




## 3-axis universal Bluetooth digital position readout (DRO)

This document explains how to install a 3-Axis Universal Digital Position Readout. We offer a kit (part number 5515) that includes all the pieces you need to fit any machine with up to a combined total of X-, Y-, and Z-travel that is no more than 31.8 inches. The kit includes the Bluetooth transceiver, three reader heads, and a one-meter-long section of scale.

Alternatively, you can assemble your own kit using the following components:

|   |   |
|---|---|
|   | <p>Bluetooth transceiver (part number 5501)</p>   |
|  | <p>A magnetic read head (part number 5499) for each axis</p>  |
|  | <p>One or more magnetic scales (part number 5498 is one meter long and can be cut to the required length)</p> |

Whether you use the kit or a roll-your-own solution, you will need an Android tablet that meets the following requirements to use as a display:

- Android OS 4.0 or newer
- 7" multi-touch screen with 1024x600 resolution (recommended); 4" screen with 800x480 resolution (minimum)
- Bluetooth capability

We offer an Android tablet (part number 5513) that meets the recommended requirements.

To mount the magnetic scales and read heads, you will need:

- M3 socket head cap screws (part number 1528) to mount the scales (2 for each axis)
- 2.5 mm or #39 tap drill
- M3x0.5 metric tap

### *Calculating the number of magnetic scale sections*

The first question you need to answer is how many 1-meter sections of magnetic scale you need.

Begin by measuring the travel on each axis of your machine. With the machine off, position the machine to one end of its travel. With a grease pencil, make a mark across where the moving and stationary surfaces meet. The line should be half on the moving part and half on the stationary part. Next, move your machine to the opposite end of its travel, and then simply measure the distance between the marks.

Fill out the chart below to calculate your scale lengths. Write the measured travel for each axis in the boxes provided. Then add the head width and margin for overtravel to each one to arrive at the scale length for each axis. Finally, add the three scale lengths to determine the total scale length you need.

|                     | <b>X-Axis</b> | <b>Y-Axis</b> | <b>Z-Axis</b> |                             |
|---------------------|---------------|---------------|---------------|-----------------------------|
| Travel, in inches   |               |               |               |                             |
| Add head width      | +2.0          | +2.0          | +2.0          |                             |
| Add margin          | +0.5          | +0.5          | +0.5          | <b>Total scale length ↓</b> |
| <b>Scale length</b> |               | +             | +             | =                           |

If the total of all scales is less than 39.3 inches (1 m), you need one section of magnetic scale. Get one section of magnetic scale for each 39.3 inches or part thereof. Note that you cannot have any single axis with more than 36.8 inches of travel.

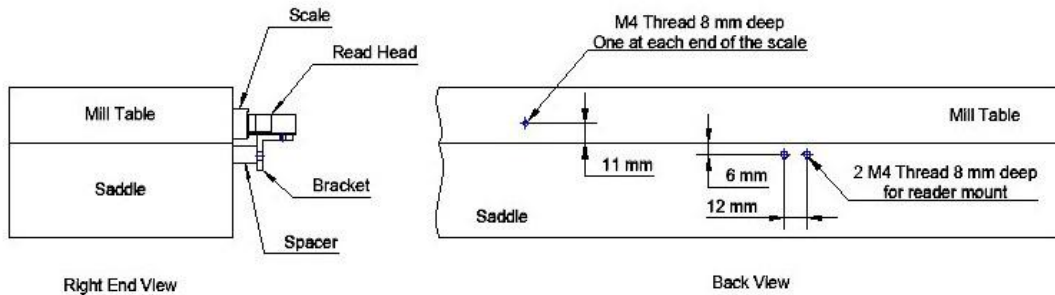
## Planning where to install the scales and read heads

The DRO scales and read heads are simple to mount where two flush surfaces move adjacent to each other. This is typical of the back side of the mill table and the saddle below it, as shown here. In some cases it's also suitable for the Z-axis, but we've not seen many machines where the Y-axis is this simple.



The drawing below shows the same thing along with the relationship of the mounting holes. As described later in this document, you might need to design and build a bracket and spacer to mount the magnetic read head as shown.

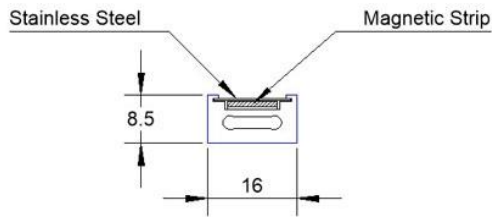
**Note:** Because the scales are manufactured for use worldwide, they are made to metric dimensions. From this point forward in this document, dimensions shown are in millimeters.



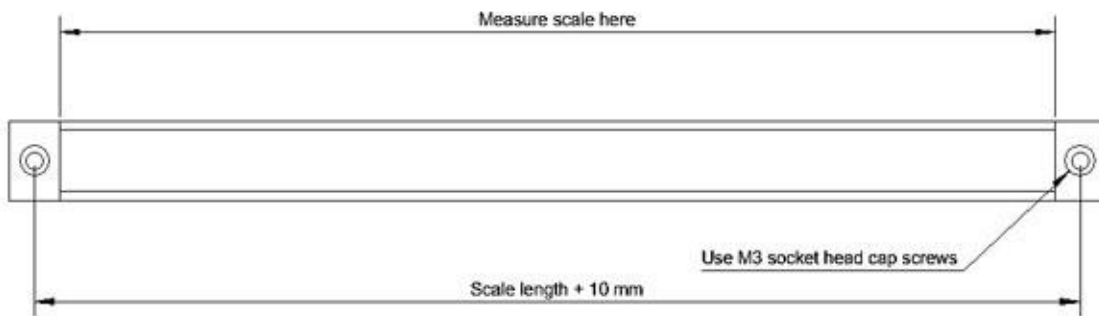
In most cases, the reader can be mounted at the center of the saddle with the scale symmetrically mounted on the table. But on some very small machines there's not enough room between the saddle and the column so the reader must be mounted off center, with the scale also mounted off center.

## Cutting the magnetic scale

The scale consists of an extruded aluminum channel with a magnetic strip in the channel. The magnetic strip is protected by a stainless strip.



Each 1-meter section of magnetic scale includes six plastic end caps for mounting. When measuring a scale for cutting, measure the length of the aluminum channel before the end caps are installed.



Place the channel in a vise with the “U” facing up and your mark just off the side of the vise. There is a thin strip of stainless steel protecting the magnetic strip in the channel. Using the finest hacksaw blade (or band saw blade) you have (preferably 32 teeth per inch), carefully saw down through the channel.

Use a fine file to debur the end of the aluminum channel.



Install the two end caps. Note that there is a slot in the end cap that should align with the stainless steel strip. Use a Phillips screwdriver to secure the two screws in each cap.

## ***Mounting the scales***

You can mount the scales directly to your machine if there is a flat surface. Or you can make stand-offs or mounts.

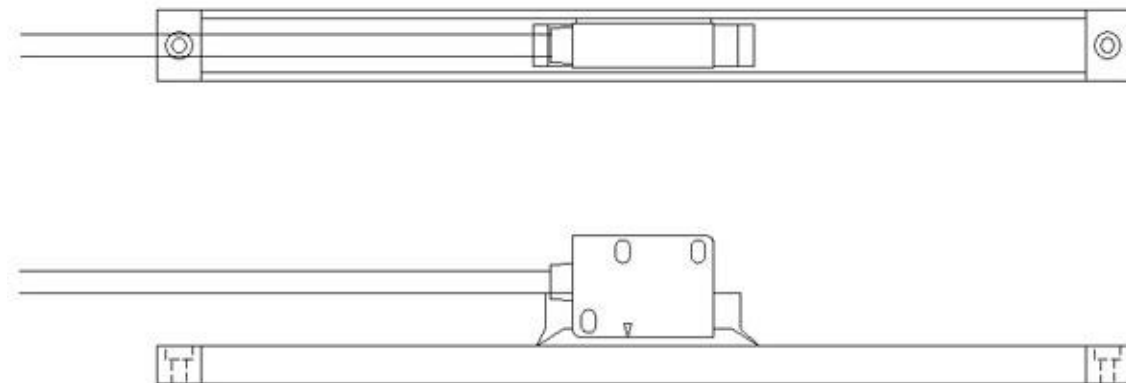
The distance between the mounting holes is 10 mm greater than the scale length. So if you cut your scale to 320 mm, place the holes 330 mm apart.

The most critical thing when mounting a DRO is to get the scales parallel to the motion of the axis. You need to be accurate, but not exceptionally so. If you are off parallel by 0.010" in 10" of travel you will introduce an error of 0.0005" over that distance.

Use M3 socket head cap screws to mount the scales. Use a 2.5 mm or #39 tap drill and an M3x0.5 metric tap.

## ***Mounting the reader heads***

This drawing shows the relationship between the reader head and the scale. The reader head should be centered over the scale with the chip scrapers touching the stainless steel shield. Note the small triangle on the read head that indicates the active surface.

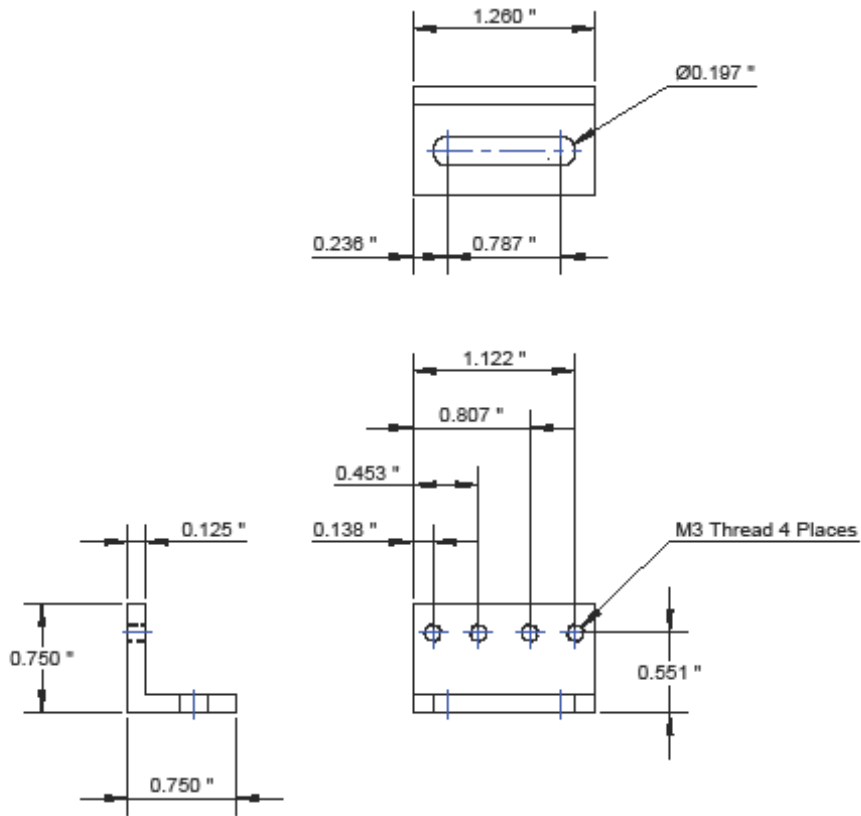


Use the provided M3 screws to mount the reader heads. Use a 2.5 mm or #39 tap drill and an M3x0.5 metric tap.

In most cases, you'll need to make a mounting bracket to mount the reader head. In many cases you can use aluminum architectural angle to make appropriate brackets. You can use or adapt the drawings on the next page to create the necessary bracket and spacer block.

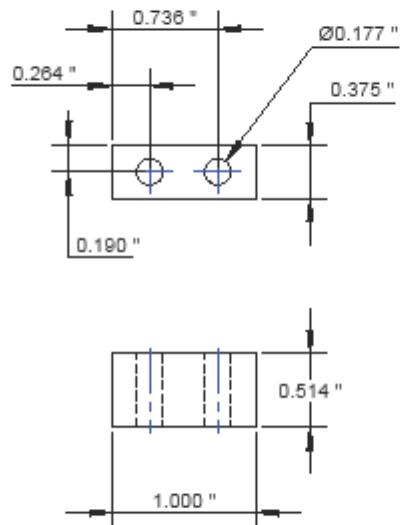
## Bracket

Material:  $\frac{3}{4}$ "  $\times$   $\frac{3}{4}$ "  $\times$   $\frac{1}{8}$ " aluminum angle



## Spacer

Material:  $\frac{3}{8}$ "  $\times$  1" aluminum bar



## Connecting the Bluetooth transceiver

1. Use a small straight screwdriver to open the Bluetooth transceiver. Use both corner slots to open it.



2. Identify the connector for each axis. Remove the green plug from each one.



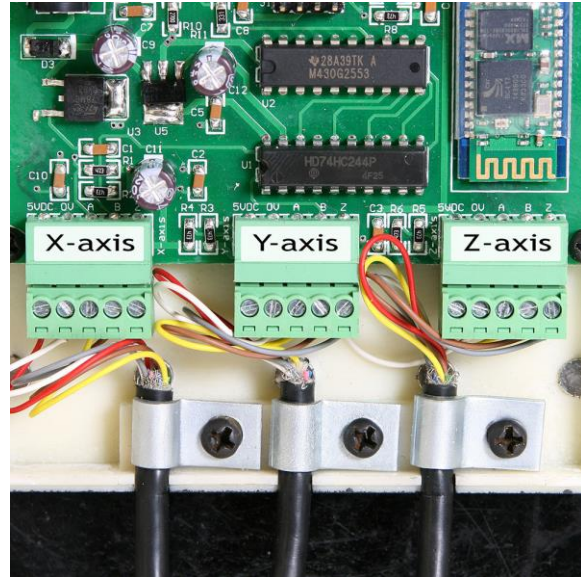
3. Install a green plug on the wire from each read head. With the screw heads up, the colors, from left to right are:  
Red White Yellow Brown Gray

Double check each wire to ensure that the wires are in the correct order and that the screw terminals are secure.

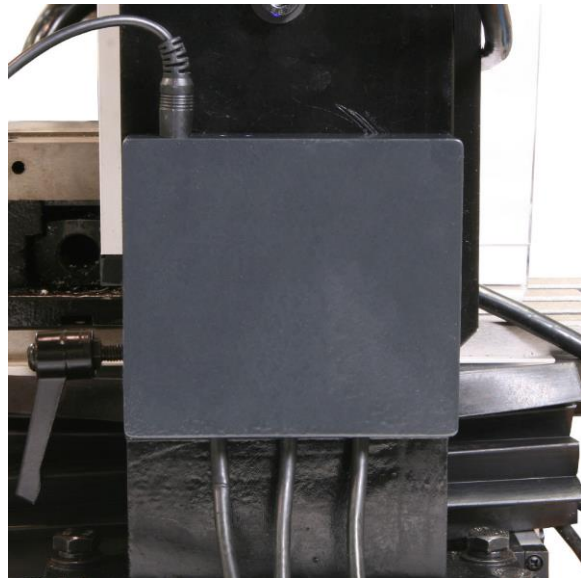
**Chris' Tip:** You can shorten the wires if that makes sense for your installation. It's good practice to tin (apply a bit of solder to) the bare wire ends. Be sure to leave enough length for full travel of your machine.



4. Insert each axis plug into the appropriate socket. Clamp the black-jacketed wire in the corresponding strain relief.
5. Snap the cover onto the Bluetooth transceiver.



6. The Bluetooth transceiver mounts magnetically. Place it at a convenient location on your machine.
7. Plug in the power supply and you are ready to go to work.



## ***Done!***

That's it, the DRO is ready to go. Fire up the Android tablet and go to work.

If you have our Android Tablet, the software is already installed. If you have another Android tablet go to the Apps store at Google Play to find and install Yuriy's Toys TouchDRO.