

NanoEls H4 controller



Based on [ESP32-S3-WROOM-1U-N16R2 module](#), this controller is designed to be used for home and light industrial automation and control:

- automation of lathes processing metal or plastic parts
- automation of desktop CNC routers and milling machines
- similar applications to control actuators based on digital I/O and user input

Safety

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. Unplug all connections before disassembly, protect internal components from static electricity when disassembled.

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

Case

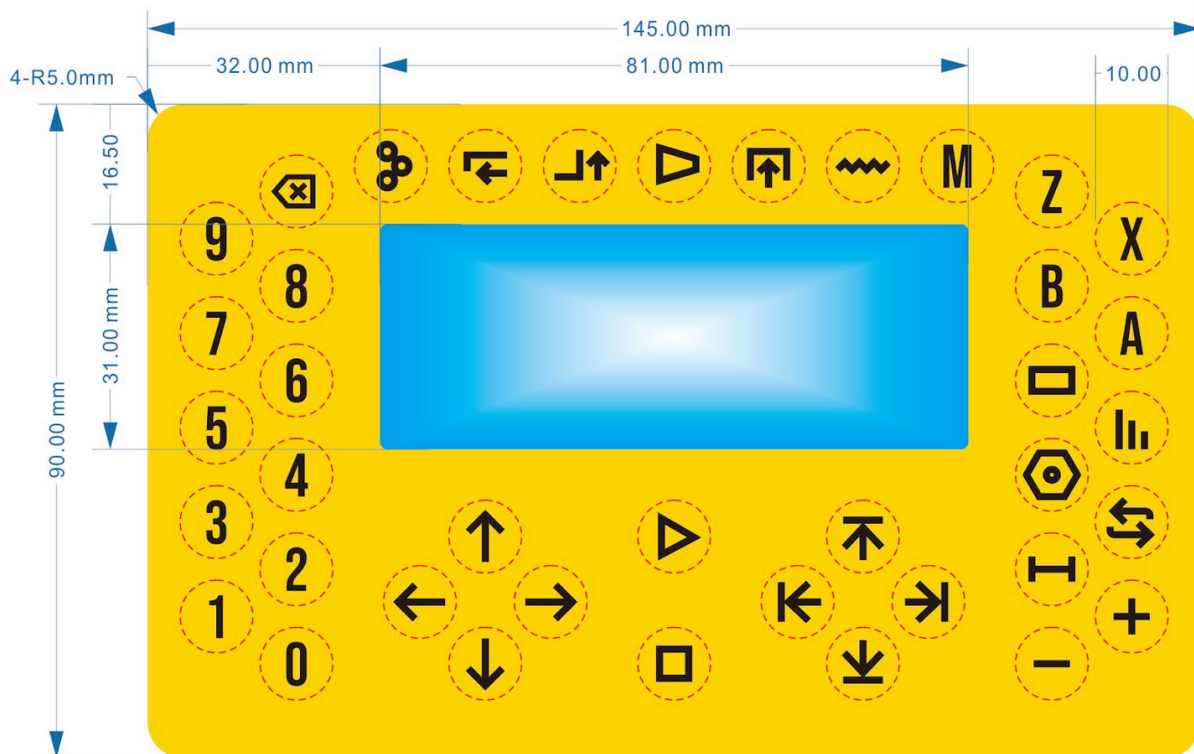
Plastic case is 3D-printed from PLA. Two M5 mounting holes that are 50mm on center are located on the back side.

Two parts of the case are held together with four M3 DIN 7985 4.8 galvanized steel bolts.

Display

Blue backlight LCD display HD44780 20x04 offers good visibility, acceptable refresh speed and viewing angles. Backlight brightness is controlled with a 1k Ω potentiometer marked "BRIGHTNESS" which is accessible when the back cover is taken off. Display contrast is controlled with the 10k Ω potentiometer tip located on the back.

Front panel



Front panel is made from 0.25mm polycarbonate with dimensions 145x90mm with 39 embossed buttons each 10mm in diameter. Attached with a double-sided adhesive tape, it can be replaced with a different one.

Front panel buttons are controlled with a TCA8418 chip connected to IO5 and IO6 of the ESP32-S3, see schematic below. Software libraries available for this chip making it easy to handle button events in your code.

Power and USB

Device is powered with 5V via the USB-C port on the back protected with a 300mA holding / 600mA instantaneous current resettable fuse. USB data and power lines are connected to USB ground through ESD diodes.

Uploading software

USB data lines are connected to the CH9102 USD-to-UART chip that is connected with RX and TX lines of the ESP32-S3. When using Arduino IDE, select "ESP32S3 Dev Module" to upload your sketch. Due to the [module firmware issue](#) you might have to unplug USB after upload.

Terminals



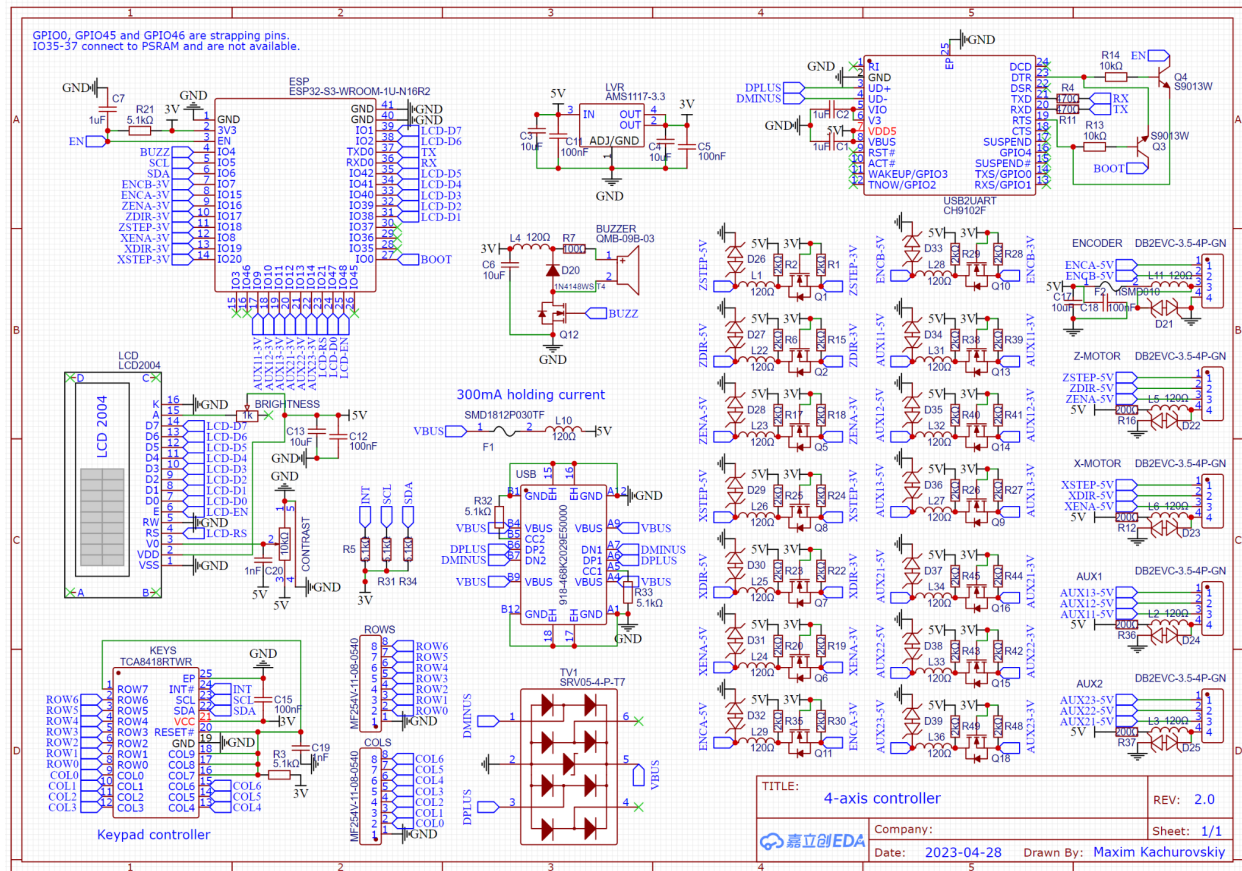
Pluggable screw terminals with 3.5mm pitch are located on the back side of the device. All terminals have ESD and short-circuit protection.

Group	Terminal	I/O	Description
Encoder	GND	output	Ground / neutral
	5V	output	Encoder 5V power with resettable fuse tripping at 100mA continuous or 200mA instantaneous current at 25°C
	ENCB	in/out	5V general purpose digital input/output line, IO7
	ENCA	in/out	5V general purpose digital input/output line, IO15
Z axis	5V	output	5V signal line current-limited with a 200Ω resistor
	ENA	in/out	5V general purpose digital input/output line, IO16
	DIR	in/out	5V general purpose digital input/output line, IO17
	STEP	in/out	5V general purpose digital input/output line, IO18
X axis	5V	output	5V signal line current-limited with a 200Ω resistor
	ENA	in/out	5V general purpose digital input/output line, IO8
	DIR	in/out	5V general purpose digital input/output line, IO19
	STEP	in/out	5V general purpose digital input/output line, IO20
A1	5V	output	5V signal line current-limited with a 200Ω resistor
	ENA	in/out	5V general purpose digital input/output line, IO9
	DIR	in/out	5V general purpose digital input/output line, IO10
	STEP	in/out	5V general purpose digital input/output line, IO11
A2	5V	output	5V signal line current-limited with a 200Ω resistor
	ENA	in/out	5V general purpose digital input/output line, IO12
	DIR	in/out	5V general purpose digital input/output line, IO13
	STEP	in/out	5V general purpose digital input/output line, IO14

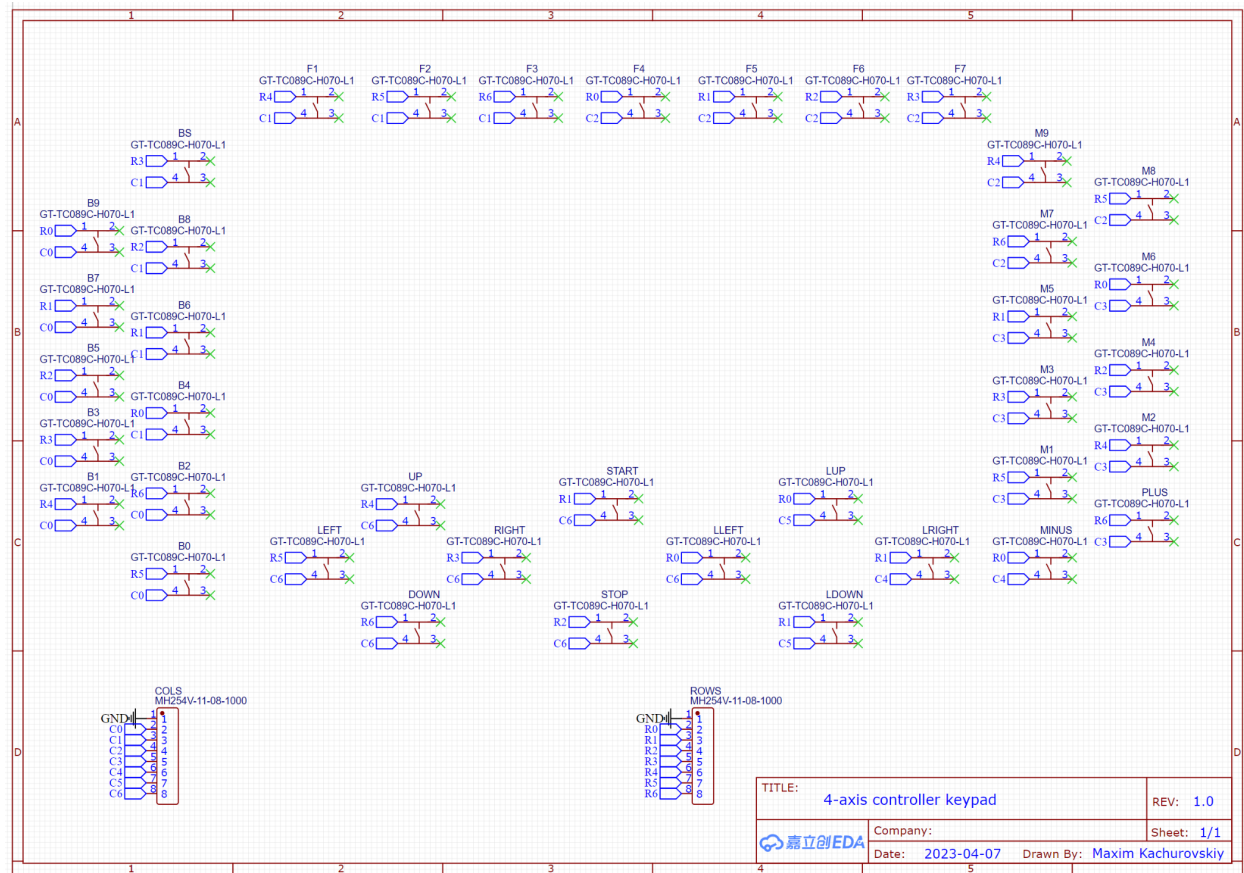
Buzzer

Passive buzzer is connected to IO4 allowing the device to emit a variety of sounds.

Main board schematic



Keyboard schematic



Usage limits

- Not a safety device
- Use in temperatures above freezing and below 40°C, not exposed to direct sunlight
- Do not connect over 5.5V on any input, output or terminal
- Flammable

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 [H4 GitHub](#), start a new discussion there or reach out to m.kachurovskiy@gmail.com.

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