FCC Part 1 Subpart I
FCC Part 2 Subpart J
INDUSTRY CANADA RSS 102 ISSUE 3

RF EXPOSURE REPORT

FOR

LIGHT BULB WITH 2.4 GHz TRANSCEIVER

MODEL NUMBER: BA19-08027OMF-12CE26-1U100 (US)
BA19-08027OMF-12CE26-1U200 (CANADA)

FCC ID: 2ACQ6-A19
IC: 11481A-A19

REPORT NUMBER: R10455472-RF

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Prepared for
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NVLAP LAB CODE 200246-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	2014-10-06	Initial Issue	Jeff Moser

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CREE INC.
4600 SILICON DR.
DURHAM, NC 27709 USA

EUT DESCRIPTION: Light bulb with 2.4 GHz Transceiver

MODEL: BA19-08027OMF-12CE26-1U100 (US)
BA19-08027OMF-12CE26-1U200 (CANADA)

SERIAL NUMBER: Non-serialized units

DATE TESTED: 2014-09-14 through 2014-09-16; 2014-09-24; 2014-09-29

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 1 SUBPART I & PART 2 SUBPART J	Pass
INDUSTRY CANADA RSS 102 ISSUE 3	Pass

UL LLC calculated the RF Exposure of the above equipment in accordance with the requirements set forth in the above standards, using test results reported in the test report documents referenced below and/or documentation furnished by the applicant. All indications of Pass/Fail in this report are opinions expressed by UL LLC based on interpretations of these calculations. The results show that the equipment is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released
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2. TEST METHODOLOGY

All calculations were made in accordance with FCC OET Bulletin 65 Edition 97-01 and IC Safety Code 6.

3. REFERENCES

All measurements were made as documented in test report UL LLC Report R10455472-RF for operation 2.4 GHz band.

Output power, Duty cycle and Antenna gain data is excerpted from the applicable test reports.

Antenna gain data is excerpted from product documentation provided by the applicant.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2002460.htm.

5. DESCRIPTION OF EUT

Part Number BA19-08027OMF-12CE26 is a Light Bulb that contains a 2.4 GHz DSSS transceiver used with light fixtures. The BA19-08027OMF-12CE26 utilizes an O-QPSK modulation and a 250 kbps data rate. The Light Bulb receives signals from other devices to control the fixture.

The radio module is manufactured by Cree Inc.

Nomenclature explanation:

BA19-08027OMF-12CE26
"B" indicates "Bulb"
"A19" indicates "Bulb shape"
"080" indicates "800" Lumens
"27" indicates the CCT (2700K color temperature)
"OM" indicates "Omni directional" (beam angle)
"F" indicates "Frosted"

The remaining characters are:
12CE26-1U100
12CE26-1U200

"12" indicates 120V
"C" indicates controls, i.e. Zigbee etc….
"E26" indicates the Edison base
"1" indicates the version
"U" indicates U.S. manufactured
The last 3 characters have to do with packaging and marketing (Country specific for US and Canada)

6. MAXIMUM PERMISSIBLE RF EXPOSURE

6.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

6.2. IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

6.3. EQUATIONS

POWER DENSITY

Power density is given by:

S = EIRP / (4 * Pi * D^2)

Where

S = Power density in mW/cm^2
EIRP = Equivalent Isotropic Radiated Power in mW
D = Separation distance in cm

Power density in units of mW/cm^2 is converted to units of W/m^2 by multiplying by 10.

DISTANCE

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

Where

D = Separation distance in cm
EIRP = Equivalent Isotropic Radiated Power in mW
S = Power density in mW/cm^2

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

Source-based time-averaged EIRP = (DC / 100) * EIRP

Where

DC = Duty Cycle in %, as applicable
EIRP = Equivalent Isotropic Radiated Power in W

MIMO AND COLOCATED TRANSMITTERS (IDENTICAL LIMIT FOR ALL TRANSMITTERS)

For multiple chain devices, and colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the EIRP (in linear units) of each transmitter.

Total EIRP = (EIRP1) + (EIRP2) + ... + (EIRPn)

where

EIRPx = Source-based time-averaged EIRP of chain x or transmitter x

The total EIRP is then used to calculate the Power Density or the Distance as applicable.

MIMO AND COLOCATED TRANSMITTERS

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply:

The Power Density at the specified separation distance is calculated for each transmitter chain or transmitter.

The fraction of the exposure limit is calculated for each chain or transmitter as
(Power Density of chain or transmitter) / (Limit applicable to that chain or transmitter).

The fractions are summed.

Compliance is established if the sum of the fractions is less than or equal to one.

6.4. LIMITS AND IC EXEMPTION

VARIABLE LIMITS

For mobile radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency:

824 MHz / 1500 = 0.55 mW/cm^2 (FCC)
824 MHz / 150 = 5.5 W/m^2 (IC).

FIXED LIMITS

For operation in the PCS band, the 2.4 GHz band and the 5 GHz bands:

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2
From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

INDUSTRY CANADA EXEMPTION

RSS-102 Clause 2.5.2 RF exposure evaluation is required if the separation distance between the user and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W;
- at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W.

7. RF EXPOSURE RESULTS

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

According to KDB 447498 D01 General RF Exposure Guidance v05, section 4.3.1
At 100 MHz to 6 GHz and for test separation distances ≤ 50 mm, the SAR test exclusion threshold is determined according to the following;

a) [(max. power of channel, including tune-up tolerance, ㎽) / (min. test separation distance, mm)] x [√f(GHz)] ≤ 3.0

1. SAR test exclusion threshold

Frequency : 2405 MHz (min. separation distances = 5 mm)
SAR test exclusion thresholds (5 mm) = [(4 / 5) * √2.405] = 1.24 ≤ 3.0.

Distances less than or equal to 50mm

Antenna	Tx Type	Frequency (MHz)	Output power Note 2, 4		Separation distance (mm) Note 1 and 4	SAR Exclusion Value Note 3 and 4	SAR Exclusion Threshold
			dBm	mW			1-g SAR
PCB Trace	O-QPSK	2405	6	4.00	0	1.2	3

Note 1: For distances < 5mm, a distance of 5mm is used to determine SAR exclusion. For distances < 50mm the calculation must yield a value <= 3.0 to exlcude that position from body or head SAR and <=7.5 for Extremities

Note 2: Output power is the maximum rated power (including tune-up or manufacturing tolerances) and includes source-based averaging.

Note 3: If the antenna separation distance is > 50mm then the threshold power value is calculated.

Note 4: Formulas round separation distance to nearest mm and power to nearest mW before determining if SAR is excluded.

2. Conclusion : SAR was not required

END OF REPORT