



## Summary

Polaron is a Universal Serial Bus (USB) to Transistor-Transistor Logic (TTL) serial converter. The device is designed to plug into a USB type A computer jack. It provides a six-pin TTL interface for uploading programs (sketches) into Arduino<sup>1</sup> compatible systems - such as the many versions of Arduino Pros, Arduino Pro Minis, or Heron Circuits Proboard 328Ps and Proboard PBs, all of which use the same TTL interface. A polarized TTL cable can be used to prevent reversal of connections, and reduce risk of damaging equipment, but the TTL port of a Polaron can also connect with non-polarized 2.54 mm pitch DuPont connectors.

A Polaron is a quasiparticle, but also an Arduino compatible programming device with the following features:

- Seamless compatibility with the Arduino Integrated Development Environment (IDE)
- A genuine FT231XQ chip from Future Technology Devices International (FTDI)
- The ability to connect using either a polarized or non-polarized TTL plug
- A separate onboard 3.3 volt regulator capable of delivering up to 200 mA
- A Positive Temperature Coefficient (PTC) fuse. The fuse limits current that can be pulled from a computer's USB port to 200 mA for increased safety when powering breadboards.
- Dimensions: 44.5mm x 17.8mm (1.75in x 0.70in)
- Weight: 4.0 g

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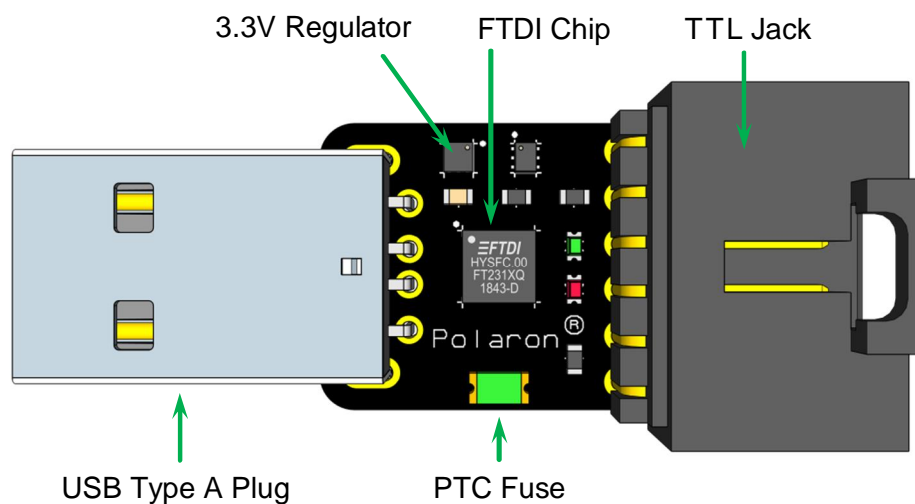
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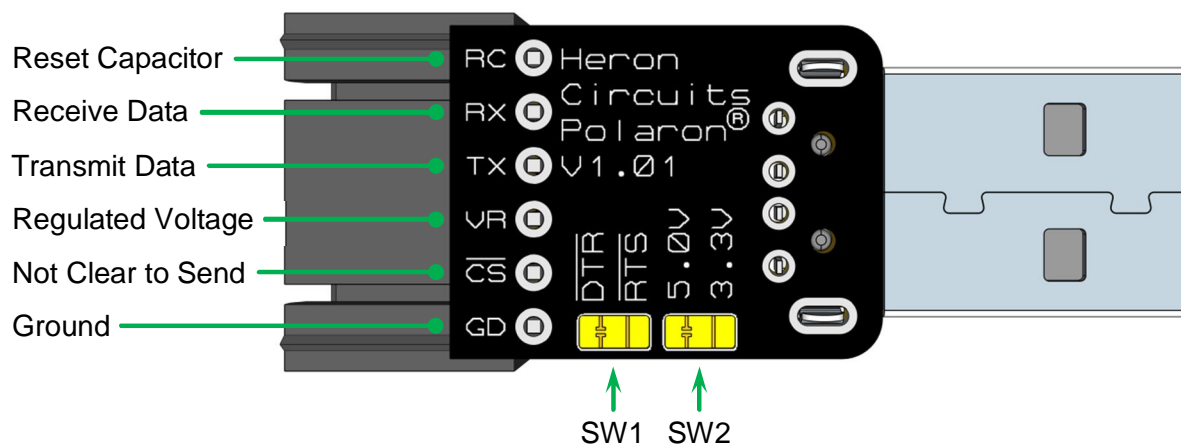
## 1. Top and Bottom

Figure 1 shows the locations of key components.



**Figure 1 Top View**

Figure 2 shows TTL pin names, and the locations of two configuration switches SW1 and SW2.

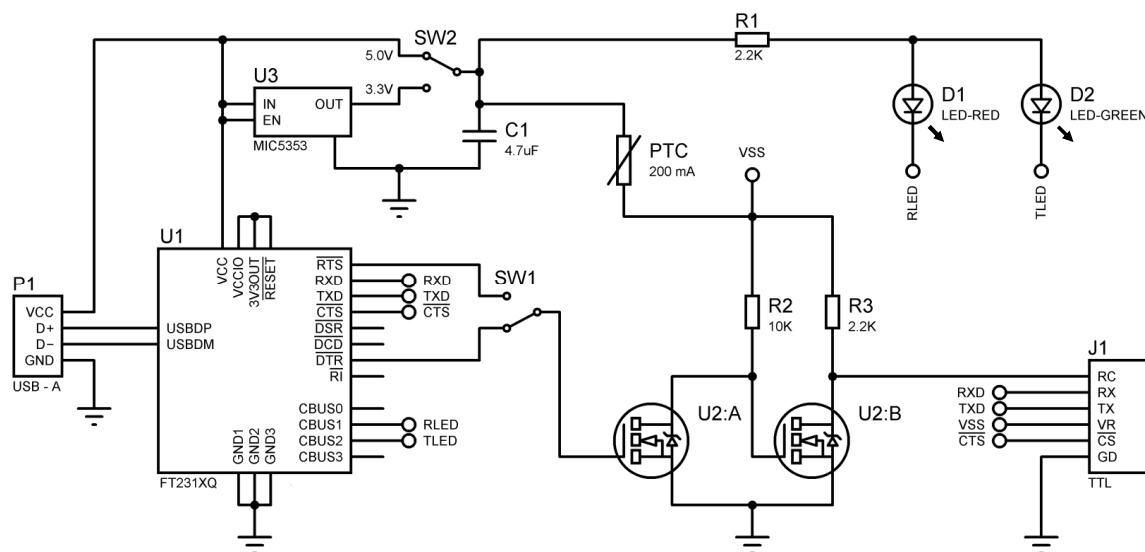


**Figure 2 Bottom View**



## 2. Schematic

As shown in the schematic in Figure 3 below, one pin in the J1 jack is RC. The RC pin connects to a reset capacitor that is embedded in all Arduino compatible systems. It supports serial TTL upload functions. Normally, the output signal on the RC pin stays high. It drops low to trigger a microcontroller reset when the Arduino IDE starts transmitting an upload. The schematic shows how a Polaron guarantees the RC output signal will snap completely low for reliable uploads. The circuit contains a pair of highly conductive MOSFET switching transistors that are cascaded to form a low impedance buffer for the reset signal.



**Figure 3 Polaron Schematic**

## 3. Configuration

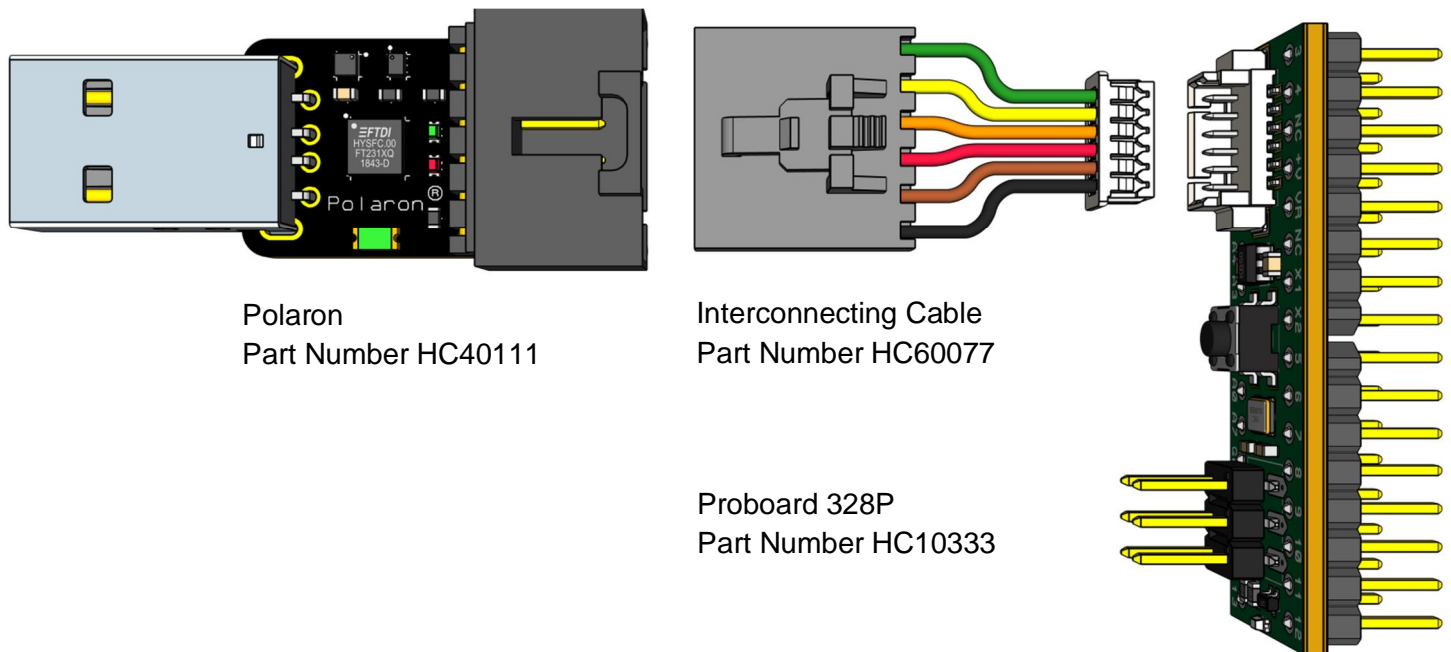
Polaron has two solder switches, SW1 and SW2. For SW1, the default configuration includes a thin gold trace connecting the reset logic of RC to the  $\overline{\text{DTR}}$  signal of the FTDI chip. If needed, SW1 can be changed to use  $\overline{\text{RTS}}$  instead of  $\overline{\text{DTR}}$ . This can be needed for applications such as using a Polaron to interface a computer to a serial display terminal. SW2 selects the output voltage, and is set for 5.0 volts by default. In order to change the switches, an experienced hobbyist can cut the prewired traces using the tip of a fresh hobby knife blade. Add a small blob of solder to connect the center pad to the opposite setting.

An FT231XQ chip is capable of supplying 3.3 volts from an internal voltage regulator that is built into the chip, but the output current available from the FTDI chip is very small. The chip's datasheet specifies 50 mA maximum, but that seems to be a theoretical value. Our testing showed that the output remained stable at up to about 30 mA, so perhaps the 50 mA figure is intended to describe where the chip would be damaged.

The Polaron design includes a larger independent 3.3 volt regulator that can deliver 200 mA. This is included because users can need greater current when powering small breadboard projects directly with a laptop.



## 4. Connecting



**Figure 4 Connecting a Polaron to a Proboard 328P**

Figure 4 shows how to connect a Polaron 328P to a Proboard 328P. The interconnecting cable is pictured with wires shortened for illustration. The actual cable length is about 30 centimeters. The white plug on the right side of the cable plugs into J1, which is a wire-to-board connector with 1.25mm pin spacing. Compatible plugs that fit J1 are available from manufacturers such as Japan Solderless Terminals (JST) and Molex.

If a Polaron is plugged into a laptop, and a Proboard 328P is plugged into a breadboard, the combination allows a user to place a laptop and a breadboard together on a table with simplified wiring. Connections at both ends of the interconnecting cable are polarized, so setup can be accomplished without risk of accidentally orienting the TTL connections backwards. Users are free to concentrate on learning how to control any components that are connected to the microcontroller on the breadboard.

A Polaron can provide 200mA, which is enough oomph for most breadboard projects. The device also includes a self-resettable fuse that limits the current that can be pulled from a computer's USB port. Damage is unlikely to happen, but when connecting any equipment to a computer the user assumes all risk. Heron Circuits will not be liable for any damage done when connecting equipment to computers, but the built-in fuse and the polarized connectors effectively reduce risk.



## 5. Notice

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