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Report On

Radio Testing of the
Baltech AG
Model 10117-810 RFID Reader

FCC Part 15 Subpart C §15.225
IC RSS-210 Issue 9 August 2016

Report No. SD72124699-0217A Rev. 1 March 2017

REPORT ON	EMC Evaluation of the Baltech AG 10117-810 Model No. 10117-810
TEST REPORT NUMBER	SD72124699-0217A Rev. 1
REPORT DATE	March 2017
PREPARED FOR	Baltech AG Lilienthalstr.27 85399 Hallbergmoos Germany
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APPROVED BY	Juan Manuel Gonzalez Name Authorized Signatory Title: EMC SL Manager West Region
DATED	March 29, 2017

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

Revision History

SD72124699-0217A Rev. 1 Baltech AG 10117-810 RFID Reader					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
03/29/2017	Initial Release				Juan Manuel Gonzalez
04/04/2017	Initial Release	Rev. 1	Update reference of Model 10115 to Model 10117	9	Ferdinand S. Custodio

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Baltech AG
10117-810

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Baltech AG RFID Reader to the requirements of FCC Part 15 Subpart C §15.225 and IC RSS-210 Issue 9 August 2016.

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	Baltech AG
Model Number(s)	10117-810
FCC ID Number	OKY10117810A01A
IC Number	7657A-10117810
Serial Number(s)	00000000
Number of Samples Tested	2
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.225 (October 1, 2016). • RSS-210 - Licence-exempt Radio Apparatus: Category I Equipment (Issue 9, August 2016). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 4, November 2014).
Start of Test	March 06, 2017
Finish of Test	March 13, 2017
Name of Engineer(s)	Ivan Retana Alex Chang
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 §15.225 with cross-reference to the corresponding IC RSS standard is shown below.

Section	FCC Part 15	§15.225 Spec Clause	RSS	Test Description	Result	Comments/Base Standard
	§15.31(e)			Voltage Requirement	Compliant	§15.225(e)
	§15.203 and 204		RSS-Gen 8.3	Antenna Requirements	Compliant	See Test Note[1]
2.1		§15.225(e)	RSS-210 B.6	Frequency Tolerance	Compliant	
2.2	§15.215(c)			20dB Bandwidth	Compliant	
2.3			RSS-Gen 6.6	Occupied Bandwidth	Compliant	
2.4		§15.225(a)(b)(c)	RSS-210 B.6(a)(b)(c)	Emission Mask	Compliant	
2.5	§15.209	§15.225(d)	RSS-210 B.6(d)	Spurious Radiated Emissions	Compliant	
			RSS-Gen 4.10	Receiver Spurious Emissions	N/A	See Test Note[2]
2.6		§15.207(a)	RSS-Gen 7.2.4	Conducted Emissions	Compliant	

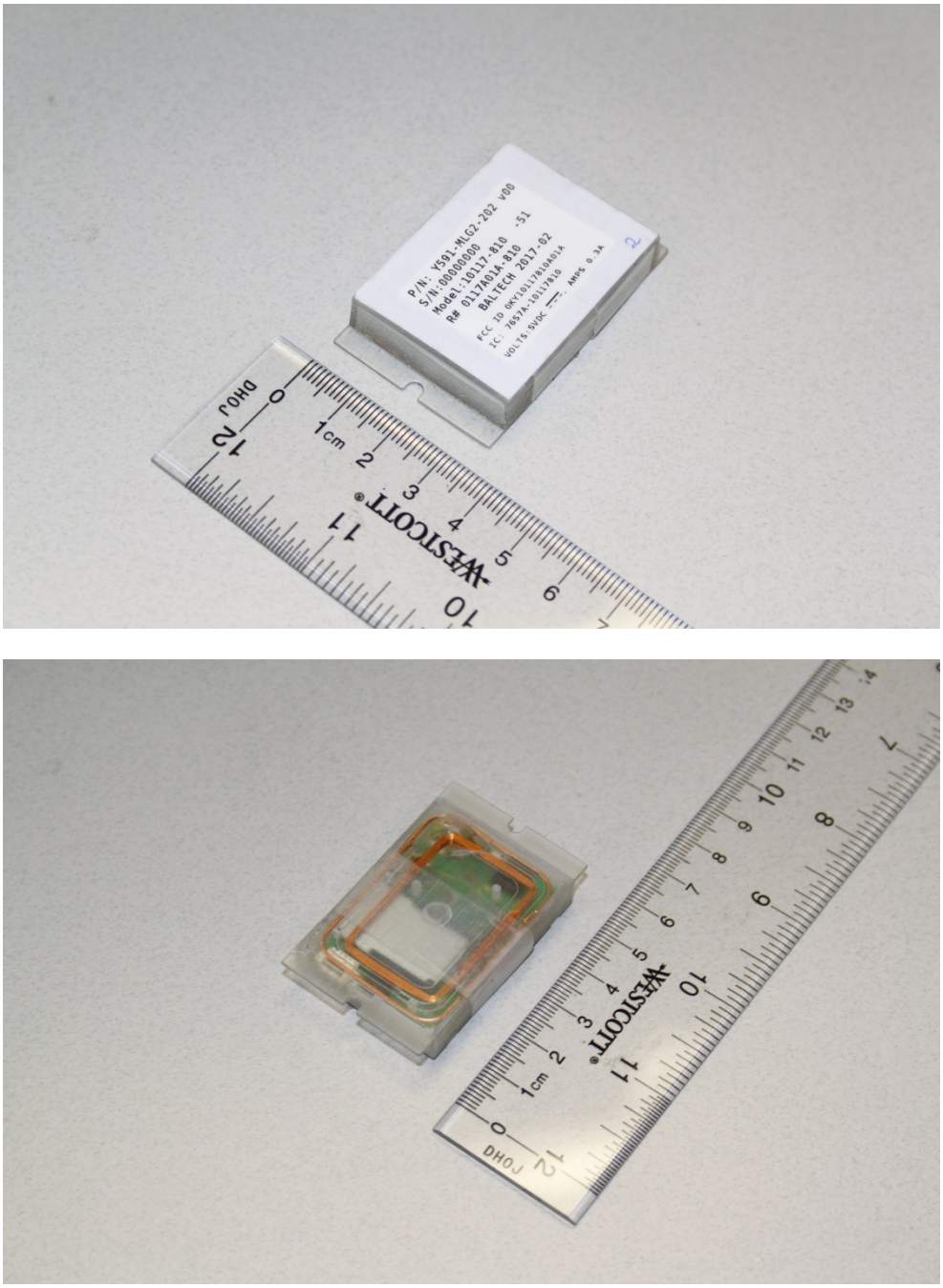
Test Note[1]: The EUT uses a permanently attached antenna to the intentional radiator and is considered sufficient evidence to comply with the provisions of this requirement.

Test Note[2]: The EUT does not fall into the category of a Receiver as per RSS-Gen 5.0.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Baltech AG Model no. 10117-810 RFID Reader as shown in the photograph below. The EUT is a USB powered RFID reader supporting 125 kHz and 13.56 MHz. The EUT also supports Bluetooth Smart 4.2 (2402 MHz to 2480 MHz).



Equipment Under Test

1.3.2 EUT General Description

EUT Description	RFID Reader
Model Number(s)	10117-810
Rated Voltage	5VDC (USB)
Type Designation	10117-XYZ-A where X, Y, Z and A may be replaced by any alphanumerical numbers:

Version/HW Revision	10117-100	13.56MHz
	10117-110	
	10117-200	13.56MHz & BLE
	10117-210	
	10117-300	125kHz & 13.56MHz
	10117-310	
	10117-400	125kHz, 13.56MHz & BLE
	10117-410	
	10117-500	13.56MHz
	10117-510	
	10117-600	13.56MHz & BLE
	10117-610	
	10117-700	125kHz & 13.56MHz
	10117-710	
	10117-800	125kHz, 13.56MHz & BLE
	10117-810	
The applicant declares the conformity of the variants listed above. The test results are valid for the tested variant 10117-810, and models listed with 13.56MHz Tx.		

HW	10117-810
FW	1976_Test
Configuration	Auto Read
Host IF	USB
Frequency (Capability)	13.56 MHz, 125 KHz and 2.4 GHz
Mode Verified	13.56 MHz
Configuration	Auto Read

Bluetooth Smart Transmit Power	3 dBm
Bluetooth Smart Conducted Power	< 9.9 dBm
Bluetooth Smart Antenna Type	Integrated Chip
Bluetooth Smart Antenna Gain	1 dBi

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1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	*Description*
Default	The EUT operating at 125 kHz and 13.56 MHz sequentially once powered by 5VDC via USB.

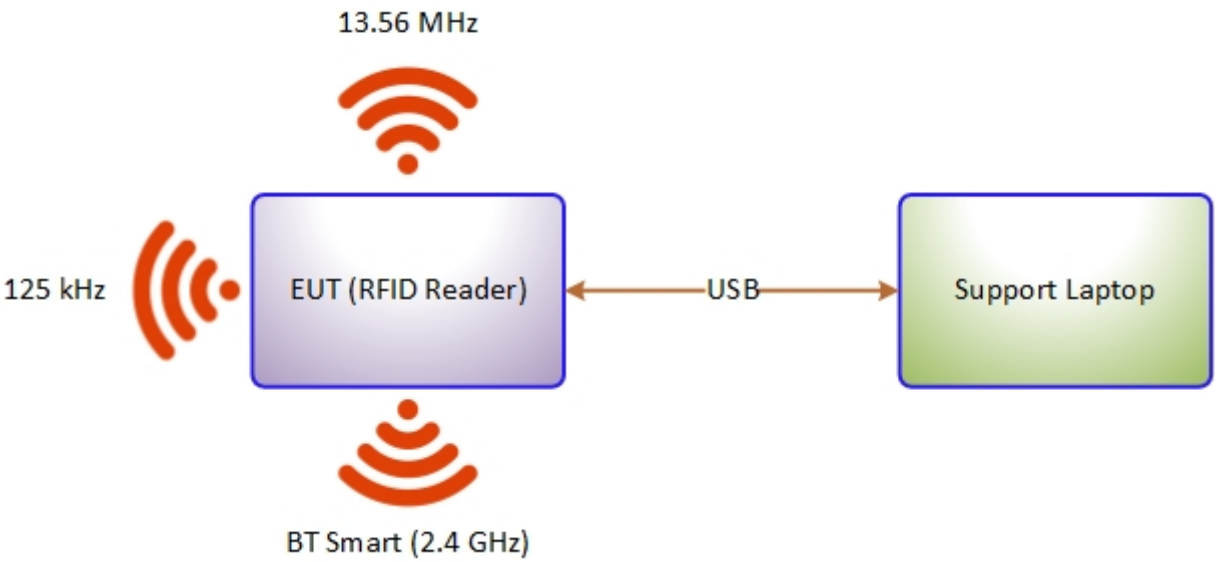
1.4.2 EUT Exercise Software

Testing software (3544_bluetooth_hf_test_tool_1_00_01.exe) was provided by the manufacturer to exercise the Bluetooth function together with the RFID.

1.4.3 Support Equipment and I/O cables

Manufacturer	*Equipment/Cable*	*Description*
-	USB Cable	1.8 meters USB Type A to Molex connector
Lenovo	Support Laptop	X100e Type 3508-2AU S/N LR-CHGDB 10/06
Lenovo	Support AC Adapter for Laptop	M/N 42T4418 S/N 11S42T4418Z1ZGWG28Z0KB

1.4.4 Simplified Test Configuration Diagrams



1.5 DEVIATIONS FROM THE STANDARD

All deviations made during testing from the applicable test standards or test plan are detailed under Section 1.2 of this test report.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number 00000000		
N/A		

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

1.7 TEST METHODOLOGY

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

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.10-2013. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

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

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678-1400 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

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

1.9.2 Innovation, Science and Economic Development Canada (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 Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 NCC (National Communications Commission - US0102)

TUV SUD America Inc. (San Diego) is listed as a Foreign Recognized Telecommunication Equipment Testing Laboratory and is accredited to ISO/IEC 17025 (A2LA Certificate No.2955.13) which under APEC TEL MRA Phase 1 was designated as a Conformity Assessment Body competent to perform testing of equipment subject to the Technical Regulations covered under its scope of accreditation including RTTE01, PLMN01 and PLMN08 for TTE type of testing and LP002 for Low-Power RF Device type of testing.

1.9.5 VCCI – Registration No. A-0230

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.

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SECTION 2

TEST DETAILS

Radio Testing of the
Baltech AG
10117-810

2.1 FREQUENCY STABILITY

2.1.1 Specification Reference

Part 15 Subpart C §15.225(e) and RSS-210 B.6

2.1.2 Standard Applicable

(e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

2.1.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

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

March 06, 2017 /IR

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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	26.1 °C
Relative Humidity	43.6 %
ATM Pressure	99.3 kPa

2.1.7 Additional Observations

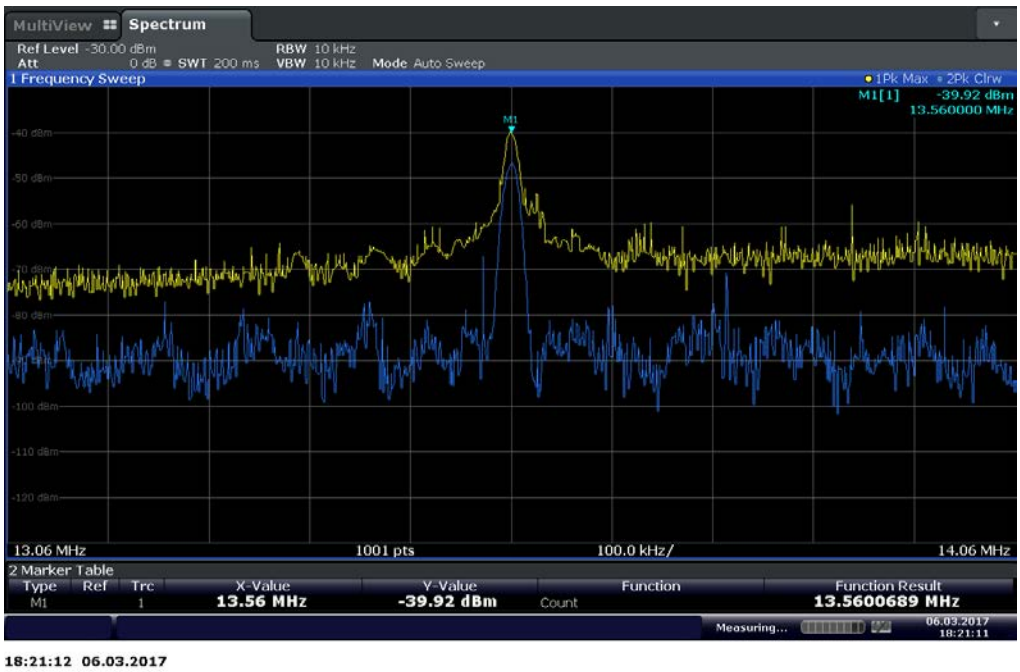
- This is a radiated test with the loop antenna next to the environmental chamber.
- Measurement was done using the spectrum analyzer's frequency counter function to measure the frequency variation of the EUT's RFID system.
- The RBW was set to 10 kHz Hz for better resolution.
- The temperature was varied from −20°C to +50°C in 10 degree increments with voltage variation of 85% and 115% (4.25VDC to 5.75VDC on the USB cable) at 20°C.
- The EUT was powered off, then powered on once the temperature stabilized and the frequency was then measured.

2.1.8 Test Results

RFID @ 13.56MHz					
Voltage (%)	***Power (VDC)***	***Temp (°C)***	***Frequency (Hz)***	***Frequency Deviation***	***Deviation (%)***
100	5.0	-20	13.5600449	0.000045	0.000
100		-10	13.5604414	0.000441	0.003
100		0	13.5600111	0.000011	0.000
100		+10	13.5601664	0.000166	0.001
100		+20	13.5601198	0.000120	0.001
100		+30	13.5599437	-0.000056	0.000
100		+40	13.5600667	0.000067	0.000
100		+50	13.5600689	0.000069	0.001
Voltage Variation (85% and 115%)	4.25	+20	13.5599966	-0.000003	0.000
	5.75	-20	13.5599596	-0.000040	0.000

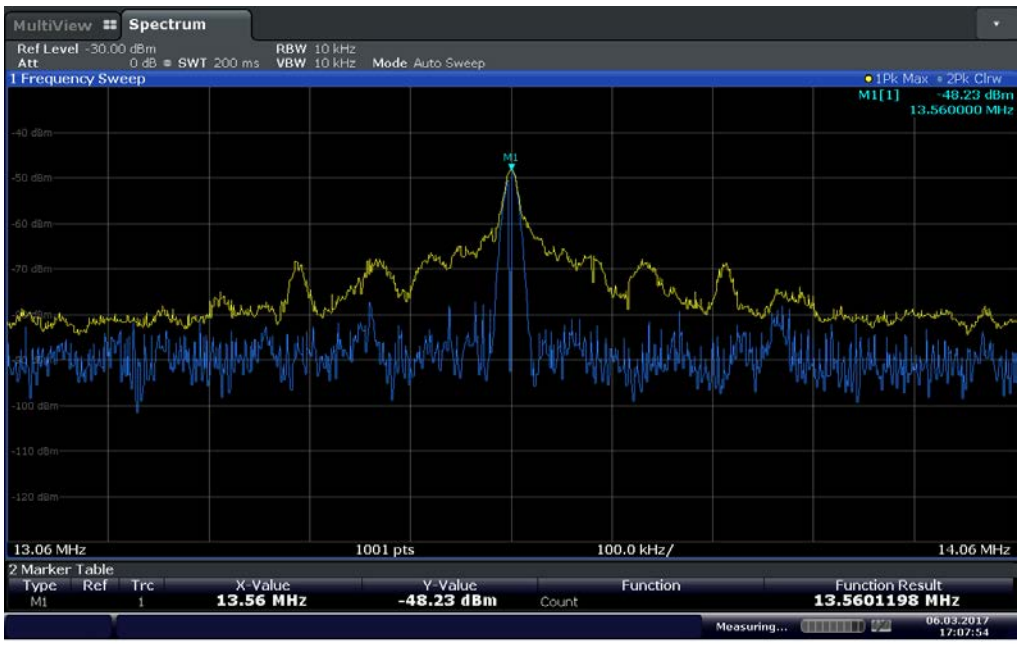
Maximum Deviation = 0.003%
= 0.003% < 0.01% Limit **(Complies)**

2.1.9 Sample Test Plots



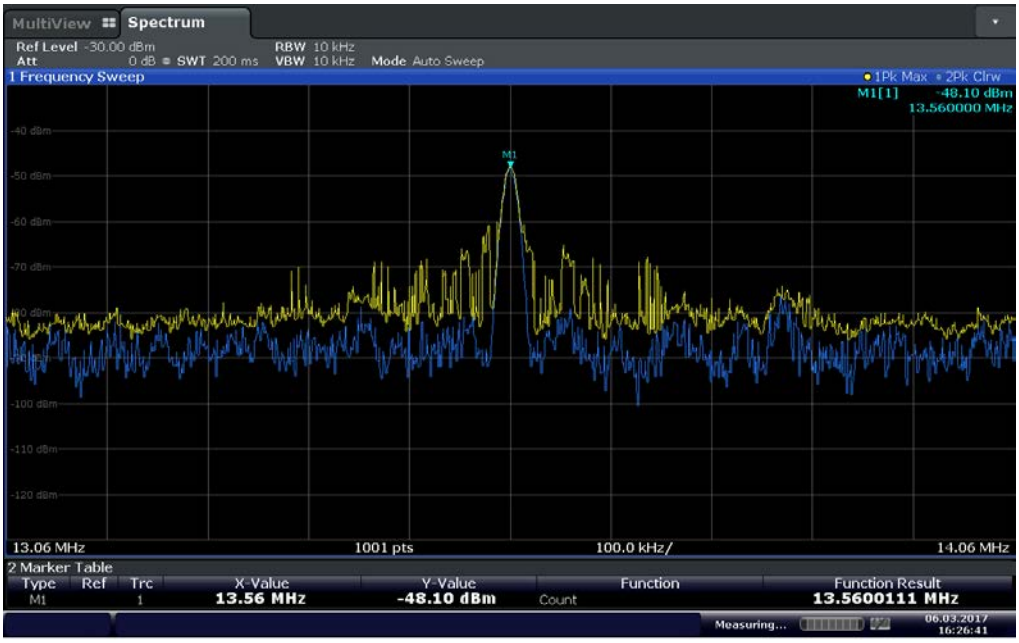
18:21:12 06.03.2017

Nominal Voltage @ 50°C



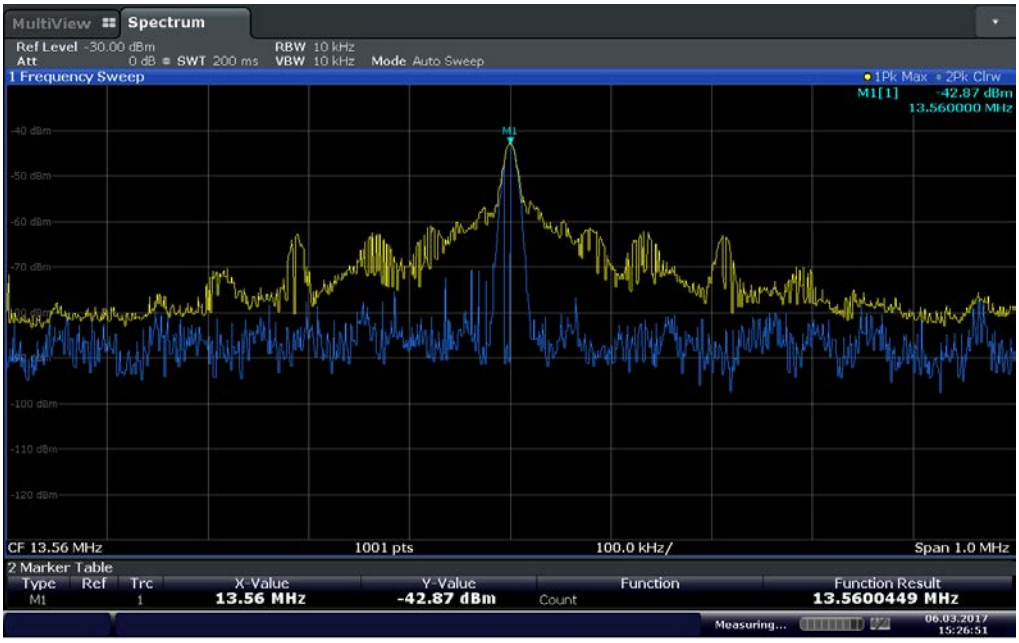
17:07:54 06.03.2017

Nominal Voltage @ 20°C



16:26:41 06.03.2017

Nominal Voltage @ 0°C



15:26:52 06.03.2017

Nominal Voltage @ -20°C

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: 00000000 / Default Test Configuration

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

March 07, 2017 /IR

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

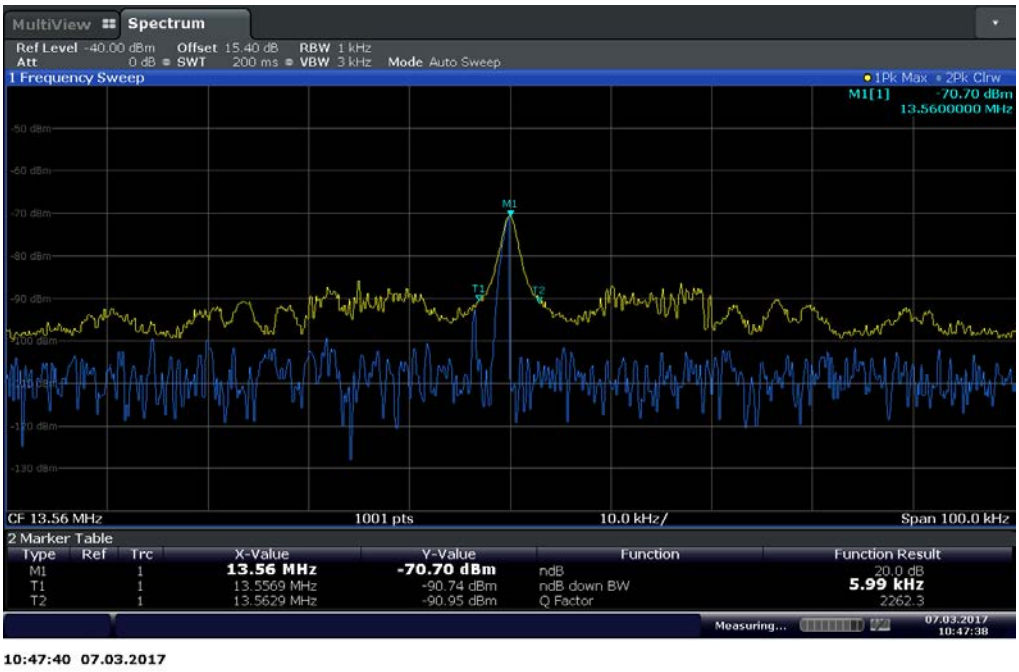
Ambient Temperature	25.7 °C
Relative Humidity	44.6 %
ATM Pressure	99.8 kPa

2.2.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW was set to 1 kHz.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- The “n” dB down marker function of the spectrum analyser was used for this test.

2.2.8 Test Results

Frequency	20dB bandwidth
13.56 MHz	5.99 kHz



10:47:40 07.03.2017

Measured 20dB Bandwidth: 5.99 kHz
Frequency Band: 13.110 to 14.010 MHz

13.56 MHz – (20dB BW/2) = 13.557005 MHz (within the frequency band - **Compliant**)
13.56 MHz + (20dB BW/2) = 13.562995 MHz (within the frequency band - **Compliant**)

2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 6.6

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: 00000000 / Default Test Configuration

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

March 7, 2017 /IR

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	25.7 °C
Relative Humidity	44.6 %
ATM Pressure	99.8 kPa

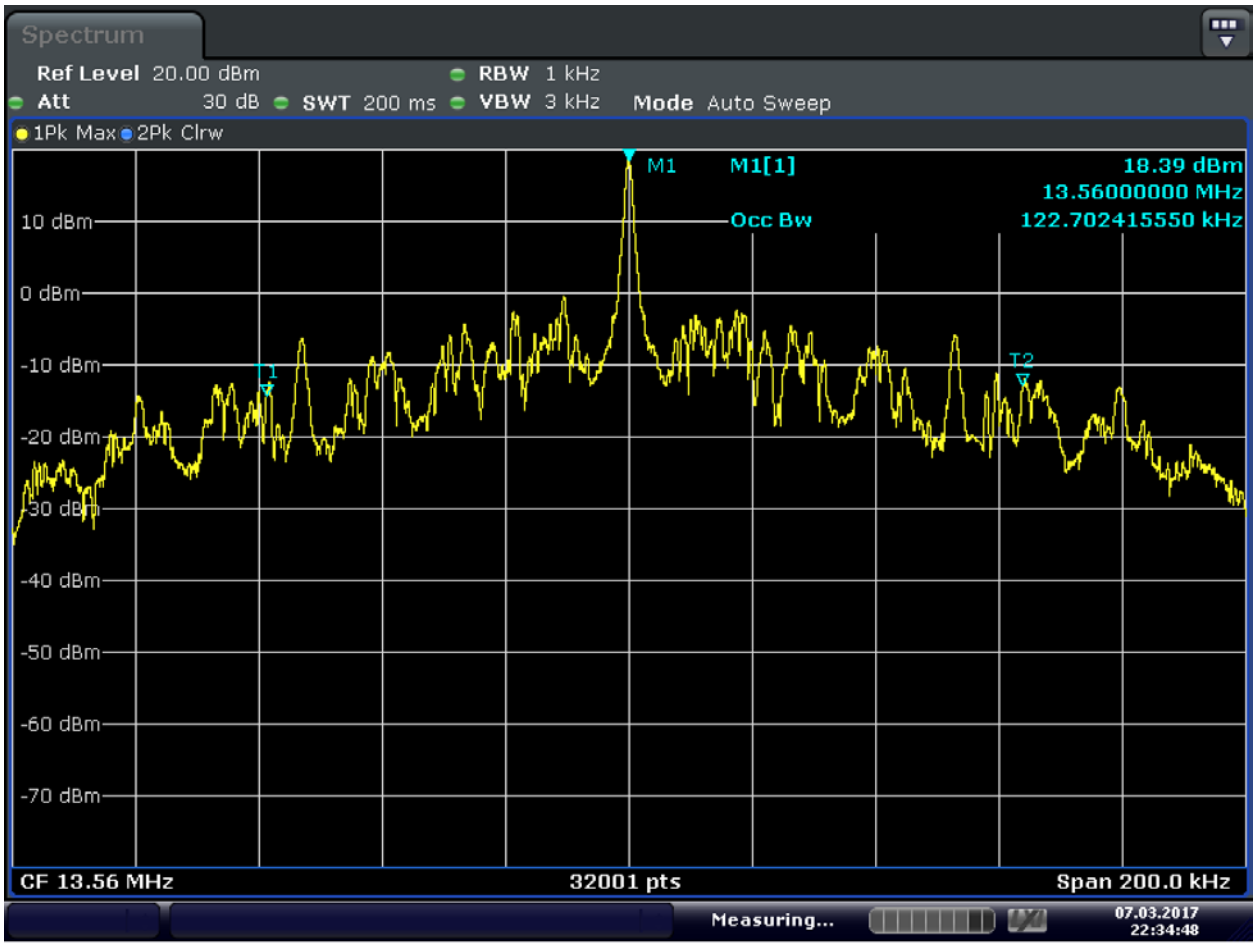
2.3.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW was set to 1 kHz.
- 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 (Reporting Purposes Only)

Frequency	99% Emission bandwidth
13.56 MHz	122.7 kHz



Date: 7.MAR.2017 22:34:48

2.4 EMISSION MASK

2.4.1 Specification Reference

Part 15 Subpart C §15.225(a)(b)(c) and RSS-210 B.6(a)(b)(c)

2.4.2 Standard Applicable

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

2.4.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

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

March 13, 2017 /AC

2.4.5 Test Equipment Used

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

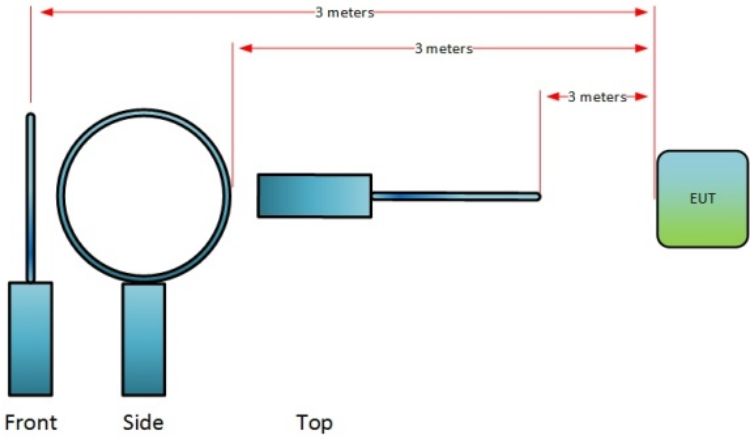
2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.6 °C
Relative Humidity	44.4 %
ATM Pressure	99.9 kPa

2.4.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9kHz to 30MHz. Only 13.110 MHz to 14.010 MHz presented. There are no significant emissions observed other than the fundamental frequency (13.56 MHz) measured at 3 meters.
- Limits were converted from 30 meters to 3 meters using worst case 20 dB/decade extrapolation rules.
- Prescans were performed to determine the best test antenna orientation with the highest recorded emissions. Verification was performed using “Front” configuration (see the figure on the following page) corresponding to the best antenna orientation as found during the prescans.



- 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 2.4.1 for sample computation.

2.4.1 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) @ 13.56MHz			15.0
Correction Factor (dB)	Asset# 1026 (cable)	0.6	21.5
	Asset# 1057 3m (cable)	0.7	
	Asset# 6628 (antenna)	19.9	
	Asset# 1187(cable)	0.3	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**36.5**

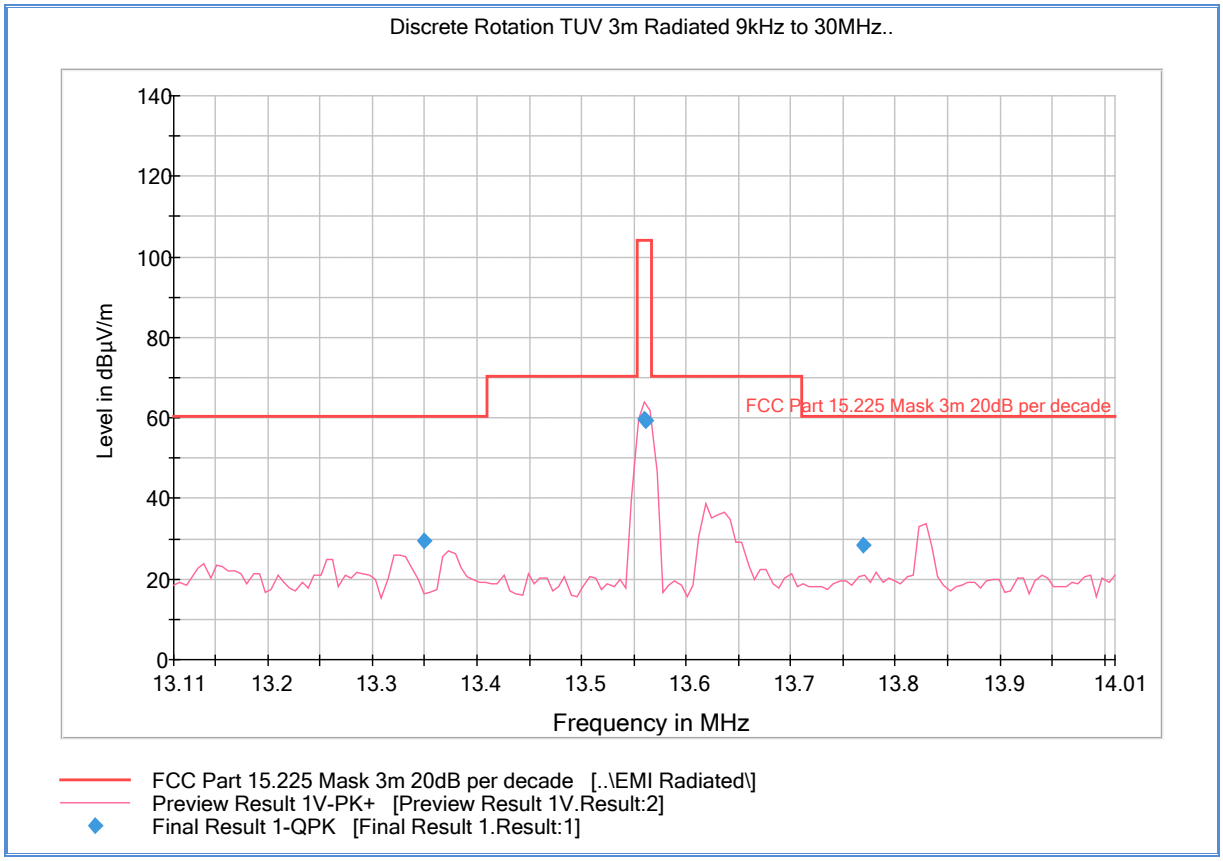
2.4.2 Sample Computation (Limits)

Limit @ 13.553–13.567 MHz:	= 15,848 µV/m @30 meters
	= 20 log(15,848 µV/m)
	= 84 dB µV/m @30 meters
Using 20dB/decade extrapolation rule:	= 20 log (30m/3m)
Measuring distance correction factor:	= 20 dB
Calculated limit @ 3 meters:	= 84 dB µV/m + 20 dB
	= 104 dB µV/m

2.4.3 Test Results

See attached plots.

2.4.4 Test Results



Quasi Peak Data (§15.225 Limits)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
13.349390	29.7	1500.0	9.000	100.0	V	191.0	15.4	30.8	60.5
13.559442	59.8	1500.0	9.000	100.0	V	185.0	15.4	44.2	104.0
13.561000	59.5	1500.0	9.000	100.0	V	191.0	15.4	44.6	104.0
13.769831	28.4	1500.0	9.000	100.0	V	205.0	15.4	32.1	60.5

2.5 SPURIOUS RADIATED EMISSIONS

2.5.1 Specification Reference

Part 15 Subpart C §15.225(d) and RSS-210 B.6(d)

2.5.2 Standard Applicable

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

2.5.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

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

March 13, 2017 /AC

2.5.5 Test Equipment Used

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

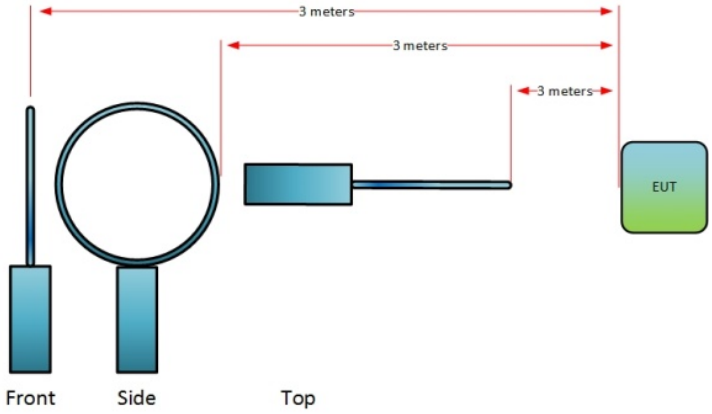
2.5.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.6 °C
Relative Humidity	44.4 %
ATM Pressure	99.9 kPa

2.5.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9 kHz to the 10th harmonic (25 GHz).
- There are no emissions found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.
- Prescans were performed to determine the best test antenna orientation with the highest recorded emissions. Verification was performed using “Front” configuration (see the figure on the following page) corresponding to the best antenna orientation as found during the prescans.
- 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 2.5.8 and 2.5.9 for sample computations.



2.5.8 Sample Computation (Radiated Emission 9 kHz to 30 MHz)

Measuring equipment raw measurement (dbµV) @ 9 kHz			25.0
Correction Factor (dB)	Asset# 1057 (cable)	0.1	25.9
	Asset# 8850 (cable)	0.0	
	Asset# 6628 (antenna)	25.8	
	Asset# 1026 (cable)	0.0	
Reported QuasiPeak Final Measurement (dbµV/m) @ 9kHz			**50.9**

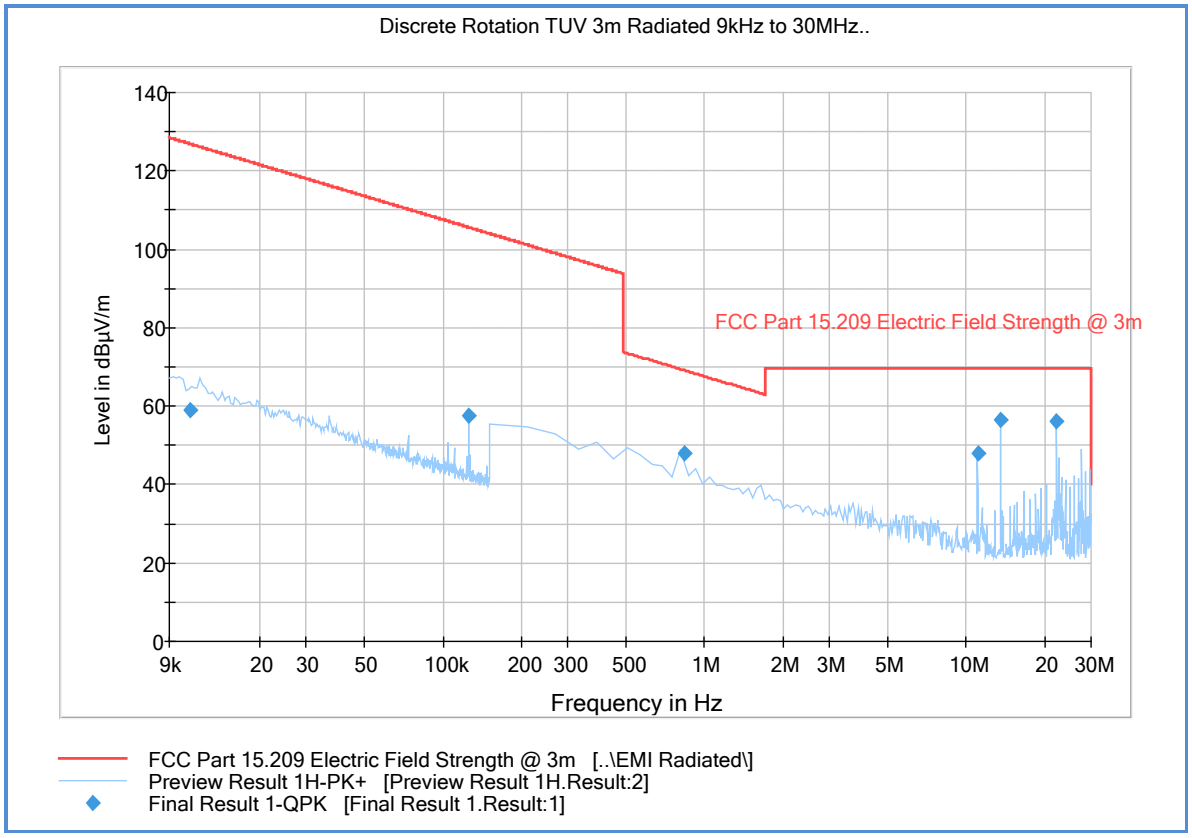
2.5.9 Sample Computation (Radiated Emission 30 MHz to 1 GHz)

Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1026 (cable)	0.8	-7.0
	Asset# 1057 (cable)	0.2	
	Asset# 1016 (preamplifier)	-30.8	
	Asset# 8850 (cable)	0.2	
	Asset# 1033 (antenna)	17.2	
	Asset# 8771 (6-dB attenuator)	5.4	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**17.4**

2.5.10 Test Results

See attached plots.

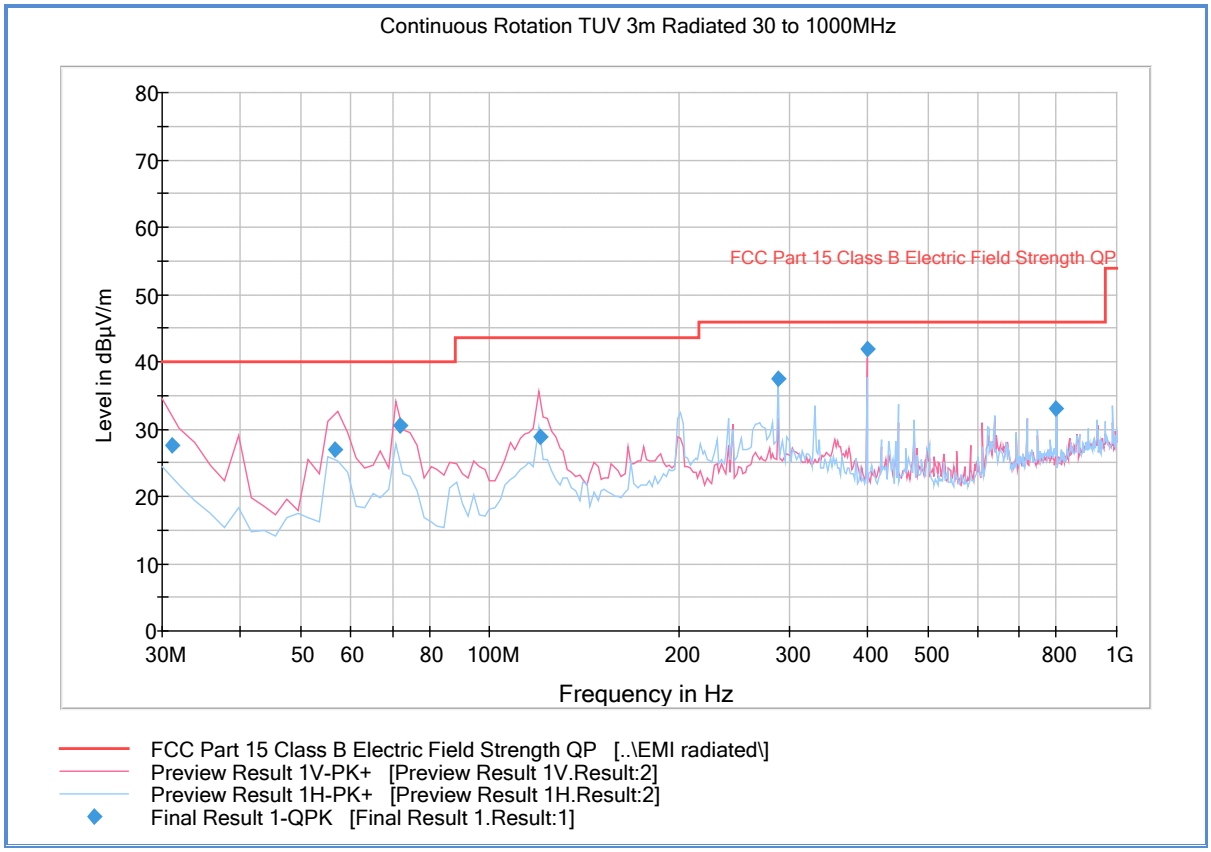
2.5.11 Test Results Below 30MHz



Quasi Peak Data (§15.209 Limits)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
0.010826	59.1	1000.0	0.200	100.0	H	221.0	15.6	67.9	126.9
0.125134	57.5	1000.0	0.200	100.0	H	279.0	14.2	47.9	105.4
0.833016	47.8	1500.0	9.000	100.0	H	6.0	14.5	21.4	69.2
11.058174	48.0	1500.0	9.000	100.0	H	147.0	15.4	21.6	69.5
13.558599	56.6	1500.0	9.000	100.0	H	255.0	15.4	12.9	69.5
22.120627	56.1	1500.0	9.000	100.0	H	29.0	15.1	13.5	69.5

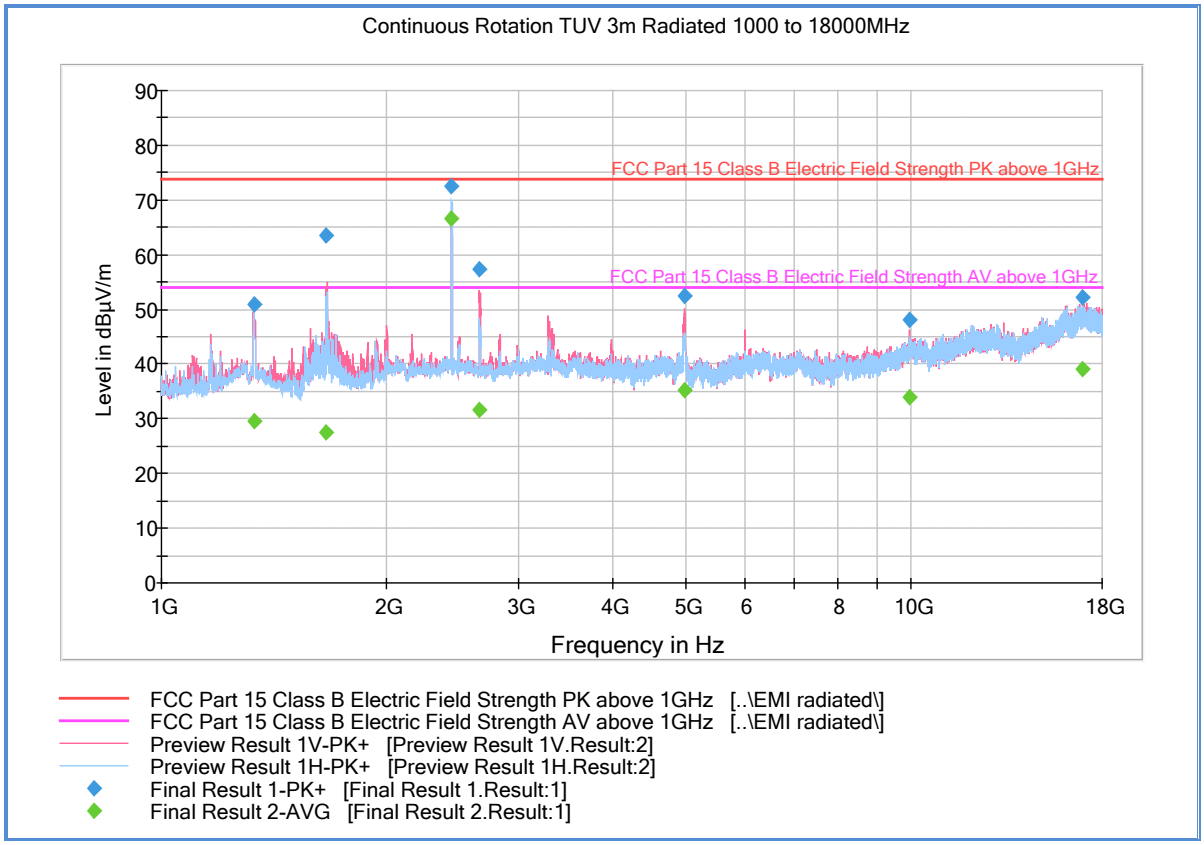
2.5.12 Test Results 30MHz to 1GHz



Quasi Peak Data (§15.209 Limits)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
31.120000	27.6	1000.0	120.000	100.0	V	341.0	-7.7	12.4	40.0
56.574429	27.0	1000.0	120.000	100.0	V	156.0	-16.7	13.0	40.0
71.981643	30.5	1000.0	120.000	100.0	V	78.0	-17.7	9.5	40.0
120.058838	28.8	1000.0	120.000	100.0	V	51.0	-16.6	14.7	43.5
287.977074	37.5	1000.0	120.000	105.0	H	258.0	-9.5	8.5	46.0
399.978677	41.9	1000.0	120.000	116.0	V	15.0	-5.0	4.1	46.0

2.5.13 Test Results above 1GHz



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1332.500000	51.0	1000.0	1000.000	149.7	H	80.0	-5.0	22.9	73.9
1659.966667	63.5	1000.0	1000.000	195.5	H	102.0	-5.0	10.4	73.9
2440.133333	72.5	1000.0	1000.000	103.7	H	143.0	-0.8	Fundamental BT	
2659.200000	57.4	1000.0	1000.000	127.7	V	1.0	-0.7	16.5	73.9
4985.400000	52.4	1000.0	1000.000	303.2	V	335.0	3.9	21.5	73.9
9950.733333	48.1	1000.0	1000.000	143.7	V	183.0	10.0	25.8	73.9
16926.366667	52.1	1000.0	1000.000	116.7	H	298.0	19.5	21.8	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)
1332.500000	29.5	1000.0	1000.000	149.7	H	80.0	-5.0	24.4	53.9
1659.966667	27.6	1000.0	1000.000	195.5	H	102.0	-5.0	26.3	53.9
2440.133333	66.6	1000.0	1000.000	103.7	H	143.0	-0.8	Fundamental BT	
2659.200000	31.6	1000.0	1000.000	127.7	V	1.0	-0.7	22.3	53.9
4985.400000	35.1	1000.0	1000.000	303.2	V	335.0	3.9	18.8	53.9
9950.733333	34.0	1000.0	1000.000	143.7	V	183.0	10.0	19.9	53.9
16926.366667	39.1	1000.0	1000.000	116.7	H	298.0	19.5	14.8	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures. Fundamental of the Bluetooth Smart will be ignored for this test.

2.6 CONDUCTED EMISSIONS

2.6.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.6.2 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.*

2.6.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

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

March 13, 2017 /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	23.6 °C
Relative Humidity	44.4 %
ATM Pressure	99.9 kPa

2.6.1 Additional Observations

- Measurement was performed on the support laptop where the EUT was connected via USB.
- Termination of the EUT RFID antenna is not possible, the position of the EUT on the test table was adjusted to lessen the influence of the RFID frequencies on the measurements.

- 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 2.6.2 for sample computation.

2.6.2 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# 7568 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbµV) @ 150kHz			**26.2**

2.6.3 Test Results

Compliant. See attached plots and tables.

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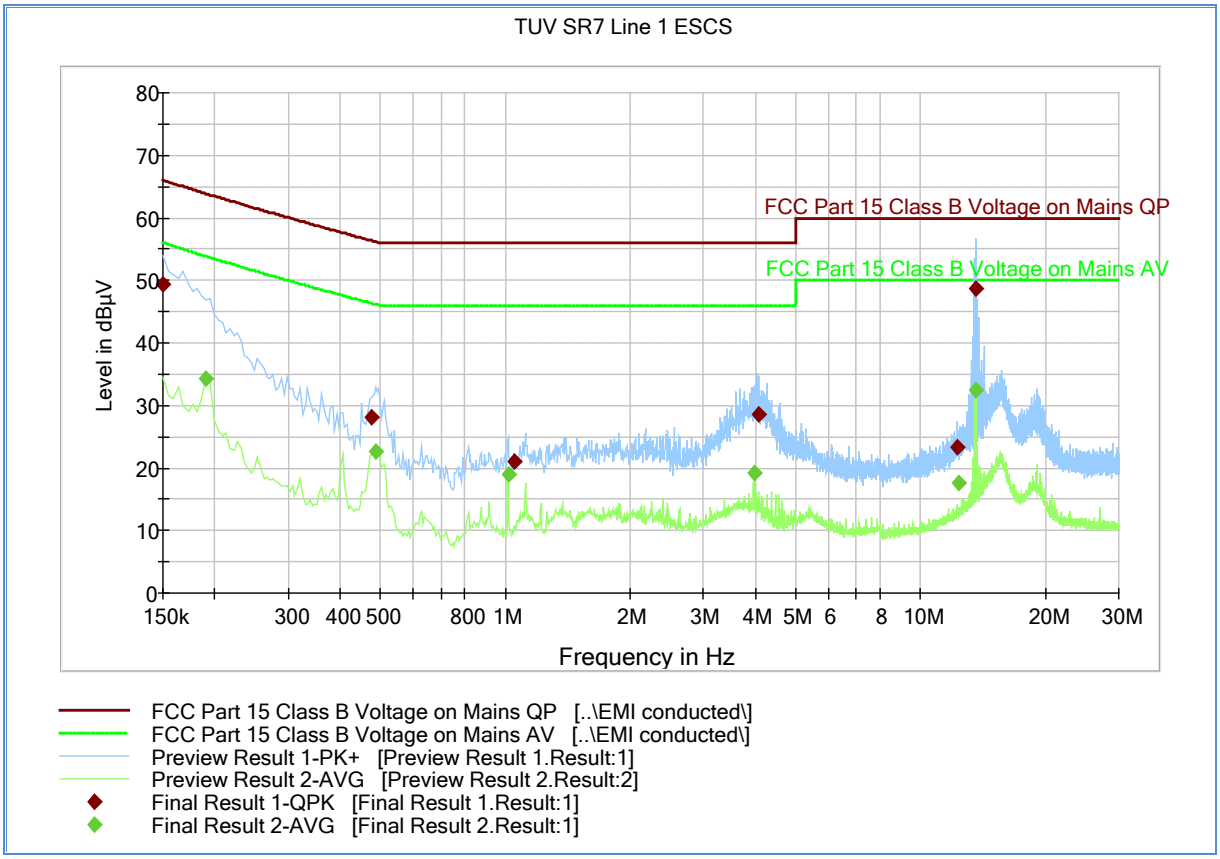
2.6.1 120VAC 60Hz (Line 1)



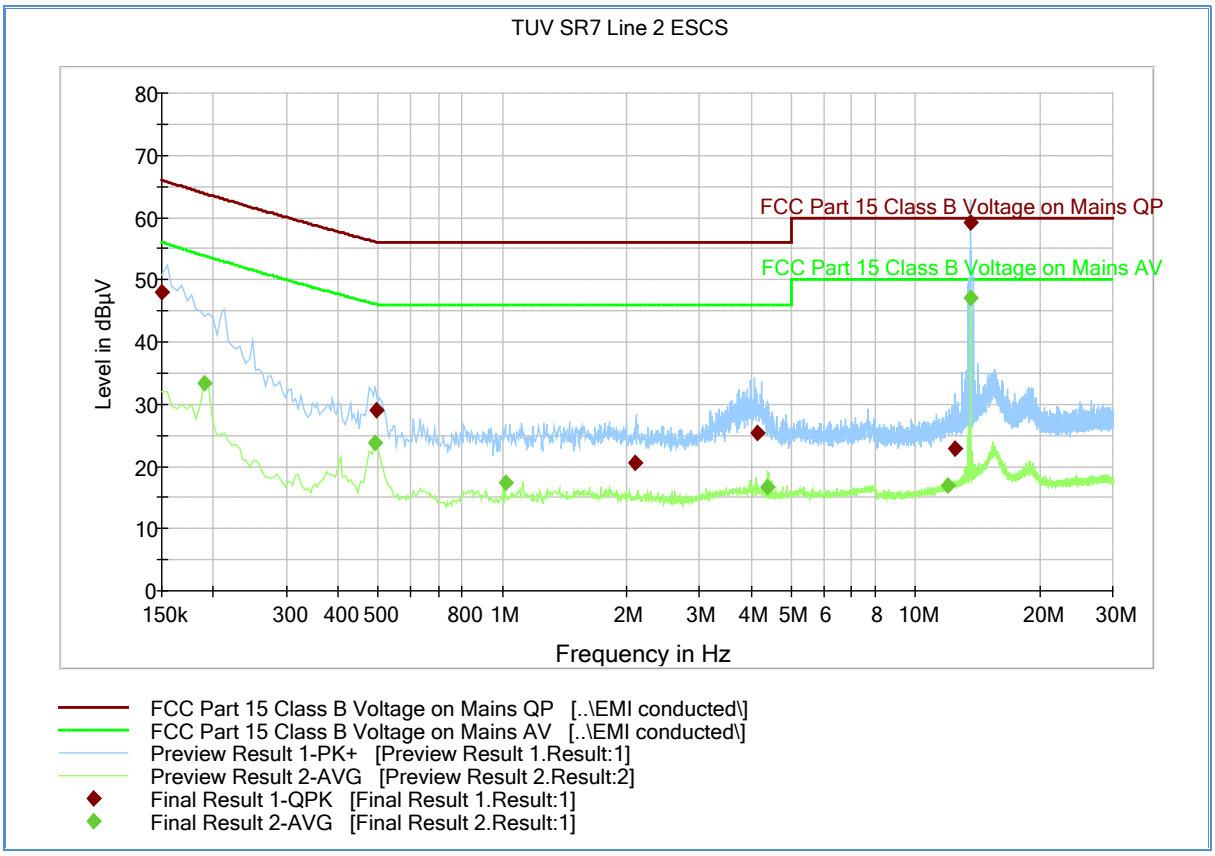
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	49.3	1000.0	9.000	Off	L1	19.9	16.7	66.0
0.478500	28.0	1000.0	9.000	Off	L1	19.9	28.3	56.3
1.054500	21.0	1000.0	9.000	Off	L1	19.9	35.0	56.0
4.083000	28.6	1000.0	9.000	Off	L1	20.3	27.4	56.0
12.282000	23.4	1000.0	9.000	Off	L1	20.5	36.6	60.0
13.573500	48.7	1000.0	9.000	Off	L1	20.5	11.3	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.190500	34.3	1000.0	9.000	Off	L1	19.8	19.5	53.9
0.487500	22.7	1000.0	9.000	Off	L1	19.9	23.5	46.2
1.018500	19.0	1000.0	9.000	Off	L1	19.9	27.0	46.0
3.966000	19.2	1000.0	9.000	Off	L1	20.3	26.8	46.0
12.358500	17.7	1000.0	9.000	Off	L1	20.5	32.3	50.0
13.569000	32.3	1000.0	9.000	Off	L1	20.5	17.7	50.0

2.6.2 120VAC 60Hz (Line 2)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	48.1	1000.0	9.000	Off	N	19.9	17.9	66.0
0.496500	28.9	1000.0	9.000	Off	N	19.9	27.1	56.1
2.103000	20.5	1000.0	9.000	Off	N	19.9	35.5	56.0
4.150500	25.4	1000.0	9.000	Off	N	20.3	30.6	56.0
12.457500	22.8	1000.0	9.000	Off	N	20.5	37.2	60.0
13.560000	59.3	1000.0	9.000	Off	N	20.5	0.7	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.190500	33.4	1000.0	9.000	Off	N	19.9	20.5	53.9
0.492000	23.8	1000.0	9.000	Off	N	19.9	22.3	46.1
1.018500	17.3	1000.0	9.000	Off	N	19.9	28.7	46.0
4.371000	16.8	1000.0	9.000	Off	N	20.3	29.2	46.0
11.967000	16.9	1000.0	9.000	Off	N	20.4	33.1	50.0
13.564500	47.1	1000.0	9.000	Off	N	20.5	2.9	50.0

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 Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	09/07/16	09/07/17
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	11/05/16	11/05/17
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	Verified by 7582 and 7608	
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	Verified by 7582 and 7608	
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	10/26/16	10/26/17
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/02/16	09/02/17
Radiated Emission						
7640	Loop Antenna	AL-130R	121086	Com-Power	11/21/16	11/21/17
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
1016	Pre-amplifier	PAM-0202	187	PAM	02/09/17	02/09/18
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	03/21/16	03/21/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/16/16	05/16/17
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	06/29/16	06/29/17
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 1003 and 7582	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 1003 and 7582	
Miscellaneous						
7579	Temperature Chamber	115	151617	TestQuity	08/25/16	08/25/17
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/29/17
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	08/22/16	08/22/17
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Radiated Measurements (Below 30MHz)

	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
4	Loop Antenna	Rectangular	0.75	0.44	0.19
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.76
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.53

3.2.2 Radiated Measurements (30 MHz to 1GHz)

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

3.2.3 Radiated 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	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.78
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.56

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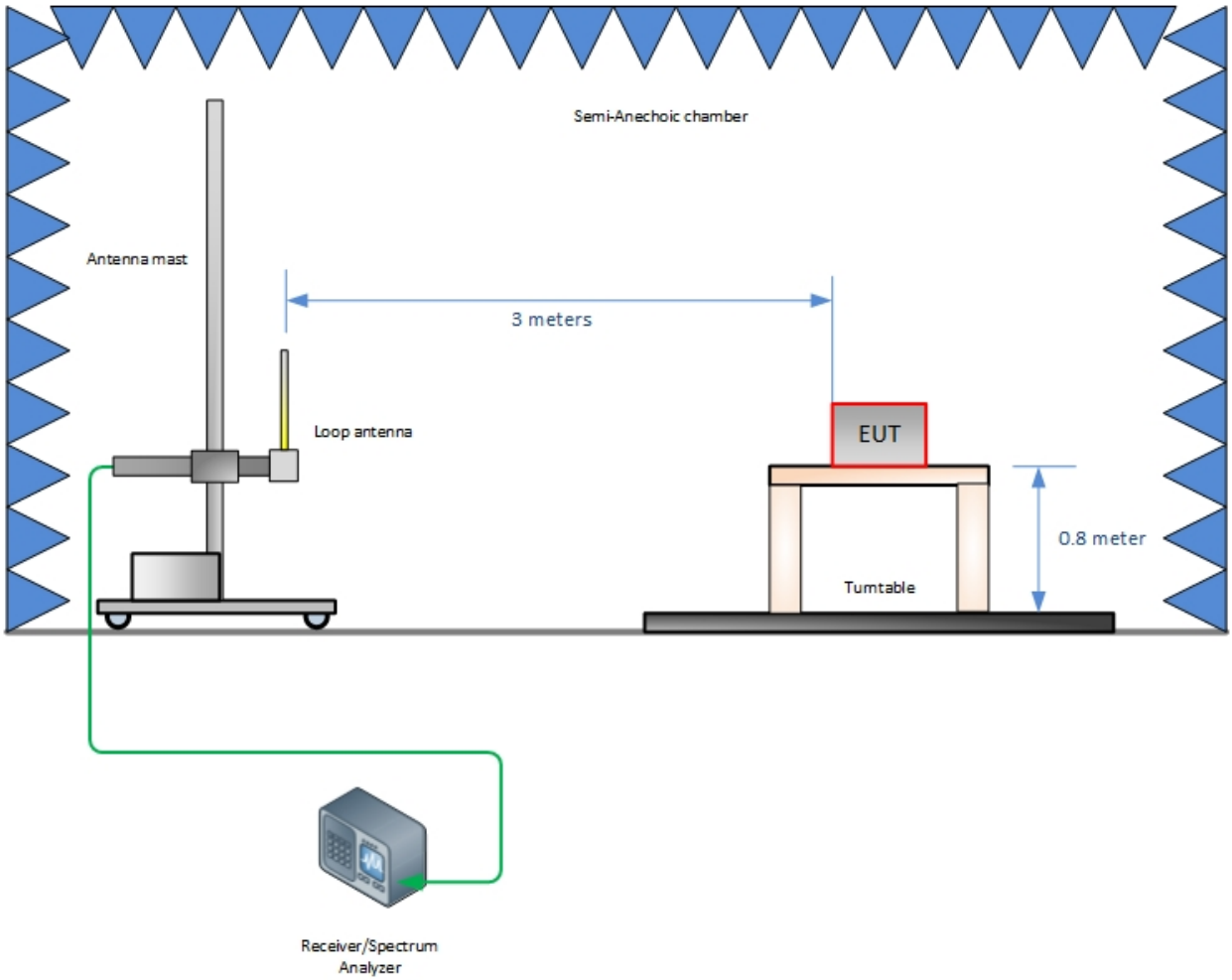
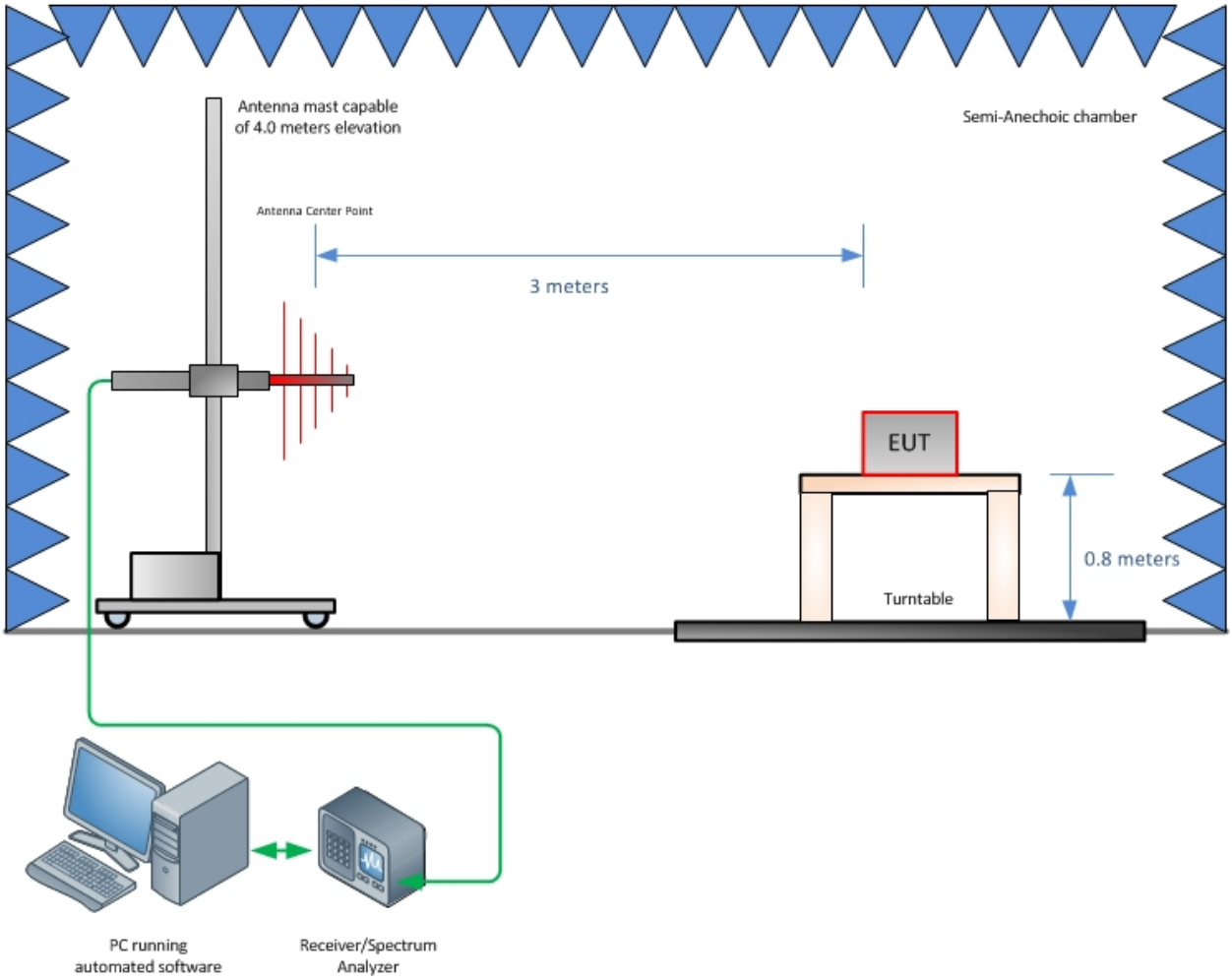
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM (EMISSION MASK AND BELOW 30MHZ)

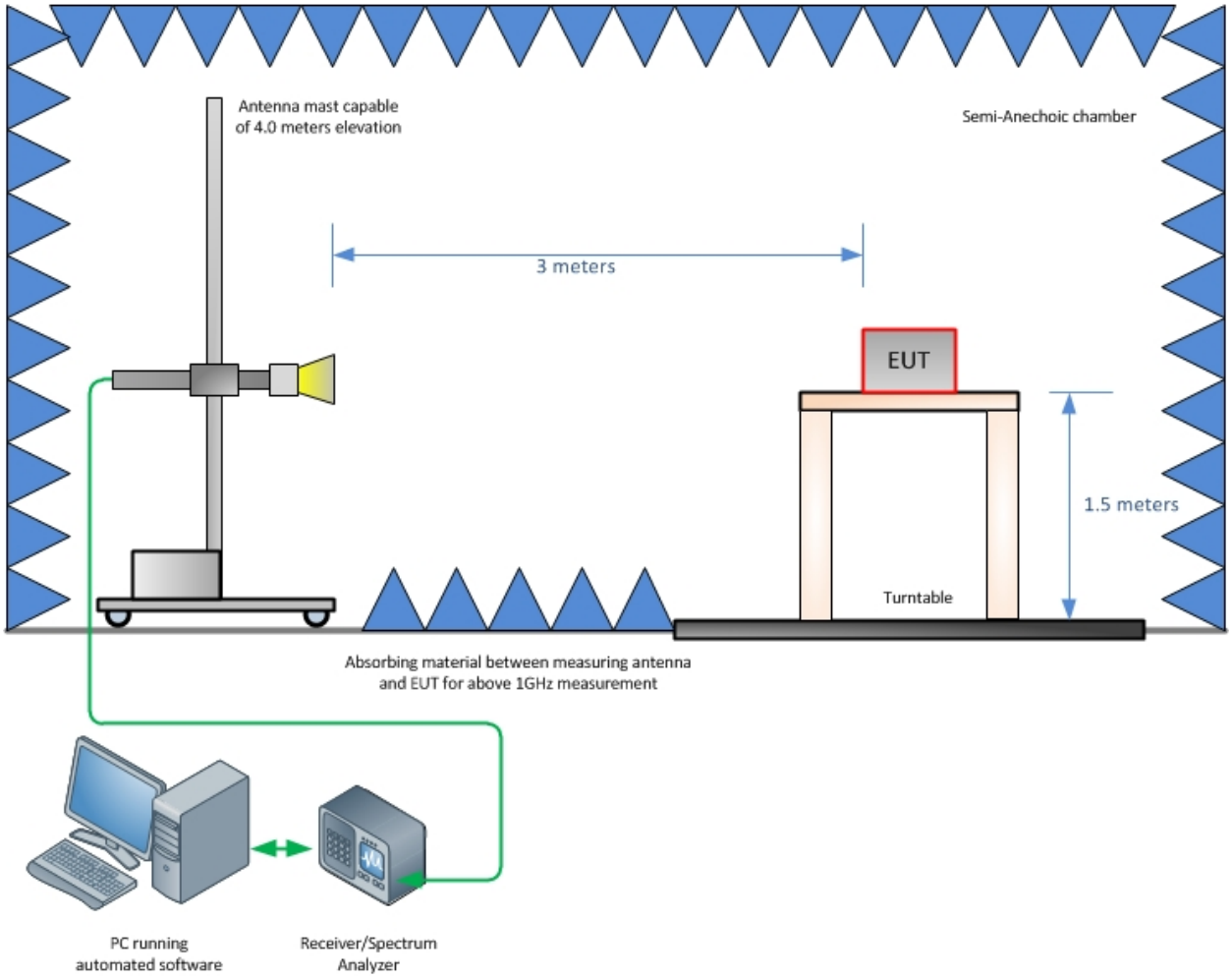


4.2 TEST SETUP DIAGRAM (30MHZ TO 1GHZ)



Radiated Emission Test Setup (Below 1GHz)

4.3 TEST SETUP DIAGRAM (> 1GHZ)



Radiated Emission Test Setup (Above 1GHz)

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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