COMPLIANCE WORLDWIDE INC.
TEST REPORT

In Accordance with the Requirements of

FCC PART 2.1093 Radio Frequency Exposure Evaluation: Portable Devices
ISED RSS-102, Issue 5 + Amendment 1:2021
Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus

Issued to

Ciholas, Inc.
3700 Bell Road
Newburgh, IN 47630

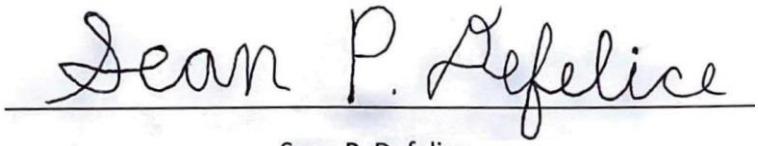
For the

MU250
UWB Module

FCC ID: 2ALIR-MU250
IC: 26788-MU250

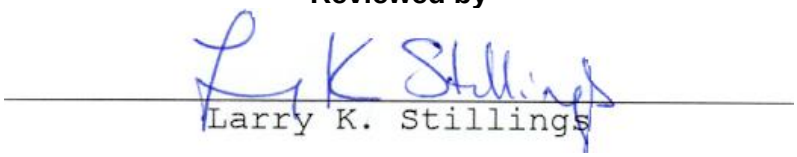
Report Issued on July 29, 2022

Tested by



Sean P. Defelice

Reviewed by



Larry K. Stillings

1. Scope

This test report certifies that the Ciholas MU250 UWB Module, as tested, meets the FCC Part 2.1093 and RSS-102 requirements exempting the device from a SAR Evaluation.

The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated, and a retest may be required.

2. Product Details

2.1. Manufacturer:	Ciholas, Inc.
2.2. Product Name:	MU250 UWB Module
2.3. Model Number:	MU250
2.4. Serial Number:	MU250 FCC2, AN202 (0109030D)
2.5. Description:	The MU250 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 from laptop to AN202 support board
2.7. Hardware Revision:	v1.1
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 via a virtual USB connection to a laptop. Using the custom embedded firmware configure the module to operate on Channel 5. The module is tested for operation with PRF 16 and PRF 64 at a 6.8 MBPS data rate.

3.2. Cables

Cable Type	Length	Shield	From	To
USB Cable	6M	Yes	EUT	Laptop

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3. Product Configuration (cont.)

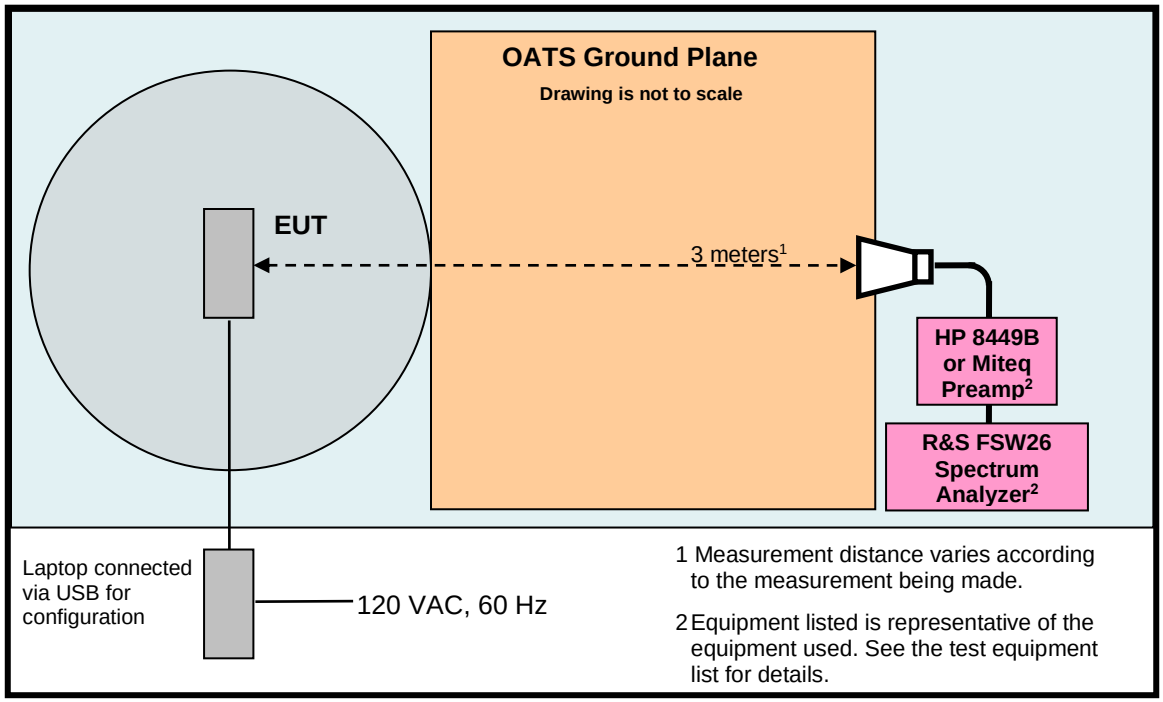
3.3. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
Ciholas	MU250	FCC2	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 configuring the UWB Module

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
Spectrum Analyzer, 2 Hz to 26.5 GHz[2]	Rohde & Schwarz	FSW26	102057	6/24/2023	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 2 to 12 GHz	JCA	JCA48-4111B1	7087S	3/31/2023	1 Year
Barometric Pressure/Humidity & Temp Datalogger	Extech Instruments	SD700	Q590483	10/14/2022	1 Year

[1] ESR7 Firmware revision: V3.48 SP3, Date installed: 09/30/2020 Previous V3.48 SP2, installed 07/23/2020.
[2] FSW26 Firmware revision: V4.71 SP1, Date installed: 11/16/2020 Previous V4.61, installed 08/11/2020.
[3] FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016 Previous V2.30 SP1, installed 10/22/2014.
[4] FSVR40 Firmware revision: V2.23 SP1, Date installed: 08/19/2016 Previous V2.23, installed 10/22/2014.

4.2. Measurement & Equipment Setup

Test Dates:	3/17/2022, 4/13/2022
Test Engineers:	Sean Defelice
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	6 to 7 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth:	≥ 3 * RBW or IF(BW)
Detector Function:	Peak

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4. Measurements Parameters (continued)

4.3. Measurement Procedure

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

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

4.4. Measurement Uncertainty

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

RF Frequency (out of band)	$\pm$ 1x10^{-8}
Radiated Emission of Transmitter to 100 GHz	$\pm$ 4.55 dB
Radiated Emission of Receiver	$\pm$ 4.55 dB
Temperature	$\pm$ 0.91^{o} C
Humidity	$\pm$ 5%

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5. Measurement Data

5.1. 99% Emission Bandwidth (RSS-GEN 6.7)

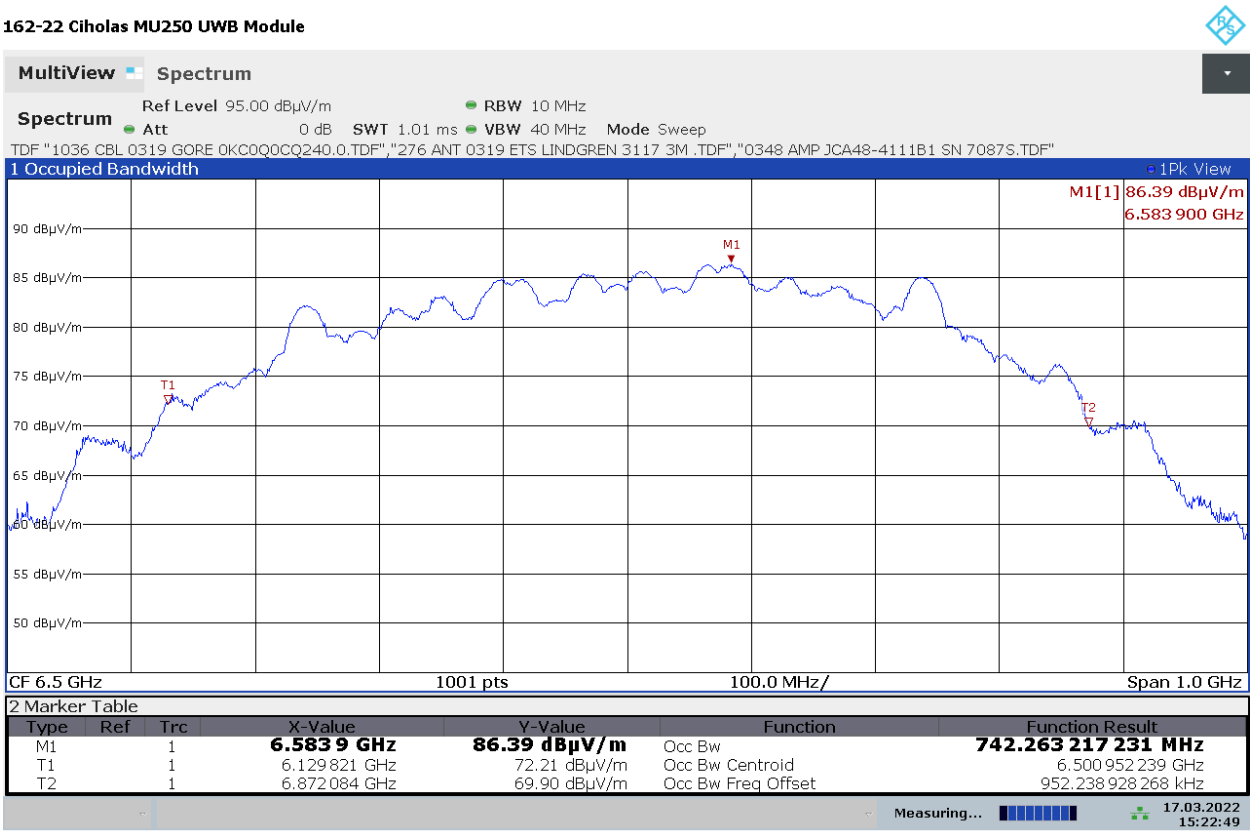
Requirement: The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs RSS-Gen, Section 6.7.

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.

5.1.1 Plot of 99% Emission Bandwidth, 16M PRF 742.26 MHz

162-22 Ciholas MU250 UWB Module



15:22:50 17.03.2022

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5. Measurement Data (continued)

5.1. 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.

5.1.2 Plot of 99% Emission Bandwidth, 64M PRF 718.26 MHz

15:39:39 17.03.2022

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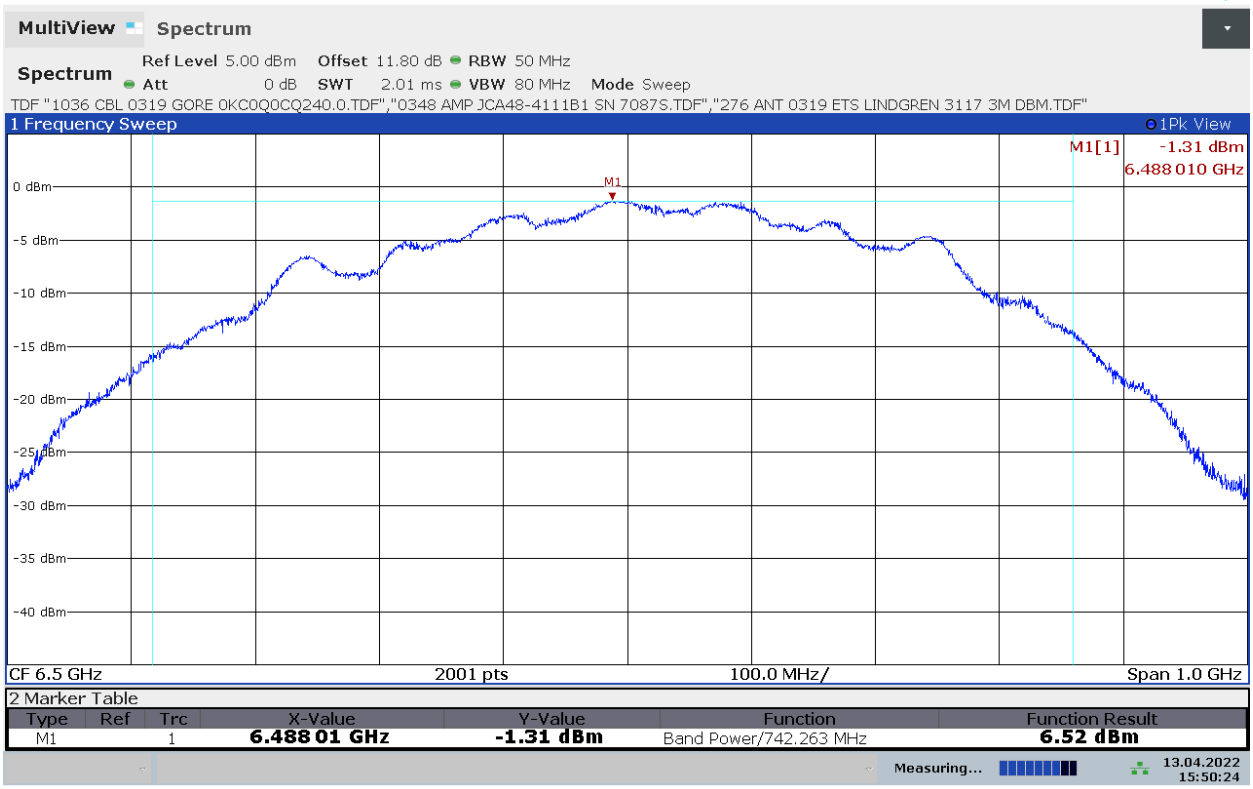
5. Measurement Data (continued)

5.2. Band Power based on 99% Occupied Bandwidth

5.2.1 Band Power 16M PRF 6.52 dBm

162-22 Ciholas MU250 UWB Module



15:50:25 13.04.2022

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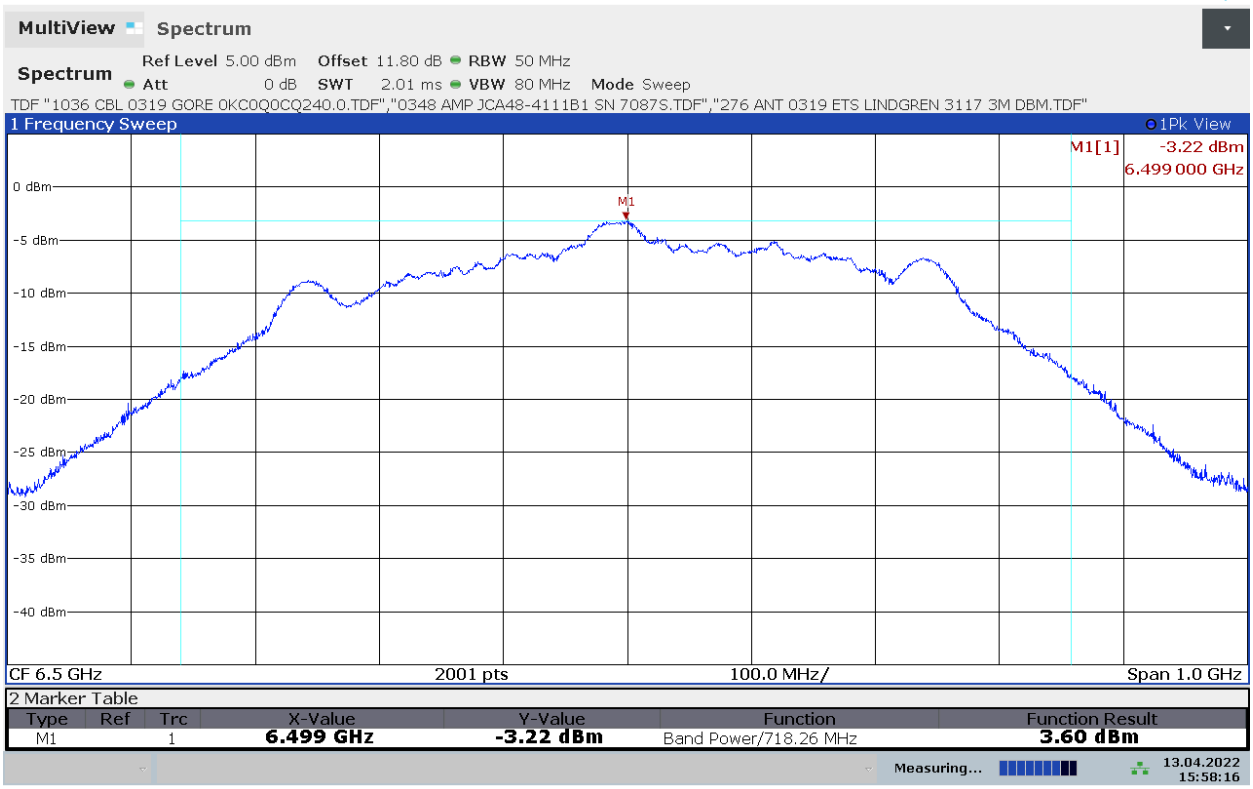
5. Measurement Data (continued)

5.2. Band Power based on 99% Occupied Bandwidth

5.2.2 Band Power 64M PRF 3.60 dBm

162-22 Ciholas MU250 UWB Module



15:58:17 13.04.2022

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5. Measurement Data (continued)

5.3. Duty Cycle Correction Factor (FCC Part 15.35(c), RSS-GEN 8.2)

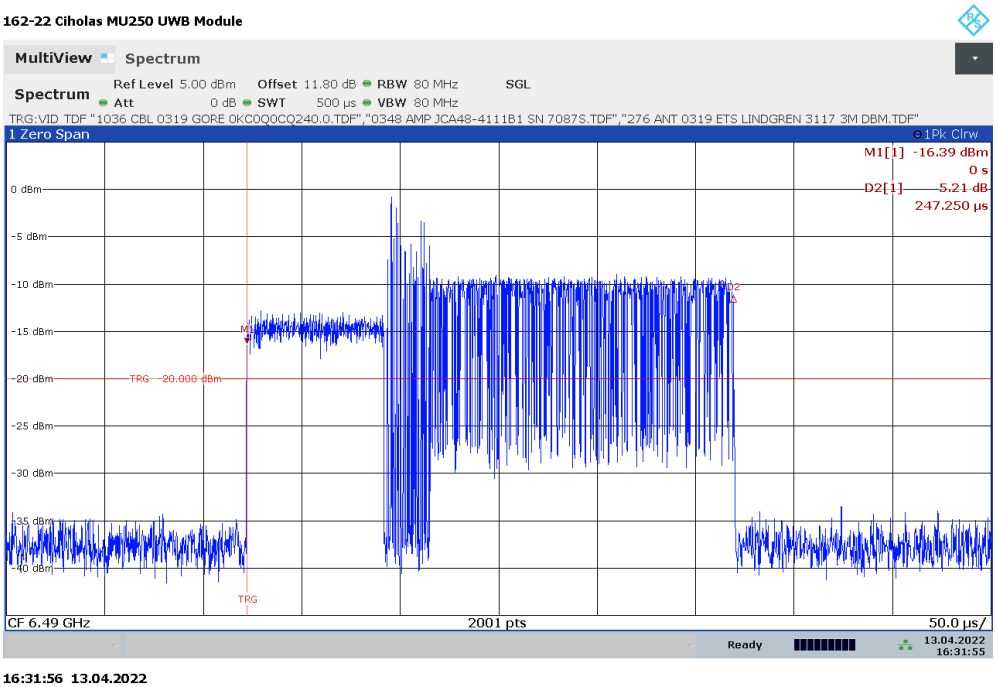
Requirement: When the field strength or envelope power is not constant or it is in pulses, and an average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train during which the field strength or power is at its maximum value, including blanking intervals within the pulse train, provided that the pulse train does not exceed 0.1 seconds. In cases where the pulse train exceeds 0.1 seconds, the average value of field strength or output power shall be determined during a 0.1 seconds interval during which the field strength or power is at its maximum value.

Procedure: The duty cycle correction was determined using the information provided in ANSI C63.10-2013, Section 7.5: Procedure for determining the average value of pulsed emissions.

Note: This is the maximum duty cycle allowed by the operational software/firmware for the device.

Channel Frequency	Time On	Time per Period	Duty Cycle (DC)	Maximum Peak Power	Duty Cycle Correction (10 log(DC))	Average Conducted Power	
	T_{on}	$T_{on} + T_{off}$					
(MHz)	(mS)	(mS)	$T_{on}/(T_{on} + T_{off})$	(dBm)	dB	dBm	mW
6488.010	0.24725	1.9975	0.12378	6.52	0.24725	-2.55	0.5555
6499.000	0.24950	1.9995	0.12478	3.60	0.24950	-5.44	0.2859

5.3.1. T_{on} 16M PRF



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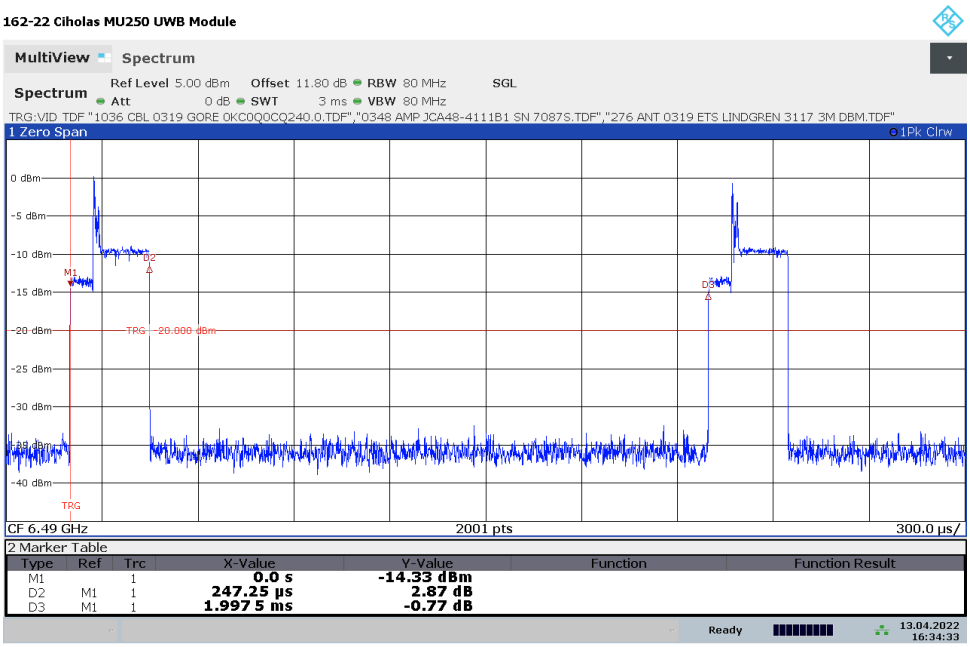
5. Measurement Data (continued)

5.3. Duty Cycle Correction Factor (FCC Part 15.35(c), RSS-GEN 8.2) (continued)

5.3.2. T_{off}, 16M PRF



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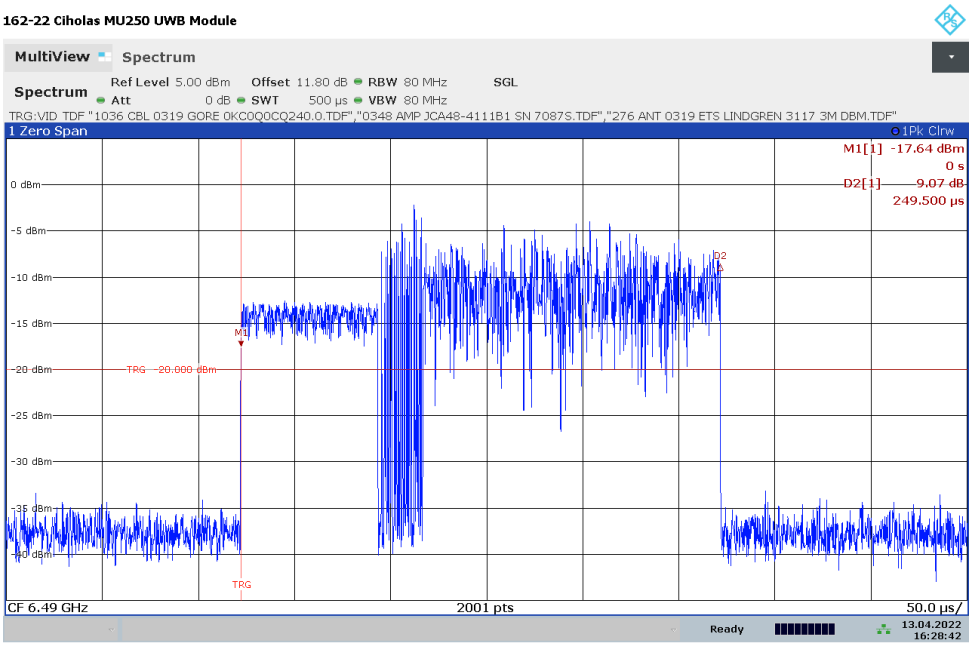
5.3.3. T_{on} 64M PRF



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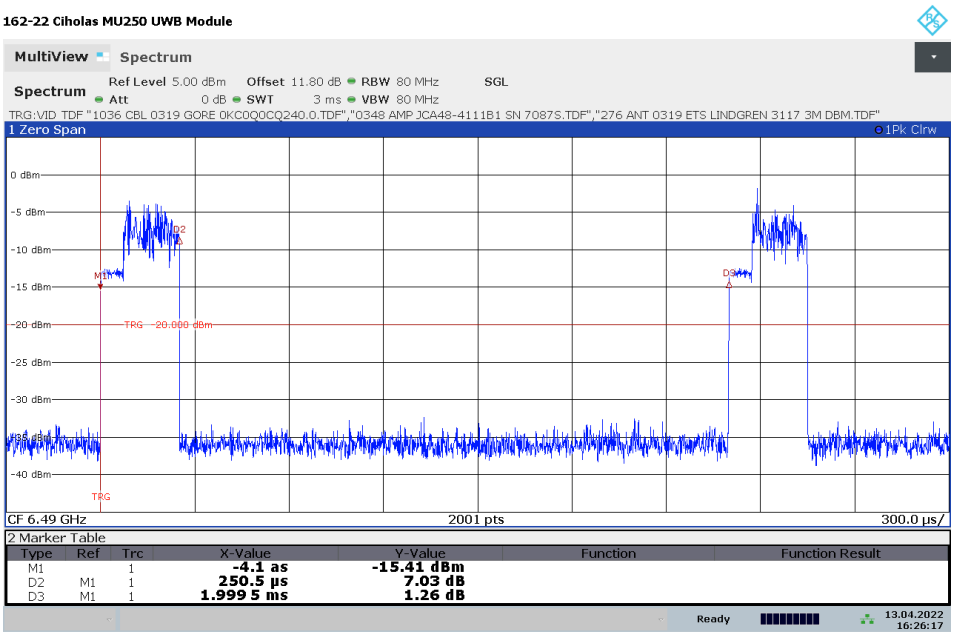
5. Measurement Data (continued)

5.3. Duty Cycle Correction Factor (FCC Part 15.35(c), RSS-GEN 8.2) (continued)

5.3.4. T_{off}, 64M PRF



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5. Measurement Data (continued)

5.4. Public Exposure to Radio Frequency Energy Levels (2.1093)

5.4.1. 2.1093 Requirements

Requirement: Portable devices are subject to radio frequency radiation exposure requirements. For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

Time-averaging provisions of the MPE guidelines identified in § 1.1310 of

this chapter may not be used in determining typical exposure levels for portable devices intended for use by consumers, such as hand-held cellular telephones, that are considered to operate in general population/uncontrolled environments as defined above. However, ‘‘source-based’’ time-averaging based on an inherent property or duty-cycle of a device is allowed.

Evaluation of compliance with the exposure limits in § 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for portable devices having single RF sources with more than an available maximum time-averaged power of 1 mW. The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it may not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period.

Duty cycle values from Section 5.3 and Power levels from Section 5.2

Frequency	PRF	Ton	Ton+Toff	DC Ton/(Ton+Toff)	Peak Power	Duty Cycle Correction = 10 Log(DC)	Average Power	Average Power
MHz		ms	ms		dBm	dB	dBm	mW
6488.010	16M	0.24725	1.9975	0.12378	6.52	-9.07	-2.55	0.5555
6499.000	64M	0.24950	1.9995	0.12478	3.60	-9.04	-5.44	0.2859

Conclusion: The device under test meets the exclusion requirement detailed in FCC OET 447498 D01, dated October 23, 2015 Clause 4.3.1 (a).

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5. Measurement Data (continued)

5.5. Radio Frequency Exposure of Radiocommunication Apparatus (RSS-102, Notice 2021-DRS0005)

5.5.1 RF Exposure for devices that operate above 6 GHz

Requirement: ISED respect to Notice 2021-DRS0005: Introduction of an interim exemption limit for routine localized power density evaluations of transmitters operating in the 6 – 30 GHz frequency range.

Duty cycle values from Section 5.3 and Power levels from Section 5.2

Frequency	PRF	Ton	Ton+Toff	DC Ton/(Ton+Toff)	Peak Power	Duty Cycle Correction = 10 Log(DC)	Average Power	Average Power
MHz		ms	ms		dBm	dB	dBm	mW
6488.010	16M	0.24725	1.9975	0.12378	6.52	-9.07	-2.55	0.5555
6499.000	64M	0.24950	1.9995	0.12478	3.60	-9.04	-5.44	0.2859

Conclusion: The device under test meets the exclusion requirement of 1 mW detailed in Notice 2021-DRS0005.

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