

# Electronic lead screw

No more greasy gear swapping!

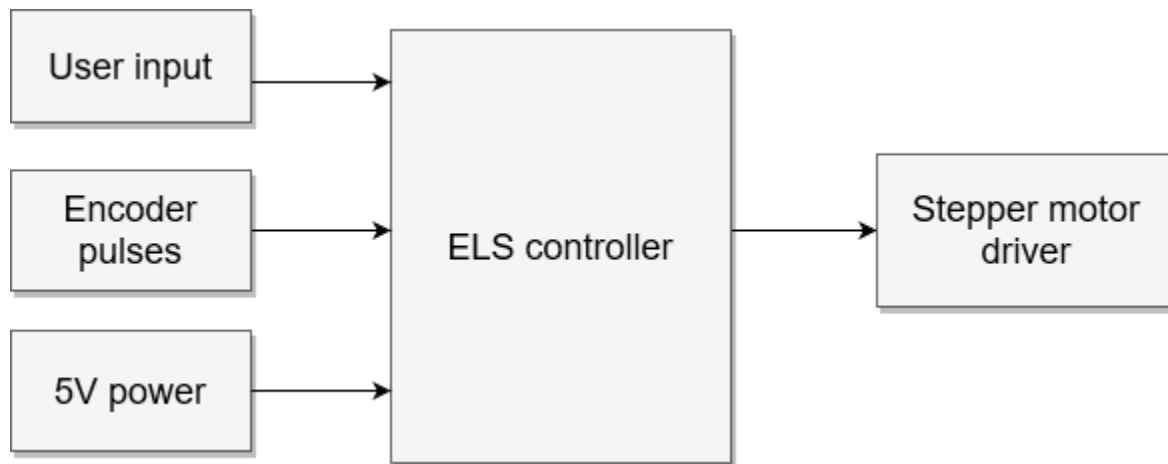
Control your metal lathe lead screw with a few clicks.

- Set leadscrew pitch for feed or thread
- Soft limits for the carriage
- Multi-start threads in 1 start of the spindle



## Description

This electronic lead screw controller is designed for lathes processing metal or plastic parts. It is powered with 5V, controls stepper motor that drives the lathe lead screw and receives signals from rotary encoder connected to the lathe spindle.



It's recommended to use a 600 PPR 5V A/B encoder and a 200-step stepper motor driver with a motor suitable for the cutting loads of the lathe e.g. 3 N.M. NEMA 23 for a mini lathe. Using microstepping will reduce max. stepper RPM (200 steps - 800 RPM, 800 steps - 200 RPM).

# Features

## Gearbox

Controller removes the need to use the lathe gearbox since it can drive the stepper motor with high precision according to lathe spindle rotation.

It supports metric, inch and TPI pitches (-10mm to 10mm) with resolution up to 0.001 mm/inch.

## Soft limits


Controller can limit lathe carriage movement with soft limits: just move the carriage using manual move buttons to the desired soft limit position and press the left/right limit button. Now controller won't move the motor past the given limit when e.g. cutting the thread.

## Move carriage without turning off the spindle


You can use manual move buttons without turning off the spindle and without losing the thread. With one hand holding the move button and another controlling the cross-slide, you can cut threads including multi-start ones in one go.

## Move carriage with high precision


When gearbox is on, manual move calculates the step to ensure that the tool stays in the thread.

When gearbox is on, manual move step is determined using  button cycling through 1/0.1/0.01/0.001 inch or mm. Picking any value other than 1 causes the manual move to pause for a fraction of the second between steps.

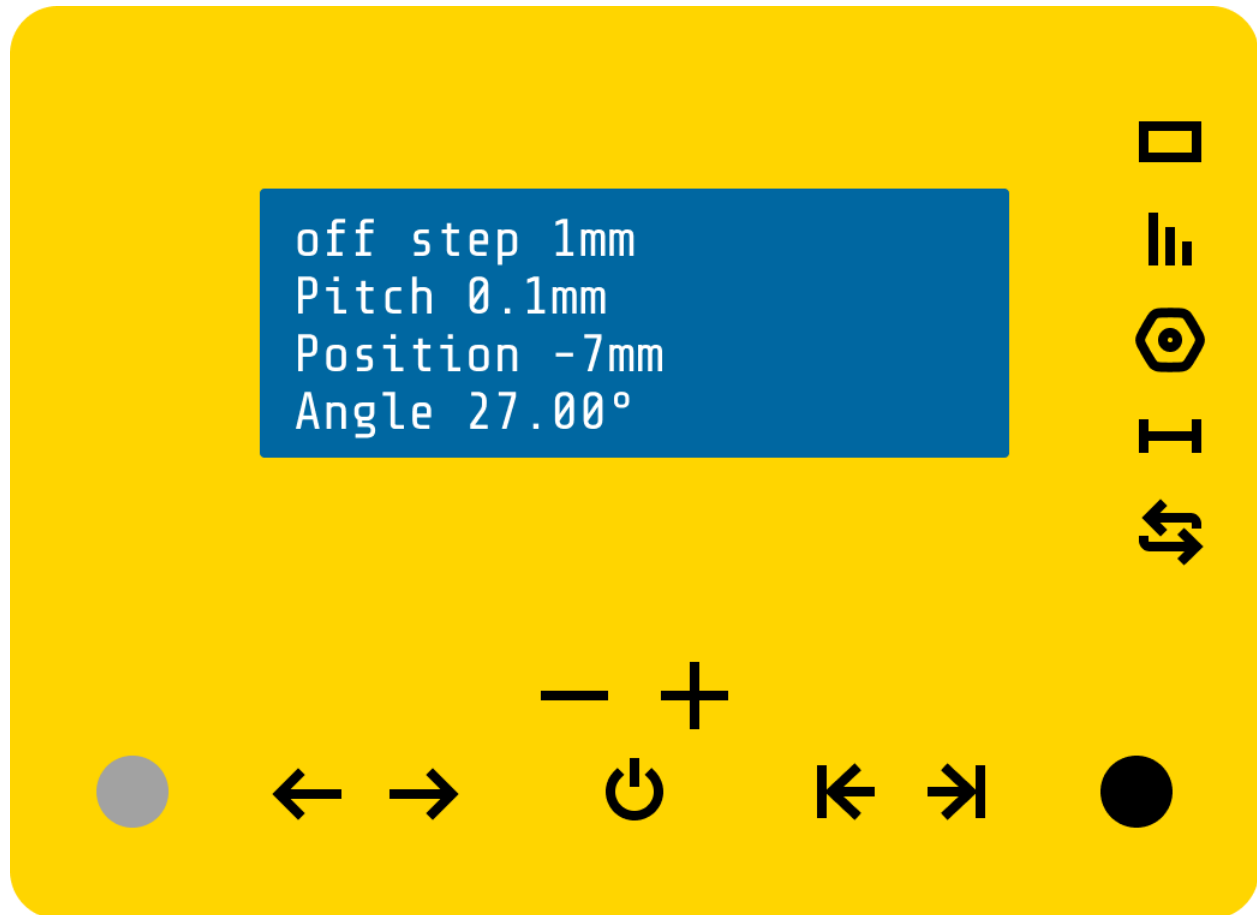
## Position, angle and RPM indication

Display shows relative carriage position, spindle angle and spindle RPM. Showing angle and RPM is controlled with  button. Angle is only shown when the spindle is stationary. RPM is only shown when the gearbox is off.











## Multi-start threads

Use  to switch to MUL mode, select number of thread starts, set both soft limits and controller will automatically switch to the next thread when a soft limit is reached.

## Controls



Icon	Function
	Power switch. Interrupts the 5V line coming from the topmost terminal. Has no effect when controller is powered via USB.
	Move the carriage to the left (increase Z position). Respects left stop (if set). Move distance depends on whether the controller is on/off. When on, will move by step distance but stay in the thread by possibly traveling a little more. When off, will move by step distance.
	Move the carriage to the right (decrease Z position). Respects right stop (if set). Move distance depends on whether the controller is on/off. When on, will move by step distance but stay in the thread by possibly traveling a little more. When off, will move by step distance.
	Decrements pitch. In mm mode: if step is 1 micron, by 1 micron - otherwise by 0.01mm, then by 0.1mm if held continuously. In inch mode: if step is 0.001", by 0.001" - otherwise by 0.01", then by 0.1" if held continuously. In TPI mode by 1 tpi.

	Increments pitch. In mm mode: if step is 1 micron, by 1 micron - otherwise by 0.01mm, then by 0.1mm if held continuously. In inch mode: if step is 0.001", by 0.001" - otherwise by 0.01", then by 0.1" if held continuously. In TPI mode by 1 tpi.
	Turns ELS on or off. Each press marks current position as 0 (soft limits stay in place). Continuous press for 5+ seconds resets the controller.
	Sets the left soft limit at current motor position. If left limit is already set, removes it.
	Sets the right soft limit at current motor position. If right limit is already set, removes it.
	Adjusts screen contrast.
	Inverts pitch sign e.g. changes 1mm to -1mm.
	Changes measurement system between metric, inch and TPI.
	Changes operating mode between gearbox, multi-start and asynchronous.
	Changes manual move step.
	Controls whether angle or RPM are shown on screen.

## Terminals

3.5mm pluggable screw terminals are located on the left side of the device.

Terminal	I/O	Description
5V	input	Power-in, 5V at ~100mA. Emergency Stop should interrupt power.
GND	input	Ground / neutral
ENCA	input	Lathe spindle rotary encoder quadrature signal A.
ENCB	input	Lathe spindle rotary encoder quadrature signal B.
5V	output	Lathe spindle rotary encoder power
GND	output	Lathe spindle rotary encoder ground and signal wire shielding
STEP	output	Stepper motor driver step signal, connect to PUL-
DIR	output	Stepper motor driver direction signal, connect to DIR-

ENA	output	Optional stepper motor driver enable signal, connect to ENA-
5V	output	Stepper motor driver reference voltage, connect to PUL+, DIR+, ENA+ and signal wire shielding

## Assembly

For a kit that requires soldering:

1. Connect microcontroller to your computer and test that you can upload software onto it e.g. by following instructions in the [Software](#) section
2. Disassemble the plastic case by loosening the 4 bolts on the back
3. Unscrew 2 more bolts located inside
4. Remove the PCB board from the case
5. Solder Nano microcontroller into the back side of board with long end of the legs pointing to the back side of the PCB
6. Solder the screen header pins to the screen
7. Place the screen, toggle switch and potentiometer into the front half of the case, place main PCB on top and solder them together
8. Place terminals into the back half of the case, place PCB on top and solder them together
9. Place the assembled PCB inside the case and screw everything back together

## Software

Controller USB port can be used to install controller software of your choice e.g. [NanoEls H2](#):

- Download the [IDE](#)
- Install [LiquidCrystal](#) and [FastGPIO](#) libraries via the [Library Manager](#)
- Download [source code](#), unzip, go to [h2](#) directory and open [h2.ino](#) file in the IDE
- Check the top constants (e.g. encoder steps, motor steps, display offset) and adjust if needed
- Upload the sketch to your microcontroller
- Spindle direction: show angle on screen using top-right button. Rotate the chuck forward manually - angle should increment. If it decrements, either swap ENCA and ENCB wires in the terminals or swap [ENC\\_A](#) and [ENC\\_B](#) values in the code (re-upload the sketch)
- Motor direction: try [LEFT](#) and [RIGHT](#) buttons - if motor is moving in the wrong direction, change the value of [INVERT\\_STEPPER](#) in the code (re-upload the sketch)

## Safety

Ensure that your Emergency Stop button stops all motion and it can't automatically restart when Emergency Stop is lifted.

If controller is used as a part of machinery, ensure that resulting machine complies with all applicable laws and regulations. Controller is not a safety device. Do not use the controller if it's damaged or is not working normally.

## NanoEls H2 usage

### Switching between metric and imperial

Press **H** to change the system of measurement between metric (mm), inch and TPI.

### Setting pitch

Pitch is the distance that carriage will move when the spindle makes the full turn. For example, M14 thread uses 2mm pitch.

Select the desired pitch using **—** and **+** buttons. If you hold the button pressed, pitch starts changing faster after a few seconds.

Use negative pitch values e.g. -2mm to cut left-to-right threads. To do that, you have 2 options:





- hold the **—** button until the pitch drops below 0 to the required value
- or press **↔** to toggle the pitch sign between + and -

Some inch threads require setting the micron part (3rd precision point) of the pitch, to do that click **||** until step is 0.001mm. Now **—** or **+** will adjust pitch by 1 micron.



### Turning or threading


1. Set desired feed/pitch using **—** or **+** buttons
2. Turn on the lead screw using **⏻**
3. Start the lathe spindle, use **←** or **→** to move if needed, stop spindle when done
4. Turn off the lead screw using **⏻**

## Soft limits / automatic stops



Move the carriage using  or  to the desired stop position and press  or  depending on which stop you'd like to set.


When both stops are set, you can:


- Use lathe forward/reverse spindle movements to move the carriage between the stops
- Use  and  buttons to move the carriage within the stops

Setting only one stop is also supported. Stops aren't lost when  is clicked or pitch is changed.






## Moving the carriage

Use  and  buttons to move the carriage. If stops are set, they will be respected during the movement.

When the ELS is off, carriage will move by the distance set by  but at least 1 motor step.


When the ELS is ON, carriage will move in pitch increments (stay in the thread) and travel at least the distance set by .

## Multi-start threads




1. Use  and switch into the MUL mode
2. Use  or  to set the number of starts in your multi-start thread
3. Set left and right limits
4. Cut thread normally and use  and  button to move the carriage between cuts

No need to turn off the spindle until the entire thread is done. Controller automatically moves to the next start of the thread when a limit is reached.

## Asynchronous mode

Click  until you enter the ASY mode. In this mode the spindle rotation is ignored and motor moves with a constant speed when ELS is ON and pitch is non-zero. Limits and manual movement works normally.

## Losing the thread


The spindle and stepper positions are reset to 0 when ,  or  are pressed. This can result in thread being "lost" if ELS is waiting on a soft limit.

## Out-of-sync situations

It's possible for the lead screw to go out of sync with the spindle by removing the soft limit while the carriage is standing on it. It's indicated by the SYN word on the display.

This condition is lifted once the spindle makes a full turn.

## Reset

ELS saves pitch, mode, step, spindle, motor and soft limit positions in the internal memory. Hold  for 5+ seconds to:

- Reset stepper and spindle positions to 0
- Resets pitch to 0
- Removes stops
- Removes out-of-sync state
- Shows NanoEls version

## Usage limits

Supplying over 5.5V on 5V input pin or reversing polarity might damage the device.

Flammable, don't expose to temperatures above 40°C or direct sunlight.

## Disposal

Don't dispose this kit in the unsorted waste, please check with your municipality for electronic parts disposal options.

## Contact

With any questions, corrections or concerns please check [Discussions · GitHub - kachurovskiy nanoels](#), start a new discussion there or reach out to [m.kachurovskiy@gmail.com](mailto:m.kachurovskiy@gmail.com).

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