Mark Roberts Motion Control

BOLT

QUICK START GUIDE

Product Code: MRMC-1077-05
MRMC-1177-02B
Part number: MRMC-1191-04

Bolt Quick Start Guide

Document version: BOLT-QSG-20160331
Part number: MRMC-1191-04

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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 Bolt High-speed Cine-bot from Mark Roberts Motion Control (MRMC). Bolt is designed for reliable day-in, day-out use in professional studio and Outside Broadcast environments. There are two versions of Bolt:

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

Bolt On Track has a base designed for moving along Precision Track. Is has removable trolley wheels for moving between sets, and can also be held down with weights at temporary locations.

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 Bolt.

- Unlike traditional motion control equipment, Bolt 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 Bolt On Track then 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 Bolt 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 Bolt 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 Bolt itself (530 Kg for Bolt On Pedestal, 730 for Bolt On Track) plus the weight of the track (95 Kg per section) or anchor weights (644 Kg) without flexing.
- Does the site have access? You need to make sure you can either push Bolt 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?
  - Bolt On Pedestal gets its power from the Stäubli CS8 unit. The system optimally runs on a **415 Volt, three-phase power supply** (four-wire including Ground), although you can configure it to run on a lower voltage and single phase (with a proportionate drop in performance) by adjusting the winding connections inside the Stäubli CS8 unit. If you need to run the system on a different power supply, contact us for advice on how to change the winding connections inside the Stäubli CS8.
  - Bolt On Track requires a **415 Volt, three-phase power supply** (five-wire including Neutral and Ground), and can **not** be configured to run on less.
  - The computer stack that controls Bolt (that is, the desktop computer and the power supply brick for the RT-12 or 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

- The ring on top of the Bolt arm is designed for lifting the arm **alone** (without the base) during manufacture and maintenance. **Do not** use this ring to lift the entire rig with its base unit, as this would put too much stress on both the ring itself (which could break) and on the Bolt gears.

- 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.

⇔ When using track, ensure that it is properly bolted to the floor. No amount of counterweight will stop the track from moving and twisting if the track isn't secured, especially with short lengths of track.

⇔ Make sure there is plenty of clearance around the length of the track for the trailing cables of the rig to slide along the floor. Ensure that they are not mounted in such a way so that they can catch on the track or robot as it moves along the full length.

- 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.

⇔ Never let anyone cross the robot's track when the track motor is powered up. In fact, it is a good idea to get into the routine of walking around the track instead of over it so that you don't cross the track out of habit when the track motor is powered up.

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.

⇔ When using track motion always have someone keep an eye on the trailing rig cables to ensure they don’t get caught on anything or anyone.

- 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 weight wings

If you want to use Bolt 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 Bolt 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 both Bolt On Pedestal and Bolt On Track, although you would only put wings on Bolt On Track when you are going to use it off the track. The procedure is similar for both Bolt types, except that Bolt On Track has optional wheels that you can use to raise and lower the rig, as an alternative to using a pallet truck.

1. Use the wheels (for Bolt On Track) or a pallet truck (for Bolt On Pedestal) to lift Bolt high enough to go over the wings (about 4 cm).
2. Lay one of the wings beside the Bolt base and push the edge of the wing under the edge of Bolt, 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. For a Bolt On Track, the wheels should be off the ground.
7. Put the weights onto the wings. Bolt requires four boxes of weights — one at each corner. Each box contains 140 Kg of weights (7 × 20 Kg).

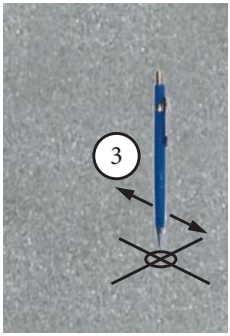
> Hint
>
> You can move Bolt without removing the wings if you want, as long as you take the weights off first.

Bolt On Pedestal with wings and weights

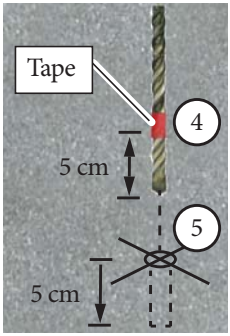
Anchoring Bolt On Pedestal to the floor

If you are setting up Bolt On Pedestal 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

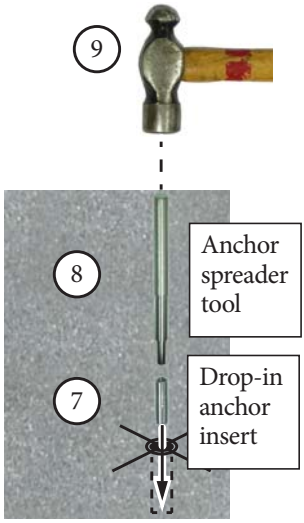
1. Temporarily put the Bolt On Pedestal into place where you want.
2. At one corner of the pedestal, use one of the two holes to draw a circle on the concrete with a pencil, to mark the position of the hole. You can use either hole.

   Repeat for the other three corners of the pedestal.
3. Temporarily remove Bolt On Pedestal 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.

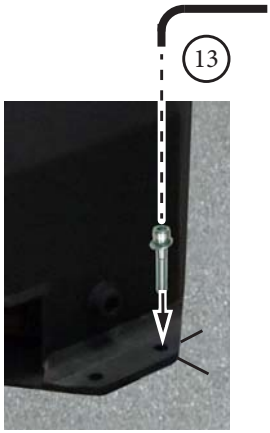
   Repeat for the other three corners.
4. On the 15mm diameter drill bit, put tape around the bit 5 cm from the tip. This will help you gauge the depth of the hole in the next step.
5. At one of the corner circles, drill a hole 5 cm deep into the concrete, centred on the cross. When the tape on the drill bit reaches the floor, drilling is complete.

   Repeat for the other three corners.
6. Clean the four holes.

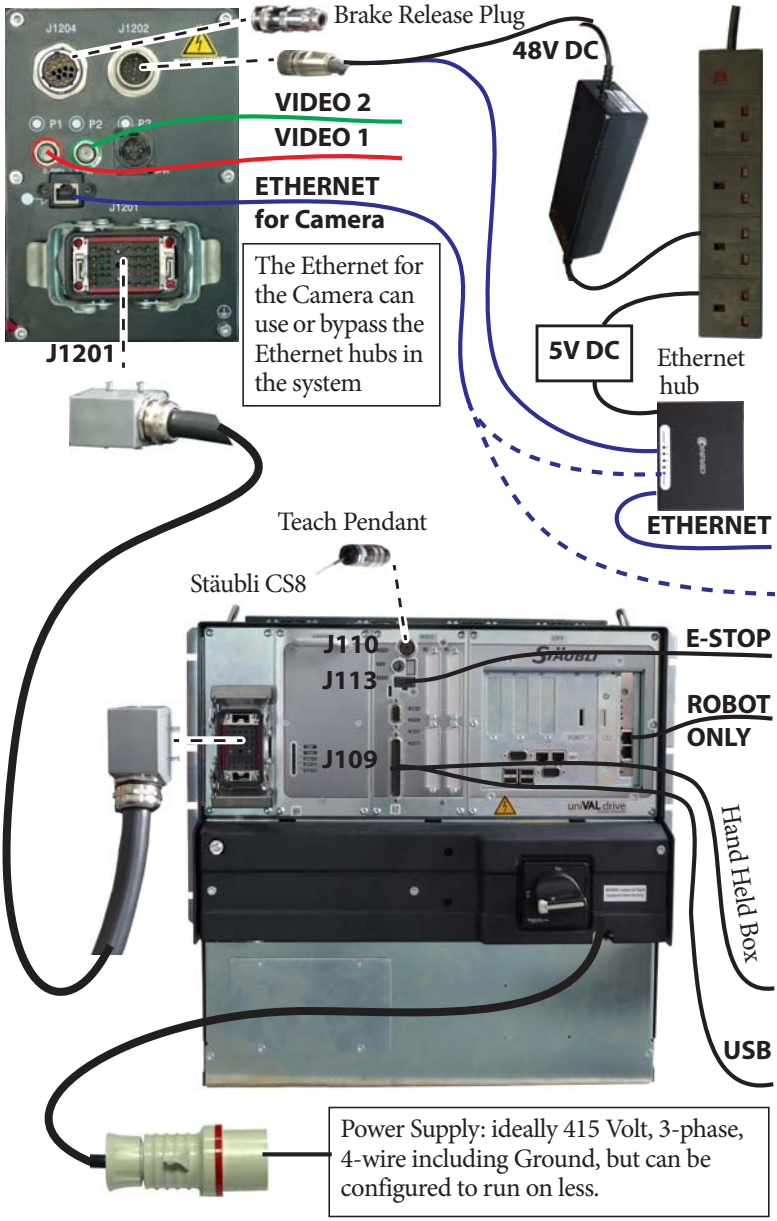
7. At one of the holes insert the drop-in anchor insert, threads upward, all the way to the bottom.
8. Insert the anchor spreader tool into the drop-in anchor insert.
9. Hit the top of the anchor spreader tool with a hammer until the anchor is fully spread in the concrete.
10. Remove the anchor spreader tool.
11. Repeat steps 7 to 10 for the other three corners.
12. Put Bolt On Pedestal 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.



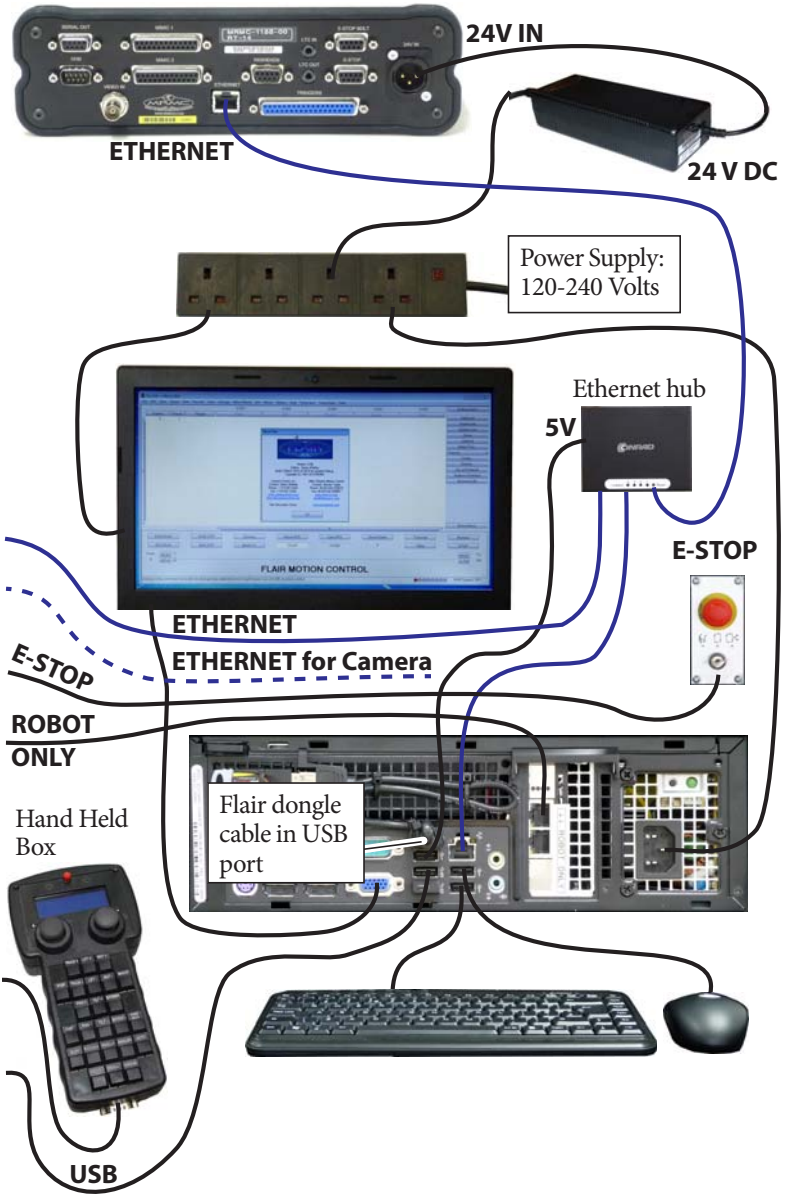
× 4 corners



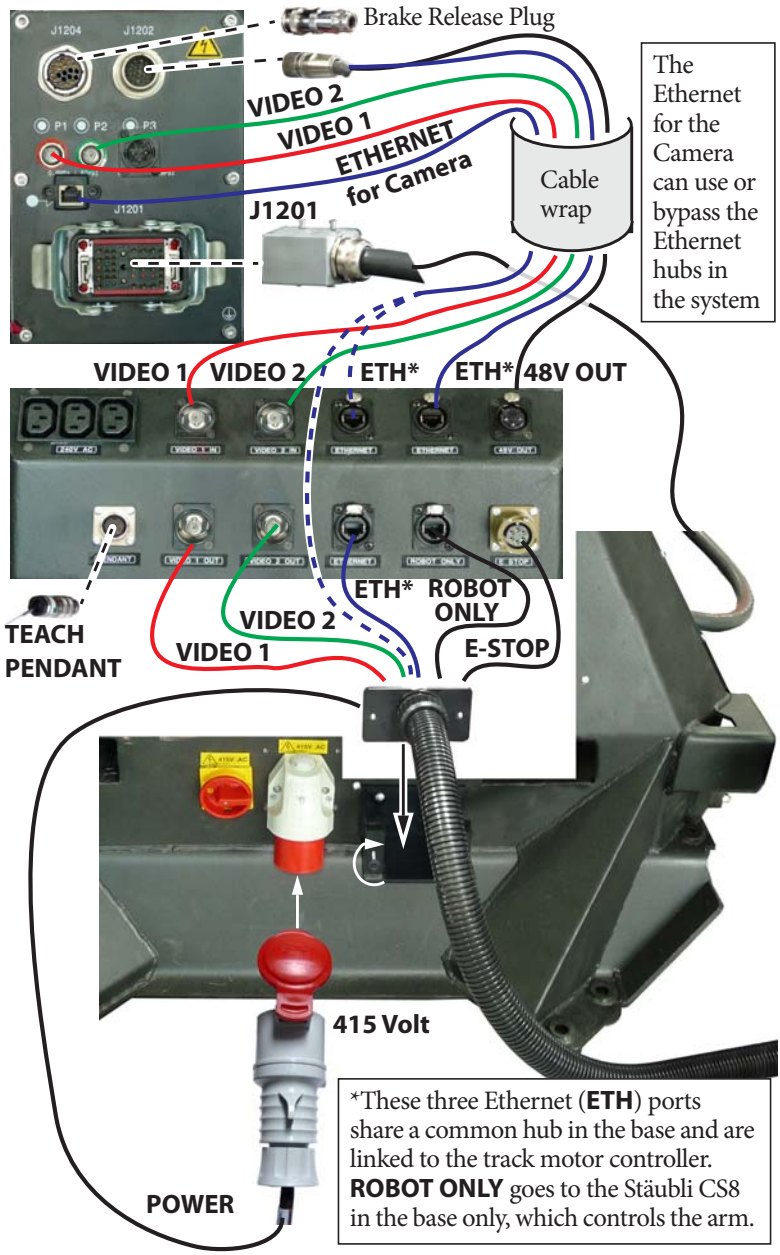
Connecting the cables — Bolt On Pedestal

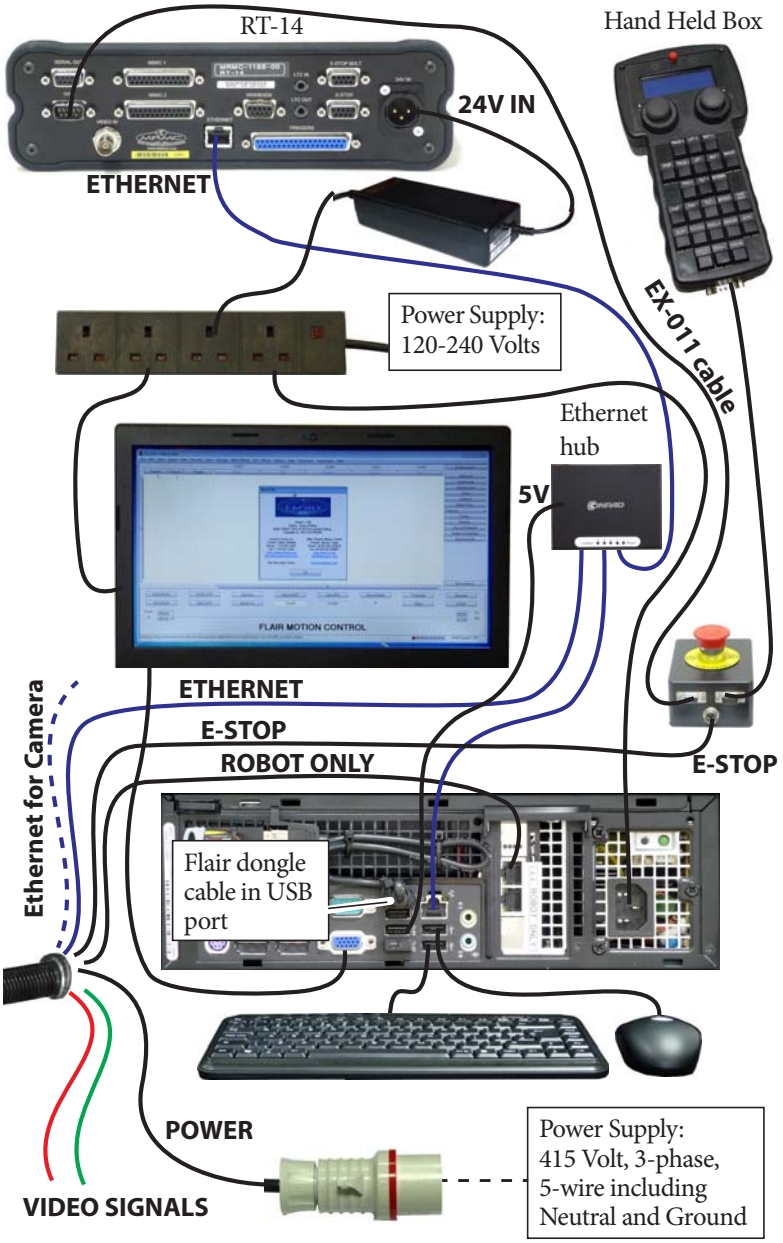


Optional RT-14 for connecting additional devices



Connecting the cables — Bolt On Track

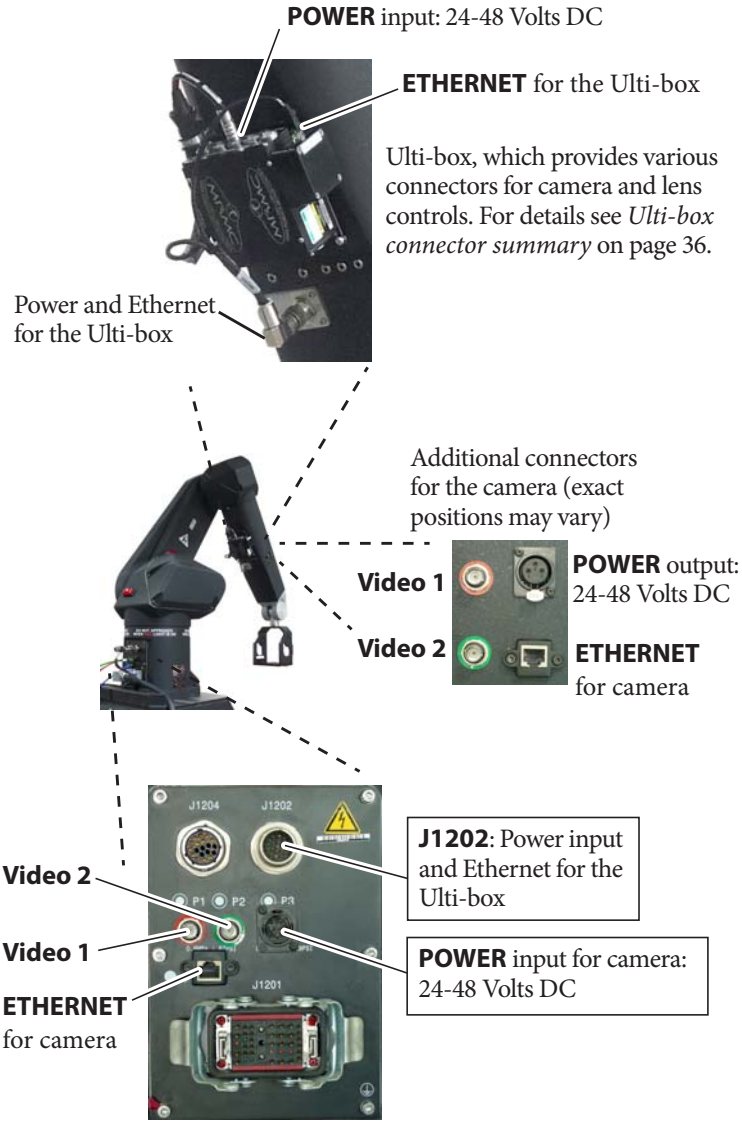



RT-14
Hand Held Box
24V IN
ETHERNET
Power Supply:
120-240 Volts
EX-011 cable
Ethernet
hub
5V
FLAIR MOTION CONTROL
ETHERNET
E-STOP
ROBOT ONLY
E-STOP
Ethernet for Camera
Flair dongle
cable in USB
port
POWER
VIDEO SIGNALS
Power Supply:
415 Volt, 3-phase,
5-wire including
Neutral and Ground

Picture of Bolt On Track connections:

Bolt arm connectors for Ulti-box and camera

The connections that go through the Bolt arm are shown below. These are for the Ulti-box mounted on the arm, and for the camera that you mount in the cage at the end of the arm.



Starting up the Bolt system

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

1. Make sure you have secured the area around Bolt. Put up guard rails around Bolt (and the track) 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** (if using Bolt On Pedestal) or the E-stop that is on the **Bolt base** (if using Bolt On Track) 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. Power up Bolt itself as follows:

   For Bolt On Pedestal, turn on the power switch on the Stäubli CS8.

   For Bolt On Track, turn on the power switch on the side of the Bolt Base.

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

Hint

If you are using a Bolt On Track, the Stäubli CS8 is inside the Bolt base and you can see the CS8 display and lights by looking through the window.

4. Power up the Flair computer system and all of its components, including the RT-12 or RT-14 interface box. You can do this while the Bolt is powering up (step 3). **Do not start the Flair application yet**.

5. After Bolt has finished powering up (step 3) 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). Again, if you are using a Bolt On Track, look through the window in the Bolt base to check the lights. This pattern indicates that the dedicated Ethernet connection running over the **ROBOT ONLY** cable is now working.

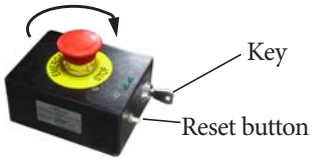
   If the cifX board lights do not show this pattern after about three minutes, then the dedicated Ethernet connection between the cifX boards has failed to auto-start, and you will need to start this connection manually by double-clicking on the **Start Robot** icon on the Flair computer's Desktop (outside of Flair). Wait a few minutes and check the cifX lights again. You should only use the **Start Robot** icon if necessary, as using it while the connection is running can interrupt the connection.

6. 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 quad board that runs the track motor (Bolt On Track only)
   - The Ulti-box that is mounted on the Bolt arm
   - Any additional interface boxes that are attached to the computer stack

7. 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 Reset button. Also make sure the key is in the vertical position. The horizontal position of the key bypasses E-stop from Hand Held box and Flair. Therefore, the key should not be kept in horizontal position when using Bolt except for testing purposes.



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

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

   - The track (if using a Bolt On Track). To do this you use the **Zero > Home Axis > Track** menu option.
   - 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.

9. In Flair, click on the **Engage Robot** button.

> Hint
>
> You use the **Track** button in Flair to toggle the track on and off, independently of the **Engage Robot/Disengage Robot** button that you use to toggle the Bolt arm on and off.

10. In Flair, move the Bolt arm to its home position (rotated straight forward and tucked under).

> Hint
>
> If the Bolt 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 Homing it.
> - When you home the rig, have one hand ready on the E-stop in case you need to stop the rig quickly.

11. Set the soft limits for the rig axes in Flair as required:
    - Arm position limits
    - Track limits (if using Bolt On Track)
    - Lens Control Motor limits (if using external LCMs)

Bolt start-up summary

1. Secure the area
2. Release the E-stop on the rig
3. Switch on Bolt (the Stäubli CS8 unit or the Bolt base)
4. Switch on the Flair PC
5. Check networking lights after three minutes; **Start Robot** if needed
6. Start Flair
7. Release the E-stop on the computer stack

In Flair:

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

The rig is now ready to use.

Shutting down the Bolt system

1. Move Bolt to its Home position, for both the arm and the track (if using Bolt On Track).

   or...

   If you are going to transport Bolt to a new location, put the Bolt arm into its transport position. You can do this either by using Flair (although you might have to reset the soft limits to reach the transport position) or by moving the arm manually. For details see page 24.

2. In the Flair software, click on the **Disengage Robot** button.
3. In the Flair software, disengage the track by toggling off the **Track** button.
4. Press down all E-stop buttons:
   - On the computer stack
   - On the **Stäubli CS8** (if using Bolt On Pedestal) or on the **Bolt base** (if using Bolt On Track)
5. Close the Flair software.
6. Shut down Windows on the Flair PC.
7. Turn off Bolt as follows:

   For Bolt On Pedestal, turn off the power switch on the Stäubli CS8.

   For Bolt On Track, turn off the power switch on the side of the Bolt Base.

To remove Bolt On Track from the track see *Mounting Bolt on the track* in the separate *Precision Track Quick Start Guide* and follow the instructions there in reverse order, to attach the trolley wheels, detach the pinch motor wheels and remove the rig from the track bearings.

Bolt shut-down summary

1. Move Bolt to the Home or Transport position
2. In Flair: **Disengage Robot**
3. In Flair: Toggle off the **Track**
4. Press down all E-stops
5. Close Flair
6. Shut down Windows
7. Switch off Bolt (the Stäubli CS8 unit or the Bolt base)

Moving the Bolt arm by hand

In some circumstance you need to move the Bolt 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 Bolt 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.

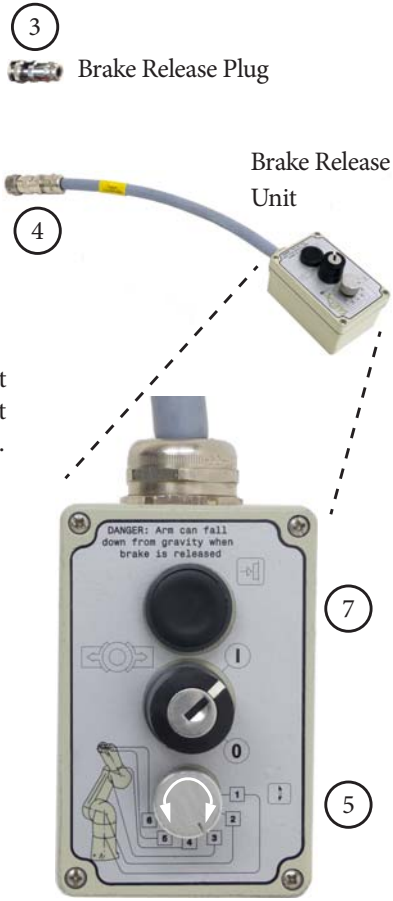
Transport position:

- Arm rotated forward and tucked under.
- Camera platform perpendicular to base slope, above the wheel unit, with about 3 cm clearance between it and the base.

> Hint
>
> Moving the Bolt 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 Bolt arm by hand:

1. Make sure that Bolt 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, Bolt must have power and be switched on.
2. If Bolt 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.
5. Person 1: On the Brake Release Unit, use the lower dial to select which Bolt axis you want to move.



6. 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.
7. Person 1: Press and hold the Brake Release button.
8. Person 2: Move the arm by hand.
9. Person 1: Release the Brake Release button.
10. Repeat steps 5 to 9 to move all the axes you want.
11. When you have finished, unplug the Brake Release Unit from Bolt, replace the plug in socket J1204, and power down.

Notes

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 interlace to MRMC Bolt system.

Symptoms	Cause and/or action
Flair fails to establish a network connection to the Bolt controller (the Stäubli CS8) over the **ROBOT ONLY** cable.	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. Check that all cables are connected correctly (page 12 and page 14) and that all devices, including the Ethernet hubs, have power. Check the order in which you are powering up the devices (page 18). Make sure you have allowed enough time for the Bolt/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.

Symptoms	Cause and/or action
Bolt won't move	Make sure you have enabled Bolt in Flair (click on the **Engage Robot** button). 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 *Moving the Bolt arm by hand* on page 24. 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 Stäubli CS8 panel displays a "**U**". If you have moved the Bolt 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 *Moving the Bolt arm by hand* on page 24.

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 Bolt arm by hand* on page 24.

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. Bolt on tack: he main e-stop needs to be released. Bolt on pedestal: Release the pendant and Stäubli e-stop.
3. Switch the Stäubli e-stop to manul (hand) position. The LED on the 'hand' symbol will go green.
4. Clear any options in teach pendant by clicking OK.

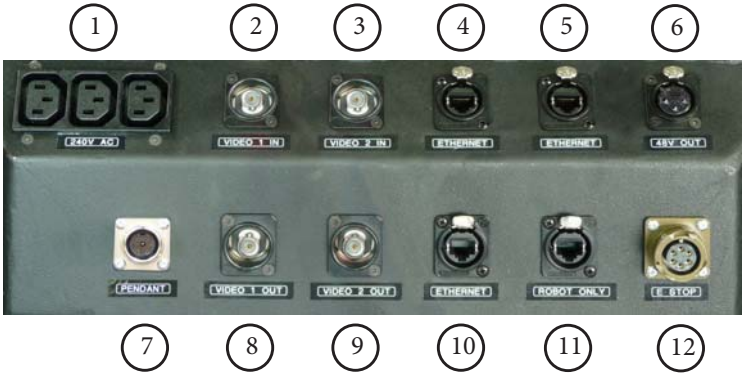
5. Put the dead man's handle to the middle position.
6. Press the Power (green) button.You should hear the robot engage and the light on the arm should come on.
7. Select **Joint in the Move** mode. The light on it comes on.
8. Press the button, + or -, to take the axis back to the required position. 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 Bolt 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!

Notes

Appendix 2 **Bolt panels**

Bolt On Track base panel connector summary



1. **240V AC** output, for general use by additional devices that you want to mount on the base.

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 connection to the **VIDEO 2 OUT** connector (9).

4, 5, 10. **ETHERNET** connectors for communications between multiple Ethernet devices on the rig. These three connectors share a common Ethernet hub within the Bolt base. You ordinarily attach one of these to the computer stack (via the umbilical cable), one to connector J1202 on the base of the arm to service the Ulti-box mounted on the arm, and one to the Ethernet connector on the base of the arm to service the camera or other Ethernet device mounted on the end of the arm. This Ethernet port is rated at 100 Mbits/sec.

6. **48V OUT** power connector. You usually use this to power the Ulti-box (and its attachments) on the Bolt arm, by attaching a cable from this connector to the J1202 connector on the arm.

7. **PENDANT** connector, for attaching a Teach Pendant to the rig. This is required for the rig to operate, and should only be removed under advice from MRMC support staff.

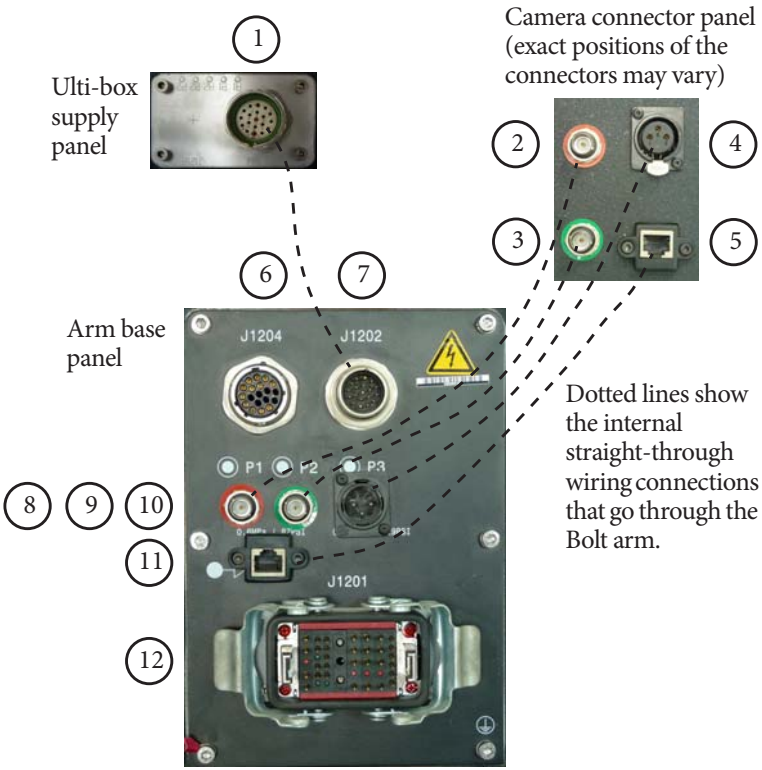
8. **VIDEO 1 OUT** connector for the video 1signal from the camera. This has a straight-through connection to the **VIDEO 1 IN** connector (2).

9. **VIDEO 2 OUT** connector for the video 2signal from the camera. This has a straight-through connection to the **VIDEO 2 OUT** connector (3).

11. **ROBOT ONLY** Ethernet connector. You use this to connect the cifX board in the Stäubli CS8 unit (inside the Bolt base) to the cifX board in the Flair PC, via the umbilical cable. The cifX Ethernet network is an industrial grade high speed network used to control the Bolt motion, and is completely separate from the Ethernet network that runs the Ulti-box and camera.

12. **E STOP** connector. You connect this to the E-stop button beside the computer stack, via the umbilical cable.

Bolt arm panels connector summary



1. **Ulti-box output** connector. This supplies 48 Volts DC output and Ethernet for the Ulti-box mounted on the arm. This has a straight-through internal connection to the **Ulti-box input** connector (7). This connector uses a special two-into-one cable that attaches to the **ETHERNET** and **POWER** connectors on the Ulti-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 (for Bolt On Pedestal) or to one of the Ethernet connectors in Bolt base (for Bolt On Track).

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 Bolt arm by hand* on page 24. 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 (for Bolt On Base), or to the **ETHERNET** and **48V OUT** connectors on the Bolt base (for Bolt On Track).

8. **VIDEO 1 OUT** connector for the video 1signal 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. For a Bolt On Track the Stäubli CS8 controller is housed inside the Bolt base.

Ulti-box connector summary

The Ulti-box that is mounted on the Bolt 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, as Bolt 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 38.

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 38.

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 **H**igh **V**oltage) uses 24-48 Volts. For pin-out information see *Power connector* on page 39.

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 39.

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 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 40.

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, 8. **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 38.

9. **TILT** connector for a Tilt servo motor on a head. For pin-out information see *Servo motor connector* on page 38.

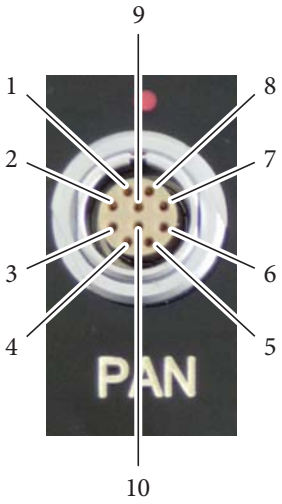
10, 11. **AUX-1**, **AUX-2** connectors for control of auxiliary servo motors. For pin-out information see *Servo motor connector* on page 38.

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.

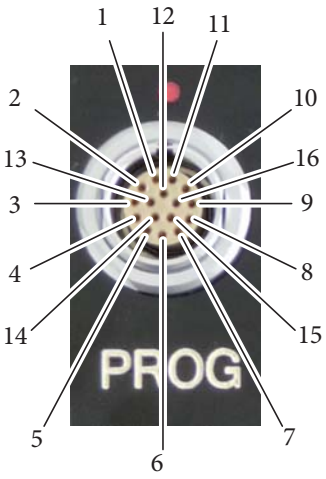
1. DATUM
2. A+
3. B+
4. Z+
5. N/C
6. MOTOR_B
7. MOTOR_A
8. LIMIT
9. +5V
10. GND



Program serial connector

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

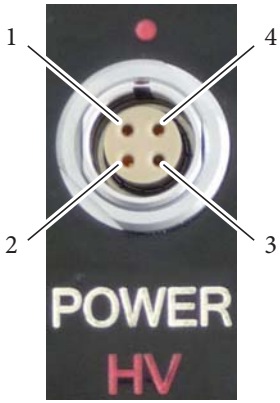
1. SerialTxA
2. SerialRxA
3. +5V
4. FGPIO
5. DSP_TRSTN
6. TCK
7. TMS
8. DSP_TDI
9. DSP_TDO
10. DSP_EMU0
11. DSP_EMU1
12. FPGA_TDI
13. FPGA_TDO
14. BOOT_SEL
15. +3.3V
16. GND



Power connector

The power input connector for the Ulti-box. For usage see page 37.

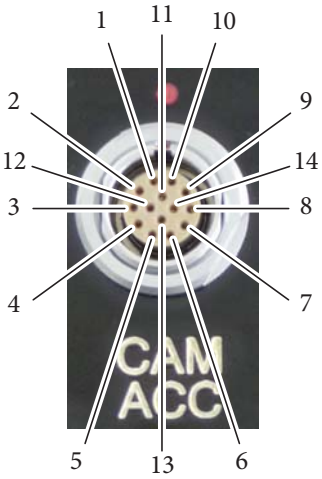
1. GND
2. GND
3. +35V
4. +35V



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.

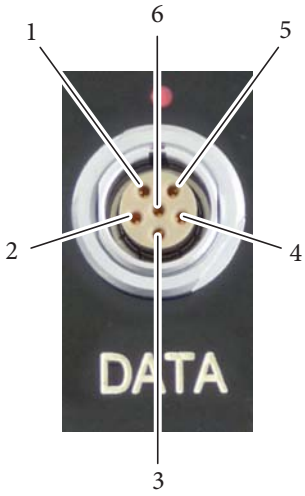
1. Step1
2. Gp2In (Trigger In 2)
3. Step2
4. SerialTxB serial lens control
5. Step3
6. SerialRxB serial lens control
7. Dir3
8. GND
9. +5V
10. Gp1In (Trigger In 1)
11. Dir1
12. Dir2
13. Gp2Out (Trigger Out 2)
14. Gp1Out (Trigger Out 1)



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 37.

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



Appendix 3 **Specifications**

Dimensions	Bolt On Pedestal	Bolt On Track
Weight	530 Kg	730 Kg with built-in Stäubli CS8 and wheels
Weight - Stäubli CS8 controller unit	60 Kg	
Weight - anchor weights and wings	644 Kg	644 Kg
Height - maximum lens height	3.2 m	3.5 m
Height - maximum mechanical clearance needed	4.0 m	4.0 m
Length/width - maximum lens reach from centre	1.8 m	1.8 m
Length/width - maximum clearance needed	2.3 m	2.3 m
Height - arm in transport position	2.0 m	2.0 m
Length - arm in transport position	1.53 m	1.86 m
Width - without wheels	870 mm	1.21 m
Width - with wheels	–	1.4 m

Temperature range: 0-45 °C (32-113 °F)
Humidity tolerance: 0% to 85% relative humidity, non-condensing
Camera payload: 20 Kg

Power requirements: 415 Volt, three-phase, 52 Amps, 50-60 Hz with Earth (Ground) connection. Bolt On Pedestal can be configured to run on less, with a proportionate drop in performance.
Optional power generator requirements: 3 kVA for Bolt
14 kVA for Bolt On Track

Performance:

Axis	Range of travel	Maximum speed
Rotate	±160°	240°/sec
Lift	±137°	240°/sec
Arm	±150°	300°/sec
Pan	±270°	315°/sec
Tilt	+120° −105°	350°/sec
Roll	±270°	870°/sec
Track	Limited by umbilical length	4.5 m/s

Camera platform inside measurements (mm):

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