

Hardwired DRO Installation for Large Bench Mills

The LittleMachineShop.com [Large Bench Mill 3-Axis DRO kit #6389](#) includes everything you need to add a DRO to your HiTorque Large Bench Mill.

If you want to retrofit a Bluetooth DRO system to hardwiring, you only need to replace the read heads with heads wired to 9-pin connectors ([part # 6467](#)), the DRO display unit ([part #6464](#)) and a display mounting arm ([part # 6469](#)).

Your current scales will work with the hardwired version.

Safety Considerations

Always use common sense when using power tools and working with electrically powered equipment. To safely install this DRO kit, the mill should be powered off and unplugged from a power source.

Project Summary

The installation of the DRO system involves mounting magnetic scales on the three axes (X, Y & Z) then mounting the read heads on brackets that are positioned so that the read heads glide along the scales sending positioning information to the display unit.

The X and Y-axis read heads are mounted on brackets that are affixed to the saddle. The Z-axis read head is mounted on a bracket attached to one of the feed nuts of the Z-axis feed screw.

Because the Z-axis read head is affixed to a support in the Z-axis feed screw system, and the Z-axis scale is attached directly to the column, the entire Z-axis DRO assembly is mounted inside of the mills cover. Therefore, the mill cover will be removed as part of the installation.

The mounting arm for the DRO display is mounted to the right side of the column in holes that must be drilled and tapped as indicated later in these instructions.

The magnetic scales come in two forms. The Z-axis scale has a mounting channel which attaches directly to the back of the column. The X and Y-axis scales mount to the table and mill base respectively, in areas where a shelf marks their placement. These last two scales are affixed to the base and table using M2x4 rivets.

Be Sure You Have Everything

The kit includes the following items:

- DRO display with protective plastic cover (qty 1)
- Display mounting arm (qty 1)
- Magnetic scale for X-axis - no frame (qty 1)
- Magnetic scale for Y-axis - no frame (qty 1)
- Magnetic scale for Z-axis - with frame (qty 1)
- Wired read heads - 9-pin adapter (qty 3) *

*** The two machine screws and scale wipe bracket are often loosely packaged in the read head envelopes. Be careful when opening, they will be needed.**

The DRO system for the large bench mill has thin magnetic scales for both the X-axis and the Y-axis. They are referred to here as having “no frame”. These thin scales are mounted on the table back (X-axis) and the side of the base (Y-axis). They are held in place an adhesive backing and two M2x4 rivets.

Mounting Hardware

Read Head Brackets

- Z-axis Reader Bracket (qty 1)
- X & Y-axis Reader Brackets (qty 2)

Mounting fasteners

- M3x10 pan head machine screw (qty 2)
- M3x14 pan head machine screw (qty 6)
- M4x10 socket head cap screw (qty 6)
- M2x4 rivets (qty 4)

In addition, you'll need the following tools, which are not included with the DRO kit:

- 2 mm or #47 drill bit
- 2.5 mm or #39 drill bit*
- 3.3 mm or #30 drill bit*
- 10 mm or 0.375" drill bit
- M3x0.5 thread-cutting tap*
- M4x0.7 thread-cutting tap*
- 2.5 mm hex key wrench
- PH 1 Phillips screwdriver

*These tools are available as a kit (PN 5820) from LittleMachineShop.com

Chris' Tip: On later machines, the holes for the DRO may already exist. Check your machine before ordering drills and taps.

Install the X-Axis Scale and Reader

Chris' Tip: These instructions tell how to remove the table so the mounting holes for the X-axis scale may be drilled true. If you feel you can drill the two M2 holes on the back of the table without removing it, you can skip to [insert link](#).

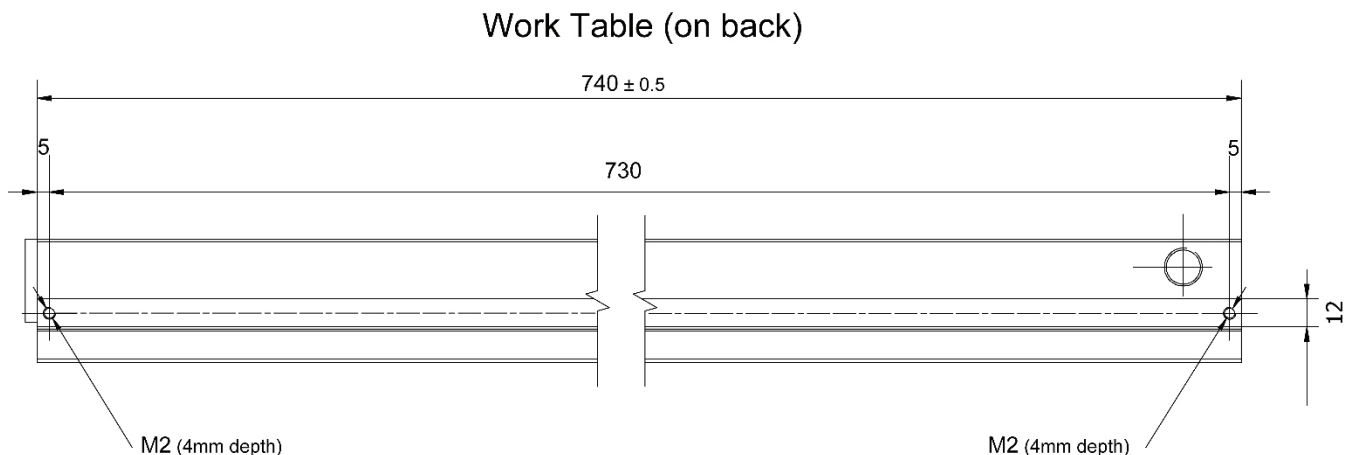
To remove the table:

1. Remove the retainer that attaches the chip guard bellows to the back of the mill table. Two screws hold the retainer in place; remove the screws and the retainer and set them aside.
2. Remove the four socket head cap screws that secure the Y-axis bearing retainer to the front of the saddle.
3. Unscrew the Y-axis screw from the machine. The bearing retainer and screw will come out of the front of the machine. When it is about 1/3 of the way out, remove the socket head cap screw and washer from the **back end** of the screw.
4. Loosen the Y-axis gib and slide the mill table and saddle forward off the machine.

(Caution! The table and saddle on a bench mill weigh approximately 73 pounds, so you might want to have a friend help you with this step.)

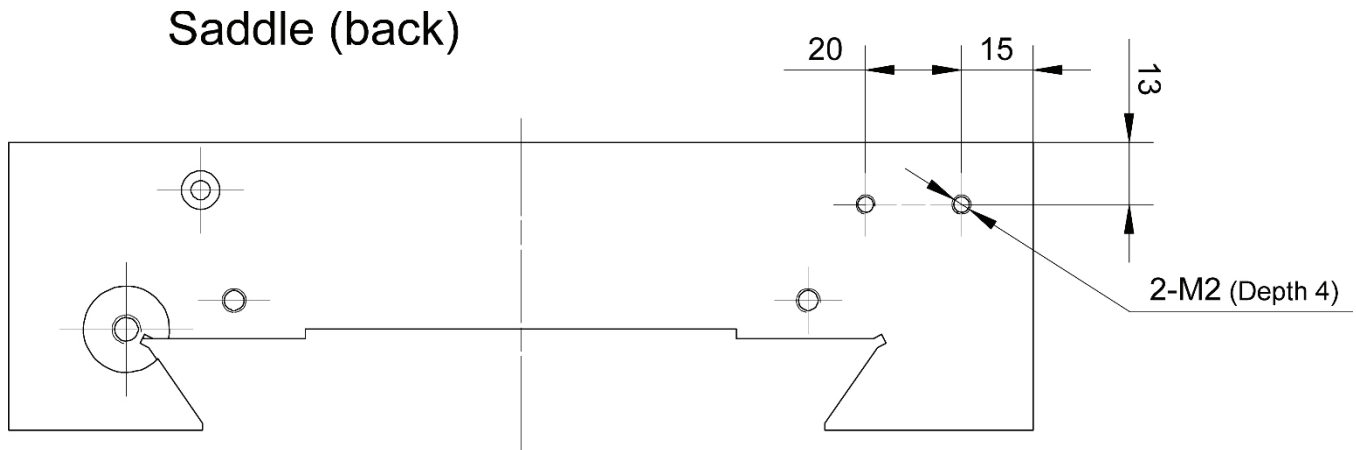
Follow these steps to install the scale and reader for the X-axis.

1. Clean the back side of the mill table and the saddle to remove all chips and oil.
2. Work Table DRO Scale Placement On the back side of the mill table, mark the hole locations, two in total, as shown below. Measure table from inside of end retainers (table only).



3. Drill the two holes M2 to a depth of 4mm (0.157 in). Use a 2 mm (0.0787 in) or #47 (0.0785 in / 1.994 mm) drill. There is no need to tap these holes.

4. On the back of the saddle, mark two hole locations as shown below. {If the holes are pre-drilled, skip this step and the next step.}



5. Drill two holes M2 to a depth of 4 mm (0.157 in). Use a 2 mm (0.0787 in) or #47 (0.0785 in / 1.994 mm) drill. There is no need to tap these holes.
6. Using the longer scale with no frame, pull the backing off to expose the adhesive. To ensure the scales do not shift over time, use two M2x4 rivets to attach the magnetic scale to the back of the mill table using the holes drilled in step three.
7. Reassemble the mill table and adjust the X-axis gib.

Install Read Head Wipes

Each read head comes with a metal plate and two machine screws. The plate has two rubber wipes attached. These wipes keep the scale clean of obstructions that could impair accurate reading.

The plate is held to the read head by two machine screws which pass through the read head and



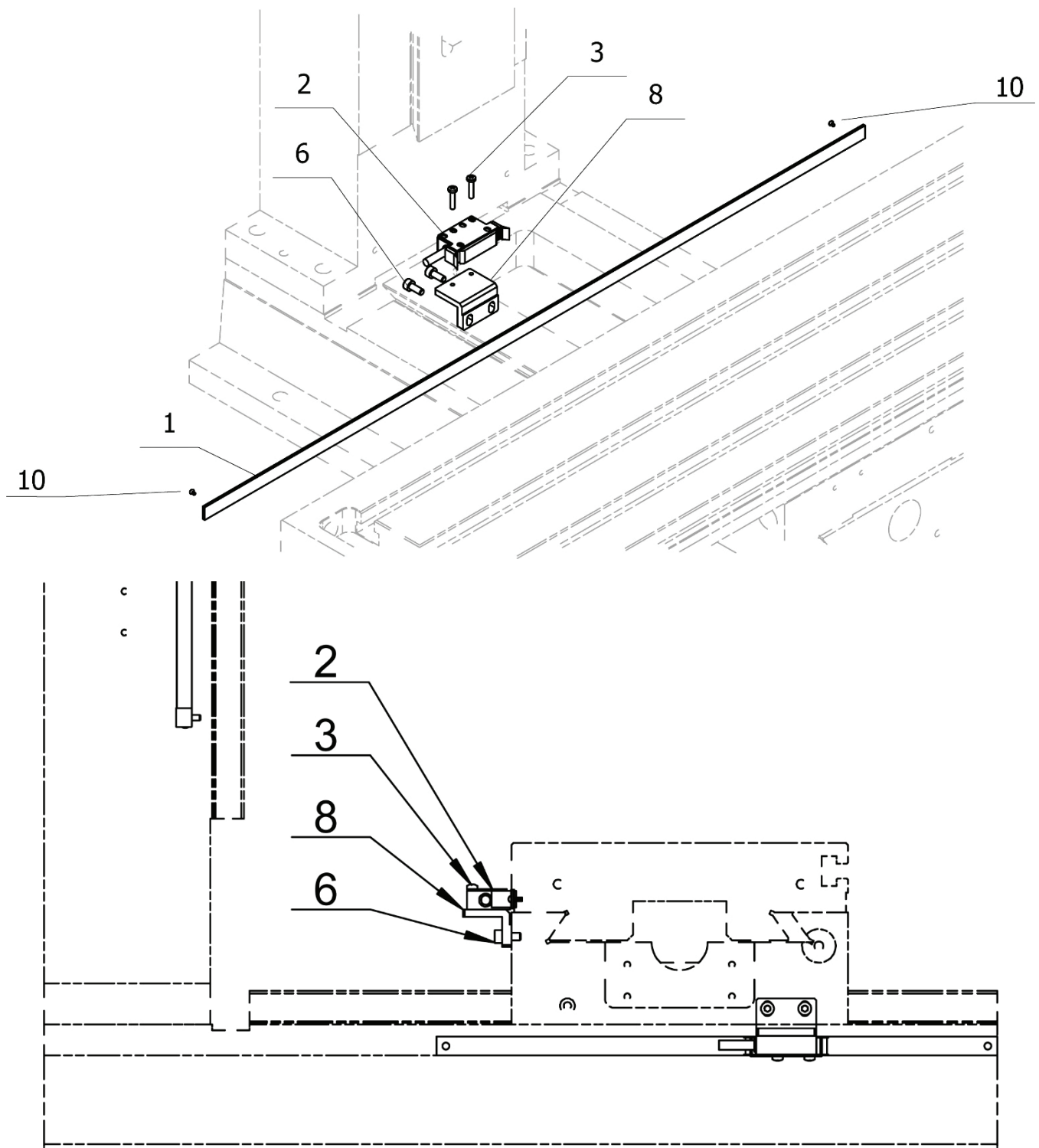
screw into the appropriate mounting bracket. (The plate can be mounted on either side of the read head depending on which side you want the wire to exit from.) The bracket is then mounted to the appropriate location. In the case of the large bench mill, those locations are on the saddle and a support nut on the Z-axis feed screw.

- Using the two M3x16 pan head machine screws that came in the read head packaging, attach the read head to one of the two two-hole brackets. A sample bracket is shown. (Your kit may come with 2 extra screws size M3x14. These may also be used to secure the wipe plate and read head to the bracket.)



Note: once the assembly is fully installed, you may need to adjust the machine screws to ensure that the rubber wipes are contacting the magnetic scale.

9. Install the X-axis reader and bracket to the saddle as shown in the diagram below.



Item	Qty	Item	Item	Qty	Item
1	1	Magnetic scale (X-axis)	6	2	M4x10 cap screws
2	1	Read Head	8	1	Reader mounting bracket
3	2	M3x14 Pan head machine screws	10	2	M2x4 rivets

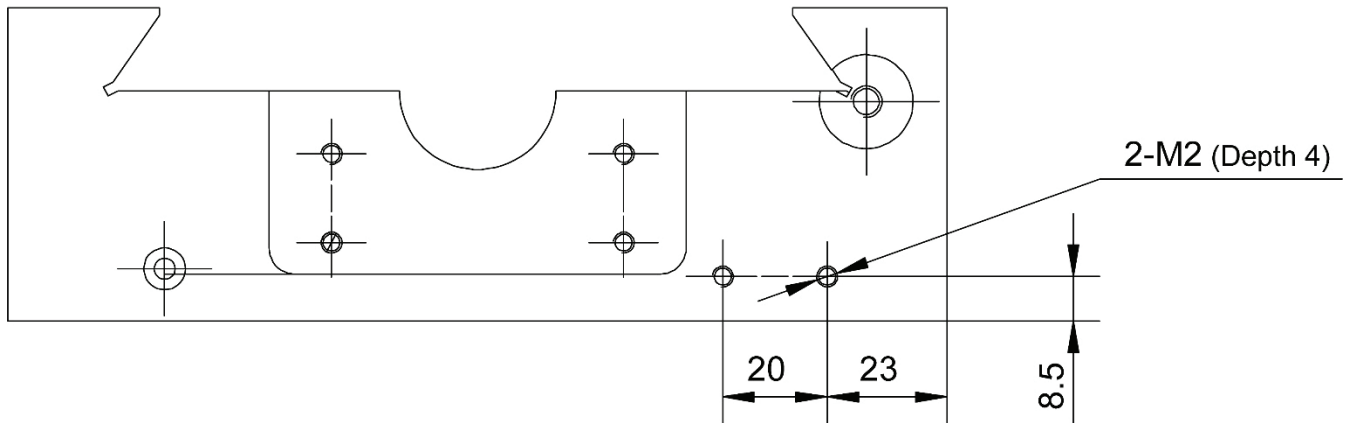
Install the Y-Axis Scale and Reader

Like the X-axis scale, the Y-axis scale is a “frameless” scale. It consists of the magnetic strip and is held to the base of the mill with an adhesive back and two M2x4 rivets.

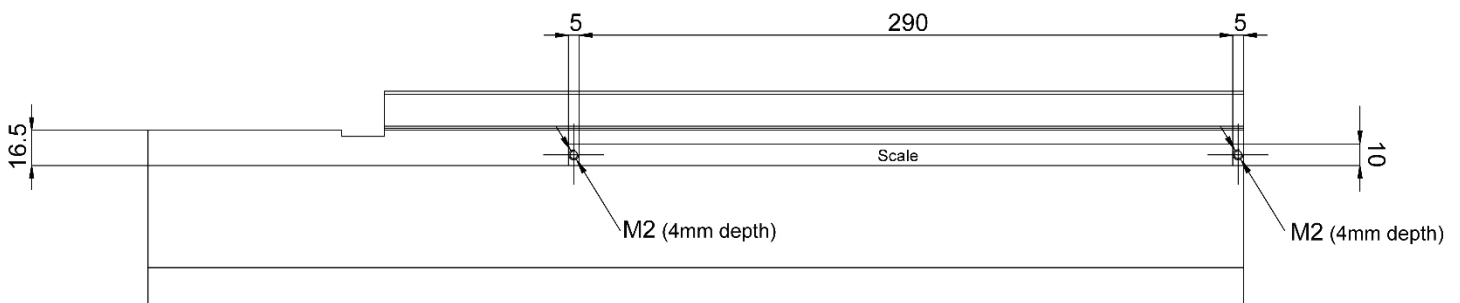
Follow these steps to install the scale and reader for the Y-axis.

1. On the left side of the saddle, mark two hole locations as shown below. {If the holes are pre-drilled, skip this step and the next step.}

Saddle (left side)



2. Drill two holes M2 to a depth of 4 mm (0.157 in). Use a 2 mm (0.0787 in) or #47 (0.0785 in / 1.994 mm) drill. There is no need to tap these holes.
3. On the left side of the machine base, mark two hole locations on the mill base as shown below.



4. Drill two holes M2 to a depth of 4 mm (0.157 in). Use a 2 mm (0.0787 in) or #47 (0.0785 in / 1.994 mm) drill. There is no need to tap these holes.
5. Using the shorter scale with no frame, pull the backing off to expose the adhesive. To ensure the scales do not shift over time, use two M2x4 rivets to attach the magnetic scale to the mill table using the holes drilled in step four.
6. Affix read head with wiper to the Y-axis bracket. Note this bracket is the same as the bracket used for the X-axis as shown above.

7. Install the Y-axis reader and bracket to the saddle using the two holes described in steps one and two. The reader and bracket installation are similar to the install on the X-axis described on pages five and six.

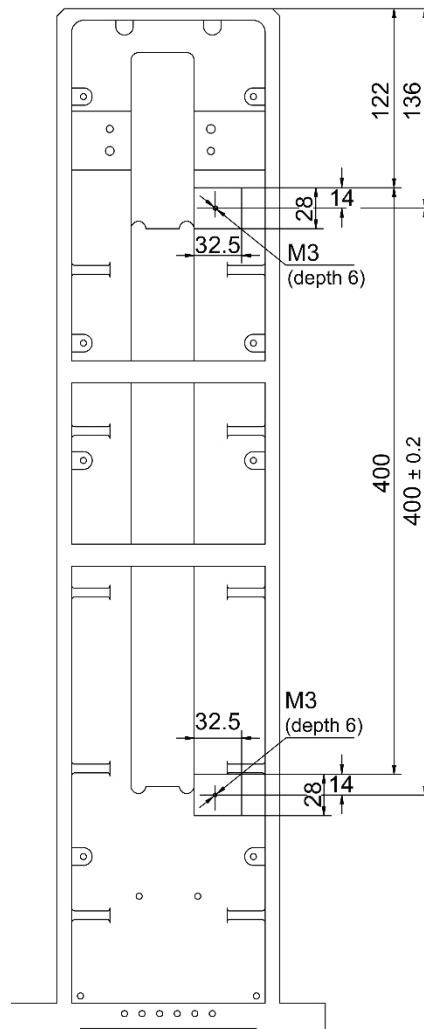
Z-Axis Install

As noted in the introduction, the Z-axis scale and read head are mounted to the column underneath the column cover. Depending on which version of large bench mill you are adding the DRO kit to, and if this is a retrofit from Bluetooth to hard-wired, the steps may vary slightly.

Follow these steps to install the scale and reader for the Z-axis.

1. Remove the lower back panel from the mill cover. Then remove the two screws that are holding the cover to the column.
2. Remove the two screws on the top of the mill holding the cover secure.
3. Pull the cover back, off the column, and swing it to the side. This allows all wiring to remain connected. Take care not to strain any wire connections.
4. Once the cover is removed, you should have a clear view of the back of the column. Note two pre-drilled holes in the back of the column as indicated in the following drawing. Mount the Z-axis scale (with frame) to the column using two M3x10 Phillips head screws.

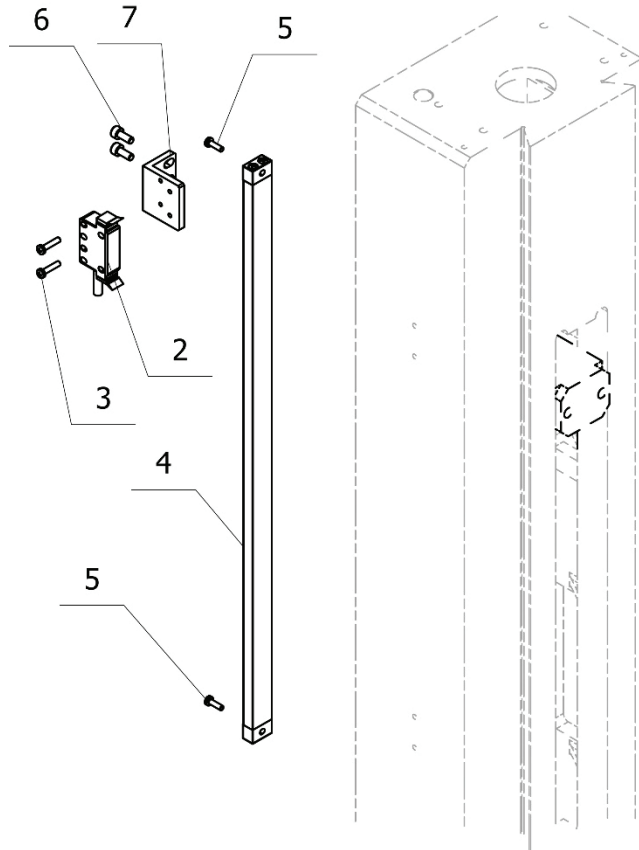
Column (back)



- Secure the Z-axis read head with wipers to the Z-axis mounting bracket.
- Attach the DRO bracket with read head to the lower Z-axis feed screw bracket using the two M4x10 cap screws. The bracket attaches to the feed screw bracket using the two pre-drilled holes on the back of the bracket on the right side. The feed screw bracket looks like the image.



The orientation of the read head and bracket should be as shown below.



Item	Qty	Item	Item	Qty	Item
2	1	Read Head	5	2	M3x10 Pan head machine screws
3	2	M3x14 Pan head machine screws	6	2	M4x10 cap screws
4	1	Magnetic scale (Z-axis)	7	1	Reader mounting bracket

- Feed the read head cable through the rectangular hole on the bottom left (as you are facing the mill) of the column cover.

If you are modifying a HiTorque model 6700 Large Bench Mill, we suggest you add a cover plate and wiring stay to protect the cable from being cut by the edge of the cover hole. If you are retrofitting a Bluetooth version of the HiTorque model 6750 Deluxe Large Bench Mill, this covering plate and wiring stay are already in place.

Remove the Bluetooth senders.

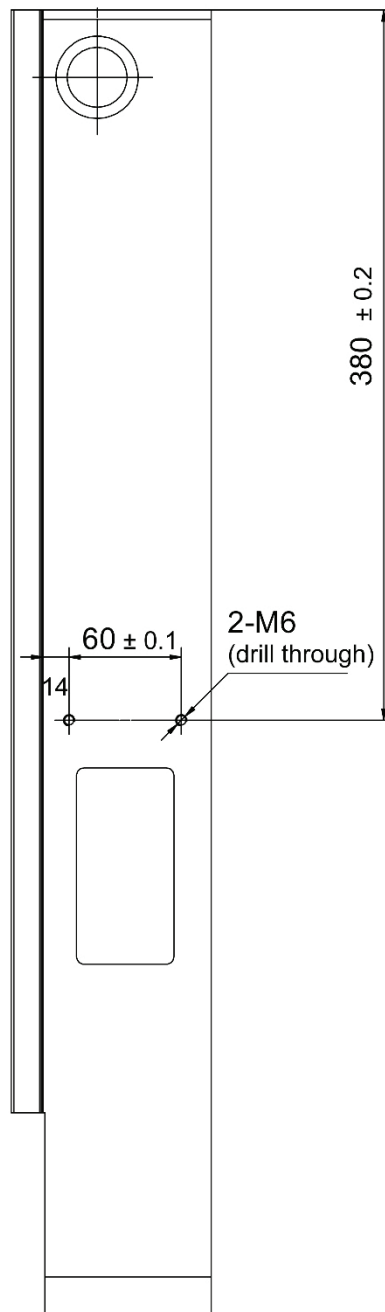
Display Mounting Bracket

The mill cover will require two holes to be drilled so that the DRO display mounting bracket can be attached to the mill column. Additionally, the column will need two holes drilled and tapped to accept the mounting screws.

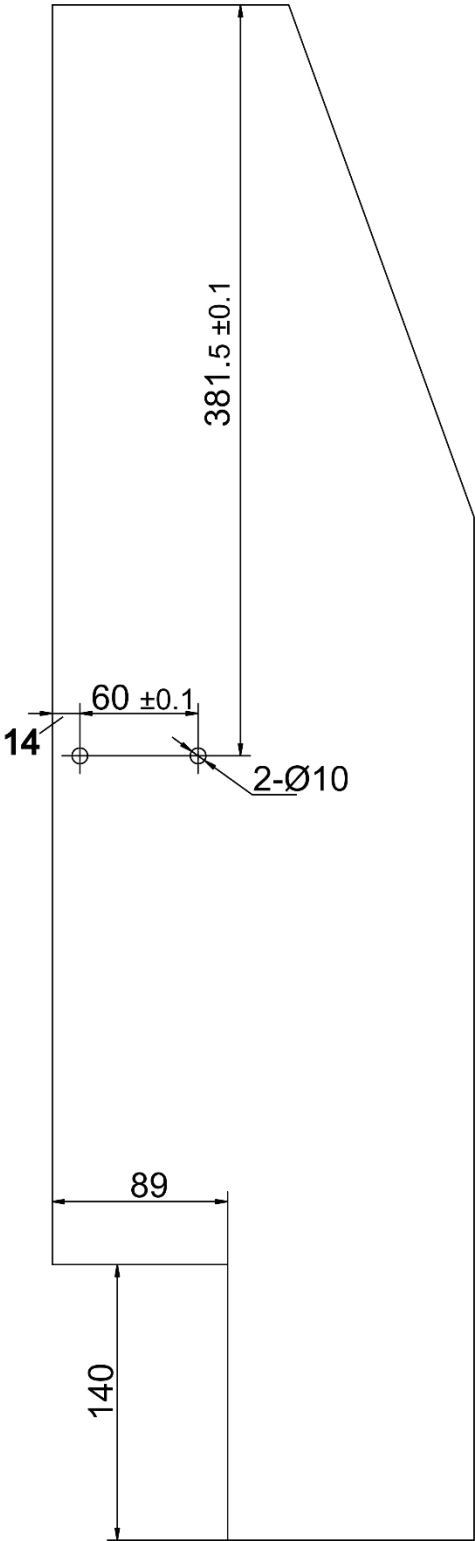
Follow these steps to install the DRO display bracket.

1. On the right side of the column, mark two hole locations as shown below. Don't drill these holes yet.

Column (right side)



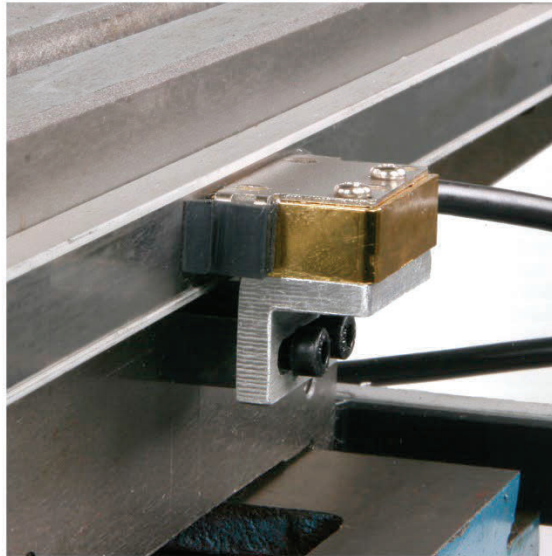
2. On the right side of the column cover, mark the two hole locations as shown below. These are clearance holes for the DRO display mountings.



3. Drill the two holes in the mill cover. Use a 10 mm or “X” (0.397) drill bit. Test fit the cover on the column. Be sure the new holes align with the two holes marks made on the column in step one. Notice that these holes are large enough (10 mm) to provide clearance for slight misalignment.
4. Drill and tap the two holes marked on the column. Using a 5 mm or #8 tap drill, drill through the column. Tap the hole with an M6 x 1 metric tap.
5. With the holes aligned, secure the cover with the screws removed earlier.
6. Mount the display mounting bracket using two M6x24 cap screws and two M6 washers.
7. Connect all three read head cables to the display using the 9-pin connectors.
8. Power up your display and see if you are getting readings.

Adjusting the Read Heads

Adjust the DRO read heads so that the wiper touches the magnetic strip, but the reader head is clear of it.



Done!

That's it, the DRO is ready to go. Position your table and mill head to your desired Zero position and turn on the display from the switch on the back. Illuminated display lights indicate you are getting a signal. Move the table in X and Y-axis directions to test that you are getting a position reading. Move the mill head to test the Z-axis reading.