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 0.9-5.2 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

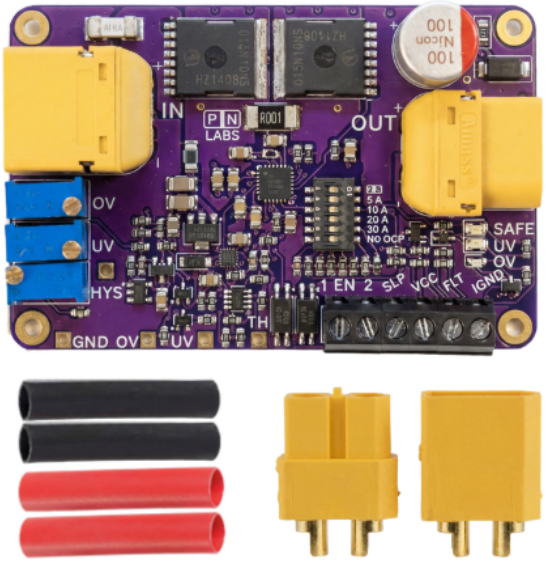
2. Applications

- Battery over-discharge protection
- Paralleling of power supplies
- High-side power input protection and load switch
- Over-current protection device

3. Description

The Protect+ is a versatile power management module that protects against a variety of 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 5 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

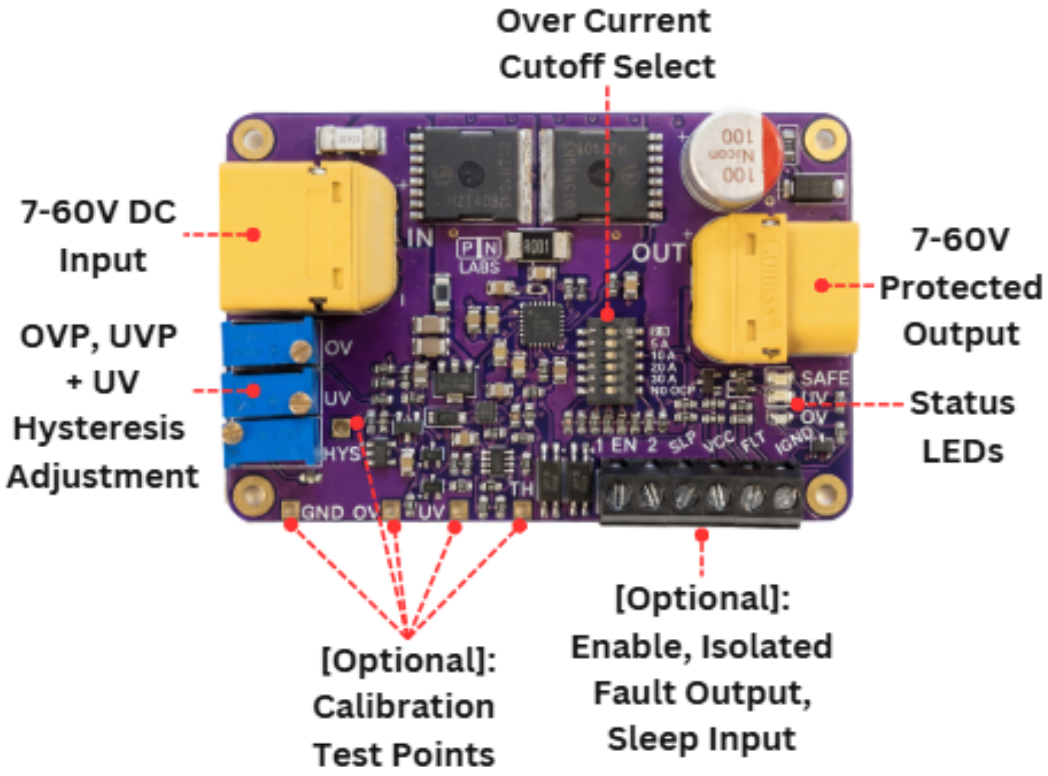
5. Safety Disclaimer

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.

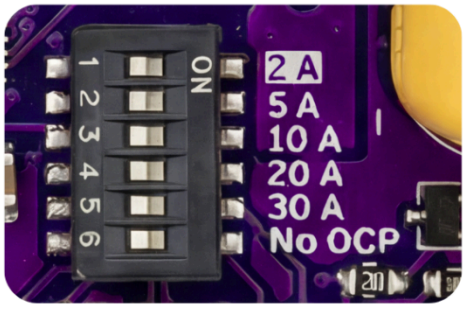
Not respecting the maximum ratings and guides outlined in this data sheet may result in damage to the product and/or your circuit. You are responsible for the safe integration of this module into your system.

6. Board Diagram and Setup Guide



Configuration

OCP Setting Switch



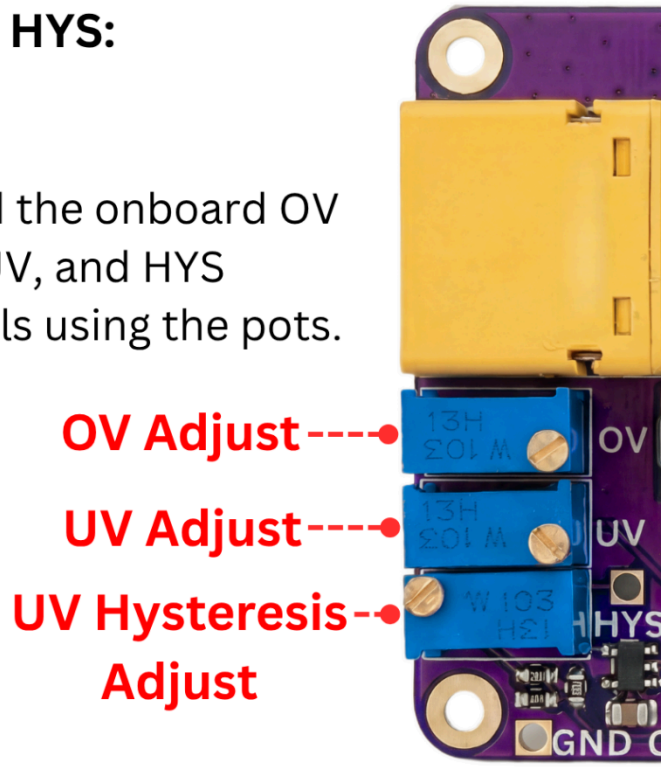
1. Over Current (OCP) Limit:

Flip ONE switch ON to configure it to corresponding limit.

2. Set OV, then UV, then HYS:

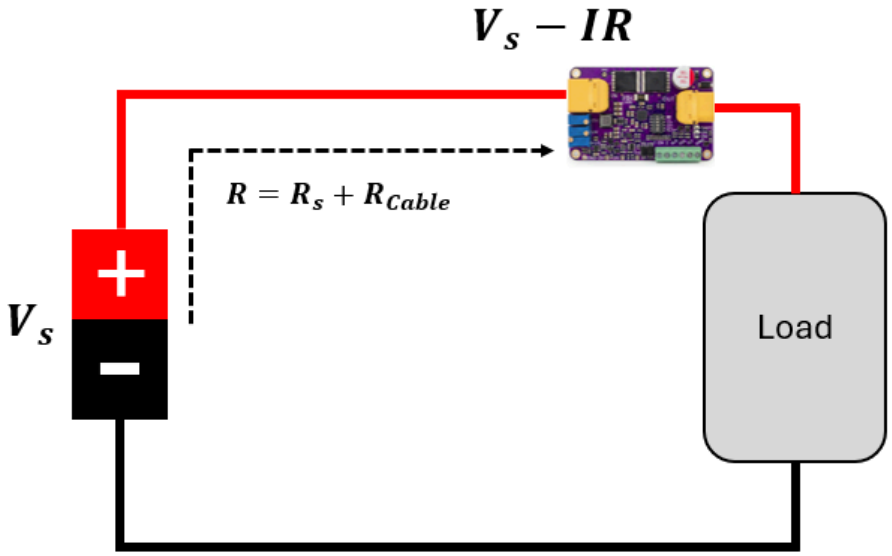
Method 1 (Fast):
Use an adjustable PSU and the onboard OV and UV LEDs to tune OV, UV, and HYS cutoffs to the desired levels using the pots.

Method 2 (Precise):
Measure OV, UV, and HYS with a multimeter while adjusting each pot to the value calculated from the datasheet.



To use the Protect+ under-voltage feature effectively, you must add the appropriate amount of under-voltage hysteresis to account for any cable drop, particularly when working with long cables (more than ~3 ft) or thin wires.

Without adding enough hysteresis, the voltage auto-recovery feature can cause the module to turn back on as the voltage rises when the current drops to zero, leading to unexpected power blips and restarts:



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.

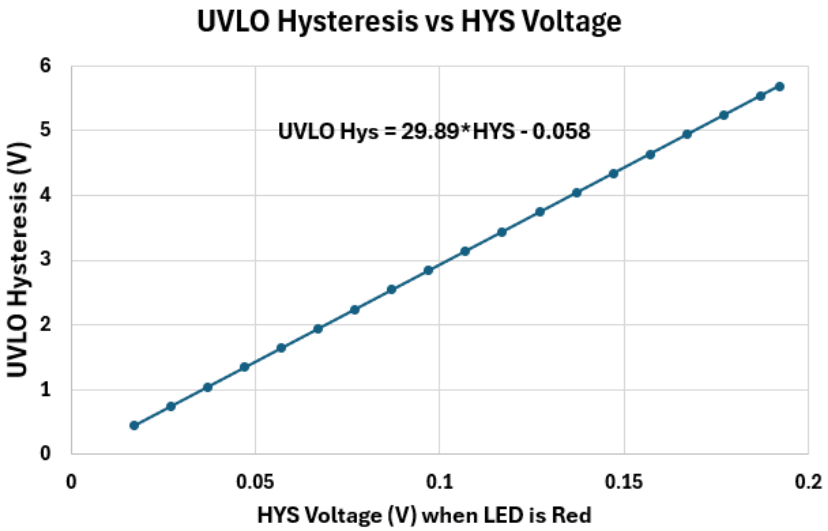
To this end, we recommend **2.5 V of UVLO hysteresis (HYS = 0.086 V)** for most projects. If you plan to run long or thin wires at high currents, more hysteresis should be added.

To set up the Protect+ for protection operation in the quickest possible way:

1. Select the OCP dip switch corresponding to the desired trip current. It will be accurate to within +/- 5%
2. Connect an adjustable power supply to the module, and leave the output to the load unconnected.
3. Apply power and note whether the **SAFE**, **UV**, **OV** leds come on. Using a screwdriver, tune the UV and OV values to the desired triggering setpoints.
4. Connect the load with the power supply turned off.

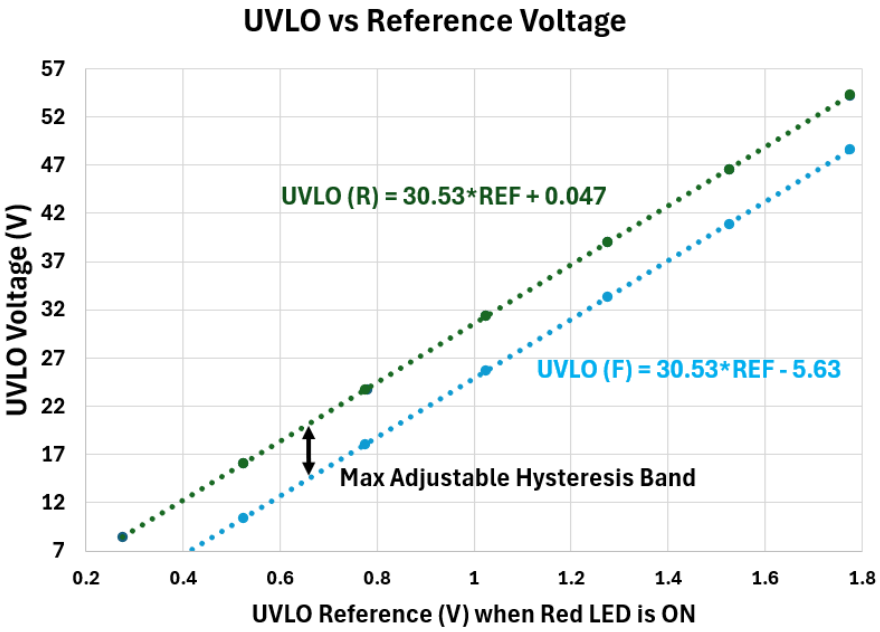
Supporting Charts

Shown below is the HYS pad voltage (measured when the red LED is on) versus UVLO hysteresis added, in volts. :

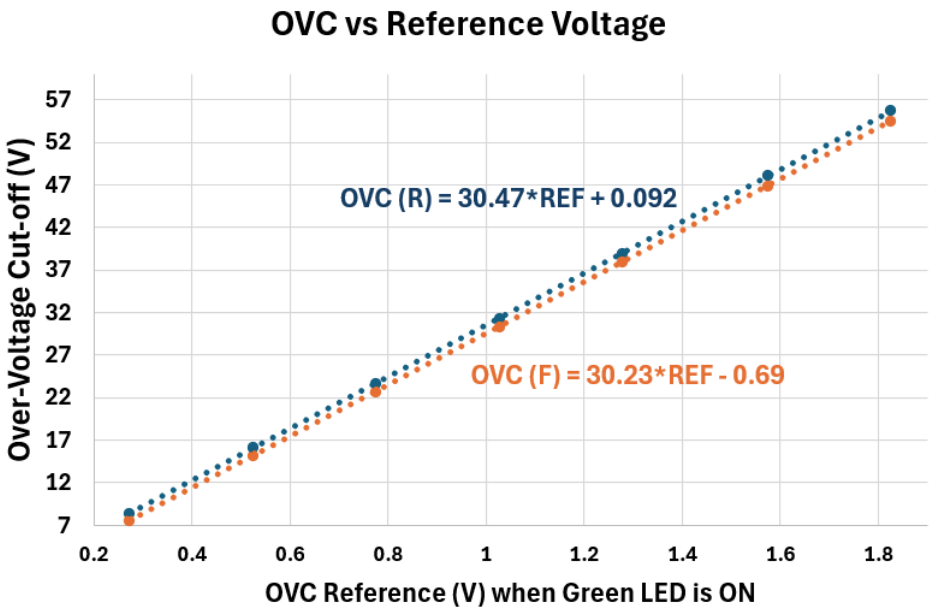


The max UVLO hysteresis that can be added is 5.2 V (HYS = 176 mV) and the minimum is 0.9 V (HYS = 32 mV).

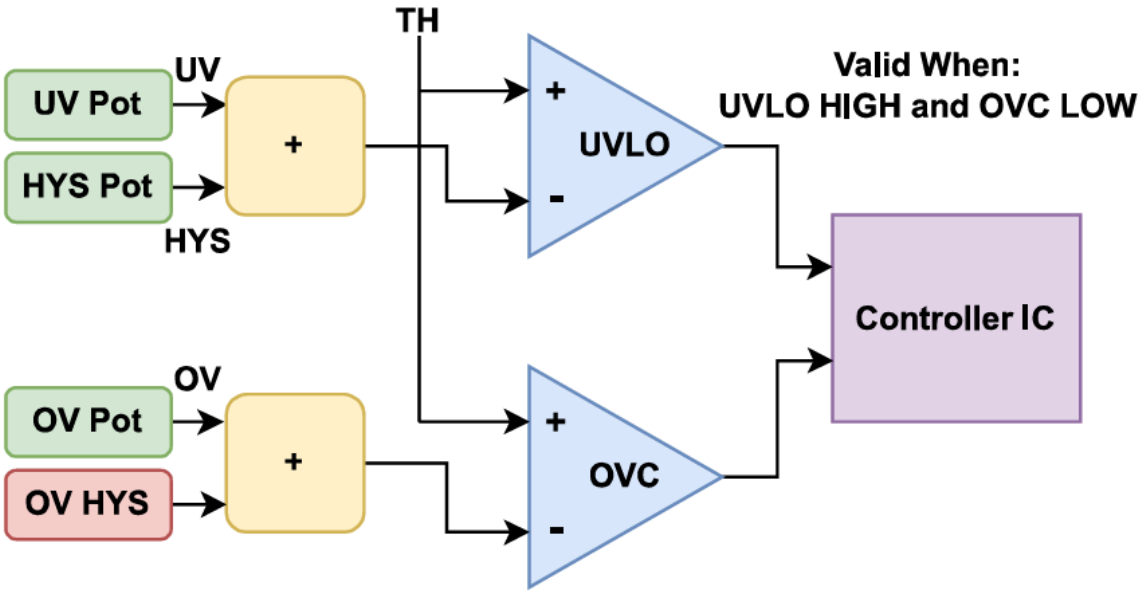
The effect of adding UVLO hysteresis is to shift the blue falling line downwards, away from the green rising line which is fixed:



The OV cutoff vs reference voltage is shown below. Its hysteresis is not user-adjustable because it does not suffer from the same fundamental issue as UVLO:



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

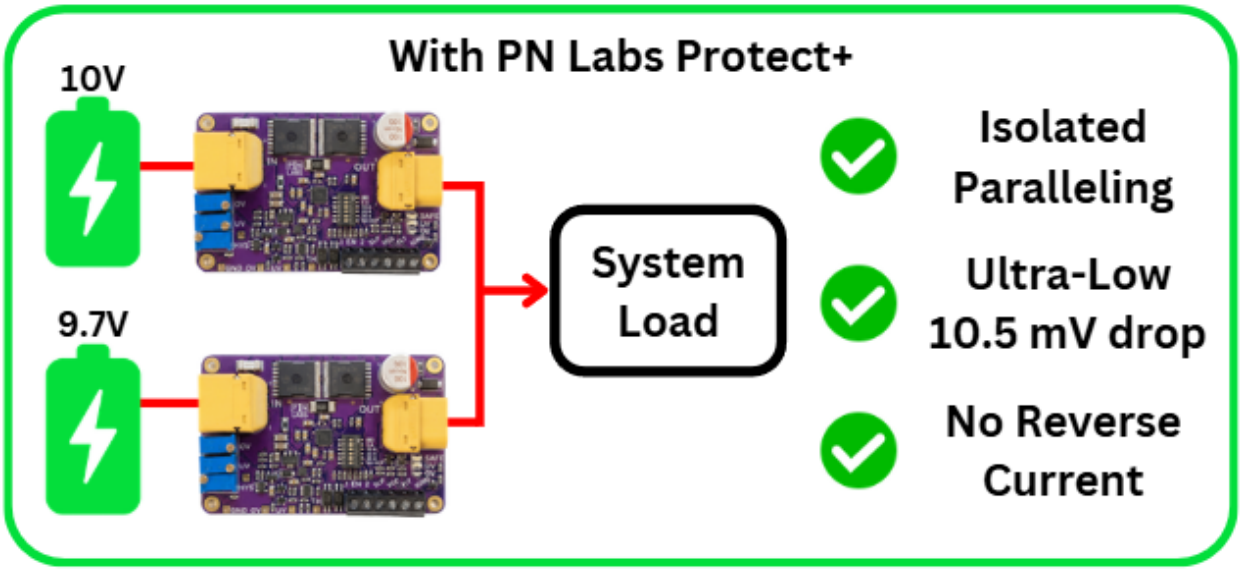


- **TH** is a scaled down version of the input voltage (0.0328*Vin).

- **UV** is the under-voltage reference which is added to the HYS value to trigger the UVLO comparator
- **OV** is the over-voltage reference

Parallel Operation for Power ORing:

For **parallel operation**, use one Protect+ module per power source, and connect them to a common bus using wires that are roughly equal length so that voltage drop across the cabling is similar:



Please note that the Protect+ module does not ensure that the supplies share the current equally when put in parallel - that comes from ensuring both supplies are near the same voltage, about 50 mV.

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

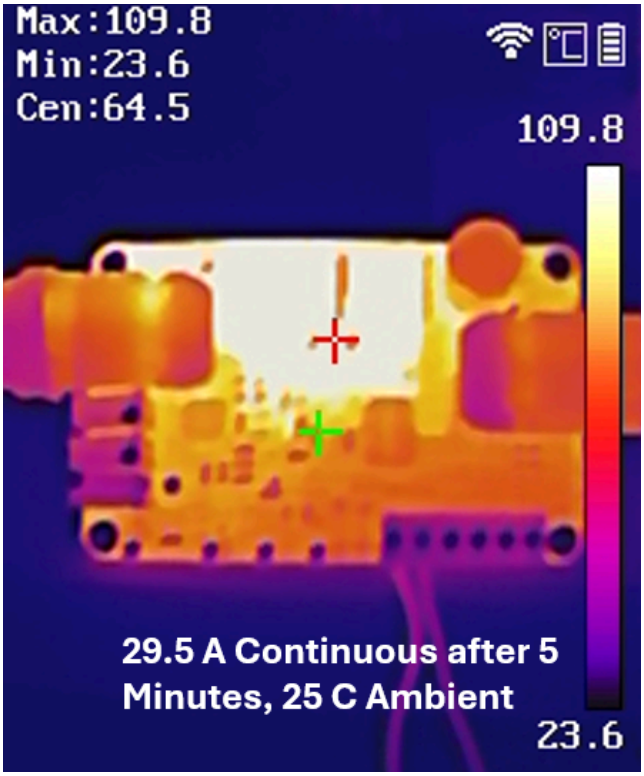
7.3 Electrical Characteristics

At 25 °C ambient temperature.

	MIN	NOM	MAX	UNIT
Nominal Series Resistance	-	5.3	-	mOhm
Typical current draw under no-load	2	5	7	mA

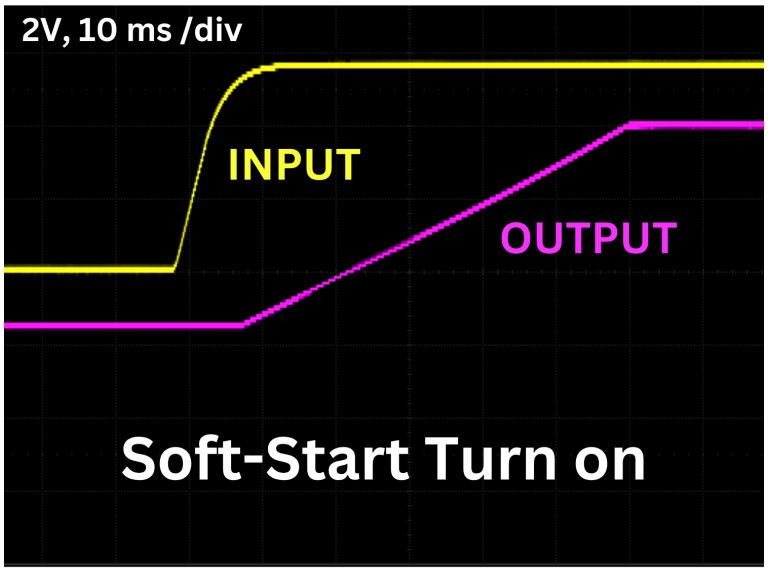
7.4 Thermal Information

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.

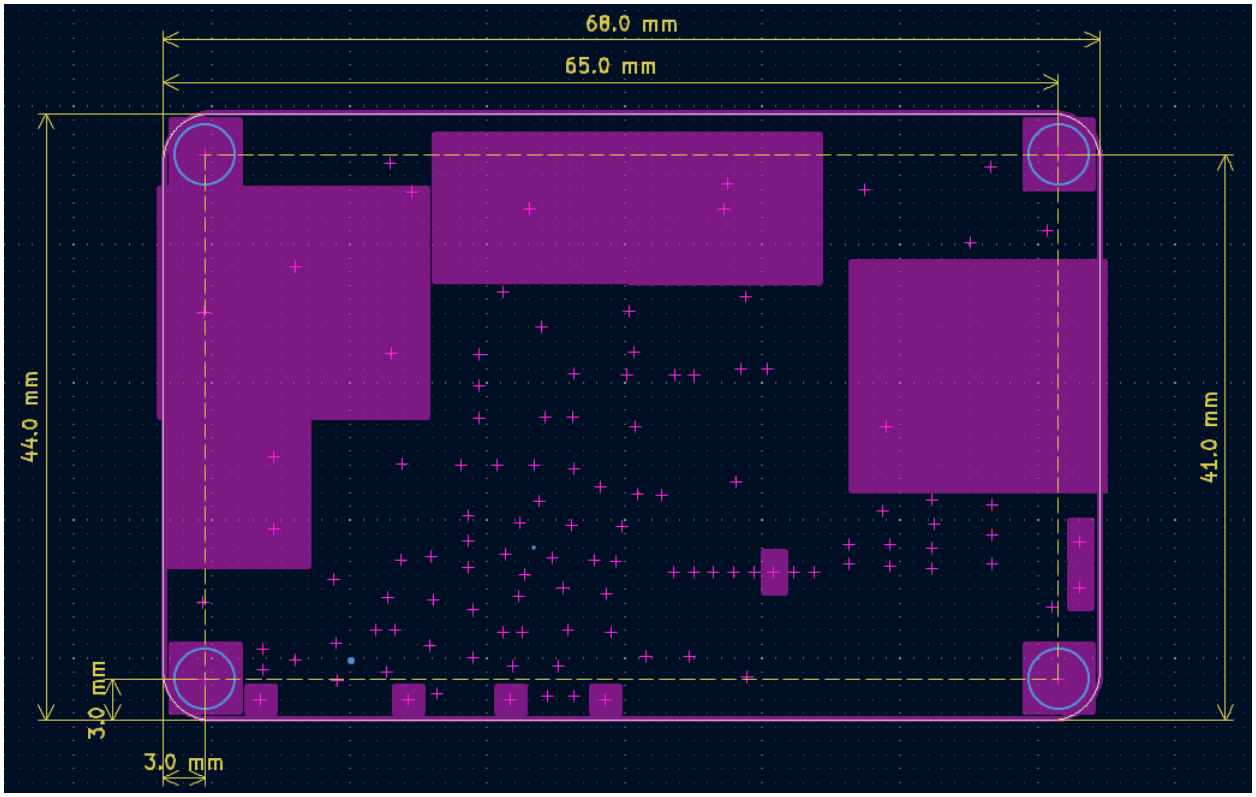
7.6 Typical Failure Modes

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 (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 and we'll answer!