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Report On

Radio Testing of the
OnRamp Wireless Inc.
ULP Tracker Test Device ULPT100

FCC Part 15 Subpart C §15.247

Report No. SC1202962B April 2012

REPORT ON	Radio Testing of the OnRamp Wireless Inc. Test Device
TEST REPORT NUMBER	SC1202962B
	April 2012
PREPARED FOR	OnRamp Wireless Inc. 10920 Via Frontera, Suite 200 San Diego, CA 92127
CONTACT PERSON	David Howard david.howard@onrampwireless.com (858) 592-6008
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Chip R. Fleury **Name** Authorized Signatory
DATED	April 26, 2012

CONTENTS

SECTION 1

REPORT SUMMARY

Radio Testing of the
OnRamp Wireless Inc.
Test Device

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the OnRamp Wireless Inc. Test Device to the requirements of FCC Part 15 Subpart C §15.247.

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	OnRamp Wireless Inc.
Model Number(s)	ULP Tracker
FCC ID Number	XTE-ULPT100
Serial Number(s)	43117005
Number of Samples Tested	1
Test Specification/Issue/Date	FCC Part 15 Subpart C §15.247 (October 1, 2011).
Start of Test	April 11, 2012
Finish of Test	April 11, 2012
Name of Engineer(s)	Ferdinand S. Custodio
Related Document(s)	• TUV SUD America Test Report No. SC1108236 (eNode RF module) • Supporting documents for EUT certification are separate exhibits

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 is shown below.

Section	§15.247 Spec Clause	Test Description	Result	Comments/Base Standard
2.1	§15.247(b)(3)	Peak Output Power	Compliant	
2.2	§15.207(a)	Conducted Emissions	N/A*	
2.3	§15.215(c)	20 dB Bandwidth	Compliant**	
2.5	§15.247(a)(2)	Minimum 6 dB RF Bandwidth	Compliant**	
2.6	§15.247(d)	Out-of-Band Emissions - Conducted	Compliant**	
2.7	§15.247(d)	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.8	§15.247(d)	Spurious Radiated Emissions	Compliant	
2.9	§15.247(e)	Power Spectral Density for Digitally Modulated Device	Compliant**	

* Not applicable. EUT is battery operated.

** EUT contains a fully certified RF module (eNode Model ULPN120 FCC ID XTE-ULPENODE120). Test results from module testing apply.

1.3 PRODUCT INFORMATION

1.3.1 EUT General Description

The Equipment Under Test (EUT) was an OnRamp Wireless Inc. Test Device as shown in the photograph below. The EUT is used to support network coverage verification and demonstration. The EUT is intended as a representative example for integrating the ULP eNode and an application processor to create a simple sensor – in this case, a GPS location sensor. The EUT consists of ULP eNode (FCC ID XTE-ULPENODE120), appHost processor board and Trimble 67650-10 GPS module. The EUT is powered by three (3) "C" type batteries.

Equipment Under Test

1.3.2 EUT General Description

EUT Description	Test Device
Model Number(s)	ULP Tracker
Rated Voltage	4.5VDC (Three “C” type batteries)
Output Power	20.35dBm (108.4mW)
Frequency Range	2402 MHz to 2475.63 MHz
Number of Operating Frequencies	38
Channels Verified	Channel 1 (Low Channel 2402 MHz) Channel 20 (Mid Channel 2439.81 MHz) Channel 38 (High Channel 2475.63 MHz)
Antenna Type (used during evaluation)	2.4 GHz Wireless “Rubber Duck” antenna.
Antenna Gain	2.2 dBi
EUT Antenna Connector	RP-SMA Connector
Modulation Used	DSSS-DBPSK

1.3.3 Test Antenna Details

Model	HG2402RD-RSF
Manufacturer	L-COM Global Connectivity
Antenna Connector	RP-SMA Connector
General Description	Compact 2.4GHz Omni-directional “Rubber Duck” WiFi antenna
Design	Coaxial sleeve with an Omni-directional pattern
Length	105mm

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1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	EUT transmitting max power through the test antenna.
B	EUT transmitting max power, antenna port connected to the spectrum analyzer through a 20dB external attenuator.

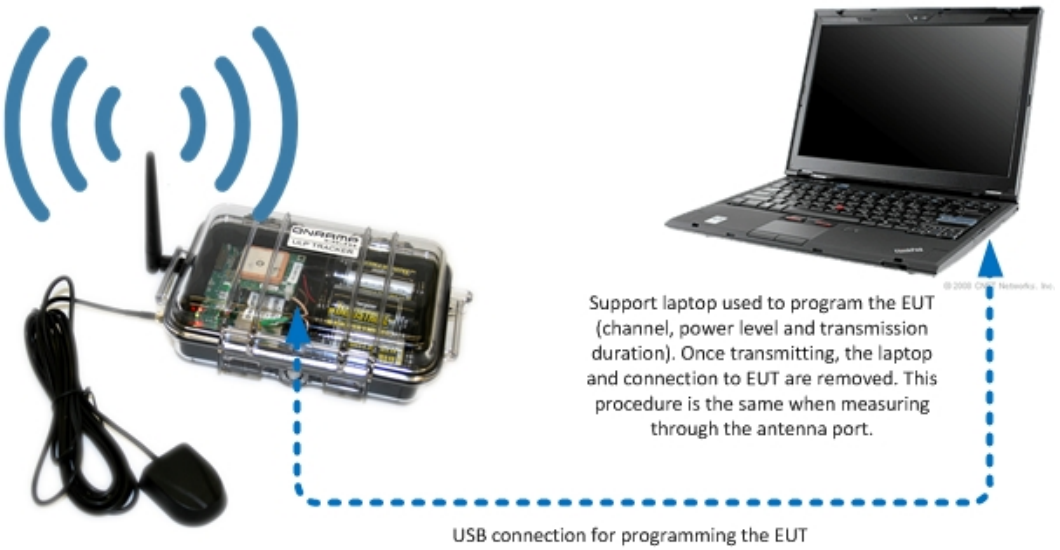
1.4.2 EUT Exercise Software

"Python Commands" software provided by the client was used to exercise the EUT. The line commands are typed and executed one at a time. Simplified example: Reset, Frequency, TX power, TX ON. Once set the EUT will continue in its configured mode until new commands are sent. Each time the EUT must change its channel, TX power, or mode (RX or TX), operator intervention is required to send commands.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Taoglas	Titan GPS antenna	AA-105 3m RG174 GPS-SMA(M) Straight

1.4.4 Simplified Test Configuration Diagram



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 43117005		
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 C63.4-2009, 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.
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 C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY

1.8.1 FCC – Registration No.: US5281

TUV SUD America Inc. (San Diego), a §2.498 listed test firm operates the EMC Laboratory registered under Sony Electronics Inc. Product Quality Division EMC. This laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the Registration is US5281.

1.8.2 Industry Canada (IC) Registration No.: 3067A

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

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SECTION 2

TEST DETAILS

Radio Testing of the
OnRamp Wireless Inc.
Test Device

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2.1 PEAK OUTPUT POWER

2.1.1 Specification Reference

Part 15 Subpart C §15.247(b)(3)

2.1.2 Standard Applicable

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

2.1.3 Equipment Under Test and Modification State

Serial No: 43117005 / Test Configuration B

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

April 11, 2012/FSC

2.1.5 Test Equipment Used

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

2.1.6 Environmental Conditions

Ambient Temperature	23.1°C
Relative Humidity	40.9%
ATM Pressure	99.5 kPa

2.1.7 Additional Observations

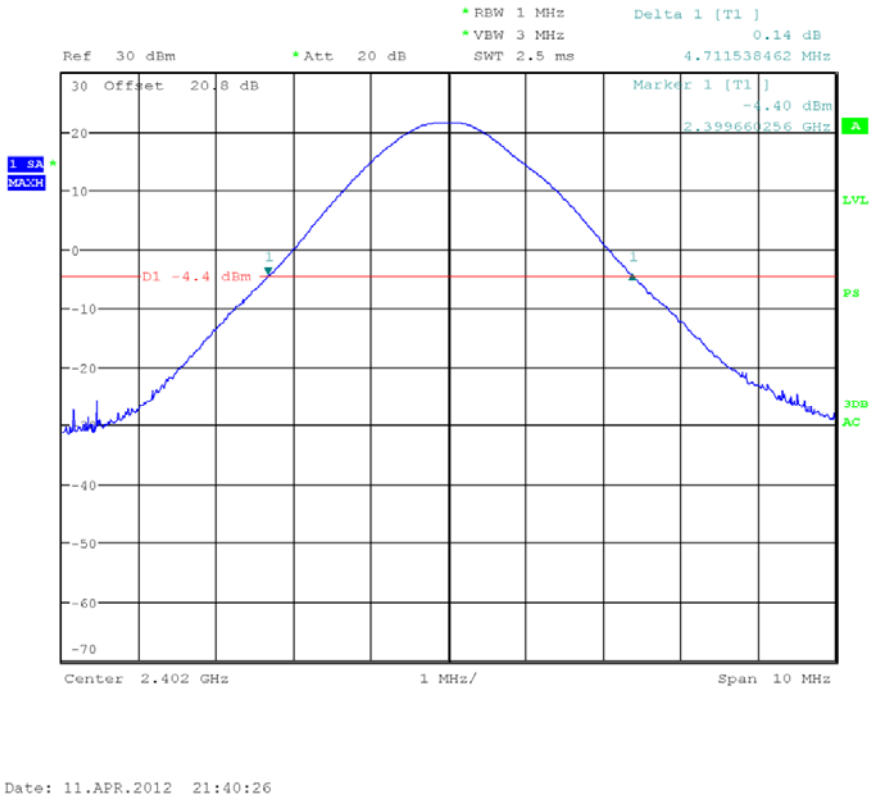
- This is a conducted test using Power Output Option 2 Method #1 FCC KDB Publication Number 558074 (Measurement of Digital Transmission System under Section 15.247 March 23, 2005).
- An offset of 20.2dB was added to compensate for the external attenuator and cable used.
- Measurements were verified using a fresh set of batteries.
- Span was set to encompass the entire emission bandwidth of the signal.
- RBW=1MHz while VBW=3MHz.
- Sample detector used since bin width < 0.5RBW.
  = 10000000 (span)/625 (sweep points) < 0.5 (1000000)
  = 16kHz < 500kHz

- Trigger is set to “free run” as the EUT transmits continuously.
- Trace was averaged 100 times in power averaging mode.
- Power was measured using the spectrum analyzer built-in power measurement function by integrating the spectrum across the 26 dB emission bandwidth of the signal.
- Measured 26 dB emission bandwidth of the EUT is 4.71MHz.

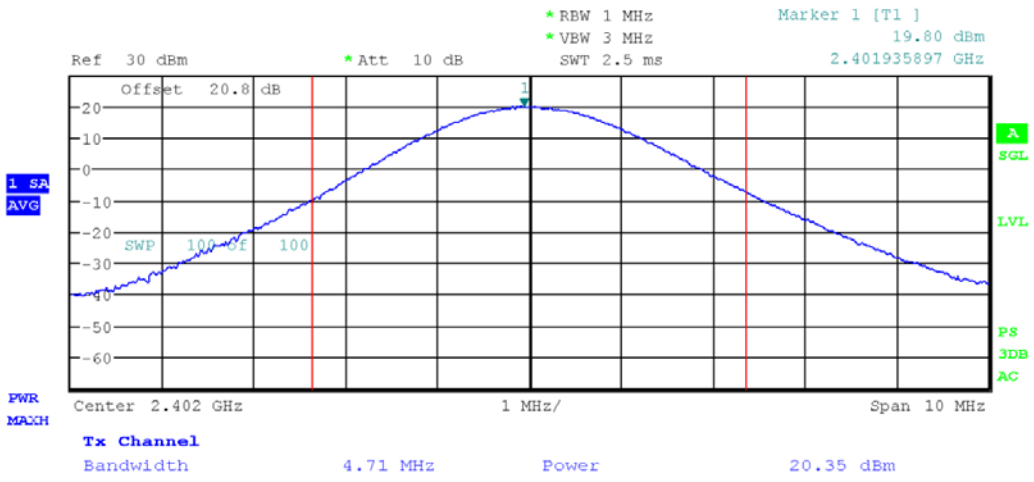
2.1.8 Test Results

See attached table and plots

Voltage Input	Measured Power (Low Channel) dBm	Measured Power (Mid Channel) dBm	Measured Power (High Channel) dBm
4.5VDC	20.35	19.73	19.21

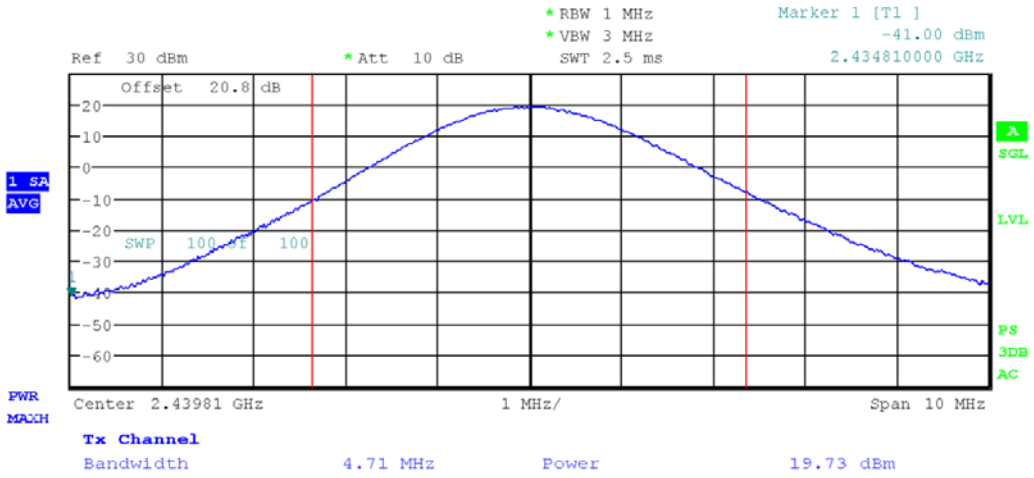


26dB Bandwidth



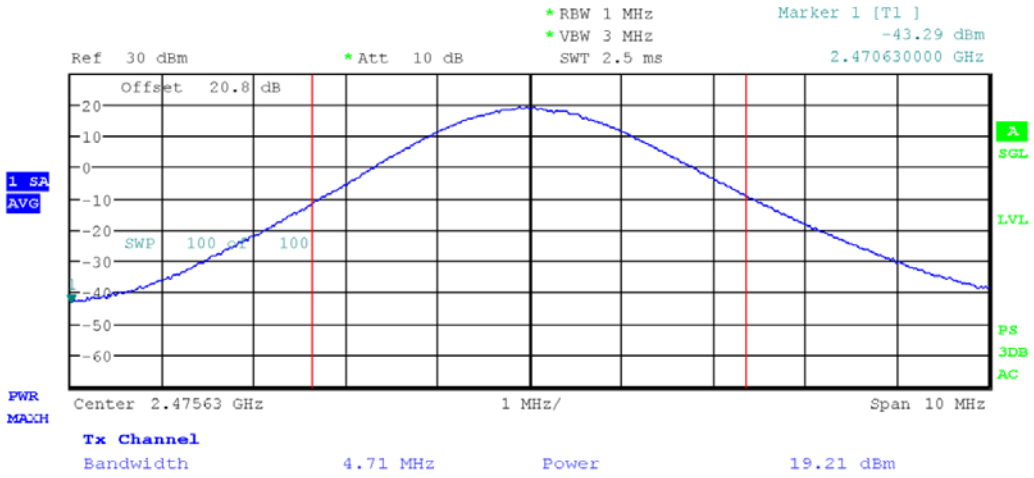
Date: 11.APR.2012 21:52:25

Low Channel (2402 MHz)



Date: 11.APR.2012 21:56:54

Mid Channel (2439.81 MHz)



Date: 11.APR.2012 21:58:18

High Channel (2475.63 MHz)

2.2 SPURIOUS RADIATED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.2.2 Standard Applicable

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.2.3 Equipment Under Test and Modification State

Serial No: 43117005 / Test Configuration A

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

April 11, 2012/FSC

2.2.5 Test Equipment Used

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

2.2.6 Environmental Conditions

Ambient Temperature	23.1°C
Relative Humidity	40.9%
ATM Pressure	99.5 kPa

2.2.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic (25GHz).
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Measurement was done using EMC32 V8.52 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 2.2.8 for sample computation.

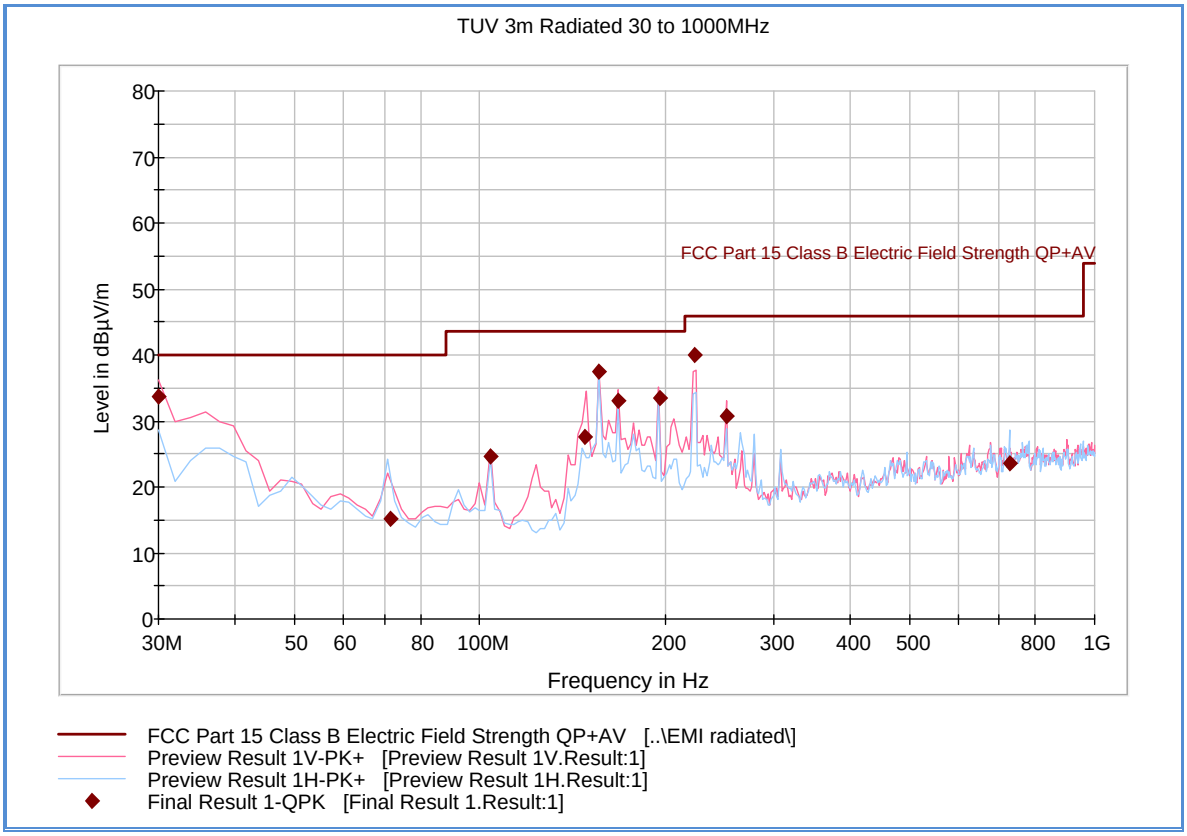
2.2.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) @ 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# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.2.9 Test Results

See attached plots.

2.2.10 Test Results Below 1GHz (High Channel – Worst Case Configuration)

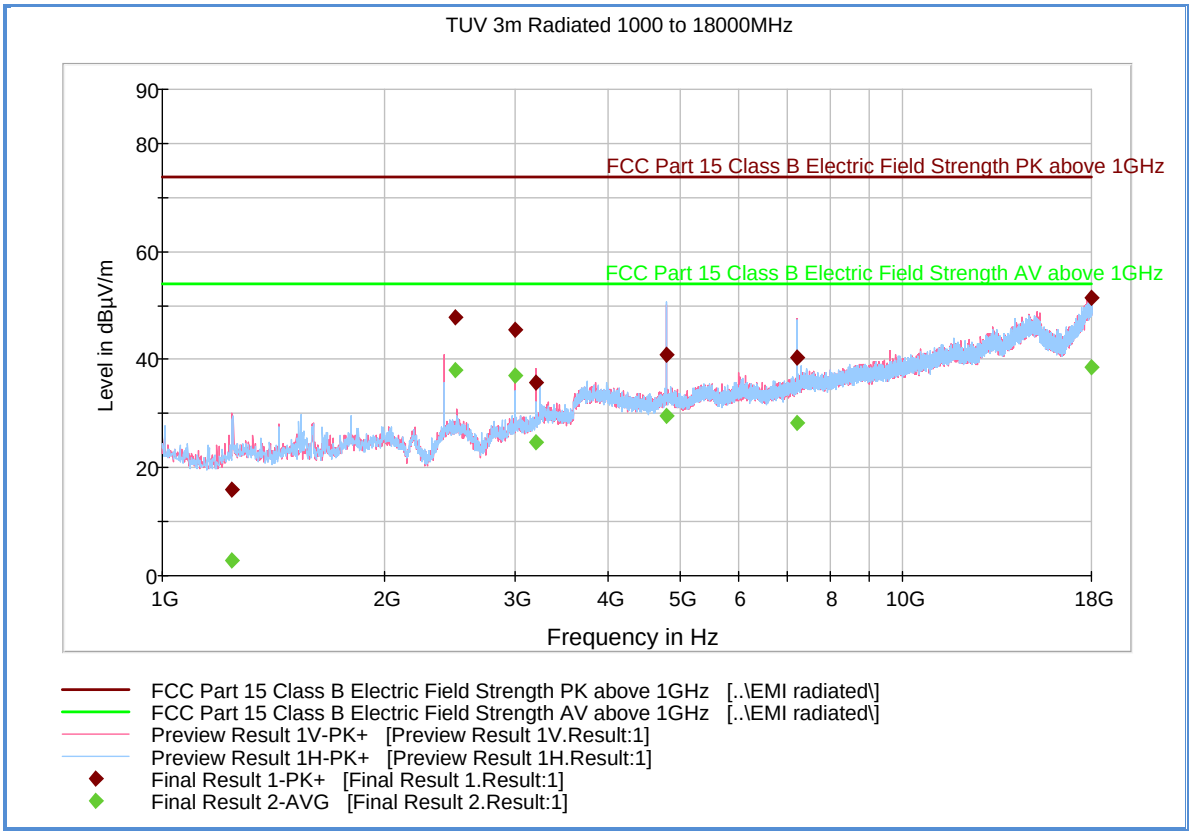


Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.000000	33.7	1000.0	120.000	150.0	V	51.0	-12.2	6.3	40.0
71.581643	15.3	1000.0	120.000	100.0	H	285.0	-22.2	24.7	40.0
104.027735	24.6	1000.0	120.000	107.0	V	66.0	-20.2	18.9	43.5
147.977154	27.6	1000.0	120.000	129.0	V	104.0	-19.8	15.9	43.5
155.992705	37.5	1000.0	120.000	100.0	V	42.0	-18.4	6.0	43.5
167.776032	33.0	1000.0	120.000	109.0	V	198.0	-17.6	10.5	43.5
195.750461	33.4	1000.0	120.000	100.0	V	50.0	-16.6	10.1	43.5
223.684890	40.0	1000.0	120.000	100.0	V	242.0	-15.3	6.0	46.0
251.683206	30.6	1000.0	120.000	350.0	V	71.0	-13.9	15.4	46.0
728.055711	23.6	1000.0	120.000	206.0	H	208.0	-2.3	22.4	46.0

Test Notes: Only worst case channel presented for spurious emissions below 1GHz.

2.2.11 Test Results Above 1GHz (Low Channel including Band Edges)



Peak Data

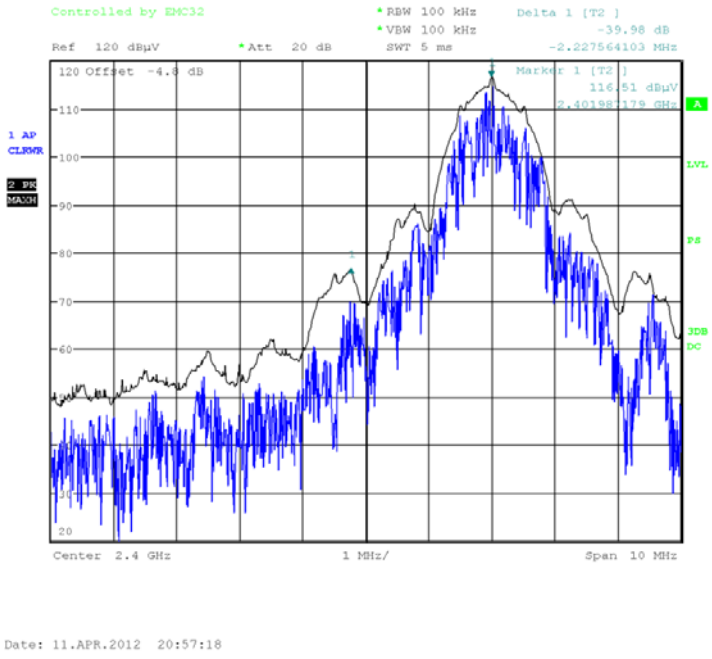
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1243.120000	15.9	1000.0	1000.000	112.0	V	219.0	-9.5	58.0	73.9
2483.360000	47.9	100.0	1000.000	104.0	V	110.0	7.8	26.0	73.9
2999.700000	45.5	1000.0	1000.000	142.0	V	31.0	-2.2	28.4	73.9
3201.720000	35.8	1000.0	1000.000	181.0	V	37.0	-1.0	38.1	73.9
4804.780000	41.0	1000.0	1000.000	400.0	H	268.0	2.1	32.9	73.9
7204.780000	40.3	1000.0	1000.000	281.0	V	28.0	6.4	33.6	73.9
17986.660000	51.4	1000.0	1000.000	158.0	V	283.0	21.3	22.5	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)
1243.120000	2.7	1000.0	1000.000	112.0	V	219.0	-9.5	51.2	53.9
2483.360000	38.0	100.0	1000.000	104.0	V	110.0	7.8	15.9	53.9
2999.700000	36.9	1000.0	1000.000	142.0	V	31.0	-2.2	17.0	53.9
3201.720000	24.8	1000.0	1000.000	181.0	V	37.0	-1.0	29.1	53.9
4804.780000	29.5	1000.0	1000.000	400.0	H	268.0	2.1	24.4	53.9
7204.780000	28.4	1000.0	1000.000	281.0	V	28.0	6.4	25.5	53.9
17986.660000	38.5	1000.0	1000.000	158.0	V	283.0	21.3	15.4	53.9

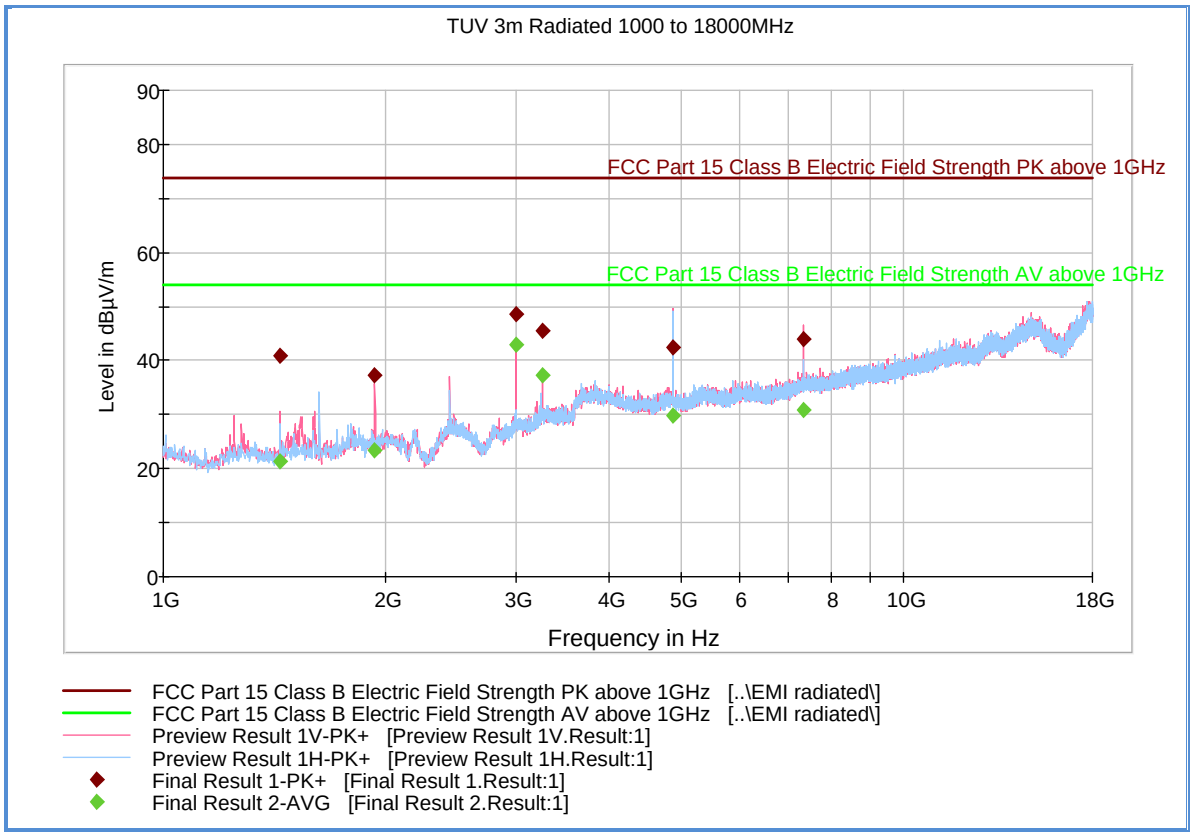
Test Notes: Measurement was performed with a 2.4GHz notch filter. Band edge measurements were performed with the notch filter removed. Lower band edge was verified manually using 100kHz RBW (see attached plot Section 2.2.12).

2.2.12 Test Results Lower Band Edge (Radiated - Low Channel using 100 kHz RBW)



Test Notes: Carrier frequency (Low Channel) was maximized for this test. Correction factor of -4.8dB is from the cable, antenna and preamp used. The EUT complies with the conducted power limits based on the use of RMS averaging over a time interval therefore the limit for this test is -30dBc. The highest measured emission close to the lower band edge is -39.98dBc. EUT complies.

2.2.13 Test Results Above 1GHz (Mid Channel)



Peak Data

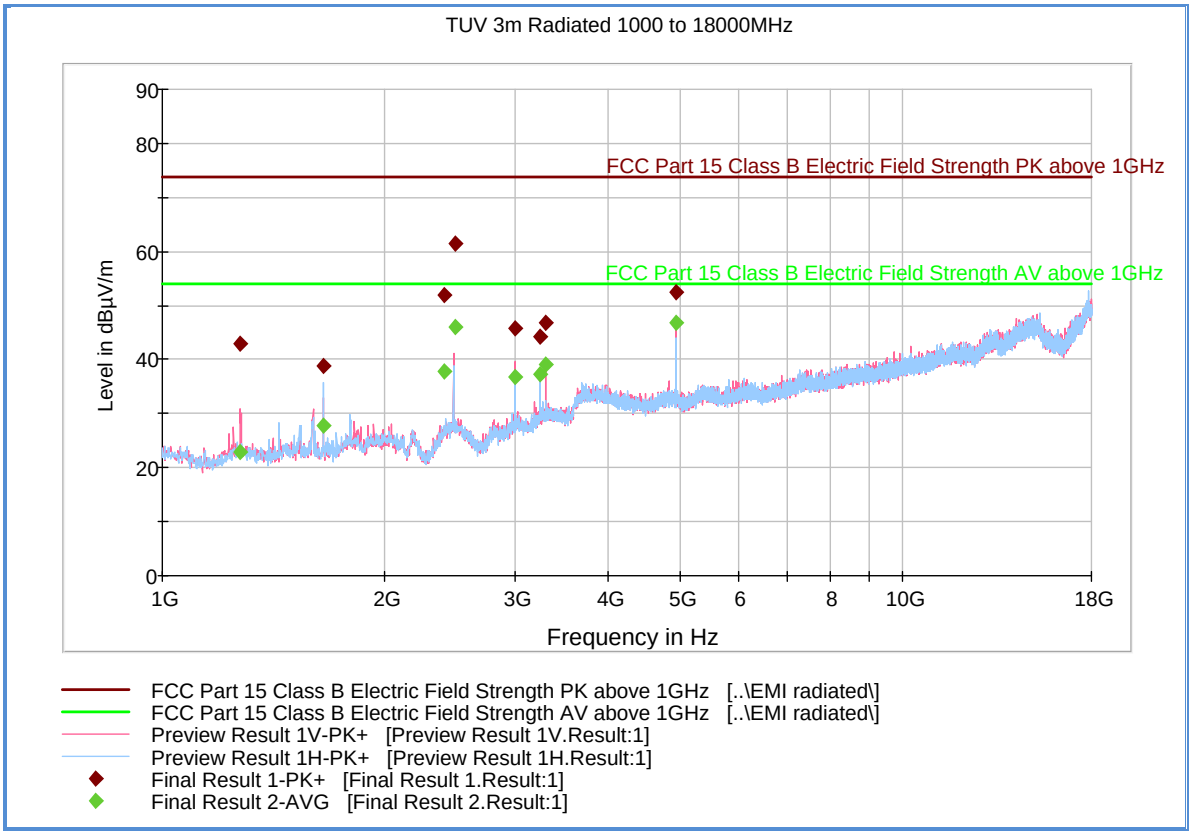
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1438.420000	41.0	1000.	1000.000	173.0	V	266.0	-9.2	32.9	73.9
1932.180000	37.2	1000.	1000.000	128.0	V	97.0	-6.5	36.7	73.9
2999.940000	48.5	1000.	1000.000	100.0	V	286.0	-2.2	25.4	73.9
3253.080000	45.5	1000.	1000.000	104.0	V	0.0	-0.7	28.4	73.9
4879.620000	42.4	1000.	1000.000	154.0	V	17.0	2.2	31.5	73.9
7319.440000	43.9	1000.	1000.000	372.0	V	89.0	7.1	30.0	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)
1438.420000	21.3	1000.	1000.000	173.0	V	266.0	-9.2	32.6	53.9
1932.180000	23.4	1000.	1000.000	128.0	V	97.0	-6.5	30.5	53.9
2999.940000	43.0	1000.	1000.000	100.0	V	286.0	-2.2	10.9	53.9
3253.080000	37.2	1000.	1000.000	104.0	V	0.0	-0.7	16.7	53.9
4879.620000	29.8	1000.	1000.000	154.0	V	17.0	2.2	24.1	53.9
7319.440000	31.0	1000.	1000.000	372.0	V	89.0	7.1	22.9	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. Band edge measurements were performed with the notch filter removed, however no emissions were observed (noise floor).

2.2.14 Test Results Above 1GHz (High Channel including Band Edges)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1274.560000	42.9	1000.0	1000.000	139.0	V	359.0	-9.3	31.0	73.9
1650.020000	38.8	1000.0	1000.000	125.0	V	5.0	-8.5	35.1	73.9
2400.000000	52.0	100.0	1000.000	100.0	V	17.0	7.0	21.9	73.9
2483.500000	61.4	100.0	1000.000	212.0	V	308.0	7.8	12.5	73.9
2999.940000	45.9	1000.0	1000.000	110.0	V	17.0	-2.2	28.0	73.9
3239.800000	44.2	1000.0	1000.000	100.0	H	66.0	-0.8	29.7	73.9
3300.840000	46.7	1000.0	1000.000	130.0	V	359.0	-0.5	27.2	73.9
4951.260000	52.3	1000.0	1000.000	100.0	V	22.0	2.3	21.6	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)
1274.560000	23.0	1000.0	1000.000	139.0	V	359.0	-9.3	30.9	53.9
1650.020000	27.9	1000.0	1000.000	125.0	V	5.0	-8.5	26.0	53.9
2400.000000	37.8	100.0	1000.000	100.0	V	17.0	7.0	16.1	53.9
2483.500000	46.1	100.0	1000.000	212.0	V	308.0	7.8	7.8	53.9
2999.940000	36.7	1000.0	1000.000	110.0	V	17.0	-2.2	17.2	53.9
3239.800000	37.2	1000.0	1000.000	100.0	H	66.0	-0.8	16.7	53.9
3300.840000	39.0	1000.0	1000.000	130.0	V	359.0	-0.5	14.9	53.9
4951.260000	46.7	1000.0	1000.000	100.0	V	22.0	2.3	7.2	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. Band edge measurements were performed with the notch filter removed.

SECTION 3

TEST EQUIPMENT USED

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

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
1033	Bilog Antenna	3142C	00044556	EMCO	08/01/11	08/01/12
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	08/10/11	08/10/12
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	06/15/11	06/15/12
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1040	
1051	Double-ridged waveguide horn antenna	3115	9412-4364	EMCO	11/07/11	11/07/12
1016	Pre-amplifier	PAM-0202	187	PAM	08/17/11	08/17/12
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	10/13/11	10/13/12
1150	Horn antenna	RA42-K-F-4B-C	012054-004	CMT	Verified by 1003 and 1049	
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	Verified by 1003 and 1049	
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	08/17/11	08/17/12
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	08/17/11	08/17/12
1173	Low-loss coaxial cable	Nokia Kabel RG213	N/A	Chase London	04/15/11	04/15/12
7514	Multimeter	34410A	MY45002624	Agilent	08/01/11	08/01/12
	Test Software	EMC32	V8.52	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Conducted Port Measurements

	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	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	0.67
				Coverage Factor (k):	2
				Expanded Uncertainty:	1.39

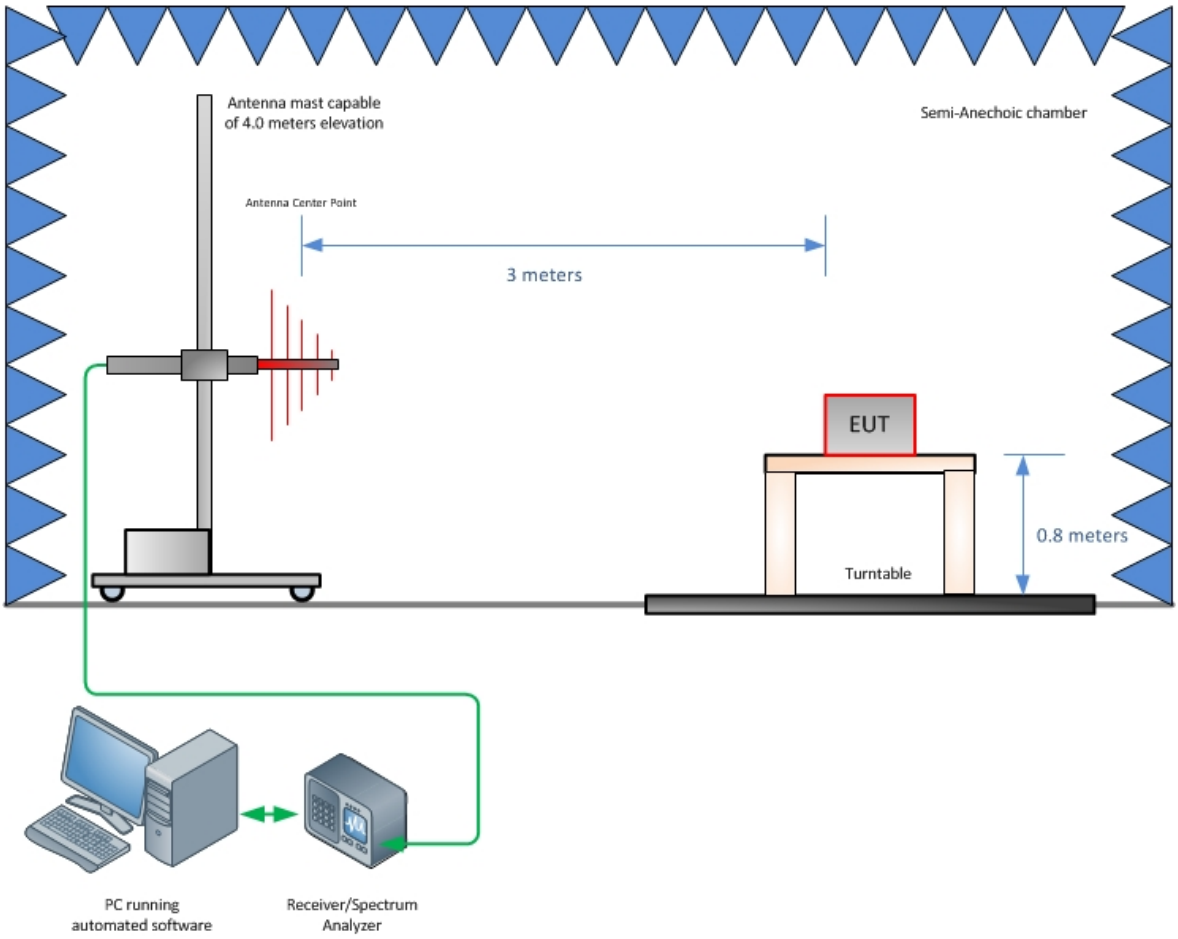
3.2.2 Radiated Emission Measurements

	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	0.41	0.24	0.06
5	Site	Rectangular	2.00	1.15	1.33
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.38
				Coverage Factor (k):	2
				Expanded Uncertainty:	2.79

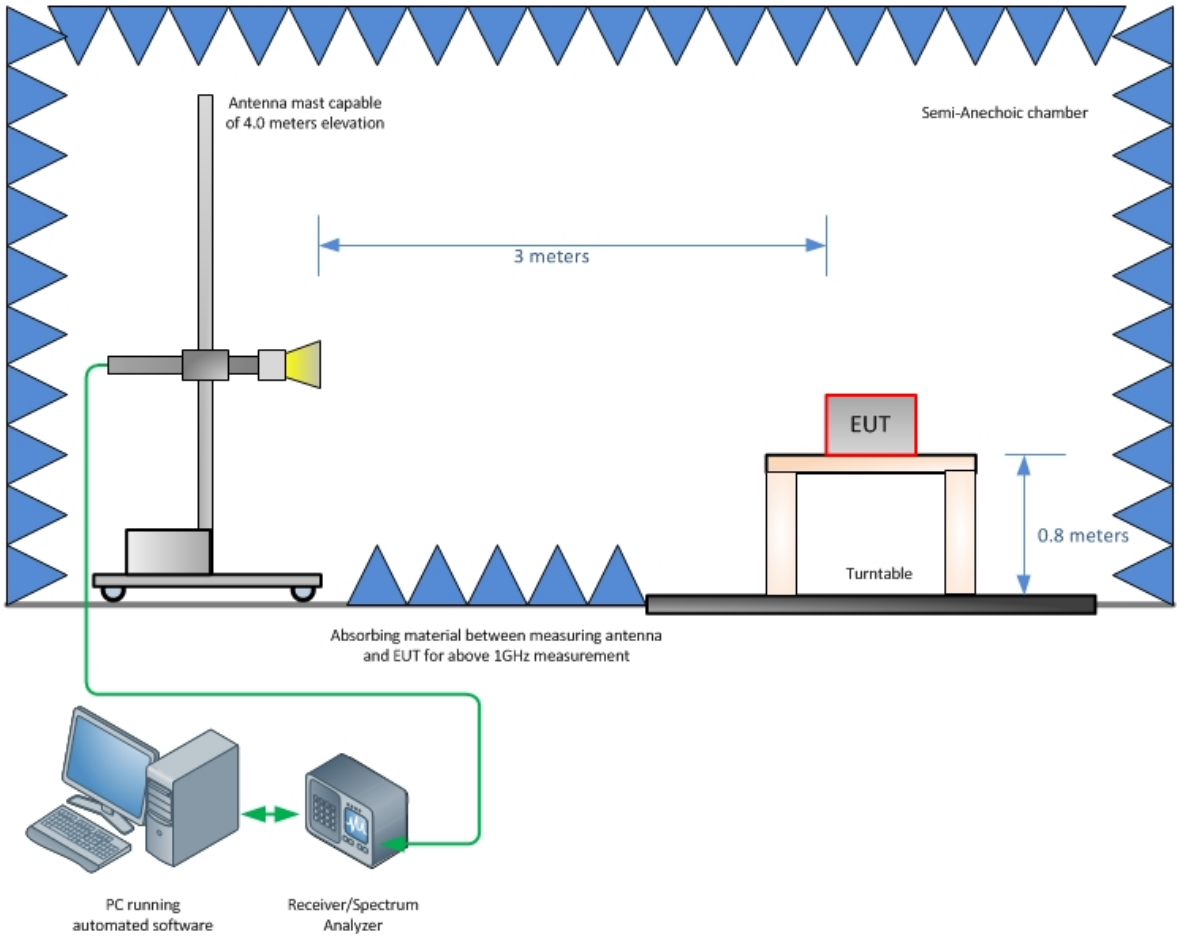
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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