

EMC Test Report

Project Number: 4108818

Report Number: 4108818EMC01

Revision Level: 0

Client: Time Domain Corporation

Equipment Under Test: UWB transmitter

Model Number: P330

FCC ID: NUF-P330-A

Applicable Standards: FCC Part 15, Subpart F

ANSI C63.10:2013

Report issued on: 27 February 2017

Test Result: Compliant

Tested by:



Jeremy O. Pickens, Senior EMC Engineer

Reviewed by:



David Schramm, EMC/RF/SAR/HAC Manager

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 Summary of Test Results

Reference	Description	Test Result
15.519(b)	10dB bandwidth contained within 3100 to 10600 MHz	Compliant
15.503(d)	10dB bandwidth greater than 500 MHz	Compliant
15.519(c)	Radiated emissions above 960 MHz	Compliant
15.519(d)	Radiated emissions in GPS receive band	Compliant
15.519(e)	Peak emission in a 50 MHz bandwidth	Compliant
15.519(c)	Radiated emissions below 960 MHz per 15.209	Compliant
15.107	Conducted emissions	Compliant

1.1 Modifications Required to Compliance

None

2 General Information

2.1 *Client Information*

Name: Time Domain
Address: 4955 Corporate Dr. NW, Suite 101
City, State, Zip, Country: Huntsville, AL 35805, USA

2.2 *Test Laboratory*

Name: SGS North America, Inc.
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA

2.3 *General Information of EUT*

Model Number: P330
Serial Number: 2247BAK03N0122

Voltage: 5Vdc provided by USB power Supply (120Vac, 60Hz)

Sample Received Date: 13 February 2017
Dates of testing: 13 -14 February 2017

2.4 *Operating Modes and Conditions*

The EUT was programmed by the manufacturer to transmit continuously.

3 UWB Bandwidth requirements

3.1 Test Result

Test Description	Reference	Test Result
10dB bandwidth contained within 3100 MHz and 10,600 MHz	15.519(b)	Compliant
10dB bandwidth greater than 500 MHz	15.503(d)	Compliant

3.2 Test Method

The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3,100 MHz and 10,600 MHz.

Ultra-wideband (UWB) transmitter: An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

3.3 Test Site

3m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.8°C

Relative Humidity: 28.1 %

3.4 Test Equipment

Test End Date: 14-Feb-2017

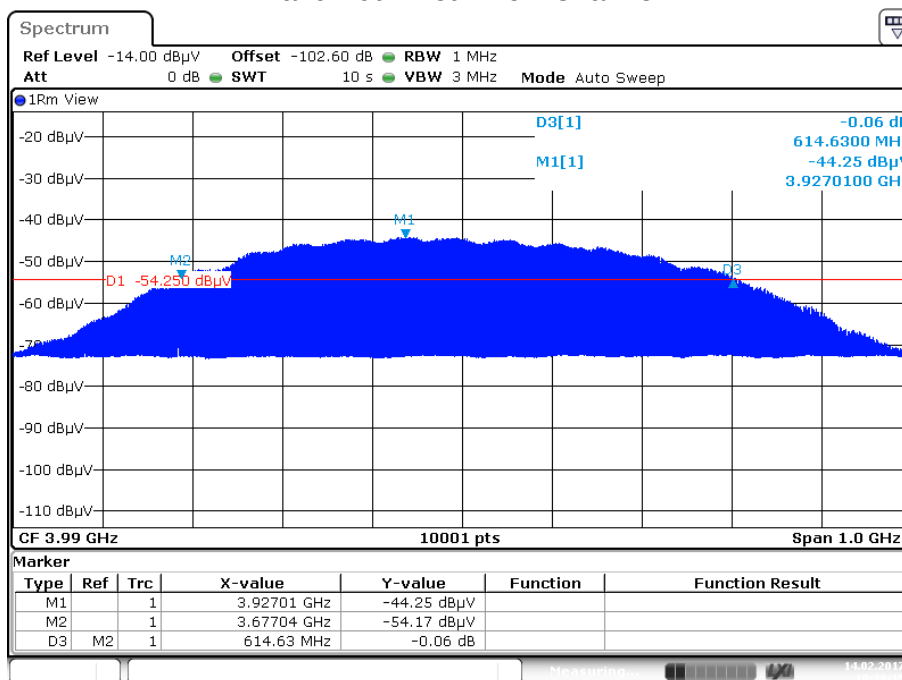
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	20-Jun-2017
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	29-Jul-2017
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	29-Jul-2017
RF CABLE	104PE	HUBER & SUHNER	B079793	27-Jul-2017

Note: The calibration period for this equipment is 1 year.

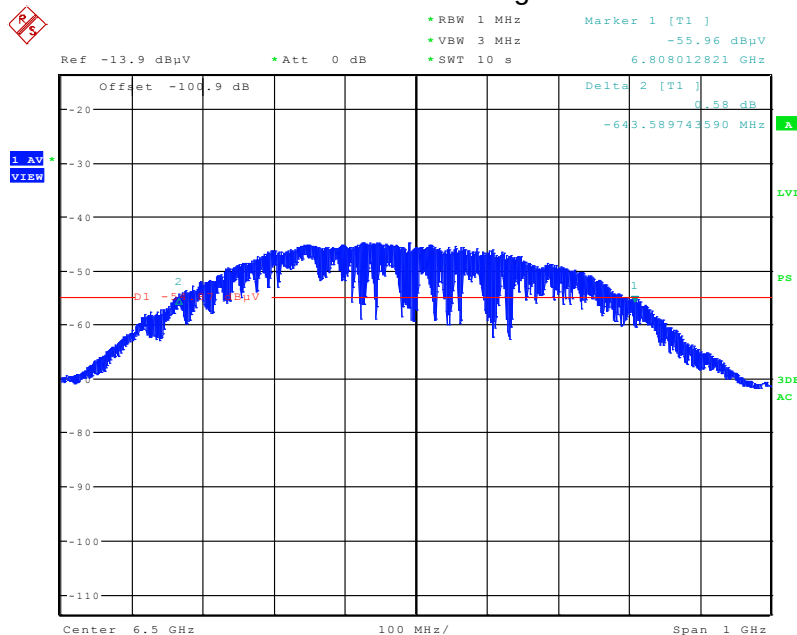
3.5 Test Data

Bandwidth Plot – Low Channel



Date: 14.FEB.2017 10:38:15

Bandwidth Plot – High Channel



Date: 13.FEB.2017 13:27:44

Bandwidth Results					
Antenna Polarity	Frequency 10dB below peak MHz	Frequency 10dB above peak MHz	10 dB bandwidth MHz	Bandwidth requirement >500 MHz	Detectors / RBW / VBW
V	3677.0	4291.6	614.6	Compliant	RMS 1MHz / 3MHz
V	6164.4	6808	643.6	Compliant	RMS 1MHz / 3MHz

4 Radiated emissions above 960 MHz

4.1 Test Result

Test Description	Reference	Test Result
Radiated emissions above 960 MHz	15.519(c)	Compliant

4.2 Test Method

Emissions from a transmitter operating under this section shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

- 1) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following RMS average limits based on measurements using a 1 MHz resolution bandwidth:

Frequency (MHz)	EIRP in dBm	EIRP (dBμV/m) at 3m	EIRP (dBμV/m) at 1m	EIRP (dBμV/m) at 0.5m
960–1610	-75.3	19.9	29.4	35.5
1610–1990	-63.3	31.9	41.4	47.5
1990–3100	-61.3	33.9	43.4	49.5
3100–10600	-41.3	53.9	63.4	69.5
Above 10600	-61.3	33.9	43.4	49.5

Because the limits are so low, some bands may have been scanned at a distance closer than 1 meter. If any emissions were detected in these bands, final measurements were made at distance of 1 meter or greater. The actual distance for final measurement was indicated in the measurement data.

4.3 Test Site

3m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.8°C

Relative Humidity: 28.0 %

4.4 Test Equipment

Test End Date: 14-Feb-2017

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	20-Jun-2017
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2017
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	29-Jul-2017
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	29-Jul-2017
RF CABLE	104PE	HUBER & SUHNER	B079793	27-Jul-2017
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2017
RF CABLE	SF102	HUBER & SUHNER	B079823	27-Jul-2017
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	29-Jul-2017
HORN(SMALL)	LB-180400-20-C-KF	A-INFO	15007	29-Mar-2017

Note: The equipment calibration period is 1 year.

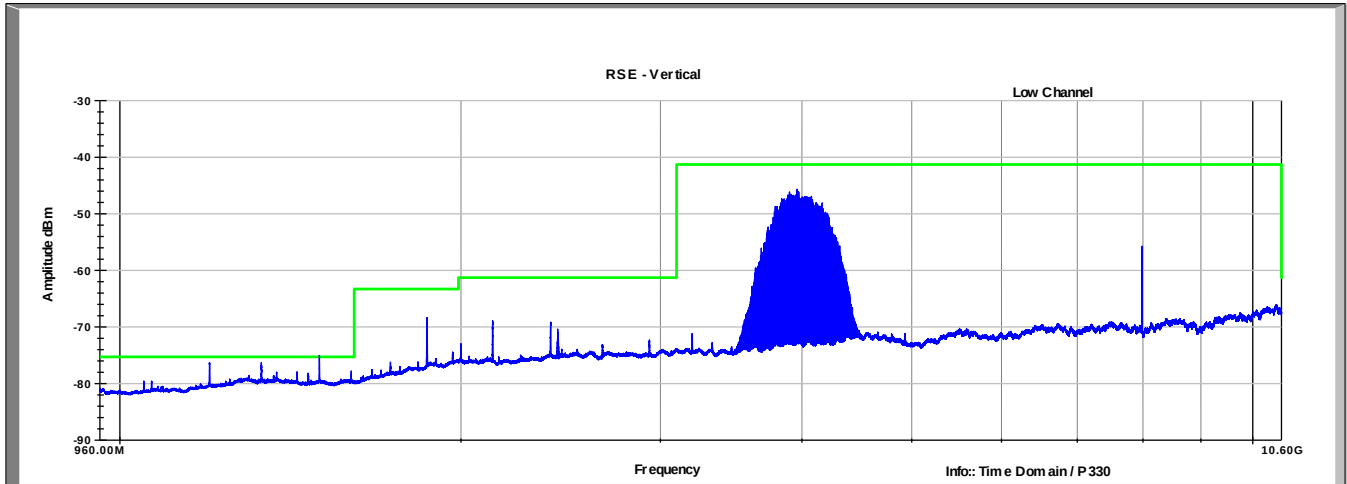
Software:

“Radiated Emissions 1-18GHz.TIL” TILE! profile dated Dec 2015

“Radiated Emissions 18-40GHz.TIL” TILE! profile dated Dec 2015

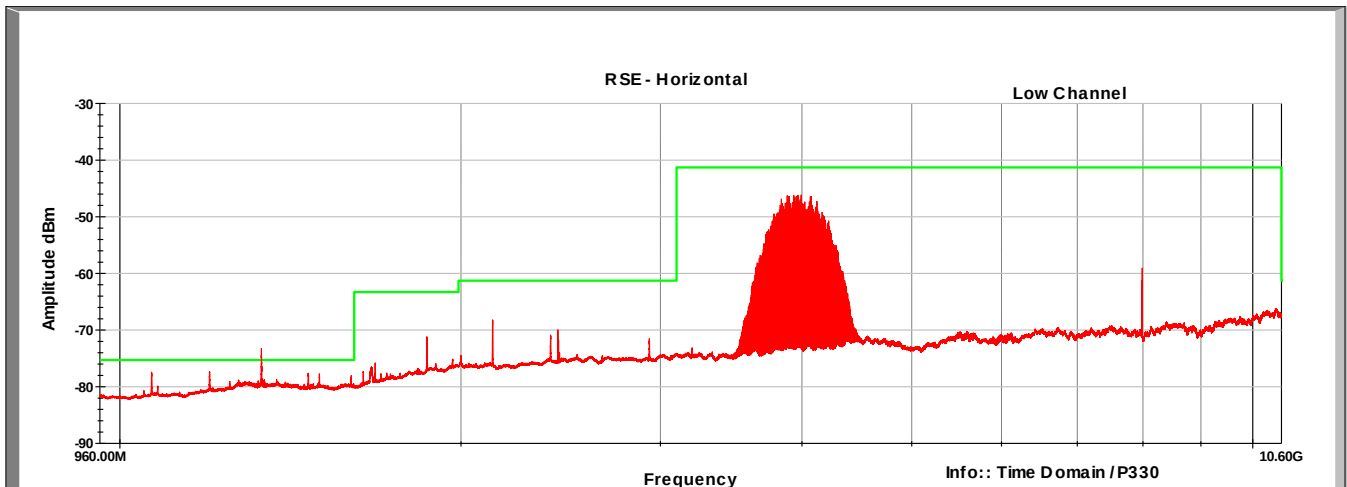
4.5 Test Data – Low Channel

Radiated Emissions (960MHz – 10.6GHz) – Vertical
Test Distance = 1 meter



Digital Emissions not related to UWB intentional transmissions

Radiated Emissions (960MHz – 10.6GHz) – Horizontal
Test Distance = 1 meter



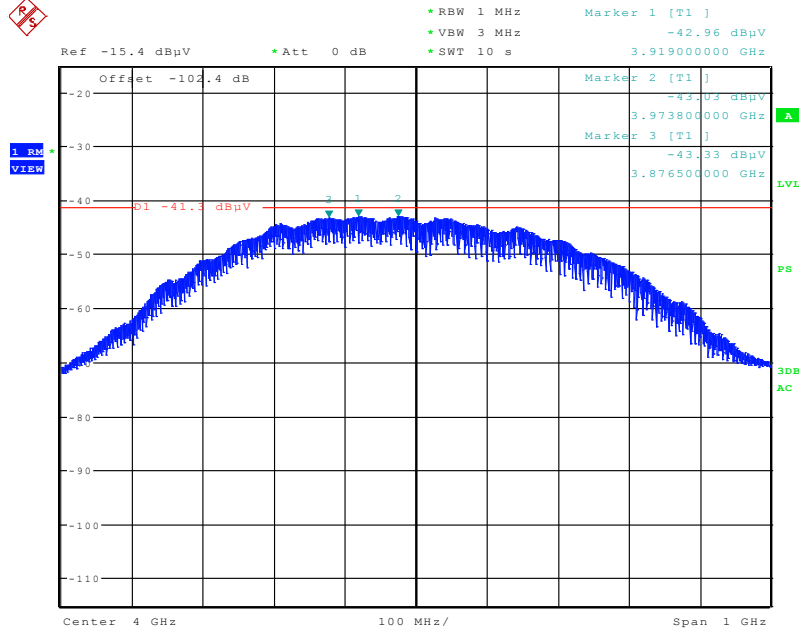
Digital Emissions not related to UWB intentional transmissions

Test Distance: 1.0m

Frequency MHz	Antenna Polarity	Measured RMS value	RMS Limit dBm	Margin dB
1199.747	V	-76.3	-75.3	-1.0
1332.972	V	-76.3	-75.3	-1.0
1499.84	V	-75.1	-75.3	+0.3
1200.132	H	-77.4	-75.3	-2.1
1333.261	H	-73.3	-75.3	+2.0

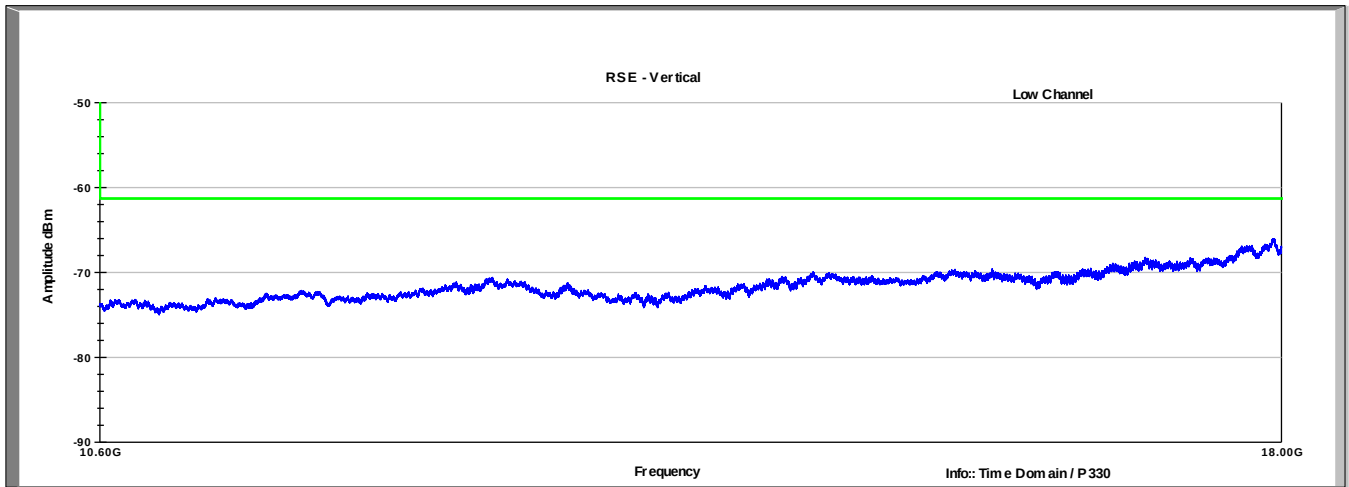
* These emissions were from the digital portion of the device unrelated to the UWB transmission and meet the 15.209 radiated limits.

Fundamental – Low Channel

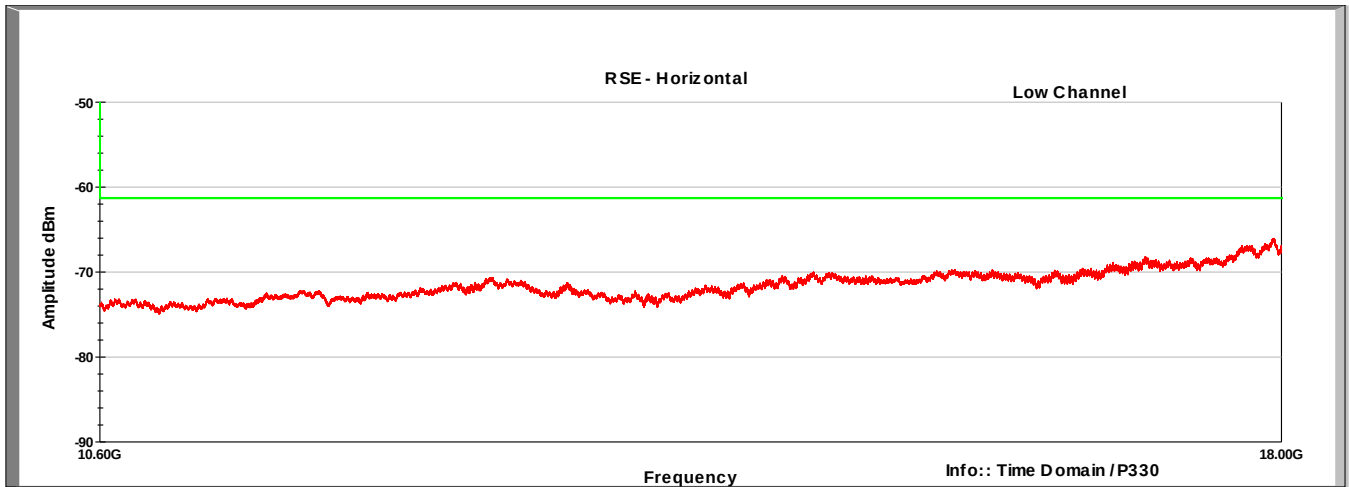


Antenna Polarity	Frequency (MHz)	Measured RMS value	RMS Limit dBm	Margin dB
V	3876.5	-43.3	-41.3	-2.0
V	3919.8	-43.0	-41.3	-1.7
V	3973.8	-43.0	-41.3	-1.7

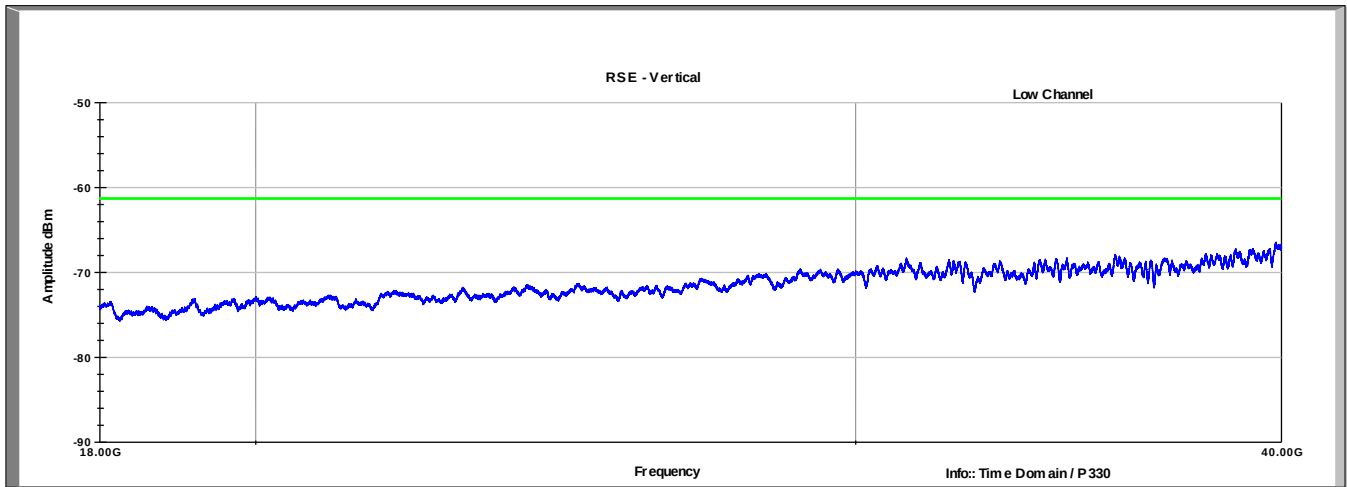
Radiated Emissions (10.6-18GHz) – Vertical
Test Distance = 1 meter



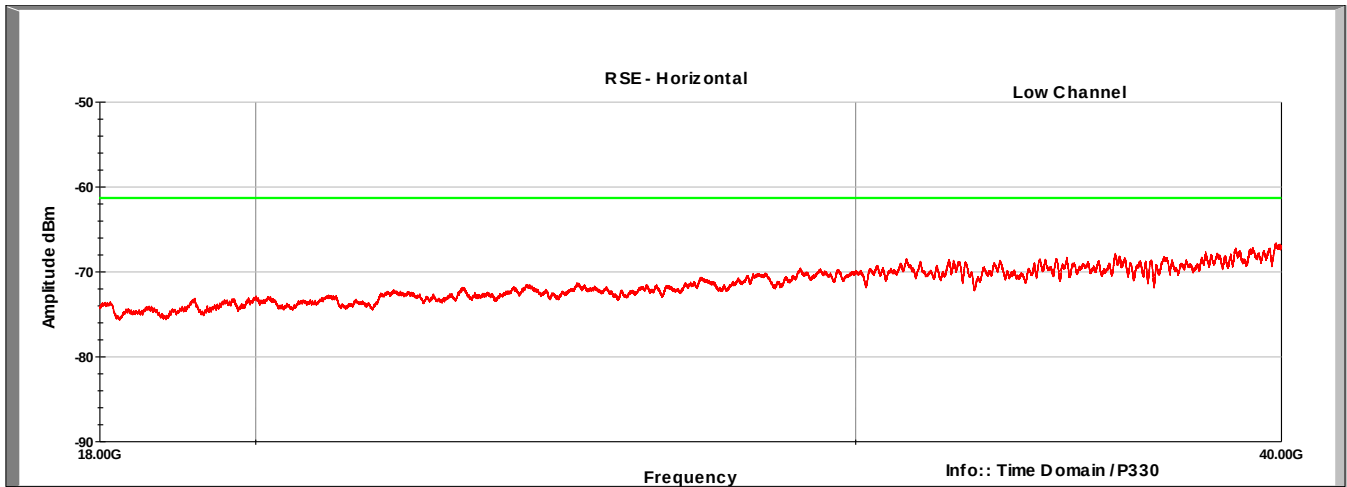
Radiated Emissions (10.6-18GHz) – Horizontal
Test Distance = 1 meter



Radiated Emissions (18-40GHz) – Vertical
Test Distance = 1 meter



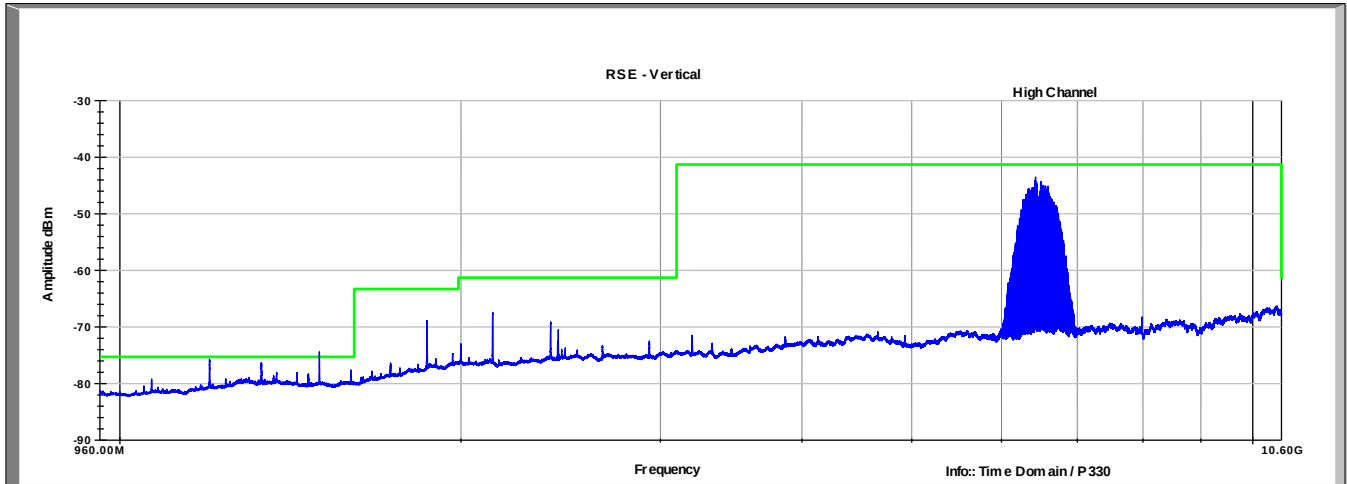
Radiated Emissions (18-40GHz) – Horizontal
Test Distance = 1 meter



4.6 Test Data – High Channel

Radiated Emissions (960MHz – 10.6GHz) – Vertical

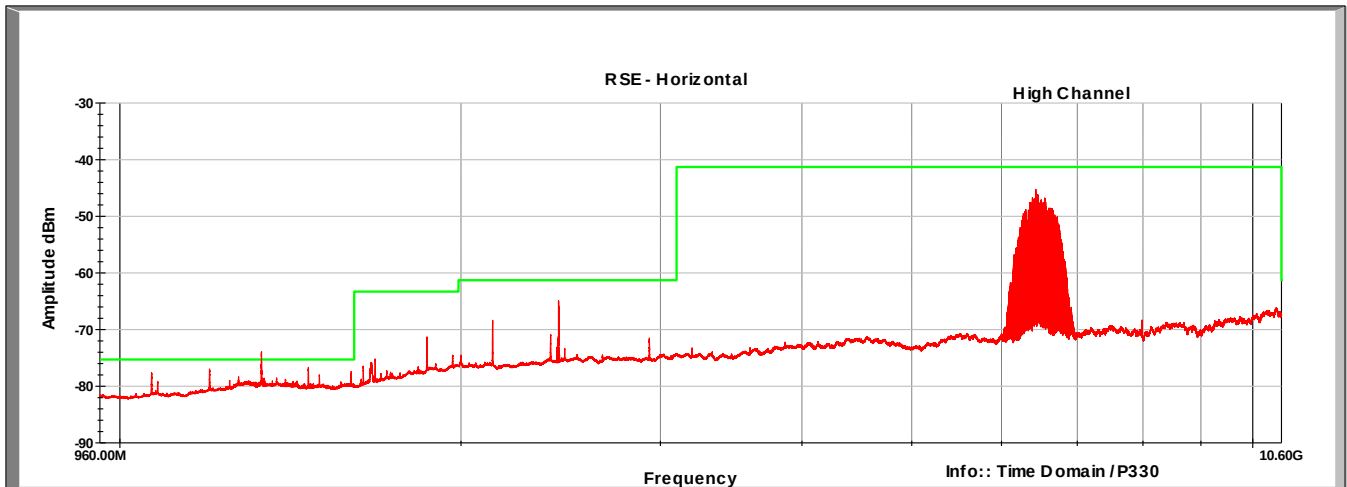
Test Distance = 1 meter



Digital Emissions not related to UWB intentional transmissions

Radiated Emissions (960MHz – 10.6GHz) – Horizontal

Test Distance = 1 meter



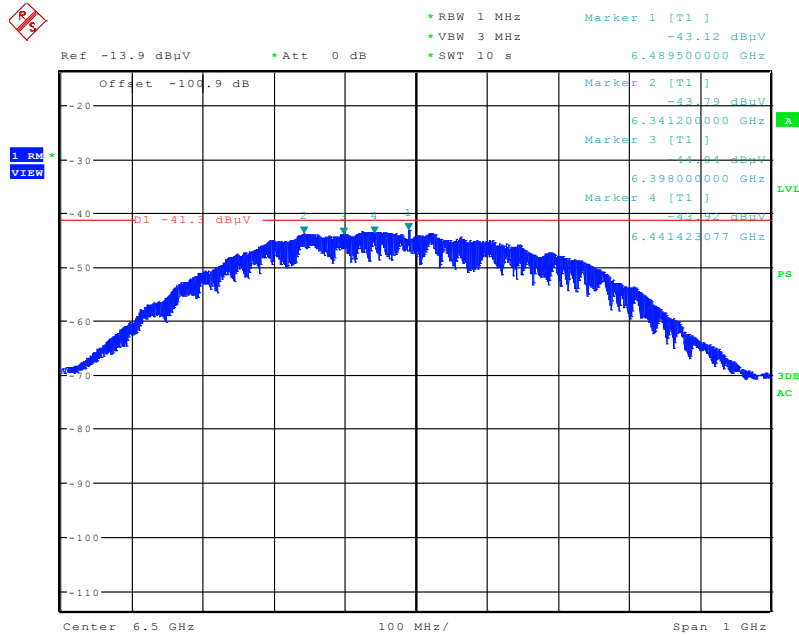
Digital Emissions not related to UWB intentional transmissions

Test Distance: 1.0m

Frequency MHz	Antenna Polarity	Measured RMS value	RMS Limit dBm	Margin dB
1199.843	V	-75.7	-75.3	-0.4
1332.875	V	-76.4	-75.3	-1.1
1499.936	V	-74.4	-75.3	+0.9
1199.843	H	-77.0	-75.3	-1.7
1333.454	H	-73.9	-75.3	+1.4

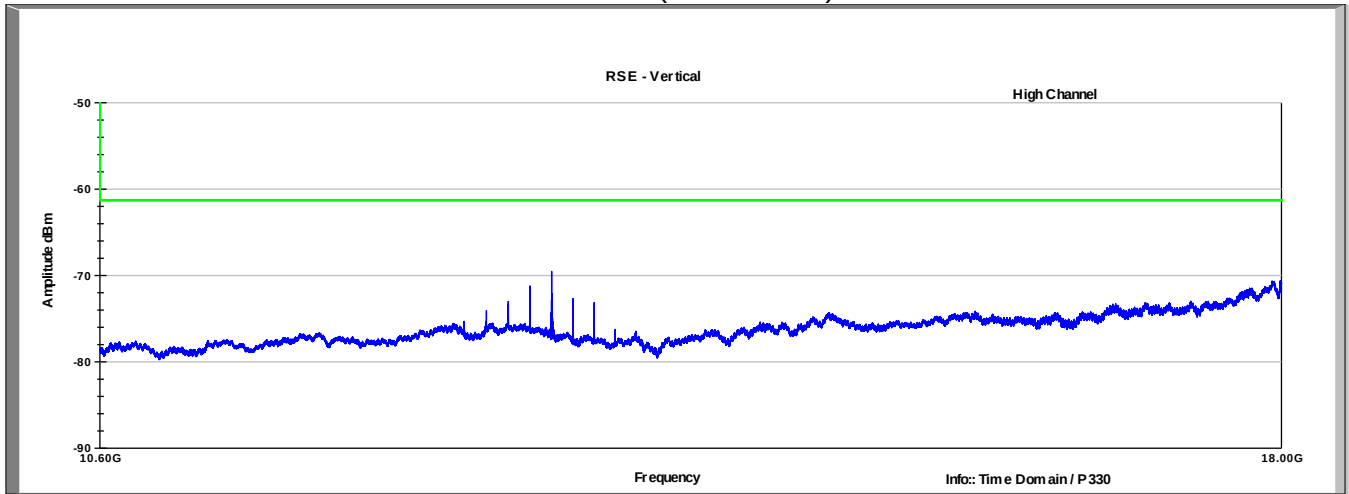
* These emissions were from the digital portion of the device unrelated to the UWB transmission and meet the 15.209 radiated limits.

Fundamental

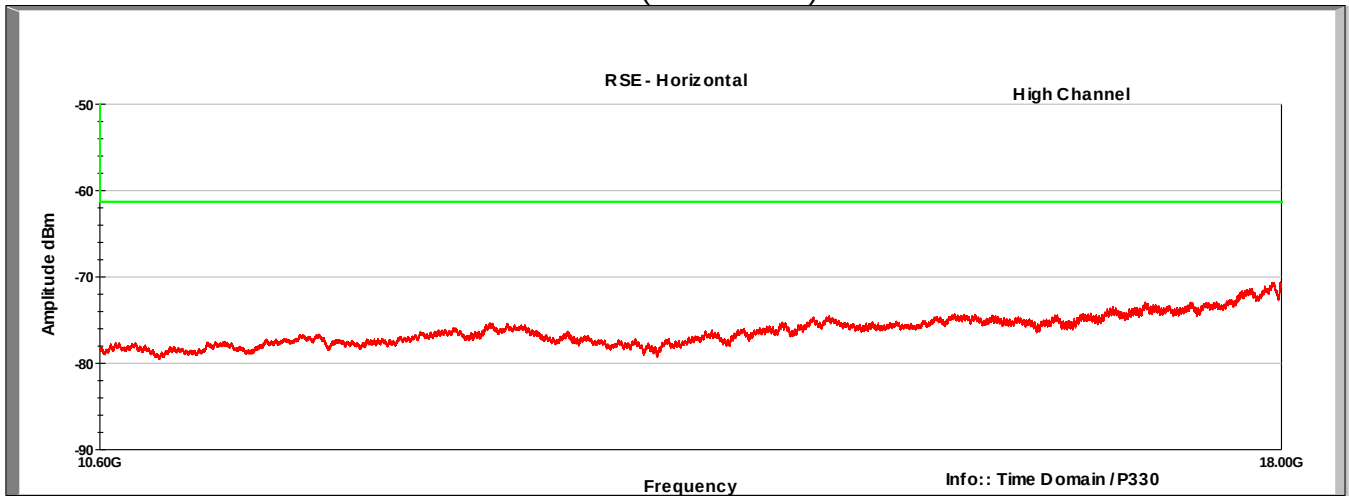


Antenna Polarity	Frequency (MHz)	Measured RMS value	RMS Limit dBm	Margin dB
V	6341.2	-43.8	-41.3	-2.5
V	6398.0	-44.0	-41.3	-2.7
V	6441.4	-43.9	-41.3	-2.6
V	6489.5	-43.1	-41.3	-1.8

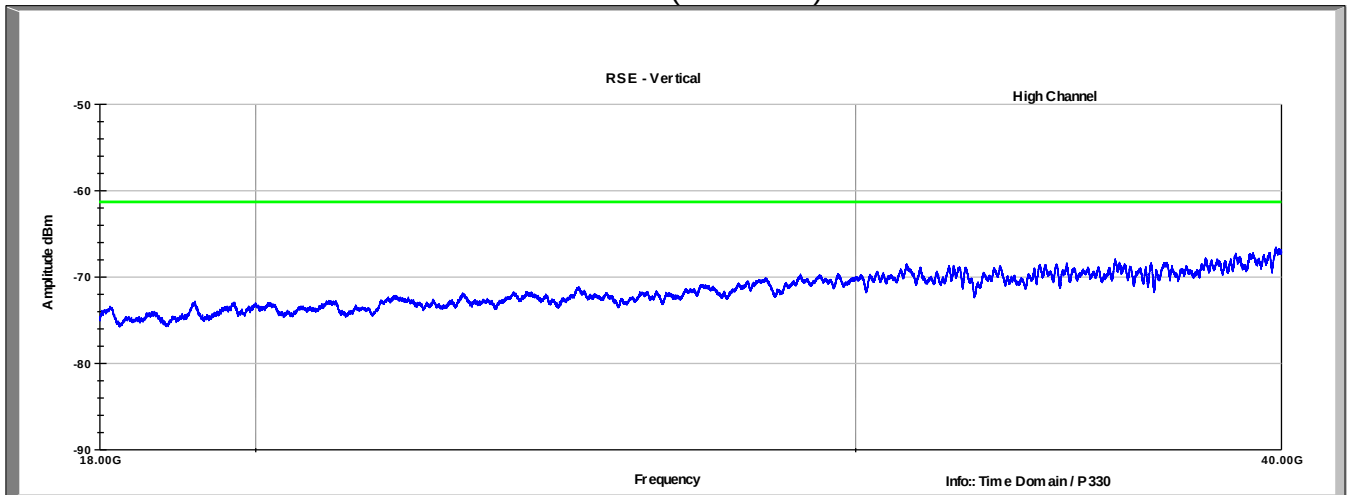
Radiated Emissions (10.6-18GHz) – Vertical



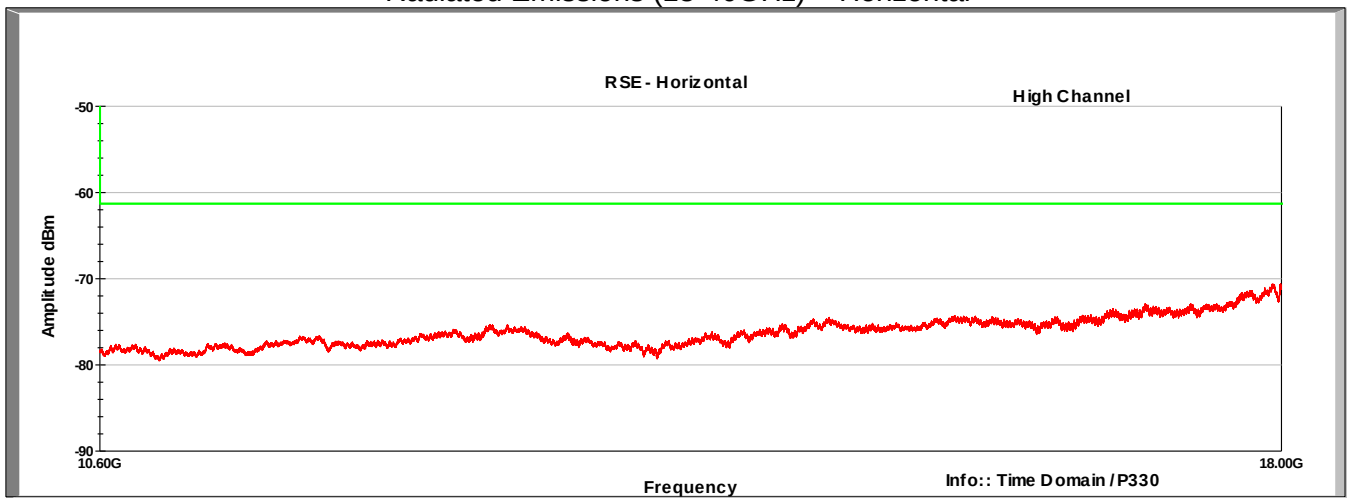
Radiated Emissions (10.6-18GHz) – Horizontal



Radiated Emissions (18-40GHz) – Vertical



Radiated Emissions (18-40GHz) – Horizontal



5 Radiated emissions in GPS receive band

5.1 Test Result

Test Description	Reference	Test Result
Radiated emissions in GPS receive band	15.519(d)	Compliant

5.2 Test Method

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

Frequency (MHz)	EIRP dBm	EIRP (dBμV/m) at 3m	EIRP (dBμV/m) at 1m
1164–1240	-85.3	9.9	19.4
1559–1610	-85.3	9.9	19.4

5.3 Test Site

3m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.8°C

Relative Humidity: 28.0 %

5.4 Test Equipment

Test End Date: 14-Feb-2017

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	20-Jun-2017
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2017
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	29-Jul-2017
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	29-Jul-2017
RF CABLE	104PE	HUBER & SUHNER	B079793	27-Jul-2017

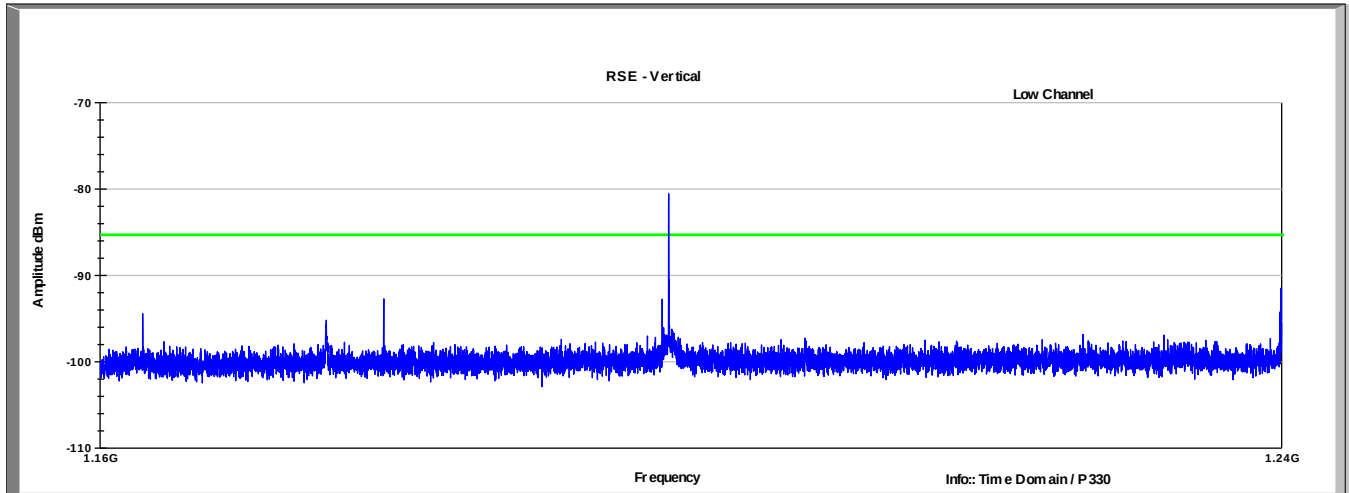
Note: The equipment calibration period is 1 year.

Software:

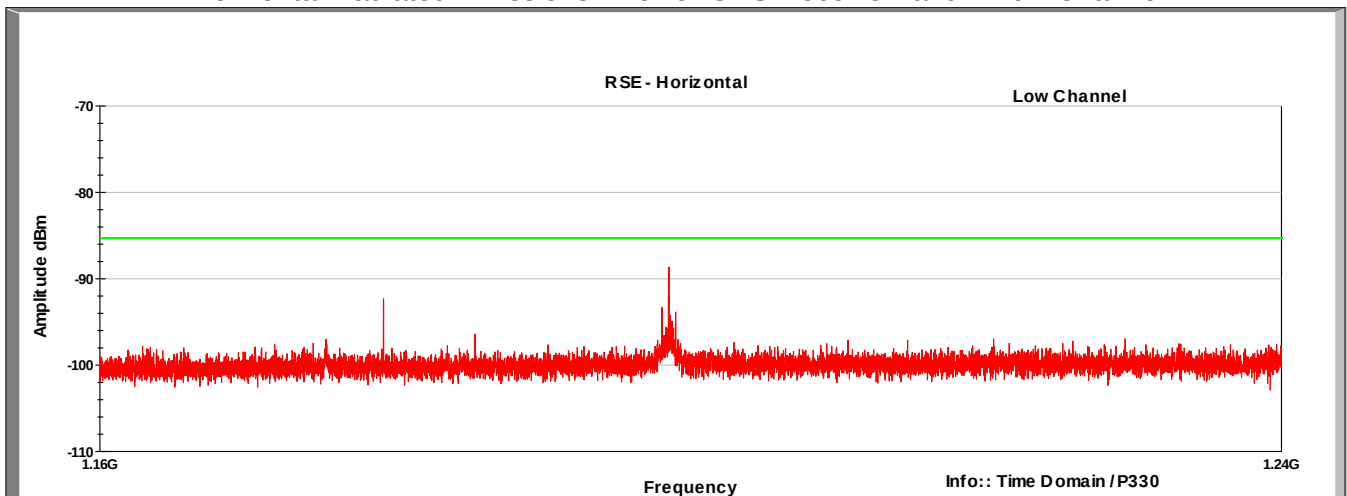
“Radiated Emissions 1-18GHz.TIL” TILE! profile dated Dec 2015

5.5 Test Data

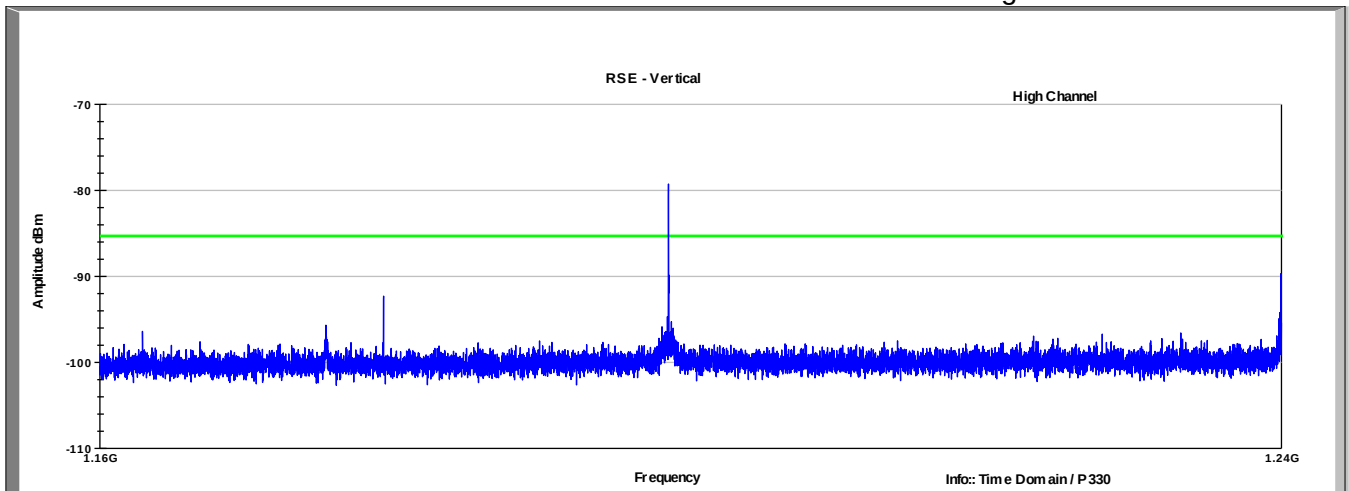
Vertical Radiated Emissions in lower GPS Receive Band – Low Channel



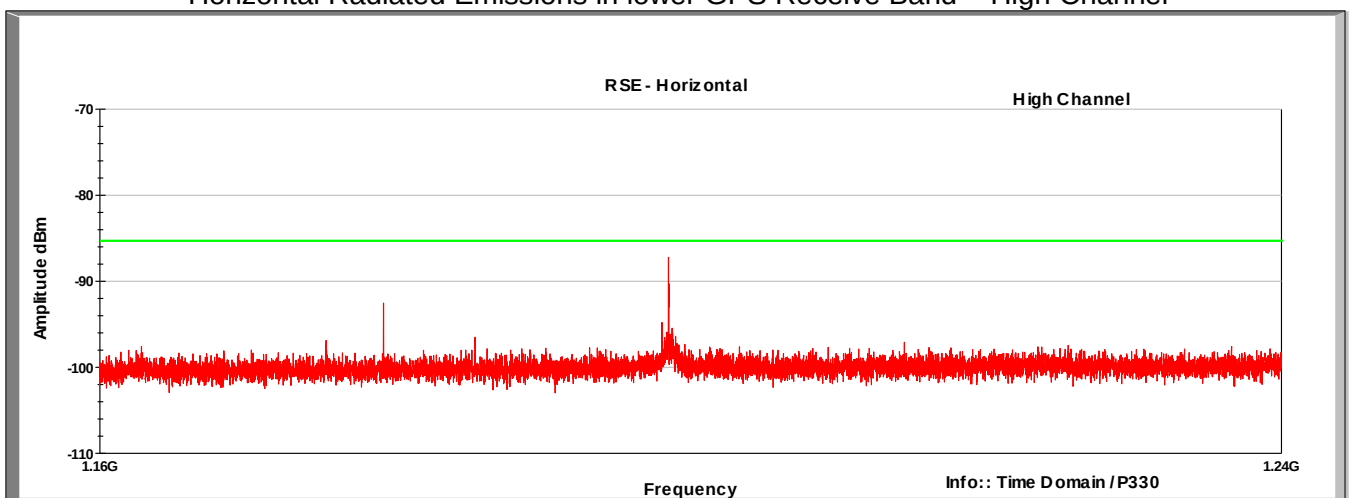
Horizontal Radiated Emissions in lower GPS Receive Band – Low Channel



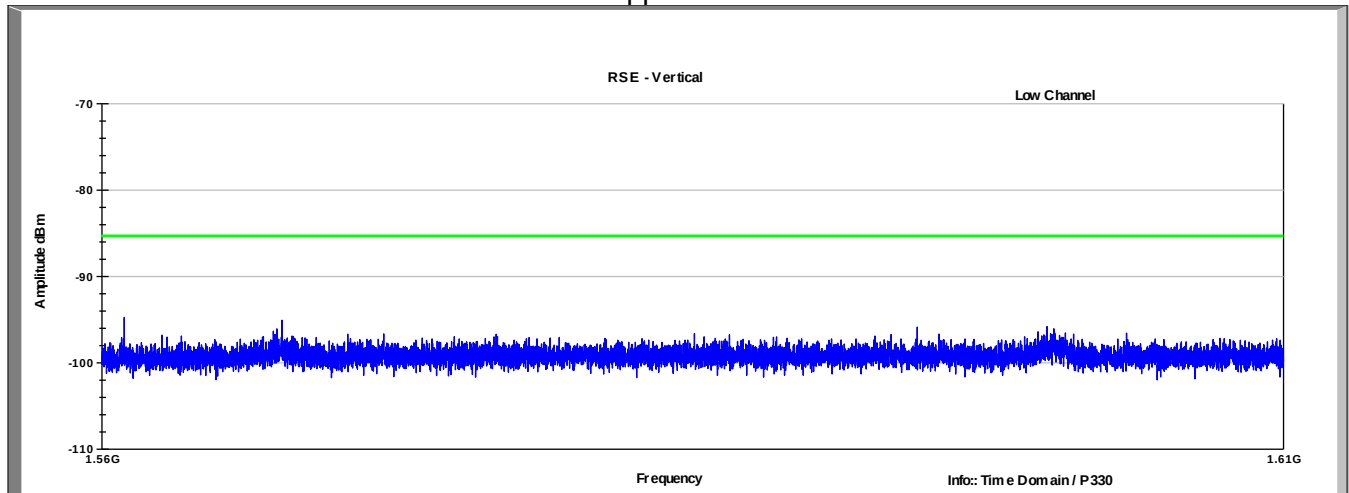
Vertical Radiated Emissions in lower GPS Receive Band – High Channel



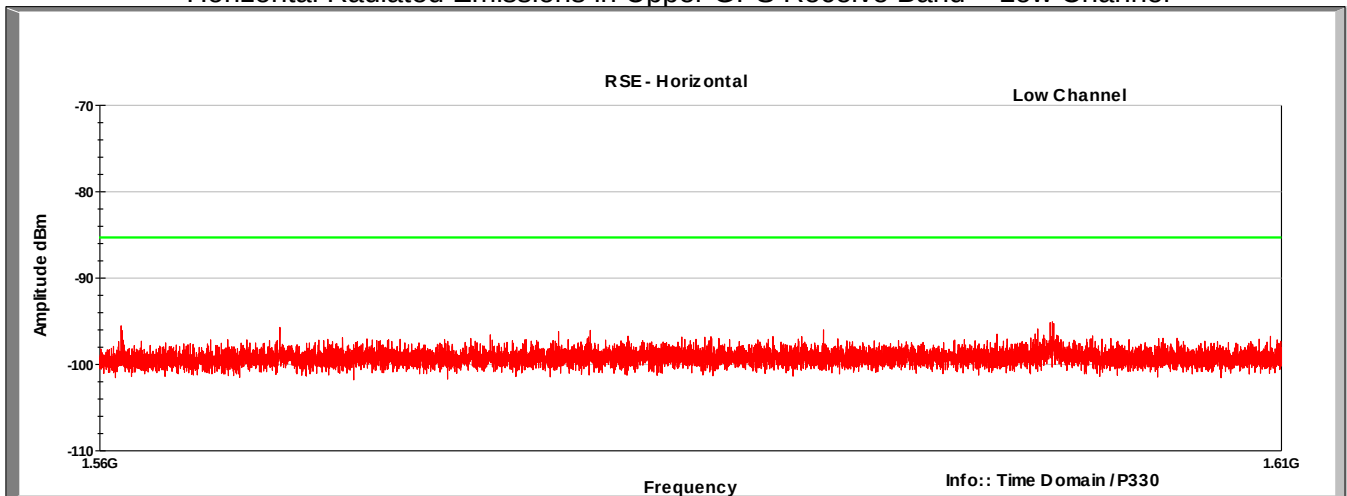
Horizontal Radiated Emissions in lower GPS Receive Band – High Channel



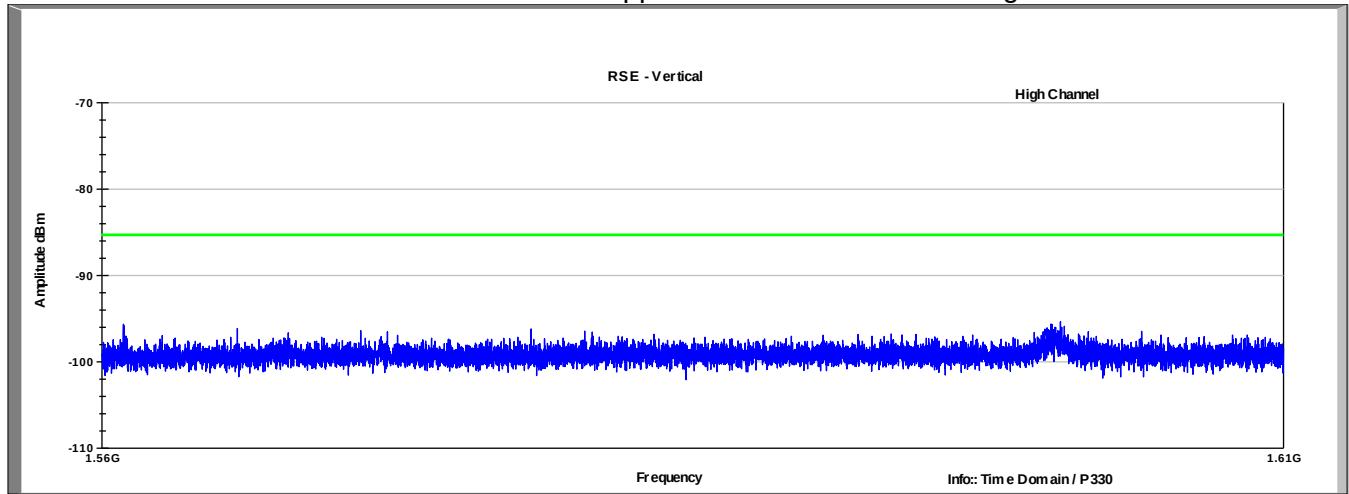
Vertical Radiated Emissions in Upper GPS Receive Band – Low Channel



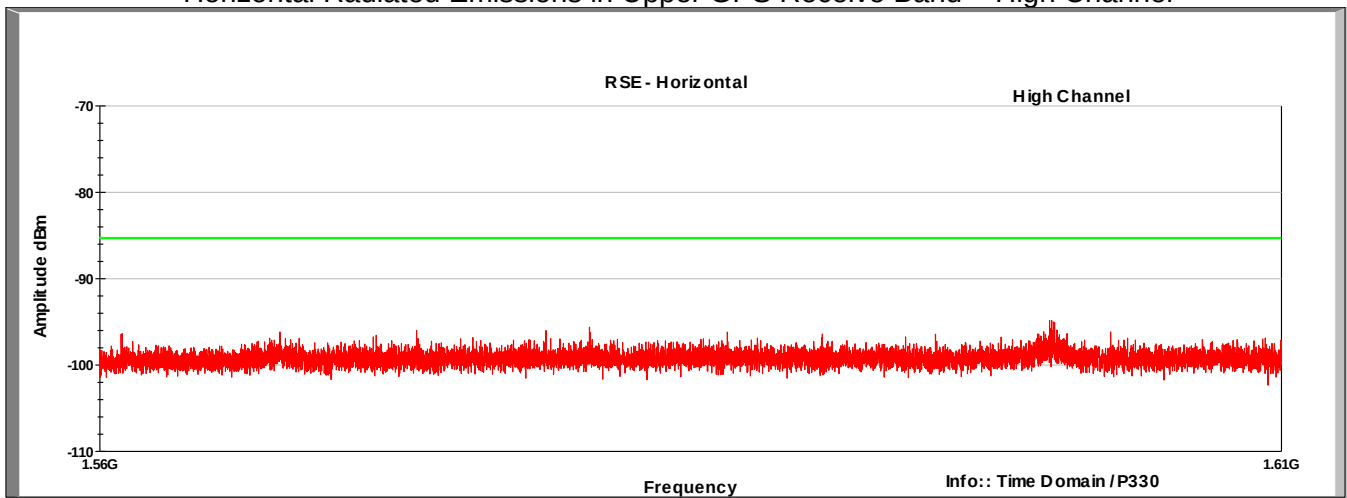
Horizontal Radiated Emissions in Upper GPS Receive Band – Low Channel



Vertical Radiated Emissions in Upper GPS Receive Band – High Channel



Horizontal Radiated Emissions in Upper GPS Receive Band – High Channel



Data: Radiated Emissions in Lower GPS Receive Bands

Test Distance: 1.0m

Channel	Frequency MHz	Antenna Polarity	Measured RMS value	RMS Limit dBm	Margin dB
Low	1199.978	V	-80.6	-85.3	+4.7
Low	1199.978	H	-88.7	-85.3	-3.4
High	1199.978	V	-79.3	-85.3	+6.0
High	1199.978	H	-87.2	-85.3	-1.9

* These emissions were from the digital portion of the device unrelated to the UWB transmission and meet the 15.209 radiated limits.

6 Peak Power within a 50 MHz bandwidth

6.1 Test Result

Test Description	Basic Standards	Test Result
Peak Power in a 50 MHz Bandwidth	15.519(e)	Compliant

6.2 Test Method

- 1) 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 and this 50 MHz bandwidth must be contained within the 3100–10600 MHz band.
- 2) The peak EIRP limit is $20 \log (RBW/50)$ dBm where RBW is the resolution bandwidth in megahertz that is employed by the measurement instrument. RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than RBW.

Limits

Frequency (MHz)	EIRP in 50 MHz BW dBm	EIRP in 50 MHz BW (dB μ V/m) at 3m	EIRP in 50 MHz BW (dB μ V/m) at .5m
3100 - 10600	0	95.2	104.7

Limits converted to 10 MHz RBW

Frequency (MHz)	EIRP in 10 MHz BW dBm	EIRP in 10 MHz BW (dB μ V/m) at 3m	EIRP in 10 MHz BW (dB μ V/m) at .5m
3100 - 10600	-14	61.2	80.3

Limits converted to 20 MHz RBW

Frequency (MHz)	EIRP in 20 MHz BW dBm	EIRP in 20 MHz BW (dB μ V/m) at 3m	EIRP in 20 MHz BW (dB μ V/m) at .5m
3100 - 10600	-8	67.2	86.3

6.3 Test Site

3m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.9°C

Relative Humidity: 28.2 %

6.4 Test Equipment

Test End Date: 14-Feb-2017

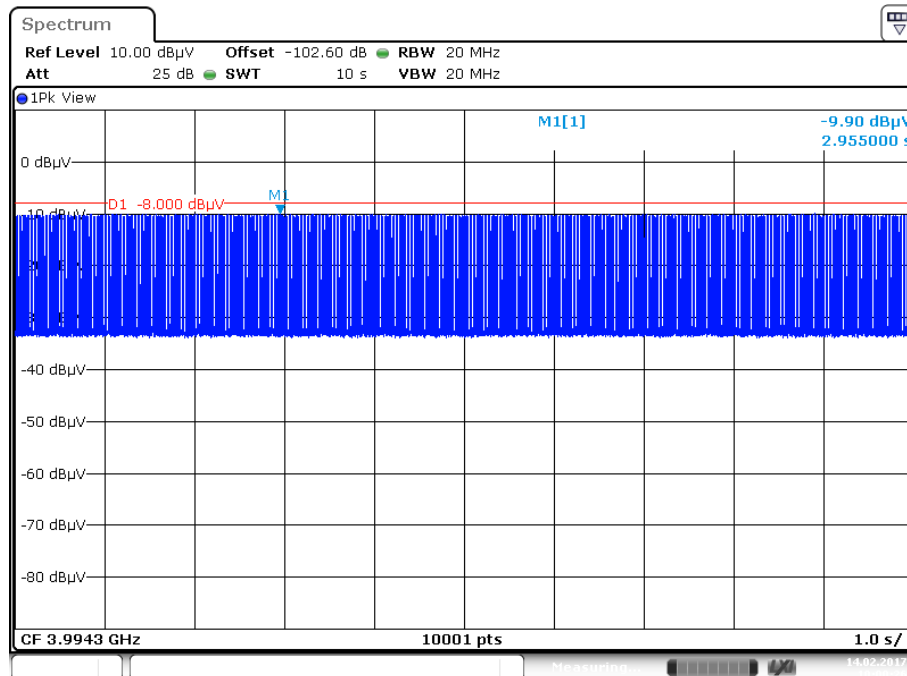
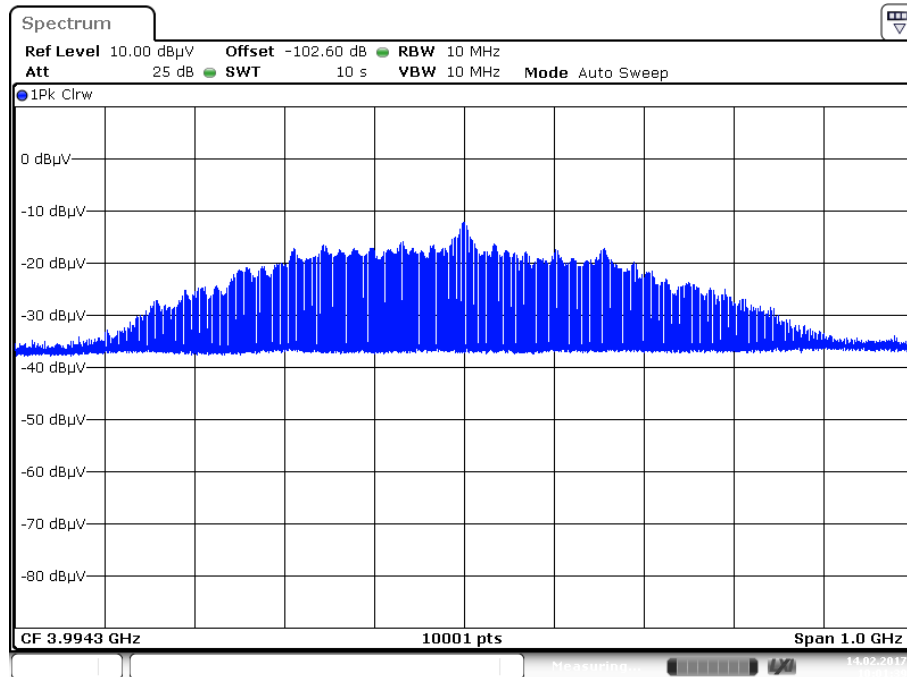
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	29-Jul-2017
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	29-Jul-2017
RF CABLE	104PE	HUBER & SUHNER	B079793	27-Jul-2017

Note: The calibration period for this equipment is 1 year.

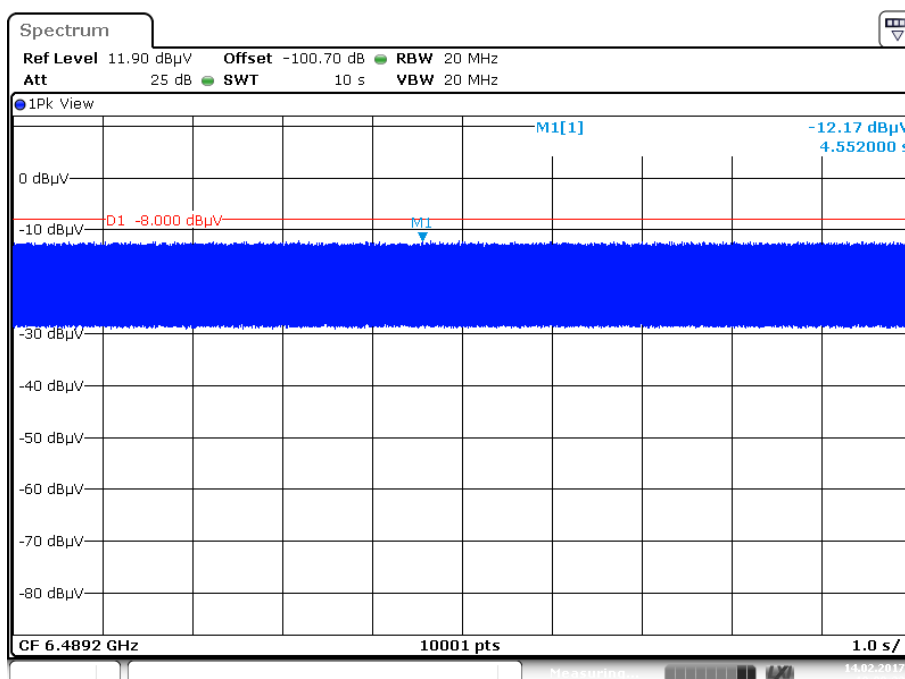
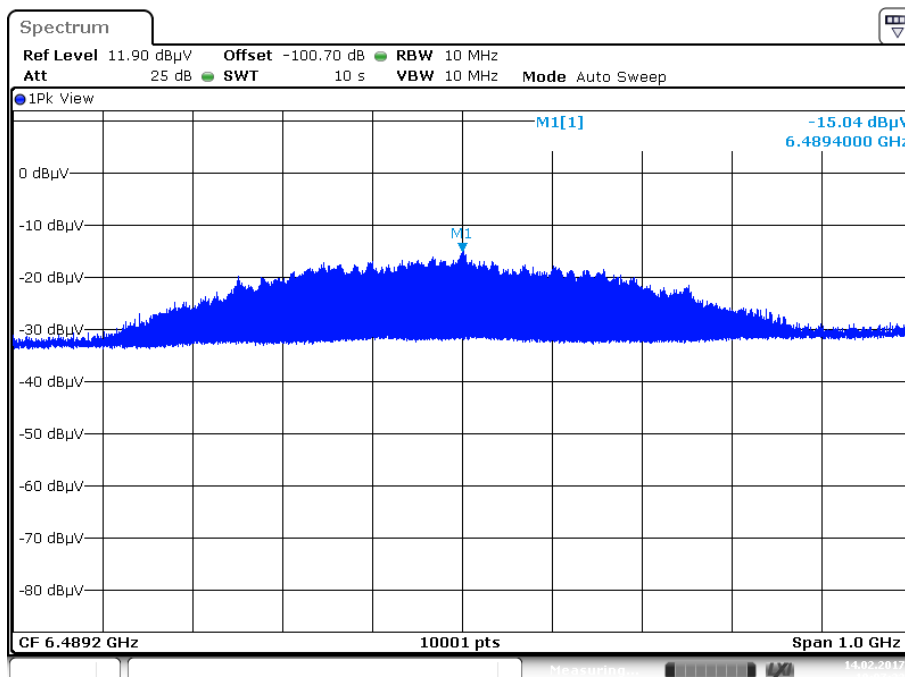
6.5 Test Data

Channel 2



Offset value allows the reading in dBμV to be seen as the power in dBm.
The Display line is the 0 dBm limit adjusted down to account for the 20 MHz RBW.

Channel 5



Offset value allows the reading in dBuV to be seen as the power in dBm.
The Display line is the 0 dBm limit adjusted down to account for the 20 MHz RBW.

6.6 Data Table

Channel	Measurement 20 MHz RBW dBm	Corrected Value 50 MHz RBW dBm	Limit, dBm 50 MHz RBW	Result
5	-12.2	-4.2	0	Compliant
2	-9.9	-1.9	0	Compliant

7 Radiated emissions below 960 MHz

7.1 Test Result

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15.517(c) and 15.209	Compliant

7.2 Test Method

The initial scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector. The receiver's resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limit below 1 GHz		
Frequency Range(MHz)	Limit(QP dBμV/m)	Distance
30 – 88	40	3m
88 – 216	43.5	3m
216 – 960	46	3m

7.3 Test Site

3m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.8°C

Relative Humidity: 28.0 %

7.4 Test Equipment

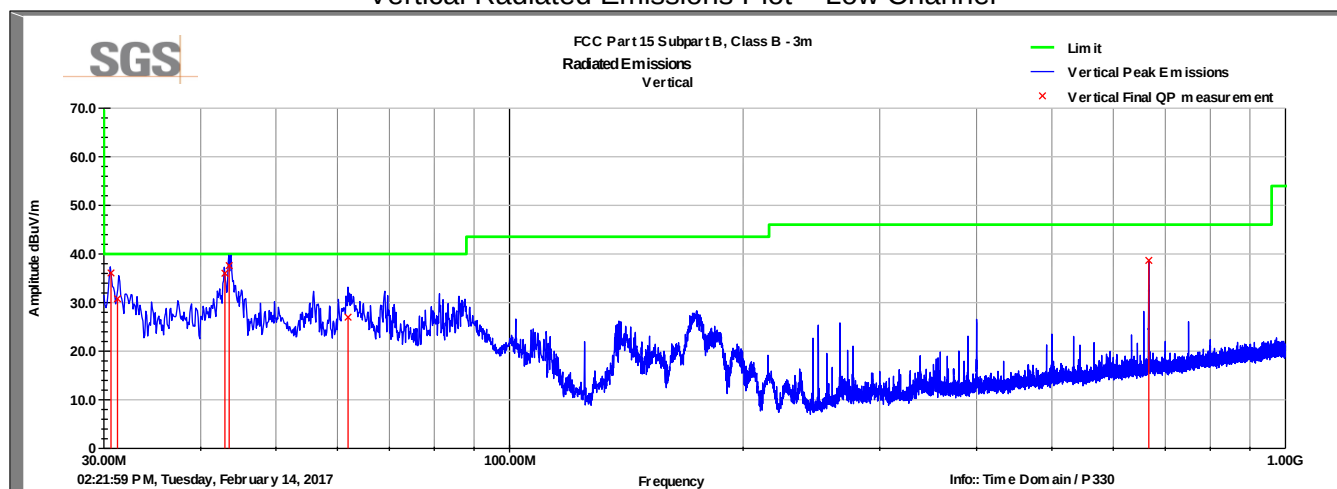
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	20-Jun-2017
ANTENNA, BILOG	JB6	SUNOL	B079689	8-Sep-2017
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	29-Jul-2017
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	29-Jul-2017
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	4-Aug-2017
RF CABLE	SF106	HUBER & SUHNER	B079661	29-Jul-2017
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	28-Jul-2017

Note: The equipment calibration period is 1 year.

Software: "Radiated Emissions" TILE! profile dated Dec 2015

7.5 Test Data

Vertical Radiated Emissions Plot – Low Channel

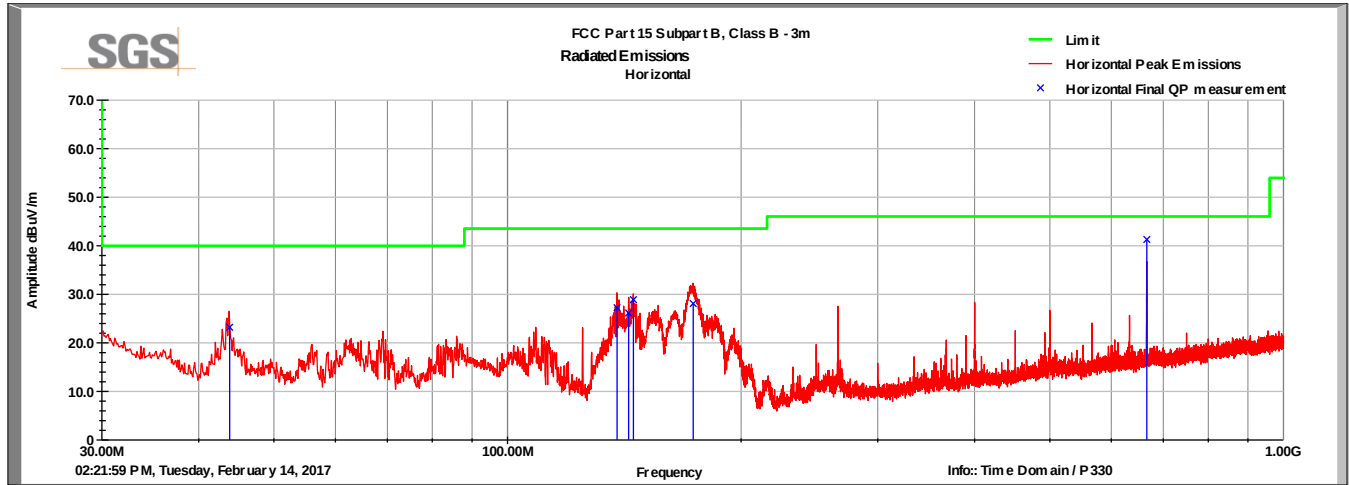


Note: There was no discernible difference in the emission profile between low and high channel in this frequency range.

Vertical Radiated Emissions Data – Low Channel

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.64	45.6	V	240.0	100.0	21.3	0.3	31.1	36.1	40.0	-3.9
31.25	40.8	V	72.0	100.0	20.9	0.3	31.2	30.8	40.0	-9.2
42.97	55.7	V	295.0	111.0	12.1	0.4	32.1	36.0	40.0	-4.0
43.52	57.7	V	1.0	110.0	11.7	0.4	32.2	37.6	40.0	-2.4
61.93	52.0	V	14.0	138.0	7.7	0.4	33.2	27.0	40.0	-13.0
666.67	49.9	V	254.0	205.0	20.6	1.7	33.5	38.7	46.0	-7.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Horizontal Radiated Emissions Plot – Low Channel



Note: There was no discernible difference in the emission profile between low and high channel in this frequency range.

Horizontal Radiated Emissions Data – Low Channel

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
43.83	43.5	H	266.0	345.0	11.5	0.4	32.2	23.2	40.0	-16.8
138.42	47.1	H	268.0	250.0	13.3	0.7	33.8	27.2	43.5	-16.3
143.25	46.3	H	88.0	250.0	13.0	0.7	33.8	26.2	43.5	-17.4
145.27	49.0	H	276.0	196.0	13.0	0.7	33.8	28.9	43.5	-14.6
173.48	49.3	H	263.0	195.0	11.9	0.8	33.8	28.1	43.5	-15.4
666.67	52.5	H	132.0	129.0	20.6	1.7	33.5	41.3	46.0	-4.7
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

8 Conducted Emissions

8.1 Test Result

Test Description	Basic Standards	Test Result
Conducted Emissions, Class B	FCC Part 15, Subpart B	Compliant

8.2 Test Method

With the receiver's resolution bandwidth set to 9 kHz the initial preliminary exploratory scans were performed over the measuring frequency range (0.15MHz to 30MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Class A Limits (dBuV)	Class B Limits (dBuV)
0.15 to 0.5 MHz	Avg 66 QP 79	Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz	Avg 60 QP 73	Avg 46 Pk 56
5 to 30 MHz	Avg 60 QP 73	Avg 50 Pk 60

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.2°C

Relative Humidity: 22.9%

8.4 Test Equipment

Test End Date: 14-Feb-2017

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jul-2017
RF CABLE	SF106	HUBER & SUHNER	B085892	27-Jul-2017
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	16-Nov-2017

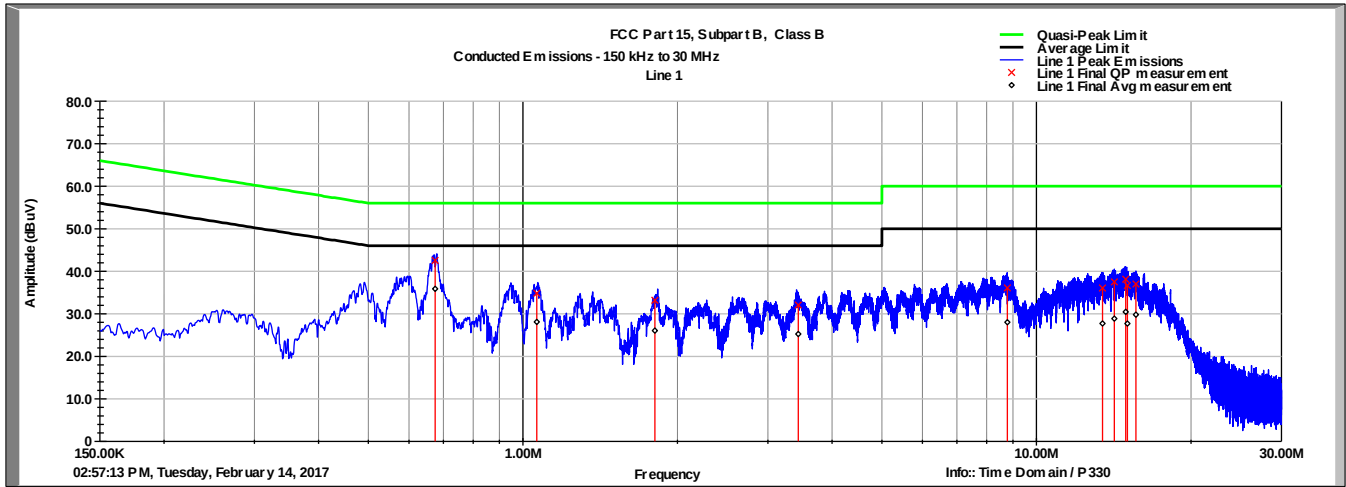
Note: The equipment calibration period is 1 year.

Software:

"Conducted Emissions" TILE! profile dated Dec 2015

8.5 Test Data

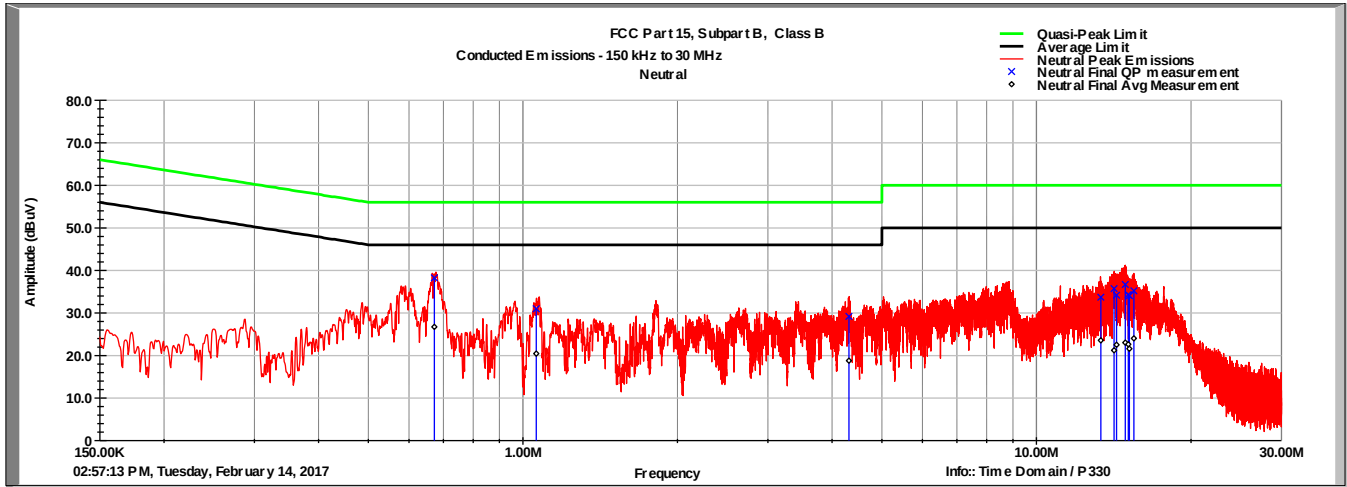
Line 1 Conducted Emissions Plot



Line 1 Conducted Emissions Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.675	42.5	56.0	-13.5	35.9	46.0	-10.1
1.064	34.8	56.0	-21.2	28.1	46.0	-17.9
1.807	33.2	56.0	-22.8	26.0	46.0	-20.0
3.438	32.1	56.0	-23.9	25.2	46.0	-20.8
8.777	36.1	60.0	-23.9	28.0	50.0	-22.0
13.445	36.0	60.0	-24.0	27.7	50.0	-22.3
14.181	37.5	60.0	-22.5	28.9	50.0	-21.1
14.922	38.1	60.0	-21.9	30.4	50.0	-19.6
15.038	36.6	60.0	-23.4	27.7	50.0	-22.3
15.621	37.0	60.0	-23.0	29.8	50.0	-20.2

Neutral Conducted Emissions Plot



Neutral Conducted Emissions Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.672	38.2	56.0	-17.8	26.7	46.0	-19.3
1.062	31.0	56.0	-25.0	20.4	46.0	-25.6
4.314	29.2	56.0	-26.8	18.8	46.0	-27.2
13.347	33.7	60.0	-26.3	23.5	50.0	-26.5
14.166	35.7	60.0	-24.3	21.2	50.0	-28.8
14.323	34.2	60.0	-25.8	22.5	50.0	-27.5
14.897	36.7	60.0	-23.3	23.0	50.0	-27.0
15.100	34.3	60.0	-25.7	22.6	50.0	-27.4
15.172	34.1	60.0	-25.9	21.6	50.0	-28.4
15.478	35.2	60.0	-24.8	24.0	50.0	-26.0

9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	27 February 2017