FAST Bin User Manual

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Trademark Information

Fastenal is a registered trademark of Fastenal Company. FAST Bin is a service mark of Fastenal Company. All other trade names mentioned in this manual are the trademarks or registered trademarks of their respective holders.

Support Information

These units are manufactured, owned, installed, maintained, and operated by:
Fastenal Company
2001 Theurer Blvd
Winona, Minnesota 55987 USA

Support (toll free): +1 866-829-1564

CAUTION: Qualified Fastenal support staff are required to install and maintain the FAST Bin℠ system. Unauthorized installation, changes, or maintenance by non-Fastenal personnel can result in the system not working as intended and could void the user's authority to operate the equipment. Please contact Fastenal at the toll-free number listed above if you need assistance or have questions regarding the FAST Bin system.

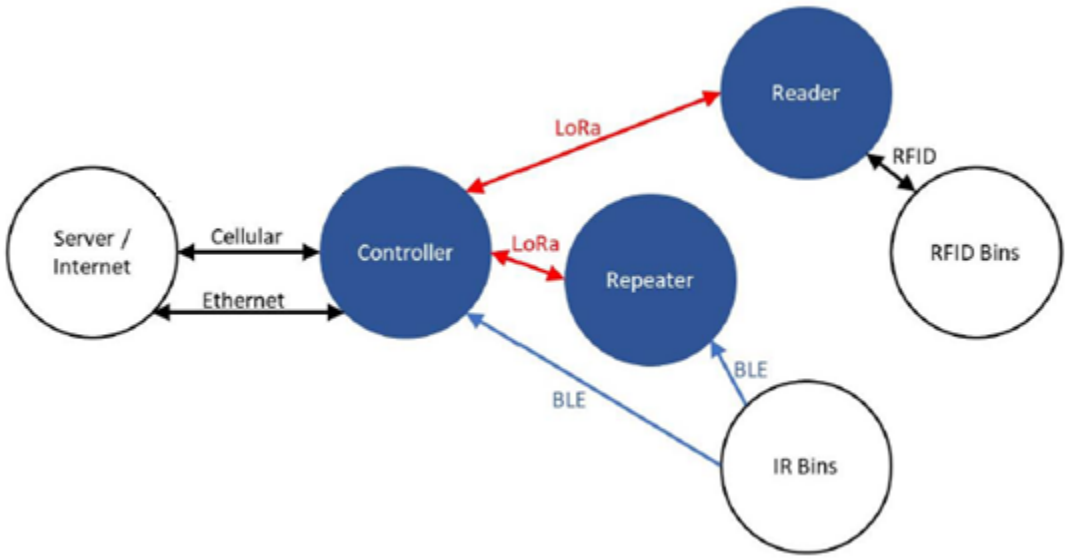
System Description

This document describes the Fastenal® FAST Bin℠ system, which enables remote monitoring of inventory by means of sensing and communication technologies to report the state of the inventory to a central Fastenal server.

The FAST Bin system consists of the five devices that are used to create two different types of installations: Infrared (IR) Bins and Radio Frequency Identification (RFID) Bins. The devices include IR Bins, RFID Bins, Controllers, Readers, and Repeaters.

The IR system uses IR Bins, Controller(s) and Repeater(s) to communicate information, while the RFID system uses RFID Bins, Controller(s), and a Reader.

Each device uses one or more communication technologies to transfer the information, as shown below:



FAST Bin Communication

The communication technologies are as follows:

- Ethernet: A standard technology used to connect digital devices on a network using a wired connection
- Long Range Radio (LoRa): A protocol that provides low power, wide area communication between remote sensors & gateways connected to a network
- Cellular: A network technology that enables mobile device communication via cells and transceivers
- Bluetooth Low Energy (BLE): A power-conserving variant of Bluetooth technology, which provides short-range wireless interconnection of digital devices

System Operation

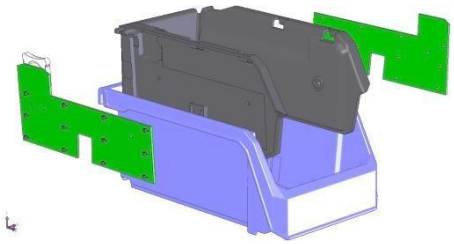
The FAST Bin system automates the current manual method of checking inventory that is stored in Fastenal standard Bin systems as shown below :

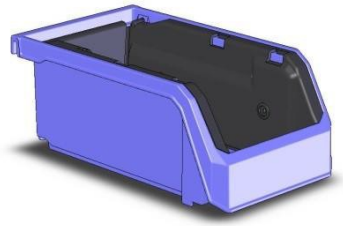
Standard Fastenal Bin Systems

The following subsections describe how each of the FAST Bin devices work.

Infrared (IR) Bins

The IR Bins consist of a standard Bin plus two printed circuit boards (PCBs) that sit opposite each other inside the Bin; the PCBs are protected by a plastic insert as shown below:





Infrared (IR) Bin

- There is an array of LED IR emitters on one PCB and corresponding IR sensors on the opposite PCB.
- Obstruction of an IR beam equates to the presence of inventory at that point inside the bin.
- The obstructed or unobstructed state, as detected by the sensors, is transmitted to the Controller by means of Bluetooth Low Energy (BLE), and the data for each Bin is then transmitted to the Fastenal Server via the Internet.

- Multiple IR Bins communicate via BLE directly with a single Controller. If distance or obstructions are an issue, a Repeater can be used. In this case, the IR Bins communicate via BLE with the Repeater, which in turn communicates via Long Range Radio (LoRa) with the Controller.

Radio Frequency Identification (RFID) Bins

- RFID Bins are standard Bins with RFID tags applied (as shown below). When a Bin has been emptied of its contents, it is manually placed in the replenishment area of the RFID enclosure.
- The Reader, which is located in the enclosure's subfloor, registers the presence of the RFID tag on the Bin. The Reader then transmits the tag ID to the Controller via LoRa, and the data is then transmitted to the Fastenal Server via the Internet.

Bin with Radio Frequency Identification (RFID) tag

RFID Bins in Standard Rivet Rack

Reader

The Reader reads Bins with RFID tags and sends the information to the Controller via a LoRa connection. See the Radio Frequency Identification (RFID) Bins section for more information on the location of the Reader.

Controller

The Controller is a communication hub for the overall FAST Bin system and uses several different data streams to communicate with the other FAST Bin devices.

FAST Bin Controller

Repeater

The Repeater is used when it is necessary to increase the range of the BLE transmitters. BLE messages are received by the BLE Module. The Repeater then relays the message delivered to the Controller using LoRa communications.

Indicator Lights

The following sections define the indicator lights located on each device.
For the controller, repeater, and RFID repeater a blink of all green LEDs in a pattern indicates that the device is being updated.

Controller

LED	Color	State
BLE	Green	• Solid: At least one IR Bin is being actively monitored • Off: No IR Bins are being actively monitored
LoRa	Green	• Solid: At least one Repeater or RFID Reader is being actively monitored. • Off: No Repeater or RFID Reader is being monitored.
Internet	Red	• Solid: There is no network connection to the controller via Ethernet or Cellular radio.
	Yellow	• Solid: Ethernet port has a local network connection, but there is no connection to the Internet.
	Green	• Solid: Either the Ethernet port or an installed cellular radio adapter has a good internet connection.

Repeater

LED	Color	State
BLE	Green	• Solid: At least one IR Bin is being actively monitored • Off: No IR Bins are being actively monitored
LoRa	Green	• Solid: LorA Link to a Controller has been established. • Off: No LoRa link to a Controller has been established.
Power	Green	• Solid: Powered on but locked up • Heartbeat: Powered on and running • Off: No power

Reader

LED	Color	State
LoRa	Green	• Solid: LoRa link to a Controller has been established. • Off: No LoRa link to a controller has been established.

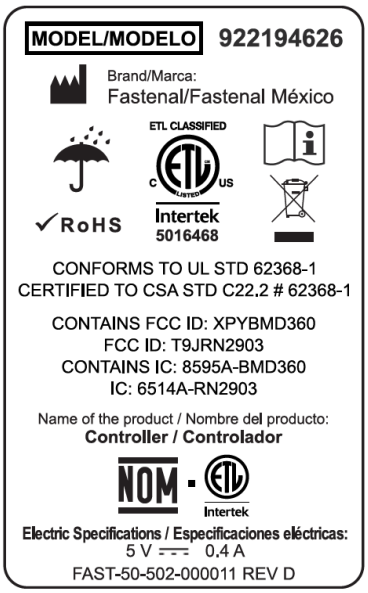
LED	Color	State
Power	Green	• Solid: Powered on but locked up • Heartbeat: Powered on and running • Off: No power
New Tag	Green	• Solid: A new tag has been read at 25 times • Off: No new tags within the last five seconds

Device Labels [Controller and Reader]

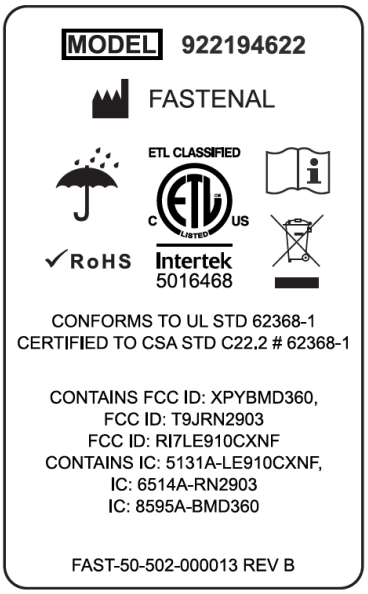
The following images define the labels for the Controller, Repeater, and Reader.

Controller Label

The label for the Controller is shown below; this label is located on the bottom of the device:



Basic Controller



Controller
(with cellular data interface)

Reader Label

The label for the Reader is shown in figure below:

Reader Label

The label is located on the RFID enclosure as shown with the red circle in Figure 11:

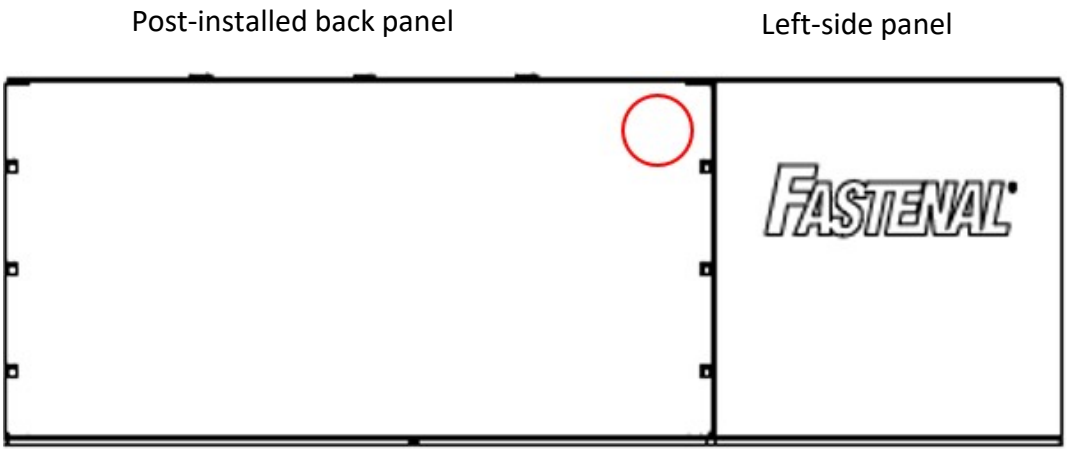


Figure 11. Reader Label Location

Installation Instructions

The following instructions define how to install the FAST Bin devices. Qualified Fastenal support staff are required to install the FAST Bin system.

The Controller, Repeater, and Reader devices are powered on when plugged in (i.e., there is no on/Off switch on the devices).

It is recommended that the Readers/RFID Bins, Repeaters, and/or racks of IR Bins be installed before choosing the Controller location. This will allow optimal placement of the Controller based on the range requirements of the other devices. See *Physical Placement Guidelines* in Appendix A for more information on placing the devices.

The following table summarizes the maximum distances between each device.

From	To	Range
Controller	Reader	500 ft (152.4 m)
Controller	Repeater	500 ft (152.4 m)
Controller	IR Bin 2nd Gen	50 ft (15.2 m)
Repeater	IR Bin 2nd Gen	50 ft (15.2 m)

IR Bins

1. Remove the battery insulation pull tab.
2. Ensure that the placement of the Bin is within 50 feet (15.2 meters) of nearest Controller or Repeater.

RFID Enclosure

1. Assemble the RFID enclosure per assembly instructions provided with the enclosure.
2. Place the enclosure on top of the Bin rack and plug in the power cable.
3. Ensure that the enclosure placement is within 500 feet (152.4 meters) of the nearest Controller.
4. Ensure that the communications diagnostic light on the front of the enclosure is lit up showing a connected state.

Repeater

1. Install the Repeater using the guidelines in Appendix A.
2. Ensure the Repeater is within 500 feet (152.4 meters) of the Controller.
3. Plug in the power cable to a standard wall power outlet.
4. Ensure that the LEDs are showing that the device is in a connected state.

Controller

1. Configure the device:
    a. If the site uses DHCP Ethernet, then no special network setup is required.
    b. If the site requires use of a static IP address, contact Fastenal support to configure the network settings.
2. Plug in the power cable to a standard wall power outlet.
3. Ensure that the controller has a network connection and is plugged in via the network connection LED indicator.
4. Ensure that no Reader or Repeater is more than 500 feet (152.4 meters) from the Controller and that the LEDs are showing that all devices are in a connected state.

Technical Specifications [Controller and Reader]

Controller

Regulatory Numbers – Basic Controller	FCC ID: 2APK7-922194626V10 IC ID: 23979-922194626V10
Regulatory Numbers – Controller with cellular data interface	FCC ID: 2APK7-922194622V10 IC ID: 23979-922194622V10
Dimensions	5.556” W x 4.862” L x 2.0” H (14.11 cm W x 12.35 cm L x 5.08 cm H)
Weight	0.71 lbs. (0.322 kg)
Power	5.0 VDC +/-10%, 1.2A max input
Operating Temperature	60.8° to 89.6° F (16° to 32° C)
Operating Humidity	20% to 80%
External Ports & Connections	Ethernet, Power
Supported Protocols & Regulatory Identification Numbers	LoRa: 903-914.2 MHz (12500 bps max) FCC ID: T9JRN2903 IC ID: 6514A-RN2903 BLE: FCC ID: XPYBMD360 IC ID: 8595A-BMD360
Supported Antennas	• LoRa: Flat Patch RF Antenna (Yageo ANTX100P001BWPEN3) • BLE: Integrated trace antenna in BLE module • 4G LTE (with optional cellular module installed): Taoglas, Ltd. TG.30.8113

Reader

Regulatory Identifications Numbers	FCC ID: 2APK7-992194627V10 IC ID: 23979-992194627V10
Dimensions of RFID enclosure (in which Reader is housed)	48” W x 18” H x 24” H (121.92 cm W x 45.72 cm L x 60.96 cm H)
Power	5.0 VDC+/-10%, 0.4 A max input
Operating Temperature	60.8° to 89.6° F (16° to 32° C)
Operating Humidity	20% to 80%
External Ports & Connections	Power
Supported Protocols & Regulatory Identification Numbers	LoRa: 903-914.2 MHz (12500 bps max) FCC ID: T9JRN2903 IC ID: 6514A-RN2903
Supported Antennas	LoRa: Flat Patch RF Antenna (Yageo ANTX100P001BWPEN3) RFID: Two (2) Patch Antennas (Abracon ARRG-0004)

Compliance Information

The following compliance information applies to the Controller, Reader, and Repeater devices.

FCC Compliance Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian (IC) Statement of Compliance

This device complies with RSS-247 of the Industry Canada rules. Operation is subject to two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.

Cet appareil est conforme à la norme RSS-247 des règles d'Industrie Canada. Le fonctionnement est soumis à deux conditions: (1) Cet appareil ne doit pas causer d'interférences nuisibles, et (2) cet appareil doit accepter toute interférence qui pourrait être reçue ou qui pourrait causer un fonctionnement indésirable.

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

ISED Compliance Statement

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1) L'appareil ne doit pas produire de brouillage;

2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Appendix A: Physical Placement Guidelines

Controller Placement

Placing the Controller in an optimal location ensures that the Controller will have a much better signal with far less interference. It may be necessary in large facilities to install multiple controllers. The following guidelines can be used to help place the Controller in an optimal location.

NOTE: The Controller and Repeater are designed to sit on a shelf or other surface to allow for access to the regulatory information on the device label (which is located on the bottom of each device).

1. Centralize the Controller: Make sure you place the Controller in the middle of all the devices (i.e., Readers and Repeaters) that are being used. The signal strength from the Controller is somewhat based on the distance. A central position can allow even distribution to all the devices.
2. Controller Placement: Try to place the Controller as high as possible in the room, so the signal gets dispersed throughout the facility.
3. Minimize Number and Angle of Walls: Keep the number of walls and ceilings between the Controller and the Reader/Repeater devices to a minimum. Always imagine a direct line of sight between the Controller and Reader/Repeater devices. Position devices so that the signal will travel straight through a wall or ceiling (instead of at an angle) for better reception.
4. Wall Building Materials: Consider the type of building material through which the signal must travel. Drywall or open doorways are good choices. Materials and objects such as walls with insulation, glass, brick, concrete, steel, metal, water, or mirrors can degrade signal strength. Also, do not place the Controller inside a cabinet or a storage area/space.
5. Avoid Other Wireless Devices: Place appliances, such as cordless telephones, microwaves, Wi-Fi routers, and televisions, as far away as possible from the Controller (at least 3 to 6 feet (1 to 2 meters)). This will significantly reduce any interference that theses appliances may cause.

Repeater and RFID Enclosure/Reader Physical Placement

1. IR Bin Placement:
    - Envision each IR bin as being at the center of a large circle with a 25-foot radius. At least one Repeater, or a Controller should be within the edge of that circle.
    - It is important that no IR Bin be more than 25 feet (7.62 meters) from a

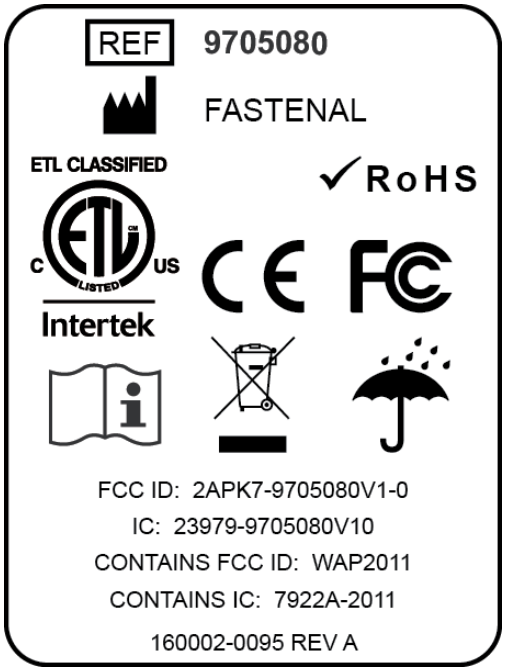
Controller or repeater**.** Then install each Repeater within this distance from all bins it must support using the same guidelines as defined for the Controller Placement.

2. RFID Bin Placement: Placing the RFID enclosure/Reader is constrained only by the requirement that it cannot be more than 500 feet (152.4 meters) from the Controller.

Device Labels [Repeater]

Repeater Label

The label for the Repeater is shown; the label is located on the bottom of the device.



Repeater Label

Technical Specifications [Repeater]

Repeater

Regulatory Identifications Numbers	FCC ID: 2APK7-9705080V1-0 IC ID: 23979-9705080V10
Dimensions	3.839” W x 3.352” L x 1.5” H (9.75 cm W x 8.51 cm L x 3.81 cm H)
Weight	0.33 lbs.
Power	5.0 VDC+/-10%, 0.4 A max input
Operating Temperature	60.8° to 89.6° F (16° to 32° C)
Operating Humidity	20% to 80%
External Ports & Connections	Power
Supported Protocols & Regulatory Identification Numbers	LoRa: 903-914.2 MHz (12500 bps max) FCC ID: T9JRN2903 IC ID: 6514A-RN2903 BLE: FCC ID: XPYBMD360 IC ID: 8595A-BMD360
Supported Antennas	LoRa: Flat Patch RF Antenna (Yageo ANTX100P001BWPEN3) BLE: Integrated trace antenna in BLE module

Repeater