# BLACKTRAX


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CAST
BlackBox Corporation

***User Guide***

Product release V 1.0
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# Contents

# Chapter 1

# Introduction

This chapter introduces you to text conventions used in the *BlackTrax User's Guide*, provides information for troubleshooting, and lists contact information if you need further assistance.

## In this chapter

# About this manual

## Introduction

This manual provides instructions for the installation, configuration and operation of the BlackTrax system.

## Text conventions

The following text conventions are used in this manual:

- Menus and menu commands appear in **Arial bold**. For example, "To open the camera window if closed, go to the **View** menu and click **Cameras**."
- User interface elements such as buttons, tools, shortcuts, and dialog boxes appear in *Tahoma Oblique*. For example, "To close the project, click *Yes*."
- Keyboard keys are indicated in ALL CAPITALS. For example, "To call up the save menu, enter in the command CTRL+SHIFT+B."
- References to manuals appear in *italic underlined* font. For example, "For an in depth understanding on WYSIWYG and its capabilities, please refer to the *WYSIWYG Reference Guide*."
- Instructions to direct you to different features of the BTSystem or areas in the physical Space are indicated in **dark blue underlined**. For Example "**In the Space**, take the BTBeacon."

# Troubleshooting

## Introduction

If you have problems using your software, please consult the following resources:

- The contents of this manual
- The Cast Software Web site at www.cast-soft.com
- Your designated BlackTrax Expert (BTE)

If these resources are insufficient, please contact CAST Technical Support.

## Errors Icon

Be alert for **Error** icons that may appear in BlackTrax. A **Error** icon indicates that there is a problem with the project, specifically with the part branded by the **Error** icon. Objects that have a **Error** icon will not function.

Common reasons an **Error** icon can appear are:

- **A project update was preformed, and the object was not present in the update** - When updating an existing BlackTrax project, it is possible that information used by the project was removed or not present in the update. The project will need to be updated with the missing information to use it again.
- **The device is powered off** - If a module or connected fixture has an error, it is possible that there is no power cycling through the device. Powering on the device should correct the error.

## Help from Technical Support

For assistance with a problem, contact Technical Support directly at one of the offices identified below.

When calling for help, please have the following information ready:

- BlackTrax serial number

### North America

#### CAST Software

Technical Support

35 Ripley Avenue, Unit 1

Toronto, ON M6S 3P2

Canada

Phone: +1 877 989 2278

Fax: +1 416 597 9594

E-mail: techsupport@cast-soft.com

Web site: www.cast-soft.com

# Welcome to BlackTrax

## Introduction

BlackTrax is a powerful, customizable solution that can track anything that needs tracking inside a predefined area, the Space. Use it alone to connect media servers, 3D spatial audio, robotic cameras and moving lights, or connect them all together with anything else that needs to be tracked. BlackTrax is robust, universal, and unassuming - it performs almost any tracking task you can devise with real time accuracy.

BlackTrack is the essential tool if you are looking to preform:

- **Positional Tracking** – The BTBeacon's position (X,Y,Z) and orientation (roll, pitch, yaw) is tracked by the BTSystem. This means you will know the precise location of anything you are interested in tracking.
- **Light Tracking** – By placing a BTBeacon on a Trackable, be it a person or object, and setting a relationship to some fixtures, BlackTrax grants these fixtures the ability to follow Trackables' position. By extending positional tracking using inverse kinematics, BlackTrax calculates the DMX values to send to a lighting console, allowing lights to follow this Trackable in real time as they move around, without any pre-planned paths or lighting cues.
- **Spatial Surround Sound** – By knowing the location of a Trackable, and streaming this position in real time to an audio client, an audio client can utilize this positional information in its synthesizing software. This will allow the audio client to deliver a 3D spatial surround sound experience to an audience.
- **Media Content Manipulation** – By streaming a Trackable position in real time to a media client, the media client can incorporate this positional data into the variables driving or effecting the video content, creating an interactive experience.
- **Lighting Calibration** – After preforming calibration of the BTCameras, BlackTrax can preforming a calibration routine on connected fixtures. This will instruct moving fixtures to focus on a BTBeacon in the Space, and based on this data, precisely calculate the real-world positions of these fixtures.
- **WYSIWYG Visualization** – Using the included BlackTrax edition of WYSIWYG included with the system, you can visualize the interactions between BTBeacons (and the associated people and objects Trackables) moving around the Space, and the lights following them.

# Chapter 2

# BlackTrax System Overview

This chapter provides a brief understanding of the BTSystem and define its various modules. It provides information on how to install and configure the BTSystem.

## In this chapter

# BTSystem Modules

## System modules

- (1) BTServer
  - WYSIWYG BlackTrax Edition (pre-installed software)
  - BlackTrax Tracking Tools (pre-installed software)
  - BlackTrax GUI (pre-installed software)
- (1) Timekeeper
  - (2) Ferrites
- (1) eSync Controller
- (6) BTCamera
- (2) BTBeacon
- (20) Pulsers
- (1) Charging Station
- (1) BTCalibration Kit
  - (1) BTCalibration Wand Head
  - (1) BTCalibration Telescopic Wand Handle
  - (1) BTCalibration Ground Plane
  - (1) BTCalibration Power Unit
  - (3) LED Diffusers

### Not Included Mandatory Components

- Category 6 Ethernet cable
- Power over Ethernet (PoE) gigabit Switch with Virtual LAN

### Optional Components

- DMX/Ethernet Node (for tracking with moving lights)
- Additional Power over Ethernet (PoE) gigabit Switches

## BTServer

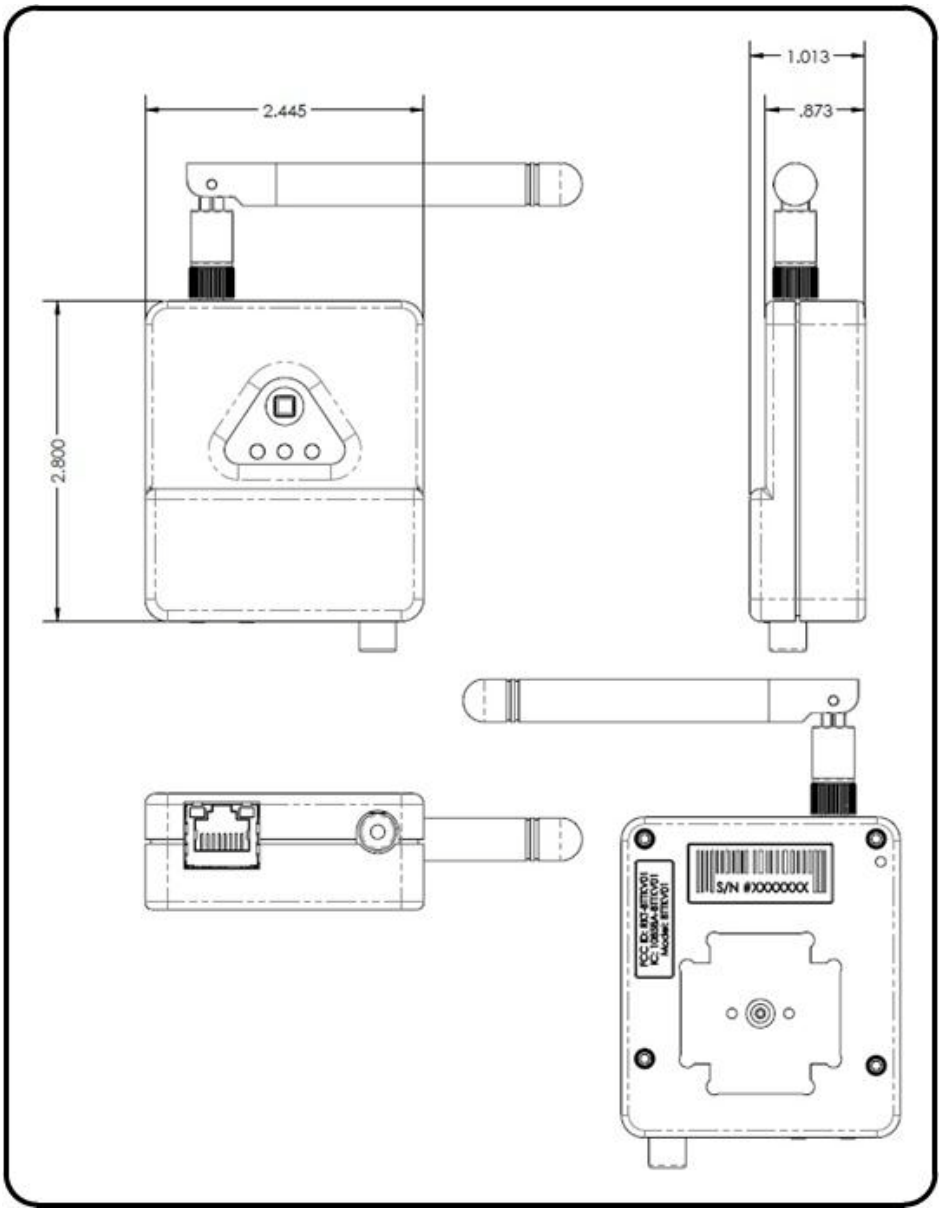
### Physical Characteristics

- Width: 1’7”
- Height: 7”
- Depth: 2’2”
- Operating Temperature: 0°C to +40°C

### Input/Output

- Data: Ethernet

# Timekeeper




### Product ID

- FCC ID: RKT-BTTKV01
- IC: 10858A-BTTKV01
- Model Number: BTTKV01

### Physical Characteristics

- Width: 2.245”
- Height: 2.8”
- Depth: 1.013”
- Operating Temperature: 0°C to +40°C

### Input/Output & Power

- Data: Ethernet, Radio 2.4 (GHz) 10Hz
- Power: 48VDC/15.6W from PoE Network Switch via Ethernet port (No input power via USB port)

### Status LEDs

- 3 LED lights

| LED # | LED Color | Significance |
|---|---|---|
| 1 | Red | Radio RX |
| | Green | Radio TX |
| 2 | Red | Undefined |
| | Green | Undefined |
| 3 | Red | Power Indication (3.3v) |
| | Green | Serial Sync packet |

### Timekeeper functions

The Timekeeper is a single wireless access point that uses a proprietary radio system running on 2.4 Ghz frequency to receive and send data from all BTBeacons. Data received includes IMU data for calculating the BTBeacon's orientation, position, button presses, battery status, and configuration details. Data sent includes a signal used to synchronize the BTBeacons with the BTCameras, and configuration commands sent to the eSync Controller.

## Ferrites

### Product ID

- Manufacturer: API
- Model Number: BF1835

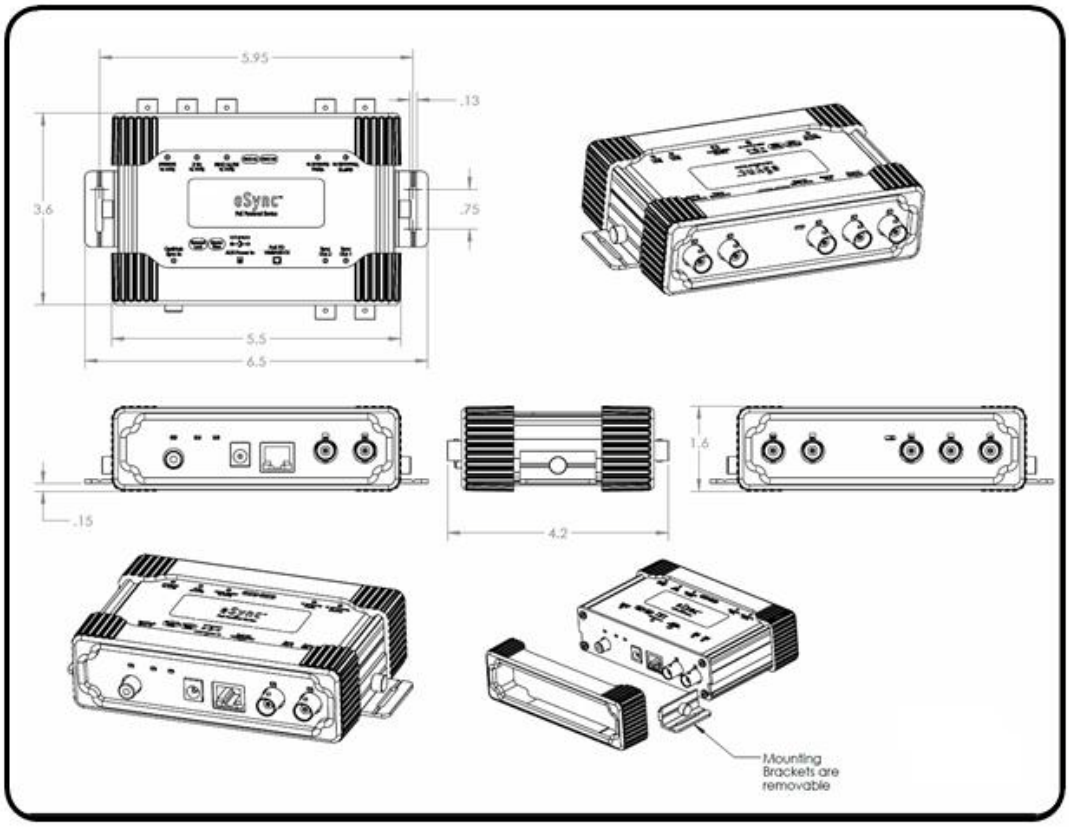
### Physical Characteristics

- Width: .70
- Height: .77”
- Depth: 1.37”
- Center Diameter: .35”
- Operating Temperature: 0°C to +40°C
- Impedance: 172 Ohm

### Ferrite Functions

The ferrite filter is cylindrical clamp fastened over cables to meet interference requirements. One ferrite filter is clamped over the cord connecting the Timekeeper to the switch, the other clamped over the cord connecting the Timekeeper to the eSync Controller. Both ferrite filters should be fastened on their cords as close to the Timekeeper as possible.

# eSync Controller




### Physical Characteristics

- Width: 5.47”
- Height: 1.61”
- Depth: 3.64”
- Weight: 13 oz
- Operating Temperature: 0°C to +40°C

### Power

- IEEE 802.3af-2003 PoE

### Ethernet Port

- 100BASE-TX Ethernet
- Cat6 Ethernet cabling

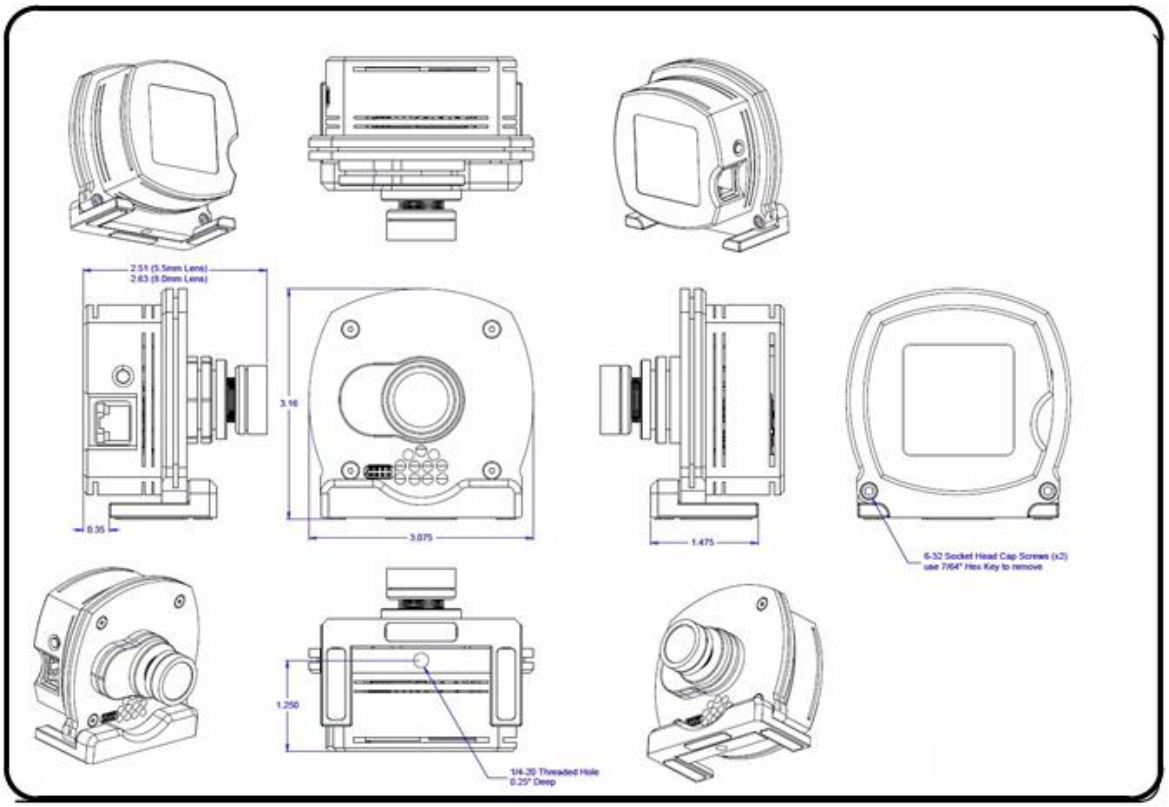
### Status LEDs

- Per port activity status
- Master time
- External lock
- Ethernet link status
- Ethernet activity

### eSync Functions

The eSync synchronizes the BTCamera so that the camera shutters open and close simultaneously in sync with the pulsing of the BTBeacons' pulsers. Other commands sent to the cameras include exposure, and whether to use the infrared or visible spectrum of light.

# BTCamera




### Product ID

- Model Number: S250e

### Physical Characteristics

- Case: Aluminum and Polycarbonate
- Width: 3.19”
- Height: 3.15”
- Depth: 2.66”
- Weight: 15.2 oz
- Mounting: 1/4”-20 tripod thread
- Status Indicators:
  - 2 digit numeric LEDs
  - 1 internal LED
- Operating Temperature: 0°C to +40°C

### Lens & Filter

- Stock Lens: 5.5 mm F#1.8 (wide band AR coated)
- Optional Lens: 8 mm F#1.8 (wide band AR coated)
- M12 Lens Mount
- Adjustable focus with wave spring assist
- 800nm IR long pass filter with Filter Switcher

### Image Sensor

- Resolution: 832 × 832
- Frame Rate: 30–250 FPS (adjustable)
- Accuracy: Sub-millimeter
- Latency: 4 ms
- Shutter Type: global
- Shutter Speed:
  - Default: 500 µs (0.5 ms)
  - Minimum: 10 µs (0.01 ms)
  - Maximum: 3,800 µs (3.8 ms) at 100 FPS

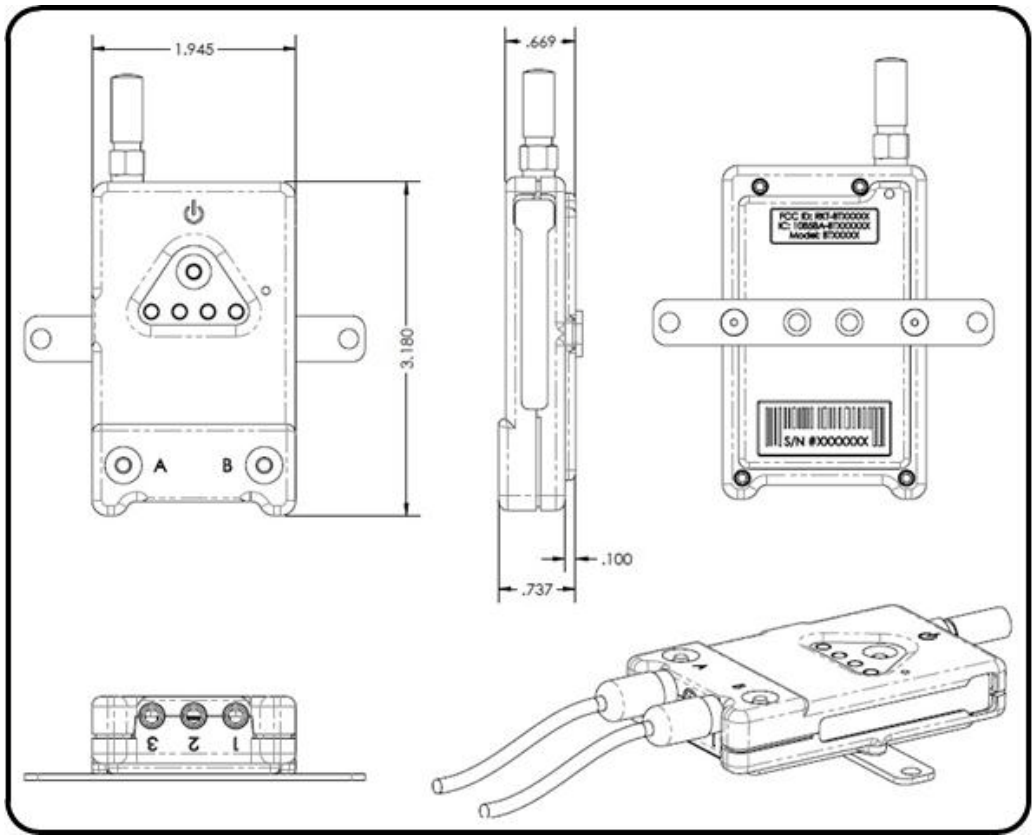
### Input/Output & Power

- Data: Ethernet (100BASE-T)
- Camera Sync: Ethernet
- Power: PoE

### Camera Functions

BTCameras are used to determine BTBeacon positions in the Space. A BTBeacon's position in 3 dimensions (X, Y, and Z) can be determined when two or more BTCameras have a direct line-of-sight to the Pulser. This information is then sent to the BTServer.

# BTBeacon




### Product ID

- FCC ID: RKT- BTBCV01
- IC: 10858A- BTBCV01
- Model: BTBCV01P

### Physical Characteristics

- Case: Plastic with Velcro strap attachments
- Width: 1.945”
- Height: 3.18”
- Depth: .737”

### Input/Output & Power

- Data: USB, Radio 2.4 (GHz) 10Hz
- Power: Rechargeable Lithium-ion Battery, charged by 5V USB

### BTBeacon Status LEDs

| LED # | LED Color | Significance |
|---|---|---|
| LED 1 | Solid Red | Battery Charging |
| | Solid Green | Battery fully charged |
| | Solid Orange | Charge Error* - Discontinue Use |
| LED 2 | Solid Red | Error |
| | Solid Amber | Power/ No Error |
| | Flashing Amber | No IMU/No Error |
| LED 3 | Solid Red | Radio RX |
| | Solid Green | Radio TX |
| LED 4 | Solid Green | Power 100-50% |
| | Solid Amber | Power 50-20% |
| | Solid Red | Power 20-10% |
| | Flashing Red | Power 10-0% |
| | Off | Power Off |

**Warning:** *If a BTBeacon experiences a charge error, there could be a potential issue with the Lithium-ion battery. Discontinue use immediately.

### BTBeacon Functions

Each BTBeacon has three ports to power a Pulser with. When a Pulser is connected to a BTBeacon's LED port, the BTBeacon will emit infrared light pulses through the Pulser LED. Each port of the BTBeacon pulses a unique code. When the LED pulse is seen by 2 or more BTCameras, the positional coordinates (XYZ) for BTBeacon are calculated by the BTServer. Position is based on the location of the Pulser LED. The pulse of each port on the BTBeacon is not shared by any other BTBeacons in that system.

Orientation data (roll, pitch, yaw) is determined by an internal inertial measurement unit (IMU). The IMU also functions as a backup for determining the BTBeacon's position. The IMU measures acceleration and rotation. This data is used by the BTServer to calculate the BTBeacon's position for up to 2 seconds when the BTBeacon Pulser LED is not visible to enough BTCameras.

The BTBeacons has a red power and reset button, and two white auxiliary buttons. The auxiliary buttons are used during Fixture Calibration (blue link) and can also be used to trigger other effects as determined by 3rd party systems.

BTBeacon transmit the following data over radio to the timekeeper and relayed to the BTServer: IMU sensor data, button presses, battery status, configuration details, Pulser IDs.

Currently a limit of 12 BTBeacon can be active at any one time. BTBeacon are docked in the Charging Station to recharge the BTBeacon's battery, to update configuration settings, and to update firmware.

# LED Pulser

### Physical Characteristics

- Length: 1’, 3’, 5’

### Pulser function

When a Pulser is connected to a BTBeacon LED port, the LED portion of a Pulser will pulse the BTBeacon’s unique identifier signal. The pulse is viewed by BTCameras, sent to the BTServer and used to calculate the BTBeacon position in the Space.

# Charging Station

### Size and weight

- Case: Steel
- Width: 6”
- Height: 3”
- Depth: 1’1”

### Input/Output & Power

- Data: Ethernet, USB
- Power: 25 Watt

### BlackTrax Charging Station Function

The Charging Station is a device used to recharge the battery of a BTBeacon. BTBeacons are connected to the Charging Station using the BTBeacon’s USB port. While connected the BTSystem can read the status of the battery, regulate charging and maximize battery life.

The Charging Station can hold a maximum of 6 BTBeacons at one time. BTBeacons connected to the Charging Station have their functionality disabled while charging. BTBeacons connected to the Charging Station do not count towards the limit of BTBeacons that can be active simultaneously.

# Calibration Kit

## BTCalibration Wand Head

### Size and weight

- Width: 41.7”
- Height: 10.6”
- Depth: 0.8”

## BTCalibration Telescopic Wand Handle

### Size and weight

- Width: 0.8”
- Height: 59”
- Depth: 0.8”

## BTCalibration Ground Plane

### Size and weight

- Width: 30.3”
- Length: 38.6”
- Depth: 2”

## BTCalibration Power Unit

### Size and weight

- Width: 8.7”
- Height: 8.7”
- Depth: 1.8”

### Power

- Power: 10 Watt

## BTCalibration LED Diffuser

### Size and weight

- Size: 1.6”

### BlackTrax Calibration Kit Function

The Calibration Kit is used for calibrating the BTCameras position in the Space. During calibration the Wand Head, attached to the Wand Handle and connected to the Power Unit, moves inside the Space. During calibration BTCameras look for the Wand Head LEDs, which are covered by LED Diffuser. When multiple BTCameras see the LEDs, the BTSystem is able to generate data for camera calibration. BTCameras use this data to determine their position relative to each other. The Ground Plane, connect to the Power Unit, is placed in the origin of the Space. The BTSystem uses the Ground Plane to calculate BTCamera position relative to the ground.

# Not Included Mandatory Components

**Attention:** BlackTrax requires additional components to function which are not included with purchase of the BTSystem.

## Category 6 Ethernet cabling

All Ethernet cabling used to connect the system components together must be of Category 6 (Cat6) quality or greater. The amount needed will vary depending on the Space dimensions and user needs.

**Attention:** The maximum allowed length of a Cat6 cable is 100 meters. It is recommended that Cat6 standards be followed when connecting modules together to ensure the BTSystem operates as intended.

## Power over Ethernet gigabit switch for BTCameras

BlackTrax requires a dedicated Power over Ethernet (PoE) gigabit switch to connect all the BTCameras with the rest of the system. The switch should be:

- A PoE gigabit switch.
- Possess a PoE port for each BTCamera, plus 3 extra to connect to the Timekeeper, eSync controller and BTServer.
- PoE switches must support 15.4 watts per Ethernet port.

# Optional Components

Depending on the purpose of tracking, you may need additional hardware components that are not included with the BTSystem.

### DMX to Ethernet/Ethernet to DMX node for lighting

To connect BlackTrax with a lighting console, a DMX to Ethernet/Ethernet to DMX node is required. The following nodes have been tested and are approved to work with BlackTrax:

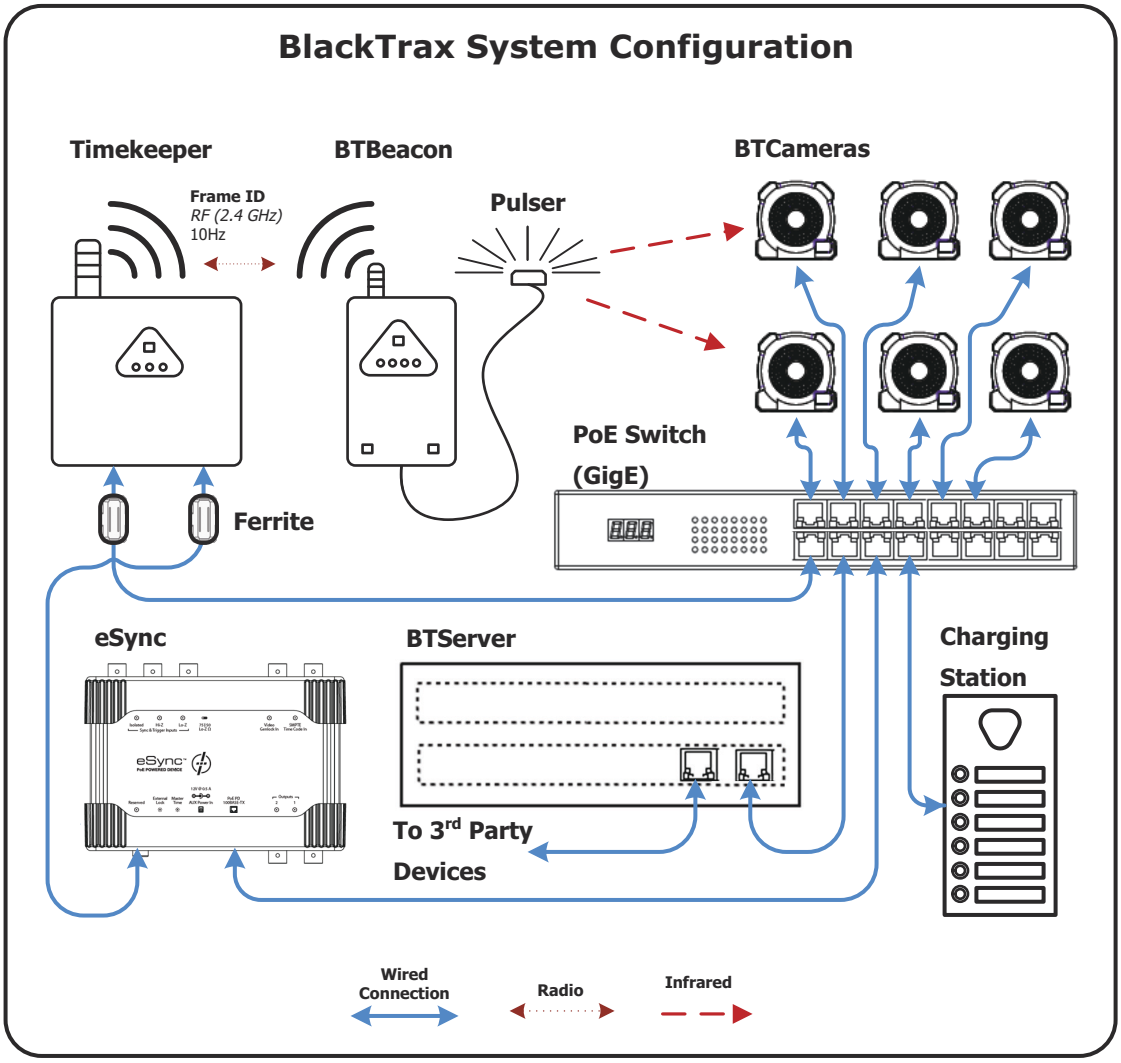
- ELC dmXLAN Node 8S

# BTSystem Hardware Configuration

## System configuration

It is recommended that all modules that connect to the BTServer except for the BTCameras be kept in the same area outside of the Space. The following diagram outlines a typical hardware configuration and how all BlackTrax modules connect to together.

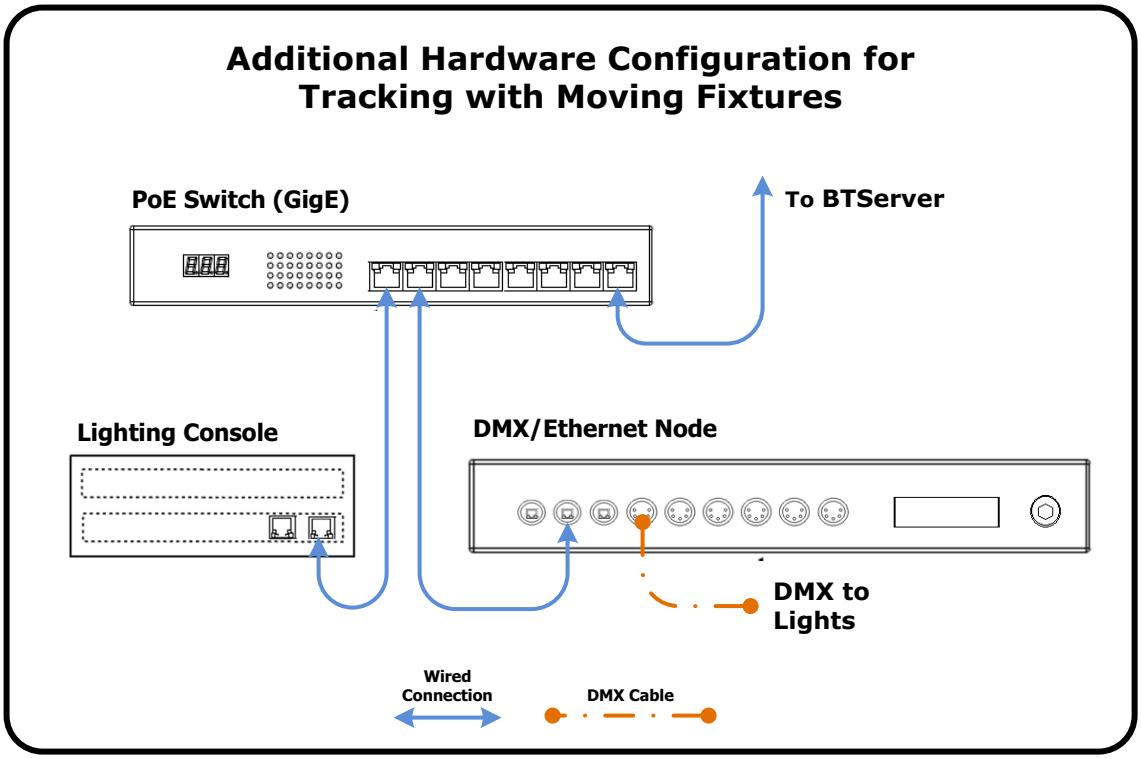
**Attention:** The Timekeeper's Ethernet port is designed to only connect to a commercially available Power over Ethernet (PoE) network switch. The Timekeeper is not designed to be a peripheral device to a Class B personal computer. As such, the Ethernet port shall not be connected to a Class B personal computer in any operating configuration.



# Optional equipment configuration

Depending on your tracking needs, additional components must be connected with the BTSystem. The following outlines how to connect this optional equipment with the BTSystem.

## Additional Hardware Configuration for tracking with moving light fixtures



# System Procedures

## Charging BTBeacons

BTBeacon can be charged using the Charge Station. BTBeacons are connected to the Charging Station using the Mini USB port found on the side of the BTBeacon. BTBeacons connected to the Charge Station become completely inoperative and do not transmit data. Charging BTBeacons do not count towards the limit of BTBeacons that can be active simultaneously.

**Attention:** The USB port of the BTBeacon is not designed to be a peripheral device to a Class B personal computer. As such, the user shall not connect the USB port to a Class B personal computer during normal operation.

**Attention:** The sole power source of the BTBeacon is the internal 3.7V rechargeable Lithium-ion battery. The BTBeacon does not require a connection at the USB port to operate

### To charge a BTBeacon using the Charging Station

Connect the BTBeacon to the charge station via the Mini USB port found on the side of the BTBeacon.

**Result:** The BTBeacon is charging. See the *BTBeacon Status LEDs* section to determine when the BTBeacon is fully charged.

# Camera Installation

## Introduction

BlackTrax is designed to track any object, called a Trackables, within a predefined tracking area, called the Space. This Space is created when multiple BTCameras, installed around the perimeter of the Space, have overlapping fields of view. When 2 or more BTCameras view the same area, at the same time, that area can be tracked.

## Environment considerations for camera installation

The environment of the Space can have a great impact on the capacity of BlackTrax to function as intended. The following precautions should always be remembered when installing the BlackTrax System to minimize interference and make an optimal tracking environment.

- **Infrared Interference:** External infrared sources and reflections can cause interference with camera tracking. For best results, ensure the tracking area is free from sunlight, lights which emit in the infrared spectrum, infrared based devices, and highly reflective materials.

  For infrared sources and reflections which cannot be removed from the tracking area, there are provisions within the software to mask out the affected areas of the BTCamera's field of view.

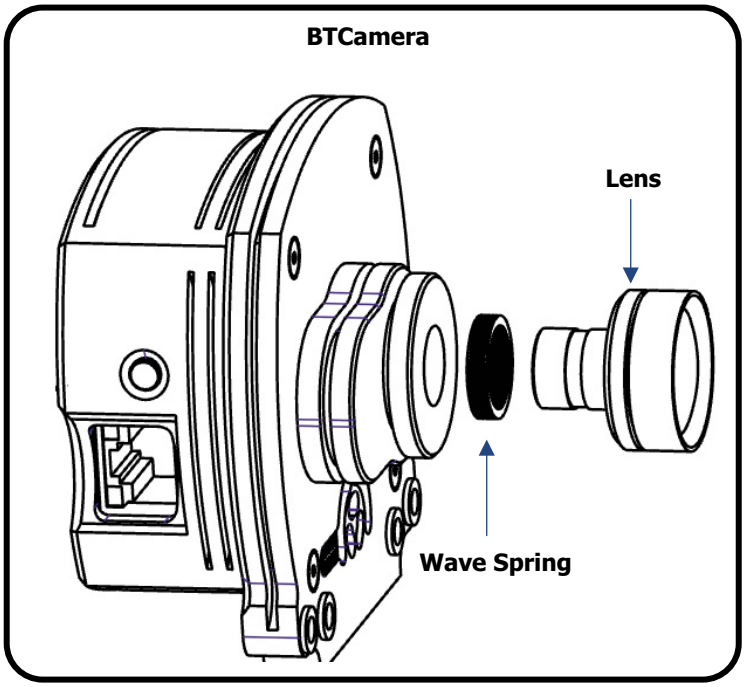
  **Note:** Infrared interference is more of a concern during the camera calibration than during tracking operation. Since the system looks for special pulsed signals during tracking, there is some tolerance for other infrared sources.
- **Reflective surfaces**: A Space that possess material that is reflective might reflect and mimic a BTBeacon’s unique LED pulse, creating errors with tracking. If this causes interference it is recommended that covering be placed to block reflections.
- **Cabling:** When setting up Ethernet connected BTCameras, remember that they are subject to the to the limitation of Ethernet communication standards. Ethernet cables can not be longer then 100m for BlackTrax to function correctly.
- **Camera Stability**: Ensure that the location where you choose to install BTCameras is stable, sturdy and always stationary. Any movement of a BlackTrax camera will require recalibration of the entire camera system.

  **Example:** If a camera is hung on a truss system which sways, the accuracy and performance of the system will be affected.

## Installing BTCamera Lens

### To install BTCamera lens

Screw the lens onto the BTCam with the included wave spring between the camera and the lens. Tighten until proper focus is achieved.




## Camera placement and orientation

In order for tracking to function correctly, multiple BTCameras must be arranged to have overlapping fields of view of the Space. A BTCamera field of view is the part of the Space that is visible through the camera while the camera is in a fixed position and orientation.

**Attention: Good camera placement and orientation is absolutely critical to proper operation of the system!**

# Chapter 3

# WYSIWYG for BlackTrax

This chapter provides information on how to use WYSIWYG for BlackTrax. WYSIWYG for BlackTrax is a separate program used to create the foundation of a BlackTrax project. BlackTrax draws upon the libraries and Space information within WYSIWYG, as well as using WYSIWYG to visualize activity.

## In this chapter

# .BTX File Creation

## Introduction

WYSIWYG is an award winning program that offers lighting designers a customized 3D CAD, paperwork and rendering application which is included in the BlackTrax software suite. Using WYSIWYG you will create a virtual representation of the Space. If you are tracking with moving fixtures, fixture position and patching must also be included. WYSIWYG exports this information as a .btx file, which is then used by BlackTrax for tracking.

When connected to BlackTrax, WYSIWYG will also act as a visualizer for what is happening in the Space. Trackable and fixture movement can be fully simulated, using information from BlackTrax or other data sources.

The following section on WYSIWYG only covers use related to BlackTrax. For an in depth understanding on WYSIWYG and its full capabilities, please refer to the *WYSIWYG Reference Guide*.

**Attention:** Due to complexity of using WYSIWYG and making an accurate drawing, it is recommended that a BlackTrax Expert (BTE) be consulted for assistance as needed.

## The Space in WYSIWYG

To use BlackTrax you must create a virtual representation of the Space in WYSIWYG. This virtual Space will possess vital information that BlackTrax requires: what the dimensions of the Space are, information on devices in use (Fixtures), and what objects or people you want BlackTrax to follow (Trackables). This section will guide you on creating the Space in WYSIWYG and aspects that have to be included.

To track with moving fixtures in BlackTrax, the following steps must be taken in the creation of the WYSIWYG file:

- Create a virtual representation of the venue the Space is in.
- Define a common origin position (0,0,0 coordinate) in the Space.
- Hang moving fixtures approximately where they will be.
- Create avatars of Trackables.
- Patch Trackables for use with BlackTrax.
- Patch fixtures to DMX universe and assign Spot IDs.
- Patch DMX universes to console.
- Save the WYSIWYG project.
- Export the WYSIWYG project for use with BlackTrax.

If you are **NOT** using BlackTrax for tracking with moving fixtures, only the following steps need to be completed:

- Create avatars of Trackables.
- Patch Trackables for use with BlackTrax.
- Save the WYSIWYG project
- Export the WYSIWYG project for use with BlackTrax.

## Creating the venue in WYSIWYG

Using the tools in WYSIWYG's **CAD** mode, create an accurate scale representation of the venue the Space is in. The suggested minimum level of detail is that it contain the floor, the walls and any pipes, trusses or structural frames in which BlackTrax cameras or other moving fixtures will be attached. The more detailed the venue, the better looking and accurate the visualization will be.

**Note:** Due to the complexity of recreating an accurate representation of a venue, it is recommended that the *WYSIWYG User Guide's* chapter on "*The CAD environment"* is read for a thorough understanding.

## Defining the origin in WYSIWYG

Most objects in WYSIWYG are drawn as 3D objects, with width, depth, and height values using the Cartesian coordinate system of 3 working axes, X, Y, and Z. The point where the 3 axes meet is called the origin and the value of X, Y, and Z is 0 respectively (0,0,0).

### Origin requirements

The location of the origin needs to be inside the Space. It should be easy to see and determine in the physical Space. The location of the origin and how the axes are orientated needs to be consistent. The origin needs to be the same in WYSIWYG, in Tracking Tools, and in the Space. Inconsistencies will cause errors in the BTSystem and confuse tracking. The origin will also need to be visible to at least 2 BTCameras for camera calibration to function.

### To set the origin in WYSIWYG

1 **In WYSIWYG**, in **CAD** mode at the bottom of the screen, click the **Wireframe** view tab.

2 From the **Tools** menu, choose **Set User Origin**.

**Tip:** You can also use the *Origin* tool on the *Tools* toolbar.

3 Click a point on your drawing or type in the coordinates (X,Y,Z) that will assume the values 0,0,0. This point will remain 0,0,0 until you change it again.

## Hanging moving fixtures in WYSIWYG

Any moving fixtures that you want to follow Trackables will need to be placed in WYSIWYG. By placing a fixture BlackTrax will be able to pull valuable information, such as the properties and capabilities of the fixture and its position in the Space.

Fixtures will need to be connected to pipes or trusses to be hung. The position and orientation of the fixtures in WYSIWYG need to be close to where they will be in the actual Space for tracking to work correctly. Minor variations, up to 3m in distance and 10° in orientation from the actual position in the Space can be corrected during *BlackTrax Fixture Calibration*.

**Note:** It is recommended that the *WYSIWYG User Guide's* chapter on "*Hanging and focusing fixtures"* is read for a complete understanding on how to hang fixtures.

**Attention:** Only moving fixtures are capable of following Trackables.

### To insert fixtures in WYSIWYG

1 **In WYSIWYG** **CAD** mode, at the bottom of the screen, click the **Wireframe** view tab.

2 From the **Library** menu, choose **Browse Library**.

**Result:** The **Library Browser** window will open.

3 At the bottom of the **Library Browser** click the *Fixture Tool*  .

4 In the menu that is now visible, double-click **Manufacturer** to select fixtures by manufacturer name, **Type** to select by fixture type, or **All** to see all the fixtures in alphabetical order.

5 **Note:** Alternately, you can use the **Library Browser**'s search function to locate the fixture that you want to insert. Simply type the name of the fixture (or a partial name) in the search box at the top of the **Library Browser**, and then click the search icon  .

6 Double-click the fixture name.

**Result:** A fixture with default settings for this type attaches to the cursor.

7 To change the properties of the fixture before inserting, in the **Library Browser** right-click on the fixture name. In the menu that appears click **Properties**.

**Result:** A dialog box opens with a shaded view of the fixture on the left and an image of its symbol on the right. Use the **Photometrics** tab to change the lamp and lens settings for the fixture, if applicable.

8 To place the fixture, click over a hang structure.

**Result:** Copies of the fixture will attach to hang structures when clicked. Continue placing this type of fixture by clicking on the other hang structures as desired.

9 Finish placing this fixture type by right-clicking. In the menu that appears select **Finish placing fixtures.**

10 To place other fixture types, repeat the above steps for each type.

**Attention: It is recommended that fixtures intended for tracking are not hanging directly over the space.** When placing moving fixtures that are to follow Trackables, it is recommended that fixtures are not placed directly above the Space. Fixtures placed above the space may run into pan and tilt range limitations when attempting to follow a Trackable.

## Smart practices for moving fixture placement

To obtain the precise tracking in BlackTrax, the limitations of moving fixtures must be taken into account. The following section will guide you through known limitations of moving fixtures in BlackTrax and provide smart practices used to overcome these limits.

### Do not place moving fixtures directly above the Space

If fixtures are placed above the Space and are following a Trackable which moves in a circular path underneath, this can cause fixtures to spiral and reach a pan stop.

When a Trackable moves almost directly underneath a moving fixture which is following it, the pan-motion of the fixture must be very fast in order to remain pointing at the Trackable. It is likely that the moving fixture will not be able to move quick enough to track in this way and a lag in tracking will occur.

## Creating Trackables in WYSIWYG

Objects or people that are to be tracked are called Trackables. An avatar of each Trackable needs to be created in WYSIWYG. They can be represented by any library object found in WYSIWYG.

### To create a Trackable in WYSIWYG

1 **In WYSIWYG**, in **CAD** mode, at the bottom of the screen click the **Wireframe** view tab.

2 From the **Library** menu, choose **Browse Library.**

**Result:** The Library Browser window will appear on the right side of the screen.

3 At the bottom of the browser window click the  *Library Items (scenic)* tab to view the contents.

4 Navigate to the desired object you which to represent a Trackable.

**Note:** The actual look of the Trackable is purely cosmetic.

5 At the top of the **Library Browser**, click the *Insert*  tool.

**Tip:** You can also double-click on the object name.

6 To insert the object, click in your drawing.

7 To stop inserting the object, right-click in the drawing. In the menu that appears, click **Finish Library Item**.

8 In the **Draw** menu choose **Frame.**

9 In the window that appears, type a unique name of the object Frame in the field.

10 Click *OK*.

11 In your drawing, in the Trackable object click the desired pivot point.

**Result:** A **Frame** will appear where the mouse was clicked. The **Frame** is represented as a Cartesian axis.

12 On the Trackable object you inserted into the drawing, right-click.

13 In the menu that appears, select **Properties**.

14 On the **General** tab, from the **Attach to Axis** drop-down list, select the unique name you created for the object Frame.

15 Click *OK*.

**Result:** The Trackable is created. It is represented as the inserted object and its motion is associated with the Frame.

## Patching Trackables in WYSIWYG

After Trackables are created they need to be patched to a Motion Universe. The patch will allow the visualization of Trackable movement to occur in BlackTrax.

**Note:** It is recommended that the *WYSIWYG User Guide's* chapter on "*Data mode"* is read for a complete understanding of patching.

### To create a new patch universe for Trackables

1 **In WYSIWYG**, in **DATA** mode, click the **Patch** layout tab at the bottom of the screen.

2 In the patch shortcut area at the left side of the screen, right-click.

3 In the menu that appears click **New Patch**.

**Result:** A dialog box is displayed, prompting for the type of universe that you want to create, and the name of the new universe.

4 Type a descriptive name for the patch universe in the empty field.

5 Set the **Patch Universe Type** to **Motion Control System**.

6 Click *OK*.

**Result:** The patch universe for Trackables is created and a shortcut is created in the **Patch** shortcut area.

### To patch a Trackable to a universe

1 **In WYSIWYG**, in **DATA** mode click either the **H Select** or **V Select** layout tab at the bottom of the screen.

2 In the wireframe drawing, right-click the **Frame** of the Trackable.

**Tip:** Remember that the **Frame** of the Trackable is the Cartesian axis associated with the Trackable, not the Trackable object itself.

3 In the menu that appears, select **Properties** from the menu.

4 Click the **Axis** tab.

5 In the **Patch** section, from the **Patch Type** drop-down list, select **Motion Patch**.

6 In the **Motion Patch** section, from the **Universe** drop-down list, select the patch universe you created to patch Trackables to.

7 In the **ID** drop-down list, type the unique name of the Trackable.

**Note:** The **ID** should be unique for every Trackable. BlackTrax will associate the Trackable with this name.

8 Click *Apply*.

9 Click *OK*.

**Result:** The Trackable will be patched to the motion universe. When WYSIWYG and BlackTrax are connected, Trackable movement will be visualized in WYSIWYG.

## Patching and assigning an ID to fixtures in WYSIWYG

The patching of fixtures as they appears in the connected console has to be recreated in WYSIWYG. When tracking occurs, BlackTrax uses the DMX values generated by the console, but overrides the pan and tilt channels with new values. These new values instruct the fixture where it should be aimed to follow a Trackable. If a fixture is edited to have a persistent beam size, then the zoom and iris values will change as well. The patching needs to be the same so that BlackTrax knows where to override the DMX values.

Each fixture in the project will also need to be assigned an individual fixture ID. The fixture ID is used by the BTSystem to differentiate between fixtures in the project.

### To create a patch universe

1 **In WYSIWYG**, in **DATA** mode, click the **Patch** layout tab at the bottom of the screen.

2 In the patch shortcut area on the right of the screen, right-click.

3 In the menu that appears select **New Patch**.

4 **Result:** A dialog box is displayed, prompting for the type of universe that you want to create, and the name of the new universe.

5 Type the name of the patch universe.

6 Under **Patch Universe Type**, select **DMX**.

7 Click OK.

**Result:** The patch shortcut appears in the Patch tab.

### Fixture patching methods

There are multiple ways to patch fixtures in WYSIWYG. The following section will guide you through some of the simplest methods.

For more information see the *WYSIWYG User Guide's Data Mode* chapter.

### To patch fixtures in using drag and drop

It is possible to drag and drop fixtures to the appropriate channel to patch them. This method is easy to use, but it can be tedious if there are many moving fixtures in the project.

1 **In WYSIWYG**, in **DATA** mode, click the *Patch* layout tab at the bottom of the screen

2 In the wireframe drawing, click and hold on the desired fixture.

3 Drag and drop the fixture to the desired patch location in the bottom half of the screen.

4 For re-patching, repeat the above steps, or click and drag the fixture's patch information to the new location.

### To patch fixtures and assign spot IDs using Quick Tools

Using Quick Tools, fixtures can be patched and assigned spot IDs by clicking on their **Wireframe** view image. The first fixture clicked will be assigned the patch and ID as configured in Quick Tools. The next fixture clicked will be assigned the next available channel in the patch and the next fixture ID in the sequence until you are finished using Quick Tools.

1 **In WYSIWYG**, in **CAD** mode, in **Wireframe** view, go to the **Tools** menu and click **Quick Tools**.

**Result:** The *Quick Fixture Tool* window will open.

2 In the *Quick Fixture Tool* window, in the **Fixture Attributes** section, mark the **Spot** check box.

3 In the **Spot** field, enter a number which will be the first fixture ID used in the sequence.

4 In the **Fixture Data** section, mark the **Patch** check box.

5 In the **Patch** field, enter the universe and channel the first fixture will patching to, separated by a period.

**Example:** "A.1" would patch to universe A, chapter 1.

6 Click *Ok*

**Result:** When a fixture is clicked on, it will be assigned a Universe and channel to operate on. The first fixture clicked will be assigned the to the channel number entered in Quick Tools. Subsequent fixtures clicked will be assigned the next sequential channel.

7 Click on a fixture to patch it to a universe and channel. Clicking on each fixture that you want patched and assigned a spot ID.

8 To stop patching fixtures, right click.

9 In the menu that appears, click **Finish Quick Tools**.

### To patch fixtures and assign spot IDs using the data spreadsheet

In **DATA** mode, the **Spreadsheet** view has information on all fixtures created in the WYSIWYG project. Using the spreadsheet you can edit the patch information and Spot ID directly in the table.

1 **In WYSIWYG**, in **Data** mode, click on the **Wireframe** view tab.

2 In the **Columns** section on the left side of the window, click *All Data (Sortable)*.

**Result:** All fixture data will be displayed in the spreadsheet.

3 In the **Patch** column, enter the appropriate patch information for each fixture.

4 In the **Spot** column, enter a unique Spot ID for each fixture.

**Tip:** It is possible to assign sequential values to fixtures quickly by entering a value for the first fixture at the top of the list, then entering **ALT + Down Arrow**. The fixture below will be assigned the next available value. This can be repeated as necessary.

## Patching DMX universes to a console

BlackTrax requires that the patching information of the connected console be recorded in WYSIWYG. This will inform BlackTrax which console is in use and which ports will transmit information.

### To patch the DMX universe to a console

1 **In WYSIWYG**, in **LIVE** mode, go to the **Live** menu and click **Device Manager...**.

**Result:** The *Device Manager* dialog window is displayed.

2 Click *New*.

**Result:** The *Library Selection* window is displayed.

3 Navigate through the console library until you find the console or device that you are connecting to. Click the console name to highlight it.

4 Click *Insert*.

**Result:** The console appears in the *Device Manager*.

5 With the console name still selected, click *Properties*.

**Result:** The *Properties* dialog window is displayed.

6 From the **Protocol** drop-down list, select the protocol used by the console.

**Result:** The console model is displayed in the **Model** field. The name of the console is displayed in the **Name** field.

7 In the **Address** field, type the designated address of the console, if applicable.

8 You must bind output ports from the console to WYSIWYG patch universes. Bind a **Port** output to the appropriate universe by clicking the **Universe** field next to the output.

**Result:** A drop-down list of available Universes is displayed.

9 Select the appropriate Universe from the list.

10 Repeat the above steps to bind all ports to their appropriate patch universes.

11 Click *Close* to close the *Properties* window.

12 Click *Close* to exit the *Device Manager*.

## Saving the WYSIWYG project

Once you have all the information on the Space in WYSIWYG created, The information will need to be saved as a WYSIWYG project file (.wyg). *Save* will save the open WYSIWYG project to the same file name and location under which it was previously saved. If you are saving the project for the first time, this command will perform *Save As...* . *Save As...* is used to save the current project with a new file name and/or a new destination.

### To save the WYSIWYG project using Save

1 **In WYSIWYG**, from the **File** menu, click **Save**.

**Result:** A dialog window will appear.

2 In the window, navigate to where you want to save the project file.

3 In the **File name** field type in the name of the project.

4 Click *Save*.

### To save the WYSIWYG project using Save As...

1 **In WYSIWYG**, from the **File** menu, click **Save As...** .

**Result:** A dialog window will appear.

2 In the window, navigate to where you want to save the project file.

3 In the **File name** field type in the name of the project.

4 Click *Save*.

## Creating a .btx file in WYSIWYG

After creating and saving the WYSIWYG project as a .wyg file, BlackTrax requires that the information be converted. The conversation will take all the valuable information that was put into the WYSIWYG project, and put it into the .btx formate that BlackTrax understands.

### To convert a .wyg file to .btx

1 **In WYSIWYG**, from the **File** menu, click *Open*.

2 Navigate to the .wyg file location, select the file and then click *Open*.

3 In the .wyg file, go to **DESIGN** mode.

4 Click the **Wireframe** view tab at the bottom of the screen.

5 In the **Wireframe** view, click inside an empty space of the wireframe.

6 Enter in the command **CTRL+SHIFT+B**.

**Result:** A pop-up window will appear.

7 In the window, navigate to where you want to save the .btx file.

8 In the **File Name** field enter in the name of the .btx file.

9 Click *Save*.

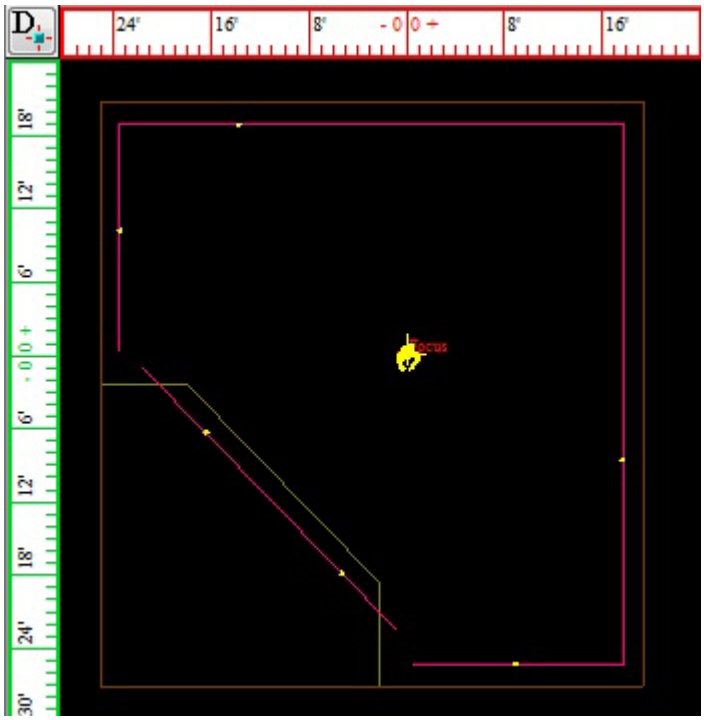
**Result:** The WYSIWYG file (.wyg) will convert to the BlackTrax format (.btx) and be saved as a separate file.

# Planning Camera Placement

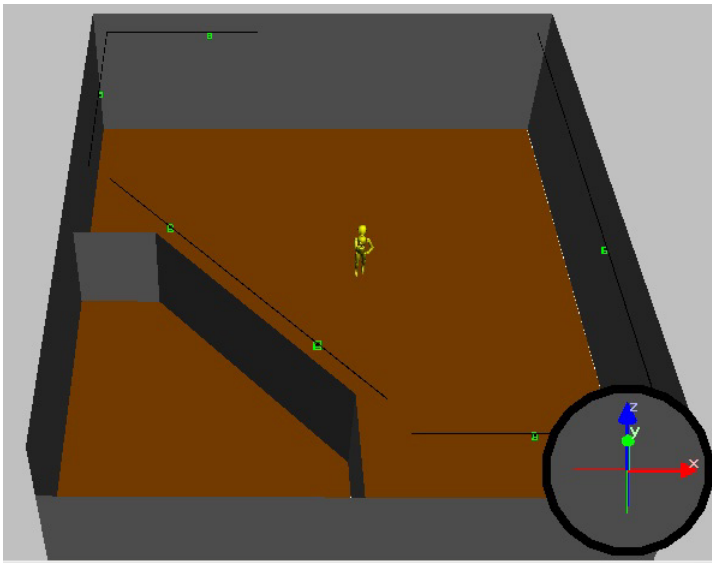
## Introduction

It is recommended that BTCameras are placed and aimed in WYSIWYG before you actually hang and aim them in the Space. This step is optional and will not affect the .btx file. Planning BTCamera placement in WYSIWYG will enable you to test BTCamera coverage and field of view overlap.

In the **Wireframe** view BTCameras are hung around the perimeter of the Space on pipes. The BTCameras are represented as small yellow squares.

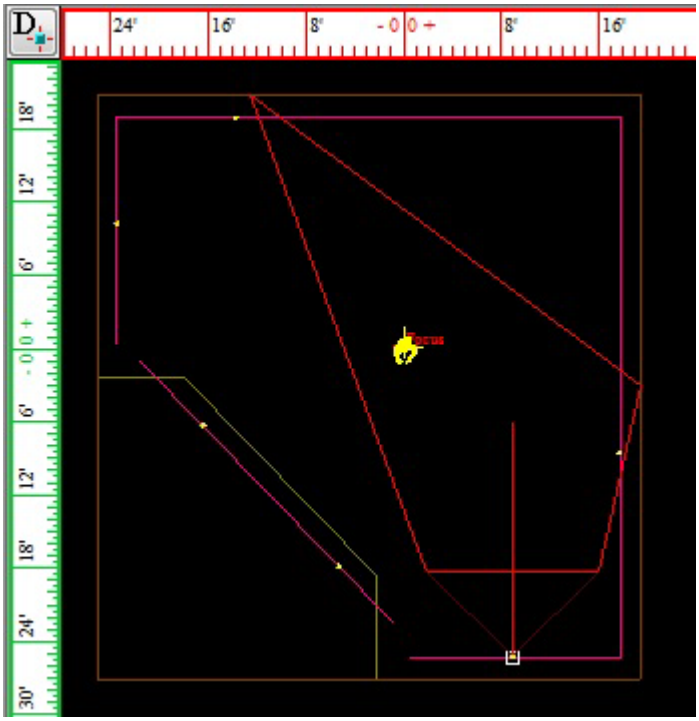



**Wireframe** view of the Space venue in **CAD** mode.

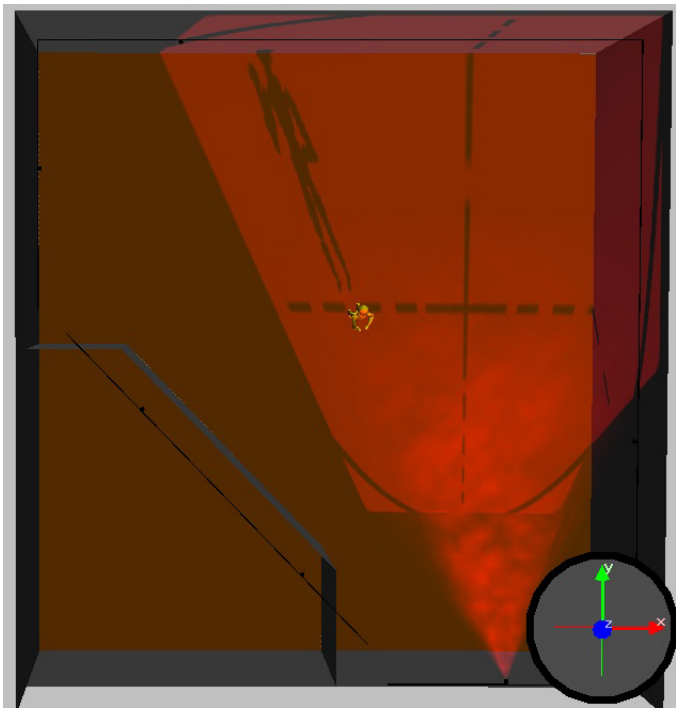


The Space in **Shaded** view, with BTCameras highlighted in green.

In WYSIWYG you can choose the BTCamera and lens type and the BTCamera field of view will correctly project in the simulation. A BTCamera field of view of in WYSIWYG is depicted as a red beam with a cross hair in the center.

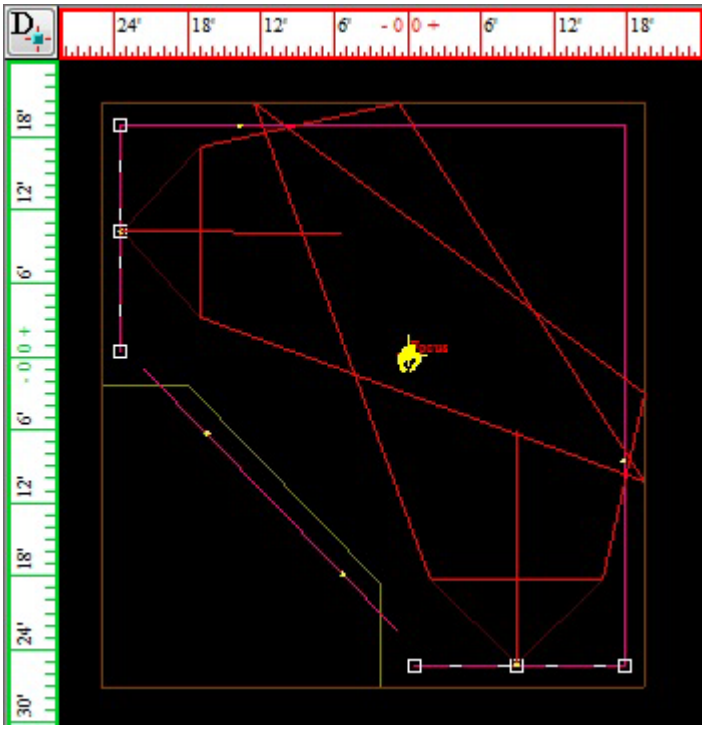


BTCamera field of view in **CAD** mode **Wireframe** view.

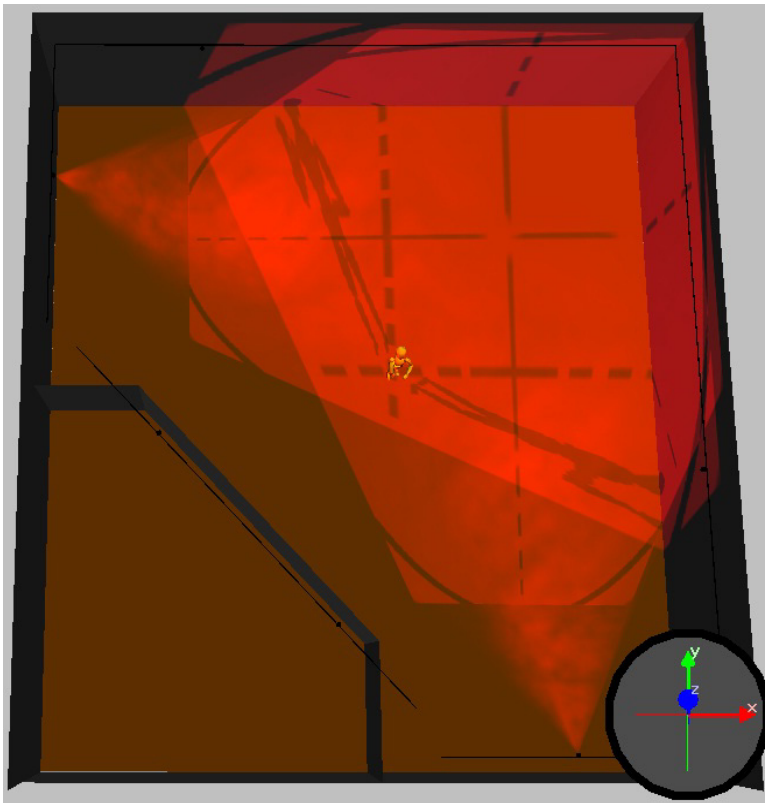


BTCamera field of view in **Live** mode, **Shaded** view.

BlackTrax requires that two BTCameras see the same area at the same time for tracking to occur in that area. By positioning BTCameras in WYSIWYG, we are able to see where fields of view will overlap and tracking will occur. Only the area where the views overlap does tracking occur.




**CAD** mode **Wireframe** view of two BTCameras that have their field of view overlapping.



**LIVE** mode **Shaded** view of two BTCameras that have their field of view overlapping.

## To access BlackTrax cameras in WYSIWYG

1 **In WYSIWYG**, in **CAD** mode, click the **Wireframe** view tab.

2 From the **Library** menu, choose **Browse Library**.

**Result:** The **Library Browser** window will open

3 At the bottom of the **Library Browser** window, click the *Fixture* tool  .

4 In the menu that is now visible, double-click *Manufacturer* to select fixtures by manufacturer name, *Type* to select by fixture type, or *All* to see all the fixtures in alphabetical order. BlackTrax fixtures can be found in *Manufacturer* under **CAST**, in *Type* under **BlackTrax**.

**Note:** Alternately, you can use the **Library Browser**'s search function to locate the fixture that you want to insert. Simply type the name of the fixture (or a partial name) in the search box at the top of the **Library Browser**, and then click the search icon  .

5 Double-click on the name of the BTCamera that you want to insert.

6 **Result:** A fixture with default settings for this type attaches to the cursor.

7 To change the properties of the fixture before inserting, such as the lens size, right-click on the fixture name, and then click **Properties**.

**Result:** A dialog box opens with a shaded view of the BTCamera on the left and an image of its symbol on the right. Use the *Appearance* tab to change the lens settings for the camera. Options are wide 5.5mm to narrow 8.0mm.

8 To place the BTCamera, move the mouse over a hang structure, and then click. Continue placing this type of fixture by clicking on the other hang structures as desired.

9 Finish placing this fixture type by right-clicking, and then choosing **Finish placing fixtures** from the resulting menu.

10 Click on a BTCamera.

**Result:** A red wireframe of the field of view will be appear.

11 To drag the field of view and aim the BTCamera, click and hold the beam wireframe.

**Result:** Once the BTCameras are correctly placed in WYSIWYG, you can record the positions and orientation reproduce in the physical Space.

# BlackTrax visualization

## Introduction

BlackTrax projects can be visualized within WYSIWYG, allowing fixture and Trackable interactions to be simulated in the WYSIWYG virtual Space. Fixtures or Trackables when selected in BlackTrax will be selected in the WYSIWYG. WYSIWYG, Tracking Tools and BlackTrax will need to each be open and running the project file for visualization to work correctly.

### To visualize BlackTrax activity in WYSIWYG

1 **In BlackTrax**, have the BlackTrax project file open.

2 **In WYSIWYG**, in **LIVE** mode, go to the *BlackTrax Pannel*.

**a.** To open the *BlackTrax Pannel* if closed, from the **Live** menu, select **BlackTrax Panel**.

**Result:** The *BlackTrax Panel* will appear on the right side of the WYSIWYG window.

3 Mark the check box next to **BTX Mode**.

4 With BlackTrax running, click *Connect*.

**Result:** Activity in BlackTrax will now be visualized in WYSIWYG.

## Using WYSIWYG to visualize data streams

WYSIWYG can visualize data from the *Third Party Stream* and *DMX from Art-Net*. This can be useful for debugging. Seeing fixtures and Trackables move in WYSIWYG based on the data can help determine if data is actually being transmitted. If there is no activity in WYSIWYG there could be problems in the BTSystem connections.

### To visualize Third Party Stream activity in WYSIWYG

1 **In WYSIWYG**, in **LIVE** mode, go to the *BlackTrax Pannel*.

**a.** To open the *BlackTrax Pannel* if closed, from the **Live** menu, select **BlackTrax Panel**.

**Result:** The *BlackTrax Panel* will appear on the right side of the WYSIWYG window.

2 Mark the check box next to **BTX Mode**.

3 With BlackTrax running, click *Connect*.

4 Mark the check box next to **Motion from Third Party Stream**.

**Result:** *Third Party Stream* activity will now be visualized in WYSIWYG.

### To visualize DMX from Art-Net activity in WYSIWYG

1 **In WYSIWYG**, in **LIVE** mode, go to the *BlackTrax Pannel*.

**a.** To open the *BlackTrax Pannel* if closed, from the **Live** menu, select **BlackTrax Panel**.

**Result:** The *BlackTrax Panel* will appear on the right side of the WYSIWYG window.

2 Mark the check box next to **BTX Mode**.

3 With BlackTrax running, click *Connect*.

4 Mark the check box next to **DMX From Art-Net**.

**Result:** *DMX From Art-Net* data will now be visualized in WYSIWYG.

## Using calibration data to adjust visualization in WYSIWYG

Once fixtures have their position calibrated in BlackTrax, this information can be used to improve visualization WYSIWYG. The position of fixtures in WYSIWYG will change to the calibration locations, creating a more accurate visualization.

### To use calibrated fixture positions in WYSIWYG

1 **In BlackTrax**, have the BlackTrax project file open.

2 **In WYSIWYG**, in **LIVE** mode, go to the *BlackTrax Pannel*.

**a.** To open the *BlackTrax Pannel* if closed, from the **Live** menu, select **BlackTrax Panel**.

**Result:** The *BlackTrax Panel* will appear on the right side of the WYSIWYG window.

3 Mark the check box next to **BTX Mode**.

4 Click *Connect*.

5 Mark the check box next to **Calibrated Fixture Position**.

**Result:** The position of fixtures in WYSIWYG will change to reflect the calibration data created in BlackTrax.

## Using Stick Beams for fixtures in WYSIWYG

When visualizing in WYSIWYG, the beams of light fixtures can be changed to be represented as sticks. This can be useful for reducing clutter and confusion in the visualization and help to determine where fixtures are aiming and which fixtures are selected.

### To use fixture stick beams in WYSIWYG

1 **In BlackTrax**, have the BlackTrax project file open.

2 **In WYSIWYG**, in **LIVE** mode, go to the *BlackTrax Pannel*.

**a.** To open the *BlackTrax Pannel* if closed, from the **Live** menu, select **BlackTrax Panel**.

**Result:** The *BlackTrax Panel* will appear on the right side of the WYSIWYG window.

3 Mark the check box next to **BTX Mode**.

4 Click *Connect*.

5 Mark the check box next to **Show Beams With Stick**.

**Result:** Fixture beams will be represented as sticks in WYSIWYG.

# Chapter 4

# Tracking Tools for BlackTrax

This chapter provides information on how to use of Tracking Tools for BlackTrax. Tracking Tools is a separate program that controls the BTCameras used by the BTSystem.

## In this chapter

# Initial Set Up

## Introduction

Tracking Tools is used by to manage and control BTCameras. It is already installed on the BTServer and is ready for you to use. The following section will guide you though specific steps on how to use Tracking Tools to configure BTCameras to work in the Space and function with the BTSystem.

## Using Tracking Tools to aim BTCameras

For tracking to occur, BTCameras have to be positioned around the perimeter of the Space looking in. Tracking occurs in an area when 2 or more BTCameras view the same area at the same time. A video feed of what BTCameras see is shown in Tracking Tools. Viewing the BTCamera feed in the visible spectrum, BTCamera positions can be evaluated.

**Attention:** The Space origin must be visible to at least 2 BTCamera for camera calibration to function correctly.

### To view BlackTrax camera feed in visible spectrum

**Note:** BTCameras have to be connected with the BTSystem and Tracking Tools open for the BTCamera feed to be visible.

1. Go to the **Cameras** window, which by default is automatically open on the left side of the UI.
   a. To open this window if closed, go to the **View** menu and click **Cameras**.
2. In the **Cameras** window, select the camera group by clicking on the group name.
3. While the camera group is still selected, look below to the **Property** section for the camera group. Under the **Camera Settings** heading, set the **Video Type** field to **MJPEG Mode** from the drop down list.
4. Set the **Filter Type Switch** field to **Visible Spectrum**.

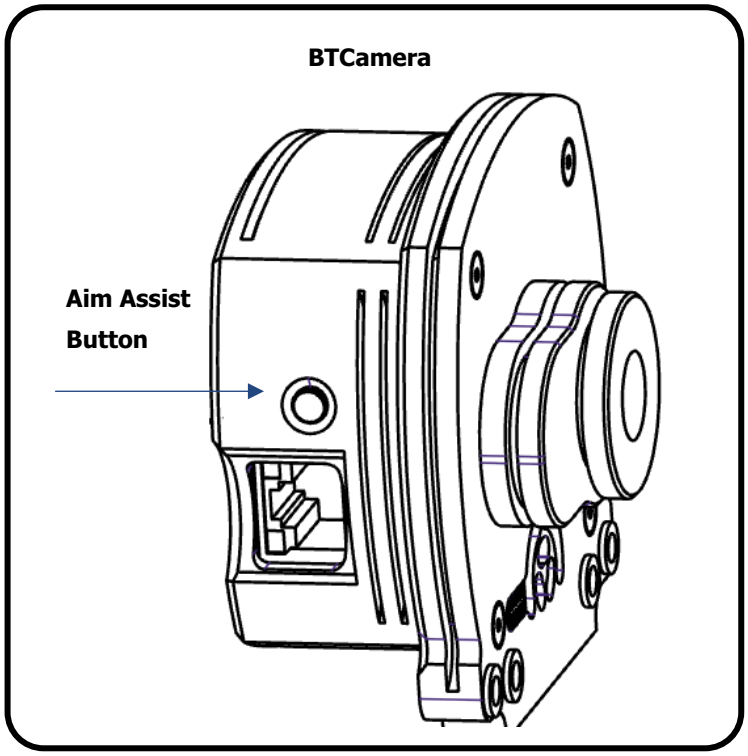
   **Result:** The video displayed from the BTCameras will appear as a gray scale image in the visible spectrum.

### BTCamera Aim Assist

BTCameras possess an Aim Assist function to help with aiming BTCameras. When toggled on and Tracking Tools is running, the BTCamera will be selected and its live video feed prominently displayed in Tracking Tools. The camera image will be set to grayscale so the Space is visible, and exposure increased for a brighter image. Pressing the button again after aiming will return the BTCamera's view to its previous settings.

#### To toggle Aim Assist on BTCamera

With the BTCamera is connected to the BTSystem and Tracking Tools running, push the button on the right side of the BTCamera, above the Ethernet port.




## Tracking Tools project file

A BlackTrax project requires specific information from Tracking Tools, (camera configuration, calibration and settings) that is unique to every BlackTrax project. This information is required every time BlackTrax runs. A Tracking Tools project file (.ttp) should be created to save and load all this needed information.

*Save Project* will save the open Tracking Tools project to the same file name and location under which it was previously saved. If you are saving the project for the first time, this command will perform as *Save Project As...*. *Save Project As...* is used to save the current project with a new file name and/or a new destination.

#### To save a Tracking Tools Project using Save Project

**In Tracking Tools**, go to the **File** menu and click **Save Project**.

### To save a Tracking Tools Project using Save Project As...

1 In Tracking Tools, go to the **File** menu and click **Save Project As...** .

**Result:** The *Save As* dialog box will appear.

2 In the *Save As* dialog box, navigate to location you want to save Tracking Tools file.

3 In the **File Name** field, type the name of the project.

4 Click *Save*.

### To load a Tracking Tools Project

1 In Tracking Tools, go to the **File** menu and click **Open...** .

**Result:** The *Open* dialog box will appear.

2 In the *Open* dialog box, navigate to where the desired .ttp file is saved. Click on the file to select it.

3 Click *Open*.

**Result:** The .ttp file will load. Its information and settings will load into Tracking Tools.

# Camera Calibration Mode

## BTCamera calibration settings

After BTCameras are placed and orientated with overlapping views around the Space, BlackTrax requires that all BTCameras are calibrated. Tracking Tools setting need to be configured for calibration to occur.

### To configure BlackTrax cameras for calibration

1 In Tracking Tools, open the **Project Explorer** window. From the **View** menu, click **Project Explorer**.

   **a.** In the **Project Explorer** window, ensure all the BTCameras are in the same camera group and all cameras are connected. **Group 1** should be the default group.

   **Note:** If cameras are not visible in the **Project Explorer** window, check connections to see if any cameras are disconnected from the system.

   **b.** Close the **Project Explorer** window.

2 Go to the **Cameras** window, which by default is automatically open on the left side of the UI.

   **Note:** To open this window if closed, go to the **View** menu and click **Cameras**.

   **a.** In the **Cameras** window, select the camera group by clicking on the group name.

   **b.** While the camera group is still selected, look below to the **Property** section for the camera group. Under the **Camera Settings** heading, set the **Video Type** field to **Precision Mode** from the drop down list.

   **c.** Set the **Filter Type Switch** field to **Infrared Spectrum**.

3 Open the **Reconstruction Properties** window. From the **View** menu and click **Reconstruction Properties**.

   **a.** In the **Reconstruction Properties** window, in the **Point Cloud** section, **Enable Point Cloud Reconstruction** by clicking and checking the check box.

   **b.** Under the **2D Object Filter** heading set the **Filter Type** to **None** from the drop down list.

   **c.** Close the **Reconstruction Properties** window.

4 Open the **Application Setting** window. From the **Edit** menu, click **Tracking Tools Settings...**.

   **a.** In the **Application Setting** window, in the **Options** tab, under the **Application Options** heading, set the **Active Marker Labeling** field to **False**.

   **b.** In the **Display** tab, under the **2D Display Options** heading, set the **Camera Reticle** field to **True**.

   **c.** Under the **3D Options** heading, set the **Show Marker Label** field to **True**.

   **d.** Close the **Application Setting** window.

5 Open the **Synchronization** window. From the **Tools** menu, click **Synchronization**.

- **a.** Under the **Synchronization** heading, from the drop down list select **Custom Synchronization**.
- **b.** Under the **Sync Input** heading, set the **Source** field to **Reserved**.
- **c.** Set the **Synchronization** offset to **5000**.
- **d.** Click **Apply**.
- **e.** Close the **Synchronization** window.

6 Open the **Streaming Properties** window. From the **View** menu click **Streaming Pane**.

- **a.** In the **Streaming Properties** window, under the **OptiTrack Streaming Engine** heading, click to check the **Broadcast Frame Data** check box.
- **b.** Under the **Network Interface Section** heading, set the **Local Interface** field to **Local Loopback**.
- **c.** Save the changes to the project file. Go to the **File** menu and click **Save Project**.

## Unique camera configuration setting

Because every Space is different, there are certain BTCamera setting that will be unique. This section will provide guidelines on what certain Tracking Tools setting should be, to create an accurate tracking environment.

### Space Boundaries

In Tracking Tools you must create a boundary around the Space. The boundary will tell the system to ignore infrared sources outside this boundary. It is important to properly define the boundaries as tracking will only occur inside these bounds.

**Attention:** The default boundaries are set at 6m from the origin on each axis in Tracking Tools. If your Space is larger then the default setting you will have to enter the boundaries of your Space.

To define boundaries you will have to measure how far the origin of the Space is from the intended boundary in the Space, on each axis (XYZ). The origin of the Space should be the same origin as the copy of the Space made in WYSIWYG.

**Attention:** In Tracking Tools the **Z** axis represents length and the **Y** axis represents height. In the rest of BlackTrax the **Z** axis represents height and the **Y** axis represents length.

**Note:** Be aware of the **-Y** setting for your Space. If the origin of the Space is elevated and tracking occurs below, enter a high enough value so tracking can occur. An example would be a Space whose venue is a stage with an apron and tracking occurs below in the audience.

### To set the tracking boundary of the Space

1. Open the **Reconstruction Properties** window. From the **View** menu click **Reconstruction Properties**.
2. In the **Reconstruction Properties** window, in the **Point Cloud** section, under the **2D Object Filter** heading set the **Filter Type** to **None** from the drop down list.
3. Under the **Reconstruction Bound** heading, set the **Minimum X (meters)** field to the distance from the origin of the Space to the intended boundary on the negative (-) X axis (width). Represent the number as a negative (-).
4. Set the **Maximum X (meters)** field to the distance from the origin of the Space to the intended boundary on the positive (+) X axis (width). Represent the number as a positive (+) number.
5. Set the **Minimum Y (meters)** field to the distance from the origin of the Space to the intended boundary on the negative (-) Y axis (height). Represent the number as a negative (-).
6. Set the **Maximum Y (meters)** field to the distance from the origin of the Space to the intended boundary on the positive (+) Y axis (height). Represent the number as a positive (+).
7. Set the **Minimum Z (meters)** field to the distance from the origin of the Space to the intended boundary on the negative (-) Z axis (length). Represent the number as a negative (-).
8. Set the **Maximum Z (meters)** field to the distance from the origin of the Space to the intended boundary on the positive (+) Z axis (length). Represent the number as a positive (+).
9. Close the **Reconstruction Properties** window.
10. Save the changes to the project file. Go to the **File** menu and click **Save Project**.

    **Result:** The boundary in your Space will be defined, tracking is only possible inside this boundary.

### To view the tracking boundary of the Space

1. Open the **Reconstruction Properties** window. From the **View** menu and click **Reconstruction Properties**.
2. In the **Reconstruction Properties** window, in the **Point Cloud** section, under the **Reconstruction Bounds** heading set the **Visible Bounds** field to **True.**

   **Result:** In Perspective View window the boundary of the space will appear as a transparent shape when zoomed out.
3. Save the changes to the project file. Go to the **File** menu and click **Save Project**.

### BTCamera beam length

Tracking tools has a maximum and a minimum beam length for all BTCameras. Infrared sources, such as a LED Stringer of a BTBeacon, that are outside this range will not be acknowledged by the system. Depending on the size of the Space the beam length values will have to change in Tracking Tools.

**Attention:** The default BTCamera beam range is set at minimum 0.2m, maximum 10m. The Maximum distance should be the largest distance between a BTCamera and the furthest visible tracking boundary. The minimum distance should be the shortest distance between a BTCamera and the closest visible tracking boundary.

### To set BlackTrax BTCamera beam length

1. Open the **Reconstruction Properties** window. From the **View** menu and click **Reconstruction Properties**.
2. In the **Reconstruction Properties** window, in the **Point Cloud** section, under the **Reconstruction Bounds** heading set the **Minimum Ray Length** field to the desired value**.**
3. Set the **Maximum Ray Length** field to the desired value**.**
4. Save the changes to the project file. Go to the **File** menu and click **Save Project**.

   **Result:** The beam length of cameras will be set and cameras will only view within this range.

## Masking infrared interference during calibration

Masking is a function in Tracking Tools where an area of the BTCamera's vision is blocked out (masked). This will tell the system to ignore the masked section when looking for infrared sources. This is used primarily to block out infrared interference that can confuse the system during camera calibration.

Excessive masking may limit a BTCamera field of view, as a masked area makes a BTCamera blind to tracking in that area. It may be more beneficial to reposition BTCameras to create different fields of view, rather then masking in extreme cases of infrared interference.

**Attention:** Masking is done automatically in Tracking Tools as part of camera calibration. The following instructions are only needed if you intended to mask a BTCamera view from interference manually.

### To manually mask a camera view

1. **In Tracking Tools**, open the **Camera View** window. From the **View** menu, click **Camera Preview**.
2. At the top of the **Camera View** window is a toolbar. Enable 2D Multi Camera View by clicking the *2D Multi Camera View* icon  in the toolbar.

   **Result:** The Camera View window will display a 2D view of what each connected camera sees. Infrared sources will appear as white.
3. In the **Camera View** toolbar, select either rectangular blocking by clicking the *Rectangular Blocking* icon  , or circular blocking by clicking the *Circular Blocking* icon  in the toolbar.
4. Click inside the 2D view window of a camera. Mask the infrared interference areas by clicking in one corner of the interference, and while holding the mouse button down, dragging the mask to the desired size.

   **Result:** The infrared interference (white) area will be covered in a mask (red).
5. Repeat **Step 4** for each instance of camera infrared interference.

   **a.** To have masks only cover infrared sources, in the **Camera View** toolbar, click the *Block All Visible Markers* icon  .

   **Result:** Any infrared interference in a masked portion of a camera 2D view will stay masked. Areas that are covered by a mask but show no interference will be unmasked.
6. Save the changes to the project file. Go to the **File** menu and click **Save Project**.

### To clear all masks from a camera view

1. **In Tracking Tools**, open the **Camera View** window. From the **View** menu, click **Camera Preview**.
2. At the top of the **Camera View** window is a toolbar. Enable 2D Multi Camera View by clicking the *2D Multi Camera View* icon  in the toolbar.

   **Result:** The Camera View window will display a 2D view of what each connected camera sees. Infrared sources will appear as white.
3. In the **Camera View** toolbar, click the *Clear Blocking* icon  .

   **Result:** All masking will be cleared from the Camera View window.

## Camera calibration

When BTCameras are initially placed in the Space, or if they are moved after set up, or bumped accidentally, calibration of BTCameras is required. Camera calibration enables the system to determine where the BTCameras are in relation to each other using the calibration wand, and where they are in relation to the floor using the ground plane. Proper calibration is very important, as incorrect calibrations will give incorrect position data and negatively influence BlackTrax system accuracy.

**Attention:** Anytime a BTCamera is moved or bumped, camera calibration will have to be performed and saved to the project file.

### To calibrate BTCameras with the calibration wand

1 **In Tracking Tools,** go to the **3 Mark Calibration** window, which by default is automatically open on the right side of the UI.

**Note:** To open this window if closed, go to the **Tools** menu, click **3-Marker Calibration**.

**a.** In the **3-Mark Calibration** window, in the **Calibration** tab, under the **3-Marker Calibration** heading, click *Block Visible*

**Result:** All visible infrared sources all camera's field of vision will be blocked

**b.** Under the **Solver Option** heading, set **Quality field** to **Medium** from the drop down menu.

**c.** Set the **OptiWand** heading to **Custom**.

**d.** Under the **OptiWand** heading, set the **Wand Length (mm)** field to **990**.

**e.** Set the **Center Distance (mm)** field to **330**.

**f.** Under the **Data Acquisition** heading, set the **Sample Speed** field to **50%**.

**g.** Set the **Minimum Camera Coverage** field to **50%**.

**h.** Under the **Wand Acquisition** heading, set the **Minimum Object Roundness** field to **0.3**.

2 Click *Start Wanding*.

**Result:** BlackTrax cameras will now record calibration wand data within the Space.

**a.** **In the Space**, plug the power source into the calibration wand.

**b.** Wand the Space by moving the calibration wand slowly across the Space. Try to move the wand up and down and back and forth while you move, to create different data points. Ensure the calibration wand LEDs are not covered or being blocked from BTCamera view.

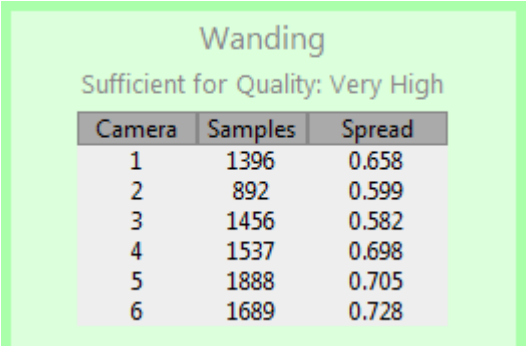
**Tip:** A recommended path to take is to start at the Space origin, and then to do a circle around the inside of the Space perimeter.

3 **In Tracking Tools**, open the **Camera View** window. From the **View** menus, click **Camera Preview.**

**a.** Look at the **2D Multi Camera** window. Examine each BTCamera's recording of the calibration wand. Wand samples are represented as colored lines by each camera. Each camera view should have samples recorded.

**Attention:** If a BTCamera will not record samples while wanding, even though the wand is visible, consult the **2D Multi Camera View**. See if other BTCameras are detecting the wand. If the wand does not appear on any other BTCameras, the area will not calibrate due to lack of coverage. If the wand shows up on at least two other BTCameras, continue wanding, but adjust the path and angle of the wand to give the BTCameras different views. If a section of the intended Space will not record samples after all of the steps above, cancel the calibration. Reposition the cameras to obtain better field of view overlap for that area.

**b.** View the **3-Marker Calibration** window, under the **Calibration Engine** heading in the **Samples Window.** Here feedback will display on the number of times the calibration wand was viewed from each BTCamera. The window will give a rating which defines whether sufficient samples were recorded for low, medium, high, or very high quality calibration.




| Camera | Samples | Spread |
|---|---|---|
| 1 | 1396 | 0.658 |
| 2 | 892 | 0.599 |
| 3 | 1456 | 0.582 |
| 4 | 1537 | 0.698 |
| 5 | 1888 | 0.705 |
| 6 | 1689 | 0.728 |

**Note:** The average number of samples per BTCamera should be about 500-1000.

**Note:** Be careful to not create too many samples. If BTCamera samples are too large camera calibration will take significantly longer

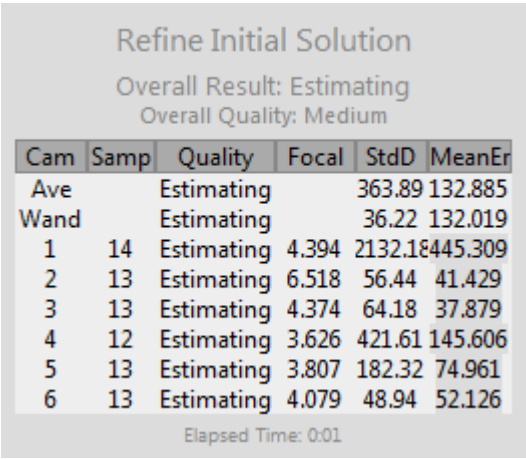
4 Click *Calculate*.

**Result:** Under the **Calibration Engine** heading, the **Samples Window** will change into the **Solver Window**. Displayed at the top of the solver window is the current stage the solver is in, followed by the overall result rating and the overall quality the engine is attempting to achieve.

The calibration engine will attempt to solve for "Medium" calibration quality. This will let the BTCameras determine their general position in the Space quickly.

The calculation is run automatically. The first phase is "Refine Initial Solution", then "Global Optimization: Initial" phase, and last is "Global Optimization: Final" phase. Each phase will solve the calibration of the system in greater detail, and the system will move from to the next automatically. Once the solver reaches the final optimization phase, it will continue to refine the solution until the user applies the results to the BTCameras.

The solver window will display a quality rating for all BTCameras as well as the global average and the wand average. Valid quality ratings are (in order from worst to best rating): Poor < Fair < Good < Great < Excellent < Exceptional.




| Cam | Samp | Quality | Focal | StdD | MeanEr |
|---|---|---|---|---|---|
| Ave | | Estimating | | 363.89 | 132.885 |
| Wand | | Estimating | | 36.22 | 132.019 |
| 1 | 14 | Estimating | 4.394 | 2132.18 | 445.309 |
| 2 | 13 | Estimating | 6.518 | 56.44 | 41.429 |
| 3 | 13 | Estimating | 4.374 | 64.18 | 37.879 |
| 4 | 12 | Estimating | 3.626 | 421.61 | 145.606 |
| 5 | 13 | Estimating | 3.807 | 182.32 | 74.961 |
| 6 | 13 | Estimating | 4.079 | 48.94 | 52.126 |

**Note:** In the **Perspective View** window you can see a visualization of the wand sample collected being used in the calculation. The BTCameras will also move in the **Perspective View** Space to match their position in the physical Space as they learn where they are.

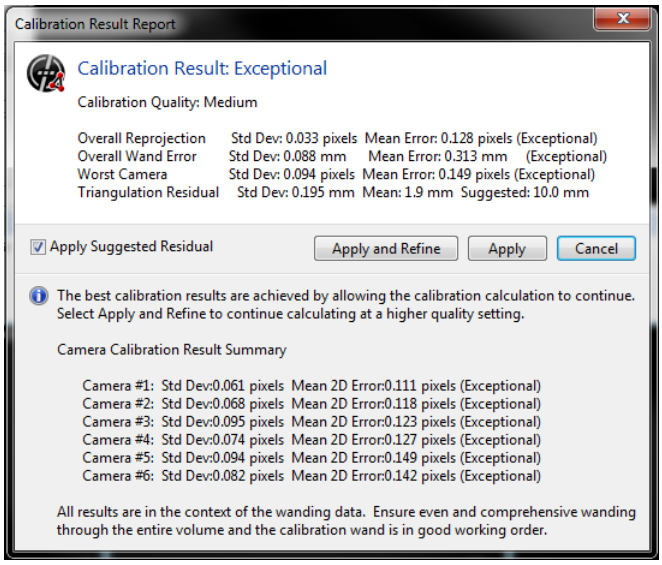
**Note:** The mean error is what determines the quality rating. The lower the mean error the better the quality rating. After a time, the system will have diminishing returns with the calibration data and the ratings will not improve quickly beyond that point. You can tell if you have reached diminished returns if all the **MeanError** column numbers have frozen after a time and will not go lower.

**Note:** If a BTCamera's mean error is disproportionately higher then the rest, that is an indication of poor wand samples collected for that BTCamera during calibration. It is recommended that you

restart the wand calibration process. Make sure the BTCamera and at least one other have vision of the calibration wand during wanding.

5 Once the rating for each BTCamera reaches "**Excellent**" or greater, and the Overall Results quality rating reaches "**Excellent**" or greater, click *Apply Results*.

**Result:** The *Calibration Results Reports* window will open. Calibration results and addition options are available.




6 In the *Calibration Results Reports* window click *Apply and Refine*.

**Result:** The desired calibration quality will increase from "Medium" to "Very High". A "Very High" calibration is used to determine BTCamera positions to a greater degree. The calibration engine will attempt to further refine data to reach an "Excellent" or greater rating for all cameras on "Very High" calibration. It is necessary to *Apply and Refine* calibration results at least once during calibration.

The calibration results for each BTCamera will initially downgrade when the calibration quality is changed to "Very High". The standards for a "Very High" calibration are greater then that of a "Medium" calibration.

7 Once the quality rating reaches "Excellent" for each BTCamera and for the Overall Results, click *Apply Results*.

8 In the *Calibration Results Reports* window click *Apply*.

**Result:** BTCameras will know their position in the Space in relation to each other. This can be viewed as cameras arrange themselves in the **Perspective View** window in Tracking Tools.

9 Save the changes to the project file. Go to the **File** menu and click **Save Project**.

## Known calibration issues

- **Issue**: When **Calibration Engine** is calculating, calibration might lock up before it has reached diminishing returns or desired calibration rating.

  **Solution**: This could be a calculation error the system is stuck on. A possible solution is to click *Apply Results*, then in the *Calibration Results Reports* window click *Apply and Refine.* This will give the **Calibration Engine** more data to work with and it might be able to move past the error.

- **Issue**: After trying to calibrate multiple times the **Calibration Engine** will not give a Global "Excellent" rating.

  **Solution 1**: The data samples taken from wanding may be bad and could be an issue. Ensure the Space is properly masked from infrared interference and rewand.

## To calibrate BTCameras with the ground plane

After the BTCameras are calibrated with the calibration wand, it is necessary to calibrate with the ground plane. This step will inform the System where the floor is and where the BTCameras are in relation to the floor. It will also inform the system the direction of the axis.

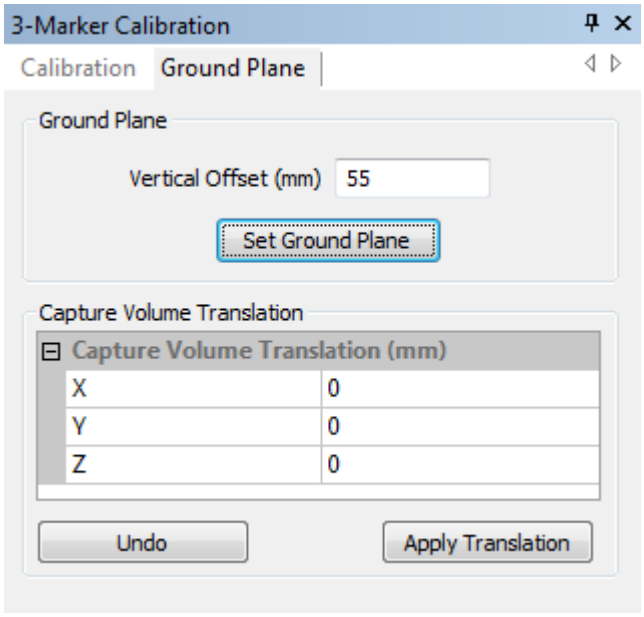
**Attention:** The origin of the Space must be visible to a minimum of 2 BTCameras to calibrate correctly.

1. **In the Space**, unfold and lock the ground plane into an L shape, ensuring the arms are at a 90° angle.
2. Plug in the power source to an outlet and connect the power source to the ground plane.
3. Move the center marker or the ground plane over the Origin of the Space. Adjust the feet of the ground plane to align the ground plane level with the floor. You can see if the ground plane is level with the built in level on the ground plane arms.

   **Attention:** The origin of the coordinate plane of the tracking space must be the same as the origin of the virtual representation of the tracking space as made in WYSIWYG. Ensure this matches the (0,0,0) position in the WYSIWYG file. If the virtual representation and actual tracking area do not share the same origin, positional data and fixture tracking will be incorrect.
4. Point the long arm of the ground plane to the +Y axis (what is called the +Z axis in Tracking Tools), the short arm to the +X axis.
5. **In Tracking Tools**, in the **3-Marker Calibration** window, in the **Ground Plane** tab, enter **90mm** in the **Vertical Offset (mm)** field.

   **Attention:** If the ground plane is not placed on the surface of the origin, such as on a tripod, measure the distance between the X-Z plane and the center of the ground plane markers. Enter in this value in the Vertical Offset (mm) field instead.
6. To apply ground calibration, click *Set Ground Plane*.

   **Result:** The BTCameras will know their position in relation to the ground and adjust accordingly in **Camera View** window in Tracking Tools.
7. Save the changes to the project file. Go to the **File** menu and click **Save Project**.



# Tracking Mode

After BTCameras are calibrated, minor adjustments need to be entered in Tracking Tools for the system to switch from camera calibration to tracking mode. These setting enable fixture tracking to occur. Once tracking mode is configured, no changes to the Tracking Tools project need to be made unless cameras were moved or bumped since camera calibration.

## To configure BTCameras for normal tracking

1 **In Tracking Tools**, open the **Cameras** window. From the **View** menu click **Cameras**.

2 In the **Cameras** window, select the BlackTrax camera group by clicking on the camera group name.

   **a.** While the camera group is still selected, look below to the **Property** section for the camera group. Under the **Capture Volume Visualization** heading, set the **Volume Resolution** field to **100**.

   **b.** Set the **Opacity** field to **20%**.

   **c.** Set the **Camera Overlap** field to **2**.

   **Result:** A 3D image of the Space will be visible in the Perspective View window

3 Open the **Applications Setting** window. From the **Edit** menu, click **Tracking Tools Settings**.

   **a.** In the **Applications Setting** window, under the **Applications Options** heading, set the **Active Marker Labeling** field to **True**.

   **Result:** BTCameras will only track infrared sources with identifying pulses, such as the LED of a Pulsers connected to BTBeacons.

4 Save the changes to the project file. Go to the **File** menu and click **Save Project**.

# Chapter 5

# BlackTrax GUI

This chapter provides information on the BlackTrax user interface and various functions of BlackTrax.

## In this chapter

# Before Using BlackTrax

**Attention:** Before running the BlackTrax GUI, ensure you have completed the following mandatory steps to ensure a successful BlackTrax experience:

- **Set up the BTSystem in the Space -** The BTSystem needs to be physically installed in the Space. See *BlackTrax System Overview* for information on how to set up the BTSystem.
- **Create a .btx file in WYSIWYG -** A .btx file provides BlackTrax with information on Trackables, Fixtures and Space dimensions. See *WYSIWYG for BlackTrax* for information on how to create a .btx file.
- **Configure and Calibrate BTCameras using Tracking Tools -** Tracking Tools needs to be used to configure BTCameras and inform the BTSystem how to track and how to communicate position information with the other components. See *Tracking Tools for BlackTrax* for information on how to configure and calibrate BTCameras.

# BlackTrax User Interface

## Introduction

When BlackTrax launches, it will bring you by default to the **Project** page. Before the **Project** page and the other pages of BlackTrax are explained, we will first familiarize you with the various parts of the user interface.

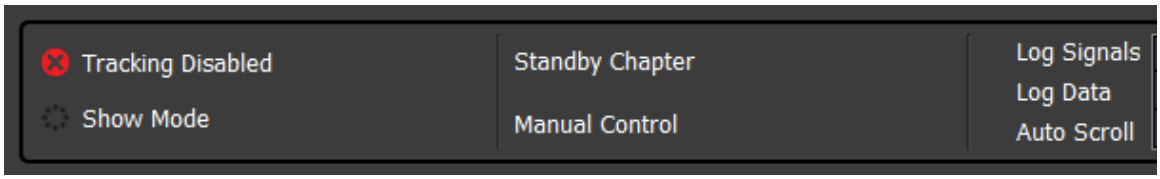
## Layout of BlackTrax GUI

The functions of BlackTrax are divided into several simple pages. At the top of the window is the **Page Bar** which allows for navigation to the pages when clicked. The pages of BlackTrax are:


- **Control Panel:** The **Control Panel** page is where you will control a BlackTrax project. You will have control over the ability to toggle **Following** by and **Calibration Mode** On/Off. You can manually switch between chapters or enable chapter control from a console. You can connect or disconnect BlackTrax modules to the system as well as view current BTBeacon assignments and data. Only information that is saved and applied to the project is displayed here.
- **Project:** The **Project** page is the starting point for any BlackTrax project. From here you will import a WYSIWYG (.btx) file to use as a foundation for your BlackTrax project (.btprj) file. Here you can open, save and modify existing BlackTrax projects as well as update a .btprj file with additional information from an updated .btx file.
- **Beacon Assignment:** The **Beacon Assignment** page is where information on all active BTBeacons is shown. Available Trackables are also visible on this page for BTBeacons to be assigned to.
- **Chapters:** The **Chapter** page is where you will assign fixtures to follow Trackables. The beam size of fixtures following can also be set. An single instance of fixture relationships is called a chapter. Chapters can be edited, saved and managed in this page.
- **Trackables :** The **Trackables** page is where you can assign attributes to Trackables. Trackables are anything you want to be tracked that has a BTBeacon assigned to it. Attributes of Trackables are the functions of the assigned BTBeacon buttons, the following offset of the BTBeacon's Pulser, and the creation of Sub-Trackables.
- **Fixture Calibration:** The **Fixture Calibration** page allows for correction and adjustments of approved movable fixture connected to BlackTrax, ensuring precision when following Trackables. Features of fixtures that can be calibrated are the pan and tilt settings. The calibrations profiles created can then be exported and imported for use as needed.
- **System:** The **System** page displays BlackTrax system data in addition to allowing further customization of your BlackTrax experience. A detailed system log, a list of network outputs, and a complete list of all fixtures and BTBeacons including attributes are available for viewing in this page.

## Status Bar

Along the bottom of the screen there is a status bar that displays important system information at a glance. The following information is available for view:




I. Following Icon: Signifies if fixtures are following Trackables.
II. Calibration Icon: Signifies if calibration mode is active.
III. Chapter Control: Signifies if chapters are in manual or Art-Net control.
IV. Current Chapter: Displays the chapter currently active.
V. Units: Unit of measurement used in the project.

## Change Buttons

At the bottom right corner of each page are the change project buttons. These buttons are used to affect changes made to a BlackTrax project.

- *Discard Changes* - Will rollback changes made in the BlackTrax project to the last savepoint created. If no savepoint was created, the project will revert to as it was when opened.
- *Apply Changes* - Any changes made to the BlackTrax project will be applied and usable by the BTSystem. A temporary savepoint for any changed made to the BlackTrax project will also be created. The savepoint will last until the BlackTrax project is closed.
- *Verify Changes* - Will check the project for errors since the last changes were applied. Will verify if any changes made will break the project.

# Project Page

The **Project** page is where a BlackTrax project starts. From this page a WYSIWYG (.btx) file is imported to create a BlackTrax project (btprj) file . Other features that are available is the ability to save, load, and update projects with new information.

## Layout of Project Page

I. *Create Project* - Imports a .btx file to create a .btprj file.

II. *Open Project* - Opens a previously saved .btprj file.

III. *Update BT Project* - Updates the current .btprj with information from an updated .btx file.

IV. *Close Project*- Closes the current .btprj file.

V. *Save Project* - Saves the current .btprj file.

VI. *Save Project As* - Makes a copy of the current .btprj file in a different folder and/or makes a copy with a different name.

## Starting a BlackTrax project

*Create Project* will import information from a previously created WYSIWYG (.btx) file to create a BlackTrax project (.btprj) file. A .btprj file is the accumulation of all the information gathered from a .btx file, plus all the settings and tracking information created in BlackTrax.

If another project is currently opened, you will be prompted to save changes to that project before a new project is created. Only one BlackTrax project may be open at a time.

### To create a .btprj file

1 Click *Create Project*.

**Result:** The *Create Project* dialog window will appear.

2 In the *Create Project* window, next to the **BTX File** field, click *"..."*.

**Result:** The *Browse* window will open.

3 In the *Browse* window, navigate to the .btx file location and select the file.

4 Click *Open.*

5 Next to the **Project File** field, click *"..."*.

**Result:** The *Browse* window will open.

6 In the *Browse* window, navigate to where you want to save the BlackTrax project file (.btprj).

7 In the Name field, enter the name of the .btprj file.

8 Click *Save*

9 Click *Ok.*

**Result:** Information from the .btx file (e.g. fixtures, Trackables, Space dimensions) will be loaded into a new BlackTrax project. The project will be named and saved as directed.

## Opening BlackTrax projects

*Open Project* will open a previously created BlackTrax project. If another project is currently opened, you will be prompted to save changes to that project before a new project is opened.

### To open a BlackTrax project

1 Click *Open Projects*.

**Result:** The *Browse* window will open.

2 The *Browse* window, navigate to the .btprj file location and select the file.

3 Click *Open.*

## Closing BlackTrax projects

*Close Project* will exit out of the currently open BlackTrax project while keeping the GUI open. *Close Project* will not save the BlackTrax project.

### To close a BlackTrax project

1 Click *Close*.

2 A dialog box will appear asking if you really want to close the project. To close the project click *Yes*.

**Result:** The .btprj file will close.

## Updating BTX Projects

If a WYSIWYG project file has been edited, *Update BTX Projects* will update the BlackTrax project that is based on the WYSIWYG project with the new information.

### To update a BlackTrax project with new information from WYSIWYG

1 Click *Update BTX Projects*.

**Result:** The *Browse* window will open.

2 In the *Browse* window, navigate to the edited .btx file location, and select the file.

3 Click *Open.*

**Result:** Information from the .btx file (e.g. fixtures, trackables, Space dimensions) will be loaded into BlackTrax.

## Saving BlackTrax projects

BlackTrax projects are saved as a .btprj file. *Save Project* will save the open BlackTrax project to the same file name and location under which it was previously saved. If you are saving the project for the first time, this command will perform as *Save Project As*. *Save Project As* is used to save the current project with a new file name and/or a new destination.

### To save a BlackTrax project using Save Project

To save the current project, click *Save Project*.

### To save a BlackTrax project using Save Project As

1 Click *Save Project As.*

2 The *Browse* dialog box will appear.

3 In the *Browse* dialog box, navigate to location you want to save the file.

4 In the **File Name** field, type the desired name of the file.

5 To save the file, in the dialog box click *Save*.

# Trackables Page

## Introduction

The **Trackables** page is where information on all Trackables in the project is shown, and where Trackables settings can be edited. Trackable setting are linked to the Trackable itself. Any BTBeacon assigned to the Trackable will inherit the Trackable's settings, and function as directed.

## Layout of Trackable Page

I. **Trackables** - List of all Trackables in the project.
   1. **Name** - Name of the Trackable.
   2. **Wysiwyg Frame** - Name of the Frame assigned to the Trackble in WYSIWYG.
   3. **Beacon Assign** - Indicates if a BTBeacon is assigned to a Trackable.
   4. **LED Tracking** - Indicates if Sub-Trackables are enabled in the Trackable.

II. **Trackable Setup** - Customization options of a Trackable.
   1. **Name** - Name of Trackable as it will be displayed in BlackTrax.
   2. **LEDs** - Method of tracking BTBeacon assigned to the Trackable.
   3. **Beacon Centroid Offset** - Section to configure how off-center from an assigned BTBeacon Pulser LED the system should follow.
      a. **X** - The offset value on the X axis.
      b. **Y** - The offset value on the Y axis.
      c. **Z** - The offset value on the Z axis.
   4. **3 Trackable LEDs** - Section to configure Sub-Trackables parts of a Trackable.
      a. **Active -** Check box to toggle a Sub-Trackable On/Off.
      b. **Sub-ID** - Identifying number of the Sub-Trackable.
      c. **Sub-Trackable Name** - Name of the Sub-Trackable.
      d. **LED Assignment** - A drop-down list of which port on the BTBeacon will relay position data for the Sub-Trackable.
   5. **IMU** - Enables/disables use of the BTBeacon IMU.
   6. **Orientation** - Enables/disables the use of orientation data in Trackable positions.

III. **Third Party Output Settings** - Drop-down list for selecting third party output setting.

## Configurable Trackable Functions

The **Trackable Setup** section is where the settings of Trackables can be edited. A BTBeacon assigned to the Trackable will function according to these settings.

### To edit a Trackable name

1. In the **Trackables** section, select the Trackable you want to edit.
2. In the **Trackable Setup** section, in the **Name** field, enter the name of the Trackable.
3. For the changes to take effect, click *Apply Changes*.

### To set the IMU configuration of an assigned BTBeacon

A BTBeacon can have their IMU enabled or disabled during tracking when assigned to a Trackable. If the IMU is disabled, the Trackable's position is only based on where BTCameras can see the assigned BTBeacon's Pulser LED.

**Attention:** Disabling the IMU will disable the backup tracking that the IMU provides if Pulser LEDs become covered.

1. In the **Trackables** section, select the Trackable you want to configure.
2. In the **Trackable Setup** section, from the **IMU** drop-down list select the desired IMU configuration.
3. For the changes to take effect, click *Apply Changes*.

## LED Tracking Configurations

There are two methods for tracking of Pulser LEDs to be configured; *Centroid Tracking* and *Individual LED Tracking*.

### Centroid Tracking

Centroid Tracking is used when you want a track a single point on a Trackable. One or more Pulser can be connected to a BTBeacon assigned to the Trackable in this mode. If a single Pulser is used, the Pulser's LED pulses its position data to the BTSystem. The BTSystem uses this position as the focal point of the Trackable.

When multiple Pulsers are attached to a BTBeacon, each Pulser's LED broadcasts its individual position to the system. BlackTrax determines the center between all of the Pulser LEDs and sets that as the focal point of the Trackable.

**Note:** Centroid Tracking supports **Beacon Centroid Offsets**.

### Individual LED Tracking

Individual LED Tracking is used when a Trackable has multiple points you want to track independently. An assigned BTBeacon has multiple Pulsers attached, each broadcasting its individual position to the BTSystem. The Trackable is separated into Sub-Trackables, with an single Pulser and its position assigned to a single Sub-Trackable. Sub-Trackables act exactly as Trackables; they can have fixtures assigned and be tracked independently using their own positional data.

### To set the LED configuration of an assigned BTBeacon

1. In the **Trackables** section, select the Trackable you want to configure.
2. In the **Trackable Setup** section, from the **LEDs** drop-down list select the LED configuration.
3. For the changes to take effect, click *Apply Changes*.

## Configuring centroid offsets

By default the focal point of a Trackable is the center of a connected Pulser LED. You may find that where the Pulser LED is positioned on a Trackable is not where you want the focal point of a Trackable to be. The focal point can be offset relative to the position of the Pulser LED. You can offset the position on the X,Y,Z axes. This ensures that BlackTrax is always following how you intend it to.

**Attention:** Ensure **LEDs** is set to **Centroid Tracking** to use the **Beacon Centroid Offsets** section.

### To configure the BTBeacon centroid offset

1. In the **Trackables** section, select the Trackable you want to configure.
2. In the **Trackable Setup** section, go to the **Beacon Centroid Offset** sub-section.

3 Enter the desired off-set values in the appropriate fields.

4 For the changes to take effect, click *Apply Changes*.

## Configuring Sub-Trackables

A Sub-Trackable is created when there is a Trackable that has multiple areas you want to track separately, using a single BTBeacon and multiple Pulsers. Sub-Trackables share the same rotational data generated by the parent BTBeacon, but have independent positional data from their assigned Pulser.

**Note:** A maximum of 3 Sub-Trackables can be created for each Trackable.

**Attention:** Ensure **LEDs** is set to **Individual LED Tracking** to use the **3 Trackable LEDs** section.

### To toggle a Sub-Trackable On/Off

1 In the **Trackables** section, select the Trackable you want to configure.

2 In the **Trackable Setup** section, go to the **3 Trackable LEDs** sub-section.

3 In the **Active** column, in the **Sub-ID** row of the Sub-Trackable, click the check box to toggle the Sub-Trackable.

**Note:** If the check box is marked, the Sub-Trackable will be active. If the box is blank, the Sub-Trackable will be disabled.

4 For the changes to take effect, click *Apply Changes*.

### To assign an LED port to a Sub-Trackable

1 In the **Trackables** section, select the Trackable you want to configure.

2 In the **Trackable Setup** section, go to the **3 Trackable LEDs** sub-section.

3 In the **LED Assignment** column, in the **Sub-ID** row of the Sub-Trackable, select the LED port from the drop-down list.

**Note:** If the selected LED port was in use by another Sub-Trackable, that Sub-Trackable's assigned port will change to **None**.

4 For the changes to take effect, click *Apply Changes*.

**Result:** The Sub-Trackable's position will now be associated with the Pulser that is in the assigned LED port of an assigned BTBeacon.

### To name a Sub-Trackable

1 In the **Trackables** section, select the Trackable you want to configure.

2 In the **Trackable Setup** section, go to the **3 Trackable LEDs** sub-section.

3 In the **Trackable Name** column, in the **Sub-ID** row of the Sub-Trackable, click in the field and enter the name of the Sub-Trackable in the field.

4 For the changes to take effect, click *Apply Changes*.

## Configuring the IMU of Trackables

By default, when a BTBeacon is assigned to a Trackable, the BTBeacon's IMU will generate orientation data on the Trackable's position. The IMU also generates positional data to be used as a safeguard against tracking disruption.

### To toggle the generation of IMU positional data

1. In the **Trackables** section, select the Trackable you want to configure.
2. In the **Trackable Setup** section, from the **IMU** drop-down list select the IMU setting.
3. For the changes to take effect, click *Apply Changes*.

### To toggle the generation of IMU orientational data

1. In the **Trackables** section, select the Trackable you want to configure.
2. In the **Trackable Setup** section, from the **Orientation** drop-down list select the orientation setting.
3. For the changes to take effect, click *Apply Changes*.

## Configuring third party output of Trackables

By default, the position information of all Trackables is sent to third parties as both Euler and Quaternion. BlackTrax can be configured to send information as Euler and Quaternion or only send data as Euler.

### To toggle third party output

1. In the **Trackables** section, select the Trackable you want to configure.
2. In the **Third Party Output Settings** section, from the drop-down list select the desired output setting.
3. For the changes to take effect, click *Apply Changes*.

# Chapters Page

## Introduction

The **Chapters** page is where moving fixtures are assigned to follow the position of Trackables. A chapter is saved information on which Trackables are to be tracked and which fixtures are to follow them at a specific instance. BlackTrax allows for up to 48 fixtures following, and up to 12 BTBeacons active in a chapter. You can create as many chapters as you need and can switch between them freely, enabling infinite combinations of fixtures and Trackables.

## Layout of Chapter page

I. **Chapters** - List of created chapters and chapter management tools.
   1. **Name** - Name of the chapter.
   2. **Description** - A short description or note of the chapter.
   3. *Copy Chapter* - Creates a copy of a selected chapter.
   4. *Plus* - Creates a new blank chapter.
   5. *Minus* - Deletes currently selected chapter.
   6. *Up Arrow* - Move selected chapter up one position in the chapter list.
   7. *Down Arrow* - Move selected chapter down one position in the chapter list.

II. **Fixture Properties** - Configuration options for fixtures.
   1. **Fixture** - Name of selected fixture.
   2. **Beam Control** - Section for controlling the footprint of a beam.
      a. **Enable Iris Control** - Control the beam footprint using the iris of the fixture.
      b. **Enable Zoom Control** - Control the beam footprint using the zoom of the fixture.
      c. **Beam Size** - Size of the beam footprint.
      d. **Distance Range** - The range of distance from a fixture a Trackable can be and maintain the beam size.
   3. **LED Control** - Fixtures assignment to Sub-Trackables.

III. **Project Information** - Metadata on the BlackTrax project.
   1. **Show Name** - Name of the BlackTrax project.
   2. **Author** - Author of the BlackTrax project.
   3. **Description** - Description about the BlackTrax project.

IV. **Relationships** - Trackables and assigned fixtures in a chapter.
   1. **Trackable Container** – A representation of a Trackable used in the chapter.
      a. *Delete Icon* - Deletes the Trackable from the chapter.
      b. *Maximize / Minimize* - Toggles the size of the Trackable Container.
   2. *Fixture Icon* - A representation of a fixture assigned to a Trackable in the chapter.
      a. **Sub-Trackable ID** - Identifier of which Sub-Trackable the fixture is assigned to.
   3. *Fixture settings filter* - Drop-down list for enabling visual displays of fixture settings.
   4. *Delete All* - Deletes every Trackable Container from the chapter.
   5. *Minimize All* - Minimizes every Trackable Container in the chapter.
   6. *Maximize All* - Maximizes every Trackable Container in the chapter.

V. **Library** - A list of all Trackables and fixtures in the BlackTrax project.

1. **Trackables** - List of all available Trackables.
    a. **Name** - Name of the Trackable.
    b. **Patched** - Patch status of Trackable.
    c. *Add* - Adds selected Trackable to current chapter.
    d. *Delete* - Deletes selected Trackable from current chapter.
    e. *Trackable patch filter* - Drop-down list for filtering Trackables based on patch status.
2. **Fixtures**- List of all available fixtures.
    a. **Name** - Name of fixture.
    b. **Patch Info** - Universe and channel information of fixture.
    c. **Assigned** - Assignment status of fixture.
    d. *Assign* - Adds selected fixture to the selected chapter.
    e. *Unassign* - Removes selected fixture from the selected chapter.
    f. *Fixture assignment filter* - Drop-down list for filtering fixtures based on assignment.

## Managing chapters

The **Chapters** section is where chapters are created and edited. A chapter contains information on which Trackables are to be followed by assigned fixtures when the chapter is active.

### To create a new chapter

1 In the **Chapters** tab, click the *Plus* button.

**Result:** A blank chapter will be created in the list below the currently selected chapter.

2 For the changes to take effect, click *Apply Changes*.

### To create a copy of an existing chapter

Copying a chapter will copy all aspects of the selected chapter, including fixture and Trackable relationships.

1 In the **Chapters** tab, select the chapter you want to copy.

2 Click the *Copy Chapter* button.

**Result:** A copy of the chapter will be created in the list below the currently selected chapter.

3 For the changes to take effect, click *Apply Changes*.

### To delete a chapter

1 In the **Chapters** tab, select the chapter you want to delete.

2 Click the *Minus* button.

3 A dialog box will appear asking if you really want to delete the chapter. To confirm deletion, click *Yes*.

4 For the changes to take effect, click *Apply Changes*.

### To move chapters in the chapter list

1 In the **Chapters** tab, select the chapter you want to move.

2 Move the chapter up or down by clicking the *Up Arrow* or *Down Arrow* button respectively.

3 For the changes to take effect, click *Apply Changes*.

### To name a chapter

1. In the **Chapter** tab, in the **Name** field of the chapter, double-click to enable editing.
2. Enter the name of the chapter in the **Name** field.
3. For the changes to take effect, click *Apply Changes*.

### To write a description of a chapter

1. In the **Chapter** tab, in the **Description** field of the chapter, double-click to enable editing.
2. Enter the chapter description in the **Description** field.
3. For the changes to take effect, click *Apply Changes*.

## Managing Trackables and fixtures in a chapter

The **Relationship** section displays which fixtures are assigned to which Trackables in the chapter. Available Trackable and fixtures are shown in the **Library** section.

### To add a Trackable to a chapter

Adding a Trackable to a chapter tells the BTSystem that this Trackable has fixtures following it when the chapter is active.

1. In the **Chapter** tab, select a chapter you want to add a Trackable to.
2. View available Trackables by going to the **Library** section and clicking on the **Trackables** tab.
3. In the **Trackables** tab, select the Trackable you want to add.
4. Click *Add*.

   **Result:** A **Trackable Container** of the Trackable will appear in the **Relationship** section for the chapter.

   **Note:** Trackables can also be added to a chapter by dragging and dropping a Trackable from the **Trackable** tab into the **Relationship** section.
5. For the changes to take effect, click *Apply Changes*.

**Note:** To add a Sub-Trackable to a chapter, add the configured parent Trackable to the chapter.

### To delete a Trackable from a chapter

1. In the **Chapter** tab, select a chapter you want to delete a Trackable from.
2. View available Trackables by going to the **Library** section and clicking on the **Trackables** tab.
3. In the **Trackables** tab, select the Trackable you want to delete.
4. Click *Delete*.
5. For the changes to take effect, click *Apply Changes*.

### To remove all Trackables from a chapter

1. In the **Chapter** tab, select a chapter you wish removes all Trackables from.
2. In the **Relationship** section of the chapter, click *Delete All*.
3. A dialog box will appear asking if you really want to delete all Trackables. To confirm deletion, click *Yes*.
4. For the changes to take effect, click *Apply Changes*.

### To assign a fixture to a Trackable

When a fixture is assigned to a Trackable, the BTSystem will instruct the fixture to follow the Trackable. Fixtures will only follow an assigned Trackable in the chapter they are assigned, and only when that chapter is active.

1. In the **Chapter** tab, select a chapter that has a Trackable you want to assign a fixture to.
2. In the **Relationship** section, select the **Trackable Container** of the Trackable.
3. View available fixtures by going to the **Library** section and clicking the **Fixtures** tab.
4. In the **Fixture** tab, select a fixture you want to assign to the Trackable.
5. Click *Assign*.

   **Result:** A *Fixture Box* of the fixture will appear in the **Trackable Container** of the Trackable.

   **Note:** Fixtures can also be assigned a Trackable by dragging fixtures from the **Fixture** tab and dropping them onto a **Trackable Container**.
6. For the changes to take effect, click *Apply Changes*.

### To unassign a fixture from a Trackable

1. In the **Chapter** tab, select a chapter that has a Trackable you want to unassign a fixture from.
2. In the **Relationship** section, select the **Trackable Container** of the Trackable.
3. Go to the **Library** section and click the **Fixtures** tab.
4. In the **Fixture** tab, select the fixture you want to unassign from the Trackable.
5. Click *Unassign*.

   **Result:** The *Fixture Box* will be removed from the **Trackable Container**.

   **Note:** Fixtures can also be removed from Trackables by dragging fixtures from the **Trackable Box** to the **Fixture** tab.
6. For the changes to take effect, click *Apply Changes.*

## Using filters in the Chapter page

The **Chapter** page allows you to add filters so that information on the page can be easily understood at a glance. This section will guide you on the various filters available.

**Fixture settings filter** - Drop-down list for enabling visual displays of fixture settings. When a filter is selected, the appropriate icons will appear on fixtures in the Relationship section that meet the criteria. The filters available are:

- **Has setting** - Will display if a fixture has any setting altered in the **Fixture Settings** section.
- **Has beam setting** - Will display if a fixture has any beam settings altered in the **Fixture Settings** section.
- **Uses Iris** - Will display if a fixture uses iris to change the beam size.
- **Uses Zoom** - Will display if a fixture uses zoom to change the beam size.
- **Has LED setting** - Will display if a fixture is assigned to a Sub-Trackable.
  - **Uses LED 1** - Will display if a fixture is assigned to a Sub-Trackable assigned to BTBeacon port 1.
  - **Uses LED 2**- Will display if a fixture is assigned to a Sub-Trackable assigned to BTBeacon port 2.
  - **Uses LED 3**- Will display if a fixture is assigned to a Sub-Trackable assigned to BTBeacon port 3.

**Trackable patch filter** - Drop-down list for filtering Trackables based on patch status. When a filter is selected, Trackables that meet the criteria will be displayed in **Trackables** tab in the **Library** section.

**Fixture assignment filter** - Drop-down list for filtering fixtures based on assignment. When a filter is selected, Fixtures that meet the criteria will be displayed in **Fixtures** tab in the **Library** section.

## Managing fixture properties

The **Fixture Properties** section allows you to configure how fixtures interact with Trackables. The beam size of an assigned fixture on a Trackable and Sub-Trackable selection is controlled from here.

### To control the beam size of a fixture

BlackTrax allows you to control the size of a fixture's beam while it is following a Trackable. This is done using the iris or zoom features of a fixture. The beam setting of a fixture is linked to the chapter it was created. Fixtures can be in multiple chapters and have a different beam sizes in each chapter.

**Note:** If both zoom and iris control are enabled, the BTSystem will tell the fixture to first use zoom control to shape the beam size. If zoom is unable to create the intended beam size alone, then iris will be used as well.

1. In the **Chapter** tab, select the chapter the fixture is in.
2. In the **Relationship** section, in the **Trackable Container** of the Trackable the fixture is assigned to, click on the *Fixture Icon* of the fixture to select it.
3. With the *Fixture Icon* is selected, go to the **Fixture Properties** tab.
4. Under the **Beam Control** section, select the method of controlling the beam size by marking the check-box next to the desired method.
5. In the **Beam Size** field enter in the desired size of the beam.

   **Result:** The **Distance Range** field will display the range the Trackable can be from the fixture and maintain the beam size.
6. For the changes to take effect, click *Apply Changes.*

### Assigning fixtures to Sub-Trackables

Each Sub-Trackable can be tracked individually by the BTSystem using separate Pulsers attached to the same BTBeacon. Sub-Trackables can have fixtures assigned and be followed by independently.

For details on configuring Sub-Trackables, see *Individual LED Tracking*.

#### To assign a fixture to a Sub-Trackable

1. In the **Chapter** tab, select a chapter that has a Trackable configured for Sub-Trackables.
2. In the **Relationship** section, select the **Trackable Container** of the Trackable.
3. Assign fixtures to the parent Trackable of the Sub-Trackable as normal.

   **Result:** In the **Relationship** section, the assigned fixture will display a *Sub-Trackable ID*. The ID is which Sub-Trackable of the parent Trackable the fixture will follow.

   **Note:** The default Sub-Trackable setting is centroid tracking. Centroid tracking is when fixtures focus on the average position of all Pulsers attached to a BTBeacon.
4. In the **Trackable Container** of the Trackable the fixture is assigned to, click on the *Fixture Icon* of the fixture.
5. While the *Fixture Icon* is selected, go to the **Fixture Properties** tab.
6. In the **Fixture Properties** tab, in the **LED Control** section, click the radio of a sub-Trackable you want the fixture assigned to.

   **Result:** The *Sub-Trackable ID* will change to match your selection. The fixture will follow the selected Sub-Trackable.
7. For the changes to take effect, click *Apply Changes*.

## Managing project information

The **Project Information** section is where descriptive metadata about the BlackTrax project is created, such as the show name, author, and description about the project.

#### To edit project information

1. Go to the **Project Information** tab.
2. Click in a field to enable editing.
3. Enter in the project details as required.
4. For the changes to take effect, click *Apply Changes*.

   **Result:** The project information will then be displayed in the **Control Panel** page, in the **Project Information** tab.

# Beacon Assignment Page

## Introduction

The **Beacon Assignment** page is where the assignment of BTBeacons to Trackables is controlled. For the position of a Trackable to be known, a BTBeacon must first be assigned to the Trackable. The assignment will link the BTBeacon's location with that of the Trackable.

The X, Y, Z position of a Trackable is based on the position of the assigned BTBeacon's Pulser LED in the Space. The Trackable's orientation is based on the IMU within the BTBeacon. BlackTrax interprets the data based on the configuration of the Trackable as set in the **Trackables** page.

BTBeacons broadcast data at all time when the BTBeacon is on, even if it is not assigned.

**Attention:** BTBeacons that are turned on count towards the limit of 12 BTBeacons allowed on at any one time. Even if the BTBeacon is not assigned, an active BTBeacon will count towards the system limit. If more then 12 BTBeacons are on at any time errors in tracking may occur. BTBeacons connected to the Charging Station do not transmit data and do not count towards the system limit.

## Layout of Beacon Assignment page

I. **Available Beacons** - Area for active BTBeacons currently not assigned.
   1. *Beacon Icon* - Representation of an active BTBeacon.
      a. **Beacon Name** - Name of BTBeacon.
      b. **Battery Icon** - Percentage of power remaining in the BTBeacon.
      c. **X** - The current X coordinate of the BTBeacon.
      d. **Y** - The current Y coordinate of the BTBeacon.
      e. **Z** - The current Z coordinate of the BTBeacon.
      f. **R** - The current roll (rotation of X axis) value of the BTBeacon.
      g. **P** - The current pitch (rotation of Y axis) value of the BTBeacon.
      h. **Y** - The current yaw (rotation of Z axis) value of the BTBeacon.
      i. **A** - Current status of the A button on the BTBeacon.
      j. **B** - Current status of the B button on the BTBeacon.
      k. *Page Arrow* (insert symbol) - Button to switch between data pages.
      l. **LED #**- BTBeacon LED port number.
      m. **ID #** - Unique identification pulse of connected Pulser.
      n. **Connectivity** - Connection status of Pulser connected to the LED port.
      o. **XYZ** - Position data of Pulsers in connected port.

II. **Available Trackables** - A visual of Trackables in the project.
   1. **Trackable Container** – A visual representation of a Trackable.
      a. **Trackable Name** - Name of Trackable.

## Assigning BTBeacons to Trackables

To know the position of a Trackable, a BTBeacon is first assigned to the Trackable. This will associate the data of the BTBeacon with the Trackable.

### To assign a BTBeacon to a Trackable

1. Drag and drop the *Beacon Icon* of the BTBeacon from its location onto the **Trackable Container** of the Trackable.
2. For the changes to take effect, click *Apply Changes*.

   **Note:** Assigning a BTBeacon to a Trackable that already has a BTBeacon assigned will cause the BTBeacons will switch places.

### To unassign a BTBeacon from a Trackable

1. Drag and drop the *Beacon Icon* of the assigned BTBeacon into the **Available Beacons** section.
2. For the changes to take effect, click *Apply Changes*.

# Fixture Calibration Page

## Introduction

The **Fixture Calibration** page is where the position of fixtures can be calibrated to ensure fixture tracking is precise and accurate.

To have a fixture follow an assigned Trackable, BlackTrax determines the position of the Trackable using the BTCameras and assigned BTBeacon. BlackTrax then references where the fixture is based on information collected from the WYSIWYG .btx file. Based on the Trackable and fixture positions, the BTSystem calculates the pan and tilt angles the fixture needs for it to aim at the Trackable. This information is then sent to the fixture.

If there are inconsistencies between the location of the fixture in the Space, and the virtual Space in WYSIWYG, tracking information BlackTrax creates will be inaccurate.

Fixture calibration allows you to correct these inconsistencies and ensures fixture tracking is accurate. It is recommended that all fixtures be calibrated when they are first installed in the Space, and individually anytime a fixture is moved or bumped.

**Attention:** *Discard Changes, Apply Changes* and *Verify Changes* are disabled during **Calibration Mode**.

**Attention:** The **Fixture Calibration** page is locked until BlackTrax is set to **Following** and **Calibration Mode**.

## Layout of Fixture Calibration page

I. **Fixtures** - Information on all fixtures in the BlackTrax project.
   1. **Name** – Name of fixture.
   2. **Patch Info** – DMX patch information of fixture.
   3. **Calibrated** – Calibration status of fixture.
   4. **Algo ID** – Algorithm type for fixture movement.
   5. **Latency (ms)** – Latency value of the fixture.
   6. *Clear All* – Removes calibration data from all fixtures.
   7. *Import Calibration* – Load previously saved calibration data (.cal).
   8. *Export Calibration* – Save current calibration data (.cal).

II. **Calibration Results** – Result of fixture calibration.
   1. **Original Data** – Fixture values from WYSIWYG.
   2. **Calibration Data** – Created fixture values from calibration.
   3. **X** - X axis position of fixture.
   4. **Y** - Y axis position of fixture.
   5. **Z** - Z axis position of fixture.
   6. **RX** - Rotation of X axis of fixture.
   7. **RY** - Rotation of Y axis of fixture.
   8. **RZ** - Rotation of Z axis of fixture.
   9. **Pan** - Pan value of fixture set to normal or inverted.
   10. **Tilt** - Tilt value of fixture set to normal or inverted.
   11. *Use Original Fixture Position* – BlackTrax uses the original fixture position.
   12. *Use Calibrated Fixture Position* – BlackTrax uses the calibrated fixture position.

III. **Calibration Beacon** – Information on BTBeacon used for calibration.
   1. *Calibration Beacon list* – A drop-down list of all available BTBeacons.
   2. **Current Value** – Current position data of selected BTBeacon.

IV. **Measurement Points** – Information on fixture measurement points sampled.
   1. **X** – Measured X coordinate value of measurement point.
   2. **Y** – Measured Y coordinate value of measurement point.
   3. **Z** – Measured Z coordinate value of measurement point.
   4. **Pan Angle** – Measured pan angle value of measurement point.
   5. **Tilt Angle** – Measured tilt angle value of measurement point.
   6. **Calibration Error (Residual)** – A value that indicates how accurate the pan and tilt angles of measurement points were based on all sampled measurement points.
   7. *Freeze Beam /Unfreeze Beam – Freeze Beam* will stop a BTBeacon from following a fixture, allowing a measurement point to be sampled. *Unfreeze Beam* will make a fixture continue following a BTBeacon.
   8. *Collect Data Point* – Will add a BTBeacon's Pulser location as a measurement point.
   9. *Delete Point(s)* – Will delete selected measurement points.
   10. *Delete Fixture Calibration* – Will delete all measurement points and created calibration data from a fixture.
   11. *Calibrate* – Will create and apply calibration data to a fixture based on all collected measurement points.

## Fixture Calibration

### To turn on fixture calibration

1 In the **Control Panel** page, in the **Tracking Control** section, ensure **Following** is turned on.

**a.** To turn on fixture following, click *Start Following*.

**Result:** The BTSystem will be set to **Following**. Fixtures will follow assigned BTBeacons as directed by the selected chapter.

2 Click *Enter Calibration*.

**Result:** The BTSystem will be set to **Calibration Mode**. The features of the **Fixture Calibration** page are enabled.

### To turn off fixture calibration

In the **Control Panel** page, in the **Tracking Control** section, click *Exit Calibration*.

**Result:** The BTSystem will exit **Calibration Mode** and enter **Normal Mode**. The features of the **Fixture Calibration** page are disabled.

## Fixture latency

BlackTrax always transmits the position of Trackables instantly in real time to fixtures. A fixture can only follow as fast as it is physically able to move. Slower fixtures may be lagged in following faster Trackables. A possible solution is to change the latency of the fixture.

When a fixture's latency is changed, BlackTrax will attempt to predict where the Trackable will be milliseconds in the future. The prediction is based on the previous movement and speed of the Trackable. BlackTrax will then tell the fixture to move ahead of the Trackable on the predicted path. Since the fixture is slow moving, the fixture it will be on top of the Trackable instead of ahead.

### To edit a fixture's latency

1 In the **Fixtures** section, in the **Fixture List**, select the desired fixture.

2 Double-click in **Latency (ms) field** of the fixture, enter in the latency value in the field.

**Result:** Changes take effect immediately after new values are entered. The fixture will operate at the set latency value.

## Collecting calibration data

To calibrate a fixture, you will have to first collect measurement points for the fixture. Measurement Points are samples of fixture and BTBeacon data collect while a fixture is following a BTBeacon in the Space during calibration mode.

### To create measurement points

1 **In BlackTrax**, in the **Fixture Calibration** page, in the **Fixture** list select the fixture that needs to be calibrated.

**Note:** If calibration data has already been created for the fixture, the fixture will have to be set to *Use Original Fixture Position*.

**a.** To use original data, in the **Calibration Results** section, click the *Use Original Fixture Position* radio.

2 A BTBeacon will be used to calibrate the fixture. In the **Calibration Beacon** section, click the *Calibration Beacon List* to view a drop-down list of all available BTBeacons

3 Select the desired BTBeacon from the list.

**Result:** The selected fixture will follow the selected BTBeacon in the Space.

4 **In the Space**, take the chosen BTBeacon. Make sure that a single Pulser is connected to the BTBeacon.

5 Move the BTBeacon to a point within the Space.

**Result:** The selected fixture should be following the BTBeacon in the Space.

**Attention:** The LED of the Pulser must be visible to 2 or more BTCameras simultaneously for tracking to occur.

6 At a point in the Space with the fixture following the BTBeacon, **in BlackTrack** click *Freeze Beam*.

**Tip:** Pushing the *A* button on the BTBeacon being tracked will activate *Freeze Beam* remotely.

**Result:** The fixture will stop in place.

**Attention:** You will not be able to use *Freeze Beam* if the BTBeacon is not tracked within the Space.

7 **In the Space** put the Pulser LED as close to the center of the fixture beam as possible.

8 With the LED still in the center of the beam, **in BlackTrack** click *Collect Data Point*.

**Tip:** Pushing the *B* button on the BTBeacon being tracked will activate *Collect Data Point* remotely.

**Result:** BlackTrax will collect the data of BTBeacon and fixture as a measurement point when *Add Point* is clicked. It will add the data to the **Measurement Points** section. The fixture will unfreeze and continue following the BTBeacon.

9 At different location in the Space, **repeat steps 5 to 8** until you create a total of 8 measurement points.

**Attention:** The minimum number of measurement points needed for calibration is 8.

**Note:** For best results the measurement points samples should be at different points in the Space, creating different pan and tilt angles. It is recommended to take measurement points in different areas of the Space and at different heights, creating the most variation.

### To calibrate a fixture using collected measurement points

Once measurement points are created for a fixture, they can be used to create calibration data for the fixture and determine the fixtures calibrated position.

1. In the **Fixture** list select the fixture that needs to be calibrated.
2. In the **Calibration Results** section, click the *Use Original Fixture Position* radio.
3. In the **Measurement Points** section, have a minimum of 8 measurement points created**.**
4. Click *Calibration.*

   **Result:** Calibration data is created from the measurement points and displayed in the **Calibration Results** section under the **Calibration Data** column. *Use Calibrated Fixture Position* becomes selected and the **Calibration Data** is automatically applied to the fixture. In the **Fixtures** section, the **Calibrated** field for the fixture will change to (**green**) to indicate that calibration data was created and that it is applied to the fixture. In the **Measurement Point** section, in the **Calibration Error (Residual)** column, residual values are create for each measurement point.

## Refining Calibration Data

After calibrating a fixture, **Calibration Error (Residuals)** for each measurement point will be calculated and shown in the **Measurement Points** section.

Calibration errors are the difference between the calculated pan/tilt values of a fixture, and the estimated pan/tilt values of the fixture, based on all measurement points used in the calibration. A calibration error residual close to 0, plus or minus 1, is a good indication that the sample was collected in a similar way compared to the rest. The quality of the sample should be good for fixture calibration.

A measurement point with a large residual number is an indication that the measurement point was collected differently then the other samples. The measurement point could also be too poor in quality to be of use in calibration. Such incorrect measurement points should be removed and then calibration reapplied to the fixture.

**Note:** If when removing measurement points from a fixture you have less then 8 remaining, you will have to collect more sample measurement points before recalculating fixture calibration.

### To delete measurements point from a fixture

1. In the **Fixtures** section, in the **Fixture List**, select the fixture with measurement points you want to delete.
2. In the **Measurement Points** section, select any measurement points you want to delete.
3. Click *Delete Point(s).*

   **Result:** The selected measurement points will be deleted from the fixture.

## Managing Calibration Data

Fixture calibration data can be saved as a calibration (.cal) file separate from of the BlackTrax project. Calibration profiles can be loaded and edited as needed in a project.

### To export calibration data

Created calibration data can be saved separately from the BlackTrax project as a BlackTrax calibration (.cal) file.

1. In the **Fixtures** section, click *Export Calibration.*
2. In the dialog widow that opens, navigate to the location where you want to save the calibration file.
3. In the **File Name** field, type the name of the calibration session.

4 Click *Save*.

**Result:** Information on any fixtures calibrated will be saved to the calibration file. The information will be accurate so long as the calibrated fixtures are not moved or bumped.

## To import calibration data

1 In the **Fixtures** section, click *Import Calibration.*

2 In the dialog window that opens, browse to the location where the calibration (.cal) file is located.

3 Select the .cal file.

4 Click *Open.*

**Result:** The calibration file will load. Fixtures will inherit the calibration data saved in the file.

## To apply calibration data to fixture

If calibration data is created but not applied to a fixture, BlackTrax continues using the original fixture position. Calibrated fixture positions need to be applied to fixtures for BlackTrax to use the calibration data.

**Note:** A fixture that has a calibrated position available, but is currently not in use, will display as ***Calibrated, Not Used (Yellow)***.

1 In the **Fixtures** section, select a fixture that has calibration data created but not in use.

2 In the **Calibration Results** section, click the *Use Calibrated Fixture Position* radio.

**Result:** BlackTrax will use the calibrated fixture position for the fixture. The calibrated value will change from ***Not Used*** **(yellow)** to ***Active*** **(green)**.

## To uncalibrate a fixture

1 In the **Fixtures** section, in the **Fixture List**, select the fixture you want to remove all calibration data from.

2 In the **Measurement Points** section, click *Delete Fixture Calibration*.

**Result:** All calibration data and measurement points will be removed from the fixture.

## To uncalibrate all fixtures in the project

1 In the **Fixtures** section, in the **Fixture List**, click *Clear All.*

2 A dialog window will appear asking if you really want to clear all calibration data from the project. Click *Yes*.

**Result:** All calibration data will be removed from all fixtures in the project.

# Control Panel Page

## Introduction

The **Control Panel** page is where a BlackTrax project is controlled. Only information that is applied to project file will appear here. Edits made to the opened project on other pages which are not applied using *Apply Changes* will not be shown.

From this page you can connect BlackTrax modules, toggle fixture following, toggle the tracking mode, and manage chapter selection and see project information.

## Layout of Control Panel Page

I. **Tracking Control** - Controls fixture following and BlackTrax modes.
   1. *Start Following/Stop Following* - Toggles fixture following On/Off.
   2. *Enter Calibration /Exit Calibration* - Toggles Calibration mode On/Off.

II. **BlackTrax Engine Modules** - Connected BlackTrax modules.
   1. *Discover* - Connects all linked modules to BlackTrax.
   2. **Module** - Name of the BlackTrax module.
   3. **Connection** - Connection status of modules.

III. **Chapter Control** - List of all created chapters in the project.
   1. **Active** - Status of the chapter.
   2. **Name** - Name of the chapter
   3. **Description** - Description of the chapter.
   4. **Control Type** - Drop-down list of chapter control options.

IV. **Project Information**- Read only metadata about the BlackTrax project.
   1. **Show Name** - Name of the BlackTrax project.
   2. **Author** - Author of the BlackTrax project.
   3. **Description** - Description of the BlackTrax project.
   4. **Creation** - Date the BlackTrax project was created.
   5. **Modification** - Date the BlackTrax project was last modified.
   6. **Calibration** - Date BlackTrax project fixtures were last calibrated.
   7. **Can Calibrate** - The project has enough information to run calibration.
   8. **Can Run Show** - The project has enough information to run full fixture tracking.

V. **Live Trackables -** All live Trackables and assigned BTBeacon in the project.

## BlackTrax Modules

The **BlackTrax Engine Modules** section, is where the different parts of the BTSystem are connected together. The status of all connected modules is shown so you can easily troubleshoot if any part is not connected.

### Purpose of BlackTrax modules

Each module has a specific role that comes together to create the BTSystem. The following is a brief explanation of the various modules:

- **Tracker** - Determines position of Trackables. Loads automatically with the BlackTrack GUI, operates in the background.
- **Follower** - Sends position data out to fixtures. Loads automatically with the BlackTrack GUI, operates in the background.
- **Visualizer** - WYSIWYG BlackTrax Edition, used to visualize activity in the Space.

### To connect modules to BlackTrax

In the **Network Clients** section, click *Discover*.

**Result:** The **BlackTrax Engine Modules** section will be populated with all linked modules. Modules have to be

## Chapter Selection

The **Chapter Control** section contains a list of created chapters that can be selected to be active. If **Following** is active, assigned fixtures will follow Trackables assigned to the active chapter.

Selection of which chapter is active can be controlled by using manual control in BlackTrax, or using Art-Net control from a lighting console.

### Manual Chapter Control

Manual control enables control of chapters from within the BlackTrax GUI.

### To enable manual control of chapters

In the **Chapter Control** section, click the drop-down list. From the list, select *Manual*.

### To select a chapter to be active using manual control

In the **Chapter Control** section, in the list of created chapters, click the chapter.

**Result:** The chapter will have an **Active Icon** in the **Active** field to show it is currently selected. Fixtures assigned in the chapter will follow assigned Trackables in the Space.

### Art-Net Chapter Control

With Art-Net control enable, the selection of which chapter is active can be controlled from a console.

### To enable Art-Net control of chapters

In the **Chapter Control** section, click the drop-down list. From the list, select *Art-Net Input*.

**Result:** A connected lighting console now has control over chapter selection. Under the **Chapter Control** drop-down list the Universe and Channel which the console will control chapter selection is displayed. The *Auto Scroll* feature is now available as well.

### To toggle auto scrolling to an active chapter

With *Art-Net InPut* enabled, the *Auto Scroll* feature becomes available for use. Auto Scroll will make the chapter list always display the active chapter when enabled.

To toggle auto scrolling, in the **Chapter Control** section, click *Auto Scroll*.

## Tracking Control

The **Tracking Control** section is where fixture following and calibration is controlled. When **Following** is enabled, Trackables assigned to the active chapter will have assigned fixtures follow them in the Space. When BlackTrax is set to **Not Following**, fixtures will stop following and revert to positions determined by a connected lighting console. When **Calibration Mode** is active, the features of the **Fixture Calibration** page become enabled. When **Normal Mode** is active, the **Fixture Calibration** page becomes locked.

**Note:** To calibrate fixtures, the BTSystem has to have **Following** and **Calibration Mode** active at the same time

### To enable fixtures following Trackables

In the **Tracking Control** section, click *Start Following*.

**Result:** BlackTrax will attempt to connect modules as if *Discover* was used. A dialog window will appear showing the status of modules. If successful the following icon will change to **Active**. Assigned fixtures will now follow Trackables assigned to the active chapter.

**Attention:** Any edits made in other pages will be implemented as if *Apply Changes* was used when the BTSystem is set to **Following**.

### To disable fixtures following of Trackables

1 In the **Tracking Control** section, click *Stop following*.

2 A dialog window will appear asking if you really want to stop following. Click *Yes*.

**Result:** The BTSystem will stop follow with fixtures and the following icon will change to **Stopped**. Assigned fixtures in the active chapter will revert to positions assigned by the connected console.

### To enable fixture calibration

In the **Tracking Control** section, click *To Calibration Mode*.

**Result:** BlackTrax will be set to **Calibration Mode** and the features of the **Fixture Calibration** page will be unlocked. The calibration icon will change to Calibration.

### To disable fixture calibration

In the **Tracking Control** section, click *To Normal Mode*.

**Result:** BlackTrax will be set to **Normal Mode** and the **Fixture Calibration** page features will be locked. The calibration icon will change to Normal.

## Project Information

The **Live Show** tab displays helpful project information that can be used to help manage and track changes to a project. The **Show Name**, **Author** and **Description** fields are user created information, made in the **Project Information** section of the **Chapter** page. The **Creation** field displays the date when the BlackTrax project was first created. The **Modification** field displays the last time *Apply Changes* was used in the project. The **Calibration** field displays the last time fixtures were calibrated in the project.

## Live Trackables

The **Live Trackables** tab displays all Trackables and assigned BTBeacons applied to the project using *Apply Changes*. Only the current BTBeacon information is shown.

# System Page

The **System** page containing valuable system information well as the ability to configure how information is represented in BlackTrax. System information includes a system log, detailed information on data imported from WYSIWYG, as well as the BlackTrax version number and general information.

**Note:** Changes made in the **System** page will be applied to the project automatically.

## Layout of System page

I. **General -** Section containing basic system information.

1. **Unit Setup**- A drop-down list to allow switching between Metric and Imperial measurement in BlackTrax.
2. **Art-Net Patch**- Art-Net settings BlackTrax will patch to.
    a. **Universe** - Universe BlackTrax will patch to.
    b. **Channel** - Channel BlackTrax will patch to.
3. *System Log*- A record of all BlackTrax system events.
    a. **Time** - Time event occurred.
    b. **Level** - The severity of the system event.
    c. **Message** - Detailed explanation of the system event.
    d. Enable logging - Toggle to enable/disable logging of main system events.
    e. **Log Data** - Toggle to enable/disable logging of all system data.
    f. **To File** - Toggle to enable/disable recording of the system log to a separate file.
    g. **Auto Scroll** - Toggle to enable/disable automatically scrolling of the system log to the current event.
    h. *Clear* - Removes every event from the System Log section.

II. **Wysiwyg BTX -** Section containing information imported from the WYSIWYG.

1. **Motion Patching** - Trackable information.
    a. **Frame Name** - Name of the Trackable object in WYSIWYG.
    b. **Frame Id** - Patch name of the Trackable in WYSIWYG, name of Trackable in BlackTrax.
2. **Consoles** - Connected console information.
    a. **Console Name** - Name of connected console.
    b. **Console Mode** - Mode connected console is operating in.
    c. **Console Ports** - Port information of connected console.
    d. **BB Port** - Reserved for internal use.
    e. **Port** - Port which connects the console to BlackTrax.
    f. **Patched To** - Type of universe console is patched to.
3. **Lighting Patching** - Patch information about connected moving fixtures.
    a. **Universe** - Universe patch type.
    b. **Spot ID** - ID number of fixture.
    c. **Offset** - Channel the fixture starts in the universe.
    d. **Size** - Number of channels fixture occupies in the universe.
    e. **Fixture** - Fixture product information
    f. **Pan Inverted** - Information if the pan is inverted.

g. **Tilt Inverted** - Information if the tilt is inverted.
h. **Profile** - Fixture profile the fixture is operating as.

4. **Fixture Profiles** - Information about connected fixture profiles.
   a. **Name** - Name of fixture profile.
   b. **Type** - Movement type of the fixture.
   c. **Has Pan/Tilt** - Information on the fixture's pan and tilt capability.
   d. **Has Zoom**- Information on the fixture's zoom capability.
   e. **Has Iris** -Information on the fixture's iris capability.
5. **User Origin** - The offset value from the origin the

III. **System Configuration** - Section to edit system behavior.
1. **Editing Behavior** - Allows for configuration of basic system behavior.
2. **Calibration Setting** - Allows for configuration of certain system behavior related to calibration.

IV. **About BlackTrax**- Section containing information about BlackTrax.

## Setting up units of measurement

BlackTrax allows for either metric or imperial measurement to be used. This setting can be changed in the **Unit Setup** section. The default unit settings of BlackTrax is metric. Loading a project will revert BlackTrax to the default unit of measurement.

### To set the units of measurement

Go to the **General** tab, in the **Unit Setup** section click the drop-down list. From the list click to select the desired measurement type.

**Result:** The chosen unit of measurement will apply to the BlackTrax project.

## Setting Art-Net Patch

BlackTrax by default will patch chapter control by Art-Net on Universe 1 and Channel 1. The patch information can be changed in the **Unit Setup** section.

### To set Art-Net Patch

1. In the **General** tab, in the **Art-Net Patch** section, enter the universe number in the **Universe** field.
2. In the **Channel** field enter the channel number.

   **Result:** BlackTrax chapter selection will be controlled on the selected universe and channel on the connected console

## Configuration of system log

The system log is used to display system information about the BlackTrax project. The various features of the system log are as follows:

- **Enable Logging** - Will enable events to be logged in the system log when enable.
- **Log Data** - If logging is enabled, will record all data transmitted when enabled. Used primarily for debugging purposes.
- **To file** - Will save the system log to **C:\bt_run_time** when enabled.
- **Auto scroll** - Will automatically scroll to the latest event when it is created in the log when enabled.

**Note:** If logging data **To File** is enabled, it is possible to accumulate Gigabytes of data in a single day of use. It is recommend that the log file be removed periodically to conserve BTSystem memory.

### To set the system log as a separate window

In the **General** tab, double-click the *System Log* heading.

**Result:** The *System Log* window will now display as a seperate window.

### To reattached the system log window to BlackTrax

In the *System Log* window, in the top right of the window, click *Attach*.

**Result:** The *System Log* window will now reattach to the **General** tab.

## Setting system behavior

BlackTrax allows for the configuration of how it behaves in certain instances. The prompt section allows for toggling certain system prompts On/Off.

### To toggle a system prompt

In the **System Configuration** tab, in the **Editing Behavior** section, click the checkbox to toggle the system prompt.

# Appendix A

# Important Product Information

This appendix contains safety information and declarations that may be valuable to the user.

## In this appendix

# FCC/ IC Information

## FCC/ IC Information:

This device complies with Part 15 of the FCC Rules and with Industry Canada License-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications to this equipment, not expressly approved by CAST Group of Companies Inc. could void the user’s authority to operate the equipment.

## Information de la FCC/ IC:

Ce dispositif est conforme à la norme 15 des règlements de la FCC et des standards CNR d'exempts de licence d'Industrie Canada. Son fonctionnement est soumis aux deux conditions suivantes:

- (1) cet appareil ne peut causer d'interférence nuisible, et
- (2) cet appareil doit accepter toute interférence reçue, y compris les interférences pouvant provoquer un fonctionnement non désiré.

REMARQUE : Cet équipement a été testé et déclare conforme aux limites imposées aux appareils numériques de Classe B, telles que définie dans l'article 15 des règlements de la FCC. Ces limites sont destinées à protéger de façon raisonnable contre les perturbations nuisibles qui peuvent apparaitre dans une installation résidentielle. Cet équipement génère, utilise et peut radier de l'énergie de fréquence radiophoniques. S'il n'est pas installé et utilisé conformément aux instructions, peut causer des interférences radiophoniques nuisibles.

Toutefois, il n'existe aucune garantie que des interférences ne se produiront pas dans une installation particulière. Si cet équipement produit de l'interférence nuisible à la réception radio ou TV, ce qui peut être détecté en mettant ou coupant le contact, l'utilisateur sera contraint d'essayer de corriger la situation par un ou plusieurs des moyens suivants :

- Réorienter ou relocaliser l'antenne de réception
- Augmenter la distance entre l'équipement et le récepteur
- Raccorder l'équipement dans une prise ou sur un autre circuit que celui du récepteur
- Demander l'aide du distributeur ou d'un technicien expérimenté en radio et télévision

Tout changement ou modification sans l'autorisation expresse de CAST Group of Companies Inc. pourrait annuler le droit d'utiliser cet équipement.