

# **TB048 (Rev1) - Laser Mapping Procedure (Software Versions Prior to 2.61)**

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## **Overview**

This document describes how to use a laser for ball screw mapping with **CNC7 version 7.17 to CNC10 version 2.61**. It assumes that the laser measurement software is Optodyne 2.18.

## **Laser set up**

It is very **important** to run Autotune and Drag mapping from the Centroid CNC7 control for checking the status of the machine before proceeding with laser compensation. Please refer to CNC Tech News TB044, TB045, and TB047 for more detailed information on Autotune and Drag mapping procedures. Be certain drag and PID values are within reasonable ranges before you continue with the laser mapping procedure.

First, install the laser measurement software on a PC or laptop, these installation disks are provided by the laser equipment supplier. If the laser manufacturer is Optodyne, a LDDM icon will be created after the software setup is complete. Make sure all laser cables are connected and the serial cable is connected to your PC (laptop) serial port. Turn on the power for the laser module and launch the laser measurement software. (If Optodyne, double click on the [LDDM] icon.)

## **Delete the CNC10? .TAB File**

Centroid recommends that you remove any existing correction CNC10?.TAB file, where ? is the axis on which you are running the laser compensation.

To delete the files:

1. Goto the Laser Measurement Menu by pressing **F1 - Setup**, **F3 - Config** and enter password **137** press **Enter**, then press **F4 - PID**, **F7 - Laser**
2. Press **F2 - Delete Comp**

## **Setting up for the X axis**

Move the X-axis to the X- travel limit. (If using version 7.17, move the X-axis to Home position.) Double click on the [Linear] icon and check on the [Intensity] to help align the laser beam. Set up the laser (with mirror assembly) on the table so the beam is aiming in the X+ direction. Adjust the beam to run parallel to the X-axis. Mount the mirror on the head in a drill-chuck and set the window perpendicular to the beam. Move the window into the beam, in the YZ plane until you see the beam reflecting back into the laser.

1. At the X- end of travel, move in the Y and Z axes until intensity is 100 %
2. Begin to move in the X+ direction (do not move in Y or Z) and watch for the beam to move outside the window.
3. If and when the beam moves outside of the window, use the alignment screws on the laser to bring it back in and maximize the intensity reading. When the intensity reading is at 100%, repeat step (2) until you get 100% intensity at Max X+ travel.
4. Repeat steps (1) to (3) until a 100% intensity reading is measured from both ends of the axis.

## Set Pitch and Lash

Be sure to set the pitch for the axis accurately on the Machine Configuration screen. Once you have the laser set up, you can use it to measure the pitch over a large segment of the axis and update the pitch value accordingly. Move the axis to the zero position and press "Reset" on the laser software. Command the axis to move out to its travel limit. Record the actual distance moved. Move the axis back to the zero point. Set the pitch according to the equation below.

$$\frac{\text{DRO (displayed distance)}}{\text{Actual distance (measured)}} \times \text{Current ratio setting} = \text{New ratio setting}$$

Note: **Re-home** the machine after setting the pitch.

Set the lash to **0**.

## Ready for data collection

**On the PC**, click Setup. Fill in the identification information and choose the X-axis. Use the start position from the Control screen. (If using version 7.17, set start to 0.) For End use End position from the Control screen. (Note: if Number of points is ((End Position - Start Position / Move Increment)+1, or in our example, ((34.5 - 0) / .5) + 1 = 70. The Optodyne software requires the exact measurement positions. If Start Position - End Position is not an even multiple of the Move Increment, subtract the fractional part of the Start Position from the End Position on the Control and use the result for End. (For example, -25.29 to 0 should be entered as -25.29 and -0.29 when using a 0.5 increment.) Click "Verify" to verify the number of points and measurement positions. Number of runs: match with control. Make sure the following check boxes are NOT checked: Forward only, Positions Shown as below, and both ATC boxes. Click on the Auto button. Set Target Window to 0.1 inch, Trigger Dwell to 0.9 second, and Velocity Threshold to 0.1. Make sure Backlash is not checked. Click save, then OK to get out of the setup and then Reset.

**At the CNC10 control's** main screen; press **F1 - Setup**, press **F3 - Config**, press **F4 - PID**, and then press **F7** to run the laser mapping. The screen should look something like the picture below. (Note: version 7.51 depicted here. 7.17 does not have all the fields shown.) laser software should be set as Optodyne v2.18 by using <Space bar> . Axis should be X. Laser Units should be inches. Start Position is for reference and cannot be modified. End position should be set as your X travel rounded down to the nearest half inch. (e.g. 34.87 inches travel would be 34.5 inches.) Move Increment should be 0.5. Working Area Start and Working Area End should be the same as Start Position and End Position. Number of runs - use 1. Dwell Time should be 3.0. Feedrate should be 20.0. (In version 7.17, you must specify the Laser File Name before the run and it should be KssssXn.LIN, where ssss is the machine serial number and n is the trial #.) After pressing the <Cycle Start>, the X-axis will go to the X- travel limit. (In version 7.17, it will go to the home position.)

Machine	Current Position (inches)	Job Name: GTESTE .CNC
X	+0.0701	Tool: T0 H0
Y	+0.0000	Feedrate: 149% Part
Z	+0.0000	Spindle: 0 Count: 66
		Feed Hold: Off

Stopped

Laser Measurement

1) Edit Laser Parameters	Laser Software:	Optodyne v2.18
2) Press CYCLE START to Move to 0	Axis:	X
	Laser Units:	Inches
	Start Position:	-11.5000
	End Position:	16.0000
	Move Increment:	0.5000
	Working Area Start:	-11.5000
	Working Area End:	16.0000
	Number of Runs:	1
	Dwell Time (Secs):	3.0000
	Feedrate:	50.0000

Press SPACE to change



**At the PC**, press [Reset] to reset the zero position for the laser. Click [Start]. The PC will capture the "zero" position and then prepare to take the next measurement. At the second beep/green light, press **Cycle Start** on the Control. You should hear a beep from the PC every time the machine pauses. Watch the PC to verify it is collecting all points. When it is finished, click OK then save as A:KssssXn.lin, where ssss is the machine serial number and n is the trial. You may want to also save it on the C drive with a filename like C:lddmKssssXn.lin for later analysis. After LDDM writes the file to disk, take the disk out and put it into the floppy drive of the Centroid control. It will have a message asking for the file name. Type in the file name, press **Enter** and **Enter** again when it asks for the disk. After the file is read by the control, run the procedure again to verify the position accuracy of the X-axis. Successive trials on an axis will be added into the existing corrections and should result in greater accuracy.

After completing the verification run, be sure to manually set the first and last points in the compensation table to 0. See "Verifying/Viewing Corrections" below for details.

**Repeat the same procedure for the other axes**

### Verifying/Viewing Corrections

In version 7.51 you can view the corrections in effect by going to the Machine Configuration Screen and pressing **F5 - M. Comp**. (See Tech Bulletin TB058.) The automatic procedure performs a linear analysis on the given work area and performs some smoothing to eliminate excessive correction values in the work area.

Set the first forward and backward corrections to 0. Use the down arrow to scroll down to the very last entries in the table and set the last forward and backward value to 0. Set the next to the last backward value to equal the next to the last forward value. For example, if next to last forward value is -2.591 set the next to last backward value to -2.591. Press **F10 - Save**. Press **Esc** and **F5**, select the axis, and verify that the last backward correction is set to zero.

Version 7.51 uses independent forward and backward correction tables. To verify forward corrections, you must have moved in the + direction. To verify backward corrections, you must have moved in the - direction.

See Tech Bulletin TB058 for details.

**To print the laser or drag output files, perform the following steps:**

System requirements - CPU7 & WIN95 & CNC7 software.

1. Set screen to B/W by setting parameter #7 to 1.
2. Press **F2 - Load** and **F8 - Graph** to view the files listed below from the C:CNC7 directory

<b>Drag Files</b>	<b>Laser Files</b>
drag_x.out	laser_x.out
drag_y.out	laser_y.out
drag_z.out	laser_z.out

3. Press Print Screen, putting the contents of the screen into the clipboard.
4. Open Microsoft paint and paste contents of clipboard. Invert the black background colors to white color.
5. Print out a hard copy of drag plot.
6. E-mail all the drag and laser result files back to support@centroidcnc.com for further analysis.

### **Common Problems**

**All laser measurements are off by a fixed amount on both forward and backward runs.**

Probable causes:

- Stiction and/or slippage of the machine at some point after pressing "Reset" on the laser.
- Failure to set home on the axis after setting the pitch.
- The offset is well below the tolerance of the machine (for example, 0.00005 inches.)

Remedies:

- Set home on the axis and take another laser run.
- If the problem persists, load the data from the second trial or delete the laser data and start over.

**Note:** This does not necessarily indicate a problem with the laser compensation data. Seeing approximately the same error at all forward and backward points means that the relative positions of all those points to one another are correct. The problem may be a positioning error at the initial point. If the initial point is at the end of the axis, this constant will not cause a problem under normal usage of the machine.

**There is a very slight but consistent slope on the corrected axis (for example, 0.0000 to 0.0003).**

Probable causes:

- Excessive pitch error on the initial run. If it takes a large number of counts to correct the pitch, the corrections themselves can be off by very small amounts.

Remedies:

- Load the data from the second trial.

***The laser readout shows larger or different errors when using the MDI to position the axis versus the errors shown by the last automatic run.***

Probable causes:

- The feed rate is too high. High feed rates can exacerbate positioning problems due to stiction and/or slippage in the axis.

Remedies:

- Use the same feed rate that was used in the laser menu to take the original data.

***When I load the data from the second run, the results seem to get worse. Loading data from subsequent runs causes alternating "better" and "worse" results.***

Probable cause(s):

- The errors shown are less than the positional repeatability of the axis. Each subsequent run only adds noise to the compensation data resulting in apparent worsening and improvement. In this case any apparent worsening and improvement is having no real effect.

Remedies:

- Do not attempt to load correction data that is less than the positional repeatability of the axis. To gauge the repeatability of the axis, take an automatic laser measurement containing at least three or four runs (the more, the better) and graph the results. The resulting band shows the inherent positional variability of the machine at any given point on the axis. Laser compensation cannot reduce errors below this inherent variability.

***Each time that I position the machine at, for example, 5.0000 inches, the laser shows different errors.***

Probable causes:

- You are arriving at the position from different directions. The error when traveling to the point from plus or minus directions may be slightly different but within acceptable limits. The error should be consistent when arriving at the point from the same direction.
- The feed rate is too high. High feed rates can exacerbate positioning problems due to stiction and/or slippage in the axis.
- The axis has an inherent variability at this point or across its entire length.
- Any error shown is less than the repeatability of the axis.

Remedies:

- Look at the "Abs Pos" readout for the axis on the PID screen. When arriving at the point from the same direction, the "Abs Pos" should be identical. The readout will be different but consistent when arriving from the opposite direction. If the readouts are identical when arriving at the same point from the same direction yet the laser shows different readouts, the difference is due to the inherent variability of the axis.

***I cannot change the Move Increment in the laser menu.***

Probable causes:

- Compensation data has already been loaded and is in effect. The move increment cannot be changed once compensation data has been loaded.

Remedies:

- Delete the compensation data and start over or use the same increment on confirming trials.

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**Document History**

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