Protect+: 7-60 V DC, 28 A, Solid-State Power Management Module with Over/Under Voltage, Over-Current Protection, and Ideal Diode

1. Features

- Wide **7 to 60 V Input Voltage** with fully adjustable UV/OV thresholds
- Latch-off over-current protection (50 ms) with adjustable cut-off
- Adjustable 0.5-5.4 V Under-Voltage hysteresis for long cable drops
- 28 A continuous current rating
- Reverse Current Blocking due to ideal diode functionality
- High-Current XT-60 Connectors with connecting pair and heat shrink included
- 40 A Series fuse for secondary level protection
- Soft-start for mitigating high-inrush currents.
- [Optional] Switch enable function
- [Optional] Isolated Fault output
- [Optional] Isolated Sleep input

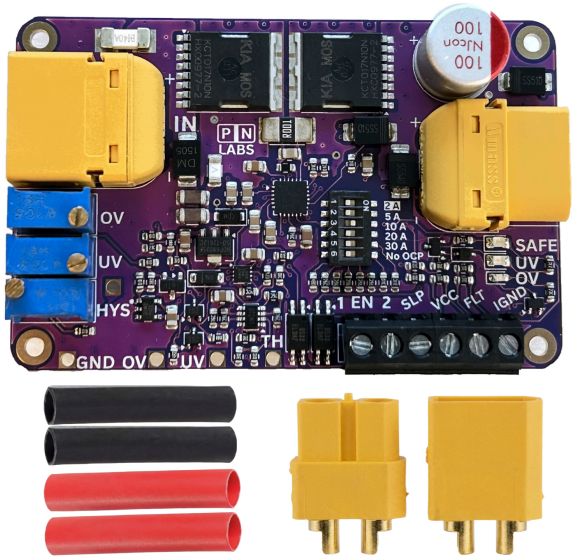
2. Applications

- Battery over-discharge protection
- ORing of power supplies
- High-side power input protection and load switch
- Over-current protection device for robotics development

3. Description

The Protect+ is a highly configurable power electronic fuse (e-Fuse) that offers the complete set of protective features for common power faults. It sits between your power source and load, continuously monitoring input conditions and disconnecting the load if unsafe conditions are detected. It supports a wide 7 to 60 V input range and can be adjusted to block any voltage between those values, with the absolute maximum FET breakdown voltage nearing 100 V DC. With nominally 6 mΩ of series resistance, and easily adjustable under-voltage fixed-band hysteresis, it is a widely applicable and power-dense protective device. Its compact, high current design with ideal diode functionality also allows it to be used to isolate multiple power supplies in parallel, known as power ORing.

Product Photo:



4. Revision History

- June 2026 - Released
- November 7, 2026 - Updated set-up guide to be more concise and added statistical data relating to trip current and no-load current

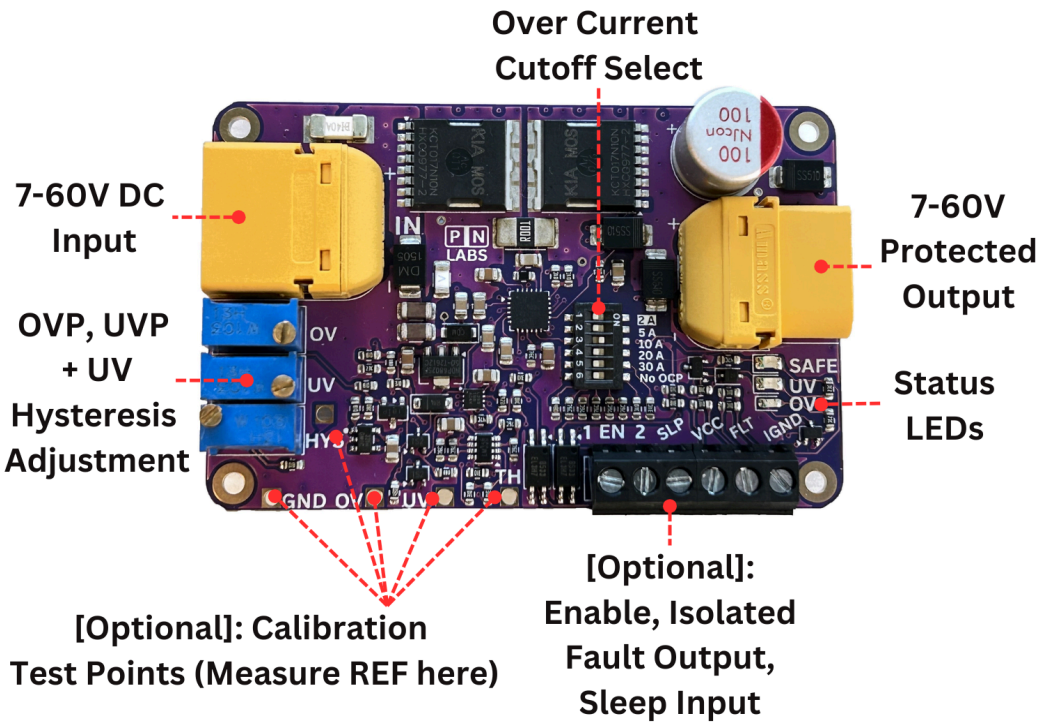
5. Safety Disclaimer

During normal operation at high currents, this product can get hot enough to burn you. Take care when handling this product or other components connected to it.

Not warranted for use in safety-critical systems as a replacement for UL or CSA certified branch-level circuit breakers. This product is a supplemental protective component for integration.

Not respecting the maximum ratings and guides outlined in this data sheet may result in damage to the product and/or your circuit. You are responsible for the safe integration of this module into your system.

6. Board Diagram and Setup Guide



Step 1:
Decide your undervoltage (UV), over-voltage (OV) and over-current protection (OCP) threshold values for your application that you want to protect against.

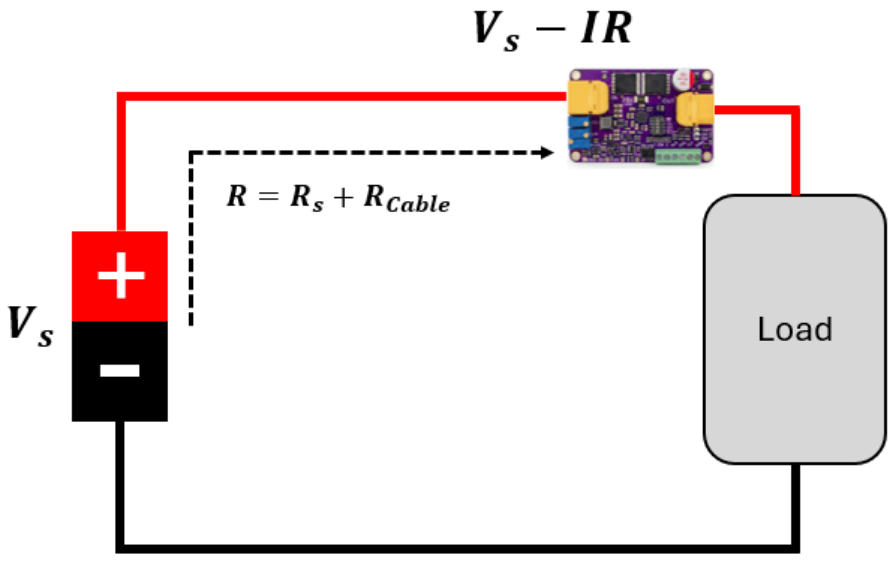
UV = _____

OV = _____

OCP = _____

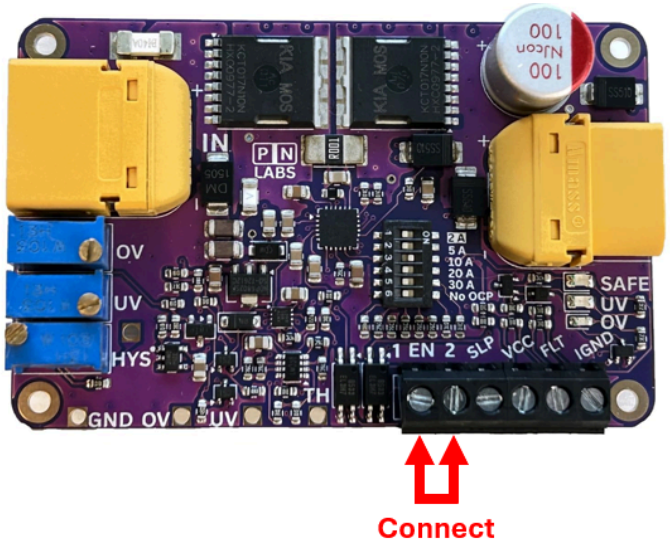
We recommend adding at least 2.5 V (HYS = 86 mV) of under-voltage hysteresis to avoid problems with chatter under high loads, so the under voltage setting now becomes:

UV_{rising} = UV + 2.5 V
$UV_{falling}$ = UV

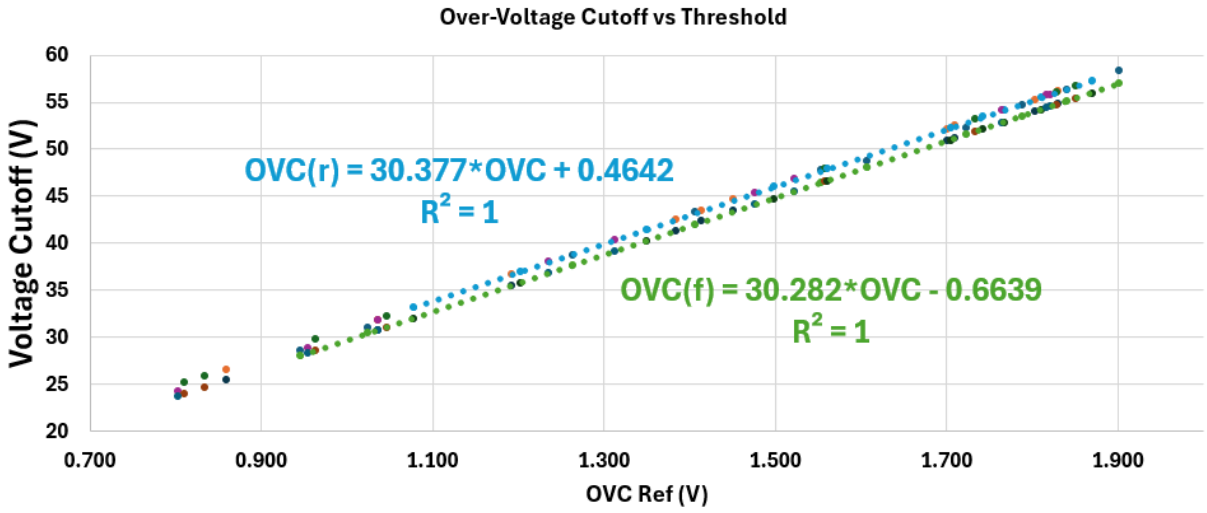


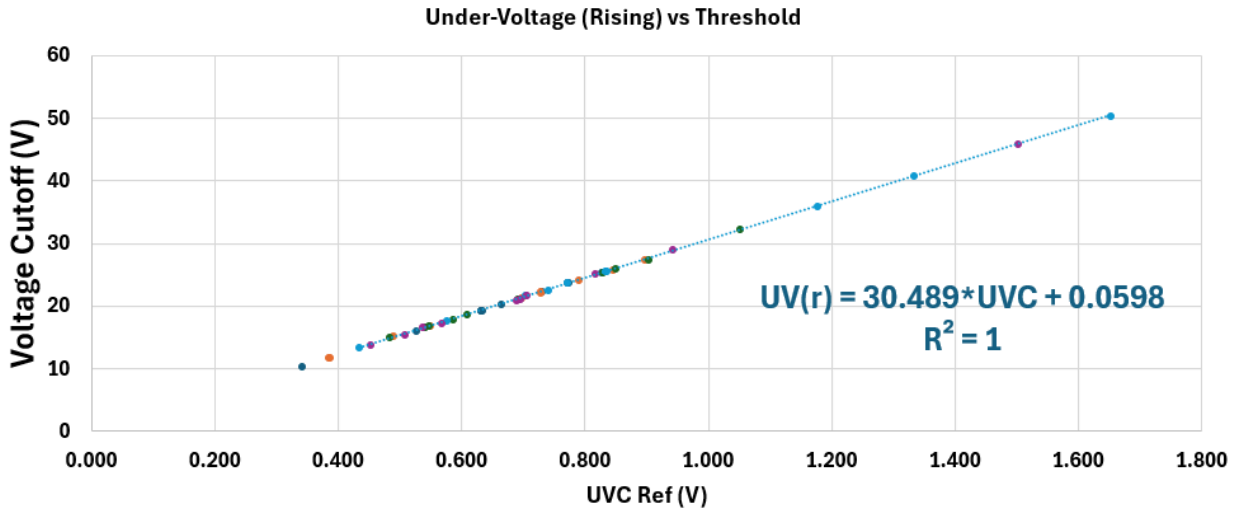
Voltage drop can cause UVLO chatter under high-currents. If the load is persistent (i.e. a constant, high-power resistive load), this chatter combined with the soft-start feature can be severe enough to cause the pass MOSFET to fail short.

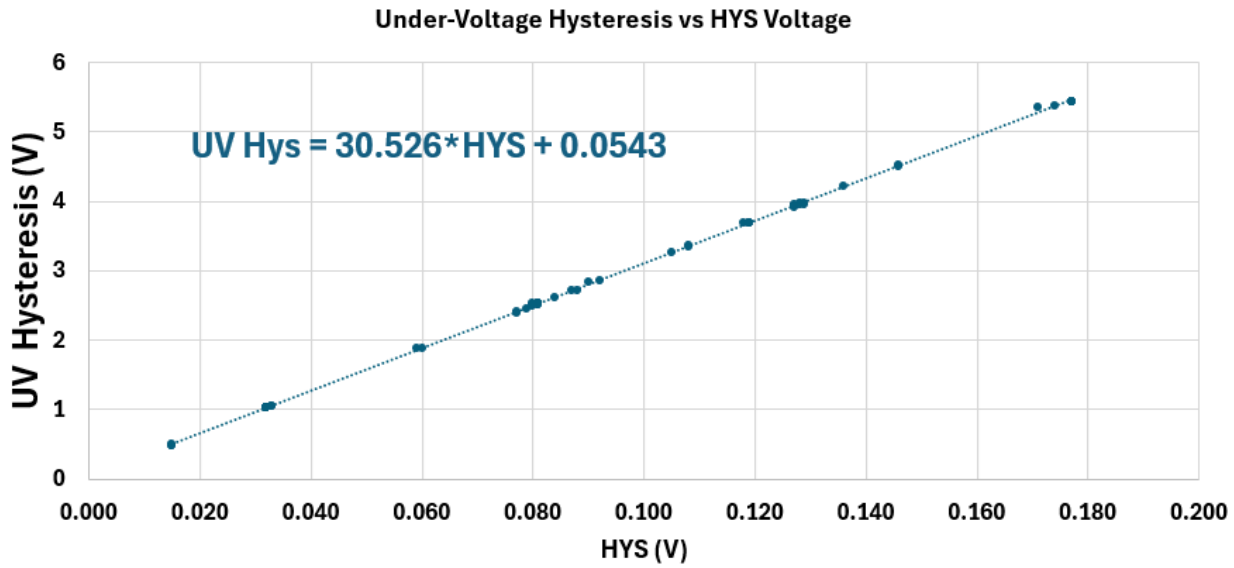
Step 2:
Using a piece of wire or the leads of your on/off switch, short the ENABLE pins together to put the board in set-up mode and then proceed to step 3.



Step 3:
Visit the Protect+ description on pnlabs.ca to find the **Thresholds Calculator** to find what OV, UV, and HYS pad voltages to set to achieve your desired settings from steps 1 and 2, **OR** use the equations shown below:







Step 4:
Select the OCP dip switch corresponding to the desired trip current, else the unit won't turn on. See appendix for typical OCP accuracy. Apply power to the Protect+. **The red UV LED should be on**, indicating that it is in set-up mode.

Using a flat-tip screwdriver and multimeter, dial in the OV, HYS, and then finally UV pad voltages identified in Step 3.

Step 5 [Optional, but highly recommended]:
Use an adjustable power supply to verify the settings by changing the voltage and watching the UV (red), SAFE (green), and OV (blue) LEDs trigger.

7. Specifications

Stresses beyond those listed under Section 7.1 may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Section 7.2. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

7.1 Absolute Maximum ratings

At 25 °C ambient temperature.

	MIN	NOM	MAX	UNIT
Input Voltage	6.5	-	65	V
MOSFET Drain-Source Voltage (Max DC Blocking Voltage)	-	-	100	V
Vcc (Isolated Fault Pull-up)	1.8	-	30	V
SLEEP (SLP) Voltage Input	2.7	-	15	V
Continuous Output Current	-	-	30	A

7.2 Recommended Operating Conditions

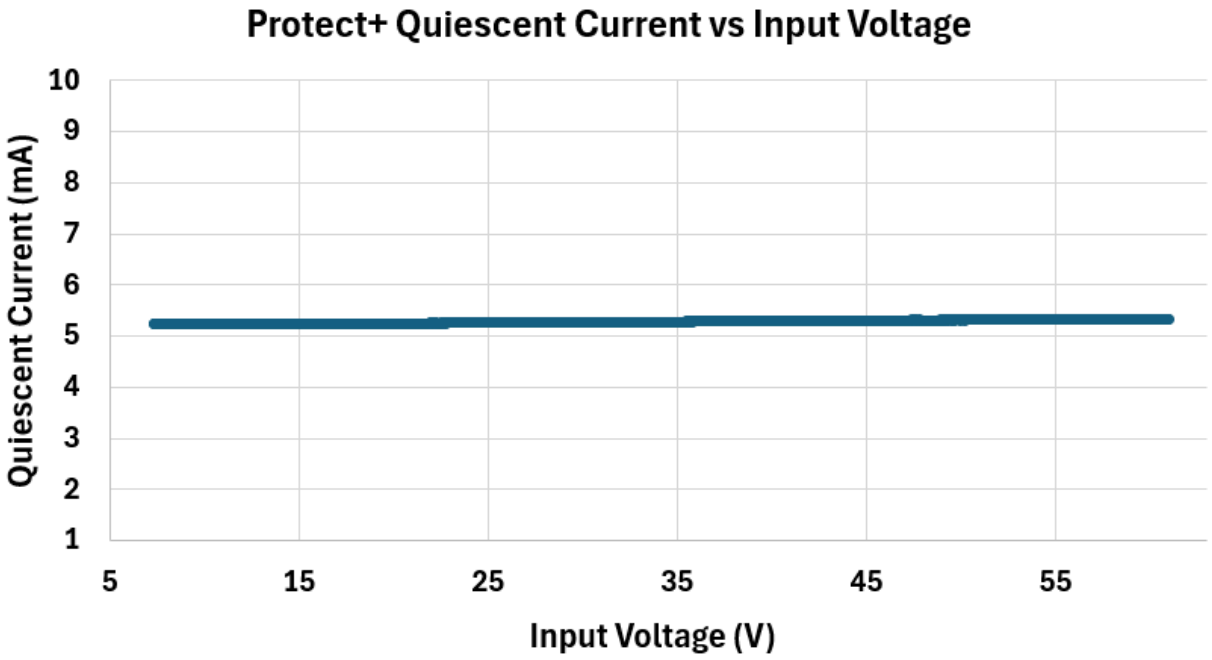
At 25 °C ambient temperature.

	MIN	NOM	MAX	UNIT
Input Voltage	7	-	60	V
Vcc (Isolated Fault Pull-up)	2	-	25	V
SLEEP (SLP) Voltage Input	3	-	12	V
Continuous Output Current	-	-	28	A

7.3 Electrical Characteristics

At 25 °C ambient temperature.

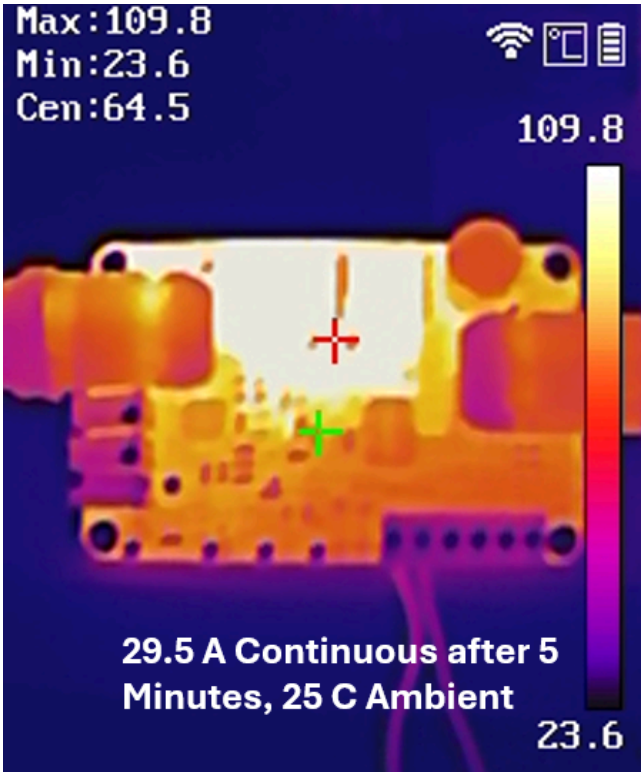
	MIN	NOM	MAX	UNIT
Nominal Series Resistance	-	6	-	mOhm



The quiescent current is measured at no-load with the green SAFE LED on.

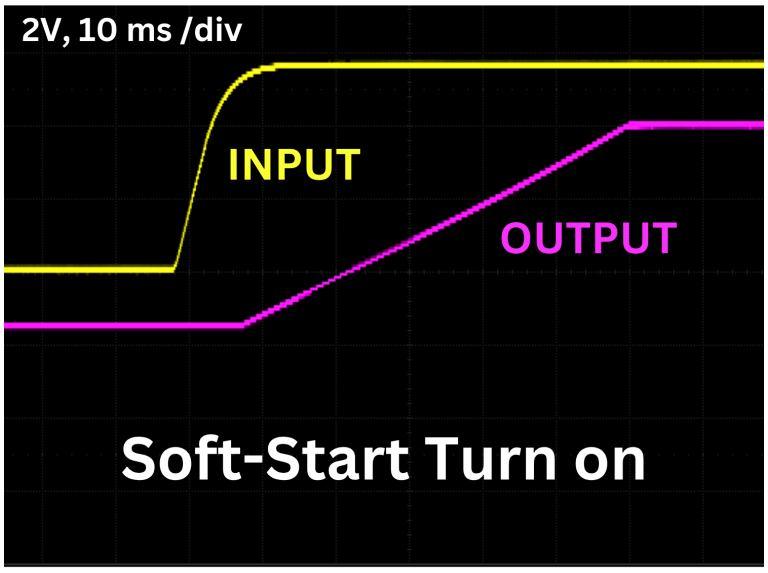
7.4 Thermal Information

30 V input, drawing 29.5 A for 5 minutes:



7.5 Soft-start Behavior on Start-up

The soft-start protection window is shown below. The Protect+ is unloaded and not passing any current in this setup.



As can be seen, the Protect+ does not immediately begin ramping upon power on, owing to the UVLO threshold. Once the voltage rises above this value, it begins to ramp at approximately 0.2 V/ms until the maximum value is reached.

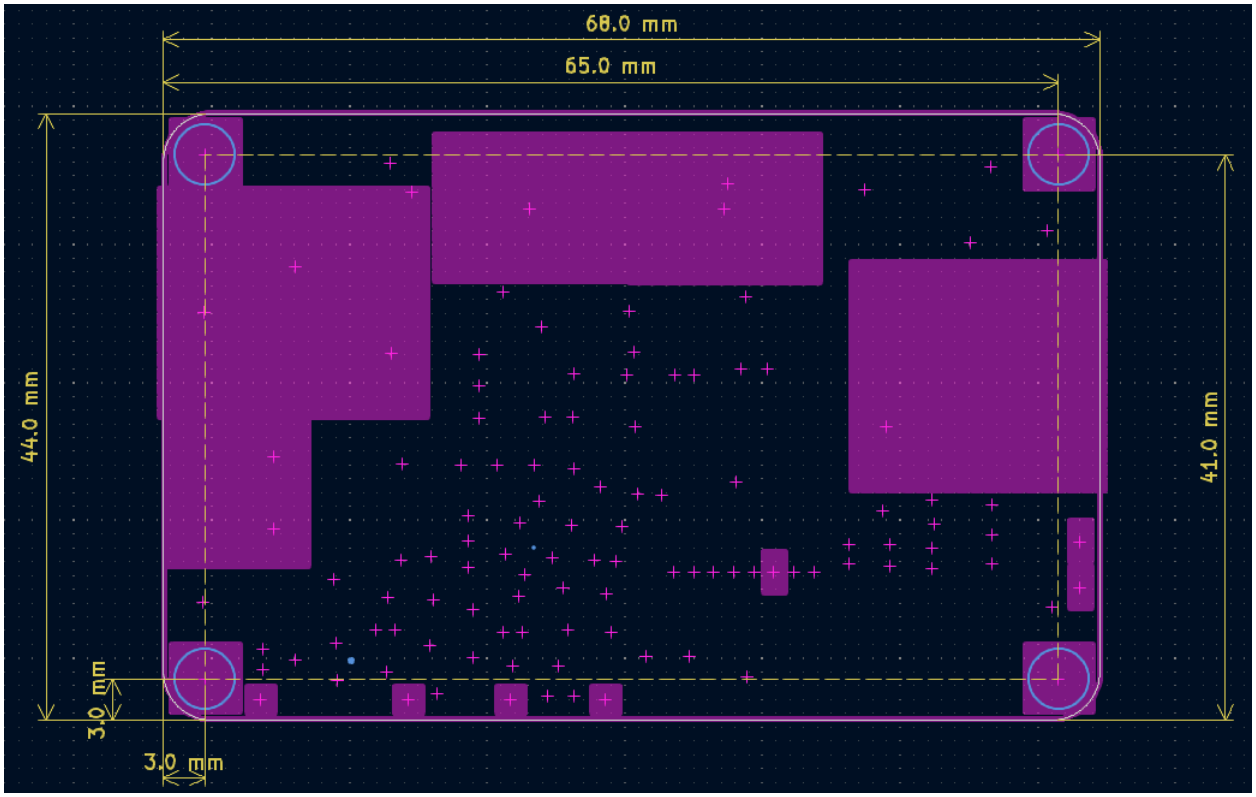
7.6 Typical Failure Modes

As with many semiconductors, MOSFETs fail short when overstressed by excessive voltage or high current. This means that the module will not protect against voltages higher than the maximum rated value in this datasheet and can let current through uninterrupted if the ratings are not respected. To this end, the Protect+ uses a 40 A series fuse as a secondary layer of protection.

This specific class of module uses MOSFETs for their speed and solid-state reliability. If you want a circuit with a higher isolation voltage (and can withstand higher voltage faults), we recommend looking into conventional relay-based protection solutions.

8. Mechanical Dimensions

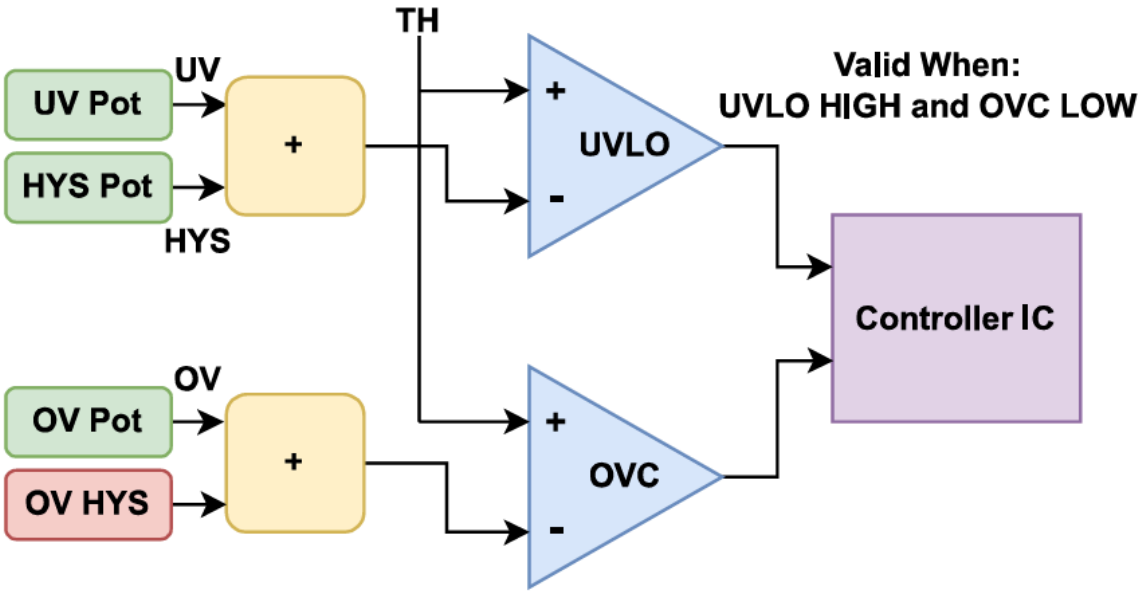
The hole sizes are M2 (⌀2.2 mm). The STEP file for the board can be downloaded from pnlabs.ca for insertion into your favorite CAD software.



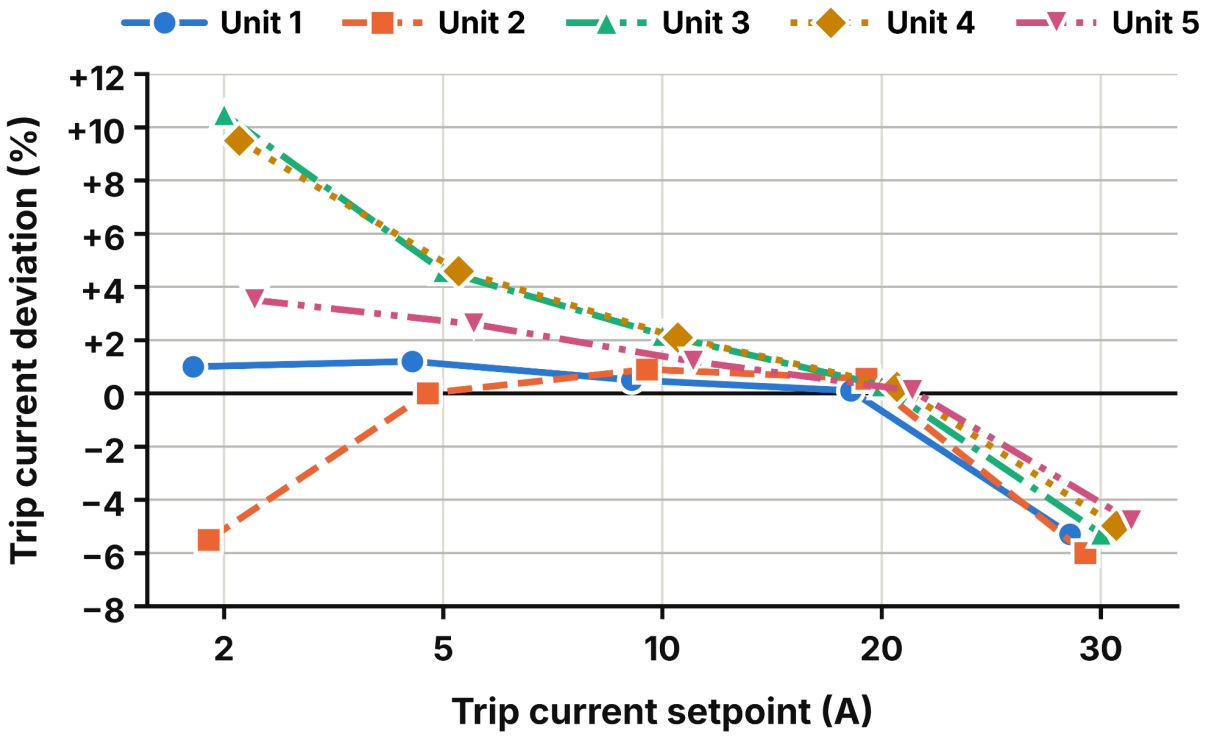
Further Questions? Reach out to support@pnlabs.ca

Appendix:

The relationship between the voltage comparison threshold (TH), UV, OV and HYS is captured by the block diagram below:



- **TH** is a scaled down version of the input voltage (0.0328*Vin).
- **UV** is the under-voltage reference which is added to the HYS value to trigger the UVLO comparator
- **OV** is the over-voltage reference



Typical OCP accuracy as a percentage of the trip current setpoint set by DIP switch. The 5 samples were selected at random from a production batch of 300.