



Collision Avoidance Module

Installation Guide

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4. We will be great to work with.
5. We will do something extra for our customers, as an apology, when something big goes wrong and it's our fault.
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9. We will go above and beyond in times of crisis. *If there's no one to authorize the required action in times of company or customer crisis - do what you know in your heart is right. (You may rent helicopters if necessary.)*

Collision Avoidance Module Installation Guide

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Introduction

Thank you for choosing Ross Video.

About This Guide

This is the Installation Guide for the Furio Collision Avoidance Module. The collision avoidance module is an optional accessory that prevents two Furio robotic dollies on the same track from colliding. The module enables the dollies to exchange data about their positions. Dollies are configured to slow down and/or stop moving if they are in danger of colliding.

This Installation Guide describes the collision avoidance module. It includes the following chapters:

- Chapter 1, “**Introduction**” on page 1–1, introduces the guide and provides information about documentation conventions and how to contact Ross Video Technical Support.
- Chapter 2, “**The Collision Avoidance Module**” on page 2–1, introduces the collision avoidance module.
- Chapter 3, “**Installation**” on page 3–1, describes how to install and test the collision avoidance module.
- Chapter 4, “**Configuration**” on page 4–1, describes configuration tasks that must be performed after installation. It also describes options to customize the collision avoidance behavior of your dollies.

If you have questions pertaining to the operation of the Ross Video product, please contact us at the numbers listed in the section “**Contacting Technical Support**” on page 1–1. Our technical staff is always available for consultation, training, or service.

Documentation Conventions

Special text formats are used in this guide to identify parts of the user interface, text that a user must enter, or a sequence of menus and submenus that must be followed to reach a particular command.

Interface Elements

Bold text is used to identify a user interface element such as a dialog box, menu item, or button. For example:

On the **Axis Settings** tab, in the **Track_Encoder** section, click **Set Current**.

User Entered Text

Courier text is used to identify text that a user must type. For example:

In the address bar, type `localhost`, and then press **Enter**.

Referenced Guides

Italic text is used to identify the titles of referenced guides, manuals, or documents. For example:

For more information, refer to the *SmartShell User Guide (5100DR-002)*.

Menu Sequences

Menu arrows are used in procedures to identify a sequence of menu items that you must follow. For example, if a step reads “Click **Server** > **Save As**,” you would click the **Server** menu and then click **Save As**.

Contacting Technical Support

At Ross Video, we take pride in the quality of our products, but if problems occur, help is as close as the nearest telephone.

Our 24-hour Hot Line service ensures you have access to technical expertise around the clock. After-sales service and technical support is provided directly by Ross Video personnel. During business hours (Eastern Time), technical support personnel are available by telephone. After hours and on weekends, a direct emergency technical support phone line is available. If the technical support person who is on call does not answer this line immediately, a voice message can be left and the call will be returned shortly. This team of highly trained staff is available to react to any problem and to do whatever is necessary to ensure customer satisfaction.

- **Technical Support:** (+1) 613-652-4886
- **After Hours Emergency:** (+1) 613-349-0006
- **E-mail:** techsupport@rossvideo.com
- **Website:** <http://www.rossvideo.com>

The Collision Avoidance Module

The Furio Collision Avoidance Module is an optional accessory that prevents two Furio robotic dollies on the same track from colliding. The module enables the dollies to exchange data about their positions.

Each dolly is configured to slow down and/or stop moving if it is in danger of colliding with the other dolly:

- If one dolly is moving towards a stationary dolly, it slows to a stop to avoid colliding.
- If two dollies are moving towards each other, both dollies will slow to a stop to avoid colliding.
- If both dollies are moving the same direction and they get too close, the faster dolly slows down to match the slower dolly's pace.
- If a dolly is performing a move or preset and the collision avoidance features slow or stop it, the move or preset resumes as soon as the way is clear. The dolly moves to the final position, but because of the interruption, the move or preset may not perform exactly as expected. You can cancel the rest of the move or preset by stopping the camera system. For information about executing and stopping moves and presets, see the *SmartShell User Guide (5100DR-002)*.

The collision avoidance module has four data cables that connect it to the dollies and to their wiredraw encoders. The wiredraw encoders provide positional data, which the module sends to both dollies. Configuration settings on the dolly heads enable you to customize the collision avoidance behavior for each dolly.



Figure 2.1 Furio Collision Avoidance Module

Note: If you are installing the collision avoidance module in a new system, do so before you create the cable bundles that run to the dollies. Depending on your layout, data cables that run between the dollies and the collision avoidance module may need to be added to the bundles. The detailed procedures in this chapter include more information about this.

IMPORTANT: After you install and configure the collision avoidance module, you must test collision avoidance behavior to ensure the system is functioning as expected. You must also test collision avoidance behavior after any changes to the configuration, or maintenance of, the collision avoidance system. For information about testing collision avoidance behavior, see “**Test Collision Avoidance Behavior**” on page 4–10.

Package Contents

In addition to the collision avoidance module unit, the package includes the following:

- Two CAN bus data cables, 0.5m (18 inches) long
- Two CAN bus data cables, 20m (65 feet) long
- One adhesive rubber mounting pad
- One set of hook-and-loop mounting pads
- Four #8 wood screws
- Four #8 plastic anchors
- This Installation Guide

Routine Maintenance and Cleaning

The collision avoidance module requires no routine maintenance.

To clean the module, wipe it with a slightly damp rag.

IMPORTANT: The collision avoidance module is not waterproof or water resistant. Protect it from inclement weather, and do not immerse it in any liquid.

Installation

This chapter describes how to install the Furio Collision Avoidance Module. It includes the following sections:

- “**Recommended System Layouts**” on page 3–1
- “**Retrofit Considerations**” on page 3–7
- “**Installing the Collision Avoidance Module**” on page 3–8

IMPORTANT: For the purpose of describing how to set up and configure collision avoidance, one end of the track is designated as the **primary** end. The other end is the **secondary** end. The procedures in this installation guide frequently refer to the primary and secondary ends of the track. It is important to select the primary end properly and take it into consideration as you install and configure the collision avoidance module. The installation procedures include steps for determining which end of the track is the primary end.

Note: After you install the collision avoidance module, you must configure and test it. For more information, see “**Configuration**” on page 4–1.

Recommended System Layouts

This section describes recommended layout options for the Furio system and the collision avoidance module. If you are installing the collision avoidance module as part of a new Furio system, ensure that it conforms to one of the recommended layouts.

Set up the Furio system and test it before you install the collision avoidance module.

Note: Other layouts may be supportable. If you are adding the collision avoidance module to an existing Furio system that does not conform to one of the recommended layouts, system modifications may be required. For more information, see “**Retrofit Considerations**” on page 3–7.

Layout Factors that Affect Collision Avoidance Setup

System layout factors that affect setup of the collision avoidance module include:

- **Shape of the track**

Tracks can be straight, curved, or mixed.

For mixed track layouts, only the following combinations are supported:

- › Straight + curved
- › Straight + curved + straight

- **Length of the track**

Tracks are either short or long:

- › Short tracks are 15m (50 feet) or less.
- › Long tracks are more than 15m (50 feet), but less than 38m (124 feet).

Tip: The length of a curved or mixed track is measured along the outside (long) edge of the track.

- **Position of the wiredraw encoders**

For short tracks, install the wiredraw encoders on the same end of the track.

For long tracks, wiredraw encoders must be installed on opposite ends of the track.

Short Straight Track

If your layout consists of a short, straight track, install both wiredraw encoders on the same end of the track.

Figure 3.1 shows the recommended layout for a short, straight track.

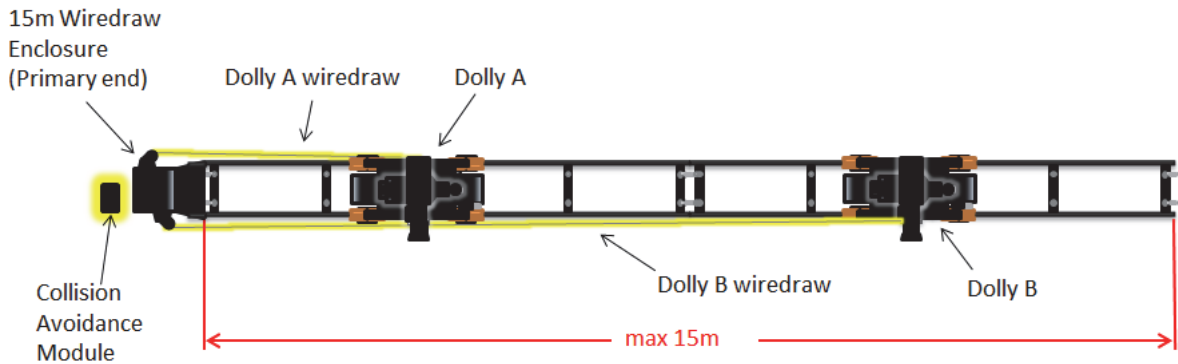


Figure 3.1 Layout for short, straight track

Figure 3.2 shows typical data cabling for a short, straight track.

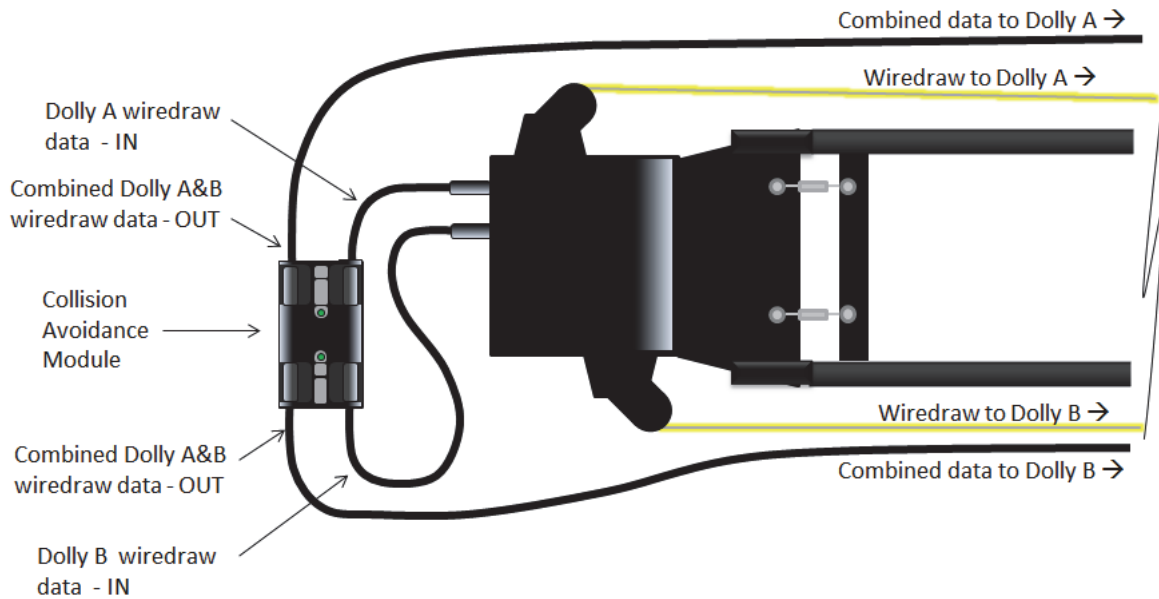


Figure 3.2 Typical cable layout for a short, straight track

Long Straight Track

If your layout consists of a long, straight track, the two wiredraw encoders must be on opposite ends of the track.

Figure 3.3 shows the recommended layout for a long, straight track.

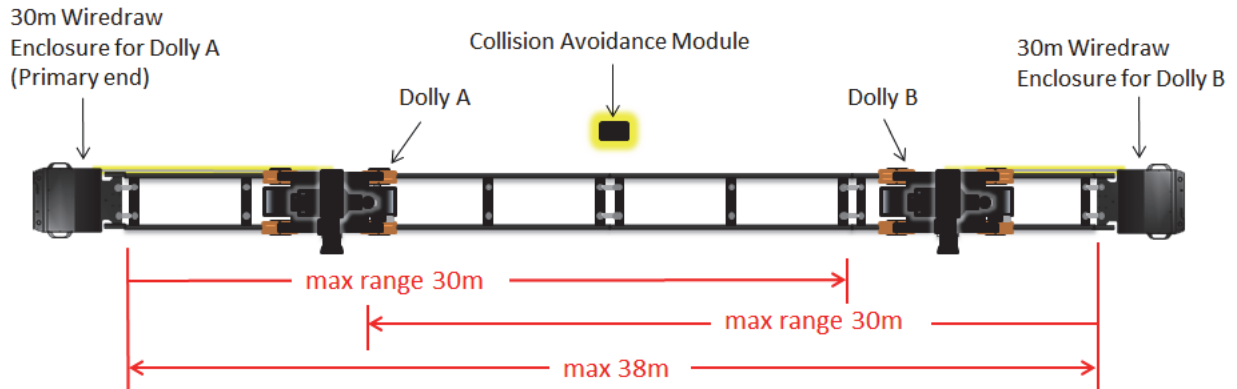


Figure 3.3 Layout for long, straight track

Figure 3.4 shows typical data cabling for a long, straight track.

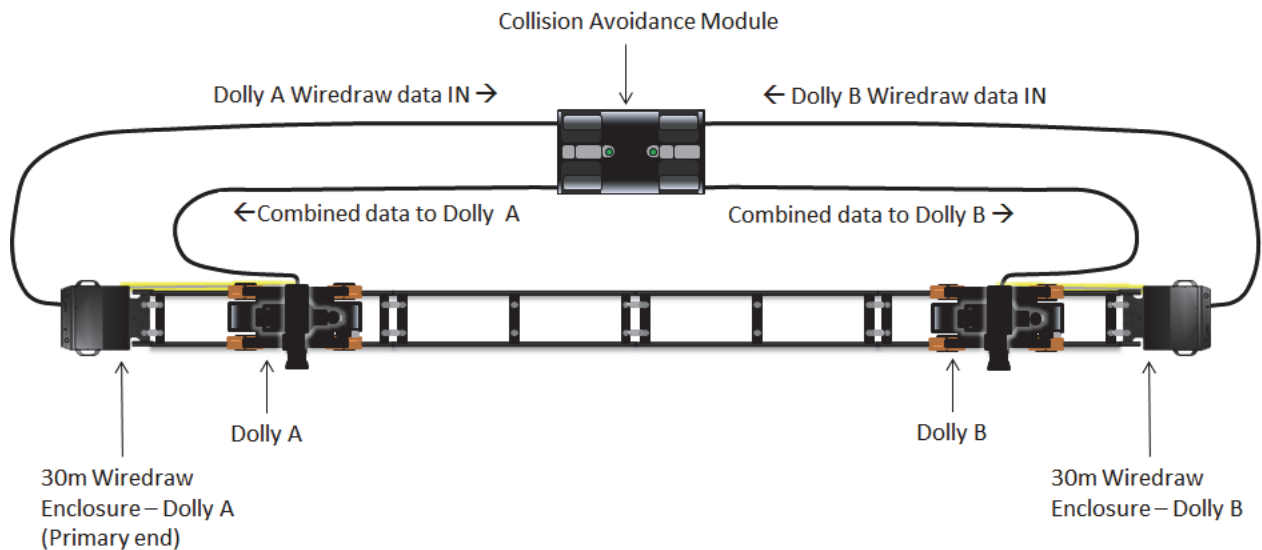


Figure 3.4 Typical cable layout for a long, straight track

Short Curved Track

If your layout features a short, curved track, install the wiredraw encoders on the same end of the track. The track consists of two rails. Position each wiredraw wire to ride along the long edge of a separate rail. **Figure 3.5** shows the recommended layout for a short, curved track.

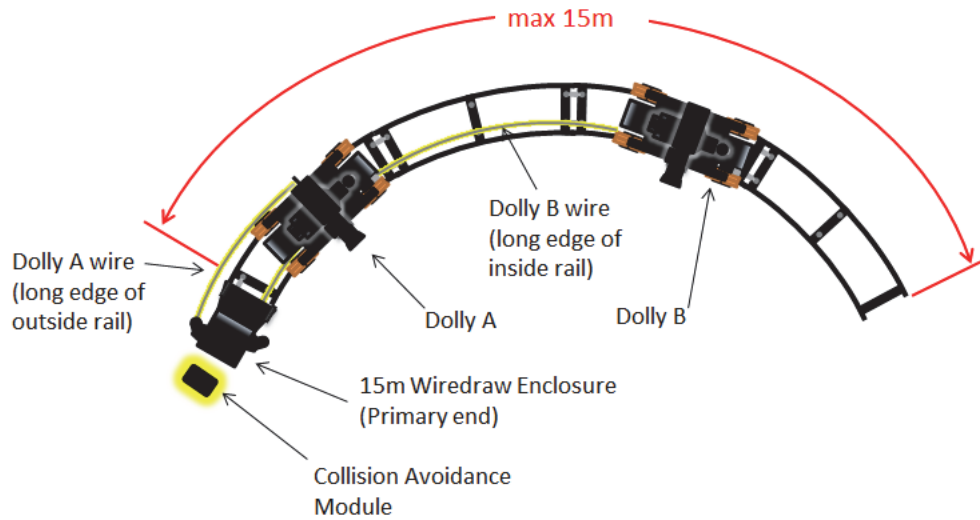


Figure 3.5 Layout for short, curved track

Figure 3.6 shows typical data cabling for a short, curved track.

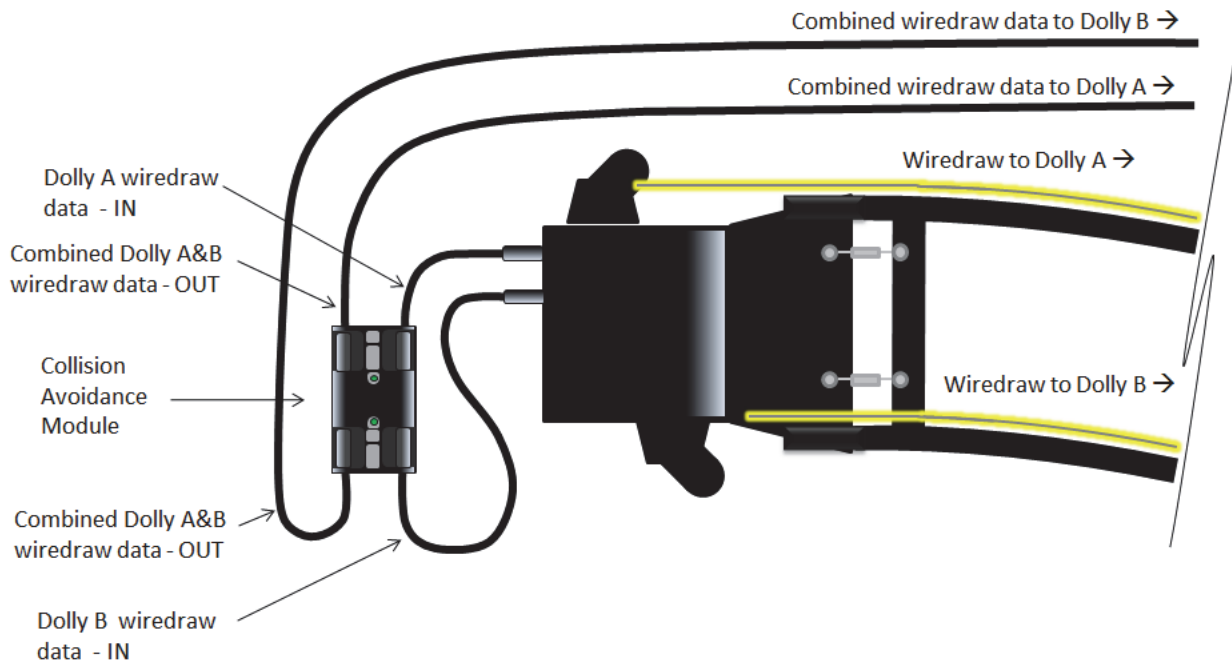


Figure 3.6 Typical cable layout for a short, curved track

Long Curved Track

If your layout features a long, curved track, the wiredraw encoders must be installed on opposite ends of the track.

Figure 3.7 shows the recommended layout for a long, curved track.

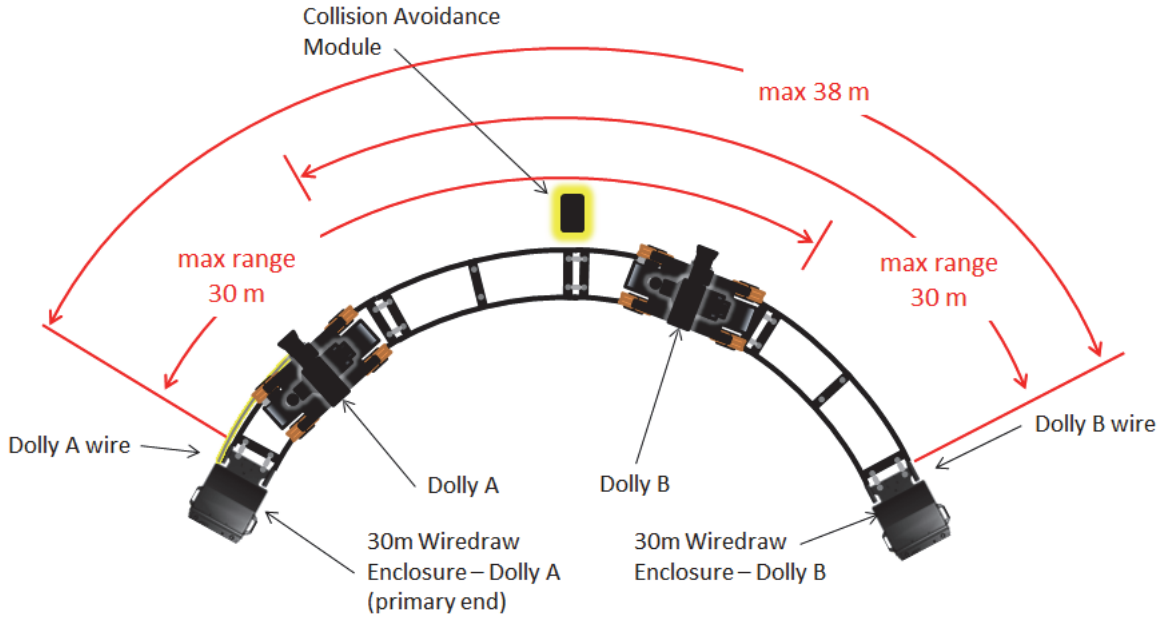


Figure 3.7 Layout for long, curved track

Figure 3.8 shows typical data cabling for a long, curved track.

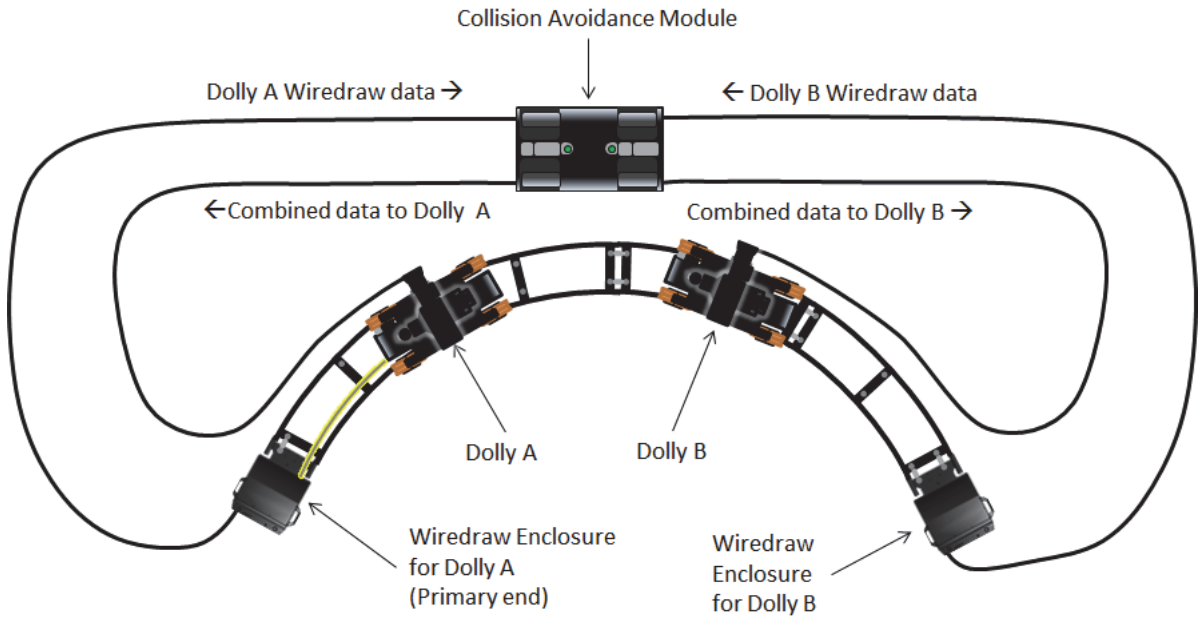


Figure 3.8 Typical cable layout for a long, curved track

Mixed Shape Track

Mixed tracks include curved and straight sections. Only the following combinations are supported:

- Straight + curved
- Straight + curved + straight

If your layout has a mixed shape track, the following conditions **MUST** be met for collision avoidance:

- Wiredraw encoders must be on opposite ends of the track.
- The motorized wheels of both dollies must ride on the same rail of the track.
- The wiredraw cables of both dollies must ride on the same rail as the motorized wheels.

Figure 3.7 shows the recommended layout for a mixed shape track (straight + curve).

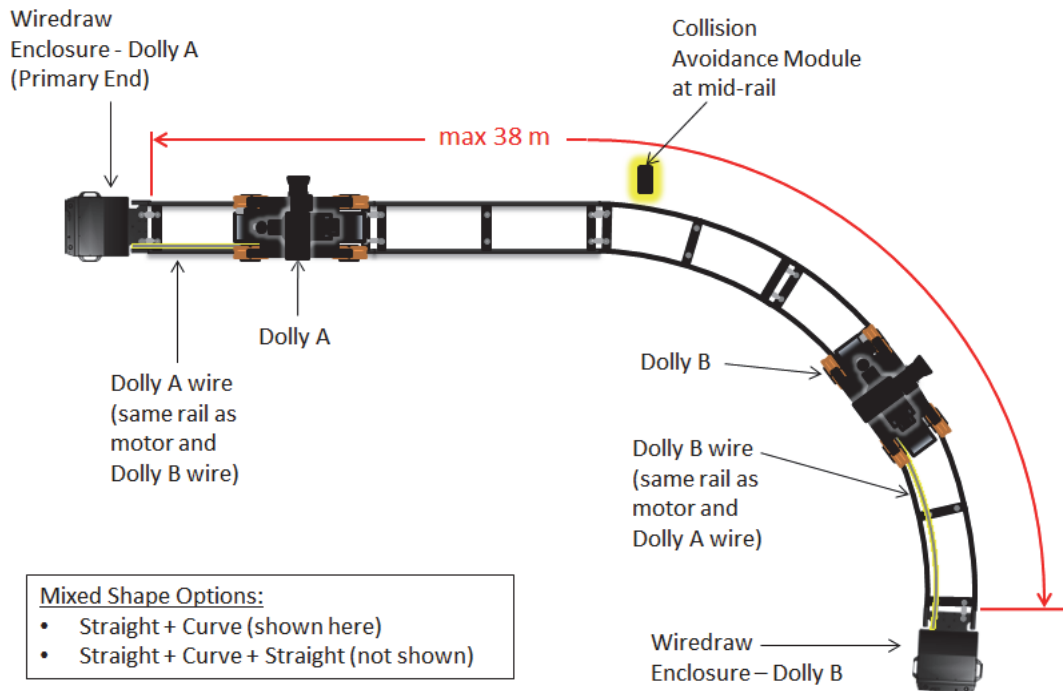


Figure 3.9 Layout for a mixed shape track (straight + curve)

Figure 3.8 shows typical data cabling for a mixed shape track (straight + curve).

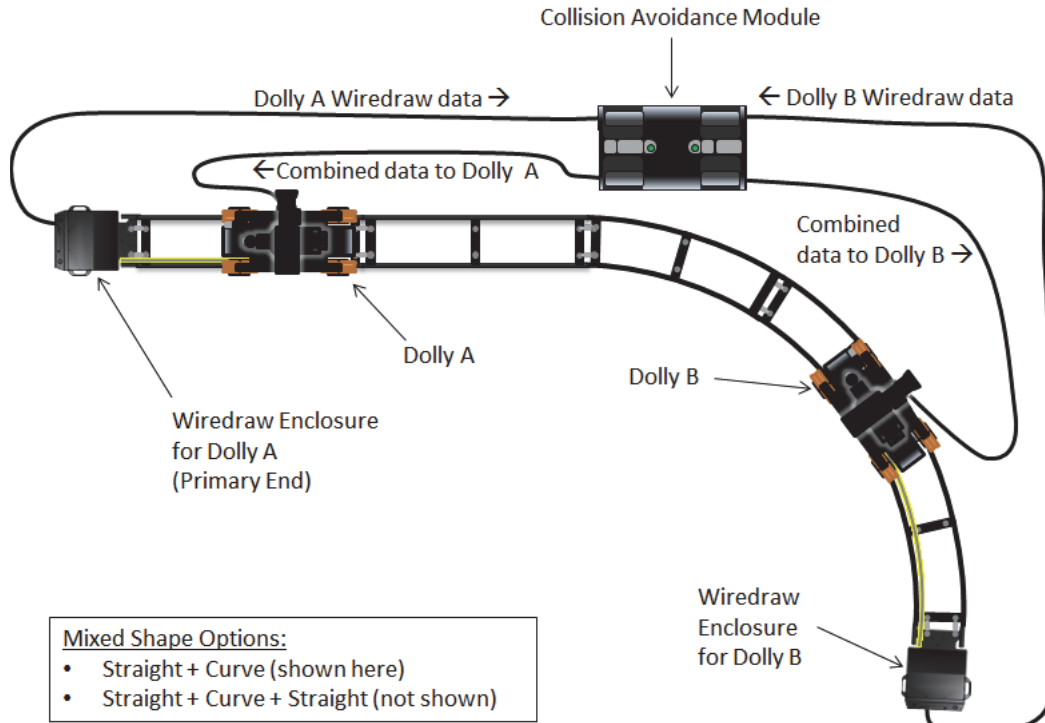


Figure 3.10 Typical cable layout for a mixed shape track (straight + curve)

Retrofit Considerations

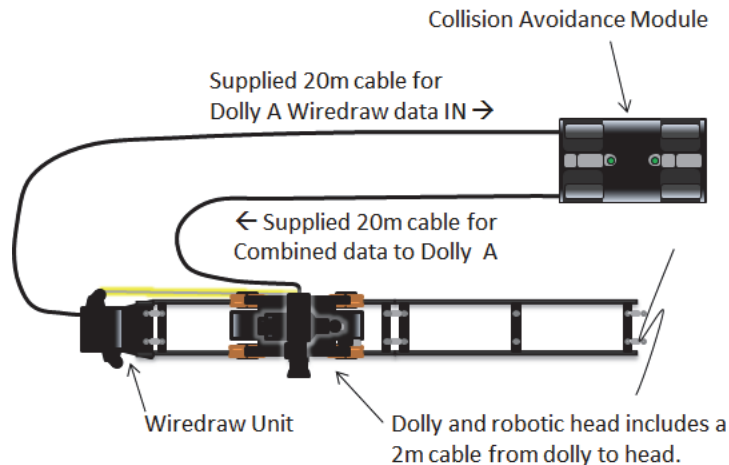
If you are adding the collision avoidance module to an existing Furio system that does not conform to one of the recommended layouts, it may still be supportable.

This section describes accommodations that may be required to support other layouts.

Cable Length Limit for CAN Bus Cables

The collision avoidance module uses a CAN bus network to transfer positional data. Each side of the collision avoidance module supports one dolly. There is a limit to the total length of CAN bus cables that can be used for each side of the collision avoidance module. For each dolly, the maximum total length of cable running from the wiredraw unit to the collision avoidance module to the dolly to the robotic head is 43m (141 feet).

Maximum total CAN bus cable run for each dolly is 43m.



Note: For short track installations, both wiredraw units are typically on the same end of the track, so supplied 0.5m cables are used instead of 20m cables between the wiredraw units and the collision avoidance module.

Figure 3.11 CAN bus cable length limitation of 43m for each dolly

Cable Management

Attached to each dolly is a bundle of power and data cables to support the dolly, robotic head, camera, prompter, etc. Ideally, the CAN bus cable connecting the collision avoidance module to the dolly would be part of the cable bundle, but this is not always possible due to the CAN bus cable length limit.

In long track layouts, the collision avoidance module is located halfway along the track. If cable bundles originate from the middle of the track, the CAN bus cables can be added to the cable bundles. If the cable bundles must originate from the ends of the track, the cable length required exceeds the CAN bus cable length limit. In this case, the CAN bus cables must be run separately.

Installing the Collision Avoidance Module

Before you install the collision avoidance module:

- If you are installing it with a new Furio system, set up the rest of the system and test it. Ensure that the system conforms to one of the recommended layouts.
- If you are adding it to an existing Furio system, ensure that the system conforms to one of the recommended layouts, or is supportable. For more information, see **“Recommended System Layouts”** on page 3–1.

The installation process consists of the following major steps:

1. Designate one end of the track as the primary end.
For detailed instructions, see **“Designate One End of the Track as the Primary End”** on page 3–9.
2. Determine where to install the collision avoidance module.
For detailed instructions, see **“Position the Collision Avoidance Module”** on page 3–9.
3. Connect data cables between the wiredraw units, the collision avoidance module, and the dollies.
For detailed instructions, see **“Connect the Data Cables”** on page 3–10.
4. Test data connectivity to ensure data cables are installed correctly.
For detailed instructions, see **“Test Data Connectivity”** on page 3–13.

5. Position and dress all cables to protect them and to help ensure safety.

For detailed instructions, see “**Dress the Data Cables**” on page 3–13.

6. Fasten the collision avoidance module in its final position.

For detailed instructions, see “**Mount the Collision Avoidance Module**” on page 3–13.

Note: After you install the collision avoidance module, you must configure and test it. For more information, see “**Configuration**” on page 4–1.

IMPORTANT: After you install and configure the collision avoidance module, you must test collision avoidance behavior to ensure the system is functioning as expected. You must also test collision avoidance behavior after any changes to the configuration, or maintenance of, the collision avoidance system. For information about testing collision avoidance behavior, see “**Test Collision Avoidance Behavior**” on page 4–10.

Designate One End of the Track as the Primary End

For the purpose of describing how to set up and configure collision avoidance, one end of the track is selected to be the **primary** end. The other end is the **secondary** end.

The procedures in this installation guide frequently refer to the primary and secondary ends of the track. This notation is used to ensure proper cabling and accurate calculation of configuration settings.

It is important to select the primary end properly, and take it into consideration as you install and configure the collision avoidance module.

To select the primary end:

- If both wiredraw encoders are on the same end of the track, that end is the primary end.
- If each end has a wiredraw encoder, choose an end to be the primary end. This is an arbitrary decision.

Tip: After configuration, the track position values for both dollies will increase as the dollies move away from the primary end and towards the secondary end.

IMPORTANT: In this Installation Guide, the dolly closest to the primary end is referred to as **Dolly A**. The other dolly is **Dolly B**.

Position the Collision Avoidance Module

Select a location for the collision avoidance module, but do not mount it yet.

The location must allow enough space for connecting and disconnecting data cables. It must be a dry location where the module will not be subject to physical damage. Ensure the mounting surface is flat, clean, and dry.

Select a mounting location according to the length of the track:

- **Short Track**

Position the collision avoidance module beside the wiredraw enclosure at the **primary** end of the track. It can be later attached to the wiredraw enclosure, or be mounted beside it.

- **Long Track**

Position the collision avoidance module such that 20m (65 foot) cables from the module can reach each dolly and each wiredraw enclosure.

Note: For each dolly, we recommend adding the cable that runs between the collision avoidance module and the dolly to the dolly’s cable bundle if possible. Cable runs to dollies must include enough slack to allow for the full range of dolly motion.

Connect the Data Cables

Each side of the collision avoidance module receives two cables to support one dolly. One cable is from the wiredraw encoder, and the other extends to the dolly. An additional 2m (6 foot) cable runs from the dolly to the robotic head.

The right side of the collision avoidance module supports **Dolly A**, which is the dolly closest to the **primary** end of the track.

The left side of the collision avoidance module supports **Dolly B**, which is the dolly closest to the **secondary** end of the track.

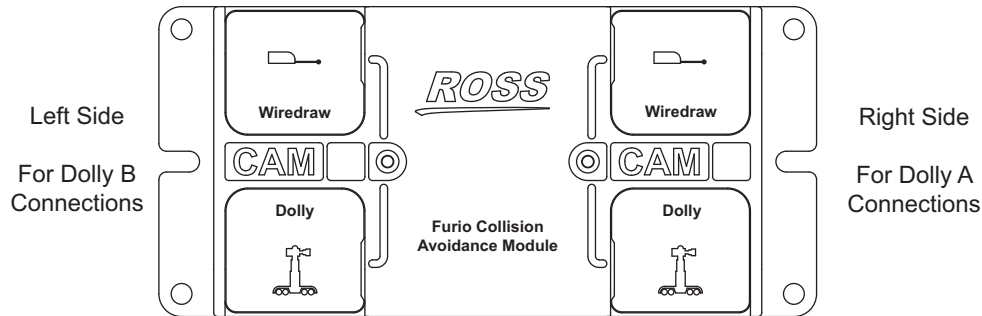


Figure 3.12 Right and Left sides of the Collision Avoidance Module

If you have two Furio dollies plus a collision avoidance module package, you should have the following cables available for this installation:

- Two short CAN bus data cables, each 0.5m (18 inches) long
These come with the collision avoidance module.
- Two 2m CAN bus cables for connecting each dolly to its robotic head.
These come with the dollies.
- Four long CAN bus data cables, each 20m (65 feet) long

Two of the long cables come with the collision avoidance module, and the other two come with the dollies (one per dolly, running between the wiredraw enclosure and the dolly).

IMPORTANT: Check the length of the two long cables that came with your Furio system. Each cable has a tag close to one end that follows the format **901-101-xxM**, where **xx** is the cable length, in meters. For each dolly, the maximum total length of cable running from the wiredraw unit to the collision avoidance module to the dolly to the robotic head is 43m (141 feet).

Note: Each CAN bus connector has an orientation key that aligns with an orientation groove on the socket (**Figure 3.13**). To connect, rotate the connector until properly aligned, and then insert the connector into the socket. The connector clicks when fully inserted.

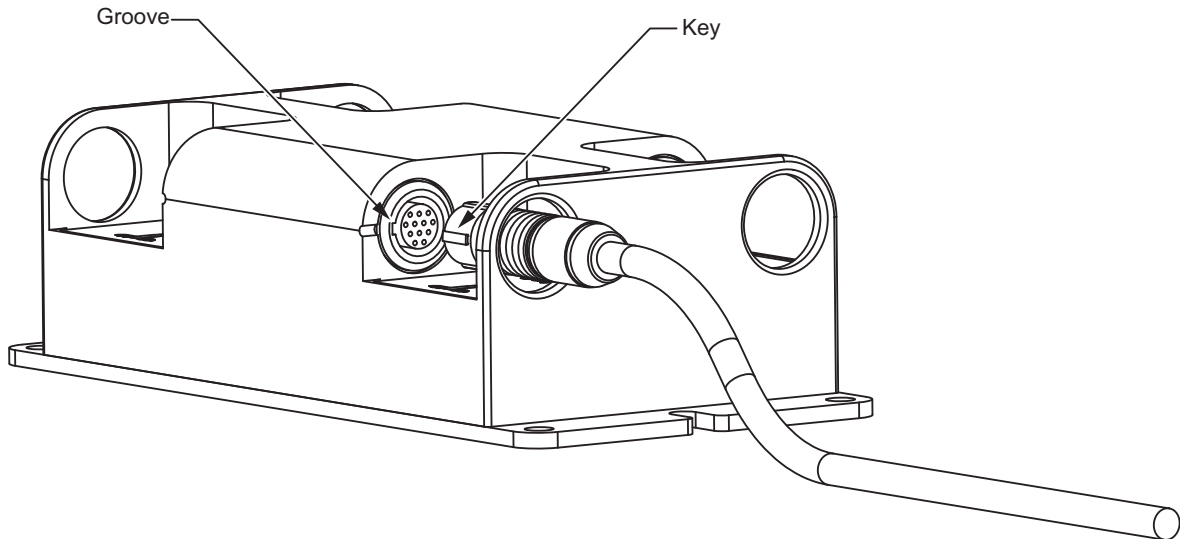


Figure 3.13 Cable connector and socket, showing orientation key and groove

To connect the data cables:

1. Each dolly has a corresponding wiredraw encoder. Disconnect the CAN bus cable that runs between one dolly and its wiredraw encoder.
2. Connect a CAN bus cable to the wiredraw encoder (**Figure 3.14**).

Use a short cable if the collision avoidance module is beside the wiredraw encoder. Otherwise, use a long cable.

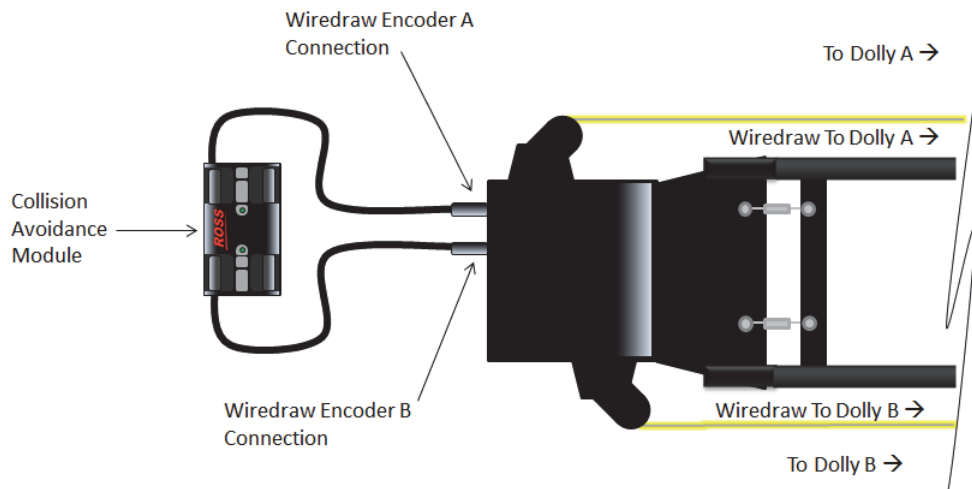


Figure 3.14 Wiredraw encoder connections for 15m wiredraws

IMPORTANT: Note which dolly the wiredraw wire is connected to. You will need this information in future steps.

3. Connect the other end of the wiredraw CAN bus cable to the correct **Wiredraw** socket on the collision avoidance module. If connecting Dolly A, plug into the right side of the module.

4. On the **same side** of the collision avoidance module, connect a long CAN bus cable to the **Dolly** socket.
IMPORTANT: Each side of the collision avoidance module has connections for one dolly and its wiredraw encoder. Improper cabling may result in unpredictable behavior, possibly including dolly collision. We recommend you label all cables as you connect them.
5. Connect the other end of the dolly CAN bus cable to the rightmost CAN bus connector on the dolly (**Figure 3.15**). This must be the same dolly you noted in step 1 on page 3-11.
Tip: The leftmost connector also works. Avoid using the center connector for this purpose.

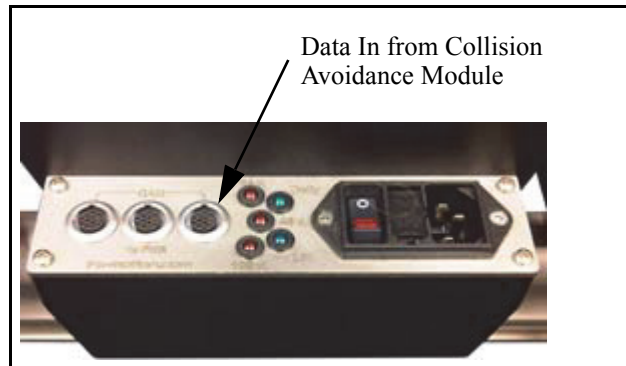


Figure 3.15 Connecting to the dolly

6. Connect a 2m CAN bus cable between the center CAN connector on the dolly, and one of the **NETWORK** connectors on the robotic head (**NETWORK A** or **NETWORK B**).
7. Route the dolly CAN bus cable.
8. Repeat steps 1 to 7 for the second dolly.
9. If you intend to refer to the dollies as something other than Dolly A and Dolly B, you can use a marker to label the white squares on the collision avoidance module (**Figure 3.16**). This is an optional step.

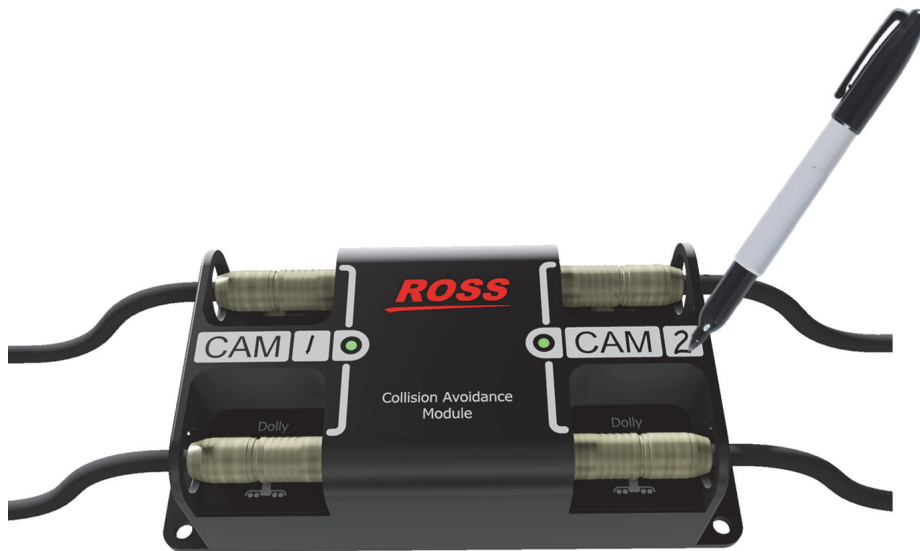


Figure 3.16 Labeling the collision avoidance module

Tip: If you ever need to change the labels, attach pieces of tape or blank labels over the white squares.

Test Data Connectivity

The collision avoidance module has two LEDs that indicate connectivity.

IMPORTANT: Green LEDs do **NOT** guarantee collision avoidance! The LEDs indicate data connectivity only. When an LED is green, it indicates that the dolly connected to that side of the collision avoidance module is receiving positional data from the other dolly. Collision avoidance is ensured only when the collision avoidance behavior settings on both dollies are properly configured. For more information, see “**Configuration**” on page 4–1.

To test connectivity of the collision module:

1. Turn off both dollies.
2. Turn on both dollies.

The collision avoidance module is powered by the dollies. When the dollies are starting, one or both LEDs on the collision avoidance module may turn orange to indicate that startup is in progress.

3. Reboot both dolly heads and watch the LEDs on the collision avoidance module:
 - › When one dolly receives positional data from the other one, the first dolly’s LED turns green.
 - › When both LEDs turn green, full connectivity is established and the dollies are exchanging positional data.
4. If the LEDs do not turn green, check all cable connections and then repeat this procedure.

Dress the Data Cables

Data cables must be positioned and dressed such that:

- they do not present a tripping hazard
- they are not subject to physical damage
- they allow full range of dolly motion without snagging
- any excess cable is stored safely
- the installation complies with local safety regulations and your studio’s policies

To position and dress the data cables:

1. Position the cables that run from the wiredraw units to the collision avoidance module.
2. To each dolly’s cable bundle, add the data cable that runs between the dolly to the collision avoidance module.

Note: This may not be possible if the cable bundles originate from the ends of the track.

Ensure that the cable bundles are properly dressed to relieve strain and to allow full range of motion without snagging.

Mount the Collision Avoidance Module

Mount the collision avoidance module in a dry location where it will not be subject to physical damage.

The collision module includes an installation kit which contains one set of hook-and-loop mounting pads, four wood screws, and four plastic anchors. The kit also includes a rubber anti-skid pad you can apply to the bottom of the module if you do not want to fasten the module in place.

There are three mounting options:

- Mount on a flat surface without puncturing the surface, using supplied hook-and-loop mounting pads.

Tip: For short track systems, you can use this option to attach the collision avoidance module to the wiredraw enclosure.

- Mount on a flat surface using the supplied screws or other mechanical fasteners of your choice.

Tip: The mounting holes and slots on the collision avoidance module are designed for M4, M5, #8, and #10 size fasteners.

Tip: If you need to temporarily disconnect data cables to mount the collision avoidance module, ensure that the cables are labeled so you can easily reconnect them.

To mount the collision avoidance module using hook-and-loop mounting pads:

1. Determine the exact location where you want to mount the module.
The mounting location must allow enough space for connecting and disconnecting data cables. Ensure the mounting surface is flat, clean, and dry.
2. Examine the hook and loop mounting pads. The softer pad is the loop pad.
3. Peel the plastic protective sheet off the loop pad.
4. Align the adhesive side of the pad with the recessed area on the underside of the collision avoidance module, and then attach the pad to the module.
5. Peel the plastic protective sheet off the hook pad.
6. Align the adhesive side of the pad with the mounting location, and then attach the pad to the mounting surface.
7. Align the loop pad with the hook pad, and then press them together.

The hook and loop pads secure the module in place. For best results, rotate the module back and forth as you press it onto the hook pad, to fully seat the hooks and loops together.

To mount the collision avoidance module using wood screws or other mechanical fasteners:

1. Determine the exact location where you want to mount the module.
The mounting location must allow enough space for connecting and disconnecting data cables. Ensure the mounting surface is flat, clean, and dry. It must also be made of material that can accept the fasteners you plan to use.
2. Referring to the mounting diagram **Figure 3.17**, determine where to install the fasteners.

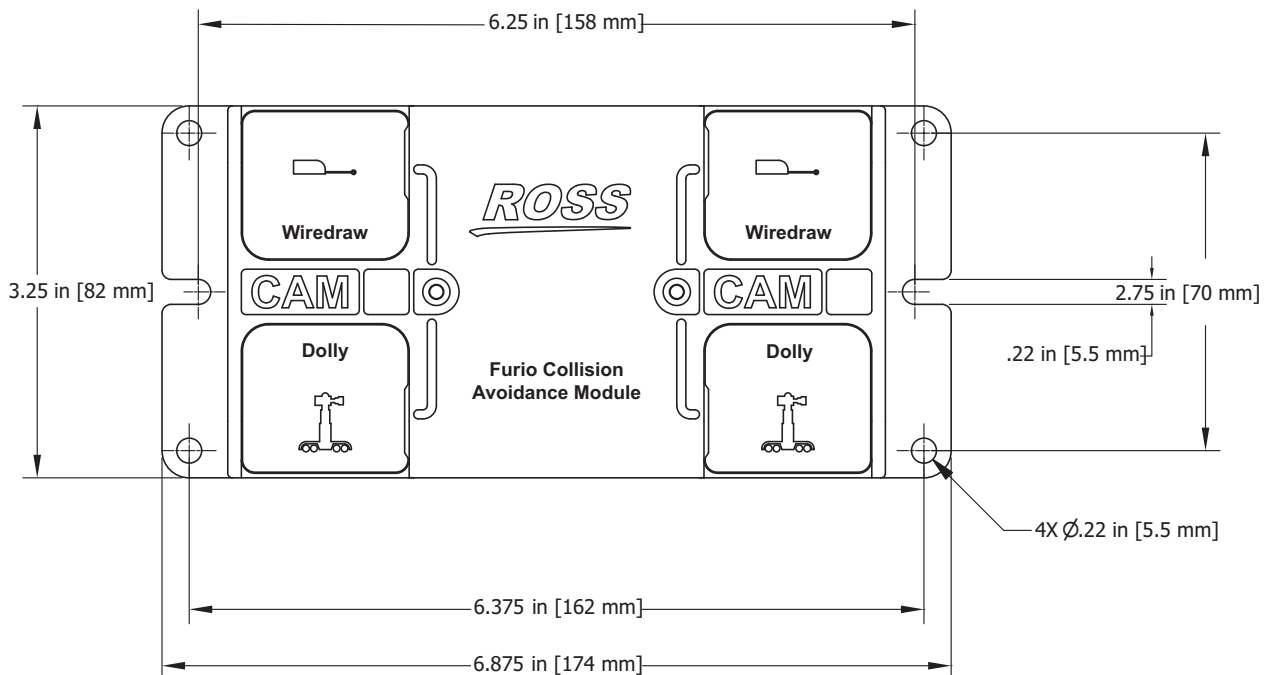


Figure 3.17 Mounting diagram showing the two end notches and four corner holes

The collision avoidance module has two end notches and four corner holes that accept #8, #10, M4, or M5 size fasteners. You can use the two end notches, or two corner holes diagonally across from each other, or all four corner holes.

3. If you are using fasteners other than those provided, prepare the surface and install the module.
Skip the remaining steps.
4. If you are using the fasteners provided, on the mounting surface mark the positions where you want to install the fasteners.
5. Drill pilot holes as follows:
 - If you are attaching to a solid surface that can accept screw threads, such as wood, plastic anchors are not required. Drill 2mm (3/32 inch) pilot holes.
 - If you are attaching to a surface that requires plastic anchors, such as drywall or concrete, drill 5mm (3/16 inch) pilot holes.
6. Insert the plastic anchors into the holes, if required.
7. Align the collision avoidance module with the holes, and then fasten it down using the supplied screws. Do not overtighten.

To attach the rubber anti-skid pad:

1. Peel the plastic protective sheet off the rubber anti-skid pad.
2. Align the adhesive side of the pad with the recessed area on the underside of the collision avoidance module, and then attach the pad to the module.

Configuration

This chapter includes instructions for configuring your Furio system to work with the Furio Collision Avoidance Module. To ensure collision avoidance, you must perform some or all of the configuration tasks described in this chapter. Your system layout determines which tasks are required.

Before you configure your system for collision avoidance, ensure that

- the Furio system is completely set up and works properly
- the collision avoidance module is installed according to the instructions in the chapter, “**Installation**” on page 3–1.

IMPORTANT: Green LEDs on the collision avoidance module do **NOT** guarantee collision avoidance! The LEDs indicate data connectivity only. When an LED is green, it indicates that the dolly connected to that side of the collision avoidance module is receiving positional data from the other dolly. Collision avoidance is ensured only when the collision avoidance behavior settings on both dollies are properly configured.

IMPORTANT: After you install and configure the collision avoidance module, you must test collision avoidance behavior to ensure the system is functioning as expected. You must also test collision avoidance behavior after any changes to the configuration, or maintenance of, the collision avoidance system. For information about testing collision avoidance behavior, see “**Test Collision Avoidance Behavior**” on page 4–10.

To configure collision avoidance behavior, you must perform all of the following configuration tasks in the order listed below:

- “**Calculate Parameter Values**” on page 4–1
- “**Edit the Configuration Template File**” on page 4–3
- “**Calibrate to a Common Reference Point At the Center of the Track**” on page 4–8
- “**Set Track Axis Limits**” on page 4–9
- “**Test Collision Avoidance Behavior**” on page 4–10

Calculate Parameter Values

This section contains procedures for calculating parameter values that help the dollies determine their position on the track, and direction of travel. The parameter values will be required when you edit the configuration template file in a later procedure.

Calculate Wiredraw Radius (WR)

Perform this procedure if your track is curved. This does not apply to straight layouts, or to mixed shape (curved + straight or straight + curved + straight) layouts.

In this procedure, you calculate the radius of the arc along which a wiredraw cable travels if it rides along the outer (longest) rail of the track. This is referred to as the **Wiredraw Radius (WR)**. **WR** is used to determine other configuration values. Calculate **WR** even if neither of the wiredraw cables in your system rides along the outer rail.

To calculate the radius:

1. Read the label on a section of track to determine the nominal radius.

In the example shown in **Figure 4.1**, the nominal radius is 5 meters. For our radius calculation, we start with the nominal track radius in millimeters, so the starting value is **5000**.



Figure 4.1 Reading track labels to determine track radius

Tip: Nominal track radius is measured from the center of the circle to the center of the outside rail.

2. Add 12.5.

This is the value of **WR**. Record the value and keep it available for subsequent procedures.

Calculate UnitValue for the Track Encoder (UV_TE)

Perform this procedure once per dolly.

This procedure describes how to calculate the correct value for the **UnitValue** parameter, for the DataSource Track Encoder (**UV_TE**). This value is used in subsequent procedures.

If your track is curved, you must know the wiredraw radius (**WR**) value before you perform this procedure. For more information, see “**Calculate Wiredraw Radius (WR)**” on page 4–1.

In this procedure, you calculate the absolute value of **UV_TE**, and then determine its sign (positive or negative).

To calculate UV_TE:

1. Look at the position of the wiredraw cable and note which rail it travels along.
2. Note whether the track wiredraw unit is a 15m unit or a 30m unit.
3. If the wiredraw unit is a **15m unit**, calculate the absolute value of **UV_TE**, based on the scenario that applies:
 - If the track is straight or mixed shape, then **UV_TE = 315.07**.
 - If the track is curved and the wiredraw cable rides on the outer (long) rail, then **UV_TE = 315.07**.
 - If the track is curved and the wiredraw cable rides on the inner (short) rail, **UV_TE = 315.07 x (WR / (WR - 360))**.
4. If the wiredraw unit is a **30m unit**, calculate the absolute value of **UV_TE**, based on the scenario that applies:
 - If the track is straight or mixed shape, then **UV_TE = 500**.
 - If the track is curved and the wiredraw cable rides on the outer (long) rail, then **UV_TE = 500**.
 - If the track is curved and the wiredraw cable rides on the inner (short) rail, **UV_TE = 500 x (WR / (WR - 360))**.
5. Determine whether **UV_TE** is positive or negative:
 - If the wiredraw encoder for the dolly is **at the primary end** of the track, **UV_TE** is positive.
 - If the wiredraw encoder for the dolly is **at the secondary end** of the track, **UV_TE** is negative.
6. Apply the sign to the absolute **UV_TE** value and then record it as **UV_TE**. Keep it available for subsequent procedures.

IMPORTANT: Be sure to record which dolly the value is for (Dolly A or Dolly B).

7. If this is the first dolly, repeat this procedure for the other dolly.

Calculate UnitValue for the Axis Track Motor (UV_AT)

Perform this procedure once per dolly.

This procedure describes how to calculate the correct value for the **UnitValue** parameter, for AxisTrack>Motor>MotorUnits (UV_AT). This value is used in subsequent procedures.

If your track is curved, you must know the wiredraw radius (**WR**) value before you perform this procedure. For more information, see “**Calculate Wiredraw Radius (WR)**” on page 4–1.

In this procedure, you calculate the absolute value of UV_AT, and then determine its sign (positive or negative).

To calculate UV_AT:

1. Look at the position of the drive wheels and note which rail they travel on.
2. If the track is curved, determine the **Motor Radius (MR)**, which is the radius of the center of the rail upon which the drive wheels travel:
 - If the drive wheels ride on the outer (long) rail, **MR** is equal to **WR** minus **12.5**.
 - If the drive wheels ride on the inner (short) rail, **MR** is equal to **WR** minus **372.5**.
3. Calculate the absolute value of **UV_AT**, based on the scenario that applies:
 - If the track is straight or mixed shape, then the absolute value of **UV_AT** = **1**.
 - If the track is curved and the drive wheels ride on the outer (long) rail, then the absolute value of **UV_AT** = **1**.
 - If the track is curved and the drive wheels ride on the inner (short) rail, then the absolute value of **UV_AT** = **((MR+360) / (MR))**.
4. Standing at the **primary** end of the track, and looking towards the dolly, determine whether **UV_AT** is positive or negative:
 - If the drive wheels are on the end of the dolly that is closest to you, then **UV_AT** is positive.
 - If the drive wheels are on the end of the dolly that is farthest from you, then **UV_AT** is negative.
5. Apply the sign to the absolute **UV_AT** value and then record it as **UV_AT**. Keep it available for subsequent procedures.

IMPORTANT: Be sure to record which dolly the value is for (Dolly A or Dolly B).
6. If this is the first dolly, repeat this procedure for the other dolly.

Edit the Configuration Template File

Each dolly’s robotic head has a configuration template file, which contains various configuration settings. You must edit each head’s configuration template file to enable collision avoidance. The configuration template files are different for each head.

This section describes how to download the configuration template file from a head, edit it, and upload it back to the head.

IMPORTANT: Perform all the procedures in this section for one dolly, and then perform them all again for the other dolly.

Before you begin, you must know the following values:

- Wiredraw Radius (**WR**) for the dolly you are configuring (curved tracks only).
For more information, see “**Calculate Wiredraw Radius (WR)**” on page 4–1.
- UnitValue for Track Encoder (**UV_TE**) for both dollies. There are two values, one for each dolly. Be sure to keep track of which is which.
For more information, see “**Calculate UnitValue for the Track Encoder (UV_TE)**” on page 4–2.

- UnitValue for AxisTrack>Motor>MotorUnits (UV_AT) for the dolly you are configuring.
For more information, see “Calculate UnitValue for the Axis Track Motor (UV_AT)” on page 4–3.

Editing the configuration template file includes:

- “**Downloading and Backing Up the Configuration Template File**” on page 4–4
- “**Setting Dynamic Maximum or Dynamic Minimum**” on page 4–4
- “**Setting UnitValue Parameter for the Axis Track Motor**” on page 4–6
- “**Setting the UnitValue Parameter for the Track Encoder**” on page 4–7
- “**Setting Dynamic Clearance Distance**” on page 4–8
- “**Applying the Edited Configuration Template File**” on page 4–8

Downloading and Backing Up the Configuration Template File

This section describes how to download and back up a configuration template file from a dolly’s robotic head.

If you are configuring a head that is already part of **an existing system**, use the steps in this section to download and back up the configuration template file.

If you are setting up a **new head**, you must extract the configuration template file from the software distribution instead of downloading it from the head. This is because different versions of the configuration template file exist for different types of heads. You must extract the correct file for your head type. Extract the file, then skip the steps in this section, and proceed to “**Setting Dynamic Maximum or Dynamic Minimum**” on page 4–4.

Tip: Configuration template file names end in a **.tmpl** extension. For example, the default file name for the VR-One configuration template file is **SmartFX_conf.tmpl**.

To download and back up the configuration template file:

1. On a computer connected to your Furio network, using a web browser, navigate to the web interface for the dolly’s robotic head.
Note: Each head has a separate web interface. Be sure to use the correct IP address for the head you are configuring.
2. On the **Status and Logging** tab, right-click **Download Configuration Template** and select the option to save the **.tmpl** file locally.
Tip: Create a separate folder for each head’s file. The files for the heads may have identical names, and it is very important that each head receives its own file.
3. Make a backup copy of the file in a separate folder, in case you need to revert to it later.

Setting Dynamic Maximum or Dynamic Minimum

Dynamic limits on the two dollies are set differently. One is assigned a dynamic maximum, and the other is assigned a dynamic minimum.

This section contains separate procedures for each scenario (dynamic maximum or dynamic minimum). For each dolly, perform only **ONE** of these procedures, depending on which dolly you are configuring.

Dynamic maximum and dynamic minimum are assigned as follows:

- **Dolly A**, the dolly closest to the **primary** end of the track, gets a **dynamic maximum**.
- **Dolly B**, the dolly closest to the **secondary** end of the track, gets a **dynamic minimum**.

The configuration template file (**.tmpl** file) contains segments of code applicable to both scenarios (dynamic maximum and dynamic minimum). By default these code segments are “commented out” by the presence of a number sign (#) at the beginning of each line. The required code segments can be activated by uncommenting them.

To set a dynamic maximum:

1. Open the configuration template file (**.tmpl** file) in a text editor.
2. Close to the top of the file, if there is a line that looks like this:

```
# - No Dynamic Limits
```

3. Edit it to look like this:

```
# - Dynamic Limits are set
```

4. In the file, find the segment of code that closely resembles the following:

```
# DynamicMaximumSource REF { Param ref { Value  
Track_Dynamic_Maximum; }; };
```

5. Uncomment the preceding code by removing the number sign (#).

6. In the file, find the segment of code that closely resembles the following:

```
# Node Track_Dynamic_Maximum {  
# ID 34;  
# Device Posital;  
# };
```

7. Uncomment each line of the preceding code by removing the number signs (#).

8. Find the segment of code that closely resembles the following:

```
# DataSource Track_Dynamic_Maximum {  
# Type CAN {  
# Param Node { Value Track_Dynamic_Maximum; };  
# Param Index { Value 0x6004; };  
# Param Subindex { Value 0; };  
# Param BitDepth { Value 25; };  
# };  
# UnitValue 315.07 ;  
# UnitCounts 8192;  
# <tmpl_var name="DATA_SOURCE_OFFSET_Track_Dynamic_Maximum" />  
# };
```

9. Uncomment each line of the preceding code by removing the number signs (#).

10. In the preceding code, replace the **UnitValue** value (**315.07** in this example) with the **UV_TE** value for the **OTHER DOLLY**.

11. Save the file. Leave it open for the next procedure.

To set a dynamic minimum:

1. Open the configuration template file (**.tmpl** file) in a text editor.
2. Close to the top of the file, if there is a line that looks like this:

```
# - No Dynamic Limits
```

3. Edit it to look like this:

```
# - Dynamic Limits are set
```

4. In the file, find the segment of code that closely resembles the following:

```
# DynamicMinimumSource REF { Param ref { Value  
Track_Dynamic_Minimum; }; };
```

5. Uncomment the preceding code by removing the number sign (#).

6. Find the segment of code that closely resembles the following:

```
# Node Track_Dynamic_Minimum {  
# ID 33;  
# Device Posital;  
# };
```

7. Uncomment each line of the preceding code by removing the number signs (#).

8. Find the segment of code that closely resembles the following:

```
# DataSource Track_Dynamic_Minimum {  
# Type CAN {  
# Param Node { Value Track_Dynamic_Minimum; };  
# Param Index { Value 0x6004; };  
# Param Subindex { Value 0; };  
# Param BitDepth { Value 25; };  
# };  
# UnitValue 315.07 ;  
# UnitCounts 8192;  
# <tmpl_var name="DATA_SOURCE_OFFSET_Track_Dynamic_Minimum" />  
# };
```

9. Uncomment each line of the preceding code by removing the number signs (#).

10. In the preceding code, replace the **UnitValue** value (**315.07** in this example) with the **UV_TE** value for the **OTHER DOLLY**.

11. Save the file. Leave it open for the next procedure.

Setting UnitValue Parameter for the Axis Track Motor

This procedure describes how to set the **UnitValue** for the Axis Track (**UV_AT**).

Before you begin, you must know the value you need to apply for **UV_AT**. Instructions for calculating **UV_AT** appear in an earlier section. For more information, see “**Calculate UnitValue for the Axis Track Motor (UV_AT)**” on page 4–3.

To set the UnitValue parameters for the axis track motor:

1. In the configuration template file (**.tmpl** file), find the segment of code that closely resembles the following:

```
Axis Track {  
    Motor 0 {  
        Param SoftLimitDecel { Value 5000; };  
        Param VelocityCorrection { Value TRUE; };  
        Param SlavingVelocity{ Value 1200000; };  
        Param SlavingAcceleration { Value 15000; };  
        Param SlavingDeceleration { Value 15000; };  
        Param AutomationVelocity{ Value 1200000; };  
        Param AutomationAcceleration { Value 3000; };  
        Param AutomationDeceleration { Value 3000; };  
        Node Track;
```

```

NegativeSwitch 4; # or 2
PositiveSwitch 5; # or 3
Frequent 1;
MustHome;
MotorUnits {
    UnitValue -1;
    UnitCounts 126;
};
Home ExternalAbsolute {
    Source REF {
        Param Ref { Value Track_Encoder; };
    };
};
};

```

2. In the preceding code, replace the **UnitValue** value (-1 in this example) with the **UV_AT** value you calculated for the dolly.
3. Save the file. Leave it open for the next procedure.

Setting the UnitValue Parameter for the Track Encoder

This procedure describes how to set the **UnitValue** for the Track Encoder (**UV_TE**).

Before you begin, you must know the value you need to apply for **UV_TE**. Instructions for calculating **UV_TE** appear in an earlier section. For more information, see “**Calculate UnitValue for the Track Encoder (UV_TE)**” on page 4-2.

To set the UnitValue parameters for the Track Encoder:

1. In the configuration template file (.tmpl file), find the segment of code that closely resembles the following:

```

DataSource Track_Encoder {
    Type CAN {
        Param Node { Value Track_Encoder; };
        Param Index { Value 0x6004; };
        Param Subindex { Value 0; };
        Param BitDepth { Value 25; };
    };
    UnitValue 315.07;
    UnitCounts 8192;
    <tmpl_var name="DATA_SOURCE_OFFSET_Track_Encoder" />
};

```

2. In the preceding code, replace the **UnitValue** value (315.07 in this example) with the **UV_TE** value you calculated for the dolly.
3. Save the file. Leave it open for the next procedure.

Setting Dynamic Clearance Distance

The dynamic clearance distance determines how close the dollies are allowed to come to each other. The collision avoidance system slows and/or stops one or both dollies to prevent them from coming too close.

The clearance distance is the distance between dolly centers, in millimeters. By default the clearance distance is set to 1600mm, which prevents the dollies from touching each other.

IMPORTANT: If the dolly is carrying a payload that extends past the ends of the dolly, you must adjust the clearance distance accordingly. We recommend you set the same clearance distance for each dolly.

To set the Dynamic Clearance distance:

1. In the configuration template file (**.tmpl** file), search for the following line:

```
# DynamicClearance 1600;
```

2. Remove the number sign (#) at the beginning of the line.
3. If you want to set **DynamicClearance** to a different value, replace **1600** with the new value, in millimeters.

IMPORTANT: **DynamicClearance** is the distance between the **CENTERS** of the dollies, in millimeters. **DO NOT** set it a value lower than **1600**. Lower values may allow dollies to collide.

4. Save the file.

Applying the Edited Configuration Template File

To apply the configuration template file you edited:

1. Log on to the web interface for the dolly.
2. On the **Upgrade** tab, click **Browse**, and then select the configuration template file (**.tmpl** file) you edited.
3. Click the **Upload File and Reboot** button.

The dolly head reboots and applies the new configuration file.

4. If this is the first dolly, go to “**Edit the Configuration Template File**” on page 4–3 and repeat all the procedures you just completed, but for the second dolly.

Calibrate to a Common Reference Point At the Center of the Track

The dollies must be calibrated to a common reference point in order for each dolly to know where the other one is.

Note: After you perform this procedure, any previously-created presets and moves will not work.

To calibrate to a common reference point:

1. Find a cross-member close to the center of the track.

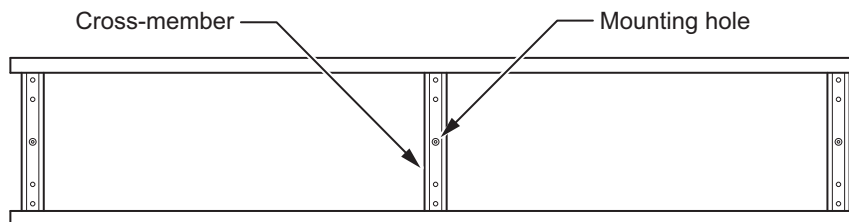


Figure 4.2 Track section, showing cross-member and mounting holes

2. Position **Dolly A** so that the center of its wiredraw post is perfectly aligned with the mounting holes of the cross-member.
3. On a computer connected to the Furio network, use a web browser to navigate to the web interface for **Dolly A**.

Note: Each dolly has a separate web interface. Be sure to use the correct IP address for **Dolly A**.

4. On the **Axis Settings** tab, in the **Track_Encoder** section, click **Set Current**.
Record the number from the **New Offset** box. You will later transfer this value to the other dolly.
5. Move **Dolly A** away from the cross-member.
6. Save changes and reboot.
7. Position **Dolly B** so that the center of its wiredraw post is perfectly aligned with the mounting holes of the cross-member.
8. Navigate to the web interface for **Dolly B**.
9. On the **Axis Settings** tab, in the **Track_Encoder** section, click **Set Current**.
Record the number from the **New Offset** box. You will later transfer this value to the other dolly.
10. In the **Track_Dynamic_Minimum** area, in the **New Offset** box, type or paste the number you recorded from the **OTHER DOLLY, Dolly A**.
11. Save changes and reboot.
12. Navigate to the web interface for **Dolly A**.
In the **Track_Dynamic_Minimum** area, in the **New Offset** box, type or paste the number you recorded from the **OTHER DOLLY, Dolly B**.
13. Save changes and reboot.

Set Track Axis Limits

As part of configuration process, you must limit how far each dolly can move along the track. Limits prevent the dollies from colliding with the bumpers at the end of the track. For layouts where the track is longer than the range of one or both of the wiredraws, limits also prevent the dollies from pulling the wiredraws too far and damaging them.

To set track axis limits:

1. On a computer connected to your Furio network, using a web browser, open two tabs and navigate to the web interfaces for both of the dollies.
Note: Each dolly has a separate web interface. Be sure to keep track of which browser tab is for which dolly.
2. Perform this step once per dolly. For each dolly, clear the **Track Axis** limits:
 - a. In the web interface, open the **Axis Settings** tab.
 - b. Click the **Enable Edit** button.
 - c. Scroll down to the **Axis Properties** section.
Each axis of motion is represented, including the Track axis.
 - d. In the **TRACK** section, click both of the **Clear** buttons.
3. Manually drive each dolly to opposite ends of the track, to the position you want to set as the limit of dolly motion.
Tip: When approaching the end of the track, move the dolly slowly to prevent it from colliding with the bumpers. Leave a safety margin distance of 0.5m or more between the dolly and the bumpers.
4. In the web interface for **Dolly A**, on the **Axis Settings** tab, scroll to the **TRACK** section.
Reminder: **Dolly A** is the dolly closest to the **primary** end of the track. You designated one end of the track as the primary end before you began the installation.
5. In the **TRACK** section, beside the **New Low Limit** box, click the **Set Current** button.
Leave the browser window open so the **TRACK** section remains visible.

6. Manually reposition **Dolly A** to the other end of the desired range.

IMPORTANT: If the track is longer than the wiredraw range for Dolly A, you must be careful not to move the dolly past the wiredraw range. Measure the distance from the wiredraw unit to where you want to set the track limit. If the track layout is curved or mixed shape, measure along the rail that the wiredraw rides along. Allow 1m as a safety margin. For example, if the dolly has a 15m wiredraw, measure 14m, and then move the dolly so that the center of the dolly, where the wiredraw is attached, is at the 14m mark.

7. In the web interface, beside the **New High Limit** box, click **Set Current**.
8. Scroll to the bottom of the web interface and click **Save**.
9. Move **Dolly A** back to the end of the track.
10. In the web interface for **Dolly B**, on the **Axis Settings** tab, scroll to the **TRACK** section.

Reminder: **Dolly B** is the dolly closest to the **secondary** end of the track. You designated the primary and secondary ends of the track before you began the installation.

11. In the **TRACK** section, beside the **New High Limit** box, click the **Set Current** button.

Leave the browser window open so the **TRACK** section remains visible.

12. Manually reposition **Dolly B** to the other end of the desired range.

IMPORTANT: If the track is longer than the wiredraw range for Dolly B, you must be careful not to move the dolly past the wiredraw range. Measure the distance from the wiredraw unit to where you want to set the track limit. If the track layout is curved or mixed shape, measure along the rail that the wiredraw rides along. Allow 1m as a safety margin. For example, if the dolly has a 15m wiredraw, measure 14m, and then move the dolly so that the center of the dolly, where the wiredraw is attached, is at the 14m mark.

13. In the web interface, beside the **New Low Limit** box, click **Set Current**.

14. Scroll to the bottom of the web interface and click **Save**.

The track axis limits are set. All configuration related to collision avoidance is complete. You can close the web interfaces, or perform other configuration tasks such as setting axis limits for other axes.

Test Collision Avoidance Behavior

IMPORTANT: After you install and configure the collision avoidance module, you must test collision avoidance behavior to ensure the system is functioning as expected. You must also test collision avoidance behavior after any changes to the configuration, or maintenance of, the collision avoidance system. For information about testing collision avoidance behavior, see “**Test Collision Avoidance Behavior**” on page 4–10.

Before you test collision avoidance behavior, ensure that:

- The Furio Robo system is fully set up, turned on, and operational.
- The Collision Avoidance Module is connected and shows two green LEDs
- All preceding configuration procedures in this chapter have been completed as required, for both dollies.

To test collision avoidance behavior:

1. Using manual controls, move the dollies apart.
2. Using manual controls, slowly move **Dolly A** towards **Dolly B** until it stops.
3. Check that the clearance distance is adequate. Be sure to take the payloads of the dollies into account, if the payloads can extend beyond the dollies.
4. Move the dollies apart and then use manual controls to move **Dolly B** towards **Dolly A** until it stops.
5. The clearance distance should be the same as it was in the first test.

Troubleshooting

If an LED on the collision avoidance module turns red, it means the dolly plugged into that side of the module is no longer receiving positional data from the other dolly. If both LEDs turn red, neither dolly is receiving data from the other.

To restore data connectivity:

1. Turn off both dollies.
2. Turn on both dollies.
3. Reboot both dolly heads.
4. If one or both LEDs are still red, log on to each dolly's web interface to check whether all nodes are operational. Specifically, check for node 33 if the dolly is configured with a dynamic minimum, or node 34 if it has a dynamic maximum.
5. If any nodes are not operational, check all cable connections and repeat steps 1 to 3.
6. If one or both LEDs are still red, contact technical support.

