

Client:	Ecobee Inc.
Product Name/Model:	Smart Thermostat/ ECB601/ECB501
FCC ID:	WR92025AA2060G
Reference	FCC KDB 447498 D04 v01

FCC RF Exposure

Where the Device Under Test (DUT) can be shown to meet the requirements for an exemption pursuant to FCC 47 CFR §1.1307(b)(3), an evaluation is not required with respect to the limits on human exposure to RF emissions provided in FCC 47 CFR §1.1310.

1. Determination of Exemption

As per 47 CFR §1.1307(b)(3), for single RF sources (i.e., any single fixed RF source, mobile device, or portable device), a single RF source is exempt if:

- A. **1-mW Test Exemption:** The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);
- B. **SAR-Based Exemption:** 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:

$$P_{th} (mW) = \begin{cases} ERP(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20cm} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

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

And

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

d = the minimum separation distance (cm) in any direction from any part of the device antenna(s) or radiating structure(s) to the body of the device user.

- C. **MPE-Based Exemption:** 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).

Table 1 of § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency (MHz)	Threshold ERP (Watts)
0.3-1.34	$1,920 R^2$
1.34-30	$3,450 R^2/f^2$
30-300	$3.83 R^2$
300-1,500	$0.0128 R^2 f$
1,500-100,000	$19.2 R^2$

Where R is the separation distance in meters and f is in MHz

2. RF Exposure Evaluation

The DUT is a mobile device designed to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the RF source's radiating structure and the body of the user or nearby persons.

The EUT contains 902 – 928 MHz FHSS/Hybrid transmitters, 2400 – 2483.5 MHz DTS/FHSS transmitters, 5.2 GHz and 5.8 GHz WLAN transmitters.

ERP exemption threshold was calculated using the lowest operating frequency for each transmitter; the lower frequency resulted in a lower exemption limit.

2.1 DUT RF Output Power

Highest power (peak or average) for each operation band was used in the RF exposure evaluation.

Transmitter	Operation Band (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Max ERP (dBm)	Max ERP (W)	Minimum Separation Distance (cm)
FHSS/Hybrid	920 – 927	17.99	-9.71	6.13	0.0041	20
BLE	2400 - 2480	11.36	-2.05	7.16	0.0052	20
WLAN	2412 - 2462	25.35	-2.05	21.15	0.1303	20
WLAN	5150 - 5250	19.54	-1.88	15.51	0.0356	20

WLAN	5725 - 5850	20.98	-1.88	16.95	0.0495	20
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Note:

1. ERP (dBm) = conducted power (dBm) + Antenna Gain (dBi) – 2.15
2. ERP (W) = $10^{((\text{ERP(dBm)} - 30)/10)}$

2.2 MPE-Based Exemption

The EUT contains 902 – 928 MHz FHSS/Hybrid transmitters, 2400 – 2483.5 MHz DTS/FHSS transmitters, 5.2 GHz and 5.8 GHz WLAN transmitters. EIRP exemption threshold was calculated using the lowest operating frequency for each transmitter; the lower frequency resulted in a lower exemption limit

Evaluation Frequency (MHz)	Minimum Required Separation Distance ($\lambda/2\pi$) (cm)	Threshold ERP (W)	DUT Maximum ERP (W)
920.00	5.19	0.471	0.0041
2402.00	1.99	0.768	0.0052
2412.00	1.99	0.768	0.1303
5180.00	0.92	0.768	0.0356
5745.00	0.83	0.768	0.0495

Note:

$\lambda/2\pi = (3 \times 10^8 \text{ m/s}) / (2 * 3.14 * f \text{ (Hz)})$ in meters

Threshold ERP = $19.2 * 0.2^2 = 0.768$

The DUT separation distance is greater than the Minimum Required Separation Distance. And each transmitter operates below its applicable Threshold ERP Limit; thus, the RF Exposure Exemption requirement is met.

According to 47 CFR §1.1307(b)(3)(i)(B), this device complies with the RF exposure test exemption.

2.3 Simultaneous Transmission Evaluation

The transmitters on the EUT are located on different SoCs. BLE and WLAN are on SoC1. 900 MHz transmitter is on SoC2. The 2.4 GHz BLE share the same antenna as the 2.4 GHz WLAN; the two 5.2GHz and 5.8 GHz WLAN share an antenna.

Each SoC could only transmit one mode at a time; i.e. SoC1 could only either transmit BLE or WLAN, and SoC2 could only either transmit FHSS or Hybrid. Thus, the worst-case RF exposure is a combination of the highest ERP from each SoC. The highest ERP from SoC1 is 0.1303 W and from SoC2 is 0.004 W.

Per 47 CFR Section 1307(b)(3)(ii)(B), the DUT qualify for simultaneous exemption if the transmitters meet the following requirement:

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

$$\frac{0.1303W}{0.768 W} + \frac{0.004 W}{0.471 W} = 0.17 < 1$$

The DUT qualifies for simultaneous transmission exemption.