

# Productivity®Open Overview

ProductivityOpen leverages the modern processing power of Arduino and the proven industrial value of the Productivity1000 input and output modules. Make use of the wide variety of Arduino MKR form factor shields.

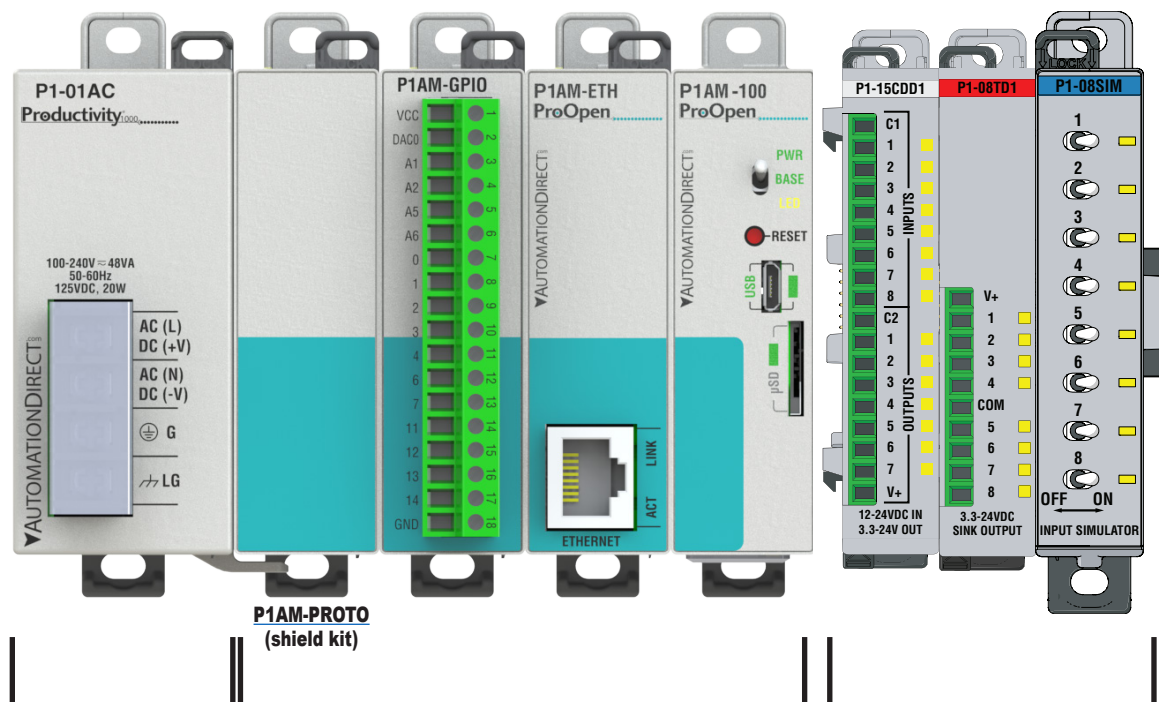
The P1AM-100 module is programmed with the Arduino IDE or ProductivityBlocks, an optional proprietary block programming environment.

## Features

- Supports Productivity1000 inputs and outputs modules
- Supports Arduino MKR form factor shields
- UL listed CPU
- UL listed ProductivityOpen branded shields



| Productivity®Open Modules |          |                                |
|---------------------------|----------|--------------------------------|
| Part Number               | Price    | Description                    |
| <b>P1AM-100</b>           | \$69.00  | Arduino compatible CPU         |
| <b>P1AM-ETH</b>           | \$55.00  | Ethernet shield                |
| <b>P1AM-GPIO</b>          | \$61.00  | Extended I/O shield            |
| <b>P1AM-PROTO</b>         | \$44.50  | Custom housing kit             |
| <b>P1AM-START1</b>        | \$288.00 | Maker community start kit      |
| <b>P1AM-START2</b>        | \$223.00 | Industrial community start kit |



**Productivity1000  
Power Supply**

**The power of Arduino in  
ProductivityOpen.**

**Productivity1000  
Input and Output  
Modules**

# Productivity®Open Overview

## Productivity1000 I/O Modules

A variety of discrete and analog I/O modules from our Productivity1000 line are available for use with the [P1AM-100](#).

### Productivity1000 Discrete Modules

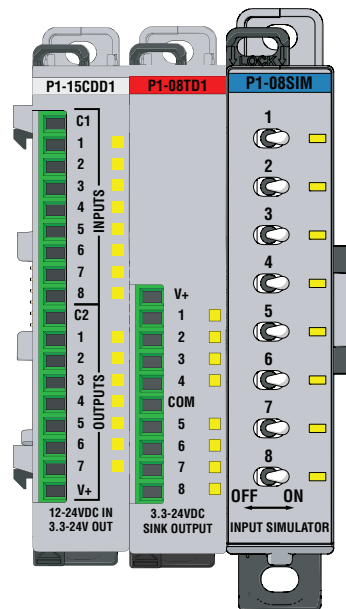
| Part Number                 | Number of Inputs     | Description                         |
|-----------------------------|----------------------|-------------------------------------|
| <b>Input Modules</b>        |                      |                                     |
| <a href="#">P1-08SIM</a>    | 8                    | Input Simulator Module              |
| <a href="#">P1-08ND3</a>    | 8                    | Sinking/Sourcing<br>12–24 VDC Input |
| <a href="#">P1-16ND3</a>    | 16                   | Sinking/Sourcing<br>12–24 VDC Input |
| <a href="#">P1-08NE3</a>    | 8                    | Sinking/Sourcing<br>24V AC/DC       |
| <a href="#">P1-16NE3</a>    | 16                   | Sinking/Sourcing<br>24V AC/DC       |
| <a href="#">P1-08NA</a>     | 8                    | AC Isolated<br>100–240 VAC          |
| <b>Output Modules</b>       |                      |                                     |
|                             | Number of<br>Outputs |                                     |
| <a href="#">P1-08TD1</a>    | 8                    | Sinking DC Output                   |
| <a href="#">P1-08TD2</a>    | 8                    | Sourcing DC Output                  |
| <a href="#">P1-15TD1</a>    | 15                   | Sinking DC Output                   |
| <a href="#">P1-15TD2</a>    | 15                   | Sourcing DC Output                  |
| <a href="#">P1-08TA</a>     | 8                    | AC Output                           |
| <a href="#">P1-08TRS</a>    | 8                    | Isolated Relay Output               |
| <a href="#">P1-16TR</a>     | 16                   | Relay Output                        |
| <b>Input/Output Modules</b> |                      |                                     |
|                             | Inputs               | Outputs                             |
| <a href="#">P1-15CDD1</a>   | 8                    | 7                                   |
| <a href="#">P1-15CDD2</a>   | 8                    | 7                                   |
| <a href="#">P1-16CDR</a>    | 8                    | 8                                   |

### Productivity1000 Specialty Modules

| Part Number              | Description                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Input Modules</b>     |                                                                                                                                                                   |
| <a href="#">P1-04PWM</a> | 4 channels of sinking/sourcing 0–20 kHz, 0–100% duty cycle outputs                                                                                                |
| <a href="#">P1-02HSC</a> | 2 independent single-ended 5–24 VDC inputs that accept up to 100kHz of pulse/direction and quadrature signals and 2 - 5–24 VDC general-purpose high-speed inputs. |

### Productivity1000 Analog Modules

| Part Number                   | Number of Inputs     | Description               |
|-------------------------------|----------------------|---------------------------|
| <b>Input Modules</b>          |                      |                           |
| <a href="#">P1-04AD</a>       | 4                    | Analog Input (Current)    |
| <a href="#">P1-04ADL-1</a>    | 4                    | Analog Input (Current)    |
| <a href="#">P1-04ADL-2</a>    | 4                    | Analog Input (Voltage)    |
| <a href="#">P1-08ADL-1</a>    | 8                    | Analog Input (Current)    |
| <a href="#">P1-08ADL-2</a>    | 8                    | Analog Input (Voltage)    |
| <a href="#">P1-04RTD</a>      | 4                    | RTD Input                 |
| <a href="#">P1-04THM</a>      | 4                    | Analog Thermocouple Input |
| <a href="#">P1-04NTC</a>      | 4                    | Analog Thermistor Input   |
| <b>Output Modules</b>         |                      |                           |
|                               | Number of<br>Outputs |                           |
| <a href="#">P1-04DAL-1</a>    | 4                    | Analog Output (Current)   |
| <a href="#">P1-04DAL-2</a>    | 4                    | Analog Output (Voltage)   |
| <a href="#">P1-08DAL-1</a>    | 8                    | Analog Output (Current)   |
| <a href="#">P1-08DAL-2</a>    | 8                    | Analog Output (Voltage)   |
| <b>Input/Output Modules</b>   |                      |                           |
|                               | Inputs               | Outputs                   |
| <a href="#">P1-4ADL2DAL-1</a> | 4                    | 2                         |
| <a href="#">P1-4ADL2DAL-2</a> | 4                    | 2                         |



# P1AM-100 Arduino Compatible CPU

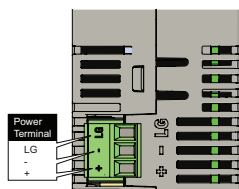
## P1AM-100 \$69.00

The P1AM-100 is an Arduino-compatible CPU. It uses the Atmel SAMD21G18 microcontroller and can be programmed using Arduino IDE or ProductivityBlocks. It interfaces with all Productivity1000 Series I/O modules connected to the right side

of the P1AM-100 and most Arduino MKR form factor shields connected to the left side. The specifications are listed in the tables below.



P1AM-100



### User Specifications

|                                                    |                                                                                                                                                                                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>User Memory</b>                                 | 256kB Flash with 10kB used for bootloader                                                                                                                                                                       |
| <b>Memory Type</b>                                 | Flash: 256kB, SRAM: 32kB                                                                                                                                                                                        |
| <b>Base Controller and I/O Power Requirement 1</b> | 24VDC $\pm 2\%$<br>Plan 0.5 W for the SAMD chip and base controller<br>Plan 1.25 W per P1000 I/O module<br>Plan 9W for max. header power draw (which provides max. 4.25 W power to left side connected shields) |
| <b>Recommended Fuse (External)</b>                 | Edison S5061-R, Time Delay, 1A Fuse<br>For 9–15 modules: Edison S5062-R, Time Delay, 2A Fuse                                                                                                                    |
| <b>Peripherals</b>                                 | MicroB USB, Arduino MKR-compatible, microSD card slot for data logging (32GB max), User controlled LED                                                                                                          |
| <b>Hardware Limits of System 2</b>                 | 15 Productivity1000 I/O Modules;<br>Arduino MKR shields                                                                                                                                                         |
| <b>Programming</b>                                 | Programmed in C/C++ with the Arduino IDE or ProductivityBlocks                                                                                                                                                  |

<sup>1</sup> If you do not use a Productivity1000 power supply, like the P1-01AC, then use a power supply that has transformer isolation. Use different 24VDC supplies for the CPU and inductive loads to keep the CPU power clean and free of voltage spikes caused by switching solenoids, motors and relay coils.

<sup>2</sup> See "MKR Expansion Bus Pins" table and notes for shield power budget restrictions.

### General Specifications

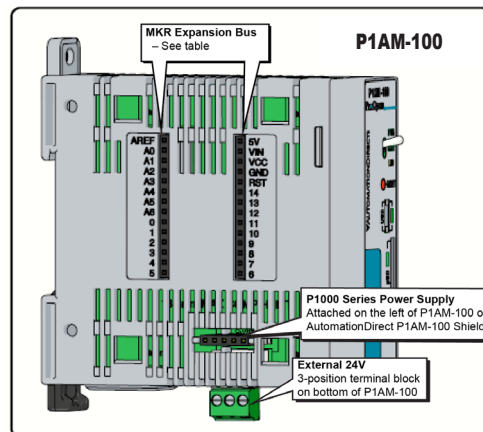
|                              |                                                                                                                                                                       |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Operating Temperature</b> | 0° to 60°C (32° to 140°F)                                                                                                                                             |
| <b>Storage Temperature</b>   | -20° to 70°C (-4° to 158°F)                                                                                                                                           |
| <b>Humidity</b>              | 5 to 95% (non-condensing)                                                                                                                                             |
| <b>Environmental Air</b>     | No corrosive gases permitted                                                                                                                                          |
| <b>Vibration</b>             | IEC60068-2-6 (Test Fc)                                                                                                                                                |
| <b>Shock</b>                 | IEC60068-2-27 (Test Ea)                                                                                                                                               |
| <b>Heat Dissipation</b>      | 4000mW                                                                                                                                                                |
| <b>Enclosure Type</b>        | Open Equipment                                                                                                                                                        |
| <b>Module Location</b>       | Productivity1000 I/O modules connect on the right side of module. Productivity1000 power supply, P1AM Shields and MKR Shields connect on the left side on the module. |
| <b>Weight</b>                | 76g (2.8 oz)                                                                                                                                                          |
| <b>Agency Approvals</b>      | UL 61010-1 and UL 61010-2-201 File E139594, Canada & USA; CE                                                                                                          |

### CPU Status Indicators

|             |                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------|
| <b>PWR</b>  | Green LED is illuminated when power is ON                                                                  |
| <b>BASE</b> | Green LED is illuminated when BASE controller is powered and has been initialized                          |
| <b>LED</b>  | Yellow LED is illuminated when commanded by user program. LED can be referred to as LED_BUILTIN or Pin 32. |

### Toggle Switch Specifications

Switch can be read using the "digitalRead" function. Switch can be referred to as "SWITCH\_BUILTIN" or Pin 31.



### MKR Expansion Bus Pins

|                           |                        |
|---------------------------|------------------------|
| <b>GPIO</b>               | A0–A6, 0–14            |
| <b>Analog Input Pins</b>  | A0–A6                  |
| <b>Analog Output Pins</b> | A0                     |
| <b>PWM Pins</b>           | 0–8, 10, A3, A4        |
| <b>Interrupt Pins</b>     | 0, 1, 4–8, A1, A2      |
| <b>5V</b>                 | 5V supply output       |
| <b>Vin</b>                | 5V regulated supply    |
| <b>VCC</b>                | 3.3 V supply output    |
| <b>GND</b>                | Ground                 |
| <b>RST</b>                | Reset                  |
| <b>AREF</b>               | Analog Input Reference |

#### Critical Notes:

Pins A3, A4, and 8–10 are used for the base controller.  
Do not exceed 46mA combined from pins 0, 1, and 4–10.  
Do not exceed 3.3 V on any I/O pin.  
Do not exceed 7mA on any I/O pin.  
Do not apply power to 5V or VCC

# Shields

## P1AM-ETH

\$55.00

### Ethernet Communications Shield

The P1AM-ETH is a housed Arduino Compatible Ethernet Shield based on the Wiznet W5500 Ethernet Controller. It interfaces to the left side

of the [P1AM-100](#) CPU and most Arduino MKR form factor shields.



### General Specifications

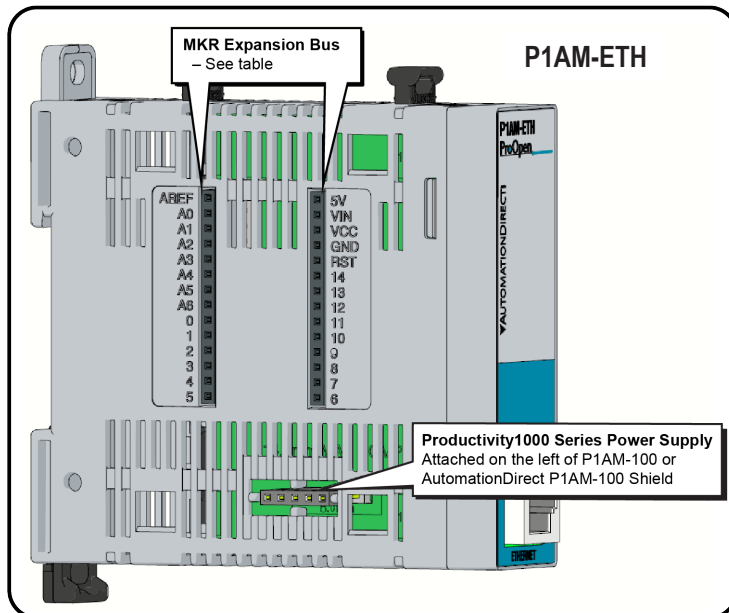
|                              |                                                                   |
|------------------------------|-------------------------------------------------------------------|
| <b>Operating Temperature</b> | 0° to 60°C (32° to 140°F)                                         |
| <b>Storage Temperature</b>   | -20° to 70°C (-4° to 158°F)                                       |
| <b>Humidity</b>              | 5 to 95% (non-condensing)                                         |
| <b>Environmental Air</b>     | No corrosive gases permitted                                      |
| <b>Vibration</b>             | IEC60068-2-6 (Test Fc)                                            |
| <b>Shock</b>                 | IEC60068-2-27 (Test Ea)                                           |
| <b>Heat Dissipation</b>      | 750mW                                                             |
| <b>Enclosure Type</b>        | Open Equipment                                                    |
| <b>Power Budget</b>          | 150mA/5V                                                          |
| <b>Recommended Library</b>   | Arduino Ethernet                                                  |
| <b>Module Location</b>       | Connects to the left side of the <a href="#">P1AM-100</a> CPU.    |
| <b>Weight</b>                | 20g (0.8 oz.)                                                     |
| <b>Agency Approvals</b>      | UL 61010-1 and<br>UL 61010-2-201 File E139594, Canada & USA<br>CE |

### Ethernet Features

- Supports Hardwired TCP Protocols:
- TCP, UDP, ICMP, IPV4, ARP, IGMP, PPPOE
- Supports 8 independent sockets simultaneously
- Supports Power Down Mode
- Supports Wake on LAN over UDP
- Supports High Speed Serial Peripheral Interface (SPI MODE 0, 3)
- Internal 32K bytes of Memory for TX/RX Buffers
- 10BaseT / 100BaseTX Ethernet PHY embedded
- Supports Auto Negotiation (Full and Half Duplex, 10 and 100-based)
- Does Not Support IP Fragmentation
- 3.3 V operation with 5V I/O signal tolerance
- LED outputs (Full / Half duplex, Link, Speed, Active)

### !WARNING!

Do not add or remove modules with field power applied!



### MKR Expansion Bus Pins

|                           |                        |
|---------------------------|------------------------|
| <b>GPIO</b>               | A0–A6, 0–14            |
| <b>Analog Input Pins</b>  | A0–A6                  |
| <b>Analog Output Pins</b> | A0                     |
| <b>PWM Pins</b>           | 0–8, 10, A3, A4        |
| <b>Interrupt Pins</b>     | 0, 1, 4–8, A1, A2      |
| <b>5V</b>                 | 5V supply output       |
| <b>Vin</b>                | 5V regulated supply    |
| <b>VCC</b>                | 3.3 V supply output    |
| <b>GND</b>                | Ground                 |
| <b>RST</b>                | Reset                  |
| <b>AREF</b>               | Analog Input Reference |

#### Critical Notes:

Pins A3, A4, and 8–10 are used for the base controller.  
Do not exceed 46mA combined from pins 0, 1, and 4–10.  
Do not exceed 3.3 V on any I/O pin.  
Do not exceed 7mA on any I/O pin.  
Do not apply power to 5V or VCC

### Header Pins Used for Ethernet Shield

| Pins Used | Function | Description                                       |
|-----------|----------|---------------------------------------------------|
| 5         | ETH SS   |                                                   |
| 8         | MOSI     |                                                   |
| 9         | SCK      | SPI pins are shared with other devices on SPI bus |
| 10        | MISO     |                                                   |

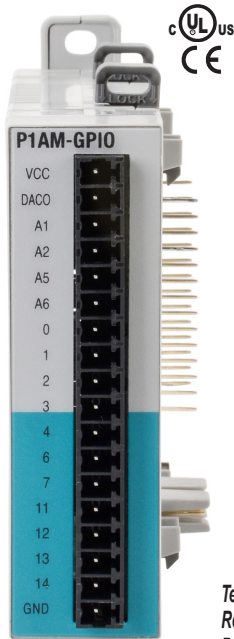
# Shields

## P1AM-GPIO \$61.00

### Header Pin Breakout Module

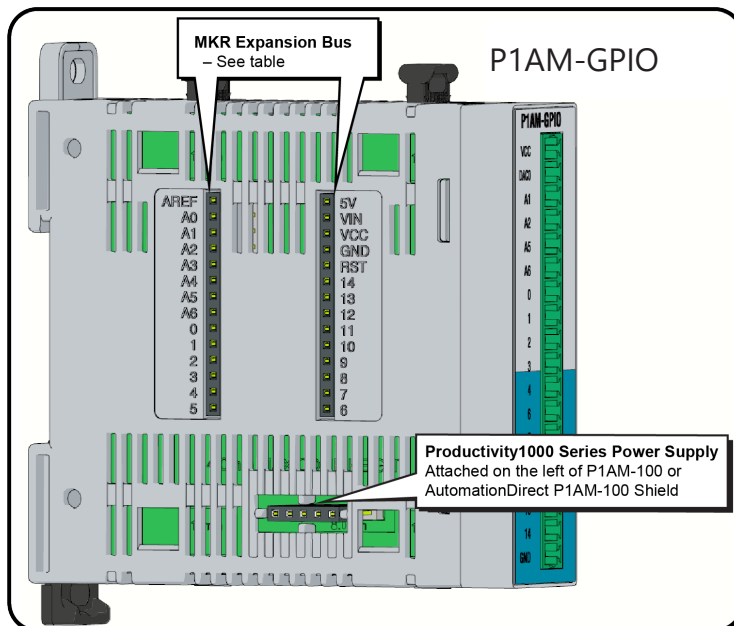
The P1AM-GPIO is a housed Arduino MKR form factor shield that brings a subset of the MKR header pins to the front faceplate with an 18-position terminal block. These pins include

basic overvoltage, undervoltage, and overcurrent protection. It connects to the left side of the [P1AM-100](#) CPU and most Arduino MKR form factor shields.



| General Specifications       |                                                                   |
|------------------------------|-------------------------------------------------------------------|
| <b>Operating Temperature</b> | 0° to 60°C (32° to 140°F)                                         |
| <b>Storage Temperature</b>   | -20° to 70°C (-4° to 158°F)                                       |
| <b>Humidity</b>              | 5 to 95% (non-condensing)                                         |
| <b>Environmental Air</b>     | No corrosive gases permitted                                      |
| <b>Vibration</b>             | IEC60068-2-6 (Test Fc)                                            |
| <b>Shock</b>                 | IEC60068-2-27 (Test Ea)                                           |
| <b>Heat Dissipation</b>      | 475mW                                                             |
| <b>Enclosure Type</b>        | Open Equipment                                                    |
| <b>Module Location</b>       | Connects to the left side of the <a href="#">P1AM-100</a> CPU.    |
| <b>Weight</b>                | 56g (2.0 oz.)                                                     |
| <b>Agency Approvals</b>      | UL 61010-1 and<br>UL 61010-2-201 File E139594, Canada & USA<br>CE |

Terminal block connector sold separately.  
Recommended connector options  
P2-RTB or P2-RTB-1.



| MKR Expansion Bus Pins    |                        |
|---------------------------|------------------------|
| <b>GPIO</b>               | A0-A6, 0-14            |
| <b>Analog Input Pins</b>  | A0-A6                  |
| <b>Analog Output Pins</b> | A0                     |
| <b>PWM Pins</b>           | 0-8, 10, A3, A4        |
| <b>Interrupt Pins</b>     | 0, 1, 4-8, A1, A2      |
| <b>5V</b>                 | 5V supply output       |
| <b>Vin</b>                | 5V regulated supply    |
| <b>VCC</b>                | 3.3 V supply output    |
| <b>GND</b>                | Ground                 |
| <b>RST</b>                | Reset                  |
| <b>AREF</b>               | Analog Input Reference |

#### Critical Notes:

Pins A3, A4, and 8-10 are used for the base controller.  
Do not exceed 46mA combined from pins 0, 1, and 4-10.  
Do not exceed 3.3 V on any I/O pin.  
Do not exceed 7mA on any I/O pin.  
Do not apply power to 5V or VCC

### !WARNING!

Do not add or remove modules  
with field power applied!

# P1AM Kit

## P1AM-PROTO \$44.50

The P1AM-PROTO is an Arduino-compatible kit of parts that includes everything you need to make your own customized shield in the MKR form factor.

### **Arduino Housing Kit**

This kit includes:

- Custom MKR stacking-headers
- PC Board with 100mm (0.1 in.) grid of through-holes
- Plastic Productivity housing
- Footprint for 18-pin terminal block receptacle (Right Angle, Through Hole, 3.81 mm pitch) and plug for user I/O connections
- ProductivityOpen Overlay which can be easily cut to expose parts (LEDs, connectors, etc.) custom to the user.

### General Specifications

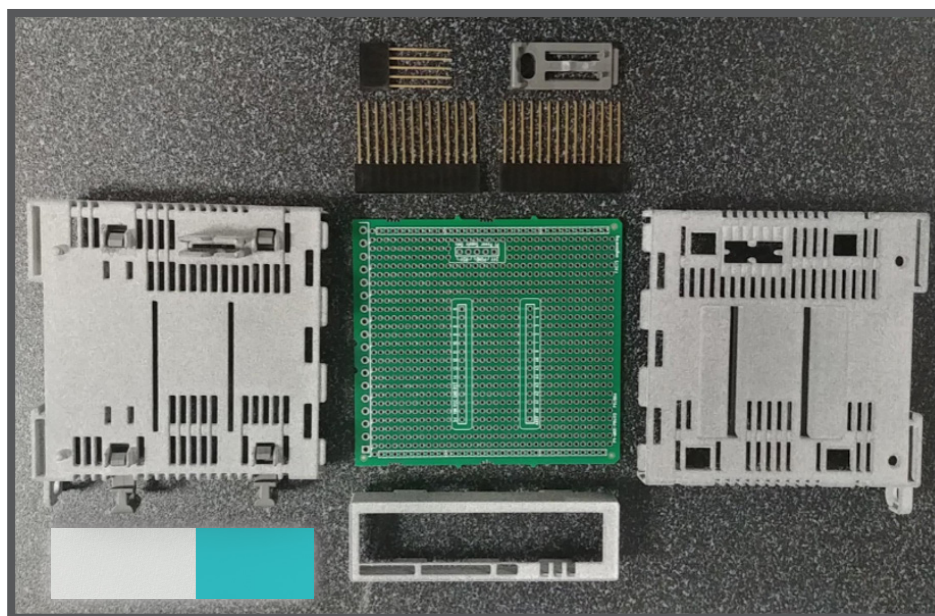
|                              |                                                                 |
|------------------------------|-----------------------------------------------------------------|
| <b>Operating Temperature</b> | 0° to 60°C (32° to 140°F)                                       |
| <b>Storage Temperature</b>   | -20° to 70°C (-4° to 158°F)                                     |
| <b>Humidity</b>              | 5 to 95% (non-condensing)                                       |
| <b>Environmental Air</b>     | No corrosive gases permitted                                    |
| <b>Enclosure Type</b>        | Open Equipment                                                  |
| <b>Module Location</b>       | Connects to the left side of the <a href="#">P1AM-100 CPU</a> . |



**P1AM-PROTO**



**P1AM-PROTO**  
(with overlay applied)



**VIEW OF DISASSEMBLED P1AM-PROTO**

# Starter Kit Boxes

## P1AM-100 Starter Kit Components

ProductivityOpen has two starter kits available - P1AM-START1 and P1AM-START2. Each kit allows you to get up and running in short order. Kit components are listed in the tables below.

### P1AM-START1    \$288.00



A convenient start to a project which will use primarily Arduino MKR Zero shields:

- [P1AM-100](#) module - Arduino compatible CPU module
- [P1AM-ETH](#) shield - Ethernet communication module
- [P1AM-GPIO](#) shield - Header Pin Breakout module
- [P1-4ADL2DAL-1](#) Productivity1000 analog expansion I/O module
- [PSL-24-030](#) power supply – 24VDC (adjustable) output, 1.25 A, 30W, 120/240 VAC or 125–375 VDC nominal input, 1-phase
- [P1-10RTB](#) 10-pin terminal block
- [P2-RTB](#) 18-pin terminal block
- 3-pin terminal block
- AC power cord
- [USB-CBL-AMICB6](#) USB programming cable

### P1AM-START2    \$223.00



A convenient start to a project which will use primarily Productivity1000 input and output modules:

- [P1AM-100](#) module - Arduino compatible CPU module
- [P1-01AC](#) power supply
- [P1-08TRS](#) Productivity1000 relay output module
- [P1-08SIM](#) Productivity1000 simulator input module
- [P2-RTB](#) 18-pin terminal block
- 3-pin removable terminal block
- AC power cord
- [USB-CBL-AMICB6](#) USB programming cable