Advanced
Compliance Laboratory

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Electromagnetic Emission Compliance Test Report

Equipment Under Test (EUT)	FlexNX
Model	FLEXNX
Applicant	Geophysical Survey Systems, Inc.
In Accordance With	FCC Part 15, Subpart F Industry Canada RSS-220 (Issue 1/2009)
Tested by	Advanced Compliance Laboratory, Inc. 210 Cougar Court Hillsborough, New Jersey 08844
Authorized by	Wei Li Lab Manager Signature 
Date	March 1, 2023
AC Lab Report Number	0048-230201-01-FCC-IC

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: Geophysical Survey Systems, Inc.
Product Name: FlexNX

Model/Parts No. : FLEXNX

S/N: PT-001

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

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& 15.204 &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) &15.519(a)(1)	15	Complies

***** NOT APPLICABLE to the EUT as it is a battery-powered 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: March 1, 2023

Section 2. General Equipment & Test Configuration

2.1. EUT Specification

EUT	FlexNX , Model No.: **FLEXNX** manufactured by Geophysical Survey Systems, Inc. This GPR is an SFCW Radar system intended to be used in non-destructive testing and geophysical surveying.
Supply Voltage	10.8V Smart Li-on Battery
Operating Frequency	Specific Frequency Range: 400MHz to 5160 MHz
-10dB UWB Bandwidth	Normal Operation Mode: 2532.5MHz (from f_L=1642.0MHz to f_H=5174.5MHz)
Modulation Type	SFCW: Stepped CW, Dwell Time 2us, Cycle time 7.2ms
Peak Emissions in a 50 MHz Bandwidth	Max. peak emissions: 66.4dBuV/m (RBW=3MHz) @1760MHz as d=3m i.e 90.8dBuV/m (RBW=50MHz), equivalent to -4.4dBm under 0dBm limit
Antenna	Two Dipole Antenna Pairs
Hardware Version	5.0
Software Version	OS.006/Freqscan 1.50

2.2. Description of Operation

The system performs time domain reflectometry by radiating a radio frequency CW with a cycle frequency of up to 200Hz 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.

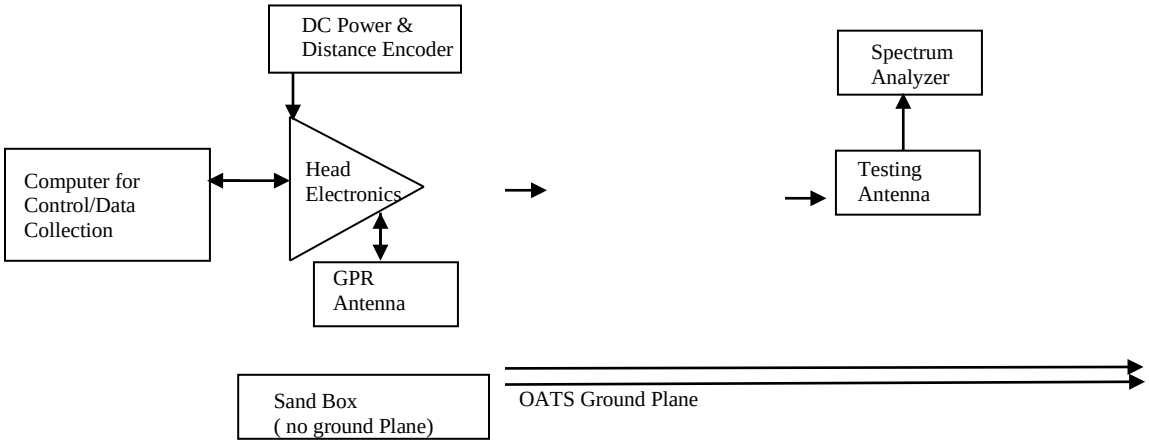
2.3. System Diagram

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:

- CPU Clock : 1.6GHz, 1.26GHz and 266MHz
- Other Clocks: 32.768KHz, 40MHz, 100MHz
- RF antenna center frequencies for TX/RX modulations : 400-5160MHz

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	25/09/23
Agilent	E4440A	US40420700	3Hz-26.5GHz Spectrum Analyzer	17/06/23
EMCO	3104C	9307-4396	20-300MHz Biconical Antenna	15/01/24
EMCO	3146	9008-2860	200-1000MHz Log-Periodic Antenna	15/01/24
EMCO	3115	4945	Double Ridge Guide Horn Antenna	22/01/24

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:	02/01/2023-12/16/2022

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:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	David Tu
Temperature:	65°F
Humidity:	30%

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

Freq. (MHz)	H,V	SA Peak/QP* Reading (dBuV/m)	Height (m)	Angle (degree)	Refer to Part 15.209 10m Limit (dBuV/m)	Margin (dB)	Result
34.5	H	25.1	1.8	180	39.1	-14.0	Pass
150.0	H	26.4	1.8	180	43.5	-17.1	Pass
192.0	H	25.5	1.8	180	43.5	-18.0	Pass
273	H	28.6	1.6	180	46.5	-17.9	Pass
409	H	25.0	1.1	180	46.5	-21.5	Pass
477	H	21.6	1.0	180	46.5	-24.9	Pass
545	H	19.8	1.0	225	46.5	-26.7	Pass
1227.5	H	32.4	1.0	225	49.5	-17.1	Pass
1500	H	32.5	1.0	225	49.5	-17	Pass
1704	H	33.3	1.0	225	49.5	-16.2	Pass
34.5	V	23.6	1.2	000	39.1	-15.5	Pass
142.2	V	23.8	1.2	000	43.5	-19.7	Pass
150.0	V	26.2	1.1	000	43.5	-17.3	Pass
273	V	21.4	1.1	315	46.5	-25.1	Pass
409	V	26.6	1.1	315	46.5	-19.9	Pass
477	V	30.5	1.1	315	46.5	-16.0	Pass
545	V	27.7	1.1	315	46.5	-18.8	Pass
1227.6	V	32.6	1.1	000	49.5	-16.9	Pass
1704	V	33.6	1.1	000	49.5	-15.9	Pass
1901	V	33.5	1.1	000	49.5	-16.0	Pass

Note: Quasi-peak readings will be marked with *. The missions with 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. Distance factor (Radiated field Strength at 10m distance = Radiated field Strength at 3m distance - 10.5 dBuV/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:**	02/01/2023-12/16/2022

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:**	02/01/2023-12/16/2022

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

Cycle Frequency=70Hz SFCW

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: **Cycle Frequency=70Hz SFCW**

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:**	02/01/2023-12/16/2022

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):

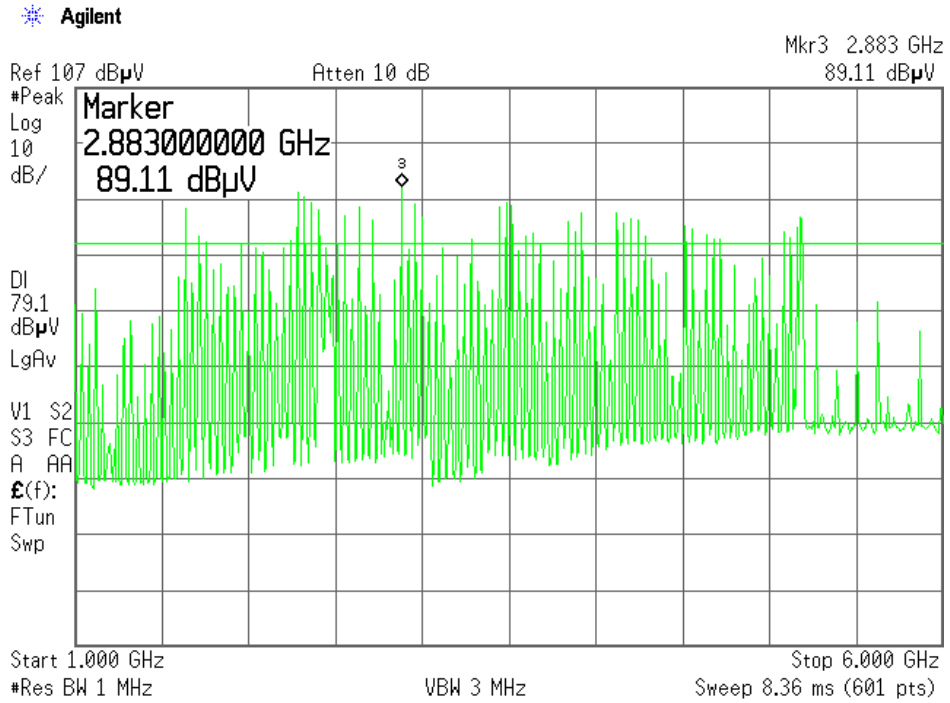
f_M	The highest emission peak	2883
f_L	10 dB below the highest peak	1642
f_H	10 dB above the highest peak	5174.5
f_C	Calculated: $(f_H + f_L)/2$	3408.25
Bandwidth	Calculated: $(f_H - f_L)$	3532.5
Fractional BW	Calculated: $2*(f_H - f_L)/(f_H + f_L)$	2.07

Note: The Fraction Bandwidth is greater than 0.2.

Measurement Plots:

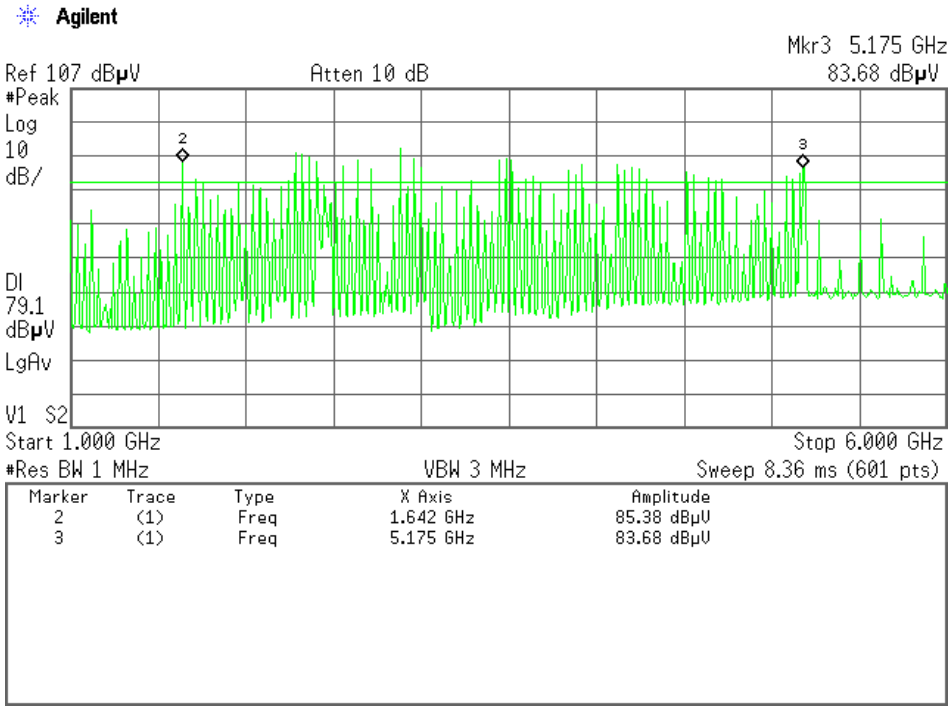
Project Number:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	Wei Li
Temperature:	65°F
Humidity:	30%

Section:	**UWB Bandwidth/ LF Antenna**
Plot Name:	**-10dB UWB Bandwidth in Anechoic Chamber Max Peak**
Configuration:	Stand alone, Continue operation



Project Number:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	Wei Li
Temperature:	65°F
Humidity:	30%

Section:	**UWB Bandwidth**
Plot Name:	**-10dB UWB Bandwidth in Anechoic Chamber Lower edge & Upper Edge**
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:**	02/01/2023-12/16/2022

Minimum Standard: 15.509(b) &RSS-220 6
Operation under the provisions of this section is limited to FLEXNXs 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:**	02/01/2023-12/16/2022

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:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	David Tu
Temperature:	65°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
560	H	28.5	1.0	315	46.0	-17.5	Pass
600	H	30.3	1.0	315	46.0	-15.7	Pass
640	H	29.8	1.0	315	46.0	-16.2	Pass
680	H	32.9	1.0	315	46.0	-13.1	Pass
720	H	35.5	1.0	315	46.0	-10.5	Pass
760	H	36.3	1.0	000	46.0	-9.7	Pass
800	H	35.8	1.0	000	46.0	-10.2	Pass
840	H	28.4	1.0	315	46.0	-17.6	Pass
880	H	30.2	1.0	315	46.0	-15.8	Pass
920	H	29.1	1.0	000	46.0	-16.9	Pass
960	H	29.8	1.0	000	46.0	-16.2	Pass
560	V	28.5	1.1	180	46.0	-17.5	Pass
600	V	30.3	1.1	135	46.0	-15.7	Pass
640	V	29.8	1.1	135	46.0	-16.2	Pass
680	V	32.9	1.1	180	46.0	-13.1	Pass
720	V	35.5	1.1	180	46.0	-10.5	Pass
760	V	36.3	1.1	135	46.0	-9.7	Pass
800	V	35.8	1.1	135	46.0	-10.2	Pass
840	V	28.4	1.1	135	46.0	-17.6	Pass
880	V	30.2	1.1	135	46.0	-15.8	Pass

920	V	29.1	1.1	180	46.0	-16.9	Pass
960	V	29.8	1.1	180	46.0	-16.2	Pass

*Emissions from Digital circuitry (identified in Test No.1 for FCC Part 15 B) shall be excluded.

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:**	02/01/2023-12/16/2022

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:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	David Tu
Temperature:	65°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
1000	H	38	1.0	315	39.4	-1.4	Pass
1040	H	37.5	1.0	315	39.4	-1.9	Pass
1080	H	37.2	1.0	315	39.4	-2.2	Pass
1120	H	37.9	1.0	225	39.4	-1.5	Pass
1160	H	36.7	1.0	225	39.4	-2.7	Pass
1200	H	36.4	1.0	315	39.4	-3	Pass
1240	H	36.1	1.0	225	39.4	-3.3	Pass
1360	H	35.7	1.0	225	39.4	-3.7	Pass
1400	H	35.7	1.0	315	39.4	-3.7	Pass
1440	H	37.4	1.0	315	39.4	-2	Pass
1520	H	36.9	1.0	315	39.4	-2.5	Pass
1560	H	37.8	1.0	315	39.4	-1.6	Pass
1600	H	38.1	1.0	315	39.4	-1.3	Pass
1760	H	47.3	1.0	315	51.4	-4.1	Pass
1800	H	46.5	1.0	315	51.4	-4.9	Pass
1840	H	46.8	1.0	315	51.4	-4.6	Pass
2160	H	45.3	1.0	315	53.4	-8.1	Pass
2440	H	45.9	1.0	315	53.4	-7.5	Pass
2520	H	46.2	1.0	315	53.4	-7.2	Pass

2600	H	46.9	1.0	315	53.4	-6.5	Pass
2680	H	44.8	1.0	315	53.4	-8.6	Pass
2720	H	44.1	1.0	315	53.4	-9.3	**Pass**
2840	H	45.0	1.0	315	53.4	-8.4	Pass
2880	H	43.8	1.0	315	53.4	-9.6	Pass
3640	H	42.3	1.0	315	63.4	-21.1	Pass
4520	H	42.7	1.0	315	63.4	-20.7	Pass
1040	V	37.6	1.1	180	39.4	-1.8	Pass
1080	V	36.2	1.1	180	39.4	-3.2	Pass
1120	V	36.4	1.1	135	39.4	-3	Pass
1160	V	36.4	1.1	135	39.4	-3	Pass
1200	V	37.3	1.1	180	39.4	-2.1	Pass
1240	V	36.6	1.1	180	39.4	-2.8	Pass
1280	V	36.8	1.1	180	39.4	-2.6	Pass
1320	V	37.6	1.1	180	39.4	-1.8	Pass
1360	V	37.8	1.1	180	39.4	-1.6	Pass
1400	V	35.3	1.1	135	39.4	-4.1	Pass
1440	V	37.4	1.1	135	39.4	-2	Pass
1480	V	36.4	1.1	135	39.4	-3	Pass
1560	V	38	1.1	180	39.4	-1.4	Pass
1720	V	46.8	1.1	135	51.4	-4.6	Pass
1760	V	47.0	1.1	180	51.4	-4.4	Pass
1800	V	46.1	1.1	180	51.4	-5.3	Pass
2040	V	46.5	1.1	135	53.4	-6.9	Pass
2160	V	46.0	1.1	135	53.4	-7.4	Pass
2400	V	45.8	1.1	180	53.4	-7.6	Pass
2440	V	46.9	1.1	180	53.4	-6.5	Pass
2560	V	45.2	1.1	180	53.4	-8.2	Pass
2600	V	46.8	1.1	135	53.4	-6.6	Pass
2680	V	45.7	1.1	135	53.4	-7.7	Pass
2760	V	44.5	1.1	180	53.4	-8.9	Pass
2840	V	45.1	1.1	180	53.4	-8.3	Pass
3680	V	43.2	1.1	180	63.4	-20.2	Pass
4600	V	44.6	1.1	180	63.4	-18.8	Pass

*Emissions from Digital circuitry (identified in Test No.1 for FCC Part 15 B) shall be excluded.

** Emissions above 3100MHz has larger margin comparing to the higher limit.

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:**	02/01/2023-12/16/2022

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 MHz BW) (dBm)	Field strength @ 3 meters (1 MHz BW) (dBµV/m)	Field strength @ 1 meters (1 MHz BW) (dBµV/m)
1164-1240	-	19.9	29.4
1559-1610	-	19.9	29.4

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:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	David Tu
Temperature:	65°F
Humidity:	30%

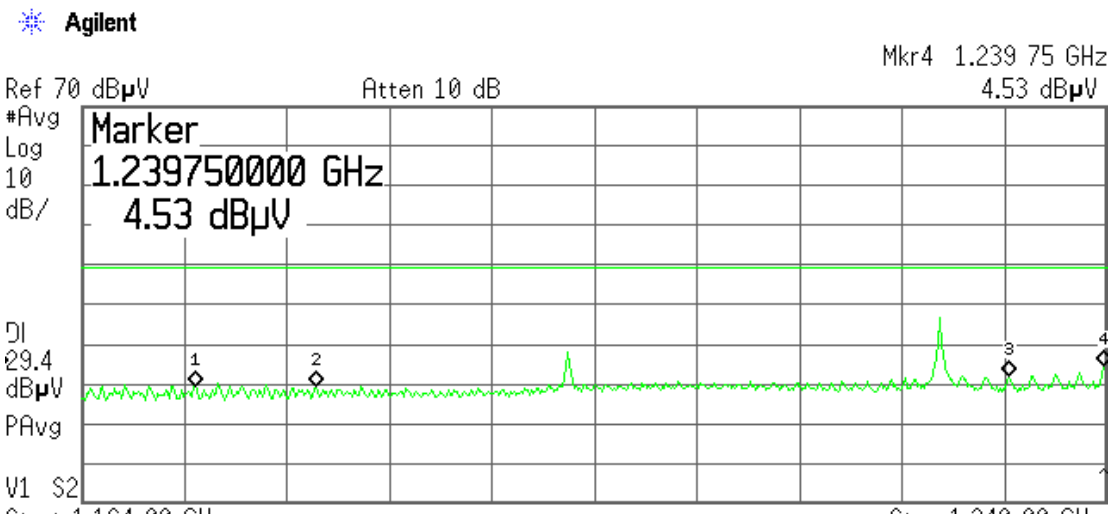
Worst Case Scenario: All maximum Field strength emissions were found at the following test set-up conditions:

Freq. (MHz)	H,V	SA Reading (dBuV/m)	Height (m)	Angle (degree)	1m Limit (dBuV/m)	Margin (dB)	Result
1172	H	-0.49	1.1	315	29.4	-29.89	Pass
1181	H	-0.38	1.1	000	29.4	-29.78	Pass
1232	H	2.00	1.1	315	29.4	-27.40	Pass
1240	H	4.53	1.1	315	29.4	-24.87	Pass
1560	H	-2.07	1.1	315	29.4	-31.47	Pass
1575	H	-2.32	1.1	000	29.4	-31.72	Pass
1597	H	-1.76	1.1	000	29.4	-31.16	Pass
1604	H	-3.87	1.1	315	29.4	-33.27	Pass
1176	V	0.63	1.1	180	29.4	-28.77	Pass
1180	V	-0.17	1.1	180	29.4	-29.57	Pass
1227	V	9.10	1.1	180	29.4	-20.30	Pass
1237	V	5.16	1.1	135	29.4	-24.24	Pass
1563	V	-2.44	1.1	135	29.4	-31.84	Pass
1575	V	-2.02	1.1	135	29.4	-31.42	Pass
1597	V	-1.13	1.1	180	29.4	-30.53	Pass
1605	V	-3.74	1.1	180	29.4	-33.14	Pass

* Digital Circuitry emissions do not fall under the requirements of this section.

Project Number:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	Wei Li
Temperature:	65°F
Humidity:	30%

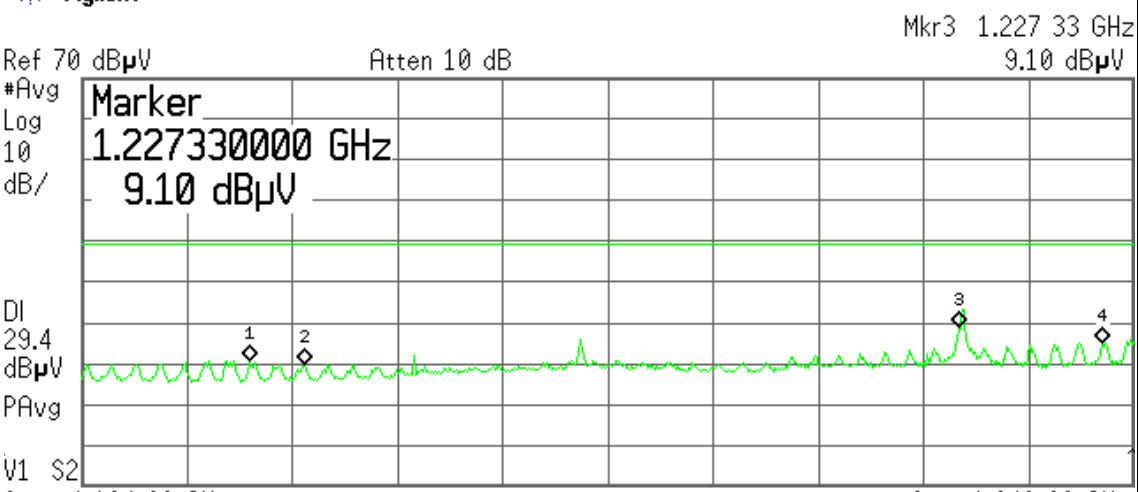
Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1164-1240MHz Band H Polarity**
Configuration:	Stand alone, Continue operation



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	1.172 49 GHz	-0.49 dBµV
2	(1)	Freq	1.181 35 GHz	-0.38 dBµV
3	(1)	Freq	1.232 78 GHz	2.00 dBµV
4	(1)	Freq	1.239 75 GHz	4.53 dBµV

Project Number:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	Wei Li
Temperature:	65°F
Humidity:	30%

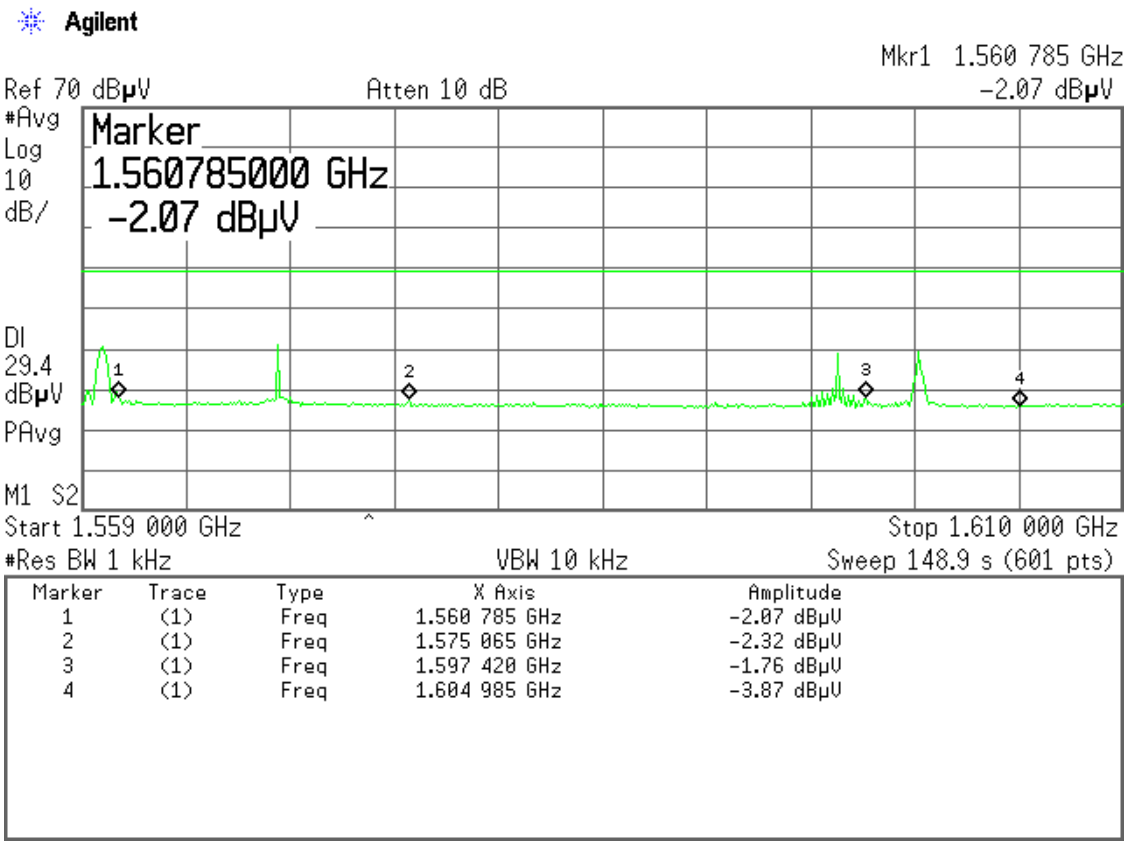
Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1164-1240MHz Band V Polarity**
Configuration:	Stand alone, Continue operation



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	1.176 16 GHz	0.63 dBµV
2	(1)	Freq	1.180 09 GHz	-0.17 dBµV
3	(1)	Freq	1.227 33 GHz	9.10 dBµV
4	(1)	Freq	1.237 72 GHz	5.16 dBµV

Project Number:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	Wei Li
Temperature:	65°F
Humidity:	30%

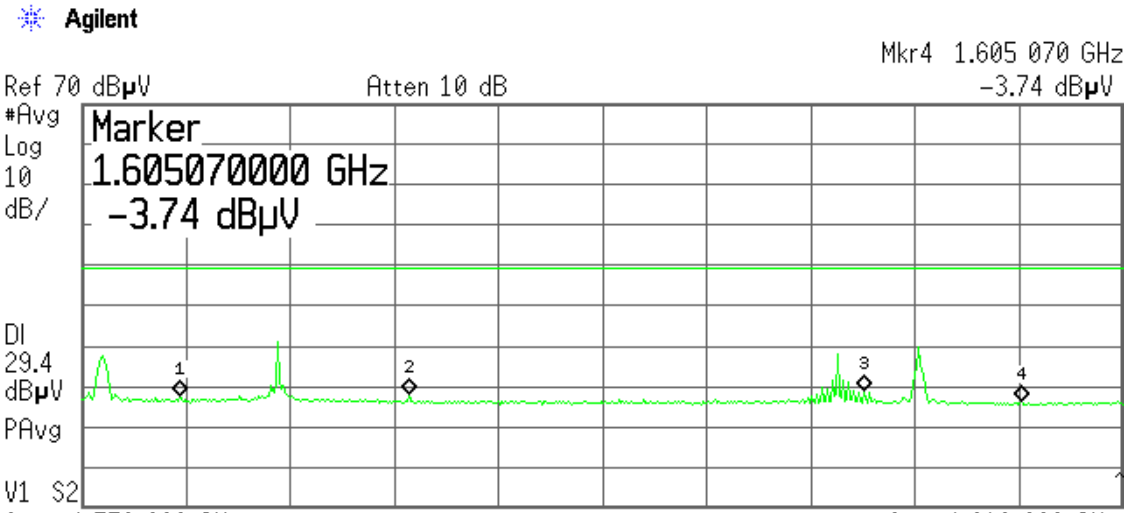
Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1559-1610MHz Band H Polarity**
Configuration:	Stand alone, Continue operation



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	1.560 785 GHz	-2.07 dBµV
2	(1)	Freq	1.575 065 GHz	-2.32 dBµV
3	(1)	Freq	1.597 420 GHz	-1.76 dBµV
4	(1)	Freq	1.604 985 GHz	-3.87 dBµV

Project Number:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	Wei Li
Temperature:	65°F
Humidity:	30%

Section:	***Radiated Emissions in GPS Bands***
Plot Name:	**Radiated Emissions in 1559-1610MHz Band V Polarity**
Configuration:	Stand alone, Continue operation



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	1.563 760 GHz	-2.44 dBµV
2	(1)	Freq	1.575 065 GHz	-2.02 dBµV
3	(1)	Freq	1.597 335 GHz	-1.13 dBµV
4	(1)	Freq	1.605 070 GHz	-3.74 dBµV

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:**	02/01/2023-12/16/2022

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) (dBµV/m)	Field strength limit @ 3 meters (measured with 3 MHz RBW) (dBµV/m)
0	95.2	70.8

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

20 log (3/50)= -24.4 dB. Therefore the 0dBm limit will be converted to -24.4 dBm with 3MHz RBW, i.e 70.8 dBuV/m field strength.

Method of Measurement:

Tested at 3-meter OATS per ANSI C63.4
Spectrum Analyzer Settings:
RBW: 3MHz
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 3 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:

Project Number:	0048-230201-01-FCC-IC
EUT:	FLEXNX
S/N:	PT-001
Tested By:	David Tu
Temperature:	65°F
Humidity:	30%

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

Applicable to Normal Mode:

Freq. (MHz)	H,V	SA Peak Reading At 3 meter (dBuV/m)	RBW	Reading correction		Limit (dBuV/m)	Margin (dB)	Result
1760.0*	V	66.4	3MHz	0		70.8	-4.4	Pass

Test No.10

Name of Test:	***Technical Requirements Applicable to ALL UWB Devices***	**Test Standard:**	***15.521***
Tested By:	WEI LI	**Test Date:**	02/01/2023-12/16/2022

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:**	02/01/2023-12/16/2022

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&15.204 &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: **Complied with 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:	02/01/2023-12/16/2022

LIMITS for FCC RF Exposure Evaluation

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

LIMITS for FCC SAR Evaluation

KDB 447498 D04 Interim General RF Exposure Guidance v01, section 2.1.3 **SAR-Based Exemption: "**A more comprehensive exemption, considering a variable power threshold that depends on both the *separation distance* and power, is provided in § 1.1307(b)(3)(i)(B). This exemption is applicable to the frequency range between 300 MHz and 6 GHz, with *test separation distances* between 0.5 cm and 40 cm, and for all RF sources in fixed, mobile, and portable device exposure conditions**."**

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,
where f(GHz) is the RF channel transmit frequency in GHz

FCC KDB 447498 D01 General RF Exposure Guidance v06, section 4.3.1 & Appendix A provides the SAR Test Exclusion Thresholds (ERP/Conducted) to verify that the device is exempt from 1-g extremity SAR at different separation distances. As example, for 900MHz Tx: 16mW (12dBm); For 2450MHz Tx: 10mW (10dBm) at ≤5 mm.

Details in calculation formula for reference, given in § 1.1307(b)(3)(i)(B) to calculate the exemption:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\,cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\,cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\,cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\,cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

LIMITS per ISED RSS-102, Section 2.5 & Table 1

Per 2.5.1 Exemption Limits for Routine Evaluation — SAR Evaluation

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance[4,5]

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

Example: Exclusion Thresholds to verify that the 2450MHz Tx is exempt from 1-g SAR at separation distance of ≤5 mm: 4mW (6dBm) & 10-g SAR at separation distance of ⩽5 mm: 10mW (10dBm).

Per 2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:
• below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
• at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
• at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
• at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
• at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Summary

For FCC and IC, that max. declared power level can be modified by any duty cycle over the time averaging period. Time-averaging period is a time period not to exceed 30 minutes for fixed RF sources or a time period inherent from device transmission characteristics not to exceed 30 minutes for mobile and portable RF sources.

For rf exposure, the averaging period is 6 minutes for ISED Canada and for FCC it varies by frequency but 1~60 second for RF exposure or the period specified by product design spec. for RF exposure can be used.

So the power value for RF exposure= Declared power x Duty Cycle factor

CALCULATIONS for MPE distance and Power Density

Given

$E = \sqrt{(30 * P * G) / d}$

and

$S = E \wedge 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using: P(mW) = P (W) / 1000 and d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$

$$d = 0.282 * \sqrt{(P * G / S)}$$

where
d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using: P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)
yields

$$d = 0.282 * 10 \wedge ((P + G) / 20) / \sqrt{S}$$ Equation (1)
$$S = 0.0795 * 10 \wedge ((P + G)/10)/ d\wedge 2$$ 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 Output power is used to calculate the MPE distance.
Equation (2) and the measured Output power is used to calculate the Power density.

APPLICABLE LIMITS

RF Exposure for separation >= 20cm

FCC: From §1.1310 Table 1 (B), for Public S = 1.0 mW/cm^2 ; for Professional, S = 5.0 mW/cm^2
IC: With formula of 1.31 x 10^{-2} $f^{0.6834}$ W, more restricted EIRP limit value are 1.37W at 902MHz, 2.67W at 2400MHz.

SAR Exclusion Thresholds for separation ≤5~40cm:

FCC : Use Formular in FCC § 1.1307(b)(3)(i)(B) & KDB 447498 D04
IC: Use RSS-102 Table1
Apply duty cycle factor & 2.5 factor for extremity or limb-worn devices

RESULTS

No non-compliance noted.

For GPR UWB Transmitter:

1-mW Test Exemption:
Per § 1.1307(b)(3)(i)(A), a single RF source is exempt RF device (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions.

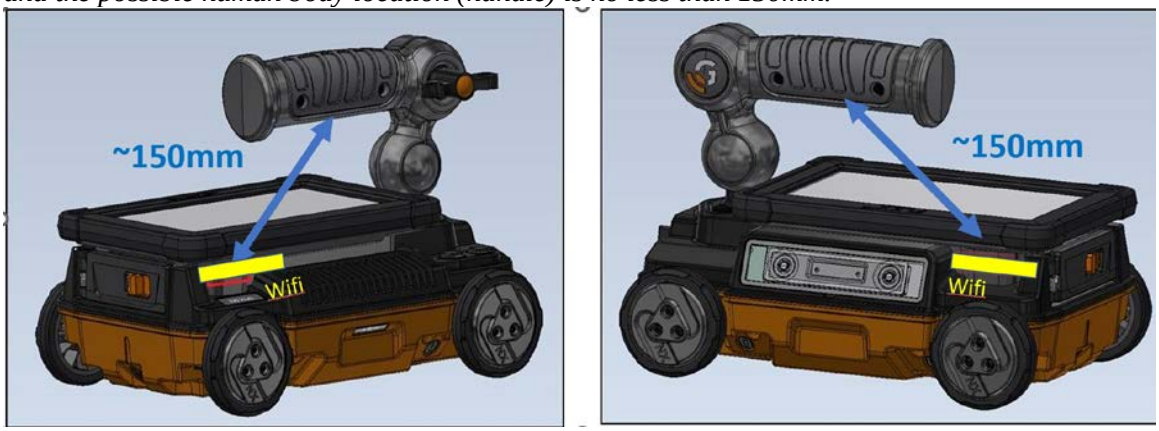
For this EUT, max emission level is under the 0dBm limit set in Part 15F: -4.4dBm (0.363mW). No RF hazard need to be concerned.

For WiFi Transmitter:
with Hand-held /limb-worn usage: **SAR Exemption Evaluation** (2.5 factor with 10-g extremity SAR)

WiFi Module Information:
Chip Module: Marvell / NXP/ W8997-M1216/FCC ID: UAY-W8997-M1216
Modular: AzureWave /AW-CM276NF with max. RF power: 18.5dBm at 2.4GHz band, 15dBm at 5GHz band.
Antenna: Molex /2042811100 / 2.562dBi for 2.4GHz band & 3.904dBi for 5GHz band.
Max. duty cycle factor is close to 100%.

Minimum separation distance: 150mm (15cm).

On FlexNX, the WIFI module uses the AzureWave AW-CM276NF wireless module which comes with Apalis iMX8 module.
AW-CM276NF is 2x2 MU-MIMO Wlan&BT module which adopts NXP SOC-88W8997.
There are two Wifi antennas (Molex 2042811300) are inside FlexNX, they are inside and at two front-side of the module (shown as the following diagram), the distance between the Wifi antenna and the possible human body location (handle) is no less than 150mm.



Worst Case Scenario: GPR and WiFi Transmitting Simultaneously

	GPR	WiFi 2.4G	WiFi 5GHz	GPR+WiFi 2.4G	GPR+WiFi 5G
Frequency (MHz)	400-5160	2.4GHz Band	5GHz Band		
Antenna Gain		2.562	3.904		
Conducted Power (dBm)		18.5	15		
EIRP (dBm/mW)	-4.4/ 0.363	21.062/127.7	18.904 /77		
Total Combined Power (mW)				**128.063mW**	**77.363mW**

---For FCC:
Using the formula in 1.1307(b)(3)(i)(B), ERP_{20cm}=3060mW, min. $x=-\log_{10}(60/(3060\sqrt{2.4}))=1.9$ corresponding to the lowest frequency of 2.4GHz & 5GHz bands.
Then the most restricted P_{th}= 3060 $(15/20)^{1.9}$=1771mW.

The max. combined power of the EUT is 128.063mW for GPR+ WiFi 2.4G mode, which is under calculated P_{th}. So the SAR test exclusion condition is met.

--- For IC:
With the max. combined power calculated above, considering a factor of 2.5 for 10-g extremity SAR, the power value used to compare Table 1 threshold is

128.063/2.5=51.23mW for 2.4GHz Band, which is under the limit of 309mW at separation distance of ≥50mm.

77.363/2.5=30.95mW for 5GHz Band, which is under the limit of 106mW at separation distance of ⩾50mm.

Conclusion: This module is used limited portable application (Handheld/limb-worn) with minimum 15mm separation distance from antenna to user's hand/wrist, which meets the requirement for SAR test exclusion.

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)& 15.519(a)(1)***
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.

15.519(a)(1)---for hand held UWB Systems
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.

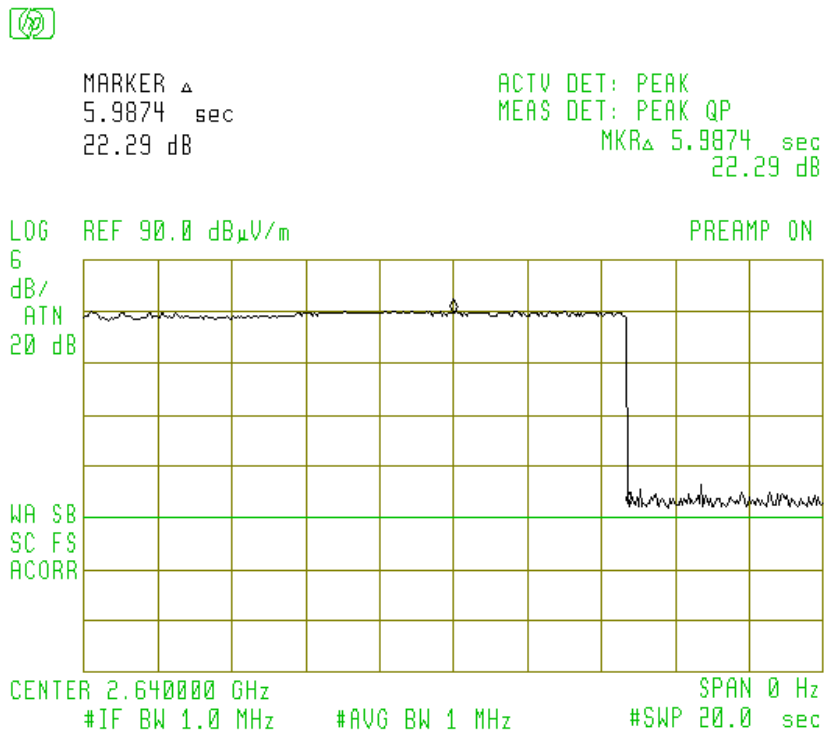
Method of Measurement: Functional Check

Test Result: **Complies**

Test Data: De-activation takes place within 10 seconds of the control system being switched off/not active or released by the operator or an acknowledgment of reception was received by the UWB intentional radiator within 10 seconds. Procedure is documented in operational description manual.

Project Number:	0048-230201-01
EUT:	FlexNX
S/N:	PT-001
Tested By:	Wei Li
Temperature:	65°F
Humidity:	30%

Section:	***Transmission Duration***
Plot Name:	**Transmission Duration with Switch Control (worst case)**
Configuration:	Stand alone, Software Control or Power Switch (worst case)



De-activation takes place within 10 second of the control system being released by the operator or Software command.