GENTEX CORPORATION

Technical Report to the FCC and ISED Regarding Gentex Corporation - HomeLink© IV

Model: ADHL5D
FCC ID: NZLADHL5D
ISED: 4112A-ADHL5D

A report concerning approval for Gentex Corporation HomeLink® model ADHL5D.
Please issue grant immediately upon review.

Measurements Made and Report Prepared by:

Bolay Pacheco
Digitally signed by Bolay Pacheco
Date: 2023.09.11 14:01:04 -04'00'

Bolay Pacheco
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Measurements Reviewed by:

Daniel Brasier
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Date: 2023.09.11 18:07:22 -04'00'

Dan Brasier
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Report Approved by:

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Date: 2023.09.12 10:02:20 -04'00'

Jason Vargo
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Report Submitted by:

Brian Miller
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Date: 2023.09.11 14:23:15 -04'00'

Brian Miller
Laboratory Group Leader – Regulatory II
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Test Report Revision

REV Number	Date	Author	Description
1.0	9/11/2023	Bolay Pacheco	Initial Release.

Results relate only to the items tested as received.

Compliance has been evaluated based on the Lab Manual section 7.6.2. The decision rule used regarding measurement uncertainty was to determine results solely on whether the measured values met the defined acceptance criteria without factoring in measurement uncertainty values.

1. General Information

1.1. Product Description

The Gentex Corporation HomeLink® HLX Universal Garage Door Opener is a low-power transceiver OEM device that is installed into an overhead area of the automobile or rearview mirror. The installation is provided by trained technicians during the manufacture of the automobile. It is powered by the 12 Volt system of the automobile.

This Universal Garage Door Opener has the capability to

1. Learn the frequency and bit code format of the user's existing garage door remote control devices and
2. Reproduce and transmit the frequency and bit code format to remotely operate the user's garage door.

The unit is designed for the periodic operation of a control signal, which typically activates a garage door opener receiver.

The unit is supplied to the automobile manufacturer without harness. For testing purposes, a typical assembly and 2-conductor cable harness were used to power the unit.

The unit is only operational when the user depresses the control button. It becomes inactive after release of the control button.

The three-button HomeLink® unit replaces up to three hand-held transmitters. In addition to the typical operation of the garage door, the unit will learn the radio frequency codes of other transmitter types to activate entry door locks, estate gates, security systems, and home or office lighting.

The antenna system is an integral part of the unit. It cannot be altered nor replaced by the user. Service of this system is only available from the Automobile Manufacturer's Dealerships and Gentex Corporation.

1.2. Test Methodology

Antenna gain testing was performed according to ANSI C63.5:2017 section 6.2- Calibrations of antennas using a reference antenna.

The unit is supplied to the automobile manufacturer without harness. For testing purposes, a 2-conductor cable harness was used to interface to the unit.

1.3. Test Facility

The 3-meter semi-anechoic chamber Swhere these measurements were taken is located on the grounds of Gentex Corporation's Corporate Labs, in the city of Zeeland, county of Ottawa, state of Michigan, United States of America.

2. Test Configuration

Antenna Gain measurements presented in the report were made in accordance with ANSI C63.5-2017 section 6.2. The AUT was placed on a 30cm (in diameter) round non-metallic table elevated 150 cm above a ground plane for measurements below 1GHz. Peaks were found by moving antenna up and down from 1 to 4 meters and spinning AUT 360. The AUT harness was held ~40cm straight back and away from AUT. Test distance was at 3 meters.

3. Antenna Gain Data

3.1. Date(s) Tested: 09-07-2023 to 09-09-2023.

3.2. Test Method Deviation: None

3.3. Temperature and Humidity conditions

	Measured Value	Unit
Temperature	22.6	ºC
Humidity	43.1	%R.H.

3.4. Results

Worst Case Antenna Gain		
Frequency (MHz)	AUT Orientation	Antenna Gain (dBd)
288	End	-22.28
310	Flat	-23.14
340	Flat	-23.57
365	Flat	-19.2
390	Side	-20.06
430	Flat	-17.13
926	End	-10.87

3.5. Test Equipment Setup and Procedure

3.5.1. Test Equipment Used

Equipment used			
ID / Serial #	**Manufacturer**	**Description**	**Cal / PM Due Date**
6595	Rohde and Schwarz	EMI Receiver	10/11/2023
CF GCL	Megaphase/Pasternack	3m Chamber Port and Cables	4/30/2024
H6192	EMCO	3148 Log Periodic RX	5/3/2024
10290	Com-Power	10020022	5/4/2026
Tower 2	ETS-Lindgren	2171B Boresight Tower	VBU
PJ2246	ETS-Lindgren	Shielded Enclosure	VBU
8292	Omega	iBTHX-W Virtual	9/23/2023
6368	Rohde & Schwarz	Signal Generator	9/16/2024
6539	Stanley	Tape Measure	6/19/2026
6203	87V	Multimeter	01/05/2024
SW30	Gentex	3m Chamber Software	3/31/2024

Spectrum Analyzer Settings:

Detector:	Peak
Resolution Bandwidth:	120 KHz
Video Bandwidth	300 KHz
Span	1 MHz
Sweep Time:	25ms

For testing, the AUT was placed at the center of a non-conducting table 150cm above the ground plane pursuant to ANSI C63.5:2017 section 6.2. The AUT harness was held ~40cm straight back and away from AUT.

Equipment is placed in one of the three orthogonal orientations, End, Side, and Flat. These orientations are described below in Figure 6.2.1.

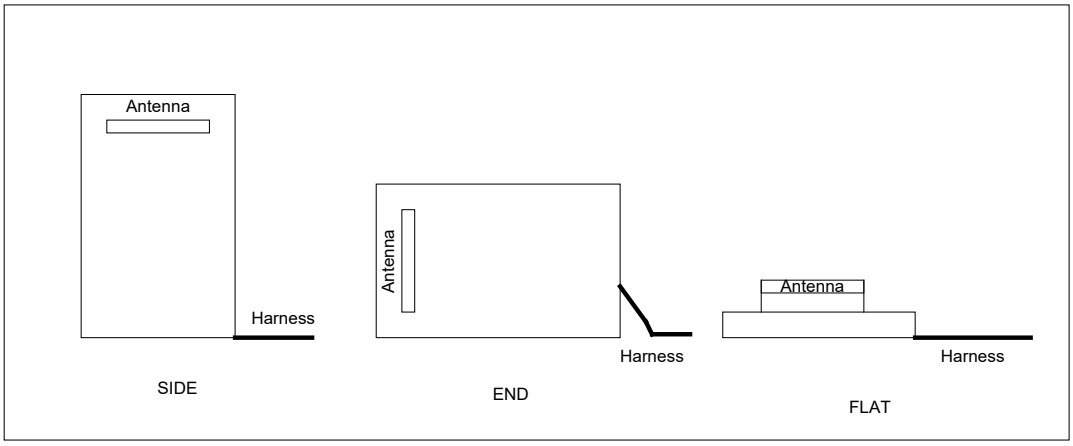

Figure 6.2.1 EUT Orthogonal Orientations

4. Formulas and Sample Calculations

4.1. Antenna Gain Calculation

The delta between the AUT and Signal Generator Output Power at various frequencies was used to calculate Antenna Gain (dBi).

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Appendix A

A. Antenna Gain Measurements

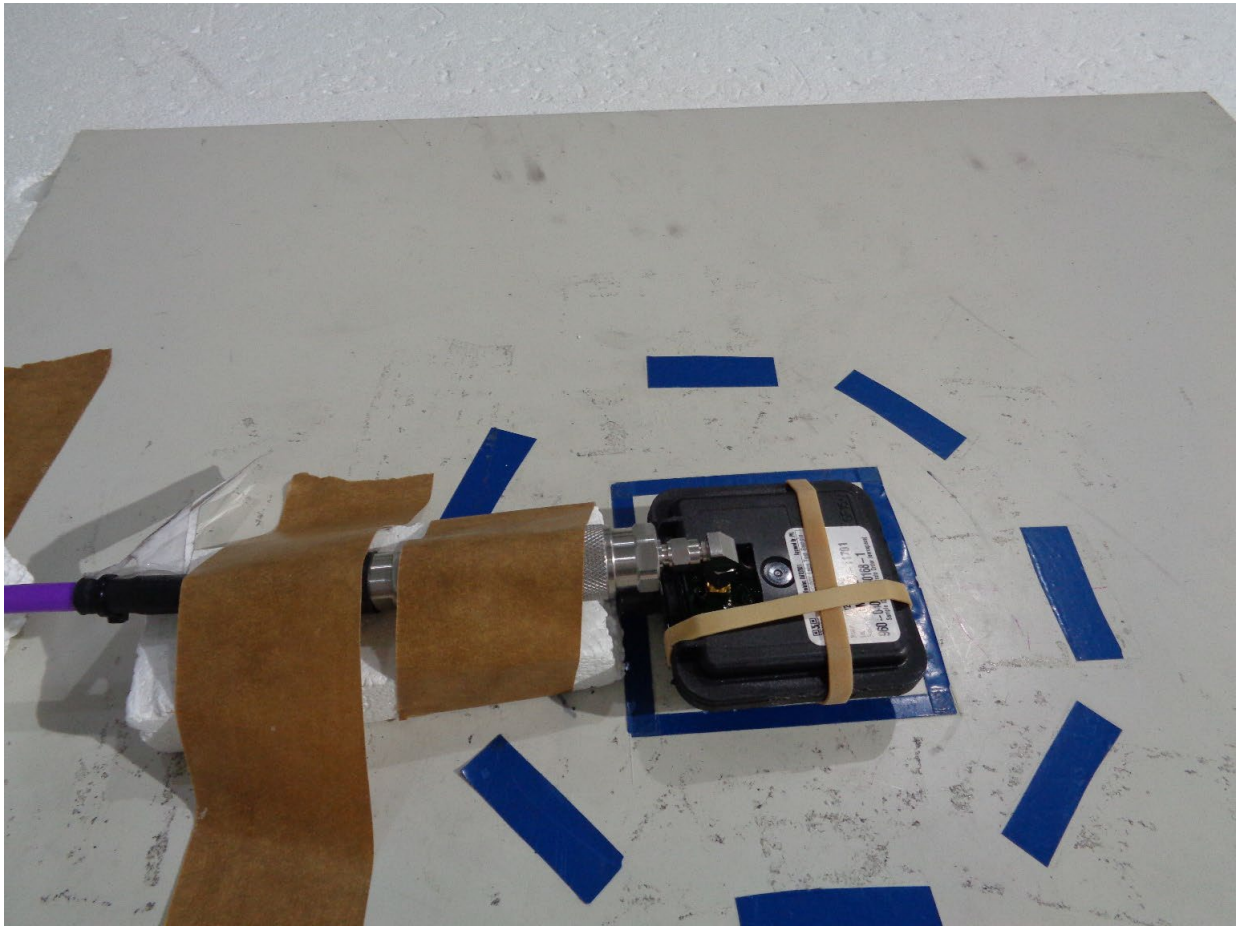
Measurements described in this section were taken according to ANSI C63.5-2017-Section 6.2 on the Gentex Corporation 3m test table.
* Measurements include Cable corrections and Antenna Factors

Measurement Settings:

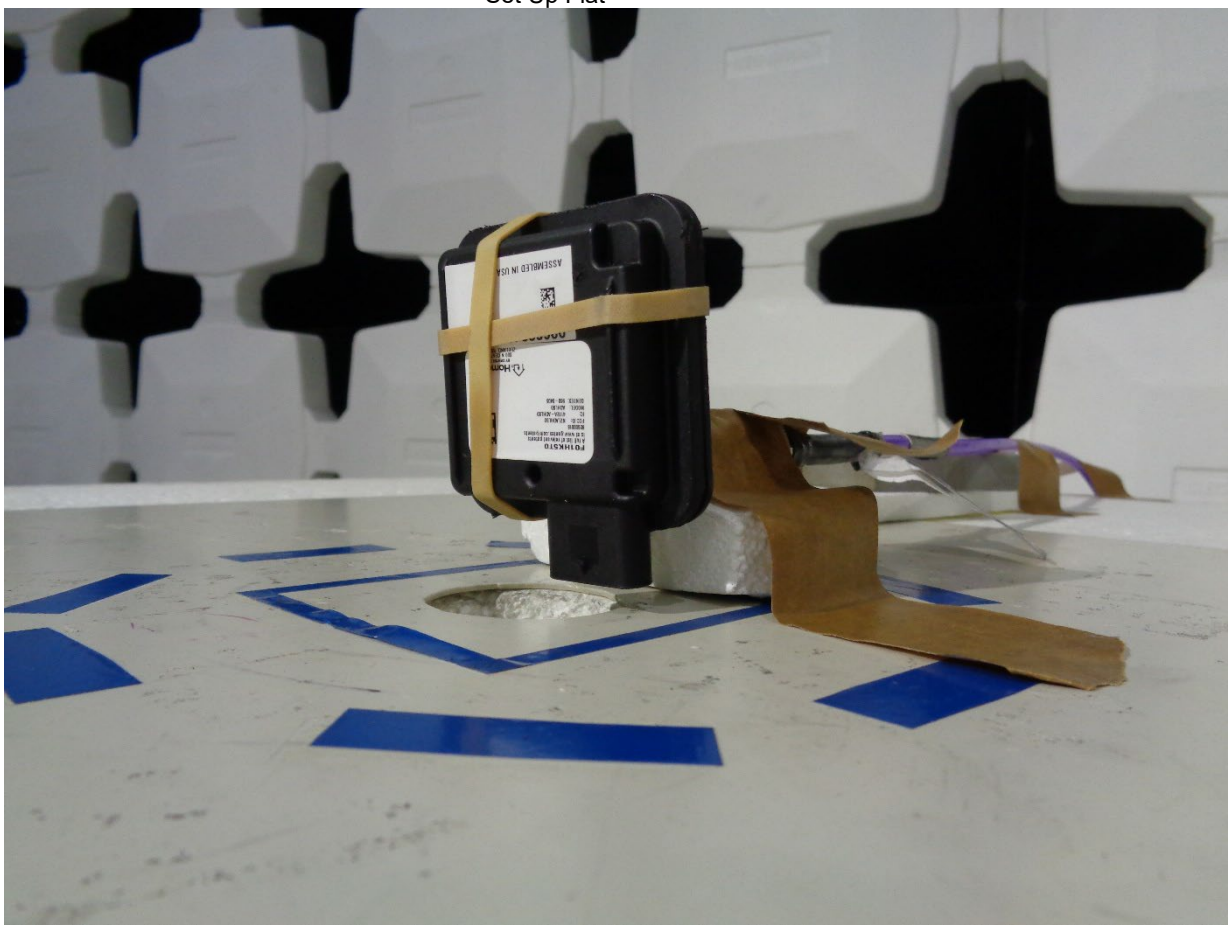
Detector:	Peak
Resolution Bandwidth:	120 KHz
Video Bandwidth	300 KHz
Span	1 MHz
Sweep Time:	25ms

	GCL Data							ANTENNA GAIN (dBd)			WORST CASE ANTENNA GAIN (For Each Frequency)	
Balun	Frequency	Refrence ACF (dBi)	SG Out Put (dBµV)	Dipole Antenna Horizontal	AUT Peak Flat	AUT Peak Side	AUT Peak End	AUT Peak Flat	AUT Peak Side	AUT Peak End	Max Antenna Gain	Orientation
DB-3	288	-4.65	90	81.17	62.98	59.23	63.54	-22.84	-26.59	-22.28	-22.28	End
	310	-4.65	90	83.94	65.45	63.2	64.59	-23.14	-25.39	-24	-23.14	Flat
	340	-4.75	90	83.51	64.69	63.75	64.47	-23.57	-24.51	-23.79	-23.57	Flat
	365	-4.85	90	83.63	69.28	64.61	65.64	-19.2	-23.87	-22.84	-19.2	Flat
	390	-4.95	90	83.58	67.85	68.47	67.45	-20.68	-20.06	-21.08	-20.06	Side
DB-4	430	-5.05	90	83.91	71.83	66.94	67.13	-17.13	-22.02	-21.83	-17.13	Flat
	902	-4.85	90	84.21	77.95	73.48	78.04	-11.11	-15.58	-11.02	-11.02	End
	914	-4.85	90	84.41	77.52	73.08	77.77	-11.74	-16.18	-11.49	-11.49	End
	926	-4.85	90	84.36	78.21	74.5	78.34	-11	-14.71	-10.87	-10.87	End

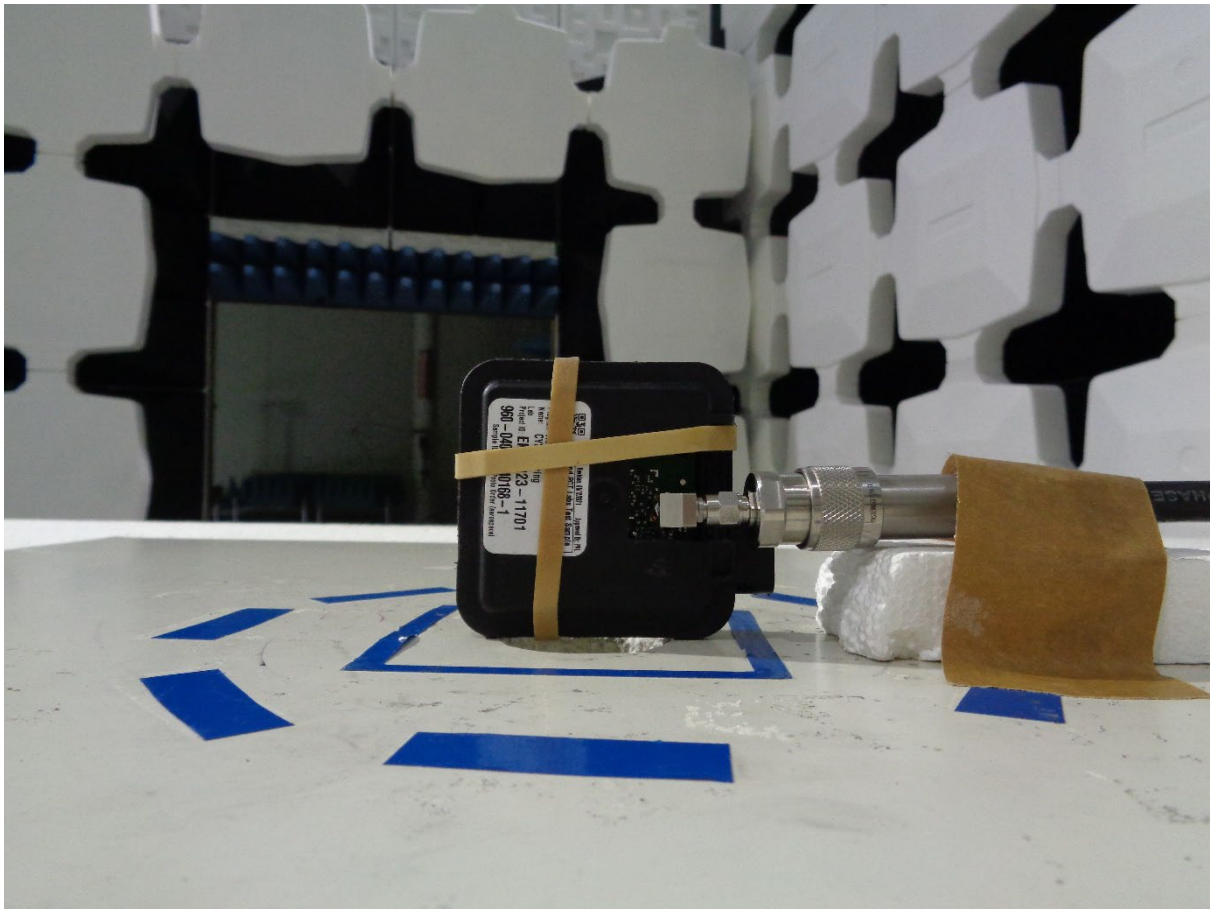
5. Test Set Up Photos



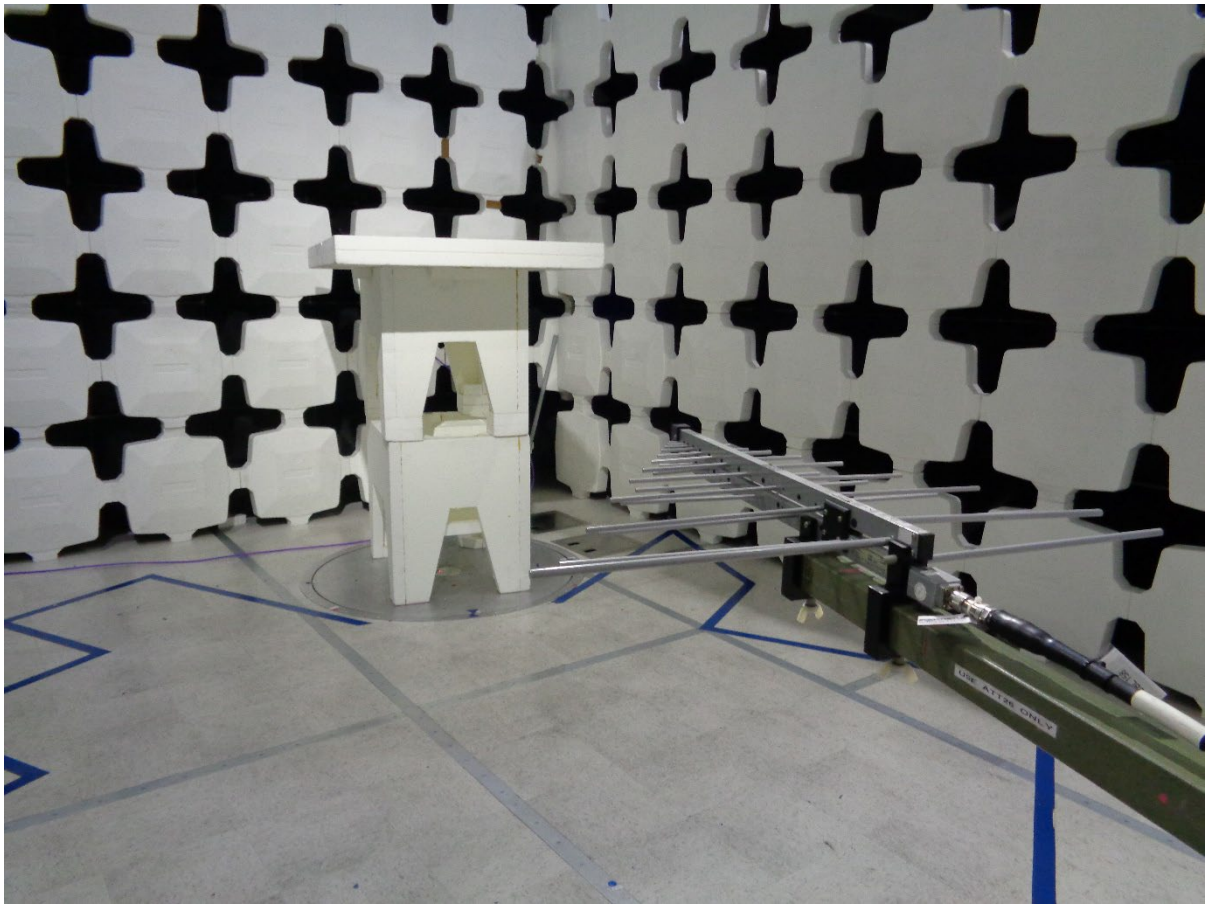
Set Up Flat



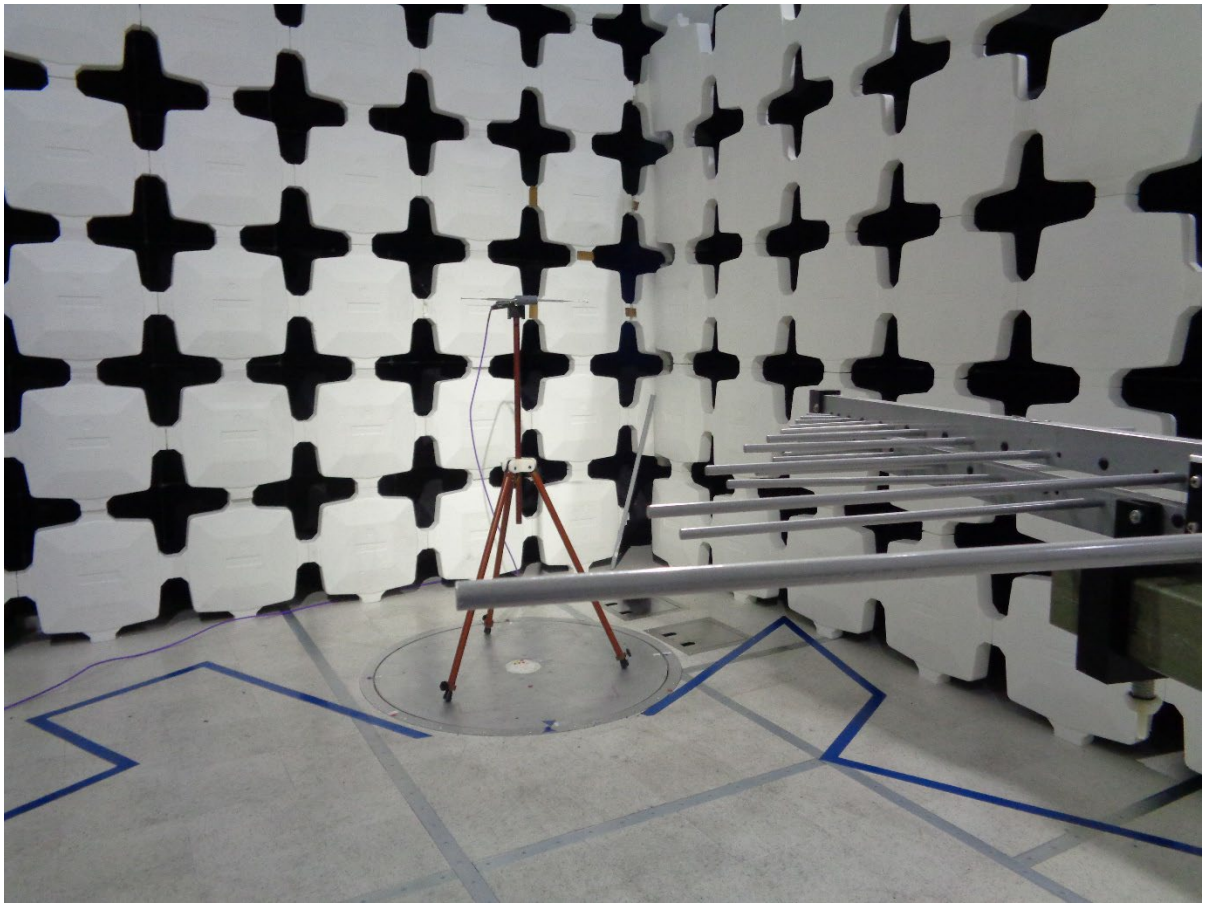
Set Up End



Set Up Side



AUT and Receive Antenna Set Up



Refrence Antenna and Receive Antenna Set Up