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Report On

Application for Grant of Equipment Authorization of the
OnRamp Wireless
Raptor EM110100 RF Board

FCC Part 15 Subpart C §15.247
IC RSS-Gen and RSS-210 Issue 8 December 2010

Report No. SC1208118A

August 2012



REPORT ON Radio Testing of the
OnRamp Wireless
RF Board

TEST REPORT NUMBER SC1208118A

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Title: EMC/Wireless Test Engineer



APPROVED BY

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Name

Authorized Signatory

DATED

August 09, 2012



Revision History

SC1208118A OnRamp Wireless Raptor RF Board					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
08/17/2012	Initial Release				Ferdinand Custodio

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SECTION 1

REPORT SUMMARY

Radio Testing of the
OnRamp Wireless
RF Board



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the OnRamp Wireless RF Board to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-Gen and RSS-210 Issue 8 December 2010.

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
Model Name	Raptor
Model Number(s)	EM110100
FCC ID Number	XTE-EM110100
IC Number	8655A-EM110100
Serial Number(s)	N/A
Number of Samples Tested	1
Test Specification/Issue/Date	<ul style="list-style-type: none">• FCC Part 15 Subpart C §15.247 (October 1, 2011).• RSS-210 - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment (Issue 8, December 2010).• RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 3, December 2010).
Start of Test	July 31, 2012
Finish of Test	August 01, 2012
Name of Engineer(s)	Ferdinand S. Custodio
Related Document(s)	None. Supporting documents for EUT certification are separate exhibits.



1.2 BRIEF SUMMARY OF RESULTS

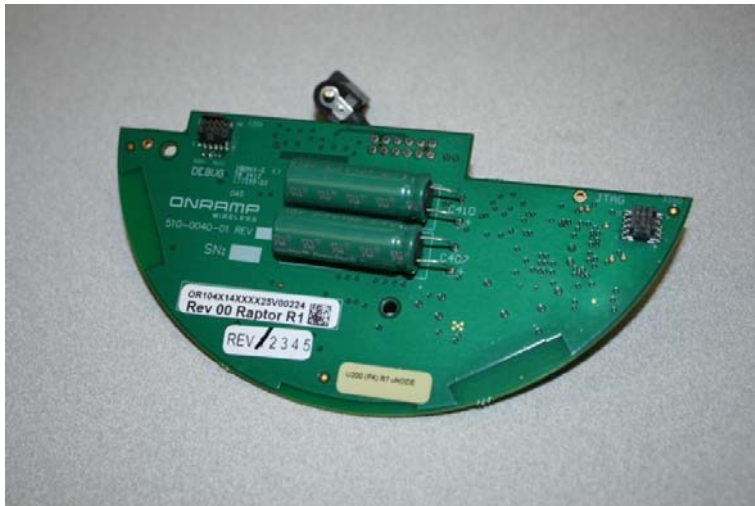
A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 with cross-reference to the corresponding IC RSS standard is shown below.

Section	§15.247 Spec Clause	RSS	Test Description	Result	Comments/ Base Standard
2.1	§15.247(b)(3)	RSS-210 A8.4 (4)	Peak Output Power	Compliant	
2.2	§15.207(a)	RSS-Gen 7.2.4	Conducted Emissions	Compliant	
2.3	§15.215(c)	RSS-Gen 4.6.3	20 dB Bandwidth	Compliant	
2.4		RSS-Gen 4.6.1	99% Emission Bandwidth	Compliant	
2.5	§15.247(a)(2)	RSS-210 A8.2(a)	Minimum 6 dB RF Bandwidth	Compliant	
2.6	§15.247(d)	RSS-210 A8.5	Out-of-Band Emissions - Conducted	Compliant	
2.7	§15.247(d)	RSS-210 A8.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.8	§15.247(d)	RSS-210 A8.5	Spurious Radiated Emissions	Compliant	
2.8		RSS-Gen 4.10	Receiver Spurious Emissions	Compliant	
2.9	§15.247(e)	RSS-210 A8.2(b)	Power Spectral Density for Digitally Modulated Device	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an OnRamp Wireless Raptor RF Board as shown in the photograph below. The EUT contains an OnRamp uNode RF module (XTE-ULPU100) along with a power supply, microprocessor, and two antennas. It is used in electric power meters to transmit and receive information from the power meter to an access point.



Equipment Under Test



1.3.2 EUT General Description

EUT Description	RF Board
Model Number(s)	Raptor
Rated Voltage	4.0VDC Nominal voltage.
Output Power	128mW (21.06 dBm) conducted 207mW(23.16 dBm) EIRP
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)
Modulation Used	DSSS-DBPSK

1.3.3 Antenna Details

Model	Prestta™ Part No. 1001013
Manufacturer	ethertronics
Antenna Type	Isolated Magnetic Dipole (IMD).
Antenna Gain	2.1 dBi
Polarization	Linear
EUT Antenna Connector	Integral embedded antenna.
Maximum Dimensions	15.0x3.2x3.3mm
Mechanical Mounting	Antenna Assembly is Surface Mounted onto main PCB
RF Mounting	RF and Ground feed pads are Surface Mounted onto main PCB. No Ground Clearance is required under antenna

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configurations	Description
A	EUT transmitting max power through the integral antenna.
B	EUT transmitting max power, antenna service port connected to the spectrum analyzer through a 20dB external attenuator.
C	EUT transmitting max power, EUT installed inside representative electric meter simulating real world installation and accurate AC conducted emissions profile.

1.4.2 EUT Exercise Software

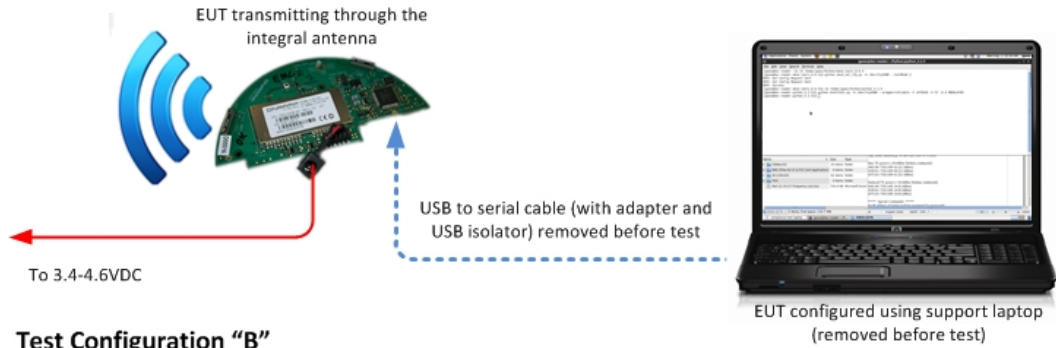
“Python Commands” software provided by the client was used to exercise the EUT. The line commands are typed and executed one at a time. Simplified example: Reset, Frequency, TX power, TX ON. Once set the EUT will continue in its configured mode until new commands are sent. Each time the EUT must change 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

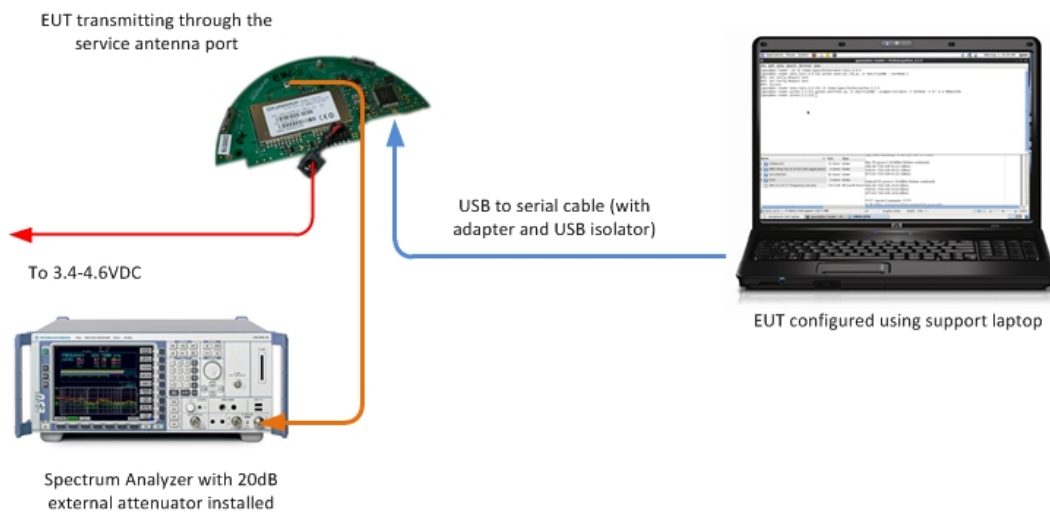
Manufacturer	Equipment/Cable	Description
Dell	Support Laptop	Latitude E5500 SN: GRMMMK1 36499111345
CUI Inc.	Support AC Adapter (Support Laptop)	Model 3A-211DN05 5VDC Output 4A
V-Infinity	Support AC Adapter (EUT)	Model EPS0500100-P5RP 5VDC Output 1A
ULINX	Support USB to USB Isolator	Model UH401
Generic	Support USB to Serial Adapter	Model TTL-232RG
GE	Support Electric Meter	Model CL200 103X547014

1.4.4 Simplified Test Configuration Diagram

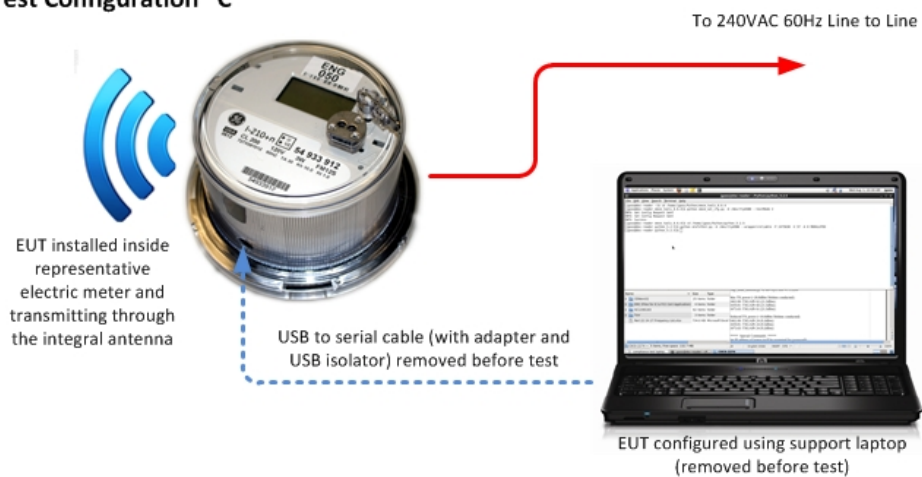
Test Configuration "A"



Test Configuration "B"



Test Configuration "C"



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 N/A		
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.



SECTION 2

TEST DETAILS

Radio Testing of the
OnRamp Wireless
RF Board



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: N/A / Test Configuration B

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

August 01, 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	23.2°C
Relative Humidity	50.5%
ATM Pressure	99.1 kPa

2.1.7 Additional Observations

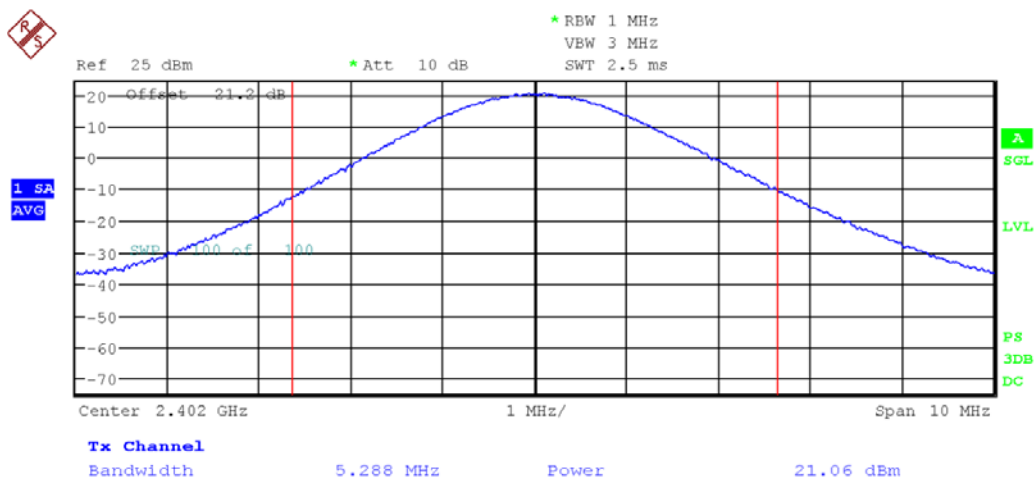
- This is a conducted test using Power Output Option 2 Method #1 FCC KDB Publication Number 558074 (Measurement of Digital Transmission System under Section 15.247 March 23, 2005).
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- Measurements were verified at 85% of nominal (3.06VDC), nominal and 115% of nominal (4.14VDC) voltage. Nominal voltage is defined as 3.6VDC. However there are no significant deviations in measurement observed.
- 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 5.288MHz.

2.1.8 Test Results

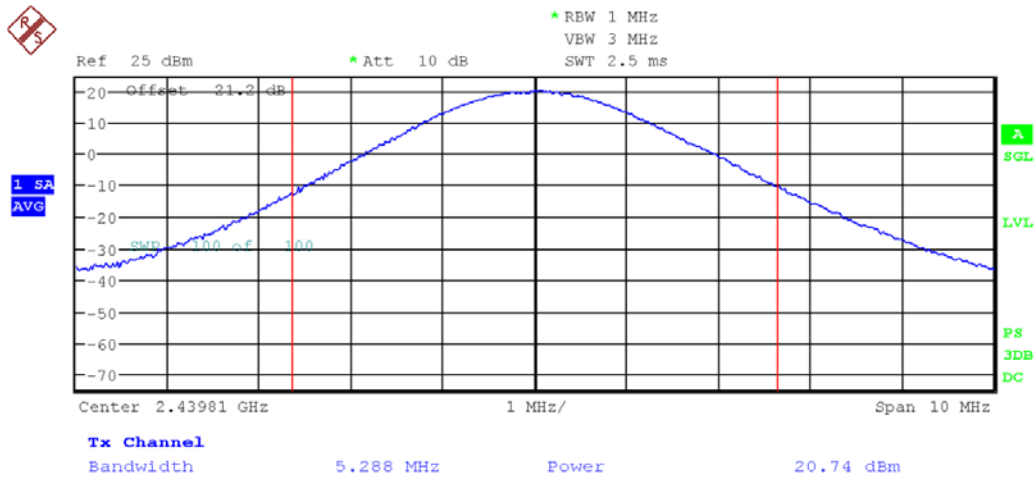
See attached table and plots

Voltage Input	Measured Power (Low Channel) dBm	Measured Power (Mid Channel) dBm	Measured Power (High Channel) dBm
3.4VDC	21.06	20.74	20.81
4.0VDC	21.06	20.74	20.81
4.6VDC	21.06	20.74	20.81



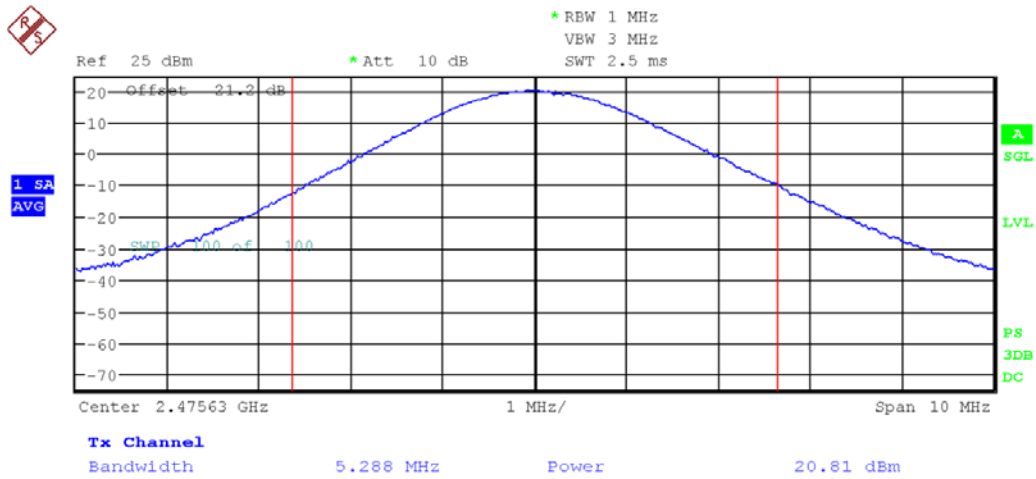
Date: 1.AUG.2012 15:49:12

Low Channel (2402 MHz)



Date: 1.AUG.2012 15:50:02

Mid Channel (2439.81 MHz)



Date: 1.AUG.2012 15:50:44

High Channel (2475.63 MHz)

2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.2.2 Standard Applicable

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

2.2.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration C

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

July 31, 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 23.5°C
Relative Humidity 47.4%
ATM Pressure 99.1 kPa

2.2.7 Additional Observations

- The EUT is a RF board and is not AC powered.
- To show general compliance to the present requirement, the EUT was installed inside an electric meter representing real world installation.
- The EUT was set to transmit max. power. Only the worst channel presented.



- 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.

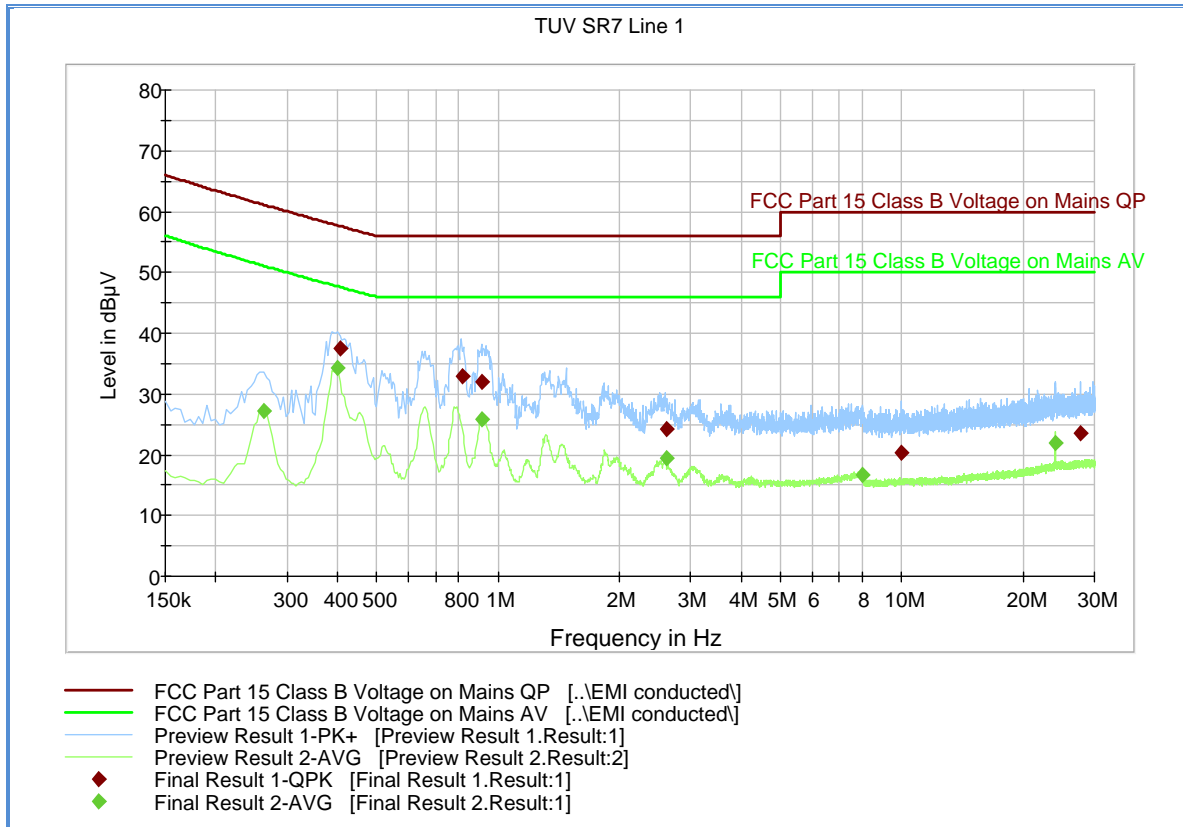
2.2.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbμV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7567 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbμV) @ 150kHz			26.2

2.2.9 Test Results

Compliant. See attached plots and tables.

2.2.10 Line 1 (Hot)



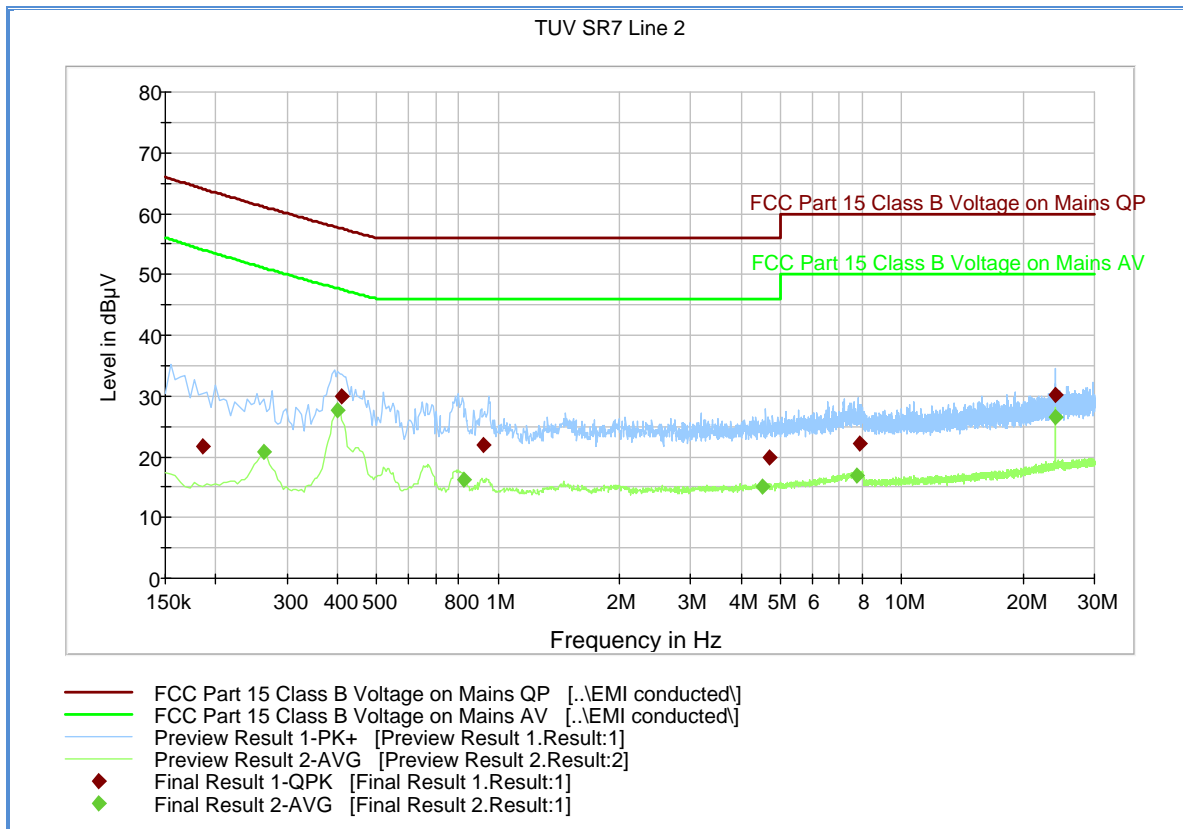
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.406500	37.4	1000.0	9.000	Off	L1	20.2	20.2	57.6
0.816000	33.0	1000.0	9.000	Off	L1	20.2	23.0	56.0
0.910500	32.0	1000.0	9.000	Off	L1	20.2	24.0	56.0
2.620500	24.3	1000.0	9.000	Off	L1	20.1	31.7	56.0
9.942000	20.4	1000.0	9.000	Off	L1	20.4	39.6	60.0
27.793500	23.5	1000.0	9.000	Off	L1	21.3	36.5	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.262500	27.2	1000.0	9.000	Off	L1	20.4	23.9	51.1
0.402000	34.2	1000.0	9.000	Off	L1	20.2	13.5	47.7
0.915000	25.8	1000.0	9.000	Off	L1	20.2	20.2	46.0
2.607000	19.5	1000.0	9.000	Off	L1	20.1	26.5	46.0
8.011500	16.7	1000.0	9.000	Off	L1	20.3	33.3	50.0
24.000000	21.8	1000.0	9.000	Off	L1	21.0	28.2	50.0

2.2.11 Line 2 (Neutral)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)
0.186000	21.8	1000.0	9.000	Off	N	20.9	42.3	64.1
0.411000	29.9	1000.0	9.000	Off	N	20.6	27.6	57.5
0.919500	22.0	1000.0	9.000	Off	N	20.6	34.0	56.0
4.690500	20.0	1000.0	9.000	Off	N	20.7	36.0	56.0
7.872000	22.1	1000.0	9.000	Off	N	20.7	37.9	60.0
23.977500	30.2	1000.0	9.000	Off	N	21.4	29.8	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBμV)
0.262500	20.8	1000.0	9.000	Off	N	20.8	30.3	51.1
0.402000	27.7	1000.0	9.000	Off	N	20.6	20.0	47.7
0.825000	16.3	1000.0	9.000	Off	N	20.6	29.8	46.0
4.519500	15.1	1000.0	9.000	Off	N	20.7	30.9	46.0
7.719000	16.9	1000.0	9.000	Off	N	20.7	33.1	50.0
23.977500	26.6	1000.0	9.000	Off	N	21.4	23.4	50.0



2.3 20 dB BANDWIDTH

2.3.1 Specification Reference

Part 15 Subpart C §15.215(c)

2.3.2 Standard Applicable

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

2.3.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration B

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

July 31, 2012/FSC

2.3.5 Test Equipment Used

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

2.3.6 Environmental Conditions

Ambient Temperature	23.5°C
Relative Humidity	47.4%
ATM Pressure	99.1 kPa

2.3.7 Additional Observations

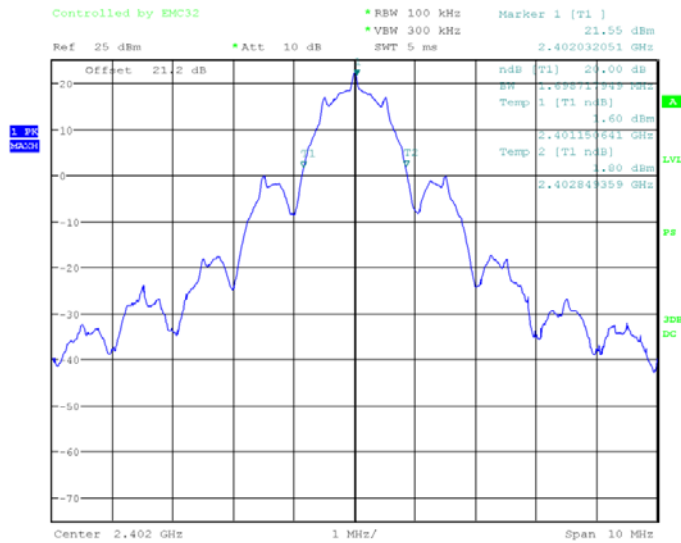
- This is a conducted test.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.

- Trace is max hold.
- “n dB down” (20dB) marker function of the spectrum analyzer was used for this test.

2.3.8 Test Results

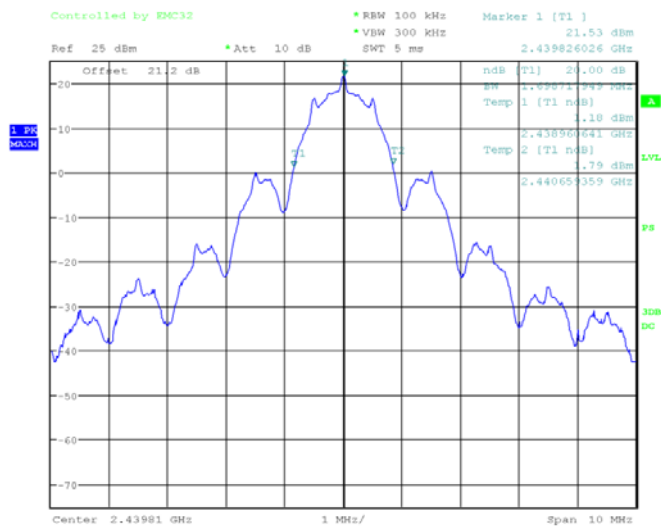
Low Channel (2402 MHz)	Mid Channel (2439.81 MHz)	High Channel (2475.63 MHz)
1.698 MHz	1.698 MHz	1.698 MHz

2402.00 MHz – (20dB BW/2) = 2401.15MHz (within the frequency band - **Compliant**)
 2475.63 MHz + (20dB BW/2) = 2476.48 MHz (within the frequency band - **Compliant**)



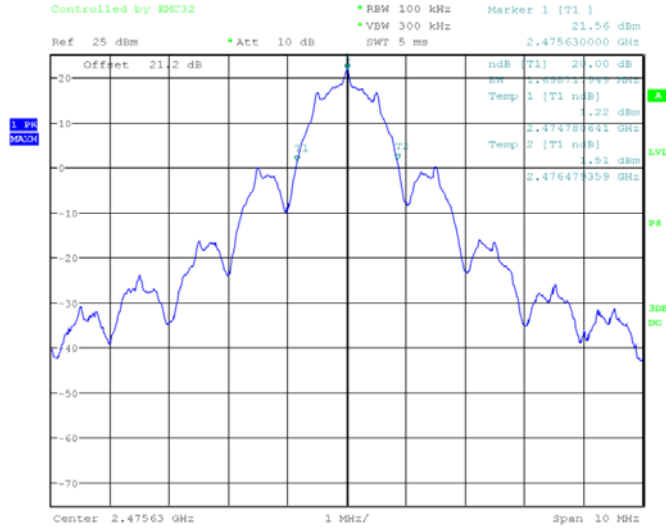
Date: 31.JUL.2012 11:35:46

Low Channel



Date: 31.JUL.2012 11:34:44

Mid Channel



Date: 31.JUL.2012 11:33:35

High Channel



2.4 99% EMISSION BANDWIDTH

2.4.1 Specification Reference

RSS-Gen Clause 4.6.1

2.4.2 Standard Applicable

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

2.4.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration B

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

July 31, 2012/FSC

2.4.5 Test Equipment Used

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

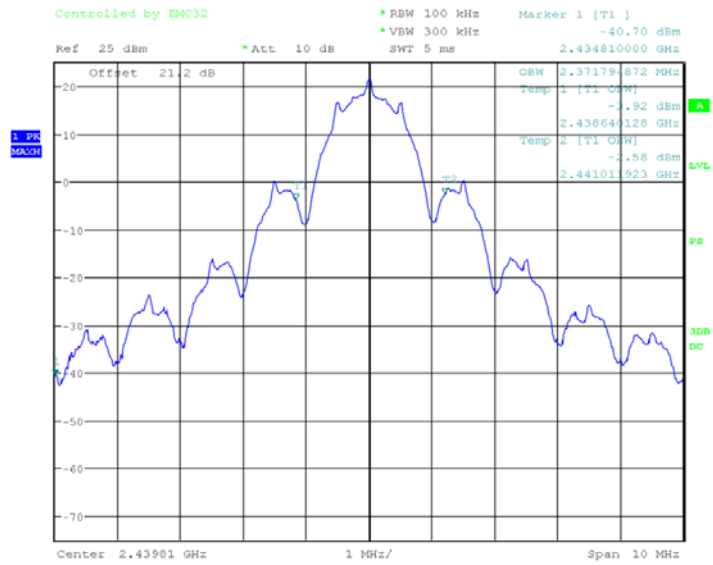
2.4.6 Environmental Conditions

Ambient Temperature	23.5°C
Relative Humidity	47.4%
ATM Pressure	99.1 kPa

2.4.7 Additional Observations

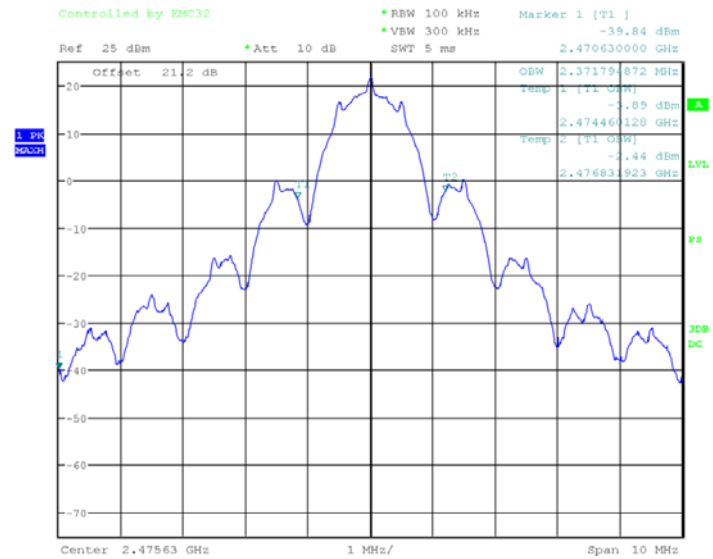
- This is a conducted test.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.

- | Low Channel
(2402 MHz) | Mid Channel
(2439.81 MHz) | High Channel
(2475.63 MHz) |
|---------------------------|------------------------------|-------------------------------|
| 2.083 MHz | 2.372 MHz | 2.372 MHz |



Date: 31.JUL.2012 11:42:02

Mid Channel



Date: 31.JUL.2012 11:43:45

High Channel

2.5 MINIMUM 6 dB RF BANDWIDTH

2.5.1 Specification Reference

Part 15 Subpart C §15.247(a)(2)

2.5.2 Standard Applicable

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.5.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration B

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

July 31, 2012/FSC

2.5.5 Test Equipment Used

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

2.5.6 Environmental Conditions

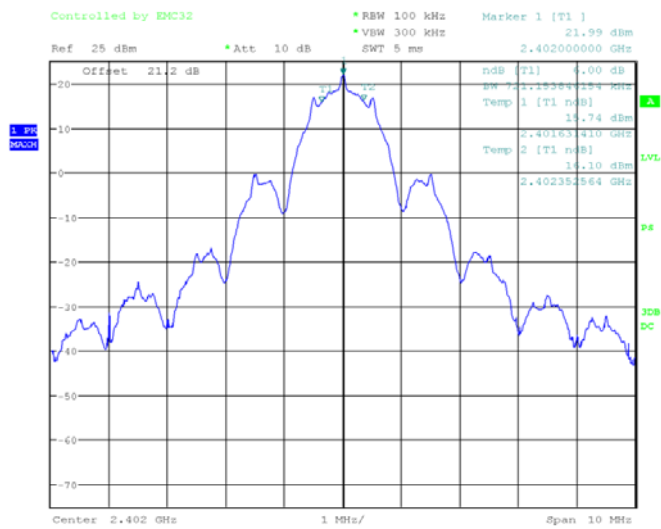
Ambient Temperature	23.5°C
Relative Humidity	47.4%
ATM Pressure	99.1 kPa

2.5.7 Additional Observations

- This is a conducted test.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- Trace is max hold.
- “n dB down” (6dB) marker function of the spectrum analyzer was used for this test.

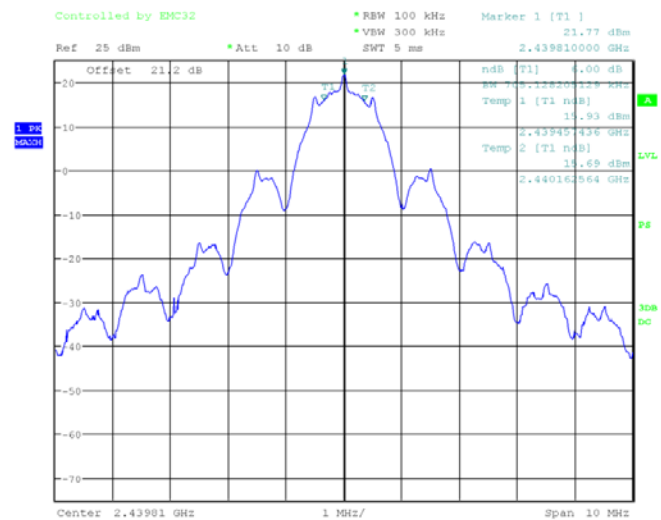
2.5.8 Test Results

Low Channel (2402 MHz)	Mid Channel (2439.81 MHz)	High Channel (2475.63 MHz)
721.15 kHz	705.13 kHz	721.15 kHz



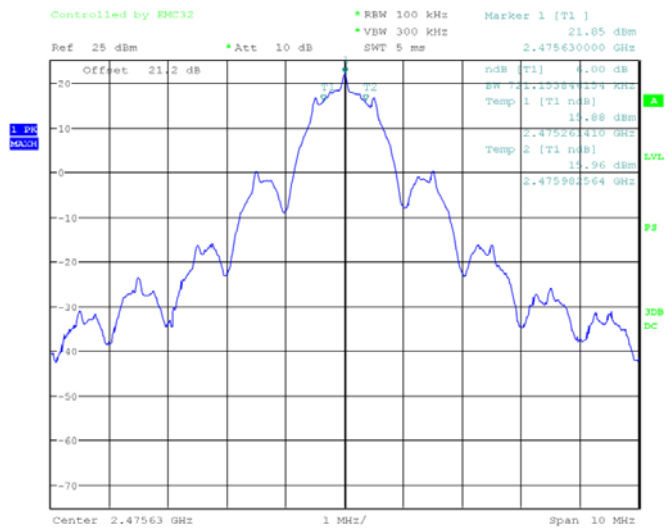
Date: 31.JUL.2012 11:53:57

Low Channel



Date: 31.JUL.2012 11:50:18

Mid Channel



Date: 31.JUL.2012 11:49:00

High Channel

2.6 OUT-OF-BAND EMISSIONS - CONDUCTED

2.6.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.6.2 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)).

2.6.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration B

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

July 31, 2012/FSC

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

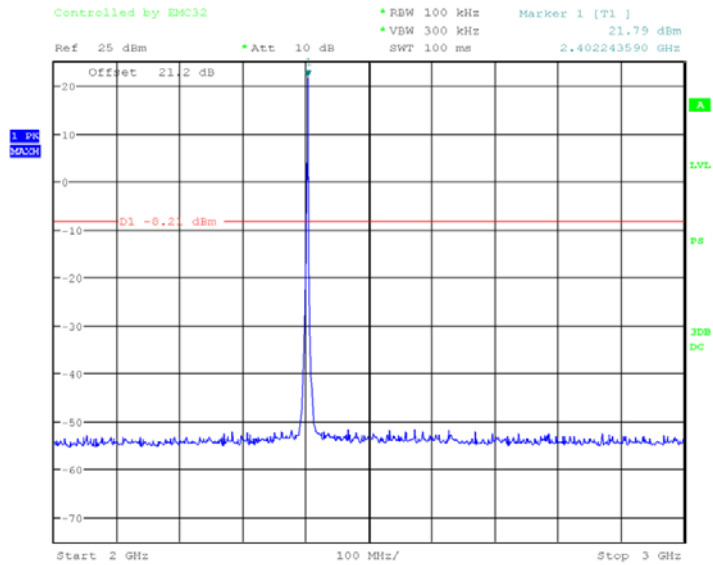
Ambient Temperature	23.5°C
Relative Humidity	47.4%
ATM Pressure	99.1 kPa

2.6.7 Additional Observations

- This is a conducted test.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 30dB below this level.
- Spectrum was searched from 30MHz up to 25GHz.

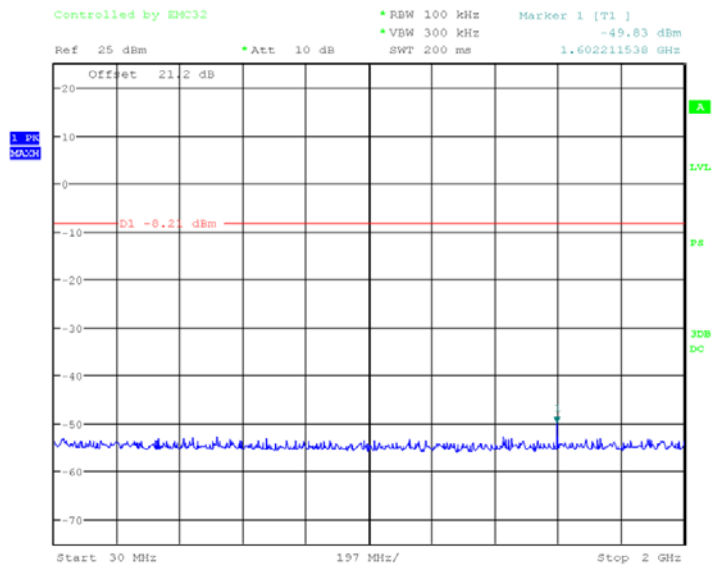
2.6.8 Test Results

See attached plots.



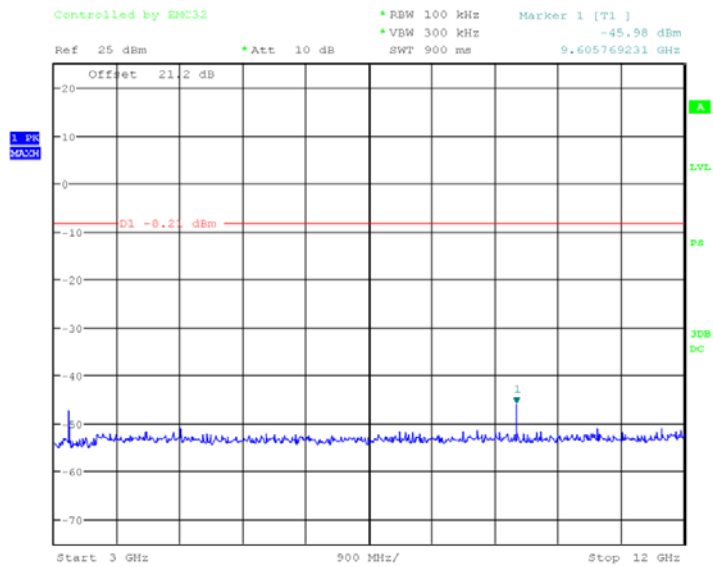
Date: 31.JUL.2012 13:09:51

Low Channel (2 to 3GHz)



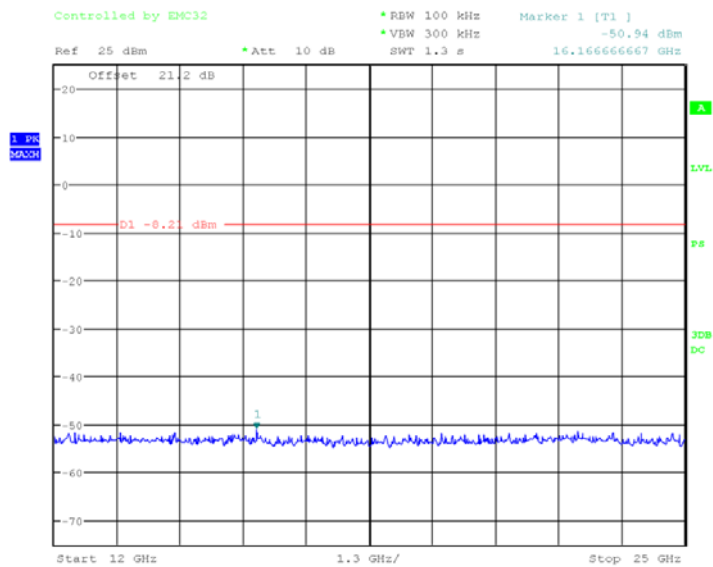
Date: 31.JUL.2012 13:10:35

Low Channel (30MHz to 2GHz)



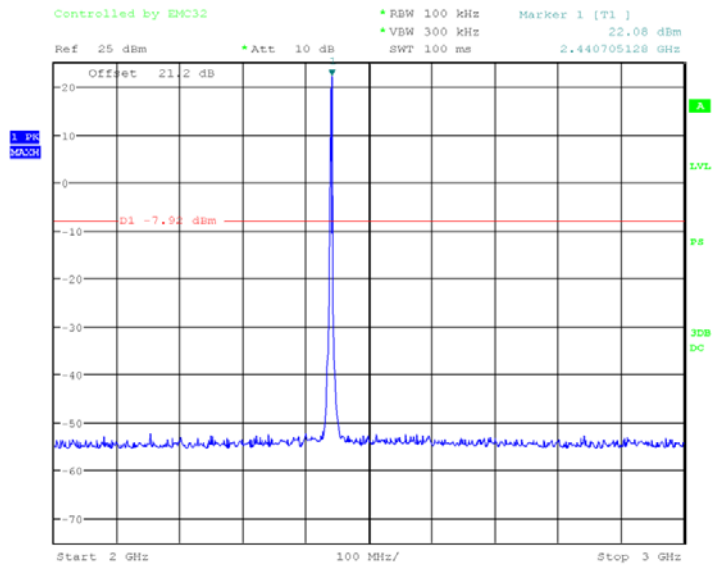
Date: 31.JUL.2012 13:11:31

Low Channel (3GHz to 12GHz)



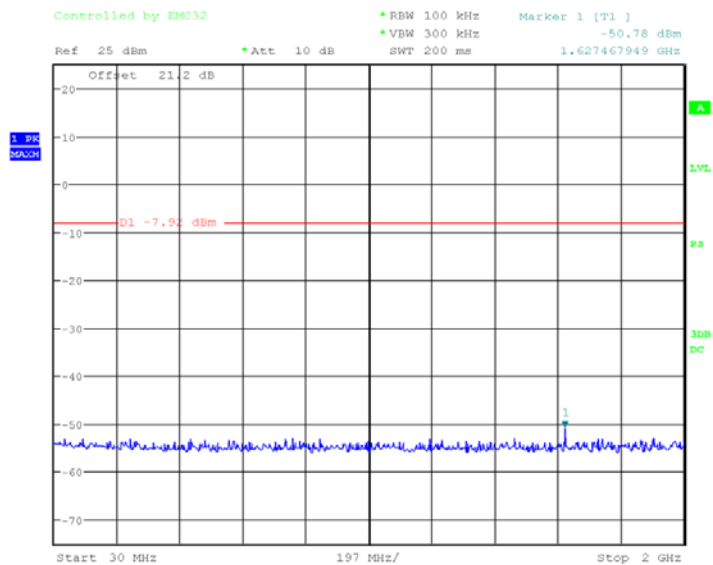
Date: 31.JUL.2012 13:13:22

Low Channel (12GHz to 26.5GHz)



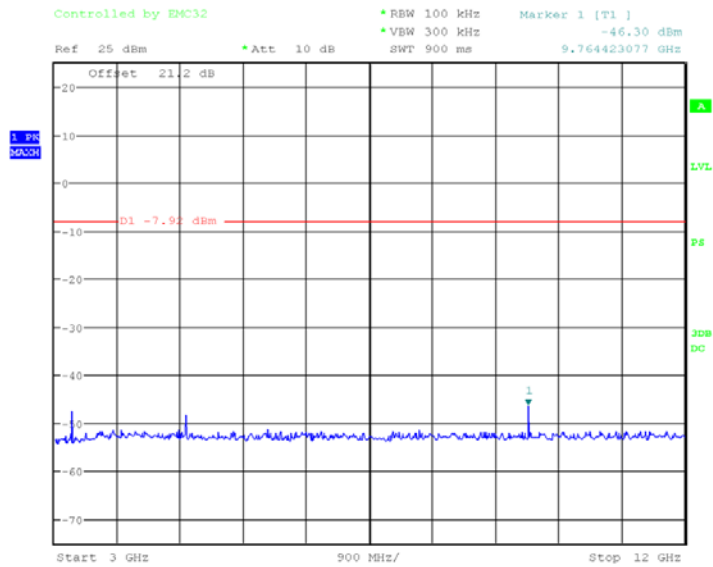
Date: 31.JUL.2012 13:18:52

Mid Channel (2GHz to 3GHz)



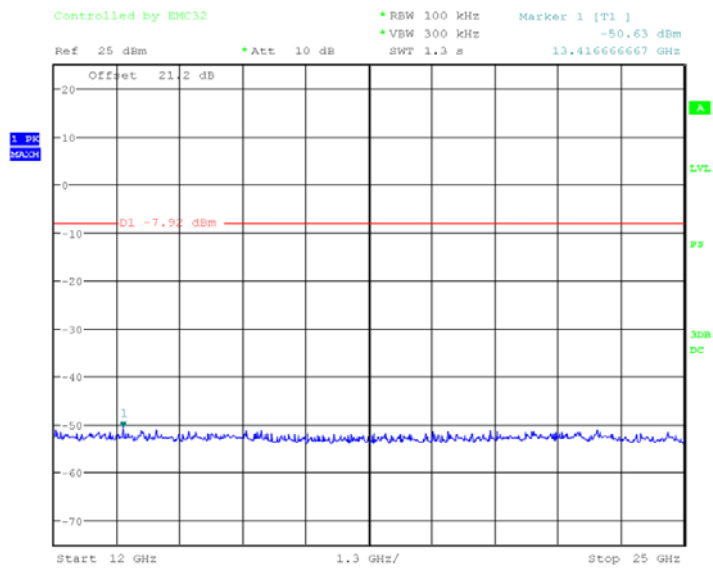
Date: 31.JUL.2012 13:19:30

Mid Channel (30MHz to 2GHz)



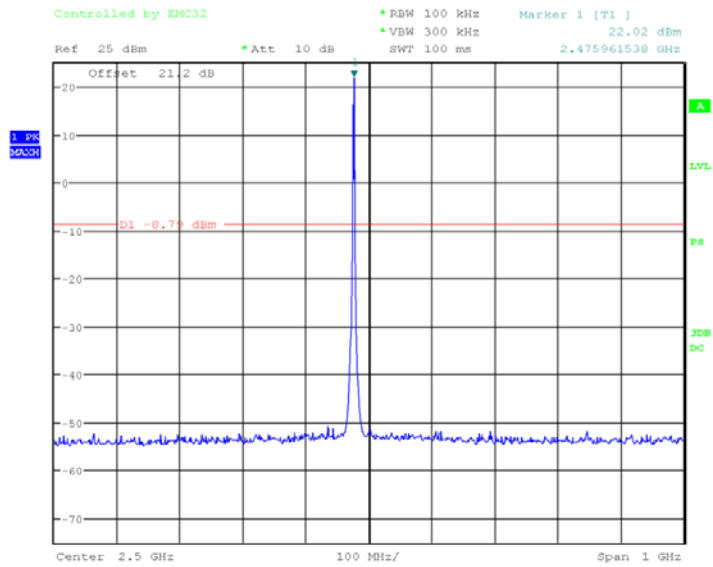
Date: 31.JUL.2012 13:22:17

Mid Channel (3GHz to 12GHz)



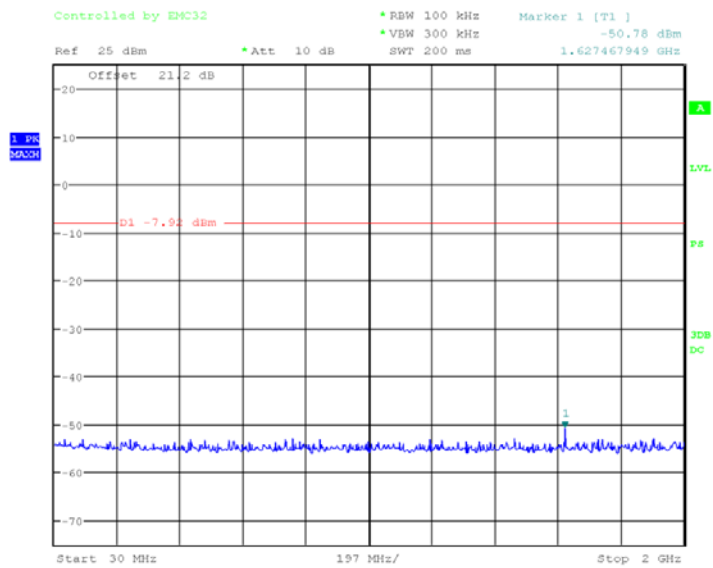
Date: 31.JUL.2012 13:24:37

Mid Channel (12GHz to 26.5GHz)



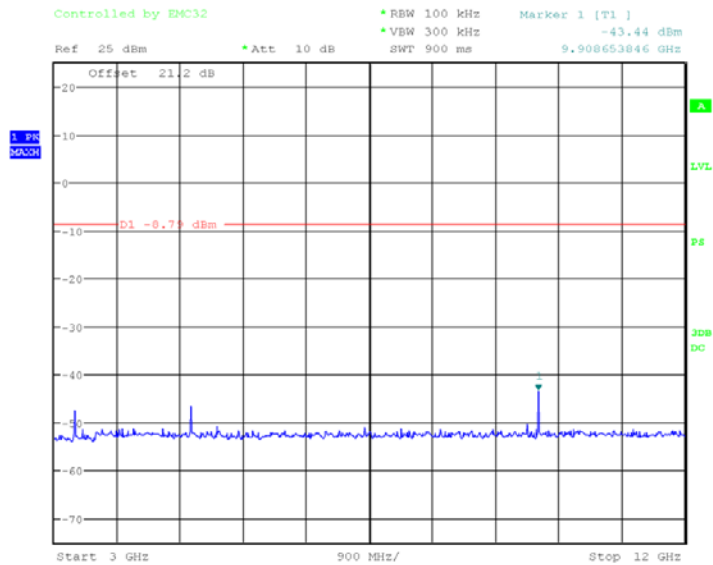
Date: 31.JUL.2012 13:28:39

High Channel (2GHz to 3GHz)



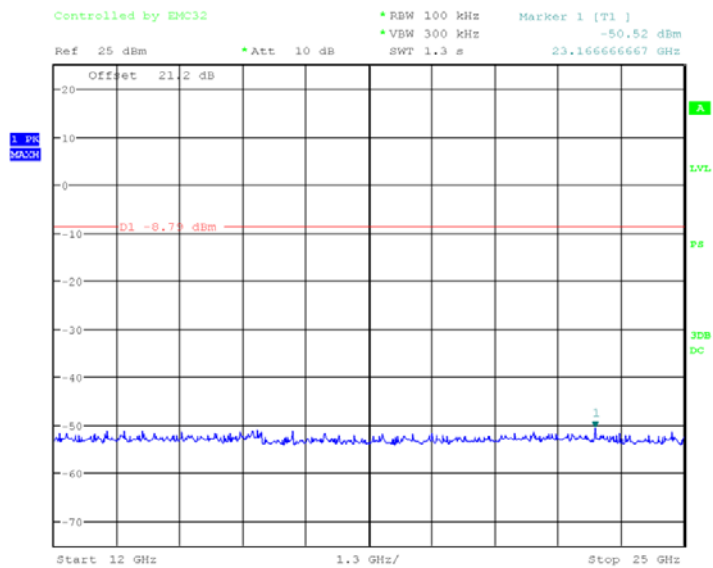
Date: 31.JUL.2012 13:19:30

High Channel (30MHz to 2GHz)



Date: 31.JUL.2012 13:34:13

High Channel (3GHz to 12GHz)



Date: 31.JUL.2012 13:35:38

High Channel (12GHz to 26.5GHz)

2.7 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.7.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.7.2 Standard Applicable

See previous test.

2.7.3 Equipment Under Test and Modification State

Serial No: N/A/ Test Configuration B

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

July 31, 2012/FSC

2.7.5 Test Equipment Used

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

2.7.6 Environmental Conditions

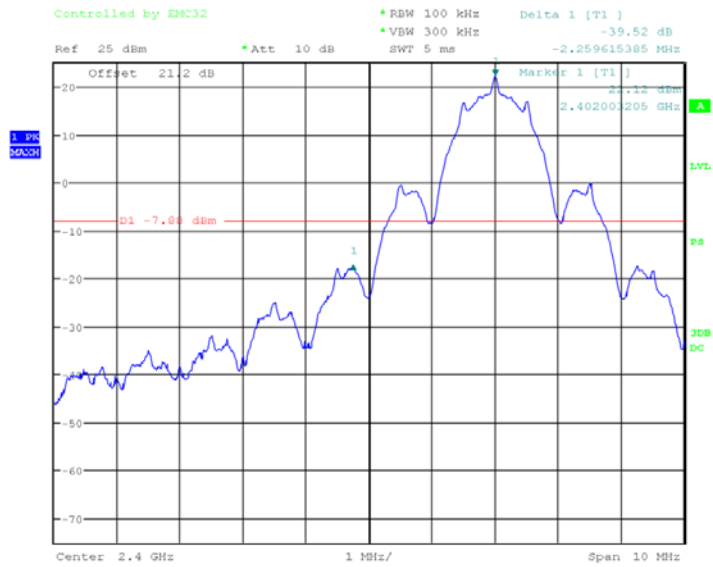
Ambient Temperature	23.5°C
Relative Humidity	47.4%
ATM Pressure	99.1 kPa

2.7.7 Additional Observations

- Setup is identical to “Out-of-Band Emissions – Conducted” test (previous test).
- Band-edge (2400MHz and 2483.5MHz) emissions were verified in this test.
- The spectrum analyzer was centred on the band-edge frequency while setting the EUT to the corresponding transmit channel (i.e. Low Channel for lower band-edge).
- Limit is 30dB below the highest level of the desired power within the band.

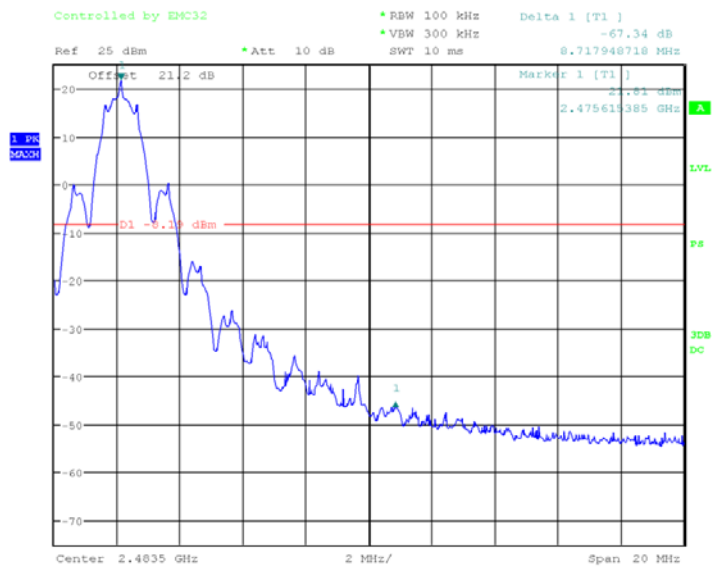
2.7.8 Test Results

Complies. See attached plots.



Date: 31.JUL.2012 11:59:29

Lower Band-Edge



Date: 31.JUL.2012 12:01:43

Higher Band-Edge



2.8 SPURIOUS RADIATED EMISSIONS

2.8.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.8.2 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)).

2.8.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration A

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

August 01, 2012/FSC

2.8.5 Test Equipment Used

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

2.8.6 Environmental Conditions

Ambient Temperature	23.3°C
Relative Humidity	50.7%
ATM Pressure	99.2 kPa

2.8.7 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 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 2.8.8 for sample computation.

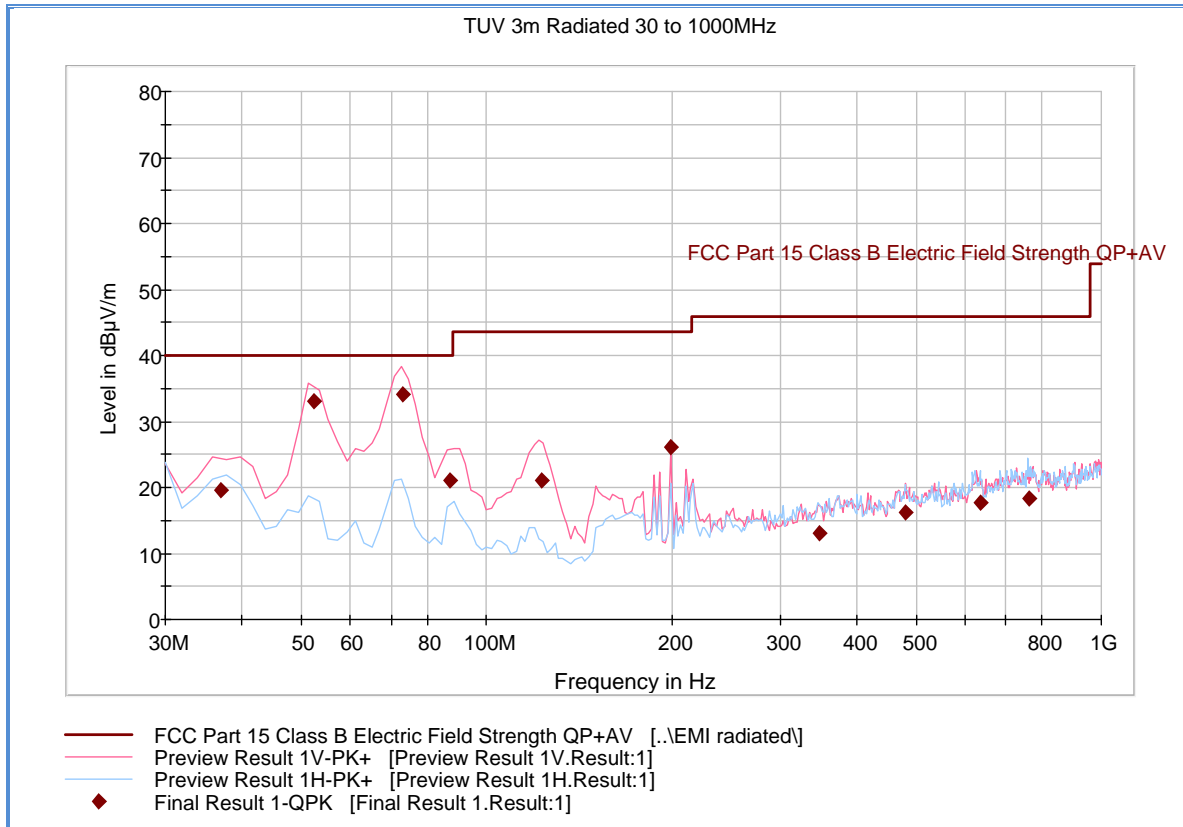
2.8.8 Sample Computation (Radiated Emission)

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# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (db μ V/m) @ 30MHz			11.8

2.8.9 Test Results

See attached plots.

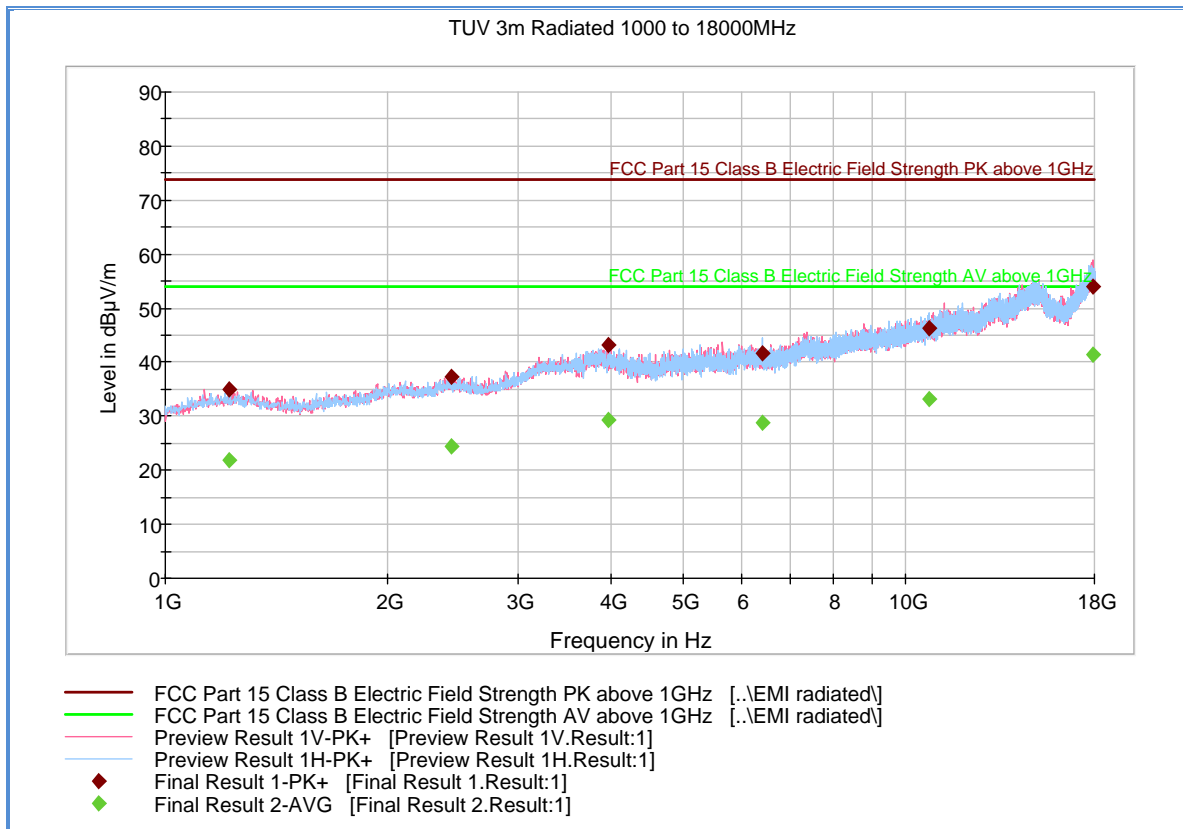
2.8.10 Test Results Below 1GHz (Receive Mode)



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)
36.871663	19.5	1000.0	120.000	127.0	V	330.0	-15.9	20.5	40.0
52.302766	33.0	1000.0	120.000	100.0	V	189.0	-21.0	7.0	40.0
72.965531	34.0	1000.0	120.000	132.0	V	210.0	-22.2	6.0	40.0
87.132745	21.0	1000.0	120.000	100.0	V	229.0	-21.2	19.0	40.0
122.666613	21.0	1000.0	120.000	100.0	V	90.0	-20.9	22.5	43.5
199.238236	26.1	1000.0	120.000	100.0	V	354.0	-16.5	17.4	43.5
348.293707	13.0	1000.0	120.000	377.0	H	270.0	-10.4	33.0	46.0
479.901964	16.3	1000.0	120.000	371.0	V	195.0	-6.6	29.7	46.0
635.469098	17.6	1000.0	120.000	337.0	H	120.0	-3.7	28.4	46.0
763.221804	18.3	1000.0	120.000	189.0	H	265.0	-1.6	27.7	46.0

2.8.11 Test Results Above 1GHz (Receive Mode)



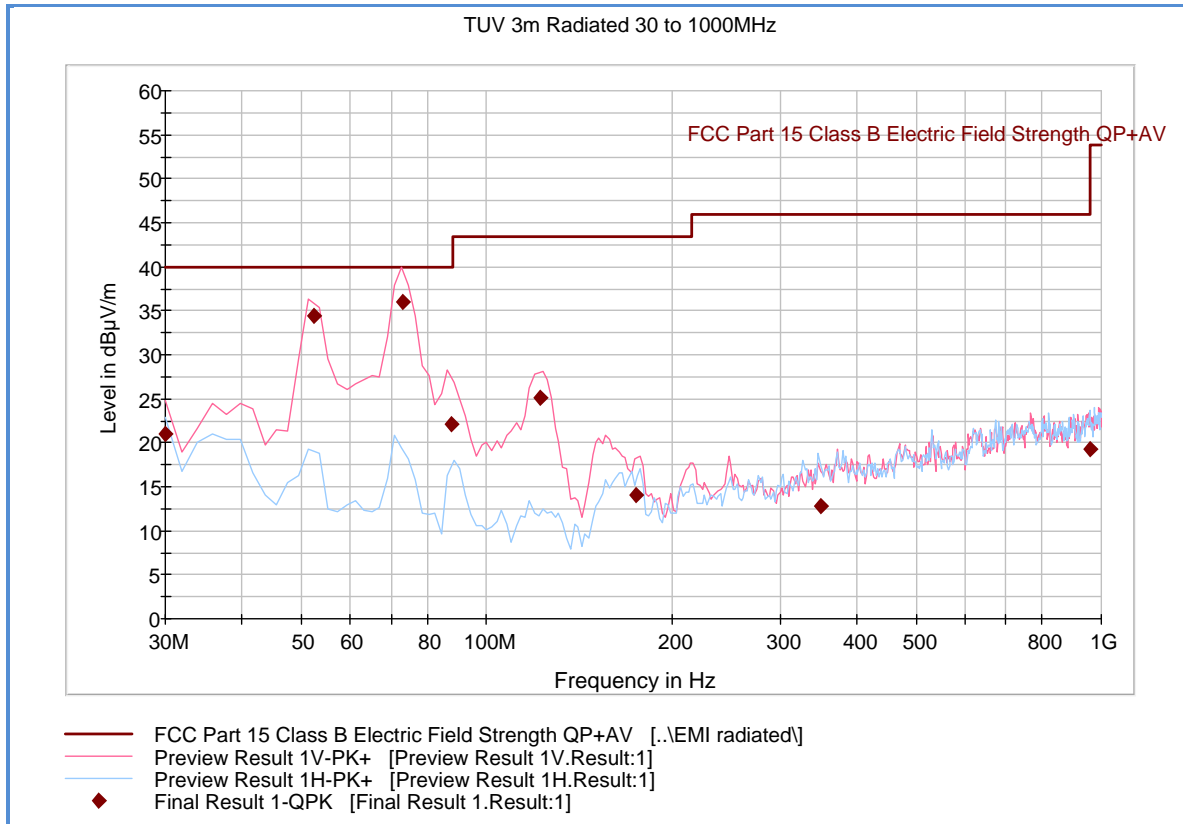
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1222.200000	34.9	1000.0	1000.000	227.0	H	287.0	-9.6	39.0	73.9
2430.940000	37.3	1000.0	1000.000	374.0	V	255.0	-4.7	36.6	73.9
3970.000000	43.3	1000.0	1000.000	183.0	V	111.0	3.1	30.6	73.9
6406.260000	41.7	1000.0	1000.000	321.0	H	265.0	4.6	32.2	73.9
10746.000000	46.2	1000.0	1000.000	288.0	H	339.0	11.2	27.7	73.9
17954.240000	54.1	1000.0	1000.000	380.0	V	131.0	21.2	19.8	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)
1222.200000	21.9	1000.0	1000.000	227.0	H	287.0	-9.6	32.0	53.9
2430.940000	24.4	1000.0	1000.000	374.0	V	255.0	-4.7	29.5	53.9
3970.000000	29.4	1000.0	1000.000	183.0	V	111.0	3.1	24.5	53.9
6406.260000	28.8	1000.0	1000.000	321.0	H	265.0	4.6	25.1	53.9
10746.000000	33.2	1000.0	1000.000	288.0	H	339.0	11.2	20.7	53.9
17954.240000	41.4	1000.0	1000.000	380.0	V	131.0	21.2	12.5	53.9

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

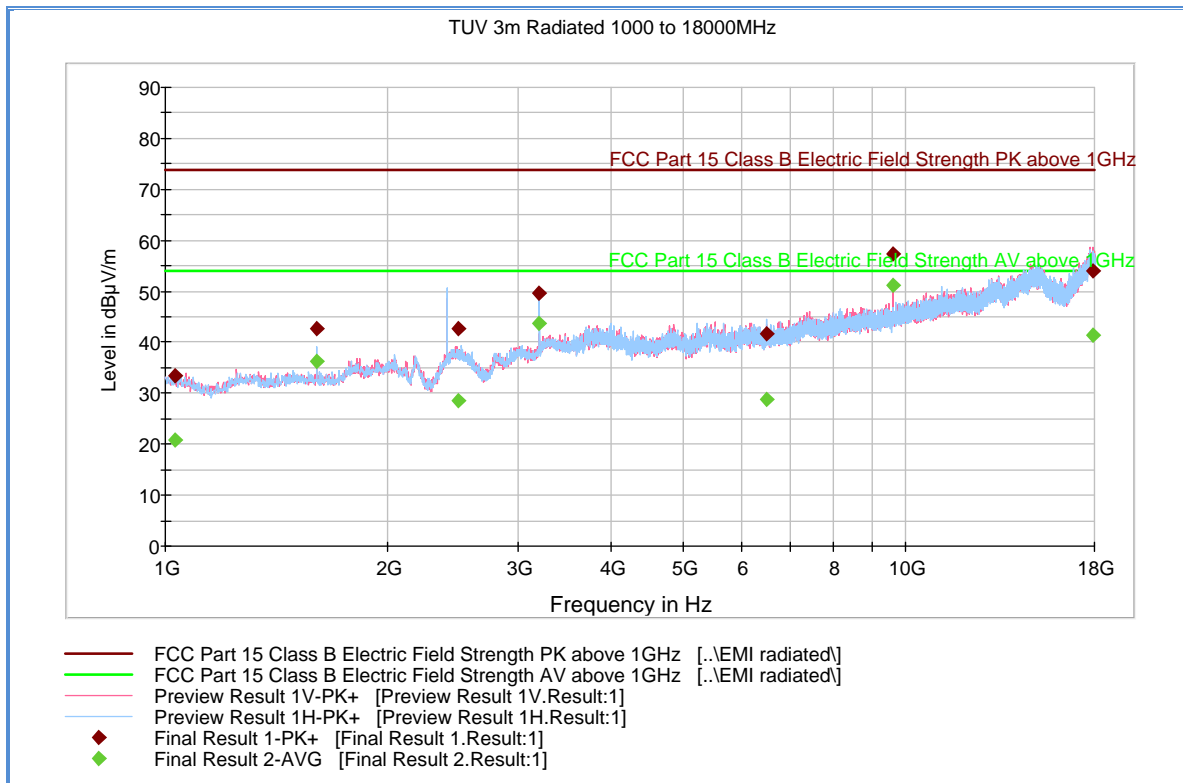


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
30.040000	20.9	1000.0	120.000	125.0	V	294.0	-12.3	19.1	40.0
52.342766	34.5	1000.0	120.000	100.0	V	165.0	-21.0	5.5	40.0
72.885531	36.0	1000.0	120.000	115.0	V	146.0	-22.2	4.0	40.0
87.612745	22.2	1000.0	120.000	108.0	V	245.0	-21.2	17.8	40.0
122.186613	25.2	1000.0	120.000	100.0	V	250.0	-20.9	18.3	43.5
175.455471	14.1	1000.0	120.000	106.0	V	62.0	-17.6	29.4	43.5
348.733707	12.8	1000.0	120.000	171.0	H	309.0	-10.3	33.2	46.0
958.674469	19.2	1000.0	120.000	310.0	H	286.0	0.0	26.8	46.0

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

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



Peak Data

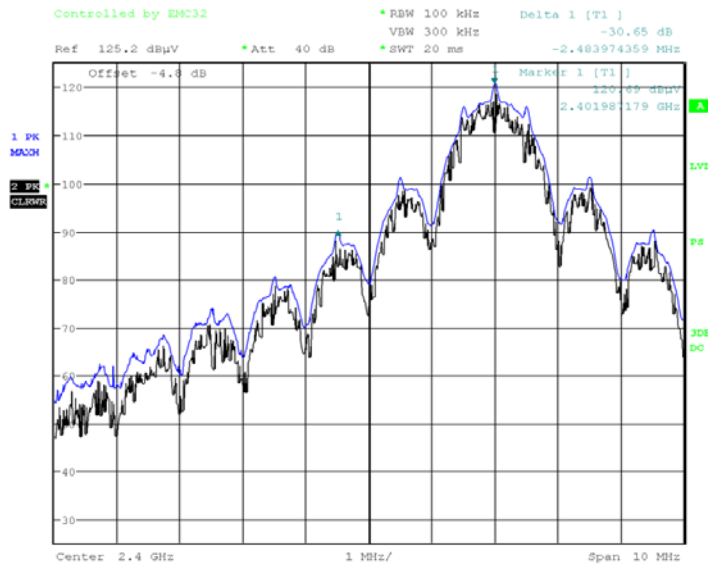
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1032.400000	33.5	1000.0	1000.000	210.0	V	30.0	-11.0	40.4	73.9
1601.340000	42.7	1000.0	1000.000	107.0	H	45.0	-8.8	31.2	73.9
2483.520000	42.6	1000.0	1000.000	129.0	H	63.0	-4.6	31.3	73.9
3202.660000	49.6	1000.0	1000.000	126.0	H	290.0	-0.9	24.3	73.9
6494.100000	41.6	1000.0	1000.000	128.0	H	331.0	4.5	32.3	73.9
9608.000000	57.2	1000.0	1000.000	144.0	V	281.0	9.4	16.7	73.9
17950.800000	54.0	1000.0	1000.000	112.0	V	284.0	21.1	19.9	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)
1032.400000	20.9	1000.0	1000.000	210.0	V	30.0	-11.0	33.0	53.9
1601.340000	36.4	1000.0	1000.000	107.0	H	45.0	-8.8	17.5	53.9
2483.520000	28.6	1000.0	1000.000	129.0	H	63.0	-4.6	25.3	53.9
3202.660000	43.7	1000.0	1000.000	126.0	H	290.0	-0.9	10.2	53.9
6494.100000	28.7	1000.0	1000.000	128.0	H	331.0	4.5	25.2	53.9
9608.000000	51.2	1000.0	1000.000	144.0	V	281.0	9.4	2.7	53.9
17950.800000	41.4	1000.0	1000.000	112.0	V	284.0	21.1	12.5	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 2.8.14).

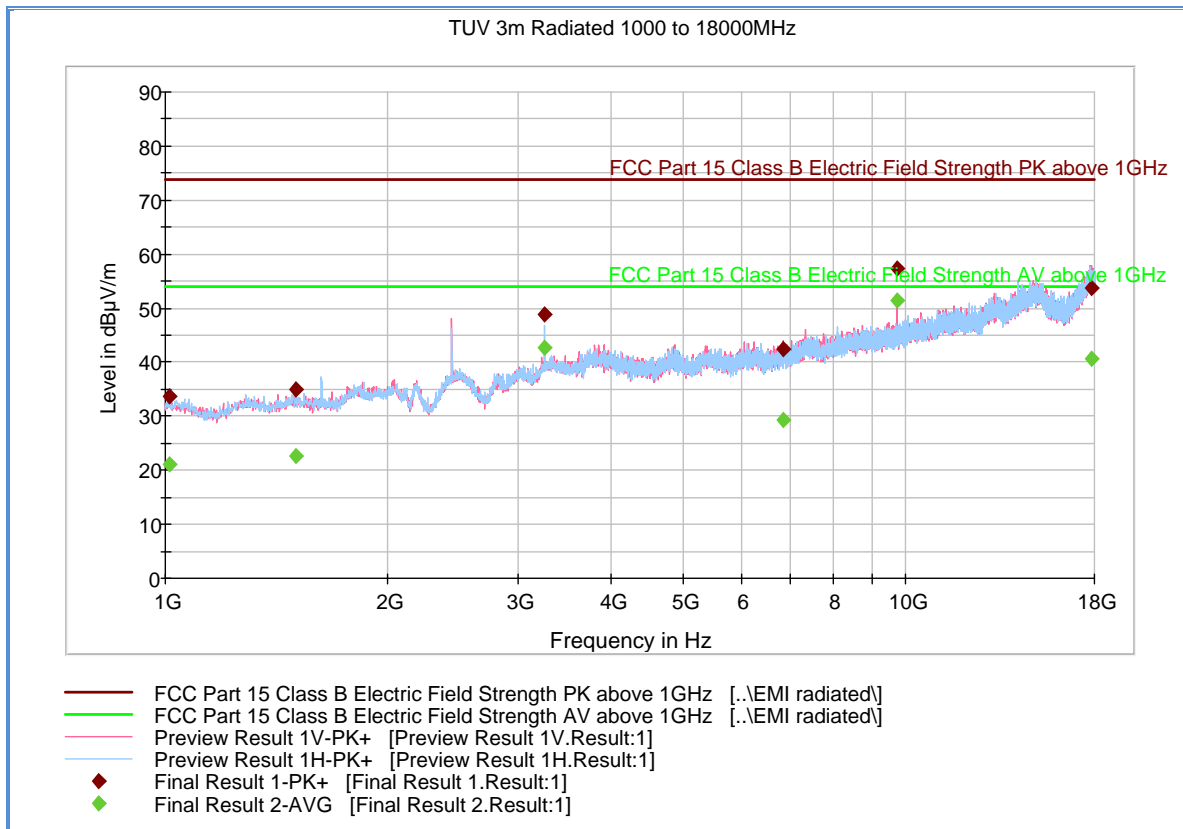
2.8.14 Test Results Lower Band Edge (Radiated - Low Channel using 100 kHz RBW)



Date: 1.AUG.2012 15:13:53

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 -30.65dBc. EUT complies.

2.8.15 Test Results Above 1GHz (Mid Channel)



Peak Data

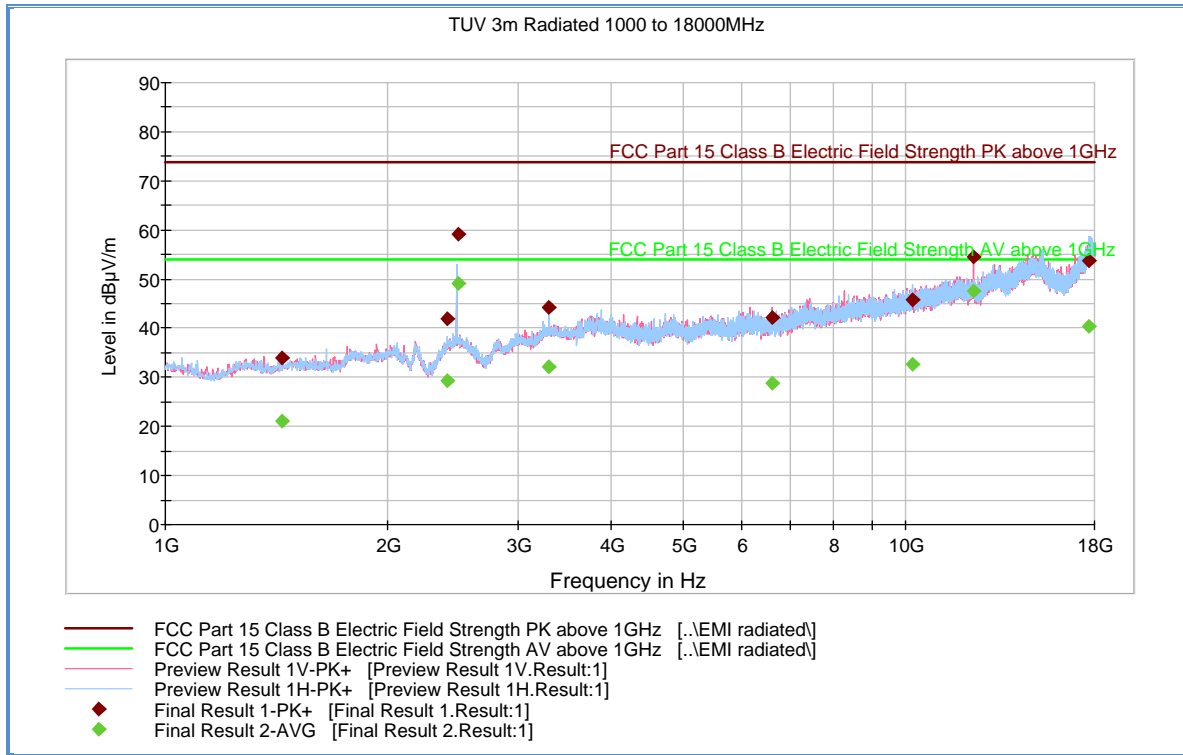
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1013.940000	33.8	1000.	1000.000	162.0	V	194.0	-11.1	40.1	73.9
1500.020000	35.1	1000.	1000.000	144.0	V	356.0	-9.0	38.8	73.9
3253.080000	49.0	1000.	1000.000	126.0	H	286.0	-0.7	25.0	73.9
6825.800000	42.4	1000.	1000.000	297.0	V	120.0	5.4	31.5	73.9
9759.220000	57.3	1000.	1000.000	157.0	V	282.0	9.6	16.6	73.9
17834.140000	53.7	1000.	1000.000	283.0	V	146.0	20.9	20.2	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)
1013.940000	21.0	1000.0	1000.000	162.0	V	194.0	-11.1	32.9	53.9
1500.020000	22.7	1000.0	1000.000	144.0	V	356.0	-9.0	31.2	53.9
3253.080000	42.7	1000.0	1000.000	126.0	H	286.0	-0.7	11.2	53.9
6825.800000	29.4	1000.0	1000.000	297.0	V	120.0	5.4	24.5	53.9
9759.220000	51.4	1000.0	1000.000	157.0	V	282.0	9.6	2.5	53.9
17834.140000	40.7	1000.0	1000.000	283.0	V	146.0	20.9	13.2	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).

2.8.16 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)
1440.400000	33.8	1000.0	1000.000	186.0	V	21.0	-9.2	40.1	73.9
2400.060000	42.0	1000.0	1000.000	184.0	H	68.0	-4.8	31.9	73.9
2483.520000	59.2	1000.0	1000.000	132.0	H	41.0	-4.6	14.8	73.9
3299.840000	44.2	1000.0	1000.000	100.0	H	96.0	-0.5	29.7	73.9
6607.180000	42.2	1000.0	1000.000	308.0	V	15.0	4.5	31.7	73.9
10219.280000	45.8	1000.0	1000.000	170.0	H	14.0	10.3	28.1	73.9
12378.160000	54.6	1000.0	1000.000	112.0	V	147.0	12.2	19.3	73.9
17710.420000	53.7	1000.0	1000.000	400.0	H	274.0	20.5	20.2	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)
1440.400000	21.0	1000.0	1000.000	186.0	V	21.0	-9.2	32.9	53.9
2400.060000	29.3	1000.0	1000.000	184.0	H	68.0	-4.8	24.6	53.9
2483.520000	49.2	1000.0	1000.000	132.0	H	41.0	-4.6	4.7	53.9
3299.840000	32.2	1000.0	1000.000	100.0	H	96.0	-0.5	21.7	53.9
6607.180000	28.9	1000.0	1000.000	308.0	V	15.0	4.5	25.0	53.9
10219.280000	32.6	1000.0	1000.000	170.0	H	14.0	10.3	21.3	53.9
12378.160000	47.6	1000.0	1000.000	112.0	V	147.0	12.2	6.3	53.9
17710.420000	40.4	1000.0	1000.000	400.0	H	274.0	20.5	13.5	53.9

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



2.9 POWER SPECTRAL DENSITY

2.9.1 Specification Reference

Part 15 Subpart C §15.247(e)

2.9.2 Standard Applicable

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

2.9.3 Equipment Under Test and Modification State

Serial No: N/A / Test Configuration B

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

August 01, 2012/FSC

2.9.5 Test Equipment Used

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

2.9.6 Environmental Conditions

Ambient Temperature	23.2°C
Relative Humidity	50.5%
ATM Pressure	99.1 kPa

2.9.7 Additional Observations

- This is a conducted test using PSD Option 2 of FCC KDB Publication Number 558074 (Measurement of Digital Transmission System under Section 15.247 March 23, 2005).
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- RBW is 3kHz.
- VBW is 3X RBW.
- Sweep time is auto.
- Sample detector was used since bin width < 0.5RBW and the transmission pulse remains at maximum transmit power throughout each sweep.
- Trigger is set to "free run" since the EUT transmits continuously.
- Initial scan to encompass the entire emission bandwidth was first performed.
- From this scan the peak emission is determined.
- The peak is centred and zoomed in.

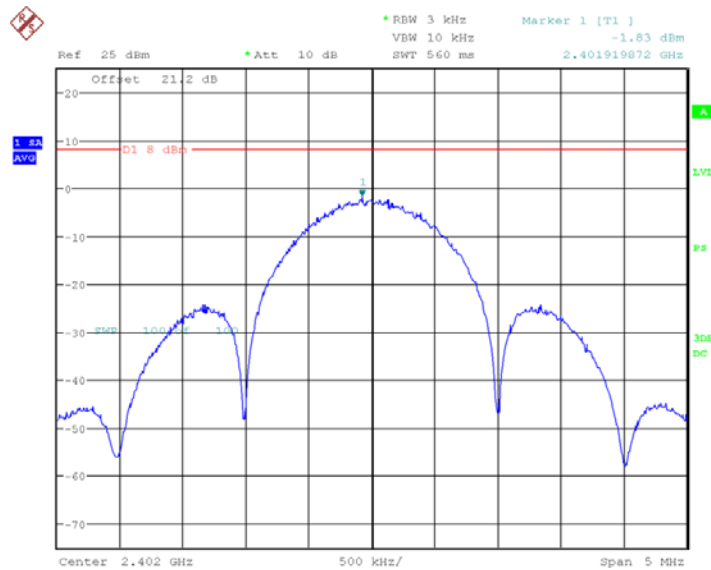
- Trace was averaged 100 times in "Power Averaging Mode".
- PSD is the max peak measured during this scan.

2.9.8 Test Results

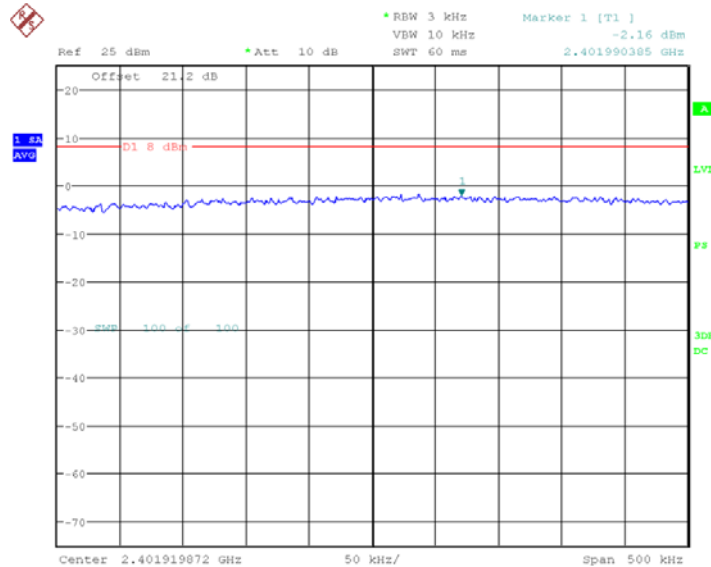
See attached table and plots.

Channel Frequency (MHz)	RF Power Spectral Density (dBm)	Limit (dBm)	Pass/Fail
2402.00	-1.83	8	Pass
2439.81	-2.31	8	Pass
2475.63	-2.00	8	Pass

2.9.9 Test Plots

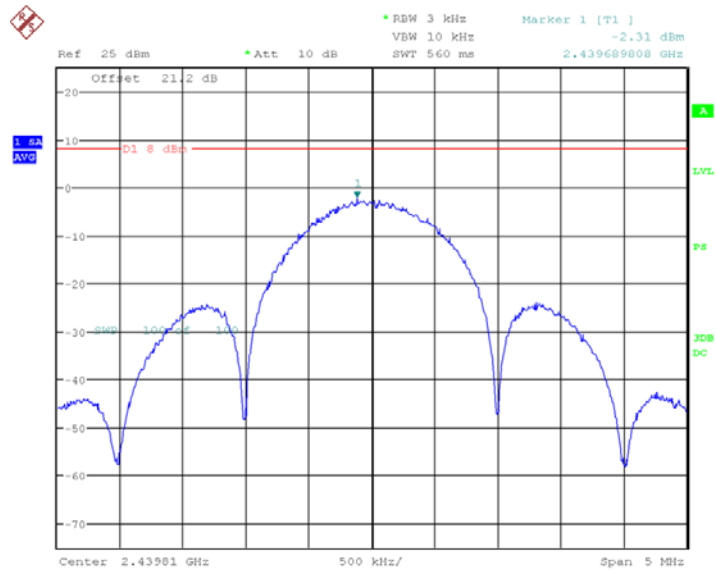


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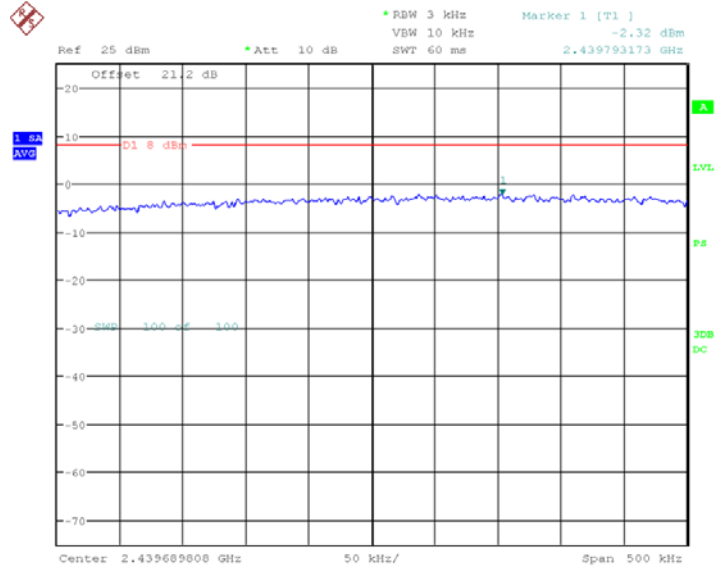


Date: 1.AUG.2012 15:57:07

Low Channel

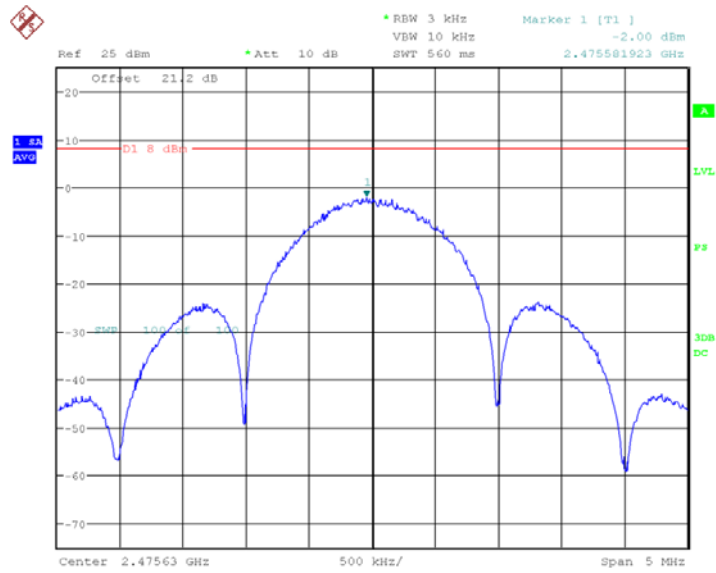


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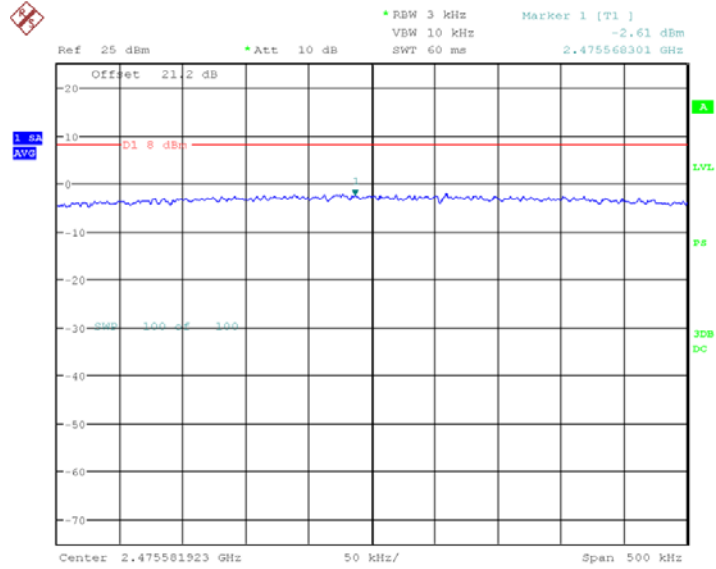


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Mid Channel



Date: 1.AUG.2012 15:52:53



Date: 1.AUG.2012 15:53:25

High Channel



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
Conducted Port Setup						
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	06/13/12	06/13/13
Conducted Emissions Test Setup						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	02/29/12	02/28/13
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	05/24/12	05/24/13
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	05/24/12	05/24/13
8607	20dB Attenuator	CAT-20	N/A	MCL HAT-20	07/29/11	07/29/12
8609	20dB Attenuator	CAT-20	N/A	MCL HAT-20	07/29/11	07/29/12
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	12/06/11	12/06/12
6669	Double-ridged waveguide horn antenna	3115	94124364	EMCO	11/07/11	11/07/12
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
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	08/10/11	08/10/12
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	06/13/12	06/13/13
1016	Pre-amplifier	PAM-0202	187	PAM	08/17/11	08/17/12
6815	2.4GHz Band Notch	Filter	BRM50702 008	Micro-Tronics	Verified by 1040	
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	
Miscellaneous						
1003	Signal Generator	SMR-40	1104.0002.4 0	Rhode & Schwarz	10/13/11	10/13/12
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	07/12/11	07/12/12
	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 Radiated Emission 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	3.55	2.05	4.20
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.23
Coverage Factor (k):					2
Expanded Uncertainty:					4.45

3.2.2 Radiated Emission 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	3.55	2.05	4.20
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.22
Coverage Factor (k):					2
Expanded Uncertainty:					4.44

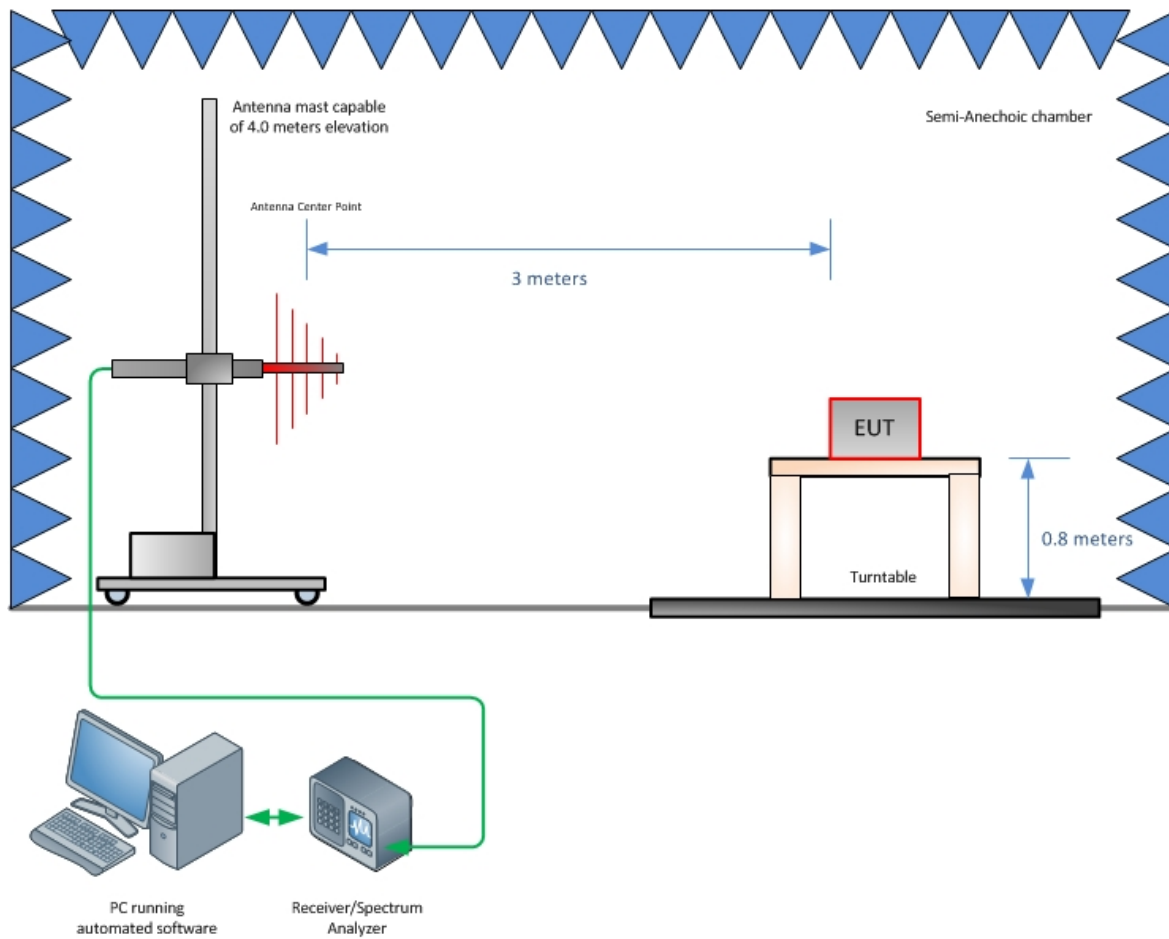
3.2.3 Conducted Antenna Port Measurement

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	0.50	0.29	0.08
3	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.72
Coverage Factor (k):					2
Expanded Uncertainty:					1.45

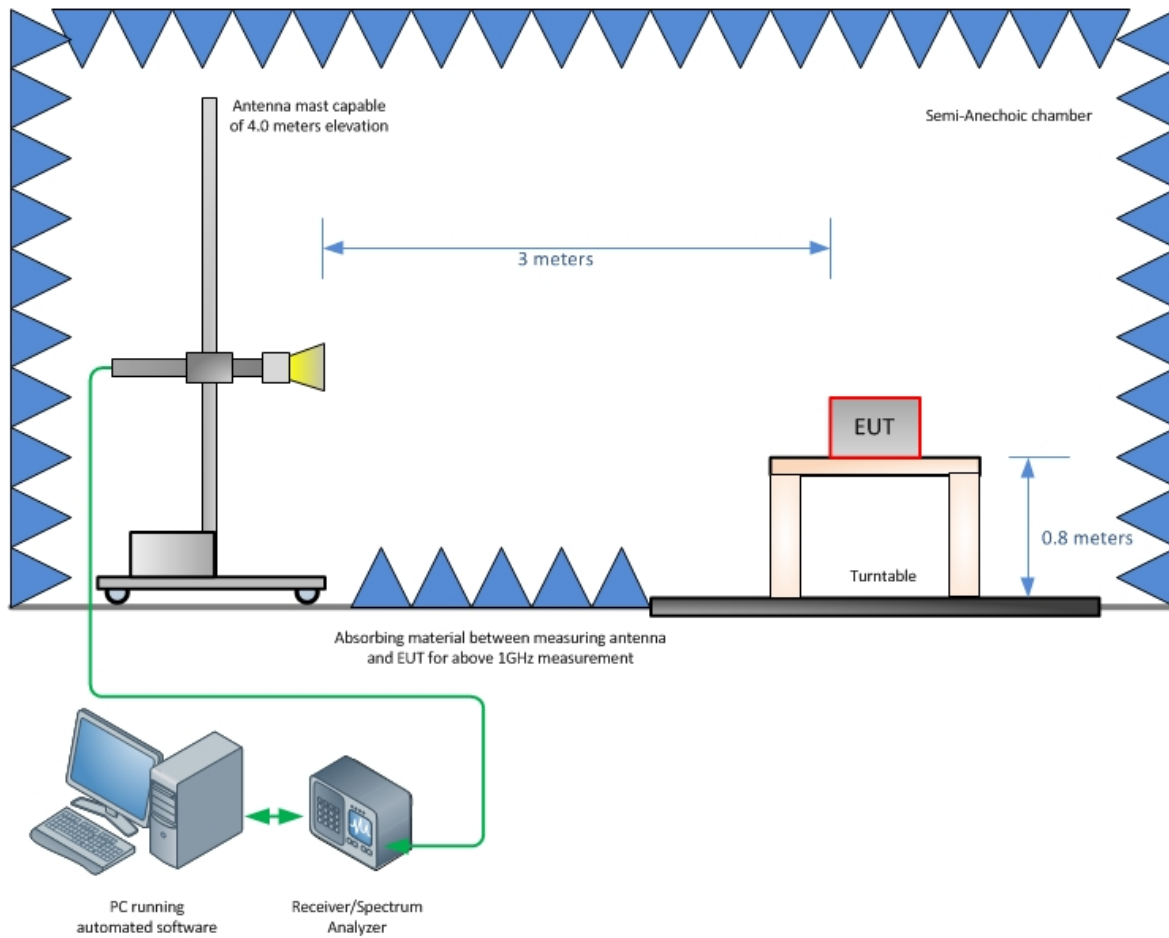
SECTION 4

DIAGRAM OF TEST SETUP

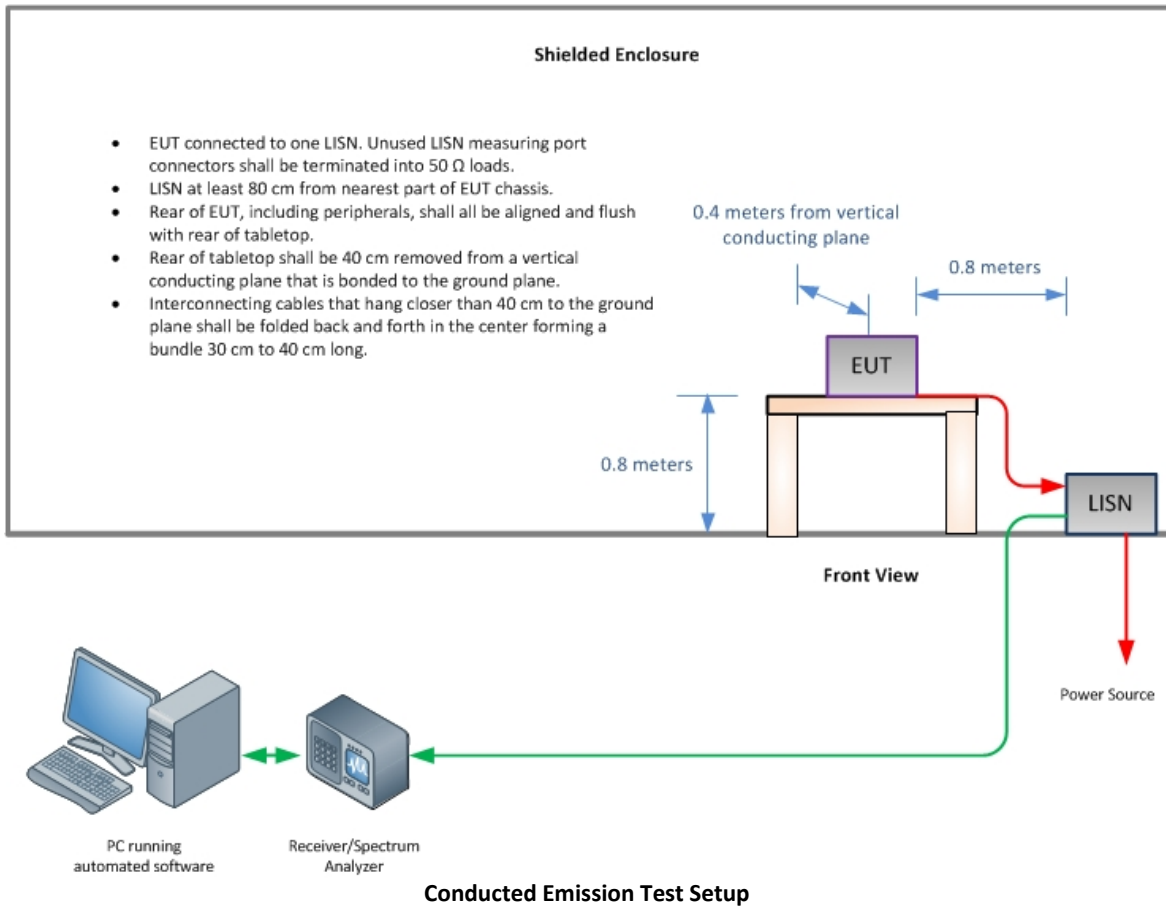
4.1 TEST SETUP DIAGRAM



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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