LSR
a Laird Business
ACCREDITED
TESTING CERT #1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

RF Evaluation Exclusion Exhibit For:

Valve Box

Prepared by:

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Product Description:

1. Overview

The control unit adjusts the pressure in a Select Comfort it™ Mattress in response to commands from a Bluetooth Low Energy device or through the USB connection. The it™ Mattress system is managed through two assemblies, one that houses the power supply along with the sleep expert diagnostic hardware (referred to as the "PS or power supply box"), the other houses valves for pressure adjustment and a Bluetooth radio (referred to as the "VB or valve box"). A microcontroller manages all control functions and communications to the identified interfaces. The valve box control board will be equipped with two pressure sensors for a dual chamber mattress system. The valve box control board can operate both valves simultaneously, one for each mattress chamber. A Sleep Expert circuit board is consolidated in the power supply circuit board and is used to analyze pressure changes in real time and connect to the cloud via WiFi.

2. Operational Details

The valve box control board is a 24V powered device that operates a BT radio at a frequency of 2.4 GHz and supports both USB and serial UART wired interfaces. The onboard microcontroller communicates over a UART channel to a Texas Instruments CC2541 programmable Bluetooth 4.0 compliant radio.

- The Texas Instruments CC2541 radio supports 2 Mbps Gaussian Frequency Shift Keying (GFSK) data in 2MHz channels between the frequency range of 2.402 GHz and 2.480 GHz. The over-the-air frequency is generated with a phase-locked loop from a 32MHz crystal. The CC2541 radio chip operates under the Bluetooth 4.0 protocol and a board etched Omni-directional meandered PCB Printed PIFA antenna creates a gain of approximately 5.3 dBi.

The sleep expert portion of the circuit board is a USB powered device that operates on frequencies between 2.412 GHz and 2.462 GHz. The onboard microcontroller communicates over an SDIO channel to a TI WLink8 Module WiFi module operating in WiFi mode only. This radio module supports up to 72Mbps under the 802.11 b/g/n protocol. The over-the-air frequency is generated within the WiLink 8 module and transmitted to the TDK WLAN ceramic chip antenna creating a gain of approximately 2.27 dBi peak.

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Associated Antenna(s):

The BLE Radio uses a PCB printed PIFA antenna with a maximum gain of 5.3 dBi.

Statement of compliance:

The It was evaluated against the requirements and limits of OET Bulletin 65, KDB 447498 as well as RSS-102 Issue 5 and was found to be compliant.

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Limits:

A. Portable (SAR Test Exclusion Threshold).

FCC:

SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 20 cm

1-g SAR test exclusion threshold equation:

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

10-g SAR test exclusion threshold equation:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)] ≤ 7.5

RSS 102:

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Note:

1. Table above if for 1-gram tissue, head and body, evaluation (uncontrolled). Limb-worn devices where 10-gram tissue applies, multiply limit by a factor of 2.5

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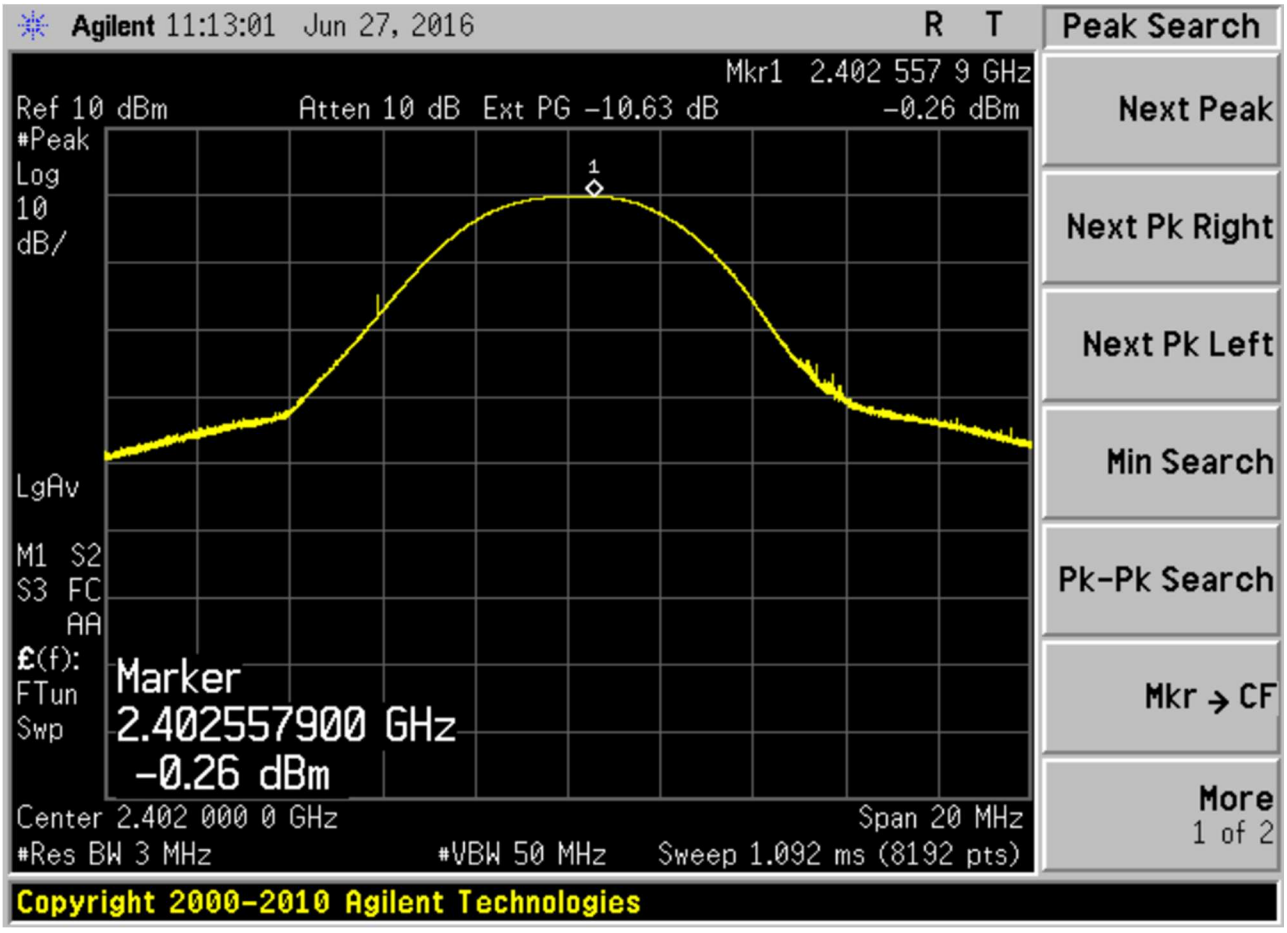
Data and calculations:

Screen Capture of maximum output power



Frequency 2402 MHz;

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A. SAR Test Exclusion

FCC:

Frequency = 2402MHz
Output Power = 3.24 dBm (-.26 + 3.50 dB for tune up tolerance)
EIRP = 3.24 dBm = 2.11 mW

Minimum separation distance for SAR test exclusion (1g tissue) = (Pout * [√f(GHz)])/3
= (2.11*1.55)/3
= **1.09 mm**

RSS 102 :-

Frequency = 2402MHz
Output Power = 3.24 dBm (-.26 + 3.50 dB for tune up tolerance)
Antenna gain = 5.3 dBi
EIRP = 8.54 dBm = 7.14 mW

Minimum separation distance for SAR test Exclusion (1g tissue) **= 10mm** (based on table 1 of RSS 102)

Limit at 2402 MHz = 7.3 mW

Minimum separation distance for SAR test Exclusion (10g tissue) **< 5mm** (based on table 1 of RSS 102)

Limit at 2402 MHz = 10.7 mW

Summary:

Based on the calculation above, the EUT, when used in a portable application complies with SAR test exclusion requirement when used at a minimum separation distance of 10 mm.