FAST Bin℠ User Manual

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FAST Bin℠ User Manual

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 which is enclosed in the RFID enclosure.

Each device uses one or more communication technologies to transfer the information, as shown in Figure 1:

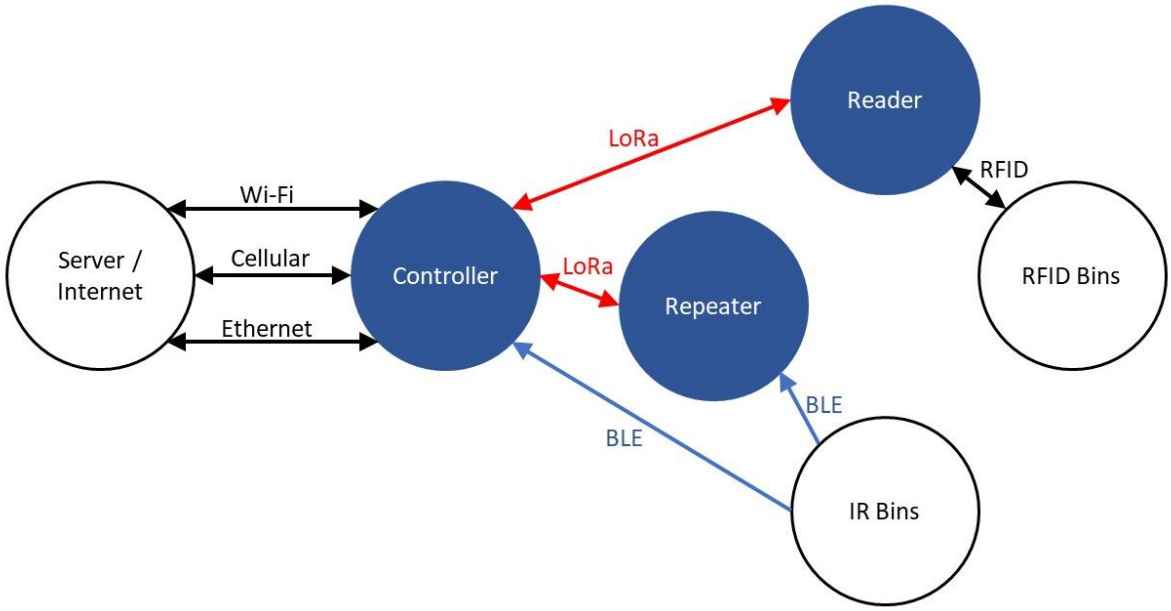

Figure 1. FAST Bin Communication Technologies

The communication technologies are as follows:

- Wi-Fi: Standard technology used to connect digital devices to each other and to the Internet
- Cellular: A network technology that enables mobile device communication via cells and transceivers

- 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 and gateways connected to a network
- 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 in Figure 2:

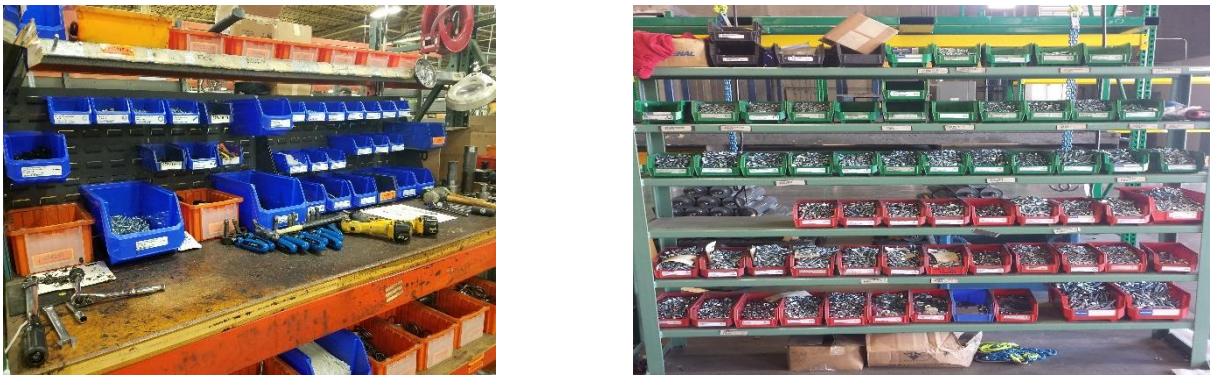

Figure 2. Standard Fastenal Bin Systems

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 in Figure 3:

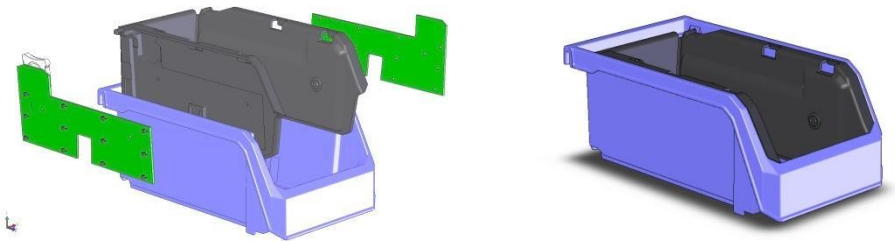

Figure 3. Infrared (IR) Bin

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 in Figure 4). 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. A typical RFID enclosure is shown in Figure 5.

Figure 4. Bin with Radio Frequency Identification (RFID) tag

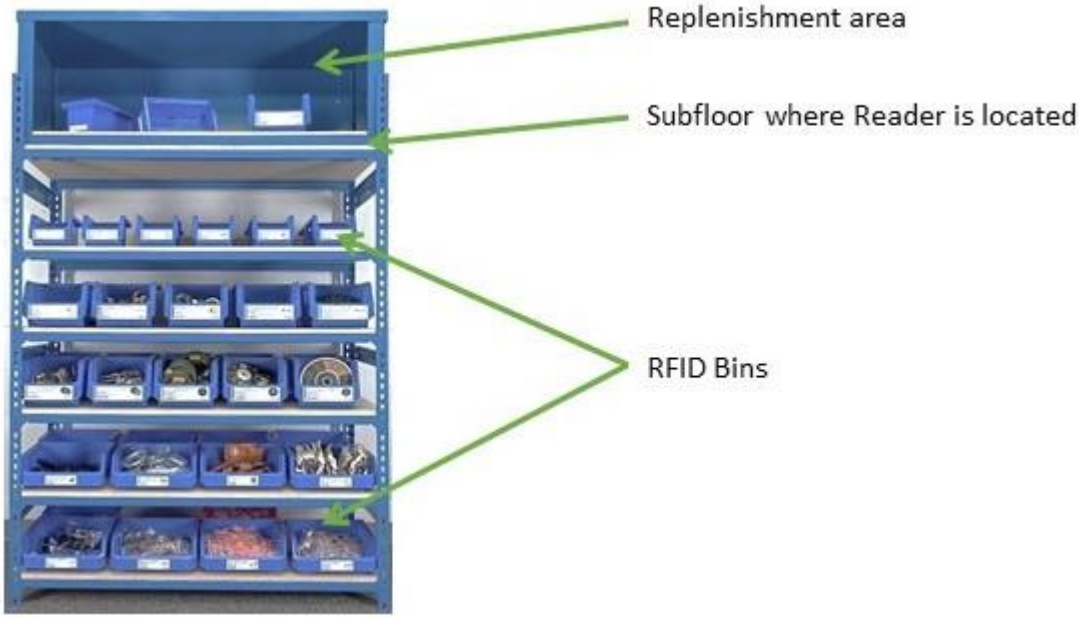

Figure 5. RFID Bins in Standard Rivet Rack

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, which is shown in Figure 6, is a communication hub for the overall FAST Bin system and uses several different data streams to communicate with the other FAST Bin devices. The only concurrent transmissions possible are LoRa with either Ethernet, Wi-Fi, or Cellular communications as the firmware does not allow other interactions.

The Controller uses the following technologies to communicate with the other FAST Bin devices:

- Wi-Fi
- Cellular Modem
- Ethernet
- LoRa
- BLE

Figure 6. FAST Bin Controller

Repeater

The Repeater, which is shown Figure 7, 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.

Figure 7. FAST Bin Repeater

Indicator Lights

The following sections define the indicator lights located on each device.

For all the devices, a blink of all green LEDs in a pattern indicates that the device is being updated.

Controller

LED	Color	State
BLE	Green	• Solid: BLE connections are good • Off: No BLE connections
LoRa	Green	• Solid: LoRa connections are good • Off: No LoRa connections
Internet	Red	• Solid: Unable to connect to Wi-Fi, Ethernet, or Cellular
	Yellow	• Solid: weak Wi-Fi/Cellular strength • Blink 1: No connection to host server • Blink 2: Authentication failure
	Green	• OK/Good • Light should not be off if device is powered on

Repeater

LED	Color	State
BLE	Green	• Solid: BLE connections are good • Off: No BLE connections
LoRa	Green	• Solid: LoRa connections are good • Off: No LoRa connections
Power	Green	• Solid: Powered on but locked up • Heartbeat: Powered on and running • Off: No power

Reader

LED	Color	State
LoRa	Green	• Solid: LoRa connections are good • Off: No LoRa connections

LED	Color	State
Power	Green	• Solid: Powered on but locked up • Heartbeat: Powered on and running • Off: No power
New Tag	Green	• Solid: New tag read X times in Y seconds • Off: No new tags

Device Labels

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

Controller Label

The label for the Controller is shown in Figure 8; this label is located on the bottom of the device:

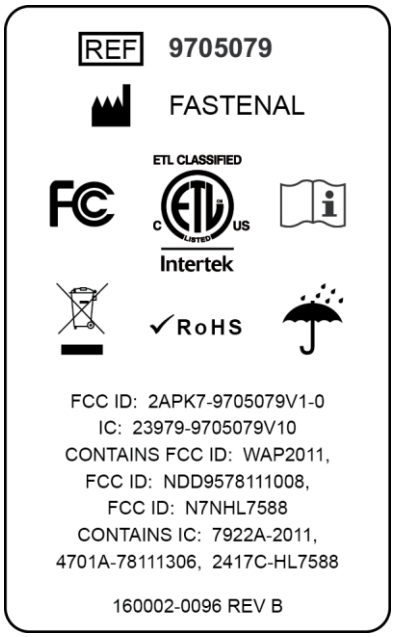

Figure 8. Controller Label

Repeater Label

The label for the Repeater is shown in Figure 9; this label is located on the bottom of the device:

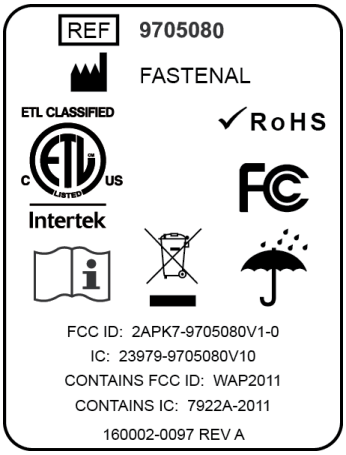

Figure 9. Repeater Label

Reader Label

The label for the Reader is shown in Figure 10:

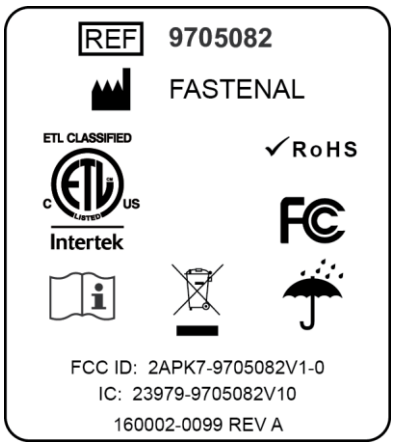

Figure 10. Reader Label

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

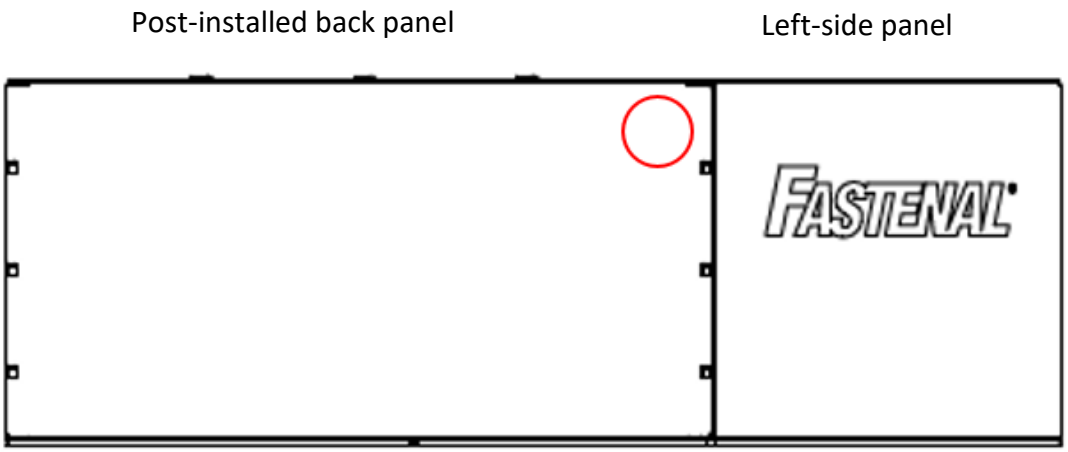

Figure 11. Reader Label Location

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.

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). This note applies only to these two devices, as the Reader can only be located in the RFID enclosure as shown in Figure 5 (see Figure 11 for location of the Reader's device label).

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	80 ft (24.38 m)
Repeater	IR Bin	80 ft (24.38 m)

IR Bins

1. Remove the battery insulation pull tab.
2. Ensure that the placement of the Bin is within 80 feet (24.38 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 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 Wi-Fi or a static IP address, contact Fastenal support to configure the network settings.
    c. If the site requires a cellular connection, contact Fastenal support to install a cell modem and SIM card.
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

Model Number	9705079
Regulatory Identifications Numbers	FCC ID: 2APK7-9705079V1-0 IC ID: 23979-9705079V10
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, 3.0 A 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 Wi-Fi: FCC ID: T9JRN2903 IC ID: 4701A-78111306 Cellular: FCC ID: N7NHL7588 IC ID: 2417C-HL7588 BLE: FCC ID: WAP2011 IC ID: 7922A-2011
Supported Antennas	LoRa: Flat Patch RF Antenna (Yageo ANTX100P001BWPEN3) Wi-Fi: Internal chip antenna Cellular: Taoglas TG.30.8113 BLE: Integrated trace antenna in BLE module

Repeater

Model Number	9705080
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 (.149 kg)
Power	5.0 VDC, 3.0 A 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: WAP2011 IC ID: 7922A-2011
Supported Antennas	LoRa: Flat Patch RF Antenna (Yageo ANTX100P001BWPEN3) BLE: Integrated trace antenna in BLE module

Reader

Model Number	9705082
Regulatory Identifications Numbers	FCC ID: 2APK7-9705082V1-0 IC ID: 23979-9705082V10
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)
Weight of RFID enclosure (in which Reader is housed)	72 lbs (32.66 kg)
Power	5.0 VDC, 3.0 A 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 ARRUN5-915.000MHz)

Power Supply

Manufacturer	CUI, Incorporated
Model Number	SDI18-5-UDC-P254-C1
Input Voltage	90 to 264 VAC
Output Voltage/Output Current	5.0 VDC, 3.0 A maximum

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.

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.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and all persons.

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). This note applies only to these two devices, as the Reader can only be located in the RFID enclosure as shown in Figure 5 (see Figure 11 for location of the Reader's device label).

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

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). This note applies only to these two devices, as the Reader can only be located in the RFID enclosure as shown in Figure 5 (see Figure 11 for location of the Reader's device label).

1. IR Bin Placement: First, make sure that the IR Bin rack setup is no more than 160 feet (48.7 meters) across in its longest direction. A good way to determine this distance is to picture the Bin setup inside of a large circle – the radius of the circle should be less than 80 feet (24.38 meters). It is important that no IR Bin be more than 80 feet (24.38 meters) from a Controller or repeater**.** Then install the Repeater near the Bins 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.