GENTEX CORPORATION

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

Model: UAHL5H
FCC ID: NZLUAHL5H
ISED: 4112A-UAHL5H

A report concerning approval for Gentex Corporation Homelink® Model UAHL5H
Please issue grant immediately upon review.

Measurements Made by:

Bolay Pacheco Digitally signed by Bolay Pacheco Date: 2023.12.07 16:04:24 -05'00'

Bolay Pacheco
Laboratory Validation Engineer III
Gentex Corporation

Measurements Reviewed by:

Daniel Brasier Digitally signed by Daniel Brasier Date: 2023.12.07 14:50:09 -05'00'

Dan Brasier
Laboratory Development Engineer II
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Report Prepared by:

Patricia Klawitter Digitally signed by Patricia Klawitter Date: 2023.12.07 14:52:53 -05'00'

Patricia Klawitter
Laboratory Validation Engineer I
Gentex Corporation

Report Approved by:

Jason Vargo Laboratory Lab Manager I Digitally signed by Jason Vargo Laboratory Lab Manager I Date: 2023.12.08 09:45:53 -05'00'

Jason Vargo
Laboratory Manager I
Gentex Corporation

Report Submitted by:

Brian Miller Digitally signed by Brian Miller Date: 2023.12.07 12:41:48 -05'00'

Brian Miller
Laboratory Group Leader – Regulatory II
Gentex Corporation

Test Report Revision

REV Number	Date	Author	Description
1	11/20/2023	Patricia Klawitter	Initial Release.
2	12/7/2023	Brian Miller	Updated table to include units of measurement.

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® HLV Universal Garage Door Opener is a low-power transceiver OEM device that is installed into a rearview mirror of an automobile. The installation is provided by trained technicians during the course of 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 the 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. The 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 where 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.

<u>Corporate Mailing/Shipping Address</u> <u>Site Address</u>

Gentex Corporation
600 N. Centennial Street
Zeeland, MI 49464

Gentex Corporation
380 Riley Street
Zeeland, MI 49423

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 1 x 1.5m non-metallic table elevated 150cm above the ground plane for measurements below 1GHz. Peaks were found by moving the receive antenna up and down from 1 to 4 meters and spinning AUT 360. The AUT harness was held ~75cm straight back and away from AUT. The test distance was 3 meters.

3. Antenna Gain Data

3.1. Date(s) Tested: 11/17/2023 – 11/19/2023.

3.2. Test Method Deviations: None

3.3. Temperature and Humidity conditions

	Measured Value	Unit
Temperature	20.6-22.9	ºC
Humidity	39.8-47.5	%R.H.

3.4. Results

Worst Case Antenna Gain (dBd)		
Frequency (MHz)	AUT Orientation	Antenna Gain (dBd)
288	End	-21.53
310	End	-27.01
340	End	-21.68
365	End	-21.53
390	Side	-18.95
430	Side	-6.29
433.92	Side	-5.00
868.3	Side	-3.88
868.8	Flat	0.63
902	Side	0.37
914	Side	-0.66
926	Side	-2.55

3.5. Test Equipment Setup and Procedure

3.5.1. Test Equipment Used

Equipment used			
ID / Serial #	**Manufacturer**	**Description**	**Cal / PM Due Date**
9860	Rohde and Schwarz	ESW Receiver	1/18/2024
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	10/2/2024
6368	Rohde & Schwarz	Signal Generator	9/16/2024
6539	Stanley	Tape Measure	6/19/2026
H4554	87V	Multimeter	1/5/2024
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 ~75cm 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.

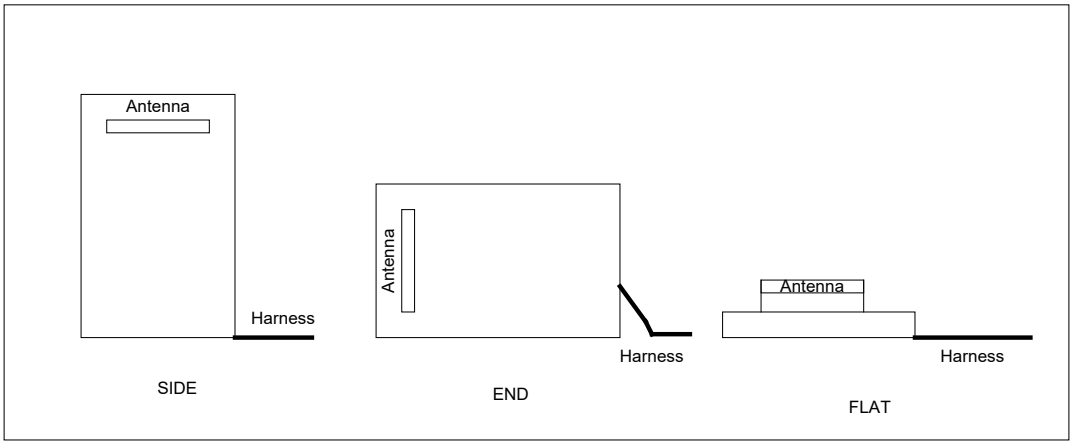

Figure 6.2.1 EUT Orthogonal Orientations

4. Formulas and Sample Calculations

4.1. Antenna Gain Calculation

Gain (dBd) = Reference Gain + (Measured Level - Reference Level), where Reference Gain is the gain of the reference Dipole antenna in dBd. The Measured Level is the peak value recorded with the AUT and the Reference Level is the peak value recorded with the Dipole Antenna.

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Appendix A

A. Antenna Gain Measurements

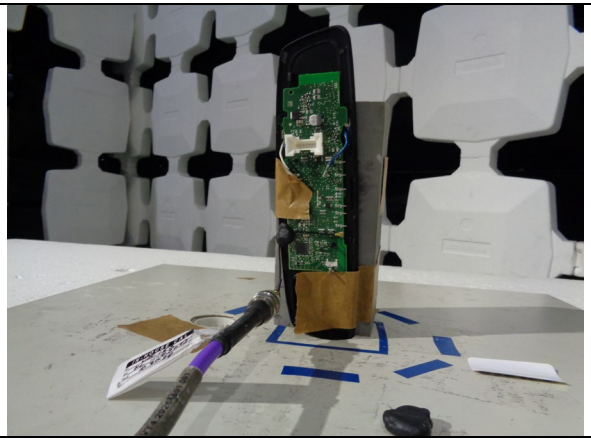
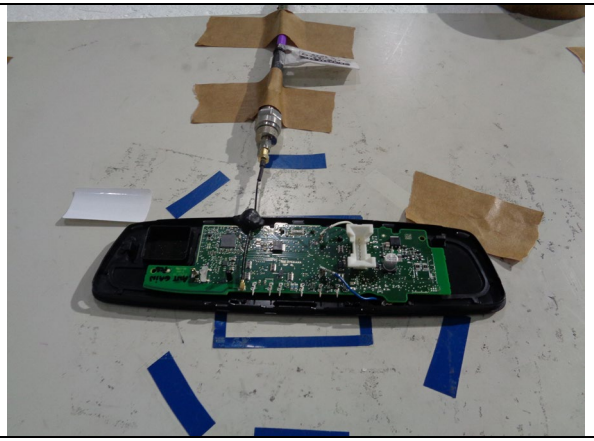
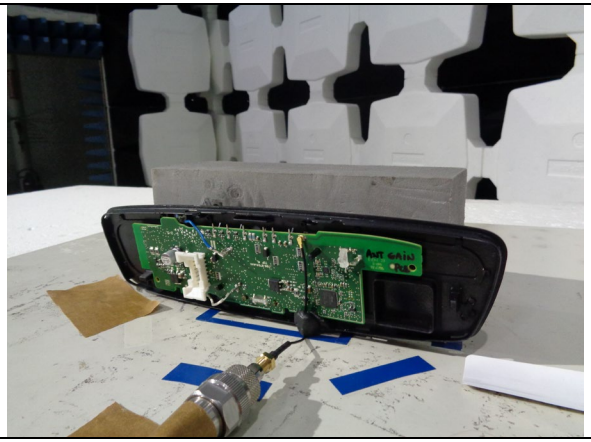
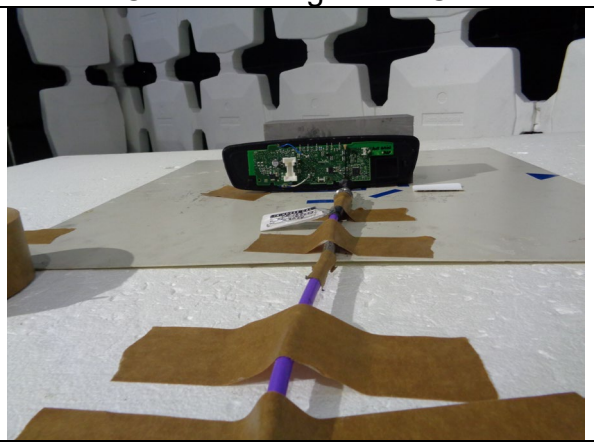
Measurements described in this section were taken according to ANSI C63.5-2017-Section 6.2 on the Gentex Corporation 3m test table.
* Measurements include Cable corrections and Antenna Factors

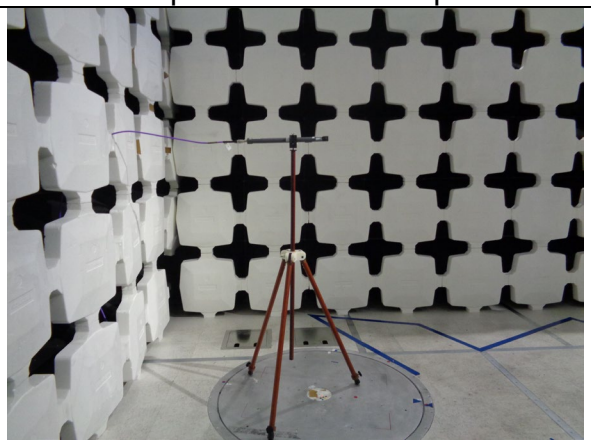
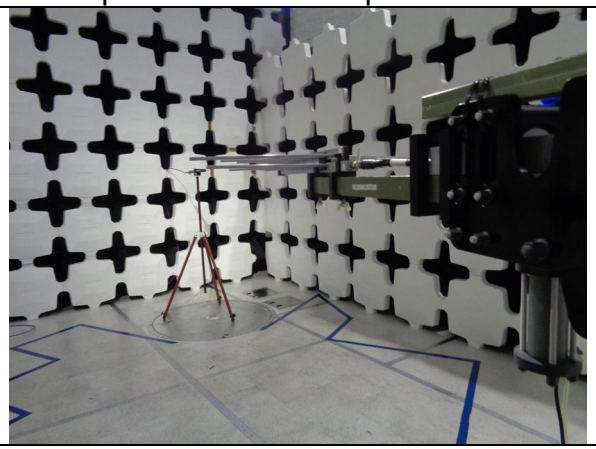
Measurement Settings:

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

Balun	Frequency	Receive Antenna Orientation	Signal Generator Output (dBuV)	Reference Antenna Gain (dBd)	Reference Antenna Output (dBuV/m)	AUT Output (dBuV/m)			Max Output (dBuV/m)	Antenna Gain (dBd)
						Side	End	Flat		
AD-100A (180-400MHz)	288	H	107	-4.65	93.13	72.66	76.25	75.36	76.25	-21.53
	310	H	107	-4.65	98.68	74.65	76.32	75.22	76.32	-27.01
	340	H	107	-4.75	99.68	80.21	82.75	82.32	82.75	-21.68
	365	H	107	-4.85	99.34	82.65	82.66	82.64	82.66	-21.53
	390	H	107	-4.95	98.78	84.78	80.23	83.22	84.78	-18.95
AD-100A (400-1000MHz)	430	H	107	-5.05	89.89	88.65	88.32	87.24	88.65	-6.29
	433.92	H	107	-5.05	88.97	89.02	87.98	88.36	89.02	-5.00
	868.3	H	107	-4.95	90.17	91.24	89.26	89.01	91.24	-3.88
	868.8	H	107	-4.95	90.07	93.01	93.41	95.65	95.65	0.63
	902	H	107	-4.85	88.25	93.47	93.47	93.47	93.47	0.37
	914	H	107	-4.85	89.25	93.44	90.35	92.55	93.44	-0.66
	926	H	107	-4.85	90.48	92.78	91.22	92.24	92.78	-2.55

5. Test Set Up Photos

End Orientation AUT	Flat Orientation AUT
	
Side Orientation AUT	**Cable Routing from AUT**
	

Dipole Antenna Setup	Dipole Antenna Setup Overview
	
AUT Setup Overview