



SHERLINE/WETTROTH

## DRO Mode Instructions

Mill P/N 8100 (Metric P/N 8160), Lathe P/N 8100 (Metric P/N 8160)

### About the New DRO Chip

Our new DRO chip allows our Digital Readout to function with our ball screw machines and our standard leadscrew machines. While creating this chip, we decided to do some other upgrades based on our customer feedback. We believe that this new chip covers all of the possible combinations that our customers have requested.

This new DRO chip has six different modes to choose from based on the machine type, e.g., mill, lathe, leadscrew, or ball screw, and your preference of either inch or metric display on the DRO.

- **Mode 1** is the same as the original DRO. This mode is for an Inch leadscrew machine and the display is also in Inches.
- **Mode 2** is the same as the original DRO. This mode is for a Metric leadscrew machine and the display is also in Metric.
- **Mode 3** is for our Ball screw machines (which have a 10 x 2mm ball screw). The display will be in Inches.
- **Mode 4** is for our Inch leadscrew machines and the display will be in Metric.
- **Mode 5** is for our Metric leadscrew machines and the display will be in Inches.
- **Mode 6** is for our Ball screw machines and the display will be in Metric.

**NOTE:** Before you choose a mode, the mode must be for the actual leadscrew or ball screw that is on your machine.

### Mode Examples

1. If you have an Inch leadscrew on your machine, you cannot use modes 2,3,5, or 6. You can only use modes 1 or 4. The DRO software calculations (and display) are based on the actual screw that is on your machine.

When you power on the DRO, you hold down the “Key Combinations” in the chart shown in Figure 1 to activate the specific mode for which you would like the DRO to be set.

Mode	Key Combination
1	ON + X
2	ON + Y
3	ON + Z
4	ON + X + Y
5	ON + Y + Z
6	ON + X + Z

FIGURE 1—Key combinations for mode power up.

2. If you have a ball screw machine and you would like the DRO display to be in metric, you will hold down the Power, X, and Z buttons when you power on the DRO. This will set the DRO for Mode 6. The power up display will show “M2MMT5” when the DRO comes on. See the “Power Up Display” on the chart in Figure 2 below for each mode.

Mode	Display Units	Power Up Display
1	Inch	ININT6
2	mm	M1MMT6
3	Inch	M2INT5
4	mm	INMMT6
5	Inch	M1INT6
6	mm	M2MMT5

FIGURE 2—Mode power-up display settings

### Instructions for Setting the Mode

1. Disconnect the DC 9V power cord from the side of the DRO housing (see Figure 3).

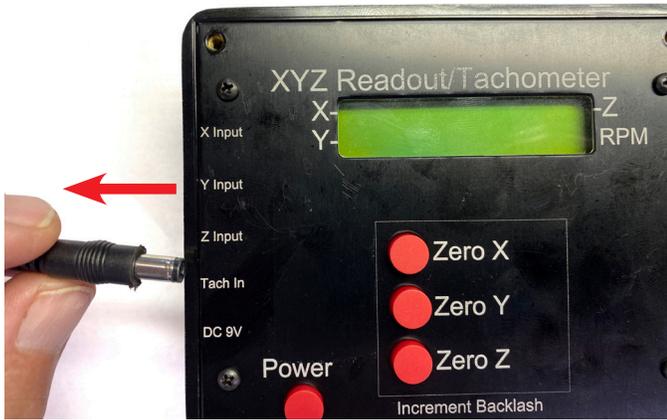


FIGURE 3—The red arrow shows the disconnection of the power cord.

2. Push down, and hold the desired key buttons (example below is for Mode 1, holding down the Power button and then the X button at the same time).



FIGURE 4—The red arrows indicate that the X button and the Power button are pushed simultaneously.

3. While holding down the designated buttons, plug in the DC power cable (see Figure 5).



FIGURE 5—Plug the power cord back into the DRO display in the direction of the red arrow while holding down the buttons.

4. Hold the buttons down until the display shows the Mode. In this case, mode 1 will display “ININT6” (see Figure 6).



FIGURE 6—The white rectangle highlights the example of the mode 1 display “ININT6.”

### Tach Readout

In addition to the mode selections, the tach readout is also different for our leadscrew machines and our ball screw machines.

The leadscrew machines have a tach sticker that goes on the headstock pulley. This is the tach sticker that comes with the DRO. This tach sticker is a 6-pulse tach sticker. If you have a leadscrew machine, use the 6-pulse tach sticker.

The ball screw machines come with the MASSO 5-pulse tach sticker. This 5-pulse tach sticker is what the optical encoder uses with the MASSO controller. Use the 5-pulse tach sticker on the ball screw machine. When you set your DRO to Mode 3 or Mode 6, the software is set up to read the 5-pulse tach sticker.

You can also change the “Tach Pulse Number” on the DRO to match either a 5 or 6-pulse tach sticker on your machine.

To do this, follow the previous instructions to set the DRO to your machine and desired readout setting.

Then follow the instructions below to change the tach pulse setting:

1. Disconnect the DC power from the DRO box.
2. Simultaneously hold down the Power, X, Y, and Z buttons, and reconnect the DC power. This is accomplished easiest by using your forefinger to hold down the X, Y, and Z buttons, and your pointer finger to hold down the Power button (see Figure 7 on the following page). If you are having difficulty holding down all three X, Y, and Z buttons with one finger, try using a small piece of wood about the size of a popsicle stick to span all three buttons.

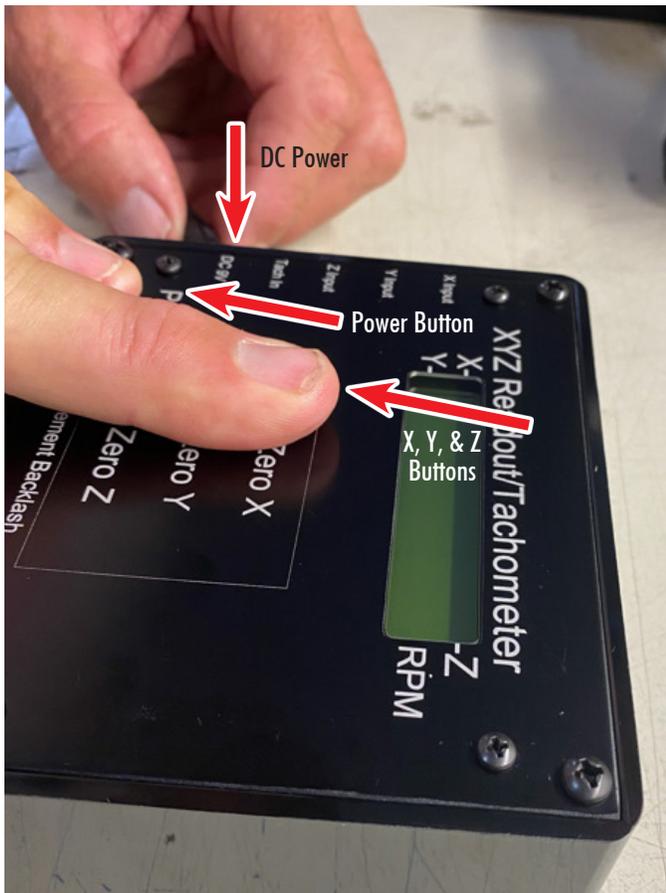


FIGURE 7— The red arrows indicate the buttons that must be pushed simultaneously to change the Tach Pulse Number.

3. When the DRO display screen comes on the “T6” should change to a “T5” in this case (see Figure 8).



FIGURE 8—The white rectangle in the readout highlights the example of the display changing from “T6” to “T5.”

**NOTE:** If you have a ball screw machine, and you are using a controller other than our MASSO controller, you will need to request the 5-pulse tach sticker (P/N 87860) for the DRO tach readout to be correct.

#### Additional instructions for the DRO

The basic instructions for DRO are still the same as the original instructions found at the links below.

Mill Digital Readout (P/N 8100 Inch, P/N 8160 Metric)  
[https://www.sherline.com/wp-content/uploads/2015/11/8100inst\\_2021.pdf](https://www.sherline.com/wp-content/uploads/2015/11/8100inst_2021.pdf)

Lathe Digital Readout (P/N 8200 Inch, P/N 8260 Metric)  
[https://www.sherline.com/wp-content/uploads/2015/02/8200inst\\_2021.pdf](https://www.sherline.com/wp-content/uploads/2015/02/8200inst_2021.pdf)

Thank you,  
 Sherline Products Inc.

#### FAQs

**Q1** – I notice that there are Metric and Inch versions of Sherline’s DRO. Can the DRO convert Inch to Metric or vice versa?

**A1** – Yes! Originally and for many years, the DRO just read handwheel rotations based on the lead screw pitch installed in the machine and this was set during installation. With the addition of the 2 mm ball screws with no inch equivalent, this became an issue for some users. In early 2021, the DROs operation was modified so that it can do metric or inch conversions—providing readings in the units required with any lead screw installed. DROs shipping after March OF 5021 includes this feature and older units can be upgraded for a fee. (Contact Sherline)

**Q2** – I am concerned about the accuracy of Sherline’s DRO since it only measures handwheel turns rather than actual table position. What about backlash?

**A2** – Sherline’s were used with great accuracy with just handwheels for many years before the DRO. The DRO is a convenience and is as accurate as the leadscrews; which is very good. Remember that the most accurate measuring instrument for most machinists is the micrometer, which also relies on turns of a lead screw!

The DRO measures rotations of the handwheels to an effective accuracy of 1/100 of a rotation. If the encoder wheels are perfect, i.e. no flash, perfect geometry of tooth width to open slot width and the runout and placement of the light sensors are perfect, you would expect that each 100th turn would be split in half and make the transition in the exact leading or trailing edge of a gap or tooth. Because of all the vagaries of all the stack up, this transition can happen anywhere in the interval; it seems to be about 30-70% of an interval. This isn’t really an accuracy issue, it’s a minimum resolution issue. You can’t depend on fractions of a 1/100th but you can depend on each 100th. This is similar to trying to split thousandths on a handwheel – it’s better than nothing but you’re interpolating.

**Q3** – On most full-sized DROs, I can enter values on a keypad to set the datum. On the Sherline DRO, I can only zero an axis. How can I get the DRO to read out the position relative to my part?

**A3** – There is no keyboard but if you’re clever you can enter any datum you like. On the lathe for example. Take a skim cut on your part to establish a position and zero the DRO. Measure the part diameter accurately. Advance the axis half this distance and zero the DRO again. The readings are now referenced to the center of the part. Similarly, on the Mill. Edge find on the part. Zero the DRO. Advance

## Mode Displays

half of the edge finder diameter and your readings are now referenced to the edge of your part. Once you establish a datum, you can move it around this way. This is really what the keypad is doing on a full sized DRO – it's simulating a motion and making it "zero."

**Q4** – I don't understand the whole DRO backlash compensation feature. When I enter values, it doesn't seem like anything changes.

**A4** – Its operation is subtle and can be ignored if you always dial values in the same direction, which is a good practice anyway. Backlash represents the "slop" in a thread when the direction is reversed. The backlash feature holds the last displayed value on the display until a motion greater than the backlash is made. If you watch closely, you'll see that the display doesn't change until you exceed the backlash then it follows – this compensates for the slop. This is same thing that you're doing with feel when you dial in a value, reverse direction a bit and dial to the final value. The backlash feature doesn't have to be used if you find it confusing or distracting. Just leave the values at zero and remember to also load the lead screw with the dial.

**Q5** – I noticed that when I move my axis on my CNC machine at rapid, the display freezes on the DRO until I come to the end of the move. Is the DRO losing steps while the axis is moving at a rapid feed rate? Is the position reading at the end of a rapid move accurate?

**A5** – The following explanation is from John Wettroth, who designed both the original DRO chip and the new DRO chip.

At high speeds, you may see the DRO display freeze during fast moves but it will update after the move is complete. It won't lose steps at any usable rate. The DRO looks for changes in the encoder very often if it's in the middle of a calculation to display a new value and it senses a change in the encoder, it just aborts the display task and captures the new data so it won't miss a step. At very high move rates, this causes the display to freeze but the DRO is capturing all the moves perfectly. As soon as the movement slows down enough to do the display formatting – the display will update in real-time.

The limitation is driven mostly by how fast you can put characters on the display. It takes about 40 microseconds per character, and writing a sign, decimal point, value, and some spaces take about 400 microseconds for the display. There is also a bit of time spent formatting the display. This adds up to about 1 millisecond total to give you a best-case display rate of <1000/second. The DRO gets close to this theoretical value.

### Native Modes

In "native" modes where the displayed units are the same as the leadscrew units – the unit can measure and display readings up to about 900 readings per second. These are modes 1, 2, and 6.

Mode	Leadscrew Units	Display	Travel Speed
1	Leadscrew inch (.05"/turn)	inch	27"/min
2	Leadscrew mm (1 mm/turn)	mm	550 mm/min
6	Ball screw mm (2 mm/turn)	mm	850 mm/min

The speeds in the table represent the travel speed at which "freezes" will occur. This is governed by the basic reading speed of about 900/second modified by the leadscrew pitch and a few other small technical details.

### Non-Native Modes

In "non-native" modes like 3, 4, and 5, the raw units are measured and then have to be converted to the desired units. For metric to inch, this involves multiplying by 25.4 mm/inch. For inch to metric, this is a divide by 25.4. This math is done in a very optimized way but still takes a bit of time. The non-native modes add an additional millisecond to the display routine for this math. This varies a bit depending on the specific mode but it makes the rate about 350 to 500 readings per second.

Mode	Leadscrew Units	Display	Travel Speed
3	Ball screw mm (2 mm/turn)	inch	24"/min
4	Leadscrew inch (.05"/turn)	mm	330 mm/min
5	Leadscrew mm (1 mm/turn)	inch	8"/min

Overall, the travel speeds in the two preceding tables are the speeds at which the display will appear to freeze. These are probably good limits for a CNC machine of this size. The rates at which the DRO will miss steps are about 10x higher than these speeds. Though speeds higher than those listed in the tables are possible, and the DRO will register them correctly, they're not appropriate even for rapid (non-cutting) movements for the Sherline. High-speed movements will create excessive wear on the machine.

## 2021 DRO Mode Settings

Mode	Key Combination	Leadscrew Pitch	Displayed Units	Example Display	Position Resolution	Backlash Entry Units	Power Up Display	Notes
1	ON + X	.05"/Turn	Inch	+ 1.0055	.0005"	Inch	ININT6	Original Inch Mode for a machine with an inch leadscrew
2	ON + Y	1 mm/Turn	Metric	+ 25.41	.01 mm	mm	M1MMT6	Original Metric Mode for a machine with an metric leadscrew
3	ON + Z	2 mm/Turn	Inch	+ 0.3937	0.0008"	mm	M2INT5	For a Ball Screw machine showing the readout in inches
4	ON + X + Y	.05"/Turn	Metric	+ 1.0055	.01 mm	Inch	INMMT6	For an Inch Leadscrew machine showing the readout in metric
5	ON + Y + Z	1 mm/Turn	Inch	+ 1.0055	0.0004"	mm	M1INT6	For a Metric Leadscrew machine showing the readout in inch
6	ON + X + Z	2 mm/Turn	Metric	+ 25.42	0.02 mm	mm	M2MMT5	For a Ball Screw machine showing the readout in metric