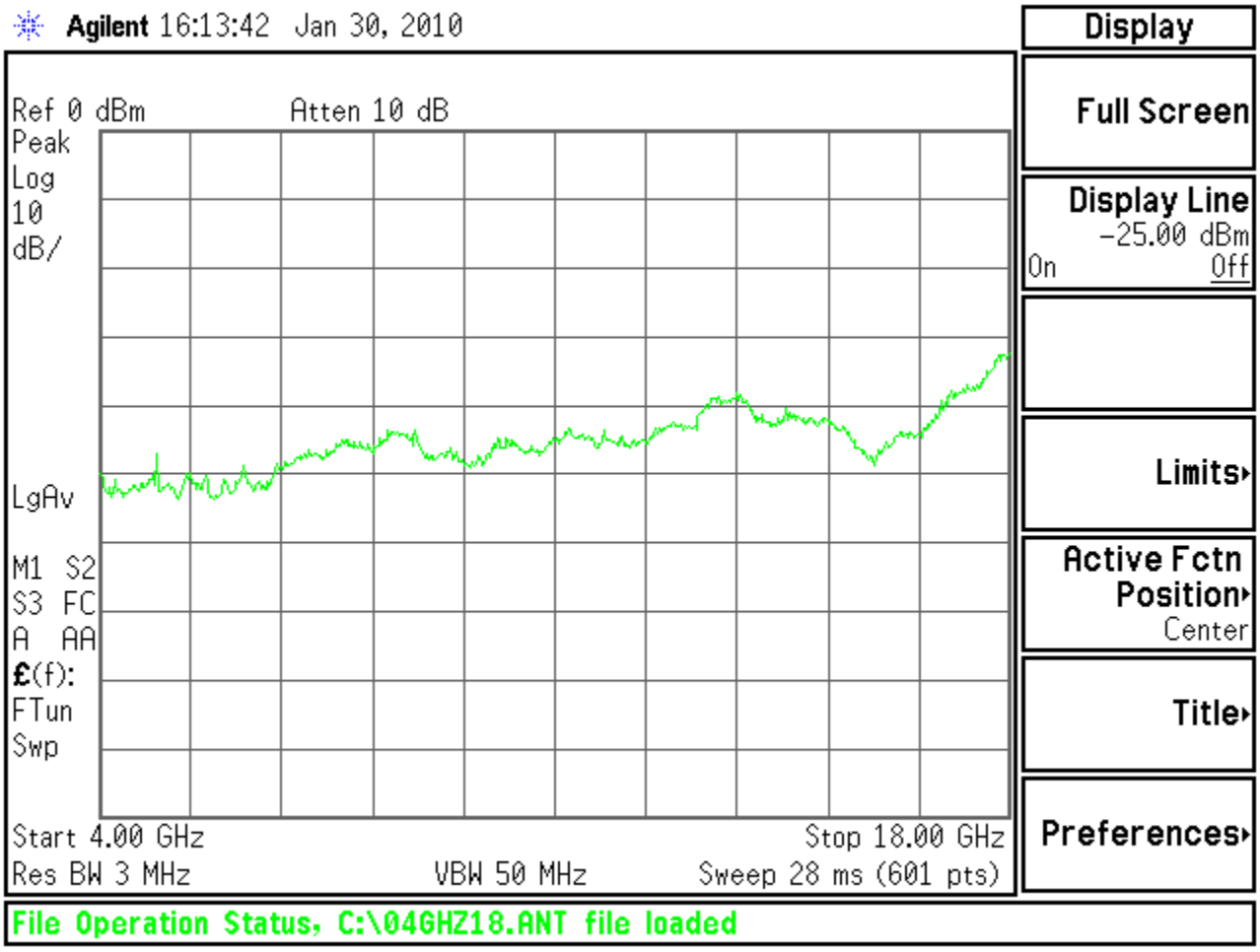
Channel 11, Antenna Horizontally Polarized, Highest Fundamental Emission, at 3m



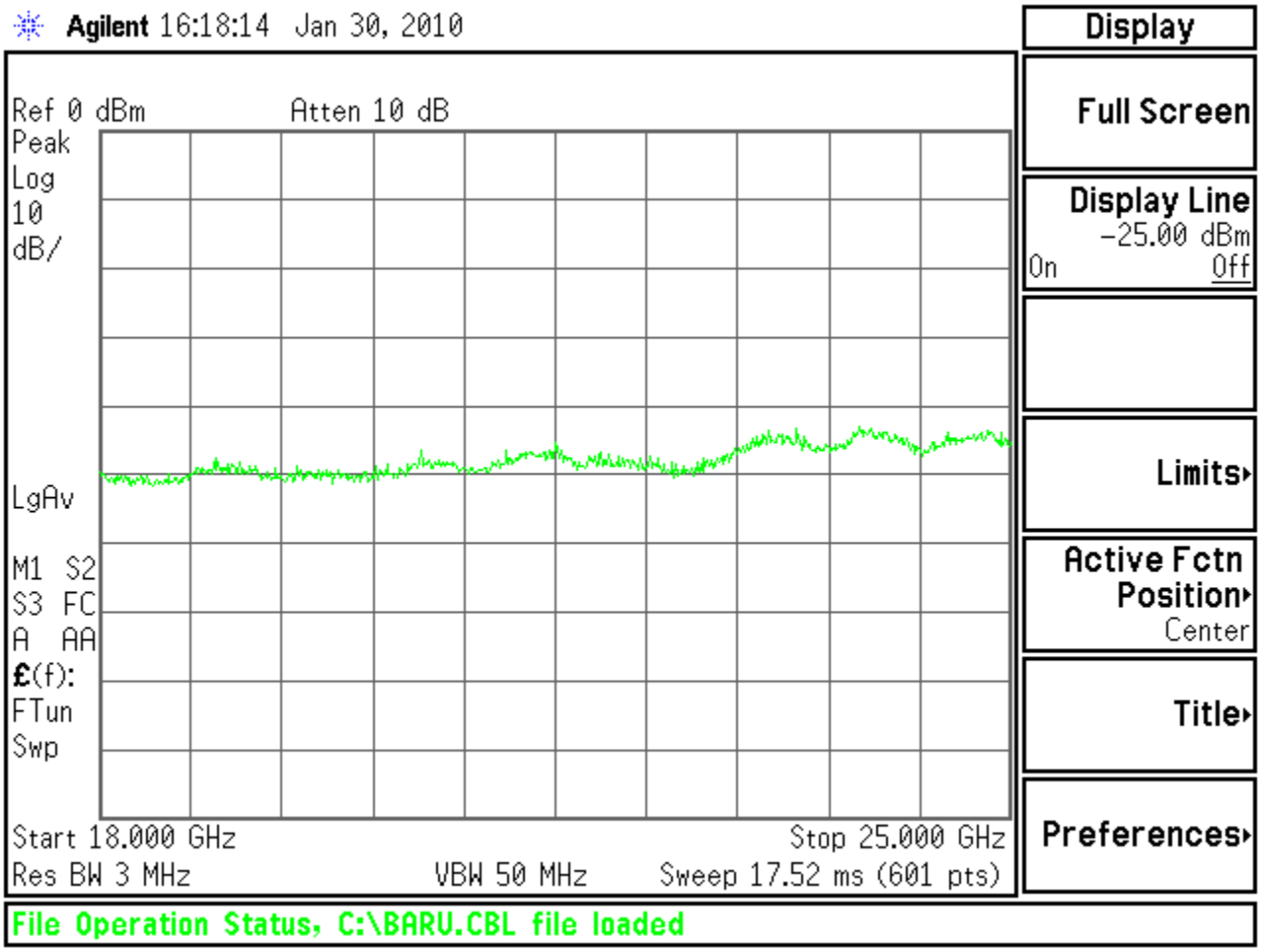
Channel 18, Antenna Horizontally Polarized, 2500-5000 MHz, at 3m



Channel 18, Antenna Horizontally Polarized, 4000-18000 MHz, at 1m



Channel 18, Antenna Vertically Polarized, 18000-25000 MHz, at 1m



5.9 Receive Mode Testing

Per the requirements of RSS-210, the EUT was placed in continuous receive mode and the radiated spurious emissions were measured and compared to the limits stated in RSS-Gen Section 4.10.

The test setup, procedure, and equipment utilized were identical to that described in sections 5.1, 5.2, and 5.3 of this document.

Measurement data and screen captures from the receive tests are presented below:

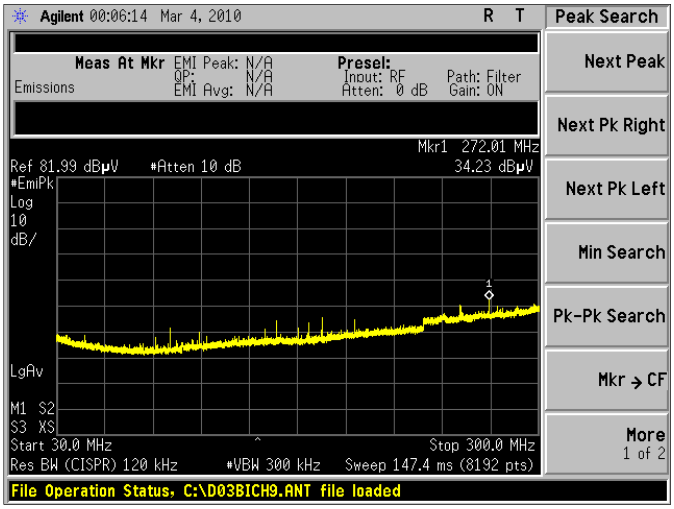
Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
178.44	1.00	0	13.44	43.00	29.56	Horizontal	Horizontal
272.01	1.12	43	33.23	46.00	12.77	Horizontal	Horizontal

Screen Captures - Radiated Emissions Testing – Receive Mode

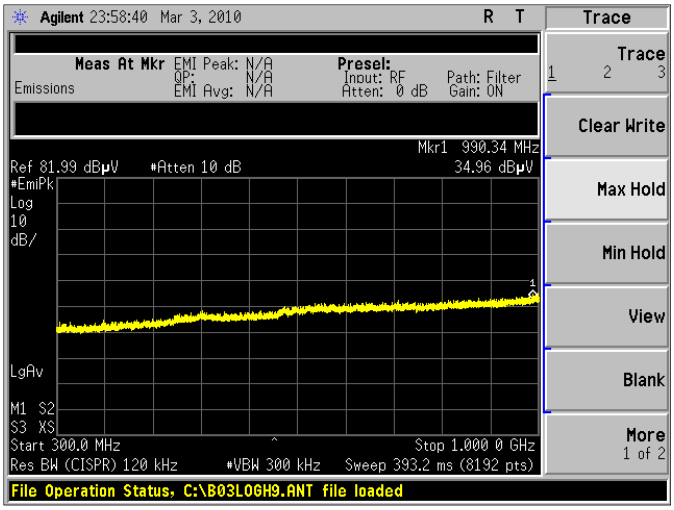
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 11, 18 and 26, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 18, 30-300 MHz, Antenna Vertically Polarized at 3m

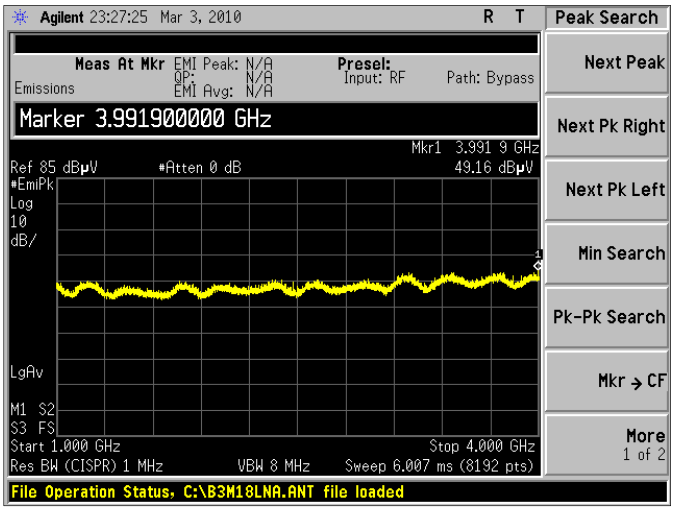


Channel 18, 300-1000 MHz, Antenna Vertically Polarized, at 3m

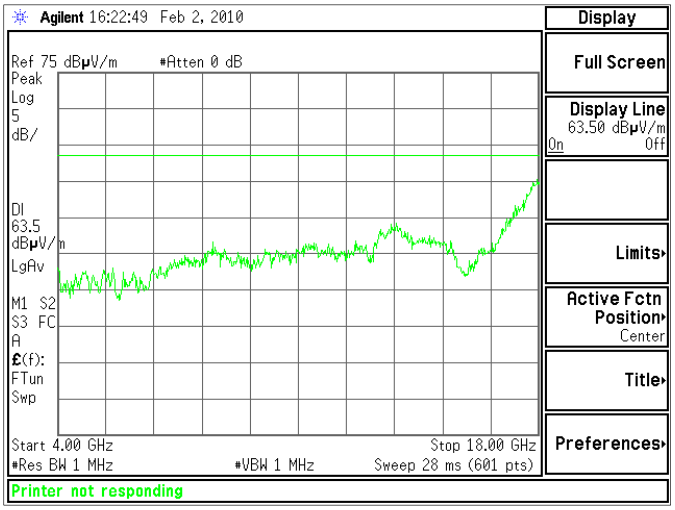


Screen Captures - Radiated Emissions Testing – Receive Mode **(continued)**

Channel 18, 1000-4000 MHz, Antenna Vertically Polarized at 3m



Channel 18, 4000-18000 MHz, Antenna Vertically Polarized, at 1m



Notes:

1. Across the three channels similar emissions were exhibited.
2. The worst case orientation is represented in the screen captures

EXHIBIT 6. OCCUPIED BANDWIDTH:

6.1 Limits
For a Digital Modulation System, the 6 dB bandwidth shall be at least 500 kHz.

6.2 Method of Measurements
Refer to ANSI C63.4 and FCC Procedures (2007) for Digital Transmission Systems operating under 15.247.

The transmitter output was connected to the Spectrum Analyzer. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 100 kHz RBW and VBW=300 kHz.

The bandwidth requirement found in FCC Part 15.247(a)(2) and RSS 210 A8.2(a) requires a minimum -6dBc occupied bandwidth of 500 kHz. In addition, Industry Canada (IC RSS GEN 4.6.1) requires the measurement of the -20dBc occupied bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the Agilent E4446A spectrum analyzer. The loss from the cable was loaded into the analyzer and measurement corrections were made internally; thereby allowing direct measurements without the need for any further corrections. An Agilent model E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The EUT was configured to run in modulated continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the closest measurement (6 dB bandwidth) when compared to the specified limit, is 1800 kHz, which is above the minimum of 500 kHz.

6.3 Test Equipment List

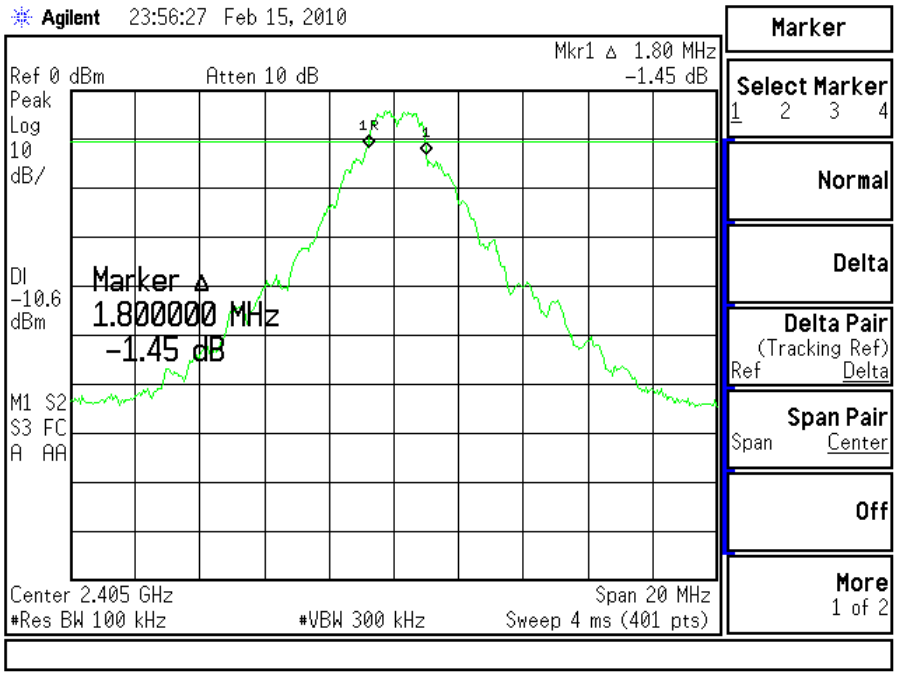
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

6.4 Test Data

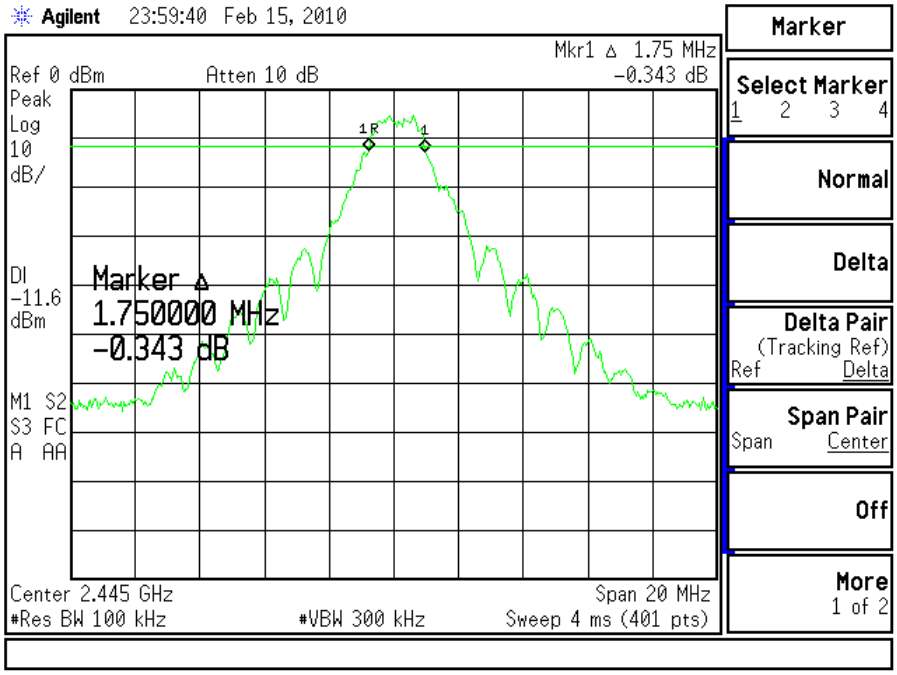
Channel	Center Frequency (MHz)	Measured -6 dBc Occ. BW (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc Occ.Bw (kHz)
11	2405	1800	500	4450
18	2445	1750	500	3900
25	2480	1800	500	3700

6.5 Screen Captures - OCCUPIED BANDWIDTH

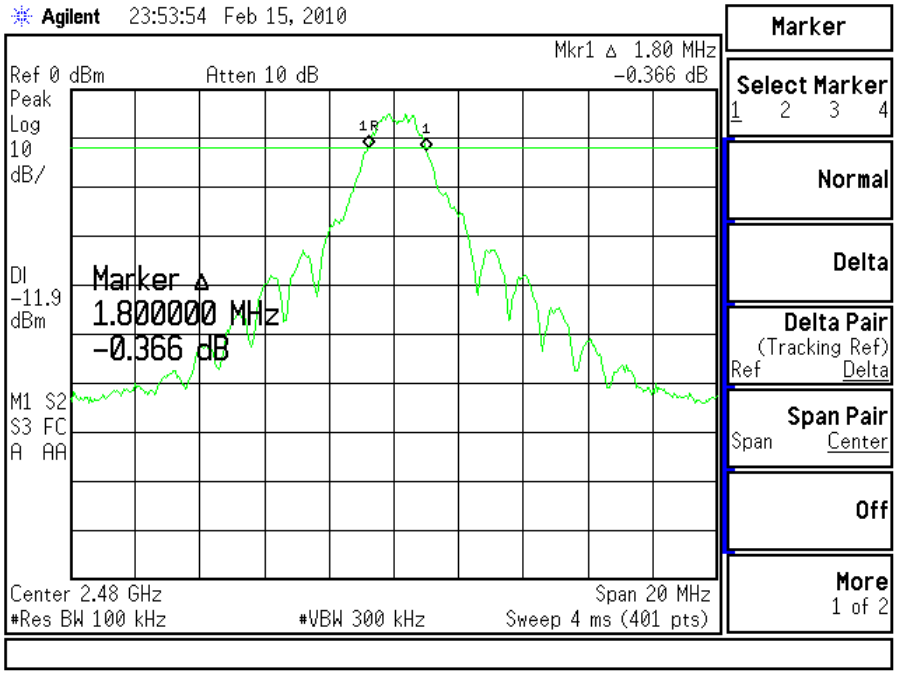
Channel 11, -6 dBc Occupied Bandwidth



Channel 18, -6 dBc Occupied Bandwidth



Channel 26, -6 dBc Occupied Bandwidth



Representative Plot of -20dBc Occupied Bandwidth
Channel 26, -20 dBc Occupied Bandwidth

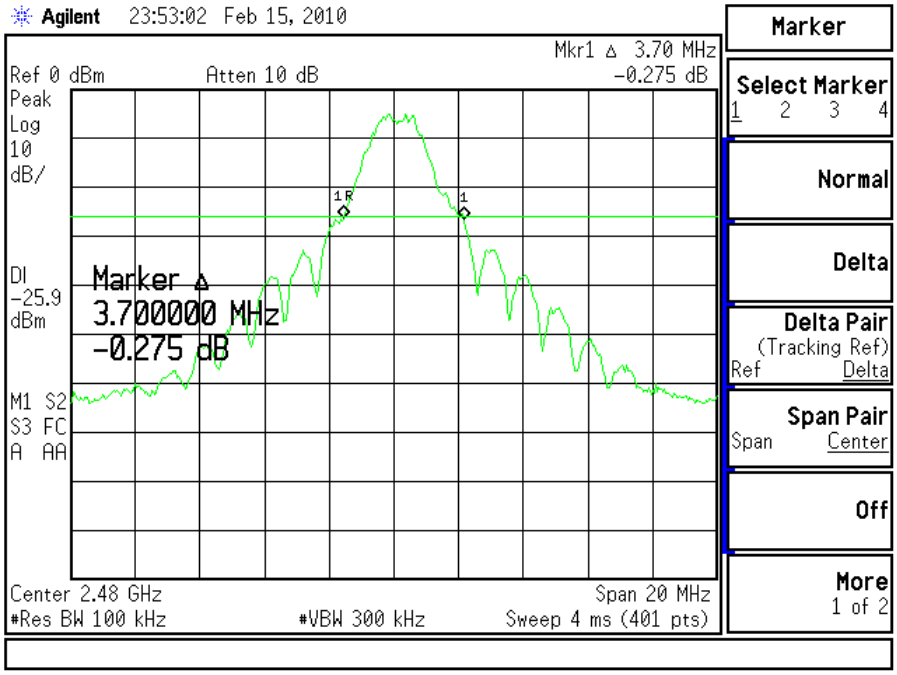


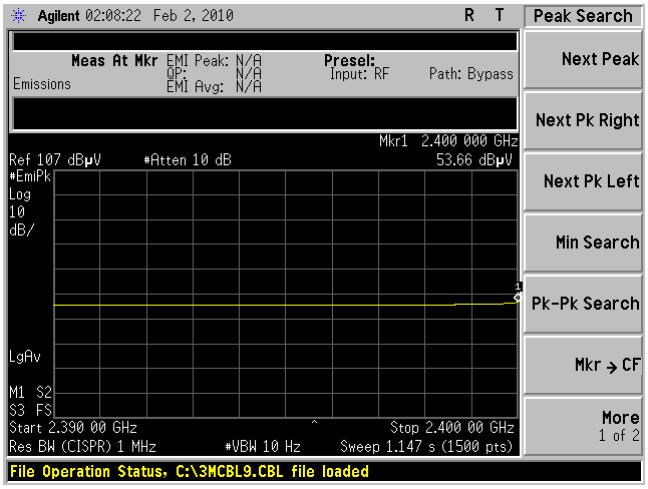
EXHIBIT 7. BAND-EDGE MEASUREMENTS

7.1 Method of Measurements

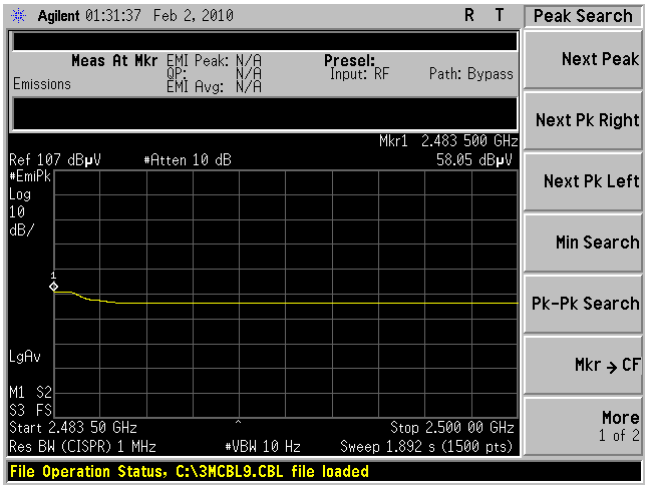
FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in tables 2 and 3 of the same standard and also to the limits in the applicable annex. The following screen captures demonstrate compliance of the intentional radiator at the 2400-2483.5 MHz Band-Edges. The EUT was operated in Modulated Continuous Transmit Mode, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.
The Lower Band-Edge limit, in this case, would be -20 dBc with respect to the fundamental level.

The Upper Band-Edge limit, in this case, would be + 54 dBµV/m at 3m.

Screen Capture Demonstrating Compliance at the Lower Band-Edge

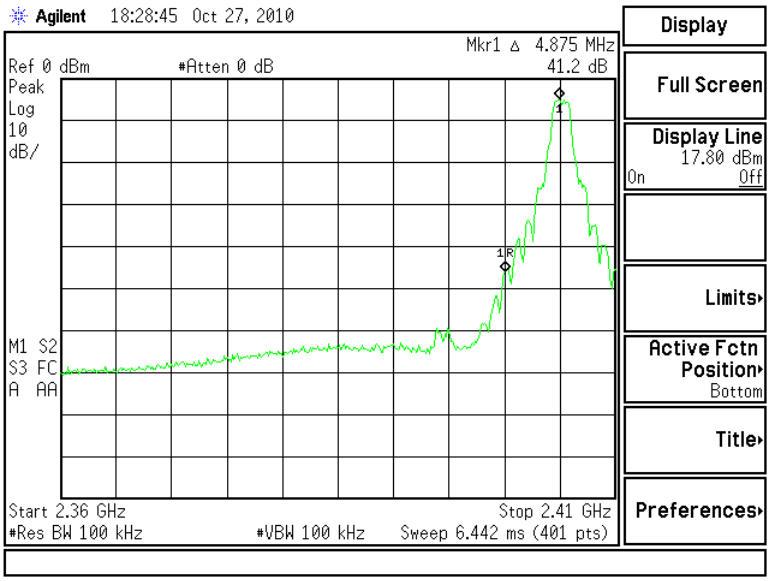


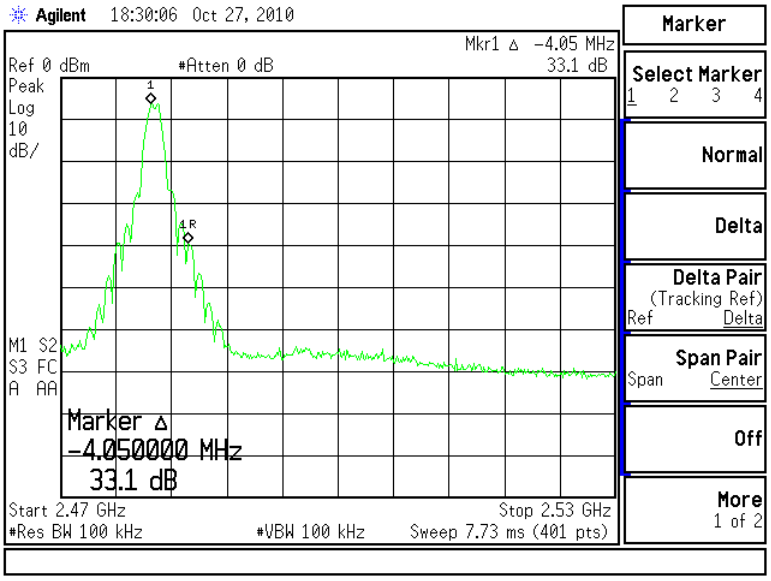
Screen Capture Demonstrating Compliance at the Higher Band-Edge



NOTE: Please reference appendix D. Peak Reading can be effectively corrected by -26dB to 32.05 dBuV using duty cycle correction.

Conducted Measurements demonstrating band edge and spurious emission compliance





A greater than 20 dB delta is observed both at the lower and upper end of the band. Therefore the 20 dB difference between the fundamental and nearest out of band emission is demonstrated as compliant.

EXHIBIT 8. POWER OUTPUT (CONDUCTED): 15.247(b)

8.1 Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable for the spectrum analyzer. The loss from the cable is added on the analyzer using a correction file as part of the internal memory of the analyzer, there by allowing direct measurements without the need for any further corrections. The unit was configured to run in modulated continuous transmit mode, while being supplied with typical data from an internal source. The spectrum analyzer was used with resolution and video bandwidths set to 3 MHz, and a span of 20 MHz, with measurements from a peak detector presented in the chart below.

8.2 Test Equipment List

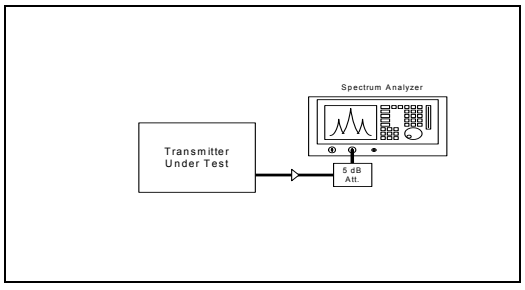
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	9 kHz-44GHz

8.3 Test Data

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
11	2405.000	+30 dBm	-1.461	31.461
18	2445.000	+30 dBm	-1.791	31.791
26	2480.000	+30 dBm	-1.809	31.809

Transmitter Channel	Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	(1) Calculated EIRP (dBm)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Lowest	2405	-1.461	-1.991	30.0	36.0
Middle	2445	-1.791	-2.291	30.0	36.0
Highest	2480	-1.809	-2.309	30.0	36.0

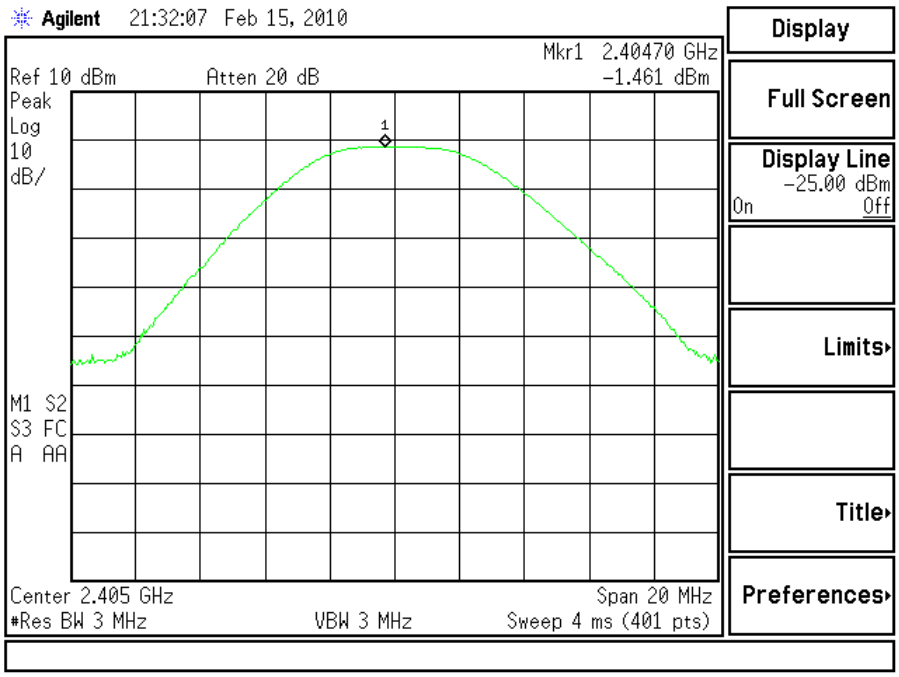
(1) EIRP Calculation:
EIRP = (Peak power at antenna terminal in dBm) + (EUT Antenna gain in dBi)



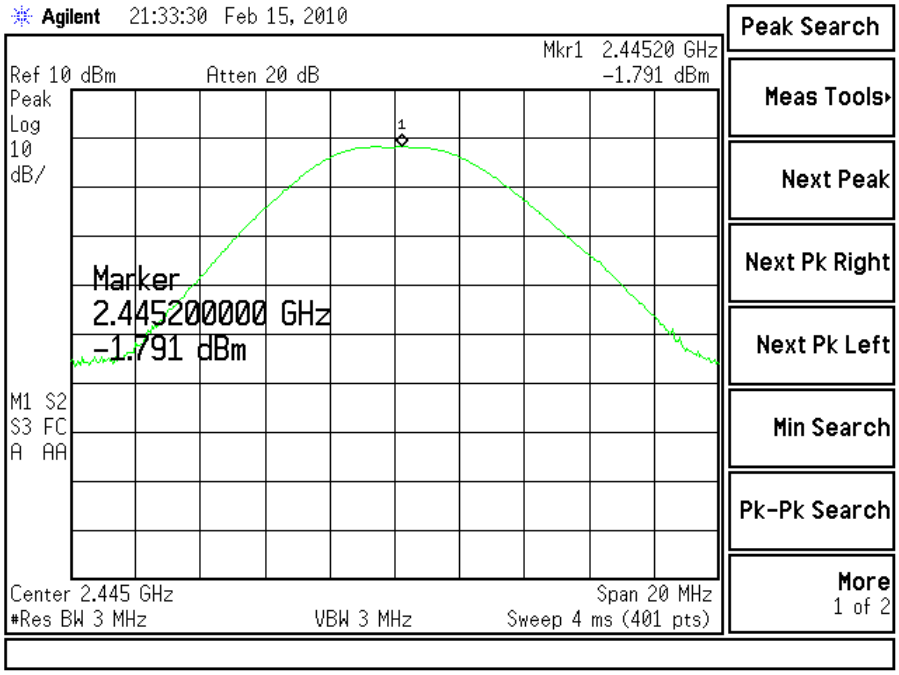
Measured RF Power Output (in Watts): 0.000632 W

8.4 Screen Captures – Power Output (Conducted)

Channel 11



Channel 18



Channel 26

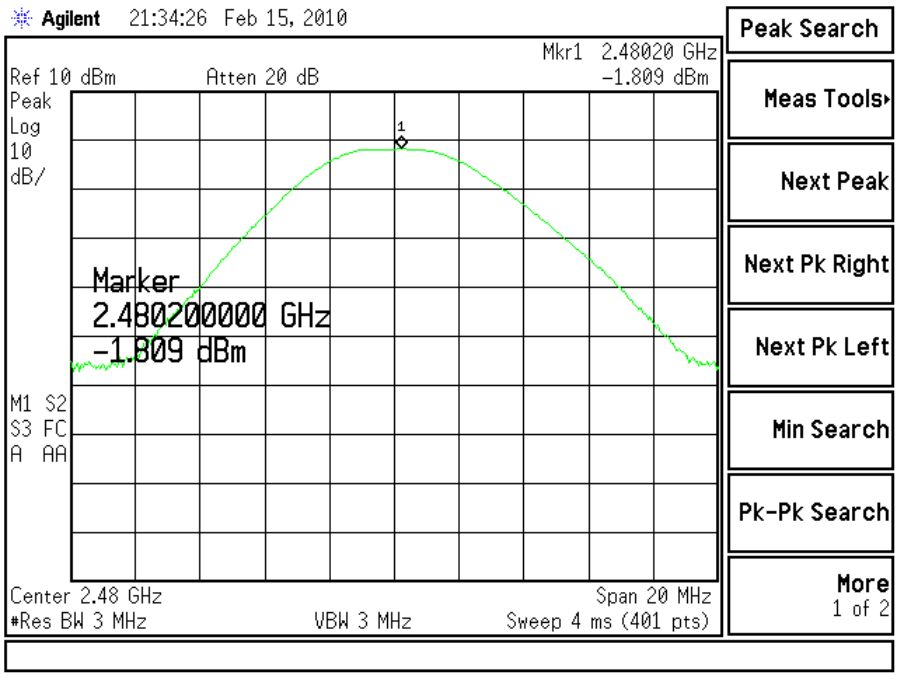

Agilent 21:34:26 Feb 15, 2010
Mkr1 2.48020 GHz
Ref 10 dBm
Atten 20 dB
-1.809 dBm
Peak
Log
10
dB/
Marker
2.480200000 GHz
-1.809 dBm
M1 S2
S3 FC
A AA
Center 2.48 GHz
#Res BW 3 MHz
VBW 3 MHz
Span 20 MHz
Sweep 4 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

EXHIBIT 9. POWER SPECTRAL DENSITY: 15.247(e)

9.1 Limits

For digitally modulate systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e) and RSS 210 A8.2(b), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed using the utility built into the Agilent Analyzer. The resultant density was then corrected to a 3 kHz bandwidth using the spectrum analyzer built-in function to correct to a 3 kHz measurement . The highest density was found to be no greater than -26.29 dBm, which is under the allowable limit by more than 34 dB.

9.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

9.3 Test Data

Channel	Center Frequency (MHz)	Measured Channel Power (dBm/1 Hz)	3 kHz Correction (dB)	Corrected Power Measurement (dBm/3kHz)	Limit (dBm)	Margin (dB)
11	2405	-61.06	34.77	-26.29	+8.0	34.29
18	2445	-61.65	34.77	-26.88	+8.0	34.88
26	2480	-62.55	34.77	-27.78	+8.0	35.78

EXHIBIT 10. SPURIOUS EMISSIONS: 15.247(d)

10.1 Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

In addition, emissions, which fall in the restricted band, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(e)

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in Section 15.35 for limiting peak emissions apply.

FCC 47 CFR 15.205(a) – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 – 0.110	162.0125 – 167.17	2310 – 2390	9.3 – 9.5
0.49 – 0.51	167.72 – 173.2	2483.5 – 2500	10.6 – 12.7
2.1735 – 2.1905	240 – 285	2655 – 2900	13.25 – 13.4
8.362 – 8.366	322 – 335.4	3260 – 3267	14.47 – 14.5
13.36 – 13.41	399.9 – 410	3332 – 3339	14.35 – 16.2
25.5 – 25.67	608 – 614	3345.8 – 3358	17.7 – 21.4
37.5 – 38.25	960 – 1240	3600 – 4400	22.01 – 23.12
73 – 75.4	1300 – 1427	4500 – 5250	23.6 – 24.0
108 – 121.94	1435 – 1626.5	5350 – 5460	31.2 – 31.8
123 – 138	1660 – 1710	7250 – 7750	36.43 – 36.5
149.9 – 150.05	1718.8 – 1722.2	8025 – 8500	Above 38.6
156.7 – 156.9	2200 – 2300	9000 – 9200	

FCC 47 CFR 15.209(a) Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 – 0.490	2,400 / F (kHz)	300
0.490 – 1.705	24,000 / F (kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

Calculation of Radiated Emission Measurements

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	1 m Limit (dBµV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-25,000	500	54.0	63.5

FCC Part 15.247(d) and IC RSS 210 A8.5 requires a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable. The loss from the cable was loaded into the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. An Agilent E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

No significant emissions could be noted within -35 dBc of the fundamental level for this product.

	Channel 11	Channel 18	Channel 26
Fundamental	-1.46 (dBm)	-1.79 (dBm)	-1.81 (dBm)
2nd Harmonic	- 43.18 (dBm)	- 39.11 (dBm)	- 37.80 (dBm)
3rd Harmonic	- 43.47 (dBm)	- 43.76 (dBm)	- 43.60 (dBm)
4th Harmonic	- 60.20 (dBm)	- 62.24 (dBm)	- 60.90 (dBm)
5th Harmonic	- 60.27 (dBm)	- 62.67 (dBm)	- 63.61 (dBm)
6th Harmonic	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

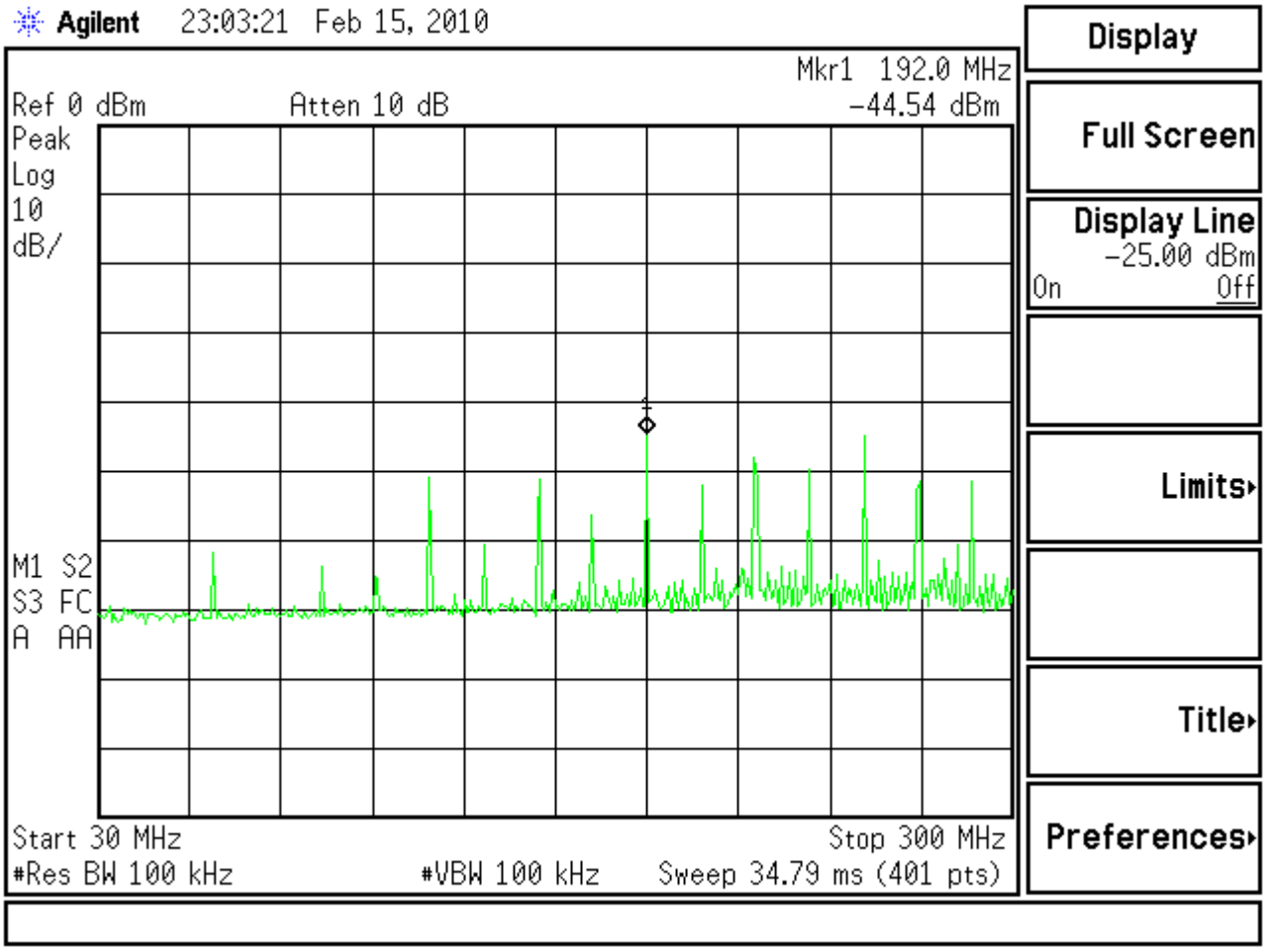
Notes:
(1) Measurement at system noise floor.

10.2 Test Equipment List

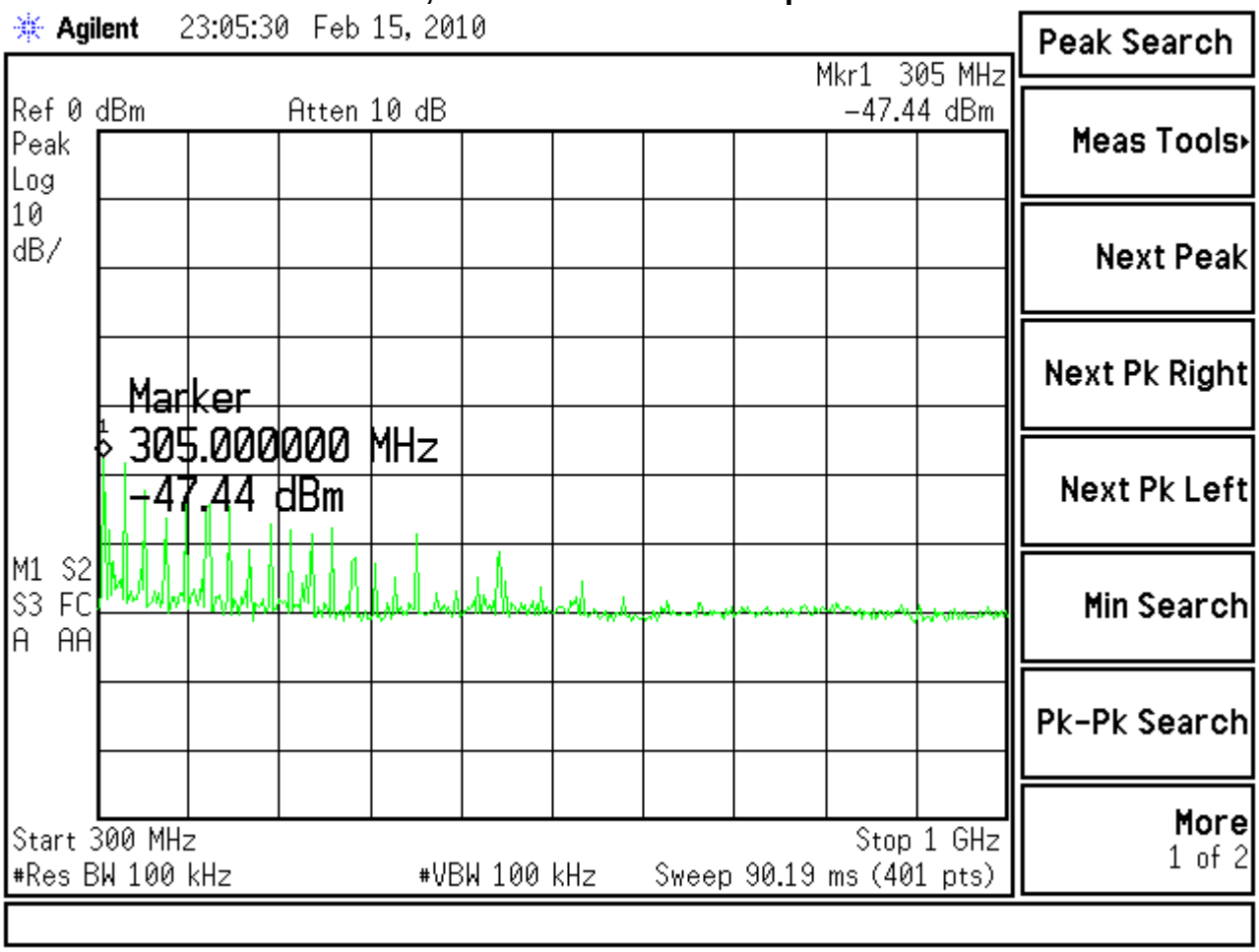
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	3 Hz to 44 GHz

10.3 Screen Captures – Spurious Radiated Emissions

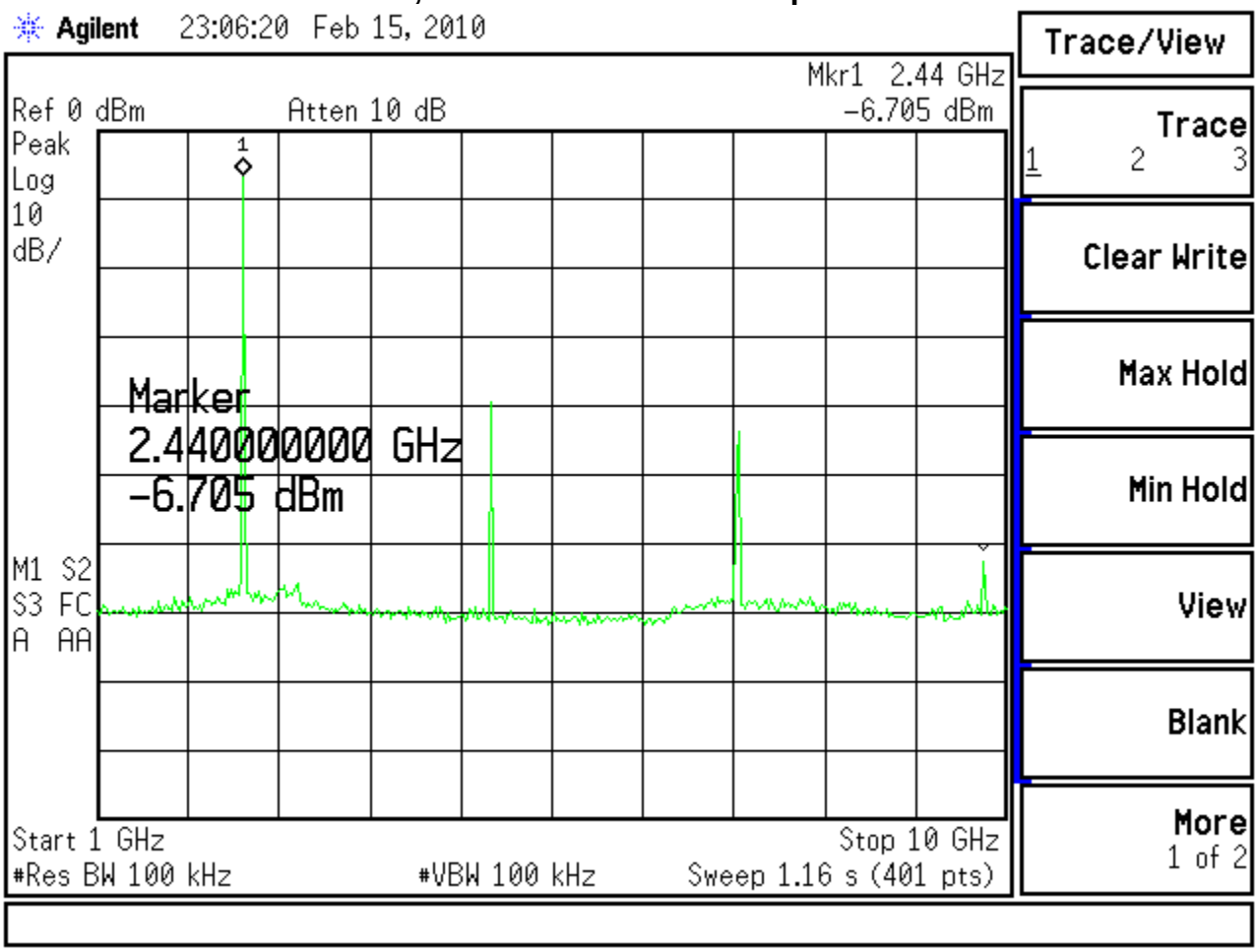
Channel 18, shown from 30 MHz up to 300 MHz



Channel 18, shown from 300 MHz up to 1000 MHz



Channel 18, shown from 1000 MHz up to 10000 MHz



Channel 18, shown from 10000 MHz up to 25000 MHz

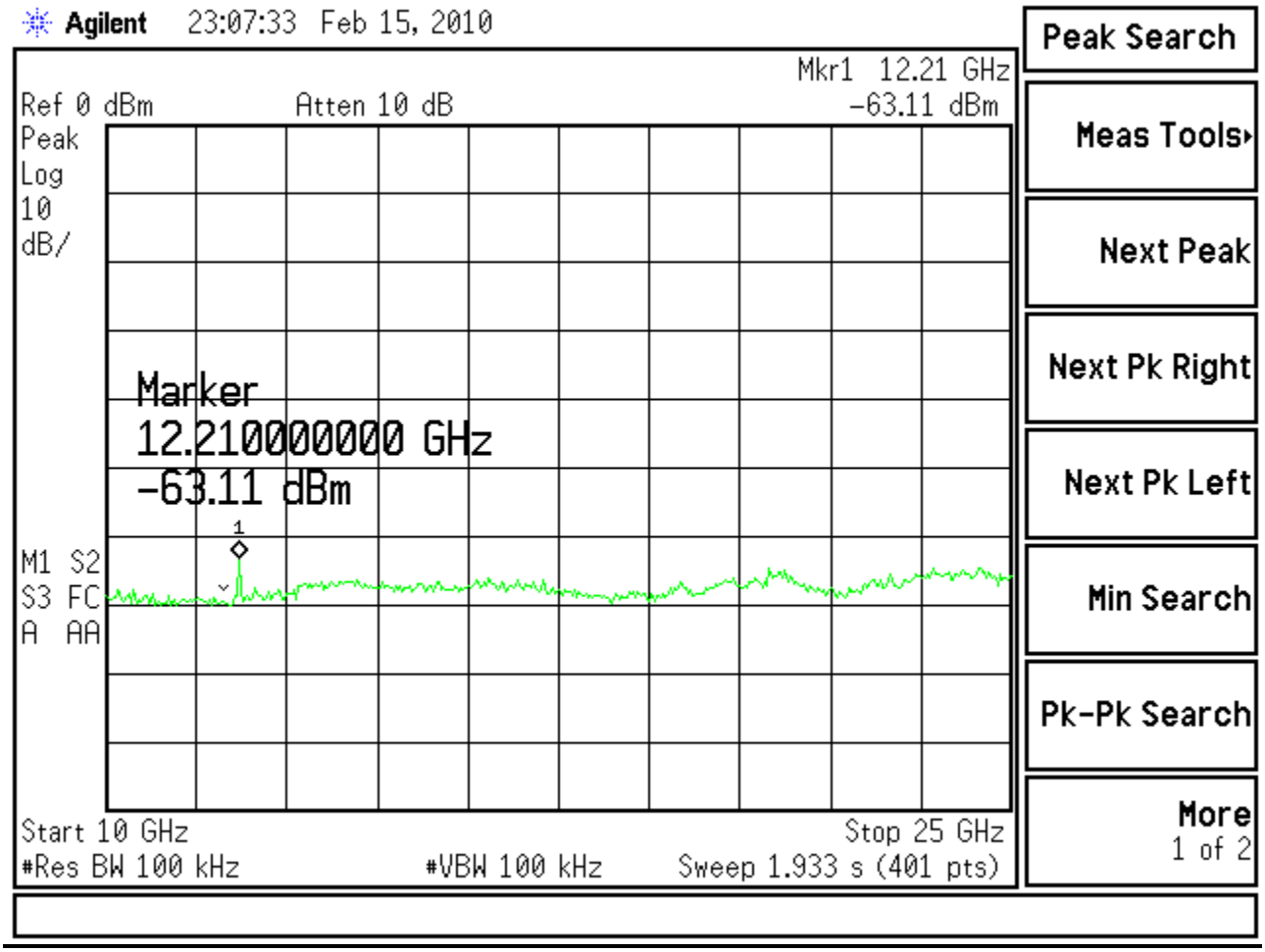


EXHIBIT 11. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

The stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers. Power was supplied by an external bench-type variable power supply, and the frequency of operation was monitored using the spectrum analyzer,

A spectrum analyzer was used to measure the frequency at the appropriate frequency markers. For this test, the EUT was placed in continuous transmit CW mode. Power to the EUT was supplied by an external bench-type variable power supply. The frequency of operation was monitored using the spectrum analyzer with RBW=VBW=1 kHz settings while the voltage was varied.

	DC/AC Voltage Source		
	5.1 VDC	6.0 VDC	6.9 VDC
Channel 11	2404.710000(MHz)	2404.790000(MHz)	2405.430000 (MHz)
Channel 18	2445.660000(MHz)	2445.390000(MHz)	2445.550000 (MHz)
Channel 26	2479.700000(MHz)	2479.980000(MHz)	2480.180000 (MHz)

The RF Power Output of the EUT was also monitored in a separate test, also using a Spectrum Analyzer with RBW=VBW=3 MHz setting while the voltage was varied.

	DC/AC Voltage Source		
	5.1 VDC	6.0 VDC	6.9 VDC
Channel 11	-1.023(dBm)	-1.186(dBm)	-1.239 (dBm)
Channel 18	-1.423(dBm)	-2.033(dBm)	-1.478 (dBm)
Channel 26	-1.722(dBm)	-1.023(dBm)	-1.592 (dBm)

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characterizes were well behaved, and the system returned to the same state of operation as before the power cycle.

No anomalies were noted, in the measured transmit power, varying less than 1 dB, during the voltage variation tests.

APPENDIX A-Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Mar-2010 Type Test : Radiated Emissions Job # : C-828

Prepared By: Customer : Saflok Quote #: 310025

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	EE 960130	Multi-Device Controller	ETS	2090	45968	XXX	XXX	Cal Not Required
4	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
5	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
6	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
7	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration
8	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Mar-2010 Type Test : Occupied Bandwidth (6dB & 20dB) Job # : C-828

Prepared By: Peter Customer : Saflok Quote #: 310025

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Mar-2010 Type Test : Band-Edge Job # : C-828

Prepared By: Peter Customer : Saflok Quote #: 310025

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	EE 960130	Multi-Device Controller	ETS	2090	45968	XXX	XXX	Cal Not Required
4	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
5	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Mar-2010 Type Test : Conducted Power Output Job # : C-828

Prepared By: Peter Customer : Saflok Quote #: 310025

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Mar-2010 Type Test : Spurious Emissions Job # : C-828

Prepared By: Peter Customer : Saflok Quote #: 310025

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	EE 960130	Multi-Device Controller	ETS	2090	45968	XXX	XXX	Cal Not Required
4	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
5	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
6	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
7	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration
8	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Mar-2010 Type Test : Radiated Emissions (109) Job # : C-828

Prepared By: Peter Customer : Saflok Quote #: 310025

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	EE 960130	Multi-Device Controller	ETS	2090	45968	XXX	XXX	Cal Not Required
4	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
5	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
6	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
7	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Mar-2010 Type Test : Power Spectral Density Job # : C-828

Prepared By: Peter Customer : Saflok Quote #: 310025

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

APPENDIX B-TEST STANDARDS – CURRENT PUBLICATION DATES

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2009		
ANSI C63.10	2009		
CISPR 11	2009-05	2009-12 P	
CISPR 12	2007-05		
CISPR 14-1	2005-11	2008-11	
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2010-01		
CISPR 16-1-2 Note 1	2003	2004-04	2006-07
CISPR 22	2008-09		
CISPR 24	1997-09	2001-07	2002-10
EN 55011	2007-05		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006	2007	
EN 60601-1-2	2007-03		
EN 61000-3-2	2006-05		
EN 61000-3-3	2008-12		
EN 61000-4-2	2009-05		
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2009-05		
EN 61000-4-8	1994	2001	
EN 61000-4-11	2004-10		
EN 61000-6-1	2007-02		
EN 61000-6-2	2005-12		
EN 61000-6-3	2007-02		
EN 61000-6-4	2007-02		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2008		
FCC Public Notice DA 00-1407	2000		
FCC ET Docket # 99-231	2002		
FCC Procedures	2007		
ICES 001	2006-06		
ICES 002	2009-08		
ICES 003	2004-02		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005-11	2008-03	2009-02
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2008-12		
IEC 61000-4-3	2008-04	incl in 2008-04	2009-12 FD

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-4	2004-07	2010-10	
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-10		
IEC 61000-4-8	2009-09		
IEC 61000-4-11	2004-03		
IEC 61000-6-1	2005-03		
IEC 61326-1	2006-06		
ISO 14982	1998-07		
MIL Std. 461E	1999-08		
RSS GEN	2007-06		
RSS 119	2007-06		
RSS 123	1999-11		
RSS 125	2000-03		
RSS 131	2003-07		
RSS 136	2002-10		
RSS 137	2009-02		
RSS 210	2007-06		
RSS 213	2005-12		
RSS 243	2005-11		
RSS 310	2007-06		

Note 1: Test not on LSR Scope of Accreditation.

Updated on 02-03-10

P=Project FD= Final Draft

APPENDIX C- Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V

Appendix D

Justifications of Average Duty Factor Calculations

Average (Relaxation) Factor

Average Factor = 20* Log_{10} (Worst Case EUT On-time over 100 ms time window)

The transmit packet occupies up to 2.8 ms of time, within any 5 ms window, with a period of 62ms. Therefore, the relaxation factor allowance is calculated as:

Average Factor = 20* Log_{10} (2(1.4) / 62 ms) = 26

A relaxation factor of 26 dB would be allowable for this product.

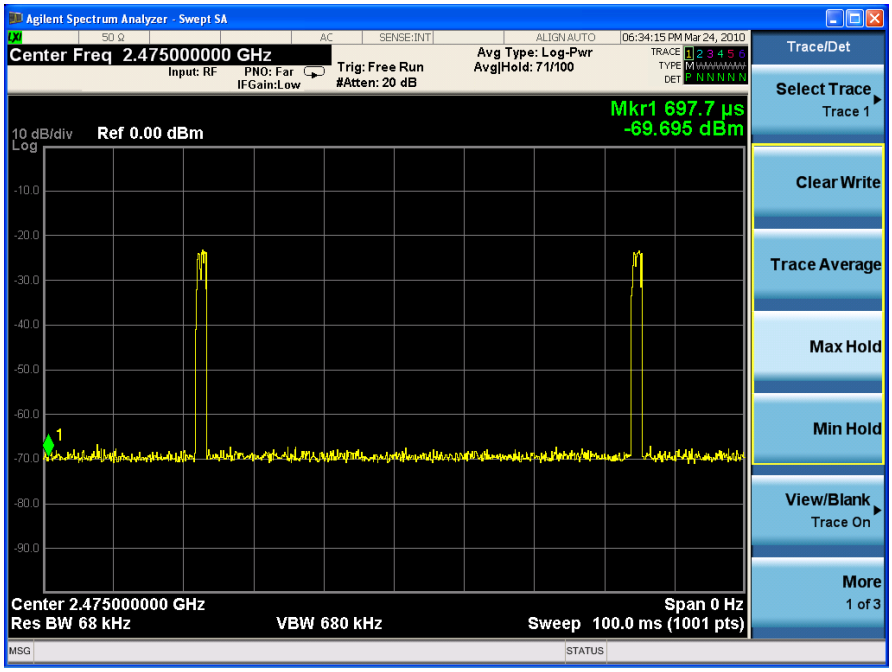


Figure 1: Demonstration of period between transmissions as 62 ms.

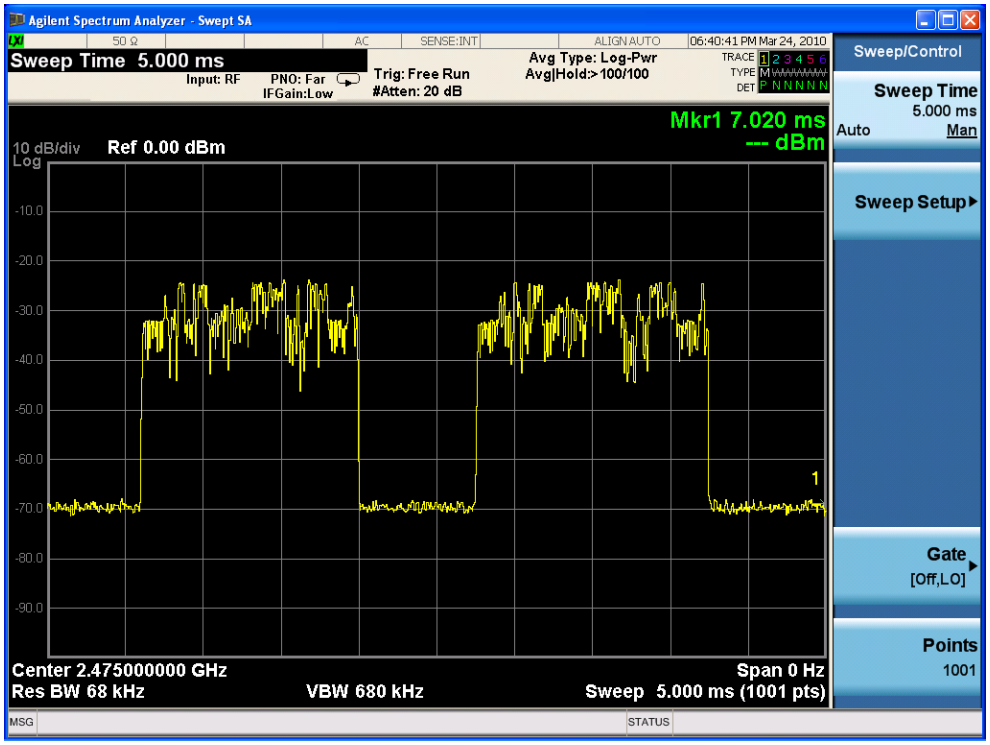


Figure 2: Plot demonstrating one transmission as seen in figure 1. Figure 2 gives better resolution to show exact on time for one transmission, as compared to figure 1.

Appendix E

Antenna Data Sheet

"High Frequency Ceramic Solutions"

2.4 GHz WLAN, Home RF, Bluetooth Antenna **P/N 2450AT43B100**

NEW with Ground Clearance Requirements Minimized

Detail Specification: 09/04/08 Page 1 of 4

General Specifications

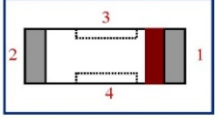
Part Number	2450AT43B100
Frequency Range	2400 - 2500 Mhz
Peak Gain	1.3 dBi typ. (XZ-V)
Average Gain	-0.5 dBi typ. (XZ-V)
Return Loss	9.5 dB min.

Input Power	2W max.
Impedance	50 Ω
Reel Quanity	1,000
Operating Temperature	-40 to +85°C
Storage Temperature	+5 to +35°C, Humidity: 45-75%RH, 12 mos. Max

P/N Suffix	**Packaging Style**	Bulk	Suffix = S	Eg. 2450AT43B100S
		T & R	Suffix = E	Eg. 2450AT43B100E
	Termination Style	100% Tin	Suffix = None	Eg. 2450AT43B100(E or S)
		Tin / Lead	Please consult Factory	

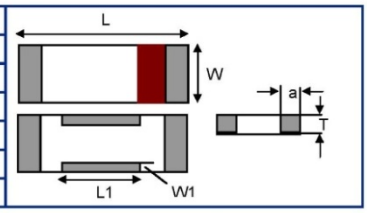
Terminal Configuration

No.	Function
1	Feed Point
2	NC
3	NC
4	NC



Mechanical Dimensions

	In	mm
L	0.276 ± 0.008	7.00 ± 0.20
W	0.079 ± 0.008	2.00 ± 0.20
L1	0.102 ± 0.008	2.60 ± 0.20
W1	0.020 ± 0.008	0.50 ± 0.20
T	0.079 +.004/-.008	2.00 +0.1/-0.2
a	0.020 ± 0.012	0.50 ± 0.30



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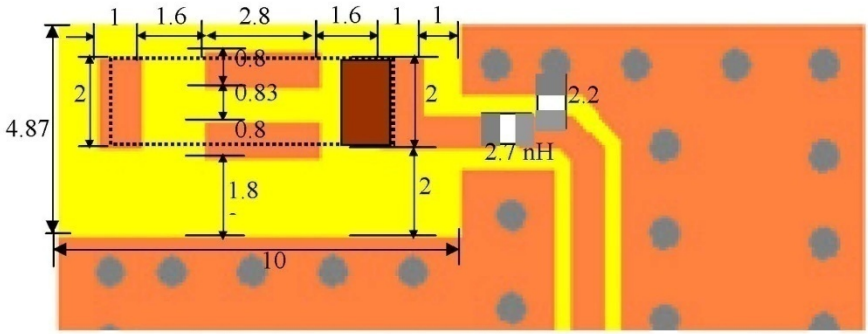
Mounting Considerations

Mount these devices with brown mark facing up. Units: mm

Line width should be designed to provide 50Ω impedance matching characteristics.

* Note: Pins 3 & 4, although "NC", must be soldered to its PCB pads for proper electrical operation

With Matching Circuits

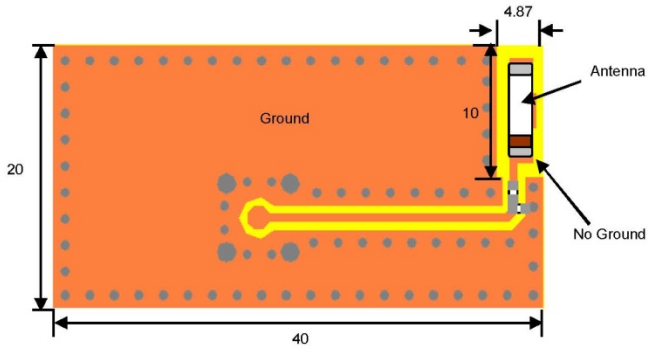


(Matching circuit and component values will be different, depending on PCB layout)

JTI P/N for Matching Circuit:
Inductor (2.2nH): L-07C2N2SV6T
Inductor (2.7nH): L-07C2N7SV6T

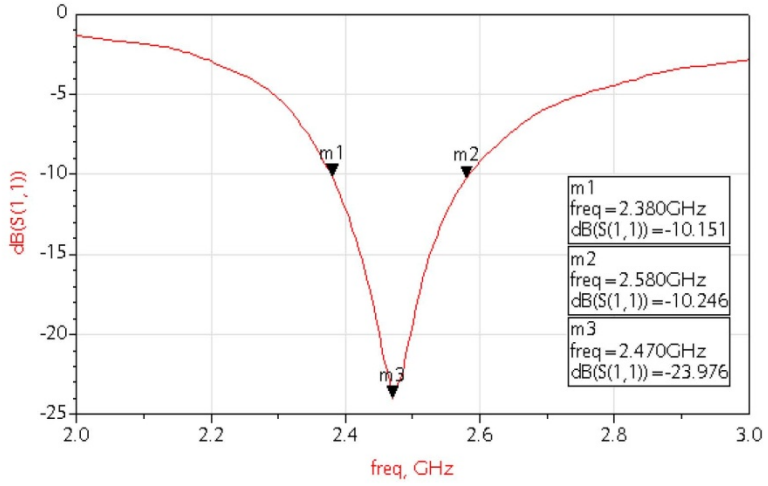
Typical Electrical Characteristics (T=25°C)

Test Board:



Return Loss

With Matching Circuit



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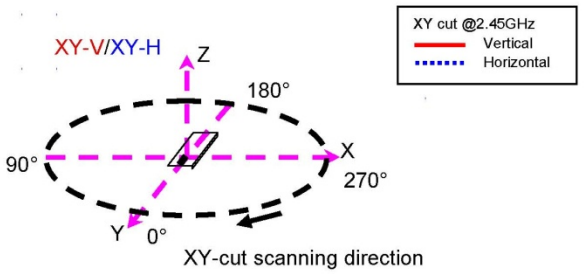
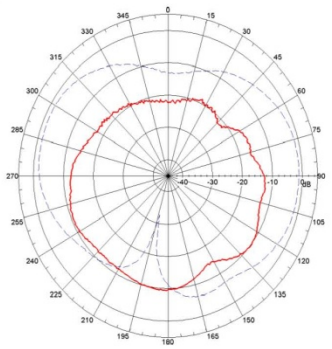
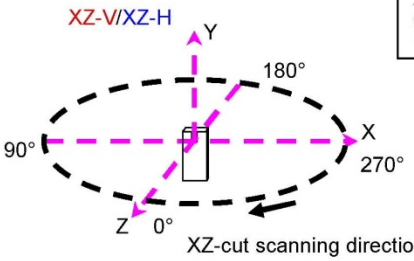
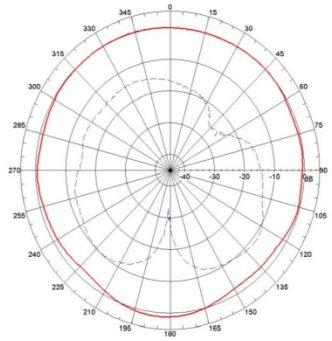
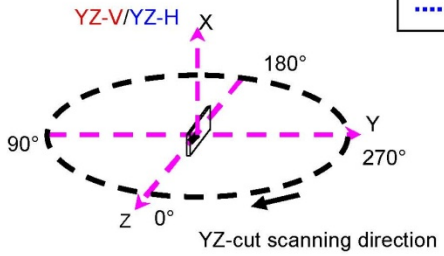
Typical Radiation Patterns

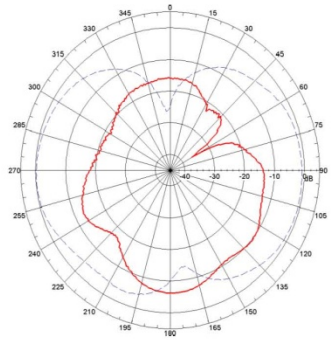












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