



## Uragan™-μ

8 A stepper motor driver with acquisition functions

### Features

- High power stepper motor driver
- Micro-stepping
- Supply voltage up to 100 V
- 4 highly configurable input ports (channels)
- Solid state relay
- PWM output
- 5V auxiliary supply
- USB interface
- Easy to use graphical user interface

### Applications

- CNC translation stages
- Measurement stations
- Data acquisition
- Laboratory applications

## Overview

Uragan-μ provides a powerful stepper motor driver and several acquisition functions in a small package. Together with the graphical user interface, Uragan Studio, the driver can be configured in a matter of minutes for many different applications via an USB interface. A usage diagram is shown in Figure 1.

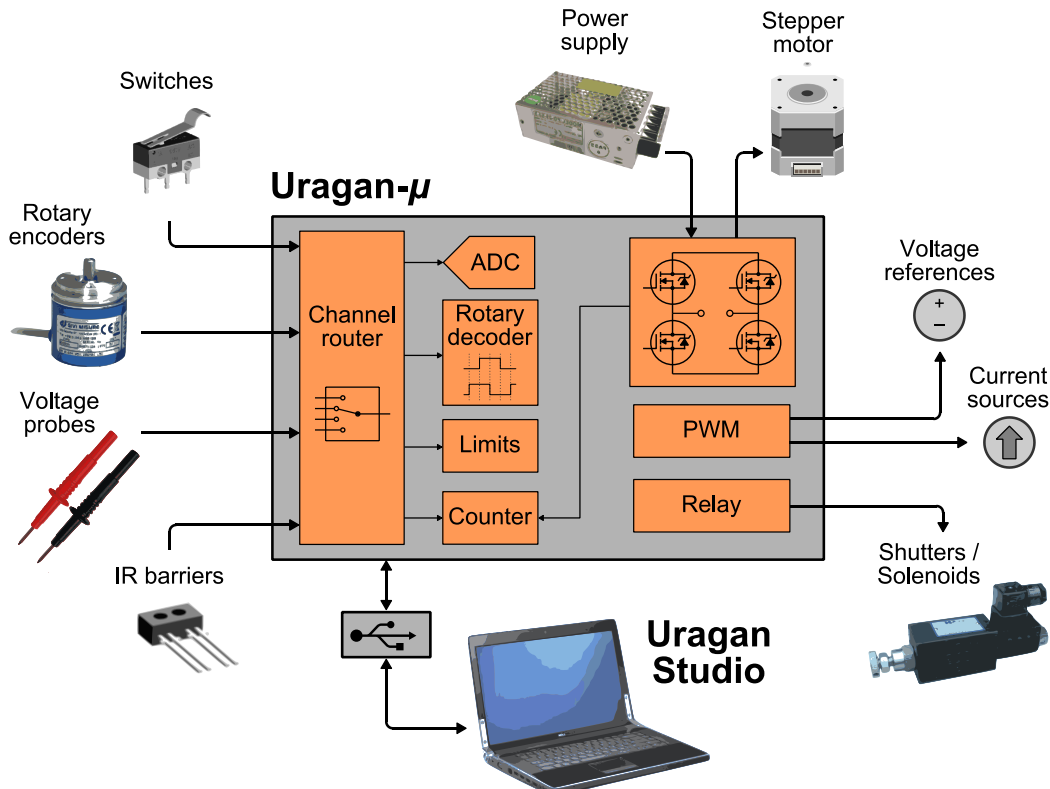


Figure 1 Uragan-μ usage diagram.

# Uragan Studio

Uragan Studio is a graphical user interface for Windows. It provides an easy-to-use and familiar interface to configure the Uragan- $\mu$  stepper driver and acquisition functions. The main features of Uragan Studio are highlighted in Figure 2 and supported operating systems are summarised in Table 1. All settings can be stored and auto-loaded when an Uragan- $\mu$  is connected.

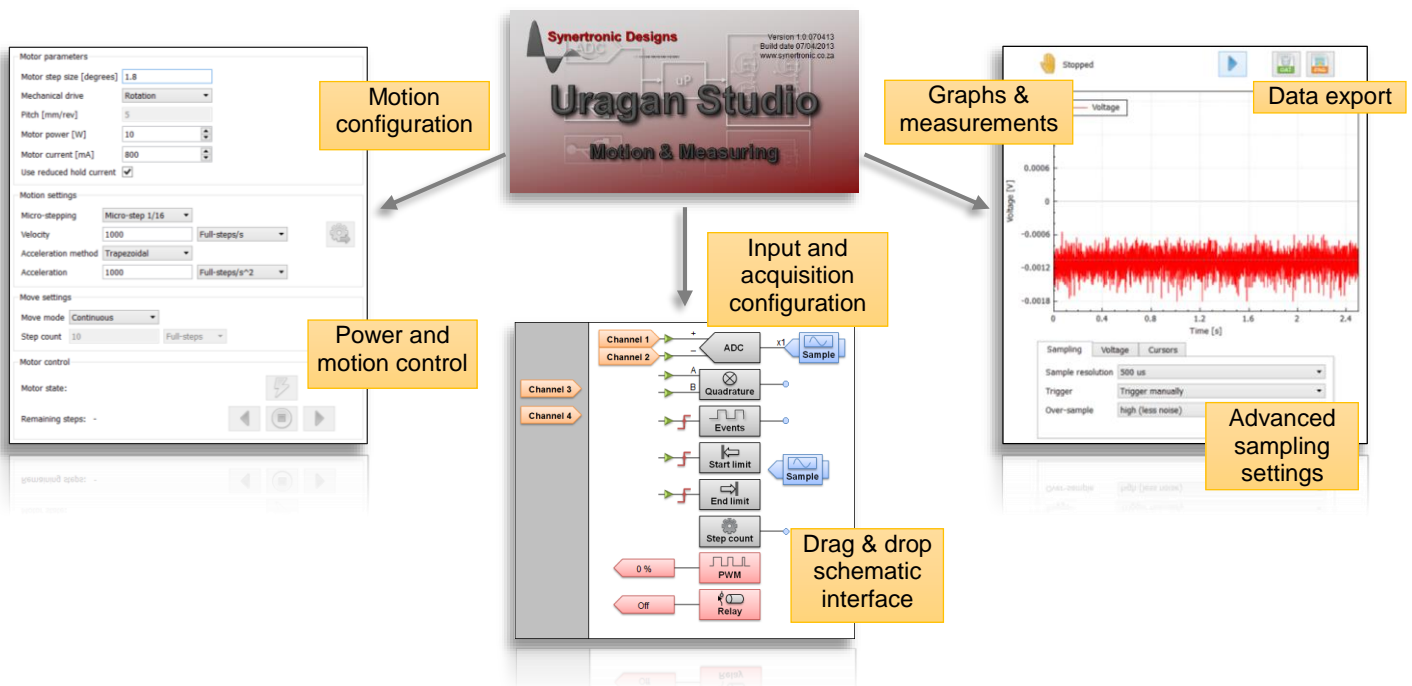


Figure 2 Uragan Studio interface and functionality.

Windows 98		✘
Windows XP		✔
Windows Vista		✔
Windows 7 & 8		✔
Linux	Scheduled for release 3 <sup>rd</sup> quarter 2013	
Raspberry Pi	Scheduled for release 3 <sup>rd</sup> quarter 2013	
Mac		✘

Table 1 Supported operating systems.

Uragan Studio is available as freeware. The latest version can be downloaded from [www.synertronic.co.za](http://www.synertronic.co.za). More information about using Uragan Studio with Uragan- $\mu$  is given in the following sections.

## Stepper driver

The stepper driver makes use of silent switch-mode technology. It can be operated from a 24 V to 100 V external power supply and can deliver 8 A continuous motor current. The motor current, speed, acceleration and micro-step settings can be configured via Uragan Studio. Care was taken to reduce EMI emissions from the driver and to optimise the driver efficiency.

A wide range of stepper motors can be connected ranging from low-current (<100 mA) to high-current, high-power (>5 A) motors.

Full-step, half-step and micro-stepping up to 1/16 is supported, which is ideal for most practical applications. The motor speed can be set from 1 to 20,000 steps per second and covers the practical step frequency range of most stepper motors. Motor acceleration can be set to trapezoidal, S-curve (for reduced jerk) or none. If no acceleration is selected, the motor speed will jump from zero to the specified speed when movement is initiated.

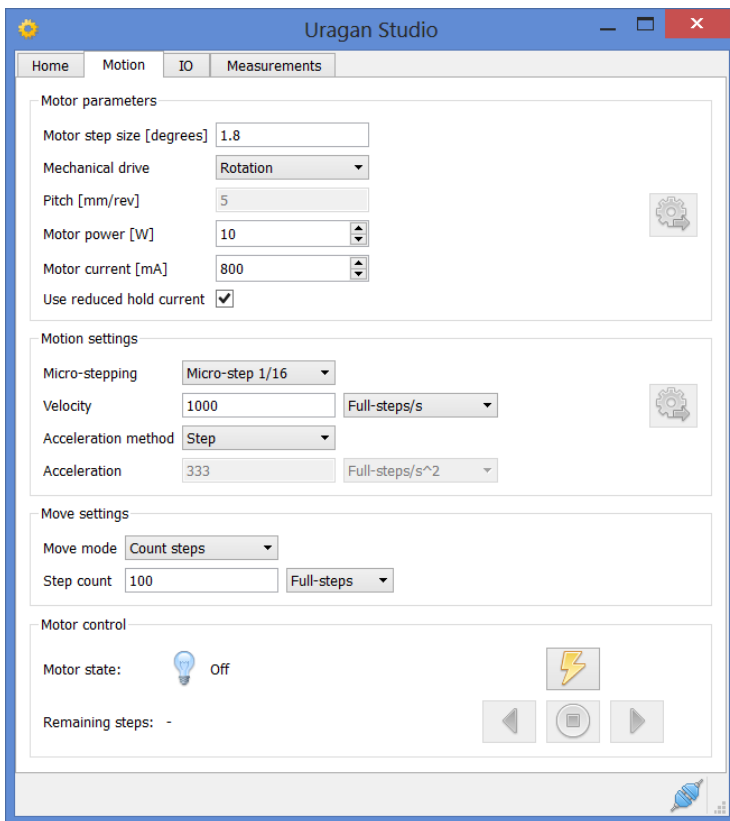


Figure 3 Motion configuration via Uragan Studio.

It is possible to specify the motor step size and if a translation stage is used, the pitch can also be specified. This allows the motor speed and acceleration to be specified in terms of motor revolutions and translation distances, thereby simplifying motion configurations.

To reduce motor heating the holding current can be reduced automatically when the motor is stationary.

Two move modes allow continuous movement or counted movements. If the step size of the motor and the pitch of the translation stage is specified, relative movements can be performed with up to 2  $\mu\text{m}$  accuracy, depending on the quality of the translation stage.

Robust fault handling detects incorrect motor connections and short-circuits. The motor driver specifications and capabilities are summarised in Table 2 and Table 3, respectively.

Description	Value	Unit
$\bar{I}_{m,max}$ Maximum continuous motor current	8	A
$\bar{I}_{m,min}$ Minimum continuous motor current	50	mA
$\bar{I}_{m,res}$ Motor current resolution	15	mA
$R_{hold}$ Holding current reduction	50	%
$V_{m,max}$ Maximum supply voltage	100	V
$V_{m,min}$ Minimum supply voltage	24	V
$f_{s,max}$ Maximum step frequency	20,000	steps/s
$N_{m,max}$ Maximum micro-step resolution	16	
$\eta_m$ Typical driver efficiency	>90	%

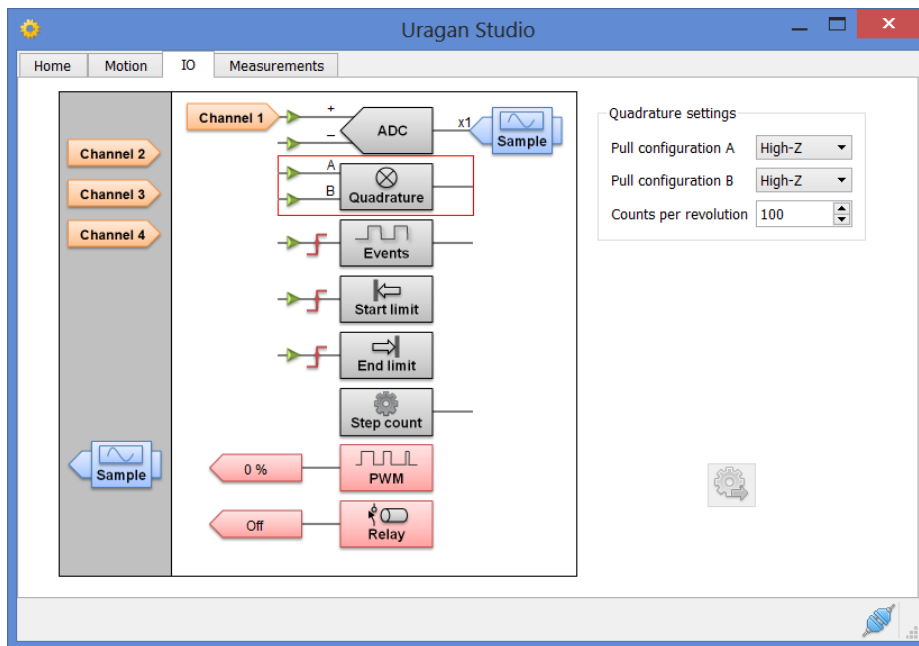
Table 2 Motor driver specifications.

Capability	
Trapezoidal acceleration profile	✓
S-curve acceleration profile	✓
Micro-stepping	✓
Short-circuit protection	✓
Phase wiring error protection	✓
Over-voltage protection	✗
Under-voltage protection	✓
Supply reverse polarity protection	✓

Table 3 Motor driver capabilities.

# Acquisition functions

Integrated into Uragan- $\mu$  are several acquisition functions. Applications are not only limited to translation stages, but extend to measurement stations, scientific experiment and laboratory applications.



Although only 4 input channels are provided, they can be easily and quickly configured using Uragan Studio. Channels can be used for different functions, simply by dragging and dropping them on a diagram interface in Uragan Studio. On the same interface acquisition and pull-up/down settings can be changed and applied.

Input channels can either be used as analogue or digital inputs. When channels are configured as digital inputs, it is possible to enable internal pull-up or pull-down resistors. This eliminates the need for external resistors when connecting mechanical switches.

**Figure 4** Input and acquisition configuration via Uragan Studio.

Protection is provided on all 4 input channels and include voltage-clamping and electric discharge protection. The input channels are optimised for voltages up to 5 V, above this voltage the clamping circuits will increase the input current. Two of the channels also feature a low-pass filter to reduce noise during voltage measurements. A summary of the input channel specifications is given in Table 4.

Protection is provided on all 4 input channels and include voltage-

Description		Value	Unit
<b>Maximum ratings</b>			
$V_{i,max}$	Absolute maximum continuous input voltage	15	V
$V_{i,min}$	Absolute minimum continuous input voltage	-15	V
$V_{i,pulse}$	Short-term over-voltage (<1 ms)	$\pm 100$	V
$I_i$	Input current	@ $V_i < 1V$ , no pull-up/down	< 0.1 $\mu A$
		@ $V_i < 3V$ , no pull-up/down	< 20 $\mu A$
		@ $V_i < 15V$ , no pull-up/down	< 5 mA
<b>Digital interface</b>			
$V_{i,lo}$	Input digital low level	< 1.3	V
$V_{i,hi}$	Input digital high level	> 1.5	V
$R_{i,pull}$	Effective pull-up/down resistance	24	k $\Omega$
<b>Analogue interface (ADC voltage measurements)</b>			
$V_{adc,max}$	Maximum measureable voltage	2.048	V
$V_{adc,min}$	Minimum measureable voltage	-0.2	V
$V_{adc,noise}$	Voltage noise level (with maximum over-sampling)	< 5	mV
$G_{adc,gain}$	Maximum voltage gain	64	
$f_{c,lo}$	Low-pass filter cut-off frequency (channel 3 & 4)	150	kHz

**Table 4** Input channel specifications.

Note: The input channels are not optically isolated. The USB interface and internal power supply of Uragan- $\mu$  is, however, fully isolated. It is highly recommended to also use an isolated external power supply for the motor driver. This will ensure safe operation and will eliminate any ground return-loops.

## Measurements with Uragan Studio

Acquisition functions can be motor driver related and/or measurable quantities. Measureable quantities are buffered and can be plotted in Uragan Studio. Uragan Studio provides useful measurement functions and

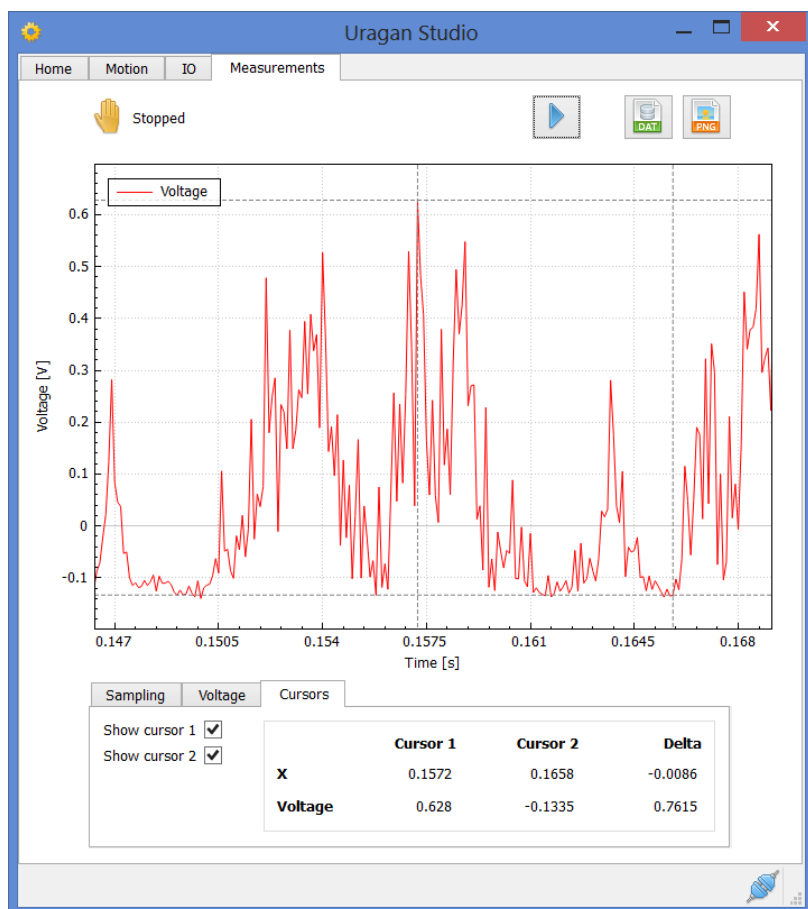


Figure 5 Measurements in Uragan Studio.

can sample data with a sampling frequency of 0.2 Hz to 10 kHz. A single measurement run consist of 5000 sampling points.

In order to reduce noise for small-signal measurements and to increase the measurement resolution, over-sampling can be enabled. With maximum over-sampling voltage measurements of less than 5mV are possible. Uragan- $\mu$  also uses novel burst averaging to reduce noise of voltage measurements.

Basic post-processing is provided and measurements can be scaled, offset or inverted. Measured data can be exported to PNG image format or CVS data format for further post-processing.

Cursors can be used to read data values directly from the plotted data in Uragan Studio.

The motor driver supply voltage and current are measured and shown by default.

Below follows a list of the different provided acquisition functions. The function type is indicated with a  $\odot$  symbol for motor functions and with a  $\equiv$  symbol for measureable quantities.

### Limit functions $\odot$

End and start limits can be connected. For this function a channel for each the start and end limit is used as digital input. Limit switches can either be passive mechanical switches or optical barriers. The auxiliary 5 V supply can be used to power any external electronics. The limits can be activated on either the positive or negative going edge of the limit signal. The motor driver will automatically stop if any of the limits are activated.

### Quadrature (rotary) decoder $\odot \equiv$

In order to measure rotation a quadrature decoder is provided. For this function two channels are used as digital inputs. The connected quadrature encoder can either be a passive mechanical, optical or magnetic encoder. The auxiliary 5V supply can be used to power any external electronics needed by the encoder. The number of cycles per rotation can be specified to calculate revolutions or when using a translation stage the pitch can be specified to calculate the distance travelled. The maximum measurable cycle frequency is 2 MHz. The output of the quadrature decoder can be buffered and displayed in Uragan Studio.

### Event counter $\equiv$

For some applications it is useful to count events. For this function a channel is connected as digital input. Events can be counted either on the positive or negative going edge of the input signal. The maximum event frequency is 16 MHz. The output of the event counter can be buffered and displayed in Uragan Studio.

## Step counter

The stepper motor steps can be also measured. This is performed internally and no channels are required for this function. If the motor step is specified the data can be displayed as revolutions in Uragana Studio. If in addition the pitch of a connected translation is specified, the data can be displayed as distances in Uragan Studio.

## Voltage measurements (ADC)

Voltage measurements can be performed using one or two channels as analogue inputs. Single-ended measurements only use one channel. Differential measurements and measurements that require gain require two channels. Different gain factors can be specified, ranging from 1x to 64x gain. For small-signal measurements channels 3 and 4 should be used. These channels have internal low-pass filters. To further reduce measurement noise levels over-sampling can be used in Uragan Studio.

## PWM output

A 10 kHz, 5 V PWM output is provided and can be varied between 0% and 100% duty cycle. The output can be used to generate variable reference voltages via a simple filter network or to driver external power transistors. With very simple external circuits it is possible to construct variable current and voltage sources which in turn can be used for different applications.

The output can also be used as digital output by varying the PWM duty cycle between 0% for logic '0' and 100% for logic '1'.

## Solid state relay

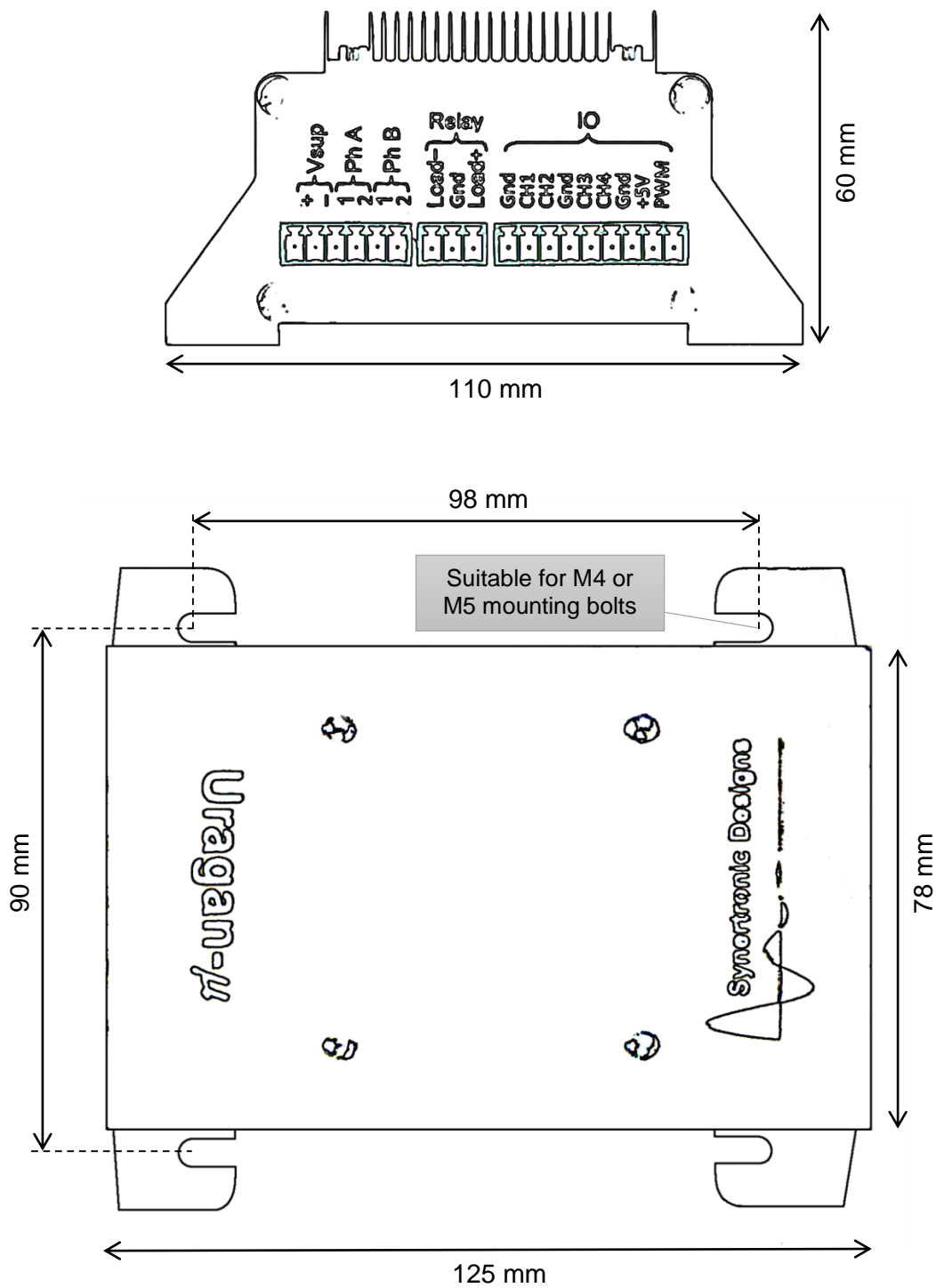
A high-power solid state relay is integrated into Uragan- $\mu$ . It is rated up to 36 V and 5 A and can be used to drive relays, resistive loads (e.g. lamps) or inductive loads (e.g. shutters and solenoids) directly.

## Auxiliary supply

A 5 V, 35 mA auxiliary supply can be used to power external electronics. For example, IR barriers, optical rotary encoders, logic circuits, pre-amplifiers and other low-power circuits.

# Dimensions

External dimensions: 110 x 60 x 126 mm (w x h x l)



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