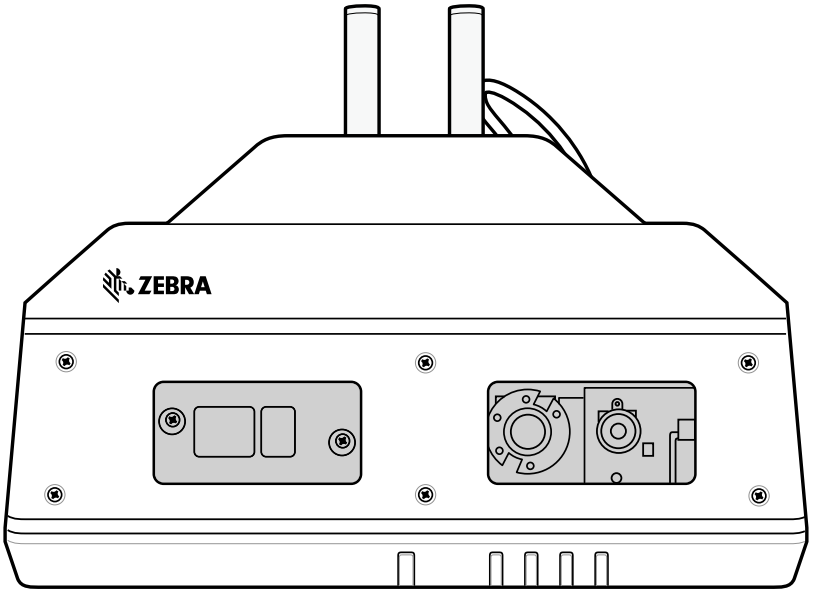
TM2000
Load Monitoring Unit



Installation Guide

ZEBRA

MN-003280-08EN Rev. A

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Publication Date

December 13, 2021

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About

Introduction

This guide provides information about installing the Zebra TM2000 LMU (Load Monitoring Unit) and accessories for trailer and container applications.

IMPORTANT: If you have a problem with your equipment, contact Zebra Global Customer Support for your region. Contact information is available at: www.zebra.com/support.

Configurations

This guide covers the following configurations:

Configuration	Operating System	Radios	Memory	Data Capture
TM2000-10011001-WW	Linux	802.11 a/b/g/n	64 GB Flash, 1 GB RAM	RGB and 3D Sensor
TM2000-10011001-US	Linux	802.11 a/b/g/n	64 GB Flash, 1 GB RAM	RGB and 3D Sensor

Chapter Descriptions

Topics covered in this guide are as follows:

- Getting Started provides a product overview, unpacking instructions, product features, and standard LED indicator information.
- Installing BRKT-10002-02R U-Mount Bracket provides installation requirements and instructions for the u-mount bracket and installing the LMU.
- Installing LMU Adapter Bracket BRKTS-TM1-TM2-EXT provides requirements and instructions for installing the BRKTS-TM1-TM2-EXT bracket adapter with the LMU and the BRKT-10002-02R u-mount bracket.
- Installing Telescoping Short Pole with Interface Bracket and U-Mount Bracket provides requirements and instructions for installing the AS-000341-01 telescoping short pole with the BI-000237-01-TLA interface bracket kit, and BRKT-10002-02R u-mount bracket to a steel door jamb or concrete for trailer applications.

- Installing Telescoping Long Pole with Interface Bracket and U-Mount Bracket provides requirements and instructions for installing the BR-000237-XX telescoping long pole with the BI-000237-01-TLA interface bracket kit, and BRKT-10002-02R u-mount bracket to a truss or a strut and aligning the LMU for container applications.
- LMU Container Alignment Procedure provides requirements and instructions for setting up and aligning ULDs for proper FOV (Field of View).

Notational Conventions

The following conventions are used in this document:

- "LMU" (Load Monitoring Unit) or "Device" refers to the Zebra TM2000.
- **Bold** text is used to highlight the following:
  - Dialog box, window and screen names
  - Drop-down list and list box names
  - Check box and radio button names
  - Icons on a screen
  - Key names on a keypad
  - Button names on a screen.
- Bullets (•) indicate:
  - Action items
  - Lists of alternatives
  - Lists of required steps that are not necessarily sequential.
- Sequential lists (e.g., those that describe step-by-step procedures) appear as numbered lists.

Icon Conventions

The documentation set is designed to give the reader more visual clues. The following graphic icons are used throughout the documentation set. These icons and their associated meanings are described below.

NOTE: The text here indicates information that is supplemental for the user to know and that is not required to complete a task.

IMPORTANT: The text here indicates information that is important for the user to know.

CAUTION: Disconnect the printer power before performing certain procedures to avoid the risk of electric shock.

WARNING: If danger is not avoided, the user CAN be seriously injured or killed.

DANGER! If danger is not avoided, the user WILL be seriously injured or killed.

Related Documents and Software

The following documents provide more information about the TM2000:

- TM2000 Configuration Guide
- LMU Mounting Bracket Template
- LMU Telescoping Pole Mounting Template
- TM2000 Regulatory Guide.

For the latest version of this guide and all guides, go to www.zebra.com/support.

Service Information

To return a faulty device:

1. Complete a repair return request (RMA) form at: www.zebra.com/repair.
2. Place a clean cloth over the device camera window to protect it from damage during transit.
3. Put the device in a container provided by the on-site contact.

Ship to the repair depot address identified in the RMA.

Feedback

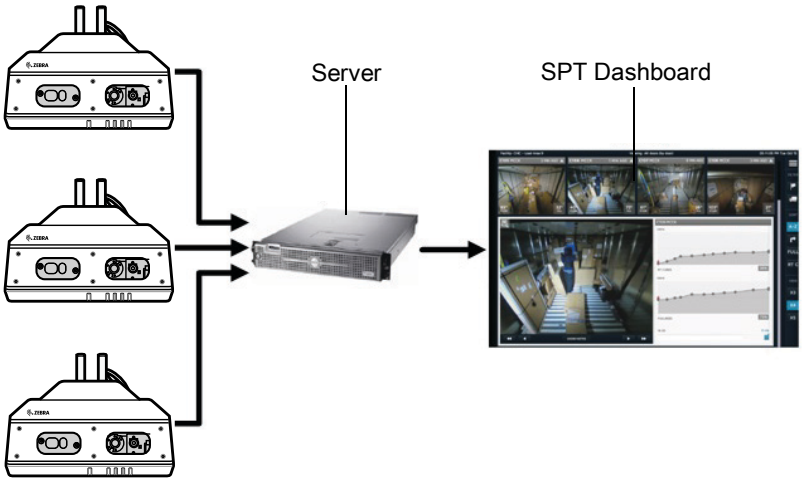
If you have comments, questions, or suggestions about this guide, send an email to EVM-techdocs@zebra.com.

Getting Started

Introduction

The TM2000 captures load information using an onboard RGB camera and 3D sensor, processes the captured data, and sends the results to a server over a wired or wireless connection. The TM2000 is installed on docks/load points at loading facilities to monitor trailer/container load progress and provide real time data about important load metrics. The Smart Pack Solution (SPS) analytics dashboard displays this data in a web based interface.

Figure 1 Solution Overview



Box Contents and Unpacking

The TM2000 box contains:

- TM2000
- Four mounting screws
- TM2000 Regulatory Guide.

Carefully remove the device from the packaging to avoid damaging the hardware. Inspect the device for damage.

NOTE: The mounting bracket is sold separately. For information or to purchase the mounting bracket, contact your Zebra sales representative.

TM2000 Features

Figure 2 Front View

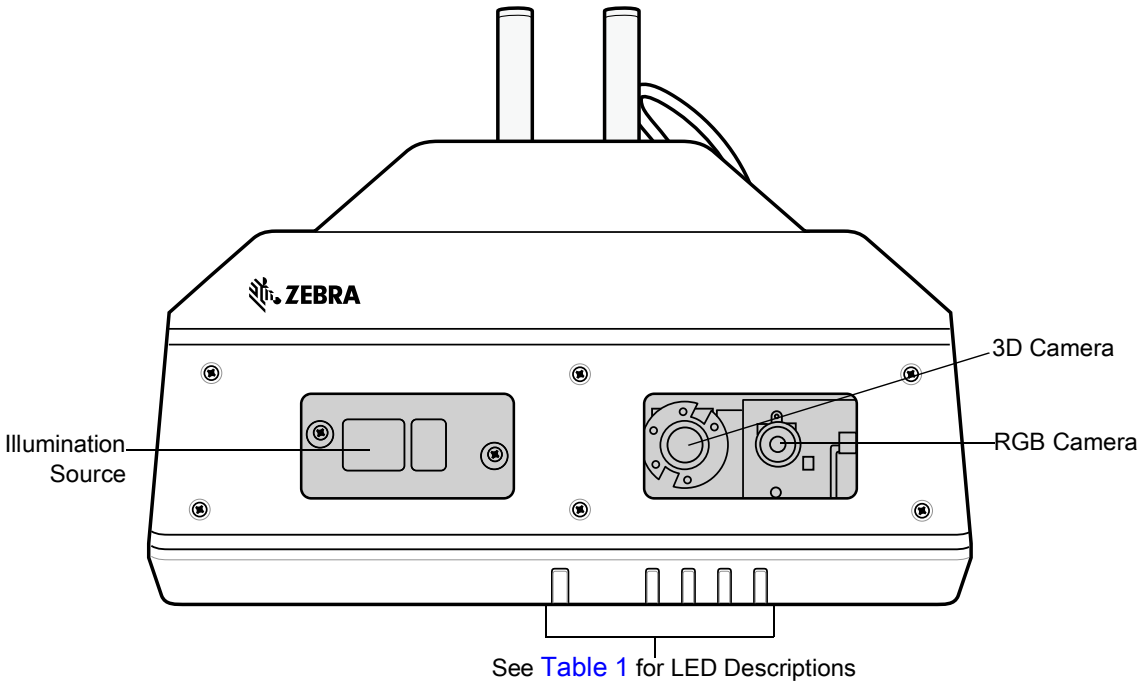


Figure 3 Top View

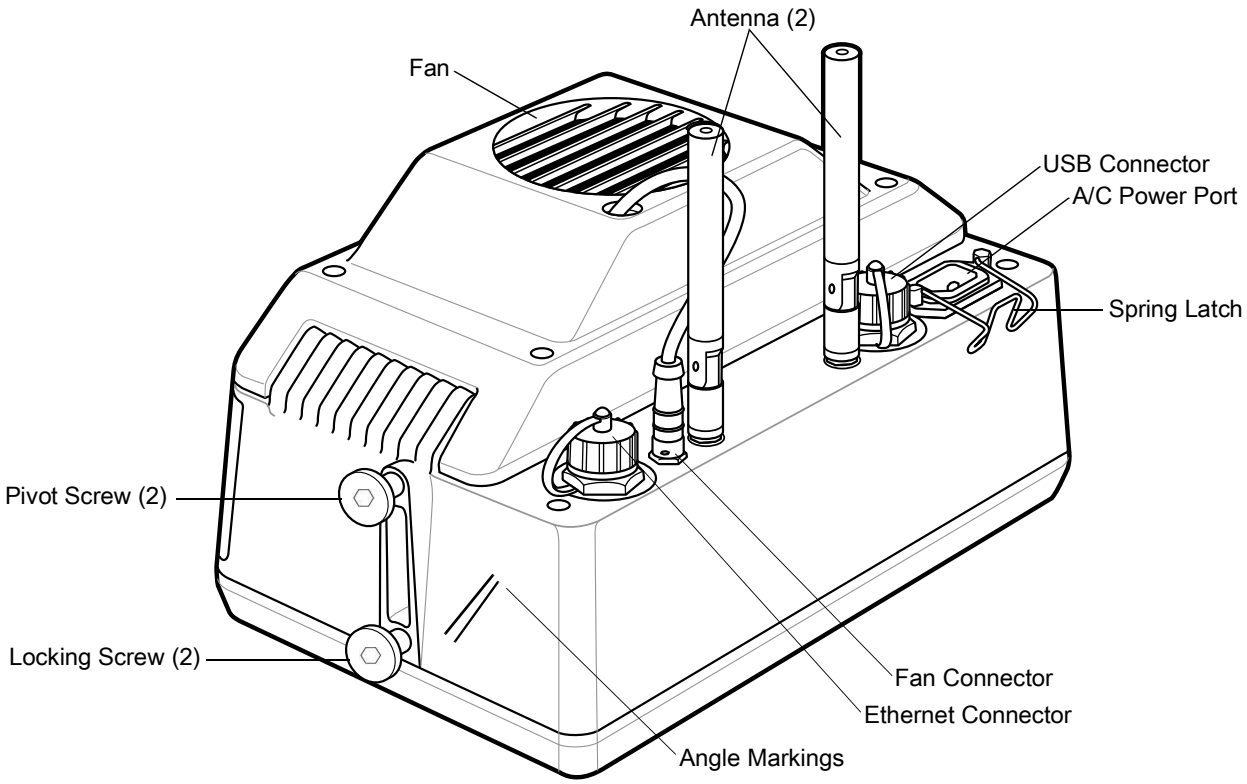
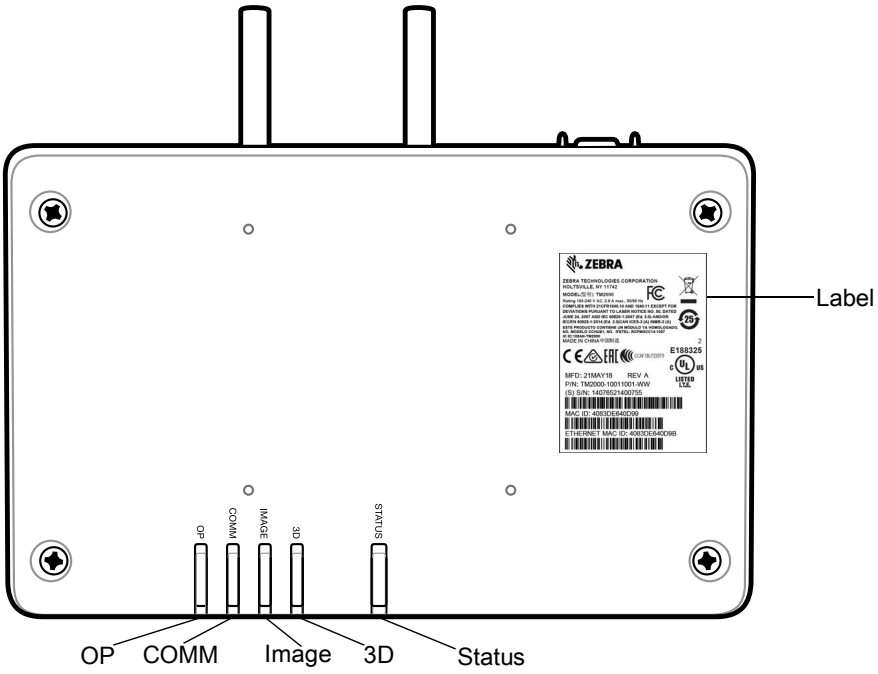


Figure 4 Bottom View



LED Indicators

The device LED indicators light to indicate status as follows:

- Image - RGB camera indicator lights to indicate the device is taking an image.
- 3D - Depth sensor indicator lights when acquiring a depth image.
- COMM - Wi-Fi communication lights when Wi-Fi is on.
- Status - Provides current operational status of the device.
- OP - Lights to indicate that the device has power.

Table 1 Standard LED Indicators

Image	3D	COMM	Status	OP	Description
---	---	---	---	On	Device has power.
---	---	On	---	On	Wi-Fi is on and accessible.
---	---	Off	---	On	Wi-Fi interference; does not have an IP address; cannot connect to an AP.
Off	On	---	---	On	Acquiring depth image.
On	Off	---	---	On	Acquiring RGB image.
On	On	---	---	On	Writing PCD or JPG RGB image to file.
Off	Off	---	---	On	Processing scene.
---	---	---	Blinking Red	On	Depth camera not operational due to the device overheating.
---	---	---	Pink	On	Current angle is beyond +/- 20° from the configured angle.
(---) Indicates that the LED may or may not be illuminated					

Installing BRKT-10002-02R U-Mount Bracket

Introduction

This chapter provides installation requirements and instructions for the BRKT-10002-02R u-mount bracket and installing the TM2000 LMU.

Installation Requirements

CAUTION: Always utilize professional installers to safely install, mount, and supply power to the device. Always ensure device mounting and power routing meets regional building codes.

Tools

- Impact drill (an 8 mm Allen wrench or ratchet hand socket wrench can also be used, although it is not as time efficient)
- Torque wrench with 6 mm Allen wrench
- 3/8 in. hex socket for screws.

Hardware

IMPORTANT: Hardware requirements are based on mounting to structural steel.

- U-Mount bracket, p/n BRKT-10002-02R (sold separately)
- Four #12 x 1 in., type F, galvanized steel, thread cutting screws (no washers needed) for attaching the BRKT-10002-02R to the door frame (not provided)
- Mounting screws for attaching the device to the u-mount bracket
- Power receptacle located near (approximately 1 ft/.3 m) the top of the dock door frame
- Ladder or step stool.

Software Setup

- Add TM2000 Wi-Fi MAC addresses to the site access point control list (contact your local IT support person).
- If using an Ethernet connection, the Ethernet MAC address must be added to the control list (contact your local IT support person).

BRKT-10002-02R Installation

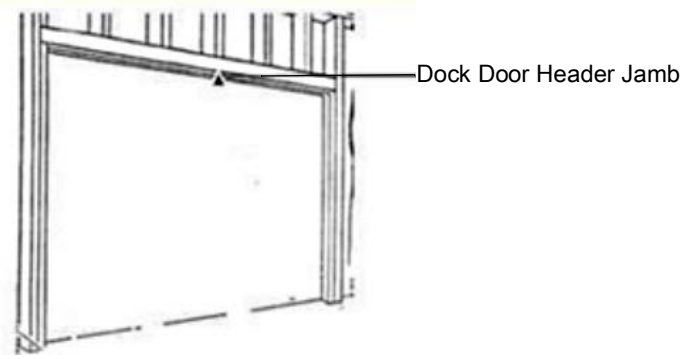
IMPORTANT: The device power cord is 3 ft/.9 m in length. Ensure the electrical receptacle is easily accessible and located within proper distance to the device.

Initial Measurements for BRKT-10002-02R

Measuring Door Height for BRKT-10002-02R

Measure from the floor to the bottom of the dock door header jamb opening. If the measurement is greater than 9 ft (274.32 cm), additional adjustments and modifications may be required.

Figure 5 Measure Door Height



Validating Height Relative to Trailer for BRKT-10002-02R

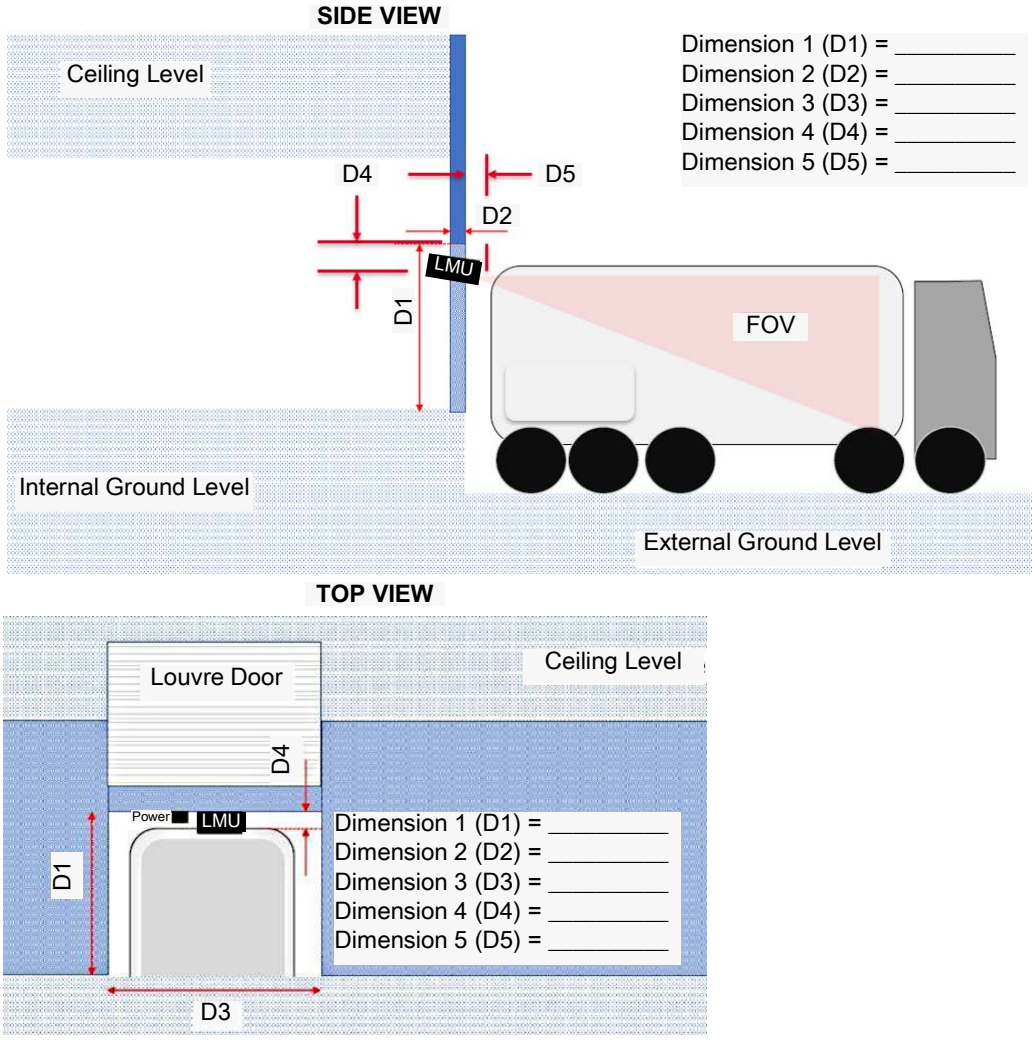
The height relative to the trailer is the vertical distance from the inside roof of the trailer to the underside of the dock door header jamb. This distance determines where the camera is viewing and whether the BRKT-10002-02R is adequate or if a custom modification is required.

The measurement requires the truck trailer to be at the dock or to know the height of the trailers that are in use at the door. Before installing the BRKT-10002-02R, check to see if proper vertical alignment is possible for the dock doorway (see Figure 6).

An 8 - 9 ft height doorway results in an acceptable mounting for a typical 9 ft trailer. The key measurement is that the underside vertical height of the dock door header jamb must be within 0 in. - 12 in. (30.48 cm) of the truck's trailer inside roof.

If the aforementioned dimension of 0 in. - 12 in. (30.48 cm) is not achievable, being that the door is too high, then an extension is required, see Installing Telescoping Short Pole with Interface Bracket and U-Mount Bracket on page 21 (for container applications, see Installing Telescoping Long Pole with Interface Bracket and U-Mount Bracket on page 30) or contact Zebra Engineering for further instructions.

Figure 6 LMU Positioning Relative to Trailer



Installing BRKT-10002-02R With Template

IMPORTANT: Measure the width of dock door header jamb. The optimal width must at least 6 in. (15.24 cm**)** or greater for mounting. If the jamb is less than 6 in., contact Zebra Engineering.

To install the BRKT-10002-02R using the Mounting Bracket Template included in the bracket box:

1. Verify the dock door header jamb underside vertical height is within the proper range of the truck's trailer inside roof, see Validating Height Relative to Trailer for BRKT-10002-02R.
2. Measure and mark a center line on the bottom of the dock door header jamb.
3. Place the Mounting Bracket Template in the center of the trailer door.
4. Align the template center line with the marked center line. Position the edge of the template, facing the dock, ~3.5 in. (89.3 mm) from the center of the mounting holes on the dock side of the mounting bracket and tape the template in place. Ensure the template faces the correct direction. The dock side faces the building and the Trailer side faces the truck trailer.
5. Drill the mounting bracket holes.
6. Remove the template.
7. Install the bracket using four #12 x 1 in. thread cutting screws.

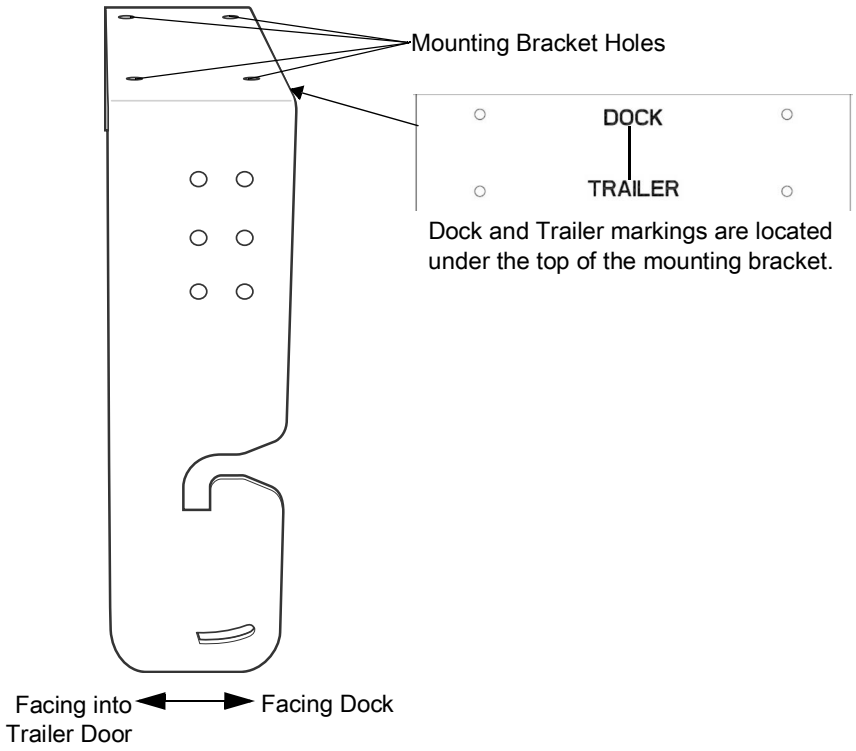
Installing BRKT-10002-02R Without Template

IMPORTANT: Measure the width of dock door header jamb. The optimal width must at least 6 in. (15.24 cm**)** or greater for mounting. If the jamb is less than 6 in., contact Zebra Engineering.

To install the BRKT-10002-02R without using the Mounting Bracket Template:

1. Verify the dock door header jamb underside vertical height is within the proper range of the truck's trailer inside roof, see Validating Height Relative to Trailer for BRKT-10002-02R on page 12.
2. Measure and mark a center line on the bottom of the dock door header jamb.
3. Place the BRKT-10002-02R in the center of the trailer door.
4. Position the edge of the bracket, facing the dock, ~3.5 in. (89.3 mm) from the center of the mounting holes on the Dock side of the BRKT-10002-02R. Ensure the mounting bracket faces the correct direction. The Dock side faces the building and the Trailer side faces the truck trailer.

Figure 7 Proper Direction for Installing the BRKT-10002-02R



5. While holding the mounting bracket in position, mark the surface with a pencil through each of the four mounting bracket holes to determine the location of the screw holes to drill. It is recommended to use four screws to mount the bracket securely. Use two screws on each side. If there is a center hole (not shown), do not use the center hole.
6. Drill the holes and install the bracket using four #12 x 1 in. thread cutting screws.

LMU Installation with BRKT-10002-02R

NOTE: If using the BRKTS-TM1-TM2-EXT adapter bracket, see Installing LMU Adapter Bracket BRKTS-TM1-TM2-EXT on page 18 before installing the LMU.

WARNING: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

CAUTION: Always utilize professional installers to safely install, mount, and supply power to the device. Always ensure device mounting and power routing meets regional building codes**.**

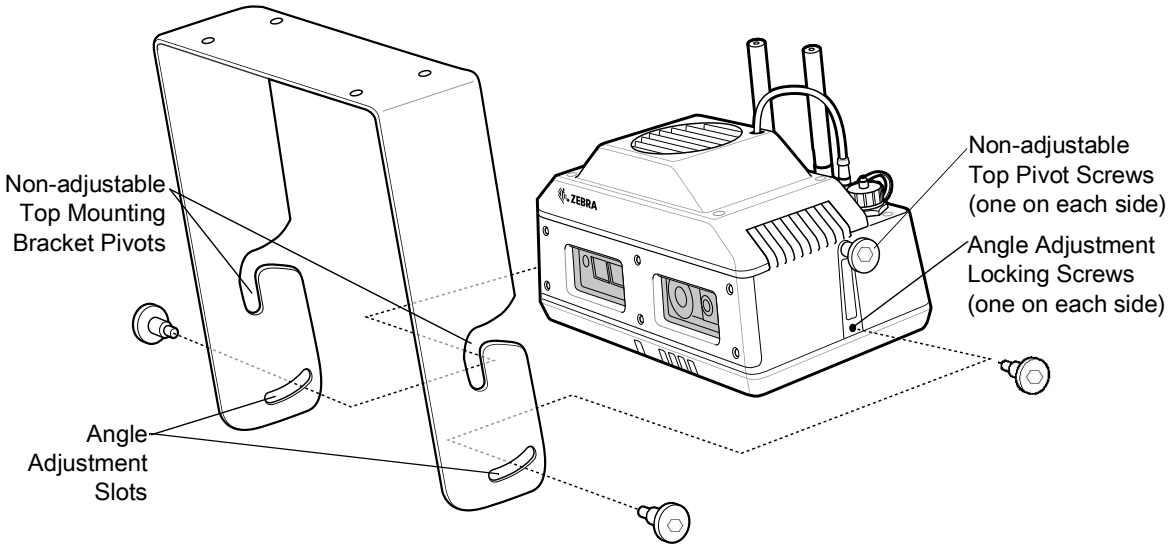
Double Pole/Neutral Fusing: If a fuse in the neutral conductor is out, the fuse in the line conductor may still be intact which can result in internal parts remaining energized. Take extreme caution when servicing the unit.

IMPORTANT: To reduce the risk of cross threading, begin fastening the pivot and locking screws by hand before employing the torque wrench. The knurled edge of the screws is provided for this purpose.

To install the LMU on the BRKT-10002-02R u-mount bracket:

1. Screw and torque the non-adjustable top pivot screws on each side of the device to 6.0 ft-lbs.
2. Make sure the required installation tools are within reach (see Tools on page 11).
3. Place a ladder or step stool at the trailer door.
4. Hang the device on the mounting bracket (see BRKT-10002-02R Installation on page 12) by sliding the two non-adjustable top pivot screws into the non-adjustable top mounting bracket pivots on the u-mount bracket, or the corresponding pivots on the adapter bracket.
5. Allow the device to rotate backwards and come to a stop. Release the unit and hand thread the angle adjustment locking screws through the angle adjustment slots on the u-mount bracket, or the corresponding slots on the adapter bracket. Do not tighten the locking screws in this position.

Figure 8 Hanging LMU on BRKT-10002-02R

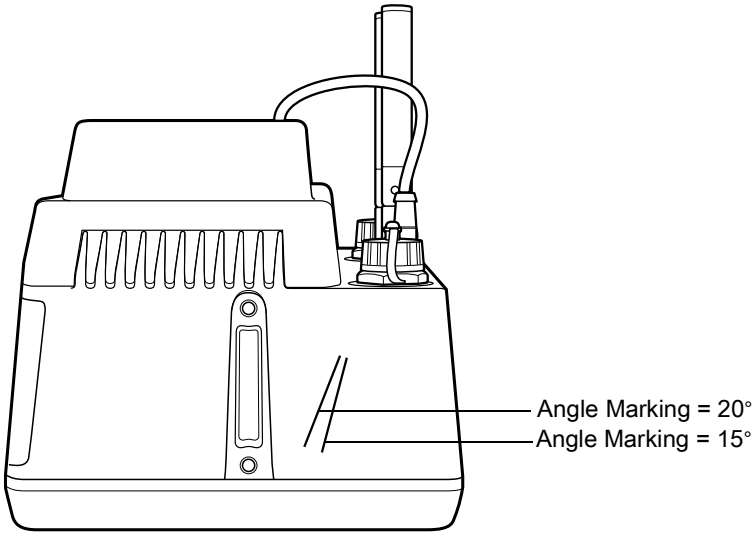


6. Rotate the device to the proper operating orientation of 20°or 15° depending on the use case. The angle markings on the device are guidelines only.

7. Check the LMU's syslog for the current camera angle to ensure it is at 20° for Inbound (unload) or 15° for Outbound (load) dock doors. An inclinometer app on a smartphone may also be used to check for the proper angle.

NOTE: You must know if the TM2000 is being used for Inbound Loading or Outbound Loading as the angle requirements are different. Inbound is an unloading operation and requires a 20° angle, while Outbound is a loading operation that requires a 15° angle. In the event that the syslog is not available, set the angle using the bottom of the TM2000 housing plate. the proper angle for maximum viewing coverage of the trailer.

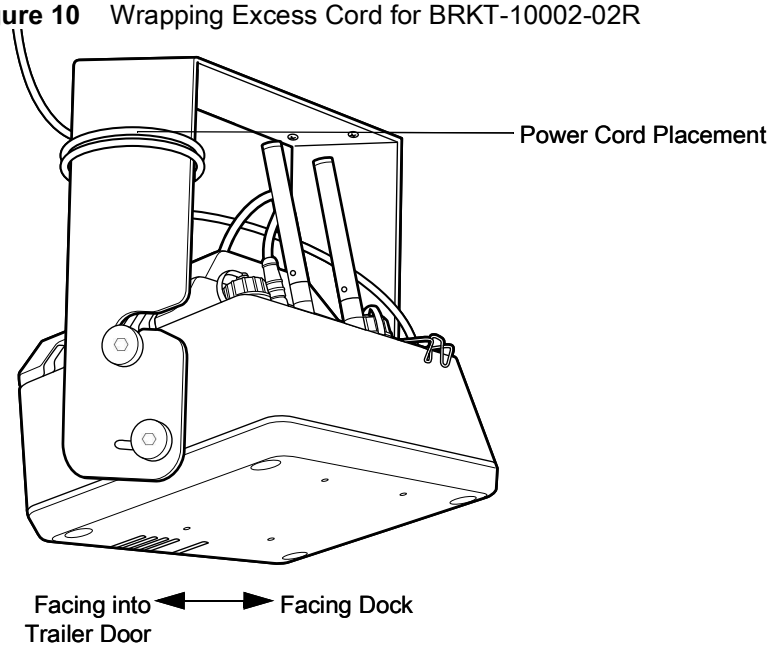
Figure 9 Orienting LMU Angle on BRKT-10002-02R



NOTE: When the TM2000 is connected to the server, check the syslog for the current camera angle to confirm it has the proper angle for maximum viewing coverage of the trailer.

8. Torque the angle adjustment locking screws to 6.0 ft-lbs.
9. Plug the female side of the power cable into the TM2000 and lock it in place using the rotating spring latch.
10. Wrap the excess power cord around the bracket. Leave adequate length for the cable to reach the power receptacle at the trailer door. Do not plug the device in until the installation is complete.

Figure 10 Wrapping Excess Cord for BRKT-10002-02R

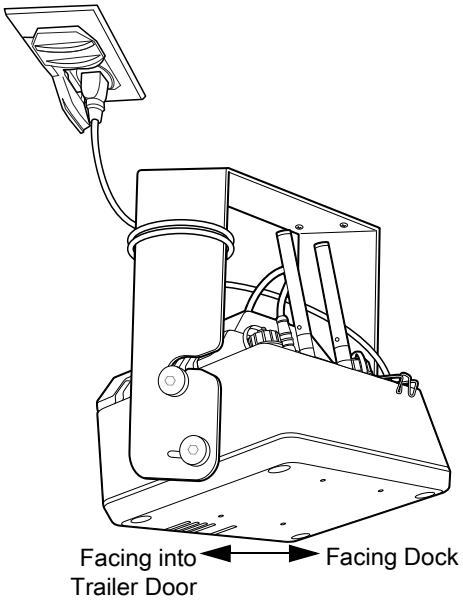


11. Ensure that the antennas are positioned vertically.

NOTE: The preferred antenna orientation is vertical or 45° (90° antenna orientation is not recommended).

12. Plug the power cord into a socket outlet with earthing connection, which is grounded in accordance with local regulations. It may take 2-3 minutes for the device to boot up.

Figure 11 Connecting Power with BRKT-10002-02R



13. Check the LEDs for normal operation (see Standard LED Indicators on page 10).

NOTE: The pink LED indicates that the angle is off beyond acceptable tolerance. Re-align the unit + or - 2° until the pink LED shuts off.

Installing LMU Adapter Bracket BRKTS-TM1-TM2-EXT

Introduction

This chapter provides requirements and instructions for installing the BRKTS-TM1-TM2-EXT adapter bracket with the TM2000 LMU and the BRKT-10002-02R u-mount bracket. The adapter bracket installs on an existing u-mount bracket to allow the LMU to clear the overhead dock door frame.

Installation Requirements

CAUTION: Always utilize professional installers to safely install, mount, and supply power to the device. Always ensure device mounting and power routing meets regional building codes.

Tools

- Torque wrench with 6 mm Allen wrench
- 3/8 in. hex socket for screws.

Hardware

IMPORTANT: Hardware requirements are based on mounting to structural steel door jamb or concrete.

- BRKTS-TM1-TM2-EXT Adapter Bracket Kit
- Power receptacle located near (approximately 1 ft/.3 m) the top of the dock door frame
- Ladder or step stool.

Software Setup

For software setup information, see Software Setup on page 11.

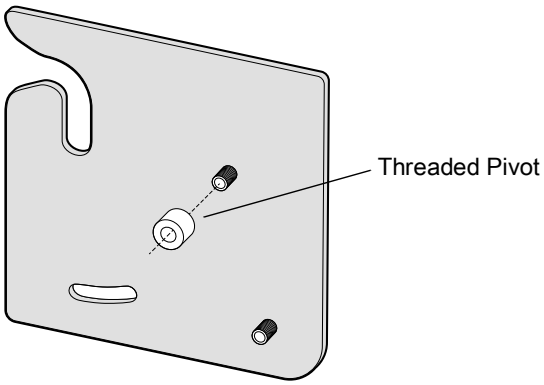
BRKTS-TM1-TM2-EXT Installation

IMPORTANT: The device power cord is 3 ft / 0.9 m in length. Ensure the electrical receptacle is easily accessible and located within proper distance to the device.

To install the LMU adapter bracket BRKTS-TM1-TM2-EXT on the LMU and BRKT-10002-02R u-mount bracket:

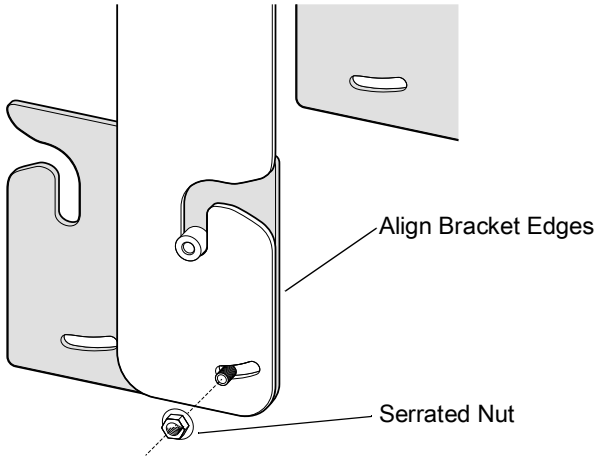
1. Place a ladder or step stool at the trailer door.
2. Install the u-mount bracket as described in BRKT-10002-02R Installation on page 12.
3. Screw the threaded pivot onto the adapter bracket and hand tighten. Repeat for the second bracket.

Figure 12 Threaded Pivot in Adapter Bracket



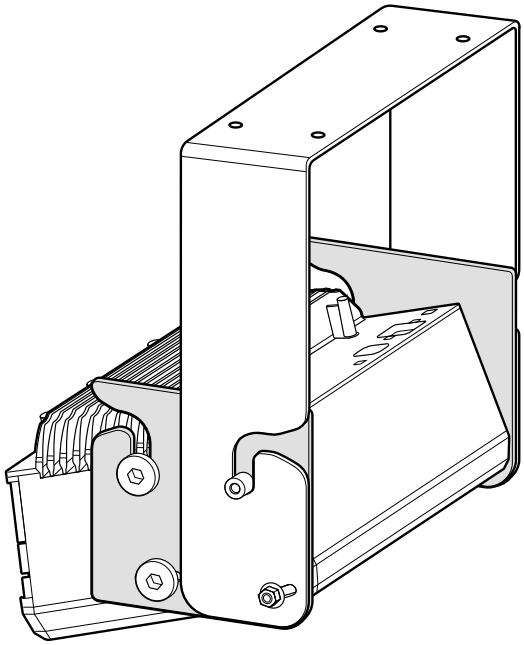
4. Place the adapter bracket into the u-mount bracket, allowing it to hang on the threaded pivot.
5. Align the back edges of the adapter and u-mount brackets and fasten together with the serrated nut using 6 ft-lbs of torque. Repeat with the other set of brackets.

Figure 13 Aligning Adapter and U-Mount Brackets



6. Install the LMU to the adapter brackets in the same manner as the u-mount bracket installation described in LMU Installation with BRKT-10002-02R on page 15.

Figure 14 LMU Installed at Desired Angle



Installing Telescoping Short Pole with Interface Bracket and U-Mount Bracket

Introduction

This chapter provides requirements and instructions for installing the AS-000341-01 telescoping short pole with the BI-000237-01-TLA interface bracket kit, and BRKT-10002-02R u-mount bracket to a steel door jamb or concrete.

Installation Requirements

CAUTION: Always utilize professional installers to safely install, mount, and supply power to the device. Always ensure device mounting and power routing meets regional building codes.

Tools

- Impact drill (an 8 mm Allen wrench or ratchet hand socket wrench can also be used, although it is not as time efficient)
- Torque wrench with 6 mm Allen wrench
- Phillips screwdriver
- Tape measure
- Drill/driver.

Hardware

IMPORTANT: Hardware requirements are based on mounting to structural steel door jamb or concrete.

- Telescoping adjustable short pole mount assembly, p/n AS-000341-01 (sold separately)
- Interlock pin with tether
- M6 locking nut (6) inner hex bolt
- Interface bracket kit, p/n BI-000237-01-TLA
  - Interface bracket
  - M5 x 6 mm, Phillips pan head (2) (for securing the interface bracket sides and telescoping pole)
  - M6 x 50 mm, Phillips pan head (2) (for attaching interface bracket and telescoping pole)
  - M6 x 20 mm, Phillips pan head (4) (for u-mount bracket (p/n BRKT-10002-02R)
- Power receptacle located near (approximately 1 ft/.3 m) the top of the dock door frame
- Ladder or step stool.

Software Setup

For software setup information, see Software Setup on page 11.

AS-000341-01 Installation

IMPORTANT: The device power cord is 3 ft/.9 m in length. Ensure the electrical receptacle is easily accessible and located within proper distance to the device.

Initial Measurements for AS-000341-01

The key measurement is from the underside of the dock door header jamb to the truck's trailer inside roof. This distance determines where the camera is viewing.

If the dimension is between 0 in. - 12 in. (30.48 cm), then the BRKT-10002-02RU-Mount bracket may be installed directly on the dock door header jamb (see Installing BRKT-10002-02R U-Mount Bracket on page 11).

If the dimension is between 12 in. (30.48) - 18 in. (45.72), an extension is needed which requires the AS-000341-01 Telescoping Short Pole assembly and the BI-000237-01-TLA Interface Bracket Kit in addition to the BRKT-10002-02R U-Mount bracket.

Installing AS-000341-01

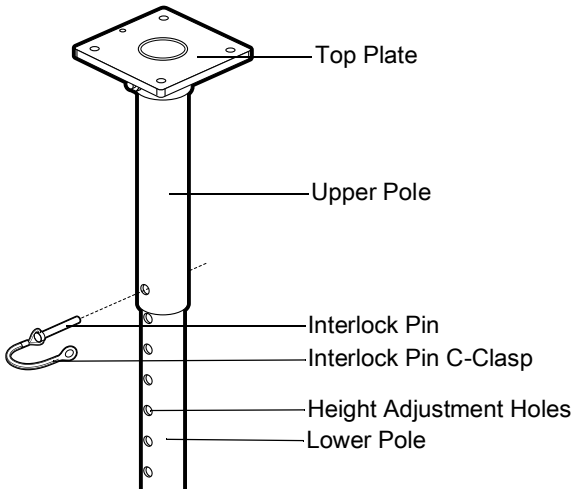
IMPORTANT: Measure the width of Dock Door Header Jamb. The optimal width must at least 7 in. (17.78 cm) or greater for mounting. If the Jamb is less than 7 in., contact Zebra Engineering.

To install the AS-000341-01:

1. Adjust the telescoping pole height as required. Remove the interlock pin and extend the lower pole to the desired position.
2. Insert the interlock pin.

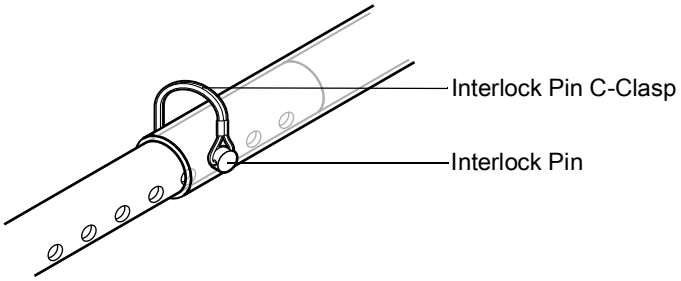
NOTE: The length of the telescoping pole may be adjusted to accommodate the TM2000 height as per the site survey after the bracket is fully installed.

Figure 15 Inserting Interlock Pin for AS-000341-01



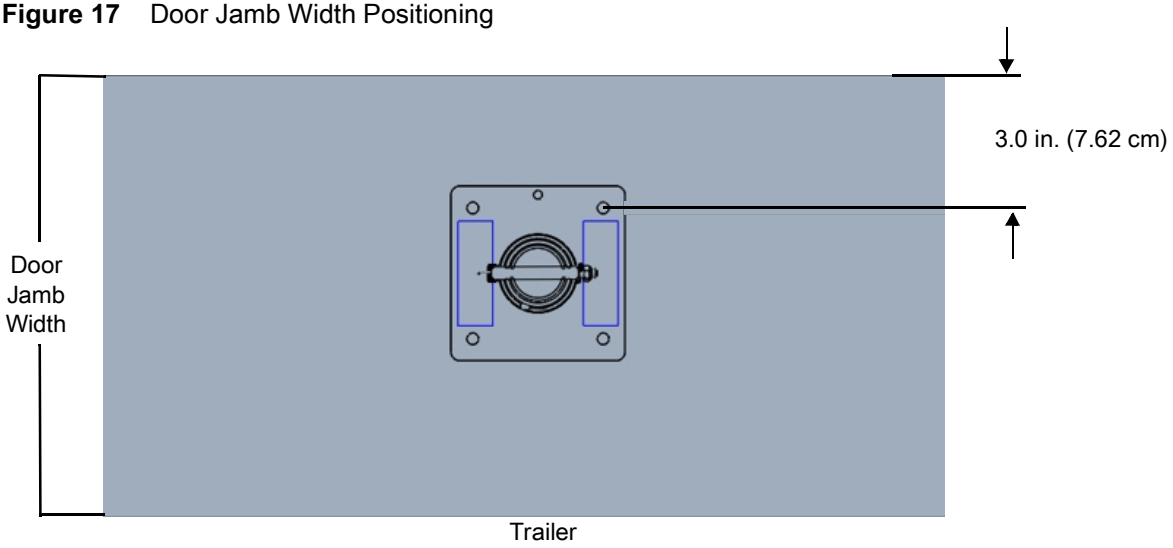
3. Place the interlock pin c-clasp on the opposite side of the hole over the interlock pin and secure using the interlock pin bolt.

Figure 16 Securing Interlock Pin for AS-000341-01



4. Verify the dock door header jamb underside vertical height is within the proper range of the truck's trailer inside roof, see Initial Measurements for AS-000341-01 on page 22.
5. Mark and drill mounting holes.
   - Using the Telescoping Pole Mounting Template:
     i. The door jamb must be a minimum of 7 in. (17.78 cm) in width. Measure and mark a center line on the bottom of the dock door header jamb.
     ii. Place the Telescoping Pole Mounting Template in the center of the door jamb. Position the pole template at least 3.0 in. (7.62 cm) from the center of the mounting holes to the edge of the door jamb.

Figure 17 Door Jamb Width Positioning



NOTE: Do not mark or drill a hole for the Safety Cable Hole (see Figure 18 on page 24).

iii. Align the template center line with the marked center line and tape the template in place. Ensure the template faces the correct direction. One side on the bottom of the top plate has a **Trailer** marking and arrow. Ensure the top plate is positioned in the correct direction by placing the trailer side in the direction of the trailer.

iv. Drill the mounting holes (see Figure 18 on page 24). The through holes in the mounting top plate accepts four #12 screws. Always use the appropriate anchors when fastening to concrete (i.e., do not screw directly into the concrete).

v. Remove the template.

- Using the Telescoping Pole top plate:

  i. Attach the top plate to the dock door header jamb. The door jamb must be a minimum of 7 in. (17.78 cm).

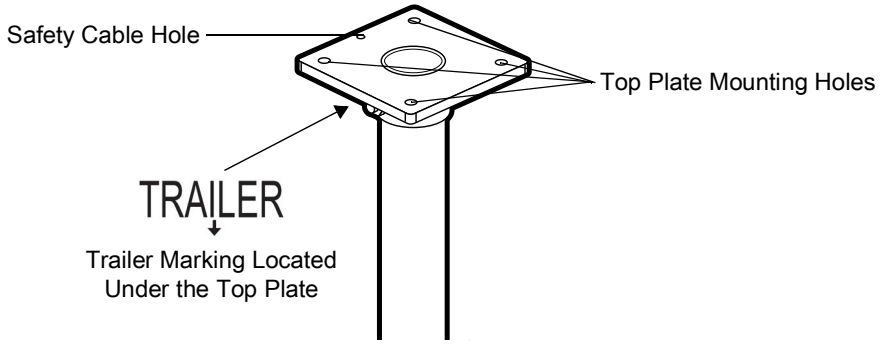
  ii. Measure and mark a center line on the bottom of the dock door header jamb.

  iii. Place the center top plate of the telescoping pole in the center of the door jamb. Position the top plate at least 3.0 in. (7.62 cm) from the center of the mounting holes to the edge of the door jamb.

  iv. While holding the telescoping pole in position, mark the surface with a pencil through each of the four top plate corner mounting holes to determine the location of the screw holes to drill.

NOTE: Do not mark or drill a hole for the Safety Cable Hole (see Figure 18).

Figure 18 Attaching Top Plate for AS-000341-01



  i. Drill the holes. The through holes in the mounting top plate accepts four #12 screws. Always use the appropriate anchors when fastening to concrete (i.e., do not screw directly into the concrete).

6. Attach the interface bracket.

  a. Place the interface bracket over the base of the lower pole.

  b. Align the two lower holes of the lower pole with the two holes on the interface bracket.

  c. Insert two M6 x 50 mm bolts and fasten in place using the two M6 lock nuts. Torque to 6 ft-lbs.

  d. Insert the two M5 x 6 mm bolts to side interface bracket holes (the interface bracket holes Do Not mate with corresponding holes in the lower pole). The bolts engage with the side wall of the lower pole to prevent extraneous motion. For best LMU orientation results, alternate tightening the two bolts using a Phillips screw driver.

Figure 19 Attaching AS-000341-01 with BI-000237-01-TLA

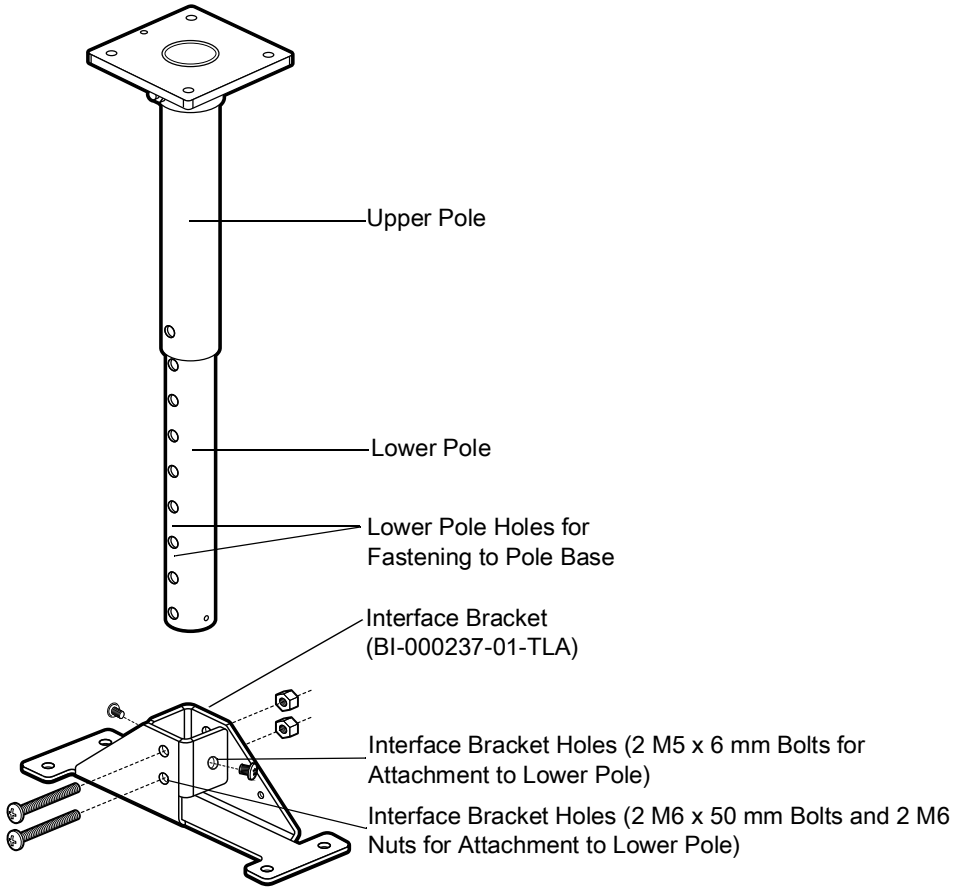
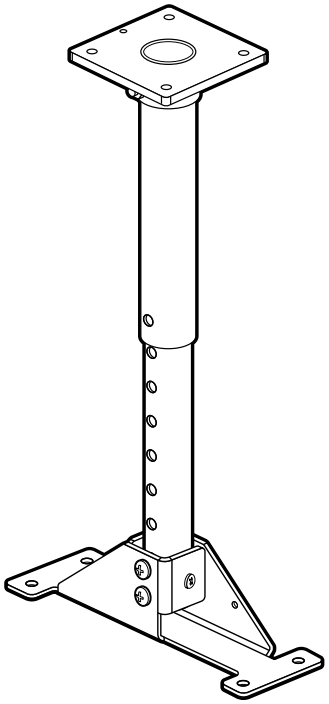


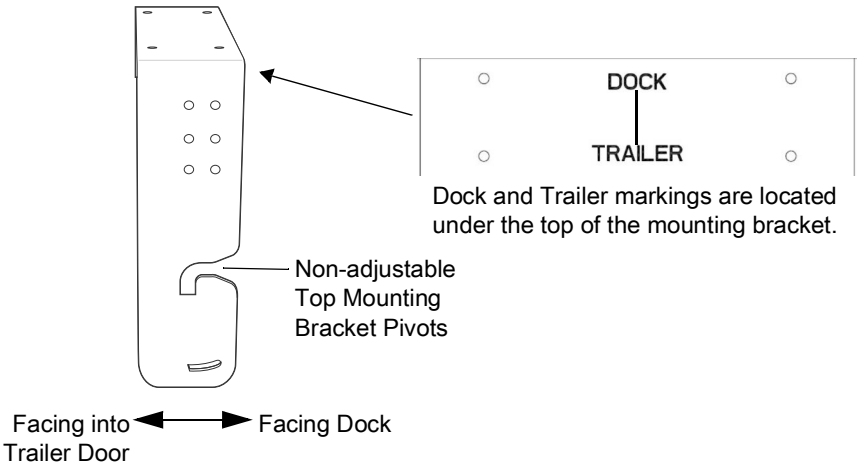
Figure 20 AS-000341-01 with BI-000237-01-TLA Assembled



7. Secure the BRKT-10002-02R u-mount bracket to the interface bracket.

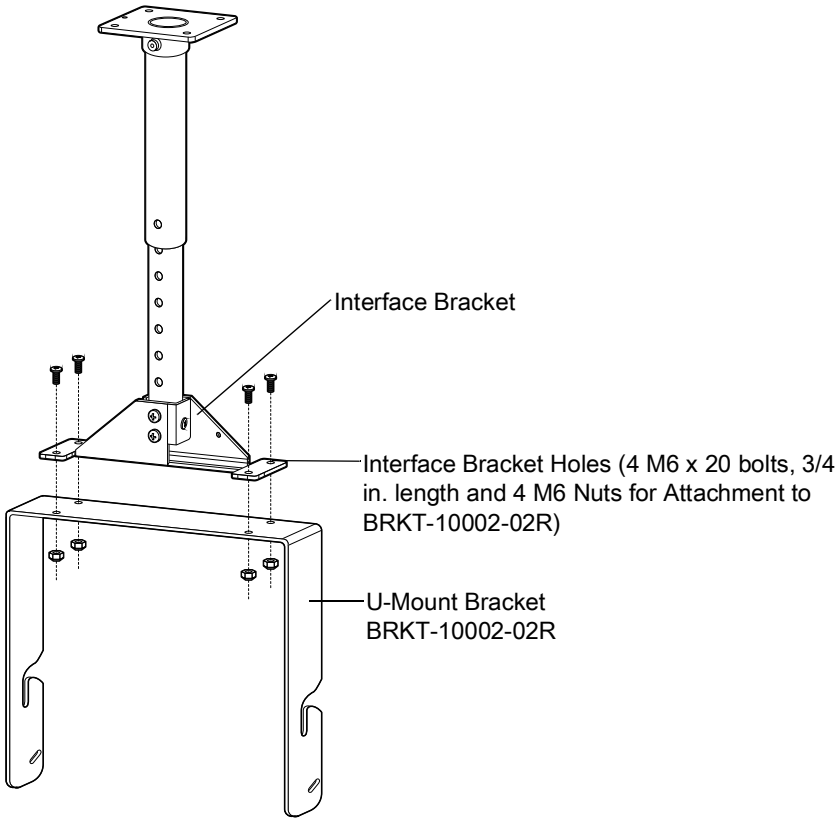
   a. Ensure the mounting bracket faces the correct direction. The dock side faces the building and the trailer side faces the trailer.

Figure 21 Proper Direction for Installing BRKT-10002-02R with AS-000341-01



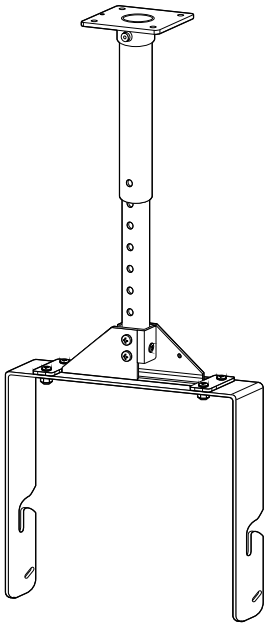
   b. Align the four holes on the BRKT-10002-02R with the four holes on the interface bracket.

Figure 22 Attaching BRKT-10002-02R to AS-000341-01



c. Secure the BRKT-10002-02R to the interface bracket using four M6 x 20 screws and four M6 lock nuts. Torque to 6 ft-lbs.

Figure 23 BRKT-10002-02R and AS-000341-01 Assembled

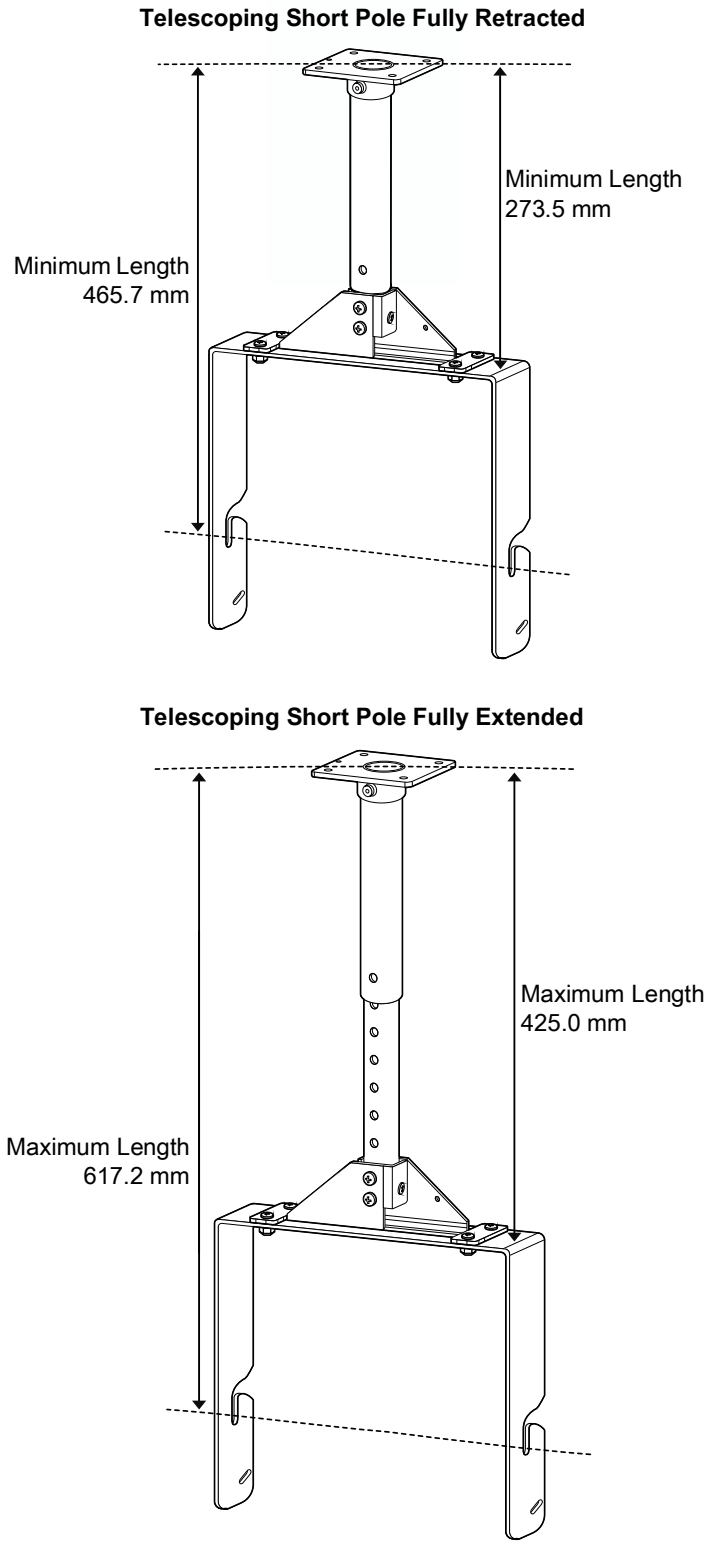


8. If necessary, adjust the length of the telescoping pole to accommodate the TM2000 height as per the site survey.

a. Remove the interlock pin (see Figure 15 on page 22).

b. Pull the lower portion of the pole down or push the pole up to achieve the desired height.

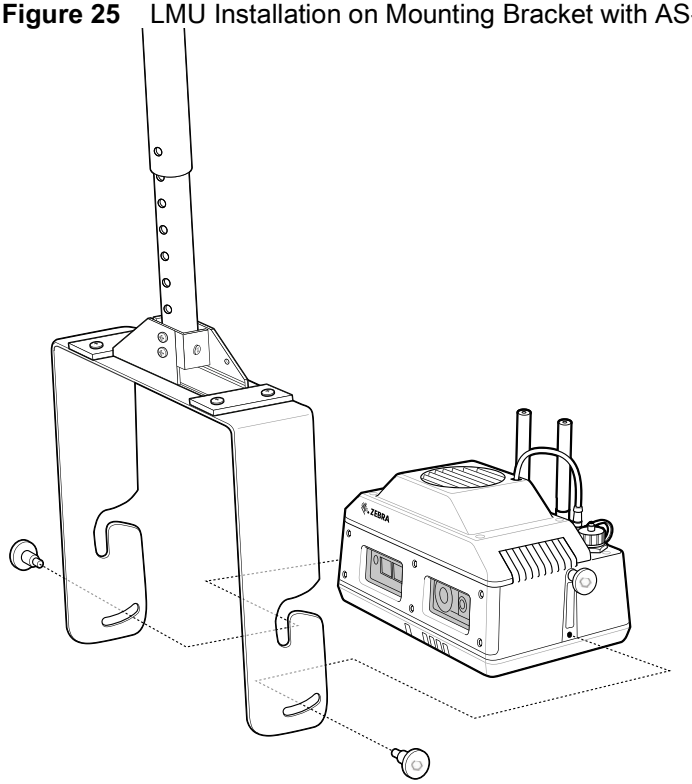
Figure 24 Telescoping Short Pole Measurements



c. Insert the interlock pin (Figure 16 on page 23).

9. Install the LMU on the BRKT-10002-01R (see LMU Installation with BRKT-10002-02R on page 15).

Figure 25 LMU Installation on Mounting Bracket with AS-000341-01



Installing Telescoping Long Pole with Interface Bracket and U-Mount Bracket

Introduction

This chapter provides requirements and instructions for installing the BR-000237-XX telescoping long pole with the BI-000237-01-TLA interface bracket kit, and BRKT-10002-02R u-mount bracket to a truss or a strut and aligning the LMU for container applications.

Installation Requirements

CAUTION: Always utilize professional installers to safely install, mount, and supply power to the device. Always ensure device mounting and power routing meets regional building codes.

Tools

- Impact drill (an 8 mm Allen wrench or ratchet hand socket wrench can also be used, although it is not as time efficient)
- Torque wrench with 6 mm Allen wrench
- Phillips screwdriver
- Tape measure
- Drill/driver
- Truss or strut structure if not readily available.

IMPORTANT: Based on the site survey, it may be necessary to create an additional structure such as a truss or strut from which to mount the telescoping pole. Consult with the customer to determine a suitable option for mounting.

Hardware

NOTE: Hardware requirements are based on mounting to a truss or strut.

- Telescoping adjustable long pole mount assembly (sold separately):
  - BR-000237-01 - 18 in. - 32 in.
  - BR-000237-02 - 36 in. - 66 in.
  - BR-000237-03 - 72 in. - 138 in.
- 1/2”-13 lock nut and fender washer (for threaded screw located on the top plate)

- 1/4” - 20 x 2” hex head bolt, lock washer, washers (2), locknut
- M6 locking nut (6) inner hex bolt
- Safety cable
- Interface bracket kit, p/n BI-000237-01-TLA
  - Interface bracket
  - M5 x 6 mm, Phillips pan head (2) (for securing the interface bracket sides and telescoping pole)
  - M6 x 50 mm, Phillips pan head (2) (for attaching interface bracket and telescoping pole)
  - M6 x 20 mm, Phillips pan head (4) (for U-Mount bracket, p/n BRKT-10002-02R)
- Power receptacle located near (approximately 1 ft/.3 m) the top of the dock door frame
- Ladder or step stool.

Software Setup

For software setup information, see Software Setup on page 11.

BR-000237-01 Installation

IMPORTANT: The device power cord is 3 ft/.9 m in length. Ensure the electrical receptacle is easily accessible and located within proper distance to the device.

Initial Measurements for LMU Positioning Relative to Container

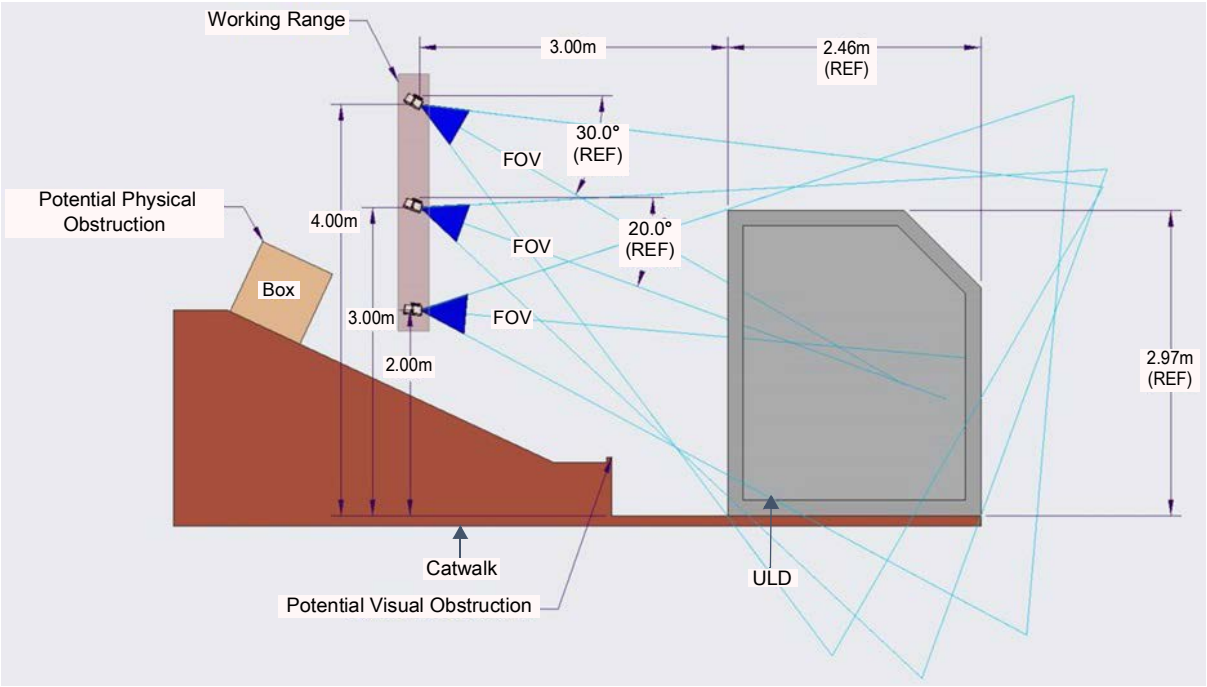
The recommended mounting measurements, as illustrated in Figure 26, are as follows:

- Vertical mounting position - The acceptable working range is 2.00 m to 4.00 m. The preferred measurement is 2.00 m from the catwalk.
- Horizontal mounting position - 3.00 m from the ULD front face; Centered between AMX.

IMPORTANT: Avoid physical and visual obstructions (see Figure 26). Ensure that there is adequate clearance to avoid a potential physical parcel collision. Avoid potential visual obstructions such as the edge of the chute.

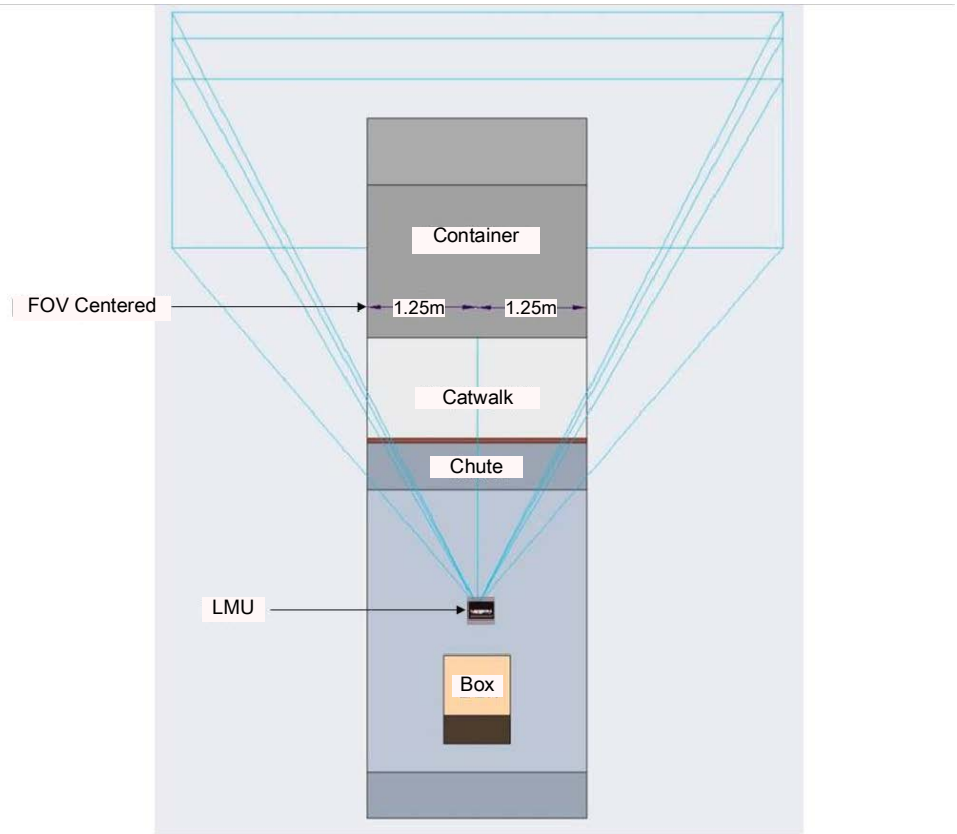
NOTE: The LMU may need to be rotated downward so that the edge of the vertical FOV includes the top of the ULD.

Figure 26 Side View Measurements for LMU Positioning Relative to Container



IMPORTANT: The LMU must be centered with the ULD. Mounting the LMU off-center results in poor fullness measurements (see Figure 27).

Figure 27 Top View Measurements for LMU Positioning Relative to Container



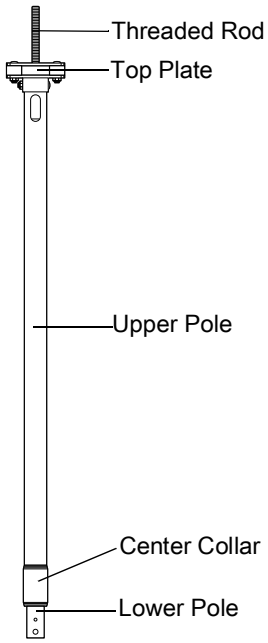
Installing BR-00237-XX

To install the BR-000237-XX:

1. Attach the upper pole to the lower pole.
2. Lock the pole in position by rotating the center collar clockwise. Hand tighten the collar.

NOTE: The length of the telescoping pole may be adjusted to accommodate the TM2000 height as per the site survey after the bracket is fully installed.

Figure 28 Adjusting the BR-00237-01

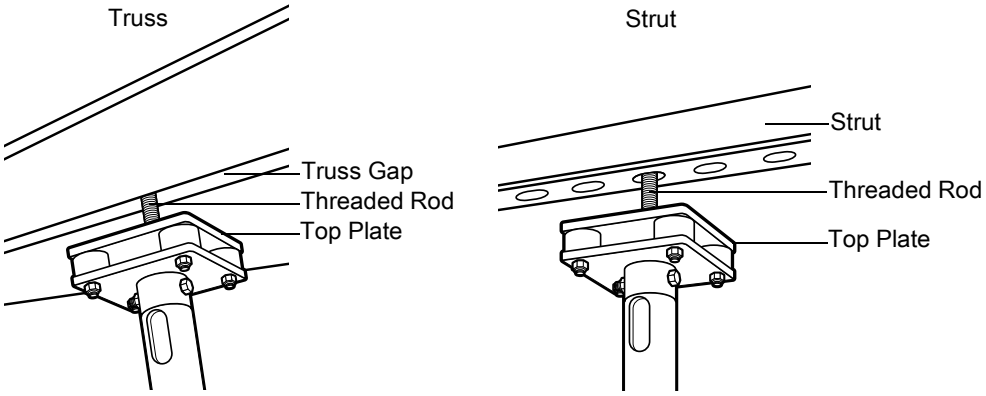


1. Verify the truss or strut underside vertical height is within proper required range (see Initial Measurements for LMU Positioning Relative to Container on page 31).

IMPORTANT: Based on the site survey, it may be necessary to create an additional structure such as a truss or strut from which to mount the telescoping pole. Consult with the customer to determine a suitable option for mounting.

2. Attach the telescoping pole to the truss or strut channel.
   a. Insert the threaded rod on the plate at the top of the telescoping pole in the truss gap or through a hole in the strut channel.

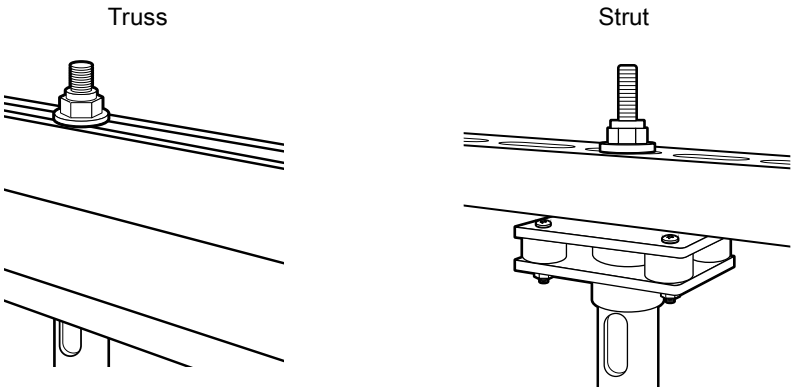
Figure 29 Inserting Threaded Rod in Truss Gap or Strut Channel



b. Place the fender washer over the threaded rod and assemble the 1/2 in. lock nut.

c. Tighten the lock nut using a 3/4 in. wrench.

Figure 30 Securing the BR-000237-01 to the Truss or Strut



3. Attach the interface bracket.

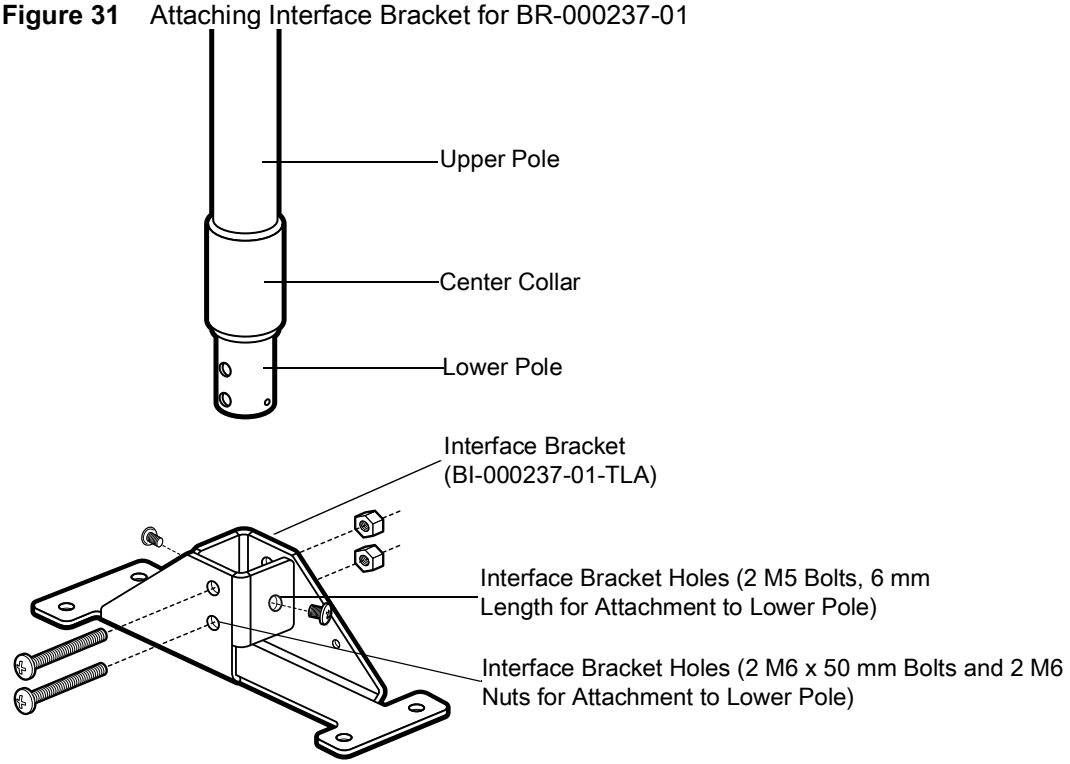
a. Place the interface bracket over the base of the lower pole.

b. Align the two lower holes of the lower pole with the two holes on the interface bracket.

c. Insert two M6 x 50 mm bolts and fasten in place using the two M6 lock nuts. Torque to 6 ft-lbs.

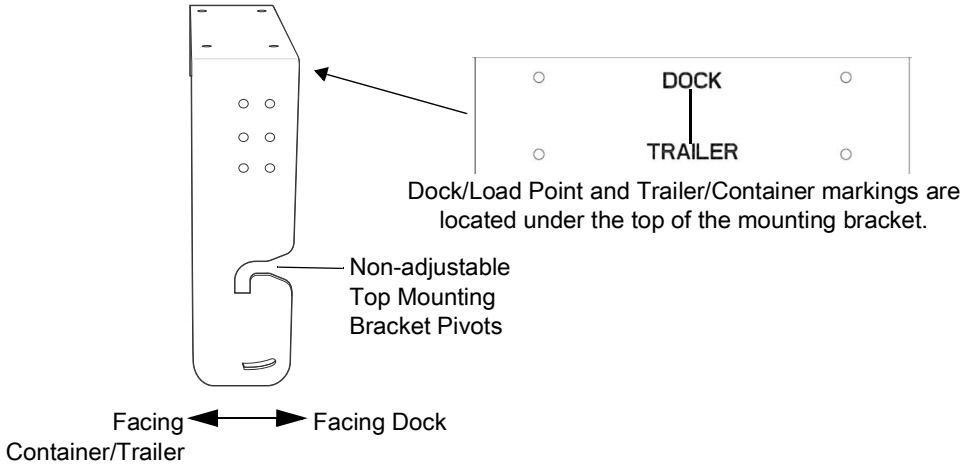
d. Insert the two M5 x 6 mm bolts to side interface bracket holes (the interface bracket holes Do Not mate with corresponding holes in the lower pole). The bolts engage with the side wall of the lower pole to prevent extraneous motion. For best LMU orientation results, alternate tightening the two bolts using a Phillips screw driver.

Figure 31 Attaching Interface Bracket for BR-000237-01



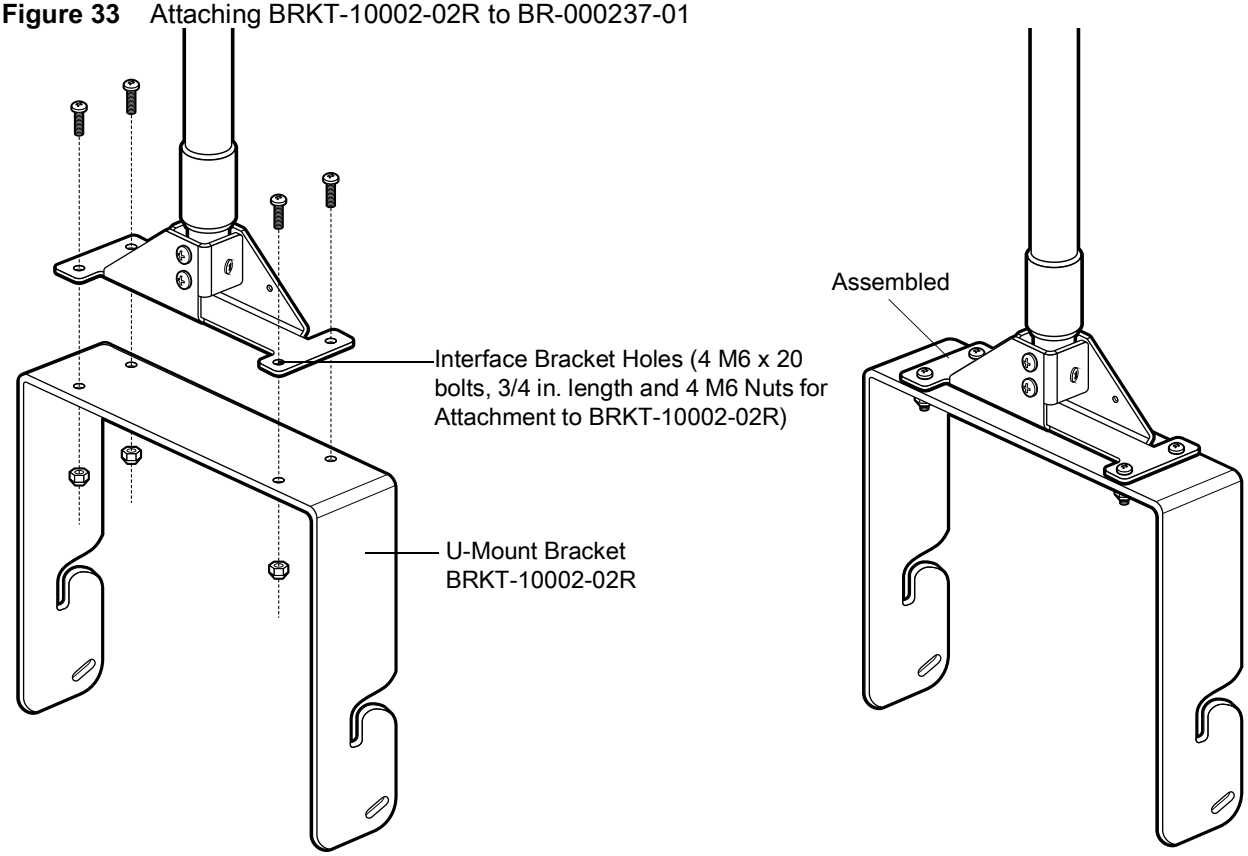
4. Secure the BRKT-10002-02R u-mount bracket to the interface bracket.
   a. Ensure the mounting bracket faces the correct direction. The dock/load point side faces the building and the trailer/container side faces the container.

Figure 32 Proper Direction for Installing BRKT-10002-02R with BR-000237-01



   b. Align the four holes on the BRKT-10002-02R with the four holes on the interface bracket.
   c. Secure the BRKT-10002-02R to the interface bracket using the M6 x 20 screws and four M6 lock nuts. Torque to 6 ft-lbs.

Figure 33 Attaching BRKT-10002-02R to BR-000237-01

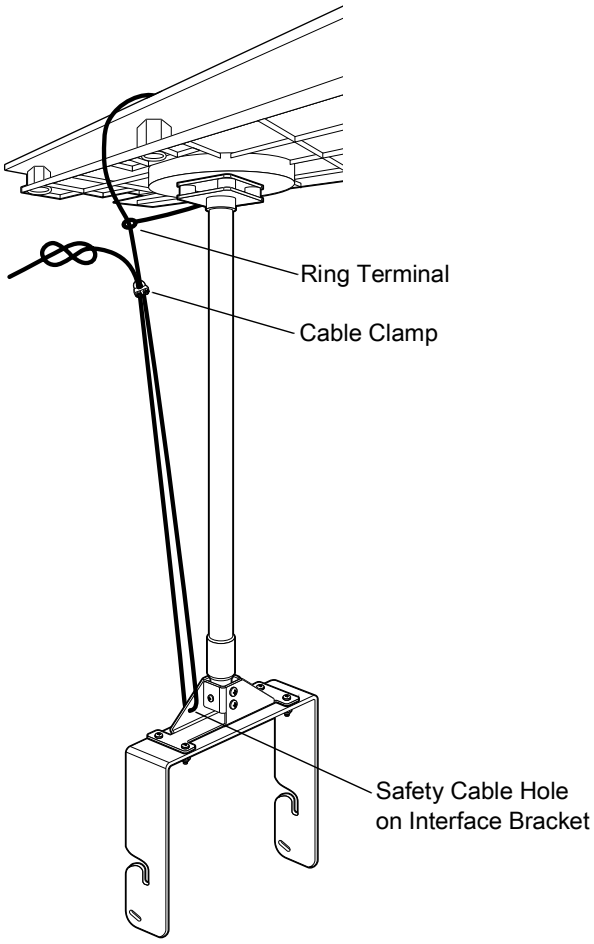


5. If necessary, adjust the length of the telescoping pole to accommodate the TM2000 height as per the site survey.
   a. Loosen the telescoping pole by rotating the center collar counter clockwise slightly (see Figure 28 on page 33).
   b. Pull the lower portion of the pole down or push the pole up to achieve the desired height.
   c. Lock the pole in position by rotating the center collar clockwise. Hand tighten the collar (see Figure 28 on page 33).
6. Install the safety cable. The safety cable may be installed over the truss/strut or from the top plate as follows:

   To install the safety cable over a truss or strut:

   a. Loop the ring terminal end of the safety cable around the truss or strut, and pass the other end of the cable through the ring terminal to securely fasten the cable to the truss or strut.
   b. Run the safety cable into the safety cable hole on the interface bracket.

Figure 34 Securing the Safety Cable Over a Truss or Strut



c. Fasten the cables using the cable clamp.

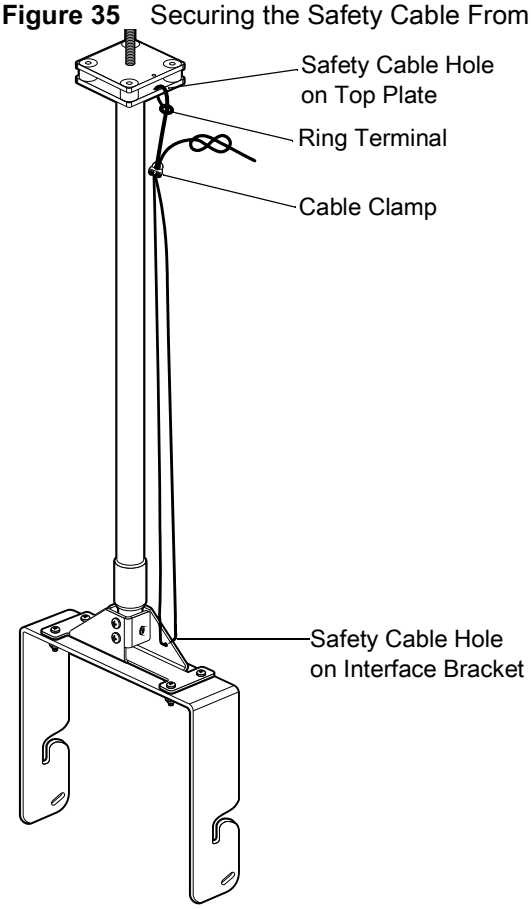
d. Remove all slack from the cable, and tie a knot at the loose end to prevent potential slippage of the cable through the clamp. A figure eight knot is recommended as it does not come loose easily. Snug the knot to the cable clamp to prevent any movement of the cable. Cut excess safety cable as needed.

To install the safety cable from the top plate:

a. Run the safety cable into the safety cable hole on top plate of the pole and pass the other end of the cable through the ring terminal to securely fasten the cable to the top plate.

b. Run the safety cable into the safety cable hole on the interface bracket.

Figure 35 Securing the Safety Cable From the Top Plate

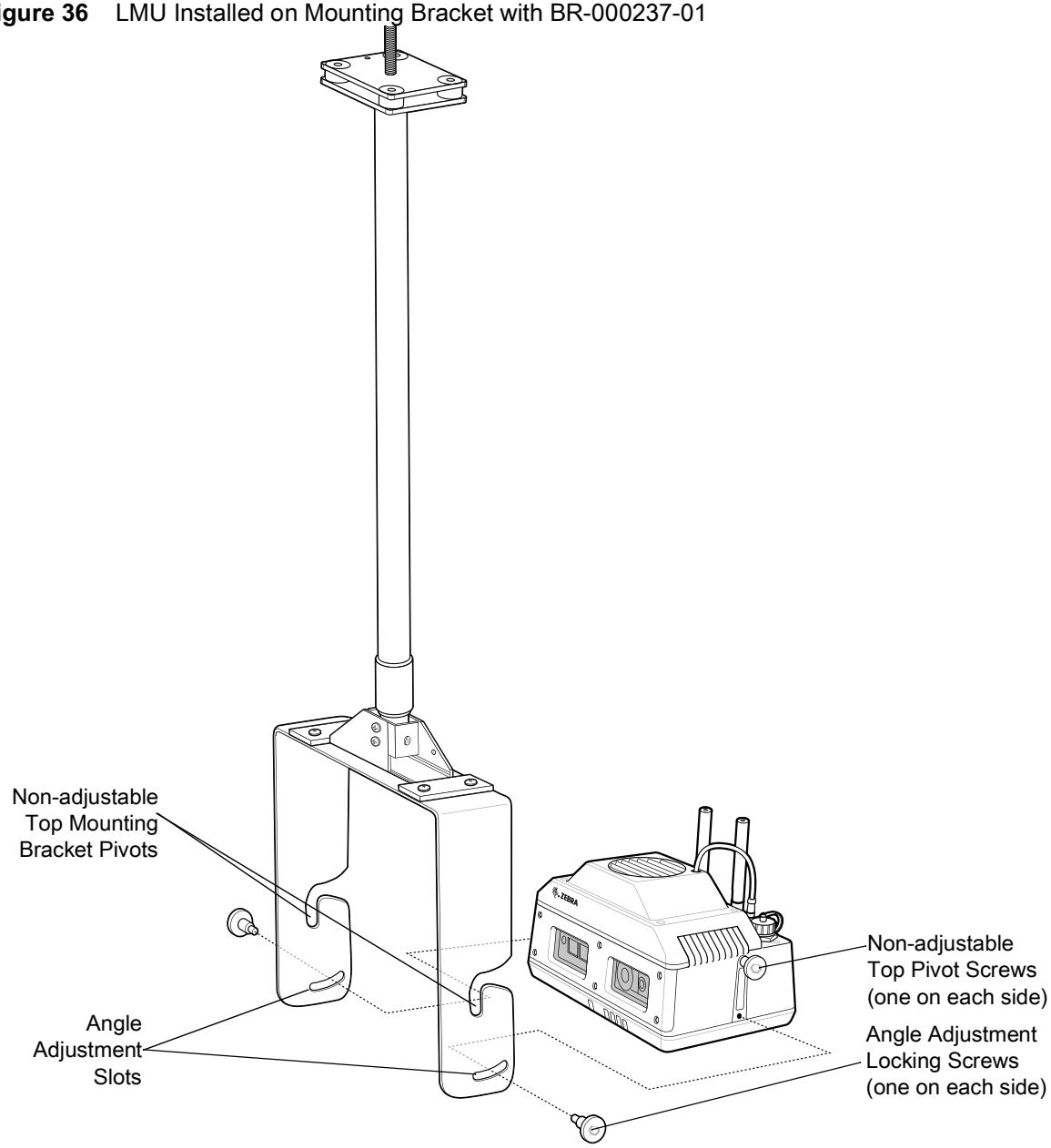


c. Fasten the cables using the cable clamp.

d. Remove all slack from the cable, and tie a knot at the loose end to prevent potential slippage of the cable through the clamp. A figure eight knot is recommended as it does not come loose easily. Snug the knot to the cable clamp to prevent any movement of the cable. Cut excess safety cable as needed.

7. Install the LMU on the BRKT-10002-01R (see LMU Installation with BRKT-10002-02R on page 15).

Figure 36 LMU Installed on Mounting Bracket with BR-000237-01



8. For Smart Pack Container installations only, see LMU Container Alignment Procedure on page 40.

LMU Container Alignment Procedure

Introduction

This chapter provides requirements and instructions for setting up and aligning the LMU for proper FOV (Field of View) of the ULD.

Installer Kit Contents

Installers must bring the provided kit on site:

- Cables
  - Cat 5 and above Ethernet cable.
  - 25 ft+ LAN cable recommended (longer cables provide more maneuverability when connected to a LMU mounted to a load point).
- USB Powered Router
  - The GL.iNET GL-MT300N-V2 Wireless Mini Portable Travel Router is recommended which can be purchased online. Other similarly capable USB bus powered routers may work. This router avoids having to connect to an external power supply as power outlets may not be available in the ULD load area.
- ULD Auto Configuration
  - Two white fabric tarp (6 ft x 9 ft) to be placed on the floor and back wall of the container (see Figure 37).
  - Two coded markers on foam boards need to be placed at the front edges of the container (see Figure 38 for detailed instructions).

ULD

- Empty the biggest available ULD, pull up to the front of the load scale, and secure.

Additional Tools and Supplies

- See Tools on page 11.
- Laser distance measure or tape measure.

LMU Container Alignment Procedure

CAUTION: Always utilize professional installers to safely install, mount, and supply power to the device. Always ensure device mounting and power routing meets regional building codes**.**

Perform pre-alignment verifications to ensure the Load Monitoring Unit (LMU) covers the field of view (FOV) into the unit load device (ULD).

NOTE: Select the largest ULD to perform the pre-alignment verification to ensure the LMU completely covers the FOV into all ULD sizes.

Before aligning the LMU, verify the following:

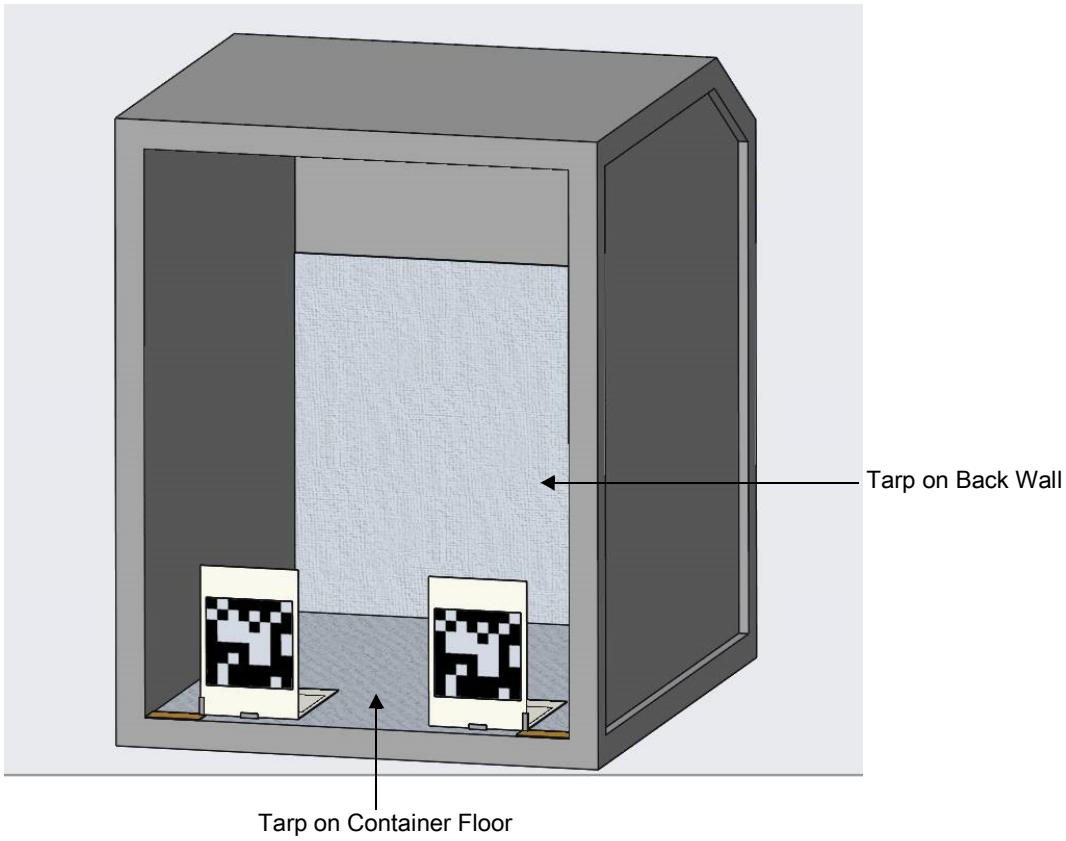
1. Place the largest ULD on the load scale to be observed by the LMU under alignment.
2. Open the ULD and make sure container is empty. If not, remove all items in the container.
3. Install the LMU on the installation bracket and point the LMU toward the ULD.
4. Power on the LMU and make sure it is capturing data. Verify that the **IMAGE** and **3D** LEDs (see Figure 4 on page 10) are cycling every 15 seconds.

Setting up Markers

It is necessary to place markers in the container to ensure proper FOV settings and maximize TM2000 analytics as follows:

1. Before setting the FOV, lay the fabric white tarp, provided in the kit, on the bottom of the inside of the container as follows:
   - Cover the container floor all the way up to the front edge of the container, as shown in Figure 37.
   - Cover the floor toward the back of the container to within 3 in. of the back wall of boxes, as shown in Figure 37. The tarp must be taut without creases and securely taped in place.
2. Cover the back wall with the second tarp provided in the kit. It must be aligned from the bottom edge of the back wall and up 6 ft (there may be a ~2 ft. space at the top of the back wall that will not be covered). The tarp must be taut without creases and securely taped in place.

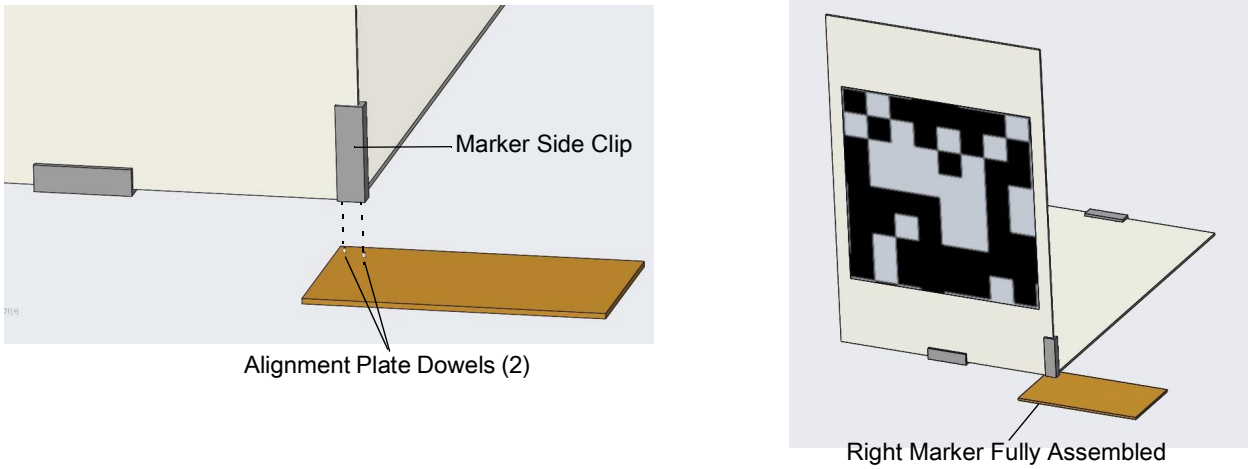
Figure 37 Tarp Placement



3. Assemble the markers provided in the kit as follows:

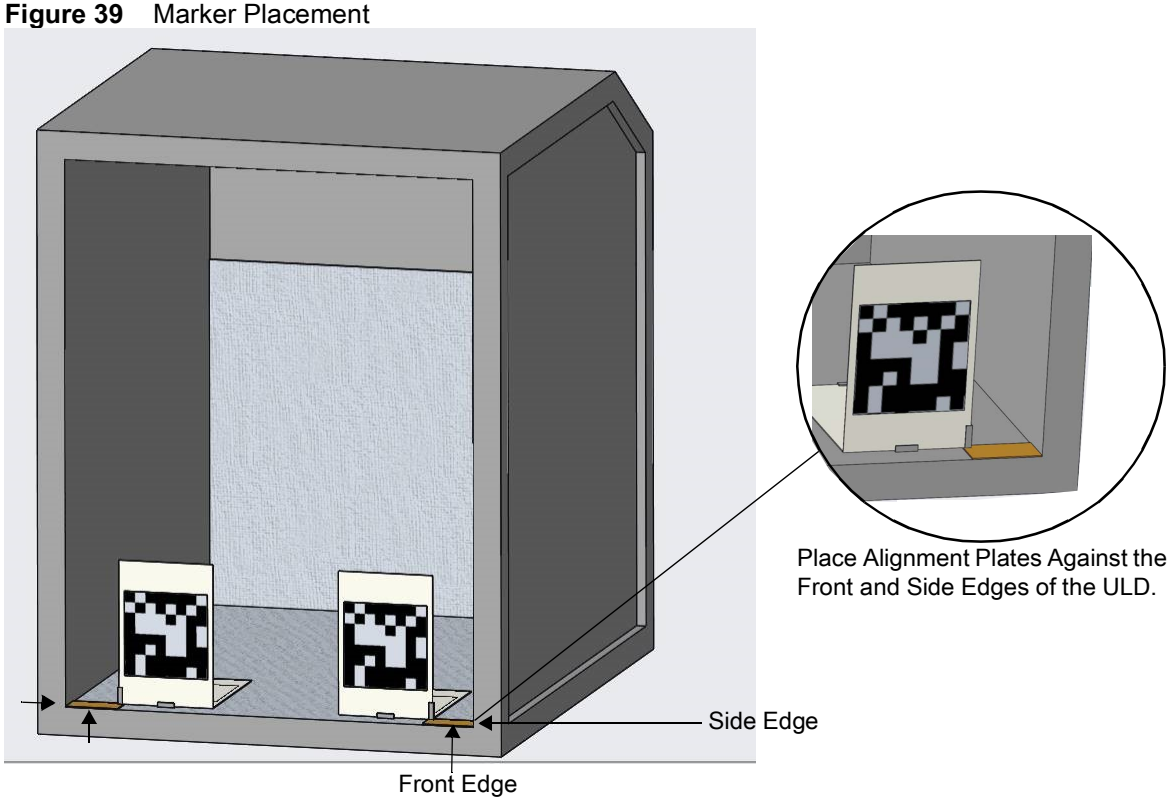
   - Both the right and left markers have side clips to attach the alignment plate as shown in Figure 38. Align the two holes on the bottom of the side clip with the two dowels on the alignment plate and attach.

Figure 38 Marker Assembly



   - Place the markers at each front side of the ULD as shown in Figure 39. Ensure that both the right and left alignment plates are placed up against the front and side edges of the ULD.

Figure 39 Marker Placement



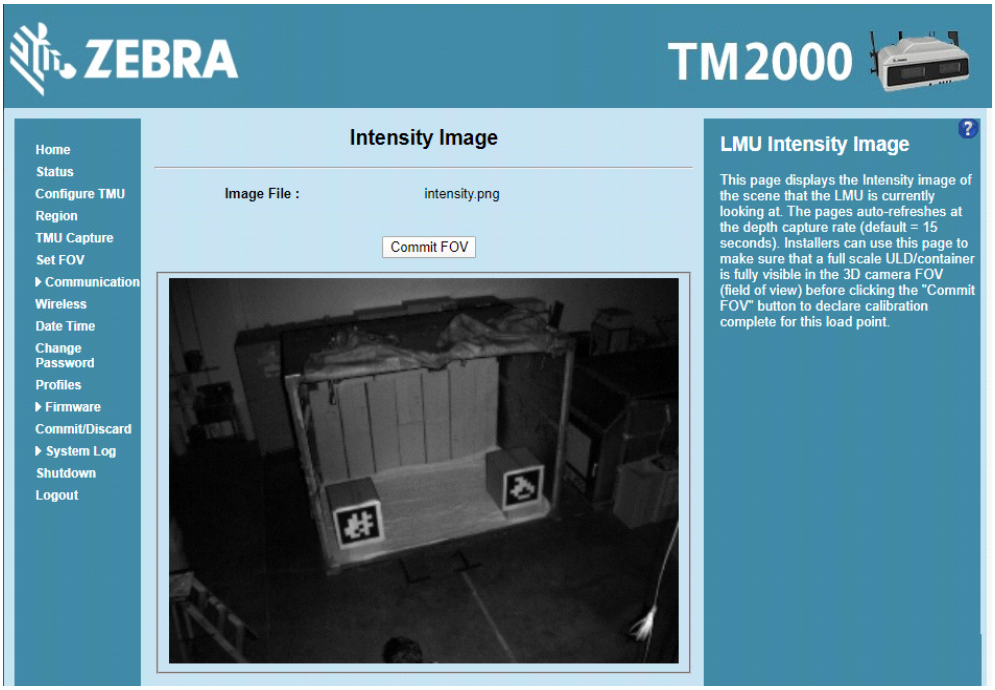
   - You must validate that the markers still lie along the same plane and there is no yaw or rotation to the front facing plane of the markers.

Auto-Config

After the markers are fully set up, start the auto-configuration process as follows:

1. Login to the web interface using Admin credentials (ask your Zebra contact for the password).
2. Click **Set FOV** to set the Field of View. A greyscale intensity or amplitude image displays.

Figure 40 Configuring FOV



3. Adjust the pitch and yaw angles of the LMU so that the entirety of the empty AMJ container and the markers are visible in the image.

   In order to adjust the LMU position, you must ensure that the bracket and the LMU do not have any roll angle to it. It must be parallel to the floor. The LMU pitch and yaw angles have to be adjusted by tilting the LMU up or down (pitch) or rotating it sideways (yaw).

   A few examples of an AMJ container with unacceptable and faulty FOV depth images are shown in Figure 41, Figure 42, and Figure 43.

   In Figure 41, the image shows that the LMU is too shallow. As a result, the marker is cut off and not fully in the field of view.

Figure 41 Image with Incorrect Pitch

In Figure 42, the image shows that the container is visible but not centered.

Figure 42 Image Not Centered

In Figure 43, the image shows that the LMU is rotated too far to the left. As a result, the container side panels are not fully visible.

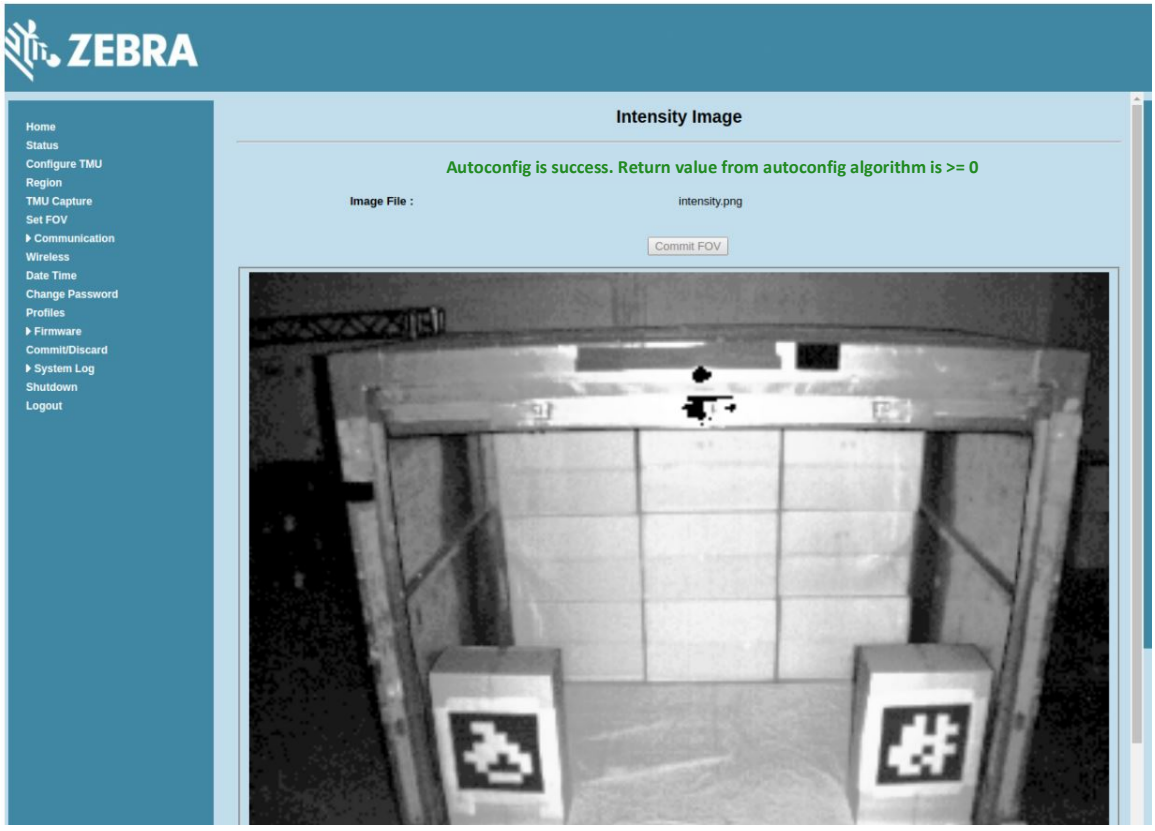
Figure 43 Image with Incorrect Yaw

An ideal FOV setting with an AMJ container is shown in Figure 44. The positioning is such that the top, bottom, and both sides of the container are fully in the FOV.

Figure 44 Proper FOV Positioning

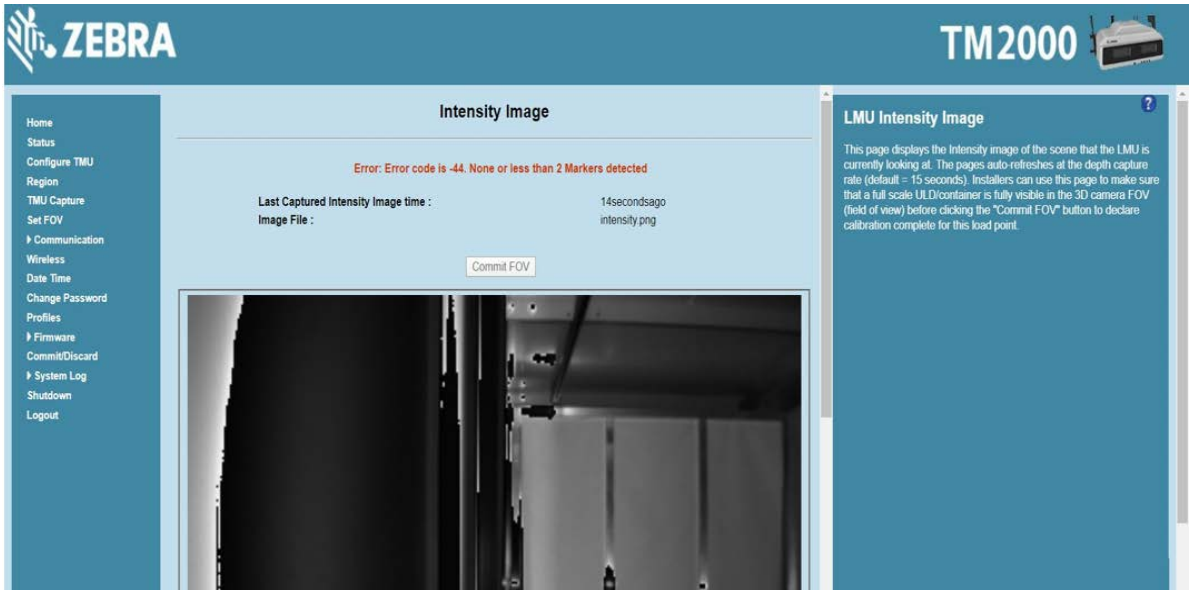
4. After the LMU is positioned correctly, press the **Commit FOV** button.
5. The button and auto-refreshing of the web page remain disabled until the calibration parameters are computed (this may take up to a minute) and a Success or Error message is displayed.
   - If successful, the auto-config process is complete. Disconnect cables and move to the next load point.

Figure 45 FOV Success Message



- If an error message displays as shown in Figure 46, see Troubleshooting on page 48 for a list of error codes and definitions.

Figure 46 FOV Error Message

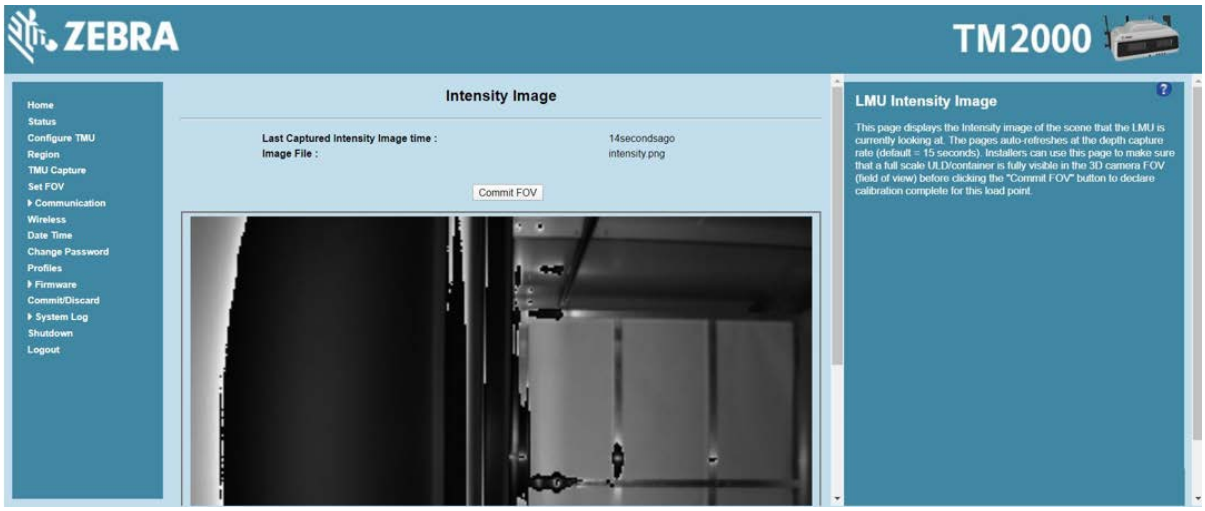


6. When the unit is aligned correctly, tighten the LMU by torquing the angle adjustment locking screws to 6.0 ft-lbs. After the LMU is tightened, continue to observe the alignment results to make sure the unit does not move during the tightening operation.

Captured Intensity Image Time

The **Last Captured Intensity Image time** is displayed on the Intensity Image screen. This is the time difference between the last proper intensity image captured and the current system time. Only proceed if the time shown is under 20 seconds. If the time shown is more than 20 seconds, reboot the LMU.

Figure 47 Captured Intensity Image Time



Troubleshooting

Table 2 Troubleshooting

Error Code	Error Definition
-20	The AutoConfig function failed. The container ROI parameters are not successfully established. Need to run AutoConfig again after verifying that the container is fully in the field of view including the container floor and sides being fully visible.
-21	AutoConfig needs a point cloud to work on. This point cloud is captured after the installer feedback step. This error is generated if there is an issue in saving the point cloud.
-23	The pitch angle calculated is above the set tolerance value (~30°). This requires physical adjustment of the unit to adjust the pitch angle.
20	This is not an error. It means autotuning read is not needed; the auto tune feature parameter is turned off.
-44	None or less than 2 markers detected.
-45	More than 2 markers detected.
-46	Markers detected are not distinct.
-47	Marker ID detected is different from the Config File (tmu_algorithms.xml).
-50	AutoConfig error during ground detection.
-51	AutoConfig error during front board detection.
>=0	Autoconfig is successful.

LED

Table 3 Status LEDs

LED	Description
Red	Autoconfig failure.
Blue	Autoconfig success.
Purple	LMU mounted angle is more than +/- 3° from the angle calculated at calibration time.

LED Scenarios:

- If Autoconfig is a failure, the LED turns Red. If the LMU mounted angle is changed to more than +/- 3° from the required actual angle, the LED color remains Red.
- If Autoconfig is a success, the LED is Blue. If the LMU mounted angle is changed to more than +/- 3° from the required actual angle, the LED color changes to Purple. In this case Purple overrides Blue.