

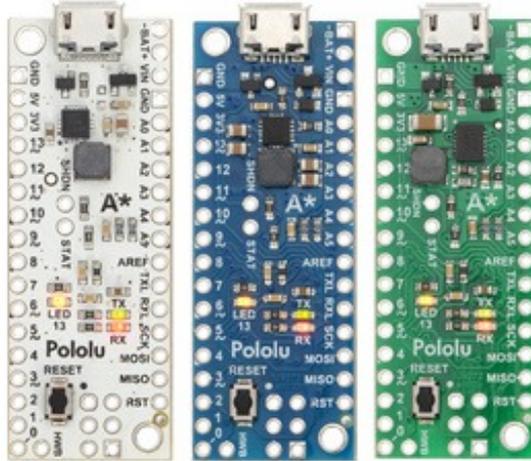
# Pololu

## Robotics & Electronics

### A-Star 32U4 Mini ULV

#### Overview

The Pololu A-Star 32U4 Mini boards are general-purpose programmable modules based on Atmel's ATmega32U4 AVR microcontroller, which has 32 KB of flash program memory, 2.5 KB of RAM, and built-in USB functionality. The A-Star (abbreviated A\*) adds a number of onboard features to support the microcontroller and make it easier to work with, including a 16 MHz crystal, a USB Micro-B connector, an in-system programming (ISP) header, a reset button, and three indicator LEDs.



A-Star 32U4 Mini ULV, LV, and SV.

Each A-Star 32U4 Mini contains a switching regulator that efficiently produces 5 V from an external voltage source to power the microcontroller. Three different versions are available, covering a wide range of input voltages:

- **A-Star 32U4 Mini ULV: 0.5 V to 5.5 V**
- **A-Star 32U4 Mini LV: 2.7 V to 11.8 V**
- **A-Star 32U4 Mini SV: 5 V to 36 V**

A robust power selection circuit enables seamless transitions between regulator power and USB power, and overcurrent and reverse-voltage protection help safeguard the board against accidental damage.

All 26 general-purpose I/O lines on the ATmega32U4 are accessible on the A\* 32U4 Mini; 7 of these are usable as PWM outputs and 12 are usable as analog inputs. The board measures 1.9" × 0.7", the same size as an Arduino Micro, and features a pair of mounting holes sized for #2 or M2 screws (not included). Its 0.1" pin spacing makes the A\* easy to use with solderless breadboards, perfboards, and 0.1"-pitch connectors.

Our comprehensive user's guide provides the basics you need to get started with the A-Star as well as detailed technical information for advanced users.



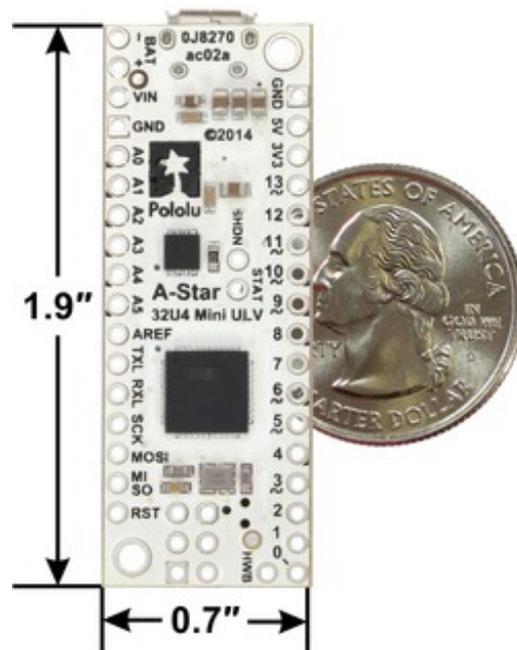
This product requires a USB A to Micro-B cable (not included) to connect to a computer.

#### Features

- **Dimensions: 1.9" × 0.7" (1.95" × 0.7" including USB Micro-B connector)**

- Programmable 16 MHz Atmel ATmega32U4 AVR microcontroller
  - 32 KB flash (4 KB used by bootloader, leaving 28 KB available for user program by default)
  - 2.5 KB SRAM
  - 1 KB EEPROM
  - Native full-speed USB (12 Mbps)
- Preloaded with Arduino-compatible bootloader (no external programmer required)
- All I/O lines from the ATmega32U4 broken out in a compact package
  - 26 general-purpose I/O pins available along the sides of the board
  - 7 pins can be configured as hardware PWM outputs
  - 12 pins can be configured as analog inputs
- 3 user-controllable LEDs
- Reset button
- Can be powered from USB or from an external source:
  - ULV: 0.5 V to 5.5 V
  - LV: 2.7 V to 11.8 V
  - SV: 5 V to 36 V
- Switching regulator enables efficient low-power operation
- Power selection circuit with seamless switching between power sources and overcurrent protection
- Reverse-voltage protection on external power inputs
- Precision 16 MHz crystal
- 6-pin ISP header for use with an external programmer
- Comprehensive user's guide

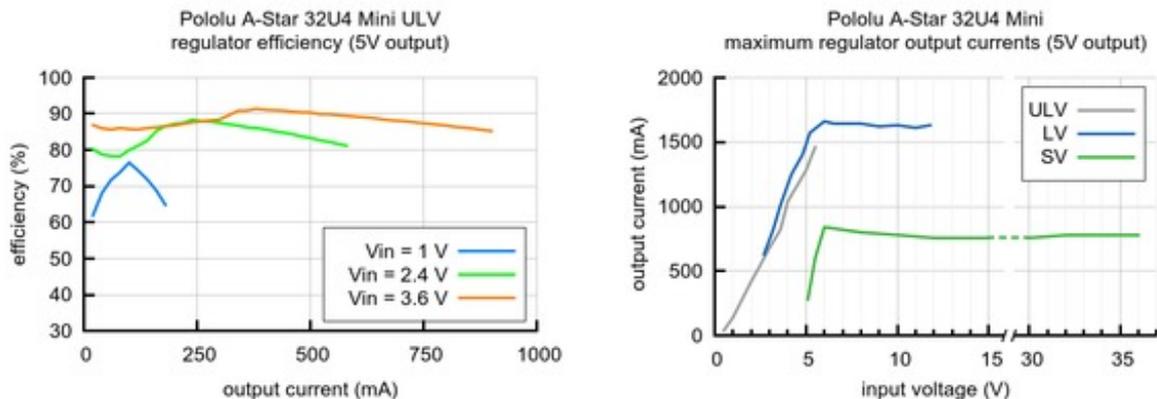
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This version, the A-Star Mini ULV, can be powered from a 0.5 V to 5.5 V external source. The input voltage is regulated to 5 V by a TPS61202 switching step-up (boost) converter from Texas Instruments. (We also make a standalone regulator based on this integrated circuit.)

The regulator's low minimum input voltage makes it possible to power this A\* with 1 to 3 NiMH, NiCd, or alkaline cells or from a single lithium cell. Unlike standard boost regulators, the TPS61202 also features a linear down-regulation mode that is automatically enabled when the input voltage exceeds 5 V, allowing it to handle input voltages as high as 5.5 V.

As shown in the left graph below, the ULV's switching regulator has an efficiency – defined as (Power out)/(Power in) – of 70% to 90% for most combinations of input voltage and load.

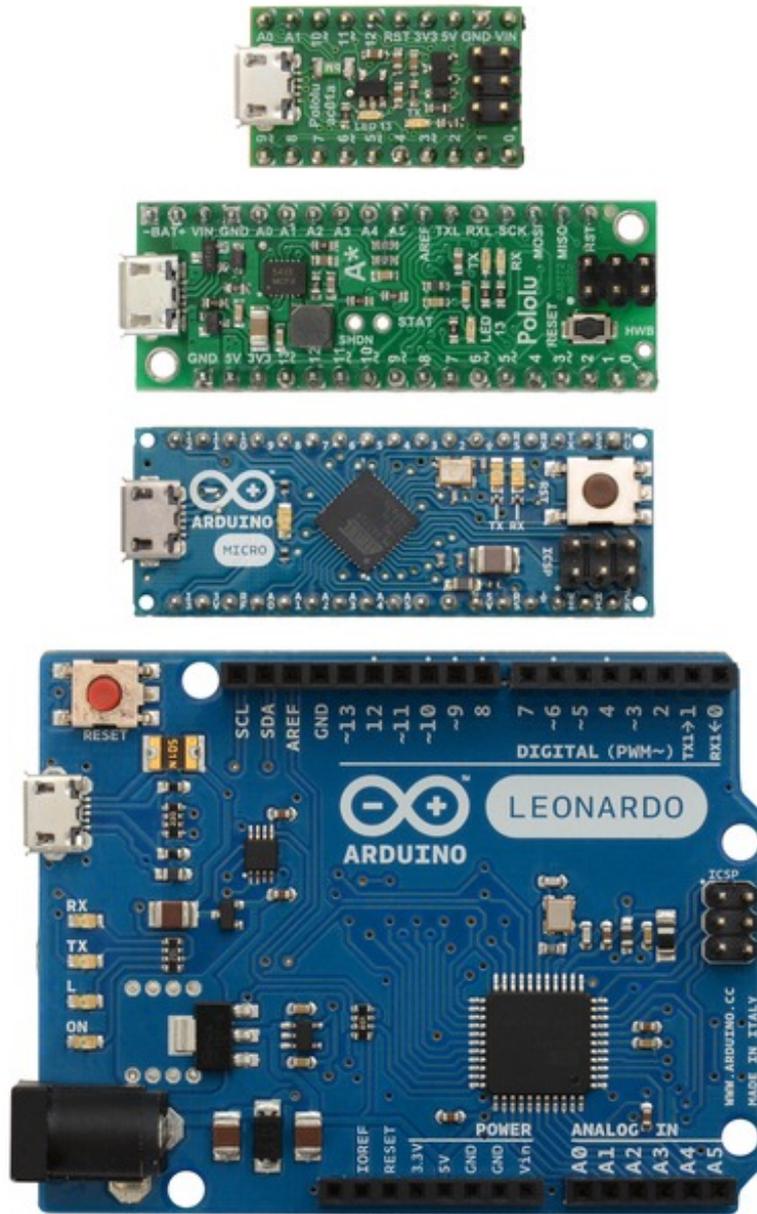


The A-Star's components, including the microcontroller and LEDs, draw 30 mA to 40 mA in typical applications. The rest of the regulator's achievable output current, which depends on input voltage as well as ambient conditions, can be used to power other devices. The right graph above shows output currents at which the voltage regulator's over-temperature protection typically kicks in after a few seconds. These currents represent the limit of the regulator's capability and cannot be sustained for long periods; a good estimate for the maximum continuous regulator output current is 60% to 70% of the values shown in the graph.

### Arduino compatibility

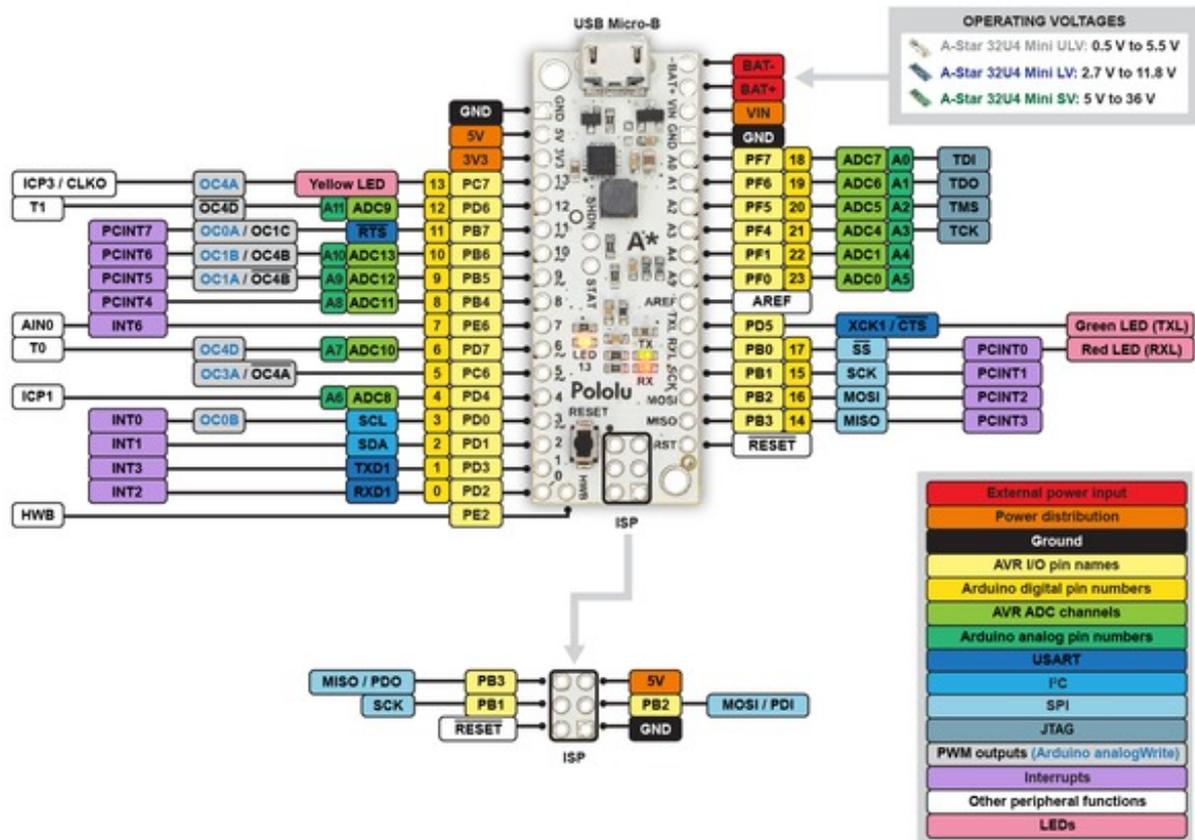
The A-Star 32U4 ships with a preloaded Arduino-compatible bootloader (which uses 4 KB of flash memory, leaving 28 KB available for the user program). We provide a software add-on that enables the board to be easily programmed from the Arduino environment.

The A-Star 32U4 Mini boards use the same microcontroller as the Arduino Leonardo and Arduino Micro and run at the same frequency, and they are the same size as the Arduino Micro, but they offer a number of advantages over these other ATmega32U4-based boards. Most notably, their efficient switching regulators cover a wide range of input voltages, opening up new possibilities for powering projects built around Arduino-compatible microcontroller boards. Another advantage is the power selection circuit based on the TPS2113A power multiplexer from Texas Instruments, which allows safe, seamless power switching between USB and an external source without losses from passive components like fuses or diodes along with the ability to monitor and control the selected power source. Additionally, the A\* 32U4 Mini breaks out a few additional pins from the ATmega32U4 microcontroller that are not exposed on the Arduino Micro or Leonardo, and it features larger, more convenient mounting holes than the Arduino Micro.



Pololu A-Star 32U4 Micro, Pololu A-Star 32U4 Mini SV, Arduino Micro, and Arduino Leonardo.

## Pinout



This diagram identifies the I/O and power pins on the A-Star 32U4 Mini (even though it shows the ULV version, it applies to all three A-Star Mini boards); it is also available as a printable PDF (269k pdf). For more information about the ATmega32U4 microcontroller and its peripherals, see Atmel's ATmega32U4 documentation.

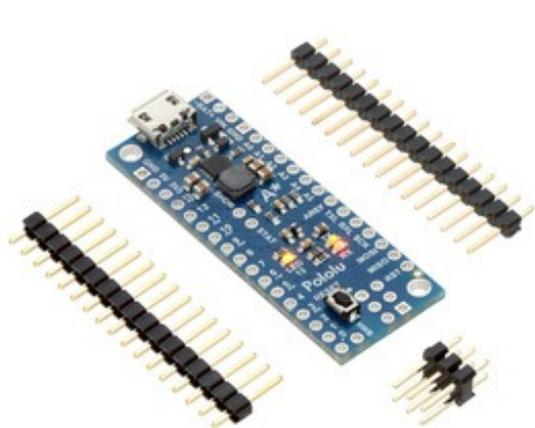
Printed on the A\* circuit board are indicators that you can use to quickly identify each pin's capabilities: a triangle next to the pin means it can be used as an analog input, and a square wave symbol under the pin number means it can be used as a PWM output.

The A-Star 32U4 Mini can either be powered directly from the USB 5 V supply or from an external voltage source, which is regulated to 5 V by its onboard regulator, and the board's power selection circuit enables automatic, uninterrupted transitions between the two power sources. When the A-Star is powered through an external power supply connected to the BAT+ and BAT- pins, its reverse-voltage protection circuit helps prevent it from being damaged by accidentally-reversed power connections, and the VIN pin can be used as an output to supply reverse-protected power to other devices. Alternatively, the external supply can be connected directly between VIN and GND, bypassing the reverse-voltage protection.

The A-Star 32U4 user's guide discusses the board's features in more detail.

## Included hardware

A pair of 1×17-pin breakaway 0.1" male headers is included with the A-Star 32U4 Micro, which can be soldered in to use the board with perfboards, breadboards, or 0.1" female connectors. Also included is a 2×3 header that can be installed to allow external programming of the microcontroller through the AVR ISP interface, such as with our USB AVR programmer. The board has two mounting holes that work with #2 and M2 screws (not included).



A-Star 32U4 Mini LV with included optional headers.



A-Star 32U4 Mini SV with soldered headers and connected USB cable.

## The A-Star family

The table below shows some key features and specifications of our A-Star microcontroller boards to help you choose the right one for your application.

	A-Star 32U4 Micro	A-Star 32U4 Mini ULV	A-Star 32U4 Mini LV	A-Star 32U4 Mini SV
<b>Microcontroller:</b>	ATmega32U4	ATmega32U4		
<b>User I/O lines:</b>	151	26		
<b>PWM outputs:</b>	7	7		
<b>Analog inputs:</b>	8	12		
<b>User LEDs:</b>	2	3		
<b>Reset button:</b>		<input type="checkbox"/>		
<b>Operating voltage:</b>	5.5 V to 15 V	0.5 V to 5.5 V	2.7 V to 11.8 V	5 V to 36 V
<b>Regulator type:</b>	linear	switching step-up	switching step-up/step-down	switching step-down
<b>Regulated current<sup>2</sup>:</b>	100 mA	500 mA	1000 mA	500 mA
<b>Dimensions:</b>	1" × 0.6"	1.9" × 0.7"		
<b>Weight<sup>3</sup>:</b>	1.3 g	3.4 g		

<sup>1</sup> Three extra digital I/O lines are accessible through the ISP header.

<sup>2</sup> These values are rough approximations for comparison purposes. Available current depends on input voltage, current consumed by the board, ambient conditions, and regulator topology. See product documentation and performance graphs for details.

<sup>3</sup> Without included optional headers.

[Documentation on producer website.](#)