



MARK ROBERTS MOTION CONTROL

SHOWBOLT JUNIOR



QUICK START GUIDE

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Showbolt Junior Quick Start Guide

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Chapter 1 Quick Start

Overview

Thank you for using the Showbolt Junior rig from Mark Roberts Motion Control (MRMC). Showbolt Junior is a lighter-weight high-speed robot arm and camera capable of shooting and editing cinematic quality content in seconds that can be used as a reliable solution for your experience and event.



Showbolt Junior has a stationary base which you either hold down with weights or, for more permanent installations, attach to the floor.

Showbolt Junior is complete motion control system that includes:

- The **Showbolt Junior rig**
- The weights and weight wings mounted on the rig
- **Zcam** camera mounted on the Showbolt Junior arm to shoot the footage
- A **SICK safety scanner** for area and access protection around the robot
- A **flight case** that includes: a PC running Flair and Showbolt Bridge application, RT-14, switch and other connection boxes

How it Works

Once the Showbolt Junior system is set up, every time a move is run on MRMC's Flair software application, Zcam is triggered and when the move is stopped, Zcam is stopped and the recording from the camera is downloaded on to the Showbolt Junior PC. Showbolt Bridge Program processes the recording and sends, shares or transfers it to a defined media. The Showbolt Bridge program allows you to set various operational modes such as:

- Triggering the camera when the robot starts shooting or on a desired frame
- Auto-processing the Zcam video footage
- Auto file transfer of the recording to the local PC, share drive or an FTP server.

Setting up the Showbolt Junior System

To setup the Showbolt Junior system, perform the following:

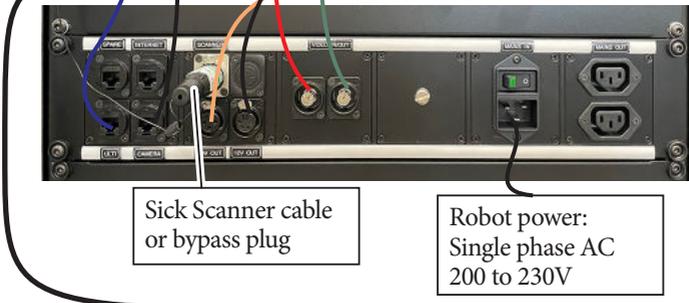
1. Mount the weight wings, page 30, or anchor to the floor, page 38, as required.
2. Connect the cables including those between the flight case, the rig and the Showbolt Bridge PC, page 3. For detailed information of other connections within the flight case, refer to page 54.
3. Start the Showbolt Junior system, page 6.
4. Set up the SICK proximity scanner, page 40. The proximity device will enable the E-stop when any object comes in the 'safe zone'. If you are only testing the system, this step can be performed after step 5.
5. Set up a robotic move on Showbolt Junior in Flair. Instructions on setting up a move in Flair are out of scope of this Quick Start Guide. For more information, refer to *Flair 6.4 Operator's Manual*.
6. Set up the Showbolt Bridge program and editing sample batch files to define how the Bridge program processes the video files and shares them on the choice of media, page 9.

Connecting the cables

Robot Arm (Rear)



POWER



Robot Controller CR800 (Rear)



Connecting the Cables - Showbolt Arm

1. Mount the camera platform on the Showbolt. Also add the matte bars and focus and zoom motors on the matte bars. For more information, refer to the *Camera Platform for Bolt Family Quick Start Guide*.
2. Add the connections for the Ulti-box mounted on the arm, and for the camera.

Ulti-box, which provides various connectors for camera and lens controls. For details see *Ulti-box connector summary* on page 43.

POWER
input: 24-48
Volts DC

ETHERNET for
Ulti box



POWER output:
48 Volts DC

Video 1

ETHERNET
for Ulti

Video 2

ETHERNET
for camera



3. Attach the power cable from the **Camera Power** connector on the arm to the 12V distribution box.



12v distribution box - To supply power to Camera, Light Ring and HDMI converter

Starting up the Showbolt system

Once you have attached all the cables, you power up the rig by switching on the components in the order described below.

1. Make sure you have secured the area around Showbolt Jr. Put up guard rails around Showbolt Jr (and the track) as necessary, and tell others on the set that you are now powering up the rig.



2. Power up the Flight Case switch. Wait for the robot to boot up for a few seconds.

Note.

The window in the flight case can be used to observe the LEDs on the CR800 controller.



The state of LEDs show the booting up sequence of the CR800 controller

Booting sequence	Time (sec)	Power	Auto	Error	Ready
1	20	I	I	I	I
2	11	I	I	I	F
3	5	I	F	F	F
4	fraction	I	I	I	I
5	3	I	I	O	O
6	3	I	O	F	O
7	7	I	F	O	F

Booting sequence	Time (sec)	Power	Auto	Error	Ready
Booting complete					

(I=On; O=Off; F=Flashing)

- Power up the Flair computer system and all of its components, including the RT-14 interface box. You can do this while the robot is powering up (step 2).
- On the Flair PC, start the Flair application by double-clicking on the Flair icon on the Desktop.

Flair automatically loads the relevant firmware into all attached axis boards, including:

- The Ulti-box that is mounted on the Showbolt Jr arm
- Any additional interface boxes or model movers that are attached to the computer stack such as Turntable

Robot status	Power	Auto	Error	Ready
Robot engaged	I	I	F	I (Fast)
Robot disengaged	I	I	F	I (Slow)
ESTOP	I	I	F	F

5. Release the E-stop that is plugged into the computer stack, by turning the button clockwise until the red button pops up and then pressing the Enable button.
6. In Flair, click on the **Engage Robot** button.
7. Zero the axes as required in Flair. The Showbolt Jr arm itself does not require zeroing but you need to zero other axes such as:



ENABLE button

- Any external Lens Control Motors (LCMs) that you are using. To zero these you first set the **focus to infinity** (∞), **zoom to wide-angle** (zoomed out all the way), **iris/aperture to wide open** and then use the relevant **Zero > Direct Zero Axis** menu option to set those lens positions as the zero points in Flair.
 - Any model mover axes like Turntable.
8. In Flair, move the Showbolt Jr arm to its home position (rotated straight forward and tucked under).
 9. Set the soft limits for the rig axes in Flair as required:
 - Lens Control Motor limits (if using external LCMs)
 - Any model mover limits
 - It is not recommended that you change the soft limits on the arm; if not done correctly it can lock up the arm.

Showbolt Jr start-up summary

1. Secure the area
2. Switch on Showbolt Jr
3. Switch on the Flair PC
4. Check networking lights for robot in Ready state
5. Start Flair
6. Release the E-stop on the computer stack

In Flair:

7. **Engage Robot**
8. Zero the track and Lens Control Motor axes
9. Home the arm, carefully
10. Set the soft limits

The rig is now ready to use.

Showbolt Bridge Application

Network setup

- The zCam connected to the Showbolt Jr arm network connection
- Showbolt Jr PC: PC running Flair Motion Control software and the Showbolt bridge program.
- Your FTP server (if used)

Note

There is no DHCP server running on that network so all IP addresses are set up as a static IP.

IP settings (for reference):

Showbolt Jr PC: 192.168.1.200

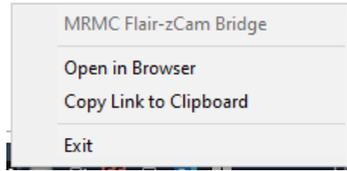
zCam (static): 192.168.1.77

Using the Showbolt Bridge

1. On the Showbolt Junior PC, launch the SB-MP-Bridge.exe by double-clicking the Desktop icon if not launch at Windows startup.
2. After that you will see a black icon in the taskbar with a capital M in the middle like this:

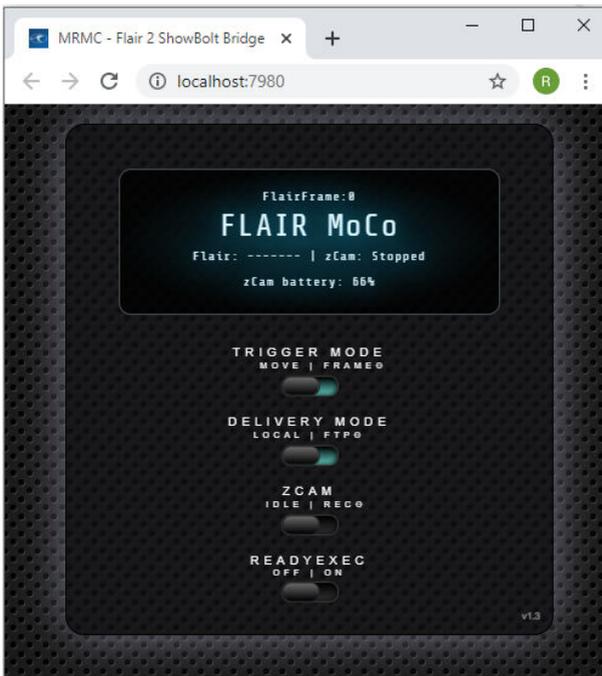


3. Left clicking the icon will display the default web interface. Right clicking it presents the following options:



Using the Exit will close the application.

Web interface



The Web Interface allows you to view and change many settings on the Showbolt Bridge while the application is running. You can open the bridge's web interface by using the following URL:

<http://localhost:7980>

You can read the current Flair status, Frame number and zCam status.

Operational modes

By default the bridge will **trigger** the camera when Flair is moving the arm (shooting) and will **stop** the camera when it is stopped (changing from shooting to anything else) and download the footage from the camera to the local folder (next to the SB-MP-Bridge.exe) and delete the footage from the camera.

- Trigger mode (tmode):
 - **Move:** Trigger the camera when the robot moves (flair: shoot)
 - **Frame:** Start the camera at the specific (Flair) frame and stop it at the specific (Flair) frame number or when the move stops.
 - Start frame/stop frame can be changed independently by clicking the **Frame** option



- Delivery mode (dmode):
 - Local: deliver the captured footage to a local computer (or to locally mapped network drive)
 - Ftp: deliver the footage to an ftp server
- Ftp server address (ftpip):



- Enter both the FTP server address (can be hostname or IP address) and its port number separated by a colon



zCam recording

By default, running a Flair move will automatically change the state of the camera to recording.



This switch can also be toggled manually, if you need the camera to record in the current position.

Note

To change any settings on the zCam, access the zCam web interface using the IP address on page 9. When the zCam webpage is open, the Showbolt Bridge will not work.

zCam is capable of recording using H264 or H265 compression. H265 allows the camera to record at up to 240FPS but H264 only allows up to 120FPS. The advantage of H264 is that it is readily viewable and editable by Windows or third party editors but H265 requires conversion to H264 for which Showbolt Bridge program uses FFMPEG by default in the batch files, see *Batch file commands* on page 14.

Checking the zCam Video Feed

1. Open the browser and click on “CAMERA CONTROLLER” at the top of the screen. This will open the LIVE camera view and a menu of all the camera functions available.

Note

If the camera is mounted upside down, the software does not have the ability to invert this live image in this main window. (If required for viewing live, please use a regular video viewing monitor and invert it).

The Screen Rotation option on the side menu will invert the final recorded image automatically, but it does not invert the live image.

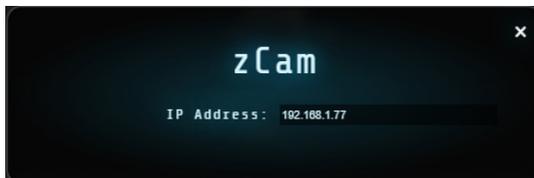
2. Click the Record tab and check the frames rates and camera settings in this display and apply to the camera. Click on the Playback tab and check the playback settings are as required.

Note

Procedure to download the video files to external devices or software is outside the scope of this Quick Start guide.

Modifying zCam’s IP Address

Use the **Rec** option to change the IP address of the zCam, if required.



Batch file commands

If you need to execute a set of commands on the recording from zCam, these can be included in a batch file called **readyexec.bat** and included in the same folder as the **SB-MP-Bridge.exe**. Once, the switch is toggled to **On**, all the commands in the file will be executed when the move is run in Flair. A few such example files with commands that uses FFMPEG are included in the Showbolt folder. This can be modified to commands as per your need:



- **any_input_FFMPEG_edit.bat:** This sample file uses FFMPEG commands to decode video (any format), segment and resize the input video, concentrate the parts and speed up the first part, play the second part backwards, play the third part normally, rotate the movie 180 degrees and does CUDA encoding to H264 and then creates a thumbnail.
- **any_input_FFMPEG_edit_with_logo.bat:** Does the same edit as any_input_FFMPEG_edit.bat, in addition overlays the PNG file (logo).
- **h264_forward_reverse_to_premier:** This batch file takes an H264 file and makes two copies, one going forwards and the other going backwards and saves them at a lower bandwidth ready for Adobe Premier Pro or alternative editor.
- **h265_forward_reverse_to_premier:** This batch file takes an H265 file and makes two copies, one going forwards and the other going backwards and saves them at a lower bandwidth ready for Adobe Premier Pro or alternative editor.
- **h265_FFMPEG_edit:** This sample batch file takes an H265 video file as input and uses FFMPEG commands to decode the H265 video, segment and resize the input video, concentrate the parts and speed up the first part, play the second part backwards, play the third part normally, rotate the movie 180 degrees and does CUDA encoding to H264 and then creates a thumbnail.
- **h265_FFMPEG_edit_with_logo.bat:** Does the same edit as h265_FFMPEG_edit.bat, in addition overlays the PNG file (logo).

- **readyexec.bat:** This sample batch file runs the h265_FFMPEG_edit_with_logo.bat.

Note

The sample batch files provided with the Showbolt include FFMPEG commands as a preferred tool to edit the zCam footage. You can use Adobe Premier Pro or any other media editor of your choice. The FFMPEG solution does not have a user interface is faster when doing simple edits like:

- Play 4X the speed forwards
- Play at original speed backwards
- Rotate the whole footage 180 degrees
- Transcode it to H264 using 6Mbps fixed rate using an MP4 container

An example of an efficient method to edit your video files could be that you use FFMPEG for simple edits and then use the batch files to pass the videos to Adobe Premier Pro where you set up a proj file to further add video compositing effects, such as fading and kaleidoscope, to your video files.

Showbolt Bridge Editing Sequence

When a Flair move is run, zCam records with H264 or H265 compression and downloads the video to the Showbolt PC in the “SB-MB-BRIDGE” folder next to the SB-MP-Bridge.exe.

Note

As the video files are being downloaded, the software makes at “TMP” (temp) file while it gathers the info from the camera. This changes into a MP4 file when it is complete.

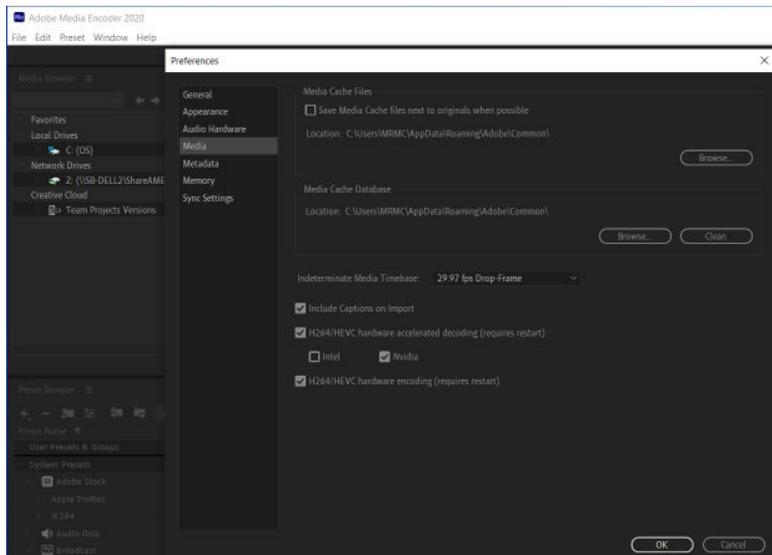
Once the video is downloaded, the batch file run by the Showbolt Bridge application initiates the media editing programs like FFMPEG or Adobe Premier Pro to do the video editing.

When using Adobe Premier Pro, you can create proj files to:

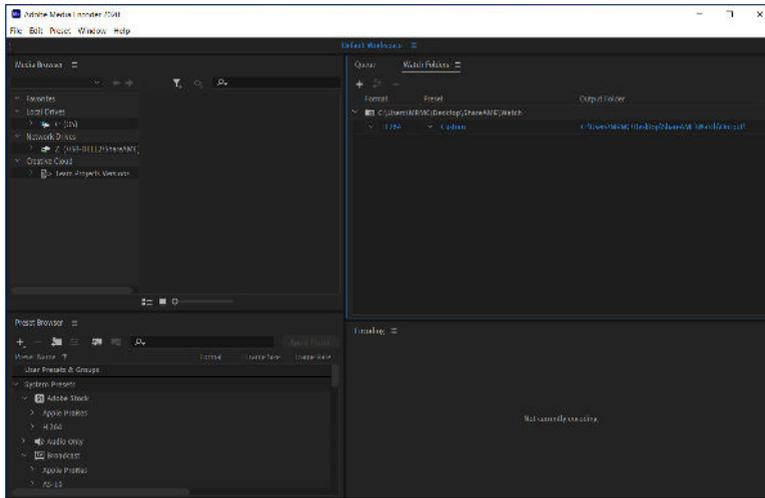
- Set up initial auto-editing to be performed on your media files.
- Place them in a ‘watch’ folder being watched by Adobe Media Encoder that is running in the background.

The Adobe Media Encoder creates temporary files for processing, transcodes and outputs to a chosen format. The Showbolt Bridge makes them available to be downloaded for transfer on a media of choice (FTP server, share drive or USB stick) and then deletes the temporary files. In this manner, it waits for files to be dropped again in the ‘watch’ folder to process when the Flair move is run next time.

CUDA acceleration is already enabled in settings in Adobe Media Encoder. When setting up Adobe Media Encoder it is best to only allow hardware acceleration with the NVIDIA graphics card so that it doesn’t accidentally use the onboard Intel graphics card which is slower.



The Watch folder is setup as follows:

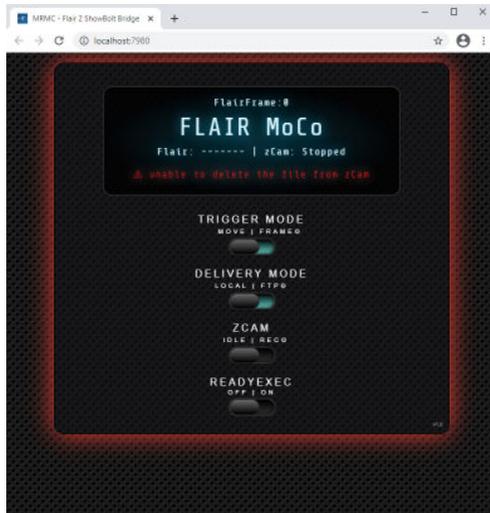


Note

The Bridge PC is set to autostart Adobe Media Encoder and the Bridge software when Windows starts but if they are closed for any reason, then they need starting manually from the desktop shortcuts on the Showbolt PC.

Error Message

While transferring the video file from the camera and deleting the file once downloaded, any occurring errors are displayed on the Showbolt Bridge web interface with a red border. For example, after downloading the file, it could not be deleted from the zCam memory card, then the following error is displayed.



The error is automatically cleared after 60 seconds so application is ready to perform the next action like downloading the next video if the camera is recording and connected.

Debugging interface

The main UI of the Web interface allows access to many settings. For additional settings, you can use the Debugging interface. Entering the “/ debug” after the URL in the browser will show the debugging interface for example: <http://localhost:7980/debug/> (if you are working on the same PC where the bridge is running) or <http://192.168.1.55:7980/debug/> on any other PC. On the Bridge web interface, if you press the version number in the bottom right corner it will bring up the debug screen without having to type anything in.



At the top (big white) box you will see the messages from the server and at the bottom part you can send instructions (commands) to the server by typing in the command to the input box and after that pressing the send button.

Note

If you stop the bridge (by right clicking to the bridge server and selecting the exit) you will still see the debugging interface but it will warn you that the debugging interface is “disconnected” from the server and it will try to establish the connection in every 5 seconds.

Once the connection established you will see the “connected” message.

The “auto scroll” option is enabled by default but if you scroll up it will be disabled (to be able to read the messages and prevent it to running).

If you want to enable again you have to scroll down to the last message and it will scroll automatically again.

Each command must start with a letter **c** and then a colon for example:
c:help

That will produce the following options:



```
localhost:7980/debug/
2021-01-07T17:20:18.578Z: Connected
2021-01-07T17:33:46.945Z: c:help
2021-01-07T17:33:46.946Z: * help
2021-01-07T17:33:46.947Z: * available commands:
2021-01-07T17:33:46.947Z: * - help : this help message
2021-01-07T17:33:46.948Z: * - exit, quit: exit and terminate the listener
2021-01-07T17:33:46.949Z: * - showparam : display system parameters
2021-01-07T17:33:46.950Z: * - fackon : send ACK to Flair
2021-01-07T17:33:46.952Z: * - fackoff : don't send ACK to Flair
2021-01-07T17:33:46.952Z: * - wsdebugon : debug WS receiver
2021-01-07T17:33:46.953Z: * - wsdebugoff : don't debug WS receiver
2021-01-07T17:33:46.953Z: * - f2wson : relay Flair udp messages over WS
2021-01-07T17:33:46.954Z: * - f2wsoff : don't relay Flair udp messages over WS
2021-01-07T17:33:46.955Z: * - tmodemove : trigger when the robot moving
2021-01-07T17:33:46.955Z: * - tmodeframe : trigger at the specific framenum
2021-01-07T17:33:46.956Z: * - flair2stateon : enable 2s Flair state echo
2021-01-07T17:33:46.956Z: * - flair2stateoff : enable 2s Flair state echo
2021-01-07T17:33:46.956Z: * - campip=xxx.xxx.xxx.xxx : IP address of the zCam
2021-01-07T17:33:46.957Z: * - ftpip=xxx.xxx.xxx.xxx:yy : IP address and port number of the FTP server
2021-01-07T17:33:46.957Z: * - ftpuser=xxxxxxx : username for the FTP server
2021-01-07T17:33:46.958Z: * - ftppass=xxxxxxx : password for the FTP server
2021-01-07T17:33:46.958Z: * - dmodeftp : FTP delivery of the raw file
2021-01-07T17:33:46.959Z: * - dmodelocal : LOCAL / LAN delivery of the raw file
2021-01-07T17:33:46.959Z: * - deletezcamon : delete raw file after downloading it from zCam
2021-01-07T17:33:46.960Z: * - deletezcamoff : keep raw file after downloading it from zCam
2021-01-07T17:33:46.961Z: * - sbadownloadon : enable automatic file download after stop
2021-01-07T17:33:46.961Z: * - sbadownloadoff : disable automatic file download after stop
2021-01-07T17:33:46.961Z: * - battcam : zCam battery charge level in %
2021-01-07T17:33:46.962Z: * - getlatestcamfile : get the path of the latest file from the zCam
2021-01-07T17:33:46.962Z: * - startcam : start the capture at zCam
2021-01-07T17:33:46.962Z: * - stopcam : stop the capture at zCam
2021-01-07T17:33:46.963Z: * - delfromcam=xxxxxxx : delete the filepath[xx] from the zCam
2021-01-07T17:33:46.963Z: * - dfilename=xxxxxxx : destination filename/path {[*]filepath}
2021-01-07T17:33:46.963Z: * - sbtransferfile : routine to transfer file from zCam
2021-01-07T17:33:46.964Z: * - sbstartcam : sequence to start the zCam
2021-01-07T17:33:46.964Z: * - sbstopcam : sequence to stop the zCam
2021-01-07T17:33:46.964Z: * - startframe=xx : start the zCam at this framenum
2021-01-07T17:33:46.965Z: * - stopframe=xx : stop the zCam at this framenum
2021-01-07T17:33:46.966Z: * - readyexecon : enable readyexec.bat after filetransfer
2021-01-07T17:33:46.967Z: * - readyexecoff : disable readyexec.bat after filetransfer
2021-01-07T17:33:46.967Z:
```

For example:

If you want to change the FTP username to MRMC then you have to send the following command:

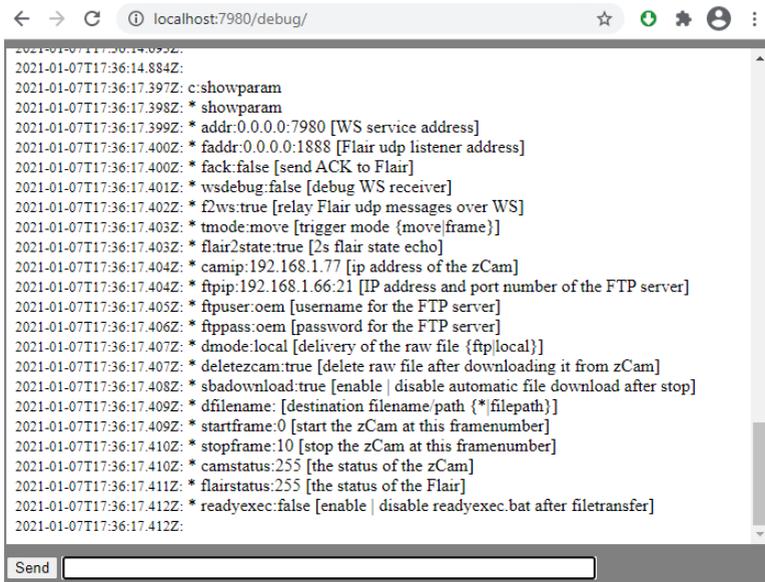
c: ftpuser=MRMC

if you want to enable the readyexce.bat then you have to send this:

c: readyexecon

You can check the actual settings (internal variables/parameters) by typing **c: showparam**

That will produce the following:



The screenshot shows a web browser window with the address bar displaying 'localhost:7980/debug/'. The main content area contains a list of internal variables and their current values, each preceded by a timestamp. The variables include parameters like 'showparam', 'addr', 'faddr', 'fack', 'wsdebug', 'f2ws', 'tmode', 'flair2state', 'camip', 'ftpip', 'ftpuser', 'ftppass', 'dmode', 'deletezcam', 'sbadownload', 'dfilename', 'startframe', 'stopframe', 'camstatus', 'flairstatus', and 'readyexec'. At the bottom of the browser window, there is a 'Send' button and an empty input field.

```
2021-01-07T17:36:14.095Z:
2021-01-07T17:36:14.884Z:
2021-01-07T17:36:17.397Z: c:showparam
2021-01-07T17:36:17.398Z: * showparam
2021-01-07T17:36:17.399Z: * addr:0.0.0.0:7980 [WS service address]
2021-01-07T17:36:17.400Z: * faddr:0.0.0.0:1888 [Flair udp listener address]
2021-01-07T17:36:17.400Z: * fack:false [send ACK to Flair]
2021-01-07T17:36:17.401Z: * wsdebug:false [debug WS receiver]
2021-01-07T17:36:17.402Z: * f2ws:true [relay Flair udp messages over WS]
2021-01-07T17:36:17.403Z: * tmode:move [trigger mode {move|frame}]
2021-01-07T17:36:17.403Z: * flair2state:true [2s flair state echo]
2021-01-07T17:36:17.404Z: * camip:192.168.1.77 [ip address of the zCam]
2021-01-07T17:36:17.404Z: * ftpip:192.168.1.66:21 [IP address and port number of the FTP server]
2021-01-07T17:36:17.405Z: * ftpuser:oem [username for the FTP server]
2021-01-07T17:36:17.406Z: * ftppass:oem [password for the FTP server]
2021-01-07T17:36:17.407Z: * dmode:local [delivery of the raw file {ftp|local}]
2021-01-07T17:36:17.407Z: * deletezcam:true [delete raw file after downloading it from zCam]
2021-01-07T17:36:17.408Z: * sbadownload:true [enable | disable automatic file download after stop]
2021-01-07T17:36:17.409Z: * dfilename: [destination filename/path {*/filepath}]
2021-01-07T17:36:17.409Z: * startframe:0 [start the zCam at this framenumbr]
2021-01-07T17:36:17.410Z: * stopframe:10 [stop the zCam at this framenumbr]
2021-01-07T17:36:17.410Z: * camstatus:255 [the status of the zCam]
2021-01-07T17:36:17.411Z: * flairstatus:255 [the status of the Flair]
2021-01-07T17:36:17.412Z: * readyexec:false [enable | disable readyexec.bat after filetransfer]
2021-01-07T17:36:17.412Z:
```

Here you can see the internal variables and its current values and some help message as well.

For example:

```
* dmode:local [delivery of the raw file {ftp|local}]
```

You can read like this:

```
Name of the parameter : value of the parameter [ help
message { available option1 | available option2..} ]
```

In the example above the current delivery mode is: local and you have the option to select in between ftp or local

Additional Notes

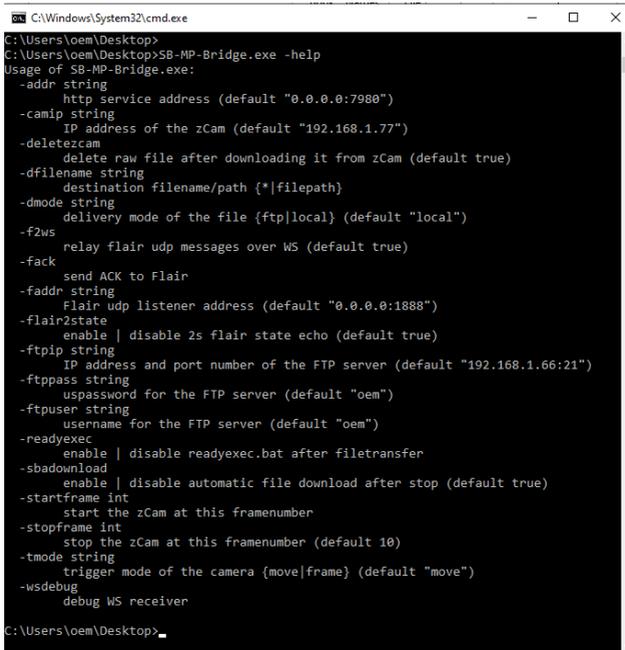
It is possible to start the application using custom parameters instead of the pre-defined (like a different delivery mode or a different port number) by using the command line parameters like this:

```
SB-MP-Bridge.exe -addr "0.0.0.0:1234" -faddr "0.0.0.0:6666"
```

This will start the bridge and will listen on all interfaces but on port number 1234 instead of the default 7980 and the Flair UDP listener will be at port number 6666 on all interfaces instead of the default port 1888.

You can limit the bridge to listen only on a single interface by entering its IP address instead of 0.0.0.0

The Help message is also available using command line interface:



```
C:\Windows\System32\cmd.exe
C:\Users\oem\Desktop>
C:\Users\oem\Desktop>SB-MP-Bridge.exe -help
Usage of SB-MP-Bridge.exe:
-addr string
    http service address (default "0.0.0.0:7980")
-camip string
    IP address of the zCam (default "192.168.1.77")
-deletezcam
    delete raw file after downloading it from zCam (default true)
-dfilename string
    destination filename/path (*|filepath)
-dmode string
    delivery mode of the file (ftp|local) (default "local")
-f2ws
    relay flair udp messages over WS (default true)
-fack
    send ACK to Flair
-faddr string
    Flair udp listener address (default "0.0.0.0:1888")
-flair2state
    enable | disable 2s flair state echo (default true)
-ftpip string
    IP address and port number of the FTP server (default "192.168.1.66:21")
-ftpPASS string
    password for the FTP server (default "oem")
-ftpuser string
    username for the FTP server (default "oem")
-readyexec
    enable | disable readyexec.bat after filetransfer
-sbadownload
    enable | disable automatic file download after stop (default true)
-startframe int
    start the zCam at this framenummer
-stopframe int
    stop the zCam at this framenummer (default 10)
-tmode string
    trigger mode of the camera {move|frame} (default "move")
-wsdebug
    debug WS receiver
C:\Users\oem\Desktop>
```

Notes

Chapter 2 Safety and Installation

Safety procedures for using industrial robots, including high speed track

Note that the words **Robot** and **Rig** are completely interchangeable and identical in meaning, for the purposes of this document.

Motion Control rigs are potentially dangerous. It is important that you and everyone else on the set understand the safety notes on the following pages in order to stay safe.

You should use this document in addition to the normal Safety Manual instructions that are applicable to all motion control rigs, such as Milos. This section emphasises the safety concerns that are especially important around high-speed, high-acceleration, industrial-grade robots which can cause severe injuries, such as Showbolt Jr.

- Unlike traditional motion control equipment, Showbolt Jr can get to maximum speed in the blink of an eye - too fast for someone to be able to quickly move out of the way.
- ⇔ If you are using Showbolt Jr on Track, you need to take extra steps during installation and use due to the additional risks involved in using track. See the separate *Precision Track Quick Start Guide* for information on laying the track, securing it to the floor, and mounting Showbolt Jr onto it. The notes given below for track users are marked with this symbol: ⇔.
- It is ultimately the **operator** of the rig who is responsible for the safe use of the equipment so never bypass any of the safety points listed here.
- No one other than a highly trained operator should use the robot, no matter how simple it looks or is.
- This document is for the use of robots for carrying cameras or props, not people. Additional safety steps should be taken prior to using a rig to carry people.

Assessing a site

Before setting up Showbolt Jr you need to **assess the site**, paying particular attention to the following points:

- Is the ground or floor firm enough and level enough? You might have to use boards or bricks to create a level surface. The surface needs to be strong enough to take the weight of Showbolt Jr itself (390kg) plus the weight of the track (95 kg per section) or for Showbolt Jr 264kg plus weights 280kg of weights (2x140kg).
- Does the site have access? You need to make sure you can either push Showbolt Jr into position on its wheels or carry it there using a pallet truck or forklift.
- Does the site have a power source with sufficient capacity for the robot and the correct mains voltage?
 - Showbolt Jr requires a **230V, single-phase power supply via a 13A power connector**.
 - The computer stack that controls Showbolt Jr (that is, the desktop computer and the power supply brick for the RT-14 interface box) are auto-switching and can run on 120-240 Volts AC.
- Does the site have unusual environmental attributes that require specialised protection from extreme temperatures, humidity, rain, or dust?

Installation safety

- Due to the large mass of the rigs and the accelerations they achieve it is important that they are securely mounted, with the recommended plates and bolts to a secure and concrete floor.
- Ensure the floor can support the load and the stresses (see above).
- Ensure the power supply is properly earthed (grounded) and of the correct voltage (see above).
- If the rig is mounted to something other than the floor then the mount should be heavy and strong enough to take the forces and not move or fall over during sudden starts and

stops. Use the recommended minimum thickness steel plates. Check with MRMC if you are unsure of the exact requirements for your robot.

- Check that all cables are securely fixed and are not going to catch during motion.
- Ensure the camera, lens, focus motor, accessories, power supplies/batteries, etc. are all very securely mounted and will not come off during sudden motions, to become lethal missiles.
- Ensure all safety accessories are securely attached and in working order, including emergency stops, safety sensors, etc.
- Clearly mark the area around the robot in which no persons are allowed to enter. As a bare minimum, use brightly marked tape on the floor, outside the reach of the robot, to indicate the “No Go Zone”. Ideally, use physical safety barriers, and light guards/curtains.
- Keep stands, lights and accessories out of the No Go Zone, if possible. If not possible then try to take as much care with their positioning and the motion of the rig, as if they were a person. Remember a light, accidentally hit at high speed by the robot, can be just as dangerous to someone standing outside the No Go Zone as the robot is to someone standing in the zone.
- Where physical safety barriers are impractical, light guards should be used or similar alternatives such as laser scanners, to stop anyone entering the No Go Zone during motion.
- Ideally have the robot surrounded on all four sides by a safety barrier, but where that is not practical, ensure that the maximum number of sides feasible are closed off, and that any person having to stand within reach of the robot is located as far away as possible for the shot.

Software setup

- Always ensure you have the right configuration for the robot you are using, such as maximum axis speeds and accelerations.
- Prior to running moves, enter in and keep to a minimum all software axis and Cartesian limits. For example if the main axis only needs to travel +/-40 degrees then reduce the limit to +/-

-40 degrees even though it could do +/-180 degrees. This keeps the likelihood of operator or software errors to a minimum.

- Also check the Cartesian speed and acceleration limits are set to reasonable values.

Operational safety

- Do not use around flammable gas. All electrical equipment can generate sparks that can ignite flammable gas.
- Keep the equipment dry. The system has **not** been made weatherproof. Do not use with wet hands.
- Always run moves only when standing within easy reach of the emergency stop.

- Always tell the production company and the crew to keep away from the robot and not approach it when any of its red lights are on which indicates it is powered up. Have them sign the appropriate safety documents and disclaimers to ensure they understand this and are indemnifying MRMC if anything happens.

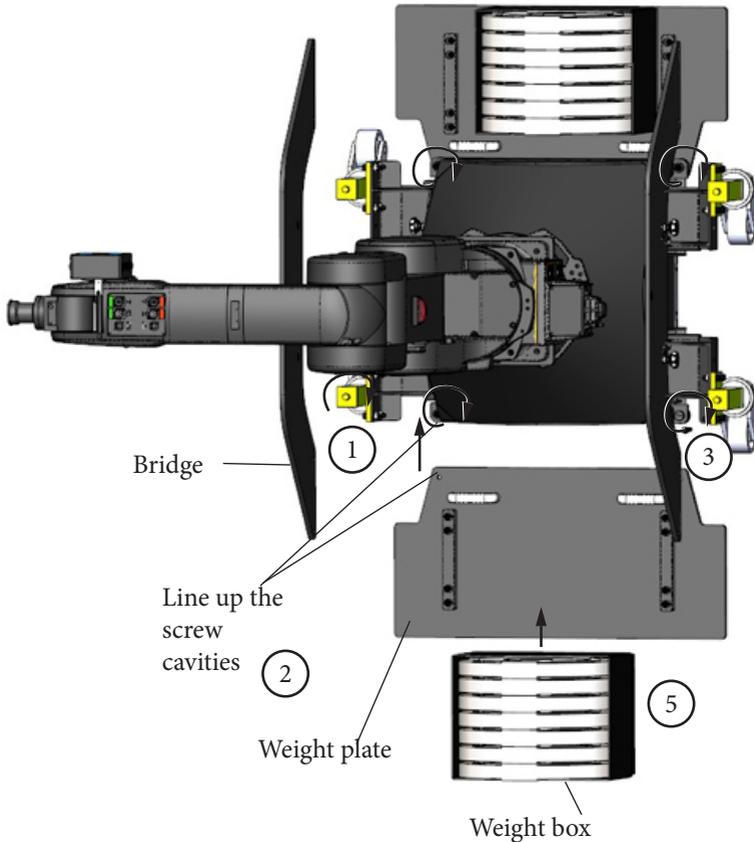


- Always loudly and clearly indicate to others when the rig is about to move. Shout “Rig Moving!” if no other means exists.
- Always ensure the rig is disabled when someone has to enter the No Go Zone.
- Always run any move or adjusted move slowly at first to check the motion. Even if you have checked the move previously, if you make a minor change to it then you need to recheck it.
- Keep the software in “slow mode” unless the move has been tested and is now specifically doing a high speed pass.
- In the event that a person or Actor has to be within the no-go zone during a move (hand model etc.) ensure that they are fully briefed on the safety requirements and that they know not to change their position or do anything other than the

rehearsed moves without fully warning the operator. Any such person is to have a clear escape route to allow them to move safely away from the robot.

- During use, repeatedly check the rig mounting points, cables, camera mount, accessories etc. to ensure nothing has, or is, working its way loose.
- Never bypass any safety hardware or software.

Mounting the Weight Plates



1. Use the jack screws on the castor wheels to lift the base high enough to insert each of the weight plates on either side of the Showbolt Jr Base lining up the screw cavities.
2. Lower the base close to the wing but not quite resting on it, close enough for the two retaining bolts to reach the wings through the base.
3. Lower the base completely so it is resting on both wings. Secure the weight plates using the 2xM10 screws on either plate. The screws

should be wedged to the ground to secure the weight plate completely.

4. At this point, you can remove the castor wheels.

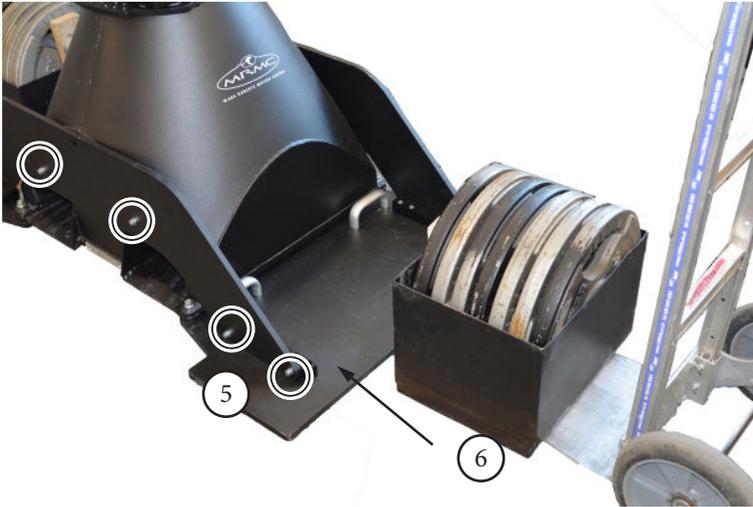


5. Attach the bridges with two weight plates on one side using the 4xM10 screws that attach to the weight plates and 2xM10 screws that attach to the pedestal base.

Repeat this to secure the bridge on the opposite side.



- Put the weights onto the wings. Showbolt Jr requires 2 boxes of weights — one on each side. Each box contains 140kg of weights (7 × 20kg).



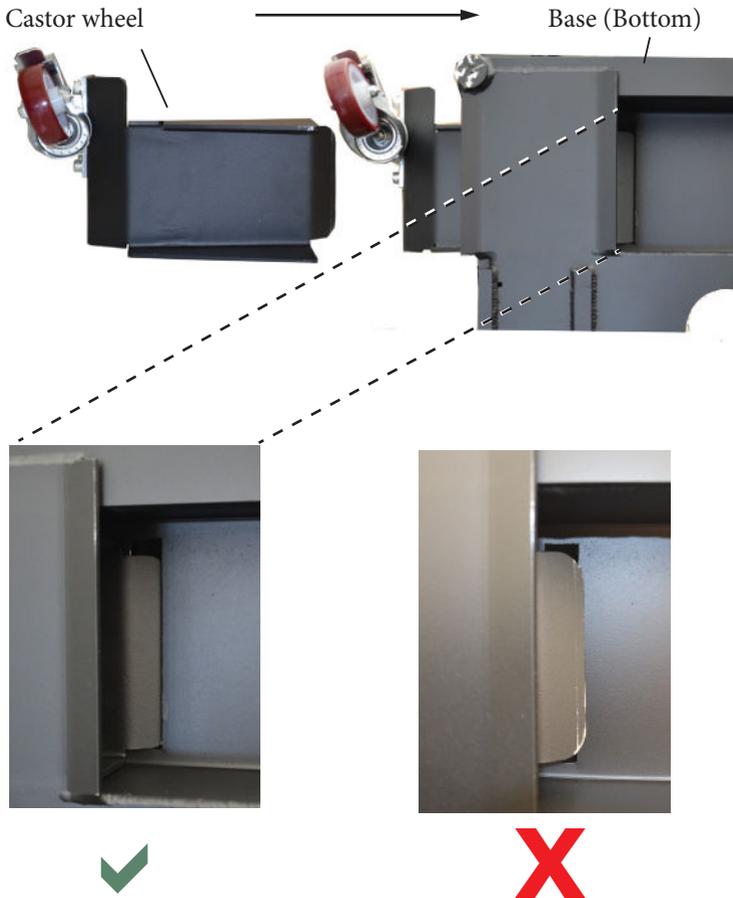
Hint

You can use a pallet truck to move Showbolt Jr without removing the wings and bridges if you want, as long as you take the weights off first.

Mounting the Castor Wheels

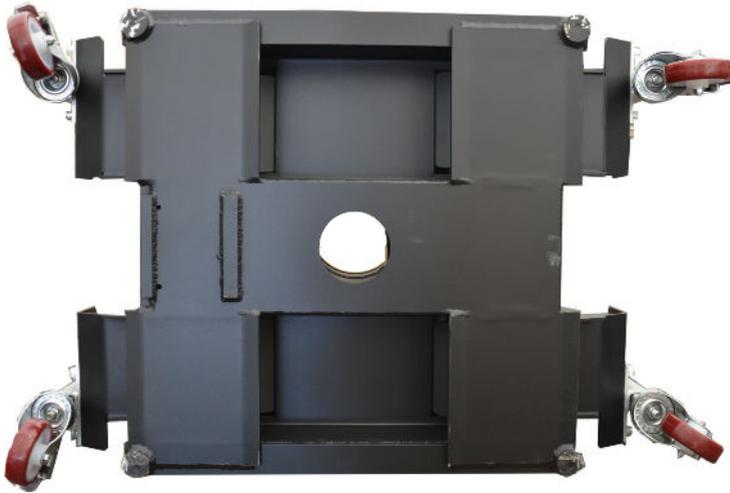
If you need to move the Showbolt Jr around, use the following procedure to mount the castor wheels:

1. Remove the bridge plates.
2. Slide one castor wheel into the base ensuring that edge of the plate in the wheel assembly is inserted in the slot in the base.



Note that the wedge in the castor plate should be slotted properly under the base.

3. Similarly insert all the castors into the base ensuring the plates are inserted into the slots.



4. Secure and tighten the castor wheels to the base and use the four jack screws to lift it off the floor (24mm socket/wrench).

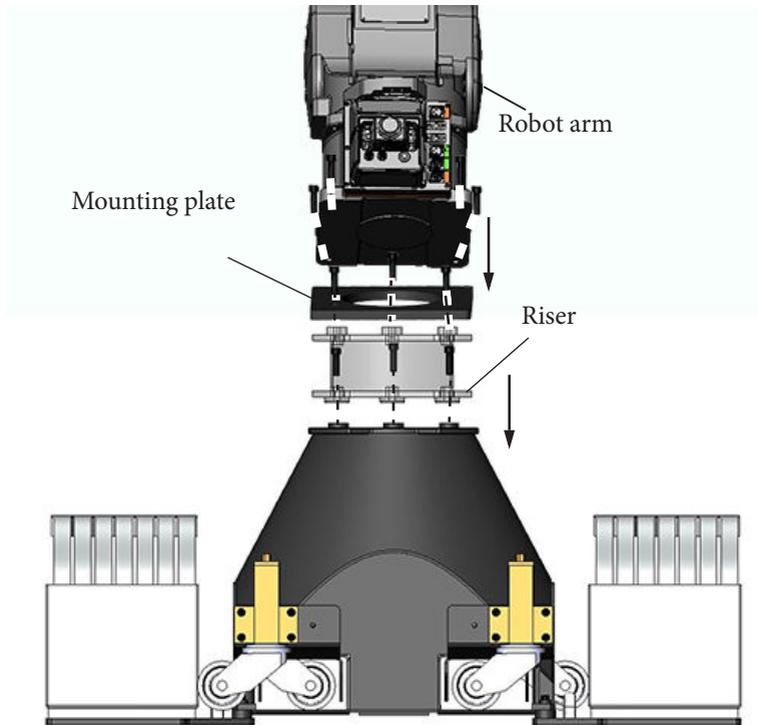


Notes

Mounting the Optional Riser(s)

Showbolt Jr can include optional risers if higher arm reach is required. These come in two sizes: 150mm and 300mm; either or both of them can be used. Use the following instructions to mount any riser on the pedestal:

1. Remove the arm from the base by unscrewing the 4xM12 screws and using a gantry hoist to lift the arm.
2. Remove the mounting plate from the base by unscrewing the 3xM12 screws.
3. Lower the riser on the base aligning the three screw cavities and tighten the 3xM12 screws to secure the riser on the base.
4. Mount the mounting plate on the riser using 3xM12 screws.
5. Carefully lower the arm on the base aligning the screw cavities on the mounting plate and those on the robot arm. Screw 4xM12 to secure the arm on the base.



Note

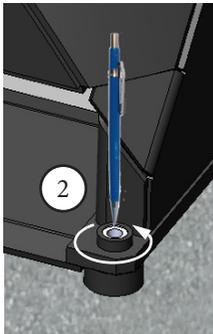
If you are using the 300mm riser, anchor the Showbolt Jr down to the floor. Refer to the next section for details.

Limitations when using weights

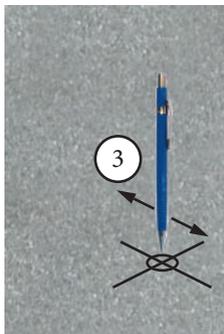
If you are using weights, reduce the top-speed by 50% when you have the 300mm riser added. With the small riser, reduce the speed by 25%. If you are using both the risers together, then the rig can only be used at slow speeds.

Anchoring Showbolt Jr to the floor

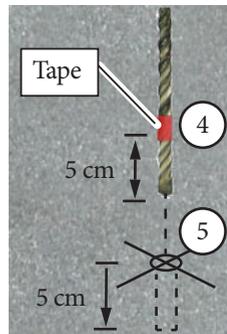
If you are setting up Showbolt Jr in a permanent (or semi-permanent) location, you can anchor the pedestal to the floor as an alternative to holding it down with weights. The following procedure tells you how to anchor the pedestal to a concrete floor.



× 4 corners



× 4 corners



× 4 corners

1. Wheel the Showbolt Jr to the spot where you want to bolt it to the ground and lower it using the jacks on the castor wheels.
2. At one corner of the pedestal, use the hole to draw a circle on the concrete with a pencil, to mark the position of the hole. You can use either hole.

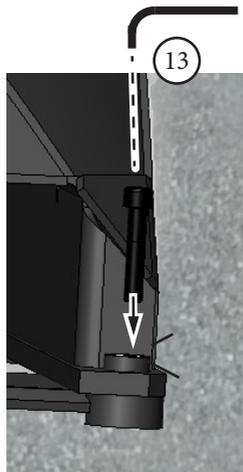
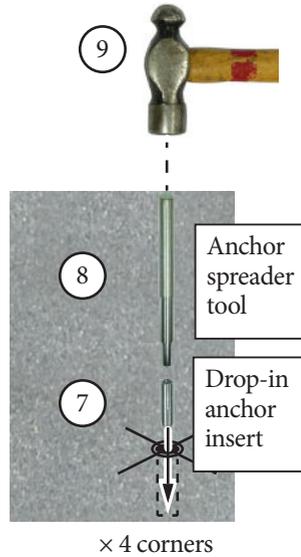
Repeat for the other three corners of the pedestal.

3. Temporarily remove Showbolt Jr (jack the castor wheels up) and at the four circles that you have drawn, draw cross centred on the circle, to help you precisely locate the drill bit.
4. On the 15mm diameter drill bit, put tape around the bit 5 cm from the tip. This will help you gauge the depth of the hole in the next step.
5. At one of the corner circles, drill a hole 5 cm deep into the concrete, centred on the cross. When the tape on the drill bit reaches the floor, drilling is complete.

Repeat for the other three corners.

6. Clean the four holes.

7. At one of the holes insert the drop-in anchor insert, threads upward, all the way to the bottom.
8. Insert the anchor spreader tool into the drop-in anchor insert.
9. Hit the top of the anchor spreader tool with a hammer until the anchor is fully spread in the concrete.
10. Remove the anchor spreader tool.
11. Repeat steps 7 to 10 for the other three corners.
12. Put Showbolt Jr in place over the holes.
13. Insert the four retaining bolts through the corners of the base and into the drop-in anchor inserts, and tighten.



Setting up the “SICK” Proximity Safety Device

1. With the system securely fitted to the front of the Bolt rig, and the E-stop cabling is correctly connected.
2. Plug in the orange PLL cable to the sensor port.



3. Plug in the other end of the PLL cable to the host PC USB port.
4. Run the “SICK CDS” program on the host PC by double clicking. The main screen appears.

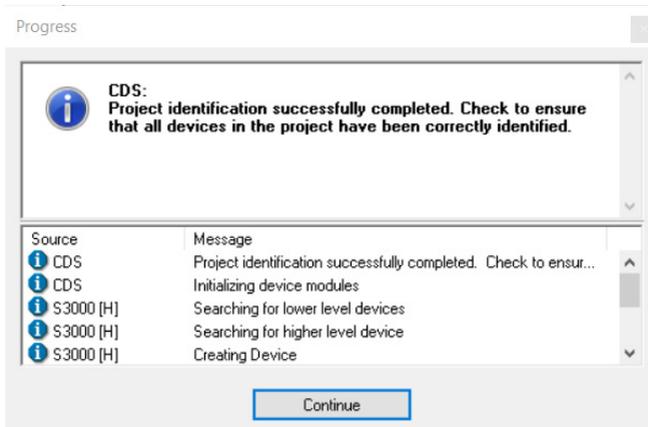


5. Power up the device by plugging in the cream coloured XLR power lead into the black XLR labelled “SICK SCANNER” on the umbilical cable at the rear of the robot, and the other end of this black cable to

the breakout panel on the rear of the PC TOWER labelled “SICK SCANNER”.



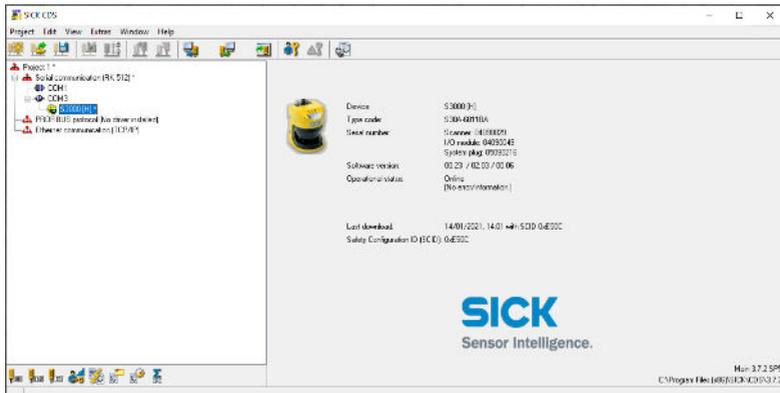
6. In order for the programme to detect the device, it might need to be power cycled by unplugging the grey ‘scanner’ cable from the E-Stop connector box and then re connecting it again after a few seconds.
7. The programme may state a different “COM” port number when the device is reconnected.
8. Right-click the “COM” port and select “IDENTIFY”.The program scans the system will log onto the SICK scanner and will display a message on screen.



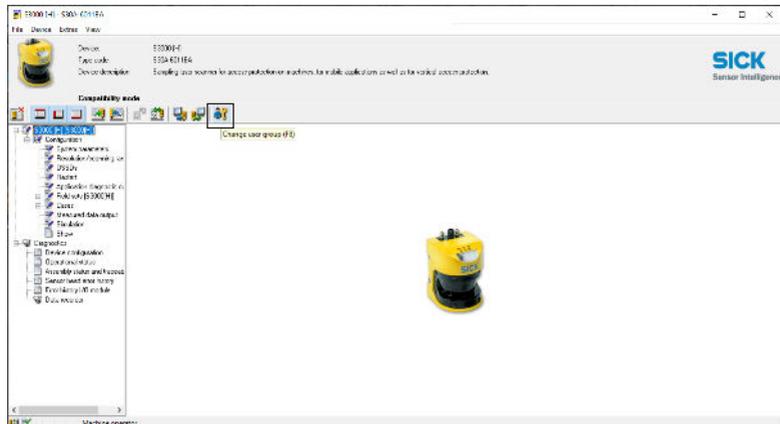
- Click “Continue” and it will give a new box that asks to “read current config?” Click Yes and the last used settings from the scanner will be uploaded to the PC. (This will save having to be re input all the settings again. **DO NOT CLICK “NO”**.) A new box will appear and the configs will be read in.
- The SICK scanner icon will appear below the “COM” port on the navigation pane.



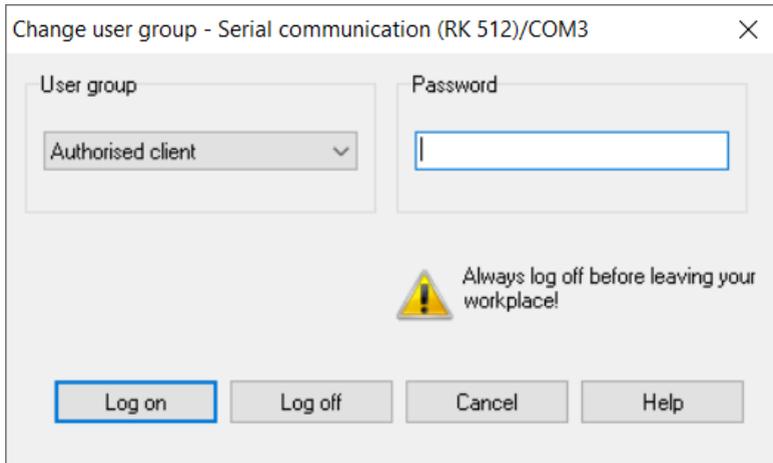
11. Click on the highlighted line. The right side of the screen will show all its' attributes and current settings. It also shows the last download date.



12. Double-click on the device line.
13. Click the “CHANGE USER GROUP” icon. This displays an ‘authorisation’ window which is a security and safety request from the device to ensure that you have permission to change the settings.



14. Ensure that the “USER GROUP” is set to ‘AUTHORISED CLIENT’ and then enter the password **SICKSAFE**.

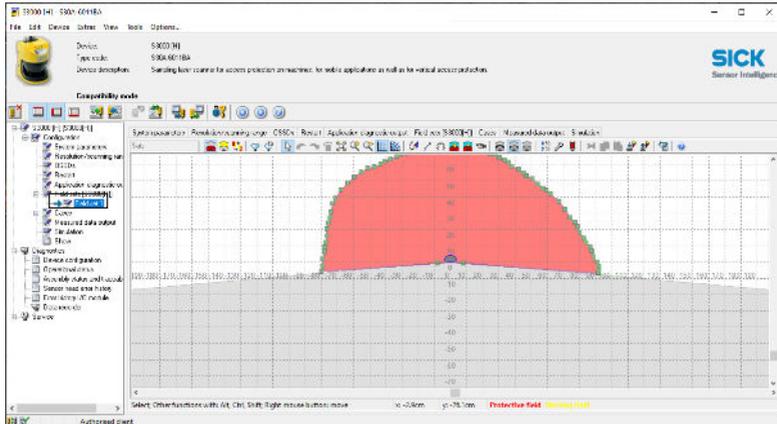


15. Click “Log on”. When this is successfully done, the left side window will now show some user adjustable sub menus and parameter headings.



16. To be able to change the “scan window” that is seen by the system and to set a “No Go” zone, you will need to adjust the FIELD SETTINGS.

- Click “FIELD SETS”. Click “+” to expand the sub menu. This gives a ‘parameters’ window which shows the previous field of view that was stored on the device.

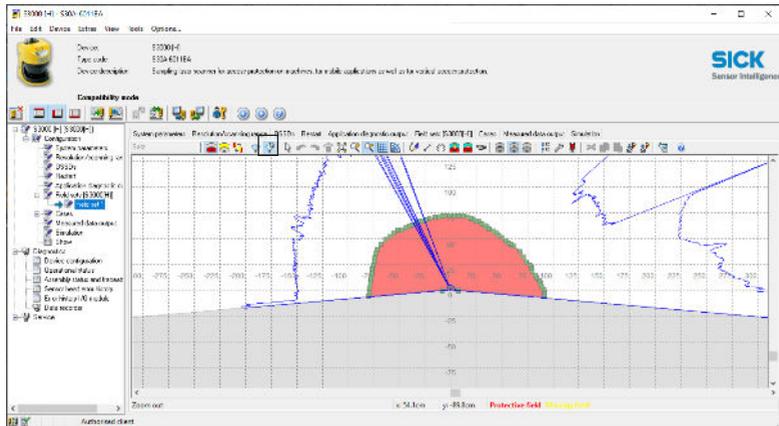


The central measure point of the device is shown at the centre of the red zone, and the field of view is indicated by the diagonal straight lines protruding left and right.

The red area the current “protected area”. The yellow area (if there is one) is the “warning” area. If this is in Blue/Grey, this means that the area is not in use even though it is still shown on the overview. (NOTE: For motion control work, the yellow area is not required so this can stay Blue/Grey).

- This window currently shows the latest zone(s) uploaded FROM the device. In order to view the current ‘live’ zone, click on “Show

measurement data”. This gives a wire ‘scan’ of the surrounding area and is updated every few seconds.

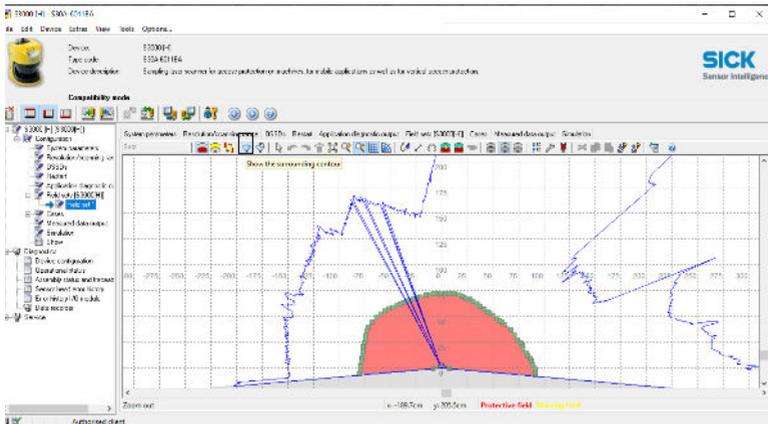


Objects that are within the viewing range of the device are visible as interference of the wire line contour.

Note

User interpretation of this wire line will get better with use

19. In order to draw and set the safe zone, click “Show surrounding contour” ()



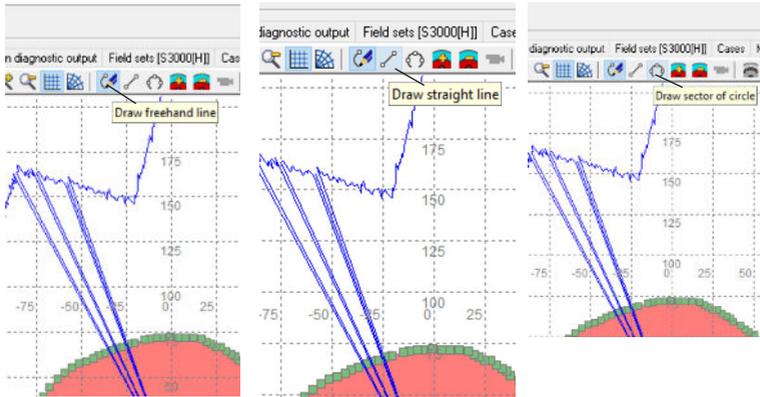
The safe zone can only be changed in this window, so ensure that all the static objects that need to be in the safe zone are positioned and that any part of the rig does not encroach the safe zone during movement.

20. Run the Flair move slowly whilst watching the “Show measurements data” window view to check this.

This overlays a static line wire ‘scan’ of the surrounding area.

21. To draw the “no go” zone click on one of the “draw freehand”, “straight” or curve “sector of a circle” tabs at the top of the screen.

These are self-explanatory and operator requirements come into play to use these.

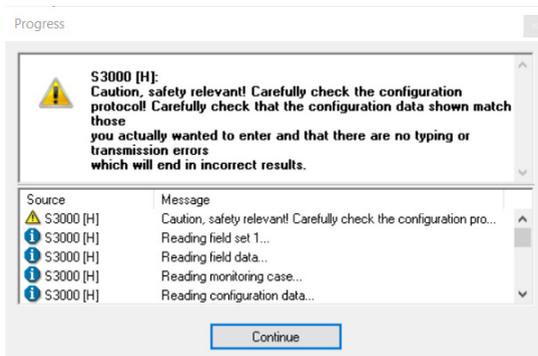


22. Draw around the objects on the screen by using the mouse. (Note that the grid markings on the screen are in cm's and the Bolt's maximum arm reach is 2.5meters from the sensor measure point.
23. Once the "Safe zone area" is drawn as desired, it will need to be transferred to the device.

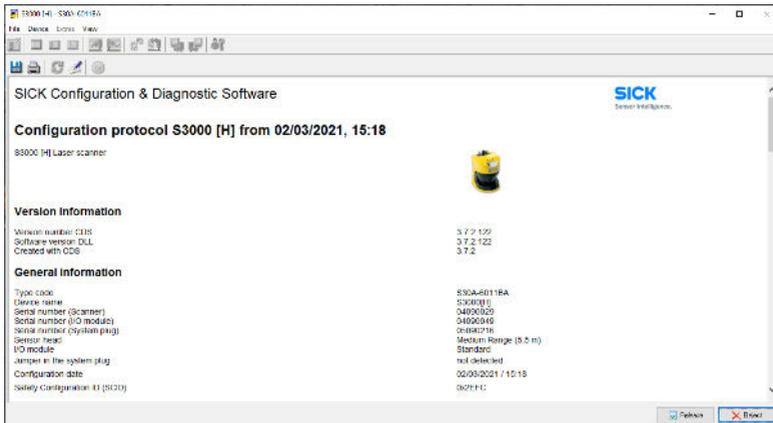
24. Click on "Transfer configuration to the device". A box will appear and ask "Do you want the transmission now?". Click "Yes".



25. After a few seconds, another confirmation/warning box will appear that asks if you are sure..? Click "Continue".



The zone information will be uploaded and a window will appear showing the safety report and the drawing of the area set.

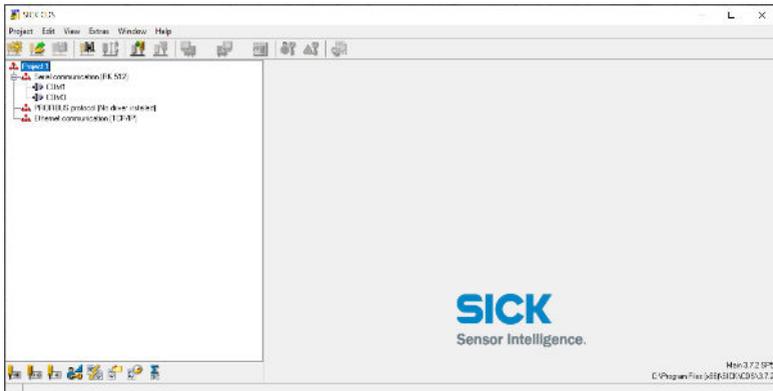


26. Scroll down to the bottom of this window and click "Release". Doing this will upload the settings to the device. In order to repeat the process of setting the area, do not click "Reject"; instead click "Release" and start again from step 16.

When the "Release" button is clicked, a window will appear that shows 'transfer in progress' and, once successful, click "Continue".



27. The programme will now return to the main screen. The device can now be used alongside Flair.



28. Note that the lights on the device will change from GREEN to RED when the safe zone area is breached. The E-STOP will engage and Flair will not allow the robot to move when this is in the RED state.



Remove any objects placed in the safe zone area. The light on the sick sensor must be green for the E-stop to be released again.

The orange PLL cable can now be removed if required, although it can be left in if multiple zones are needed to be programmed throughout the shoot.

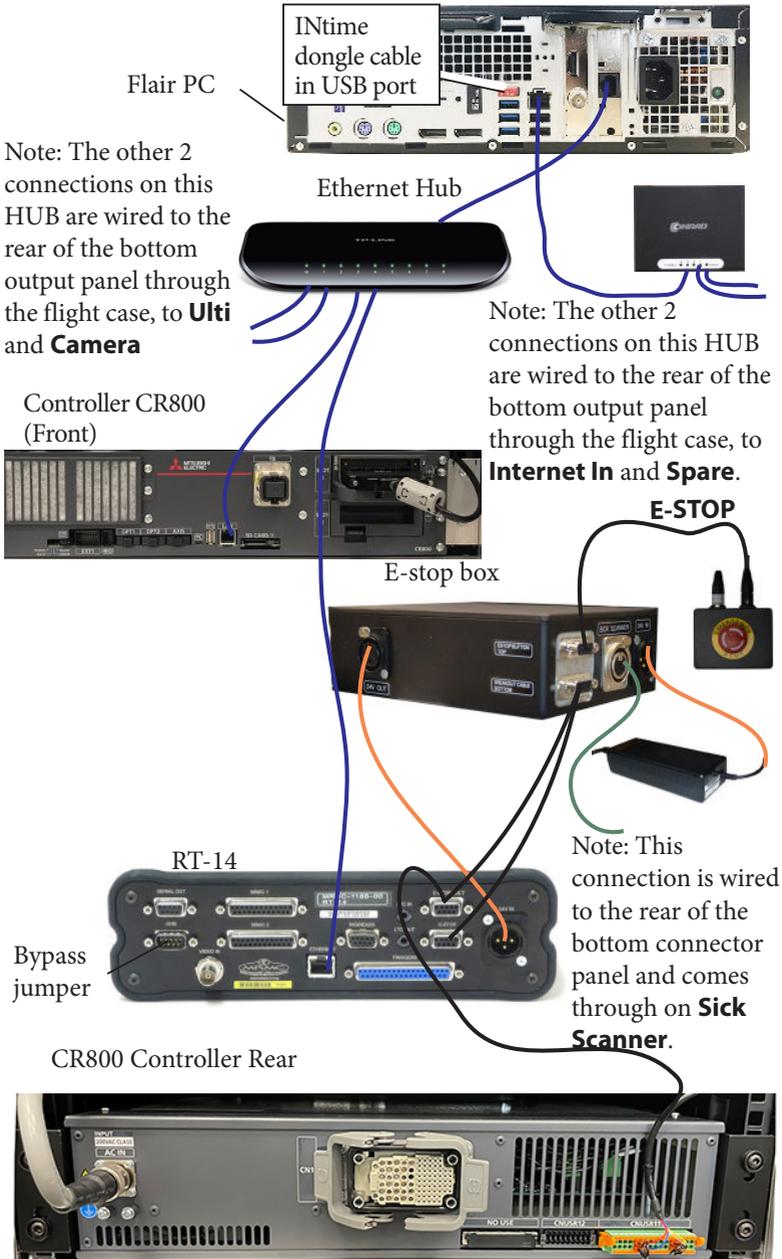
Notes

Appendix 1 Troubleshooting

Sick Sensor Troubleshooting

1. If “Reject” is accidentally pressed at step 26 on page 42, the system will erase the settings from the SICK device and it will give a “lock-out” error ‘6’ on the device and the line shown in will be in RED. To reset this, the right-click on the RED device name and click “open device window”
2. Click on the “Restart” tab and make sure that the “Without restart interlock” is selected.
3. This means that when the device is triggered, it automatically resets the interlock (E-stop equivalent) when the zone area is clear again.
4. Also click “measured data output” and check that send mode is set to “continuous data output”.
5. With these set again, you can now start from step 16 on page 37.

Flight Case Cable Connections



Notes

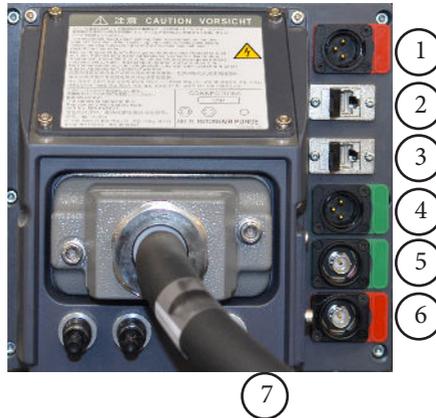
Notes

Notes

Appendix 2 Showbolt Jr panels

Showbolt Jr arm panels connector summary

Arm base
panel



1. **ULTI POWER** input power connector supplies 48 Volts DC output to the Ulti box on the Showbolt Jr arm. This has a straight-through internal connection to the **Ulti 48V 6A** connector at the far end of the arm. For pin-out information, refer to *Power 48V 6A connector* on page 61.
2. **ULTI ETHERNET** connector is an Ethernet connector or communications between the Ulti box on the robot arm and the rest of the system.
3. **CAMERA** connector is an Ethernet 10GB connector or communications between the camera and the rest of the system. The connection between this and the CAMERA ETHERNET connector is a straight-through internal connection through arm.
4. **CAMERA POWER** is a 12V connector. You can use this to power the camera or other devices mounted on the camera platform. For pin-out information, refer to *Power 12V connector* on page 61.
5. **VIDEO 2** connector for the video/sync signal from/to the camera, if required. This is connected straight to the video out device. For pin-out information, refer to *Video/Sync connector* on page 60.

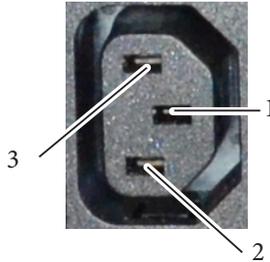
6. **VIDEO 1** connector for the video/sync signal from the camera. This is connected to the **VIDEO** connector on the Showbolt Jr base. For pin-out information, refer to *Video/Sync connector* on page 60.
7. **CR800 power and controller** connector. This is for the encoder and power cable that runs between the Showbolt Jr arm and the CR800 controller unit, which supplies control to the arm.

Connector pin-out information

Mains Out connector

Power output connector for connecting any external devices. It is a 3-Way (Male) C14 IEC connector. 240 Volts AC.

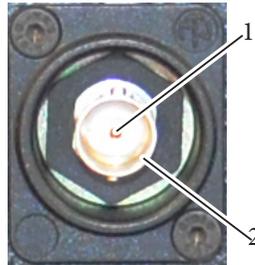
1. Earth
2. Live
3. Neutral



Video/Sync connector

The **VIDEO** and **SYNC** are multi-purpose connectors on the arm and base and connected to each other through the internal wiring, allowing the video signal from the camera to go into the arm, through The arm SYNC connector is connected to the Video#2 connector on top of the arm via internal wiring where it can be connected to the camera. They can be used for synchronization signals between the camera and controller in either direction.

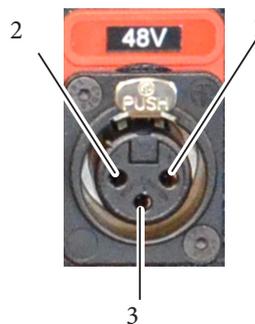
1. VIDEO (inner)
2. GND (outer)



48V Out connector (3-way XLR)

General purpose 48V DC outlet on the base and far end of the Showbolt Jr arm.

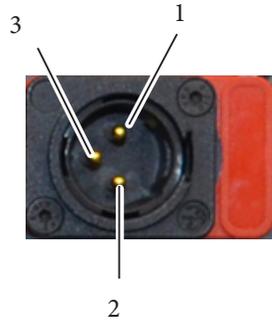
1. GND
2. N/C
3. 48V OUT



Power 48V 6A connector

48V Power input for the Ulti box at the base of the arm.

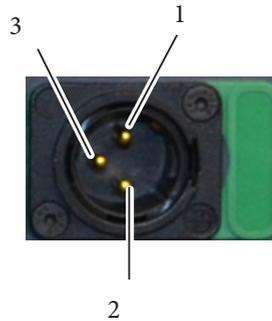
1. GND
2. N/C
3. 48VIN



Power 12V connector

12V (max 8A) Power input (on Arm base) for the camera or any other device mounted on the arm.

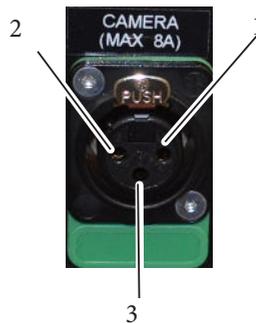
1. GND
2. 12VIN
3. N/C



Power (Max 8A)

12-24V (max 8A) Power output (on the end of the Arm) for the camera or any other device mounted on the arm.

1. GND
2. 12VOUT
3. N/C



Ulti-box connector summary

The Ulti-box that is mounted on the Showbolt Jr arm is a multi-purpose interface box that is used to control servo motors on many MRMC heads and Lens Control Motor (LCM) units. The Ulti-box offers versatile connections for many camera and lens configurations although some of the axes connectors such as **PAN**, **TILT**, and **DATA** are not ordinarily used in the context of Showbolt Jr, as Showbolt Jr itself provides these features.



1. **PAN** connector for the Pan servo motor on a head. For pin-out information see *Servo motor connector* on page 65.
2. **PROG** serial connector for connection to a controller using a Serial RS232 connection (as an alternative to an Ethernet or DataLink connection), and for updating the firmware in the Ulti-box. For pin-out information see *Program serial connector* on page 65.
3. **POWER** DC input for the Ulti-box and its attached devices. The standard unit uses a power input of 24-36 Volts. The high-power variant (marked **HV**, for **High Voltage**) uses 24-48 Volts. For pin-out information see *Power connector* on page 66.
4. **CAM ACC** Camera Accessory input/output connector. It has pins for three stepper motors, two serial lens controls, two trigger in controls, and two trigger out controls. For pin-out information see *Camera Accessory connector* on page 66.
5. **DATA** DataLink In (Up Link) connector for controlling the Ulti-box and its attached devices using a DataLink connection, as an alternative to an Ethernet or Serial RS232 connection. You connect this to a device that is further up the DataLink daisy-chain, such as:
 - The **DATA OUT** (or **DOWN LINK**) connector on a controller such as the MSA-20 Handwheels or Large Format Panel (LFP).
 - The **RIG/HEAD** connector on an RT-14 interface box which is in turn connected to a PC running Flair Motion Control Software.

Note that because there is no DataLink Out connector on the Ulti-box, the Ulti-box must be connected at the end of the DataLink daisy-chain rather than the middle. For pin-out information see *Data In connector* on page 67.

6. **ETHERNET** RJ45 connector for controlling the Ulti-box and its connected devices from a Flair PC. This Ethernet port is rated at 100 Mbits/sec but can operate at lower speeds of 10 Mbits/sec or less.
7. **BRAKE 24V** connector to connect the 24V brake power supply.
8. **E-STOP** connector can be used as an input for E-Stop. To enable the motors, Pins of this connector needs to be shorted, else all drivers are disabled and enable signal from Flair is ignored. It can be connected to the external E-Stop box, but if no external E-Stop is needed, a bypass jumper may be used.

9. **CAN** connector is used to communicate with external CAN capable motor drives.
- 10,11. **ZOOM, FOCUS** connectors for external servo LCMs mounted on the camera platform. For pin-out information see *Servo motor connector* on page 65.
12. **TILT** connector for a Tilt servo motor on a head. For pin-out information see *Servo motor connector* on page 65.
- 13, 14. **AUX-1, AUX-2** connectors for control of auxiliary servo motors. For pin-out information see *Servo motor connector* on page 65.

Note

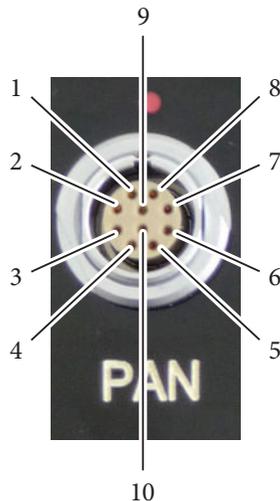
Connectors 1, 7, 8, 9, 13 and 14 are identical and are labelled only for ease of use.

Ulti-box connector pin-out information

Servo motor connector

This type of connector is used for six servo motor connectors on the Ulti-box:
Pan, Zoom, Focus, Tilt, Aux-1, Aux-2.

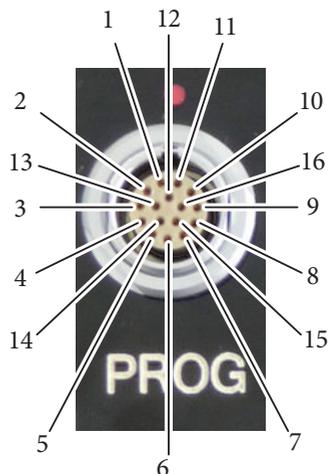
1. DATUM
2. A+
3. B+
4. Z+
5. Brake/Enable output
6. MOTOR_B
7. MOTOR_A
8. LIMIT
9. +5V
10. GND



Program serial connector

Serial connector for connection to a controller using a **Serial RS232** connection, and for updating the firmware in the Ulti-box.

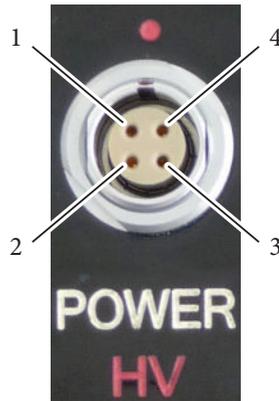
1. SerialTxA
2. SerialRxA
3. +5V
4. FGPIO
5. DSP_TRSTN
6. TCK
7. TMS
8. DSP_TDI
9. DSP_TDO
10. DSP_EMU0
11. DSP_EMU1
12. FPGA_TDI
13. FPGA_TDO
14. BOOT_SEL
15. +3.3V
16. GND



Power connector

The power input connector for the Ulti-box. For usage see page 63.

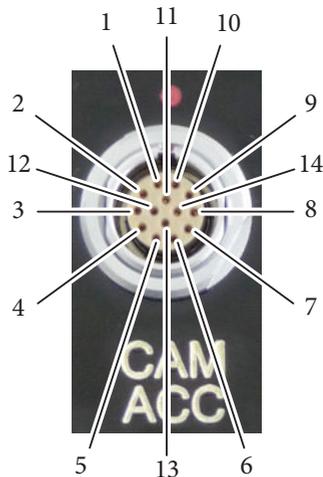
1. GND
2. GND
3. +35V for Basic and +48V for HV
4. +35V for Basic and +48V for HV



Camera Accessory connector

This is a multi-purpose camera accessory connector with connections for three stepper motors, two serial lens controls, two trigger in controls, and two trigger out controls.

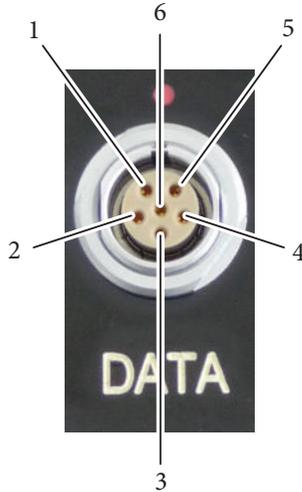
1. Step1
2. Gp2In (Trigger In 2)
3. Step2
4. SerialTxB serial lens control
5. Step3
6. SerialRxB serial lens control
7. Dir3
8. GND
9. +5V
10. Gp1In (Trigger In 1)
11. Dir1
12. Dir2
13. Gp2Out (Trigger Out 2)
14. Gp1Out (Trigger Out 1)



Data In connector

This is a DataLink In connector for connection to a controller using a DataLink connection. DataLink In (Up Link) connector for connection to a DataLink device higher up in the DataLink daisy-chain. For usage see, page 63.

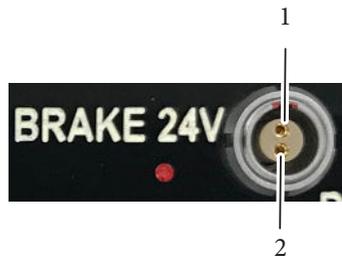
1. Watchdog-
2. Link1Out-
3. Link1Out+
4. Link1In-
5. Link1In+
6. Watchdog+



Brake 24V connector

This is a Lemo Size 0 2-way connector and is sourced from external PSU.

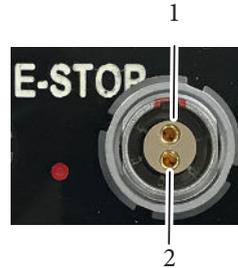
1. GND
2. +24V



E-Stop connector

This is a Lemo Size 1 2-way connector; external circuitry should keep the pins closed.

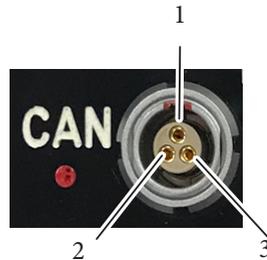
1. E-STOP-
2. E-STOP+



CAN connector

This is a Lemo Size 0 3-way connector; is used to communicate with external CAN capable motor drives.

1. CAN Hi
2. CAN Lo
3. GND



Appendix 3 Specifications

Rig Weights

Dimensions	
Total weight (base+arm+2xcastor wheels)	262kg
Weight- Arm	138kg
Weight - Base	130kg (including 2 x weight plates, 4 x castor wheels, 2 x bridges and 2 x weight buckets)
Weight - anchor weights for track (when track is not bolted to the ground)	-
Weight - Anchor weights for each side of base when base not secured to ground	2x140kg (not included in total weight above)
Maximum camera payload	10kg (28.6lbs)

Rig Performance

Axis	Travel (degrees)	Max Speed (degrees/s)
Rotate	370(±185)	234
Lift	230 (-55 to +175)	164
Arm	160 (-65 to +95)	219
Pan	390 (±195)	375
Tilt	230 (-205 to +25)	375
Roll	1420(±710)	720

Note

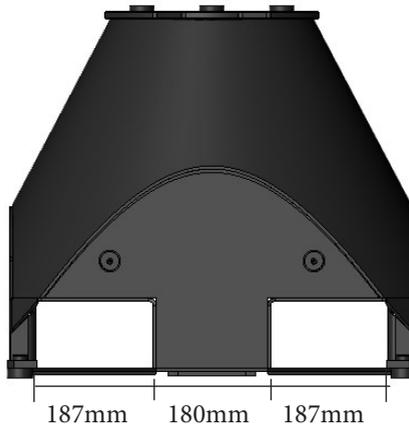
The Roll limits can be extended further but will require caution for the external cables

Temperature range: 0-40 °C

Humidity tolerance: 0% to 85% relative humidity, non-condensing

Dimensions

Showbolt Jr Base Cavities



Power Requirements

Power supply: Single phase Line+Neutral+Earth

Voltage: 200-230 Volts with 10% tolerance

Current: 13A; At 220V and 3KVA gives a peak current of 13A

Frequency: 50-60 Hz

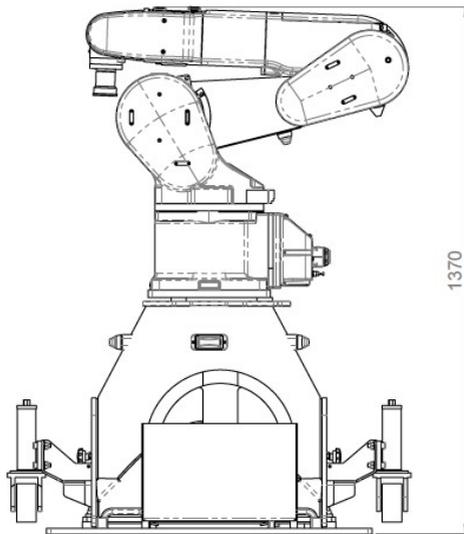
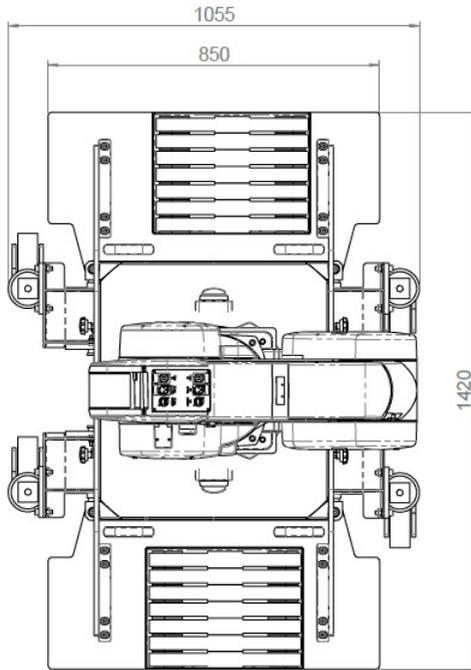
The CR800 controller is supposed to be installed and used in the customer's system. Supply the primary power of the controller from system. In addition, provide a safety device (eg earth-leakage current breaker) that can shut off the power of the controller in the customer's system. When using an earth-leakage current breaker as a safety device, select the product that meets the following specifications:

Item	Unit	Specification
Rated voltage	V	AC200 to 230
Rated sensitivity current	mA	300
Rated current	A	13

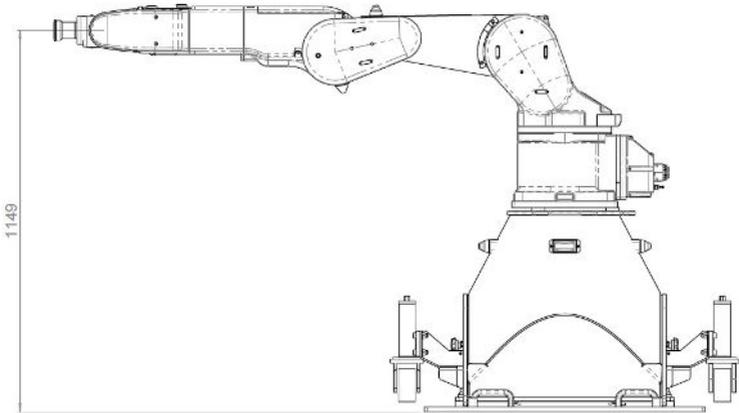
Notes:

1. The two power cables can be plugged into the same 13A UK circuit at this voltage.
2. Nominal input voltage of the Mitsubishi is 230VAC +/- 10%. The transformer must be designed to provide a nominal 230VAC output, in this case from 120V ± 6% to keep the output within the maximum allowed. Operating the Showbolt Jr from a 120VAC 20A supply (via a 120-230VAC 4KVA transformer) will reduce the rated accelerations and speed by around 20%. Upgrading to a 25A supply will recover the full performance.
3. The specification states that the supply should be 10A as the upper limit. The additional value is due to the inrush current at switch-on.

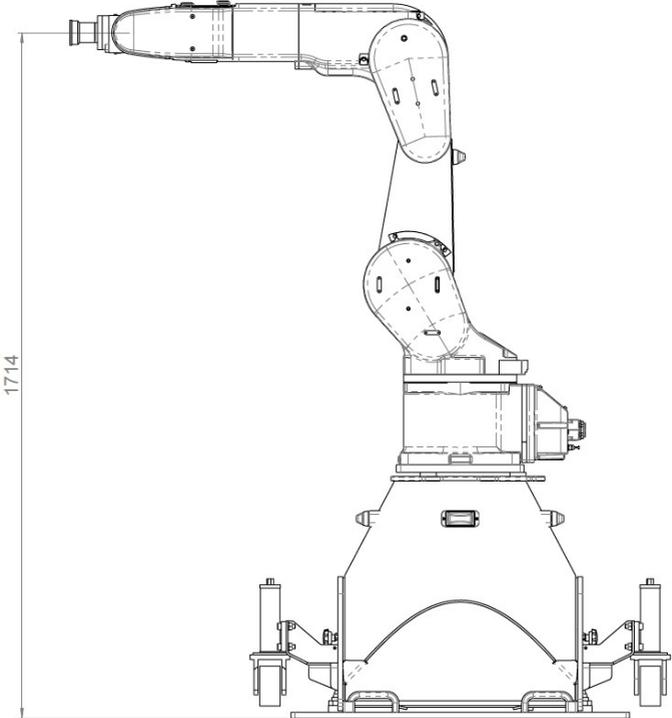
Physical Specifications



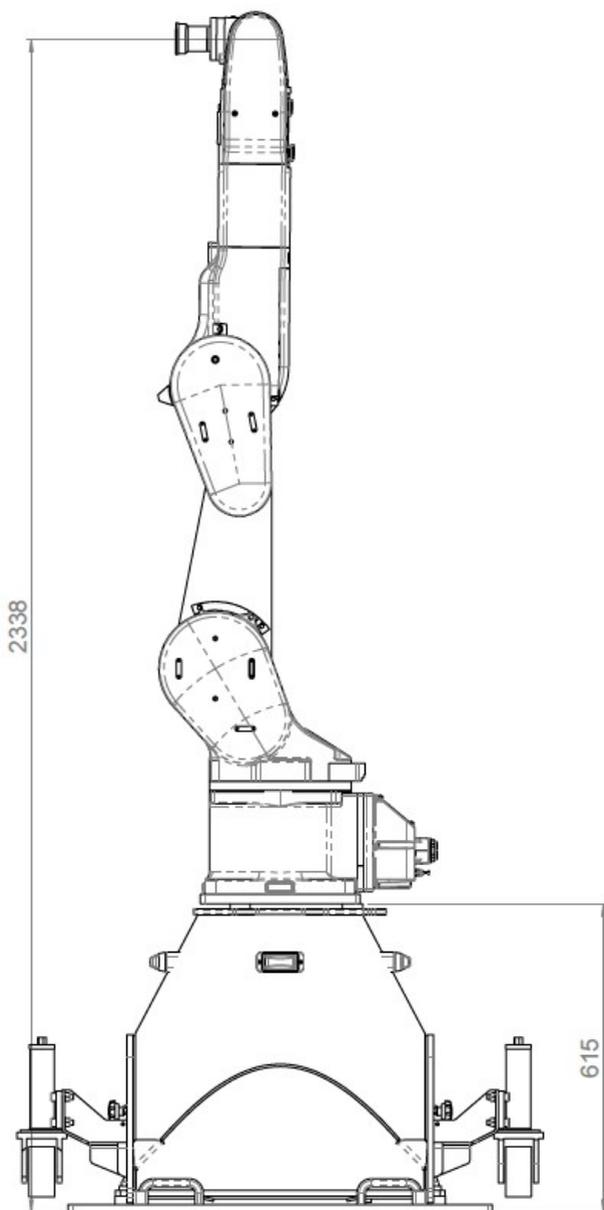
No Riser, Transport Config
Weight 555kg



Arm Horizontal



Arm Square



Notes



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