



element

Steelcase, Inc.

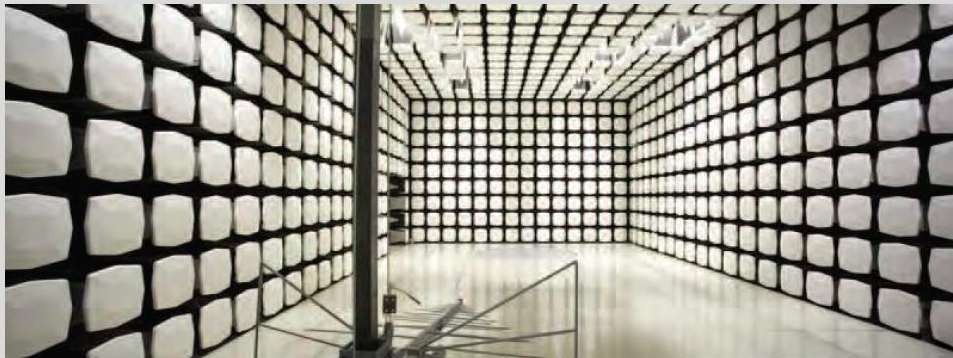
DeskWizard

FCC 1.1307:2022

802.11 b/g/n

Bluetooth Low Energy

Report: POLV0172 Rev.2, Issue Date: January 19, 2022



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CERTIFICATE OF EVALUATION

Last Date of Evaluation: January 19, 2022

Steelcase, Inc.

EUT: DeskWizard

RF Exposure Evaluation

Standards

Specification	Method
FCC 1.1307:2022	FCC 1.1307:2022

Results

Method Clause	Description	Applied	Results	Comments
(b)(3)(i)(B)	Exemption From RF Exposure Evaluation	Yes	Pass	

Deviations From Evaluation Standards

None

Approved By:



Donald Facteau, Process Architect

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing

REVISION HISTORY



Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		
01	Changed used distance to 0.5 cm. Completed evaluation at 0.5 cm distance	2021-12-10	1-3, 6, 8, 11
02	Updated assessment based upon duty cycle analysis information provided by client. Assessment BLE radio at 0.5 cm distance.	2022-01-19	1-3, 6, 8, 11
02	Updated date (year) of referenced standard	2022-01-19	1,2

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United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

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US0158	US0175	US0017	US0191	US0157



PRODUCT DESCRIPTION

Client and Equipment Under Evaluation Information

Company Name:	Steelcase, Inc.
Address:	901 44th St. SE
City, State, Zip:	Grand Rapids, MI 49508
Evaluation Requested By:	Nathan Thielman
EUT:	DeskWizard
Date of Evaluation:	January 19, 2022

Information Provided by the Party Requesting the Evaluation

Functional Description of the Equipment:

The DeskWizard is a desk reservation solution, using LEDs to illuminate whether a workspace is available or reserved. The device mounts to the work surface underside and receives power via USB (5 Vdc).

The device includes a combo Bluetooth Low Energy / 802.11 b/g/n (2.4 GHz) radio (FCC ID: 2AC7Z-ESP32WROVERE). The Bluetooth Low Energy radio is used only for setup of the device and it is anticipated that it will be located a minimum of 20 cm from the installer. The 802.11 b/g/n radio communicates with the customer's IoT to tell the device when to change status from available to occupied or vice versa. Normal operation of the radio is to 'ping' the customer's IoT every 5 minutes, otherwise it is in sleep mode until the IoT tells the device to change status.

The device is dimensioned approximately 3" x 1.9" x 1.7" and weighs 0.12 lbs.

Note: Only one radio can work at a time. The Bluetooth Low Energy and 802.11 b/g/n radios cannot operate simultaneously.

Objective:

To demonstrate compliance with FCC Requirements for RF exposure for 1.1307 RF exempt devices

The following duty cycle information was provided by Nathan Thielman, Senior Codes Consultant at Steelcase Inc.:

Duty Cycle Analysis for Device General Operation/Use (Wi-Fi):

Measurement Methodology:

The WireShark application was used to analyze the Antenna Duty Cycle under two captures that were determined as worst-case exposure conditions. The measurements were filtered to only capture transmissions from the DeskWizard under test. The DeskWizard operated in 802.11b mode while under test due to the highest transmission duty cycle compared to the other modes.

For the first capture, a DeskWizard continually performed an Over-The-Air (OTA) update over a duration of thirty (30) minutes to capture the worst-case Duty Cycle.

- OTA updates will be performed infrequently (less than once per month at a duration of 1- 2 minutes during off-peak hours at a customer facility i.e. no user is likely present).
- For testing purposes, a simulated OTA cycle operated for 30 minutes because it represented the highest worst-case volume of radio traffic and therefore the worst-case exposure condition possible.

PRODUCT DESCRIPTION

The second capture was of a normally operating DeskWizard device over a duration of sixty (60) minutes to capture the normal Duty Cycle.

- During normal operation, the DeskWizard sends out telemetry messages once every five minutes (duration <5ms) and otherwise maintains a ‘stand-by’ connection to the WiFi Access Point.
- A few times per day, the DeskWizard device will receive status changes from a backend application and respond with updated information. This instance duration is also <5ms with comparable radio traffic.

Results: WireShark calculated the transmission time for each packet by using the frame length and modulation. The Transmission (TX) Duty Cycle was calculated using the following formula:

$$TX \text{ Duty Cycle (\%)} = \frac{\text{Total TX Time (uS)}}{\text{Test Duration (uS)}} * 100$$

The results of the first capture of the DeskWizard continually performing OTA updates for thirty (30) minutes were summarized in the table below.

Test Duration (Microseconds)	Transmitted Packets	Average Packet Length (Bytes)	Total TX Time (Microseconds)	Calculated TX Duty Cycle (%)
1800000000	48758	140.301099	2941360	0.163408889

The results of the second capture of the DeskWizard operating normally for sixty (60) minutes was summarized in the table below.

Test Duration (Microseconds)	Transmitted Packets	Average Packet Length (Bytes)	Total TX Time (Microseconds)	Calculated TX Duty Cycle (%)
3600000000	1600	93.619375	846817	0.02352269

Duty Cycle Analysis for Device Setup (BLE):

Measurement Methodology:

The programming session (device setup) was monitored in zero span (time domain) using a spectrum analyzer with a nearfield probe to capture transmission activity. A threshold was applied to the data set to distinguish between transmissions on channel. The threshold was determined to be a transmission measured above -50 dBm. Transmissions measured above this threshold were captured as true transmissions and summed over the duration of the device’s programming session. Note each transmission event (pulse) lasted for 1 milli-second.

Because BLE uses 40 channels, it is assumed worst-case there are simultaneous transmissions across all channels. Therefore, the total on-time duration of a single channel during the programming session is multiplied by 40 to determine the total on-time during an observation period.

PRODUCT DESCRIPTION

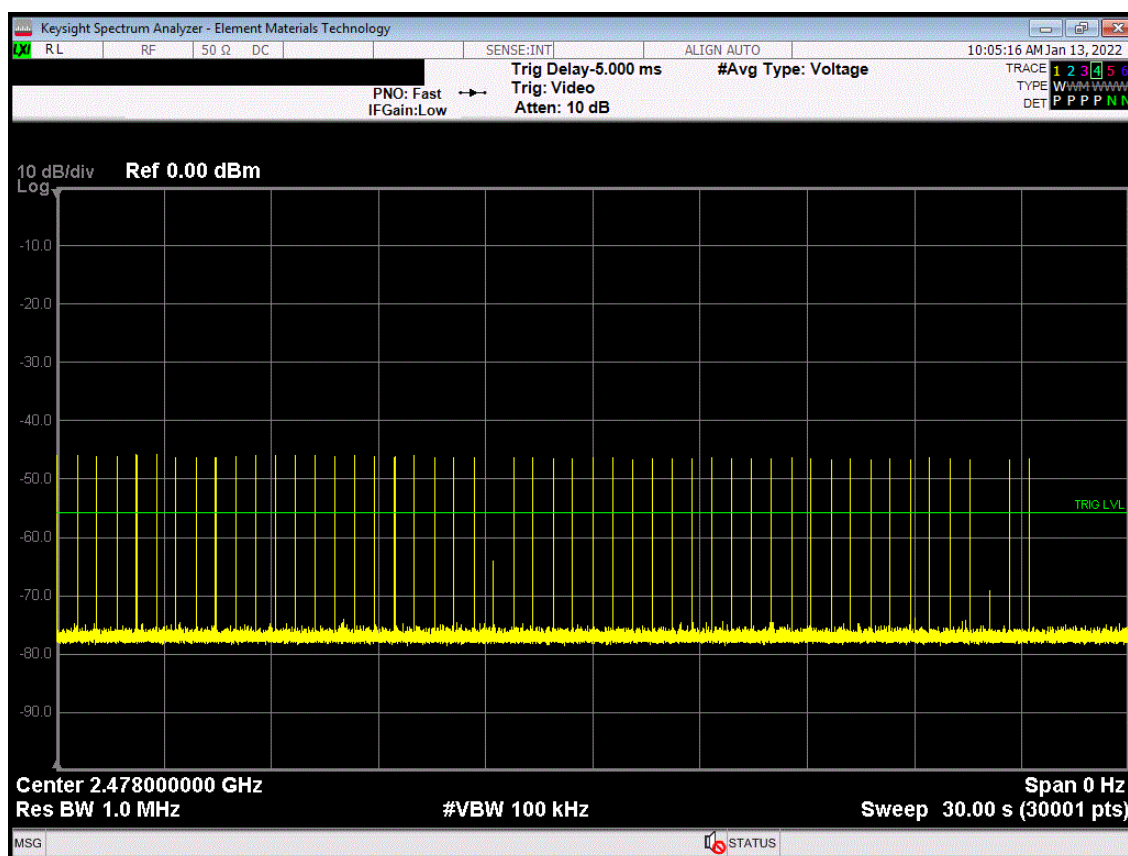
Results:

The total duty cycle over the observation period is calculated as follows:

Total Duty Cycle = # Pulses * Pulse Duration (1 ms) * Total Number of Channels (40) * (1 s/1000 ms)/Observation Period (s)

Number of Pulses observed	Total On-time (ms)	On-time across 40 channels (ms)	Observation Period (s)	Duty Cycle (%)
65	65	2600	1800 (30 min)	0.14
65	65	2600	360 (6 min)	0.72

Figure – Spectrum Analyzer Display Screen Capture, Illustrating Transmission Events (Pulses) During Programming Session:



RF Exposure Condition



The following RF Exposure conditions were used for the assessment documented in this report:	
Intended Use	Portable
Location on Body (if applicable)	Head/Torso
How is the Device Used	The DeskWizard can be used at a distance of less than 20 cm from the user.
Radios Contained in the Same Host Device	802.11 b/g/n Bluetooth Low Energy
Simultaneous Transmitting Radios	None
Body Worn Accessories	None
Environment	General Population/Uncontrolled Exposure

EXEMPTION FROM RF EXPOSURE EVALUATION

OVERVIEW

With respect to the limits on human exposure to RF emissions provided in 47 CFR §1.1310, if equipment can be shown to qualify for an exemption pursuant to 47 CFR §1.1307(b)(3), an evaluation is not required.

COMPLIANCE WITH FCC 1.1310

Per 1.1307(b)(3), (i) For single RF sources (*i.e.*, any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

- (A) 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) Or 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 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

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

Where

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

And

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

- (C) Or 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 TO §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	$19.2 R^2$.

EXEMPTION FROM RF EXPOSURE EVALUATION

(ii) For multiple RF sources: Multiple RF sources are exempt if:

- (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). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
- (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_m , 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).

$P_{m,i}$ = the exemption threshold power (P_m) 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 .

$ERP_{m,j}$ = 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

EXEMPTION FROM RF EXPOSURE EVALUATION

ASSESSMENT

The exemption from RF exposure evaluation is summarized in the following table(s):

Radio	Transmit Frequency (MHz)	Maximum Conducted Output Power	Duty Cycle	Antenna Assembly Gain (dBi)	Minimum Separation Distance (cm)	Calculated Radiated Exposure Power (mW) ERP	Calculated Conducted Exposure Power (mW)	Limit (mW)	Compliant
BTLE	2480	7 dBm	0.72%	3.4	0.5	0.05	0.04	2.73	Yes

The information in the table above was obtained from:

The rated value was used in these calculations. Customer provided information and Bay Area Compliance Laboratories report # RSHD2000116001-00A were used.

Radio	Transmit Frequency (MHz)	Maximum Conducted Output Power	Duty Cycle	Antenna Assembly Gain (dBi)	Minimum Separation Distance (cm)	Calculated Radiated Exposure Power (mW) ERP	Calculated Conducted Exposure Power (mW)	Limit (mW)	Compliant
802.11 b/g/n	2412	27 dBm	0.2%	3.4	0.5	1.1	0.8	2.73	Yes

The information in the table above was obtained from:

The rated value was used in these calculations. Customer provided information and Bay Area Compliance Laboratories report # RSHD2000116001-00A were used.

End of Test Report