COMPLIANCE WORLDWIDE INC.
TEST REPORT 287-09R1

In Accordance with the Requirements of

Industry Canada RSS 220, Issue 1, March 2009
Federal Communications Commission 47 CFR Part 15, Part F
Technical Requirements for Vehicular Radar Systems

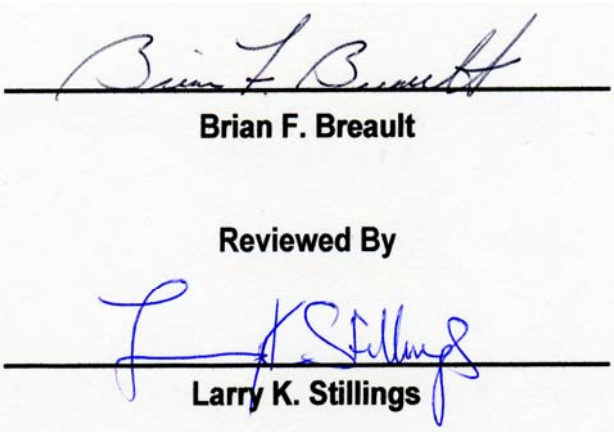
Issued to

Autoliv Electronics
1011B Pawtucket Blvd
PO Box 1858
Lowell, MA 01853
Tel: 978-674-6500

For the
24 GHz SRS Sensor

FCC ID: WU8SRSC5
IC: 8436B-6181175

Report Issued on August 27, 2009



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1. Scope

This test report certifies that the Autoliv Electronics 24 GHz SRS Sensor, New Design, 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:	Autoliv Electronics
2.2. Model Number:	6181175
2.3. Serial Number:	520001008
2.4. Description:	Vehicular Radar Sensor
2.5. Power Source:	DC 12 volts – Automotive power system.
2.6. Hardware Revision:	618345100B
2.7. Software Revision:	63.36
2.8. Modulation Type:	Pulse Modulation
2.9. Operating Frequency:	24.175 GHz Nominal
2.10. EMC Modifications:	None

3. Product Configuration

3.1 Operational Characteristics & Software

The 24 GHz SRS Sensor will simulate normal operations when exercised with the software provided by the manufacturer. Within the normal operating conditions, the sensor utilizes two operating modes:

- Short pulse mode
- Long pulse mode

Instructions were provided to operate the DUT. Specialized operating conditions for specific tests are also outlined in the software setup.

Hardware Setup:

Connect the 24 GHz SRS Sensor lead set to the CANcard/DHSC dongle and the +12 VDC power supply.

Software Setup:

Boot the Dell laptop provided by the customer and load the DanView application.

For normal operation:

1. Click on the flag button (8th icon from right).
2. Click on the Enable/Disable Master/Slave icon to the left of the Flag button. Make sure the data in the Target View window is updating.

To change pulse width:

1. Click on the Short Pulse button to obtain a long pulse.
2. Click on the Mode button to obtain a short pulse.

To set CW mode:

1. Click on the EEPROM button (5th icon from left). Make sure the selected sensor is #2.
2. Click on the Read button.
3. Scroll down to address 169.
4. Double-click on the Value entry.
5. Type the frequency (MHz) <Enter>.
6. Click on the Write Changes Only button.
7. Cycle the SRS's power.

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3. Product Configuration (continued)

3.1 Operational Characteristics & Software (continued)

8. Click on the Create and Send Configuration Commands button. It is the Table that has the arrow and is located to the right of the drop-downs.
9. Make sure the selected sensor is #2. Set Display Format to decimal.
10. Write Byte 0 1 2 3 4 5
    Value 2 5 0 0 4 134
    Send - value will be updated.
11. Additional register values:
    i. CW switch open (high insertion loss):
    Byte 0 1 2 3 4 5
    Value 2 5 0 0 0 0
    ii. CW switch closed (low insertion loss):
    Byte 0 1 2 3 4 5
    Value 2 5 0 0 4 6

3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Frq (Hz)	Description/Function
Autoliv	6181175	520001008	12	DC	SRS Sensor

3.3. EUT Cables/Transducers

Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
Custom	NA	10	N	Power and signal cable from Softing CANCard 2 DHSC to the DUT
Softing	CANCard 2 DHSC	0.5	N	Softing CANCard 2 DHSC dongle/cable

3.4. Support Equipment

Manufacturer	Model/Part #	Serial Number	Input Voltage	Input Frq.	Description/Function
Dell	Latitude D830	CN-OHN338-48643-7AF-2781	120/240	50/60	Laptop computer
Softing	CANCard 2 DHSC	003700748	N/A	N/A	Dual CAN PC Card

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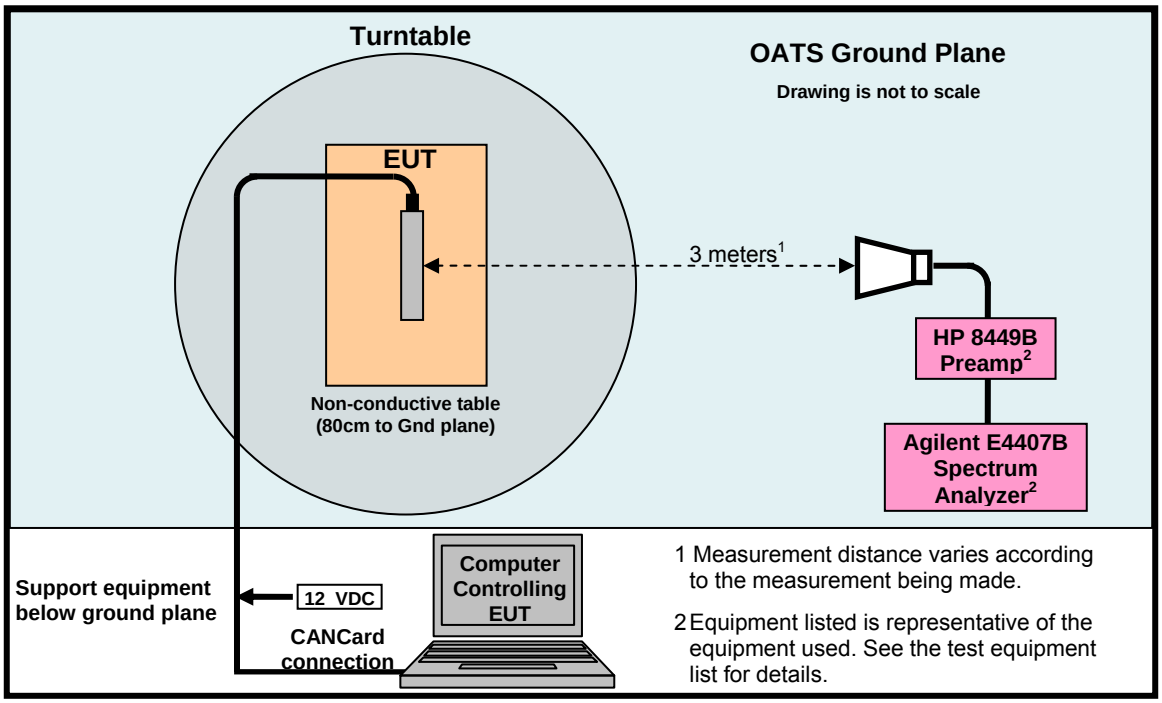
3. Product Configuration (continued)

3.5. Test Setup Diagram



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4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	Agilent	E4407B	MY4510449	7/09/2010
Spectrum Analyzer	Agilent	N9020A-526	MY47380140	4/16/2011
Microwave Preamp	Hewlett Packard	8449B	3008A01323	9/22/2009
Spectrum Analyzer	Hewlett Packard	8593E	3829A03887	9/17/2009
Bilog Antenna	Com-Power	AC-220	25509	8/6/2009
Horn Antenna 1 to 18 GHz	Electro-Metrics	EM-6961	6337	7/22/2010
Horn Antenna 1 to 18 GHz	ComPower	AH-840	03075	7/23/2010
Horn Antenna 18 to 26 GHz	ComPower	AH-826	081051	4/16/2010
Mixer Horn Antenna 18 to 26 GHz	Hewlett Packard Hughes	11970K 45820H-2020	2332A00807 037	Not Req'd
Mixer Horn Antenna 26 to 40 GHz	Hewlett Packard Alpha Industries	11970A 861A/599	3003A08210 324	Not Req'd
Mixer Horn Antenna 33 to 50 GHz	Hewlett Packard Alpha Industries	11970Q 861B/383	3003A01273 133	Not Req'd
Mixer Horn Antenna 40 to 60 GHz	Hewlett Packard M/A Com Baytron	11970U 3-19-720	2332A00425 N/A	Not Req'd
Mixer Horn Antenna 50 to 75 GHz	Hewlett Packard Aerowave	11970V 15-7025	2521A00357 N/A	Not Req'd
Mixer Horn Antenna 75 to 110 GHz	Hewlett Packard Alpha Industries	11970W 861A/387	2521A00230 359	Not Req'd
DMM / Temperature	Fluke	187	79690058	2/19/2010
RF Signal Generator	Hewlett Packard	8648C	3623A03429	2/17/2010
RF Signal Generator	Agilent	83630B	3844A00851	2/12/2010
RF Power Meter	Boonton	4220A	203603AA	6/9/2010
Power Sensor	Boonton	51075	23339	6/9/2010
DC Variable Source 60 Volt, 3 Amp	Hewlett Packard	6296A	7M0599	N/A
Thermal Chamber	Associated Testing Labs	SLHU-1-CRLC	N/A	N/A

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4. Measurements Parameters (continued)

4.2. Measurement & Equipment Setup

Test Date:	7/24/2009
Test Engineer:	Brian Breault
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	30 MHz to 100 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	100 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth:	300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak & Average

4.3. Measurement Procedure

Test measurements were made in accordance FCC Part 15.203, 15.249, 15.515, and IC RSS-220 Issue I.

The test methods used to generate the data is this test report is in accordance with ANSI C63.4: 2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

In accordance with ANSI C63.4-2003, section 13.1.4.1, (c), the device under test was rotated through three orthogonal axes to determine which attitude produced the highest emission relative to the limit. The attitude 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)	$\pm$ 1x10^{-8}
Radiated Emission of Transmitter to 100 GHz	$\pm$ 4.55 dB
Radiated Emission of Receiver	$\pm$ 4.55 dB
Temperature	$\pm$ 0.91^{o} C
Humidity	$\pm$ 5%

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5. Measurements Summary

Test Requirement	FCC Rule Requirement	IC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	RSS-GEN 7.1.4	6.1	Compliant	The antenna is housed within a sealed enclosure with the intentional radiator.
Operational Requirements	15.515 (a)	RSS-220 4	6.2	Compliant	
UWB Bandwidth	15.515 (b) 15.503 (d)	RSS-220 4.1	6.3	Compliant	
Emissions Attenuation Above the Horizontal Plane	15.515 (c)	RSS-220 4.1(g)	6.4	Compliant	
Spurious Radiated Emissions	15.515 (d) 15.209	RSS-220 3.4 RSS-220 4.1(d)	6.5	Compliant	No measurable spurious emissions.
Radiated Emissions in GPS Bands	15. 515 (e) 15.209	RSS-220 4.1(e)			No measurable spurious emissions.
Peak Emissions in a 50 MHz Bandwidth	15.515 (f)	RSS-220 4.1(h)	6.6	Compliant	
Conducted Emissions	15.207	RSS-GEN	N/A	N/A	Automotive Battery Powered Device
Effect of Supply Voltage Variations	2, 15.215	RSS-GEN	6.8	Compliant	
Transmitter Frequency Stability	N/A	RSS-GEN 4.7	6.9	Compliant	
Radio Frequency Exposure	FCC OET Bulletin 65	RSS-GEN	6.10	Compliant	

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6. Measurement Data

6.1. Antenna Requirement (15.203), RSS-GEN Section 7.1.4

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

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

6.2. Operational Requirements of the Device under Test (15.515 (a)), RSS-220 Sec 4

Requirement: Operation under the provisions of this section is limited to UWB field disturbance sensors mounted in terrestrial transportation vehicles. These devices shall operate only when the vehicle is operating, e.g., the engine is running. Operation shall occur only upon specific activation, such as upon starting the vehicle, changing gears, or engaging a turn signal.

The manufacturer states that the device under test complies with the requirements outlined in section 6.1 (FCC Part 15.515 (a).

6.3. UWB Bandwidth (15.515 (b)), RSS-220 Section 4.1

Requirement: The UWB bandwidth of a vehicular radar system operating under the provisions of this section shall be contained between 22 GHz and 29 GHz. In addition, the center frequency, f_C, and the frequency at which the highest level emission occurs, f_M, must be greater than 24.075 GHz. Operation under the provisions of this section is limited to UWB field disturbance sensors mounted in terrestrial transportation vehicles.

6.3.1. Measurement Data – Long Pulse Mode (Values in GHz)

f_M	The highest emission peak	24.500
f_L	10 dB below the highest peak	23.570
f_H	10 dB above the highest peak	25.162
f_C	Calculated: $(f_H + f_L)/2$	24.366
Bandwidth	Calculated: $(f_H - f_L)$	1.592
Fractional BW	Calculated: $2*(f_H - f_L)/(f_H + f_L)$	0.06534

Note: the Bandwidth is greater than 500 MHz and therefore the fractional bandwidth requirement does not need to be met.

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6. Measurement Data (continued)

6.3. UWB Bandwidth (15.515 (b), RSS-220 Sec 4.1) (continued)

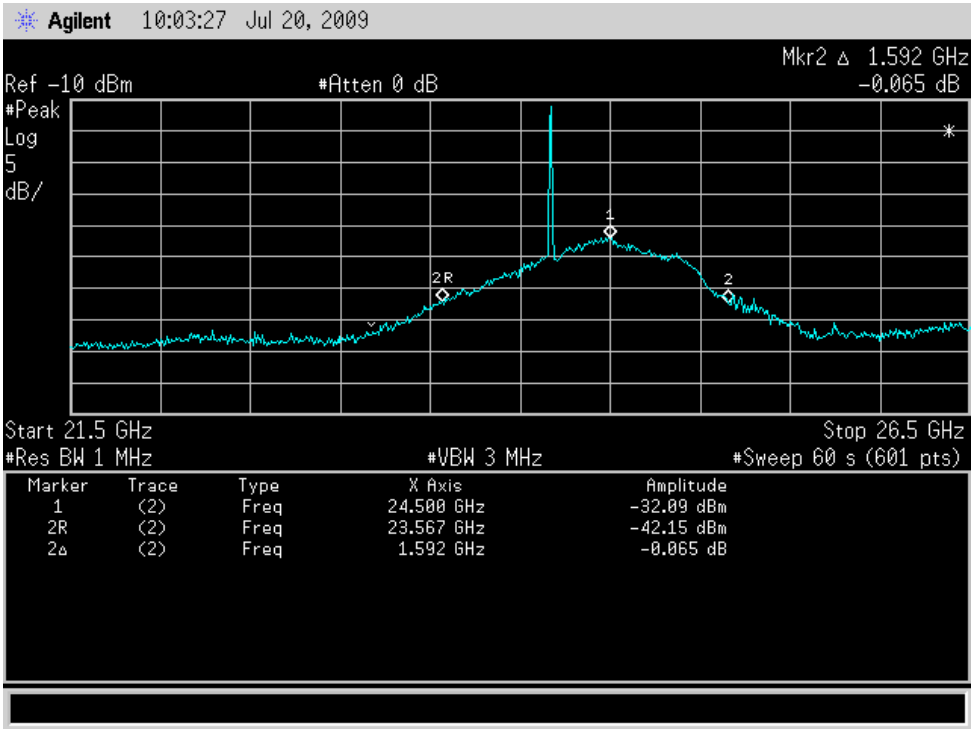
6.3.2. Measurement Data – Short Pulse Mode (Values in GHz)

f_M	The highest emission peak	24.442
f_L	10 dB below the highest peak	23.575
f_H	10 dB above the highest peak	25.258
f_C	Calculated: $(f_H + f_L)/2$	24.4165
Bandwidth	Calculated: $(f_H - f_L)$	1.683
Fractional BW	Calculated: $2*(f_H - f_L)/(f_H + f_L)$	0.06893

Note: the Bandwidth is greater than 500 MHz and therefore the fractional bandwidth requirement does not need to be met.

6.3.3. Measurement Plots

Long Pulse Mode



The peak at 24.175 GHz is related to the receiver's LO and is exempt per 15.101(b) of the rules.

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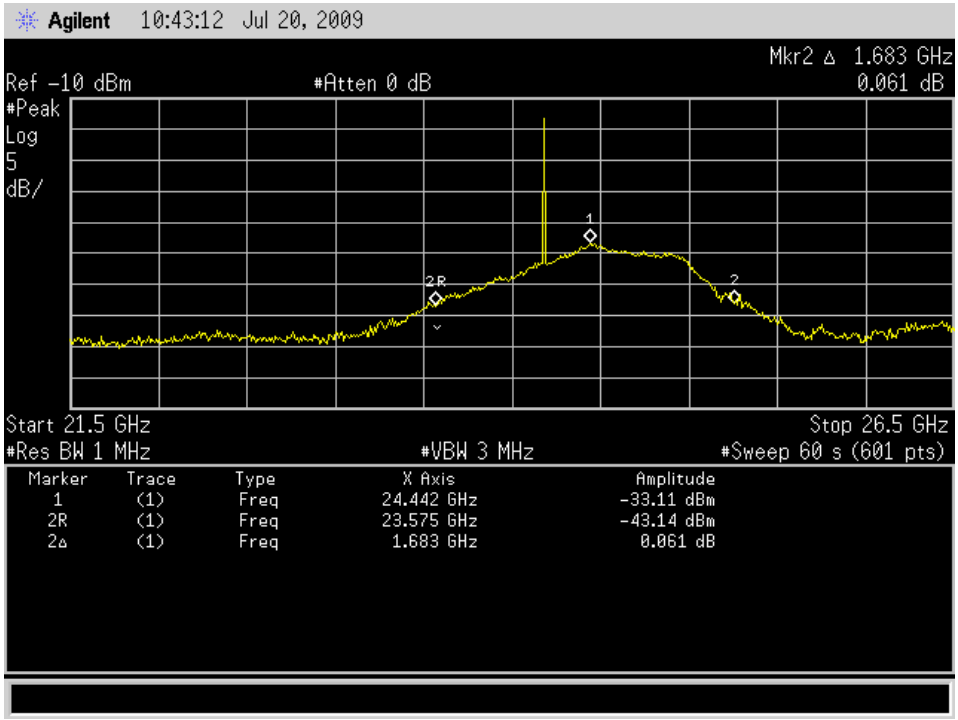
6. Measurement Data (continued)

6.3. UWB Bandwidth (15.515 (b), RSS-220 Sec 4.1) (continued)

6.3.3. Measurement Plots (cont.)

Short Pulse Mode



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6. Measurement Data (continued)

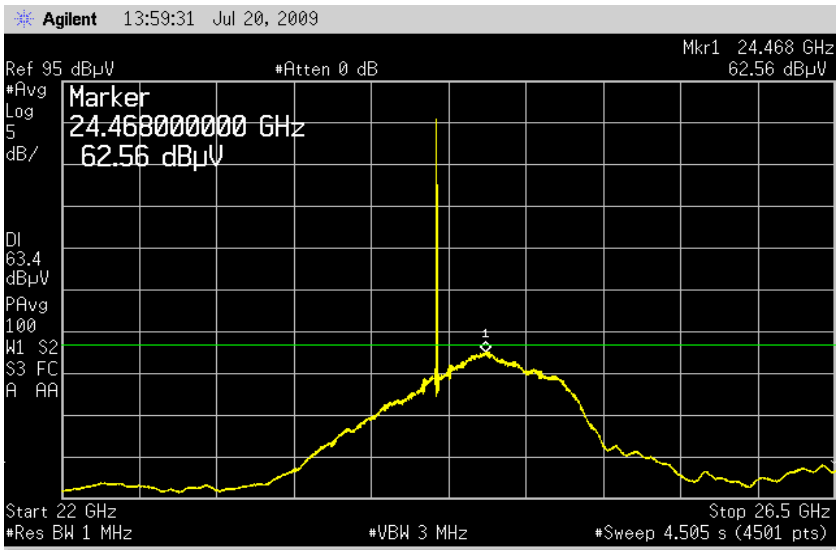
6.3. UWB Radiated Emissions 22 to 26.5 GHz (15.515 (d), RSS-220 Section 3.4)

Mode	Frequency (GHz)	EIRP[1] (dBm)	Limit (dBm)	Margin (dB)	Result
Long Pulse	24.468	-42.18	-41.3	-0.88	Compliant
Short Pulse	24.470	-43.24	-41.3	-1.94	Compliant

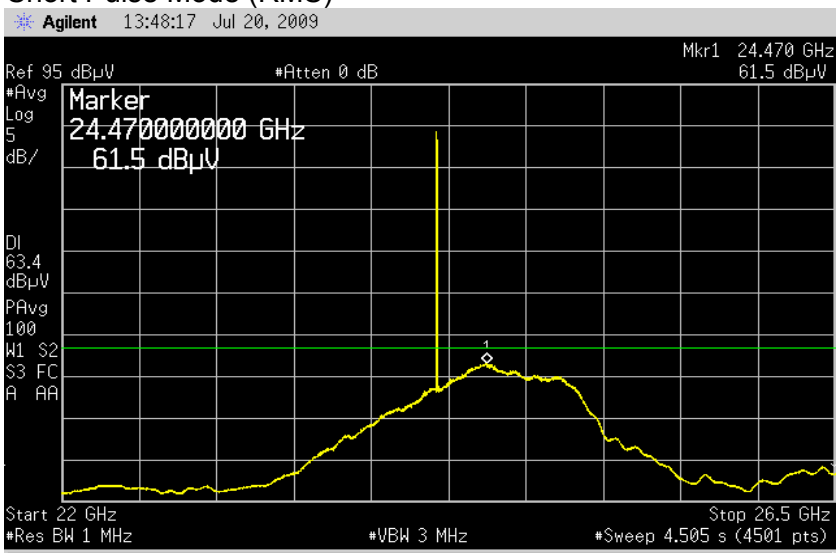
[1] Derived from the field strength measurements and adjusted for distance.

6.3.4. Measurement Plots (RMS)

Long Pulse Mode



Short Pulse Mode (RMS)



The peak at 24.175 GHz is related to the receiver's LO and is exempt per 15.101(b) of the rules.

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6. Measurement Data (continued)

6.4. Emissions Attenuation above the Horizontal Plane

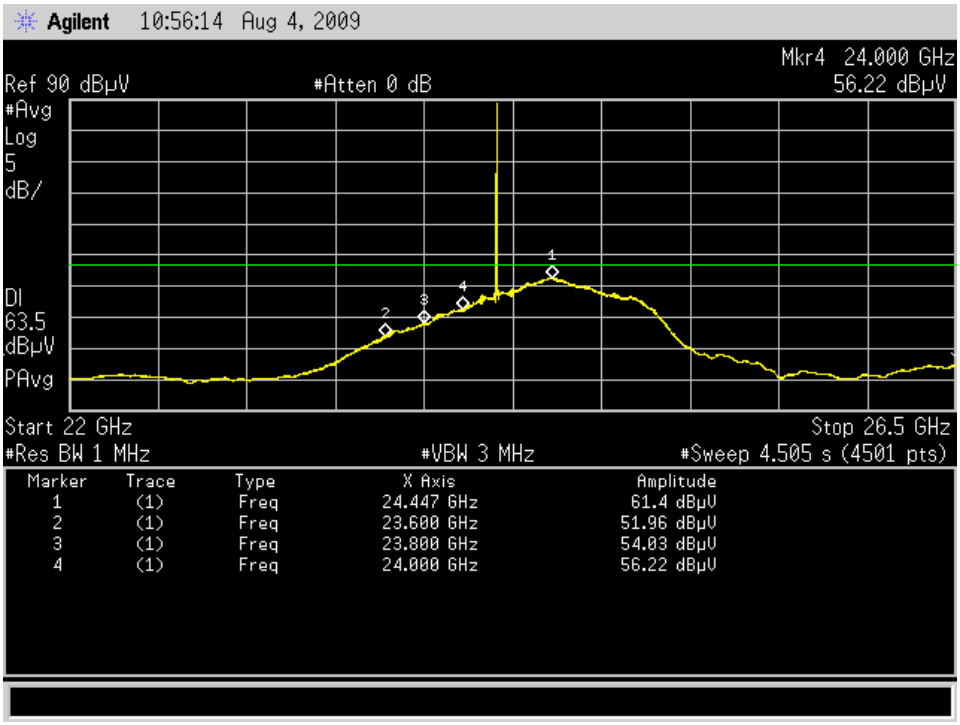
(15.515 (c), RSS-220 Section 4.1(g))

Requirement: Following proper installation, vehicular radar systems shall attenuate any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane by 25 dB below the limit specified in paragraph section 6.5 of this report. [January 1, 2005 requirement].30 dB by January 1, 2010 and 35 dB by January 1, 2014

Test Note: The 0 value on the plots in this section refer to the absolute limit outlined in section 6.5 of this report.

6.4.1. Worst Case Results (Long Pulse Mode)

Angle	Frequency	Sidelobe Attenuation	Boresight Emission Level	Sidelobe Emission Level	Limit	Result
Deg. (°)	(GHz)	(dB)	(dBm)	(dBm)	(dBm)	
30	23.6	-29.706	-11.51	-41.216	-35	Compliant
-62	23.8	-31.678	-9.44	-41.118	-35	Compliant
36	24.0	-31.846	-7.25	-39.096	-35	Compliant



The peak at 24.175 GHz is related to the receiver's LO and is exempt per 15.101(b) of the rules.

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6. Measurement Data (continued)

6.4. Emissions Attenuation above the Horizontal Plane (continued)

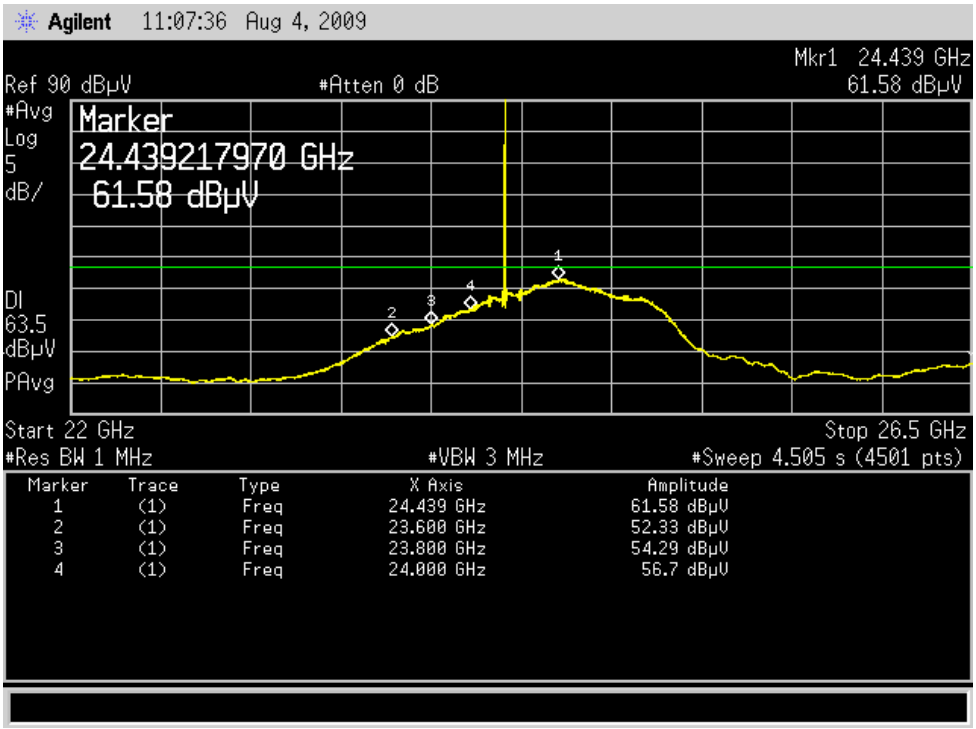
(15.515 (c), RSS-220 Section 4.1(g))

Requirement: Following proper installation, vehicular radar systems shall attenuate any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane by 25 dB below the limit specified in paragraph section 6.5 of this report. [January 1, 2005 requirement] 30 dB by January 1, 2010 and 35 dB by January 1, 2014

Test Note: The 0 value on the plots in this section refer to the absolute limit outlined in section 6.5 of this report.

6.4.2. Worst Case Results (Short Pulse Mode)

Angle	Frequency	Sidelobe Attenuation	Boresight Emission Level	Sidelobe Emission Level	Limit	Result
Deg. (°)	(GHz)	(dB)	(dBm)	(dBm)	(dBm)	
30	23.6	-29.706	-11.14	-40.846	-35	Compliant
-62	23.8	-31.678	-9.18	-40.858	-35	Compliant
36	24.0	-31.846	-6.77	-38.616	-35	Compliant



The peak at 24.175 GHz is related to the receiver's LO and is exempt per 15.101(b) of the rules.

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6. Measurement Data (continued)

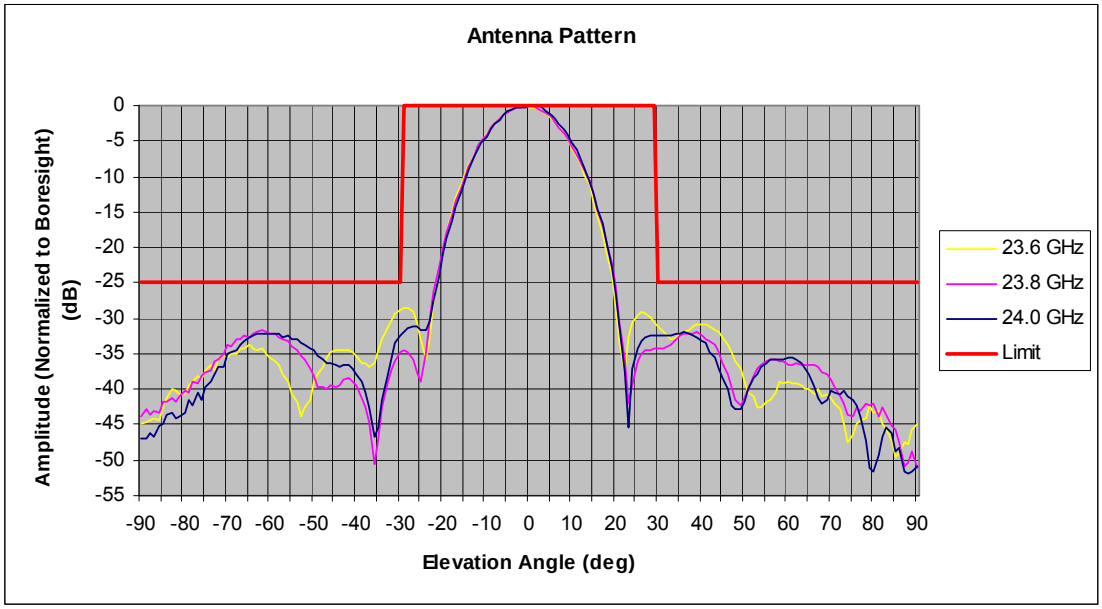
6.4. Emissions Attenuation above the Horizontal Plane (continued)

(15.515 (c), RSS-220 Section 4.1(g))

Requirement: Following proper installation, vehicular radar systems shall attenuate any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane by 25 dB below the limit specified in paragraph section 6.5 of this report. [January 1, 2005 requirement] 30 dB by January 1, 2010 and 35 dB by January 1, 2014

Test Note: The 0 value on the plots in this section refer to the absolute limit outlined in section 6.5 of this report.

6.4.3. Plot of Results with Respect to the Limit in Section 6.5



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6. Measurement Data (continued)

6.4. Emissions Attenuation above the Horizontal Plane (continued)

6.4.4. Numerical Results for the Angular Range -35º to -25º and +25º to +35º

Long Pulse

Frequency	Angle	Sidelobe Attenuation	Boresight Emission Level	Sidelobe Emission Level	Limit	Result
(GHz)	Deg. (º)	(dB)	(dBm)	(dBm)	(dBm)	
23.6	-35	-36.96	-11.51	-48.47	-35	Compliant
	-34	-36.19	-11.51	-47.70	-35	Compliant
	-33	-34.44	-11.51	-45.95	-35	Compliant
	-32	-32.88	-11.51	-44.39	-35	Compliant
	-31	-31.47	-11.51	-42.98	-35	Compliant
	-30	-30.42	-11.51	-41.93	-35	Compliant
	-29	-29.22	-11.51	-40.73	0	Compliant
	-28	-28.69	-11.51	-40.20	0	Compliant
	-27	-28.50	-11.51	-40.01	0	Compliant
	-26	-28.56	-11.51	-40.07	0	Compliant
	-25	-29.13	-11.51	-40.64	0	Compliant
	25	-32.74	-11.51	-44.25	0	Compliant
	26	-30.60	-11.51	-42.11	0	Compliant
	27	-29.53	-11.51	-41.04	0	Compliant
	28	-29.01	-11.51	-40.52	0	Compliant
	29	-29.21	-11.51	-40.72	0	Compliant
	30	-29.71	-11.51	-41.22	-35	Compliant
	31	-30.49	-11.51	-42.00	-35	Compliant
	32	-31.16	-11.51	-42.67	-35	Compliant
	33	-31.96	-11.51	-43.47	-35	Compliant
	34	-32.37	-11.51	-43.88	-35	Compliant
	35	-32.83	-11.51	-44.34	-35	Compliant
23.8	-35	-47.03	-9.44	-56.47	-35	Compliant
	-34	-42.65	-9.44	-52.09	-35	Compliant
	-33	-39.28	-9.44	-48.72	-35	Compliant
	-32	-37.47	-9.44	-46.91	-35	Compliant
	-31	-36.13	-9.44	-45.57	-35	Compliant
	-30	-34.76	-9.44	-44.20	-35	Compliant
	-29	-34.47	-9.44	-43.91	0	Compliant
	-28	-34.72	-9.44	-44.16	0	Compliant
	-27	-35.80	-9.44	-45.24	0	Compliant
	-26	-37.59	-9.44	-47.03	0	Compliant
	-25	-38.99	-9.44	-48.43	0	Compliant
	25	-36.10	-9.44	-45.54	0	Compliant
	26	-35.02	-9.44	-44.46	0	Compliant
	27	-34.57	-9.44	-44.01	0	Compliant
	28	-34.43	-9.44	-43.87	0	Compliant
	29	-34.35	-9.44	-43.79	0	Compliant
	30	-34.20	-9.44	-43.64	-35	Compliant
	31	-34.30	-9.44	-43.74	-35	Compliant
	32	-34.00	-9.44	-43.44	-35	Compliant
	33	-33.79	-9.44	-43.23	-35	Compliant
	34	-32.96	-9.44	-42.40	-35	Compliant
	35	-32.32	-9.44	-41.76	-35	Compliant

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6. Measurement Data (continued)

6.4. Emissions Attenuation above the Horizontal Plane (continued)

6.4.4. Numerical Results for the Angular Range -35º to -25º and +25º to +35º

Long Pulse (continued)

Frequency	Angle	Sidelobe Attenuation	Boresight Emission Level	Sidelobe Emission Level	Limit	Result
(GHz)	Deg. (º)	(dB)	(dBm)	(dBm)	(dBm)	
24	-35	-45.29	-7.25	-52.54	-35	Compliant
	-34	-41.38	-7.25	-48.63	-35	Compliant
	-33	-38.01	-7.25	-45.26	-35	Compliant
	-32	-35.72	-7.25	-42.97	-35	Compliant
	-31	-33.42	-7.25	-40.67	-35	Compliant
	-30	-32.45	-7.25	-39.70	-35	Compliant
	-29	-31.84	-7.25	-39.09	0	Compliant
	-28	-31.46	-7.25	-38.71	0	Compliant
	-27	-31.20	-7.25	-38.45	0	Compliant
	-26	-31.11	-7.25	-38.36	0	Compliant
	-25	-31.63	-7.25	-38.88	0	Compliant
	25	-34.25	-7.25	-41.50	0	Compliant
	26	-33.11	-7.25	-40.36	0	Compliant
	27	-32.68	-7.25	-39.93	0	Compliant
	28	-32.54	-7.25	-39.79	0	Compliant
	29	-32.38	-7.25	-39.63	0	Compliant
	30	-32.46	-7.25	-39.71	-35	Compliant
	31	-32.49	-7.25	-39.74	-35	Compliant
	32	-32.41	-7.25	-39.66	-35	Compliant
	33	-32.37	-7.25	-39.62	-35	Compliant
	34	-32.18	-7.25	-39.43	-35	Compliant
	35	-32.10	-7.25	-39.35	-35	Compliant

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6. Measurement Data (continued)

6.4. Emissions Attenuation above the Horizontal Plane (continued)

6.4.4. Numerical Results for the Angular Range -35º to -25º and +25º to +35º

Short Pulse

Frequency	Angle	Sidelobe Attenuation	Boresight Emission Level	Sidelobe Emission Level	Limit	Result
(GHz)	Deg. (º)	(dB)	(dBm)	(dBm)	(dBm)	
23.6	-35	-36.96	-11.14	-48.10	-35	Compliant
	-34	-36.19	-11.14	-47.33	-35	Compliant
	-33	-34.44	-11.14	-45.58	-35	Compliant
	-32	-32.88	-11.14	-44.02	-35	Compliant
	-31	-31.47	-11.14	-42.61	-35	Compliant
	-30	-30.42	-11.14	-41.56	-35	Compliant
	-29	-29.22	-11.14	-40.36	0	Compliant
	-28	-28.69	-11.14	-39.83	0	Compliant
	-27	-28.50	-11.14	-39.64	0	Compliant
	-26	-28.56	-11.14	-39.70	0	Compliant
	-25	-29.13	-11.14	-40.27	0	Compliant
	25	-32.74	-11.14	-43.88	0	Compliant
	26	-30.60	-11.14	-41.74	0	Compliant
	27	-29.53	-11.14	-40.67	0	Compliant
	28	-29.01	-11.14	-40.15	0	Compliant
	29	-29.21	-11.14	-40.35	0	Compliant
	30	-29.71	-11.14	-40.85	-35	Compliant
	31	-30.49	-11.14	-41.63	-35	Compliant
	32	-31.16	-11.14	-42.30	-35	Compliant
	33	-31.96	-11.14	-43.10	-35	Compliant
	34	-32.37	-11.14	-43.51	-35	Compliant
	35	-32.83	-11.14	-43.97	-35	Compliant
23.8	-35	-47.03	-9.18	-56.21	-35	Compliant
	-34	-42.65	-9.18	-51.83	-35	Compliant
	-33	-39.28	-9.18	-48.46	-35	Compliant
	-32	-37.47	-9.18	-46.65	-35	Compliant
	-31	-36.13	-9.18	-45.31	-35	Compliant
	-30	-34.76	-9.18	-43.94	-35	Compliant
	-29	-34.47	-9.18	-43.65	0	Compliant
	-28	-34.72	-9.18	-43.90	0	Compliant
	-27	-35.80	-9.18	-44.98	0	Compliant
	-26	-37.59	-9.18	-46.77	0	Compliant
	-25	-38.99	-9.18	-48.17	0	Compliant
	25	-36.10	-9.18	-45.28	0	Compliant
	26	-35.02	-9.18	-44.20	0	Compliant
	27	-34.57	-9.18	-43.75	0	Compliant
	28	-34.43	-9.18	-43.61	0	Compliant
	29	-34.35	-9.18	-43.53	0	Compliant
	30	-34.20	-9.18	-43.38	-35	Compliant
	31	-34.30	-9.18	-43.48	-35	Compliant
	32	-34.00	-9.18	-43.18	-35	Compliant
	33	-33.79	-9.18	-42.97	-35	Compliant
	34	-32.96	-9.18	-42.14	-35	Compliant
	35	-32.32	-9.18	-41.50	-35	Compliant

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6. Measurement Data (continued)

6.4. Emissions Attenuation above the Horizontal Plane (continued)

6.4.4. Numerical Results for the Angular Range -35º to -25º and +25º to +35º

Short Pulse (continued)

Frequency	Angle	Sidelobe Attenuation	Boresight Emission Level	Sidelobe Emission Level	Limit	Result
(GHz)	Deg. (º)	(dB)	(dBm)	(dBm)	(dBm)	
24	-35	-45.29	-6.77	-52.06	-35	Compliant
	-34	-41.38	-6.77	-48.15	-35	Compliant
	-33	-38.01	-6.77	-44.78	-35	Compliant
	-32	-35.72	-6.77	-42.49	-35	Compliant
	-31	-33.42	-6.77	-40.19	-35	Compliant
	-30	-32.45	-6.77	-39.22	-35	Compliant
	-29	-31.84	-6.77	-38.61	0	Compliant
	-28	-31.46	-6.77	-38.23	0	Compliant
	-27	-31.20	-6.77	-37.97	0	Compliant
	-26	-31.11	-6.77	-37.88	0	Compliant
	-25	-31.63	-6.77	-38.40	0	Compliant
	25	-34.25	-6.77	-41.02	0	Compliant
	26	-33.11	-6.77	-39.88	0	Compliant
	27	-32.68	-6.77	-39.45	0	Compliant
	28	-32.54	-6.77	-39.31	0	Compliant
	29	-32.38	-6.77	-39.15	0	Compliant
	30	-32.46	-6.77	-39.23	-35	Compliant
	31	-32.49	-6.77	-39.26	-35	Compliant
	32	-32.41	-6.77	-39.18	-35	Compliant
	33	-32.37	-6.77	-39.14	-35	Compliant
	34	-32.18	-6.77	-38.95	-35	Compliant
	35	-32.10	-6.77	-38.87	-35	Compliant

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6. Measurement Data (continued)

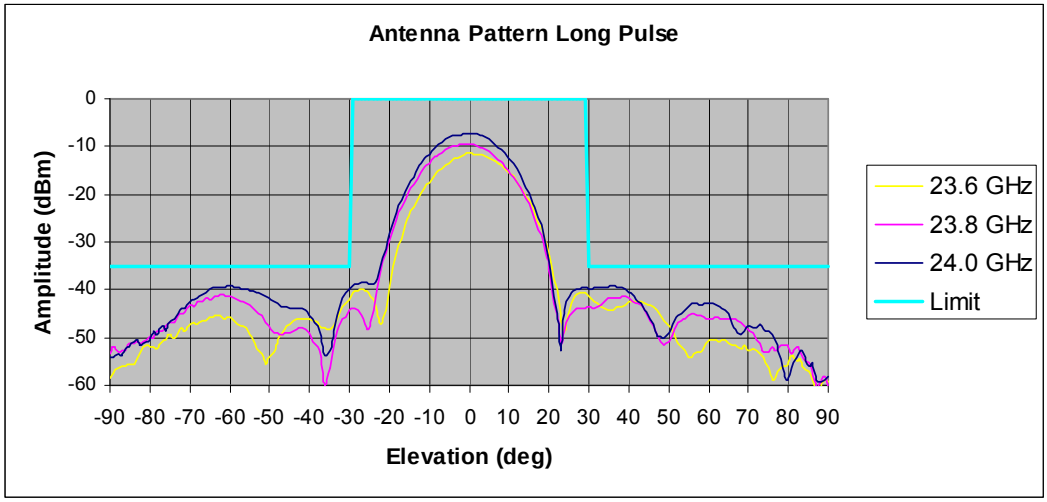
6.4. Emissions Attenuation above the Horizontal Plane (continued)

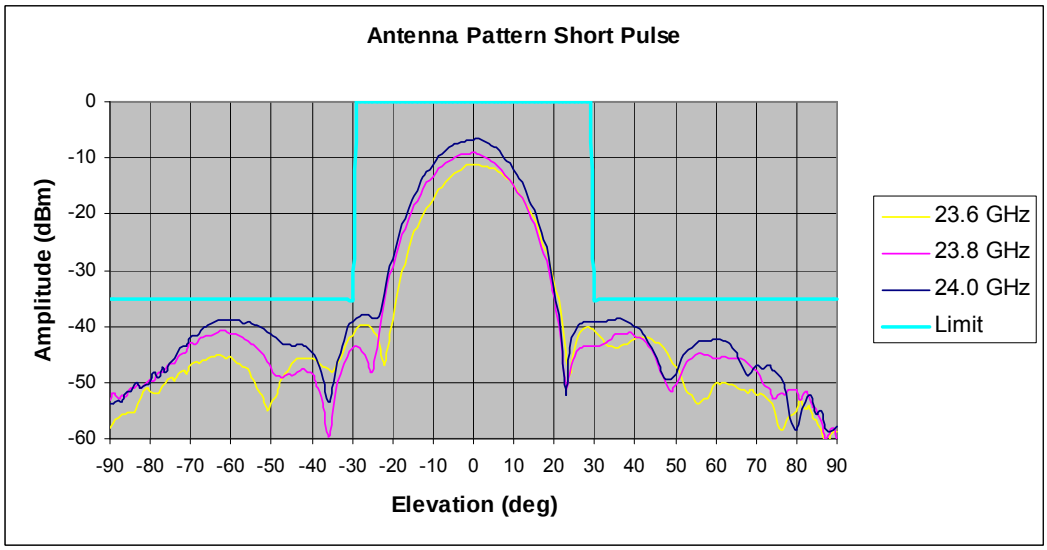
(15.515 (c), RSS-220 Section 4.1 (g))

Requirement: Following proper installation, vehicular radar systems shall attenuate any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane by 25 dB below the limit specified in paragraph section 6.5 of this report. [January 1, 2005 requirement] 30 dB by January 1, 2010 and 35 dB by January 1, 2014

Test Note: The 0 value on the plots in this section refer to the absolute limit outlined in section 6.5 of this report.

6.4.4. Plot of Results with Respect to the Limit in Section 6.5





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6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.515 (d), 15.209, RSS-220 Section 4.1(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:

Frequency (MHz)	EIRP (dBm)
960 - 1610	-75.3
1610 - 22000	-61.3
22000 - 29000	-41.3
29000 - 31000	-51.3
Above 31000	-61.3

Spurious Radiated Emissions in GPS Bands
(15.515 (e), 15.209, RSS-220 Section 4.1(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)
1164 - 1240	-85.3
1559 - 1610	-85.3

Radiated Emissions Field Strength Limits at 3 Meters
(Section 15.209, RSS-GEN)

Frequency (MHz)	Field Strength (dBµV/m)
30 - 88	40
88 - 216	43.5
216 - 960	46
960 - 100,000	54

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

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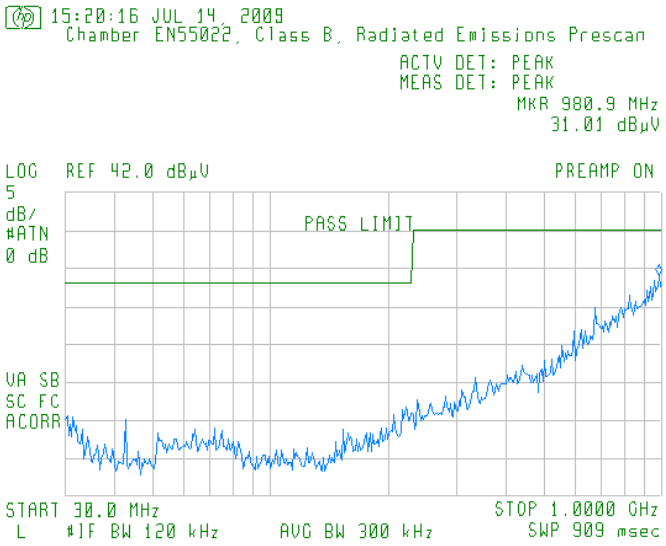
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.515 (d), 15.209, RSS-220 Section 4.1(d))

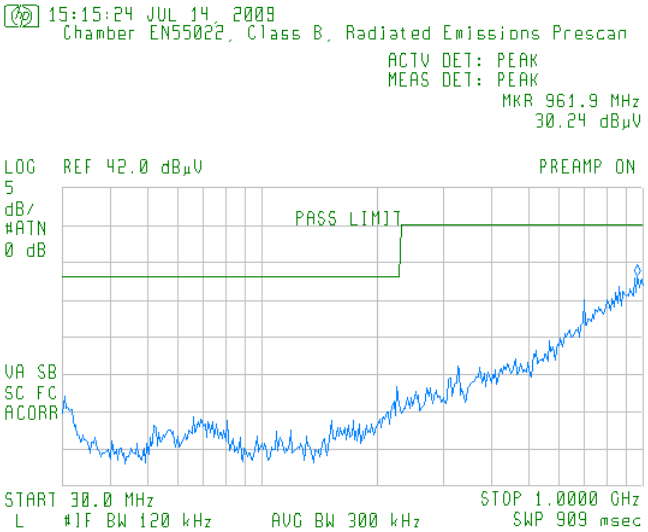
6.5.1. 30 MHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

Horizontal Measurement Polarity



Vertical Measurement Polarity



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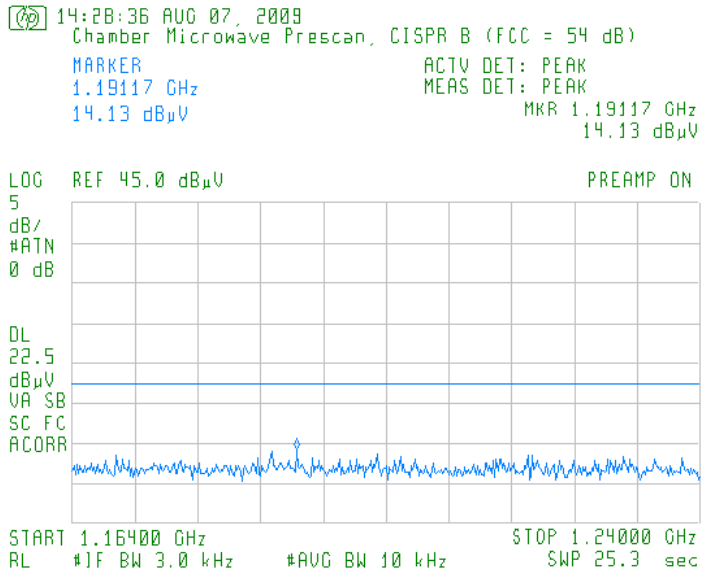
6. Measurement Data (continued)

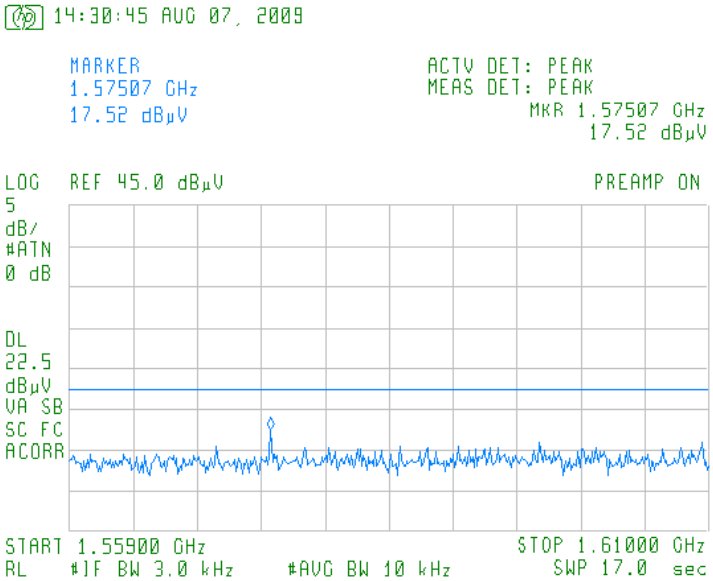
6.5. Spurious Radiated Emissions (15.515 (d), 15.209, RSS-220 Section 4.1(d))

Spurious Radiated Emissions in GPS Bands (15.515 (e), 15.209, RSS-GEN)

6.5.2 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 1 Meter and the -85.3 dBm limit was converted to a field strength limit of 22.5 dBuV/m.





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6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.515 (d), 15.209, RSS-220 Section 4.1(d))

6.5.3. 960 MHz to 40 GHz

Freq. (GHz)	Amplitude (dBµV)		Corr. Factor (dB)	Amplitude (dBµV/m)		Limit (dBµV/m)	Margin (dB)	Pol (H/V)	El. (cm)	Az. (deg)
	Peak	Avg		Peak	Avg					
12.084125	55.60	39.92	Included	55.60	39.92	54	-14.08	V	100	0

There were no other measurable emissions between 960 MHz and 40 GHz other than the UWB signal and the 24.175 GHz Receiver L.O.

6.5.4. 40 GHz to 100 GHz

Frequency (GHz)	Amplitude (dBµV/m) [2]		Average Limit	Margin (dB)	Ant Pol	Ant Ht	TT Pos	Result
	Peak	Avg	Avg		H/V	cm	Deg	
48.342	24.06	14.77	54.00	-39.23	V	100	0	Compliant
60	There were no measurable emissions at 60 GHz							Compliant
72	There were no measurable emissions at 72 GHz							Compliant
84	There were no measurable emissions at 84 GHz							Compliant
96	There were no measurable emissions at 96 GHz							Compliant

[1] Individual points representing the low, middle and high points of the device under test were taken across the span of the measured signal in non-sweeping mode. Refer to Section 3.1 for information regarding sweeping vs. non-sweeping modes.

[2] Measurement taken at 50 centimeters and corrected for a 3-meter distance. Distance and measurement equipment correction factors are included in the columns 2 and 3 test data.

There were no other measurable emissions between 40 and 100 GHz other than the 2nd Harmonic of the 24.175 GHz Receiver L.O.

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6. Measurement Data (continued)

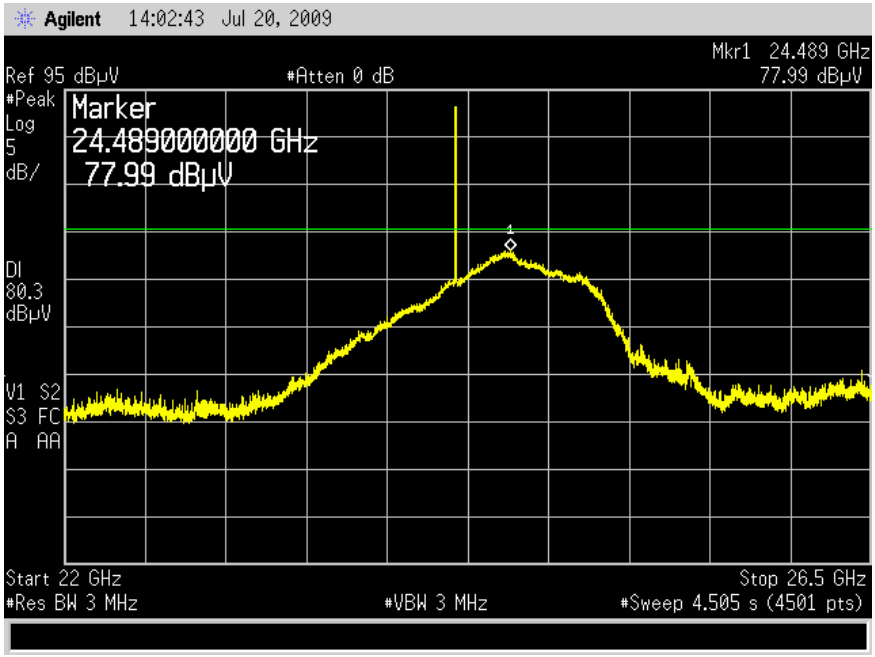
6.6. Peak Emissions in a 50 MHz Bandwidth (15.515 (f), RSS-220 Section 4.1 (h))

Requirement: There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, 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.

Refer to the measurement data in Section 6.3. The resolution bandwidth used to perform the measurements was 3 MHz and the limit was adjusted to -24.44 dBm or 80.26 dBuV/m at 1 meter.

Long Pulse Mode

Highest emission peak (f_M) GHz:	24.489
Adjusted limit based on a 3 MHz bandwidth:	80.26
Measured value in a 3 MHz bandwidth:	77.99
Margin:	-2.27



The peak at 24.175 GHz is related to the receiver's LO and is exempt per 15.101(b) of the rules.

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6. Measurement Data (continued)

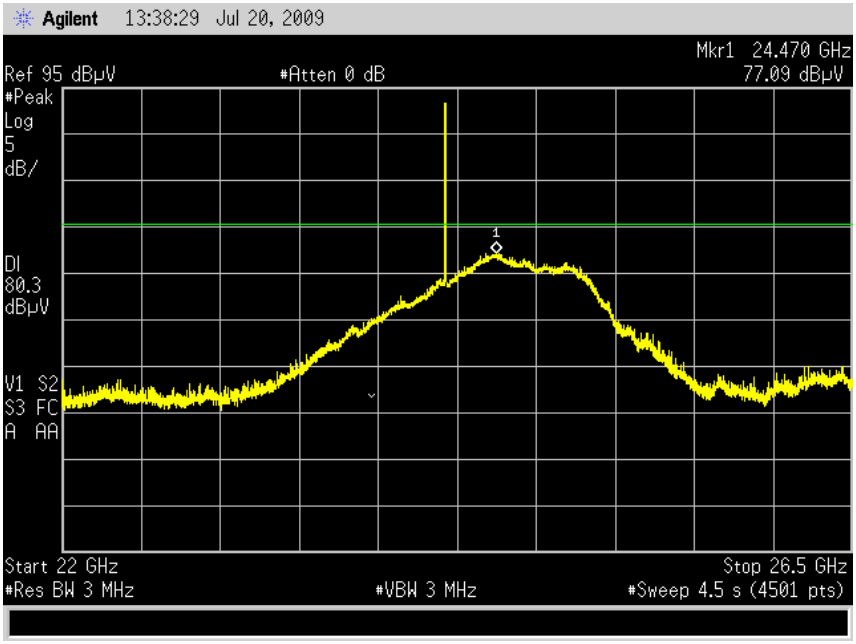
6.6. Peak Emissions in a 50 MHz Bandwidth (15.515 (f), RSS-220 Section 4.1(h))

Requirement: There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, 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.

Refer to the measurement data in Section 6.3. The resolution bandwidth used to perform the measurements was 3 MHz and the limit was adjusted to -24.44 dBm or 80.26 dBuV/m at 1 Meter.

Short Pulse Mode

Highest emission peak (f_M) GHz:	24.470
Adjusted limit based on a 3 MHz bandwidth:	80.26
Measured value in a 3 MHz bandwidth:	77.09
Margin:	-3.17



The peak at 24.175 GHz is related to the receiver's LO and is exempt per 15.101(b) of the rules.

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6. Measurement Data (continued)

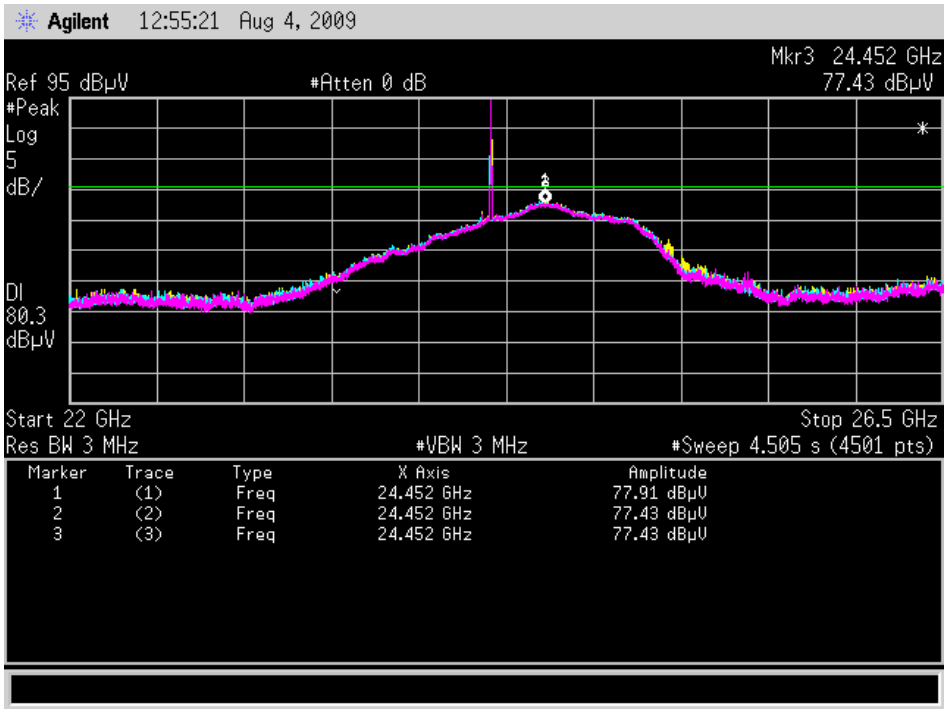
6.7. Devices that Employ Gated Transmissions

Requirement: The emission levels from devices operating under the provisions of this section that employ gated transmissions may be measured with the gating active. Measurements made in this manner shall be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

6.8. Effect of Voltage Variations on Peak Emissions (15.215, RSS-GEN)

Requirement: Devices operating under this provision shall not increase in amplitude or change in bandwidth of the emission whereas it would fall out of the requirements of these rules.

Result: Three traces from the spectrum analyzer were used. Trace 1 – Yellow represents the device at 12 VDC. Trace 2 – Blue represents the device operating at 9 VDC and Trace 3 – Purple Represents the device operating at 15 VDC. The plots show that both the amplitude and bandwidth of the signal is not significantly affected by voltage variations.



The peak at 24.175 GHz is related to the receiver's LO and is exempt per 15.101(b) of the rules.

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6. Measurement Data (continued)

6.9. Transmitter Frequency Stability of Unmodulated Carrier (RSS-GEN 4.7)

Requirement: Frequency stability is a measure of frequency drift due to temperature and supply voltage variations with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage. Measure the device at temperatures of -30, +20 and +50 degrees C at the rated supply voltage and at a temperature of +20 degrees C at +/- 15 percent of the rated supply voltage. Measurement should be made on an unmodulated carrier frequency.

Temperature & Voltage Conditions	Low (GHz)	High (GHz)
+20 Degrees C 12 VDC	24.1670	24.1720
+20 Degrees C 10.2 VDC	24.1800	24.1930
+20 Degrees C 13.8 VDC	24.1800	24.1850
-30 Degrees C 12 VDC	24.1675	24.1775
+50 Degrees C 12 VDC	24.1800	24.1820
Minimum and Maximum Frequencies	**24.1670**	**24.1930**

6.10. Public Exposure to Radio Frequency Energy Levels (15.247(i) (1.1307 (b)(1)) RSS-GEN 5.5, RSS 102

6.10.1. MPE Power Density Table.

MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	Power Density (mW/cm^2)	Power Density (W/m^2)	Limit (mW/cm^2)	Result
(1)	(2)	(3)	(4)		(5)	
20	-26.71	0.00000	0.0000004	0.0000042	1	Compliant

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

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.

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7. Test Images

7.1. Spurious and Harmonic Emissions - Front

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7. Test Images

7.2. Spurious and Harmonic Emissions - Rear

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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 Federal Communications Commission (FCC) and Industry Canada standards. A description of the test sites is on file with the FCC (registration number **96392**) and Industry Canada (file number **IC 3023A-1)**.

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.

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

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