Engineering Test Report No. 1901064-04

Report Date	12/18/2019
Manufacturer Name	Master Lock Company
Manufacturer Address	6744 Howell Ave Oak Creek, WI 53154
Product Name Brand/Model No.	6400
Assessment Dates	10/18-31/2019
Specifications	FCC 47 CFR Part 2.1093 KDB, 447498 D01 OET Bulletin 65:1997
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515
Signature	*Richard E. King*
Evaluated by	Richard E. King
Signature	*Raymond J Klouda*
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894

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1. Report Revision History

Revision	Date	Description
–	26 DEC 2019	Initial Release of Engineering Test Report No. 1901064-04

2. Introduction

The FCC publishes standards regarding the evaluation of the RF Exposure hazard of radio communications devices. An evaluation has been performed on the Master Lock Company High Security Padlock, Model No. 6400 pursuant to the relevant requirements.

3. Subject of Investigation

This document presents the demonstration of RF Exposure compliance on a High Security Padlock, (hereinafter referred to as the Equipment under Test (EUT)). The High Security Padlock utilizes the following radio access technology(s):

- Silicon Labs, Model No EFR32BG13 Blue Gecko Bluetooth® Low Energy, 2400-2483.5MHz

4. Standards and Requirements

The tests were performed to selected portions of, and in accordance with the following specification(s).

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 Polices 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,"

5. Radiation Sources

Radio Type	Description	
BLE Access Technology	Frequency Range (MHz)	2400-2483.5
	Maximum Power (dBm)[1]	-1.9
	Antenna Gain (dBi)	0.5
	Number of Antennas	1
	Duty Cycle %	100

[1] – Maximum Rated Output Power

6. Sample Calculations

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

$$S = \frac{PG}{4\pi R^2} \tag{1}$$

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:

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

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

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

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

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

For sources with frequencies >30MHz

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

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

7. Statement of Conformity

The Master Lock Company High Security Padlock, Model No. 6400, Serial No. FCC did fully conform to the RF Exposure requirements of the FCC.

8. Photographs of EUT

9. Limits and Requirements

9.1. As mandated by the FCC,

The first step is to determine if the product is categorically exempt from RF exposure evaluation based on the criteria listed in 1.1307(b)(1)

The next step is to evaluate RF exposure either by 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 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.

Per 1.1310(e), 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

10. Assessment Results

10.1. Evaluation Relevant to the Requirements of the FCC

This assessment is based on the device's radio characteristics measured by Elite Electronic Engineering and documented in 1901064-01. The power density will be calculated for the worst case with a 100% transmitter duty cycle.

Radio Type	f Mid-Band of Transmit Frequency (MHz)	Antenna Gain (dB)	Number of Antennas	G Maximum Antenna Gain (Linear)	P Output Power (mW)
BLE	2402	0.50	1	1.12	0.64

(General/Uncontrolled) Exposure			
Assessment Results for Power Density Relative to Exposure Limit			
Radio Type	f Mid-Band of Transmit Frequency (MHz)	Calculated Power Density, S (mW/cm^2)	MPE Limit (mW/cm^2)
BLE	2402	0.00014	1.00

The calculated power density is below the limit. The EUT complies with the RF exposure requirements of the FCC.

11. Statement of Compliance

The Master Lock Company High Security Padlock, Model 6400 is in compliance with the FCC requirements for RF Exposure at a minimum separation distance of 20cm.