



Engineering Test Report No. 2501108-04 Rev. A

Report Date	July 24, 2025
Manufacturer Name	Badger Meter, Incorporated
Manufacturer Address	4545 W. Brown Deer Road Milwaukee, WI 53553
Product Name Brand/Model No.	ORION Cellular HLG – HLG
Date Received	May 21, 2025
Assessment Dates	June 23, 2025 – July 15, 2025
Specifications	FCC 47 CFR Part 2.1093 KDB, 447498 D01 OET Bulletin 65:1997 RSS-102 EN 62311 EN 62479 AS/NZS 2772.2 RPS S-1
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515
Signature	<i>Nathaniel Bouchie</i>
Tested by	Nathaniel Bouchie
Signature	<i>Raymond J. Klouda</i>
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894
PO Number	508151

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1. Report Revision History

Revision	Date	Description
–	28 JUL 2025	Initial Release of Engineering Test Report No. 2501108-04
A	29 AUG 2025 By JCJ	-Throughout the report: In the header added “Rev. A” -Throughout the report: Changed the RSS-102 reference from Issue 5 to Issue 6. -In Section 8.2: Updated the data to reflect an assessment performed pursuant to RSS-102 Issue 6.

2. Introduction

The FCC, Innovation, Science and Economic Development Canada, European Union and Australia/New Zealand publish standards regarding the evaluation of the RF Exposure hazard of radio communications devices. An evaluation has been performed on the Badger Meter, Incorporated ORION Cellular HLG, Model No. HLG pursuant to the relevant requirements.

3. Subject of Investigation

This document presents the demonstration of RF Exposure compliance on a ORION Cellular HLG, (hereinafter referred to as the Equipment under Test (EUT)). The EUT was identified as follows:

EUT Identification	
Description	ORION Cellular HLG
Model/Part No.	HLG
S/N	18001156
Radio Access Technology	Sub1GHz, LTE
Bands of Operation	902 – 928MHz, LTE Band 4, LTE Band 12
Conducted Output Power	904.9MHz → 11.29dBm LTE Band 4 → 23.2dBm LTE Band 12 → 23.91dBm

4. Standards and Requirements

The tests were performed to selected portions of, and in accordance with the following specifications.

- 47 CFR Parts 1.1310, 2.1091 and 2.1093 Code of Federal Regulations, Title 47, Telecommunications
- KDB 447498 D01 – “RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices, General RF Exposure Guidance v06”
- OET Bulletin 65 Edition 97-01:1997 – “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”
- ANSI/IEEE C95.1:1992 – "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,"
- RSS-102, Issue 6 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
- EN 62311:2020 Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
- EN 62479:2010 Assessment of the Compliance of Low Power Electronic and Electrical Equipment with the Basic Restrictions Related to Human Exposure to Electromagnetic Fields (10MHz-300GHz)
- 1999/519/EC Council Recommendation on the Limitation of Exposure of The General Public to Electromagnetic fields (0Hz-300GHz)
- AS/NZS 2772.2: 2016 Principles and methods of measurement and computation-3 kHz to 300 GHz
- RSP S-1 Standard for Limiting Exposure to Radiofrequency Fields – 100 kHz to 300 GHz

5. Sample Calculations

The far field power density can be calculated using the following formula:

$$S = \frac{PG}{4\pi R^2} \quad (1)$$

where P is the transmit output power (mW), G is the maximum antenna gain relative to an isotropic antenna (linear) and R is the evaluation distance (cm).

In cases where multiple antennas are utilized for a single signal, the following formula is applied to calculate the maximum antenna gain:

$$Gain (dBi) = G + 10 \log N \quad (2)$$

where N is the number of antennas, G is the gain of a single antenna.

A minimum separation distance can be calculated using the following formulas

$$Minimum Separation Distance = \sqrt{\frac{PG}{4\pi(Power Density Limit)}} \quad (3)$$

where P is the transmit output power (mW) and G is the maximum antenna gain relative to an isotropic antenna (linear).

For sources with frequencies <30MHz

$$Separation Distance = R \left(10^{\frac{(FS_{Limit} - FS_R)}{40}} \right)^{-1} \quad (4)$$

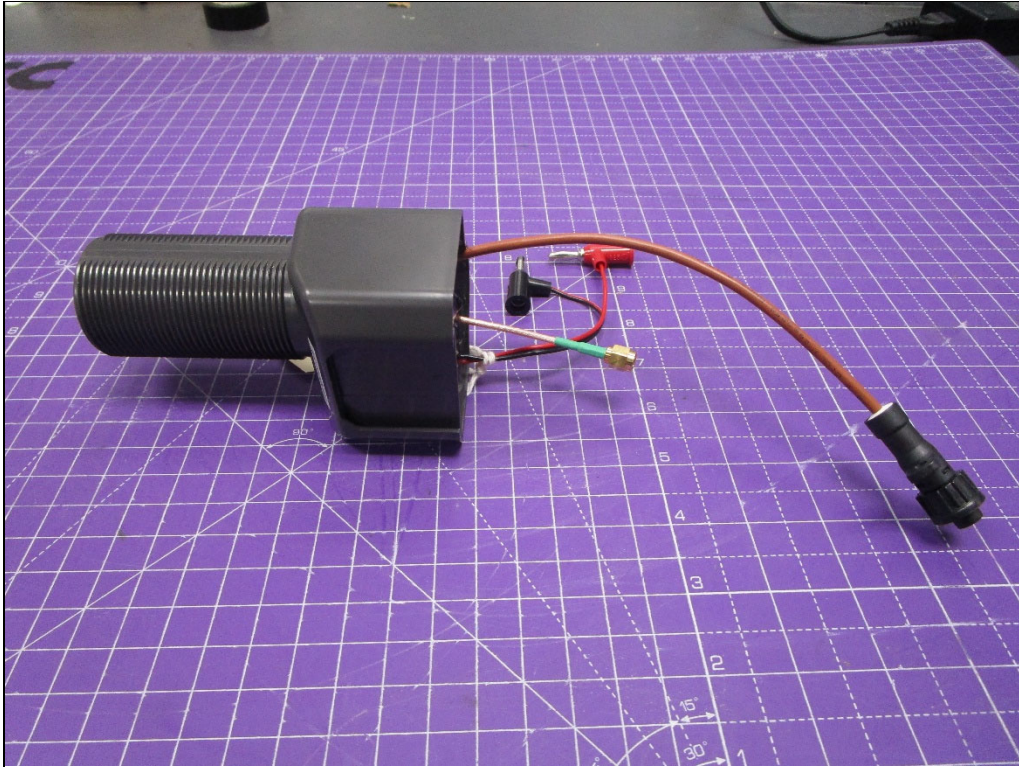
For sources with frequencies >30MHz

$$Separation Distance = R \left(10^{\frac{(FS_{Limit} - FS_R)}{20}} \right)^{-1} \quad (5)$$

where R is the measurement distance, FS_{Limit} is the field strength limit and FS_R is the measured field strength at distance R.

6. Photographs of EUT





7. Limits and Requirements

7.1. Requirements mandated by the FCC

Equipment pursuing compliance to the requirements with respect to the limits of human exposure to RF provided in FCC 1.1310, need follow the criteria in FCC 1.1307(b)(1).

Equipment exemption qualification must be demonstrated pursuant to FCC 1.1307(b)(3).

For single RF sources (i.e., any single portable device, mobile device or fixed RF source): A single RF source is exempt if:

- FCC 1.1307(b)(3)(i)(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance.
- FCC 1.1307(b)(3)(i)(B) The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}(mW) = \begin{cases} ERP_{20cm} \left(\frac{d}{20cm} \right)^x & d \leq 20cm \\ ERP_{20cm} & 20cm < d \leq 40cm \end{cases}$$

With

$$x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right)$$

Where f is in GHz, and

$$ERP_{20cm}(mW) = \begin{cases} 2040f & 0.3GHz \leq f < 1.5GHz \\ 3060 & 1.5GHz \leq f < 6GHz \end{cases}$$

- FCC 1.1307(b)(3)(i)(C) Using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF Source frequency (MHz)	Threshold ERP (watts)
0.3 – 1.34	$1920 R^2$
1.34 – 30	$3450 R^2 / f^2$
30 – 300	$3.83 R^2$
300 – 1,500	$0.0128 R^2$
1,500 – 100,000	$19.2 R^2$

Multiple RF sources are exempt if:

- FCC 1.1307(b)(3)(ii)(A) The available maximum time-averaged power of each source is no more

than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required).

- FCC 1.1307(b)(3)(ii)(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for P_{th} , including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

$P_{th,i}$ = the exemption threshold power (P_{th}) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i .

ERP_j = the ERP of fixed, mobile, or portable RF source j .

$ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$ according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

$Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure Limit_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k , as applicable from § 1.1310 of this chapter.

If it is determined that the EUT is not exempt from routine evaluation an assessment must be performed to determine compliance in regard to the RF exposure limits by means of measurement or calculation of the electric field, magnetic field or power density. It may be the case that a minimum separation distance will need to be calculated or measured and maintained from the source of RF to meet the basic restrictions.

In environments where the possibility of simultaneous exposure to fields on different frequencies exists, the exposure shall be considered to be additive. The fraction of the recommended limit incurred within each frequency should be determined, and the sum of all fractional contributions should not exceed 1.0.

Per 1.1310(e)(1), the power density shall not exceed the levels below:

Limits for Occupational/Controlled Exposure			
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)
0.3 - 3.0	614	1.63	*100
3.0 – 30	1842 / f	4.89 / f	*900 / f ²
30 – 300	61.4	0.163	1.0
300 – 1,500	—	—	f / 300
1,500 – 100,000	—	—	5
Limits for General/Uncontrolled Exposure			
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)
0.3 – 1.34	614	1.63	*100
1.34 – 30	842 / f	2.19 / f	*180 / f ²
30 – 300	27.5	0.073	0.2
300 – 1,500	—	—	f / 1500
1,500 – 100,000	—	—	1.0
f – Frequency in MHz			
* – Plane wave Equivalent Power Density			

7.2. Requirements mandated by Innovation, Science and Economic Development Canada

Equipment exemption qualification must be demonstrated pursuant to RSS-102 Issue 6 section 6. If it is determined that the equipment under investigation is not exempt, it must be demonstrated that the equipment does not exceed the exposure limits in section 5 of RSS-102 Issue 6 or a minimum separation distance must be calculated to ensure that the exposure limits are met.

Per RSS 102 Section 5, the equipment shall not exceed the levels below:

Specific Absorption Rate (SAR) - SAR Limits for Occupational/Controlled Exposure			
Frequency Range (MHz)	Whole Body SAR Limit (W/kg)	Peak Spatial AVG SAR Limit (W/kg)	Peak Spatial Extremities SAR Limit 10g (W/kg)
0.1 - 6000	0.4	8	20
Specific Absorption Rate (SAR) - SAR Limits for General/Uncontrolled Exposure			
Frequency Range (MHz)	Whole Body SAR Limit (W/kg)	Peak Spatial AVG SAR Limit 1g (W/kg)	Peak Spatial Extremities SAR Limit 10g (W/kg)
0.1 - 6000	0.08	1.6	4

7.3. Requirements mandated by the European Union and outlined in EN 62311

The RF exposure level shall be determined by either measurement or by calculating the power density at an evaluation distance of 0.2m, as specified by ANSI/IEEE C95.1-1992. If it is determined that the measured or calculated power density does not meet the basic restrictions, a separation distance must be measured or calculated such that the basic restrictions are met. If the device output power is less than the low power exclusion level, then the device is deemed to comply with the basic restrictions listed in the 1999/519/EC Council Recommendation.

In environments where the possibility of simultaneous exposure to fields on different frequencies exists, the exposure shall be considered to be additive. The fraction of the recommended limit incurred within each frequency should be determined, and the sum of all fractional contributions should not exceed 1.0. The following formula shall apply:

$$\sum_{i=1}^n \frac{S_1}{S_{L,1}} + \frac{S_2}{S_{L,2}} + \frac{S_3}{S_{L,3}} + \dots \frac{S_n}{S_{L,n}} \leq 1 \quad (6)$$

where:

S is the measured/calculated power density;
S_L is the power density limit.

Per the 1999/519/EC Council Recommendation, the measured field strength shall not exceed the levels below:

Reference Levels for Maximum Exposure			
Frequency Range	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m ²)
0 – 1Hz	—	3.2 x 10 ⁴	—
1 – 8Hz	10000	3.2 x 10 ⁴ / f ²	—
8 – 25Hz	10000	4000 / f	—
0.025 – 0.8kHz	250 / f	4 / f	—
0.8 – 3kHz	250 / f	5	—
3 – 150kHz	87	5	—
0.15 – 1MHz	87	0.73 / f	—
1 – 10MHz	87 / f ^{1/2}	0.73 / f	—
10 – 400MHz	28	0.073	2
400 – 2000MHz	1.375 f ^{0.5}	0.0037 / f ^{0.5}	f / 200
2 – 300GHz	61	0.16	10

f as indicated in the frequency range column

7.4. Requirements mandated by Australia/New Zealand and outlined in AS/NZS 2772.2

As stated in Schedule 5 of RPS 3, S5.2.2, the evaluation of transmitting equipment for compliance with RPS S-1 is not required where the nominal mean power output averaged over 6 minutes does not exceed the levels listed in the table below. For devices exceeding the power levels below, evaluation of transmitting equipment for compliance with this standard is not required where it can be demonstrated that in normal use the mean radiated power output does not exceed the alternative low-power exclusion levels as defined in IEC 62479 (2010).

Exposure Scenario	Low Power Exclusion Level at Frequency, f		
	100 kHz ≤ f ≤ 6 GHz	6 GHz ≤ f ≤ 30 GHz	30 GHz ≤ f ≤ 300 GHz
Occupational	100 mW	40 mW	20 mW
General Public	20 mW	8 mW	4 mW

The RF exposure levels shall be assessed either by measurement or by calculating the power density at an evaluation distance of ??m, as specified by ANSI/IEEE C95.1-1992. If it is determined that the measured or calculated power density does not meet the basic restrictions, a minimum separation distance must be measured or calculated such that the basic restrictions are met. The assessment is based on transmitter power levels, transmit frequency(s) and antenna parameters.

In environments where the possibility of simultaneous exposure to fields on different frequencies exists, the exposure shall be considered to be additive. The fraction of the recommended limit incurred within each frequency should be determined, and the sum of all fractional contributions should not exceed 1.0.

The following formula shall apply:

$$\sum_{i=1}^n \frac{S_1}{S_{L,1}} + \frac{S_2}{S_{L,2}} + \frac{S_3}{S_{L,3}} + \dots \frac{S_n}{S_{L,n}} \leq 1 \quad (7)$$

where:

S is the measured/calculated power density;
S_L is the MPE limit.

Per RPS 3, the calculated power density shall not exceed the levels below:

Limits for Occupational/Controlled Exposure			
Frequency Range	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m ²)
100kHz – 1MHz	614	1.63 / f	-
1MHz – 10MHz	614 / f	1.63 / f	1000 / f ²
10MHz – 400MHz	61.4	0.163	10
400MHz – 2GHz	3.07 x f ^{0.5}	0.00814 / f ^{0.5}	f / 40
2GHz – 300GHz	137	0.364	50
Limits for General/Uncontrolled Exposure			
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m ²)
100kHz – 150kHz	86.8	4.86	-
150kHz – 1MHz	86.8	0.729 / f	-
1MHz – 10MHz	86.8 / f ^{0.5}	0.729 / f	-
10MHz – 400MHz	27.4	0.0729	2
400MHz – 2GHz	1.37 x f ^{0.5}	0.00364 x f ^{0.5}	f / 200
2GHz – 300GHz	61.4	0.163	10
f – Frequency in MHz			

8. Assessment Results

8.1. RF Exposure Evaluation Relevant to the Requirements of the FCC

The following transmitters operate non-simultaneously at the corresponding duty cycles:

Radio Access Technology	f Transmit Frequency (MHz)	P Conducted Output Power (mW)	EIRP (W)	Duty Cycle
Sub1GHz	904.9	13	0.032	0.041
LTE Band 4	1732.9	209	0.700	0.014
LTE Band 12	713.9	246	0.155	0.014

Radio Access Technology	f Transmit Frequency (MHz)	Nerve Stimulation ¹	SAR ²	Localized APD ³	Localized IPD ⁴	FRL ⁵
Sub1GHz	904.9	NA	Exempt	NA	NA	NA
LTE Band 4	1732.9	NA	Exempt	NA	NA	NA
LTE Band 12	713.9	NA	Exempt	NA	NA	NA

¹Only applicable to inductive systems operating in the 3kHz to 10MHz range with loop outer dimensions less than or equal to 100mm and separation distances greater than and equal to 0.15mm and separation distance less than or equal to 50mm.

²Only applicable to sources operating in the 100kHz to 6GHz range if the separation between the user or bystander is less than and equal to 20cm.

³Only applicable to sources operating in the 7GHz to 30GHz range if the separation between the user or bystander is less than and equal to 20cm.

⁴Only applicable to sources operating in the 6GHz to 30GHz range.

⁵Only applicable to sources operating at or below 6GHz if the separation between the user or bystander is greater than 20cm.

Radio Access Technology	f Transmit Frequency (MHz)	P Conducted Output Power (mW)	EIRP (W)	SAR Exemption Limit (mW)
Sub1GHz	904.9	13	0.032	749
LTE Band 4	1732.9	209	0.700	798
LTE Band 12	713.9	246	0.155	743

The equipment under investigation is determined to be exempt from routine evaluation.

8.2. RF Exposure Evaluation Relevant to the Requirements of the ISED

The following transmitters operate non-simultaneously:

Radio Access Technology	f Transmit Frequency (MHz)	P Conducted Output Power (mW)	EIRP (W)	FRL Exemption Limit (W)
Sub1GHz	904.9	13.4586035	0.03235937	1.37344774
LTE Band 4	1732.9	208.929613	0.699842	2.14115993
LTE Band 12	713.9	246.03676	0.1552387	1.1680114

Radio Access Technology	f Transmit Frequency (MHz)	FRL
Sub1GHz	904.9	Exempt
LTE Band 4	1732.9	Exempt
LTE Band 12	713.9	Exempt

The equipment under investigation is determined to be exempt from routine evaluation.

8.3. RF Exposure Evaluation Relevant to the Requirements of the EU

The following transmitters operate non-simultaneously at the corresponding duty cycles:

Radio Access Technology	f Transmit Frequency (MHz)	P Conducted Output Power (dBm)	EIRP (dBm)	Duty Cycle
Sub1GHz	904.9	11.29	15.1	0.041
LTE Band 4	1732.9	23.2	28.45	0.014
LTE Band 12	713.9	23.91	21.91	0.014

Radio Access Technology	f Transmit Frequency (MHz)	P Conducted Output Power (mW)	EIRP (mW)	Exemption Threshold Level (mW)	Low-power Exclusion Level Derivation Method	Result
Sub1GHz	904.9	13.4586035	32.3593657	9.049	EN 62479, Annex A.3	Not Exempt
LTE Band 4	1732.9	208.929613	699.841996	17.329	EN 62479, Annex A.3	Not Exempt
LTE Band 12	713.9	246.03676	155.238701	7.139	EN 62479, Annex A.3	Not Exempt

Radio Access Technology	f Transmit Frequency (MHz)	S Power Density (W/m ²)	S _L Power Density Limit (W/m ²)
Sub1GHz	904.9	0.06437685	4.5245
LTE Band 4	1732.9	1.39229002	8.6645
LTE Band 12	713.9	0.30883727	3.5695

Based on the evaluation above, the EUT meets the MPE requirements for transmitters.

8.4. RF Exposure Evaluation Relevant to the Requirements of Australia/New Zealand

The following transmitters operate non-simultaneously at the corresponding duty cycles:

Radio Access Technology	f Transmit Frequency (MHz)	P Conducted Output Power (dBm)	EIRP (dBm)	Duty Cycle
Sub1GHz	904.9	11.29	15.1	0.041
LTE Band 4	1732.9	23.2	28.45	0.014
LTE Band 12	713.9	23.91	21.91	0.014

Radio Access Technology	f Transmit Frequency (MHz)	P Conducted Output Power (mW)	Duty Cycle	Time Averaged Power (mW)	Low Power Exclusion Level (mW)	Result
Sub1GHz	904.9	11.29	0.041	0.4629	20	Exempt
LTE Band 4	1732.9	23.2	0.014	0.3222	20	Exempt
LTE Band 12	713.9	23.91	0.014	0.3321	20	Exempt

The equipment under investigation is determined to be exempt from routine evaluation.

9. Statement of Compliance

The Badger Meter, Incorporated ORION Cellular HLG, Model HLG is in compliance with the FCC, Innovation, Science and Economic Development Canada, European Union and Australia/New Zealand requirements for RF Exposure at a minimum separation distance of 20cm.

10. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

ELITE ELECTRONIC ENGINEERING, INC.
1516 Centre Circle
Downers Grove, IL 60515
Robert Bugielski (QA Manager) Phone: 630 495 9770 ext. 168
Email: rbugielski@elitetest.com
Craig Fanning (EMC Lab Manager) Phone: 630 495 9770 ext. 112
Email: cfanning@elitetest.com
Brandon Lugo (Automotive Team Leader) Phone: 630 495 9770 ext. 163
Email: blugo@elitetest.com
Richard King (FCC/Commercial Team Leader) Phone: 630 495 9770 ext. 123
Email: reking@elitetest.com
Website: www.elitetest.com

ELECTRICAL

Valid To: August 31, 2025

Certificate Number: 1786.01

In recognition of the successful completion of the A2LA Accreditation Program evaluation process, accreditation is granted to this laboratory to perform the following automotive electromagnetic compatibility and other electrical tests:

Test Technology:**Test Method(s)¹:**

Transient Immunity
(Max Voltage 60V/Max current 100A)

ISO 7637-2 (including emissions); ISO 7637-3;
ISO 16750-2:2012, Sections 4.6.3 and 4.6.4;
CS-11979, Section 6.4; CS.00054, Section 5.9;
EMC-CS-2009.1 (CI220); FMC1278 (CI220, CI221, CI222);
GMW 3097, Section 3.5; SAE J1113-11; SAE J1113-12;
ECE Regulation 10.06 Annex 10

Electrostatic Discharge (ESD)
(Up to +/-25kV)

ISO 10605 (2001, 2008);
CS-11979 Section 7.0; CS.00054, Section 5.10;
EMC-CS-2009.1 (CI 280); FMC1278 (CI280); SAE J1113-13;
GMW 3097 Section 3.6

Conducted Emissions

CISPR 25 (2002, 2008), Sections 6.2 and 6.3;
CISPR 25 (2016), Sections 6.3 and 6.4;
CS-11979, Section 5.1; CS.00054, Sections 5.6.1 and 5.6.2;
GMW 3097, Section 3.3.2;
EMC-CS-2009.1 (CE 420); FMC1278 (CE420, CE421,
CE 430, CE440)

(A2LA Cert. No. 1786.01) Revised 05/08/2025



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Test Technology:

Radiated Emissions Anechoic
(Up to 6GHz)

Vehicle Radiated Emissions

Bulk Current Injection (BCI)
(1 to 400MHz 500mA)

Radiated Immunity Anechoic
(Up to 6GHz and 200V/m)
(Including Radar Pulse 600V/m)

Radiated Immunity Magnetic Field

Radiated Immunity Reverb
(360MHz to 6GHz and 100V/m)

Radiated Immunity
(Portable Transmitters)
(Up to 6GHz and 20W)

Vehicle Radiated Immunity (ALSE)

Vehicle Product Specific EMC Standards

Electrical Loads

Stripline

Transverse Electromagnetic (TEM) Cell

Test Method(s)¹:

CISPR 25 (2002, 2008), Section 6.4;
CISPR 25 (2016), Section 6.5;
CS-11979, Section 5.3; CS.00054, Section 5.6.3;
GMW 3097, Section 3.3.1;
EMC-CS-2009.1 (RE 310); FMC1278 (RE310, RE320);

CISPR 12; CISPR 36; ICES-002;
ECE Regulation 10.06 Annex 4;
ECE Regulation 10.06 Annex 5

ISO 11452-4; CS-11979, Section 6.1; CS.00054, Section 5.8.1;
GMW 3097, Section 3.4.1; SAE J1113-4;
EMC-CS-2009.1 (RI112); FMC1278 (RI112);
ECE Regulation 10.06 Annex 9

ISO 11452-2;
CS-11979, Section 6.2; CS.00054, Section 5.8.2;
GMW 3097, Section 3.4.2;
EMC-CS-2009.1 (RI114); FMC1278 (RI114); SAE J1113-21;
ECE Regulation 10.06 Annex 9

ISO 11452-8; FMC 1278 (RI140)

ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3;
EMC-CS-2009.1 (RI114); FMC1278 (RI114);
ISO 11452-11

ISO 11452-9;
EMC-CS-2009.1 (RI115); FMC1278 (RI115);
GMW 3097, Sec 3.4.4

ISO 11451-2; ECE Regulation 10.06 Annex 6

EN 14982; EN ISO 13309; ISO 13766; EN 50498;
EC Regulation No. 2015/208; EN 55012

ISO 16750-2

ISO 11452-5

ISO 11452-3

Test Technology:
Test Method(s)¹:
Emissions

Radiated and Conducted
(3m Semi-anechoic chamber,
up to 40 GHz)

47 CFR, FCC Part 15 B (using ANSI C63.4:2014);
47 CFR, FCC Part 18 (using FCC MP-5:1986);
ICES-001; ICES-003; ICES-005;
IEC/CISPR 11, Ed. 4.1 (2004-06); AS/NZS CISPR 11 (2004);
IEC/CISPR 11 Ed 5 (2009-05) + A1 (2010);
KN 11 (2008-5) with RRL Notice No. 2008-3 (May 20, 2008);
CISPR 11; EN 55011; KS C 9811; CNS 13803 (1997, 2003);
CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1;
CISPR 16-2-1 (2008); CISPR 16-2-1; KS C 9814-1; KN 14-1;
IEC/CISPR 22 (1997);
EN 55022 (1998) + A1(2000);
EN 55022 (1998) + A1(2000) + A2(2003); EN 55022 (2006);
IEC/CISPR 22 (2008-09); AS/NZS CISPR 22 (2004);
AS/NZS CISPR 22, 3rd Edition (2006); KN 22 (up to 6 GHz);
CNS 13438 (up to 6 GHz); VCCI V-3 (up to 6 GHz);
CISPR 32; EN 55032; KS C 9832; KN 32;
ECE Regulation 10.06 Annex 7 (Broadband);
ECE Regulation 10.06 Annex 8 (Narrowband);
ECE Regulation 10.06 Annex 13 (Conducted);
ECE Regulation 10.06 Annex 14 (Conducted)

Cellular Radiated Spurious Emissions

ETSI TS 151 010-1 GSM; 3GPP TS 51.010-1, Sec 12;
ETSI TS 134 124 UMTS; 3GPP TS 34.124;
ETSI TS 136 124 LTE; E-UTRA; 3GPP TS 36.124

Current Harmonics

IEC 61000-3-2; IEC 61000-3-12;
EN 61000-3-2; KN 61000-3-2;
KS C 9610-3-2; ECE Regulation 10.06 Annex 11

Flicker and Fluctuations

IEC 61000-3-3; IEC 61000-3-11;
EN 61000-3-3; KN 61000-3-3;
KS C 9610-3-3; ECE Regulation 10.06 Annex 12

Immunity

Electrostatic Discharge

IEC 61000-4-2, Ed. 1.2 (2001);
IEC 61000-4-2 (1995) + A1(1998) + A2(2000);
EN 61000-4-2 (1995); EN 61000-4-2 (2009-05);
KN 61000-4-2 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-2; EN 61000-4-2; KN 61000-4-2;
KS C 9610-4-2; IEEE C37.90.3 2001

Radiated Immunity

IEC 61000-4-3 (1995) + A1(1998) + A2(2000);
IEC 61000-4-3, Ed. 3.0 (2006-02);
IEC 61000-4-3, Ed. 3.2 (2010);
KN 61000-4-3 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-3; EN 61000-4-3; KN 61000-4-3;
KS C 9610-4-3; IEEE C37.90.2 2004

Test Technology:
Test Method(s)¹:
Immunity (cont'd)

Electrical Fast Transient/Burst

IEC 61000-4-4, Ed. 2.0 (2004-07);
IEC 61000-4-4, Ed. 2.1 (2011);
IEC 61000-4-4 (1995) + A1(2000) + A2(2001);
KN 61000-4-4 (2008-5);
RRL Notice No. 2008-5 (May 20, 2008);
IEC 61000-4-4; EN 61000-4-4; KN 61000-4-4;
KS C 9610-4-4; ECE Regulation 10.06 Annex 15

Surge

IEC 61000-4-5 (1995) + A1(2000);
IEC 61000-4-5, Ed 1.1 (2005-11);
EN 61000-4-5 (1995) + A1(2001);
KN 61000-4-5 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-5; EN 61000-4-5; KN 61000-4-5;
KS C 9610-4-5;
IEEE C37.90.1 2012; IEEE STD C62.41.2 2002;
ECE Regulation 10.06 Annex 16

Conducted Immunity

IEC 61000-4-6 (1996) + A1(2000);
IEC 61000-4-6, Ed 2.0 (2006-05);
IEC 61000-4-6 Ed. 3.0 (2008);
KN 61000-4-6 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
EN 61000-4-6 (1996) + A1(2001); IEC 61000-4-6;
EN 61000-4-6; KN 61000-4-6; KS C 9610-4-6

Power Frequency Magnetic Field
Immunity (*Down to 3 A/m*)

IEC 61000-4-8 (1993) + A1(2000); IEC 61000-4-8 (2009);
EN 61000-4-8 (1994) + A1(2000);
KN 61000-4-8 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-8; EN 61000-4-8; KN 61000-4-8; KS C 9610-4-8

Voltage Dips, Short Interrupts, and Line
Voltage Variations

IEC 61000-4-11, Ed. 2 (2004-03);
KN 61000-4-11 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-11; EN 61000-4-11; KN 61000-4-11;
KS C 9610-4-11

Ring Wave

IEC 61000-4-12, Ed. 2 (2006-09);
EN 61000-4-12:2006;
IEC 61000-4-12; EN 61000-4-12; KN 61000-4-12;
IEEE STD C62.41.2 2002

Test Technology:

Generic and Product Specific EMC Standards

Test Method(s)¹:

IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1;
KS C 9610-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2;
KN 61000-6-2; KS C 9610-6-2; IEC/EN 61000-6-3;
AS/NZS 61000-6-3; KN 61000-6-3; KS C 9610-6-3;
IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4;
KS C 9610-6-4; EN 50130-4; EN 61326-1; EN 50121-3-2;
EN 12895; EN 50270; EN 50491-1; EN 50491-2; EN 50491-3;
EN 55015; EN 60730-1; EN 60945; IEC 60533;
EN 61326-2-6; EN 61800-3; IEC/CISPR 14-2; EN 55014-2;
AS/NZS CISPR 14.2; KN 14-2; KS C 9814-2;
IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24;
IEC/CISPR 35; AS/NZS CISPR 35; EN 55035; KN 35;
KS C 9835; IEC 60601-1-2; JIS T0601-1-2

TxRx EMC Requirements

EN 301 489-1; EN 301 489-3; EN 301 489-9;
EN 301 489-17; EN 301 489-19; EN 301 489-20

European Radio Test Standards

ETSI EN 300 086-1; ETSI EN 300 086-2;
ETSI EN 300 113-1; ETSI EN 300 113-2;
ETSI EN 300 220-1; ETSI EN 300 220-2;
ETSI EN 300 220-3-1; ETSI EN 300 220-3-2;
ETSI EN 300 330-1; ETSI EN 300 330-2;
ETSI EN 300 440-1; ETSI EN 300 440-2;
ETSI EN 300 422-1; ETSI EN 300 422-2;
ETSI EN 300 328; ETSI EN 301 893;
ETSI EN 301 511; ETSI EN 301 908-1;
ETSI EN 908-2; ETSI EN 908-13;
ETSI EN 303 413; ETSI EN 302 502;
EN 303 340; EN 303 345-2; EN 303 345-3; EN 303 345-4

Canadian Radio Tests

RSS-102 measurement (RF Exposure Evaluation);
RSS-102 measurement (Nerve Stimulation);
SPR-002; RSS-111; RSS-112; RSS-117; RSS-119; RSS-123;
RSS-125; RSS-127; RSS-130; RSS-131; RSS-132; RSS-133;
RSS-134; RSS-135; RSS-137; RSS-139; RSS-140; RSS-141;
RSS-142; RSS-170; RSS-181; RSS-182; RSS-191; RSS-192;
RSS-194; RSS-195; RSS-196; RSS-197; RSS-199; RSS-210;
RSS-211; RSS-213; RSS-215; RSS-216; RSS-220; RSS-222;
RSS-236; RSS-238; RSS-243; RSS-244; RSS-247; RSS-248;
RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN

Mexico Radio Tests

IFT-008-2015; NOM-208-SCFI-2016

Japan Radio Tests

Radio Law No. 131, Ordinance of MPT No. 37, 1981,
MIC Notification No. 88:2004, Table No. 22-11;
ARIB STD-T66, Regulation 18

Taiwan Radio Tests

LP-0002 (July 15, 2020)

Test Technology:
Test Method(s)¹:
Australia/New Zealand Radio Tests

AS/NZS 4268; Radiocommunications (Short Range Devices) Standard (2014)

Hong Kong Radio Tests

HKCA 1039 Issue 6;
HKCA 1042;
HKCA 1033 Issue 7;
HKCA 1061;
HKCA 1008;
HKCA 1043;
HKCA 1057;
HKCA 1073

Korean Radio Test Standards

KN 301 489-1; KN 301 489-3; KN 301 489-9;
KN 301 489-17; KN 301 489-52; KS X 3124; KS X 3125;
KS X 3130; KS X 3126; KS X 3129

Vietnam Radio Test Standards

QCVN 47:2015/BTTTT; QCVN 54:2020/BTTTT;
QCVN 55:2011/BTTTT; QCVN 65:2013/BTTTT;
QCVN 73:2013/BTTTT; QCVN 74:2020/BTTTT;
QCVN 112:2017/BTTTT; QCVN 117:2020/BTTTT

Vietnam EMC Test Standards

QCVN 18:2014/BTTTT; QCVN 86:2019/BTTTT;
QCVN 96:2015/BTTTT; QCVN 118:2018/BTTTT

***Unlicensed Radio Frequency Devices
(3 Meter Semi-Anechoic Room)***

47 CFR FCC Part 15C, 15D, 15E, 15F, 15G, 15H
(using ANSI C63.10:2013, ANSI C63.17:2013 and
FCC KDB 905462 D02 (v02))

Licensed Radio Service Equipment

47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87,
90, 95, 96, 97, 101 (using ANSI/TIA-603-E,
TIA-102.CAAA-E, ANSI C63.26:2015)

OTA (Over the Air) Performance

GSM, GPRS, EGPRS
UMTS (W-CDMA)
LTE including CAT M1
A-GPS for UMTS/GSM
LTS A-GPS, A-GLONASS,
SIB8/SIB16
Large Device/Laptop/Tablet Testing
Integrated Device Testing
WiFi 802.11 a/b/g/n/a

CTIA Test Plan for Wireless Device Over-the-Air
Performance (Method for Measurement for Radiated Power
and Receiver Performance) V4.0;
CTIA Test Plan for RF Performance Evaluation of WiFi
Mobile Converged Devices V4.0

Test Technology:
Test Method(s)¹:
Electrical Measurements and Simulation
AC Voltage / Current

(1mV to 5kV) 60 Hz
(0.1V to 250V) up to 500 MHz
(1μA to 150A) 60 Hz

FAA AC 150/5345-10H;
FAA AC 150/5345-43J;
FAA AC 150/5345-44K;
FAA AC 150/5345-46E;
FAA AC 150/5345-47C;
FAA EB 67D

DC Voltage / Current

(1mV to 15 kV) / (1μA to 10A)

Power Factor / Efficiency / Crest Factor

(Power to 30kW)

Resistance

(1mΩ to 4000MΩ)

Surge

(Up to 10 kV / 5 kA) (Combination
Wave and Ring Wave)

On the following products and materials:

Telecommunications Terminal Equipment (TTE), Radio Equipment, Network Equipment, Information Technology Equipment (ITE), Automotive Electronic Equipment, Automotive Hybrid Electronic Devices, Maritime Navigation and Radio Communication Equipment and Systems, Vehicles, Boats and Internal Combustion Engine Driven Devices, Automotive, Aviation, and General Lighting Products, Medical Electrical Equipment, Motors, Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment, Household Appliances, Electric Tools, Low-voltage Switchgear and Control gear, Programmable Controllers, Electrical Equipment for Measurement, Control and Laboratory Use, Base Materials, Power and Data Transmission Cables and Connectors

¹ When the date, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA R101 - *General Requirements- Accreditation of ISO-IEC 17025 Laboratories*.

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Unintentional Radiators</u>		
Part 15B	ANSI C63.4:2014	40000
<u>Industrial, Scientific, and Medical Equipment</u>		
Part 18	FCC MP-5 (February 1986)	40000
<u>Intentional Radiators</u>		
Part 15C	ANSI C63.10:2013	40000

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Unlicensed Personal Communication Systems Devices</u>		
Part 15D	ANSI C63.17:2013	40000
<u>U-NII without DFS Intentional Radiators</u>		
Part 15E	ANSI C63.10:2013	40000
<u>U-NII with DFS Intentional Radiators</u>		
Part 15E	FCC KDB 905462 D02 (v02)	40000
<u>UWB Intentional Radiators</u>		
Part 15F	ANSI C63.10:2013	40000
<u>BPL Intentional Radiators</u>		
Part 15G	ANSI C63.10:2013	40000
<u>White Space Device Intentional Radiators</u>		
Part 15H	ANSI C63.10:2013	40000
<u>Commercial Mobile Services (FCC Licensed Radio Service Equipment)</u>		
Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>General Mobile Radio Services (FCC Licensed Radio Service Equipment)</u>		
Parts 22 (non-cellular), 90 (below 3 GHz), 95, 97, and 101 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment)</u>		
Part 96	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Maritime and Aviation Radio Services</u>		
Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	40000
<u>Microwave and Millimeter Bands Radio Services</u>		
Parts 25, 30, 74, 90 (above 3 GHz), 97 (above 3 GHz), and 101	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Broadcast Radio Services</u> Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Signal Boosters</u> Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	40000

² Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (<https://apps.fcc.gov/oetcf/eas/>) for a listing of FCC approved laboratories.



Accredited Laboratory

A2LA has accredited

ELITE ELECTRONIC ENGINEERING INC.

Downers Grove, IL

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 15th day of August 2023.



Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1786.01
Valid to August 31, 2025
Revised May 8, 2025

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.