

COMPLIANCE WORLDWIDE INC. TEST REPORT 440-16

In Accordance with the Requirements of
Federal Communications Commission 47 CFR Part 15.250, Subpart C
Wideband Systems within the band 5925 to 7250 MHz

IC RSS-220, Issue 1 (March 2009)
Devices Using Ultra-Wideband (UWB) Technology

Issued to

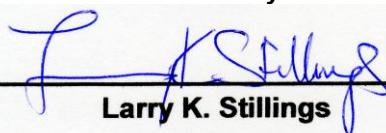
Radiation Safety & Control Services, Inc.
91 Portsmouth Avenue
Stratham, NH 03885
800-525-8339

For the
RSCS DW1000 UWB Module
Model Number: 211701

FCC ID: 2ADY2RSCSDWUWBM1
IC: 12574A-RSCSDWUWBM1

Report Issued on September 30, 2016

Tested By


Larry K. Stillings

Reviewed By


Brian F. Breault

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1. Scope

This test report certifies that the RSCS DW1000 UWB Module, Model 211701 as tested, meets the FCC Part 15.250, Subpart C 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.

2. Product Details

2.1. Manufacturer:	Radiation Safety & Control Services, Inc.
2.2. Model Number:	211701
2.3. Serial Number:	Pre production
2.4. Description:	Wireless 2 Way Ranging and TDoA Real Time Location System
2.5. Power Source:	3.7 VDC 2500 mAh Rechargeable Battery
2.6. Hardware Revision:	Rev A
2.7. Software Revision:	N/A
2.8. Modulation Type:	Pulse Modulation, Frequency Hopping
2.9. Operating Frequency:	6489.6 GHz Center Frequency Nominal (Channel 5 – 500 MHz BW)
2.10. EMC Modifications:	None

3. Product Configuration

3.1 Operational Characteristics & Software

Hardware Setup:

Press the power button on the keypad. The unit has been preprogrammed to transmit a typical waveform used for communication. The module was mounted on a Rad Tag board for the purpose of connection to a keypad, battery and USB Charger and to support the co-location with a pre-approved Atmel Zigbee module FCC ID: VW4A091732, IC: 11019A-091732

During the measurement testing, the product was mounted on a polystyrene form to facilitate rotating the In-Line Control Module through three orthogonal axes as required by ANSI C63.10-2013, section 5.10.1, for a hand held or body worn device. The three axes were defined as follows:

X-Axis	Flat on the Table. The surface mount antenna of the EUT was facing the antenna at 0° turntable azimuth.
Y-Axis	Sideways on the table. The surface mount antenna of the EUT was facing the antenna at 0° turntable azimuth.
Z-Axis	Upright on the table. The surface mount antenna was pointed upwards with the top side of the circuit board facing the antenna at 0° turntable azimuth.

3. Product Configuration (cont.)

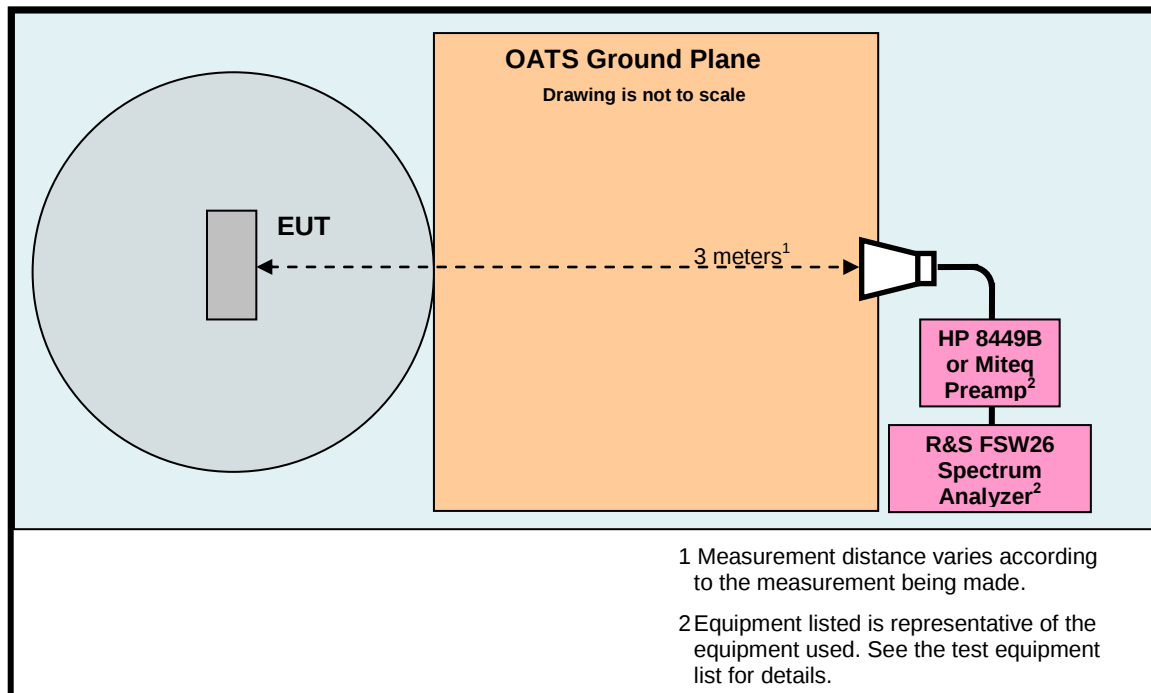
3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
RSCS	211701	Pre production	3.7	DC	UWB RTLS Module

3.3. Support Equipment

Manufacturer	Model/Part #	Serial Number	Description
Anker	71AN10W	K4539122	USB Power Adapter
Atmel	ATZB-S1-256-3-0-C		802.15.4 Zigbee Module

3.4. Test Setup Diagram



Note: An Anker USB Charger was used for the conducted emissions configuration.

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4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
EMI Receiver 9 kHz to 7 GHz	Rohde & Schwarz	ESR7	101156	7/23/2017	2 Years
Spectrum Analyzer 9 kHz to 40 GHz	Rohde & Schwarz	FSV40	100899	7/23/2017	2 Years
Spectrum Analyzer 10 Hz to 40 GHz	Rohde & Schwarz	FSVR40	100909	7/23/2017	2 Years
Spectrum Analyzer 3 Hz to 26.5 GHz	Rohde & Schwarz	FSW26	102044	6/1/2017	1 Year
Combilog Antenna 30 MHz to 2 GHz	Com-Power	AC-220	25509	5/12/2018	2 Years
Loop Antenna 9 kHz to 30 MHz	EMCO	6512	9309-1139	9/23/2016	2 Years
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3-00100200-10-15P-4	988773	6/2/2017	1 Year
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	10/15/2016	1 Year
Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	7/22/2017	2 Years
Preamplifier 18 to 40 GHz	Avantek	AWT-40039	FM22038832	11/25/2016	1 Year
Horn Antenna 1 to 18 GHz	ETS-Lindgren	3117	00143292	2/22/2019	3 Years
Horn Antenna 18-40 GHz	Com Power	AH-840	101032	2/24/2018	2 Years
High Pass Filter 8 to 18 GHz	Micro-Tronics	HPM50107	G036	5/15/2017	1 Year
2.4 GHz Band Pass Filter	Micro-Tronics	BRM50702	150	6/1/2017	1 Year
Barometer	Control Company	4195	Cal ID# 236	10/8/2017	2 Years

¹ ESR7 Firmware revision: V2.28.SP1 Date installed: 9/2/2016 Previous V2.26, installed 8/15/2014.
² FSV40 Firmware revision: V2.30 SP4, Date installed: 5/4/2016 Previous V2.30 SP1, installed 10/22/2014.
³ FSVR40 Firmware revision: V2.23, Date installed: 10/20/2014 Previous V1.63 SP1, installed 8/28/2013.
⁴ FSW26 Firmware revision: V2.50, Date installed: 9/12/2016 Previous V2.40, installed 5/4/2016.

4. Measurements Parameters (continued)

4.2. Measurement & Equipment Setup

Test Dates:	8/26/2016, 9/19/2016, 9/28/2016
Test Engineers:	Brian Breault, Larry Stillings
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 - 75%RH):	35
Frequency Range:	10 kHz to 40 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	200 Hz – 10 kHz to 150 kHz 9 kHz – 10 to 30 MHz 120 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth:	300 Hz – 10 kHz to 150 kHz 30 kHz – 10 to 30 MHz 300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak & Average

4.3. Measurement Procedure

Test measurements were made in accordance FCC Parts 15.209, 15.250 Subpart C, IC RSS-220, Issue 1 (March 2009), RSS-GEN, Issue 4 (November 2014).

The test methods used to generate the data is this test report is in accordance with ANSI C63.10:2013, American National Standard for Testing Unlicensed Wireless Devices.

4.4. Measurement Uncertainty

The following uncertainties are expressed for an expansion/coverage factor of K=2.

RF Frequency (out of band)	$\pm 1 \times 10^{-8}$
Radiated Emission of Transmitter to 100 GHz	± 4.55 dB
Radiated Emission of Receiver	± 4.55 dB
Temperature	$\pm 0.91^{\circ}$ C
Humidity	$\pm 5\%$

5. Measurements Summary

Test Requirement	FCC Rule Requirement	IC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	RSS-220 5.1 (b)	6.1	Compliant	The antenna is a surface mount PCB type antenna.
Operational Requirements	15.250 (a)	RSS-220	6.2	Compliant	
Wideband Bandwidth	15.250 (b)	RSS-220 2 RSS-220 5.1	6.3	Compliant	
Spurious Radiated Emissions	15.250 (d) (1) 15.209	RSS-220 3.4	6.4	Compliant	
Radiated Emissions in GPS Bands	15.250 (d) (2)	RSS-220 5.3.1 (e)	6.5	Compliant	
RMS Power in a 1 MHz Bandwidth	15.250 (d) (1)	RSS-220 5.3.1 (d)	6.6	Compliant	
Peak Emissions in a 50 MHz Bandwidth	15.250 (d) (3)	RSS-220 5.3.1 (g)	6.7	Compliant	
Conducted Emissions	15.207	RSS-GEN	6.8 6.9	Compliant	Anker USB Charger
Radio Frequency Exposure	FCC OET Bulletin 65 1.1307 (b) (1)		6.10	Compliant	

6. Measurement Data

6.1. Antenna Requirement (15.203)

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

Result: The antenna utilized by the device under test is a surface mount PCB Type, non user replaceable unit.

6.2. Operational Requirements of the Device under Test (15.250 (a))

Requirement: The -10 dB bandwidth of a device operating under the provisions of this section must be contained within the 5925 to 7250 MHz band under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

Result: Compliant

6.2.1 Frequency Stability over Temperature

Marker	Temp °C	Meas Freq.	-10 dB Band Edges		15.250 Frequency Band		Result
		(MHz)	Lower	Upper	F _{MIN} (MHz)	F _{MAX} (MHz)	
-	OATS	6521.0	6183.3	6799.7	5925	7250	Compliant
-	Ambient	6521	6228.3	6897.6	5925	7250	Compliant
1	-20	6521	6228.3	6921.6	5925	7250	Compliant
2	-10	6521	6228.3	6919.7	5925	7250	Compliant
3	0	6521	6227.3	6918.6	5925	7250	Compliant
4	+10	6521	6226.3	6896.6	5925	7250	Compliant
5	+20	6521	6226.3	6892.6	5925	7250	Compliant
6	+30	6521	6228.3	6900.6	5925	7250	Compliant
7	+40	6521	6271.2	6839.7	5925	7250	Compliant
8	+50	6521	6232.3	6823.7	5925	7250	Compliant

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6. Measurement Data (continued)

6.3. Wideband Bandwidth (15.250 (b), RSS-220 5.1 (a))

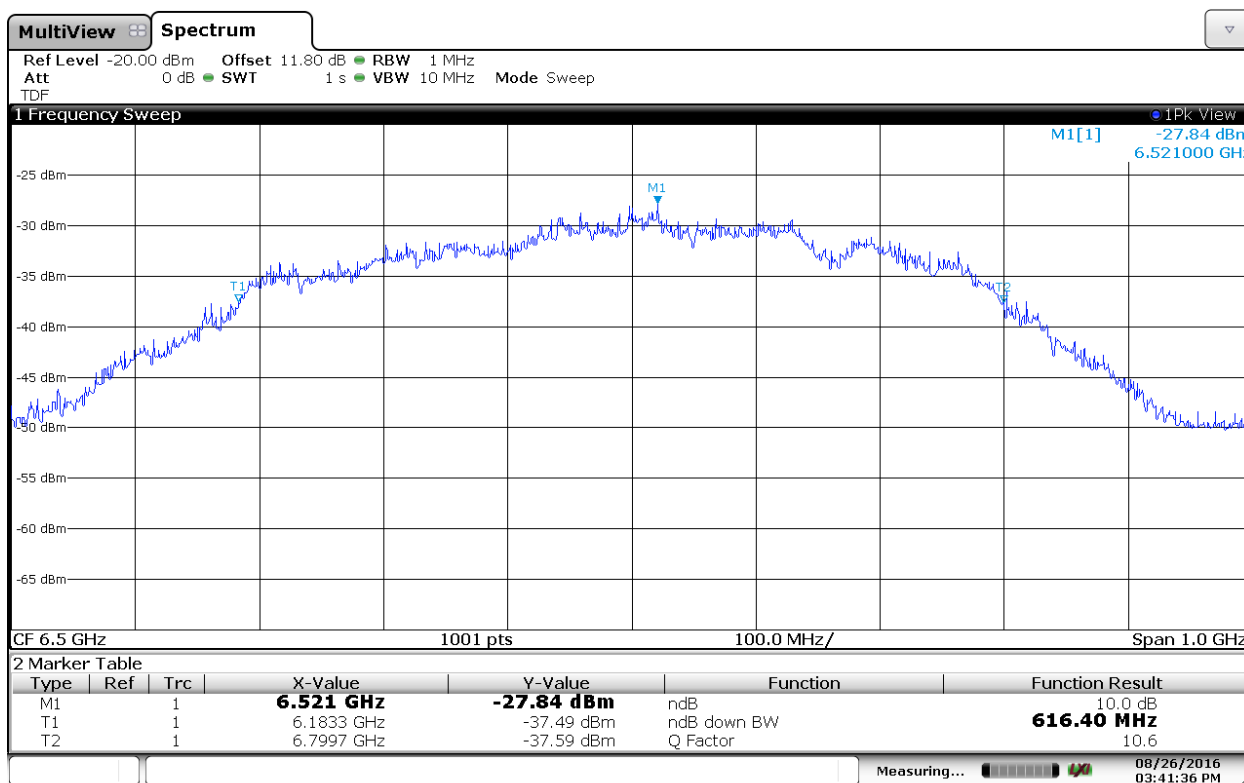
Requirement: The -10 dB bandwidth of the fundamental emission shall be at least 50 MHz.

Result: Compliant

6.3.1. Measurement Data – Values in GHz

f_M	The highest emission peak	6.5210
f_L	10 dB below the highest peak	6.1833
f_H	10 dB above the highest peak	6.7997
Bandwidth	Calculated: ($f_H - f_L$)	0.6164

6.3.2. Measurement Plot of 10 dB frequencies (Channel 5)



03:41:36 PM 08/26/2016

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209)

Requirement: The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
960 - 1610	-75.3	19.9
1610 - 1990	-63.3	31.9
1990 - 3100	-61.3	33.9
3100 – 5925	-51.3	43.9
5925 – 7250	-41.3	53.9
7250 – 10,600	-51.3	43.9
Above 10,600	-61.3	33.9

Spurious Radiated Emissions (RSS-220 5.3.1 (d))

Requirement: The radiated emissions at or below 960 MHz from a device shall not exceed the limits in Section 3.4. The radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
960 - 1610	-75.3	19.9
1610 – 4750	-70.0	25.2
4750 – 10,600	-43.1	53.9
Above 10,600	-61.3	33.9

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209 Continued)

Radiated Emissions Field Strength Limits at 3 Meters (Section 15.250 (d), 15.209, RSS-220 3.4)

Frequency (MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)
0.009 to 0.490	2,400/F	128.5 to 93.8
0.490 to 1.705	24,000/F	73.8 to 63
1.705 - 30	30	69.5
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
960 - 40,000	500	54

Test Notes: Refer to Section 4.1 for the test equipment used.

Frequency Range:	10 kHz to 40 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	200 Hz – 10 kHz to 150 kHz 9 kHz – 150 kHz to 30 MHz 120 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth (minimum):	300 Hz – 10 kHz to 150 kHz 30 kHz – 150 kHz to 30 MHz 300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak & Average

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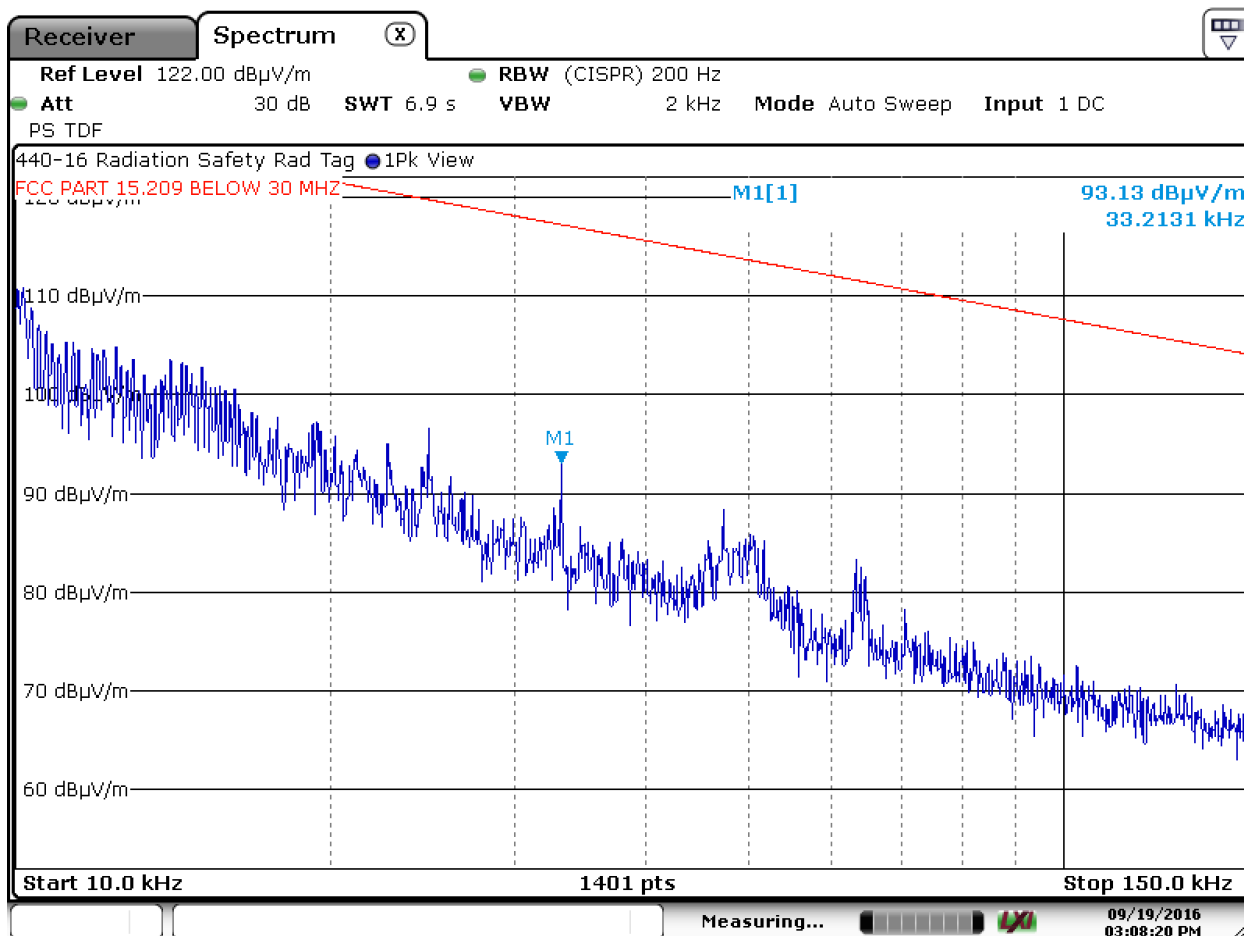
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.1 Parallel Measurement Antenna – 10 to 150 kHz



Date: 19.SEP.2016 15:08:20

Test Number: 440-16

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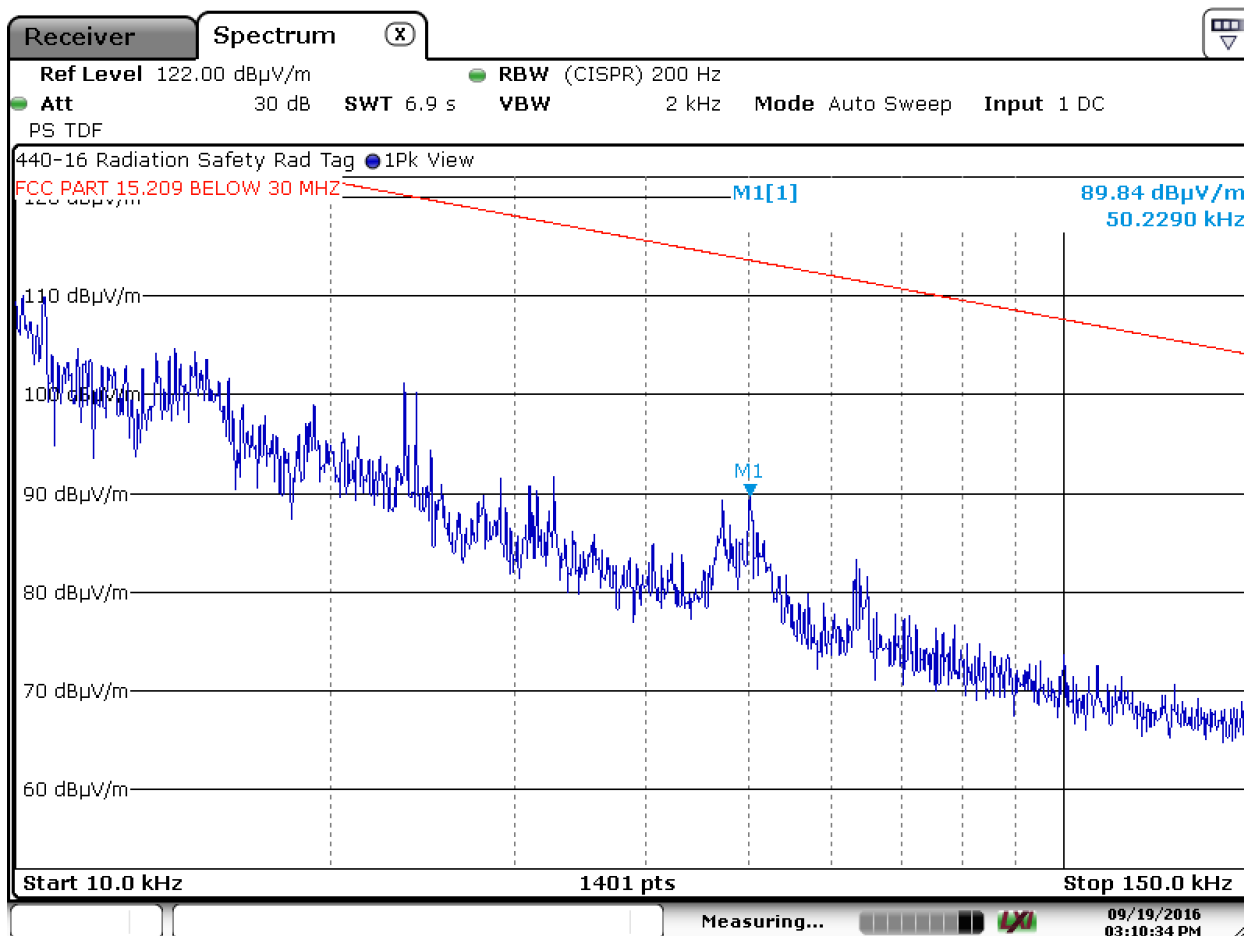
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.2 Perpendicular Measurement Antenna – 10 to 150 kHz



Date: 19.SEP.2016 15:10:34

Test Number: 440-16

Issue Date: 9/30/2016

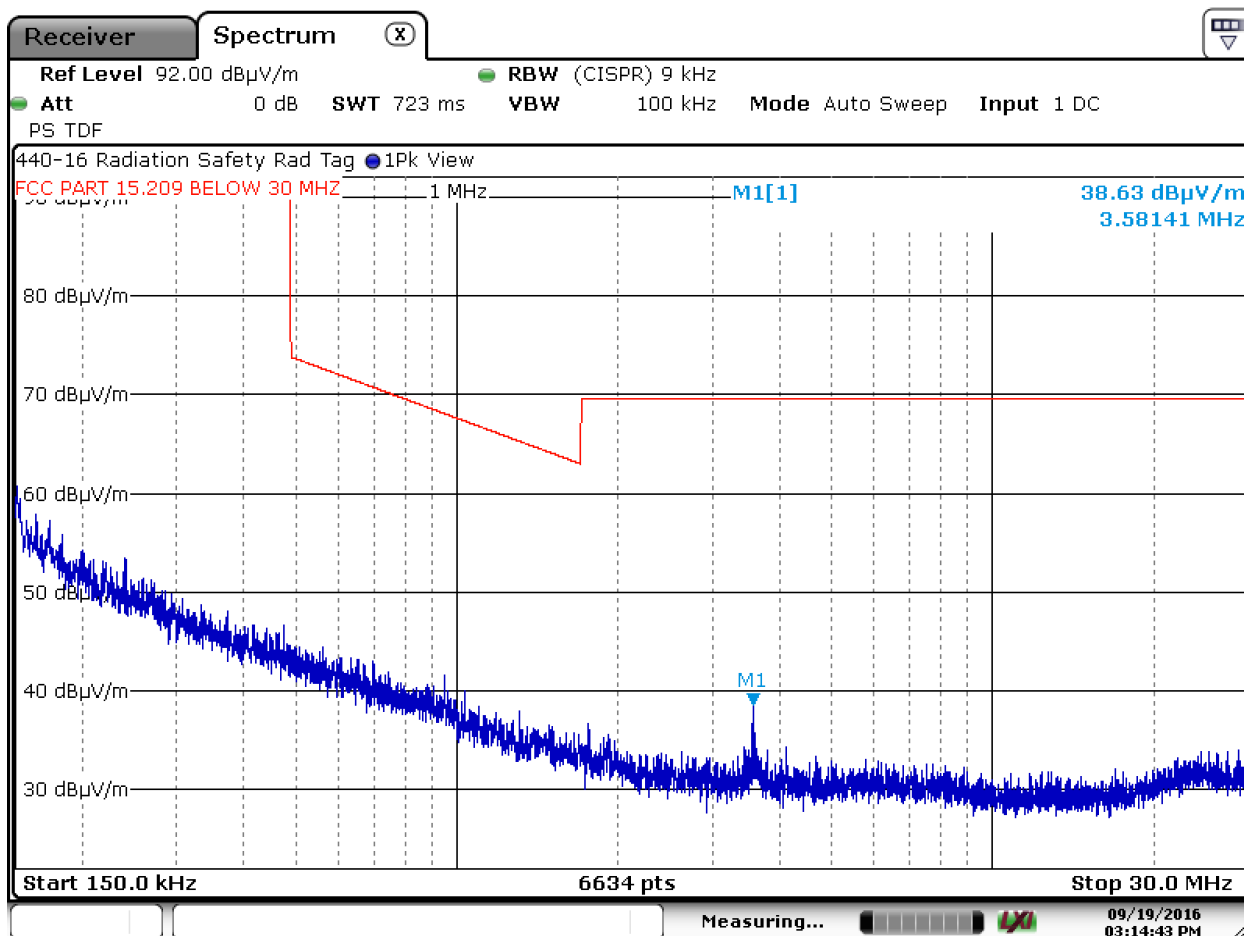
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.3 Parallel Measurement Antenna – 150 kHz to 30 MHz



Date: 19.SEP.2016 15:14:43

Test Number: 440-16

Issue Date: 9/30/2016

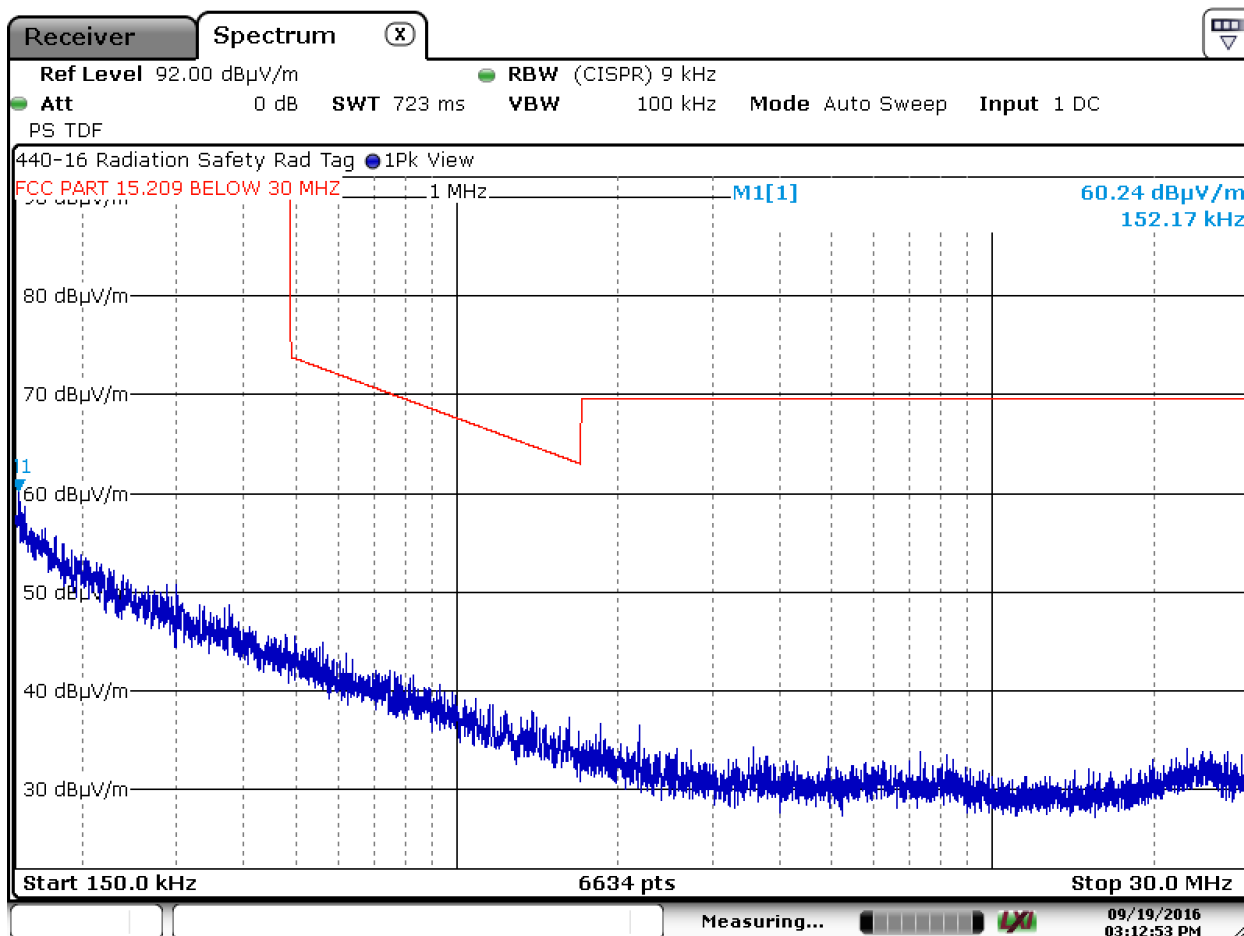
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.4 Perpendicular Measurement Antenna – 150 kHz to 30 MHz



Date: 19.SEP.2016 15:12:53

Test Number: 440-16

Issue Date: 9/30/2016

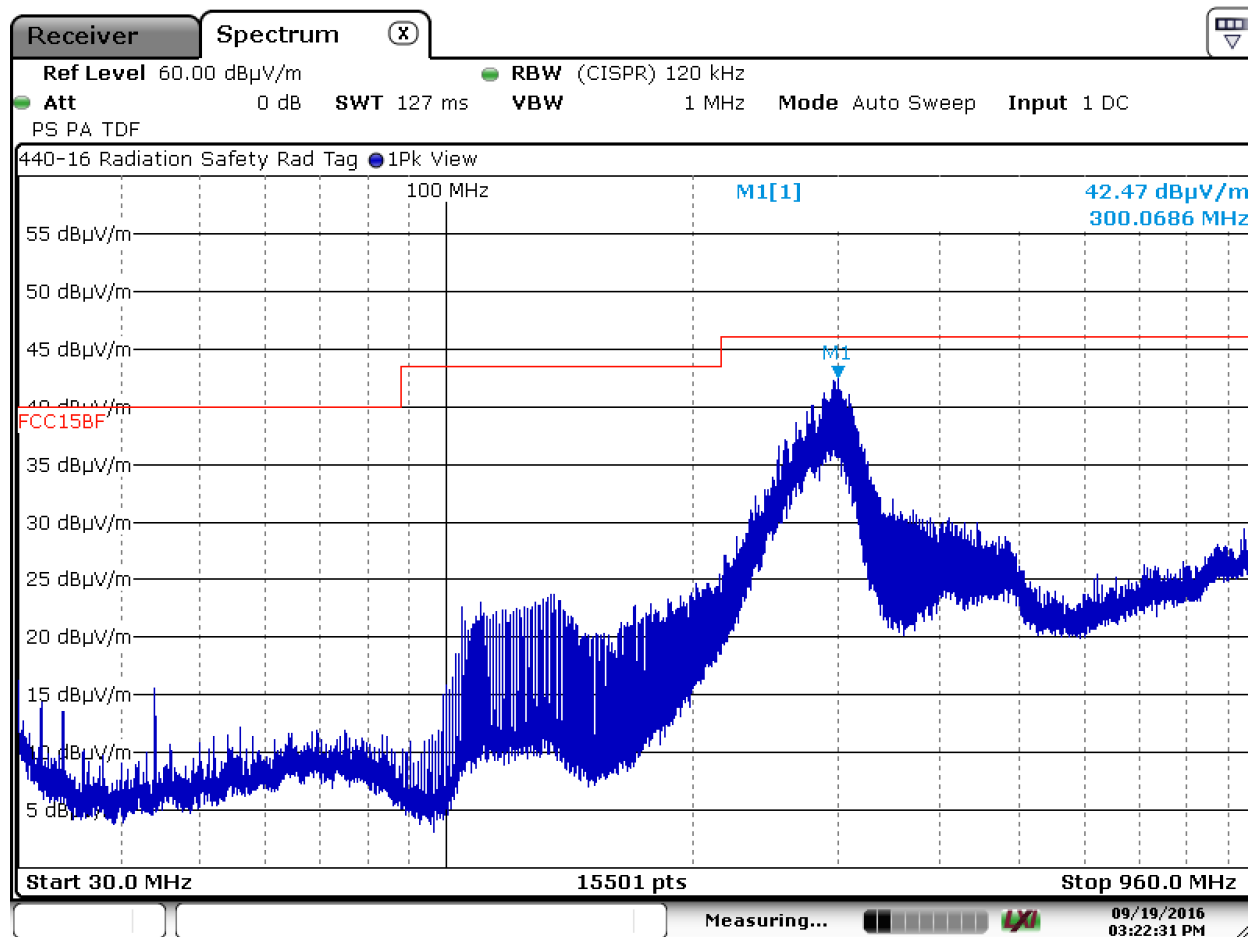
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4)

6.4.1. 10 MHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no emissions within 6 dB of the limits below 960 MHz on our 3 Meter OATS.

6.4.1.5 Horizontal Polarity – 30 to 960 MHz



Date: 19.SEP.2016 15:22:31

Test Number: 440-16

Issue Date: 9/30/2016

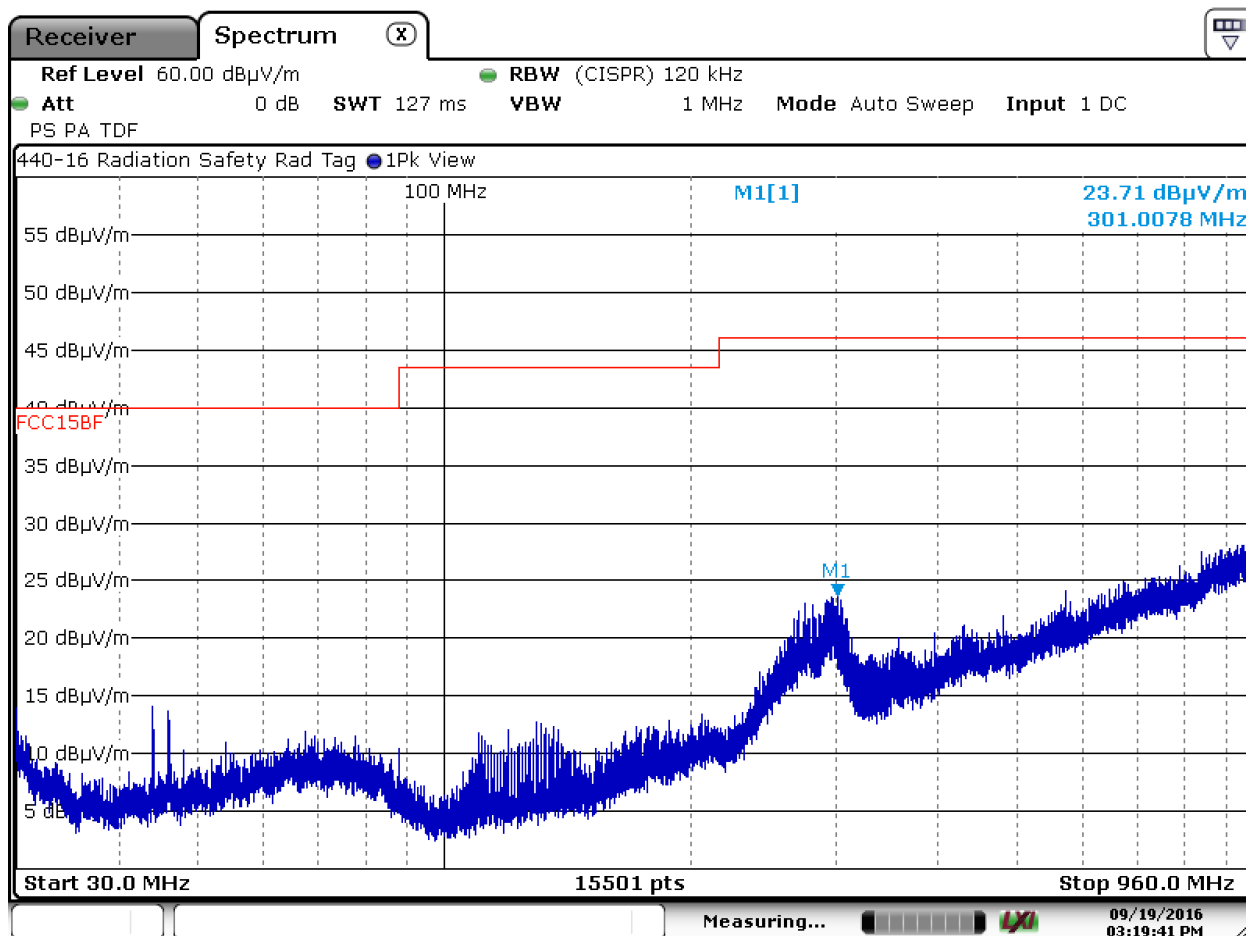
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4)

6.4.1. 10 MHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.6 Vertical Polarity – 30 to 960 MHz



Date: 19.SEP.2016 15:19:41

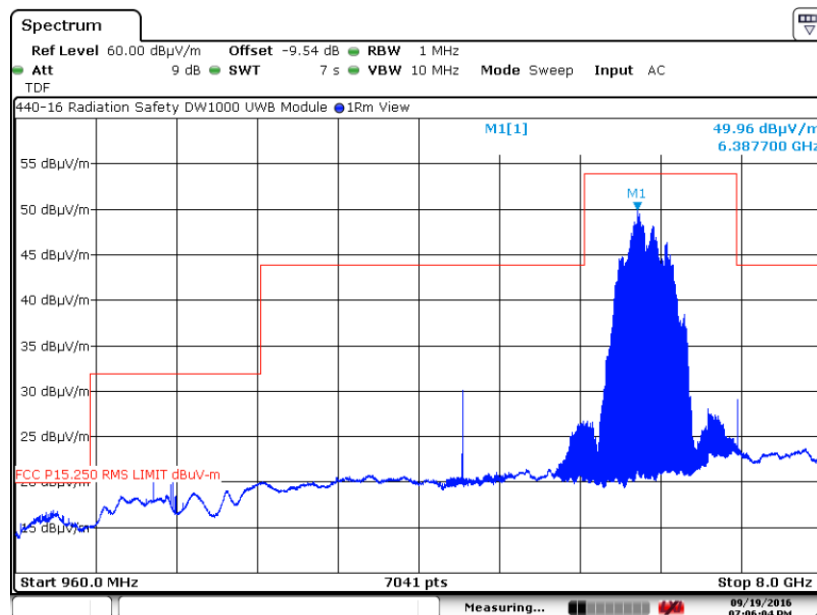
Test Number: 440-16

Issue Date: 9/30/2016

6. Measurement Data (continued)

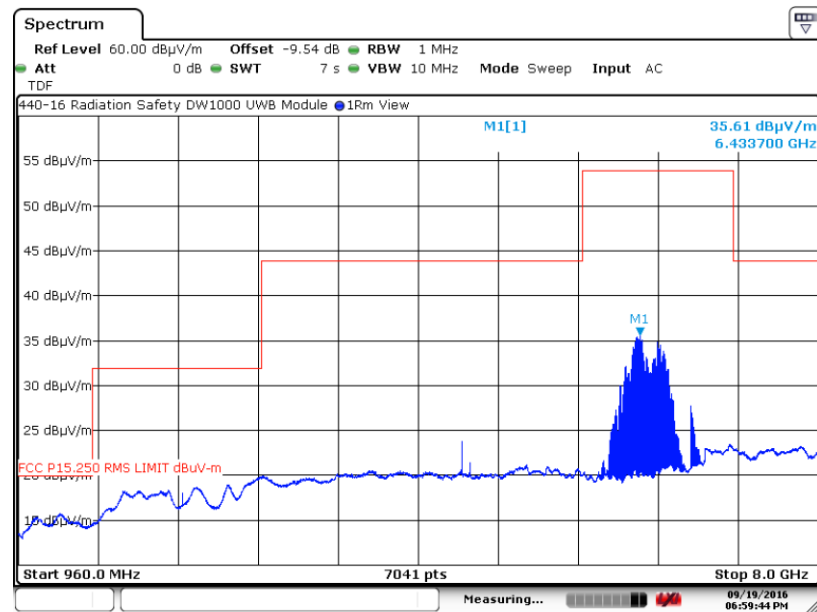
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1(d))

6.4.2. 960 MHz to 8 GHz Horizontal at 1 Meter (FCC Limits)



Date: 19.SEP.2016 19:06:03

6.4.3. 960 MHz to 8 GHz Vertical at 1 Meter (FCC Limits)



Date: 19.SEP.2016 18:59:43

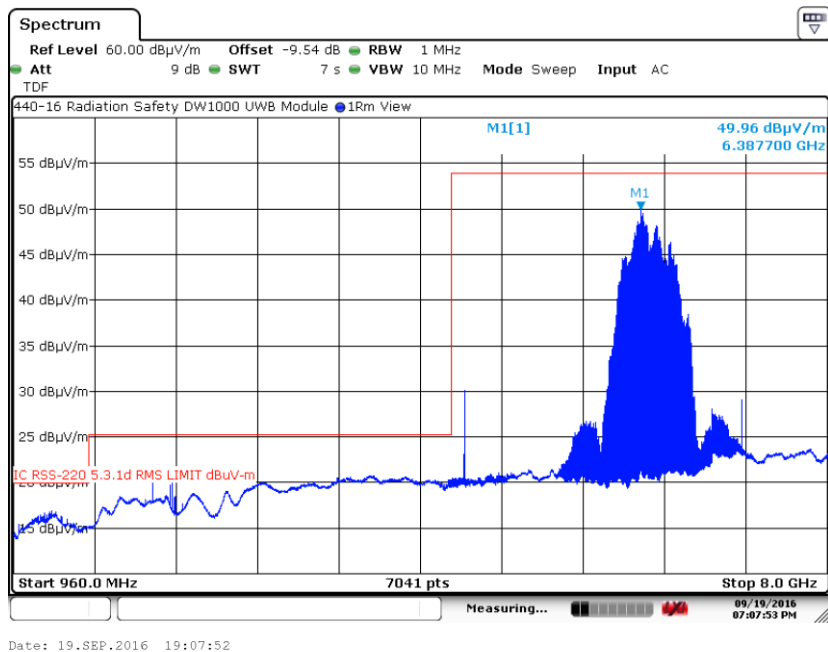
Test Number: 440-16

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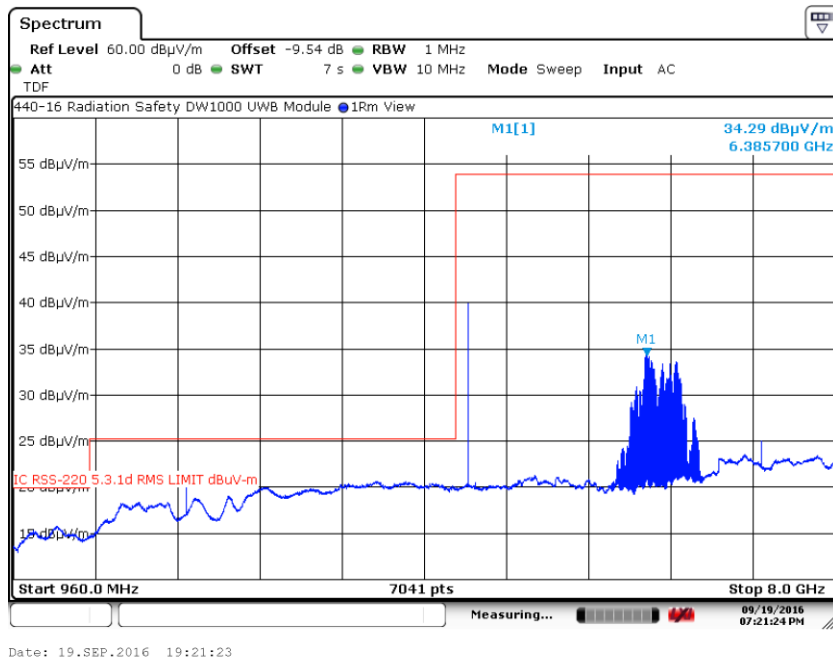
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1(d))

6.4.4. 960 MHz to 8 GHz Horizontal at 1 Meter (IC Limits)



6.4.5. 960 MHz to 8 GHz Vertical at 1 Meter (IC Limits)



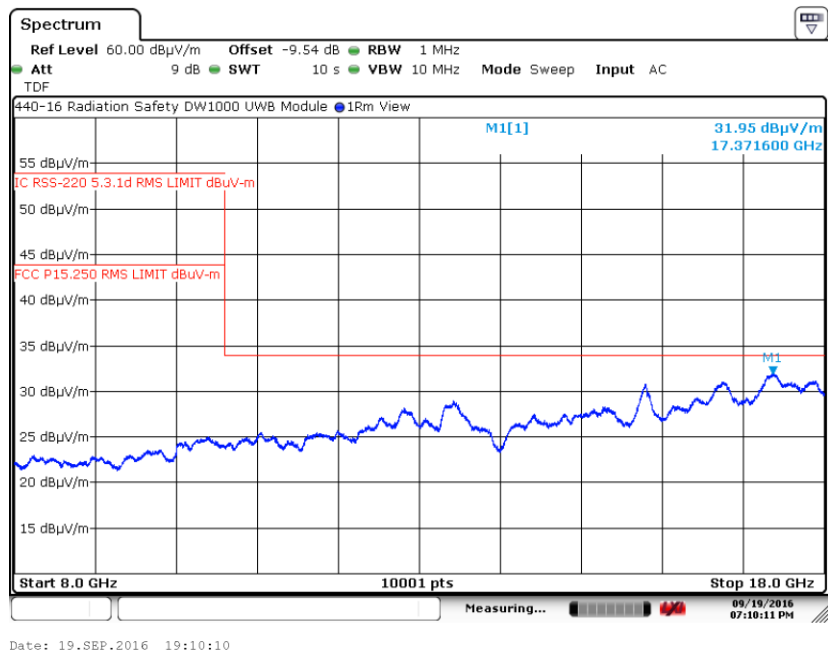
Test Number: 440-16

Issue Date: 9/30/2016

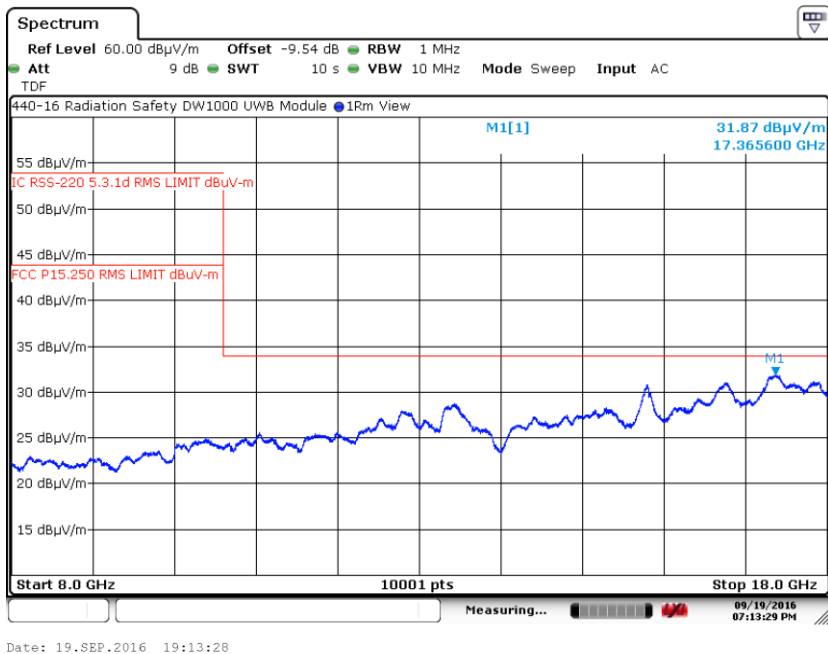
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1(d))

6.4.6. 8 to 18 GHz Horizontal at 1 Meter



6.4.7. 8 to 18 GHz Vertical at 1 Meter



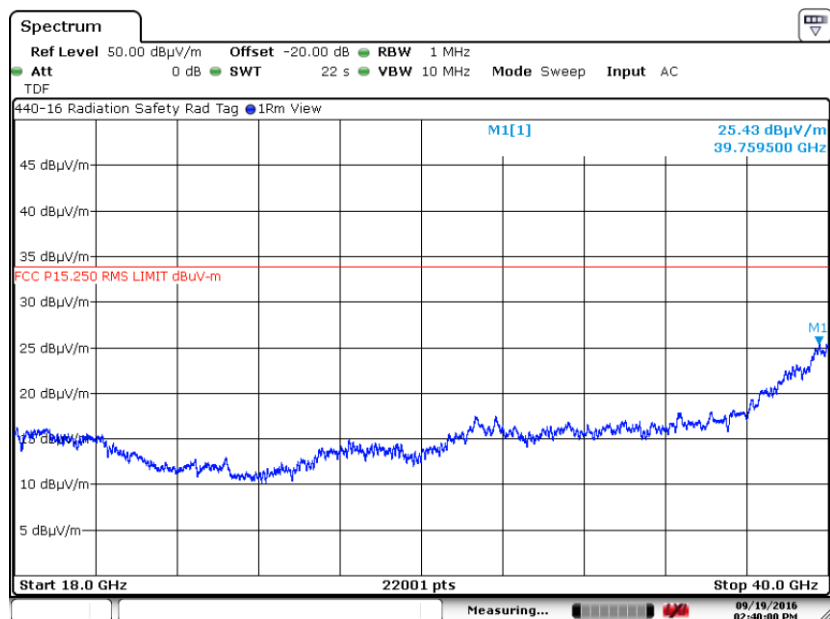
Test Number: 440-16

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6. Measurement Data (continued)

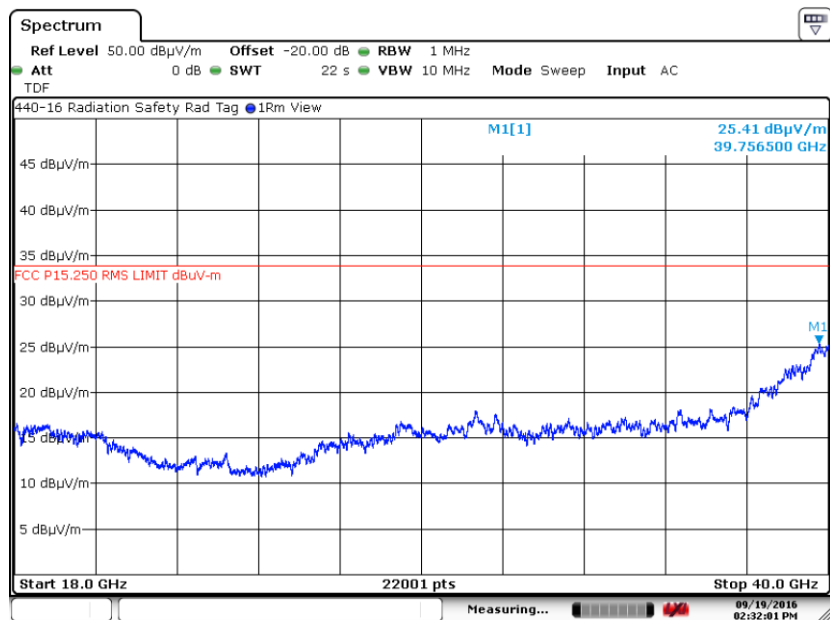
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d))

6.4.8. 18 to 40 GHz Horizontal at 0.3 Meter



Date: 19.SEP.2016 14:39:59

6.4.9. 18 to 40 GHz Vertical at 0.3 Meter



Date: 19.SEP.2016 14:31:59

6. Measurement Data (continued)**6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))**

Requirement: In addition to the radiated emission limits specified in the table in paragraph (d) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
1164 - 1240	-85.3	9.9
1559 - 1610	-85.3	9.9

6.5.1. Measurement & Equipment Setup

EMI Receiver IF Bandwidth: 1 kHz
EMI Receiver Avg Bandwidth: 10 kHz
Detector Function: RMS

6.5.2. Test Procedure

Test measurements were made in accordance with ANSI C63.10:2013, American National Standard for Testing Unlicensed Wireless Devices.

6.5.3. 1164 to 1240 MHz & 1559 to 1610 MHz

There were no broadband emissions related to the UWB transmitter. Measured signals were narrowband and related to the microprocessor / clocks and do not fall under the requirements of this section. Measurements were made at 3 Meters and the -85.3 dBm limit was converted to a field strength limit of 9.9 dBuV/m using a distance correction factor of 95.2.

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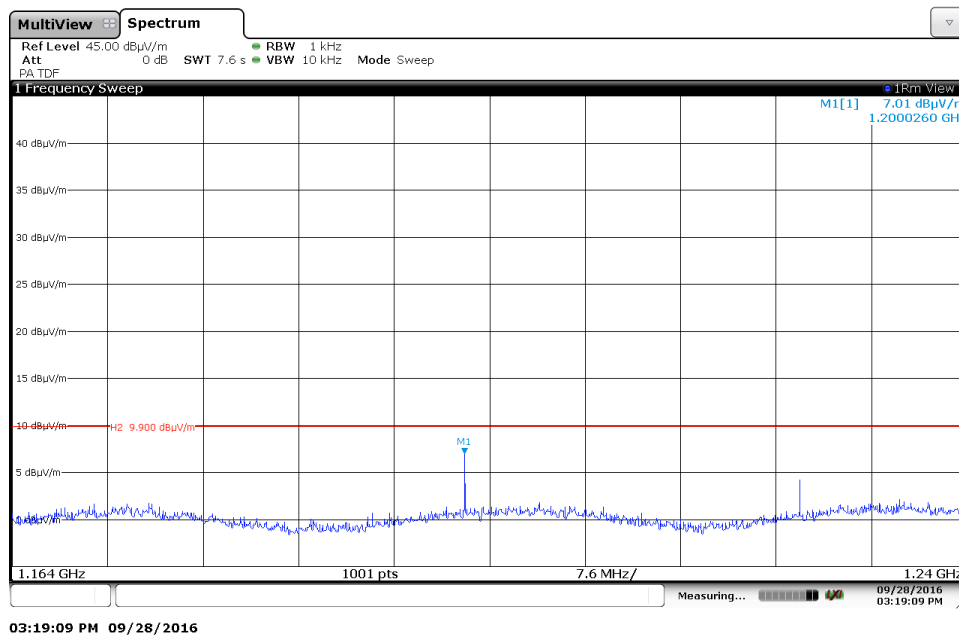
Issue Date: 9/30/2016

6. Measurement Data (continued)

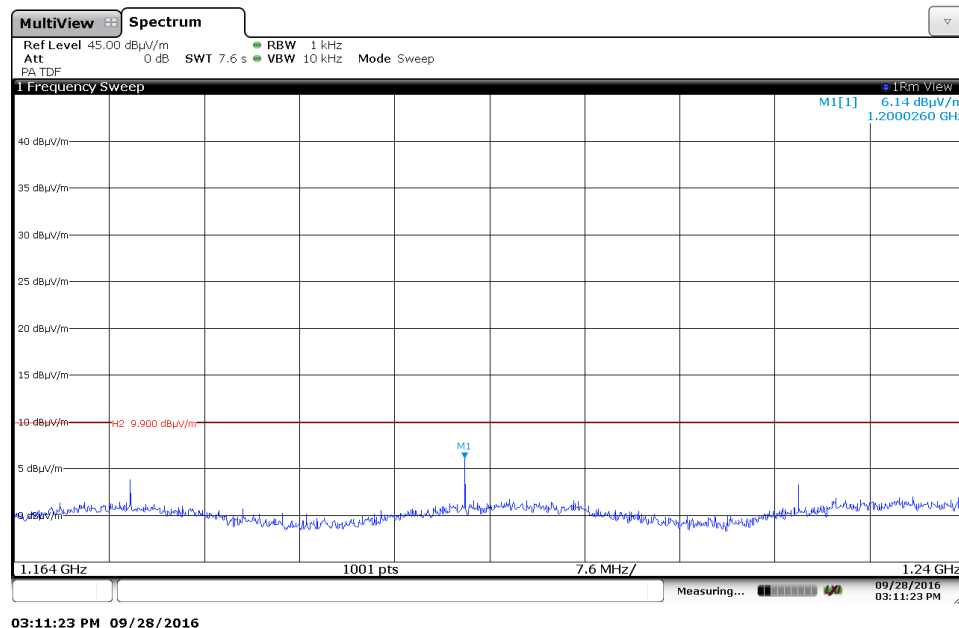
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.2 1164 to 1240 MHz Band

6.5.2.1 Horizontal Measurement Polarity 1164 to 1240 MHz



6.5.2.2 Vertical Measurement Polarity 1164 to 1240 MHz



Test Number: 440-16

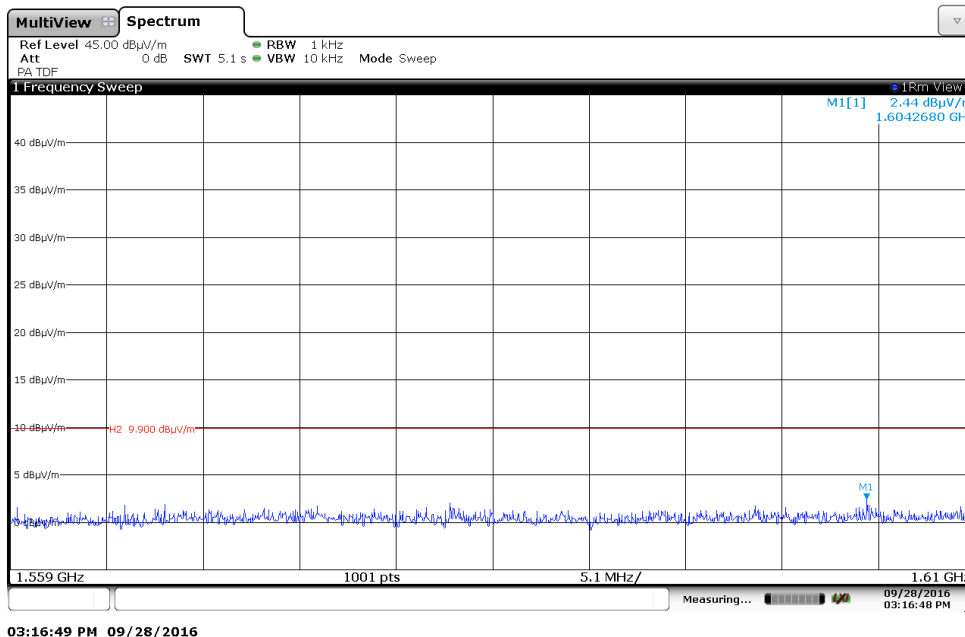
Issue Date: 9/30/2016

6. Measurement Data (continued)

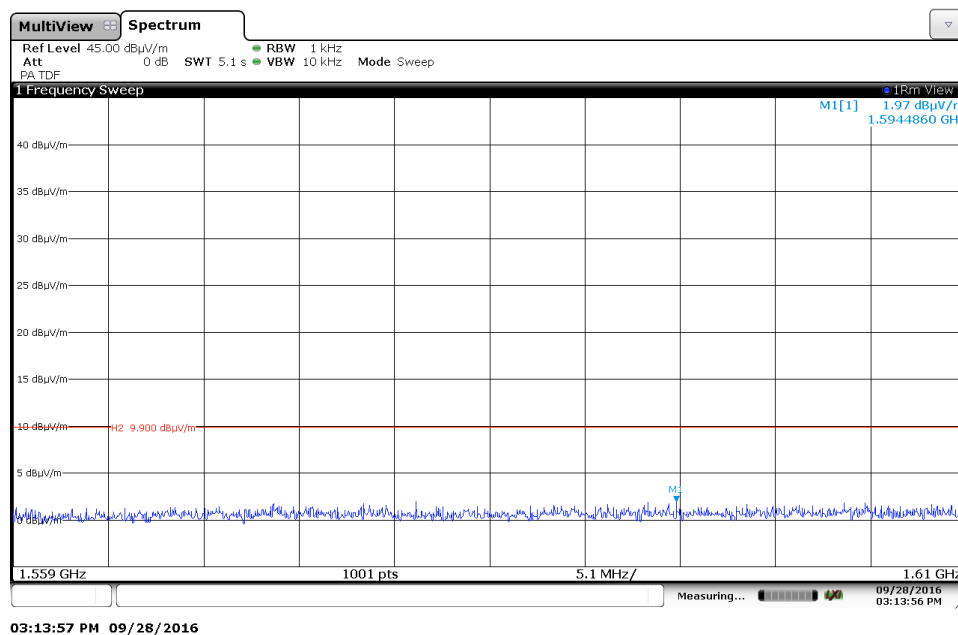
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.3 1559 to 1610 MHz Band

6.5.3.1 Horizontal Measurement Polarity 1559 to 1610 MHz



6.5.3.2 Vertical Measurement Polarity 1559 to 1610 MHz



6. Measurement Data (continued)

6.6. RMS Power in a 1 MHz Bandwidth (15.250 (d) (1), RSS-220 5.3.1 (d))

Requirement: The limit for operation in the 5925 to 7250 MHz band is -41.3 dBm EIRP.

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBμV/m)	(dBμV/m)	(dB)	H/V	cm	Deg	
6.509	51.87	53.90	-2.03	H	100	4	Compliant

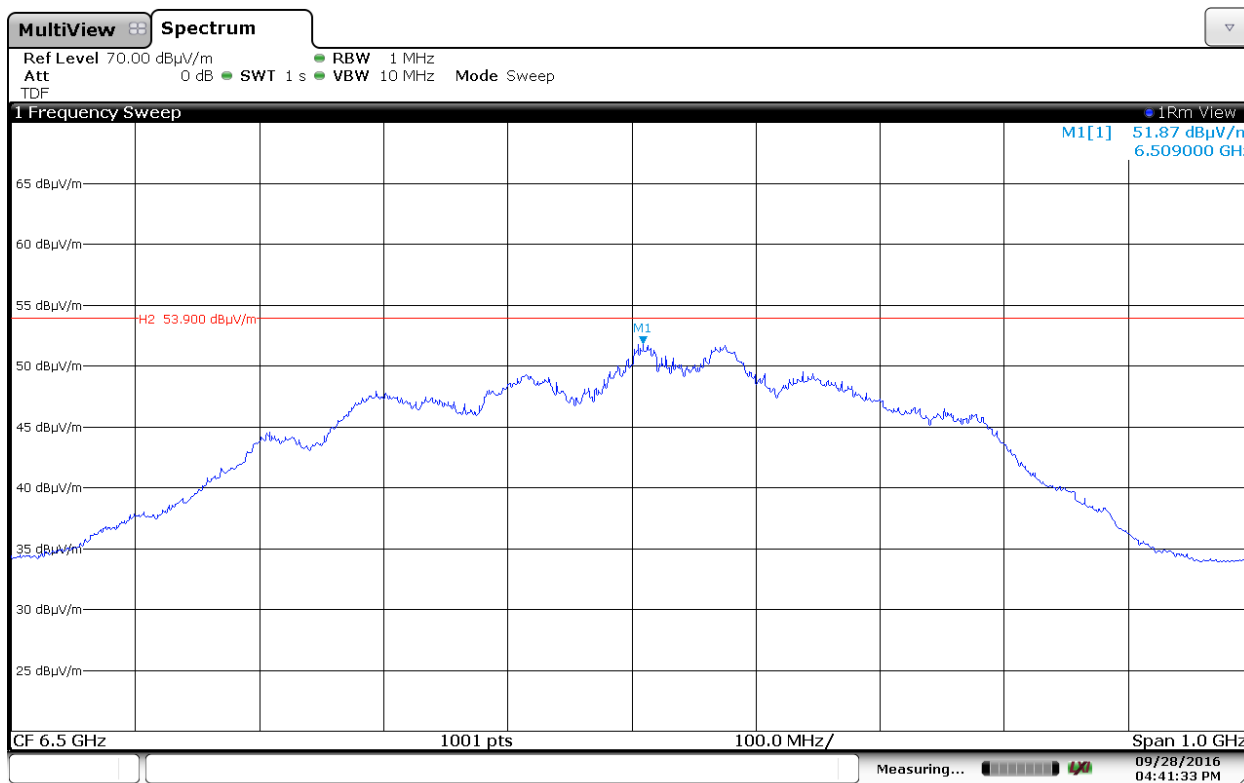
Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

$EIRP (dBm) = E_{meas} (dBμV/m) - 95.2$

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.509	-43.33	-41.30	-2.03	H	100	4	Compliant

6.6.1. Plot of RMS Power at 3 Meters



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6. Measurement Data (continued)

6.7. Peak Emissions in a 50 MHz Bandwidth (15.250 (d) (3), RSS-220 5.3.1 (g))

Requirement: There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M . That limit is 0 dBm EIRP.

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBμV/m)	(dBμV/m)	(dB)	H/V	cm	Deg	
6.6508	93.13	95.20	-2.03	H	100	4	Compliant

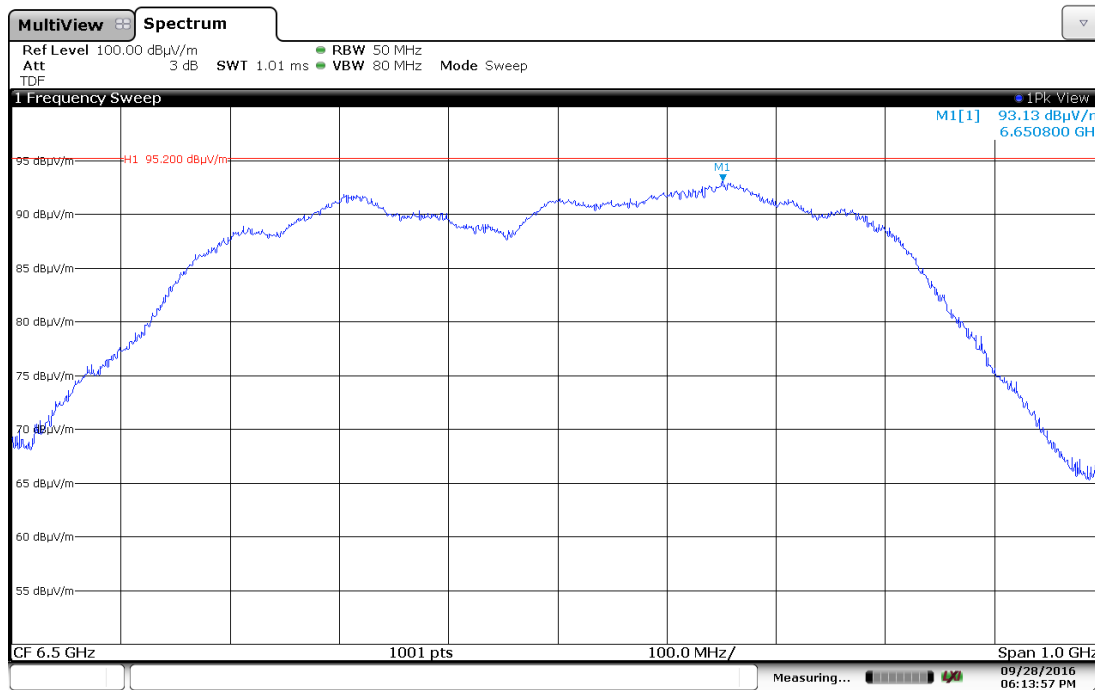
Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

$EIRP (dBm) = E_{meas} (dBμV/m) - 95.2$

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.6508	-2.03	0.00	-2.03	H	100	4	Compliant

6.7.1 Plot of Peak Power at 3 Meters



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6. Measurement Data (continued)

6.8 Conducted Emissions Test Setup

6.8.1. Regulatory Limit: FCC Part 15.207, RSS-GEN

Frequency Range (MHz)	Limits (dBµV)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5.0	56	46
5.0 to 30.0	60	50

* Decreases with the logarithm of the frequency.

6.8.2 Measurement Equipment and Software Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
EMI Receiver	Hewlett Packard	8546A	3330A00115	6/2/2017
RF Filter Section	Hewlett Packard	85460A	3325A00121	6/2/2017
LISN	EMCO	3825/2	9109-1860	7/21/2017
Manufacturer	Software Description		Title/Model #	Rev.
Compliance Worldwide	Test Report Generation Software		Test Report Generator	1.0

6.8.3. Measurement & Equipment Setup

Test Date: 10/2/2016
 Test Engineer: Brian Breault
 Site Temperature (°C): 22.2
 Relative Humidity (%RH): 45.3
 Frequency Range: 0.15 MHz to 30 MHz
 EMI Receiver IF Bandwidth: 9 kHz
 EMI Receiver Avg Bandwidth: 30 kHz
 Detector Functions: Peak, Quasi-Peak. & Average

6.8.4. Test Procedure

Test measurements were made in accordance with ANSI C63.4-2014, Standard Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 9 kHz to 40 GHz.

Test Number: 440-16

Issue Date: 9/30/2016

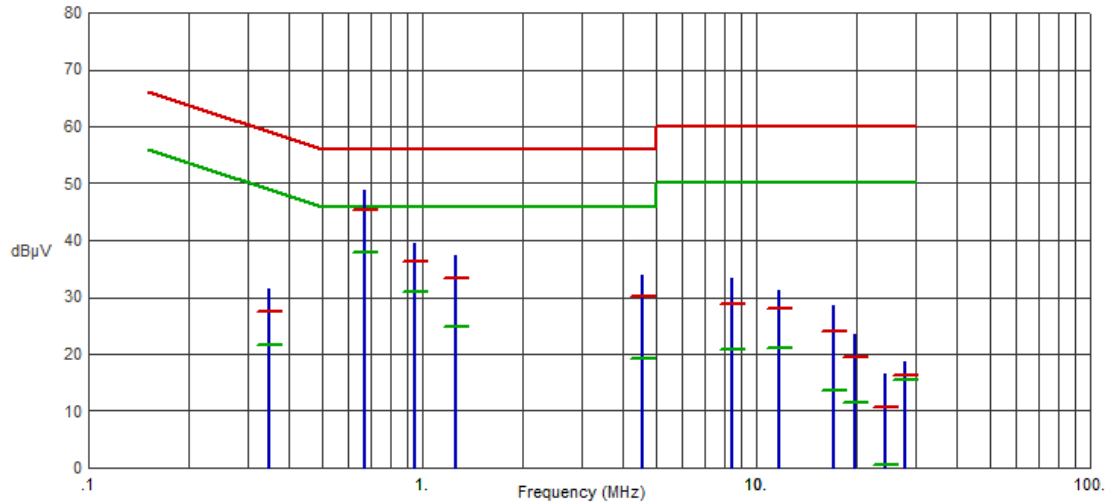
6. Measurement Data (continued)

6.9 Conducted Emissions Test Results

6.9.1 120 Volts, 60 Hz Phase

Test No.: 440-16, 120 Volts, 60 Hz Phase

FCC, Class B



Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
.3470	31.53	27.44	59.03	-31.59	21.67	49.03	-27.36	
.6720	48.73	45.36	56.00	-10.64	37.90	46.00	-8.10	
.9452	39.38	36.22	56.00	-19.78	30.84	46.00	-15.16	
1.2604	37.43	33.29	56.00	-22.71	24.81	46.00	-21.19	
4.5411	33.98	30.04	56.00	-25.96	19.17	46.00	-26.83	
8.4269	33.37	28.83	60.00	-31.17	20.76	50.00	-29.24	
11.7039	31.29	27.99	60.00	-32.01	21.12	50.00	-28.88	
17.0864	28.48	24.07	60.00	-35.93	13.56	50.00	-36.44	
19.7836	23.49	19.50	60.00	-40.50	11.52	50.00	-38.48	
24.3002	16.60	10.61	60.00	-49.39	0.54	50.00	-49.46	
28.0015	18.54	16.36	60.00	-43.64	15.37	50.00	-34.63	

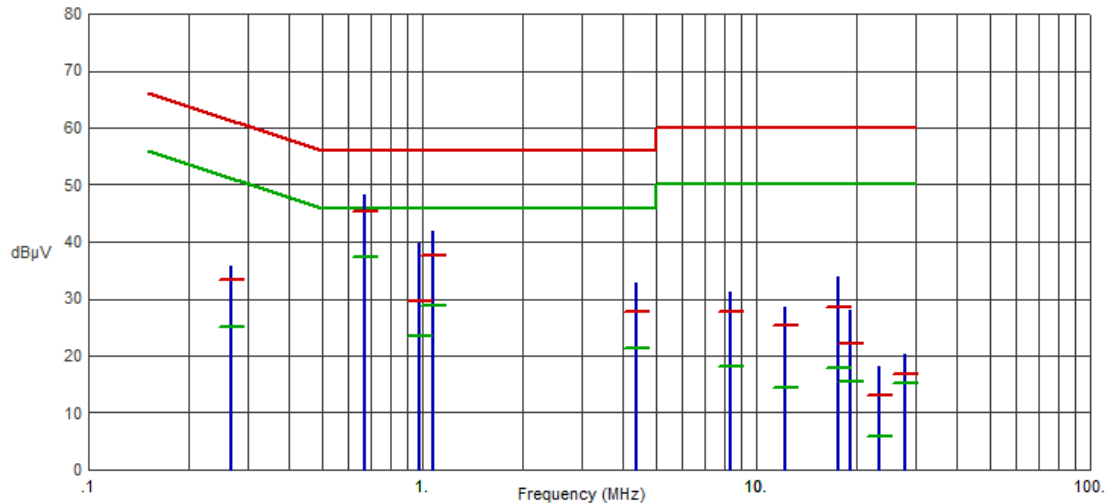
6. Measurement Data (continued)

6.9. Conducted Emissions Test Results (continued)

6.9.2. 120 Volts, 60 Hz Neutral

Test No.: 440-16, 120 Volts, 60 Hz Neutral

FCC, Class B



Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
.2667	35.86	33.38	61.22	-27.84	25.17	51.22	-26.05	
.6737	48.35	45.40	56.00	-10.60	37.29	46.00	-8.71	
.9773	39.75	29.50	56.00	-26.50	23.39	46.00	-22.61	
1.0716	41.92	37.49	56.00	-18.51	28.84	46.00	-17.16	
4.3614	32.80	27.84	56.00	-28.16	21.35	46.00	-24.65	
8.3374	31.12	27.65	60.00	-32.35	18.00	50.00	-32.00	
12.1916	28.62	25.41	60.00	-34.59	14.50	50.00	-35.50	
17.5094	33.78	28.51	60.00	-31.49	17.78	50.00	-32.22	
19.1434	27.88	22.06	60.00	-37.94	15.40	50.00	-34.60	
23.3036	18.23	12.94	60.00	-47.06	5.89	50.00	-44.11	
27.9995	20.20	16.81	60.00	-43.19	15.22	50.00	-34.78	

6. Measurement Data (continued)

6.10. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1))

6.10.1. SAR Test Exclusion Calculation

Requirement: Portable devices as defined in § 2.1093 of this chapter operating under Part 15 are subject to radio frequency radiation exposure requirements as specified in §§ 1.1307(b) and 2.1093 of this chapter.

For a 1-g SAR, the test exclusion result must be ≤ 3.0 .

Test Notes: The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by the following formula:

$$\text{SAR Test Exclusion} = \frac{P_{\text{MAX}}}{d_{\text{MIN}}} \times \sqrt{f_{(\text{GHz})}} \quad (1)$$

P_{MAX} mW Maximum power of channel, including tune-up tolerance

d_{MIN} mm Minimum test separation distance, mm (≤ 50 mm)

$f_{(\text{GHz})}$ GHz $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz (>100 MHz and <6 GHz)

(1) FCC OET 447498 - Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

Result: The device under test meets the exclusion requirement detailed in FCC OET 447498.

Zigbee			
Input:	P_{MAX}	2.970	mW
	d_{MIN}	5.000	mm
	$f_{(\text{GHz})}$	2.480	GHz
Test Exclusion:		0.94	
Limit Exemption:		3.00	

¹ RF Power Taken from FCC Grant.

The device does not exceed the test limit exemption and therefore a routine SAR Evaluation is not required

Note: The transmitters never operate simultaneously.

6. Measurement Data (continued)

6.10. Public Exposure to Radio Frequency Energy Levels (RSS-GEN, RSS-102)

Public Exposure to Radio Frequency Energy Levels 1.1307 (b)(1), RSS-GEN, Issue 4 Section 3.2, RSS 102

6.10.2. RSS-102 Issue 5 Requirements

Requirement: SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. Portable devices are subject to radio frequency radiation exposure requirements.

Test Notes: The limit was taken from Table 1 of RSS-102 Issue 5.

Frequency (MHz)	Separation Distance (mm)	Maximum Power (mW)	RSS-102 Limit (mW)	Result
2480	≤5	2.97	3.84	Compliant

6.10.3 RF Exposure for devices that operate above 6 GHz

Center Frequency (GHz)	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	Power Density		FCC Limit (mW/cm ²)	IC Limit (W/m ²)
				(mW/cm ²)	(W/m ²)		
	(1)	(2)	(3)	(4)		(5)	(6)
6.6508	5	-2.03	0.8	0.0023980	0.0239801	1	10

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

- 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 5 centimeters of the body of the user.
- Section 6.7 of this test report.
- Data supplied by the client.
- Power density is calculated from field strength measurement and antenna gain.
- Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure.
- Reference IC RSS-102 Section 4 Table 4 RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

7. 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 the Federal Communications Commission (FCC) and Industry Canada standards. Through our American Association for Laboratory Accreditation (A2LA) ISO Guide 17025:2005 Accreditation our test sites are designated with the FCC (designation number **US1091**), Industry Canada (file number **IC 3023A-1**) and VCCI (Member number 3168) under registration number A-0208.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 22, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 11, KN 13, KN 14-1, KN 22, KN 32, KN 61000-6-3, KN 61000-6-4.

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. A second conducted emissions site is also located in the basement of the OATS site with a 2.3 x 2.5 meter ground plane and a 2.4 x 2.4 meter vertical wall.

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

8. Test Images

8.1. Spurious and Harmonic Emissions – 10 kHz to 1 GHz Front



8. Test Images

8.2. Spurious and Harmonic Emissions – 10 kHz to 30 MHz Rear



8. Test Images

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



8. Test Images

8.4. Spurious and Harmonic Emissions – 1 to 18 GHz Front



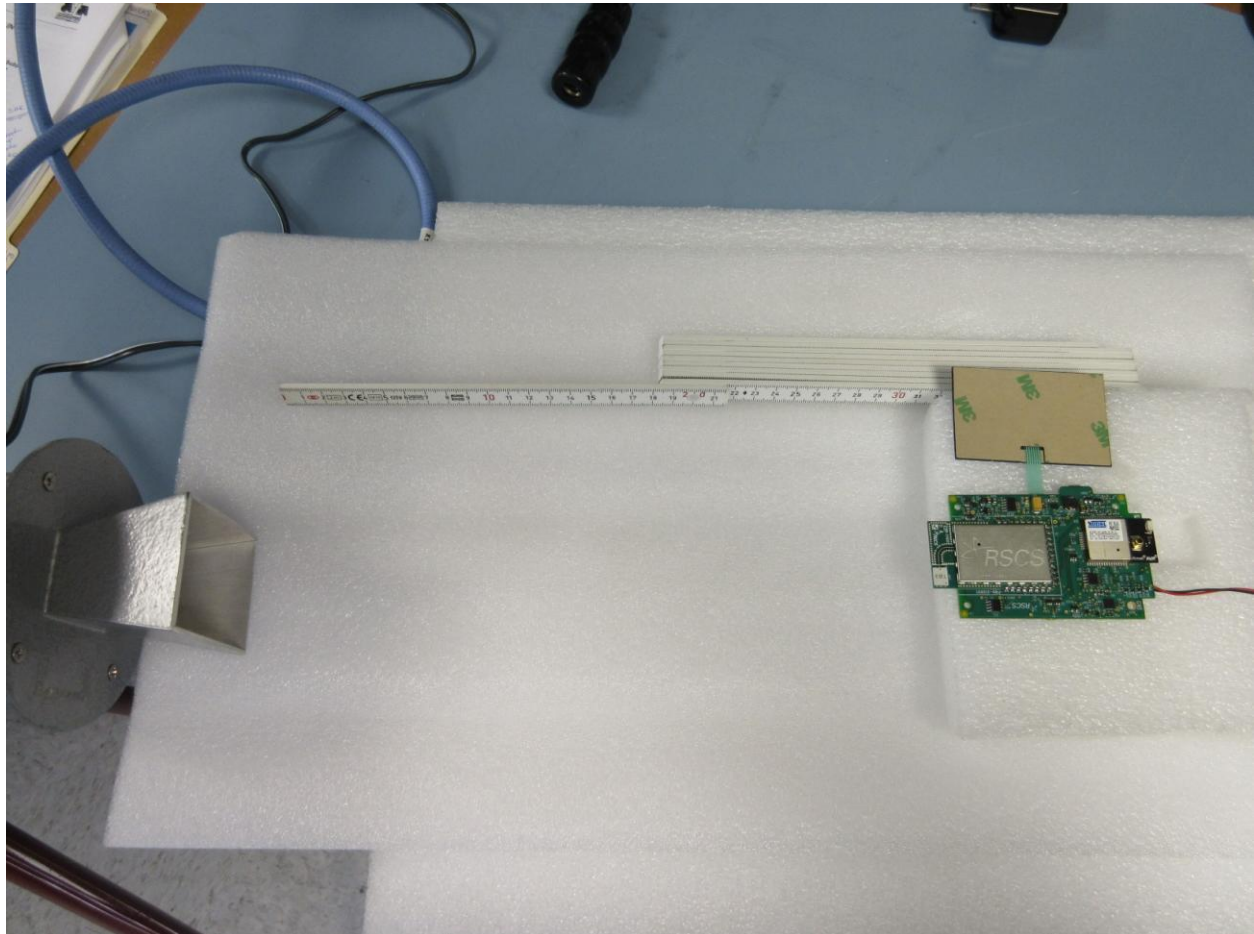
8. Test Images

8.5. Spurious and Harmonic Emissions – 1 to 18 GHz Rear



8. Test Images

8.5. Spurious and Harmonic Emissions – 18 to 40 GHz Side



8. Test Images

8.7. Conducted Emissions (Front)



8. Test Images

8.8. Conducted Emissions (Rear)



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8. Test Images

8.9. Frequency Stability (Setup)

