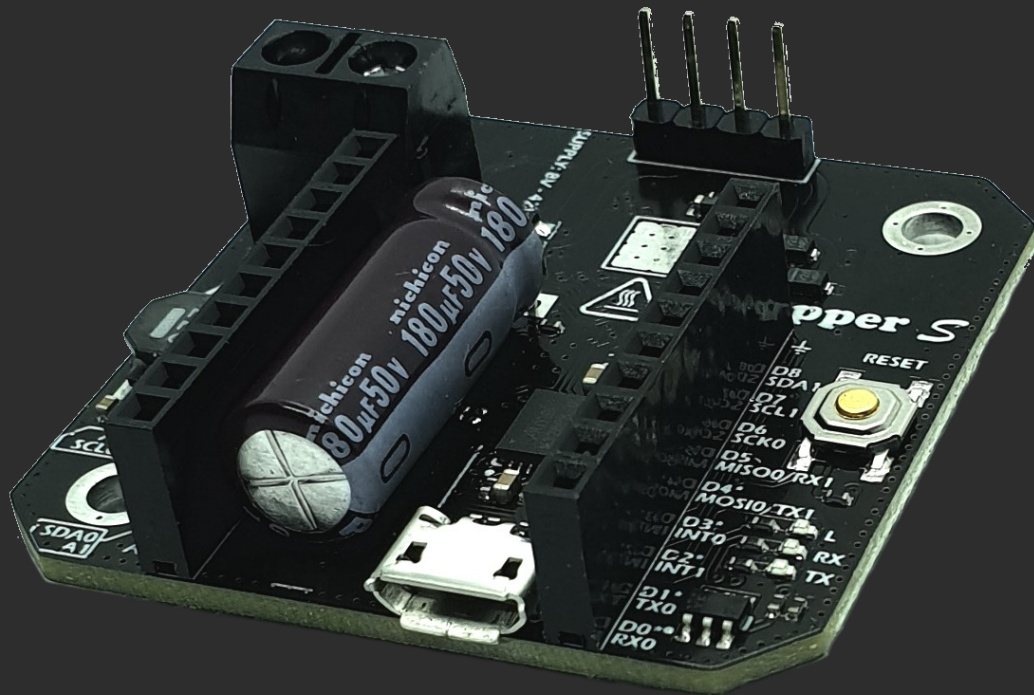# uStepper S

Datasheet

Microcontroller, stepper driver and encoder in an ultra-compact design!

By uStepper ApS

Product: **uStepper** *S*

Document revision: 1.1

Author: MGN

Approved by: THO

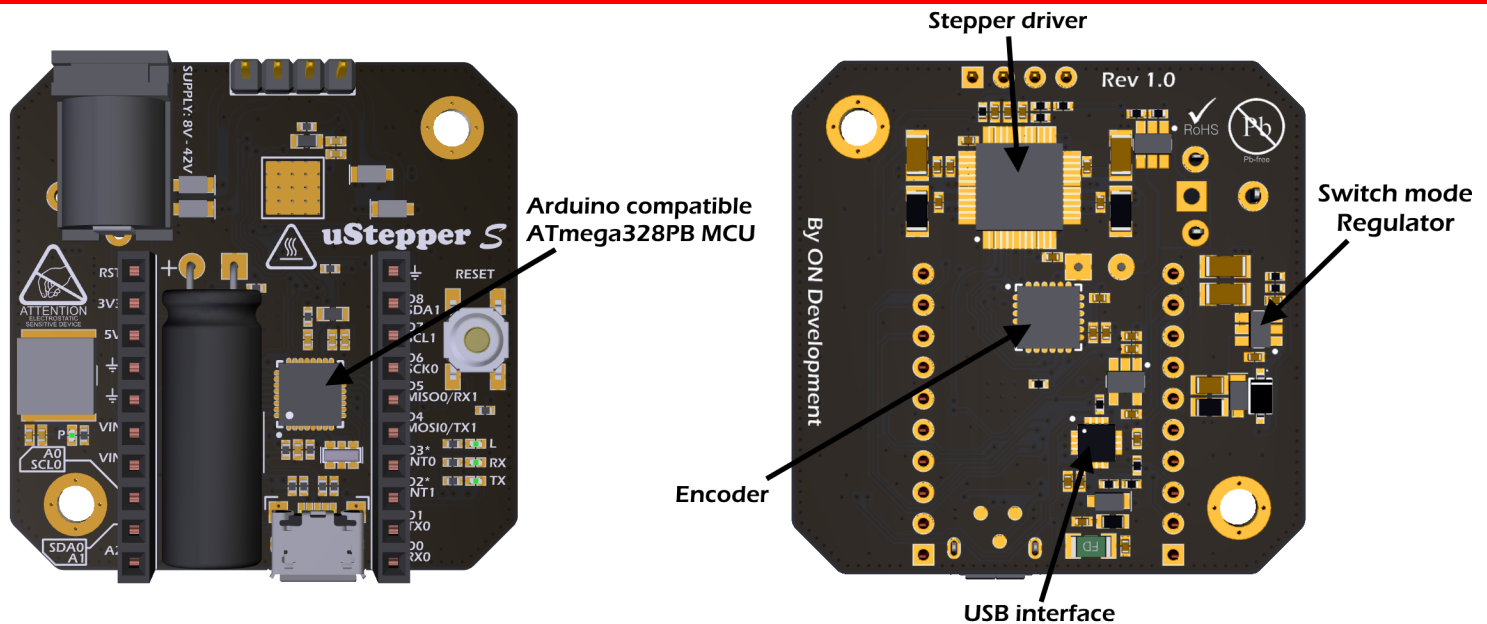Approval date: January 27th 2019

System overview

uStepper *S* incorporates a super silent stepper driver, high resolution encoder and Arduino compatible MCU in a super slim design!

- Program uStepper with ease using the Arduino IDE and our extensive Arduino library !
- Make your stepper motor applications extremely compact !
- Make sure that you never miss a step again, thanks to the on-board encoder and control algorithm !

The super slim design of **uStepper** *S* makes it possible to develop applications using a stepper motor, without the need for long and messy wiring to an external Arduino/stepper shield. Furthermore the 16-bit rotary encoder ensures that the absolute position of the motor shaft can be tracked, enabling the **uStepper** *S* to detect any loss of steps and act on it !

Stepper driver

Arduino compatible ATmega328PB MCU

Switch mode Regulator

Encoder

USB interface

Rev 1.0

By ON Development

uStepper *S* has the following highlighted features:

- Compact design, fitting on the back of a NEMA 17 size stepper motor (41.8 mm x 41.8 mm)

- Incorporates the Trinamic TMC5130 with dynamic microstepping for very smooth operation with integrated ramp generator

- Driver delivers 2.5 A current (peak)

- New upgraded 328PB MCU from Microchip

- 16-bit encoder (0.0055 degrees resolution)

- Drive current is software controllable

- 12 I/O

- 3 Analog, 5 PWM

- 1 x SPI , 2 x UART, 2 x I2C

- Supply voltage 8 - 42 V

- Reverse polarity protection

Even though **uStepper *S*** features reverse polarity protection, it is always advisable to check the polarity before supplying power to the board in order to prevent damaging the board.

uStepper S features

MCU

uStepper S uses the successor of the well tested and widely used ATmega328P - the ATmega328PB. Why? Because it does the job and does it good! The new upgraded ATmega328PB has been upgraded on multiple points including double USART, double I2C, double SPI and upgraded timers !

Stepper driver chip

The TMC5130 is a serious powerhouse and features a native 1/256th microstepping processing engine, complete with acceleration and deceleration ramping profiles, to give smooth transition to the desired speed. The native 1/256th microstepping not only ensures low noise levels and smooth operation, it also improves the precision of your application, by reducing the smallest step size of the motor to an astonishing 0.007 degrees (assuming a motor with 200 steps per revolution)! To put this into perspective, if the motor was mounted onto a CNC machine, where the axis moves 10 mm per full rotation, this would correspond to a resolution of 0.195 microns !

Encoder

The **uStepper** S uses the AEAT8800-Q24 encoder from Broadcom, delivering 16 bits resolution corresponding to 0.0055 degrees ! This is a perfect match for the TMC5130 with it's native high resolution microstepping since this sensors is able to detect deviations just below the step resolution - enabling **uStepper** S to compensate properly.

Switch mode regulator

uStepper S Incorporates a switch mode regulator for delivering the 5 V logic supply. This is done to ensure that a supply voltage of up to 42 V can be applied ! The relatively high supply voltage has the benefit of increasing the stepper drivers ability to overcome the back EMF voltage generated by the motor, and hereby increasing the available torque at increasing velocities, compared to lower supply voltages.

uStepper S pin mapping
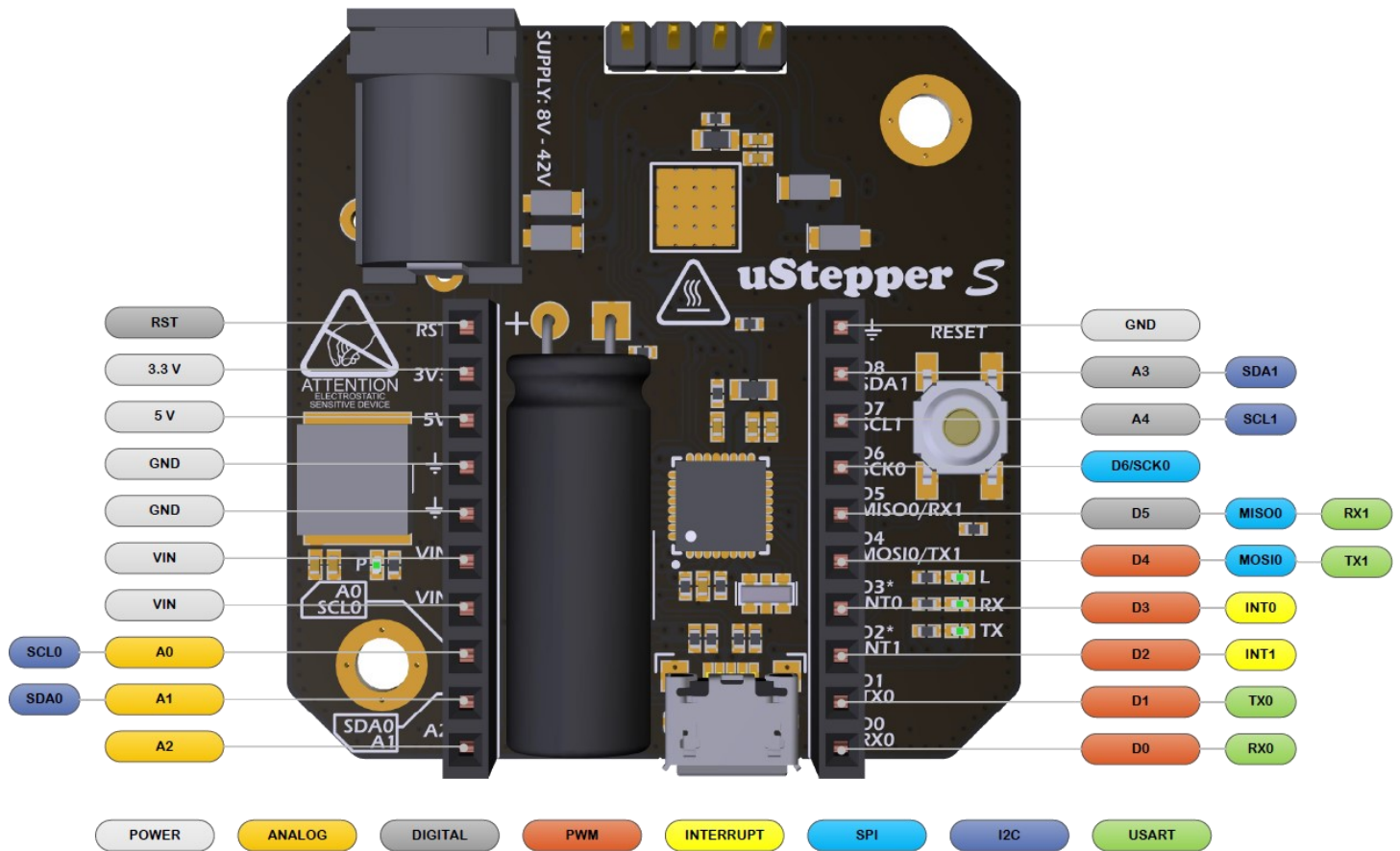
As it can be seen from the PIN mapping above, **uStepper S** offers a vast amount of GPIO's from it's ATmega328PB MCU. This makes the uStepper capable of interacting with various sensors, actuators, communication modules etc. - Besides functioning as a stepper driver with feedback capability.

When mounting the heatsink - please make sure that you don't short anything like e.g. this capacitor!
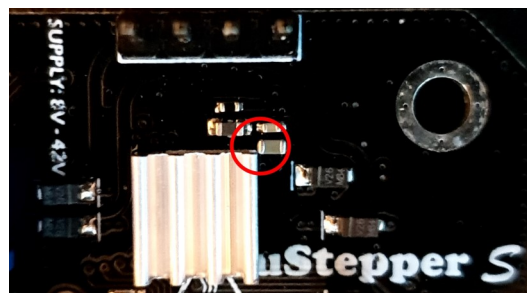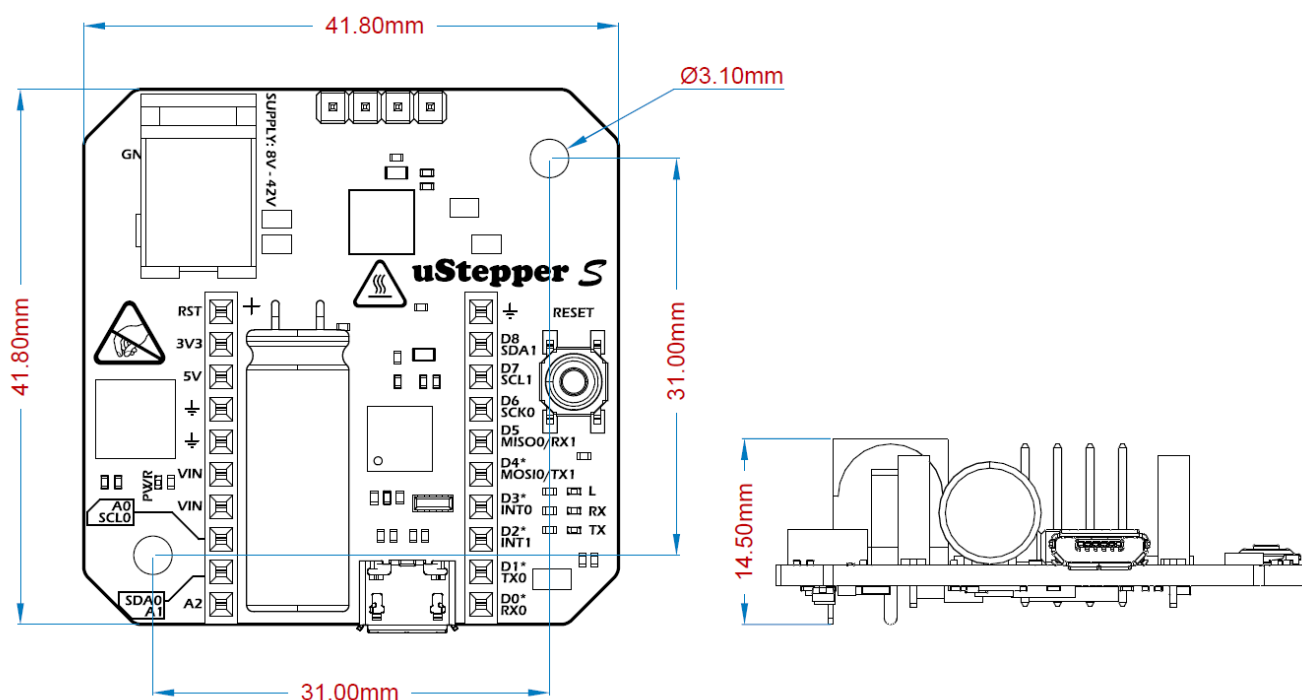
uStepper S characteristics

Electrical characteristics

I/O Voltage	5 V
Input Voltage (recommended)	8 - 42 V
DC Current per I/O Pin (max)	40 mA (max 200 mA total I/O draw)
DC Current for 5 V Pin (max)	1000 mA
DC Current for 3.3 V Pin (max)	150 mA
Stepper drive current	Up to 2.5 A (peak)

Physical characteristics

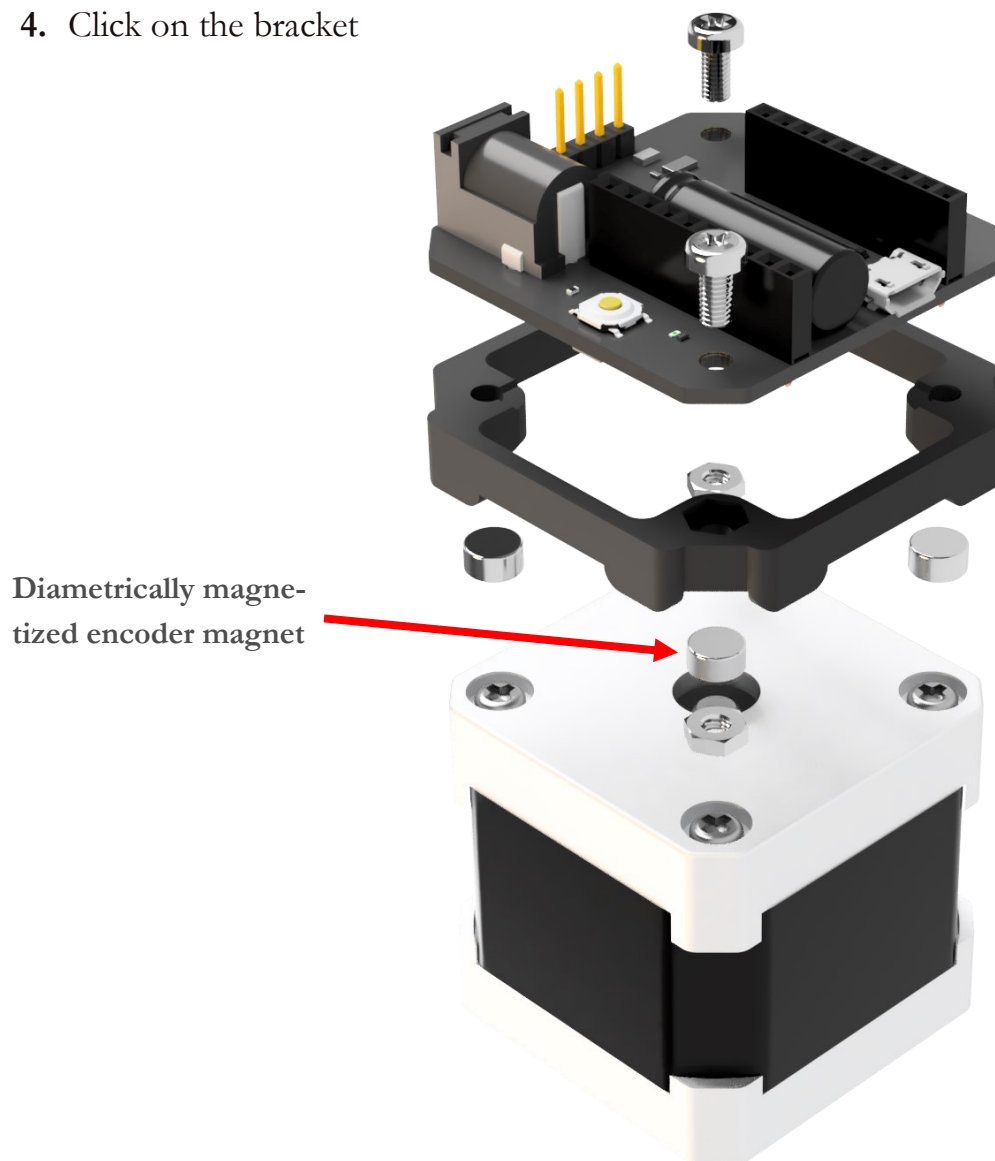|	
Dimensions	41.8 x 41.8 x 14.5 mm
Weight	~15g

uStepper *S* comes with a bracket allowing you to easily mount it on the back of a NEMA 17

Magnet mount:

1. Place encoder magnet on motor shaft
2. Insert magnets into bracket
3. Secure **uStepper** *S* to the bracket with screws and nuts
4. Click on the bracket

Diametrically magnetized encoder magnet

For information on how to setup uStepper in the Arduino IDE, visit our GitHub repository at **www.github.com/uStepper** or have a look at our videos on YouTube - search for uStepper.

More information/documentation on the uStepper Arduino library is also found in the readme section on out GitHub repository.

Q: I can't program uStepper from the Arduino IDE, what is wrong?

A: Three most common issues:

1. If you use the Windows store app "Arduino IDE" you might experience problems. Download the executable or portable version of Arduino IDE from www.arduino.cc

2. Install hardware support and the **uStepper *S*** library

3. Remember to chose **uStepper *S*** as the board you program to

Q: When I run uStepper closed loop PID or Drop-in the motor spins up and runs fast in one direction, what is wrong?

A: Two most common issues:

1. Check that the encoder magnet is placed correctly on the motor shaft

2. Check that your PID parameters in the Arduino code are sane. A good starting point is to set P and I to 0.5 and D to 0.

For more FAQ visit www.ustepper.com !

Because of low cost and reliability stepper motors are favored over servo drives in a variety of applications, as for example robots, CNC machines, 3D-printers etc. With added feedback uStepper can add a new dimension to stepper operation utilizing closed loop control or correction of missed steps - making the stepper even more appealing than a more costly servo drive. With the numerous features and the vast amount of I/O's (including various busses), uStepper is the choice for DIY hobbyists when in need of a reliable, precise and compact actuator for almost any application.

Almost unlimited applications and ease of programming using the Arduino IDE also makes uStepper well suited for educational purposes !

"After all, learning just gets a bit more fun when there's movement involved!"

Disclaimer

1 Disclaimers and Limitation of Liability

1.1 uStepper ApS and/or ON Development IVS (or any individuals affiliated with either of the two companies) can not be held responsible for any damage inflicted upon mounting or interfacing with the uStepper board. This also includes damage to stepper motor (both electrical and mechanical) or any other 3rd party hardware connected to uStepper. Most stepper motor cases are made of aluminum, and care must be taken when preparing the mountings for uStepper.

1.2 By using the uStepper products (including, but not limited to, hardware and software) you acknowledge that uStepper ApS and/or ON Development IVS (or any individuals affiliated with either of the two companies) can not be held responsible for any personal injuries and/or damage to any 3rd party hardware that may occur when using the uStepper products.

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