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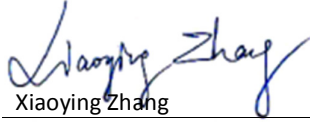

Application for Grant of Equipment Authorization of the
Protequus LLC
Nightwatch NW-1000 Smart Halter

FCC Part 15 Subpart F §15.519
RSS-220 Issue 1 March 2009

Report No. CG72118338-0617A Rev 1.0

September 2017



REPORT ON	Radio Testing of the Protequus LLC Smart Halter
TEST REPORT NUMBER	CG72118338-0617A Rev 1.0
PREPARED FOR	Protequus LLC 3001 S Lamar Blvd Suite 250 Austin, TX 78704
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PREPARED BY	 Xiaoying Zhang Name Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	 Alex Chang Name Authorized Signatory Title: EMC/Wireless Test Engineer
DATED	August 15, 2017



Revision History

CG72118338-0617A Rev 1.0 Protequus LLC Nightwatch Smart Halter					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
08/15/2017	Initial Release				Alex Chang
09/25/2017	Initial Release	Rev 1.0	Update the test diagram for Radiated Emission above 1GHz; Re-organize the test result note for section 2.6.8 to make the limit align with test distance.	41 35	Alex Chang



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SECTION 1

REPORT SUMMARY

Radio Testing of the
Protequus LLC
Nightwatch NW-1000 Smart Halter



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Protequus LLC Smart Halter to the requirements of FCC Part 15 Subpart F §15.519 and RSS-220 Issue 1 March 2009.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Protequus LLC
Model Number(s)	NW-1000
FCC ID Number	2AJZL-NW1000
IC Number	22101-NW1000
Serial Number(s)	XB-0001022
Number of Samples Tested	1
Test Specification/Issue/Date	<ul style="list-style-type: none">• FCC Part 15 Subpart F §15.519 (October 1, 2016).• RSS-220 Issue 1 March 2009 – Devices Using Ultra-Wideband (UWB) Technology• RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014).• 393764 D01 Ultra-Wide Band (UWB) Device FAQ (July 31, 2015)
Start of Test	August 01, 2017
Finish of Test	August 08, 2017
Name of Engineer(s)	Xiaoying Zhang
Related Document(s)	protequus_nightwatch_test_unit_userguide_v2.pdf



1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart F §15.519 with cross-reference to the corresponding RSS standard is shown below.

Operation in the U-NII 1 and U-NII 3 Bands (New Rules)					
Section	Spec Clause	RSS-220	Test Description	Result	Comments/ Base Standard
-	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	N/A	EUT is battery powered.
2.1	§15.203 §15.519 (a)(2)	§5.1 (b) §5.3.1 (a)	Antenna Requirement	Compliant	The antenna is surface mounted.
2.2	§15.519 (a)(1)	§6.2.1 (b)	Operational Requirements	N/A	There is no UWB receiver. The EUT transmits data through Cell or WiFi.
2.3	15.503 (a)(d) 15.519 (b)	§6.2.1 (a)	UWB Bandwidth	Compliant	-
2.4	§15.519 (c) §15.209	§3.4 §5.3.1 (d)	Spurious Radiated Emissions	Compliant	-
2.5	§15.519 (d)	§5.3.1 (e)	Radiated Emissions in GPS Bands	Compliant	-
2.6	§15.519 (e)	§5.3.1 (g)	Peak Emissions in a 50 MHz Bandwidth	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Protequus LLC Model NW-1000 Smart Halter as shown in the photograph below. The EUT is designed to alert you via text, phone call, and/or email at the early signs of equine distress, such as colic or being cast. This device monitors real-time data on your horse's vital signs using Ultra Wide Band (UWB) and behaviors, works across cellular and Wi-Fi networks, offers GPS tracking, and adapts to your horse over time as the system learns their unique and normal patterns and parameters.



Equipment Under Test



1.3.2 EUT General Description

EUT Description	Smart Halter
Model Name	Nightwatch
Model Number(s)	NW-1000
Rated Voltage	5VDC via USB
Mode Verified	6.1GHz Ultra-Wide Band (UWB)
Capability	WCDMA Band 2 and 5, 802.11b/g and 6.1GHz Ultra-Wide Band
Primary Unit (EUT)	<input checked="" type="checkbox"/> Production
	<input type="checkbox"/> Pre-Production
	<input type="checkbox"/> Engineering
Antenna Type	PCB Patch
Antenna Manufacturer	NRGXP
Antenna Model Number	4200-1101
Antenna Gain	Max. 1.7 dBi

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	Radiated Test Setup (Cabinet Spurious Emissions). EUT and the support laptop connect to the Router through WiFi. The EUT was set to work in UWB mode using putty with command provide by the client.

1.4.2 EUT Exercise Software

The EUT is connected to the support laptop via WiFi. Putty was used to communicate with the EUT. The manufacturer provided different macros to load and configures the RF settings of the EUT.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
HTC	AC/DC Adaptor	P/N TC U250 S/N 2RRA113W038188 IP 100 – 240 VAC 200 mA 50 – 60 Hz; OP 5VDC 1A
Nightwatch	DC Charger	Model NWC 2000
Sony	Support Laptop	M/N PCG-31311L S/N 27545534 3006488
Sony	Support Laptop AC Adapter	M/N PCGA-AC19V9 S/N 147839091 0023259

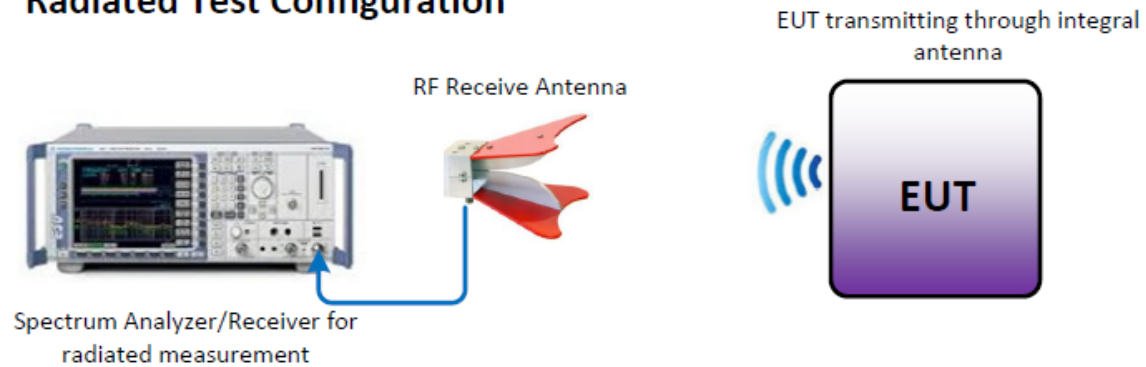
1.4.4 Worst Case Configuration

The EUT has only one modulation scheme. Being a mobile device, the EUT was verified on all axes. Only the worst axis ("X") presented in this test report for radiated measurements.



1.4.5 Simplified Test Configuration Diagram

Radiated Test Configuration



Not To Scale – Illustration Purpose Only
Objects may not represent actual image of
original equipment/s or set-up.



1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number XB-0001022		
N/A		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2014. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.



1.9.2 Innovation, Science and Economic Development Canada Registration No.: 3067A-1 & 22806-1

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 22806-1.



SECTION 2

TEST DETAILS

Radio Testing of the
Protequus LLC
Nightwatch NW-1000 Smart Halter



2.1 ANTENNA REQUIREMENT

2.1.1 Specification Reference

Part 15 §15.203 and §15.519 (a)(2)
RSS-220 §5.1 (b) and §5.3.1 (a)

2.1.2 Standard Applicable

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 antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

2.1.3 Equipment Under Test and Modification State

Serial No: XB-0001022/Default Test Configuration

2.1.4 Test Results

Compliant. The antenna utilized by the device under test is a PCB surface mount type.



2.2 OPERATIONAL REQUIREMENT

2.2.1 Specification Reference

Part 15 §15.519 (a)(1)
RSS-220 §6.2.1 (b)

2.2.2 Standard Applicable

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

2.2.3 Equipment Under Test and Modification State

Serial No: XB-0001022 / Default Test Configuration

2.2.4 Test Results

N/A. The EUT has no UWB receiver. It transmits data through Cell or WiFi.



2.3 UWB BANDWIDTH

2.3.1 Specification Reference

Part 15 §15.503 (a)(d) and §15.519 (b)
RSS-220 §6.2.1 (a)

2.3.2 Standard Applicable

UWB bandwidth. For the purpose of this subpart, 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 .

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.

The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

2.3.3 Test Methodology

C63.10 §10.1 Evaluation of -10 dB bandwidth

2.3.4 Equipment Under Test and Modification State

Serial No: XB-0001022 / Default Test Configuration

2.3.5 Date of Test/Initial of test personnel who performed the test

August 04, 2017/XYZ

2.3.6 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.



2.3.7 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.5 °C
Relative Humidity	49.0 %
ATM Pressure	98.8 kPa

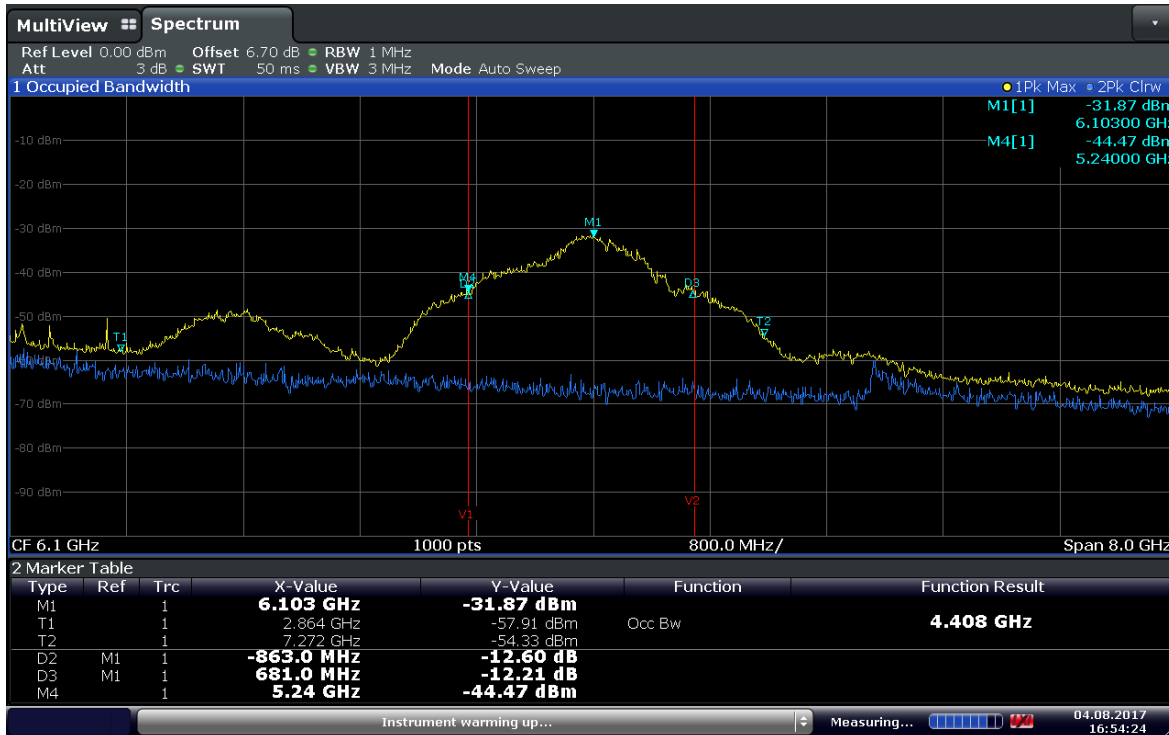
2.3.8 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW is 1 MHz.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- Trace is Max Hold.
- The -10 dB points were marked.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

2.3.9 Summary Test Results

-	Description	Result (GHz)	Limit (GHz)
f_M	The highest emission peak	6.103	-
f_L	10 dB below the highest peak	5.24	3.1
f_H	10 dB above the highest peak	6.784	10.6
f_c	$(f_H + f_L) / 2$	6.012	-
Bandwidth	$(f_H - f_L)$	1.544	-
Fraction Bandwidth	UWB Bandwidth is greater than 500 MHz	N/A	-

2.3.10 Test Plots



Date: 4.AUG.2017 16:54:24

UWB -10 dB Bandwidth



2.4 SPURIOUS RADIATED EMISSIONS

2.4.1 Specification Reference

Part 15 §15.519 (c) and §15.209
 RSS-220 §3.4 and 5.3.1 (d)

2.4.2 Standard Applicable

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 § 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 in MHz	EIRP at 3 meter in dBm	EIRP at 3 meter in dBμV/m
960 - 1610	-75.3	19.9
1610 - 1990	-63.3	31.9
1990 – 3100	-61.3	33.9
3100 – 10600	-41.3	53.9
Above 10600	-61.3	33.9

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

Frequency in MHz	EIRP at 3 meter in dBμV/m
0.009 to 0.490	128.5 to 93.8
0.490 to 1.705	73.8 to 63
1.705 - 30	69.5
30 - 88	40
88 - 216	43.5
216 - 960	46

2.4.3 Equipment Under Test and Modification State

Serial No: XB-0001022 / Default Test Configuration

2.4.4 Date of Test/Initial of test personnel who performed the test

August 01 to 08, 2017 /XYZ



2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.1 - 26.9 °C
Relative Humidity	46.5 - 53.7 %
ATM Pressure	98.7 - 99.0kPa

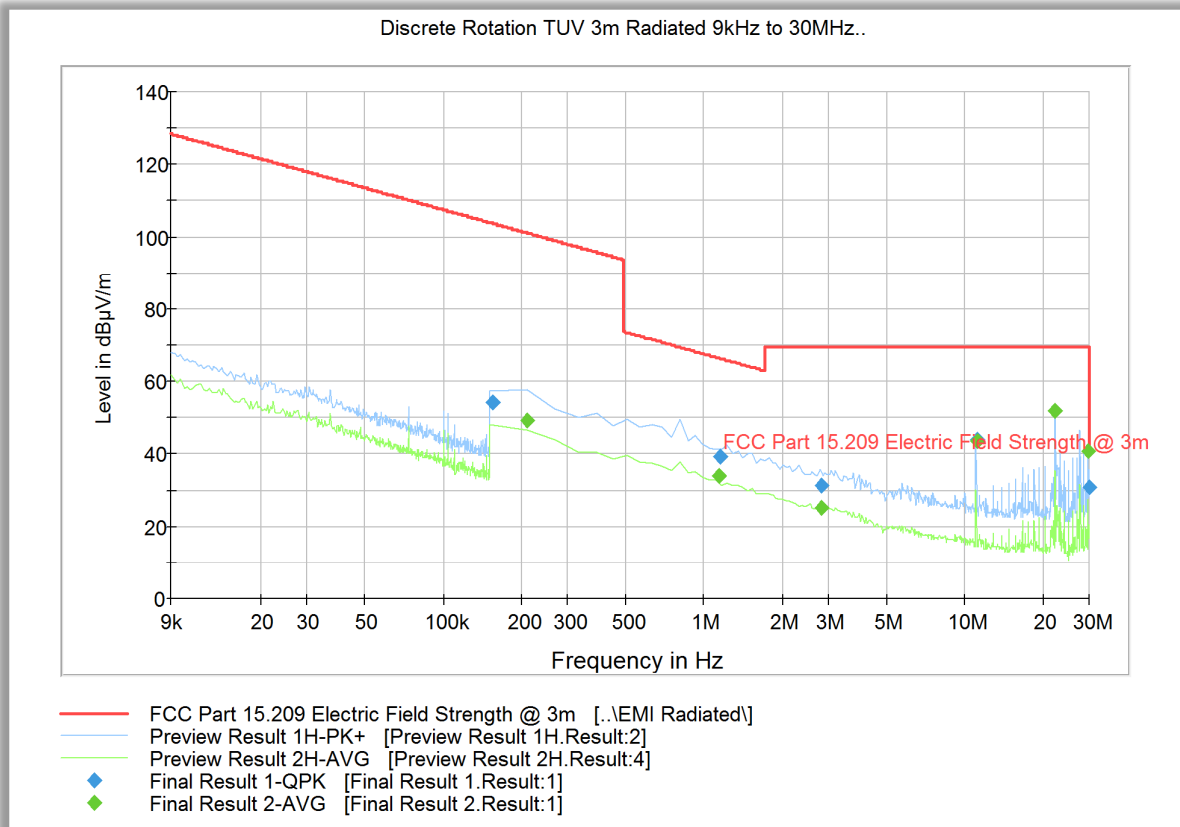
2.4.7 Additional Observations

- This is a radiated test.
- The spectrum was searched from 9 kHz to 40 GHz.
- For spurious below 960 MHz, verification was performed at 3 meters
- For spurious from 1 GHz to 10.6 GHz, verification was performed at 1 meter
- For spurious from 960 MHz to 1 GHz and 10.6 GHz to 40 GHz, verification was performed at 0.2 meter.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.4.8 for sample computation.

2.4.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1033 (antenna)	17.2	
Reported QuasiPeak Final Measurement (db μ V/m) @ 30MHz			11.8

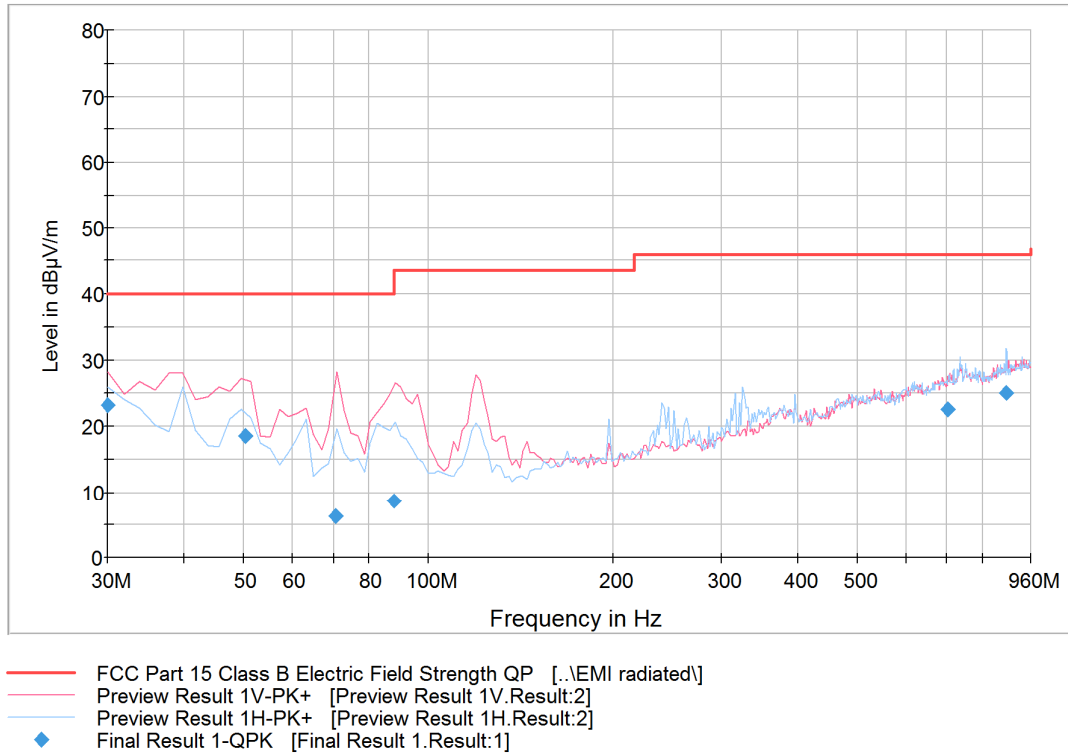
2.4.9 Test Result



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
0.154000	54.4	1500.0	9.000	100.0	H	145.0	14.2	49.4	103.9
1.147754	39.4	1500.0	9.000	100.0	H	175.0	14.8	27.0	66.4
2.811064	31.4	1500.0	9.000	100.0	H	72.0	15.0	38.2	69.5
11.058174	43.9	1500.0	9.000	100.0	H	195.0	15.8	25.7	69.5
22.120627	52.0	1500.0	9.000	100.0	H	35.0	15.4	17.5	69.5
29.953000	30.8	1500.0	9.000	100.0	H	171.0	14.5	38.7	69.5

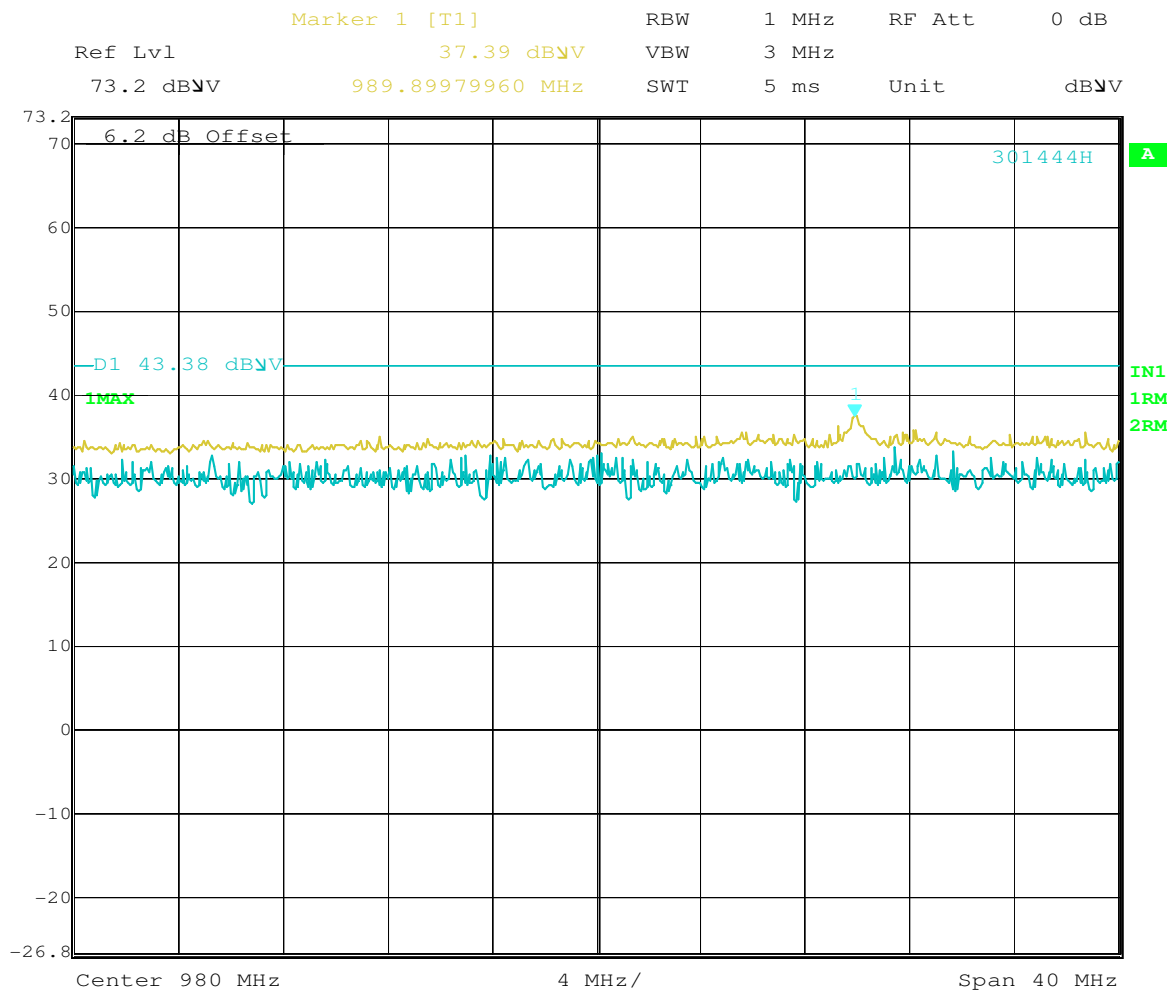
Continuous Rotation TUV 3m Radiated 30 to 1000MHz



Radiated Spurious Emission below 960 MHz

Quasi Peak Data

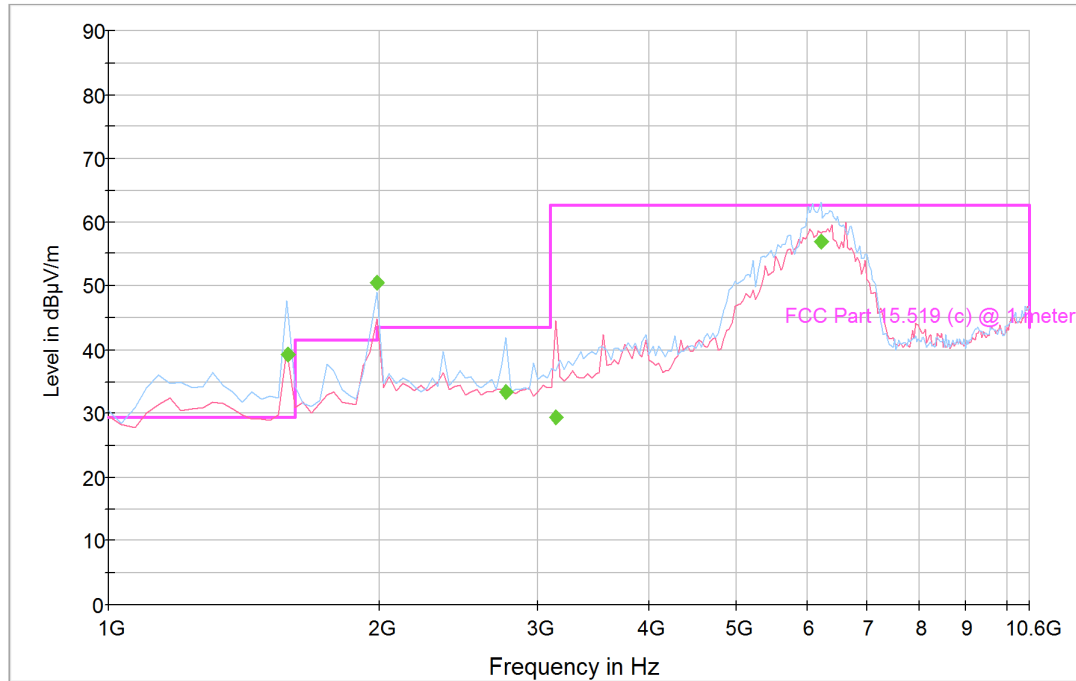
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.000000	23.2	1000.0	120.000	110.0	V	256.0	-5.9	16.8	40.0
50.358878	18.5	1000.0	120.000	106.0	V	15.0	-14.4	21.5	40.0
70.341643	6.4	1000.0	120.000	150.0	V	78.0	-17.0	33.6	40.0
87.852745	8.7	1000.0	120.000	105.0	V	216.0	-16.3	31.4	40.0
703.865170	22.4	1000.0	120.000	400.0	V	300.0	2.9	23.6	46.0
875.271182	25.0	1000.0	120.000	300.0	H	108.0	5.0	21.0	46.0



Date: 3.AUG.2017 10:24:13

Radiated Spurious Emission from 960 MHz – 1 GHz at the distance of 0.2 meter

Continuous Rotation TUV 3m Radiated 1000 to 18000MHz (ESIB40 receiver)



— FCC Part 15.519 (c) @ 1 meter [..EMI Radiated]
— Preview Result 1H-PK+ [Preview Result 1H.Result:2]
— Preview Result 1V-PK+ [Preview Result 1V.Result:1]
◆ Final Result 2-AVG [Final Result 2.Result:1]

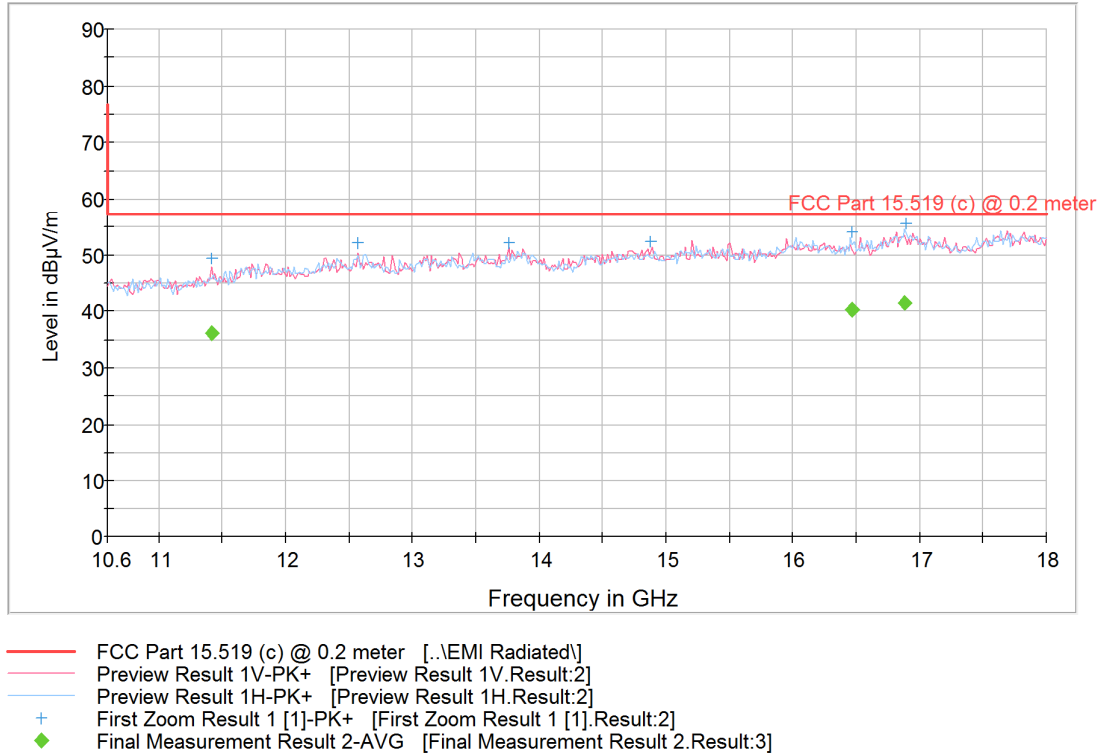
Radiated Spurious Emission from 1 GHz – 10.6 GHz at the distance of 1 meter

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1583.758317	39.4	1000.0	1000.000	125.7	H	1.0	-5.9	-10.0*	29.4
1991.775952	50.5	1000.0	1000.000	151.2	H	161.0	-2.0	-7.1*	43.4
2771.743086	33.5	1000.0	1000.000	132.7	H	77.0	0.3	9.9	43.4
3149.692585	29.4	1000.0	1000.000	103.7	V	80.0	1.1	33.4	62.8
6223.824850	56.8	1000.0	1000.000	123.7	H	20.0	6.7	6.0	62.8

Note: The spurious at 1583.758317 MHz and 1991.775952 MHz which are above the limit were verified with the digital part on only (UWB off) and proved were caused by the digital part.

Continuous Rotation TUV 3m Radiated 1000 to 18000MHz (ESIB40 receiver)

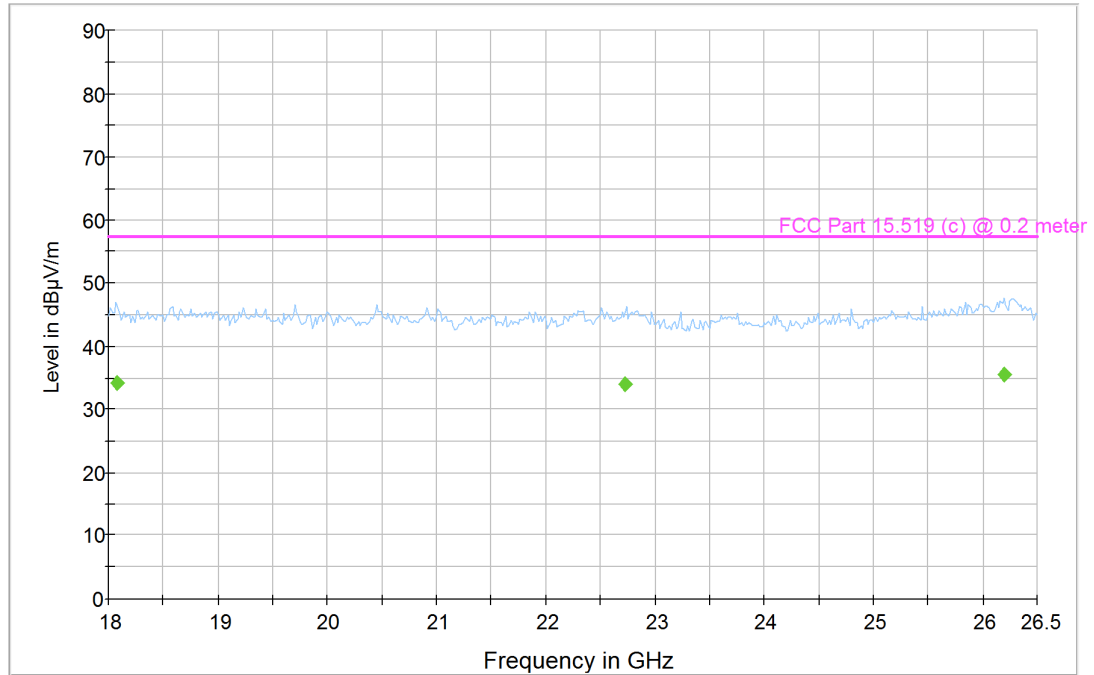


Radiated Spurious Emission from 10 GHz – 18 GHz at the distance of 0.2 meter

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
11420.63126	36.1	1000.0	1000.000	205.3	36.1	20.0	14.8	21.4	57.4
16466.31543	40.4	1000.0	1000.000	205.3	40.4	20.0	21.7	17	57.4
16885.17555	41.5	1000.0	1000.000	177.6	41.5	-20.0	23.1	15.9	57.4

Continuous Rotation TUV 3m Radiated 18G to 26.5GHz (ESIB40)



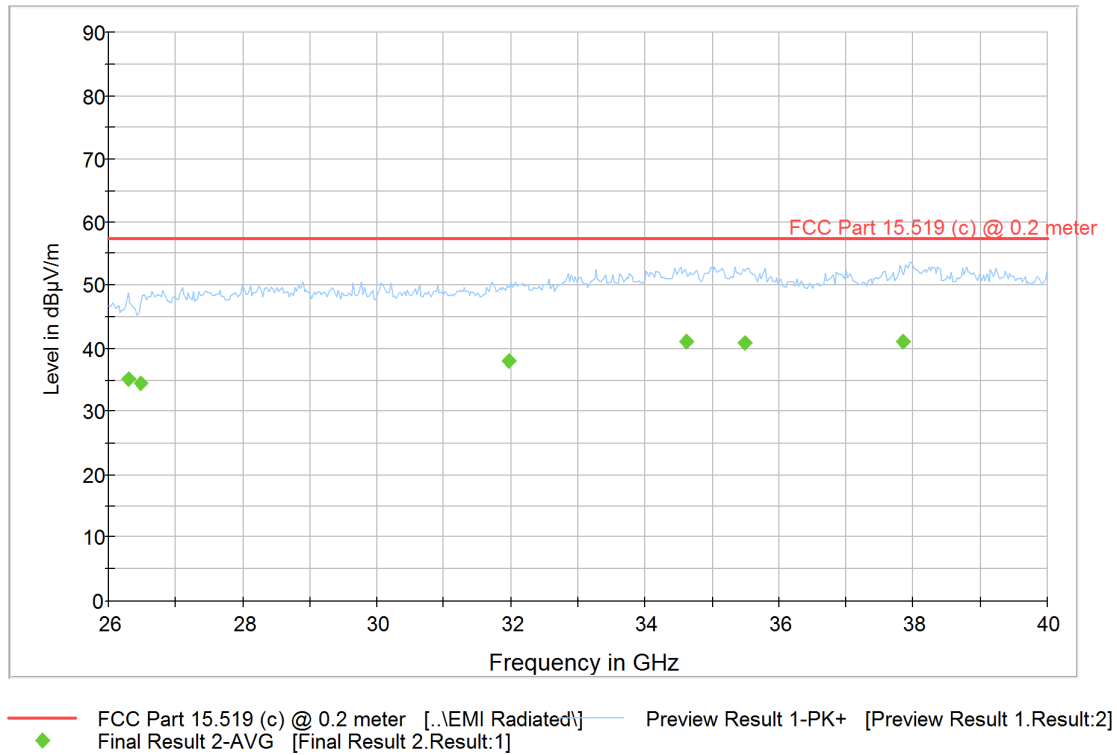
— FCC Part 15.519 (c) @ 0.2 meter [..\EMI Radiated\] — Preview Result 1H-PK+ [Preview Result 1H.Result:1]
◆ Final Result 2-AVG [Final Result 2.Result:1]

Radiated Spurious Emission from 18 GHz – 26.5 GHz at the distance of 0.2 meter

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
18070.33627	34.3	1000.0	1000.000	157.2	H	-5.0	11.2	23.1	57.4
22726.87094	34.1	1000.0	1000.000	157.2	H	0.0	13.2	23.3	57.4
26194.38677	35.6	1000.0	1000.000	157.2	H	0.0	14.7	21.8	57.4

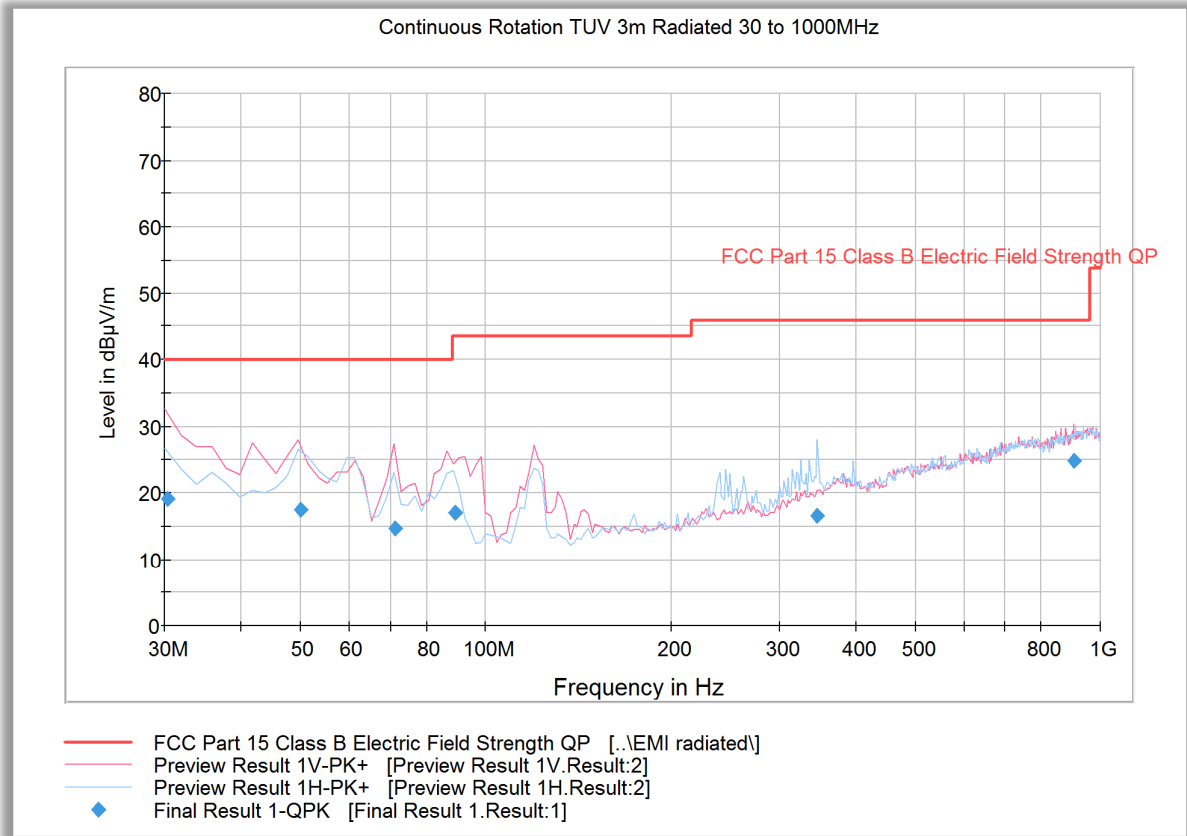
Continuous Rotation TUV 3m Radiated 26G to 40GHz (ESIB-40)



Radiated Spurious Emission from 26 GHz – 40 GHz at the distance of 0.2 meter

Average Data

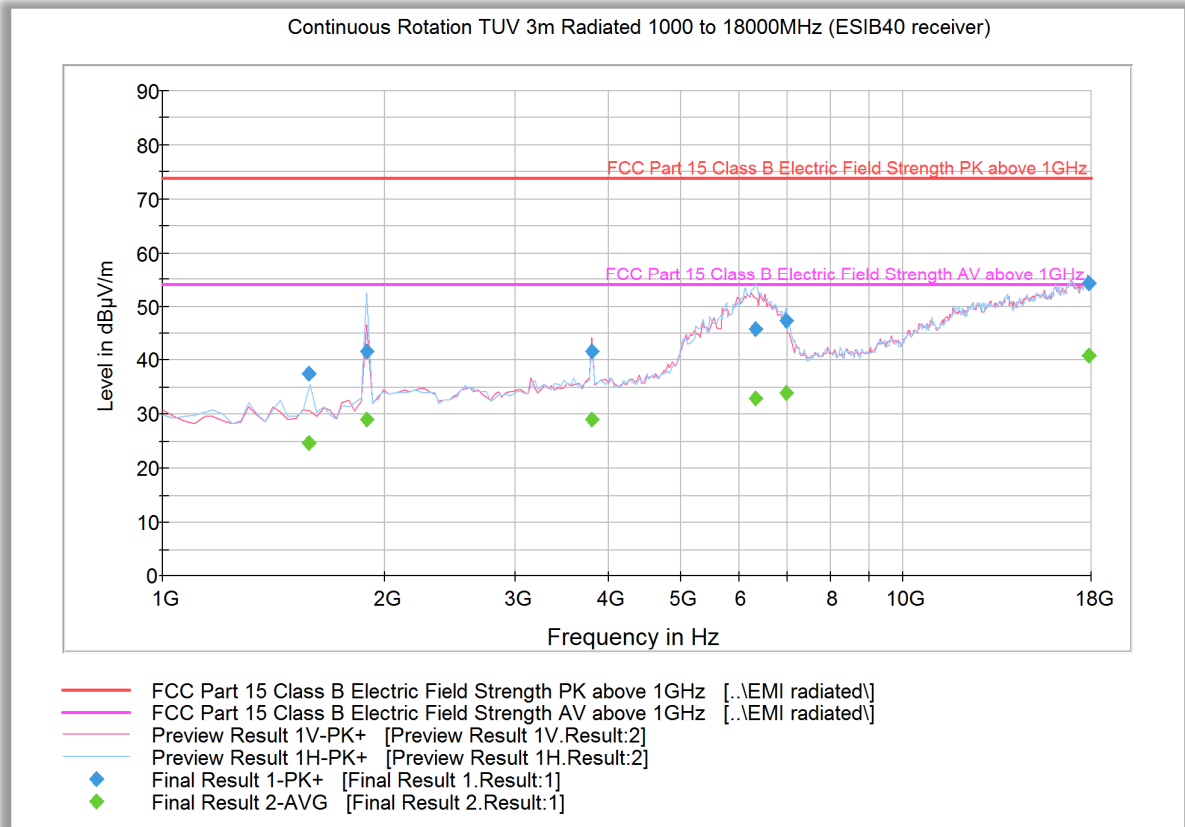
Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
26280.76112	35.2	1000.0	1000.000	159.0	V	12.0	2.2	22.2	57.4
26469.95390	34.4	1000.0	1000.000	159.0	H	5.0	2.1	23	57.4
31972.15190	38.0	1000.0	1000.000	159.0	H	-2.0	4.4	19.4	57.4
34625.02645	40.9	1000.0	1000.000	159.0	H	2.0	6.1	16.5	57.4
35475.96593	40.8	1000.0	1000.000	159.0	H	7.0	6.6	16.6	57.4
37837.07935	41.1	1000.0	1000.000	159.0	H	-2.0	7.6	16.3	57.4



**Radiated Spurious Emission below 1GHz in worst case simultaneous transmission (WCDMA, WiFi and UWB on)
(UWB has been verified separately)**

Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.240000	19.2	1000.0	120.000	250.0	V	-10.0	-6.1	20.8	40.0
50.078878	17.5	1000.0	120.000	100.0	V	182.0	-14.4	22.5	40.0
71.021643	14.8	1000.0	120.000	100.0	V	133.0	-16.9	25.2	40.0
89.212745	17.0	1000.0	120.000	100.0	V	164.0	-16.1	26.5	43.5
345.853707	16.6	1000.0	120.000	110.0	H	8.0	-5.8	29.4	46.0
904.909499	24.8	1000.0	120.000	150.0	V	96.0	5.9	21.2	46.0



**Radiated Spurious Emission above 1GHz in worst case simultaneous transmission (WCDMA, WiFi and UWB on)
(UWB has been verified separately)**

Peak Data

Frequency (MHz)	Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1572.558317	37.7	1000.0	1000.000	152.6	H	19.0	-6.0	36.2	73.9
1887.571543	41.7	1000.0	1000.000	292.2	H	281.0	-2.6	32.2	73.9
3799.387174	41.6	1000.0	1000.000	201.5	V	246.0	2.1	32.3	73.9
6322.429259	45.8	1000.0	1000.000	233.4	H	39.0	6.9	28.1	73.9
6950.923848	47.2	1000.0	1000.000	102.7	H	19.0	7.8	26.7	73.9
17806.99118	54.2	1000.0	1000.000	292.2	V	322.0	23.0	19.7	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1572.558317	24.7	1000.0	1000.000	152.6	H	19.0	-6.0	29.2	53.9
1887.571543	29.1	1000.0	1000.000	292.2	H	281.0	-2.6	24.8	53.9
3799.387174	29.1	1000.0	1000.000	201.5	V	246.0	2.1	24.8	53.9
6322.429259	32.9	1000.0	1000.000	233.4	H	39.0	6.9	21.0	53.9
6950.923848	34.0	1000.0	1000.000	102.7	H	19.0	7.8	19.9	53.9
17806.99118	40.9	1000.0	1000.000	292.2	V	322.0	23.0	13.0	53.9

Note: A 2.4GHz and a 1900 MHz Notches are used when testing. No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.



2.5 RADIATED EMISSIONS IN GPS BANDS

2.5.1 Specification Reference

Part 15 §15.519 (d)
RSS-220 5.3.1 (e)

2.5.2 Standard Applicable

In addition to the radiated emission limits specified in the table in paragraph (c) 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:

Frquency in MHz	EIRP at 3 meter in dBm	EIRP at 3 meter in dBμV/m
1164 - 1240	-85.3	9.9
1559 - 1610	-85.3	9.9

2.5.3 Equipment Under Test and Modification State

Serial No: XB-0001022 / Default Test Configuration

2.5.1 Date of Test/Initial of test personnel who performed the test

August 04, 2017 / XYZ

2.5.2 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.3 Environmental Conditions

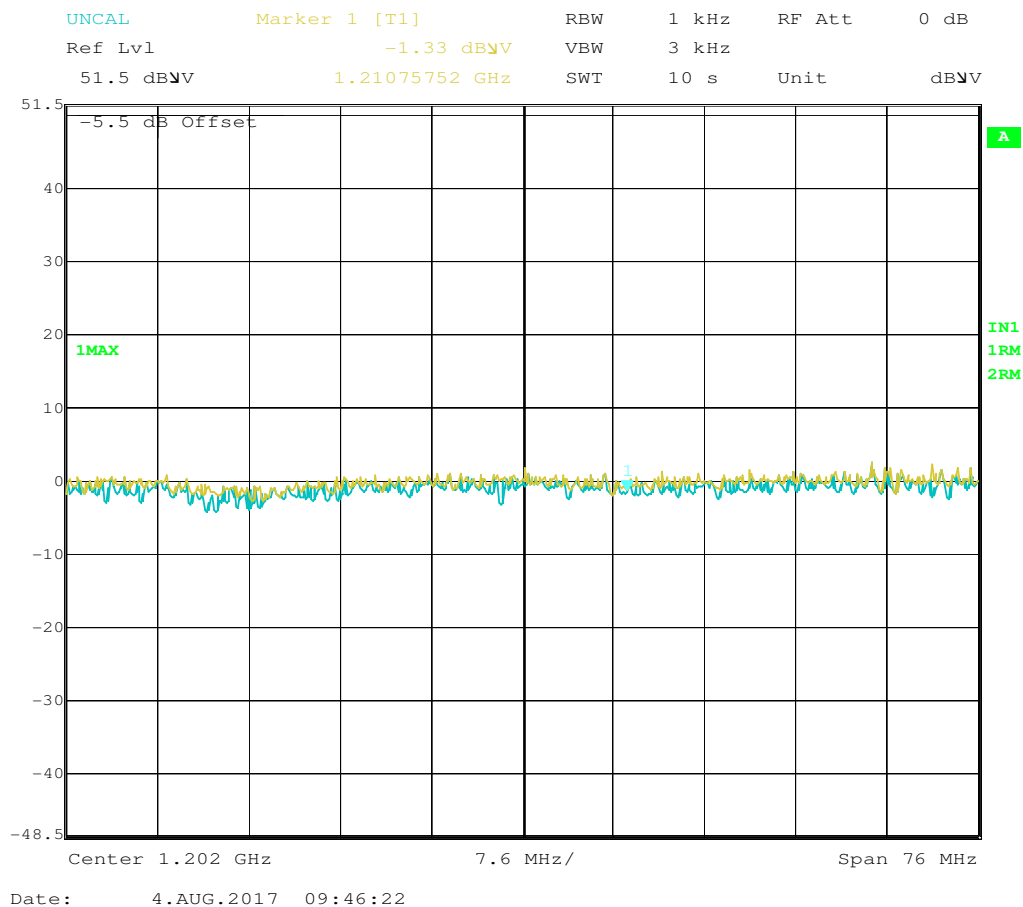
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 25.5 °C
 Relative Humidity 49.0 %
 ATM Pressure 98.8 kPa

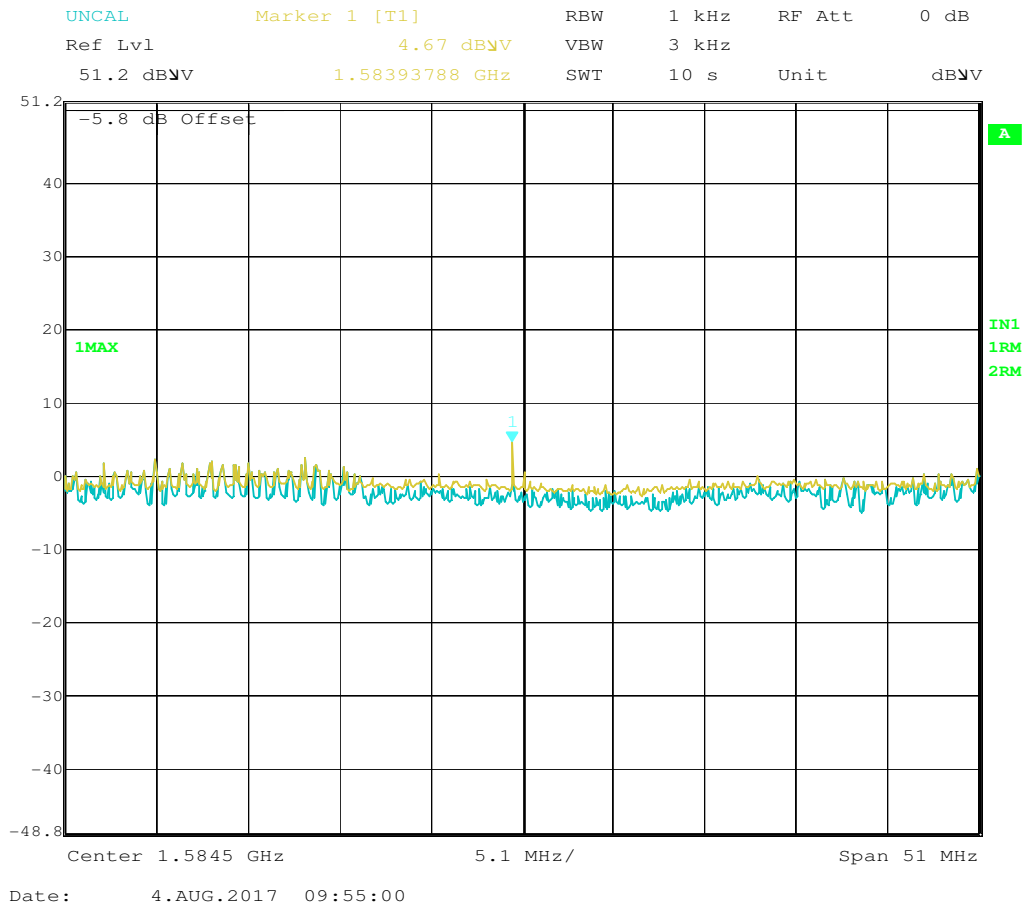
2.5.4 Additional Observations

- This is a radiated test.
- The spectrum was searched from 1164 MHz to 1240 MHz, and 1559 MHz to 1610 MHz.
- Verification was performed at 3 meters

2.5.5 Test Results



Radiated Spurious Emissions in 1164 MHz to 1240 MHz



Radiated Spurious Emissions in 1559 MHz to 1610 MHz



2.6 PEAK EMISSIONS IN A 50 MHZ BANDWIDTH

2.6.1 Specification Reference

Part 15 §15.519 (e)
RSS-220 5.3.1 (g)

2.6.2 Standard Applicable

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 § 15.521.

2.6.3 Equipment Under Test and Modification State

Serial No: XB-0001022 / Default Test Configuration

2.6.4 Date of Test/Initial of test personnel who performed the test

August 04, 2017 / XYZ

2.6.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.6 Environmental Conditions

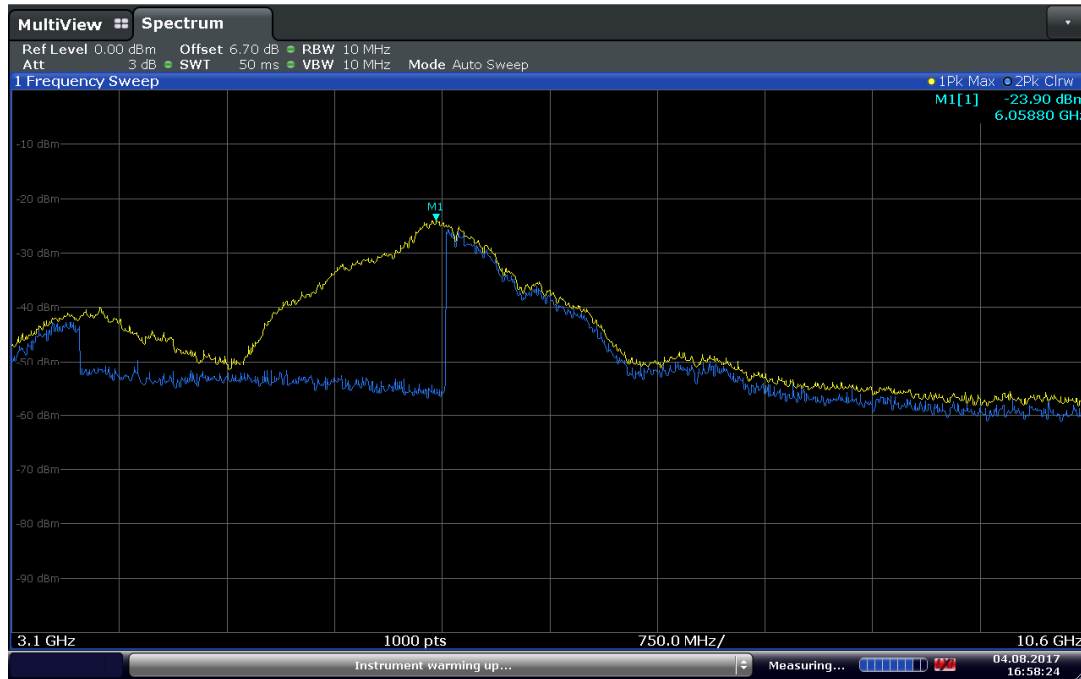
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.5 °C
Relative Humidity	49.0 %
ATM Pressure	98.8 kPa

2.6.7 Additional Observations

- This is a radiated test
- Verification was performed at the distance of 0.2 meter
- RBW is 10 MHz.
- VBW is 10 MHz.
- Sweep is auto.
- Detector is peak.
- Trace is Max Hold.
- The limit is $20\lg(10/50) + 20\lg(3/0.2) = 9.54 \text{ dBm}$

2.6.8 Test Plots



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Peak Emissions in Ultra Wide Band

Peak Emission at 0.2m in 10MHz RBW = -23.9dBm (limit at 0.2m is 9.54 dBm, **Complies**);

Calculation:

EIRP in 50MHz RBW = $-23.9\text{dBm} + 20\lg(50/10) - 20\lg(3/0.2) = -33.44\text{ dBm}$
 (limit at 3m is 0 dBm, **Complies**)



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Test Setup						
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
1016	Pre-amplifier	PAM-0202	187	PAM	02/09/17	02/09/18
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	06/01/17	06/01/18
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	04/26/17	04/26/18
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
9001	Horn Antenna (18-26GHz)	H042S	101	Custom Microwave	08/23/16	08/23/17
8893	Pre-amplifier (18-40 GHz)	SLKka-30-6	15G27	Spacek Labs	09/04/16	09/04/17
9002	Horn antenna (26-40 GHz)	HO28S	102	Custom Microwaves	07/14/17	07/14/19
8893	Pre-amplifier (18-40 GHz)	SLKka-30-6	15G27	Spacek Labs	Verified by and 1040	
7640	Loop Antenna	AL-130R	121086	Com-Power	11/21/16	11/21/17
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/02/16	09/02/17
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	10/26/15	10/26/17
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7608 and 7582	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 7608 and 7582	
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1040	
8806	1.8GHz to 2.0GHz Notch Filter	BRM50707	005	Micro-Tronics	Verified by 1040	
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/29/17
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	08/22/16	08/22/17
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 AC Conducted Emissions

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.80
Coverage Factor (k):					2
Expanded Uncertainty:					1.59

3.2.2 Radiated Measurements (Below 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57

3.2.3 Radiated Measurements (Above 1GHz)

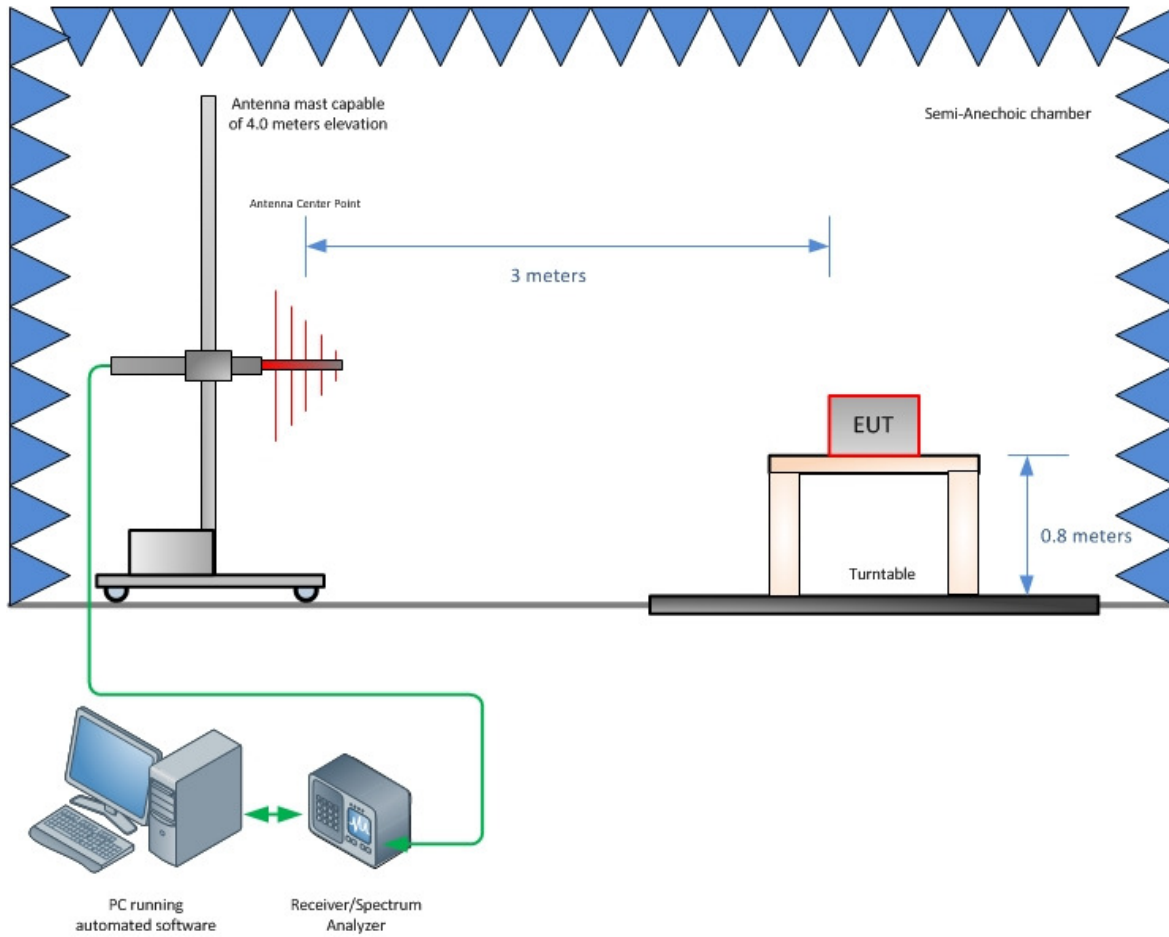
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57



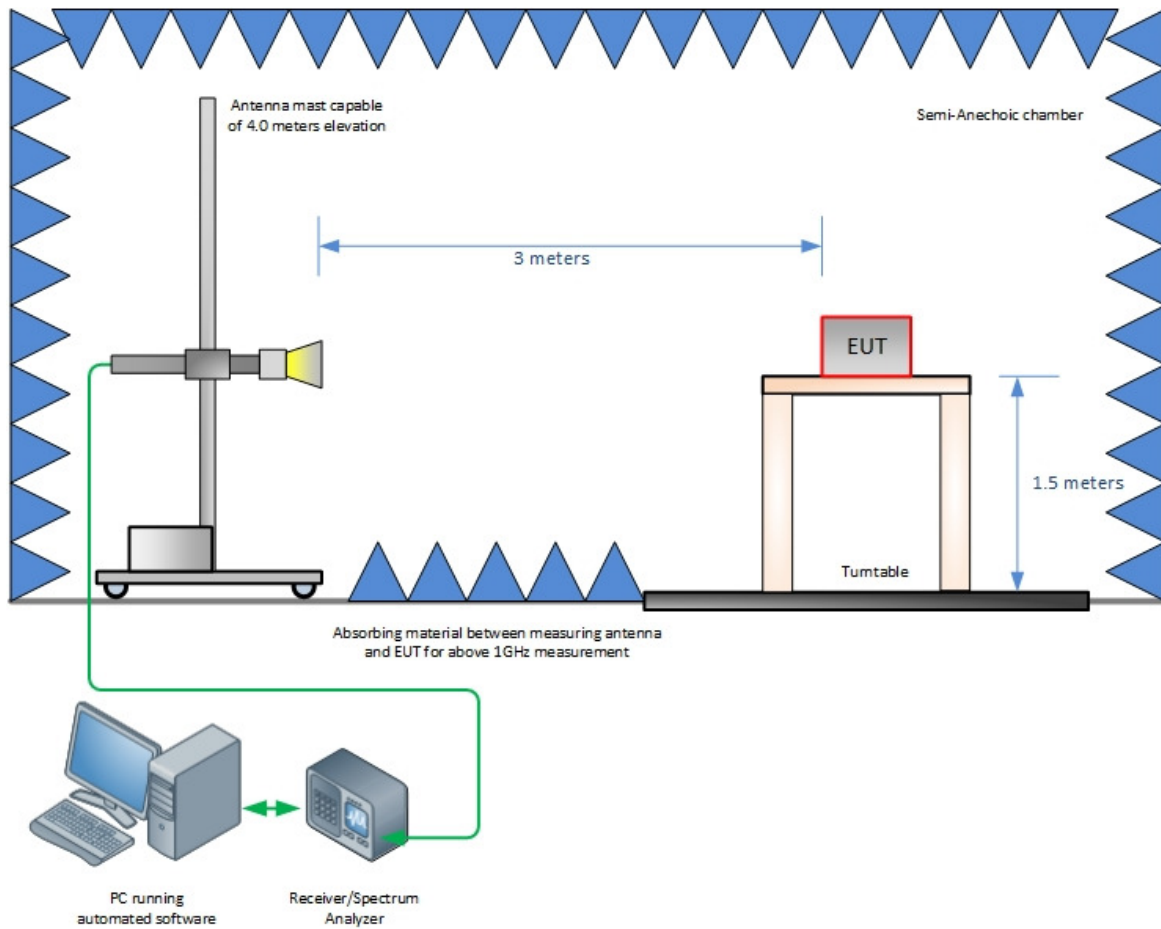
SECTION 4

DIAGRAM OF TEST SETUP

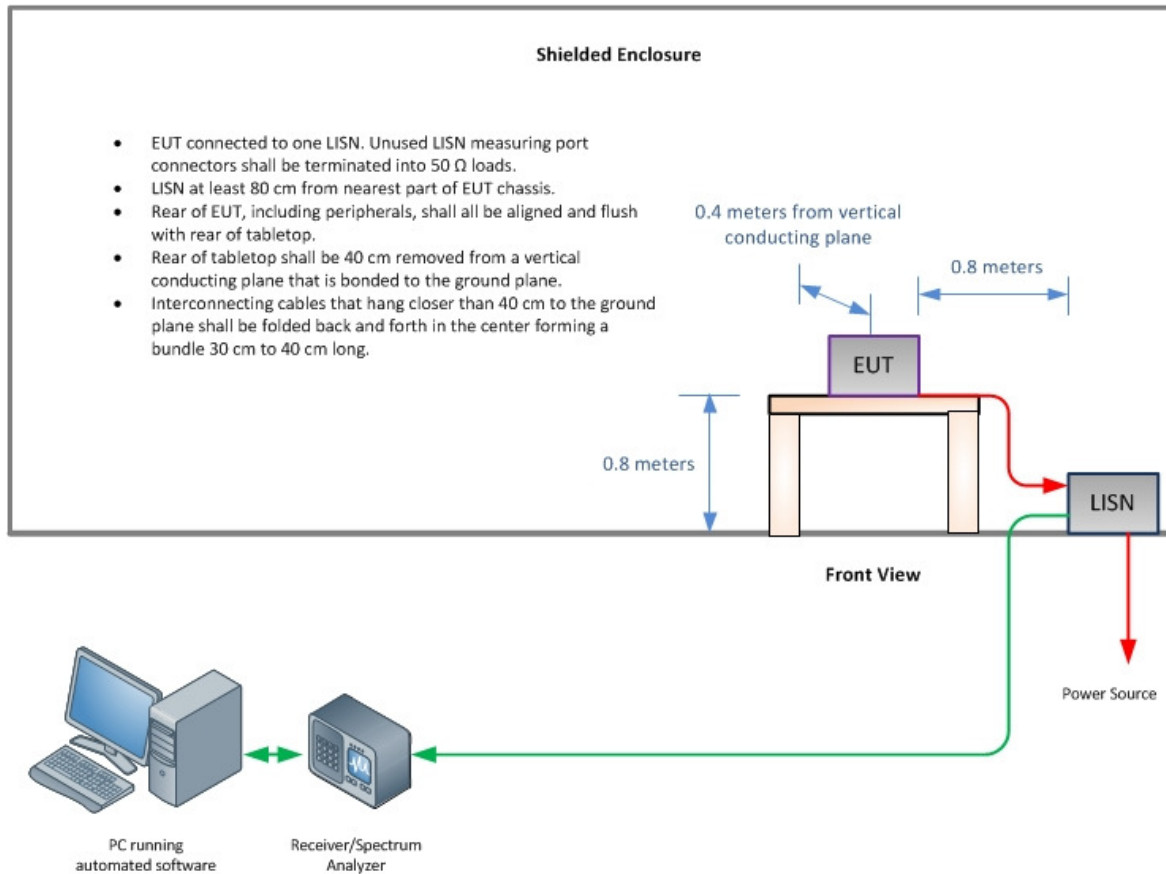
4.1 TEST SETUP DIAGRAM



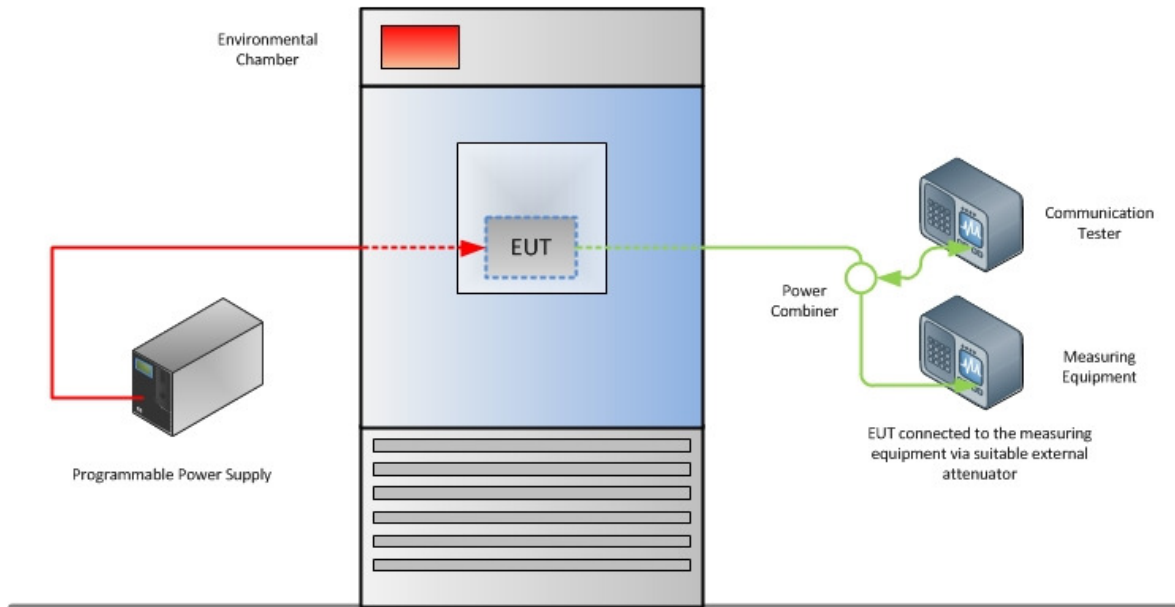
Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Conducted Emission Test Setup



Frequency Stability Test Configuration

** Diagram presented is for a typical licensed cellular test setup, the EUT on the other hand does not use a Communication tester instead it uses a direct connection to the support laptop (please see separate test setup photo for details).*



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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