



# COMPLIANCE WORLDWIDE INC. TEST REPORT 341-22R1

In Accordance with the Requirements of

Federal Communications Commission 47 CFR Part 15.517, Subpart F Technical Requirements for Indoor UWB Systems

Issued to

Ciholas, Inc. 3700 Bell Road Newburgh, IN 47630

For the Linear Phase Array Model: LP202

# FCC ID: 2ALIR-LP202

Report Issued on November 30, 2022 Revision R1 Issued on January 26, 2023

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#### 1. Scope

This test report certifies that the Ciholas Linear Phase Array LP202 as tested, meets the FCC Part 15.517, Subpart F requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required. Revision R1 added channel & PRF to plots & data of sections 6.4.1.25 and 6.4.1.26

#### 2. Product Details

<ul><li>2.1. Manufacturer:</li><li>2.2. Model Numbers:</li><li>2.3. Serial Numbers:</li><li>2.4. Description:</li></ul>	Ciholas LP202 0E00004B The LP202 is part of a wireless system that relies on ultra-wideband (UWB) pulses and time-stamp information to determine real-time location tracking data. The LP202 transmits UWB beacons and co- exists with other devices on a UWB network. The LP202 are used in an object of interest within the operational area in order to locate and track the object. The LP202 receives power from its host device. The LP202 is a large format-based module. The module board consists of 4 receiving antennas and one transceiver antenna.
2.5. Power Source:	DC 5 Volts
2.6. Hardware Revision:	1.0
2.7. Software Revision:	1.0.0
2.8. Modulation Type:	Pulse Modulation, Frequency Hopping
2.9. Operating Frequencies:	4.576 GHz (Channel 3), 6.49 GHz (Channel 5) Nominal (500 MHz BW)
2.10. EMC Modifications:	None

#### 3. Product Configuration

#### 3.1 Operational Characteristics & Software

#### Hardware Setup:

Connect via a virtual USB connection to a laptop. Using the custom embedded firmware configure the module to operate on Channel 3 or 5. The module is tested for operation with PRF 16 and PRF 64 at a 6.8 MBPS data rate.

#### 3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
Ciholas	LP202	0E00004B	5	DC	UWB Large format module

#### 3.3. EUT Cables/Transducers

Cable Type	Length	Shield	From	То
USB	6M	Yes	EUT	Laptop Computer

#### 3.4. Support Equipment

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

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### 3. Product Configuration (cont.)

### 3.5. Test Setup Diagram



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### 4. Measurements Parameters

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

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
EMI Test Receiver, 9kHz - 7GHz <sup>1</sup>	Rohde & Schwarz	ESR7	101156	10/25/2023	2 Year
EMI Test Receiver, 10 Hz - 7GHz <sup>1</sup>	Rohde & Schwarz	ESR7	101770	7/23/2023	2 Year
Spectrum Analyzer, 2 Hz to 26.5 GHz <sup>2</sup>	Rohde & Schwarz	FSW26	102057	6/24/2023	2 Years
Spectrum Analyzer, 9 kHz to 40 GHz <sup>3</sup>	Rohde & Schwarz	FSV40	100899	8/12/2023	3 Years
Spectrum Analyzer 10 Hz – 40 GHz <sup>4</sup>	Rohde & Schwarz	FSVR40	100909	9/18/2023	3 Years
Loop Antenna 9 kHz - 30 MHz	EMCO	6512	9309-1139	4/14/2025	3 Years
Biconilog Antenna, 30 MHz - 2 GHz	Sunol Sciences	JB1	A050913	7/1/2023	2 Years
Dbl Ridged Guide Antenna 1- 18 GHz	ETS-Lindgren	3117	00143292	5/11/2024	2 Years
Dbl Ridged Guide Antenna 1- 18 GHz	ETS-Lindgren	3117	00227631	4/21/2024	2 Years
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3- 00100200- 10-15P-4	988773	3/31/2023	1 Year
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D- 00101800- 30-10P	1953081	3/31/2023	1 Year
Preamplifier 2 to 12 GHz	JCA	JCA48- 4111B1	7087S	3/31/2023	1 Year
Preamplifier, 1 GHz to 26.5 GHz	Hewlett Packard	8449B	3008A01323	11/30/2023	2 Years
Preamplifier 18 to 40 GHz	Miteq	JSD42- 21004200-40- 5P	649199/649219	3/31/2023	1 Year
Horn Antenna 18 to 40 GHz	Com Power	AH-840	101032	1/25/2024	2 Years
High Pass Filter 8 to 18 GHz	Micro-Tronics	HPM50107	G036	3/30/2023	1 Year
Barometric Pressure/Humidity & Temp Datalogger	Extech Instruments	SD700	Q590483	10/14/2023	2 Years

<sup>1</sup> ESR7 Firmware revision: V3.48 SP3, Date installed: 09/30/2020 <sup>2</sup> FSW26 Firmware revision: V4.71 SP1, Date installed: 11/16/2020 <sup>3</sup> FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016 <sup>4</sup> FSVR40 Firmware revision: V2.23 SP1, Date installed: 08/19/2016

Previous V3.48 SP2, installed 07/23/2020. Previous V4.61, installed 08/11/2020. Previous V2.30 SP1, installed 10/22/2014. Previous V2.23, installed 10/22/2014.





#### 4. Measurements Parameters (continued)

#### 4.2. Measurement & Equipment Setup

Test Dates:	11/11/2022, 11/14/2022, 11/15/2022, 11/16/2022
Test Engineers:	Sean Defelice
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, 1 Meter, 0.5 Meter
EMI Receiver IF Bandwidth:	200 Hz – 30 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:	≥ 3 * RBW or IF(BW)
Detector Functions:	Peak, Quasi-Peak, RMS & CISPR Average

#### 4.3. Measurement Procedure

Test measurements were made in accordance FCC Parts 15.209 Subpart C and 15.517 Subpart F requirements.

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)	± 1x10 <sup>-8</sup>
Radiated Emission of Transmitter to 100 GHz	± 4.55 dB
Radiated Emission of Receiver	± 4.55 dB
Temperature	± 0.91° C
Humidity	± 5%





## 5. Measurements Summary

Test Requirement	FCC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	6.1	Compliant	
Operational Requirements	15.517 (a)	6.2	Compliant	
UWB Bandwidth	15.503 (a) (d) 15.517 (b)	6.3	Compliant	
Radiated Emissions below 960 MHz	15.209	6.4	Compliant	
Radiated Emissions above 960 MHz	15.517 (c) 15.521 (d)	6.5	Compliant	
Radiated Emissions in GPS Bands	15.517 (d)	6.6	Compliant	
RMS Emissions of UWB Transmission in a 1 MHz Bandwidth	15.517 (c) 15.521 (d)	6.7	Compliant	
Peak Emissions in a 50 MHz Bandwidth	15.517 (e) 15.521 (g)	6.8	Compliant	
Conducted Emissions	15.207	6.9	N/A	

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#### 6. Measurement Data

### 6.1. Antenna Requirement (FCC Part 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 contains an printed circuit board antenna





### 6.2. Operational Requirements of the Device under Test (15.517 (a))

- Requirement: (1) Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g., a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.
- Result: Compliant, the EUT is an indoor anchor designed to receive location information from a tag filed under a separate application. The statement required by Section 15.517(f) is located in the manual regarding the use of indoor equipment.

(2) The emissions from the equipment operated under this section shall not be intentional directed outside of the building in which the equipment is located, such as through a window or a doorway, to perform an outside function, such as the detection of persons about to enter a building.

Result: Not Applicable, Compliant.

(3) The use of outdoor mounted antennas, e.g. antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.

Result: Not Applicable, Compliant.

(4) Field disturbance sensors installed inside of metal or underground storage tanks are considered to operate indoors provided the emissions are directed towards the ground.

Result: Not Applicable, Compliant.

(5) A communications system shall transmit only when the intentional radiator is sending information to an associated receiver.

Result: Compliant.





### 6.3. UWB Bandwidth (15.503 (a) (d), 15.517 (b)

Requirement: The UWB bandwidth of a device operating under the provisions of this section shall be contained between 3,100 MHz and 10,600 MHz and at any point in time and has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

#### 6.3.1. Measurement Data – Values in GHz.

		CH3 16M	CH3 64M	CH5 16M	CH5 64M
fм	The highest emission peak	4.5789	4.5280	6.5060	6.5050
fL	10 dB below the highest peak	4.2872	4.2582	6.2223	6.2193
fн	10 dB above the highest peak	4.8147	4.8107	6.7877	6.7957
fc	Calculated: (f <sub>H</sub> + f <sub>L</sub> ) / 2	4.5510	4.5345	6.5050	6.5075
Bandwidth	Calculated: (f <sub>H</sub> - f <sub>L</sub> )	0.5275	0.5525	0.5654	0.5764
Fractional BW	Calculated: $2^{(f_H - f_L)} / (f_H + f_L)$	0.1159	0.1218	0.0869	0.0886

#### 6.3.2. Measurement Plot of 10 dB frequencies (Channel 3, 16M PRF)



09:40:50 11.11.2022





### 6.3. UWB Bandwidth (15.503 (a) (d), 15.517 (b)

6.3.3. Measurement Plot of 10 dB frequencies (Channel 3, 64M PRF)



### 6.3.4. Measurement Plot of 10 dB frequencies (Channel 5, 16M PRF)



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# 6.3. UWB Bandwidth (15.503 (a) (d), 15.517 (b)

6.3.5. Measurement Plot of 10 dB frequencies (Channel 5, 64M PRF)



11:52:47 11.11.2022





### 6.4. Spurious Radiated Emissions below 960 MHz (15.517 (c), 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.

#### Radiated Emissions Field Strength Limits at 3 Meters (Section Part 15.209)

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

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

Frequency Range:	30 kHz to 960 MHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	200 Hz – 30 kHz to 150 kHz 9 kHz – 150 kHz to 30 MHz 120 kHz <i>-</i> 30 MHz to 960 MHz
EMI Receiver Avg Bandwidth:	≥ 3 * RBW or IF(BW)
Detector Function:	Peak, Quasi-Peak & Average

Sample Calculation: Final Result  $(dB\mu V/m) =$  Measurement Value  $(dB\mu V) +$  Antenna Factor (dB/m) + Cable Loss (dB) - Pre-amplifier Gain (dB) Internal or External.

**Note:** All correction factors are loaded into the measurement instrument prior to testing to determine the final result.





#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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 - Channel 3 16M PRF



6.4.1.2 Perpendicular Measurement Antenna – 30 to 150 kHz – CH 3 16M PRF



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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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 - CH3 16M PRF



6.4.1.4 Parallel Measurement Antenna – 30 to 150 kHz – CH3 64M PRF



Date: 14.NOV.2022 11:30:37





#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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 – 30 to 150 kHz – CH3 64M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.7 Parallel Measurement Antenna - 30 to 150 kHz - CH5 16M PRF



6.4.1.8 Perpendicular Measurement Antenna – 30 to 150 kHz – CH5 16M PRF







#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.9 Ground Parallel Measurement Antenna - 30 to 150 kHz - CH5 16M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.11 Perpendicular Measurement Antenna - 30 to 150 kHz - CH5 64M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.13 Parallel Measurement Antenna - 150 kHz to 30 MHz - CH3 16M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.15 Ground Parallel Measurement Antenna - 150 kHz to 30 MHz - CH3 16M PRF











#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.17 Perpendicular Measurement Antenna - 150 kHz to 30 MHz - CH3 64M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.19 Parallel Measurement Antenna - 150 kHz to 30 MHz - CH5 16M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.21 Ground Parallel Measurement Antenna - 150 kHz to 30 MHz - CH5 16M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 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.

6.4.1.23 Perpendicular Measurement Antenna - 150 kHz to 30 MHz - CH5 64M PRF







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#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 continued)

6.4.1. 30 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. The device was then tested on our 3M OATS from 30 to 960 MHz.

6.4.1.25 Horizontal Polarity - 30 to 960 MHz CH3, 16M PRF



Note: All other channels were similar.

Frequency (MHz)	Pk Amp (dBµV/m)	QP Amp (dBµV/m)	QP Limit (dBµV/m)	Margin (dB)	Ant Ht (cm)	Table (Deg)	Comments
32.4800	38.86	22.68	40.00	-17.32	N/A	N/A	
60.0000	41.52	16.02	40.00	-23.98	N/A	N/A	
72.2900	44.07	25.03	40.00	-14.97	N/A	N/A	
84.2900	42.02	14.20	40.00	-25.80	N/A	N/A	
120.4700	34.30	26.68	43.50	-16.82	N/A	N/A	
156.0000	35.17	17.69	43.50	-25.81	N/A	N/A	
168.0000	35.85	17.92	43.50	-25.58	N/A	N/A	
180.0000	36.48	23.21	43.50	-20.29	N/A	N/A	
216.7700	32.83	25.54	46.00	-20.46	N/A	N/A	
228.8000	30.68	20.74	46.00	-25.26	N/A	N/A	
276.9200	33.97	16.05	46.00	-29.95	N/A	N/A	
348.0000	34.42	13.20	46.00	-32.80	N/A	N/A	
395.5100	36.51	14.50	46.00	-31.50	N/A	N/A	
576.0000	35.10	27.91	46.00	-18.09	N/A	N/A	
614.3900	31.11	21.03	46.00	-24.97	N/A	N/A	
791.3000	32.15	20.84	46.00	-25.16	N/A	N/A	





#### 6.4. Spurious Radiated Emissions (15.517 (c), 15.209 continued)

6.4.1. 30 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. The device was then tested on our 3M OATS from 30 to 960 MHz.

6.4.1.26 Vertical Polarity - 30 to 960 MHz CH3, 16M PRF



#### Note: All other channels were similar

Frequency (MHz)	Pk Amp (dBµV/m)	QP Amp (dBµV/m)	QP Limit (dBµV/m)	Margin (dB)	Ant Ht (cm)	Table (Deg)	Comments
39.5000	36.54	30.53	40.00	-9.47	N/A	N/A	
60.0000	38.42	29.56	40.00	-10.44	N/A	N/A	
72.2900	37.98	33.23	40.00	-6.77	N/A	N/A	
84.0200	36.46	26.87	40.00	-13.13	N/A	N/A	
108.4700	40.09	34.02	43.50	-9.48	N/A	N/A	
120.5000	43.38	37.49	43.50	-6.01	N/A	N/A	
156.0000	33.35	23.79	43.50	-19.71	N/A	N/A	
168.7100	37.91	30.75	43.50	-12.75	N/A	N/A	
180.3200	31.84	26.71	43.50	-16.79	N/A	N/A	
192.6800	38.01	30.78	43.50	-12.72	N/A	N/A	
216.7700	37.22	29.60	46.00	-16.40	N/A	N/A	
252.0000	32.20	15.12	46.00	-30.88	N/A	N/A	
265.1000	29.10	20.05	46.00	-25.95	N/A	N/A	
276.0000	22.48	13.18	46.00	-32.82	N/A	N/A	
289.0700	29.42	18.21	46.00	-27.79	N/A	N/A	
360.0000	32.80	29.18	46.00	-16.82	N/A	N/A	
432.0000	29.40	17.85	46.00	-28.15	N/A	N/A	
541.4600	29.31	17.27	46.00	-28.73	N/A	N/A	





### 6.5. Spurious Radiated Emissions above 960 MHz (15.517 (c), 15.521 (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  $dB\mu V/m$  at 3 Meters by adding 95.2.

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dBµV/m)
960 - 1610	-75.3	19.9
1610 - 1990	-53.3	41.9
1990 - 3100	-51.3	43.9
3100 - 10600	-41.3	53.9
Above 10600	-51.3	43.9

Frequency Range:	960 MHz to 40 GHz
Measurement Distance:	1 Meter and 0.3 Meter
EMI Receiver IF Bandwidth:	1 MHz
EMI Receiver Avg Bandwidth	10 MHz
Detector Function:	RMS 1 mS Average as defined in 15.521(d)

Notes: Measurements made from 960 MHz to 18 GHz were made in a semianechoic chamber at 1 Meter using a -9.54 dB distance offset was programmed into the spectrum analyzer.

Measurements made from 6.4 to 18 GHz and 8 to 18 GHz were done with the aid of a High Pass Filter before the low noise amplifier.

Measurements made from 18 to 40 GHz were done at 0.3 meters and a -20.00 dB distance offset was programmed into the spectrum analyzer.

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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.1. 960 MHz to 6.4 GHz Horizontal at 1 Meter, CH3, 16M



#### 6.5.2. 960 MHz to 6.4 GHz Vertical at 1 Meter, CH3, 16M







### 6.5. Spurious Radiated Emissions (15.517 (d) continued)





#### 6.5.4. 960 MHz to 6.4 GHz Vertical at 1 Meter, CH3, 64M



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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.5. 960 MHz to 8 GHz Horizontal at 1 Meter, CH5, 16M



#### 6.5.6. 960 MHz to 8 GHz Vertical at 1 Meter, CH5, 16M



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#### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.7. 960 MHz to 8 GHz Horizontal at 1 Meter, CH5, 64M



#### 6.5.8. 960 MHz to 8 GHz Vertical at 1 Meter, CH5, 64M



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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.9. 6.4 to 18 GHz Horizontal at 1 Meter, CH3, 16M



### 6.5.10. 6.4 to 18 GHz Vertical at 1 Meter, CH3, 16M







### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.11. 6.4 to 18 GHz Horizontal at 1 Meter, CH3, 64M



#### 6.5.12. 6.4 to 18 GHz Vertical at 1 Meter, CH3, 64M



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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.13. 8 to 18 GHz Horizontal at 1 Meter, CH5, 16M



### 6.5.14. 8 to 18 GHz Vertical at 1 Meter, CH5, 16M







### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

#### 6.5.15. 8 to 18 GHz Horizontal at 1 Meter, CH5, 64M



#### 6.5.16. 8 to 18 GHz Vertical at 1 Meter, CH5, 64M



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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.17. 18 to 40 GHz Horizontal at 0.3 Meter, CH3, 16M



#### 6.5.18. 18 to 40 GHz Vertical at 0.3 Meter, CH3,16M



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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.19. 18 to 40 GHz Horizontal at 0.3 Meter, CH3, 64M



#### 6.5.20. 18 to 40 GHz Vertical at 0.3 Meter, CH3, 64M



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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

6.5.21. 18 to 40 GHz Horizontal at 0.3 Meter, CH5, 16M



#### 6.5.22. 18 to 40 GHz Vertical at 0.5 Meter, CH5, 16M



Date: 15.NOV.2022 15:21:20

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### 6.5. Spurious Radiated Emissions (15.517 (d) continued)

#### 6.5.23. 18 to 40 GHz Horizontal at 0.3 Meter, CH5, 64M



### 6.5.24. 18 to 40 GHz Vertical at 0.3 Meter, CH5, 64M







#### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d)

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		

#### 6.6.1. Measurement & Equipment Setup

EMI Receiver IF Bandwidth:	1 kHz
EMI Receiver Avg Bandwidth:	10 kHz
Detector Functions:	RMS Average 1mS / point

#### 6.6.2. 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 1 Meter with a -9.54 dB distance correction factor. The -85.3 dBm limit was converted to a field strength limit of 9.9 dBuV/m using a factor of 95.2.

**Note:** Narrow band spikes in plots are created by digital circuitry and not subjected to this limit.





### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

6.6.3.1 Horizontal Measurement Polarity 1164 to 1240 MHz, CH3, 16M

Spectrum	ر آ												
Ref Leve	35.00	dBµ∨/n	n <b>O</b>	ffset -9	9.54 dB	RBW	1 kHz						
Att		0 dE	3 <b>e s</b>	wт	76 s	● VBW	10 kHz	Mod	e Sweep	Input	DC		
TDF			D.			10 11							
341-22 Cino	ias LP20	2 Linea	ar Phas	se Array	UVVB O	1KM VIEV	V						70 10 11 1
								M1	[1]			3.	70 dBµV/m 799600 CH:
30 dBµV/m-		-						-			-	1.2201	
25 dBµV/m-		_					_				_		
20 dBµV/m-		_					_						
15 dBµV/m-		_					_	_			_		
10 dBµV/m	D1 9.90	10 dBµV	/m										
5 dBµV/m—		_						_				M1	
0 dBµV/m—		_					_						
-5 dBµV/m-			-										
n dan darke	mahded	(MA)	hphla	hlylyha	hahhl	a <sup>ha</sup> ikili	u jilun		nagingladed	heplan	Whilly	No No No	lepel hide
Start 1.16	4 GHz					760	01 pts					Stop	3 1.24 GHz
								Meas	uring			a	15.11.2022 09:46:11
ate: 15.NG	V.2022	09:4	6:11										

#### 6.6.3.2 Vertical Measurement Polarity 1164 to 1240 MHz, CH3, 16M



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### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

6.6.3.3 Horizontal Measurement Polarity 1559 to 1610 MHz, CH3, 16M

Spectrum	-											
Ref Level	35.00	dBµ∨/n	n Offs	set -9.54 dB	B 👄 RBW	1 kHz						
Att TDF		0 di	8 🖷 SW1	T 51 9	s 👄 VBW	10 kHz	Mode	Sweep	Input	DC		
341-22 Cihol	as LP2	02 Linea	r Phase	Array UWB (	∋1Rm Viev	v						
							M1[1	]			7.7 1.5744	′9 dBµV/m 00200 GHz
30 dBµV/m-						+				+		
25 dBµV/m−						-				+		
20 dBµV/m-						+				+		
15 dBµV/m−										-		
10 dBµV/m	D1 9.9	00 dBµV	/mt	<u>,</u>			_			+		
5 dBµV/m—							_			+		
0 dBµV/m—										+		
-5 dBµV/m—	Lut i ki	Lud					uur Ilai				n daharan d	Ka Kar Bula
entelse en lots	1,644	1470)UH	ta Nationa	regularitedente	a na	en jan ma		n Alaisadil	allatedala	177 P.	utvo Arjahtel	Ania Antolla, an
Otout 1 FFF	CLI-				E + 7	01 ptc					Qt	1.61.011-
Locart 1.559	GHZ				510	orpes	M				stop	5.11.2022
							Measur	ing				09:42:00

Date: 15.NOV.2022 09:42:00

### 6.6.3.4 Vertical Measurement Polarity 1559 to 1610 MHz, CH3, 16M

Spectrum							
Ref Level 35.00 dBµ	V/m Offset -9.54	4 dB 👄 RBW	1 kHz				
Att (	) dB 👄 SWT	51 s 👄 <b>VBW</b> 1	.0 kHz <b>Mo</b>	de Sweep	Input DC		
341-22 Ciholas LP202 Li	near Phase Array UV	/B olRm View					
			м	1[1]		10.7 1.5744	′6 dBµV/m 00200 GHz
30 dBµV/m							
25 dBµV/m							
20 dBµV/m							
15 dBµV/m							
<del>-10 dBµV/m -</del> D1 9.900 dl	BµV/m						
5 dBµV/m							
0 dBµV/m							
-5 dBµV/m	All here and the	na cator	mand due	da ta fi	t show i	n na k	a at a
Petropologica di kanala kana	a linit a finit a finit an	a shaars kulid	aller	TANKA PANANAN	K GURANAN A	, dan selandi.	ALIGA ANA ANA ANA ANA ANA ANA ANA ANA ANA A
Start 1.559 GHz		5100	1 pts			Stop	1.61 GHz
			Mea	suring		4/0	5.11.2022 11:05:16

Date: 15.NOV.2022 11:05:16

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### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

6.6.3.5 Horizontal Measurement Polarity 1164 to 1240 MHz, CH3, 64M

Spectrum	ī												
Ref Leve	I 35.00 d	dBµV/m	Off	set -	9.54 dB	🖷 RBW	1 kHz						`
Att TDF		0 dB	● SW	т	76 s	● VBW	10 kHz	Mod	e Sweep	Input	DC		
341-22 Ciho	las LP20:	2 Linea	r Phase	Array	UWB 🔵	1Rm Viev	v						
								M1	[1]			2. 1.228	98 dBµV/m 799600 GHz
30 dBµV/m-		+						-			+		1
25 dBµV/m-		+		-							_		
20 dBµV/m-		+					_				_		
15 dBµV/m-		+		-							_		
10 dBµV/m	D1 9.90	o dBµVj	/m										
5 dBµV/m—		+									-	M1	
0 dBµV/m—		+									-		
-5 dBµV/m-													
ud blandby	W Wala	http	հմվեսդե	hudh	halph	hilling	diller of	4,41	uhphphu	half also	dout []		Mandatati
Start 1.16	4 GHz					760	001 pts					Stop	o 1.24 GHz
								Meas	uring		III 4	X	15.11.2022 09:27:12
ate: 15.NG	DV.2022	09:2	7:11										

### 6.6.3.6 Vertical Measurement Polarity 1164 to 1240 MHz, CH3, 64M



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### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

#### 6.6.3.7 Horizontal Measurement Polarity 1559 to 1610 MHz, CH3, 64M

spectrum						
Ref Level 35.00	IdBµV/m Offs	et -9.54 dB 👄 F	RBW 1 kHz			
Att	0 dB 👄 SW1	51 s 👄 🕻	/BW 10 kHz	Mode Sweep	Input DC	
41-22 Cibolas LP2	02 Linear Phase	Array UWB 🔵 1 Rm	View			
				M1[1]		7.74 dBµV/m 1.574400200 GHz
30 dBµV/m						
25 dBµV/m						
20 dBµV/m						
15 dBµV/m						
<del>10 dBµV/m D</del> 1 9.9	100 dBµV/m - м	1				
5 dBµV/m						
0 dBµV/m						
-5 dBµV/m	the second		h in the	1 1 1 1		
Malai Mahada da kati pi	hing the adda while	lal lei Markitiankia	within within the	-deland physical pairs and	Antela Alter	Pitte, Nils of Hills Aparts Helds
start 1.559 GHz			51001 pts			Stop 1.61 GHz
				Measuring		09:35:58

#### 6.6.3.8 Vertical Measurement Polarity 1559 to 1610 MHz, CH3, 64M

Spectrum					
Ref Level 35.00	dBµ∀/m Offs	et -9.54 dB 👄 RBW	1 kHz		
TDF	O dB 📟 SW	51 s 🖝 VBW	10 kHz Mode	Sweep Input I	DC
341-22 Ciholas LP2	02 Linear Phase	Array UWB 🔵 1Rm Vie	w		
			M1[1		11.06 dBµV/m 1.574400200 GHz
30 dBµV/m					
25 dBµV/m	_				
20 dBµV/m					
15 dBµV/m		(1			
<del>10 dBµV/m</del> _D1 9.9	00 dBµV/m				
5 dBµV/m					
0 dBµV/m					
-5 dBµV/m					1
Andrik Alpenska depisje	Mandelahad perjeti.	licii, haalape <mark>llis</mark> poleadh	hall be one bold	alf bhaile the paraite is an a	- aktor funda antil fast ana a station
Start 1.559 GHz		51	001 pts		Stop 1.61 GHz
			Measuri	ing 🚺 🚺 🖬	15.11.2022 11:09:30

Date: 15.NOV.2022 11:09:30

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### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

6.6.3.9 Horizontal Measurement Polarity 1164 to 1240 MHz, CH5, 16M

Ref Level     35.00     dBµV/m     Offset     -9.54     dB     RBW     1 kHz       Att     0 dB     SWT     76 s     VBW     10 kHz     Mode     Sweep     Input     DC       TDF     341-22     Ciholas     LP202     Linear Phase     Array UWB     1Rm     View       30     dBµV/m     1     3.51     dBµV/n     1.228799600 G       30     dBµV/m     1     3.51     dBµV/n     1.228799600 G       20     dBµV/m     1     3.61     Mu     1.228799600 G       15     dBµV/m     1     9.900     dBµV/m     1.228799600 G       15     dBµV/m     1     9.900     Mu     Mu     Mu       16     dBµV/m     1     9.900 dBµV/m     Mu     Mu     Mu       5     dBµV/m     1     9.900 dBµV/m     Mu     Mu     Mu	Spectrum	٦					
Att     0 dB     SWT     76 s     VBW     10 kHz     Mode     Sweep     Input     DC       TDF     31-22     Ciholas LP202 Linear Phase Array UWB     1Rm View     1.228799600 G     3.51 dBµV/n     1.228799600 G       30 dBµV/m     25 dBµV/m     20 dBµV/m     1.228799600 G     1.228799600 G     1.228799600 G       15 dBµV/m     10 dBµV/	Ref Level 35	.00 dBµV/m	Offset -9.54 dB	🖷 RBW 1 kHz			\
30 dBµV/m 3.51 dBµV/   25 dBµV/m 25 dBµV/m   10 dBµV/m 1.228799600 G   20 dBµV/m 1.228799600 G   15 dBµV/m 1.10 dBµV/m   10 dBµV/m 1.10 dBµV/m	Att	0 dB 👄	<b>SWT</b> 76 s	👄 VBW 10 kHz	Mode Sweep	Input DC	
30 dBµv/m M1[1] 3.51 dBµv/, 1.228799600 G   25 dBµv/m 20 dBµv/m 1   15 dBµv/m 1 1   10 dBµv/m 01 9.900 dBµv/m M1	341-22 Ciholas I	1 P202 Linear Ph	ase Array LIWB	1Pm View			
30 dBµV/m 25 dBµV/m 15 dBµV/m 16 dBµV/m 16 dBµV/m 17 dBµV/m 19 9.900 dBµV/m 10 dB					M1[1]		3.51 dBµV/m
25 dBµV/m 20 dBµV/m 15 dBµV/m 16 dBµV/m 5 dBµV/m 5 dBµV/m 10	30 dBµV/m						
20 dBµV/m 15 dBµV/m 16 dBµV/m 5 dBµV/m 10 dBµV/m 1	25 dBµV/m						
15 dBµV/m 10 dBµV/m D1 9.900 dBµV/m 5 dBµV/m	20 dBµV/m						
10 dBµV/m D1 9.900 dBµV/m 5 dBµV/m	15 dBµV/m						
5 dBµV/m	10 dBµV/m D1	9.900 dBµV/m-					
	5 dBµV/m						
0 dBµV/m	0 dBµV/m						
-5 dBµV/m-	-5 dBµV/m	1 1		the time follow	1 4 1		
desente contententing of the final sector constitute field with the desentence of a finite of the sector being	lependentente	erpophilicites for	himites which he	with the Difference	en per aller par par de la contra	Hoh ( Liptley ( Here	manananan
Start 1.164 GHz 76001 pts Stop 1.24 GH	Start 1.164 GH	-lz		76001 pts			Stop 1.24 GHz
Measuring <b>1</b> 404 15.11.2022 09:52:39					Measuring		15.11.2022 09:52:39

### 6.6.3.10 Vertical Measurement Polarity 1164 to 1240 MHz, CH5, 16M



Date: 15.NOV.2022 10:56:58

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### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

6.6.3.11 Horizontal Measurement Polarity 1559 to 1610 MHz, CH5, 16M

Spectrun	n									
Ref Leve	I 35.00	dBµV/m	Offs	et -9.54 d	B 👄 RBW	1 kHz				`
Att TDF		0 dB	SWT	51	s 👄 VBW	/ 10 kHz	Mode Swee	p Input	DC	
341-22 Ciho	olas LP20	2 Linear	Phase 4	Array UWB	●1Rm Vie	w				
							M1[1]		1	7.28 dBµV/ 1.574400200 GI
30 dBµV/m∙										
25 dBµV/m·						_				
20 dBµV/m·						_				
15 dBµV/m∙						-			_	
10 dBµV/m	D1 9.90	10 dBµV/r	n M	1						
5 dBµV/m—										
0 dBµV/m−									_	
-5 dBµV/m-	<u> </u>								_	
lade.H) with p	halanda		hplat	th he had	dependent (her	d blinds	a day wardy bits	philip later	nadak falli	approximation of the second
Start 1.55	9 GHz				51	001 pts				Stop 1.61 GH
							Measuring		<b>1</b> , 1, 0	09:56:53
)ate: 15.N	ov.2022	09:56	:52							

# 6.6.3.12 Vertical Measurement Polarity 1559 to 1610 MHz, CH5, 16M

Spectrum	)							
Ref Level 35.0	0 dBµV/m Off	<b>set</b> -9.54 dB	e RBW	1 kHz				`
Att TDF	O dB 👄 SW	T 51 s	• <b>VBW</b> 1	.0 kHz Mo	ode Sweep	Input DO	2	
341-22 Ciholas LP:	202 Linear Phase	Array UWB (	1Rm View					
				м	11[1]		11.6 1.5744	50 dBµV/m 00200 GHz
30 dBµV/m								
25 dBµV/m								
20 dBµV/m								
15 dBµV/m		M1						
<del>-10 dBµV/m -</del> D1 9.	900 dBµV/m							
5 dBµV/m								
0 dBµV/m								
-5 dBµV/m			L I					
	ulunklaris lakitajar	d hid hid hid hid hid hid	hillenthe	bhahathat	MMMM	dimplation	nd Print	lydl gefel
Start 1.559 GHz			5100	1 pts			Stop	1.61 GHz
				Mea	asuring		490	5.11.2022 10:49:04
Date: 15.NOV.202	2 10:49:03							

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#### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

6.6.3.13 Horizontal Measurement Polarity 1164 to 1240 MHz, CH5, 64M

Spectrum	'n																			₽
Ref Level	35.00	) dBµʻ	//m	Offs	<b>et</b> -9	9.54 dB	3 😑	RBW	1	kHz										
Att TDF		C	dB 😑	SWT		76 9	5 👄	VBW	10	kHz	Mo	de	Sweep	i In	put	DC				
341-22 Ciho	las LP2	02 Li	near P	hase /	Array	UWB (	<b>1</b> Rı	n Viev	V											
											М	1[1]	]				1	3. .2287	03 dB 79960	µV/m 0 GHz
30 dBµV/m-									+					1		+			+	
25 dBµV/m-									+							+				
20 dBµV/m-									+							+				
15 dBµV/m-									+							_				
10 dBµV/m	D1 9.9	900 de	lµV/m−						+							+				
5 dBµV/m—							-		+			-				+	M	11 T	<u> </u>	
0 dBµV/m—							-		+			-				+				
-5 dBµV/m-									_							_			 	. 1.
an period	phydr	Hpur	U P	lttler	ul III p	Alpha	h la	hun	Щ.	alleh	ωų	11ha	d fail dh	<u>didi</u> j	har	WW	<sup>al</sup> lene	MILN	ji pili W	n participation
Start 1.16	4 GHz							760	001	pts								Stop	o 1.24	GHz
											Mea	suri	ng			1	цха		15.11.20 10:08:	22 40 //
ate: 15.NC	V.202	2 10	:08:3	9																

### 6.6.3.14 Vertical Measurement Polarity 1164 to 1240 MHz, CH5, 64M



Date: 15.Nov.2022 10:15:50

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### 6.6. Spurious Radiated Emissions in GPS Bands (15.517 (d) continued)

6.6.3.15 Horizontal Measurement Polarity 1559 to 1610 MHz, CH5, 64M

Spectrum								₩
Ref Level 35.00 de	Bµ∀/m Off	set -9.54 dB	RBW	1 kHz				
Att	0 dB 😑 SW	<b>T</b> 51 s	VBW	10 kHz	Mode Sweep	Input DC		
IUF 241-22 Cibolar I D202	Linoar Dhaco	Arroy LIMP (	1Dm Viow					
541-22 CITUIAS LP202			1611 164		M1[1]		9.9	2 dBuV/m
					wit[1]		1.5744	00200 GHz
30 dBµV/m								
OF dBub/(m								
25 0BµV/m								
20 dBµV/m								
15 - 40 - 62 (								
15 UBHV/III-								
10 dBµV/m D1 9.900	dBµV/m	M1						
5 dBµV/m								
0 db. d//m								
-5 dBµV/m	_							
ika kalender bildet skelt harte	والدورة التعليل لعال	LINE SEL	ليوابط والأرابار	han de h	واصابوا بالجر فاستحز وازاقه	فالمالية ويساييا	and shall be as t	
							i i i i i i i i i	1.1.1
Start 1.559 GHz			510	01 pts			Stop	1.61 GHz
					Measuring		4/0 1	5.11.2022 10:01:35
								//

# 6.6.3.16 Vertical Measurement Polarity 1559 to 1610 MHz, CH5, 64 M

Spectrum								
Ref Level 35.0	00 dBµV/m	Offset -9.54	dB 👄 RBW	1 kHz				
🖷 Att	O dB 👄	<b>SWT</b> 5	1 s 👄 VBW 🗄	10 kHz	Mode Sweep	Input D	0	
TDF								
341-22 Ciholas LP	202 Linear Pl	hase Array UW	B o1Rm View					
					M1[1]		11.0	)1 dBµV/m 00200 GHz
30 dBµV/m-								
25 dBµV/m								
20 dBµV/m								
15 dBµV/m		M1						
- <del>10 dBµV/m  </del> D1 9	.900 dBµV/m-							
5 dBµV/m								
0 dBµV/m								
	harden	ullindgeolooin	hand a line had a se	ahuduadh	date later of the	u handa hana a	dh lan / A	ndert hat l
Start 1.559 GHz	2		5100	1 pts			Stor	0 1.61 GHz
					Measuring		4,70	15.11.2022 10:41:39
Date: 15.NOV.20	22 10:41:3	8						

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### 6.7. Radiated Emissions of UWB Transmission (15.517 (c), 15.521 (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  $dB\mu V/m$  at 3 Meters by adding 95.2.

Frequency	EIRP	EIRP at 3 Meters
(MHz)	(dBm)	(dBµV/m)
3100 - 10600	-41.3	53.9

Frequency Range:	4 to 5 GHz, 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 as defined in 15.521(d)





### 6.7. Spurious Radiated Emissions (15.517 (c), 15.521(d))

6.7.1. Plot of RMS Power at 3 Meters (Channel 3, 16M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0112)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
4.5889	53.42	53.90	-0.48	н	127	297	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub>) - 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dB $\mu$ V/m) - 95.2

Frequency	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	EIRP	EIRP	(dB)	H/V	cm	Deg	
4.5889	-41.78	-41.30	-0.48	н	127	297	Compliant



09:43:51 11.11.2022





### 6.7. Spurious Radiated Emissions (15.517 (c), 15.521(d)) continued

6.7.2. Plot of RMS Power at 3 Meters (Channel 3, 64M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.1.2)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
4.5899	53.54	53.90	-0.36	н	127	297	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub>) - 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dB $\mu$ V/m) - 95.2

Frequency (GHz)	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	EIRP	EIRP	(dB)	H/V	cm	Deg	
4.5899	-41.66	-41.30	-0.36	н	127	297	Compliant



10:19:58 11.11.2022

![](_page_52_Picture_0.jpeg)

![](_page_52_Picture_1.jpeg)

### 6.7. Spurious Radiated Emissions (15.517 (c), 15.521(d)) continued

6.7.3. Plot of RMS Power at 3 Meters (Channel 5, 16M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
6.490	53.49	53.90	-0.41	V	152	18	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub>) – 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dB $\mu$ V/m) – 95.2

Frequency (GHz)	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0112)	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.490	-41.71	-41.30	-0.41	V	152	18	Compliant

![](_page_52_Figure_9.jpeg)

10:57:39 11.11.2022

![](_page_53_Picture_0.jpeg)

![](_page_53_Picture_1.jpeg)

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#### 6. Measurement Data (continued)

#### 6.7. Spurious Radiated Emissions (15.517 (c), 15.521(d)) continued

6.7.4. Plot of RMS Power at 3 Meters (Channel 5, 64M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
6.490	53.77	53.90	-0.13	V	152	18	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub>) - 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dB $\mu$ V/m) - 95.2

Frequency (GHz)	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.490	-41.43	-41.30	-0.13	V	152	18	Compliant

+1-22 CIIIUIa:	CF202 Lillear F	-nase Anay On	в						<u>×</u>
MultiView	Spectrum								-
Postrum	Ref Level 70.0	00 dBµV/m	RBW	1 MHz					
spectrum	Att	0 dB 🖷 SV	VT 1 s ● VBW :	LO MHz Mode	Sweep				
DF "1036 CBL Frequency S	U319 GORE UKCU	JQUCQ240.0.TDF	-","276 ANT 0319	ETS LINDGREN (	3117 3MLTDF","(	J348 AMP JCA48	-4111B1 SN 708	37S.TDF"	01Rm View
Limit Che	eck		PA	SS				M1[1]	53.77 dBuV/
Line FCC	P15-517 RMS L	IMIT DBUV-M	PA	SS					6.490 000 GH
dBµV/m───									
) dBuV/m									
dBµV/m				M1					
C P15-517 RMS	LIMIT DBUV-M		مر ا	min	mm	m			
) dBµV/m							5		
		mont	<u>∼</u>				Vm		
ы dвµ∨/m———	at the second se	m					1 Martin	m	
) dBµV/m									
	Januar							- marke	
dBµV/m									- man
dBµV/m									
i dBµV/m───									
6.5 GHz			1001 pt	<u> </u>	10	0.0 MHz/			Span 1.0 GH
0.0 012			1001 pt	-	10		Measuring		11.11.202

![](_page_54_Picture_0.jpeg)

![](_page_54_Picture_1.jpeg)

### 6.8. Peak Emissions in a 50 MHz Bandwidth (15.517 (e), 15.521 (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<sub>M</sub>. That limit is 0 dBm EIRP.

The EIRP in terms of dBm, can be converted to a field strength, in  $dB\mu V/m$  at 3 Meters by adding 95.2. As used in this subpart, EIRP refers to the highest signal strength measured in any direction and at any frequency from the UWB device.

Frequency	EIRP	EIRP at 3 Meters
(MHz)	(dBm)	(dBµV/m)
3100 - 10600	0	95.2

Frequency Range:
Measurement Distance:
EMI Receiver IF Bandwidth:
EMI Receiver Avg Bandwidth
Detector Function:

4 to 5 GHz, 6 to 7 GHz 3 Meters 50 MHz 80 MHz Peak, Max Held

![](_page_55_Picture_0.jpeg)

![](_page_55_Picture_1.jpeg)

### 6.8. Peak Emissions in a 50 MHz Bandwidth (15.517 (e), 15.521 (g) continued)

6.8.1 Plot of Peak Power at 3 Meters (Channel 3, 16M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
4.6538	94.95	95.20	-0.25	Н	127	297	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub>) - 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dB $\mu$ V/m) - 95.2

Frequency (GHz)	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	EIRP	EIRP	(dB)	H/V	cm	Deg	
4.6538	-0.25	0.00	-0.25	Н	127	297	Compliant

![](_page_55_Figure_9.jpeg)

09:35:37 11.11.2022

![](_page_56_Picture_0.jpeg)

![](_page_56_Picture_1.jpeg)

 $\wedge$ 

#### 6. Measurement Data (continued)

#### 6.8. Peak Emissions in a 50 MHz Bandwidth (15.517 (e), 15.521 (g) continued)

6.8.2 Plot of Peak Power at 3 Meters (Channel 3, 64M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0112)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
4.500	91.06	95.20	-4.14	Н	127	297	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub>) - 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dBµV/m) - 95.2

Frequency (GHz)	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	EIRP	EIRP	(dB)	H/V	cm	Deg	
4.500	-4.14	0.00	-4.14	н	127	297	Compliant

341-22 Ciholas	LP202 Linear F	Phase Array UW	В						
MultiView	Spectrum								
Spectrum	RefLevel 100 Att	.00 dBµV/m 0 dB <b>SV</b>	● F VT 1.01 ms ● V	NBW 50 MHz NBW 80 MHz N	<b>1ode</b> Sweep				
TDF "1036 CBL	0319 GORE OKCO	Q0CQ240.0.TDF	',"276 ANT 0319	ETS LINDGREN 3	3117 3M .TDF","0	)348 AMP JCA48	-4111B1 SN 708	7S.TDF"	
1 Frequency S	weep								O1Pk View
								MILI	91.06 dBµV/m
95 dBuV/m	H1 95.200 dBµ	V/m							4.500 000 012
					M1				
00 dBuV/m					×				
90 UBH4/m				( and )	to by wat many	mushing	$\sim \sim$		
				- northeres to			man of		
85 dBµV/m				l'			1		
		~~~	1					an way	
80 dBµV/m——		1.0						- When	
								here and the second sec	
75 dBµV/m	0							1	
	www.ka								mar and a second
70 авµ∨/т—	W								work
	March								Whends
65 авµv/m—	pre								
, All									
60 dBuW/m									
55 dBµV/m									
CE 4 49 GHz			1001 pt	 s	10	0.0 MHz/			Spap 1.0 GHz
	~		1001 pt.	<u> </u>	10		Measuring		11.11.2022
									10:27:07

10:27:07 11.11.2022

![](_page_57_Picture_0.jpeg)

![](_page_57_Picture_1.jpeg)

### 6.8. Peak Emissions in a 50 MHz Bandwidth (15.517 (e), 15.521 (g) continued)

6.8.3 Plot of Peak Power at 3 Meters (Channel 5, 16M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0112)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
6.488	94.60	95.20	-0.60	V	152	18	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub>) - 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dB $\mu$ V/m) - 95.2

Frequency (GHz)	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.488	-0.60	0.00	-0.60	V	152	18	Compliant

![](_page_57_Figure_9.jpeg)

11:06:38 11.11.2022

![](_page_58_Picture_0.jpeg)

![](_page_58_Picture_1.jpeg)

#### 6. Measurement Data (continued)

#### 6.8. Peak Emissions in a 50 MHz Bandwidth (15.517 (e), 15.521 (g) continued)

6.8.4 Plot of Peak Power at 3 Meters (Channel 5, 64M PRF)

Frequency (GHz)	Amplitude <sup>1</sup>	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0)	(dBµV/m)	(dBµV/m)	(dB)	H/V	cm	Deg	
6.495	92.20	95.20	-3.00	V	152	18	Compliant

Notes: <sup>1</sup> 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<sub>meas</sub> + 20 log (d<sub>meas</sub>) - 104.7; d<sub>meas</sub> = 3 EIRP (dBm) =  $E_{meas}$  (dB $\mu$ V/m) - 95.2

Frequency (GHz)	Amplitude <sup>1</sup> (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
(0.12)	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.495	-3.00	0.00	-3.00	V	152	18	Compliant

341-22 Ciholas	LP202 Linear	Phase Array UW	/B						
MultiView	Spectrum								-
	Ref Level 100	).00 dBµV/m	• P	BW 50 MHz					_
Spectrum	Att 🛛	0 dB <b>S</b> V	NT 1.01 ms 👄 V	BW 80 MHz N	lode Sweep				
TDF "1036 CBL	0319 GORE OKC	0Q0CQ240.0.TDF	","276 ANT 0319	ETS LINDGREN 3	3117 3M .TDF","(	0348 AMP JCA48	-4111B1 SN 708	7S.TDF"	o 1 Dk View
I frequency 5	меер							M1[1]	92.20 dBuV/m
									6.495000 GHz
95-dBµV/m	H1 95.200 dB	JV/m							
				M	~~~				
90 dBµV/m				mar.	manner	m			
			monor	i v k w		- m	Mar y		
85 dBµV/m									
		15							
80 dBµV/m───		4 <sup>4</sup>						m h	
75 49 41 (4)	and the second							And a second	
75 dBµv/m	all when							and we are	
70 dBuV/m									Mart I and And
Marchalant									We want of a second
<b>65 d</b> Bµ∨/m									MANN
ľ.									
60 dBµV/m									
55 dBuV/m									
00 abp 17 m									
CF 6.5 GHz			1001 pt	5	10	0.0 MHz/			Span 1.0 GHz
							Measuring		11.11.2022 11:49:01

11:49:01 11.11.2022

![](_page_59_Picture_0.jpeg)

![](_page_59_Picture_1.jpeg)

### 6.9 Conducted Emissions Test Setup

### 6.9.1. Regulatory Limit: FCC Part 15.207

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.					

### 6.9.2 Measurement Equipment and Software Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
EMI Receiver	Rohde & Schwarz	ESR7	101156	10/25/2024
LISN	EMCO	3825/2	9109-1860	1/4/2023
Manufacturer	Software De	scription	Title/Model #	Rev.
Compliance Worldwide	Test Report Gener	ation Software	Test Report Generator	1.0

#### 6.9.3. Measurement & Equipment Setup

Test Date:	N/A
Test Engineer:	N/A
Site Temperature (°C):	N/A
Relative Humidity (%RH):	N/A
Frequency Range:	0.15 MHz to 30 MHz
EMI Receiver IF Bandwidth:	9 kHz
EMI Receiver Avg Bandwidth:	≥ 3 * RBW or IF(BW)
Detector Functions:	Peak, Quasi-Peak. & Average

#### 6.9.4. 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.

![](_page_60_Picture_0.jpeg)

![](_page_60_Picture_1.jpeg)

### 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.

![](_page_61_Picture_0.jpeg)

![](_page_61_Picture_1.jpeg)

8.1. Spurious and Harmonic Emissions – 30 kHz to 30 MHz Front

![](_page_61_Picture_4.jpeg)

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![](_page_62_Picture_0.jpeg)

![](_page_62_Picture_1.jpeg)

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

![](_page_62_Picture_4.jpeg)

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![](_page_63_Picture_0.jpeg)

![](_page_63_Picture_1.jpeg)

8.3. Spurious and Harmonic Emissions – 30 MHz to 960 MHz Front

![](_page_63_Picture_4.jpeg)

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![](_page_64_Picture_0.jpeg)

![](_page_64_Picture_1.jpeg)

8.4. Spurious and Harmonic Emissions – 30 MHz to 960 MHz Rear

![](_page_64_Picture_4.jpeg)

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![](_page_65_Picture_0.jpeg)

![](_page_65_Picture_1.jpeg)

8.5. Spurious and Harmonic Emissions – 960 MHz to 18 GHz Front

![](_page_65_Picture_4.jpeg)

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![](_page_66_Picture_0.jpeg)

![](_page_66_Picture_1.jpeg)

8.6. Spurious and Harmonic Emissions – 960 MHz to 18 GHz Rear

![](_page_66_Picture_4.jpeg)

![](_page_67_Picture_0.jpeg)

![](_page_67_Picture_1.jpeg)

8.7. Spurious and Harmonic Emissions – 18 to 40 GHz Side View

![](_page_67_Picture_4.jpeg)

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