



# SISU Cinema Robotics Manual

Version: 1.3

with SISU LAB Version: 2.2

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SISU

1520 Royston Lane

Round Rock, Texas 78664

United States of America

This manual corresponds with the following: SISU Cinema Robotics Installation Guide: v1.2, SISU Cinema Robotics Installation Guide for C31: v1.0, SISU Lab: v2.2, and SISU Cinema Robotics Quick Guide: v1.1.

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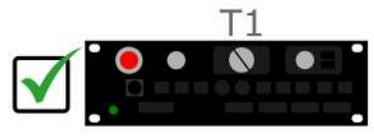
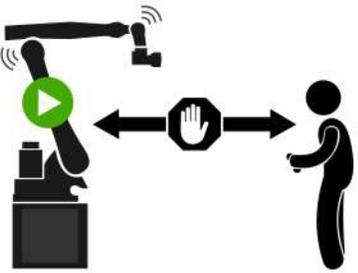
This document is subject to regular technical alterations.

# IMPORTANT SAFETY INFORMATION

The following general safety requirements and specifications must be observed during all phases of operation of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, intended use, and could void all warranty of this system. SISU assumes no liability for the customer's failure to comply with the requirements herein.

Using the SISU Cinema Robot and any of its components in a manner not specified by this manual may diminish the life of the equipment and/or personnel safety measures.

Before undertaking the installation process, carefully read the following caution notices. Protection equipment may be impaired if equipment is not used in the manner specified. **This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.**

DANGER!		
		
 Avoid situations where you could become pinned by the robot	 NEVER touch the robot while it is engaged or while it is moving	 Always test programs in T1 mode before running the programs at higher speeds
		
 Stay outside of the robot's reach while running a program in ANY mode	 Always warn others BEFORE moving the robot in ANY mode	 Carefully review and follow all of the safety information given by the robot manufacturer
 <b>ONLY SISU TRAINED OPERATORS ARE AUTHORIZED TO OPERATE THE ROBOT SAFELY</b>		

# IMPORTANT SAFETY INFORMATION



## OPERATING THE ROBOT

Train ALL robot users to do the following:



1. **FIRST, AND BEFORE DOING ANYTHING ELSE:** check around the system and robot to make sure the area is clear of any people and/or objects that could come into contact with the robot.
2. **SECOND:** Anytime someone picks up the tablet to move the robot, the following needs to be spoken loudly enough for ALL people within the vicinity of the robot to hear:
  - **Main operator:** Clear to move?
  - **Assistant (or other) after verifying the area is clear:** All clear.
  - **Main operator:** Robot moves.
3. **OR,** when there is not an assistant available, the main operator will perform all of the safety calls and checks.

(**WARNINGS!** continued on next page)

# IMPORTANT SAFETY INFORMATION



## RUNNING THE ROBOT WARNINGS

-  **DANGER:** See robot installation and users manuals about high voltage connections to robot controller.  
**Voltage is hazardous to human life.**
-  **DANGER:** Proper guarding and safety procedures must be in place when running robot in T2 or Auto mode.
-  **DANGER:** Secure the robot base by setting the feet and adding weights before moving the robot arm.
-  **DANGER:** Avoid situations where you could become pinned by the robot.
-  **DANGER:** NEVER touch the robot while it is engaged or while it is moving.
-  **DANGER:** Always test programs in T1 mode BEFORE running the programs at higher speeds.
-  **DANGER:** Stay outside of the robot's reach while running a program in ANY mode.
-  **DANGER:** Always warn others BEFORE moving the robot in ANY mode.

(**WARNINGS!** continued on next page)

# IMPORTANT SAFETY INFORMATION



## USER SAFETY WARNINGS

- ! CAUTION:** Use personal protective equipment (protective eye-ware, gloves, steel-toed shoes, etc.) when installing equipment to avoid injuries from any debris, sharp edges, or dropped equipment.
- ! CAUTION:** Observe all hazardous warning labels located on the SISU Cinema Robotics components.
- ! CAUTION:** As per OSHA recommendations, the tip angle of the robot and/or base track section while it is being moved should not exceed 10 degrees. Failing to follow these recommendations could result in the robot and/or base track section tipping over and becoming damaged.
- ! CAUTION:** Robots and equipment are heavy. Failure to follow proper lifting procedures and hoists can result in damage to people and equipment.
- ! CAUTION:** Cables and outriggers can be a trip hazard. Properly manage cabling and outriggers to prevent injury.
- ! CAUTION:** Exercise caution when closing the case lid to avoid smashing and/or otherwise injuring fingers and loose cables.
- ! CAUTION:** Prolonged use of the enable button or wand on the tablet may cause excessive strain on finger muscles; take breaks as needed.
- ! CAUTION:** The safety of any devices incorporated into the equipment during installation is the responsibility of the installer.
- ! CAUTION:** Carefully review and follow all of the safety information given by the robot and system manufacturer.

(**WARNINGS!** continued on next page)

## IMPORTANT SAFETY INFORMATION



### SYSTEM MAINTENANCE WARNINGS



**DANGER:** There is a risk of electrocution and burn while performing maintenance.



**CAUTION:** Do not remove protective electrical box covers or side panels during operation and servicing of the the SISU Cinema Robot components. During service of this equipment, the main AC power connector must be disconnected from the power source.



**CAUTION:** The SISU Cinema Robot components should be cleaned using a damp cloth with mild soap.



**CAUTION:** Do **not** use near liquids.



**CAUTION:** Dropping the tablet and/or the wand can cause damage to these components.



**IMPORTANT:** For any preventative maintenance of the robot, please consult the robot user manual for their specific recommendations.

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# 1. BEFORE YOU BEGIN

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## 1.1 Chapter Contents

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- **Robot Size and Speed Capacity** - [1.3](#)
- **Intended Use** - [1.4](#)
- **Inspect Before Use and Install** - [1.5](#)
- **Internal Fuses** - [1.6](#)
- **Service Personnel** - [1.7](#)
- **Glossary Reference** - [1.8](#)
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## 1.2 Icon Key

The following icons will be used throughout this manual



NOTE



DANGER



CAUTION



EXAMPLE



JUMP TO

## 1.3 Robot Size and Speed Capacity

If the C14 robot is powered off the standard 120V solution provided, the max velocity of a joint move is limited to 80% (assuming 100% acceleration). If speeds above 80% are desired, please reach out to SISU for a custom quote of a system powered with 208V.

 **IMPORTANT:** For more information on max payload and speed for your robot, see [11 Appendix C - Robot Specs and Replacement Parts](#). To know if you are running into a power limitation, see [10.2.8 ISSUE: Robot dips or stops suddenly when you are running a program](#).

## 1.4 Intended Use

The SISU Cinema Robotics system is to be used for controlling robot motion with a wand and tablet for the purpose of creating programs that can then be saved in SISU Lab and run automatically.

## 1.5 Inspect Before Use and Install

1. Check handheld parts for cracks.
2. Check tablet screen for cracks.
3. Check cables for wear.
4. Check that all cables and connectors are not damaged, and check that they are tightly connected.
5. Check joystick and trigger for cracks or breaks.

 **DANGER:** If any issues are identified immediately cease use of the robot until the maintenance issues are remedied.

## 1.6 Internal Fuses

- **Fuses in the SIM:** 10, 5, 4, 2, 2 Amps, mini blade fuses, automotive type

## 1.7 Service Personnel

The following represent product specific risks that may affect service personnel.

-  **DANGER: There is a risk of electrocution and burn while performing maintenance.**
- Only the SIM can be serviced (opened) onsite **by SISU certified support personnel.**

 **JUMP TO:** To service the case, wand, and tablet please contact support listed in section [1.9 Contact Information](#).

- Power off the system and wait **10 minutes** before servicing.
- To verify correct functionality, power the system on and perform start-up procedure.

## 1.8 Glossary Reference

 **JUMP TO:** If, at any time during the reading of this manual, you are in need of the alphabetized glossary please reference section [8.3 Glossary of Used Terms](#).

## 1.9 Contact Information

For additional help or questions please contact SISU Cinema Robotics support:

- [support@sisucinemarobotics.com](mailto:support@sisucinemarobotics.com)
- 512-377-6075, extension 2



# SECTION 1

## THE BASICS



# 2. INTRODUCTION TO SISU CINEMA ROBOTICS

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**PURPOSE OF THIS CHAPTER:** The purpose of this chapter is to give a **brief** introduction to basic SISU Cinema Robotics elements. Sections here will have references and links to more detailed information in later chapters.

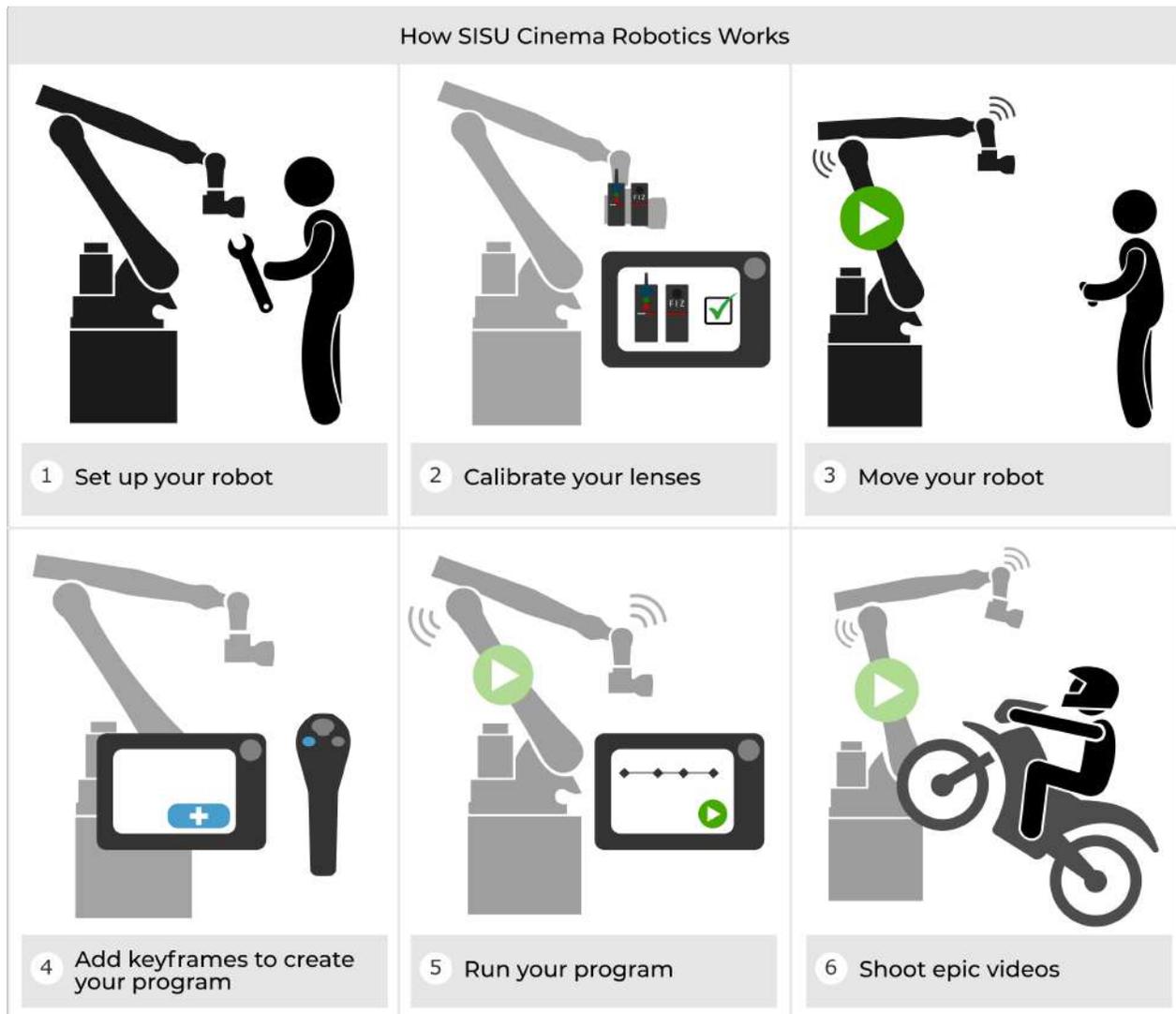
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  - Hardware Maps - [2.3.1](#)
    - \* Hardware Components - Links - [2.3.1](#)
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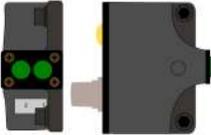
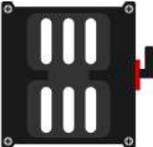
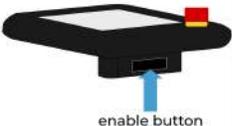
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  - How to Preview a Program - [2.8.1](#)
  - How to Run a Program - [2.8.2](#)

## 2.2 How SISU Cinema Robotics Works



## 2.3 Hardware and Software Maps

### 2.3.1 Hardware Maps

Hardware Map INCLUDED with SYSTEM			
1	 <p><b>CASE</b></p> <p>The case houses the tablet and the wand. It must be set up at least 3 feet off of the ground.</p>	7	 <p><b>KUKA PENDANT</b></p> <p>The KUKA Pendant is used to perform mastering tests. It can also be used to move and program the robot.</p>
2	 <p><b>CHEESE PLATE</b></p> <p>The cheese plate is attached to the end of the robot arm. The dovetail is then attached to the cheese plate.</p>	8	 <p><b>REFERENCE SWITCH</b></p> <p>The reference switch is a sensor that verifies the robot has reached its mastering position.</p> <p>FRONT SIDE</p>
3	 <p><b>DOVETAIL</b></p> <p>The dovetail is attached to the cheeseplate. The dovetail clamp is then attached to the dovetail.</p>	9	 <p><b>ROBOT ARM</b></p> <p>You will control the robot arm with the wand and program it with the wand, tablet, and FIZ motors.</p>
4	 <p><b>DOVETAIL CLAMP</b></p> <p>The dovetail clamp is used to mount the camera to the dovetail/cheese plate at the end of the robot arm.</p>	10	 <p><b>SIM</b></p> <p>The SISU Interface Module (SIM) is the network and hardware interface between the components.</p>
5	 <p><b>FIZ MOTORS and CLAMPS</b></p> <p>The FIZ motors allow you to use the SISU Lab software on the tablet to manipulate the Focus, Iris, and Zoom for each keyframe.</p>	11	 <p><b>TABLET &amp; ENABLE BUTTON</b></p> <p>The tablet is what you will use to program the robot arm and the attached FIZ motors. The enable button engages the robot during use.</p> <p>enable button</p>
6	 <p><b>KRC4 COMPACT or KRC4</b></p> <p>The KRC4 compact comes with the C11 and C14 robot, while the KRC4 comes with the C20 and C31 robots. The KRC4 is also called the KUKA robot controller.</p>	12	 <p><b>WAND</b></p> <p>The wand allows you to easily move and manipulate the robot arm, as well as create keyframes.</p>

(Continued on next page)

Hardware Map NOT INCLUDED with SYSTEM			
1		<p><b>CAMERA</b></p> <p>Your camera will mount to the robot arm and allow you to shoot videos by programming them in SISU Lab on the tablet.</p>	2
			<p><b>FIZ 15 mm MOUNTING ROD</b></p> <p>The FIZ mounting rod is used to mount the FIZ motors to the camera.</p>
<p>These hardware items do NOT come with purchase of the system. You will need to provide your own camera and FIZ mounting rod system.</p>			

## Hardware Components - Links

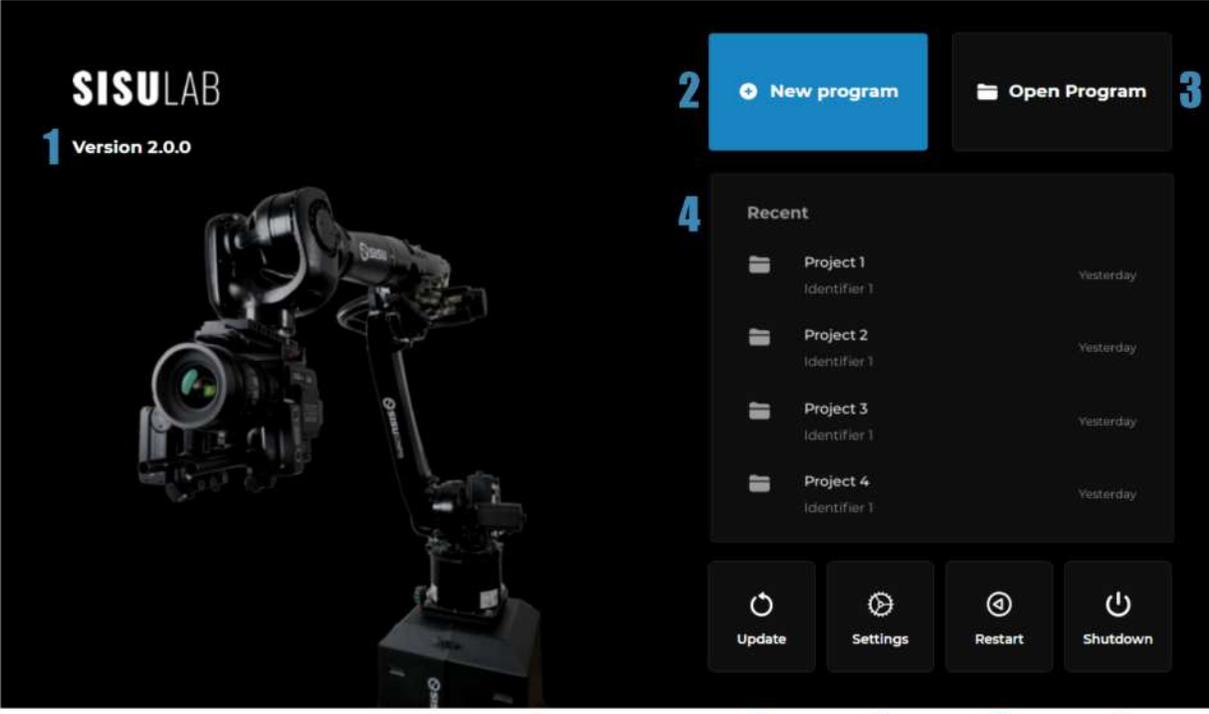
1. **CASE**: See section [3.9 Powering ON Case, Tablet, and Wand](#) in your **SISU Cinema Robotics Installation Guide**. Also see section [2.4.1 How to Set Up the System](#).
2. **CAMERA**: See section [3.13 Mounting Camera and Setting Up FIZ Motors](#) in your **SISU Cinema Robotics Installation Guide**. Also see sections [4.7 Setting the Camera Tools](#), and [5.6 Quick Set Settings Options](#).
3. **CHEESE PLATE**: See section [3.12 Mount Cheese Plate and Dovetail](#) in your **SISU Cinema Robotics Installation Guide**.
4. **DOVETAIL**: See section [3.12 Mount Cheese Plate and Dovetail](#) in your **SISU Cinema Robotics Installation Guide**.
5. **DOVETAIL CLAMP**: See section [3.13 Mounting Camera and Setting Up FIZ Motors](#) in your **SISU Cinema Robotics Installation Guide**.
6. **FIZ MOTORS**: See section [3.13 Mounting Camera and Setting Up FIZ Motors](#) in your **SISU Cinema Robotics Installation Guide**. Also see section [5.7 How to Move FIZ Motors](#).
7. **KRC4 or KRC4 COMPACT**: See section [3.7 Powering ON SIM, Reference Switch, and KUKA Robot Controller](#) in your **SISU Cinema Robotics Installation Guide**.
8. **KUKA PENDANT**: See section [3.10 Powering ON KUKA Pendant](#) in your **SISU Cinema Robotics Installation Guide**.

(Continued on next page)

9. **REFERENCE SWITCH**: See section **3.7 Powering ON SIM, Reference Switch, and KUKA Robot Controller** in your **SISU Cinema Robotics Installation Guide**. Also see section [4.8 Running the Mastering Check](#).
10. **ROBOT ARM**: See sections **3.4 Setting Robot Feet and Adding Weights**, and **3.6 Powering ON the Robot Arm** in your **SISU Cinema Robotics Installation Guide**. Also see section [4.11 Robot Orientation](#), and [5.2.1 Singularities - Robot Positions to Avoid](#).
11. **SIM**: See section **3.7 Powering ON SIM, Reference Switch, and KUKA Robot Controller** in your **SISU Cinema Robotics Installation Guide**. Also see sections [4.13 Hooking up Digital I/O on the SIM](#), and [7.2 How to Set the Operator Modes](#).
12. **TABLET**: See section **3.9 Powering ON Case, Tablet, and Wand** in your **SISU Cinema Robotics Installation Guide**. Also see sections [4.2 Using Enable Button to Engage Robot](#), and [4.5 Calibrating the Wand](#).
13. **WAND**: See section **3.9 Powering ON Case, Tablet, and Wand** in your **SISU Cinema Robotics Installation Guide**. Also see section [2.6 Basics - Moving the Robot and FIZ Motors](#).

## 2.3.2 Software Maps

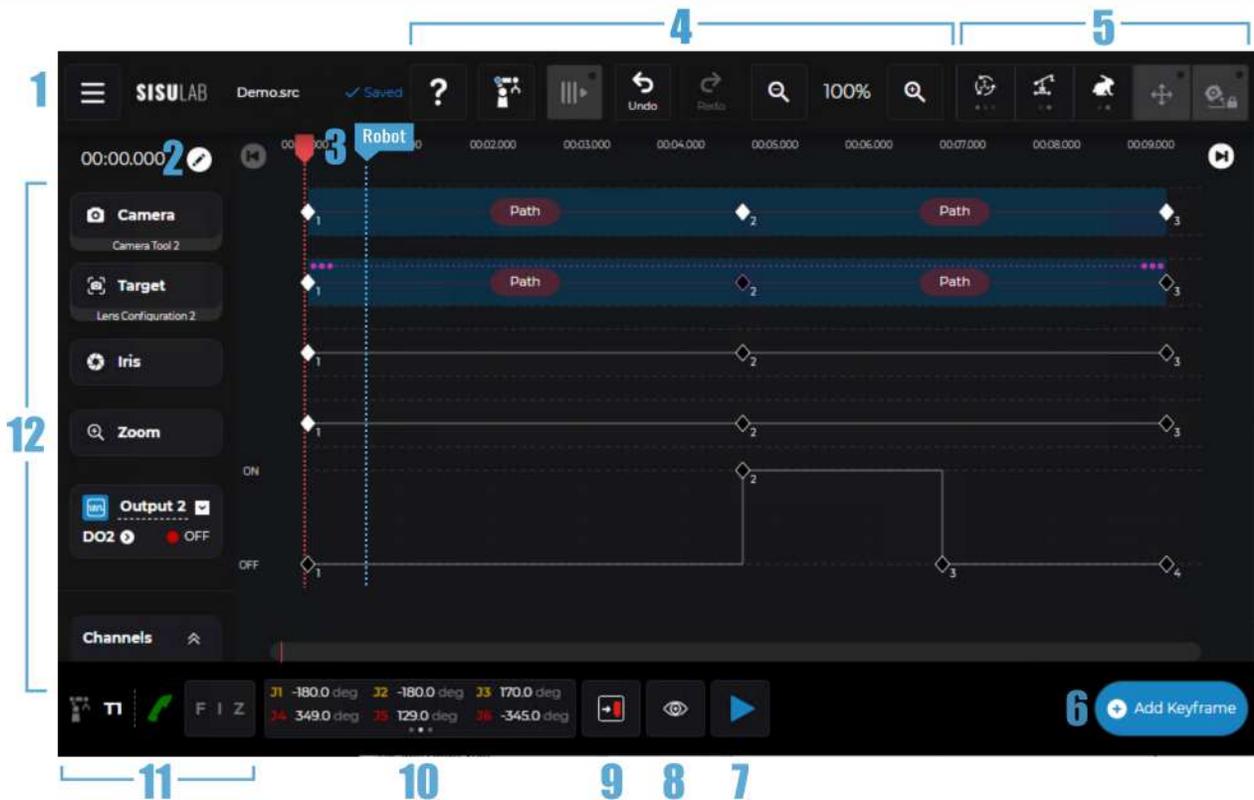
Software Map - Home Page



The screenshot shows the SISU Lab software interface. On the left, there is a large image of a robotic arm with a camera attached. The interface includes a 'SISU LAB' logo and 'Version 2.0.0' (callout 1). At the top right, there are two buttons: 'New program' (callout 2) and 'Open Program' (callout 3). Below these is a 'Recent' section (callout 4) listing four projects: Project 1, Project 2, Project 3, and Project 4, each with an 'Identifier 1' and a 'Yesterday' timestamp. At the bottom of the interface, there are four buttons: 'Update' (callout 5), 'Settings' (callout 6), 'Restart' (callout 7), and 'Shutdown' (callout 8).

<p><b>1 VERSION</b></p> <p>Shows you what version of SISU Lab you are using</p>	<p><b>2 NEW PROGRAM</b></p> <p>Open and write a new program</p>	<p><b>3 OPEN PROGRAM</b></p> <p>Open any previously saved programs from the machine or USB drive</p>	<p><b>4 RECENT PROGRAMS BOX</b></p> <p>Shows any recently opened program</p>
<p><b>5 UPDATE</b></p> <p>Provides available software updates for SISU Lab</p>	<p><b>6 SETTINGS</b></p> <p>Takes you to the settings page where you have access to all program settings options</p>	<p><b>7 RESTART</b></p> <p>Safely restart SISU Lab</p>	<p><b>8 SHUTDOWN</b></p> <p>Safely shut down SISU Lab</p>

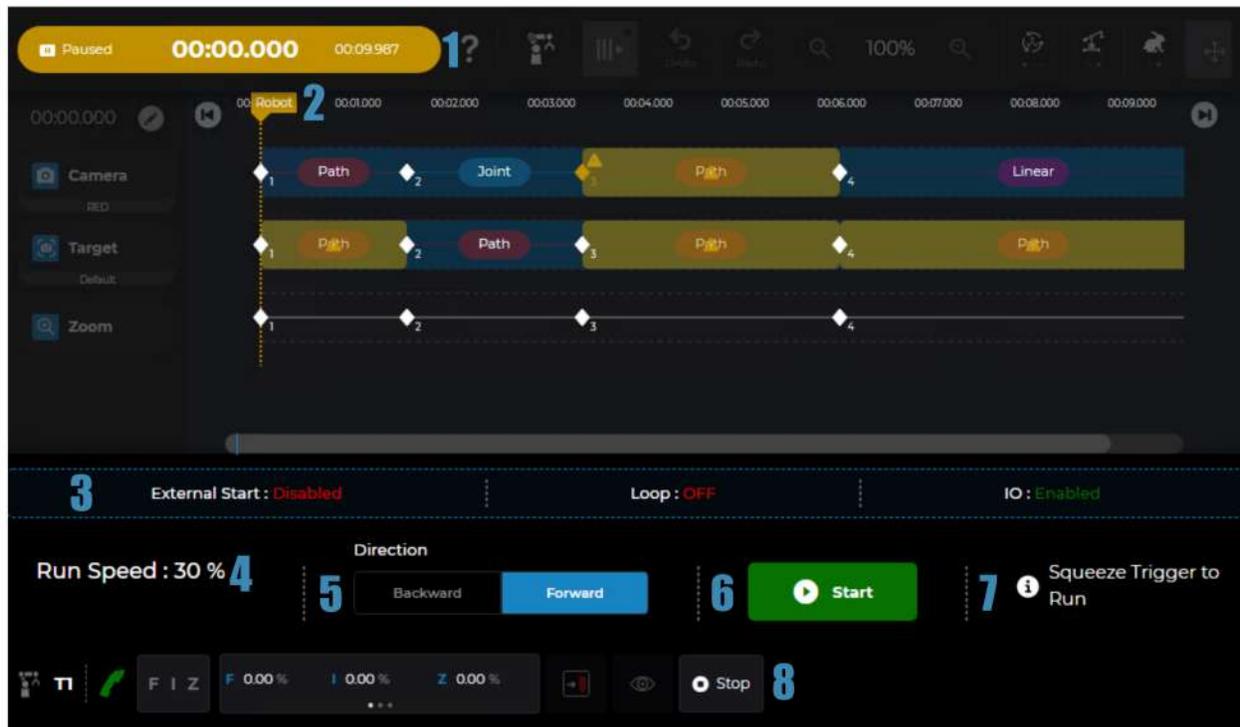
Software Map - Writing a Program



<p><b>1 MAIN MENU</b> Gives you access to the settings page, updates, import/export, help, etc.</p>	<p><b>2 TIMELINE PROPERTIES</b> Lets you scale program, switch between frame rate and time in seconds, and jump to a specific time or frame</p>	<p><b>3 CURSORS</b> <b>Program cursor</b> shows where keyframe will be added. <b>Robot cursor</b> shows you where in the program the robot is at</p>	<p><b>4 HEADER OPTIONS</b> Access to the joint page, timeline zoom, ripple, and undo/redo</p>
<p><b>5 QUICK SET TRAY</b> Access to quick set rotation/translation, snap to axis, speed, tool reference, and horizon lock for robot movement</p>	<p><b>6 ADD KEYFRAME BUTTON</b> Adds a keyframe at the program cursor location for the selected channels</p>	<p><b>7 RUN PROGRAM BUTTON</b> Configure program settings and run program using the trigger or the start button</p>	<p><b>8 PREVIEW PROGRAM</b> Lets you preview the program before running it</p>
<p><b>9 GO TO LOCATION</b> Moves robot to the position at the time that the cursor is located in the program</p>	<p><b>10 CURRENT POSITION TRAY</b> Displays FIZ motor, robot joint, and camera tool cartesian positions</p>	<p><b>11 INDICATORS</b> Lets you view the robot, wand, FIZ, and track status. You can also calibrate the wand, track, and FIZ motors here</p>	<p><b>12 CHANNELS</b> Add and remove channels</p>

**JUMP TO:** See chapter [In-Depth: Programming](#) for more information.

## Software Map - Running a Program

**1 RUN STATUS BAR**

Will appear yellow when program is paused, and green when program is actively running

**2 ROBOT CURSOR**

Shows you where in the program the robot is currently at

**3 RUN SETTINGS DISPLAY**

Shows the previously selected run settings

**4 RUN SPEED**

Shows the program run speed compared to the asked for program speed

**5 DIRECTION INDICATOR**

Allows you to choose which direction you want the program to run

**6 START BUTTON**

Allows you to start the program and pause the program from the tablet

**7 RUN NOTIFICATIONS**

Displays instructions and notifications during run

**8 STOP BUTTON**

Lets you stop the program



**JUMP TO:** See sections [7.4 How to Run a Program in T1](#), and [7.5 How to Run a Program in T2](#) for more information.

## Reading the Robot Ready Indicator

Robot Ready Indicator Status

**ROBOT READY INDICATOR**



### STATUS AND INSTRUCTIONS



### ROBOT ENGAGED

**NOTE:** A green robot engaged indicator means that the robot is ready to move



### ROBOT DISENGAGED

- 1 Push **Enable button** down to engage





### ROBOT DISCONNECTED

- 1 Confirm robot is powered and push **RST button** on the SIM to try and re-establish connection to the robot





### ROBOT SAFETY STOP

- 1 Push the yellow/orange flashing **Safety Reset button** on the SIM after disengaging **E-stops**



 **JUMP TO:** See section [4.4.1 Robot Ready Indicator](#) for more information.

Version: v1.3

Issued: November 2021

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## Reading the FIZ Indicator

FIZ Indicator Status

FIZ INDICATOR

T | F | Z

31 -180.0 deg 32 -180.0 deg 33 170.0 deg

34 349.0 deg 35 129.0 deg 36 -345.0 deg

+ Add Keyframe

STATUS AND INSTRUCTIONS

- F GREEN = FIZ CALIBRATED
- I BLUE = FIZ CALIBRATING
- Z RED = FIZ NOT CALIBRATED
  - 1 Click on the **FIZ indicator**
  - 2 Click on the **Initialize FIZ button**
- Z GRAY = FIZ DISCONNECTED or FIZ EXTERNAL

 **JUMP TO:** See section [4.4.3 FIZ Indicators](#) for more information.

## Reading the Wand Indicator

Wand Indicator Status

WAND INDICATOR

T | F | Z

31 -180.0 deg 32 -180.0 deg 33 170.0 deg

34 349.0 deg 35 129.0 deg 36 -345.0 deg

+ Add Keyframe

STATUS AND INSTRUCTIONS

- W GREEN = WAND CALIBRATED
- W BLUE = WAND CALIBRATING
- W GRAY = WAND DISCONNECTED
- W RED = WAND NOT CALIBRATED
  - 1 Place wand in case
  - 2 Click on the wand indicator & **Run Calibration button**

 **JUMP TO:** See section [2.5.1 How to Calibrate the Wand](#) for more information.

## Reading the Track Indicator (if applicable)

Track Indicator Status (if applicable)

TRACK INDICATOR

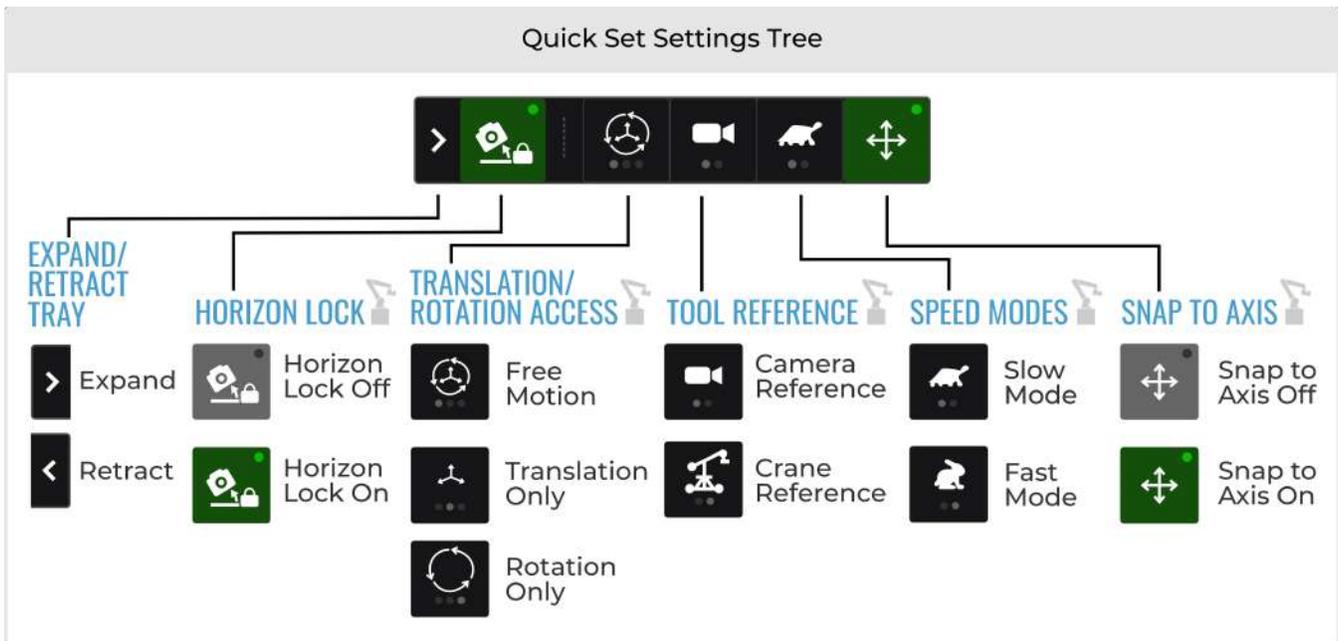


**STATUS AND INSTRUCTIONS**

-  **GREEN = TRACK CALIBRATED**
  - 1 Track is calibrated and can be programmed and moved
-  **RED = TRACK UNCALIBRATING**
  - 1 Track is NOT calibrated. It can be moved, but it cannot be programmed
-  **GRAY = TRACK DISCONNECTED**
  - 1 The track cannot be detected

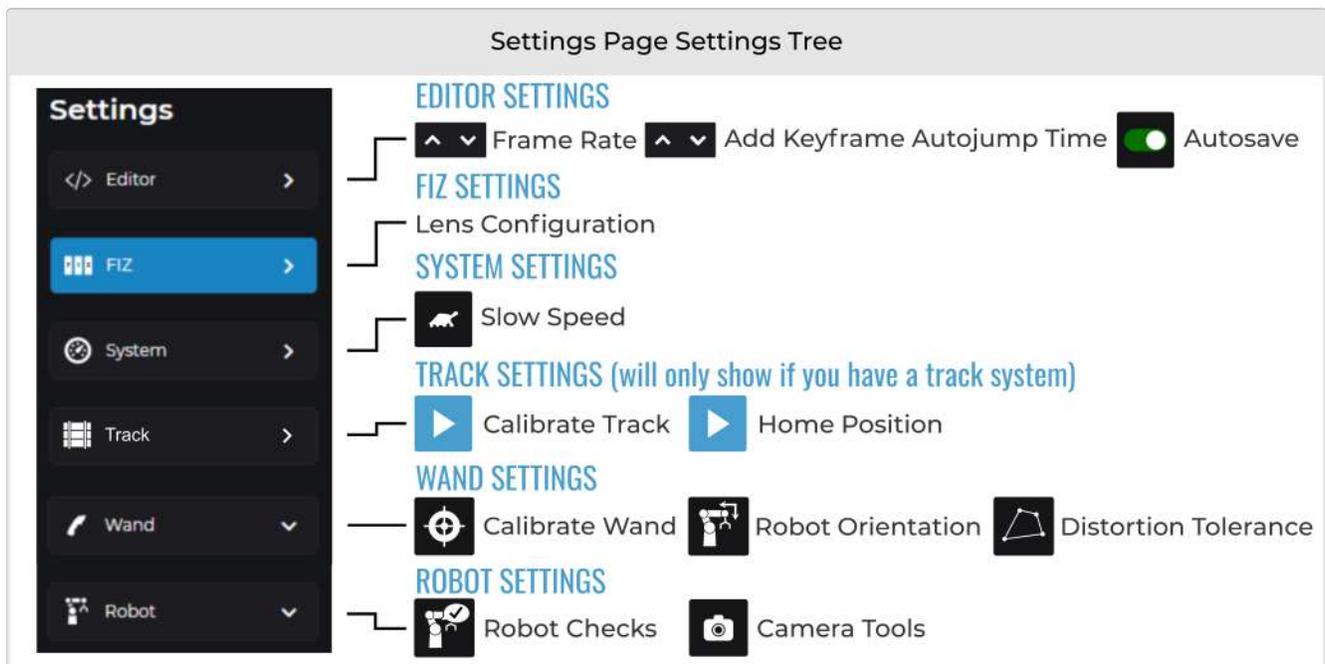
 **JUMP TO:** See section [2.5.3 How to Calibrate the Track \(if applicable\)](#) for more information.

### 2.3.3 Quick Set Settings Tree



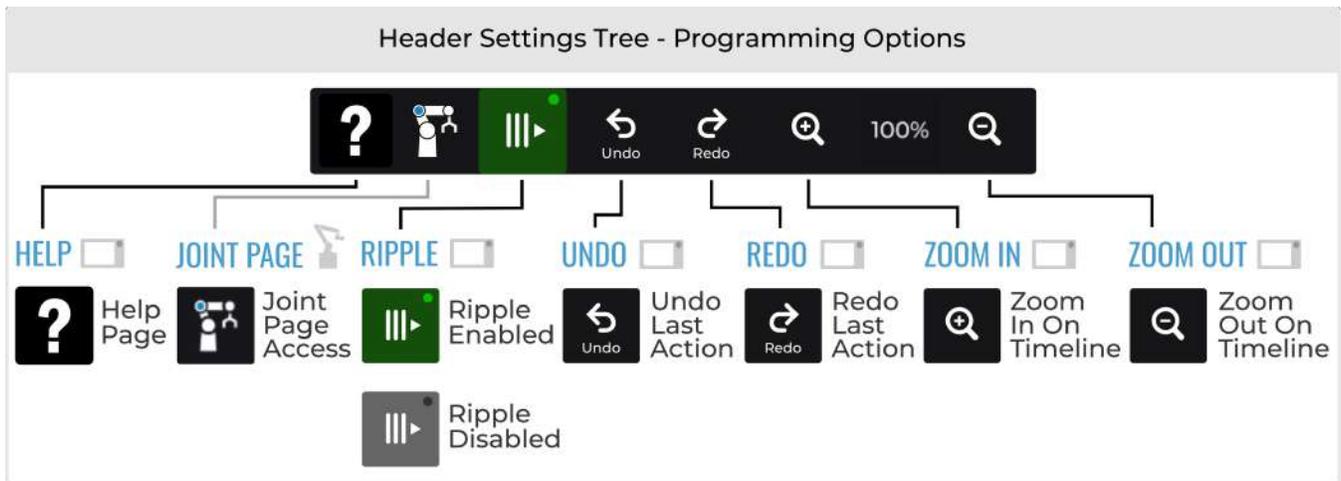
**JUMP TO:** See section [5.6 Quick Set Settings Options](#) for more information.

### 2.3.4 Settings Page Settings Tree



**JUMP TO:** See chapter [6 In-Depth: Programming](#) for more information.

## 2.3.5 Header Options Settings Tree



 **JUMP TO:** See section [6.3.2 Header Programming Options](#) for more information.

## 2.4 Basics - Getting the System Set Up

### 2.4.1 How to Set Up the System

#### How to Set Up the System



#### INSTRUCTIONS

- 1 Make sure all connections between pieces of equipment are properly secured

**NOTE:** See your **SISU Cinema Robotics Installation Guide** for set up images and instructions

- 2 Make sure your case is at least 3 feet off of the ground, and is not sitting on or located near large pieces of metal



- 3 Make sure the space around your robot is clear of obstacles before you begin

#### SISU CASE NOTES

- 1 After plugging in the case it may take a few seconds before the power button is ready to respond
- 2 The power button light on the case will blink when it is powering on, and will remain solid once it is completely powered on
- 3 The power button light on the case will blink quickly when it is powering on, and will blink slowly when it is powering off



**JUMP TO:** See your **SISU Cinema Robotics Installation Guide** for more information on setting up the system.

## 2.5 Basics - Getting the Robot Ready to Move

### 2.5.1 How to Calibrate the Wand

How to Calibrate the Wand

< Back to Settings
Calibrate Wand

- Calibrate Wand
>
- Robot Orientation
>
- Distortion Tolerance
>



Frequency

A

B

C

D

▶ Run Calibration

METHOD 1  
INSTRUCTIONS

METHOD 2  
INSTRUCTIONS

**IMPORTANT:** The wand must be set in its position in the case **BEFORE** running calibration

- 1 Select the **Wand indicator** 
- 2 Select the **Run Calibration button**

---

- 1 Select **Settings** from the main menu 
- 2 Select **Wand** from the settings menu
- 3 Select **Calibrate Wand** from the wand menu
- 4 Select your desired frequency for the wand

**NOTE:** There are four available frequencies for you to choose from: A, B, C and D

- 5 Select the **Run Calibration button**

**NOTE:** The wand calibration indicator will appear green after a successful calibration





WAND CALIBRATION INDICATOR

 **JUMP TO:** See section [4.5 Calibrating the Wand](#) for more information.

## 2.5.2 How to Calibrate a Lens

Calibrating a Lens

< Back
**Lens Configuration**

**Settings**

- </> Editor >
- 📷 FIZ >
- ⚙️ System >
- 🔧 Wand ▾
- 🤖 Robot ▾

**Saved Lenses**

- Default (Uncalibrated)
- Zeiss CP.2 50 Super Speed ✓
- Zeiss CP.2 85 Compact Prime

**Lens Info**

**Zeiss CP.2 50 Super Speed**

Focus Calibration Points : 8

Iris Calibration Points : 8

Zoom Calibration Points : 8

+ Add New
⌂ Activate
✎ Edit
🗑 Delete

### INSTRUCTIONS

- 1 Select **Settings** from the main menu
- 2 Select **FIZ** from the settings menu
- 3 Add a new lens by clicking on the **Add New button**
- 4 Select your newly created lens from the **Saved Lenses box** and click on the **Edit button**
- 5 Enter the lens **Backlash**

**NOTE:** See chapter on how to computer the backlash compensation factors for more details
- 6 Select the lens type (**Focus/Iris/Zoom**)
- 7 Fully calibrate the lens by adding **at least 5** calibration points per lens
 

**NOTE:** Without those 5 saved calibration points the lens will continue to work - but without calibration - which can result in the image being out of focus
- 8 Go back one page and activate the lens by selecting the correct lens and clicking on the **Activate button**
- 9 You can now use the lens when creating your program

**JUMP TO:** See section [4.10 Lens Configuration](#) for more information.

**JUMP TO:** See section [4.10.1 Calculating Backlash Compensation Factors](#) for more information.

## 2.5.3 How to Calibrate the Track (if applicable)

How to Calibrate the Track

< Back

Settings

</> Editor >

FIZ >

System >

Track >

Wand >

Track



▶ Calibrate Track

▶ Home Position

**IMPORTANT** These options will move the robot on the track. Ensure you are in TI and any objects and cables are clear of the track. Confirm that the track is properly connected and powered

CALIBRATE TRACK  
INSTRUCTIONS

HOME POSITION  
INSTRUCTIONS

**IMPORTANT:** Make sure there are no obstacles along the length of the track **BEFORE** performing either of these functions

- 1 Set the SIM to be in **TI mode**
- 2 Select **Settings** from the main menu
- 3 Select **Track**
- 4 Select **Calibrate**
- 5 Track calibration will begin when you hold down the **Enable Button** on your tablet

**NOTE:** Calibration can take a few minutes, depending on how long your track is

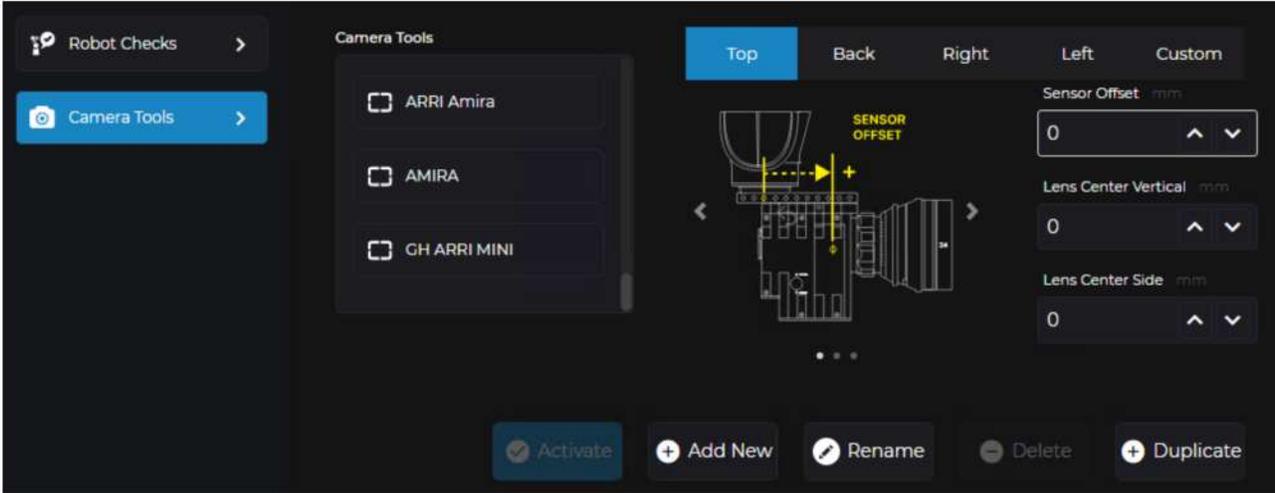
---

- 1 Select **Settings** from the main menu
- 2 Select **Track**
- 3 Select **Home Position**
- 4 Your robot should move to the home position

**JUMP TO:** See section [4.6 Calibrating the Track \(if applicable\)](#) for more information.

## 2.5.4 How to Set a Camera Tool

How to Set a Camera Tool



### INSTRUCTIONS

**IMPORTANT:** Setting the **Camera Tool** correctly is important for correct target tracking and ensuring that the **Horizon Lock** is calculated correctly

- 1 Select **Settings** from the main menu
- 2 Select **Robot** from the settings menu
- 3 Select **Camera Tools** from the robot menu
- 4 Select the **Add New** button
- 5 Select the new tool from the box
- 6 Edit your new **Camera Tool's** coordinates by choosing **Top, Right, Back, or Left** and entering the sensor offset, lens center vertical, and lens center side values in mm
 

OR

 Create a custom **Camera Tool** by manually changing the XYZ and ABC coordinates to match where you want your camera to point relative to the end of the robot
- 7 Select the tool that you want to activate and select the **Activate** button

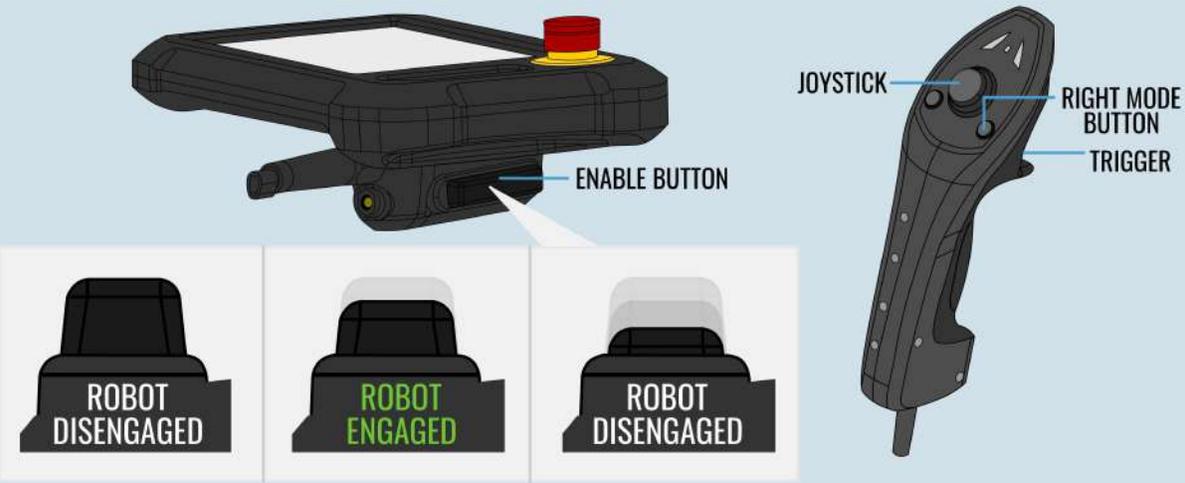


**JUMP TO:** See section [4.7 Setting the Camera Tools](#) for more information and images.

## 2.6 Basics - Moving the Robot and FIZ Motors

### 2.6.1 How to Move the Robot

How to Move the Robot



**IMPORTANT:** The **Enable button** will only engage the robot if it is pressed halfway down, as shown in the image above

**IMPORTANT:** **Live Control** is the general term for moving the robot in any way using the wand (NOT using the joint page or run page)

**TRIGGER CONTROL INSTRUCTIONS**

- 1 Hold down the **Enable button** on the tablet
- 2 Hold down **Trigger** on the wand
- 3 Move the wand around as desired; the robot will mimic your movements

**JOYSTICK CONTROL INSTRUCTIONS**

- 1 Hold down the **Enable button** on the tablet
- 2 Point the wand in the direction you wish to move and then push the **Joystick** in the desired direction. The robot will move in the same direction that you are pushing the **Joystick**

**JOINT MODE INSTRUCTIONS**

- 1 Open the **Joint Mode page** by clicking the **Right Wand button** or the tablet's **Joint Mode button**  
- 2 Select the joint and direction that you want to move the robot
- 3 Hold down the **Enable button** on the pendant and the **Trigger** on the wand to move the robot in the correct direction

 **JUMP TO:** See section [4.2 Using Enable Button to Engage Robot](#), [5.3 Moving Robot with Trigger Control](#), [5.4 Moving Robot with Joystick Control](#), and [5.5 Moving Robot with Joint Mode](#) for more information.

## 2.6.2 How to Stop the Robot

How to Stop the Robot



**STOP w/ENABLE BUTTON INSTRUCTIONS**

- 1 Push the **Enable button** ALL of the way down. This will stop the robot and apply the brakes 
- OR
- 2 Completely release the **Enable button**. This will stop the robot and apply the brakes 

NOTE: These methods only work in T1 & T2 mode

---

**STOP w/WAND INSTRUCTIONS**

- 1 Release the **Joystick** on the wand. This will reduce robot speed to 0
- OR
- 2 Release the **Trigger** on the wand. This will reduce robot speed to 0

NOTE: These methods only work in T1 & T2 mode

---

**STOP w/E-STOPS INSTRUCTIONS**

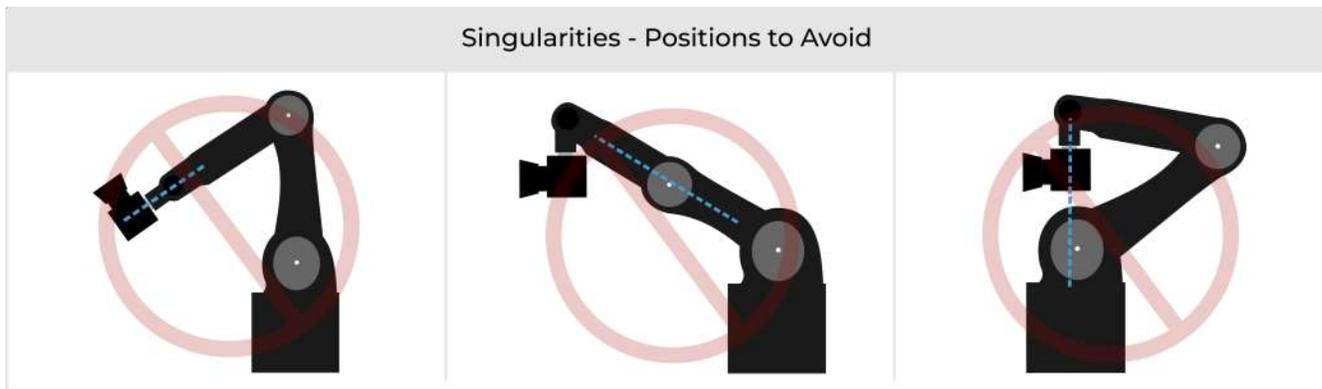
- 1 Push the **E-Stop button** on the tablet, the KUKA pendant, or the SIM. This will immediately stop the robot and apply the brakes



NOTE: This method works at ANY time, and it works in T1, T2, & AUTO mode

 **JUMP TO:** See section [4.3 Stopping the Robot and Track \(if applicable\)](#) for more information.

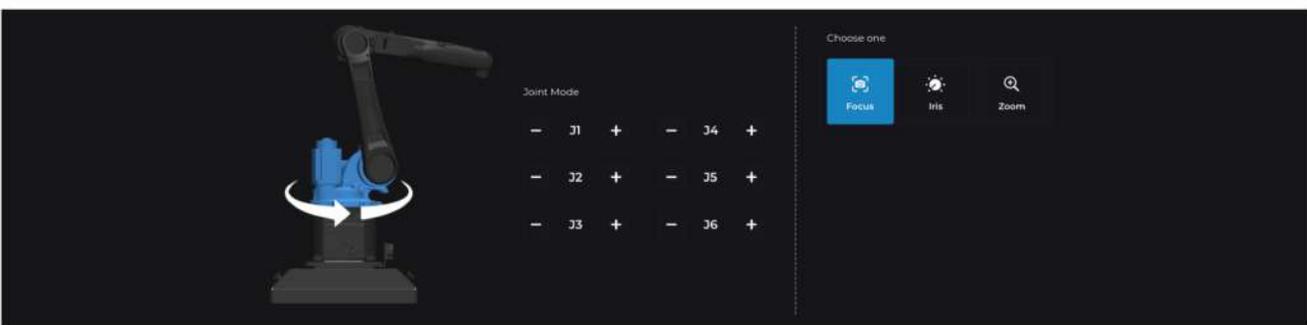
### 2.6.3 Singularities - Positions to Avoid



 **JUMP TO:** See section [5.2.1 Singularities - Robot Positions to Avoid](#) for more info.

### 2.6.4 How to Move the FIZ Motors

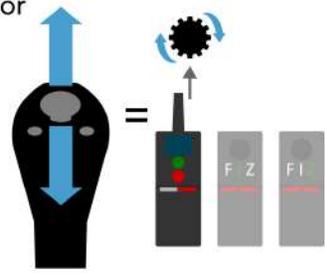
Moving FIZ Motors



**INSTRUCTIONS**

**IMPORTANT:** The **Enable** button does not need to be engaged to move the FIZ motors

- 1 Open the **Joint Mode** page by clicking the **Right Wand button** or the tablet's **Joint Mode button**  
- 2 Select which **FIZ motor** you want to move
- 3 Push **forwards or backwards** on the wand **Joystick** to move the motor



 **JUMP TO:** See section [5.7 How to Move FIZ Motors](#) for more information.

## 2.6.5 How to Move the Track (if applicable)

Moving the Track



Joint Mode

- J1 +    - J4 +

- J2 +    - J5 +

- J3 +    - J6 +

Choose one

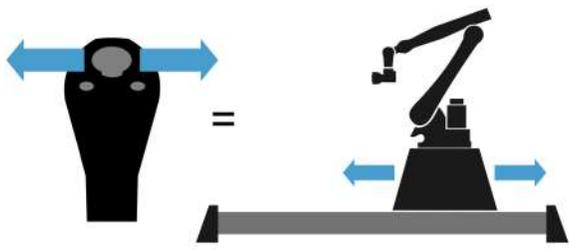
Focus
Info
Zoom

Track

INSTRUCTIONS

**IMPORTANT:** The **Enable** button needs to be engaged to move the track

- 1 Open the **Joint Mode** page by clicking the **Right Wand button** or the tablet's **Joint Mode** button  
- 2 Select the **Track** option
- 3 Hold down the **Enable** button on the tablet
- 4 Push **left or right** on the wand **Joystick** to move the robot and pedestal in the desired direction



 **JUMP TO:** See section [5.8 How to Move Track \(if applicable\)](#) for more information.

Version: v1.3

Issued: November 2021

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## 2.7 Basics - Programming

### 2.7.1 How to Write a Program

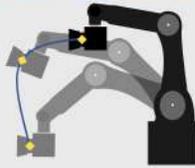
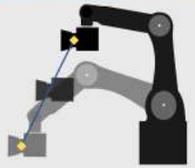
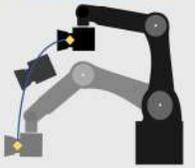
#### How to Write a Program



### INSTRUCTIONS

- 1 Move the robot to your desired first position
- 2 Select all channels that you want to get the next keyframe by clicking on those channel's **icons** (selected icons are blue) 
- 3 Click the **Left Wand button** or the **Add Keyframe button** on the pendant to add a keyframe at time 0 on the program timeline 
- 4 Move robot to second position and **add keyframe**
- 5 Choose the move type for the newly created keyframe by clicking on the listed **move type** in FRONT of the keyframe



Path Move 	Linear Move 	Joint Move 
		
Will pass through all points exactly but the path between the points is undetermined	The selected camera center moves in a straight line between keyframe points	The path in between the keyframe points is not controlled

**NOTE: Joint moves** will not target track

- 6 Select the **keyframe** to configure the keyframe's settings

(Illustrations continued on next page)

Version: v1.3

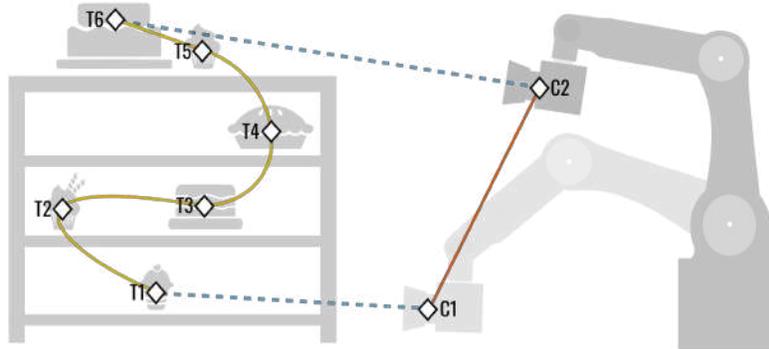
Issued: November 2021

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Target and Camera Channel Keyframes

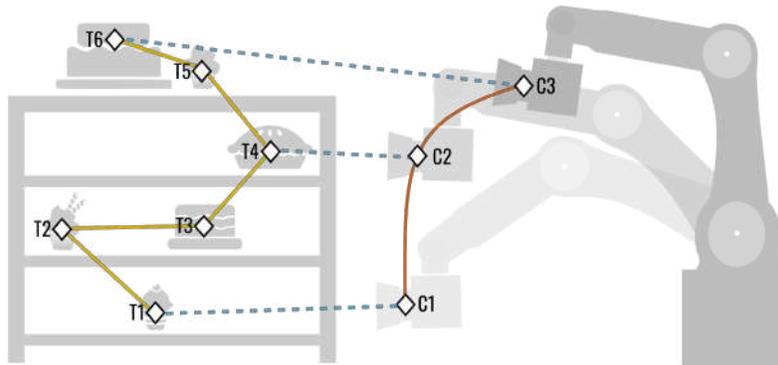
SCENARIO 1 of 3

— CAMERA channel = LINEAR move      - - - - = Keyframes occurring at the same time on the program timeline  
 — TARGET channel = PATH move



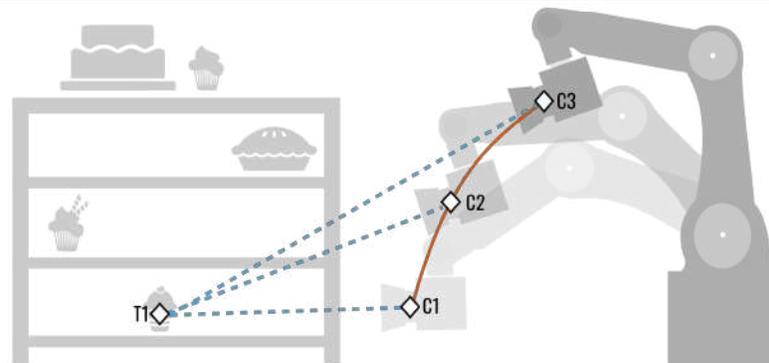
SCENARIO 2 of 3

— CAMERA channel = PATH move      - - - - = Keyframes occurring at the same time on the program timeline  
 — TARGET channel = LINEAR moves



SCENARIO 3 of 3

— CAMERA channel = PATH move      - - - - = Keyframes occurring at the same time on the program timeline

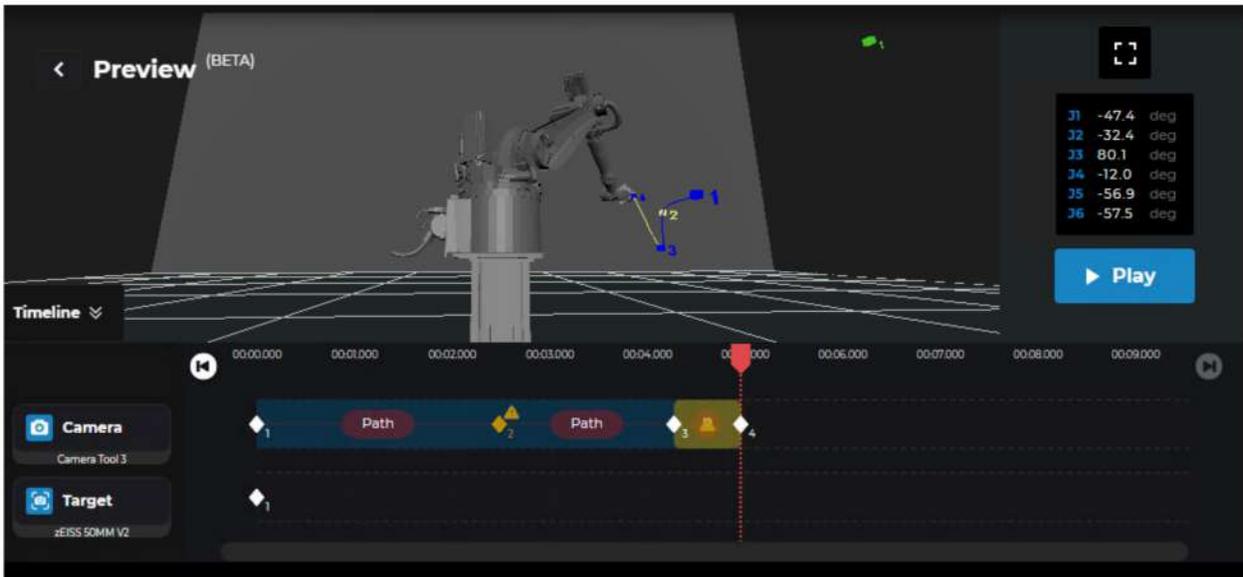


**JUMP TO:** See figure 1: [6.5.1](#), figure 2: [6.5.1](#), and figure 3: [6.5.1](#) for more detailed images.

## 2.8 Basics - Running a Program

### 2.8.1 How to Preview a Program

How to Preview the Program



The screenshot shows a 3D visualization of a robotic arm in a virtual environment. The interface includes a 'Preview (BETA)' title, a 'Timeline' section with a play button and a 'Play' button. Below the timeline are 'Camera' and 'Target' controls. A table on the right lists joint angles for joints 31 through 36.

31	-47.4	deg
32	-32.4	deg
33	80.1	deg
34	-12.0	deg
35	-56.9	deg
36	-57.5	deg

### INSTRUCTIONS

- 1 Select the **Preview button** 
- 2 SISU Lab will automatically start running your program **from the beginning**
- 3 Navigate around the visualization:
  - a) **Pinch with two fingers** to zoom in and out
  - b) Scroll by **swiping your finger**
  - c) Return to original view by selecting the **return button** 
  - d) Select the **Timeline button** to minimize the timeline

**NOTE:** Keyframes will appear as numbered squares. A yellow keyframe  has a **warning** attached to it. A red keyframe  has an **error** attached to it.

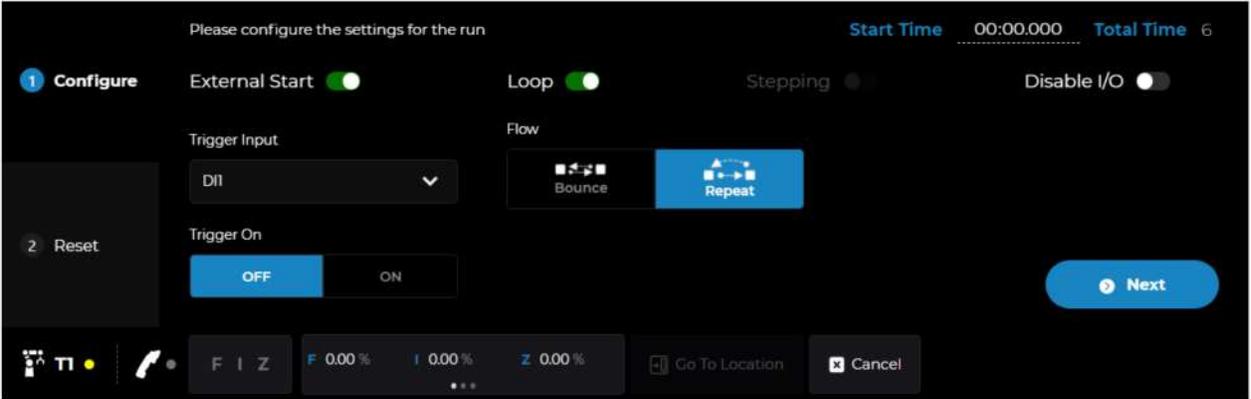
**NOTE:** Paths will appear as colored lines in between the keyframes. Camera = blue. Target = green. A yellow path  has a **warning** attached to it. A red path  has an **error** attached to it.

- 4 Exit the preview by selecting the **back button** 

 **JUMP TO:** See sections [7.4 How to Run a Program in T1](#) and [7.5 How to Run a Program in T2](#) for more information.

## 2.8.2 How to Run a Program

Running a Program in T1 or T2 Mode



**INSTRUCTIONS**

- 1 Set the **Mode Key Switch** on the SIM to **T1 or T2 mode**



**NOTE: T1 mode** should be used for teaching keyframes and proofing a program; operator must be present

**NOTE: T2 mode** should be used for proofing a program at full speed, and running mastering / brake checks; operator must be present
- 2 Select **Run Program** at the bottom of the tablet screen
- 3 Set your **Run Configuration settings** and select the **Next button**

**NOTE:** Available settings are: external start, loop, disable I/O, start frame / time
- 4 Press and hold **Enable button** and wand **Trigger** until the robot reset is complete
- 5 Select the direction that you want the program to run: **fwd/bkwd**
- 6 Press and hold **Enable button** and use wand **Trigger** to play and pause the program
 

or

Press and hold **Enable button** and use the **Start button** on the tablet
- 7 Select the **Stop button** at the bottom of the tablet screen to stop the program and return to the program editing page

 **JUMP TO:** See sections [7.4 How to Run a Program in T1](#) and [7.5 How to Run a Program in T2](#) for more information.



# SECTION 2

## IN DEPTH



# 3. IN-DEPTH: STARTUP AND SHUTDOWN PROCEDURES

---

## 3.1 Chapter Contents

- Startup Procedure - [3.2](#)
- Shutdown Procedures - [3.3](#)

## 3.2 Startup Procedure



### POWER ON - CASE POWER BUTTON

**INSTRUCTIONS:** Power on the system by doing the following:

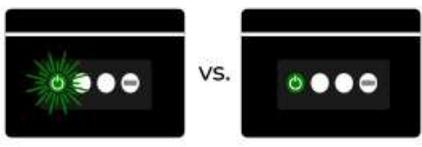
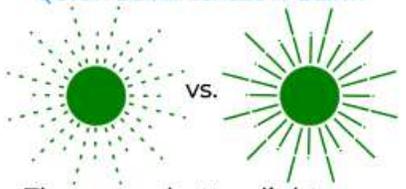
1. Connect the **case**.
2. Turn on **KRC4** (or **KRC4 compact**).
3. Set **KUKA pendant** to **External**: Flip key switch/press **Ext**/Flip key switch back.
4. Press yellow **Safety Reset** on the **SIM**.
5. Turn on **case** by pressing the **Power button** (S9). The light on the case will blink while the case is powering ON and will then remain solid once the case is ON. The screen on the **tablet** will NOT turn ON until the Power button on the case is solid.



**HARDWARE CONNECTIONS:** See chapter **3 Installation and Setup Procedures** in your **SISU Cinema Robotics Installation Guide** to set up hardware and power connections for the system.

(Continued on next page)

Case Power Button

POWER BUTTON DELAY	BLINKING vs. SOLID LIGHT	QUICK BLINK vs. SLOW BLINK
		
<p>After plugging in the case it may take a few seconds before the power button is ready to respond.</p>	<p>The power button light on the case will blink when it is powering on, and will remain solid once it is completely powered on.</p>	<p>The power button light on the case will blink quickly when it is powering on, and will blink slowly when it is powering off.</p>

**!** **TABLET SCREEN:** The tablet screen will not come on until the power button on the case is solid, and the screen may initially take up to 30 seconds to power on.

### 3.3 Shutdown Procedures



#### POWER DOWN - MAIN MENU

**INSTRUCTIONS:** Power down the system by doing the following:

1. Power down SISU Lab by selecting **Shutdown** in the main menu.
2. Power down the case by pressing the **Power button** (S9).
3. Power down the robot (refer to your **Quick Start Guide**).
4. Unplug the **case**.



#### POWER DOWN - CASE

**INSTRUCTIONS:** If you need to bypass the previous route and power down via the **case**, the **Power button** on the case needs to be HELD DOWN for 3 seconds. The power light on the case will then start blinking which means the shut down sequence is initiated.



#### POWER DOWN - UNPLUGGING CASE

**INSTRUCTIONS:** If you need to bypass the previous two power down methods it is possible to power down the system by unplugging the **case**.

# 4. IN-DEPTH: GETTING THE ROBOT READY TO MOVE

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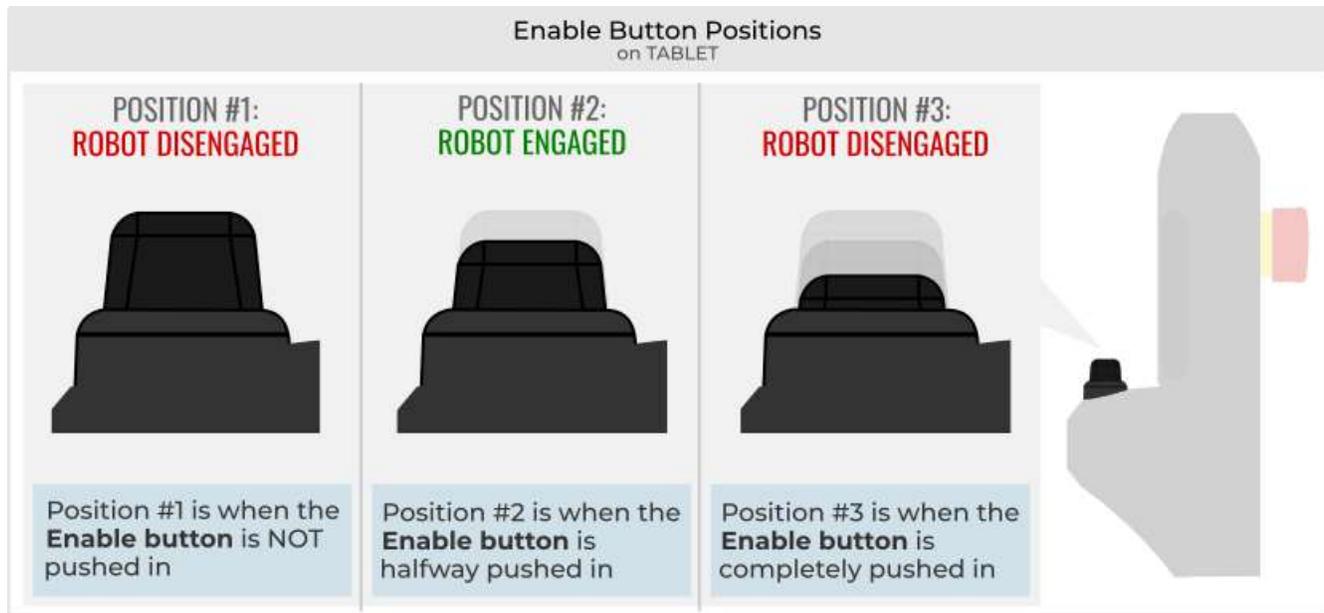
## 4.1 Chapter Contents

- **Using Enable Button to Engage Robot** - [4.2](#)
- **Stopping the Robot and Track (if applicable)** - [4.3](#)
- **Interpreting Status Indicators** - [4.4](#)
  - Robot Ready Indicator - [4.4.1](#)
  - Wand Indicator - [4.4.2](#)
  - FIZ Indicators - [4.4.3](#)
  - Track Indicators (if applicable) - [4.4.4](#)
  - Wand Ready Indicator Lights - [4.4.5](#)
- **Calibrating the Wand** - [4.5](#)
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- **Running the Mastering Check** - [4.8](#)
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  - Calculating Backlash Compensation Factors - [4.10.1](#)
- **Robot Orientation** - [4.11](#)
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- **Hooking up Digital I/O on the SIM** - [4.13](#)

## 4.2 Using Enable Button to Engage Robot

The **Enable button** engages the robot and prepares it for movement in T1 and T2 mode.

 **JUMP TO:** See section [7 In Depth - Running a Program](#) for more information on T1 and T2 mode.



(Continued on next page)

### 4.3 Stopping the Robot and Track (if applicable)

#### ENABLE BUTTON - TABLET

**DESCRIPTION:** If you push the **Enable button** all the way down or completely release the **Enable button** the robot will stop and apply the brakes. (This only applies in T1 and T2 modes.)

#### TRIGGER / JOYSTICK RELEASE - WAND

**DESCRIPTION:** If you release the **Joystick** or **Trigger** on the wand the robot's speed will be reduced to 0. **This is NOT the case when running the brake check.**

#### E-STOP BUTTONS

**DESCRIPTION:** If you push the **E-stop button** on the tablet, KUKA pendant, or the SIM the robot will immediately stop and apply the brakes.

 **STOPPING WHILE TRACK IS MOVING >2.5 m/s:** If you press an E-stop button OR let go of the enable button while the track is moving >2.5 m/s, the track will become uncalibrated. In this instance, your program will stop running and you will need to recalibrate the track.

 **JUMP TO:** See section [2.6.2 How to Stop the Robot](#) for quick reference instructions.

### 4.4 Interpreting Status Indicators

There are 4 possible status indicators on the bottom left of the tablet screen: **Robot, Wand, FIZ, and Track**. You can select the indicators to see a label for the current indicator state. Read the sections below for information on how to interpret them.

(Continued on next page)

## 4.4.1 Robot Ready Indicator



### ROBOT ENGAGED INDICATOR - GREEN

**DESCRIPTION:** If the **Robot Ready indicator** is green that means the robot is ready to move with wand movement or ready to run the program.

---



### ROBOT DISENGAGED INDICATOR - YELLOW

**DESCRIPTION:** If the **Robot Ready indicator** is yellow, the robot is NOT engaged.

**INSTRUCTIONS:** Push halfway down on the **Enable button** on the tablet to engage the robot. If this does not work, check all connections to the robot and restart the system.

---



### ROBOT DISCONNECTED INDICATOR - GRAY

**DESCRIPTION:** If the **Robot Ready indicator** is gray, the state of the robot is not known or is unresponsive.

**INSTRUCTIONS:** Check all connections to the robot and KUKA pendant for errors. Push the small **RST button** on the SIM to try and re-establish communication, or restart the system.

---



### ROBOT SAFETY STOP INDICATOR - RED

**DESCRIPTION:** If the **Robot Ready indicator** is red, the system has registered an error, or an **E-stop**.

**INSTRUCTIONS:** Release any **E-stops**, and then push the flashing **Safety Reset button** on the SIM.



**JUMP TO:** See section [2.3.2 Reading the Robot Ready Indicator](#) for quick reference instructions.

(Continued on next page)

## 4.4.2 Wand Indicator



### WAND CALIBRATED INDICATOR - GREEN

**DESCRIPTION:** If the **Wand indicator** is green, the wand is calibrated.

---



### WAND CALIBRATING INDICATOR - BLUE

**DESCRIPTION:** If the **Wand indicator** is blue, the wand is actively calibrating.

---



### WAND DISCONNECTED INDICATOR - GRAY

**DESCRIPTION:** If the **Wand indicator** is gray, the wand is disconnected or is still being detected (if it was recently plugged in).

---



### WAND NOT CALIBRATED INDICATOR - RED

**DESCRIPTION:** If the **Wand indicator** is red, the wand needs to be calibrated.

**INSTRUCTIONS:** On the tablet go to **Settings/Wand/Calibrate Wand/Run Calibration**, or select the **Wand indicator** on the tablet screen. **Place the wand in the case** and then select **Calibrate**.



**JUMP TO:** See sections [2.3.2 Reading the Wand Indicator](#) and [2.5.1 How to Calibrate the Wand](#) for quick reference instructions.

### 4.4.3 FIZ Indicators



#### FIZ CALIBRATED INDICATOR - GREEN

**DESCRIPTION:** If the **FIZ indicator** is green, the FIZ motor is calibrated.

---



#### FIZ CALIBRATING INDICATOR - BLUE

**DESCRIPTION:** If the **FIZ indicator** is blue, the FIZ motor is actively calibrating.

---



#### FIZ NOT CALIBRATED INDICATOR - RED

**DESCRIPTION:** If the **FIZ indicator** is red, the FIZ motor needs to be calibrated.

**INSTRUCTIONS:** Select the **FIZ indicator** and then select the **Initialize FIZ button**.



**JUMP TO:** See section [2.3.2 Reading the FIZ Indicator](#) quick reference instructions.

---



#### FIZ DISCONNECTED INDICATOR - GRAY

**DESCRIPTION:** If the **FIZ indicator** is gray, the FIZ motors have been disconnected or are still being detected (if they were recently plugged in).



**JUMP TO:** See section [10.3.3 ISSUE: FIZ motors have power but appear as disconnected in SISU Lab](#) for troubleshooting information.

---



#### FIZ EXTERNAL INDICATOR - GRAY

**DESCRIPTION:** If the **FIZ Indicator** is gray AND reads **External** when the icon is selected, the FIZ motors are connected but are being controlled by an external hand unit.

(Continued on next page)

#### 4.4.4 Track Indicators (if applicable)



##### TRACK CALIBRATED INDICATOR - GREEN

**DESCRIPTION:** If the **Track indicator** is green, the track is calibrated and ready to move and be programmed.

---



##### TRACK UNCALIBRATED INDICATOR - RED

**DESCRIPTION:** If the **Track indicator** is red, the track is uncalibrated. In this state it can be moved, but it CANNOT be programmed.

---



##### TRACK DISCONNECTED INDICATOR - GRAY

**DESCRIPTION:** If the **Track indicator** is gray, the track is disconnected and cannot be detected.

## 4.4.5 Wand Ready Indicator Lights

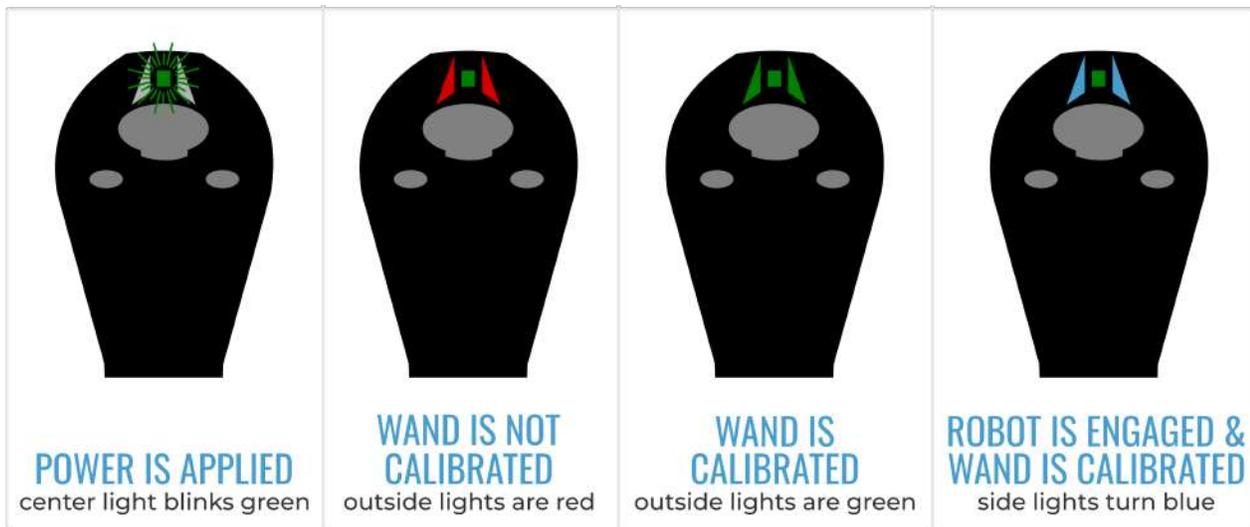


### READY INDICATOR LIGHTS

**DESCRIPTION:** LED lights on the wand that indicate various states of the wand's connectivity and power.

#### NOTES:

1. As soon as power is applied to the wand the center LED light will start blinking green.
2. Once connected, the wand will take over a minute to boot up and be ready to calibrate. Once ready, the calibration prompt will appear on the tablet screen.
3. The inside lights will flash green when power is applied.
4. The outside lights are red when the wand is not calibrated.
5. The outside lights are green when the wand is calibrated.
6. The outside lights are blue when the robot is engaged and the wand is calibrated.



## 4.5 Calibrating the Wand



### CALIBRATE WAND

**DESCRIPTION:** Allows you to calibrate the wand to one of four different frequencies.

**INSTRUCTIONS:**

1. Select **Settings** from the main menu.
2. Select **Wand** from the settings menu.
3. **Set wand down in the case in its travel place.**
4. Select **Calibrate Wand** from the wand menu.
5. Select your desired frequency for the wand (**A, B, C, or D**).
6. Select the **Run Calibration button**.



**WAND INDICATOR:** The **Wand Calibration indicator** at the bottom of the tablet screen will appear green after a successful calibration.



**JUMP TO:** See section [2.5.1 How to Calibrate the Wand](#) for quick reference instructions on calibrating the wand.

## 4.6 Calibrating the Track (if applicable)

**DESCRIPTION:** Calibration will run the robot on the track from one end of the track to the other to find the safety stops. **You have to hold the enable button until you see the Calibration complete message.**

 **WHEN TO CALIBRATE TRACK:** **The track should be calibrated in these instances:**

- After changing the length of your track
- If the track is ever uncalibrated
- After an E-Stop event
- After hitting or running into the track end stops

### INSTRUCTIONS:

1. **Ensure that there are no obstacles along the length of the track, as the robot pedestal will move all of the way down the track during the homing process.**
2. Set the SIM to be in **T1 mode**.
3. Navigate to the **Settings** menu on your tablet.
4. Select **Track**.
5. Select **Calibrate**.

 **DURING CALIBRATION:** After you select **Calibration** you will not be able to do anything on the tablet except hit **Cancel**.

6. Track calibration will begin when you hold down the **Enable button** on your tablet.

 **LENGTH OF CALIBRATION:** Calibration can take a few minutes, depending on how long your track is.

## 4.7 Setting the Camera Tools



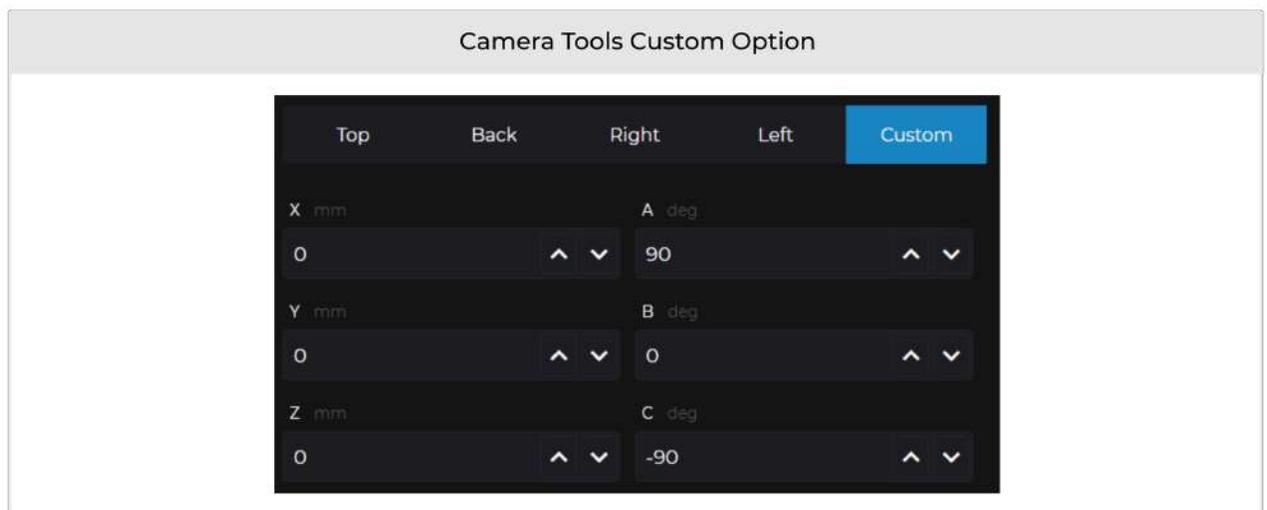
### CAMERA TOOLS

**DESCRIPTION:** A **Camera Tool** describes how the camera is mounted to the robot to calculate the sensor plane. Setting the Camera Tool also sets the point controlled by the wand. This point is also used when calculating the path of the robot and targets during programs. **Setting the Camera Tool correctly is important for correct target tracking and ensuring that Horizon Lock is calculated correctly.**

**USE CASE:** Each camera and mounting configuration will have different **Camera Tool** coordinates.

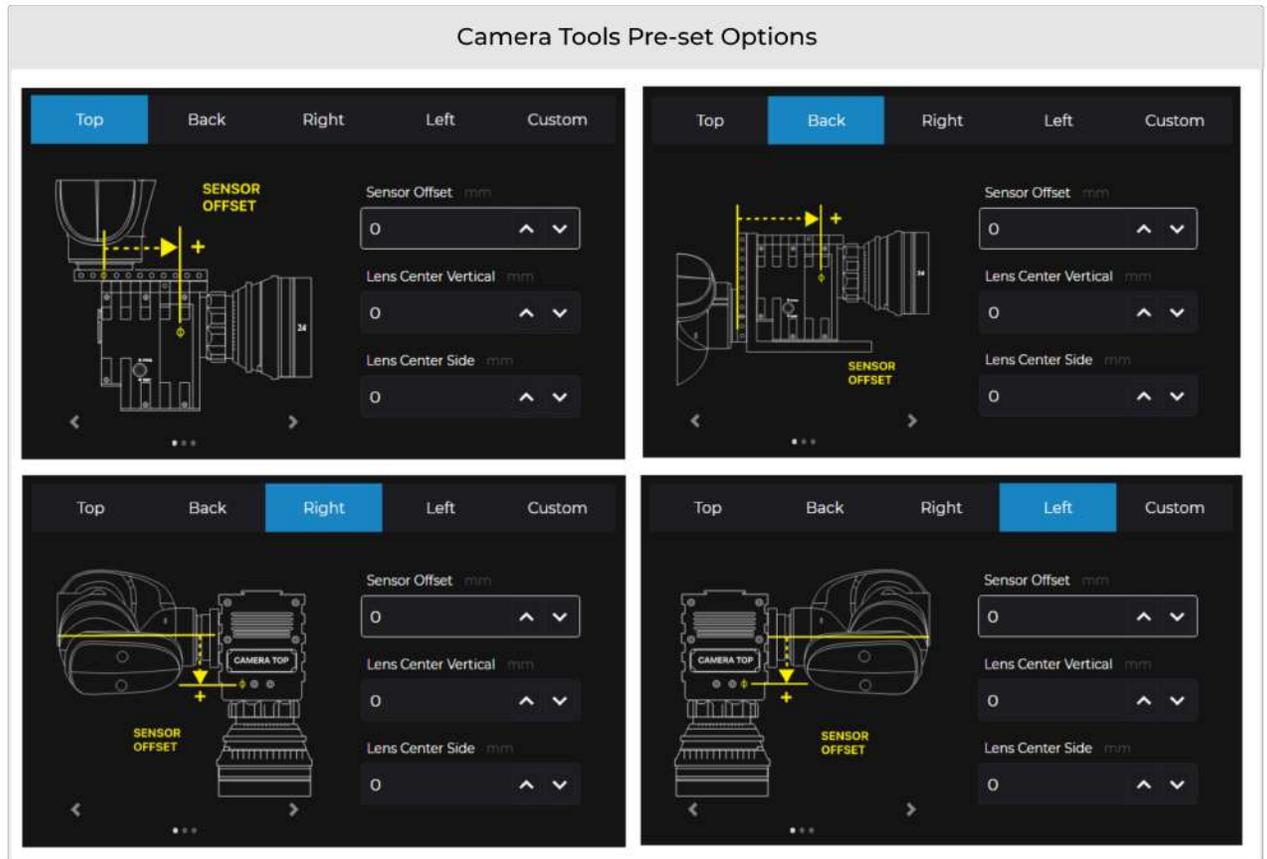
#### INSTRUCTIONS:

1. Select **Settings** from the main menu.
2. Select **Robot** from the settings menu.
3. Select **Camera Tools** from the robot menu.
4. Select the **Add New button**. A new tool should be added to the **Camera Tools box**.
5. Select the new tool from the box and click on the **Rename button**. Type in your desired name.
6. With the tool selected, you can edit the new **Camera Tool coordinates** with one of the following ways; **custom**, or one of the **pre-set options** (top/back/right/left):
  - a) **Custom:** If you choose this option, you need to manually change the XYZ / ABC coordinates to match where you want your **Camera Tool** point to be relative to the end of the robot.



(Continued on next page)

- b) **Top, Back, Right, Left:** Select the mounting option that matches your camera mounting and enter the sensor offset, lens center vertical, and lens center side in mm. If your camera mounting does not match, select **custom**.



**!** **CAMERA TOOL TABS / PAGES:** You only need to fill out **ONE Camera Tool tab / page per camera configuration.**

**🔗 JUMP TO:** To learn how to manually calculate **Camera Tools** see section [4.7.1 Manually Calculating Camera Tools](#).

7. Select the tool that you want to activate and select the **Activate button**.
8. To delete a saved tool, select the tool that you want to delete and select the **Delete button**.

**🔗 JUMP TO:** To check whether or not you have set the **Camera Tool** correctly, see section [10.2.5 ISSUE: Target tracking does not work \(or goes wild\) when running your program](#).

(Continued on next page)

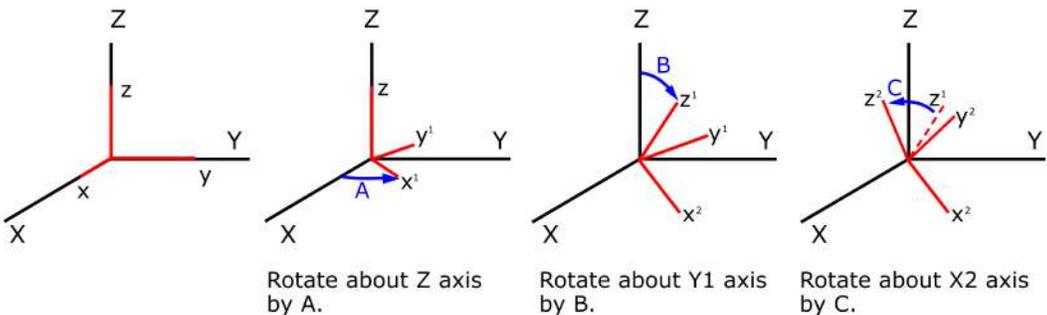
## 4.7.1 Manually Calculating Camera Tools

SISU Cinema Robotics uses standard Euler angle mathematics in its programming.

 **JUMP TO:** See section [5.6.3 Tool Reference](#) for more information on the orientation of the axes and axis rotation.

**Euler Angles Example and Definition**

— = Original XYZ axes    — = Euler Angle movement    — = Rotated axes



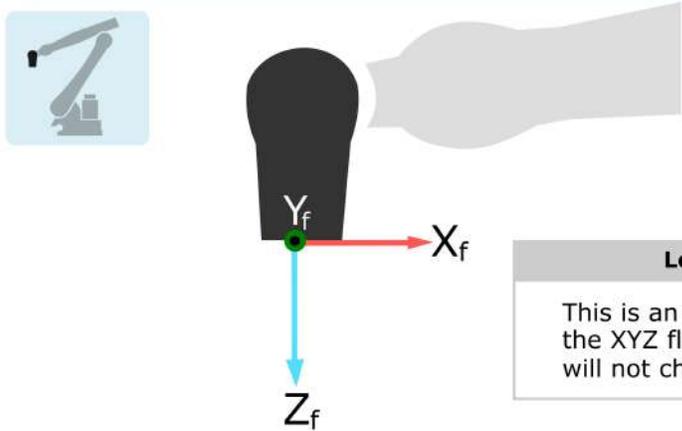
Rotate about Z axis by A.      Rotate about Y1 axis by B.      Rotate about X2 axis by C.

**Definition:** Euler angles describe the orientation of an object (whose relative position of all of its points is constant) in 3-dimensional space. To give an object a specific orientation it may be subjected to a sequence of **3 rotations** described by the Euler angles. See example above.

Reference the following graphics when computing a **Camera Tool** using the XYZ coordinates and as an example of how to compute ABC angles both when a camera is present and when one is not present.

**Example 1: Flange Coordinate System**

The axes for **Y flange ( $Y_f$ )** and **Y tool ( $Y_t$ )** in these examples are pointing **out of** the page and are shown as a green dot. ● =  $Y_f$  and  $Y_t$



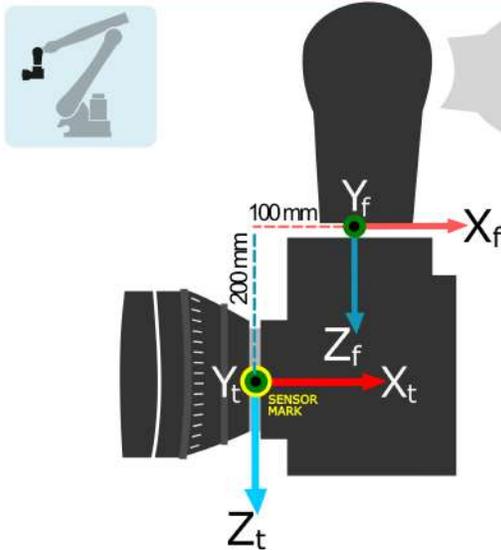
**Location of XYZ Flanges**

This is an example of the location of the XYZ flange axes. These locations will not change when a camera is added.

(Continued on next page)

**Example 2: Locating Sensor Offset and ABC Angles on Top Mount Camera**

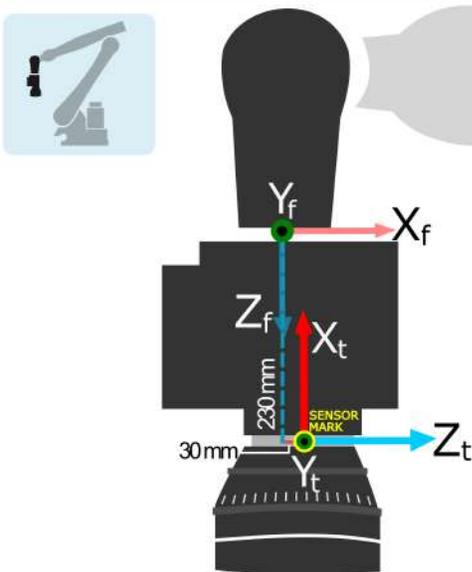
The axes for **Y flange** ( $Y_f$ ) and **Y tool** ( $Y_t$ ) in these examples are pointing **out of** the page and are shown as a green dot. ● =  $Y_f$  and  $Y_t$



Tool Coordinates		
TCP tool (t) coordinates relative to the flange (f) axes	TRANSLATION	ROTATION
	$X_t = -100$	$C_t = 0$
	$Y_t = 0$	$B_t = 0$
	$Z_t = 200$	$A_t = 0$

The rotation coordinates are all equal to 0 because the XYZ tool axes have NOT been rotated relative to the XYZ flange axes.

**Example 3: Locating Sensor Offset and ABC Angles on Rear Mount Camera**



Tool Coordinates		
TCP tool (t) coordinates relative to the flange (f) axes	TRANSLATION	ROTATION
	$X_t = 30$	$C_t = 0$
	$Y_t = 0$	$B_t = 90$
	$Z_t = 230$	$A_t = 0$

The  $B_t$  rotation coordinate is equal to 90 because the XYZ tool axes have been rotated 90 degrees around  $Y_t$  relative to the XYZ flange axes

**IMPORTANT:** Adding the ABC values is needed in order to maintain -x always being aligned with the camera's center axis.

**! SENSOR OFFSET TOOL:** The sensor offset tool should be set for the **Camera Sensor Mark** (the yellow dot in the above diagram) and should align with the center of the lens horizontally and vertically.

## 4.8 Running the Mastering Check

**JUMP TO:** The Mastering Check is different than Reconfiguring the Mastering Reference Position or Manually Mastering the robot. To Reconfigure the Mastering Reference Position OR Manually Master the robot, see chapter 9 [Appendix A - Mastering Helps](#).



### MASTERING CHECK

**DESCRIPTION:** The **Mastering Check** is an internal test done to check the calibration of the robot's joints. The following image is of an example mastering reference position that the robot will move to. **Note that the dovetail clamp needs to be taken off completely.**



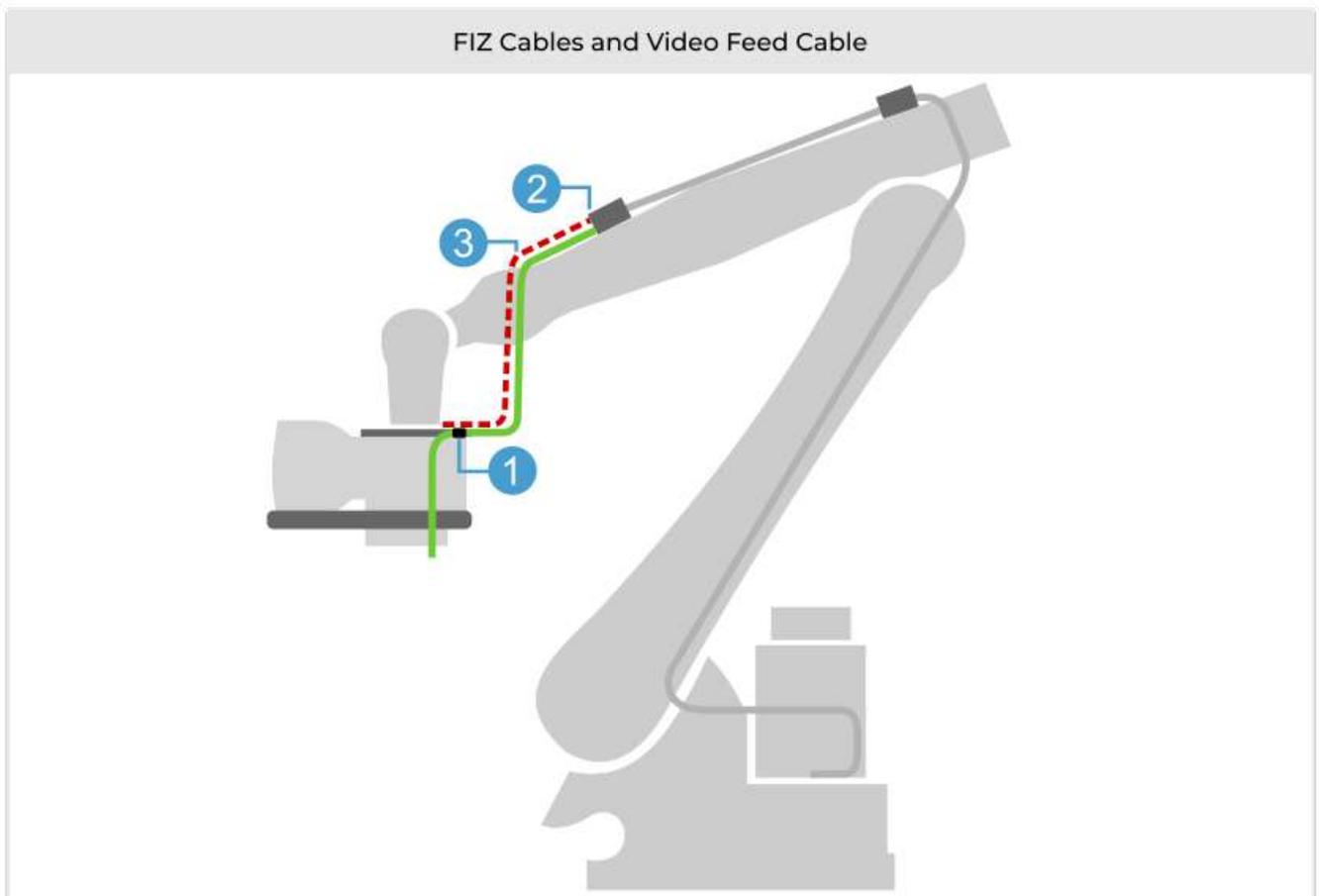
**HOW IT WORKS:** The **Mastering Check** helps to ensure the robot moves precisely to the programmed positions. It is an internal test done to check the robot's joints. In the mastering reference position the cheese plate, dovetail, or robot are detected by the reference switch. This verifies that the joints are calibrated, then the robot will move back to its starting position.

**USE CASE:** It is recommended that you run the mastering check after every reboot of the SISU Cinema Robotics system, after moving the robot, and before each day of robot usage. (While running the Mastering Check every day is not necessary for the system to work, it is recommended for optimal performance.)

(Instructions continued on next page)

**INSTRUCTIONS:**

1. Remove FIZ cables and video feed by doing the following:
  - a) Unplug all 4 ends of the **combo cable** from the bloop light, camera, FIZ motor, and I/O.
  - b) Using a 4 mm allen wrench, unscrew the **combo cable** from the cheeseplate. See Figure 3, circle 1.
  - c) Twist to loosen and then pull to remove the combo cable connector from the top of the robot arm. See Figure 3, circle 2.
  - d) If your **video feed cable** is attached, unplug it from both ends. See Figure 3, circle 3.
  - e) Combo cable and video cable should now be fully disconnected from the robot and camera. Set aside to reinstall after successfully running the mastering check.



2. Remove camera and dovetail clamp from the end of the robot arm.

 **NO CAMERA DURING CHECK: Never perform a Mastering Check with your camera attached.**

(Continued on next page)

3. Switch to **T2** on the SIM.
4. Select **Settings** from the main menu.
5. Select **Robot** from the settings menu.
6. Select **Robot Checks** from the robot menu.
7. Select the **Run Mastering** button.
8. Squeeze the robot **Enable button** and wand **Trigger** to allow the robot to move for the **Mastering Check**.

**! INTERRUPTED MASTERING CHECK:** If you cancel or interrupt the **Mastering Check** you will need to restart the KRC4.

- a) **PASS:** If the **Mastering Check** passes, the robot will move the robot flange to lightly tap the reference switch, then return to the original position of the robot. You will also receive a message on the tablet that it completed successfully.



- b) **FAIL:** If the robot does NOT end up in the position it started in just before the **Mastering Check** began, and/or you do not receive a message on the tablet that the mastering check completed successfully, reboot the system and refer to section [4.8.1 Mastering Check Failures](#).
9. If the **Mastering Check** passes, you can reattach your FIZ cables and video feed.

(Continued on next page)

## 4.8.1 Mastering Check Failures



### POSSIBLE MASTERING CHECK FAILURES

**FAILURE #1:** If the **Mastering Check** fails but the lights on the reference switch turn OFF when the flange touches the reference switch during the Mastering Check, reboot the system and run the Mastering Check again.

**FAILURE #2:** If the **Mastering Check** fails because the robot is NOT coming close enough to turn off the lights on the reference switch, this could be that the robot mastering is wrong and the robot needs to be **Manually Mastered**. Contact customer support for instructions on how to manually master the robot or see chapter [9 Appendix A - Mastering Helps](#).

**FAILURE #3:** After the robot has been **Manually Mastered** and it is still failing the **Mastering Check**, you may need to **Reconfigure the Mastering Reference Position**. To Reconfigure the Mastering Reference Position see chapter [9 Appendix A - Mastering Helps](#).

**FAILURE #4:** Look for an error on the KUKA pendant. If you come across an error that reads **Level at mastering reference switch is unexpectedly low** make sure that the reference switch is plugged in properly on both ends. Also make sure that the two lights on the back of the reference switch are lit up. Finally, make sure that the pins in the reference switch cable are not bent.

## 4.9 Running the Brake Check



### BRAKE CHECK

**DESCRIPTION:** The **Brake Check** is an internal test done to check the calibration of the robot's braking system.

**HOW IT WORKS:** The Brake Check will slowly move each of the robot's joints one at a time from the base of the robot to the end of the arm.

**USE CASE:** It is recommended that you run the Brake Check after every reboot of the SISU Cinema Robotics system, after moving the robot, and before each day of robot usage. (While running the Brake Check every day is not necessary for the system to work, it is recommended for optimal performance.)

#### INSTRUCTIONS:

1. **Remove camera** from the end of the robot arm.



**NO CAMERA DURING CHECK:** Never perform a Brake Check with your camera attached. Make sure there is **nothing** on the end of your robot arm before you begin the Brake Check.

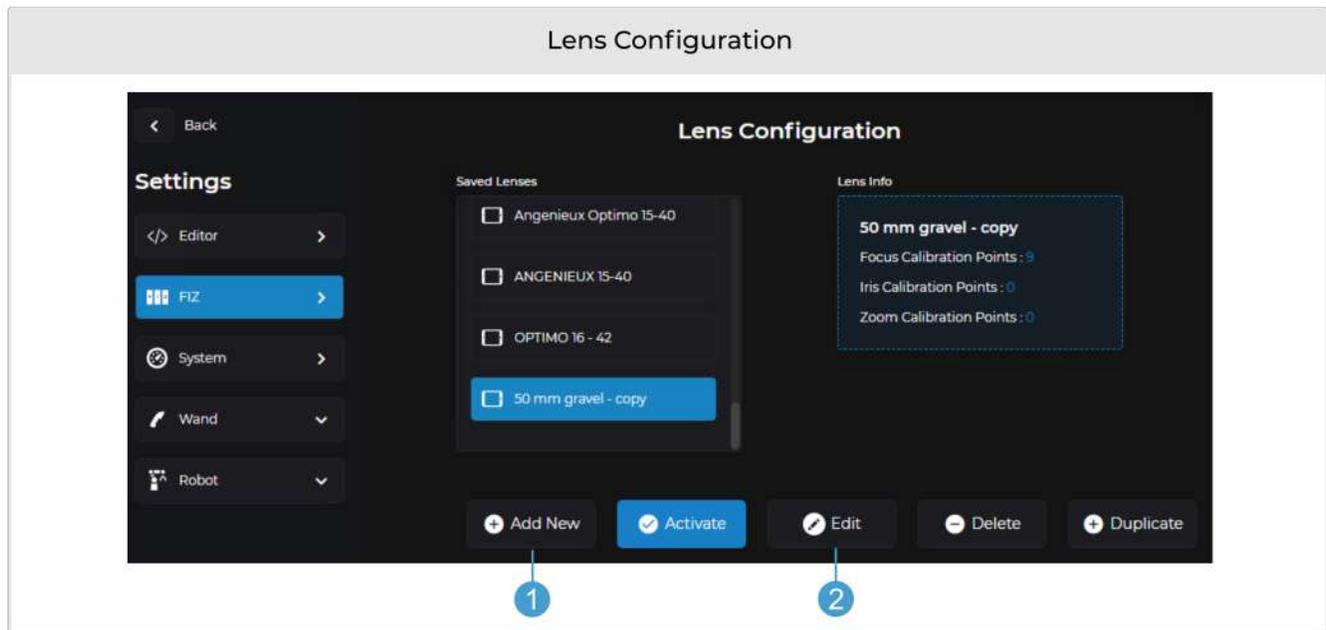
2. Switch to **T2** on the SIM.
3. Select **Settings** from the main menu.
4. Select **Robot** from the settings menu.
5. Select **Robot Checks** from the robot menu.
6. Select the **Run Brake Check button**.
7. Squeeze the **Enable button** on the tablet and the **Wand Trigger** to begin robot movement for the Brake Check. Robot will rotate the joints one by one until it has gone through each joint.
8. After the final robot joint has moved, refer to the **KUKA pendant** for a message that the Brake Check was successful. Select **Cancel** on the Brake Check pop up notification in SISU Lab.

## 4.10 Lens Configuration



### LENS CONFIGURATION

**DESCRIPTION:** **Lens Configuration** maps the actual lens mark (focal distance, focus, T-stops) to the rotation of the FIZ motor.



**USE CASE:** A lack of configuration can result in the lens being out of focus between keyframes, especially for push in/pull out motions. Configuring the lens will keep it in focus. Also, once a lens is configured the FIZ position values for the calibrated motors will read in terms of marks (ft, mm, T-stops).

**HOW IT WORKS:** Lens Configuration will calibrate the marks on the lens (e.g. focal distance) to the lens throw (0-100%).

**EXAMPLE OF LENS CONFIGURATION WORKFLOW:** (more detailed instructions below)

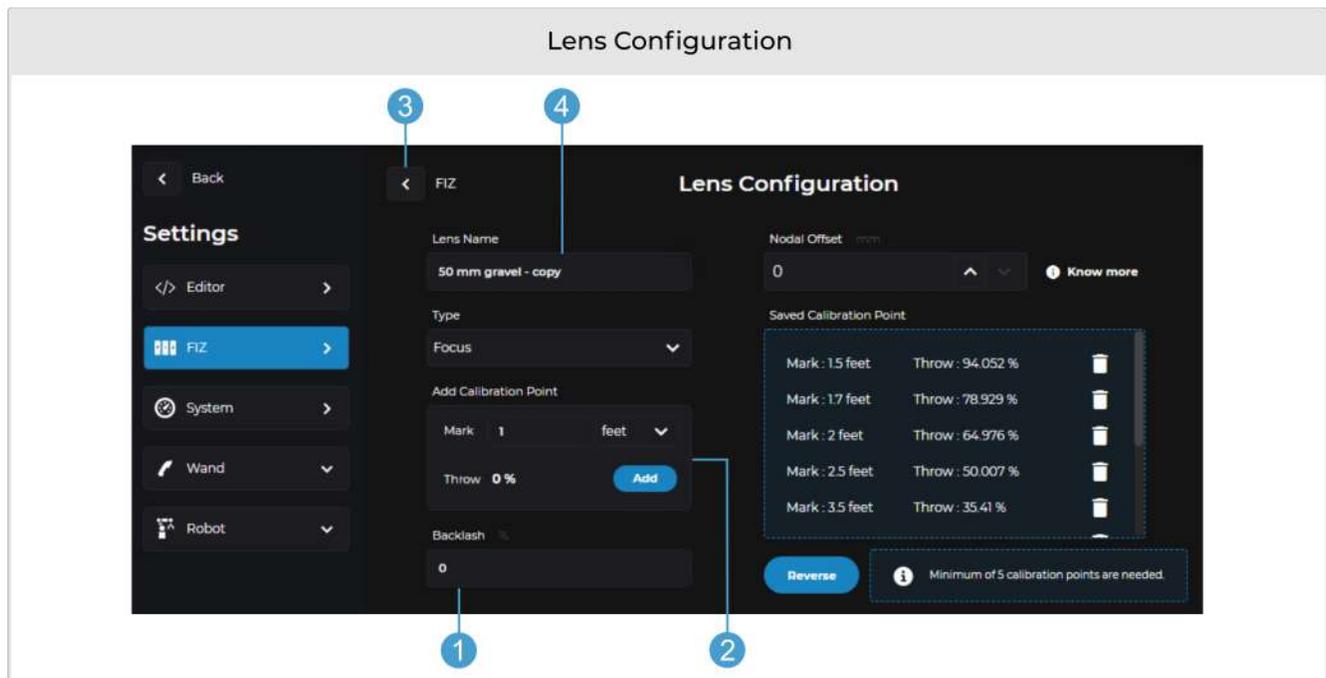
1. Add a new lens to the **Lens Configuration** page. **See number 1 in above image.**
2. Select **Edit** on the newly created lens. **See number 2 in above image.**

(Workflow continued on next page)

- Set the lens **Backlash** in its settings page. **See number 1 in below image.**

**BACKLASH:** See section [4.10.1 Calculating Backlash Compensation Factors](#) for instructions on calculating the backlash.

- Set calibration point for the lens' **Focus, Iris, and Zoom** - or any combination of the ones you will need. **See number 2 in below image.**
- Activate** the lens. The active lens configuration is used while saving keyframes to set the correct lens data. **See number 3 in below image.**



#### INSTRUCTIONS:

- Select **Settings** from the main menu.
- Select **FIZ** from the settings menu.
- Select the **Add New button**. A new lens should be added to the **Saved Lenses box**.
- Select the new lens from the box. The **Lens Info box** will update with information specific to the selected lens, including whether or not the configurations for that lens are complete.
- Select the lens you want to edit and click on the **Edit button**. This will take you to a new screen.
- Rename the lens using the **Lens Name box**. **See number 4 in above image.**

(Continued on next page)



7. Use the drop down menu under **Type** to choose whether the lens will be a Focus, Iris, or Zoom lens. **See number 1 in above image.**
8. Enter the backlash number in the **Backlash** box. **See number 2 in above image.**

**!** **BACKLASH:** Set your **Backlash** BEFORE adding your calibration points. See section 4.10.1 [Calculating Backlash Compensation Factors](#) for instructions.

**📄** **JUMP TO:** See section 4.10.1 [Calculating Backlash Compensation Factors](#) for more information on how to calculate the Backlash.

9. Add a calibration point by using the wand **Joystick** to move the desired motor until it is lined up with your desired marker on the lens. The Lens Configuration page will allow the selected FIZ motor to move the selected FIZ lens with the joystick.
10. Enter the value of the marker on your lens into the **Mark** box (the throw % will automatically update). **See number 3 in above image.**

**!** **MIXING UNITS:** Units cannot be mixed yet in the SISU Lab Lens Configuration page. Use only one unit (e.g. mm, feet, inches) for all saved calibration points.

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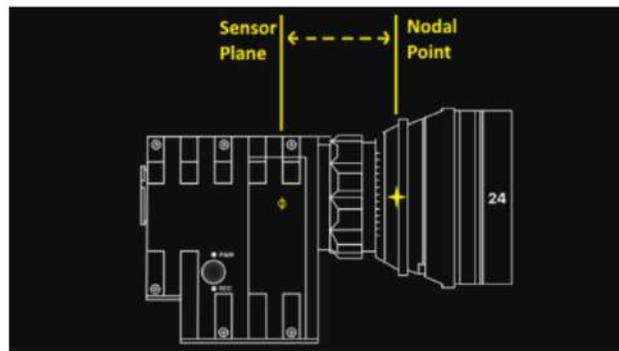
11. Select the **Add button** and the new calibration point will be added to the **Saved Calibration Points box** on the right side of the screen. **If you receive an error when adding the calibration point, check the Lens Configuration.**

**MINIMUM # OF POINTS:** A total of 5 calibration points have to be configured for a lens to be rendered complete. **Without 5+ points the lens will continue to work - but without calibration - which can result in the lens being out of focus between keyframes.**

**TIP WHEN ADDING POINTS:** It is recommended that you add points at both your lowest mark and highest mark. While the minimum number of points for a lens calibration is 5, lenses with short minimum focus distances (<3 ft) may require more points to achieve accurate results.

**TIP FOR INFINITY MARK:** For an **Infinity** mark on the lens, set the value to at least double the value of the last mark on your lens.

12. The **Nodal Offset value** will default to zero. If you know that you want to measure and set a Nodal Offset value, do the following steps (otherwise, skip to step #13):
- Measure (in mm) the distance from the camera's **sensor plane** (your camera should have a marking at this location) to the entrance pupil of the camera lens also known as the **Nodal Point** (this is the location where the iris/aperture blades change in size).



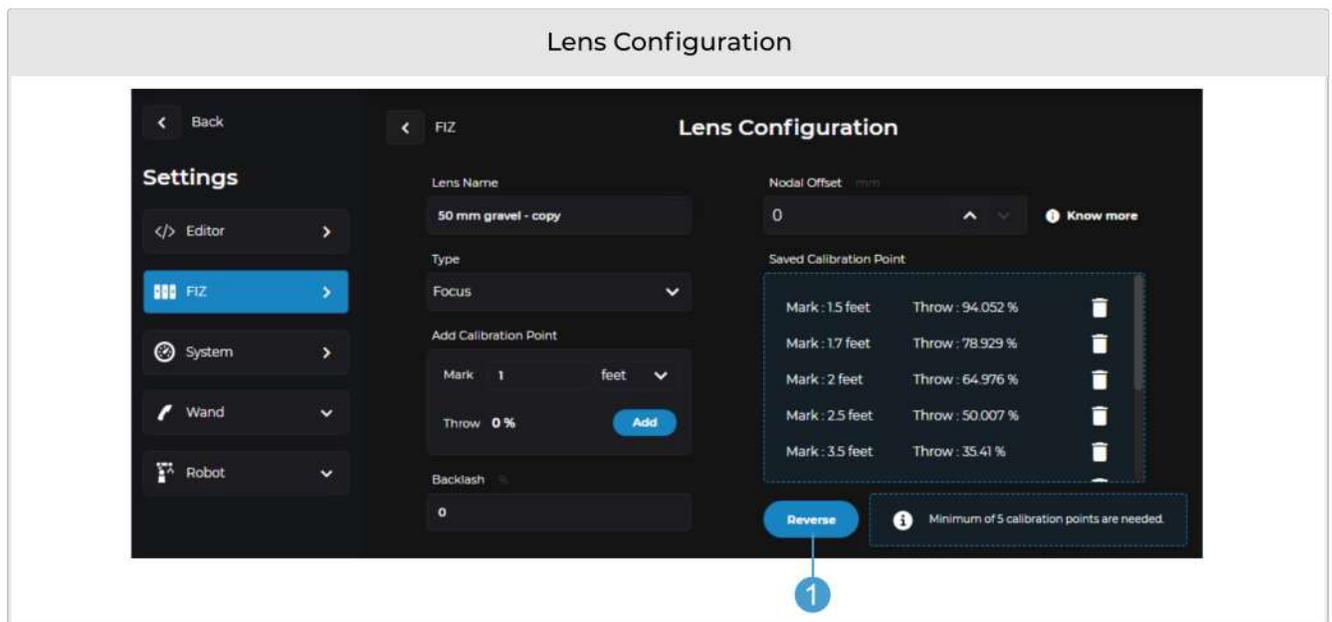
- Enter the distance in the **Nodal Offset value box**. Keep in mind that the number you measured might not be entirely accurate and is more of a good estimate. **You will test your nodal offset value in a later step.**

**DIFFERENT LENS / CAMERA COMBINATIONS:** The **Nodal Offset value** is specific to the camera and lens combination that you used to set the value. **If you change either the lens OR the camera, you will need to remeasure a new Nodal Offset value.**

(Continued on next page)

13. Go back one page and select the lens that you want to activate from the **Saved Lenses box**.
14. Select the **Activate button**.
15. If you measured a **Nodal Offset value** in step #12, test it by setting an object in the foreground and setting an object in the background (both objects should be in the middle of your camera view). As you pan the camera left to right these two objects should stay aligned. If they do NOT stay aligned, adjust your Nodal Offset value up or down. You may need to adjust this several times to get it just the way you want it.
16. To delete a previously saved lens, select the lens that you want to delete from the **Saved Lenses box** and select the **Delete button**.
17. The **Reverse button** will flip the Lens Configuration mapping for the selected FIZ motor if you decide to mount your motor on the other side of the camera. **See number 1 in below image.**

 **REVERSE BUTTON:** When using the **Reverse button**, you will need to reteach any FIZ keyframes if you have already started a program.



 **JUMP TO:** See section [2.5.2 How to Calibrate a Lens](#) for quick reference instructions.

## 4.10.1 Calculating Backlash Compensation Factors

### What is backlash?

There is some amount of play (i.e. backlash) between the internal motor of the FIZ motor and the gear on the outside that interfaces with the gears on the camera. Because of the backlash the actual motor will go to the exact programmed position, but the outside gear may reflect something different.

 **EXAMPLE:** You can feel this backlash by rotating the gear on the FIZ motor forwards and backwards, before mounting it. Notice how the gear will move slightly in both directions before engaging the internal motor.

### Why do I need to find the backlash compensation factors?

Going through the process outlined in this chapter will help you achieve the most accurate Focus, Iris, and Zoom control.

### How do I find the backlash compensation factors for my lens?

These instructions will describe how to measure the backlash of the FIZ controller and input those values into the system, so that the backlash can be compensated for automatically. **This process will only need to be done once for each pairing of motor and lens.**

 Backlash compensation factors should be set BEFORE writing a program or configuring a lens in SISU Lab. Please read through and carefully follow all instructions listed below.

### MATERIALS NEEDED

- Camera and lens (preferably a lens with suitable markings)



- Tape that can safely be put on the lens (**only needed if the lens does not have suitable line markings**)
- A marker

(Continued on next page)

**STEP 1 of 3** | SET UP PROCESS**INSTRUCTIONS:**

1. Mount camera and FIZ motors.

 **JUMP TO:** See your **SISU Cinema Robotics Installation Guide** for instructions on how to mount the camera and FIZ motors.

2. Run the SISU Cinema Robotics system and calibrate the FIZ motors.

 **JUMP TO:** See section [4.4.3 FIZ Indicators](#) for instructions on calibrating FIZ motors.

3. Set the backlash compensation factor in the **Settings/FIZ page** to 0.
4. After the FIZ motors are calibrated, move them so that their values are somewhere in the middle (ideally between 30% and 70%).

**STEP 2 of 3** | MEASURING THE BACKLASH**INSTRUCTIONS:**

1. Pick a motor to calibrate (this example will use the Focus motor).
2. Line up two lines on your lens, or (if your lens does not have suitable markings) put two pieces of tape on your lens.



- a) The two pieces of tape should be placed directly across from one another.

(Continued on next page)

- b) One piece of tape should go on a part of the lens that will **NOT** move when you adjust whichever FIZ motor is being calibrated.
  - c) The other piece of tape should go on a part of the lens that **WILL** move when you adjust whichever FIZ motor is being calibrated.
  - d) Using a marker, draw a line across both pieces of tape.
3. Using the wand, adjust the **Focus** in a POSITIVE direction (towards 100) until the tape/lines are visibly no longer aligned.



 **EXAMPLE:** If the motor was set at 40 when the tape/lines were aligned, moving it to 60 would be fine.

4. Move the motor so that the tape/lines are once again aligned.

 **IMPORTANT:** Only move in the NEGATIVE direction (towards 0). If you overshoot go back towards 100 and start again.

5. Write down the **FIZ value**.
6. Move the motor to adjust the **Focus** in a NEGATIVE direction (towards 0) until the tape/lines are visibly no longer aligned.

 **EXAMPLE:** If the motor was set at 40 when the tape/lines were aligned, moving it to 20 would be fine.

(Continued on next page)

7. Move the motor so that the tape/lines are once again aligned.

 **IMPORTANT:** Only move in the POSITIVE direction (towards 100). If you overshoot go back towards 0 and start again.

8. Write down the **FIZ value**.
9. Subtract the smaller value from the larger value to get the **Backlash value**.

$$48.245 - 46.201 = 2.044$$

 **CHANGING LENSES:** If the same FIZ motor is used with a different lens, a new **Backlash value** will need to be calculated. Changing the FIZ motor used on the lens ring will also require finding a new Backlash.

### STEP 3 of 3 | CHECKING THAT THE VALUE IS CORRECT

#### INSTRUCTIONS:

1. With the tape lined up, record a **Linear keyframe**. This must be done AFTER the Backlash has been input into the **Settings/FIZ page**.
2. Check the NEGATIVE direction by moving FIZ to 100, selecting the keyframe, and selecting **Move to Position** from the settings options. The moving tape/line should realign with the stationary tape/line.
3. Check the POSITIVE direction by moving FIZ to 0, selecting the keyframe, and selecting **Move to Position** from the settings options. The moving tape/line should realign with the stationary tape/line.
  - a) **COMPLETE:** If, after these tests, the pieces of tape and/or lines are aligned with each other than the backlash compensation is complete.
  - b) **INCOMPLETE:** If, after these tests, the pieces of tape and/or lines are **NOT** aligned with each other then you may have to repeat the process or adjust the backlash compensation experimentally until the focus returns to the same point.

 **IMPORTANT:** Repeat this entire process for **ALL** FIZ motors.

 **BACKLASH FACTORS ARE STORED WITH EACH KEYFRAME:** Backlash compensation factors are stored with each keyframe. If you change the backlash compensation factor you need to move to and update the position for each keyframe in your program.

## 4.11 Robot Orientation



### ROBOT ORIENTATION

**DESCRIPTION:** **Robot Orientation** allows you to rotate the robot and/or the case to achieve the desired relative orientation between the two.

**! IMPORTANT:** **Robot Orientation should be set BEFORE moving the robot to ensure that the robot will move in the expected motions.**

#### INSTRUCTIONS:

1. Select **Settings** from the main menu.
2. Select **Wand** from the settings menu.
3. Select **Robot Orientation** from the wand menu.
4. Click on the **Rotate Robot button** until the robot on the screen matches the actual physical orientation of the robot.
5. Click on the **Rotate Case button** until the case on the screen matches the actual physical orientation of the case.
6. Test that the robot moves in the expected direction by pressing the **Enable button** and moving the robot with **Joystick Control**.

## 4.12 Distortion Tolerance



### DISTORTION TOLERANCE

**DISTORTION TOLERANCE:** **Distortion Tolerance** allows you to set the distortion tolerance to an acceptable level to allow or prevent the robot from moving unexpectedly due to signal interference.

**USE CASE:** To account for distortion in the signal between the wand and the case.



**EXAMPLE #1:** A LOW distortion tolerance value will be more strict in detecting distortion and will stop the robot if distortion is detected.



**EXAMPLE #2:** A HIGH distortion tolerance value will be less strict in detecting distortion and may let the robot move in an unexpected direction if distortion is detected.

#### INSTRUCTIONS:

1. Select **Settings** from the main menu.
2. Select **Wand** from the settings menu.
3. Select **Distortion Tolerance** from the wand menu.
4. Move the slider around on the **Tolerance bar** to set your desired distortion tolerance.



**DEFAULT TOLERANCE:** The default distortion tolerance level is 50. You may need to move this higher for your configuration.



**JUMP TO:** See section [10.2.10 ISSUE: Interference Detected message pops up constantly](#) for troubleshooting information.

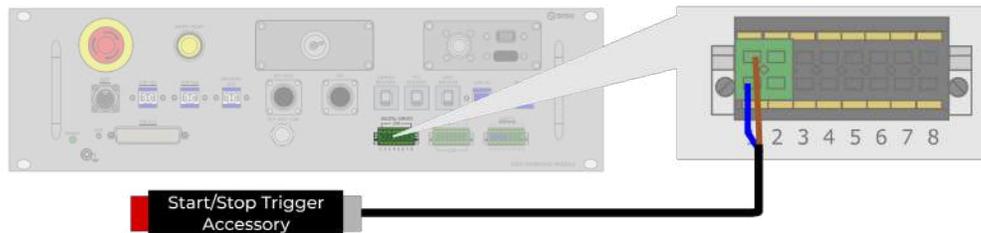
## 4.13 Hooking up Digital I/O on the SIM

### Instructions for hooking up Inputs:

1. Plug one wire for your accessory into an empty spot on the top row of **DIGITAL INPUTS**.

**!** **SIM INPUT VOLTAGE:** The top row of the input header supplies a constant 24V to power accessories.

2. Plug the ground wire for your accessory into the bottom row of **DIGITAL INPUTS** on the SIM directly beneath the one you just plugged into the top row.



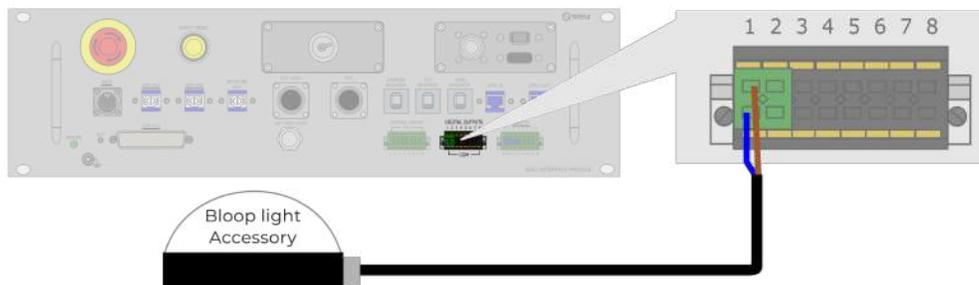
**JUMP TO:** See section [7.4](#) and [7.5](#) for information on the **External Start** function.

### Instructions for hooking up Outputs:

1. Plug one wire for your accessory into an empty spot on the top row of **DIGITAL OUTPUTS**.

**!** **SIM OUTPUT VOLTAGE:** The top row of the outputs supplies a 27V pulse when set to high, and 0v when set to low.

2. Plug the ground wire for your accessory into the bottom row of **DIGITAL OUTPUTS** on the SIM directly beneath the one you just plugged into the top row.



**JUMP TO:** See section [6.6.1 How to Add a Channel - Adding TRIGGER CHANNEL](#) for information on programming your input and output channels.

# 5. IN-DEPTH: MOVING THE ROBOT, FIZ MOTORS & TRACK

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## 5.1 Chapter Contents

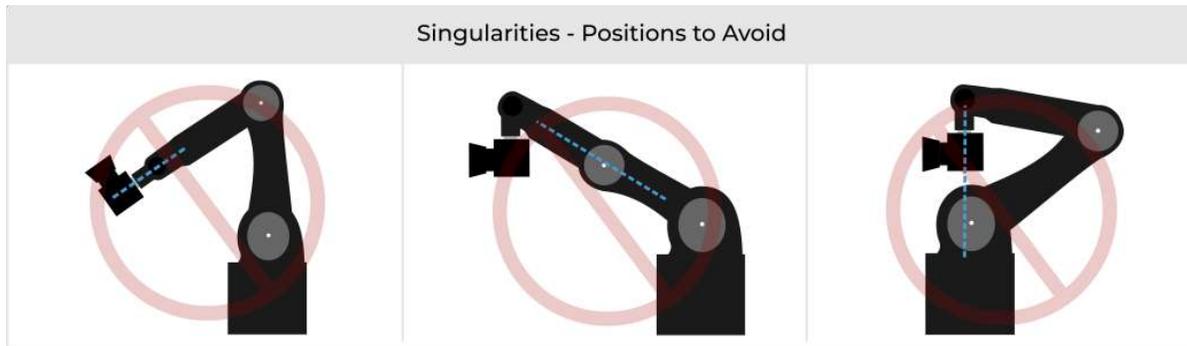
- **Problems when Moving Robot** - [5.2](#)
  - Singularities - Robot Positions to Avoid - [5.2.1](#)
  - Troubleshooting Appendix - [5.2.3](#)
- **Moving Robot with Trigger Control** - [5.3](#)
- **Moving Robot with Joystick Control** - [5.4](#)
- **Moving Robot with Joint Mode** - [5.5](#)
  - Accessing Joint Mode via Wand or Tablet - [5.5.1](#)
- **Quick Set Settings Options** - [5.6](#)
  - Horizon Lock - [5.6.1](#)
  - Translation/Rotation Modes - [5.6.2](#)
  - Tool Reference - [5.6.3](#)
  - Speed Modes - [5.6.4](#)
  - Snap to Axis - [5.6.5](#)
- **How to Move FIZ Motors** - [5.7](#)
- **How to Move Track (if applicable)** - [5.8](#)

## 5.2 Problems when Moving Robot

### 5.2.1 Singularities - Robot Positions to Avoid

#### What is a robot Singularity?

A robot **Singularity** is a condition when the alignment of two or more axes/joints results in an unpredictable robot motion; often the robot will become stuck.



#### How do I move the robot if I encounter a Singularity and the robot gets stuck?

If you encounter a Singularity and cannot move the robot out of a position using the **Wand** and/or **Joystick**, you can jog the robot to a new position using **Joint Mode**.

 **SINGULARITIES NOTIFICATION:** SISU Lab will warn you with notifications when the robot is nearing a limit, or when you are close to a joint limit or Singularity.

 **JUMP TO:** See section [5.5 Moving Robot with Joint Mode](#) for instructions.

#### How can I move the robot through Singularities?

If you need to move the robot THROUGH a Singularity without getting stuck, do the following:

1. Create a keyframe in the **Robot Channel** right before the robot is going to enter the singularity.
2. Make the keyframe you just made a **Joint move** (as Joint moves are the only moves that can allow you to travel through Singularities).
3. Create a keyframe in the **Robot Channel** right after the robot will leave the singularity position.
4. Make the keyframe you just made a **Joint move** (as Joint moves are the only moves that can allow you to travel through Singularities).

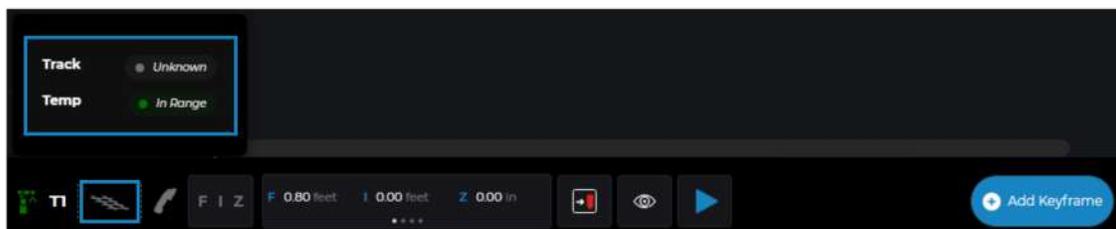
## 5.2.2 Track Temperature Warnings (if applicable)



### TRACK TEMPERATURE WARNINGS

**DESCRIPTION:** You will receive a **yellow warning** notification in SISU Lab if the track is approaching a temperature at which it will shut down for safety reasons. You will receive a **red warning** notification in SISU Lab if the track shuts down due to overheating.

**INSTRUCTIONS:** Check the current temperature status of the track by selecting the **Track status indicator** in the bottom left of the pendant screen. There are 4 possible states:



1. **In Range** (green): You can continue to run the track.
2. **Warning** (yellow): The track will overheat soon. Stop running the track immediately and allow it to cool down sufficiently.
3. **Overheated** (red): The track has overheated and has emergency stopped. Unplug the track and wait long enough for the track to cool down to a safe temperature before powering the system back on and continuing.
4. **Unknown** (gray): The temperature status of the track is unknown.

## 5.2.3 Troubleshooting Appendix

For all other issues regarding moving the robot, please review [Appendix B - Troubleshooting Known Issues](#).

(Continued on next page)

## 5.3 Moving Robot with Trigger Control



### TRIGGER CONTROL

**DESCRIPTION:** In **Trigger Control** the robot's movements will mimic the movements of the wand.

**INSTRUCTIONS:** Hold down the **Enable button** on the tablet AND hold down the **Trigger** on the wand. Move the wand around and the robot will follow.

**Available Quick Set MOTION FILTERS:** Horizon Lock, Translation/Rotation Modes, and Speed Mode



**LIVE CONTROL:** **Live Control** is the general term for moving the robot in any way using the wand. **Trigger Control** is a form of **Live Control**.



**JUMP TO:** See section [2.6.1 How to Move the Robot](#) for quick reference instructions.

## 5.4 Moving Robot with Joystick Control



### JOYSTICK CONTROL

**DESCRIPTION:** In **Joystick Control** the robot will move in the same direction that you are pushing the joystick.

**INSTRUCTIONS:** Hold down the **Enable button** on the tablet AND push the **Joystick** on the wand. The robot will move in the same direction that you are pushing the joystick.

**Available Quick Set MOTION FILTERS:** Horizon Lock, Translation/Rotation Modes, Snap to Axis, Tool Reference, and Speed Mode



**LIVE CONTROL:** **Live Control** is the general term for moving the robot in any way using the wand. **Joystick Control** is a form of **Live Control**.



**JUMP TO:** See section [2.6.1 How to Move the Robot](#) for quick reference instructions.

(Continued on next page)

## 5.5 Moving Robot with Joint Mode

The following sections describe the two ways that you can access the joint mode page.

**STUCK ROBOT:** If the robot ever gets stuck and the wand will not move it out of position, you can use **Joint Mode** to move it. This can happen either when the robot reaches its limits or when a Singularity is encountered.

**JUMP TO:** The **Joint page** also allows you to move the FIZ motors individually using the joystick. See section [5.7 How to Move FIZ Motors](#) for these instructions.

**JUMP TO:** See section [2.6.1 How to Move the Robot](#) for quick reference instructions.

### 5.5.1 Accessing Joint Mode via Wand or Tablet

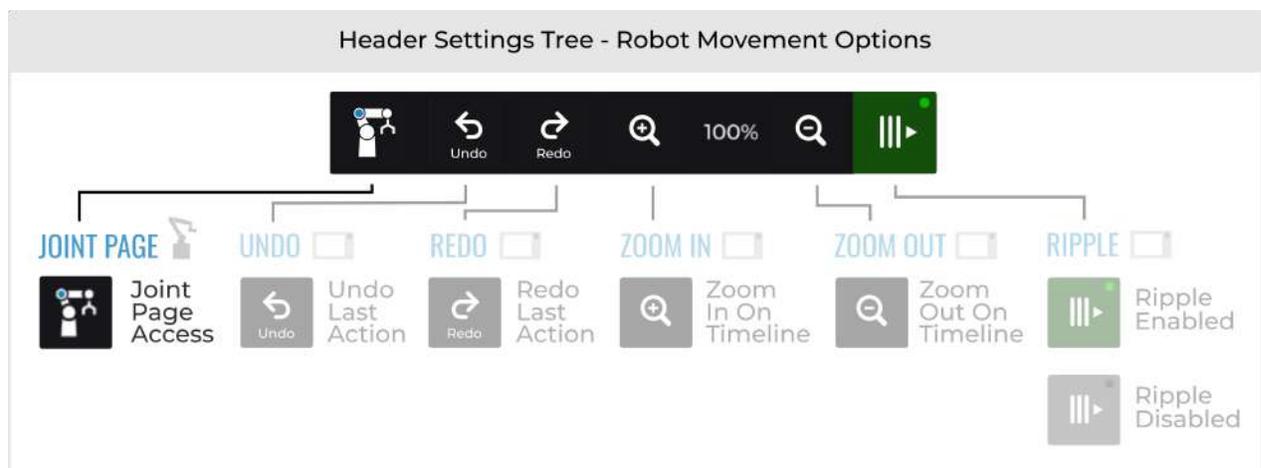


#### JOINT MODE BUTTON - WAND

**DESCRIPTION:** The **Joint Mode button** on the wand allows you to access the **Joint Page** where you can move each of the robot's six axes individually.

#### INSTRUCTIONS:

1. Push the **Right Wand button** OR select the **Joint Page access** on the tablet. The Joint page will appear on the tablet.



**JUMP TO:** For information on the grayed out header settings related to programming (not running the robot) see section [6.3.2 Header Programming Options](#).

(Continued on next page)

2. Select the **Joint** and **Direction** that you want to move. The robot image will highlight - in blue - the joint that will move and the direction in which it will move.



3. Hold down the **Enable button** on the tablet and hold down the **Trigger** on the wand. This will move the selected joint in the selected direction.

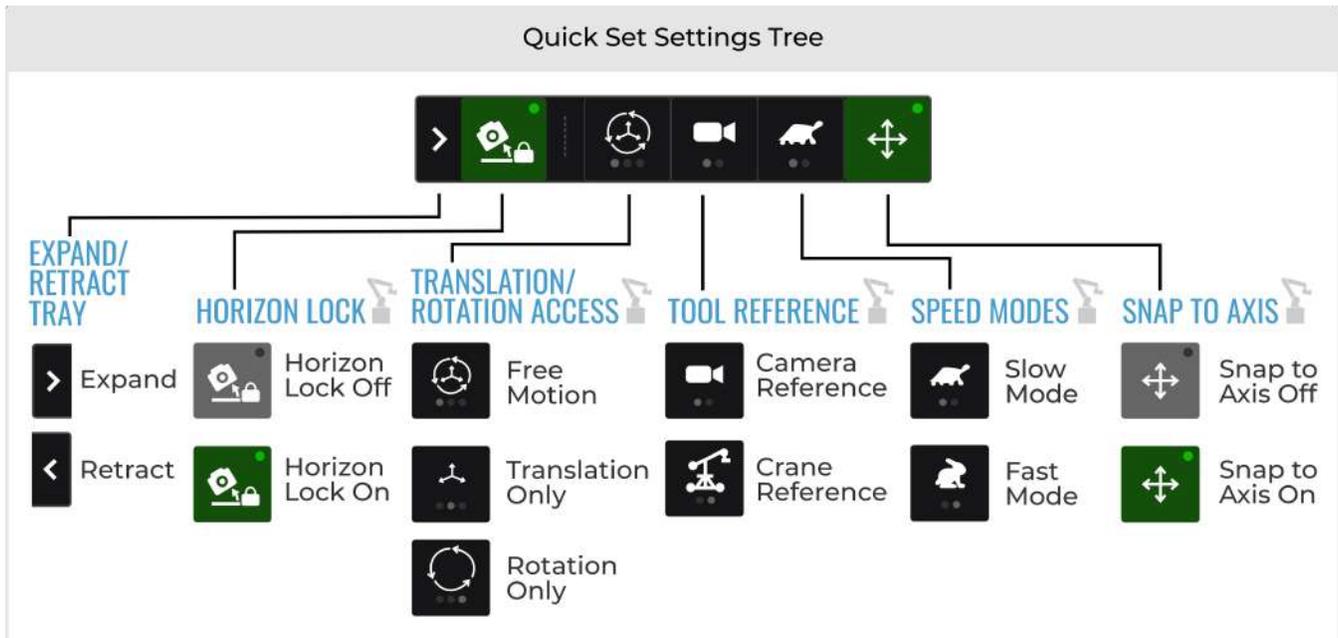


**ENABLE BUTTON: Do NOT hold down the Enable button to move the FIZ motors.**

This could jeopardize the otherwise smooth movement in the FIZ motor.

4. Press the **Right Wand button** OR **Joint Page access** again to return to the previous screen (Editor or Settings).

## 5.6 Quick Set Settings Options



 **REORDER QUICK SET TRAY:** Press and drag a quick set option to reorder it in the top bar.

### 5.6.1 Horizon Lock

**Horizon Lock** will allow you to lock your camera's horizon during **Live Control**. It can be likened to the ease of moving your camera around on a tripod. In this scenario you can tilt and rotate around the tripod's vertical axis or around the camera's horizontal axis, but you can NEVER roll around the lens.



**HORIZON LOCK - OFF**

**DESCRIPTION:** With Horizon Lock OFF you CAN roll around the lens.



**HORIZON LOCK - ON**

**DESCRIPTION:** If Horizon Lock is ON you can still rotate and translate in all other directions, you will just not be able to roll around the lens.

(Continued on next page)

## 5.6.2 Translation/Rotation Modes



### FREE MOTION MODE

**DESCRIPTION:** **Free Motion mode** allows the robot to rotate AND translate at the same time.

---



### TRANSLATION ONLY MODE

**DESCRIPTION:** **Translation Only mode** allows the robot to translate, but it will NOT be able to rotate.

---



### ROTATION ONLY MODE

**DESCRIPTION:** **Rotation Only mode** allows the robot to rotate, but it will NOT be able to translate.



**IMPORTANT:** In **Rotation Only mode** the joystick behaves differently than in the other two modes. In Rotation Only mode the joystick will cause the robot to rotate around whatever plane the joystick is most closely aligned to when it is pushed.



**GRAYED OUT SNAP TO AXIS:** If Rotation Mode is ON, then the Snap to Axis option will be grayed out.

(Continued on next page)

### 5.6.3 Tool Reference

The wand's joystick will cause the robot to rotate around whatever axis the wand is most closely aligned to. This will vary depending on which **Tool Reference** is selected. (See images in this section.)



#### CRANE CONTROL

**DESCRIPTION:** In the **Crane Control** setting the joystick will cause the robot to rotate and translate relative to the base of the robot system.

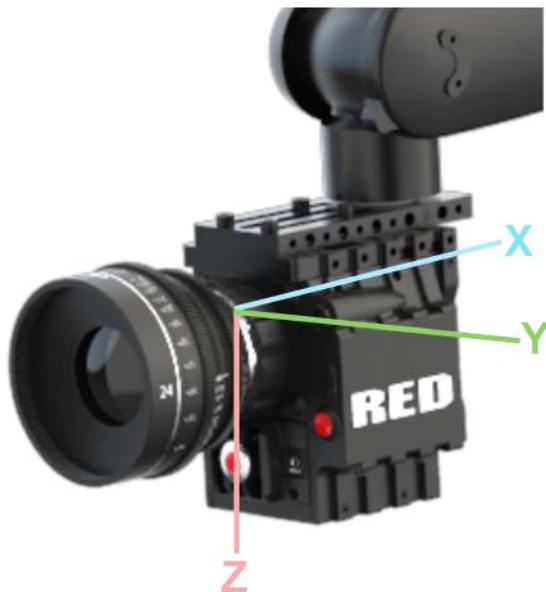


#### CAMERA CONTROL

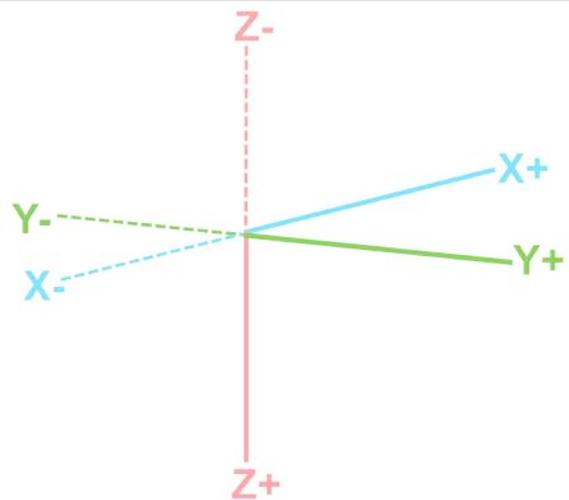
**DESCRIPTION:** In the **Camera Control** setting the joystick will cause the robot to rotate and translate relative to the camera's orientation.

#### Tool Reference - XYZ Axes

Positive directions of XYZ axes



Negative directions of XYZ axes



— = positive direction  
 - - - - = negative direction

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### Tool Reference - XYZ Rotation

Location #1



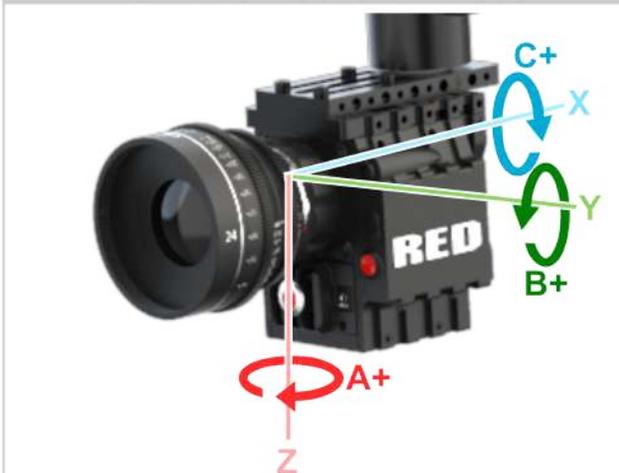
Location #2



 = Axes will rotate along with camera

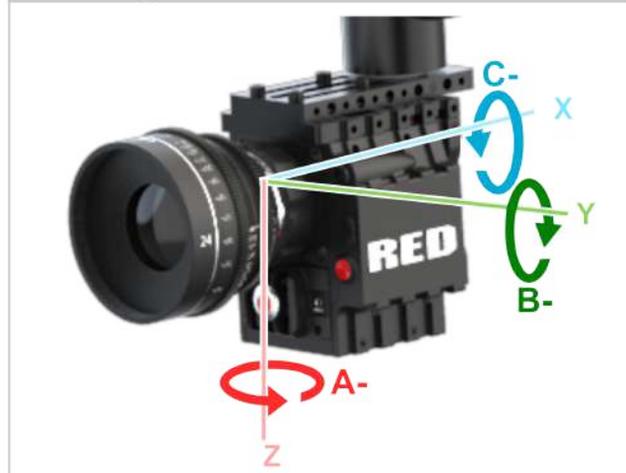
### Tool Reference - ABC Rotation

Positive rotations around XYZ axes



A+ = positive rotation around the Z axis  
 B+ = positive rotation around the Y axis  
 C+ = positive rotation around the X axis

Negative rotations around XYZ axes



A- = negative rotation around the Z axis  
 B- = negative rotation around the Y axis  
 C- = negative rotation around the X axis

## 5.6.4 Speed Modes



### FAST MODE

**DESCRIPTION:** **Fast mode** allows the robot to move with Live Control and in the Joint Page at the maximum safe speed. **This does not affect the speed of program run.** Only T1 and T2 keyswitch settings affect program run speed.



### SLOW MODE

**DESCRIPTION:** **Slow mode** allows the robot to move with Live Control and the Joint Page at a slower speed for precise movements. **This does not affect the speed of program run.** Only T1 and T2 keyswitch settings affect program run speed.



**JUMP TO:** For more information on how to adjust the speeds of different pieces of hardware, see section [6.2.5 Slow Speed Option](#).

## 5.6.5 Snap To Axis



### SNAP TO AXIS - OFF

**DESCRIPTION: (FOR JOYSTICK CONTROL ONLY.)** When **Snap to Axis** is OFF the robot can move in any direction indicated by the **joystick**. The camera may also move at small diagonal angles to follow your hand placement or the joystick movement.



**JUMP TO:** See images [1 Snap to Axis - Crane Mode](#), [2 Snap to Axis - Camera Mode](#), and [3 Snap to Axis - Example](#).



### SNAP TO AXIS - ON

**DESCRIPTION: (FOR JOYSTICK CONTROL ONLY.)** When **Snap to Axis** is ON the robot's movements will automatically snap to the nearest X, Y, or Z axis that the **wand** and **joystick** are aligned with. **Use this when trying to get more "straight line" movements that filter out small angles in your hand or the joystick movement.**



**JUMP TO:** See images [1 Snap to Axis - Crane Mode](#), [2 Snap to Axis - Camera Mode](#), and [3 Snap to Axis - Example](#).

**+** SNAP TO AXIS - CRANE MODE (IMAGE 1 of 3)

CRANE MODE

<b>Snap to Axis - OFF </b> = Plane on which the robot/camera can travel Your camera will travel within the highlighted CRANE plane	<b>Snap to Axis - ON </b> = Axes on which the robot/camera can travel Your camera will snap to the CRANE axis (red line) that is NEAREST to the direction the joystick is being pushed
<div style="background-color: #f8d7da; padding: 5px; border: 1px solid #c3e6cb;">                     Only applies to JOYSTICK mode                 </div>	<div style="background-color: #f8d7da; padding: 5px; border: 1px solid #c3e6cb;">                     Only applies to JOYSTICK mode                 </div>

Figure 1: Snap to Axis - Crane Mode



## SNAP TO AXIS - CAMERA MODE (IMAGE 2 of 3)

CAMERA MODE

### Snap to Axis - OFF

= Plane on which the robot/camera can travel

Your camera will travel within the highlighted CAMERA plane

Only applies to JOYSTICK mode

### Snap to Axis - ON

= Axes on which the robot/camera can travel

Your camera will snap to the CAMERA axis (red line) that is NEAREST to the direction the joystick is being pushed

Only applies to JOYSTICK mode

Figure 2: Snap to Axis - Camera Mode



## SNAP TO AXIS - EXAMPLE (IMAGE 3 of 3)

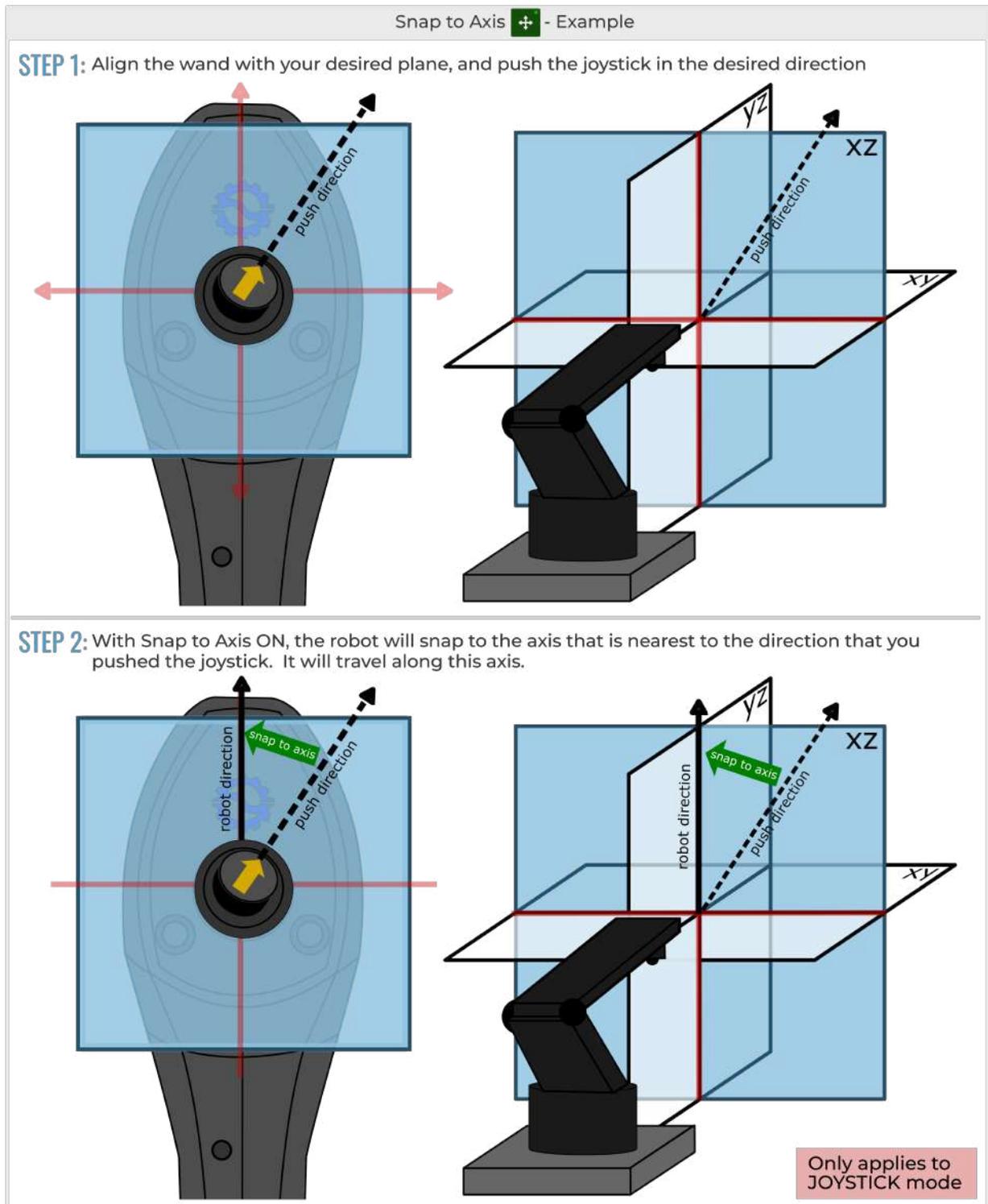


Figure 3: Snap to Axis - Example

## 5.7 How to Move FIZ Motors

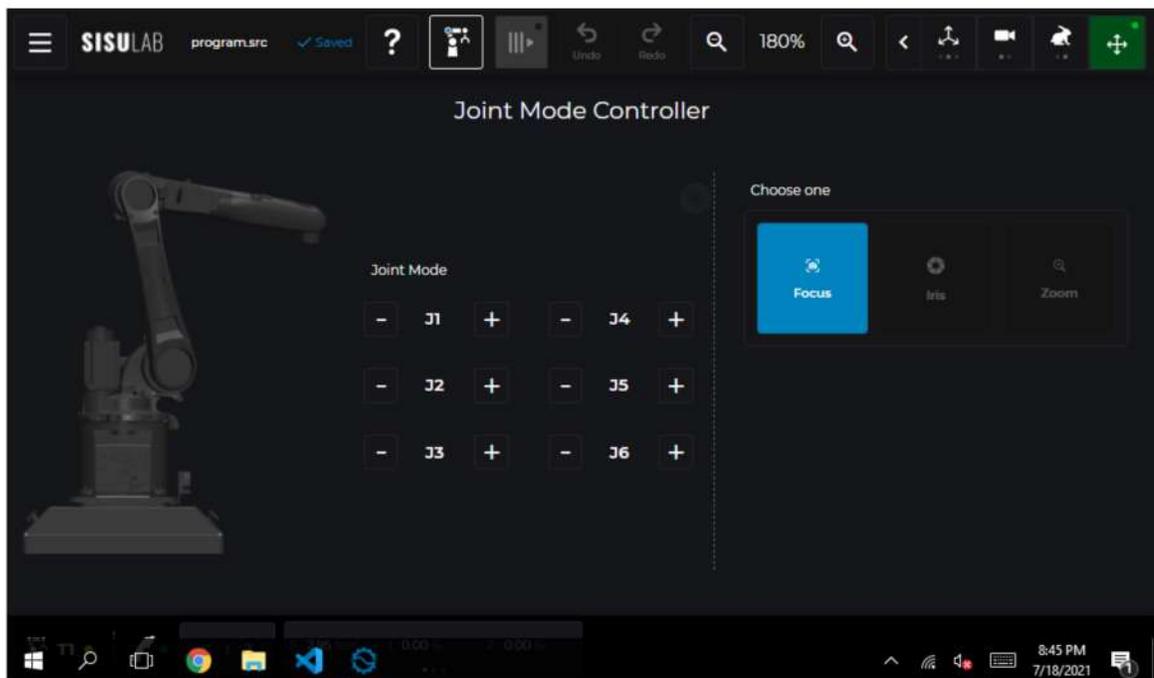


### MOVING FIZ MOTORS

**Description:** You can adjust each of the **FIZ motors** using the tablet and joystick.

#### INSTRUCTIONS:

1. Open the **Joint Page** by clicking on the **Right Wand button** or the tablet's **Joint button**.
2. Select which **FIZ motor** you want to move.
3. Push forwards or backwards on the wand **Joystick** to move the motor in the desired direction.



## 5.8 How to Move Track (if applicable)

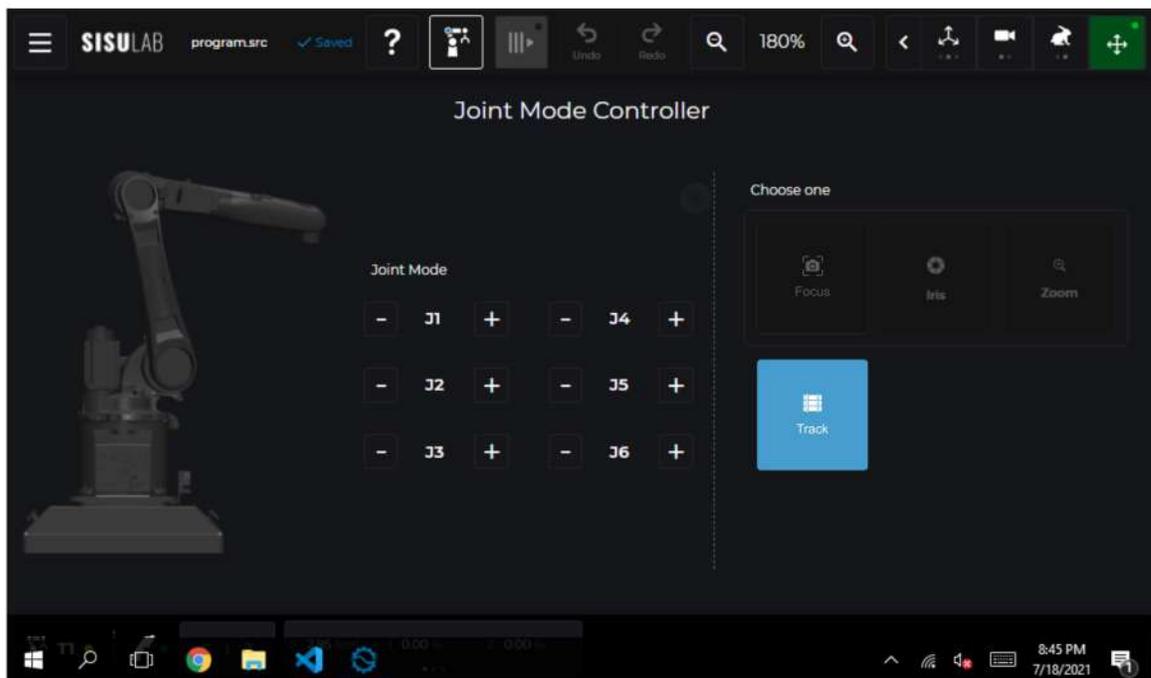


### MOVING TRACK

**Description:** You can move the robot and robot pedestal up and down the **track** using the tablet and joystick.

#### INSTRUCTIONS:

1. Open the **Joint Page** by clicking on the **Right Wand button** or the tablet's **Joint button**.
2. Select the **Track** option.
3. Hold down the **Enable button** on the tablet.
4. Push left or right on the wand **Joystick** to move the robot and pedestal in the desired direction.



# 6. IN-DEPTH: PROGRAMMING

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  - Go To Location Button - [6.2.3](#)
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  - Program Cursor and Robot Cursor - [6.3.4](#)
    - \* Ways to Move the Program Cursor - [6.3.4](#)
    - \* Robot Cursor - [6.3.4](#)
  
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    - \* Creating Keyframes in Channels - [6.5.1](#)
    - \* Creating a Series of Equally Spaced Out Keyframes - [6.5.1](#)
    - \* Choosing Moves for Camera Channel Keyframes - [6.5.1](#)
    - \* Choosing Moves for Target Channel Keyframes - [6.5.1](#)
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  - \* Settings Options for Target Channel Keyframes - [6.5.2](#)
  - \* Settings Options for Focus, Iris and Zoom Channel Keyframes - [6.5.2](#)
  - \* Settings Options for Trigger Channel Keyframes - [6.5.2](#)
- **Adding and Editing Channels** - [6.6](#)
  - How to Add a Channel - [6.6.1](#)
  - How to Edit a Channel - [6.6.2](#)
- **Compilation Errors and Warnings** - [6.7](#)

## 6.2 Things To Know Before Writing Your Program

### 6.2.1 Main Menu Options



NEW PROGRAM

**DESCRIPTION:** Allows you to create a new program.

---



OPEN PROGRAM

**DESCRIPTION:** Allows you to open a previously created and saved program.

---



MAKE A COPY

**DESCRIPTION:** Creates a copy of the currently opened program, and then opens the copy for editing.

---



SYSTEM LOG

**DESCRIPTION:** Allows you to export and save the most current system log files.

**INSTRUCTIONS:** Select **Main Menu/System Log**. You can then save the zipped folder that contains the system log files.

---



INFO

**DESCRIPTION:** Displays system software information, such as the user interface and robot versions.

(Continued on next page)

**FX** | FX - EXPORT TO VFX

**DESCRIPTION:** Allows you to export your camera position information for external tools. Script files will be generated to load the camera position and depth of field information into Unreal Engine™ or other modeling environments that accept FBX files.

Export to FX Map

Export to
File Path

Unreal Engine

C:/Users/Public/Documents/SISU/Saved Programs/StainlessTable1.py

1

Camera Position 2

X (mm)

0

Y (mm)

0

Z (mm)

698.5

Depth of Field 3

Manual Focus Distance (feet)

0.016

Current Focal Length (mm)

23.021

Current Aperture (f-Stop)

2.8

Cancel

Export

**1 SAVE FILE ICON**

Tap to select a file location to save the camera position and depth of field to

**2 CAMERA POSITION**

Offsets the camera starting position when importing into Unreal Engine™

**3 CAMERA DEPTH OF FIELD INFORMATION**

**Manual Focus Distance** is from the Target/Focus channel. **Current Focal Length** is from the Zoom channel. **Current Aperture** is from the Iris channel

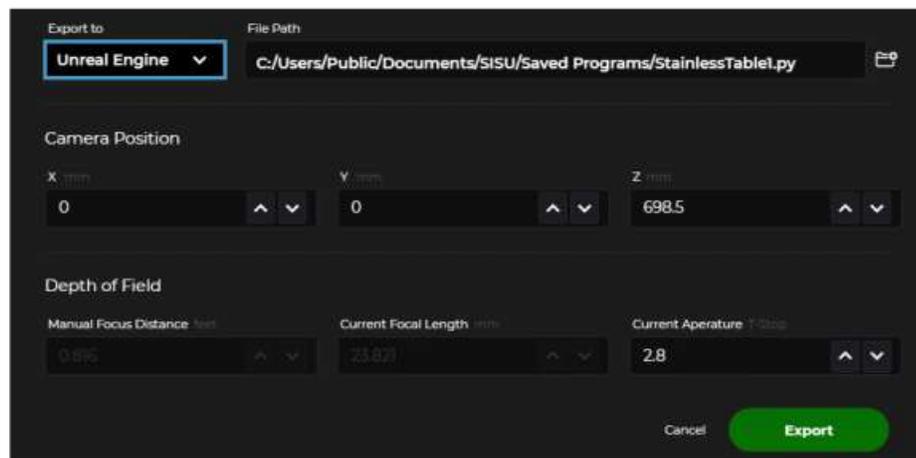
**Z DISTANCE:** Z Distance is the distance from the bottom of the pedestal to the robot center point. For accurate results, add the distance from the floor to the bottom of the pedestal.

- [6.2.1 INSTRUCTIONS FOR EXPORTING PROGRAMS INTO UNREAL ENGINE™:](#)
- [6.2.1 INSTRUCTIONS FOR EXPORTING AN FBX PROGRAM:](#)
- [6.2.1 INSTRUCTIONS FOR USING THE SCRIPT IN UNREAL ENGINE™:](#)
- [6.2.1 INSTRUCTIONS FOR IMPORTING FBX FILES INTO MAYA™:](#)
- [6.2.1 INSTRUCTIONS FOR IMPORTING FBX FILES INTO CINEMA 4D™:](#)
- [6.2.1 INSTRUCTIONS FOR IMPORTING FBX FILES INTO BLENDER™:](#)

## INSTRUCTIONS FOR EXPORTING PROGRAMS INTO UNREAL ENGINE™:

**! UNREAL ENGINE™ VERSION TESTED:** Export out of SISU Lab and import into Unreal Engine™ was built and tested with Unreal Engine™ version 4.26.

1. Select **Unreal Engine** from the **Settings** menu.



2. Select the File icon to choose the name and location for the exported file.

**! SAVING TO A USB:** For easier file transfer, plug in a USB flash drive to the case USB input, and select to save the file to the USB drive.

3. If desired, set your **Camera Position Offset** values (mm) using the X, Y, and Z coordinates.
4. If desired, change your depth of field by setting your **Manual focus distance** (mm), **Current focal length** (mm), and **Current aperture** (F-stop).

**! GRAYED OUT OPTIONS:** If these values have been adequately defined in the program (e.g. you have a channel for it, or you have at least the required 5 lens calibration points) these options will be deselected and grayed out here.

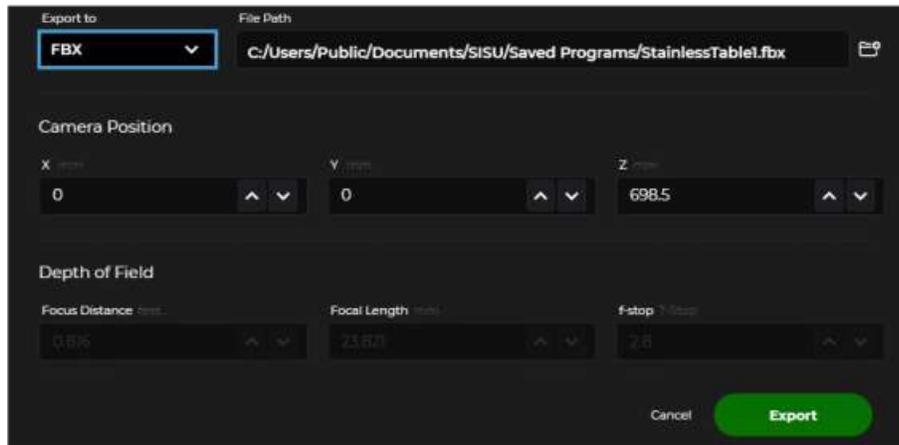
5. Select **Export** to save the file to the selected location.

**! ERRORS WHILE EXPORTING:** If you try to export a program with an error in it, you will receive both an **error warning** and a **failed compilation warning**.

(Continued on next page)

## INSTRUCTIONS FOR EXPORTING AN FBX PROGRAM:

1. Select **FBX** from the **Settings** menu.



2. Select the File icon to choose the name and location for the exported file.

**! SAVING TO A USB:** For easier file transfer, plug in a USB flash drive to the case USB input, and select to save the file to the USB drive.

3. If desired, set your **Camera Position Offset** values (mm) using the X, Y, and Z coordinates.
4. If desired, change your depth of field by setting your **Manual focus distance** (mm), and **Current focal length** (mm). **Current aperture (F-stop) is not supported and will be grayed out.**

**! GRAYED OUT OPTIONS:** If these values have been adequately defined in the program (e.g. you have a channel for it, or you have at least the required 5 lens calibration points) these options will be deselected and grayed out here.

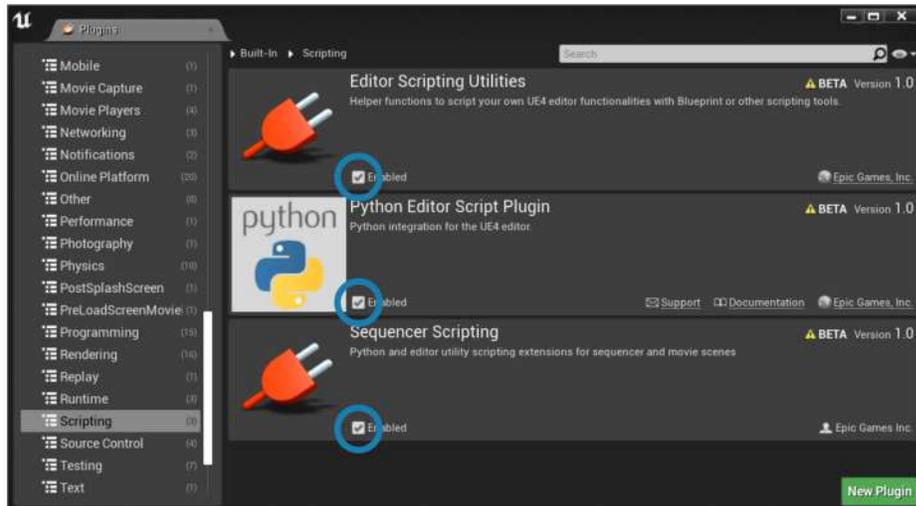
5. Select **Export** to save the file to the selected location.

**! ERRORS WHILE EXPORTING:** If you try to export a program with an error in it, you will receive both an **error warning** and a **failed compilation warning**.

(Continued on next page)

## INSTRUCTIONS FOR USING THE SCRIPT IN UNREAL ENGINE™:

1. In your project in Unreal Engine™, go to **Edit**, and then select **Plugins**.
2. In the Plugins window, navigate to **Built-In**, and select **Scripting**.
3. Enable all **scripting utilities** (Editor Scripting Utilities, Python Editor Script Plugin, and Sequencer Scripting).



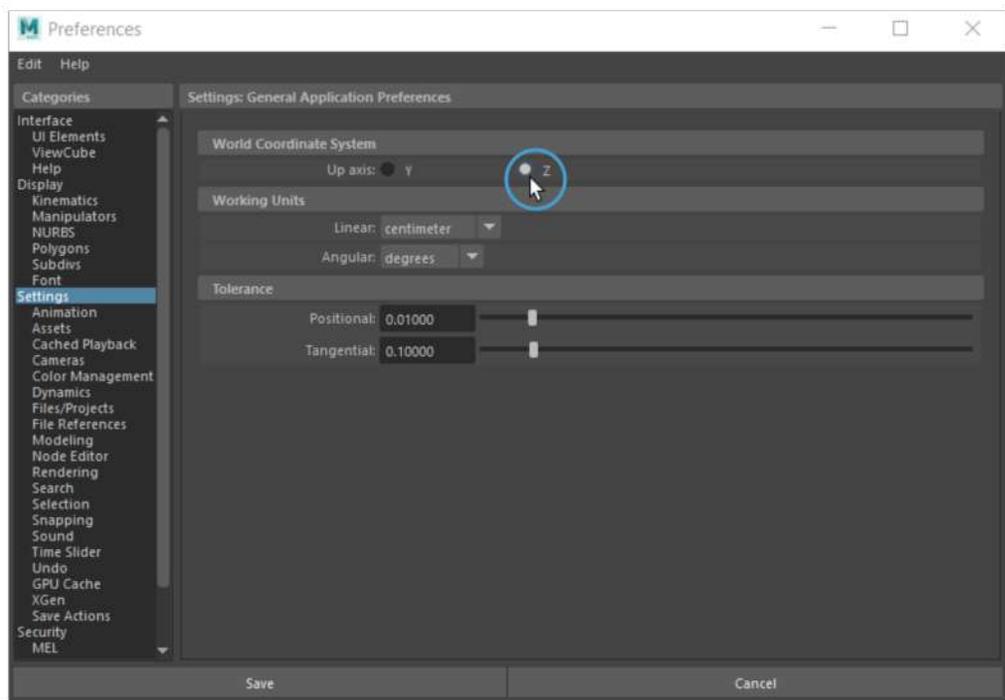
4. Restart Unreal Engine™ to apply the update.
5. In Unreal Engine™, select **File**, and select **Execute Python Script**.
6. Select the **.py** file that you exported from SISU Lab. This will start importing the CineCamera actor and the sequence. **Depending on the length of your program, it may take a minute to load the Cine Camera Actor and the Level Sequence.**
7. You should now see a **SISUCamera** in your world. In the **LevelSequences** in your project, you will now see a Level Sequence to animate the SISUCamera with your robot program. The Level Sequence will be named the same as the file you exported.

(Continued on next page)

## INSTRUCTIONS FOR IMPORTING FBX FILES INTO MAYA™:

**!** **MAYA™ VERSION TESTED:** Export out of SISU Lab and import into Maya™ was built and tested with Autodesk Maya™.

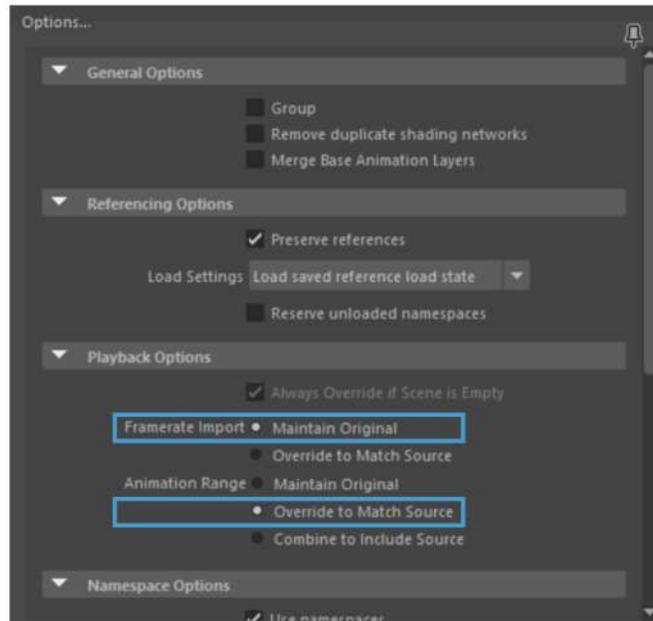
1. To prepare your scene and environment do the following:
  - a) Choose the **Z axis** as your **Up axis** by doing the following:
    - i. In your environment, go to Windows / Settings Preferences / Preferences / Settings.
    - ii. Select **Z** as your World Coordinate System.



- b) In your environment, go to **Windows / Settings Preferences / Preferences**.
  - c) Under **Settings**, set your World Coordinate System Up axis to **Z**.
  - d) Under **Time slider**, set the frame rate to **250fps** or a multiple.
  - e) Select **Real-time playback**.
2. Select **File / Import**.

(Continued on next page)

3. Select the FBX file exported from SISU Lab and uncheck **Always Override if Scene is Empty**.
4. Under **Playback Options**, select **Maintain Original** and **Override to Match Source**.

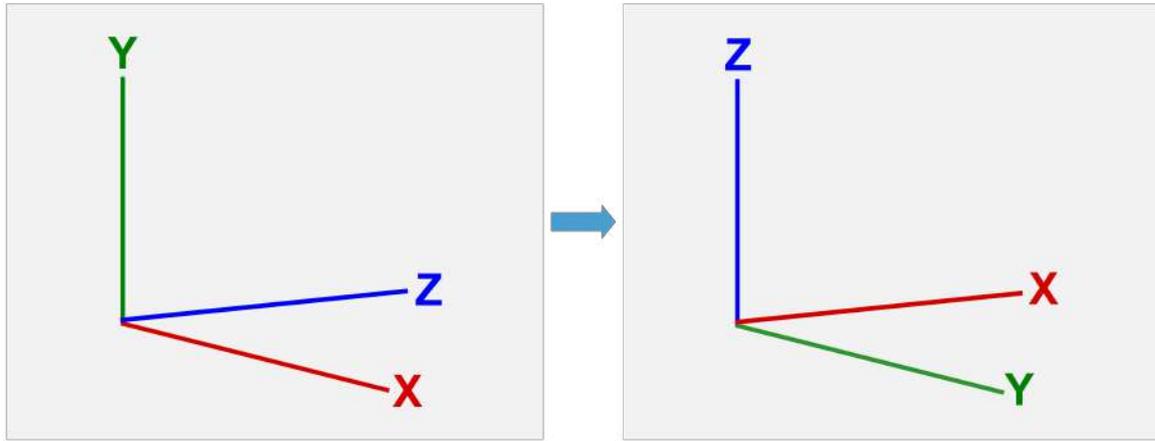


5. Select **Import**.

(Continued on next page)

## INSTRUCTIONS FOR IMPORTING FBX FILES INTO CINEMA 4D™:

1. Cinema 4D™ has **Y** as the **up** axis. Rotate the scene so that **Z** becomes the **up** axis.



 **CINEMA 4D™ COORDINATE SYSTEM:** Cinema 4D™ uses the left-handed coordinate system with the **Y** in the **up** direction as shown in the figure above.

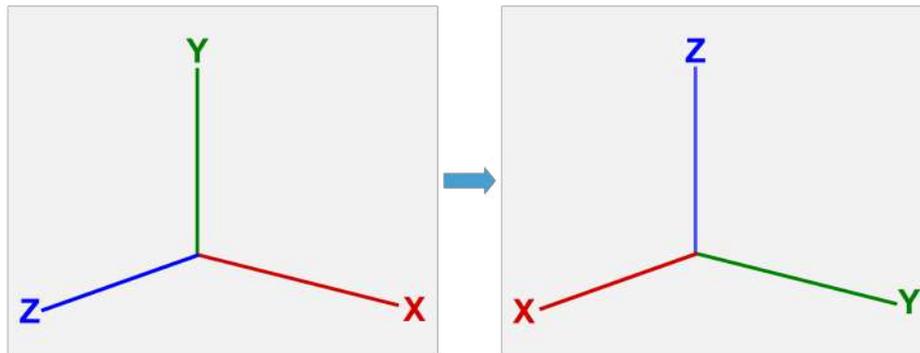
 **F-STOP AND FOCUS DISTANCE:** **F-stop** and **Focus distance** are not currently supported by FBX. However, after adding a null object you can set the **focus distance**.

2. Leave all settings at **Default** while importing. Ensure that **Default** is selected as **Up Axis**. Now, when the imported camera is set as the active camera, the scene will look similar to how it is seen in SISU Lab.
3. Import the FBX from SISU Lab by selecting **File / Merge** and then select the desired FBX file.

(Continued on next page)

## INSTRUCTIONS FOR IMPORTING FBX FILES INTO BLENDER™:

1. Blender™ has **Y** as the **up** axis. Rotate the scene so that **Z** becomes the **up** axis.



**!** **CINEMA 4D™ COORDINATE SYSTEM:** Blender™ uses the right-handed coordinate system with the **Y** in the **up** direction as shown in the figure above.

**!** **F-STOP AND FOCUS DISTANCE:** **F-stop** and **Focus distance** are not currently supported by FBX. However, after adding a null object you can set the **focus distance**.

2. Leave all settings at **Default** while importing. Ensure that **Default** is selected as **Up Axis**. Now, when the imported camera is set as the active camera, the scene will look similar to how it is seen in SISU Lab.
3. Import the FBX from SISU Lab by selecting **File / Import** and select the desired FBX file.



### SETTINGS

**DESCRIPTION:** Allows you to access the **Settings Page**.



**JUMP TO:** For a picture of the **Settings Page** options see section [2.3.4 Settings Page Settings Tree](#).



### ACTIVITY

**DESCRIPTION:** View recent system errors and notifications.

(Continued on next page)



## UPDATE

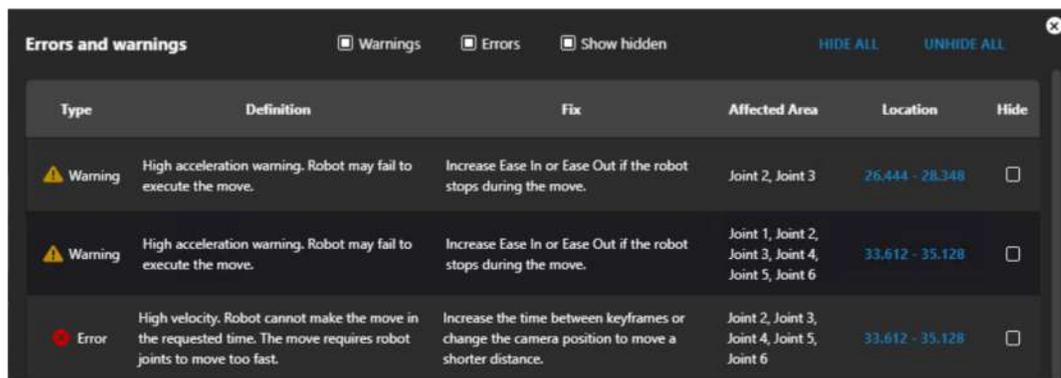
**DESCRIPTION:** Allows you to receive periodic SISU Lab software updates.

**INSTRUCTIONS:** Insert your USB stick and click on the **Update button**. The USB stick will be checked for current updates, and the installer will run if an update is detected.



## ERROR LOGS

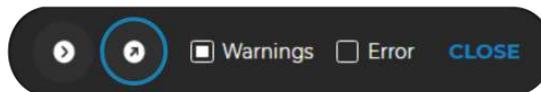
**DESCRIPTION:** Allows you to view all program compilation errors and warnings.



Type	Definition	Fix	Affected Area	Location	Hide
Warning	High acceleration warning. Robot may fail to execute the move.	Increase Ease In or Ease Out if the robot stops during the move.	Joint 2, Joint 3	26.444 - 28.348	<input type="checkbox"/>
Warning	High acceleration warning. Robot may fail to execute the move.	Increase Ease In or Ease Out if the robot stops during the move.	Joint 1, Joint 2, Joint 3, Joint 4, Joint 5, Joint 6	33.612 - 35.128	<input type="checkbox"/>
Error	High velocity. Robot cannot make the move in the requested time. The move requires robot joints to move too fast.	Increase the time between keyframes or change the camera position to move a shorter distance.	Joint 2, Joint 3, Joint 4, Joint 5, Joint 6	33.612 - 35.128	<input type="checkbox"/>

## INSTRUCTIONS - VIEWING ERROR LOG OPTIONS:

1. Select the **Expand button** in the bottom right corner of the screen, **OR**



2. Navigate to the **Main Menu**.
3. Select **Error Logs**.
4. You should now be able to view all compilation errors and warnings.
5. Select the listed **Location** next to an error or warning and you will be redirected to the area in the program where that error or warning occurs.



**JUMP TO:** For more information on how to view, show, and hide **compilation errors and warnings** see section [6.7 Compilation Errors and Warnings](#).

(Continued on next page)


**RESTART**

**DESCRIPTION:** Lets you safely restart the system from the tablet.


**SHUTDOWN**

**DESCRIPTION:** Lets you safely shut down the system from the tablet.

## 6.2.2 Current Position Tray

**CURRENT POSITION TRAY:** Allows you to toggle between viewing the **FIZ Motor Positions**, **Joint Positions**, and **Cartesian Positions**. The current position tray is located at the bottom of the screen.

Current Position Tray

<p style="color: #0070C0; font-weight: bold;">JOINT POSITIONS</p>	<div style="background-color: #333; color: white; padding: 5px; border-radius: 5px;"> <p>J1 21.7 deg    J2 -60.6 deg    J3 115.2 deg</p> <p>J4 -4.0 deg    J5 39.4 deg    J6 -44.6 deg</p> <p style="text-align: center;">...</p> </div>
<p style="color: #0070C0; font-weight: bold;">CARTESIAN POSITIONS</p>	<div style="background-color: #333; color: white; padding: 5px; border-radius: 5px;"> <p>X 1180.1 mm    Y -502.5 mm    Z 498.2 mm</p> <p>A -69.5 deg    B 4.5 deg    C 178.8 deg</p> <p style="text-align: center;">...</p> </div>
<p style="color: #0070C0; font-weight: bold;">FIZ MOTOR POSITIONS</p>	<div style="background-color: #333; color: white; padding: 5px; border-radius: 5px;"> <p>F 8.34 feet    I 3.18 T-Stop    Z 18.00 mm</p> <p style="text-align: center;">...</p> </div>



**RED AND YELLOW POSITIONS:** If you see a **yellow position** it is a **warning** that you are approached that joint's limits. If you see a **red position** it is an **error** showing you that the joint's limits have been reached.

J1 -180.0 deg    J2 -180.0 deg    J3 170.0 deg

J4 349.0 deg    J5 129.0 deg    J6 -345.0 deg

...

### 6.2.3 Go To Location Button



#### GO TO LOCATION

**DESCRIPTION:** Moves the robot to the position at the time that the cursor is located in the program.

**INSTRUCTIONS:**

1. Move your **Program Cursor** to the location that you want to move the robot to.
2. Select the **Go To Location button** on the bottom of the tablet screen.
3. When you select **Proceed** a robot alignment bar will pop up.

**! KEYFRAME BETWEEN 2 LINEAR CONTINUOUS MOVES:** If the location that you are trying to go to is between 2 linear continuous moves, when you click the **Go To Location** button you will see a pop-up asking you whether you want to go to the **compiled** or **saved** location. The saved location of the keyframe is the location of the actual keyframe that you saved previously. The compiled location of the keyframe is the location the robot will move to when the program is run; which, because it is a continuous linear move, will be slightly off from the actual keyframe.

### 6.2.4 Editor Settings



#### FRAME RATE

**DESCRIPTION:** Allows you to the set the frame rate of the timeline display.

**INSTRUCTIONS:**

1. Select the **Main Menu button** in the upper left corner of the tablet screen.
2. Select **Settings** from the main menu.
3. Select **Editor** from the settings menu.
4. Select the up or down arrows until you reach your desired frame rate, or tap and type in the desired frame rate with the keyboard and select **Enter**.



## ADD KEYFRAME AUTO-JUMP TIME

**DESCRIPTION:** Allows you to specify the amount of time that the **Program Cursor** will jump forward on the timeline when a new keyframe is added.

**USE CASE:** You could select **Add keyframe** 5 times in a row and the program will add 5 equally spaced out new keyframes.

### INSTRUCTIONS:

1. Select the **Main Menu button** in the upper left corner of the tablet screen.
2. Select **Settings** from the main menu.
3. Select **Editor** from the settings menu.
4. Select the up or down arrows until you reach the desired number of seconds you want to appear between new keyframes, or tap and enter the desired number using the keyboard and select **Enter**.

## 6.2.5 Slow Speed Option



## SLOW SPEED

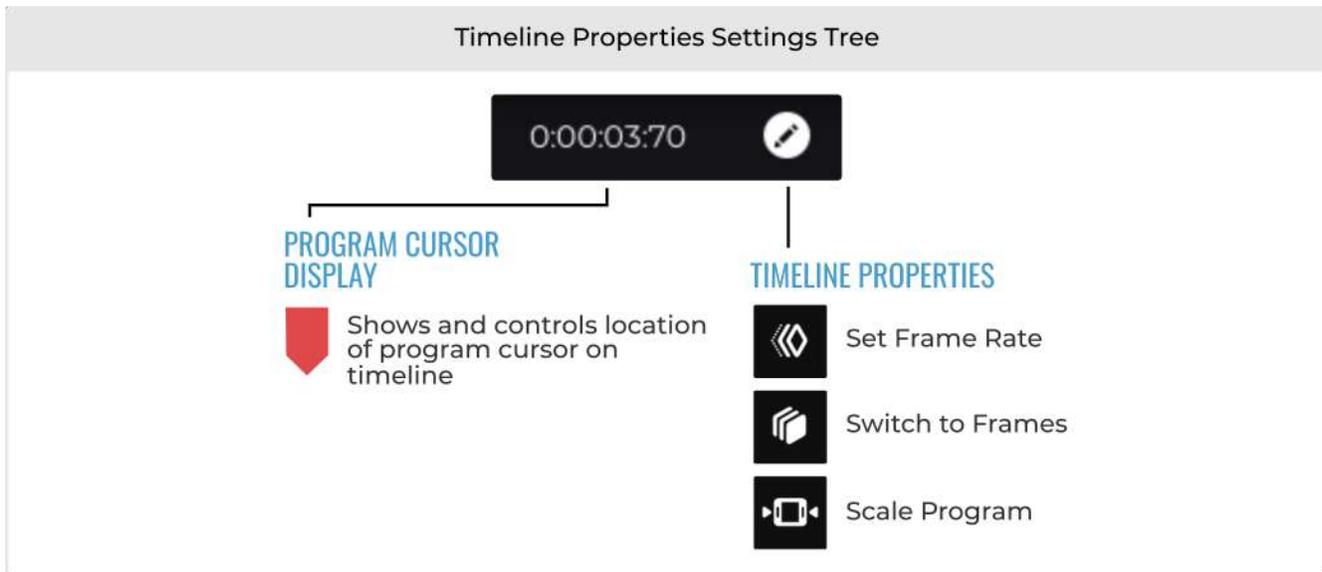
**DESCRIPTION:** Allows you to attribute different speeds to the following pieces of hardware: trigger, joystick, joints, FIZ.

### INSTRUCTIONS:

1. Select the **Main Menu button** in the upper left corner of the tablet screen.
2. Select **Settings** from the main menu.
3. Select **System** from the settings menu.
4. Select a piece of hardware (trigger, joystick, joints, or FIZ).
5. Move the **Slow Speed slider** until you reach the desired slow speed percentage.

## 6.3 Navigating the Program Timeline

### 6.3.1 Timeline Properties



0:00:03:70

#### PROGRAM CURSOR DISPLAY

**DESCRIPTION:** Shows and controls the location of the **Program Cursor** on the timeline.

#### INSTRUCTIONS:

1. Select the **displayed time**.
2. Enter in the time that you want to move the **Program Cursor** to on the timeline.
3. The **Program Cursor** will move to the time that you entered.



#### SET FRAME RATE

**DESCRIPTION:** Allows you to view and set the desired program frame rate.

#### INSTRUCTIONS:

1. Select the **Timeline Properties icon** (the pencil inside of a white circle).

(Continued on next page)

2. Select **Set Frame Rate**.
3. A box will pop up that will allow you to enter the number frames per second that is associated with your camera. Enter the desired number.
4. Select **Set** to finish, or select **Cancel** to return to the program.

 **JUMP TO:** You can also set the Frame Rate from **Settings Page/Editor Settings**. See section [6.2.4 Editor Settings](#).



## SWITCH TO FRAMES / SWITCH TO TIME

**DESCRIPTION:** Allows you to toggle between viewing the program timeline in terms of **Time** or **Frames**.



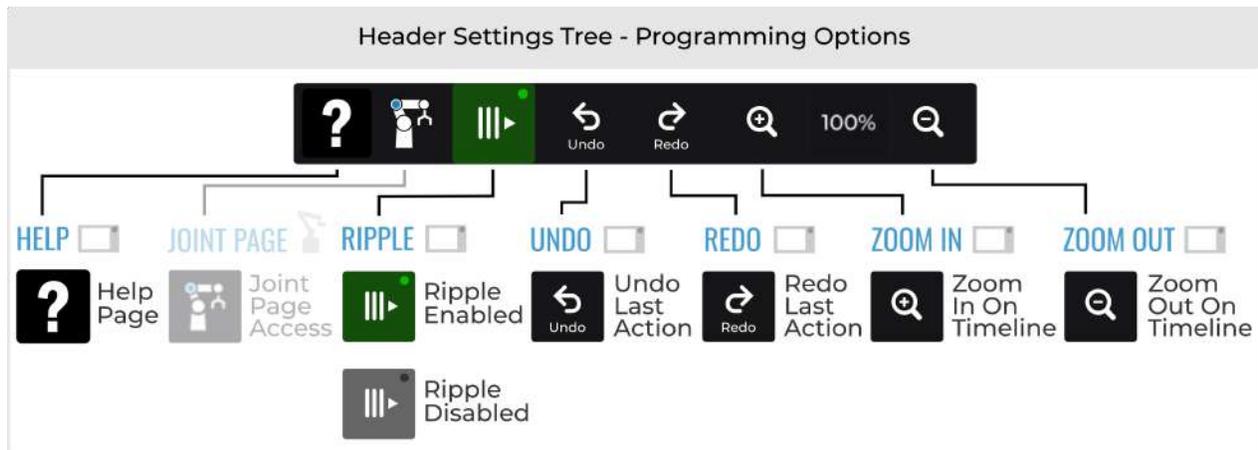
## SCALE PROGRAM

**DESCRIPTION:** Allows you to increase or decrease the program's duration. This will shorten or lengthen the time between each keyframe so that the last keyframe will occur at the time specified.

### INSTRUCTIONS:

1. Select the **Timeline Properties icon** (the pencil inside of a white circle).
2. Select **Scale Program**.
3. A box will pop up that will allow you to enter the number of seconds that you want the program screen to show at one time. Enter the desired number.
4. Select **Scale** to scale the program, or select **Cancel** to return to the program.

## 6.3.2 Header Programming Options



 **JUMP TO:** For information on grayed out header settings related to running the robot (not programming) see section [5.5 Moving Robot with Joint Mode](#).

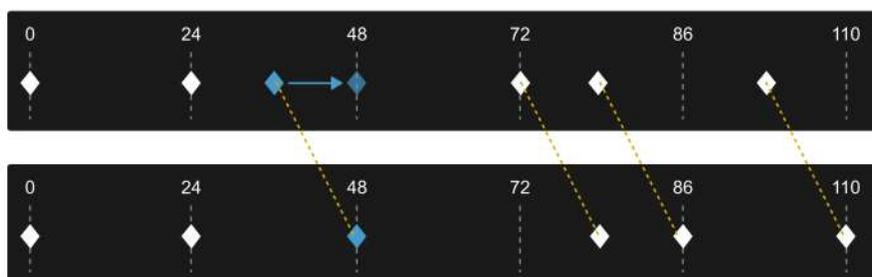
### HELP

**DESCRIPTION:** Provides access to helpful information about features on the SISU Lab app.

### RIPPLE ENABLED

**DESCRIPTION:** When you move a keyframe in time all the keyframes after it will also be shifted, keeping their time relative to each other.

If we move the 3rd keyframe forward 12 seconds with RIPPLE ENABLED all following keyframes will ALSO move forward 12 seconds



(Continued on next page)

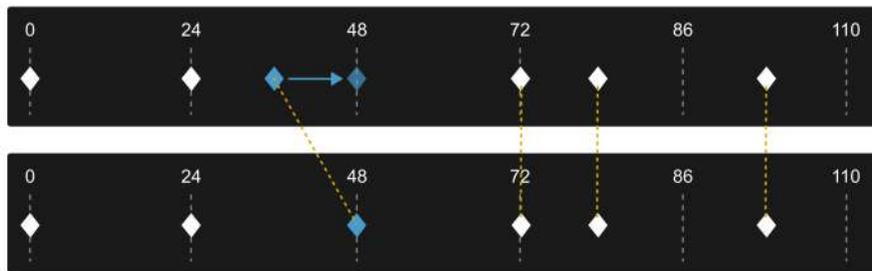
**USE CASE:** You will want to enable **Ripple** when you have a keyframe that needs to be edited to have an increased or decreased duration, but you don't want to modify the relative duration on the keyframe after it.



## RIPPLE DISABLED

**DESCRIPTION:** When you move a keyframe in time all the keyframes after it will stay where they are in time.

If we move the 3rd keyframe forward 12 seconds with RIPPLE DISABLED all following keyframes will stay where they are on the timeline



**USE CASE:** You will want to disable **Ripple** when you want to re-arrange the keyframe order.



## UNDO

**DESCRIPTION:** Allows you to undo the last action(s) that you made in the SISU Lab program.



## REDO

**DESCRIPTION:** Allows you to redo the last action(s) that you undid in the SISU Lab program.

(Continued on next page)



## ZOOM IN

**DESCRIPTION:** Allows you to zoom in on the visible program timeline. The zoom percent will be shown between the zoom in and zoom out buttons.



**HIGHEST AVAILABLE ZOOM:** The highest zoom amount allowed is 500%, but that percentage may be lower if you have a long program.



**PINCH ZOOM OPTION:** You can also pinch zoom in and out which will compress or expand the timeline along the time axis.



## ZOOM OUT

**DESCRIPTION:** Allows you to zoom out of the visible program timeline. The zoom percent will be shown between the zoom in and zoom out buttons.



**LOWEST AVAILABLE ZOOM:** The lowest zoom amount allowed is 25%.



**PINCH ZOOM OPTION:** You can also pinch zoom in and out which will compress or expand the timeline along the time axis.

### 6.3.3 Timeline Navigation Options



1. **LEFT CURSOR JUMP:** If you select the **Left Cursor Jump button** your cursor will jump to the first keyframe in your program.

**! LEFT CURSOR JUMP DISABLED:** This option will be disabled if you are at time 0 in the program.

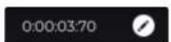
2. **RIGHT CURSOR JUMP:** If you select the **Right Cursor Jump button** your cursor will jump to the last keyframe in your program.

**! RIGHT CURSOR JUMP DISABLED:** This option will be disabled if you are at the end of your program.

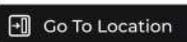
3. **VERTICAL SCROLL:** Allows you to scroll through all of the added and visible **channels** in the timeline.
4. **HORIZONTAL SCROLL:** Allows you to scroll through the **time** on the timeline.

## 6.3.4 Program Cursor and Robot Cursor

### Ways to Move the Program Cursor

Ways to Move the Program Cursor 		
LEFT CURSOR JUMP BUTTON:		Will cause your Program Cursor to jump to the <b>first keyframe</b> in your program
RIGHT CURSOR JUMP BUTTON:		Will cause your Program Cursor to jump to the <b>last keyframe</b> in your program
MANUALLY DRAG WITH FINGER:		Can manually drag the Program Cursor to a new location in the program with your <b>finger</b>
PROGRAM CURSOR DISPLAY:		The Program Cursor will jump to whatever time you enter into the <b>program cursor display</b>
CLICK ON ROBOT CURSOR:		Clicking on the <b>Robot Cursor</b> will cause the Program Cursor to move and align with the Robot Cursor
CLICK ON KEYFRAME:		Clicking on the <b>keyframe</b> will cause the Program Cursor to jump to that keyframe

### Robot Cursor

Robot Cursor		
GRAY ROBOT CURSOR:		 Shows the current location of the robot while you are <b>creating a program</b>  Will cause your Robot Cursor and robot to move to the current location of the Program Cursor
GREEN ROBOT CURSOR:		Shows the location of the robot in the program timeline when you are <b>actively running</b> a program
YELLOW ROBOT CURSOR:		Shows the location of the robot in the program timeline when you have <b>paused</b> a running program
RED ROBOT CURSOR:		Shows the location of the robot in the program timeline when the robot is at the <b>same position as the cursor</b> in the editor view

## 6.4 Available Channels Where You Can Create Keyframes

Available Channels			
CHANNEL	ICON	DESCRIPTION	AVAILABLE MOVE TYPES
CAMERA CHANNEL:		<p>The <b>Camera Channel</b> is how you document and string together a series of robot arm positions by creating saved keyframes</p> <p><b>ADDING KEYFRAMES to the CAMERA CHANNEL</b></p> <p>Whenever you add a keyframe to the Camera Channel a duplicate keyframe will automatically be added to the target channel. This is necessary for keeping the intended object in focus</p>	Joint Linear Path
TARGET CHANNEL:		<p>The <b>Target Channel</b> uses a combination of the focus motor and the lens calibration settings to guarantee that the camera is always focused on your target by creating saved keyframes</p> <p><b>ADDING KEYFRAMES to the TARGET CHANNEL</b></p> <p>A keyframe will be added to the Target Channel every time one is added to the camera channel. However, you CAN add more Target Channel keyframes than there are Camera Channel keyframes. This can be done if you need to fine-tune your target position in the middle of a robot movement</p> <p>You can either have a Target Channel OR a Focus Channel, <b>but not both</b>. Use Target if you want total control over target tracking, use Focus if you want total control over the focus</p>	Linear Path
FOCUS CHANNEL:		<p>The <b>Focus Channel</b> is how you directly control the focus motor that is attached to the camera (using only the tablet) by creating saved keyframes</p> <p>You can either have a Target Channel OR a Focus Channel, but not both. Use Target if you want total control over target tracking, use Focus if you want total control over the focus</p>	Joint
IRIS CHANNEL:		<p>The <b>Iris Channel</b> is how you directly control the iris motor that is attached to the camera (using only the tablet) by creating saved keyframes</p>	Joint
ZOOM CHANNEL:		<p>The <b>Zoom Channel</b> is how you directly control the zoom motor that is attached to the camera (using only the tablet) by creating saved keyframes</p>	Joint
TRIGGER CHANNEL:		<p>The <b>Trigger Channel</b> is used to send a digital signal to user specified devices. Examples include: trigger dropper, bloop light, launcher, etc.</p>	N/A

 **JUMP TO:** For more information on how to add and edit your channels, see section [6.6.1 How to Add a Channel](#) and [6.6.2 How to Add a Channel, How to Edit a Channel](#).

## 6.5 Creating and Editing Keyframes

Keyframes appear as diamonds in each channel.



Keyframe States		
WHITE KEYFRAME:		If a keyframe is <b>white</b> it is synced to the corresponding Camera Channel keyframe. Also, all Camera Channel keyframes will be white.
BLACK KEYFRAME:		If a keyframe is <b>black</b> it is <b>not</b> synced to the corresponding Camera Channel keyframe.
BLUE KEYFRAME:		<b>Blue</b> is the color of keyframes that have been highlighted or selected in all program channels
PURPLE KEYFRAME:		<b>Purple</b> is the color of keyframes that have Continuous velocity turned ON
YELLOW KEYFRAME:		<b>Yellow</b> is the color of keyframes that have a compilation warning
RED KEYFRAME:		<b>Red</b> is the color of keyframes that have a compilation error
BLUE DOT INSIDE KEYFRAME:		If a keyframe contains a <b>blue dot</b> inside of it, that keyframe has a <b>Full Stop</b> associated with it.
NUMBER on KEYFRAME:		A <b>number</b> on a keyframe signifies the order in which that keyframe was created. <b>This number will not change even if you move the keyframe to a different location in the program.</b> These numbers are meant to assist you in associating keyframes with their locations on your set.

Options for Adding Keyframes		
TABLET BUTTON:		Click on the <b>Add Keyframe button</b> on the bottom right side of the screen to add a keyframe at the location of the Program Cursor
LEFT WAND BUTTON:		Click on the <b>Left Wand button</b> to add a keyframe at the location of the Program Cursor
ADD KEYFRAME AUTO-JUMP TIME:		Editor setting that lets you specify the amount of time that the Program Cursor will jump on the timeline each time a keyframe is added. To access, go to <b>Main Menu/Settings/Editor</b> .

## 6.5.1 Creating Keyframes and Choosing Move Types

### Creating Keyframes in Channels



**KEYFRAMES AT TIME 0:** All active channels need to have a keyframe at time 0.



#### ADD KEYFRAME - TABLET

##### INSTRUCTIONS:

1. Move the robot or motor into the desired position.
2. On the far left side of the tablet screen, select all of the **Channel icons** that you want to add the keyframe to (selected Channel icons will appear blue; deselected Channel icons will appear black).
3. Select the **Add Keyframe button** on the bottom right side of the screen. A keyframe will be added to all of the channels that you selected in step 2.



#### ADD KEYFRAME - WAND

##### INSTRUCTIONS:

1. Move the robot or motor into the desired position.
2. On the far left side of the tablet screen, select all of the **Channel icons** that you want to add the keyframe to (selected Channel icons will appear blue; deselected Channel icons will appear black).
3. Click on the **Left Wand button**. A keyframe will be added to all of the channels that you selected in step 2.

(Continued on next page)

## Creating a Series of Equally Spaced Out Keyframes

### ADD KEYFRAME AUTO-JUMP TIME

**DESCRIPTION:** Allows you to specify the amount of time that the Program Cursor will jump on the timeline when a new keyframe is added.

**USE CASE:** For example, you could click **Add Keyframe** 5 times in a row and the program will add 5 keyframes with the same amount of time between them.

#### INSTRUCTIONS:

1. Go to **Settings/Editor**.
2. Click on the up or down arrows next to the **Add Keyframe Auto-Jump Time box** until you reach the desired number of seconds you want to appear between new keyframes.
3. On the far left side of the tablet screen, select all of the **Channel icons** that you want to add the keyframe(s) to (selected Channel icons will appear blue; deselected Channel icons will appear black).
4. Move your Program Cursor to the desired location in the program, and click the **Add Keyframe button**, or click on the **Left Wand button**. A keyframe will be added to all of the channels that you selected in step 3. Add as many keyframes as desired, and they will all appear with the same amount of time between them.

 **JUMP TO:** For more information on **Add Keyframe Auto-Jump Time** see section [6.2.4 Editor Settings](#).

## Choosing Moves for Camera Channel Keyframes

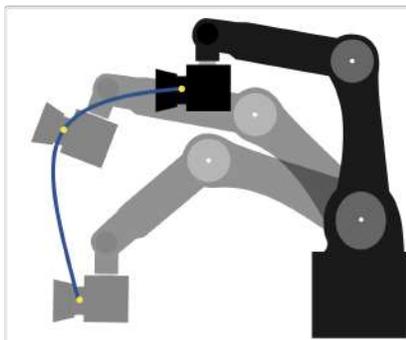
Joint

### CAMERA CHANNEL - CHOOSE MOVE TYPE

**DESCRIPTION:** Allows you to choose whether to make the move LEADING UP to the Camera Channel keyframe a **Joint**, **Linear**, or **Path** move.

#### INSTRUCTIONS:

1. Click on the **move name** that appears JUST AHEAD of the keyframe.
2. Choose from the list of move types: **Path**, **Linear**, or **Joint**.



#### PATH MOVE

Will pass through each point exactly, but the path in between points is undetermined

**This move CANNOT be used to safely traverse through singularities**



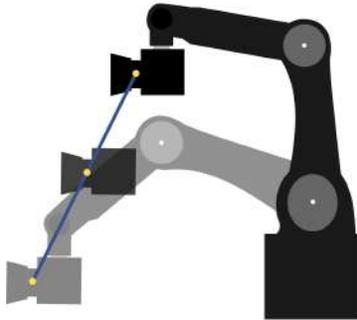
**180 DEGREE TURNS:** If you try to make a 180 degree turn in a **Path move** (e.g. going from location A, to location B, and back to location A) you will encounter a 180 degree turn error. There are several ways to get around this error.

- **First**, do **NOT** copy and paste the location you want to go back to. Instead, manually move the robot where you want it to go and save it as a new keyframe.
- **Second**, you can change one of the moves going into or out of location B to be a Linear move instead of a Path move.
- **Third**, you can change the move where the 180 degree turn is happening (location B in our example) to contain a **Full Stop** and **Finish Path**.
- **Fourth**, you can add an extra keyframe in your path block near position B. This gives the path the opportunity to curve around instead of doing a 180 degree turn.



**JUMP TO:** For more information on singularities see section [5.2.1 Singularities - Robot Positions to Avoid](#).

(Continued on next page)

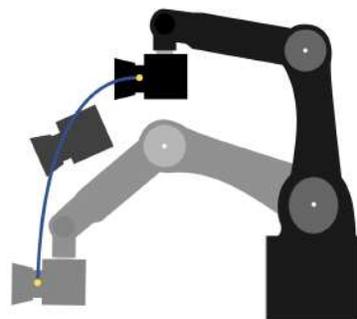


### LINEAR MOVE

The selected center moves in a straight line from the first point to the second point

**You CANNOT do two linear moves in a row unless there is a full stop between them**

**This move CANNOT be used to safely traverse through singularities**



### JOINT MOVE

Will exactly pass through the first and second points, but the path in between is not controlled

This is the easiest move for the robot to compute, and is the fastest possible move.

**This move CAN be used to safely traverse through singularities**



**JOINT MOVES IGNORE THE TARGET:** A **Joint move** on the camera will ignore and disable the target path, and will take the robot to the keyframe in the shortest possible path. If you make a move in the **Camera channel** a **Joint move**, the target (or your object of focus) will be focused on at the beginning and end of the Joint move, but will NOT be focused on during the move itself. Likewise, if you add any extra keyframes in the **Target channel** during a camera **Joint move** those Target channel keyframes will be grayed out and ignored.

## Choosing Moves for Target Channel Keyframes

Linear

### TARGET CHANNEL - CHOOSE MOVE TYPE

**CHOOSE MOVE TYPE:** Allows you to choose whether to make the move LEADING UP to the **Target channel** keyframe a Linear or Path move.

#### INSTRUCTIONS:

1. Click on the **move name** that appears JUST AHEAD of the keyframe.

(Continued on next page)

2. Choose from the list of move types: **Linear or Path**.

### LINEAR MOVE

A **Linear move** in the Target Channel will allow the directional focus of your camera to follow a straight line from the first point to the second point. If you want to use a Linear move's speed, but alter the camera's focus during the move, you can add extra keyframes in the Target Channel

This move has speed limitations that might need to be considered

### PATH MOVE

A **Path move** in the Target Channel will allow you to easily keep your camera's focus on contoured objects.



**180 DEGREE TURNS:** If you try to make a 180 degree turn in a **Path move** (e.g. going from location A, to location B, and back to location A) you will encounter a 180 degree turn error. There are several ways to get around this error.

- **First**, do **NOT** copy and paste the location you want to go back to. Instead, manually move the robot where you want it to go and save it as a new keyframe.
- **Second**, you can change one of the moves going into or out of location B to be a Linear move instead of a Path move.
- **Third**, you can change the move where the 180 degree turn is happening (location B in our example) to contain a **Full Stop** and **Finish Path**.
- **Fourth**, you can add an extra keyframe in your path block near position B. This gives the path the opportunity to curve around instead of doing a 180 degree turn.



**ADJUSTING PATH MOVE CURVES:** When **Path moves** are made **Continuous** (e.g. they're all part of the same curve), adjusting any one of those points can change how the entire curve looks. If you are trying to adjust points at the beginning of the curve, but don't want it to affect the points at the end of the curve, try making one of those beginning points a **Finish Path**.



**JUMP TO:** See figure 6.5.1 on the following pages for illustrated examples of Linear and Path moves in the Target and Robot channels.

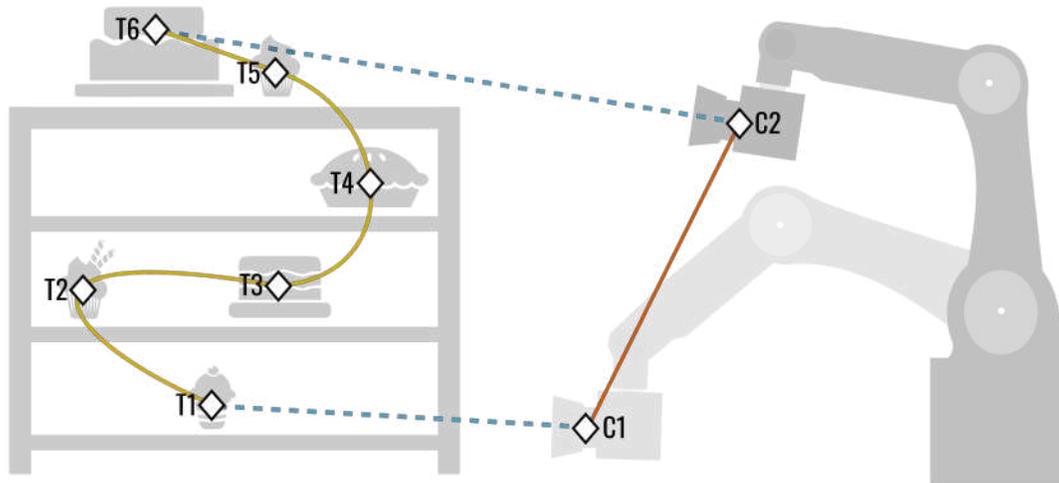
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Target and Camera Channel Keyframes

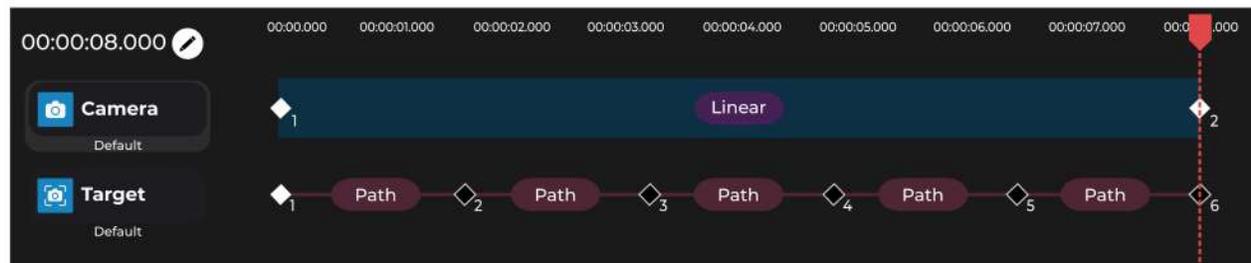
SCENARIO 1 of 3

— CAMERA channel = LINEAR move  
 — TARGET channel = PATH move

- - - = Keyframes occurring at the same time on the program timeline



What your PROGRAM will look like:



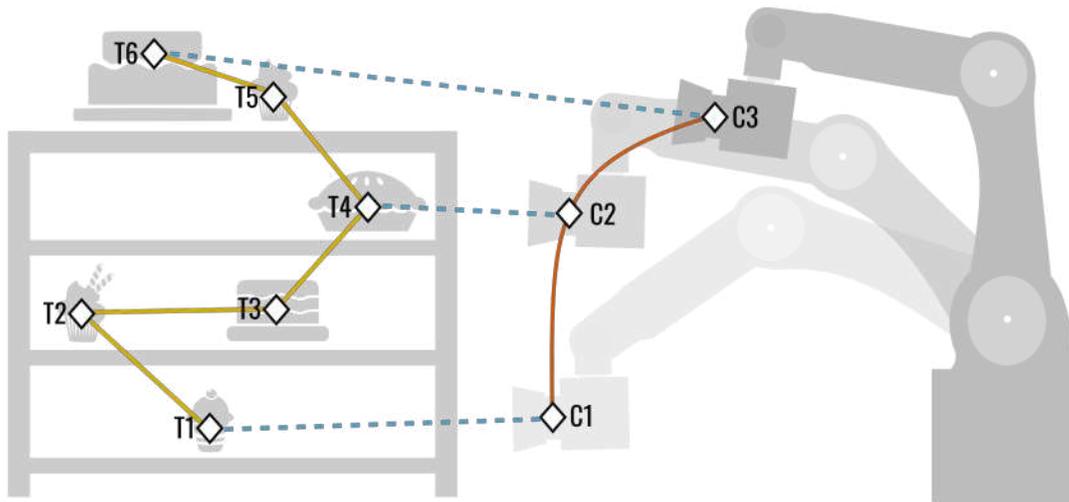
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Target and Camera Channel Keyframes

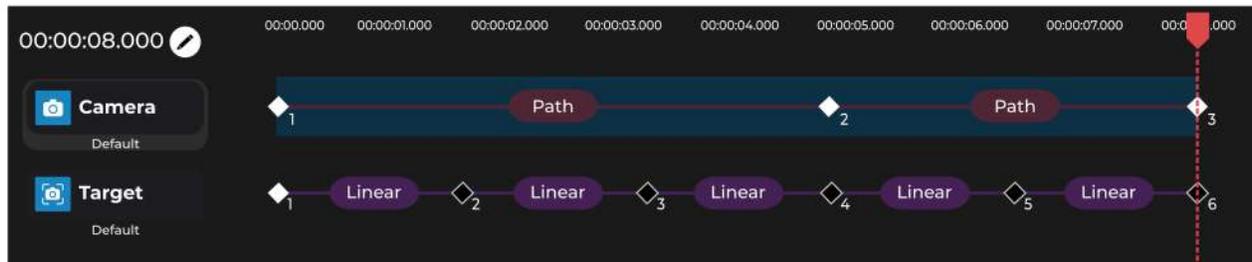
SCENARIO 2 of 3

- CAMERA channel = PATH moves
- TARGET channel = LINEAR moves

--- = Keyframes occurring at the same time on the program timeline



What your PROGRAM will look like:

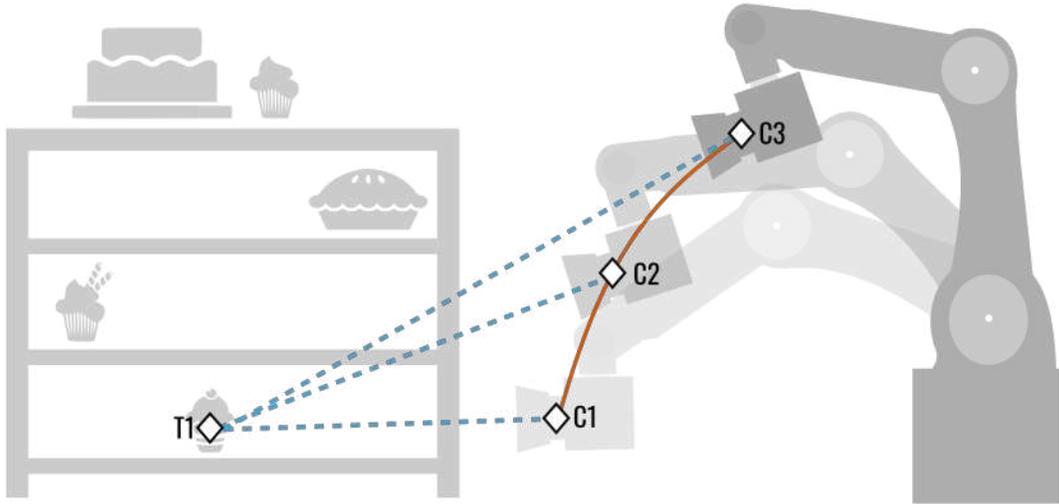


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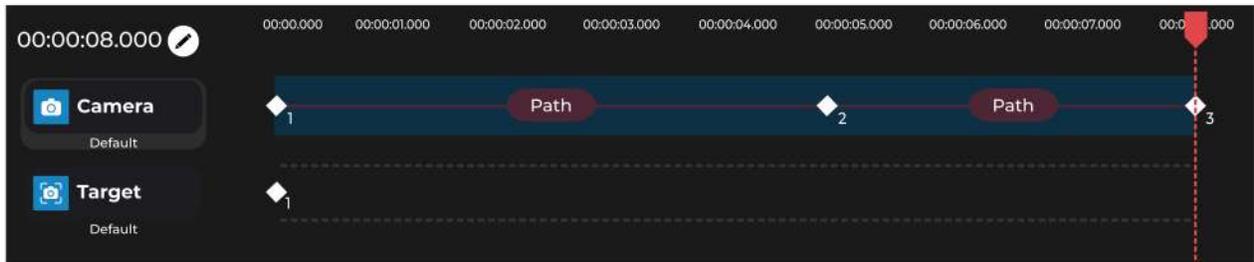
Target and Camera Channel Keyframes

**SCENARIO 3 of 3**

— CAMERA channel = PATH moves      - - - - = Keyframes occurring at the same time on the program timeline



**What your PROGRAM will look like:**



## Moves for Focus, Iris and Zoom Channel Keyframes

Moves for the **Focus, Iris, and Zoom** channel keyframes will always move at a constant linear rate.

## 6.5.2 Editing Keyframes

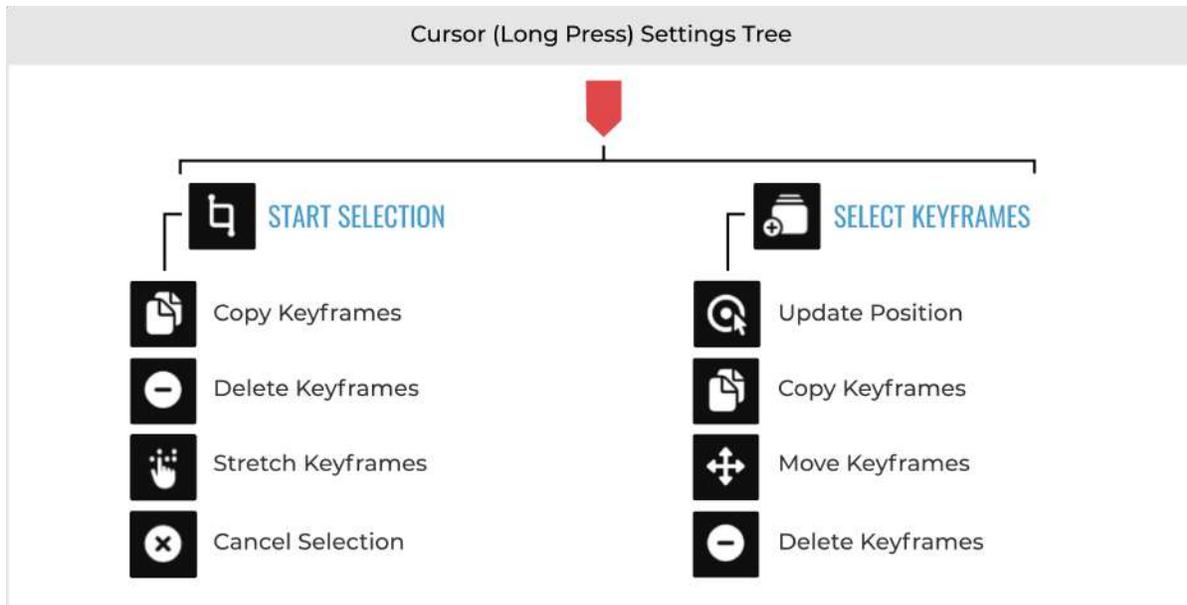
### Different Ways to Select Keyframes

Different Ways to Select Keyframes		
LONG PRESS ON CHANNEL ICON:	    	 Select all keyframes in that channel  Deselect all keyframes in that channel  Delete all selected keyframes in that channel
LONG PRESS ON CURSOR:		 Start selection  Copy selected keyframes  Delete selected keyframes  Stretch Keyframes  Cancel Selection  Select keyframes  Update position of the selected keyframes  Copy selected keyframes  Move selected keyframes to a different location  Delete selected keyframes
SHORT PRESS ON KEYFRAME:		Will cause the <b>Program Cursor</b> to align with the keyframe that you clicked on Will give you access to settings options for the selected keyframe settings (options can differ between keyframes in different channels)

 **JUMP TO:** Read the sections below for more information on what happens when you select keyframes: [Selecting Groups of Keyframes](#); [Selecting or Deleting All Keyframes in a Channel](#); [Settings Options For Camera Channel Keyframes](#); [Settings Options for Target Channel Keyframes](#); [Settings Options for Focus, Iris and Zoom Channel Keyframes](#); and [Settings Options for Trigger Channel Keyframes](#).

## Selecting Groups of Keyframes

If you long press (i.e. hold down) on the **Program Cursor** you will have access to the following options: **Start Selection** ( 6.5.2 ) and **Select Keyframes** ( 6.5.2 )



### START SELECTION

**DESCRIPTION:** If you click on **Start Selection** you will be able to expand the highlighted selection to include keyframes at different times on the program timeline. Your available menu options will be: **Copy Keyframes**, **Delete Keyframes**, **Stretch Keyframes**, and **Cancel Selection**.

**! DIRECTION YOU CAN HIGHLIGHT:** You will only be able to expand your selection to include keyframes that occur **AFTER** the keyframes you initially selected. You will **NOT** be able to include keyframes that occur **BEFORE** the keyframes you initially selected.

**! WILL ONLY INCLUDE KEYFRAMES IN SELECTED CHANNELS:** If you select a group of keyframes in different channels to edit, only the ones in **SELECTED** channels will be edited.

(Continued on next page)



## COPY KEYFRAMES

**DESCRIPTION:** Allows you to select and highlight a group of keyframes to copy and then paste in another timeline location.

### INSTRUCTIONS:

1. Long press on the **Program Cursor** until the desired keyframes are highlighted.
2. Select **Copy Keyframes**.
3. Move the **Program Cursor** to a new location and long press on the **Program Cursor**.
4. Select **Paste**.
5. A dialog box will appear. If you want to update the keyframe location select **Proceed**. If you do not want to update the position select **Cancel**.



**COPYING KEYFRAMES WITH EASE IN / EASE OUT:** If you copy any keyframes with Ease In or Ease Out values, those values will default to 25% when you paste them.



## DELETE KEYFRAMES

**DESCRIPTION:** Allows you to delete a selection of keyframes in the timeline.



## STRETCH KEYFRAMES

**DESCRIPTION:** Allows you to move the selected keyframes further down the timeline (thereby stretching the amount of time that occurs before the moved keyframes).

### INSTRUCTIONS:

1. Long press on the **Program Cursor** until the desired keyframes are highlighted.
2. Click on **Start Selection**.
3. Move the **Arrows** to highlight all desired keyframes that you want to move.

(Continued on next page)

4. Click on the **Arrows** and a menu will appear.
5. Select **Stretch Keyframes**.
6. Select the **Arrow button** and move the selection forwards or backwards.
7. Select the green **Done button** in the bottom right corner of the screen.



## CANCEL SELECTION

**DESCRIPTION:** Allows you to cancel your current selection.



## SELECT KEYFRAMES

**DESCRIPTION:** If you click on **Select Keyframes**, all keyframes DIRECTLY UNDERNEATH the Program Cursor (that are at the same time location on the timeline) will be selected. You will then have the following options:



## UPDATE POSITION

**UPDATE POSITION:** Allows you to change the previously saved position for the keyframe.

### INSTRUCTIONS:

1. Long press on the **Program Cursor** until the desired keyframe is highlighted.
2. Move your **robot and camera** to the desired new position.



**SYNC TARGET TO CAMERA:** If the Target keyframe is NOT synced to the camera then it will NOT get the updated position.

3. Select **Update Position**.

(Continued on next page)



## COPY KEYFRAMES

**DESCRIPTION:** Allows you to select and highlight a group of keyframes to copy and then paste in another timeline location.

### INSTRUCTIONS:

1. Long press on the **Program Cursor** until the desired keyframes are highlighted.
2. Select **Copy Keyframes**.
3. Move the **Program Cursor** to a new location and long press on the **Program Cursor**.
4. Select **Paste**.
5. A dialog box will appear. If you want to update the keyframe location select **Proceed**. If you do not want to update the position select **Cancel**.



**COPYING KEYFRAMES WITH EASE IN / EASE OUT:** If you copy any keyframes with Ease In or Ease Out values, those values will default to 25% when you paste them.



## MOVE KEYFRAMES

**DESCRIPTION:** Allows you to move the selected keyframes to a different location in the timeline.

### INSTRUCTIONS:

1. Long press on the **Program Cursor** until the desired keyframes are highlighted.
2. Select **Move Keyframes**.
3. Using the **Program Cursor**, move the keyframes to the desired location in the timeline.



## DELETE KEYFRAMES

**DESCRIPTION:** Allows you to delete a selection of keyframes in the timeline.

## Selecting or Deleting All Keyframes in a Channel

The **Channels** are located on the left side of the program timeline.



If you long press (i.e. hold down) on the **Channel icon** you will have access to the following options:



SELECT ALL

**DESCRIPTION:** Allows you to select all of the keyframes in that channel.

---



DESELECT ALL

**DESCRIPTION:** Allows you to deselect all of the keyframes in that channel.

---



DELETE

**DESCRIPTION:** Allows you to delete all selected keyframes in that channel.

## Settings Options For Camera Channel Keyframes

Each keyframe is represented by a diamond shaped point on the program timeline.



If you short press (i.e. click) on a keyframe in the **Camera channel** you will have access to the following settings for that keyframe:



### KEYFRAME TIME / DURATION

**DESCRIPTION:** Allows you to toggle between/edit **Keyframe Time** or **Duration** between keyframes.



### EASE IN

**DESCRIPTION:** Allows you to set how long you want the robot to take to get up to full speed for the move. Longer easing will result in smoother robot motion.

**INSTRUCTIONS:** Move the square on the **slider** until it reads your desired Ease In amount.



**DISABLED ON FIRST KEYFRAME:** The Ease In and Ease Out functions on the VERY FIRST keyframe in the program will be disabled.



### EASE OUT

**DESCRIPTION:** Allows you to set how long you want the robot to take to slow down from full speed into the keyframe. Longer easing will result in smoother robot motion.

**INSTRUCTIONS:** Move the square on the **slider** until it reads your desired Ease Out amount.



**DISABLED ON FIRST KEYFRAME:** The Ease In and Ease Out functions on the VERY FIRST keyframe in the program will be disabled.

(Continued on next page)



## FULL STOP

**DESCRIPTION:** Allows the camera to stop and hold position for a certain period of time (the **Hold Time**) before accelerating. While stopped, the camera can still rotate slightly to keep focus on the intended target. A keyframe WITH a **Full Stop** will have a blue dot in the middle.

### INSTRUCTIONS:

1. Click on the **Full Stop button** until it turns green. This means Full Stop is **ON** for the keyframe.



**MOVING PARTS DURING FULL STOP:** Even though the camera will not move to a new location during a Camera channel Full Stop, the camera or focus motor can still rotate slightly to keep focused on the target, and the robot arm can still move around the camera.

2. Enter the desired number of seconds in the **Hold Time box**, or use the adjacent up and down arrows. The duration that you select will appear in the program timeline denoted by a pause button.



**ADDING KEYFRAMES DURING HOLD TIMES:** You CANNOT add a keyframe to a channel if it is in the middle of a Hold Time.



**HOLD TIME AVAILABILITY:** Hold Time will only become available if you turn Full Stop ON for the selected keyframe.



**HOLD TIME LIMIT:** The Hold Time cannot extend past the next keyframe.

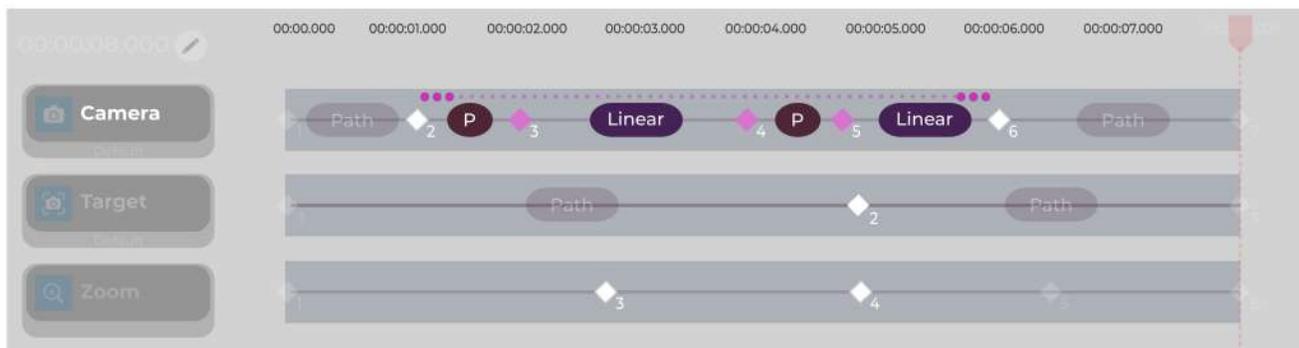
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**NORMALIZE SPEED**

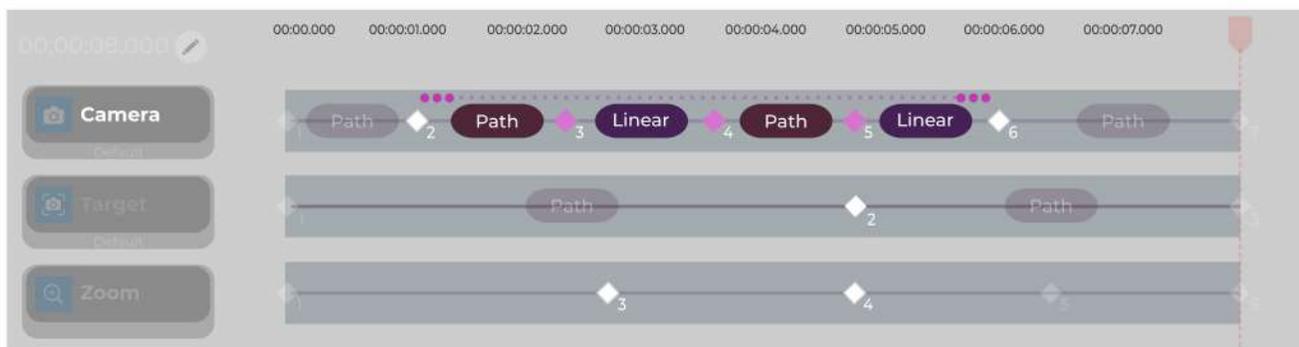
**DESCRIPTION:** Allows you to create a scenario where the robot moves at a constant speed through a group of keyframes in either the **target** OR **camera** channel.

**!** **NORMALIZE SPEED:** Normalize speed is ideal for single target program (such as orbits) or multi-target object moves. You may see some “bumps” if you have one target, but you can get around this by setting many target points.

**EXAMPLE:** Turn **Normalize speed** ON for keyframes 3, 4, & 5 in the **Camera** channel.



After compiling the program, keyframes 3, 4, & 5 in the **Camera** channel will be moved so that the speed is continuous between moves 2 - 6.



**NOTE:** If there are keyframes happening in other channels at the same time as any of your **Normalize speed** keyframes, those keyframes in other channels will also be moved to maintain timing relative to the **Target channel** keyframes (or **Camera channel**, if that's where your normalize speed keyframes are). This may require you to go back and tweak some of your keyframes. (See images above.)

(Continued on next page)

**USE CASE:** If you are running a program and notice that - in a particular section of the program - the robot is speeding up and slowing down more than you want, you can turn **Normalize speed** ON for those keyframes to keep the robot moving at a constant speed.

#### INSTRUCTIONS:

1. Turn ON the **Normalize speed** setting for all desired individual keyframes.
2. Compile your program. Your **Normalize speed** keyframes should now be moved so that the velocity is continuous between the chosen moves.

 **KEYFRAMES IN OTHER CHANNELS MAY MOVE:** Other channel keyframes happening **at the same time** as the normalize speed keyframes will move to try to maintain the previous path and timing. You may need to go back and modify the timing of those keyframes on other channels.

3. Now that those keyframes have been redistributed evenly, you can turn **Normalize speed** OFF for those keyframes, or leave it on.

 **NORMALIZE SPEED and FULL STOP / SYNC:** If **Normalize speed** is turned ON for a keyframe, that keyframe can NOT have a **Full stop** or be synced to another keyframe.

 **TARGET vs. CAMERA CHANNEL:** You can ONLY choose to use the **Normalize speed** feature in either the Target channel OR the camera channel; you cannot use the feature in both channels in the same program.



#### SYNC ROLL

**DESCRIPTION:** Allows you to sync your camera's roll to the pitch and yaw movement of the robot arm (pitch and yaw) in the move leading up to a keyframe. Unsyncing will cause the roll to be planned without considering the rest of the robot motion. Will default to ON.

 **SEVERAL UNSYNCD ROLL MOVES IN A ROW:** If you have several unsynced roll moves IN A ROW you can end up with an unwanted wave-like pattern in roll speed across these moves.

(Continued on next page)

**USE CASE - SYNC ROLL ON:** Turning **Sync Roll ON** will synchronize the roll of the camera orientation with the robot arm movement. For example, if you are halfway between keyframe 1 and keyframe 2, the roll of the camera will also be halfway complete.

**USE CASE - SYNC ROLL OFF:** Having **Sync Roll OFF** will plan a path that smoothes the roll of the camera orientation as much as possible. This is useful when you have two simultaneous moves with a different amount of roll. In that case, having Sync Roll ON can create a bump at the keyframe BETWEEN those two moves. This bump can be fixed if you turn Sync Roll OFF at the keyframe where the bump occurs, at the keyframe immediately following where the bump occurs, or both.

#### INSTRUCTIONS:

1. Select the keyframe.
2. Select the **Path tab** on the left side of the screen.
3. Turn the **Sync Roll button ON**.



**DESCRIPTION:** Allows you to tie together two **Linear moves** by curving the path between the two linear moves in the Camera OR the Target Channel. **This feature is beta and limited to certain angles.**

**! BETA FEATURE WARNING:** It is NOT recommended that you use SISU beta features during client shoots or demos.

**! BETA FEATURE WARNING:** It is NOT currently supported for programs WITHOUT a **Target channel**.

**USE CASE:** **Curve control** works well for single targets and simple linear moves.

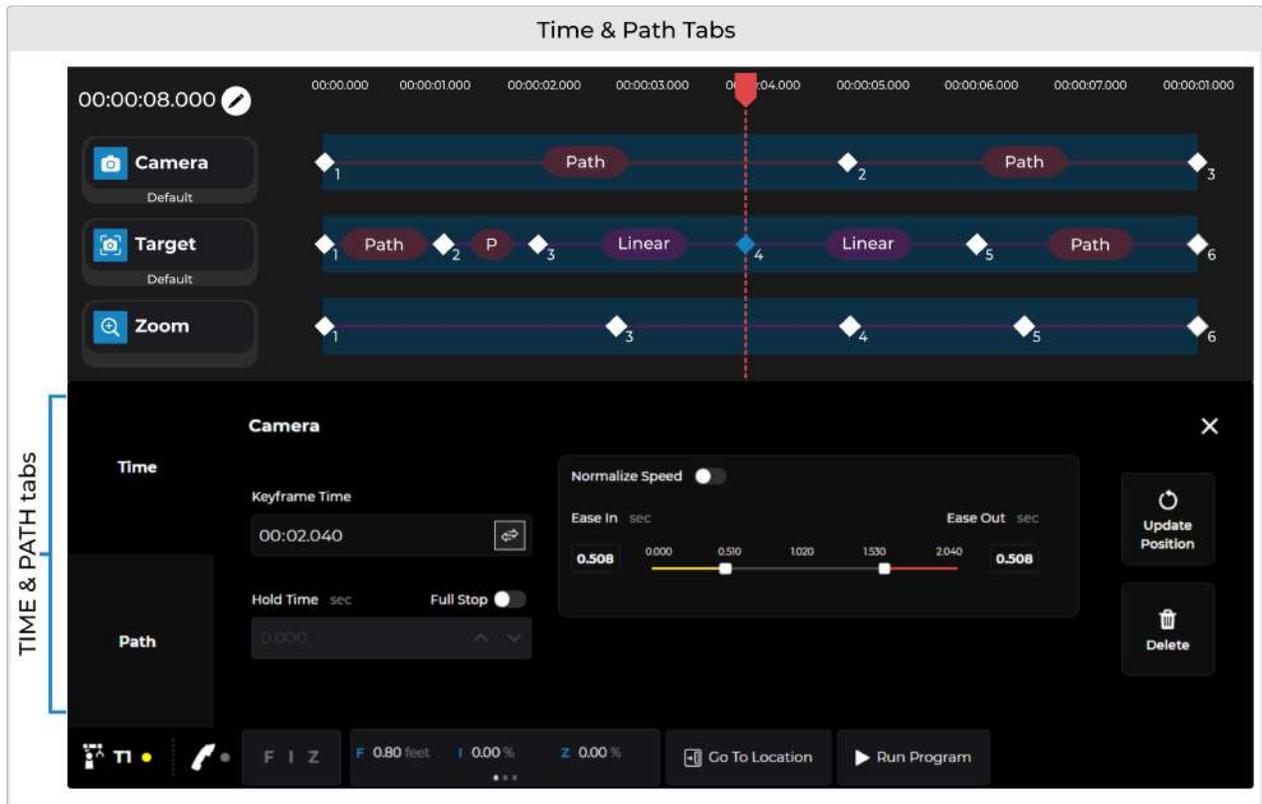
**RECOMMENDATIONS for SINGLE TARGET PROGRAMS:** For programs focused on a **single target**, use one target keyframe when using Curve Control in the Camera.

**RECOMMENDATIONS for MULTIPLE TARGET PROGRAMS:** For programs with **multiple synchronized Target keyframes** that are in a small area, try using Path Moves in the Target when using Curve Control in the Camera.

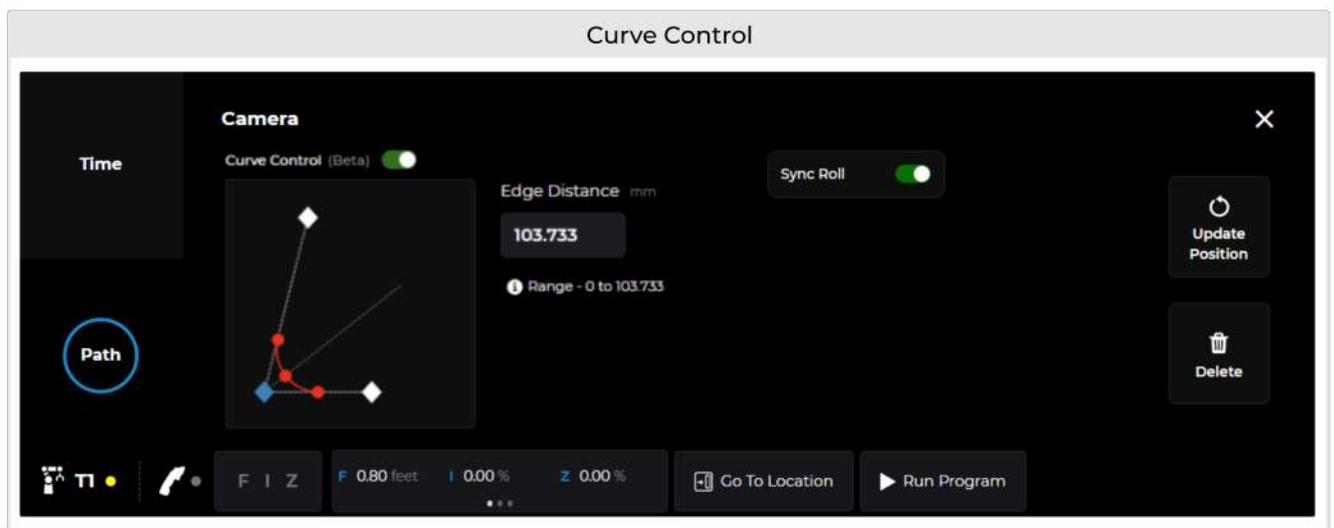
(Instructions for curve control continued on next page)

## INSTRUCTIONS:

1. Select a keyframe that is between 2 **Linear** moves.



2. Select the **Path** tab on the left side of the screen.



(Instructions for curve control continued on next page)

3. Turn the **Curve Control** button ON.
4. Slide the **red dots** to adjust the curve, or use the **Edge Distance** box to adjust the curve.

 **EDGE DISTANCE DEFINITION:** **Edge distance** is the distance from your middle keyframe that the camera will start leaving the original linear path.

 **CURVE CONTROL LIMITATIONS:**

1. You cannot **Curve control** between two Linear moves when the angle between them is 0-10 degrees (almost an exact turnaround) or 160-180 degrees (close to a straight line).
2. The camera may change orientation unexpectedly when using Camera and Focus channels.
3. For movements with large amounts of camera roll, the camera roll timing may change while curving.



## PATH MOVE - FINISH vs. CONTINUOUS

 **AVAILABILITY:** This option is ONLY available for path move keyframes.

**DESCRIPTION:** Allows you to choose whether to continue your path through the keyframe, or whether to make the selected keyframe the end of your path.

**INSTRUCTIONS:** Select the **Finish Path** button to make the keyframe the end of your path. Select the **Continuous Path** button to continue your path through the keyframe.

 **ADJUSTING PATH MOVE CURVES:** When Path moves are made Continuous (e.g. they're all part of the same curve), adjusting any one of those points can change how the entire curve looks. If you are trying to adjust points at the beginning of the curve, but don't want it to affect the points at the end of the curve, try making one of those beginning points a **Finish Path**.

(Continued on next page)



## UPDATE POSITION

**DESCRIPTION:** Allows you to change and update the position of the robot and camera for the selected keyframe.

**INSTRUCTIONS:** Move the robot to the desired new position and select the **Update Position button**.

---



## DELETE

**DESCRIPTION:** Allows you to delete any previously created keyframes that you select in your program.

**INSTRUCTIONS:** Select **Delete** to delete the selected keyframe.

## Settings Options for Target Channel Keyframes

Each keyframe is represented by a diamond shaped point on the program timeline.



If you short press (i.e. click) on a keyframe in the **Robot channel** you will have access to the following settings for that keyframe:

### KEYFRAME TIME / DURATION

**DESCRIPTION:** Allows you to toggle between viewing either **keyframe time** or **keyframe duration**.

### EASE IN

**DESCRIPTION:** Allows you to set how long you want the robot to take to get up to full speed for the move. Longer easing will result in smoother robot motion.

**INSTRUCTIONS:** Move the square on the **slider** until it reads your desired Ease In percent.

 **DISABLED ON FIRST KEYFRAME:** The Ease In and Ease Out functions on the VERY FIRST keyframe in the program will be disabled.

### EASE OUT

**DESCRIPTION:** Allows you to set how long you want the robot to take to slow down from full speed. Longer easing will result in smoother robot motion.

**INSTRUCTIONS:** Move the square on the **slider** until it reads your desired Ease Out percent.

 **DISABLED ON FIRST KEYFRAME:** The Ease In and Ease Out functions on the VERY FIRST keyframe in the program will be disabled.

(Continued on next page)



## FULL STOP

**DESCRIPTION:** Allows the camera to stop and hold position for a certain period of time (the **Hold Time**) before accelerating and moving on. While stopped, the camera can still rotate slightly to keep focus on the intended target. A keyframe WITH a Full Stop will have a blue dot in the middle.

### INSTRUCTIONS:

1. Click on the **Full Stop button** until it turns green. This means Full Stop is ON for the keyframe.



**MOVING PARTS DURING FULL STOP:** Even though the camera will not move to a new location during a Camera channel **Full Stop**, the camera can still rotate slightly to keep focused on the target, and the robot arm can still move around the camera.

2. Enter the desired number of seconds in the **Hold Time box**, or use the adjacent up and down arrows. The duration that you select will appear in the program timeline denoted by a pause button.



**ADDING KEYFRAMES DURING HOLD TIMES:** You CANNOT add a keyframe to a channel if it is in the middle of a Hold Time.



**HOLD TIME AVAILABILITY:** Hold Time will only become available if you turn Full Stop ON for the selected keyframe.



**HOLD TIME LIMIT:** The Hold Time cannot extend past the next keyframe.



## SYNC TO CAMERA CHANNEL

**DESCRIPTION:** Allows you to sync the Ease In, Ease Out, and Full Stop to the Camera channel keyframe that occurs at the same time on the program timeline.

**INSTRUCTIONS:** Turn the **Sync to Camera button** ON.



**SYNC TO CAMERA NOT AVAILABLE:** If the keyframe that you are trying to sync to a Camera channel keyframe DIRECTLY FOLLOWS a keyframe that is NOT in line with a corresponding Camera channel keyframe, you will NOT be able to sync it.

 **FOCUS**

**DESCRIPTION:** Allows you to set the Focus % for that keyframe.

**INSTRUCTIONS:** Turn the **Edit button** ON. Then adjust the focus distance using the up and down arrows or the keyboard.

---

 **UPDATE POSITION**

**DESCRIPTION:** Allows you to change and update the robot and focus motor position for the selected keyframe.

**INSTRUCTIONS:** Move the robot and/or focus motor to the desired new position and select the **Update Position button**.

---

 **DELETE**

**DESCRIPTION:** Allows you to delete any previously created keyframes that you select in your program.

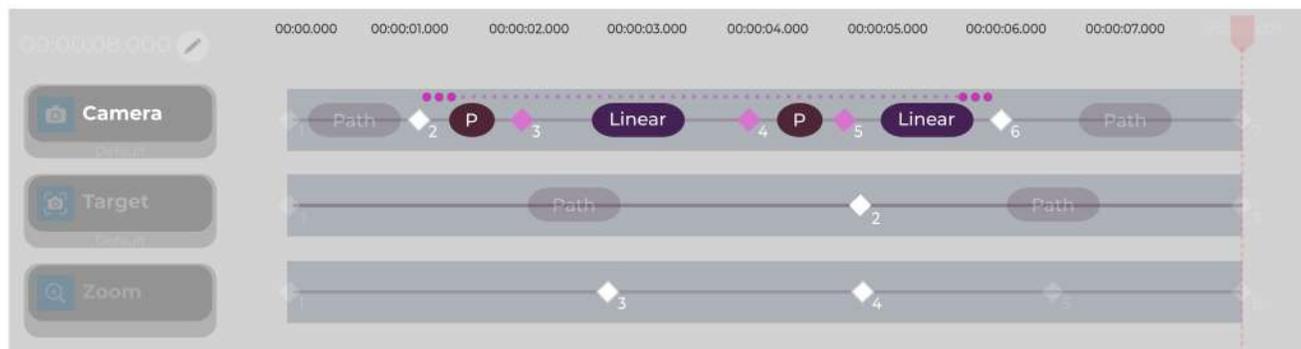
**INSTRUCTIONS:** Select **Delete** to delete the selected keyframe.

(Continued on next page)

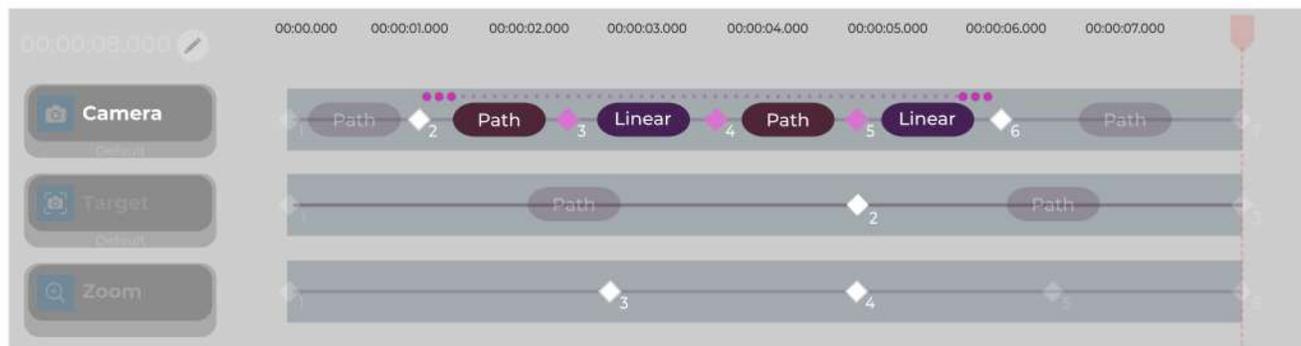

**NORMALIZE SPEED**

**DESCRIPTION:** Allows you to create a scenario where the robot moves at a constant velocity through a group of keyframes in either the **target** OR **camera** channels.

**EXAMPLE:** Turn **Normalize speed** ON for keyframes 3, 4, & 5 in the **Camera** channel.



After compiling the program, keyframes 3, 4, & 5 in the **Camera** channel will be moved so that the speed is continuous between moves 2 - 6.



**NOTE:** If there are keyframes happening in other channels at the same time as any of your **Normalize speed** keyframes, those keyframes in other channels will also be moved to maintain timing relative to the **Target channel** keyframes (or **Camera channel**, if that's where your normalize speed keyframes are). This may require you to go back and tweak some of your keyframes. (See images above.)

**USE CASE:** If you are running a program and notice that - in a particular section of the program - the robot is speeding up and slowing down more than you want, you can turn **Normalize speed** ON for those keyframes to keep the robot moving at a constant speed. It is also ideal for single target and synchronized target programs.

**INSTRUCTIONS:**

1. Turn ON the **Normalize speed** setting for all desired individual keyframes.

(Continued on next page)

2. Compile your program. Your **Normalize speed** keyframes should now be moved so that the velocity is continuous between the chosen moves.
3. Now that those keyframes have been redistributed evenly, you can turn **Normalize speed** OFF for those keyframes, or leave it on.

 **NORMALIZE SPEED and FULL STOP / SYNC:** If **Normalize speed** is turned ON for a keyframe, that keyframe can NOT have a **Full stop** or be synced to another keyframe.

 **TARGET vs. CAMERA CHANNEL:** You can ONLY choose to use the **Normalize speed** feature in either the Target channel OR the camera channel; you cannot use the feature in both channels in the same program.



## PATH MOVE - FINISH vs. CONTINUOUS

 **AVAILABILITY:** This option is ONLY available for **Path move** keyframes, and is ONLY available if you turn Full Stop ON.

**DESCRIPTION:** Allows you to choose whether to continue your path through the keyframe, or whether to make the selected keyframe the end of your path.

**INSTRUCTIONS:** Select the **Finish Path button** to make the keyframe the end of your path. Select the **Continuous Path button** to continue your path through the keyframe.

 **ADJUSTING PATH MOVE CURVES:** When **Path moves** are made **Continuous** (e.g. they're all part of the same curve), adjusting any one of those points can change how the entire curve looks. If you are trying to adjust points at the beginning of the curve, but don't want it to affect the points at the end of the curve, try making one of those beginning points a **Finish Path**.

(Continued on next page)


**CURVE CONTROL**

**DESCRIPTION:** Allows you to tie together two **Linear moves** by curving the path between the two linear moves in the Camera OR the Target Channel. **This feature is beta and limited to certain angles.**

**! BETA FEATURE WARNING:** It is NOT recommended that you use SISU beta features during client shoots or demos.

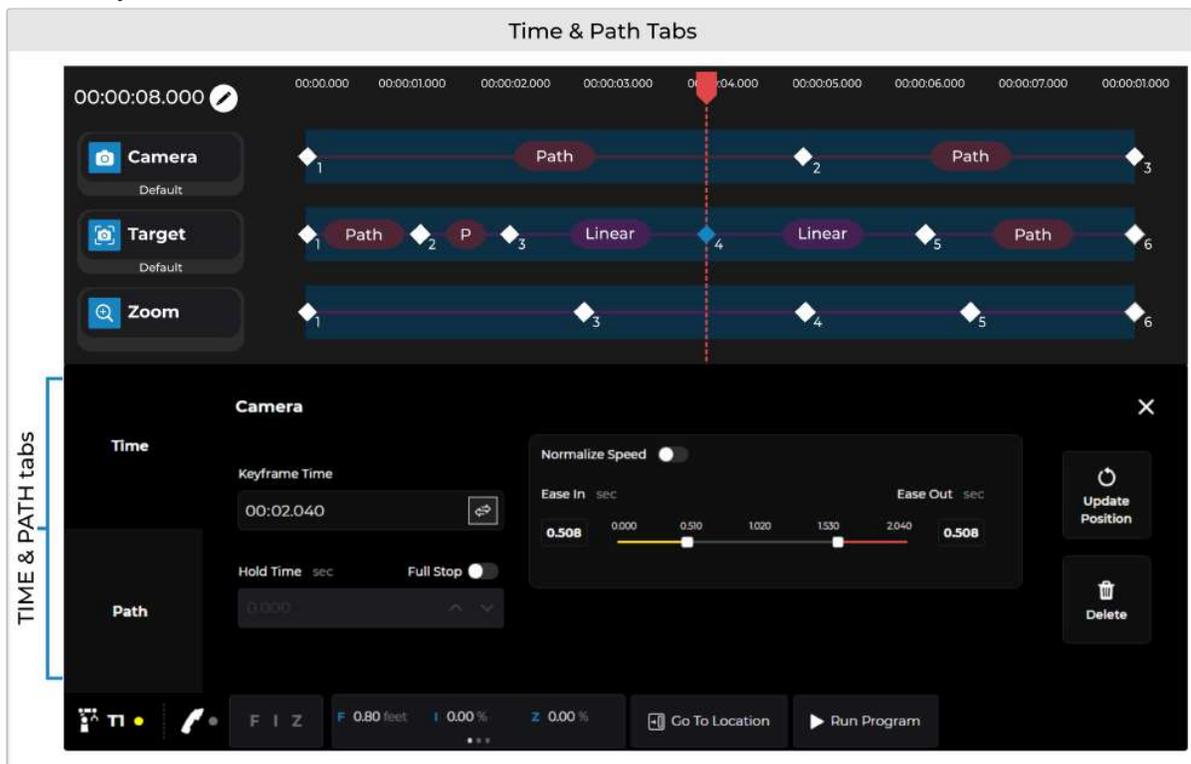
**! BETA FEATURE WARNING:** It is NOT currently supported for programs WITHOUT a Target channel.

**USE CASE:** Curve control works well for single targets and simple linear moves.

**RECOMMENDATIONS:** For programs focused on a **single target**, use one target keyframe when using Curve Control in the Camera. For programs with **multiple synchronized Target keyframes** that are in a small area, try using Path Moves in the Target when using Curve Control in the Camera.

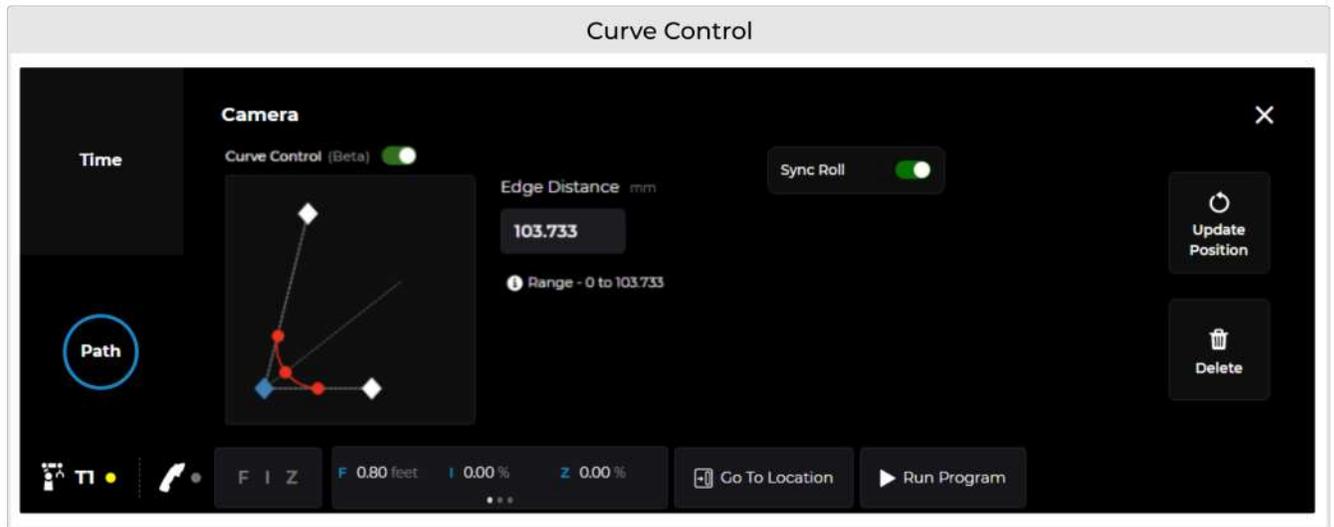
**INSTRUCTIONS:**

1. Select a keyframe that is between 2 **Linear moves**.



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2. Select the **Path tab** on the left side of the screen.



3. Turn the **Curve Control button** ON.
4. Use the **Edge Distance box** to adjust the curve.

#### **CURVE CONTROL LIMITATIONS:**

1. You cannot **Curve control** between two Linear moves when the angle between them is 0-10 degrees (almost an exact turnaround) or 160-180 degrees (close to a straight line).
2. The camera may change orientation unexpectedly when using Camera and Focus channels.
3. For movements with large amounts of camera roll, the camera roll timing may change while curving.

## Settings Options for Focus, Iris and Zoom Channel Keyframes

Each keyframe is represented by a diamond shaped point on the program timeline.



If you short press (i.e. click) on a keyframe in either the **Focus, Iris, or Zoom channel** you will have access to the following settings for that keyframe:



### KEYFRAME TIME / DURATION

**DESCRIPTION:** Allows you to toggle between viewing either keyframe time or keyframe duration.



### EASE IN

**DESCRIPTION:** Allows you to set how long you want the robot to take to get up to full speed for the move. Longer easing will result in smoother robot motion.

**INSTRUCTIONS:** Move the square on the **slider** until it reads your desired Ease In percent.



**DISABLED ON FIRST KEYFRAME:** The Ease In and Ease Out functions on the VERY FIRST keyframe in the program will be disabled.



### EASE OUT

**DESCRIPTION:** Allows you to set how long you want the robot to take to slow down from full speed. Longer easing will result in smoother robot motion.

**INSTRUCTIONS:** Move the square on the **slider** until it reads your desired Ease Out percent.



**DISABLED ON FIRST KEYFRAME:** The Ease In and Ease Out functions on the VERY FIRST keyframe in the program will be disabled.

(Continued on next page)



## FULL STOP

**DESCRIPTION:** Allows the camera to stop and hold position for a certain period of time (the **Hold Time**) before accelerating and moving on. While stopped, the camera can still rotate slightly to keep focus on the intended target. A keyframe WITH a Full Stop will have a blue dot in the middle.

### INSTRUCTIONS:

1. Click on the **Full Stop button** until it turns green. This means Full Stop is ON for the keyframe.



**MOVING PARTS DURING FULL STOP:** Even though the camera will not move to a new location during a Camera channel **Full Stop**, the camera can still rotate slightly to keep focused on the target, and the robot arm can still move around the camera.

2. Enter the desired number of seconds in the **Hold Time box**, or use the adjacent up and down arrows. The duration that you select will appear in the program timeline denoted by a pause button.



**ADDING KEYFRAMES DURING HOLD TIMES:** You CANNOT add a keyframe to a channel if it is in the middle of a Hold Time.



**HOLD TIME AVAILABILITY:** Hold Time will only become available if you turn Full Stop ON for the selected keyframe.



**HOLD TIME LIMIT:** The Hold Time cannot extend past the next keyframe.



## SYNC TO CAMERA CHANNEL

**DESCRIPTION:** Allows you to sync the Ease In, Ease Out, and Full Stop to the Camera channel keyframe that occurs at the same time on the program timeline.

**INSTRUCTIONS:** Turn the **Sync to Camera button** ON.



**SYNC TO CAMERA NOT AVAILABLE:** If the keyframe that you are trying to sync to a Camera channel keyframe DIRECTLY FOLLOWS a keyframe that is not in line with a corresponding Camera channel keyframe, you will NOT be able to sync it.

(Continued on next page)



## FOCUS / IRIS / ZOOM VALUE

**DESCRIPTION:** Allows you to set the **Iris or Zoom %** for that keyframe.

**INSTRUCTIONS:** Turn the **Edit button** ON. Then adjust your Focus, Iris, or Zoom mark using the up and down arrows or the keyboard.



## UPDATE POSITION

**DESCRIPTION:** Allows you to change and update the robot and Focus, Iris, or Zoom motor positions to the current position of the motor.

**INSTRUCTIONS:** Move the robot and/or Focus, Iris, or Zoom motor to the desired new position and select the **Update Position button**.



## DELETE

**DELETE:** Allows you to delete any previously created keyframes that you select in the program.

**INSTRUCTIONS:** Select **Delete** to delete the selected keyframe.

## Settings Options for Trigger Channel Keyframes

Each keyframe is represented by a diamond shaped point on the program timeline.



If you short press (i.e. click) on a keyframe in the **Trigger channel** you will have access to the following settings for that keyframe:

(Continued on next page)



## KEYFRAME TIME / DURATION

**DESCRIPTION:** Allows you to toggle between viewing either keyframe time or the keyframe duration.

---



## TYPE

**DESCRIPTION:** Allows you to choose how the IO changes for that keyframe. **Change** will have the program set the output state for that keyframe to whatever you have selected. **Single pulse** will have the program set the output state for that keyframe to whatever you have selected but then it will automatically change back after the selected **Pulse Time**.

**CHANGE INSTRUCTIONS:** Select the **Change** option, then select whether you want the output to be turned ON or OFF for that keyframe.

**SINGLE PULSE INSTRUCTIONS:** Select the **Single pulse** option, then select ON or OFF for the pulse behavior. Adjust your pulse width using the up and down arrows or the keyboard.

---



## OUTPUT STATE

**DESCRIPTION:** Allows you to change the output state for the keyframe to **ON** or **OFF**.

---



## DELETE

**DELETE:** Allows you to delete any previously created keyframes that you select in the program.

**INSTRUCTIONS:** Select **Delete** to delete the selected keyframe.

## 6.6 Adding and Editing Channels

### 6.6.1 How to Add a Channel

The **Channels** button is located at the bottom left side of the tablet.



If you select the **Channels** button you will be able to add the following channels:

 **CHANNEL AVAILABILITY:** If a channel can only be added once and you have already created one it will be grayed out. You will be able to select any channel that is available to add.



Adding CAMERA CHANNEL

**DESCRIPTION:** The **Camera channel** will be added by default.



Adding TARGET CHANNEL

**DESCRIPTION:** The **Target channel** will be added by default.



Adding FOCUS CHANNEL

**DESCRIPTION:** Allows you to add a channel for the Focus motor attached to the camera.



Adding IRIS CHANNEL

**DESCRIPTION:** Allows you to add a channel for the Iris motor attached to the camera.

(Continued on next page)



## Adding ZOOM CHANNEL

**DESCRIPTION:** The **Zoom channel** will be added by default.



## Adding TRIGGER CHANNEL

**DESCRIPTION:** Allows you to add a channel to control **Digital Outputs** from the SIM in your program.

### INSTRUCTIONS:

1. After you select **Trigger** and **Add** a box will appear with Trigger channel options.
2. Select which output you want to attribute to the channel: **DO1, DO2, DO3, DO4, DO5, DO6, DO7, or DO8**.
3. Select **Add** if you want to add that channel, or select **Cancel**.
4. If you selected **Add**, you will see a new **Trigger channel** in the channels column on the program screen. You can click on the name of your new channel to rename it.
5. Select the **Arrow** next to the channel name.
6. In the **Output State box** you can choose to change the current output to ON or OFF. Press the **Enable button**, then change to ON or OFF.



**WARNING:** This will change the **Output State** and could trigger any connected devices.

7. If you choose to make the **Output State** ON, a green circle will appear under the channel name to help notify you as to which Trigger channels are turned ON and which are turned OFF.



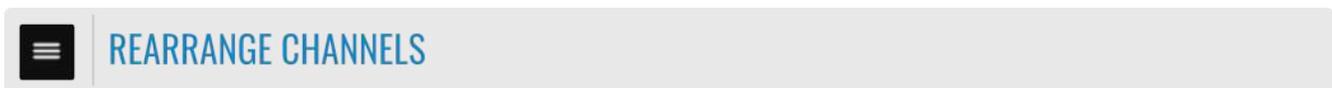
**JUMP TO:** See section [4.13 Hooking up Digital I/O on the SIM](#) - for information on how to hook up the digital inputs and outputs.

## 6.6.2 How to Edit a Channel

The **Channels** button is located at the bottom left side of the tablet.



If you click on the **Channels** button you will be able to edit your channels with the following options:

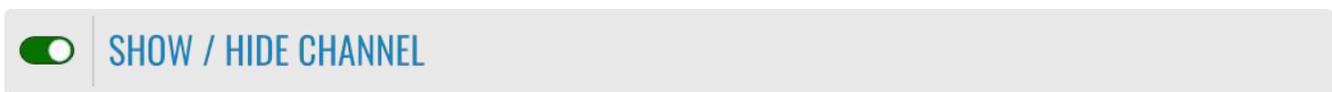


**DESCRIPTION:** Allows you to rearrange the order of the channels listed in the box.

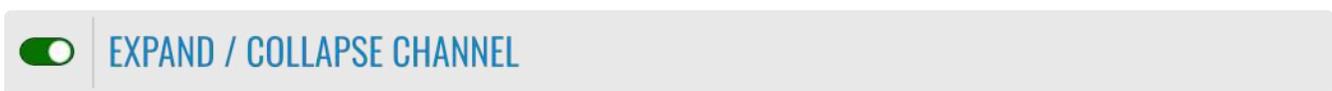
**INSTRUCTIONS:** Select the **Rearrange** button (3 horizontal lines) and drag the channel to a new location in the list.



**DESCRIPTION:** Tells you how many keyframes are currently in that channel.



**DESCRIPTION:** Allows you to let that channel be visible in the program timeline (**Show**), or allows you to make it not visible (**Hide**).



**DESCRIPTION:** Allows you to either make the channels larger in the program editor (**Expand**), or make the channels smaller (**Collapse**).

**USE CASE:** **Expand** will allow you to see ALL information displayed on that particular channel.

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## DELETE CHANNEL

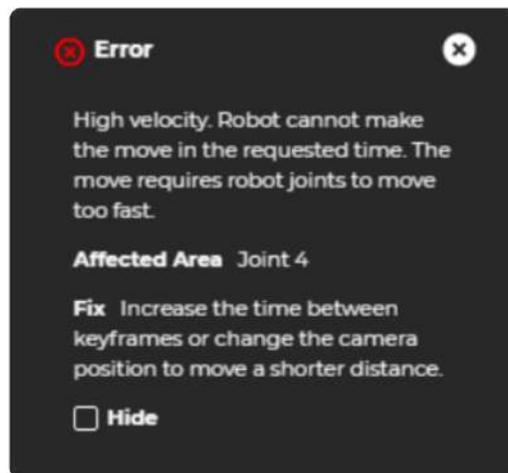
**DESCRIPTION:** Allows you to delete the channel.

## 6.7 Compilation Errors and Warnings



## COMPILATION ERRORS &amp; WARNINGS

**DESCRIPTION:** After you compile your program, **compilation errors and warnings** are shown in the timeline at the time or keyframe they occur. Tapping compilation errors and warnings will show the error and the affected robot joints.



**COMPILATION ERRORS:** Compilation errors prevent your program from running until resolved. These can be asking the robot to move too quickly, or asking the robot to reach further than its joints can handle.



**COMPILATION WARNINGS:** Compilation warnings do NOT prevent you from running the program. They provide guidance on potential problem areas in your program where your robot may have unexpected motion, or may be unable to complete the move.



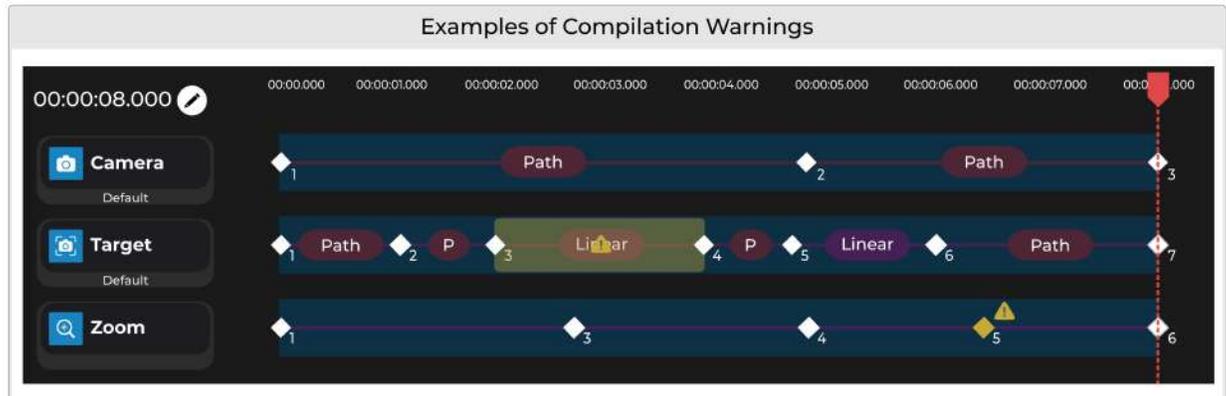
**ACCELERATION OR VELOCITY WARNINGS:** Acceleration or velocity warnings could cause the robot to hard stop. If you see these warnings, you should ALWAYS have all robot weights on when running in T2.

(Continued on next page)

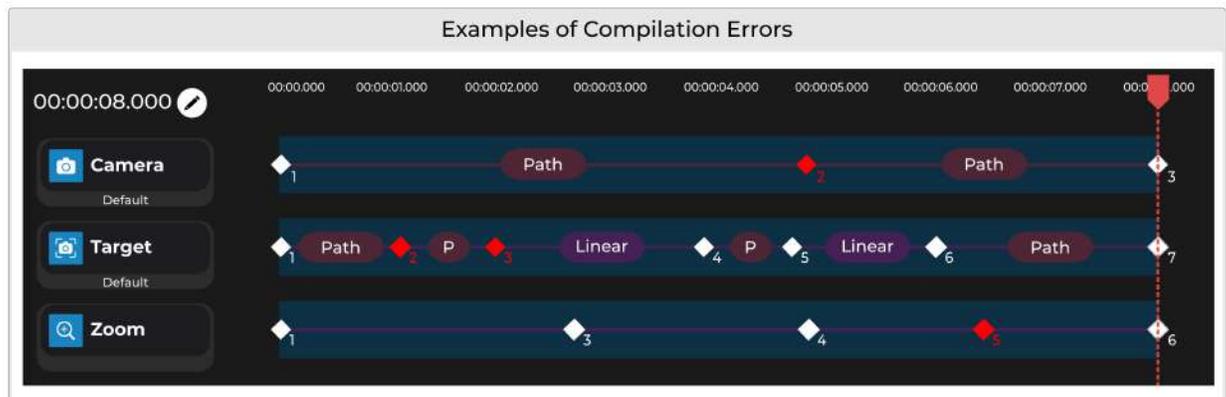
## INSTRUCTIONS - COMPILING PROGRAM:

## 1. Compile your program.

- If you see a yellow keyframe accompanied by a yellow warning sign, or a yellow warning sign on a move, this is a **compilation warning**.

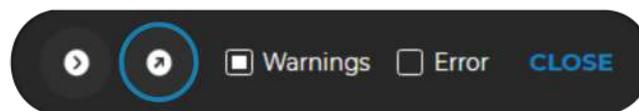


- If you see a red keyframe accompanied by a red warning sign, or a red warning sign on a move, this is a **compilation error**.



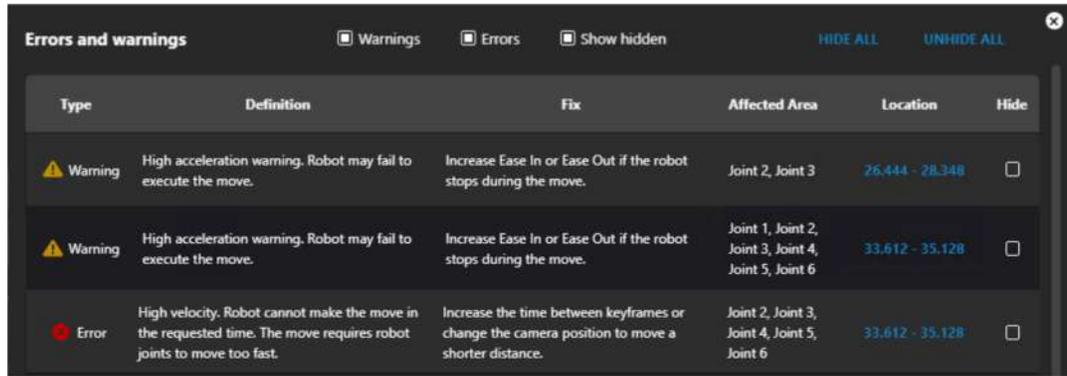
## INSTRUCTIONS - VIEWING ERROR LOG:

1. Select the **Expand button** in the bottom right corner of the screen, **OR**



(Continued on next page)

2. Navigate to the **Main Menu**.
3. Select **Error Logs**.
4. You should now be able to view all compilation errors and warnings.

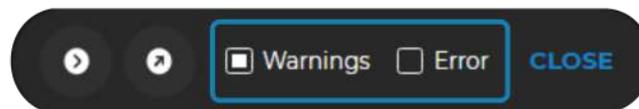


Type	Definition	Fix	Affected Area	Location	Hide
Warning	High acceleration warning. Robot may fail to execute the move.	Increase Ease In or Ease Out if the robot stops during the move.	Joint 2, Joint 3	26.444 - 28.348	<input type="checkbox"/>
Warning	High acceleration warning. Robot may fail to execute the move.	Increase Ease In or Ease Out if the robot stops during the move.	Joint 1, Joint 2, Joint 3, Joint 4, Joint 5, Joint 6	33.612 - 35.128	<input type="checkbox"/>
Error	High velocity. Robot cannot make the move in the requested time. The move requires robot joints to move too fast.	Increase the time between keyframes or change the camera position to move a shorter distance.	Joint 2, Joint 3, Joint 4, Joint 5, Joint 6	33.612 - 35.128	<input type="checkbox"/>

5. Select **Show in Timeline** next to an error or warning and you will be redirected to the area in the program where that error or warning occurs.

#### INSTRUCTIONS - HIDING ERRORS & WARNINGS OPTION #1:

1. Select **Warnings** or **Errors** in the bottom right corner of the screen to view all warnings or errors in your program.
2. Deselect **Warnings** or **Errors** in the bottom right corner of the screen if you don't want the warnings or errors to show in your program.



#### INSTRUCTIONS - HIDING ERRORS & WARNINGS OPTION #2:

1. Navigate to the **Main Menu**.
2. Select **Error Logs**.
3. You should now be able to view all compilation errors and warnings.
4. At the top of the Error Log, select **Warnings** or **Errors** to view all warnings or errors in your program.
5. At the top of the Error Log, deselect **Warnings** or **Errors** if you don't want the warnings or errors to show in your program.

# 7. IN DEPTH - RUNNING A PROGRAM

## 7.1 Chapter Contents

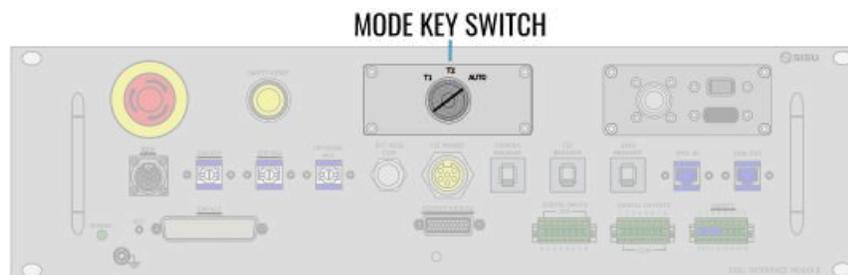
- **How to Set the Operator Modes** - [7.2](#)
  - Available Operator Modes - [7.2.1](#)
- **How to Preview the Program** - [7.3](#)
- **How to Run a Program in T1** - [7.4](#)
- **How to Run a Program in T2** - [7.5](#)

## 7.2 How to Set the Operator Modes



**DESCRIPTION:** You have the choice to run in **T1 mode**, **T2 mode**, or **AUTO mode** via the **Mode Key Switch** on the SIM. (Read details on each in section [7.2.1 Available Operator Modes](#).)

**INSTRUCTIONS:** Turn the **Mode Key Switch** on the SIM until the switch is pointing at your desired mode (**T1**, **T2**, or **AUTO**). The **Mode Notifier** at the bottom of the tablet screen should accurately tell you which mode you are in.



**! C11 and C14 ROBOTS:** If you have a C11 or C14 robot your **Mode Key Switch** is located on the outside of your controls cart at the top of the front panel.

## 7.2.1 Available Operator Modes



### T1 MODE CAPABILITIES

**CAPABILITIES:** **T1 mode** allows you the following capabilities when moving the robot and running a program:

1. You can run the robot using **Trigger control**, **Joystick Control**, or **Joint Mode**.
2. The **Enable button** on the tablet is required to perform moves.
3. Velocities are limited for safety reasons.
4. Programs can only be run from the tablet.
5. Programs can be both edited and run from the tablet.

**INSTRUCTIONS:** Turn the **Mode Key Switch** until it points to **T1**. See section [7.4 How to Run a Program in T1](#).



### T2 MODE CAPABILITIES

**CAPABILITIES:** **T2 mode** allows you the following capabilities when moving the robot and running a program:

1. You CANNOT use **Trigger Control** with the robot.
2. The **Enable button** on the tablet is required to run the program.
3. You CAN run programs at full speed.
4. Programs can only be run from the tablet.
5. Programs and keyframes cannot be edited in **T2**.
6. Programs in **T2** will always run at 100% speed, unless you slow the movement down by partially squeezing the **Wand Trigger**.

**INSTRUCTIONS:** Turn the **Mode Key Switch** until it points to **T2**. See section [7.5 How to Run a Program in T2](#).

## 7.3 How to Preview the Program



### PREVIEW THE PROGRAM

**DESCRIPTION:** You can previsualize your camera keyframes, target keyframes, and program before running it on the robot.



#### INSTRUCTIONS:

1. Select the **Preview** button. **See number 1 in above image.**
2. SISU Lab will automatically start running your program **from the beginning.**
3. Navigate around the visualization:
  - a) **Pinch with two fingers** to zoom in and out.
  - b) Scroll by **swiping your finger.**
  - c) Return to original view by selecting the **return** button. **See number 2 in above image.**
  - d) Select the **Timeline** button to minimize the timeline. **See number 3 in above image.**

**PREVIEW - KEYFRAMES:** Keyframes will appear as numbered squares. A yellow keyframe has a **warning** attached to it. A red keyframe has an **error** attached to it. **See number 4 in above image.**

**PREVIEW - PATHS:** Paths will appear as colored lines in between the keyframes (Camera channel = blue, Target channel = green). A yellow path has a **warning** attached to it. A red path has an **error** attached to it. **See number 5 in above image.**

4. Exit the preview by selecting the **back** button. **See number 6 in above image.**

## 7.4 How to Run a Program in T1



### INSTRUCTIONS:

1. Set the **Mode Key Switch** to **T1 mode**.
2. Place the **Program Cursor** where you want to start the program.
3. Select **Run Program** at the bottom of the tablet screen.
4. Set all desired **Run Configuration Settings**:
  - a) **START FRAME/TIME**: Select **Start Frame** or **Start Time** and edit which frame you want to start running your program from. Or you can move the **Program Cursor** to where you want the program to start running.
  - b) **EXTERNAL START**: Allows you to start the program run based on a signal into the Digital Input on the SIM. The program will delay starting until the selected Digital Input channel receives the trigger. **You must still squeeze the enable button and the wand trigger to run the program. The robot will start once it receives the trigger while you have the enable button and trigger squeezed.** (If you turn **External Start** ON you will need to choose the Trigger Input and select ON (high) or OFF (low) for the trigger.)
  - c) **LOOP**: You have the option to decide whether to continuously run your program in a loop or not.
    - i. **BOUNCE LOOP**: If you turn **Bounce Loop** ON your program will run from beginning to end, then immediately run backwards from end to beginning.
    - ii. **REPEAT LOOP**: If you turn **Repeat Loop** ON your program will run from beginning to end, then immediately jump back to the beginning and run from beginning to end again.
  - d) **DISABLE I/O**: If **Disable I/O** is turned ON, all of the I/O channels will NOT be changed from their current state.
5. Select the **Next button** in the bottom right corner of the **Run Configurations page**. This will compile the program if needed, and then take you to the **Robot Reset page**.

 **COMPILATION ERRORS**: Any compilation errors that are found will be marked on the program timeline with a red exclamation point. See [6.7](#) for more details.

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6. Press and hold the **Enable button** and the wand **Trigger** until the robot is in the correct position to start the program and the robot reset is complete. The robot speed can be controlled by how far the wand **Trigger** is squeezed.
7. There is a **Run Speed indicator** to the left of the buttons that will tell you at what speed the program is running (e.g. 24%). This speed is set automatically and cannot be changed, though you can slow the robot down by partially squeezing the wand **Trigger**.

 **RUN SPEED DETAILS:** Note that the **Run Speed** is determined by the total time that the program will run, and by scaling the program to a longer time so that the fastest move is within the **T1** safe speed limits.

8. Select whether you want the program to run **Backward** or **Forward**. (Program will default to run forward.)
9. How to run the program:
  - a) **Trigger method:** Press and hold the **Enable button** and wand **Trigger** to run the program. The **Robot Cursor** will show you where the robot is on the timeline while running the program. You can pause the program by releasing the wand **Trigger** OR by releasing the **Enable button**.

 **SPEED CONTROL:** You can partially squeeze the trigger to run the program at partial speeds. (The trigger will act like a gas pedal on a car when running your program.)

- b) **Start button method:** Press and hold the **Enable button**. You can now use the **Start** and **Pause** buttons to run the program.

 **RELEASING THE ENABLE BUTTON:** Releasing the wand **Trigger** during a program run sets the commanded speed to 0, while releasing the **Enable button** during a program run tells the robot to stop as quickly as possible by engaging its brakes. Note that, if you release the Enable button while the robot is moving quickly, the brakes may jerk the joints slightly off of their prescribed path and the program will have to be stopped and restarted. This will give you a **Robot off path** notification.

10. Press the **Stop button** at the bottom of the tablet screen to stop the program and return to the program editing page.

 **JUMP TO:** See section [2.8.2 How to Run a Program](#) for the quick reference instructions on running programs.

## 7.5 How to Run a Program in T2



### INSTRUCTIONS:

1. Set the **Mode Key Switch** to **T2 mode**.
2. Place the **Program Cursor** where you want to start the program.
3. Select **Run Program** at the bottom of the tablet screen.
4. Set all desired run configuration settings:
  - a) **START FRAME/TIME:** Select **Start Frame** or **Start Time** and edit which frame you want to start running your program from. Or you can move the **Program Cursor** to where you want the program to start running.
  - b) **EXTERNAL START:** Allows you to start the program run based on a signal into the Digital Input on the SIM. The program will delay starting until the selected Digital Input channel receives the trigger. **You must still squeeze the enable button and the wand trigger to run the program. The robot will start once it receives the trigger while you have the enable button and trigger squeezed.** (If you turn **External Start** ON you will need to choose the Trigger Input and select ON (high) or OFF (low) for the trigger.)
  - c) **LOOP:** You have the option to decide whether to continuously run your program in a loop or not.
    - i. **BOUNCE LOOP:** If you turn **Bounce Loop** ON your program will run from beginning to end, then immediately run backwards from end to beginning.
    - ii. **REPEAT LOOP:** If you turn **Repeat Loop** ON your program will run from beginning to end, then immediately jump back to the beginning and run from beginning to end again.
  - d) **DISABLE I/O:** If **Disable I/O** is turned ON, all of the I/O channels will NOT be changed from their current state.
5. Select the **Next button** in the bottom right corner of the **Run Configurations page**. This will compile the program if needed, and then take you to the **Robot Reset page**.

 **COMPILATION ERRORS:** Any compilation errors that are found will be marked on the program timeline with a red exclamation point. See [6.7](#) for more details.

(Continued on next page)

6. Press and hold the **Enable button** and wand **Trigger** until the robot is in the correct position to start the program and the robot reset is complete. The robot speed can be controlled by how far the wand **Trigger** is squeezed.
7. There is a **Run Speed indicator** to the left of the buttons that will tell you at what speed the program is running (e.g. 24%). This speed is set automatically and cannot be changed, though you can slow the robot down by partially squeezing the wand **Trigger**.

 **RUN SPEED DETAILS:** Note that the **Run Speed** is determined by looking at the maximum velocity that the robot will move during the program, and scaling everything down so that the fastest move is within the safe speed. For **T2**, this should always read 100%.

8. Select whether you want the program to run **Backward** or **Forward**. (Program will default to run forward.)
9. How to run the program:
  - a) **Trigger method:** Press and hold the **Enable button** and wand **Trigger** to run the program. The **Robot Cursor** will show you where the robot is on the timeline while running the program. You can pause the program by releasing the wand **Trigger** OR by releasing the **Enable button**.

 **SPEED CONTROL:** You can partially squeeze the trigger to run the program at partial speeds. (The trigger will act like a gas pedal on a car when running your program.)

- b) **Start button method:** Press and hold the **Enable button**. You can now use the **Start** and **Pause** buttons to run the program.

 **RELEASING THE ENABLE BUTTON:** Releasing the wand **Trigger** during a program run sets the commanded speed to 0, while releasing the **Enable button** during a program run tells the robot to stop as quickly as possible by engaging its brakes. Note that, if you release the Enable button while the robot is moving quickly, the brakes may jerk the joints slightly off of their prescribed path and the program will have to be stopped and restarted. This will give you a **Robot off path** notification.

10. Press the **Stop button** at the bottom of the tablet screen to stop the program and return to the program editing page.

 **JUMP TO:** See section [2.8.2 How to Run a Program](#) for the quick reference instructions on running programs.



# SECTION 3

## GLOSSARY



# 8. GLOSSARY

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## 8.1 Chapter Contents

- Icon Key - [8.2](#)
- Glossary of Used Terms - [8.3](#)

## 8.2 Icon Key

The following icons will be used throughout this manual



NOTE



DANGER



CAUTION



EXAMPLE



JUMP TO

## 8.3 Glossary of Used Terms

### A

**ACTIVITY:** If you go to **Main Menu > Activity** you will be able to find a list of programming and system updates with accompanying timestamps. See [6.2.1 Main Menu Options](#).

**ADD KEYFRAME:** You can add keyframes to your SISU Lab program using the **Add Keyframe button** on the tablet, or by clicking on the **Left Wand button**. See [6.5.1 Creating Keyframes and Choosing Move Types](#).

**ADD KEYFRAME AUTO-JUMP TIME:** If you go to **Main Menu > Settings > Editor > Add Keyframe Auto-Jump Time** you will be able to specify the amount of time that the Program Cursor will jump on the timeline when a new keyframe is added. See [6.2.4 Editor Settings](#).

**AUTO MODE:** **This feature is not currently available.**

**B**

**BACKLASH COMPENSATION FACTORS:** There is some amount of play (i.e. backlash) between the internal motor of the FIZ motor and the gear on the outside that interfaces with the gears on the camera. Because of the backlash the actual motor will go to the exact programmed position, but the outside gear may reflect something different. These instructions will describe how to measure the backlash of the FIZ controller and input those values into the system, so that the backlash can be compensated for automatically. This process will only need to be done once for each pairing of motor and lens. **Backlash** is entered at **Main Menu > Settings > FIZ > Lens Configuration**. See [4.10.1 Calculating Backlash Compensation Factors](#).

**BRAKE CHECK:** The **Brake Check** is an internal check done to ensure the readiness and safety of the robot's brake system. The purpose of the Brake Check is to go through all of the robot's individual joints to test their readiness. To run the Brake Check go to **Main Menu > Settings > Robot > Robot Checks**. See [4.9 Running the Brake Check](#).

**C**

**CALIBRATE WAND:** The **Calibrate Wand** option allows you to calibrate the wand to different frequencies when needed (A, B, C, or D). To calibrate the wand go to **Main Menu > Settings > Wand > Calibrate Wand**. See [4.5 Calibrating the Wand](#).

**CAMERA TOOL:** In the SISU Cinema Robotics system the **Camera Tool** represents the location of the sensor plane and the reference point that the camera will move around. Multiple Camera Tools can be entered and saved in the tablet depending on how many different cameras are being used on the robot arm. To set the Camera Tool go to **Main Menu > Settings > Robot > Camera Tools**. See [4.7 Setting the Camera Tools](#). To see images of how to set Camera Tools, see [4.7.1 Manually Calculating Camera Tools](#).

**CARTESIAN POSITIONS:** The term **Cartesian Position** refers to the X, Y, Z and A, B, C coordinates of the camera from the robot base. X, Y, and Z refer to how far a point is in each direction from the origin along the XYZ axes. A, B, and C refer to the respective rotations around the XYZ axes. See [5.6.3 Tool Reference](#).

**CASE:** The **Case** is a black box that holds the tablet and the wand. The box itself has a power button and contains connection points to the SIM and the tablet. See your **SISU Cinema Robotics Installation Guide** for more detailed information.

**CHANNELS:** SISU Lab allows you to create different channels that run simultaneously on your program. Available channel options are: **Camera, Target, Focus, Iris, Zoom, and Trigger**. See [6.4 Available Channels Where You Can Create Keyframes](#) and [6.5.1 Creating Keyframes and Choosing Move Types](#).

**COMPILATION ERRORS:** **Compilation errors** appear as gold keyframes and/or gold warning signs on the program timeline. They will only show up **after** the program has been compiled. See [6.7 Compilation Errors and Warnings](#).

**CURRENT POSITION TRAY:** The **Current Position tray** is located at the bottom right of the tablet and allows you to toggle between viewing either the Cartesian Positions (XYZ, ABC), the Joint Positions (J1, J2, J3, etc.), or the FIZ Motor Positions. See [6.2.2 Current Position Tray](#).

**CURVE CONTROL:** Allows you to smoothly tie together two **Linear moves** by curving the path between the two linear moves in the Camera OR the Target Channel. See [6.5.2 Settings Options for Target Channel Keyframes](#) and [6.5.2 Settings Options For Camera Channel Keyframes](#).

## D

**DISABLE I/O:** Turning **Disable I/O ON** will disable all of the Trigger channels while running your program. See sections [7.4](#) - [7.5](#).

**DISTORTION TOLERANCE:** You have the option to set the **Distortion Tolerance** to an acceptable level in order to either allow or prevent the robot from moving unexpectedly due to distortion in the signal between the wand and the case. Distortion is often caused by the signal being distorted around large metal objects. You can raise the tolerance setting higher to ignore more distortion in the signal. To set the Distortion Tolerance go to **Main Menu > Settings > Wand > Distortion Tolerance**. See [4.12 Distortion Tolerance](#).

## E

**EASE IN %:** This keyframe setting allows you to set how long you want the robot to take to get up to full speed for the move. Longer easing will result in smoother robot motion. See sections [6.5.2](#) - [6.5.2](#).

**EASE OUT %:** This keyframe setting allows you to set how long you want the robot to take to slow down from full speed. Longer easing will result in smoother robot motion. See sections [6.5.2](#) - [6.5.2](#).

**E-STOP (emergency stop):** **E-stop buttons** will override other system commands and cause the robot to stop immediately as a safety precaution. See [4.3 Stopping the Robot and Track \(if applicable\)](#).

**ENABLE BUTTON:** The **Enable button** is a button on the tablet that enables robot motion (i.e. running programs and Live Control) in modes T1 and T2. See [4.2 Using Enable Button to Engage Robot](#).

**EXTERNAL START:** External start is like a trigger channel that only affects the start of the program and is set in the run configurations page. The program will delay starting until the external start condition is met. See sections [7.4](#) - [7.5](#).

**F**

**FAST MODE:** **Fast mode** is located in the **Quick Set Tray** and causes the robot Live Control and FIZ jogging to run at the fastest safe speed. See [5.6.4 Speed Modes](#).

**FIZ CONTROLS - joint mode:** While in **Joint Mode** you can move the FIZ motors with the **Joystick**.

**FIZ INDICATOR:** The **FIZ Indicator** is located at the bottom left of the tablet screen and lets you know whether the motors are calibrated or not. See [2.3.2 Reading the FIZ Indicator](#).

**FIZ MOTORS:** The FIZ motors are the **Focus, Iris, and Zoom motors** that attach to your camera and allow you to control the Focus, Iris, and Zoom on your camera remotely by using your **Wand** (in Joint Mode) or the **Tablet**. See [5.7 How to Move FIZ Motors](#) or your **SISU Cinema Robotics Installation Guide**.

**FRAME RATE:** If you go to **Main Menu > Settings > Editor > Frame Rate** you will be able to set the **Frame Rate** of your camera. See [6.2.4 Editor Settings](#).

**FREE MOTION MODE:** **Free Motion mode** is located in the **Quick Set Tray** and causes the robot to rotate AND translate using the wand's **Trigger**. You can use the **Joystick** to translate. See [5.6.2 Translation/Rotation Modes](#).

**FULL STOP:** **Full Stop** allows the Camera or Target channel to stop and hold position for a certain period of time (the **Hold Time**) before accelerating and moving on. Full Stop is available for all channels EXCEPT Trigger channels. See sections [6.5.2 Settings Options For Camera Channel Keyframes](#) and [6.5.2 Settings Options for Target Channel Keyframes](#).

**FX:** This programming setting allows you to export a version of your SISU Lab program that will work with Unreal Engine™. It also lets you set some default values needed for Unreal Engine™ programs. See section [6.2.1 Main Menu Options](#).

**G**

**GO TO LOCATION:** This button is located at the bottom of the tablet screen and lets you move the robot to the current location of the Program Cursor. See [6.2.3 Go To Location Button](#).

**H**

**HARDWARE MAP:** See section [2.3.1 Hardware Maps](#) for hardware maps featuring all hardware components.

**HELP:** The **Help page** provides access to helpful information about features on the SISU Lab app. See section [6.3.2 Header Programming Options](#).

**HOLD TIME:** This option in keyframe settings is available when **Full Stop** is ON, and it allows you to choose how long you want the camera to hold at that keyframe location before continuing on to the next move. See sections [6.5.2 Settings Options For Camera Channel Keyframes](#) and [6.5.2 Settings Options for Target Channel Keyframes](#).

**HORIZON LOCK: Horizon Lock** can be likened to the ease of moving your camera around on a tripod. In this scenario you can tilt and rotate around the tripod's vertical axis or around the camera's horizontal axis, but you can NEVER roll around the lens. See [5.6.1 Horizon Lock](#).

## I

**INFO:** If you go to **Main Menu > Info** you will be able to find the system information, such as model name, serial number, version number, etc. See [6.2.1 Main Menu Options](#).

## J

**JOINT MODE:** If you push the **Right Wand button** (C3), or push the **Joint Mode button** on the screen header, the tablet will display the **Joint Mode page**. This page allows you to move one of the six joints at a time in either the positive or negative direction, and it allows you to move the **FIZ motors** using the wand **Joystick**. See [5.5 Moving Robot with Joint Mode](#).

**JOINT MOVE:** During a **Joint move** the camera will NOT move in a straight line between points A and B, and all of the robot's joints can move to get the camera to where it needs to be. See [6.5.1 Choosing Moves for Camera Channel Keyframes](#).

**JOINT POSITIONS:** The term **Joint Position** (e.g. J1, J2, J3, etc.) refers to the location of each of the six movable joints on the robot's arm. These positions can be viewed on the **Current Position tray** located on the bottom right corner of the tablet. See [6.2.2 Current Position Tray](#).

**JOYSTICK:** The **Joystick** is located on the wand and is used to move the robot and FIZ motors. See [5.4 Moving Robot with Joystick Control](#) or your **SISU Cinema Robotics Installation Guide** for more detailed information.

**JOYSTICK CONTROL:** If you do NOT hold down the wand's **Trigger** but instead drive the robot with the **Joystick** you will be operating with **Joystick Control**. This mode allows for controlled motion in the direction that the Joystick is pointed. See [5.4 Moving Robot with Joystick Control](#).

**K**

**KEYFRAME:** A **Keyframe** in the SISU Lab software designates a saved location or point on the program timeline. Keyframes can occur in the Camera, Target, FIZ, and Trigger channels. Keyframes will appear blue when they have been highlighted or selected, and will appear red when they are about to be deleted. Add a keyframe by clicking on the **Left Wand button** (C2), or the **Add Keyframe button** on the tablet screen. See [6.5 Creating and Editing Keyframes](#).

**KUKA ROBOT CONTROLLER (KRC4 or KRC4 compact):** The **KRC4** is the KUKA Robot Controller. The KRC4 comes with the larger size robots, while the KRC4 compact comes with the smaller size robots. See your **SISU Cinema Robotics Installation Guide** for more detailed information.

**KUKA PENDANT:** The **KUKA pendant** is used to reconfigure the mastering position when needed. It can also be used to control the robot and write programs independent of the tablet. See your **SISU Cinema Robotics Installation Guide** for more detailed information.

**KUKA ELECTRONIC MASTERING DEVICE (EMD) KIT:** The **KUKA Electronic Mastering Device (EMD) Kit** is used to manually master KUKA robots when necessary. See [9 Appendix A - Mastering Helps](#).

**L**

**LEFT CURSOR JUMP:** The **Left Cursor Jump button** is a small arrow located at the upper left corner of the program timeline. Clicking on this button will cause your **Program Cursor** to jump to the first keyframe in the program. See [6.3.3 Timeline Navigation Options](#).

**LEFT WAND BUTTON (C2):** The **Left Wand button** (or C2) allows you to capture robot program points, or add keyframes to your program. See [6.5 Creating and Editing Keyframes](#).

**LENS CONFIGURATION:** In **Lens Configuration** you are able to both calibrate your lenses and set the lens **Backlash Compensation Factor** for each lens. To access the **Lens Configuration Settings** go to **Main Menu > Settings > FIZ > Lens Configuration**. See [4.10 Lens Configuration](#).

**LINEAR MOVE:** A **Linear move** guarantees that the camera moves in a straight line between the keyframes. See [6.5.1 Choosing Moves for Camera Channel Keyframes](#) and [6.5.1 Choosing Moves for Target Channel Keyframes](#).

**LIVE CONTROL:** **Live Control** is the general term for moving the robot in any way using the **Wand**. (Live Control is NOT when you move the robot via the Joint Page or when the robot is moving during a run.) See sections [5.3 Moving Robot with Trigger Control](#) and [5.4 Moving Robot with Joystick Control](#).

**LOOP - BOUNCE:** When this loop option is selected in the **Run Configuration Settings** your program will run from beginning to end, then run backwards from end to beginning. See sections [7.4](#) - [7.5](#).

**LOOP - REPEAT:** When this loop option is selected in the **Run Configuration Settings** your program will run from beginning to end, then jump back to the beginning and run from beginning to end again. See sections [7.4](#) - [7.5](#).

## M

**MAKE A COPY:** If you go to **Main Menu > Make a Copy** you will be able to make a copy of a previously created program. See section [6.2.1 Main Menu Options](#).

**MAIN MENU:** The **Main Menu** is located in the upper left corner of the tablet and has the following options: New program, Open program, Make a copy, Help, Info, Settings, Activity, Update, and Shutdown. See section [6.2.1 Main Menu Options](#).

**MANUAL MASTERING FOR KUKA ROBOTS:** KUKA robots occasionally need to be **Manually Remastered**, especially if motion is not fluid. Usually the robot will tell you when this is necessary, though it is a good idea to perform mastering every time you transport the robot as vibrations can induce position error on each axis. This can result in Linear moves not being linear. This process involves testing the joints using the Mastering Tool included with each robot. See [9 Appendix A - Mastering Helps](#).

**MASTERING CHECK:** The **Mastering Check** is an internal test done to check the calibration of the robot. If the Mastering Check fails, then you either need to **Reconfigure the Mastering Reference Position**, or **Manual Mastering** needs to be performed. To run the Mastering Check go to **Main Menu > Settings > Robot > Robot Checks**. See section [4.8 Running the Mastering Check](#).

**MODE KEY SWITCH:** The **Mode Key Switch** (also referred to as the **Mode Switch** or **Key Switch**) allows you to switch between running the robot in T1, T2, or AUTO mode. See section [7.2 How to Set the Operator Modes](#).

## N

**NEW PROGRAM:** If you go to **Main Menu > New Program** you will be able to create a new program. See section [6.2.1 Main Menu Options](#).

**NODAL OFFSET:** The nodal offset is to be measured as the distance between the **No-Parallax Point** (commonly referred to as the **Nodal Point**) and the **sensor plane**. Inputting this number under the lens configuration settings can help keep your objects in the background and foreground lined up when panning the camera or moving side to side. See section [4.10 Lens Configuration](#).

**NORMALIZE SPEED:** The normalize speed function allows you to create a scenario where the robot moves at a constant velocity through a group of keyframes in either the **Target** OR **Camera** channels. See section [6.5.2 Settings Options For Camera Channel Keyframes](#) and [6.5.2 Settings Options for Target Channel Keyframes](#).

## O

**OPEN PROGRAM:** If you go to **Main Menu > Open Program** you will be able to open a previously created program. See section [6.2.1 Main Menu Options](#).

## P

**PATH MOVES:** A **Path move** allows you to create a spline trajectory of path points. The trajectory is planned to smoothly pass through all keyframes in the path sequence without any sharp turns. To make a keyframe a Path move in the **Robot channel** click on the **Move button** just ahead of the keyframe, and select **Path**. See [6.5.1 Choosing Moves for Camera Channel Keyframes](#) and [6.5.1 Choosing Moves for Target Channel Keyframes](#).

**PROGRAM CURSOR DISPLAY:** If you click on the **Program Cursor Display** in the upper left corner of the tablet screen it will show you the current location of the **Program Cursor** on the timeline. If you click on the **Time Display** and enter in a new time, the Program Cursor will jump to the time that you entered. See section [6.3.1 Timeline Properties](#).

**PULSE WIDTH:** This allows you to choose the length of the **Pulse Width** when the **Single Pulse** option is selected for a keyframe in the **Trigger channel**. See section [6.5.2 Settings Options for Trigger Channel Keyframes](#).

## Q

**QUICK SET TRAY:** The **Quick Set Tray** is located in the upper right corner of the tablet screen header. The Quick Set Tray allows you quick and easy access to the following robot movement options: Rotation/Translation Access, Snap to Axis, Reference Frame Selector, and Speed Mode Selector. See section [5.6 Quick Set Settings Options](#).

## R

**READY INDICATOR LIGHTS (RIL):** The **Ready Indicator Lights** (RIL) are lights on both the wand and the bottom right corner of the tablet that show when the robot is engaged and ready to move. See section [4.4.5 Wand Ready Indicator Lights](#).

**RECONFIGURING THE MASTERING REFERENCE POSITION:** If you master the robot and it still fails the **Mastering Check** then it may be that the **Mastering Reference Position** needs to be updated. See chapter [9 Appendix A - Mastering Helps](#).

**REDO:** The **Redo button** on the tablet screen header allows you to redo a programming action. See section [6.3.2 Header Programming Options](#).

**REFERENCE SWITCH:** The **Reference Switch** is a sensor that verifies the robot has reached its mastering position. See section [4.8 Running the Mastering Check](#).

**RIGHT CURSOR JUMP:** The **Right Cursor Jump button** is a small arrow located at the upper right corner of the program timeline. Clicking on this button will cause your **Program Cursor** to jump to the last keyframe in the program. See [6.3.3 Timeline Navigation Options](#).

**RIGHT WAND BUTTON (C3):** The **Right Wand button** (or C3) on the wand takes you in and out of **Joint Mode**. See [6.5 Creating and Editing Keyframes](#).

**RIPPLE:** The **Ripple** function can be found in the tablet screen header. Turning Ripple ON makes it so that when you move a previously created keyframe in the timeline, all keyframes after it will also be shifted so that they keep their time relative to each other. Turning Ripple OFF makes it so that when you move a previously created keyframe in the timeline, all keyframes after it remain where they are in time. See section [6.3.2 Header Programming Options](#).

**ROBOT ARM:** The **Robot Arm** is the mechanism to which your camera will be attached. The Robot Arm's movements are controlled with the **Wand** or the **Joint Mode page**. See your **SISU Cinema Robotics Installation Guide**.

**ROBOT BASE:** The robot arm is connected to the top of the **Robot Base**. The base holds all of the weights, is covered in a latched shroud, and has base feet and outrigger feet that are used to stabilize the robot while it is in motion. See your **SISU Cinema Robotics Installation Guide** for more detailed information.

**ROBOT CURSOR:** The **Robot Cursor** shows the current location of the robot while you are creating a program. It will appear green when you are actively running a program, and it will appear yellow when you have paused a running program. See section [6.3.4 Program Cursor and Robot Cursor](#).

**ROBOT READY INDICATOR:** The **Robot Ready Indicator** is located at the bottom left of the tablet screen and lets you know whether the robot is engaged and ready to move or not. See section [4.4.1 Robot Ready Indicator](#).

**ROBOT ORIENTATION:** The wand uses the position of the case with respect to the robot as a reference. (Meaning if the case is ever rotated the robot will move in unexpected directions.) The orientation of the case and the robot can be set here. To change the **Robot Orientation** go to **Main Menu > Settings > Wand > Robot Orientation**. See [4.11 Robot Orientation](#).

**ROTATION ONLY MODE:** **Rotation Only mode** is located in the **Quick Set Tray** and makes it so that the robot will no longer be able to translate. It will only be able to rotate around the camera. See [5.6.2 Translation/Rotation Modes](#).

**RUN SPEED:** The program **Run Speed** will show on the run page whenever you are configuring your run settings. See sections [7.4](#) - [7.5](#).

## S

**SCALE PROGRAM:** If you click on the **Edit Timeline Properties button** in the upper left corner of the tablet screen (next to the **Program Cursor Display**), you can click on the **Scale Program button** and scale the program. See [6.3.1 Timeline Properties](#).

**SELECT KEYFRAMES:** If you long press on the **Program Cursor** and click on **Select Keyframes** you will have the following options regarding the highlighted keyframes: Update Position, Copy Keyframes, Move Keyframes, and Delete Keyframes. See section [6.5.2 Selecting Groups of Keyframes](#).

**SET FRAME RATE:** If you click on the **Edit Timeline Properties button** in the upper left corner of the tablet screen (next to the **Program Cursor Display**), you can click on the **Set Frame Rate button** and set your desired program frame rate. See [6.3.1 Timeline Properties](#).

**SETTINGS:** If you go to **Main Menu > Settings** you will have access to editor, wand, robot, FIZ, system, import, and export settings. See [6.2.1 Main Menu Options](#).

**SHUTDOWN PROCEDURE:** The recommended way to power down the system is to go through **Main Menu > Shutdown**. You can also hold down the case power button for 3 seconds, or unplug the case if the first option is not feasible. See [3.3 Shutdown Procedures](#).

**SINGULARITIES:** A robot **Singularity** is a condition when the alignment of two or more axes results in an unpredictable robot motion; often the robot will become stuck. See section [5.2.1 Singularities - Robot Positions to Avoid](#).

**SISU INTERFACE MODULE (SIM):** The **SISU Interface Module (SIM)** has a connection point to the reference switch, a **Mode Key Switch** to flip between T1/T2/AUTO modes, and an **E-stop button**. See your **SISU Cinema Robotics Installation Guide** for more detailed information.

**SISU SMART TRANSFORMER 2.0:** The **SISU Smart Transformer 2.0** DOES NOT come with the system, but can be purchased separately to power the system. See [11.5 SISU Smart Transformer 2.0 Specs](#).

**SLOW MODE:** **Slow Mode** is located in the **Quick Set Tray** and will cause the robot to operate at a reduced speed during **Live Control**. See [5.6.4 Speed Modes](#).

**SLOW SPEED:** You have the option to set slower speeds for the trigger, joystick, joint moves, and FIZ components using the **Slow Speed** setting. This is implemented when **Slow Mode** is enabled. To turn **Slow Speed** ON go to **Main Menu > Settings > System > Slow Speed**. See [6.2.5 Slow Speed Option](#).

**SNAP TO AXIS:** **Snap to Axis** is located in the **Quick Set Tray**, and will automatically align the robot's movements to the closest axis of the selected **Tool Reference**. See [5.6.5 Snap To Axis](#).

**SOFTWARE MAPS:** See section [2.3.2 Software Maps](#) for various software maps featuring some of the SISU Lab components.

**START FRAME:** This option in the **Run Configuration Settings** allows you to choose which frame to start running your program on. See sections [7.4](#) - [7.5](#).

**START SELECTION:** If you long press on the **Program Cursor** and click on **Start Selection** you will have the following options regarding the highlighted keyframes: Copy Keyframes, Delete Keyframes, Stretch Keyframes, and Cancel Selection. See section [6.5.2 Selecting Groups of Keyframes](#).

**STARTUP PROCEDURE:** To learn how to turn your system ON, see section [3.2 Startup Procedure](#).

**STOPPING THE ROBOT:** You can stop the robot by doing any of the following: 1) you can push the **Enable button** all of the way down or completely let up on the **Enable button**, 2) you can release the **Joystick** and/or the **Trigger** on the wand to reduce the robot's speed to 0, or 3) you can push the **E-stop button** on the tablet, KUKA pendant, or SIM. See [4.3 Stopping the Robot and Track \(if applicable\)](#).

**SYNC TO CAMERA CHANNEL:** This keyframe setting will match the channel's **Ease In** and **Ease Out** to that of the **Camera channel**. See sections [6.5.2](#) - [6.5.2](#).

## T

**T1 MODE:** When **T1 mode** is enabled the following occur: **Live Control** is enabled, the **Enable button** on the tablet is required to perform moves, code will limit velocities to stay within safe limits, and the program will run at a reduced speed. See [7.4 How to Run a Program in T1](#).

**T2 MODE:** When **T2 mode** is enabled the following occur: you can NO longer control the robot with **Trigger Control**, the program CAN run at full speed, and the **Enable button** on the tablet is still required to perform moves. See [7.5 How to Run a Program in T2](#).

**TABLET:** The **Tablet** has connection points to the case and wand and has a screen that allows you to interface with the software, write robot programs, access settings, and run programs on the robot. See the **SISU Cinema Robotics Installation Guide** for more detailed information.

**TOOL REFERENCE: Tool Reference** options are located in the **Quick Set Tray**: you can choose between the **Camera** or **Crane** option. The wand's **Joystick** will cause the robot to move relative to this reference, according to what the wand is most closely aligned to. This will vary depending on which Tool Reference is selected. See [5.6.3 Tool Reference](#).

**TOTAL FRAME COUNT:** Displays the **Total Frame Count** for the program. See sections [7.4 - How to Run a Program in T2](#).

**TRANSLATION ONLY MODE: Translation Only mode** is located in the **Quick Set Tray** and makes it so that the robot will no longer be able to rotate. It will only be able to translate. See [5.6.2 Translation/Rotation Modes](#).

**TRIGGER - on wand:** The **Trigger** is on the wand and is used to control the robot speed. See [5.3 Moving Robot with Trigger Control](#) or your **SISU Cinema Robotics Installation Guide**.

**TRIGGER - channel type:** Adding a **Trigger channel** allows you to add digital outputs to switch ON and OFF other hardware. See [6.4 Available Channels Where You Can Create Keyframes](#) and [6.6 Adding and Editing Channels](#).

**TRIGGER CONTROL:** If you hold down the wand's **Trigger** and proceed to use the wand to move the robot then the robot will operate with **Trigger Control**. Trigger Control can be likened to grabbing the camera and moving it as desired. See [5.3 Moving Robot with Trigger Control](#).

**TYPE:** This keyframe settings option allows you to choose how the **Trigger Output** changes for that keyframe. If you choose the **Change** option the program will set the output state to whatever you have selected. If you choose the **Single Pulse** option the program will change the state to whatever you have selected but then automatically change back after the selected **Pulse Width** time. See [6.5.2 Settings Options for Trigger Channel Keyframes](#).

## U

**UNDO:** The **Undo button** on the tablet screen header allows you to undo the last programming action that you made. See [6.3.2 Header Programming Options](#).

**UPDATE - software:** If you go to **Main Menu > Update** you will be able to access relevant SISU Lab updates. See [6.2.1 Main Menu Options](#).

**UPDATE POSITION:** This keyframe settings option allows you to change and update the position of the robot for the selected keyframe. See sections [6.5.2 Selecting Groups of Keyframes](#) and [6.5.2 - 6.5.2](#).

## W

**WAND:** The **Wand** allows you to move the robot using several different modes. It also allows you to capture program points and can take you in and out of **Joint Mode**. See your **SISU Cinema Robotics Installation Guide** for more detailed information.

**WAND INDICATOR:** The **Wand Indicator** is located at the bottom left of the tablet screen and lets you know whether the wand is calibrated and ready to use or not. See [2.3.2 Reading the Wand Indicator](#).

**WAND INDICATOR LIGHTS:** The **Wand Indicator Lights** (also called the **Ready Indicator Lights (RIL)**) are located near the wand's **Joystick**. They indicate various states of the wand's connectivity and power. See [4.4.5 Wand Ready Indicator Lights](#).

## Z

**ZOOM IN:** The **Zoom In** option on the tablet screen header allows you to zoom in on the program timeline along the time axis. See [6.3.2 Header Programming Options](#).

**ZOOM OUT:** The **Zoom Out** option on the tablet screen header allows you to zoom out of the program timeline along the time axis. See [6.3.2 Header Programming Options](#).

## 0 - 9

**180 DEGREE TURNS:** Trying to make a 180 degree with the robot can require additional instructions. See [6.5.1 Choosing Moves for Camera Channel Keyframes](#) and [6.5.1 Choosing Moves for Target Channel Keyframes](#).



# SECTION 4

## APPENDICES



# 9. APPENDIX A - MASTERING HELPS

---

## 9.1 Chapter Contents

- **Reconfiguring the Mastering Reference Position** - [9.2](#)
- **Manual Mastering for KUKA Robots** - [9.3](#)
  - **Materials Needed for Mastering** - [9.3.1](#)
  - **Manual Mastering Setup** - [9.3.2](#)
  - **Manual Mastering Procedure** - [9.3.3](#)
  - **Joint 6 Special Instructions** - [9.3.4](#)

## 9.2 Reconfiguring the Mastering Reference Position

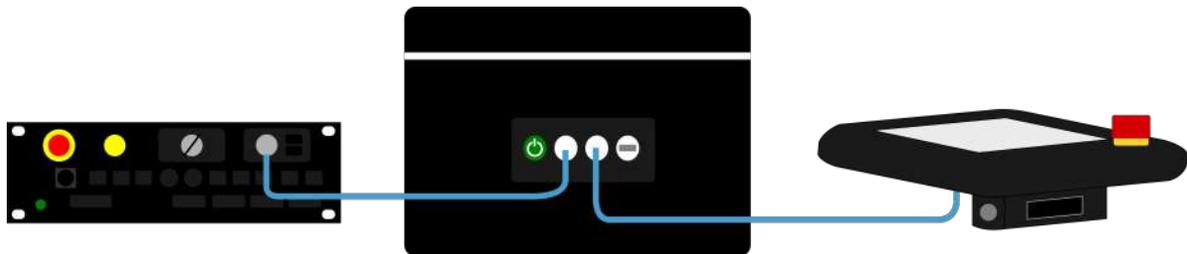
### When do I need to Reconfigure the Mastering Reference Position?

You only need to **Reconfigure the Mastering Reference Position** if your robot FAILS the **Mastering Check**, or if you have recently **Manually Mastered** your robot.

#### STEP 1 of 3 RECONFIGURING THE MASTERING POSITION

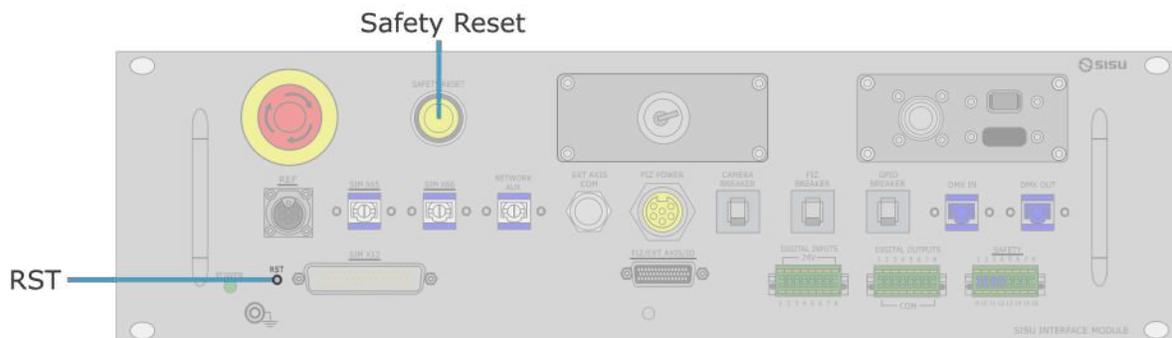
##### INSTRUCTIONS:

1. Connect your case to the SIM, and connect your tablet to the case.



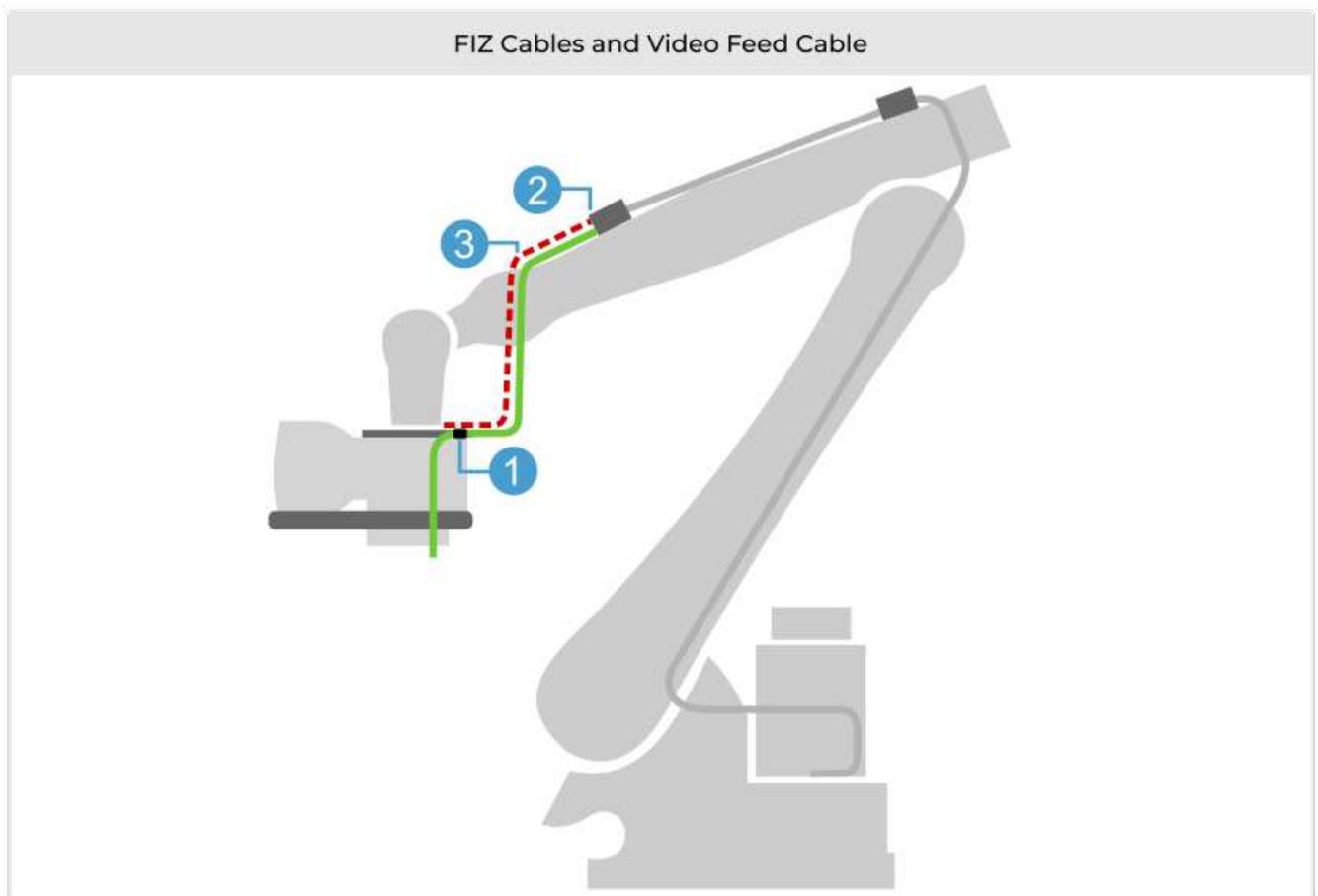
**! WARNING:** You will not be able to move the robot to reconfigure the mastering position without first doing this step.

2. Plug the SIM into power, and power ON the KRC4 Compact. When powering ON, the yellow SIM **Safety Reset** button may flash. Wait a few minutes, and press the yellow **Safety Reset** button. It should stop flashing after you press it if everything has booted up successfully and all connections are made.



(Continued on next page)

3. Remove FIZ cables and video feed cable by doing the following:
  - a) Unplug all 4 ends of the **combo cable** from the bloop light, camera, FIZ motor, and I/O.
  - b) Using a 4 mm allen wrench, unscrew the **combo cable** from the cheeseplate. See Figure 3, circle 1.
  - c) Twist to loosen and then pull to remove the combo cable connector from the top of the robot arm. See Figure 3, circle 2.
  - d) If your **video feed cable** is attached, unplug it from both ends. See Figure 3, circle 3.
  - e) Combo cable and video cable should now be fully disconnected from the robot and camera. Set aside to reinstall after successfully reconfiguring the mastering position.



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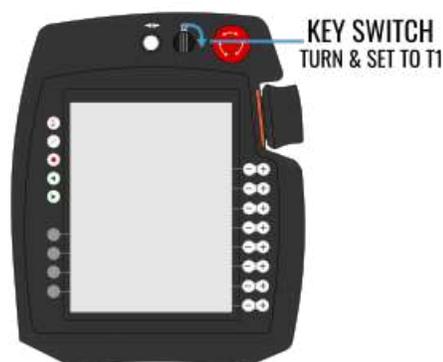
4. Move the robot close enough to the reference switch that the lights on the back of the reference switch both turn OFF. See the following steps on how to easily move using the KUKA pendant:



- a) Turn the **Mode Key Switch** on the SIM to **AUTO**.



- b) Set the KUKA pendant to **T1** by turning the switch at the top of the KUKA pendant and selecting **T1**. Then turn the switch back.

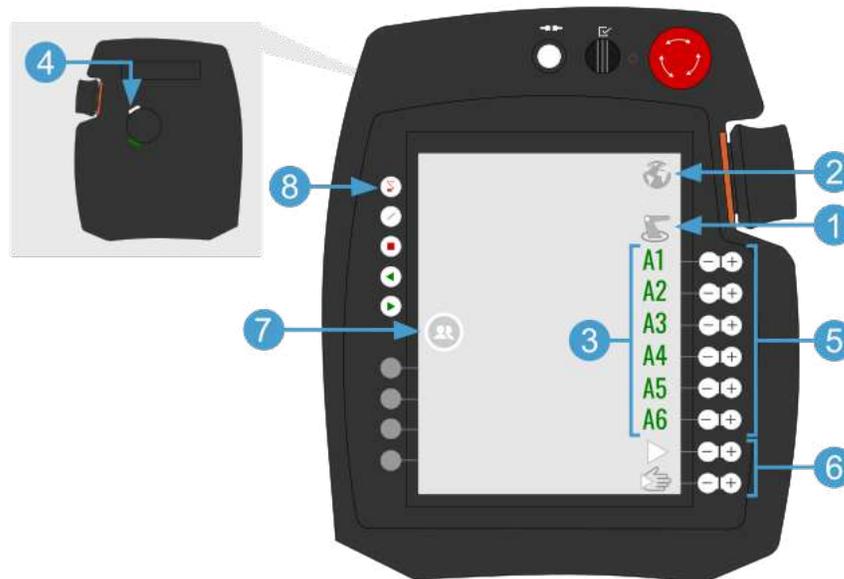


(Continued on next page)

- c) Select the **Robot** icon on the right side of the screen. **See figure 4f, circle 1.**
- d) Select the **Global** icon on the right side of the screen to more quickly move the robot tip in X, Y, and Z directions. **See figure 4f, circle 2.**
- e) Hold in one of the white buttons on the back of the pendant. The joint/axis indicators on the right of the pendant (A1 - A6) should light up green. (If in **Global** these will be X, Y, Z instead of A1-A6.) **See figure 4f, circles 3 and 4.**
- f) While holding one of the white buttons on the back of the KUKA pendant, use the **+/- buttons** on the right side of the pendant to move the robot joint by joint until the robot cheese plate or robot are close enough to the two green sensors on the reference switch that the yellow lights on the back turn OFF. **See figure 4f, circles 4 and 5.**

**!** **WARNING:** You may need to use the **Global** icon to switch back and move joints A5 and A6 so that the cheeseplate is level, similar to the robot in figure 4.

You can adjust the speed of the robot using the **+/- buttons** on the right side of the screen next to the symbol of an arrow and a hand. **See figure 4f, circle 6.**



**!** **WARNING:** You will have to MOVE SLOWLY to safely get close enough to the switch.

5. Log in as a **Safety Maintenance Technician** on the KUKA pendant by doing the following:
  - a) Select the **People** icon on the left side of the screen and go to **Main Menu > Configuration > User Group**. **See figure 4f, circles 7 and 8.**
  - b) **User group:** Safety Maintenance Technician
  - c) **Password:** kuka or k

(Continued on next page)

6. Open the mastering reference position on the KUKA pendant by going to **Main Menu > Configuration > Safety Configuration > Reference Position**. (This will be a tab on the bottom of the screen.) **See figure 4, circle 1.**
7. To update the mastering reference position, first make sure the current position boxes are all **green**. If they are red, that means that they are in an invalid location, and you will need to rotate the corresponding joint until it becomes green. This may require you to try several different positions. **See figure 4, circle 2.**
8. Once all boxes are green, select the **touch-up reference position for group**. **See figure 4, circle 3.**
9. Select the **Save button**. You will need to confirm that you want to update (this may take a few minutes to process). **See figure 4, circle 4.**
10. Select the **Exit button**. **See figure 4, circle 5.**

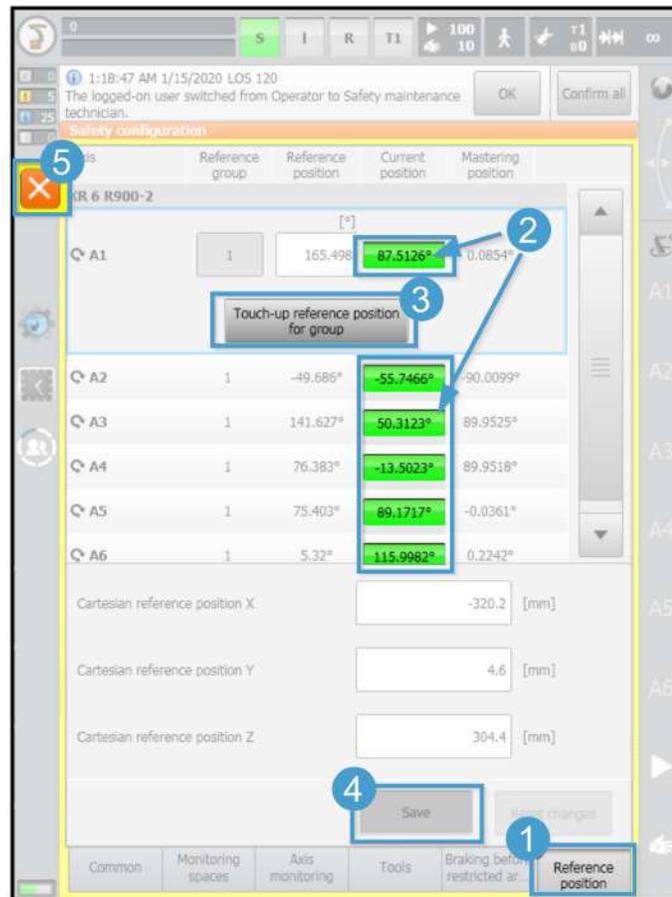


Figure 4: KUKA Pendant - Mastering 2.

(Continued on next page)

**STEP 2 of 3** | **UPDATING POINT 2**
**INSTRUCTIONS:**

1. Navigate to **KRC > R1 > System**.
2. Select **masref\_user.src**.
3. Select **Open** in the bottom right of the screen.
4. Place the cursor on the text line with **LIN P2 (or PTP P2)**.
5. Select **Change** in the bottom left of the screen.
6. Select **Touch Up** in the bottom right of the screen.
7. **Confirm** desire to touch up the point.
8. Select **Cmd Ok** in the bottom right of the screen.
9. Exit the program by selecting the red **X** on the left side of the screen.
10. Mastering reference position for Point 2 (P2) has been reconfigured.
11. If Point 3 (P3) and Point 1 (P1) also need to be reconfigured, use your KUKA pendant to move the robot out to the points on the image below (P3 should be about 30 mm from the ref switch, P1 should be about 150 mm from the ref switch) and follow the above set of steps again for those points. Please see figure 5.

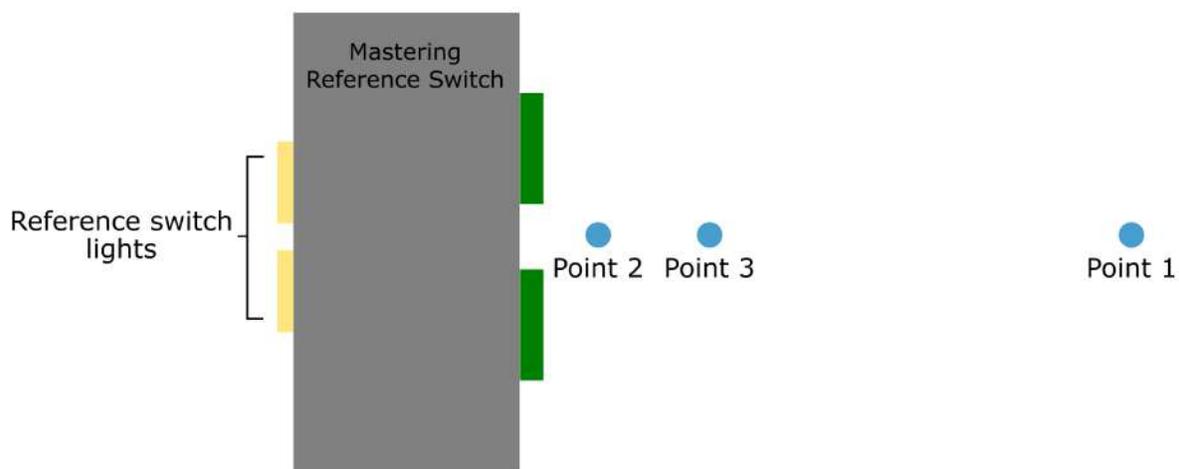


Figure 5: Robot Mastering Points.

(Continued on next page)

**STEP 3 of 3** | VALIDATING THAT MASTERING POSITION HAS BEEN SUCCESSFULLY RECONFIGURED**INSTRUCTIONS:**

1. Move the robot to a different position using the **tablet** by doing the following:
  - a) Switch to **T1** on the SIM.
  - b) Switch to **Ext** on the KUKA pendant.
  - c) Move the robot to a new position.
2. Run the **Mastering Check** from the tablet until a mastering complete message shows up.



**EXPECTED ROBOT MOVEMENT:** The robot should move to the mastering reference position that was just set, and then move back to its starting position.

3. If a mastering complete message shows up then the new mastering reference position has been successfully set. If a mastering complete message does NOT show up then please contact SISU customer support.
4. If your mastering reference position was successfully set, you can reattach your FIZ cables and video feed.

## 9.3 Manual Mastering for KUKA Robots

### What is Manual Mastering?

KUKA robots occasionally need to be **Manually Remastered**, especially if the robot motion is not fluid. Usually the robot will tell you when this is necessary, though your robot should be mastered if it gets severely jostled as vibrations can induce position error on each axis. **This can result in linear moves not being linear.** This process involves testing the joints using the **Mastering Tool** included with each robot.

### How is Manual Mastering different than the Mastering Test?

**Manually Mastering** the robot is different than the **Mastering Test**. Manual Mastering is like calibrating the robot joints, while running the Mastering Test simply checks that calibration. If you FAIL the Mastering Test, you will likely need to Manually Master the robot.

### 9.3.1 Materials Needed for Mastering

#### MATERIALS NEEDED

- Wide flathead screwdriver
- KUKA Electronic Mastering Device (EMD) Kit



## 9.3.2 Manual Mastering Setup

### Where are the six cartridges located?

There are six mastering cartridges on the robot, one for each of the six joints. The following picture shows where all six cartridges are located on the C11 robot.

 **JUMP TO:** Not all robots have a 6th joint mastering cartridge (the yellow circle). See section [9.3.4 Joint 6 Special Instructions](#) for an explanation on how to handle this situation.

 **DIFFERING CARTRIDGE LOCATIONS:** These cartridges may be in different positions depending on the robot.

Six Mastering Cartridge Locations



## How do you connect the pen to a cartridge?

The picture below shows the pen connected to the cartridge for joint 2.



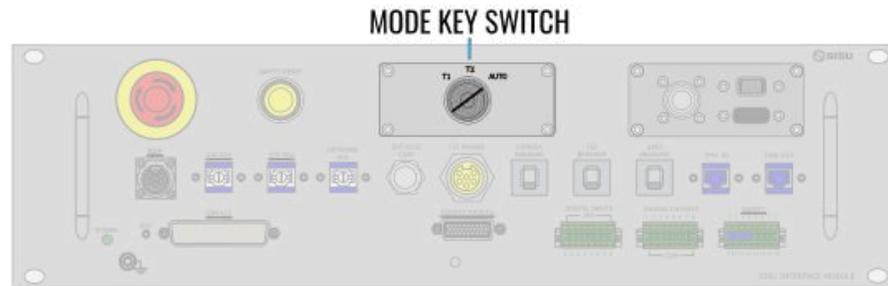
### STEP 1 of 2 SET UP INSTRUCTIONS

1. Plug the small black cable into the **Mastering Box**. Use the larger gray cable to connect the box to the base of the robot in port X32, as shown. Line up all contacts so as not to break any pins in the various connectors.



(Continued on next page)

2. Set the **Mode Key Switch** to **AUTO**.



3. Set the **KUKA pendant** to **T1**.

 **WARNING:** At this point, ensure that **NOTHING** is attached to the robot.

4. Open the **KUKA pendant menu** and click on **Start-up/Master/EMD/Standard/Set Mastering**.
  - a) Click each axis and delete the stored mastering values by clicking **Unmaster**.
  - b) Then, return to the **EMD/Standard/Set Mastering**.

 **NO AXES REQUIRE MASTERING MESSAGE:** If text appears saying **No Axes Require Mastering** but you still want to master the robot, return to the **Unmaster** selection within the **Master** submenu.



 **DO NOT PERFORM THE NEXT STEP AND ATTACH THE MASTERING PEN UNTIL THE JOINT IS IN THE CORRECT POSITION.** See procedure in section ?? ??.

(Continued on next page)

5. Attach the mastering pen to the joint. The pen screws into each mastering cartridge and extends the cartridge's internal pin. The whole assembly looks like the picture below, with the pen screwed into the cartridge and the mastering box plugged into the pen using the small black cable.



(Manual mastering procedure continued on next page)

### 9.3.3 Manual Mastering Procedure

STEP 2 of 2 | PROCEDURE TO FOLLOW FOR EACH JOINT

 **BEFORE YOU BEGIN**, make sure that the mastering pin is **DETACHED** from the robot.

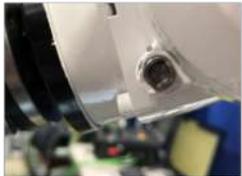
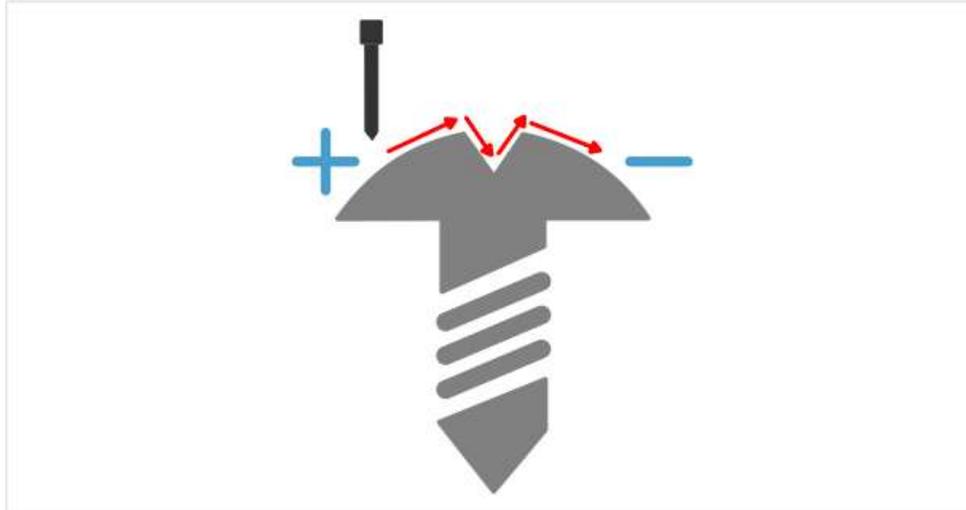
Joint 1			
Joint 2			
Joint 3			
Joint 4			
Joint 5			
Joint 6			

Figure 6: Joint Table

(Continued on next page)

1. Use **Joint Jog** on the **KUKA pendant** to line up the slots on either side of the joint. The joint will rotate from + to -.

 **Make sure that the pin will start PAST the positive (+) side of the groove on the screw.**



2. Unscrew the cap from the robot joint carriage.

 **JOINT 4 CAP LOCATION:** The cap for joint 4 is harder to find, but should be on the robot arm closer to joint 3.

3. With the pen UNPLUGGED from the mastering box, slowly screw the pen into the cartridge.

 **MAKE SURE THE PIN EXTENDING FROM THE CARTRIDGE DOES NOT BEND.**

 **JUMP TO:** See section [9.3.4 Joint 6 Special Instructions](#) for special instructions on joint 6 and how to avoid bending the cartridge pin.

4. Insert the connector from the mastering box into the pen.
5. Select the joint you want to master on the **KUKA pendant** and select **Master**.

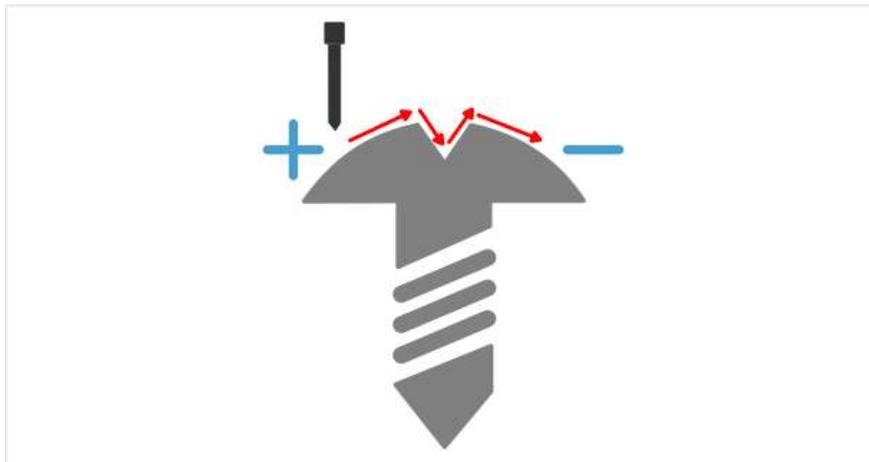
(Continued on next page)

6. Hold down one of the gray/white **Operator Presence buttons** on the back of the **KUKA pendant**. Then, push down the **Play button** next to the screen (the Play button is the green triangle pointing to the right).

**! COMMANDS INHIBITED MESSAGE:** If you press the green button first, it will say **Commands Inhibited** because you need to have the **Operator Presence** held down first. Play with this until it says **Program started**.

7. The robot will begin to move. Initially, the cartridge pin will start on the positive (+) side of the mastering screw (opposite the cartridge, affixed to the joint's other appendage) and will then move in the negative (-) direction and follow down the groove of the screw, back up the other side of the groove, and down the curve a bit. **See diagram below.**

**🚫 WATCH ROBOT MOTION CAREFULLY:** **Watch the robot's motion and check to make sure that nothing breaks.** The cartridge pin should not get bent, the master pen should not get hit, and the robot should move slowly and smoothly.



8. The **KUKA pendant** will show a confirmation page with the new mastering values for that joint. Select **Save** to set the new value.
9. Unplug the connector from the back end of the mastering pen. **Some older EMD's do not detach from the cable. In this case, just unscrew the mastering pen using the slip fit screw.**
10. Unscrew the mastering pen from the robot joint cartridge.
11. Screw the cartridge cap back in.
12. Repeat these steps for the next joint.

### 9.3.4 Joint 6 Special Instructions

 **DO NOT** plug the mastering pen into the cartridge for joint 6 until you have moved joint 5 back so that it sits underneath the cartridge. Reference Figure 6 for the location that joint 5 should be moved to.

 **ROTATING JOINT 5:** If the mastering pen is plugged in while you attempt to rotate joint 5 (whether that be before the mastering test, or homing the joint after the test), you will bend the pin inside the mastering cartridge. At which point the entire cartridge needs to be replaced with a spare part from KUKA. See picture below for an example of a broken cartridge that needs to be replaced.



### Joint 6 Special Instructions - WITH Mastering Cartridge

**If joint 6 DOES have a mastering cartridge, follow these instructions carefully:**

1. Detatch the pen from the robot.
2. Rotate joint 5 to sit underneath the joint 6 mastering cartridge.
3. Line up the slots for joint 6.
4. Insert the mastering pen.
5. Perform the **Manual Mastering** procedure.

 **JUMP TO:** See section [9.3.3 Manual Mastering Procedure](#) for instructions.

6. Unscrew the mastering pen and detatch it from the robot.
7. Rotate joint 5 back to a safer position.

## Joint 6 Special Instructions - WITHOUT Mastering Cartridge

If joint 6 does NOT have a mastering cartridge, follow these steps to master by reference:

1. Put the **Mastering Kit** away. You will NOT need it for this.
2. In the menu on the KUKA pendant, go to **Start-up/Master/Reference**.
3. If the pendant says that joint 6 does NOT need to be mastered, return to the **Master menu** and delete the joint 6 values.
4. Go back to **Reference** on the KUKA pendant. Rotate joint 6 so that the slot is centered with the markings on the surround plate.



5. Select **Master** at the bottom of the page.

# 10. APPENDIX B - TROUBLESHOOTING KNOWN ISSUES

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## 10.1 Chapter Contents

- **Robot issues** - [10.2](#)

- ISSUE: The robot's movements are erratic or halting / The robot randomly starts plunging while using trigger control - [10.2.1](#)
- ISSUE: The robot's movements are shaky - [10.2.2](#)
- ISSUE: Wave-like pattern in camera roll speed - [10.2.3](#)
- ISSUE: The robot bumps or jerks AT keyframe - [10.2.4](#)
- ISSUE: Target tracking does not work (or goes wild) when running your program - [10.2.5](#)
- ISSUE: The robot is stuck in position - SISU Lab case does NOT power on - [10.2.6](#)
- ISSUE: The robot is stuck in position - SISU Lab case powers on - [10.2.7](#)
  - \* Reset button on SIM is flashing - [10.2.7](#)
  - \* Reset button on SIM is not flashing - [10.2.7](#)
- ISSUE: Robot dips or stops suddenly when you are running a program - [10.2.8](#)
- ISSUE: Mastering check failure - [10.2.9](#)
- ISSUE: Interference Detected message pops up constantly - [10.2.10](#)
- ISSUE: Robot suddenly loses power - [10.2.11](#)

- **FIZ and focus issues** - [10.3](#)

- ISSUE: The FIZ motor lights are blinking - [10.3.1](#)
- ISSUE: Focus marks are off when running a program - [10.3.2](#)
- ISSUE: FIZ motors have power but appear as disconnected in SISU Lab - [10.3.3](#)
- ISSUE: FIZ motor movement not smooth in Joint Mode - [10.3.4](#)
- ISSUE: Items in the foreground and background are not staying lined up when you pan the camera - [10.3.5](#)

## 10.2 Robot issues

### 10.2.1 ISSUE: The robot's movements are erratic or halting / The robot randomly starts plunging while using trigger control

**PROBLEM: ERRATIC MOVEMENT:** When the signal from the wand gets distorted the robot's motions can become erratic (e.g. it moves on its own or in a halting manner). **ROBOT PLUNGING:** While moving the robot using **Trigger Control**, the robot will start moving in a set direction no matter how you move the wand or joystick.

**SOLUTION #1:** Try turning down your **Distortion Tolerance**. When your Distortion Tolerance is low, you will receive notifications for wand signal interference which can confirm that the signal is becoming distorted. If your signal IS becoming distorted, steps from solutions 2-4 may improve the signal.

 **JUMP TO:** See section [4.12 Distortion Tolerance](#) for instructions on adjusting the **Distortion Tolerance**.

**SOLUTION #2:** Move your case to a new location.

**SOLUTION #3:** Make sure your case is at least 3 feet off of the ground.



**SOLUTION #4:** Make sure your case is not near any large metal objects that could interfere with the signal - including the transformer and/or controls cart.

**SOLUTION #5:** Try unplugging the wand from the tablet and then plugging it back in. If movement is still erratic, try powering down and powering back up the case.

**SOLUTION #6:** If none of the above instructions fix the problem, please contact SISU customer support.

## 10.2.2 ISSUE: The robot's movements are shaky

**PROBLEM:** The robot appears to have a measure of shakiness to it when it is moving. It's important to note that all robots have some degree of shakiness due to mechanical constraints, but steps can be taken to minimize the degree of shakiness appearing in the footage.

**SOLUTION #1:** Avoid large movements using joint 6 and joint 4.



**SOLUTION #2:** Keep in mind that the shakiness can get worse when you are moving the robot away/out, and the shakiness can lessen if the robot is moving across. The more extended the robot arm is, the worse the shakiness will get due to more force about the base of the robot. Modify the program to reduce any long reaches of the robot arm.

**SOLUTION #3:** Shakiness can be even more present in both macro lenses and lenses with a focal length longer than 35mm.

**SOLUTION #4:** Place the 2 bolts on the dovetail and cheeseplate as **far apart** as possible.



**JUMP TO:** See section **Mount Installation Guide, Dovetail, and Dovetail Clamp** in your **SISU Cinema Robotics Installation Manual** for an illustration.

## 10.2.3 ISSUE: Wave-like pattern in camera roll speed

**PROBLEM:** There is a wave-like pattern in your camera's roll speed across a set of moves.

**SOLUTION #1:** If you have several unsynced roll moves IN A ROW you can end up with an unwanted wave-like pattern in roll speed. Try turning **Sync Roll ON** for one or more of these moves.



**JUMP TO:** See section [6.5.2 Settings Options For Camera Channel Keyframes](#) for more information on **Sync Roll**.

## 10.2.4 ISSUE: The Robot bumps or jerks AT keyframe

**PROBLEM:** The robot/camera bumps or jerks right at a keyframe.

**SOLUTION #1:** If you have two simultaneous moves - one with a lot of roll and one with a small amount of roll - you may get a bump at the keyframe BETWEEN those moves where there is a large change in roll speed. In this case, you can try turning **Sync Roll** OFF at the keyframe where the bump occurs, at the keyframe immediately following where the bump occurs, or both.

 **JUMP TO:** See section [6.5.2 Settings Options For Camera Channel Keyframes](#) for more information on **Sync Roll**.

## 10.2.5 ISSUE: Target tracking does not work (or goes wild) when running your program

**PROBLEM:** When you go to run your program, target tracking either goes wild or does not appear to be working correctly.

**SOLUTION #1:** Your **Camera Tool** could be set incorrectly. To double check this, do the following steps:

1. Move the robot with the joystick, and switch between **Camera** and **Crane Reference**. If the camera appears to be moving in the wrong direction, check your **Robot Orientation**. If your Robot Orientation is correct, move on to step 2.

 **CAMERA TOOL TABS / PAGES:** You only need to fill out **ONE** Camera Tool tab / page per camera configuration.

 **JUMP TO:** See section [4.11 Robot Orientation](#) for more information.

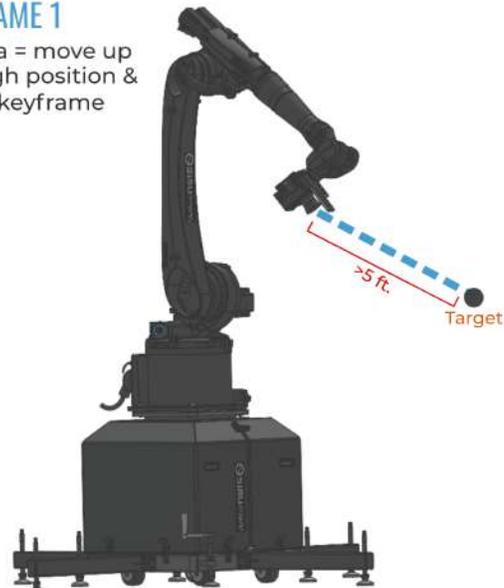
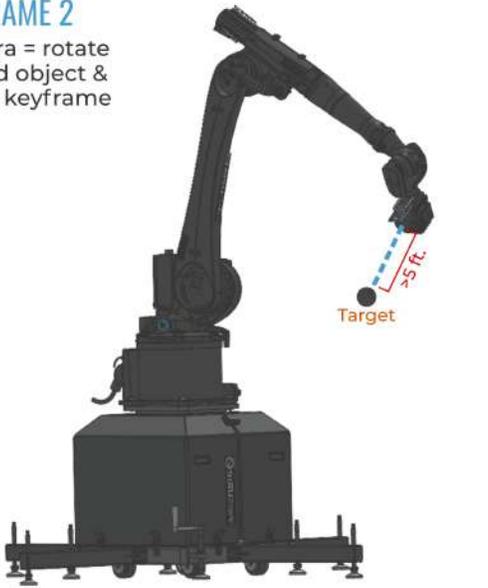
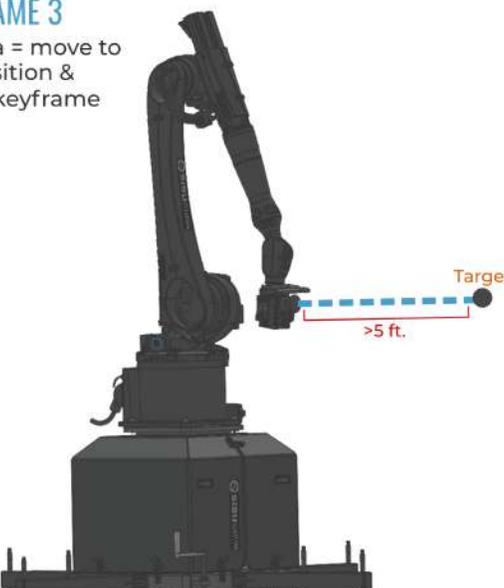
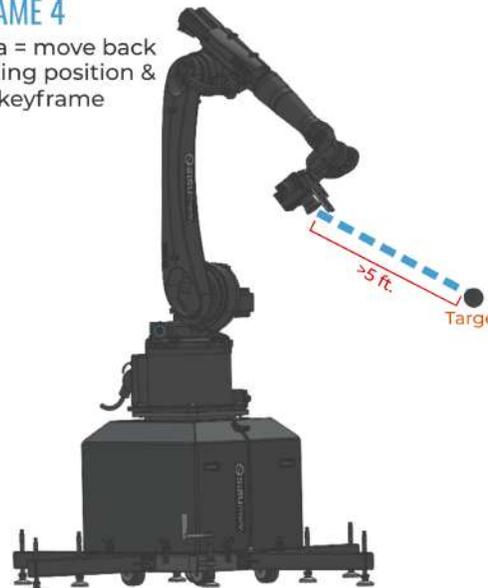
2. Write a 4 point **Camera channel** program with 1 target keyframe by doing the following:



(Written instructions continued on next page)

- Create a new program in SISU Lab.
- Add a **Camera** and **Target keyframe** (see Keyframe 1 in previous image) in your program with an accurate Focus distance.
- Add the remaining 3 **Camera keyframes** similar to those in the previous image. **Do NOT add more Target keyframes.**

Program to check Camera Tools Configuration

<p><b>KEYFRAME 1</b> Camera = move up to a high position &amp; create keyframe</p> 	<p><b>KEYFRAME 2</b> Camera = rotate around object &amp; create keyframe</p> 
<p><b>KEYFRAME 3</b> Camera = move to low position &amp; create keyframe</p> 	<p><b>KEYFRAME 4</b> Camera = move back to starting position &amp; create keyframe</p> 

**The object should be AT LEAST 5 feet away from the camera when making these keyframes**  
 The camera should focus on the object (e.g. the black ball) the entire time  
 The object that the camera is focusing on should not move

(Continued on next page)

3. Turn **Horizon Lock** ON and rotate / translate.
  - a) Turn **Horizon Lock** ON in the **Quick Set Tray** at the top of the screen.
  - b) Move the camera around with **Trigger Control**. With **Horizon Lock** turned ON you should NOT be able to roll around the lens. **If you ARE able to roll around the lens with Horizon Lock turned ON, your Camera Tool may be set incorrectly.**

 **JUMP TO:** See section [4.7 Setting the Camera Tools](#) in your for instructions on how to set your **Camera Tool**.

**SOLUTION #2:** Your lens configuration settings could be incorrect. Go to the lens configuration settings page and double check all values and settings.

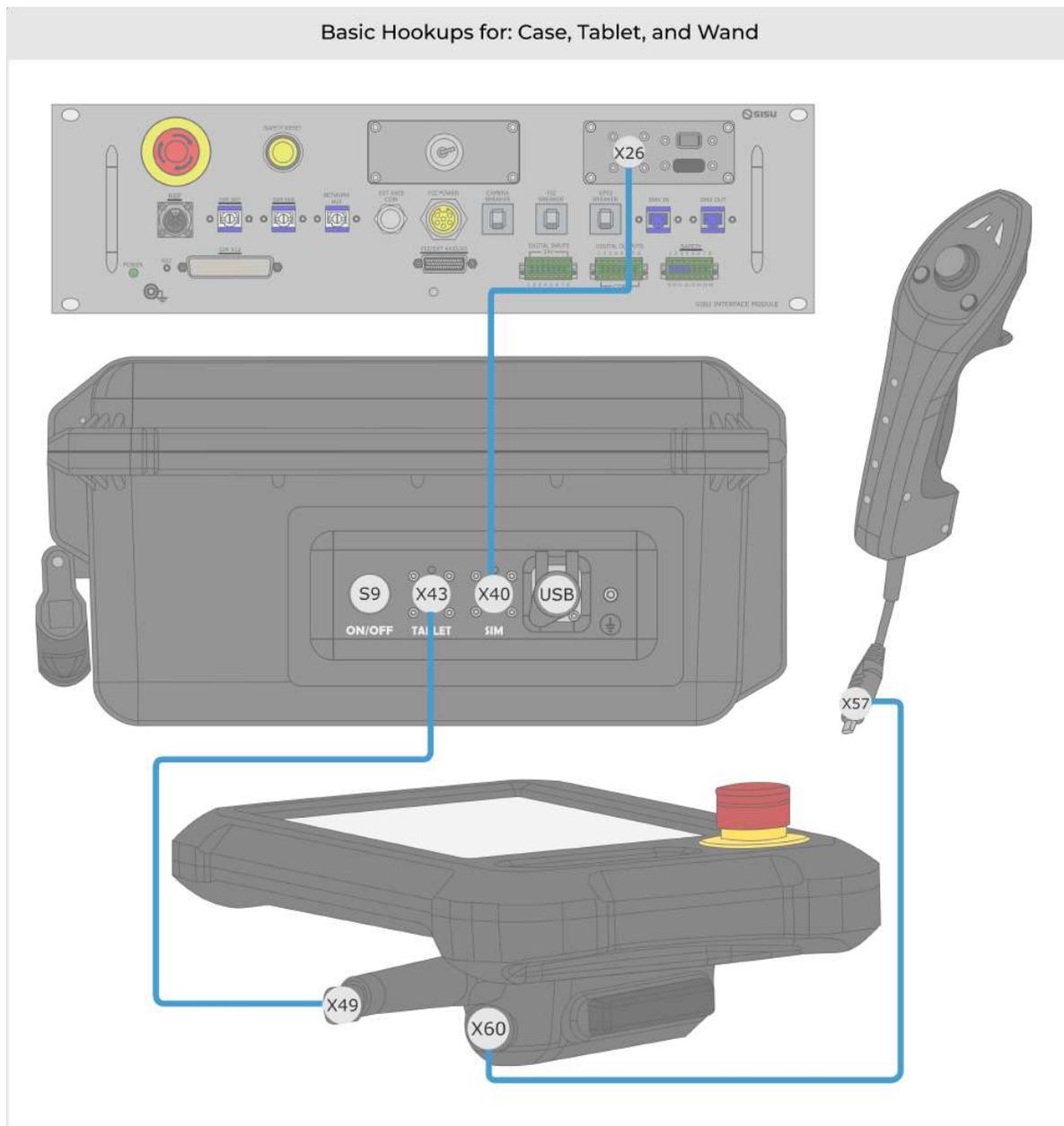
**SOLUTION #3:** Make sure that you are accurately measuring the distance between the camera sensor and the target **at every keyframe**.

## 10.2.6 ISSUE: The robot is stuck in position - SISU Lab case does NOT power on

 **JUMP TO:** If the SISU Lab case **DOES** power on see section [10.2.7 ISSUE: The robot is stuck in position - SISU Lab case powers on](#) for instructions.

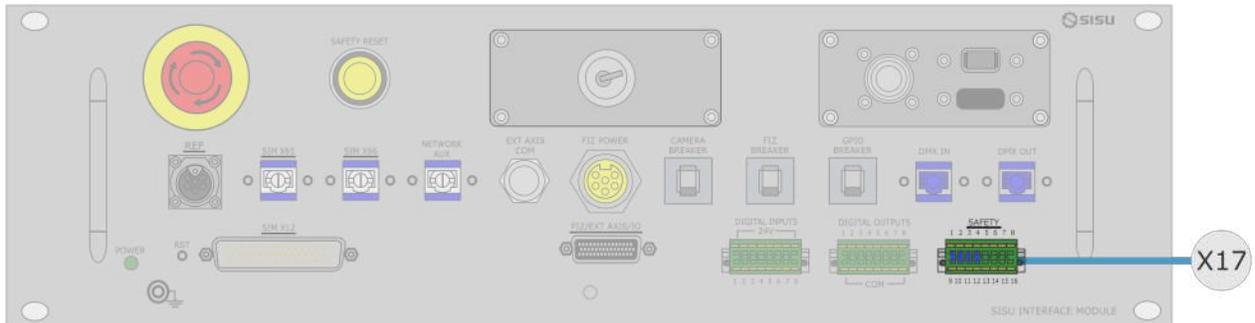
**SOLUTION #1:** Make sure your robot is turned ON. (If the KUKA pendant can turn ON, the robot is ON.)

**SOLUTION #2:** Make sure all of your connections are plugged in correctly.



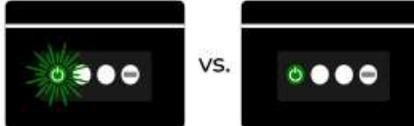
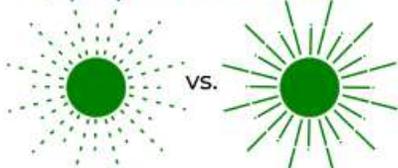
(Continued on next page)

**SOLUTION #3:** Make sure that the SIM safety cable is plugged in.



**SOLUTION #4:** After applying power to the case, check to see if the wand lights and/or the case light (located on the side of the case) is on. If NO lights appear on the wand or case please contact SISU customer support.

### Case Power Button

<p><b>POWER BUTTON DELAY</b></p>  <p>After plugging in the case it may take a few seconds before the power button is ready to respond.</p>	<p><b>BLINKING vs. SOLID LIGHT</b></p>  <p>The power button light on the case will blink when it is powering on, and will remain solid once it is completely powered on.</p>	<p><b>QUICK BLINK vs. SLOW BLINK</b></p>  <p>The power button light on the case will blink quickly when it is powering on, and will blink slowly when it is powering off.</p>
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## 10.2.7 ISSUE: The robot is stuck in position - SISU Lab case powers on

 **JUMP TO:** If the SISU Lab case does **NOT** power on see section [10.2.6 ISSUE: The robot is stuck in position - SISU Lab case does NOT power on](#) for instructions.

**PROBLEM:** The robot is stuck and you are no longer able to move it with the wand (but you CAN power the SISU Lab case on).

If the yellow **Safety Reset button** on the SIM IS flashing, follow the steps in section [10.2.7 Reset Button On SIM Is Flashing](#).

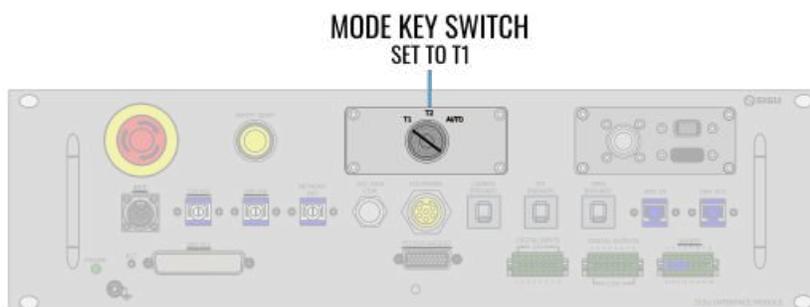
If the yellow **Safety Reset button** the SIM is NOT flashing, follow the steps in section [10.2.7 Reset Button On SIM Is Not Flashing](#).

### Reset Button On SIM Is Flashing

If your robot is stuck and the yellow **Safety Reset button** on the SIM IS flashing, press it. If you press it and it does NOT stop flashing, follow these steps:

**SOLUTION #1:** Clear all depressed red **E-stops** (by turning them counter clockwise) and press the yellow **Safety Reset button** on the SIM again. You also need to make sure that the **Mode Key Switch** is set to **T1**, and the KUKA pendant is set to **Ext.**.

 **EXT. INSTRUCTIONS:** If your KUKA pendant says **T1**, **T2**, or **Aut**, you will need to turn the switch on top of the KUKA pendant, select **Ext.**, and then turn the key switch back.



(Continued on next page)

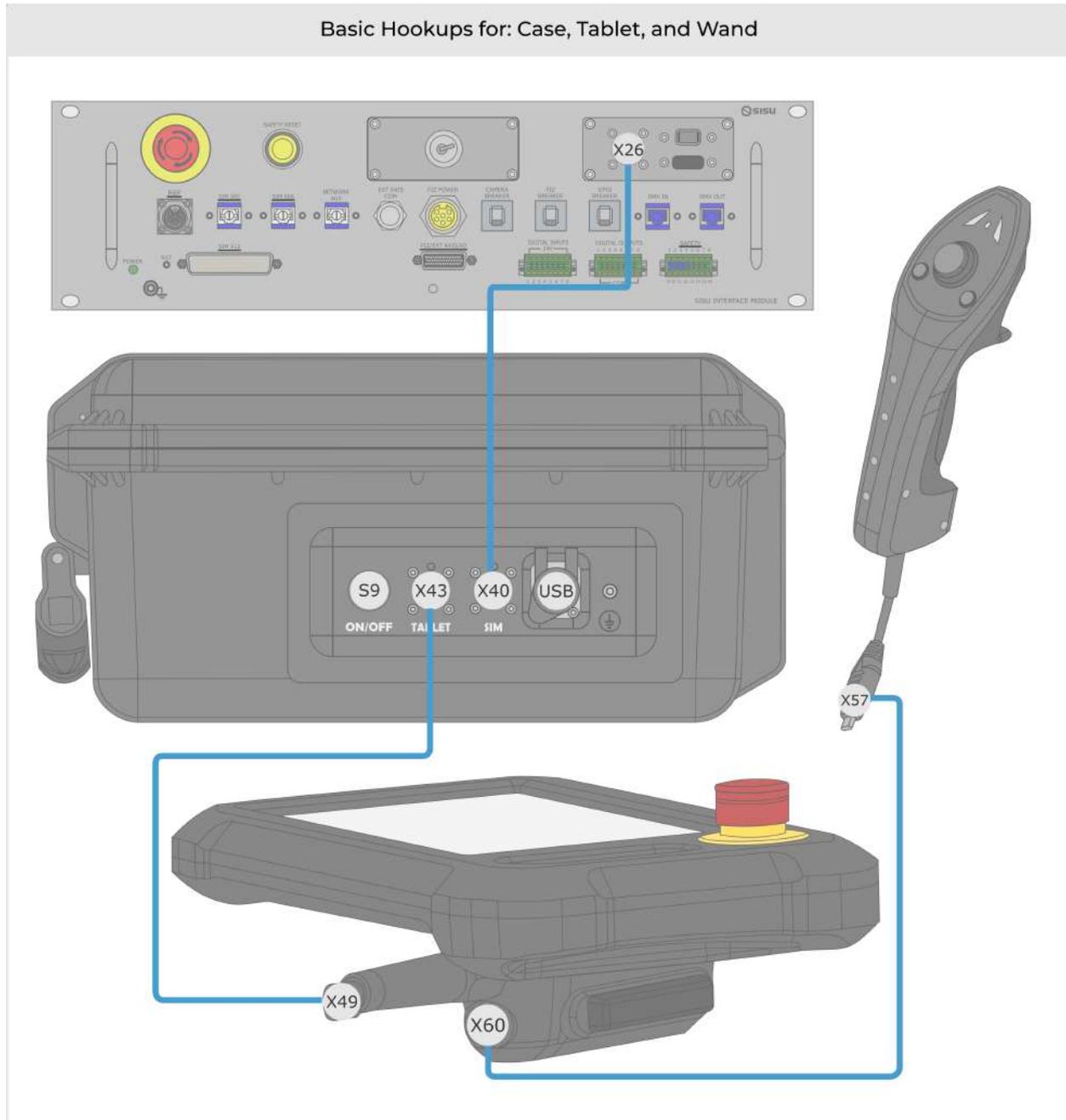


## Reset Button On SIM Is Not Flashing

If your robot is stuck and the yellow **Safety Reset** button on the SIM is NOT flashing, follow these steps:

**SOLUTION #1:** Make sure your robot is turned ON. (If the KUKA pendant can turn ON, the robot is ON.)

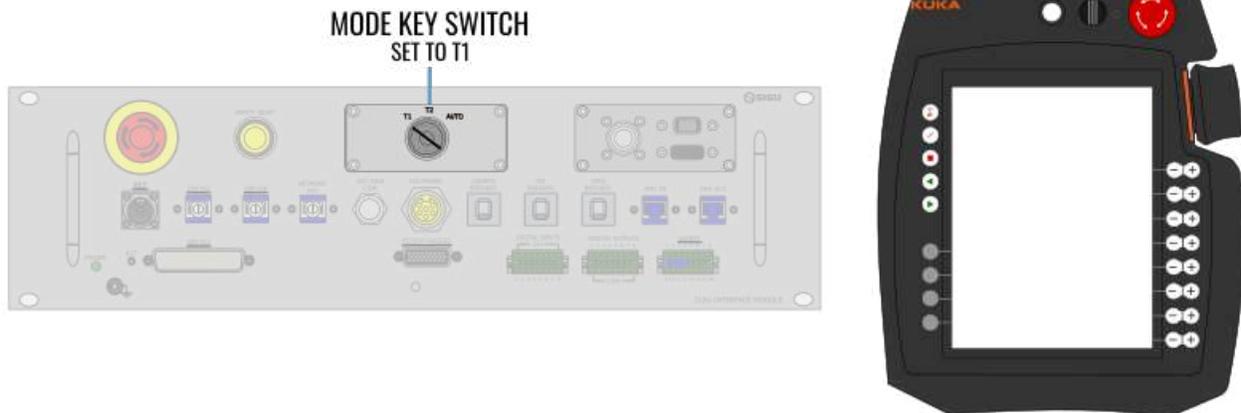
**SOLUTION #2:** Make sure all of your connections are plugged in correctly.



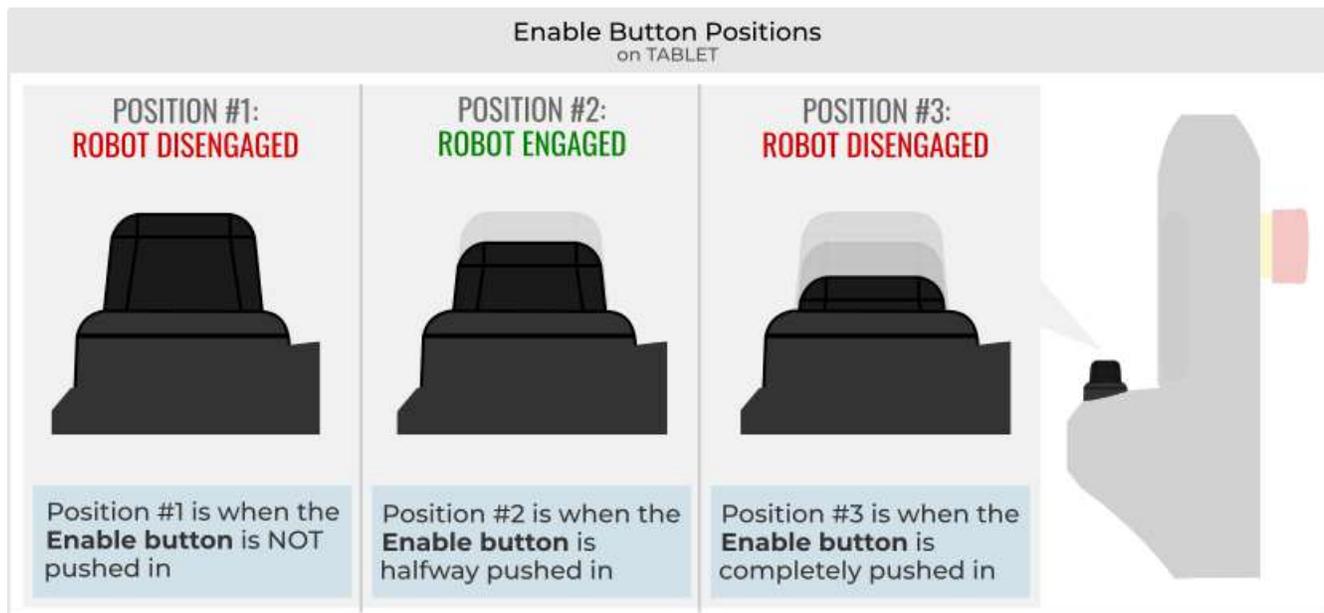
(Continued on next page)

**SOLUTION #3:** Make sure your **Mode Key Switch** is set to **T1 mode** and your KUKA pendant is set to **Ext.**

**! EXT. INSTRUCTIONS:** If your KUKA pendant says **T1, T2, or Aut**, you will need to turn the switch on top of the KUKA pendant, select **Ext.**, and then turn the key switch back.



**SOLUTION #5:** If you do NOT hear a clicking sound when you hold down the **Enable button** follow these steps:

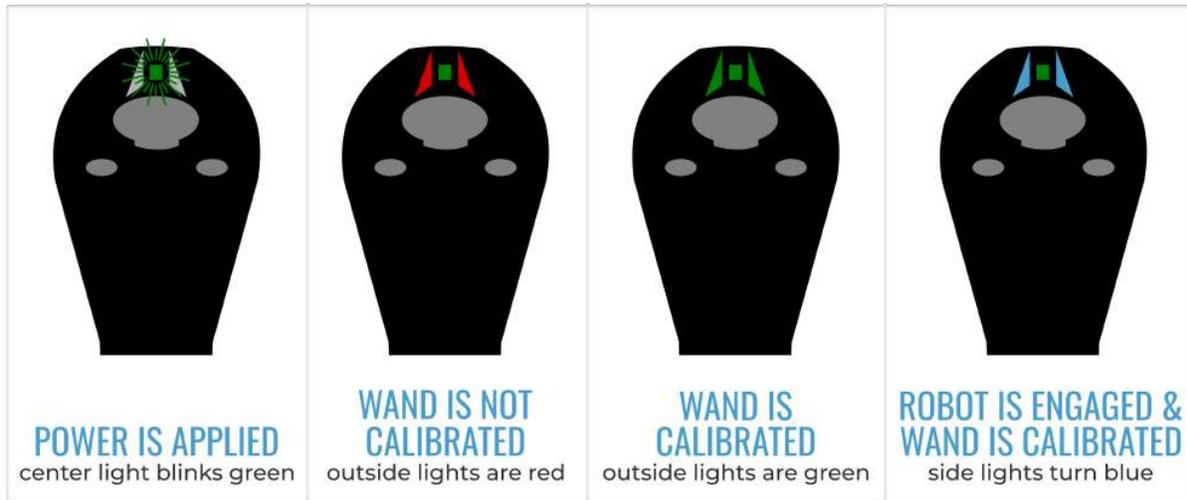


1. View the above image to ensure that you are using the **Enable button** correctly. If everything is working properly, the robot notifier at the bottom left of your tablet should appear green.

(Continued on next page)

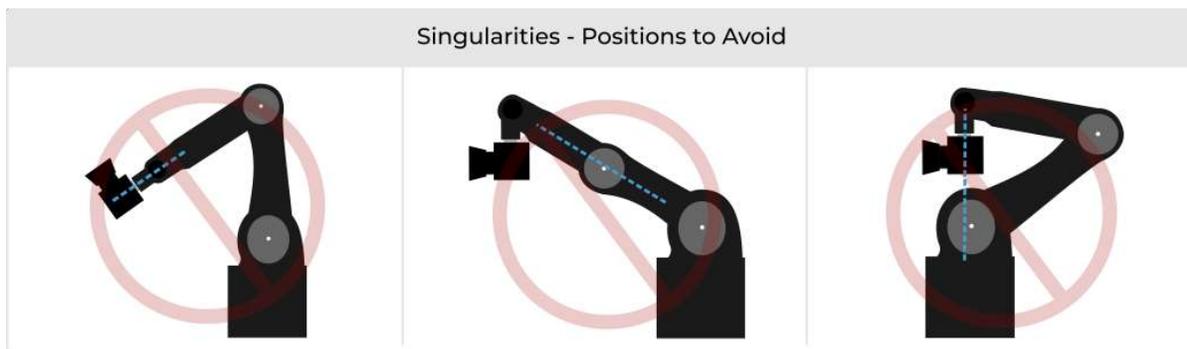
2. Make sure that the top of the KUKA pendant says **Ext.**. If it says **T1, T2, or Aut** you will need to turn the switch on top of the KUKA pendant, select **Ext.**, and then turn the key switch back.
3. If the wand and case lights are ON, you are holding the **Enable button** down in the correct position, and you still cannot move the robot please contact SISU customer support as there may be something wrong with your tablet. **Please let customer support know if it has been recently dropped.**

**SOLUTION #6:** Make sure the wand is calibrated and the correct wand lights are on.



Unplug your wand from the tablet and plug it back in, then calibrate your wand. If you still do not see the lights on the wand (but you do see the power light on the side of the case) contact SISU customer support as there may be something wrong with your wand. **Please let customer support know if the wand has been recently dropped, crushed, etc.**

**SOLUTION #7:** Make sure you haven't encountered a **Singularity**.



If you **HAVE** encountered a **Singularity**, use **Joint Mode** to jog the robot out of the singularity position.

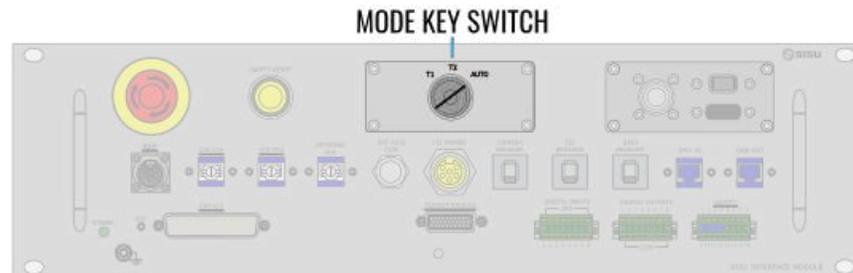
(Continued on next page)

**IF NONE OF THE ABOVE SOLUTIONS WORKED, TRY THE FOLLOWING:**

**SOLUTION #1:** Make sure that the **S** (located in the leftmost display button at the top of the KUKA pendant) is green. If it is gray, contact SISU customer support.

**SOLUTION #2:** Can you move the robot using the KUKA pendant? To test this, do the following:

1. Switch to **AUTO mode** on the SIM.



2. Switch to **T1** on the KUKA pendant, hold the **Enable button** on the KUKA pendant, and hit **Confirm** in the error bar. Axes 1-6 (on the right side of the pendant) should turn green. If they are, you should be able to move the robot one joint at a time with the buttons on the left side of the pendant.

**! T1 INSTRUCTIONS - KUKA PENDANT:** To change your KUKA pendant to **T1 mode**, you will need to turn the switch on top of the KUKA pendant, select **T1**, and then turn the mode key switch back.

If axes 1-6 are not green, contact SISU customer support.

**SOLUTION #3:** Check for errors on your KUKA pendant: first press **Confirm All** to clear old errors, then look at the remaining errors.

1. Look at the error messages on the KUKA pendant to see if you have a “Mastering Test Required” error message: **Upper left Robot icon/Diagnosis/Logbook/Display** will show a history of all errors encountered. **This is not the same as a “Perform Mastering” error message.**

If you DO have a “Mastering Test Required” error message, you will need to perform the **Mastering Test** using the link below.

**📄 JUMP TO:** See section [4.8 Running the Mastering Check](#) for instructions.

(Continued on next page)

- Look at the error messages on the KUKA pendant to see if you have a “Perform Mastering” error message: **Upper left Robot icon/Diagnosis/Logbook/Display** will show a history of all errors encountered. **This is not the same as a “Mastering Test Required” error message.**

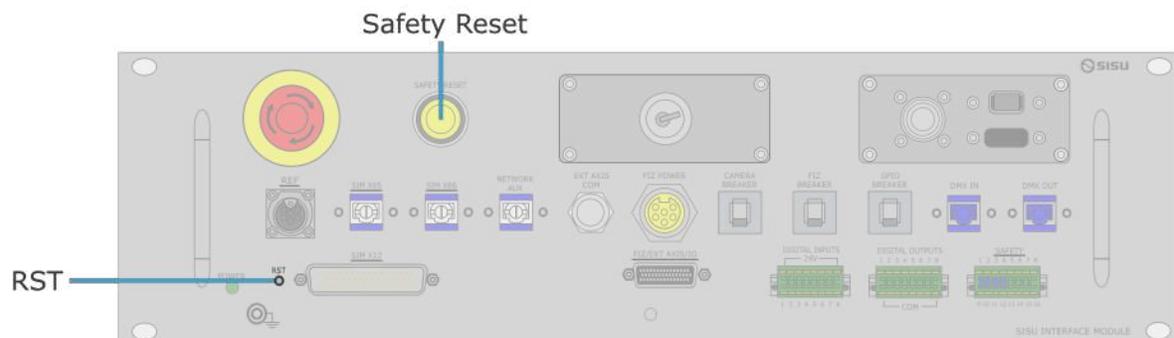
If you DO have a “Perform Mastering” error message, you will need to **Manually Master** the robot using the link below. If not, keep reading.

 **JUMP TO:** See section [9 Appendix A - Mastering Helps](#) for instructions.

- If any other errors remain active on the KUKA pendant, take a photo and contact SISU customer support.

**SOLUTION #4:** If you have a red error bar on the KUKA pendant, do the following:

- Push the yellow **Safety Reset button** on the SIM, and reset the SIM by pushing on the small SIM **RST button**. If you still cannot move the robot, keep reading.



- Power cycle the whole system by doing the following:

- Shut down the SISU Lab case from the tablet screen.

 **CASE POWER BUTTON:** You should **always try to avoid** powering down the case using the case power button.

- Power down the KUKA robot.
- Check the SIM and the KRC4 connections per the installation guide.
- Power everything back ON.

(Continued on next page)

- e) Press the small **RST button** on the SIM.



**SOLUTION #5:** If you have gone through all possible solutions above and still cannot move the robot, please contact SISU customer support.

## 10.2.8 ISSUE: Robot dips or stops suddenly when you are running a program

**PROBLEM:** Your C14 robot dips or stops suddenly while you are running a program.

**SOLUTION #1:** If the robot stops suddenly check for the following notification messages at the top of the KUKA pendant.

1. Error: Charging of intermediate circuit failed
2. Error: General power supply error

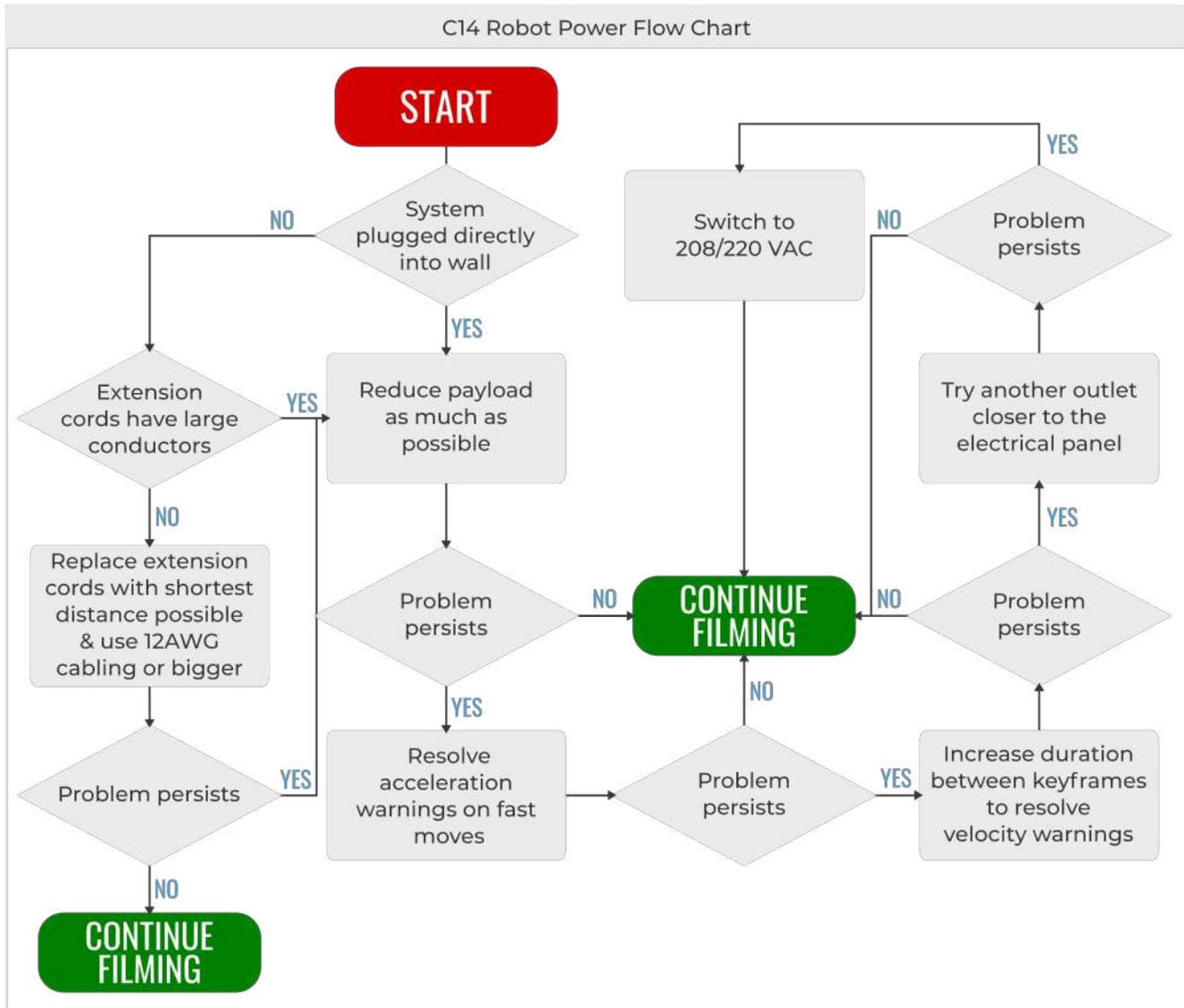
If any of these notifications are present, jump to [solution #2](#).

If none of these notifications are present, jump to [solution #3](#).

**SOLUTION #2:** If the robot stops suddenly, check for acceleration or velocity **warnings** in the **Activity Logs** for your program at the time of the issue. On the KUKA pendant, check for **Max Torque** or **High Acceleration** errors. Increase duration between keyframes or Ease In/Out where the robot stopped to remove the warning. Try to run the program again.

(Continued on next page)

**SOLUTION #3:** If the robot motion unexpectedly dipped or dropped and you do NOT have errors on the KUKA pendant, you could be running into power limitations on a C14. Follow the troubleshooting flowchart to try to resolve the issue.



 **JUMP TO:** For more information on the C14 power limitations, see section [1.3 Robot Size and Speed Capacity](#).

## 10.2.9 ISSUE: Mastering check failure

**FAILURE #1:** If the **Mastering Check** fails but the lights on the reference switch turn OFF when the flange touches the reference switch during the Mastering Check, reboot the system and run the Mastering Check again.

**FAILURE #2:** If the **Mastering Check** fails because the robot is NOT coming close enough to turn off the lights on the reference switch, this could be that the robot mastering is wrong and the robot needs to be **Manually Mastered**. Contact customer support for instructions on how to manually master the robot or see section [9 Appendix A - Mastering Helps](#).

**FAILURE #3:** After the robot has been **Manually Mastered** and it is still failing the **Mastering Check**, you may need to **Reconfigure the Mastering Reference Position**. To Reconfigure the Mastering Reference Position see section [9 Appendix A - Mastering Helps](#).

**FAILURE #4:** Look for an error on the KUKA pendant. If you come across an error that reads **Level at mastering reference switch is unexpectedly low** make sure that the reference switch is plugged in properly on both ends. Also make sure that the two lights on the back of the reference switch are lit up. Finally, make sure that the pins in the reference switch cable are not bent.

## 10.2.10 ISSUE: Interference Detected message pops up constantly

**PROBLEM:** You keep seeing the message **Interference Detected**. Release the wand **Trigger**, and make sure no objects are too close to the wand. If this message continues to pop up repeatedly, recalibrate the wand. If recalibrating the wand does not solve the problem, go through the following solutions:

**SOLUTION #1:** Ensure that your case is not placed on or near large metal objects, and that the case is not sitting on the ground.

**SOLUTION #2:** Update your **Distortion Tolerance** to a higher value and test robot motion with the **Trigger** to confirm that it is smooth.

**SOLUTION #3:** Calibrate the wand to a different frequency. (If you have multiple SISU Cinema Robots on set, each should be calibrated to a different frequency).



**JUMP TO:** See section [4.5 Calibrating the Wand](#) for more information on calibrating the wand to different frequencies.

### 10.2.11 ISSUE: Robot suddenly loses power

**PROBLEM:** The robot was working fine but suddenly loses power.

**SOLUTION #1:** Check to make sure that you have not experienced a power outage.

**SOLUTION #2:** Walk around and inspect cables: make sure they are all properly plugged in, and make sure none of the cables are damaged.

**SOLUTION #3:** The robot can power down when the smart transformer overheats. In this case, try unplugging the smart transformer, letting it sit for 30 minutes to cool off, and plugging it back in.

**SOLUTION #4:** If none of the above solutions fix the problem, please contact customer support.

## 10.3 FIZ and focus issues

### 10.3.1 ISSUE: The FIZ motor lights are blinking

**PROBLEM:** If the FIZ motors stop moving it could be that they have torqued out: meaning they have tried to switch directions too quickly or they receive a signal that interferes with their normal motion control.

**SOLUTION #1:** Look in your FIZ users manual to adjust the torque and artistry settings.

### 10.3.2 ISSUE: Focus marks are off when running a program

**PROBLEM:** After writing a program, you run the program and the focus seems to be a little off at the saved robot positions.

**SOLUTION #1:** Depending on the lens and the FIZ motor combination, you may experience an offset from your saved FIZ keyframes when running a program. This can be due to gaps in the gearing between the FIZ motors and the lens ring gears: this gap is known as **Backlash**. To fix, calibrate and set the backlash values for the Focus, Iris, and Zoom.



**JUMP TO:** See section [4.10.1 Calculating Backlash Compensation Factors](#) for instructions on how to calibrate the **Backlash**.

**SOLUTION #2:** Always use cine lenses with hard stops and cinegears. Continuously rotating lenses may slip while running a program, causing the programmed focus marks to be offset.

### 10.3.3 ISSUE: FIZ motors have power but appear as disconnected in SISU Lab

**PROBLEM:** Your FIZ motors appear to be powered ON (e.g. lights are blinking), but they are showing as being disconnected in SISU Lab.

**SOLUTION #1:** Press the small **RST** button on the SIM and wait for the system to reboot (this could take several minutes).



### 10.3.4 ISSUE: FIZ motor movement not smooth in Joint Mode

**PROBLEM:** Moving your FIZ motor on the **Joint Mode page** is not smooth. After switching to another motor, it jerks the last moved motor position.

**SOLUTION #1:** Do NOT press the **Enable button** (robot disengaged) when changing the FIZ motor position.

### 10.3.5 ISSUE: Items in the foreground and background are not staying lined up when you pan the camera

**PROBLEM:** When you use your camera to pan across your set the items in your foreground and background are not staying lined up properly.

**SOLUTION #1:** Measure and set a **Nodal Offset** point in your **Lens Configuration** page. For more details on how to do this, see section [4.10 Lens Configuration](#).

# 11. APPENDIX C - ROBOT SPECS AND REPLACEMENT PARTS

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## 11.1 Chapter Contents:

- **Environmental Conditions** - [11.2](#)
- **Ventilation Requirements** - [11.3](#)
- **General Robot Specs** - [11.4](#)
- **SISU Smart Transformer 2.0 Specs** - [11.5](#)
- **Replacement Parts** - [11.6](#)

## 11.2 Environmental Conditions

- **Operating Ambient Temperature:** Min 0C - Max 45C
- **Storage Temperature:** Min 0C - Max 45C
- **Humidity:** 90% non-condensing

 **IMPORTANT:** For indoor use **only**.

 **IMPORTANT:** Do **not** use near liquids.

## 11.3 Ventilation Requirements

- Keep the side vents of the SISU Interface Module (SIM) clear (a minimum of 2 inches).
- **The case must sit flat on a table that is at least 3 feet off of the ground.** Keep a space of 3 inches between the case heat sink and another object to allow for adequate airflow.

 **JUMP TO:** See section [2.4.1 How to Set Up the System](#) for a case placement graphic and more information.

## 11.4 General Robot Specs

### METRIC VERSION:

 SISU CINEMA ROBOTS - ROBOT COMPARISON				
	C11	C14	C20	C31
				
<b>DIMENSIONS</b>				
Max Height	2.3 m	2.5 m	3.4 m	3.6 m
Lowest Position	0.3 m	0 m	-0.75 m	-2.1 m
Wingspan	2.4 m	2.8 m	4 m	6.2 m
<b>REPEATABILITY</b>				
Repeatability	0.02 mm	0.04 mm	0.04 mm	0.05 mm
<b>WEIGHT</b>				
Robot	57 kg	160 kg	255 kg	549 kg
Max Payload	10 kg	10 kg	19 kg	20 kg
<b>TEMPERATURE</b>				
Min	0C	5C	5C	0C
Max	45C	45C	45C	55C
<b>REQUIRED POWER</b>				
Power	Standard Outlet	Standard Outlet	480V 3-Phase	480V 3-Phase
<b>FITS THROUGH STANDARD DOORWAY</b>				
Standard Door	Yes	Yes	Yes	No
<b>TRANSPORTABILITY</b>				
Recommended	Truck/Trailer	Truck/Trailer	Truck w/lift gate	Mobile in studio

(Imperial version on next page)

## IMPERIAL VERSION:

				
	C11	C14	C20	C31
				
<b>DIMENSIONS</b>				
Max Height	7' 6.5"	8' 2"	11' 2"	12' 0"
Lowest Position	12"	0'	-2' 5"	-7' 0"
Wingspan	7' 10"	9' 2"	13' 2"	20' 4 "
<b>REPEATABILITY</b>				
Repeatability	0.0008 in.	0.0016 in.	0.0016 in.	0.0020 in.
<b>WEIGHT</b>				
Robot	126 lbs.	353 lbs.	562 lbs.	1210 lbs.
Max Payload	22 lbs.	22 lbs.	42 lbs.	44 lbs.
<b>TEMPERATURE</b>				
Min	32F	40F	40F	32F
Max	113F	113F	113F	131F
<b>REQUIRED POWER</b>				
Power	Standard Outlet	Standard Outlet	480V 3-Phase	480V 3-Phase
<b>FITS THROUGH STANDARD DOORWAY</b>				
Standard Door	Yes	Yes	Yes	No
<b>TRANSPORTABILITY</b>				
Recommended	Truck/Trailer	Truck/Trailer	Truck w/lift gate	Mobile in studio

## 11.5 SISU Smart Transformer 2.0 Specs

Contact the SISU sales team at: [sales@sisucinemarobotics.com](mailto:sales@sisucinemarobotics.com), 512-377-6075 for more information on the SISU Smart Transformer 2.0.

### METRIC VERSION:

v1.0m

# SISU SMART TRANSFORMER 2.0



### POWER

**PWR INPUT RECEPTACLE** ● ----- 250V 60A (male)  
IEC 60309 60A 3P 4W

**ROBOT PWR OUTPUT RECEPTACLE** ● ----- 480V 20A (female)  
IEC 60309 20A 3P 4W (x2)

**SHORT CIRCUIT CURRENT RATING** ----- 5kA

**MAX POWER** ----- 15kVA

**FREQUENCY (HZ)** ----- 60

### OTHER SPECS

**CART POWER PLUG TYPE** -----  NEMA 14-50P

### INPUT / OUTPUT

INPUT	OUTPUT
208 VAC, 1Φ, 63A	480 VAC, 3Φ, 15.6A
208 VAC, 3Φ, 46A	480 VAC, 3Φ, 20A
240 VAC, 1Φ, 63A	480 VAC, 3Φ, 18A
240 VAC, 3Φ, 40A	480 VAC, 3Φ, 20A

### DIMENSIONS

**CART POWER CABLE** ----- 3m

**ROBOT POWER CABLE for C20/C31** ----- 7m or 15m  
*(Not included with smart transformer)*

**CART DIMENSIONS** ----- 1.3m x 1.2m x 0.7m

**WEIGHT** ----- 306.2 kg



**ONLY QUALIFIED ELECTRICIANS AND PERSONNEL SHOULD SERVICE THIS DEVICE**  
 ARC FLASH EXPLOSION HAZARD  
 RISK OF ELECTRIC SHOCK  
 THE SMART TRANSFORMER IS FOR INDOOR USE ONLY  
 DO NOT TRY TO LIFT THE SMART TRANSFORMER BY THE HANDLES



**IMPERIAL VERSION:**

v1.0i

# SISU SMART TRANSFORMER 2.0



### POWER

<b>PWR INPUT RECEPTACLE</b> ●	250V 60A (male) IEC 60309 60A 3P 4W
<b>ROBOT PWR OUTPUT RECEPTACLE</b> ●	480V 20A (female) IEC 60309 20A 3P 4W (x2)
<b>SHORT CIRCUIT CURRENT RATING</b>	5kA
<b>MAX POWER</b>	15kVA
<b>FREQUENCY (HZ)</b>	60

### OTHER SPECS

<b>CART POWER PLUG TYPE</b>	Ⓜ NEMA 14-50P
-----------------------------	---------------

### INPUT / OUTPUT

INPUT	OUTPUT
208 VAC, 1Φ, 63A	480 VAC, 3Φ, 15.6A
208 VAC, 3Φ, 46A	480 VAC, 3Φ, 20A
240 VAC, 1Φ, 63A	480 VAC, 3Φ, 18A
240 VAC, 3Φ, 40A	480 VAC, 3Φ, 20A

### DIMENSIONS

<b>CART POWER CABLE</b>	9' 10"
<b>ROBOT POWER CABLE (C20/C31)</b>	22' 11" or 49' 2"
<i>(Not included with smart transformer)</i>	
<b>CART DIMENSIONS</b>	51.5" x 50" x 29"
<b>WEIGHT</b>	675 lb



ONLY QUALIFIED ELECTRICIANS AND PERSONNEL SHOULD SERVICE THIS DEVICE  
 ARC FLASH EXPLOSION HAZARD  
 RISK OF ELECTRIC SHOCK  
 THE SMART TRANSFORMER IS FOR INDOOR USE ONLY  
 DO NOT TRY TO LIFT THE SMART TRANSFORMER BY THE HANDLES



## 11.6 Replacement Parts

Individual Spare Parts	Spare Parts Kits
Case	Camera Mounting Assembly
Individual Cables	Complete Cable Kit
Tablet	Complete Electrical Cabinet
SIM	FIZ Control Kit
Wand	FIZ Wireless Control Kit
Weight Plates	Reference Switch Assembly
	SIM Cables

 **JUMP TO:** To inquire about purchasing replacement parts please contact support listed in section [1.9 Contact Information](#).

# 12. APPENDIX D - SISU CINEMA ROBOTICS COMPLIANCE

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## 12.1 Chapter Contents:

The SISU Cinema Robotics system conforms to the following compliances and standards:

- **CE Certification** - [12.2](#)
- **Industrial EMC Standards** - [12.3](#)
- **Electrical Safety** - [12.4](#)
- **Emergency Stop Buttons** - [12.5](#)
- **Standards Applied to Design** - [12.6](#)
- **Risk Assessment** - [12.7](#)

## 12.2 CE Certification

SISU Cinema Robotics systems are CE certified.



## 12.3 Industrial EMC Standards

SISU Cinema Robotics systems are tested to industrial EMC standards per IEC 61326-1:2012:

1. Radiated Emissions, 30MHz - 1GHz, CISPR 11:2009 / A1:2010, Group 1, Class A
2. AC Power, Conducted Emissions, 230VAC / 50Hz, CISPR 11:2009 / A1:2010, Group 1, Class A
3. ESD on Enclosure, 4kV/8kV IEC 61000-4-2:2008 Criteria B

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4. Radiated Immunity, 80MHz - 1GHz, 10V/m, IEC 61000-4-3:2006 / A1:2007 / A2:2010, Criteria C\*
5. Radiated Immunity, 1.4GHz - 2GHz, 3V/m, IEC 61000-4-3:2006 / A1:2007 / A2:2010, Criteria A
6. Radiated Immunity, 2GHz - 2.7GHz, 1V/m, IEC 61000-4-3:2006 / A1:2007 / A2:2010, Criteria A
7. AC Power, Burst: 2kV, 5/50ns, 5kHz, IEC 61000-4-4:2004 / Corr:2007 / A1:2010, Criteria B
8. I/O Line, Burst: 1kV, 5/50ns, 5kHz, IEC 61000-4-4:2004 / Corr:2007 / A1:2010, Criteria B
9. AC Power, Surge: 1kV line-to-line / 2kV line-to-earth, IEC 61000-4-5:2005 / Corr:2009, Criteria B
10. AC Line, Conducted Immunity: 150kHz - 80MHz, 3Vrms, IEC 61000-4-6:2008, Criteria A
11. I/O Line, Conducted Immunity: 150kHz - 80MHz, 3Vrms, IEC 61000-4-6:2008, Criteria A
12. Radiated Magnetic Field, 30A/m, IEC 61000-4-8:2009, Criteria A
13. AC Power, Voltage Dips: 0% for 1 cycle, 40% for 10/12 cycles, 70% for 25/30 cycles, IEC 61000-4-11:2004, Criteria A
14. AC Power, Short Interruptions: 0% for 250/300 cycles, IEC 61000-4-11:2004, Criteria C

\*Exception to IEC 61326-1:2012 - Industrial Requirements: System is rated to criteria C and not A for Radiated Immunity, 80MHz - 1GHz, 10V/m. High peaks of electromagnetic noise may cause loss of signal from the tablet and require a user recalibration in the case.

## 12.4 Electrical Safety

The SISU Cinema Robotics system is tested to Electrical Safety per UL/EN 61010-1:2010.

## 12.5 Emergency Stop Buttons

Emergency stop buttons are compliant to IEC60947-5-5 following EN ISO 13850:2015 Safety of machinery.

## 12.6 Standards Applied to Design

Principles of the following standards are applied to design:

1. EN ISO 10218-1:2011 Robots and robotic devices – Safety requirements for industrial robots – Part 1: Robots (equivalent to ANSI/RIA R.15.06-2012, Part 1)

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2. EN ISO 10218-2:2011 Robots and robotic devices – Safety requirements for industrial robots – Part 2: Robot systems and integration (equivalent to ANSI/RIA R.15.06-2012, Part 2)
3. EN ISO 12100:2010 Safety of machinery – General principles for design – Risk assessment and risk reduction and RIA TR R15.306-2016 Task-based Risk Assessment Methodology

## **12.7 Risk Assessment**

A risk assessment must be performed by the final integrator following EN ISO 12100:2010 or RIA TR R15.306-2016 to be compliant with general safety standards.