RF Exposure Exhibit

EUT Name: Controller

Model No.: FAST-60-601-000002 FCC ID: 2APK7-9705079V1-0; IC: 23979-9705079V10

CFR 47 Part 15.247 and Part 15.407

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Contents

1 Test Methodology

In this document, we evaluate the RF Exposure to human body due the intentional transmission from the transmitter (EUT). The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

1.1 RF Exposure Limit

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				
300 - 1500	…	…	F/300	6
1500 - 100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300 - 1500	…	…	F/1500	6
1500 - 100,000	…	…	1.0	30

F = Frequency in MHz

1.2 EUT Operating Condition

Fastenal Company supplied the following description of the EUT:

Device that receives LoRa messages from in-range Repeaters, Readers, and BLE Bins. Messages received by the Controller will be forwarded to the Fastenal Store after filtering out all redundant information.

Method of forwarding data is by Ethernet, WiFi, or Cellular connections.

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually. Software provided enables to transmit on multi channels simultaneously.

1.2.1 Classification

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

1.3 Test Results

1.3.1 Antenna Gain

Device uses LORA Technology

Type of transmission Digital Transmission System (DTS)

Rated RF Output 17.67 dBm

Antenna(s) & Gain PCB Antenna, Gain: 5.1 dBi, see test report 103436674MPK-002, page 6

Frequency Range 923.3 – 927.5 MHz (Tx); 903 – 914.2 MHz (Rx)

Type of modulation LoRa® Technology

Data rate 1760 bps

Number of Channel(s) 16 Total (8 Tx and 8 Rx)

1.3.2 Mobile Configuration

Calculations for this report are based on highest power measured for each band.

Band	Mode	Max Output Power dBm	Antenna gain (Max)	EIRP/ERP		# of simultaneous Channels ON	Total EIRP	
				dBm	W		W	dBm
903 – 927.5MHz	LORa	17.67	5.1	22.77	0.186	1	0.186	22.7
LTE band 2 LTE band 3 LTE band 4 LTE band 5 LTE band 7 LTE band 17	LTE	24.00	3.0	27.00	0.500	1	0.500	27.0
2402-2480MHz	BLE		-0.5	0	0.001	1	0.530	27.21
2412-2462MHz	Wi-Fi	24.21	3.0	27.21	0.530			
					Totals:	2 *	**0.716**	**28.55**

* Note: As per manufacturer LORA is always ON, device Transmits only on LTE or Wi-Fi at any time not on both simultaneously.

Blue tooth is not included in the calculation, due to very low power.

Calculating the Power Density at 20cm

The highest simultaneous power measured power is +28.55dBm or 0.716W.

Using the Friss transmission formula, the EIRP is Pout*G, and R is 20cm.

Pd= EIRP/(1600π)

Pd = (716) / (1600π) = 0.142 mW/ cm^2, which is below the limit. Limit is 1.0mWatts/ cm^2

The device complies with mobile device requirements of Power density limit of 1.0mWatts/ cm^2 at 20cm.

1.3.3 Sample Calculation

The Friss transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in mW/cm^2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).