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Report On

Radio Testing of the
Kronegger GmbH
CCID MicroReader

FCC Part 15 Subpart C §15.225
FCC Part 15 Subpart C §15.209

Report No. SD72121799-1116

December 2016

REPORT ON

Radio Testing of the
Kronegger GmbH
RFID reader module

TEST REPORT NUMBER

SD72121799-1116

REPORT DATE

December 2016

PREPARED FOR

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DATED

December 13, 2016

Revision History

SD72121799-1116 Kronegger GmbH CCID MicroReader					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
12/13/2016	Initial Release				Juan Manuel Gonzalez

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Kronegger GmbH
CCID MicroReader

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Kronegger GmbH RFID reader module to the requirements of FCC Part 15 Subpart C §15.225.

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	Kronegger GmbH
Model Number(s)	CCID MicroReader
FCC ID Number	ZKCPP-4018-6028
Serial Number(s)	Engineering Sample
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.225 (October 1, 2016). • FCC Part 15 Subpart C §15.209 (October 1, 2016)
Start of Test	November 30, 2016
Finish of Test	December 01, 2016
Name of Engineer(s)	Nikolay Shtin
Related Document(s)	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 standard is shown below.

Section	FCC Part 15	§15.225 Spec Clause	Test Description	Result	Comments/Base Standard
	§15.31(e)		Voltage Requirement	Compliant	§15.225(e)
	§15.203 and 204		Antenna Requirements	Compliant	N/A *
2.1		§15.225(e)	Frequency Tolerance	Compliant	
2.2	§15.215(c)		20dB Bandwidth	Compliant	
2.3		§15.225(a)(b)(c)	Emission Mask	Compliant	
2.4	§15.209	§15.225(d)	Spurious Radiated Emissions	Compliant	
		§15.207(a)	Conducted Emissions	N/A **	

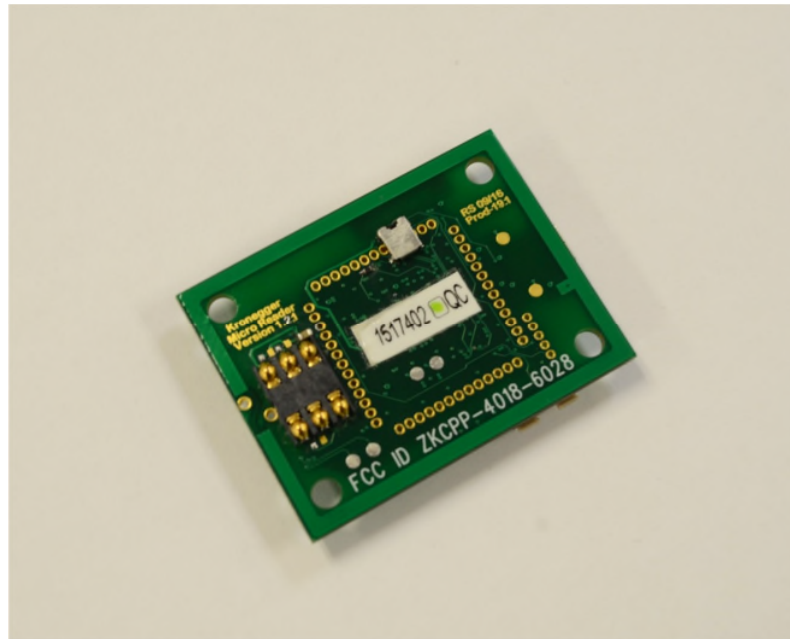
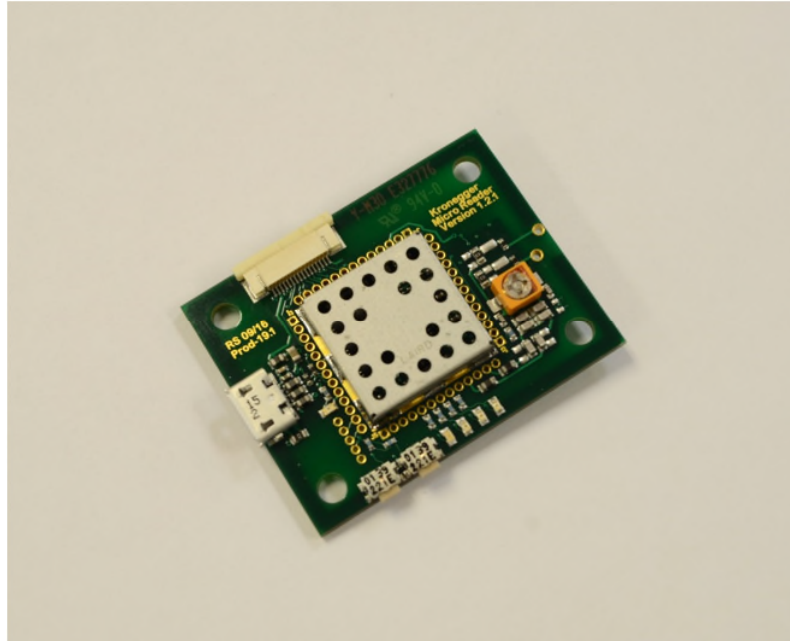
N/A * This requirement does not apply to intentional radiators that are professionally installed.

N/A ** EUT is a USB powered device, test is not required.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Kronegger GmbH CCID MicroReader as shown in the photographs below.



Equipment Under Test

1.3.2 EUT General Description

EUT Description	RFID reader module
Model Number(s)	CCID MicroReader
Rated Voltage	5.0 VDC
EUT RFID Field Strength	68.67 dBμV/m @ 3 meters
Frequency Range	RFID: 13.56 MHz in the 13.110 to 14.0101 MHz band
Number of Operating Frequencies	1
Modulation Used	ASK
Antenna(s) Dimension	42,0 mm x 32,0 mm

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	EUT configured in continuous modulated transmission mode transmitting from the integral antenna.

1.4.2 EUT Exercise Software

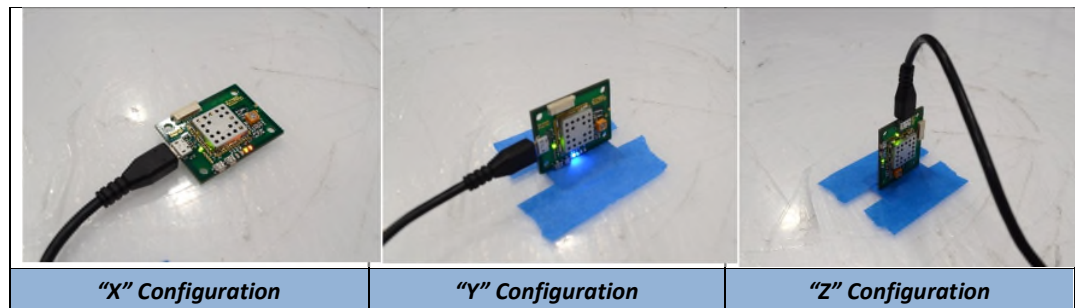
None. No special software was used during evaluation.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
LIN SHIUNG	Hi-speed USB 2.0 Cable 0.9m	Model: E166307

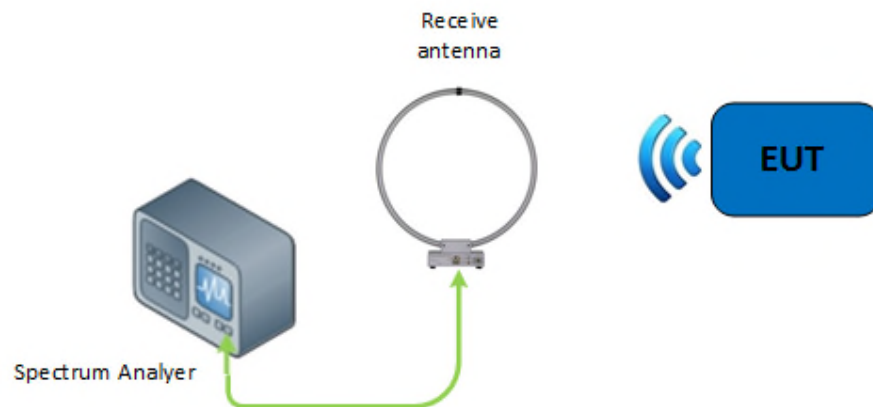
1.4.4 Worst Case Configuration

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



1.4.5 Simplified Test Configuration Diagrams

Radiated Test Setup



Not To Scale – Illustration Purpose Only
Objects may not represent actual image of
original equipment or set-up.

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: N/A		
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)

16936 Via Esprillo, 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 §2.498 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 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 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
Kronegger GmbH
CCID MicroReader



2.1 FREQUENCY STABILITY

2.1.1 Specification Reference

Part 15 Subpart C §15.225(e)

2.1.2 Standard Applicable

(e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees C 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: 1517402 / Default test configuration

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

December 01, 2016 /NS

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. MM Laboratory

Ambient Temperature	24.6°C
Relative Humidity	38.5%
ATM Pressure	99.1 kPa

2.1.7 Additional Observations

- The temperature was varied from -20°C to $+50^{\circ}\text{C}$ in 10 degree increments with a nominal voltage of 5.0 VDC, then the voltage was changed from 4.25 VDC to 5.75 VDC (75% and 115% of nominal voltage) maintaining a temperature of 20°C .

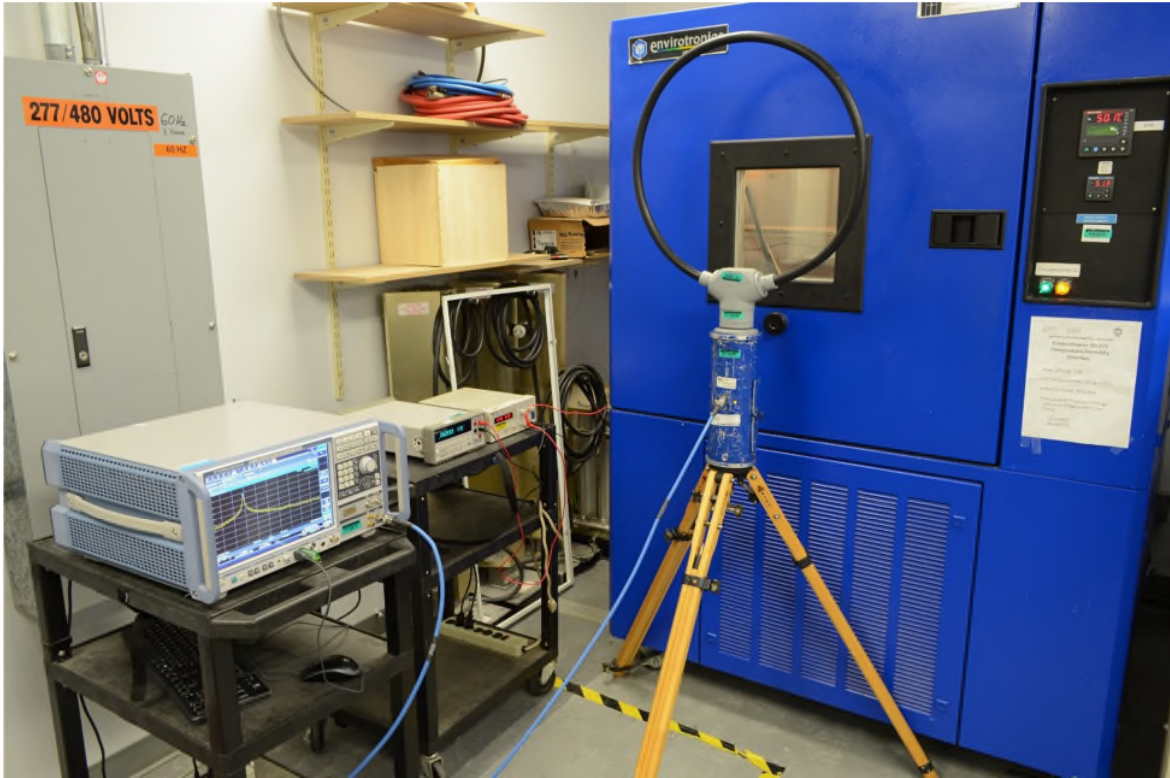
2.1.8 Test Results

RFID @ 13.56MHz					
Voltage (%)	Power (VDC)	Temp (°C)	Frequency (MHz)	Frequency Deviation (MHz)	Deviation (%)
100		-20	13.56074379	0.00074379	0.00548518
100		-10	13.56075558	0.00075558	0.00557181
100		0	13.56074272	0.00074272	0.00547699
100		+10	13.56007122	0.00007122	0.00052519
100		+20	13.56067200	0.00067200	0.00495551
100		+30	13.56062948	0.00062948	0.00464197
100		+40	13.56059150	0.00059150	0.00436190
100		+50	13.56056578	0.00056578	0.00417224
85	4.25	+20	13.56067858	0.00067858	0.00500403
115	5.75	+20	13.56066177	0.00066177	0.00488007

Maximum Deviation Allowed = 0.001356MHz < 0.01% (13.558644MHz to 13.561356MHz)

Maximum Deviation Recorded = 0.00075558 (Complies)

2.1.9 Test Set Up Pictures





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: 1517402 / Default Test Configuration

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

November 30, 2016 /NS

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. MM laboratory

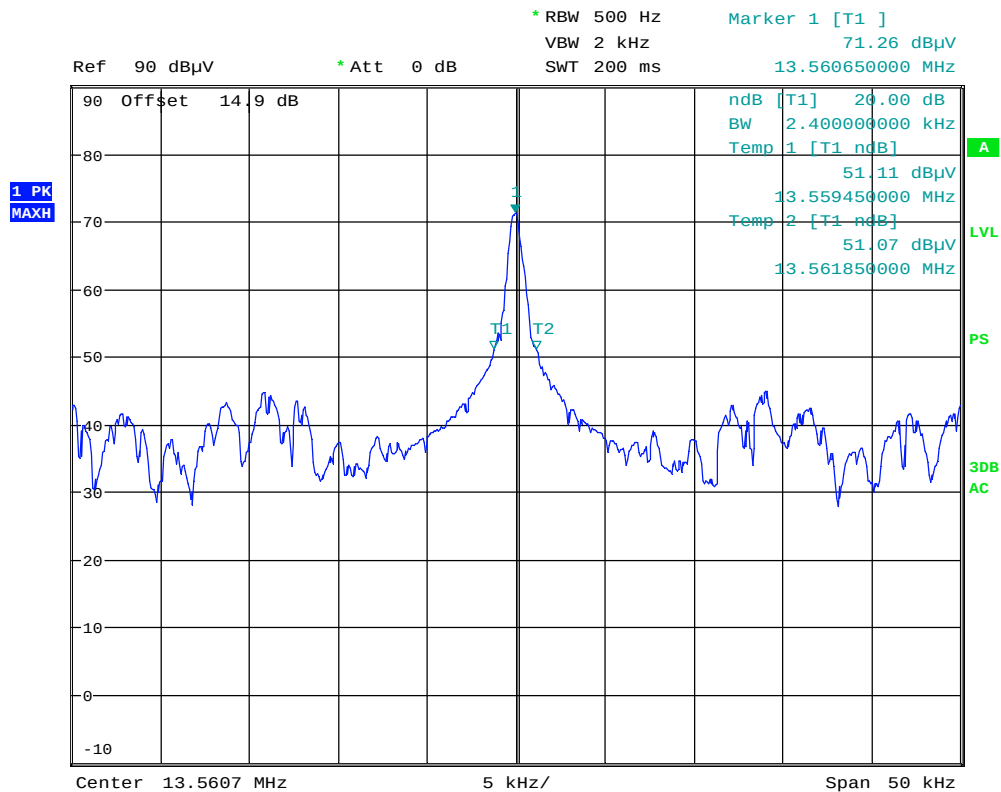
Ambient Temperature	24.2°C
Relative Humidity	40.6%
ATM Pressure	99.5 kPa

2.2.7 Additional Observations

- This is a Radiated test.
- Span is wide enough to capture the channel transmission.
- RBW is set to 500 Hz.
- VBW is 2 kHz.
- Sweep is auto.
- Detector is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.

2.2.8 Test Results

Frequency	20dB bandwidth
13.56063 MHz	2.40 kHz



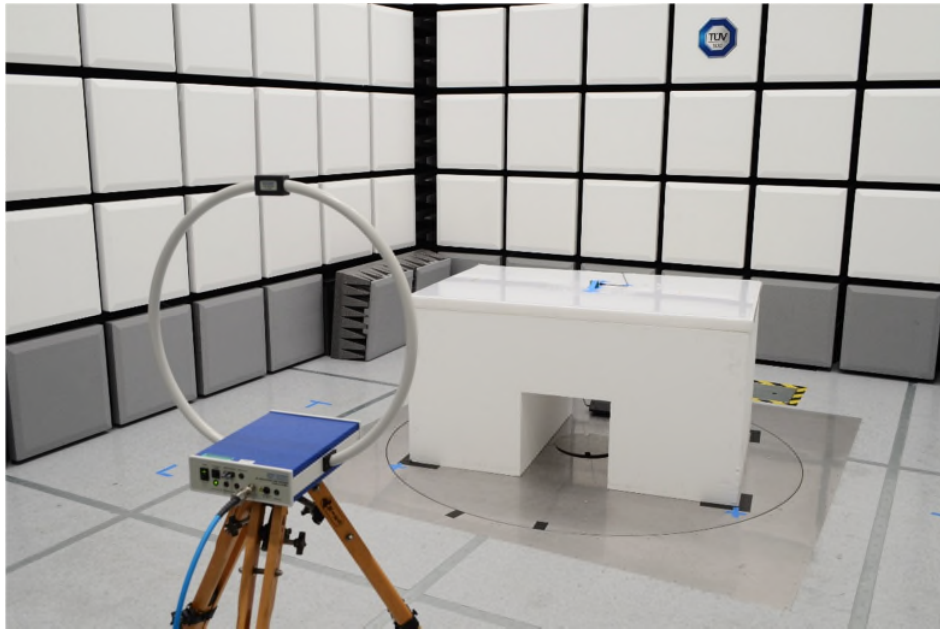
Date: 30.NOV.2016 15:29:54

Measured 20dB Bandwidth: 2.4 kHz
Frequency Band: 13.110 to 14.010 MHz

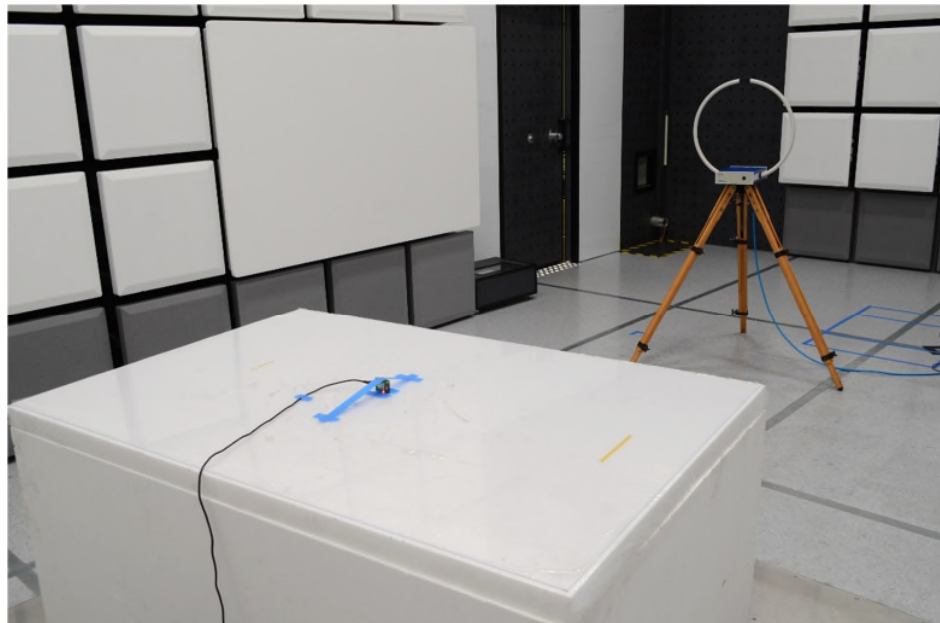
$13.56 \text{ MHz} - (20\text{dB BW}/2) = 13.557595\text{MHz}$ (within the frequency band - **Compliant**)
 $13.56 \text{ MHz} + (20\text{dB BW}/2) = 13.562405\text{MHz}$ (within the frequency band - **Compliant**)

2.2.9 Test Set Up Pictures

Front



Back





2.3 EMISSION MASK

2.3.1 Specification Reference

Part 15 Subpart C §15.225(a)(b)(c)

2.3.2 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.

2.3.3 Equipment Under Test and Modification State

Serial No: 1517402 / Default Test Configuration

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

November 30, 2016 /NS

2.3.5 Test Equipment Used

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

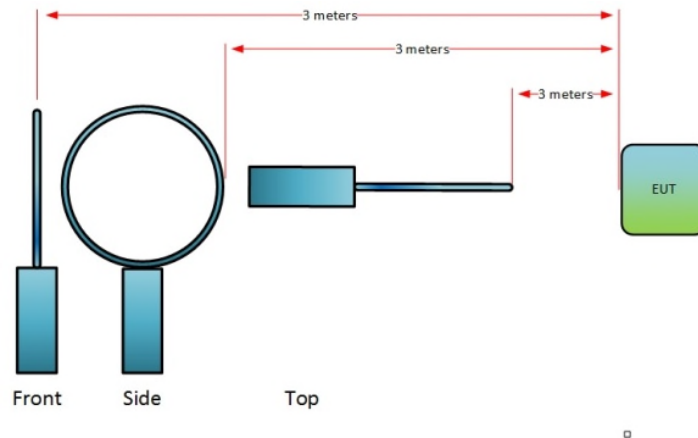
2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. MM Laboratory

Ambient Temperature	24.2°C
Relative Humidity	40.6%
ATM Pressure	99.5 kPa

2.3.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9 kHz to 30 MHz. Only 13.110 MHz to 14.010 MHz data is 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 below) corresponding to the best antenna orientation as found during the prescans.



- 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 Sections 2.3.8 for sample computations.

2.3.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbμV) @ 13.56MHz			15.0
Correction Factor (dB)	Asset# 1026 (cable)	0.5	20.9
	Asset# 1057 3m (cable)	0.1	
	Asset# 6628 (antenna)	20.2	
	Asset# 8850 (cable)	0.1	
Reported QuasiPeak Final Measurement (dbμV/m) @ 13.56MHz			35.9

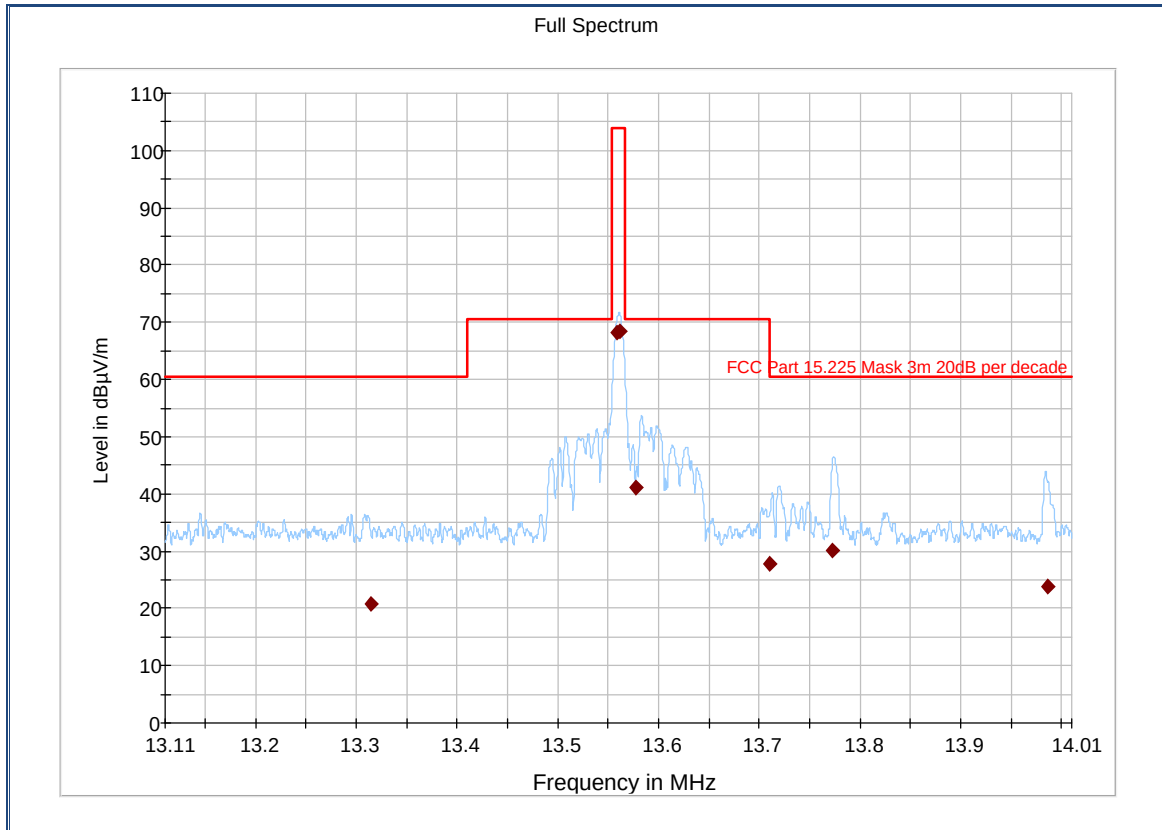
2.3.9 Sample Computation (Limits)

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

2.3.10 Test Results

See attached plots.

2.3.11 Test Results



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
13.314500	20.89	60.50	39.61	1000.0	9.000	100	H	1.0	15.0
13.559300	68.25	104.00	35.75	1000.0	9.000	100	H	180.0	14.9
13.561700	68.42	104.00	35.58	1000.0	9.000	100	H	180.0	14.9
13.577300	41.05	70.47	29.42	1000.0	9.000	100	H	177.0	14.9
13.709800	27.76	70.47	42.71	1000.0	9.000	100	H	-4.0	14.9
13.772400	30.14	60.50	30.36	1000.0	9.000	100	H	177.0	14.9
13.986700	23.88	60.50	36.62	1000.0	9.000	100	H	9.0	14.9

Test Notes:



2.3.12 Test Set Up Pictures

Identical to section 2.2.9 of this test report.

2.4 SPURIOUS RADIATED EMISSIONS

2.4.1 Specification Reference

Part 15 Subpart C §15.225(d)

2.4.2 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.

2.4.3 Equipment Under Test and Modification State

Serial No: 1517402 / Default Test Configuration

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

November 30, 2016 /NS

2.4.5 Test Equipment Used

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

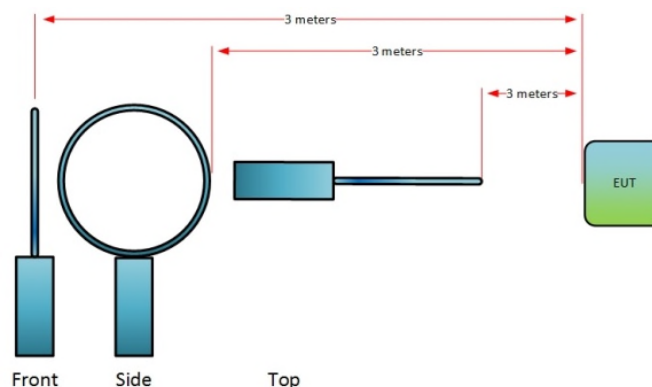
2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. MM Laboratory

Ambient Temperature	24.2°C
Relative Humidity	40.6%
ATM Pressure	99.5 kPa

2.4.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9 kHz to 1 GHz.
- Below 30 MHz emissions 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 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 Sections 2.4.8 and 2.4.9 for sample computations.

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

Measuring equipment raw measurement (db μ V) @ 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

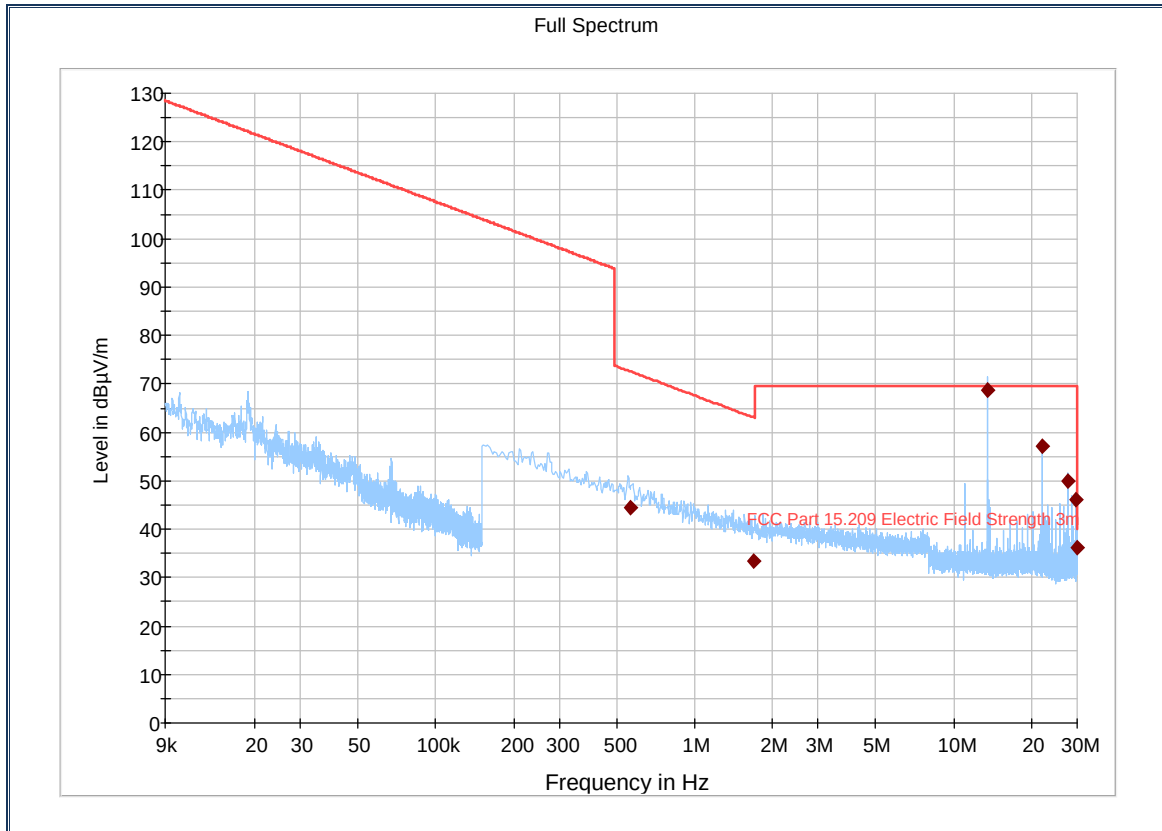
2.4.9 Sample Computation (Radiated Emission 30 MHz to 1 GHz)

Measuring equipment raw measurement (db μ V) @ 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

2.4.10 Test Results

See attached plots.

2.4.11 Test Results 9 kHz to 30 MHz

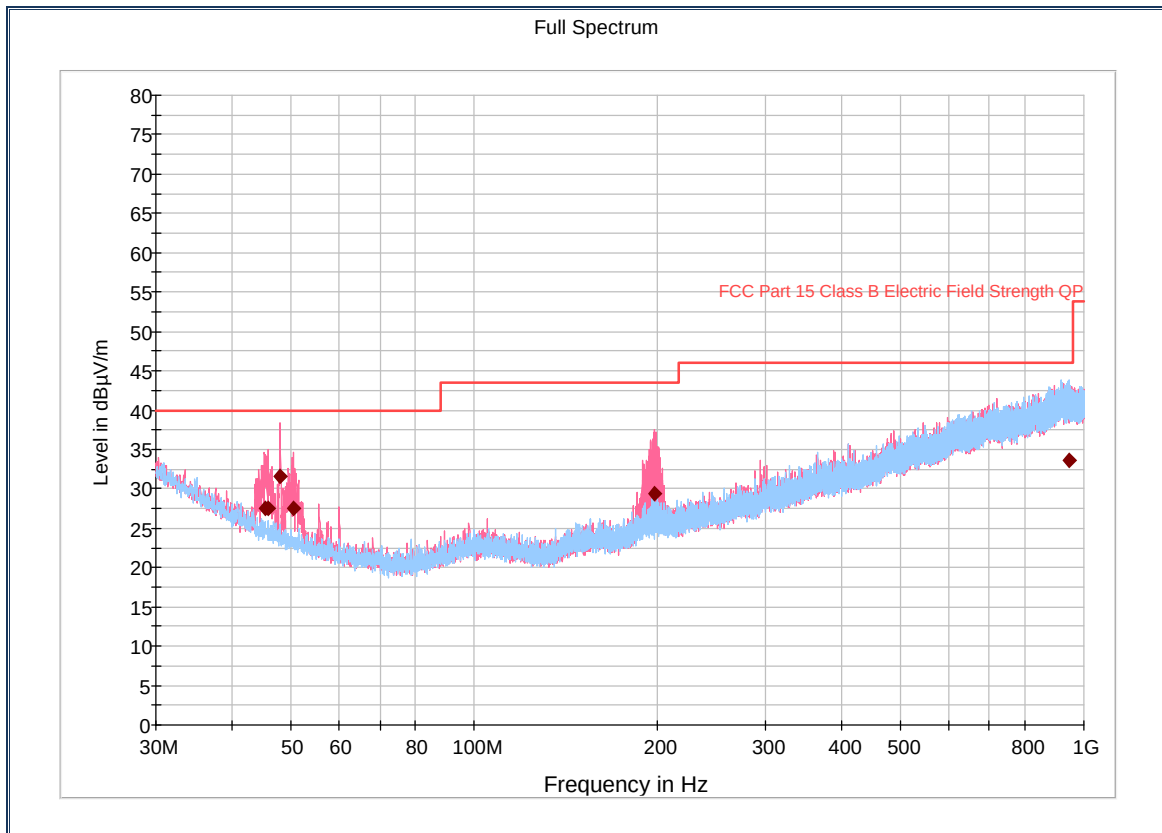


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
0.563475	44.43	72.59	28.15	1000.0	9.000	100	H	148.0	14.3
1.688700	33.52	63.04	29.53	1000.0	9.000	100	H	262.0	14.6
13.560105	68.67	69.50	0.83	1000.0	9.000	100	H	178.0	14.9
22.121085	57.09	69.50	12.41	1000.0	9.000	100	H	-10.0	14.6
27.652290	49.97	69.50	19.53	1000.0	9.000	100	H	325.0	13.7
29.494035	46.05	69.50	23.45	1000.0	9.000	100	H	162.0	13.8
29.953725	36.11	69.50	33.39	1000.0	9.000	100	H	72.0	13.7

Test Notes:

2.4.12 Test Results 30 MHz to 1 GHz



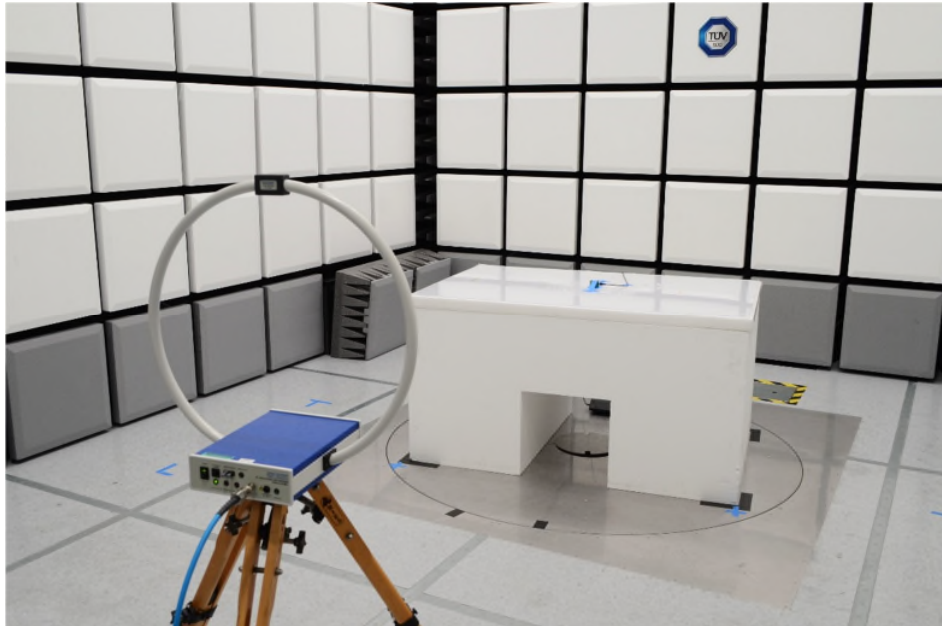
Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
45.321333	27.45	40.00	12.55	1000.0	120.000	103.2	V	24.0	17.5
45.895667	27.59	40.00	12.41	1000.0	120.000	99.8	V	134.0	17.4
48.022000	31.65	40.00	8.35	1000.0	120.000	104.0	V	166.0	16.8
50.519333	27.49	40.00	12.51	1000.0	120.000	99.8	V	90.0	16.2
197.103333	29.38	43.50	14.12	1000.0	120.000	112.0	V	184.0	18.5
947.429000	33.65	46.00	12.35	1000.0	120.000	150.3	H	126.0	33.5

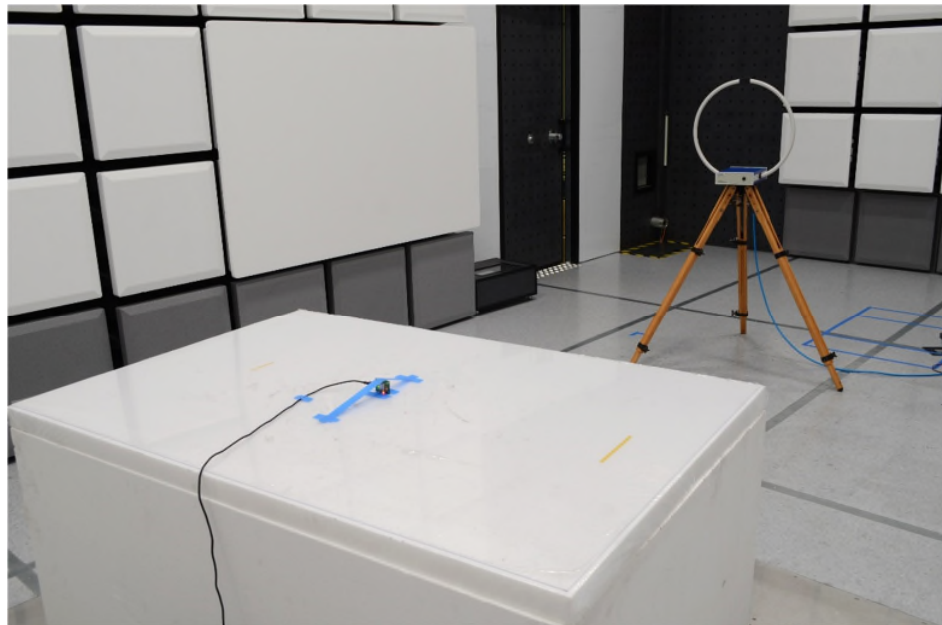
Test Notes:

2.4.13 Test Set Up Pictures

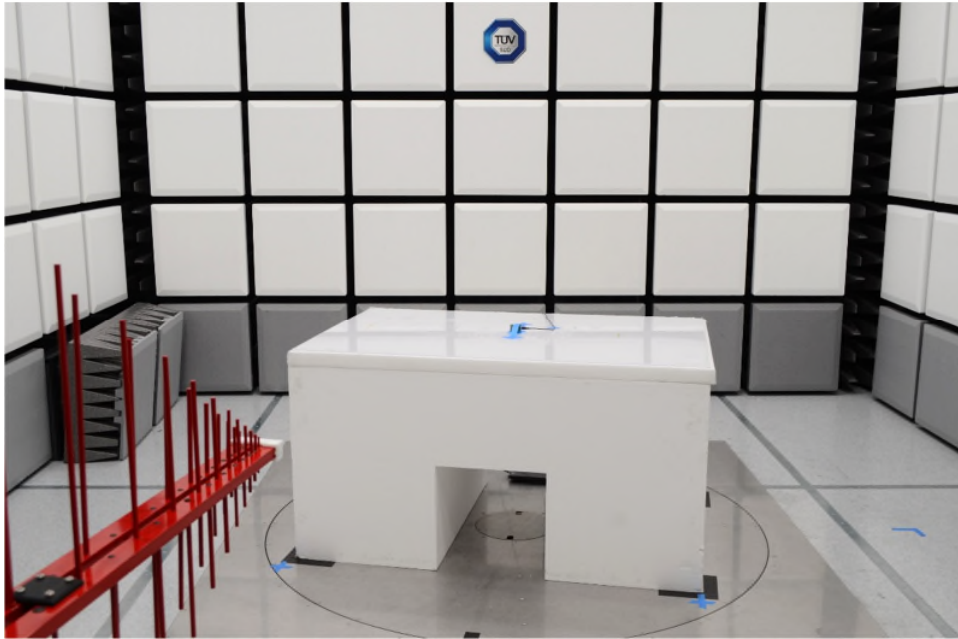
Below 30 MHz (front)



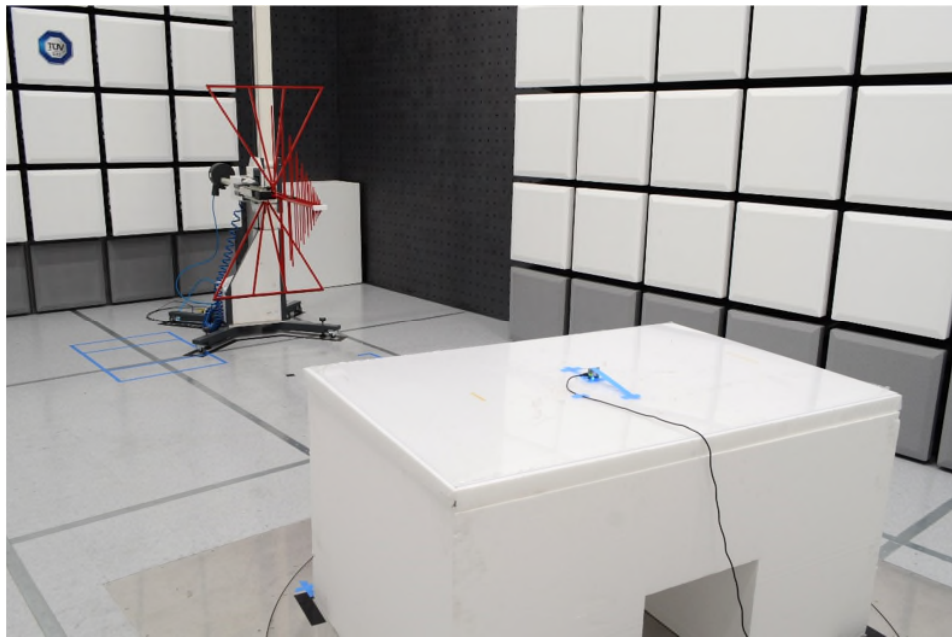
Below 30 MHz (back)



30 MHz to 1 GHz (front)



30 MHz to 1 GHz (back)





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 Corporation	11/21/16	11/21/17
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
8878	High-frequency cable	R90-088-240	N/A	Teledyne/Storm Microwave	03/16/16	03/16/17
8879	High-frequency cable	084-0505-100	N/A	Teledyne/Storm Microwave	03/16/16	03/16/17
Miscellaneous						
6708	Multimeter	34401A		Hewlett Packard	06/09/16	06/09/17
6672	DC Power Supply	E3611A	KR73012637	HP	Verified by 6708	
6610	Temperature chamber	SH-27C	9963481-S1074	Envirotronics	01/20/16	01/20/17
6628	Loop Antenna	HFH2-Z2	880.458/25	Rhode & Schwarz	Verified by 7640	
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	08/22/16	08/22/17
	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	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

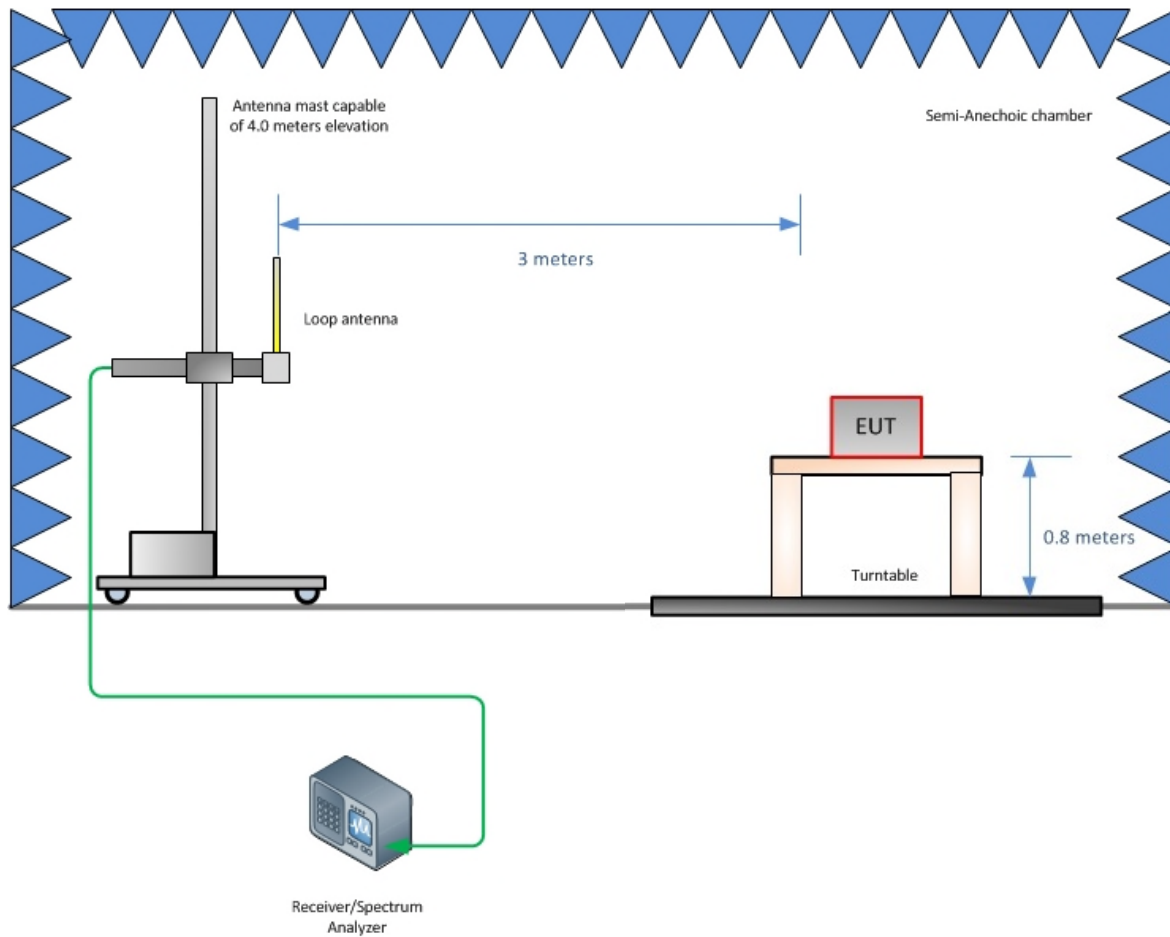
3.2.2 Radiated Emission Measurements (Above 1GHz)

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

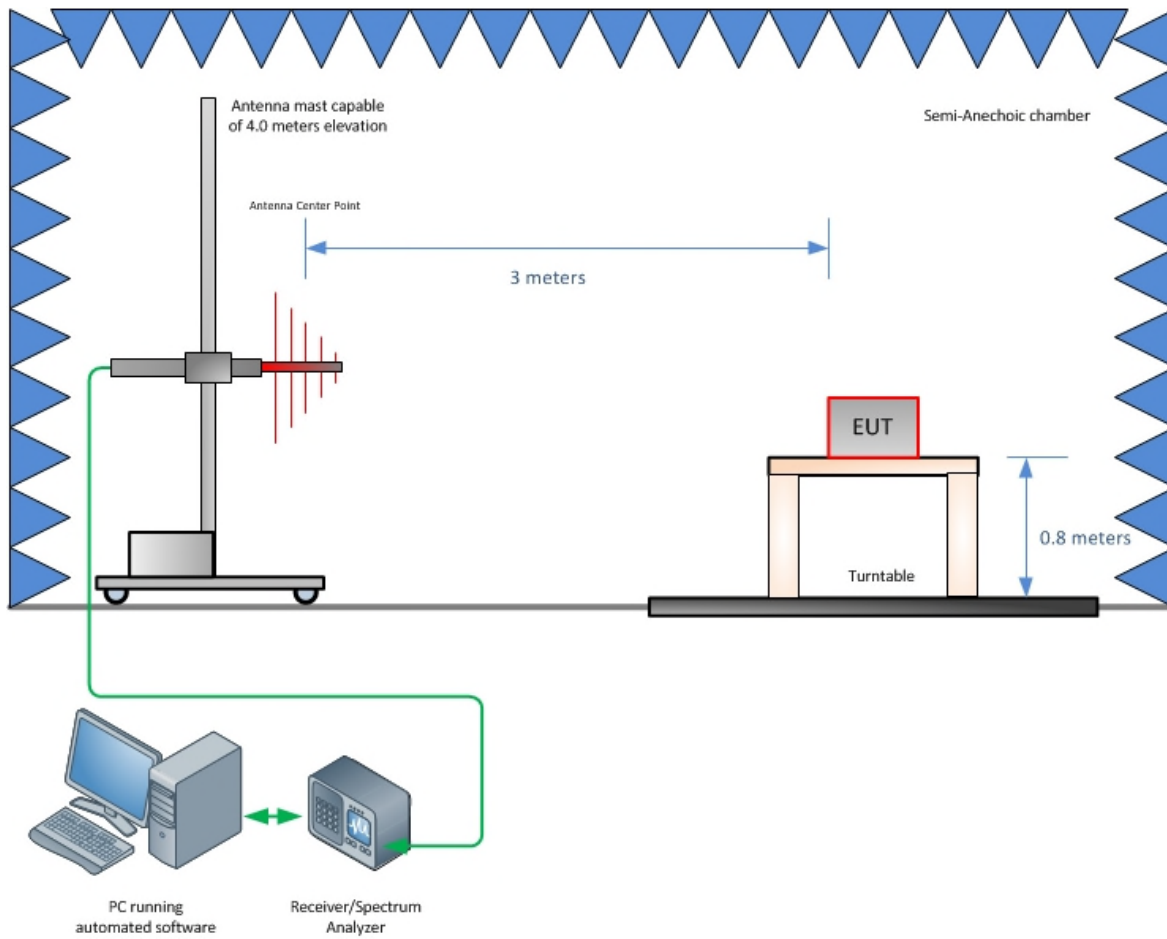
SECTION 4

DIAGRAM OF TEST SETUP

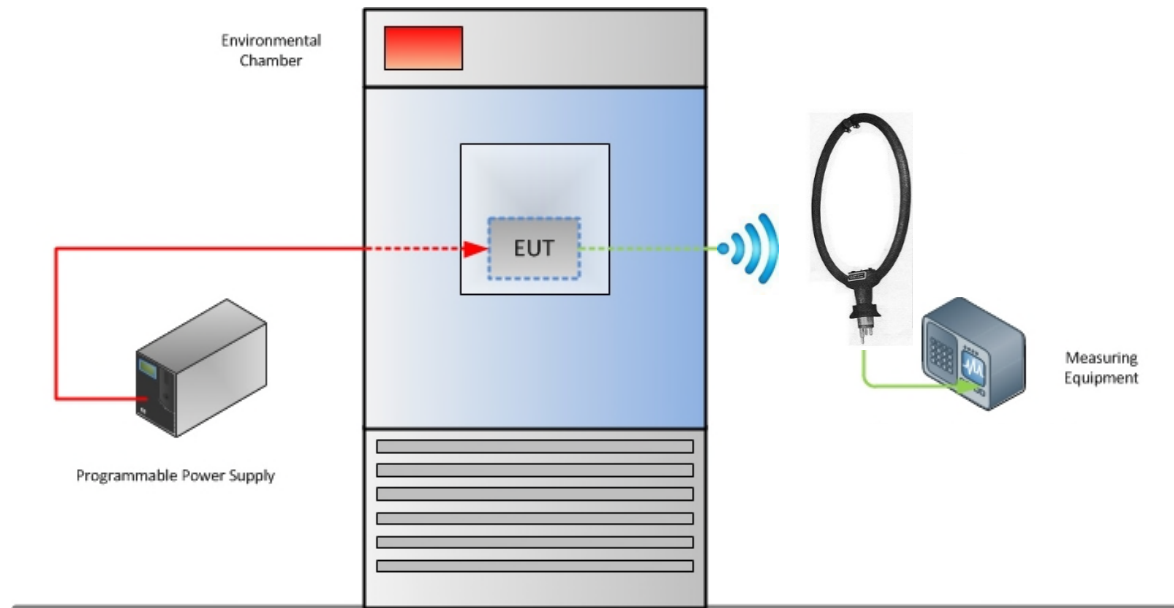
4.1 TEST SETUP DIAGRAM (EMISSION MASK)



4.2 TEST SETUP DIAGRAM (RADIATED EMISSIONS 30 TO 1000 MHZ)



4.3 TEST SETUP DIAGRAM (FREQUENCY STABILITY)





SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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