



COMPLIANCE WORLDWIDE INC. TEST REPORT 283-18R2

In Accordance with the Requirements of

**Federal Communications Commission 47 CFR Part 15, Subpart F
Technical Requirements for Ground Penetrating Radar Systems**

Issued to

**Utsi Electronics Ltd
Glenmore Business Park
Ely Road, Unit 26
Waterbeach, Cambridge CB25 9PG**

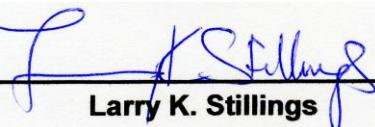
For the

**Ground Penetrating Radar
Groundvue 3_1
Model: GV3_1**

FCC ID: 2AQLZGV3-1-400

**Report Issued on July 17, 2018
Revision R2 Issued on September 14, 2018**

Tested by



Larry K. Stillings

Reviewed By



Brian F. Breault

This test report shall not be reproduced, except in full, without written permission from Compliance Worldwide, Inc.

Table of Contents

1. Scope.....	3
2. Product Details.....	3
3. Product Configuration.....	3
3.1. Operational Conditions.....	3
3.2. EUT Hardware	3
3.3. EUT Cables	3
3.4. Support Equipment	4
3.5. Test Setup Diagram	4
4. Measurements Parameters	5
4.1. Measurement Equipment to Perform the Test.....	5
4.2. Measurement & Equipment Setup.....	5
4.3. Measurement Procedures	6
4.4. Measurement Uncertainty	6
5. Measurements Summary	7
6. Measurement Data.....	8
6.1. Antenna Requirement	8
6.2. Operational Requirements	8
6.3. UWB Bandwidth.....	8
6.4. Spurious Radiated Emissions	11
6.5. Radiated Emissions in GPS Bands	17
6.6. Peak Emissions in a 50 MHz bandwidth.....	20
6.7. Conducted Emissions Setup	22
6.8. Conducted Emissions Test Data	23
6.9. Public Exposure to Radio Frequency Energy Levels.....	25
7. Test Site Description	26
8. Test Images	27
8.1. Spurious Emissions – 30 MHz – 960 MHz (Front).....	27
8.2. Spurious Emissions – 30 MHz – 960 MHz (Rear)	28
8.3. Spurious Emissions – 960 MHz - 18 GHz (Front).....	29
8.4. Spurious Emissions – 960 MHz - 18 GHz (Rear)	30
8.5. Conducted Emissions – (Front).....	31
8.6. Conducted Emissions – (Rear)	32

Test Number: 283-18R2

Issue Date: 9/4/2018

1. Scope

This test report certifies that the Utsi Electronics Ltd, Model Groundvue 3_1, as tested, meets the FCC Part 15, Subpart F requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required. Revision R1 updates the RF Exposure in Section 6.9 to include the WiFi Module. Revision R2 adds the requirements of 15.509 (a) to section 6.3.

2. Product Details

2.1. Manufacturer:	Utsi Electronics, Ltd
2.2. Model Number:	GV3_1
2.3. Serial Number:	132_002
2.4. Description:	Ground Penetrating Radar
2.5. Power Source:	12VDC Battery Powered
2.6. Hardware Revision:	N/A
2.7. Software Revision:	N/A
2.8. Modulation Type:	20 to 80 nS Impulse
2.9. Operating Frequency:	400 MHz Nominal, (WiFi Module 2.4 & 5 GHz)
2.10. EMC Modifications:	None

3. Product Configuration

3.1 Operational Characteristics & Software

1. Turn on the laptop.
2. Turn on the Groundvue 3_1 antenna and allow the unit to boot up.

Software Setup:

1. After boot up of the laptop start the unit scanning using the control software.

3.2. EUT Hardware

Manufacturer	Model	Serial Number	Description/Function
UTSI Electronics	GV3_1	132_002	GPR 400 MHz Antenna
Mascot	2241	N/A	Power Supply for Charging batteries
B plus B SmartWorx	9373	000B280DF4FD	WiFi Module FCC ID: F4AWLNN551

3.3. EUT Cables/Transducers

Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
Any	Ethernet	1	Y	Remote communications to Laptop when not using WiFi
Any	Wheel	1	N	Marking wheel interface
Any	GPS In/Out	2	Y	DB-9 & PS2 type connection for external GPS Interface

Test Number: 283-18R2

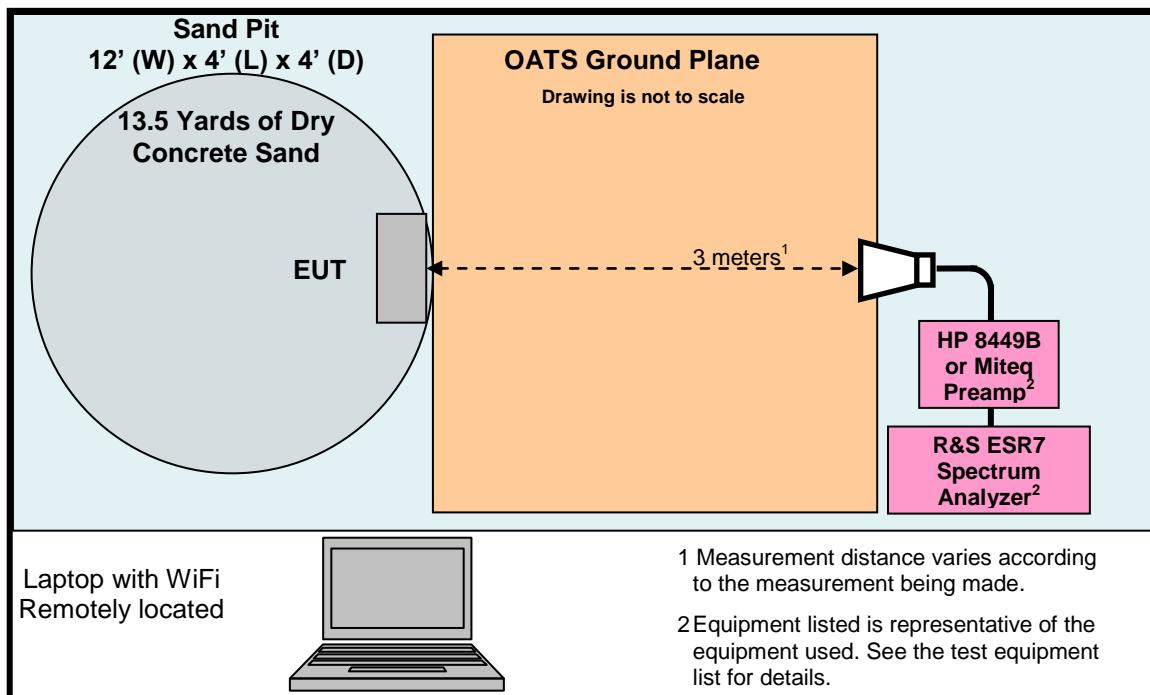
Issue Date: 9/4/2018

3. Product Configuration (continued)

3.4. Support Equipment

Laptop

3.5. Test Setup Diagram



Test Number: 283-18R2

Issue Date: 9/4/2018

4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Cal Interval
EMI Test Receiver, 9kHz - 7GHz	Rohde & Schwarz	ESR7	101156	7/23/2018	3 Year
Spectrum Analyzer	Rohde & Schwarz	FSV40	100899	7/23/2018	3 Year
Microwave Preamp	Hewlett Packard	8449B	3008A01323	7/23/2018	3 Year
Preamp 100 MHz – 7 GHz	Miteq	AFS3-01000200-10-15P-4	988773	4/17/2019	1 Year
Bilog Antenna 30 to 2000 MHz	Com-Power	AC-220	25509	5/12/2019	3 Year
Horn Antenna 960 MHz to 18 GHz	Electro-Metrics	EM-6961	6337	5/2/2019	3 Year
Barometer – Temperature & Humidity	Control Company	4195	ID236	4/3/2020	2 Year

¹ ESR7 Firmware revision: V2.28,SP1 Date installed: 9/2/2016 Previous V2.26, installed 8/15/2014.

² FSV40 Firmware revision: V2.30 SP4, Date installed: 5/4/2016 Previous V2.30 SP1, installed 10/22/2014.

4.2. Measurement & Equipment Setup

Test Date:	7/2/2018, 7/3/2018
Test Engineer:	Larry Stillings
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 - 75%RH):	35
Frequency Range:	30 MHz to 6 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	120 kHz - 30 MHz to 960 MHz 1 MHz - Above 960 MHz
EMI Receiver Avg Bandwidth:	300 kHz - 30 MHz to 960 MHz 3 MHz - Above 960 MHz
Detector Function:	Peak, Quasi-Peak, EMI Average and RMS Average

Test Number: 283-18R2**Issue Date: 9/4/2018**

4. Measurements Parameters (continued)

4.3. Measurement Procedures

Test measurements were made in accordance FCC Part 15.509, 15.521, IC RSS-220 Issue I, RSS-Gen, Issue 4, ANSI C63.10:2013 Clause 10 and KDB Publication 393764 D01 UWB FAG v01, dated July 31, 2015.

The test methods used to generate the data in this test report is in accordance with ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of 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 (per 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.

4.4. Measurement Uncertainty

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

RF Frequency (out of band)	$\pm 1 \times 10^8$
Radiated Emission of Transmitter to 10 GHz	± 4.55 dB
Radiated Emission of Receiver	± 4.55 dB
Temperature	$\pm 0.91^\circ$ C
Humidity	$\pm 5\%$

Test Number: 283-18R2**Issue Date: 9/4/2018**

5. Measurements Summary

Test Requirement	FCC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	6.1	Compliant	The antenna is housed within a sealed enclosure with the intentional radiator.
Operational Requirements	15.509 (b)	6.2	Compliant	
UWB Bandwidth	15.503 (a) 15.509 (a)	6.3	Compliant	
Spurious Radiated Emissions	15.509 (d) 15.209	6.4	Compliant	
Radiated Emissions in GPS Bands	15.509 (e) 15.209	6.5	Compliant	
Peak Emissions in a 50 MHz Bandwidth	15.509 (f)	6.6	Compliant	
Conducted Emissions	15.207	6.7 6.8	Compliant	EUT is battery powered, tested with charger
Radio Frequency Exposure	FCC OET Bulletin 65	6.9	Compliant	

Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data

6.1. Antenna Requirement (15.203)

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply

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

6.2. Operational Requirements of the Device under Test (15.509 (b))

Requirement: 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.

Result: The manufacturer states that the device under test complies with the requirements outlined in section FCC Part 15.509 (b).

6.3. UWB Bandwidth (15.503 (a), 15.509 (a))

Requirement: The UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, 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 $2 * (f_H - f_L) / (f_H + f_L)$.

Result: Compliant, see plots on the next page

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

Result: Compliant, the highest frequency (f_H) of the 10 dB BW is below 10.6 GHz, see the plot and table on the next page.

Test Number: 283-18R2
Issue Date: 9/4/2018

6. Measurement Data (continued)

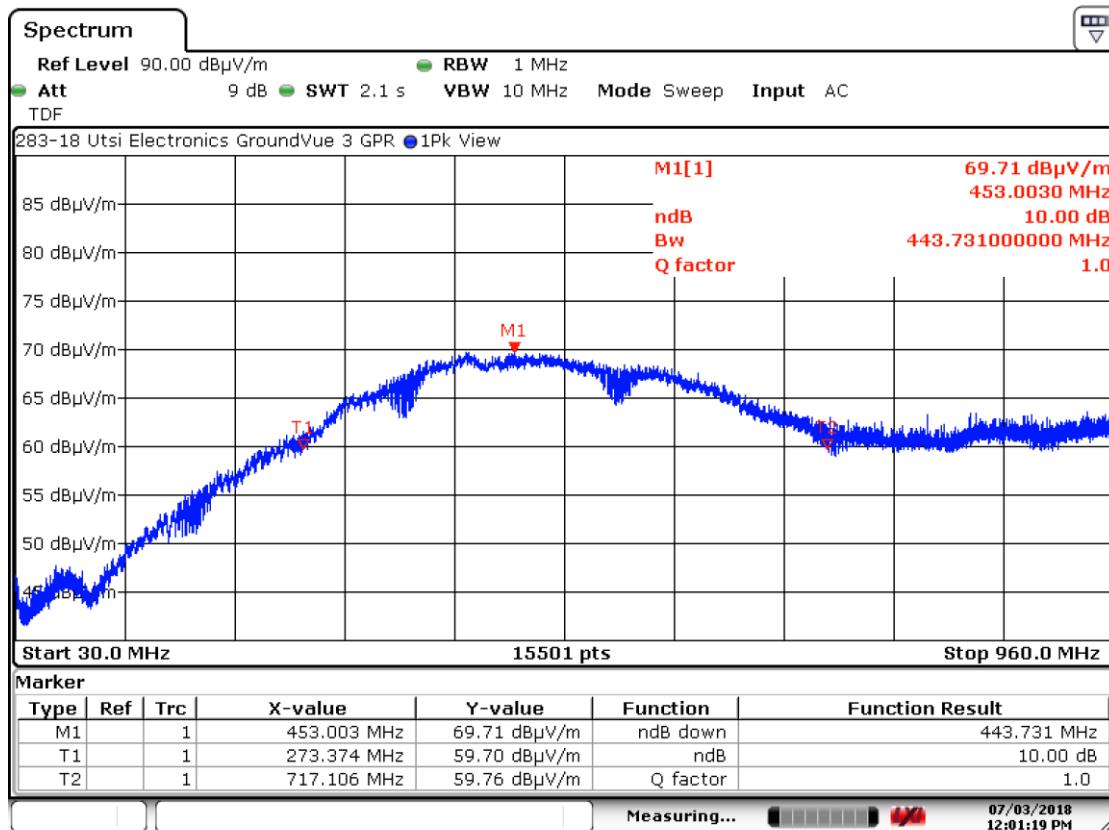
6.3. UWB Bandwidth (15.503 (a)) (continued)

6.3.1. Measurement Data (Values in GHz)

f_M	The highest emission peak	0.453003
f_L	10 dB below the highest peak	0.273374
f_H	10 dB above the highest peak	0.717106
f_C	Calculated: $(f_H + f_L)/2$	0.495240
Bandwidth	Calculated: $(f_H - f_L)$	0.443732
Fractional BW	Calculated: $2*(f_H - f_L)/(f_H + f_L)$	0.895994

Note: The Fraction Bandwidth is greater than 0.2 and therefore the minimum UWB Bandwidth of 500 MHz requirement does not need to be met.

6.3.2. Measurement Plot of 10 dB BW in Anechoic Chamber = 443.731 MHz



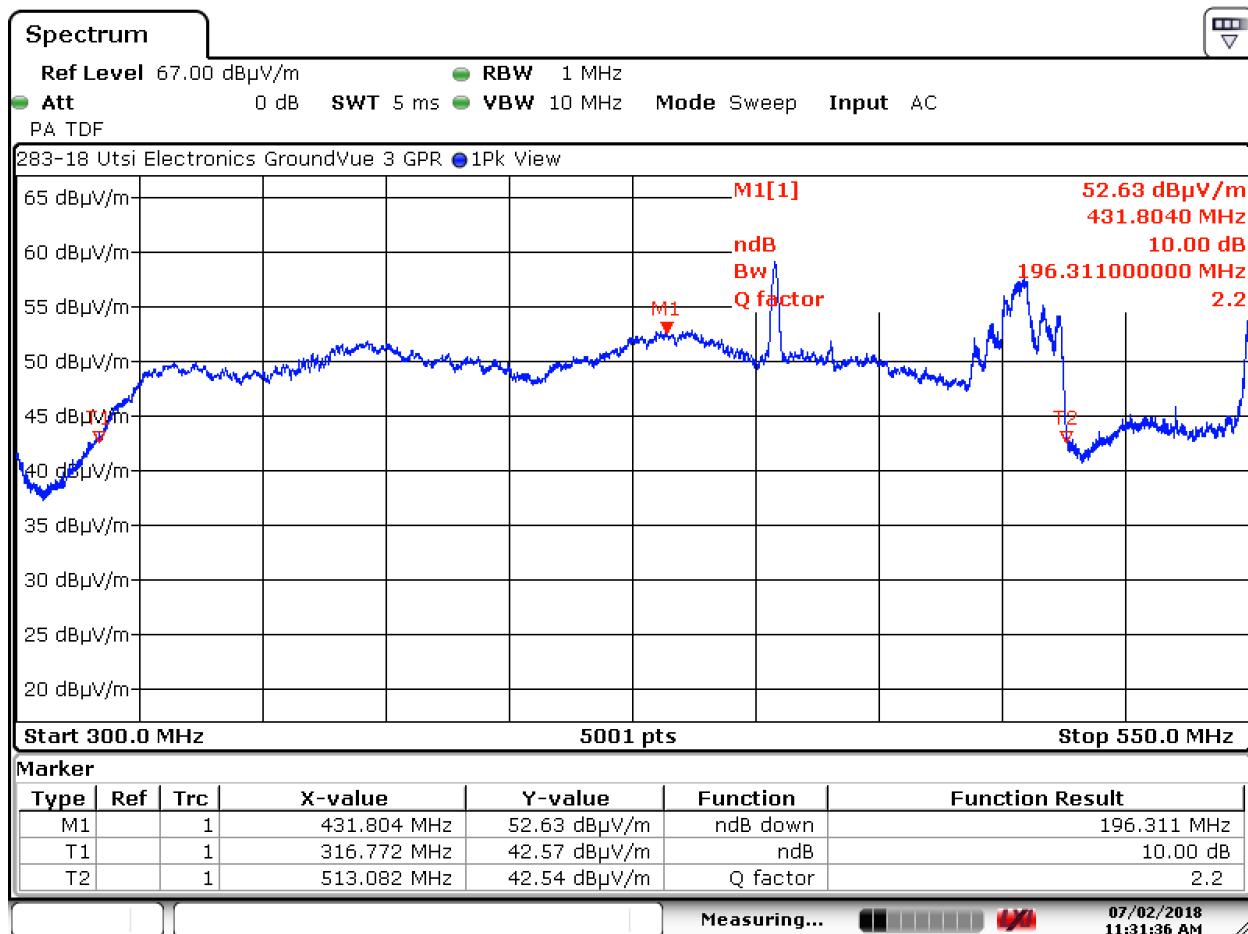
Date: 3.JUL.2018 12:01:16

Test Number: 283-18R2
Issue Date: 9/4/2018

6. Measurement Data (continued)

6.3. UWB Bandwidth (15.503 (a)) (continued)

6.3.3. Measurement Plot of 10 BW on GPR Site = 196.311 MHz



Date: 2.JUL.2018 11:31:33

Test Number: 283-18R2**Issue Date: 9/4/2018**

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209)

Requirement: The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209. 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 are converted from EIRP (dBm) to field strength at 3 meters using a conversion factor of 95.2.

Frequency (MHz)	EIRP (dBm)	Field Strength (dB μ V/m)
960 - 1610	-65.3	29.9
1610 - 1990	-53.3	41.9
1990 - 3100	-51.3	43.9
3100 - 10600	-41.3	53.9
Above 10600	-51.3	43.9

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

Frequency (MHz)	Field Strength (dB μ V/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0

Test Notes: Refer to Section 4.1 for the test equipment used and Section 4.2 for the test equipment setups.

Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209 continued)

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

Frequency (MHz)	Amplitude (dB μ V/m)		Limit (dB)	Margin (dB)	Polarity (H/V)	Antenna Height (cm)	Azimuth (Dev.)
	Peak	Quasi-Peak					
128.04	33.75	31.30	43.5	-12.20	H	225	0
139.07	34.34	30.96	43.5	-12.54	H	225	0
170.48	38.32	35.37	43.5	-8.13	H	300	0
186.74	40.57	37.29	43.5	-6.21	H	300	0
189.86	43.15	38.68	43.5	-4.82	H	300	0
206.13	35.05	32.69	43.5	-10.81	H	200	0
210.88	37.77	33.18	43.5	-10.32	H	200	0
255.46	41.56	37.17	46.0	-8.83	H	150	0
278.93	41.52	37.50	46.0	-8.50	H	200	0
286.67	41.57	38.44	46.0	-7.56	H	200	0
329.98	46.84	42.59	46.0	-3.41	H	200	0
360.45	45.74	44.17	46.0	-1.83	H	200	0
377.62	46.73	43.22	46.0	-2.78	H	200	0
391.92	46.60	41.94	46.0	-4.06	H	200	0
420.63	47.38	43.90	46.0	-2.10	H	200	0
436.99	48.09	44.78	46.0	-1.22	H	200	0
486.09	46.21	44.71	46.0	-1.29	H	200	0
541.88	42.42	40.50	46.0	-5.50	H	250	0
668.01	40.20	36.73	46.0	-9.27	H	250	0
712.30	41.55	38.43	46.0	-7.57	H	250	0
716.15	41.54	39.74	46.0	-6.26	H	250	0
811.38	33.91	28.98	46.0	-17.02	H	250	0
894.09	35.50	31.62	46.0	-14.38	H	275	0

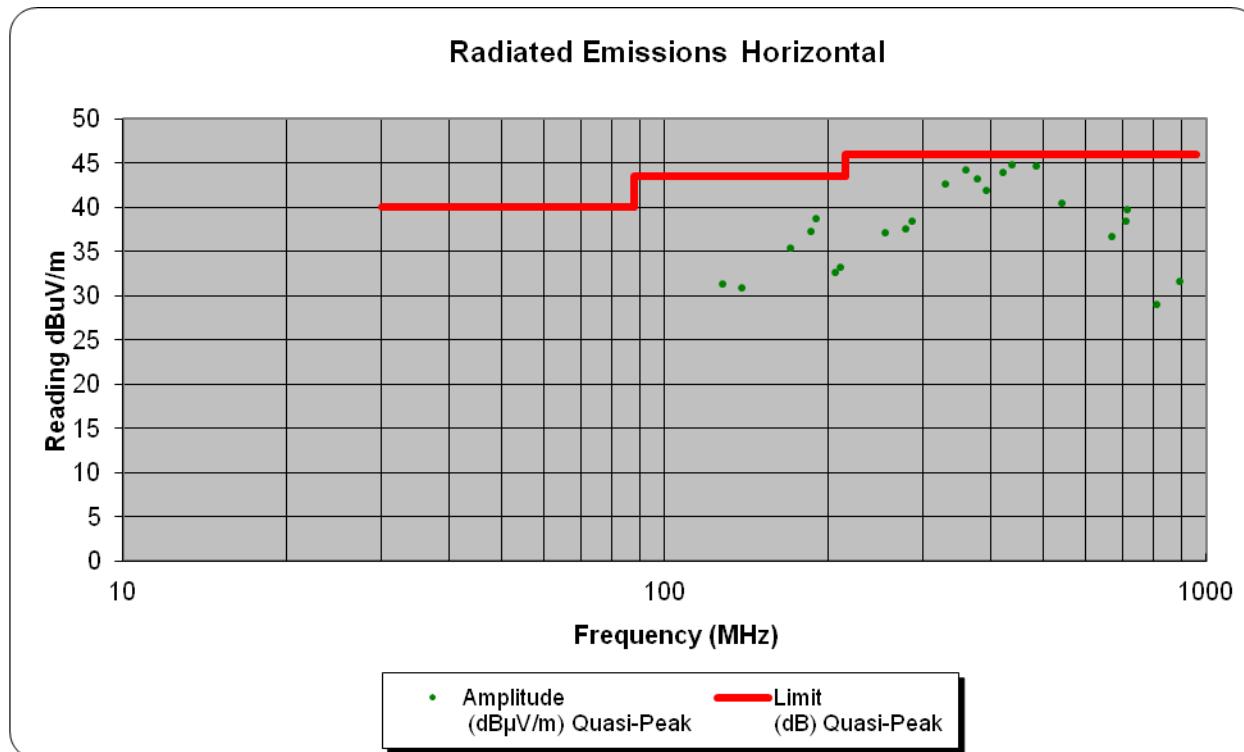
Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209 continued)

6.4.2. 30 MHz to 960 MHz, Horizontal Plot



Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209 continued)

6.4.3. 30 MHz to 960 MHz, Vertical measured at 3 Meters

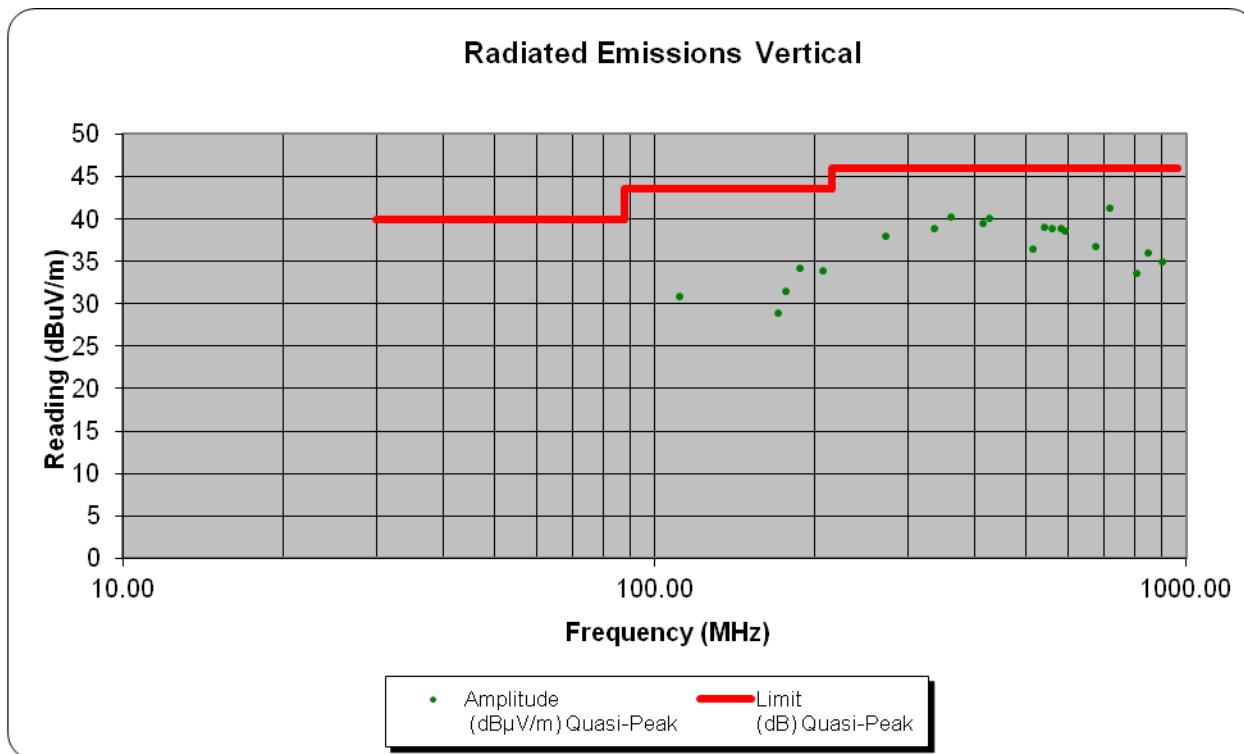
Frequency (MHz)	Amplitude (dB μ V/m)		Limit (dB)	Margin (dB)	Polarity (H/V)	Antenna Height (cm)	Azimuth (Dev.)
	Peak	Quasi-Peak					
111.36	34.86	30.83	43.5	-12.67	V	125	45
170.31	31.51	28.83	43.5	-14.67	V	125	45
176.14	33.05	31.51	43.5	-11.99	V	125	45
187.72	37.62	34.17	43.5	-9.33	V	125	45
206.94	37.28	33.87	43.5	-9.63	V	100	45
271.54	37.96	37.97	46.0	-8.03	V	100	45
336.49	42.77	38.88	46.0	-7.12	V	100	45
360.49	41.03	40.29	46.0	-5.71	V	100	45
414.95	42.46	39.52	46.0	-6.48	V	100	45
425.33	43.40	40.08	46.0	-5.92	V	100	45
514.51	40.38	36.46	46.0	-9.54	V	100	45
541.90	40.39	39.02	46.0	-6.98	V	100	45
557.38	42.02	38.80	46.0	-7.20	V	100	45
579.93	41.06	38.85	46.0	-7.15	V	100	45
590.33	39.69	38.61	46.0	-7.39	V	100	45
674.81	41.01	36.83	46.0	-9.17	V	100	45
718.05	42.61	41.32	46.0	-4.68	V	100	45
804.22	38.54	33.57	46.0	-12.43	V	100	45
847.03	38.74	36.06	46.0	-9.94	V	100	45
899.99	35.85	35.02	46.0	-10.98	V	100	45

Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)**6.4. Spurious Radiated Emissions (15.209 continued)**

6.4.4. 30 MHz to 960 MHz, Vertical Plot



Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d))

6.4.5. 960 MHz to 4 GHz at 3 meters

6.4.5.1 Data Table of 960 MHz to 1.6 GHz RMS Power

Freq. (MHz)	Amplitude (dB μ V/m) RMS	Corr. Factor (dB)	Amplitude (dB μ V/m) RMS	Limit (dB μ V/m)	Margin (dB)	Pol (H/V)	El. (cm)	Az. (deg)
961.50	29.86	Included	29.86	29.90	0.04	H	100	0
966.50	29.40	Included	29.40	29.90	0.50	H	100	0
1074.00	29.77	Included	29.77	29.90	0.13	H	100	0
1077.00	29.50	Included	29.50	29.90	0.40	H	100	0
1083.00	29.24	Included	29.24	29.90	0.66	H	100	0
1104.00	29.38	Included	29.38	29.90	0.52	H	100	0
1136.00	29.37	Included	29.37	29.90	0.53	H	100	0
1199.00	27.79	Included	27.79	29.90	2.11	H	100	0
969.50	29.05	Included	29.05	29.90	0.85	V	150	90
973.50	29.32	Included	29.32	29.90	0.58	V	150	90
1036.40	28.85	Included	28.85	29.90	1.05	V	150	90
1049.40	29.08	Included	29.08	29.90	0.82	V	150	90
1186.30	28.56	Included	28.56	29.90	1.34	V	150	90
1264.20	26.33	Included	26.33	29.90	3.57	V	150	90
1587.80	23.26	Included	23.26	29.90	6.64	V	150	90

Notes: Using: 1 MHz RBW / 10 MHz VBW and 1mS/MHz RMS Average Detector.

There were no other measurable emissions between 1.6 to 6 GHz.

Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)

6.5. Spurious Radiated Emissions in GPS Bands (15.509 (e))

Requirement: In addition to the radiated emission limits specified in the table in paragraph (d) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	EIRP (dBm)	Field Strength (dB μ V/m) at 3 Meters
1164 - 1240	-75.3	19.9
1559 - 1610	-75.3	19.9

6.5.1. Measurement & Equipment Setup

EMI Receiver IF Bandwidth: 1 kHz
EMI Receiver Avg Bandwidth: 10 kHz
Detector Function: RMS

6.5.2. Test Procedure

Test measurements were made in accordance with ANSI C63.10:2013, American National Standard for Testing Unlicensed Wireless Devices.

6.5.3. 1164 to 1240 MHz & 1559 to 1610 MHz

There were no broadband emissions related to the UWB transmitter. Measured signals were narrowband and related to the microprocessor / clocks and do not fall under the requirements of this section. Measurements were made at 3 Meters and the -75.3 dBm limit was converted to a field strength limit of 19.9 dB μ V/m using a distance correction factor of 95.2.

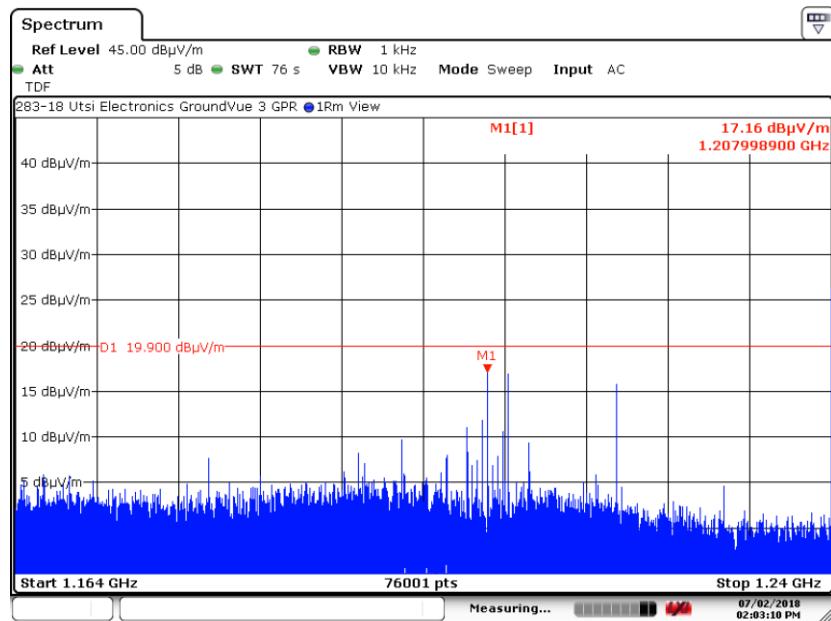
Test Number: 283-18R2

Issue Date: 9/4/2018

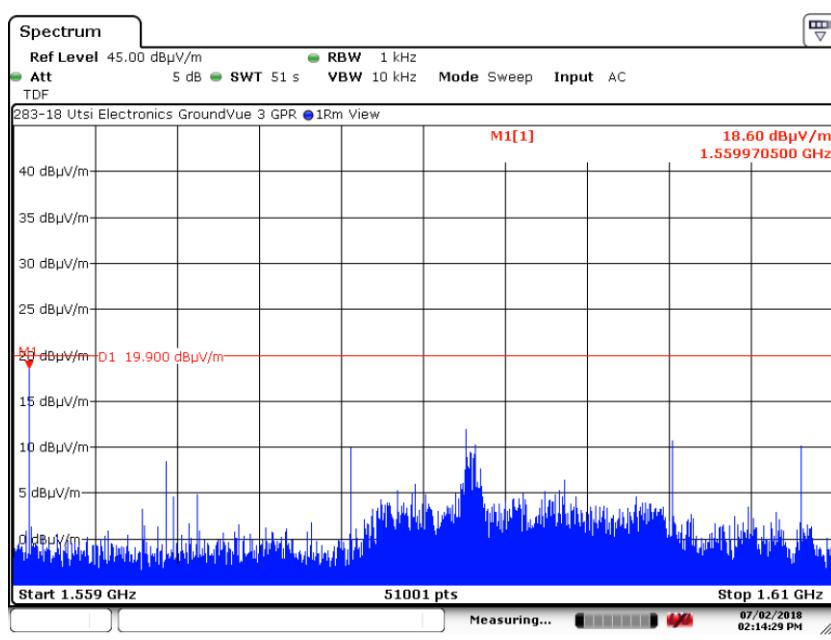
6. Measurement Data (continued)

6.5.4 Spurious Radiated Emissions in GPS Bands (15.509 (e) continued)

6.5.4.1 1164 to 1240 MHz - Horizontal



6.5.4.2 1559 to 1610 MHz - Horizontal



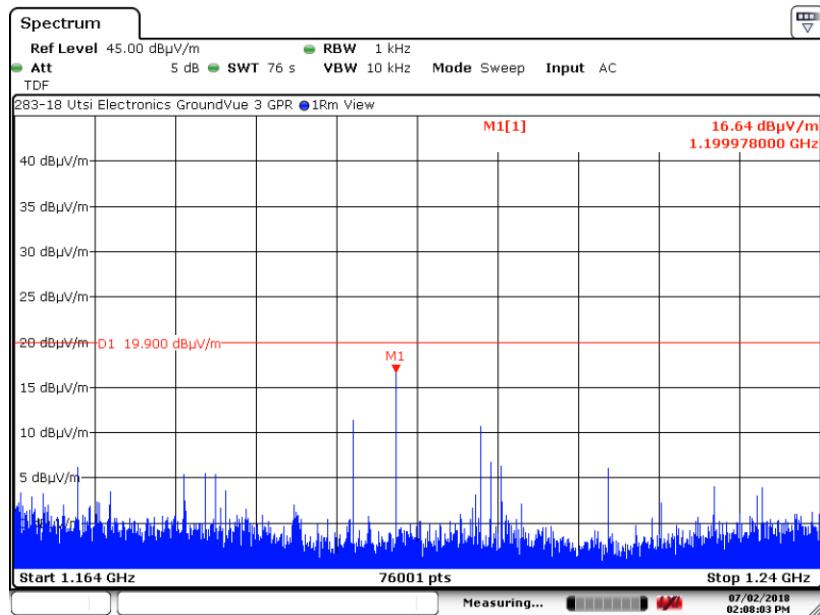
Test Number: 283-18R2

Issue Date: 9/4/2018

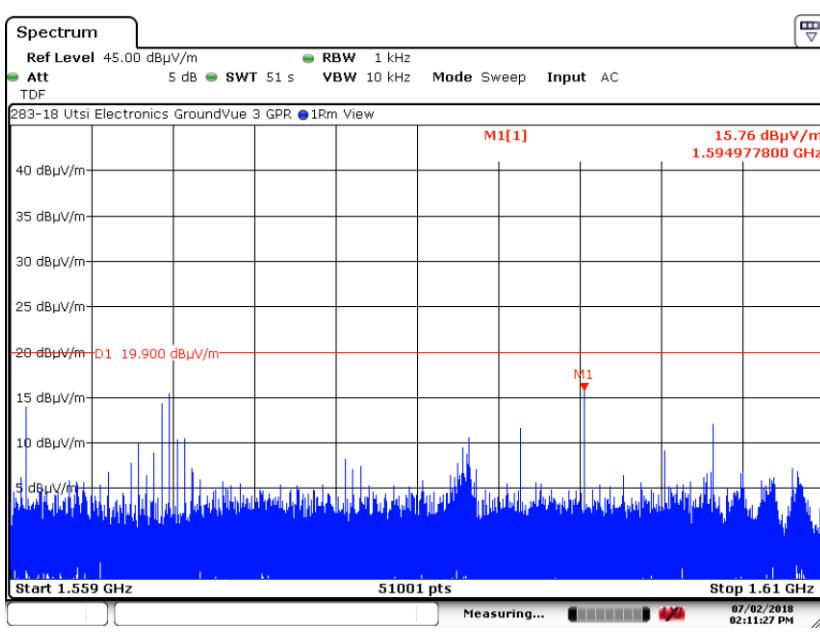
6. Measurement Data (continued)

6.5.4 Spurious Radiated Emissions in GPS Bands (15.509 (e) continued)

6.5.4.3 1164 to 1240 MHz - Vertical



6.5.4.4 1559 to 1610 MHz - Vertical



Test Number: 283-18R2
Issue Date: 9/4/2018

6. Measurement Data (continued)

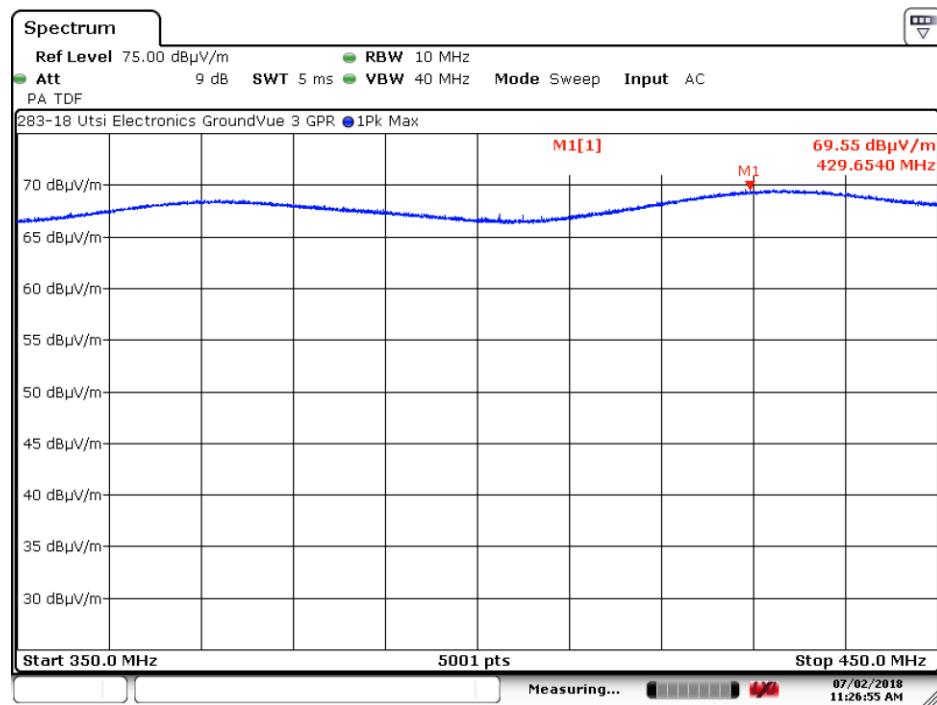
6.6. Peak Emissions in a 50 MHz Bandwidth (15.509 (f))

Requirement: For UWB devices where the frequency at which the highest radiated emissions 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 the frequency 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 Section 15.521. The 0 dBm limit was converted to -13.98 dBm limit when using a 10 MHz RBW. The limit was then converted to a 3 meter field strength limit of 81.22 dB μ V/m by using a conversion factor of 95.2.

Freq. (MHz)	Peak Amplitude (dB μ V/m)	Corr. Factor (dB)	Peak Amplitude (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Pol (H/V)	El. (cm)	Az. (deg)
429.654	69.55	Included	69.55	N/A	N/A	H	200	0
961.50	53.00	Included	53.00	81.22	28.22	H	100	0

Note using: 10 MHz RBW / 40 MHz VBW

6.6.1 Plot of Peak Power below 960 MHz



Date: 2.JUL.2018 11:26:52

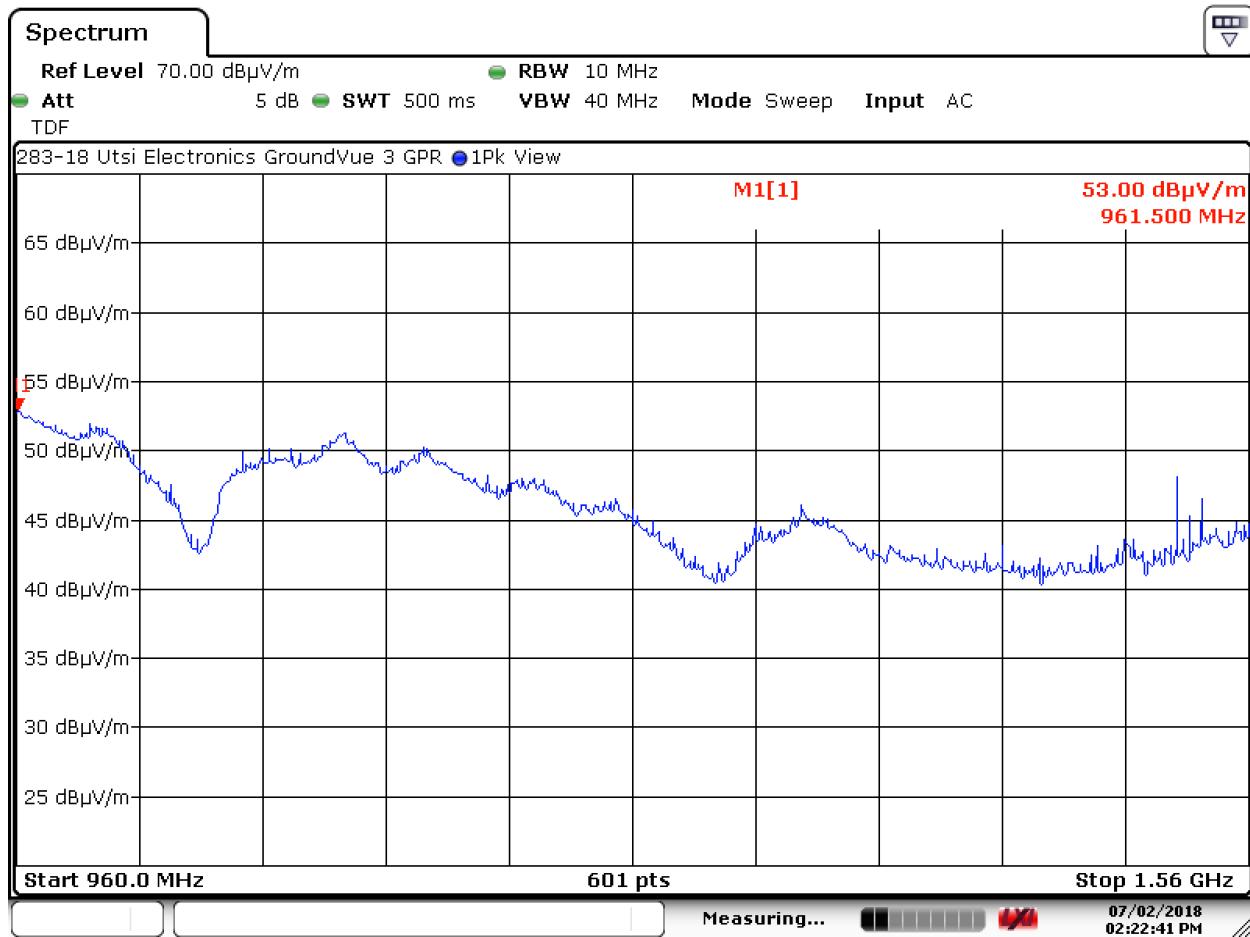
Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)

6.6. Peak Emissions in a 50 MHz Bandwidth (15.509 (f) continued)

6.6.2 Plot of Peak Power above 960 MHz



Date: 2.JUL.2018 14:22:39

Test Number: 283-18R2

Issue Date: 9/4/2018

6. Measurement Data (continued)

6.7. Conducted Emissions, Regulatory Limit: FCC Part 15.209

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5.0	56	46
5.0 to 30.0	60	50

* Decreases with the logarithm of the frequency.

6.7.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
EMI Receiver	Hewlett Packard	8546A	3330A00115	12/4/2018
RF Filter Section	Hewlett Packard	85460A	3325A00121	12/4/2018
LISN	EMCO	3825/2	9109-1860	11/17/2018

6.7.2. Measurement & Equipment Setup

Test Date:	7/3/2018
Test Engineer:	Larry Stillings
Site Temperature (°C):	24.1
Relative Humidity (%RH):	41
Frequency Range:	0.15 MHz to 30 MHz
EMI Receiver IF Bandwidth:	9 kHz
EMI Receiver Avg Bandwidth:	30 kHz
Detector Functions:	Peak, Quasi-Peak. & Average

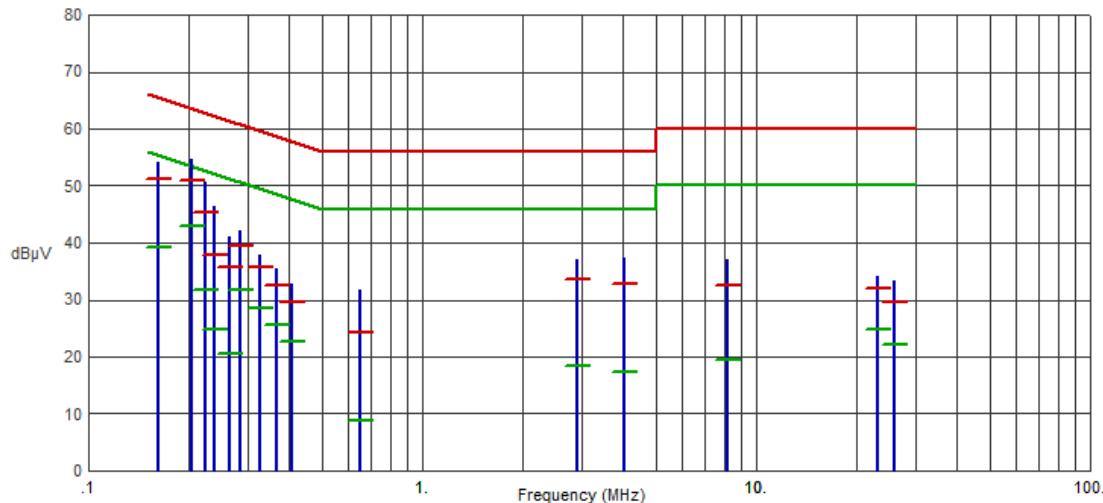
6.7.3. Test Procedure

Test measurements were made in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

Test Number: 283-18R2
Issue Date: 9/4/2018

6. Conducted Emissions Test Results

6.8. 120 Volts, 60 Hz Phase

Test No.: 283-18, 120 Volts, 60 Hz Phase
FCC, Class B


Frequency (MHz)	Pk Amp (dB μ V)	QP Amp (dB μ V)	QP Limit (dB μ V)	QP Margin (dB)	Avg Amp (dB μ V)	Avg Limit (dB μ V)	Avg Margin (dB)	Comments
.1621	54.05	51.33	65.36	-14.03	39.16	55.36	-16.20	
.2043	54.66	50.85	63.43	-12.58	42.93	53.43	-10.50	
.2229	50.61	45.27	62.71	-17.44	31.67	52.71	-21.04	
.2378	46.44	37.85	62.17	-24.32	24.79	52.17	-27.38	
.2641	41.07	35.68	61.30	-25.62	20.51	51.30	-30.79	
.2835	42.01	39.49	60.71	-21.22	31.76	50.71	-18.95	
.3249	37.93	35.72	59.58	-23.86	28.62	49.58	-20.96	
.3648	35.54	32.44	58.62	-26.18	25.49	48.62	-23.13	
.4060	32.68	29.63	57.73	-28.10	22.59	47.73	-25.14	
.6497	31.78	24.21	56.00	-31.79	8.70	46.00	-37.30	
2.8999	37.00	33.50	56.00	-22.50	18.47	46.00	-27.53	
4.0358	37.31	32.93	56.00	-23.07	17.27	46.00	-28.73	
8.1571	36.98	32.40	60.00	-27.60	19.42	50.00	-30.58	
23.1289	34.22	31.91	60.00	-28.09	24.91	50.00	-25.09	
25.8761	33.31	29.64	60.00	-30.36	22.07	50.00	-27.93	

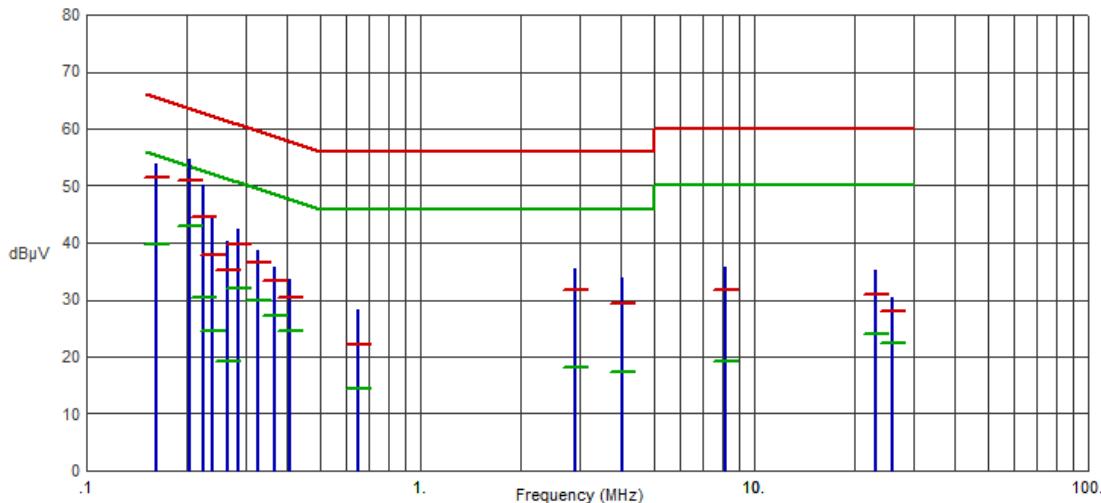
Test Number: 283-18R2
Issue Date: 9/4/2018

6. Conducted Emissions Test Results (continued)

6.8. 120 Volts, 60 Hz Neutral

Test No.: 283-18, 120 Volts, 60 Hz Neutral

FCC, Class B



Frequency (MHz)	Pk Amp (dBµV)	QP Amp (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Avg Amp (dBµV)	Avg Limit (dBµV)	Avg Margin (dB)	Comments
.1621	53.95	51.36	65.36	-14.00	39.69	55.36	-15.67	
.2043	54.77	51.04	63.43	-12.39	42.88	53.43	-10.55	
.2229	50.21	44.47	62.71	-18.24	30.44	52.71	-22.27	
.2379	44.25	37.88	62.17	-24.29	24.54	52.17	-27.63	
.2641	40.33	35.15	61.30	-26.15	19.20	51.30	-32.10	
.2835	42.33	39.65	60.71	-21.06	32.00	50.71	-18.71	
.3249	38.56	36.48	59.58	-23.10	29.80	49.58	-19.78	
.3648	35.73	33.36	58.62	-25.26	27.07	48.62	-21.55	
.4060	33.50	30.49	57.73	-27.24	24.48	47.73	-23.25	
.6497	28.18	22.18	56.00	-33.82	14.42	46.00	-31.58	
2.8999	35.41	31.79	56.00	-24.21	18.11	46.00	-27.89	
4.0358	33.77	29.33	56.00	-26.67	17.41	46.00	-28.59	
8.1571	35.73	31.81	60.00	-28.19	19.27	50.00	-30.73	
23.1289	35.08	30.99	60.00	-29.01	24.02	50.00	-25.98	
25.8761	30.51	28.02	60.00	-31.98	22.34	50.00	-27.66	

6. Measurement Data (continued)

6.9. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1))

6.9.1. SAR Test Exclusion for UWB transmitter

Requirement: Portable devices are subject to radio frequency radiation exposure requirements as explained in FCC KDB 447498 D01 General RF Exposure Guidance v06, dated October 23, 2015.

For a 1-g SAR, the test exclusion result must be ≤ 3.0 and ≤ 7.5 for 10-g extremity SAR.

Test Notes: The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by the following formula:

$$\text{SAR Test Exclusion} = \frac{P_{\text{MAX}}}{d_{\text{MIN}}} \times \sqrt{f_{(\text{GHz})}} \quad (1)$$

P_{MAX} mW Maximum power of channel, including tune-up tolerance

d_{MIN} mm Minimum test separation distance, mm (≤ 50 mm)

$f_{(\text{GHz})}$ GHz $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz (>100 MHz and <6 GHz)

Power and distance are rounded to the nearest mW and mm before calculation

The result is rounded to one decimal place for comparison

The values 3.0 and 7.5 are referred to as numeric thresholds below

Per KDB 447498 Appendix A SAR Exclusion Threshold at 50 mm is 224 mW at 450 MHz.

Extremity SAR is 2.5 times this value or 560 mW at 450 MHz.

The EUT transmits -0.58 dBm EIRP or 0.870 mW at 429 MHz and therefore meets the SAR Test Exclusion.

WiFi Module

		WiFi Module Radio			GPR	
		P_{MAX}	d_{MIN}	$f_{(\text{GHz})}$	Test Exclusion:	Limit Exemption:
Input:		100.00	25.70	77.63	0.87	mW
		50.00	50.00	50.00	50.00	mm
		2.437	5.260	5.745	0.43	GHz
Test Exclusion:		3.12	1.18	3.72	0.01	
Limit Exemption:		7.50	7.50	7.50	7.50	

Worse Case combined (WiFi & GPR) 3.73 vs 7.50 limit exemption



Test Number: 283-18R2



Issue Date: 9/4/2018

7. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with the Federal Communications Commission (FCC) and Industry Canada standards. Through our American Association for Laboratory Accreditation (A2LA) ISO Guide 17025:2005 Accreditation our test sites are designated with the FCC (designation number **US1091**), Industry Canada (file number **IC 3023A-1**) and VCCI (Member number 3168) under registration number A-0274.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 22, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 11, KN 13, KN 14-1, KN 22, KN 32, KN 61000-6-3, KN 61000-6-4.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane required by EN 55022. A second conducted emissions site is also located in the basement of the OATS site with a 2.3 x 2.5 meter ground plane and a 2.4 x 2.4 meter vertical wall.

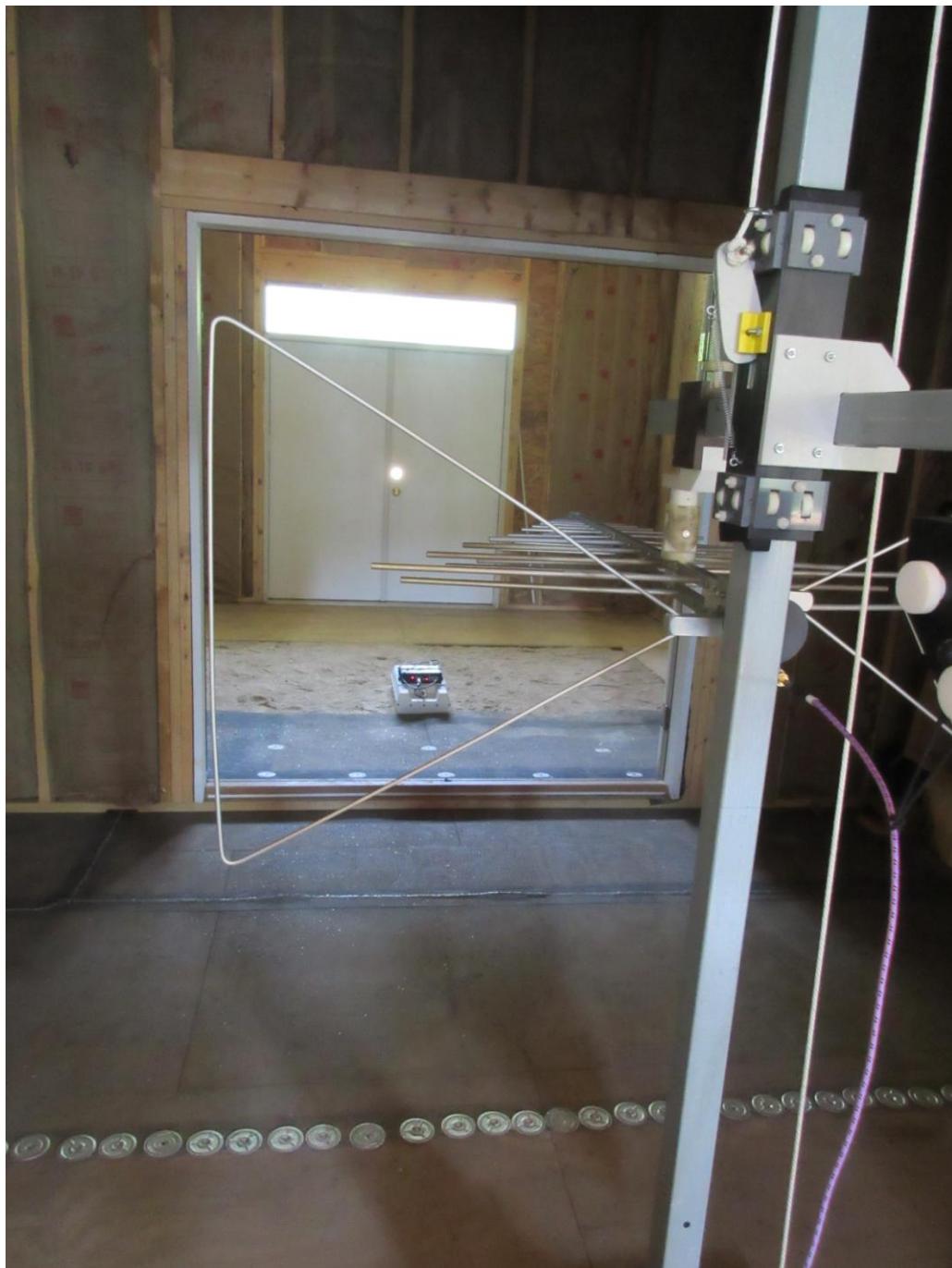
Both sites are designed to test products or systems 1.5 meters W x 1.5 meters L x 2.0 meters H, floor standing or table top.

Test Number: 283-18R2

Issue Date: 9/4/2018

8. Test Images

8.1. Spurious Emissions – 30 MHz – 960 MHz Front



Test Number: 283-18R2

Issue Date: 9/4/2018

8. Test Images

8.2. Spurious Emissions – 30 MHz – 960 MHz Rear



Test Number: 283-18R2

Issue Date: 9/4/2018

8. Test Images

8.3. Spurious Emissions – 960 MHz - 18 GHz Front



Test Number: 283-18R2

Issue Date: 9/4/2018

8. Test Images

8.4. Spurious Emissions – 960 MHz - 18 GHz Rear



Test Number: 283-18R2

Issue Date: 9/4/2018

8. Test Images

8.5. Conducted Emissions – Front



Test Number: 283-18R2

Issue Date: 9/4/2018

8. Test Images

8.6. Conducted Emissions – Rear

