



PoKeys57CNCdb25 User's manual

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1. Introduction

PoKeys products line consists of simple, easy-to-use USB and network devices with the extended list of features making them powerful input/output devices. PoKeys57CNCdb25 is an USB device and is the smallest of the PoKeys family, designed especially for use with CNC machines with existing LPT (parallel printer) port based control signals input connector. It allows a quick migration from LPT to USB bus. Although small, the device is adjustable and as such requires no complex knowledge on device programming.

PoKeys57CNCdb25 can control up to 4 STEP/DIR signal driven motors (stepper motors, servo drives, etc.) in various applications. The device features 12 digital outputs and 5 digital inputs in total. Four of the digital outputs can be configured to operate as PWM (pulse-width modulated) output.

PoKeys USB products integrate support for virtual USB keyboard and USB joystick, which can be used to emulate a standard USB keyboard. Digital input pins can be mapped to virtual keyboard and joystick keys. Configuration is simple by using our intuitive graphical PoKeys configuration application, where each function can also be tested.

Third-party application developers that are adding the support for PoKeys devices, are encouraged to use the supplied communication DLL that can be simply used in the different .NET framework based applications and various other programming languages that provide support for ActiveX interface. There is even an open-source cross-platform C library available at <https://bitbucket.org/mbosnak/pokeyslib>.

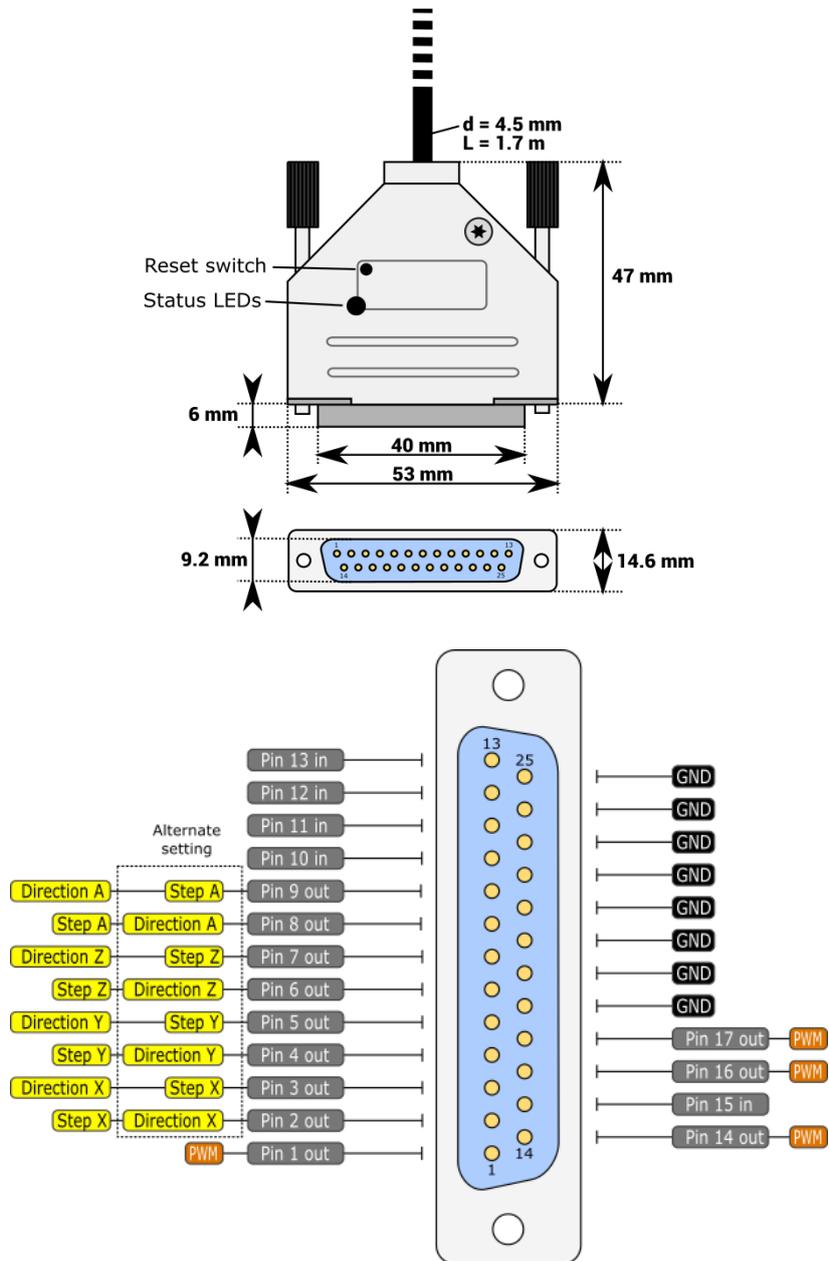
To aid developers that are communicating with PoKeys devices on the low-level, the extensive documentation on device communication protocol can be downloaded free of charge from the product webpage.

2. Features

- Compatible with USB 1.1/2.0 HID standard,
- standard English USB keyboard simulation (with triggering support for up/down keys),
- 12 digital outputs (8 are used for step/direction output signals)
- 5 digital inputs with pull-up resistors
- high performance 4-axis 125 kHz pulse engine,
- up to 4 high-speed fully configurable PWM outputs (25MHz PWM timer)
- fail-safe support in case of communication interruption,
- intuitive and user-friendly software,
- third-party support via communication DLL library and extensive protocol specification document that allows porting to other systems.

3. Device hardware description

PoKeys57CNCdb25 device is built into the standard male DB-25 connector and comes preinstalled with ~1.7 m long USB cable.



3.1. PoKeys57CNCdb25 connector pinout

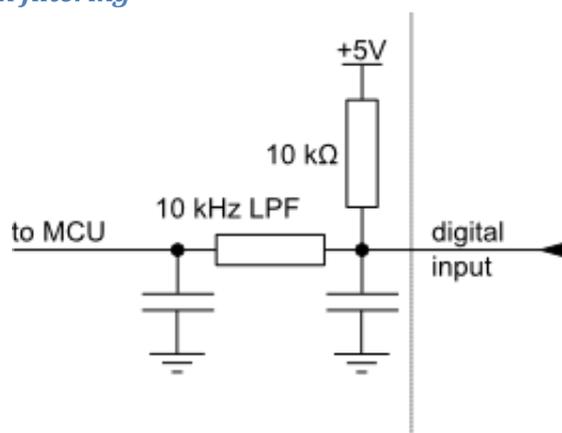
Pin types

Type code	Description
DI5P	5 V digital input with input filtering
DO5	5 V digital output

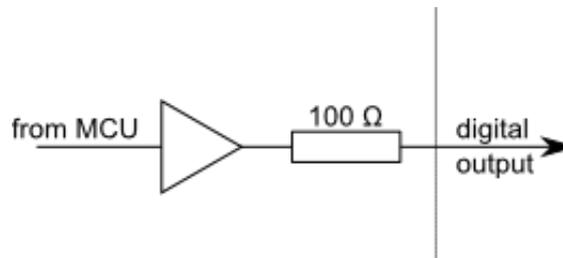
See chapter 3.2 *Pin types* for details on the listed pin types.

DB-25 connector

Pin	Type	Label	Function
1	DO5	Pin 1	PoKeys pin 1
2	DO5	Pin 2	Step or direction signal for axis 1 (X), also used as PoKeys pin 2
3	DO5	Pin 3	Direction or step signal for axis 1 (X), also used as PoKeys pin 3
4	DO5	Pin 4	Step or direction signal for axis 2 (Y), also used as PoKeys pin 4
5	DO5	Pin 5	Direction or step signal for axis 2 (Y), also used as PoKeys pin 5
6	DO5	Pin 6	Step or direction signal for axis 3 (Z), also used as PoKeys pin 6
7	DO5	Pin 7	Direction or step signal for axis 3 (Z), also used as PoKeys pin 7
8	DO5	Pin 8	Step or direction signal for axis 4 (A), also used as PoKeys pin 8
9	DO5	Pin 9	Direction or step signal for axis 4 (A), also used as PoKeys pin 9
10	DI5P	Pin 10	PoKeys pin 10 - e.g. Axis 3 (Z) limit+ switch
11	DI5P	Pin 11	PoKeys pin 11 - e.g. Axis 5 (B) limit+ switch
12	DI5P	Pin 12	PoKeys pin 12 - e.g. Axis 2 (Y) limit+ switch
13	DI5P	Pin 13	PoKeys pin 13 - e.g. Axis 1 (X) limit+ switch
14	DO5	Pin 14	PoKeys pin 14
15	DI5P	Pin 15	PoKeys pin 13 - e.g. Axis 4 (A) limit+ switch
16	DO5	Pin 16	PoKeys pin 16
17	DO5	Pin 17	PoKeys pin 17
18	GND	GND	Ground
19	GND	GND	Ground
20	GND	GND	Ground
21	GND	GND	Ground
22	GND	GND	Ground
23	GND	GND	Ground
24	GND	GND	Ground
25	GND	GND	Ground

3.2. Pin types and specifications**Type DI5P: Digital input with filtering**

Symbol	Parameter	Min	Max	Unit
$V_{DI5P,MAX}$	maximum voltage applied to DI5P pin	-	5,5	V
$V_{DI5P,LOW}$	applied voltage for LOW state	-	0,2	V
$V_{DI5P,HIGH}$	applied voltage for HIGH state	1,6	-	V

Type DO5: 5 V digital output

Symbol	Parameter	Min	Max	Unit
$I_{DO5,MAX}$	maximum current supplied by DO5 pin	-	8	mA
$V_{DO5,LOW}$	voltage of LOW state (no current)	-	0,1	V
$V_{DO5,HIGH}$	voltage of HIGH state (no current)	4,9	-	V
$R_{DO5,HIGH}$	internal resistance of the digital output	100	TBD	Ohm

3.3. Status LEDs

- TBD

3.4. Environment specifications

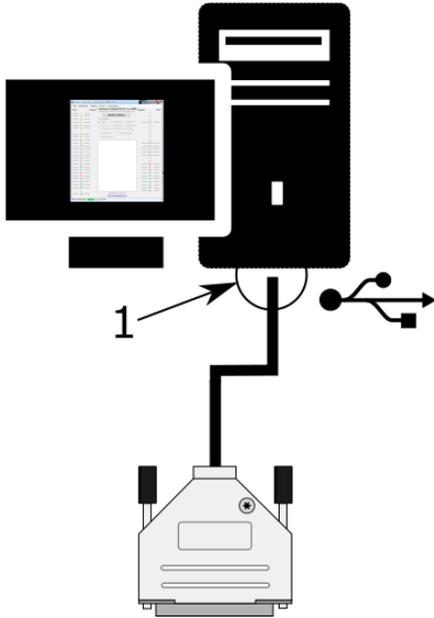
Parameter	Min	Typ	Max	Unit
Power supply range	4.5	-	5.5	V
Operating temperature	0	-	60	°C
Storage temperature	-40	-	85	°C
Humidity	5	-	95 (non-condensing)	% RH

4. Requirements

- one available USB 1.1 or USB 2.0 port,
- USB HID device driver enabled operating system (Windows 98 SE/ME/2000/XP/Vista, Linux, Mac OS) and PoKeys USB driver installed
- Included software requires Windows XP/Vista/7/8/8.1 with .NET framework 3.5 installed.

5. Installation

PoKeys57CNCdb25 is a USB 1.1/2.0 compliant device.



Step 1: Locate a free USB 2.0 port on your computer (1) and connect PoKeys57CNCdb25 board (2) to it

Step 2: Install PoKeys software

Step 3: Open PoKeys application, connect to your PoKeys57CNCdb25 device and enable Fast USB interface (go to Settings > Enable Fast USB interface).

Step 4: Remove the PoKeys57CNCdb25 device cable from your computer and insert it again. The computer will find a new device and search for drivers. See FAQ section of the manual if driver installation fails.

5.1. Mach4 setup

Setup of PoKeys57CNCdb25 device in Mach4 is simple. Install the latest Mach4 software and download the PoKeys plugin for Mach4 from PoLabs website (www.poscope.com). Follow the instructions in the manual provided with the plugin. Short overview of the procedure:

- Make sure that Microsoft Visual C++ Redistributable Package 2010 x86 is installed: this package is available as a download from Microsoft at <https://www.microsoft.com/en-us/download/details.aspx?id=5555>
- If you haven't yet, install PoKeys USB driver - use PoKeys setup package and select 'USB driver' in the installation options (the USB driver is installed by default)
- Copy the Mach4PoKeysPlugin.m4pw and Mach4PoKeysPlugin.sig into Mach4's plugins folder
- Connect the PoKeys57CNCdb25 to your CNC using the DB-25 connector, then connect it to your PC via USB (if not done earlier)
- Start Mach4 and wait for the Mach4 to load completely. During loading, PoKeys welcome screen will appear offering to open a new device wizard. Use this to configure your PoKeys57CNCdb25 device - follow the steps on the screen
- After configuration is done, restart Mach4. PoKeys will automatically be selected as default motion controller. Open Configure > Mach, switch to Axis mapping and assign motors to your CNC machine axes.
- Configure other parameters to adjust Mach4 to your machine

5.2. Mach3 setup

PoKeys57CNCdb25 operation is supported by the latest Mach3 plugin. Select 'External 4ch without IO' in Pulse engine settings.

6. PoKeys configuration options

6.1. Digital inputs and outputs

Unlike generic PoKeys devices, PoKeys57CNCdb25 doesn't have generic pin headers with fully customizable pin functions. Pins of the PoKeys57CNCdb25 device have fixed direction (separate input and outputs pins) - see the pinout diagram. Pin numbers are assigned according to the DB-25 connector pinout.

Pins configured as digital input or digital output will disable the step/direction function on that pin - e.g. configuring pin 2 as digital output will disable the step (or direction) signal on pin 2.

Although primarily targetted for CNC applications, PoKeys57CNCdb25 shares the same virtual USB keyboard and joystick capability of PoKeys USB series of devices. Digital pins can be mapped to virtual keyboard keys or virtual joystick buttons. On activation, PoKeys device sends a USB message with the key code and modifier associated with this pin. Moreover, PoKeys57CNCdb25 device can also simulate a series of key presses, what is called a macro sequence. Up to 64 different macro sequences can be setup with the combined total length of 3584 characters with each macro sequence shorter than 128 keys. All macros can be labelled with a 7-character name.

An extension to the USB keyboard mapping described above, PoKeys supports also triggered mapping of inputs to USB keyboard keys. In triggered mapping mode, only pin state transitions (low-to-high or high-to-low trigger a USB key press) with different key combinations for each transition.

Type-matic like repeat and delay is an additional extension to the triggered key mapping. Instead of relying on the user's system to trigger key repeat events, PoKeys can be configured to simulate repeated key presses at the predefined rate (period between two key presses is adjustable in 5 ms cycles – 0.78 to 200 repeats possible¹) after a predefined delay (adjustable in steps of 5 ms – 0 to 1275 ms possible).

PoKeys configuration software usage

There is graphical representation for configuration of each PoKeys device's pin on left and right side of main window. To change pin function, click on pin name and change its function in central 'Pin settings' frame.



Figure 1: PoKeys configuration window

¹ The maximum repeat rate depends on the user's system

There are 6 main pin functions possible: inactive, digital input, triggered digital input, digital output, analog input, depending on the capabilities of each pin.

Inactive

Any pin (except those fixly mapped to an activated peripheral) can be set as inactive. Inactive pin is put in high-Z state with internal pull-up resistors enabled.

Digital input

Any free pin can be configured as digital input by selecting 'Digital input' option box. If the pin polarity is wished to be inverted, check the 'Invert pin' box.

There are several additional possibilities for digital input pin functions.

Direct key mapping

Digital input set up for direct key mapping acts like a keyboard key. When there is a high state on pin (on low state when using inverted option), PoKeys device sends a key associated with this pin. Select a keyboard key from drop-down box and check appropriate key modifiers (Shift, Ctrl, ...).

Triggered digital input

Triggered digital input function is activated by selecting 'Triggered input' option box. This pin mode enables user to select a key that is pressed only when a transition in a signal occurs. Different keys can be selected for 'LOW-to-HIGH' or 'Key up' event and for 'HIGH-to-LOW' or 'Key down' event. Selecting the keys is similar to Direct key mapping described above.

Digital output

Most of the available pins (check the pin capabilities in device pinout section of this manual) can be configured as digital output by selecting 'Digital output' option box. If the polarity of the pin is wished to be inverted, check the 'Invert pin' box. On startup, all pins (although optionally configured as digital output) are by default initialized in high-Z state (behaving like inputs). To use the outputs, SetPinData should be called before attempting to set the output state. However, there is an option to disable this behaviour - use the 'Settings > Initialize outputs on startup' option to either enable or disable output activation on PoKeys startup.

View status of digital inputs and outputs

Go to 'Peripherals > Digital inputs and outputs...' to display the status dialog as shown below.

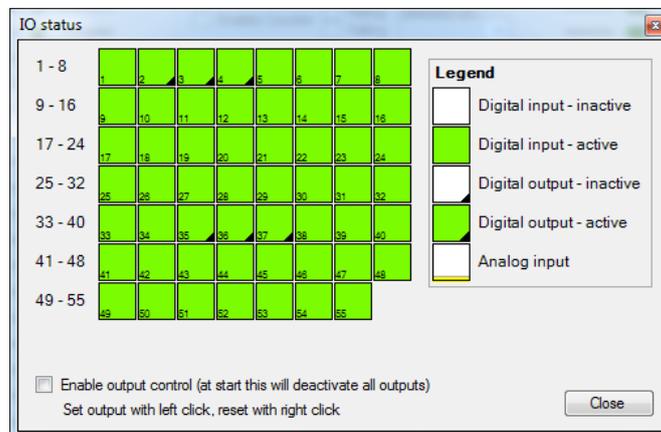


Figure 2: Input and output status dialog

There are up to 55 pins represented as colored squares in the dialog, organized in the rows of 8 pins. Each square contains a pin index number in the lower left corner, while the lower right corner is used to indicate a digital output (small black triangle is displayed on pins, configured as digital outputs). The color of the square resembles the current state of the pin – green for the activated (HIGH state) and white for the unactivated (LOW state).

To change the digital output state, first enable ‘Enable output control’ option, then either left or right click with mouse on the square representing the digital output to activate or deactivate this output.

6.2. Pulse engine

PoKeys57CNCdb25 is a compact variant of the PoKeys57CNC device. As such, it contains an external pulse generator on-board, which is capable of driving of up to 4 axes controlled by STEP/DIR signals with maximum pulse frequency of 125 kHz. In needed, the function of the step and direction outputs can be swapped.

The following table shows the default and alternate setting for the step/direction signals

Pin	Default setting	Alternate setting
Pin 2	Step 1 (X)	Direction 1 (X)
Pin 3	Direction 1 (X)	Step 1 (X)
Pin 4	Step 2 (Y)	Direction 2 (Y)
Pin 5	Direction 2 (Y)	Step 2 (Y)
Pin 6	Step 3 (Z)	Direction 3 (Z)
Pin 7	Direction 3 (Z)	Step 3 (Z)
Pin 8	Step 4 (A)	Direction 4 (A)
Pin 9	Direction 4 (A)	Step 4 (A)

The alternate setting is enabled by checking ‘Swap DIR/STEP pins’ option.

The Pulse engine is fully configurable in terms of:

- Axis switches configuration: each switch (Limit-, Limit+ and Home/Ref) can be independently enabled, inverted and positioned either on dedicated pins (pin value of 0) or standard PoKeys pins that are listed in the device pinout
- Axis motion control configuration: each axis can be configured to optionally use an internal motion controller in either position or speed mode
- Homing/referencing procedure: motion of the reference position search can be inverted if home/ref switch is positioned in the positive end of the axis travel. The speed of the homing procedure can be configured in percents of the maximum axis speed.
- Internal motion controller parameters: such as maximum speed, acceleration and deceleration can be individually configured for each axis.
- Integrated MPG jog mode: where PoKeys can handle the MPG jogging directly - encoder index and step multiplier can be individually configured
- Other axis settings: axis enable signals, direction inversion, soft limits, etc.

See the description of the Pulse engine status/control dialog on the next page.

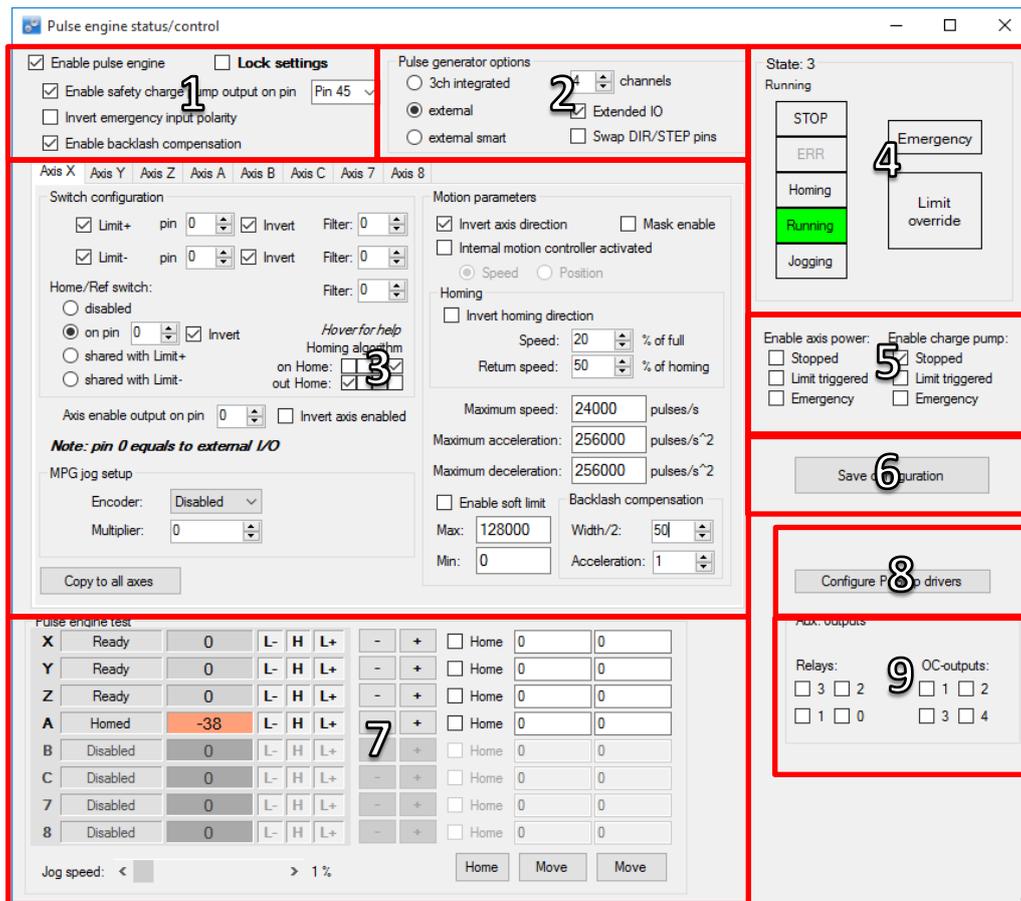


Figure 3: Pulse engine status/control dialog

Pulse engine status/control dialog parts

1. Main Pulse engine settings:
 - a. Enable pulse engine: main switch to enable or disable Pulse engine functionality
 - b. Lock: when Lock is enabled, the main Pulse engine settings and Pulse generator settings are disabled
 - c. Enable safety charge pump output: configure the pin for the charge pump output
 - d. Invert emergency input polarity: PoKeys expects NC (normally closed switch to be used as emergency switch) and HIGH signal state on emergency input indicates an emergency. If NO switch is used, the polarity of the signal must be inverted by selecting this option
 - e. Enable backlash compensation: check this option to enable the backlash compensation in PoKeys device.
2. Pulse generator options: PoKeys57CNC contains an external pulse generator on-board, thus external pulse generator option with 'Extended IO' must be selected. Up to 8 axes can be enabled
3. Axis configuration - see next page
4. Pulse engine state display and control: this panel displays current PoKeys Pulse engine state and allows the user to change between the states

- a. STOP: stopped mode - the Pulse engine is deactivated momentarily and produces no pulses. Transition to STOP mode is instantaneous - if there is any motion being executed, the pulse generation will cease immediately after switching to STOP mode.
 - b. ERR: error mode - if PoKeys detects any event that results in error (emergency stop, limit stop, etc.), this mode will automatically be activated. As STOP mode, the transition is instantaneous
 - c. Homing: in this mode, PoKeys is executing the homing procedure. The selected axes are referenced in regards to the position of Home/Ref switch. PoKeys executes homing procedure in two steps - in first step, course position of the switch is located using faster motion in the negative direction of the axes (unless Homing direction is inverted in the settings). When the switch is located, the fine position of the reference position is located using slower motion in the positive direction of the axis (again, if not inverted in the settings) until the Home/Ref switch is released.
 - d. Running: normal operating mode
 - e. Jogging: jogging mode - in this mode, PoKeys Pulse engine can use the values from the encoders to directly jog the configured axes
 - f. Emergency: this field indicates whether device entered Emergency state
 - g. Limit override: switch that allows the user to activate the limit override
5. Enable axis power and enable charge pump: these options select, when the axis enable and chargepump output signals are activated (besides normal operating modes)
 6. **Save configuration** button: after the settings are changes, this button must be clicked to send the settings to device and save them to the on-board non-volatile memory. Since this operation may produce interruptions in the motion, it is suggested to stop any motion before commencing configuration save.
 7. Pulse engine testing panel:
 8. Additional configuration options - here, additional configuration dialogs can be opened
 9. Auxiliary outputs: these can be used to test the on-board auxiliary outputs
 - a. Relays 0 and 1 control the SSR outputs
 - b. Relays 2 and 3 control the on-board relays
 - c. OC-outputs control the galvanically isolated open-collector outputs

Axis configuration panel

This panel contains settings for each axis.

Homing algorithm configuration

PoKeys devices support customization of the homing algorithm. The algorithm is based on executing selected actions on different events:

- On Home event (home switch contact is detected) - this event happens when the machine touches and activates the home switch (configured in the options above)
- Out Home event (home switch contact is released) - this event happens when the machine backs off the switch or gets past the home switch.

On these two events, the combination of the following actions can be configured (selection boxes from left to right):

- Stop and reset the position - this action marks last position as home position and commands the motion to stop. It also finishes the homing procedure for the axis
- Arm the encoder index for stop - this action arms the encoder index input for the selected axis. On the next encoder index signal, the position of the axis is marked as home, axis is commanded to stop and the homing procedure for the axis is finished. Fast encoders index inputs 1, 2, 3 (pins 9, 10 and 11 on PoKeys57CNC and 9, 11 and 27 for other PoKeys devices) are used for axes 1, 2, 3, while ultra fast encoder index input is used for axis 4.
- Reverse direction - reverse the homing direction
- Slow down - slow down the homing speed to the reduced speed, as configured

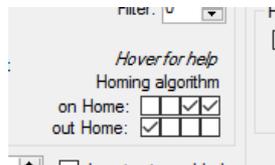


Figure 5: Homing algorithm selection boxes - default configuration (reverse and reduce speed on home and stop on home release)

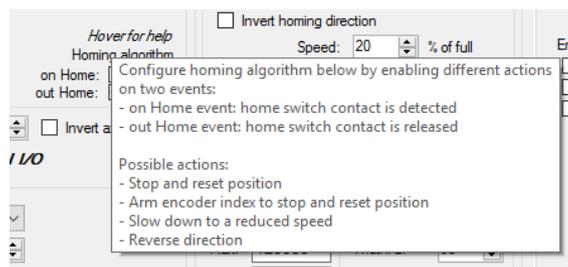
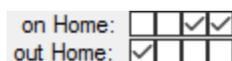


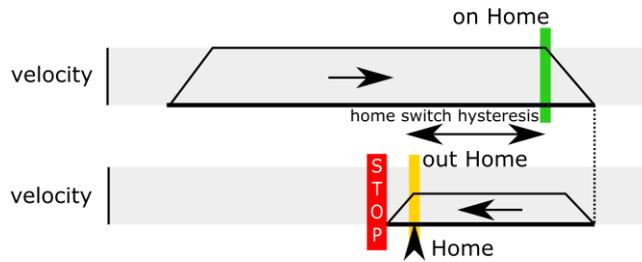
Figure 6: Built-in help

Common homing algorithm configurations

Although the homing algorithm is configurable, there are some standard configurations that fit most CNC machine configurations:

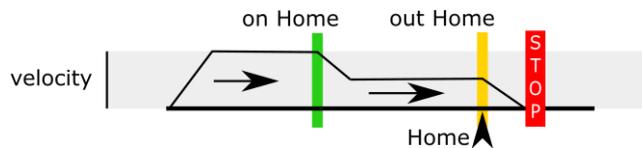
1. Standard homing configuration





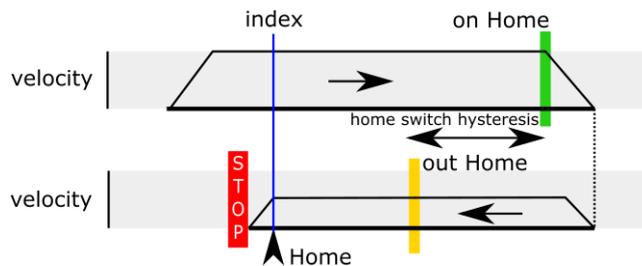
2. Homing without reverse

on Home:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
out Home:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



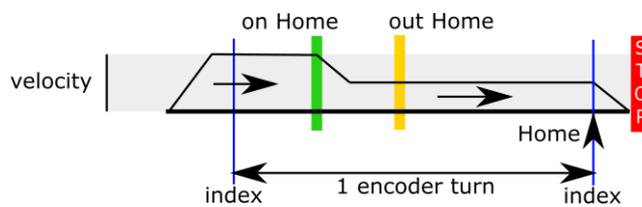
3. Homing with encoder index - standard

on Home:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
out Home:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



4. Homing with encoder index - without reverse

on Home:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
out Home:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Limit and home switch filters

The limit and home switch inputs support digital filtering. The filter value defines the minimum time for the limit or home switch signal activation (1 unit equals to 100 μ s = 0.0001 s) - possible values are between 0 (no filtering) to 254 (25.4 ms).

Charge pump output

PoKeys57CNCdb25 device supports a charge-pump output. If this is enabled, the device will generate 5 kHz square signal on the selected pin if the device is in normal operating mode. In case of emergency switch or limit switches activation, the device will stop generating signal. This signal can be used to enable power to the motors - the power will be cut in case of out of normal situation.

6.3. PWM outputs

PoKeys57CNCdb25 device supports PWM output function on 4 pins (pins 1, 14, 16 and 17). Different duty cycles can be assigned to each PWM output however, all outputs share the same PWM period. PWM outputs can be easily amplified using an external transistor and used for control of loads with increased current demand - pins with such function embedded are marked as OC (open-collector) in the pinout diagram. PoKeys PWM outputs can also be used to drive various R/C servo motors that accept PWM signal with 50 Hz frequency (20 ms PWM period) and duty cycles between 5 and 10 % (1 to 2 ms).

PoKeys devices have an in-built PWM module that operates at a fixed clock frequency (25 MHz). Both the PWM period and the PWM duty cycles must be expressed as number of module clock cycles (i.e. 20 ms PWM period equates to $0.020 \times 25\,000\,000 = 500\,000$).

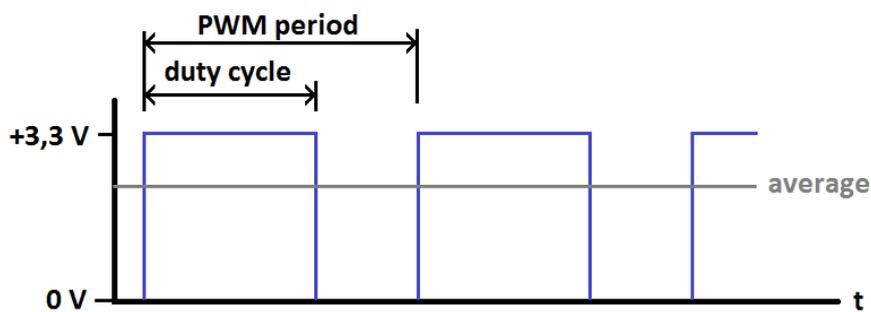


Figure 7: PWM output

PoKeys configuration software usage

PoKeys device's PWM (pulse width modulation) module can be setup via Peripherals > PWM outputs....

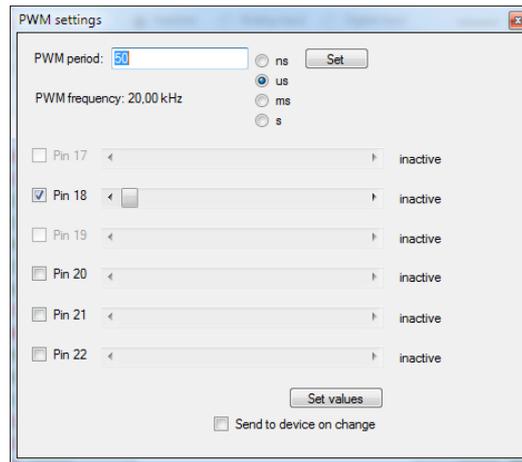


Figure 8: PWM outputs settings

In this window, user can enter PWM period and set PWM duties for each channel. Channels can be independently enabled or disabled. After a change is made, user must click 'Set values' button or check 'Send to device on change' checkbox. Left position of a slider means 0% and right position 100% respectively.

6.4. Failsafe settings

PoKeys devices support the configuration of the failsafe state for the digital outputs, PWM outputs, PoExtBus devices and PoKeys Pulse engine.

When the communication with the device is interrupted for longer than a period defined in the failsafe configuration, peripherals listed above enter the failsafe mode, which can be setup in 'Failsafe settings' dialog (Peripherals > Failsafe settings...)

Peripheral	Failsafe setting
Digital outputs	Active Off / Active On
PWM outputs	Fixed duty cycle in %
Pulse engine	No setting – Pulse engine enters emergency mode on failsafe activation

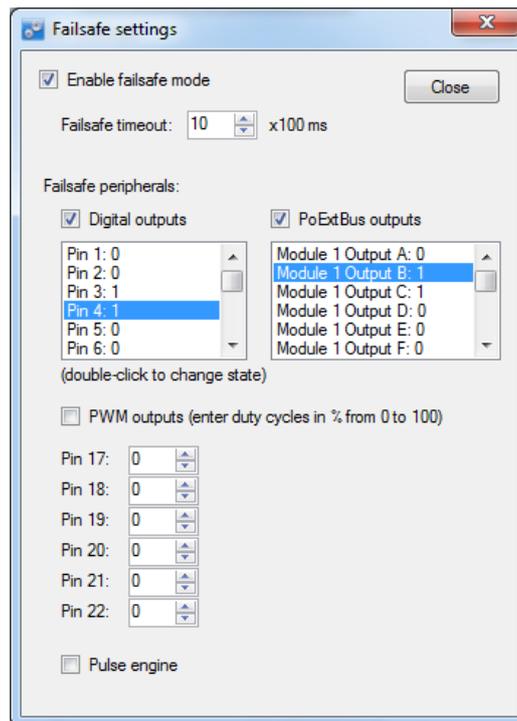


Figure 9: Failsafe settings dialog

6.5. Changing User ID number

Users can freely assign their own User ID number that represents a specific PoKeys device (enables distinguishing between different PoKeys devices in case there is more than one connected to a single host PC). To change the User ID number, go to 'Device' > 'Change user ID' menu. Simply enter any number between 0 and 255, and click the 'Change user ID' button.

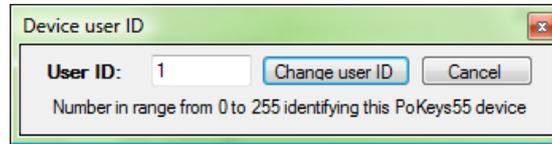


Figure 10: Device user ID dialog

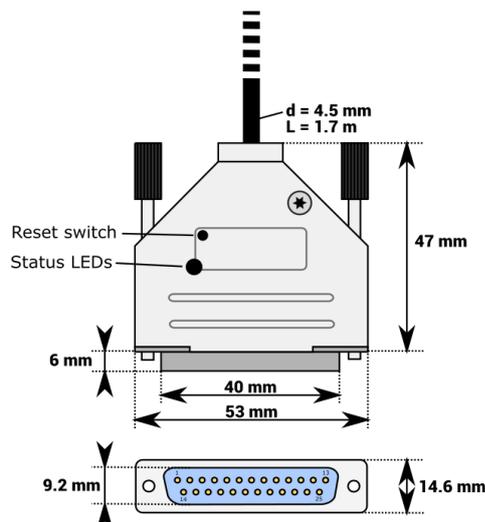
6.6. Saving current configuration to file

To save the current configuration to a file, go to 'File' > 'Save' menu and select a new filename. To reload a saved configuration from a file, go to 'File' > 'Open' menu and select the appropriate file. To transfer new settings to the device, click on the 'Save to device' button.

7. Device recovery mode

If configuration editor cannot be used to reconfigure the device, use the following steps to start the device in the recovery mode. Recovery mode can be used to clear the configuration or update the firmware.

1. Disconnect PoKeys57CNCdb25 device from USB
2. Locate reset switch hole on the PoKeys57CNCdb25 device and use a plastic tool to press on the switch in the hole



3. Reconnect the PoKeys device to USB while holding the reset switch depressed
4. Green status light should start flashing rapidly and PoKeys device will connect in recovery mode
5. Open PoKeys configuration application
6. PoKeys configuration application should detect PoKeys57CNCdb25 device in recovery mode.

- a. To reset the device configuration, use the option 'Clear settings'. By clicking this button and confirming your decision on the next dialog, settings will be erased.
 - b. To recover from bad firmware update, click 'Recover'.
7. After completing the operation, unplug PoKeys device and remove the short from the LCD connector
8. If resetting the configuration, ensure the device is properly cleared – replug PoKeys57CNCdb25 device, connect to it and execute Device > Clear settings in device.

8. Frequently asked questions

What software must be installed to operate the device?

On first use or when reconfiguring the device, the supplied software must be installed. If USB connection is to be used, device driver must be used that should be automatically installed by the setup package.

Windows can not find drivers for PoKeys57CNCdb25 device

The drivers should automatically be installed by PoKeys setup package. If this is not the case and Windows reports unknown device, install the drivers manually by instructing the Windows device setup wizard to look for drivers in PoKeys installation folder (*C:\Program Files\PoLabs\PoKeys* by default).

I misconfigured the device and device no longer responds. What can I do?

If you misconfigured the device in such a way that configuration utility cannot be used to repair the configuration, see the section 'Quick resetting the device configuration' in this manual.

There is spontaneous triggering of some of the pins. What is wrong?

Although the device implements basic noise filtering on the digital inputs, long wires between PoKeys device and switches can cause spontaneous triggering if those wires are located near high-power electrical wiring. Use twisted pair wires, shielding and try to route the signal wires away from power supply wires.

9. Errata information

This section describes special limitations of the device.

No errata information is available.

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