



# PoKeys57CNC and Mach4

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*Step by step guide - a.k.a. beginners guide*

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## SAFETY INFORMATION



This product is intended for integration by the user into a computer numerical control (CNC) machine. It is the user's responsibility to assess the overall system design and address all safety considerations that affect the users and equipment. The user assumes all responsibility for system design, including compliance with regulatory standards and codes issued by the applicable entities. PoLabs do not make any claims as to the suitability of this equipment for the user's application. Serious personal injury or equipment damage can occur from the improper integration, installation or operation of this product.

This product is not guaranteed to be fail-safe. The system that this equipment is used with shall be fitted with a separate means of fail-safe protection, emergency-stop capability and/or system power removal. This equipment may be connected to dangerous power sources, including electrical power sources. Dangerous voltage levels may be present at this equipment or at connected devices. Measures must be taken to prevent persons from contacting voltage sources which may be present. Equipment should be housed inside an enclosure suitable for the intended environment. Safety interlocks should be provided to prevent any and all dangers to personnel.

CNC machine tools are inherently dangerous, and can cause injury to operators and maintenance personnel. Operators and maintenance personnel shall be properly trained in the safe use, operation and maintenance of such machines. Automated machines that this equipment may be used with can move at any time. All persons exposed to such machines must understand the dangers that are present.

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# PoKeys57CNC and Mach4 – step by step guide

In this tutorial we will describe a step by step procedure how to build your own electronic system for CNC Machine and use Mach4 software with PoKeys plugin to get your CNC up and running.

This tutorial focuses on the electronic system of the CNC machine with software and leaves out mechanical design. We will assume that the target CNC machine has 3 axes with one motor per axis.

## Getting familiar with electronic components

For a three-axis CNC machine you will need the following parts:

- 3x stepper motor (one per axis),
- 3x stepper motor driver (e.g. PoStep driver),
- Stepper driver power supply (e.g. PoPower),
- Controller power supply (e.g. PoPower12-25),
- PoKeys57CNC controller,

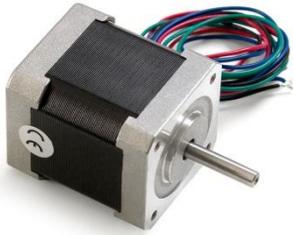
Additionally (not necessary, but helpful):

- PoPendant 1C with manual pulse generator,
- PoNETkbd48CNC keyboard with 48 keys, designed for CNC operation,
- CablePack PoKeys57CNC (connectors and flat cable set),
- Limit switches and E-Stop button.

## PoKeys57CNC and Mach4 – step by step guide

### Stepper motors

The motors vary in rated current and holding torque. As you can find out, not all stepper motors have the same number of wires. The 4-wire stepper motor has 1 coil per phase and 8-wire has 2 coils per phase and can be run in parallel or serial mode. Parallel mode needs higher current, has lower inductance and better torque. Serial mode needs lower current and has lower torque. You can find a more detailed explanation about stepper motors [here](http://blog.poscope.com/stepper-motor-driver-user-manual-complete-edition/internet) (<http://blog.poscope.com/stepper-motor-driver-user-manual-complete-edition/internet>) or on some other internet sites.



*Nema 17 (SY42STH47-1684B Stepper Motor)  
4-wire*



*Nema 23 (SY60STH86-3008 Stepper Motor)  
8-wire*

## PoKeys57CNC and Mach4 – step by step guide

### PoStep25-32 vs. PoStep60-256

Stepper motors require voltages and/or currents that the controller simply can't produce. Therefore we need to use a stepper motor driver. This electronic device will transform your movement instructions from a controller in to a sequence where the windings in stepper motor will be turned on or off, resulting in motor motion. More on <http://blog.poscope.com/stepper-motor-driver/>

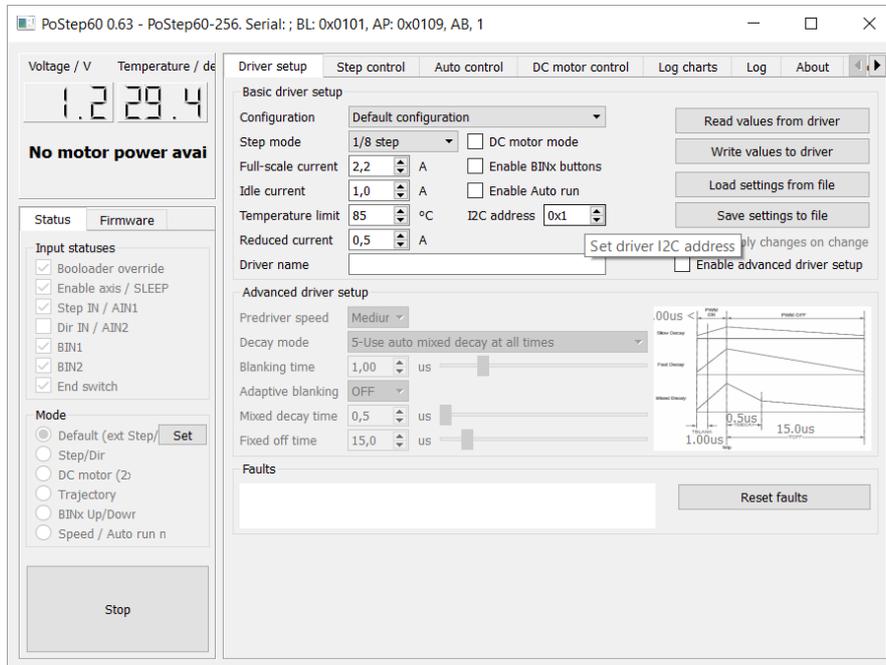
PoStep25-32	PoStep60-256
	
<ul style="list-style-type: none"><li>● 0.5 to 2.5 A phase current</li><li>● Simple current and microstepping setup with jumper</li><li>● Compatible with 4, 6 and 8 wire stepper motors of any voltage</li><li>● +10 VDC to +30 VDC power supply</li><li>● 1, 2, 4, 8, 16 and 32 micro-steps per step</li><li>● Mixed decay mode for smoother moving of motors</li><li>● 3,3V and 5V logic compatible inputs</li><li>● 250 kHz maximum step rate</li><li>● 0 °C To 70 °C operating temperature</li><li>● LED Power, Error and Enable Indicator</li><li>● Improved thermal managing</li><li>● Compact size: 50 mm X 52 mm</li></ul>	<ul style="list-style-type: none"><li>● up to 6.0 A phase current</li><li>● Simple setup of current, micro-step and other settings with software via USB</li><li>● Compatible with 4, 6 and 8 wire stepper motors of any voltage</li><li>● +10 VDC to +50 VDC power supply</li><li>● 1, 2, 4, 8, 16, 32, 64, 128 and 256 micro-steps per step</li><li>● Mixed decay mode for smoother moving of motors</li><li>● 3,3V and 5V logic compatible isolated inputs</li><li>● 250 kHz maximum step rate</li><li>● 0 °C To 70 °C operating temperature</li><li>● LED Power, VM, Status, Fault and Stal indicator</li><li>● On board temperature sensor</li><li>● Improved thermal managing</li><li>● It can be driven from USB without controller</li><li>● Compact size: 54 mm X 75 mm</li></ul>

### PoStep60 stepper motor drivers configuration

To configure the PoStep60 stepper motor drivers, download latest software pack PoStep60 (available on the PoLabs homepage under Downloads) and unpack it to your computer. The application allows you to configure and control stepper driver's parameters. You can also test the operation of the driver without CNC controller.

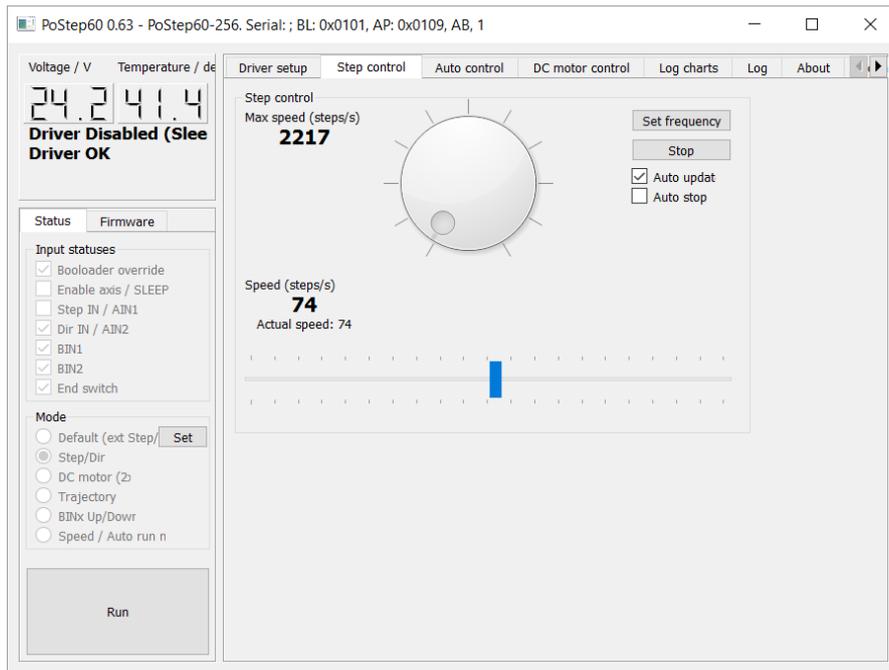
## PoKeys57CNC and Mach4 – step by step guide

Connect PoStep60-256 with USB cable to your computer and run PoStep60v0.xx.exe. Use *Driver setup* tab to configure driver. The selection boxes allow you to choose the microstepping setting and motor currents setting. Once the values are entered, click on *Write values to driver* to confirm changes. Do the same procedure for all drivers you will use.



You can check if the motor is wired correctly and if it works properly, in Step control tab. Set the maximum speed with dial button. Click on *Run* button and move speed slider left or right to command the motor rotation. More detailed description on <http://blog.poscope.com/stepper-motor-driver-user-manual-complete-edition/>

## PoKeys57CNC and Mach4 – step by step guide



### PoPower24-100 or PoPower48-320?

Choose appropriate power supply, taking into account which stepper motor and driver type you are going to use.



Stepper motor type	SY42STH47-1684B Nema 17	SY57STH56-4004A Nema 23	SY60STH86-3008 Nema 23
Power Supply	PoPower24-100	PoPower24-100 or PoPower48-320	PoPower48-320
Stepper driver	PoStep25-32	PoStep25-32 or PoStep60-256	PoStep60-256

## PoKeys57CNC and Mach4 – step by step guide

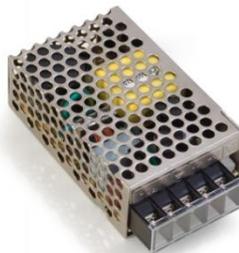
### PoKeys57CNC controller

PoKeys57CNC is a blend between general purpose PoKeys device and motor controller. The device is targeted primarily for controlling up to 8 STEP/DIR signal driven motors (stepper motors, servo drives, etc.) in various applications with the addition of powerful PoKeys device features. Device contains dedicated connectors for connections with motor drivers, pendants, (HD44780-compatible) LCD module etc. In addition, 5 analog inputs with 12-bit resolution are available.



### PoPower12-25

PoKeys57CNC requires external 6-26 V power supply to be connected to the board in order for the device to operate correctly (device may not operate according to the specifications if the external power supply is not present). For this purpose we can use PoPower12-25.

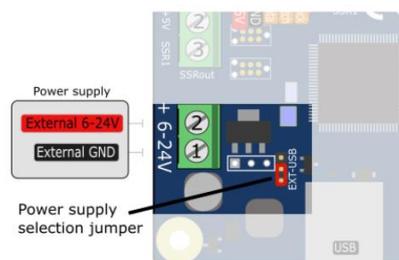


## PoKeys57CNC and Mach4 – step by step guide

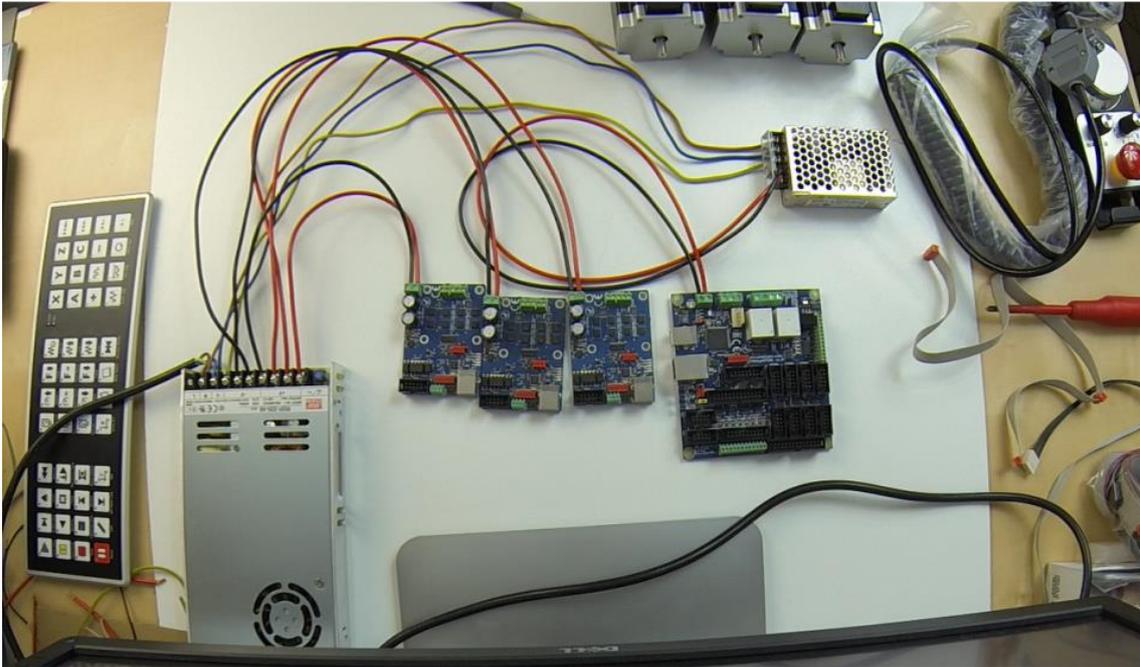
### Let's start connecting

#### Power supply

- Start connecting power supply part, but don't plug it into the AC socket until all connections are done.
- You should consider some general rules. Use color coded cable to connect all three AC plug wires (L, N and PE). L-brown, N-blue, PE- yellow/green. In some countries colors can be different as described. Remember - the yellow/green wire must be always and exclusively used for PE wire (Protective Earth)!
- Hint. You can preserve one AC plug cable if you connect both PoPower AC inputs in parallel.
- Remove approx. 1 cm (1/3 inch) of insulation at wire end. Insert wire's end into power supply connector and use a screwdriver to attach.
- Use red and black (blue) wires for DC voltage. Red for positive power supply lines (+V) and black for negative power supply lines (-V, GND).
- Connect DC outputs (+V, -V) from the PoPower24-100 or PoPower48-320 to PoStep power supply connector. DC outputs from the PoPower12-25 connect to PoKeys57CNC power supply connector. Use screwdriver to attach.
- Power supply selection jumper on PoKeys57CNC board should be set on "EXT"



## PoKeys57CNC and Mach4 – step by step guide



### Stepper motors

Connect the stepper motor wires to the PoStep60-256 or PoStep25-32 driver output pins A, A' and B, B'; marked on PCB. Use a table below for 4 or 8-wire stepper motor.

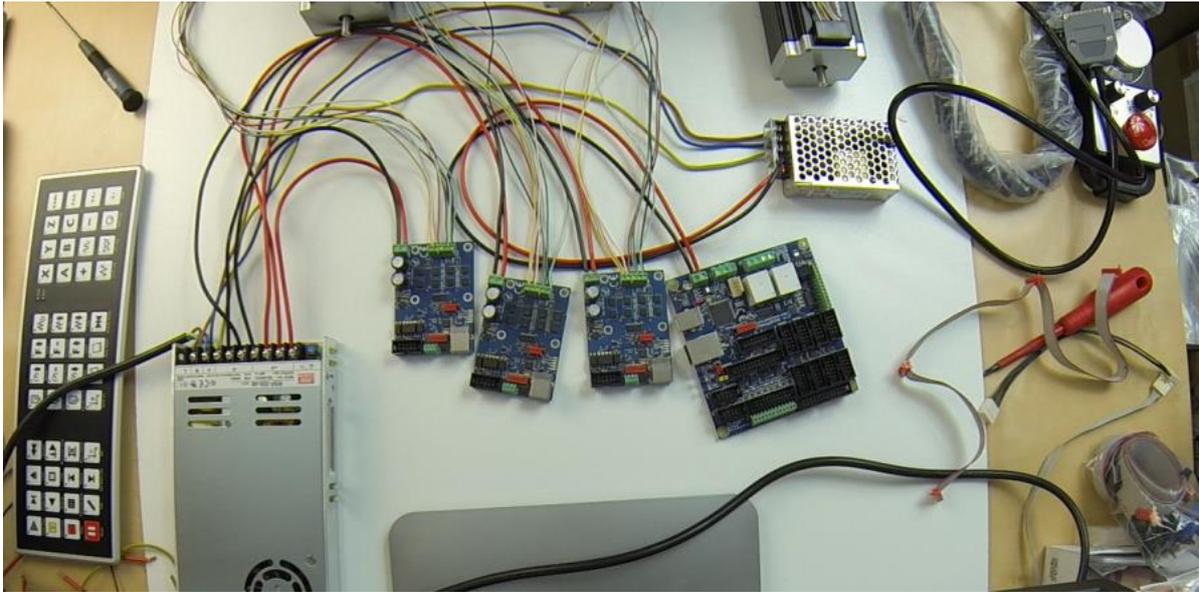
4-wire stepper motor pin-out:

green	black	blue	red
pin A	pin A'	pin B	pin B'

8-wire stepper motor pin-out (parallel coil connection):

yellow/white	yellow	red/white	red	green/white	green	black/white	black
pin A	pin A'	pin A'	pin A	pin B	pin B'	pin B'	pin B

## PoKeys57CNC and Mach4 – step by step guide



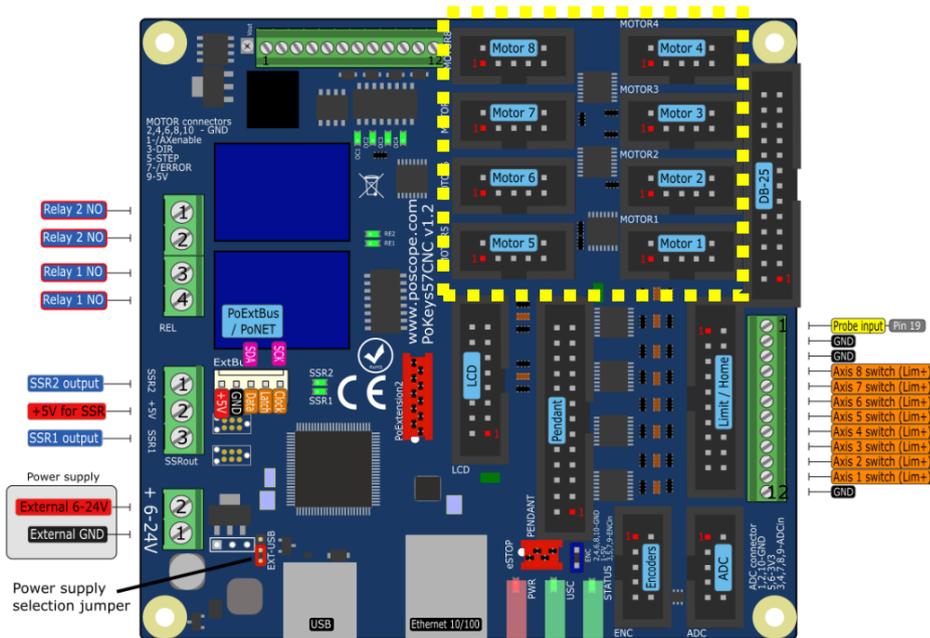
### Make custom flat cables

Make custom flat cables using the CablePackPoKeys57CNC. Some cables are included to PoStep drivers but, if you need a cable to fit your needs, you can make it on your own. If you are making cables for the first time, you can help yourself with our tutorial <http://blog.poscope.com/cablepack-pokeys57cnc-connectors/>.

### Connect the stepper motor controllers and PoKeys57CNC controller

If you are using PoStep drivers, use the provided cables to connect the PoStep motor driver to PoKeys57CNC controller. Insert one end of the cable into the 10-pin IDC connector on the PoStep driver and insert the other end to one of the PoKeys57CNC motor connectors (labeled as MOTOR1 ... MOTOR 8).

## PoKeys57CNC and Mach4 – step by step guide



If you are using a stepper driver without a 10-pin IDC connector with the correct pinout, we suggest using adapter board 10-5, shown below, which allows you to connect the motion-related signals directly.



Adapter board 10-5 (<https://www.poscope.com/product/adapter-board-10-5/>)

Alternative to the adapter board above is to use a 10-pin flat cable with so called flying leads on one end – equip the flat cable with the 10-pin IDC connector on one side only and spread the wires on the other end. Connect the wires straight to your stepper motor driver.

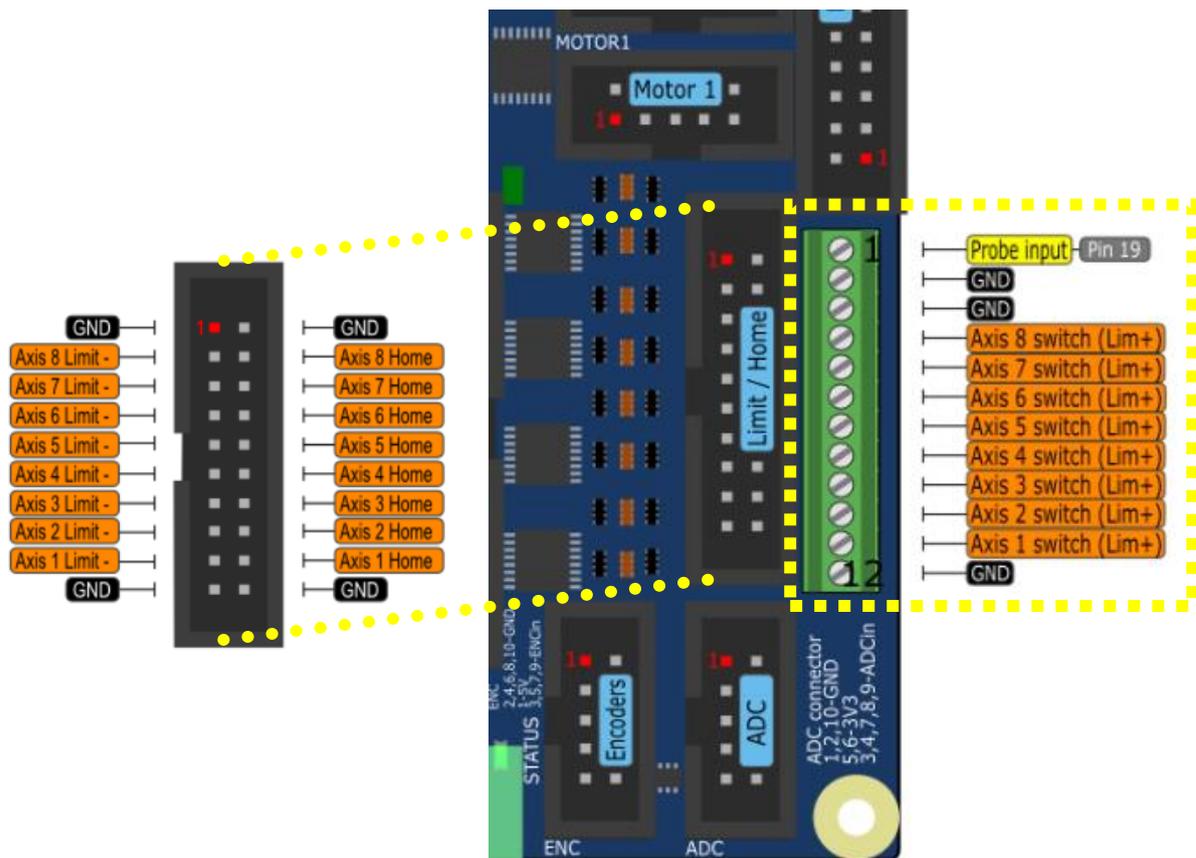
If your stepper motor driver has differential inputs (noticeable by the +/- signal pairs), we suggest wiring the negative signals (usually named PUL-, DIR- and ENA-) to GND of the PoKeys57CNC motor output and positive signals (named PUL+, DIR+ and ENA+) to step, direction and enable outputs of the PoKeys57CNC motor output.

## PoKeys57CNC and Mach4 – step by step guide

### Connect limit and home switches

We will take a look on how to connect limit and home switches of your CNC machine to the PoKeys57CNC controller.

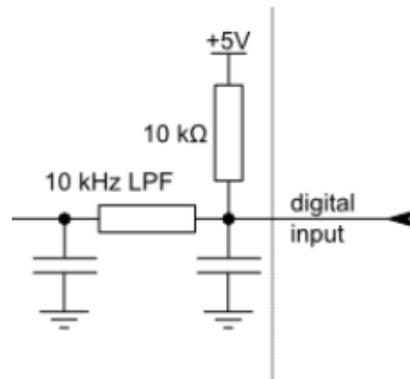
The PoKeys57CNC controller has screw terminals (labeled AX+) for one switch per each axis. Additional switches can be connected to the Limit/Home connector next to the screw terminals - adapter board 20-20 (<https://www.poscope.com/product/adapter-board-20-20/>) can be used to access individual inputs.



As can be seen on the illustration, up to three switches can be connected for each axis. Switches of axis 1 must be connected to the axis 1 switches inputs (inputs of the unused axes cannot be re-used for other axes).

Each switch input is already equipped with a 10 kOhm pull-up resistor to +5 V and a 10 kHz low-pass filter against the noise, as illustrated below.

## PoKeys57CNC and Mach4 – step by step guide



This configuration allows the simple mechanical switches and electronic switches with pure NPN-type output to be connected directly to the input.

The number of GND terminals is lesser than the number of all individual inputs. All GND terminals are connected together and can be shared among multiple switches.

### Mechanical switches

Mechanical switches can be directly connected between the GND and the selected input terminal. Both NC (normally-closed) and NO (normally-open) switches are supported.

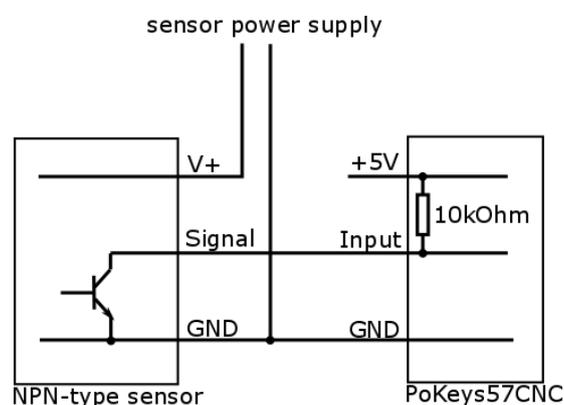
If NO (normally-open) switches are used, select the 'Invert' option for the selected switch in the Pulse engine configuration in PoKeys plugin for Mach4.

If no switch is connected to specific input, make sure that it is configured as 'Disabled' in the Pulse engine configuration in PoKeys plugin in Mach4.

### Electronic switches with pure NPN (open-collector) output

There are various types of electronic switches (e.g. inductive, capacitive, optical switches etc.) with a pure NPN (open-collector) type output. These can directly be connected to PoKeys57CNC inputs, as shown on the illustration below.

Connect the GND of the sensor to GND of the sensor's power supply and PoKeys57CNC GND. Connect the sensor's signal output to PoKeys57CNC input terminal. Connect sensor's positive power input to positive terminal of the sensor's power supply.



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Switches/sensors with pure NPN-type outputs have no built-in pull-up resistors and require an external one.

Switches/sensors with NPN-type outputs and integrated pull-up resistor have to be connected to +5 V power supply. If sensor has built-in pull-up resistor and requires higher voltage to operate, it may not be used with PoKeys57CNC device.

### Electronic switches with PNP output

PoKeys57CNC is not designed to be used with switches or sensors with PNP-type output.

### Connect probe

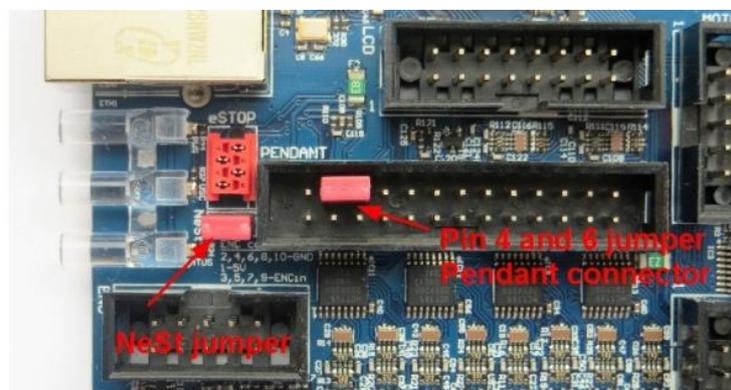
Probe input is available on the same connector as the axis limit switches and has the same characteristics.

### Connect E-stop switch

PoKeys57CNC is designed to include an emergency switch on the pendant – hence the input for the emergency switch is wired to the Pendant connector on the PoKeys57CNC.

E-stop switch can be connected either to dedicated E-stop connector (red 4-pin connector) or to pendant connector (a combination of both is also allowed since both are wired in series). You can use one of the following wiring options:

- a) E-stop switch is connected to dedicated 4-pin E-stop connector between pins 2 and 3. Jumper 'NeST' must be removed and inserted into the pendant connector between pins 4 and 6.
- b) E-stop switch is connected to pendant connector (between pins 4 and 6). Jumper 'NeST' must be present.
- c) Two E-stop switches are connected - one to dedicated 4-pin E-stop connector (between pins 2 and 3) and one to pendant connector (between pins 4 and 6).
- d) No E-stop switch is used – make sure that the 'NeST' jumper is in position and pins 4 and 6 of the Pendant connector are shorted with another jumper, as shown below.



## PoKeys57CNC and Mach4 – step by step guide

### Connecting other signals with the PoKeys57CNC device

Check the specifications of your external device to determine the type of the input or output signals.

#### Logical inputs (e.g. low current CMOS or TTL logical levels)

**Compatible PoKeys signals:** Any pin marked as 'Pin x' (where x is a number) that can be configured as digital output (DO5, DO5\_D or DIO33 types) - **suggestion: use DO5 or DO5\_D**

**Wiring:** Connect PoKeys GND to common ground of the external device, connect PoKeys output pin to external device input

#### Logical outputs (e.g. CMOS or TTL logical level output signals)

**Compatible PoKeys signals:** Any pin marked as 'Pin x' (where x is a number) that can be configured as digital input (DISP, DI33P, DIO33 types) - **suggestion: use DISP or DI33P**

**Wiring:** Connect PoKeys GND to common ground of the external device, connect PoKeys input pin to external device output

#### Optocoupler inputs - active high

**Compatible PoKeys signals:** PoKeys pin marked as either of DO5, DO5\_D, OCOC or REL type in PoKeys57CNC specifications - **suggestion: use OCOC or REL**

**Wiring for DO5, DO5\_D:**

Connect PoKeys GND to common ground of the external device (or a dedicated input ground connection if applicable), connect PoKeys output pin to external device input

**Wiring for OCOC:**

Connect PoKeys OC+ to positive power supply voltage (max. 50 V), OC- to external device input and negative power supply to external device common ground (or a dedicated input ground connection if applicable)

**Wiring for REL:**

Connect one PoKeys relay contact to positive power supply voltage, the other relay contact to the external device input and negative power supply voltage to external device common ground (or a dedicated input ground connection if applicable)

#### Optocoupler inputs - active low

**Compatible PoKeys signals:** PoKeys pin marked as either of DO5, DO5\_D, OCOC, OCSSR or REL type in PoKeys57CNC specifications - **suggestion: use OCOC or REL**

**Wiring for DO5, DO5\_D:**

Connect PoKeys GND to common ground of the external device, connect PoKeys pin to external device input.

**Wiring for OCOC:**

Connect OC+ to external device input and connect OC- to external device common ground (or a dedicated input ground connection if applicable). If external device input requires a power supply

## PoKeys57CNC and Mach4 – step by step guide

input, connect the appropriate power supply (do not use +5V from the PoKeys device or the power supply used for powering the PoKeys device to avoid ground loops).

### **Wiring** for OCSSR:

Connect PoKeys GND to common ground of the external device, connect PoKeys SSR output pin to external device input.

### **Wiring** for REL:

Connect one PoKeys relay contact to external device input and the other relay contact to the common ground of the external device (or a dedicated input ground connection if applicable)

### Optocoupler outputs (also relay outputs) - both optocoupler pins are accessible

**Compatible PoKeys signals:** Any pin marked as 'Pin x' (where x is a number) that can be configured as digital input (DI5P, DI33P, DIO33 types) - **suggestion: use DI5P or DI33P**

**Wiring:** Connect PoKeys GND to negative lead of the external device output (sometimes marked as common), connect PoKeys input pin to external device positive output lead

### Optocoupler outputs - active low (signal is tied to ground by the external device when active)

**Compatible PoKeys signals:** Any pin marked as 'Pin x' (where x is a number) that can be configured as digital input (DI5P, DI33P, DIO33 types) - **suggestion: use DI5P or DI33P**

**Wiring:** Connect PoKeys GND to common ground of the external device, connect PoKeys input pin to external device output

### Optocoupler outputs - active high (signal is tied to positive power supply by the external device when active)

**Compatible PoKeys signals:** PoKeys pins are not compatible with this signal type

## PoKeys57CNC and Mach4 – step by step guide

### Connecting spindle controller

There are different possibilities to control the spindle motor, depending on the spindle controller control inputs available and their types. The following inputs are commonly found on spindle motor controllers:

- master on/off input: turns the spindle motor on or off
- forward direction: activates the forward direction (and usually also starts the motor)
- backwards direction: activates the backwards direction (and usually also starts the motor)
- spindle speed voltage input: usually indicated with the variable resistor (potentiometer) and referenced to a certain common voltage (also one of the supply leads for the indicated potentiometer)



The selected PoKeys output signal can be found in the Mach4 output signals list as described in chapter *Mapping PoKeys digital IO signals to Mach4 IO* on page 24



Pay attention when connecting galvanically isolated I/O pins of the PoKeys device - these pins have a dedicated ground signal named GNDi. Do not connect GNDi to GND since this renders the galvanic isolation irrelevant.

### Spindle controller with master on/off function or with forward direction signal only

If your spindle controller only has an on/off control input and the spindle speed is either constant or manually adjusted, use the appropriate PoKeys pin to drive the spindle controller on/off control input (check chapter *Connecting other signals with the PoKeys57CNC device* on page 17 for more information).

Configure the selected output pin of the PoKeys device in Mach4 output signals configuration (Config > Mach4 > Output signals) for 'Spindle On' or 'Spindle Fwd' signal.

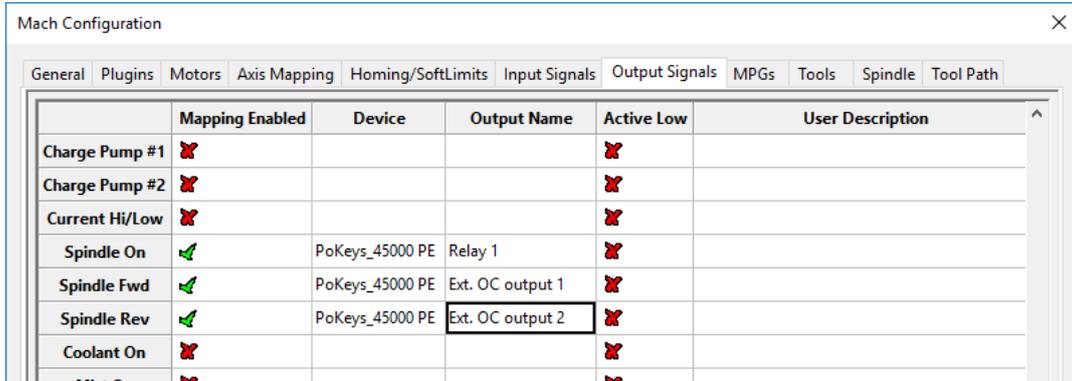
	Mapping Enabled	Device	Output Name	Active Low	User Description
Charge Pump #1					
Charge Pump #2					
Current Hi/Low					
Spindle On		PoKeys_45000 PE	Relay 1		
Spindle Fwd					
Spindle Rev					

### Spindle controller with on/off, forwards and backwards direction signals

If your spindle controller has on/off, forwards and backwards control inputs and the spindle speed is either constant or manually adjusted, use the appropriate PoKeys pin to drive the spindle controller control inputs (check chapter *Connecting other signals with the PoKeys57CNC device* on page 17 for more information).

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Configure the selected output pins of the PoKeys device in Mach4 output signals configuration (Config > Mach4 > Output signals) for 'Spindle On', 'Spindle Fwd' and 'Spindle Rev' signals.

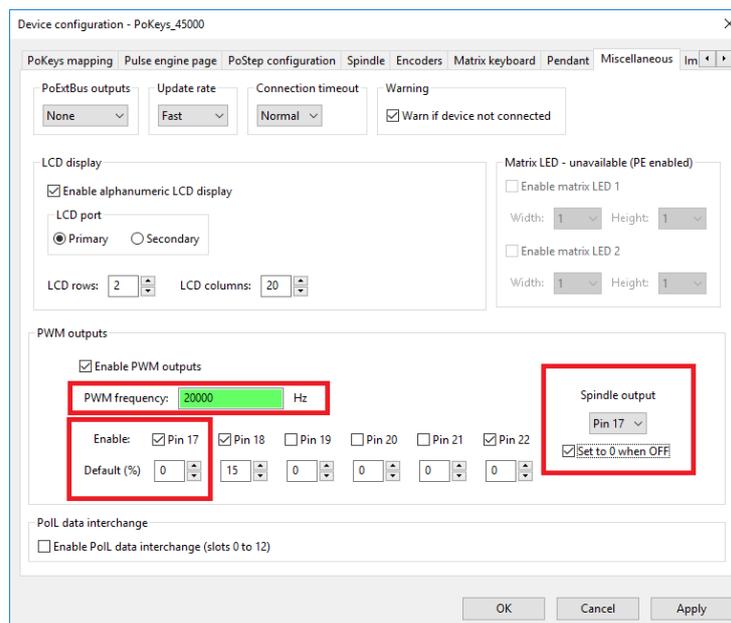


### Spindle controller with analog spindle speed input

First, connect other spindle controller digital control signals as described above for on/off and direction control signals.

Use the 0-10V analog output signal of the PoKeys device to control the speed of the spindle. Connect GNDi (pay attention to using GNDi and not GND!) to the common or ground voltage signal of the spindle speed input. Connect 0-10V analog output signal of the PoKeys device to control voltage signal of the spindle speed input. +10V voltage output of the spindle controller should be left unconnected. Make sure that the spindle controller is configured to accept 0-10V analog voltage signal as the spindle speed reference.

The 0-10V analog output signal of the PoKeys device is generated by low-pass filtering the PWM signal (on pin 17 in case of PoKeys57CNC). Therefore, the signal is configured in PoKeys plugin for Mach4 under the 'Miscellaneous' tab. Set the PWM frequency to 20000 Hz, enable PWM on pin 17, select Pin 17 as the 'Spindle output' and check 'Set to 0 when OFF', as shown on image below.

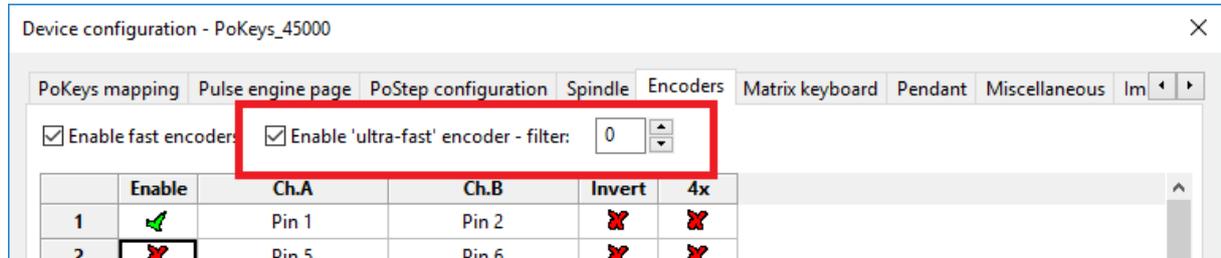


## PoKeys57CNC and Mach4 – step by step guide

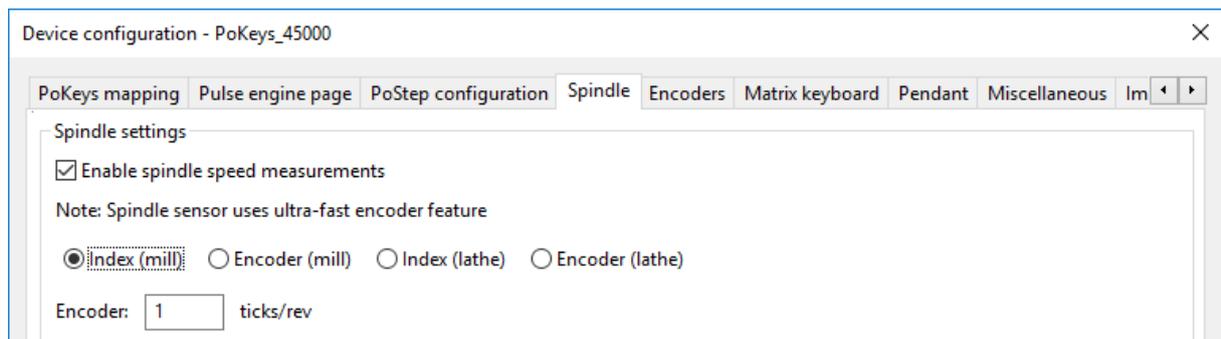
### Connecting spindle speed sensor

PoKeys57CNC expects that the spindle speed sensor outputs a digital signal with one (index) pulse per spindle rotation. Connect the spindle speed signal to PoKeys pin 13 (pin 7 of the Encoders connector) and the sensor ground to PoKeys ground.

The spindle speed measurement uses PoKeys's 'Ultra-fast encoder' input. Check that 'Enable 'ultra-fast' encoder' option is enabled under 'Encoders' tab.



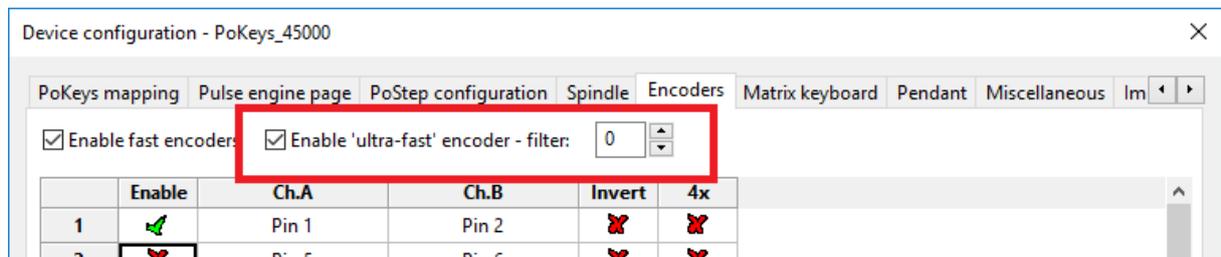
Configure the spindle speed measurement in the PoKeys plugin configuration dialog under 'Spindle' tab to use 'Index (mill)' or 'Index (lathe)', as shown below. The lathe option expects a lower frequency signal and uses different filter settings.



### Connecting spindle encoder

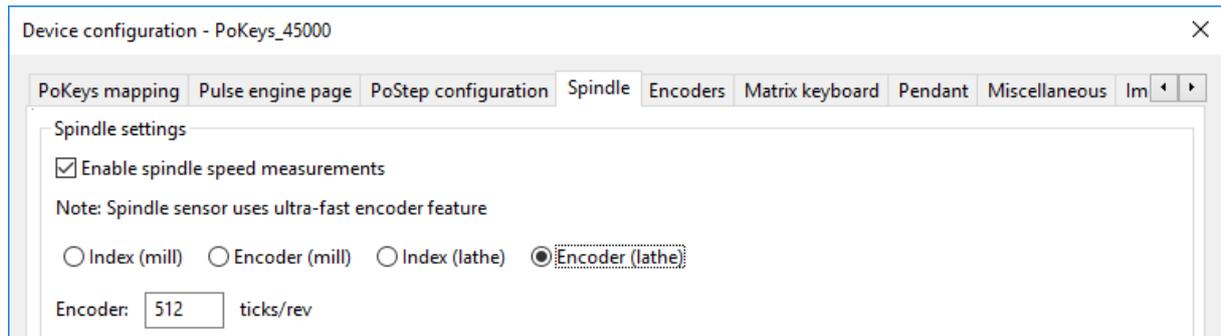
PoKeys57CNC expects that the spindle encoder outputs a digital signal and an index pulse. Connect the encoder signals to the appropriate pins of the 'Encoders' connector on the PoKeys57CNC device.

The spindle speed measurement uses PoKeys's 'Ultra-fast encoder' input. Check that 'Enable 'ultra-fast' encoder' option is enabled under 'Encoders' tab.



Configure the spindle speed measurement in the PoKeys plugin configuration dialog under 'Spindle' tab, as shown below. The lathe option expects a lower frequency signal and uses different filter settings. Enter the encoder resolution (in encoder ticks per revolution) in the field 'Encoder'.

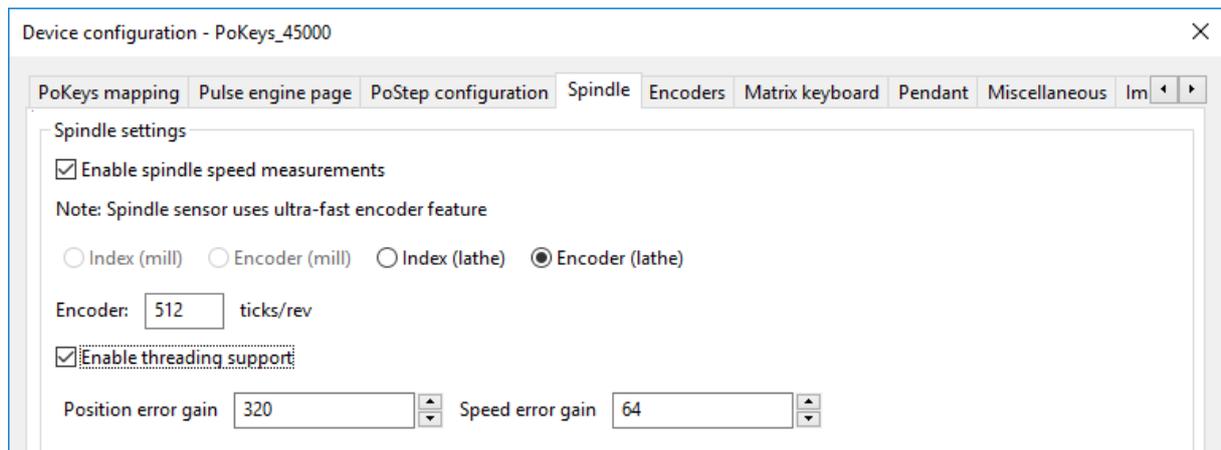
## PoKeys57CNC and Mach4 – step by step guide



### Enabling threading support

PoKeys57CNC supports threading operation with either index-only or encoder+index signals. Select 'Enable threading support' in the 'Spindle' tab of the PoKeys plugin configuration. Note that only lathe signal types for the spindle speed sensor can be selected.

It is suggested to leave the gain settings unchanged.



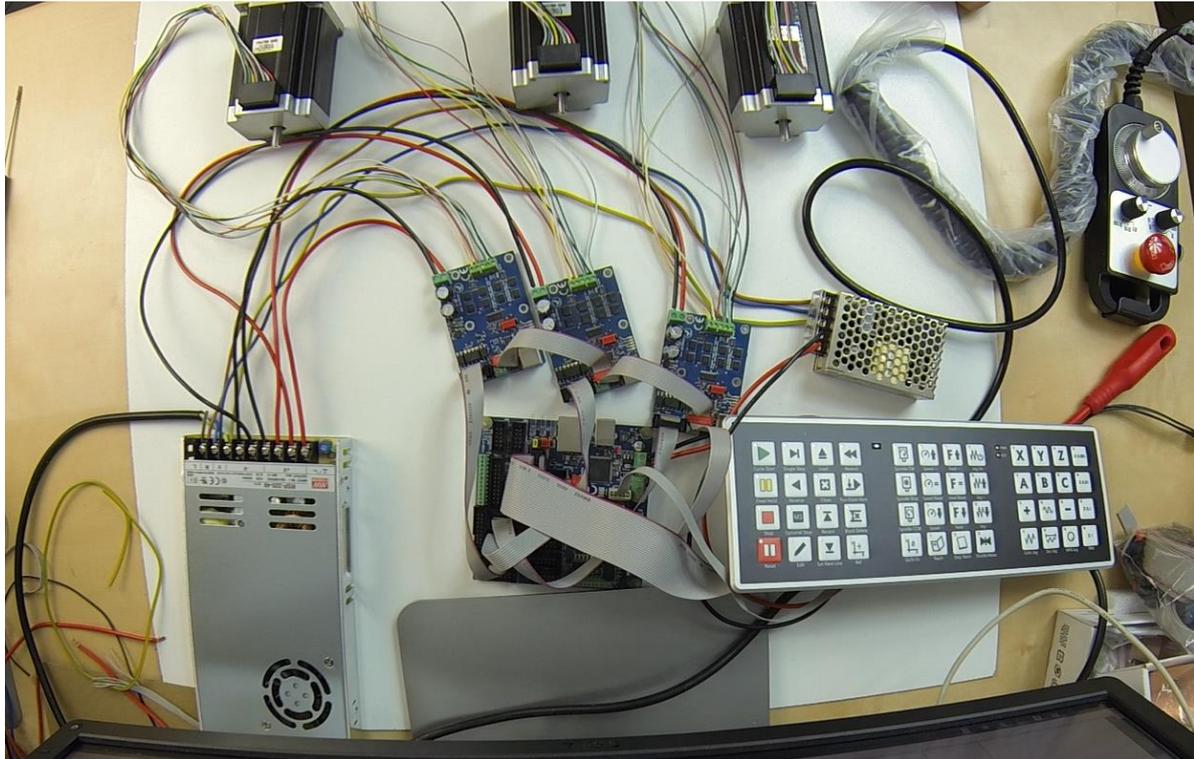
## PoKeys57CNC and Mach4 – step by step guide

### Connect other peripherals

If you are going to use Pendant and/or Keyboard, connect it to appropriate connector on PoKeys57CNC board. Use PoExtBus/PoNET connector for PoNETkbd48CNC.

### Final check and power up

After connecting all together, make some final check before plugging power supply cable into AC socket.



Make sure to separate high-voltage / high-current and low-voltage signals wires to avoid unnecessary noise injection into the signal wires.

Finally, we connect entire CNC electronic-control system. Three stepper motors for axis X, Y and Z with associated step drivers, controller and power supply. We add also PoPendant and PoNETkbd48CNC.

## PoKeys57CNC and Mach4 – step by step guide

### Mapping PoKeys digital IO signals to Mach4 IO

PoKeys pins can be mapped to Mach4 digital input and output signals via the Config > Mach4 > Input signals or Outputs signals menu/configuration dialog.

The signals are organized in multiple Mach4 Devices, as described in the table below (xxxx indicates a serial number of the PoKeys device)

PoKeys device in the Mach4 devices list	Accessible signals
<b>PoKeys_XXXX</b>	Regular “PoKeys” pins (pins marked as ‘Pin x’ in the device pinout)
<b>PoKeys_XXXX PoExtBus</b>	PoExtBus outputs
<b>PoKeys_XXXX Matrix KB</b>	Matrix keyboard input statuses, organized in rows and columns (the list contains signals for the complete 16x8 keyboard disregarding the actual configuration of the keyboard)
<b>PoKeys_XXXX Matrix LED 1/2</b>	Matrix LED outputs, organized in rows and columns (the list contains signals for the complete 8x8 LED matrix disregarding the actual configuration of the LED matrix display)
<b>PoKeys_XXXX PE</b>	Pulse engine related signals: <ul style="list-style-type: none"><li>- dedicated home and limit switch inputs</li><li>- home and limit switch statuses<sup>1</sup></li><li>- External inputs (not used in PoKeys57CNC)</li><li>- Motor driver error inputs</li><li>- OC (optocoupled open-collector) outputs</li><li>- Relay and SSR relay outputs</li></ul>

<sup>1</sup> Home and limit switch status signals report the aggregated and actual status of detected home and limit switches as calculated by the device (based on the configuration of the device). These are not physical signals directly and should not be used when configuring home and limit input signals in Mach4!

### Basic configuration of the PoKeys57CNC device

Before we start with the CNC software, let's take a look on how to update the firmware of the PoKeys57CNC controller to the latest version and configure the main device settings. Download latest version of *PoKeys software (configuration tool)* and install the setup package on your computer.

#### Selecting PoKeys57CNC connection type

PoKeys57CNC supports both USB and Ethernet connections and allows the user to choose the preferred connection type. The following facts can help choosing the connection type when in doubt which one to use:

- **Cable length:** USB devices are limited to a combined cable length of 5 meters, while Ethernet cables are limited to 100 meters in length
- **Power supply:** both connection types require that the PoKeys57CNC device is connected to an external power supply. However, for configuration purposes, PoKeys57CNC can be powered via USB connection if no external loads are connected
- **Reliability:** both connection types provide high reliability and protection against electrical noise. However, since Ethernet devices are galvanically isolated, the odds of **ground loops** are greatly reduced
- **Convenience:** since most of computers have built-in USB ports, connecting the PoKeys57CNC to a PC via a USB cable is the most convenient solution. However, this requires that the computer is in close proximity to the machine. On the other hand, Ethernet cable can be connected to a standard router and make the PoKeys57CNC device available to any PC in the network
- **USB only features:** PoKeys57CNC device functions as a **virtual USB keyboard and joystick**, which can be fully configured by the user (e.g. activating the screen controls via keyboard shortcut)
- **Ethernet only feature:** PoKeys57CNC device feature a built-in **web interface** and support for **Modbus TCP** (Server). Both are accessible to other devices in the network, allowing a remote supervision of sensor values or other parameters

## PoKeys57CNC and Mach4 – step by step guide

### Using USB connection

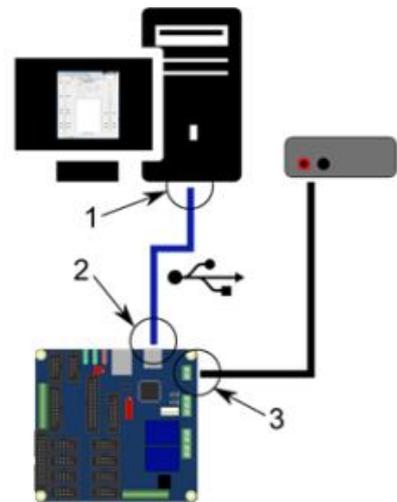
**Step 1:** Locate a free USB 2.0 port on your computer (1) and PoKeys57CNC board (2) and connect them with a standard USB cable.

**Step 2:** Connect the PoKeys57CNC board to an appropriate power supply (3).

**Step 3:** Install PoKeys software

**Step 4:** Open PoKeys application, follow the instructions to update the firmware, then connect to your PoKeys57CNC device and enable Fast USB interface (go to Device > USB > Enable Fast USB interface).

**Step 5:** Remove the USB cable from PoKeys57CNC device, turn off the power to the PoKeys57CNC device, then re-apply the power and insert the USB cable again. The computer will find a new device and search for drivers. See FAQ section of the manual if driver installation fails.



## PoKeys57CNC and Mach4 – step by step guide

### Using Ethernet connection

Ethernet connection can be used to connect PoKeys57CNC and PC directly or via router. Accessing the PoKeys57CNC device over a wireless network (employing a wireless router) is highly discouraged.

Since most network devices use IP-based communication, a proper configuration of a network is of a utmost significance. Each device in the network must have a unique IP address assigned – this has to be done manually (if using direct connection to a PC) or is done by a router with a DHCP server. PoKeys57CNC devices are designed to operate in /24 subnets (network mask of 255.255.255.0). Other network configurations can also be used, but the operation of the devices will not be optimal (reduced capabilities of automatic device discovery).

### Direct ethernet connection PoKeys57CNC – PC

Make sure that an appropriate IP address is assigned to a network card of your PC, that the PoKeys57CNC device is connected to. Follow the steps, described in the following guide: [Change TCP/IP settings in Windows 7.](#)

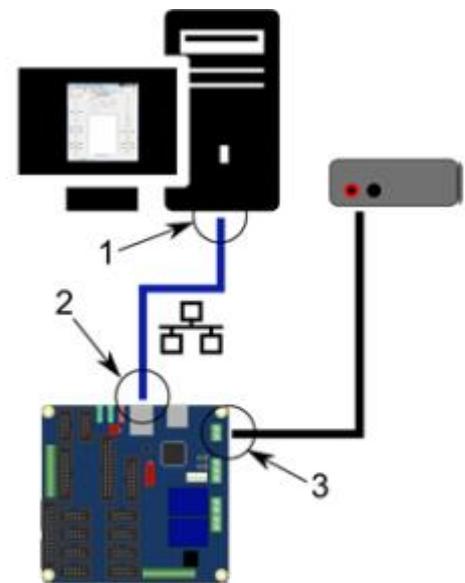
**Step 1:** Locate ethernet ports on your router (1) and PoKeys57CNC board (2) and connect them with RJ-45 cable (standard network cable).

**Step 2:** Connect the PoKeys57CNC board to an appropriate power supply (3).

**Step 3:** Install PoKeys software

**Step 4:** see below for configuration of network settings

**Step 5:** update the device's firmware.

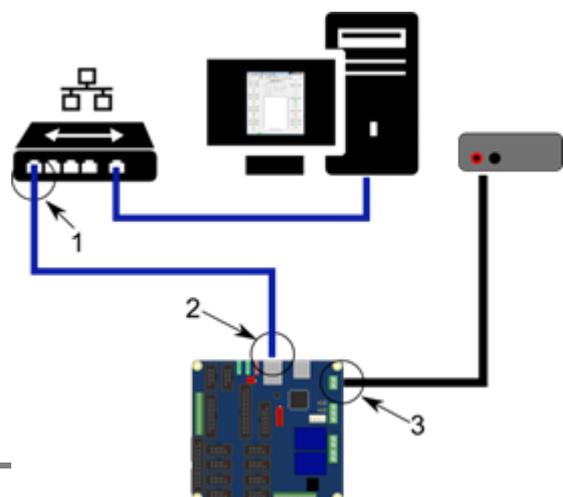


### PoKeys57CNC connected to a network with DHCP server

If your router is properly configured, it will automatically assign addresses to your PC and PoKeys57CNC device.

**Step 1:** Locate ethernet ports on your router (1) and PoKeys57CNC board (2) and connect them with RJ-45 cable (standard network cable).

**Step 2:** Connect the PoKeys57CNC board to an appropriate power supply (3).



## PoKeys57CNC and Mach4 – step by step guide

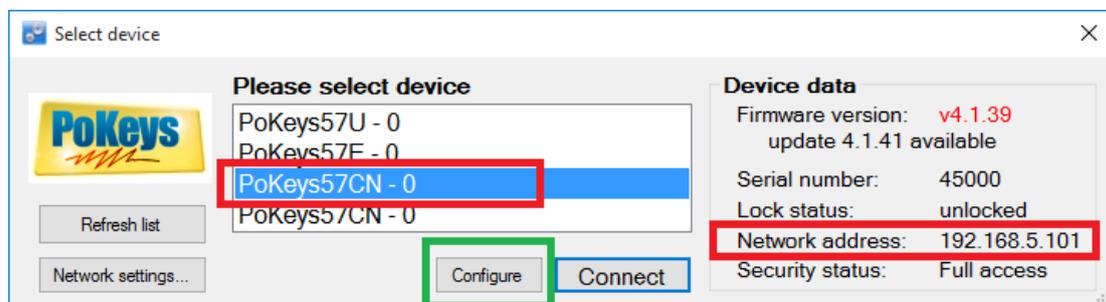
**Step 3:** Install PoKeys software

**Step 4:** see below for configuration of network settings

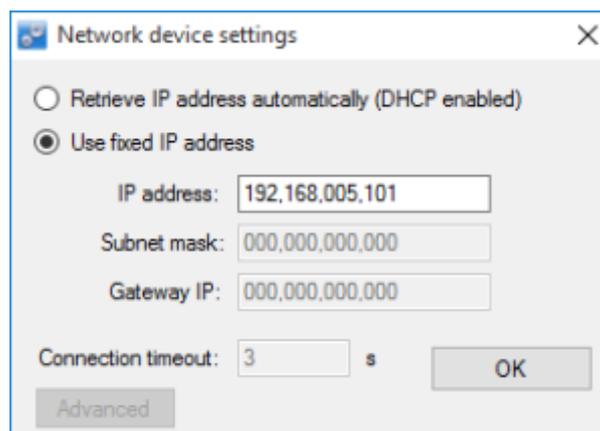
**Step 5:** update the device's firmware.

### Configuring PoKeys57CNC network settings

Open PoKeys configuration application. A 'Select device' (Connect) dialog will appear, listing all available PoKeys devices that have been automatically detected. The following screen capture shows a list of 4 devices that have been detected – one PoKeys57U device, one PoKeys57E device and two PoKeys57CNC devices. By clicking on the PoKeys57CNC device entry, the device data section on the right of the dialog will show device details, including currently assigned IP address.



In order to configure the PoKeys57CNC device network settings, click on 'Configure' button and the following dialog will appear, allowing you to change between automatic IP retrieval (using DHCP) or manual configuration.



Only IP address can be manually configured here since you are not yet connected to the device fully. In order to configure all network settings, connect to the device first, then open Device > Network device settings.

### Autoconfiguration of the device address

PoKeys57CNC devices employ an autoconfiguration process that in case of unconfigured (or misconfigured) PoKeys57CNC device network settings, assigns a temporary address to the

## PoKeys57CNC and Mach4 – step by step guide

device so that the device can be detected by the PoKeys application and configuration updated. **Such address is recognized by the last part of the IP address being equal to .250. This address must not be used during normal operation of the device.**

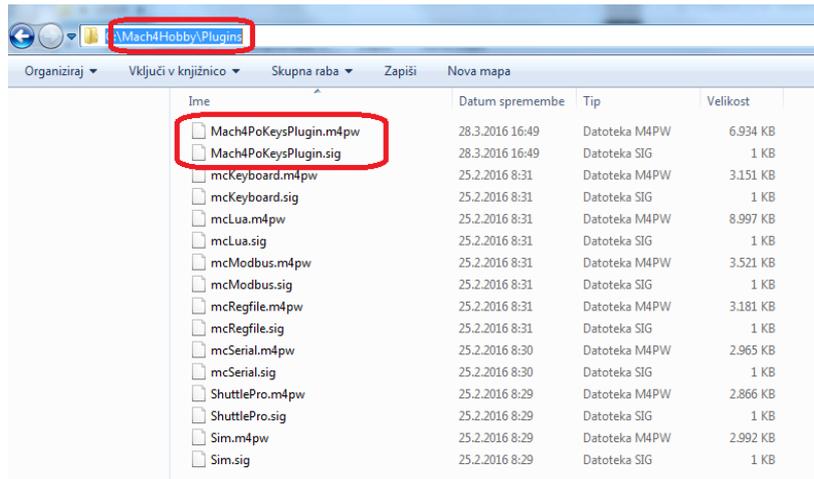
The autoconfiguration can be disabled in network device settings dialog under ‘Advanced’ options (by checking the ‘Disable automatic cross-subnet detection’ option). If automatic device discovery option is disabled, the software will not be able to automatically detect PoKeys devices in the network and a correct IP address of the device will be needed to connect to it. If settings are misconfigured, the device can be put into Recovery mode and settings reset, as described in the PoKeys manual.

Now, we can start with software setup.

### Mach4 setup

To control your CNC Machine you need a program that can translate the G-code to machine motion. We will use Mach4 for this demonstration.

1. Download Mach4 and install it on your computer.
2. Download Mach4 PoKeys plugin (the latest version is available on PoLabs homepage under Downloads). Copy both plugin files and place them inside “Plugins” folder which is found inside Mach4 installation folder.



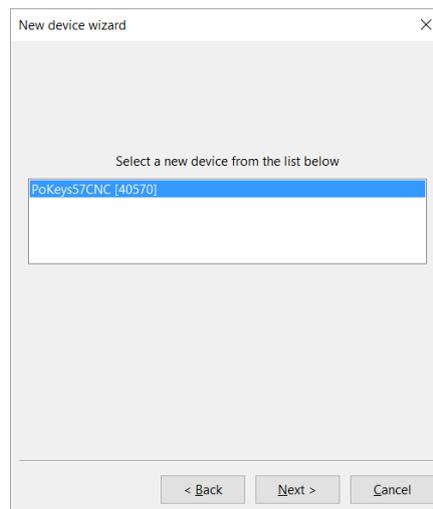
3. Connect PoKeys57CNC using USB or Ethernet cable to computer and run Mach4 software.

When Mach4 opens, a welcome screen from the PoKeys plugin should appear. Click on “Open Add new device wizard” to start the configuration. The configuration wizard is straight forward and it shouldn't be a problem to follow it.

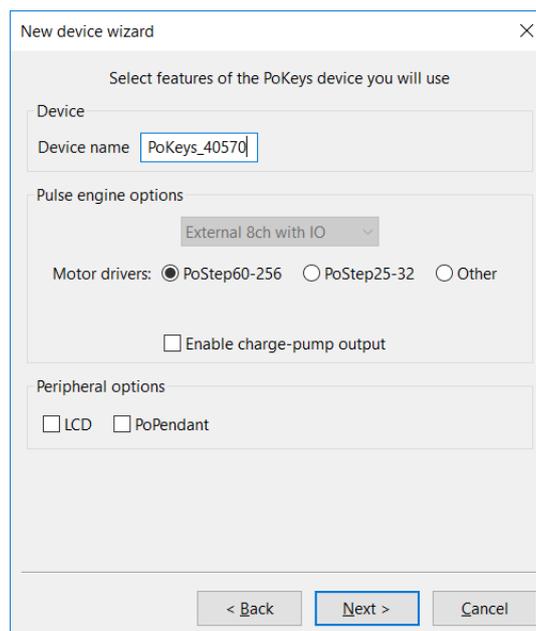


## PoKeys57CNC and Mach4 – step by step guide

4. Select your Pokeys device and click *Next*.

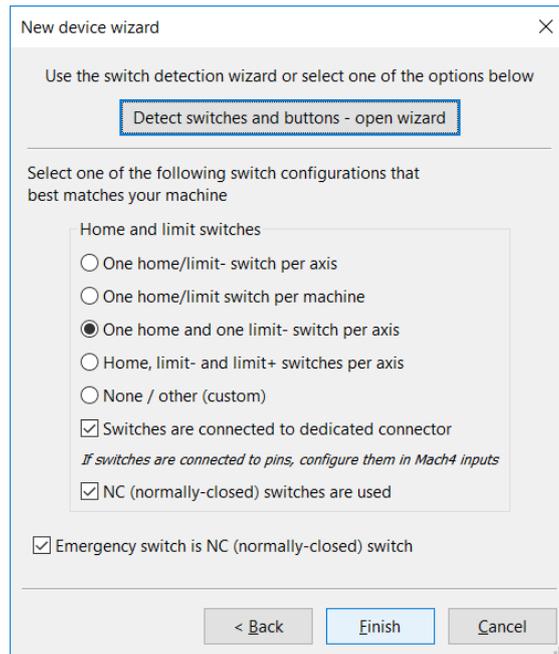


5. In *Pulse engine options* select Motor driver you use and check *Peripheral options* LCD and/or PoPendant, if you use one. You can also rename your device if you want.

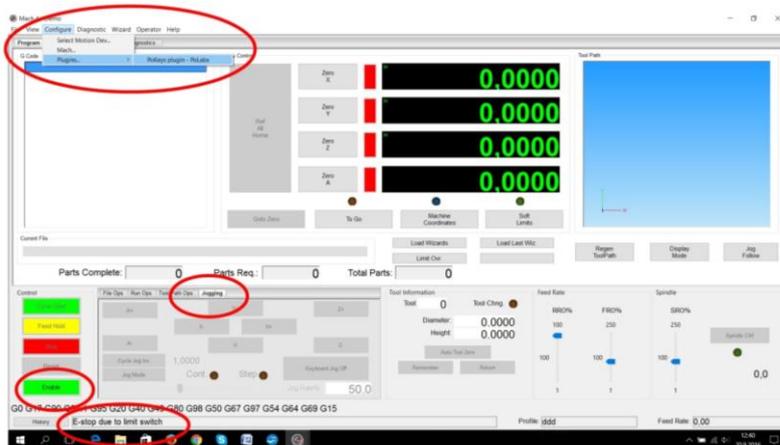


6. On the next page of the wizard, you can select the configuration of switches on your machine. If you are not certain on which option suits your machine best, use the 'Detect switches and buttons' wizard by clicking the button on the top of the dialog. This will guide you through the switches setup.

## PoKeys57CNC and Mach4 – step by step guide



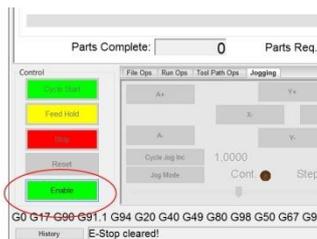
7. Please restart Mach4 software. When Mach4 starts, *'E-Stop condition!'* or *'E-stop due to limit switch!'* text may appear in status list in the lower left corner of Mach4 window. This can happen due to the following causes:
  - E-Stop switch is pressed: to enable Mach4, release the E-stop switch
  - Polarity of E-stop switch is not configured correctly – make sure that 'Invert emergency switch input' option is selected if E-stop switch with NO (normally-open) contacts is used
  - Limit switch is active: the machine activated the limit switch – use limit override option
  - Polarity of limit switch is not configured correctly – make sure that 'Invert' option for the selected limit switch is selected in NO switches are used
  - Limit switch is not connected, but is configured: check that unused switches are configured with option 'Disabled' in Pulse engine configuration in the PoKeys plugin configuration.



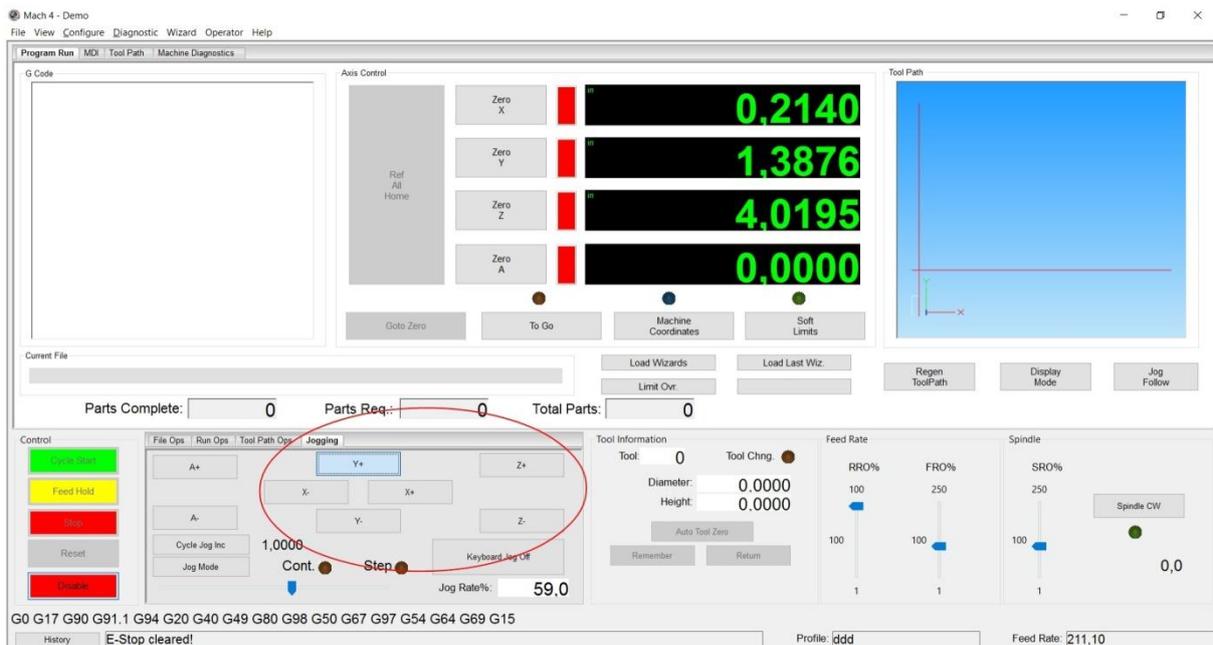
## PoKeys57CNC and Mach4 – step by step guide

- It is recommended to restart Mach4 after making major changes in plugin (changing device, adding new device, changing Pulse engine type etc).
- Configure the Mach4 with the correct settings for your machine and motors – open Configure > Mach4 menu and switch to 'Axis mapping' tab. Check that the PoKeys57CNC motor outputs (Motor0...Motor7 correspond to MOTOR1...MOTOR8 connectors on the PoKeys57CNC device) are correctly assigned to each axis. Next, switch to 'Motors' tab and select Motor0 in the list on the right. Enter the correct 'Counts per unit', maximum velocity and acceleration that suit your machine configuration. Here you can also find 'Reverse' option that will reverse the direction of motor travel if you later discover that the motor runs in the wrong direction. Once complete, click OK.
- Now everything is set up for Jogging or running G-code.

- Click on Enable button.

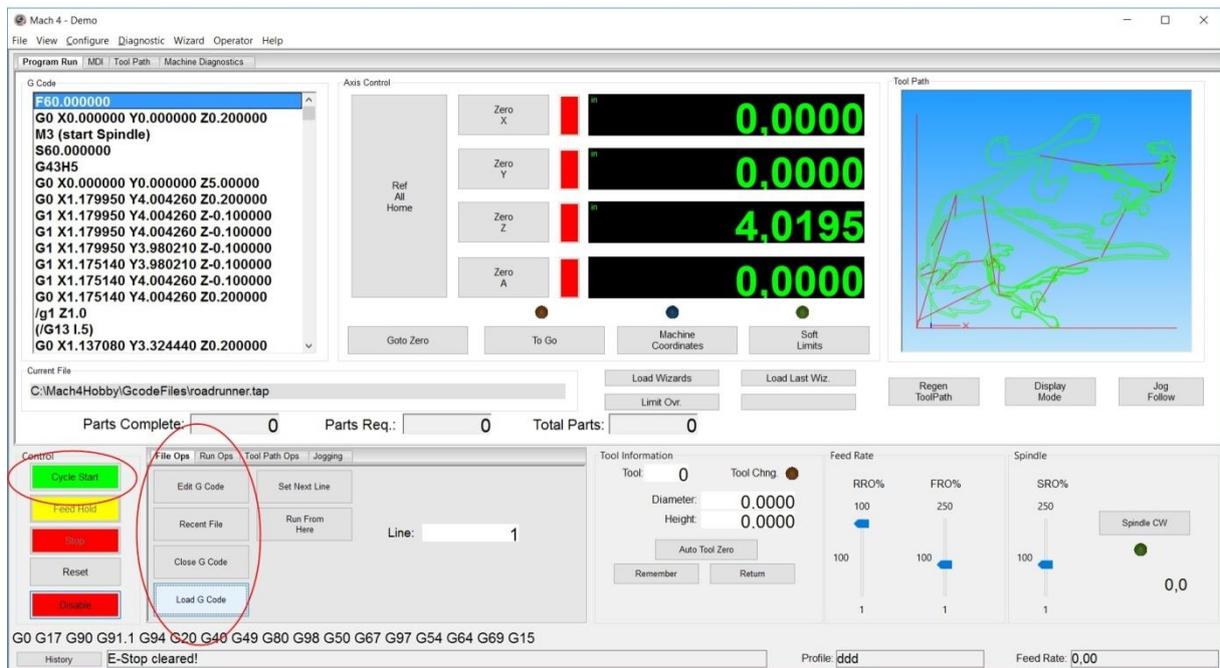


- Option 1: select *Jogging* tab and use axis + and – buttons to drive motors



## PoKeys57CNC and Mach4 – step by step guide

- Option 2: select *FileOps* tab, click on Load G Code button and select *roadrunner.tap* from *Mach4Hobby\GcodeFiles* folder and then press *Cycle Start* button.



Open user manual “PoKeys plugin for Mach4” that is provided with the Mach4 plugin for description of other available settings for the PoKeys device in Mach4.

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