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Report On

EMC Evaluation of
NX35-C200 Vehicle Tracking System

FCC Part 15 Subpart B with Collocation.
ICES-003 Issue 6

Report No. JT72130952-0817C **October 2017**

TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121
Tel: (858) 678-1400. Website: www.TUVamerica.com

REPORT ON	EMC Evaluation of the NX35-C200 Vehicle Tracking System
TEST REPORT NUMBER	JT72130952-0817C
TEST REPORT DATE	October 2017
PREPARED FOR	Novatel Wireless 9605 Scranton Rd. Ste 300 San Diego, CA 92121 USA
CONTACT PERSON	Roman Olmos Senior Regulatory Engineer (858) 812-3400 rolmos@nvtl.com
PREPARED BY	Ivan Retana **Name** Authorized Signatory Title: EMC Engineer
APPROVED BY	Ferdinand S. Custodio Name Authorized Signatory Title: EMC/Senior Wireless Test Engineer
DATED	October 17, 2017

Revision History

JT72130952-0817C NX35-C200 Vehicle Tracking System					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
10/17/2017		Initial Release			Ferdinand S. Custodio

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

EMC Evaluation of the
NX35-C200 Vehicle Tracking System

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1.1 INTRODUCTION

The information contained in this report is intended to show verification of the NX35-C200 Vehicle Tracking System to the requirements of FCC Part 15 Subpart B and Innovation, Science and Economic Development Canada ICES-003.

Objective	To perform EMC Evaluation to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Ctrak
Model Number(s)	NX35-C200
Serial Number(s)	EMC Sample 1
Number of Samples Tested	1
Date sample(s) received	September 01, 2017
Highest Frequency Generated or Used	2400 MHz
Test Specification/Issue/Date	• FCC Part 15 Subpart B (October 1, 2016) • Spectrum Management and Telecommunications Interference-Causing Equipment Standard ICES-003 Information Technology Equipment (ITE) — Limits and methods of measurement (Issue 6 January 2016 updated June 30, 2016).
Start of Test	September 01, 2017
Finish of Test	October 10, 2017
Name of Engineer(s)	Ivan Retana
Related Document(s)	None

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1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart B is shown below. Test results from these tests are deemed satisfactory evidence of compliance with Innovation, Science and Economic Development Canada Interference-Causing Equipment Standard ICES-003.

Part 15	ICES-003	Test Description	Result	Comments/Base Standard
§15.107	6.1	Conducted Emissions	**N/A**	EUT is battery operated
§15.109	6.2	Radiated Emissions with Collocation	**Compliant**	Class B requirement

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1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Model NX35-C200 Vehicle Tracking System as shown in the photograph below. The NX35 device is designed to accurately track position and other data of vehicles or assets and report this data to a data centre. The NX35 is used to gather information relevant to fleet management services, to plot a vehicle position on a map and also to follow the route taken by a vehicle during a journey. The position and speed of the vehicle is sampled using GNSS (Global Navigation Satellite System) and reported through a GSM modem data link with industry standard communication protocols.

Equipment Under Test

1.3.2 Labelling Requirement for Innovation, Science and Economic Development Canada

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section and in Notice 2014-DRS1003 for electronic labelling for every unit:

(i) Prior to marketing in Canada, for ITE manufactured in Canada, and;
(ii) Prior to importation into Canada, for imported ITE.

Each unit of an ITE model shall bear a label (see below) that represents the manufacturer's or the importer's SDoC with Innovation, Science and Economic Development Canada's ICES-003. This label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. If the dimensions of the device are too small or if it is not practical to place the label on the ITE and electronic labelling has not been implemented, the label shall be, upon agreement with Innovation, Science and Economic Development Canada, placed in a prominent location in the user manual supplied with the ITE. The user manual may be in an electronic format and must be readily available.

Innovation, Science and Economic Development Canada ICES-003 Compliance Label

CAN ICES-3 (B)/NMB-3(B)

* Insert either "A" or "B" but not both to identify the applicable Class of ITE.

1.3.3 Labelling Requirement for Part 15 (Verification) Device

See FCC Publication Number: 784748 for details:

https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=27980&switch=P

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1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	EUT is in idle mode. For Collocation EUT connected to a support laptop via a USB to RS232 cable to enable BLE transmit mode. Tools and software were provided by the manufacturer and was used to configure RF parameter of the EUT.

1.4.2 EUT Exercise Software

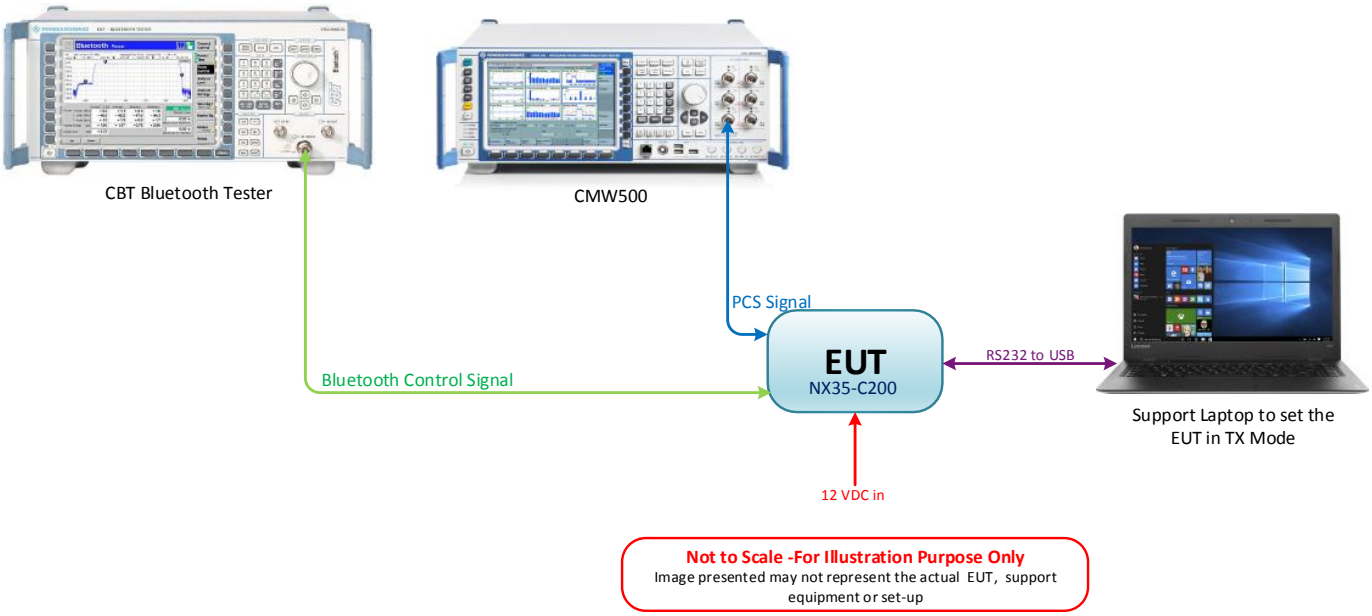
None. No special software was used during evaluation.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Apple	Support Laptop	Support laptop used to configure EUT RF parameter setting
R&S	CMW500	Support Callbox
R&S	CBT	Support Bluetooth tester

1.4.4 Simplified Test Configuration Diagram

For Collocation:



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: EMC Sample 1		
None	—	—

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 C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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 C63.4-2014. 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 – Designation 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 Designation is US1146.

1.9.2 Innovation, Science and Economic Development Canada Registration (ISED) No.: 3067A-1 & 22806-1

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 22806-1.

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.

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SECTION 2

TEST DETAILS

EMC Evaluation of the
NX35-C200 Vehicle Tracking System

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2.1 RADIATED EMISSIONS (RADIATED EMISSIONS VERIFICATION)

2.1.1 Specification Reference

Part 15 Subpart B §15.109(a)

2.1.2 Standard Applicable

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field Strength (microvolts/meter)
30-88	100
88-216	150
216-960	200
Above 960	500

2.1.3 Equipment Under Test and Modification State

Serial No: EMC Sample 1 / Default Test Configuration

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

September 01, October 10 2017 / IR

2.1.5 Test Equipment Used

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

2.1.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.3 °C
Relative Humidity	48.4 %
ATM Pressure	98.3 kPa

2.1.7 Additional Observations

- The spectrum was searched from 30 MHz to 18 GHz.
- Verification was performed at 3 meters.
- 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 2.1.8 for sample computation.

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2.1.8 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# 1033 (antenna)	17.2	
Reported Quasi Peak Final Measurement (dBµV/m) @ 30MHz			**11.8**

2.1.9 Test Results

Compliant. See attached tables and plots.

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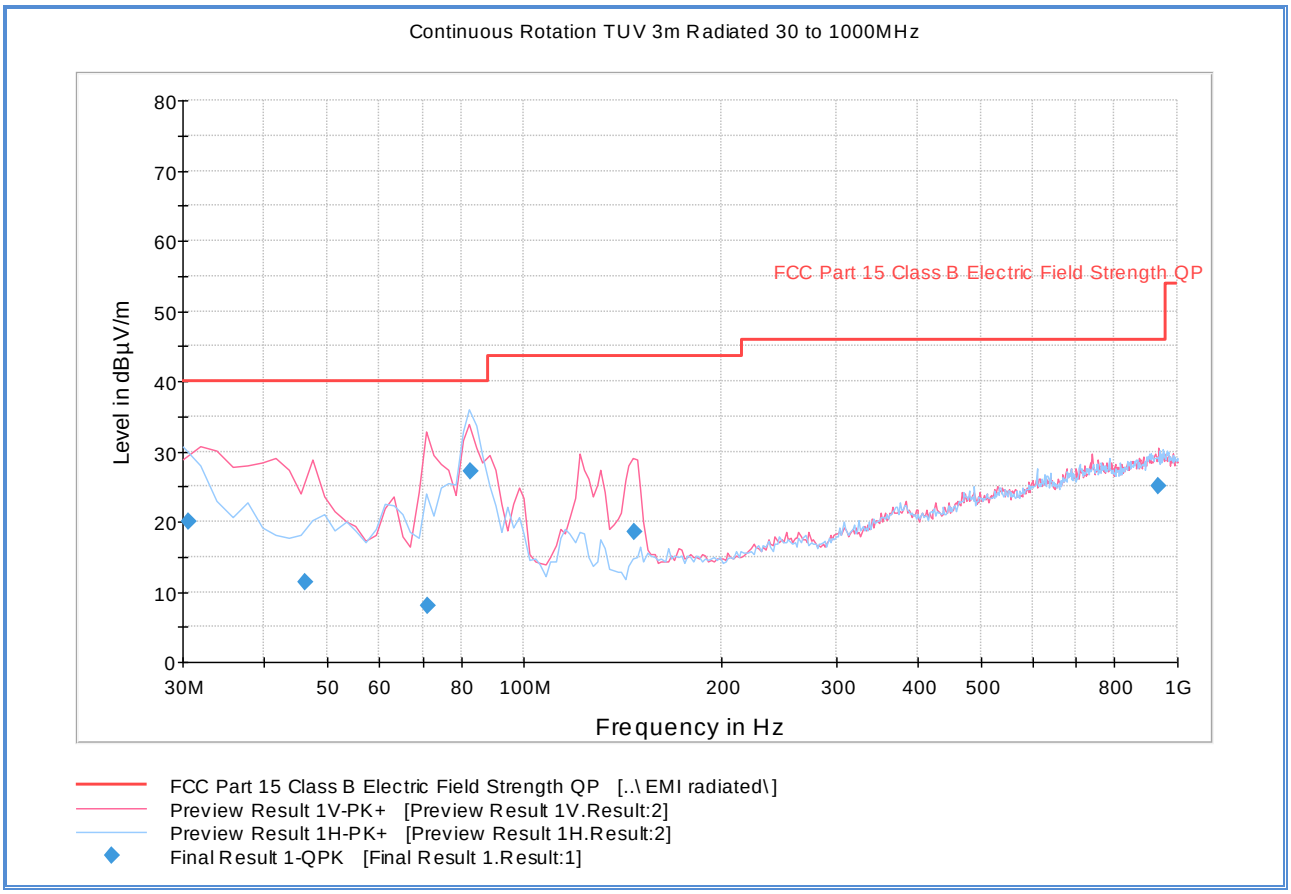
2.1.9.1 Below 1GHz Radiated Emission Test (12VDC)



Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.600000	20.0	1000.0	120.000	105.0	V	31.0	-6.4	20.0	40.0
46.254990	11.4	1000.0	120.000	100.0	V	310.0	-13.8	28.6	40.0
71.221643	8.1	1000.0	120.000	114.0	V	159.0	-16.9	31.9	40.0
82.724970	27.1	1000.0	120.000	200.0	H	19.0	-17.0	12.9	40.0
147.313267	18.5	1000.0	120.000	100.0	V	162.0	-14.2	25.0	43.5
937.011703	25.1	1000.0	120.000	350.0	V	14.0	6.2	20.9	46.0

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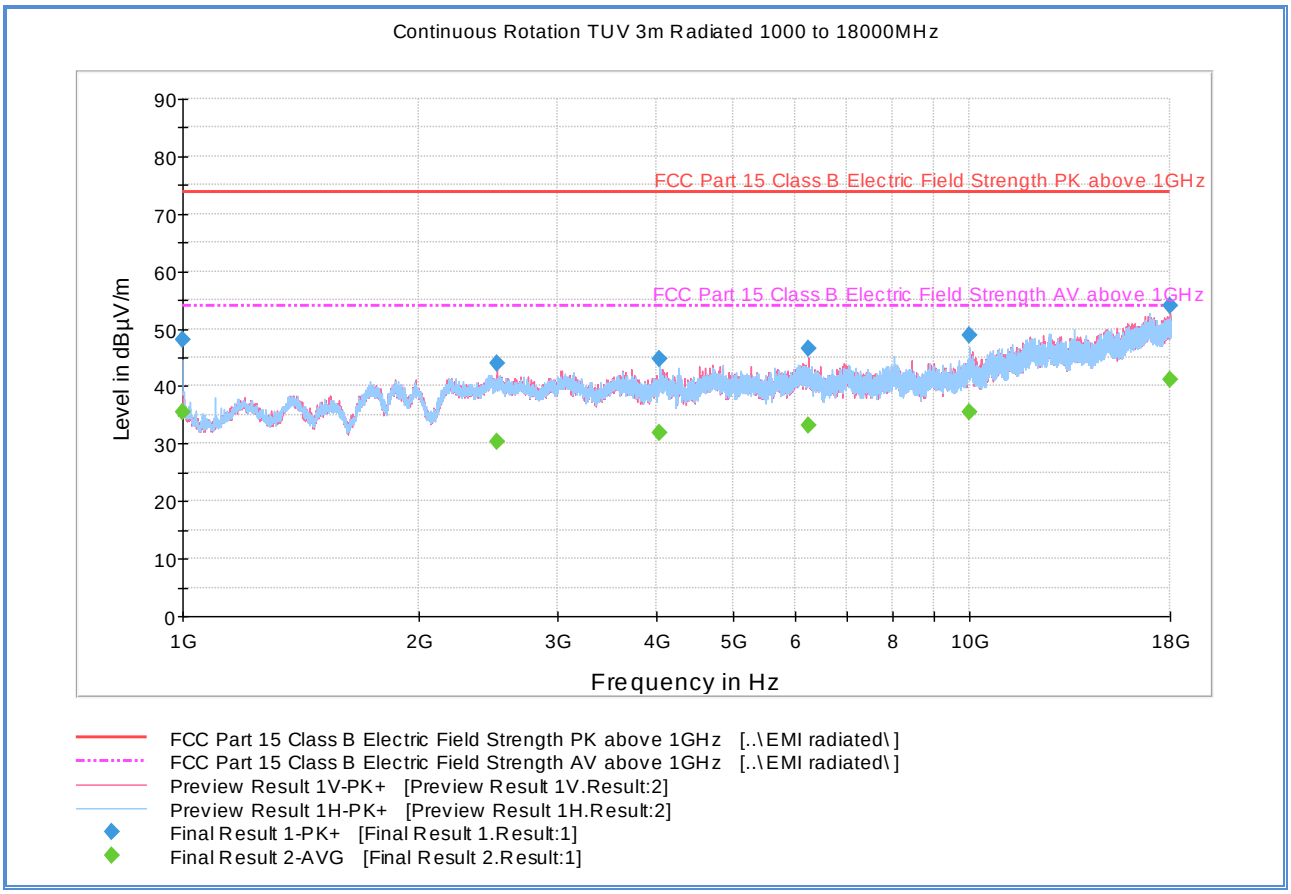
2.1.9.2 Above 1GHz Radiated Emission Test (12VDC)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	48.2	1000.0	1000.000	141.4	H	52.0	-7.2	25.7	73.9
2509.966667	44.0	1000.0	1000.000	368.0	V	262.0	-0.3	29.9	73.9
4041.833333	44.8	1000.0	1000.000	339.0	H	227.0	3.1	29.1	73.9
6240.933333	46.5	1000.0	1000.000	200.5	V	154.0	6.5	27.4	73.9
9997.733333	48.9	1000.0	1000.000	391.0	H	239.0	11.6	25.0	73.9
17993.73333	54.1	1000.0	1000.000	379.0	V	-6.0	23.4	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)
1000.000000	35.5	1000.0	1000.000	141.4	H	52.0	-7.2	18.4	53.9
2509.966667	30.4	1000.0	1000.000	368.0	V	262.0	-0.3	23.5	53.9
4041.833333	31.9	1000.0	1000.000	339.0	H	227.0	3.1	22.0	53.9
6240.933333	33.2	1000.0	1000.000	200.5	V	154.0	6.5	20.7	53.9
9997.733333	35.5	1000.0	1000.000	391.0	H	239.0	11.6	18.4	53.9
17993.73333	41.1	1000.0	1000.000	379.0	V	-6.0	23.4	12.8	53.9

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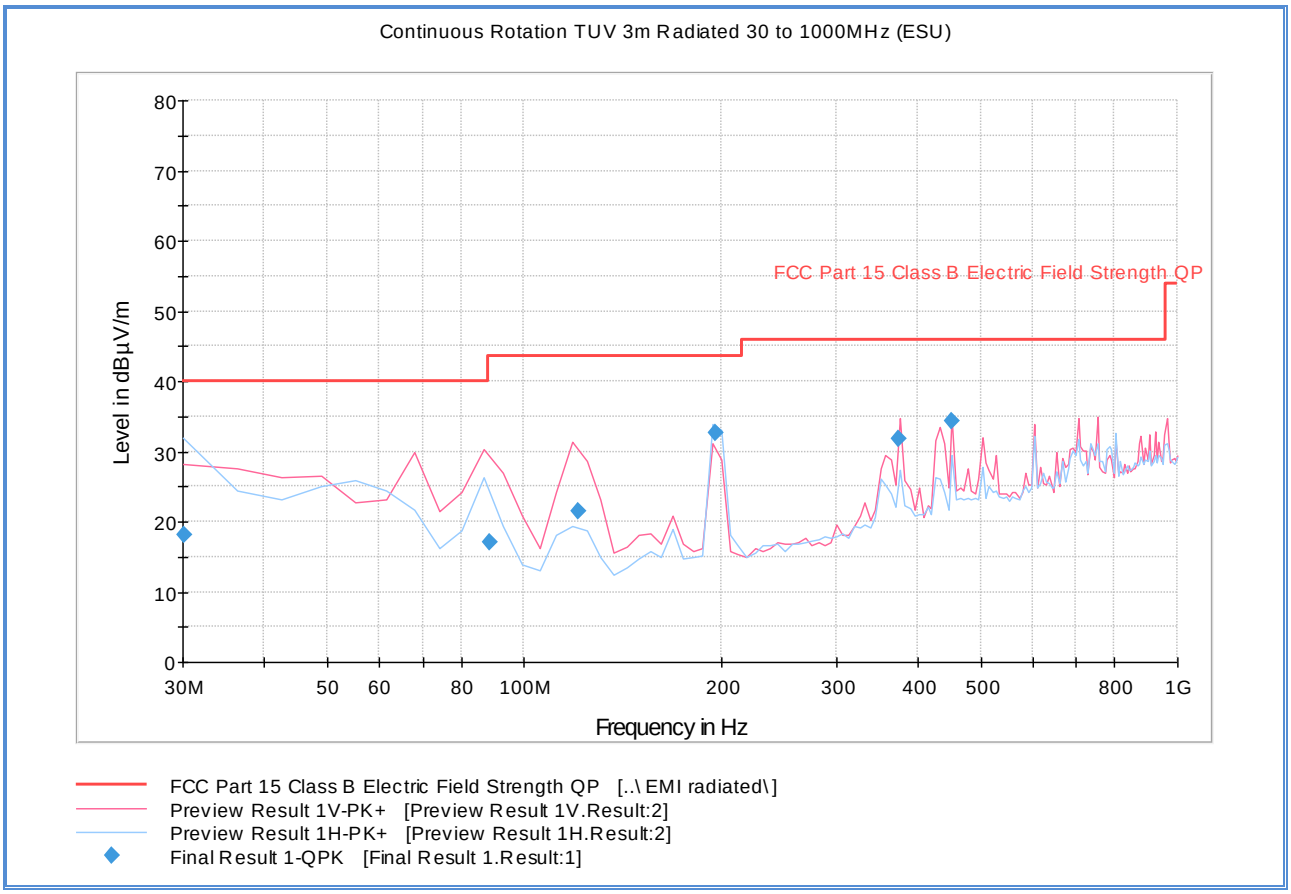
2.1.9.3 Below 1GHz Radiated Emission Test (12VDC – Co-located Bluetooth, CDMA simulataneos tx)



Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.160000	18.0	1000.0	120.000	116.0	H	344.0	-6.0	22.0	40.0
88.608312	17.0	1000.0	120.000	116.0	V	-13.0	-16.2	26.5	43.5
121.221818	21.4	1000.0	120.000	110.0	V	-13.0	-15.9	22.1	43.5
196.606234	32.7	1000.0	120.000	243.0	H	195.0	-12.0	10.8	43.5
374.988571	31.7	1000.0	120.000	100.0	V	183.0	-3.9	14.3	46.0
450.012987	34.4	1000.0	120.000	105.0	V	196.0	-3.2	11.6	46.0

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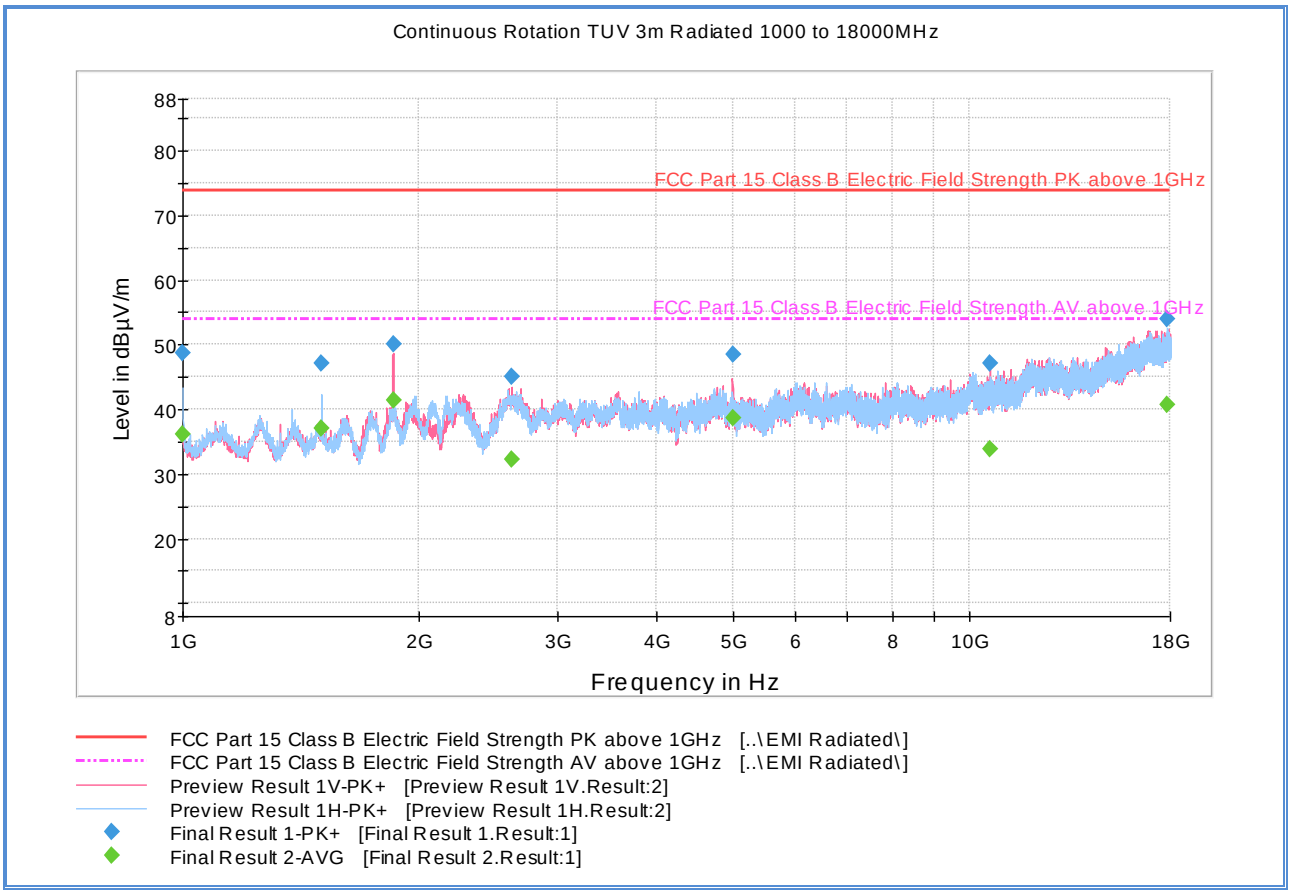
2.1.9.4 Above 1GHz Radiated Emission Test (12VDC – Co-located Bluetooth, CDMA simulataneos tx)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	48.6	1000.0	1000.000	136.4	H	113.0	-7.2	25.3	73.9
1500.000000	47.2	1000.0	1000.000	150.4	H	232.0	-6.0	26.7	73.9
1850.933333	50.0	1000.0	1000.000	197.3	V	114.0	-2.7	23.9	73.9
2620.633333	45.0	1000.0	1000.000	207.3	V	352.0	-0.5	28.9	73.9
5000.333333	48.4	1000.0	1000.000	207.3	V	148.0	3.6	25.5	73.9
10639.96666	47.0	1000.0	1000.000	112.4	V	99.0	14.1	26.9	73.9
17812.66666	53.8	1000.0	1000.000	182.3	H	176.0	23.0	20.1	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)
1000.000000	36.0	1000.0	1000.000	136.4	H	113.0	-7.2	17.9	53.9
1500.000000	37.0	1000.0	1000.000	150.4	H	232.0	-6.0	16.9	53.9
1850.933333	41.5	1000.0	1000.000	197.3	V	114.0	-2.7	12.4	53.9
2620.633333	32.3	1000.0	1000.000	207.3	V	352.0	-0.5	21.6	53.9
5000.333333	38.6	1000.0	1000.000	207.3	V	148.0	3.6	15.3	53.9
10639.96666	33.8	1000.0	1000.000	112.4	V	99.0	14.1	20.1	53.9
17812.66666	40.6	1000.0	1000.000	182.3	H	176.0	23.0	13.3	53.9

Test Note: Notch filters of 2.4 and 1.9 GHz were used.

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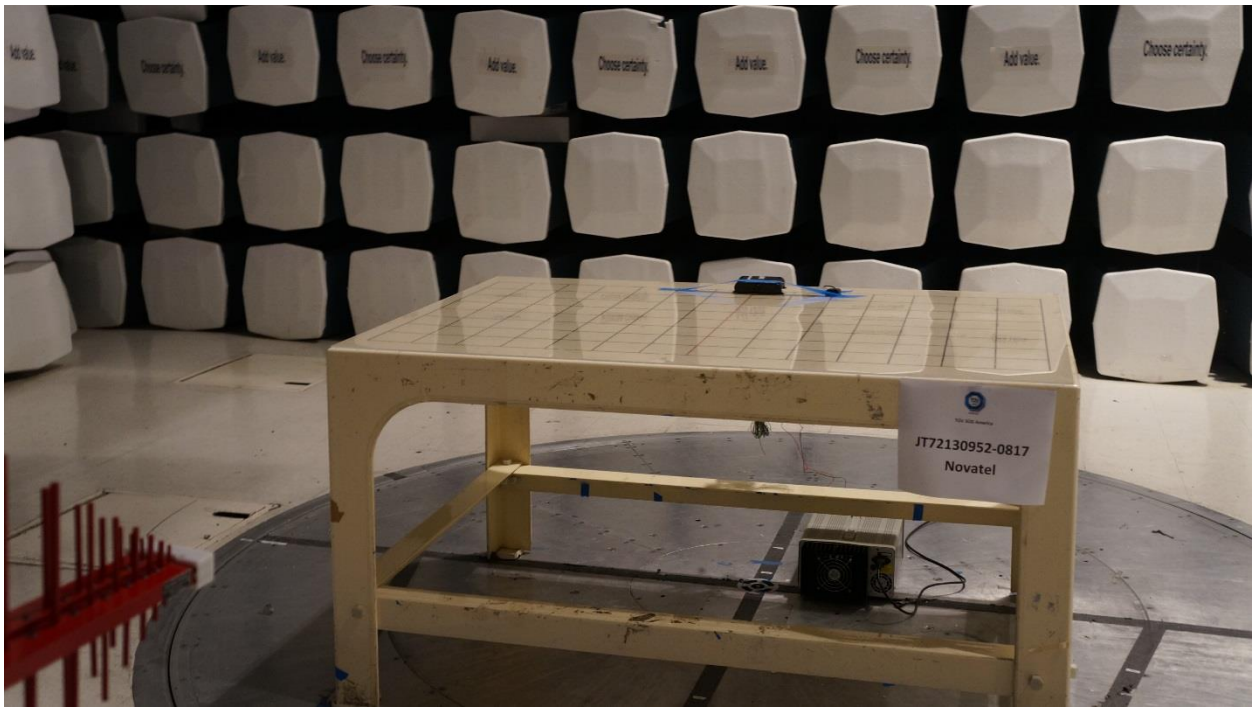
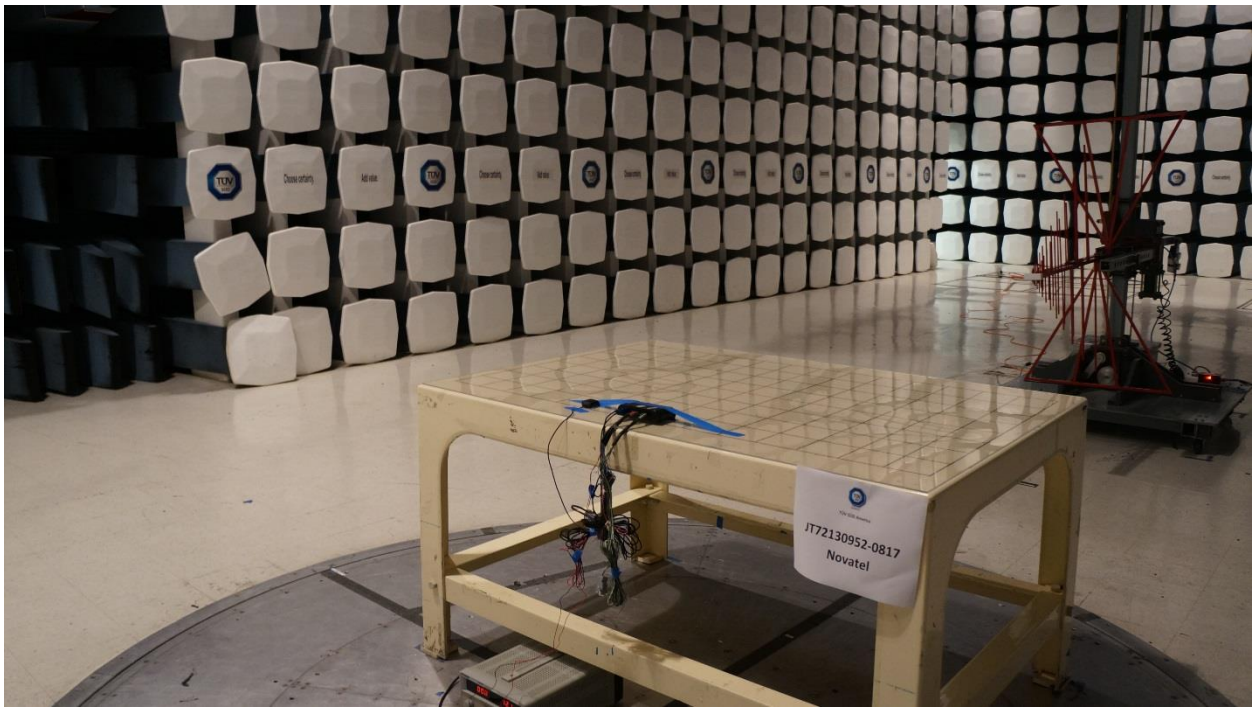
2.1.10 Test Setup Photo (Below 1GHz Front)



2.1.11 Test Setup Photo (Below 1GHz Back)



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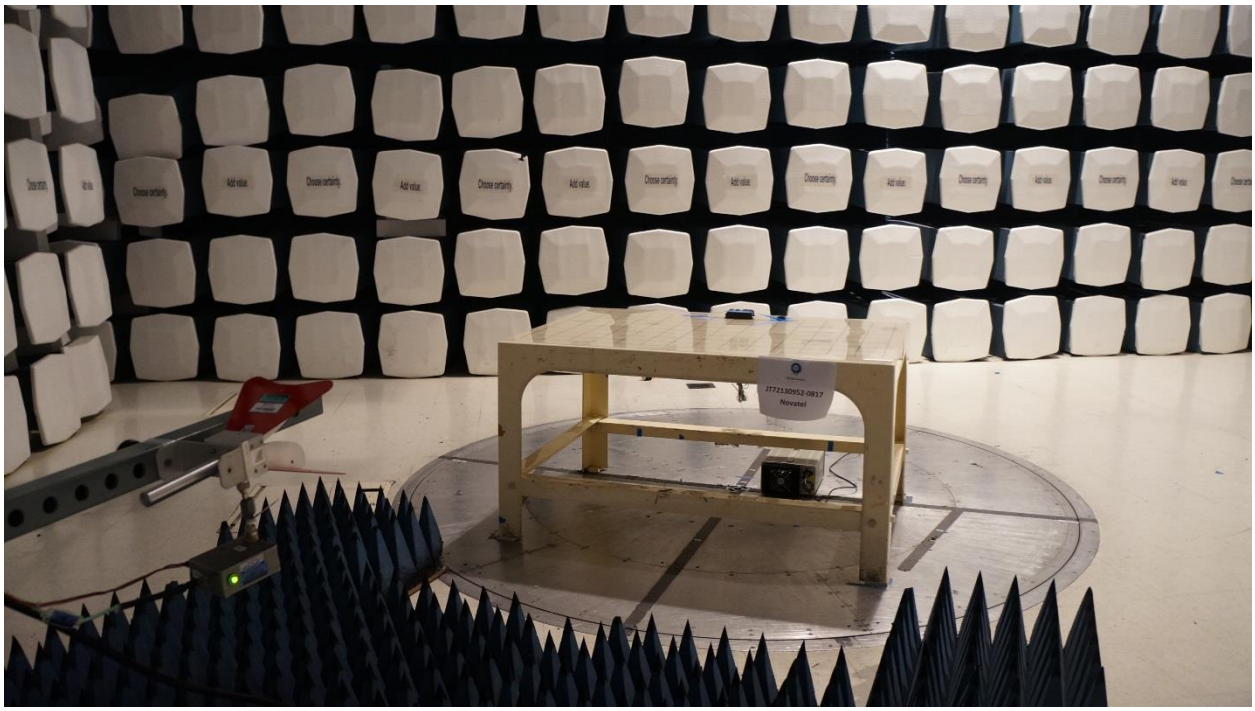
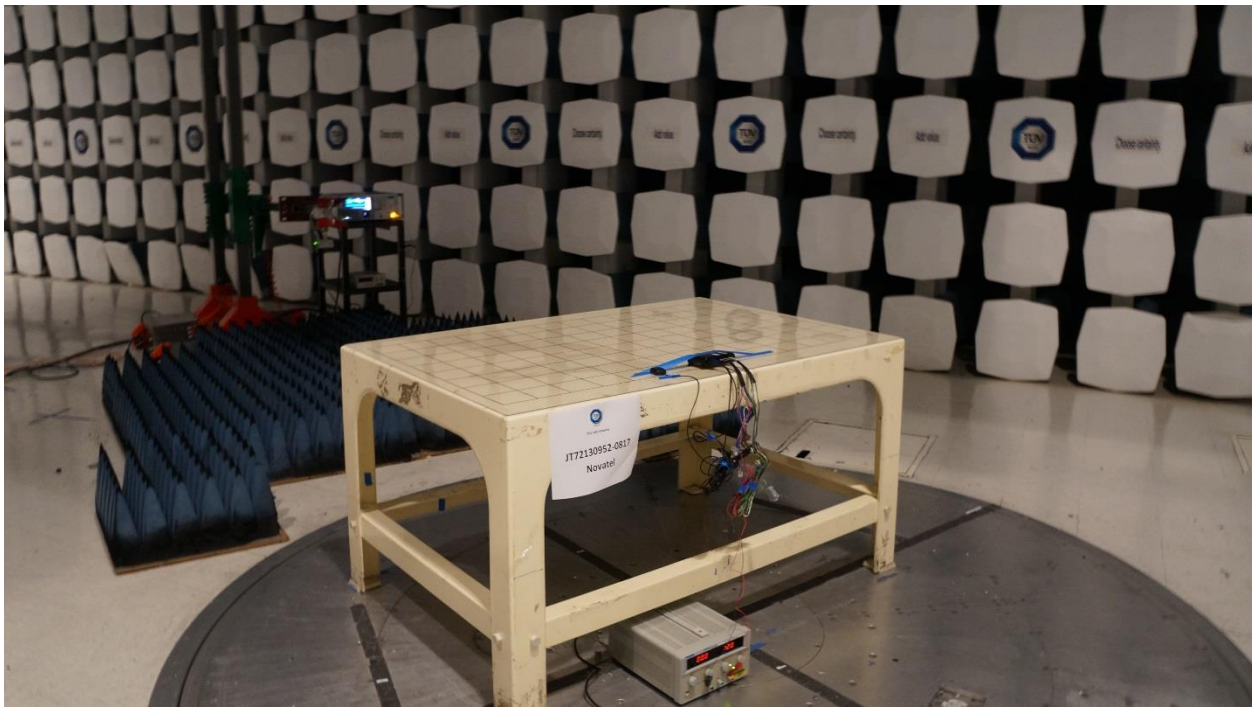
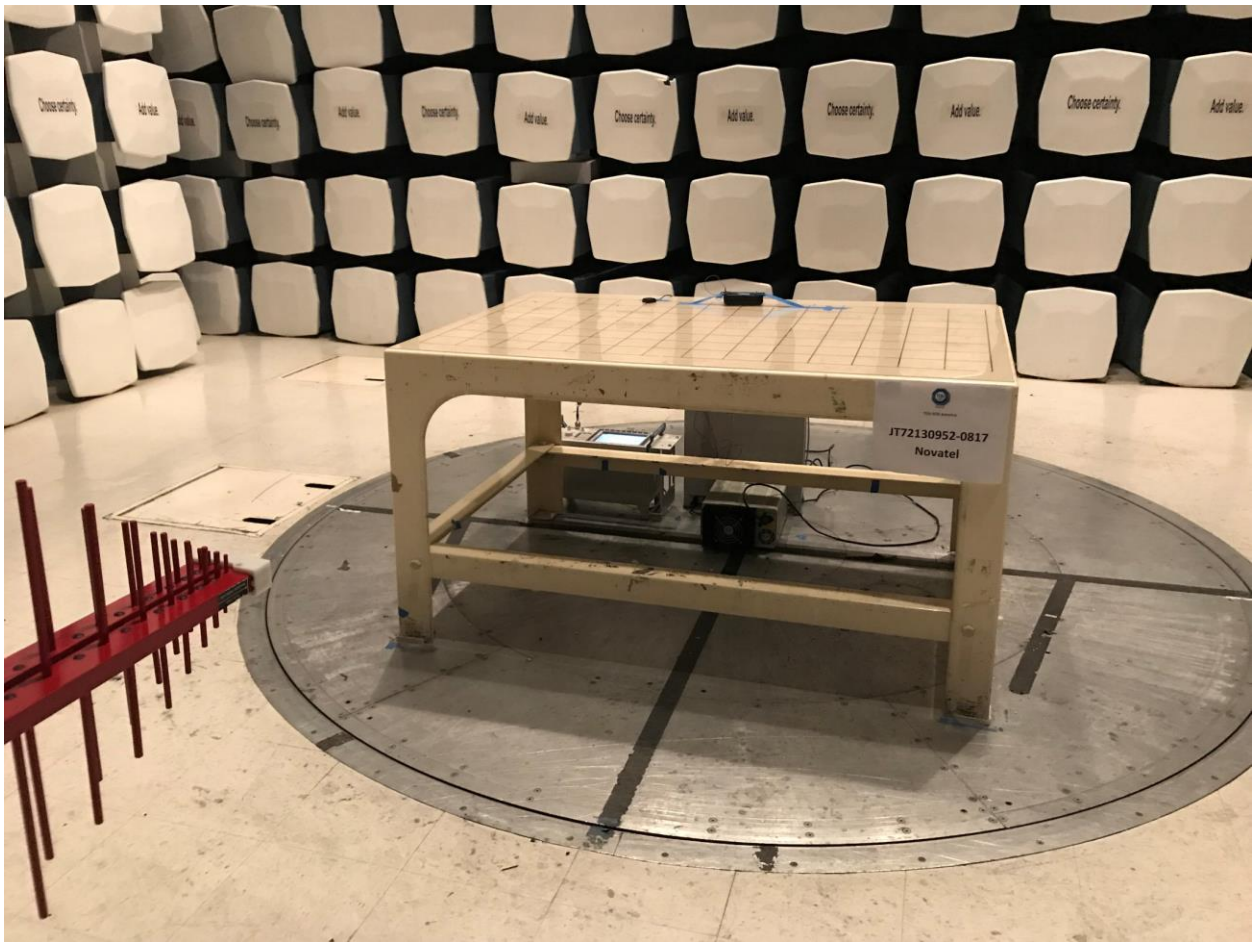
2.1.1 Test Setup Photo (Above 1GHz Front)



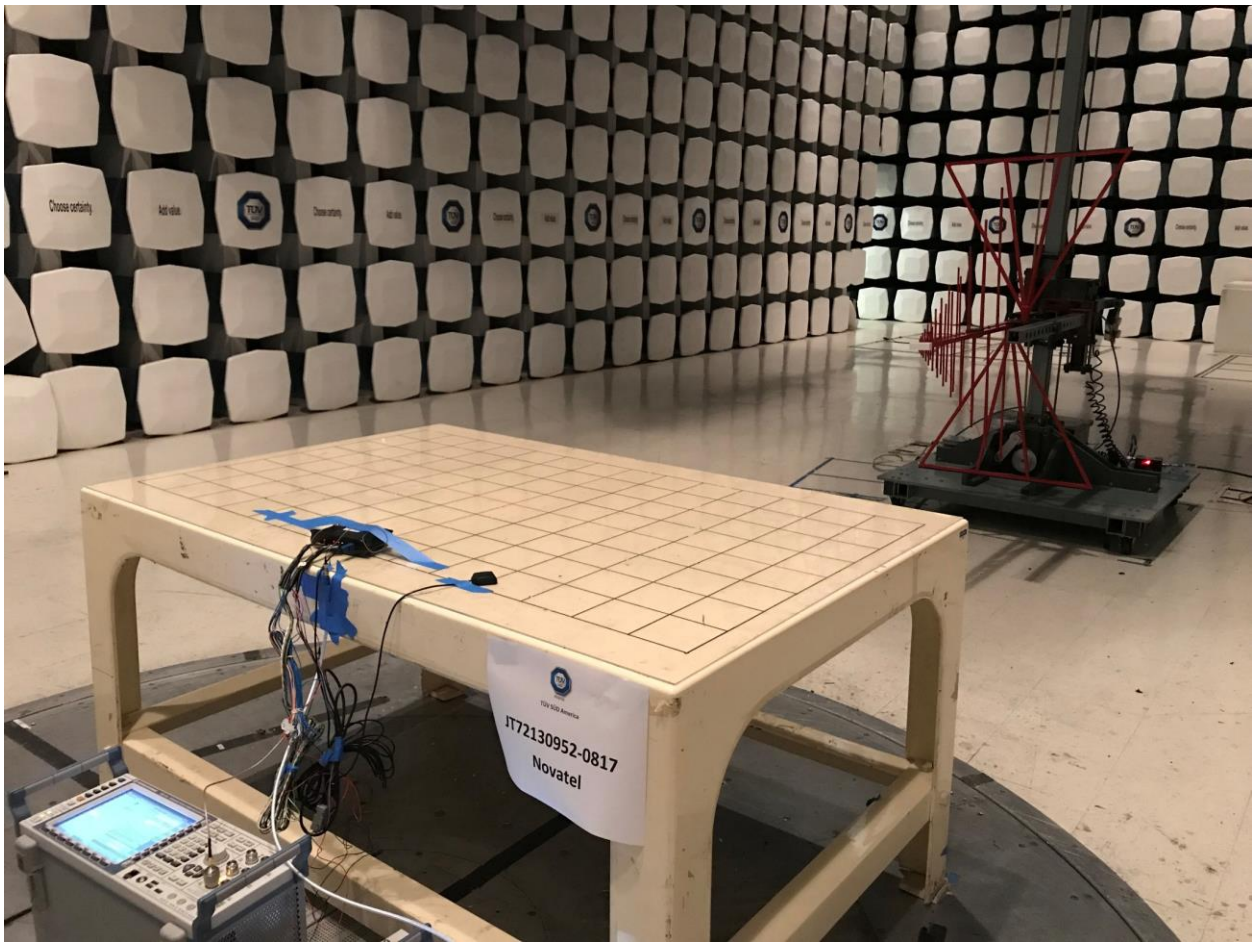
2.1.2 Test Setup Photo (Above 1GHz Back)



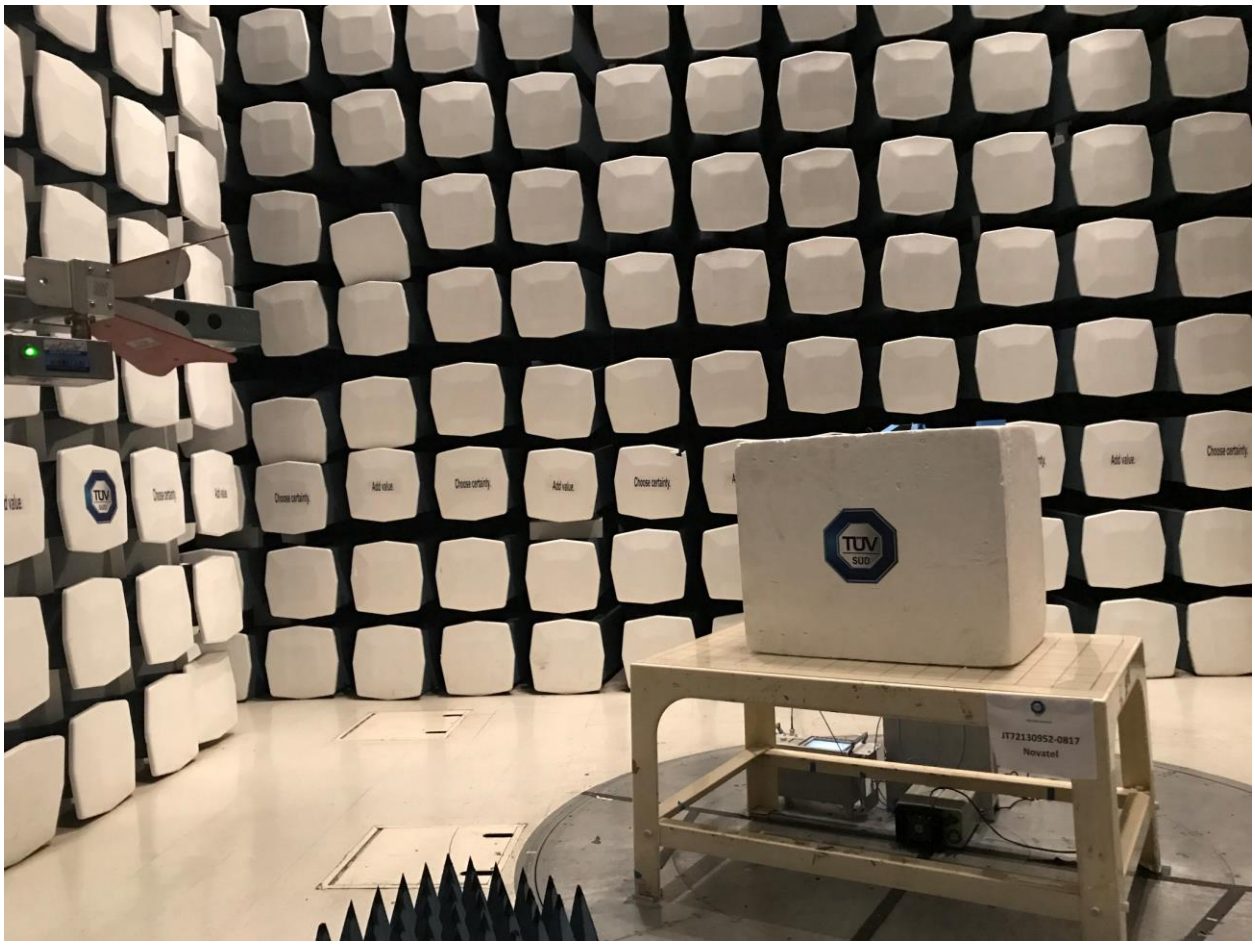
2.1.3 Test Setup Photo (Below 1GHz Front Collocation)



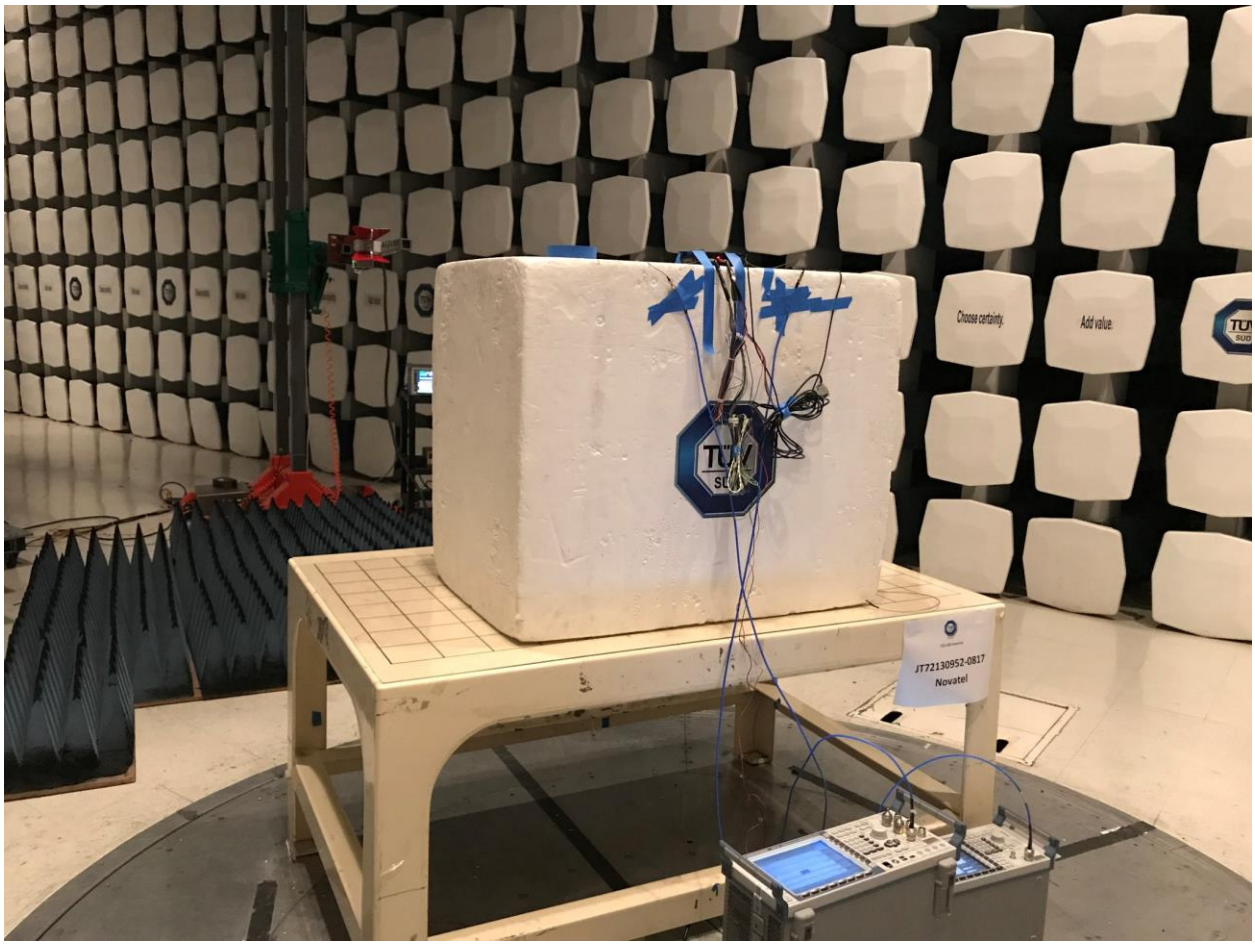
2.1.4 Test Setup Photo (Below 1GHz Back Collocation)



2.1.5 Test Setup Photo (Above 1GHz Front Collocation)



2.1.6 Test Setup Photo (Above 1GHz Back Collocation)



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SECTION 3

TEST EQUIPMENT USED

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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 Emission						
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
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	07/13/17	07/13/18
1016	Pre-amplifier	PAM-0202	187	PAM	02/09/17	02/09/18
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	06/01/17	06/01/18
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
Miscellaneous						
7554	Barometer/Temperature/Humidity Transmitter	iBTHX-W	0400706	Omega	01/17/17	01/17/18
-	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

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3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Radiated Measurements (Below 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyser	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	Triangular	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 Radiated Measurements (Above 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution xi	Standard Uncertainty u(xi)	[u(xi)]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	Triangular	3.00	1.22	1.50
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (uc):	1.49
				Coverage Factor (k):	2
				Expanded Uncertainty:	2.99

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SECTION 4

DIAGRAM OF TEST SETUP

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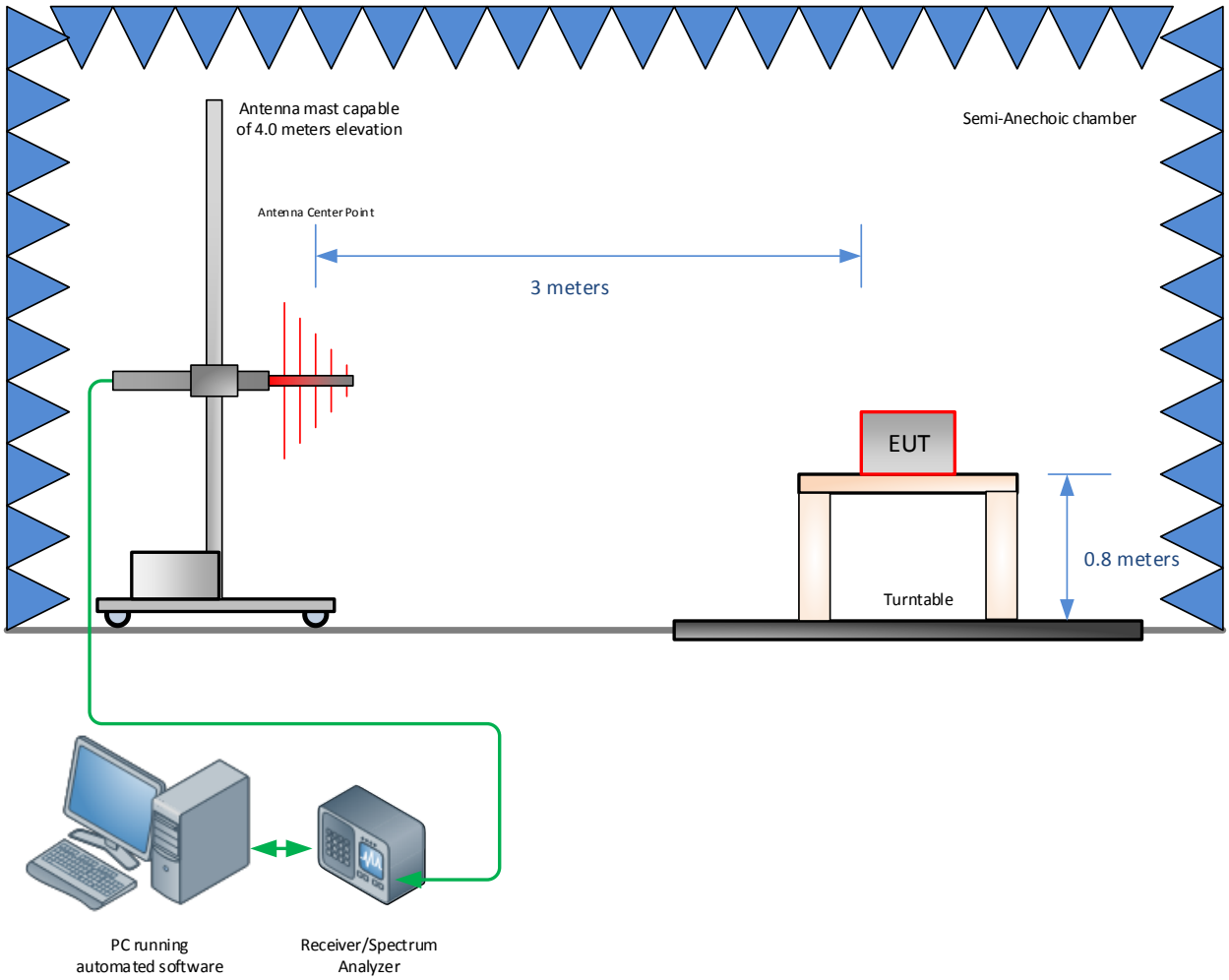
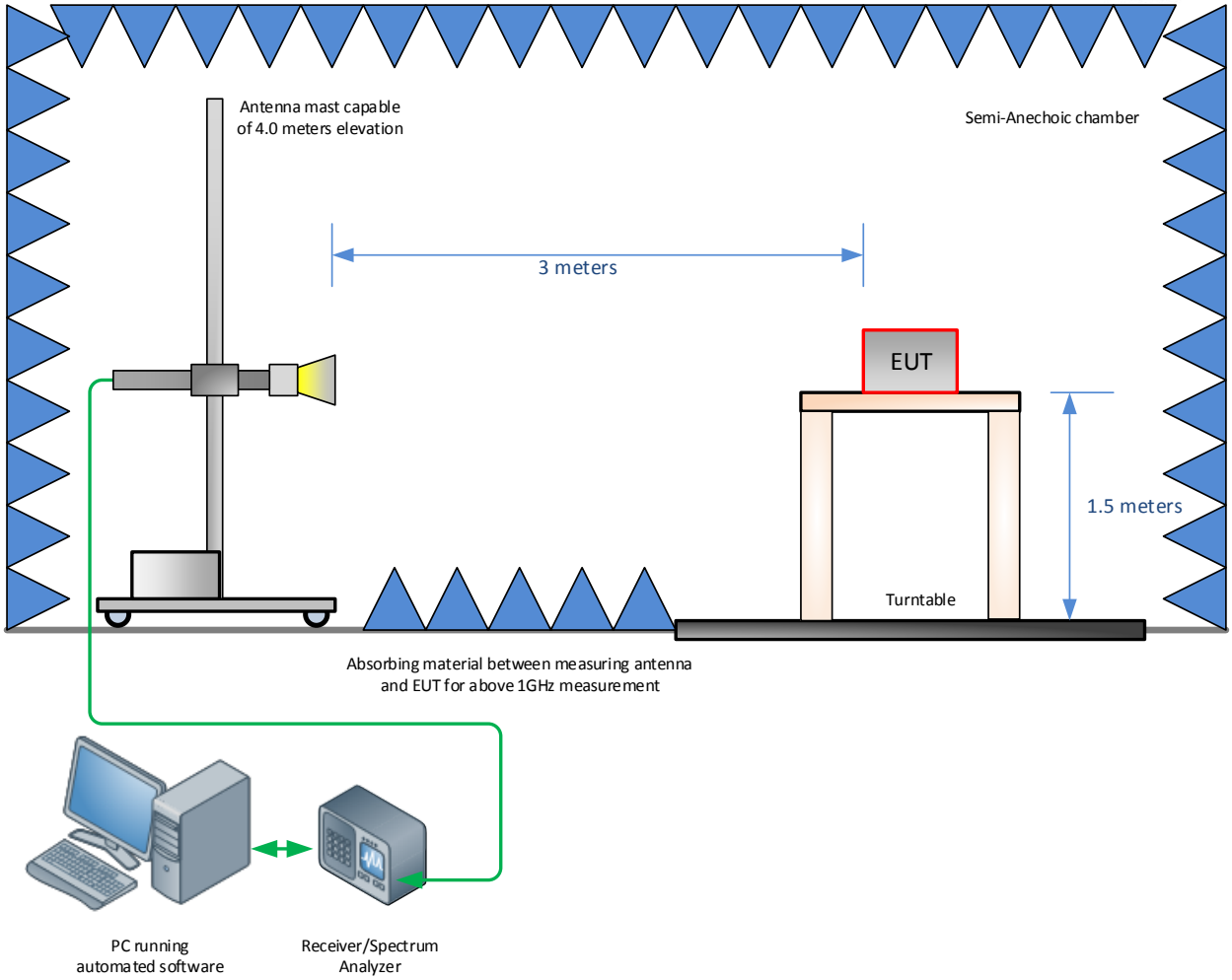
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Below 1GHz)

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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