



MARK ROBERTS MOTION CONTROL

SHOWBOLT

The ultimate content capture experience for live events



QUICK START GUIDE

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Showbolt Quick Start Guide

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Contact information	
Mark Roberts Motion Control Ltd.	
Unit 3, South East Studios	
Blindley Heath	
Surrey	
RH7 6JP	
United Kingdom	
Telephone:	+44 (0) 1342 838000
E-mail:	info@mrmoco.com (sales and general enquiries) support@mrmoco.com (customer support)
Web:	www.mrmoco.com www.mrmocorentals.com

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Chapter 1 Quick Start

Overview

Thank you for using the Showbolt High-speed Cinebot™ rig from Mark Roberts Motion Control (MRMC). Showbolt is a 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 has a stationary base which you either hold down with weights or, for more permanent installations, attach to the floor.

Showbolt is complete motion control system that includes:

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

How it Works

Once the Showbolt 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 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:

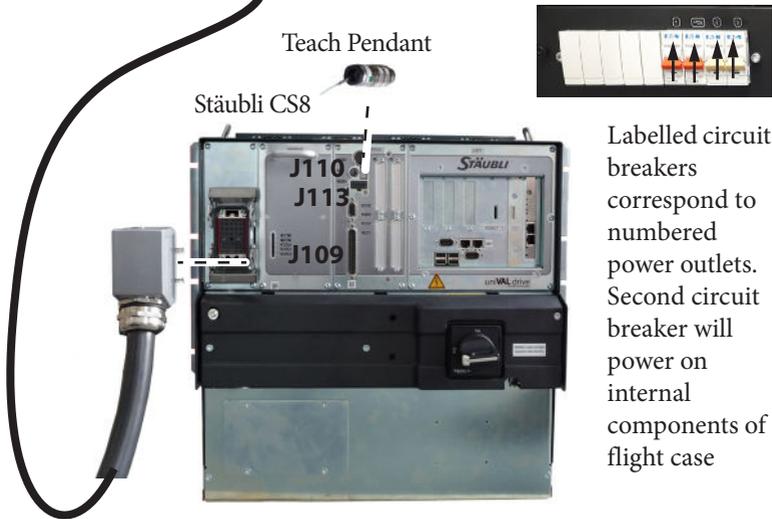
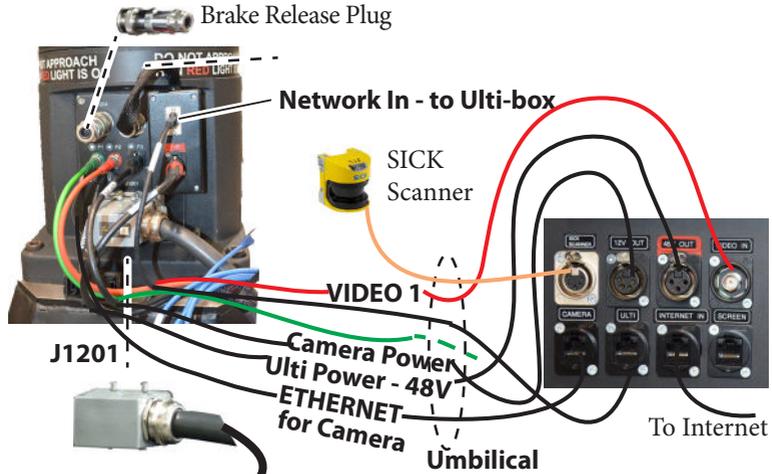
- Triggering the camera when the robot starts shooting or on a desired frame
- Auto-processing the Zcam video footage
- Auto file transfer of the recording to the local PC, share drive or an FTP server.

Setting up the Showbolt System

To setup the Showbolt system, perform the following:

1. Mounting the weight wings, page 29, or anchoring to the floor, page 31, as required.
2. Connecting the cables including those between the flight case, the rig and the Showbolt Bridge PC, page 3. For detailed information of connections within the flight case, refer to page 53.
3. Starting the Showbolt system, page 4.
4. Setting up the SICK proximity scanner, page 33. 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. Setting up a robotic move on Showbolt 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 7 Operator's Manual*.
6. Setting 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 8.

Connecting the cables



Flight Case Power Supply:
100-240VAC 3-wire
connection.

Power Supply: ideally 415 Volt,
3-phase, 4-wire including
Ground, but can be
configured to run on less.

Connecting the Cables - Showbolt Arm



Starting up the Showbolt system

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

1. Make sure you have secured the area around Showbolt. Put up guard rails around Showbolt as necessary, and tell others on the set that you are now powering up the rig.
2. Release the E-stop that is plugged into the **Stäubli CS8** by turning the red button clockwise until the button pops up. Also make sure the key is in the clockwise position. **Do not release the other E-stop by the computer stack yet.**



3. Switch on power on the flight case panel.

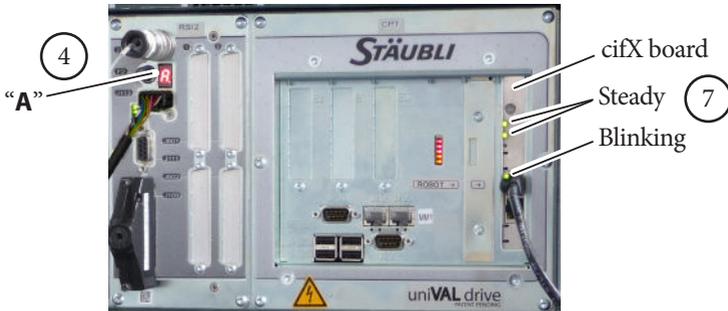


4. Power up Showbolt itself as follows:

Turn on the power switch on the Stäubli CS8.



The Showbolt power-up sequence takes about three minutes. When it has completed, the Stäubli CS8 shows an “A” on its display.

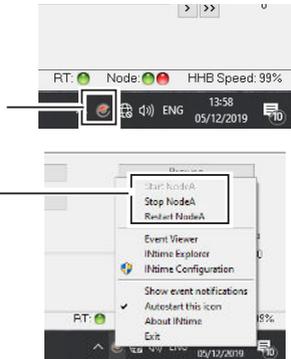


5. Power up the Flair computer system and all of its components, including the RT-14 interface box. You can do this while the Showbolt is powering up (step). **Do not start the Flair application yet.**
6. Power up the Showbolt PC, if not done already.
7. After Showbolt has finished powering up (step) and the Stäubli CS8 is displaying an “A”, check that the cifX boards in both the Stäubli CS8 and the Flair PC display two steady lights and one blinking light (see previous diagram). This pattern indicates that the dedicated Ethernet connection running over the **ROBOT ONLY** cable is now working.

For Windows 10 based Flair setup, if the cifX board lights do not show this pattern after about three minutes, then in the System Tray click the INtime Status Monitor icon and select Stop NodeA. After a few moments click the icon again and select Start Node A. Or instead of stopping and starting INtime, select Restart NodeA to restart INtimet

INtime Status
Monitor

Stopping and
Starting
INtime
options



8. 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 arm
- Any additional interface boxes that are attached to the computer stack

9. Release the E-stop that is plugged into the computer stack, by turning the button clockwise until the red button pops up.

Once all E-stop buttons on the system are up, the Stäubli CS8 display shows “U”.



10. Zero the axes as required in Flair. The Showbolt arm itself does not require zeroing but you need to zero other axes such as:

- 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) and then use the relevant

Zero > Direct Zero Axis menu option to set those lens positions as the zero points in Flair.

11. In Flair, click on the **Engage Robot** button.
12. In Flair, move the Showbolt arm to its home position (rotated straight forward and tucked under).

Hint

If the Showbolt arm is in a backward or reversed starting position, the arm might swing overhead or around the side to reach the home position, possibly striking the walls, ceiling, or other rigging! If the rig is in an enclosed space or near other equipment, it is recommended that you do the following:



- Manually move the arm close to its home position before doing a goto home position.
- When you perform a goto home position, have one hand ready on the E-stop in case you need to stop the rig quickly.

13. Set the arm position soft limits in Flair as required.

Showbolt Bridge Application

Network setup

- The zCam connected to the Showbolt arm network connection
- Flair PC: PC running MRMC's Flair software that is used to program the moves on the Showbolt
- Showbolt Bridge PC: PC running 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 PC: 192.168.1.55

zCam (static): 192.168.1.77

Using the Showbolt Bridge

The Showbolt Bridge application runs on the Showbolt PC, which is not connected to a monitor. You access this PC via RDP on the Flair PC using the following: (There is a shortcut on Desktop for the same.)

Computer: MRMC-bridge1

Username: MRMC

Password: Mrmc1234

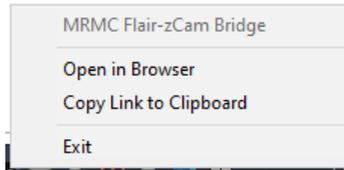
Once connected, perform the following:

1. On the ShowBolt 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:

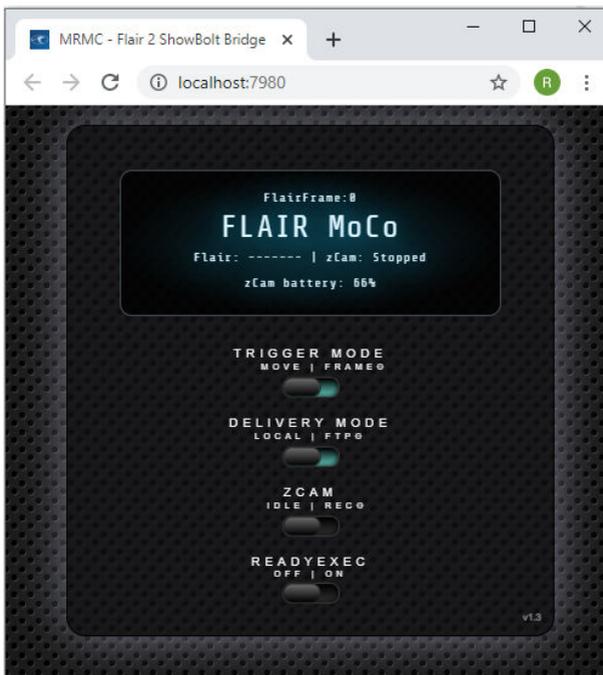


3. Left clicking the icon will display the default web interface. Right clicking it presents the following options:



Using the Exit will close the application.

Web interface



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

`http://192.168.1.55:7980`

or using the following on the Showbolt PC (via RDP):

`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 8. When the zCam webpage is open, the Showbolt Bridge will not work.

The 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 12.

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 local folder next to the SB-MP-Bridge.exe.

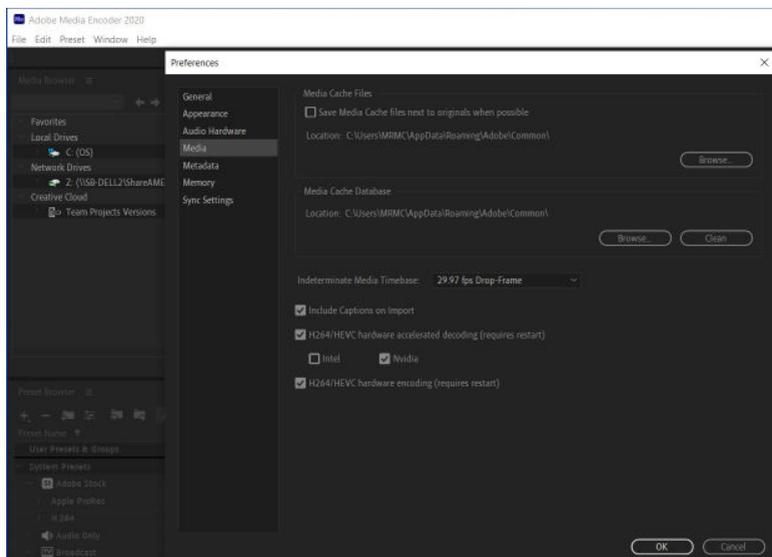
Once the video is downloaded, the batch file run by the Showbolt Bridge application initiates the media editing programs like FFMPEG or Adobe Premier Pro to do the video editing.

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

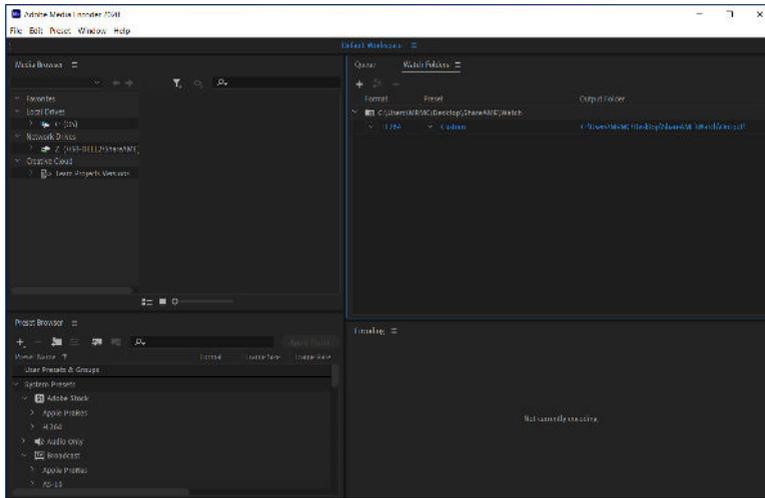
- Set up initial auto-editing to be performed on your media files.
- Place them in a ‘watch’ folder being watched by Adobe Media Encoder that is running in the background.

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:

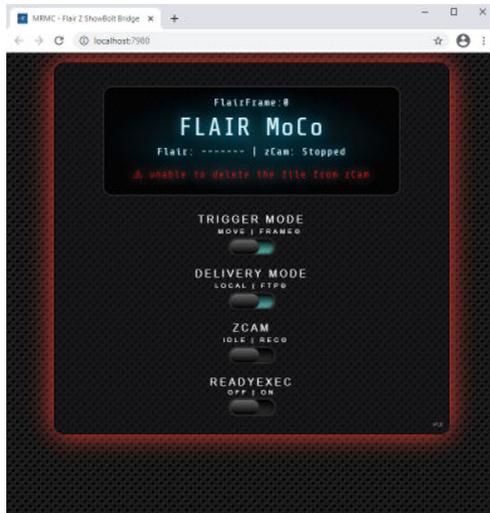


Note

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:

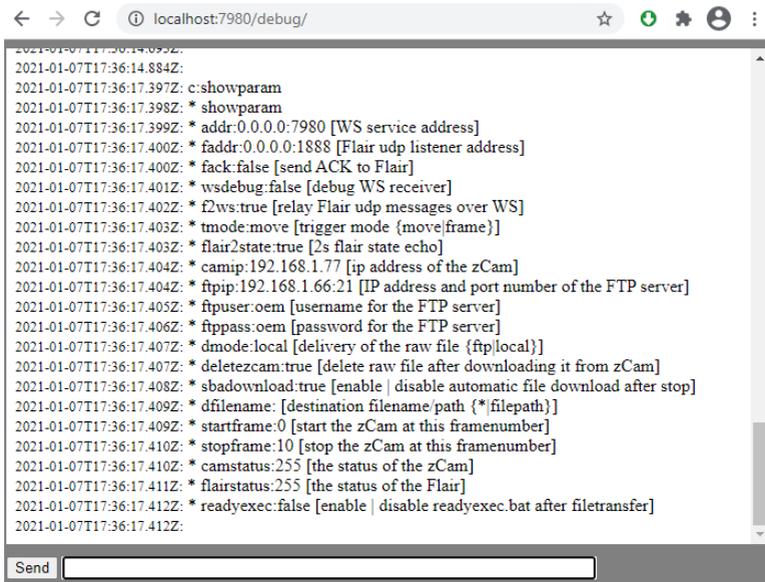
```
c:ftpuser=MRMC
```

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', 'campip', '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: * campip: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 framenummer]
2021-01-07T17:36:17.410Z: * stopframe:10 [stop the zCam at this framenummer]
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

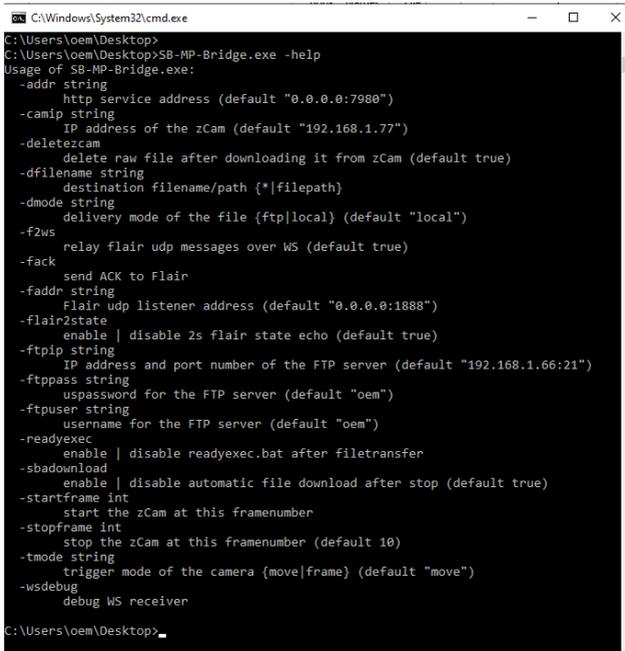
It is possible to start the application using custom parameters instead of the pre-defined (like a different delivery mode or a different port number) by using the command line parameters like this:

```
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

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.

- Unlike traditional motion control equipment, Showbolt 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.
- 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 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 itself 530 Kg. If you are using Showbolt for high-speed moves then 400kg of anchor weights on each corner are recommended.
- Does the site have access? You need to make sure you can either push Showbolt 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 gets its power from the Stäubli CS8 unit which runs with **three-phase power supply (four-wire including Ground)** set between 200 to 480V at the factory specifically for the three-phase voltage of the country of use. If the unit is to be moved to another country then CS8 will need to be set for the three-phase voltage of that country.
 - The FLAIR computer that controls Showbolt (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 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 Staubli arm

1. Tie a lifting sling around the Staubli arm and insert the hook from the gantry hoist on to it.
2. Wheel the Bolt base under the gantry hoist.
3. Use the gantry hoist to gently lift the arm and lower it in position on the Bolt base aligning the screw slots.
4. Tighten the four screws to secure the arm on the Bolt base.
5. Remove the gantry hook and the straps from the arm.

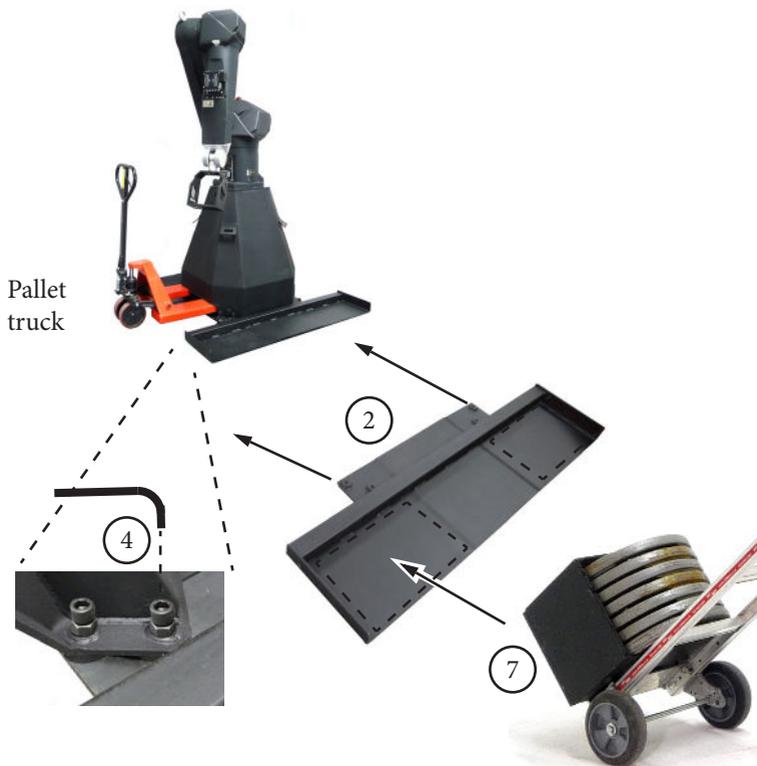


Mounting the weight wings

If you want to use Showbolt in a stationary position that is temporary (or if you don't want to damage the floor by installing anchors in it), you must weigh down the Showbolt base to keep it stable during high-speed moves. To do this you install wings on the base, which lie flat on the floor, and then put weights on the wings to securely hold down the rig.

You can fit wings to Showbolt:

Showbolt
with wings mounted



1. Use a pallet truck to lift Showbolt high enough to go over the wings (about 4 cm).

2. Lay one of the wings beside the Showbolt base and push the edge of the wing under the edge of Showbolt, lining up the four holes.
3. Lower the base close to the wing but not quite resting on it, close enough for the four retaining bolts to reach the wings through the base.
4. Insert the four retaining bolts (two on each corner of the base) and tighten. Note that some versions have locknuts.
5. Repeat steps 1 to 4 to mount the other wing.
6. Lower the base completely so it is resting on both wings.
7. Put the weights onto the wings. Showbolt requires four boxes of weights — one at each corner. Each box contains 140 Kg of weights (7×20 Kg). If you are using Showbolt for high-speed moves then 400kg of anchor weights on each corner are recommended.

Showbolt with wings and weights

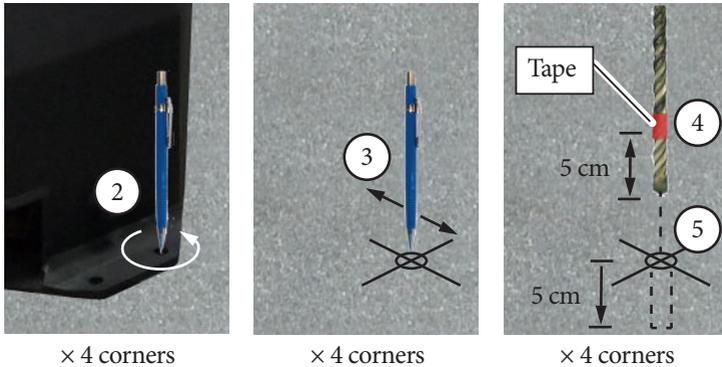


Hint

You can move Showbolt without removing the wings if you want, as long as you take the weights off first.

Anchoring Showbolt to the floor

If you are setting up Showbolt 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.



1. Temporarily put the Showbolt into place where you want.
2. At one corner of the pedestal, use one of the two holes 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 and at one of the four circles that you have drawn, draw a cross centred on the circle, to help you precisely locate the drill bit.

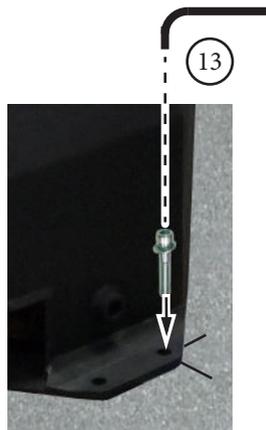
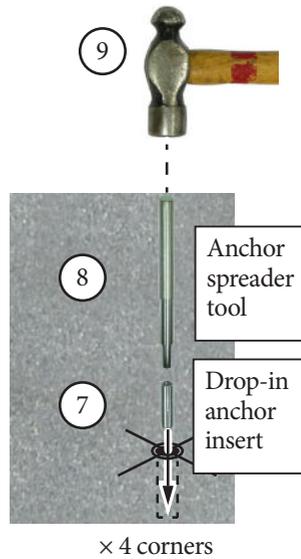
Repeat for the other three corners.

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 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.

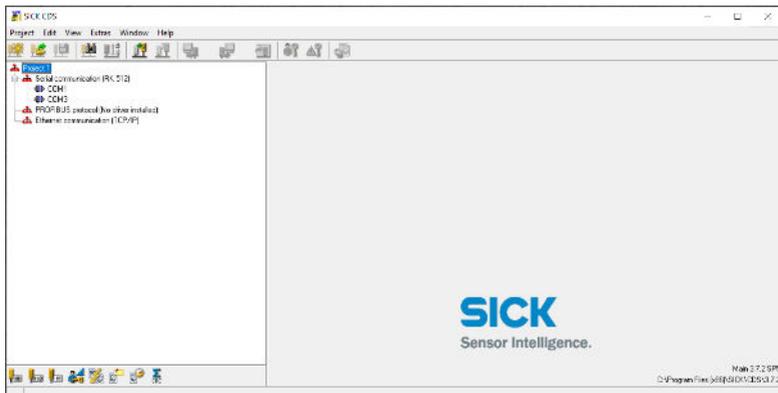


Setting up the “SICK” Proximity Safety Device

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.

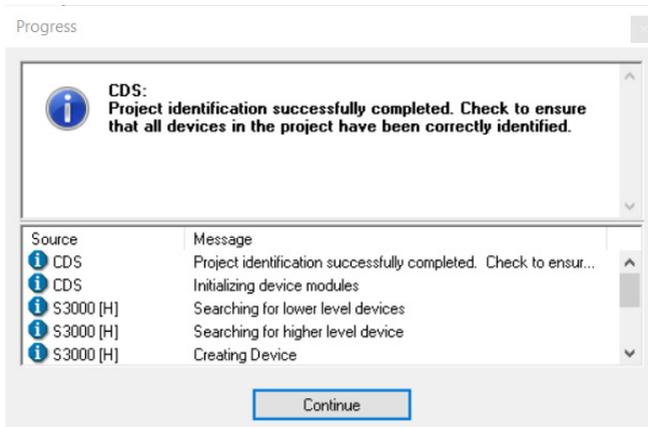


5. Power up the device by plugging in the cream coloured XLR power lead into the black XLR labelled “SICK SCANNER” on the umbilical cable at the rear of the robot, and the other end of this black cable to

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



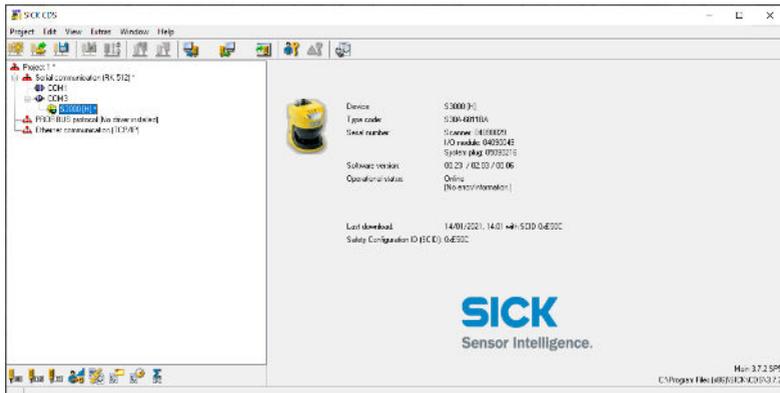
6. In order for the programme to detect the device, it might need to be power cycled by unplugging the grey ‘scanner’ cable from the E-Stop connector box and then re connecting it again after a few seconds.
7. The programme may state a different “COM” port number when the device is reconnected.
8. Right-click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



9. 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.
10. The SICK scanner icon will appear below the “COM” port on the navigation pane.



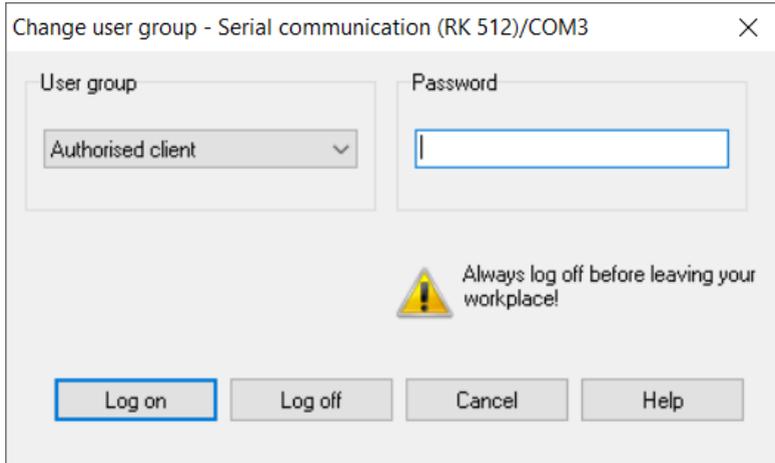
11. Click on the highlighted line. The right side of the screen will show all its' attributes and current settings. It also shows the last download date.



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**.

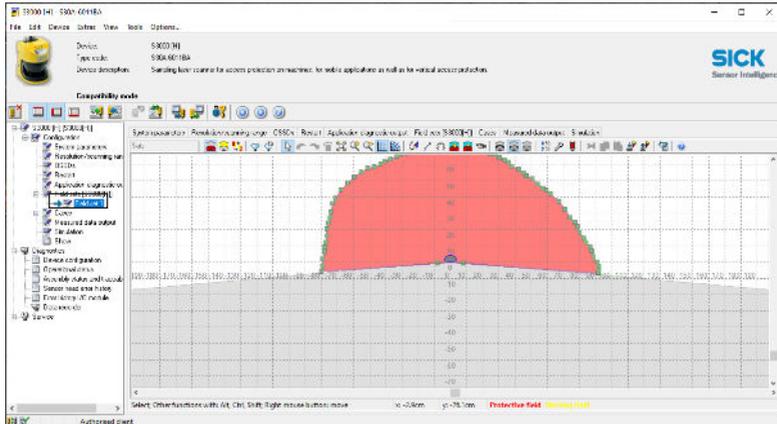


15. Click “Log on”. When this is successfully done, the left side window will now show some user adjustable sub menus and parameter headings.



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.

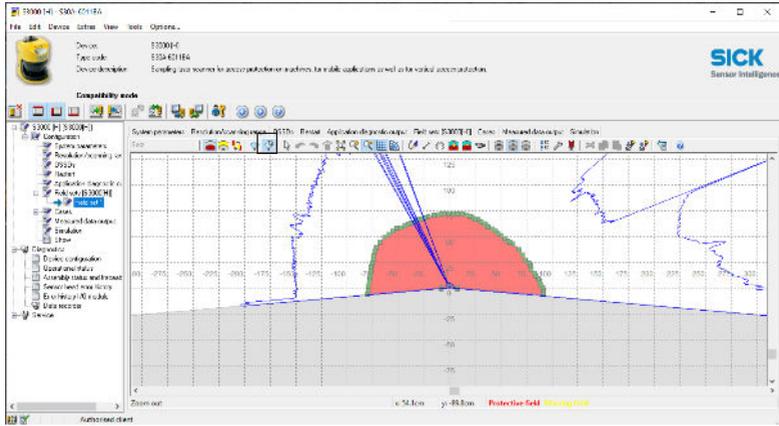


The central measure point of the device is shown at the centre of the red zone, and the field of view is indicated by the diagonal straight lines protruding left and right.

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.

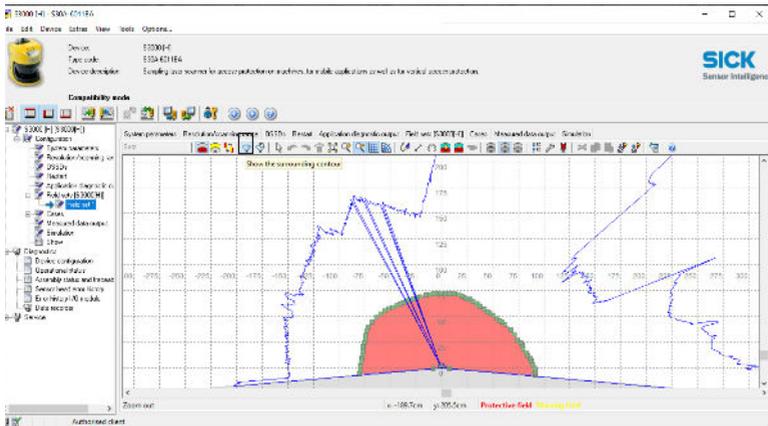


Objects that are within the viewing range of the device are visible as interference of the wire line contour.

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” ()



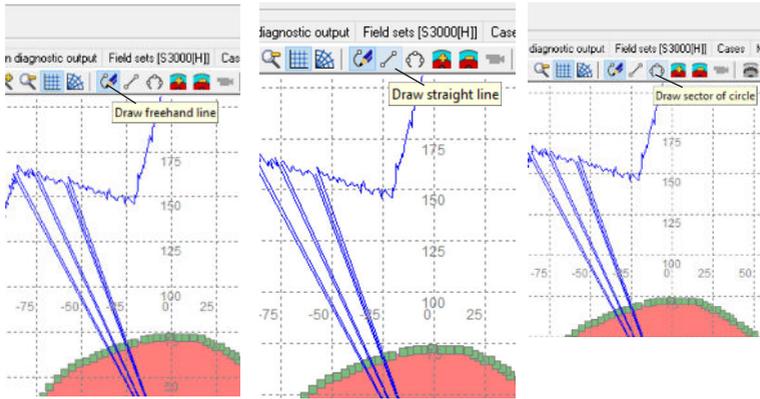
The safe zone can only be changed in this window, so ensure that all the static objects that need to be in the safe zone are positioned and that any part of the rig does not encroach the safe zone during movement.

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.

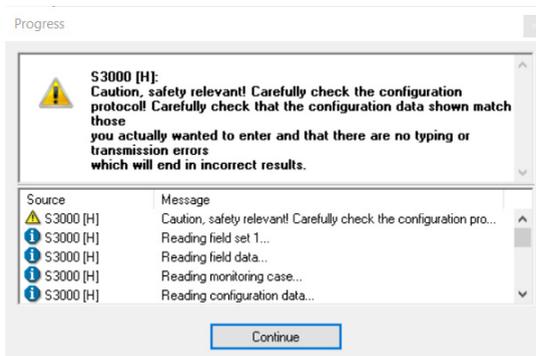


22. Draw around the objects on the screen by using the mouse. (Note that the grid markings on the screen are in cm's and the Bolt's maximum arm reach is 2.5meters from the sensor measure point.
23. Once the "Safe zone area" is drawn as desired, it will need to be transferred to the device.

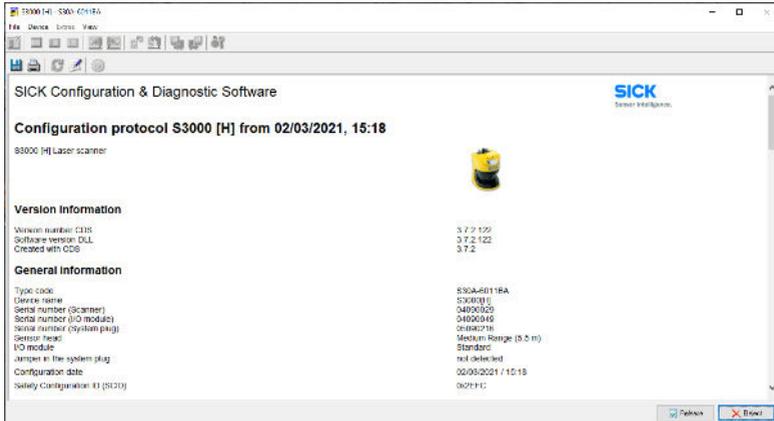
24. Click on "Transfer configuration to the device". A box will appear and ask "Do you want the transmission now?". Click "Yes".



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

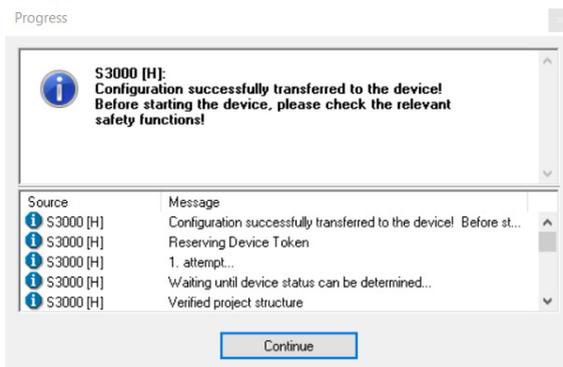


The zone information will be uploaded and a window will appear showing the safety report and the drawing of the area set.

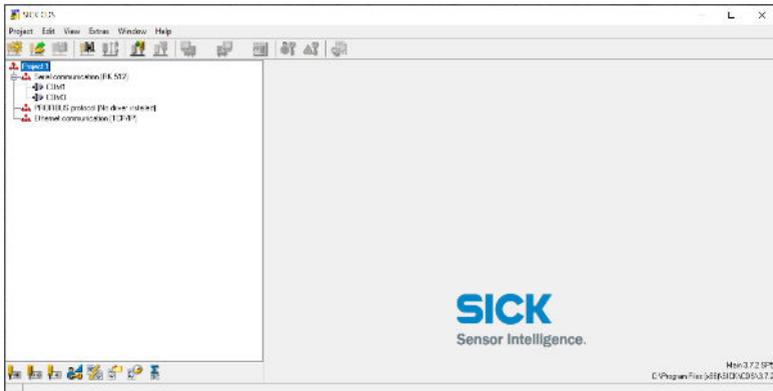


26. Scroll down to the bottom of this window and click "Release". Doing this will upload the settings to the device. In order to repeat the process of setting the area, do not click "Reject"; instead click "Release" and start again from step 16.

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

Typical symptoms, causes, and actions

Note

The Stäubli teach pendant should only be used for troubleshooting purposes and should not be used for normal operation of the rig. The teach pendant is not related to Flair in any way and is not an interface to MRMC Showbolt system.

Symptoms	Cause and/or action
Flair fails to establish a network connection to the Showbolt controller (the Stäubli CS8) over the ROBOT ONLY cable.	<p>Try a different cable. The cable between the cifX boards in the Flair PC and Stäubli CS8 needs to be a high quality, fault-free, straight-through (that is, not cross-over) Ethernet cable.</p> <p>Check that all cables are connected correctly (page 3) and that all devices, including the Ethernet hubs, have power.</p> <p>Check the order in which you are powering up the devices (page 4).</p> <p>Make sure you have allowed enough time for the Showbolt/Stäubli CS8 unit to completely power up (with the Stäubli CS8 panel displaying an “A” and the cifX board lights displaying the correct pattern) before you double-click on the Start Robot icon on the Flair PC Desktop.</p>

Symptoms	Cause and/or action
Showbolt won't move	<p data-bbox="437 199 932 256">Make sure you have enabled Showbolt in Flair (click on the Engage Robot button).</p> <p data-bbox="437 279 932 496">The Staubli arm has its own hard limits for rotate, lift and arm. If any of the axes in the arm have hit the internal limits then the arm will 'lock up' and will not engage at all. You will need to move the arm by hand. For more details, refer to <i>Moving the Showbolt arm by hand</i> on page 47.</p> <p data-bbox="437 518 932 643">Make sure all of your E-stop buttons are up, and that you have pressed the Reset button on each E-stop (if it has one). When they are all up, the Staubli CS8 panel displays a "U".</p> <p data-bbox="437 665 932 818">If you have moved the Showbolt arm by hand with the Brake Release Unit, make sure you have replaced the Brake Release Plug in the socket when you have finished. For details see <i>Moving the Showbolt arm by hand</i> on page 47.</p>

Moving the Showbolt arm by hand

In some circumstance you need to move the Showbolt arm manually with your own hands. For example:

- Recovering from a **software lock-up**. For example if momentum has carried the arm outside the soft limits, the software might refuse to move the arm to get back inside the limits.
- Recovering from a **hardware lock-up**. If momentum or a programming error moves the arm against its internal hard limits or if the camera platform gets stuck against another part of the arm, the motors might not be able to back off from this position without tripping out.
- Putting the arm into **transport position**, to make the Showbolt volume as small as possible so it will fit into a truck. You can do this with Flair software (although you will probably need to change the soft limits) but if you forget to do so before shutting down the Flair computer then you can do it by hand.

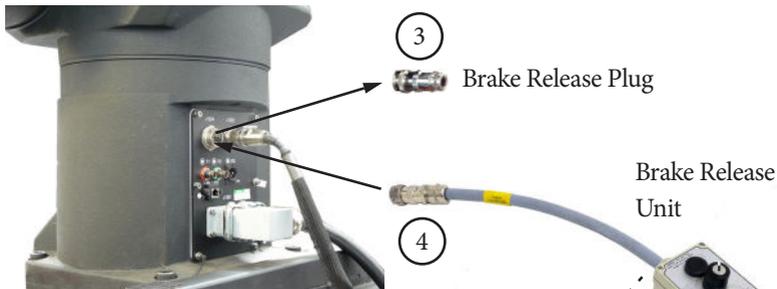
Hint

Moving the Showbolt arm by hand is usually a two-person job — one to operate the Brake Release Unit and one to move the arm.

To move the Showbolt arm by hand:

1. Make sure that Showbolt itself has power and is switched on. The brakes are **on** when the unit is switched **off**, so if you want to move the arm by hand, Showbolt must have power and be switched on.
2. If Showbolt is connected to a running Flair PC, click on the **Disengage Robot** button in Flair.
3. Remove the Brake Release Plug from socket J1204 on the arm base.
4. Plug the Brake Release Unit into socket J1204 on the arm base.

- Person 1: On the Brake Release Unit, use the lower dial to select which Showbolt axis you want to move.



- Person 2: By hand, securely hold the portion of the arm that you want to move so it does not fall when you release the brake.
- Person 1: Press and hold the Brake Release button.
- Person 2: Move the arm by hand.
- Person 1: Release the Brake Release button.
- Repeat steps 5 to 9 to move all the axes you want.
- When you have finished, unplug the Brake Release Unit from Showbolt, replace the plug in socket J1204, and power



Moving the axes when the Stäubli arm hard and soft limits are hit

The rotate, lift and arm axes in the Stäubli arm have the hard limit switches. The other three axes, pan, tilt, and roll, only have the soft limits. Moving the arm by hand is required when you hit the hardware limits. For more detail on how to move the arm by hand, refer to *Moving the Showbolt arm by hand* on page 47.

When the arm hits the software limits, use the teach pendant to move the axis. To do this:

1. Plug the teach pendant in Stäubli CS8.
2. Release the e-stop. Release the pendant and Stäubli E-stop.
3. Switch the Stäubli e-stop to manual (hand) position. The LED on the 'hand' symbol will go green.
4. Clear any options in teach pendant by clicking OK.
5. Put the dead man's handle to the middle position.
6. Press the Power (green) button. You should hear the robot engage and the light on the arm should come on.
7. Select **Joint in the Move** mode. The light on it comes on.
8. Press the button, + or -, to take the axis back to the required position. This will only let you move the axis that has crossed the limits and only in the direction that brings it back to a position within the soft limits.

Note

Always carry the Break Release cable with a Showbolt system. Once the Stäubli hard limits are hit, there's no way to bring the axes back into a position within the hard limits without using the break release cable!

Checking robot temperature using the pendant

The robots efficiency might suffer if the temperature inside the cabinet is too high. To check the temperature:

1. Replace the bypass jumper from the Pendant connector in the Showbolt base with the Pendant connector on the teach pendant.



2. Select **Main Menu > Control Panel**. Press Enter.



3. Select **Controller Status** and press '→'.



4. The Cabinet Temperature is shown on the pendant screen.

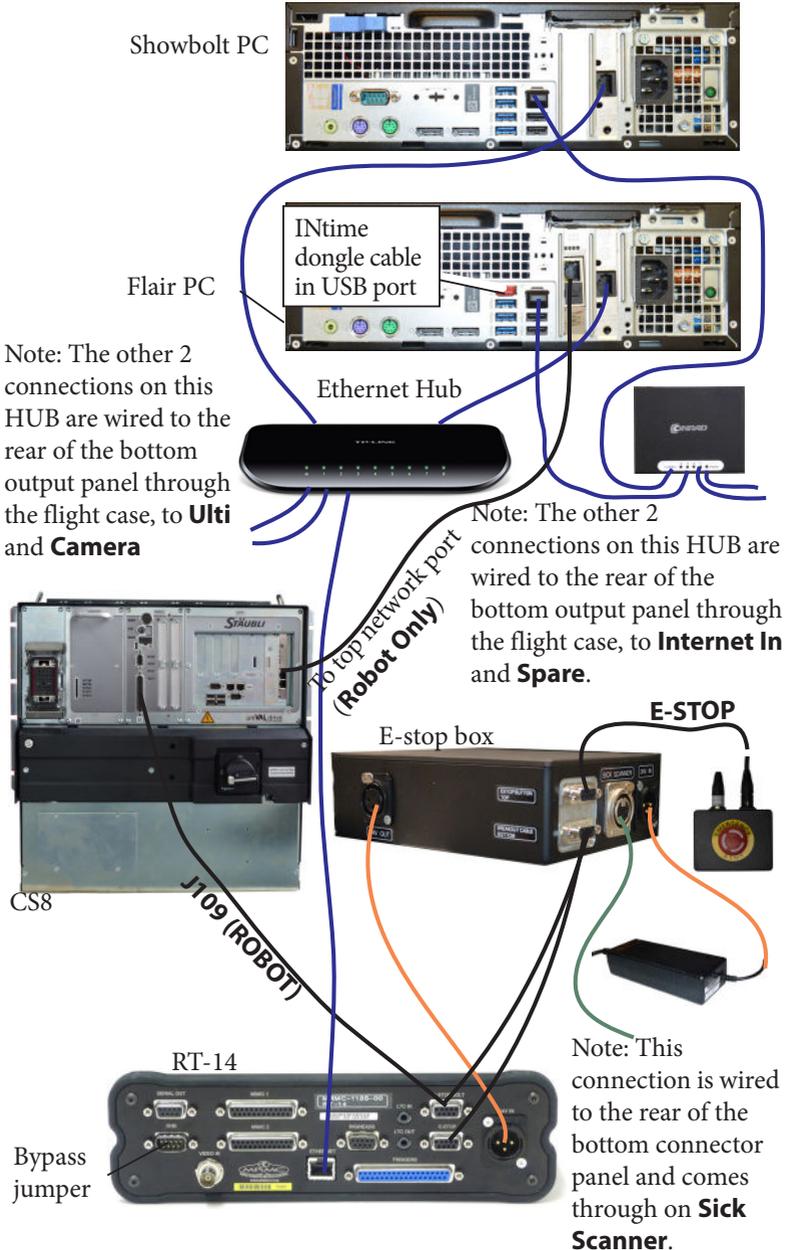


5. Remember to replace the Teach Pendant with the bypass plug after you have completed the procedure.

Sick Sensor Troubleshooting

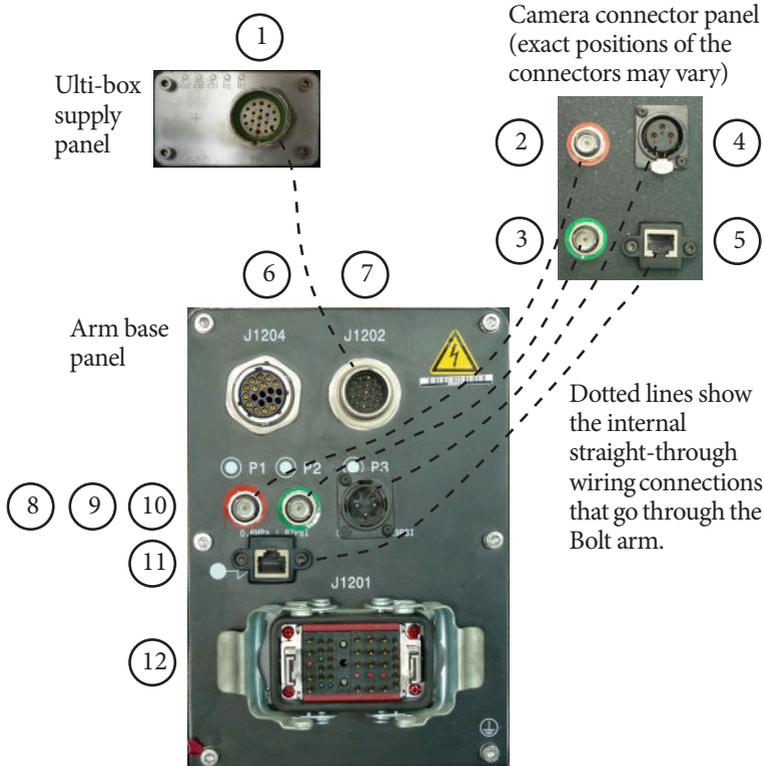
1. If “Reject” is accidentally pressed at step 26 on page 42, the system will erase the settings from the SICK device and it will give a “lock-out” error ‘6’ on the device and the line shown in will be in RED. To reset this, the right-click on the RED device name and click “open device window”
2. Click 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



Appendix 2 Bolt panels

Showbolt arm panels connector summary

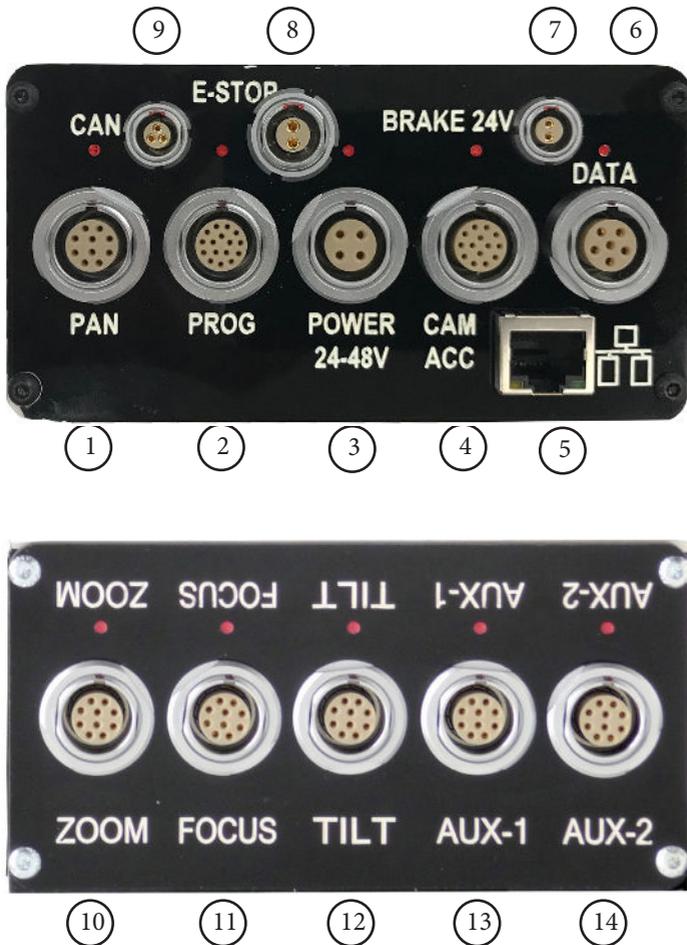


1. **Ultra-box output** connector. This supplies 48 Volts DC output and Ethernet for the Ultra-box mounted on the arm. This has a straight-through internal connection to the **Ultra-box input** connector (7). This connector uses a special two-into-one cable that attaches to the **ETHERNET** and **POWER** connectors on the Ultra-box that is mounted on the Bolt arm.
2. **VIDEO 1 IN** input connector for the video 1 signal from the camera. This has a straight-through internal connection to the **VIDEO 1 OUT** connector (8).

3. **VIDEO 2 IN** connector for the video 2 signal from the camera. This has a straight-through internal connection to the **VIDEO 2 OUT** connector (9).
4. **24-48 Volts DC output power** connector. You can use this to power the camera or other devices mounted on the camera platform. This has a straight-through internal connection to the **24-48 Volts DC input power** connector (10), so the output voltage is whatever voltage you have put into connector 10.
- 5, 11. **ETHERNET** connectors (100 Mbits/sec rating) for communications between the camera and the rest of the system. The connection between these two connectors is a straight-through internal connection through arm, and you ordinarily attach connector 11 to the Ethernet hub that services the Ulti-box.
6. **BRAKE RELEASE** connector. You attach the Brake Release Unit to this connector when you want to move the arm manually (by hand). Details are in *Moving the Showbolt arm by hand* on page 47. When you are not using the Brake Release Unit, this connector must have the Brake Release Plug attached in order for Bolt to work.
7. **Ulti-box input** connector. This accepts 48 Volts DC power and Ethernet for the Ulti-box mounted on the arm. This has a straight-through internal connection to the **Ulti-box output** connector (1). This connector uses a special two-into-one cable that attaches to the Ethernet hub and a 48 Volt DC power supply brick.
8. **VIDEO 1 OUT** connector for the video 1 signal from the camera. This has a straight-through internal connection to the **VIDEO 1 IN** connector (2).
9. **VIDEO 2 OUT** connector for the video 2 signal from the camera. This has a straight-through internal connection to the **VIDEO 2 OUT** connector (3).
10. **24-48 Volts DC input power** connector. You can use this to power the camera or other devices mounted on the camera platform. This has a straight-through internal connection to the **24-48 Volts DC output power** connector (4).
12. **Stäubli controller** connector. This is for the main cable that runs between the Bolt arm and the Stäubli CS8 controller unit, which supplies both power and control to the arm. For a Bolt On Pedestal the Stäubli CS8 controller is a separate unit.

Ulti-box connector summary

The Ulti-box that is mounted on the Bolt X 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 Bolt X, as Bolt X 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 59.
 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 59.
 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 60.
 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 60.
 5. **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.
 6. **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 one of the following:
 - 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-12 or 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 61.
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.

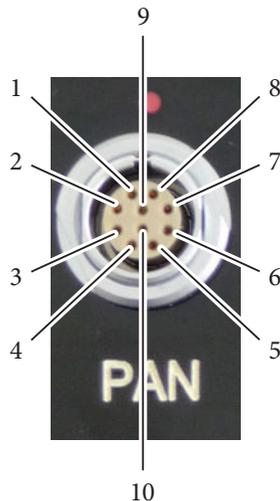
9. **CAN** connector is used to communicate with external CAN capable motor drives.
- 10,11. **ZOOM, FOCUS** connectors for external servo Lens Control Motors (LCMs) mounted on the camera platform. For pin-out information see *Servo motor connector* on page 59.
12. **TILT** connector for a Tilt servo motor on a head. For pin-out information see *Servo motor connector* on page 59.
- 13,14. **AUX-1, AUX-2** connectors for control of auxiliary servo motors. For pin-out information see *Servo motor connector* on page 59.

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.

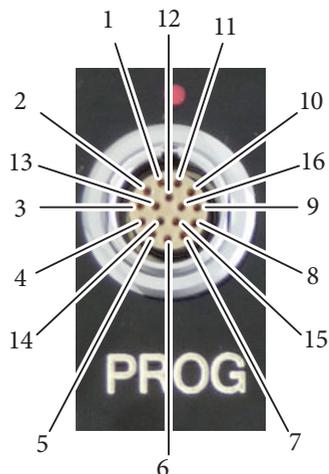
1. DATUM
2. A+
3. B+
4. Z+
5. N/C
6. MOTOR_B
7. MOTOR_A
8. LIMIT
9. +5V
10. GND



Program serial connector

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

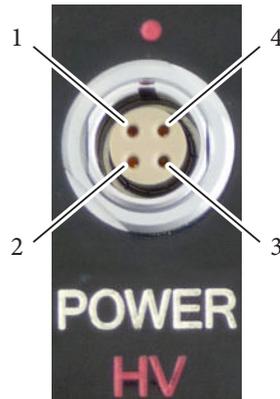
1. SerialTxA
2. SerialRxA
3. +5V
4. FGPIO
5. DSP_TRSTN
6. TCK
7. TMS
8. DSP_TDI
9. DSP_TDO
10. DSP_EMU0
11. DSP_EMU1
12. FPGA_TDI
13. FPGA_TDO
14. BOOT_SEL
15. +3.3V
16. GND



Power connector

The power input connector for the Ulti-box. For usage see page 57.

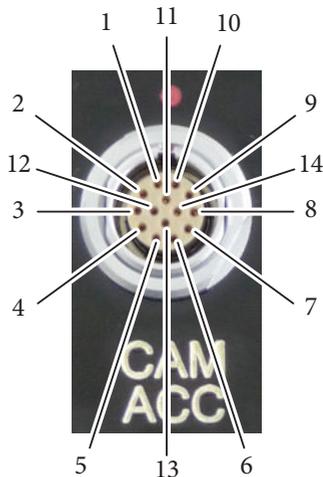
1. GND
2. GND
3. +35V
4. +35V



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.

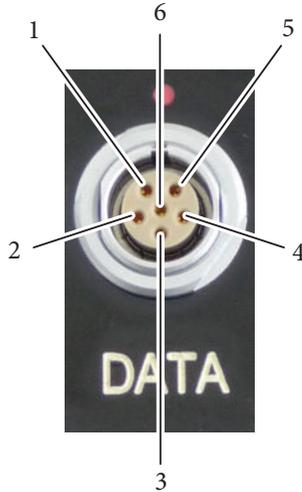
1. Step1
2. Gp2In (Trigger In 2)
3. Step2
4. SerialTxB serial lens control
5. Step3
6. SerialRxB serial lens control
7. Dir3
8. GND
9. +5V
10. Gp1In (Trigger In 1)
11. Dir1
12. Dir2
13. Gp2Out (Trigger Out 2)
14. Gp1Out (Trigger Out 1)



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 61.

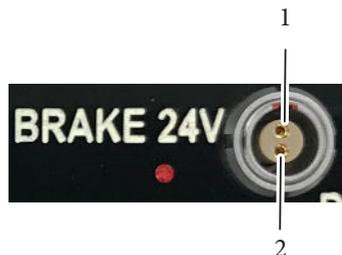
1. Watchdog-
2. Link1Out-
3. Link1Out+
4. Link1In-
5. Link1In+
6. Watchdog+



Brake 24V connector

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

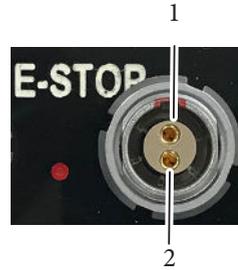
1. GND
2. +24V



E-Stop connector

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

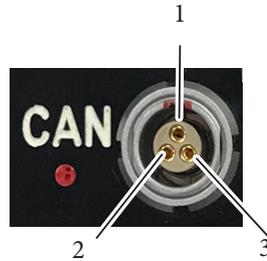
1. E-STOP-
2. E-STOP+



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

Physical Specifications

Dimensions	Showbolt
Weight	530 Kg
Weight - Stäubli CS8 controller unit	60 Kg
Weight - anchor weights and wings	644 Kg
Height - maximum lens height	3.2 m
Height - maximum mechanical clearance needed	4.0 m
Length/width - maximum lens reach from centre	1.8 m
Length/width - maximum clearance needed	2.3 m
Height - arm in transport position	2.0 m
Length - arm in transport position	1.53 m
Width - without wheels	870 mm
Width - with wheels	-

Temperature range: 0-45 °C (32-113 °F)

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

Camera payload: 20kg

Performance

Axis	Range of travel	Maximum speed
Rotate	$\pm 160^\circ$	240°/sec
Lift	$\pm 137^\circ$	240°/sec
Arm	$\pm 150^\circ$	300°/sec
Pan	$\pm 270^\circ$	315°/sec
Tilt	+120° -105°	350°/sec
Roll	$\pm 270^\circ$	870°/sec

Camera Specification

Z CAM E2 4K Cinema Camera

- ProRes 4:2:2 HQ, ProRes 4:2:2, ProRes 4:2:2 LT
- 12-Bit ProRes RAW recording over HDMI to the Ninja V 5" HDR monitor-recorder
- 4K @160fps, 10-bit color
- 4/3" WDR CMOS sensor
- 13~15 stops dynamic range (16 stops with WDR enabled)
- ZRAW (partial debayer)
- Apple ProRes certified
- Gigabit Ethernet for data, control & live streaming
- Multi-cam synchronization

Power requirements

Showbolt requires three phase but NO NEUTRAL. The power cable is wired directly to the robot's controller (CS8). It can be configured to run on different voltages without affecting performance. Change the CS8 PSU input to match the available three phase voltage (50/60 Hz) as shown in the table.

Allowed three phase input voltages:

200 V	208 V	230 V	400 V	440 V	480 V
7F 8F 9F	7E 8E 9E	7D 8D 9D	7C 8C 9C	7B 8B 9B	7A 8A 9A

Cable Colours

Brown Phase 1
Black Phase 2
Grey Phase 3
Green/Yellow Ground

Note: No NEUTRAL is used

General Electric Data

Earth

Earth must have good connection (less than 10 ohm) to the closest grounding point of the location.

Earth Leakage Protection

In industrial situations, where you are running large machinery, the earth leakage breaker (RCD/GFI) must be at least 100mA, preferably 300mA. Otherwise the machine will not power up and will sometimes trip when running.

Fuses

Fuses are 10 x 38 mm type, 500V

Three-phase 400-480 V	Three-phase 200-230 V
8Am	16Am

Power for Flair and PC (500W)

The PC running FLAIR and associated components are delivered mounted in a flight case. The power requirement is 110/240VAC single phase 50/60Hz and consumes no more than 500 Watts. All PSUs adjust automatically to the supply voltage.

Power Data by Country - United States of America

ASSUMED	VOLTAGE VAC	CURRENT AMPS	POLES	WIRING CONFIG	CONNECTOR ON WALL	NOTE
SUPPLY (7)	208	20	3+N+E	DELTA	L21-20R	N see note 1
SUPPLY (8)	208	30	3+N+E	DELTA	L21-30R	N see note 1

MRMC RIGS – MAX POWER REQUIREMENTS	POWER KVA	SUPPLY VOLTAGE	CURRENT AMPS	RIG CONFIG	WIRING CONFIG.	SUPPLIED CONNECTOR	TRANS FORMER	GFI	NOTE
BOLT on PEDESTAL (208/400/480)	3	208	8	3+E		L21-20P		300mA	2

Notes

1. The Neutral in a US three phase Delta configuration is NOT the same as the Neutral in a WYE configuration and is never used by MRMC rigs.

Notes



Mark Roberts Motion Control Ltd.

Unit 3, South East Studios, Blindley Heath, Surrey RH7 6JP

United Kingdom

Telephone: +44 (0) 1342 838000

info@mrmoco.com

www.mrmoco.com