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Report On

Radio Testing of the
TransCore

LMU TC LMU-2000B Realtime Operational Vehicle Reporting
System

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

Report No. SC1402927A

May 2014



America

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

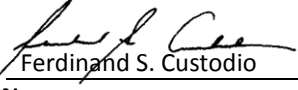
REPORT ON Radio Testing of the
TransCore
LMU TC Realtime Operational Vehicle Reporting System

TEST REPORT NUMBER SC1402927A

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DATED May 15, 2014



America

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Revision History

SC1402927A TransCore LMU TC Realtime Operational Vehicle Reporting System					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
05/15/2014	Initial Release				Ferdinand S. Custodio



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SECTION 1

REPORT SUMMARY

Radio Testing of the
TransCore
Realtime Operational Vehicle Reporting System



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the TransCore Realtime Operational Vehicle Reporting System 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	TransCore
Model Name	LMU TC
Model Number(s)	LMU-2000B
FCC ID Number	FIH-2000B
IC Number	1584A-2000B
Serial Number(s)	N/A (Individual sample marked CH1, CH2 and CH4), 4731002494 (Normal Duty Cycle Sample) and 4731006908 (Receive Sample)
Number of Samples Tested	3
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	March 24, 2014
Finish of Test	March 28, 2014
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 §15.249 with cross-reference to the corresponding IC RSS standard is shown below.

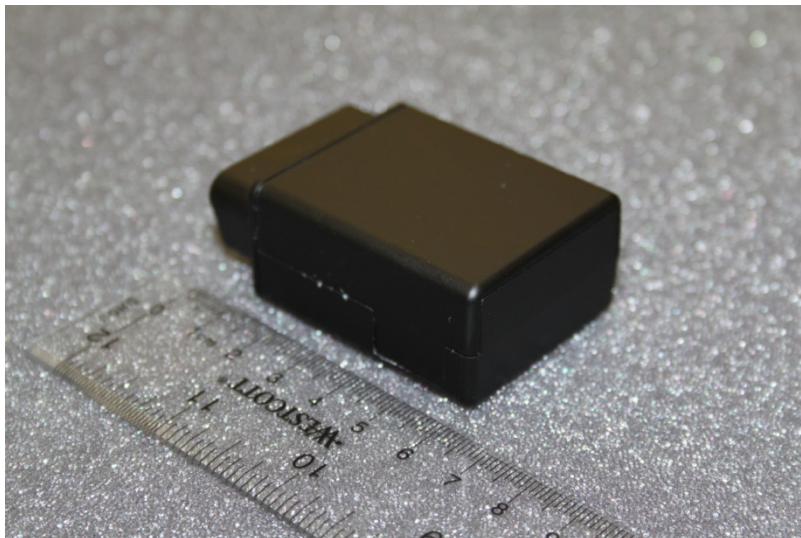
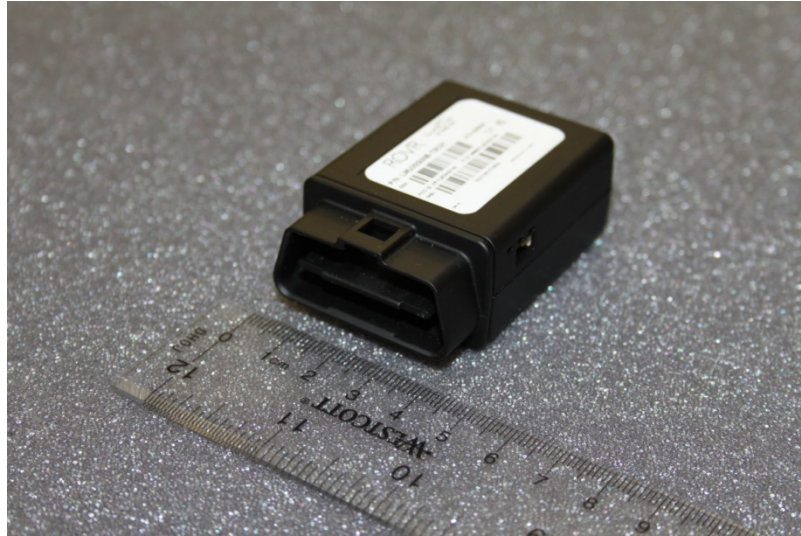
Section	Spec Clause	RSS	Test Description	Result	Comments/Base Standard
2.1	§15.207(a)	RSS-Gen 7.2.4	Conducted Emissions	N/A	
2.2	§15.215(c)	RSS-Gen 4.6.3	20 dB Bandwidth	Compliant	
2.3		RSS-Gen 4.6.1	99% Emission Bandwidth	Compliant	
2.4	§15.249(a)	RSS-210 A2.9(a)	Field Strength Limits for Fundamental and Harmonics	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	

N/A Not applicable, EUT is battery powered designed for vehicular use only.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a TransCore Realtime Operational Vehicle Reporting System as shown in the photograph below. The EUT is a device that provides GPS tracking and fleet management with realtime analysis of driving behaviour.



Equipment Under Test

1.3.2 EUT General Description

EUT Description	Realtime Operational Vehicle Reporting System
Model Name	LMU TC
Model Number(s)	LMU-2000B
Rated Voltage	12VDC (Vehicle Systems)
Output Power	94.0 dBμV/m @ 3 meters
Frequency Range	2452MHz to 2482 MHz in the 2400 MHz to 2483.5 MHz Band
Number of Operating Frequencies	4
Modulation	GFSK
Channels Verified	Low Channel 2452MHz Mid Channel 2470MHz High Channel 2482MHz
Antenna Type (used during evaluation)	Integral (Complies with Part 15.203 requirements)

1.3.3 Antenna Details

Model	Savvi™ Part No. M830310
Manufacturer	ethertronics®
Antenna Type	Embedded Bluetooth Ceramic Antenna
Antenna Peak Gain	1.39 dBi (2.4 – 2.5 GHz)
EUT Antenna Connector	N/A (surface mount).
Maximum Dimensions	8.0 x 3.0 x 1.3mm

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configurations	Description
Default	Radiated only configuration. EUT is pre-programmed to transmit at Low, Mid and High channels continuously set to max. power (modulated).

1.4.2 EUT Exercise Software

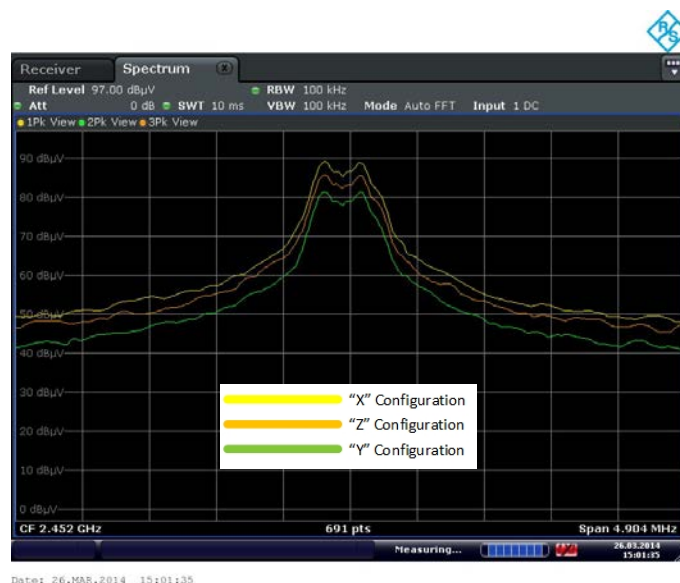
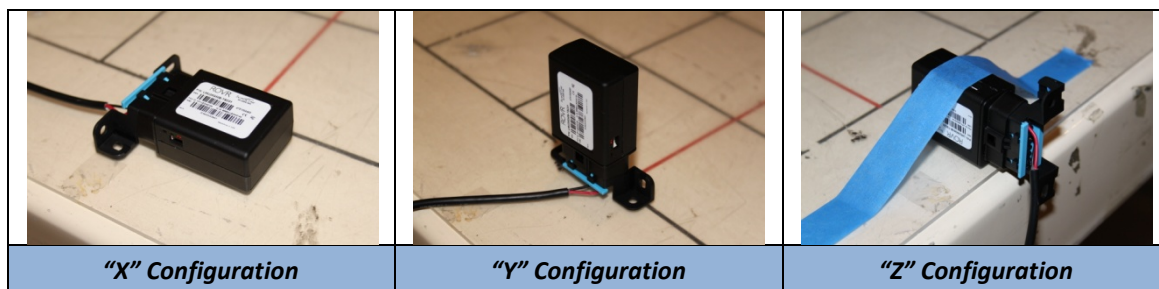
EUT is loaded with a test firmware allowing continuous transmission (test mode) at test frequencies.

1.4.3 Support Equipment and I/O cables

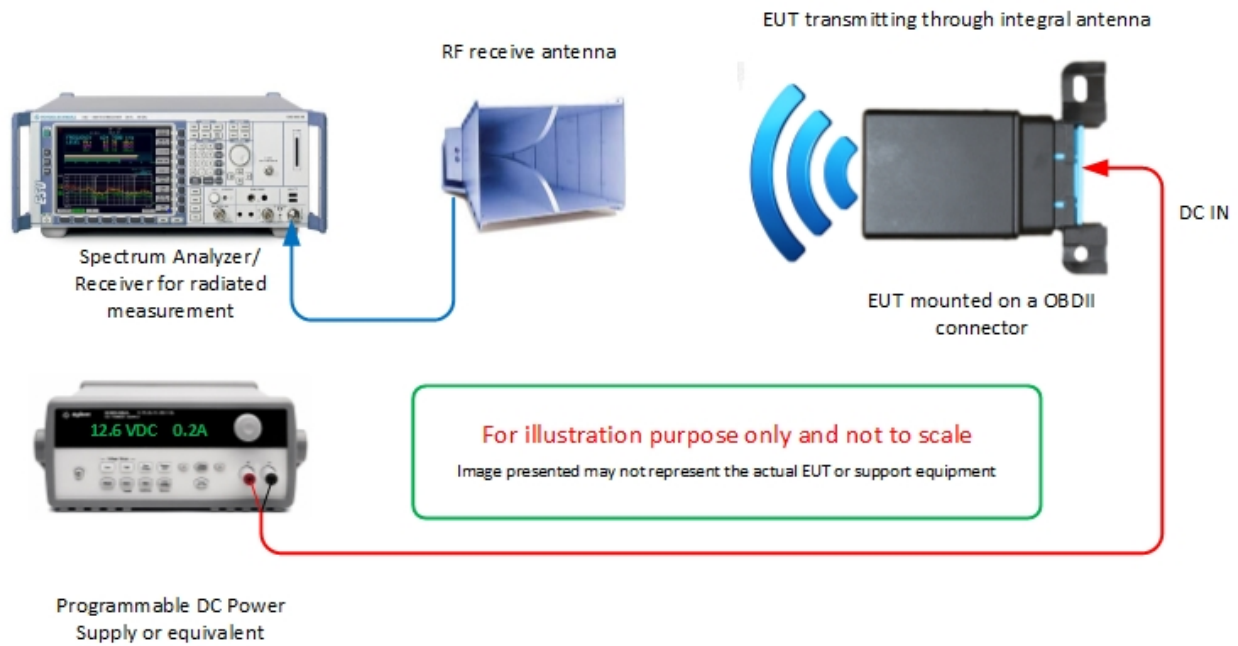
Manufacturer	Equipment/Cable	Description
Miteq	+15VDC Power Supply	P/N PS15V1 S/N 1374362
GM	Wiring Harness Connector	OBD2 OBDII ALDL (0.7m power cable only)

1.4.4 Worst Case Configuration

For radiated measurements X, Y and Z orientations were verified. Official measurements were performed using X orientation (worst case).



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 N/A (Individual sample marked CH1, CH2 and CH4)		
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.



SECTION 2

TEST DETAILS

Radio Testing of the
TransCore
Realtime Operational Vehicle Reporting System

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 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.*

2.1.3 Equipment Under Test and Modification State

Not performed. EUT is battery operated only and designed for vehicular use.



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: N/A (Individual sample marked CH1, CH2 and CH4) / Default Test Configuration

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

March 28, 2014/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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	21.7°C
Relative Humidity	42.7%
ATM Pressure	99.6 kPa

2.2.7 Additional Observations

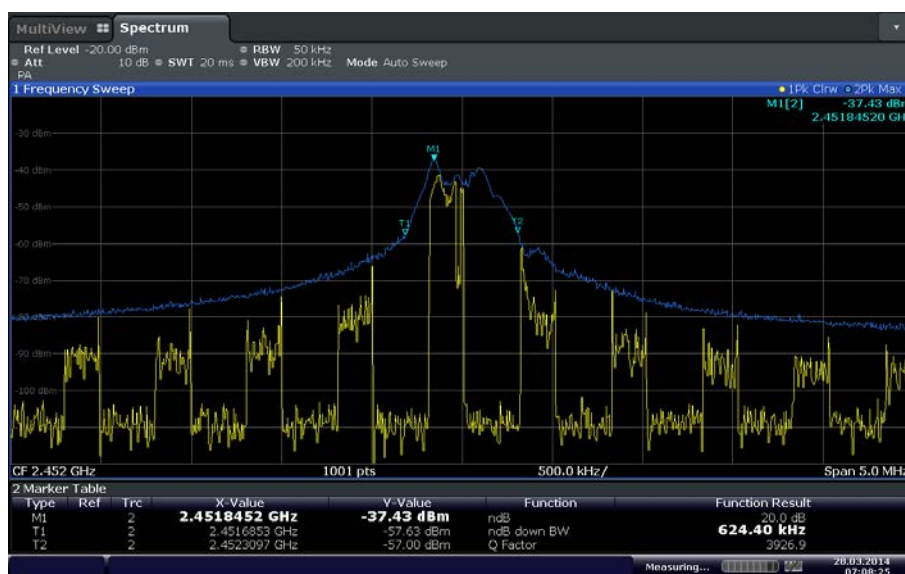
- This is a radiated test.
- "n dB down" marker function of the Spectrum Analyzer used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span, VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- Trace is max hold.

2.2.8 Test Results

Low Channel (2452 MHz)	Mid Channel (2472MHz)	High Channel (2482MHz)
624.40 kHz	629.40 kHz	584.40 kHz

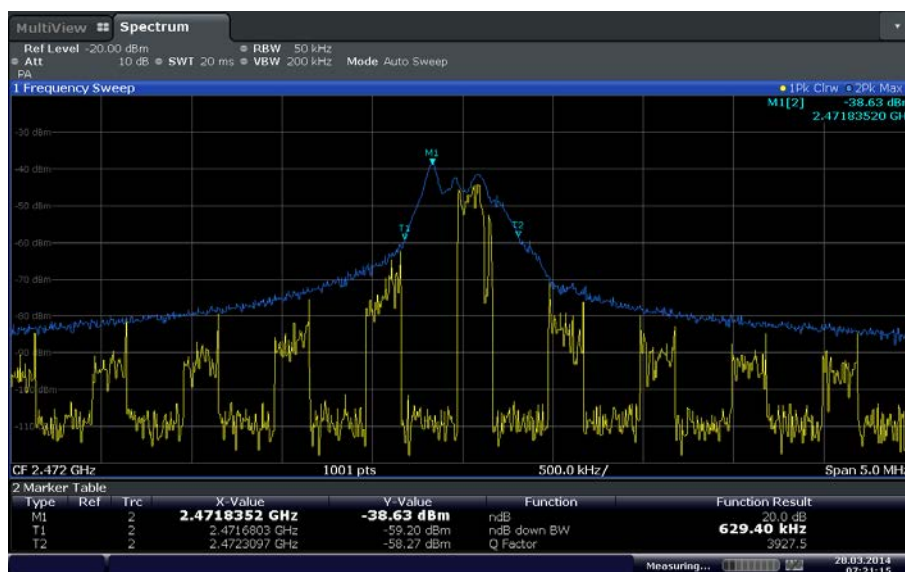
2452.00 MHz – (20dB BW/2) = 2451.6853MHz (within the frequency band - **Compliant**)

2482.00MHz + (20dB BW/2) = 2482.3147MHz (within the frequency band - **Compliant**)



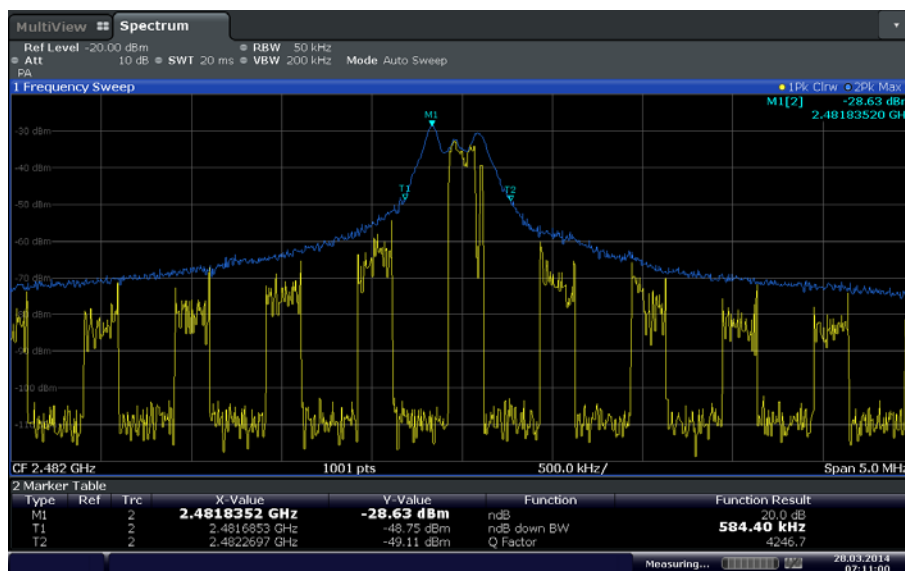
Date: 28 MAR 2014 07:08:25

Low Channel



Date: 28 MAR 2014 07:21:15

Mid Channel



Date: 28 MAR 2014 07:11:00

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: N/A (Individual sample marked CH1, CH2 and CH4) / Default Test Configuration

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

March 28, 2014/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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	21.7°C
Relative Humidity	42.7%
ATM Pressure	99.6 kPa

2.3.7 Additional Observations

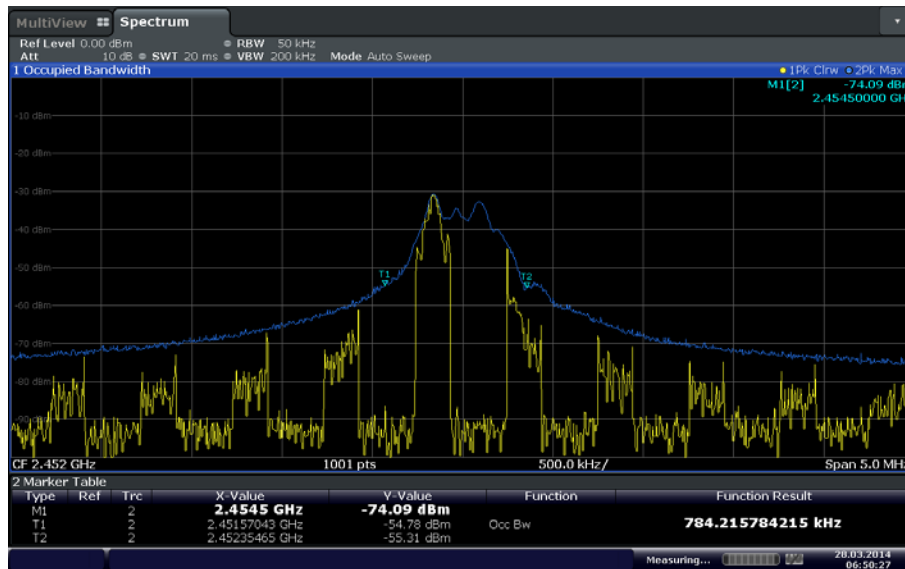
- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.

- 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

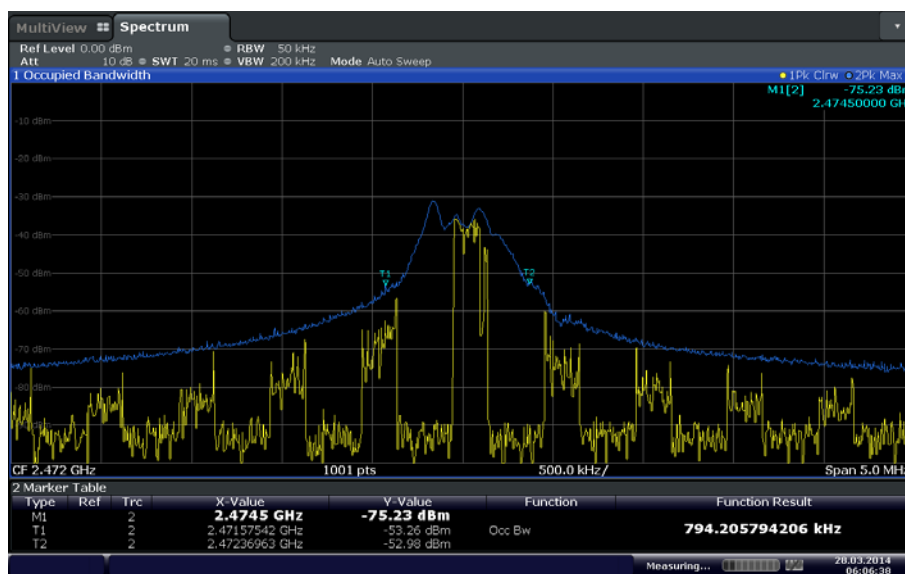
Low Channel (2452 MHz)	Mid Channel (2472MHz)	High Channel (2482MHz)
784.21 kHz	794.20 kHz	749.25 kHz

2.3.9 Test Plots



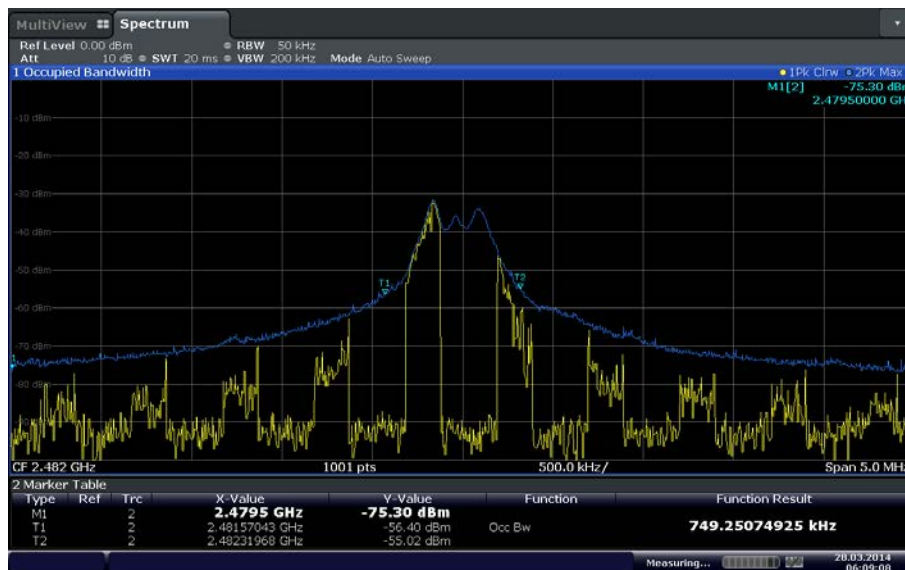
Date: 28 MAR 2014 06:50:27

Low Channel



Date: 28 MAR 2014 06:06:37

Mid Channel



Date: 28 MAR 2014 06:09:08

High Channel

2.4 FIELD STRENGTH LIMITS FOR FUNDAMENTAL AND HARMONICS

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: N/A (Individual sample marked CH1, CH2 and CH4) and 4731002494 (Normal Duty Cycle Sample)/ Default Test Configuration

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

March 27 and 28, 2014/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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	20.9-22.4°C
Relative Humidity	44.3-47.4%
ATM Pressure	99.3-99.6 kPa

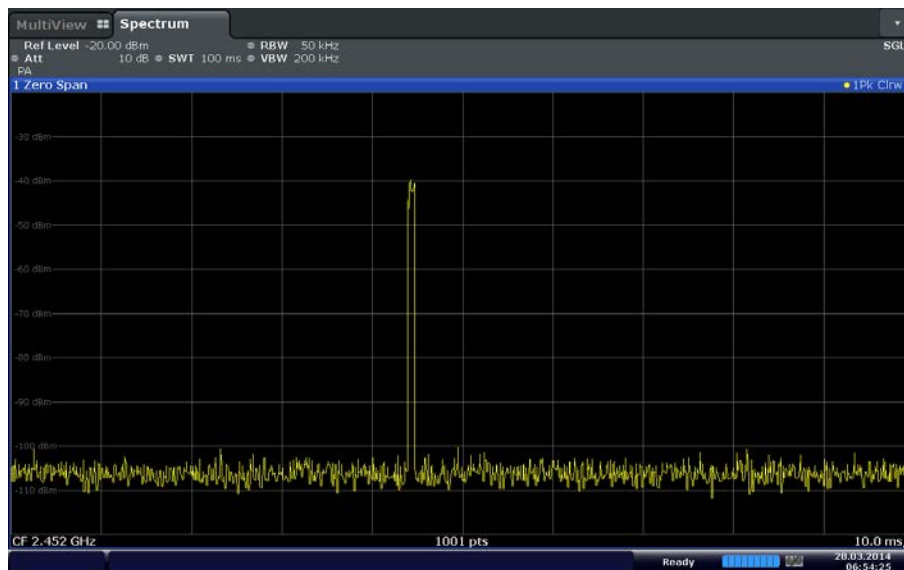
2.4.7 Additional Observations

- This is a radiated test. The spectrum was searched from 1GHz to the 10th harmonic (25GHz).
- There are no emissions observed above 18GHz.
- When calculating Duty Cycle, the EUT was configured to normal operation (actual duty cycle vs. 50% duty cycle when in test mode).
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.4.8 for sample computation.

2.4.8 Sample Computation (Radiated Emission)

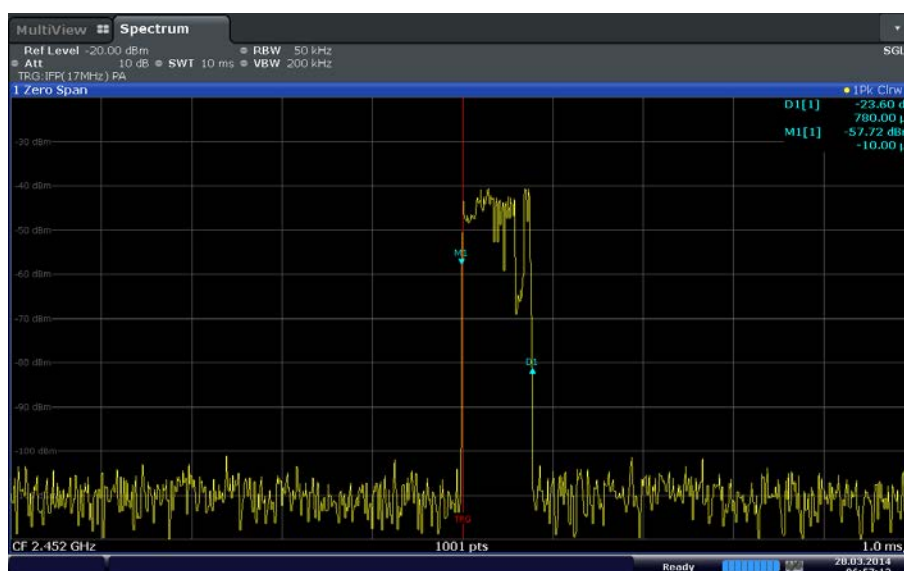
Measuring equipment raw measurement (dB μ V) @ 2400 MHz			58.4
Correction Factor (dB)	Asset# 1153 (cable)	3.3	-4.8
	Asset# 8628 (preamplifier)	-36.4	
	Asset# 7575 (antenna)	28.3	
Reported Peak Final Measurement (dBμV/m) @ 2400 MHz			53.6

2.4.9 Duty Cycle Correction Factor Calculation



Date: 28 MAR 2014 06:54:26

100ms sweep (representative channel)



Date: 28 MAR 2014 06:57:13

10ms sweep (representative channel)



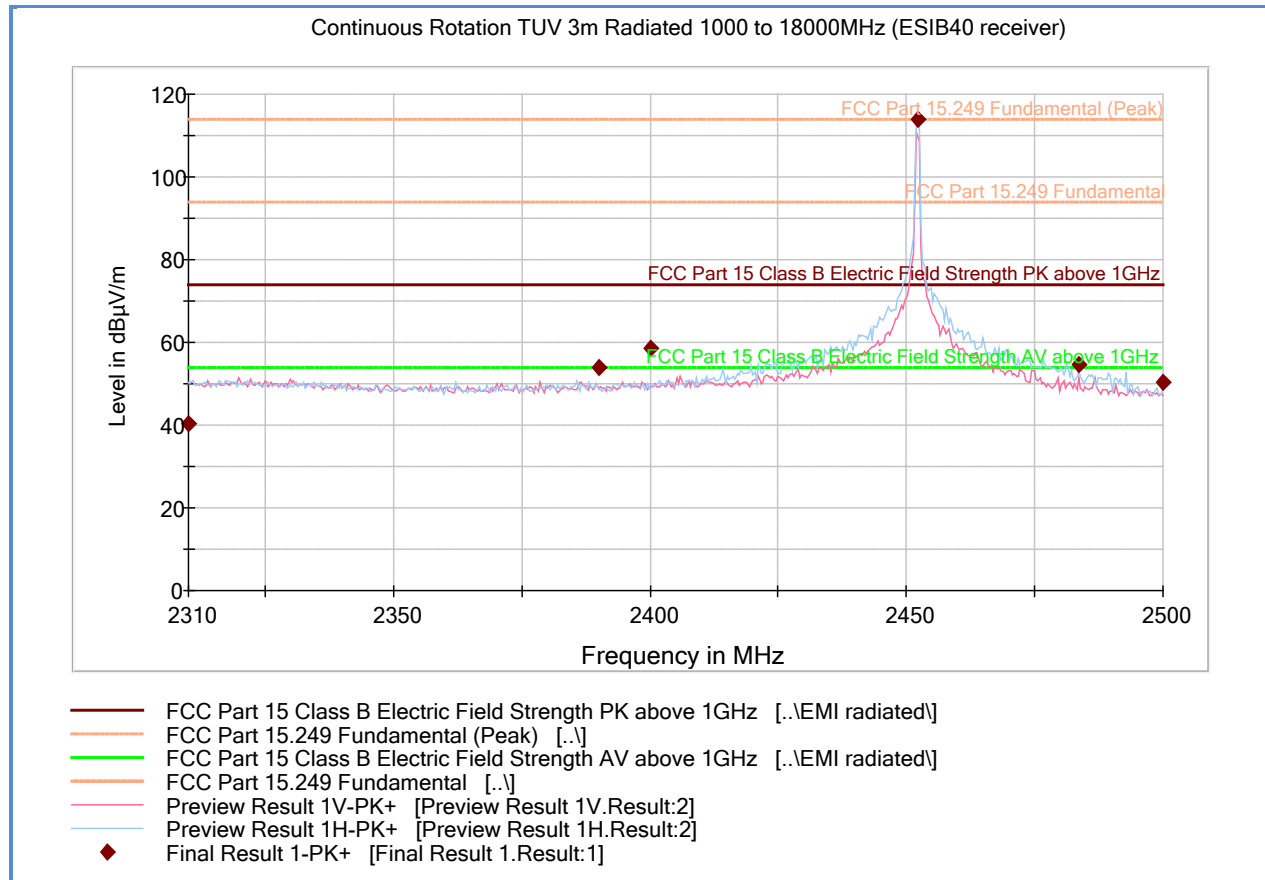
Duty Cycle Calculation: = 0.780 ms "On" time per 100 ms sweep
Duty Cycle Correction Factor = $20 \log(0.0078)$
= **-42.16 (Limited to -20dB)**

Sample Calculation for Low Channel (114.0dB μ V/m Peak @ 3 meters):
= 114.0dB μ V/m – 20dB
= 94.0 dB μ V/m Average @ 3 meters

2.4.10 Test Results

See attached plots and tables.

2.4.11 Test Results for Low Channel (Fundamental, Band Edges and Immediate Restricted Bands)



Peak Data

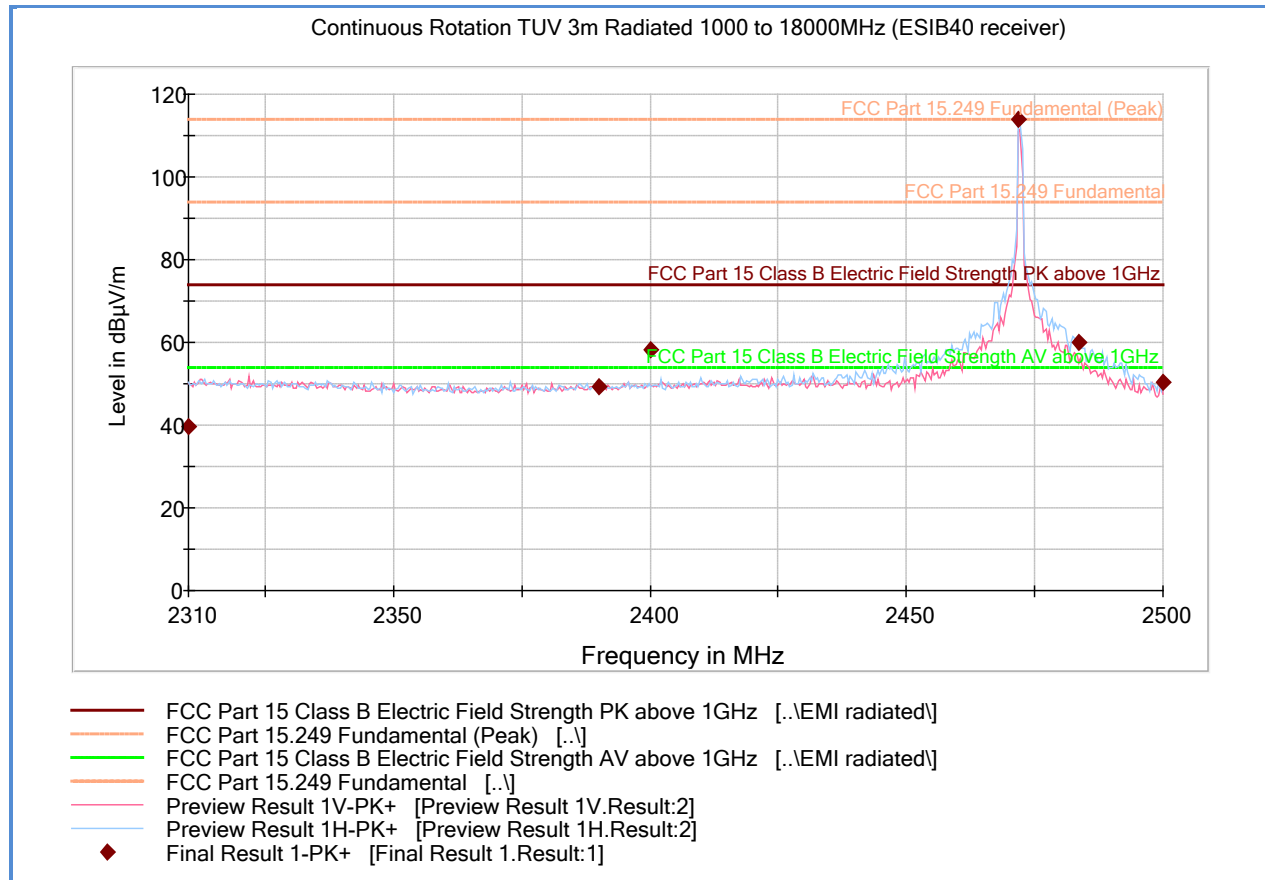
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2310.00000	40.5	1000.0	1000.000	151.5	V	28.0	-2.1	33.4	73.9
2390.00000	54.1	1000.0	1000.000	384.1	H	-16.0	2.4	19.8	73.9
2400.00000	58.6	1000.0	1000.000	195.4	V	301.0	2.4	15.3	73.9
2452.12404	114.0	1000.0	1000.000	115.6	H	169.0	-2.0	0.0	114.0
2483.50000	54.8	1000.0	1000.000	99.6	H	6.0	2.4	19.1	73.9
2500.00000	50.4	1000.0	1000.000	410.7	H	300.0	2.4	23.5	73.9

Average Data

Frequency (MHz)	MaxPeak (dBμV/m)	DCCF (dB)	Calculated Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2310.000000	40.5	-20	20.5	53.9	33.4
2390.000000	54.1	-20	34.1	53.9	19.8
2400.000000	58.6	-20	38.6	53.9	15.3
2452.124048	114.0	-20	94	94.0	0.0
2483.500000	54.8	-20	34.8	53.9	19.1
2500.000000	50.4	-20	30.4	53.9	23.5

Test Notes: All spurious emissions complies with the general requirement of 15.209

2.4.12 Test Results for MidChannel (Fundamental, Band Edges and Immediate Restricted Bands)



Peak Data

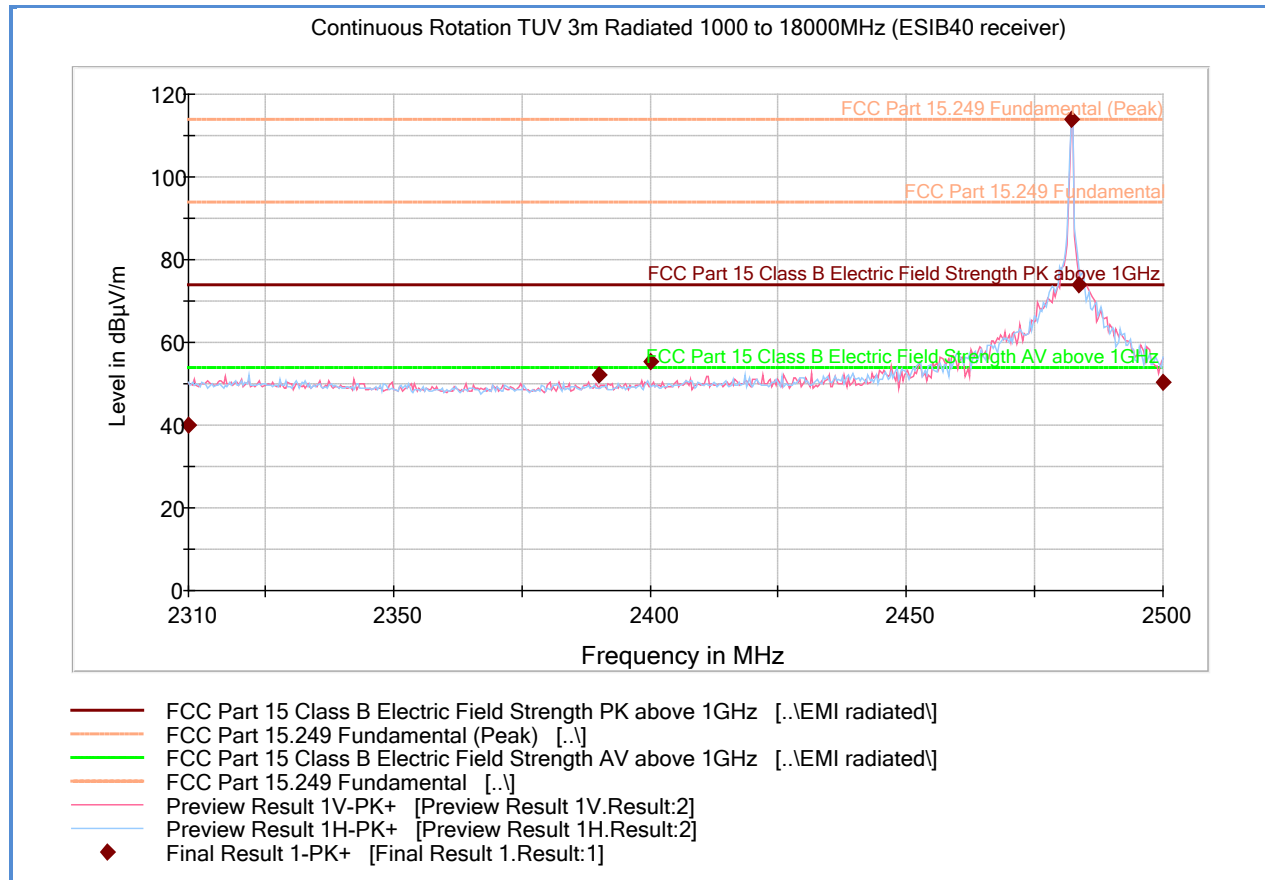
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2310.00000	39.7	1000.0	1000.000	151.3	H	102.0	-2.1	34.2	73.9
2390.00000	49.5	1000.0	1000.000	406.7	V	17.0	-2.0	24.4	73.9
2400.00000	58.2	1000.0	1000.000	225.4	V	308.0	-1.9	15.7	73.9
2471.92364	114.0	1000.0	1000.000	114.6	H	173.0	-2.0	0.0	114.0
2483.50000	60.2	1000.0	1000.000	99.6	H	6.0	2.4	13.7	73.9
2500.00000	50.4	1000.0	1000.000	410.7	H	300.0	2.4	23.5	73.9

Average Data

Frequency (MHz)	MaxPeak (dBµV/m)	DCCF (dB)	Calculated Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2310.000000	39.7	-20	19.7	53.9	34.2
2390.000000	49.5	-20	29.5	53.9	24.4
2400.000000	58.2	-20	38.2	53.9	15.7
2471.923647	114.0	-20	94	94.0	0.0
2483.500000	60.2	-20	40.2	53.9	13.7
2500.000000	50.4	-20	30.4	53.9	23.5

Test Notes: All spurious emissions complies with the general requirement of 15.209

2.4.13 Test Results for High Channel (Fundamental, Band Edges and Immediate Restricted Bands)



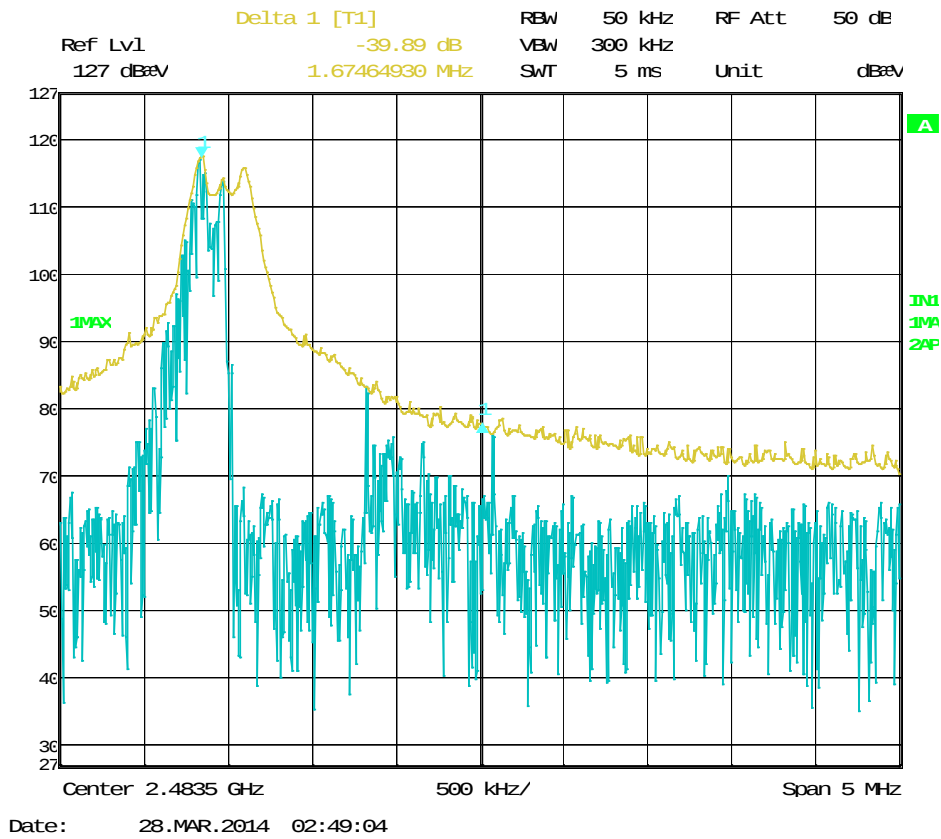
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2310.00000	40.0	1000.0	1000.000	406.7	V	245.0	-2.1	33.9	73.9
2390.00000	52.1	1000.0	1000.000	292.2	V	188.0	-2.0	21.8	73.9
2400.00000	55.2	1000.0	1000.000	384.1	V	162.0	-1.9	18.7	73.9
2482.12725	113.8	1000.0	1000.000	114.6	H	172.0	-2.0	0.2	114.0
2483.50000	73.9	1000.0	1000.000	99.6	H	6.0	2.4	0.4	73.9
2500.00000	50.4	1000.0	1000.000	410.7	H	300.0	2.4	23.5	73.9

Average Data

Frequency (MHz)	MaxPeak (dBµV/m)	DCCF (dB)	Calculated Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2310.000000	40.0	-20	20	53.9	33.9
2390.000000	52.1	-20	32.1	53.9	21.8
2400.000000	55.2	-20	35.2	53.9	18.7
2482.127255	113.8	-20	93.8	94.0	0.2
2483.500000	73.9	-20	53.9	53.9	0.4
2500.000000	50.4	-20	30.4	53.9	23.5

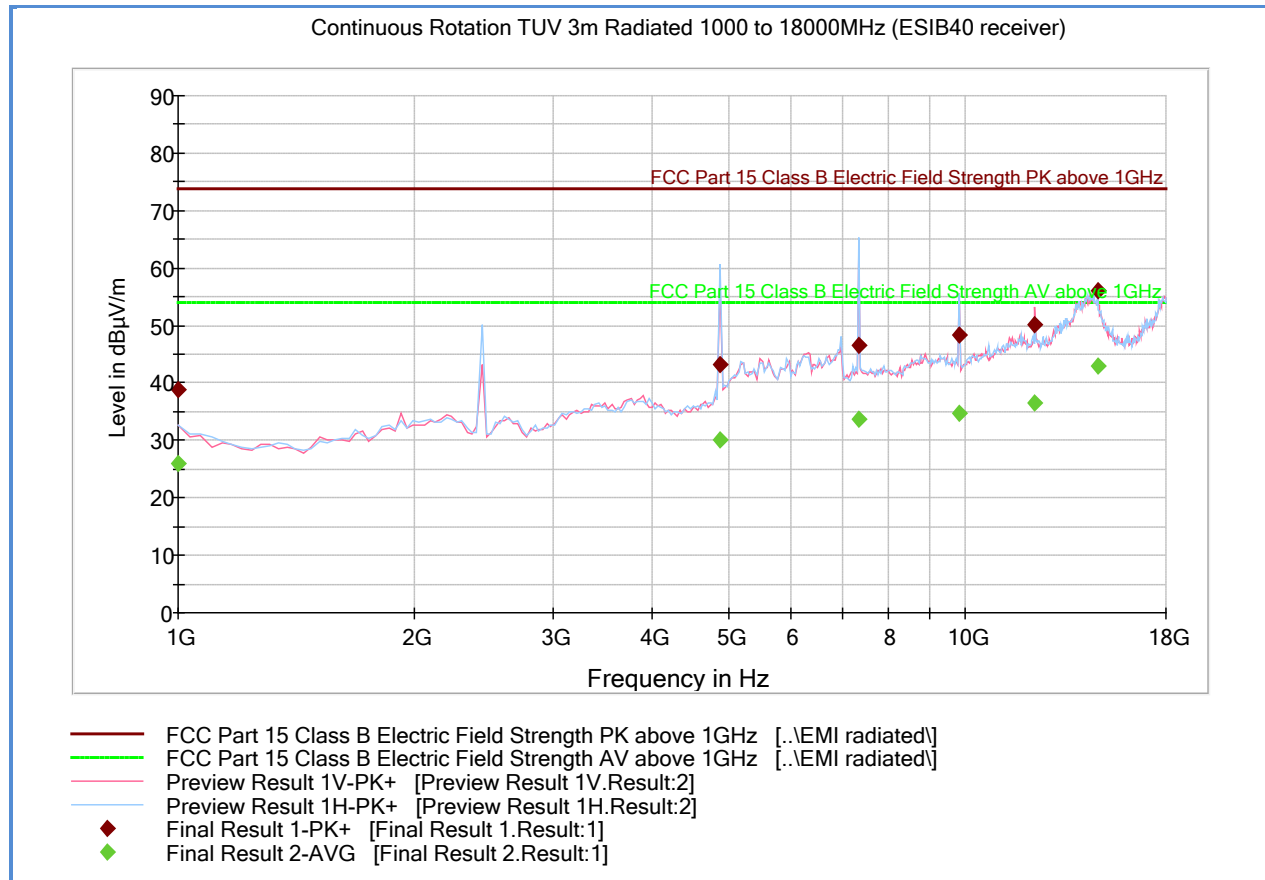
Test Notes: Upper band edge (2483.5MHz) verification was performed using Marker-Delta method (see following page for test plot). All other spurious emissions complies with the general requirement of 15.209



Delta-Marker Method (DMM) for Band Edge Measurement

Fundamental Frequency:	2482.0 MHz
Max Peak using recommended RBW:	113.8 dBμV/m
Measurement Frequency:	2483.5 MHz
Delta using recommended DMM settings:	39.89 dB
Calculated Upper Band Edge using DMM:	113.8 dBμV/m - 39.89 dB
	73.91 dBμV/m (Peak)

2.4.14 Test Results Above 1GHz (Low Channel)



Peak Data

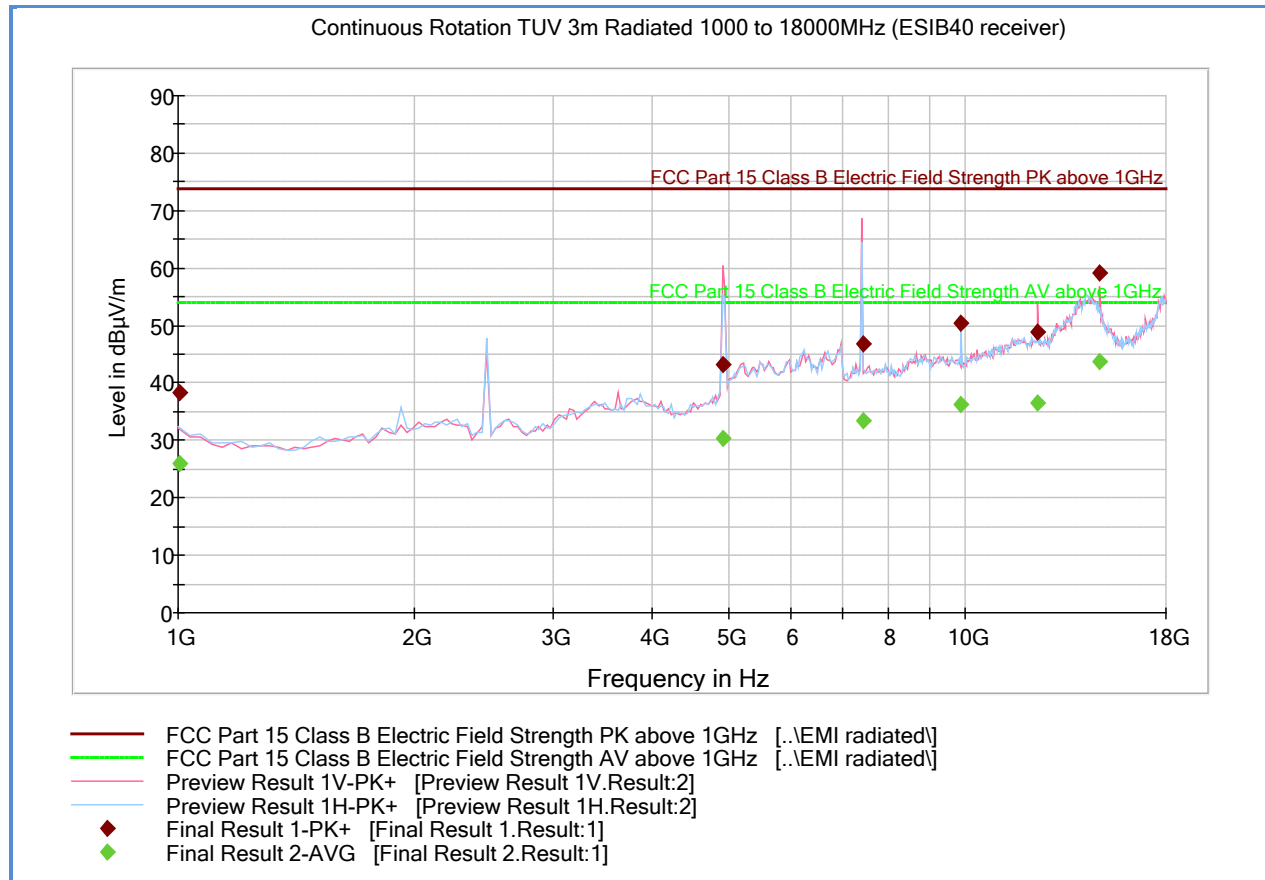
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1001.90000	38.8	1000.0	1000.000	328.1	V	-20.0	-5.5	35.1	73.9
4887.86753	43.1	1000.0	1000.000	167.5	H	49.0	4.5	30.8	73.9
7332.37334	46.5	1000.0	1000.000	176.5	H	182.0	9.2	27.4	73.9
9821.34729	48.4	1000.0	1000.000	373.0	H	182.0	11.3	25.5	73.9
12275.0531	50.0	1000.0	1000.000	176.5	V	332.0	14.3	23.9	73.9
14726.3589	56.2	1000.0	1000.000	141.5	H	142.0	20.7	17.7	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1001.90000	26.0	1000.0	1000.000	328.1	V	-20.0	-5.5	27.9	53.9
4887.86753	30.1	1000.0	1000.000	167.5	H	49.0	4.5	23.8	53.9
7332.37334	33.6	1000.0	1000.000	176.5	H	182.0	9.2	20.3	53.9
9821.34729	34.7	1000.0	1000.000	373.0	H	182.0	11.3	19.2	53.9
12275.0531	36.5	1000.0	1000.000	176.5	V	332.0	14.3	17.4	53.9
14726.3589	42.9	1000.0	1000.000	141.5	H	142.0	20.7	11.0	53.9

Test Notes: Duty Cycle Correction Factor (DCCF) not applied for this test since both Peak and Average already complies with the general limit of 15.209. Average levels were measured using Average detector @ 50% test duty cycle. A 2.4GHz notch filter was used for this test.

2.4.15 Test Results Above 1GHz (Mid Channel)



Peak Data

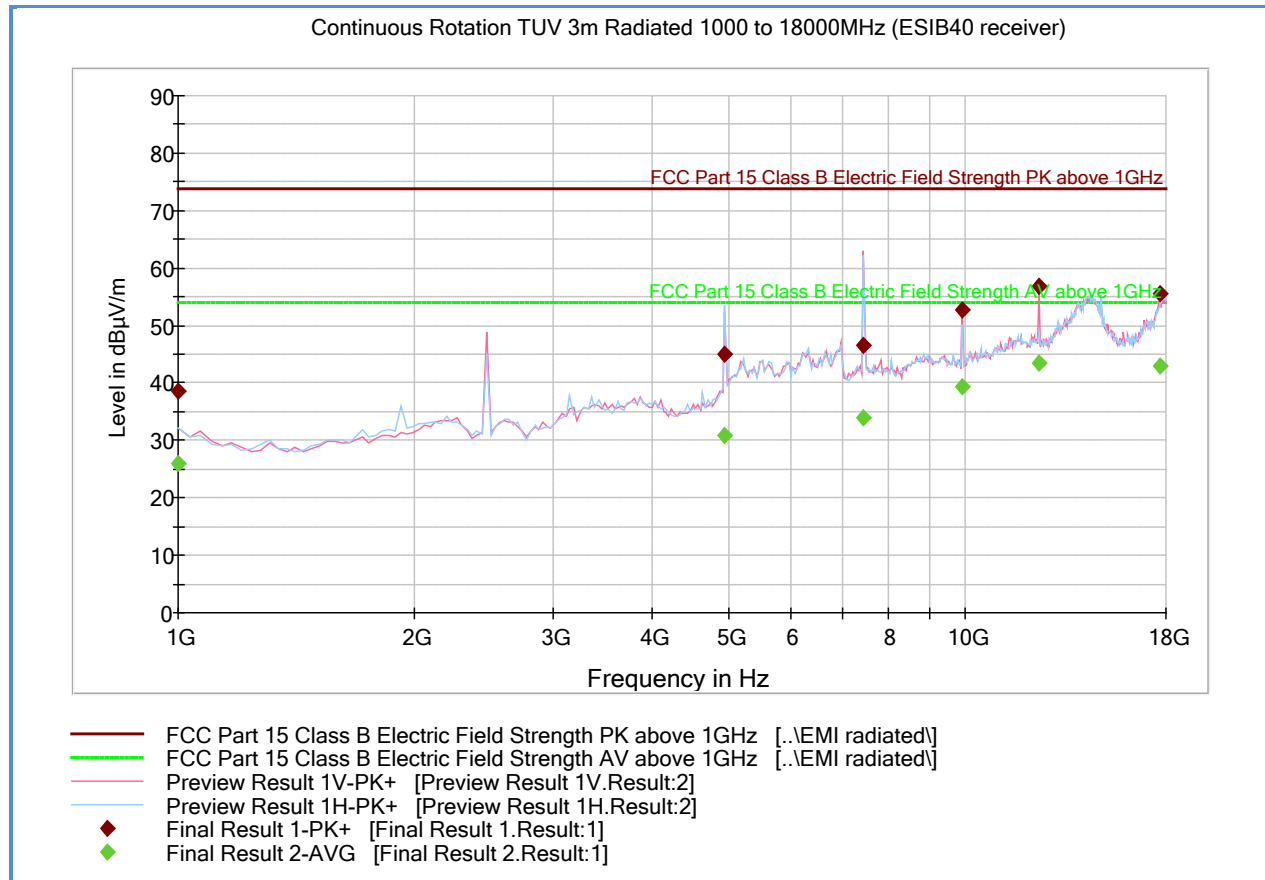
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1005.70000	38.3	1000.0	1000.000	123.6	H	321.0	-5.6	35.6	73.9
4920.33567	43.2	1000.0	1000.000	352.7	V	148.0	4.6	30.7	73.9
7411.30961	46.8	1000.0	1000.000	123.6	V	50.0	9.4	27.1	73.9
9888.28356	50.4	1000.0	1000.000	247.3	H	50.0	11.5	23.5	73.9
12373.2575	48.9	1000.0	1000.000	114.6	V	199.0	14.1	25.0	73.9
14831.7633	59.2	1000.0	1000.000	132.6	V	222.0	20.0	14.7	73.9

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1005.70000	26.0	1000.0	1000.000	123.6	H	321.0	-5.6	27.9	53.9
4920.33567	30.4	1000.0	1000.000	352.7	V	148.0	4.6	23.5	53.9
7411.30961	33.5	1000.0	1000.000	123.6	V	50.0	9.4	20.4	53.9
9888.28356	36.3	1000.0	1000.000	247.3	H	50.0	11.5	17.6	53.9
12373.2575	36.5	1000.0	1000.000	114.6	V	199.0	14.1	17.4	53.9
14831.7633	43.7	1000.0	1000.000	132.6	V	222.0	20.0	10.2	53.9

Test Notes: Duty Cycle Correction Factor (DCCF) not applied for this test since both Peak and Average already complies with the general limit of 15.209. Average levels were measured using Average detector @ 50% test duty cycle. A 2.4GHz notch filter was used for this test.

2.4.16 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)
1001.20000	38.5	1000.0	1000.000	252.3	V	158.0	-5.5	35.4	73.9
4952.20380	45.0	1000.0	1000.000	397.0	H	97.0	4.6	29.0	73.9
7432.97775	46.6	1000.0	1000.000	352.7	V	78.0	9.3	27.3	73.9
9927.15170	52.7	1000.0	1000.000	281.2	H	45.0	11.5	21.2	73.9
12409.3256	56.9	1000.0	1000.000	114.6	V	36.0	14.0	17.0	73.9
17728.7549	55.5	1000.0	1000.000	225.3	V	202.0	22.3	18.4	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)
1001.20000	25.9	1000.0	1000.000	252.3	V	158.0	-5.5	28.0	53.9
4952.20380	30.9	1000.0	1000.000	397.0	H	97.0	4.6	23.0	53.9
7432.97775	33.8	1000.0	1000.000	352.7	V	78.0	9.3	20.1	53.9
9927.15170	39.4	1000.0	1000.000	281.2	H	45.0	11.5	14.5	53.9
12409.3256	43.6	1000.0	1000.000	114.6	V	36.0	14.0	10.3	53.9
17728.7549	42.9	1000.0	1000.000	225.3	V	202.0	22.3	11.0	53.9

Test Notes: Duty Cycle Correction Factor (DCCF) not applied for this test since both Peak and Average already complies with the general limit of 15.209. Average levels were measured using Average detector @ 50% test duty cycle. A 2.4GHz notch filter was used for this test.



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: N/A (Individual sample marked CH1, CH2 and CH4) / Default Test Configuration

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

March 27, 2014/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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	20.9°C
Relative Humidity	44.3%
ATM Pressure	99.3 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 channel based from fundamental/harmonics verification ("X" axis configuration).
- Above 1GHz measurement results are identical to test results presented under Section 2.4.11 up to Section 2.4.16 of this test report. No other significant spurious emissions observed other than harmonics of the fundamental frequency.
- 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.



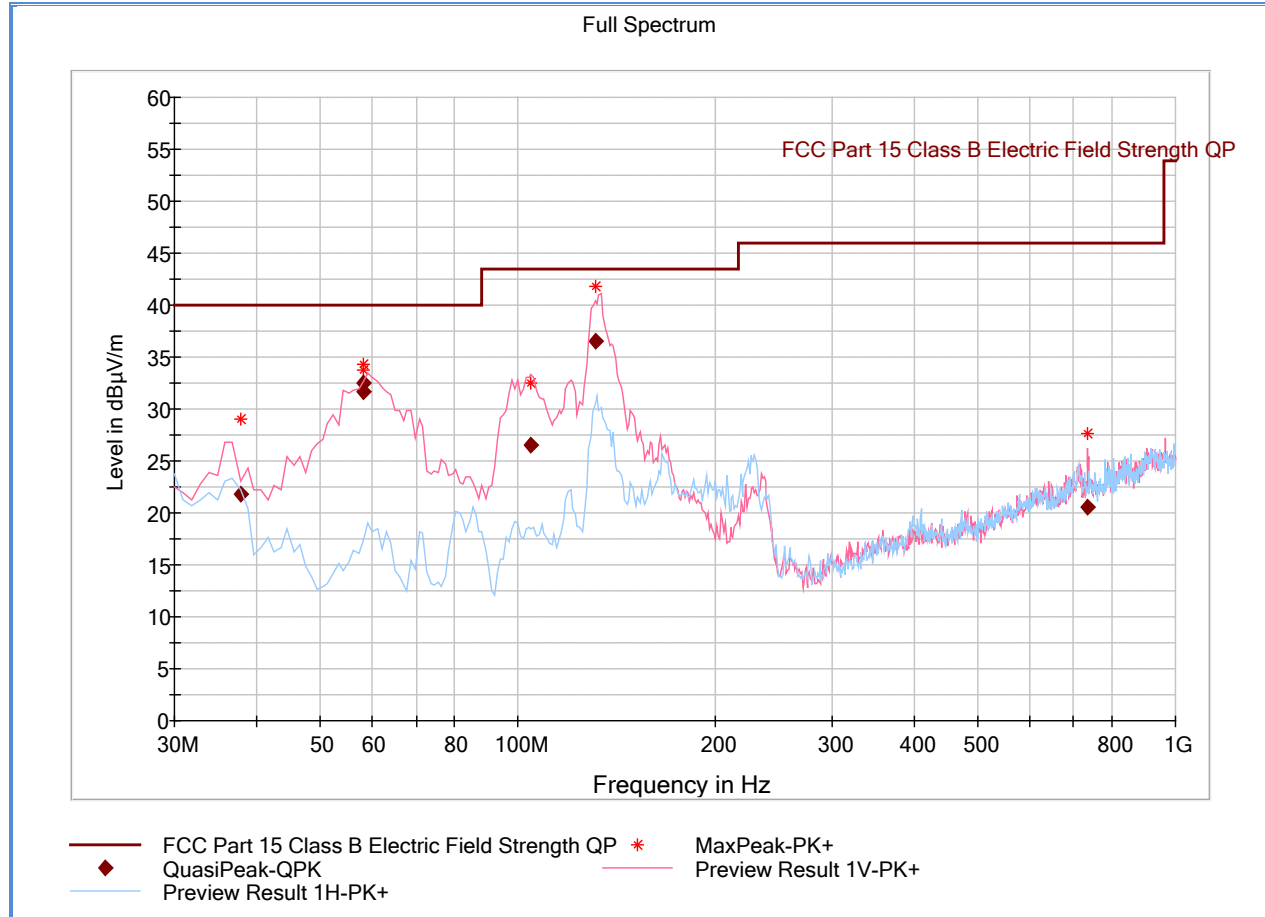
2.5.1 Sample Computation (Radiated Emission)

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

2.5.2 Test Results

See attached plots.

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



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.920000	21.86	40.00	18.14	1000.0	120.000	102.6	V	52.0	-15.2
58.130000	31.71	40.00	8.29	1000.0	120.000	140.5	V	78.0	-20.8
58.140000	32.50	40.00	7.50	1000.0	120.000	150.0	V	174.0	-20.8
104.510000	26.51	43.50	16.99	1000.0	120.000	103.6	V	148.0	-19.6
131.390000	36.58	43.50	6.92	1000.0	120.000	104.2	V	44.0	-20.4
735.790000	20.49	46.00	25.51	1000.0	120.000	107.0	V	106.0	-1.4

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: 4731006908 (Receive Sample) / Default Test Configuration

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

March 27, 2014/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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	20.9°C
Relative Humidity	44.3%
ATM Pressure	99.3 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.

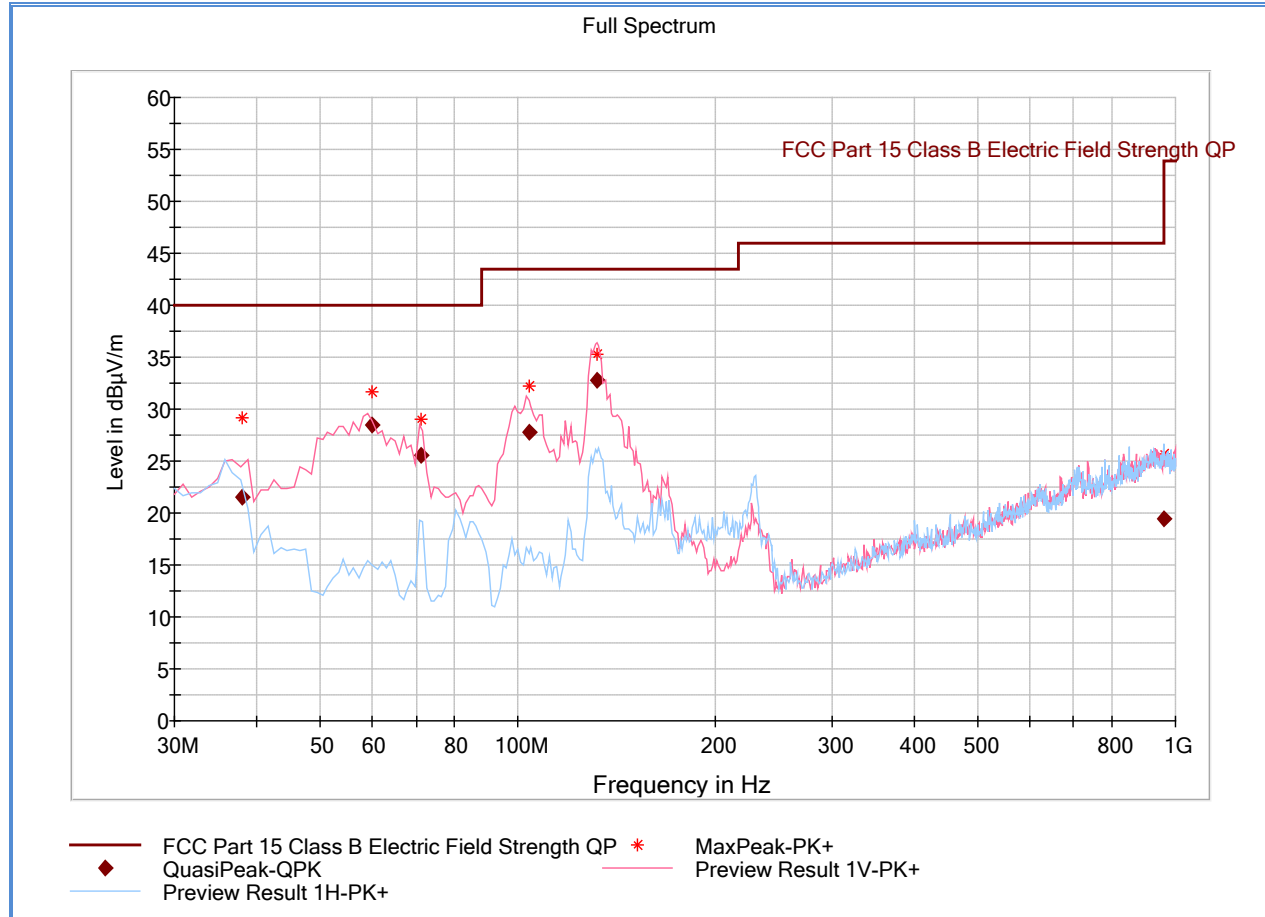


- Limit used is from FCC §15.209 which is identical to RSS-Gen limits.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.6.8 for sample computation.

2.6.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 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 (db μ V/m) @ 2400 MHz			53.6

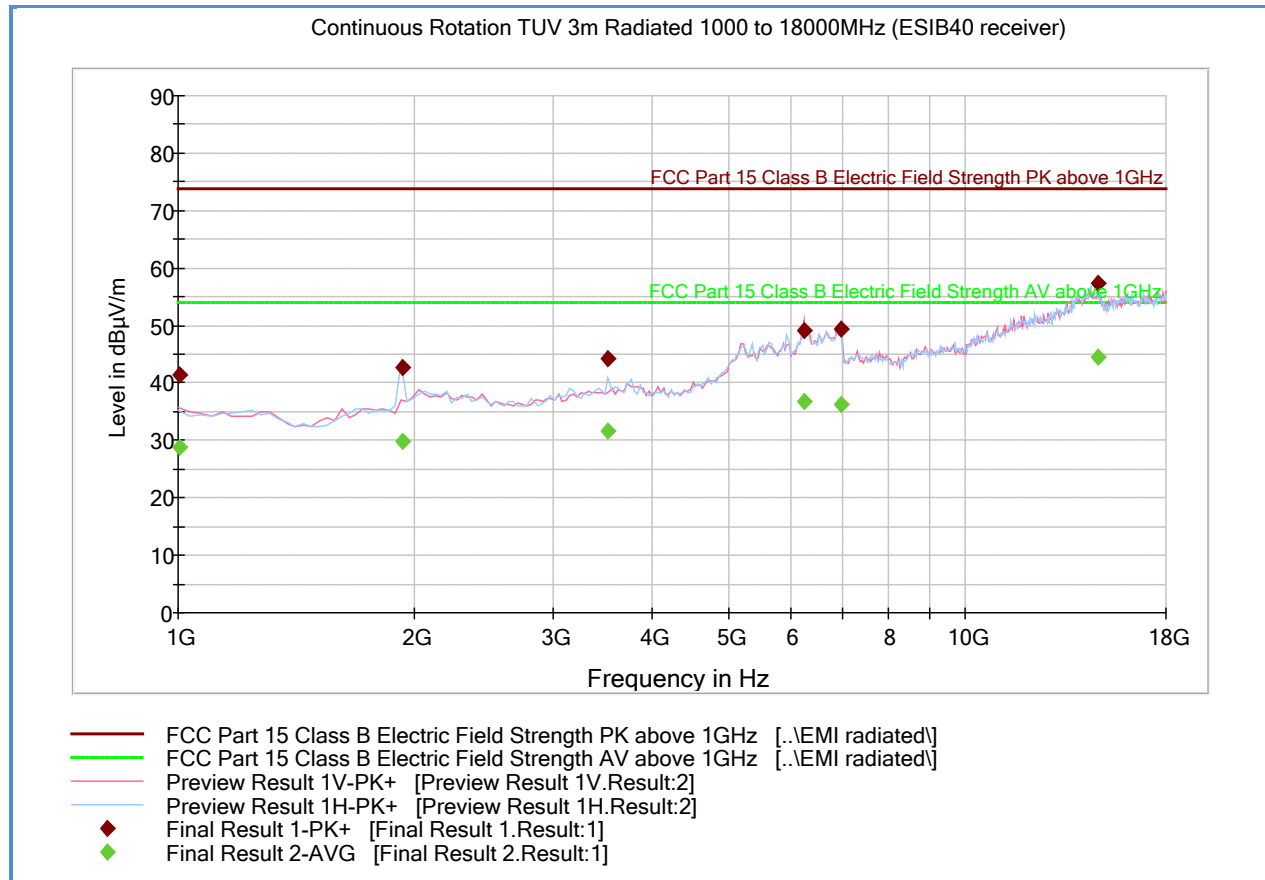
2.6.9 Test Results Below 1GHz (Receive Mode)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
38.080000	21.53	40.00	18.47	1000.0	120.000	105.5	V	146.0	-15.3
59.880000	28.42	40.00	11.58	1000.0	120.000	140.5	V	106.0	-21.0
71.280000	25.62	40.00	14.38	1000.0	120.000	102.6	V	37.0	-22.1
103.980000	27.76	43.50	15.74	1000.0	120.000	150.0	V	171.0	-19.5
131.760000	32.84	43.50	10.66	1000.0	120.000	109.4	V	170.0	-20.5
959.250000	19.41	46.00	26.59	1000.0	120.000	396.4	H	223.0	2.1

2.6.10 Test Results Above 1GHz (Receive Mode)



Peak Data

Frequency (MHz)	MaxPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1005.70000	41.4	1000.0	1000.000	406.7	V	222.0	-1.1	32.5	73.9
1924.33967	42.7	1000.0	1000.000	132.6	H	182.0	1.8	31.2	73.9
3516.74208	44.2	1000.0	1000.000	99.6	H	3.0	5.2	29.7	73.9
6243.39298	49.1	1000.0	1000.000	351.7	V	275.0	10.3	24.8	73.9
6963.62384	49.5	1000.0	1000.000	176.5	H	343.0	10.4	24.4	73.9
14733.1589	57.4	1000.0	1000.000	123.6	V	128.0	22.4	16.5	73.9

Average Data

Frequency (MHz)	Average (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1005.70000	28.7	1000.0	1000.000	406.7	V	222.0	-1.1	25.2	53.9
1924.33967	29.7	1000.0	1000.000	132.6	H	182.0	1.8	24.2	53.9
3516.74208	31.7	1000.0	1000.000	99.6	H	3.0	5.2	22.2	53.9
6243.39298	36.6	1000.0	1000.000	351.7	V	275.0	10.3	17.3	53.9
6963.62384	36.4	1000.0	1000.000	176.5	H	343.0	10.4	17.5	53.9
14733.1589	44.6	1000.0	1000.000	123.6	V	128.0	22.4	9.3	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 Emissions						
1033	Bilog Antenna	3142C	00044556	EMCO	06/25/13	06/25/14
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	03/25/13	03/25/14
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	02/28/14	02/28/16
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	09/03/13	09/03/14
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	09/03/13	09/03/14
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	11/19/13	11/19/14
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
1016	Pre-amplifier	PAM-0202	187	PAM	10/08/13	10/08/14
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1040	
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
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	01/20/14	01/20/15
Miscellaneous						
6452	Multimeter	3478A	2911A52177	Hewlett Packard	08/02/13	08/02/14
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	01/30/14	01/30/15
7539	DC Power Supply	6434B	1140A01866	Hewlett Packard	Verified by 6452	
	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	3.55	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)

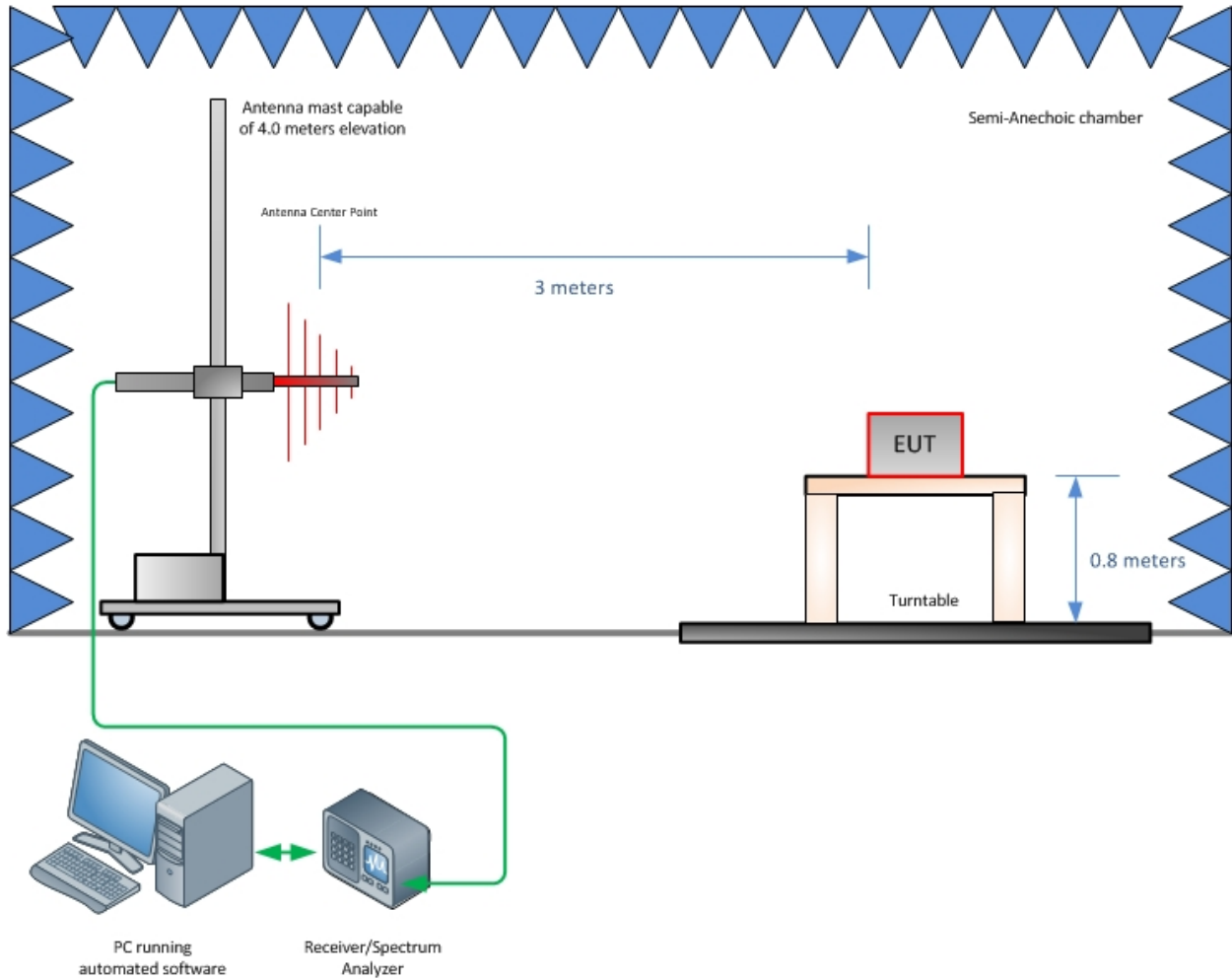
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.55	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



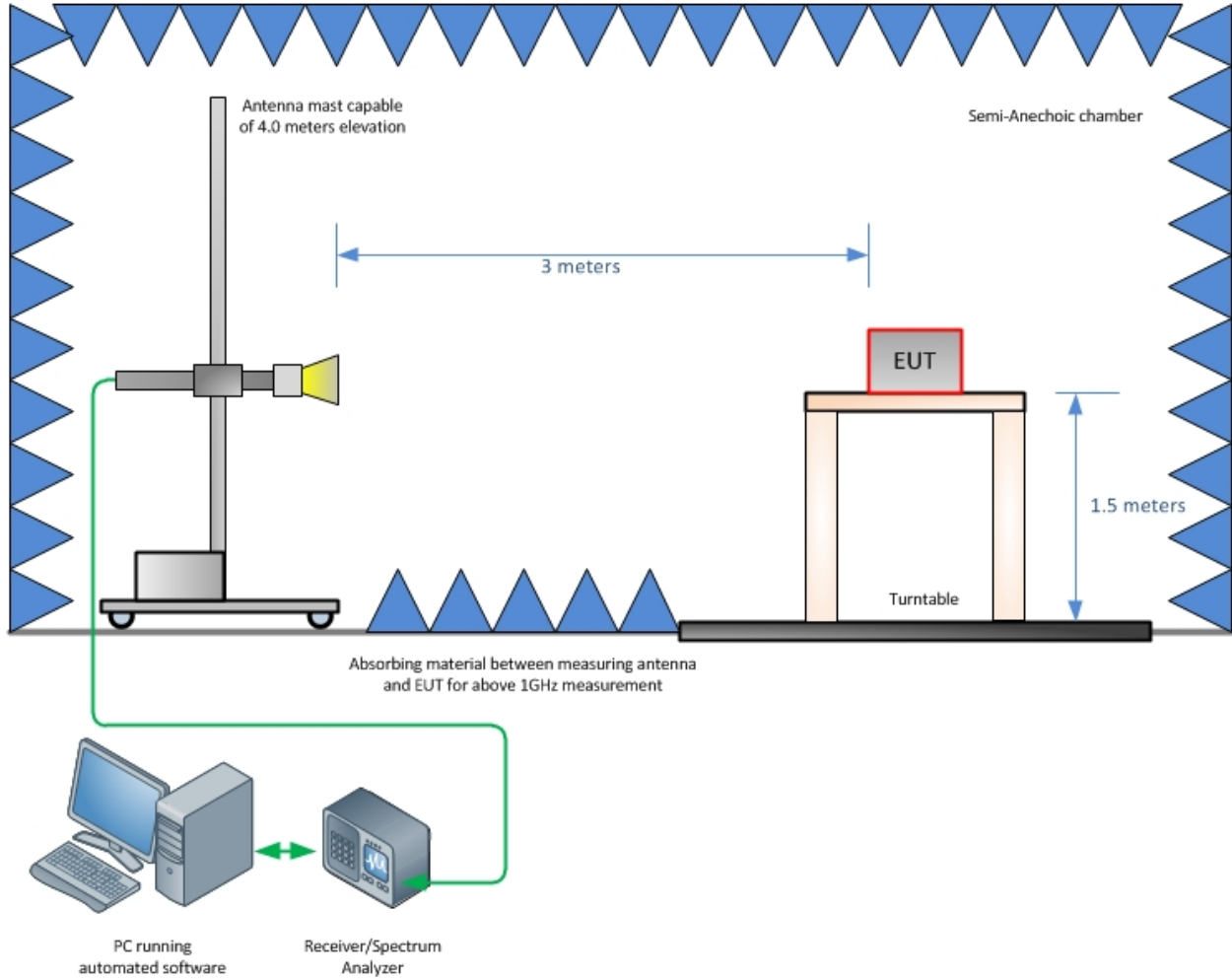
SECTION 4

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

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