Testing Tomorrow's Technology

Report of

Title 47 USC, Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and Part 15, Subpart F, paragraph 15.519 Technical requirements for hand held UWB systems

For the Modular Approval of

Okyanus Teknoloji Biligisayar ve Yazilim San. Tic.

Model Number: UWB001

FCC ID: 2AUFI-UWB001

UST Project: 20-0187

Report Issue Date: July 17, 2020

Total Pages in This Report: 28

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: July 17, 2020

NVLAP LAB CODE 200162-0

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

MEASUREMENT TECHNICAL REPORT

COMPANY NAME: OKYANUS TEKNOLOJI BILGISAYAR VE YAZILIM SAN. TIC.

MODEL: UWB001

FCC ID: 2AUFI-UWB001

DATE: July 17, 2020

This report concerns (check one): Original grant ☒
Class 2 change ☐

Equipment type: UWB Transmitter Modular Approval

Transmitter details:

UWB Transmitter per Part 15.519, hand held UWB Device for modular approval
Date Rate: 110 kbps, 850 kbps, 6.8 Mbps (Highest data rate was used for testing)
Maximum field strength: 70.30 dBuV/m @ 3 m
F_m= 4308.0 MHz
F_C= 4542.0 MHz
F_H= 4840.0 MHz
F_L= 4243.0 MHz

Summary of Test Results

FCC Rule	Description of Test	Result
Part 15.519(a)	Handheld considerations	PASS
Part 15.519(b)	UWB must be contained b/w 3.1 GHz to 10.6 GHz	PASS
Part 15.519(c)	Radiated emissions	PASS
Part 15.519(d)	Radiated emissions	PASS
Part 15.519(e)	Peak level emissions	PASS
Part 15.519(f)	UWB statement	PASS

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1 General Information

1.1 Purpose of this Report

This report is prepared to show that the OKYANUS TEKNOLOJI BILGISAYAR VE YAZILIM SAN. TIC. Model UWB001 complies with the FCC Rules and Regulations of §15.519, Technical requirements for handheld UWB systems.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on June 8, 2020 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Okyanus Teknoloji Biligisaryar ve Yazilim San. Tic. Model UWB001. The EUT is a Ultra Wide Band (UWB) radio module. The radio module is being evaluated and certified for operation in the 4.4 GHz band. This radio module will be used in numerious Wipelot products.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (2013)* and per FCC Part 15 Subpart F.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate appendices.

Table 1. EUT and Peripherals

EUT/ MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID	CABLES P/D
UWB Module/ Okyanus Teknoloji Bilgisayar Ve Yazilim San. Tic	UWB001	Engineering Sample	2AUFI-UWB001	
PERIPHERAL/ MANUFACTURER	**MODEL NUMBER**	**SERIAL NUMBER**	**FCC ID**	**CABLES P/D**
Evaluation Board/ Wipelot	FT-06DCH	V1.0	N/A	D, S
POE/ Hewlett Packard	JL383A	246000001792A	N/A	D, S
Antenna See antenna details	--	--	--	--

S= Shielded, U= Unshielded, P= Power, D= Data

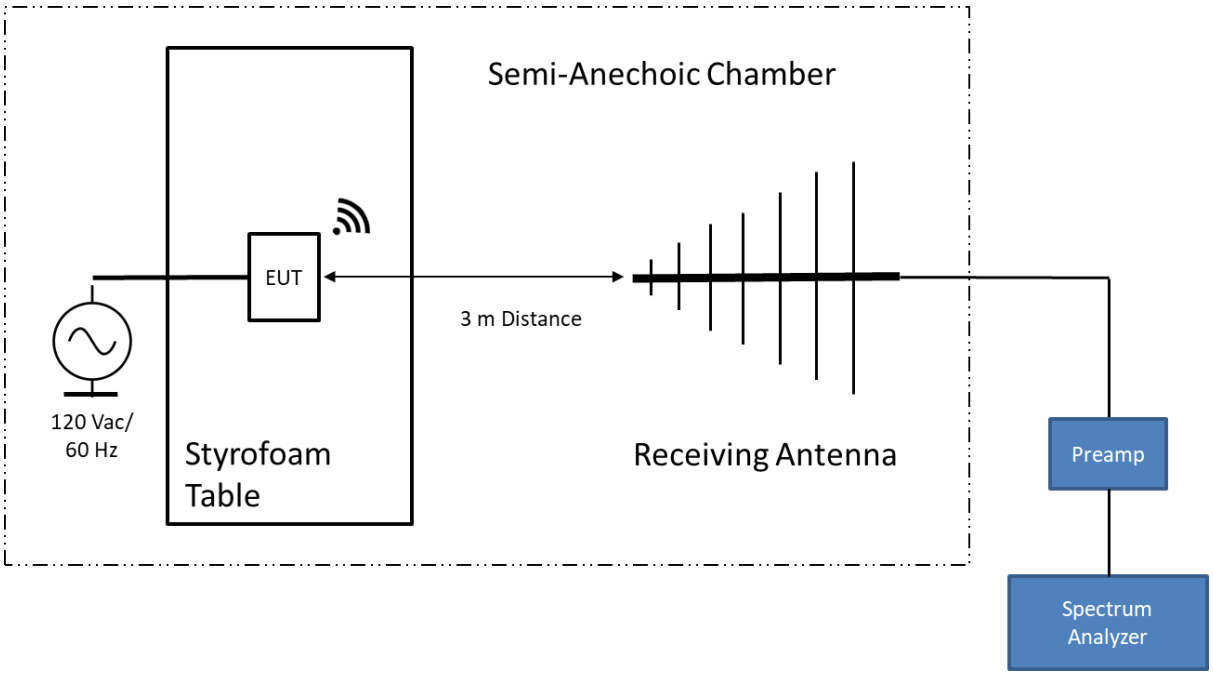


Figure 1. Block Diagram of Radiated Emissions Test Configuration

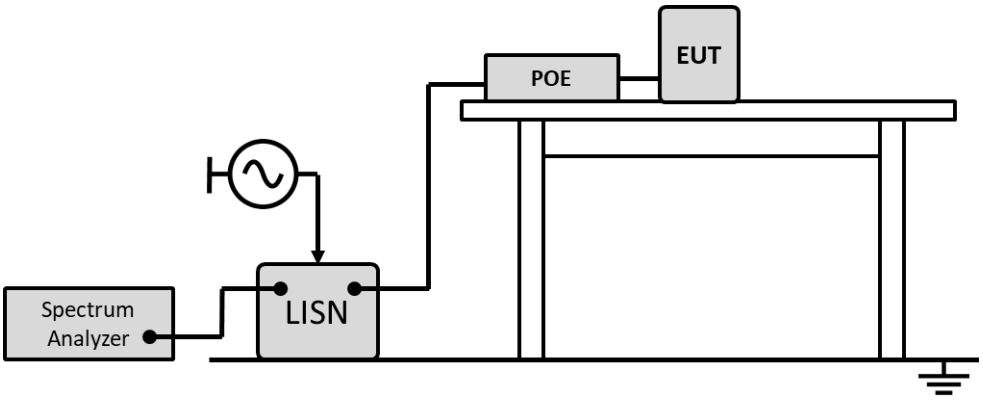


Figure 2. Block Diagram of AC Power Lines Conducted Emissions Test Configuration

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA30004. This site has been fully described and registered with the FCC, with designation number 186022.

1.6 Related Submittals

The EUT is subject to the following FCC authorizations:

a) Certification under Part 15 Subpart F as a UWB transmitter; results reported herein.

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	8/17/2020 2 yr.
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	1/29/2022 2 yr.
SPECTRUM ANALYZER	DSA815*	RIGOL	DSA8A18030 0138	12/10/2021 2 yr.
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	5/13/2021
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	5/13/2021
LOOP ANTENNA	6502	ETS Lindgren	9810-3246	4/6/2022 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9306-1708	6/27/2021 2 yr.
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/1/2021 2 yr.
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr.
HIGH PASS FILTER	H3R020G2	MICROWAVE CHIRCUITS	001DC9528	5/11/2021
8 dB ATTENUATOR	VAT-8 15542	MINI-CIRCUITS	30519	Verified before use
LISN	8028-50-TS24-BNC	Solar Electronics	910495	5/8/2021
LISN	8028-50-TS24-BNC	Solar Electronics	910494	5/8/2021

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart F Intentional Radiator Limits for the transmitter portion of the EUT.

2.3 Frequency Range of Radiated Measurements (§15.33, §15.521(h))

2.3.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 5th harmonic of the peak level of fundamental frequency generated or 40 GHz, whichever is the lowest.

The highest frequency used to determine the frequency range over which measurements are made shall be based on the center frequency (f_c). If the center frequency is less than 10 GHz there is no requirement to measure beyond 40 GHz.

2.4 Measurement Detector Function and Bandwidth (§15.35)

The radiated emissions limits shown herein are based on FCC Parts 15.209 and 15.519.

2.4.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. RBW=9 kHz from 150 kHz to 30 MHz and RBW=120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the quasi-peak device are used.

2.4.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding peak requirement as measured using a peak detector of 20 dB greater than the average limit. For all measurements above 1000 MHz, the resolution bandwidth shall be at least 1 MHz.

2.5 EUT Antenna Requirements (§15.203)

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 with the provisions of this section. Only the antenna(s) listed in Table 3 will be used with this module.

Table 3. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
PCB Antenna	Taiyo Yuden	Chip	AH086M555003	2.6	SMD

2.6 Restricted Bands of Operation (§15.205)

Only spurious emissions can fall in the frequency bands of §15.205. The field strength of these spurious cannot exceed the limits of §15.209. Radiated harmonics and other spurious elements are examined for this requirement.

2.7 Intentional Radiator, Power Line Conducted Emissions (§15.207)

The EUT is powered by a POE (power over ethernet) device which is directly connected to the AC mains supplying 120 Vac @ 60 Hz; therefore, powerline conducted emissions was evaluated from 150 kHz to 30 MHz per §15.207.

2.8 Intentional Radiator, Radiated Emissions (§15.519 (e), §15.521 (g))

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, $\mathbf{f_M}$. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth and a correspondingly different peak emission limit following the procedures described in §15.521. Since a different RBW was used, the peak emissions limit was adjusted per §15.521(g). The limit was also converted to peak field strength at 3 meters.

RBW used: 5 MHz

Peak EIRP Limit	=	20 log (RBW/50)dBm EIRP
	=	20 log(5/50) dBm EIRP
	=	-20 dBm EIRP
Peak Field Strength Limit	=	-20 dBm EIRP +95.2
	=	75.2 dBuV/m

The EUT was positioned along its Y-plane with its antenna positioned as it would be in normal operation. The fundamental radiated emission was maximized in accordance with ANSI C63.10-2013, Clause 6.3. The peak radiated emission results are found in Figure 3 and Table 4 below.

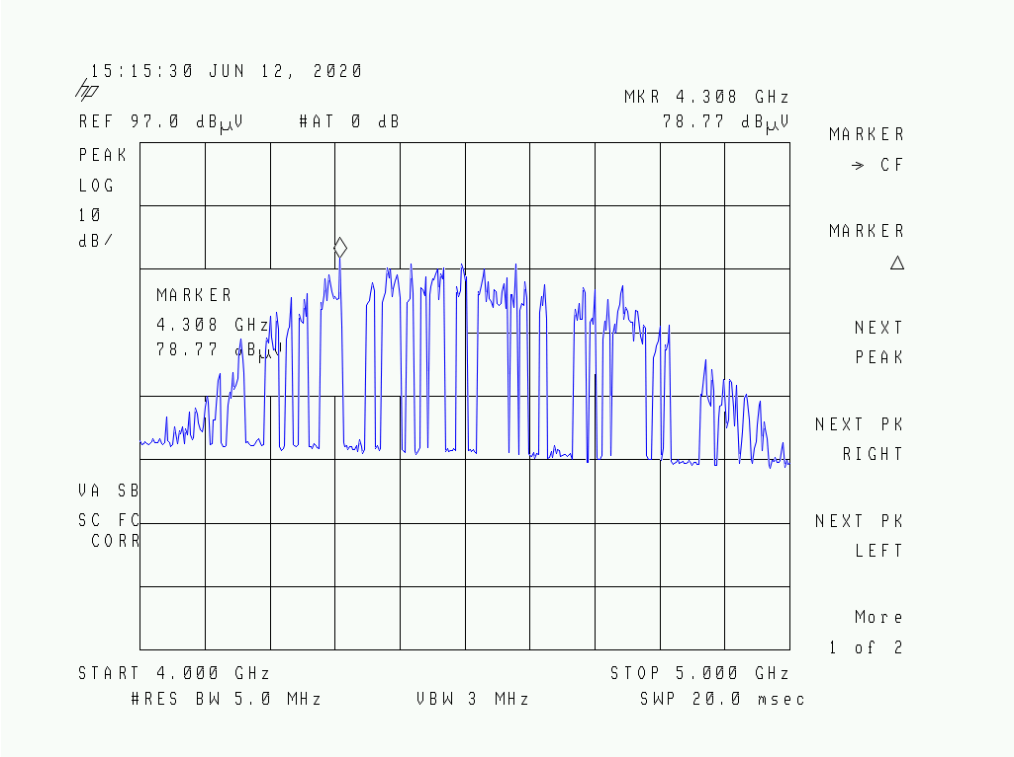


Figure 3. Worst Case Fundamental signal (f_m)

Table 4. Intentional Radiated Emissions (§15.519 (f))

Frequency (MHz)	Distance / Polarization	Raw Test Data (dBuV)	Correction Factors (dB/m)	Additional Factors	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detection
4308.00	1.0m./HORZ	78.77	1.03	-9.50	70.30	75.2	4.9	**PK**
4648.00	1.0m./VERT	70.89	4.73	-9.50	65.32	75.2	9.9	**PK**

Sample Calculation at 4308.00 MHz:

Raw Test Data	78.77	dBuV
+ Additional Factor	-9.50	dBm
+ Correction Factors	1.03	dBm
Results	70.30	dBuV/m

Test Date: June 12, 2020

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.8.1 Pulse Repetition Frequency and Duty Cycle

The device employs pulse modulation and has a repetition rate of 10.0 Hz. The pulse signal has been verified and plots of the pulse train used to calculate the pulse rate are provided below. The same plots are used to calculate the duty cycle of the emissions.

Pulse Rate: 10.0 Hz
Period= 250 mSec
Frequency= 1/seconds= 1/0.25 secs = 4.0 Hz

Duty Cycle correction factor:
20 log ($TX_{on}/TX_{on}+TX_{off}$) = 20 log (1.0ms/250ms) = -47.95 dB
DC = -20.0 dB (since the factor is greater than 20 dB, 20 dB is used).

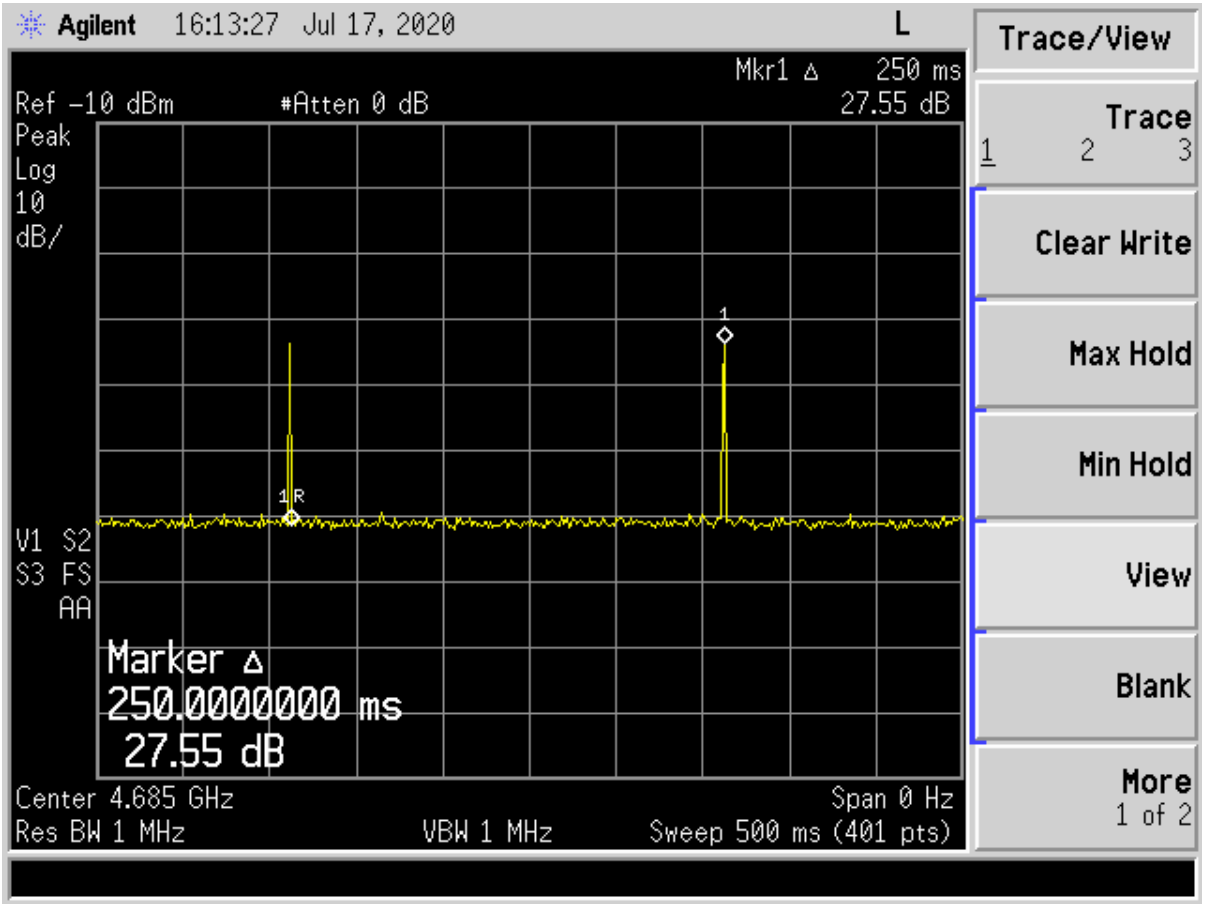


Figure 4. Duty Cycle Plot (TX OFF)

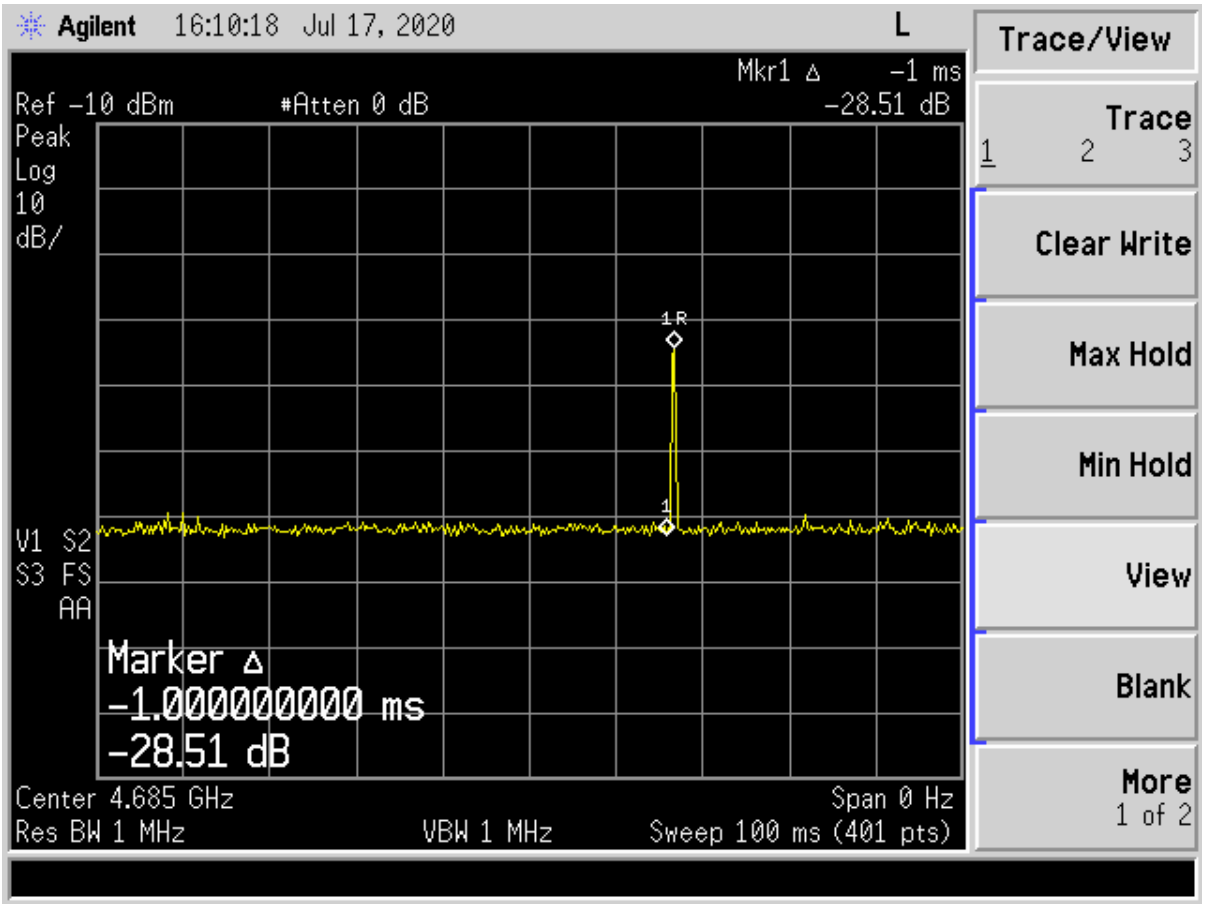


Figure 5. Duty Cycle Plot (TX ON) Single Pulse Width

2.9 UWB Bandwidth (CFR 15.519(b), 15.521(e), RSS-220 Section 6.2.1(a))

Bandwidth measurements were made in accordance with ANSI C63.10-2013 Clause 10.1. The bandwidth of an indoor UWB system under §15.519 must be contained between 3100 MHz and 10,600 MHz. The bandwidth is defined as the frequency band bounded by the points that are 10 db below the highest radiated emissions as based on the complete transmission system including the antenna. The upper boundary is designated $\mathbf{f_H}$ and the lower boundary is designated $\mathbf{f_L}$. The frequency at which the highest radiated emission occurs is designated $\mathbf{f_M}$. If multiple bandwidths occur, then the maximum bandwidth is used.

The bandwidth was determined from a radiated measurement using the designated antenna the EUT will operate with in the final product. The receiving antenna's height was repeatedly varied from 1 m to 4 m and the polarity was adjusted several times. The turntable on which the EUT was placed was also rotated several times throughout 360° clockwise and counterclockwise. This was to ensure that the true bandwidth of the EUT was measured.

Bandwidth emissions are contained within 3100 MHz and 10,600 MHz which meets the requirements of §15.519(b). The measured UWB bandwidth is presented in Figure 6 below.

Per §15.503 (d) *Ultra-wideband (UWB) transmitter* - An intentional radiator that, at any point in time, 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.

In this case, the UWB bandwidth is equal to or greater than 500 MHz. See the figure below.

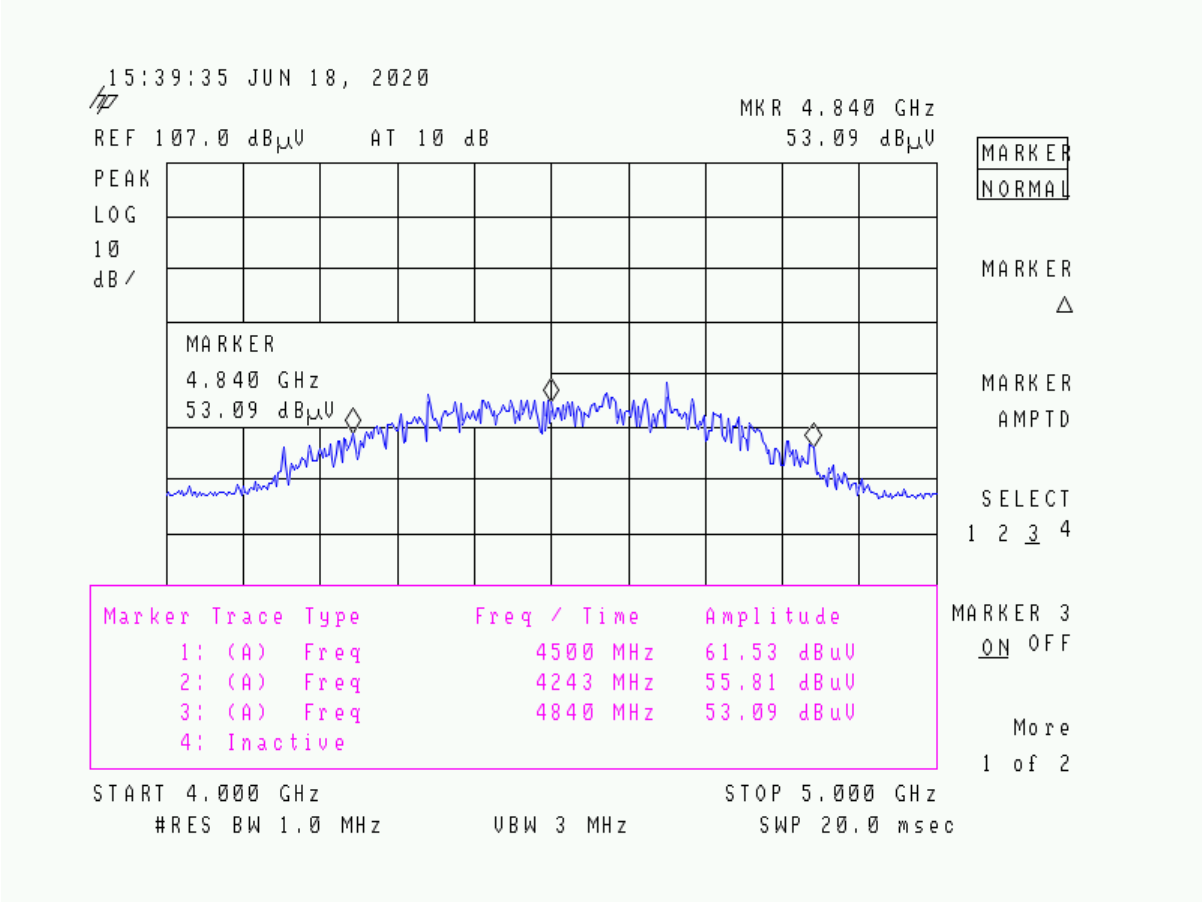


Figure 6. UWB f_L, f_M, f_H Measurement Plot

$$f_c = (f_L + f_H)/2 = (4.243 + 4.840)/2 = 4.542 \text{ GHz}$$

$$\text{UWB bandwidth} = f_H - f_L = 4.840 - 4.243 = 597 \text{ MHz}$$

2.10 UWB Purpose and Coordination (§15.519 (a))

This device is designed to be used only in a handheld infrastructure as detailed in the User Guide provided in the submittal documentation. Without first setting up the network, the device will not function as intended. The device is designed such that it will not be intentionally directed outside of the building. There are no provisions for the use of outdoor mounting antennas. There are no provisions for the use of field disturbance sensors. The device is designed such that it shall transmit only when the intentional radiator is sending information to an associated receiver.

In regards to the following requirements:

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

The device only broadcasts for 5 milliseconds and if there is no acknowledgment it goes back to sleep mode. Details are found in the Theory of Operation exhibit for the device.

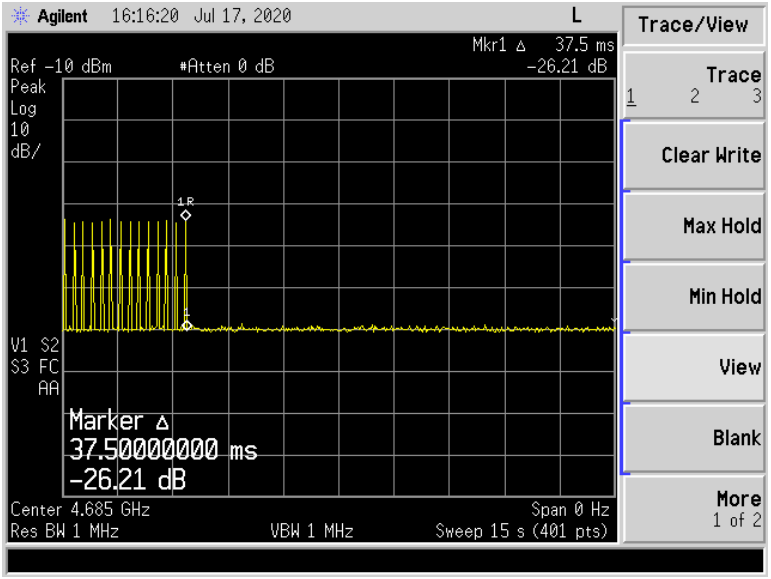


Figure 7. EUT Time-Out Plot (Transmission Ceases within 10 Seconds)

The use of antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

There are no provisions for the use of outdoor mounting antennas. The system is designed around the use of transceiver devices that have their own integral antennas. No externally mounted antennas will be necessary for operation.

2.11 Unintentional Radiator, Power line Emissions (§15.207, §15.521 (j))

The AC power line conducted emissions measurements have been carried out in accordance with §15.207, per ANSI C63.10-2013, Clause 6.2 with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission.

Table 5. Power Line Conducted Conducted Emissions Test Data

Tested By: AF	Test: FCC Part 15.207				Client: Okyanus Teknoloji	
	Project: 20-0187				Model: UWB001	
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL (dB)**	**Corrected Results (dBuV)**	**Limits (dBuV)**	**Margin (dB)**	**Detector**
Phase @ 120 Vac/60Hz						
0.1728	42.46	1.13	43.59	54.8	11.2	**PK**
0.7716	36.54	0.37	36.91	46.0	9.1	**PK**
1.1530	34.35	0.35	34.70	46.0	11.3	**PK**
9.2330	34.25	0.42	34.67	50.0	15.3	**PK**
19.7000	42.78	0.52	43.30	50.0	6.7	**PK**
20.3830	43.68	0.32	44.00	50.0	6.0	**PK**
Neutral @ 120 Vac/60Hz						
0.1506	44.35	1.62	45.97	56.0	10.0	**PK**
0.7725	34.59	0.39	34.98	46.0	11.0	**PK**
1.1530	33.55	0.37	33.92	46.0	12.1	**PK**
9.9500	34.29	0.45	34.74	50.0	15.3	**PK**
19.7000	42.15	0.55	42.70	50.0	7.3	**PK**
26.5500	43.65	0.36	44.01	50.0	6.0	**PK**

SAMPLE CALCULATION AT: 0.1728 MHz:

Magnitude of Measured Frequency	42.46	dBuV
+ LISN + Cable Loss	1.13	dB
Corrected Result	43.59	dBuV/m

Test Date: June 9, 2020

Tested By
Signature: Afzal Fazal Name: Afzal Fazal

2.12 Radiated Emissions at or Below 960 MHz (§15.519(c), §15.209)

The radiated emissions at or below 960 MHz from the transmitter shall not exceed the emissions levels in §15.209.

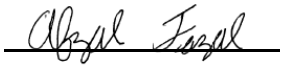
Table 6. Radiated Emissions Test Data below 960 MHz

Test By: AF	Test: FCC Part 15.209				Client: Okyanus Teknoloji		
	Project: 20-0187				Model: UWB001		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
60.28	45.80	-17.79	28.01	40.0	3m./VERT	12.0	**QP**
61.98	48.11	-16.69	31.42	40.0	3m./HORZ	8.6	**QP**
66.86	44.75	-18.12	26.63	40.0	3m./VERT	13.4	**QP**
84.32	40.50	-16.55	23.95	40.0	3m./VERT	16.1	**QP**
115.62	45.57	-15.02	30.55	43.5	3m./HORZ	13.0	**QP**
199.89	43.52	-10.01	33.51	43.5	3m./HORZ	10.0	**QP**
203.31	50.97	-13.61	37.36	43.5	3m./HORZ	6.1	**QP**
215.43	49.37	-14.30	35.07	43.5	3m./VERT	8.4	**QP**
221.49	52.70	-14.12	38.58	46.0	3m./HORZ	7.4	**QP**
255.78	48.48	-12.74	35.74	46.0	3m./VERT	10.3	**QP**
268.35	52.71	-12.22	40.49	46.0	3m./HORZ	5.5	**QP**
322.99	34.17	-10.14	24.03	46.0	3m./HORZ	22.0	**QP**
335.91	48.20	-10.26	37.94	46.0	3m./VERT	8.1	**PK**
375.00	42.21	-9.69	32.52	46.0	3m./HORZ	13.5	**QP**
375.11	47.52	-9.82	37.70	46.0	3m./VERT	8.3	**QP**
625.10	37.39	-4.20	33.19	46.0	3m./HORZ	12.8	**QP**
750.02	37.79	-2.15	35.64	46.0	3m./VERT	10.4	**QP**

SAMPLE CALCULATION AT: 60.28 MHz

Magnitude of Measured Frequency	45.80	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-17.79	dB
Corrected Result	28.01	dBuV/m

Test Date: June 15, 2020

Tested By
Signature:  Name: Afzal Fazal

2.13 Radiated Emissions above 960 MHz (§15.519(c), §15.521(d,g,h))

The radiated emissions above 960 MHz from the transmitter shall comply with the AVG limits in Table 8 when measured using a resolution bandwidth of 1 MHz. The following are the worst case emissions with the receiving antenna in both horizontal and vertical polarities. The emissions were maximized using a Peak Detector, and the final measurement was taken using an Average Detector.

Table 7. Radiated Emissions above 960 MHz (§15.519(c), §15.521(g))

Frequency Range (MHz)	EIRP Limit (dBm)	Field Strength Limit at 3 meters (dBuV/m)
960-1610	−75.3	19.9
1610-1990	−63.3	31.9
1990-3100	−61.3	33.9
3100-10600	−41.3	53.9
Above 10600	−61.3	33.9

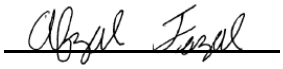
Table 8. Radiated Emissions from Transmitter Above 960 MHz

Test By: AF	Test: FCC Part 15.209				Client: Okyanus Teknoloji		
	Project: 20-0187				Model: UWB001		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
1000.56	28.12	-11.64	16.48	19.9	1.0m./VERT	3.42	**AVG**
1125.44	29.15	-10.22	18.93	19.9	1.0m./HORZ	0.97	**AVG**
1698.23	33.91	-8.51	25.40	31.9	3.0m./HORZ	6.50	**AVG**
1948.89	33.82	-7.38	26.44	31.9	3.0m./VERT	5.46	**AVG**
2102.10	33.73	-7.24	26.49	33.9	3.0m./HORZ	7.41	**AVG**
2689.63	32.01	-5.86	26.15	33.9	3.0m./VERT	7.75	**AVG**
4810.59	47.77	0.12	47.89	53.9	3.0m./HORZ	6.01	**PK**
4859.61	44.12	0.03	44.15	53.9	3.0m./VERT	9.75	**PK**
8828.29	35.53	5.05	40.58	53.9	1.0m./HORZ	13.32	**PK**
9905.38	35.63	5.62	41.25	53.9	1.0m./VERT	12.65	**PK**
10674.72	19.16	6.65	25.81	33.9	1.0m./VERT	8.09	**AVG**
10777.27	18.91	7.74	26.65	33.9	1.0m./HORZ	7.25	**AVG**

SAMPLE CALCULATION AT: 1000.56 MHz

Magnitude of Measured Frequency	28.12	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-11.64	dB
Corrected Result	16.48	dBuV/m

Test Date: June 19, 2020

Tested By
Signature:  Name: Afzal Fazal

2.14 Radiated Emissions in the GPS band (CFR 15.519(d), 15.521(g))

In addition to the radiated emissions limits from §15.519(c), the transmitter shall not exceed the following average limits in Table 9 when measured using a resolution bandwidth of no less than 1 kHz.

Note: Where applicable, measurements taken with a resolution bandwidth of greater than 1 kHz were corrected using the following equation: recorded measurement (dBuV) + 10 log (RBW_{ref}/RBW_{meas})

Table 9. Radiated Emissions in the GPS band (§15.519 (d), §15.221(g)

Frequency Range (MHz)	EIRP Limit (dBm)	Field Strength Limit at 3 meters (dBuV/m)
1164-1240	-85.3	9.9
1559-1610	-85.3	9.9

The EUT was configured in accordance with ANSI C63.10-2013, Clause 10. During testing, the EUT was rotated 360 degrees and the receive antenna was elevated between 1 m and 4 m to measure and record the maximum emissions being generated by the EUT. The receive antenna was oriented in both the horizontal and vertical polarities. The worst case data is recorded and presented in the table below.

Table 10. Radiated Emissions per §15.519(d)

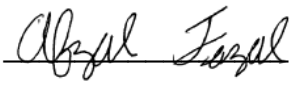
1164 – 1240 MHz and 1559- 1610 MHz								
Test: Radiated Emissions					**Client:** Okyanus Teknoloji			
Project: 20-0187					**Model:** uwb001			
Frequency (MHz)	**Test Data (dBuv)**	**Additional Factor**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector**
1224.65	19.99	-9.50	-9.26	1.23	9.9	1.0m./HORZ	8.7	**PK**
1600.12	23.90	-9.50	-8.15	6.25	9.9	1.0m./HORZ	3.7	**PK**
1200.07	23.33	-9.50	-9.31	4.52	9.9	1.0m./VERT	5.4	**PK**
1600.12	23.35	-9.50	-8.19	5.66	9.9	1.0m./VERT	4.2	**PK**

Note: measurements at 1 meter are corrected by adding an inverse extrapolation factor of -9.5 dB to the result. This value is included in the Additional Factor column.

SAMPLE CALCULATION AT: 1224.65 MHz:

Magnitude of Measured Frequency	19.99	dBuV
+Additional Factor	-9.50	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-9.26	dB
Corrected Result	1.23	dBuV/m

Test Date: June 19, 2020

Tested By
Signature:  Name: Afzal Fazal

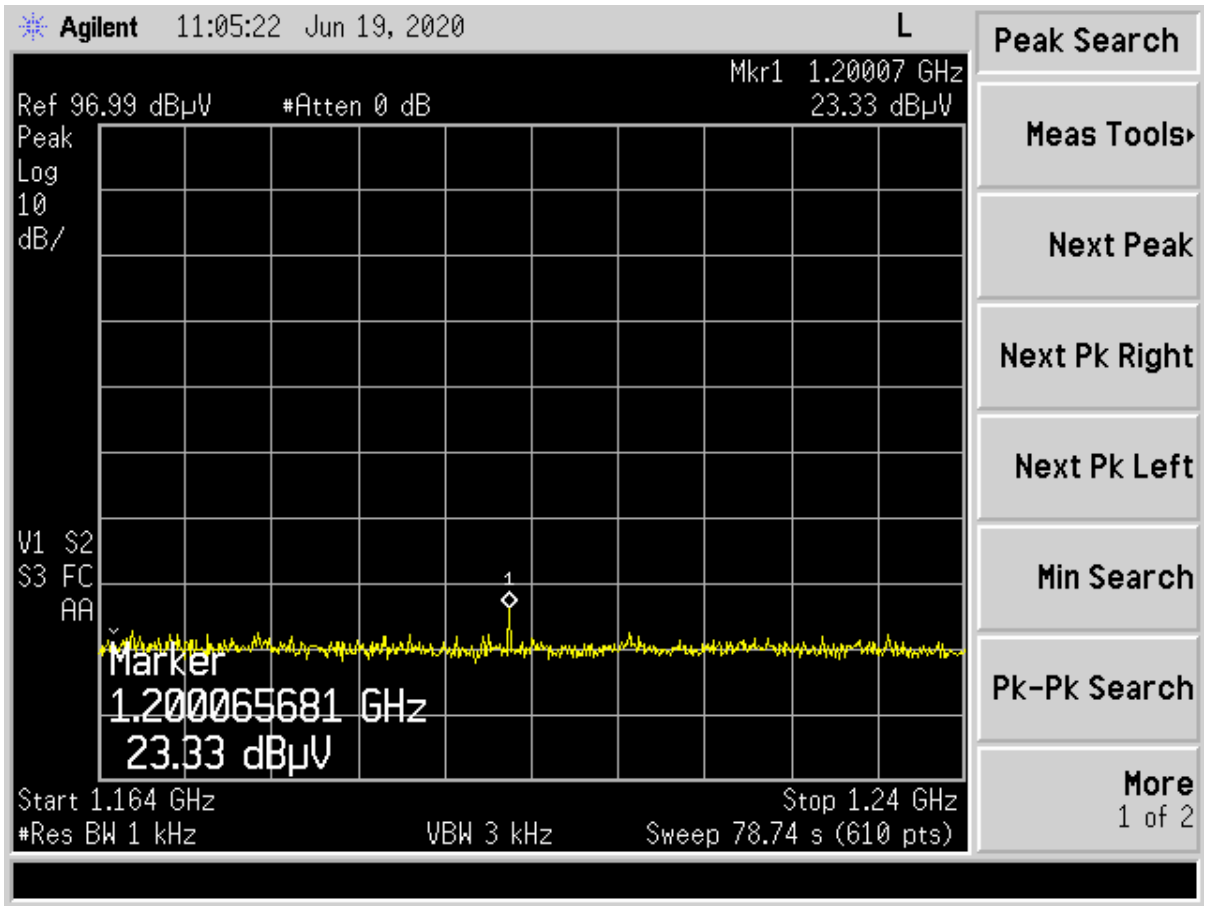


Figure 8. 1164 - 1240 MHz GPS Band

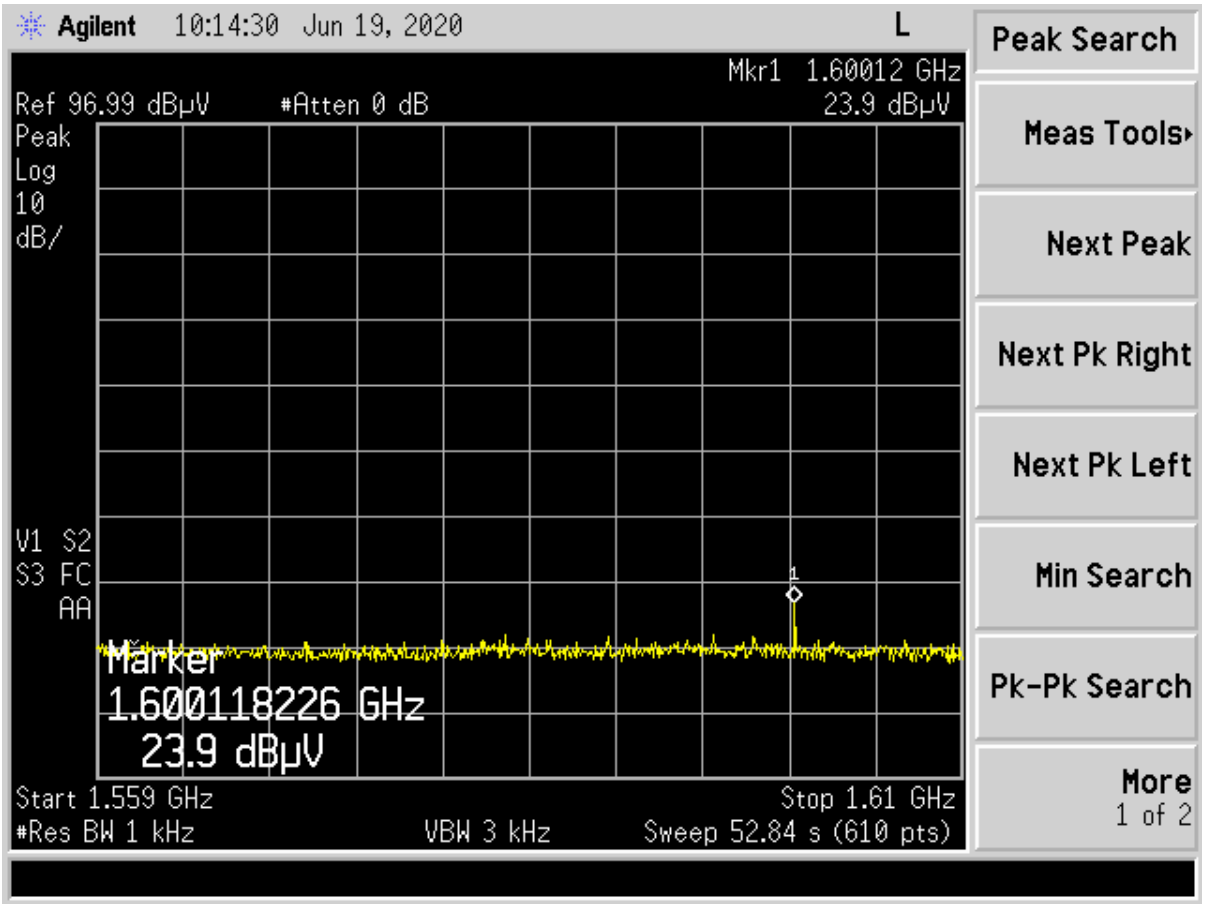


Figure 9. 1559 - 1610 MHz GPS Band

2.15 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.15.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.85 dB.

2.15.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.40 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.19 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.20 dB.

END TEST REPORT