



Engineering Test Report No. 2104123-03

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Manufacturer Address	2650 N Westgate Ave Ste 112 Springfield, MO 65803
Product Name Brand/Model No.	UBase
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Specifications	FCC 47 CFR Part 2.1093 KDB, 447498 D01 OET Bulletin 65:1997 RSS-102
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1. Report Revision History

Revision	Date	Description
–	27 JUL 2022	Initial Release of Engineering Test Report No. 2104122-03

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 Pro IAQ Inc Thermostat, Model No. UBase pursuant to the relevant requirements.

3. Subject of Investigation

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

EUT Identification	
Description	Thermostat
Model/Part No.	UBase
S/N	N/A
Radio Access Technology	802.11b/g/n FHSS
EIRP	802.11b/g/n: 9.2dBm FHSS: 17.1dBm
Bands of Operation	802.11b/g/n: 2.4GHz Band FHSS: 900MHz Band

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 5 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 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:

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

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

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

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

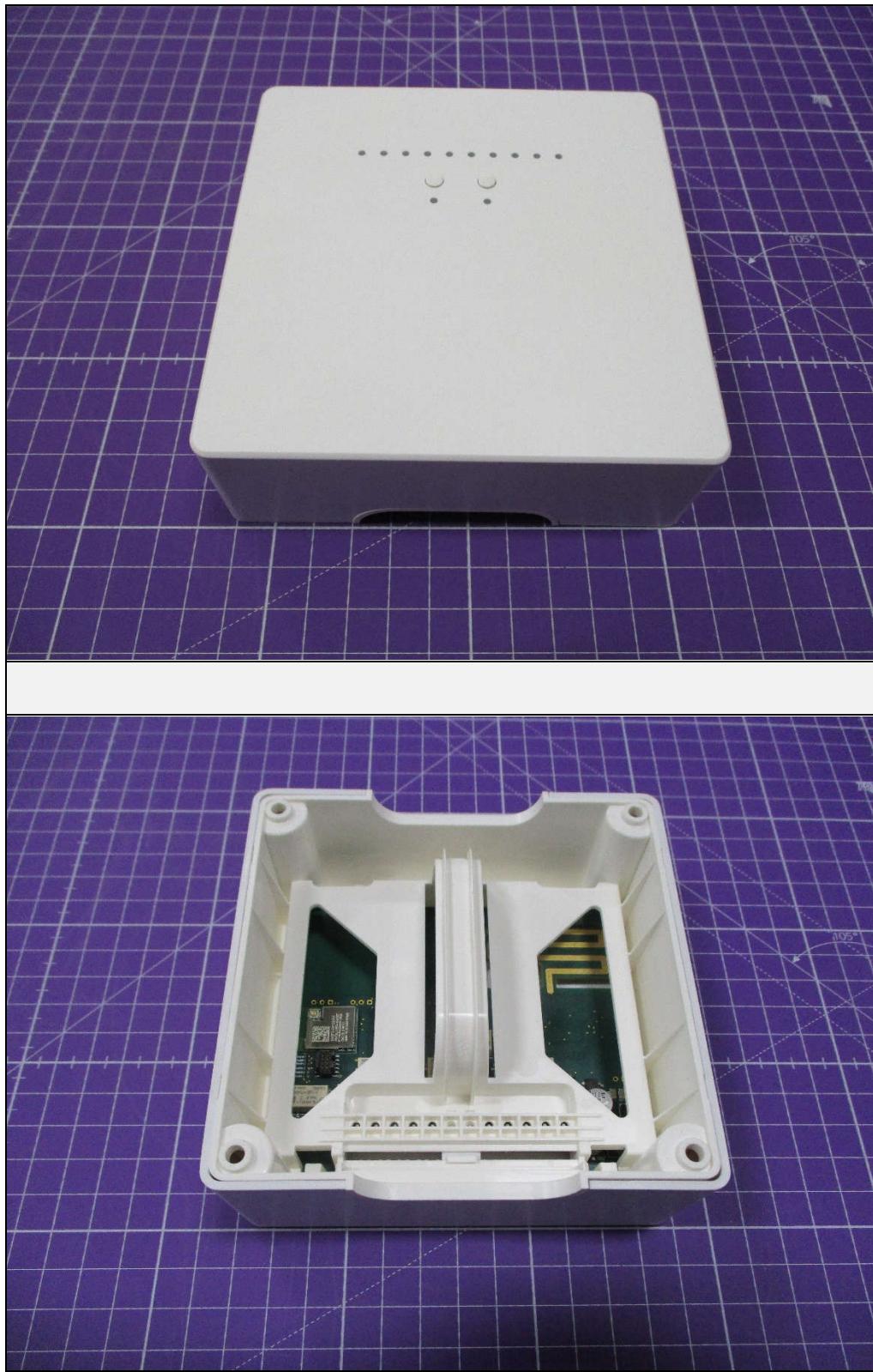
$$Separation Distance = R \left(10^{\frac{(FS_{\text{Limit}} - FS_R)}{40}} \right)^{-1} \quad (4)$$

For sources with frequencies >30MHz

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

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).

Multiple RF sources are exempt if:

Exemption 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).

Exemption 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 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.

The RF exposure level was determined by either measurement or by calculating the power density at an evaluation distance of 0.2m.

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 was determined by either measurement or by calculating the power density at an evaluation distance of 0.2m.

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:

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

where:

S_C is the measured/calculated power density;
 S_L is the RF exposure limit.

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/P (dBm)	ERP/P (mW)
FHSS	927.547	17.1	51.2861384
802.11b	2462	9.2	8.317637711

Radio Access Technology	f Transmit Frequency (MHz)	ERP/P (mW)	Power Threshold (mW)	Calculated Power Density (mW/cm ²)	Power Density Limit (mW/cm ²)	Fractional Contributions	\sum Fractional Contributions
FHSS	927.547	51.2861384	1	0.010203053	0.62	0.0165	0.018
802.11b	2462	8.317637711	1	0.001654741	1.00	0.0017	

The equipment is 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)
FHSS	927.547	17.1	0.05
802.11b	2462	9.2	0.01

8.2.1. Assessment Results for General/Uncontrolled Environments

Radio Access Technology	f Transmit Frequency (MHz)	S_c Calculated Power Density (W/m ²)	S_L Power Density Limit (W/m ²)	$S_c:S_L$ Ratio	$\sum S_c:S_L$ Ratio
FHSS	927.547	0.10	24.29	0.004	0.004
802.11b	2462	0.02	64.48	0.0002	

8.2.2. Assessment Results for General/Uncontrolled Environments

Radio Access Technology	f Transmit Frequency (MHz)	S_c Calculated Power Density (W/m ²)	S_L Power Density Limit (W/m ²)	$S_c:S_L$ Ratio	$\sum S_c:S_L$ Ratio
FHSS	927.547	0.10	19.66	0.0052	0.006
802.11b	2462	0.02	32.03	0.0005	

9. Statement of Compliance

The Pro IAQ Inc Thermostat, UBase is in compliance with the FCC, Innovation, Science and Economic Development Canada, European Union and Australia/New Zealand requirements for RF Exposure.