



Engineering Test Report No. 2300379-02 Rev. A

Report Date	July 31, 2023
Manufacturer Name	Molex Sensorcon, LLC
Manufacturer Address	307 Cayuga Rd, Suite 100 Cheektowaga, NY 14225
Product Name Model No.	Handheld Gas Detector PRO-CO-1000
Date Received	July 17, 2023
Assessment Dates	July 17 and 18, 2023
Specifications	FCC 47 CFR Part 1 §1.1310 and Part 2 §2.1091 and §2.1093 KDB 447498 D01 OET Bulletin 65:1997 RSS-102 Issue 5, Amend. 1
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1. Report Revision History

Revision	Date	Description
-	01 AUG 2023	Initial Release of Engineering Test Report No. 2300379-02
A	5 JAN 2024 By Rick King	<ul style="list-style-type: none">- Throughout report: Changed Engineering Test Report No. 2300379-02 to Engineering Test Report No. 2300379-02 Rev. A- Throughout report: Updated the manufacturer from Molex Sensorcon to Molex Sensorcon, LLC.

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 Molex Sensorcon, LLC Handheld Gas Detector (Model No. PRO-CO-1000) pursuant to the relevant requirements.

3. Subject of Investigation

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

EUT Identification	
Description	Handheld Gas Detector
Model/Part No.	PRO-CO-1000
S/N	N/A
Radio Access Technology	Bluetooth
Band of Operation	2400 – 2483.5MHz
EIRP	0.00037W (-4.26dBm)
Antenna Gain	N/A

4. Standards and Requirements

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

- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 1, Subpart I, §1.1310 – “Radiofrequency radiation exposure limits”
- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 2, Subpart J, §2.1091 – “Radiofrequency radiation exposure evaluation: mobile devices”
- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 2, Subpart J, §2.1093 – “Radiofrequency radiation exposure evaluation: portable devices”
- KDB 447498 D01 General RF Exposure Guidance v06 – “RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices”
- 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 5, Amendment 1 (February 2, 2021) – "Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)"

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 = transmit output power (mW)

G = maximum antenna gain relative to an isotropic antenna (linear)

R = 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:

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

Where:

N = number of antennas,
G = gain of a single antenna.

A minimum separation distance can be calculated using the following formulas

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

Where:

P = transmit output power (mW)
G = maximum antenna gain relative to an isotropic antenna (linear).

For sources with frequencies < 30MHz

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

For sources with frequencies > 30MHz

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

Where:

R = measurement distance
FS_{Limit} = field strength limit
FS_R = 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 1mW, 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 0.3GHz 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	$19.2 R^2$

If it is determined that the equipment under investigation 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.

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

The RF exposure level shall be determined by either measurement or by calculating the power density at an evaluation distance of less than 0.2m, as specified by ANSI/IEEE C95.1-1992.

If it is found that the product meets the low power exclusion level criteria listed in RSS 102 Section 2.5.2, no further RF exposure evaluation is required. The low power exclusion level criteria are given in the following table (f is given in MHz):

RF Source Frequency (MHz)	Threshold ERP (watts)
$f < 20$ MHz	$x \leq 1$
$20 \text{ MHz} \leq f < 48$ MHz	$x \leq \frac{4.49}{f^{0.5}}$
$48 \text{ MHz} \leq f < 300$ MHz	$x \leq 0.6$
$300 \text{ MHz} \leq f < 6$ GHz	$x \leq (1.31 * 10^{-2}) * f^{0.6834}$
$6 \text{ GHz} \leq f$	$x \leq 5$

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.

Per RSS 102 Section 4, 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 (W/m ²)
0.003 – 10 *	170	180	—
0.1 – 10 *	—	1.6 / f	—
1.29 – 10 *	193 / $f^{0.5}$	—	—
10 – 20	61.4	0.163	10
20 – 48	129.8 / $f^{0.25}$	0.3444 / $f^{0.25}$	44.72 / $f^{0.5}$
48 – 100	49.33	0.1309	6.455
100 – 6000	15.60 $f^{0.25}$	0.04138 $f^{0.25}$	0.6455 $f^{0.5}$
6000 – 15000	137	0.364	50
15000 – 150000	137	0.364	50
150000 – 300000	0.354 $f^{0.5}$	9.40x10 ⁻⁴ $f^{0.5}$	3.33x10 ⁻⁴ f
Limits for General/Uncontrolled Exposure			
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m ²)
0.003 – 10 *	83	90	—
0.1 – 10 *	—	0.73 / f	—
1.1 – 10 *	87 / $f^{0.5}$	—	—
10 – 20	27.46	0.0728	2
20 – 48	58.07 / $f^{0.25}$	0.1540 / $f^{0.25}$	8.944 / $f^{0.5}$
48 – 300	22.06	0.05852	1.291
300 – 6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$
6000 – 15000	61.4	0.163	10
15000 – 150000	61.4	0.163	10
150000 – 300000	0.158 $f^{0.5}$	4.21x10 ⁻⁴ $f^{0.5}$	6.67x10 ⁻⁵ f
f = frequency in MHz			
* = Limits only apply to Specific Absorption Rate and Nerve Stimulation requirements.			

8. Assessment Results

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

Radio Access Technology	f Transmit Frequency (MHz)	ERP (dBm)	EIRP (dBm)
BLE	2480	-6.41	-4.26

Exempt from routine evaluation per FCC 1.1307(b)(3)(i)(B)				
Radio Access Technology	f Transmit Frequency (MHz)	ERP (W)	P_{th} (mW)	Exempt /Not Exempt
BLE	2480	0.00022856	22.02635336	Exempt - (B)

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

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

Radio Access Technology	f Transmit Frequency (MHz)	EIRP (dBm)	EIRP (W)	SAR Exemption Threshold (W)	Exempt /Not Exempt
BLE	2480	-4.26	0.000375	0.002	Exempt

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

9. Statement of Compliance

The Molex Sensorcon, LLC Handheld Gas Detector (Model PRO-CO-1000) is in compliance with the FCC and Innovation, Science and Economic Development Canada requirements for RF Exposure.

10. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC and Innovation, Science and Economic Development Canada requirements for RF Exposure test specifications. The data presented in this test report pertains to the EUT as provided by the customer on the test date specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.