

**COMPLIANCE WORLDWIDE INC.
TEST REPORT 301-20R1**

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

**Ciholas, Inc.
3700 Bell Road
Newburgh, IN 47630**

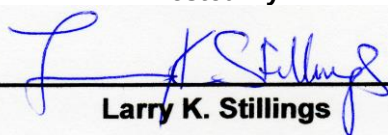
For the

**MU202
UWB Module**

**FCC ID: 2ALIR-MU202
IC: 26788-MU202**

**Report Issued on November 30, 2020
Revision R1 Issued on February 25, 2021**

Tested By



Larry K. Stillings

Reviewed By



Brian F. Breault

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Table of Contents

1. Scope.....	3
2. Product Details	3
2.1. Manufacturer	3
2.2. Model Number.....	3
2.3. Serial Number	3
2.4. Description	3
2.5. Power Source.....	3
2.6. Hardware Revision.....	3
2.7. Software Revision	3
2.8. Modulation Type.....	3
2.9. Operating Frequency	3
2.10. EMC Modifications	3
3. Product Configuration.....	3
3.1. Operational Characteristics & Software	3
3.2. Cables	3
3.3. EUT Hardware	4
3.4. Support Equipment	4
3.5. Test Setup.....	4
4. Measurements Parameters	5
4.1. Measurement Equipment Used to Perform Test	5
4.2. Measurement & Equipment Setup	6
4.3. Measurement Procedure	6
4.4. Measurement Uncertainty.....	6
5. Measurement Summary	7
6. Measurement Data	8
6.1. Antenna Requirement	8
6.2. Operational Requirements	8
6.3. UWB Bandwidth	9
6.4. Spurious Radiated Emissions	11
6.5. Radiated Emissions in GPS Bands.....	27
6.6. RMS Power in a 1 MHz Bandwidth.....	32
6.7. Peak Emissions in a 50 MHz Bandwidth	35
6.8. Conducted Emissions Test Setup.....	38
6.9. Conducted Emissions Test Results	39
6.10. 99% Emission Bandwidth	43
6.11. Public Exposure to Radio Frequency Energy Levels.....	45
7. Test Site Description	47
8. Test Images	48
8.1. Spurious and Harmonic Emissions - 30 kHz to 1 GHz Front.....	48
8.2. Spurious and Harmonic Emissions - 30 kHz to 30 MHz Rear	49
8.3. Spurious and Harmonic Emissions - 30 MHz to 1 GHz Rear	50
8.4. Spurious and Harmonic Emissions - 1 to 18 GHz Front.....	51
8.5. Spurious and Harmonic Emissions - 1 to 18 GHz Rear.....	52
8.6. Spurious and Harmonic Emissions - 18 to 40 GHz Side	53
8.7. Conducted Emissions (Front)	54
8.8. Conducted Emissions (Rear)	55
8.9. Frequency Stability Setup	56

1. Scope

This test report certifies that the Ciholas MU202 as tested, meets the FCC Part 15.250, Subpart C and ISED Canada 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. The purpose of this testing was to add an alternate antenna design to the certification. Revision R1 updates Product Configuration in Section 3.1, adds 99% Emissions Bandwidth to Section 6.10, and moved RF Exposure to Section 6.11 which was also updated to reflect RSS-102 Issue 5, Amendment 1.

2. Product Details

- 2.1. Manufacturer:** Ciholas, Inc.
2.2. Product Name: UWB Module
2.3. Model Number: A02824
2.4. Serial Number: 109195
2.5. Description: The MU202 is part of a wireless system that relies on ultra-wideband (UWB) pulses and time-stamp information to determine real-time location tracking data.
2.6. Power Source: 5 VDC via USB power
2.7. Hardware Revision: 1.0.1
2.8. Software Revision: N/A
2.9. Modulation Type: Pulse Modulation, Frequency Hopping
2.10. Operating Frequency: CH 5 – 6.49 GHz Nominal
2.11. EMC Modifications: None

3. Product Configuration

3.1 Operational Characteristics & Software

Connect the MU202 to a laptop via a UWB cable. The laptop is used with the devices embedded firmware and serial port software to configure the radio module. The module was configured for transmitting at 16M and 64M PRFs at a 6.8 Mbps data rate.

The module was tested using a support PCB to provide connectivity from the USB interface to the modules M2 connector. No other circuitry on that support PCB was enabled during testing. The enclosure was used for convenience of orienting the module in its worst case orientation. The enclosure provides no shielding and is absent of any reflective surfaces that would impact the RF signal leaving the module's antenna.

3.2. Cables

Cable Type	Length	Shield	From	To
USB	10M	Yes	EUT	Laptop

3. Product Configuration (cont.)

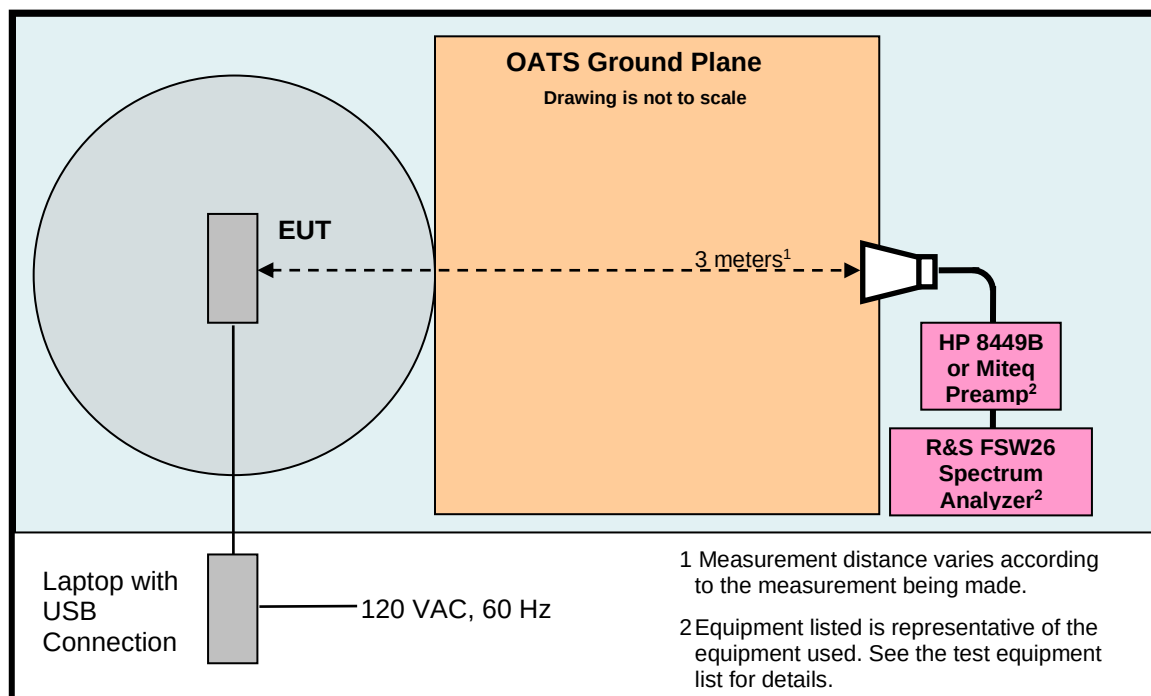
3.3. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
Ciholas	MU202	109195	5	DC	UWB Module

3.4. Support Equipment

Manufacturer	Model/Part # / Options	Serial Number	Input Voltage	Freq (Hz)	Description/Function
Dell	XPS 13 – L321X	41647808737	120	60	For controlling the UWB Module

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	10/16/2022	2 Years
Spectrum Analyzer 9 kHz to 40 GHz	Rohde & Schwarz	FSV40	100899	8/12/2022	2 Years
Spectrum Analyzer 10 Hz to 40 GHz	Rohde & Schwarz	FSVR40	100909	9/18/2022	2 Years
Spectrum Analyzer 3 Hz to 26.5 GHz	Rohde & Schwarz	FSW26	102044	9/13/2021	3 Years
Bilog Antenna 30 to 2000 MHz	Sunol Sciences	JB1	A050913	6/5/2021	2 Years
Loop Antenna 9 kHz to 30 MHz	EMCO	6512	9309-1139	1/28/2022	3 Years
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3-00100200-10-15P-4	988773	1/9/2022	2 Years
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	1/6/2022	2 Years
Preamplifier 2 to 12 GHz	JCA	JCA48-4111B1	7087S	1/6/2022	2 Years
Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	9/11/2021	3 Years
Preamplifier 18 to 40 GHz	Miteq	JSD42-21004200-40-5P	649199/649219	1/6/2022	2 Years
Horn Antenna 1 to 18 GHz	ETS-Lindgren	3117	00143292	3/21/2022	3 Years
Horn Antenna 18 to 40 GHz	Com Power	AH-840	101032	9/28/2021	3 Years
High Pass Filter 8 to 18 GHz	Micro-Tronics	HPM50107	G036	1/6/2022	2 Years
Barometer	Control Company	4195	Cal ID# 236	4/3/2021	3 Years

¹ ESR7 Firmware revision: V3.48, SP3 Date installed: 9/3/2020
² FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016
³ FSVR40 Firmware revision: V2.23 SP1, Date installed: 08/19/2016
⁴ FSW26 Firmware revision: V4.61 Date installed: 8/11/2022

4. Measurements Parameters (continued)

4.2. Measurement & Equipment Setup

Test Dates:	10/30/2020, 11/2/2020, 11/4/2020, 11/5/2020, 11/6/2020
Test Engineers:	Sean Defelice, Larry Stillings
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	30 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, RMS & CISPR Average

4.3. Measurement Procedure

Test measurements were made in accordance FCC Parts 15.209, 15.250 Subpart C.

The test methods used to generate the data in 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	
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	Via PoE Injector
99% Emission Bandwidth	N/A	RSS-GEN	6.10	Compliant	
Radio Frequency Exposure	FCC OET Bulletin 65 1.1310	RSS-102, Issue 5	6.11	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 product is a PCB mounted board antenna.

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	-10 dB Band Edges		15.250 Frequency Band		Result
		(MHz)	Lower	Upper	F _{MIN} (MHz)	F _{MAX} (MHz)	
-	OATS	6486.1	6272.2	6683.8	5925	7250	Compliant
-	Ambient	6458.3	6226.9	6755.4	5925	7250	Compliant
1	-20	6452.5	6270.3	6730.4	5925	7250	Compliant
2	-10	6454.5	6269.9	6730.2	5925	7250	Compliant
3	0	6452.5	6270.1	6724.3	5925	7250	Compliant
4	+10	6452.6	6269.9	6755.3	5925	7250	Compliant
5	+20	6459.0	6270.0	6755.1	5925	7250	Compliant
6	+30	6457.9	6270.2	6754.7	5925	7250	Compliant
7	+40	6457.7	6274.1	6754.6	5925	7250	Compliant
8	+50	6454.3	6270.3	6715.1	5925	7250	Compliant

6. Measurement Data (continued)

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

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

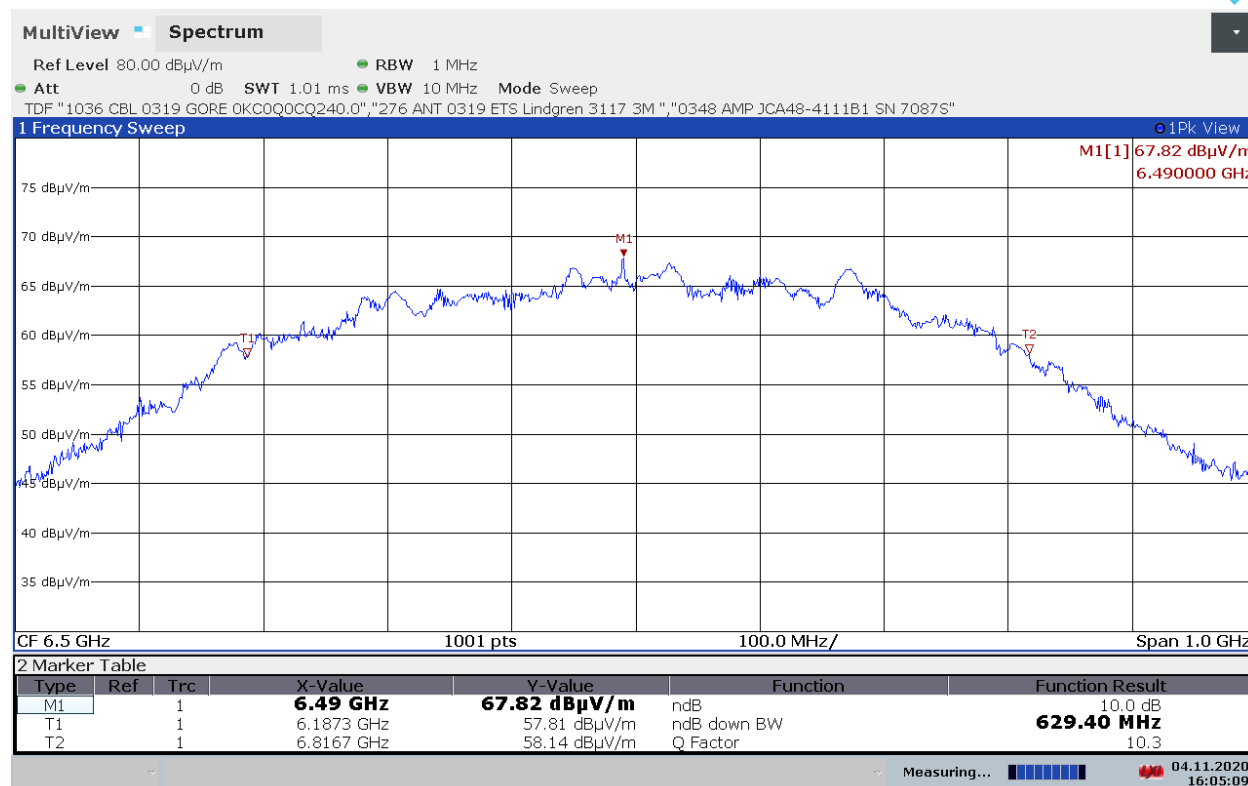
Result: Compliant

6.3.1. Measurement Data – Values in GHz

f_M	The highest emission peak	6.490
f_L	10 dB below the highest peak	6.1873
f_H	10 dB above the highest peak	6.8167
Bandwidth	Calculated: ($f_H - f_L$)	0.6294

6.3.2. Measurement Plot of 10 dB frequencies (16M PRF)

301-20 Ciholas MU202 UWB



16:05:10 04.11.2020

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.

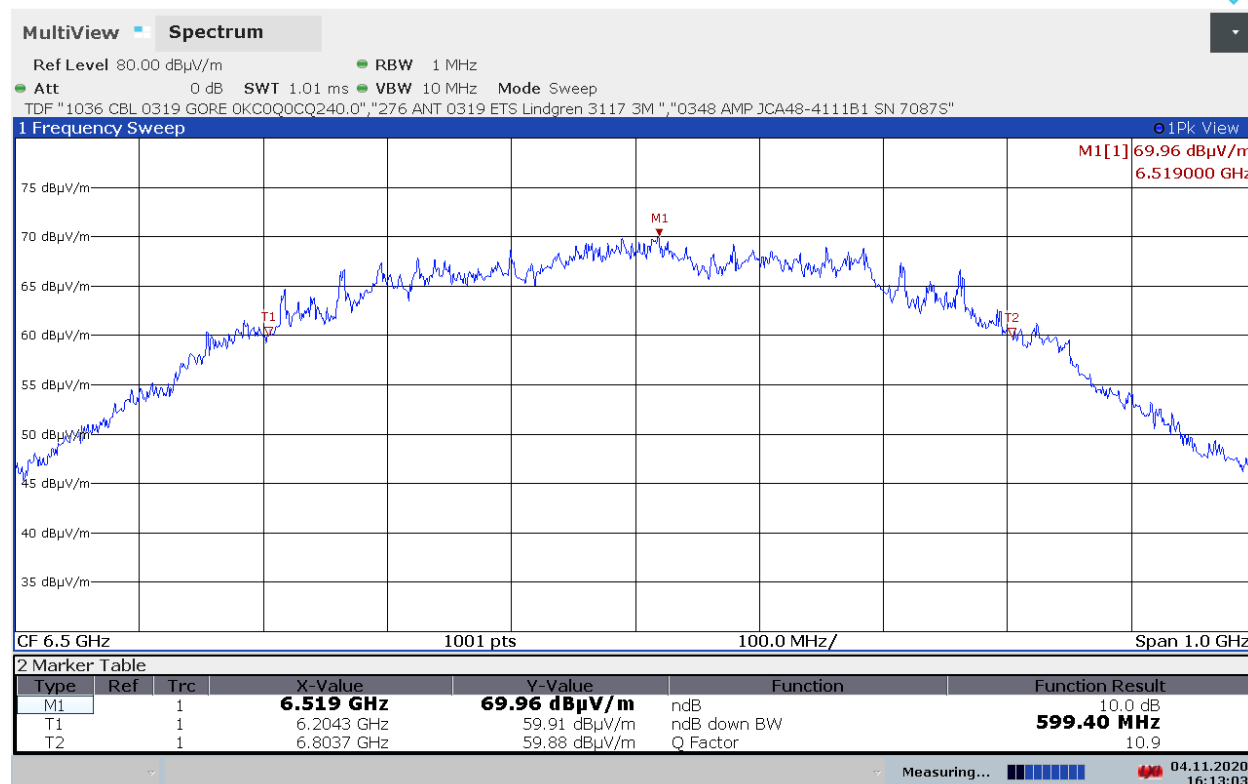
Result: Compliant

6.3.3. Measurement Data – Values in GHz

f_M	The highest emission peak	6.519
f_L	10 dB below the highest peak	6.2043
f_H	10 dB above the highest peak	6.8037
Bandwidth	Calculated: ($f_H - f_L$)	0.5994

6.3.4. Measurement Plot of 10 dB frequencies (64M PRF)

301-20 Ciholas MU202 UWB



16:13:03 04.11.2020

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 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

Note: Narrow band emissions between 960 and 1610 MHz that are over the limit are created by the digital communications between the processor and the UWB chipset and are subjected to the limits of 15.209.

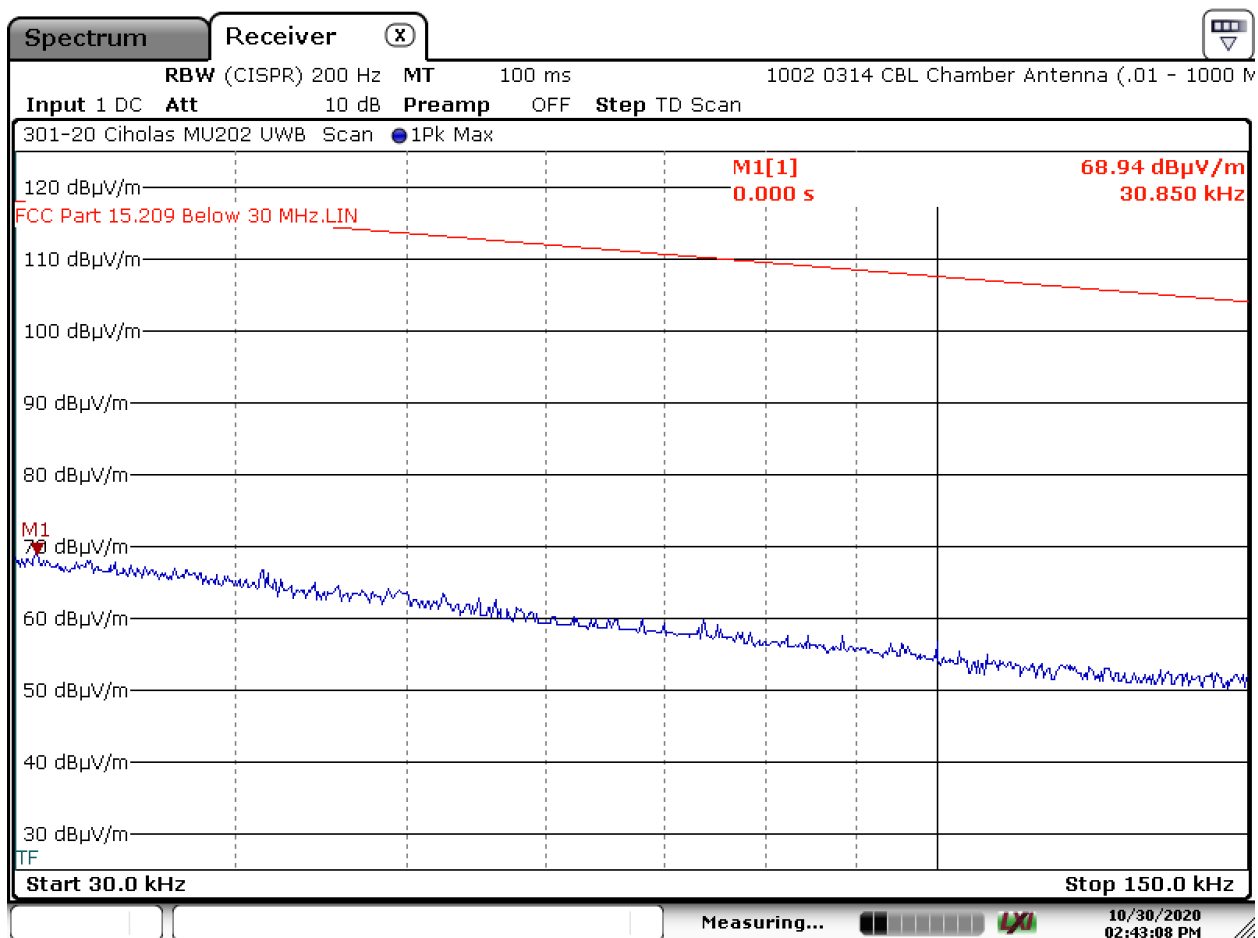
6. Measurement Data (continued)

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: 30.OCT.2020 14:43:08

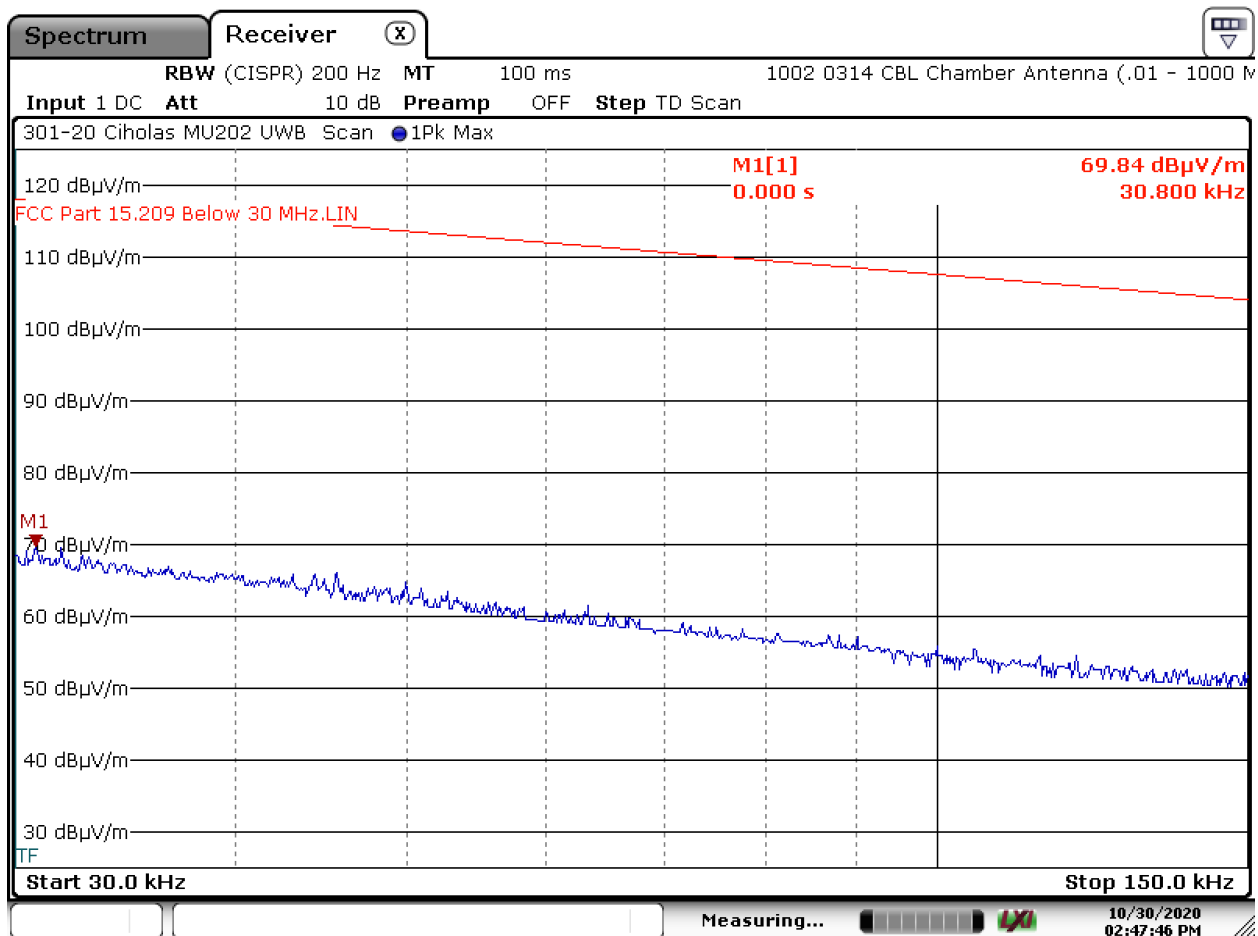
6. Measurement Data (continued)

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: 30.OCT.2020 14:47:46

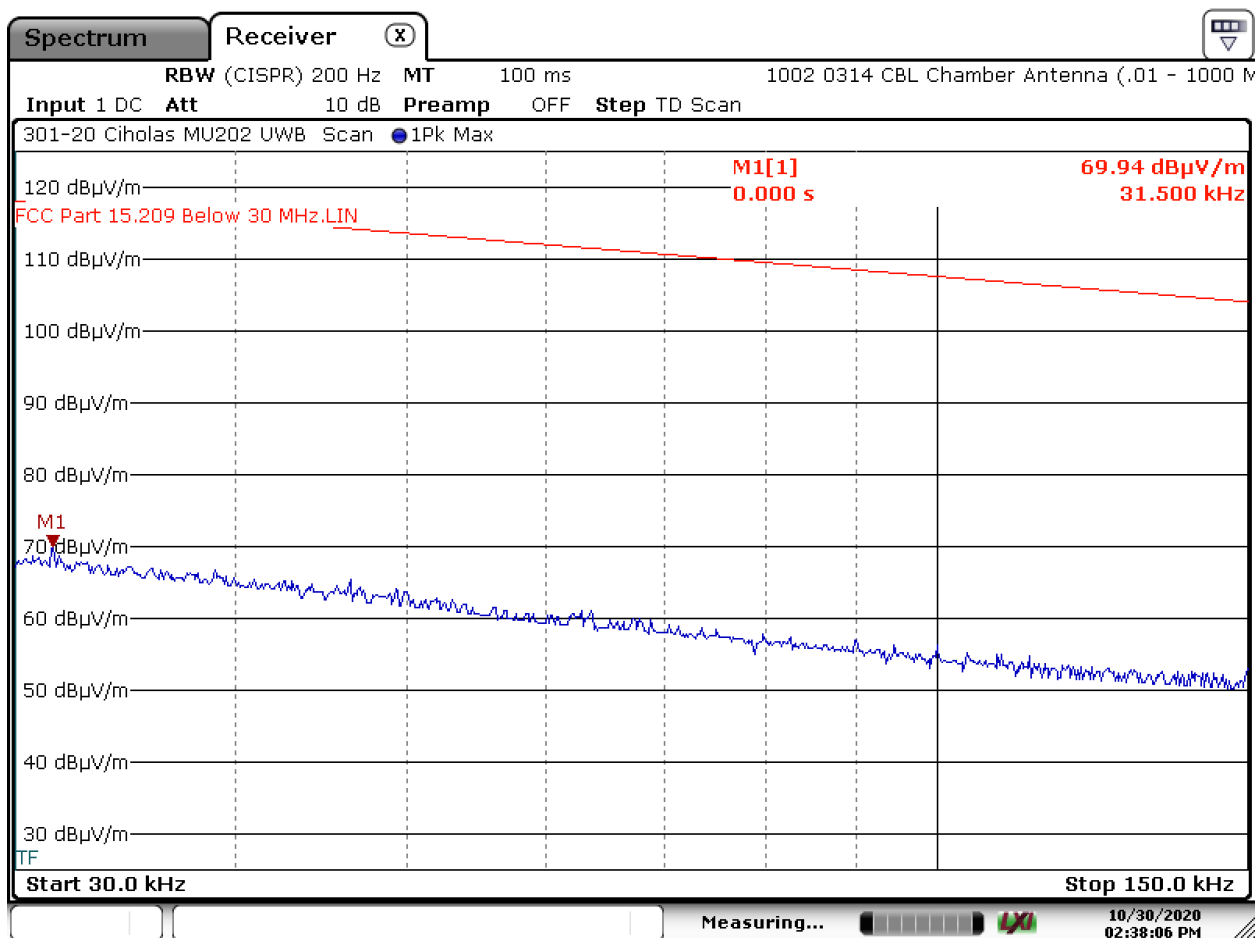
6. Measurement Data (continued)

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: 30.OCT.2020 14:38:06

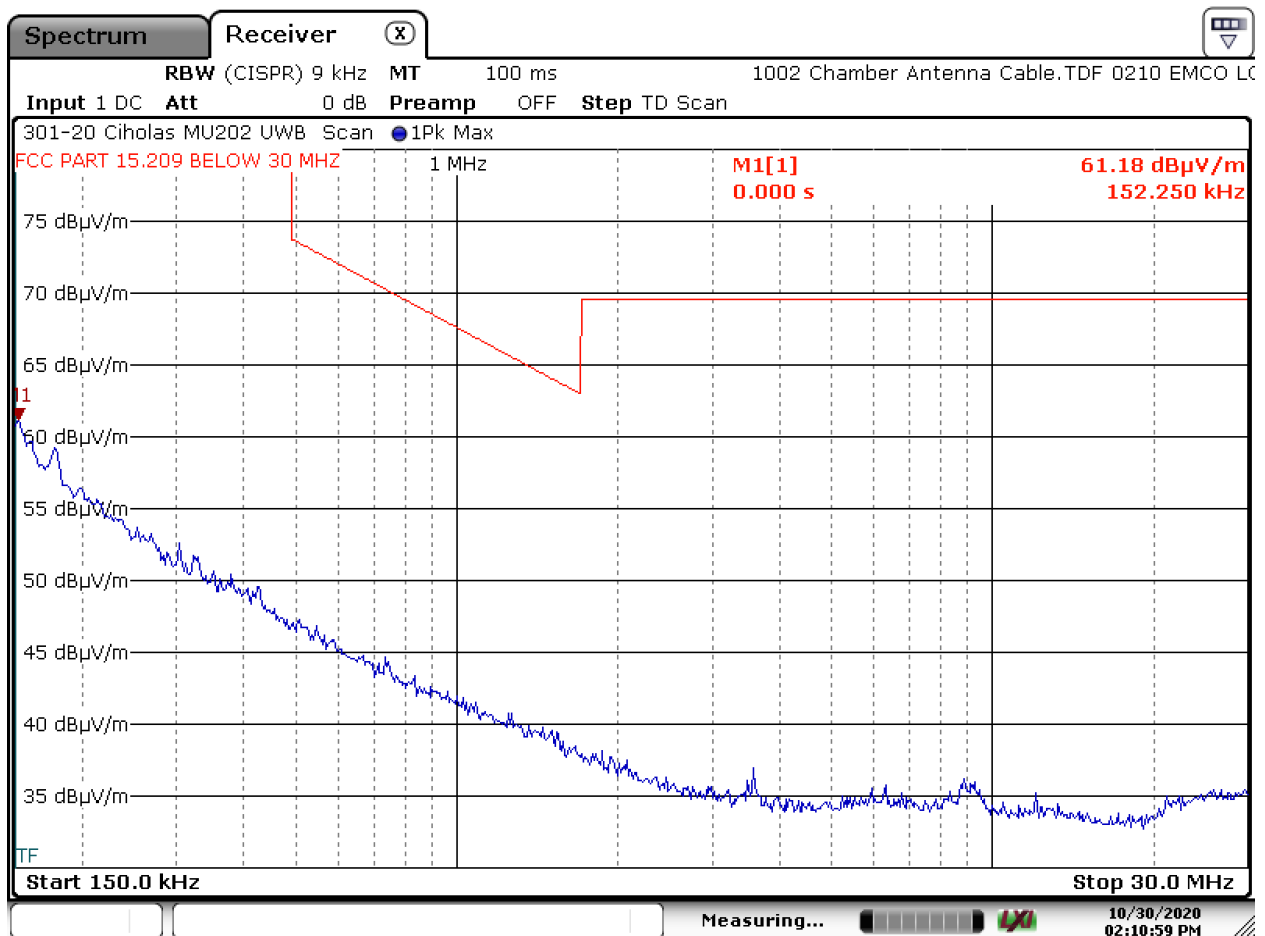
6. Measurement Data (continued)

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: 30.OCT.2020 14:11:00

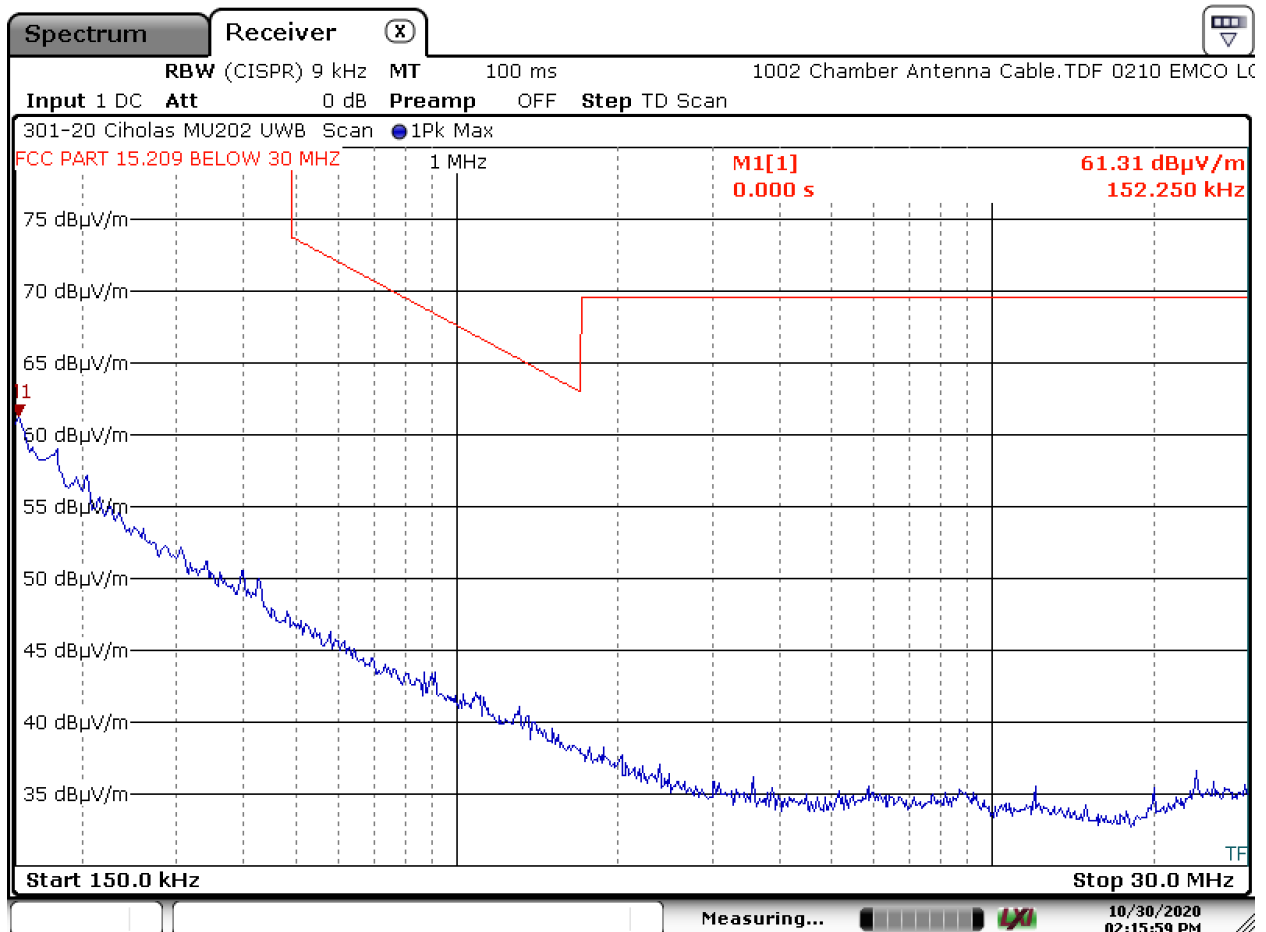
6. Measurement Data (continued)

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: 30.OCT.2020 14:16:00

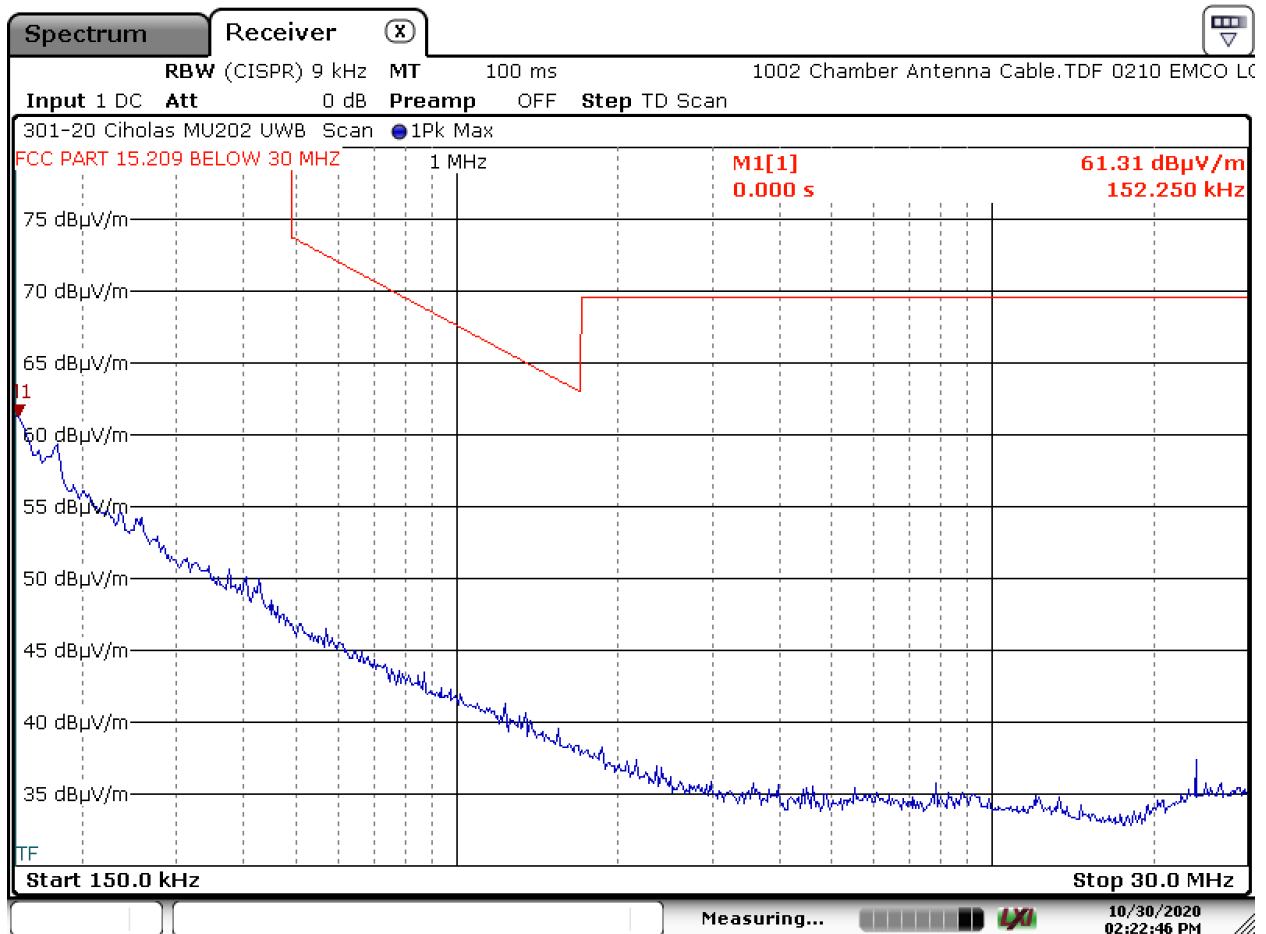
6. Measurement Data (continued)

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



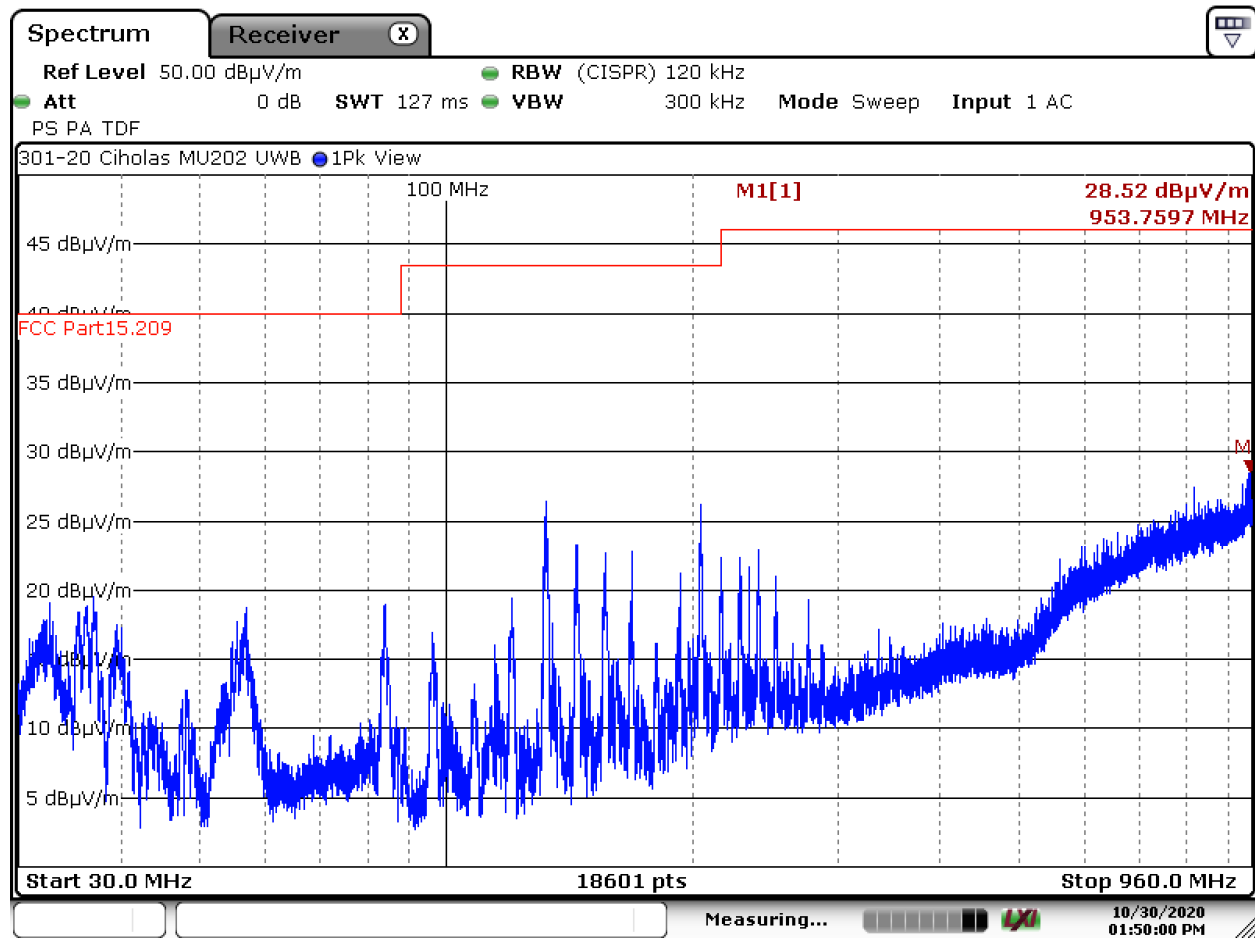
Date: 30.OCT.2020 14:22:46

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

6.4.1.7 Horizontal Polarity – 30 to 960 MHz



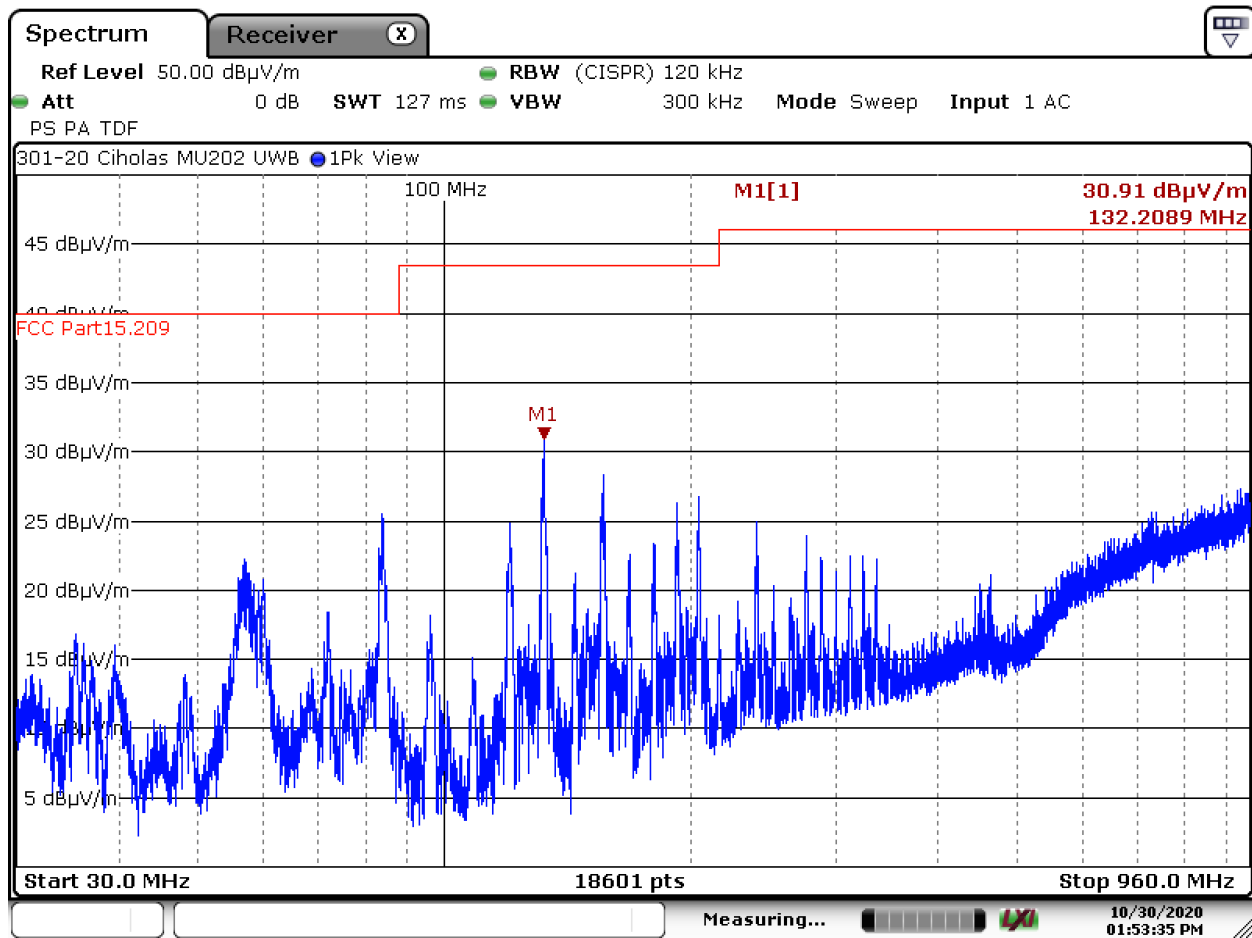
Date: 30.OCT.2020 13:50:01

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

6.4.1.8 Vertical Polarity – 30 to 960 MHz



Date: 30.OCT.2020 13:53:35

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 (16M PRF)



Date: 5.NOV.2020 16:02:25

6.4.3. 960 MHz to 8 GHz Vertical at 1 Meter (16M PRF)

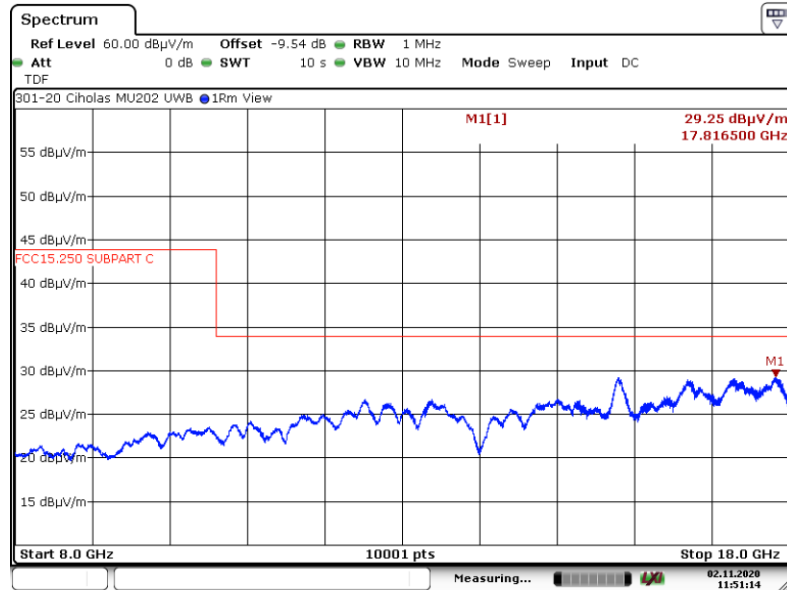


Date: 5.NOV.2020 15:27:10

6. Measurement Data (continued)

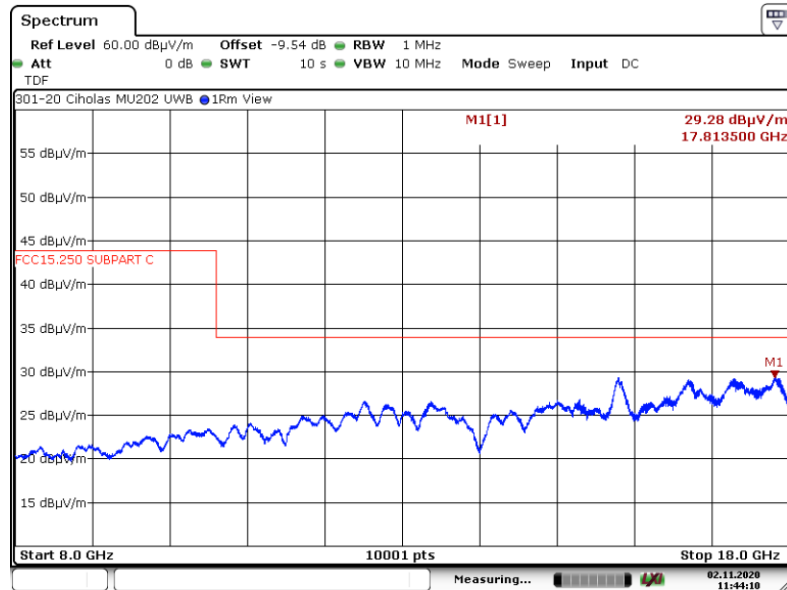
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.4. 8 to 18 GHz Horizontal at 1 Meter (16M PRF)



Vertical
Date: 2.NOV.2020 11:51:14

6.4.5. 8 to 18 GHz Vertical at 1 Meter (16M PRF)

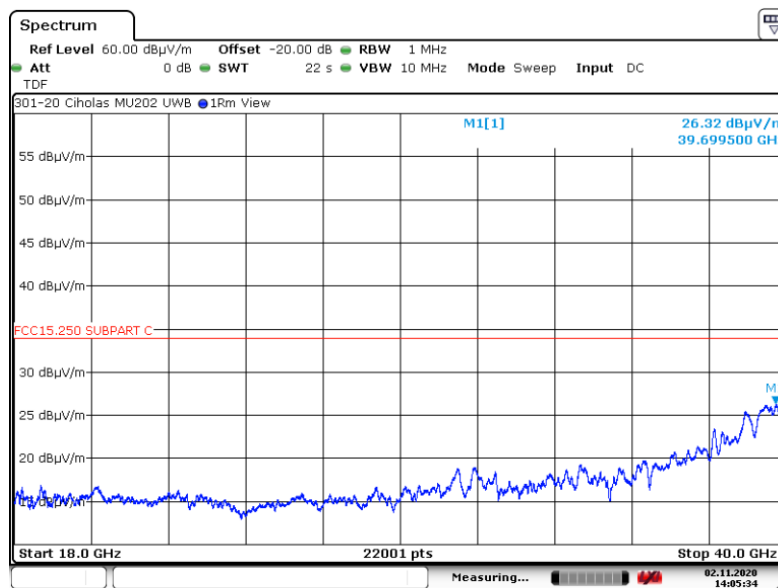


Vertical
Date: 2.NOV.2020 11:44:11

6. Measurement Data (continued)

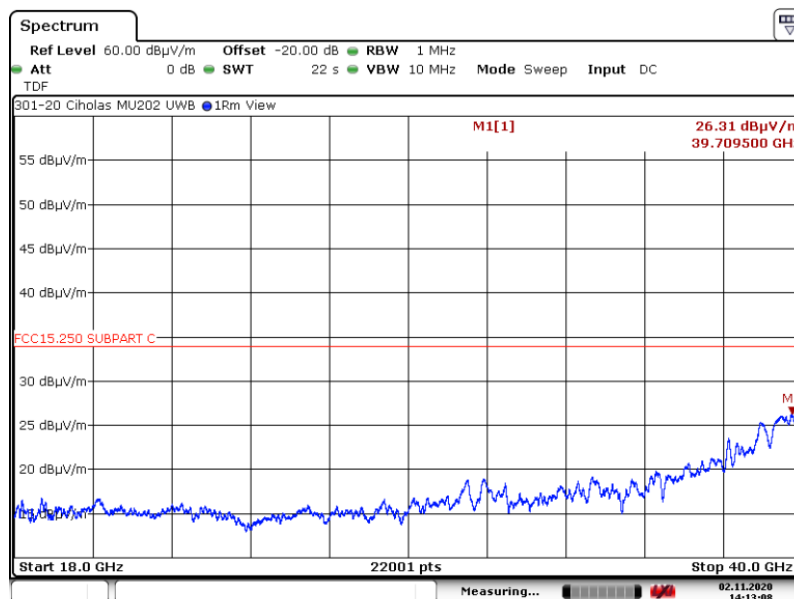
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.6. 18 to 40 GHz Horizontal at 0.3 Meter (16M PRF)



Vertical
Date: 2.NOV.2020 14:05:34

6.4.7. 18 to 40 GHz Vertical at 0.3 Meter (16M PRF)

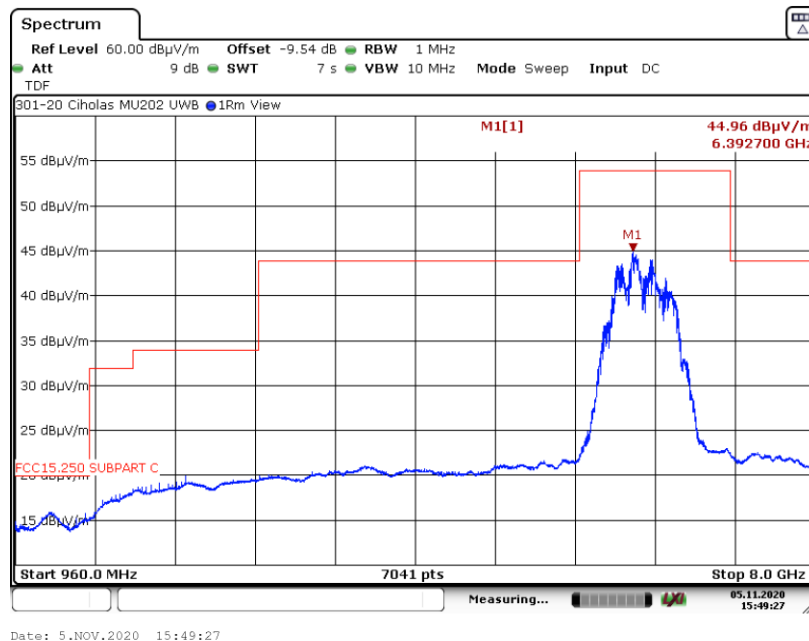


Vertical
Date: 2.NOV.2020 14:13:08

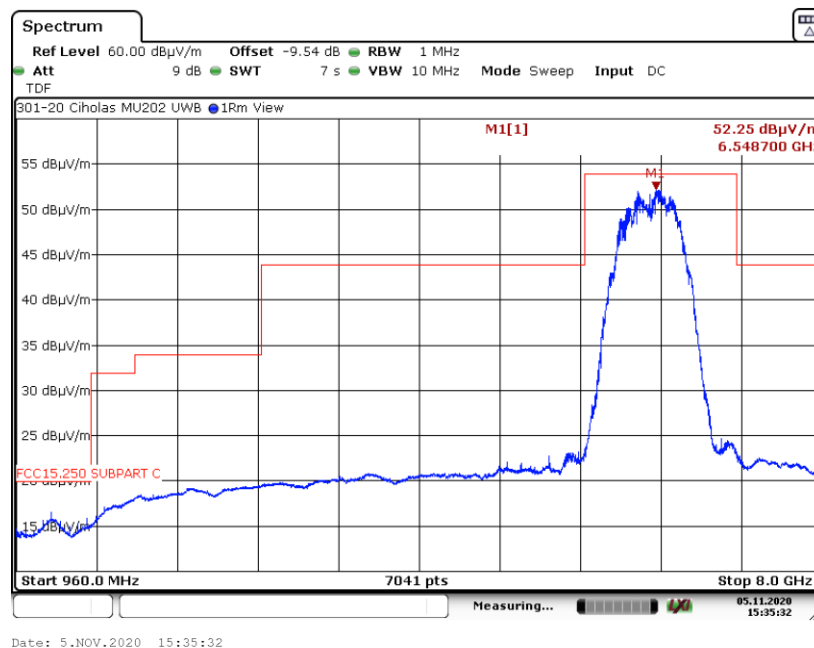
6. Measurement Data (continued)

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

6.4.8. 960 MHz to 8 GHz Horizontal at 1 Meter (64M PRF)



6.4.9. 960 MHz to 8 GHz Vertical at 1 Meter (64M PRF)



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 (64M PRF)



Vertical
Date: 2.NOV.2020 11:56:28

6.4.11. 8 to 18 GHz Vertical at 1 Meter (64M PRF)

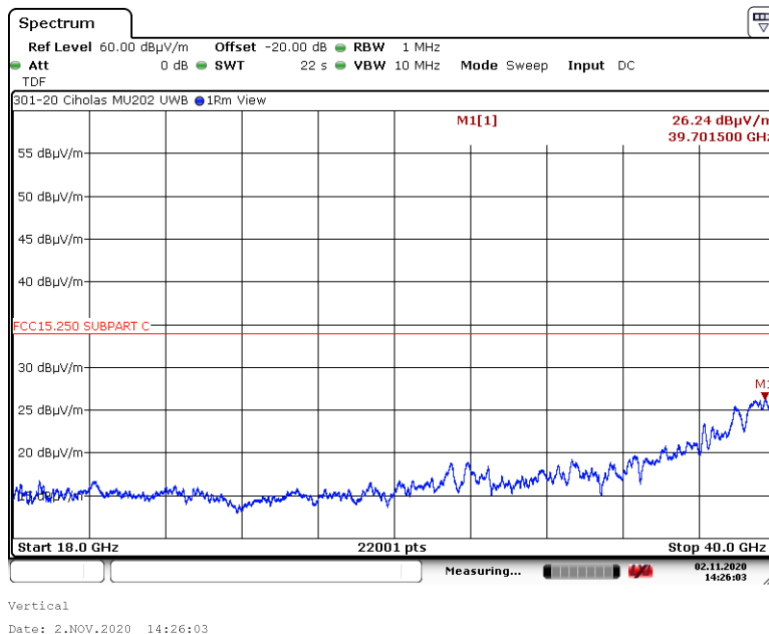


Vertical
Date: 2.NOV.2020 11:37:51

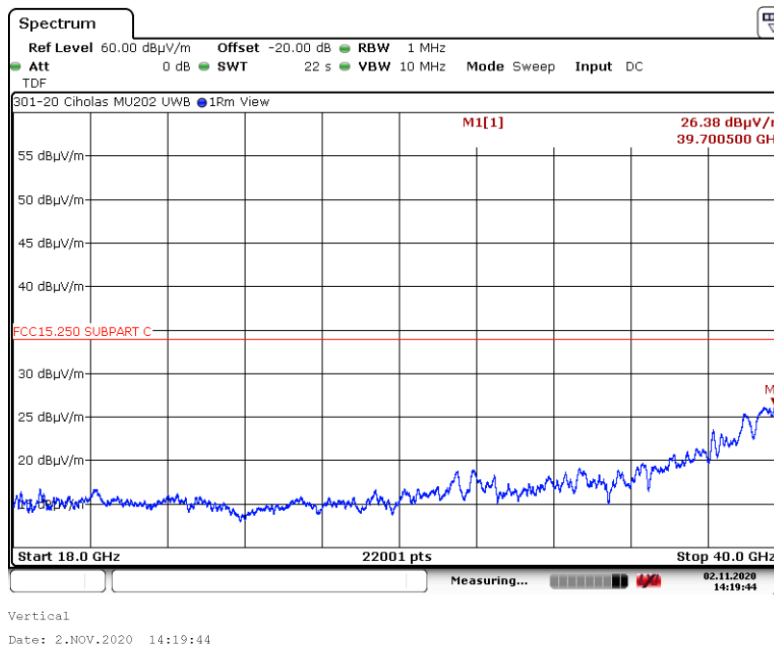
6. Measurement Data (continued)

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

6.4.12. 18 to 40 GHz Horizontal at 0.3 Meter (64M PRF)



6.4.13. 18 to 40 GHz Vertical at 0.3 Meter (64M PRF)



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. At 3 Meters the -85.3 dBm limit is converted to a field strength limit of 9.9 dBuV/m using a distance correction factor of 95.2.

A distance correction factor of -9.54 dB was entered into the analyzer as an offset since the measurements were made at 1 meter.

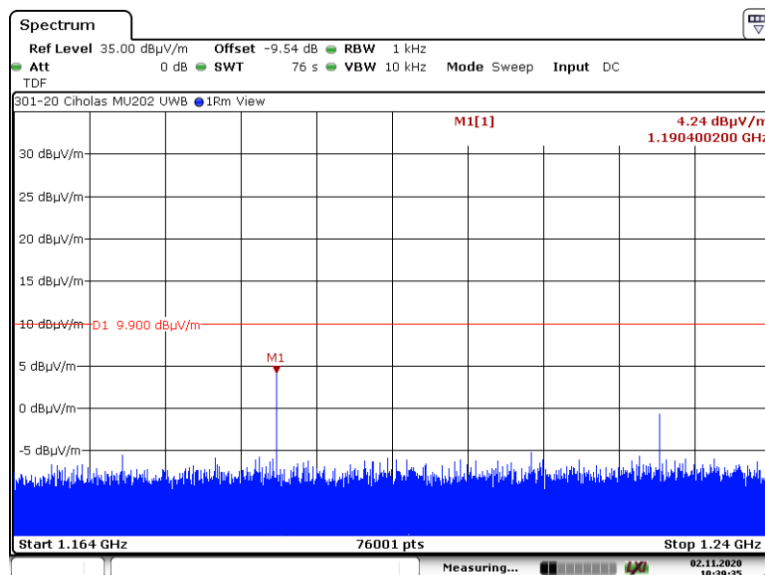
Note: Narrow band emissions that are over the limit are created by the digital communications between the processor and the UWB chipset and are subjected to the limits of 15.209.

6. Measurement Data (continued)

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

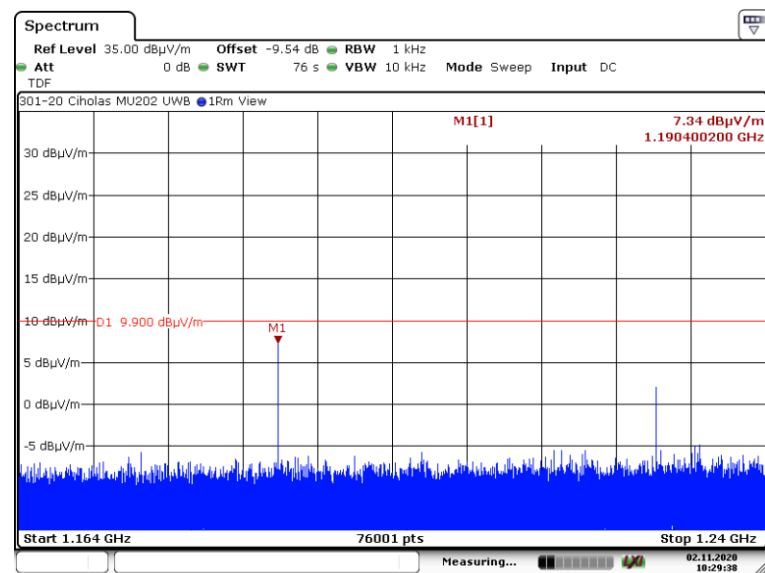
6.5.2 1164 to 1240 MHz Band

6.5.2.1 Horizontal Measurement Polarity 1164 to 1240 MHz (16M PRF)



Vertical
Date: 2.NOV.2020 10:39:35

6.5.2.2 Vertical Measurement Polarity 1164 to 1240 MHz (16M PRF)



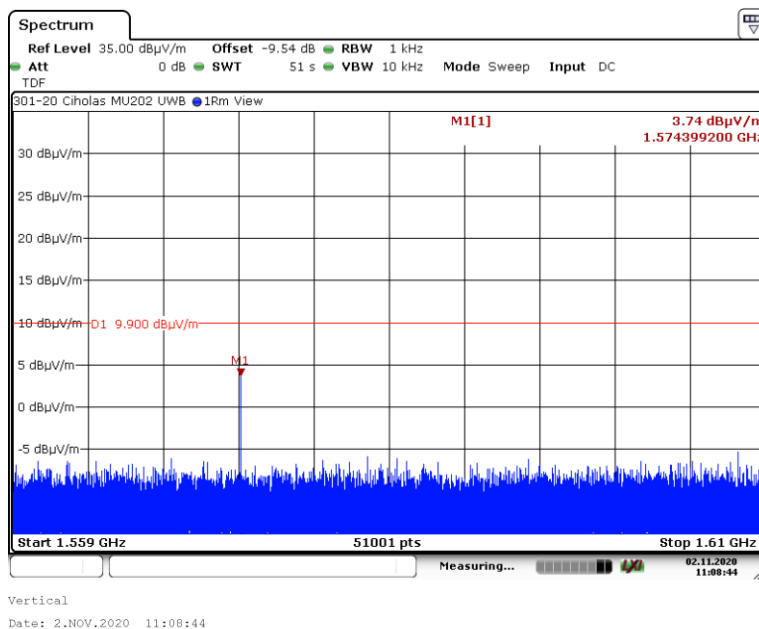
Vertical
Date: 2.NOV.2020 10:29:38

6. Measurement Data (continued)

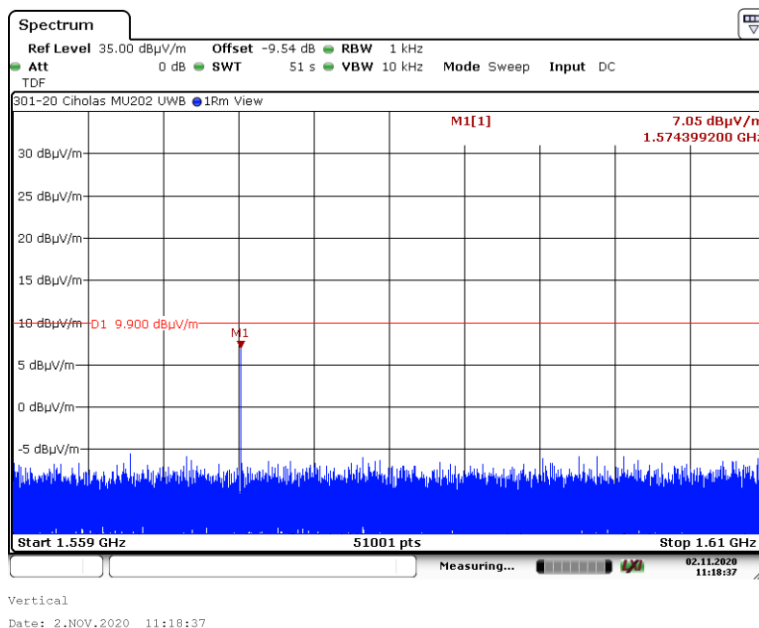
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.3 1559 to 1610 MHz Band

6.5.3.1 Horizontal Measurement Polarity 1559 to 1610 MHz (16M PRF)



6.5.3.2 Vertical Measurement Polarity 1559 to 1610 MHz (16M PRF)

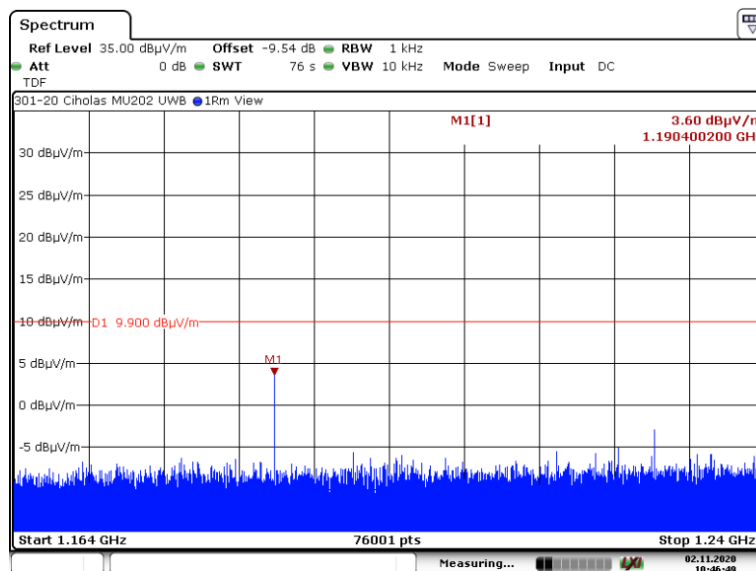


6. Measurement Data (continued)

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

6.5.4 1164 to 1240 MHz Band

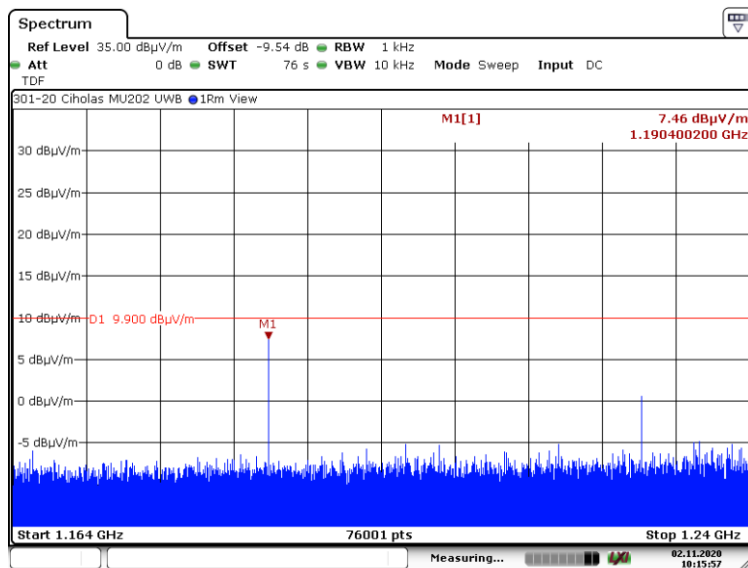
6.5.4.1 Horizontal Measurement Polarity 1164 to 1240 MHz (64M PRF)



Vertical

Date: 2.NOV.2020 10:46:49

6.5.4.2 Vertical Measurement Polarity 1164 to 1240 MHz (64M PRF)



Vertical

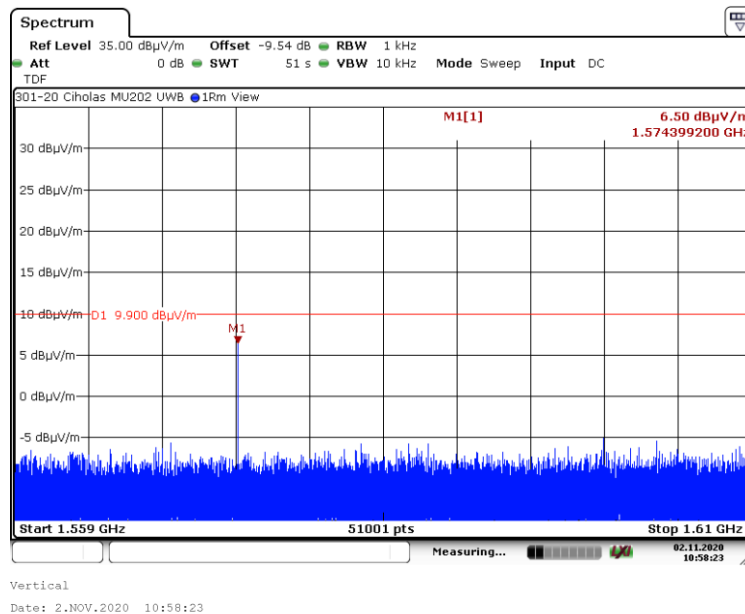
Date: 2.NOV.2020 10:15:57

6. Measurement Data (continued)

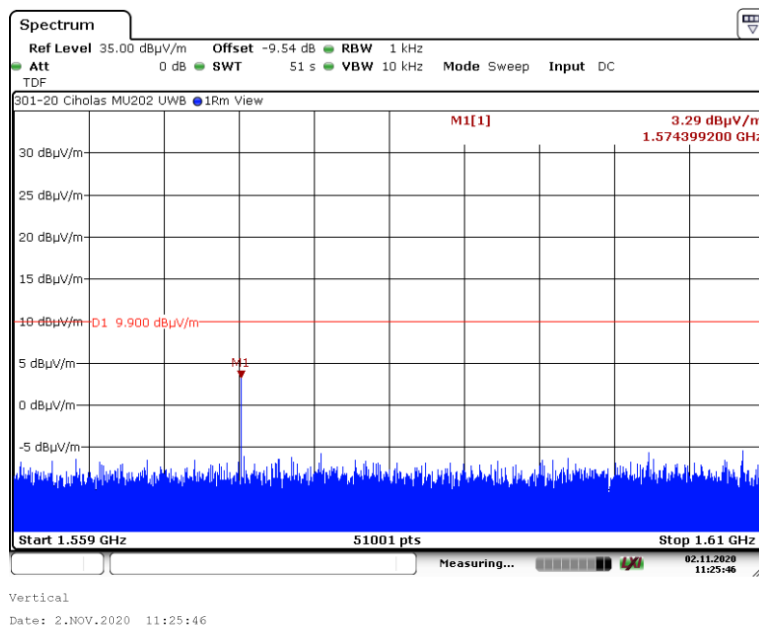
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.5 1559 to 1610 MHz Band

6.5.5.1 Horizontal Measurement Polarity 1559 to 1610 MHz (64M PRF)



6.5.5.2 Vertical Measurement Polarity 1559 to 1610 MHz (64M PRF)



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 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:

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 dB μ V/m at 3 Meters by adding 95.2.

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
5925 - 7250	-41.3	53.9

Frequency Range:	6 to 7 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	1 MHz
EMI Receiver Avg Bandwidth	10 MHz
Detector Function:	RMS 1 mS Average

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 (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Ant Polarity H/V	Ant Height cm	Turntable Azimuth Deg	Result
6.4900	53.79	53.90	-0.11	V	132	302	Compliant

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

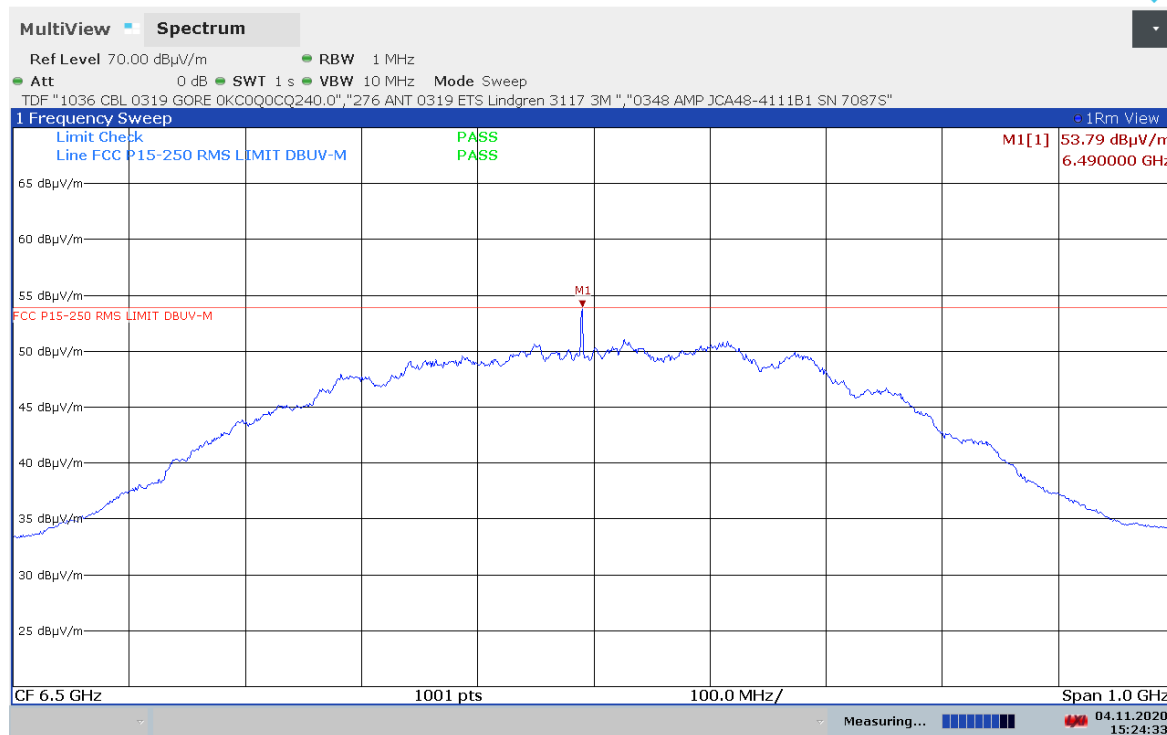
Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

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

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin (dB)	Ant Polarity H/V	Ant Height cm	Turntable Azimuth Deg	Result
6.4900	-41.41	-41.30	-0.11	V	132	302	Compliant

6.6.1. Plot of RMS Power at 3 Meters (16M PRF)

301-20 Ciholas MU202 UWB



15:24:33 04.11.2020

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 (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Ant Polarity H/V	Ant Height cm	Turntable Azimuth Deg	Result
6.4900	53.75	53.90	-0.15	V	132	302	Compliant

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

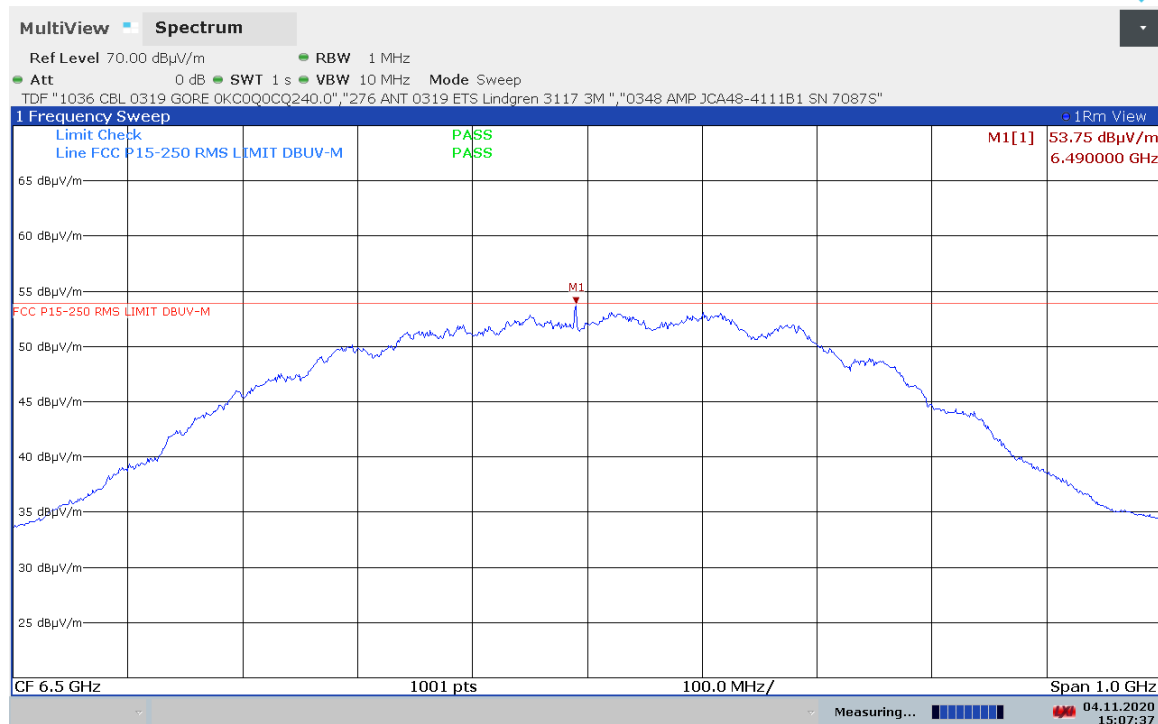
Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

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

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin (dB)	Ant Polarity H/V	Ant Height cm	Turntable Azimuth Deg	Result
6.4900	-41.45	-41.30	-0.15	V	132	302	Compliant

6.6.2. Plot of RMS Power at 3 Meters (64M PRF)

301-20 Ciholas MU202 UWB



15:07:37 04.11.2020

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.

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

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
5925 - 7250	0	95.2

Frequency Range:	6 to 7 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	50 MHz
EMI Receiver Avg Bandwidth	80 MHz
Detector Function:	Peak, Max Held

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	
6.502	95.13	95.20	-0.07	V	132	302	Compliant

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

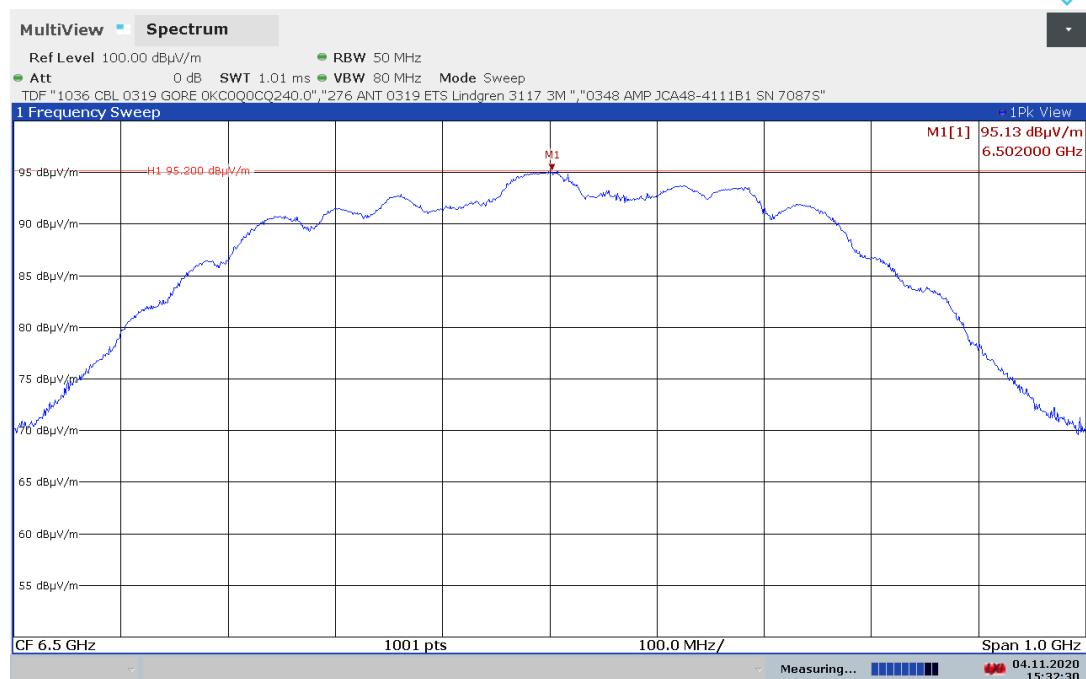
Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

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

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.502	-0.07	0.00	-0.07	V	132	302	Compliant

6.7.1 Plot of Peak Power at 3 Meters (16M PRF)

301-20 Ciholas MU202 UWB



15:32:30 04.11.2020

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	Result
	(dBμV/m)	(dBμV/m)	(dB)	H/V	cm	Deg	
6.490	92.47	95.20	-2.73	V	132	302	Compliant

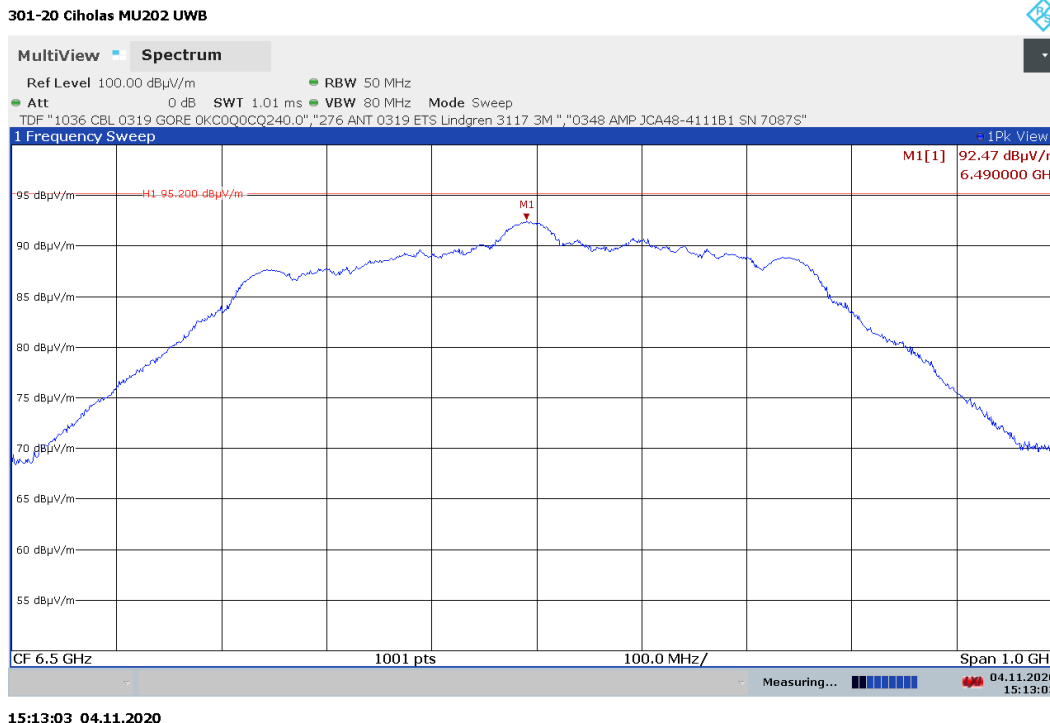
Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

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	
6.490	-2.73	0.00	-2.73	V	132	302	Compliant

6.7.2 Plot of Peak Power at 3 Meters (64M PRF)



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	Rohde & Schwarz	ESR7	101156	10/16/2022
LISN	EMCO	3825/2	9109-1860	10/13/2021
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:	11/6/2020
Test Engineer:	Sean Defelice
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.

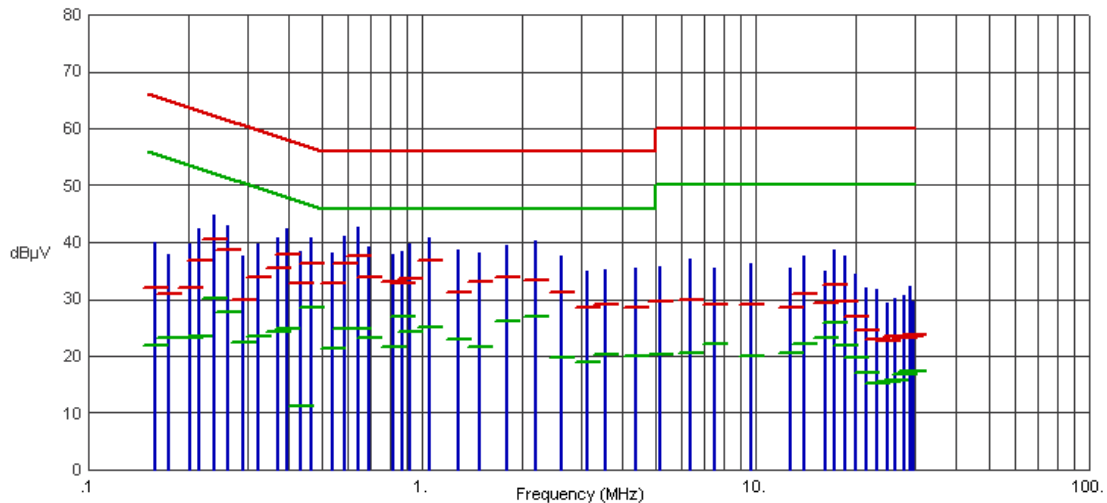
6. Measurement Data (continued)

6.9 Conducted Emissions Test Results

6.9.1 120 Volts, 60 Hz Phase

Test No.: 301-20, 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
.1590	39.97	32.10	65.52	-33.42	21.80	55.52	-33.72	
.1748	37.90	30.87	64.73	-33.86	23.20	54.73	-31.53	
.2018	39.69	31.90	63.54	-31.64	23.30	53.54	-30.24	
.2153	42.41	36.90	63.00	-26.10	23.55	53.00	-29.45	
.2378	44.81	40.57	62.17	-21.60	30.16	52.17	-22.01	
.2625	42.99	38.64	61.35	-22.71	27.62	51.35	-23.73	
.2895	37.52	29.76	60.54	-30.78	22.28	50.54	-28.26	
.3233	39.76	33.91	59.62	-25.71	23.56	49.62	-26.06	
.3683	40.69	35.56	58.54	-22.98	24.14	48.54	-24.40	
.3930	42.43	37.99	58.00	-20.01	24.72	48.00	-23.28	
.4313	38.52	32.89	57.23	-24.34	11.21	47.23	-36.02	
.4650	40.86	36.24	56.60	-20.36	28.54	46.60	-18.06	
.5415	38.20	32.74	56.00	-23.26	21.39	46.00	-24.61	
.5843	41.08	36.39	56.00	-19.61	24.93	46.00	-21.07	
.6428	42.66	37.73	56.00	-18.27	24.85	46.00	-21.15	
.6900	39.22	33.85	56.00	-22.15	23.23	46.00	-22.77	
.8205	37.96	33.19	56.00	-22.81	21.49	46.00	-24.51	
.8700	38.28	32.91	56.00	-23.09	26.93	46.00	-19.07	
.9195	39.77	33.54	56.00	-22.46	24.38	46.00	-21.62	
1.0500	40.81	36.76	56.00	-19.24	24.95	46.00	-21.05	
1.2840	38.65	31.17	56.00	-24.83	22.91	46.00	-23.09	
1.4955	38.13	33.05	56.00	-22.95	21.69	46.00	-24.31	
1.7925	39.53	33.91	56.00	-22.09	26.09	46.00	-19.91	
2.1998	40.39	33.32	56.00	-22.68	26.95	46.00	-19.05	
2.6115	37.47	31.08	56.00	-24.92	19.76	46.00	-26.24	
3.1380	35.03	28.64	56.00	-27.36	18.84	46.00	-27.16	
3.5318	35.11	29.11	56.00	-26.89	20.34	46.00	-25.66	
4.3598	35.43	28.41	56.00	-27.59	20.00	46.00	-26.00	
5.1495	35.85	29.59	60.00	-30.41	20.26	50.00	-29.74	
6.3465	36.98	29.99	60.00	-30.01	20.53	50.00	-29.47	

6. Measurement Data (continued)

6.9 Conducted Emissions Test Results

6.9.1 120 Volts, 60 Hz Phase (continued)

Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
7.5503	35.46	29.04	60.00	-30.96	22.18	50.00	-27.82	
9.6495	36.18	29.00	60.00	-31.00	20.13	50.00	-29.87	
12.7343	35.37	28.66	60.00	-31.34	20.47	50.00	-29.53	
14.0100	37.55	31.04	60.00	-28.96	22.03	50.00	-27.97	
16.2308	34.95	29.37	60.00	-30.63	23.28	50.00	-26.72	
17.2140	38.66	32.41	60.00	-27.59	25.90	50.00	-24.10	
18.5145	37.56	29.59	60.00	-30.41	21.77	50.00	-28.23	
19.9478	34.48	26.98	60.00	-33.02	19.72	50.00	-30.28	
21.4755	31.97	24.65	60.00	-35.35	16.96	50.00	-33.04	
23.1180	31.72	23.01	60.00	-36.99	15.24	50.00	-34.76	
24.8573	29.38	22.64	60.00	-37.36	15.59	50.00	-34.41	
26.1713	30.13	23.38	60.00	-36.62	15.81	50.00	-34.19	
27.9983	30.69	23.25	60.00	-36.75	16.81	50.00	-33.19	
29.1030	32.20	23.47	60.00	-36.53	17.21	50.00	-32.79	
29.6700	29.57	23.83	60.00	-36.17	17.33	50.00	-32.67	

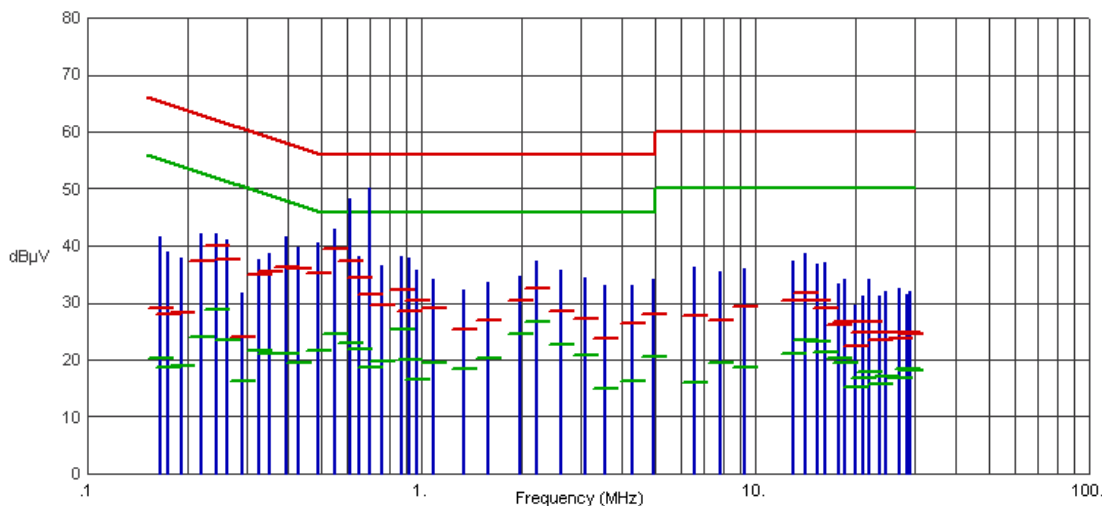
6. Measurement Data (continued)

6.9. Conducted Emissions Test Results (continued)

6.9.2. 120 Volts, 60 Hz Neutral

Test No.: 301-20, 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
.1658	41.67	29.15	65.17	-36.02	20.37	55.17	-34.80	
.1748	38.98	27.90	64.73	-36.83	18.68	54.73	-36.05	
.1905	37.87	28.31	64.01	-35.70	18.91	54.01	-35.10	
.2198	42.04	37.30	62.83	-25.53	23.92	52.83	-28.91	
.2445	42.13	40.01	61.94	-21.93	28.73	51.94	-23.21	
.2625	41.07	37.48	61.35	-23.87	23.41	51.35	-27.94	
.2895	31.72	24.02	60.54	-36.52	16.29	50.54	-34.25	
.3278	37.53	34.91	59.51	-24.60	21.61	49.51	-27.90	
.3503	38.74	35.41	58.96	-23.55	20.99	48.96	-27.97	
.3953	41.56	36.25	57.95	-21.70	21.19	47.95	-26.76	
.4290	39.78	36.01	57.27	-21.26	19.54	47.27	-27.73	
.4920	40.52	35.24	56.13	-20.89	21.66	46.13	-24.47	
.5483	43.05	39.60	56.00	-16.40	24.43	46.00	-21.57	
.6113	48.37	37.31	56.00	-18.69	22.97	46.00	-23.03	
.6540	38.22	34.48	56.00	-21.52	21.81	46.00	-24.19	
.6990	50.22	31.49	56.00	-24.51	18.67	46.00	-27.33	
.7598	36.52	29.60	56.00	-26.40	19.77	46.00	-26.23	
.8700	38.10	32.22	56.00	-23.78	25.30	46.00	-20.70	
.9240	37.74	28.65	56.00	-27.35	19.92	46.00	-26.08	
.9645	35.71	30.40	56.00	-25.60	16.64	46.00	-29.36	
1.0883	34.20	29.15	56.00	-26.85	19.49	46.00	-26.51	
1.3380	32.37	25.44	56.00	-30.56	18.44	46.00	-27.56	
1.5878	33.51	26.91	56.00	-29.09	20.14	46.00	-25.86	
1.9815	34.74	30.35	56.00	-25.65	24.59	46.00	-21.41	
2.2110	37.20	32.41	56.00	-23.59	26.76	46.00	-19.24	
2.6205	35.65	28.48	56.00	-27.52	22.76	46.00	-23.24	
3.0863	34.45	27.32	56.00	-28.68	20.71	46.00	-25.29	
3.5588	33.15	23.86	56.00	-32.14	15.06	46.00	-30.94	
4.2765	32.99	26.31	56.00	-29.69	16.31	46.00	-29.69	
4.9695	34.19	28.03	56.00	-27.97	20.52	46.00	-25.48	

6. Measurement Data (continued)

6.9. Conducted Emissions Test Results (continued)

6.9.2. 120 Volts, 60 Hz Neutral (continued)

Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
6.5985	36.23	27.78	60.00	-32.22	15.91	50.00	-34.09	
7.8855	35.42	27.04	60.00	-32.96	19.40	50.00	-30.60	
9.2648	36.07	29.26	60.00	-30.74	18.73	50.00	-31.27	
12.9413	37.44	30.39	60.00	-29.61	21.03	50.00	-28.97	
14.0933	38.75	31.71	60.00	-28.29	23.55	50.00	-26.45	
15.4095	36.77	30.44	60.00	-29.56	23.12	50.00	-26.88	
16.1790	36.99	29.09	60.00	-30.91	21.45	50.00	-28.55	
17.7338	33.22	26.19	60.00	-33.81	20.34	50.00	-29.66	
18.5438	34.26	26.66	60.00	-33.34	19.38	50.00	-30.62	
19.9815	29.58	22.33	60.00	-37.67	15.32	50.00	-34.68	
21.1313	31.21	24.77	60.00	-35.23	16.81	50.00	-33.19	
22.0290	34.17	26.72	60.00	-33.28	17.88	50.00	-32.12	
23.5163	31.17	23.40	60.00	-36.60	15.69	50.00	-34.31	
24.4703	32.07	24.92	60.00	-35.08	17.14	50.00	-32.86	
26.9520	32.57	23.81	60.00	-36.19	16.77	50.00	-33.23	
28.3785	31.58	24.76	60.00	-35.24	18.48	50.00	-31.52	
29.2155	31.97	24.60	60.00	-35.40	18.26	50.00	-31.74	

6. Measurement Data (continued)

6.10. 99% Emission Bandwidth (RSS-GEN 6.7)

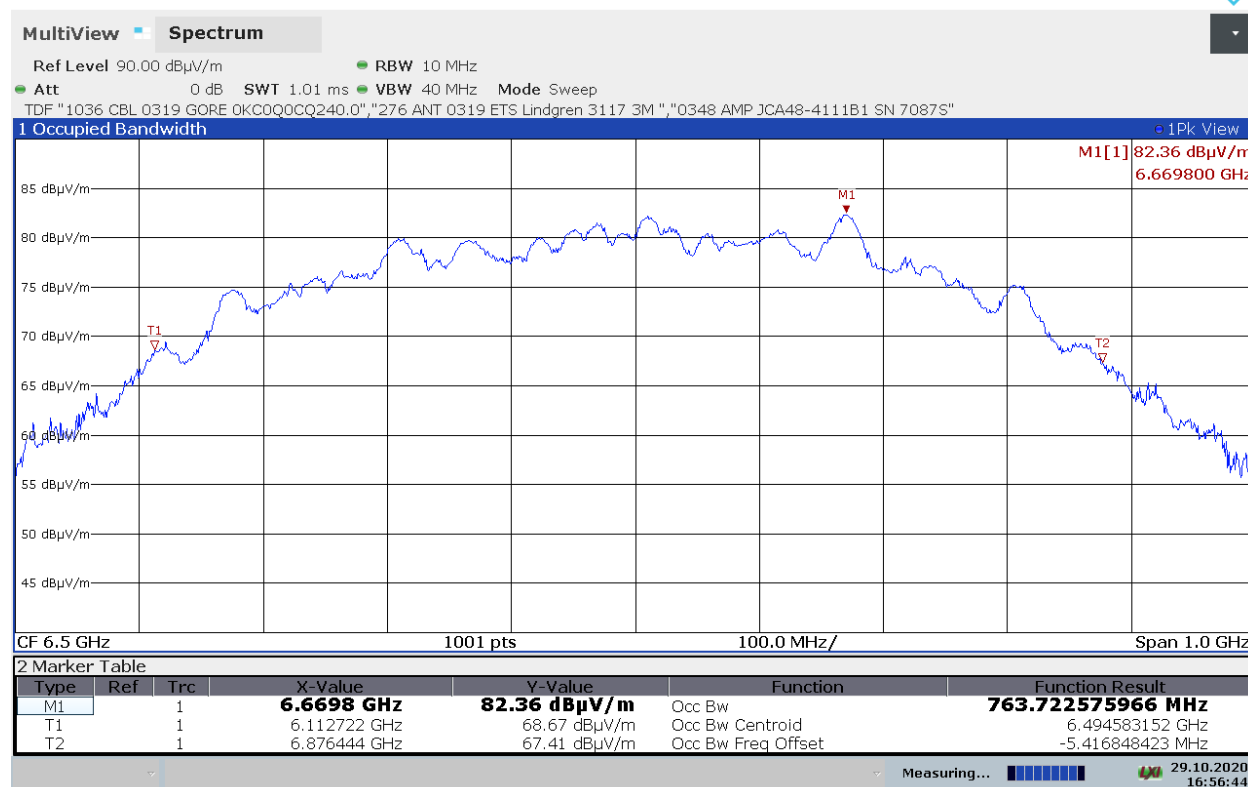
Requirement: The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs RSS-Gen, Section 6.7.

Test Note: The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

6.10.1 Plot of 99% Emission Bandwidth (Channel 5, 16M PRF)

301-20 Ciholas MU202



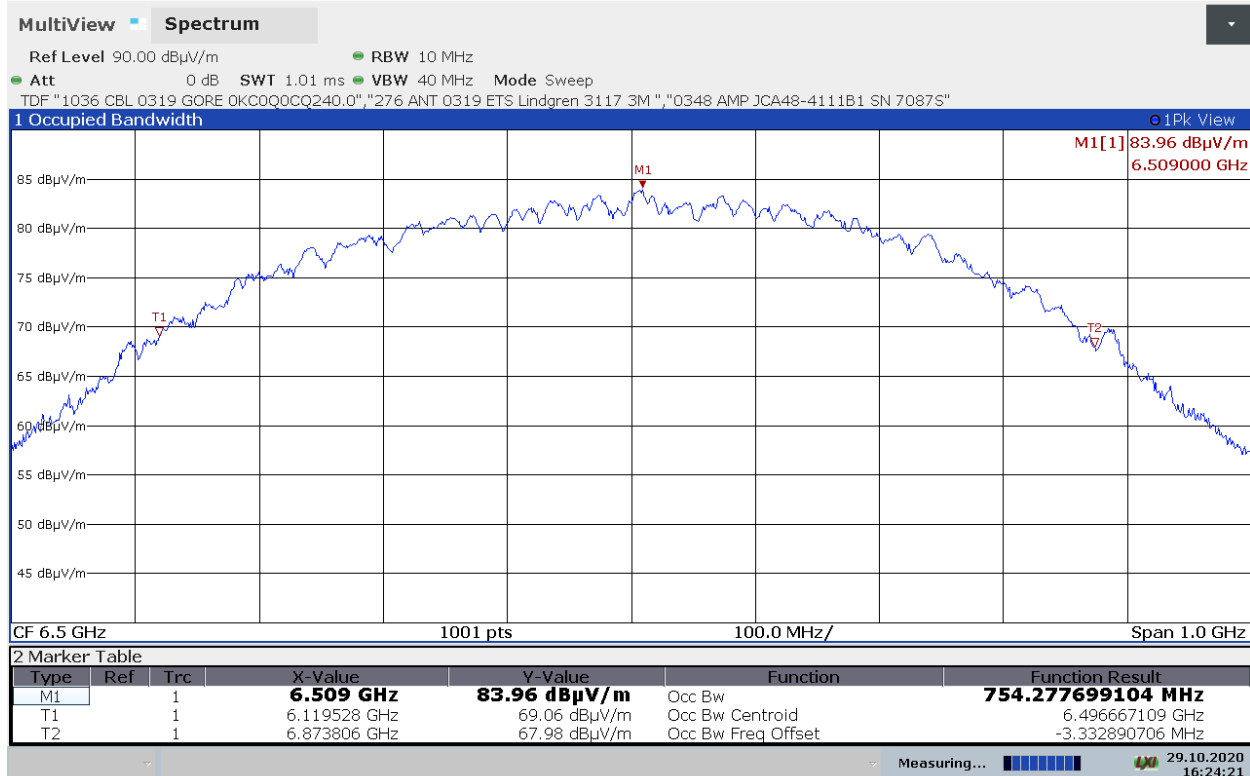
16:56:44 29.10.2020

6. Measurement Data (continued)

6.10. 99% Emission Bandwidth (RSS-GEN 6.7 continued)

6.10.2 Plot of 99% Emission Bandwidth (Channel 5, 64M PRF)

301-20 Ciholas MU202



16:24:21 29.10.2020

6. Measurement Data (continued)

6.11. Public Exposure to Radio Frequency Energy Levels (1.1310)

6.11.1 RF Exposure for devices that operate above 6 GHz (continued)

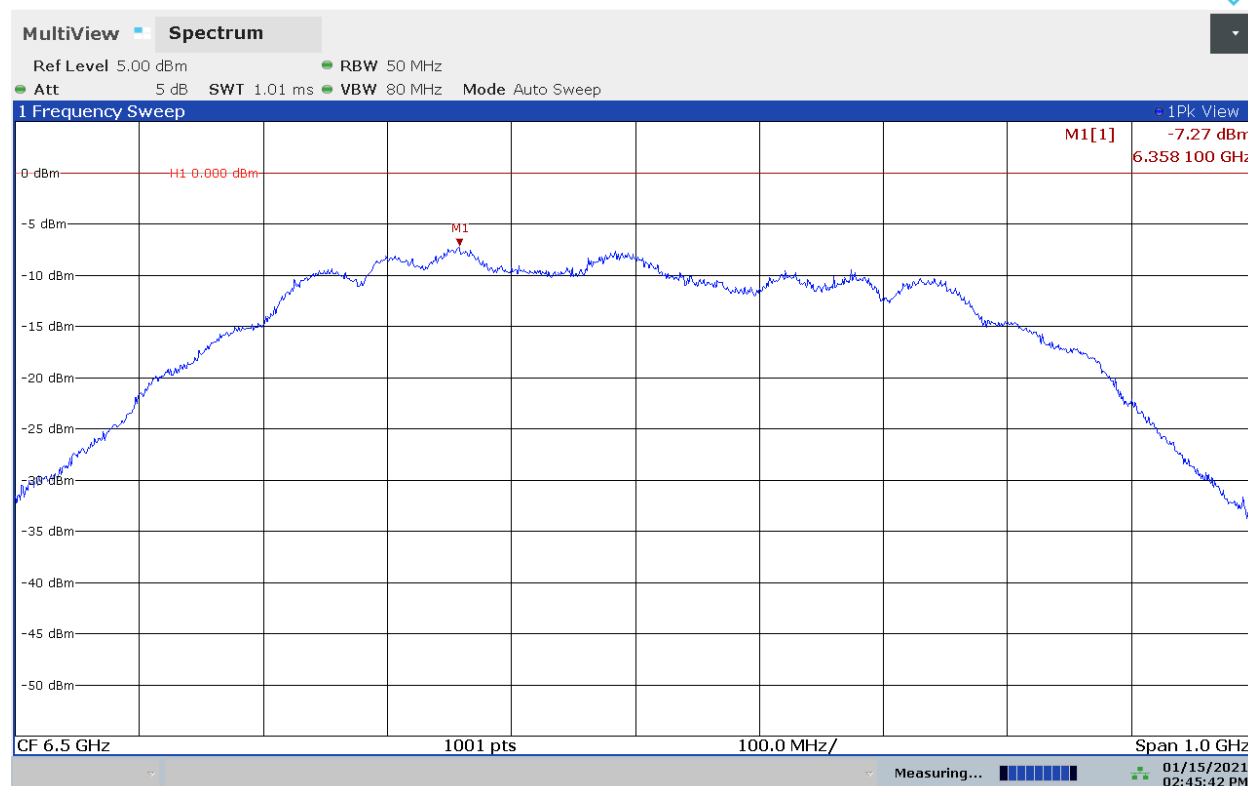
Requirement: TCB Workshop November 2019 RF Exposure Policy Updates dated November 13, 2019, specifically slide 11.

Test exclusion based on 1 mW may be used now with the portable device $f > 6$ GHz FCC MPE power density limits. Maximum time-averaged conducted power irrespective of distance from the body.

Worst Case conducted peak power = **-7.27 dBm or 0.188 mW**

Result: Device is compliant with the Test Exclusion requirement of 1 mW.

301-20 Ciholas MU202



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6. Measurement Data (continued)

6.11. Public Exposure to Radio Frequency Energy Levels (RSS-102)

6.11.2 RF Exposure for devices that operate above 6 GHz (continued)

Requirements: Transmitters that operate above 6 GHz are exempt from routine SAR and RF exposure evaluations provided that they comply with the requirements of section 2.5.2.

Section 2.5.2: RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows: at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

Center Frequency (GHz)	DUT Radiated Peak Output Power (dBm)	DUT Peak Output Power	DUT Peak Output Power	ISED 2.5.2 Limit
		(milliWatts EIRP)	(Watts EIRP)	(Watts)
	(1)	(2)	(3)	(4)
6.502	-0.07	0.984	0.000984	5

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

1. Section 6.7 of this test report. Measured Peak Power at 3 Meters
2. Converted dBm (E.I.R.P) measured in Section 6.7 to milliwatts
3. Converted dBm (E.I.R.P) measured in Section 6.7 to Watts
4. Reference ISED RSS-102 Section 2.5.2 Limit above 6 GHz

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 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 32, 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.

The radiated emissions test site for measurements above 1GHz is a 3 Meter open area test site (OATS) with a 3.6 by 3.6 meter anechoic absorber floor patch to achieve a quasi-free space measurement environment per ANSI C63.4/C63.10 and CISPR 16-1-4 standards.

The 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



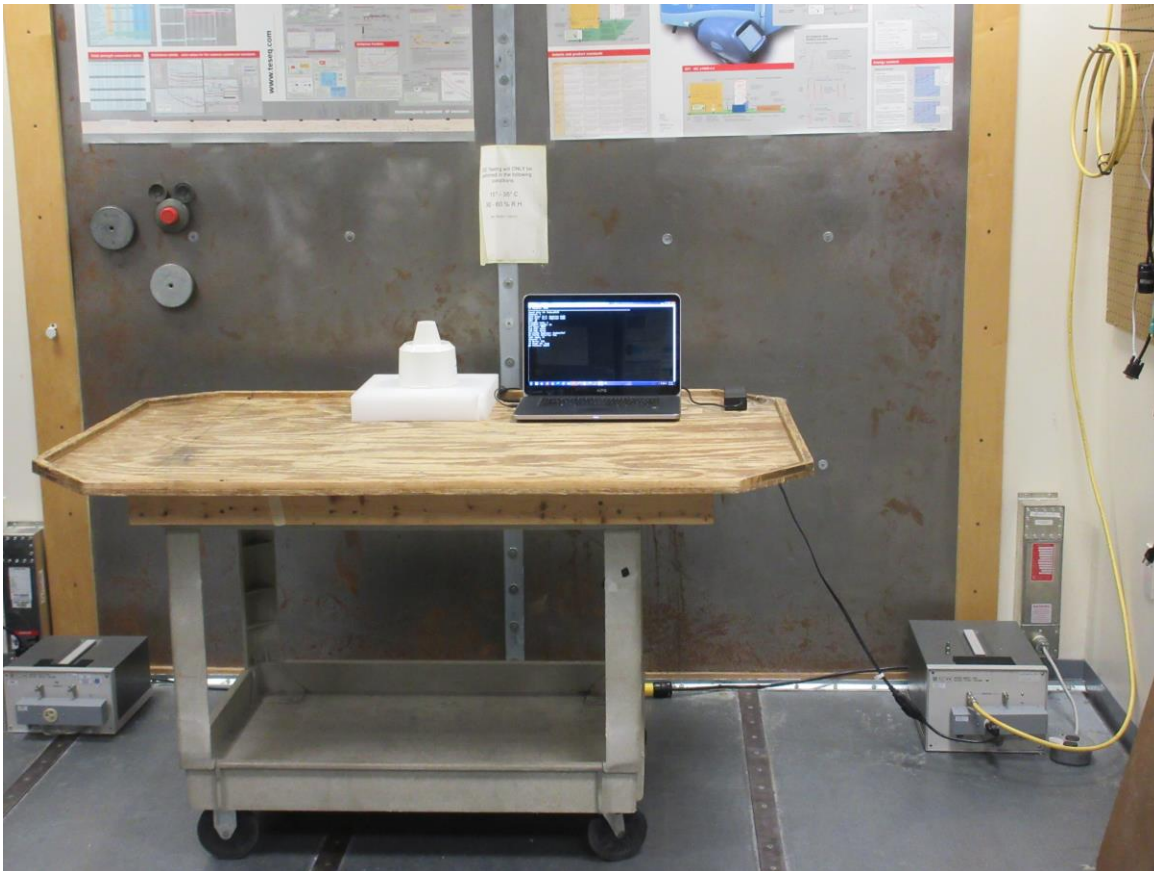
8. Test Images

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



8. Test Images

8.7. Conducted Emissions (Front)



8. Test Images

8.8. Conducted Emissions (Rear)



8. Test Images

8.9. Frequency Stability (Setup)

