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Report On

Radio Testing of the
Stahl- und Apparatebau Hans Leffer GmbH & Co. KG
E2016/5 Remote Control Receiver / Transceiver

FCC Part 15 Subpart C §15.249

Report No. SD72119117-0816B

August 2016



America

TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121
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REPORT ON	Radio Testing of the Stahl- und Apparatebau Hans Leffer GmbH & Co. KG E2016/5 Remote Control Receiver / Transceiver
TEST REPORT NUMBER	SD72119117-0816B
PREPARED FOR	Stahl- und Apparatebau Hans Leffer GmbH & Co. KG Pfählerstr. 1 D-66125 Saarbrücken
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APPROVED BY	 _____ Fleury Chip Name Authorized Signatory Title: Regional EMC manager
DATED	_____ August 10, 2016



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Revision History

SD72119117-0816B					
Stahl- und Apparatebau Hans Leffer GmbH & Co. KG E2016/5 Remote Control Receiver / Transceiver					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
08/10/2016	Initial Release				Chip Fleury



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SECTION 1

REPORT SUMMARY

Radio Testing of the
Stahl- und Apparatebau Hans Leffer GmbH & Co. KG
E2016/5 Remote Control Receiver / Transceiver



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Stahl- und Apparatebau Hans Leffer GmbH & Co. KG E2016/5 Remote Control Receiver / Transceiver to the requirements of FCC Part 15 Subpart C §15.249.

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	Stahl- und Apparatebau Hans Leffer GmbH & Co. KG
Model Name	E2016/5
FCC ID Number	2AHMMSHR12LEFFER
IC Number	21190-SHR12LEFFER
Serial Number(s)	Engineering Sample
Number of Samples Tested	1
Test Specification/Issue/Date	FCC Part 15 Subpart C §15.249 (October 1, 2015).
Start of Test	August 8, 2016
Finish of Test	August 8, 2016
Name of Engineer(s)	Juan M. Gonzalez
Related Document(s)	None. Supporting documents for EUT certification are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.249 standard is shown below:

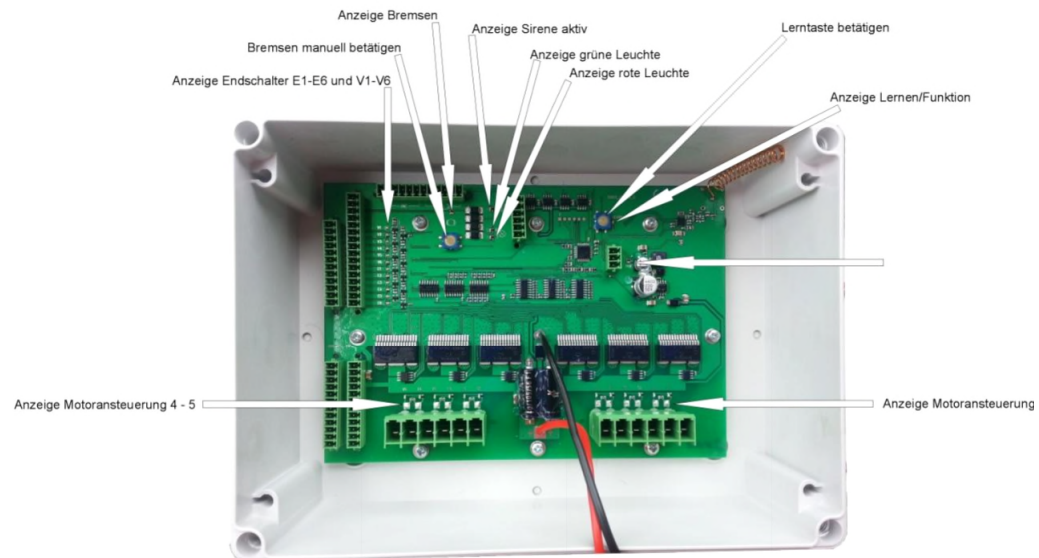
Section	Spec Clause	Test Description	Result	Comments/Base Standard
-	§15.107	Conducted Limits	N/A ¹	See Note
2.1	§15.215(c)	20 dB Bandwidth	Compliant	
2.2	§15.249(a)	Field Strength Limits for Fundamental and Harmonics	Compliant	
2.3	§15.249(d)	Radiated Spurious Emissions	Compliant	

Note: N/A¹: *Not applicable, EUT is 24 VDC..*

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Stahl- und Apparatebau Hans Leffer GmbH & Co. KG E2016/5 Remote Control Receiver / Transceiver as shown in the photograph below.



Equipment Under Test



1.3.2 EUT General Description

EUT Description	Remote Control Receiver / Transceiver
Model Name	E2016/5
Rated Voltage	24 VDC
Output Power	93.80 dBμV/m @ 3 meters
Frequency Range	910.0MHz to 910.9MHz in the 902 MHz to 928 MHz Band
Number of Operating Frequencies	4
Modulation	FSK
Channels Verified	High Channel 910.9MHz * *Per FCC §15.31(m): When the frequency range over which device operates ≤ 1MHz the measurements can be limited to the middle channel. Note. - The test was performed at High Channel since Mid channel was not operational at the moment of the test.
Antenna Type	Integral

1.3.3 Antenna Details

Antenna Type	Integrated on printed board.
Antenna Size/length	6 cm

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	The EUT was configured to transmit continuously at High Channel.

1.4.2 EUT Exercise Software

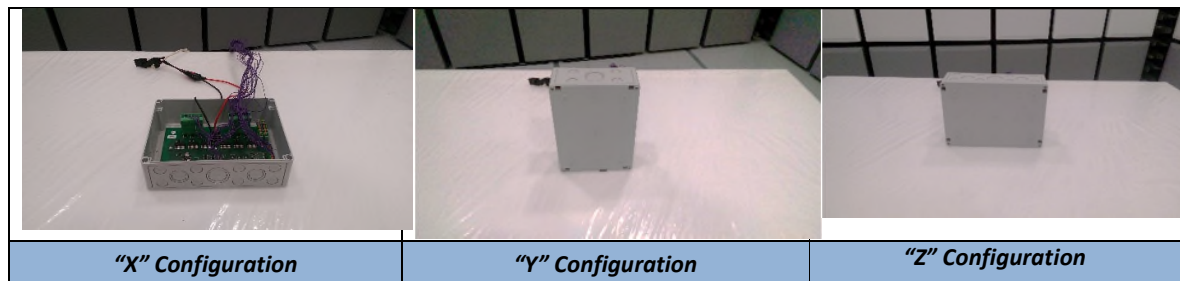
EUT is loaded with a test firmware allowing continuous transmission (test mode) at test frequencies.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Model	Description

1.4.4 Worst Case Configuration

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



1.4.5 Simplified Test Configuration Diagram





1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number Engineering Sample		
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.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

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

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

Sony Electronics Inc., Building #8 16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 FAX: 858-546 0364

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

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

1.9.2 Industry Canada (IC) Registration No.: 3067A

The Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.



SECTION 2

TEST DETAILS

Radio Testing of the
Stahl- und Apparatebau Hans Leffer GmbH & Co. KG
E2016/5 Remote Control Receiver / Transceiver



2.1 20 dB BANDWIDTH

2.1.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.215(c)

2.1.2 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.

2.1.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Default Test Configuration

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

August 8, 2016/JMG

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. Mira Mesa facility

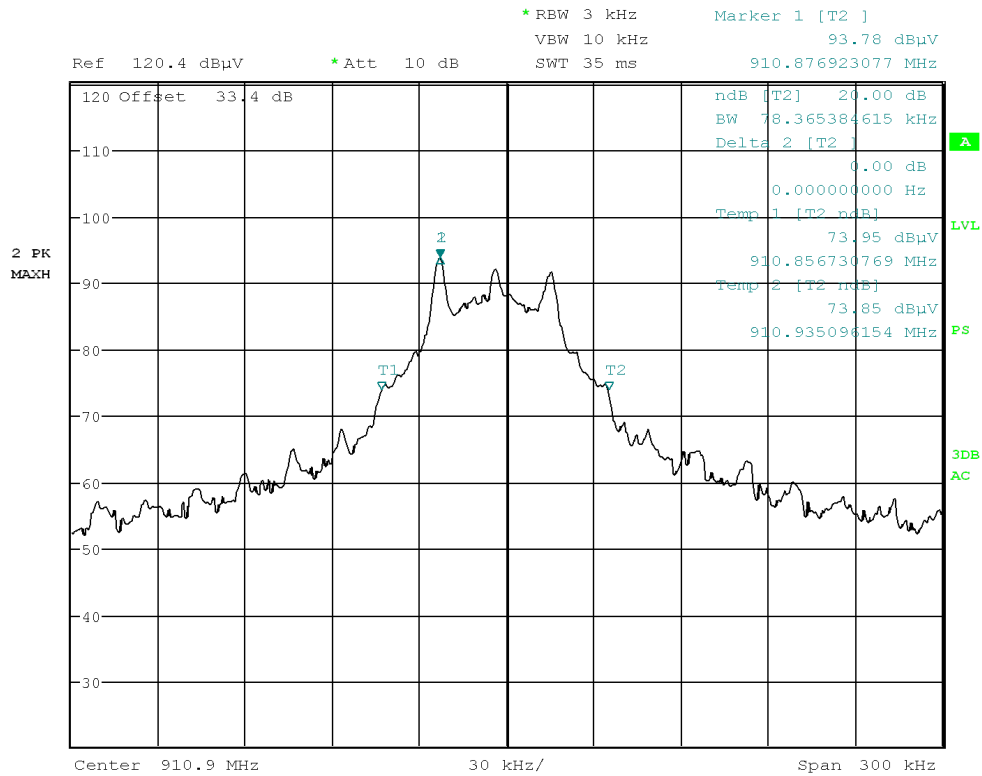
Ambient Temperature	23.5°C
Relative Humidity	50.1%
ATM Pressure	99.7 kPa

2.1.7 Additional Observations

- This is a radiated test.
- “n dB down” marker function of the Spectrum Analyzer used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the Span, VBW is 3XRBW.
- An offset of 33.4 dB was added to compensate antenna CF and cable losses.
- Sweep is auto.
- Detector is peak.
- Trace is max hold.

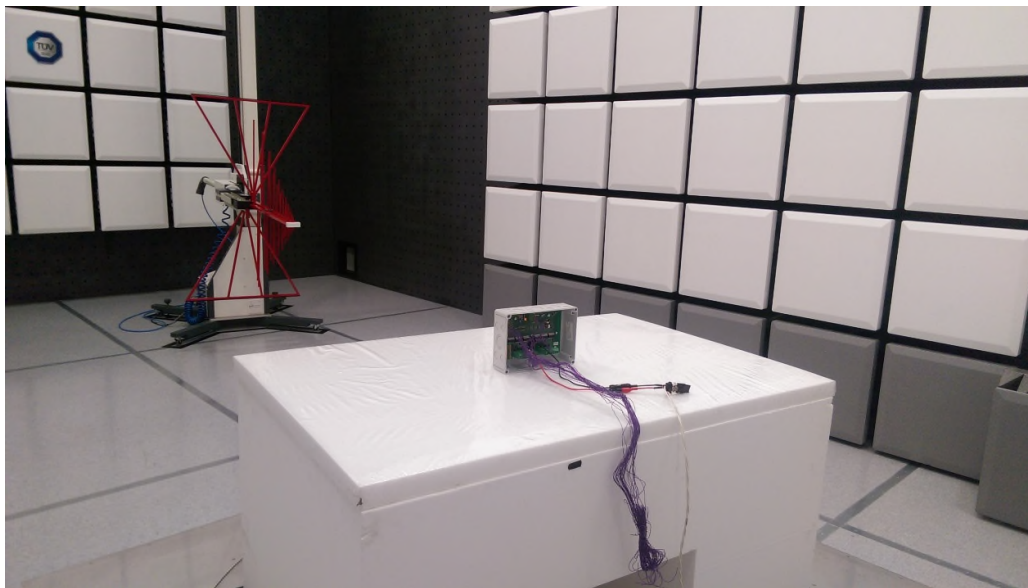
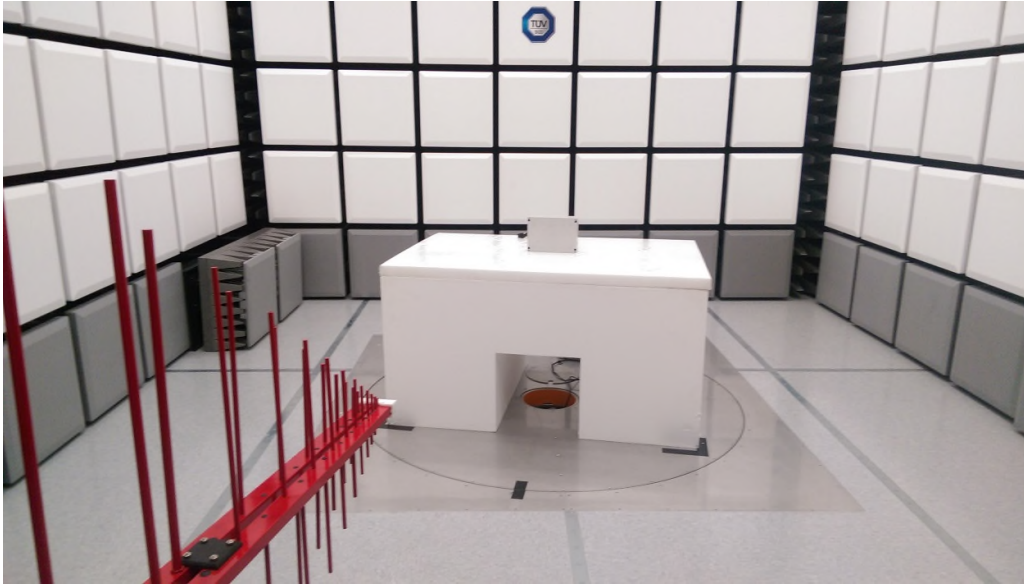
2.1.8 Test Results

Channel	Frequency (MHz)	20dB Bandwidth (kHz)
High Channel	910.9	78.36



Mid Channel (910.3 MHz)

2.1.9 Test set up pictures





2.2 FIELD STRENGTH LIMITS FOR FUNDAMENTAL AND HARMONICS

2.2.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.249(a)

2.2.2 Standard Applicable

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

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of fundamental (dB μ V/m)	Field strength of harmonics (microvolts/meter)	Field strength of harmonics (dB μ V/m)
902–928 MHz	50	93.98	500	53.98
2400–2483.5 MHz	50	93.98	500	53.98
5725–5875 MHz	50	93.98	500	53.98
24.0–24.25 GHz	250	107.96	2500	67.96

The field strength limits in paragraphs (a) of this section are based on average limits.

2.2.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Default Test Configuration

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

August 08, 2016/JMG

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. Mira Mesa facility

Ambient Temperature	23.5°C
Relative Humidity	50.1%
ATM Pressure	99.7 kPa

2.2.7 Additional Observations

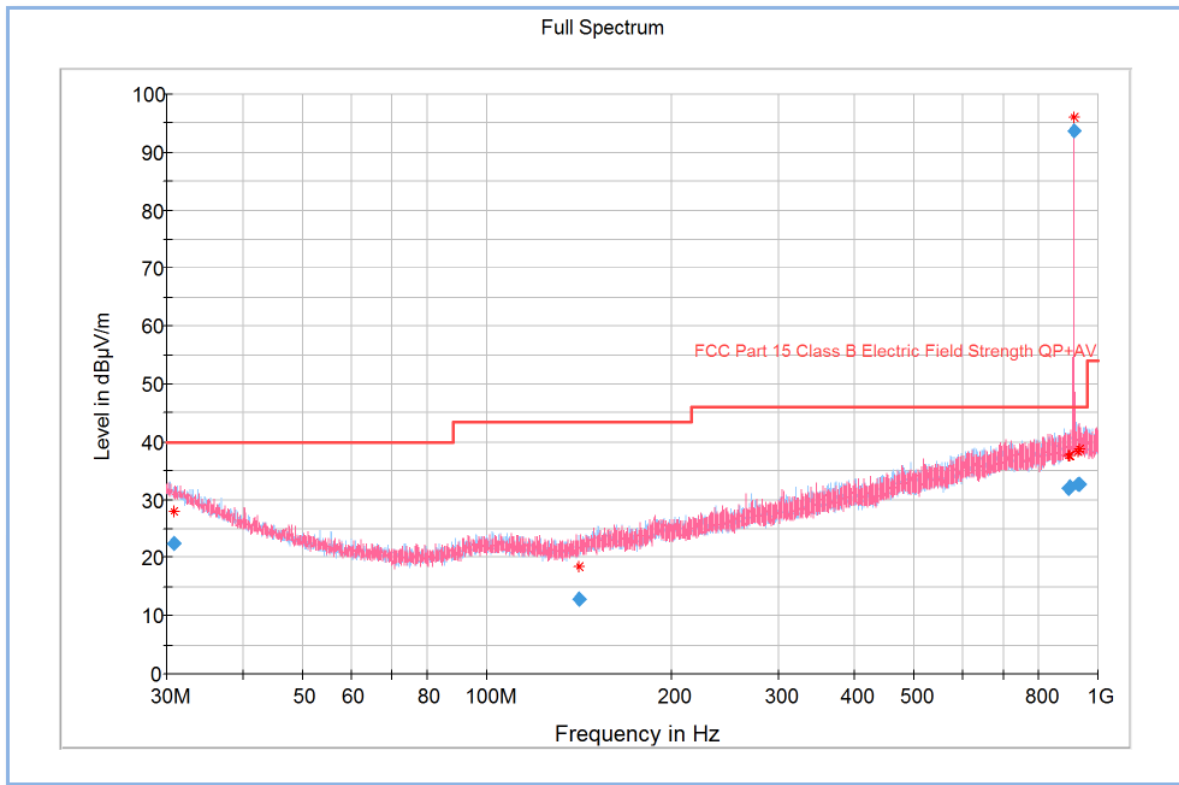
- This is a radiated test. The spectrum was searched from 1GHz to at least the 10th harmonic (10GHz).
- Measurement was done using EMC32 V9.26.0 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.2.8 for sample computation.



2.2.8 Sample Computation (Radiated Emission)

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

2.2.9 Test Results for High Channel 910.9MHz below 1GHz (Fundamental, Band Edges and Immediate Restricted Bands)

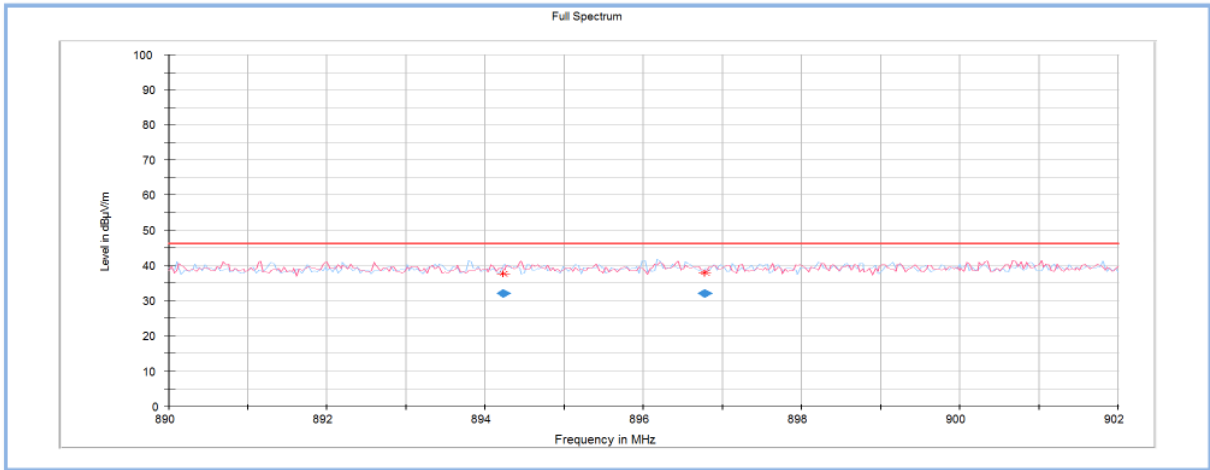


Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
30.840000	22.35	40.00	17.65	1000.0	120.000	150.2	H	77.0	24.5	
141.730667	12.92	43.50	30.58	1000.0	120.000	359.6	V	196.0	15.4	
894.225000	32.05	46.00	13.95	1000.0	120.000	172.5	H	132.0	32.9	
896.777667	32.13	46.00	13.87	1000.0	120.000	382.4	H	228.0	33.0	
910.889333	93.80	94.00	0.20	1000.0	120.000	105.2	V	283.0	33.4	Fundamental
928.452333	32.73	46.00	13.27	1000.0	120.000	250.3	V	79.0	33.5	
928.691333	32.72	46.00	13.28	1000.0	120.000	381.8	H	300.0	33.5	

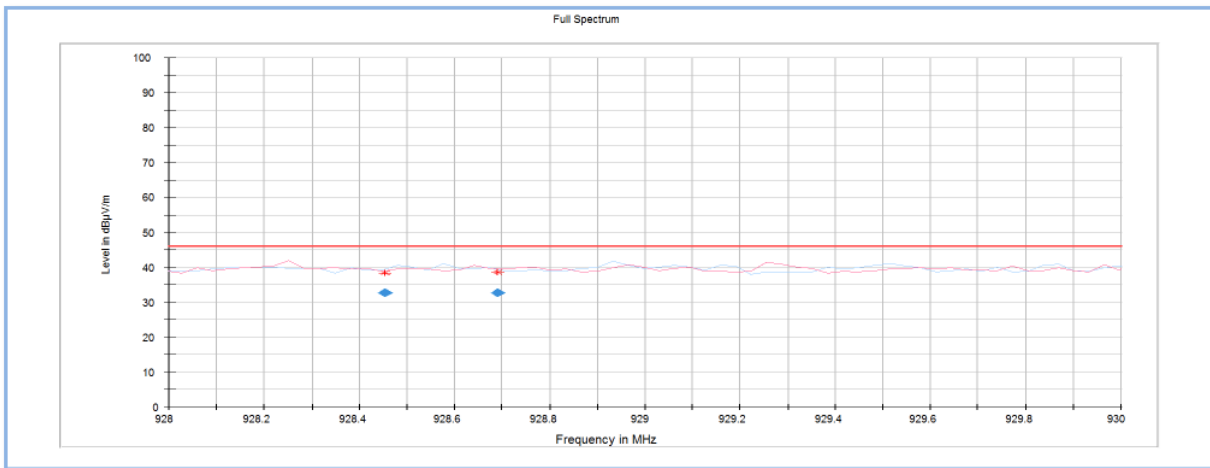
Test Notes: All spurious emissions complies with the general requirement of 15.209 and 15.249. The fundamental complies with 15.249.

Test Results Mid Channel 910.3 MHz (Band Edges)



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
894.225000	32.05	46.00	13.95	1000.0	120.000	172.5	H	132.0	32.9	
896.777667	32.13	46.00	13.87	1000.0	120.000	382.4	H	228.0	33.0	

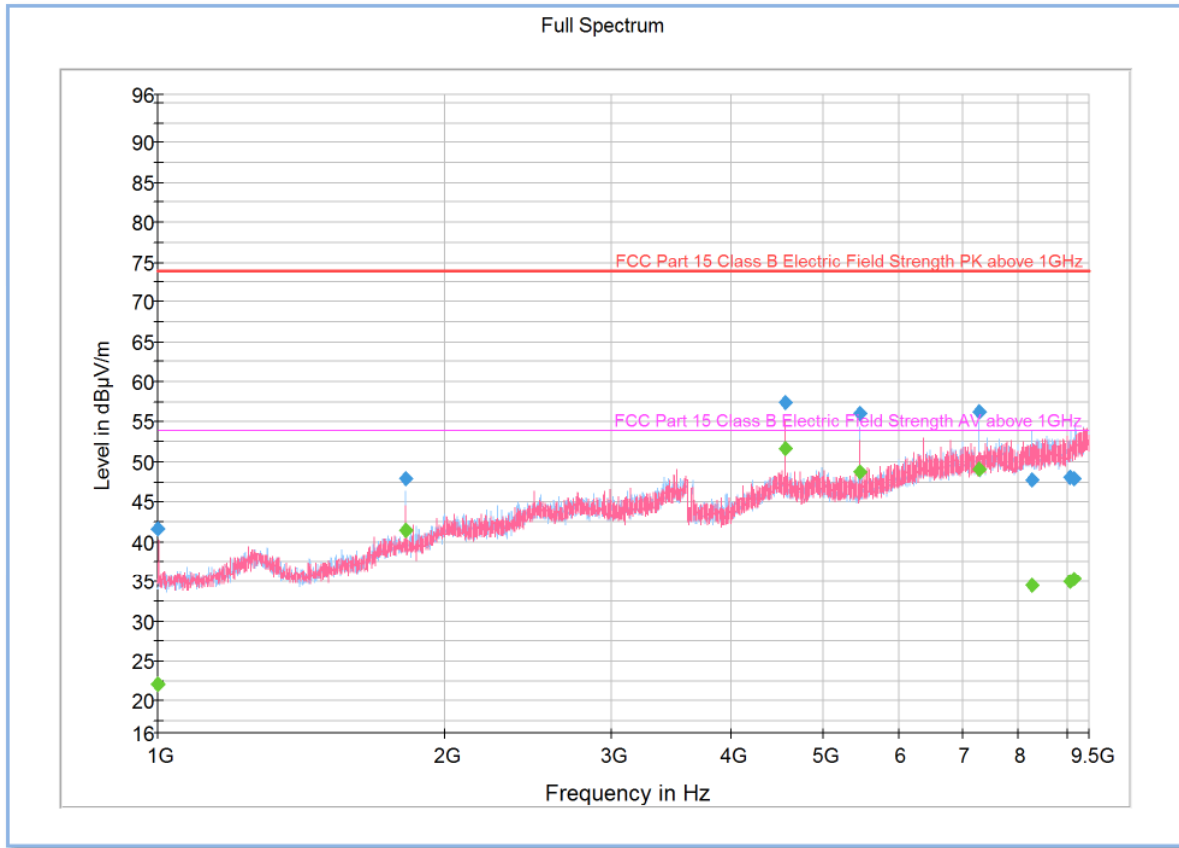
Low Band Edge



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
928.452333	32.73	46.00	13.27	1000.0	120.000	250.3	V	79.0	33.5	
928.691333	32.72	46.00	13.28	1000.0	120.000	381.8	H	300.0	33.5	

High Band Edge

Test Results for mid Channel 910.3 MHz above 1GHz (Harmonics)



Final Result PK+

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1000.400000	41.70	73.90	32.20	1000.0	1000.000	150.2	V	291.0	-2.0	
1821.750000	47.94	73.90	25.96	1000.0	1000.000	202.3	H	211.0	2.2	
4554.450000	57.45	73.90	16.45	1000.0	1000.000	149.6	V	220.0	10.9	
5465.650000	56.00	73.90	17.90	1000.0	1000.000	173.7	H	357.0	11.4	
7287.250000	56.25	73.90	17.65	1000.0	1000.000	250.2	H	231.0	14.6	
8282.150000	47.71	73.90	26.19	1000.0	1000.000	271.4	H	16.0	15.7	
9079.000000	48.03	73.90	25.87	1000.0	1000.000	250.3	H	-20.0	16.5	
9168.950000	47.97	73.90	25.93	1000.0	1000.000	406.1	H	315.0	16.9	

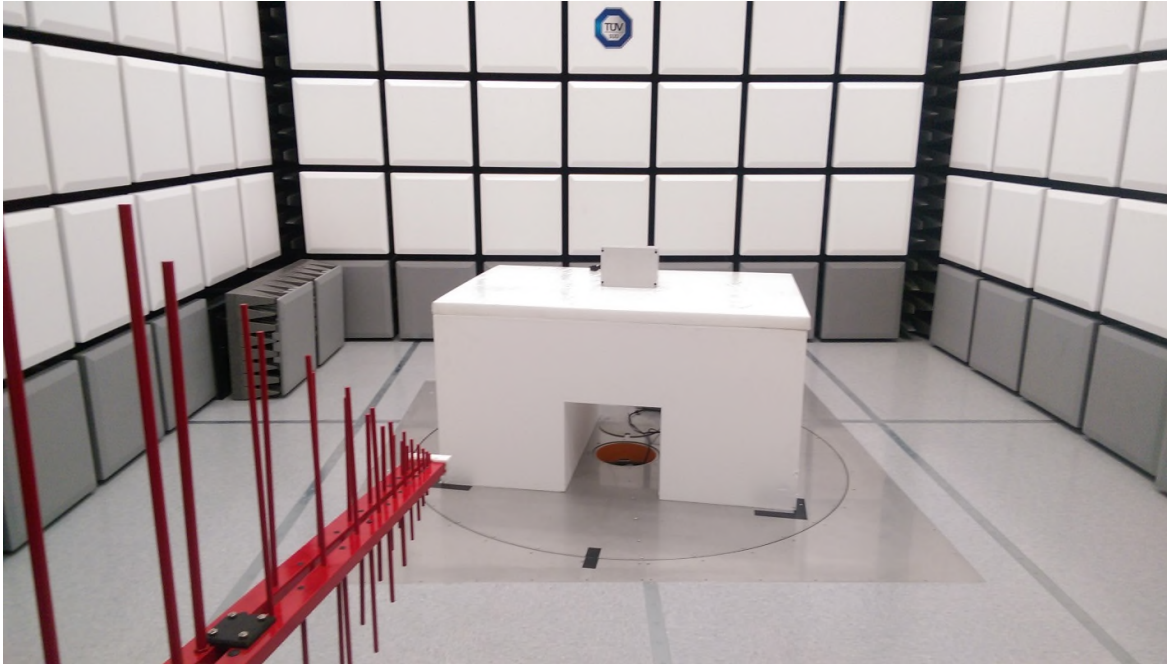
Final Result AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
1000.400000	22.12	53.90	31.78	1000.0	1000.000	150.2	V	291.0	-2.0	
1821.750000	41.47	53.90	12.43	1000.0	1000.000	202.3	H	211.0	2.2	
4554.450000	51.64	53.90	2.26	1000.0	1000.000	149.6	V	220.0	10.9	
5465.650000	48.73	53.90	5.17	1000.0	1000.000	173.7	H	357.0	11.4	
7287.250000	49.18	53.90	4.72	1000.0	1000.000	250.2	H	231.0	14.6	
8282.150000	34.50	53.90	19.40	1000.0	1000.000	271.4	H	16.0	15.7	
9079.000000	35.02	53.90	18.88	1000.0	1000.000	250.3	H	-20.0	16.5	
9168.950000	35.39	53.90	18.51	1000.0	1000.000	406.1	H	315.0	16.9	

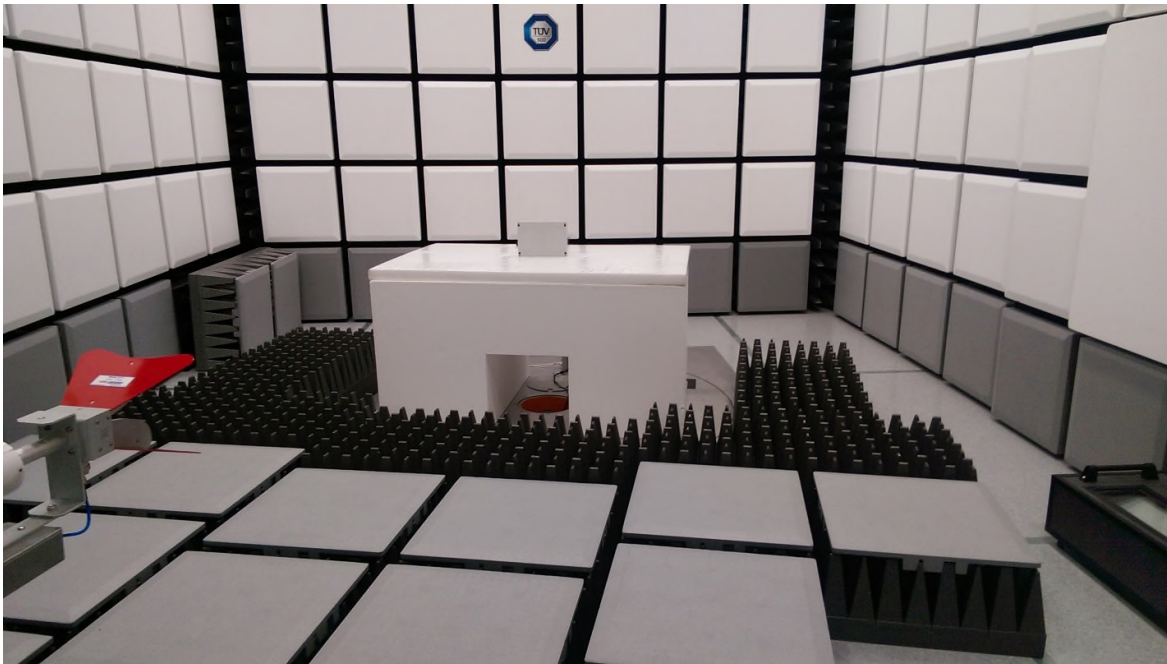
Test Notes: All harmonics complies with the general requirement of 15.209.

2.2.10 Test set up pictures

Below 1 GHZ



Above 1 GHz





2.3 RADIATED SPURIOUS EMISSIONS

2.3.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.249(d)

2.3.2 Standard Applicable

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

2.3.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Default Test Configuration

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

August 08, 2016/JMG

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. Mira Mesa facility

Ambient Temperature	23.5°C
Relative Humidity	50.1%
ATM Pressure	99.7 kPa

2.3.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to at least the 10th harmonic (9.5GHz).
- The measurement results are identical to test results presented under Section 2.2.9 of this test report. No other significant spurious emissions observed other than harmonics of the fundamental frequency.



SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	02/04/16	07/05/17
08891	Pre-amplifier 1-18GHz	PE15A3262	1012	Pasternack	04/29/16	04/29/17
7620	EMI Test Receiver	ESU	100399	Rhode & Schwarz	08/24/15	08/24/16
Miscellaneous						
	Test Software	EMC32	V9.26.0	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Radiated Emission Measurements (Below 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.55	2.05	4.20
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.23
Coverage Factor (k):					2
Expanded Uncertainty:					4.45

3.2.2 Radiated Emission Measurements (Above 1GHz)

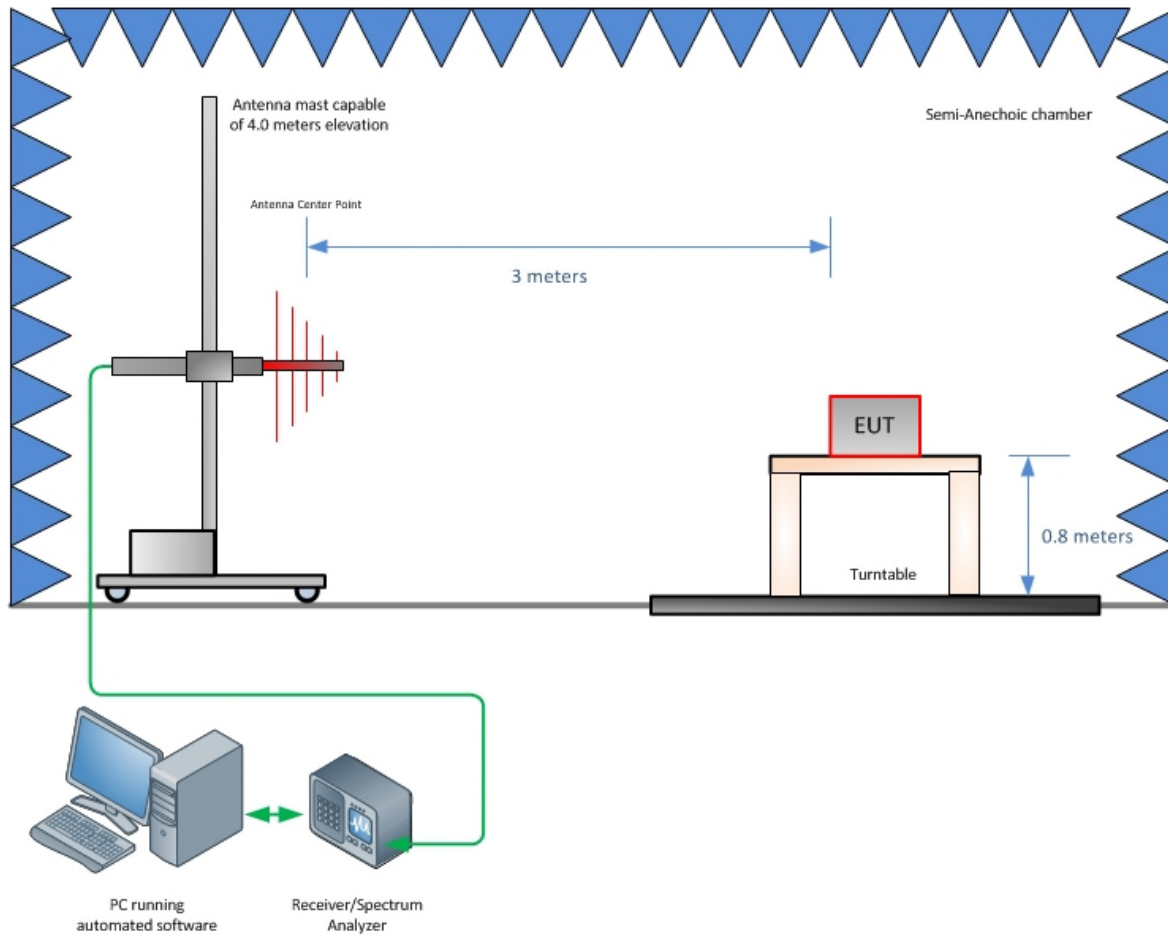
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.55	2.05	4.20
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.22
Coverage Factor (k):					2
Expanded Uncertainty:					4.44



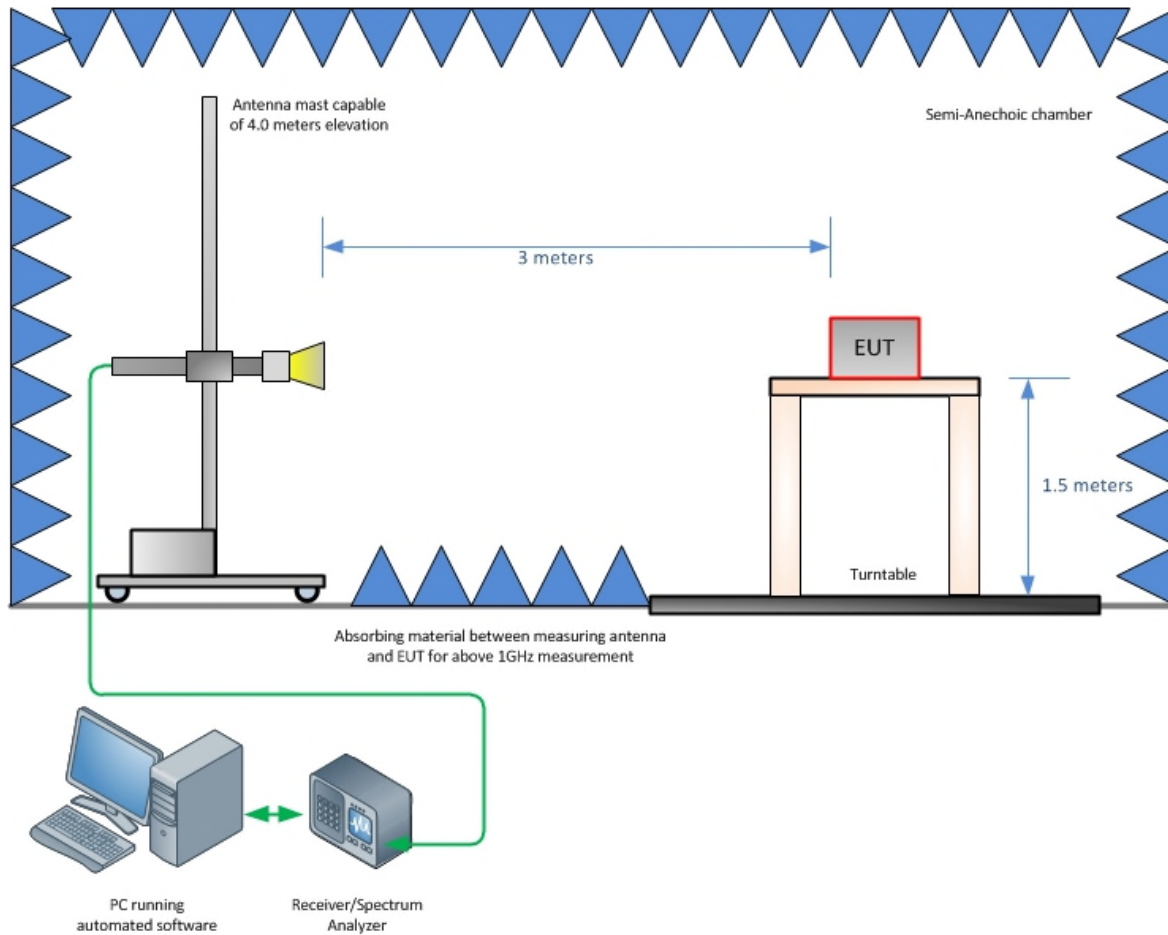
SECTION 4

DIAGRAM OF TEST SETUP

4.1 RADIATED EMISSION TEST SETUP (BELOW 1GHZ)



4.2 RADIATED EMISSION TEST SETUP (ABOVE 1GHZ)





SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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.

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