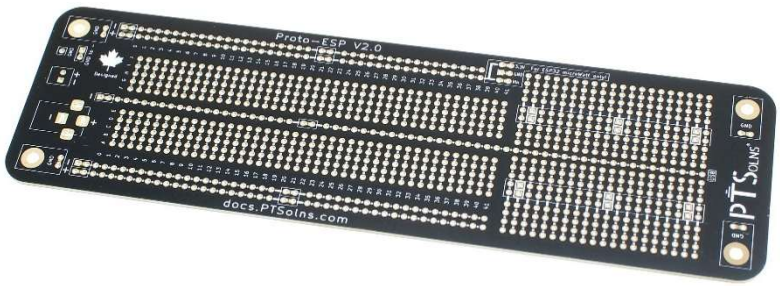
Proto-ESP

1 DESCRIPTION

The PTSolns *Proto-ESP* is a purpose-built prototyping platform engineered for seamless integration with a wide range of ESP-based development boards. This hybrid solution combines the functionality of two PTSolns innovations — the *Proto-Full* and the *ESP Master Key* — to deliver a robust and efficient prototyping experience.



On the prototyping side, the *Proto-ESP* retains all core capabilities of the *Proto-Full*, including multiple configurable power rails, versatile power input options, and an expansive prototyping area laid out in a familiar breadboard-style format. Enhancements such as high-current copper traces, clearly legible silkscreen labeling, and uniquely shaped jumper pads significantly improve durability, readability, and solder-based hardware configuration flexibility.

The opposite side of the board features a compact, high-density ESP interface section that breaks out all pins of most standard ESP modules. When paired with the PTSolns *ESP32 microWatt* additional and dedicated jumper pads are available that offer convenient powering options.

With its comprehensive feature set and thoughtfully engineered layout, the *Proto-ESP* accelerates the development of reliable, custom hardware solutions for any ESP-based system.

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2 DOCUMENT REVISION HISTORY

Current document revision is Rev 0.

3 PRODUCT FEATURES

This section highlights notable features of the *Proto-ESP*. Figure 1 shows the technical picture of the *Proto-ESP*, highlighting the main features.

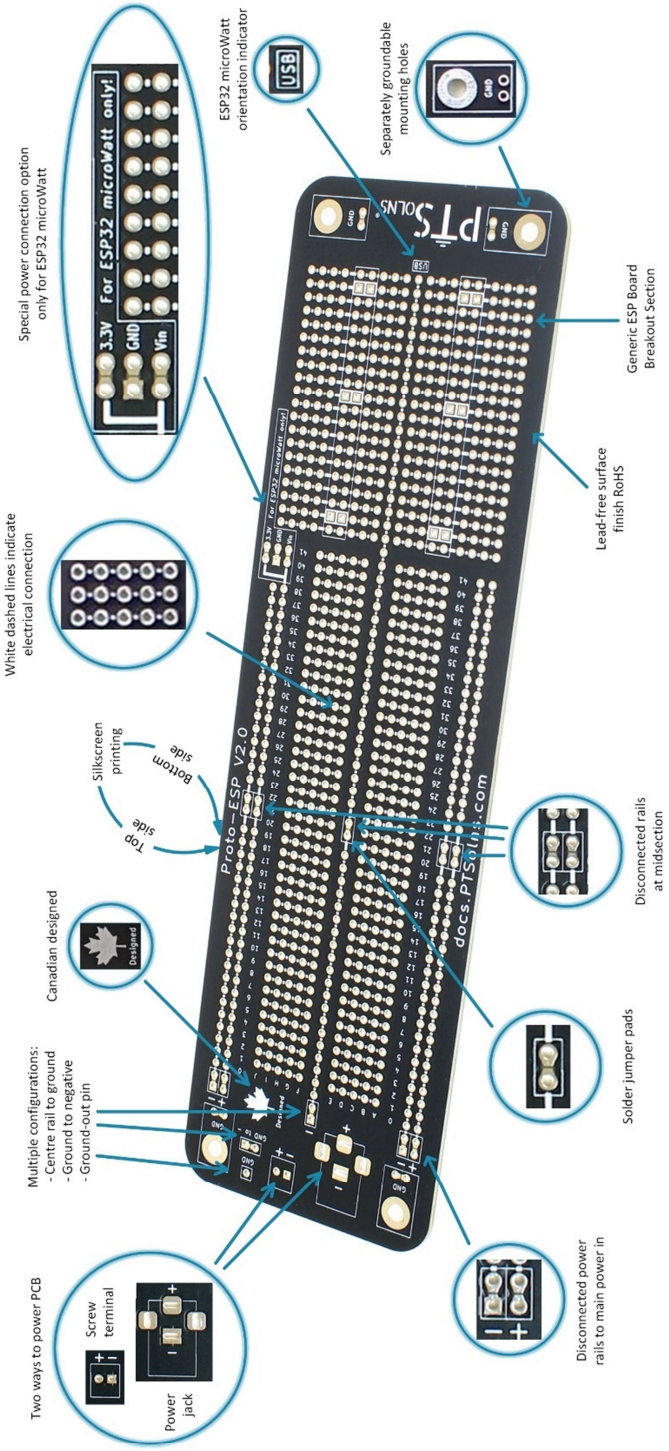

Figure 1: Technical picture showing main features of the Proto-ESP

3.1 Compatibility

The *Proto-ESP* has the same board dimensions and matching mounting holes as the *Proto-Full* and the *Proto-N2RF* boards. This makes these boards compatible with each other in terms of stacking them together using standoffs.

The ESP interface on the *Proto-ESP* is designed to accommodate most ESP-based, and similar, development board microcontrollers.

3.2 ESP Development Board Interface

On the right side of the *Proto-ESP*, as shown Figure 2, is the ESP development board interface that is designed to accommodate most generic ESP-based boards. The interface has 20 rows, broken out on either side of 2x20 Pin connector footprints. Electrical connections are marked with white silkscreen printing.

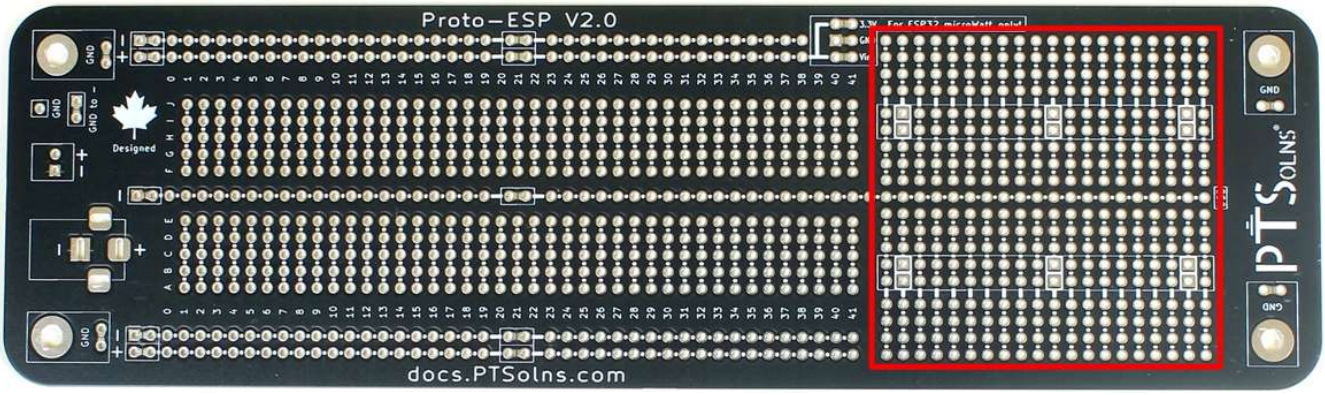

Figure 2: ESP development board interface for generic ESP-based boards.

The 2x20 Pin connector footprints, as shown in Figure 3, has a spacing of 8x, 9x, and 10x the standard spacing of 2.54mm/0.1in. Due to this design the ESP interface can accommodate most generic ESP-based boards.

Note that the ESP interface has while silkscreen printing of six rectangular boxes. These boxes are only relevant if using the *ESP32 microWatt*, as they indicate the ground pins. For the same reason, the “USB” mark is shown on the right, which is to be used as an orientation with the *ESP32 microWatt* to indicate which way around to insert the board into the interface.

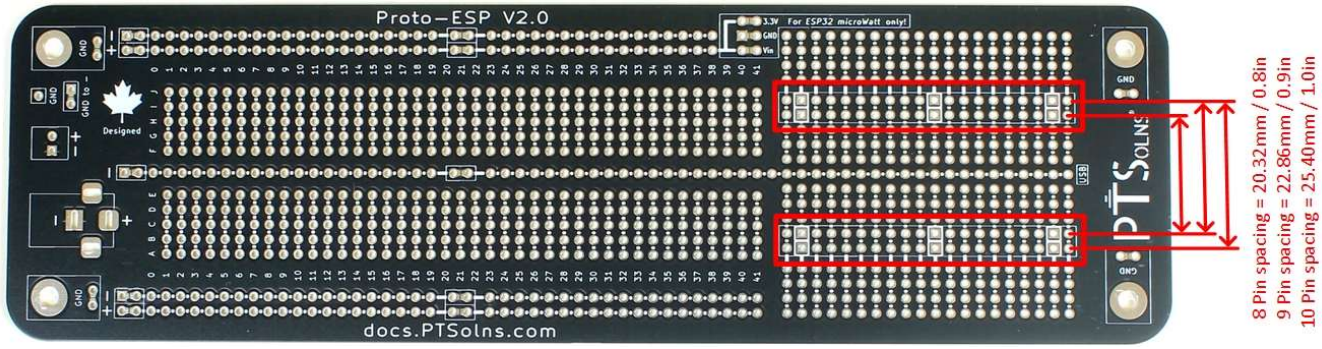

Figure 3: Spacing of the generic ESP interface.

Although the *Proto-ESP* is designed to be compatible with many generic ESP-based boards, it has a special feature compatible only with the *ESP32 microWatt*. As can be seen in Figure 4, there are three solder jumper pads that provide ground (GND) and voltage to the ESP interface breakout section, that will power the *ESP32 microWatt*. Ensure that the USB-C port on the *ESP32 microWatt* aligns with the orientation marker on the *Proto-ESP*. As many other generic ESP-based development boards have different pinouts, their ground and voltage input pins will not match the *Proto-ESP* pinouts **only when the special jumper pads are used. For generic ESP-based boards, simply do not connect any of the three special jumper pads**.

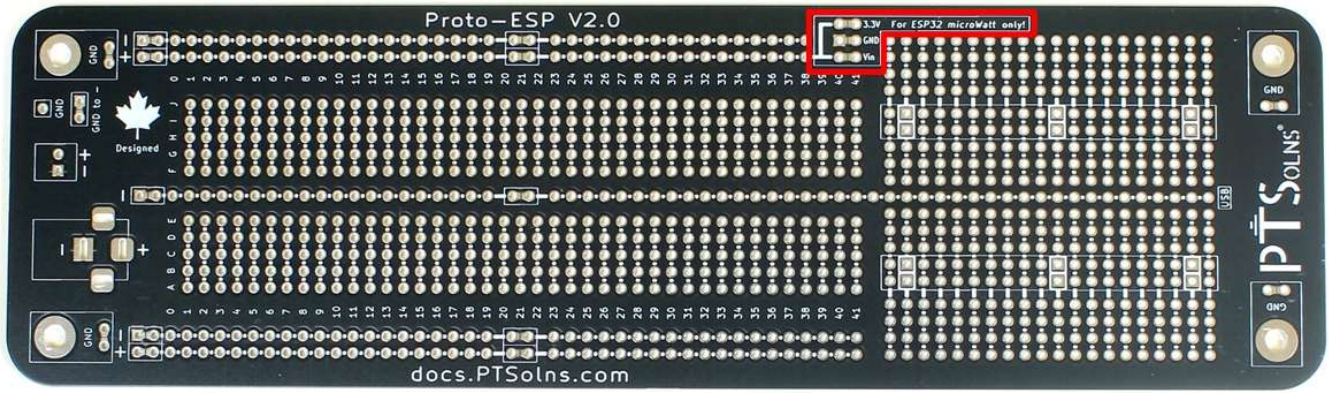

Figure 4: Special jumper pad connection for ESP32 microWatt only.

There are three jumper pads that are within the marked box “For *ESP32 microWatt* only!”, which are:

- Top jumper pad: 3.3V
- Middle jumper pad: GND
- Bottom jumper pad: Vin

If using the *ESP32 microWatt*, the user can bridge two of these jumper pads to power the *ESP32 microWatt* easily without running extra wires. To achieve this the user should bridge the GND jumper pad, which connects the ground on the *ESP32 microWatt* to the negative terminals on the *Proto-ESP*.

NOTE: Careful consideration on the terminology is required here! The GND pin (green line in Figure 5) on the *ESP32 microWatt* is connected to the “-“ negative terminal on the *Proto-ESP* (red circles in Figure 5) . There is also a “GND” terminal on the *Proto-ESP*, which connects the mounting holes. Therefore, there are two different GND terminals. The reason for this in nomenclature convention as it is common to label the power inputs on a prototyping boards with “+” and “-“, while labelling the ground pin on a microcontroller development board with “GND”, although the “-“ is connected to the “GND”. When bridging the middle jumper pad, the GND and the “-“ are connected, as expected.

Next, either, but not both, of the top or bottom jumper pads must be bridged. If the top jumper (blue line in Figure 5) is bridged, then the purple power rail in Figure 5 is connected to the 3.3V input of the *ESP32 microWatt*. It is expected then that the purple power rail is connected with a 3.3V supply.

If however the bottom jumper (orange line in Figure 5) is bridged, then the purple rail in Figure 5 is connected to the Vin pin of the *ESP32 microWatt*. It is expected then that the purple power rail is connected with a voltage that is acceptable for the *ESP32 microWatt* (which is 3.5V to 6V, see the *ESP32 microWatt* Datasheet for more details).

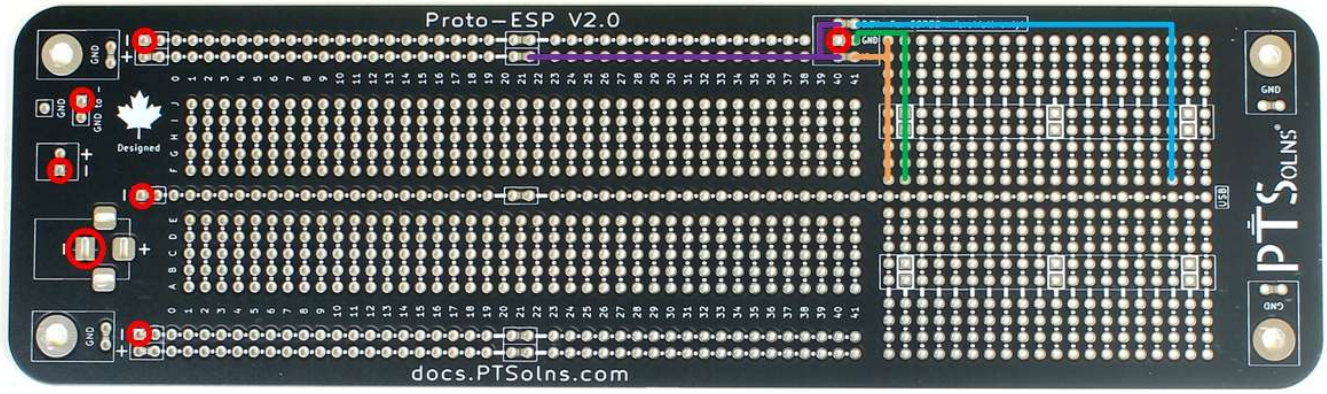

Figure 5: Special jumper pad connections.

3.3 Solder Jumper Pads

There are several electrical connections the user can make between different terminals that are by default open. These connections can be made by soldering/bridging the respective solder jumper pads, as shown in Figure 6. These jumper pads have a specially designed footprint so to make them easy to solder/bridge as shown in Figure 7.

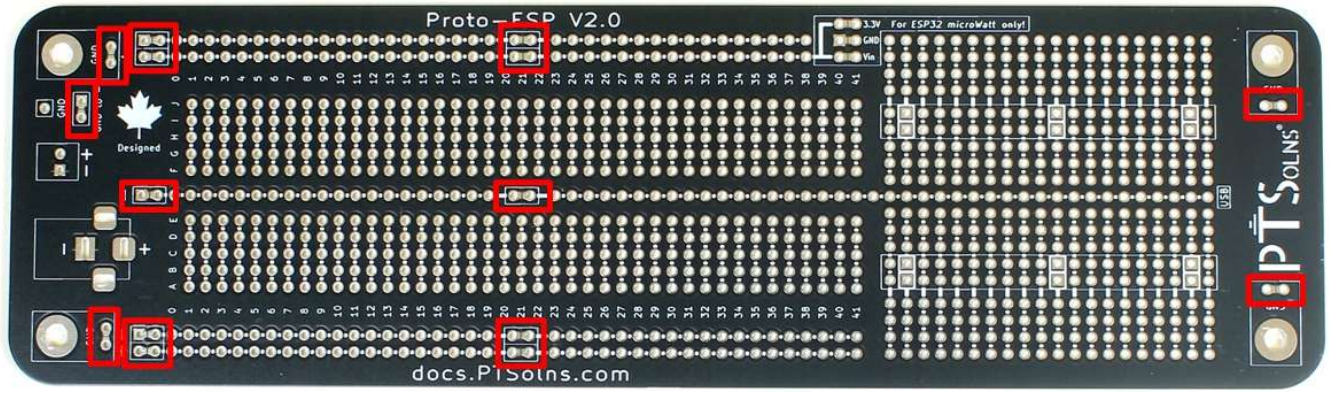

Figure 6: Jumper pads on the Proto-ESP.

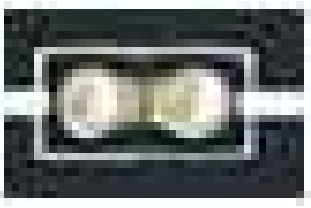

Figure 7: Specially designed jumper pad.

3.4 Power Input

The *Proto-ESP* has the following power input options:

1) 2-Pin screw terminal (2.54 mm/0.1 in).
2) Female barrel jack (2.1 mm X 5.5 mm).

These power input options are shown in Figure 8.

Note that the positive terminal of Option 1 is electrically connected to the positive terminal of Option 2. The negative terminal of Option 1 is electrically connected to the negative terminal of Option 2. **It is not recommended to use both power input options simultaneously.**

Both power input options can be soldered onto the front or back of the PCB. For this reason, the footprint of the female barrel jack of option 2) is unconventional. An additional, electrically isolated, through-hole exists such that the female barrel jack can be connected on either side while keeping the barrel opening in the same direction (away from the PCB). An example can be found in Section 6.1

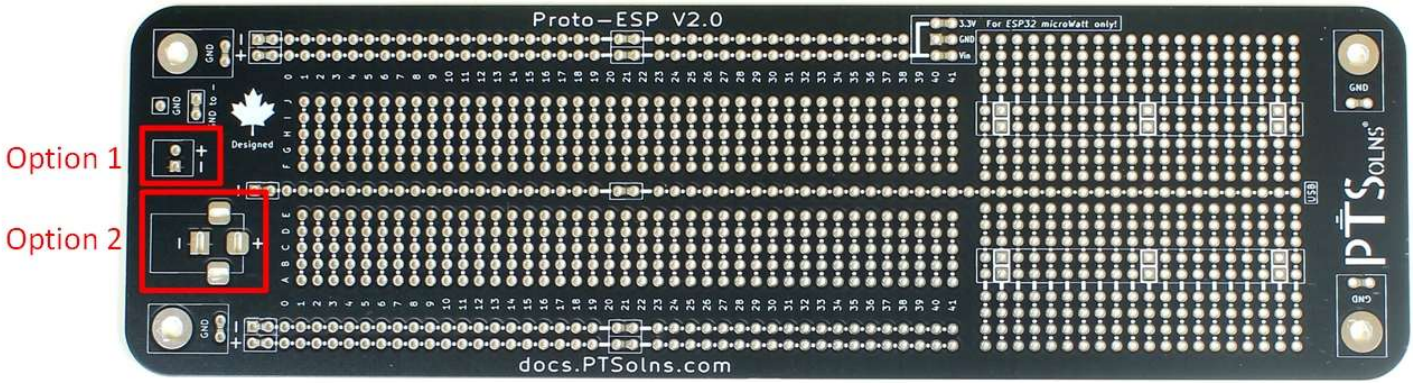

Figure 8: Two power input options for the Proto-ESP.

3.5 Power Rails

The *Proto-ESP* features ten rails as shown in Figure 9. The rails can be electrically connected in different configurations. By default, all rails are initially electrically disconnected. Four of the rails can be connected to the positive terminal. Similarly, four other rails can be connected to the negative terminal. The remaining two rails are suggested to be used in one of two ways:

1) Use the provided footprint connection to GND.
2) Don't connect to GND and use it for a data signal instead.

Connecting rails is suggested to be done in one of two methods:

1) Using a short wire to bridge the connection and soldering it in place. This is a permanent connection in which the user does not intent to change the configuration often.

2) Using male header pins connected with 2-Pin jumper caps. This is a temporary connection in which the user can easily disconnect the rail. This allows the jumper cap to act as an enable/disable for the rail and allows the rail to be easily reconfigured to transmit a different signal or voltage. An example can be found in Section 6.2.

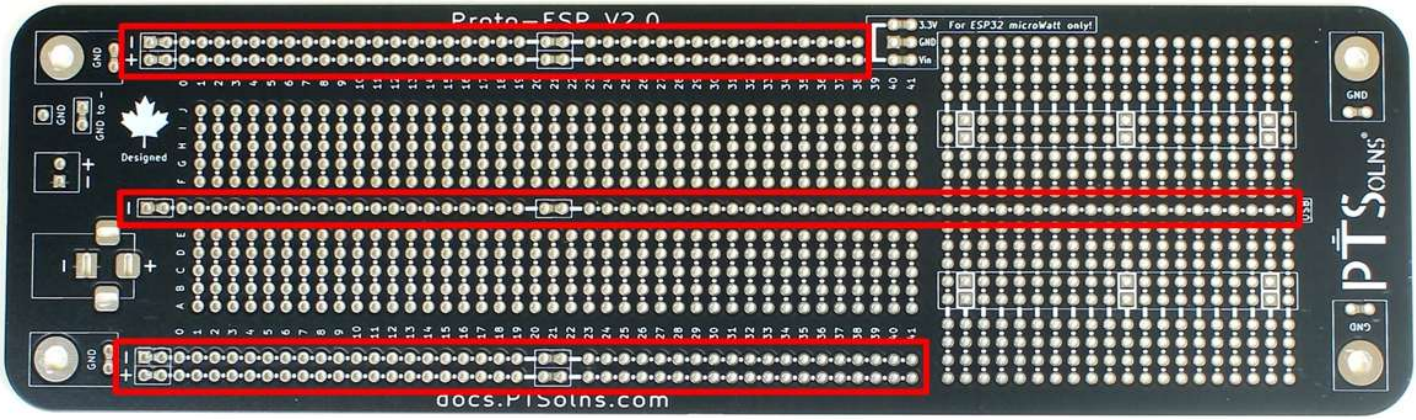

Figure 9: Rails of the Proto-ESP.

3.7 Silkscreen Printing

The breakout section of the *Proto-ESP* is fully labelled along the rows and columns. For ease of use, the silkscreen printing exists on both sides of the board. White dashed silkscreen lines between tie-points indicate an existing hardwired electrical connection. All components can be soldered on either side of the board, including asymmetrical components such as the female barrel jack.

3.8 Mounting

There are four 3.2 mm diameter mounting holes on the PCB as shown in Figure 10. These mounting holes are intended for hardware such as standoffs, of size M3. Each mounting hole has a 6.4 mm diameter copper pad and can be connected to the main ground (GND) of the PCB separately by bridging the respective 2-Pin jumper. Figure 12 shows the dimensions of the mounting holes.

Note that the mounting holes are aligned with the mounting holes on the *Proto-Full* and *Proto-N2RF*.

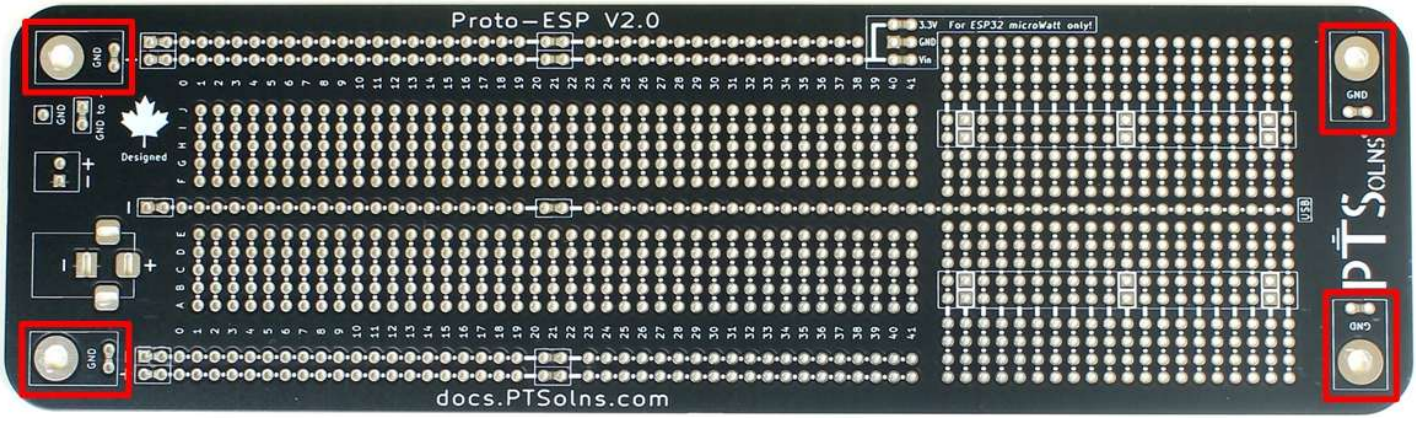

Figure 10: Four mounting holes of the Proto-ESP.

3.9 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 11.

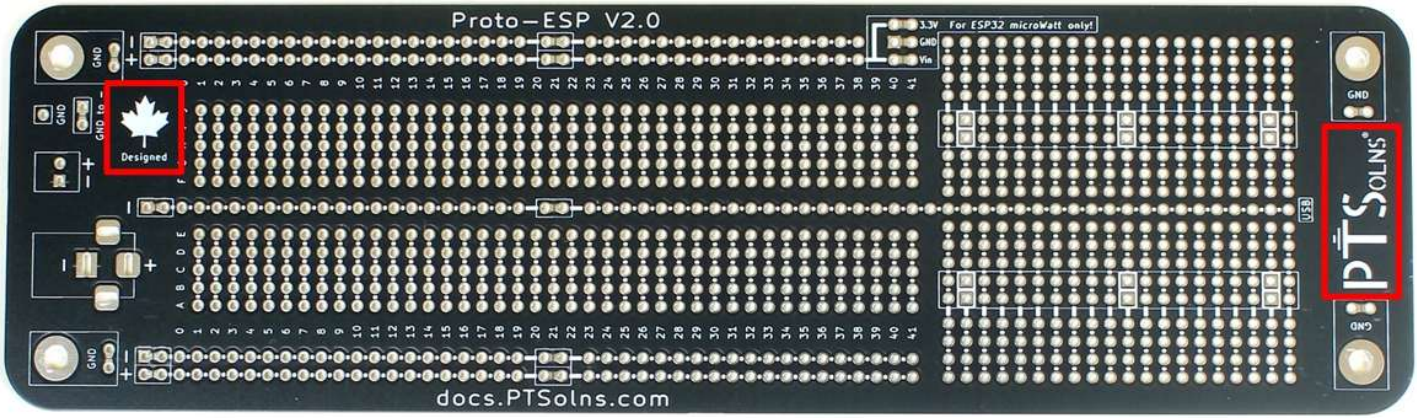

Figure 11: The "Canadian Designed" symbol found on authentic PTSolns PCBs.

4 PHYSICAL PROPERTIES

The physical properties of the *Proto-ESP* are outlined in Table 1.

Table 1: Physical Properties.

	Quantity	Value	Reference
PCB	Length	200.7mm	--
	Width	58.4mm	--
	Thickness	1.6mm	--
	Corner radius	7.6mm	--
	Weight	37g	--
	Color	Black	--
	Silkscreen	White	--
Tie-point	Number of tie-points	690	--
	Tie point spacing	2.54mm/0.1in	--
	Tie-point hole diameter	1.0mm	Figure 12
	Tie-point copper pad diameter	1.7mm	Figure 12
Mounting	Hole diameter	3.2mm	Figure 12
	Copper pad diameter	6.4mm	Figure 12
	Center-to-center distance along length	185.4mm	--
	Center-to-center distance along width	43.2 mm	--
Material	Lead free HASL-RoHS surface finish		--
	FR-4 base		--

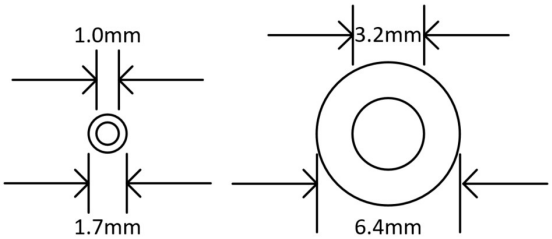

Figure 12: Dimensions of tie-point (left) and mounting hole (right).

5 ELECTRICAL PROPERTIES

The current ratings of the *Proto-ESP* are outlined in Table 2. Electrical connections made by copper traces are shown in Figure 13, with red being the top side of the PCB and blue the bottom side. Note that all traces are exclusively on the back side of the PCB, with the top side only having a ground plane. All traces have a thickness of 1mm and a weight of 1oz/ft^2.

Table 2: Current rating for *Proto-ESP*.

Type of trace	**Current rating**[1]
Positive power rails	2.3A
Negative power rails	2.3A
Central ground rails	2.3A
Power input female barrel jack	2.3A
Power input 2-Pin screw terminal	2.3A
All GND connections	2.3A
5-Pin breakout rows	2.3A

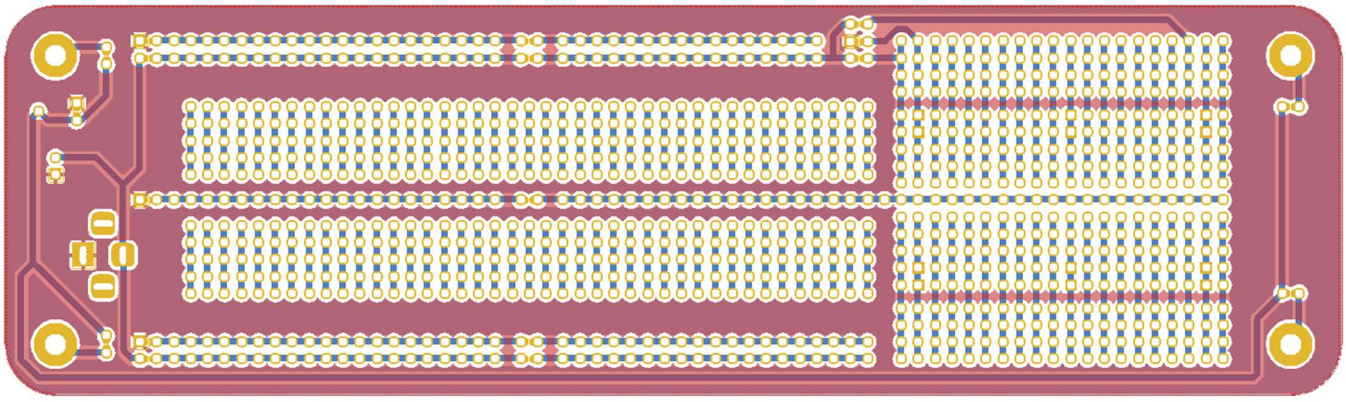

Figure 13: Electrical connections of the Proto-ESP.

[1] Current ratings based on IPC-2221B and are in part determined assuming a maximum temperature rise of 10 ˚C.

6 USAGE AND APPLICATION

This section presents some usages and applications of the *Proto-ESP*.

6.1 Power Input

This example shows two different options to power the *Proto-ESP*. The image on the left in Figure 14 shows a green 2-Pin screw terminal and a black female barrel jack, both soldered onto the top side of the PCB. The image on the right in Figure 14 shows the same screw terminal on the top side, however, the female barrel jack is soldered onto the bottom side of the PCB. In both configurations stand-offs are used to lift the PCB up off the surface.

Figure 14: Power input configuration examples.

Both a screw terminal and a female barrel jack can be soldered into place simultaneously. This gives the user the ability to power the PCB with different connections, or easily switch between two different sources. Since these inputs are electrically connected in parallel, care should be taken to not power the PCB via both input methods at the same time.

6.2 Jumper Cap Connections

Rails and GND connections can be made by simply soldering across the respective gap. This is a permanent connection. A more temporary connection can be made by soldering male header pins across the gaps and using 2-Pin jumper caps, as shown in Figure 15.

Figure 15: Connecting rails and GND using 2-Pin jumper caps.

The gap for the various GND connections consists of two through-holes separated by 2.54 mm/0.1 in. Using the jumper cap method, the male headers required are 1 X 2 Pin with a pitch of 2.54 mm/0.1 in. The gap for the adjacent positive and negative power rails consists of 4 through-holes arranged in a 2 X 2 pattern, separated by 2.54 mm/0.1 in. In this situation, a 2 X 2 Pin male header is recommended using the jumper cap method. However, two 1 X 2 Pin male headers can also be used. **Note that when using jumper caps to connect negative to negative and positive to positive always ensure the jumper caps are not crossed the negative and positive terminal. Mind the direction the jumper caps are placed in the 2 X 2 configuration.**

6.3 Use of Voltage Regulator on Power Rails

This example shows an unconventional use of a voltage regulator. The Vin and Vout pins of the voltage regulator are soldered into the left and right positive voltage rails. This is done at the mid-section of the *Proto-ESP* where the rails are disconnected by default. The GND pin of the voltage regulator is soldered into the negative voltage rail. This is done by slightly bending the GND pin backwards to reach the first through-hole of the negative rail. The left and right negative voltage rails have been bridged to make an electrical connection. Note that two smoothing capacitors are soldered across the positive and negative rails on either side of the Vin and Vout. This is not always necessary but recommended. Ratings for smoothing capacitors are project specific.

With this configuration there are two immediate advantages. The first advantage is that two voltage rails are at different levels. The left is at the supply voltage and the right at a lower down-regulated voltage. This is useful when working with different voltage levels simultaneously. The other advantage is that this configuration uses minimal space, as none of the 5-pin breakout rows are used.

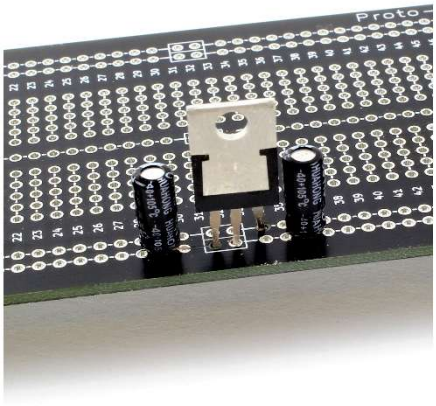

Figure 16: Voltage regulator across power rails.

6.4 Example Setup Using the *ESP32 microWatt*

The example setup shown in Figure 17 is one possible configuration that allows for the *ESP32 microWatt* to be interfaced with the *Proto-ESP* easily. For this example, configuration, the following are considered:

- Figure 17, item marked “1” in a circle.
  The *ESP32 microWatt* is powered with the special solder jumpers, using the GND and Vin jumper (leaving the 3.3V jumper open). To close the jumper caps there are two options, as follows:
  - Solder across the respective jumper, making a bridge with solder, to make a permanent hardware configuration.
  - Use double row male header and jumper caps to make a semi-permanent hardware configuration.
- Figure 17, items marked “2” in a circle.
  The top two power rails are closed with jumper caps such that the GND and Vin terminals are connected to the female barrel power jack.
- Figure 17, item marked “3” in a circle.
  Since the Vin special jumper is closed and connected all the way to the power jack, it is expected that the power input on the power jack will be within the *ESP32 microWatt* input voltage rating (3.5V to 6V).
- Figure 17, item marked “4” in a circle.
  The *ESP32 microWatt* is plugged into the female headers with the USB-C port pointing to the right, which aligns with the USB marking on the *Proto-ESP*. Matching the orientation is critical so that the power pins are properly aligned.

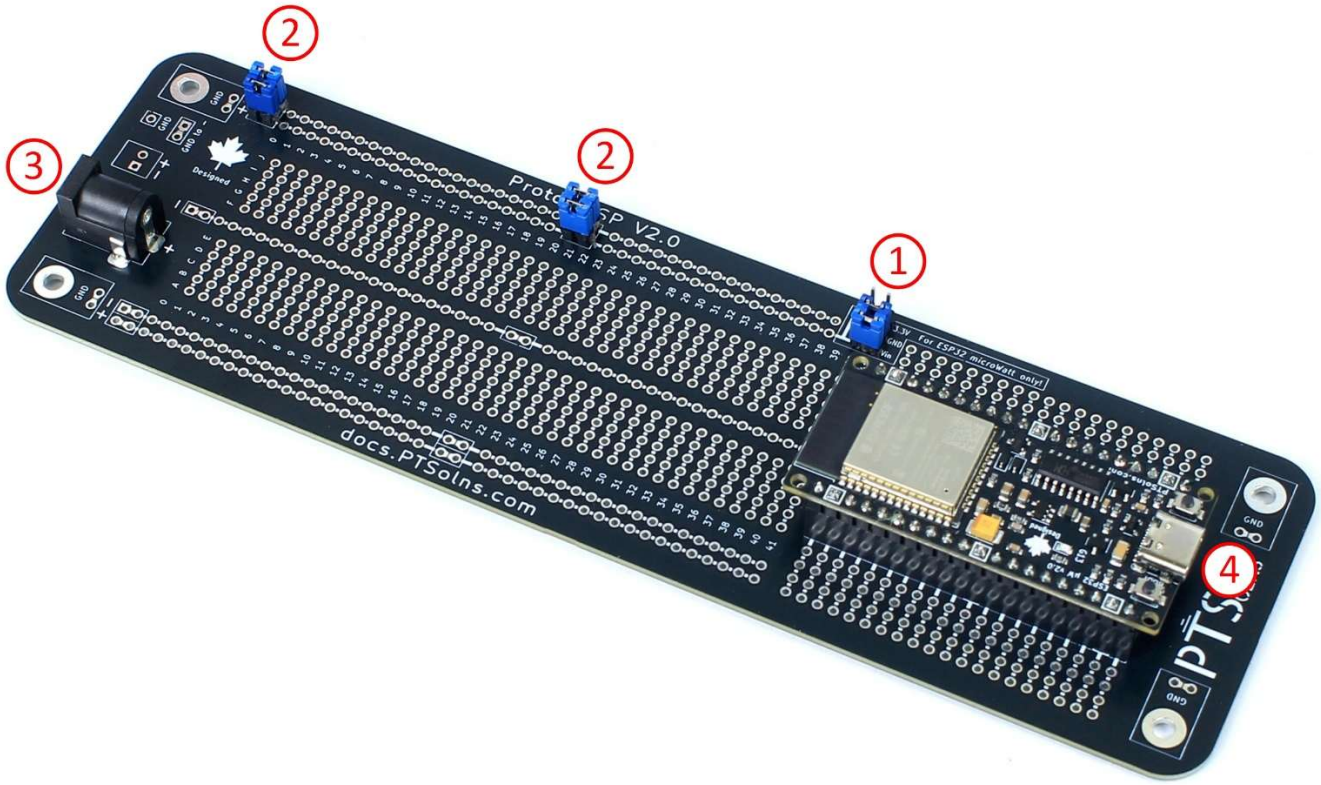

Figure 17: Example setup up of the Proto-ESP and the ESP32 microWatt.

7 REFERENCES

This section lists relevant references.

- **How to solder jumper pads – video:**
  - https://youtu.be/AOkdQ0txKpA
- **PTSolns Documentation Repository:**
  - https://docs.PTSolns.com
- **PTSolns website**
  - https://PTSolns.com
- **PTSolns support**
  - https://PTSolns.com/pages/contact