

**COMPLIANCE WORLDWIDE INC.
TEST REPORT 215-18**

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**

**ISED RSS-220, Issue 1 (March 2009) + Amendment 1 (July 2018)
Devices Using Ultra-Wideband (UWB) Technology**

Issued to

**DecaWave Ltd.
Adelaide Chambers, Peter Street
Dublin, Ireland D08 T6YA**

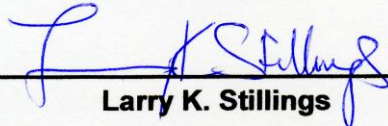
For the

DWM1001C

**FCC ID: 2AQ33-DWM1001
IC: 23794-DWM1001**


Report Issued on October 2, 2018

Tested By



Larry K. Stillings

Reviewed By



Brian F. Breault

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1. Scope

This test report certifies that the Decawave Ltd DWM1001C as tested, meets the FCC Part 15.250, Subpart C and ISSED RSS-220 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:** Decawave Ltd
- 2.2. Model Number:** DWM1001C
- 2.3. Serial Number:** 18230049E4
- 2.4. Description:** The DWM1001 RTLS Module is a full-function real-time location system (or RTLS) subsystem in a compact factor. The DWM1001C module system enables customers to quickly get a RTLS system up-and-running. The system is design to operate on 6.490 GHz (Channel 5) Centre Frequencies Nominal with a 500 MHz Bandwidth and a data rate of 6.8 Mbps only.
- 2.5. Power Source:** 2.8 - 3.6 VDC
- 2.6. Hardware Revision:** N/A
- 2.7. Software Revision:** N/A
- 2.8. Modulation Type:** Pulse Modulation, Frequency Hopping
- 2.9. Operating Frequency:** 6.49 GHz Center Frequency Nominal (Channel 5 – 500 MHz BW)
- 2.10. EMC Modifications:** None

3. Product Configuration

3.1 Operational Characteristics & Software

Hardware Setup:

Using a terminal emulator the DWM1001 was configured to transmit on Channel 5 using a preamble length of 128, a 64M PRF with a data rate of 6.8 MBPS.

During the measurement testing, the product was mounted on a polystyrene form to facilitate rotating the product 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 Arrow on the unit is facing the antenna at 0°
- Y-Axis Arrow on the unit is facing the antenna at 90°
- Z-Axis Arrow on the unit is facing the antenna at 0°

3.2. Cables

Cable Type	Length	Shield	From	To
None				

3. Product Configuration (cont.)

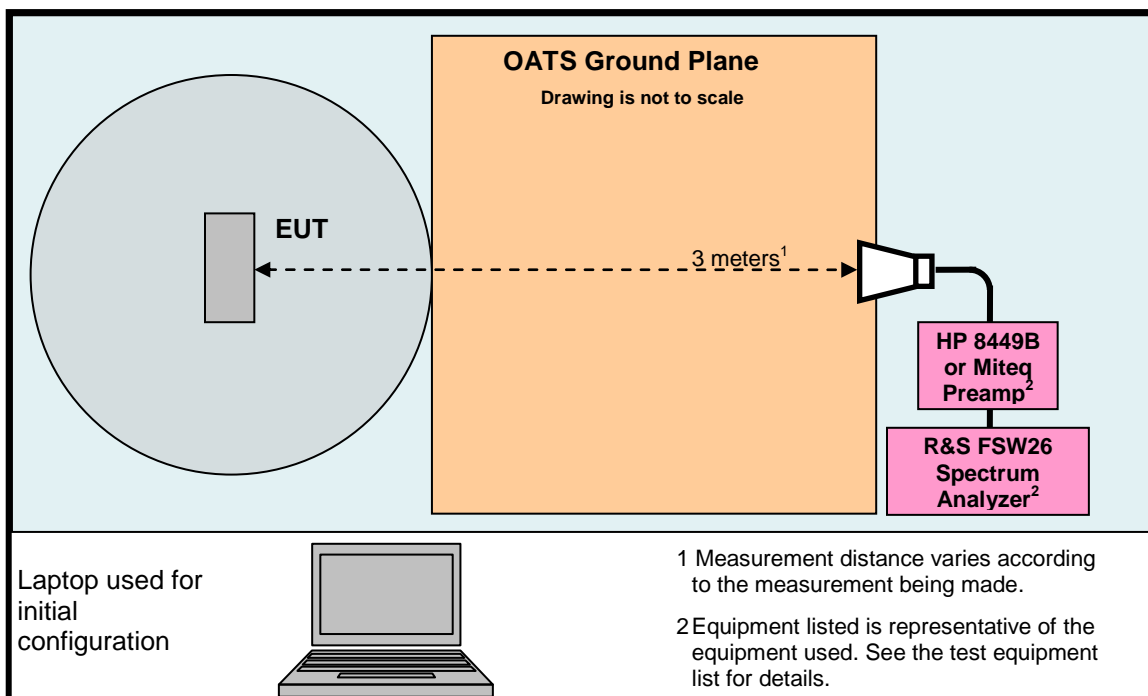
3.3. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
Decawave	DWM1001C	18230049E4	3.6	DC	UWB/BLE Module

3.4. Support Equipment

Manufacturer	Model/Part #	Serial Number	Description
Dell	Inspiron E1505	5573349937	Laptop for Initial Configuration

3.5. Test Setup Diagram



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	9/10/2020	2 Years
Spectrum Analyzer 9 kHz to 40 GHz	Rohde & Schwarz	FSV40	100899	9/10/2020	2 Years
Spectrum Analyzer 10 Hz to 40 GHz	Rohde & Schwarz	FSVR40	100909	5/3/2019	2 Years
Spectrum Analyzer 3 Hz to 26.5 GHz	Rohde & Schwarz	FSW26	102044	9/13/2020	2 Years
Biconilog Antenna 30 MHz to 2 GHz	Sunol Sciences	JB1	A050913	6/3/2019	3 Years
Loop Antenna 9 kHz to 30 MHz	EMCO	6512	9309-1139	10/26/2019	3 Years
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3-00100200-10-15P-4	988773	4/17/2020	2 Years
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	4/16/2019	1 Year
Preamplifier 2 to 12 GHz	JCA	JCA48-4111B1	7087S	4/17/2019	1 Year
Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	9/11/2020	2 Years
Preamplifier 18 to 40 GHz	Miteq	JSD42-21004200-40-5P	649199/649219	11/1/2019	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	10/9/2020	2 Years
High Pass Filter 8 to 18 GHz	Micro-Tronics	HPM50107	G036	7/20/2019	1 Year
2.4 GHz Band Pass Filter	Micro-Tronics	BRM50702	150	1/23/2019	1 Year
Barometer	Control Company	4195	Cal ID# 236	4/3/2020	2 Years

¹ ESR7 Firmware revision: V3.36, SP2 Date installed: 11/02/2017 Previous V3.36, installed 05/16/2017.
² FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016 Previous V2.30 SP1, installed 10/22/2014.
³ FSVR40 Firmware revision: V2.23 SP1, Date installed: 08/19/2016 Previous V2.23, installed 10/20/2014.
⁴ FSW26 Firmware revision: V2.80, Date installed: 10/28/2017 Previous V2.61, installed 04/04/2017.

4. Measurements Parameters (continued)

4.2. Measurement & Equipment Setup

Test Dates:	9/25/2018, 10/1/2018
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
EMI Receiver Avg Bandwidth:	1 MHz - Above 1 GHz
	300 Hz – 10 kHz to 150 kHz
	30 kHz – 10 to 30 MHz
Detector Function:	300 kHz - 30 MHz to 1 GHz
	3 MHz - Above 1 GHz
	Peak, Quasi-Peak, RMS & CISPR Average

4.3. Measurement Procedure

Test measurements were made in accordance FCC Parts 15.209, 15.250 Subpart C and ISED RSS-220, Issue 1 & A1.

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	ISED Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	RSS-220 5.1 (b)	6.1	Compliant	The antenna is an etched PCB 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	
Radio Frequency Exposure	FCC OET Bulletin 65 1.1307 (b) (1)	RSS-102, Issue 5	6.10	Compliant	

6. Measurement Data

6.1. Antenna Requirement (15.203, RSS-220 5.1 (b))

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 PCB etched type, non user replaceable unit.

6.2. Operational Requirements of the Device under Test (15.250 (a), RSS-220)

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	Measured Frequency (MHz)	-10 dB Band Edges		15.250 Frequency Band		Result
			Lower	Upper	F _{MIN} (MHz)	F _{MAX} (MHz)	
-	OATS	6439.1	6194.3	6754.7	5925	7250	Compliant
-	Ambient	6493.4	6188.3	6790.4	5925	7250	Compliant
1	-20	6493.4	6135.1	6836.9	5925	7250	Compliant
2	-10	6484.8	6167.5	6811.7	5925	7250	Compliant
3	0	6495.2	6167.5	6812.1	5925	7250	Compliant
4	+10	6495.2	6167.7	6812.1	5925	7250	Compliant
5	+20	6494.8	6191.1	6811.9	5925	7250	Compliant
6	+30	6495.0	6194.7	6811.7	5925	7250	Compliant
7	+40	6494.6	6216.3	6764.6	5925	7250	Compliant
8	+50	6494.4	6218.5	6753.0	5925	7250	Compliant

6. Measurement Data (continued)

6.3. Wideband Bandwidth (15.250 (b), RSS-220 2, 5.1)

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

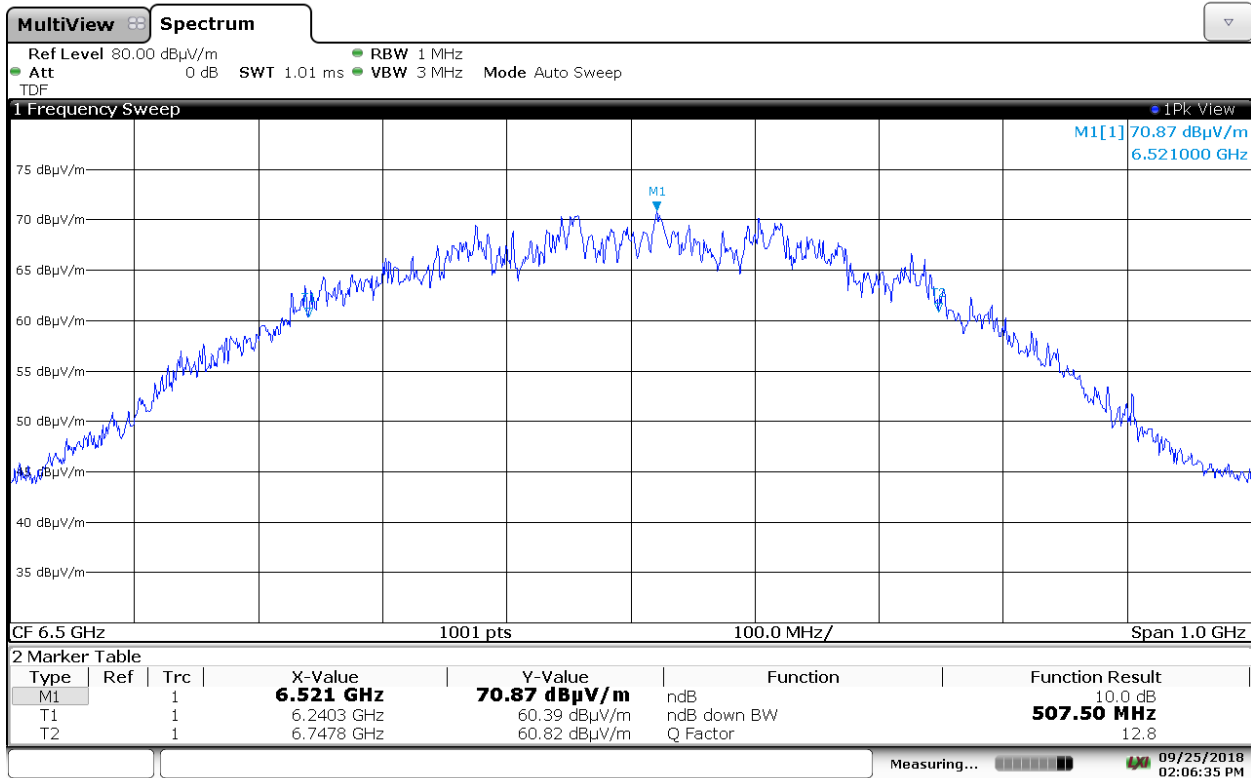
Result: Compliant

6.3.1. Measurement Data – Values in GHz

f_M	The highest emission peak	6.521
f_L	10 dB below the highest peak	6.2403
f_H	10 dB above the highest peak	6.7478
Bandwidth	Calculated: ($f_H - f_L$)	0.5075

6.3.2. Measurement Plot of 10 dB frequencies

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02:06:36 PM 09/25/2018

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209, RSS-220 3.4)

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	-41.3	53.9
Above 10,600	-61.3	33.9

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209, RSS-220 3.4 continued)

Radiated Emissions Field Strength Limits at 3 Meters (Section 15.250 (d),15.209)

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
EMI Receiver Avg Bandwidth (minimum):	1 MHz - Above 1 GHz
	300 Hz – 10 kHz to 150 kHz
	30 kHz – 150 kHz to 30 MHz
Detector Function:	300 kHz - 30 MHz to 1 GHz
	3 MHz - Above 1 GHz
	Peak, Quasi-Peak & Average

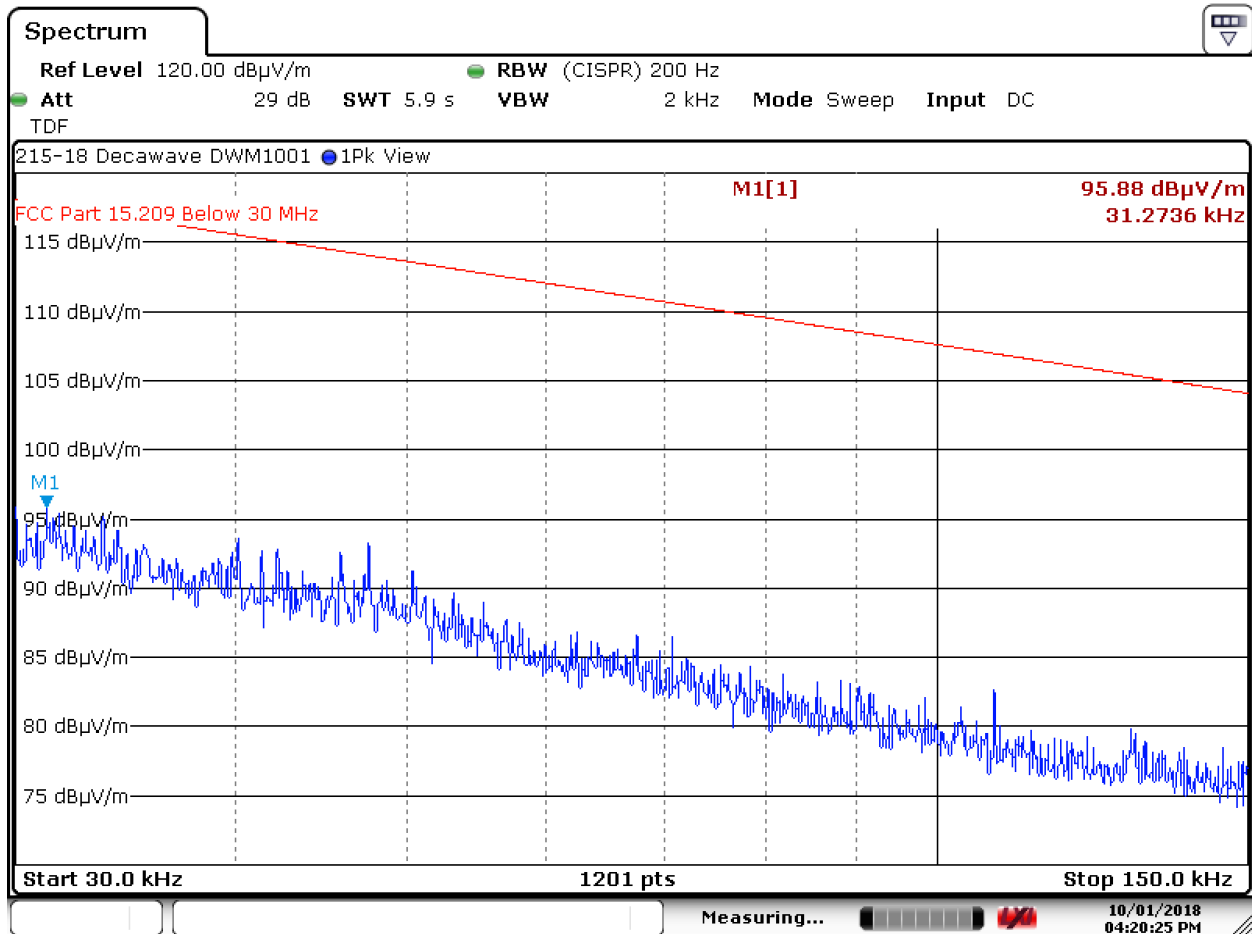
6. Measurement Data (continued)

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

6.4.1. 30 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 – 30 to 150 kHz



Date: 1.OCT.2018 16:20:22

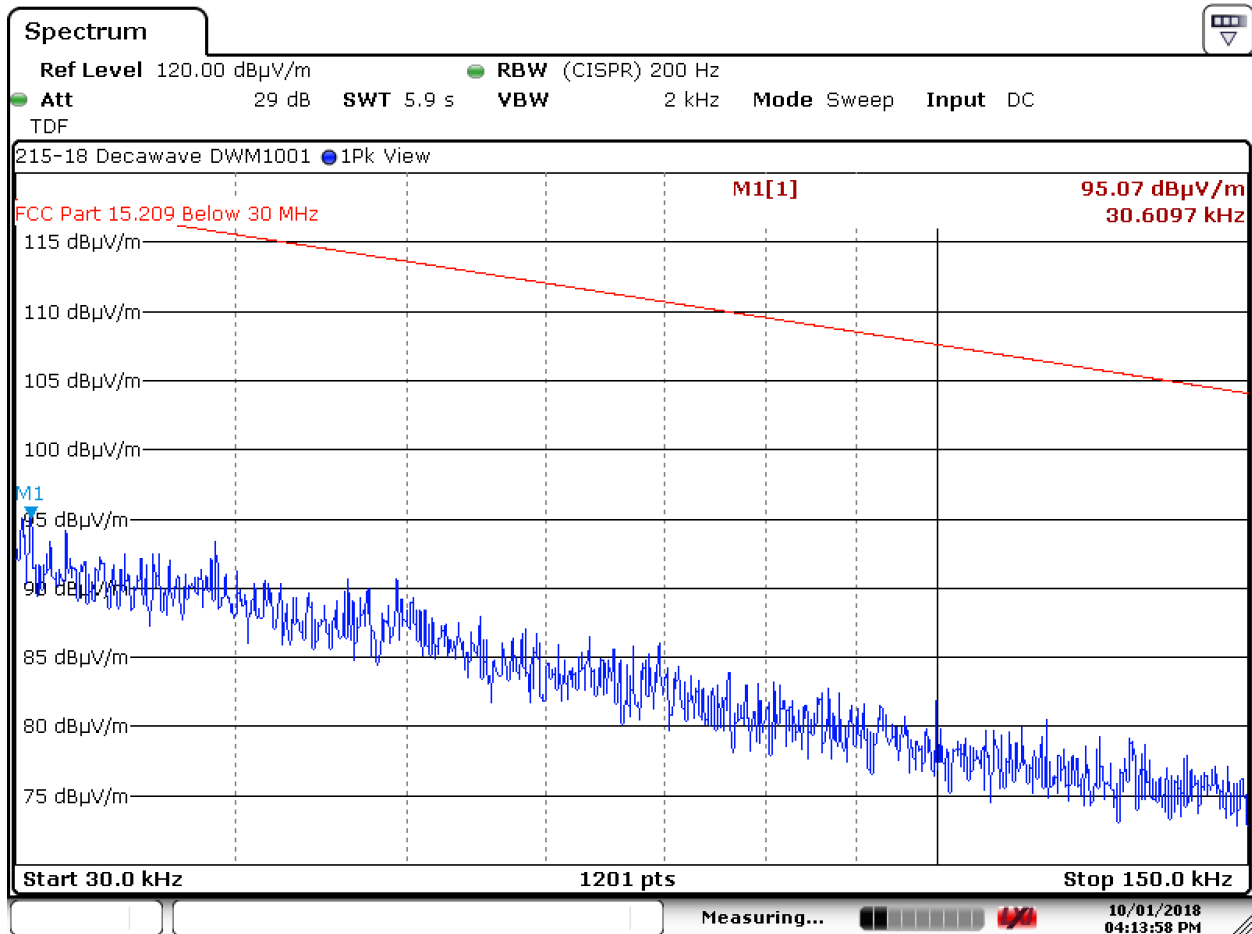
6. Measurement Data (continued)

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

6.4.1. 30 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 – 30 to 150 kHz



Date: 1.OCT.2018 16:13:56

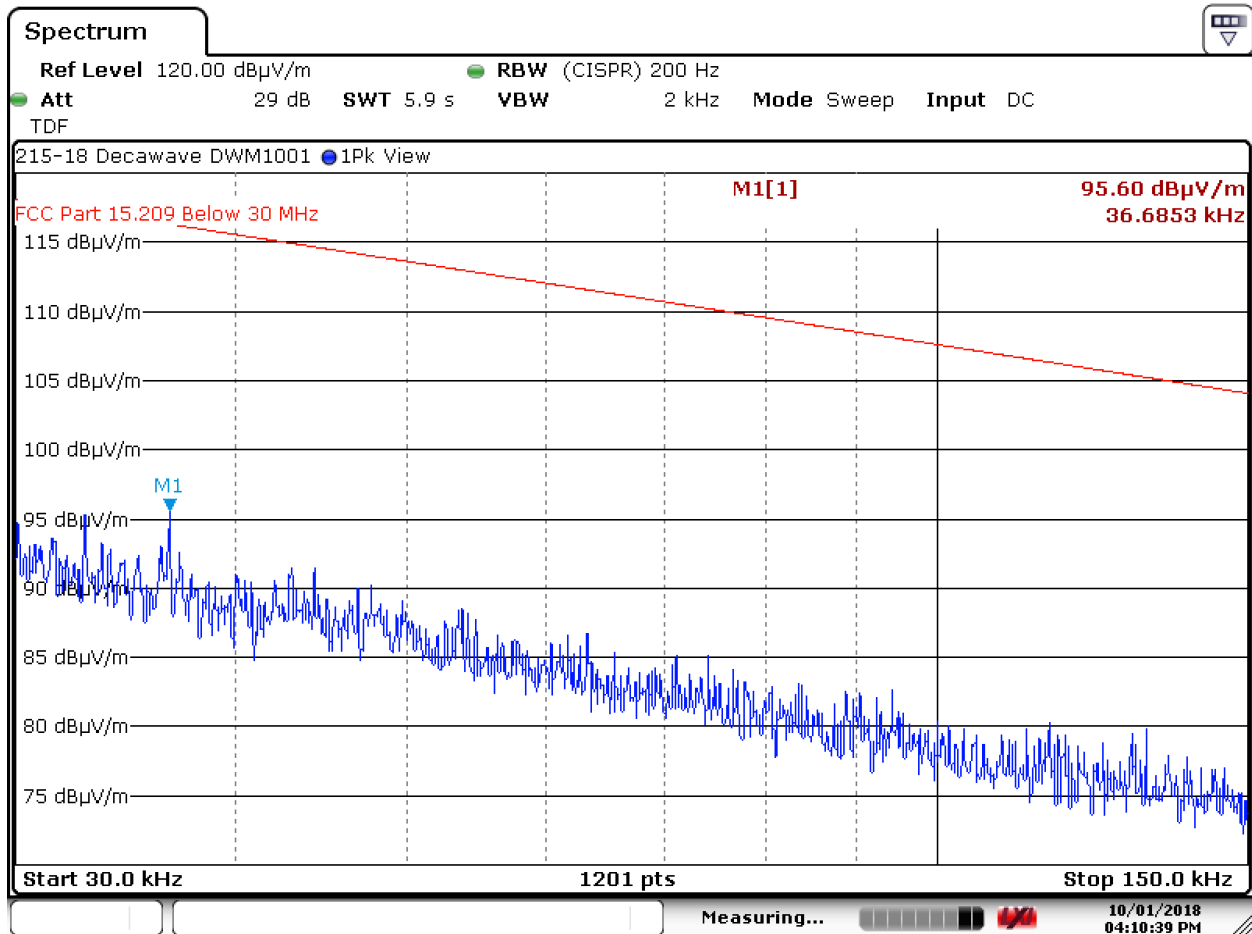
6. Measurement Data (continued)

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

6.4.1. 30 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 Ground Parallel Measurement Antenna – 30 to 150 kHz



Date: 1.OCT.2018 16:10:36

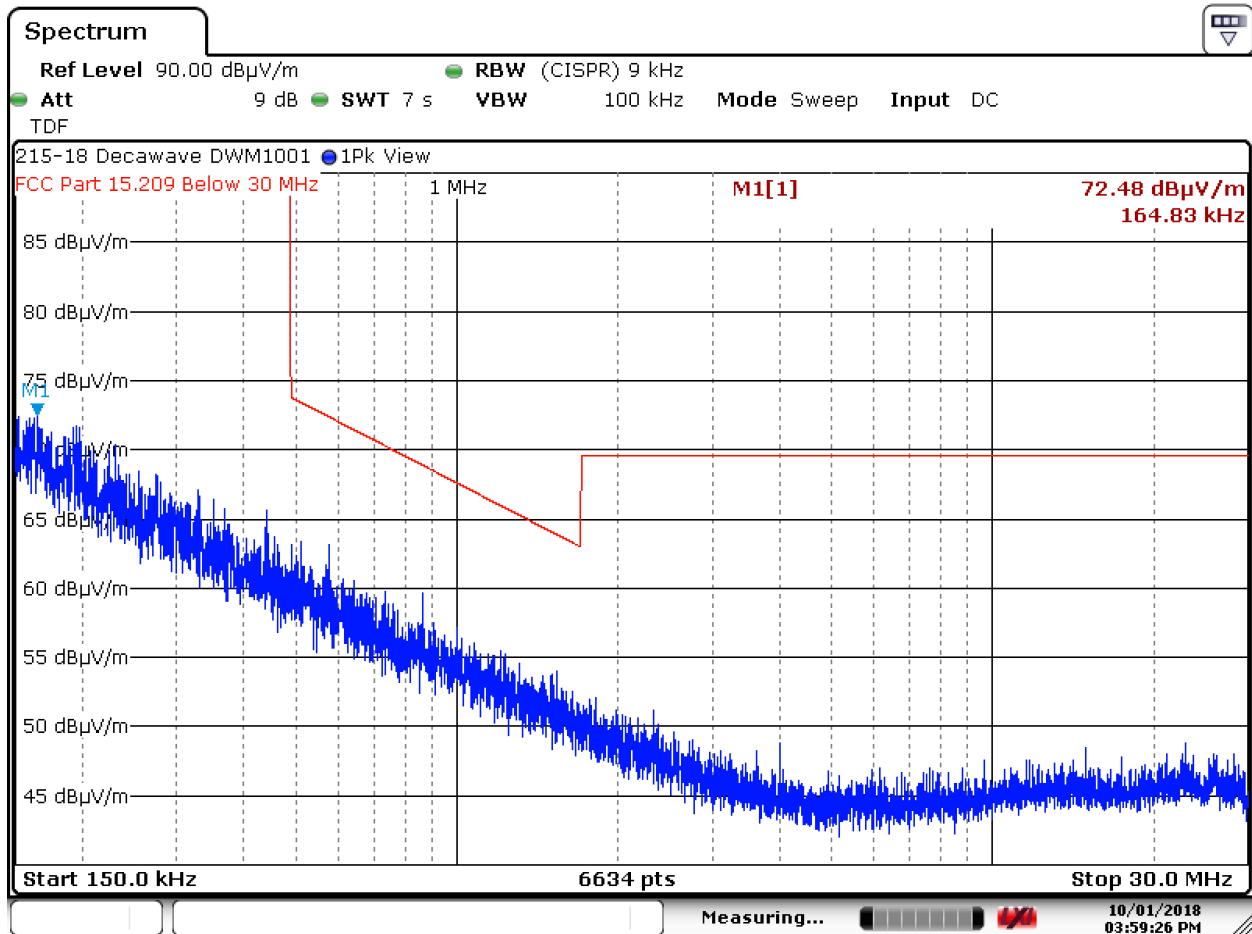
6. Measurement Data (continued)

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

6.4.1. 30 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 Parallel Measurement Antenna – 150 kHz to 30 MHz



Date: 1.OCT.2018 15:59:24

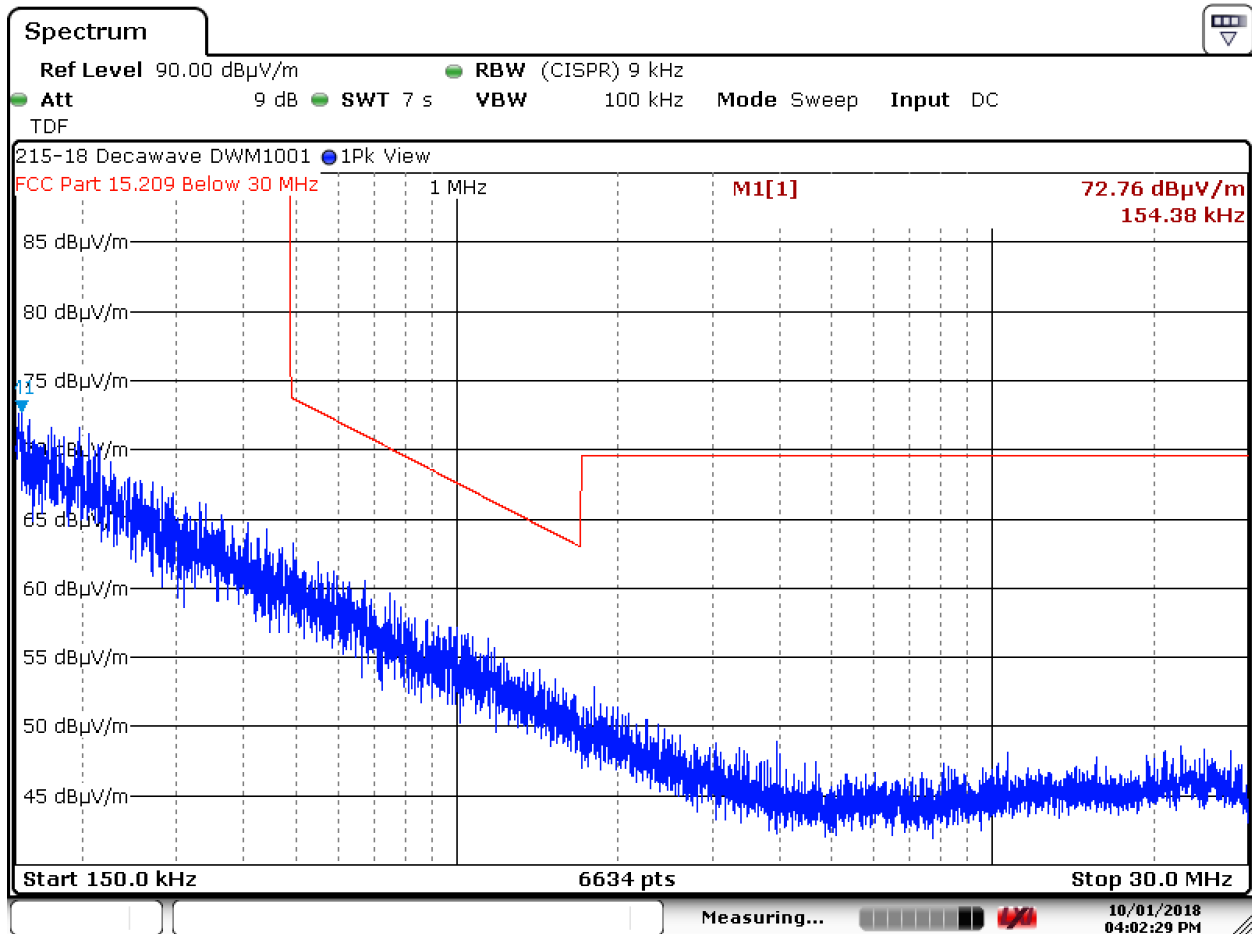
6. Measurement Data (continued)

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

6.4.1. 30 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.

6.4.1.5 Perpendicular Measurement Antenna – 150 kHz to 30 MHz



Date: 1.OCT.2018 16:02:26

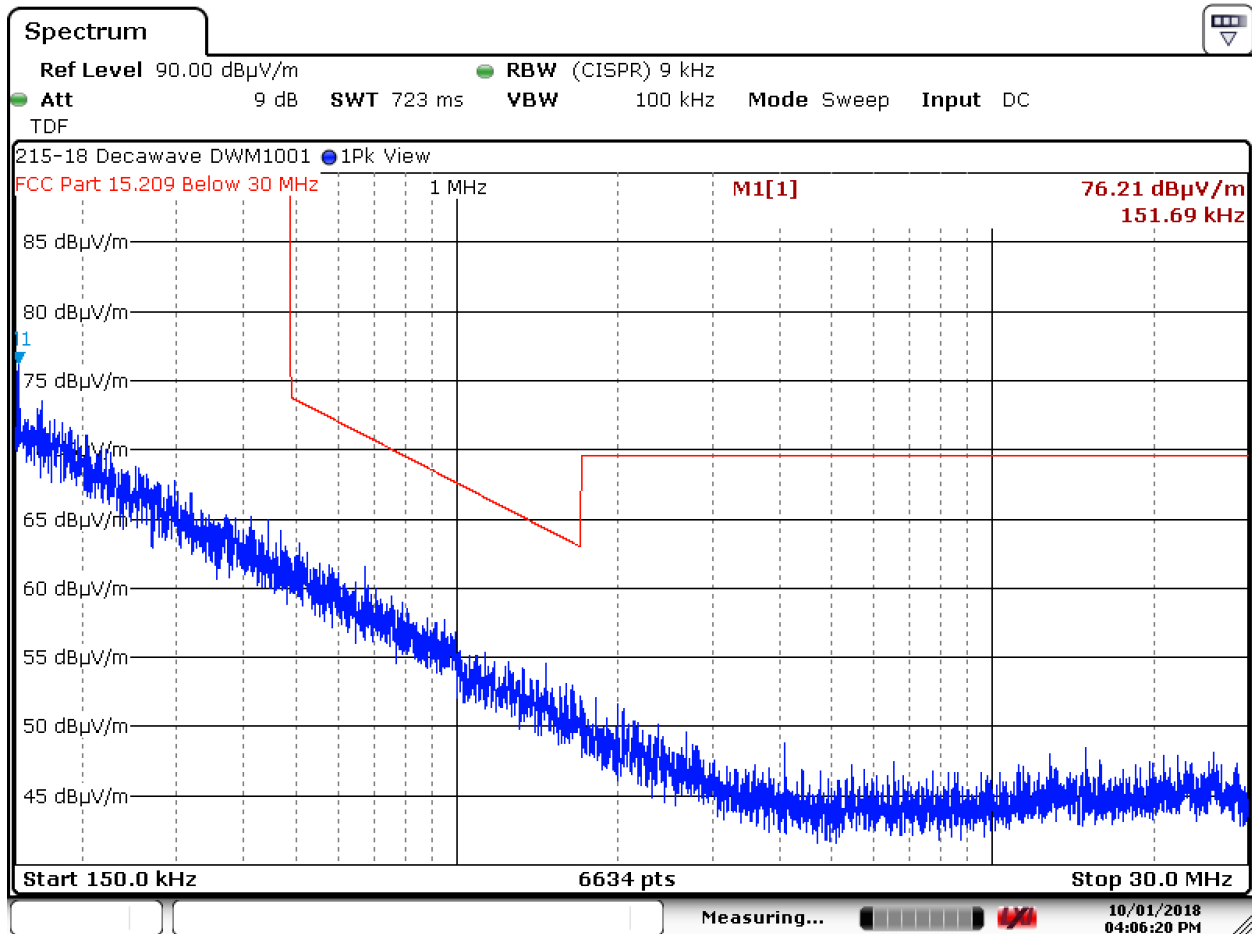
6. Measurement Data (continued)

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

6.4.1. 30 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.

6.4.1.6 Ground Parallel Measurement Antenna – 150 kHz to 30 MHz



Date: 1.OCT.2018 16:06:17

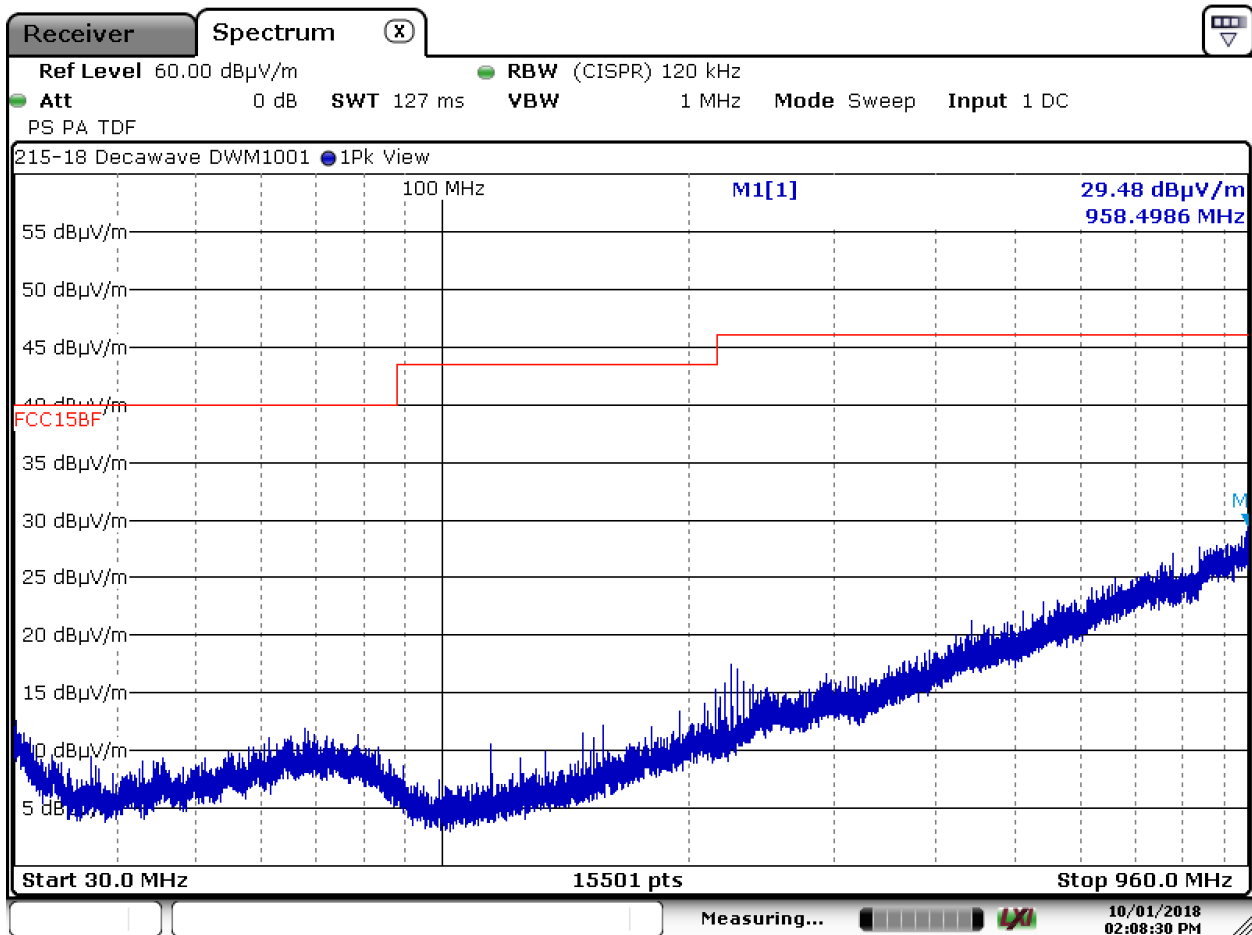
6. Measurement Data (continued)

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

6.4.1. 30 kHz 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.

6.4.1.7 Horizontal Polarity – 30 to 960 MHz



Date: 1.OCT.2018 14:08:27

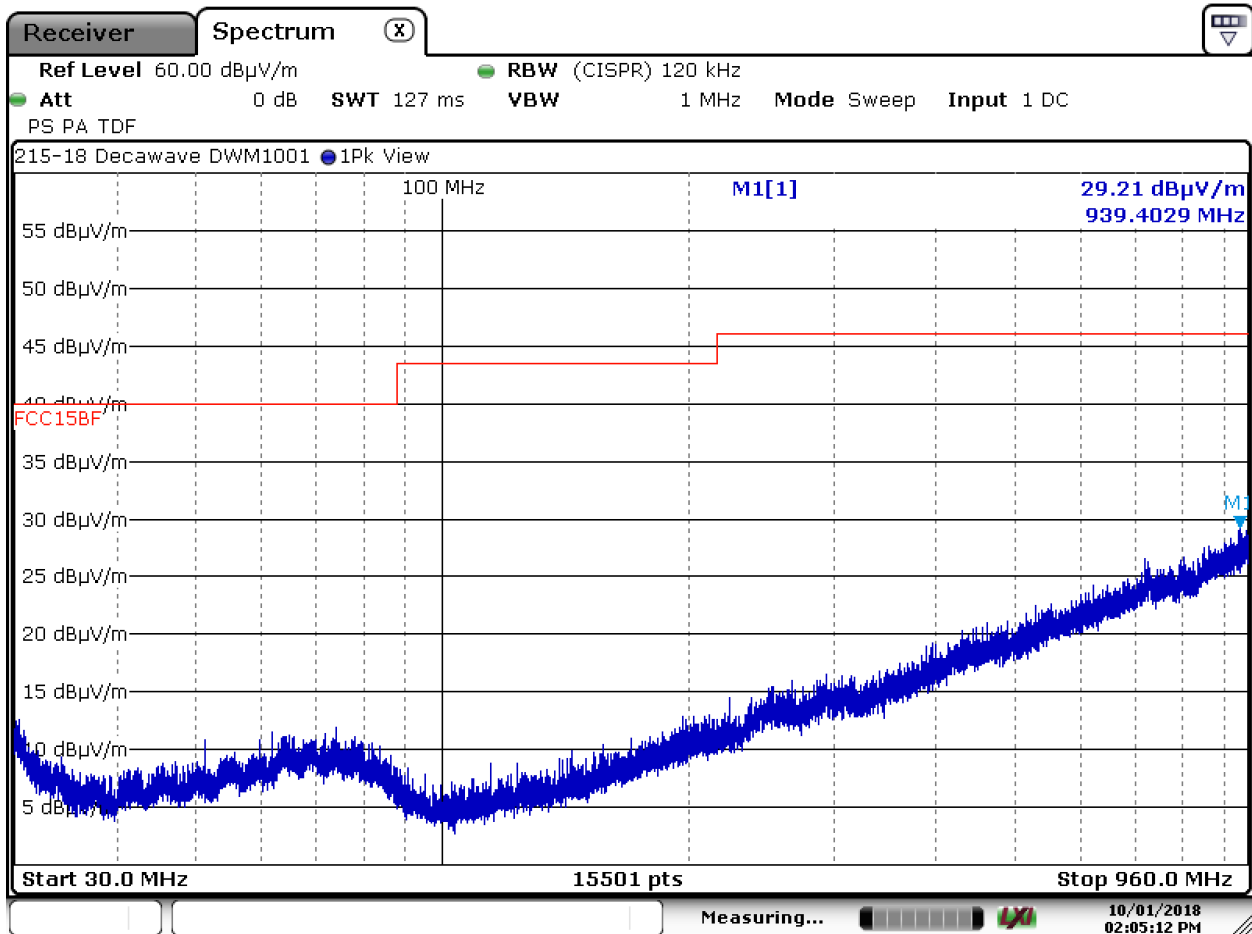
6. Measurement Data (continued)

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

6.4.1. 30 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.

6.4.1.8 Vertical Polarity – 30 to 960 MHz

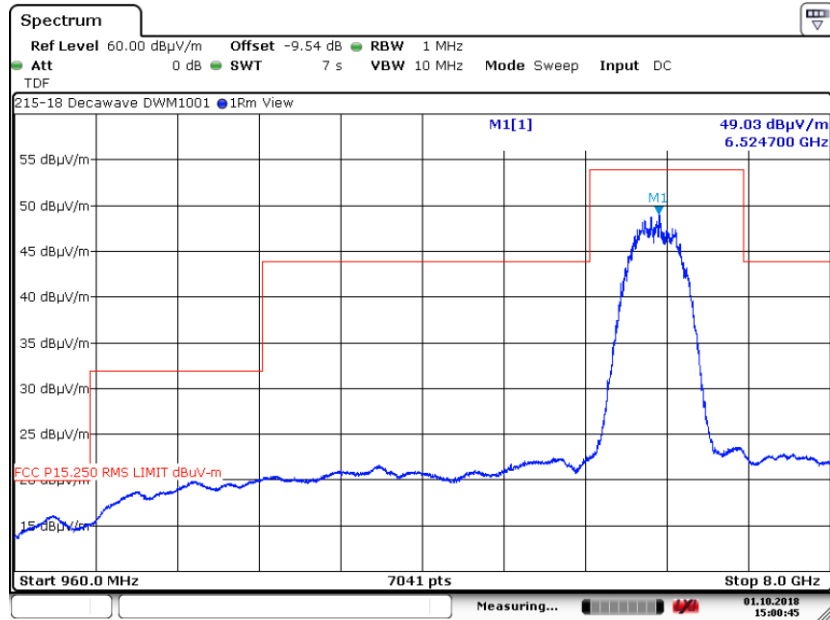


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6. Measurement Data (continued)

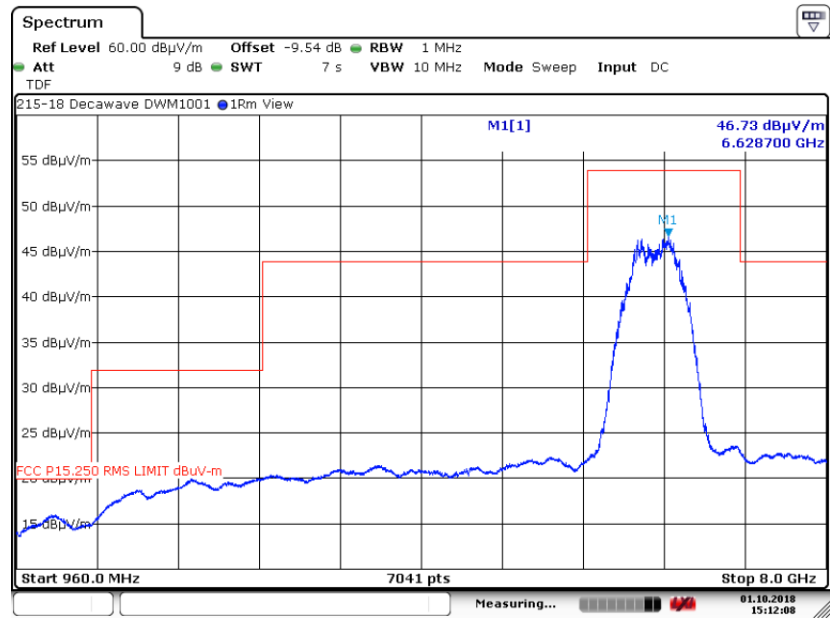
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1(d))

6.4.2. 960 MHz to 8 GHz Horizontal at 1 Meter (X-Axis)



Date: 1.OCT.2018 15:00:45

6.4.3. 960 MHz to 8 GHz Vertical at 1 Meter (X-Axis)

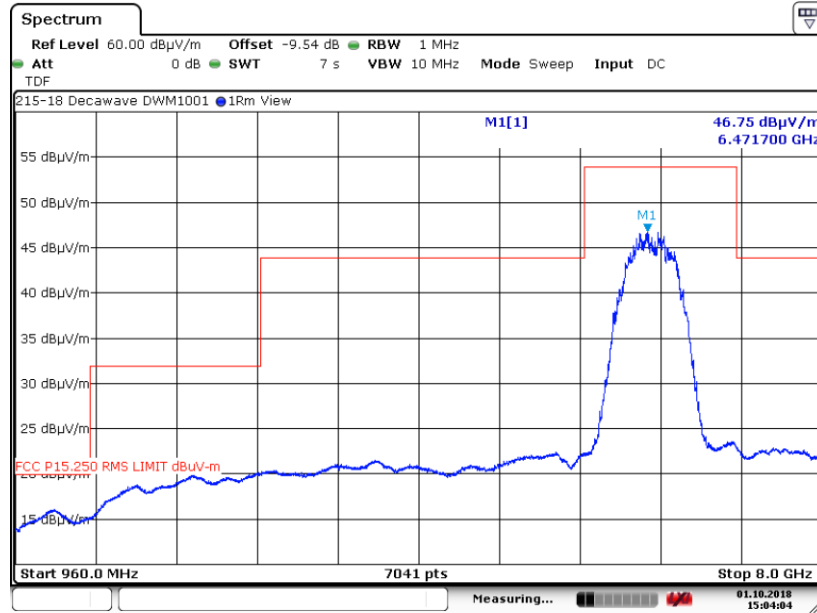


Date: 1.OCT.2018 15:12:05

6. Measurement Data (continued)

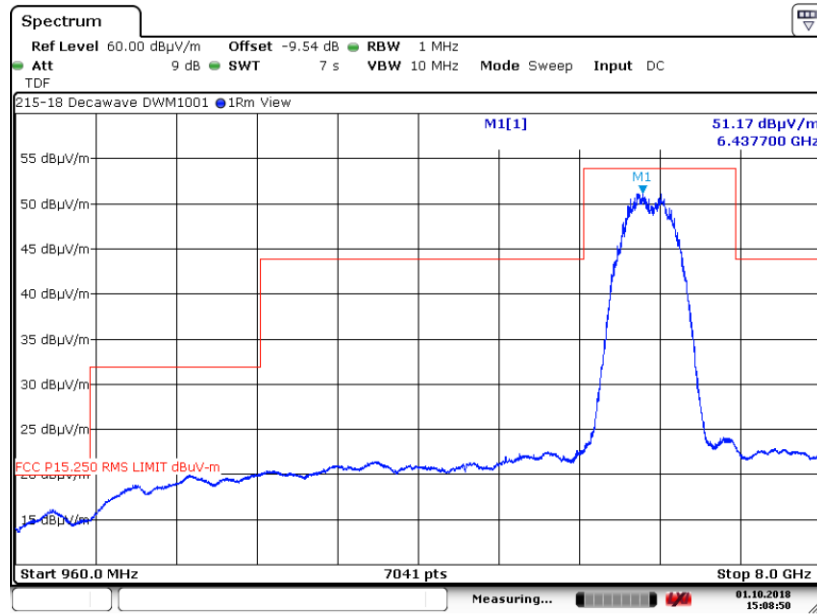
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.4. 960 MHz to 8 GHz Horizontal at 1 Meter (Y-Axis)



Date: 1.OCT.2018 15:04:01

6.4.5. 960 MHz to 8 GHz Vertical at 1 Meter (Y-Axis)

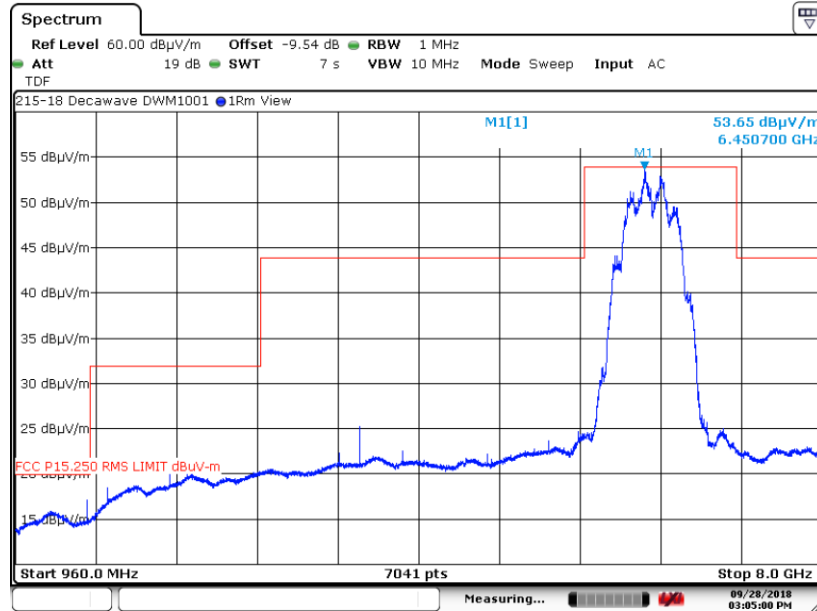


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6. Measurement Data (continued)

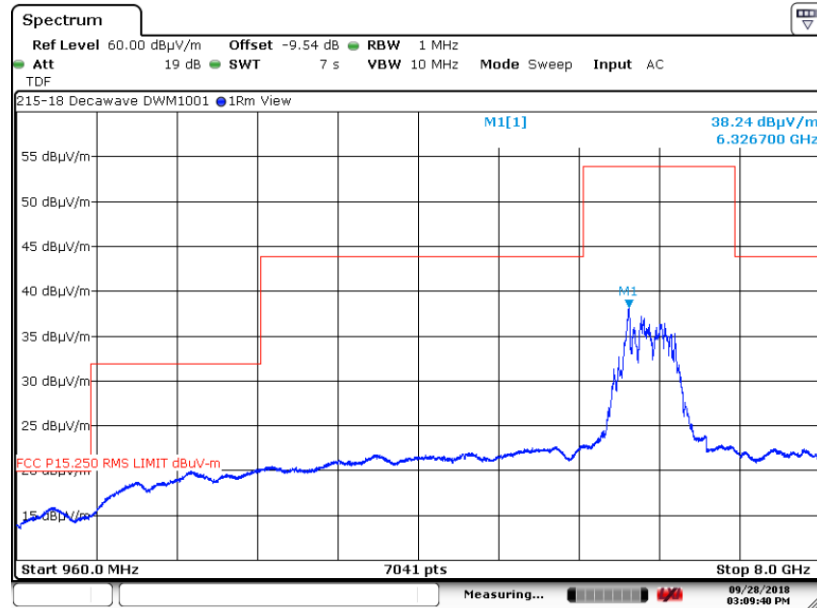
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.6. 960 MHz to 8 GHz Horizontal at 1 Meter (Z-Axis)



Date: 28.SEP.2018 15:04:57

6.4.7. 960 MHz to 8 GHz Vertical at 1 Meter (Z-Axis)

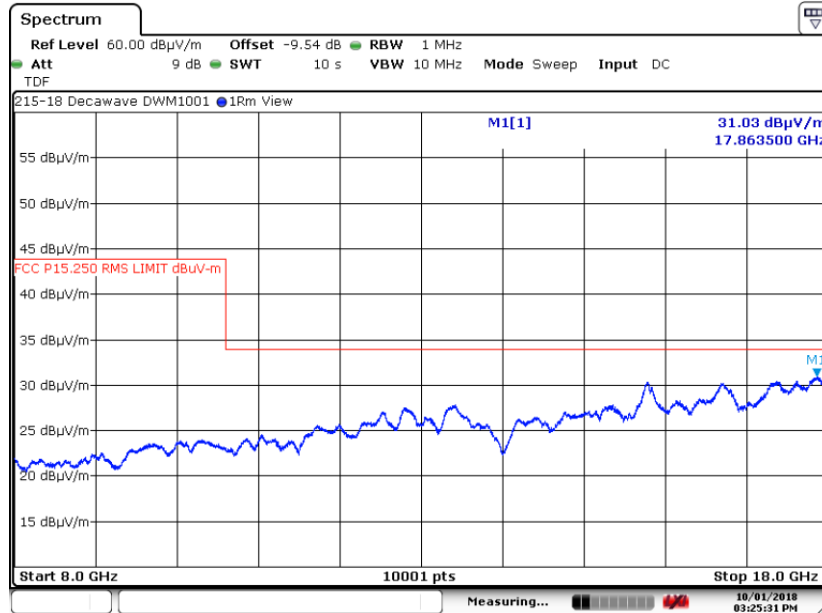


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6. Measurement Data (continued)

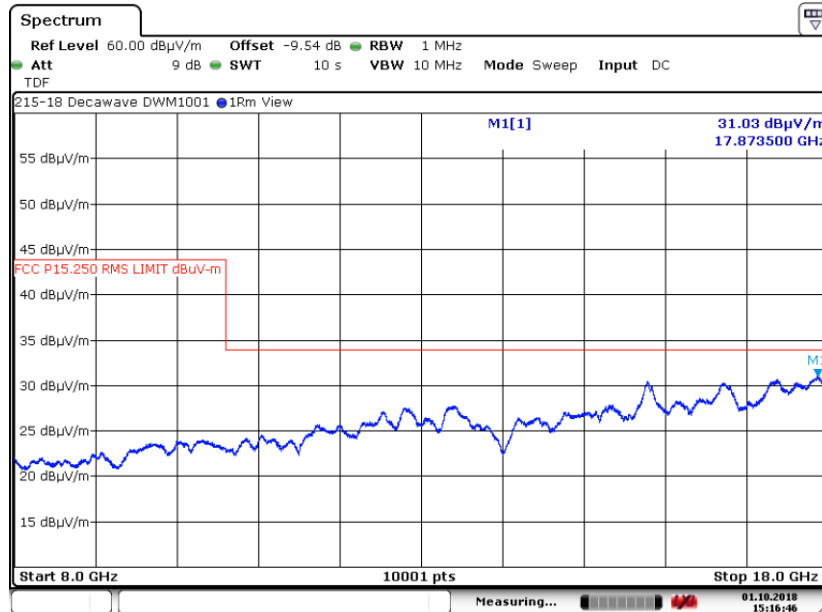
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.8. 8 to 18 GHz Horizontal at 1 Meter (X-Axis)



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6.4.9. 8 to 18 GHz Vertical at 1 Meter (X-Axis)

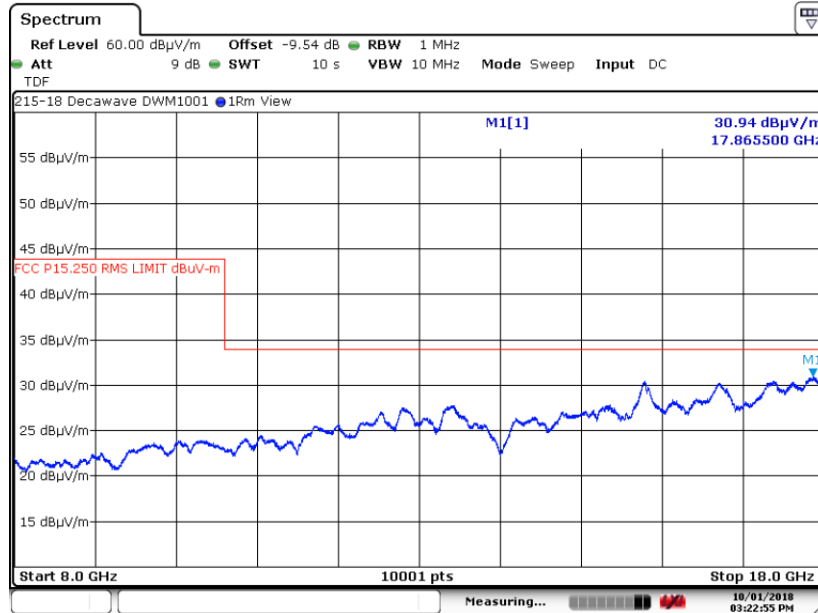


Date: 1.OCT.2018 15:16:43

6. Measurement Data (continued)

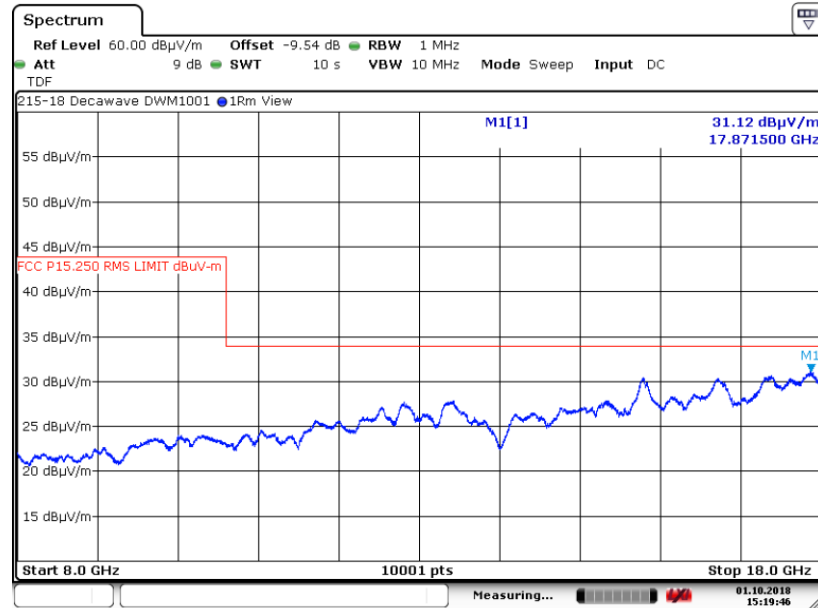
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.10. 8 to 18 GHz Horizontal at 1 Meter (Y-Axis)



Date: 1.OCT.2018 15:22:52

6.4.11. 8 to 18 GHz Vertical at 1 Meter (Y-Axis)

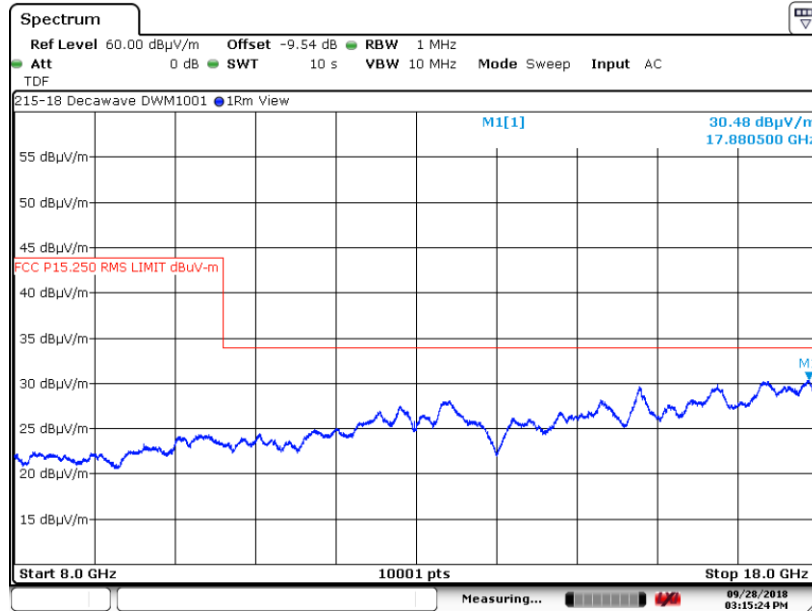


Date: 1.OCT.2018 15:19:43

6. Measurement Data (continued)

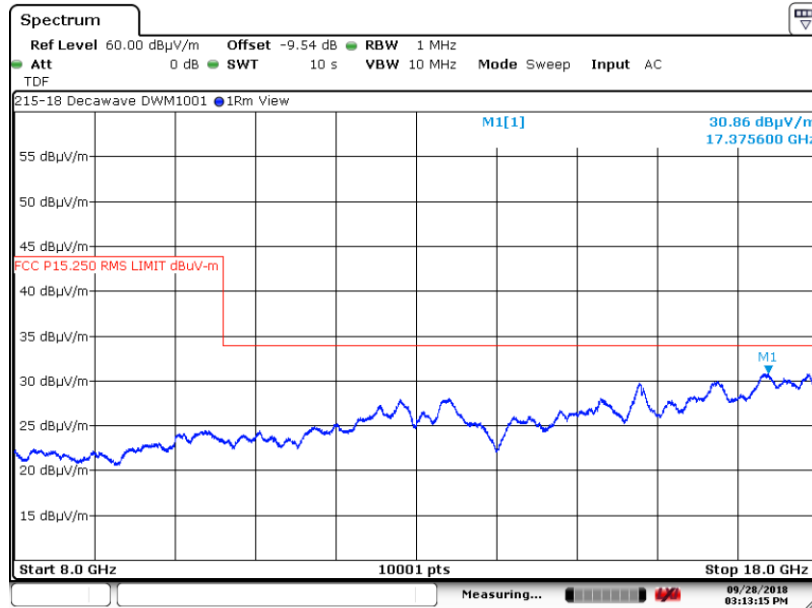
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.12. 8 to 18 GHz Horizontal at 1 Meter (Z-Axis)



Date: 28.SEP.2018 15:15:21

6.4.13. 8 to 18 GHz Vertical at 1 Meter (Z-Axis)

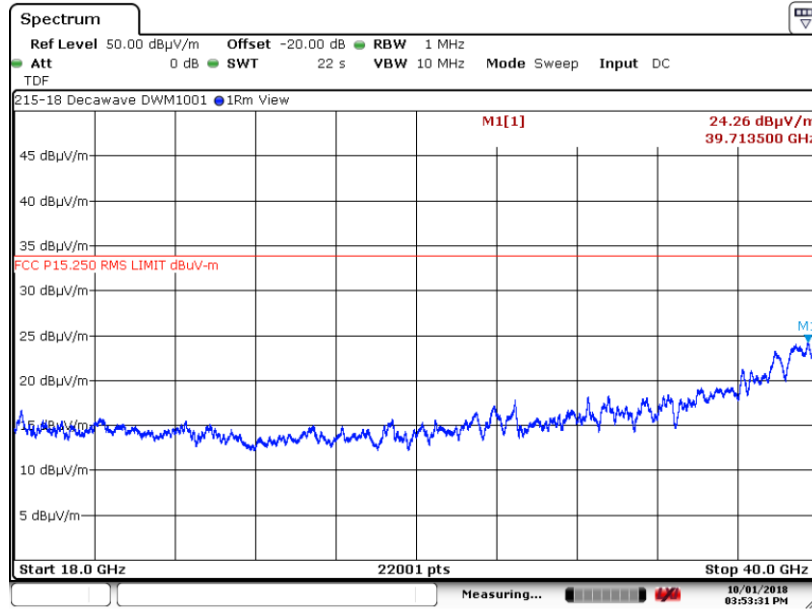


Date: 28.SEP.2018 15:13:12

6. Measurement Data (continued)

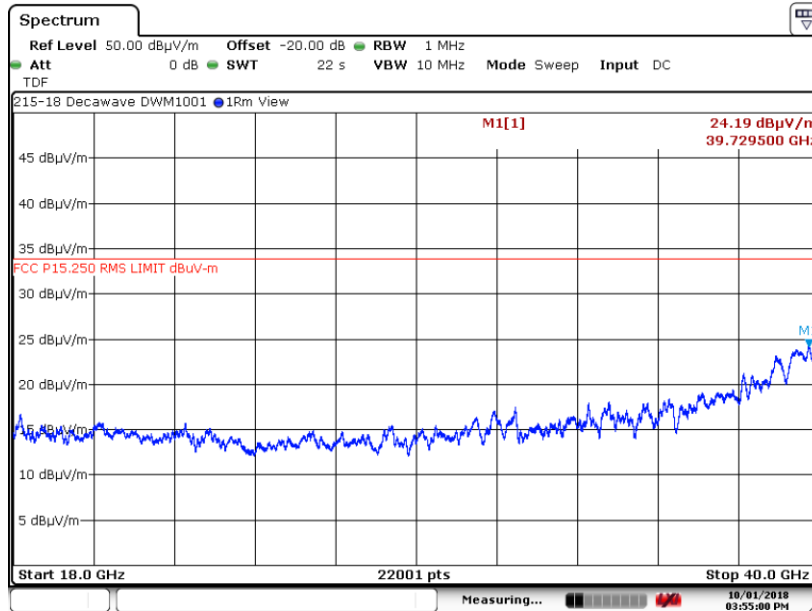
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.14. 18 to 40 GHz Horizontal at 0.3 Meter (Z-Axis)



Date: 1.OCT.2018 15:53:28

6.4.15. 18 to 40 GHz Vertical at 0.3 Meter (Z-Axis)



Date: 1.OCT.2018 15:54:57

6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (RSS-220 5.3.1 (d) continued)

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:

The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time.

The EIRP in terms of dBm, can be converted to a field strength, in dBµV/m at 3 Meters by adding 95.2.

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	-41.3	53.9
Above 10,600	-61.3	33.9

Frequency Range: 960 MHz to 8 GHz
 Measurement Distance: 1 Meter
 EMI Receiver IF Bandwidth: 1 MHz
 EMI Receiver Avg Bandwidth 10 MHz
 Detector Function: RMS 1 mS Average as defined in Annex Section 4(b)

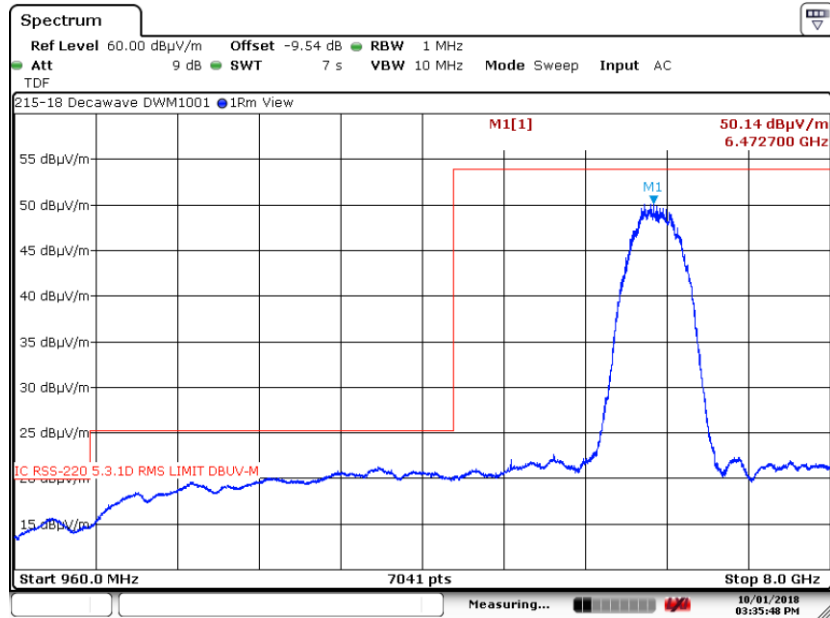
Notes: Measurements made from 960 MHz to 8 GHz were made in a semi-anechoic chamber at 1 Meter using a -9.54 dB distance offset was programmed into the spectrum analyzer.

Measurement data above 8 GHz for Channel 5 is provided in plots 6.4.8 to 6.4.13 on the previous pages.

6. Measurement Data (continued)

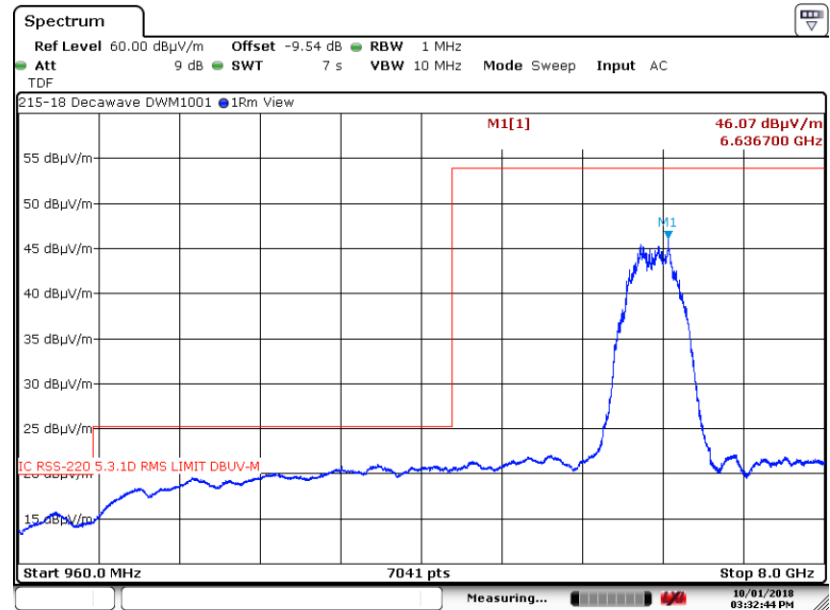
6.5. Spurious Radiated Emissions (RSS-220 5.3.1 (d)) continued)

6.5.1. 960 MHz to 8 GHz Horizontal at 1 Meter, CH5 (X-Axis)



Date: 1.OCT.2018 15:35:45

6.5.2. 960 MHz to 8 GHz Vertical at 1 Meter, CH5 (X-Axis)

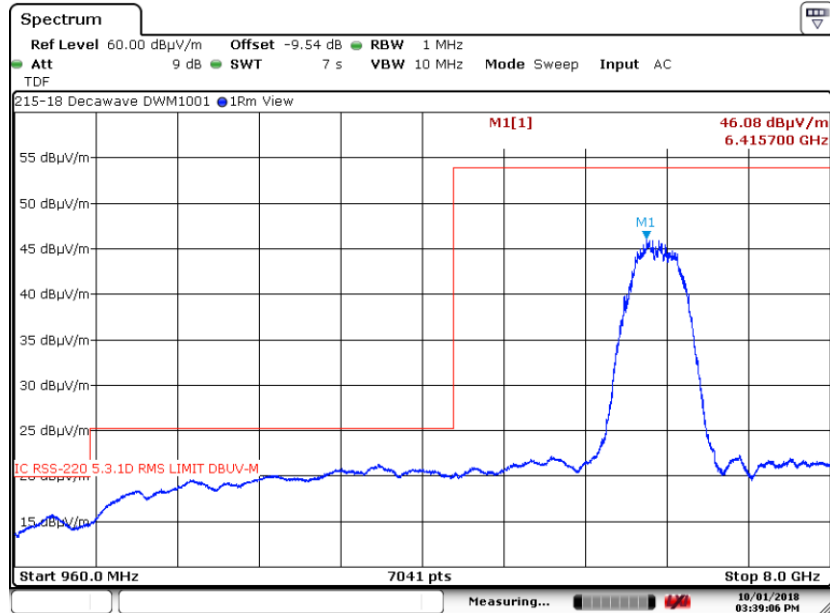


Date: 1.OCT.2018 15:32:41

6. Measurement Data (continued)

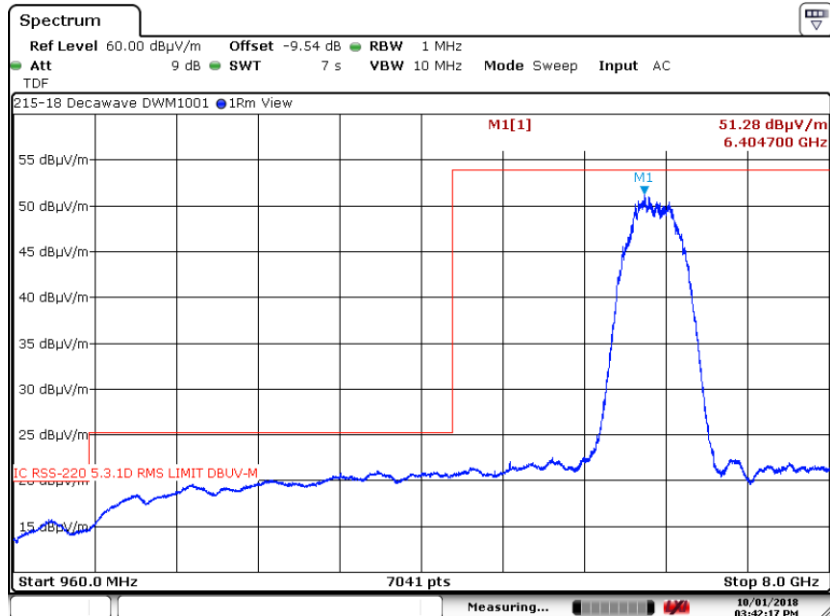
6.5. Spurious Radiated Emissions (RSS-220 5.3.1 (d)) continued)

6.5.3. 960 MHz to 8 GHz Horizontal at 1 Meter, CH5 (Y-Axis)



Date: 1.OCT.2018 15:39:03

6.5.4. 960 MHz to 8 GHz Vertical at 1 Meter, CH5 (Y-Axis)

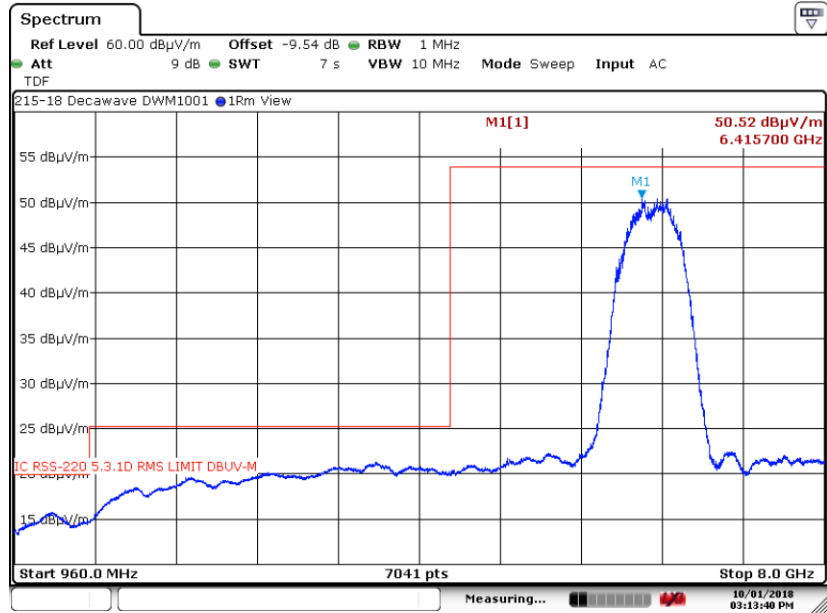


Date: 1.OCT.2018 15:42:14

6. Measurement Data (continued)

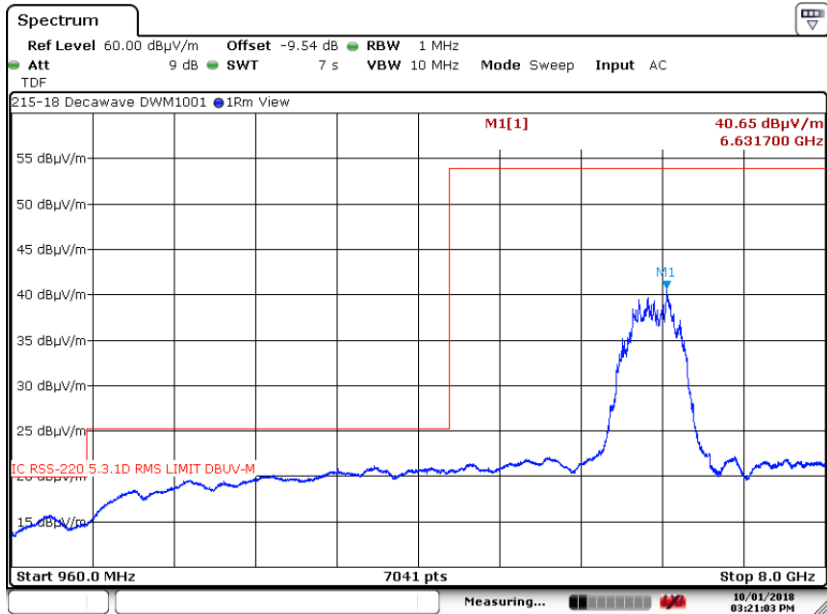
6.5. Spurious Radiated Emissions (RSS-220 5.3.1 (d)) continued)

6.5.5. 960 MHz to 8 GHz Horizontal at 1 Meter, CH5 (Z-Axis)



Date: 1.OCT.2018 15:13:37

6.5.6. 960 MHz to 8 GHz Vertical at 1 Meter, CH5 (Z-Axis)



Date: 1.OCT.2018 15:21:00

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

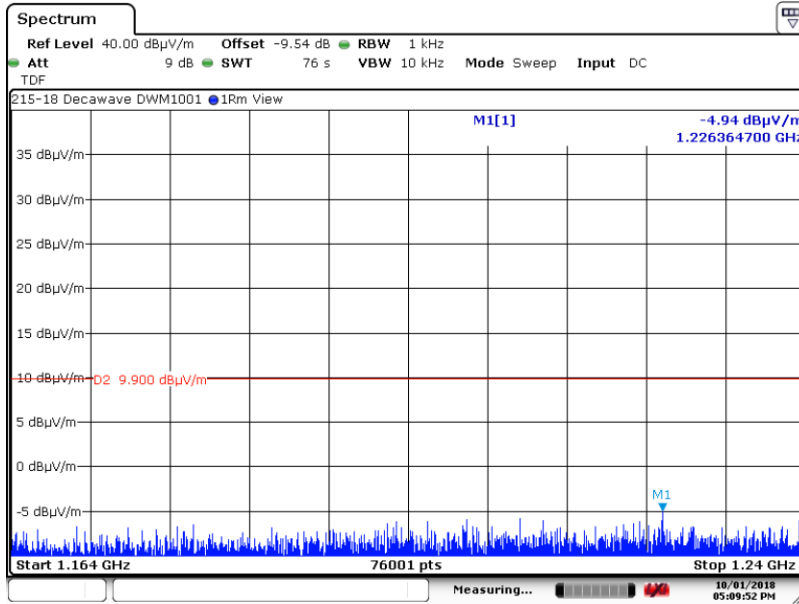
There were no broadband emissions related to the UWB transmitter. Measured signals were narrowband and related to the microprocessor / clocks and do not fall under the requirements of this section. Measurements were made at 3 Meters and the -85.3 dBm limit was converted to a field strength limit of 9.9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

6. Measurement Data (continued)

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

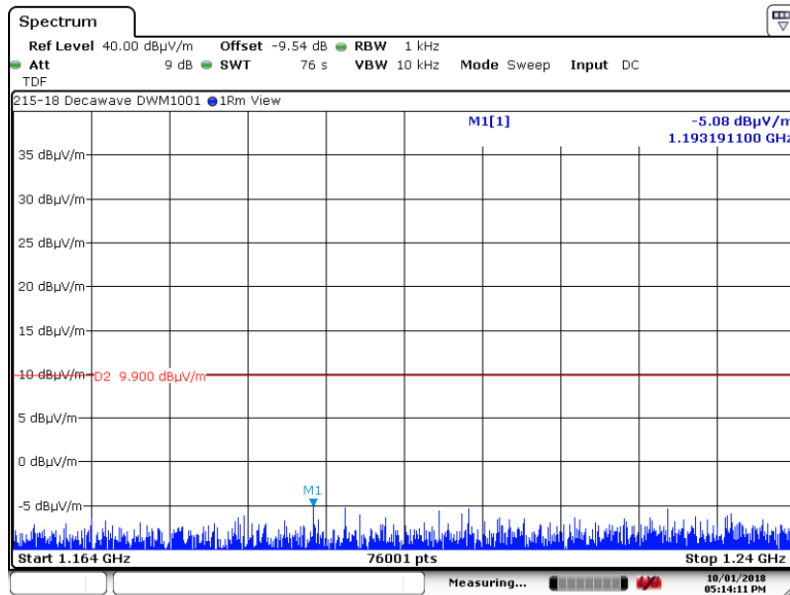
6.5.2 1164 to 1240 MHz Band

6.5.2.1 Horizontal Measurement Polarity 1164 to 1240 MHz



Date: 1.OCT.2018 17:09:49

6.5.2.2 Vertical Measurement Polarity 1164 to 1240 MHz



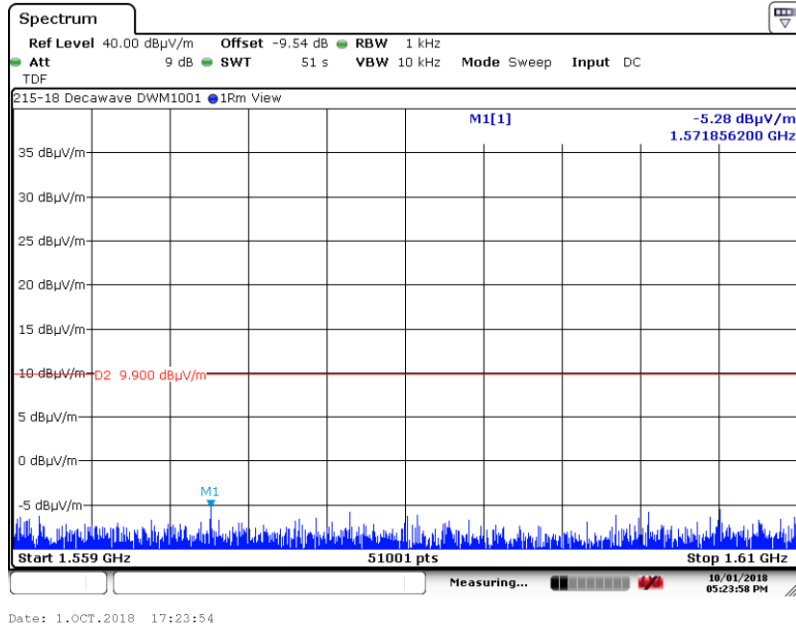
Date: 1.OCT.2018 17:14:08

6. Measurement Data (continued)

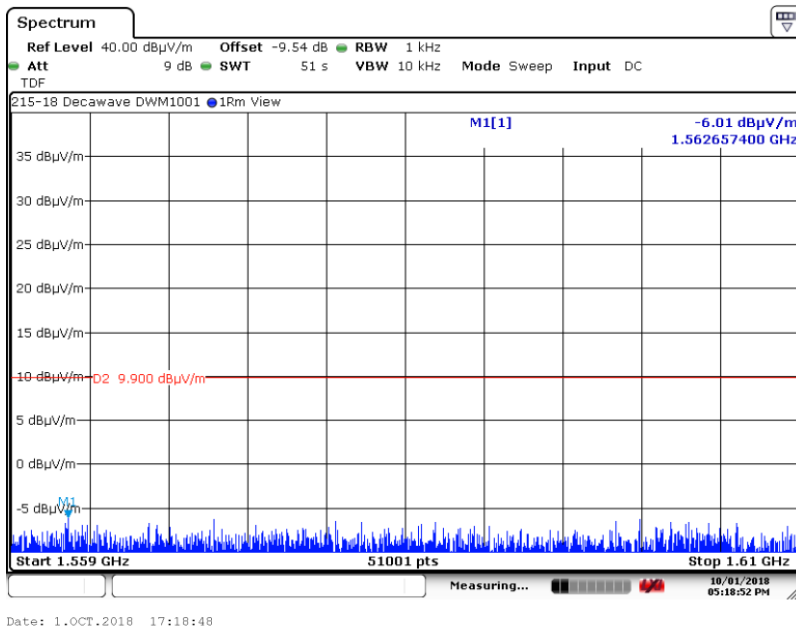
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

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	
6.508	53.63	53.90	-0.27	H	117	232	Compliant

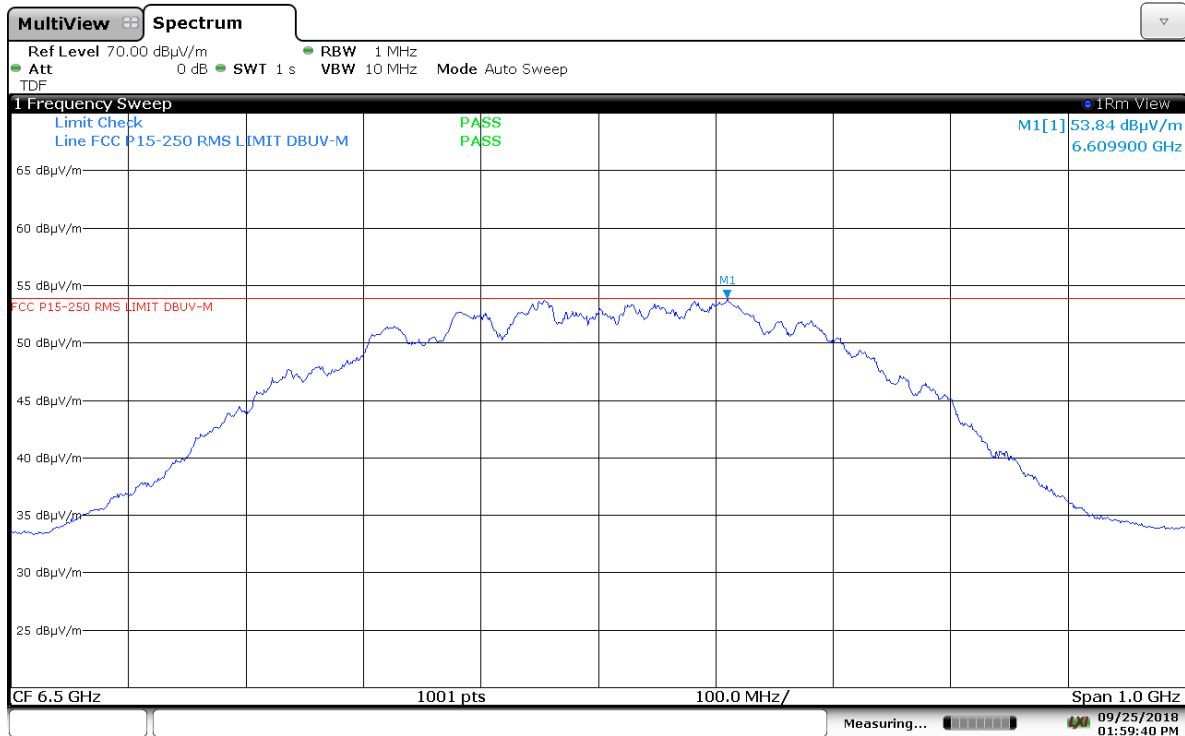
Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Pre-amplifier Gain (PAG) have been entered into the analyzer as transducer factors.

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	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
6.508	-41.57	-41.30	-0.27	H	117	232	Compliant

6.6.1. Plot of RMS Power at 3 Meters

215-18 Decawave DWM1001



01:59:41 PM 09/25/2018

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	
6.492	94.67	95.20	-0.53	H	117	232	Compliant

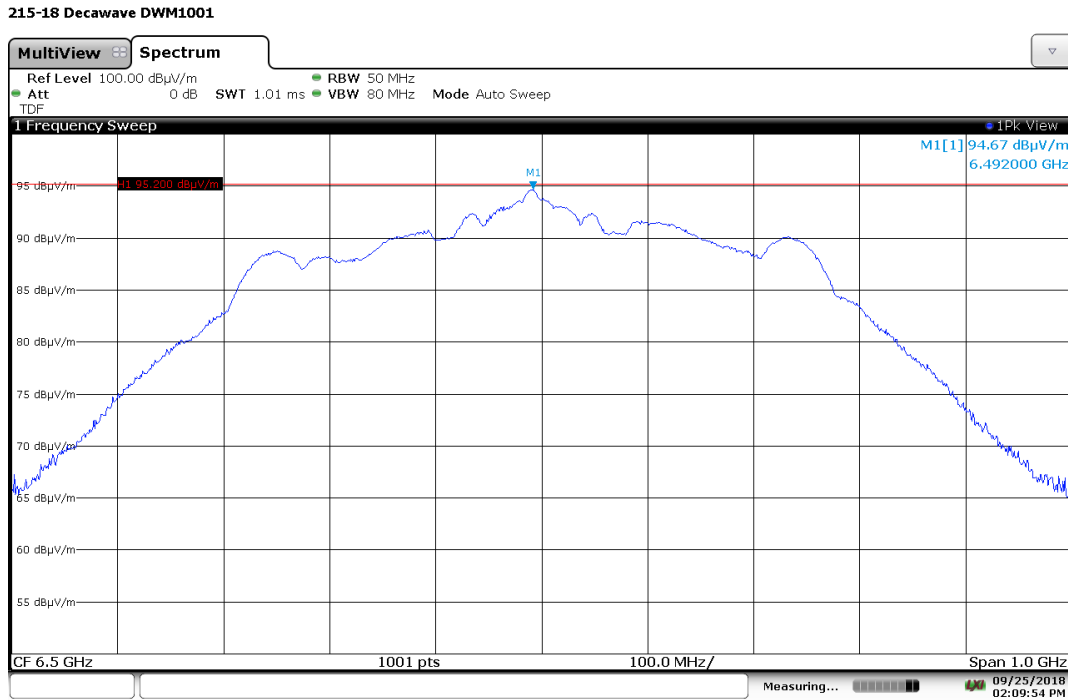
Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

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	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
6.492	-0.53	0.00	-0.53	H	117	232	Compliant

6.7.1 Plot of Peak Power at 3 Meters



02:09:55 PM 09/25/2018

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	12/4/2018
RF Filter Section	Hewlett Packard	85460A	3325A00121	12/4/2018
LISN	EMCO	3825/2	9109-1860	11/17/2018
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:	N/A
Test Engineer:	N/A
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.

6. Measurement Data (continued)

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

6.9.1 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)
				(mW/cm ²)	(W/m ²)	
	(1)	(2)	(3)	(4)		(5)
6.492	5	-0.53	0.0	0.0028174	0.0281741	1

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

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 5 centimeters of the body of the user.
2. Section 6.7 of this test report.
3. Data supplied 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.
6. Reference IC RSS-102 Section 4 Table 4 RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Note: BLE and UWB Radios do not transmit simultaneously.

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-0274.

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. 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 – 30 kHz to 1 GHz Front



8. Test Images

8.2. Spurious and Harmonic Emissions – 30 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

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



8. Test Images

8.7. Frequency Stability (Setup)



8. Test Images

8.8. Frequency Stability (Setup)

