Report On

Radio Testing of the
Continental Automotive Systems
Model RFHUB JL Passive Keyless Entry Base Station Module

FCC Part 15 Subpart C §15.207 and §15.209
IC RSS-Gen Issue 4 November 2014

Report No. JT72128999-0617A Rev.1 June 2017

REPORT ON	EMC Evaluation of the Continental Automotive Systems RFHUB JL Model No. 68307133;68307134;68307135
TEST REPORT NUMBER	JT72128999-0617A Rev.1
REPORT DATE	June 2017
PREPARED FOR	Continental Automotive Systems 4685 Investment Drive Auburn Hills, MI 48326
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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	July 12, 2017

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

Revision History

JT72128999-0617A Rev.1 Continental Automotive Systems Passive Keyless Entry Base Station Module					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
07/12/2017	Initial Release				Juan Manuel Gonzalez
07/20/2017	Initial Release	Rev.1	Update model numbers as per Manufacturer request		Ferdinand Custodio

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Continental Automotive Systems
Passive Keyless Entry Base Station Module

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Continental Automotive Systems Model RFHUB JL Passive Keyless Entry Base Station Module to the requirements of the following:

- FCC Part 15 Subpart C §15.207 and §15.209
- IC RSS-Gen Issue 4 November 2014.

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	Continental Automotive Systems
Model Name	RFHUB JL
Model Number(s)	68307133;68307134;68307135
FCC ID Number	M3N-11207900
IC Number	7812A-11207900
Serial Number(s)	084AA709700132
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.207 and §15.209 (October 1, 2016). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 4, November 2014).
Start of Test	June 21, 2017
Finish of Test	June 23, 2017
Name of Engineer(s)	Ferdie 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 §15.207 and §15.209 with cross-reference to RSS-Gen is shown below:

Section	FCC Part 15	RSS	Test Description	Result	Comments/Base Standard
	§15.203 and 204	RSS-Gen 8.3	Antenna Requirements	Compliant	See Test Note[1]
2.1		RSS-Gen 6.6	Occupied Bandwidth	Compliant	
2.2	§15.209(a)	RSS-Gen 8.9	Radiated emission limits; general requirements	Compliant	
2.3		RSS-Gen 8.11	Transmitter Frequency Stability	Compliant	
2.4	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	N/A	See Test Note[2]
		RSS-Gen 7.0	Receiver Spurious Emissions	N/A	See Test Note[3]

Test Note[1]: The EUT is professionally installed and used as OEM in the automotive industry.
Test Note[2]: Not required. The EUT do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. The EUT is designed for vehicle use only.
Test Note[3]: The EUT does not fall into the category of a Receiver as per RSS-Gen 5.0.

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1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Continental Automotive Systems Model RFHUB JL Passive Keyless Entry Base Station Module as shown in the photograph below. The EUT is an integrated receiver (base station) in the vehicle that interfaces with the Remote Keyless Entry (RKE) FOBIK using RF and LF. The EUT only transmits at 125 kHz and receive only at 433.92 MHz. Three (3) models are covered by this test report and the declared worst case representative model was verified (68307133).

1.3.2 EUT General Description

EUT Description	Passive Keyless Entry Base Station Module
Model Number(s)	68307133;68307134;68307135
Rated Voltage	12VDC
Frequency (Capability)	125 kHz (TX) / 433.92 MHz (RX)
Mode Verified	125 kHz
Modulation	ASK
Measured Field Strength	92.2 dBµV/m @ 3 meters or 81.74 dBµV/m @ 10 meters
Calculated Power	50mW EIRP / -3.03 dBm EIRP
Operating Temperature	-40°C to +85°C
Humidity	<93%RH non-condensing
Size	151 mm W x 110 mm D x 30 mm H
Weight	128 g
Antenna	Chrysler Part No. 04749301 AB
Q-Factor	Q>50
Resonant Frequency	> 800kHz
Inductance L	104µH ±3%

1.3.3 Model Table

Customer P/N	LF Frequency	RF Frequency	Description
68307133	125 kHz	433.92 MHz	LF Tx, RF Rx, Auto Transmission, Internal RF Antenna
68307134	125 kHz	433.92 MHz	LF Tx, RF Rx, Auto Transmission, External RF Antenna
68307135	125 kHz	433.92 MHz	LF Tx, RF Rx, Manual Transmission, Internal RF Antenna

The three (3) variants of the EUT all uses the same PCB layout. The differences for these variants are that they populate either internal receive antenna circuitry or external receive antenna circuitry, and populate either manual (stick) vehicle transmission brake or automatic vehicle transmission park circuitry (digital components which are not related to either receiving or transmitting).

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	Continuous Modulation Emission mode. All switches on the support switch box are set to "On". Modulated data being transmitted every 73ms for 5 seconds on each antenna sequentially. The EUT does not transmit simultaneously by design.

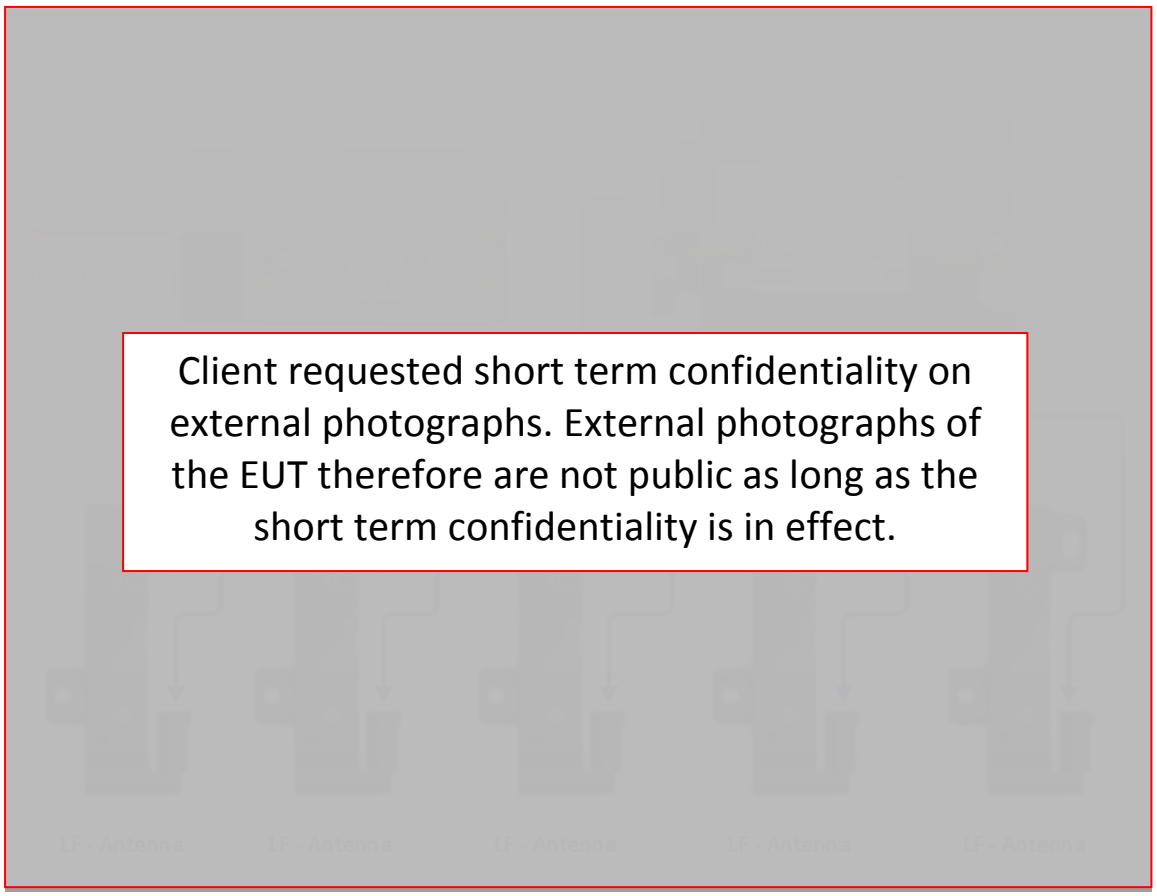
1.4.2 EUT Exercise Software

None. No special software was used during evaluation.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Continental	Support Switch Box	JL RFHM Homologation switch box

1.4.4 Simplified Test Configuration Diagram



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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 084AA709700132		
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
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Passive Keyless Entry Base Station Module

2.1 99% EMISSION BANDWIDTH

2.1.1 Specification Reference

RSS-Gen Clause 6.6

2.1.2 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.

2.1.3 Equipment Under Test and Modification State

Serial No: 084AA709700132 / Default Test Configuration

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

June 21, 2017 /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	26.0 °C
Relative Humidity	48.0 %
ATM Pressure	98.3 kPa

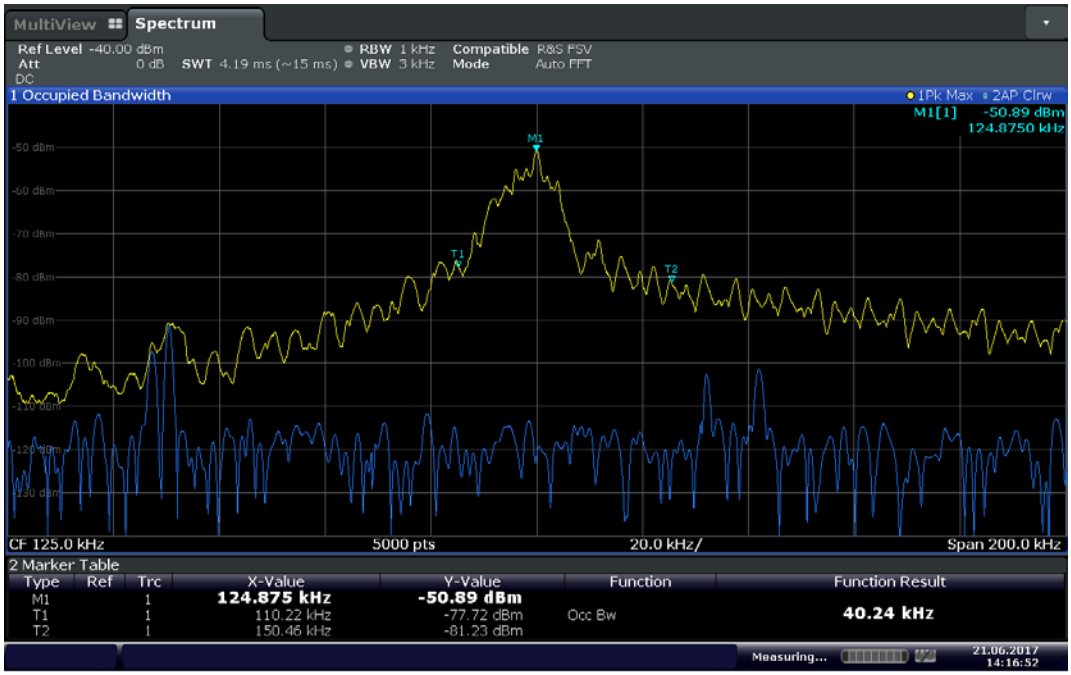
2.1.7 Additional Observations

- 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.

2.1.8 Test Results (Reporting Purposes Only)

Frequency	99% Emission bandwidth
124.875 kHz	40.24 kHz



99% OBW

2.2 RADIATED EMISSION LIMITS; GENERAL REQUIREMENTS

2.2.1 Specification Reference

Part 15 Subpart C §15.209(a) and RSS-Gen 8.9

2.2.2 Standard Applicable

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.2.3 Equipment Under Test and Modification State

Serial No: 084AA709700132 / Default Test Configuration

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

June 23, 2017/FSC

2.2.5 Test Equipment Used

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

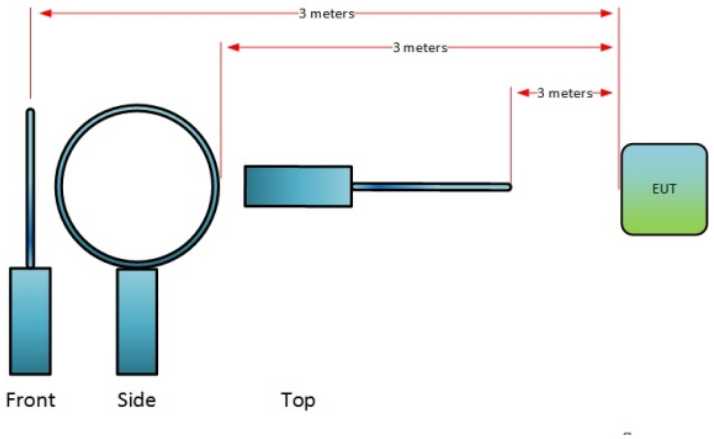
2.2.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	27.4 °C
Relative Humidity	43.0 %
ATM Pressure	98.9 kPa

2.2.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9 kHz to the 1 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 below) corresponding to the best antenna orientation as found during the prescans.
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.2.8 and 2.2.9 for sample computations.



2.2.8 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**

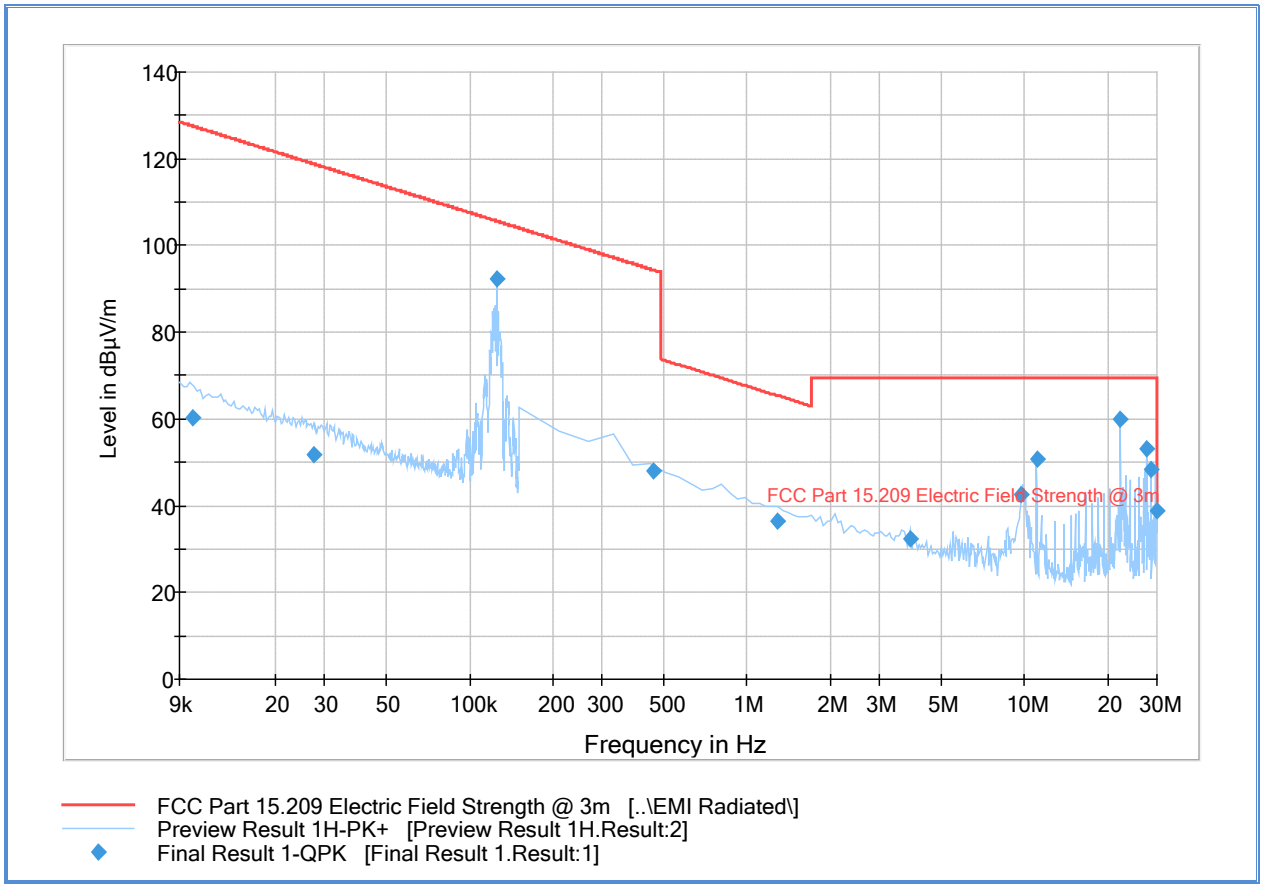
2.2.9 Sample Computation (Radiated Emission 30 MHz to 1 GHz)

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**

2.2.10 Test Results

See attached plots.

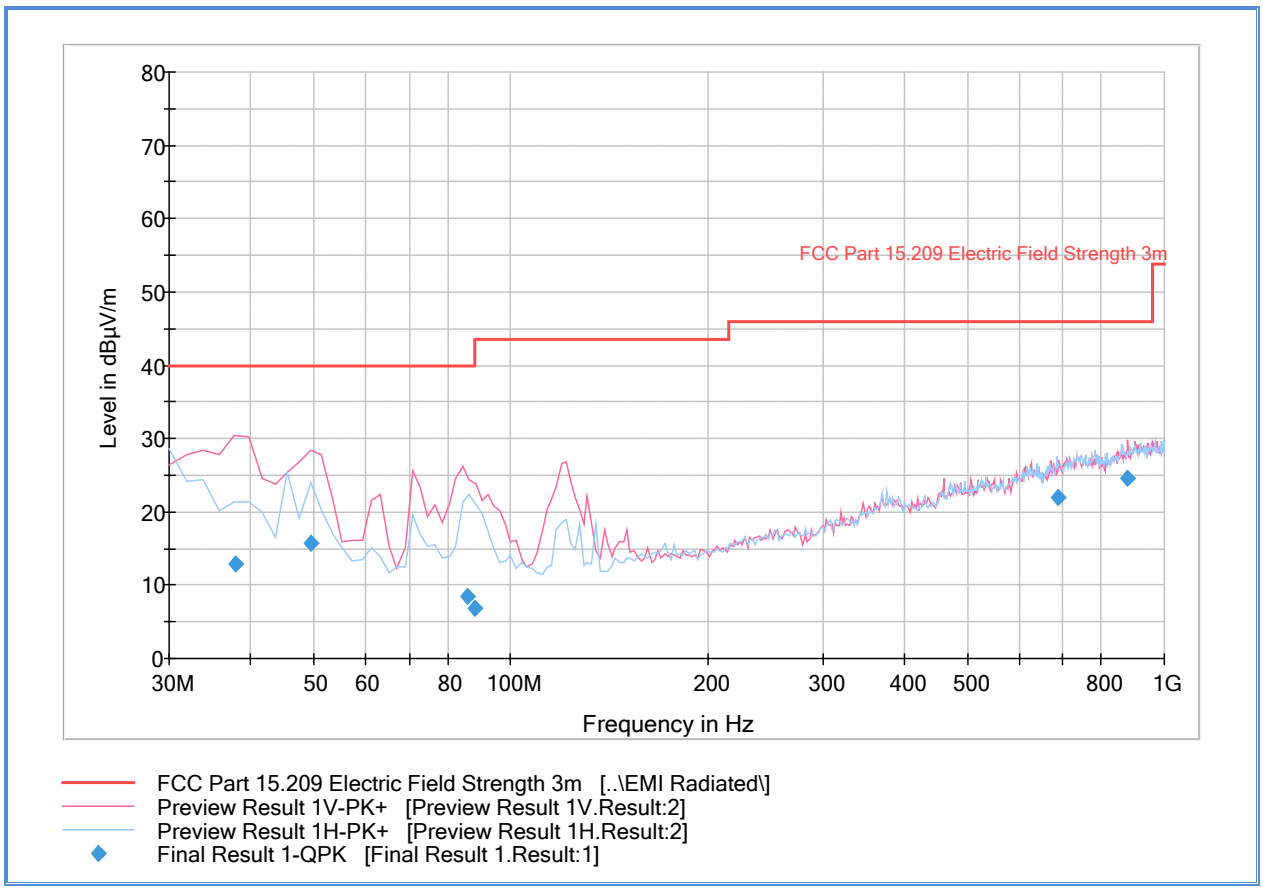
2.2.11 Test Results Below 30MHz



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)
0.010000	60.3	1000.0	0.200	150.0	H	2.0	15.7	67.3	127.6
0.027475	51.8	1000.0	0.200	150.0	H	216.0	15.5	67.1	118.8
0.125134	92.2	1000.0	0.200	150.0	H	94.0	14.4	13.7	105.9
0.457918	48.1	1500.0	9.000	150.0	H	116.0	14.6	46.3	94.4
1.279573	36.6	1500.0	9.000	150.0	H	271.0	15.1	28.9	65.5
3.859818	32.5	1500.0	9.000	150.0	H	109.0	15.5	37.0	69.5
9.746142	42.5	1500.0	9.000	150.0	H	125.0	16.0	27.1	69.5
11.058174	50.9	1500.0	9.000	150.0	H	101.0	16.3	18.7	69.5
22.120627	59.9	1500.0	9.000	150.0	H	16.0	16.1	9.6	69.5
27.652034	53.0	1500.0	9.000	150.0	H	0.0	15.2	16.5	69.5
28.573148	48.3	1500.0	9.000	150.0	H	-14.0	15.3	21.2	69.5
29.953000	38.7	1500.0	9.000	150.0	H	59.0	15.1	30.8	69.5

2.2.12 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)
37.935551	12.9	1000.0	120.000	110.0	V	159.0	-11.3	27.1	40.0
49.478878	15.8	1000.0	120.000	150.0	V	305.0	-14.3	24.2	40.0
86.028858	8.5	1000.0	120.000	150.0	V	1.0	-16.6	31.5	40.0
87.932745	6.8	1000.0	120.000	259.0	V	-12.0	-16.3	33.2	40.0
686.770180	21.9	1000.0	120.000	100.0	H	-8.0	2.6	24.1	46.0
878.838958	24.5	1000.0	120.000	182.0	V	26.0	5.0	21.5	46.0

2.3 TRANSMITTER FREQUENCY STABILITY

2.3.1 Specification Reference

RSS-Gen 8.11

2.3.2 Standard Applicable

Transmitter frequency stability for licence-exempt radio apparatus shall be measured in accordance with Section 6.11. For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F) instead of at the temperatures specified in Section 6.11.

If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz.

2.3.3 Equipment Under Test and Modification State

Serial No: 084AA709700132 / Default Test Configuration

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

June 23, 2017/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	27.4 °C
Relative Humidity	43.0 %
ATM Pressure	98.9 kPa

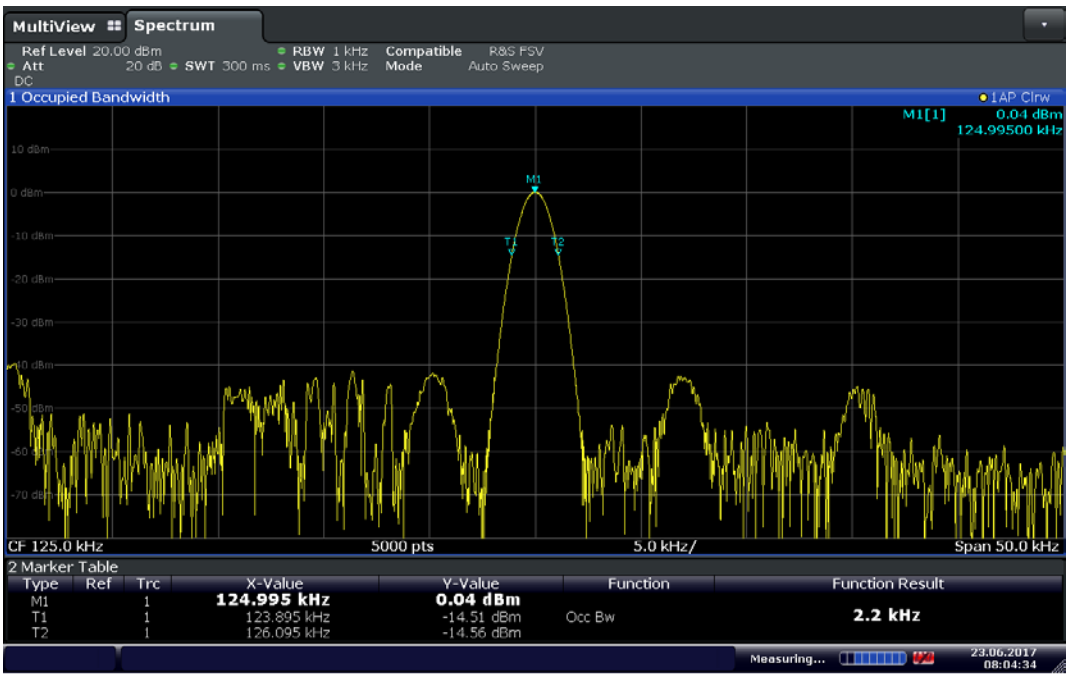
2.3.7 Additional Observations

- The CW function of the EUT was used for this test.
- Voltage variation was also performed at Normal temperature (20°C).

2.3.8 Test Results

Complies. The fundamental frequency occupied bandwidth of EUT lies entirely outside the restricted band during the test.

2.3.9 Test Plots



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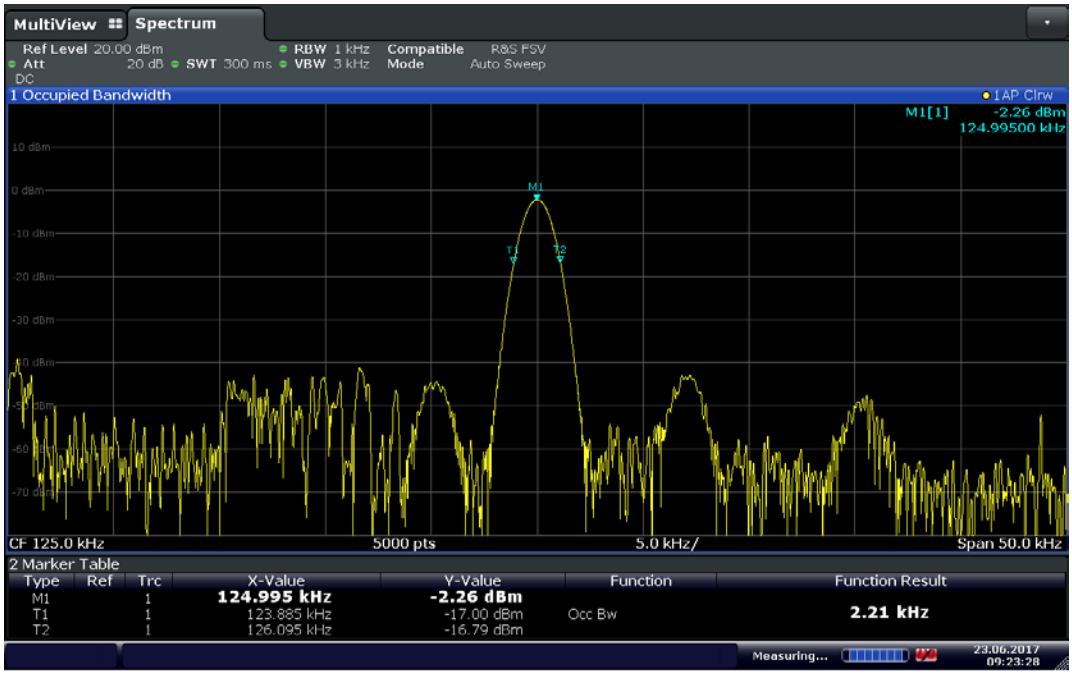
Frequency Stability @ 50°C Nominal Voltage (12VDC)



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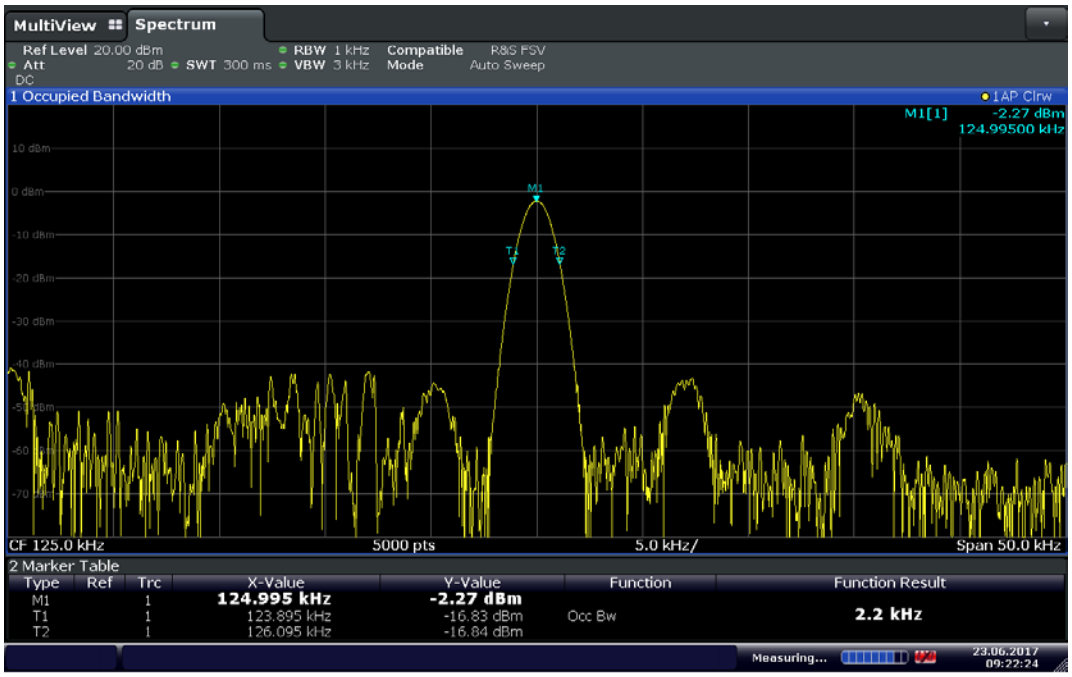
Frequency Stability @ 20°C 13.8VDC



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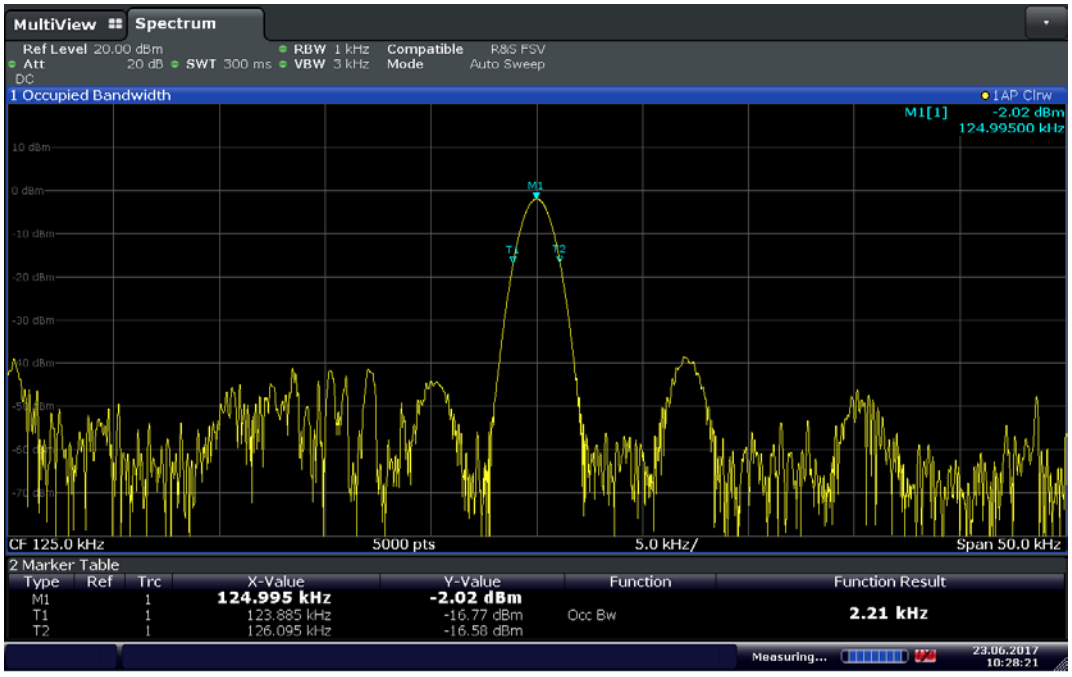
Frequency Stability @ 20°C 10.2VDC



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Frequency Stability @ -20°C Nominal Voltage (12VDC)

2.4 CONDUCTED LIMITS

2.4.1 Specification Reference

Part 15 Subpart C §15.207(a) and RSS-Gen 8.8

2.4.2 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.*

2.4.3 Equipment Under Test and Modification State

Not required. The EUT do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. The EUT is designed for vehicle use only.

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						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
7640	Loop Antenna	AL-130R	121086	Com-Power	11/21/16	11/21/17
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	10/26/16	10/26/17
1016	Pre-amplifier	PAM-0202	187	PAM	02/09/17	02/09/18
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
7554	Barometer/Temperature /Humidity Transmitter	iBTHX-W	0400706	Omega	01/17/17	01/17/18
	DC Power Supply	35010M	D102007S	Protek	Verified by 6792	
	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	3.52	1.44	2.07
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.66
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.31

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	3.52	1.44	2.07
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.68
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.36

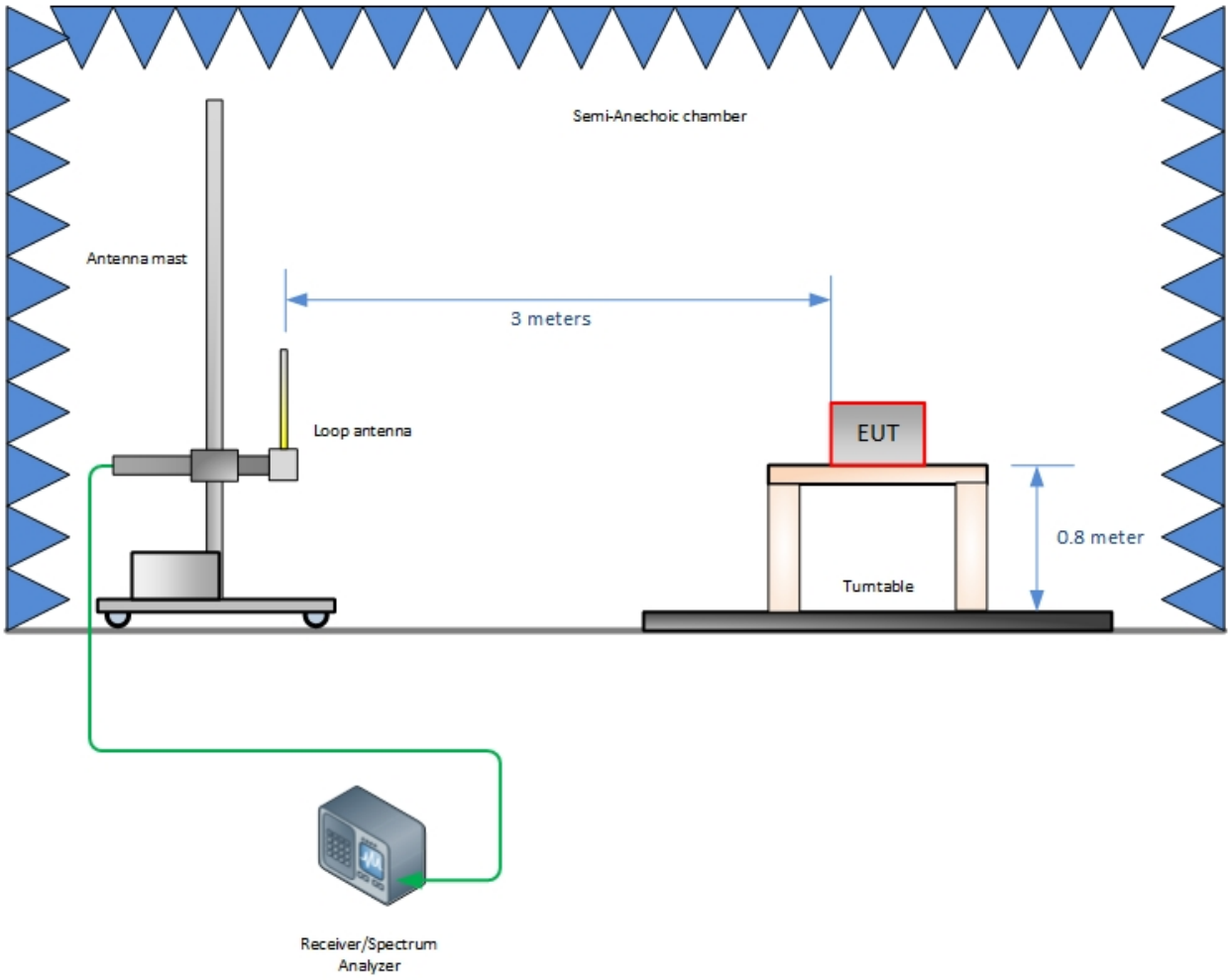
3.2.1 AC Conducted Emissions

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	0.80
				Coverage Factor (k):	2
				Expanded Uncertainty:	1.59

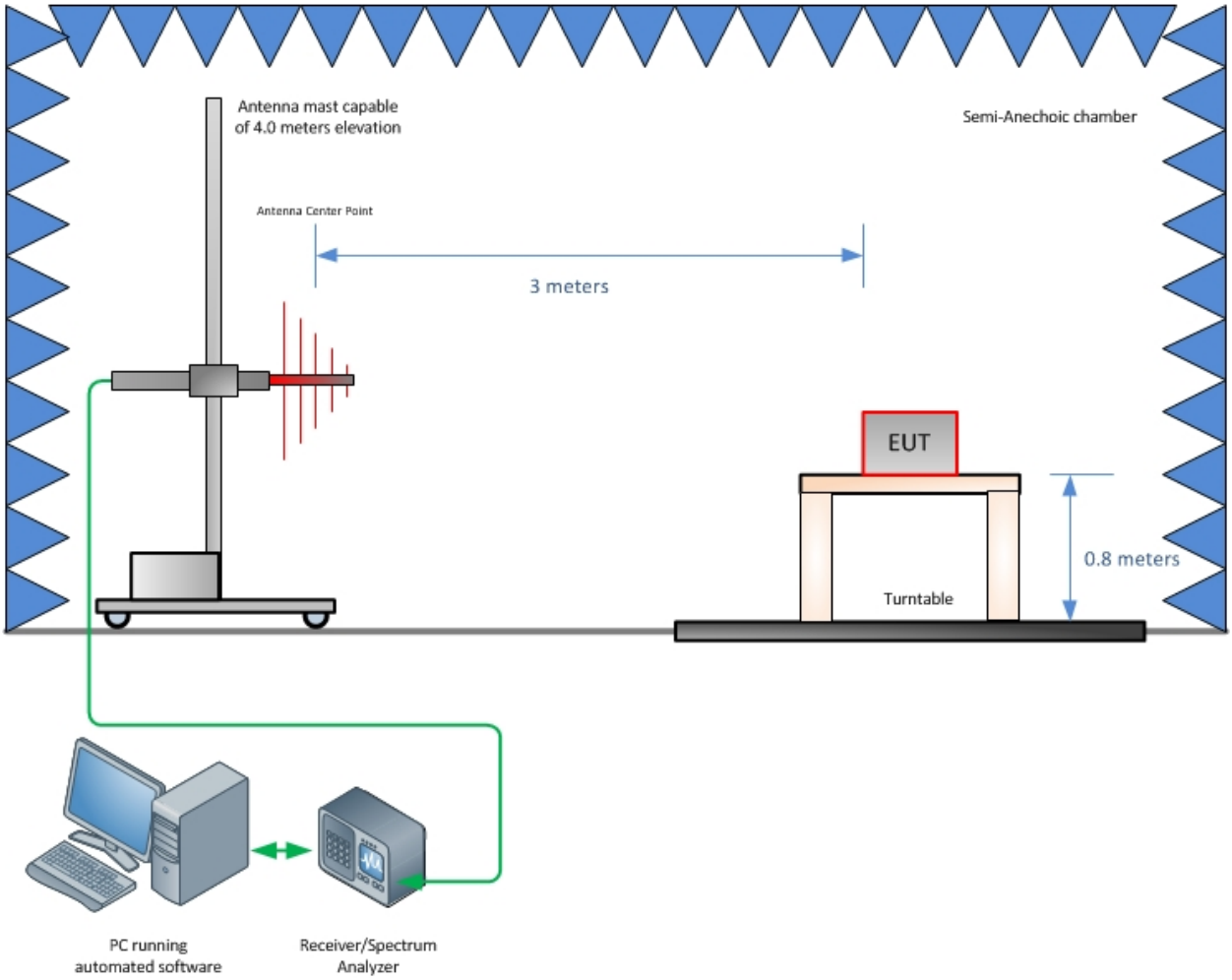
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM (BELOW 30MHZ)



4.2 TEST SETUP DIAGRAM (30MHZ TO 1GHZ)



Radiated Emission Test Setup (Below 1GHz)

SECTION 5

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5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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