
**COMPLIANCE WORLDWIDE INC.
TEST REPORT 460-16**

**In Accordance with the Requirements of
Industry Canada RSS 220, Issue 1, March 2009
Federal Communications Commission 47 CFR Part 15, Subpart F
Technical Requirements for Ground Penetrating Radar Systems**

Issued to

**Geophysical Survey Systems, Inc.
40 Simon Street
Nashua, NH 03060-3075
603-893-1109**

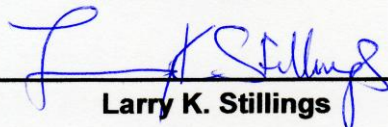
For the

**UtilityScan
Model: 50350US**

**FCC ID: QF750350US
IC: 8498A-50350US**

Report Issued on November 16, 2016

Tested by

A blue ink signature of Larry K. Stillings, written over a horizontal line.

Larry K. Stillings

Reviewed By

A blue ink signature of Brian F. Breault, written over a horizontal line.

Brian F. Breault

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1. Scope

This test report certifies that the Geophysical Survey Systems UtilityScan Antenna, Model 50350US, as tested, meets the FCC Part 15, Subpart F and Industry Canada RSS 220 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.

2. Product Details

2.1. Manufacturer:	Geophysical Survey Systems, Inc.
2.2. Model Number:	50350US
2.3. Serial Number:	0014
2.4. Description:	Ground Penetrating Radar
2.5. Power Source:	10.8V Li-On Battery Powered
2.6. Hardware Revision:	N/A
2.7. Software Revision:	N/A
2.8. Modulation Type:	4.5 μ S Impulse ~ 220 kHz PRF
2.9. Operating Frequency:	350 MHz Nominal
2.10. EMC Modifications:	None

3. Product Configuration

3.1 Operational Characteristics & Software

Turn on the UtilityScan antenna and allow the unit to boot up.

Software Setup:

For normal operation:

1. After boot up start the unit scanning by selecting the System menu and select 220 kHz PRF.

3.2. EUT Hardware

Manufacturer	Model	Serial Number	Description/Function
GSSI	50350US	0014	GPR 2 GHz Antenna

3.3. EUT Cables/Transducers

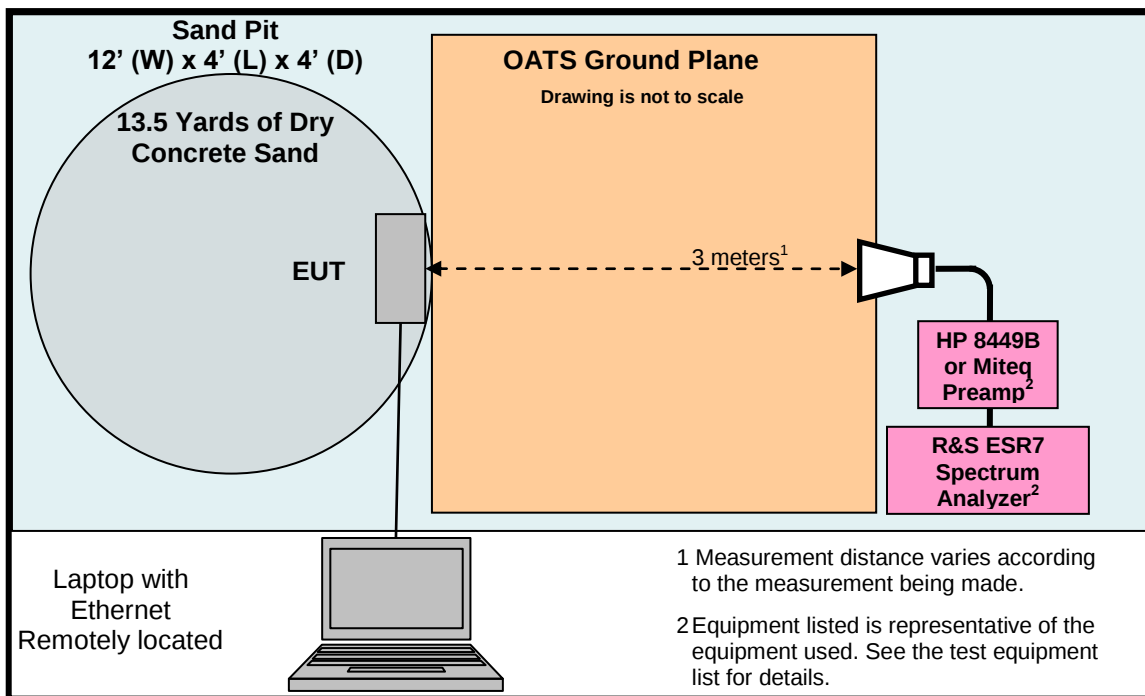
Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
GSSI	Marker Cable	2	N	Marker Accessory
GSSI	Ethernet Cable	30	Y	Control cable for Controlling Unit

3.4. Support Equipment

Laptop

3. Product Configuration (continued)

3.5. Test Setup Diagram



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	7/23/2017	2 Year
Spectrum Analyzer	Rohde & Schwarz	FSV40	100899	7/23/2017	2 Year
Microwave Preamp	Hewlett Packard	8449B	3008A01323	7/23/2017	2 Year
Preamp 100 MHz – 7 GHz	Miteq	AFS3-01000200-10-15P-4	988773	6/2/2017	1 Year
Bilog Antenna 30 to 2000 MHz	Com-Power	AC-220	25509	5/12/2018	2 Year
Horn Antenna 960 MHz to 18 GHz	Electro-Metrics	EM-6961	6337	5/2/2018	2 Year
Barometer – Temperature & Humidity	Control Company	4195	ID236	10/8/2017	2 Year

4.2. Measurement & Equipment Setup

Test Date: 9/20/2016
 Test Engineer: Larry Stillings
 Normal Site Temperature (15 - 35°C): 21.6
 Relative Humidity (20 - 75%RH): 35
 Frequency Range: 30 MHz to 20 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

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	$\pm 5\%$

5. Measurements Summary

Test Requirement	FCC Rule Requirement	IC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	RSS-GEN 8.3	6.1	Compliant	The antenna is housed within a sealed enclosure with the intentional radiator.
Operational Requirements	15.509 (b)	RSS-220 6	6.2	Compliant	
UWB Bandwidth	15.503 (a)	RSS-220 6.2.1 (a)	6.3	Compliant	
Spurious Radiated Emissions	15.509 (d) 15.209	RSS-220 3.4 RSS-220 6.2(c) & 6.2(d)	6.4	Compliant	
Radiated Emissions in GPS Bands	15.509 (e) 15.209	RSS-220 6.2(e)			
Peak Emissions in a 50 MHz Bandwidth	15.509 (f)	RSS-220 6.2(g)	6.5	Compliant	
Conducted Emissions	15.207	RSS-GEN 8.8	6.6	Compliant	EUT is battery powered
Radio Frequency Exposure	FCC OET Bulletin 65	RSS-GEN 3.2 RSS-102	6.7	Compliant	

6. Measurement Data

6.1. Antenna Requirement (15.203), RSS-GEN Section 8.3

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)), RSS-220 Sec 6

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)), RSS-220 Section 6.2.1 (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 $2 * (f_H - f_L) / (f_H + f_L)$.

6.3.1. Measurement Data (Values in GHz)

f_M	The highest emission peak	0.303458
f_L	10 dB below the highest peak	0.272348
f_H	10 dB above the highest peak	0.421847
f_C	Calculated: $(f_H + f_L)/2$	0.347098
Bandwidth	Calculated: $(f_H - f_L)$	0.149499
Fractional BW	Calculated: $2*(f_H - f_L)/(f_H + f_L)$	0.430712

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.

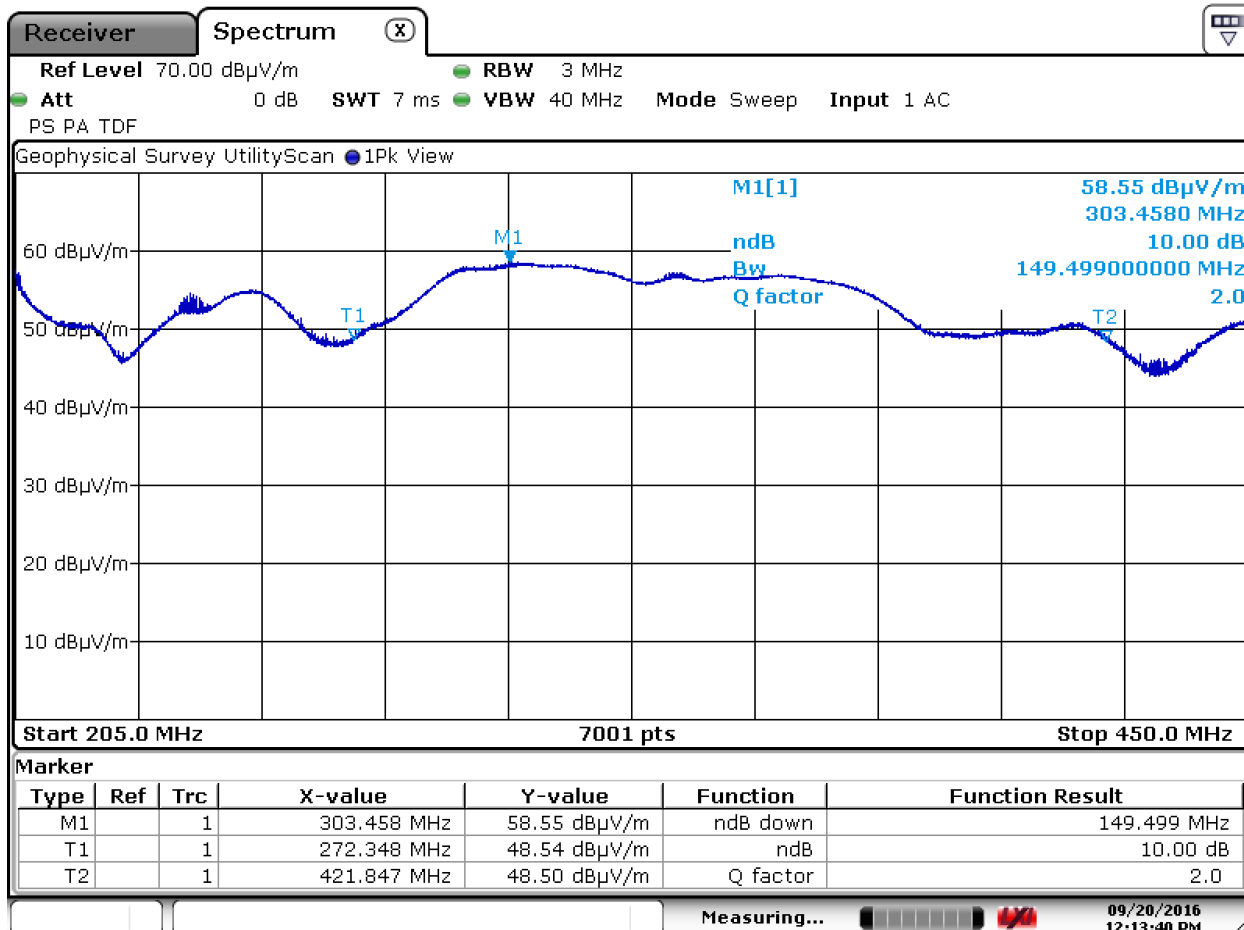
Test Number: 460-16

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6. Measurement Data (continued)

6.3. UWB Bandwidth (15.503 (a), RSS-220 Sec 6.2.1(a)) (continued)

6.3.2. Measurement Plot of 10 dB BW on GPR Site = 149.499 MHz



Date: 20.SEP.2016 12:13:40

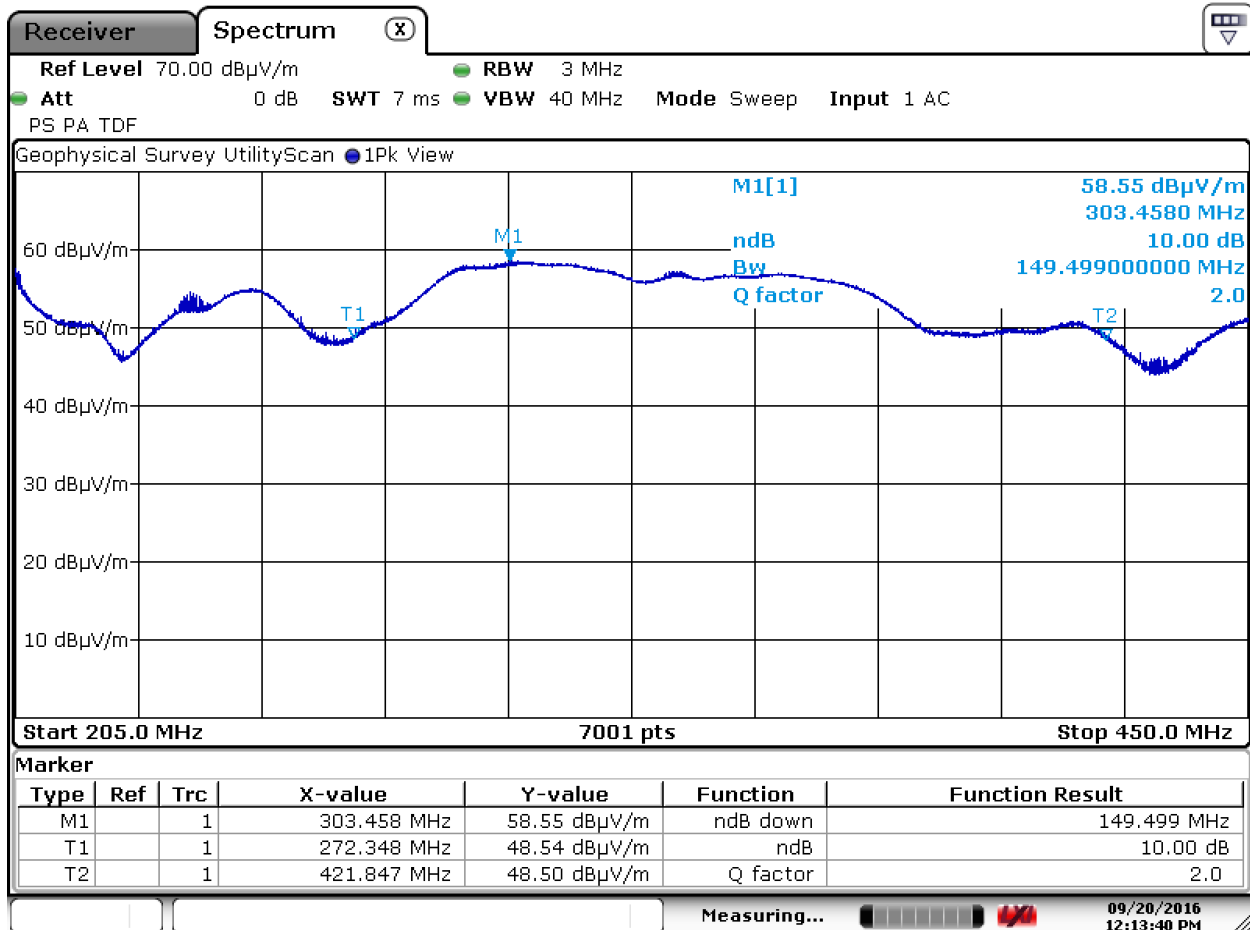
Test Number: 460-16

Issue Date: 11/16/2016

6. Measurement Data (continued)

6.3. UWB Bandwidth (15.503 (a), RSS-220 Sec 6.2.1(a)) (continued)

6.3.3. Measurement Plot of 99% BW on GPR Site = 196.98 MHz



Date: 20.SEP.2016 12:13:40

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.1(d))

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 (dBμV/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

Spurious Radiated Emissions in GPS Bands

(15.509 (e), 15.209, RSS-220 Section 6.2(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. Limits are converted from EIRP (dBm) to field strength at 3 meters using a conversion factor of 95.2 when measured with 1 kHz.

Frequency (MHz)	EIRP (dBm)	Field Strength (dBμV/m)
1164 - 1240	-75.3	19.9
1559 - 1610	-75.3	19.9

Radiated Emissions Field Strength Limits at 3 Meters

(Section 15.209, RSS-220 Section 3.4)

Frequency (MHz)	Field Strength (dBμV/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.

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.1(d))

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

Geophysical Survey, UtilityScan

Frequency (MHz)	Amplitude (dBµV/m)		Limit (dB)	Margin (dB)	Polarity (H/V)	Antenna Height (cm)	Azimuth (Dev.)
	Peak	Quasi- Peak	Quasi- Peak				
39.64	33.79	30.99	40.0	-9.01	H	200	90
53.54	31.76	29.53	40.0	-10.47	H	200	90
112.20	23.36	21.52	43.5	-21.98	H	150	90
154.00	22.61	17.56	43.5	-25.94	H	150	90
311.98	24.54	23.51	46.0	-22.49	H	150	90
375.01	22.93	21.15	46.0	-24.85	H	150	90
534.20	22.97	18.55	46.0	-27.45	H	150	90

Note: Plot of data shown on 14

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.1(d))

6.4.2. 30 MHz to 960 MHz, measured at 3 Meters

Geophysical Survey, Utility Scan

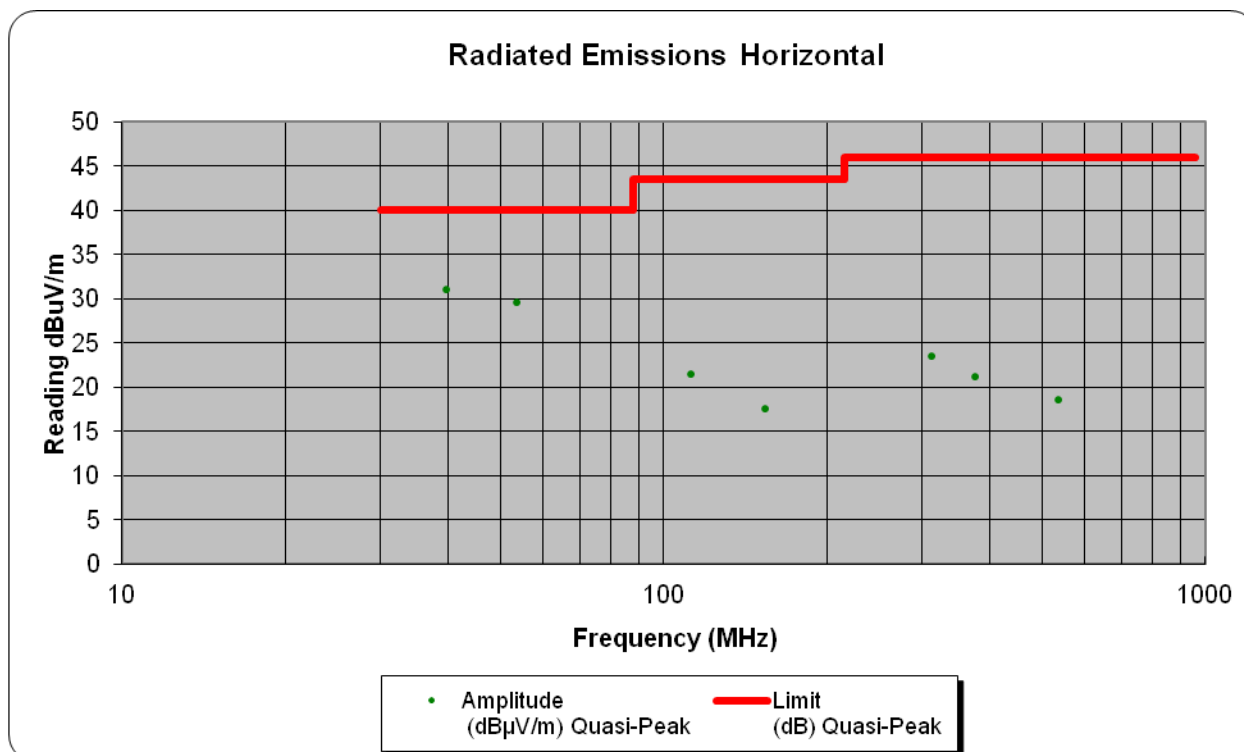
Frequency (MHz)	Amplitude (dBμV/m)		Limit (dB)	Margin (dB)	Polarity (H/V)	Antenna Height (cm)	Azimuth (Dev.)
	Peak	Quasi- Peak	Quasi- Peak				
30.61	38.74	37.25	40.0	-2.75	V	100	90
34.64	36.00	33.27	40.0	-6.73	V	100	90
38.99	38.79	35.93	40.0	-4.07	V	100	90
39.54	39.06	37.34	40.0	-2.66	V	100	90
54.17	30.91	28.13	40.0	-11.87	V	100	90
87.48	33.23	32.58	40.0	-7.42	V	100	90
110.80	28.99	27.30	43.5	-16.20	V	100	90
189.83	35.49	30.90	43.5	-12.60	V	100	90
253.14	25.57	23.41	46.0	-22.59	V	100	90
314.94	29.87	27.21	46.0	-18.79	V	100	90
336.00	38.14	36.70	46.0	-9.30	V	100	90
432.00	35.87	35.72	46.0	-10.28	V	100	90

Note: Plot of this tabular data is on page 15

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.1(d))

6.4.3. 30 MHz to 960 MHz, Horizontal Plot

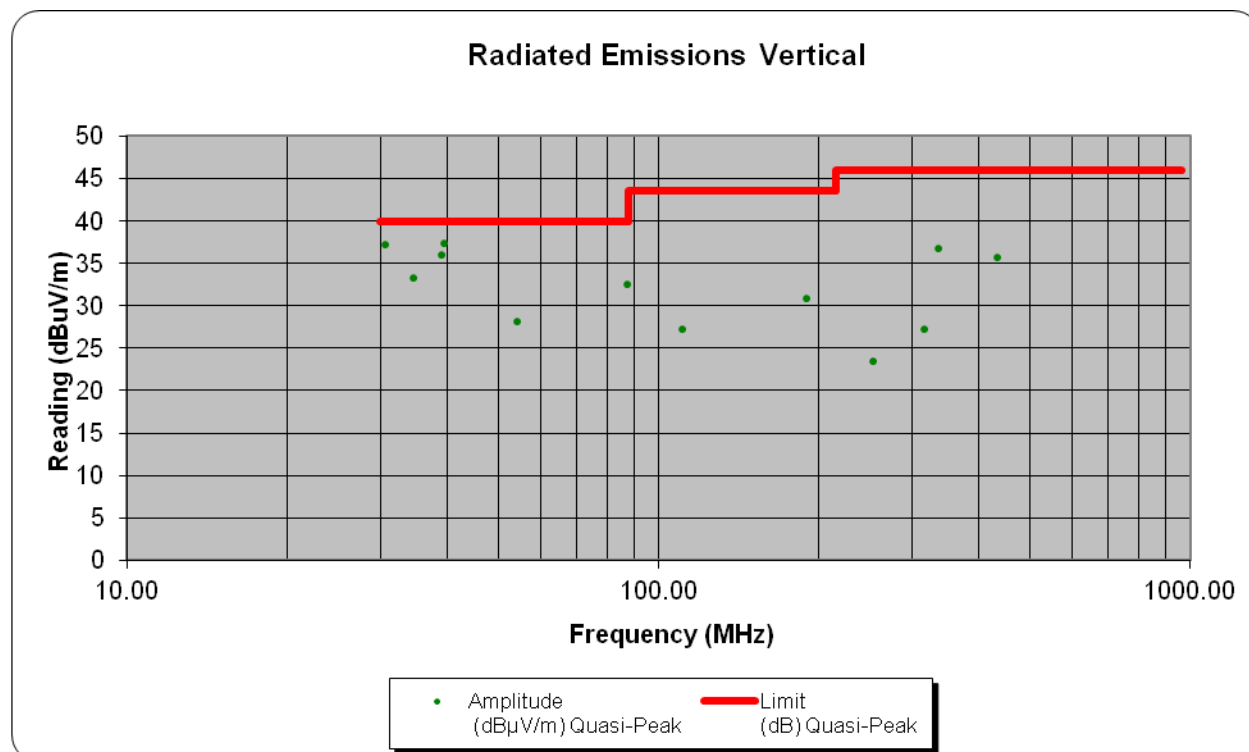


Note: Tabular Data for this plot is on page 12.

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.1(d))

6.4.4. 30 MHz to 960 MHz, Vertical Plot



Note: Tabular Data for this plot is on page 13.

Test Number: 460-16

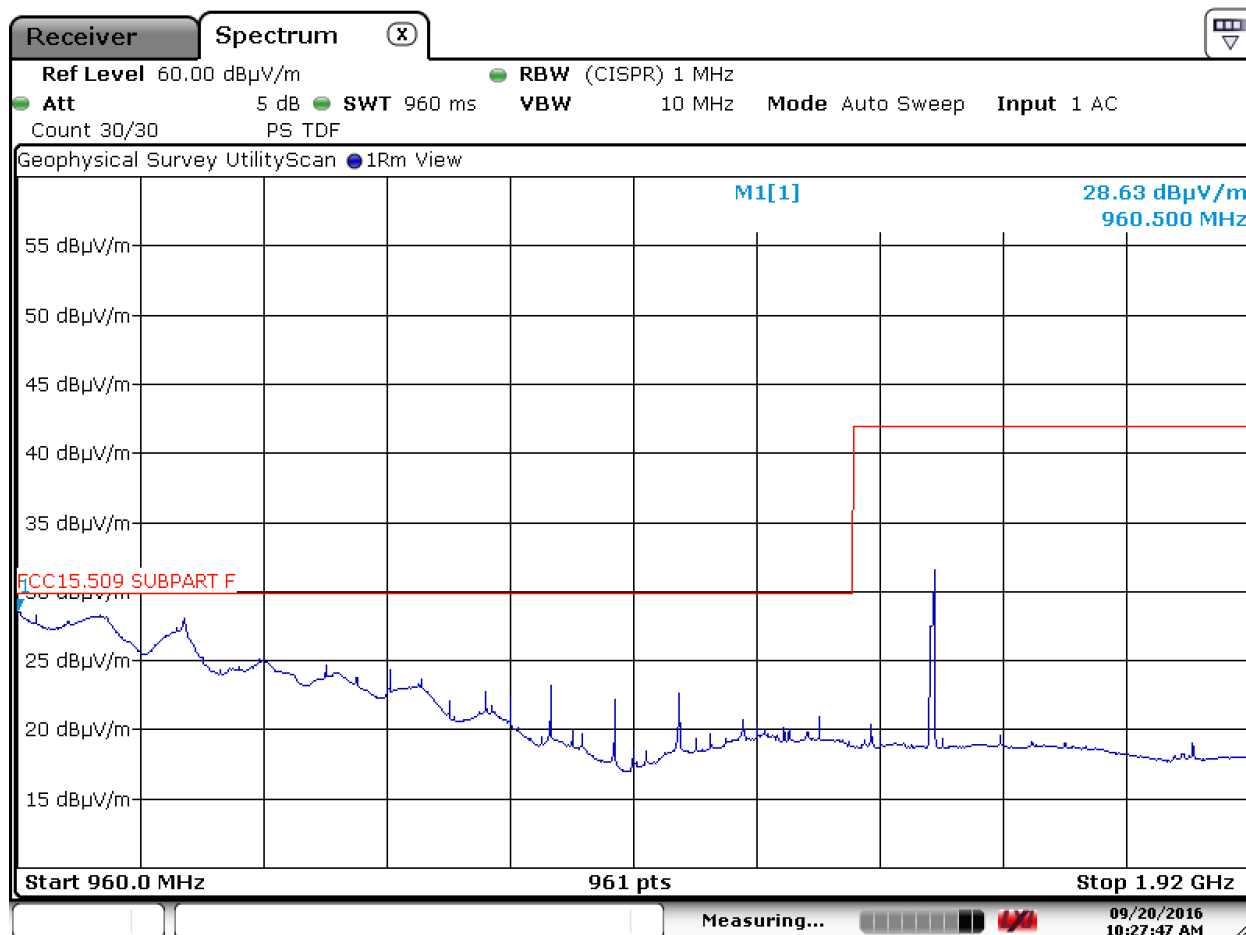
Issue Date: 11/16/2016

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.2(d))

6.4.5. 960 MHz to 25 GHz at 3 meters

6.4.5.1 Plot of 960 MHz to 1.92 GHz RMS Power



Date: 20.SEP.2016 10:27:47

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

There were no other measurable emissions between 1.92 to 25 GHz.

See the next page with the UWB turned off.

Test Number: 460-16

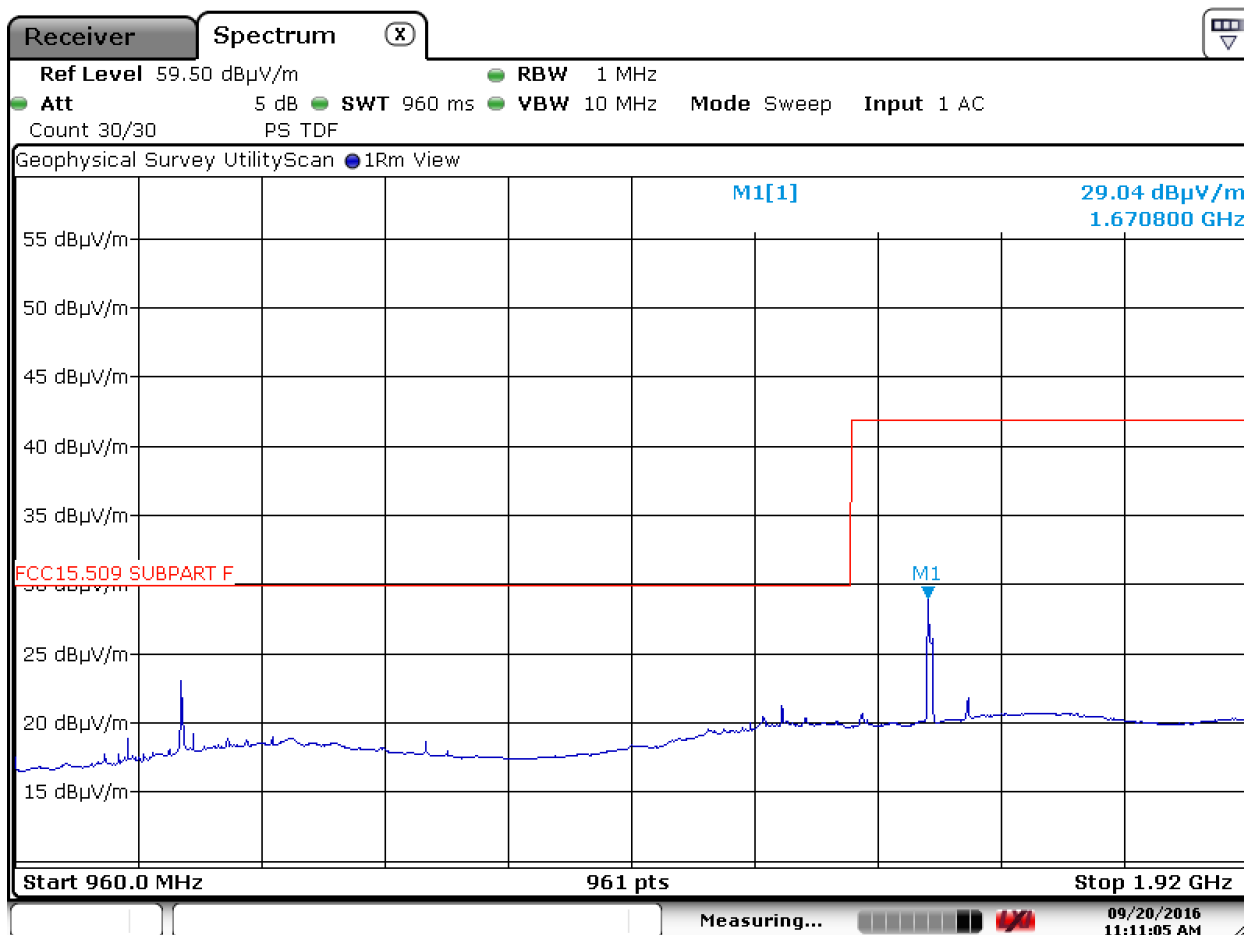
Issue Date: 11/16/2016

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.2(d))

6.4.5. 960 MHz to 25 GHz at 3 meters (continued)

6.4.5.2 Plot of 960 MHz to 1.92 GHz RMS Power with UWB turned off



Date: 20.SEP.2016 11:11:05

Note: UWB signal is turned off, clock frequencies are subject to 15.209 limits

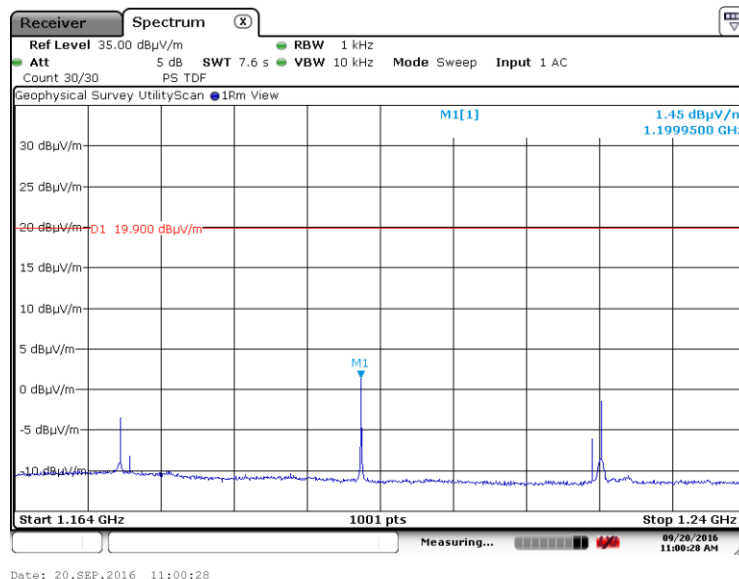
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.1(d))

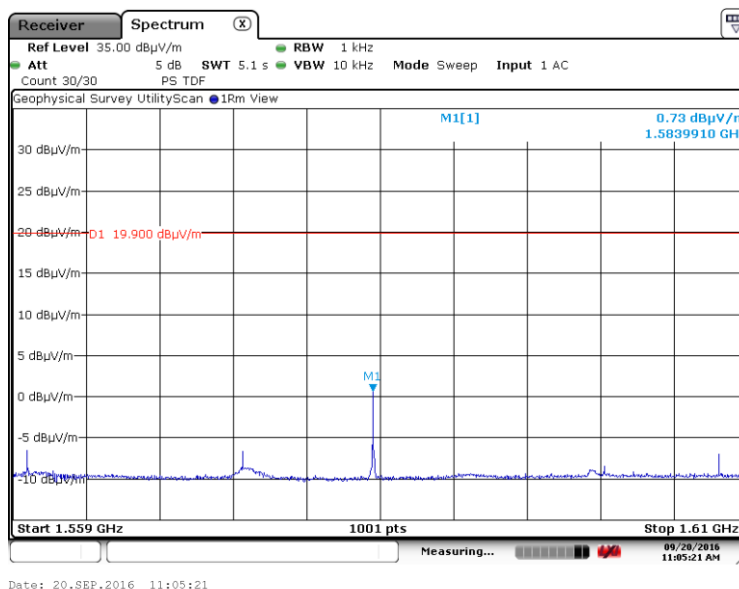
Spurious Radiated Emissions in GPS Bands (15.509 (e), RSS-220 6.2(e))

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.

6.4.6 1164 to 1240 MHz - Horizontal



6.4.7 1559 to 1610 MHz - Horizontal



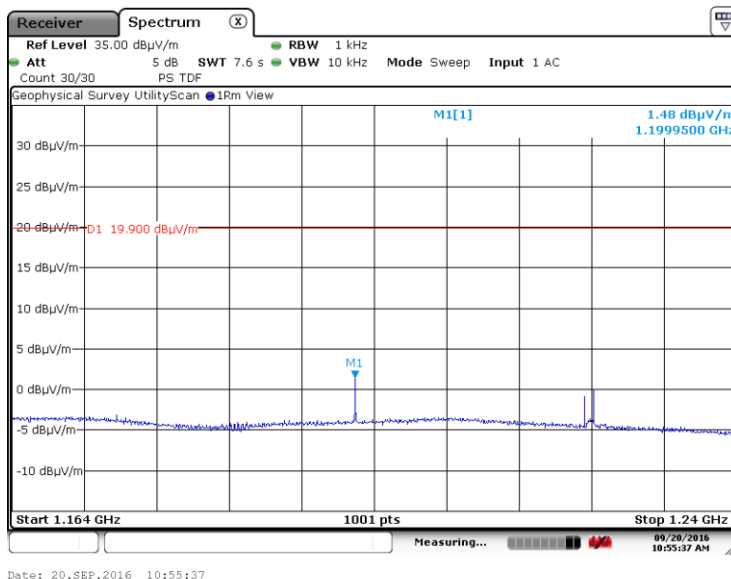
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.509 (d), 15.209, RSS-220 Section 6.1(d))

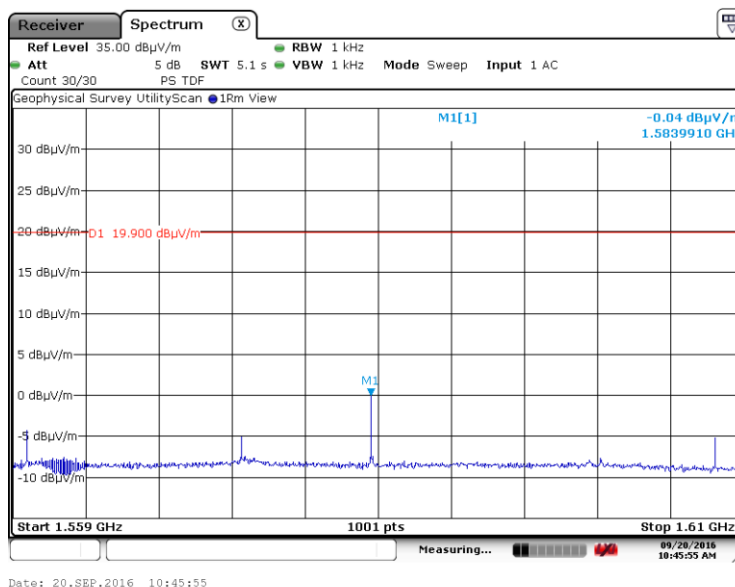
Spurious Radiated Emissions in GPS Bands (15.509 (e), RSS-220 6.2(e))

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.

6.4.8 1164 to 1240 MHz - Vertical



6.4.9 1559 to 1610 MHz - Vertical



6. Measurement Data (continued)

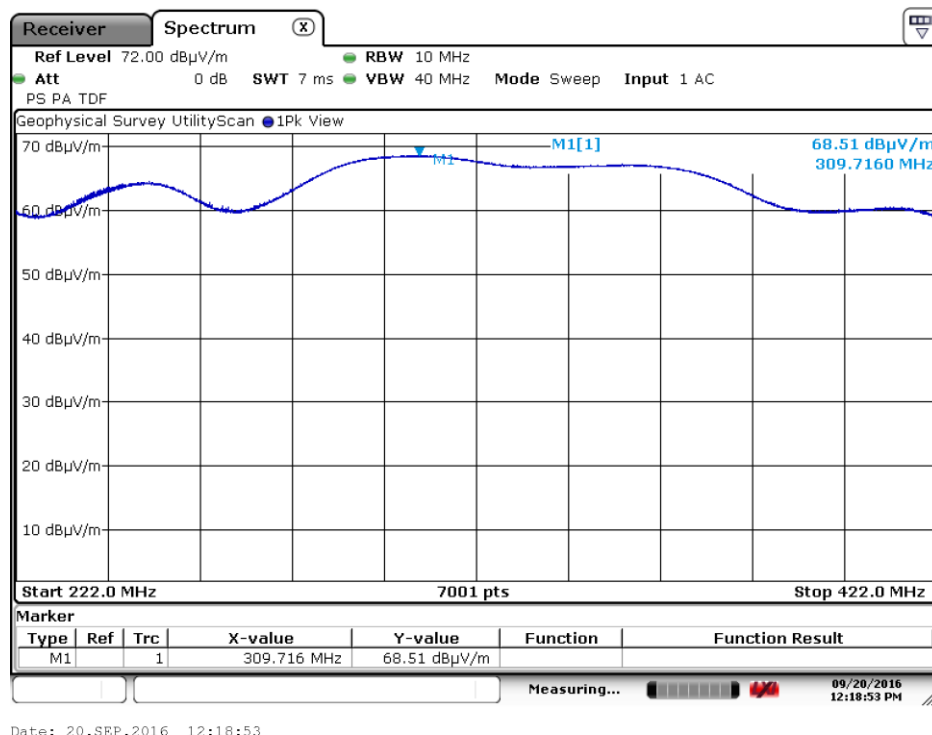
6.5. Peak Emissions in a 50 MHz Bandwidth (15.509 (f), RSS-220 Section 6.2 (g))

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)
309.716	68.51	Included	68.51	N/A	N/A	V	100	0
960.070	64.13	Included	64.13	81.22	17.09	V	100	0

Note using: 10 MHz RBW / 40 MHz VBW

6.5.1 Plot of Peak Power below 960 MHz



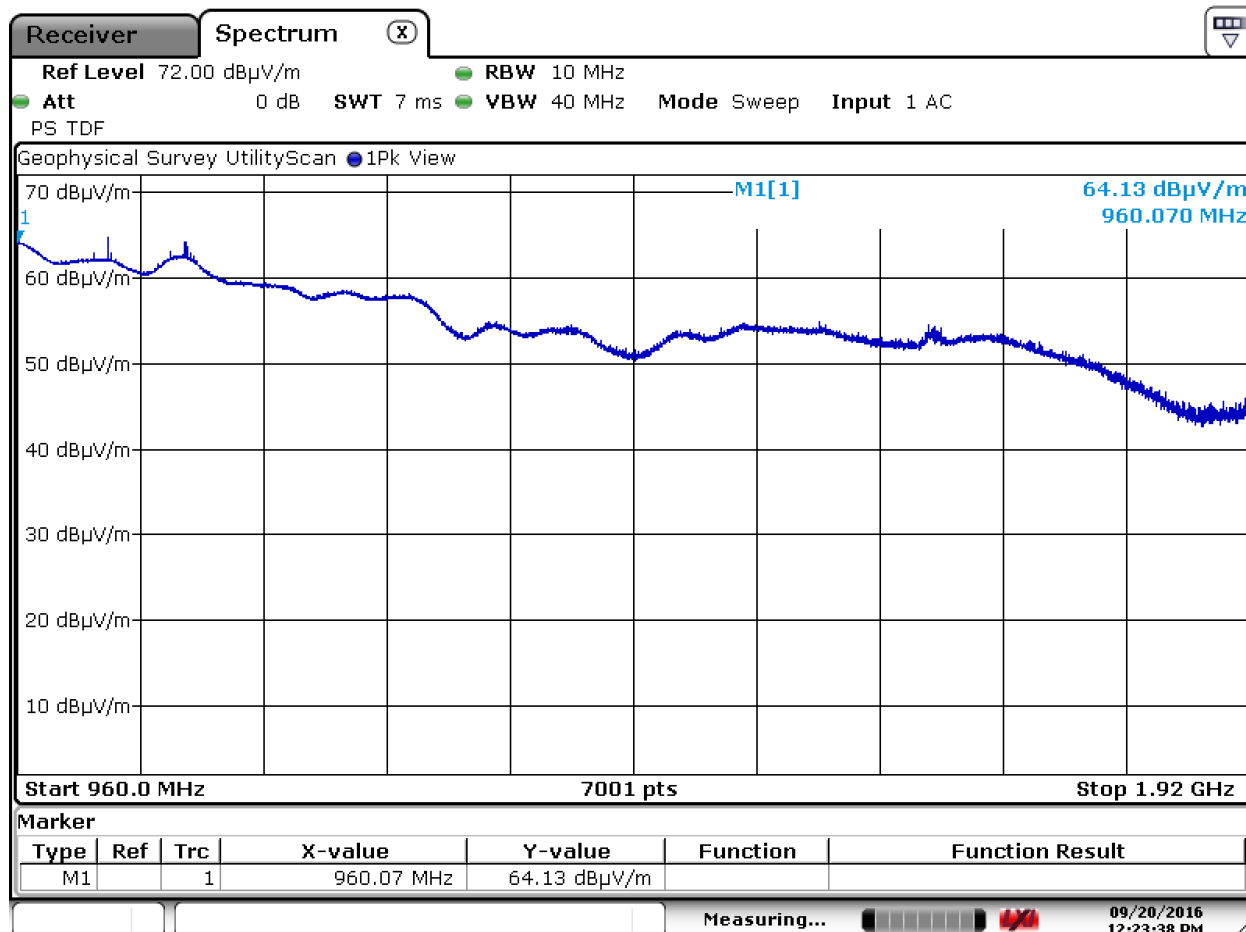
Test Number: 460-16

Issue Date: 11/16/2016

6. Measurement Data (continued)

6.5. Peak Emissions in a 50 MHz Bandwidth (15.509 (f), RSS-220 Section 6.2 (g))

6.5.2 Plot of Peak Power above 960 MHz



Date: 20.SEP.2016 12:23:39

6. Measurement Data (continued)

6.6. Conducted Emissions, Regulatory Limit: FCC Part 15.209, IC RSS-GEN 8.8

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.

6.6.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
LISN	EMCO	3825/2	9109-1860	7/21/2016
EMI Receiver	Hewlett Packard	8546A	3330A00115	6/2/2016

6.6.2. Measurement & Equipment Setup

Test Date:	N/A
Test Engineer:	N/A
Site Temperature (°C):	N/A
Relative Humidity (%RH):	N/A
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

6.6.3. Test Procedure

Test measurements were made in accordance with ANSI C63.10-2013, Standard Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 9 kHz to 40 GHz.

EUT is battery powered and the batteries are recharged using a separate charger not contained in the device.

6. Measurement Data (continued)

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

RSS-GEN 3.2, RSS 102

6.7.1. MPE Power Density Table.

MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	Power Density		Limit (mW/cm ²)	Result
			(mW/cm ²)	(W/m ²)		
(1)	(2)	(3)	(4)		(5)	Compliant
20.0	-1.78	0.0	0.0001320	0.0013205	1.0	

$$PD = \frac{OP + AG}{(4 \times \pi \times d^2)}$$

PD = Power Density

OP = DUT Output Power (dBm)

AG = Antenna Gain (dBi)

D = MPE Distance

1. Reference CFR 2.1093(b): For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.
2. Section 6.1 of this test report.
3. Power density is calculated from conducted power output measurement and antenna gain.
4. Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure.

7. Test Images

7.1. Spurious Emissions – 30 MHz – 960 MHz Front



7. Test Images

7.2. Spurious Emissions – 30 MHz – 960 MHz Rear



7. Test Images

7.3. Spurious Emissions – 960 MHz - 18 GHz Front



7. Test Images

7.4. Spurious Emissions – 960 MHz - 18 GHz Rear



8. 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-0208.

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.