America

Choose certainty.
Add value.

Report On

Radio Testing of the
IPS Group Inc.
Smart Collection Head Model 120

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

Report No. SD72121426-1016A **October 2016**

REPORT ON	EMC Evaluation of the IPS Group Inc. Smart Collection Head Model No. 120
TEST REPORT NUMBER	SD72121426-1016A
REPORT DATE	October 2016
PREPARED FOR	IPS Group Inc. 7737 Kenamar Court San Diego, CA 92121
CONTACT PERSON	Gary Thomas Sr. RF Design Engineer (858) 768-2401 gary.thomas@ipsgroupinc.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
APPROVED BY	Juan Manuel Gonzalez Name Authorized Signatory Title: EMC SL Manager West Region
DATED	October 27, 2016

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

Revision History

SD72121426-1016A IPS Group Inc. Smart Collection Head Collection Cart with BLE					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
10/27/2016	Initial Release				Juan Manuel Gonzalez

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

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
IPS Group Inc.
Smart Collection Head

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the IPS Group Inc. Collection Cart with BLE 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	IPS Group Inc.
Model Number(s)	Smart Collection Head
FCC ID Number	SGWIPS2016SC
IC Number	11583A-IPS2016SC
Serial Number(s)	0021000056 and 0021000057
Number of Samples Tested	2
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.225 (October 1, 2015). • 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	October 24, 2016
Finish of Test	October 25, 2016
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 §15.225 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	N/A	Battery powered

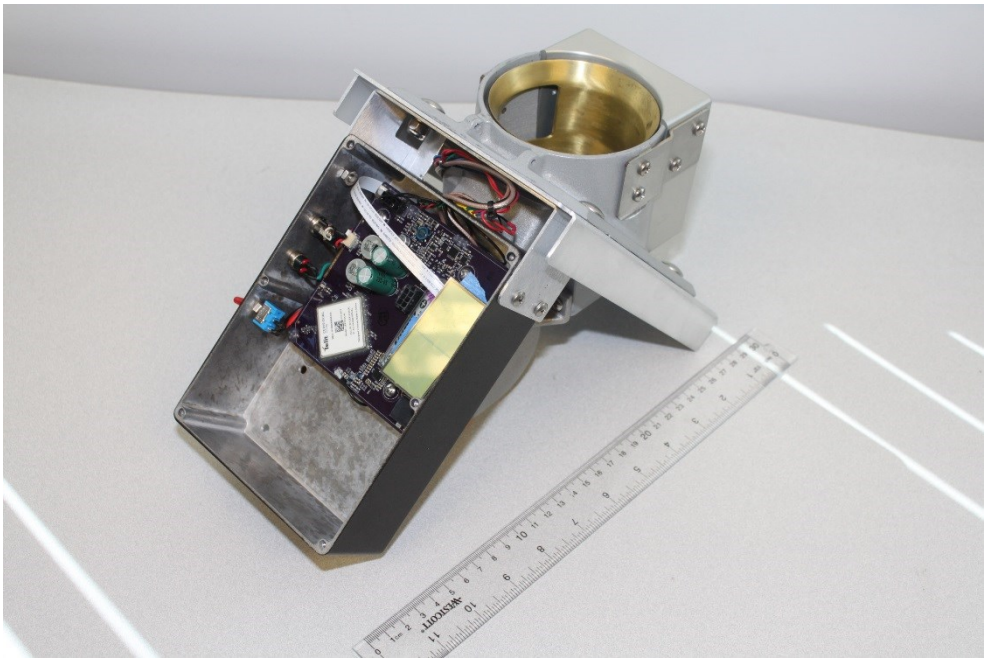
Test Note[1]: The EUT uses a permanently attached antenna to the intentional radiator and is considered sufficient evidence to comply with the provisions of this requirement.

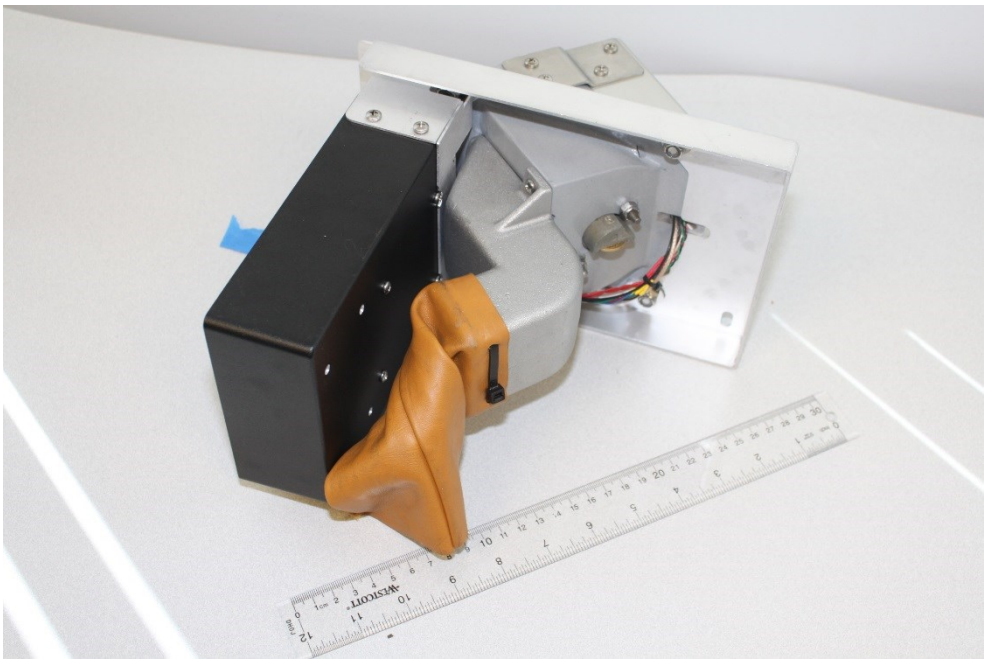
Test Note[2]: The EUT does not fall into the category of a Receiver as per RSS-Gen 5.0.

1.3 PRODUCT INFORMATION

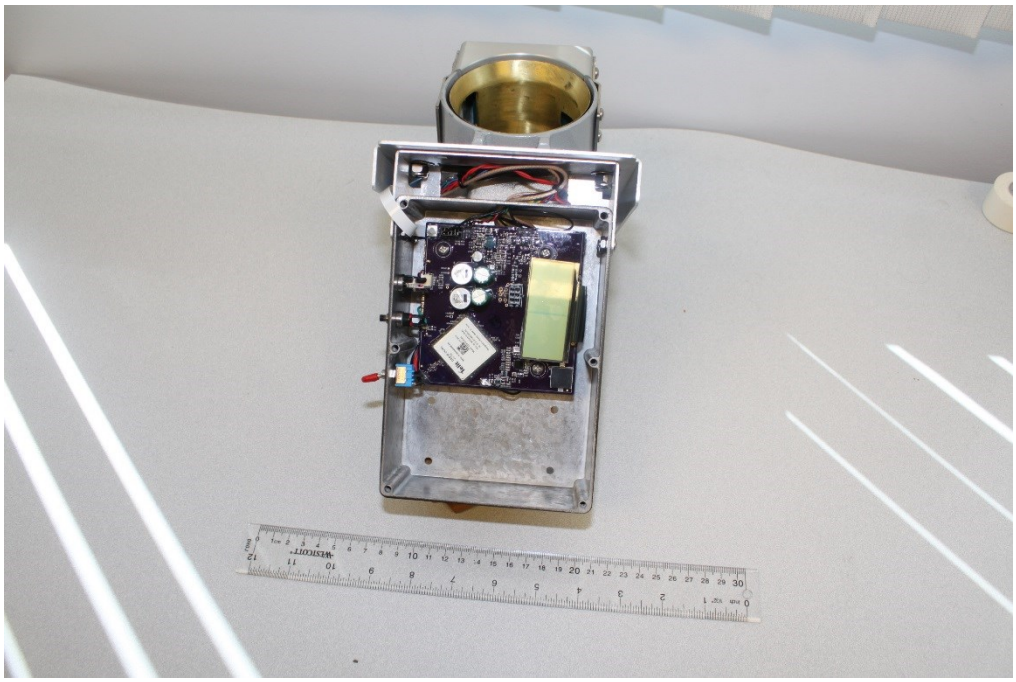
1.3.1 Technical Description

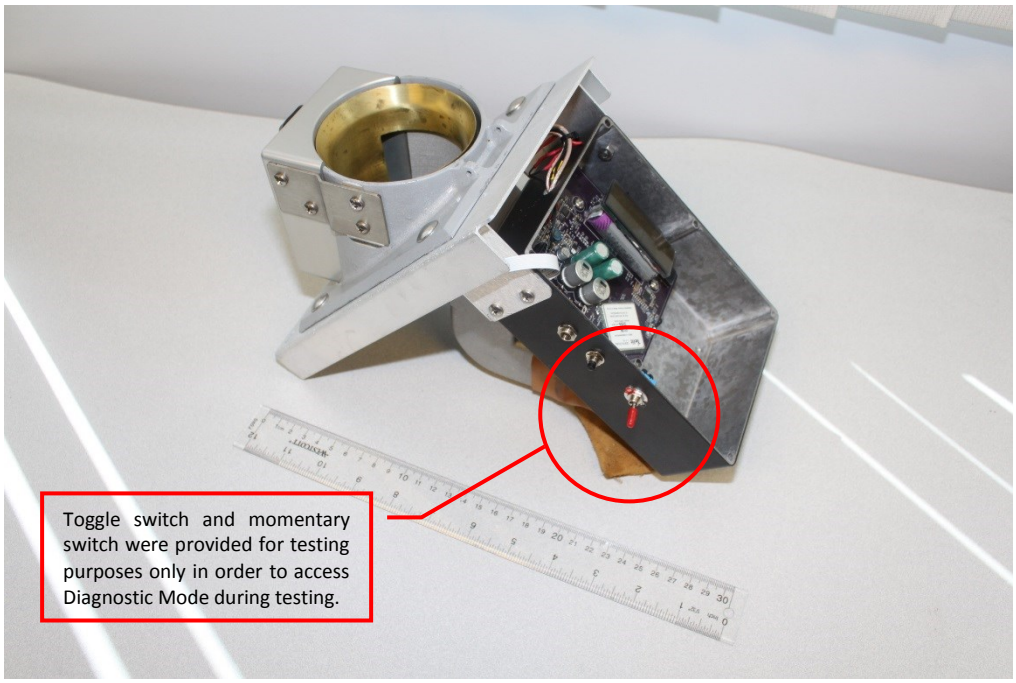
The Equipment Under Test (EUT) was an IPS Group Inc. Smart Collection Head Model no. 120 as shown in the photograph below. The EUT is part of the Smart Cash Collection System. It uses RFID for cashbox identification, BLE for recording information during collection process and Cellular for web-based Data Management System (DMS).





Equipment Under Test





Equipment Under Test

1.3.2 EUT General Description

EUT Description	Collection Cart with BLE
Model Name	Smart Collection Head
Model Number(s)	120
Rated Voltage	• Lithium Battery (3.6V) IPS Group Inc. TL-5420/5P/IPS • Tadiran Batteries TLI-1550A 4V 330mAh (on-board battery)
RFID Module Output Power	100 mW or 200 mW (programmable)
EUT RFID Field Strength	39.9 dBµV/m @ 3 meters
Frequency Range	13.56 MHz in the 13.110 to 14.0101 MHz band
Number of Operating Frequencies	1
Antenna Type	Integral
RFID Antenna Connector	IPX U.FL RF Coaxial Connector
Modulation Used	ISO 15693 Compliant
Antenna Part Number	795-773-PCBA Rev-01

1.3.3 Other Approved Module Installed

Technology	Chip Set	FCC ID	Output Power	Antenna Gain/Type
Cellular	Telit CE910-DUAL	RI7CE910-DUAL	0.292 watt	0.5 dBi, IPS LTE Batwing 795-771-PCB Rev 01
BLE	Bluegiga Oy BLE113	QOQBLE113	0.0011 watt	0.5 dBi, Mini 2.45 GHz Antenna, Johanson Technology P/N 2450AT18A100

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	*Description*
A	Transmit Mode. RFID polling, BLE set to single channel transmit mode and the cellular radio set to active under COMMS Test mode.
B	Standby Mode. BLE and cellular radio on standby mode. RFID still polling (default setting of the samples provided, the RFID however was designed for very close proximity operation thus field strength measurement at 3 meters is very low.

1.4.2 EUT Exercise Software

The EUT was running Diagnostic Software Version 62.70.7 when verified. RFID was activated by cycling through the menu until the RFID code was shown (e.g RFID:007000014D47F84). BLE was activated by cycling the menu until BLE appears (menu page 11). From this menu, any of the three test channels (Low, Mid and High) could be activated. Cellular radio was activated under the COMMS TEST (menu page 3) menu. Operation of the cellular radio could be verified by the SD10 LED on the main PCB.

1.4.3 Support Equipment and I/O cables

Manufacturer	*Equipment/Cable*	*Description*
N/A	N/A	-

1.4.4 Simplified Test Configuration Diagrams

Not required. EUT was verified on a standalone test configuration (no support equipment and no I/O cables).

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 0021000056 and 0021000057		
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.

SECTION 2

TEST DETAILS

Radio Testing of the
IPS Group Inc.
Smart Collection Head

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: 0021000056 / Test Configuration A

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

October 24, 2016 /FSC

2.1.5 Test Equipment Used

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

2.1.6 Environmental Conditions/ 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% on the battery terminal @ 20°C.
- The EUT was powered off, then powered on once the temperature stabilized and the frequency was then measured.
- The EUT has a backup battery on board (Tadiran Batteries TLI-1550A 4V 330mAh). Voltage variation tests were performed simulating this battery and not the main battery (IPS Group, Inc. TL-5420/5P/IPS 3.6V).

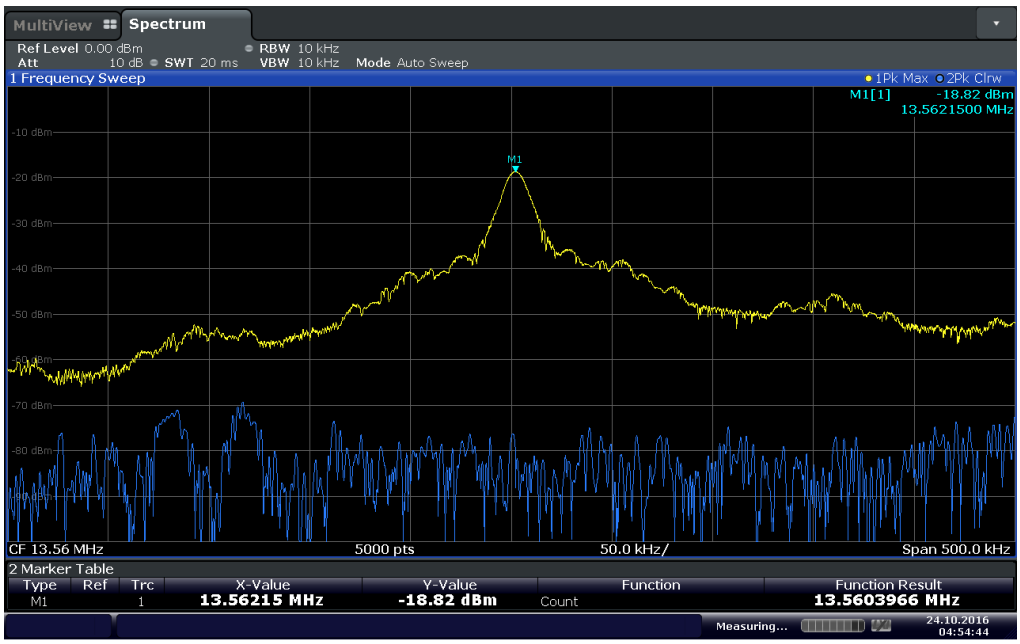
2.1.8 Test Results

RFID @ 13.56MHz					
Voltage (%)	***Power (VDC)***	***Temp (°C)***	***Frequency (Hz)***	***Frequency Deviation***	***Deviation (%)***
100	4.0	-20	13.5600127	0.0000127	0.0001
100		-10	13.5601865	0.0001865	0.0014
100		0	13.5602228	0.0002228	0.0016
100		+10	13.5608190	0.0008190	0.0060
100		+20	13.5606757	0.0006757	0.0050
100		+30	13.5604607	0.0004607	0.0034
100		+35	13.5609672	0.0009672	0.0071
100		+40	13.5605579	0.0005579	0.0041
100		+50	13.5603966	0.0003966	0.0029
Voltage Variation (85% and 115%)	3.4	+20	13.5603290	0.0003290	0.0024
	4.6	+20	13.5606916	0.0006916	0.0051

Maximum Deviation = 0.0071%
= 0.0071% < 0.01% Limit **(Complies)**

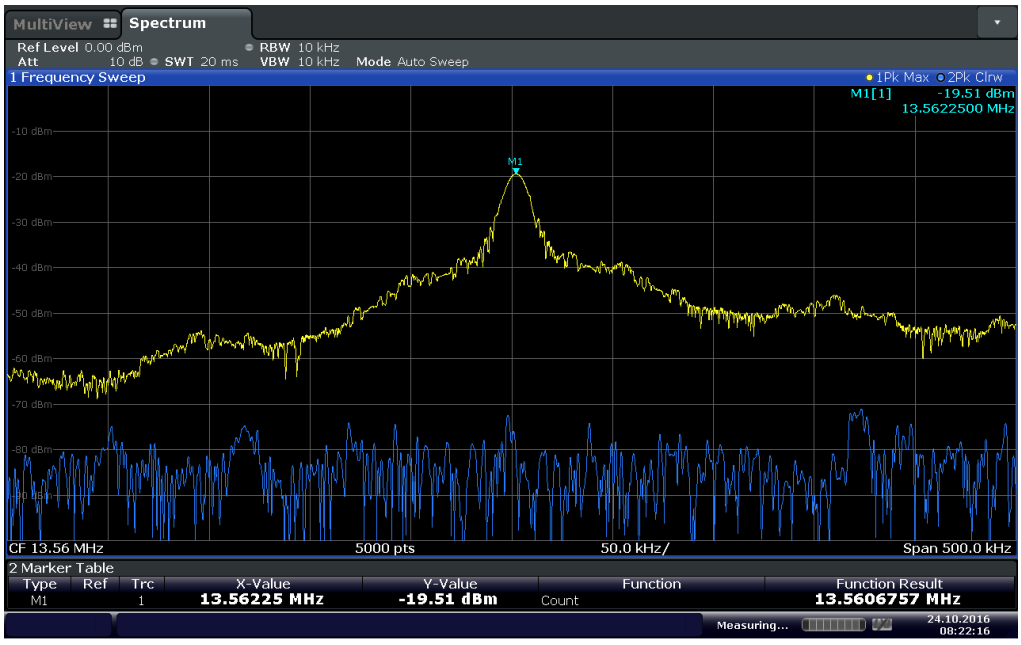
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.1.9 Sample Test Plots



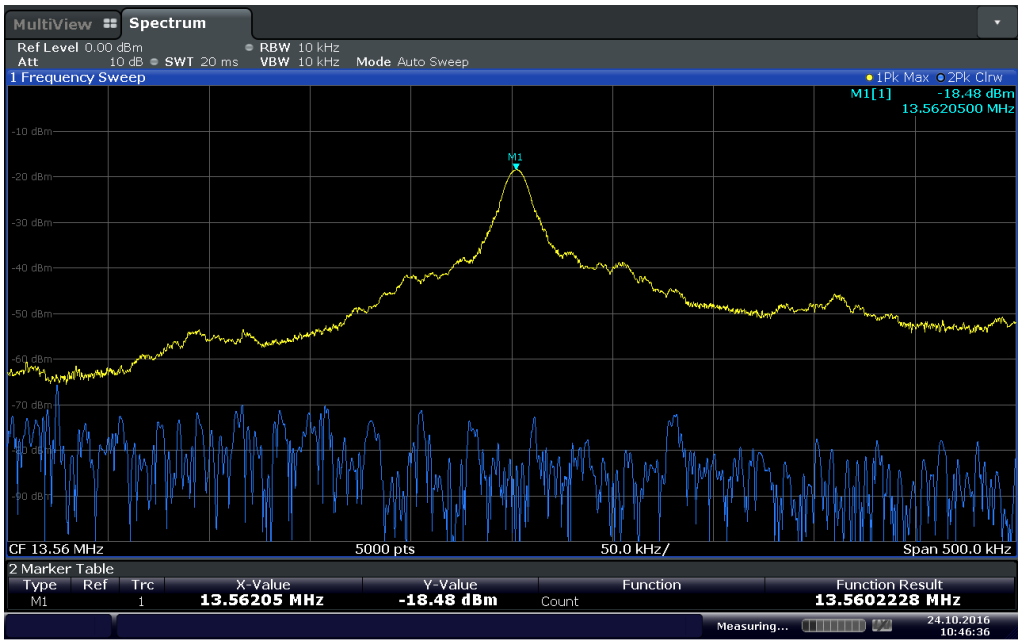
04:54:45 24.10.2016

Nominal Voltage @ 50°C



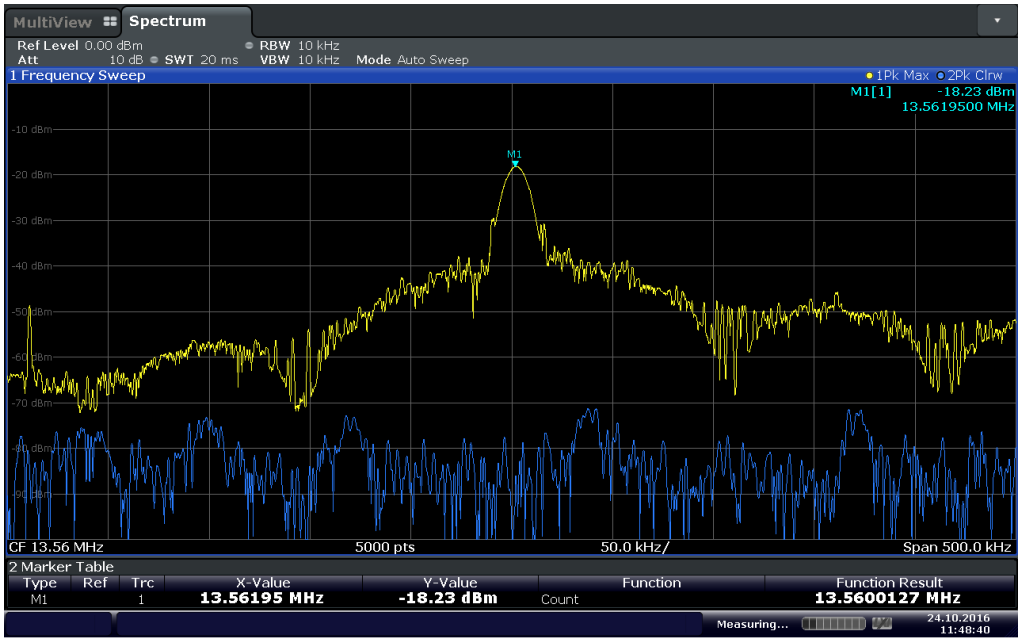
08:22:16 24.10.2016

Nominal Voltage @ 20°C



10:46:37 24.10.2016

Nominal Voltage @ 0°C



11:48:40 24.10.2016

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: 0021000056 / Test Configuration A

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

October 24, 2016 /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

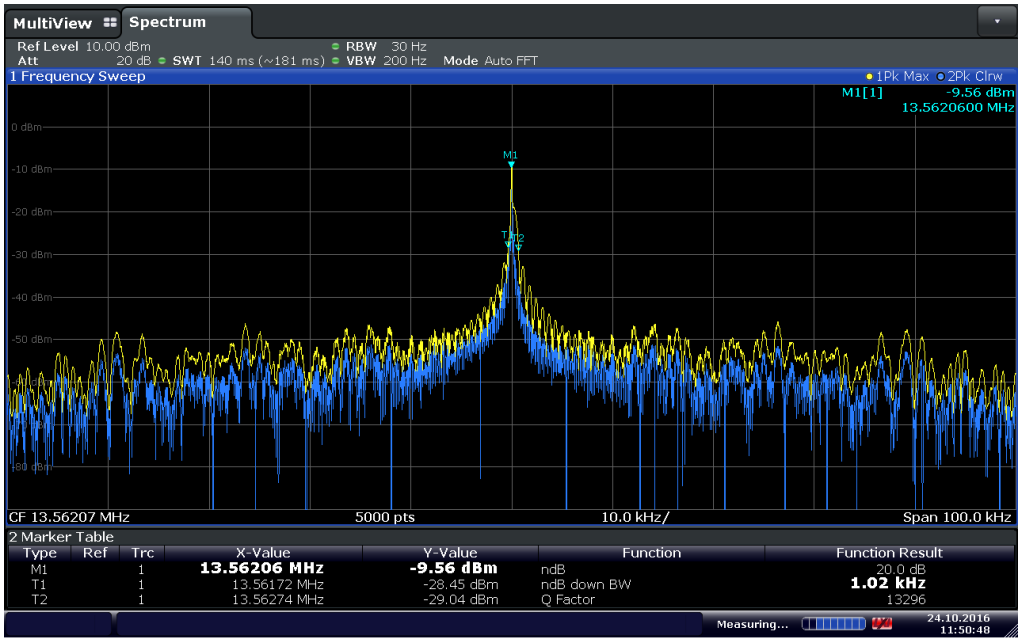
Ambient Temperature	26.1 °C
Relative Humidity	43.6 %
ATM Pressure	99.3 kPa

2.2.7 Additional Observations

- This is a conducted test.
- Span is wide enough to capture the channel transmission.
- RBW is set from 1% to 5% of the anticipated 20 dB bandwidth.
- 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	1.02 kHz



11:50:48 24.10.2016

Measured 20dB Bandwidth: 260.0 kHz
Frequency Band: 13.110 to 14.010 MHz

13.56 MHz – (20dB BW/2) = 13.55949 MHz (within the frequency band - **Compliant**)
13.56 MHz + (20dB BW/2) = 13.56051 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: 0021000056 / Test Configuration A

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

October 24, 2016 /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	26.1 °C
Relative Humidity	43.6 %
ATM Pressure	99.3 kPa

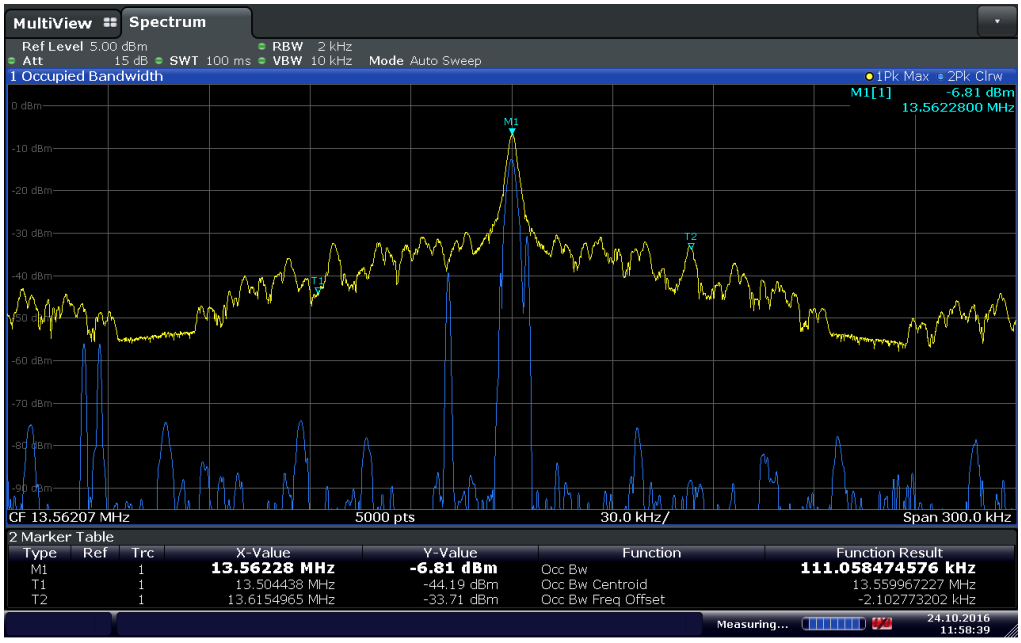
2.3.7 Additional Observations

- This is a conducted test.
- Span is wide enough to capture the channel transmission.
- RBW is set from 1% to 5% of the anticipated 99% EBW.
- 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	110.06 kHz



11:58:39 24.10.2016

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: 0021000057 / Test Configuration A

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

October 25, 2016 /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	25.5 °C
Relative Humidity	47.7 %
ATM Pressure	99.1 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.
- 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**

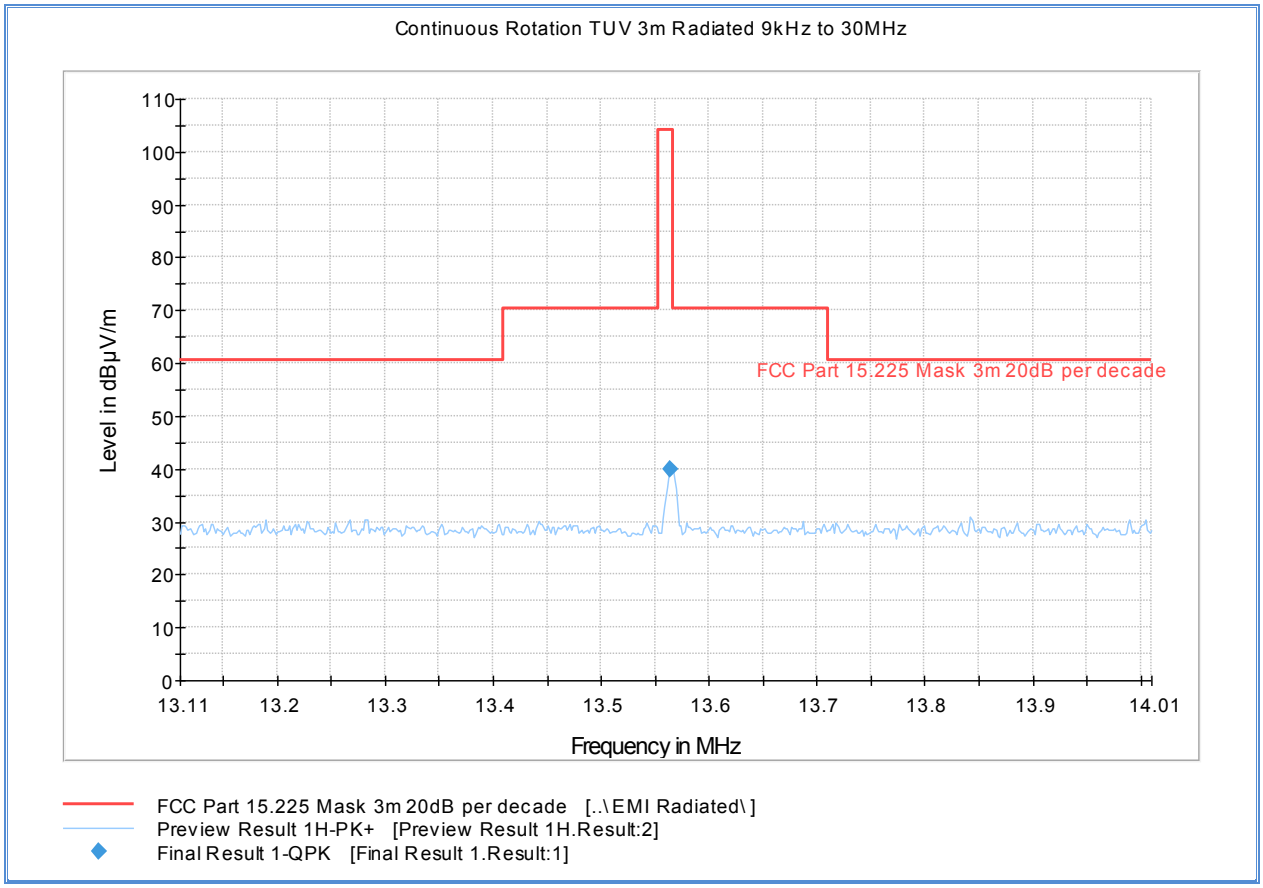
2.4.2 Sample Computation (Limits)

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)
13.564509	39.9	1500.0	9.000	100.0	H	351.0	20.9	64.1	104.0

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.

2.5.1 Equipment Under Test and Modification State

Serial No: 0021000057 / Test Configuration A

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

October 25, 2016 /FSC

2.5.3 Test Equipment Used

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

2.5.4 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.5 °C
Relative Humidity	47.7 %
ATM Pressure	99.1 kPa

2.5.5 Additional Observations

- This is a radiated test. The spectrum was searched from 9kHz to 26GHz (to satisfy intentional emitter composite emissions requirement, e.g inclusion of BLE and Cellular RF module).
- Plot presented are for both TX (composite) and RX (composite) modes.
- Only worst case channel per technology presented.
- There are no emissions found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.
- 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 for sample computation.

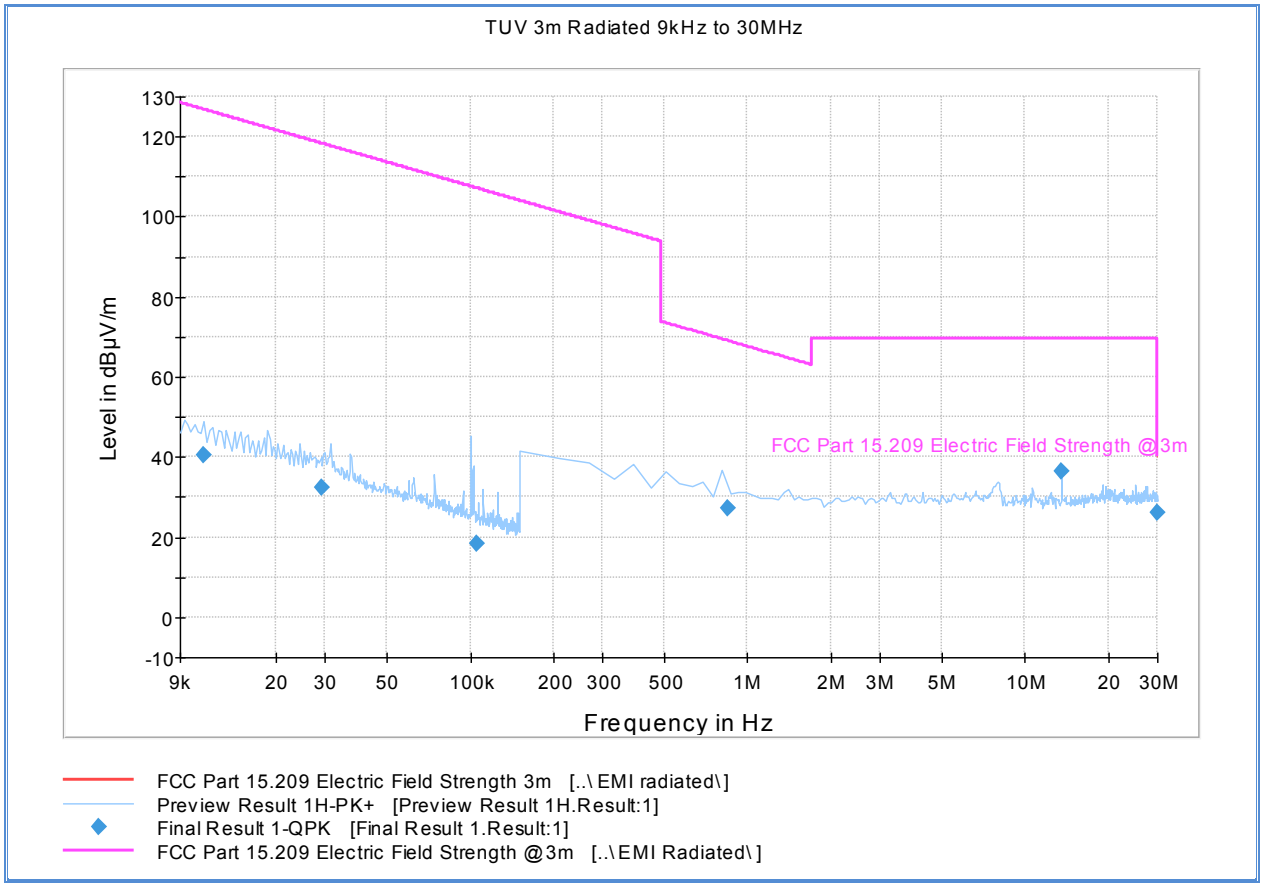
2.5.6 Sample Computation (Radiated Emission)

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**

2.5.7 Test Results

See attached plots.

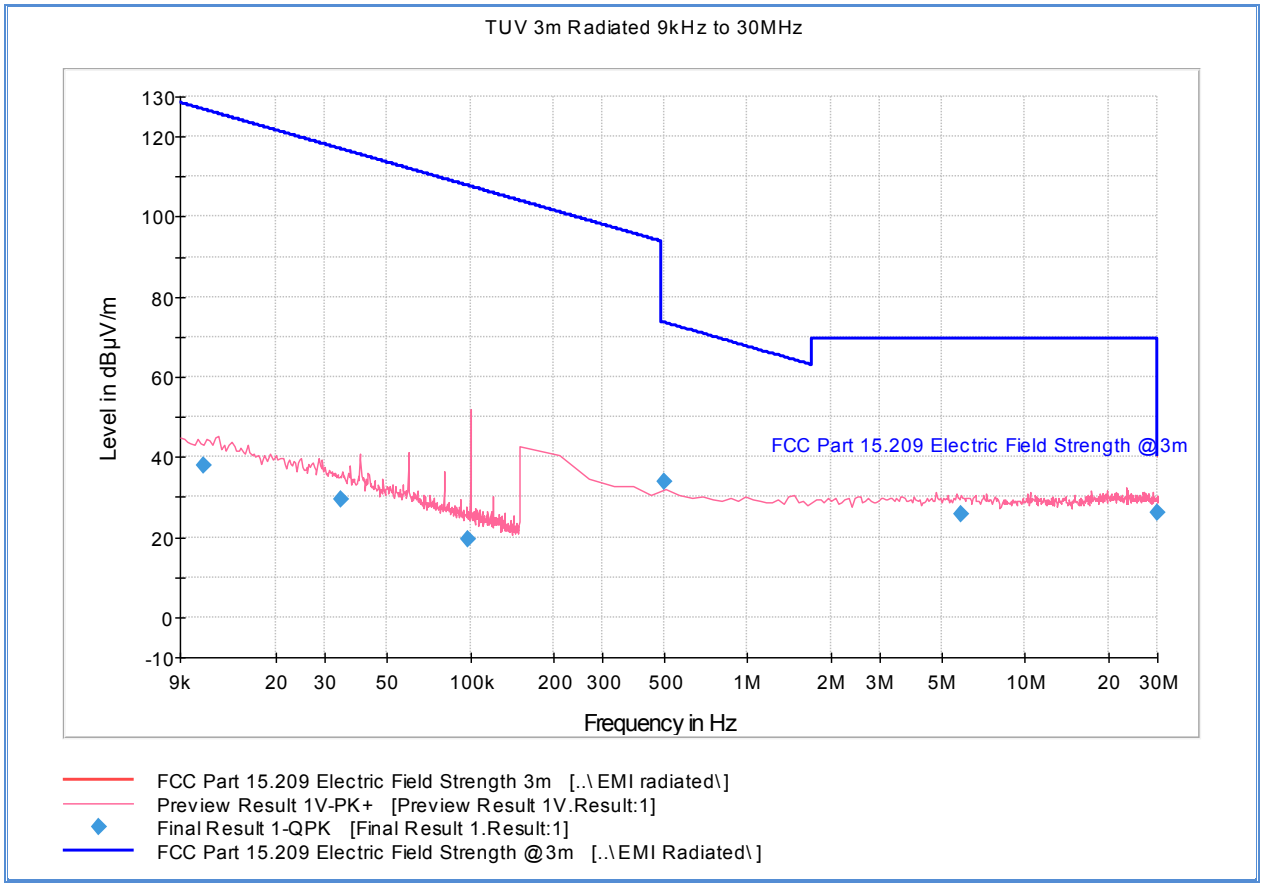
2.5.8 Test Results Below 30MHz (TX On, RFID, BLE and Cellular)



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)
0.011000	40.3	1000.0	0.200	100.0	H	168.0	23.8	86.5	126.8
0.029323	32.5	1000.0	0.200	100.0	H	332.0	21.4	85.8	118.3
0.106269	18.6	1000.0	0.200	100.0	H	270.0	19.6	88.5	107.1
0.846016	27.2	1500.0	9.000	100.0	H	168.0	19.7	41.9	69.1
13.563599	36.6	1500.0	9.000	100.0	H	330.0	20.9	33.0	69.5
29.938000	26.2	1500.0	9.000	100.0	H	-17.0	24.2	43.3	69.5

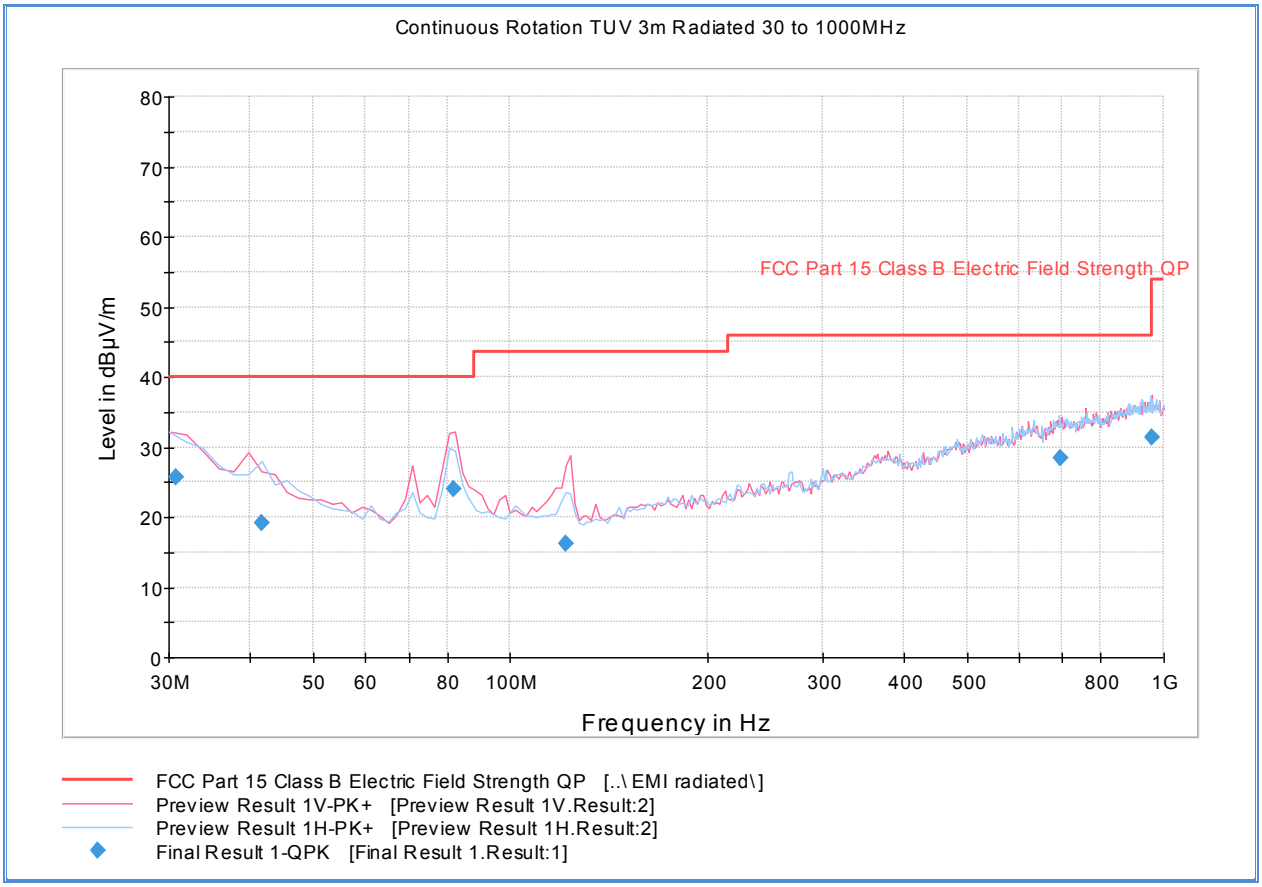
2.5.9 Test Results Below 30MHz (TX Off, RFID, BLE and Cellular)



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)
0.011000	37.8	1000.0	0.200	100.0	V	101.0	23.8	88.9	126.8
0.034082	29.3	1000.0	0.200	100.0	V	6.0	21.1	87.6	117.0
0.098269	19.6	1000.0	0.200	100.0	V	-10.0	19.6	88.1	107.8
0.502557	33.8	1500.0	9.000	100.0	V	343.0	19.7	39.8	73.6
5.883046	25.6	1500.0	9.000	100.0	V	281.0	20.6	43.9	69.5
29.898000	26.0	1500.0	9.000	100.0	V	255.0	24.2	43.5	69.5

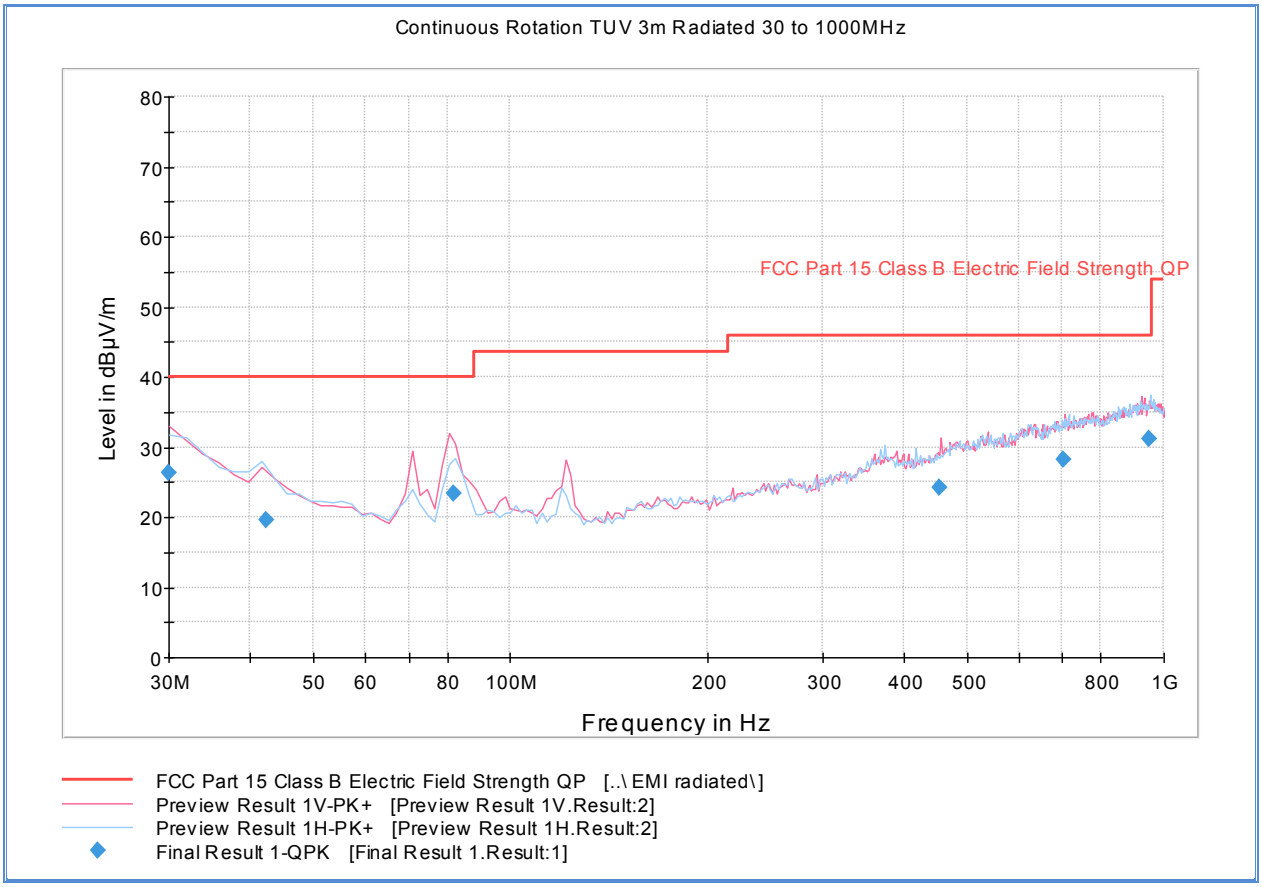
2.5.10 Test Results 30MHz to 1GHz (TX On, RFID, BLE and Cellular)



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)
30.800000	25.7	1000.0	120.000	395.0	H	157.0	-5.3	14.3	40.0
41.647214	19.2	1000.0	120.000	105.0	V	127.0	-11.4	20.8	40.0
82.084970	23.9	1000.0	120.000	100.0	V	-5.0	-15.5	16.1	40.0
121.746613	16.3	1000.0	120.000	300.0	V	-12.0	-14.4	27.2	43.5
693.105731	28.5	1000.0	120.000	189.0	H	230.0	4.6	17.5	46.0
958.834469	31.4	1000.0	120.000	278.0	V	309.0	8.7	14.6	46.0

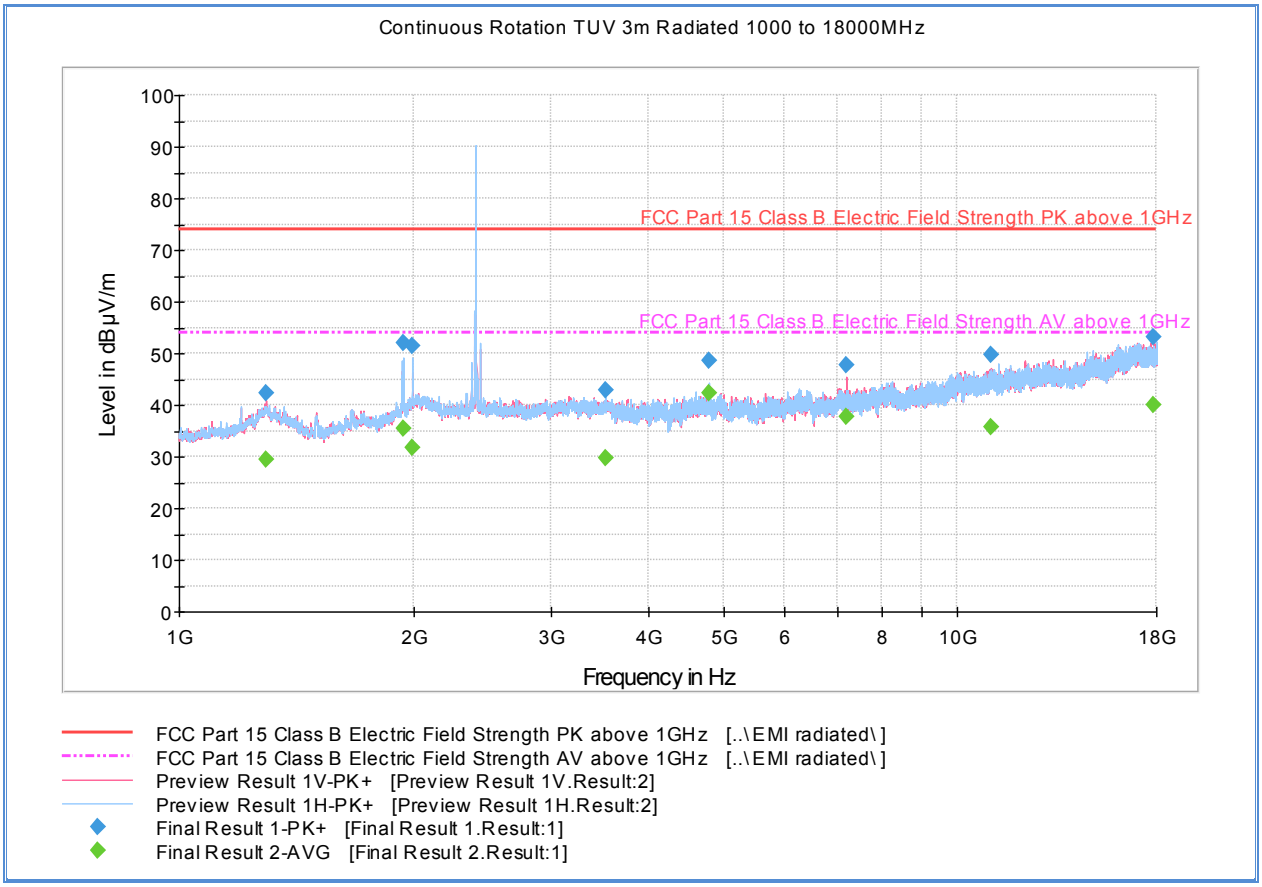
2.5.11 Test Results 30MHz to 1GHz (TX Off, RFID, BLE and Cellular)



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)
30.000000	26.4	1000.0	120.000	350.0	V	294.0	-4.6	13.6	40.0
42.207214	19.6	1000.0	120.000	400.0	H	-15.0	-11.6	20.4	40.0
81.781082	23.5	1000.0	120.000	100.0	V	7.0	-15.5	16.5	40.0
454.231423	24.2	1000.0	120.000	100.0	V	62.0	-1.2	21.8	46.0
701.137395	28.3	1000.0	120.000	100.0	H	7.0	4.7	17.7	46.0
950.946693	31.2	1000.0	120.000	400.0	H	324.0	8.5	14.8	46.0

2.5.12 Test Results above 1GHz (TX On, RFID, BLE and Cellular)



Peak Data

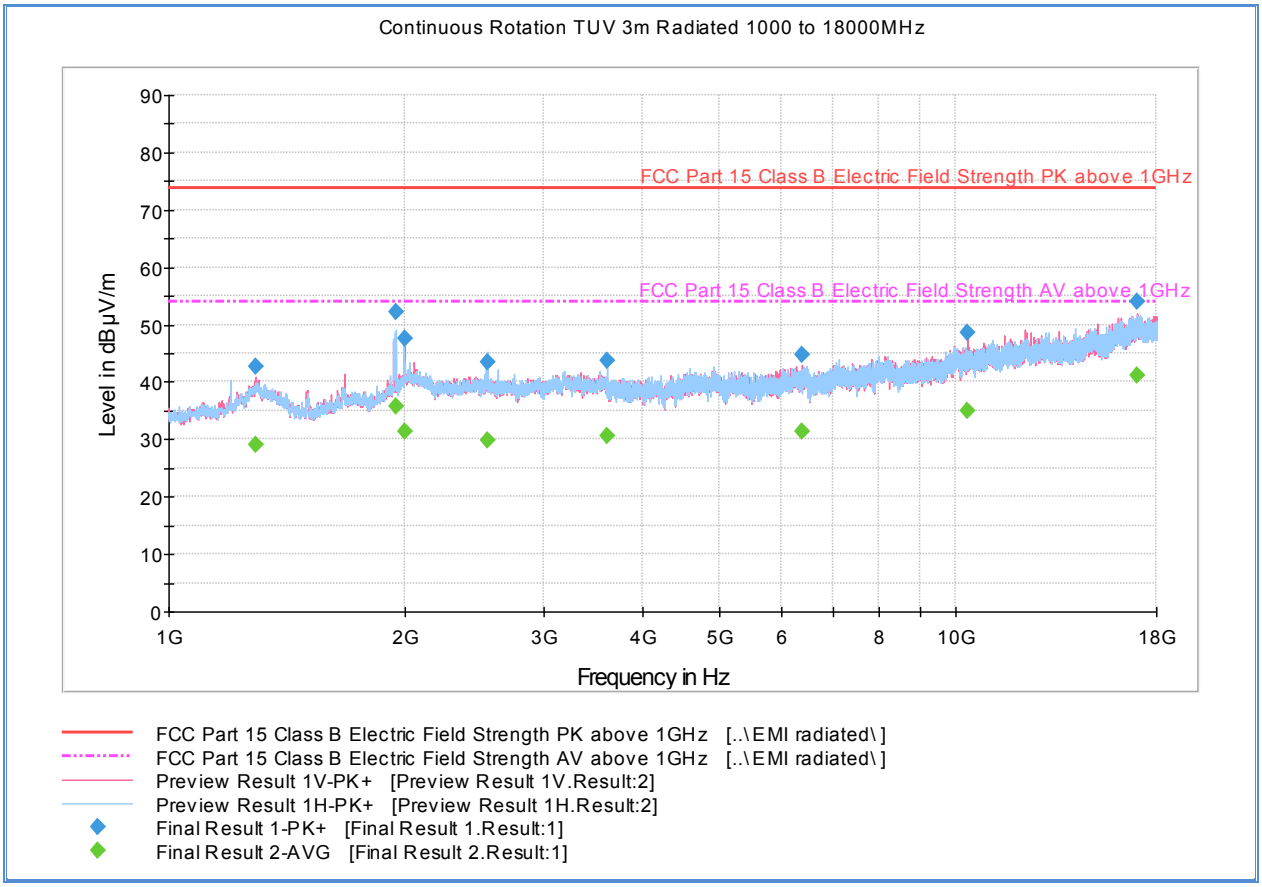
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1292.933333	42.3	1000.0	1000.000	111.7	V	269.0	-4.6	31.6	73.9
1941.066667	52.0	1000.0	1000.000	387.0	H	39.0	-0.6	21.9	73.9
1990.766667	51.4	1000.0	1000.000	407.9	H	331.0	-0.2	22.5	73.9
3535.266667	42.9	1000.0	1000.000	301.6	H	90.0	1.0	31.0	73.9
4804.233333	48.7	1000.0	1000.000	260.3	H	33.0	3.2	25.2	73.9
7206.333333	47.6	1000.0	1000.000	406.7	V	102.0	7.2	26.3	73.9
11037.933333	49.6	1000.0	1000.000	387.0	V	-19.0	12.8	24.3	73.9
17826.033333	53.1	1000.0	1000.000	347.1	V	182.0	20.3	20.8	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)
1292.933333	29.4	1000.0	1000.000	111.7	V	269.0	-4.6	24.5	53.9
1941.066667	35.5	1000.0	1000.000	387.0	H	39.0	-0.6	18.4	53.9
1990.766667	31.7	1000.0	1000.000	407.9	H	331.0	-0.2	22.2	53.9
3535.266667	29.7	1000.0	1000.000	301.6	H	90.0	1.0	24.2	53.9
4804.233333	42.3	1000.0	1000.000	260.3	H	33.0	3.2	11.6	53.9
7206.333333	37.6	1000.0	1000.000	406.7	V	102.0	7.2	16.3	53.9
11037.933333	35.8	1000.0	1000.000	387.0	V	-19.0	12.8	18.1	53.9
17826.033333	39.9	1000.0	1000.000	347.1	V	182.0	20.3	14.0	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.5.13 Test Results above 1GHz (TX Off, RFID, BLE and Cellular)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1287.833333	42.6	1000.0	1000.000	218.4	V	-6.0	-4.8	31.3	73.9
1941.433333	52.3	1000.0	1000.000	388.0	H	70.0	-0.6	21.6	73.9
1992.766667	47.6	1000.0	1000.000	165.6	V	310.0	-0.2	26.3	73.9
2540.800000	43.5	1000.0	1000.000	402.0	H	295.0	-0.8	30.4	73.9
3606.466667	43.8	1000.0	1000.000	401.7	H	53.0	1.3	30.1	73.9
6376.766667	44.7	1000.0	1000.000	128.7	V	182.0	6.0	29.2	73.9
10341.300000	48.6	1000.0	1000.000	399.0	V	-7.0	11.8	25.3	73.9
17026.266667	54.1	1000.0	1000.000	402.7	V	20.0	19.9	19.8	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1287.833333	29.0	1000.0	1000.000	218.4	V	-6.0	-4.8	24.9	53.9
1941.433333	35.7	1000.0	1000.000	388.0	H	70.0	-0.6	18.2	53.9
1992.766667	31.4	1000.0	1000.000	165.6	V	310.0	-0.2	22.5	53.9
2540.800000	29.8	1000.0	1000.000	402.0	H	295.0	-0.8	24.1	53.9
3606.466667	30.5	1000.0	1000.000	401.7	H	53.0	1.3	23.4	53.9
6376.766667	31.2	1000.0	1000.000	128.7	V	182.0	6.0	22.7	53.9
10341.300000	35.0	1000.0	1000.000	399.0	V	-7.0	11.8	18.9	53.9
17026.266667	41.1	1000.0	1000.000	402.7	V	20.0	19.9	12.8	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

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

Not performed. EUT is battery powered and designed to be charged via solar cells.

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						
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/02/16	09/02/17
6628	Loop Antenna	HFH 2 –Z2	880 458/25	Rhode & Schwarz	10/28/15	10/28/16
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
1016	Pre-amplifier	PAM-0202	187	PAM	12/15/15	12/15/16
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	05/12/16	05/12/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	01/11/16	01/11/17
1150	Horn antenna	3160-09	012054-004	ETS	07/16/15	07/16/17
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	Verified by 7608 and 7611	
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7608 and 7611	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 7608 and 7611	
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/29/17
	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 (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	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)

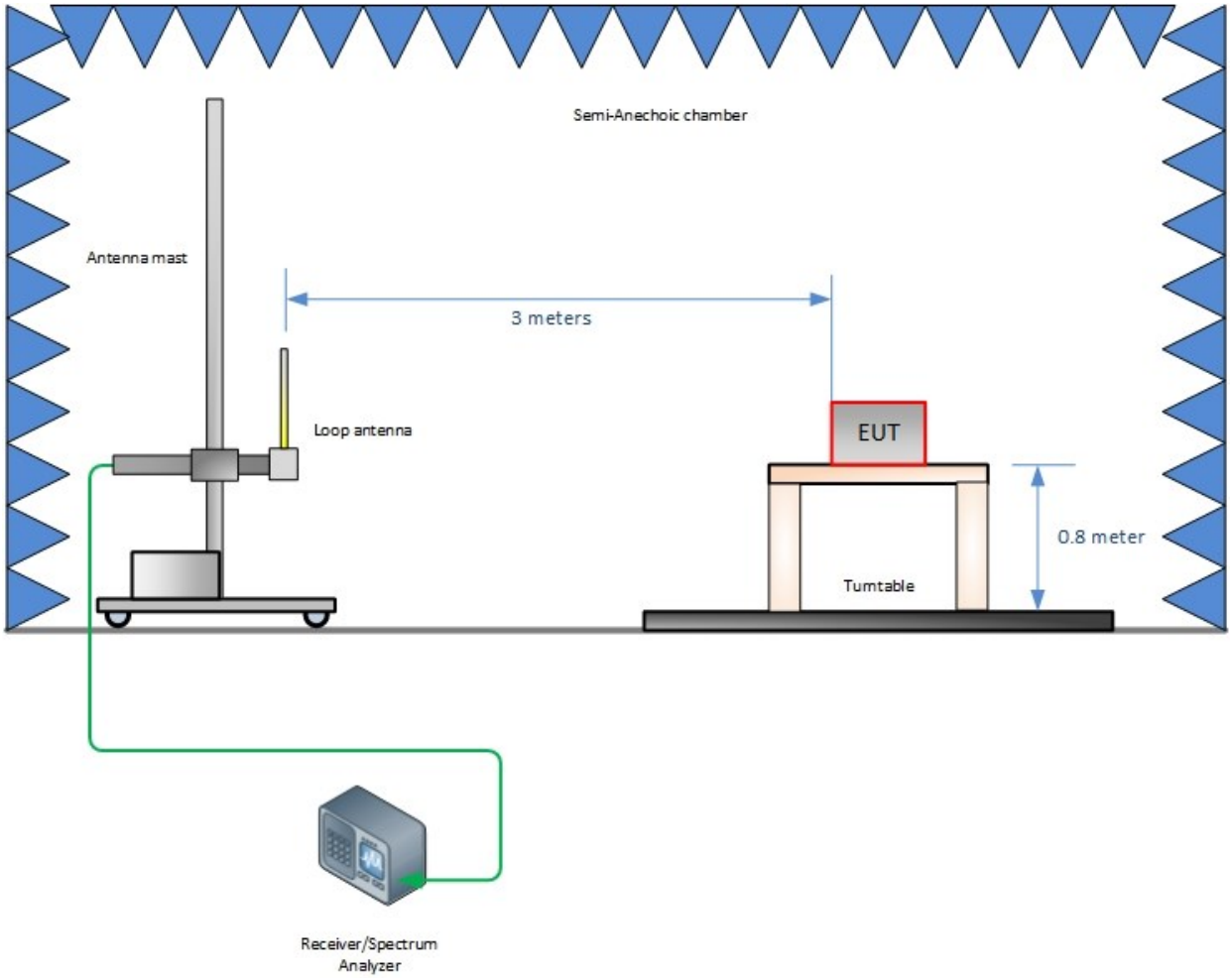
	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	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

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

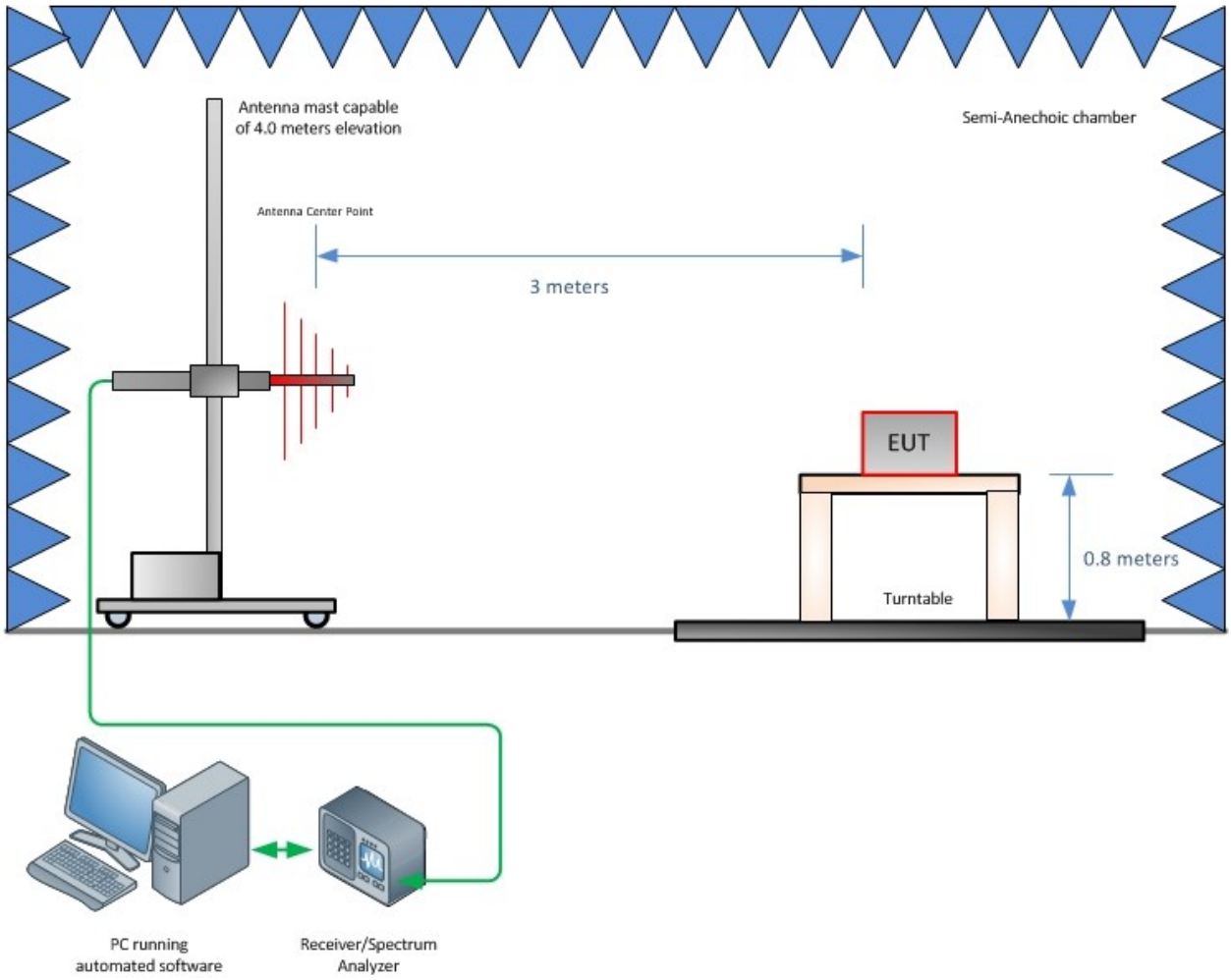
SECTION 4

DIAGRAM OF TEST SETUP

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

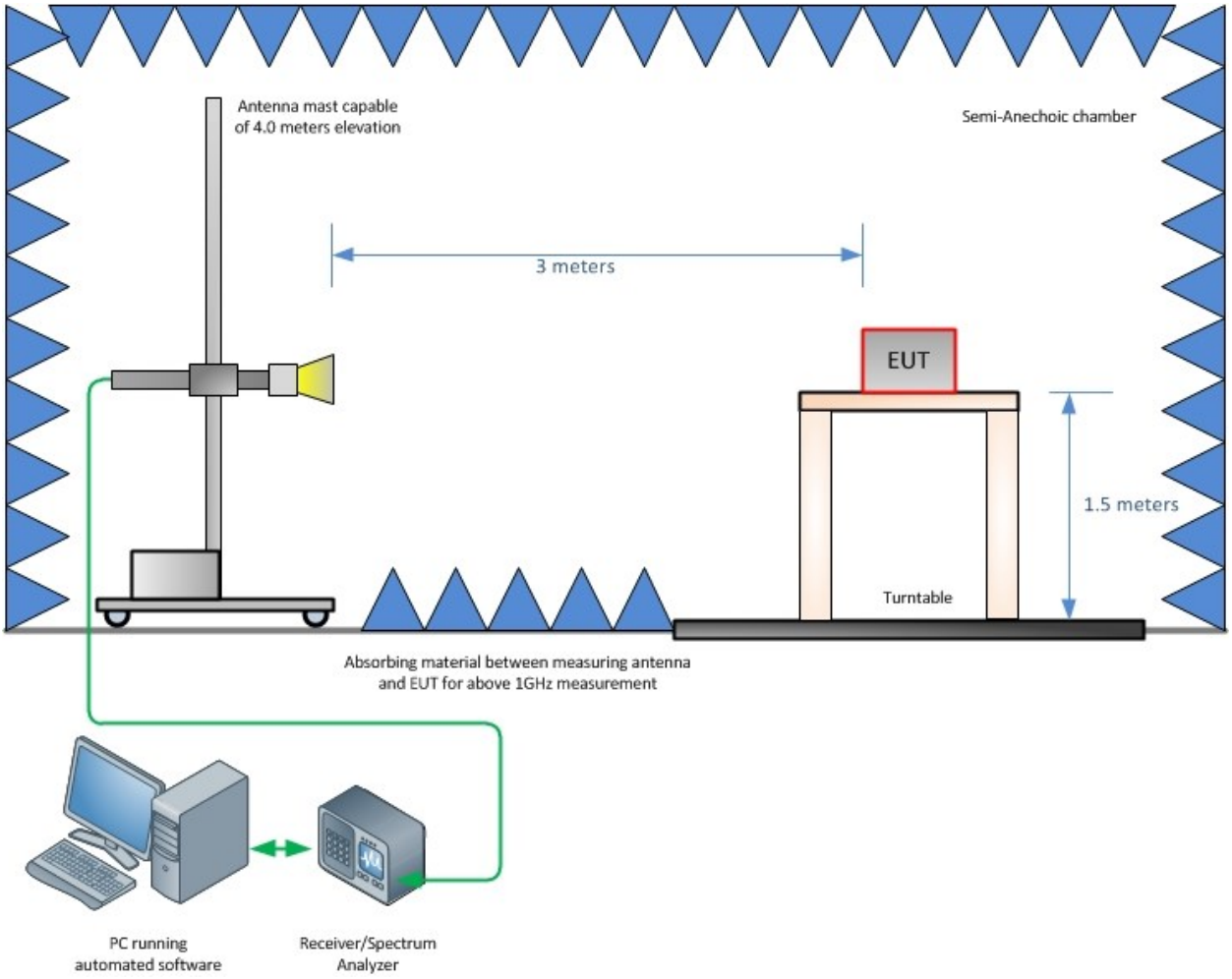


4.2 TEST SETUP DIAGRAM (30MHZ TO 1GHZ)



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

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