# Fastenal Company
# RF Exposure Exhibit

**SCOPE OF WORK**
EMC TESTING – RFID Reader, Model Tested: 922194627

**REPORT NUMBER**
104468298MPK-012

**ISSUE DATE**
February 25, 2021

PAGES
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Non-Specific Radio Report Shell Rev. December 2017 MPK


# RF Exposure Exhibit
## (mobile devices)

**Report Number: 104468298MPK-012**
**Project Number: G104468298**

**Issue Date: February 25, 2021**

**Product Designation: RFID Reader**
**Model Tested: 922194627**

**FCC ID: 2APK7-922194627V10**
**IC: 23979-92219462710**

**to**

**47CFR 2.1091**
**RSS-102 Issue 5**

**for**

**Fastenal Company**


**Tested by:**
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**Client:**
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| Report No. 104468298MPK-012 | |
|---|---|
| **Equipment Under Test:** | RFID Reader |
| **Trade Name:** | Fastenal Company |
| **Model(s) Tested**: | 922194627 |
| **Applicant:** | Fastenal Company |
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| **Applicable Regulation:** | 47CFR 2.1091<br>RSS-102 Issue 5 |

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## 1.0 RF Exposure Summary

| Test | Reference FCC | Reference Industry Canada | Result |
|---|---|---|---|
| **Radio frequency Radiation Exposure Evaluation** | 47 CFR§2.1091 | RSS-102 Issue 5 | Complies |

## 2.0 RF Exposure Limits

In this document, we evaluate the RF Exposure to human body due the intentional transmission from the transmitter (EUT). The limits for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and RSS-102 are followed.

### 2.1 FCC Limits

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density ($mW/cm^2$) | Average Time (minutes) |
|---|---|---|---|---|
| **(A)Limits For Occupational / Control 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 |
| 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 density

### 2.2 Industry Canada Limits

According to RSS-102, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline, Safety Code 6.

**Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)**

| Frequency Range (MHz) | Electric Field (V/m rms) | Magnetic Field (A/m rms) | Power Density ($W/m^2$) | Reference Period (minutes) |
|---|---|---|---|---|
| 0.003-10 | 83 | 90 | - | Instantaneous* |
| 0.1-10 | - | 0.73/ ƒ | - | 6** |
| 1.1-10 | $87/ ƒ^{0.5}$ | - | - | 6** |
| 10-20 | 27.46 | 0.0728 | -2 | 6 |
| 20-48 | $58.07/ ƒ^{0.25}$ | $0.1540/ ƒ^{0.25}$ | 8.944/ ƒ0.5 | 6 |
| 48-300 | 22.06 | 0.05852 | 1.291 | 6 |
| 300-6000 | $3.142 ƒ^{0.3417}$ | $0.008335 ƒ^{0.3417}$ | $0.02619 ƒ^{0.6834}$ | 6 |
| 6000-15000 | 61.4 | 0.163 | 10 | 6 |
| 15000-150000 | 61.4 | 0.163 | 10 | $616000/ ƒ^{1.2}$ |
| 150000-300000 | $0.158 ƒ^{0.5}$ | $4.21 \times 10\text{-}4 ƒ^{0.5}$ | $6.67 \times 10^{-5} ƒ$ | $616000/ƒ^{1.2}$ |

Note: ƒ is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

## 3.0 Test Results (Mobile Configuration)

### 3.1 Classification

Radio is installed inside a mobile host device. The antenna of the product, under normal use condition, is at least 20 cm away from the body of the user and accessible to the end user. Warning statement to the user for keeping at least 20 cm or more separation distance with the antenna should be included in user's manual.

### 3.2 EIRP calculations

The RFID Reader, Model: 922194627 consists of one LoRa radio and one RFID radio.

### 3.3 Maximum RF Power

**RFID Reader, Model: 922194627 :**

| Frequency Range (MHz) | Max Output Power (dBm) | Antenna Gain[1] (dBi) | EIRP (dBm) | Note |
|---|---|---|---|---|
| 923.3 – 927.5 (Lora) | 18.21 | 5.1 | 23.31 | Output power was taken from report # 104468298MPK-003 |

| Frequency Range (MHz) | Max Output Power (dBm) | Antenna Gain[1] (dBi) | EIRP (dBm) | Note |
|---|---|---|---|---|
| 902.7 – 927.2 (RFID) | 12.32 | 5.5 | 17.82 | Output power was taken from report # 104468298MPK-004 |

[1]As declared by the manufacturer.

### 3.4 RF Exposure Calculation

#### 3.4.1 RF Exposure calculation for LoRa, RFID Reader, Model: 922194627 :

| Frequency Range (MHz) | EIRP (dBm) | EIRP (mW) | Power Density (W/m2) @20 cm | RSS Limit (W/m2) | Results |
|---|---|---|---|---|---|
| 923.3 - 927.5 | 23.31 | 214.289 | 0.4263 | 2.784 | Complies |

| Frequency Range (MHz) | EIRP (dBm) | EIRP (mW) | Power Density (mW/cm2) @20 cm | FCC Limit (mW/cm2) | Results |
|---|---|---|---|---|---|
| 923.3 - 927.5 | 23.31 | 214.289 | 0.0426 | 0.616 | Complies |

3.4.2 RF Exposure calculation for RFID, **RFID Reader, Model: 922194627 :**

| Frequency Range (MHz) | EIRP (dBm) | EIRP (mW) | Power Density (W/m2) @20 cm | RSS Limit (W/m2) | Results |
|---|---|---|---|---|---|
| 902.7 – 927.2 | 17.82 | 60.534 | 0.1204 | 2.741 | Complies |

| Frequency Range (MHz) | EIRP (dBm) | EIRP (mW) | Power Density (mW/cm2) @20 cm | FCC Limit (mW/cm2) | Results |
|---|---|---|---|---|---|
| 902.7 – 927.2 | 17.82 | 60.534 | 0.0120 | 0.602 | Complies |

3.4.3 RF Exposure calculation for simultaneous operation:

| Band | Max Output Power (dBm) | Antenna Gain (dBi) | EIRP (dBm) | # of simultaneous Channels ON | Total EIRP | |
|---|---|---|---|---|---|---|
| | | | | | W | dBm |
| 923.3 – 927.5 | 18.21 | 5.1 | 23.31 | 1 | 0.214 | 23.31 |
| 902.7 – 927.2 | 12.32 | 5.5 | 17.82 | 1 | 0.061 | 17.82 |
| | | | Totals: | 2 | 0.275 | 24.39 |

The highest simultaneous power measured power is +24.39dBm or 0.275W.

For FCC, Power Density = 0.055 mW/ cm^2, which is below the worst-case FCC limit of 0.602mWatts/ cm^2.

For ISED, Power Density = 0.55 W/ m^2, which is below the worst-case RSS limit of 2.741Watts/ m^2.

**Power Density Calculation**

The Power Density can be calculated using the formula

$$S = EIRP/ 4\pi D^2$$

Where: S is Power Density in $mW/cm^2$
D is the distance from the antenna in cm.

**4.0 Document History**

| Revision/ Job Number | Writer Initials | Reviewers Initials | Date | Change |
|---|---|---|---|---|
| 1.0/ G104468298 | AC | KV | February 25, 2021 | Original document |