



## COMPLIANCE WORLDWIDE INC. TEST REPORT 128-14R2

In Accordance with the Requirements of  
Federal Communications Commission CFR Title 47 Part 15.249, Subpart C  
Industry Canada RSS 310

Low Power License-Exempt Radio Communication Devices  
Intentional Radiators

Issued to

**Autoliv Active Safety  
1001 Pawtucket Blvd  
Lowell, MA 01854  
978-674-6500**

For the  
**24 GHz GM Sensor LCA/BSD & RCTA/BSD Modes**  
**Autoliv Part Number: 625566400E**

FCC ID: WU8NB24G1V2  
IC: CANADA 310

**Report Issued on February 6, 2014  
Revisions R2 Issued on February 27, 2014**

Tested by

  
\_\_\_\_\_  
Brian F. Breault

Reviewed by

  
\_\_\_\_\_  
Larry K. Stillings

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## 1. Scope

This test report certifies that the Autoliv Electronics 24 GHz NB LCA/BSD/RCTA Mode Sensor, as tested, meets the FCC Part 15, Subpart C and Industry Canada RSS 310, Section 3.10 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required. Revision R2 adds measurement data for the third harmonic and plots to 100 GHz.

## 2. Product Details

<b>2.1. Manufacturer:</b>	Autoliv Electronics
<b>2.2. Model Number:</b>	625566400E
<b>2.3. Serial Number:</b>	141160000931 (LCA/BSD), 141160000932 (RCTA)
<b>2.4. Description:</b>	Vehicular Radar Sensor (Lane Collision Avoidance / Blind Spot Detection and Rear Cross Traffic Alert)
<b>2.5. Power Source:</b>	DC 13.5 volts nominal – Automotive power system.
<b>2.6. Hardware Revision:</b>	2D (LCA/BSD, RCTA)
<b>2.7. Software Revision:</b>	ETSI_WAVEFORM_20140129
<b>2.8. Modulation Type:</b>	Pulse Modulation
<b>2.9. Operating Frequency:</b>	24.05009 to 24.22991 GHz Nominal with 24.20005 GHz doppler (LCA/BSD), and 24.04729 to 24.2343 GHz Nominal (RCTA)
<b>2.10. EMC Modifications:</b>	None

## 3. Product Configuration

### 3.1. Support Equipment

Manufacturer	Model/Part #	Serial Number	Input Voltage	Input Frq.	Description/Function
NA	NA	NA	13.5	VDC	Automotive Battery

### 3.2. Cables

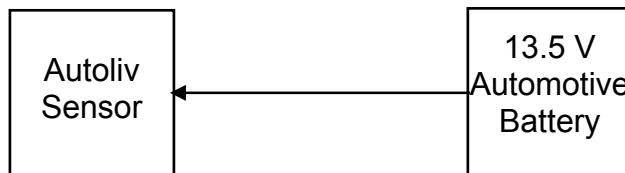
Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
Custom	NA	10	N	Power and signal cable used for power only

### 3.3. Operational Characteristics & Software

#### Hardware Setup:

The Autoliv 24 GHz LCA/BSD and/or RCTA/BSD Sensors are configured to operate in their normal state when power is applied.

### 3.4. Test Setup Diagram



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#### 4. Measurements Parameters

##### 4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer 100 Hz to 26.5 GHz	Agilent Tech	E4407B	MY45104493	2/26/2015
Spectrum Analyzer 100 Hz to 26.5 GHz	Agilent Tech	E7405A	MY45115430	5/11/2014
Spectrum Analyzer 20 Hz to 40 GHz	Rohde & Schwarz	FSV40	100899	6/6/2015
Spectrum Analyzer 9 kHz to 40 GHz	Rohde & Schwarz	FSVR40	100909	5/15/2015
EMI Receiver 9 kHz to 6.5 GHz	Hewlett Packard	8546A	3330A00115	6/8/2014
Microwave Preamp 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	6/5/2014
Microwave Preamp 2 to 50 GHz	Hewlett Packard	83050A	3331A00404	6/28/2015
Notch Filter 24.0 – 24.25 GHz	K&L Microwave	5NSP-00002	001	CBU
Bilog Antenna 30 MHz – 2 GHz	Sunol Sciences	JB1	A050913	5/15/2014
Horn Antenna 1 to 18 GHz	Electro-Metrics	EM-6961	6337	10/10/2015
Horn Antenna 1 to 18 GHz	ETS Lindgren	3117	00143292	1/14/2015
Horn Antenna 18 to 26.5 GHz	Com-Power	AH-826	081051	8/27/2014
Horn Antenna 18 to 40 GHz	Com-Power	AH-840	03075	8/27/2014
Horn Antenna 18 to 40 GHz	Com-Power	AH-840	101032	10/9/2014
Loop Antenna 9 kHz to 30 MHz	EMCO	6512	9309-1139	8/28/2014
Horn Antenna 18 to 26.5 GHz WR42 to 3.5mm Adapter	Hughes Hewlett Packard	45820H-2020 K281C	037 3032A10738	Not Req'd
External Mixer WR28 Horn Antenna 26.5 to 40 GHz WR28 to 3.5mm Adapter	Hewlett Packard Alpha Industries Hewlett Packard	11970A 861A/599 R281A	3003A08210 324 03197	Not Req'd
External Mixer WR22 Horn Antenna 33 to 50 GHz WR22 to 3.5mm Adapter	Hewlett Packard Alpha Industries Hewlett Packard	11970Q 861B/383 Q281B	3003A01273 133 00116	Not Req'd
External Mixer WR19 External Mixer WR19 Horn Antenna 40 to 60 GHz WR19 to 1.85mm Adapter	Hewlett Packard Rohde & Schwarz M/A Com Baytron Hewlett Packard	11970U FS-Z60 3-19-720 U281A	2332A00425 100128 N/A 00209	Not Req'd
External Mixer WR12 External Mixer WR12 Horn Antenna 50 to 75 GHz WR12 to 1.85mm Adapter	Hewlett Packard Rohde & Schwarz Aerowave Hewlett Packard	11970V FS-Z75 15-7025 V281B	2521A00357 100051 N/A 00369	Not Req'd
External Mixer WR10 Horn Antenna 75 to 110 GHz	Hewlett Packard Alpha Industries	11970W 861A/387	2521A00230 359	Not Req'd
Anechoic Chamber 3 Meter – Free Space	Keene Ray Proof	S-81	R-2338	Not Req'd
RF Signal Generator 100 kHz to 40 GHz	Rohde & Schwarz	SMB 100A	175352	5/14/2014
DC Variable Source 60 Volt, 3 Amp	Hewlett Packard	6296A	7M0599	2/22/2014
3 dB & 10 dB Attenuators DC to 40 GHz	Narda	4768-3 4768-10	9610 9806	Not Req'd
Barometric Pressure / Humidity / Temperature Data Logger	Extech Instruments	SD700	Q590483	9/18/2014

**Test Number: 128-14R2****Issue Date: 2/27/2014****4. Measurements Parameters (cont)****4.2. Measurement & Equipment Setup**

Test Dates:

1/27/2014, 1/28/2014,  
1/29/2014, 1/31/2014,  
2/3/2014, 2/4/2014, 2/6/2014,  
2/26/2014, 2/27/2014

Test Engineer:

Brian Breault, Larry Stillings

Normal Site Temperature (15 - 35°C): 26.0

Relative Humidity (20 -75%RH): 35

Frequency Range:

30 MHz to 100 GHz

Measurement Distance:

3.0, 1.5 and/or 0.3 Meters

EMI Receiver IF Bandwidth:

120 kHz - 30 MHz to 1 GHz  
1 MHz - Above 1 GHz

EMI Receiver Avg Bandwidth:

300 kHz - 30 MHz to 1 GHz  
3 MHz - Above 1 GHz

Detector Function:

Peak, CISPR Average

**4.3. Measurement Procedure**

Test measurements were made in accordance FCC Part 15.249 and IC RSS-310, Section 3.10 "24.00-24.25 GHz."

The test methods used to generate the data in this test report is in accordance with 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

**4.4. Choice of Operating Frequencies**

The Autoliv 24 GHz LCA/BSD mode sensor employs a modulated ISM Signal that operates over the range of 24.05009 to 24.22991 GHz with a 24.20050 GHz doppler.

The Autoliv 24 GHz RCTA/BSD mode Sensor employs a modulated ISM Signal at operates over the range of 24.04729 to 24.23343 GHz.

LCA/BSD is the normal mode of operation, RCTA is when the automobile is placed in reverse and the sensor is used as a backup sensor.

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## 5. Measurement Summary

Test Requirement	FCC Rule Requirement	IC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	RSS-GEN 7.1.4	6.1	Compliant	Unit has an internal PCB antenna.
Radiated Field Strength of Fundamental	15.249 (a),(c)	RSS-310 3.10	6.2	Compliant	
Radiated Field Strength of Harmonics	15.249 (a),(c)	N/A	6.3	Compliant	
Band Edge Measurements	15.249 (d) 15.209	RSS-310 3.10	6.4	Compliant	
Spurious Radiated Emissions	15.249 (d), 15.209	RSS-GEN 4.9	6.5	Compliant	
Occupied Bandwidth	ANSI C63.4 § 13.1.7	N/A	6.6	Compliant	
99% Bandwidth	N/A	RSS-GEN 4.6.1	6.7	Compliant	
Conducted Emissions	15.207	RSS-GEN 7.2.4	N/A	Not Required	DUT uses an automotive battery only.
Public Exposure to Radio Frequency Energy Levels	15.319 (i) 2.1091 FCC OET Bulletin 65	RSS-GEN 5.5, RSS 102	6.8	Compliant	

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## 6. Measurement Data

### 6.1. Antenna Requirement (Section 15.203, RSS-GEN 7.1.4)

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

Result: The unit under test employs a permanent, non-user accessible internal PCB antenna.

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## 6. Measurement Data

### 6.2. Radiated Field Strength of Fundamental (15.249, Section (a), (c)), IC RSS-310 3.10

Requirement: The 3 meter field strength of the fundamental emissions from intentional radiators operated within the 24.00 – 24.25 GHz frequency bands shall comply with the following requirement: 250 millivolts/meter (108 dB $\mu$ V/m), average mode, (128 dB $\mu$ V/m) peak mode measurements.

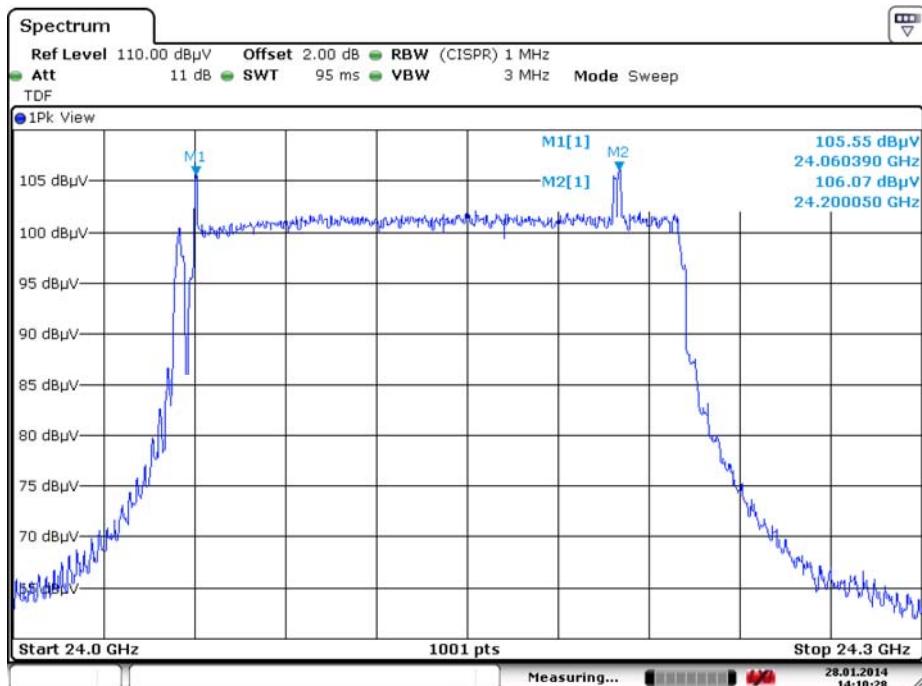
Results: The unit under test meets the 3-meter 108 dB $\mu$ V/m average and 128 dB $\mu$ V/m peak requirements.

#### 6.2.1. Worst Case Field Strength – Peak & Average – LCA/BSD

Frequency (GHz)	Amplitude <sup>1</sup> (dB $\mu$ V/m) at 3 Meters		Limit (dB $\mu$ V/m) at 3 Meters		Margin (dB $\mu$ V/m) at 3 Meters		Ant Polarity	Ant Height	Turntable Azimuth	Result
	Peak	Average	Peak	Average	Peak	Average				
24.006039	105.55	n/a	128.00	n/a	-22.45	n/a	H	113	12	Compliant
24.200050	106.07	n/a	128.00	n/a	-21.93	n/a	H	113	12	Compliant
24.055000	n/a	86.66	n/a	108.00	n/a	-21.34	H	113	12	Compliant
24.204250	n/a	75.64	n/a	108.00	n/a	-32.36	H	113	12	Compliant

<sup>1</sup> All correction factors are included in the measurement values

#### 6.2.2. Worst Case Field Strength – Peak – LCA/BSD



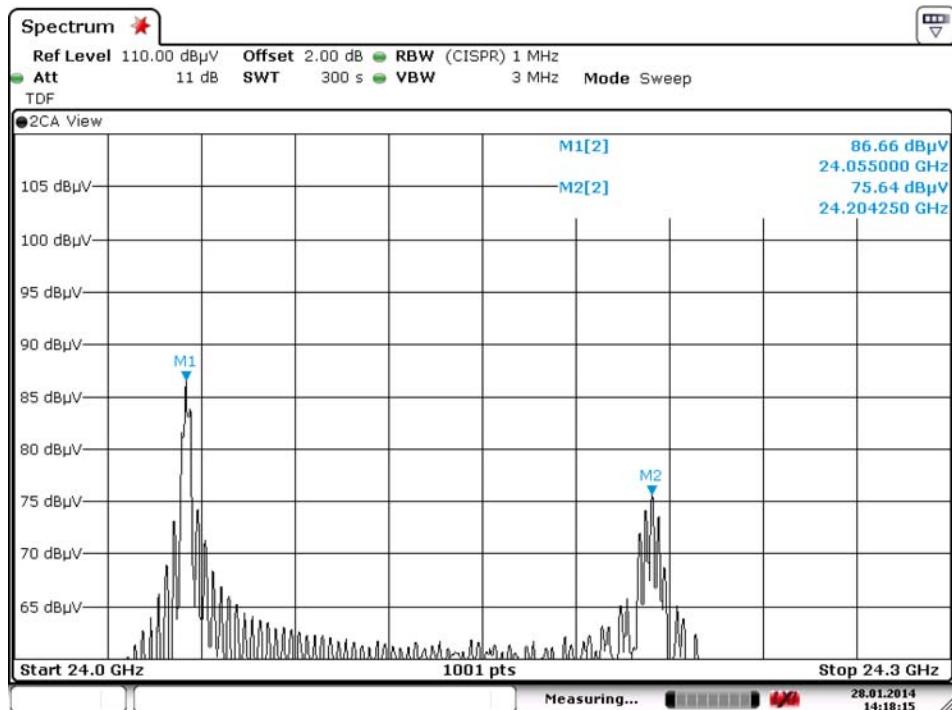
Date: 28.JAN.2014 14:10:29

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**Issue Date: 2/27/2014**

## 6. Measurement Data

### 6.2. Radiated Field Strength of Fundamental (15.249, Section (a), (c)), IC RSS-310 3.10

#### 6.2.3. Worst Case Field Strength – Average – LCA/BSD



Date: 28.JAN.2014 14:18:15

#### 6.2.4. Worst Case Field Strength – Peak & Average – RCTA/BSD

Frequency (GHz)	Amplitude <sup>1</sup> (dBμV/m) at 3 Meters		Limit (dBμV/m) at 3 Meters		Margin (dBμV/m) at 3 Meters		Ant Polarity	Ant Height cm	Turntable Azimuth Deg	Result
	Peak	Average	Peak	Average	Peak	Average				
24.06039	108.48	N/A	128.00	N/A	-19.52	N/A	H	103	15	Compliant
24.20040	109.26	N/A	128.00	N/A	-18.74	N/A	H	103	15	Compliant
24.05498	N/A	90.02	N/A	108.00	N/A	-17.98	H	103	15	Compliant
24.20034	N/A	80.66	N/A	108.00	N/A	-27.34	H	103	15	Compliant

<sup>1</sup> All correction factors are included in the measurement values

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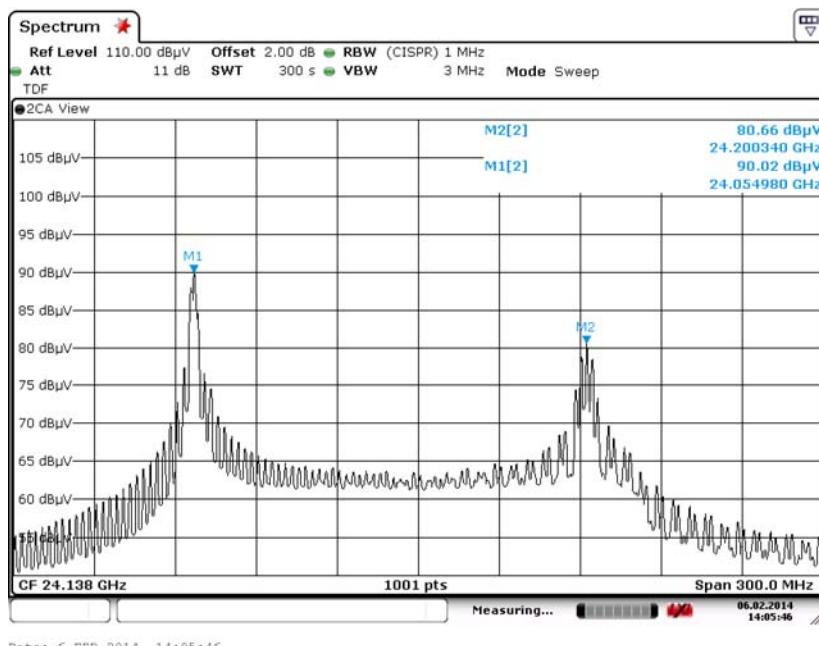
## 6. Measurement Data

### 6.2. Radiated Field Strength of Fundamental (15.249, Section (a), (c)), IC RSS-310 3.10

#### 6.2.5. Worst Case Field Strength – Peak – RCTA/BSD



#### 6.2.6. Worst Case Field Strength – Average – RCTA/BSD



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## 6. Measurement Data (continued)

### 6.3. Radiated Field Strength of Harmonics (15.249, Section (a))

Requirement: Emissions radiated outside of the specified frequency band of 24 GHz to 24.25 GHz, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation

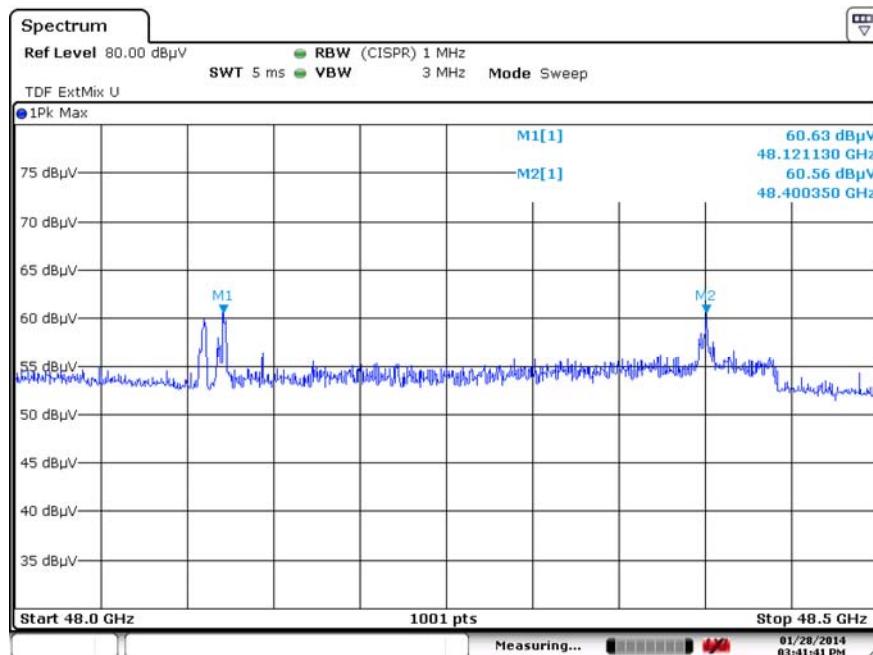
Result: Compliant

#### 6.3.1. 2<sup>nd</sup> Harmonic Peak and Average Field Strength (LCA/BSD Version)

Detector	Frequency (GHz)	Amplitude <sup>1</sup> (dB $\mu$ V/m) at 3 Meters		Limit (dB $\mu$ V/m) at 3 Meters		Margin (dB $\mu$ V/m) at 3 Meters		Ant Polarity	Result
		Peak	Average	Peak	Average	Peak	Average		
Peak	48.121130	54.63	N/A	78.00	N/A	-23.37	N/A	H	Compliant
Peak	48.400350	54.56	N/A	78.00	N/A	-23.44	N/A	H	Compliant
Average	48.121130	N/A	39.97	N/A	58.00	N/A	-18.03	H	Compliant
Average	48.396350	N/A	35.96	N/A	58.00	N/A	-22.04	H	Compliant

<sup>1</sup> Measurements were taken at a distance of 1.5 meters and field strength was adjusted by -6 dB vs the 3-meter limit. Peak values are below the average limit.

#### 6.3.2. 2<sup>nd</sup> Harmonic Peak Field Strength (LCA/BSD)



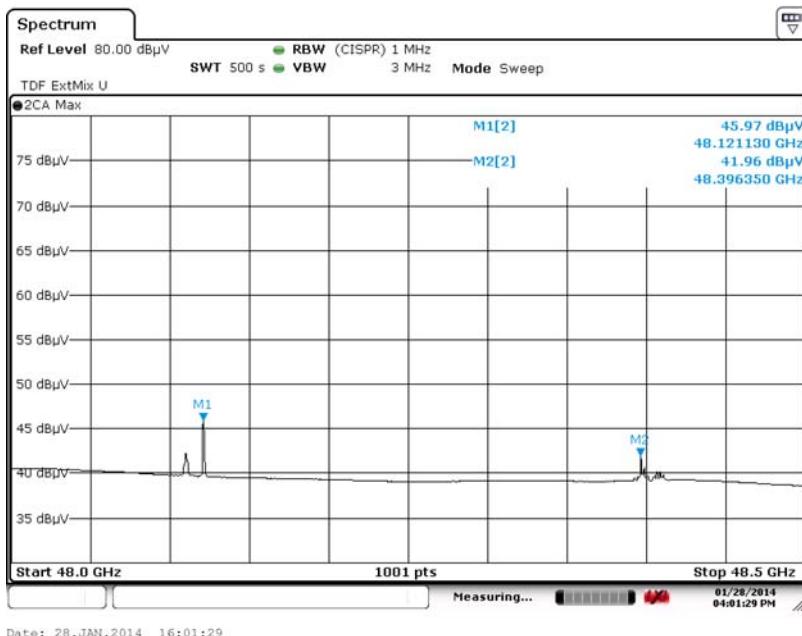
Date: 28.JAN.2014 15:41:42

**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

## 6. Measurement Data (continued)

### 6.3. Radiated Field Strength of Harmonics (15.249, Section (a))

#### 6.3.3. 2<sup>nd</sup> Harmonic Average Field Strength (LCA/BSD)



Date: 28.JAN.2014 16:01:29

#### 6.3.4. 3<sup>rd</sup> Harmonic Peak and Average Field Strength (LCA/BSD Version)

Detector	Frequency (GHz)	Amplitude <sup>1</sup> (dBμV/m) at 3 Meters		Limit (dBμV/m) at 3 Meters		Margin (dBμV/m) at 3 Meters		Ant Polarity	Result
		Peak	Average	Peak	Average	Peak	Average		
Peak	71.7992	63.02	N/A	78.00	N/A	-14.98	N/A	H	Compliant
Peak	71.8172	63.83	N/A	78.00	N/A	-14.17	N/A	H	Compliant
Peak	72.2348	63.90	N/A	78.00	N/A	-14.10	N/A	H	Compliant
Average	71.8162	N/A	-48.63	N/A	58.00	N/A	-9.37	H	Compliant
Average	72.2298	N/A	-45.77	N/A	58.00	N/A	-12.23	H	Compliant

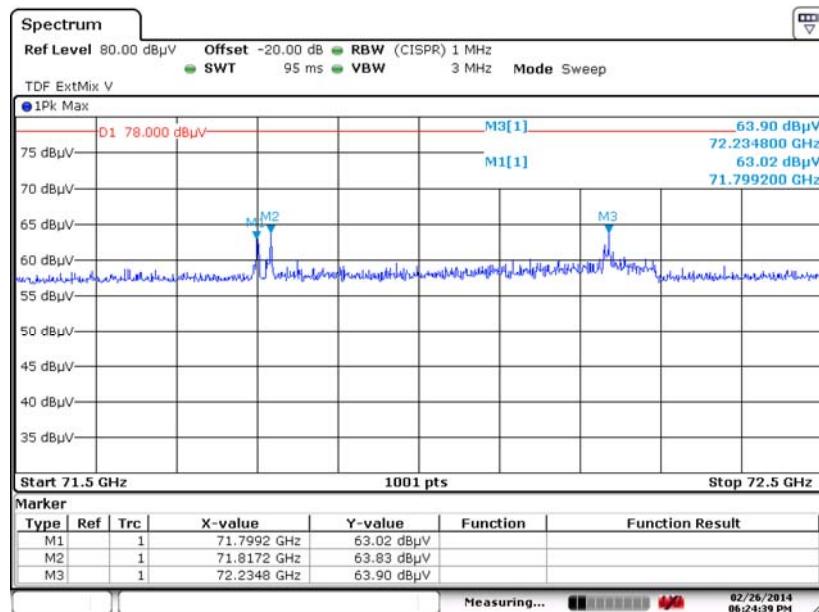
<sup>1</sup> Measurements were taken at a distance of 0.3 meters and field strength was adjusted by -20 dB within the analyzer vs. the 3-meter limit.

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## 6. Measurement Data (continued)

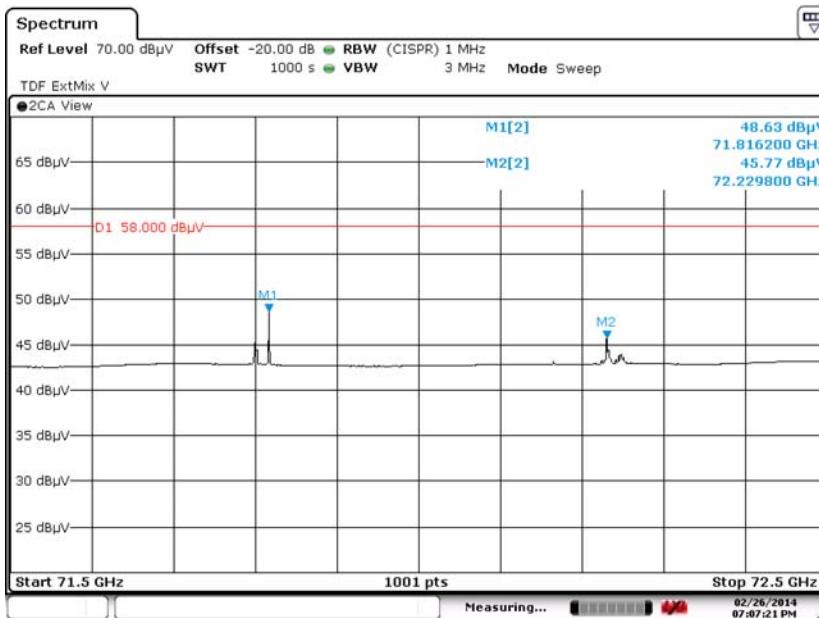
### 6.3. Radiated Field Strength of Harmonics (15.249, Section (a))

#### 6.3.5. 3<sup>rd</sup> Harmonic Peak Field Strength (LCA/BSD)



Date: 26.FEB.2014 18:24:39

#### 6.3.6. 3<sup>rd</sup> Harmonic Average Field Strength (LCA/BSD)



Date: 26.FEB.2014 19:07:21

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## 6. Measurement Data (continued)

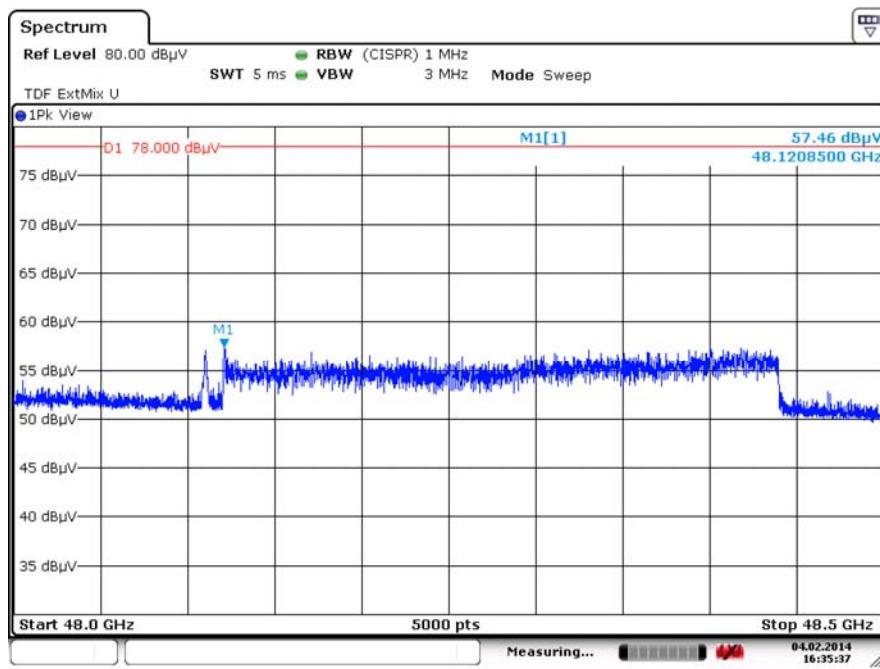
### 6.3. Radiated Field Strength of Harmonics (15.249, Section (a))

#### 6.3.7. 2<sup>nd</sup> Harmonic Peak and Average Field Strength (RCTA/BSD Version)

Frequency (GHz)	Amplitude <sup>1</sup> (dB $\mu$ V/m) at 3 Meters		Limit (dB $\mu$ V/m) at 3 Meters		Margin (dB $\mu$ V/m) at 3 Meters		Ant Polarity	Result
	Peak	Average	Peak	Average	Peak	Average		
48.12085	51.46	N/A	78.00	N/A	-26.54	N/A	H	Compliant
48.12115	N/A	35.52	N/A	58.00	N/A	-22.48	H	Compliant

<sup>1</sup> Measurements were taken at a distance of 1.5 meters and field strength was adjusted by -6 dB for comparison to the 3 meter limit. Peak Value is below the average limit

#### 6.3.8. 2<sup>nd</sup> Harmonic Peak Field Strength (RCTA/BSD)

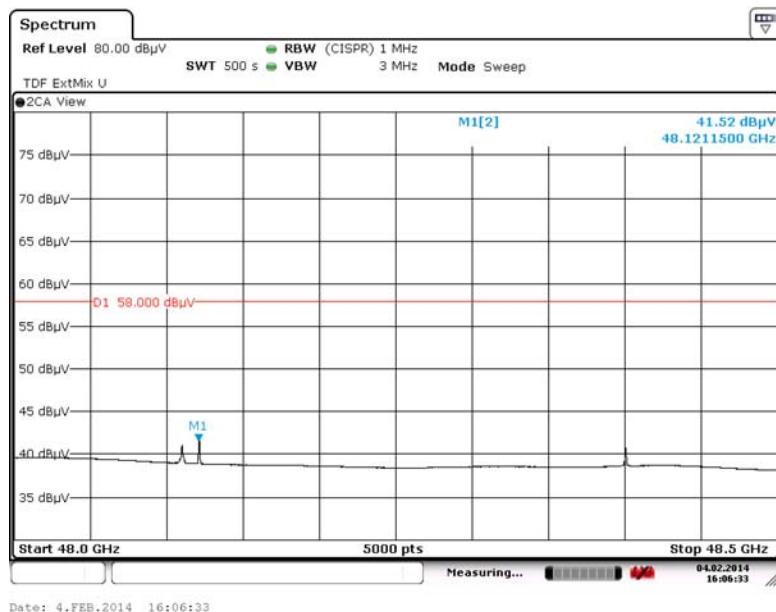


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## 6. Measurement Data (continued)

### 6.3. Radiated Field Strength of Harmonics (15.249, Section (a))

#### 6.3.9. 2<sup>nd</sup> Harmonic Average Field Strength (RCTA/BSD)



#### 6.3.10 3<sup>rd</sup> Harmonic Peak and Average Field Strength (RCTA/BSD Version)

Frequency (GHz)	Amplitude <sup>1</sup> (dBμV/m) at 3 Meters		Limit (dBμV/m) at 3 Meters		Margin (dBμV/m) at 3 Meters		Ant Polarity	Result
	Peak	Average	Peak	Average	Peak	Average		
72.2787	63.75	N/A	78.00	N/A	-14.25	N/A	H	Compliant
71.8002	N/A	48.55	N/A	58.00	N/A	-9.45	H	Compliant
71.8172	N/A	46.97	N/A	58.00	N/A	-11.03	H	Compliant
72.2358	N/A	46.48	N/A	58.00	N/A	-11.52	H	Compliant

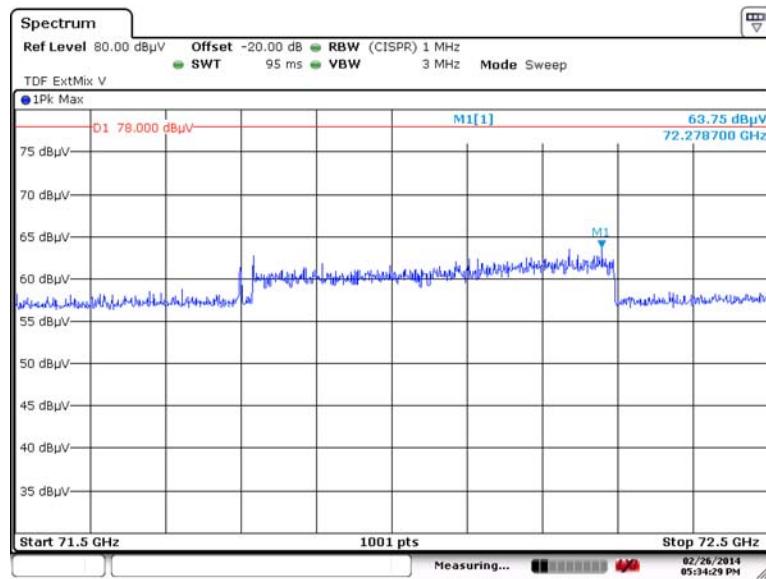
<sup>1</sup> Measurements were taken at a distance of 0.3 meters and field strength was adjusted by -20 dB for comparison to the 3 meter limit.

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## 6. Measurement Data (continued)

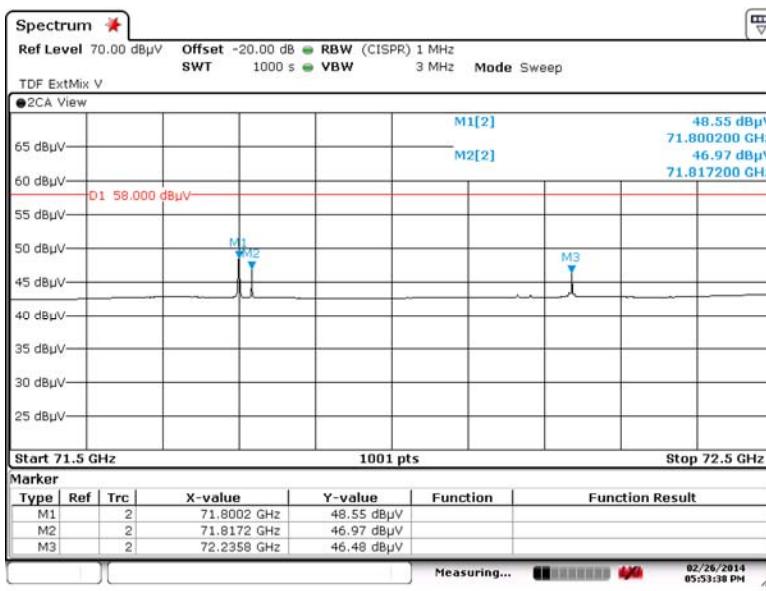
### 6.3. Radiated Field Strength of Harmonics (15.249, Section (a))

#### 6.3.11. 3<sup>rd</sup> Harmonic Peak Field Strength (RCTA/BSD)



Date: 26.FEB.2014 17:34:29

#### 6.3.11. 3<sup>rd</sup> Harmonic Average Field Strength (RCTA/BSD)



Date: 26.FEB.2014 17:53:37

#### 6.3.12. The 4<sup>th</sup> Harmonic was not measurable at 0.3 meters.

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## 6. Measurement Data (continued)

### 6.4. Band Edge Measurements (15.249, Section (a))

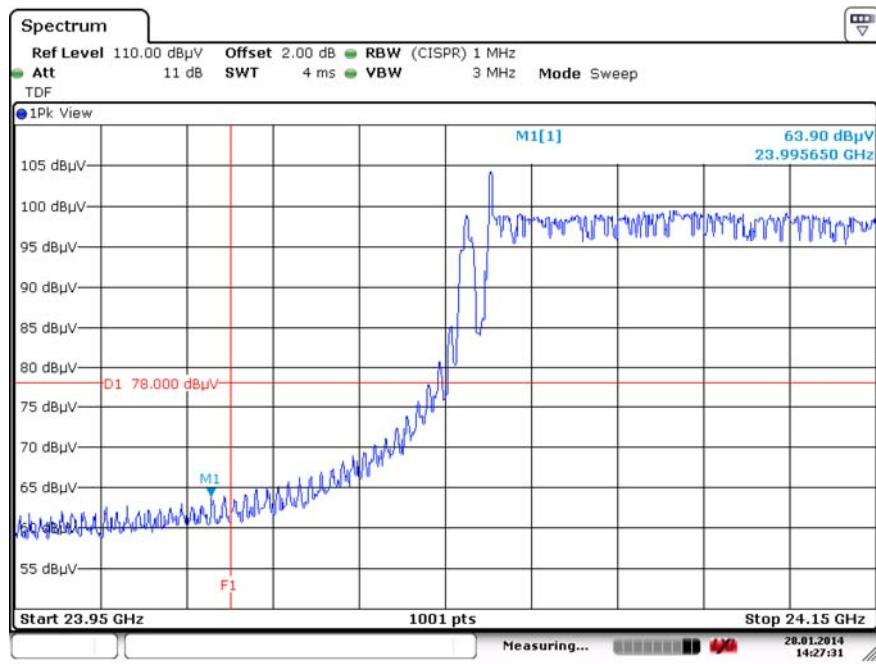
Requirement: Emissions radiated outside of the specified frequency band of 24 GHz to 24.25 GHz, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

Results: The unit under test meets the Part 15.209 radiated emissions limit.

#### 6.4.1. Band Edge Measurements – Upper & Lower Band Edges (LCA/BSD)

Frequency (GHz)	Band Edge (dB $\mu$ V/m)				Limit (dB $\mu$ V/m)		Margin (dB $\mu$ V/m)		Result
		Freq GHz	Peak	Average	Peak	Average	Peak	Average	
24.054850	Lower	24.00	63.90	52.65	78.00	58.00	-14.10	-5.35	Compliant
	Upper	24.25	68.14	53.05	78.00	58.00	-9.86	-4.95	Compliant

#### 6.4.2. Band Edge Measurements - Lower Band Edge – Peak (LCA/BSD)



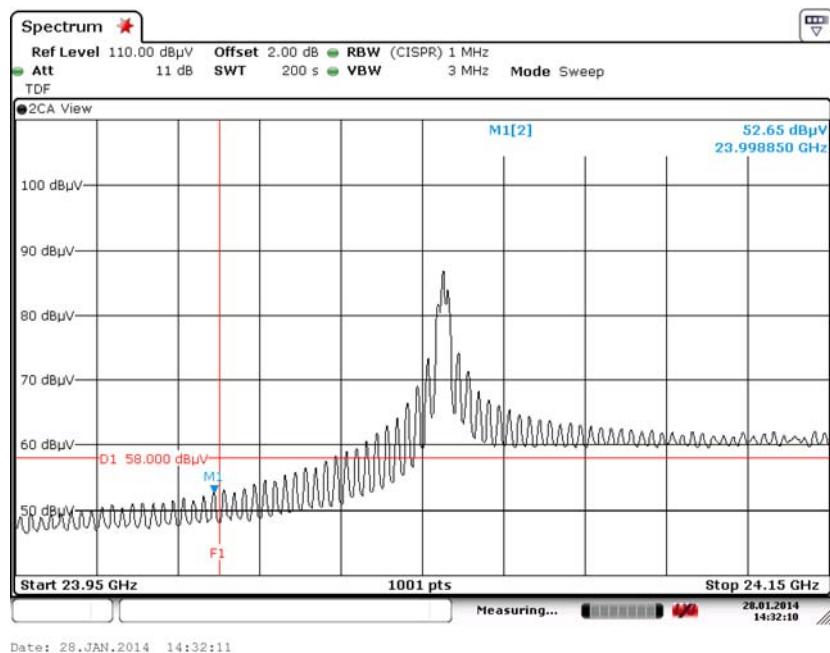
Test Number: 128-14R2

Issue Date: 2/27/2014

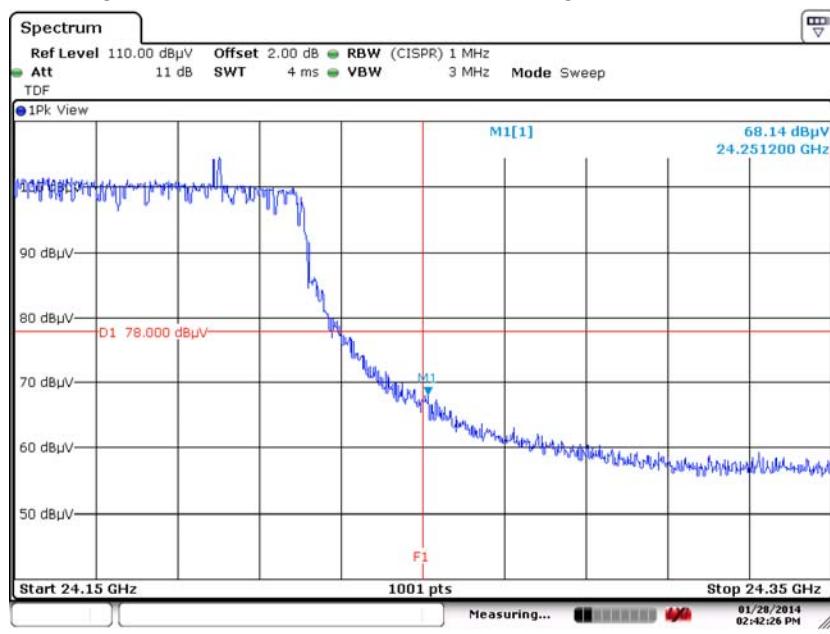
## 6. Measurement Data (continued)

### 6.4. Band Edge Measurements (continued)

#### 6.4.3. Band Edge Measurements - Lower Band Edge – Average (LCA/BSD)



#### 6.4.4. Band Edge Measurements - Upper Band Edge - Peak (LCA/BSD)



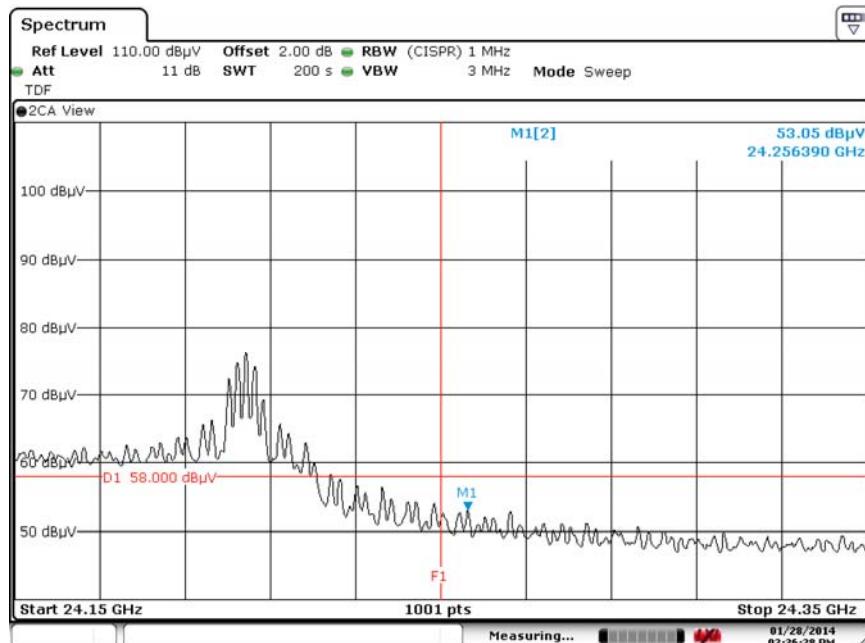
Test Number: 128-14R2

Issue Date: 2/27/2014

## 6. Measurement Data (continued)

### 6.4. Band Edge Measurements (continued)

#### 6.4.5. Band Edge Measurements - Upper Band Edge – Average (LCA/BSD)



Date: 28.JAN.2014 14:36:29

**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

## 6. Measurement Data (continued)

### 6.4. Band Edge Measurements

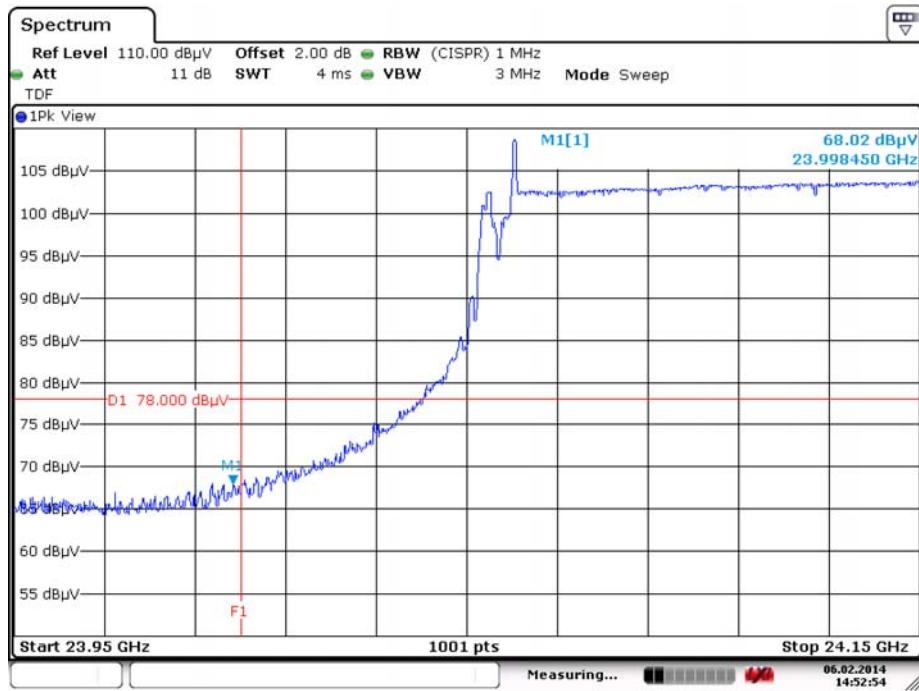
Requirement: Emissions radiated outside of the specified frequency band of 24 GHz to 24.25 GHz, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

Results: The device under test falls well within the measurement band.

#### 6.4.6. Band Edge Measurements – Lower & Upper Band Edges (RCTA/BSD)

Frequency (GHz)	Band Edge (dB $\mu$ V/m)				Limit (dB $\mu$ V/m)		Margin (dB $\mu$ V/m)		Result
		Freq GHz	Peak	Average	Peak	Avg	Peak	Avg	
24.20	Lower	24.00	68.02	56.33	78.00	58.00	-9.98	-1.67	Compliant
	Upper	24.25	77.28	57.23	78.00	58.00	-0.72	-0.77	Compliant

#### 6.4.7. Band Edge Measurements - Lower Band Edge – Peak (RCTA/BSD)



Date: 6.FEB.2014 14:52:54

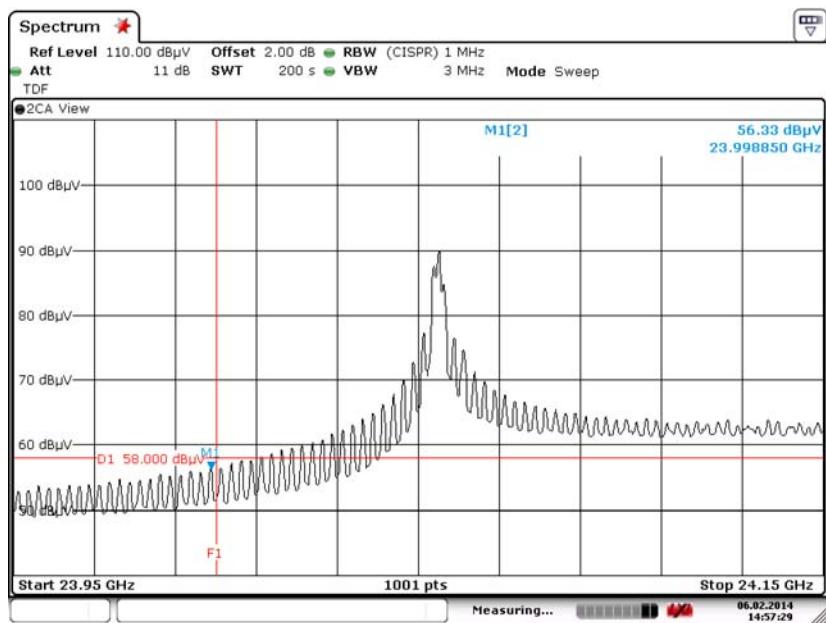
Test Number: 128-14R2

Issue Date: 2/27/2014

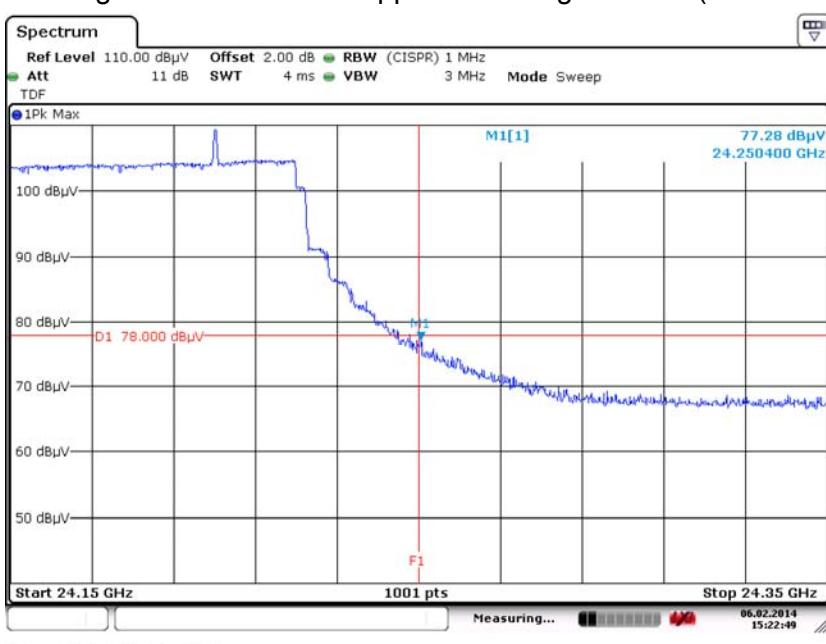
## 6. Measurement Data (continued)

### 6.4. Band Edge Measurements (continued)

#### 6.4.8. Band Edge Measurements - Lower Band Edge – Average (RCTA/BSD)



#### 6.4.9. Band Edge Measurements - Upper Band Edge – Peak (RCTA/BSD)



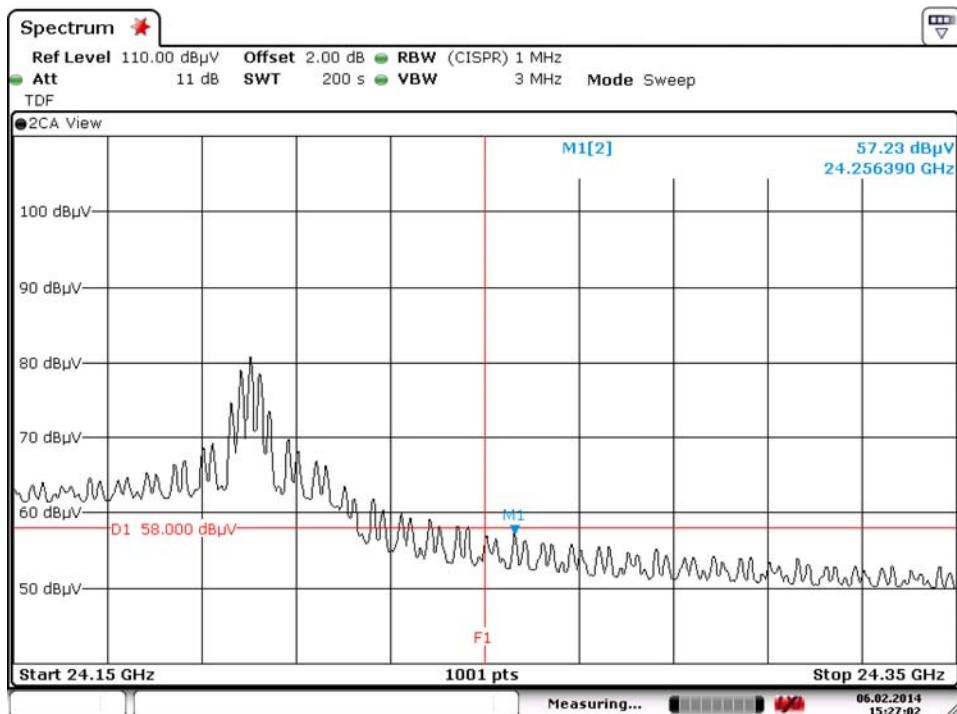
Test Number: 128-14R2

Issue Date: 2/27/2014

## 6. Measurement Data (continued)

### 6.4. Band Edge Measurements (continued)

#### 6.4.10. Band Edge Measurements - Upper Band Edge – Average (RCTA/BSD)



Date: 6.FEB.2014 15:27:02

**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

## 6. Measurement Data (continued)

### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

Requirement: Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

Frequency Range (MHz)	Distance (Meters)	Limit (dB $\mu$ V/m)
0.009 to 0.490	3	128.5 to 93.8 <sup>2</sup>
0.490 to 1.705	3	73.8 to 63.0 <sup>3</sup>
1.705 to 30	3	69.5
30 to 88	3	40.0
88 to 216	3	43.5
216 to 960	3	46.0
Above 960	3	54.0*

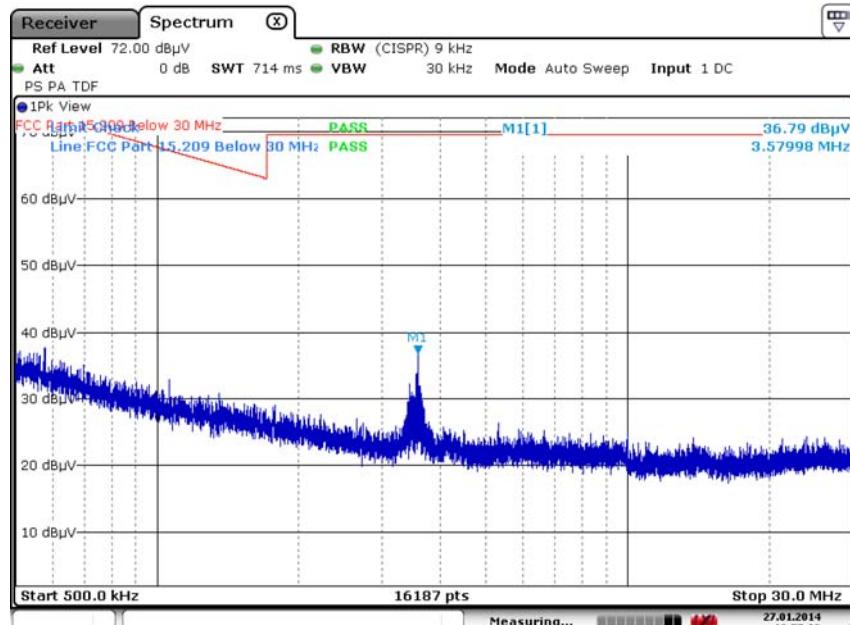
\*Note: Use of average detector above 1 GHz

Results: The unit under test meets the Part 15.209 radiated emissions limit.

Test Note: A 24 to 24.25 GHz Notch Filter was used in the range of 1 to 40 GHz

#### 6.5.1. Test Results, 500 kHz to 30 MHz

##### 6.5.1.1. Parallel (LCA/BSD)



Date: 27.JAN.2014 13:57:30

Test Number: 128-14R2

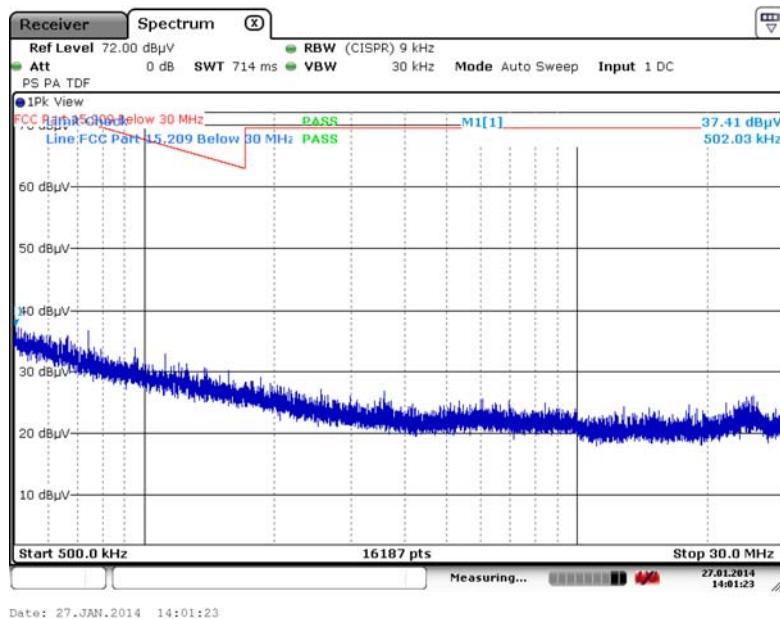
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.1. Test Results, 500 kHz to 30 MHz (continued)

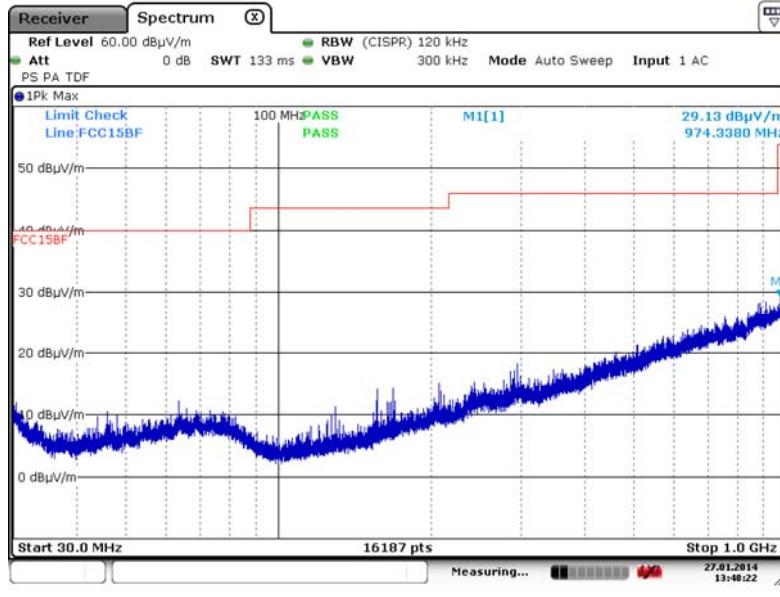
##### 6.5.1.2. Perpendicular (LCA/BSD)



Date: 27.JAN.2014 14:01:23

#### 6.5.2. Test Results, 30 MHz to 1000 MHz

##### 6.5.2.1. Horizontal (LCA/BSD)



Date: 27.JAN.2014 13:48:22

Test Number: 128-14R2

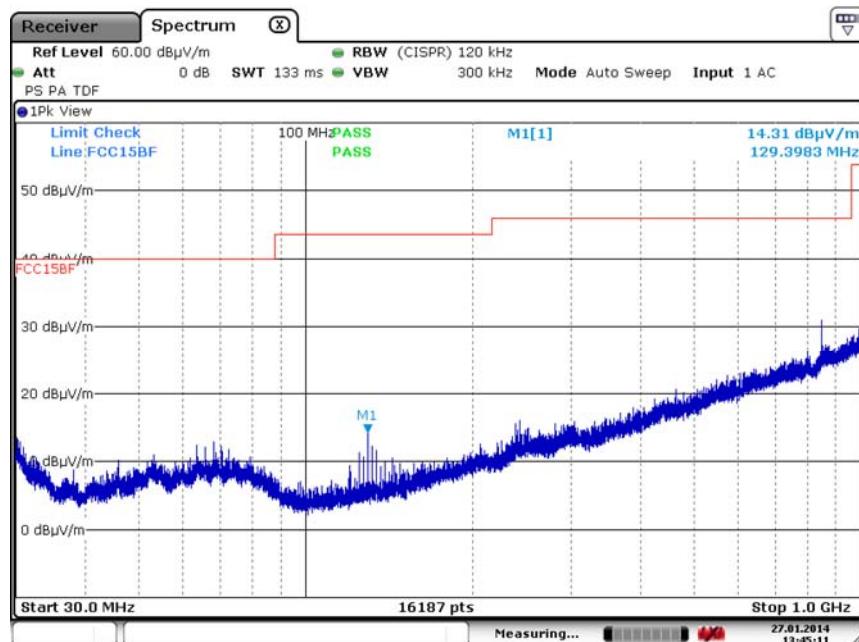
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.2. Test Results, 30 MHz to 1000 MHz (continued)

##### 6.5.2.2. Vertical (LCA/BSD)



Date: 27.JAN.2014 13:45:11

Test Number: 128-14R2

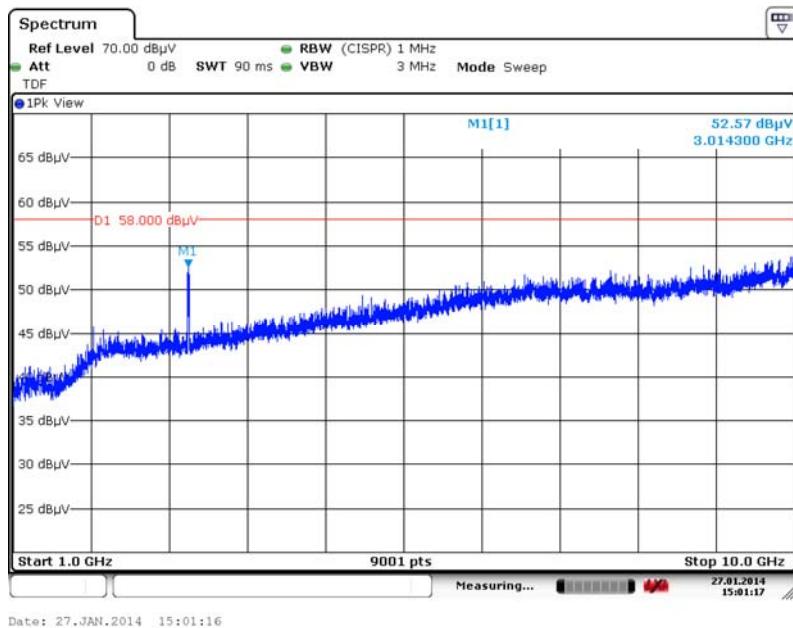
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

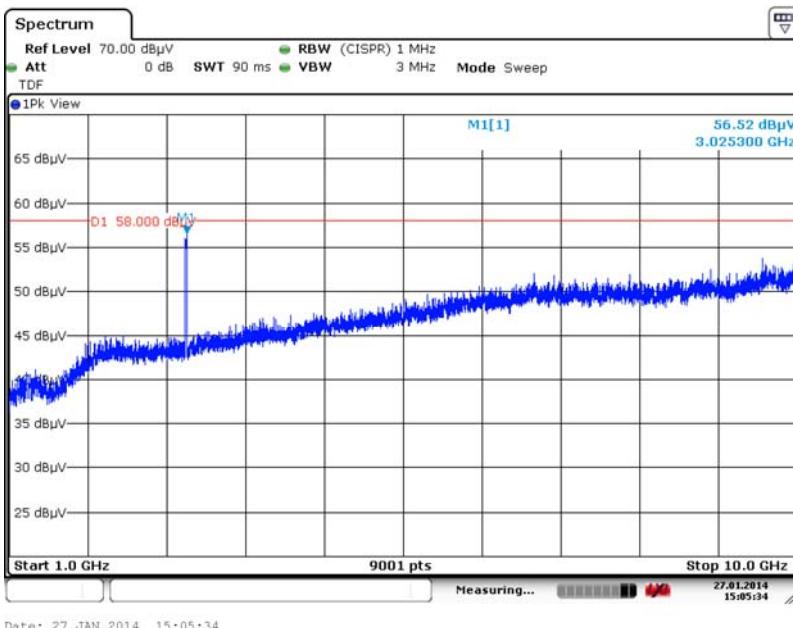
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.3. Test Results, 1 to 10 GHz

##### 6.5.3.1. Horizontal (LCA/BSD)



##### 6.5.3.2. Vertical (LCA/BSD)



Test Number: 128-14R2

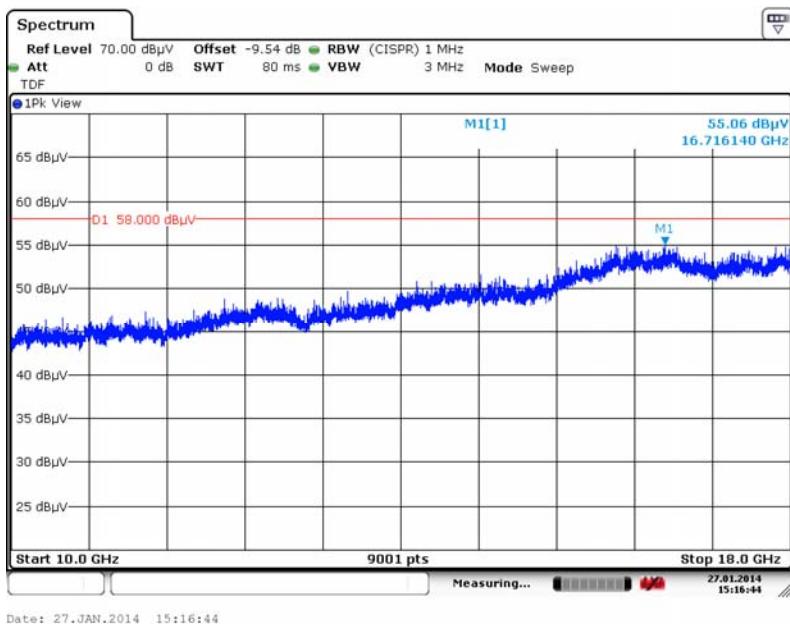
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

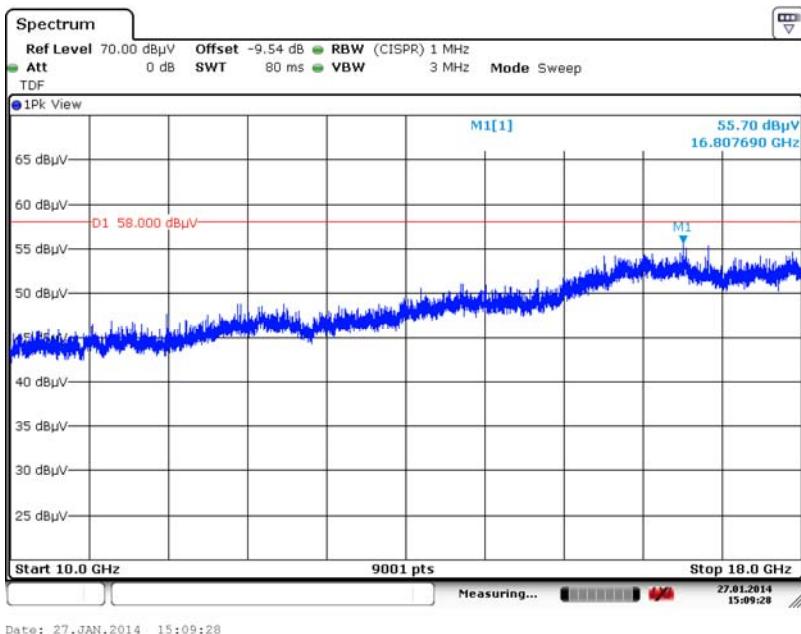
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.4. Test Results, 10 to 18 GHz

##### 6.5.4.1. Horizontal (LCA/BSD)



##### 6.5.4.2. Vertical (LCA/BSD)



Test Number: 128-14R2

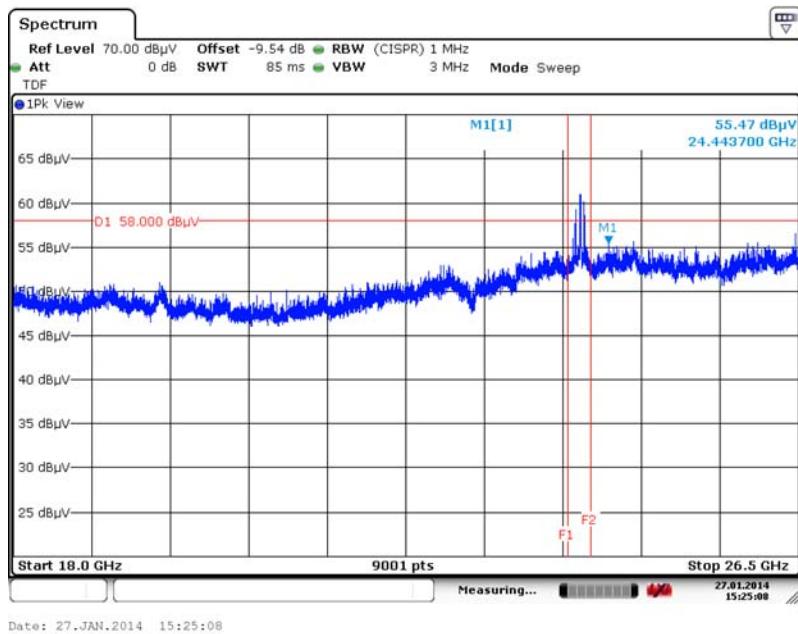
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

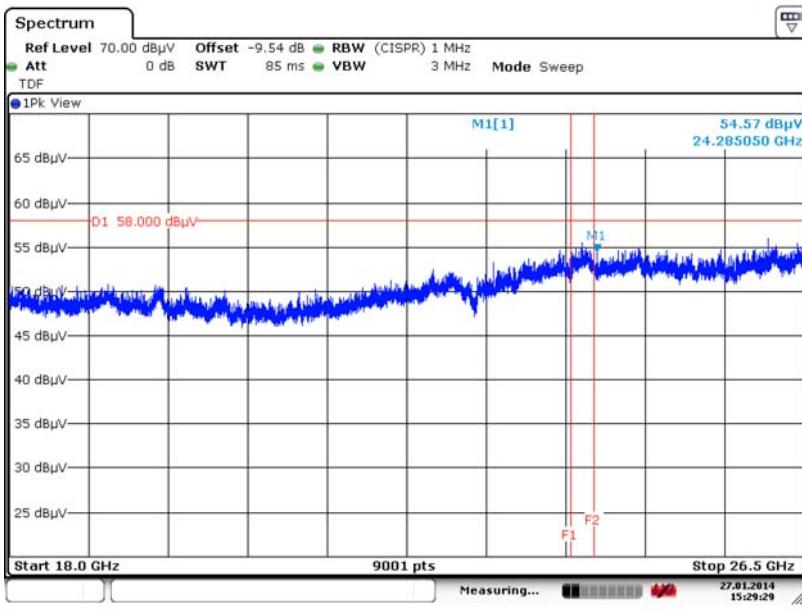
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.5. Test Results, 18 to 26.5 GHz

##### 6.5.5.1. Horizontal (LCA/BSD)



##### 6.5.5.2. Vertical (LCA/BSD)



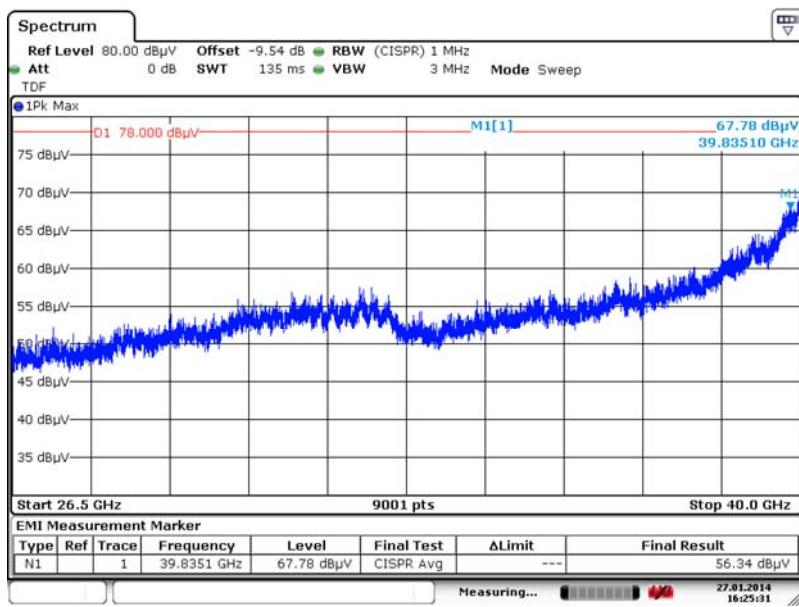
**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

## 6. Measurement Data (continued)

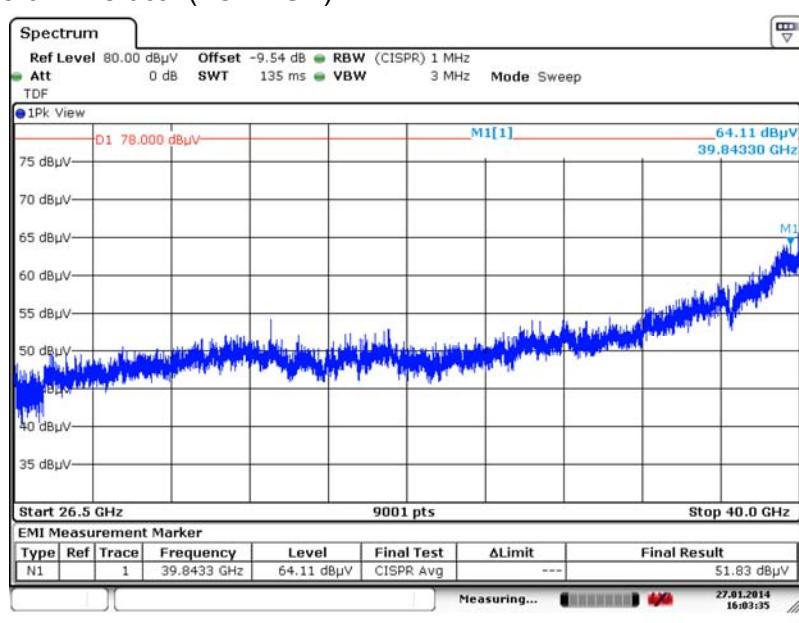
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.6. Test Results, 26.5 to 40 GHz

##### 6.5.6.1. Horizontal (LCA/BSD)



##### 6.5.6.2. Vertical (LCA/BSD)



Test Number: 128-14R2

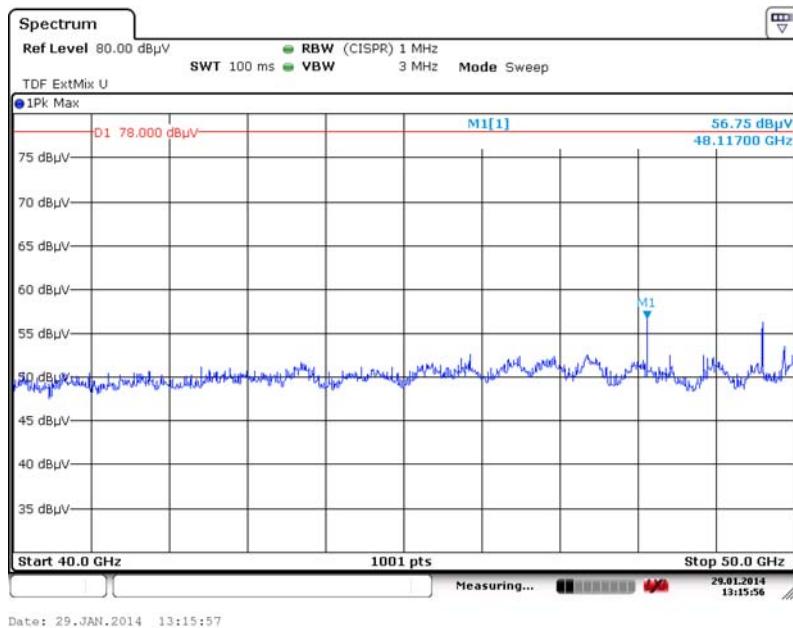
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

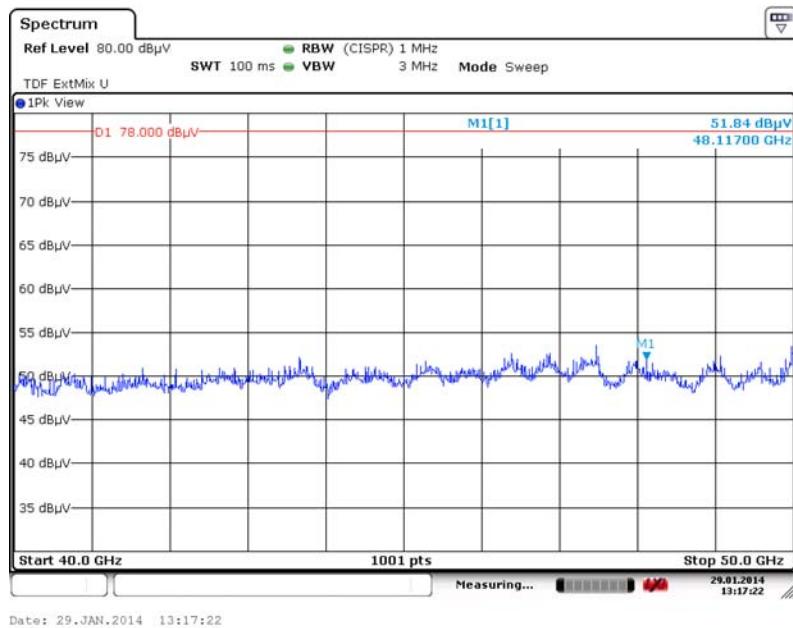
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.7. Test Results, 40 to 50 GHz

##### 6.5.7.1. Horizontal (LCA/BSD)



##### 6.5.7.2. Vertical (LCA/BSD)



Test Number: 128-14R2

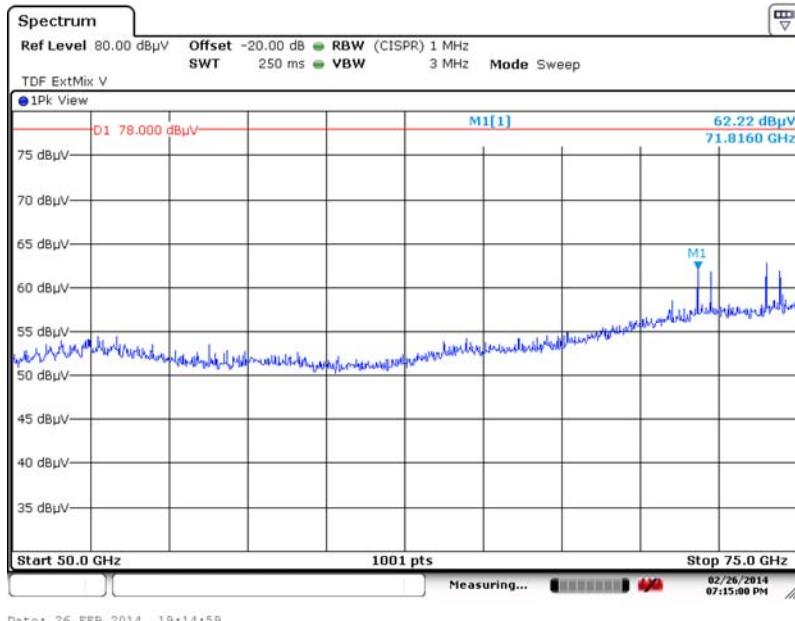
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

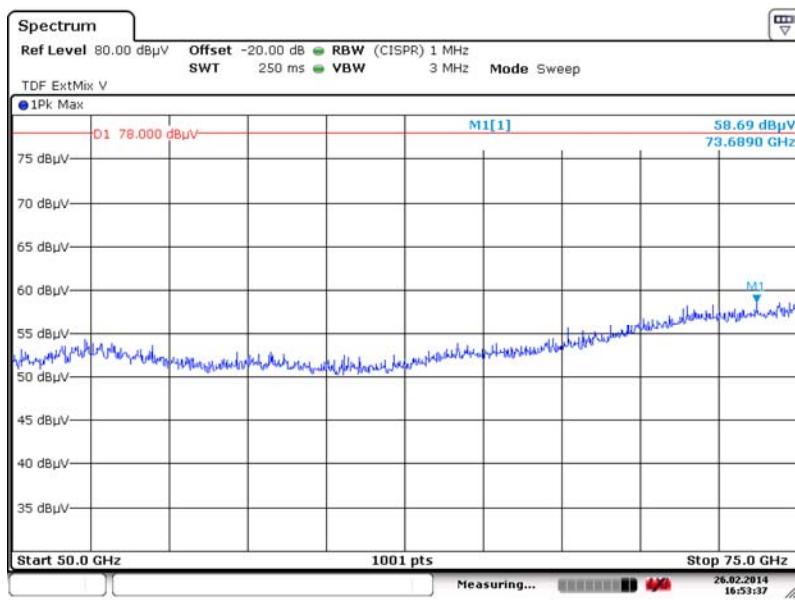
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.8. Test Results, 50 to 75 GHz

##### 6.5.8.1. Horizontal (LCA/BSD)



##### 6.5.8.2. Vertical (LCA/BSD)



Test Number: 128-14R2

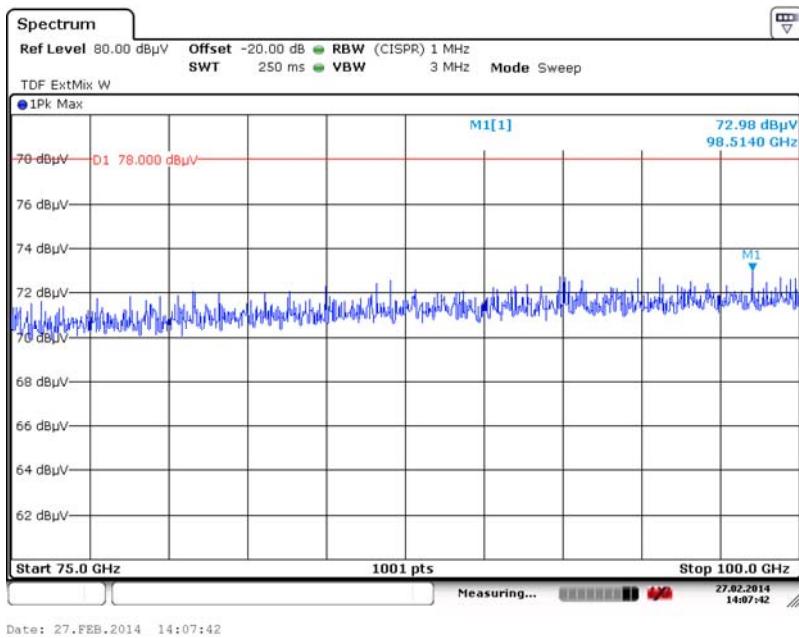
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

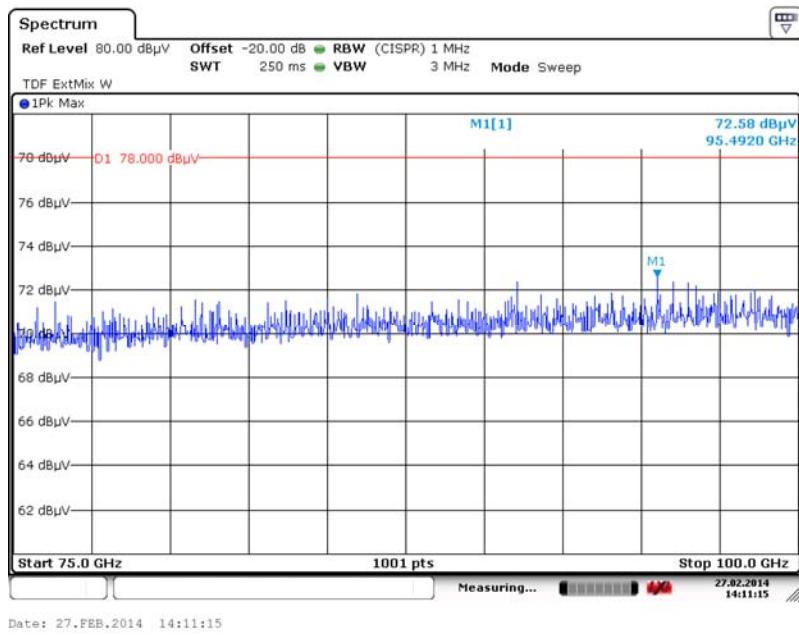
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.9. Test Results, 75 to 100 GHz

##### 6.5.9.1. Horizontal (LCA/BSD)



##### 6.5.9.2. Vertical (LCA/BSD)



Test Number: 128-14R2

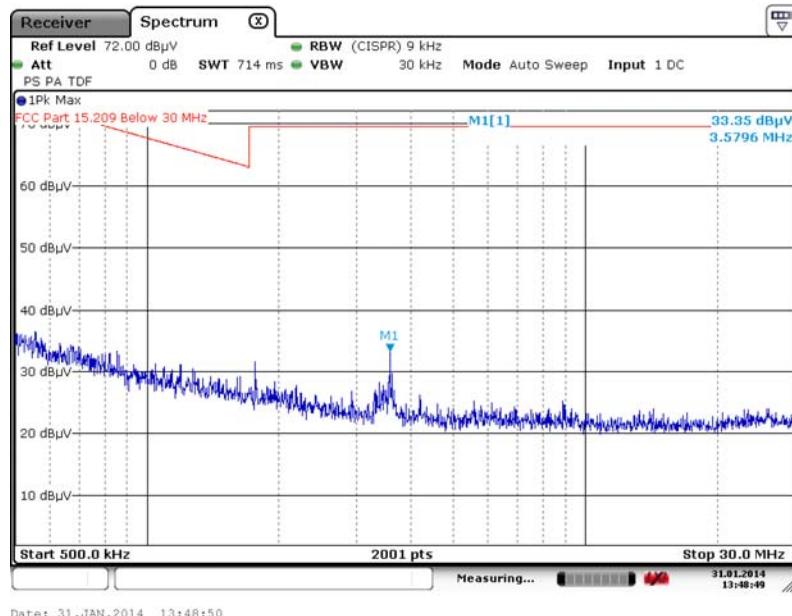
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

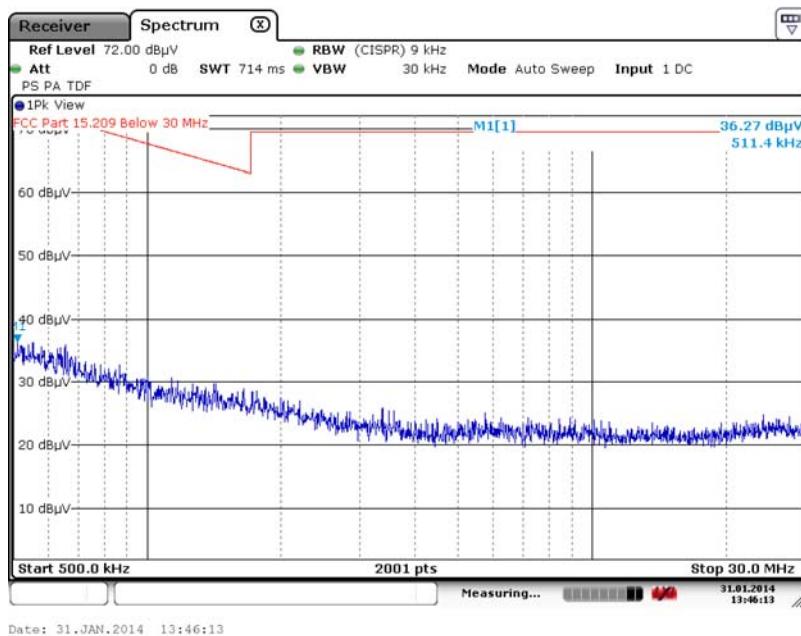
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.10. Test Results, 500 kHz to 30 MHz

##### 6.5.10.1. Parallel Orientation (RCTA/BSD)



##### 6.5.10.2. Perpendicular Orientation (RCTA/BSD)



Test Number: 128-14R2

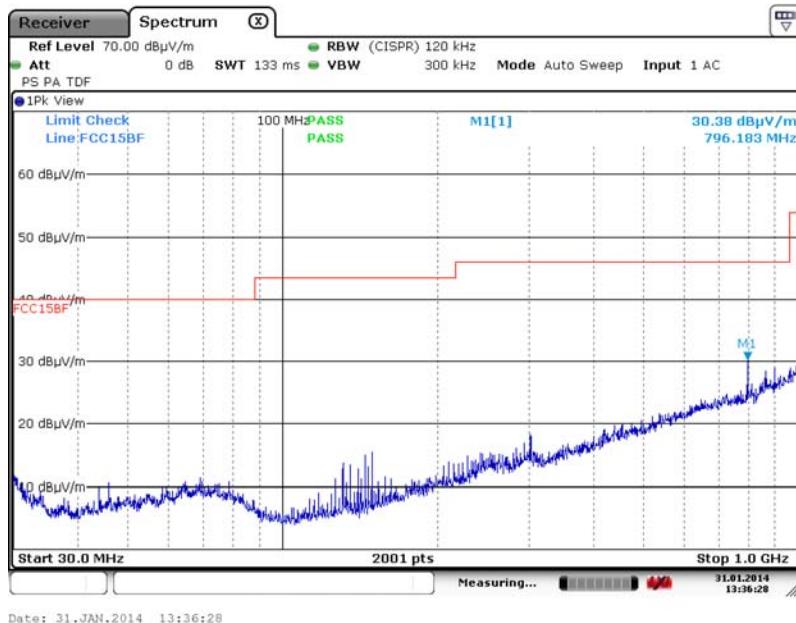
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

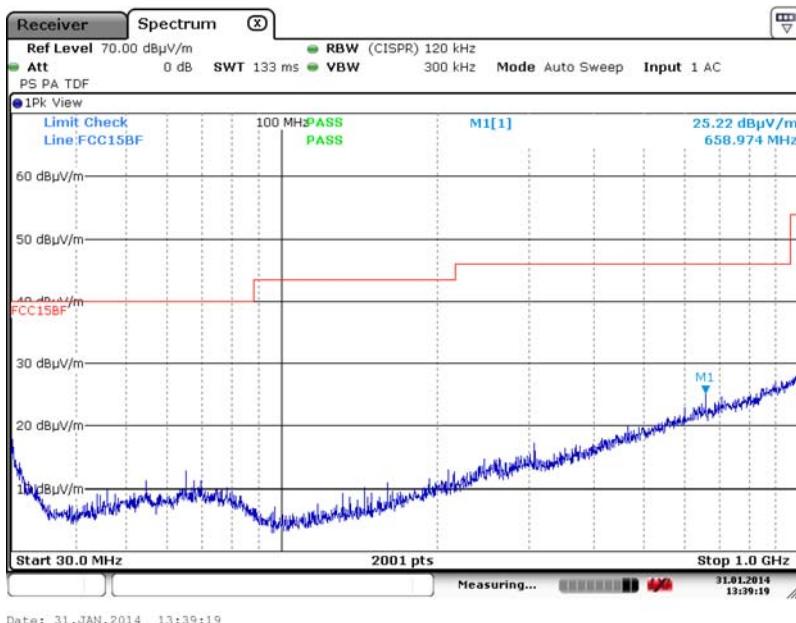
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.11. Test Results, 30 MHz to 1 GHz

##### 6.5.11.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.11.2. Vertical Polarity (RCTA/BSD)



Test Number: 128-14R2

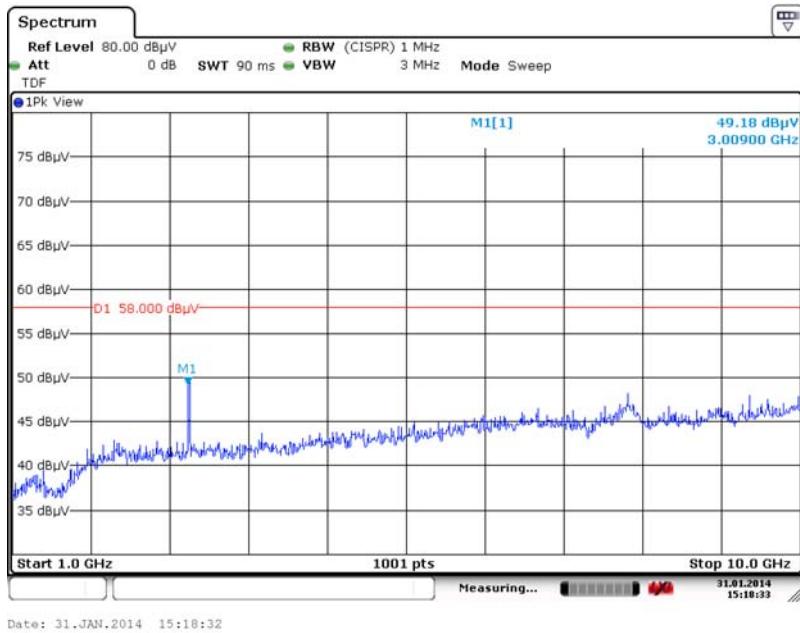
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

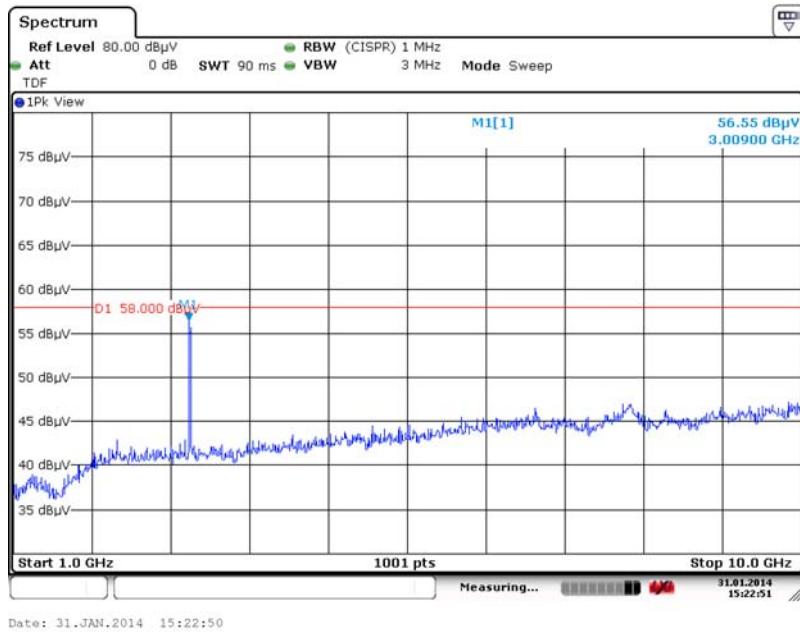
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.12. Test Results, 1 GHz to 10 GHz

##### 6.5.12.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.12.2. Vertical Polarity (RCTA/BSD)



Test Number: 128-14R2

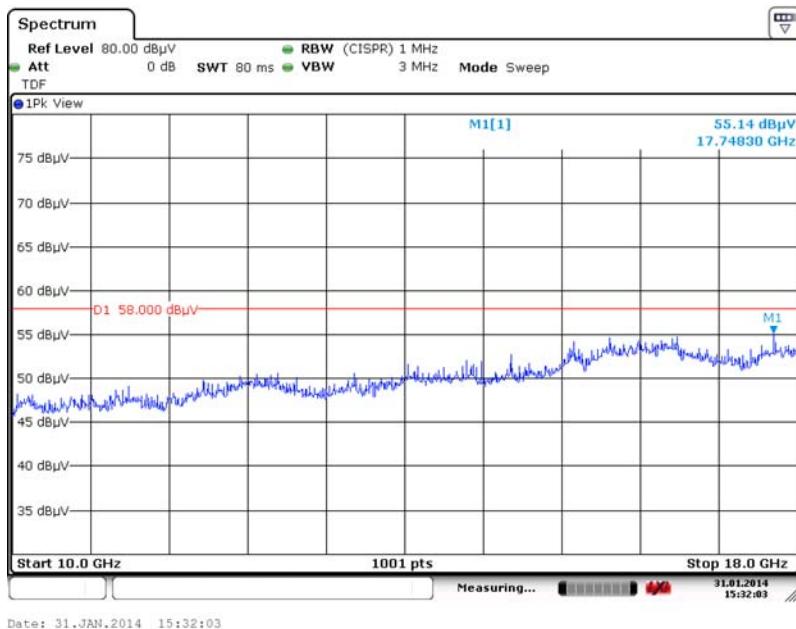
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

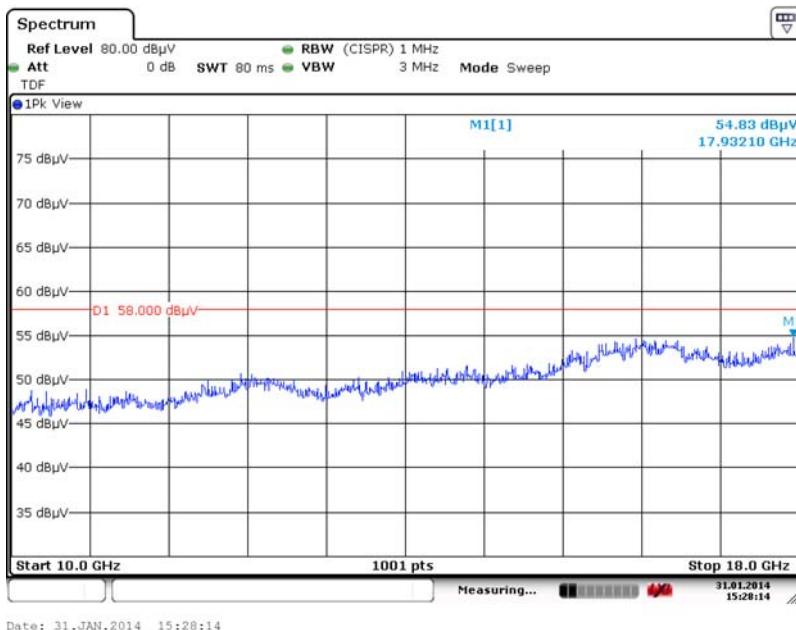
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.13. Test Results, 10 GHz to 18 GHz

##### 6.5.13.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.13.2. Vertical Polarity (RCTA/BSD)



Test Number: 128-14R2

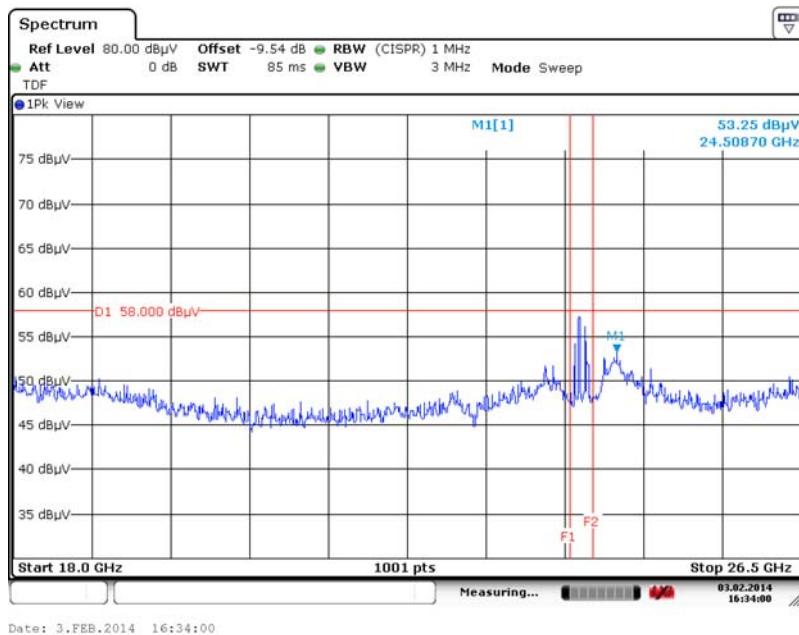
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

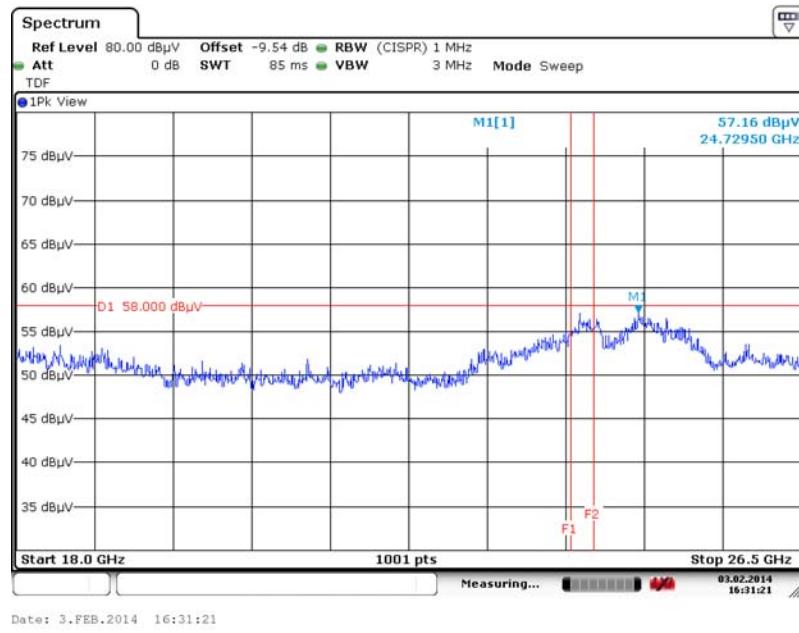
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.14. Test Results, 18 GHz to 26.5 GHz

##### 6.5.14.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.14.2. Vertical Polarity (RCTA/BSD)



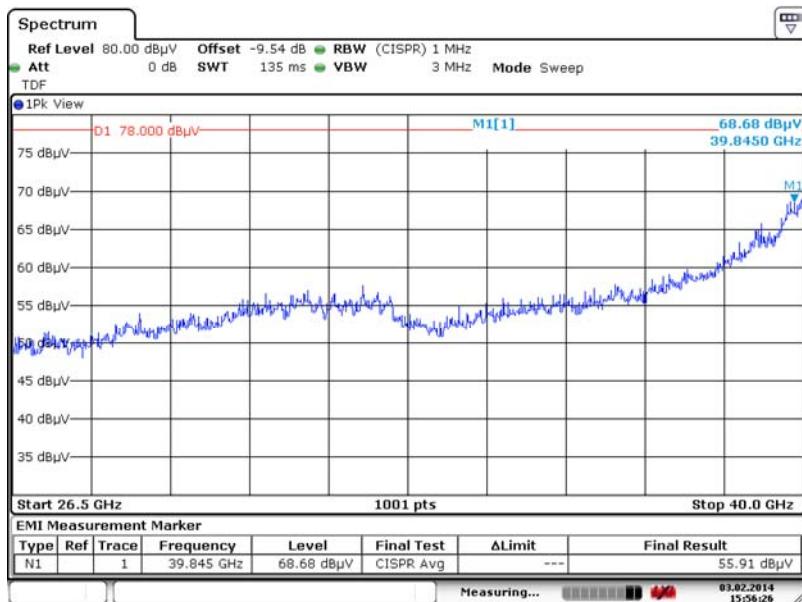
**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

## 6. Measurement Data (continued)

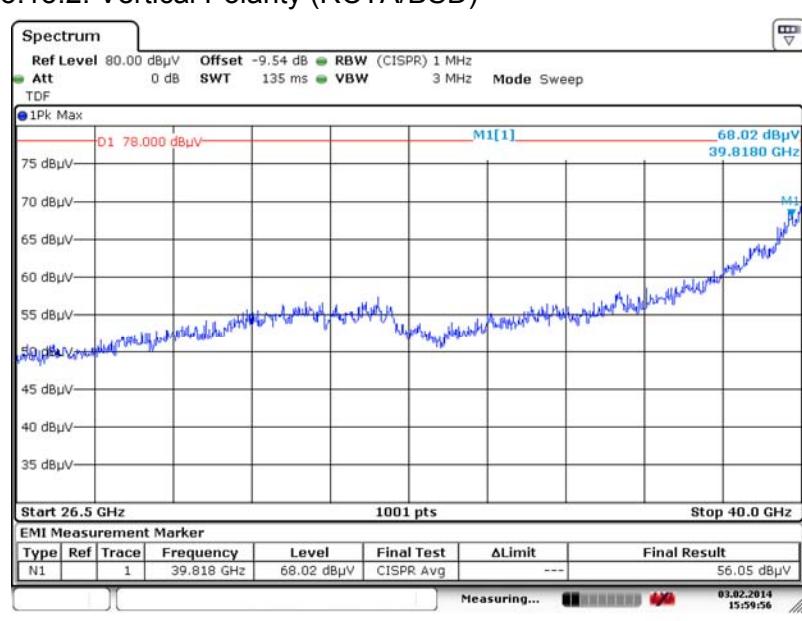
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.15. Test Results, 26.5 GHz to 40 GHz

##### 6.5.15.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.15.2. Vertical Polarity (RCTA/BSD)



Test Number: 128-14R2

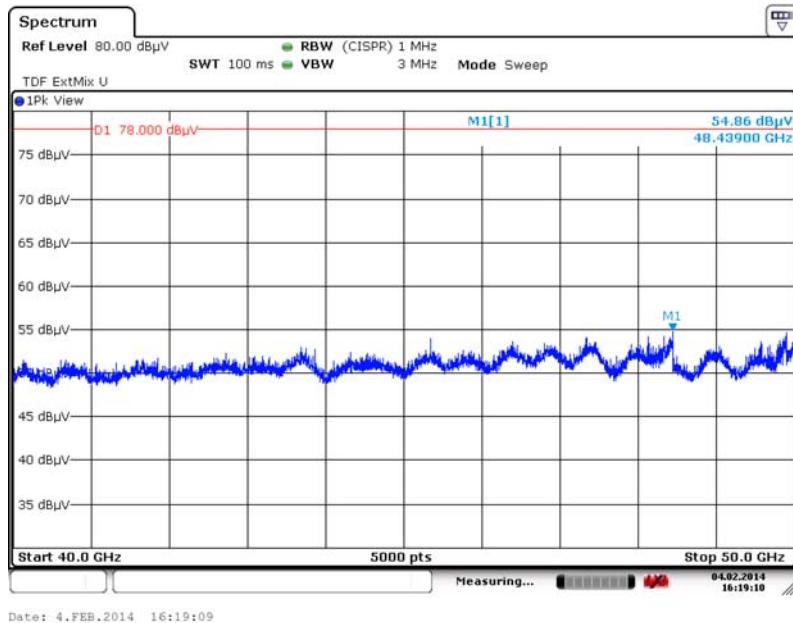
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

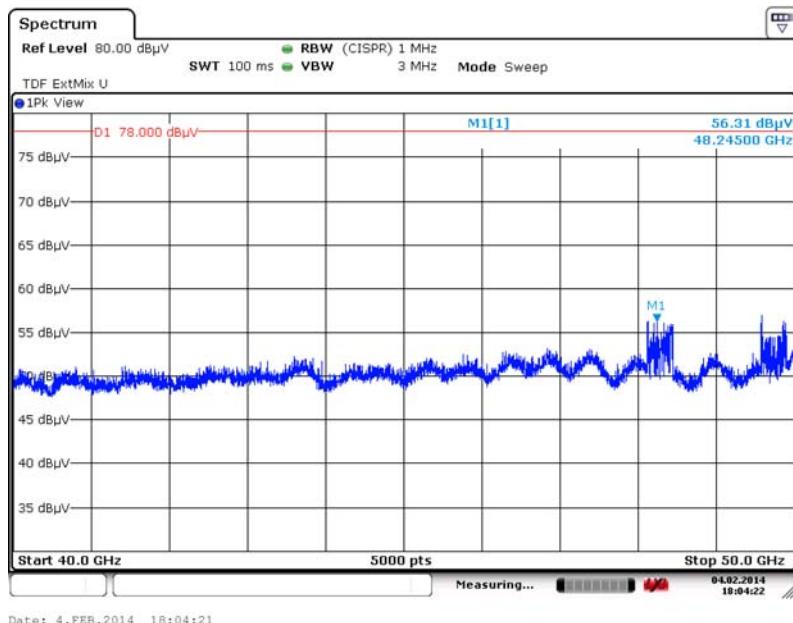
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.16. Test Results, 40 to 50 GHz

##### 6.5.16.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.16.2. Vertical Polarity (RCTA/BSD)



Test Number: 128-14R2

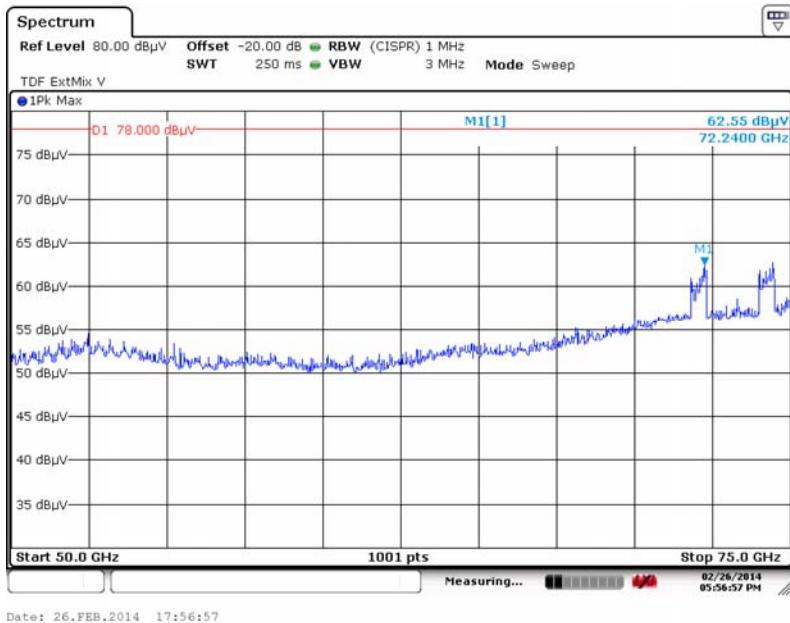
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

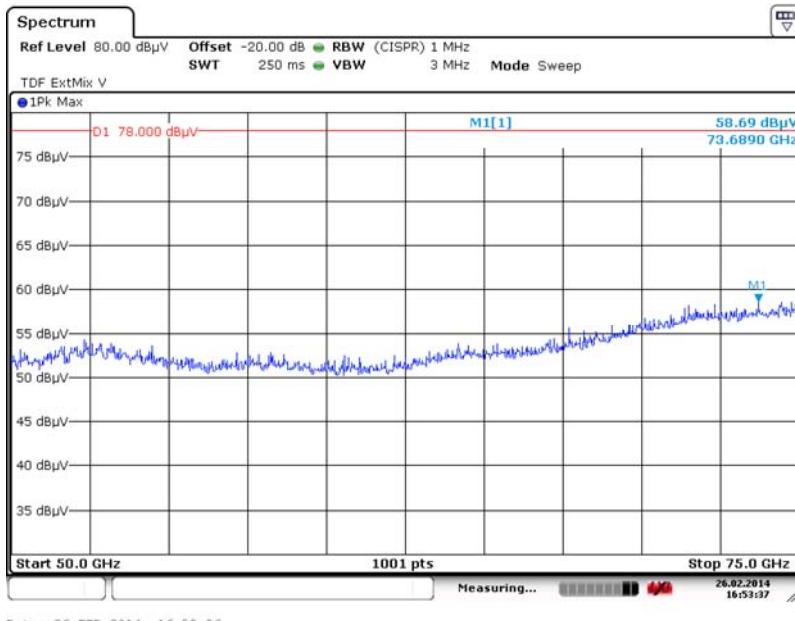
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.17. Test Results, 50 to 75 GHz

##### 6.5.17.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.17.2. Vertical Polarity (RCTA/BSD)



Test Number: 128-14R2

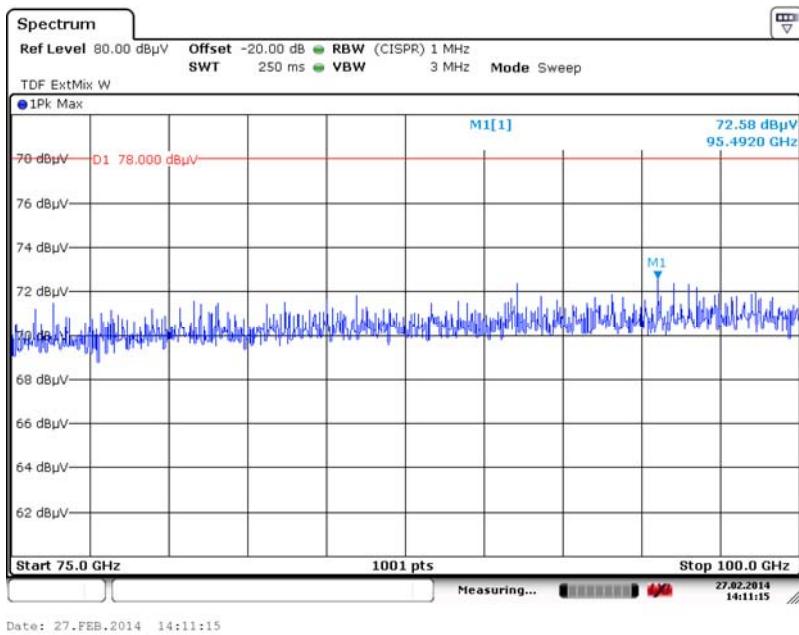
Issue Date: 2/27/2014

## 6. Measurement Data (continued)

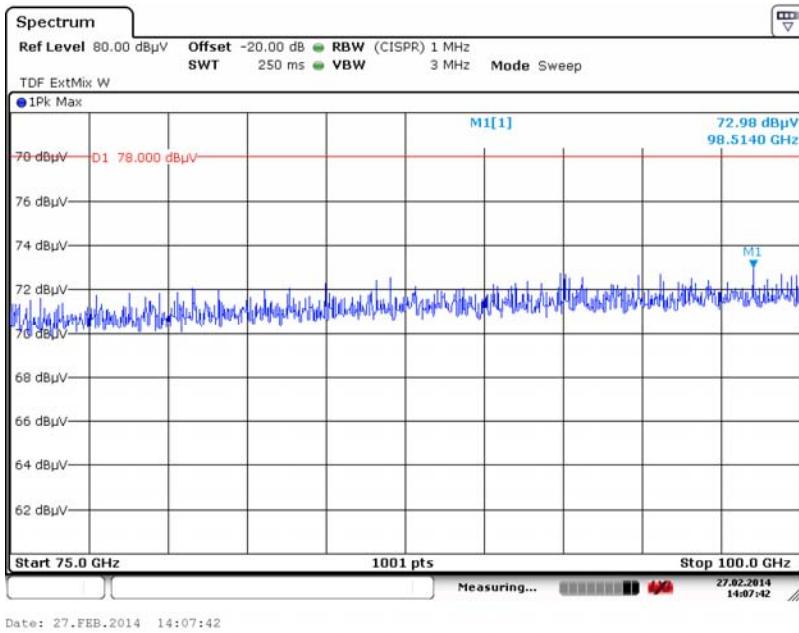
### 6.5. Spurious Radiated Emissions, 500 kHz to 100 GHz (15.249, Sect (d)), IC RSS-GEN

#### 6.5.18. Test Results, 75 to 100 GHz

##### 6.5.18.1. Horizontal Polarity (RCTA/BSD)



##### 6.5.18.2. Vertical Polarity (RCTA/BSD)



**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

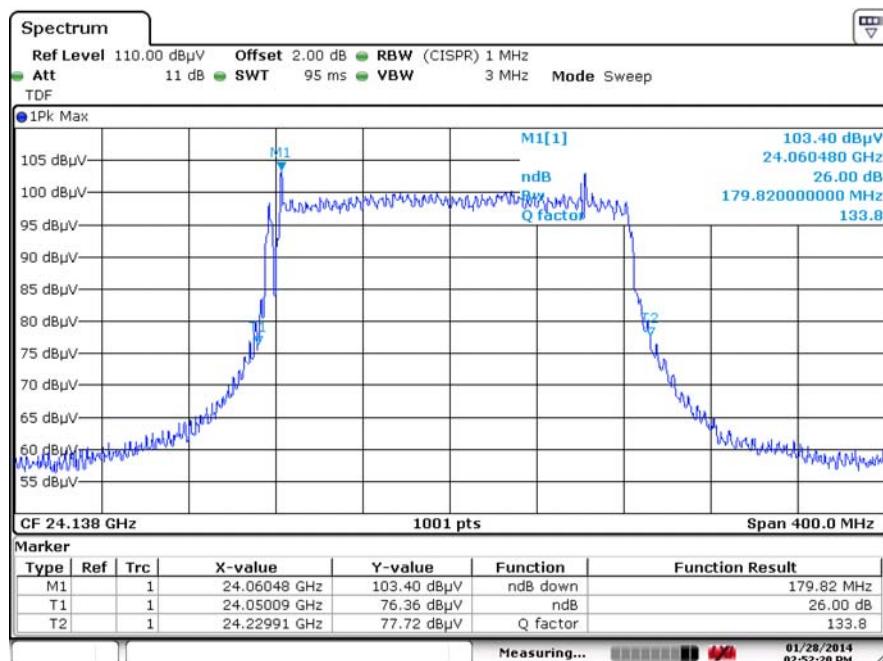
## 6. Measurement Data (continued)

### 6.6 26 dB Bandwidth (ANSI C63.4, Section 13.7)

Requirement: The occupied bandwidth measurements on an intentional radiator shall be made in accordance with the requirements outlined in ANSI C63.4-2009, Section 13.7. If no bandwidth requirement is specified by the procuring or regulatory agency, measure the bandwidth at -26 dB with respect to the reference level. The resolution bandwidth was set according to Table 5 in Section 13.7 of ANSI C63.4-2009.

Channel GHz	Center Frequency	26 dB Bandwidth	Result
	GHz	MHz	
24.060480	24.138	179.82	<b>Compliant</b>

#### 6.6.1. Measurement Plot - 26 dB Bandwidth (LCA/BSD)



Date: 28.JAN.2014 14:52:20

**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

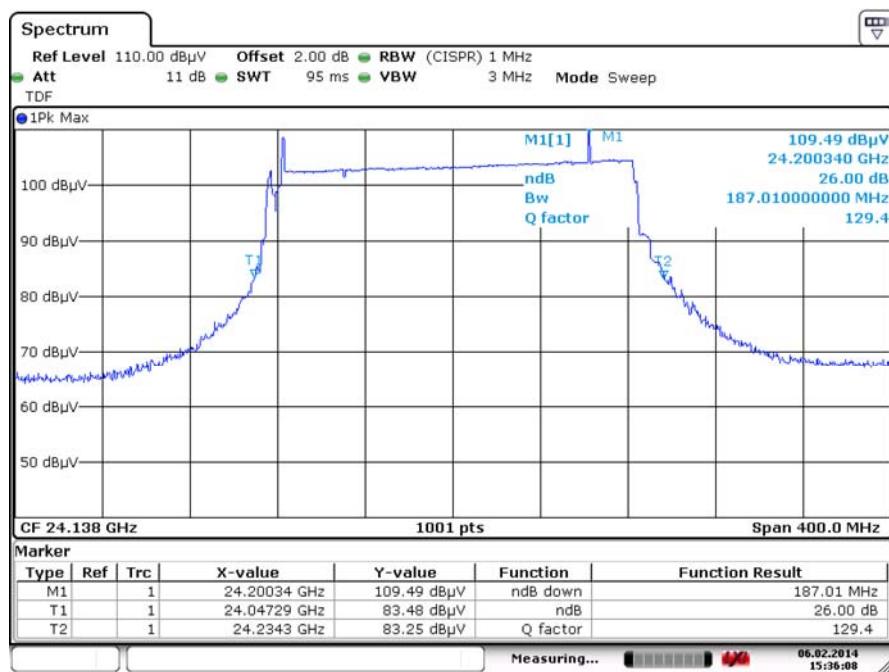
## 6. Measurement Data (continued)

### 6.6. 26 dB Bandwidth (ANSI C63.4, Section 13.7)

Requirement: The occupied bandwidth measurements on an intentional radiator shall be made in accordance with the requirements outlined in ANSI C63.4-2009, Section 13.7. If no bandwidth requirement is specified by the procuring or regulatory agency, measure the bandwidth at -26 dB with respect to the reference level. The resolution bandwidth was set according to Table 5 in Section 13.7 of ANSI C63.4-2009.

Channel	Channel Frequency	26 dB Bandwidth	Result
	GHz	MHz	
RCTA	24.138	187.01	<b>Compliant</b>

#### 6.6.2. 26 dB Bandwidth Plot (RCTA/BSD)



Date: 6.FEB.2014 15:36:08

**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

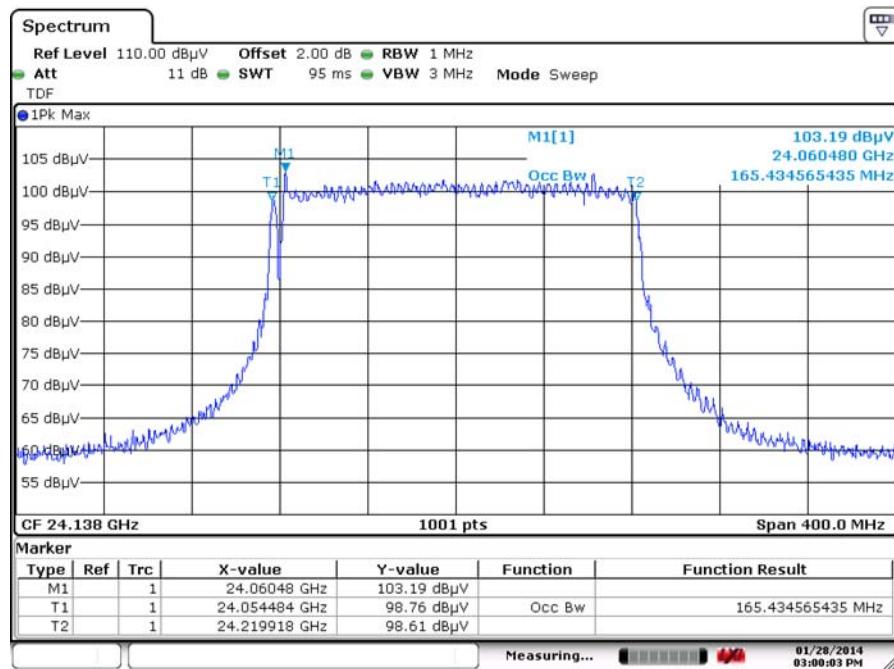
## 6. Measurement Data (continued)

### 6.7. 99% Power Bandwidth (RSS GEN 4.6.1)

Requirement: When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

Channel (GHz)	Center Frequency	99% Power Bandwidth
	GHz	MHz
24.060480	24.138	165.43

#### 6.7.1. 99% Bandwidth Plot (LCA/BSD)



Date: 28.JAN.2014 15:00:04

**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

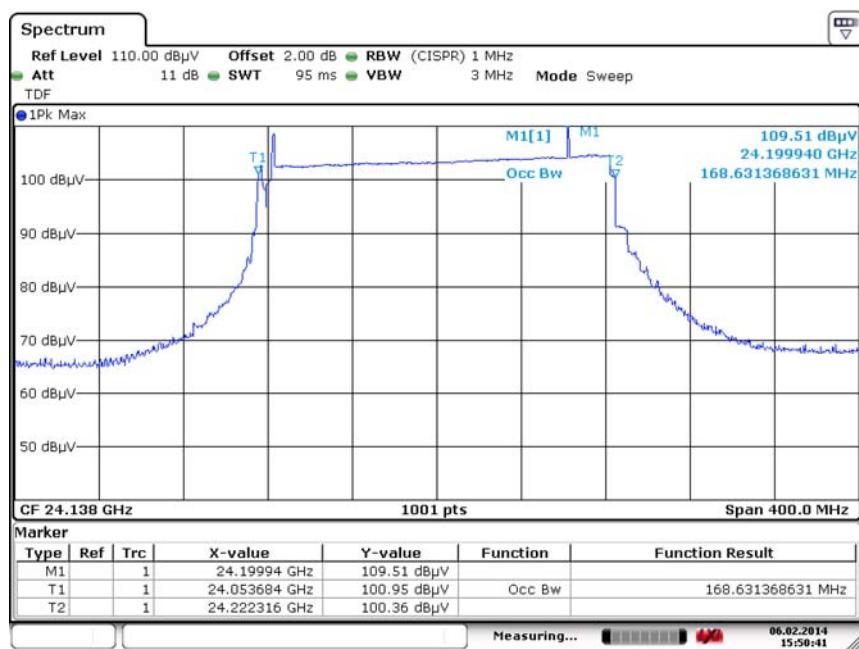
## 6. Measurement Data (continued)

### 6.7. 99% Power Bandwidth (RSS GEN 4.6.1)

Requirement: When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. The measurement bandwidth used shall be 1 to 3 % of the measurement span.

Center Frequency	99% Power Bandwidth		Result
	GHz	MHz	
24.138	168.63	Compliant	

### 6.7.2. 99% Bandwidth Plot (RCTA/BSD)



**Test Number: 128-14R2**
**Issue Date: 2/27/2014**

## 6. Measurement Data (continued)

### 6.8. Public Exposure to Radio Frequency Energy Levels (15.247(i) (1.1307 (b)(1)) RSS-GEN 5.5, RSS 102

6.8.1. Note: The following equation is used to determine the output power from the measured worst case field strength:

$$P = \frac{(E \times d)^2}{(30 \times G)}$$

P = the power in Watts.

E = the measured maximum field in V/m

G = the numeric gain of the transmitting antenna over an isotropic radiator.

d = the distance in meters of the field strength measurement.

Channel	Frequency	Peak Field Strength	Distance	Antenna Gain <sup>1</sup>	Measured Output Power
	(GHz)	(dB $\mu$ V/m)	(m)	(dBi)	(mW)
LCA	24.060390	105.55	3.0	12.200	0.649
BSD	24.200005	106.07	3.0	12.200	0.731
RCTA	24.060390	108.48	3.0	12.200	1.274
RCTA	24.200400	109.26	3.0	12.200	1.524

Channel	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	Power Density		Limit (mW/cm <sup>2</sup> )	Result
				(mW/cm <sup>2</sup> )	(W/m <sup>2</sup> )		
(1)	(2)	(3)	(4)		(5)		
LCA	20	-1.88	12.20	0.0021422	0.0214216	1	Compliant
BSD	20	-1.36	12.20	0.0024146	0.0241463	1	Compliant
RCTA	20	1.05	12.20	0.0042058	0.0420583	1	Compliant
RCTA	20	1.83	12.20	0.0050333	0.0503328	1	Compliant

$$PD = \frac{OP + AG}{(4 \times \pi \times d^2)}$$

PD = Power Density (mW/cm<sup>2</sup>)

OP = DUT Output Power (dBm)

AG = DUT Antenna Gain (dBi)

d = MPE Distance (cm)

1. Reference CFR 2.1093(b): For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.
2. Sections 6.2 of this test report.
3. Antenna gain data provided by the client.
4. Power density is calculated from field strength measurement and antenna gain.
5. Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure.

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## 7. Test Images

### 7.1. Spurious and Harmonic Emissions – Front



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## 7. Test Images

### 7.2 Spurious and Harmonic Emissions Below 30 MHz – Rear



Test Number: 128-14R2

Issue Date: 2/27/2014

**7. Test Images**

**7.3. Spurious and Harmonic Emissions – Rear – 30 MHz to 1 GHz**

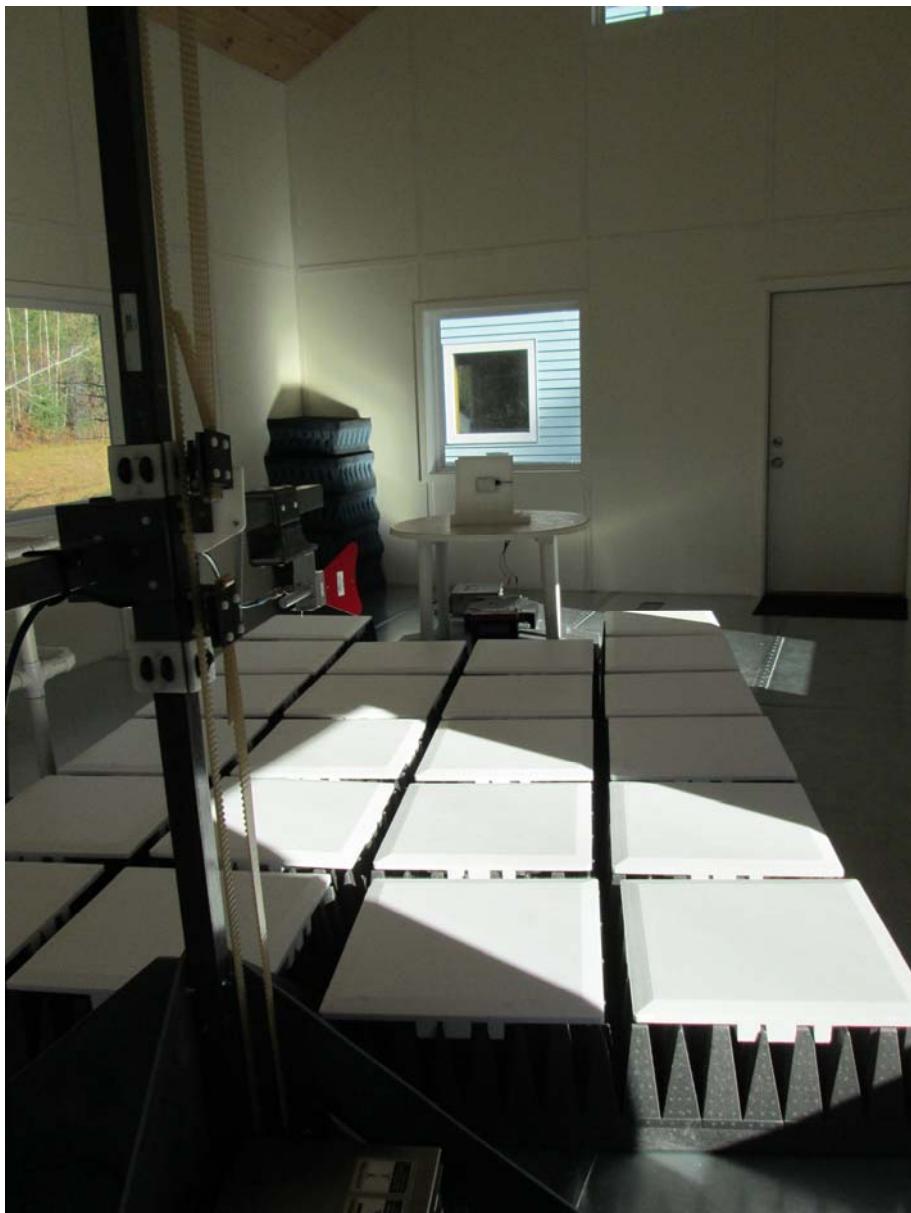


Test Number: 128-14R2

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## 7. Test Images

### 7.4. Spurious and Harmonic Emissions – Front - 1 to 18 GHz



Test Number: 128-14R2

Issue Date: 2/27/2014

## 7. Test Images

### 7.5. Spurious and Harmonic Emissions – Front - 18 to 40 GHz

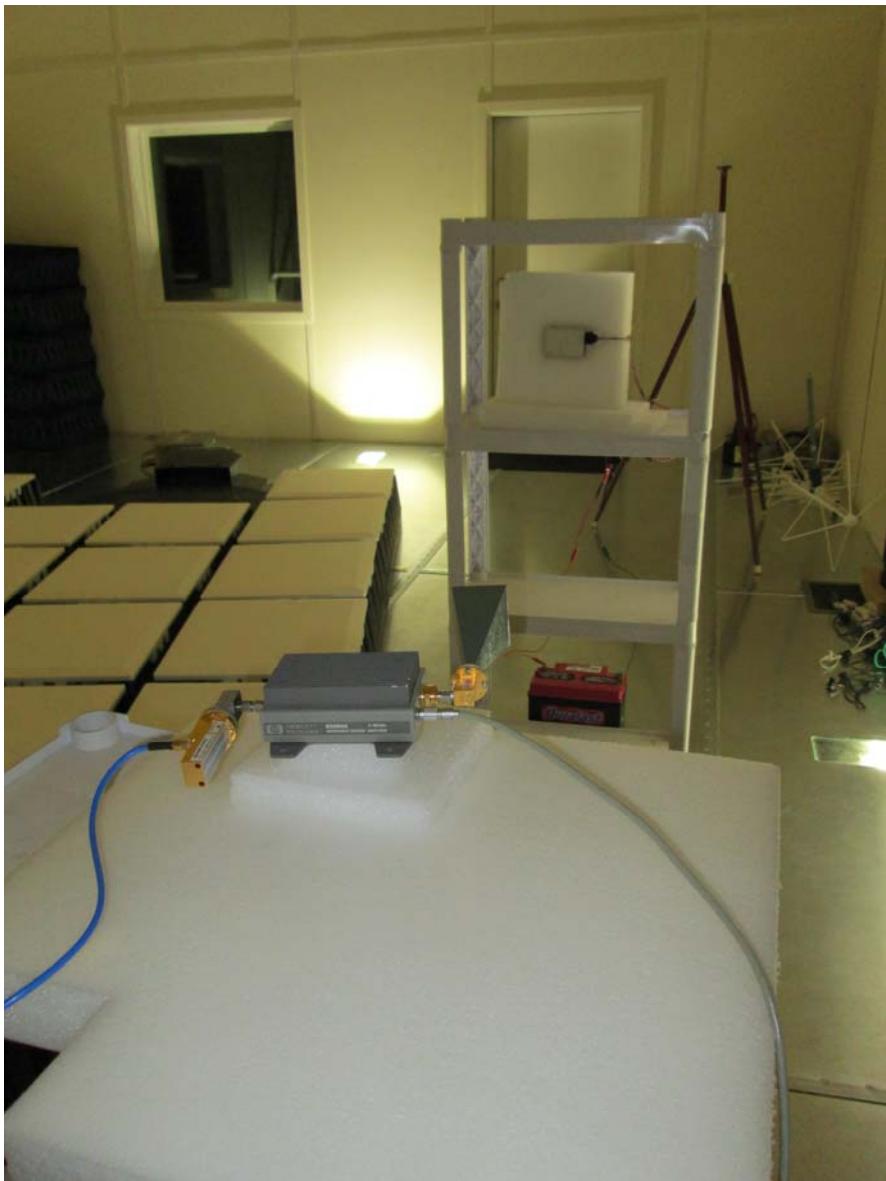


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## 7. Test Images

### 7.6. Spurious and Harmonic Emissions – Front – 40 to 50 GHz

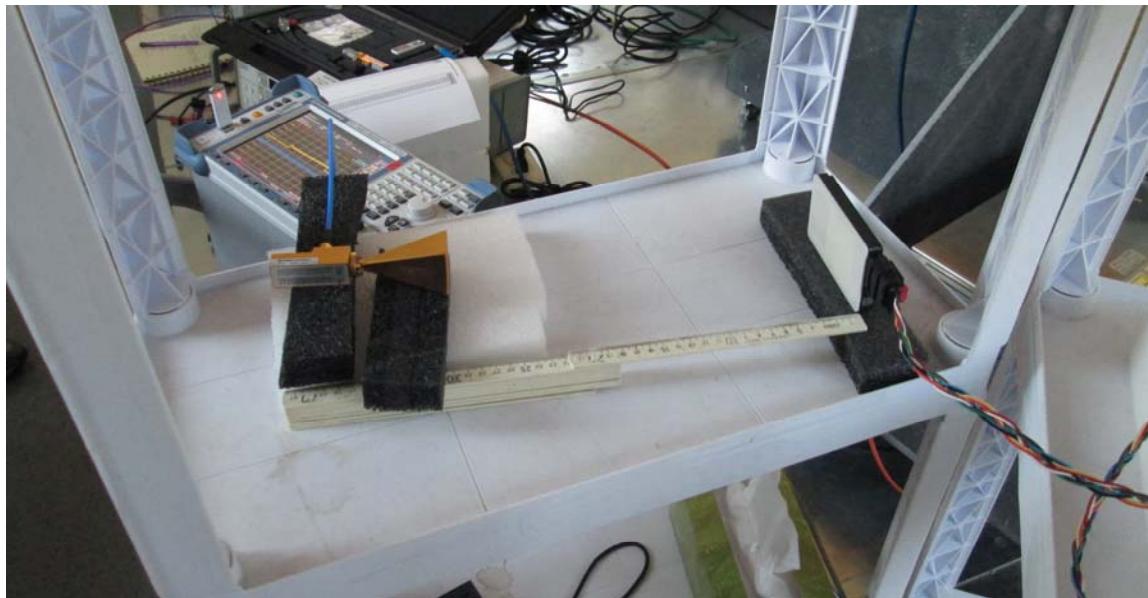


Test Number: 128-14R2

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## 7. Test Images

### 7.7. Spurious and Harmonic Emissions – Side – 50 to 75 GHz



Test Number: 128-14R2

Issue Date: 2/27/2014

**7. Test Images**

**7.8. Spurious and Harmonic Emissions – Side – 75 to 100 GHz**





Test Number: 128-14R2



Issue Date: 2/27/2014

## 8. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with Federal Communications Commission (FCC) and Industry Canada standards. A description of the test sites is on file with the FCC (registration number **96392**) and Industry Canada (file number **IC 3023A-1**).

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane required by EN 55022.

Both sites are designed to test products or systems 1.5 meter W x 1.5 meter L x 2.0 meter H, floor standing or table top.