America

Choose certainty.
Add value.

Report On

Radio Testing of the
North Pole Engineering
BLAST Wireless Sensor Product

FCC Part 15 Subpart C §15.249
IC RSS-210 Issue 8 December 2010

Report No. SC1403784 **May 2014**

TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121
Tel: (858) 678-1400. Website: www.TUVamerica.com

REPORT ON	Radio Testing of the North Pole Engineering Wireless Sensor Product
TEST REPORT NUMBER	SC1403784
PREPARED FOR	North Pole Engineering 221 N. 1st Street, Suite 310 Minneapolis, MN 55401
CONTACT PERSON	Terry Flint Engineer (612) 305-0440 terryf@npe-inc.com
PREPARED BY	Alex Chang **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
DATED	May 02, 2014

Revision History

SC1403784 North Pole Engineering BLAST Wireless Sensor Product					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
05/02/2014	Initial Release				Ferdinand Custodio

CONTENTS

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

SECTION 1

REPORT SUMMARY

Radio Testing of the
North Pole Engineering
Wireless Sensor Product

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the North Pole Engineering Wireless Sensor Product to the requirements of FCC Part 15 Subpart C §15.249 and IC 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	North Pole Engineering
Model Number(s)	BLAST
FCC ID Number	XRH-414ANT
IC Number	11922A-414ANT
Serial Number(s)	11
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.249 (October 1, 2013). • 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	April 17, 2014
Finish of Test	April 21, 2014
Name of Engineer(s)	Alex Chang
Related Document(s)	EMC Test Plan.doc provided by customer 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 §15.249 with cross-reference to the corresponding IC RSS standard is shown below.

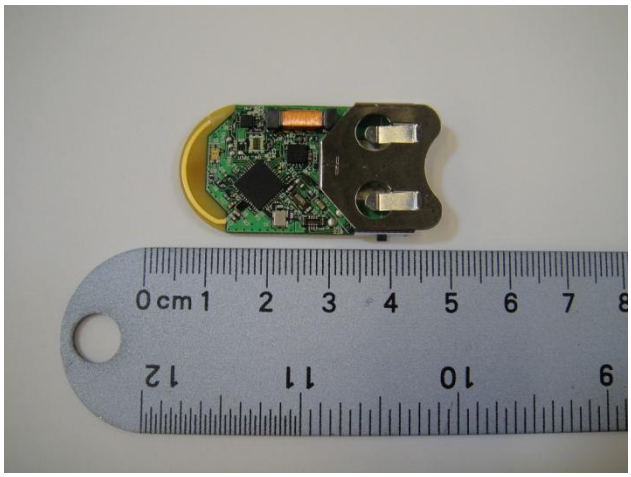
Section	Spec Clause	RSS	Test Description	Result	Comments/Base Standard
2.1	§15.207(a)	RSS-Gen 7.2.4	Conducted Emissions	N/A *	
2.2	§15.215(c)	RSS-Gen 4.6.3	20 dB Bandwidth	Compliant	
2.3	—	RSS-Gen 4.6.1	99% Emission Bandwidth	Compliant	
2.4	§15.249(a)	RSS-210 A2.9(a)	Field Strength Limits for Fundamental And Band Edge	Compliant	
2.5	§15.249(d)	RSS-210 A2.9(b)	Spurious Radiated Emissions	Compliant	
2.6	—	RSS-Gen 4.10	Receiver Spurious Emissions	Compliant	

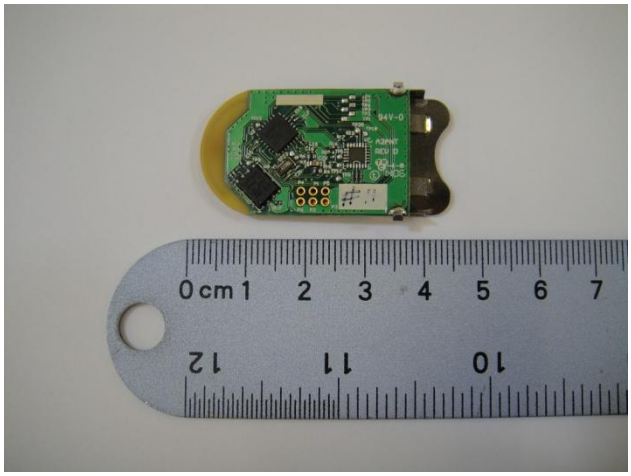
** Not applicable, EUT is a battery powered device.*

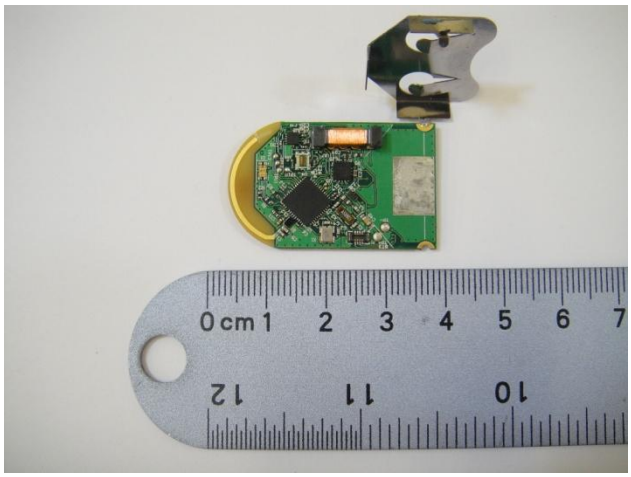
1.3 PRODUCT INFORMATION

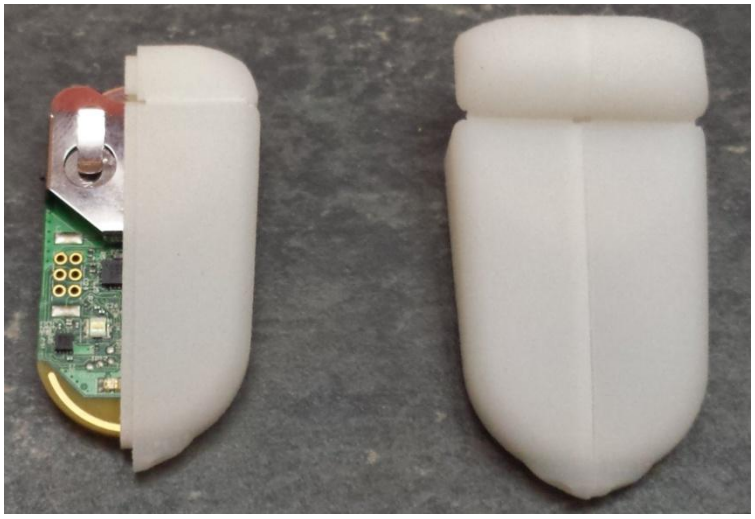
1.3.1 Technical Description

The Equipment Under Test (EUT) was a North Pole Engineering Wireless Sensor Product as shown in the photograph below. The EUT is a BLAST sensor platform and intended for use with ANT connected networks and devices. These self-contained BLAST based sensors are capable of measuring physical events via on-board sensors. The sensor data can be logged in non-volatile memory and/or transmitted on ANT/ANT+ networks. The EUT provided with programmable tool to load the firmware for channels setting. Low, mid and high channels were verified and to be evaluated in this report.









Equipment Under Test

1.3.2 EUT General Description

EUT Description	Wireless Sensor Product
Product Name	BLAST
Model Number(s)	BLAST
Rated Voltage	3.0 VDC (Coin Cell Battery)
Output Power	104.9 dBµV/m @ 3 meters
Frequency Range	2401MHz to 2482 MHz in the 2400 MHz to 2483.5 MHz Band
Number of Operating Frequencies	81
Modulation used	GFSK
Channels Verified	Low Channel 2401MHz Mid Channel 2442MHz High Channel 2482MHz
Antenna Type (used during evaluation)	Integral (Complies with Part 15.203 requirements)

1.3.3 Antenna Details

Model	Integral PCB Trace Antenna
Manufacturer	North Pole Engineering
Antenna Type	Integral PCB Trace Antenna
Antenna Gain	0 dBi
EUT Antenna Connector	N/A (surface mount)
Maximum Dimensions	28 mm long trace. Width of traces is 9.8 mm on 2oz PCB Cu

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

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configurations	Description
Default	Radiated only configuration. EUT transmitting through the integral antenna. The EUT was set to transmit continuously @ 100% duty cycle.

1.4.2 EUT Exercise Software

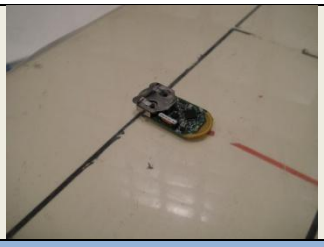
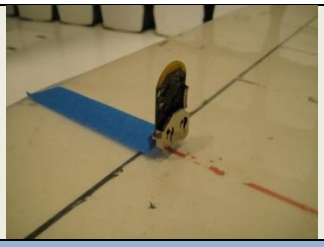
Test firmwares were loaded to the EUT in Low, Mid and High channels @ 100% duty cycle (modulated); as well as normal operation and receive modes.

1.4.3 Support Equipment and I/O cables

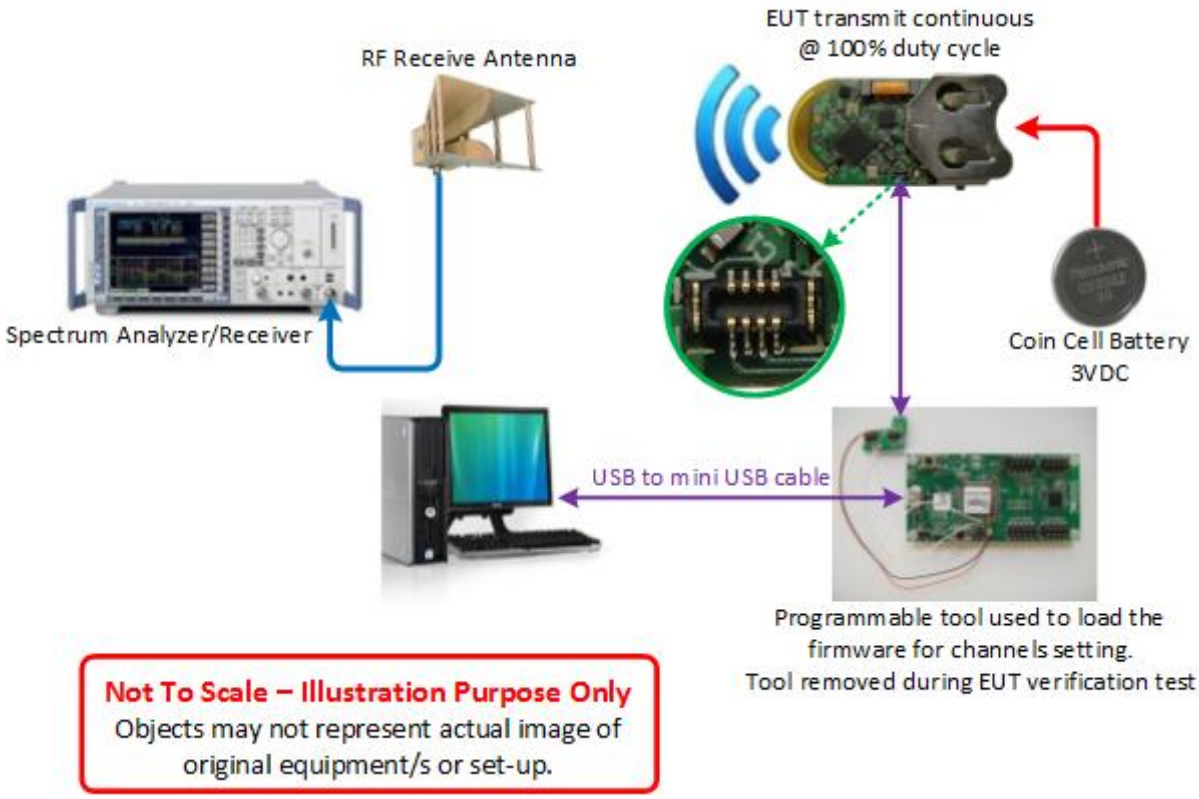
Manufacturer	Equipment/Cable	Description
North Pole Engineering	Programmable Tool	Custom made PCB. mini USB connection

1.4.4 Worst Case Configuration

For radiated measurements X, Y, and Z orientations were verified. The verification was determined "X" as worst case configuration.

		
"X" Configuration	***"Y" Configuration***	***"Z" Configuration***

1.4.5 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: 11		
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 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)

Sony Electronics Inc., Building #8 16530 Via Esprillo, 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 §2.498 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.

1.9.2 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.

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

SECTION 2

TEST DETAILS

Radio Testing of the
North Pole Engineering
Wireless Sensor Product

2.1 CONDUCTED EMISSIONS

2.1.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.1.2 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 µH/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dBµV)	
	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.*

2.1.3 Equipment Under Test and Modification State

Not performed. EUT is battery operated only.

2.2 20 dB BANDWIDTH

2.2.1 Specification Reference

Part 15 Subpart C §15.215(c)

2.2.2 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.

2.2.3 Equipment Under Test and Modification State

Serial No: 11 / Default Test Configuration

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

April 18, 2014 /AC

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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.1°C
Relative Humidity	47.3%
ATM Pressure	98.7 kPa

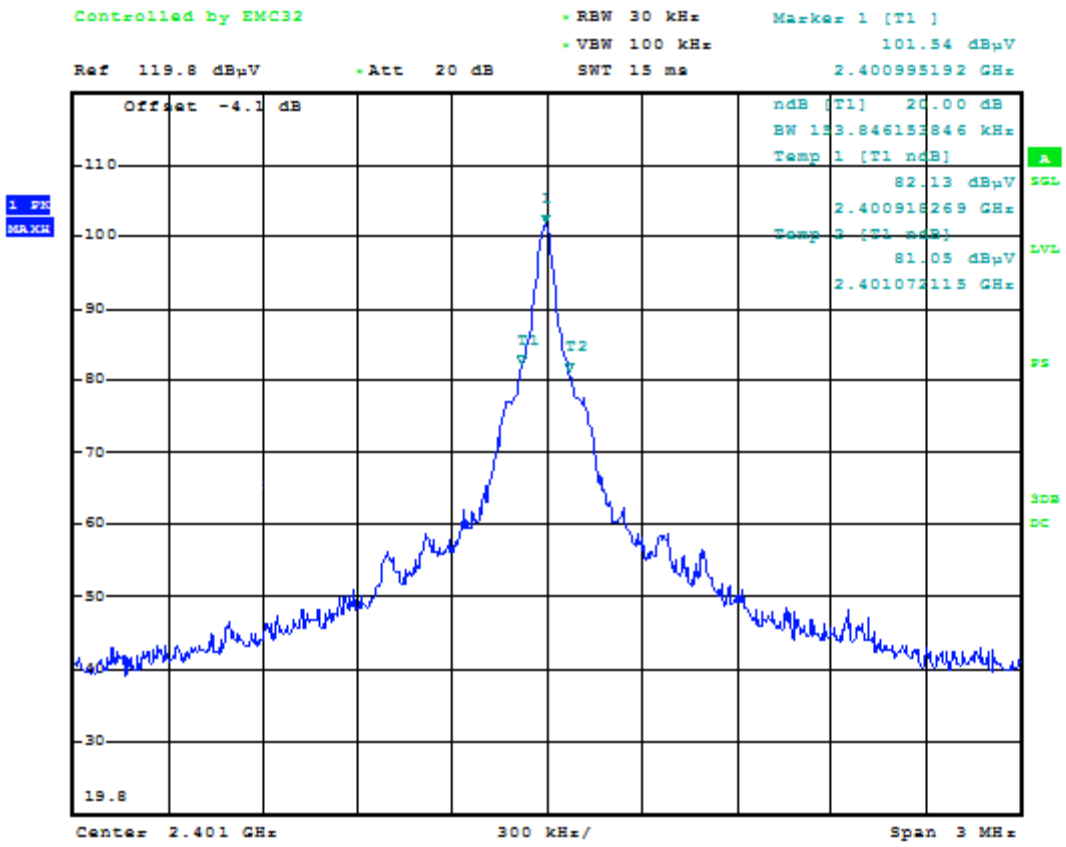
2.2.7 Additional Observations

- This is a radiated test.
- “n dB down” marker function of the Spectrum Analyzer 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.

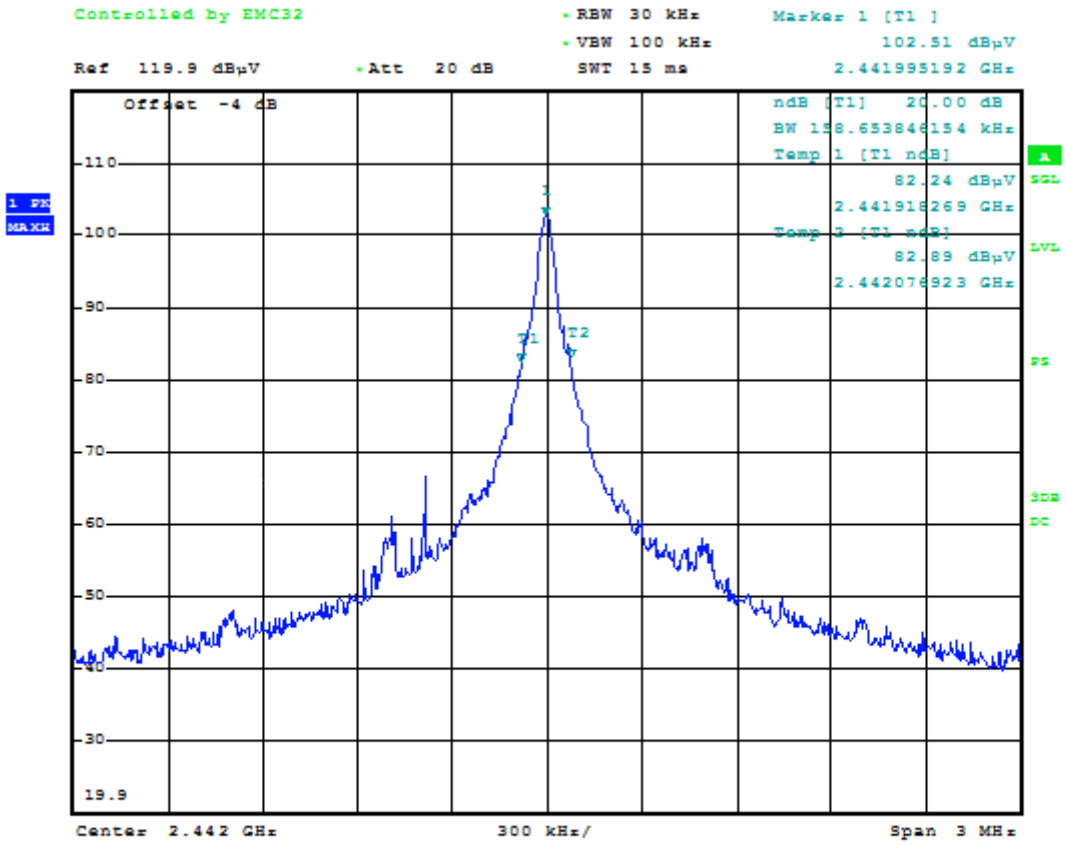
2.2.8 Test Results

Low Channel (2401 MHz)	Mid Channel (2442 MHz)	High Channel (2482 MHz)
153.84 kHz	158.65 kHz	149.03 kHz

2401.00 MHz – (20dB BW/2) = 2400.923 MHz (within the frequency band - **Compliant**)
2482.00 MHz + (20dB BW/2) = 2482.074 MHz (within the frequency band - **Compliant**)

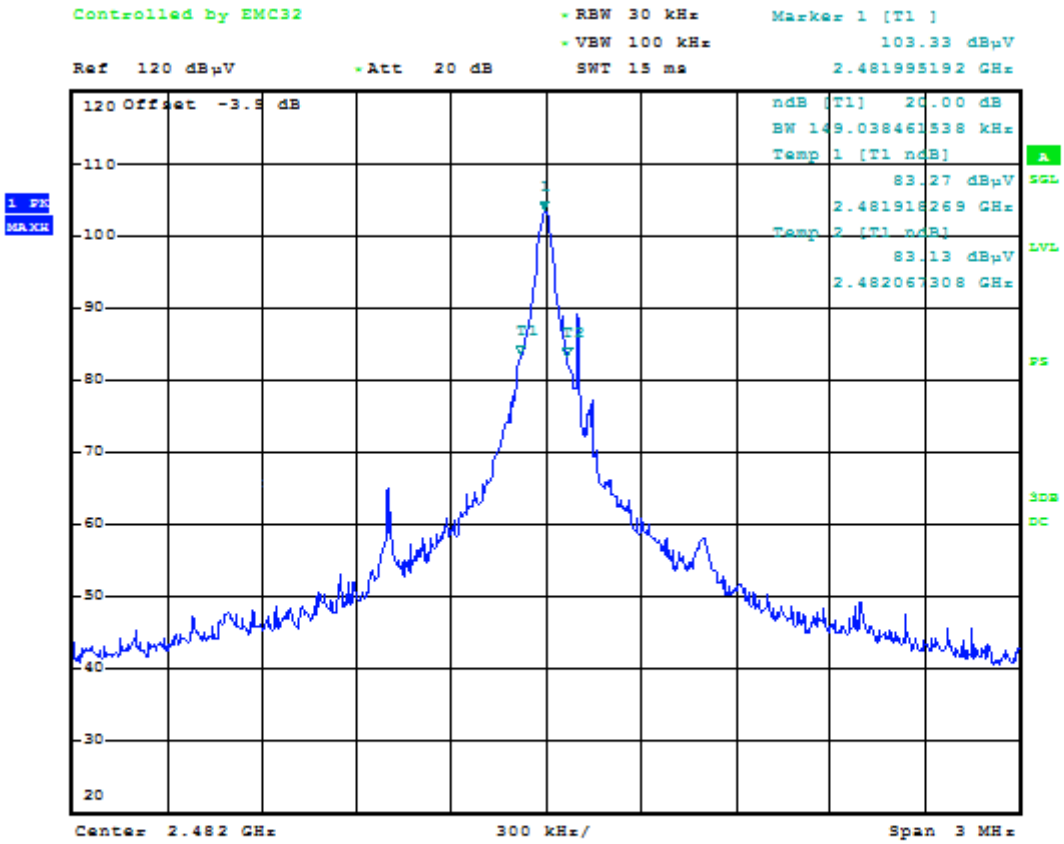


Low Channel



Date: 18.APR.2014 18:10:20

Mid Channel



Date: 18.APR.2014 18:05:53

High Channel

2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 4.6.1

2.3.2 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.

2.3.3 Equipment Under Test and Modification State

Serial No: 11 / Default Test Configuration

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

April 18, 2014 /AC

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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.1°C
Relative Humidity	47.3%
ATM Pressure	98.7 kPa

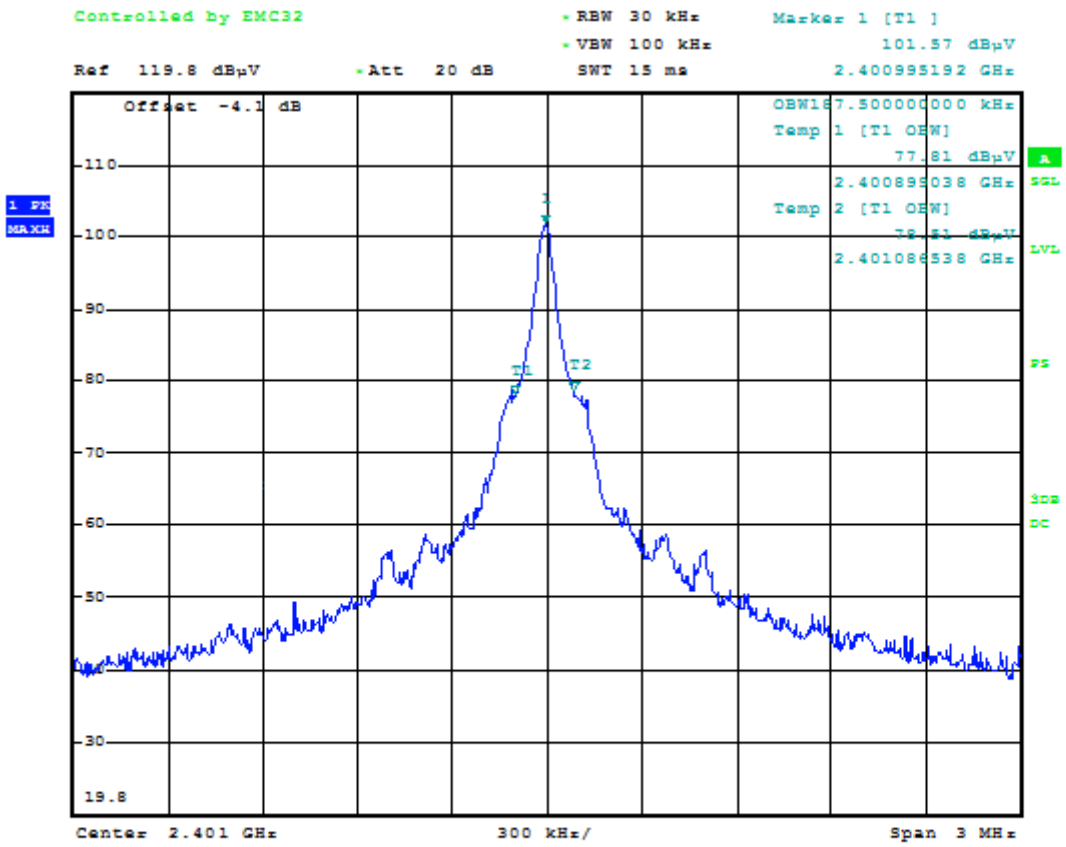
2.3.7 Additional Observations

- This is a radiated test.
- 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.

- 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.

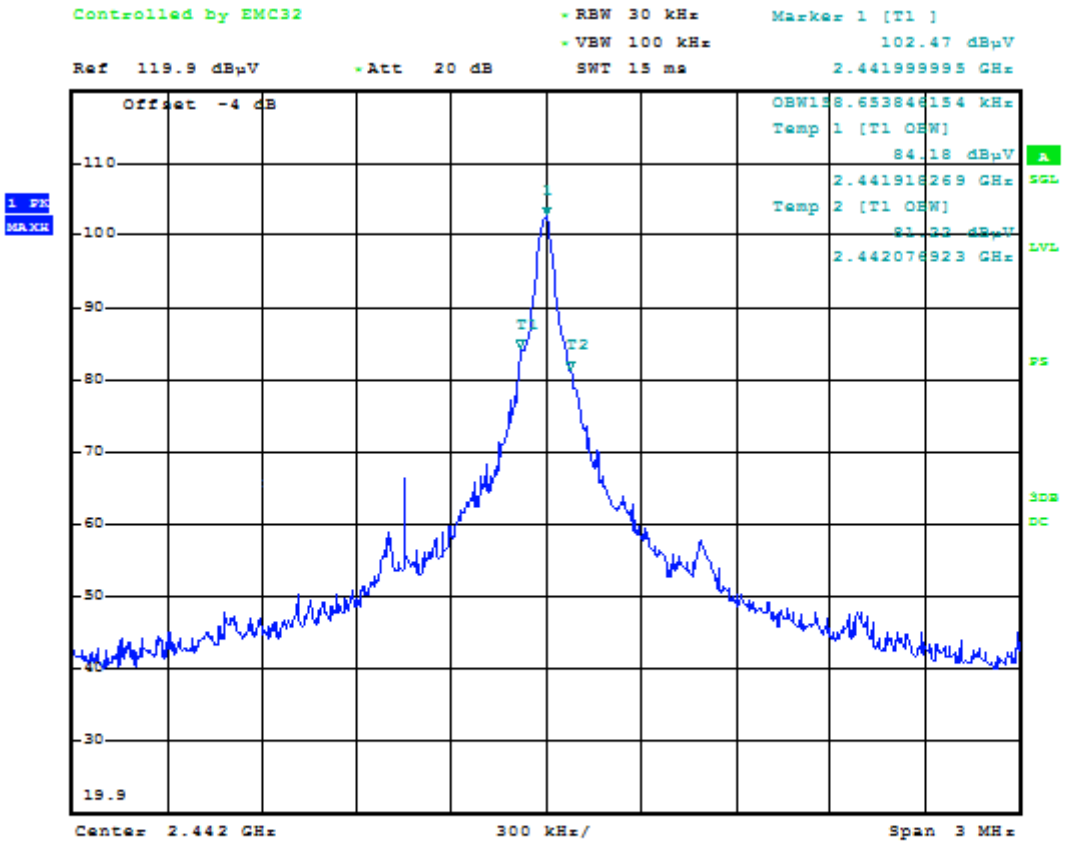
2.3.8 Test Results

Low Channel (2401 MHz)	Mid Channel (2442 MHz)	High Channel (2482 MHz)
187.50 kHz	158.65 kHz	163.46 kHz



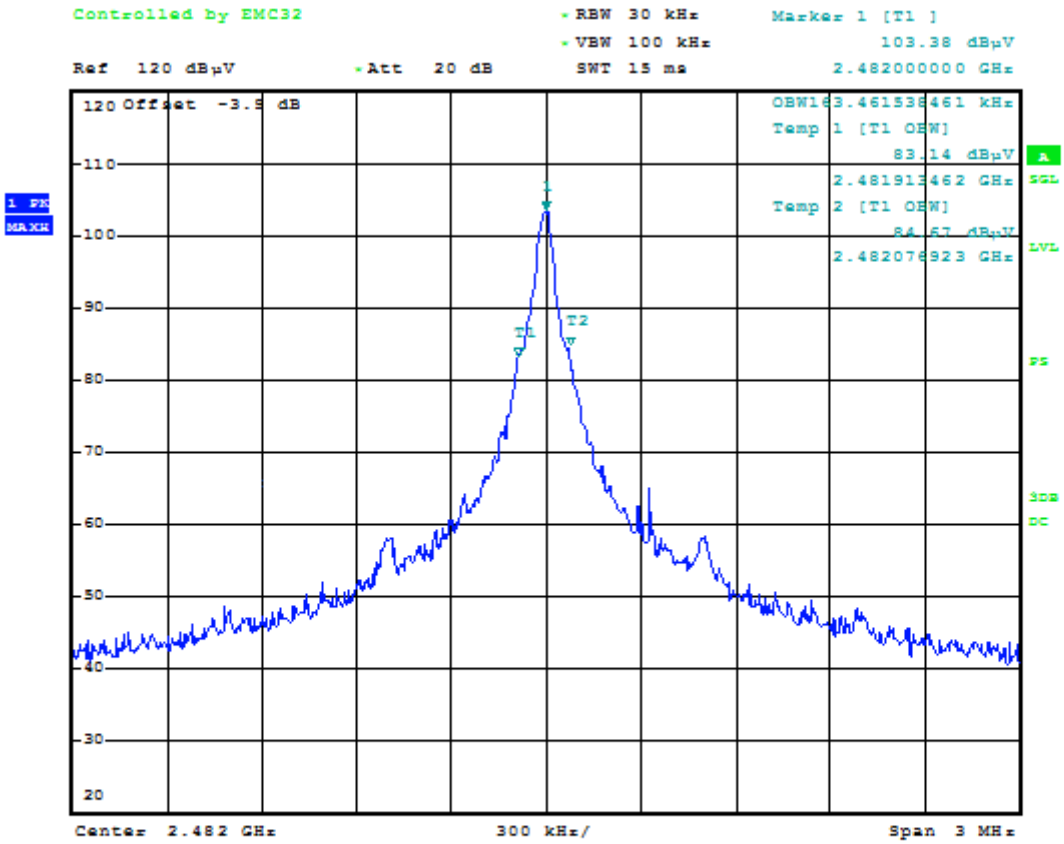
Date: 18.APR.2014 18:06:57

Low Channel



Date: 18.APR.2014 18:09:52

Mid Channel



High Channel

2.4 FIELD STRENGTH LIMITS FOR FUNDAMENTAL AND BAND EDGE

2.4.1 Specification Reference

Part 15 Subpart C §15.249(a)

2.4.2 Standard Applicable

(a) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

2.4.3 Equipment Under Test and Modification State

Serial No: 11 / Default Test Configuration

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

April 18, 2014 /AC

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.0°C
Relative Humidity	45.3%
ATM Pressure	98.9 kPa

2.4.7 Additional Observations

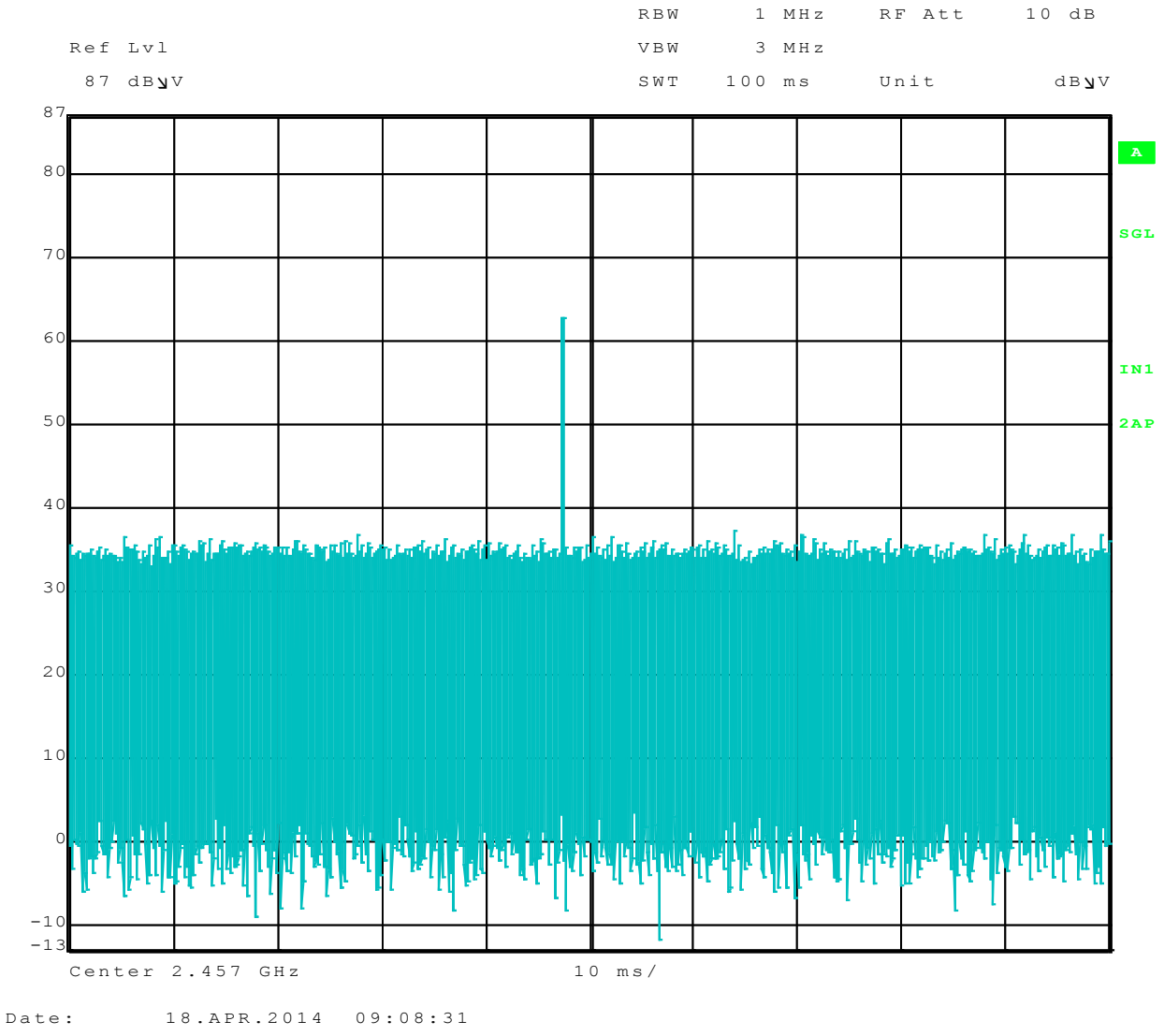
- This is a radiated test. The spectrum was measured to the fundamental frequency of low, mid, and high channels.
- Duty Cycle was used to calculate average compliance based from fundamental frequency measurements.
- When calculating Duty Cycle, the EUT was configured to normal operation (actual duty cycle vs. 100% duty cycle when in test mode).
- Only the fundamental measurements corrected for DCCF, all other emissions complies with the general radiated emission limits of §15.209 even at 100% duty cycle (test mode).
- Marker-Delta Method used for Band Edge compliance measurement in low and high channels.

- 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.

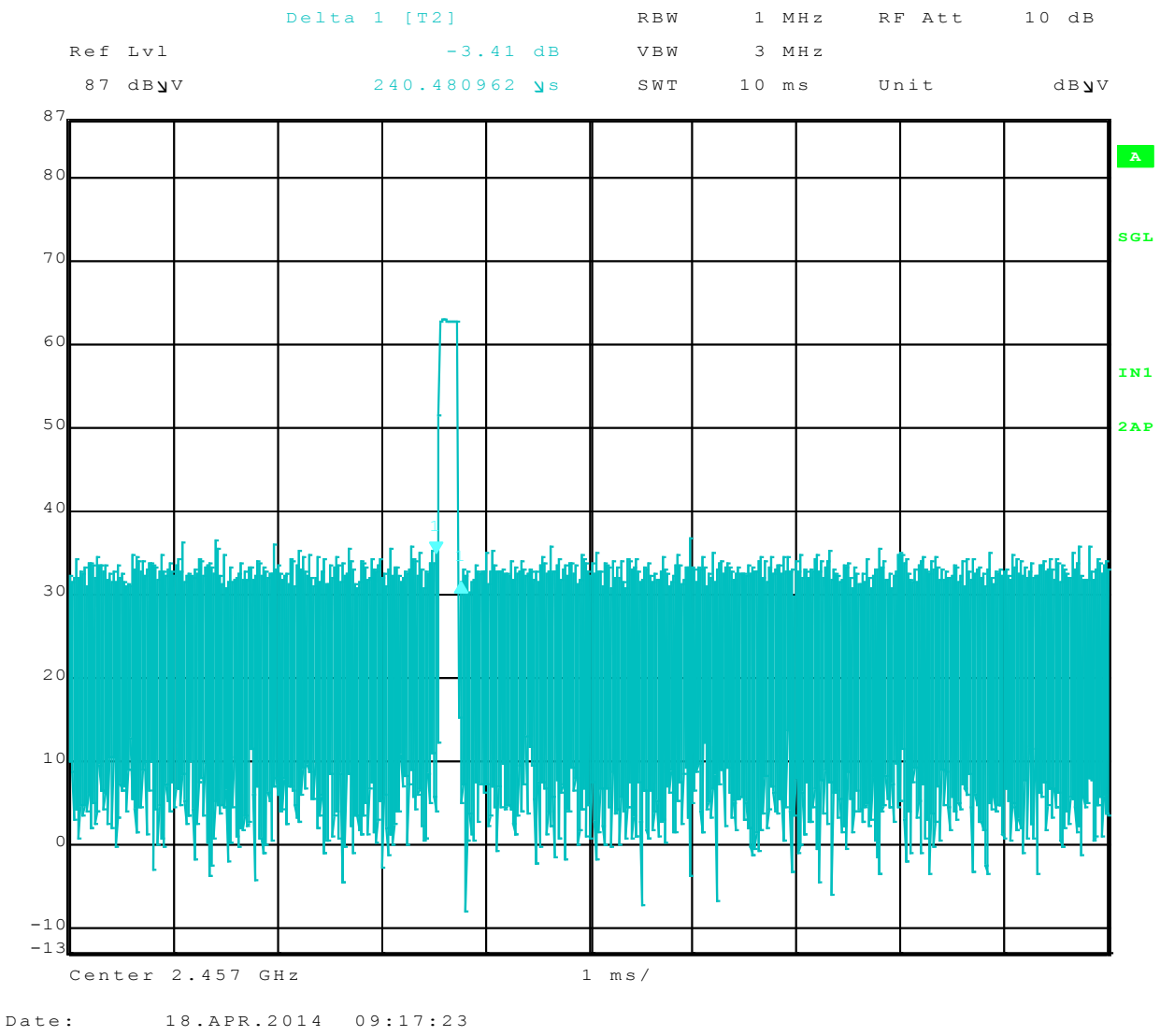
2.4.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) **@ 2400 MHz**			58.4
Correction Factor (dB)	Asset# 1153 (cable)	3.3	**-4.8**
	Asset# 8628 (preamplifier)	-36.4	
	Asset# 6669 (antenna)	28.3	
Reported Peak Final Measurement (dbµV/m) @ 2400 MHz			**53.6**

2.4.9 Duty Cycle Correction Factor Calculation



100ms sweep (representative channel)



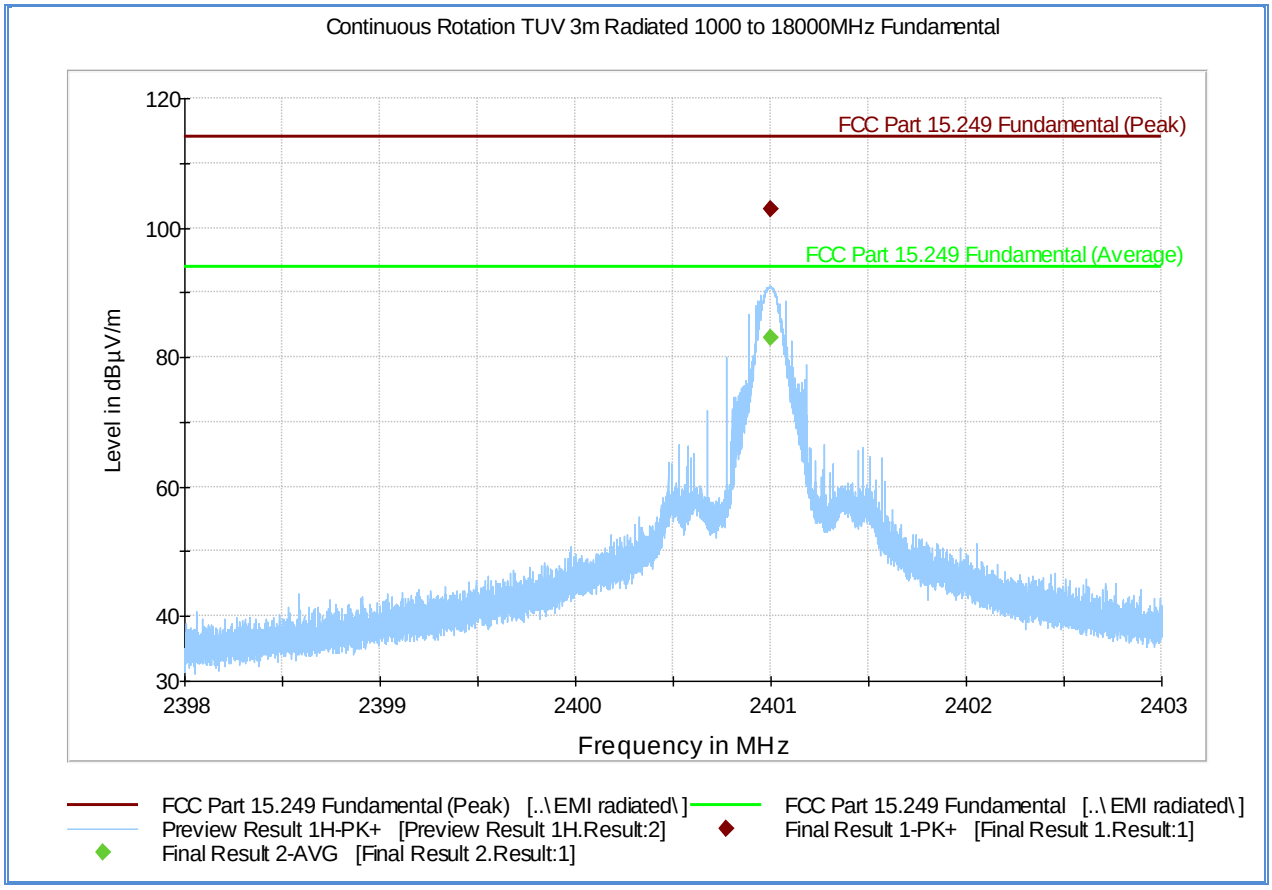
10ms sweep (representative channel)

Duty Cycle Calculation:	= 0.240ms "On" time per100 ms sweep
Duty Cycle Correction Factor	= 20 log (0.000240)
	= **-72.39 (Limited to -20dB)**
Sample Calculation for Low Channel	= 102.9 dBµV/m Peak @ 3 meters):
	= 102.9 dBµV/m + (– 20 dB)
	= 82.9 dBµV/m Average @ 3 meters

2.4.10 Test Results

See attached plots.

2.4.11 Test Results for Low Channel (Fundamental Emissions)



Peak Data

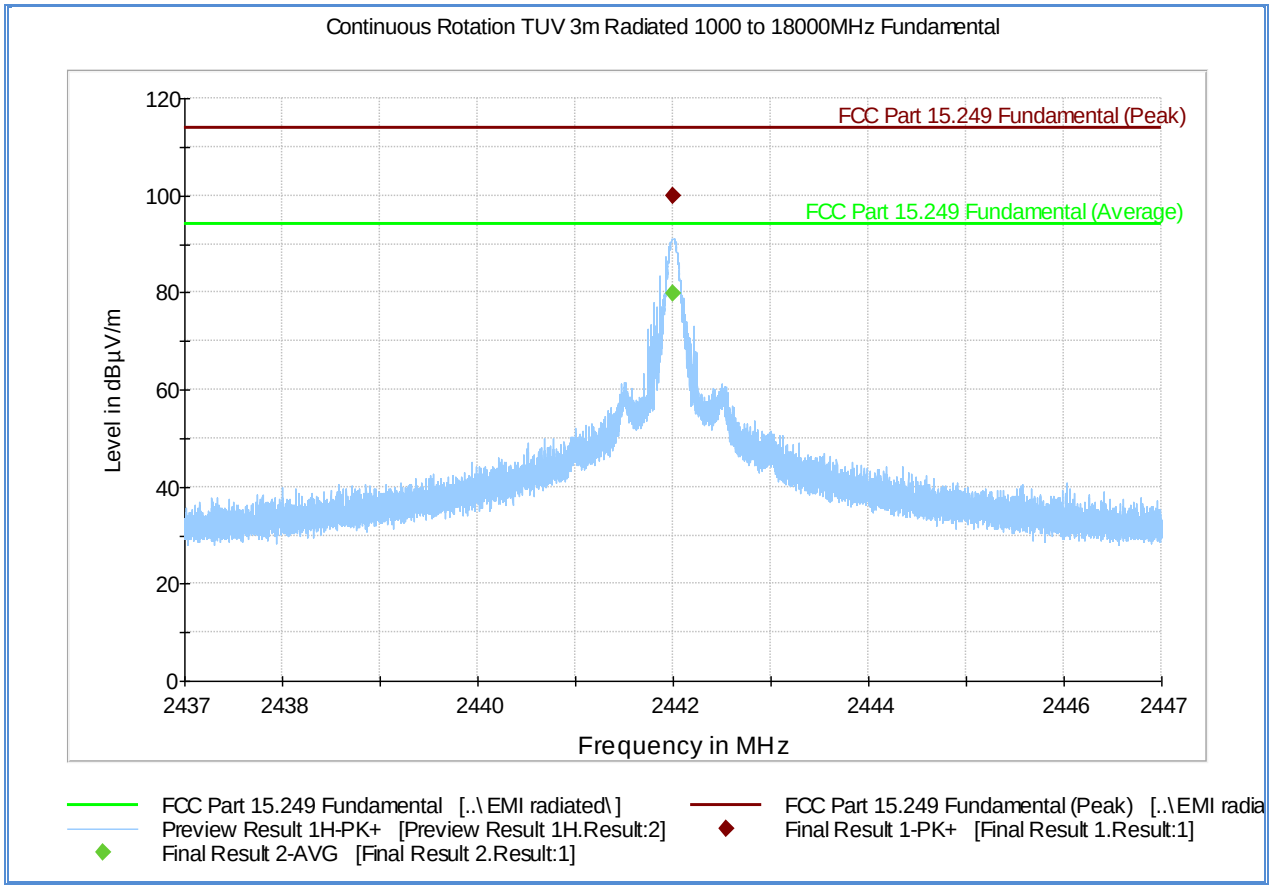
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2401.00000	102.9	1000.0	1000.000	124.6	H	253.0	-4.1	11.1	114.0

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2401.00000	82.9	—	—	—	—	—	—	11.1	94.0

Test Notes: Average data is from Peak data with Duty Cycle Correction Factor applied.
Frequency computation:
2401.0 MHz (Low Channel) = 102.9 dBµV/m (Peak)
= 102.9 dBµV/m + (-20 dB DCCF)
= 82.9 dBµV/m (Average)

2.4.12 Test Results for Mid Channel (Fundamental Emissions)



Peak Data

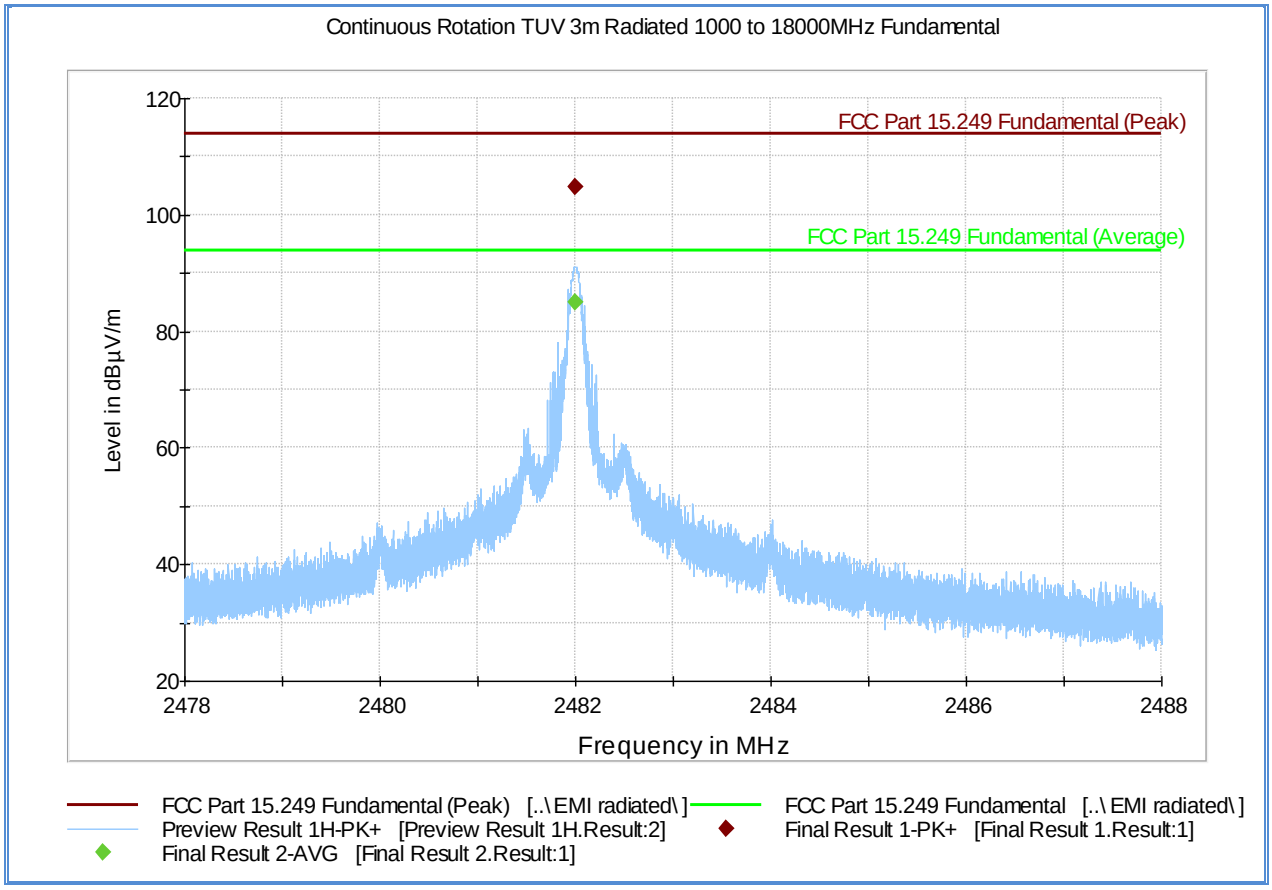
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2442.00033	99.8	1000.0	1000.000	148.5	H	332.0	-4.0	14.2	114.0

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2442.00033	79.8	—	—	—	—	—	—	14.2	94.0

Test Notes: Average data is from Peak data with Duty Cycle Correction Factor applied.
Frequency computation:
2442.0 MHz (Mid Channel) = 99.8 dBµV/m (Peak)
= 99.8 dBµV/m + (-20 dB DCCF)
= 79.8 dBµV/m (Average)

2.4.13 Test Results for High Channel (Fundamental Emissions)



Peak Data

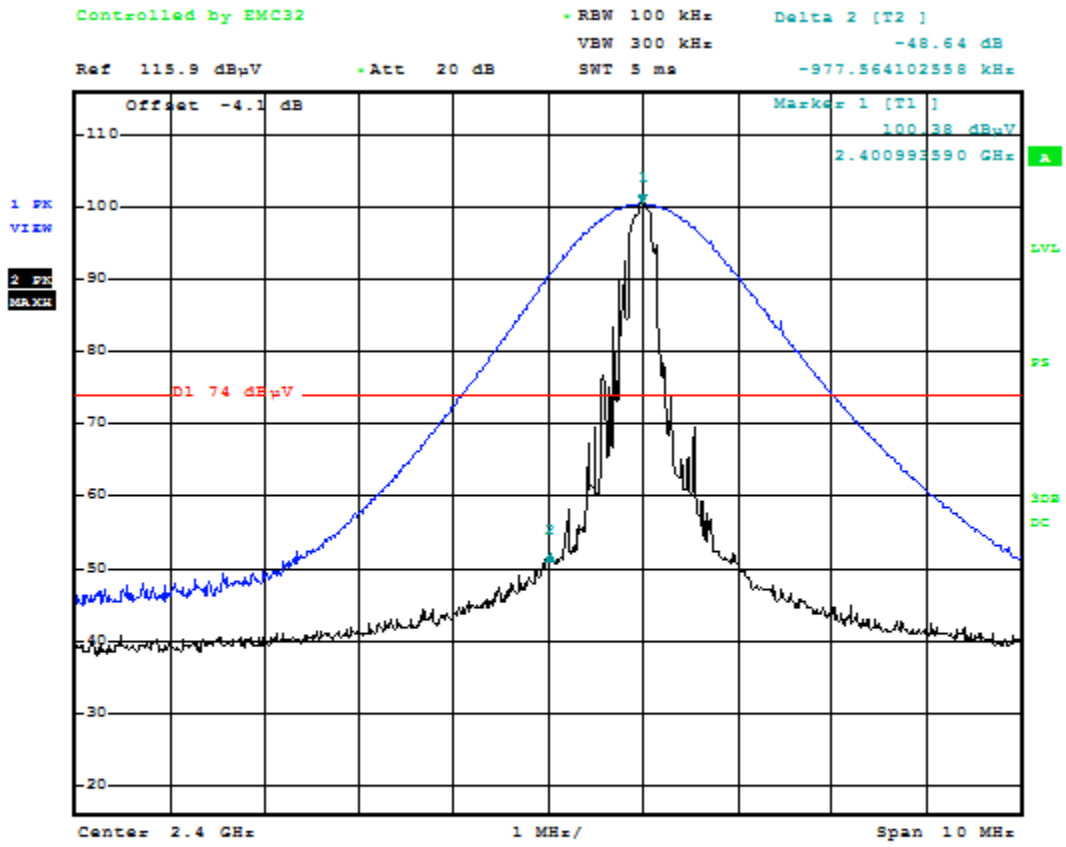
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2482.00000	104.9	1000.0	1000.000	124.6	H	287.0	-3.9	9.1	114.0

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2482.00000	84.9	—	—	—	—	—	—	9.1	94.0

Test Notes: Average data is from Peak data with Duty Cycle Correction Factor applied.
Frequency computation:
2482.0 MHz (High Channel) = 104.9 dBµV/m (Peak)
= 104.9 dBµV/m + (-20 dB DCCF)
= 84.9 dBµV/m (Average)

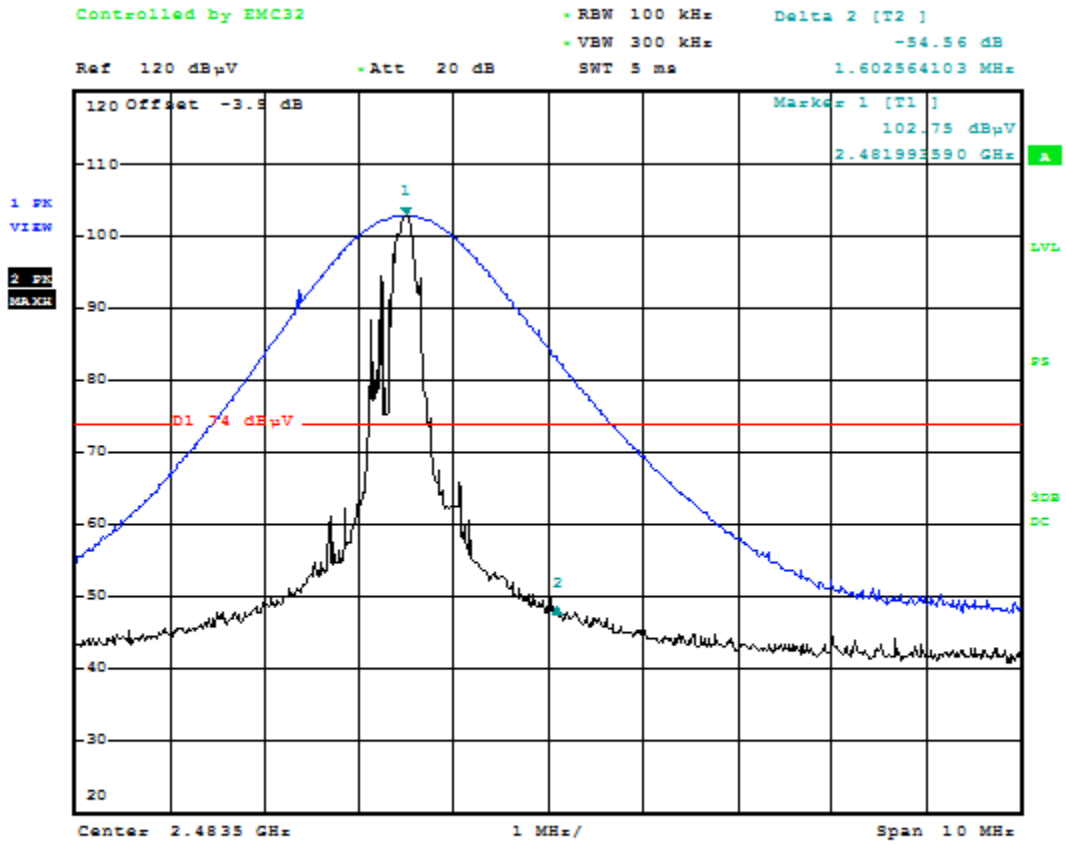
2.4.14 Test Results for Low Channel (Band Edge)



Date: 18.APR.2014 16:34:30

- This is radiated test. An offset -4.1dB correction factor was used based from the low channel fundamental emission measurement.
- Lower band edge was measured -48.64dB (Marker-Delta) as peak measurement @ 2400 MHz presented.
- Display line was set to 74dBµV as peak limit; -25.36dB margin to the limit.
- **EUT Complies.**

2.4.15 Test Results for High Channel (Band Edge)



Date: 18.APR.2014 17:07:20

- This is radiated test. An offset -3.9dB correction factor was used based from the high channel fundamental emission measurement.
- Upper band edge was measured -54.56dB (Marker-Delta) as peak measurement @ 2483.5 MHz presented.
- Display line was set to 74dBµV as peak limit; -19.44dB margin to the limit.
- **EUT Complies.**

2.5 SPURIOUS RADIATED EMISSIONS

2.5.1 Specification Reference

Part 15 Subpart C §15.249(d)

2.5.2 Standard Applicable

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

2.5.3 Equipment Under Test and Modification State

Serial No: 11 / Default Test Configuration

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

April 18 and 21, 2014 /AC

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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.0°C
Relative Humidity	45.3%
ATM Pressure	98.9 kPa

2.5.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic (25GHz). There are no significant emissions observed beyond 18GHz.
- No significant emission difference between the three channels observed below 1GHz. Data presented is from worst configuration based from fundamental verification ("X" axis configuration).
- Spurious emission measurements above 1GHz were performed with a notch filter attenuating the fundamental frequencies.
- 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 2.5.1 for sample computation.

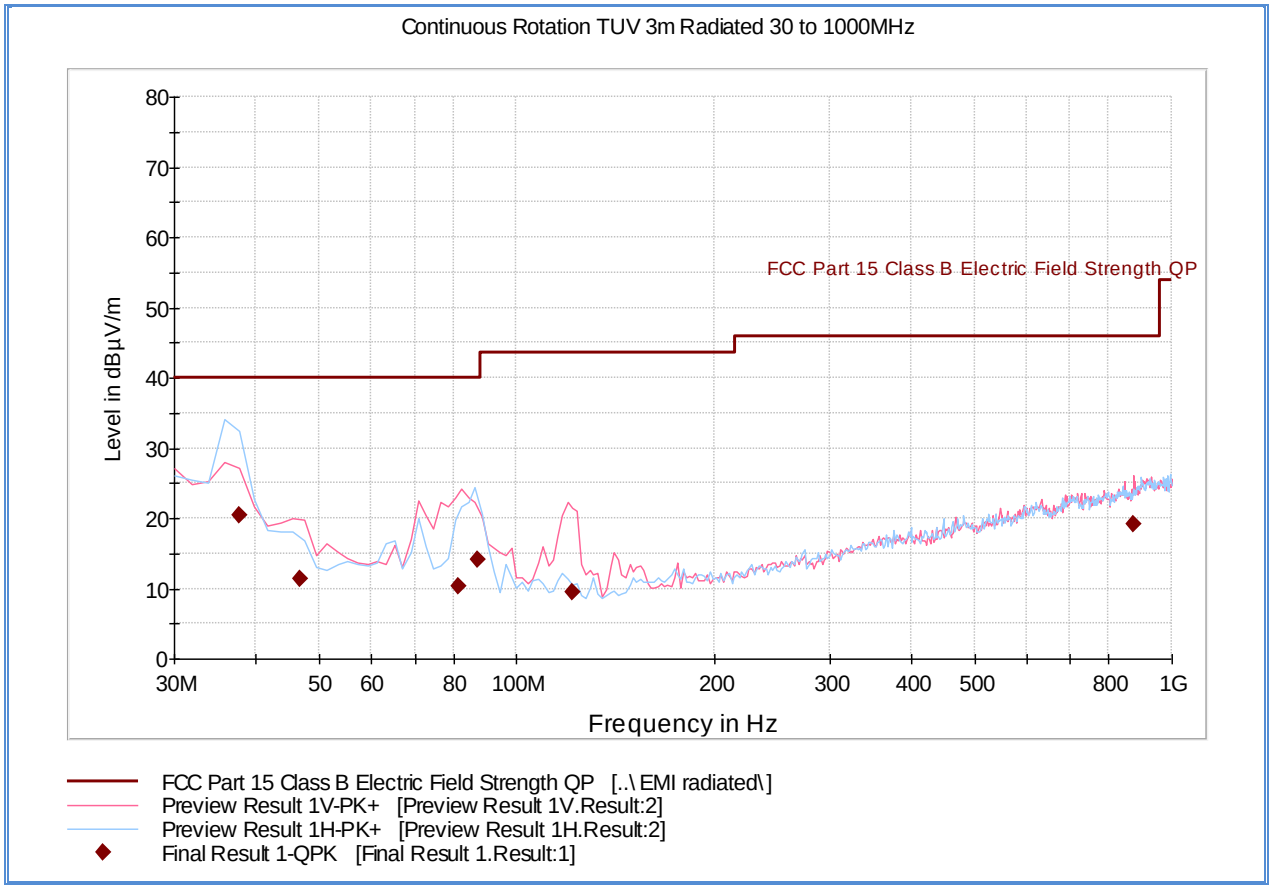
2.5.1 Sample Computation (Radiated Emission)

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**

2.5.2 Test Results

See attached plots.

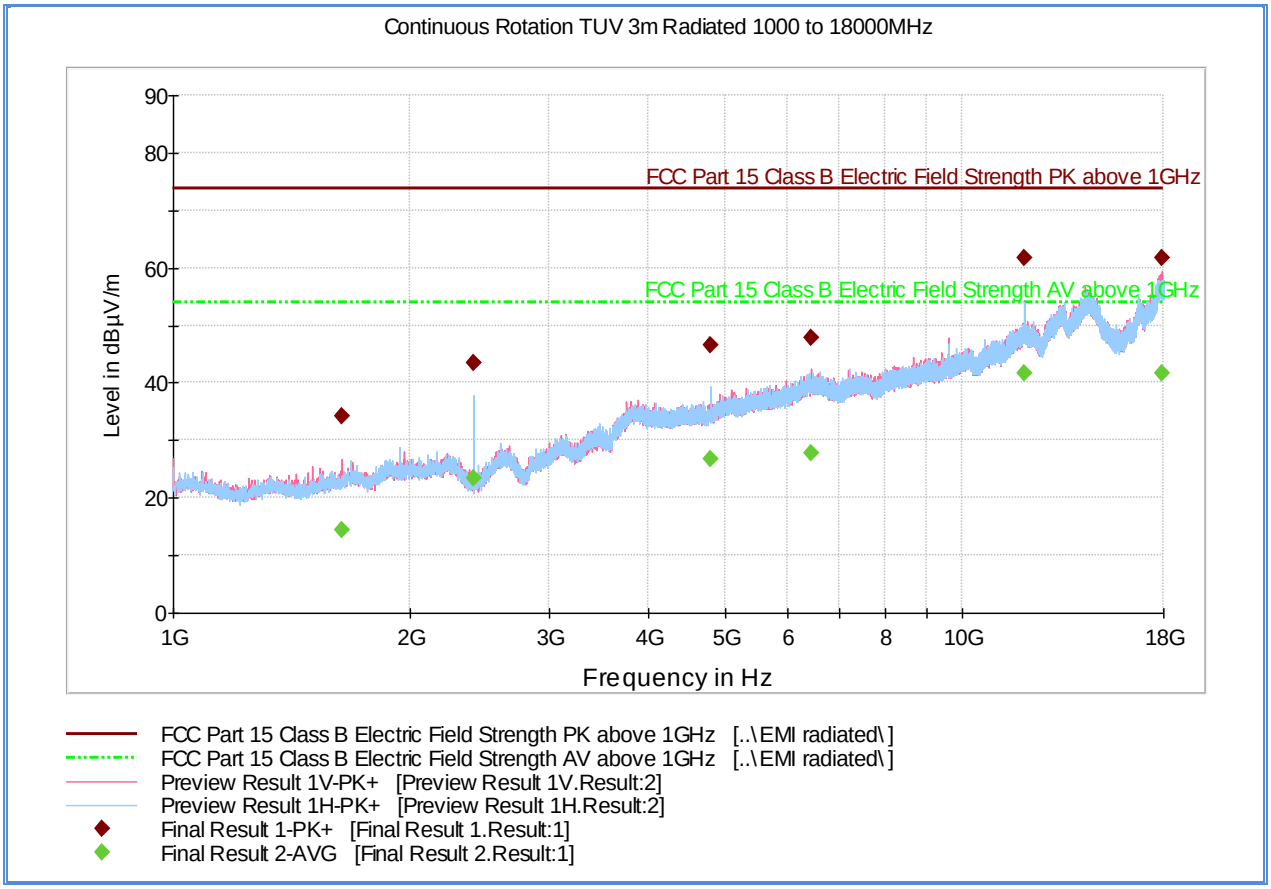
2.5.3 Test Results Below 1GHz (High Channel – Worst Case Configuration)



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)
37.751663	20.4	1000.0	120.000	350.0	H	50.0	-14.6	19.6	40.0
46.591102	11.4	1000.0	120.000	150.0	V	251.0	-18.2	28.6	40.0
81.364970	10.4	1000.0	120.000	150.0	V	1.0	-21.1	29.6	40.0
87.212745	14.1	1000.0	120.000	200.0	H	-4.0	-20.5	25.9	40.0
121.386613	9.5	1000.0	120.000	106.0	V	18.0	-19.7	34.0	43.5
871.447295	19.1	1000.0	120.000	110.0	V	201.0	1.0	26.9	46.0

2.5.4 Test Results Above 1GHz (Low Channel)



Peak Data

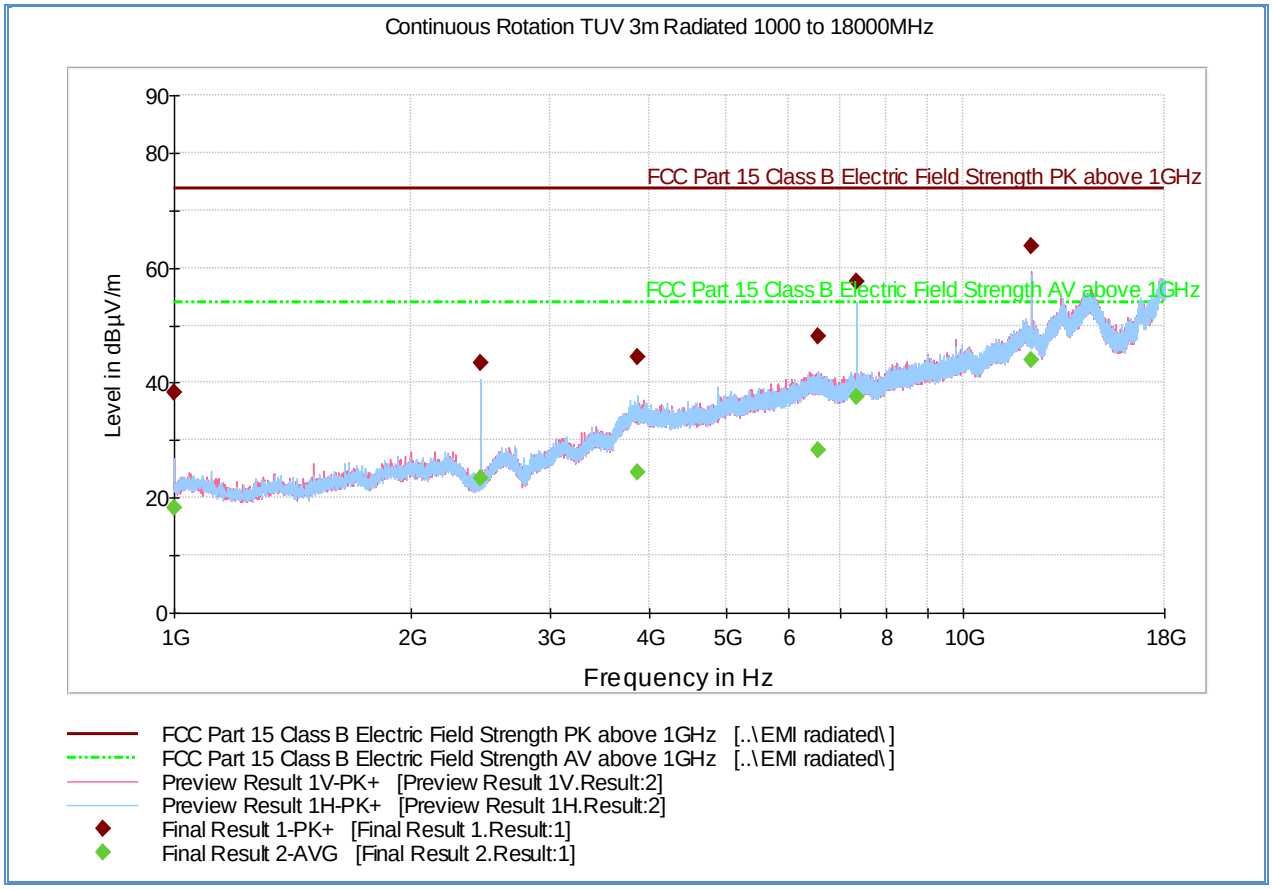
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1635.63333	34.3	1000.0	1000.000	131.6	V	0.0	-7.6	39.6	73.9
2401.00000	43.5	1000.0	1000.000	123.6	H	266.0	-4.1	30.4	73.9
4802.16666	46.7	1000.0	1000.000	140.6	H	256.0	5.4	27.2	73.9
6449.83333	47.9	1000.0	1000.000	403.1	V	42.0	11.3	26.0	73.9
12005.0333	61.7	1000.0	1000.000	379.1	H	314.0	20.7	12.2	73.9
17949.9333	61.7	1000.0	1000.000	202.4	V	227.0	28.8	12.2	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)
1635.63333	14.3	—	—	—	—	—	—	39.6	53.9
2401.00000	23.5	—	—	—	—	—	—	30.4	53.9
4802.16666	26.7	—	—	—	—	—	—	27.2	53.9
6449.83333	27.9	—	—	—	—	—	—	26.0	53.9
12005.0333	41.7	—	—	—	—	—	—	12.2	53.9
17949.9333	41.7	—	—	—	—	—	—	12.2	53.9

Test Notes: Average data is from Peak data with Duty Cycle Correction Factor applied.
Sample frequency computation:
1635.6 MHz = 34.3 dBµV/m (Peak)
= 34.3 dBµV/m + (-20 dB DCCF)
= 14.3 dBµV/m (Average)

2.5.5 Test Results Above 1GHz (Mid Channel)



Peak Data

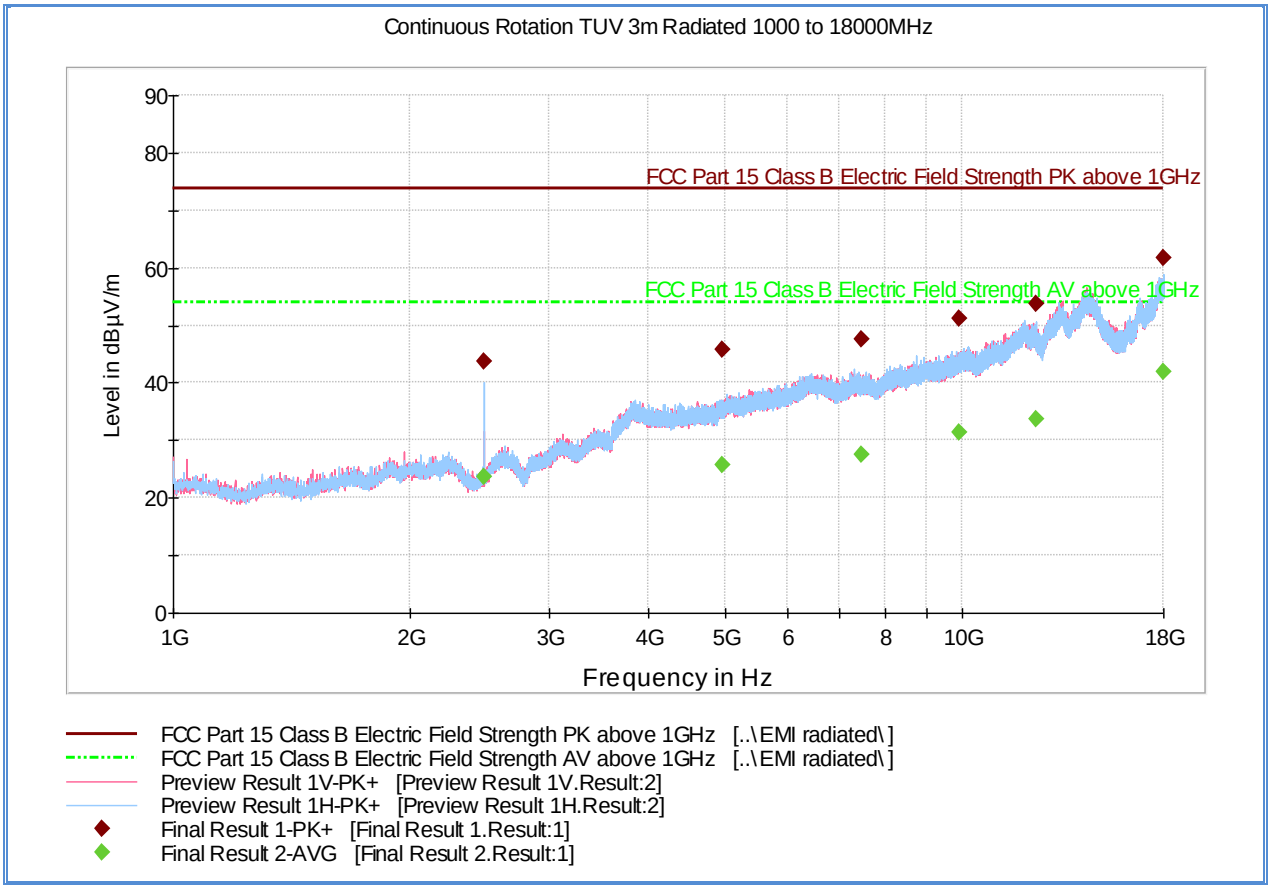
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.00000	38.3	1000.0	1000.000	104.6	H	188.0	-10.1	35.6	73.9
2441.80000	43.4	1000.0	1000.000	114.6	H	265.0	-4.0	30.5	73.9
3866.20000	44.4	1000.0	1000.000	381.0	H	200.0	5.0	29.5	73.9
6560.26666	48.2	1000.0	1000.000	356.1	H	-10.0	11.5	25.7	73.9
7325.90000	57.5	1000.0	1000.000	103.6	H	180.0	11.8	16.4	73.9
12210.0000	63.9	1000.0	1000.000	208.4	V	220.0	19.3	10.0	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)
1000.00000	18.3	—	—	—	—	—	—	35.6	53.9
2441.80000	23.4	—	—	—	—	—	—	30.5	53.9
3866.20000	24.4	—	—	—	—	—	—	29.5	53.9
6560.26666	28.2	—	—	—	—	—	—	25.7	53.9
7325.90000	37.5	—	—	—	—	—	—	16.4	53.9
12210.0000	43.9	—	—	—	—	—	—	10.0	53.9

Test Notes: Average data is from Peak data with Duty Cycle Correction Factor applied.
Sample frequency computation:
1000.0 MHz = 38.3 dBµV/m (Peak)
= 38.3 dBµV/m + (-20 dB DCCF)
= 18.3 dBµV/m (Average)

2.5.6 Test Results Above 1GHz (High 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)
2482.03333	43.7	1000.0	1000.000	114.6	H	266.0	-3.9	30.2	73.9
4964.03333	45.7	1000.0	1000.000	302.2	H	302.0	6.3	28.2	73.9
7446.83333	47.5	1000.0	1000.000	403.0	H	229.0	11.6	26.4	73.9
9928.20000	51.3	1000.0	1000.000	300.6	H	17.0	15.2	22.6	73.9
12410.2333	53.8	1000.0	1000.000	351.1	H	93.0	18.9	20.1	73.9
17962.0000	61.8	1000.0	1000.000	381.0	H	80.0	28.9	12.1	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)
2482.03333	23.7	—	—	—	—	—	—	30.2	53.9
4964.03333	25.7	—	—	—	—	—	—	28.2	53.9
7446.83333	27.5	—	—	—	—	—	—	26.4	53.9
9928.20000	31.3	—	—	—	—	—	—	22.6	53.9
12410.2333	33.8	—	—	—	—	—	—	20.1	53.9
17962.0000	41.8	—	—	—	—	—	—	12.1	53.9

Test Notes: Average data is from Peak data with Duty Cycle Correction Factor applied.
Sample frequency computation:
2482.0 MHz = 43.7 dBµV/m (Peak)
= 43.7 dBµV/m + (-20 dB DCCF)
= 23.7 dBµV/m (Average)

2.6 RECEIVER SPURIOUS EMISSIONS

2.6.1 Specification Reference

RSS-Gen 6.0

2.6.2 Standard Applicable

Receivers shall comply with the limits of spurious emissions set out in this section, measured over the frequency range determined in accordance with Section 4.10 of RSS-Gen.

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field Strength (microvolts/m at 3 metres)*
30-88	100
88-216	150
216-960	200
Above 960	500

*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 7.2.7 of RSS-Gen.

2.6.3 Equipment Under Test and Modification State

Serial No: 11 / Default Test Configuration

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

April 17, 2014 /AC

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.3°C
Relative Humidity	47.8%
ATM Pressure	98.7 kPa

2.6.7 Additional Observations

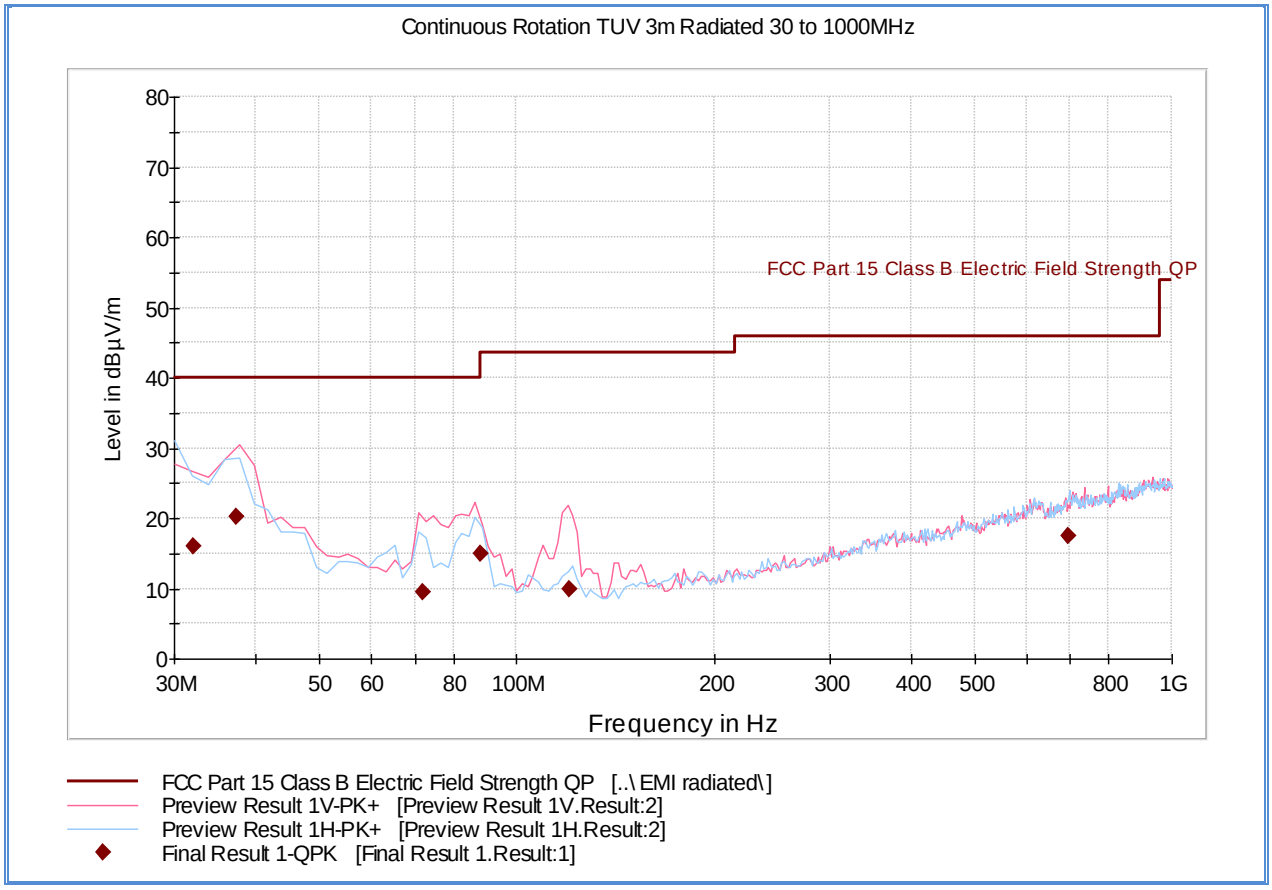
- This is a radiated test. The spectrum was searched from 30MHz to the 3rd harmonic (up to 18GHz performed).
- EUT in RX (Receive) mode configuration.
- Limit used is from FCC §15.209 which is identical to RSS-Gen limits.

- 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 2.6.8 for sample computation.

2.6.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) **@ 2400 MHz**			58.4
Correction Factor (dB)	Asset# 1153 (cable)	3.3	**-4.8**
	Asset# 8628 (preamplifier)	-36.4	
	Asset# 7575 (antenna)	28.3	
Reported Peak Final Measurement (dbµV/m) @ 2400 MHz			**53.6**

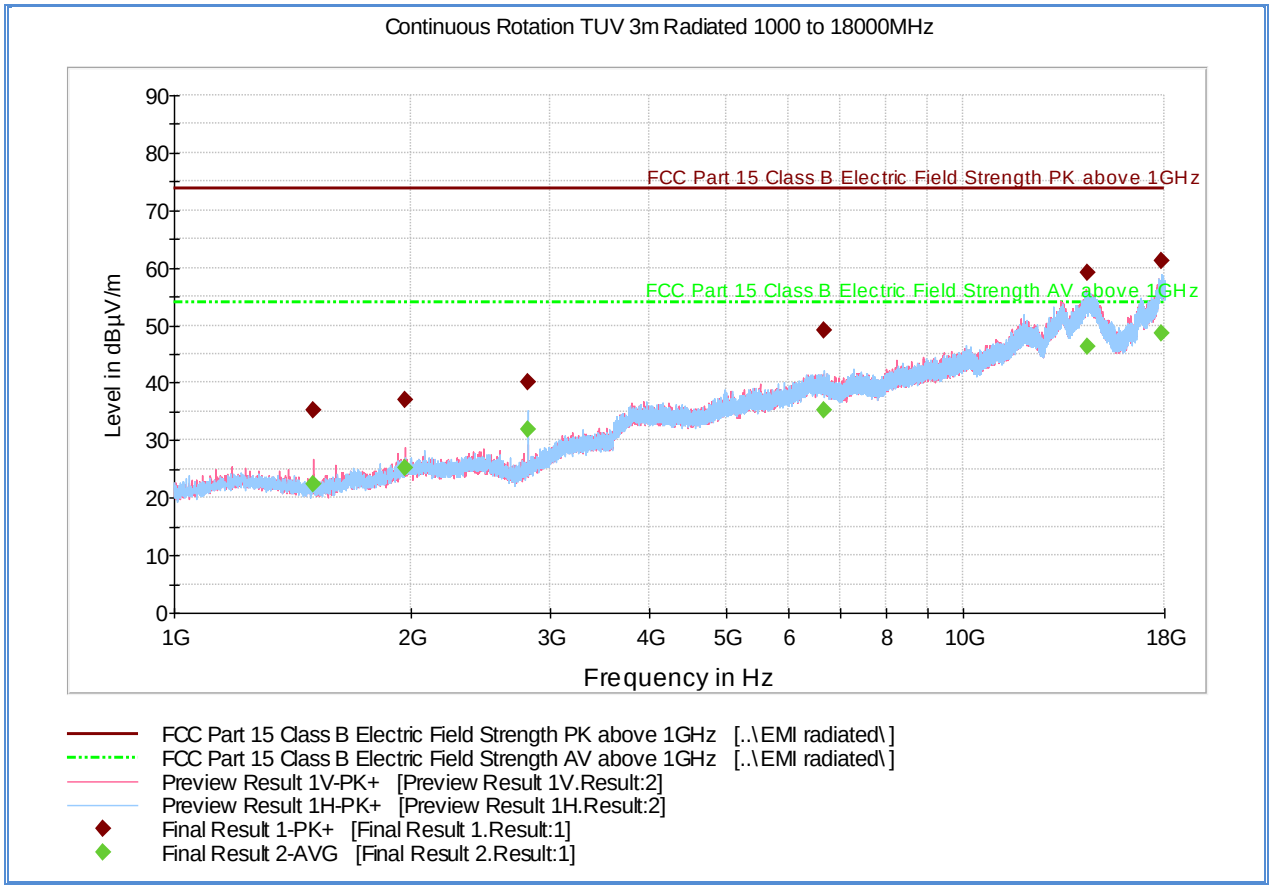
2.6.9 Test Results Below 1GHz (Receive Mode)



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)
32.040000	16.0	1000.0	120.000	278.0	H	12.0	-11.7	24.0	40.0
37.255551	20.1	1000.0	120.000	100.0	V	-4.0	-14.3	19.9	40.0
72.021643	9.6	1000.0	120.000	105.0	V	259.0	-21.6	30.4	40.0
87.892745	15.0	1000.0	120.000	105.0	V	207.0	-20.4	25.0	40.0
120.538838	9.9	1000.0	120.000	100.0	V	204.0	-19.6	33.6	43.5
693.353507	17.4	1000.0	120.000	110.0	H	53.0	-1.1	28.6	46.0

2.6.10 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)
1500.60000	35.3	1000.0	1000.000	379.0	V	288.0	-8.2	38.6	73.9
1964.26666	37.0	1000.0	1000.000	259.2	V	279.0	-5.2	36.9	73.9
2810.33333	40.1	1000.0	1000.000	99.6	H	53.0	-3.7	33.8	73.9
6658.53333	49.2	1000.0	1000.000	368.1	H	20.0	11.4	24.7	73.9
14366.1000	59.0	1000.0	1000.000	380.1	V	10.0	25.3	14.9	73.9
17845.5000	61.1	1000.0	1000.000	141.5	H	40.0	28.6	12.8	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)
1500.60000	22.4	1000.0	1000.000	379.0	V	288.0	-8.2	31.5	53.9
1964.26666	25.1	1000.0	1000.000	259.2	V	279.0	-5.2	28.8	53.9
2810.33333	31.9	1000.0	1000.000	99.6	H	53.0	-3.7	22.0	53.9
6658.53333	35.3	1000.0	1000.000	368.1	H	20.0	11.4	18.6	53.9
14366.1000	46.2	1000.0	1000.000	380.1	V	10.0	25.3	7.7	53.9
17845.5000	48.5	1000.0	1000.000	141.5	H	40.0	28.6	5.4	53.9

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						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	09/03/13	09/03/14
1150	Horn antenna	3160-09	012054-004	ETS	04/26/13	04/26/15
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	05/02/13	05/02/15
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	02/28/14	02/28/16
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	07/31/13	07/31/14
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/14	03/17/15
8816	2.4GHz to 2.5GHz Band Notch Filter	BRM50702	133	Micro-Tronics	Verified by 1049	
1016	Pre-amplifier	PAM-0202	187	PAM	10/08/13	10/08/14
Miscellaneous						
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	01/30/14	01/30/15
	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 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	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	2.41
				Coverage Factor (k):	2
				Expanded Uncertainty:	4.82

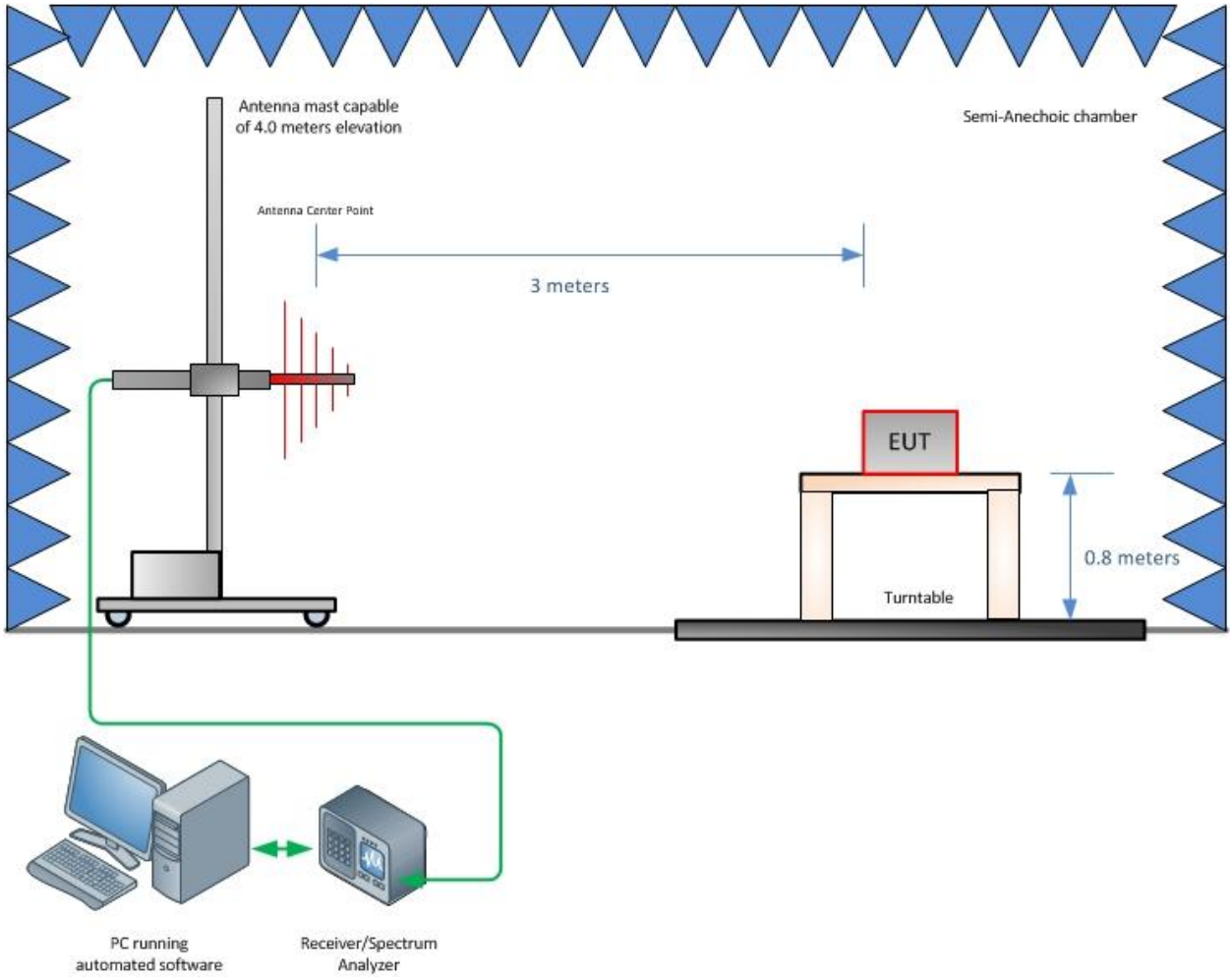
3.2.2 Radiated Emission Measurements (Above 1GHz)

	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	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	2.40
				Coverage Factor (k):	2
				Expanded Uncertainty:	4.81

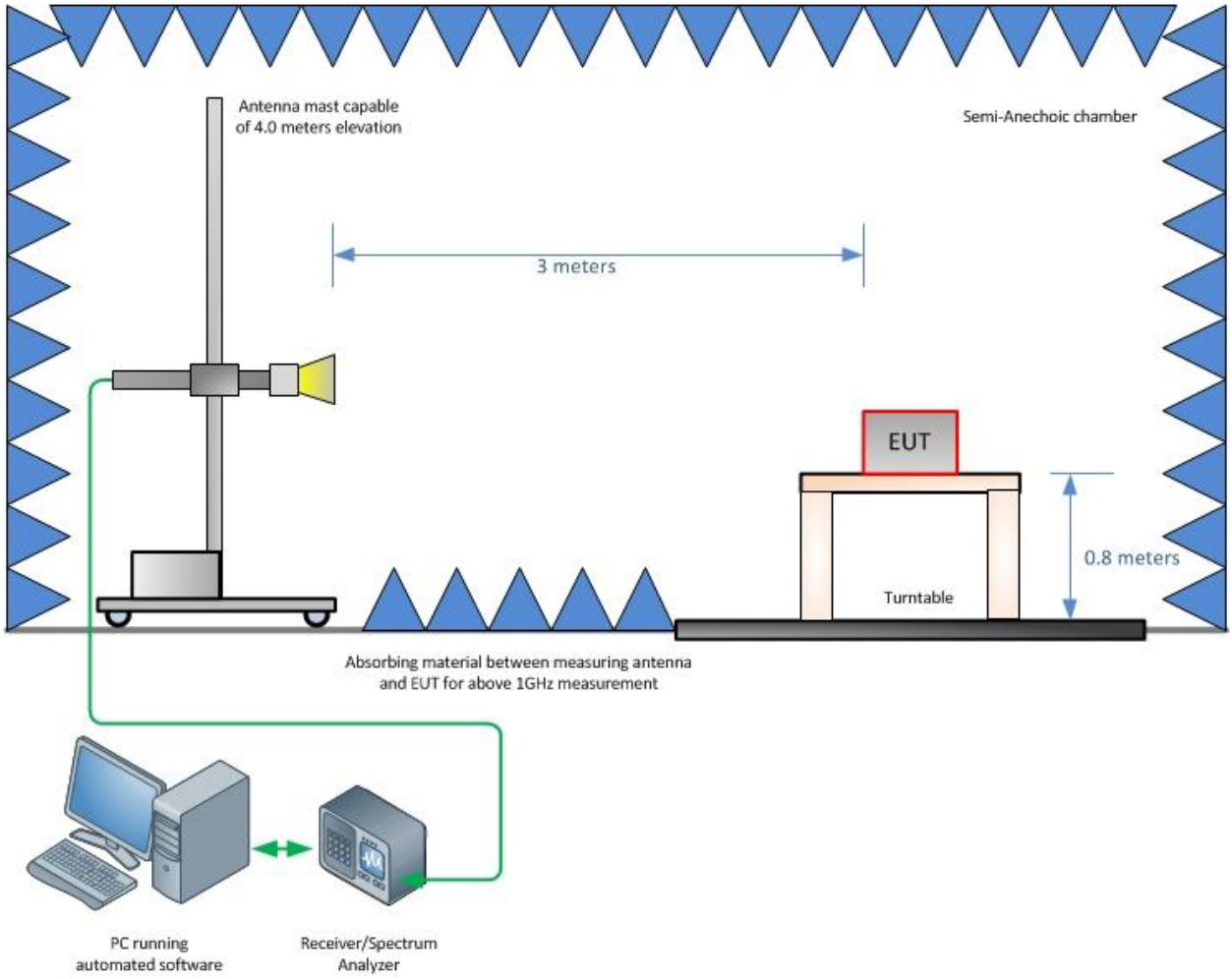
SECTION 4

DIAGRAM OF TEST SETUP

4.1 RADIATED EMISSION TEST SETUP (BELOW 1GHz)



4.2 RADIATED EMISSION TEST SETUP (ABOVE 1GHz)



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

TÜV SÜD America, Inc. and its professional staff hold government
and professional organization certifications for
AAMI, ACIL, AEA, ANSI, IEEE, A2LA, NIST and VCCI.

A2LA Cert. No. 2955.13

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