Advanced
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Electromagnetic Emission Compliance Test Report

Equipment Under Test (EUT)	GPR
Model	AE32HV
Applicant	IDS GeoRadar srl
In Accordance With	FCC Part 15, Subpart F Industry Canada RSS-220 (Issue 1/2009+A1/2018)
Tested by	Advanced Compliance Laboratory, Inc. 210 Cougar Court Hillsborough, New Jersey 08844
Authorized by	Wei Li Lab Manager Signature 
Date	July 8, 2022
AC Lab Report Number	0048-220624-02

Lab Code:200101-0

The test result in this report is supported and covered by the NVLAP accreditation.

Table of Contents

Section 1. Summary of Test Results

Manufacturer: IDS GeoRadar srl
Product Name: GPR

Model/Parts No. : AE32HV Part No. 947535

S/N: RD-0012022

General: **All measurements are traceable to national standards**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15, Sub Part F and Industry Canada RSS-220 (Issue 1/2009).

☐ New Submission ☐ Production Unit

☐ Class I Permissive Change ☒ Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

"See Summary of Test Data"

NVLAP LAB CODE: 200101-0

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Summary of Test Data

Compliance Requirement	FCC & IC Rule Part	Test No. in Section 4	Result
Cross Reference	15.505 &RSS-GEN	1	Complies
Marketing of UWB Equipment	15.507 &RSS-GEN	2	Complies
Pulse Repetition Frequency(PRF)	15.509 &RSS-220 6.2	3	Complies
UWB Bandwidth	15.509(a) &RSS-220 6.2.1(a)	4	Complies
General Operational Requirements for LF Imaging System	15.509(b) &RSS-220 6	5	Complies
Spurious Radiated Emissions≤960MHz	15.509(d) 15.209 &RSS-220 3.4, 6.2(c), 6.2(d)	6	Complies
Spurious Radiated Emissions>960MHz	15.509(d) 15.209 &RSS-220 3.4, 6.2(c), 6.2(d)	7	Complies
Radiated Emissions in GPS Bands	15.509(e) 15.209 &RSS-220 6.2(e)	8	Complies
Highest Radiated Emission at f_M	15.509(f) 15.209 &RSS-220 6.2(g)	9	Complies
Technical Requirements Applicable to All UWB Devices	15.521	10	Complies
Coordination Requirement	15.525	11	N/A
Antenna Requirement	15.203/204 &RSS-GEN 7.1.4	12	Complies
Radio Frequency Exposure	FCC OET Bulletin 65 &RSS-GEN	13	N/A
Conducted Emissions	15.507 &RSS-GEN	14	*
Transmission Duration	15.509(c)	15	**

***** NOT APPLICABLE to the EUT as it is a battery-powered device;
****** NOT APPLICABLE to the EUT as it is not a handheld device.

The estimated uncertainty of the test result is given as following. The method of uncertainty calculation is provided in Advanced Compliance Lab. Doc. No. 0048-01-01.

	Prob. Dist.	Uncertainty(dB)	Uncertainty(dB)	Uncertainty(dB)
		30-1000MHz	1-6.5GHz	Conducted
Combined Std. Uncertainty u_c	norm.	±2.36	±2.99	±1.83

Wei Li
Lab Manager
Advanced Compliance Lab

Date: July 8, 2022

Section 2. General Equipment & Test Configuration

2.1. EUT Specification

EUT	GPR Model No. AE32HV manufactured by IDS GeoRadar srl is an ultra-wide band ground penetrating radar (GPR) intended for geophysical surveying and non-destructive testing.
Supply Voltage	10.8 VDC, provided by Lithium Ion Rechargeable Battery
Operating Frequency	126.9 MHz -670.0 MHz
-10dB UWB Bandwidth	543.1 MHz
Modulation Type	400KHz Pulse Repetition Frequency (PRF)
Peak Emissions in a 50 MHz Bandwidth	Max. peak emissions is under 1GHz
Antenna	Dipole Antenna
Hardware Version (Model No.)	AE32HV
Software Version	Microcontroller v1.x, FPGA v1.x

2.2. Description of Operation

The system performs time domain reflectometry by radiating a radio frequency impulse with the designed repetition frequency from a transmitting dipole (TX dipole). Transitions between materials exhibiting different wave impedance through which the electromagnetic wave travels cause the wave to be reflected. These reflections are received by the receiving dipole (RX dipole) and sampled by the instrument. Results may be displayed in real time on the system screen and recorded on an internal solid state disk

drive for later analysis. In the field, the system is powered from a removable rechargeable battery.

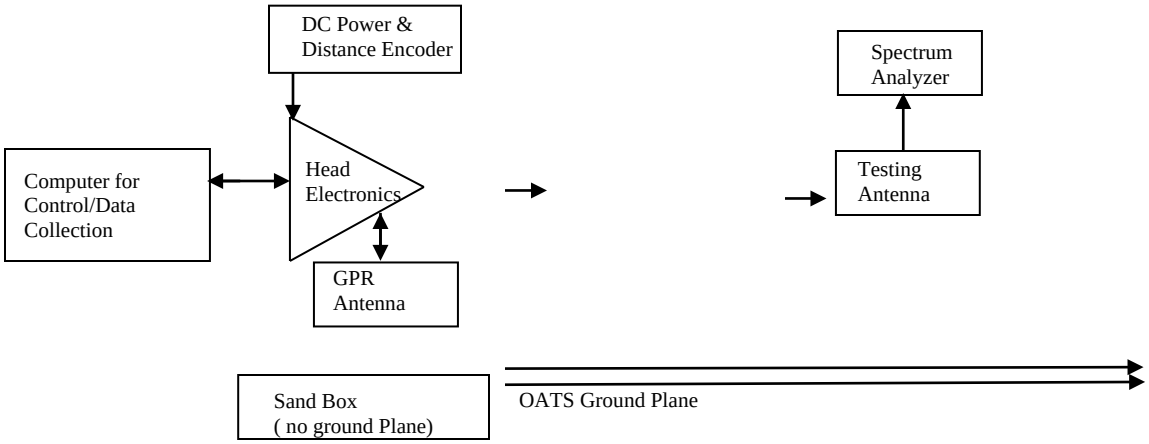
2.3. System Diagram

See Attachment provided by Applicant.

2.4. General EUT Setup

The EUT is operated in continuous transmission mode with the antennas permanently mounted in an all in one plastic housing with the controlling electronics and battery.

All measurements shall be made at room temperature and at nominal DC input voltage (provided by a battery). The EUT is placed directly on the dry sand with no ground plane under it.



2.5. Operational Frequency channel(s) for testing:

- Clock on PCB (digital part): 7.8125 MHz, 25 MHz, 100 MHz, 125 MHz, 129 MHz,1 GHz, 4 GHz
- Antenna center frequencies: 600MHz

Section 3. Test Methodology & Facilities

3.1 Measurement Procedure

The tests documented in this report were performed in accordance with ANSI C63.4 /C63.10, FCC CFR 47 Part 2 & 15, Industry Canada RSS-220 (Issue 1/2009) & FCC Order, ET Docket No. 980153(FCC02-08). Test procedure described in FCC "KDB 393764, UWB Compliance Measurements" is used in this report. 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.
In accordance with ANSI C63.10:2013, Section 10.2.2, the device under test was placed on a bed of dry sand and rotated through 16 azimuth angles (Clause 5.4) to determine which produced the highest emission relative to the limit. The azimuth that produced the highest emission relative to the limit was used for all radiated emission measurements.

3.2. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at Hillsborough, New Jersey, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 32. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods".

This site is accepted by FCC to perform measurements under Part 15 or 18 (Registration # 90601, MRA designation No. US5347) and also designated by IC as " site IC 3130A". ACL is accredited by NVLAP, Laboratory Code 200101-0. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government**.**

3.3. Test and Measurement Equipment

The following test and measurement equipment was utilized for the tests documented in this report:

Manufacture	Model	Serial No.	Description	Cal Due dd/mm/yy
Hewlett-Packard	HP8546A	3448A00290	EMI Receiver	25/09/22
Agilent	E4440A	US40420700	3Hz-26.5GHz Spectrum Analyzer	17/06/23
EMCO	3104C	9307-4396	20-300MHz Biconical Antenna	15/10/22
EMCO	3146	9008-2860	200-1000MHz Log-Periodic Antenna	15/10/22
EMCO	3115	4945	Double Ridge Guide Horn Antenna	12/06/23
Narda	BW-10W5	3037	10dB , 5W in-line Power Attenuator	15/01/23
Belden	9913	ACL23	RF 18'Coxial Cable	15/01/23

All Test Equipment Used is Calibrated, Traceable to NIST Standards. 2 Year Interval.

Section 4. Measurement Data

Test No.1

Name of Test:	*Cross Reference*	Test Standard:	*15.505 &RSS-GEN*
Tested By:	WEI LI	Test Date:	06/24/2022-07/08/2022

Minimum Standard: 15.505(a)
Equipment under test complies with all the relevant and applicable requirements of Subpart A, Subpart B and Section 15.201 through 15.204 and Section 15.207 of Subpart C. 15.505(b)
The Digital circuitry portion of the EUT has been tested and verified to comply with 47 CFR Part 15, subpart B.

Method of Measurement: a) Except where specifically stated otherwise within this subpart, the provisions of Subparts A and B and of Sections 15.201 through 15.204 and Section 15.207 of Subpart C of this part apply to unlicensed UWB intentional radiators. The provisions of Sections 15.35(c) and 15.205 do not apply to devices operated under this subpart. The provisions of Footnote US 246 to the Table of Frequency Allocations contained in Section 2.106 of this chapter do not apply to devices operated under this subpart.

b) The requirements of Subpart F apply only to the radio transmitter, i.e., the intentional radiator, contained in the UWB device. Other aspects of the operation of a UWB device may be subject to requirements contained elsewhere in this chapter. In particular, a UWB device that contains digital circuitry not directly associated with the operation of the transmitter also is subject to the requirements for unintentional radiators in Subpart B of this chapter. Similarly, an associated receiver that operates (tunes) within the frequency range 30 MHz to 960 MHz is subject to the requirements in Subpart B of this chapter.

Test Result: **Complies**

Test Data: **Data and Plots**

Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	David Tu
Temperature:	75°F
Humidity:	30%

Spurious Radiated Emissions from Digital Circuitry (RF off) complies with FCC Part 15.109 (Class A), measured per ANSI C63.4 standard setup.

Freq.* (MHz)	H,V	Height (m)	Angle (degree)	SA** Reading (dBuV/m)	Refer to Part 15.109 10m Limit (dBuV/m)	Margin (dB)	Result
33.8	H	1.8	045	28.5	39.1	-10.6	Pass
94.6	H	1.8	045	27.8	43.5	-15.7	Pass
105.2	H	1.8	045	23.8	43.5	-19.7	Pass
143.9	H	1.8	045	29.6	43.5	-13.9	Pass
197.9	H	1.8	090	25.0	43.5	-18.5	Pass
250.0	H	1.4	090	26.4	46.4	-20.0	Pass
283.2	H	1.4	090	20.3	46.4	-26.1	Pass
332.8	H	1.3	045	25.2	46.4	-21.2	Pass
412.0	H	1.3	045	23.3	46.4	-23.1	Pass
425.6	H	1.4	045	21.5	46.4	-24.9	Pass
700.1	H	1.4	045	30.0	46.4	-16.4	Pass
864.0	H	1.4	045	31.3	46.4	-15.1	Pass
1140.0	H	1.1	000	23.6	49.5	-25.9	Pass
1500.0	H	1.1	000	24.0	49.5	-25.5	Pass
1600.0	H	1.1	000	20.2	49.5	-29.3	Pass
34.7	V	1.2	045	32.4	39.1	-6.7	Pass
44.0	V	1.2	045	31.7	39.1	-7.4	Pass
87.8	V	1.2	045	31.6	43.5	-11.9	Pass
105.7	V	1.2	045	26.3	43.5	-17.2	Pass
152.4	V	1.2	000	33.0	43.5	-10.5	Pass
254.0	V	1.1	000	25.6	46.4	-20.8	Pass
300.0	V	1.1	090	26.0	46.4	-20.4	Pass
500.0	V	1.1	090	24.9	46.4	-21.5	Pass
640.0	V	1.1	090	29.4	46.4	-17.0	Pass
700.0	V	1.1	090	28.2	46.4	-18.2	Pass
900.1	V	1.1	090	31.6	46.4	-14.8	Pass

1100.0	V	1.1	045	20.7	49.5	-28.8	Pass
1200.0	V	1.1	045	18.4	49.5	-31.1	Pass
1500.0	V	1.1	045	25.6	49.5	-23.9	Pass
1600.0	V	1.1	090	23.3	49.5	-26.2	Pass
1700.0	V	1.1	090	20.6	49.5	-28.9	Pass

*Quasi-peak or average reading at these frequencies. For emissions that have peak values close to (or over) the specification limit (if any) will be also measured in the quasi-peak or average mode to determine the compliance.
** For <1GHz range, testing distance is at 10m; For >1GHz range, testing distance is at 3m. However, distance factor (Radiated field Strength at 10m distance = Radiated field Strength at 3m distance - 10.5 dB□V/m) can be used for low level signals with high level ambient, if test distance is changed from 10m to 3m.

Test No.2

Name of Test:	***Marketing of UWB Equipment***	**Test Standard:**	***15.507 &RSS-GEN***
Tested By:	WEI LI	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: 15.507/ 2.909
The responsible party is properly informed about the responsible for ensuring that the equipment is marketed only to eligible parties, and provide correct information on the customers and users.
(See Important note for the US customers of the Installation Guide and User Manual)

Method of Measurement: In some cases, the operation of UWB devices is limited to specific parties, e.g., law enforcement, fire and rescue organizations operating under the auspices of a state or local government. The marketing of UWB devices must be directed solely to parties eligible to operate the equipment. The responsible party, as defined in Section 2.909 of this chapter, is responsible for ensuring that the equipment is marketed only to eligible parties. Marketing of the equipment in any other manner may be considered grounds for revocation of the grant of certification issued for the equipment.

Test Result: **Complies**

Test Data: **NA**

Test No.3

Name of Test:	***Pulse Repetition Frequency (PRF)***	**Test Standard:**	***15.509(d) &RSS-220 6.2***
Tested By:	WEI LI	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: Definition:
Pulse Repetition Frequency (PRF) is the trigger repetition frequency.

PRF declared by applicant: Total 100KHz

Method of Measurement: Tested at 3-meter OATS per ANSI C63.4
Spectrum Analyzer Settings:
RBW: 30KHz
VBW: ≥RBW
Detector: Peak
Span: As required
Sweep: Auto

Test Result: **Complies**

Test Data: **PRF =400KHz**

Test No.4

Name of Test:	***UWB Bandwidth***	**Test Standard:**	***15.509(a) 15.503(a) &RSS-220 6.2.1(a)***
Tested By:	WEI LI	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard:

Definition:

The bandwidth of a UWB emission is defined by the points on the emission spectrum where the amplitude is 10 dB below the maximum emission amplitude (i.e., the -10 dB points), as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L. The frequency at which the highest radiated emission occurs is designated f_M. The center frequency f_C, equals $(f_H + f_L) /2$. The fractional bandwidth equals $2 * (f_H – f_L) / (f_H + f_L)$.

In cases where the measured emission spectrum contains multiple (more than two) -10 dB points, the outermost points define the bandwidth (i.e., the widest bandwidth is assumed).

Limits:

The UWB bandwidth of an imaging system operating under the provisions of this section must be below 10.6 GHz.

Method of Measurement:

Tested at 3-meter OATS per ANSI C63.4
Spectrum Analyzer Settings:
RBW: 1MHz
VBW: 3MHz
Detector: Peak
Span: As required (to display a full spectrum of the RF emission)
Sweep: Auto

Test Procedure:
1) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
2) Measure the Highest radiated emission at f_M as described in the test No. 9.
3) Recorded the upper and lower frequency that are at the side of the band bounded by the points at 10 dB below the highest radiated UWB emission level. Measuring the bandwidth of a UWB device using a radiated test set-up, it is imperative that appropriate adjustments be made to the measured amplitude levels to account for the frequency-dependent components of the measurement system (e.g., antenna gain or factor, pre-amplifier gain, cable loss, etc). Since UWB emissions can have bandwidths several GHz wide, these frequency-dependent characteristics can vary dramatically over the fundamental emission. According to the nature of the broadband emission characteristics, significant care must be taken to capture the true spectrum of emission, extremely narrow sweep widths is recommended.
4) The UWB bandwidth is the different of the upper and lower frequency recorded.

Test Result: **Complies**

Test Data: **Data and Plots**

Measurement Data (Values in MHz):

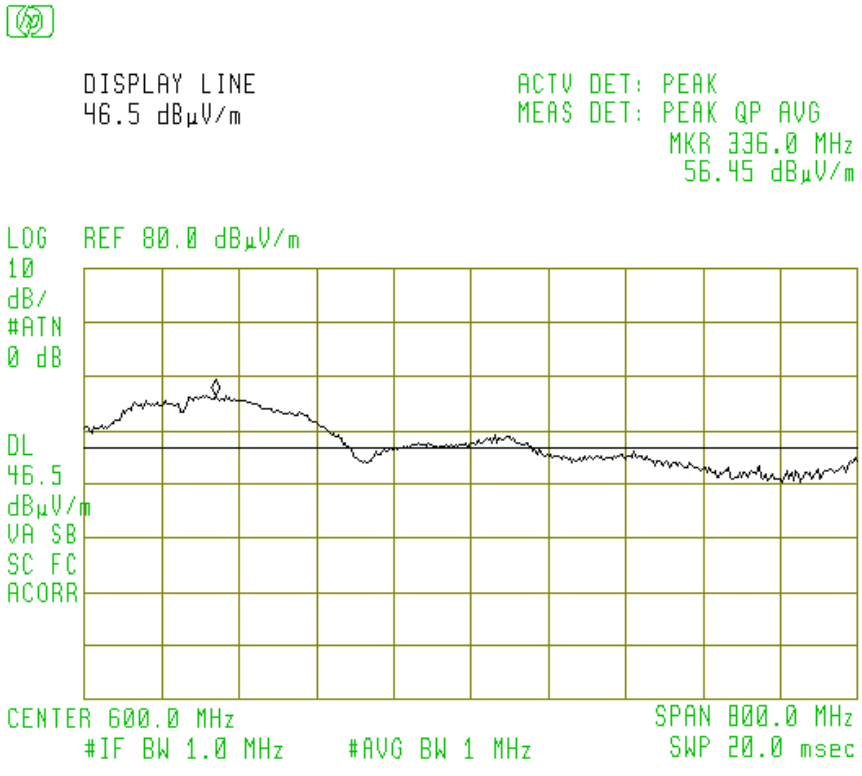
f_M	The highest emission peak	336.0
f_L	10 dB below the highest peak	670.0
f_H	10 dB above the highest peak	126.9
f_C	Calculated: $(f_H + f_L)/2$	398.45
Bandwidth	Calculated: $(f_H - f_L)$	543.1
Fractional BW	Calculated: $2*(f_H - f_L)/(f_H + f_L)$	1.363

Note: The Fraction Bandwidth is also greater than 0.2

Measurement Plots:

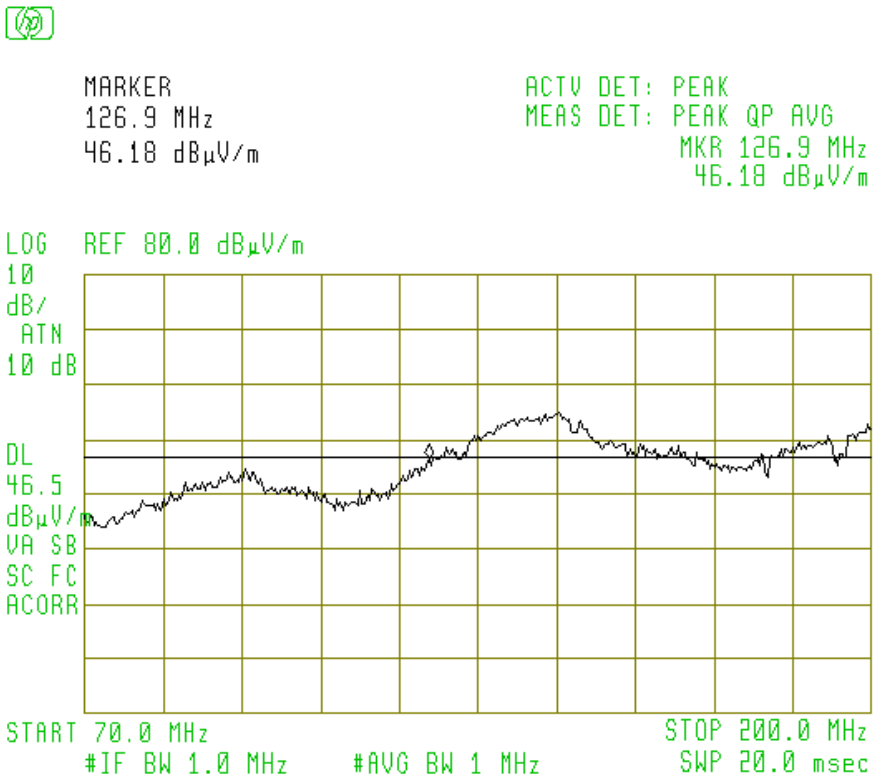
Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	Wei Li
Temperature:	75°F
Humidity:	30%

Section:	**UWB Bandwidth**
Plot Name:	**10dB UWB Bandwidth in Anechoic Chamber_Peak**
Configuration:	Stand alone, Continue operation



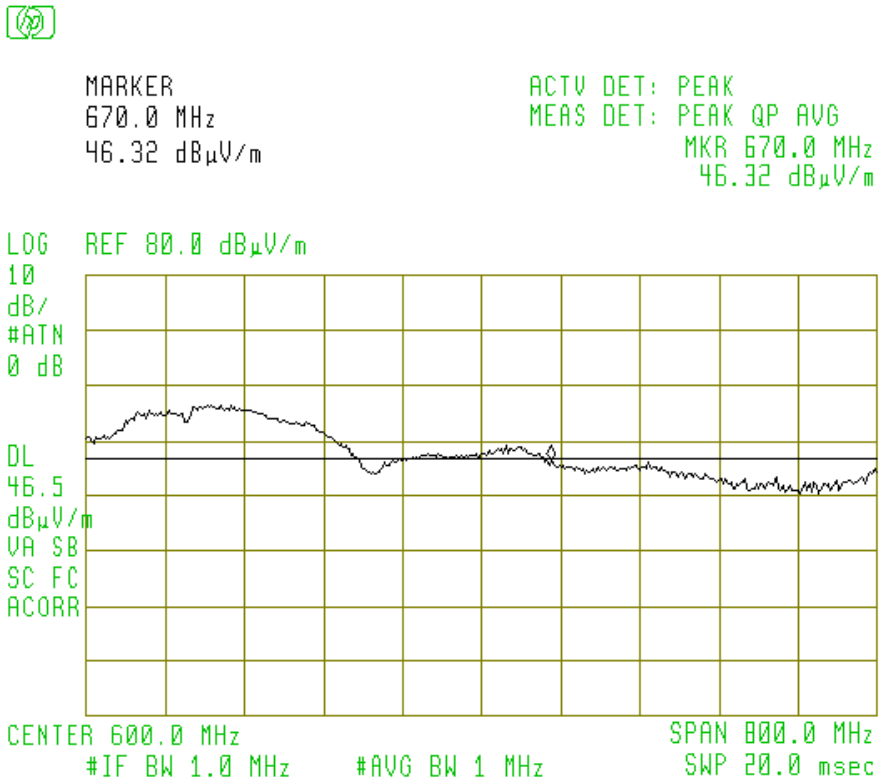
Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	Wei Li
Temperature:	75°F
Humidity:	30%

Section:	**UWB Bandwidth**
Plot Name:	**10dB UWB Bandwidth in Anechoic Chamber_Below**
Configuration:	Stand alone, Continue operation



Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	Wei Li
Temperature:	75°F
Humidity:	30%

Section:	**UWB Bandwidth**
Plot Name:	**10dB UWB Bandwidth in Anechoic Chamber_above**
Configuration:	Stand alone, Continue operation



Test No.5

Name of Test:	***General Operational Requirements for LFIS***	**Test Standard:**	***15.509(b) &RSS-220 6***
Tested By:	WEI LI	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: 15.509(b) &RSS-220 6
Operation under the provisions of this section is limited to GPRs and wall imaging systems operated for the purposes with law enforcement, fire fighting, emergency rescue, scientific research, commercial mining, or construction.

Method of Measurement: The manufacturer Shall state that the device under test complies with the requirements outlined in section FCC Part 15.509 (b).

Test Result: **Complies**

Test Data: **NA**

Test No.6

Name of Test:	***Spurious Radiated Emissions ≤960MHz***	**Test Standard:**	***15.509(d) 15.209 &RSS-220 3.4, 6.2(c), 6.2(d)***
Tested By:	David Tu	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: Definition:
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.

Limits:

Frequency (MHz)	Field Strengths Limits (dBμV/m)	Measuring RBW kHz	Distance (meters)
0.009-0.490	67,6-20*Logf(kHz)	1	300
0.490-1.705	87,6-20*Logf(kHz)	9	30
1.705-30	29,5	9	30
30-88	40,0	120	3
88-216	43,5	120	3
216-960	46,0	120	3

Method of Measurement:

Tested at 3-meter OATS per ANSI C63.4
Spectrum Analyzer Settings:
RBW: 120KHz
VBW: ≥3x RBW
Detector: Quasi-Peak
Span: As required
Sweep: Auto

Test Procedure:
1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
2) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to peak with a bandwidth of 120 kHz during monitoring the frequency range below 960 MHz.
5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
7) At the worst case combination of the EUT operating mode and antenna height, the field strength measure was recorded. At each of the frequencies were a field strength was recorded the final measurement was performed with a Quasi-Peak detector.
8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 was repeated.
9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

Test Result: **Complies**

Test Data: **Data**

Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	David Tu
Temperature:	75°F
Humidity:	30%

Worst Case Scenario: the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

- EUT Position (angle) : 45 ° interval.
- Antenna Polarization : Horizontal & Vertical; Antenna Height : 1-4m

Freq.* (MHz)	H,V	SA QP Reading (dBuV/m)	Height (m)	Angle (degree)	Refer to Part 15.209 3m Limit (dBuV/m)	Margin (dB)	Result
140.5	H	36.1	1.8	090	43.5	-7.4	Pass
149.3	H	37.8	1.8	090	43.5	-5.7	Pass
179.6	H	38.7	1.6	090	43.5	-4.8	Pass
197.9	H	37.7	1.8	090	43.5	-5.8	Pass
200.0	H	40.6	1.7	135	43.5	-2.9	Pass
240.0	H	40.2	1.7	135	46.0	-5.8	Pass
272.0	H	40.5	1.7	135	46.0	-5.5	Pass
291.2	H	41.2	1.7	135	46.0	-4.8	Pass
337.6	H	41.8	1.7	180	46.0	-4.2	Pass
355.2	H	42.0	1.7	180	46.0	-4.0	Pass
404.8	H	39.4	1.7	180	46.0	-6.6	Pass
524.8	H	36.7	1.7	135	46.0	-9.3	Pass
574.4	H	36.1	1.5	135	46.0	-9.9	Pass
660.8	H	37.8	1.5	135	46.0	-8.2	Pass
822.4	H	34.2	1.5	135	46.0	-11.8	Pass
110.7	V	34.7	1.1	045	43.5	-8.8	Pass
114.6	V	37.3	1.1	045	43.5	-6.2	Pass
122.6	V	37.8	1.0	045	43.5	-5.7	Pass
127.0	V	38.5	1.2	045	43.5	-5.0	Pass
135.7	V	39.0	1.2	045	43.5	-4.5	Pass

145.9	V	40.6	1.1	135	43.5	-2.9	Pass
165.0	V	40.4	1.1	135	43.5	-3.1	Pass
197.3	V	41.9	1.1	135	43.5	-1.6	Pass
204.8	V	42.3	1.2	180	43.5	-1.2	Pass
265.6	V	44.1	1.2	180	46.0	-1.9	Pass
297.6**	V	44.4	1.2	180	46.0	-1.6	Pass
356.8	V	44.3	1.2	180	46.0	-1.7	Pass
390.4**	V	44.0	1.1	135	46.0	-2.0	Pass
499.2	V	40.9	1.1	135	46.0	-5.1	Pass
643.2	V	37.0	1.1	135	46.0	-9	Pass
784.0	V	36.2	1.1	135	46.0	-9.8	Pass
974.4	V	36.1	1.1	135	46.0	-9.9	Pass

*High Emissions from Digital circuitry (identified in Test No.1 for FCC Part 15 B) excluded.
**Quasi-Peak Readings

Test No.7

Name of Test:	***Spurious Radiated Emissions >960MHz***	**Test Standard:**	***15.509(d) 15.209 &RSS-220 3.4, 6.2(c), 6.2(d)***
Tested By:	David Tu	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: Definition:
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.

Limits:

Frequency (MHz)	EIRP @ 3 meters (1 MHz BW) (dBm)	Field strength @ 3 meters (1 MHz BW) (dBµV/m)	Field strength @ 1 meters (1 MHz BW) (dBµV/m)
960-1610	-	29,9	39,4
1610-1990	-	41,9	51,4
1990-3100	-	43,9	53,4
3100-10600	-	53,9	63,4
Above 10600	-	43,9	53,9

Remark: The limits were converted from EIRP to field strength at 3 and 1 meter according to FCC 15.503(k).

Method of Measurement:

Tested at 3-meter OATS per ANSI C63.4
Spectrum Analyzer Settings:
RBW: 1MHz
VBW: ≥3x RBW
Detector: RMS Average Detector
Span: As required
Sweep: Auto

Test Procedure:

1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
2) The receiving antenna is placed at 1 meter away from the EUT and it is pointed in the direction of the radiating head with an inclination of -10° to find the highest emission.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to RMS with a bandwidth of 1 MHz during monitoring the frequency range above 960 MHz.
5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
7) At the worst case combination of the EUT operating mode and antenna height, the field strength measure was recorded.
8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 were repeated.
9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

Test Result: **Complies**

Test Data: **Data**

Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	David Tu
Temperature:	75°F
Humidity:	30%

Worst Case Scenario: the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

- EUT Position (angle) : 45 ° interval.
- Antenna Polarization : Horizontal & Vertical; Antenna Height: 1m-4m.

Freq.* (MHz)	H,V	SA** Average Reading @1m (dBuV/m)	Height (m)	Angle (degree)	Refer to 15.509(d) 15.209 &RSS-220 3.4, 6.2(c), 6.2(d) Limit (dBuV/m)	Margin (dB)	Result
1042.0	H	35.5	1.1	135	39.4	-3.9	Pass
1062.0	H	35.3	1.1	135	39.4	-4.1	Pass
1178.0	H	36.1	1.1	135	39.4	-3.3	Pass
1302.1	H	32.5	1.1	180	39.4	-6.9	Pass
1416.0	H	30.1	1.1	235	39.4	-9.3	Pass
1638.0	H	29.4	1.1	235	51.4	-22	Pass
1003.7	V	37.7	1.1	135	39.4	-1.7	Pass
1217.8	V	35.8	1.1	135	39.4	-3.6	Pass
1238.6	V	35.9	1.1	135	39.4	-3.5	Pass
1360.6	V	33.9	1.1	090	39.4	-5.5	Pass
1622.6	V	32.3	1.1	090	51.4	-19.1	Pass
1844.6	V	31.9	1.1	090	51.4	-19.5	Pass

NOTE:
* High emissions from Digital circuitry (identified in Test No.1 for FCC Part 15B) are excluded.

**SA (Spectrum Analyzer) Reading Setup: Average Reading for above 960MHz; 1m/3m distance factor applied if needed.

Test No.8

Name of Test:	***Radiated Emissions in GPS Bands***	**Test Standard:**	***15.509(e) 15.209 &RSS-220 6.2(e)***
Tested By:	David Tu	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: Definition:

In addition to the radiated emission limits specified for frequency above 960 MHz, 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 in the GPS frequency bands.

Limits:

Frequency (MHz)	EIRP @ 3 meters (1 KHz BW) (dB	Field strength @ 3 meters (1 KHz BW) (dBµV/	Field strength @ 1 meters (1 KHz BW) (dBµV/
1164-1240	-	19	29
1559-1610	-	19	29

Remark: The limits were converted from EIRP to field strength at 3 and 1 meter according to FCC 15.503(k).

Method of Measurement:

Tested at 3-meter OATS per ANSI C63.4
Spectrum Analyzer Settings:
RBW: 1KHz
VBW: >3xRBW
Detector: RMS Average Detector
Span: As required
Sweep: Auto

Test Procedure:

1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position)
2) The receiving antenna is placed at 1 meter away from the EUT and it is pointed in the direction of the radiating head with an inclination of -10° to find the highest emission.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to RMS during monitoring the frequency range above 960 MHz.
5) Upon detection of a suspect emission signal, its amplitude and frequency were noted.
6) It is recommended to demodulate the received signals for suitable discrimination of the ambient emission from the EUT emission.
7) At the worst case combination of the EUT operating mode and antenna height, the field strength measure was recorded.
8) The receiving antenna was positioned in vertical polarization and the steps 2 to 6 were repeated.
9) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
10) All the worst case combination field strength emissions founded of each EUT position and antenna polarization was recorded in the following table and compared with the applicable limits.

Test Result: **Complies**

Test Data: **Data and Plot**

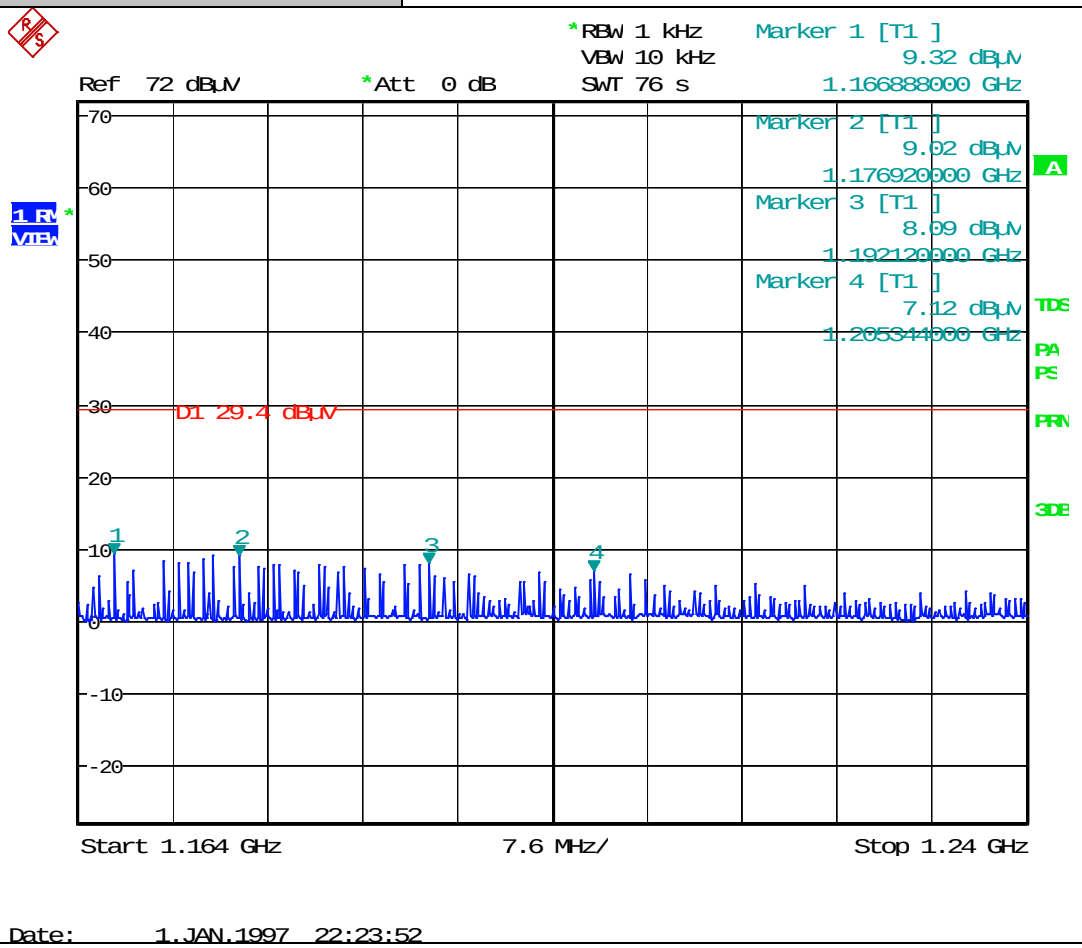
Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	David Tu
Temperature:	75°F
Humidity:	30%

Worst Case Scenario: All maximum Field strength emissions were found at the following test set-up conditions:

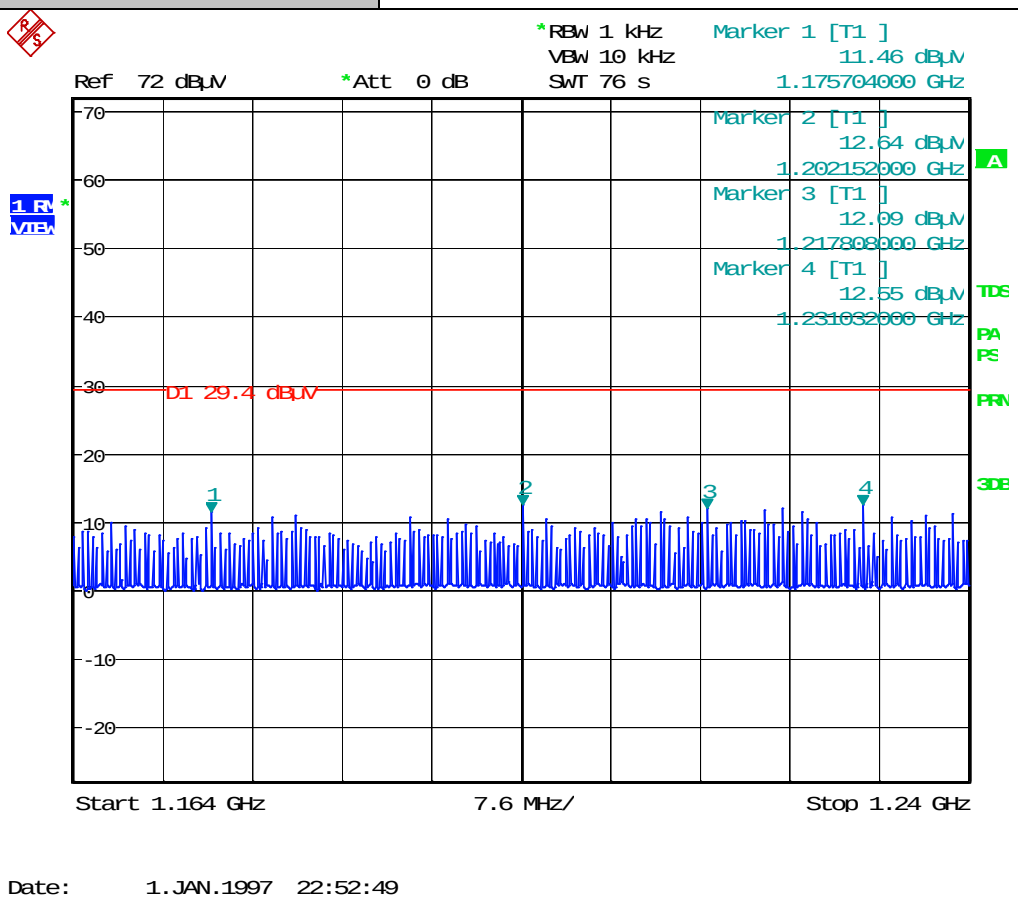
Freq. (MHz)	H,V	SA Reading (dBuV/m)	Height (m)	Angle (degree)	1m Limit (dBuV/m)	Margin (dB)	Result
1166.2	H	9.32	1.0	000	29.4	-20.08	Pass
1176.9	H	9.02	1.0	000	29.4	-20.38	Pass
1192.1	H	8.09	1.0	000	29.4	-21.31	Pass
1206.3	H	7.12	1.0	000	29.4	-22.28	Pass
1565.1	H	5.40	1.0	045	29.4	-24.00	Pass
1578.0	H	5.45	1.0	045	29.4	-23.95	Pass
1590.4	H	6.02	1.0	045	29.4	-23.38	Pass
1600.0*	H	8.13	1.0	045	29.4	-21.27	Pass
1175.7	V	11.46	1.0	045	29.4	-17.94	Pass
1202.1	V	12.64	1.0	045	29.4	-16.76	Pass
1217.8	V	12.09	1.0	045	29.4	-17.31	Pass
1231.0	V	12.55	1.0	045	29.4	-16.85	Pass
1570.4	V	8.05	1.0	090	29.4	-21.35	Pass
1581.6	V	9.17	1.0	090	29.4	-20.23	Pass
1593.7	V	7.72	1.0	090	29.4	-21.68	Pass
1600.0*	V	9.09	1.0	090	29.4	-20.31	Pass

*Narrowband signals are related to the microprocessor / clocks, which do not fall under the requirements of this section.

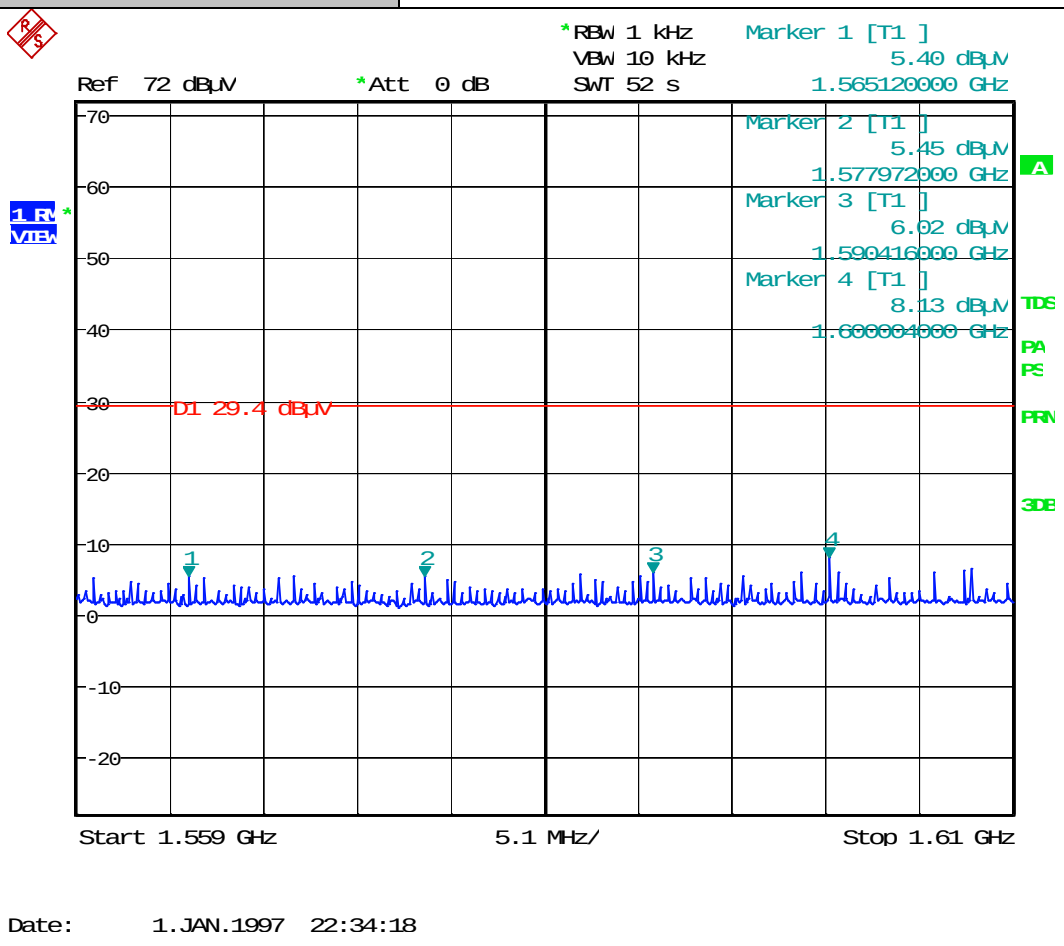
Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	Wei Li
Temperature:	75°F
Humidity:	30%
Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1164-1240MHz Band H Polarity**
Configuration:	Stand alone, Continue operation



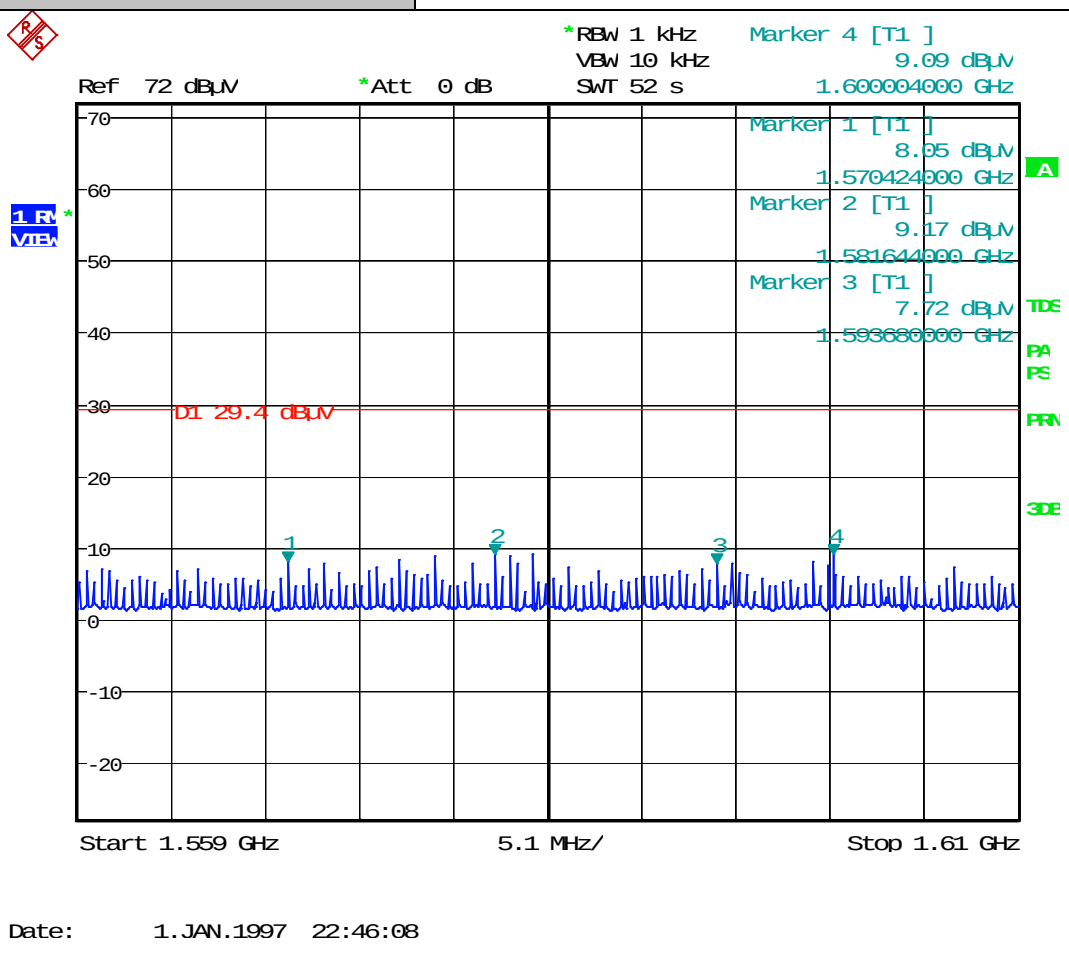
Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	Wei Li
Temperature:	75°F
Humidity:	30%
Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1164-1240MHz Band V Polarity**
Configuration:	Stand alone, Continue operation



Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	Wei Li
Temperature:	75°F
Humidity:	30%
Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1559-1610MHz Band H Polarity**
Configuration:	Stand alone, Continue operation



Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	Wei Li
Temperature:	75°F
Humidity:	30%
Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1559-1610MHz Band V Polarity**
Configuration:	Stand alone, Continue operation



Test No.9

Name of Test:	***Highest Radiated Emission at f***	**Test Standard:**	***15.509(f) 15.209 &RSS-220 6.2(g)***
Tested By:	David Tu	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard:

Definition:

For UWB devices where the frequency at which the highest radiated emission occurs, f_M, is above 960 MHz, there is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on f_M.

Limits:

The peak emission level contained within a 50 MHz bandwidth cantered on f_M mast be limited to a maximum of 0 dBm EIRP.

EIRP limit (dBm)	Field strength limit @ 3 meters for 50MHz RBW (dBuV/m)	Field strength limit @ 3 meters (measured with 1 MHz RBW) (dBµV/m)
0	95.2	61.23

The limits were converted from EIRP to field strength at 3 meter according to FCC 15.503(k).

As the measurement was employed with a 1 MHz resolution bandwidth the applicable limit is adjusted with a 20log(1/50) dB factor.

20 log (1/50)dB = -33.97 dB.

Method of Measurement:

Tested at 3-meter OATS per ANSI C63.4
Spectrum Analyzer Settings:
RBW: 1MHz
VBW: ≥3x RBW
Detector: Peak
Span: As required
Sweep: Auto

Test Procedure:

1) The EUT was placed on sandpit area filled with dry sand initially placed in front of the ground plane (0° degree position).
2) The receiving antenna which varied from 1 to 4 m to find the highest emission is positioned 3 m away from the EUT.
3) The receiving antenna was positioned in horizontal polarization.
4) The measurements were made with the detector set to peak with a bandwidth of 1 MHz during monitoring the frequency range inside the UWB of the EUT.
5) At the worst case combination of the EUT operating mode and antenna height, the field strength measure was recorded.
6) The receiving antenna was positioned in vertical polarization and the steps 4 to 6 were repeated.
7) The EUT was rotating from 0° to 360° degrees with 45° step increment and the steps 4 to 7 was repeated.
8) Record the peak emission from the EUT.

Test Result: **Complies**

Test Data: **N/A**

Project Number:	0048-220624-02
EUT:	AE32HV
S/N:	020-20-001230
Tested By:	David Tu
Temperature:	75°F
Humidity:	30%

Worst Case Scenario: The maximum peak level of emission is found at the following test set-up conditions:

Freq. (MHz)	H,V	SA Peak Reading At 1 meter (dBuV/m)	RBW	Reading corrected for 3 meter (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
1004*	V	46.13	1MHz	36.63	61.23	-24.60	Pass
297.6**	V		1MHz	55.36	N/A		

* measured at 1m due to low signal level.
** Max. emission frequency is under 1GHz.

Test No.10

Name of Test:	***Technical Requirements Applicable to ALL UWB Devices***	**Test Standard:**	***15.521***
Tested By:	WEI LI	**Test Date:**	06/24/2022-07/08/2022

Requirement	**Description**
15.521(a)	The EUT is not employed for the operation of toys, operation onboard an aircraft, ship and satellite.
15.521(b)	Permanent attached antenna, no External radio frequency power amplifiers and antenna modifications are permitted.
15.521(c)	The Digital circuitry portion of the EUT has been tested and verified to comply with 47 CFR Part 15, subpart B.
15.521(d)	Considered
15.521(e)	The f_M, frequency at which the highest radiated emission occurs is contained within the measured UWB bandwidth.
15.521(f)	The EUT is not intended to detection of tags or the transfer or data or voice information.
15.521(g)	Considered
15.521(h)	Considered
15.521(i)	Prohibition in Sections 2.201(f) and 15.5(d) of this chapter against Class B (damped wave) emissions is not applied.
15.521(j)	Battery operating device not connected to AC power lines.
15.521(a)	The EUT is not employed for the operation of toys, operation onboard an aircraft, ship and satellite.

Test Result: **Complies**

Test Data: **NA**

Test No.11

Name of Test:	***Coordination Requirement***	**Test Standard:**	***15.525***
Tested By:	Wei Li	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: The responsible party is properly informed about the required coordination requirement and provide correct information to the customers and users about their specific care and legislative obligations.

(See Important note for the US customers of the Installation Guide and User Manual)

Method of Measurement: (a) UWB imaging systems require coordination through the FCC before the equipment may be used. The operator shall comply with any constraints on equipment usage resulting from this coordination.

(b) The users of UWB imaging devices shall supply operational areas to the FCC Office of Engineering and Technology, which shall coordinate this information with the Federal Government through the National Telecommunications and Information Administration.

(c) The manufacturers, or their authorized sales agents, must inform purchasers and users of their systems of the requirement to undertake detailed coordination of operational areas with the FCC prior to the equipment being operated.

(d) Users of authorized, coordinated UWB systems may transfer them to other qualified users and to different locations upon coordination of change of ownership or location to the FCC and coordination with existing authorized operations.

(e) The FCC/NTIA coordination report shall identify those geographical areas within which the operation of an imaging system requires additional coordination or within which the operation of an imaging system is prohibited.

(f) The coordination of routine UWB operations shall not take longer than 15 business days from the receipt of the coordination request by NTIA.

Test Result:

Test Data: **NA**

Test No. 12

Name of Test:	***Antenna Requirement***	**Test Standard:**	***15.203/204 &RSS-GEN 7.1.4***
Tested By:	WEI LI	**Test Date:**	

Minimum Standard: 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.

Method of Measurement: The antenna utilized by the device under test is an internal, non user replaceable unit.

Test Result: **Complies by using an internal, non user replaceable antenna**

Test Data: **NA**

Test No.13

Name of Test:	***Radio Frequency Exposure***	**Test Standard:**	***FCC OET Bulletin 65 &RSS-GEN***
Tested By:	WEI LI	**Test Date:**	06/24/2022-07/08/2022

Minimum Standard: Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1))
Limits:

From §1.1310 Table 1 (B),
for Public S = 1.0 mW/cm^2
for Professional, S = 5.0 mW/cm^2

Method of Measurement:

d = 0.282 * 10 ^ ((P + G) / 20) / √ S Equation (1)
S = 0.0795 * 10 ^ ((P + G)/10)/ d^2 Equation (2)

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Equation (1) and the measured peak power is used to calculate the MPE distance.
Equation (2) and the measured peak power is used to calculate the Power density.

Test Result:

Test Data: **NA**

Calculation:

For this EUT, max emission level is under the limit set in Section 15.209. No RF hazard need to be concerned.

- Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure

Test No.14

Name of Test:	***Conducted Emissions***	**Test Standard:**	***15.507 &RSS-GEN***
Tested By:	-	**Test Date:**	-

Minimum Standard: 15.507 &RSS-GEN

Limit

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.		

Method of Measurement: Test measurements were made in accordance with ANSI C63.4-2003, Standard Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 9 kHz to 40 GHz.

Spectrum Analyzer Setting:
Frequency Range: 150KHz to 30MHz
RBW: 9KHz
VBW: 30KHz
Detector: Peak/QP/Average

Test Result: **NA**

(The EUT is only powered via a lithium-ion battery which is remotely recharged)

Test Data: **NA**

Test No.15

Name of Test:	***Transmission Duration***	**Test Standard:**	***15.509(c)***
Tested By:	-	**Test Date:**	-

Minimum Standard: 15.509 (c)
A GPR that is designed to be operated while being hand held and a wall imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of a switch located on the imaging system, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator.

Method of Measurement: **NA**

Test Result: **NA**

Test Data: **NA**