PRECISION TRACK
TRACK FOR LARGE MOTION CONTROL RIGS

QUICK START GUIDE
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Precision Track Quick Start Guide

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Chapter 1  Assembling the track

Safety

- Due to the size and weight of track sections, it is recommended that you use at least two people to assemble it.

- Motion control rigs have powerful motors that can injure, so take care not to get near the rig while it is switched on.

- Do not step over the track when the rig is switched on — walk around it instead.

Overview

Thank you for using Precision Track from Mark Roberts Motion Control (MRMC). The track is designed to help you achieve pixel-perfect repeatability of your camera moves by supplying smooth, rigid support when using large, heavy motion control robots such as the Milo, Titan, and Bolt over long distances.

Before you start

When deciding on the location and orientation of the track, keep in mind the following important points:

- Before laying the track, assess the site to see how level and firm the ground or floor is. You might need to use boards, bricks, or crates to create a level surface or stop the track feet sinking into soft ground. If you will be laying more than two track sections on a reasonably level floor, laying the middle section first and working outward can help prevent any unevenness of the floor from accumulating from section to section, beyond the ability of the track height adjustment range.
to cope. Beyond this range you will need to use additional supports to keep the track flat and level.

- The track is **not reversible** due to the rack, which has teeth on one side. You must lay all sections the same way around. If your track does not have the rack installed yet, look at the rack clips on the track, which will grip the rail on the teeth side when you install the rail later.

![View looking “Forward” down the track with the gear teeth on the left:](image)

- Some rigs have a sense of **Forward** and **Reverse** on the track. A Bolt High-Speed Cine-bot, for example, executes moves going Forward. Because its track motor gear is on the front left underside of the rig, the teeth of the rack are on the left side as you look in the Forward direction down the track.

- Keep in mind where the **umbilical cable** comes out on the rig (if this is important for your shot) and whether you can change it by re-routing the cables on the rig. For example the umbilical cable on Bolt comes out on the same side of the track as the track motor gear (which is the same side as the rack teeth).
- Each Precision track section has ten feet for supporting and levelling the track, and four anchor brackets for holding the track down if you are using a high-speed rig such as Bolt.

- If you are using a fast rig such as Bolt On Track then you must hold the track down. You can either anchor the track to the floor to get the best repeatable stability (page 6), or if this is not feasible you can use weights on the ends of the track to give you the safety margin that you need to perform the shoot (page 33). Anchoring the track to a concrete floor involves drilling holes in the floor. If the floor is wood you can screw directly into it. The anchor hole spacing is shown below but it is more accurate to drill through the anchor brackets once the track is in place using the procedures later in this guide.
Laying the first track section

1. Lay the first track section on the ground, on its feet.

2. If you will be using a fast rig such as Bolt and the floor already has anchor holes from a previous installation then you would obviously put the track anchor brackets over the existing holes.

3. Raise the six middle feet of the track section (three on each rail) and the four threaded anchor sleeves so they do not touch the ground.

4. Level the track in both length and width directions using a spirit level, by adjusting the four corner feet of the track. Make sure all four corner feet are touching the ground (no wobble).

Hint
The four corner feet also determine the track height. If you are laying track on a level floor, try to use the middle of the height adjustment range so that subsequent sections have some leeway (in their feet) to cater for any unevenness in the floor.

5. Tighten the lock nuts down against the track on the corner feet, being careful not to change the height.
6. Lower the six middle feet until they touch the ground (finger tight against the ground) and then tighten the lock nuts on them.
**Anchoring the track**

If you are using a fast rig such as Bolt On Track you must either hold the track down with weights (see page 33) or secure the track to the floor by using bolts or screws through the four track anchor brackets. Anchoring the track to the floor gives you more repeatable stability than using weights. The following procedure tells you how to anchor the track to a concrete floor.

1. Put the drill bit into the drill guide and attach the bit to the drill. (The cutting end of the bit is too large to fit through the guide, so you must insert the other end into the guide, then into the drill.)

2. On one of the track anchor brackets, screw the sleeve all the way down to the floor, finger tight.

3. Insert the drill bit and guide into the threaded sleeve on the anchor bracket, so the drill bit is against the floor.

4. Put tape around the drill bit 5 cm above the guide. This will help you gauge the depth of the hole in the next step.

5. Drill a hole 5 cm deep into the concrete. When the tape reaches the top of the guide, drilling is complete.

6. Remove the drill bit and guide from the sleeve and clean the hole.
7. Put the drop-in anchor insert, threads upward, through the sleeve and into the hole in the concrete, 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, **being careful not to hit the track**.

10. Remove the anchor spreader tool.

11. With the sleeve still finger-tight against the floor, insert the retaining bolt through the sleeve and into the drop-in anchor insert, and tighten.

12. Repeat steps 2 to 11 for the other three anchor brackets on the track section.
Laying subsequent track sections

1. If any of your track sections already have a rack installed, loosen the rack clips so you can temporarily slide the rack along the track and out of the way when you are joining the track sections.

2. Lay the next track section in line with the previously laid track section and as close to it as possible, making sure it is the right way around (see the notes on page 2).

   Again, if you will be using a fast rig such as Bolt and the floor already has anchor points from a previous installation, put the track anchors as close as possible to the existing holes.

3. Raise the middle feet and anchor sleeves of the new track section so they do not touch the ground.
4. Adjust the height of the new track section to match that of the previous section by adjusting the two corner feet nearest to the joint (one on each rail).

5. Level the new track section with a spirit level by adjusting the two corner feet furthest from the joint (one on each rail).

6. Slide the new track section along the floor against the previous track to firmly engage the ends of the rails. (Slide the new section — not the previous section.)

   You might need to repeat steps 4 to 6 until you get good alignment of the rails at the joint.

7. Firmly tighten the six large bolts that hold the track sections together at the joint (three on each rail). You can also use these to help pull the track sections together, once they are at the same height.

8. On the new track section, tighten the lock nuts down against the track on the four corner feet.

9. On the new section, lower the six middle feet until they touch the ground (finger tight against the ground) and then tighten the lock nuts on them.

10. If you are using a fast rig such as Bolt anchor the new track section to the floor as you did for the previous track section, using the procedures in Anchoring the track on page 6.

Repeat steps 1 to 10 in this section to lay additional sections of track.
Mounting the rack

1. If your track sections do not yet have the racks mounted on them, do this now for each track section as follows:

   1.1 Loosen all the rack clips on the track section.

   1.2 Lay the rack into the brackets on the track, tilted as shown, making sure that the clips on the track go into the groove on the rack, just under the teeth.

   1.3 Twist the rack to lay flat in the brackets. Do not tighten the clips yet.

   1.4 Repeat steps 1.1 to 1.3 for each track section.

2. In the middle of the track, slide two of the racks together end-to-end, so that the joint between them is centred over one of the rack mounting brackets near the main rail joint.

3. Make sure the rack joint has the correct spacing by clamping a rack matching block to it, teeth meshed, using a vice.

4. Insert the two retaining bolts through the ends of the racks and into the mounting bracket (one on each side of the joint), and tighten.

5. Remove the vice and rack matching block.
6. Tighten all rack clips on the two adjoining sections of track.

7. If you are using a high-speed rig such as Bolt, also secure the rack with an extra bolt through the rack at every mounting bracket. This is not usually necessary for slower standard rigs.

8. Repeat steps 1 to 7 to mount the rack on all remaining sections of track, working outwards from the centre track section.
Mounting the bearing rail joints

Hint
Always mount and remove the track bearings with care. Try to keep them squared up and in-line with the bearing rail to avoid damaging them or loosing a bearing.

1. At one of the track joints, slide two track bearings over the ends of the bearing rails.

2. Put one of the long bearing rail joints onto the track.
3. Align the bearing rail joint with the existing rail by sliding the track bearings partially over the joint at each end.

4. Insert the bolts and tighten them.

5. Slide the track bearings along the rail to the next joint and repeat steps 1 to 4 for all remaining joints. For the track ends you use the short bearing rail pieces (with only two holes) and only one track bearing to help with alignment.

**Multiple Lengths of Track**

1. Lay the first three lengths of track and join them together.

2. Treat the three lengths of track as one. Use the end corner feet of the multiple length with all intermediate feet of the floor.

3. Level the multiple length as one unit measuring the end to end level only in the centre of the entire group.

![Level the track in the centre first](image)
4. Using only the middle pair of feet, bring the centre of the rail up to the level with the ends by measuring the level at the centre of the first half.
5. Push the rest of the feet down.
6. Extra lengths of the rail can then be added and individually levelled.
Mounting Bolt on the track

This section tells you how to mount Bolt On Track onto Precision Track.

Mounting Bolt on the track bearings
1. Roll the rig to a position just off the end of the track, raise the rig on its wheels high enough to go over the track using the wheel cranks, and rotate the rig on its wheels to be the correct way around so that the track motor gear on the rig underside is on the toothed side of the rack. **Do not engage the teeth yet; just make sure the rig is the correct way around for the track.**

2. On the underside of the rig, remove the pinch wheel if you haven’t already done so and push the track motor out of the way on its sliding bearings, so that the track motor gear will not interfere with the Rack on the track. (For details of removing the pinch wheel, follow the procedure on page 18 in reverse order.) **Do not slide the pinion gear too far away from the rack when moving it into place, the rear (inner) track motor mounting bolt will hit the racking as you drop the rig down, preventing it from settling onto the bearings.**

3. Push the rig on its wheels over the track about a metre, being careful not to push the track motor gear against the rack while moving.

4. Push the four track bearings onto the ends of the track (two on each rail) and into position under the four corners of the rig base.

5. Carefully lower the rig onto the four track bearings, making sure that all four bearings are aligned with the corners of the rig base, and the track motor gear on the underside of the rig clears the rack.

6. Tighten the four track bearing mounting bolts at the corners.

7. Apply the brakes to the wheels to keep them from pivoting against the track (the brakes affect both rotation and pivot), and raise the wheels off the ground so the full rig weight is taken by the track.

8. Feed out enough umbilical cable from your control area to reach the entire length of the track without stretching the cable. Make sure the area alongside the track is clear so that the umbilical cable doesn’t catch on anything when the rig drags it alongside the track.

9. Attach the track motor pinch wheel on the underside of the rig, described in *Attaching the track motor pinch wheel to Bolt On Track* on page 18.
Attaching the track motor pinch wheel to Bolt On Track

1. On the separately supplied pinch wheel assembly, remove the brass retaining pin by pulling on the ring.

2. Mount the pinch wheel assembly onto the track motor on the rig underside, by sliding the track motor gear against the rack and putting the pinch wheel Socket onto the track motor Mounting bar.

3. Replace the retaining pin in the pinch wheel assembly by pushing on the ring (not the sleeve), to hold the assembly in place on the track motor. Also, tighten the screw under the retaining pin.

4. Hand-tighten the pinch wheel adjustment bolt so that the rubber wheel presses firmly against the smooth side of the rack. This holds the track motor gear firmly against toothed side of the rack. Check that the space between the anti skip block and racking after mounting the pinch wheel assembly is about 1mm.

5. Connect the pinch wheel cables for the Limit Switch and Datum Switch to their corresponding connectors (usually labelled L and D).
on the rig underside, and use cable ties to hold them securely up away from the track.

**Hint**

The Limits and Datum magnets on the track are physically swappable (see page 31). Make sure you connect the Limit cable from the rig to the pinch wheel switch that is over the Limit magnet position on the track, and ditto for the Datum cable.
Mounting the bumpers on Bolt On Track

1. Insert one of the bumpers into the hole in the base of the rig.
2. Insert the four retaining bolts through the bumper bracket and into the base, but do not tighten yet.
3. If you want, adjust how far the bumper extends from the rig by screwing it in or out of its threaded bracket.
4. Tighten the four retaining bolts on the bumper.
5. Repeat steps 1 to 4 to mount the other three bumpers.

Hint

One of the corners on the bumper bracket has a locking slot cut into it. Tightening the bolt on this corner flexes the bracket, which in turn locks the threaded cylinder of the bumper to prevent it from turning. To adjust the amount of bumper extension after the bumper is mounted you only need to loosen the bolt on the bracket corner with the locking slot. You can then turn the bumper in its bracket to adjust the amount of extension, and re-tighten the bolt when you have finished.
Removing the trolley wheels from Bolt On Track

After mounting the rig on the track you can remove the two trolley wheel units that are on either side of the rig.

1. With the base of the rig supported by the track, pivot the wheels away from the rig.
2. Turn the cranks to lower the wheels to the ground.
3. Apply the wheel brakes.
4. Remove the two bolts holding the wheel trolley unit on the rig.
5. Lift the wheel unit away from the rig.
6. Insert the two wheel trolley retaining bolts back into the rig base, for safe keeping.
7. If you are going to store the wheels for weeks or months, release the wheel brakes so they don’t leave a dent in the wheel rubber.
Mounting a Milo or Titan on the track

Mounting outriggers on the track

The outriggers for Precision Track are a safety feature that prevents the rig tipping when assembling or using a Milo Long Arm or Titan. Although these rigs are balanced when assembled properly, the rig can be off balance temporarily during assembly or disassembly, or when performing a large acceleration or emergency stop that produces sudden rotational force directed over the track. You install four outriggers in each section of track. Leave the centre hole and end holes empty.

1. Insert the outrigger into an appropriate hole in the side of the track as far as it will go — this is about 340 mm, or about twice the length of the shiny tip of the outrigger.

2. Loosen the bolt on the end of the outrigger to allow the off-centre disks to rotate on the shaft.

3. Rotate the off-centre discs on the shaft in opposite directions until they both press against the floor, hand tight.

4. Re-tighten the bolt.

5. Repeat for the other three outriggers for the section, and for each section of track.
Mounting a Milo or Titan on the track bearings

1. Attach the pair of ramp-up rails to one end of the track, using three bolts on each rail.

2. Roll the rig to a position just off the end of the track, making sure the base is the correct way around. The track motor gear on the underside of the rig must be on the toothed side of the Rack.

3. You can rotate the Turret later if you need to point the arm in the other direction along the track during the shoot. For now, point the arm parallel to the track to make sure the rig is balanced over the track.

4. On the underside of the rig, remove the pinch wheel if you haven’t already done so and push the track motor out of the way on its sliding bearings, so that the track motor gear will not interfere with the Rack on the track. (For details of removing the pinch wheel, follow the procedure on page 27 in reverse order.)

5. Roll the rig on its wheels up the ramp, making sure that the rail wheels (with concave edges) are centred on the ramp-up rails. **Stop the rig when it is centred over the highest point on the ramp-up rails**, and **before** the rig reaches the small down-slope at the other end of the ramp-ups.

6. Apply the brakes.
7. With the rig at the highest point on the ramp-up rails, carefully push the four track bearings onto the ends of the bearing rails (two on each rail) and into position under the four corners of the rig base.

8. At each corner of the rig, use a hex key to push the captive bolt down into the track bearing and tighten to make sure the track bearing is lined up with the corner of the rig. You will not be able to tighten it completely yet because the rig is still sitting on the ramp-up rails and not on the track bearings.

9. Under the rig, move the track motor on its sliding bearings so that the Rack is centred between the track motor gear and the pinch wheel mount point. The purpose is to make sure that no part of the rig touches or interferes with the Rack when you push the rig the rest of the way onto the track in the next step.

Hint
Always mount and remove the track bearings with care. Try to keep them squared up and in-line with the bearing rail to avoid damaging them or loosing a bearing.
10. Let off the brakes and push the rig further along the ramp, down the small slope, and the rest of the way onto the track. When you do this, make sure that each of the four track bearings fits into the recess at the corners of the rig.

11. Tighten the four track bearing mounting bolts at the corners.

12. Remove the ramp-ups from the track so that the rig has the full run of the track.

13. Feed out enough umbilical cable from your control area to reach the entire length of the track without stretching the cable. Make sure the area alongside the track is clear so that the umbilical cable doesn’t catch on anything when the rig drags it alongside the track.

14. Attach the track motor pinch wheel on the underside of the rig, described in *Attaching the track motor pinch wheel to a Milo or Titan* on page 27.
Attaching the track motor pinch wheel to a Milo or Titan

1. On the underside of the rig, slide the track motor gear against the rack.

2. Bolt the pinch wheel assembly onto the mounting point on the underside of the track motor and tighten the bolt.

3. Hand-tighten the pinch wheel adjustment bolt so that the rubber wheel presses firmly against the smooth side of the rack. This holds the track motor gear firmly against toothed side of the rack.

4. Connect the pinch wheel cables for the Limit Switch and Datum Switch to their corresponding connectors (usually labelled L and D) on the rig underside, and use cable ties to hold them securely up away from the track.

**Hint**

The Limits and Datum magnets on the track are physically swappable (see page 31). Make sure you connect the Limit cable from the rig to the pinch wheel switch that is over the Limit magnet position on the track, and ditto for the Datum cable.
Mounting the bumpers on a Milo or Titan

1. Insert one of the bumpers through the appropriate hole in the base of the Milo or Titan, and then into the mounting bracket until it clicks into place.

2. Repeat step 1 to mount the other three bumpers at the other three corners.
Notes
Mounting the Limit Switch and Datum Switch magnets on the rack

About track limits

In a track-mounted rig there are typically three devices for limiting movement along the track to prevent the rig going off the end of the track:

- **Soft limits** - You configure these in the Flair Motion Control Software that controls the rig. When the system is working correctly the soft limits act as a barrier to other parts of the software such as programmed moves or live commands, so that no part of the software can move the rig beyond the soft limits.

- **Limit and Datum Switches** - The Limit Switch consists of a magnetic sensor located on the track motor pinch wheel on the underside of the rig, and two magnets which you mount at each end of the rack. The position of the magnets along the rack defines the ultimate limits, along the track, for the rig electronics. You define the soft limits within the range of the Limit Switch magnets, so that if the soft limits fail for some reason and the rig reaches one of the Limit Switch magnets, the system electronics automatically shut down any further movement and apply the brakes. A similar switch called the Datum Switch is used in combination with a single Datum magnet which you also mount on the rack but at a different distance from it. The Datum Switch defines a fixed reference point on the track for the electronics. The Flair software can then use this position as the home position or zero point, from which all movements and soft limits along the track are measured.

- **Buffers** - These are steel plates that physically prevent the rig from going off the end of the track if the previous two limits fail. Spring-loaded bumpers on the rig help to prevent damage to the rig or track, but you should never intentionally use the buffers to stop the rig. Mounting instructions are in *Mounting the buffers without weights* on page 35.
Mounting the magnets

Although you can mount the magnets for the Limit Switch and Datum Switch on the rack at any time, you ordinarily do this after mounting the rig on the track so that you can precisely adjust the height of the magnets relative to the magnet sensors on the pinch wheel on the underside of the rig.

The bracket that holds the magnet has two holes, and there is no convention regarding which hole to use for the Limit magnets and which to use for the Datum magnet. Whichever arrangement is used, the two brackets with an identical arrangement are used for the Limits at the ends of the track, and the bracket with the magnet in the other hole is used for the Datum which is between the Limits.

The track motor pinch wheel on the underside of the rig has two switches (sensors) that run over these two magnet positions — one switch for the Limits and one for the Datum.

When you install the pinch wheel and connect the rig’s Limit and Datum cables to the switches on the pinch wheel (page 18 for Bolt or page 27 for Milo or Titan), you must make sure that you connect the Limit cable to
the switch that is in the Limit magnet position, and the Datum cable to
the switch that is in the Datum magnet position.

1. Mount the two Limit Switch magnets (the two brackets that have the
magnet in the same hole) onto the underside of the rack — one at
each end of the track about a metre from the end. The actual
distance depends on your requirements and on which side of the rig
your Limit Switch is on (located on the track motor pinch wheel on
the underside of the rig). Position the magnet along the rack so the
Limit Switch on the pinch wheel goes over the magnet before the rig
hits the physical end of the track with plenty of room to spare.

2. Mount the Datum Switch magnet (the bracket that has the magnet
in the other hole) onto the underside of the rack, usually about 0.2
metres in from one of the Limit Switch magnets depending on your
requirements.

3. Power up the rig and roll it slowly over each magnet, checking for
clearance between the magnet on the rack and the sensor on the
pinch wheel assembly on the underside of the rig. Adjust the height
of the magnet (by loosening and re-tightening the bracket, and
screwing or unscrewing the magnet in the threaded hole) to give 1
to 2 mm of clearance between the magnet and the sensor.

Caution

Mounting the magnets too high can damage them, as they can
come into contact with the pinch wheel assembly on the
underside of the rig.

To adjust the magnet when the rig is over it,
remember to observe safety procedures to
disengage the robot and make use of the E-stops
so that the rig does not move when you are
working under it.
Mounting the weight wings and buffers

If you are using a fast rig such as Bolt On Track but anchoring the track into the floor is not feasible, you can alternatively attach optional weight wings to the ends of the track and hold the track down with weights. The weight wings fit between the track ends and the buffers.

Hint
Using weight wings will not give you the same level of repeatable stability as anchoring the track to the floor, but will give you enough stability to operate Bolt On Track safely without tipping the rig over.

You ordinarily mount the weight wings and buffers after you have mounted the rig on the track, although you can mount the rig on the track later if you have a forklift that can lift the rig high enough to go over the track from the side.

If you are going to mount the rig later, slide the track bearings onto the bearing rails now, before mounting the weight wings and buffers. If you forget to do this then when you mount the rig onto the track you will need to temporarily remove the bearing rail end pieces in order to get the track bearings onto the bearing rails.
1. Put the first weight wing into place on the end of the track, resting on the floor.

2. Bolt the left buffer onto the end of the track, using one bolt from the buffer side and another from the end of the track. You might need to remove bolts from the track joint to make room for the bolts coming through from the buffer side. Bolts are not necessary at the bottom of the limits.

3. Screw the foot down against the floor, finger tight only.

4. Put a box of weights onto the wing. Each box contains 140 Kg of weights (7 × 20 Kg).

5. Bolt the right buffer onto the end of the track using the two bolts from side of the buffer.
6. Repeat steps 1 to 5 for the other two weight wings and buffers on the other side of the track so you have two boxes of weights mounted at each end of the track.

**Mounting the buffers without weights**

You ordinarily mount the buffers after you have mounted the rig on the track, although you can mount the rig on the track later if have a forklift that can lift the rig high enough to go over the track from the side.

If you are going to mount the rig later, slide the track bearings onto the bearing rails now, before mounting the buffers. If you forget to do this then when you mount the rig onto the track you will need to temporarily remove the bearing rail end pieces in order to get the track bearings onto the bearing rails.

1. Bolt one of the four buffers (mechanical limits) onto one end of the track, using two bolts in the upper holes. You might need to remove bolts from the track joint to make room for the bolts coming through from the buffer side. Bolts are not necessary at the bottom of the limits.
2. If you are mounting a limit for a Bolt On Track rig, screw the foot down against the floor, finger tight only. The buffer for a Milo or Titan rig doesn’t have a foot.

3. Repeat steps 1 to 2 for the other three buffers so you have two limits mounted at each end of the track.
Appendix 1 Specifications

Weight: 95 Kg per section including the rack
21 Kg per pair of ramp-ups
140 Kg for each box of weights \times 4 boxes if using weight wings.

Dimensions: All measurements are in mm:

- Bearing rail spacing centre-to-centre: 800 mm
- Bearing rail height: 195 mm
- Ramp-ups for Milo or Titan: 1260 mm, 1760 mm, 3020 mm
Notes