GENTEX CORPORATION

Technical Report to the FCC
Gentex Corporation

Model: UAHL5L
FCC ID: NZLUAHL5L
ISED: 4112A-UAHL5L

1/13/22

A report concerning approval for Gentex Corporation model UAHL5L
Please issue grant immediately upon review.

Measurements Made by:

Bolay Pannell
Digitally signed by Bolay Pannell
Date: 2022.01.13 15:30:10 -05'00'

Bolay Pannell
Laboratory Validation Engineer III
Gentex Corporation

Measurements Reviewed by:

Daniel Brasier
Digitally signed by Daniel Brasier
Date: 2022.01.13 14:43:35 -05'00'

Dan Brasier
Laboratory Development Engineer II
Gentex Corporation

Report Prepared, and Submitted by:

Brian Miller
Digitally signed by Brian Miller
Date: 2022.01.13 13:17:05 -05'00'

Brian Miller
Laboratory Group Leader – Regulatory II
Gentex Corporation

Report Approved by:

Craig Harder, Laboratory Manager II (EMC)
Digitally signed by Craig Harder, Laboratory Manager II (EMC)
Date: 2022.01.13 14:05:37 -05'00'

Craig Harder
Laboratory Manager II
Gentex Corporation

Test Report Revision

REV Number	Date	Author	Description
1.0	1/13/22	Brian Miller	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 OEM device that is installed into the 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.

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 to the unit.

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. Related Grants

This device will have functionality that is covered under 47 CFR Part 15.231 and ISED Canada RSS-210. The device will have FCC ID # of NZLUAHL5L and ISED ID # of 4112A-UAHL5L.

1.3. Test Methodology

Radiated Emissions testing was performed according to ANSI C63.4:2014. The power source for this product is a 12V automotive vehicle battery, thus conducted emissions measurements are not required. The DUT was tested by placing it in RX mode with a signal generator transmitting to a loop antenna within proximity of the DUT. The emissions sweeps were performed with the signal generator transmitting a CW signal at the low, mid, and high frequency of the intentional radiator frequency bands.

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.

The DUT was tested in receive mode only.

1.4. 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.

For radiated measurements above 1 GHz, RF absorbing material is placed between the antenna and EUT in accordance with ANSI C63.4:2014 Section 5.5 and chamber manufacturer's instructions.

Tabletop testing was conducted on a 3m turntable described in the site recertification report. The 3m chamber has been added to our A2LA scope of accreditation on 4/18/2019 and includes accreditation to ANSI C63.4:2014, ANSI C63.10:2013, and C63.26:2015. Our 3m chamber is registered with the ISED under Site# 4112A-2 and FCC under registration number 357351.

Gentex Corporation
600 N. Centennial Street
Zeeland, MI 49464

Gentex Corporation
380 Riley Street
Zeeland, MI 49464

1.5. Accreditation

The Gentex Corporate EMC Lab is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation (A2LA). Our laboratory scope and accreditation certificate #2529.01 are available from their web site www.a2la.org. Our scope of accreditation covers ANSI C63.4:2014, ANSI C63.10:2013, ANSI C63.26:2015 and Radiated Emissions at 3m, FCC 47 CFR Part 90, ISED RSS-137.

2. Product Labeling

2.1. Identifiers

The FCC Identifier assigned is FCC ID: NZLUAHL5L. The ISED certification number is 4112A-UAHL5L. These identifiers will be labeled on the product housing.

The label will be printed on a label, which will be placed on the exterior of the housing and permanently affixed.

Because of the small size of the device and because the installation is inside a portion of the automobile, the following statements will appear in the user's manual. Refer to attachment "Users Manual.pdf" for the entire text of the user's manual.

> "The receiver portion of the device complies with FCC rule Part 15. Operation is subject to the following two conditions:
> (1) This device may not cause harmful interference,
> (2) This device must accept any interference that may be received including interference that may cause undesired operation.
> WARNING: The transmitter has been tested and complies with FCC and ISED rules. Changes or modifications not expressly approved by the party responsible for the compliance could void the user's authority to operate the device."
>
> This equipment complies with FCC and ISED radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must be at least 20cm from the user and must not be co-located or operating in conjunction with any other antenna or transmitter.

The term "ISED:" before the certification/registration number only signifies that ISED technical specifications were met.

ISED: 4112A-UAHL5L FCC ID: NZLUAHL5L

2.2. Label Drawing and Location on Product

The label drawing is included in the "Label.pdf" attachment.

A diagram showing the location of the label on the assembly is included in the "Label Location.pdf" attachment.

3. Test Configuration

Radiated Emission measurements presented in the report were made in accordance with ANSI C63.4-2014. The EUT was placed on a 1 x 1.5m non-metallic table elevated 80cm above a conducting ground plane for all measurements. The harness was run straight down from the center of the turntable to a power supply connection sitting at the base of the table. The power supply is located beneath the floor of the chamber.

For radiated measurements above 1 GHz, RF absorbing material is placed between the antenna and EUT in accordance with ANSI C63.4:2014 Section 5.5 and chamber manufacturer's instructions.

4. Conducted Emissions Measurements

Conducted Measurements are not required for this product.

5. Radiated Emissions Data

5.1. Date(s) Tested: 1/4/22 – 1/7/22

5.2. Test Method Deviations: None.

5.3. Temperature and Humidity conditions

	Measured Value	Unit
Temperature	23.8	ºC
Humidity	32.9	%R.H.

5.4. Summary of Results

Measurement		Margin	Frequency
Worst case Digital Emission	30.24 dBuV/m	15.76dB	749.9MHz

- **Measurement Uncertainty:** The standard uncertainty of measurement has been determined in accordance with the ISO Guide to the Expression of Uncertainty in Measurements. The estimation of measurement uncertainty reported is the expanded uncertainty for a coverage factor of k=2.26 and confidence interval of approximately 95%.

  Expanded Uncertainty $U_{(k=2.26)}$ is as follows:

  - Radiated Emissions – Bicon (30-250 MHz): 4.7 dB
  - Radiated Emissions – LPA (250-1000 MHz): 5.6 dB
  - Radiated Emissions – DRWG (26.5 GHz): 4.7 dB
  - Frequency: 0.15ppm

5.5. Test Equipment Setup and Procedure

5.5.1. Test Equipment Used

Description	Model #	ID Number	Cal Due
EMCO Biconical Antenna [30-250 MHz]	3110B	H6189	5/6/24
EMCO LPA Antenna [250-1000MHz]	3148	H6192	5/3/24
Com-Power Double Ridged Waveguide [1-18GHz]	AHA-118	8893	11/25/22
Rohde & Schwarz EMI Receiver	ESR26	6595	10/23/22
Cables, attenuator and port feed through	various	CF GCL	4/30/22
Miteq Preamplifier	AMF-4D-0050100-24-10P	S/N:2053240	12/31/22
3m Chamber SW	N/A	SW30	4/30/22
Miteq Preamplifier	AM-1300	1429993	12/31/22

EMI Receiver Settings Emissions:

Detector Function: Quasi-Peak
Resolution Bandwidth: 120 kHz (below 1GHz)
1MHz (above 1GHz)

For the testing, the EUT was placed at the center of a non-conducting table 80cm above the ground plane pursuant to ANSI C63.4:2014 for stand-alone equipment. The 2-conductor harness was run straight down from the center of the turntable to a power supply sitting at the base of the table.

Equipment is placed in one of the three orthogonal orientations, End, Side, and Flat where applicable. The DUT was tested in in-vehicle position only similar to the flat orientation, see test setup photos for details. These orientations are described below in Figure 6.2.1.

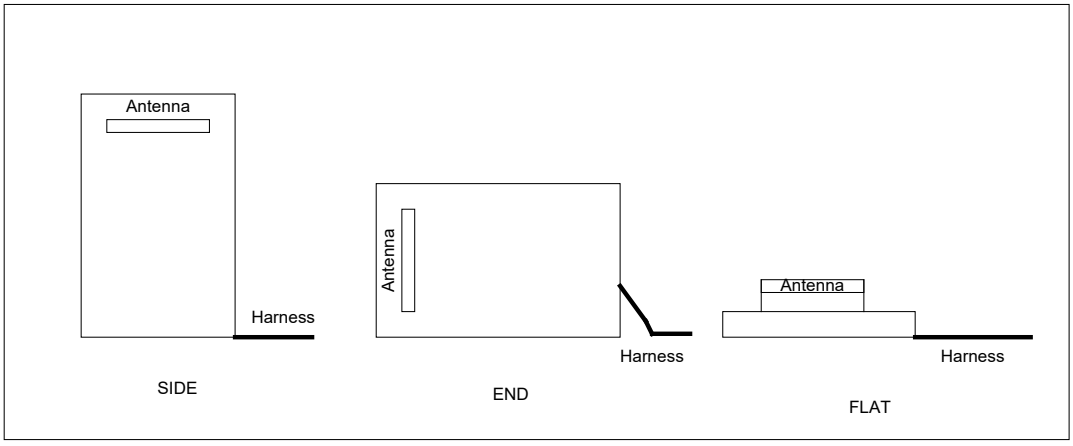

Figure 6.2.1 EUT Orthogonal Orientations

While in the prescribed orientation, the vertical antenna positioner sweeps in elevation from 1 to 4m in height until the operator finds the peak. The 3m turntable is then rotated through 360 degrees until a peak is found. The table is stopped at the peak location and the peak in elevation re-verified. Procedure is repeated for applicable orientations/measurement antenna polarizations.

6. Class B Emissions

The transmitter spurious radiation emissions were measured in a 3m semi-anechoic chamber. The design utilizes permanently attached antenna system and offers no provision antenna replacement. The DUT was placed on a turntable elevated as required above the ground plane at a distance of 3 meters from the measurement antenna. For RX mode, emissions sweeps were performed with a loop antenna in proximity of the DUT and connected to a signal generator. An emissions sweep was performed with the signal generator transmitting a CW signal for each low, mid, and high frequency of the intentional radiator frequency range to be certified.

The turntable was rotated through 360 degrees to locate the position registering the maximum amplitude emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter. Raising and lowering the measurement antenna and rotating the turntable to maximize the emission. A Biconical Antenna was used for measuring emissions from for 30-300 MHz, Log Antenna for 300-1000 MHz, and Double Ridge Wave Guide Horn for 1-9 GHz. Emissions were measured in dBuV/m at 3 meters.

Data was taken per 47CFR Part 2.1051 and applicable parts of 47CFR Part 15B. The DUT demonstrated compliance with the specifications of Paragraphs 47CFR 2.1051, 2.1057.

7. Formula and Sample Calculation

The EMI Receiver used for making the measurements in this report automatically corrects for cable correction and antenna factors using values stored in memory taken from the most recent calibration (in the case of antenna factors), periodic cable loss measurements, and preamplifier gain.

Formula 1: FS(dBuV/m) = M(dBuV) + AF(dB/m) + CF(dB) – AG(dB)

The presented field strength is computed by the EMI Receiver by taking the measured level and adding to it the antenna factor and cable loss corrections. The measurements presented were gathered using the EMI Receiver's peak-hold capability.

Test Mode	Detector	Frequency (MHz)		Worst-Case Orientation	Antenna Polarization	Frequencies (MHz)	Emission (dBuV/m)	Limit (dBuV/m)	Margin (dB)
		Start	Stop						
RX	Quasi-Peak	30	200	Side	H	30	20.14	46	-25.86
RX	Quasi-Peak	30	200	End	V	31	15.64	46	-30.36
RX	Quasi-Peak	30	200	Side	H	87.5	12.32	46	-33.68
RX	Quasi-Peak	30	200	Side	H	88	15.64	46	-30.36
RX	Quasi-Peak	30	200	Side	H	89	16.54	46	-29.46
RX	Quasi-Peak	30	200	Side	H	94	18.41	46	-27.59
RX	Quasi-Peak	30	200	End	H	124	16.54	46	-29.46
RX	Quasi-Peak	30	200	End	H	138	18.74	46	-27.26
RX	Quasi-Peak	30	200	Side	V	141	16.89	46	-29.11
RX	Quasi-Peak	30	200	Side	H	143	17.24	46	-28.76
RX	Quasi-Peak	30	200	End	V	194	21.77	46	-24.23
RX	Quasi-Peak	30	200	Side	V	195	19.65	46	-26.35
RX	Quasi-Peak	30	200	End	H	196	19.66	46	-26.34
RX	Quasi-Peak	30	200	Side	H	198	20.41	46	-25.59
RX	Quasi-Peak	200	1000	Side	V	225	16.78	46	-29.22
RX	Quasi-Peak	200	1000	Side	V	250	15.74	46	-30.26
RX	Quasi-Peak	200	1000	End	H	312.5	18.47	46	-27.53
RX	Quasi-Peak	200	1000	Flat	H	375	17.65	46	-28.35
RX	Quasi-Peak	200	1000	Flat	V	400	15.97	46	-30.03
RX	Quasi-Peak	200	1000	End	V	480	21.65	46	-24.35
RX	Quasi-Peak	200	1000	End	V	500	22.32	46	-23.68
RX	Quasi-Peak	200	1000	End	V	528	23.14	46	-22.86
RX	Quasi-Peak	200	1000	Side	H	552	23.31	46	-22.69
RX	Quasi-Peak	200	1000	End	V	757	25.14	46	-20.86
RX	Quasi-Peak	200	1000	End	H	600	22.74	46	-23.26
RX	Quasi-Peak	200	1000	Flat	H	624	23.24	46	-22.76
RX	Quasi-Peak	200	1000	End	V	687	23.54	46	-22.46
RX	Quasi-Peak	200	1000	End	H	730	22.47	46	-23.53
RX	Quasi-Peak	200	1000	End	H	749.9	30.24	46	**-15.76**
RX	Quasi-Peak	200	1000	End	H	828.5	26.74	46	-19.26
RX	Quasi-Peak	200	1000	End	H	864	27.84	46	-18.16
RX	Quasi-Peak	200	1000	End	V	875	27.85	46	-18.15
RX	Quasi-Peak	200	1000	End	H	912	27.65	46	-18.35
RX	Quasi-Peak	200	1000	End	H	960	27.84	46	-18.16
RX	Average	1000	5000	Side	V	1000	21.88	54	-32.12
RX	Average	1000	5000	Side	H	1024	23.32	54	-30.68
RX	Average	1000	5000	End	V	1056	23.62	54	-30.38
RX	Average	1000	5000	Side	V	1062	23.36	54	-30.64
RX	Average	1000	5000	End	V	1080	19.65	54	-34.35
RX	Average	1000	5000	Side	H	1104	22.14	54	-31.86
RX	Average	1000	5000	End	V	1125	20.36	54	-33.64
RX	Average	1000	5000	End	V	1128	19.21	54	-34.79
RX	Average	1000	5000	End	V	1152	23.24	54	-30.76
RX	Average	1000	5000	End	V	1200	20.41	54	-33.59
RX	Average	1000	5000	Side	H	1248	21.35	54	-32.65
RX	Average	1000	5000	Flat	V	1296	18.66	54	-35.34
RX	Average	1000	5000	End	V	1312	18.96	54	-35.04
RX	Average	1000	5000	Side	H	1375	20.35	54	-33.65
RX	Average	1000	5000	Side	V	1687	20.47	54	-33.53
RX	Average	1000	5000	End	H	2000	24.71	54	-29.29
RX	Average	1000	5000	Side	H	4432	31.47	54	-22.53