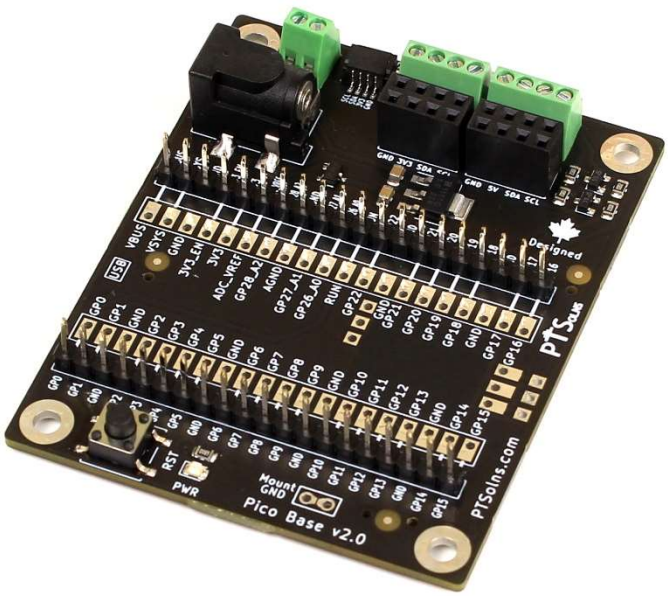
Pico Base

1 DESCRIPTION

The PTSolns *Pico Base* is intended to interface with the Raspberry Pi Pico (henceforth referred to as Pico) offering much convenience.



While mounted in the *Pico Base*, the Pico can be powered in multiple ways. Onboard protection prevents current from going into a battery (if connected via the female jack or the 2-pin screw terminal) while power is supplied by the onboard Pico USB connection. The user can switch between power sources without interrupting their circuit or the Pico. The board also offers a reset button as well as a power LED.

An onboard logic level shifter allows for the simultaneous operation of both 3.3V as well as 5V I2C peripherals. There are screw terminal and header connections for both 3.3V and 5V I2C ports, as well as the common QWIIC® connector.

For tutorials and example sketches using the *Pico Base*, the user is referred to:
https://github.com/PTSolns/PTSolns_PicoBase

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2 DOCUMENT REVISION HISTORY

Current document revision is Rev 0.

3 PRODUCT FEATURES

This section highlights the features of the *Pico Base*. Many of the features are graphically shown in Figure 1, with more details provided in the following sub-sections.

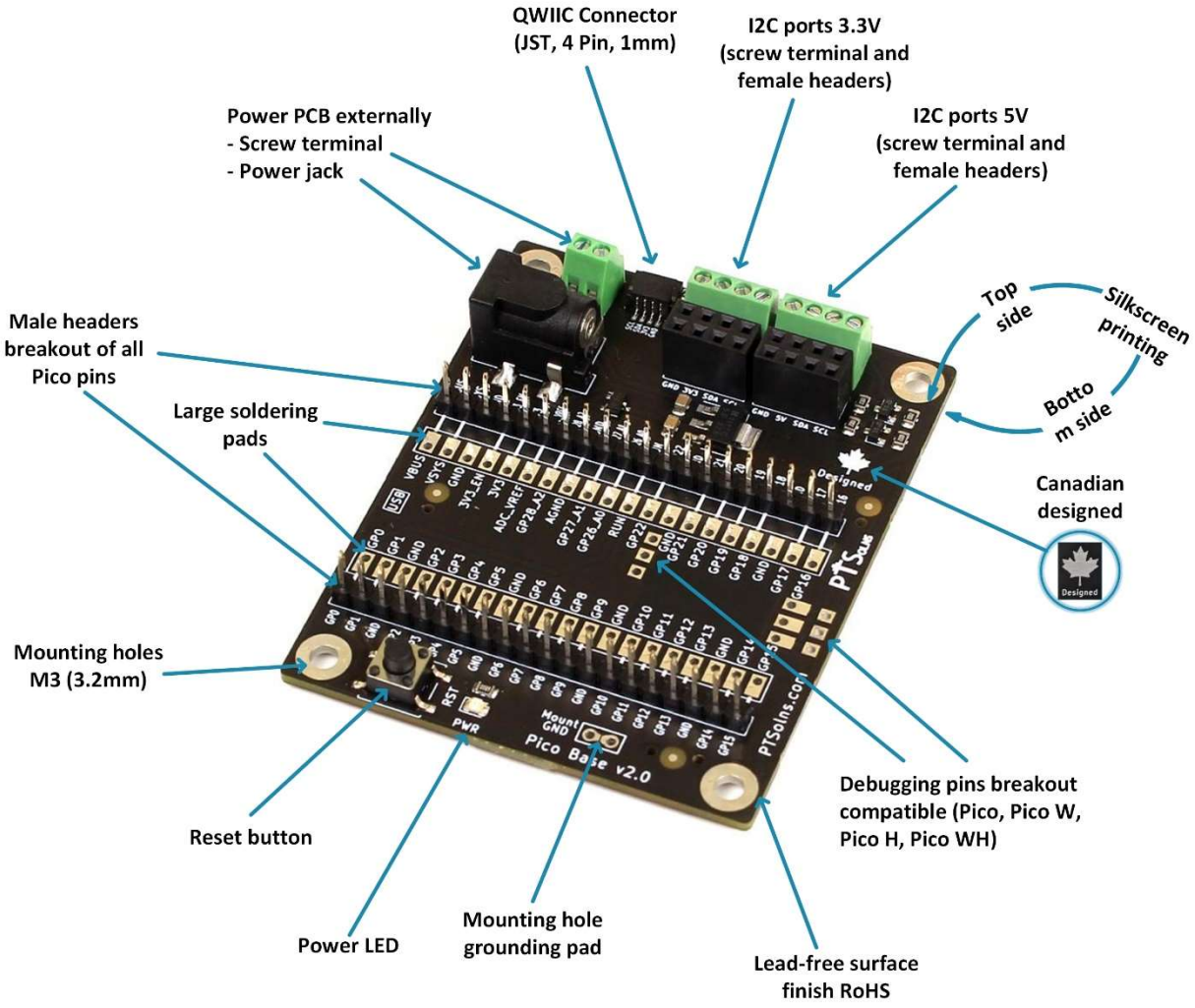

Figure 1: Features of the Pico Base.

3.1 Power Input

The *Pico Base* has the following power input options:

1a) 2-Pin screw terminal (2.54 mm/0.1 in). V_{in} = 3.0V to 12V, or 6.2V to 12V if using 5V.
1b) Female barrel jack (2.1 mm X 5.5 mm). V_{in} = 3.0V to 12V, or 6.2V to 12V if using 5V.
2) Onboard USB via Pico.

These power input options are shown in Figure 2. Note that the positive terminal of Option 1a is electrically connected to the positive terminal of Option 1b. The negative terminal of Option 1a is electrically connected to the negative terminal of Option 1b. **It is not recommended to use both power input Options 1a and 1b simultaneously.**

The board can also be powered by the Pico itself via the onboard USB port. Whenever either Option 1a or 1b is plugged in and Option 2, the USB power (Option 2) takes priority. In other words, if 5V is supplied by the onboard USB via the Pico, the power supply of Options 1a and 1b are disconnected by onboard protection. The user can switch between powering the board via Options 1a/1b and Option 2 without power interruption to any part of the *Pico Base*. This gives the user the flexibility of programming the Pico via USB connection to their computer, and without power interruption connect an external battery via Options 1a/1b.

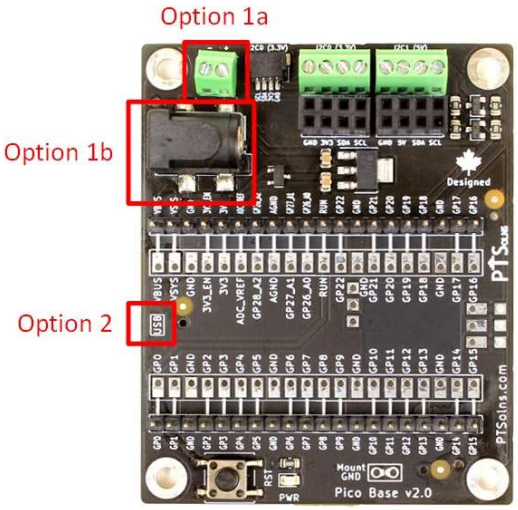

Figure 2: Two power input options for the Pico Base. Note that for Option 2 the Pico is not shown where the USB would be connected.

3.2 I2C

The Pico inherently contains two I2C ports (Port 0 and Port 1), with various respective pins a user can implement. The *Pico Base* takes advantage of this and hardwires pins GP20 and GP21 to be used for 3.3V I2C devices over Port 0. Furthermore, onboard is a 2-channel 3.3V-to-5V logic level shifter (LLS) that takes the hardwired pins GP18 and GP19 and shifts their voltage to 5V. For the 5V I2C arrangement over Port 1, note that the SCL and SDA bus is not directly connected to the pins GP19 and GP18 on the Pico directly, but rather indirectly through the LLS. With this arrangement the user can connect 3.3V I2C devices on Port 0 and simultaneously connect 5V devices over Port 1. If powering the board via the external input (Options 1a/b outlined in Section 3.1), then the 5V I2C port only functions properly if the user supplies an input voltage of at least 6.2V[1]. If powering the board via the onboard USB port on the Pico (Option 2 outlined in Section 3.1), then 5V is sufficient for the Port 1 I2C at 5V.

The I2C ports have multiple breakouts. Both the 3.3V Port 0 I2C as well as the 5V Port 1 I2C each have a screw terminal connector and a 2x4 pin female header connector. The user can connect their I2C peripherals on any of these connector breakouts. Furthermore, the 3.3V Port 0 I2C contains an addition 1mm 4-pin JST connector,

[1] 6.2V = 5V + $V_{dropout}$, where $V_{dropout}$ = 1.2V @ 1A output current.

commonly called a QWIIC® connector. Credit should be given to Sparkfun for developing and popularizing the QWIIC® Connect System. For more information the user is referred to https://www.sparkfun.com/qwiic.

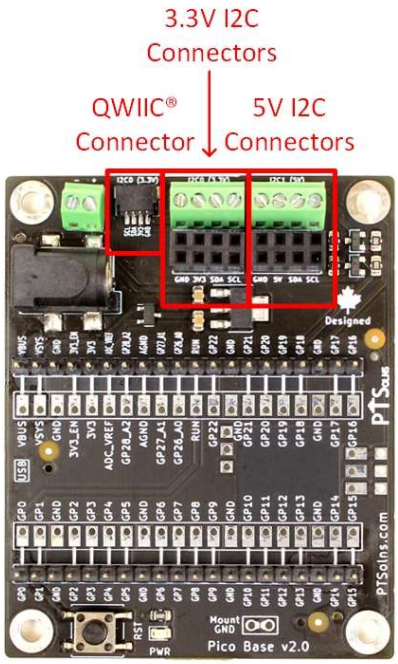

Figure 3: 3.3V and 4V I2C connectors on the Pico Base.

3.3 Pico Soldering Pads

Typically, the Pico does not have headers (usually male headers) soldered to the board. Due to this, the *Pico Base* does not have the matching headers (usually female heads) soldered on the footprint where the Pico is intended to be placed, as shown in Figure 4. This gives the user multiple configuration options as to how to connect the Pico to the *Pico Base*. Since the soldering pads are a stretched oval shape, the user can solder the Pico right onto the board. This establishes a permanent connection, and the Pico is not easily removed. If the user wants to be able to remove the Pico from the board, it is suggested that they use matching male and female headers. In most cases male headers are soldered onto the Pico, and female headers onto the *Pico Base*.

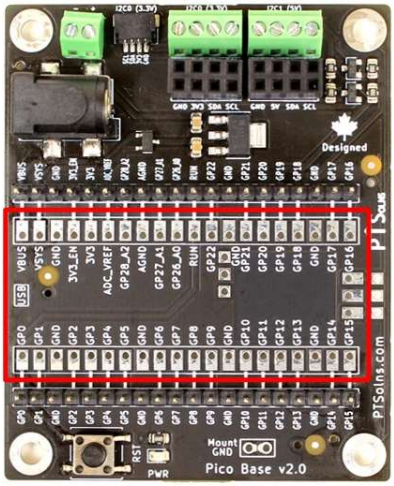

Figure 4: Soldering Pads for Pico on the Pico Base.

3.4 Pico Pins Breakout

Adjacent to the Pico soldering pads are single rows of male headers, one on either side of the Pico, as shown in Figure 5. These breakout pins give convenient access to all the pins on the Pico. **Since all the pins are exposed, the user should take caution not to accidently short circuit any of the pins.**

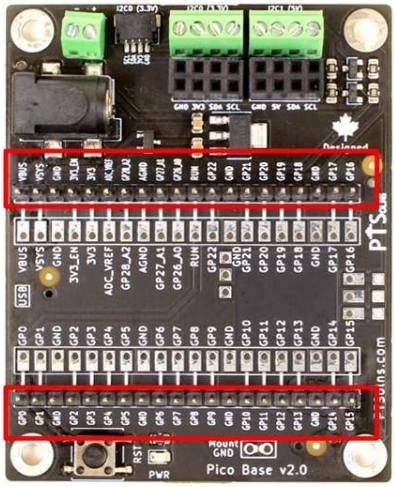

Figure 5: Male header single row breakout pins on either side of the Pico.

3.5 Debugging Pins Breakout

Different Pico versions have two locations on the board where the debugging pins are made available. The *Pico Base* is compatible with all the versions of the Pico (Pico, Pico W, Pico H, Pico WH), such that any of the Pico versions can be used to access the debugging pins on the board. This is shown in Figure 6.

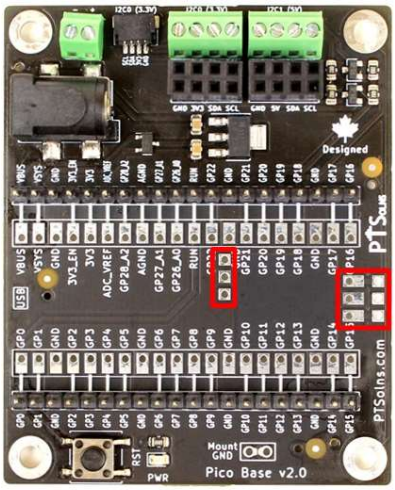

Figure 6: Debugging pins available on the Pico Base.

3.6 Reset Button

A reset button is present near the bottom right of the *Pico Base*, which when pressed pulls the RUN pin on the Pico to GND. The reset button is labelled “RST” as shown in Figure 7.

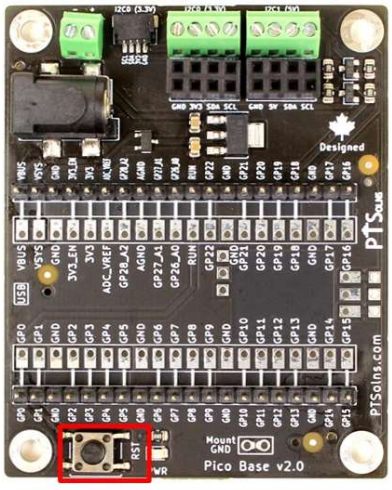

Figure 7: Reset button “RST” on the Pico Base.

3.7 Power LED

If the *Pico Base* is powered via any of the options as outlined in Section 3.1, a red LED turns on. This power LED is labelled “PWR” as shown in Figure 8.

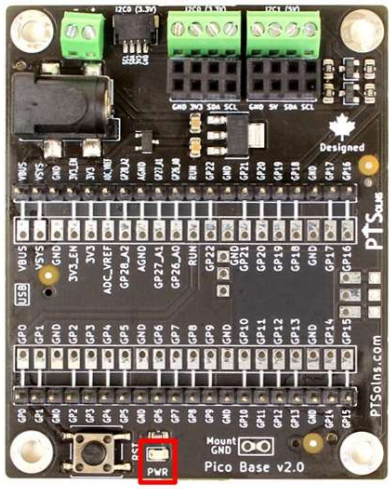

Figure 8: Power LED PWR on the Pico Base.

3.8 Silkscreen Printing

For convenience, most of the silkscreen printing is done on both sides of the *Pico Base*. The breakout section of the *Pico Base* is fully labelled along the rows and columns. White dashed silkscreen lines between tie-points indicate an existing hardwired electrical connection.

3.9 Mounting Holes

There are a total of seven mounting holes on the *Pico Base*. Some of these mounting holes serve multiple purposes. The four mounting holes located at each of the corners of the boards (labelled in Figure 9 as 1, 2, 3, and 4) are intended to mount the board itself to a sturdy surface or enclosure. Mounting hole number 4 also servers as the right mounting hole intended for an LCD. Along with mounting hole 5 and 6, these three mounting holes can support the common 1602 and 2004 LCDs. Finally, mounting holes 6 and 7 are present to align with the mounting holes of the *Pico Base*.

All the mounting holes 1-7 are electrically connected to each other, and by default isolated from the rest of the board. The user can ground these mounting holes by bridging the solder jumper pads as shown in Figure 9.

For dimensions of the mounting holes see Figure 12.

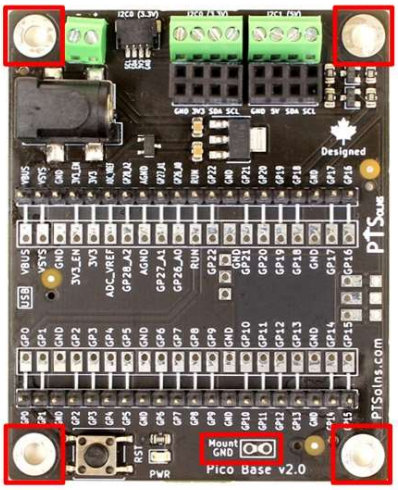

Figure 9: Mounting holes on the Pico Base.

3.10 Mark of Authenticity

Authentic PTSolns PCBs have a black solder mask color and are marked with the “PTSolns” logo in white silkscreen printing. The “Canadian Designed” symbol, consisting of the Canadian Maple Leaf with the word “Designed” underneath, can also be found on the PCB in white silkscreen printing. The “PTSolns” trademark and the “Canadian Designed” symbols are shown in Figure 10.

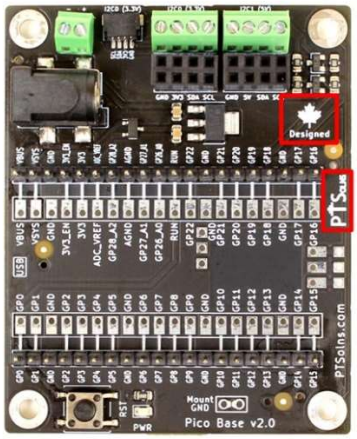

Figure 10: The "Canadian Designed" symbol found on authentic PTSolns PCBs.

4 PHYSICAL PROPERTIES

The physical properties of the *Pico Base* are outlined in Table 1.

Table 1: Physical Properties.

	Quantity	Value	Reference
PCB	Length	51.7 mm	Figure 11
	Width	70.6 mm	Figure 11
	Thickness	1.6 mm	Figure 11
	Corner radius	1.0 mm	Figure 11
	Weight	21 g	--
	Color	Black	--
	Silkscreen	White	--
Mounting	Corner mounting hole diameter	3.2 mm	Figure 12
	Corner mounting copper pad diameter	6.4 mm	Figure 12
	Corner mounting hole center-to-center distance along length	144.5 mm	Figure 11
	Corner mounting hole center-to-center distance along width	62.6 mm	Figure 11
Material	Lead free HASL-RoHS surface finish		--
	FR-4 base		--

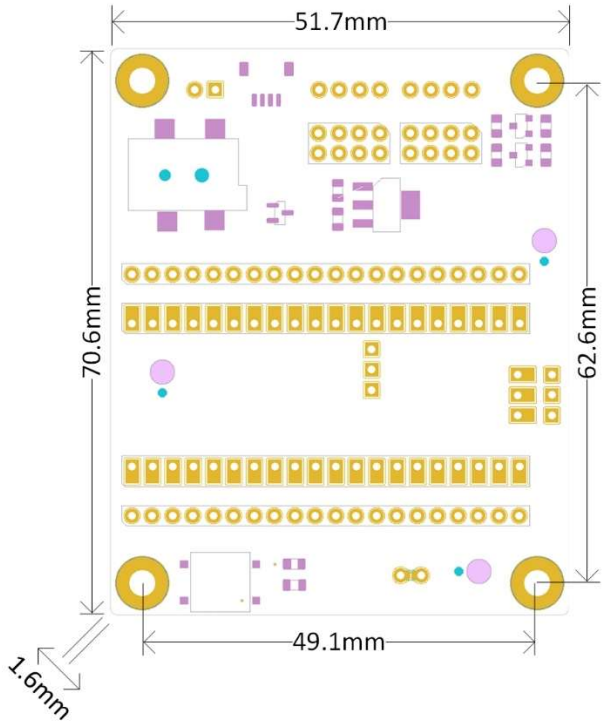

Figure 11: Dimensions of the Pico Base PCB.

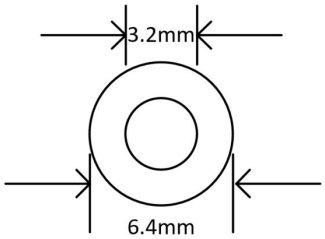

Figure 12: Dimensions of corner mounting hole.

5 ELECTRICAL PROPERTIES

The Pico has a minimum acceptable input voltage of 1.8V (see Pico datasheet for more details). However, if powering the *Pico Base* via the external Options 1a/b (outlined in Section 3.1), then an additional 1.2V to cover the dropout voltage of the onboard linear voltage regulator is required. Therefore, it is recommended that the input voltage is at least 3.0V if the user only intents to use 3.3V in their project. However, for the same reason that an additional 1.2V is needed for the regulator, the 5V and Port 1 I2C bus will not function properly unless a minimum of 6.2V is supplied.

Note that the above input voltage requirements only apply if powering the board with Options 1a/b. If powering the board via the onboard USB on the Pico (Option 2), then the 5V supplied by the USB is sufficient to operate everything on the board. This is because when the USB on the Pico is plugged in, the linear voltage regulator is bypassed and therefore there is no dropout voltage to overcome.

Electrical properties are outlined in Table 2. Electrical connections made by copper traces are shown in Figure 13. Copper traces have a weight of 1 oz/ft^2.

Table 2: Electrical Properties.

Quantity	Value
Input voltage (Option 1a/b outlined in Section 3.1)	3.0V – 12V, is only using 3.3V (6.2V – 12V, if using 5V)

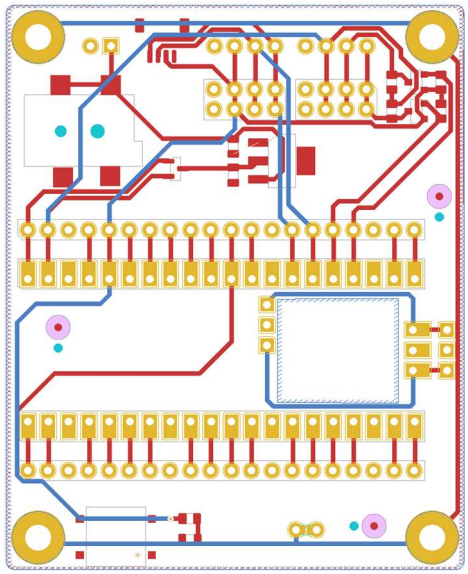

Figure 13: Electrical connections of the Pico Base.

6 RESOURCES

The following are resources relating to the *Pico Base*.

- Example Arduino IDE sketches showing various features of the *Pico Base*. This includes how to use the programmable buttons and LEDs, how to use the I2C Port 0 and Port 1, and others.
  https://github.com/PTSolns/PTSolns_PicoBase

- Raspberry Pi Pico datasheet.
  https://datasheets.raspberrypi.com/pico/pico-datasheet.pdf

- Sparkfun's Qwiic® Connect system.
  https://www.sparkfun.com/qwiic